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**Detailed Project Report  
(DPR) on  
Preliminary Exploration (G3 Stage)  
for Gold in Kanivihalli Block,  
Davangere District, Karnataka State  
(under NMET)**

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**Geovale Services Pvt Ltd.**

*Earth System Science for sustainable Development*

**September 2025**

**Preliminary Exploration (G3 Stage) for Gold in Kanivihalli  
Block, Davangere District, Karnataka State  
(under NMET)**

**(Precious metals)**

**By  
Geovale Services Pvt. Ltd**

**Place: Kolkata**

**Date: 12<sup>th</sup> September, 2025**

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## Summary of the Block for G-3 Stage Exploration

### GENERAL INFORMATION ABOUT THE BLOCK

Features	Details
<b>Block ID</b>	GSPL/NMET/KR/2025/BLOCK-1
<b>Exploration Agency</b>	Geovale Services Private Limited
<b>Commodity</b>	Gold
<b>Mineral Belt</b>	Chitradurga Schist Belt
<b>Completion Period with entire Time schedule to complete the project</b>	18 months
<b>Objectives</b>	(i) To identify controls for gold mineralization and (ii) Geological Resource (G3) assessment
<b>Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency</b>	The exploration will primarily be carried out by the proposed agency. Some elements of the exploration program like sample assay, drilling etc. will be outsourced (details mentioned in the exploration plan). The name of outsourced agencies and the components to be outsourced will be decided based upon the results from early stages of exploration.
<b>Name/ Number of Geoscientists</b>	
<b>Expected Field days (Geology) Geological Party Days</b>	Total field man-days (Geologist): 1080 man-days Geological Party Days: Approximately 14 months in phases

<b>1</b> .	<b>Location</b>	
	<b>Latitude (N)</b>	14°47'43.44" to 14°52'5.53"
	<b>Longitude (E)</b>	76°0'20.54" to 76°4'34.70"
	<b>Localities</b>	Kaykadahalli, Shurngarathota, Kanivihalli
	<b>Tehsil/ Taluk</b>	Harpanahalli
	<b>District</b>	Davangere
	<b>State</b>	Karnataka
	<b>2</b> .	<b>Area (hectares/ square kilometers)</b>
<b>Block Area</b>		30 square kilometers
<b>Forest Area</b>		Around 25 square kilometers
<b>Government Land Area</b>		Not known
<b>Private Land Area</b>		Not known
<b>3</b> .	<b>Accessibility</b>	
	<b>Nearest Rail Head</b>	Davangere
	<b>Road</b>	SH 25
	<b>Airport</b>	Jindal Vijayanagara Airport, Bengaluru Airport
<b>4</b> .	<b>Hydrography</b>	
	<b>Local Surface Drainage Pattern (Channels)</b>	Dendritic to sub-parallel
	<b>Rivers/ Streams</b>	Tungabhadra, Chikka Hagari, Sharavathi Rivers

<b>5</b>	<b>Climate</b>	
	<b>Mean Annual Rainfall</b>	630 mm
	<b>Temperatures</b>	Minimum (January): 21°C Maximum (May): 32°C
<b>6</b>	<b>Topography</b>	
	<b>Toposheet Number</b>	57B/1 (Plate 4)
	<b>Morphology of the Area</b>	This area constitutes hills and valleys
<b>7</b>	<b>Availability of baseline geoscience data</b>	
	<b>Geological Map (1:50K/ 1:12,500)</b>	Available
	<b>Geochemical Map</b>	Available
	<b>Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)</b>	Available
<b>8.</b>	<b>Justification for taking up reconnaissance survey / Regional Exploration</b>	<ul style="list-style-type: none"> <li>The project area is located within the Chitradurga Schist Belt, a geologically significant terrain known for hosting gold-bearing Banded Iron Formations (BIFs), metabasalt, and meta-argillite rock types commonly associated with auriferous mineralization in southern India.</li> <li>Strategically positioned near the Chitradurga Eastern Margin Shear Zone (CEMSZ), a prominent regional, crustal-scale shear zone. The area holds enhanced mineral potential due to tectonically driven fluid</li> </ul>

migration and the presence of structural traps.

- On the basis of National Geochemical Mapping (NGCM) data, Geological Survey of India (GSI) carried out a G4-stage reconnaissance exploration in 2018-19. This investigation revealed significant gold values and notable copper concentrations in stream sediments, trench samples, and bedrock samples.
- SEM and EPMA by GSI confirmed the presence of native gold grains and silver, along with associated sulphide minerals such as chalcopyrite, pyrite, arsenopyrite, galena, covellite, and bornite.
- The area's complex structural architecture, characterized by multiple generations of folding (notably overturned F2 folds), shear zones, and thrust faults—offers favorable conditions for structurally controlled mineralization and the development of ore traps.
- **Geovale's team has carried out reconnaissance fieldwork** in the block area and observed shear zones controlled gold and copper mineralization with in metabasalt/ meta felsic volcanics, often associated with quartz–carbonate veins. Microscopic studies indicate the presence of gold, chalcopyrite, and arsenopyrite. SEM-EDAX of some metabasalt/meta andesite also suggested presence of pyrite, chalcopyrite, arsenopyrite, and stibnite in the bedrock samples.

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## DETAILED DESCRIPTION OF THE BLOCK

### I. Block Summary

#### A. Physiography

The area is located in the central part of Karnataka, in the Davangere district. This region is characterized by low undulating terrain with scattered hillocks and narrow linear ridges exposing quartzite and banded ferruginous formations. A major part of the terrain is covered with residual soil, lateritic cover, and vegetation, especially within the Jajikkalgudda Reserved Forest. Drainage is dendritic, and many seasonal streams dissect the area. Accessibility is moderate with nearby towns like Harappanahalli and Kotturu.

#### B. Background Geology (Regional Geology, Geology of the Block)

##### Regional geology:

The project area lies within the northern extension of the Chitradurga Schist Belt (CSB) (Fig.1), a key greenstone belt in the Dharwar Craton. CSB extends ~380 km from Srirangapatna in south to the Tungabhadra River in north. It is bounded by the Chitradurga Eastern Margin Shear Zone (CEMSZ), a significant crustal-scale shear feature (Mohakul, et.l., 2021). The regional geology includes the Peninsular Gneissic Complex (PGC) as basement, overlain by metavolcanic and metasedimentary sequences of the Hiriyur Formation (Chitradurga Group) (Table 1).

Litho-units include:

- **Bababudan Group:** Quartzite with amygdular metabasalt.
- **Vanivilas Formation:** Fe-Mn phyllite, BIF, dolomite, argillite.
- **Ingaldhal Volcanics:** Bimodal volcanic and pyroclastic assemblage intercalated with BIF.
- **Hiriyur Formation:** Greywacke-argillite, BIF, volcanics.

Structurally, the belt has undergone three deformation events (D1, D2, D3), with D1 and D2 being most significant for mineralization.

**Table 1: Generalized stratigraphy of Chitradurga Schist Belt, after Swaminath and Ramakrishnan (1981)**

Basic Dykes (Gabbro and Dolerite)		
Younger granite (Chitradurga, Hosadurga and J.N.Kote)		
<b>CHITRADURGA GROUP</b> (2900-2600 my)	<b>Hiriyur Formation</b>	Greywacke – argillite suite - Basic to intermediate volcanics - Banded ferruginous chert and Polymictic conglomerates (Aimangala and Hosakere) K.M Kere and G.R. Halli conglomerates
	----- <b>Disconformity</b> -----	
	<b>Ingaldhal Formation</b>	Basic, intermediate / acid lavas/ argillite Chloritic Phyllite, Banded ferruginous chert, Limestone and dolomite
	<b>Vanivilas Formation</b>	Chlorite- biotite + garnet Phyllite/ Quartzite Talya conglomerate
----- <b>Unconformity</b> -----		
<b>BABABUDAN GROUP</b> (2900-2700my)	Amygdular metabasalt interlayered with orthoquartzite Neralekatte quartz pebble conglomerate	
----- <b>Unconformity</b> -----		
<b>PENINSULAR GNEISSIC COMPLEX (3000MY)</b>		
<b>SARGUR GROUP</b>		
<b>BASEMENT NOT EXPOSED</b>		

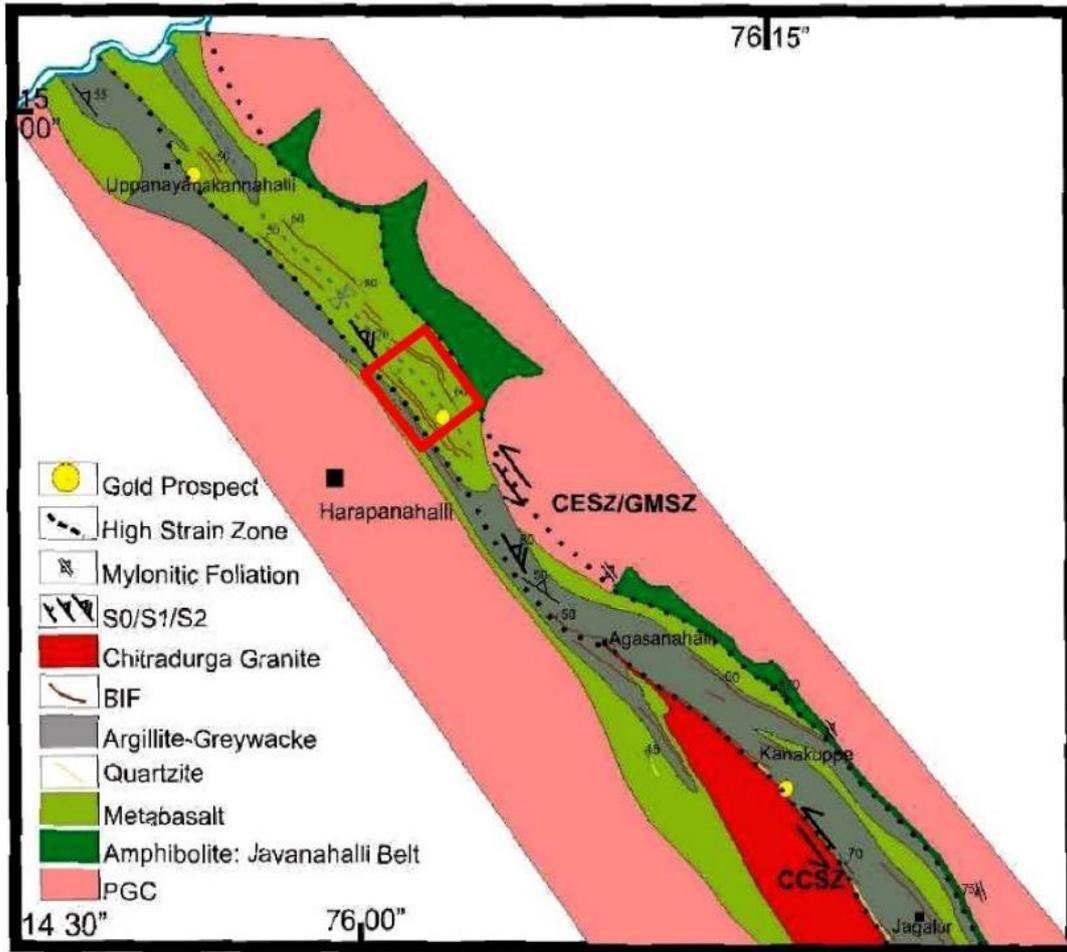


Figure 1. Geological map of the northern part of Chitradurga Schist Belt. Outline of the proposed block is marked by red box.

**Geology of the proposed block:**

Host rocks include metabasalt, argillite – meta argillite (Quartz-chlorite schist and quartz-sericite schist), BIF, pyroclastics, and granitoid intrusives (Plate 1).

Gold mineralization is typically associated with quartz-carbonate lodes, localized along second-order shear fractures or lithological contacts.

The lithological units mapped in the area include:

Metabasalt, BIF, dolomite, limestone, Meta-argillite (reclassified into quartz-chlorite schist, quartz-sericite schist, and ferruginous phyllite) Conglomerate and Amphibolite (gradational contact with metabasalt). Younger intrusives like dolerite/gabbro dykes and giant quartz veins (notably near Hombalagatti).

Structurally, the area exhibits tight F2 folds, crenulation cleavages, mylonitization, and thrust-

related shearing along the EMSZ. A major synformal fold closure is reported near Nichchapur village.

### **C. Geovale's Reconnaissance Field Observations in the Block Area**

During Geovale's recent field visit to the block area, it was observed that the lithological assemblage is dominated by metavolcanic units, primarily comprising meta-andesites and meta-basalts (Figs. 2 to 5). These rocks exhibit varying degrees of metamorphism and structural deformation, consistent with the region's complex geological evolution.

Quartz-carbonate veins are widely distributed across the area (Figs 3 & 5). These veins often exhibit cross-cutting relationships with the surrounding lithologies, notably intersecting banded iron formations (BIFs), meta-argillites, and meta-basalts. Meta argillite comprises of quartz-chlorite schist and quartz sericite schist. The structural disposition and mineral assemblage of these veins suggest they may be related to late-stage hydrothermal activity, potentially linked to mineralizing events.

The spatial association of quartz-carbonate veins with BIFs and other metavolcanic and metasedimentary rocks provides a favorable geological setting for base metal and gold mineralization. This geological framework, marked by multiple litho-structural controls and evidence of fluid activity, warrants further exploration and detailed geochemical and structural analyses to assess the mineral potential of the area.

**A total of 14 samples were analyzed using ICP-MS, with six of them additionally subjected to gold fire assay. Some of the samples yielded notable anomalous values, including cobalt concentrations ranging from 1.9 to 1400 ppm, copper from 4.8 to 400 ppm, zinc from 5.9 to 700 ppm, and gold values from 6 to 42 ppb. Selected analytical results are presented in Plate 2.**

### **D. Mineral Potentiality (Based on Geology, Geophysics, and Geochemistry)**

#### **1. Geology:**

The block under discussion is part of the CSB and includes rock types such as ferruginous chert, Fe-Mn phyllite, and volcanic-derived lithologies that are typical hosts for auriferous mineralization.

Specific formations are noted for hosting gold mineralization, particularly where lithological contrasts and structural boundaries provide fluid pathways and traps.

Observed fold patterns (including overturned  $F_2$  folds) and shear zones are critical in establishing

fluid conduits and dilatational zones, which localize mineralization.

Thrust structures and multiple generations of folding further enhance the potential for structurally trapped ore bodies. Proven gold-bearing litho-units like BIF, metabasalt, carbonaceous tuffs, and pyroclastics.

Presence of mineralized shear zones and folds (e.g., F2 anticlines, D1 fractures).

Geovale's reconnaissance fieldwork has revealed several key observations on the mineral potentiality of the area:

1. Abundant pyrite and arsenopyrite mineralization have been noted along shear zones occurring at the contact between metabasalt and felsic volcanic rocks (meta-andesite). Quartz- carbonate veins (meter-scale thick) are also recorded in this shear zone (Fig. 2 & 3).
2. Quartz veins hosted within metabasalt units exhibit malachite staining, along with visible gold and chalcopyrite mineralization (Fig. 5).
3. Evidence of hydrothermal alteration and associated mineralization has been identified in select areas (Fig. 4).

## 2. Geophysics:

Regional magnetic data of NAGMP (Block 8) from NGDR portal shows presence of magnetic high anomalous zones in the southeastern part of the block. Lineaments of the magnetic anomaly map also matching with lithological contacts and regional shear zones, supporting structural control of mineralization.

NGPM data have been shown in Plate 4.

## 3. Geochemistry:

The project is an outcome of National Geochemical Mapping (NGCM) carried out in the SOI toposheet 57B/01 during F.S 2012-13 by Shashikant Gawade and Nimmy K.C. GSI has done a G4 level exploration project in 2017-18 in this area and got good anomalous values in bed rocks samples. Bed rock and trench samples show **gold values from 25 ppb to 2084 ppb, Copper values reach 0.2775% Zinc upto 800 ppm and cobalt is about 0.25%** (Fig. 6, Plate 2).

**Gold value is upto 36 ppb, Arsenic is upto 68 ppm, Mercury upto 160 ppb.** Stream. SEM/EPMA confirms presence of native gold, silver, and sulphides (pyrite, arsenopyrite, chalcopyrite, galena, covellite, bornite).



Figure 2 Meta andesite with arsenopyrite (marked with arrow), oxidized pyrites and carbonate vein

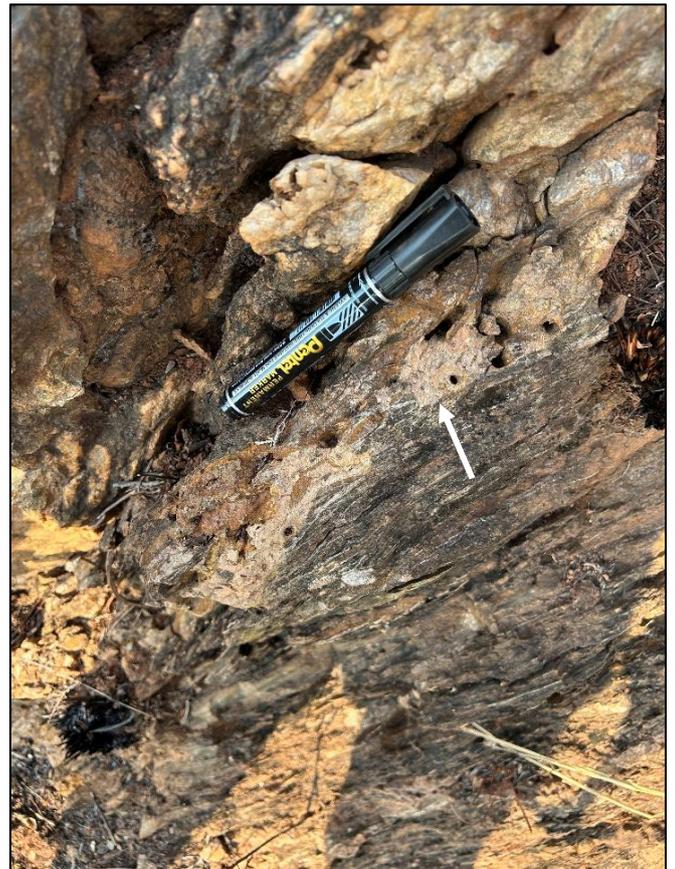


Figure 3 Sheared meta basaltic rock with quartz - carbonate vein, marked by white arrow



Figure 4 Networks of hydrothermal veins in meta-andesitic rocks



Figure 5 Quartz vein with gold and malacite steining (marked by arrow) within meta andesitic host rock

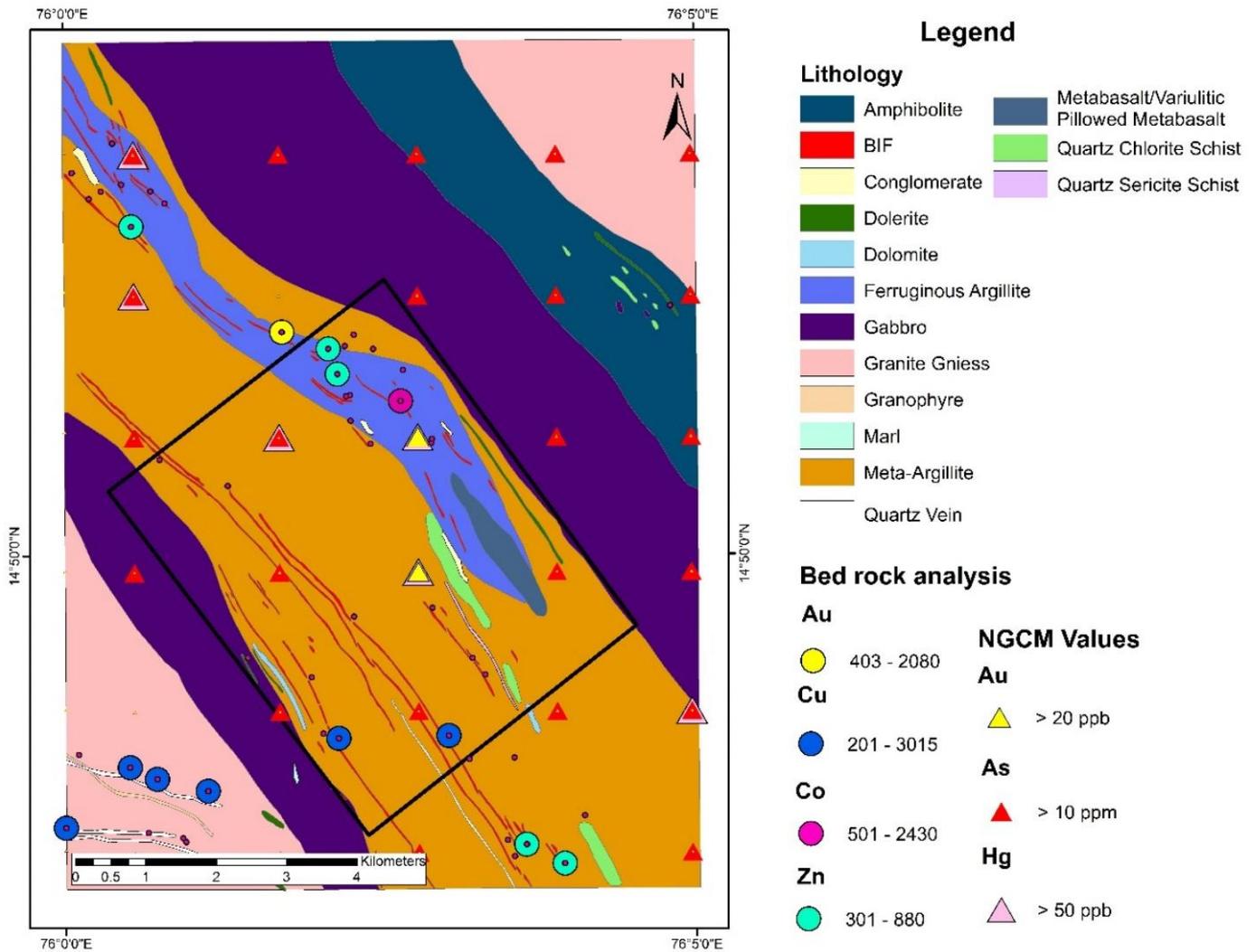


Figure 6 Geological map (1:12,500) by GSI 2017-18, with the anomalies in bed rock and stream sediment analysis (NGCM), black rectangle in the present block area.

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### **E. Scope for Proposed Exploration**

#### **1. Detailed Mapping and Sampling:**

- Undertake detailed geological mapping in 1:4,000 scale to refine the structural framework and lithological boundaries. Delineations of mineralized zones, particularly in the contact zones of carbonated metabasalt and argillite and also in the fold hinges (e.g., Ajjanahalli).
- Delineate zones of sericitization, silicification, and sulphidation.
- Systematic sampling of bedrock, trench, groove, stream sediments, and soils. Ground geochemical sampling campaigns to include localized micro-sampling in zones of known anomalies

#### **2. Ground Geophysical Surveys:**

- Implement ground geophysical surveys (Magnetic and VES) in a systematic pattern to better delineate mineralized shear zones, fault systems, and potential ore bodies.

#### **3. Drilling and Borehole Geochemistry:**

- Based on the mapping, geochemical survey and geophysical surveys, planning for Exploratory drilling then Resource drilling to test high-priority targets.
- Incorporate laboratory analyses (e.g., SEM, EPMA) in an integrated study to validate mineralization models and fluid pathways.

### **F. Observation and Recommendations of G4 Stage Mineral Exploration Report.**

G4 stage Geological Report (GSI, 2018-19) has shown anomalous bed rock values for Cu and Au mineralization. The report highlighted the forest issue in potential zones and thus has not given favourable comment for G3 stage exploration. However, considering all aspects, State DGM, Karnataka has identified 30 sq km potential block within the G4 area and recommended this block for G3 exploration.

### **G. Objectives:**

1. To identify controls for gold and copper mineralization based on the **Mineral Systems Approach** by integrating geology, structure, geochemical and geophysical data.
2. Resource Estimation through systematic drilling and subsurface geochemistry.
3. To identify promising targets for more detailed G2-level exploration.

## **II. Previous Work**

Complete Geological report of GSI's G4 exploration is attached in *Annexure I*

### **A. Previous Exploration in adjoining area (Regional area):**

Previous work by GSI and other agencies (e.g., BRGM) has: Identified major Au anomalies (2012-13 NGCM) Detected stream sediment anomalies near Kanivehalli (up to 500 ppb). Reported base metal enrichment (Cu, Pb, Zn, etc.) in folded BIF zones. Suggested that quartz veins and BIFs in sheared zones are favorable hosts. Earlier drilling was recommended by Narasimhan (1969-70) but not executed.

A summary of the exploration history in a chronological order is represented here:

<b>Year</b>	<b>Agency / Author</b>	<b>Key Findings / Recommendations</b>
<b>1882</b>	GSI / Bruce Foote	Documented gold occurrence in Ajjanahalli; early record in "Auriferous tracts of Mysore."
<b>1952-53</b>	GSI / M. Krishnamurthy	Identified major rock types including metabasalt, metapelite, dolomite, limestone, and BIFs.
<b>1969-70</b>	GSI / Narasimhan	Copper mineralization in quartz veins; recommended 900 m drilling in six boreholes.
<b>1972-73</b>	BRGM	Detected anomalous gold values in stream sediments near Kanivehalli-Harappanahalli.
<b>1989-90</b>	GSI / Bhattacharya & Ganganna	Gold anomalies (0.1-1.1 ppm) in folded BIFs with quartz veins and shearing.
<b>1990</b>	GSI / Panduranga, Purushothaman, others	Base metal and gold anomalies in southern and northern blocks including Kanakuppa and Upanayakanahalli.

<b>Year</b>	<b>Agency / Author</b>	<b>Key Findings / Recommendations</b>
<b>2000-01</b>	GSI / Krishnappa & Madusudanan	Anomalous Au (250–500 ppb) in Jajikkalgudda; recommended close-spaced sampling and detailed exploration.
<b>2001-03</b>	GSI / Subba Rao & Narasimha Rao	Continued gold investigations in northern extensions (Upanayakanahalli and surrounding areas).
<b>2002-04</b>	GSI / Hanumantha Rao	Identified 9 sulphidic BIF bands; Au up to 5.5 ppm; recommended detailed exploration.
<b>2003</b>	GSI / Chandrasekharaiha & Narasimha Rao	Follow-up gold exploration in Upanayakanahalli.
<b>2012-13</b>	GSI NGCM	Identified major Au anomalies during National Geochemical Mapping.
<b>2016-17</b>	GSI / Harsha Sundar & Danira D'Silva	Preliminary gold investigation confirmed mineralization potential near Upanayakanahalli.
<b>2018-19</b>	GSI/ Nimmy K.C, and Hima K Reghunath.	Cu (200–2700 ppm) in quartz reefs; Au (25–2084 ppb) in BIFs and meta-argillites; recommended G3 in Jajikkalgudda and Chigateri NW areas.

#### **B. Previous exploration in the proposed block area:**

GSI (2018-19) carried out a G4 level exploration work in this area. During the course of field work an area of 100 sq.km was mapped on 1:12,500 scale along with collection of Bed Rock Samples, Pitting Trenching Samples, Stream Sediment Samples followed by chemical analysis and petrographic study.

During the current work a few anomalous values of Au and Cu are reported from the area. The Cu values are varying from 200ppm to 2700ppm and are reported from the giant quartz veins (occurring as reefs) intruded into the granite/migmatite gneiss at the south western part of the area. The mineralization zone in the quartz vein is characterized by the presence of malachite, chalcopyrite, pyrite and arsenopyrite and marked by ferruginous, K- feldspar and epidote alterations. The quartz veins are brecciated at places and may be representing a silicified zone. The petrological studies, SEM and EPMA analysis carried out indicates the presence of chalcocite, galena, sphalerite, covellite and bornite along with free grains of Au and Ag. However, the quartz vein samples have not yielded any gold values. The other silicate alteration identified during SEM are chlorite, sericite and K-feldspar. The mineralized zone is 800m long with significant copper values 0.2775%, 0.149%, 0.117% and 0.144% over a width of 1m.

The Au values varying from 25ppb to 2084ppb. The values are reported from the BIFs of the area which are folded, altered and traversed by quartz veinlets and sheared meta-argillite traversed by quartz veinlets. The SEM analysis of samples indicated presence of free gold within the quartz veins along with other sulphides such as chalcopyrite, pyrite, arsenopyrite, covellite, chalcocite and galena.

## **Knowledge gaps for prospectivity analyses in a Mineral System Framework:**

### **1. Incomplete Structural Analysis at District Scale**

- While mesoscopic structures (F2 folds, S1–S3 cleavages) and major shear zones (like CEMSZ) are documented, their 3D continuity, kinematics, and timing relative to mineralization are poorly constrained.
- No detailed subsurface geophysical models (e.g., resistivity or magnetic lineaments) have been integrated to trace hidden structural traps.

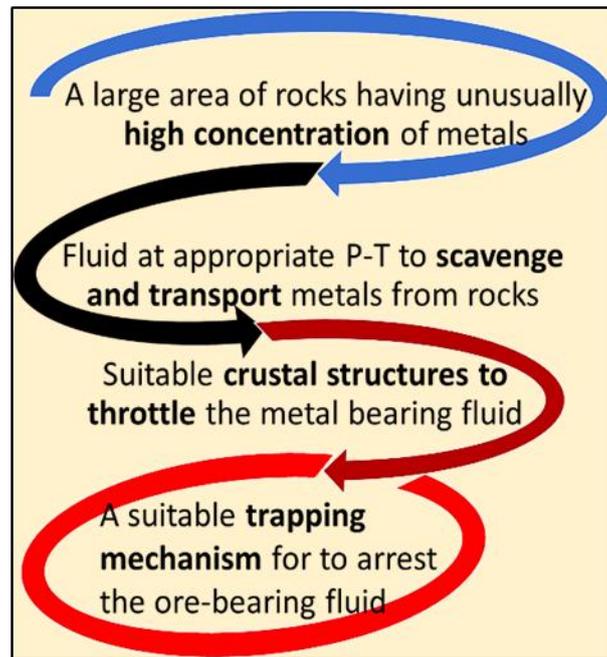
### **2. Discontinuity in Geochemical Anomaly Trends**

- Gold anomalies are sporadic and lack strike continuity, particularly in the northwestern BIF zones (e.g., only two samples >1 ppm Au).
- Insufficient close-spaced sampling hinders delineation of ore-controlling litho-structural features or geochemical halos.
- Multielement vectoring indicators for gold mineralization (As, Sb, Bi, Te) are underutilized.

### **3. Limited Subsurface Validation**

- No borehole data from the current block, only pitting was executed. Earlier drilling recommendations (e.g., 900 m in 6 holes by Narasimhan, 1969–70) were not implemented.
- No subsurface geometry of quartz veins, BIFs, or sulfide zones is available to support depth continuity of gold mineralization.

### III. Prospectivity analyses of the Kanivihalli exploration block in a Mineral System Analyses framework:



*Figure 7. Principal components of Mineral System Analysis (MSA) and their relationship*

A mineral system analyses revolves round four important components (Fig. 7)

- (i) A fertile host rock terrain
- (ii) Fluids to scavenge metals from fertile host rocks
- (iii) Tectonic force and architecture to channelize the metal bearing fluids and
- (iv) Suitable structural or lithological traps

**(i) Host rock fertility of the area:**

**Favourable Archean basement:** The area lies within the northern Chitradurga Schist Belt, which is known to host Au-Cu mineralization.

**Presence of BIF, meta-volcanics, and granitoids:** These units are geochemically fertile for Au and base metals.

**Sulphide-bearing systems:** EPMA/SEM studies confirmed the presence of chalcopyrite, arsenopyrite, pyrite, galena, bornite, and native Au, suggesting sulphidic fluid pathways.

**Cu-rich giant quartz veins (GQV):** Indicate episodic hydrothermal activity with values up to

0.2775% Cu.

**Fluids to scavenge metals:**

**Multiple deformation events (D1–D3)** and metamorphic gradients suggest generation of metamorphic and magmatic fluids.

**Crustal-scale transpressional shear zones (CEMSZ):** Serve as conduits for fluid focusing and movement.

Regional shearing caused quartz-carbonate vein emplacement and fluid overprints (sericitization, chloritization, silicification).

**Fluid Pathways (Conduits)**

Eastern Margin Shear Zone (CEMSZ) and **multiple sympathetic shear zones** provide vertically and laterally extensive pathways.

**Fold hinges (F2), fault intersections, and litho-contact zones** act as secondary conduits.

Brecciated quartz veins and gossans reflect episodic fluid pressure build-up and collapse.

**Traps and Chemical/Physical Triggers**

Chemical traps: Carbonated BIF, metabasalt, and argillite units offer reactive lithologies that enhance precipitation of gold and sulphides.

Structural traps: Fold hinges, dilation zones within shears, and quartz reefs form favorable geometries.

Redox fronts at the interface of iron-rich units (BIF/phyllite) with silica-saturated fluids promote Au precipitation.

## **IV. Block description:**

Corner Points	Latitude	Longitude
A	76.00587	14.84153
B	76.04239	14.86892
C	76.07554	14.824
D	76.0402	14.79713

## **V. Planned methodology of the present work**

The present scheme of exploration at G3 stage has been formulated to prove the mainly the depth continuity of surface mineralization through integrated ground geophysical survey followed by

exploratory drilling and associated laboratory studies.

Following methodologies will be followed in the proposed exploration (G3):

**Detailed Geological mapping:**

**Detailed Geological mapping** will be done on 1:4,000 scale. Geological map shall be utilized for activities like geophysical interpretation and drilling etc.

**Topographic Survey:**

Topographic Survey over the entire 30 sq.km (1:4,000 scale). The study area shall be surveyed with triangulation network. The block will be tied up with survey network by triangulation station. Topographical Contouring at 2m contour interval along with available surface features shall be surveyed. The location of boreholes and their Reduced levels shall be determined. The block boundary and the borehole points will be surveyed by DGPS & Total Station in WGS-84 datum.

**Detailed ground geophysical surveys:**

To carry out **Detailed ground geophysical surveys** (Resistivity and Magnetic) to delineate sub surface configuration and to identify potential anomalous zones for possible mineralization. The survey will be planned in a grid pattern of 200 m line interval for Resistivity, Magnetic survey.

**Trenching and Drilling:**

**Trenching** to prove the strike and depth persistence of potential mineralized zones.

**Exploratory drilling** to prove the depth persistence of ore zones up to 200m vertical depth from surface at 400m spacing interval in the identified potential anomalous area.

Drilling will be executed in two phase. In the 1<sup>st</sup> phase there will be **scout drilling** to identify targets in anomalous zones. In this phase, total drilling will be 1500 m; 6 BH (200 m avg depth) (Plate 6).

After successful completion of the 1<sup>st</sup> **phase drilling**, a 2<sup>nd</sup> **phase of drilling will be executed after review. In this phase, total 30 boreholes are planned in 400m spacing (drilling up to depth of 200 m); total 6000 m.**

**Detailed drill core logging** will be done with consideration of lithological details, structural features, e.g. joints, veins foliations, mineralization pattern, visual estimation of mineral content and other associated minerals in percentage etc. for entire length of all the holes and determination of Rock Quality Designations (RQD) besides core recovery for entire length of core in each borehole.

**Borehole sampling and geochemical assay:**

To estimate ore **resources under inferred category (G3)** as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules 2015.

**Broad exploration approach as proposed:  
Exploration task flow:**

A flow diagram for the exploration plan is given in Fig. 8.

**Scope of the present exploration:**

The exploration task flow is proposed to be done in two phases, each having distinct tasks and milestone. A summary of activities and milestones in both phases of the proposed exploration is given below:

**Phase I (Approximately 6 months):**

**Phase I: Surface Investigations**

- Detailed Geological Mapping (1:4,000)
- Topographic Survey
- Detailed Ground Geophysical Surveys

**Phase II: Preliminary Subsurface Investigations (4 months months):**

(Based on the positive outcome of Phase-I work & review with TCC)

- Trenching
- 1<sup>st</sup> stage Drilling (1500 m; 6 BH)

- Core Logging and Sampling
- Target identification for systematic drilling

**Phase III: Detailed Subsurface Investigations (8 months months):**

(Based on the positive outcome of Phase-I work & review with TCC)

- 2<sup>nd</sup> stage Drilling (6000m; BH, 200 m avg. depth)
- Core Logging and Sampling
- Resource Estimation (G3 Category)

## **Decision points**

The exploration strategy incorporates the GO- NO GO milestones to be collaboratively decided between the Geovale Services and NMET based on the results of the ongoing phases. The total duration of the work plan is 18 months. The exploration plan incorporates one decision point.

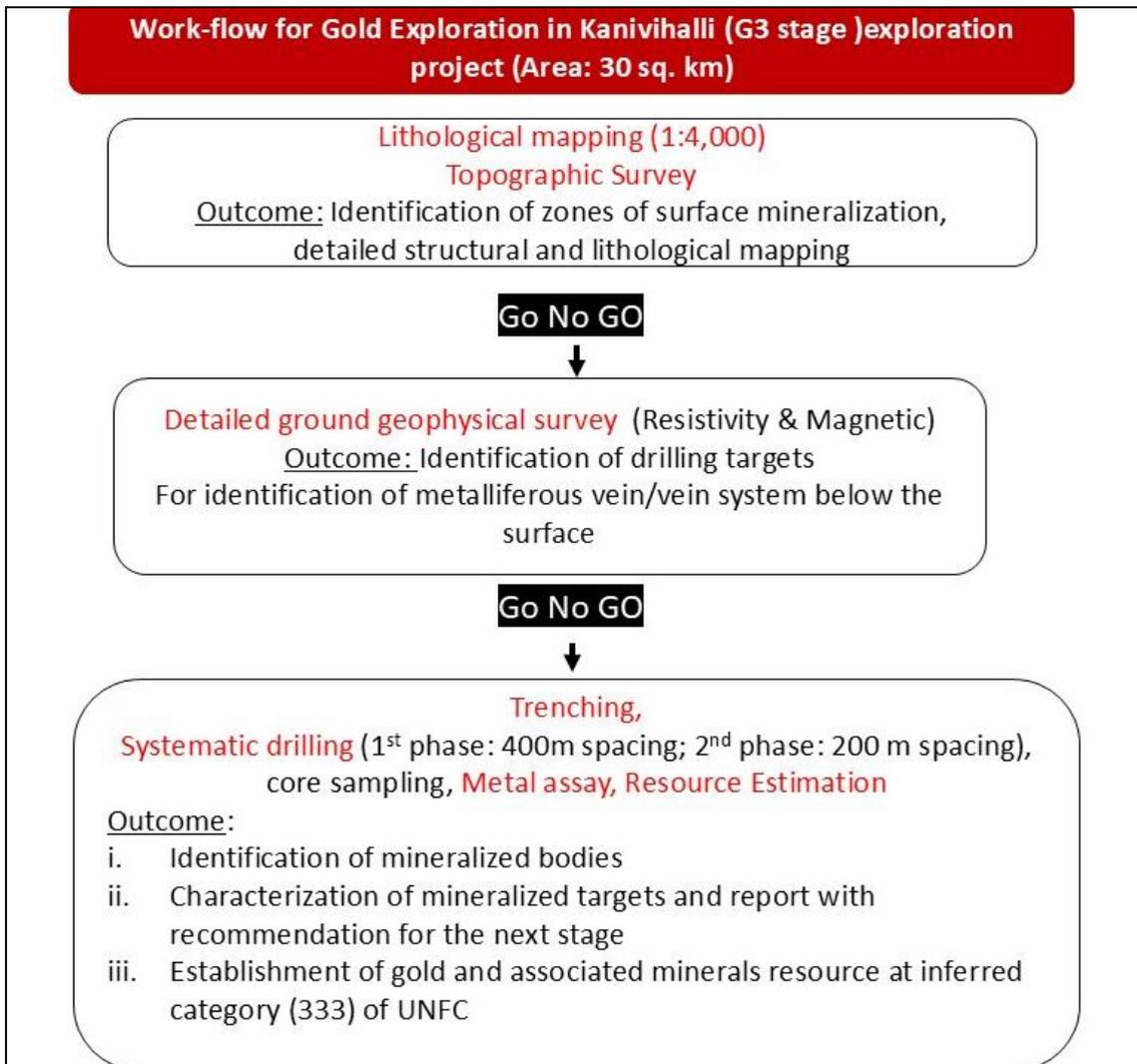


Figure 8 Work flow Kanivihalli G3 block

*Disclaimer: Progressing from one phase to another would be an internal/external decision point for the exploration program based on the results of the ongoing phase. Geovale Services would engage NMET to decide about progressing through different phases of exploration program.*

## VI. Nature Quantum and Target

A table containing the NQT table is given in *Annexure II*.

## Borehole spacing (As per MEMC, 2015)

Type of deposit	Bedded Stratiform and Tabular deposit of regular habit minerals to be identified	Bedded stratiform and tabular deposits of irregular habit (Minerals to be identified)	Lenticular bodies occurring en echelon Lenses, pockets. (Different minerals)
G3 Stage	Not Applicable	Not Applicable	Drilling up to 250m; Total 36 BH

## Geophysical Studies

Geophysical studies may be introduced at a later stage based on reconnaissance studies carried out in the area and on an understanding of the structural/ lithological control of the mineralization.

Shallow electrical resistivity (30 line km) and Magnetic survey (3000 points) will be done on identified targets for drilling target generation.

## VII. Manpower Deployment

A table containing the manpower deployment table is given in *Annexure III*.

## VII. Breakup of Expenditure

The breakup expenditure for each phase is given in *Annexure IV*.

## IX. Summary cost sheet

The summary cost sheet of expenditure for each phase is given in the table below.

*Annexure III*

Summary Expenditure		
Sl. No	Item	Estimated Cost in INR
1	Geological Mapping Other Geological Work & Surveying	14,636,160
2	Ground Geophysical Survey	15,954,360
3	Survey work	8,258,880
4	Trenching/Pitting	3,040,000
5	Phase 1 Drilling (In-house)	22,428,000
6	2nd Phase DRILLING (In-house)	84,438,000
7	LABORATORY STUDIES	19,097,413
8	Petrographical and Geotechnical	43,266,675
9	Resource Modelling by using Surpac	4,320,000
10	Report preparation	2,000,000
11	Peer review charges	30,000
12	Preparation of Exploration Proposal	500,000
13	GST (18%)	39,234,508
	<b>Grand Total</b>	<b>257,203,995.25</b>

## X Timeline

**Timeline: Preliminary Exploration (G3 Stage) for Gold in Kanivihalli Block, Davangere District, Karnataka**

S. No.			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Camp Setting	Months/ Days																		
2	Geological Mapping & Sampling	days																		
3	Geophysical survey	L.km																		
4	Geophysicist party days (HQ) for data interpretation & Report	Days																		
5	Pitting/Trenching	cu.m																		
6	Drilling (1 rigs)	m																		
7	Survey Party days	days																		

8	Geologist Man days	days																		
9	Sampler Man days	days																		
10	Camp Winding	months																		
11	Laboratory Studies	Nos.																		
12	Report Writing with Peer Review	months																		

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**Plate 2B: Geochemical map/s on 12.5K.**

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**Plate 4: Aeromagnetic map is not available.**

**Plate 5: Proposed block boundary over existing Geological map.**

**Plate 6: Proposed Borehole Location Map.**

**Plate 7: Tentative Geological Borehole Sections.**

**Plate 8A: Proposed block boundary over land use map**

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**Plate 9: Proposed block boundary over topographic map on 1:50,000.**





भारत सरकार  
Government of India  
भारतीय भूवैज्ञानिक सर्वेक्षण  
Geological Survey of India

कर्नाटक के दावणगेरे और बेल्लारी ज़िले के कानीवहल्ली और आस पास के क्षेत्र में स्वर्ण के लिए वीक्षण सर्वेक्षण (जी-4)

REPORT ON RECONNAISSANCE SURVEY FOR GOLD IN KANIVEHALLI  
AND ADJOINING AREA, DAVANGERE AND BELLARY DISTRICTS,  
KARNATAKA (STAGE: G-4)

टोपोशीट सं: 57B/01 / Toposheet No.: 57 B/01

मद संख्या : एम२एपीएमएम-एमइपि/ एनसी/एसआर/एसयू-केजी/2018/18818

Item no.: M2APMM-MEP/NC/SR/SU-KG/2018/18818

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मिशन-II  
MISSION-II

राज्य इकाई : कर्नाटक और गोवा / State Unit: Karnataka & Goa  
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नवंबर, 2019/ November, 2019

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**(Final Report for FS: 2018-19)**

**CODE NO: M2APMM/ME/SR/SU-KG/2018/18818**

**(TOPOSHEET No: 57B/01)**

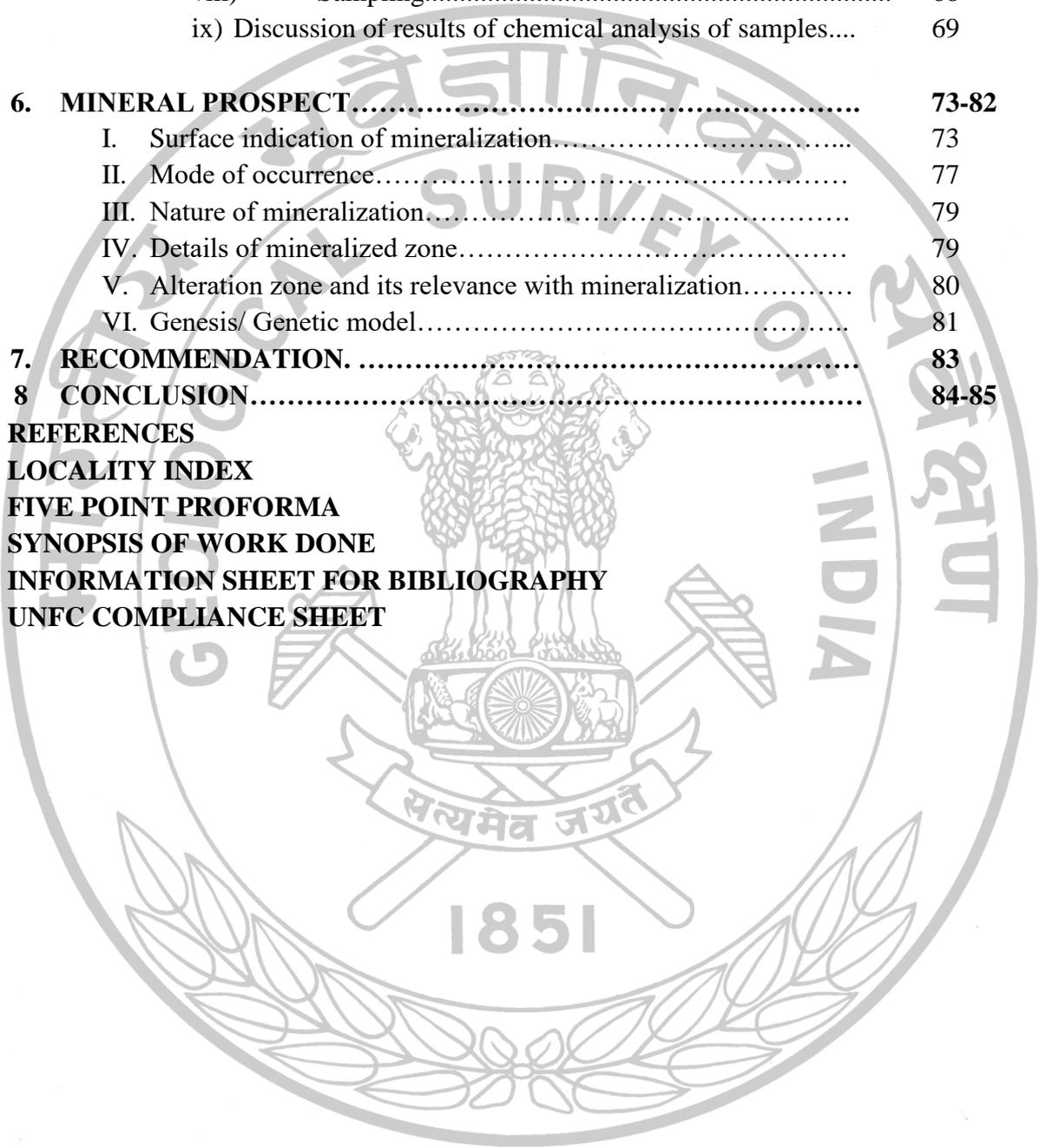
**Nimmy K. C., Sr. Geologist**

**Hima K. Reghunath, Sr. Geologist**

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Fig.6.2	Massive jointed ferruginous quartz vein exposed along the Kakadakalli-Harappanahalli road section
Fig.6.3	Malachite stains observed within the quartz vein north west of Hombalagatti.
Fig.6.4	Brecciated quartz vein observed near Hombalagatti.
Fig.6.5	Quartz veinlets intruded into the GQV. The veinlet is dextrally folded.
Fig.6.6	Limonitised BIF with quartz veinlets
Fig.6.7	Silicified BIF with quartz veins intruded along and across the BIF
Fig.6.8	Gossanized BIF with gash veins
Fig.6.9	Bornite and covellite observed within the BIF east of Kakadahalli
Fig.6.10	Development of goethite noted on BIF east of Kakadahalli
Fig.6.11	Gash-veins of quartz developed along the chert layers.
Fig.6.12	Alteration zone observed within meta-argillite marked by the presence of quartz and carbonate veins
Fig.6.13	Ferruginous argillite with folded quartz veins yielded gold values.
Fig.6.14	Chalcopyrite and covellite observed within the quartz vein.
Fig.6.15	Disseminations of chalcopyrite and chalcocite observed within quartz.
Fig.6.16	Smoky quartz with disseminations of chalcopyrite.



## अध्याय 1

### सारांश

#### कर्नाटका के दावणगेरे और बेल्लारी ज़िले के कानीवहल्ली और आस पास के क्षेत्र में स्वर्ण के लिए वीक्षण सर्वेक्षण (जी-4)

फील्ड सीज़न कार्यक्रम 2018-19 के प्रोजेक्ट "कर्नाटका के दावणगेरे और बेल्लारी ज़िले के कानीवहल्ली और आस पास के क्षेत्र में स्वर्ण के लिए वीक्षण सर्वेक्षण", आइटम कोड: एमईपी / एनसी / एसआर / एसयू-केजी / 2018 / 18818 के स्वर्ण और संबंधित खनिजों की संभावना का मूल्यांकन करने के साथ तथा प्रकृति को समझने और स्वर्ण के खनिजकरण पर विशेष जोर दिया गया है। फील्ड वर्क के दौरान 100 वर्ग किमी क्षेत्र में 1: 12,500 के पैमाने पर 172 बेड रॉक सैंपल (बीआरएस), 111 पीटिंग ट्रेचिंग सैंपल (पीटीएस), 30 स्टीम सेडिमेंट सैंपल (एसएसएस), 22 पेट्रोकेमिकल रासायनिक नमूने (पीसीएस) और 59 पतले पॉलिश अनुभाग (टीपीएस) लिए गए। इनके अलावा एनजीसीएम समग्र नमूनों की इकाई सेल नमूने (12 nos); जिस पर पैदावार करने वाले अयु मानों का पुनः विश्लेषण किया गया और क्षेत्र के खनिज क्वार्ट्ज सिराओ से 06 प्रतिनिधि नमूने द्रव समावेश अध्ययन के लिए प्रस्तुत किए गए। परियोजना क्षेत्र चित्रदुर्गा शिस्ट बेल्ट के उत्तरी भाग में स्थित है, चित्रदुर्गा पूर्वी मार्जिन शियर ज़ोन (सीईएमएसज़ेड) के रूप में जाना जाने वाला क्रस्टल स्केल शीयर ज़ोन के पास, जिसे गदग से मांड्या तक अनुरेखण किया जा सकता है।

मानचित्रण किए गए क्षेत्र में पीजीसी के ग्रेनाइट नाइस और मेगमेटिक नाइस, चित्रदुर्गा समूह के हिरियुर फॉर्मेशन के विभिन्न मेटा-तलछट और मेटा-ज्वालामुखी के चट्टानों और नए अंतर्भेदी शामिल हैं। क्षेत्र के दक्षिण पश्चिमी और उत्तर पूर्वी हिस्से में उजागर ग्रेनाइट नाइस को शीस्टबेल्ट के लिए निम्नतल के रूप में माना जाता है। ल्युक्रेटिक और मीडियम ग्रेड ग्रेनाइट नाइस, क्वार्ट्ज, फेल्डस्पर और बायोटाइट से बना है जिसमें गार्नेट और एपिडोट जैसे सहायक खनिज हैं। क्षेत्र के दक्षिण पश्चिमी भाग में नाइस मिग्मेटाइड हो गया है, जिसमें ल्यूकोसोम और मेलानोसोम पाये गए हैं। पूर्व में शीस्ट बेल्ट चट्टाने इसके ऊपर स्थापित है और इनका संपर्क शेयरेड है। नाइस और शिस्ट बेल्ट के पश्चिमी संपर्क में शेयरिंग कम हुए सुक्ष्म आकार, प्रोटोमयलॉनाइट और सेरिसीटीईज़ेशन द्वारा चिह्नित है। नाइस के भीतर सिग्मोइडल पॉर्फिरोबलास्ट सीनिस्ट्रल शेयरिंग को इंगित करता है। शीस्टबेल्ट हिरियुर फॉर्मेशन के मेटाबेसाल्ट से शुरू होता है। यह चट्टान सुक्ष्म आकार वाले दानेदार, विशाल चट्टान जैसी है और इसमें क्वार्ट्ज, एक्टिनोलाइट और क्लोराइट पाया गया है। यह चट्टान संपर्क के पास शेयरेड है जहां उसमें हॉर्नब्लेन्डे और सिलिसिफिकेशन देखा गया है। प्राप्य अथवा अप्राप्य बीआईएफ़, डोलोमाईट और लाईमस्टोन मेटा-बसाल्ट में देखा गया है। मेटा-आर्जिलाइट अन्य प्रमुख लिथोयूनीट है जो क्षेत्र के शीस्टबेल्ट भाग के भीतर पाया है। यह बड़े पैमाने पर मिलने वाली इकाई के रूप में होता है जो विभिन्न रंगों और विभिन्न बनावटों को दिखाती है।

वर्तमान मानचित्रण के दौरान क्षेत्र में अवलोकन अथवा पेट्रोलॉजिकल अध्ययनों के आधार पर मेटा-आर्जिलाइट को क्वार्ट्ज-क्लोराइट शीस्ट, क्वार्ट्ज-सेरीसाइट शीस्ट और फेरुजिनस फिलाइट के रूप में पुनर्वर्गीकृत किया जाता है। क्वार्ट्ज क्लोराइट शीस्टहरे रंग का महीन दानेदार फाइटिक इकाई है जो क्वार्ट्ज, क्लोराइट और प्लाजियोक्लेज़ से बना होता है। वर्तमान मानचित्रण के दौरान क्षेत्र की टिप्पणियों और पेट्रोलॉजिकल अध्ययनों के आधार पर मेटा आर्जिलाइट को क्वार्ट्ज-क्लोराइट विद्वान, क्वार्ट्ज-सेरीसाइट शीस्ट और फेरुजिनस फिलाइट के रूप में पुनर्वर्गीकृत किया जाता है। क्वार्ट्ज क्लोराइट शीस्ट हरे रंग का छोटा दानेदार फिलाइट इकाई है जो क्वार्ट्ज, क्लोराइट और प्लाजियोक्लेज़ से बना होता है। क्वार्ट्ज सेरीसाइट शीस्ट एक रेखाकर बैंड के रूप में मेटा-आर्जिलाइट में उजागर है जो क्वार्ट्ज और सेरीसाइट/मास्कोवाएट माइका का बना हुआ है। फेरुजिनस फिलाइट बैंगनी से लाल रंग वाली छोटा दानेदार चट्टान है जिसमें ज़ादातार एफ़ई-ऑक्साइड और क्वार्ट्ज़ पाया गया है। यह इकाई रेखाकर बैंड

के रूप में पूर्व कानीवहल्ली में उपस्थित है और विशेषता इसमें पतले फ़ोल्डएड टूटे हुए चार्ट बैंड पाये गए हैं। मेटा-आर्जिलाइट में कोंग्लोमीरेट को उपस्थिति भी है। पॉलीमेटिक इंट्रा फॉर्मेशनल कोंग्लोमीरेट जो की बीआईएफ, चर्ट, क्वार्टज़ शिरा, माफ़िक रॉक और ग्रेनाइट कंकड़ से बना है। और इसे होस्केरे कोंग्लोमीरेट के बराबर माना जाता है। मैसिव पिलोवेड्डु मेटाबेसाल्ट का एक छोटा सा पैच फेरुजिनस फिलाइट के पूर्वी संपर्क में पाया गया है। वर्तमान कार्यों के दौरान इस मेटाबेसाल्ट से वेरिओल्स की उपस्थिति सूचित की गई है। वेरिओल्स कुछ मिमी आकार के हैं और सतह पर छोटे आकार के आंसू के रूप में पाए गए हैं। यद्यपि यह कुछ स्थानों पर तानवाला विभिन्नताओं को दर्शाता है परंतु पेट्रोलॉजिकल अध्ययनों के दौरान संरचनागत अंतर नहीं देखा गया है। मेटाबेसाल्ट से एक्टिनोलाइट शीस्ट और एम्फ़ीबोलाइट के क्रमिक संक्रमण को अध्ययन क्षेत्र के पूर्व की ओर देखा जाता है। पूर्वी भाग में मेटाबेसाल्ट ठीक दानेदार और शिस्टोज है और एक्टिनोलाइट, क्लोराइट और एपिडोट से बना है। मेटाबेसाल्ट धीरे-धीरे पूर्व की ओर अम्फ़िबोलआइट में बदल जाता है। दोनों के बीच कोई स्ट्रेटिग्राफिक या संरचनात्मक विराम नहीं देखा गया है जो बताता है कि अम्फ़िबोलआइट हिरीउर फोरमेशन का एक हिस्सा है। एक्टिनोलाइट, क्वार्टज़ और क्लोराइट के अलावा, हॉर्नब्लेंड की उपस्थिति पूर्व की ओर देखी गई है। दोनों इकाइयों के संपर्क को सीधी रेखाओं के रूप में नहीं खींचा जा सकता है, इसलिए अम्फ़िबोलआइट को शीस्टबेल्ट के पूर्वी मार्जिन पर मेटाबेसाल्ट के भीतर पैच के रूप में दिखाया गया है। पूर्व में अम्फ़िबोलआइट और ग्रेनाइट नाइस का संपर्क ईएमएसजेड (ईस्टर्न मार्जिन शीयर जोन) की उपस्थिति से चिह्नित है। पूर्वी संपर्क में क्षेप क्षेत्र क्वार्टज़ रिबन, छोटे दाने, प्रोटो के साथ-साथ अल्ट्रा मायलोनाइट और स्ट्रेचिंग लिनियएण के विकास के साथ एक प्रमुख क्षेत्र है जो एक निकटवर्ती जोर का संकेत देता है। शीरींग के साक्ष्य ग्रेनाइट ग्रैनिट में अच्छी तरह से स्पष्ट किए गए हैं, जो क्वार्टज़-प्लेगियोक्लेज़ और गार्नेट से बना है। पीजीसी के भीतर कतरे गए सरगुर अम्फ़िबोलआइट के मैप्पेबल और गैर-मैपेबल एन्क्लेव की पहचान की गई है। नए गैब्रो और डोलराइट डाइक ने इस क्षेत्र घेरा है। युवा अम्लीय घुसपैठ में मैप्पेबल और नॉन-मैपेबल स्केल की क्वार्टज़ इस्पाठिक शामिल हैं। होमबालहल्ली के पास विशाल क्वार्टज़ चट्टान क्षेत्र में पहचानी जाने वाली प्रमुख क्वार्टज़ इस्पाठिक हैं। स्मोकी क्वार्टज़ इस्पाठिक की संख्या प्रमुख बेल्ट के भीतर दिखाई देती है जो प्रमुख सिस्टोसिटी के समानांतर है।

मैप किए गए क्षेत्र में निकछपुर गाँव के पास दक्षिणी भाग में वलित बीआईएफ़ समूह बनाते हैं। इस उ.प. प्लांजिंग वलय के बंद होने से एफ-2 वलय पलटा हुआ है जो कि जांच ब्लॉक के बाहर स्थित है। इस क्षेत्रीय वलय के अलावा, नीचपुर के उत्तर में मुड़े हुए सिलवटों की संख्या की पहचान की गई है। ज्यादातर पाए जाने वाला प्रमुख प्लानर विशेषताएं बीआईएफ़ (एस 0), बेड समानांतर क्लीवेज (एस 1) और क्रैनुलेशन क्लीवेज एस 1 को एक तीव्र कोण (एस 2) में काटते हैं, जो शिस्टोज चट्टानों में संरक्षित हैं। मेसोस्कोपिक स्केल में टाइप- I और टाइप- III हस्तक्षेप पैटर्न देखे जाते हैं। जैसा कि उल्लेख किया गया है, क्षेत्र में बेसमेंट-कवर संबंध दो प्रमुख कतरनी क्षेत्रों द्वारा परिभाषित किया गया है। पूर्वी संपर्क में स्थित कतरनी क्षेत्र वस्तुविक रूप में उपस्थित है और इसमें कतरनी की संवेदी भावना है। कई विलग संलगनिक कतरनी क्षेत्र पूर्वी सीमा कतरनी क्षेत्र के समानांतर शीस्टबेल्ट के भीतर देखे जाते हैं।

वर्तमान कार्य के दौरान क्षेत्र से एयू और सीयू के कुछ विषम मूल्य बताए गए हैं। सीयू मान 200 ppm से 2700 ppm तक भिन्न होते हैं और क्षेत्र के दक्षिणी पश्चिमी भाग में ग्रेनाइट / माइग्माइट नाइस में घुसपैठ किए गए विशालकाय क्वार्टज़ स्पठिक (चट्टान के रूप में होने) से रिपोर्ट किए जाते हैं। क्वार्टज़ शिरा में खनिजकरण क्षेत्र में मैलाकाइट, क्लोरोपायराइट, पाइराइट और आर्सेनोपाइराइट की उपस्थिति और फेरुजिनस के- फेल्डस्पार और एपिडोट परिवर्तन द्वारा चिह्नित किया गया है। क्वार्टज़ शिरा जगह जगह पर ब्रेक्षियटेड हैं और एक सिलसिफायड क्षेत्र का प्रतिनिधित्व कर सकते हैं। पेट्रोलॉजिकल अध्ययन, एसईएम और ईपीएमए विश्लेषण ने ए.यू. और ए.जी. के मुक्त कण के साथ-साथ चैलकोसाइट, गैलिना, स्फालराइट, कोवेललाइट और बोर्नाइट की उपस्थिति को इंगित करता है। हालांकि, क्वार्टज़ शिरो के नमूनों में कोई सोने का मूल्य नहीं मिला है। एसईएम के दौरान पहचाने जाने वाले अन्य सिलिकेट परिवर्तन क्लोराइट, सीरीसाइट और के-फेल्डस्पार हैं। खनिज क्षेत्र महत्वपूर्ण तांबे के मूल्यों के साथ 800

मीटर लंबा है जिसमें 0.2775%, 0.149%, 0.117% और 0.144% है जो 1 मीटर की चौड़ाई से अधिक है।

एयू मूल्य 25ppb से 2084ppb तक भिन्न होता है। मूल्यों को बीआईएफ क्षेत्र से सूचित किया जाता है जो क्वार्ट्ज सिराओ द्वारा वलित है, क्षरित है और क्वार्ट्ज सिराओ द्वारा कतरे गए मेटा-आर्जीलाइट में पाया गया है। नमूनों के एसईएम विश्लेषण ने क्वार्ट्ज सिराओ के भीतर मुक्त सोने की उपस्थिति के साथ-साथ अन्य सल्फाइड जैसे कि क्लोरोपीराइट, पाइराइट, आर्सेनोपाइराइट, कोवेलाइट, चालकोसाइट और गैलेना का संकेत दिया है। 283 शैल नमूनों में से (बीआरएस पीटीएस) में 51 नमूनों का विश्लेषण किया गया है, जिसमें सोने के मूल्य > 25 ppb (38 बीआरएस एंड 13 पीटीएस) उपस्थित है। इन 51 नमूनों में से केवल दो नमूनों में 1ppm से अधिक सोने के मूल्य मिले। 400 m का एक छोटा खनिज क्षेत्र चिगटेरी के बीआईएफ के उत्तर पश्चिम में 60 ppb से 192 ppb (25 ppb से ऊपर 05 मान) तक के मानों के साथ चिह्नित किया गया था। खनिजों के एक और उल्लेखनीय खिंचाव के बारे में 400 m की लंबाई के लिए बीआईएफ के भीतर कनीवाहल्ली के उत्तर पश्चिम में चिह्नित है। 1 मीटर की औसत चौड़ाई से अधिक 36 पीपीबी और 402 पीपीबी के मूल्य के साथ। मेटा-आर्जीलाइट और मेटा-बेसाल्ट के संपर्क में पुराने काम से एकत्र किए गए नमूनों से सोने के मूल्यों की छिटपुट घटना की सूचना है। यहां एकत्र किए गए पांच नमूनों में क्रमशः 238 ppb, 2080 ppb, 1744 ppb, 60 ppb, 34ppb के मान मिले। जिनके मूल्यों में कोई सहयोजनिक निरंतरता नहीं है।



## CHAPTER-1

### SUMMARY

#### RECONNAISSANCE SURVEY FOR GOLD IN KANIVEHALLI AND ADJOINING AREA, DAVANGERE AND BELLARY DISTRICTS, KARNATATKA (G4)

##### Item No. : M2APM/ME/SR/SU-KG/2018/18818

In accordance with the Field Season programme 2018-19, Project: Reconnaissance Survey for Gold in Kanivehalli and adjoining areas, Davanagere and Bellary Districts, Karnataka (G4 Stage), with Item Code: MEP/NC/SR/SU-KG/2018/18818 was taken up to evaluate the potentiality of gold and associated minerals with special emphasis to understand nature and control of gold mineralization. During the course of field work an area of 100 sq.km was mapped on 1:12,500 scale along with collection of 172 Bed Rock Samples (BRS), 111 Pitting Trenching Samples (PTS), 30 Stream Sediment Samples (SSS), 22 Petro Chemical Samples (PCS) and 59 Thin Polished Sections (TPS). Apart from these the unit cell samples (12nos.) of the NGCM composite samples; which yielded anomalous Au values were re-analysed and 06 representative samples from the mineralized quartz veins of the area were submitted for fluid inclusion studies. The project area is located within northern part of Chitradurga Schist Belt, near to the crustal scale shear zone known as Chitradurga Eastern Margin Shear Zone (CEMSZ) that can be traced from Gadag to Mandya.

The mapped area comprises granite gneiss and migmatitic gneiss of PGC, various meta sedimentary and meta-volcanic rocks of Hiriyur Formation of Chitradurga Group and younger intrusives. The granite gneiss exposed in the south western and north eastern part of the area is considered as the basement for the schist belt. The leucocratic and medium grained granite gneiss is composed of quartz, feldspar and biotite with accessory minerals such as garnet and epidote. The gneiss at the south western part of the area is migmatized at places characterized by the development of leucosome and melanosome. It is overlaid by the schist belt rocks at east and the contact is sheared. The shearing at the western contact of gneiss and schist belt is marked by the grain size reduction, development of protomylonite and intense sericitisation. The sigmoidal porphyroblasts within the gneiss indicates sinistral sense of shearing. The schist belt succession starts with the metabasalt of Hiriyur Formation. The rock is fine grained, massive to foliated and composed of quartz, actinolite and chlorite. It is sheared near to the contact and development of hornblende and silicification is observed. Mappable and non-mappable units of BIF, dolomite and limestone are observed within the metabasalt. Meta argillite is the other major lithounit identified within the schist belt part of the area. It occurs

as wide spread unit showing variegated colours and different textures. During current mapping the meta argillite is reclassified as quartz-chlorite schist, quartz-sericite schist and ferruginous phyllite based on the field observations and petrological studies. The quartz chlorite schist is greenish fine grained phyllitic unit composed of quartz, chlorite and plagioclase. Quartz sericite schist is exposed in the area as a linear band within the meta-argillite and composed of quartz and sericite/muscovite mica. The ferruginous phyllite is purple to red coloured fine grained fissile rock dominantly composed of Fe-oxides and quartz. This unit occupies the linear ridge east of Kanivehalli and characterized by the presence of thin folded impersistent chert bands. Presence of conglomerate is noted within the meta argillite. The polymictic intra formational conglomerate is composed of BIF, chert, quartz vein, mafic rock and granite pebbles and considered to be equivalent to the Hoskere conglomerate. A small patch of massive pillowed metabasalt is observed at the eastern contact of ferruginous phyllite. Presence of varioles are reported from this metabasalts during the current work. The varioles are of a few mm size and occur as tear shaped small nodules on the surface. Though it shows tonal variations at places compositional difference is not noticed during petrological studies. A gradual transition from metabasalt to actinolite schist and to amphibolite is observed towards east of the study area. The metabasalt at the eastern part is fine grained and schistose and composed of actinolite, chlorite and epidote. The metabasalt gradually changes into amphibolite towards east. No stratigraphic or structural break is observed between the two indicating that the amphibolite is a part of Hiriyur Formation. Apart from actinolite, quartz and chlorite presence of hornblende is noticed towards east. The contact of both the units cannot be drawn as straight lines hence amphibolite is shown as patches within the metabasalt at the eastern margin of schist belt. The contact of amphibolite and granite gneiss at east is marked by the presence of EMSZ (Eastern Margin Shear Zone). The shear zone at the eastern contact is a prominent zone with development of quartz ribbons, grain refinement, proto as well as ultra mylonite and stretching lineations indicating a near vertical thrust. The evidences of shearing is well pronounced in the granite gneiss which is composed of quartz-plagioclase and garnet as accessory. Mappable and non-mappable enclaves of sheared Sargur amphibolite is identified within PGC. Number of younger gabbro and dolerite dykes are seen traversing the area. The younger acidic intrusives comprise quartz veins of mappable and non-mappable scale. The giant quartz reef near Hombalahalli are the major quartz veins identified in the area. Number of smoky quartz veins are seen within the schist belt parallel to the major schistosity.

The mapped area forms macroscopic synformal fold at the southern part near Nichchapur village defined by the folded BIFs. The closure of this NW plunging overturned

F2 fold was located outside the investigation block. Apart from this regional fold, number of mappable folds are identified north of Nichchapur. The dominant planar features observed are bedding in BIF (S0), bedding parallel cleavage (S1) and crenulation cleavage cutting S1 at an acute angle (S2) preserved in the schistose rocks. Type-I and Type-III interference patterns are observed in mesoscopic scale. As mentioned, the basement-cover relationship in the area is defined by two major shear zones. The shear zone at the eastern contact is thrust in nature and has sinistral sense of shear. Many discrete sympathetic shear zones are observed within the schist belt parallel to the eastern margin shear zone.

During the current work a few anomalous values of Au and Cu are reported from the area. The Cu values are varying from **200ppm to 2700ppm** and are reported from the giant quartz veins (occurring as reefs) intruded into the granite/migmatite gneiss at the south western part of the area. The mineralization zone in the quartz vein is characterized by the presence of malachite, chalcopyrite, pyrite and arsenopyrite and marked by ferruginous, K- feldspar and epidote alterations. The quartz veins are brecciated at places and may be representing a silicified zone. The petrological studies, SEM and EPMA analysis carried out indicates the presence of chalcocite, galena, sphalerite, covellite and bornite along with free grains of Au and Ag. However, the quartz vein samples have not yielded any gold values. The other silicate alteration identified during SEM are chlorite, sericite and K-feldspar. The mineralized zone is **800m** long with significant copper values **0.2775%, 0.149%, 0.117% and 0.144%** over a width of 1m.

The Au values varying from **25ppb to 2084ppb**. The values are reported from the BIFs of the area which are folded, altered and traversed by quartz veinlets and sheared meta-argillite traversed by quartz veinlets. The SEM analysis of samples indicated presence of free gold within the quartz veins along with other sulphides such as chalcopyrite, pyrite, arsenopyrite, covellite, chalcocite and galena. Out of the 283 rock samples (BRS+PTS) analyzed 51 samples reported gold values >25ppb (38BRS and 13 PTS). Among these 51 samples only two samples yielded gold values above 1ppm. A small mineralized zone of 400m was marked along the BIF north west of Chigateri with values ranging from **60ppb to 192ppb** (05 values above 25ppb). Another notable stretch of mineralization is observed north west of Kanivehalli within BIF for a strike length about 400m. with values ranging from **36 ppb and 402 ppb** over average width of 1m. Sporadic occurrence of gold values is reported from the samples collected from the old working at the contact of Meta-argillite and meta-basalt. The five samples collected here

yielded values **238ppb**, **2080ppb**, **1744ppb**, **60 ppb**, **34ppb** respectively. The value has no strike continuity.



**CHAPTER-2**  
**INTRODUCTION**

**2.1 FSP Details**

The project “Reconnaissance survey for gold in Kanivehalli and adjoining area in Davangere and Bellary districts, Karnataka vide code no. M2APMM/MEP/NC/SR/SU-KG/2018/18818 was taken up as G4 stage investigation as per the Annual Field Season Programme of Geological Survey of India for FS 2018-19. The field components comprise large scale mapping on 1:12,5000 scale over 100 sq.km along with 100 cum trenching, collection of 100 Pit-Trench Samples, 100 Bedrock Samples, 20 Petrochemical Samples and 50 Petrological Samples (including Ore Microscopic samples). The target achievements are detailed in the table.

**2.2 Objective**

The project was taken up to assess the gold potentiality of the area

**Table: 1 Nature and quantum of work carried out in the area during FS 2018-19**

Nature of work	Total workload envisaged for FS 2018-19	Achievements
1.Spectral studies ASTER data interpretation	720	720
1.Geological Survey (a) i) LSM on 1:12,500 scale	100	100
2.Technological (a)Surface exploration i)Trenching/Pitting (cu m)	100	116
ii)PTS (no.s)	100	111
3.BRS	100	172
4.Petrographic and Mineragraphic studies (no.s)		
i)PS	30	37
ii)OM	20	22
iii)PCS	20	22
iv)SEM	10	10
v)EPMA	10	10
vi)SSS*+Unit cell sample analysis	30+12	42
vii)FIS*	06	06
iv)Chemical Analysis	220	347
vii)Check samples	20	20

**Table:1A. Expenditure details and field stay**

Expenditure details	Head	
	POL	Nil
	Wages	Rs. 2,26,495
	OC	Rs.61,079
	Total	<b>2,87,574</b>
Field stay (supervisory officer )	Anindya Bhattacharya, Director -08 days	
Officers	Nimmy K.C,Sr.Geologist- 129 days Hima K. Reghunath, Sr. Geologist-126 days	

### 2.3 Background information and scope of the project

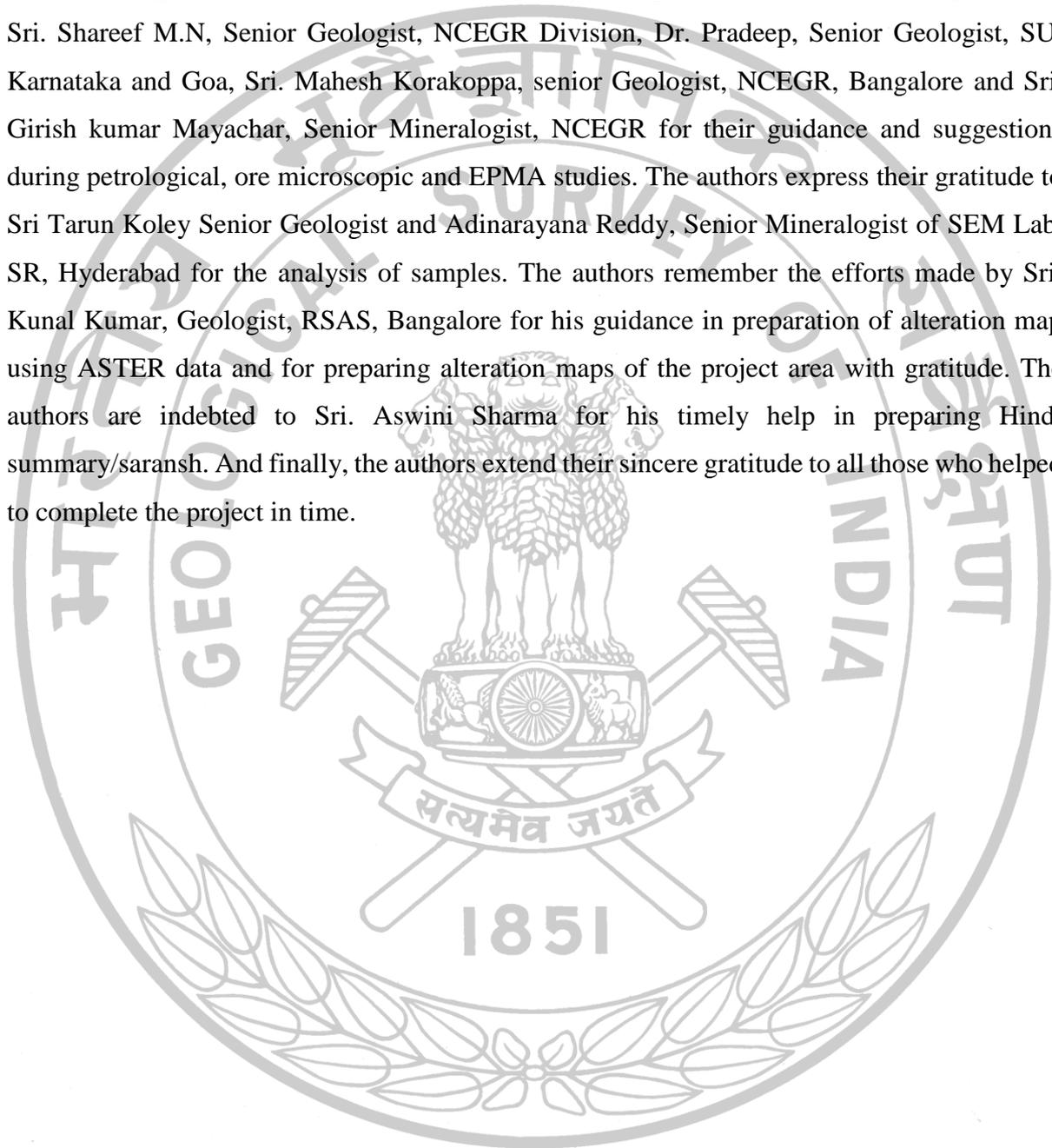
The project is a spin off item of National Geochemical Mapping (NGCM) carried out in the SOI toposheet 57B/01 during F.S 2012-13 by Shashikant Gawade and Nimmy K.C (PlateXI). Three anomalies for gold were observed. The first one is a linear anomaly with values varying from 14 ppb to 36 ppb and falls on the argillite hosted BIF (Cell nos. 18, 30, 37, 45, and 59), second anomalous zone is situated over granite gneiss (Cell no.185) with Au values ranging from 3ppb to 32ppb and the third anomaly was noticed on granite near Ramappanayakana halli (Cell no. 37) with gold value ranging up to 20ppb (plate 6). Apart from these, minor anomalies were noticed at the contact of amphibolite and PGC, and within meta basalt of Chitradurga Group.

The project area forms a part of Chitradurga Schist Belt and exposes BIF-Metabasalt-Meta argillite suite of rocks which are known to be associated with important gold deposits in Southern India. Gold occurrences have been reported in association with base metal sulphides from different parts of the Chitradurga Schist Belt, which exposes an ideal assemblage of Banded Iron Formation, basic volcanics and greywacke. The mapped area is located in the northern part of Chitradurga Schist Belt where it attenuates to attain its minimum thickness. The area is known for a few old workings in BIF for gold near Kanivehalli and Upanayknahalli.

### 2.5 Acknowledgement

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## CHAPTER-3

### PROPERTY DESCRIPTION

#### **I Title of ownership**

The area comes under the jurisdiction of Bellary as well as Davangere districts. A part of the area belongs to the Jajikkalgudda and Sogi Resrved Forests under Davangere Division and Bellary Circle and the remaining part is private land under the ownership of different parties.

#### **II Details of the area**

##### **1 Location and accessibility**

The Kanivehalli block is bounded by co-ordinates N14°47'30"-E76°00'00"; N14°54'00"-E76°00'00"; N14°54'00"-E76°05'00"; N14°47'30"-E76°05'00" in SOI toposheet 57 B/1 as shown in the location map (Plate.I). Davangere is the district head quarter which is 70 k.m. away from Harapanahalli. The nearest town to the block is Harappanahalli and is accessible by Harihar-Kotturu State Highway. The nearest Railway station is Harihar situated at 40kms away from the block. Kanivehalli is around 25 kms towards west from Kotturu and 4 kms towards east from Harapanahalli.

##### **2 Cadastral details of the area**

As mentioned, part of the area is under Jajikkalgudda and Sogi Reserved Forest under Government of Karnataka and rest of the area is private land mostly cultivated. 52 sq.km of the investigation area comes under forest. The major villages coming within the block are Bhavihalli, Konkana Hosuru, Kanivehalli and Hombalagatti of Harappanahalli Taluk. As of 2001 India census Harpanahalli had a population of 41,889 and an average literacy rate of 55%.

##### **3 Lease hold status**

The block is a free hold area.

##### **4 Climate**

The investigation block is located in the central part of Karnataka and experiences a tropical to steppe climate. The Köppen-Geiger climate classification for the area is Bsh (Arid Dry Hot climate). Harappanahalli is one of the places which records highest temperature with less humidity within Davangere District. The average annual temperature is 32°C. Similary the area has the lowest precipitation rate within the district having an average annual precipitation of 520mm (Source:IMD). The driest month is January and most precipitation falls in October, with an average of 124 mm during SW monsoon period. The months of March and April are the hottest months of the year. The warmest month of the year is April with an average temperature of 30.2 °C and maximum temperature 42°C. In December, the average temperature is 22.7 °C. It is the lowest average temperature of the whole year. The difference in precipitation

between the driest month and the wettest month is 124 mm. The average temperatures vary during the year by 7.5 °C

## **5 Flora and fauna**

The area under forest cover is characterized by dry deciduous forests to scrub jungle (Manjunath, B.K). The forest undergrowth in the district consist mainly of Tangadi (Cassia auriculata), Bandarke (Dodomia Liscosa) and grass. The chief minor forest produce are Tangadi Bark, Kakke Bark, Tamarind, Honge leaves and flowers, gallnut and tupra. The plainland is mostly covered with stones and a dwarf species of minosa, locally called “hote jali” is dotted at wide intervals. Coconut plantation can be seen in areas of the district wherever water resources are available (Census data)

The hilly tract of the district including Jajikkalgudda Reserved Forest has good number of leopards. Locally this animal is called as Cheetah, Kiruba, Ibbadi and Dodda Ibba. Hyenas, bears and wild bear form part of fauna of the district. Poisonous reptiles are common in the district. Also, harmless snakes, scorpions of different varieties can be seen. The mapped area within Jajikkalgudda and Sogi Reserved Forest are known for peacock protected zones. Apart from peacock common birds like crow, mynah, pigeons, wood pecker and eagles are found here as in other parts of the District. A rare variety of Ribbon Tailed Astrapia (Bird of paradise) was noticed within the Sogi Reserved Forest area during the field work. Pelican is also found near Hombalagatti. Hares are plentiful on the hill slopes and also in the valleys.

## **6. Infrastructure and Environment**

A part of the mapped area is Reserved Forest and devoid of any settlements and inhabitation. No national parks, historical sites and monuments are located in the area. As per the Ecologicaly Sensitive Zone notification, 2014 the area does not come under environmentally sensitive areas. Investigation area is devoid of local infrastructure facilities like police station, revenue office, postal services and health centre. The nearset town to the block is Harapanahalli which is taluk headquarters and the major infrastructure includes PWD office, RFO office, police station and taluk office.

## CHAPTER-4

### PREVIOUS EXPLORATION

#### I Details of previous exploration/work

The project area is located within Toposheet No.57B/01 and forms a part of the northern part of Chitradurga Schist Belt. The area is also renowned for gold, iron and manganese deposits along with sporadic occurrences of copper. GSI and other agencies carried out number of investigations around Harappanahalli, Uparayakanahalli and Kanivehalli to identify and assess potential zones of mineralisation. The first notable work was done by Bruce Foote, who recorded the occurrence of gold in Ajjanahalli and surrounding areas and described its geological set up in his traverse notes and his work on “Auriferous tracts of Mysore” (1882). The first-generation mapping on 1:63,360 was carried out by M. Krishnamurthy, 1952-53 who reported the disposition of major rock types like metabasalt, metapelite, dolomite, limestone and BIFs.

The area around Harappanahalli was examined for copper mineralization during FS 1969-70. The quartz veins in the selected area of Toposheet Nos. 48N/13, 48N/14 and 57B/01 were studied in brief by Narasimhan. Mineralized outcrops of quartz vein were reported from Harappanahalli-Hadagali road and Harappanahalli-Hospet road. Mineralisation is reported in the form of copper carbonates and disseminations of primary sulphides like chalcopyrite and pyrite. The author also reported presence of iron aureoles within the quartz vein. The western portion of the strike length identified as better mineralized than the eastern part. The mineralized quartz vein located 50 meters north of the 6th milestone on Harapanahalli-Hadagalli Highway identified as the prominent zone with strike length of 0.8 km. over widths varying from 4 - 8 m. According to the author the surface indications of mineralization are not very encouraging and hence a low priority was assigned for exploring the area. At the same time, he recommended 900m drilling in six boreholes over the 0.8km long zone identified to determine the grade of ore in the primary zone and also to check the incidence of mineralization, in the host rock.

Bhattacharya and Ganganna covered an area of 48 sq.kms in toposheet 57B/1 as well as an area of about 44 sq.km in toposheet no 57B/2 on 1:50000 scale by geological traverses and sampling during the preliminary exploration for gold in the Banded Iron Formations of Chitradurga Schist belt in FS 1989-90. A total of 514 geochemical samples were collected, out of which 94 samples were analyzed for gold and associated elements. The study of the distribution pattern of the basemetals and Au revealed that the folded Banded ferruginous quartzite is comparatively richer in Cu, Pb, Zn, Ni, Co and As and 94 samples were analysed

for Au, out of which 20 have yielded values varying from 0.1 to 1.1 ppm. The association of quartz veins and Banded Ferruginous Quartzite appears significant in gold concentration. The folded BIF in the sheared/deformed zones with intruded quartz veins are identified as prominent loci for gold and other base metal concentration.

Geological mapping was carried out in the Harapanahalli area in parts of Toposheets 57B/1, 57B/2 and 48N/13 during FS 2000-01 by Krishnappa and Madusudanan. An area of 108 sq.km between Rangayandurg and Kanivehalli was covered on 1:25,000 scale with the collection of 190 bedrock samples, 63 pit and trench samples and 51 stream sediment samples. The project was taken up in the background of BRGM anomaly located near Kanivehalli area. The BRGM survey (Geochemical) during 1972-73 period around Kanivehalli and Harappanahalli area reported gold values within the stream sediment samples. The work components included mapping and sampling of BIF bands to locate target areas as the outer band, which is marker horizon in Hiriya Formation, has a background value of 0.1 to 0.2 ppm of Au in the central part of Chitradurga schist belt. The quartz veins and sheared contacts of meta sedimentary and meta volcanic rocks are also targeted during the work. The anomalous gold values recorded in the Jajikkalgudda R.F. area by GSI-BRGM Project (19) were in the range of 250-500 ppb for 2 samples, 100-250 ppb for 2 samples and 50-100 ppb for 16 samples. However, the follow up carried out in the area to evaluate the anomaly did not indicate any significant mineralization. Samples collected from the old workings and other targeted area ranges from 0.2 to 0.8g/t and didn't form any significant zones of mineralization. The multi-elemental data indicates that Cu values range from 7 to 510 ppm except one sample collected from quartz vein north of Harappanahalli which analysed 0.33% Cu. The authors recommended to carry out detailed exploration with close spaced sampling in Jajikkalgudda area.

During FS 2002-2004 preliminary investigation was carried out by Hanumantha Rao around the known gold occurrences of different schist belts of different stratigraphic levels to evaluate the ore potentiality. The selected blocks included Jajikkalgudda- Kanivehalli area along with Halekallu, Anesidri and Ajjenahalli of Chitradurga Schist Belt and Kalinganahalli of Yediya Karighatta belt, Honnabetta and Kachenahalli (Haltibetta) of Nagamangala schist belt. In Jajikkalgudda, an area of 17 sq.km was mapped on 1:25,000 scale and samples are collected. The gold mineralization in this area is associated with sulphidic BIF bands (9 bands) intruded by thin quartz veins emplaced along axial plane fractures of (F2 deformation) mesoscopic F2 folds with dextral shifts developed along NNW-SSE direction. The quartz veins in BIF found to be contain plenty of sulphide minerals and pyrites. The BIF is reportedly limonitised on weathered surface due to oxidation and shows yellowish brown stain. The

authors suggested epigenetic origin of Au by the emplacement of quartz veins within BIF. The auriferous nature of BIF has been proved with gold assay value varying from 10 ppb to 5.5 ppm. The authors recommended to take up the area for detailed exploration.

Apart from the above mentioned works many investigations were carried out in the southern and northern extension of Kanivehalli block as the same geological as well as structural set up prevails all along the schist belt. Occurrence of gold was reported from Kanakuppa, Goudikette, Agasanahalli, Venkatpura and Upanayakanahalli during various exploration carried out in early and late nineties. The notable work includes preliminary evaluation for basemetal by Panduranga and Purushothaman (1993), exploration for gold in Upanayakanahalli by Chandrasekharaiha and Narasimha Rao (2003) and investigation for gold in Goudikete by Subba Rao and Narasimha Rao (2001-03). The recent work carried out in the nearby area was during FSP 2016-17. Preliminary investigation was carried out for gold near Upanayakanahalli area by Harsha Sundar and Danira D'Silva.

#### **IA. Past mining activity**

The area is well known for panning activities and ancient workings for gold in BIF. Krishnamurthy (1952) reported panning activities around Chigateri, Bhavihalli and Konkana Hosuru villages. Presences of series of old workings along the ridges of BIF are reported by many authors such as Krishnappa (2001), Hanumantha Rao (2004) and Chandrasekharaiaha (2003). During current work many old workings are observed within the area mostly at fold closures of BIF. The macroscopic fold North of Nichchapur has two old workings made along the plunge direction of the fold. The bigger one is 0.5m wide and traceable up to 3-4 meters along the plunge direction (Fig.4.1). Beyond 4m the working becomes narrower. The second one is seen as a very narrow opening within the BIF and has 2-3m depth along plunge of the fold. The Gossanised BIF and ferruginous phyllite west of Konkana Hosuru also displays shallow openings (Fig.4.2). Oldworkings are also noticed at the contacts of meta-sedimentary and meta-volcanic rocks of the area. A shallow opening is noticed at the contact of ferruginous phyllite and variolitic metabasalt (Fig.4.3 and 4.4). The old working is located on a small fold closure traversed by sulphide bearing quartz vein. Presence of suspected pouncing marks are noticed within ferruginous phyllite east of this old working (Fig.4.5). Shallow pits and depressions are noticed within the meta argillite west of Bhavihalli, and carbonatized quartz-chlorite schist near Chigateri village (Fig.4.6).



**Fig.4.1** Old working observed along the plunge direction of fold hinge formed by BIF north of Nichchapur village.



**Fig.4.2** Oldworking observed within the gossanised BIF west of Konkana Hosuru.



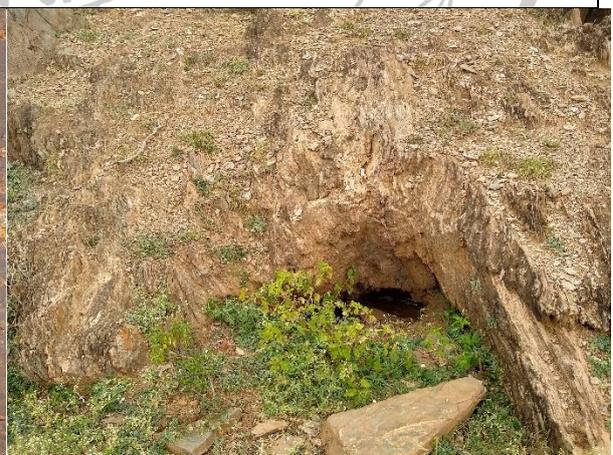
**Fig.4.3** Oldworking observed at fold hinge at the contact of ferruginous phyllite and variolitic meta basalt west of Bhavihalli



**Fig.4.4** highly oxidized host rock exposed within the old working observed at the contact of ferruginous phyllite and variolitic meta basalt west of BHavihalli



**Fig.4.5** Pounding marks observed within the ferruginous argillite west of Bhavihalli

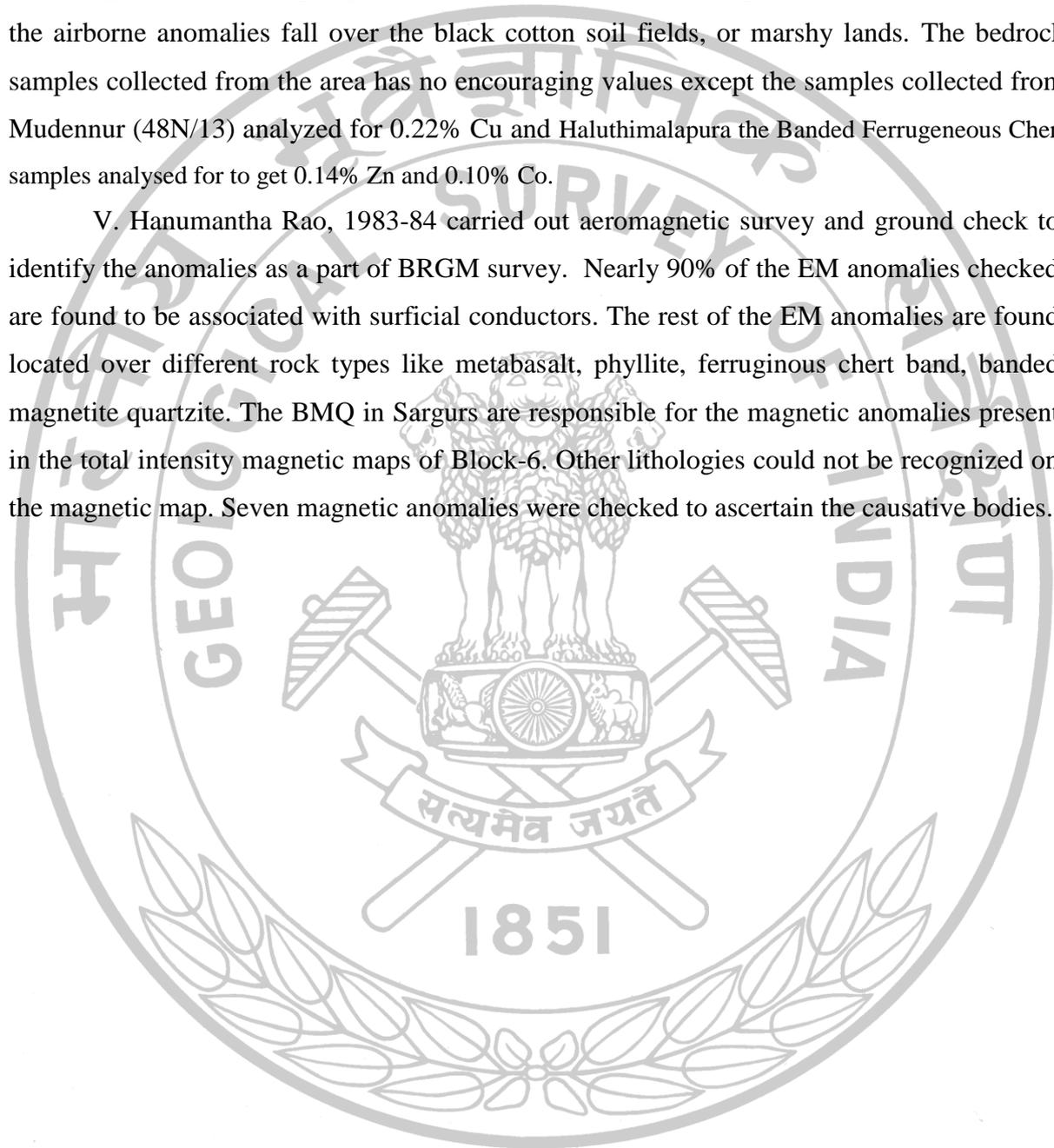


**Fig.4.6** Shallow opening observed within the carbonatized meta argillite/ quartz chlorite schist north west of Chigteri

## II. Details of aero geophysical and geophysical mapping

Aero magnetic and electromagnetic surveys were carried out in the area by S.K. Vayangankar, during 1979-80 (Plate.III). A total of 240 aero- EM anomalies were checked. Apart from this, 320 km were covered by geological reconnoitry traverses and 4.80 km by detailed geochemical sampling. In all 729-bed rock and soil samples were collected. Most of the airborne anomalies fall over the black cotton soil fields, or marshy lands. The bedrock samples collected from the area has no encouraging values except the samples collected from Mudennur (48N/13) analyzed for 0.22% Cu and Haluthimalapura the Banded Ferrugeneous Chert samples analysed for to get 0.14% Zn and 0.10% Co.

V. Hanumantha Rao, 1983-84 carried out aeromagnetic survey and ground check to identify the anomalies as a part of BRGM survey. Nearly 90% of the EM anomalies checked are found to be associated with surficial conductors. The rest of the EM anomalies are found located over different rock types like metabasalt, phyllite, ferruginous chert band, banded magnetite quartzite. The BMQ in Sargurs are responsible for the magnetic anomalies present in the total intensity magnetic maps of Block-6. Other lithologies could not be recognized on the magnetic map. Seven magnetic anomalies were checked to ascertain the causative bodies.



## CHAPTER-5

### GEOSCIENCE INVESTIGATION

#### **I Aerial Reconnaissance**

Aerial reconnaissance survey was carried out for 720 sq.km using ASTER data. The ASTER data was processed using ERDAS and ENVI softwares. Different alteration maps including chloritic, carbonate, epidote, hematite, phyllitic and silica are prepared to identify prospective blocks in the area (Plate IV to VII).

Chloritic alteration map was prepared for the area using band ratio 4 and 6(4:6). The chloritic alteration is restricted to the metabasalt and amphibolite units of the area (Plate: IV). A linear narrow zone of chloritization is noticed along the eastern contact of amphibolite with granite gneiss which can be correlated well with the shear zone. Small circular to elliptical patches of chlorite noticed within the gneiss is representing the mafic enclaves within the gneiss. Another linear zone is noticed at the contact of meta argillite and basalt. This area is characterized by the presence of old working.

Band 6 and 8 were used to prepare hematite alteration map. The map shows a large area of alteration which falls on the ferruginous phyllite of the area (Plate V). Other significant alteration noted is within the granite gneiss at the south-western part of the block possibly represents the younger intrusives.

Band ratio of  $(B7+B9)/8$  is used to identify the carbonate-epidote alterations within the area. It is noted that the entire area except the gneissic part shows carbonate-epidote alteration indicating the intense hydrothermal activity in the area. Silica map prepared using band ratios of 13 and 12 shows silicification within the granite gneiss. The WNW trending silica alteration in the south -western part is representing the giant quartz reefs present within the gneiss.

#### **II Regional Geology**

Dharwar Craton forms a part of Peninsular India and is known for its greenstone belts and younger granites. It is divided into two tectonic blocks Eastern Dharwar Craton (EDC) and Western Dharwar Craton (WDC) by transition zone including Chitradurga shear zone and Clospet Granite. The entire stratigraphy of Western Dharwar Craton is best represented by Chitradurga Group which is a linear belt of supracrustal rocks. The schist belt covers an area of about 6000 sq.km (Ramakrishnan and Vaidyanadhan, 2010) and exposes the complete succession of cratonic rocks, including Sargur supracrustals, basement gneisses and younger intrusive granitoids. It extends from Gadag in the North to Sreerangapattanam in the south over a length of about 460 kms, in NNW-SSE direction.

Chitradurga schist belt comprises an assemblage of greenschist to lower amphibolite facies rocks. Meta volcano-sedimentary rocks, which are grouped under Lower Bababudan Group and Upper Chitradurga Group, are observed in the belt. Chitradurga Group covers most of the schist belt and starts with Talya conglomerate that marks unconformable contact with Bababudan Group. Talya conglomerate consists of clasts of basement gneisses and granitoids. Chitradurga Group is divisible into three major Formations. The lowest Formation of shelf sediments, which overlies Bababudan Group and PGC is known as Vanivilas Formation and is represented by chlorite schist, quartzite, limestone, dolomite and Mn-Fe Formations. The succeeding lithopackage is called the Ingaldhal Formation to denote a wide variety of basic to acid lavas, pyroclastic, cherts and fine-grained clastics exposed in the Chitradurga anticline. These volcanics overlie the chlorite schists of Vanilas Formation but the contacts are not very sharp. Ingaldhal Formation is separated from the overlying Hiriya Formation by K.M. Kere polymictic conglomerate (unconformity). Hiriya Formation comprises of argillite, greywacke and chert along with volcanic rocks.

The generalised stratigraphic succession of Chitradurga Schist Belt is as given below

iii) **Regional Stratigraphy**

**Table 2: Generalised stratigraphy of Chitradurga Schist Belt, after Swaminath and Ramakrishnan (1981)**

Basic Dykes (Gabbro and Dolerite)	
Younger granite (Chitradurga, Hosadurga and J.N.Kote)	
<b>CHITRADURGA GROUP</b> (2900-2600 my)	<b>Hiriya Formation</b> Greywacke – argillite suite + Basic to intermediate volcanics Banded ferruginous chert and Polymictic conglomerates (Aimangala and Hosakere) K.M Kere and G.R. Halli conglomerates
	----- <b>Disconformity</b> -----
	<b>Ingaldhal Formation</b> Basic, intermediate / acid lavas/ argillite Chloritic Phyllite, Banded ferruginous chert, Limestone and dolomite
	<b>Vanivilas Formation</b> Chlorite- biotite + garnet Phyllite/ Quartzite Talya conglomerate
----- <b>Unconformity</b> -----	
<b>BABABUDAN GROUP</b> (2900-2700my)	Amygdular metabasalt interlayered with orthoquartzite Neralekatte quartz pebble conglomerate
----- <b>Unconformity</b> -----	
<b>PENINSULAR GNEISSIC COMPLEX (3000MY)</b>	
<b>SARGUR GROUP</b>	
<b>BASEMENT NOT EXPOSED</b>	

#### iv) Metamorphism and structure

Structural studies were carried out in Chitradurga Schist Belt by many workers since late 1970s and suggest polyphase deformation within the belt. Naqvi (1973) and Chadwick et al., 1978 observed three phases of deformation at the central part. The studies carried out by Mukhopadhyay et al., 1985 and Naha et al., 1985 also support polyphase deformation in the Chitradurga Schist Belt. The major structure south of Chitradurga is a southerly closing, very steeply plunging, nearly vertical folds defined by BIF horizons (Mukhopadhyay et al., 1985). The progressive widening and younging of the belt towards north together with other features indicate that the Chitradurga Belt was initiated as a rift on a thin Archaean continental crust (Naqvi, 1985).

The project area is located within northern part of Chitradurga Schist Belt, near to the crustal scale shear zone that can be traced from Gadag to Mandya. This shear zone is considered as the tectonic boundary between two sub cratonic blocks of the Dharwar. The structural disposition of the belt is the result of an overall E-W compression regime with uplift and diapirism of the sialic basement within which the N-S trending Archaean shear systems have caused buckling and refolding of earlier fold belts, making all the linear elements parallel to the direction of shear (Ramdas et.al, 2003). It can be noted from the figure that it is a narrow curvilinear belt which thins down towards north and branches out into two arms at Gadag. The main arm at east extends through Jagalur to Sokke and western arm continues up to Mayakonda. The project area forms a part of the eastern arm where the schist belt attenuates and attains its minimum thickness (about 5km).

The western arm exposes rocks of Bababudan Group and forms a regional synform at Mayakonda. The main basaltic pile and prominent iron stones typical of Bababudan Group are lacking in this belt possibly due to its truncated development (Seshadri et.al.1991). As seen in the map the major structures in the area are the antiformal folds at Dodguni, Sirekatte and Chitradurga. No major closures were noted towards north. Mukhopadhyay et.al., 1983 suggests a tectano-stratigraphic model connecting all these major antiforms and the synform at the western arm of Chitradurga schist belt (Mayakonda). He interprets the entire belt as a canoe shaped fold with axial culminations. In that case the project area is located on the eastern limb of the canoe shaped fold. The Gadag part of the belt has been re-interpreted as a structural duplex with numerous tectonic slices characterized by top to southwest movement (Chadwick et.al, 2003). He assumes the schist belt at Gadag thickened due to overturning on large-scale folds and stacking on reverse faults in a hinterland-dipping duplex. According to him the Gadag

duplex comprises four thrust slices and the gold mineralisation in Gadag is controlled by duplex structure.

A major sinistral shear zone marks the eastern margin in the north of the schist belt near Gadag (Ramakrishnan et al., 2010). This shear zone separates Javanahalli belt from Chitradurga belt at centre and passes through gneisses in the west of Kunigal belt upto the southern boundary of the craton. Thus, this shear zone marks the transitional boundary between WDC and EDC.

#### **v) Surface indications of mineralization**

As mentioned in the previous chapter, the area is characterized by the presence of old workings within BIF. According to Krishnamurthy (1952) the quartz reefs flanking the southern slopes of the Jajikkal hills are in all probability gold bearing and washed into the streams draining this area. The streams washed regularly for gold are Chigateri, Bhavihalli nullah and Konganahosur nullah. The previous reports suggest that the mineralisation is associated with the folded and deformed BIF intruded by quartz veins. The widely reported surface indications are limonitisation, silicification, carbonitisation and presence of sulphides. The copper mineralisation in the area is characterized by the presence of malachite on the surface of quartz veins. Apart from this the sheared contacts of lithounits, particularly the contact of meta-volcanic and meta-sedimentary rocks were also targeted for mineralization.

### **B Detailed Geological Mapping**

#### **i) Large Scale Mapping (on 1:12,500 scale)**

Large scale geological mapping was carried out in Kanivehalli Block, part of Survey of India toposheet No. 57B/01 on 1:12,5000 . An area of 100 sq.km was covered during the course of field work by delineating different lithounits and structural elements to understand the control of mineralization in the area. The mapped area comprises granite gneiss of PGC, various meta-volcano-sedimentary rocks of Hiriyur Formation of Chitradurga Group and younger intrusives (Plate:VIII).

The stratigraphic succession of the mapped area starts with the granite gneiss of Peninsular Gneissic Complex exposed in the south western and north eastern part of the block. The rock occupies the plain and small rocky knobs around Hombalagatti and Nandibevuru villages. It is composed of quartz, feldspar and biotite with accessory minerals such as garnet and epidote. The gneiss can be seen as intruded by the younger dolerite dykes and giant quartz veins. The schist belt rocks are exposed at the east of the granite gneiss around Hombalagatti. The succession starts with the metabasalt of Hiriyur Formation. The metabasalt which was earlier classified under Ingaldal Formation was regrouped to Hiriyur as there is no structural

or stratigraphic break in between the lithounits and the area was not exposing the litho- assemblage of Ingaldal Formation. It is noted that the contact of granite gneiss and metabasalt is sheared marked by mylonitized granite gneiss. Small patches of dolomite and limestone is noticed within the metabasalt. The contact of metabasalt and meta-argillite is sheared at places and characterized by the presence of dolomite and BIF east of Kakadahalli. The BIF near to the contact is highly oxidized and stains of sulphides are noted. Non mappable layers of meta- tuff were noticed within the meta-argillite and BIF sequence. Towards east of Kakdahalli thick sequence of meta argillite and BIF is exposed, where the argillite varies in their characteristics.

The argillite group of rocks are reclassified as quartz-chlorite schist, quartz-sericite schist and ferruginous phyllite based on the field observations and petrological studies. The pervasive lithounit, meta-argillite is characterized by small patches of quartz-chlorite schist near north west of Chigateri. It is carbonatized at many places. Thin band of quartz-sericite schist is also noticed west of the quartz-chlorite schist. Intercalations of dolomite are present within the meta-argillite. A small body of polymictic conglomerate is mapped at east of quartz- chlorite schist. The conglomerate pinches and grades into a pebbly horizon and re-appear towards north as small patches in between the quartz-chlorite schist and ferruginous phyllite. The ferruginous phyllite occur as a linear unit with gradational contact all along the Kanivehalli ridge. The BIF bands within the ferruginous phyllite are impersistent and discontinuous in comparison to the BIF along the ridge west of Kanivehalli. A small unit of pillowed and variolitic metabasalt was seen occurring as a linear body west of Bhavihalli.

The plain area and small undulating hills east of the ridge with ferruginous phyllite exposes metabasalt in large volume. The contact of meta argillite and metabasalt is characterized by intense carbonatization. It is also noted that the metabasalt at east also shows non-mappable layers of intermediate rock. A gradual transition from metabasalt to actinolite schist and to amphibolite is observed towards east of the study area. Amphibolite occur as small patches all along the eastern contact of schist belt and granite gneiss. The contact of amphibolite and granite gneiss at east is sheared and thrusts as the Eastern Margin Shear Zone passess through the area. The evidences of shear is observed in the form of mylonitization, sericitisation, grain size reduction whereas the thrust can be identified by the vertical stretching lineation on granite gneiss. Mappable and non-mappable enclaves of sheared Sargur amphibolite is identified within PGC. The stratigraphy of the area framed based on mapping is as given below.

**Table 3: Stratigraphy of exploration area based on mapping**

Acid intrusives (Quartz veins)		
Mafic intrusives (Gabbro/Dolerite)		
Mafic intrusives Meta-gabbro		
<b>Chitradurga Group</b>	<b>Hiriyur Formation</b>	Amphibolite Metabasalt Banded Iron Formation (BIF)/Ferroan dolomite/tuff /chert band Conglomerate Meta-argillite/quartz-chlorite schist/quartz-sericite schist/ferruginous phyllite with intercalations of felsic tuff Metabasalt/Actinolite schist
<b>Peninsular Gneissic Complex</b>	<b>PGC-I</b>	Granite Gneiss/migmatite gneiss
<b>Sargur</b>		Amphibolite (occur as unmappable enclaves within PGC)
.....Base not exposed .....		

**ii. Description of Rock types**

The major lithounits observed in the area are described below

**Description of the Rock types**

**Granite gneiss-**

Granite gneiss is exposed on the south-western and north-eastern part of the Kanivehalli block. It mostly occupies the low-lying plain north west of Hombalagatti and rocky knobs around Nandibevuru villages. The leucocratic medium grained gneissose rock is mainly composed of quartz, feldspar and biotite. Garnet, epidote and sericite are seen in subordinate amounts. Epidote mostly occur as veins within the granite gneiss. The gneiss is migmatitic at places where it developed alternate lighter and darker layers within the rock (Fig.5.1). The lighter layer is composed of quartz and feldspar while the melanosome part is characterised by the presence of biotite. Biotite also occur as large crystals within the granite gneiss (Fig.5.2).

The granite gneiss on either side of the block is characterised by the presence of unmappable units of amphibolite. It occurs as enclaves within the granite gneiss. The amphibolite at the eastern part of the block are comparatively larger bodies occurring as lenses and form low lying mounts within the gneiss. The sheared and foliated coarse grained rock represents the older ultramafics of Sargur Group.

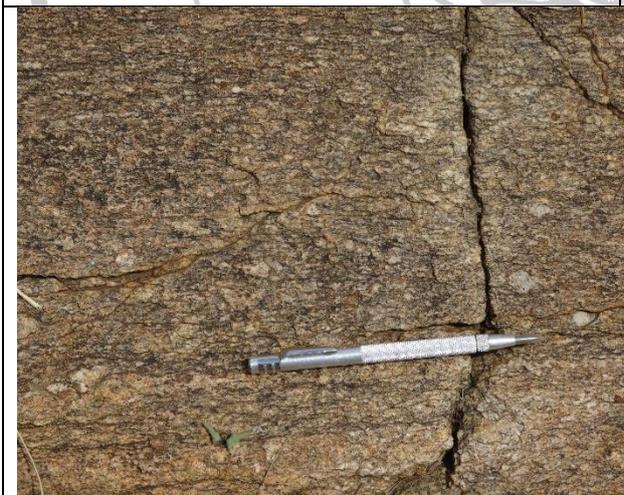
The contact between granite gneiss and schist belt is sheared in the south-western as well as the north eastern part of the block. The sheared granite gneiss exposed in the southwestern part shows the development of proto-mylonite with winged porphyroblasts of quartz and feldspar (Fig.5.3). Grain refinement and development of sericite is also noticed at the contact. Chitradurga Eastern Margin Shear Zone (EMSZ) passes through the north eastern part of the block and the gneiss within the zone is fine grained, mylonitized, strongly foliated and lineated and devoid of gneissic banding (Fig 5.4). Un-mappable pegmatite veins are observed within the gneiss 300-400 meters east of the sheared contact. The veins are mostly composed of quartz and orthoclase.



**Fig.5.1** Migmatitic gneiss observed east of Nandibevuru village.



**Fig.5.2** Large platy biotite grains observed within the granite gneiss exposed west of Nandibevuru.



**Fig.5.3** Protomylonite developed on granite gneiss with quartz and feldspar porphyroblasts exposed at west of Hombalagatti-Singarototta road.



**Fig.5.4** Strongly lineated sheared fine-grained granite gneiss without banding as observed east of Konkana Hosuru village.

## Metabasalt

Metabasalt is one of the major rock types exposed in the mapped area. Outcrops of metabasalt were observed east of Hombalagatti and Kakadahalli villages at the western part of the block and around Bhavihalli and Konkana Hosuru villages in the eastern part of the block. The rock is fine grained, greenish, massive to foliated in nature and composed of chlorite, actinolite and quartz along with saussuritised plagioclase. The metabasalt at the western contact of granite gneiss is sheared and carbonatized and forms asymmetric folds. The metabasalt in the area shows variation in its appearance and texture. As mentioned, the metabasalt near to the sheared contacts are foliated and foliation planes are intruded by quartz-carbonate veins which are folded probably during the shear to form asymmetric crenulations (Fig 5.5). The metabasalt exposed east of Kakadahalli on the western slope of a small mount is characterised by the development of big crystals of amphiboles present as clots (Fig.5.6). The rock is sheared and silicified with the presence of quartz porphyroblasts within the green chloritic matrix. Towards east of Kakadahalli both massive and foliated variety of metabasalt was seen. The massive metabasalt was seen as rounded bouldery outcrops strewn all over the small hills and planes east of Doddagarenahalli and Singaratotta. The foliated variety observed towards the contact of argillite shows development of amphibole and at places shows typical salt and pepper texture of amphibolite.

A small linear body of metabasalt was mapped within the meta argillite and ferruginous phyllite west of Bhavihalli. The metabasalt exposed here is different from the metabasalt present on either side of the mapped area in its texture and appearance. The massive metabasalt shows both pillow and variolitic structures. The varioles were observed as mm sized spherical or tear shaped nodules in a fine-grained matrix of metabasalt (Fig.5.7). These features were lighter coloured than the host rock and the size vary from 1mm to 5mm diameter. Presence of pillow structures were also noted within the same metabasalt. The pillows were elongated at places and the chilled margins are not well preserved (Fig.5.8). The pillow varies in its size from 10cm to 16cms along the longer axis. Very fine disseminations of sulphides were noted along chilled margins and the junction of chilled margins.

The metabasalt occurring east of the variolitic unit was foliated and carbonatized at its contact with meta-argillite. At many places a thick layer of carbonate was developed on the metabasalt (Fig.5.9). Presence of unmappable layers of rock having andesitic composition was identified within the metabasalt west of Bhavihalli. The metabasalt exposed on a small hill near the temple on Konkana Hosuru road shows development of rhomb shaped joints (Fig.5.10). The highly deformed rock appears like rhombic columns along vertical section.



**Fig.5.5** Sheared, carbonatized and asymmetrically folded metabasalt observed east of Hombalagatti near to the sheared contact with granite gneiss.



**Fig.5.6** Sheared metabasalt with the development of large amphibole grains (appearing as clots) as observed east of Kakadahalli village



**Fig.5.7** Variolites developed on metabasalt exposures east of Bhavihalli.



**Fig.5.8** Pillowed meta basalt with indistinct chilled margins exposed east of Bhavihalli.



**Fig.5.9** Intensely carbonatized metabasalt observed at the contact of meta-argillite north east of Konkana Hosuru



**Fig.5.10** Deformed metabasalt showing the development of rhombic joints west of Bhavihalli-Konkana Hosuru road.

## **Dolomite and Crystalline Limestone**

Dolomite occur as thin intercalations of mappable and non-mappable scale within meta-argillite and metabasalt. Presence of dolomite is also noted at the contacts of metabasalt and meta-argillite. It is noted that east of Kakadahalli the meta-argillite-BIF succession starts with a thin dolomite band at the contact and the rock is characterised by the presence of 8-10 cm size calcite veins. (Fig.5.11). Similarly, un-mappable units of dolomite were noticed at the contact of meta-argillite and metabasalt west of Konkana Hosuru. It also occurs as thin bands within quartz-chlorite schist and meta-argillite near Chigateri. The rock is fine grained, hard and massive in habit. Presence of one set of crude foliations was observed within the dolomite band near Chigateri. At places the composition of dolomite grades into ferroan-dolomite. Ferroan dolomite occur as thin bands as well as veins within the quartz-chlorite schist and meta-argillite outcrops exposed north west of Chigateri and west of Bhavihalli (Fig.5.12). It is fine grained, massive rock with yellowish brown and coffee brown colour. Dissemination of sulphides mostly pyrite was observed along the quartz veins within the ferroan dolomite (Fig.5.13). Ferroan dolomite also noticed in association with BIF of the area.

The crystalline limestone was observed along the flanks of a cultivated small hill east of Hombalagatti-Singarototta road within the metabasalt. It is the only outcrop of limestone found within the area. It occurs as 12-15m wide and 50m long unit with dirty and muddy surface suggesting that it can be an impure limestone (photo 5.14). The rock is grey in colour fine grained and crystalline in its appearance on broken surfaces with one set of crudely developed foliations. The rock may be of dolomitic in origin and the crystalline texture might have developed as a result of strong deformation during the shear as the exposure was located near to the sheared western contact of granite gneiss and metabasalt.

### **Meta-argillite**

Meta-argillite is the most wide spread lithounit mapped within the project area. It forms an integral part of meta-sedimentary sequence of Hiriyur Formation of Chitradurga Group and represents a wide variety of metamorphosed argillaceous rocks of different texture, composition and origin in general. During the current work an effort has been made to demarcate different lithounits within the meta-argillite as separate entities based on their texture, appearance, composition and petrological characteristics and to de-generalise the term argillite.



**Fig.5.11** Dolomite with calcite vein observed at the contact of meta-basalt and meta-argillite east of Kakadahalli



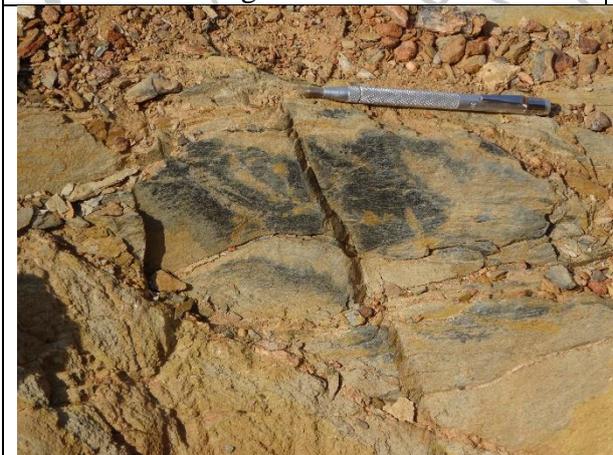
**Fig.5.12** Ferroan-dolomite intercalation observed within the meta-argillite west of Bhavihalli



**Fig.5.13** Network of quartz – carbonate veinlets observed along the ferroan dolomite north west of Chigateri.



**Fig.5.14** Outcrop of limestone exposed on a small hill east of Hombalagatti-Singarattotta road.



**Fig.5.15** Fine grained grey phyllitic meta-argillite observed north west of Chigateri village.



**Fig.5.16** Intensely carbonatized contact of meta argillite and quartz chlorite schist as observed north of Forest IB, Chigateri.

The newly demarcated lithounits such as quartz-chlorite schist, quartz-sericite schist and ferruginous phyllite will be detailed separately under respective titles. The exposures other than these lithounits which couldn't be separated either by its field disposition or by petrological characters were kept under the general term meta-argillite and discussed in detail under this subtitle. The rocks demarcated as meta-argillite are fine grained, fissile, slaty to phyllitic rocks dominantly composed of quartz, feldspar and chlorite (fig.5.15). It shows variegated colours and different kind of alterations. The meta-argillite exposed near the Forest Guest house of Chigateri is grey, phyllitic fine grained rock in contact with quartz-chlorite schist at west. The rock can be easily distinguished from the adjacent quartz-chlorite schist by its fissility, phyllitic sheen and colour. These lithounits occupies the two small hills near the Forest guest house (the western part is quartz-chlorite schist and eastern part is grey phyllitic meta-argillite) and it can be noticed that both the units are separated by intense carbonatization which can be seen along the flanks and valley between the small hills (Fig.5.16). Both the lithounits and the separation in between in the form of carbonatization continues up to the eastern ridge of Kanivehalli (●861) where the grey phyllitic meta-argillite grades into purple to red coloured ferruginous phyllite and the quartz-chlorite schist continues along the western flanks of ●861 ridge. The variation along the strike of grey phyllite may be indicating a lateral facies variation during the sedimentation.

The meta argillite is exposed in full fledge all along the western part of the block where it occupies the Kanivehalli western ridge, its flanks, and the area between Kakadahalli and the fold hinge. The meta-argillite at this part is fine grained, greenish grey to buff in colour, phyllitic and displays well developed foliations. Another noticeable feature in this part was the presence of non-mappable units of meta-tuff. It generally occurs as an intercalation between meta-argillite and BIF (Fig.5.17). The forest trench east of trench no. KHT-05 exposes off white to buff coloured, fine grained, highly fissile sericite rich meta-tuff. Similarly, south east of the dolomite band at the contact of meta-argillite (east of Kakadahalli) non-mappable layers of meta-tuff was observed in shades of ash grey and pink.

The meta-argillite exposures found near the check-dam within the Jajikkalgudda Reserved Forest (west of Bhavihalli) is characterised by the presence of bi-pyramidal quartz. The fine grained phyllitic rock may be originally derived from volcanic sediments which are pyroclastic origin. The meta-argillite near Chigateri forest guest house is intensely carbonatized and intercalations of ferroan dolomite were noticed. Presence of calcite is also noticed within the rock.

### **Quartz-chlorite schist/phyllite**

As mentioned above the meta-argillite at many places grades into quartz-chlorite schist/phyllite. The rock exposed on the small hill near forest guest house is an excellent example for quartz-chlorite schist. The rock is fine grained greenish foliated rock with or without carbonates. The exposures found near Chigateri forest guest house shows the presence of calcite and Fe carbonate (Fig.5.18). The other major exposures of quartz-chlorite schist/phyllite is observed on a low mound west of Bhavihalli, near to the conglomerate. The rock occurs as greenish, fine grained phyllitic unit with well-developed foliation planes. The foliation is defined by the alignment of dark green coloured large grains of chlorite (Fig.5.19). The outcrop was carbonatized at places and presence of carbonate veins were noticed. The quartz-chlorite schist is traceable all along the western flanks of the eastern ridge. The unit pinches at many places and reappear north of Kanivehalli as a low mound at the western flanks of the linear ridge. The mappable patches were demarcated in the large-scale map. The intraformational conglomerate was seen within the quartz-chlorite schist/phyllite. The petrological studies indicate the presence of lensoidal and bi-pyramidal quartz suggesting the pyroclastic input into the sediments.

### **Quartz-sericite Schist/phyllite**

The mappable quartz-sericite schist/phyllite of the area was traced as a linear band north west of Chigateri. The rock is fine grained, phyllitic, fragile rock composed of quartz and sericite (Fig 5.20). The width of the body varies from 3 m to 15 m. The southern part of the lithounit where it starts appearing was highly sheared and crenulated. The medium to coarse grained buff coloured rock composed of quartz and feldspar along with muscovite at the southern part may be representing the original rock (protolith) which eventually metamorphosed to form quartz-sericite schist. As mentioned, the rock is sheared and the winged porphyroblasts indicates sinistral sense of shear (Fig.5.21). The petrological studies carried out suggest that the original rock may be pyroclastic in origin.

### **Ferruginous phyllite**

As mentioned in the subtitle meta-argillite the ferruginous phyllite starts appearing from the southern tip of Kanivehalli eastern ridge. The rock is exposed all along the ridge. It is fine grained, phyllitic and purple to red in colour. The rock is characterised by the presence of numerous thin chert bands (Fig.5.22). The width of chert bands varies from 5-10cms and occur as impersistent bands separating thick layers of ferruginous phyllite.



**Fig.5.17.** Intercalation of meta-tuff observed within the meta-argillite BIF sequence east of Kakadahalli



**Fig.5.18** Calcite and Fe carbonate observed within the quartz-chlorite schist west of Bhavihalli village.



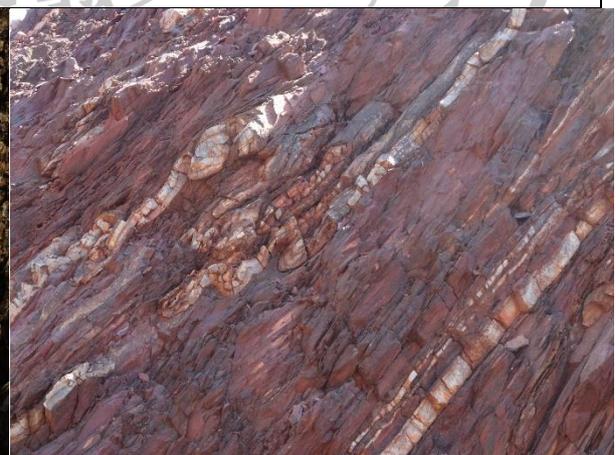
**Fig.5.19** Alignment of chlorite noticed along the foliation planes of quartz-chlorite schist west of Bhavihalli



**Fig.5.20** Quartz-sericite schist observed north west of Chigateri



**Fig5.21** sheared quartz-sericite schist with sigmoidal quartz grains observed north west of Chigateri



**Fig.5.22** Ferruginous phyllite with chert intercalations observed south east of Kanivehalli

Tuffaceous intercalations were noted within the ferruginous phyllite. A linear zone of highly oxidised, gossanised ferruginous band was observed along the eastern flanks of the Kanivehalli east ridge (Fig.5.23). This lateritised band is traceable upto Kanivehalli village. Old working in the form of narrow opening having 1m width and 2-3m length was observed within this lateritized zone along the plunge direction of the F2 folds. (The image of the old working was given in Chapter 4, Fig.4.2). The samples collected from this oxidised zone analysed for manganese as well and the values range from 150ppm to 1800ppm.

### **Banded Iron Formation**

Banded Iron Formation (BIF) is one of the prominent rock types exposed in the area. It occurs as linear bands along the ridges and low mounts of the area. The BIF in the area were Banded Hematite Quartzite (BHQ) and Banded Hematite Chert (BHC) in composition. The hematite and quartzite occur as alternate layers. The thickness of layers varies from 3-12 cms. At places the quartzite/chert layer is replaced by red jasper (Fig.5.24). Such banded hematite jasper layers were observed north west of Kanivehalli on the western most BIF. It is found that the BIF occur in association with all the major lithounits of the area such as meta-argillite, meta-basalt, ferruginous phyllite and amphibolite and shows minor variations with respect to the association.

The BIF associated with the meta-argillite in the western part of the area (western limb of fold) appeared as continuous Banded Hematite Quartzite. Presence of old workings and sulphides were noted within these bands near Nichchapur and Kanivehalli. The BIF at fold hinge north of Nichchapur is highly oxidised, limonitised and traversed by quartz veinlets (Fig.5.25). It is also noted that the BIF in the western part was marked by the presence of meta-tuff at the contact with meta-argillite. The BIF bands on the western ridge pinches towards northwest of Kanivehalli village where the ridge merges to the plane. The BIF mapped east of Kakadahalli associated with meta-argillite and meta-basalt are highly oxidised and brecciated (Fig.5.26). Goethite was observed as surface encrustations and presence of bornite and azurite were noticed within the band. It is also noteworthy that the BIF east of Singaratotta were marked by the presence of smoky quartz veins.

The BIF mapped along the eastern ridge; running parallel to the BIFs of western limb are impersistent and discontinuous in nature. It occurs as thin bands within the ferruginous phyllite and pinches to form thin chert layers within the phyllite. However, towards north of Kanivehalli the BIF becomes comparatively wider with strike running over longer distance.

The BIF associated with ferruginous phyllite shows jasper layers at places instead of quartzite. The BIF of this sector shows evidences of shearing in the form of gash veins and brecciation (Fig.5.27).

Mappable and non-mappable BIF were also found in association with the meta-basalt and amphibolite east of Konkana Hosuru, near to the sheared eastern contact of schist belt. The BIF observed in this association are shorter in strike length, intensely folded thin bands (in comparison to the BIF within meta argillite) and mostly preserved as detached hinges.



**Fig.5.23** Highly oxidized ferruginous horizon observed within ferruginous phyllite along the eastern flanks of ridge south east of Kanivehalli



**Fig.5.24** Alternate layers of hematite and jasper observed within BIF north of Kanivehalli



**Fig5.25.** Limonitised BIF traversed by quartz veins observed near Nichchapur



**Fig.5.26.** Brecciated BIF observed east of Kakadahalli.



**Fig.5.27** Gash veins developed on the sheared BIF west of Bhavihalli.

**Fig.5.28** BIF occurring as detached fold hinge within amphibolite with alternate quartzite and amphibole layers found east of Konkana Hosuru

The detached hinges and rotated bedding indicate the strong shearing deformation that the lithounit has undergone. The other noteworthy feature of the BIF is that the hematite or Fe rich layers in the band was represented by Fe-rich amphibole. At most of the places it is found that the BIF is composed of alternate silica and green amphibole layers. Layers of limonite were also noticed (Fig.5.28). The eastern most band shows presence of bornite and chalcopyrite associated with the smoky quartz veinlets intruded into the BIF.

### **Conglomerate**

Mappable patches of conglomerate were observed west of Bhavihalli on the lower flanks of the eastern ridge and north west of Kanivehalli in between quartz-chlorite schist and ferruginous phyllite. The intra-formational polymictic conglomerate is composed of sub-rounded to elongated pebbles of BIF, chert, meta-basic rocks, granite and quartz veins. The conglomerate exposed at different parts of the area shows variations in its composition, texture and matrix. The conglomerate in the southern part of the eastern ridge in between quartz-chlorite schist and ferruginous phyllite is a matrix supported, carbonatized and silicified unit with clasts of BIF and chert (Fig.5.29). The clast size varies from 3cms-10cms. The grey coloured matrix is fine grained, ferruginous and silicified at places. Presence of carbonates noticed within the silicified matrix. The presence of elongated sigmoidal clast indicates that the conglomerate is sheared (Fig.5.30). The conglomerate pinches towards north and ends as a pebbly horizon within the ferruginous phyllite.

The conglomerate reappears north-west of Kanivehalli along the western flanks of the ridge. The conglomerate in this part has a greenish fine grain chloritic matrix (phyllitic at places). The matrix supported conglomerate comprises large clasts of mafic rocks and granite in addition to the BIF, chert and quartz vein pebbles (Fig.5.31). The mafic clasts found within the rock has the same composition of matrix. The size of the clasts varies from 3 cms to 25 cms. It is noted that the clast at places were rotated anticlockwisely indicating the presence of shear sympathetic to the major shear zone at the eastern part of the block. (Fig.5.32).



**Fig.5.29** Matrix supported silicified polymictic conglomerate with clasts of chert and BIF observed west of Bhavihalli



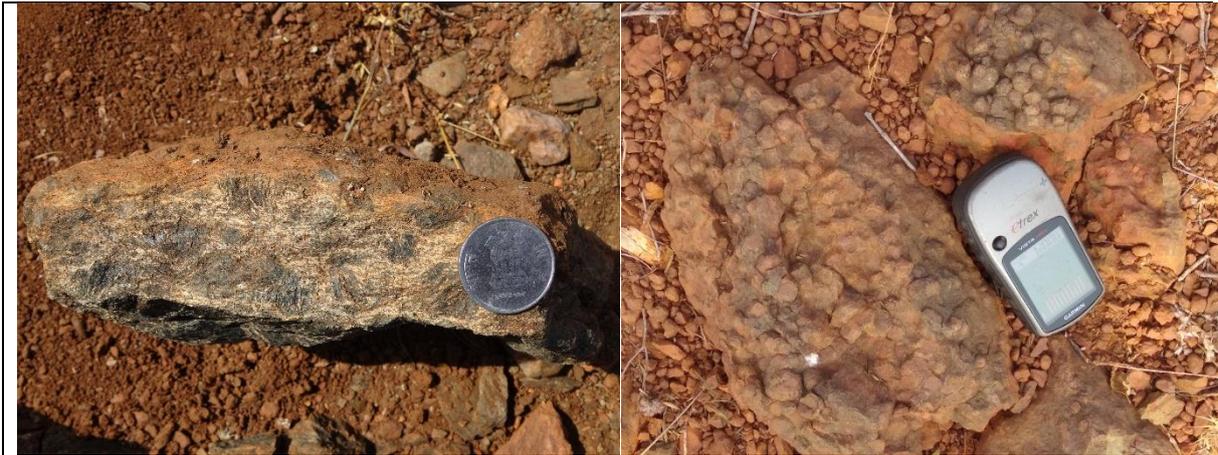
**Fig.5.30** Sheared conglomerate with the development of sigmoidal clasts of chert observed west of BHavihalli



**Fig.5.31** Very large clast of granite observed within the chloritic matrix of conglomerate observed north west of Kanivehalli



**Fig.5.32** Rotated BIF clasts observed within the sheared conglomerate observed north west of Kanivehalli.



**Fig.5.33** Coarse grained sheared amphibolite observed east of Konkana Hosuru village.

**Fig.5.34** Varioles observed in amphibolite east of KONkana Hosuru-Bhavihalli road,

### **Amphibolite**

Amphibolite in the area was seen exposed along the sheared eastern contact of the schist belt and granite gneiss east of Bhavihalli and Konkana Hosuru villages. It occurs as fine to medium grained greenish grey rock at most of the places. However coarse grained, sheared amphibolite with big stout hornblende crystals are observed as small patches (Fig.5.33). Presence of un-mappable and mappable units of BIF were noticed within the amphibolite. The amphibolite is carbonitised at places and presence of calcite veins having 20-30cms width are noted. The change from metabasalt to amphibolite is gradual and no stratigraphic break was observed between the two. Hence the amphibolite is kept within the Hiriyur Formation of Chitradurga Group. The amphibolite also shows variolitic texture at places (Fig.5.34). The petrological and petrochemical studies suggest that the rock is originally metabasalt which have undergone a little high grade of metamorphism.

### **Younger Intrusives**

#### **Gabbro/ dolerite**

The major basic younger intrusives mapped within the area are gabbro and dolerite. A few patches of meta-gabbro were also found within the area. The gabbro dykes are found cutting across the Granite gneiss east of Hombalagatti-Kakadahalli road and west of Bhavihalli. It is coarse grained, dark grey rock dominantly composed of feldspar and pyroxene. The meta-gabbro dykes are coarse grained porphyritic rock composed of feldspar and amphibole (Fig.5.35). Porphyrocrysts of both feldspar and hornblende were noted within this rock.

## **Granophyre**

A younger dyke of intermediate composition was mapped northwest of Hombalagatti village with WNW trend. The dyke which was marked as dolerite by previous workers is found to be more felsic and extremely fine grained. The rock is characterized by the presence of quartz fragments/clasts of different sizes (a few mm to 12cms) (Fig5.36). The dyke was intruded by the younger mineralised quartz vein near to the Kakadahalli- Harappanahalli road section. The petrological studies indicated the presence of feldspar, pyroxene and amphibole alongwith clasts of quartz. It is also noteworthy that the rock shows granophyric texture instead of typical ophitic, sub-ophitic textures within dolerite (Refer Fig.5.46 in petrological studies). The petrochemical studies indicate that the composition of rock varies from gabbroic diorite to granodiorite (Refer Fig.5.57 in petrochemical studies). The rocks of gabbroic composition can form granophyre by melting rocks into which the mafic magma was emplaced, a process which is commonly reported from layered igneous complexes. The granophyre in the area may be a result of melting of country rock (granite gneiss) during the emplacement of mafic dyke (originally of gabbroic composition). Further details furnished in petological and petrochemical studies.

## **Quartz vein**

The study area is traversed by many mappable and un-mappable quartz veins of different dimensions. The most important and noteworthy quartz veins are mapped north west of Hombalagatti. Three prominent giant quartz veins (GQV) are seen intruded into the granite gneiss and forms WNW-ESE trending ridges. The GQV are of 10-30 m wide and >2kms long. The western most quartz vein starts appearing from south of Hombalagatti, pinches in between and re-appears to form the ridge at the western part of the block. Another quartz vein was demarcated along the eastern flanks of the ridge and third major quartz vein was seen occupying the low mounts within the gneiss near to a major dyke. The giant quartz veins are white to pink in colour, jointed (with three sets of joints) and has grey patches at places. The quartz vein is brecciated at places and hematite encrustations are noticed near brecciation (Fig.5.37). Presence of epidote as well as K-feldspar alteration is also noted. The grey part of quartz vein found to be sulphide rich having pyrite, chalcopyrite and arsenopyrite as disseminations. The third quartz vein located near to the eastern contact was characterised by the presence of Fe-alteration and malachite stains on its surface (Fig.5.38). Presence of chalcopyrite and pyrite disseminations were also noticed within the quartz vein (Fig5.39). The quartz reefs are genetically related to the development of ductile shear zones within the granitic rocks and brittle– ductile shears in the intervening wall rock (Roday et.al,1995).



**Fig.5.35** Coarse grained meta-gabbro with porphyrocrysts of plagioclase observed west of Konkana Hosuru.



**Fig.5.36** Dyke of granodioritic composition with fragments of quartz observed west of Hombalahatti village



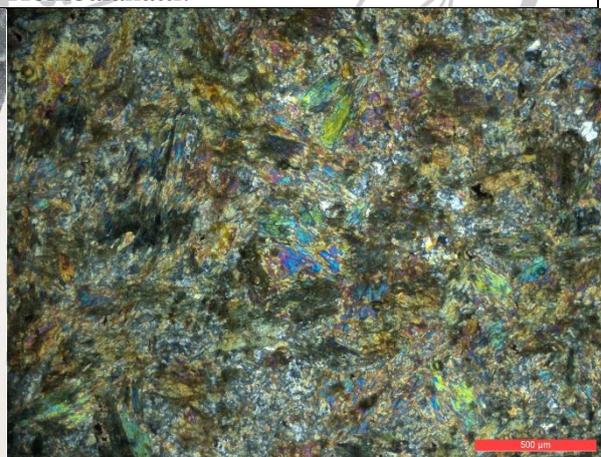
**Fig.5.37** Quartz vein with hematite encrustation observed west of Hombalahatti



**Fig.5.38** Malachite stains and Fe alterations observed along the quartz veins west of Hombalahatti.



**Fig.5.39** Chalcopyrite disseminations observed within the grey quartz part of GQV (Giant Quartz Vein) observed east of Hombalahatti



**Fig.5.40** Photomicrograph of metabasalt showing actinolite and saussuritised feldspar under cpl.

Many non-mappable quartz veins (quartz veins smaller than 12.5 m) are also seen within the granite gneiss. The quartz veins observed within the schist belt part are grey to smoky in colour and have a trend parallel to the general schistosity. Many smoky and white quartz veins are observed east of Singaratotta within meta-argillite. Non-mappable quartz veins are also seen associated with BIF.

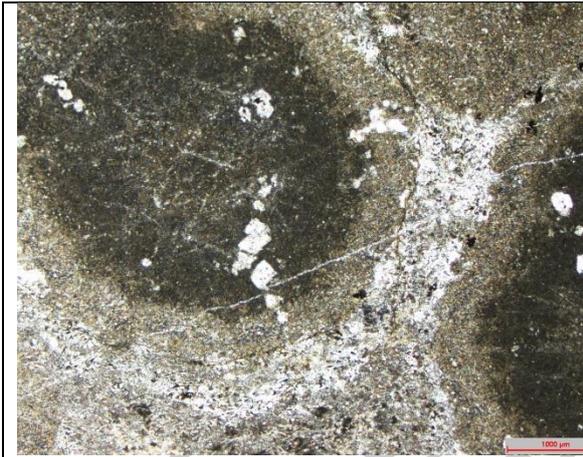
### **III Petrological and petrochemical studies including EPMA, SEM**

#### **a. Petrological studies**

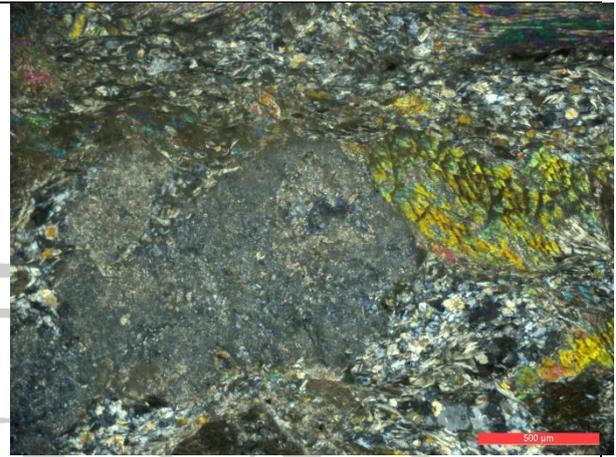
Petrological samples were collected from almost all the lithounits of the area. A total of 59 samples were submitted from different rock units and 46 thin polished sections were received including samples of meta-basalt, meta-argillite, quartz-chlorite schist, dolerite and quartz vein. The metabasalt of the area found to be composed of amphibole, chlorite, feldspar and quartz (Fig.5.40). Epidote, sphene and rutile were found as accessories. Magnetite and pyrites are the major opaques observed within the metabasalt. The samples collected from west of Bhavihalli shows presence of varioles. Varioles occur as spherical bodies with a dark coloured inner core and light-coloured rim (Fig.5.41). No compositional difference has been observed between rim and core and the lighter colour may be due to the presence of more feldspar within the rims in comparison to the core. The EPMA analysis of the same indicates that the most common amphibole found within the rock is actinolite. Presence of hornblende is also noted along with Fe rich chlorite (Fig 5.42).

The quartz-chlorite schist of the area studied in detail and comprises quartz, chlorite as primary minerals along with epidote and calcite as secondary minerals. The presence of big calcite grains within a matrix of chlorite has been noticed within the sample from Chigateri (Fig.5.43). It is noted that the foliation planes were abruptly ending near the calcite indicating that the calcite within meta-argillite and quartz-chlorite schist is much later in origin. The quartz-sericite schist is composed of quartz and sericite with magnetite in sub-ordinate amounts. It is noted that the foliation in the rock is defined by the alignment of flattened quartz vein and sericite. The sericite is showing crenulations which may be co-relatable to the F2 deformation within the area (Fig.5.44). Ferruginous phyllite largely composed of various Fe-oxides and quartz. The EPMA analysis of quartz-chlorite schist and meta-argillite indicated the presence of plagioclase in abundance within the interstitial spaces between irregular chlorite (Fig.5.45).

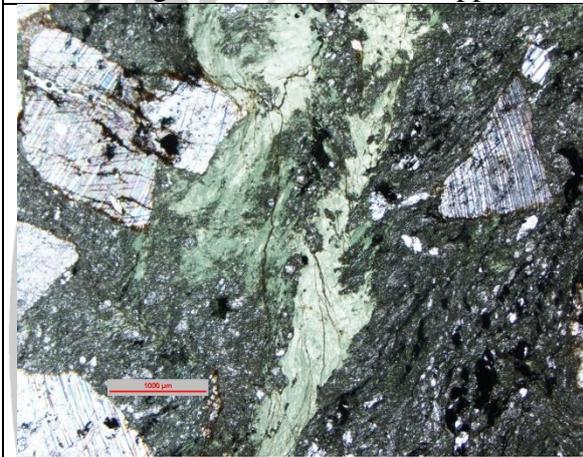
Another important rock studied under microscope is the fine grained, intermediate dyke of granodioritic composition observed the west of Hombalagatti. The rock is dominantly composed of feldspar, pyroxene and quartz. Disseminated sulphides mostly pyrite



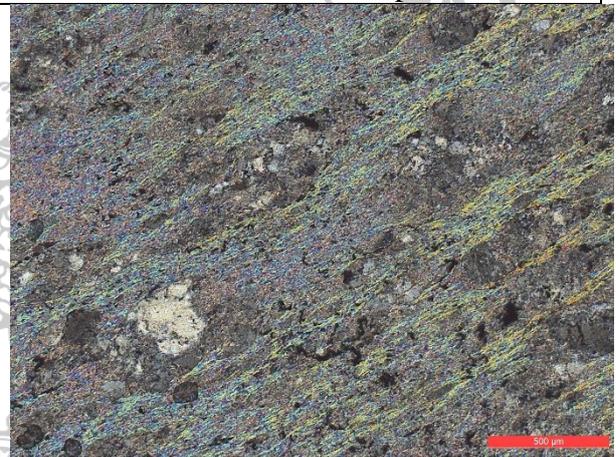
**Fig.5.41** Photomicrograph of varioles observed within metabasalt with dark colour core and light coloured rim under ppl.



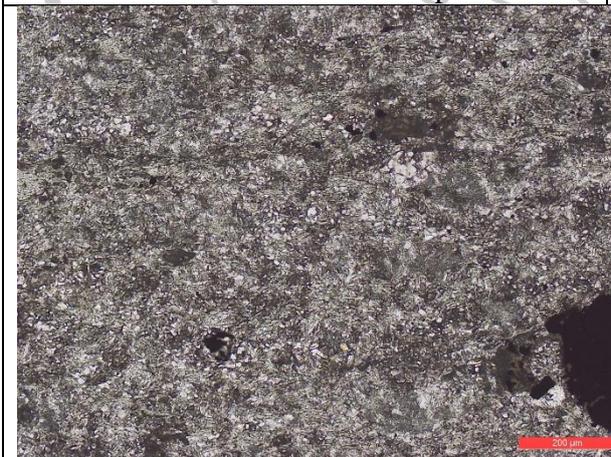
**Fig.5.42** Photomicrograph of Hornblende and sericitized feldspar observed within the metabasalt of the area under cpl.



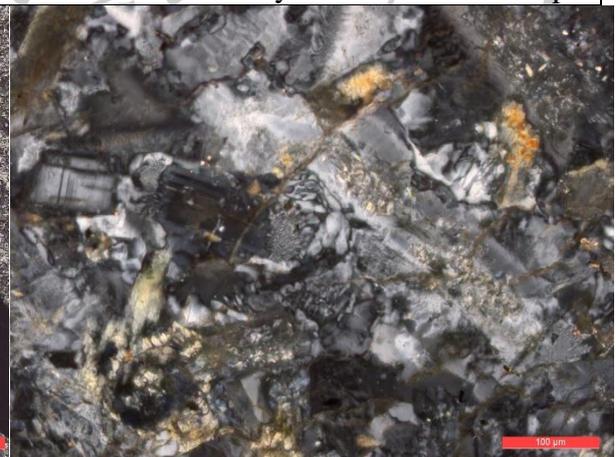
**Fig.5.43** Photomicrograph of calcite grains within a quartz-saussuritised feldspar and chlorite matrix observed under cpl.



**Fig.5.44** Photomicrograph of sheared quartz-sericite schist with crenulated sericite/muscovite layers observed under cpl.



**Fig.5.45** Photomicrograph of meta-argillite with quartz, chlorite and sericitized feldspar under cpl.

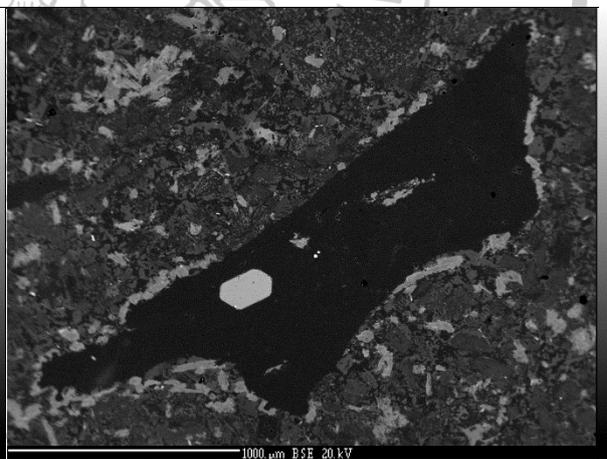
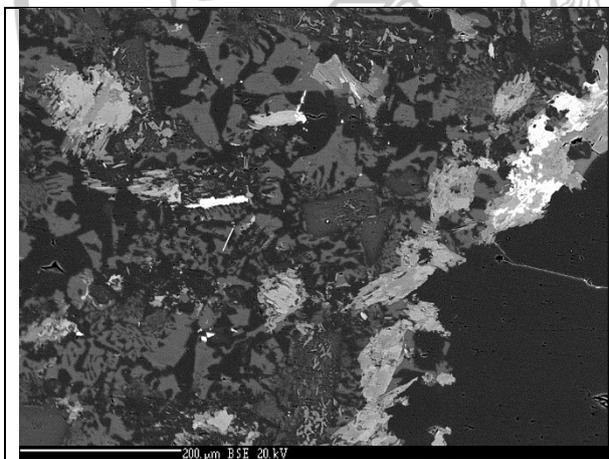


**Fig.5.46** Photomicrograph of granophyric texture and zoned feldspar observed within the dyke under cpl.

and magnetite are the important opaques observed. The major petrological feature observed within this sample is the presence of granophyric texture where intergrowth of quartz is noticed within feldspar (Fig.5.46). Granophyric textures are formed within subvolcanic rocks due to the simultaneous crystallization of quartz and feldspar from a silicate melt. Magmas that ascend close to the surface without erupting can be undercooled quickly by: (1) isothermal depressurization and associated degassing, (2) adiabatic cooling by exsolving, expanding vapor, and (3) convecting, superjacent hydrothermal systems (Lowenstern, 1997). When silicic magmas are present in such setting, their tendency to become supercooled and crystallize as granophyre will be maximised (Lowenstern, 1997).

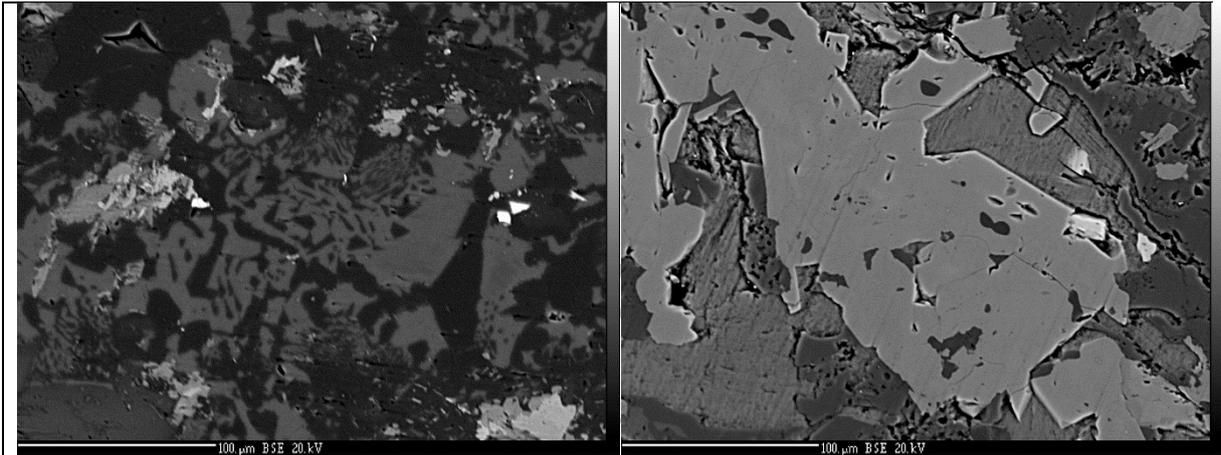
**b. EPMA Studies**

The EPMA analysis of the rock helped to identify the REE phases within the rock. Allanite was found to occur as irregular grain around the quartz clast within the rock (Fig.5.47). Presence of well-developed euhedral apatite and zircon were observed within the quartz clasts present (Fig.5.48). The other important minerals identified by EPMA are augite, actinolite and plagioclase along with a few orthoclase and quartz. Inter growth of quartz and feldspar is noticed (Fig.5.49 and 5.50). The petrology of ore minerals and SEM analysis have been discussed under sub-title ore texture and mineralised zone.



**Fig.5.47** BSE image of granophyre showing allanite (irregular bright grain) identified at the grain boundary of quartz and pyroxene

**Fig.5.48** BSE image of granophyre showing euhedral apatite crystal identified within the amoeboidal quartz grain along with zircon



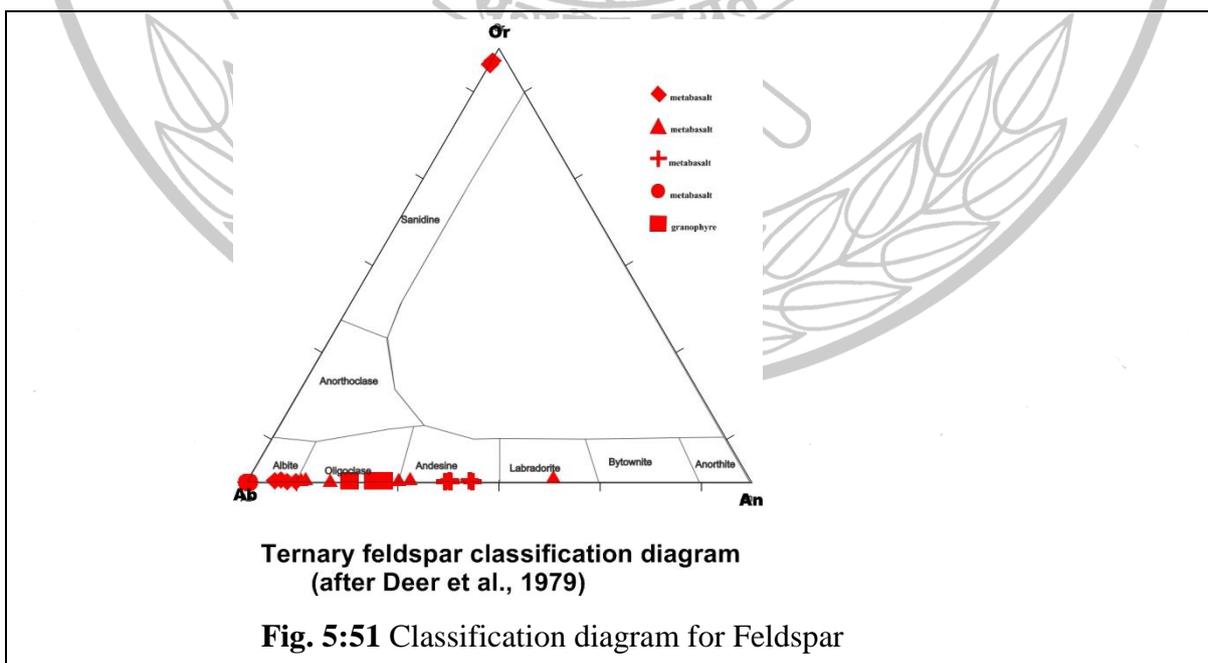
**Fig.5.49** BSE image of granophyre showing intergrowth of quartz within the feldspar to form granopyric texture.

**Fig.5.50** BSE image of granophyre showing Inclusions of quartz within the feldspar grain.

### Feldspar

Feldspar were analysed in six samples (PS-6, PS-14, PS-4, PS-7, PS-5404). The calculated An, Ab, or based on 8 oxygen and analyzed data of the Feldspar from the mineral analysis are presented in the Annexure X.

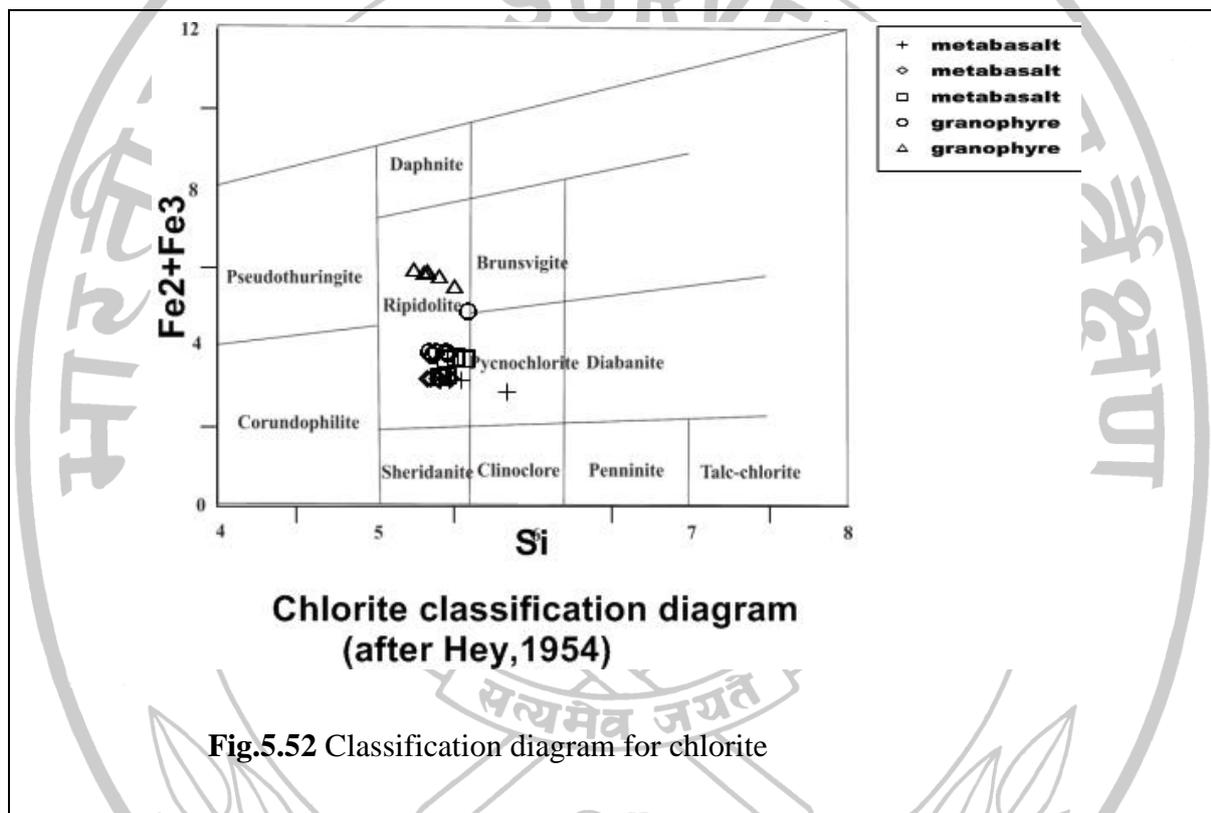
Feldspar were analyzed from metabasalt (Kakadahalli, Kongana hosuru, Chigateri , Kakadahalli east) and granophyre (Hombalagatti) of the study area. An, Ab and Or content calculated for the rocks of the study area show variation. Metabasalt from Kakkadahalli contains orthoclase feldspars as well as albite rich plagioclase. Metabasalt from kakkadahalli east falls in andesine, oligoclase and labradorite field. In metabasalt from Kongana hosuru, plagioclase consists of andesine variety. Metabasalt from chigateri shows albite plagioclase. In granophyre from Hombalagatti , metabasalt falls in oligoclase field (Fig. 5.51).



## Chlorite

Chlorite were analysed in five samples (PS-6, PS-14, PS-7, PS-5403 AND PS-5404). The mineral analysis is represented in Annexure VIII.

The chlorite in the study area is analysed from metabasalt from Kakkadahalli, Kakkadahalli east and Chigateri and Granophyre from Hombalagatti. Chlorite is the most characteristic mineral in the greenschist facies. It is formed by the alteration of pyroxenes of metabasalt. The chlorite in the metabasalt and granophyre of the study area is mainly ripidolite (Fig.5.52).

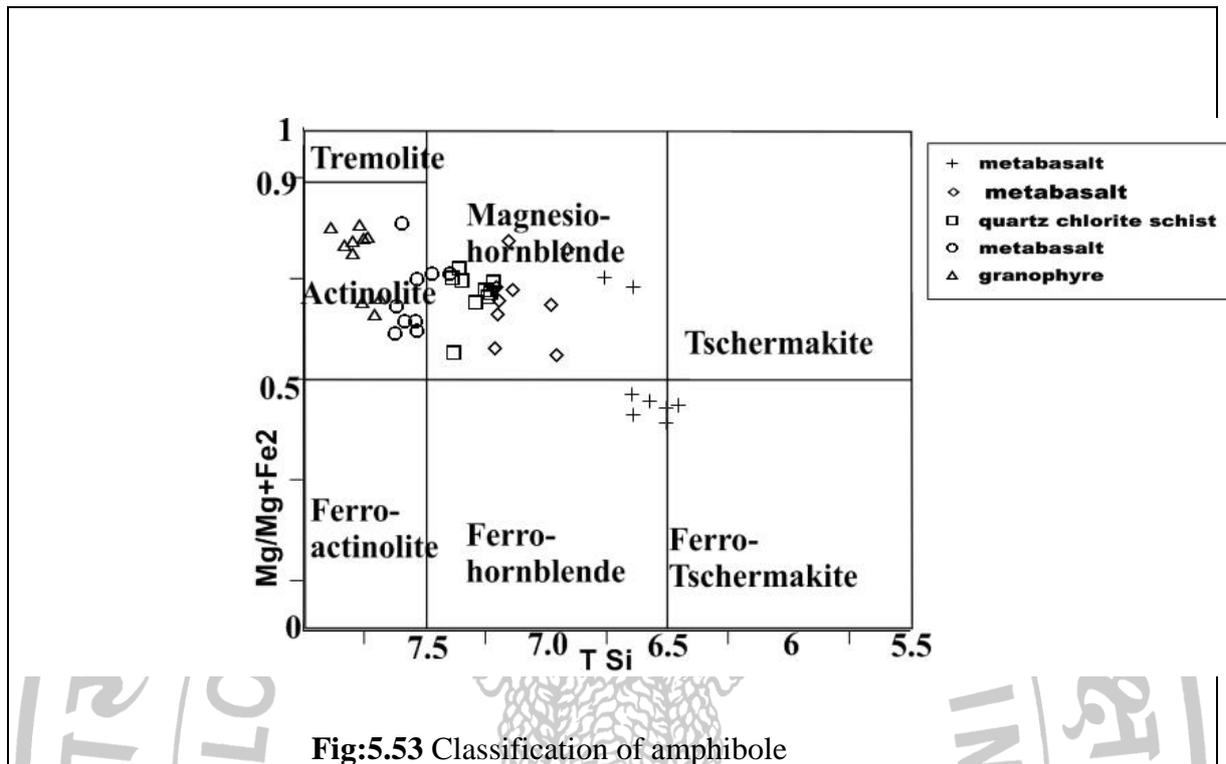


## Amphiboles

Amphiboles were analysed in 5 samples (PS-19, PS-6, PS-14, PS-4& PS-5404)) viz. They are from variolitic metabasalt from Bhavihalli, metabasalt from Kakkadahalli, Kakkadahalli east, Konganahosuru and from Granophyre from Hombalagatti.

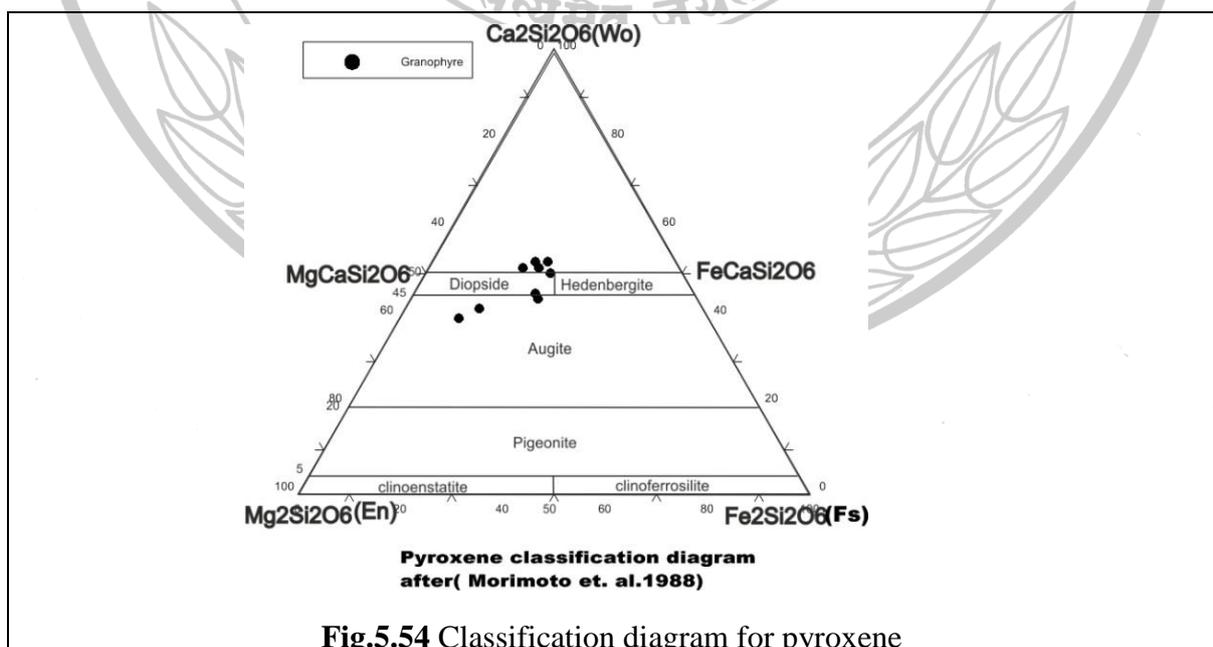
The structural formulae for these amphiboles were calculated on 23 oxygen basis and presented in Annexure XI. Amphiboles from variolitic metabasalt show actinolite affinity, metabasalt from Kakkadahalli shows magnesio-hornblende and actinolite variety. Whereas amphiboles from metabasalt of east of Kakadahalli shows magnesio-hornblende. The metabasalt near Konkana Hosuru village shows actinolite,ferro-hornblende, magnesio-

hornblende, and ferro-tschermakitic hornblende variety of amphiboles. In granophyre, from hombalagatti amphiboles shows actinolite affinity (Fig.5.53).



### 7.10. Pyroxene

Pyroxenes from Granophyre (PS-5404) were analysed. The structural formulae of pyroxene were calculated on 6 oxygen basis and presented in Annexure XII. The analyzed pyroxenes were plotted in the ternary Wo-En-Fs diagram. The clinopyroxene is falling in diopside and augite field in granophyre from Hombalagatti area (Fig.5.54).



### **c. Fluid Inclusion Petrography**

Doubly polished thin wafers were prepared for fluid inclusions studies. Petrographic studies of wafers indicate the presence of primary and secondary mono-phase/bi-phase inclusions (Fig. 5.57a to Fig.5.57f). The inclusions are generally small and rounded and also some of them are irregular and faceted. The size of inclusions varies from 1.80  $\mu\text{m}$  to 68.9  $\mu\text{m}$ . Primary bi-phase isolated inclusions are of various shapes (oval, spherical, rounded, and irregular and faceted). Secondary inclusions are smaller in sizes and are rounded, sub-rounded and faceted in shapes. They occur linearly along a healed fracture (Fig.5.57e and 5.57f).

The study of wafers indicate that the area occupied by the vapour phase ranges from 1 to 19% of the total volume. The area occupied by the aqueous phase varies from 81 to 99%. Prominent inclusions were selected for microthermometric study.

#### **Instrument and Methodology**

The microthermometric studies were carried out on a Linkam THMSG 600 heating/freezing stage fitted on an Olympus BX 50 transmitted light microscope. A silver block (THMSB) is used for heating. The unit operates in the temperature range of  $-195^{\circ}$  to  $+600^{\circ}\text{C}$ . The stage is periodically calibrated by using demineralised water ( $\text{H}_2\text{O}$  melting point= $0^{\circ}\text{C}$ ) and pure  $\text{CO}_2$  inclusions (synthetic  $\text{CO}_2$  standard, with triple point =  $-56.6^{\circ}\text{C}$ ). Estimated accuracy is  $\pm 0.1^{\circ}\text{C}$  at temperatures below  $30^{\circ}\text{C}$  and it is  $\pm 1.00^{\circ}\text{C}$  at temperatures above  $30^{\circ}\text{C}$ . Reproducibility of the results of heating above  $300^{\circ}\text{C}$  has been tested and found to be  $\pm 2$  to  $3^{\circ}\text{C}$ .

Freezing experiments were performed first, on all the wafers to avoid the decrepitation of inclusions followed by heating (Roedder, 1984). The measurements were taken during melting include final melting temperature of ice ( $T_{\text{mice}}$ ) to determine the salinity of aqueous phase. During the heating of the fluid inclusions, homogenization temperatures of the  $\text{CO}_2$  ( $T_{\text{hCO}_2}$ ) were measured to determine the density of  $\text{CO}_2$  and the total homogenization temperature ( $T_{\text{hTotal}}$ ). Calculation of density, salinity and plotting the isochores of temperature and pressure were carried out by using Linksys software (version 1.8).

#### **Microthermometry**

##### **Aqueous inclusions**

The range of homogenization temperature varies from  $130^{\circ}\text{C}$  to  $181^{\circ}\text{C}$  (average =  $148.18^{\circ}\text{C}$ ). The initial ice melting temperatures ( $T_{\text{FM}}$ ) range from  $-47^{\circ}\text{C}$  to  $-28^{\circ}\text{C}$  with an average of  $-40^{\circ}\text{C}$ . This suggests that the major component in aqueous phase is  $\text{FeCl}_2$  in the fluid system. The maximum of first ice melting temperature of  $-47.2^{\circ}\text{C}$  may indicate the presence of

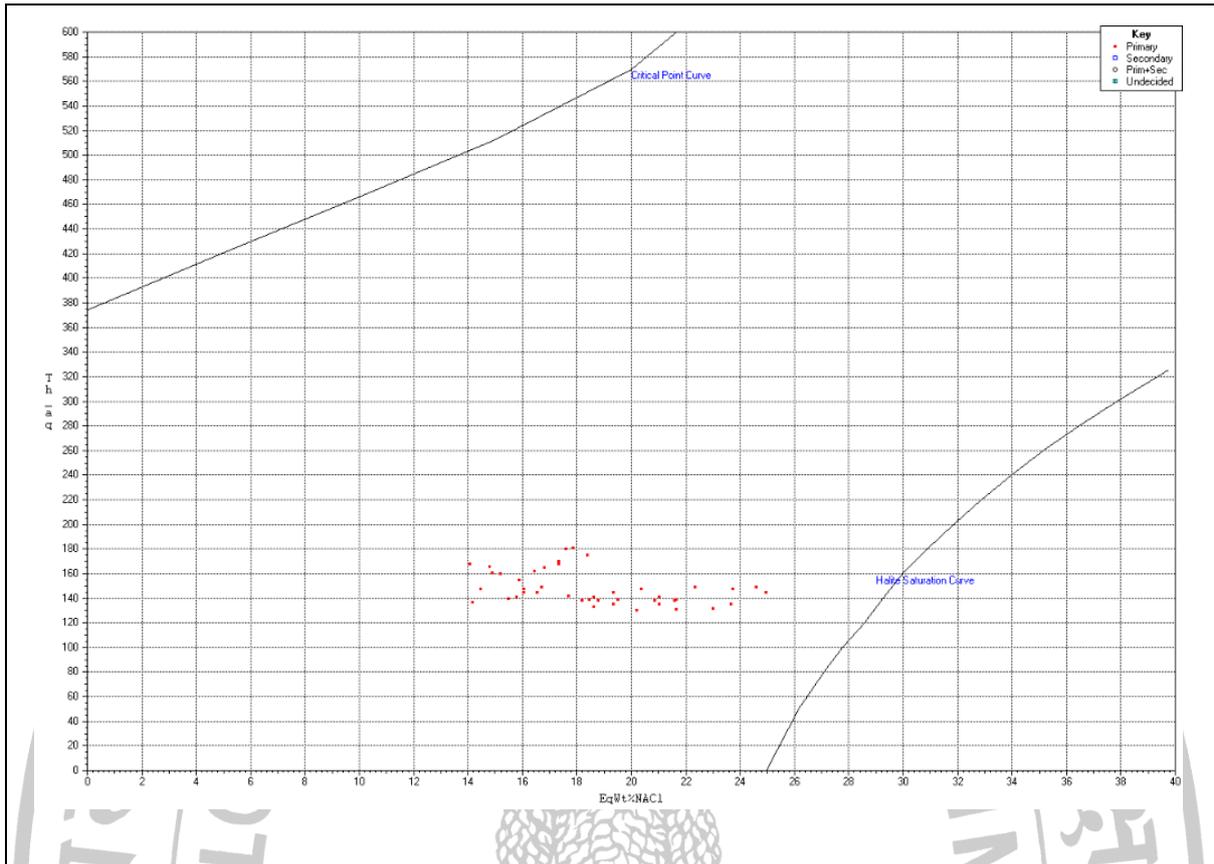
$\pm\text{CaCl}_2$  with NaCl and  $\text{H}_2\text{O}$  (Shepherd, Rankin and Alderton, 1985). The final melting temperature of ice ranges from  $-24.1^\circ\text{C}$  to  $-10.1^\circ\text{C}$  (average  $-15.3^\circ\text{C}$ ) corresponding with salinities of 14.05 to 24.94 wt.% NaCl equivalents (average 18.62 wt.% NaCl equivalent) following the equations (Bodnar, 1983, Zhang and Frantz, 1987 and Brown and Lamb, 1988 and FLUIDS (Bakker's 2003). The density of aqueous inclusions studied varies from 1.00 to 1.10  $\text{gms}/\text{cm}^3$  with an average of  $1.05 \text{ gms}/\text{cm}^3$ .

The P-T estimates made from the total homogenization of the aqueous inclusions define a P-T path of evolution as shown in Fig. 5.56. The intersecting isochores are designed for inclusions, which record the trapping of immiscible fluids (Shepherd, Rankin and Alderton, 1985). The P-T curves of the inclusions studied are reported in Fig. 5.56. The isochores are representing individual fluid inclusions studied and are widely distributed from  $130^\circ\text{C}$  to  $181^\circ\text{C}$  of temperature of homogenization (average =  $148.18^\circ\text{C}$ ). The plot of co-existing of aqueous shows intersecting isochores. The three population of isochores measured ranges between  $130^\circ\text{C}$  -  $142^\circ\text{C}$  and  $160^\circ\text{C}$  -  $180^\circ\text{C}$ .

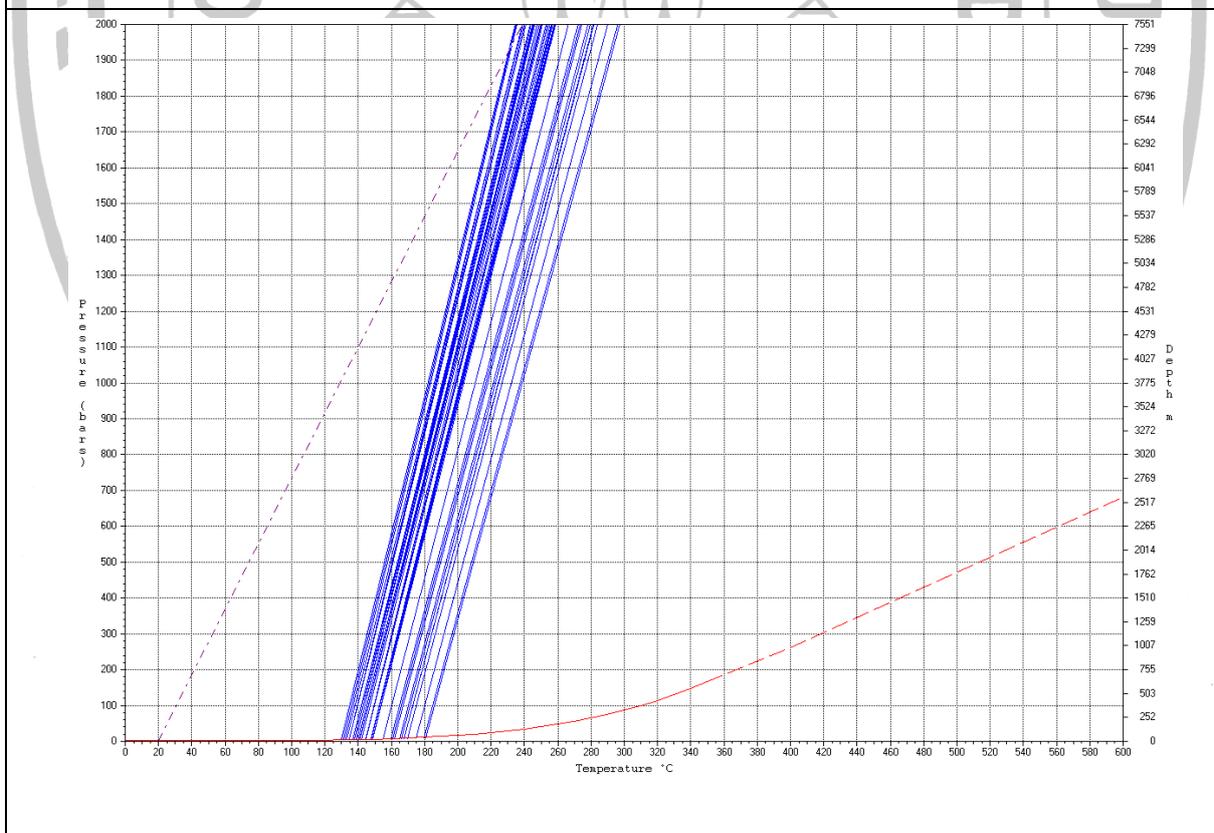
The temperature of homogenization versus salinity plots for these inclusions are plotted in Fig. 5.55. The most characteristic feature is the clustering of plots in the diagram. The trends of inclusion plots indicate the mixing with cooler lesser saline fluids (after Shepherd, Rankin and Alderton, 1985).

### **Interpretation**

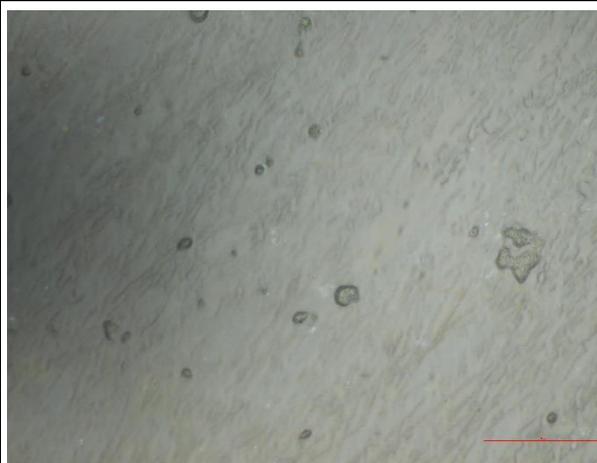
It is noted that out of 06 wafers submitted for FIS three are found to have good inclusions (non decrepited and size  $>20$  micron). The inclusions in these samples (FIS-01, FIS-05 and FIS-06) were studied (Annexure xiv) to understand the temperature and salinity of the mineralized hydrothermal fluids. FIS-01 and FIS-05 were collected from the mineralized PGC hosted quartz vein near Hombalahatti having copper values and FIS-06 collected from sulphidic quartz vein from metabasalt in the schist belt. In general, the fluids associated with the orogenic gold are low salinity fluids with  $\text{H}_2\text{O}$  and  $\text{CO}_2$ . Homogenization temperature of such fluids vary in between  $150^\circ\text{C}$  to  $350^\circ\text{C}$ . The homogenization temperature of the inclusions studied are much lower to this range ( $130$ - $180$ ). The population with Th range  $160^\circ\text{C}$  -  $180^\circ\text{C}$  are associated with the Cu bearing quartz reef and the other cluster  $130^\circ\text{C}$  -  $142^\circ\text{C}$  represent smoky quartz in schist belt. The salinity range of the fluids (13 wt% of NaCl to 24 wt% of NaCl) is not favorable for orogenic gold deposits. The absence of carbonic inclusions in abundance is also another indication that the copper bearing quartz reef may not be auriferous. The increasing salinity of FIS 01 and 05 can represent epithermal basemetal deposits without precious metal.



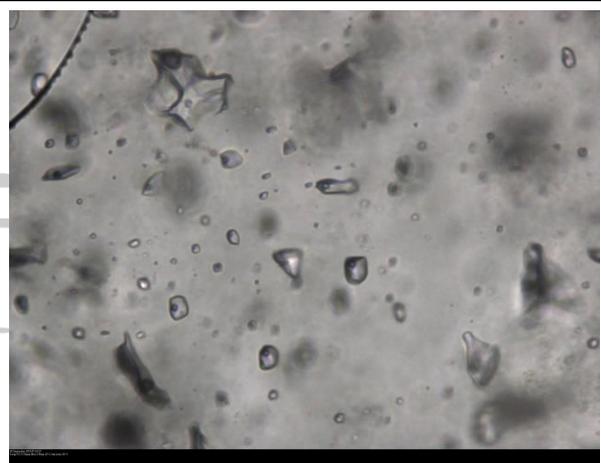
**Fig.5.55.** Plots of inclusions in Temperature of homogenisation vs Salinity field



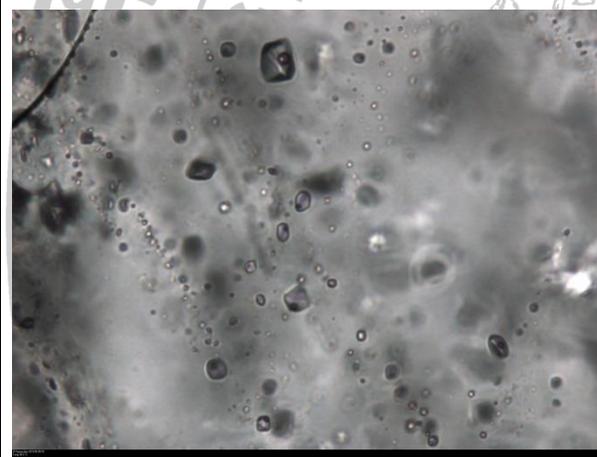
**Fig.5.56** Temperature Isochores of aqueous fluid inclusions (range between 130°C - 181°C).



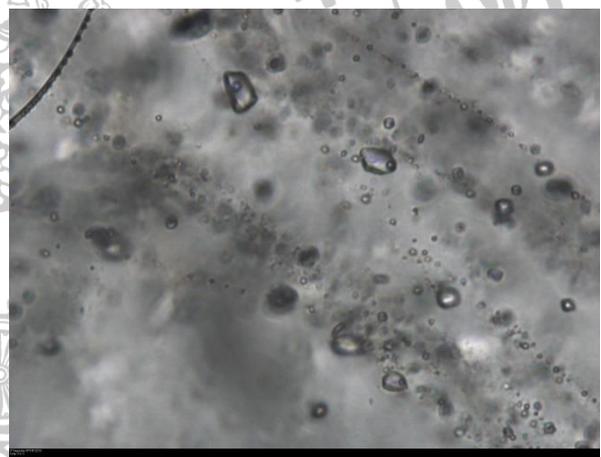
**Fig.5.57a** Primar mono phase inclusions identified within wafer no. FIS-05



**Fig.5.57b** Primary bi-phase inclusions identified within wafer no. FIS-05



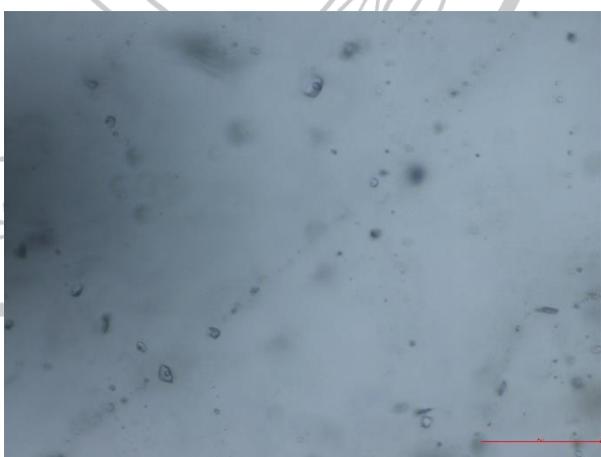
**Fig.5.57c** Primary bi-phase inclusions identified within quartz (Wafer No: FIS-05)



**Fig.5.57d** Primary bi-phase inclusions identified within quartz (Wafer No: FIS-05)



**Fig.5.57e** Secondary inclusions found along the fracture identified within wafer no. FIS-06



**Fig.5.57f** Secondary bi-phase inclusions observed within wafer no-06

### c. Petrochemical analysis

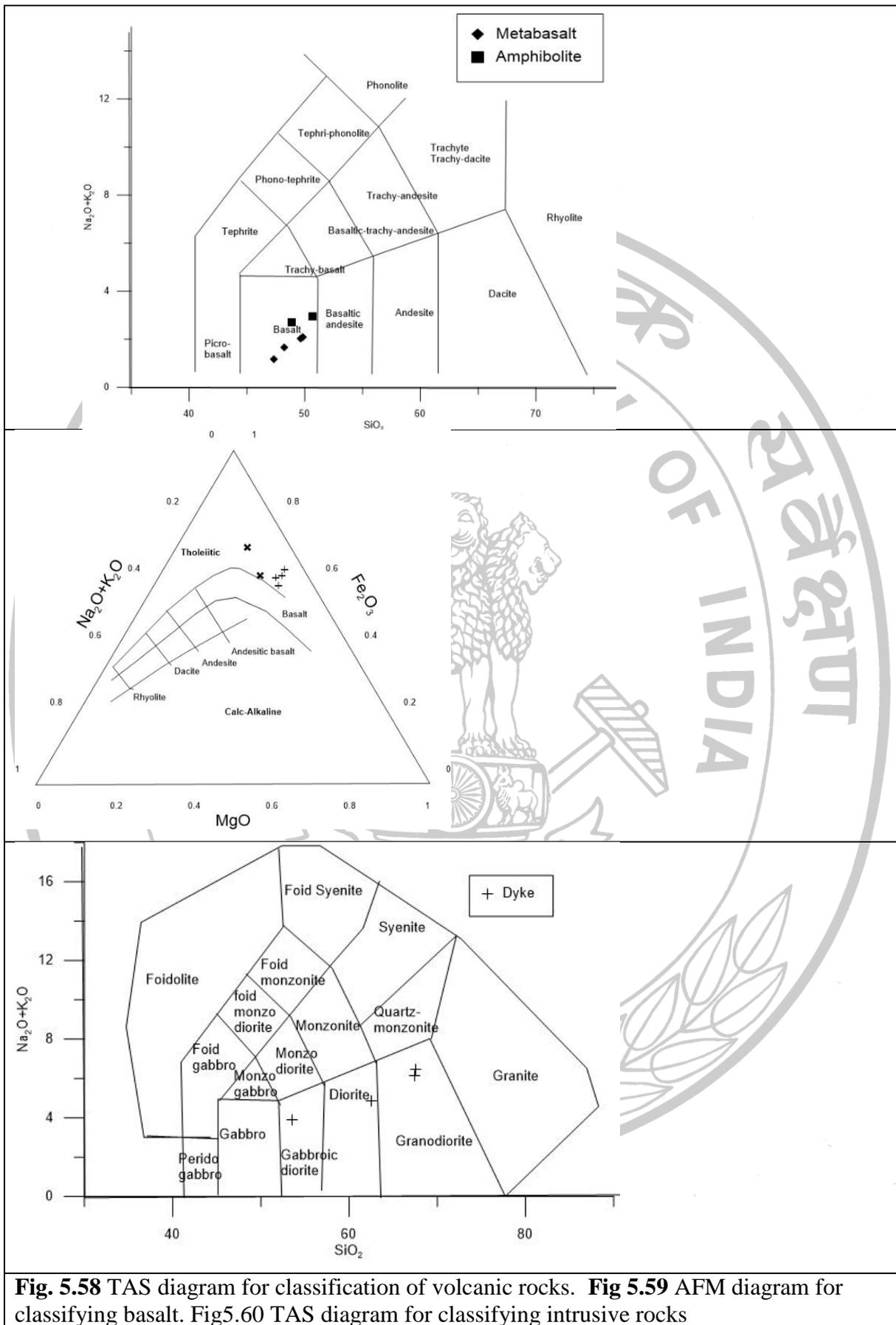
22 PCS samples were collected from different rock types of the area for the analysis of major, trace and REE elements and the analysis of major oxides, trace elements and REE were received. The representative samples of metabasalt, meta-argillite, quartz-chorite schist, quartz sericite schist and intermediate dyke near Hombalagatti were analysed.

The metabasalt samples and amphibolite samples were analysed and the silica content varying from 47% to 50% and alumina content ranging from 9% to 11% perfectly reflecting the geochemistry of basaltic magma. The TAS diagram after Le Bas et.al, 1986 shows that all the samples are falling well within the basalt regime (Fig.5.58). The AFM diagram shows that all the samples are of tholeiitic basalt with high Fe content (Fig.5.59). As mentioned in the description of lithounits the amphibolite in the area is formed from the same metabasalt which at places metamorphosed to little higher facies.

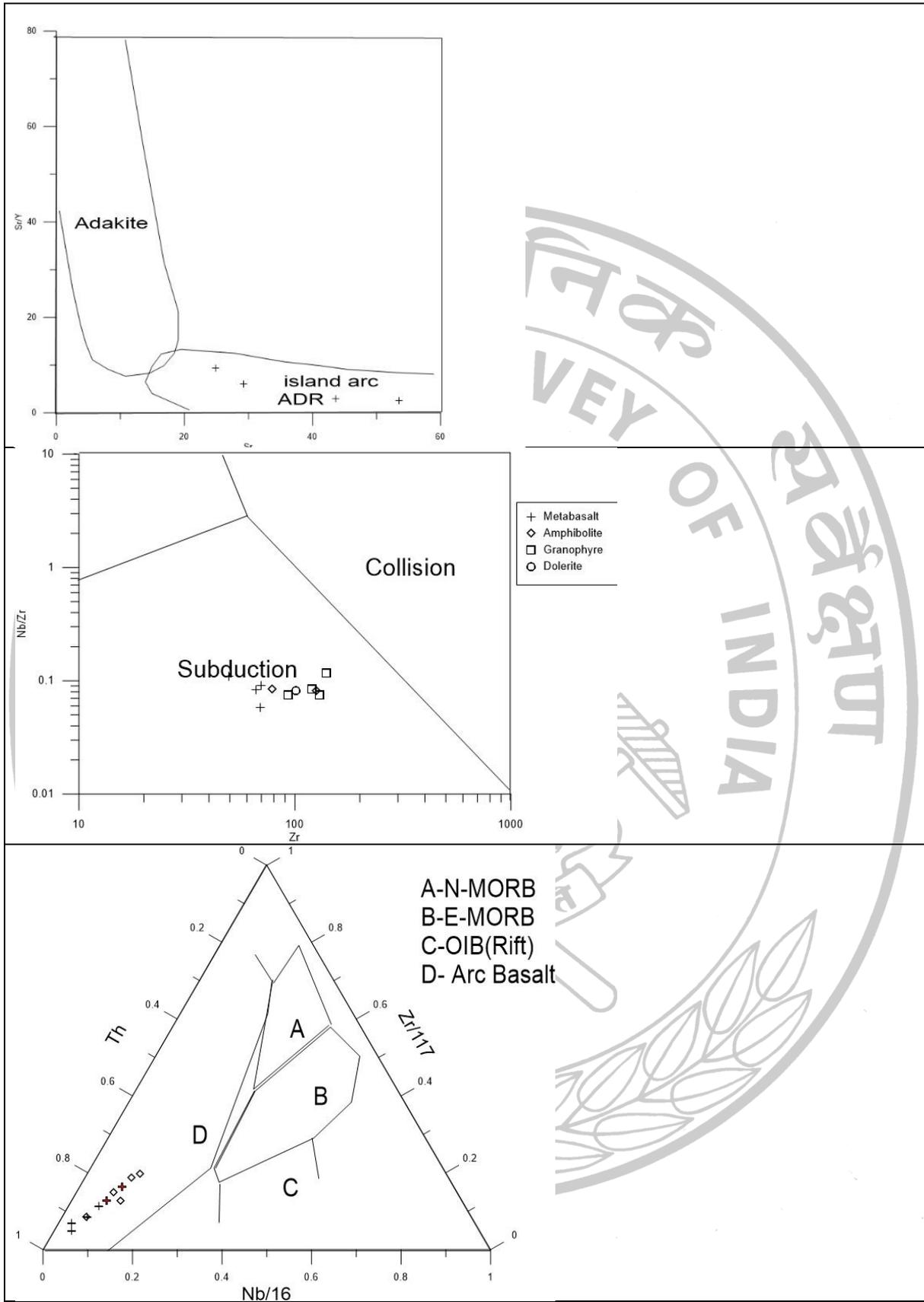
The dyke cutting across the quartz vein near Hombalagatti shows high silica content ranging from 53% to 67%. Out of the four representative samples collected from the area all the three shows >60% silica and high alumina (>12%). The TAS diagram prepared shows that three of the samples fall within the diorite-granodiorite field, where as one sample falls within the gabbroic-diorite field (Fig5.60). The rock is observed as fine-grained intrusive rock with fragments of quartz with granophyric texture. The scatter plot prepared after Dumond, 1991 (Fig5.61) suggests that the samples represent geochemical composition of island arc ADR (Andesite, Dacite, Rhyolit) which are the extrusive equivalents of diorite and granodiorite. Hence the rock which is earlier marked as dolerite dyke is of dioritic to grano-dioritic composition and may be a granophyre.

The metabasalt, dolerite, amphibolite and granophyre samples are plotted in discrimination diagrams to understand the tectonic set up. Based on the Zr v/s Nb/Zr diagram after Theibelmont et.al (1994) all the samples are plotted within the Subduction zone (Fig.5.62a). The ternary diagram prepared based on Nb, Zr and Th after Wood (1980) indicates that all the meta-basalt and amphibolite samples of the area belong to the arc basalt (5.62b).

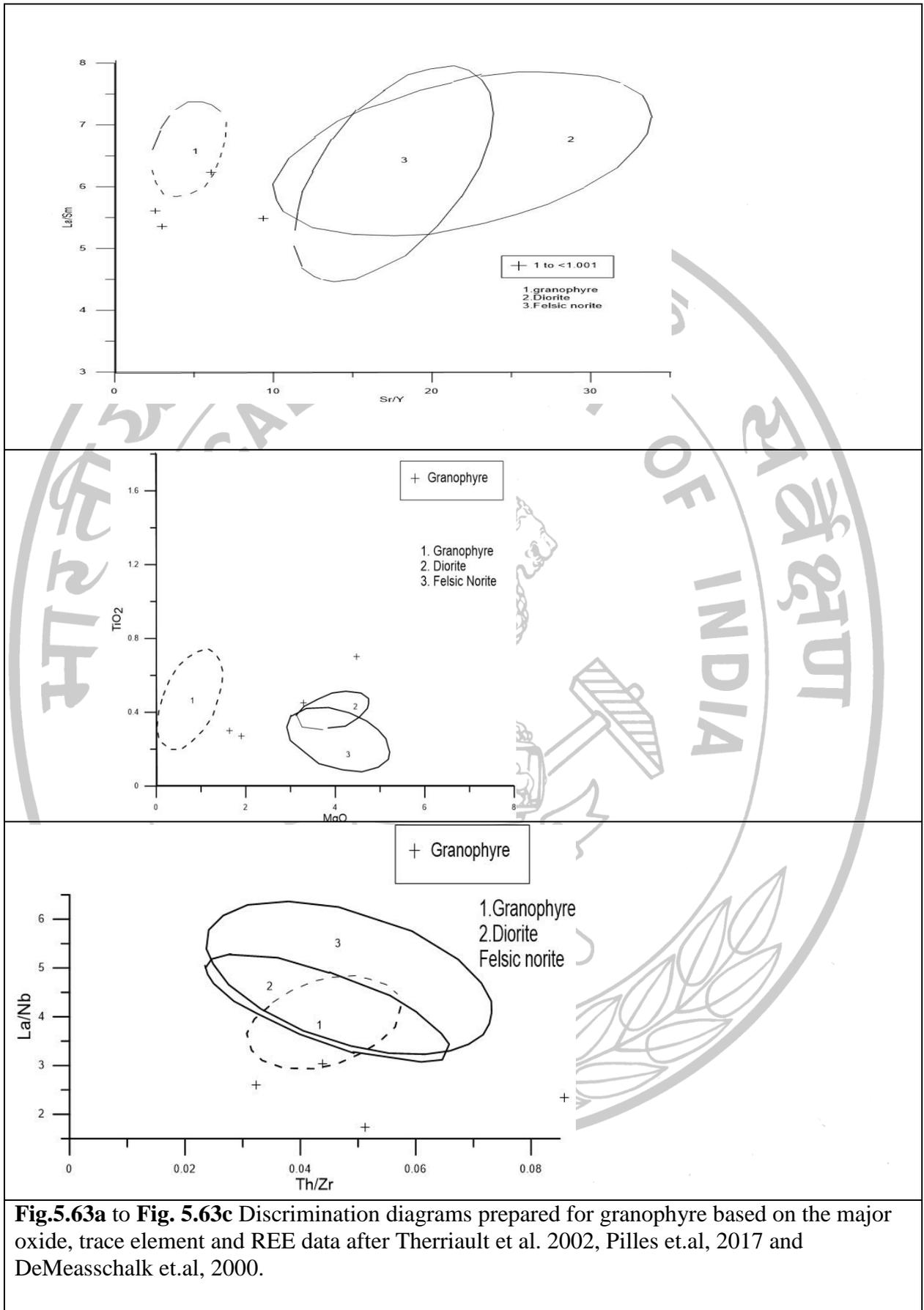
The discrimination diagrams prepared using major oxides, trace elements and REE data of the granophyric dyke south of Hombalahalli after Therriault et.al, 2002, Pilles et.al, 2017 and Measschalk, et.al, 2000 shows that the samples are not falling exactly within the granophyre field (except one sample in Fig.5.63a and 5.63c) but clustering around the ellipse representing granophyre field (Fig.5.63a to 5.63c) supporting the possibility of emplacement of mafic rock into the melt of granite gneiss which is the country rock in the area.



**Fig. 5.58** TAS diagram for classification of volcanic rocks. **Fig 5.59** AFM diagram for classifying basalt. **Fig5.60** TAS diagram for classifying intrusive rocks



**Fig.5.61** Discrimination diagram of granophyre after Dumont,1991. **Fig.5.62a** and **Fig.5.62b** Discrimination diagrams showing the tectonic set up of various rocks in the area.



**Fig.5.63a to Fig. 5.63c** Discrimination diagrams prepared for granophyre based on the major oxide, trace element and REE data after Therriault et al. 2002, Pilles et.al, 2017 and DeMeasschalk et.al, 2000.

**IV Structure**

The investigation area forms an integral part of Chitradurga Schist Belt and is located at the eastern limb of Chitradurga antiform and in close proximity to the major Chitradurga Eastern Margin Shear Zone (CEMSZ). The area has undergone three stages of deformation and shearing event probably with the second deformation. Besides, the deformational structures the rocks in the area recorded some of the primary structures developed during the formation of the rock. The detailed accounts of various structural features observed within the area are given below.

### **1.Non-Diastrophic structures**

Non diastrophic structures are signature features of a particular lithounit which mostly developed during the formation of the rocks and it plays a major role in identifying and defining the rock. Though the multiple deformation has affected the rock types of the area, some of the rock types preserve primary structures intact. However, at many places these structures are either re-oriented or transposed. The major non-diastrorphic structures observed are as follows.

#### **i) Pillow structures in metabasalt**

Pillow structures are observed within the massive metabasalt exposed west of Bhavihalli village. The pillows in the area are deformed and oriented along the general schistosity (Fig.5.64). The chilled margins are traceable only on few pillows due to the intense deformation it has undergone. The size of the pillows varies from 20cms-60cms. Presence of sulphides are noted within the chilled margins of the pillows.

#### **ii) Bedding/Compositional layering**

Bedding is the most prominent primary structure in the area and is well defined by the alternate silica and ferruginous layers within BIF (Fig.5.65). The thickness of the bedding in BIF varies from 2 - 8cms. Thin laminae is observed as compositional layering within the meta argillite units of the area (Fig.5.66). The layers are of 3mm-3cms in size and shows variegated colours (such as grey, buff and pink) due to the compositional differences. The bedding planes in the area shows NW-SE trend with moderate to steep easterly ( $50^{\circ}$  to  $70^{\circ}$ ) dips. The trend of the bedding is subjected to change with mesoscopic and macroscopic folding and warping. It is also noted that at most of the places the bedding is re-oriented due to intense deformation and brought to parallelism with the axial planar cleavages of F1 folds. Hence the bedding data in such places are denoted as bedding parallel foliations (S0//S1). At the southern part of the

area the  $S_0||S_1$  planes are folded to form a regional fold. Dip reversals of bedding plane is observed at places.

## 2. Diastrophic structures

Diastrophic structures are planar, non-planar as well as linear features produced during the deformation events. As discussed in the beginning the area has undergone three phases of deformation and the deformational events are recorded in rocks as different generations of folds, foliations and lineations. The major secondary structures observed in the area are as follows

### i) Schistosity/Foliations

Three sets of foliation planes are identified in the mapped area representing the three stages of deformation.  $S_1$  foliations are the most discernible planar feature observed within the mapped area. It occurs as closely spaced continuous cleavages within meta argillite, quartz-chlorite schist, metabasalt and ferruginous phyllite and as spaced layer parallel cleavages within the chert layers of BIF of the area. The  $S_1$  and  $S_0||S_1$  planes are folded by the  $F_2$  folds. The strike of the  $S_1$  plane varies from NNW-SSE to NW-SE with moderate to steep dips towards east. The  $S_1$  plane shows dip reversal at places due to folding.  $S_2$  planes are seen as crenulation cleavages within meta argillite and spaced cleavages within meta-basalt cutting the  $S_1$  schistosity at an acute angle (Fig.5.67). Though the general structure of the area is defined by the  $F_2$  folds, the dominant planar feature observed in the area are bedding and bedding parallel cleavages.  $S_2$  planes were limited to the  $F_2$  fold hinges in BIF and crenulations in argillite. The  $S_2$  foliations are NW-SE planes with moderate to steep dip towards east.  $S_3$  foliations occur as widely spaced fracture cleavages in BIF and axial plane cleavages related to the  $F_3$  kinks in meta-argillite (Fig.5.68). The trend of the cleavage varies from NNE-SSW to NE-SW.

A swerving of the regional trend is noticed at the eastern part of the area. The  $S_1$  planes and  $S_2$  planes measured on the metabasalt and amphibolite at the eastern part shows dragging from NW-SE to NNE-SSW direction possibly due to the presence of shear zone at east.



**Fig.5.64** Pillowed metabasalt observed west of Bhavihalli village.



**Fig.5.65** Primary banding observed within the BIF in Kanivehalli .



**Fig.5.66** Compositional banding observed within the ferruginous phyllite near Kanivehalli



**Fig.5.67** S2 and S1 foliations observed within quartz-chlorite schist and cutting at an acute angle



**Fig.5.68** S3 fracture cleavages observed parallel to the axial plane of F3 warps shown by the pen.



**Fig.5.69** Tight isoclinal intrafolial fold formed within chert layers of BIF

## ii) Folds

The investigation area displays different order of mesoscopic and macroscopic folds. The major structure in the area is the presence of fold hinges observed North of Nichchapur representing the regional overturned synformal fold with NNW plunge. It is a F2 fold defined by the BIF bands, where the bedding parallel S1 cleavages are folding. The mappable macroscopic folds represent second phase of deformation. The first-generation folds are preserved within BIF as tight isoclinal folds and rootless intra folial folds (Figure 5.69). F2 folds in the area are generally overturned in nature. The area displays different orders of F<sub>2</sub> folds from mesoscopic to macroscopic scale. Most of the F2 folds in the area are plunging inclined to reclined and open folds with north westerly plunge (Fig. 5.70 to 72). The macroscopic folds have shallow plunge varying from 15 to 27 degrees while the lower order asymmetric folds in the area show plunge variations from 20° to 62°. The eastern ridge displays Z type asymmetric folds (Fig. 5.73) whereas the western most BIFs are showing S type asymmetric folds (Fig. 5.74).

F3 folds in the area occur as open folds and broad warps in BIF. The bedding parallel S1 cleavage planes act as form surface. F3 folds in argillite were straight limbed sub angular kink/chevron folds (Fig. 5.75). In general, these folds were seen as minor kinks formed on S<sub>1</sub> planes. The axial plane varies from NE-SW to ENE-WSW with sub-vertical dip and vertical plunge.

Mesoscopic Type-I and Type-III-fold interference patterns are observed within BIF of eastern ridge west of Konkana Hosuru and near the temple on the top of the ridge. Type-I folds occur as sheath folds within the bands of BIF east of Kakadahalli and west of Kanivehalli (Fig. 5.76). Type-III folds are mostly meso-scopie hook shaped folds where F1 folds are overprinted by F2 (Fig. 5.77).

## iii) Lineations

Lineations are linear features formed by the intersection of planes, alignment of minerals and by stretching of minerals. The widely observed lineations in the area are pucker axis lineations and mineral lineations. The mineral lineation is the commonly observed lineation within the quartz-chlorite schist where chlorite is aligned to form a line on the S1 planes (Fig. 5.78). The F<sub>3</sub> fold axis developed on the S1 plane was the most commonly observed pucker lineation in the area (Fig. 5.79). Intersection lineations are noticed within BIF and ferruginous argillite north of Kanivehalli, where S<sub>0</sub> can be traced as stripes on S1 plane. Apart

from this steeply plunging near vertical stretching lineations are found along the shear planes of granite gneiss (Fig.5.71).



**Fig.5.70** Plunging F2 fold observed within BIF of south east of Kanivehalli



**Fig.5.71** F2 reclined fold with steep plunge observed within BIF east of Kanivehalli



**Fig.5.72** F2 open folds observed within BIF north west of Kanivehalli



**Fig.5.73** Asymmetric fold observed within the chert of ferruginous phyllite on the eastern limb of the regional fold



**Fig.5.74** Asymmetric S fold formed by the quartz vein in ferruginous phyllite south of Kanivehalli



**Fig.5.75** F3 kinks within meta-argillite observed west of Nichchapur village.

#### **iv. Joints**

Two sets of joints are observed in the area. First set is ENE-WSW trending fractures and second set is E-W trending fractures. Both the sets show sub vertical to vertical dips.

#### **v. Fault**

Minor displacements were observed along  $S_2$  and  $S_3$  planes within BIF bands. Both sinistral and dextral shifts were observed in the area. The mesoscopic fault planes are characterised by displaced quartz veins and bands. The thin section studies also reveal existence of minor displacements/microfaults within the layers of BIF.

#### **vi. Shear zone**

The eastern contact of schist belt with gneisses of PGC is a sheared contact, except at places intruded by younger granite. The contact near Thalakkallu, Nandibevuru, Konngana Hosuru and North of Maiduru are highly sheared and mylonitized. Gneisses occurring at the margin are leucocratic, fine grained and mylonitized. Stretching lineations are observed in gneisses east of Konkana Hosuru indicates the possibility of faulting (probably a thrust) along the contact (Fig.5.79). The stream near to the contact follows a straight course. The petrological study of granite gneiss shows that the gneiss is mylonitised and shows other evidences of shear such as development of quartz ribbons (Fig.5.80a), winged porphyroblasts and mica fish (Fig.5.80b). Amphibolites near the contact also show evidences of strong shearing in the form of sigmoidal hornblende grains (Fig.5.81 and Fig.5.81a). The other lithounits present in the schist belt also shows evidences of shearing which is sympathetic to the main shear zone. The conglomerate west of Bhavihalli is sheared with rotated clasts and the petrological study of the rock shows presence of sigmoidal clast within a chlorite matrix. Quartz and feldspar porphyroblasts are also observed within the mylonitized zone. The S-C fabric, grain refinement, winged porphyroblasts and fold asymmetry suggest a ductile shear zone with sinistral sense of shear.

#### **v. Metamorphism**

The lithounits of the area have undergone greenschist facies to lower amphibolite facies of metamorphism. The most observed greenschist facies mineral in the project area is chlorite which forms various mineral assemblages with quartz, feldspar, epidote, mica and various carbonates. The meta-sedimentary rocks in the area shows mineral assemblage of quartz-sericite-chlorite- plagioclase (albite) whereas the meta-volcanic rocks show chlorite-albite, epidote-actinolite/tremolite-carbonate assemblage. It is noted that the rocks exposed in the eastern part of the block have undergone slightly high grade of metamorphism. The amphibolite

unit in this part shows hornblende-actinolite-plagioclase-epidote assemblage. Similarly the BIF associated with the amphibolite shows layers of actinolite within it. It can be considered as quartz-albite-epidote-almandine sub facies of greenschist facies (Turner and Verhoogen, 1960) or lower amphibolite facies (Winklere, 1974) of metamorphism (Sengupta, 2001). Development of chlorite observed along both S1 and S2 planes indicates two stages of metamorphism in association with the deformation.

The mineral assemblages observed in the area are as mentioned below.

Metabasalt: tremolite/actinolite- chlorite-plagioclase-epidote-sphene

Argillite : Quartz-chlorite- feldspar-titanomagnetite-rutile-carbonate

BIF: quartz-hematite-goethite-tremolite-Carbonate

Amphibolite: actinolite-chlorite-feldspar-hornblende



**Fig.5.76** Eye fold observed within BIF south east of Kakadahalli.



**Fig.5.77** Hook fold observed within BIF south east of Kanivehalli.



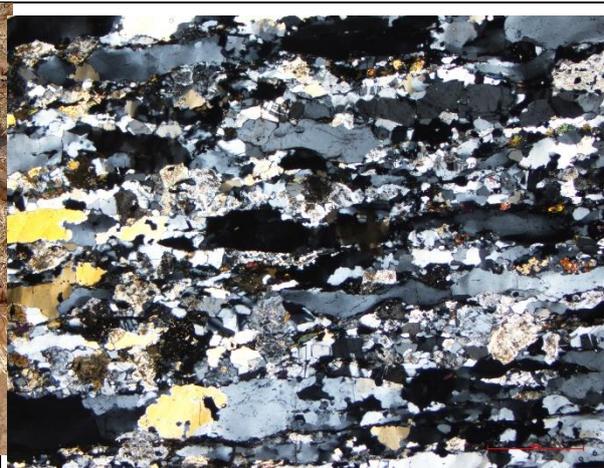
**Fig.5.78.** Mineral lineation defined by alignment of chlorite observed along the foliation plane of quartz-chlorite-schist west of Bhavihalli.



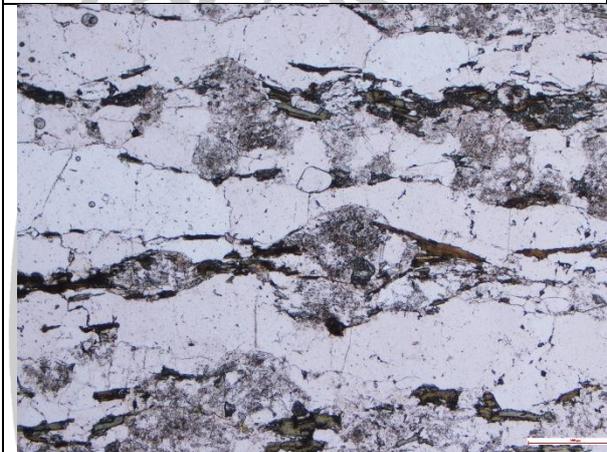
**Fig.5.79** Pucker lineations observed within meta-argillite west of Bhavihalli.



**Fig.5.80** Stretching lineation observed within sheared granite gneiss east of Konkana-Hosuru.



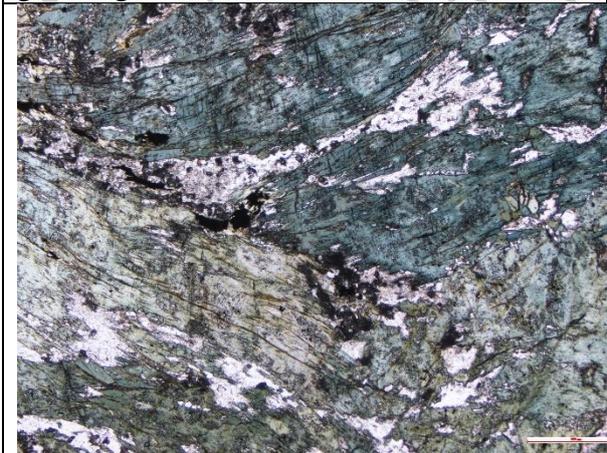
**Fig.5.80a** Development of quartz ribbon within the sheared granite gneiss east of Konkana Hosuru.



**Fig5.80b** Development of feldspar porphyroblast and mica fish in sheared granite gneiss east of Konkana Hosuru



**Fig.5.81** Sheared amphibolite with rotated amphibole observed east of Konkana Hosuru



**Fig.581a** Photomicrograph of sheared amphibolite showing sigmoidal hornblende. Sample collected from east of Konkana Hosuru

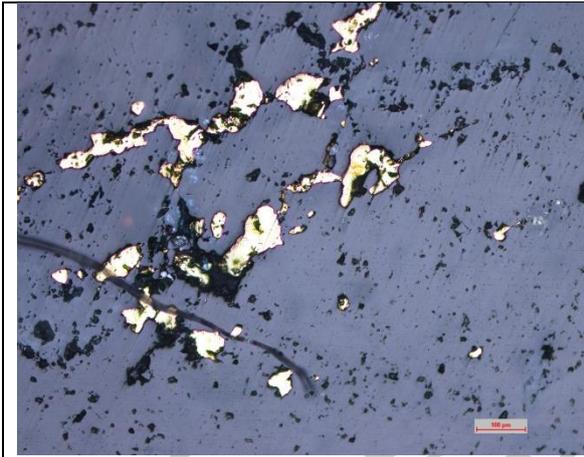


**Fig.5.81b** Photomicrograph of sheared conglomerate with mylonitic foliation defined by chlorite west of Bhavihalli.

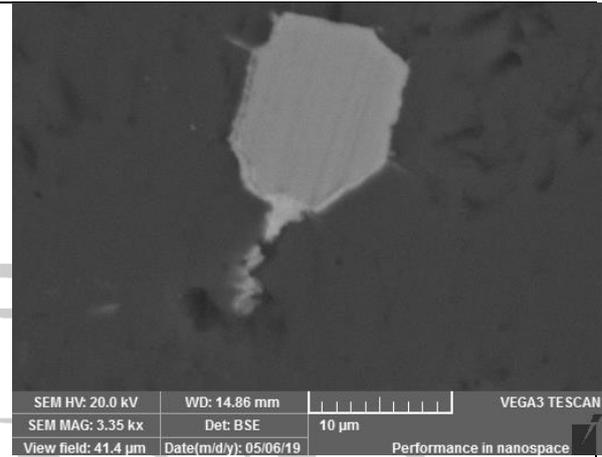
## vi). Mineralogy of ore zone and ore texture

Two different kind of mineralisation was noticed within the area with different mineral assemblage, alteration and association. The copper mineralisation associated with the giant quartz veins has a characteristic mineral assemblage of chalcopyrite, pyrite, chalcocite, covellite, bornite, galena and arsenopyrite. Among this chalcocite, bornite and covellite occur as replacement minerals along the margins and cleavages of chalcopyrite and are more enriched in Cu. Chalcopyrite is seen as stringers and disseminations within the quartz vein along with bornite, chalcocite and covellite forming replacement textures (Fig.5.82). Chalcopyrite and chalcocite are also seen along the rims of pyrite where Fe is being replaced by Cu (Fig.5.83). Bornite is seen along the fractures within covellite (Fig.5.84). Chalcopyrite is also seen as veins occupying the fractures within the quartz vein (Fig.5.85) and the quartz vein near the veins are fragmented and brecciated (Fig.5.86) with Fe oxide and feldspars. The SEM analysis of the quartz vein brought out the presence of free native gold grains of (Fig.5.87) size varying from 0.4 microns to 4.4 microns. It occurs as free grain within the fractures of quartz vein (Fig.5.88). The SEM analysis also brought out the presence of Ag, argentite, galena and sphalerite in association with the chalcopyrite. Argentite and galena were found as small inclusions within the chalcopyrite (Fig.5.89). A very small argentite vein is also observed during SEM analysis (Fig.5.90). The quartz vein also shows replacement texture where chalcopyrite alters to Fe-oxide and to gypsum indicating a highly oxidising fluid condition. The altered grain shows chalcopyrite in the core surrounded by hematite and a darker outer rim of gypsum (Fig.5.91). The other important minerals observed by SEM in association with the sulphides are alloclasite and bismoclite. The arsenopyrite identified during petrological studies are found to be rich in Co and Ni and forming alloclasite. Bismoclite is a rare oxy-chloride formed by Bi and occur as brighter spots in association with chalcopyrite. The presence of bismoclite is noticed within the oxidation zones associated with the hydrothermal breccia related Au-Cu-Bi deposits in Argentina and Nevada.

SEM was also helpful in identifying the alteration zone mineralogy of quartz vein. The important alteration minerals identified are Fe oxide, K-feldspar, chlorite and epidote. Fe oxide alterations are seen in the form of hematite veins (Fig.5.92) and granular hematite grains along with chalcopyrite (Fig.5.93). Presence of barite and gypsum were also noticed during the analysis. Barite is seen as small inclusions within the feldspar grains (Fig.5.94). The presence of barite in veins indicate the oxidising environment at the time of vein-formation as barite is highly stable in oxidizing (sulfate-stable) environments. The other important non-sulfide minerals identified are uranite, thorite, xenotime, monazite and sphene.



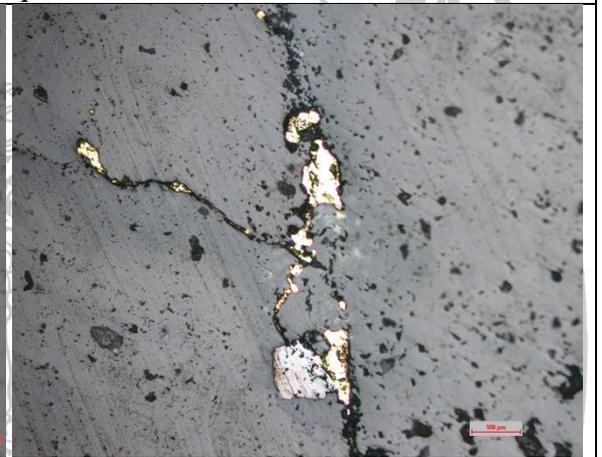
**Fig.5.82** Photomicrograph of quartz vein showing stringers of chalcopyrite under RL



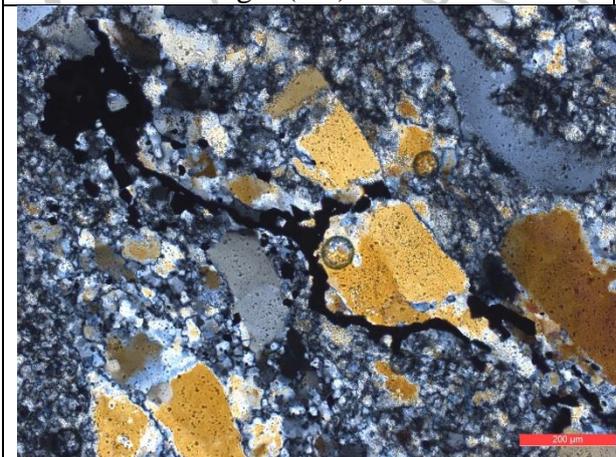
**Fig.5.83** BSE image of chalcopyrite observed at the rims of the pyrite within quartz vein



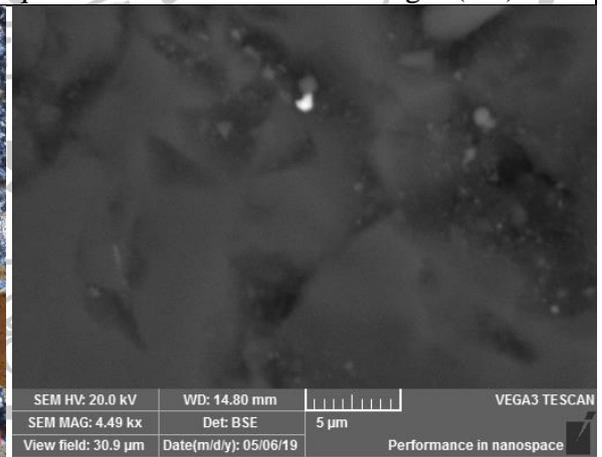
**Fig.5.84** Photomicrograph of Bornite observed within covellite as fracture filling under reflected light (RL)



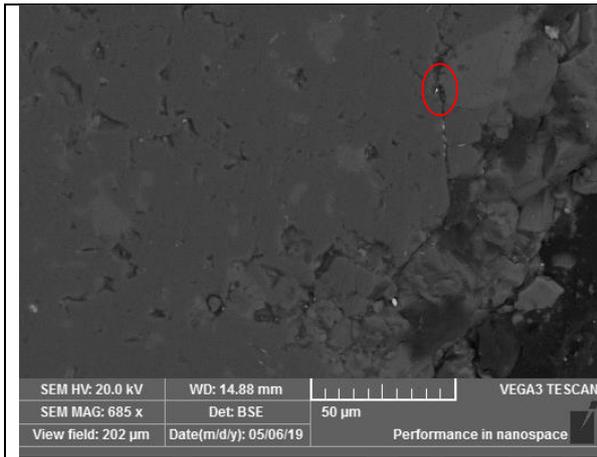
**Fig.5.85** Photomicrograph of veins of chalcopyrite occupying the fractures of quartz vein under Reflected Light (RL)



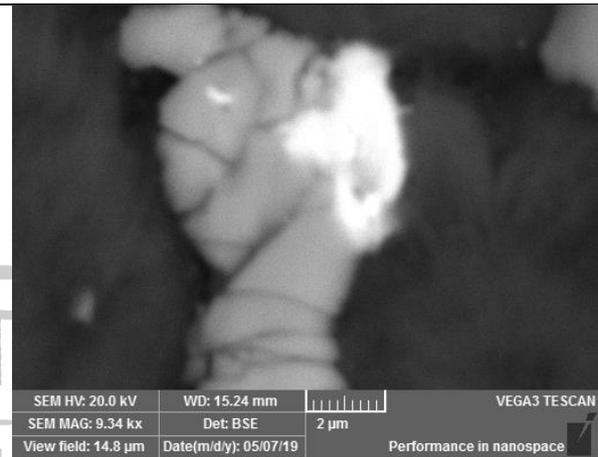
**Fig.5.86** Photomicrograph of brecciated quartz vein carrying sulphide veins (seen as black lines) under cpl.



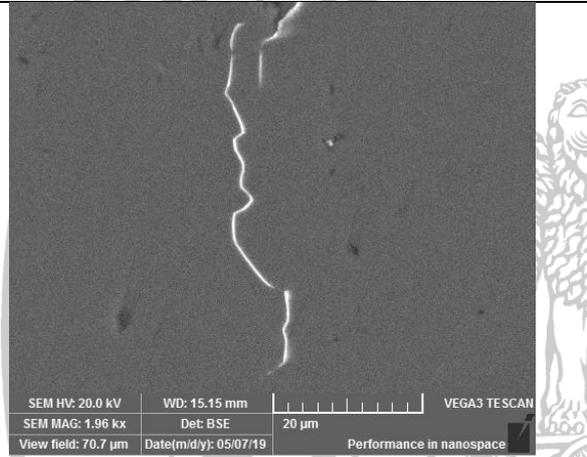
**Fig.5.87** BSE image of Native gold grain observed during SEM analysis



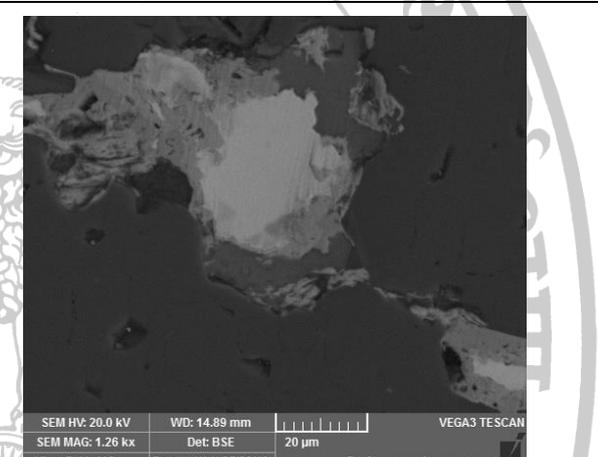
**Fig.5.88** BSE image of Au grain (within the circle) observed within the fracture of quartz vein



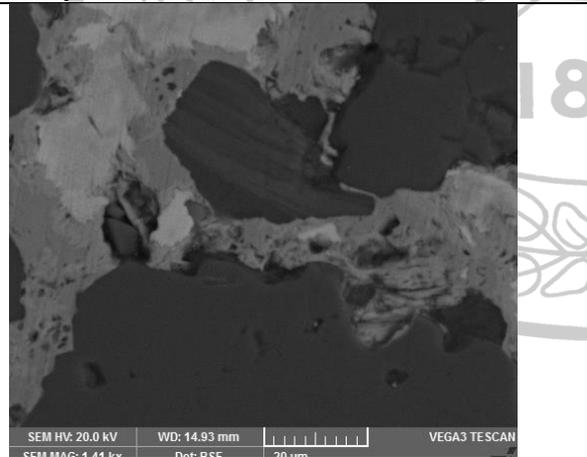
**Fig5.89** BSE image of grains of argentite and galena noticed within chalcopyrite during SEM analysis



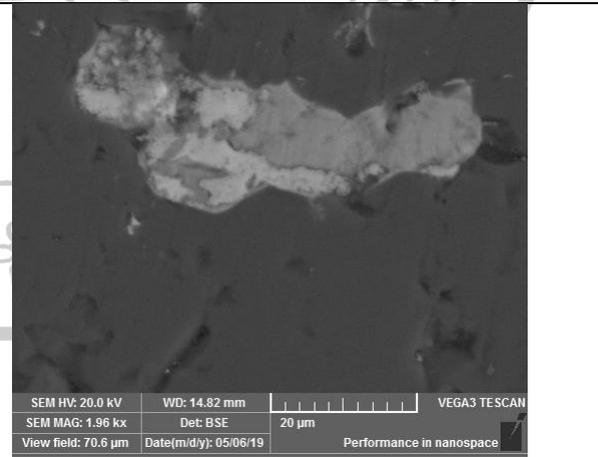
**Fig 5.90** BSE image of Argentite vein observed within quartz vein during SEM analysis.



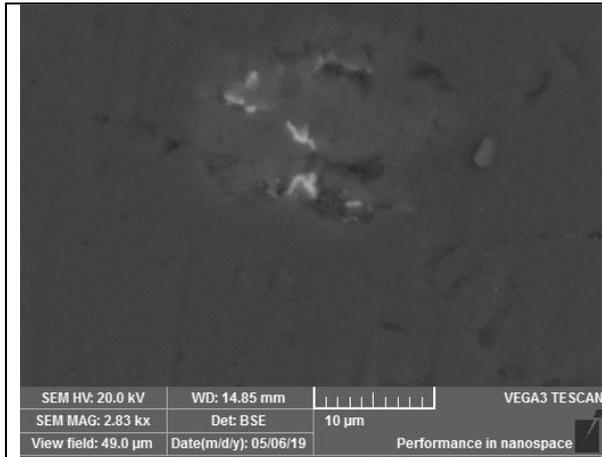
**Fig5.91** BSE image of alteration of chalcopyrite to Fe oxide and gypsum.



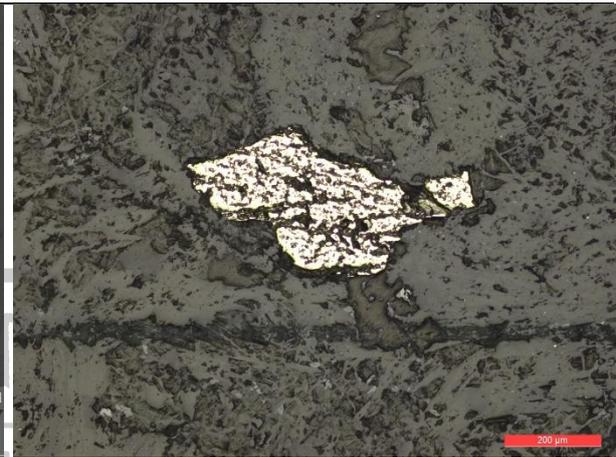
**Fig.5.92** BSE image of Fe oxide (hematite) alteration observed within the quartz vein



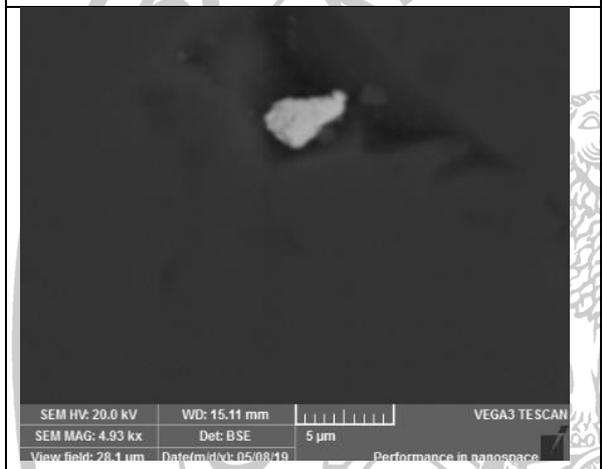
**Fig.5.93.** BSE image of hematite alteration from chalcocite and chalcopyrite



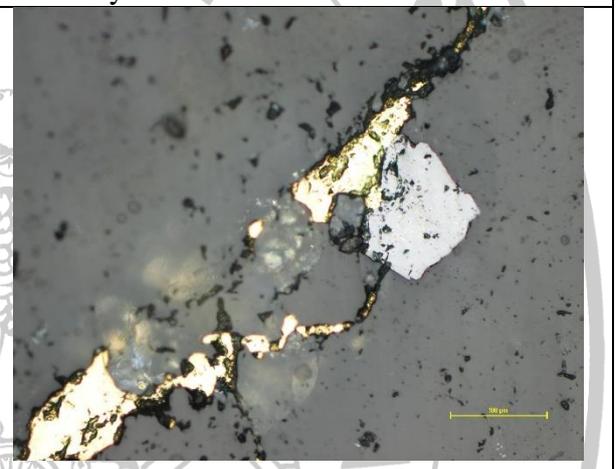
**Fig.5.94** BSE image of quartz vein showing barite grains within feldspar



**Fig.95** Photomicrograph of BIF showing euhedral pyrite grains observed within the chert layers



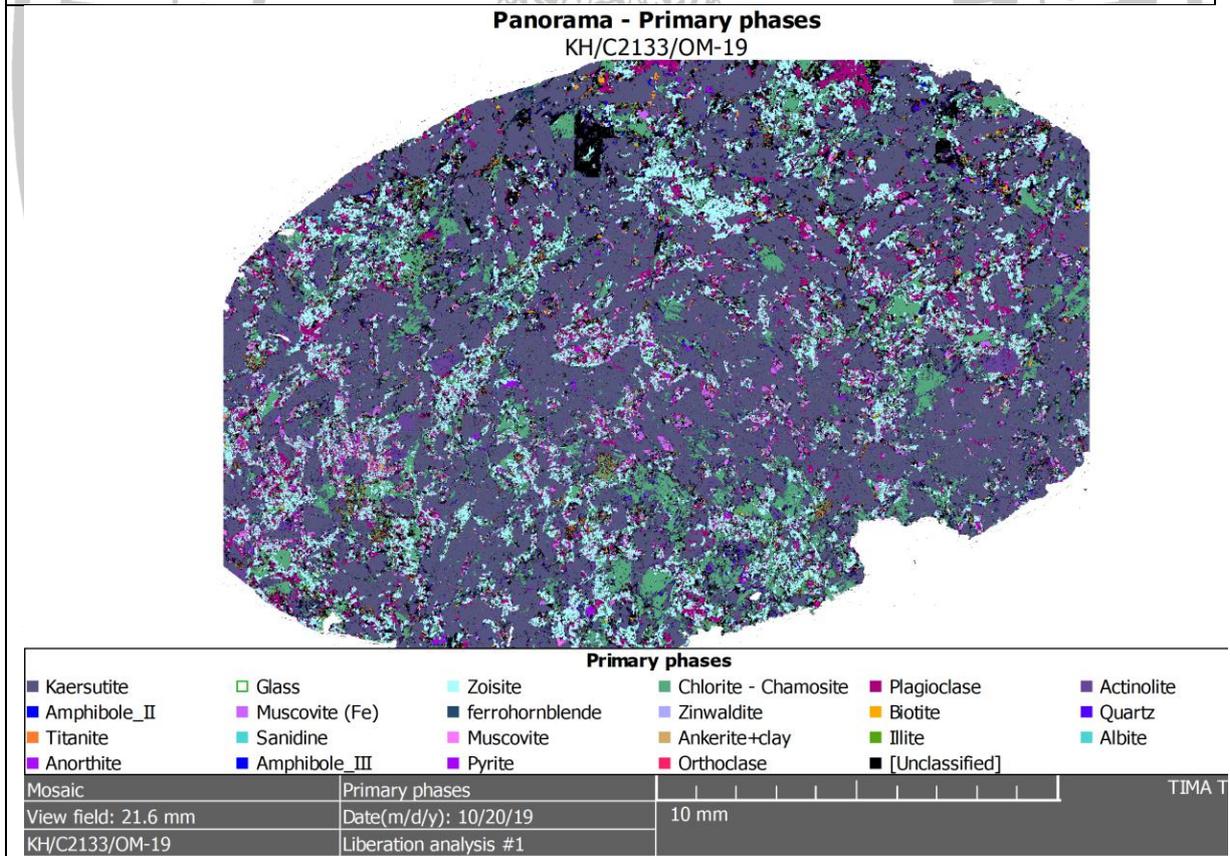
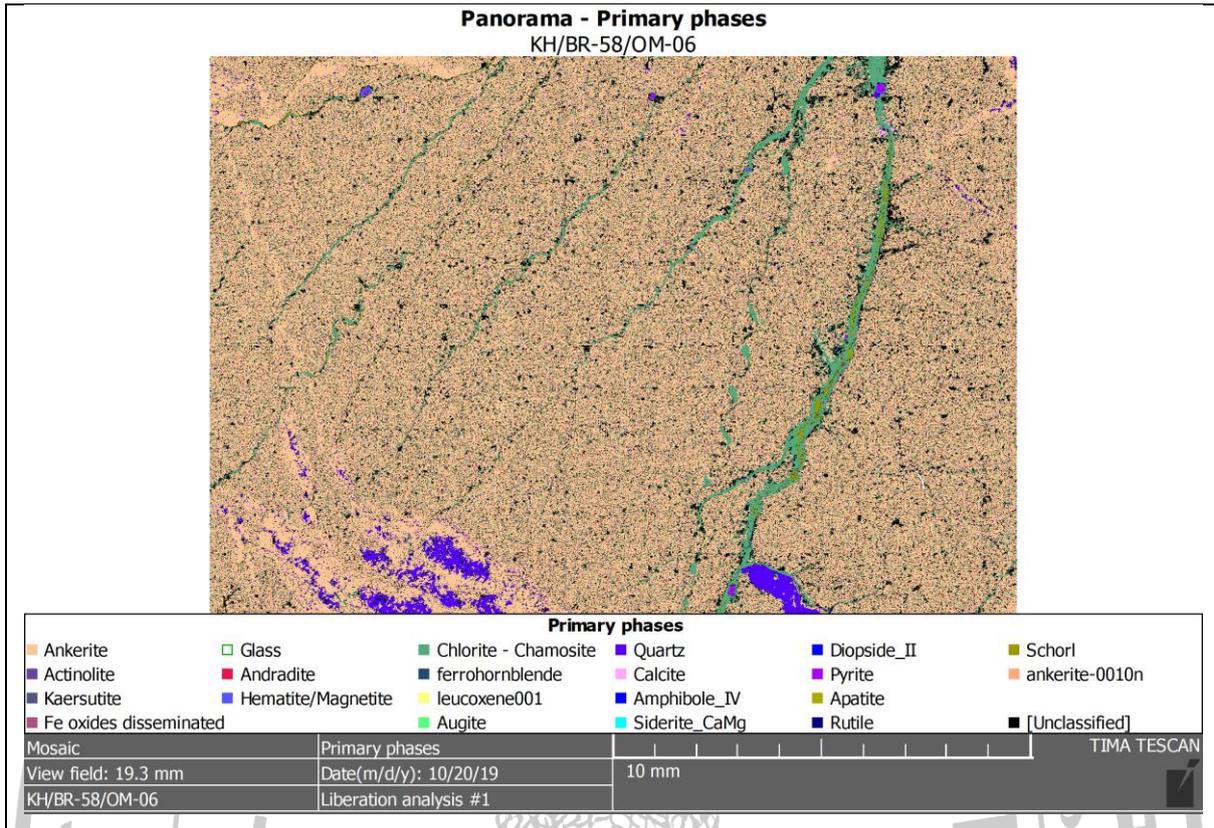
**Fig.5.96** BSE image of Au grain observed within the chert layer of BIF.



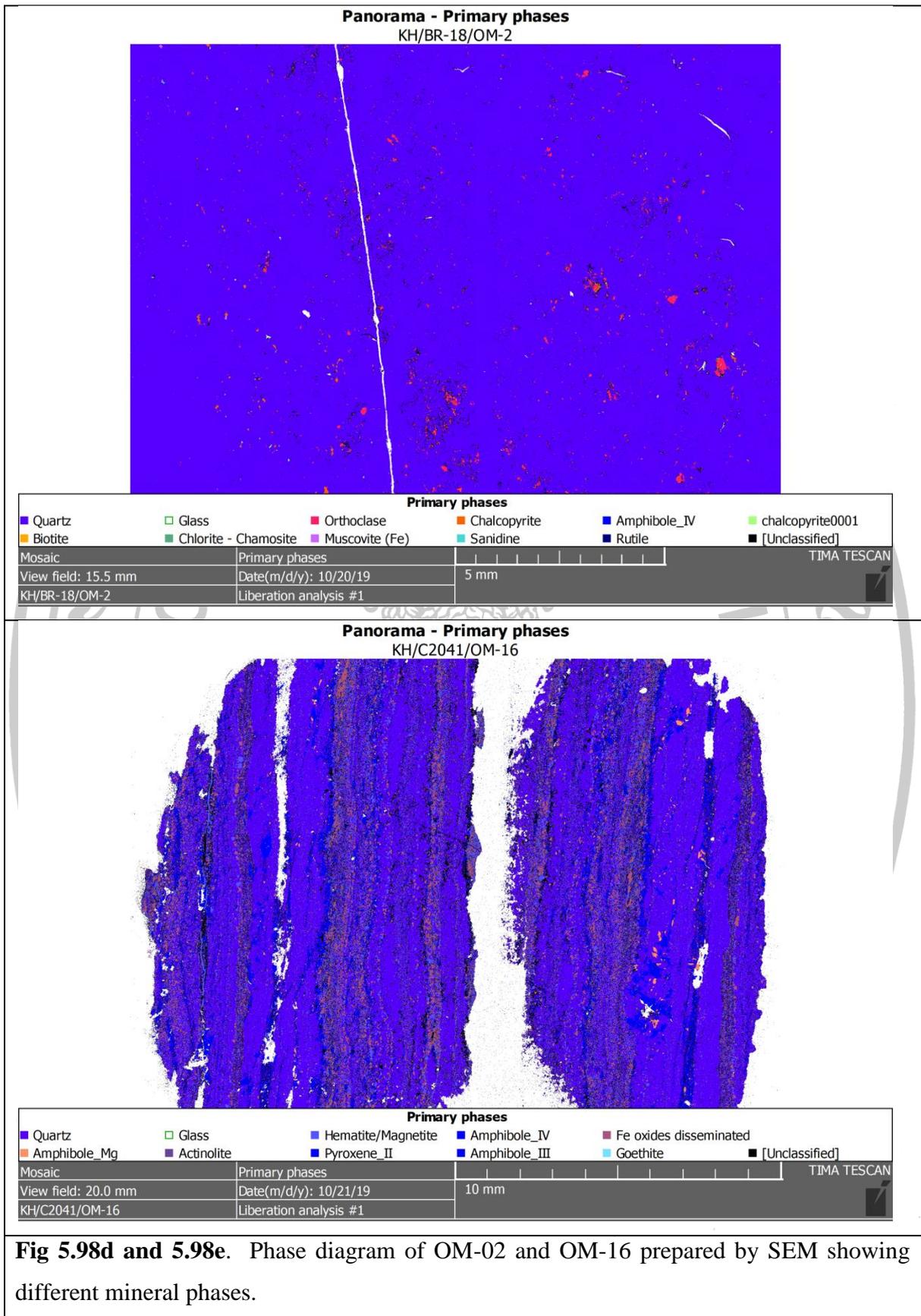
**Fig.5.97** Photomicrograph of pyrite vein along with chalcocite observed along the quartz vein

The gold mineralisation is associated with the BIF and sheared meta-argillite and quartz veins intruded into them. The mineralisation within BIF is also associated with the bedded pyrites within the chert layers and quartz veinlets intruded into the rock near fold hinges. The pyrite occurs as euhedral homogenous grains within the chert (Fig.5.95). The sheared meta argillite are intruded by quartz veins and these veins carry sulphides such as pyrite, chalcopyrite and arsenopyrite. The carbonatized meta argillite with ferroan-dolomite intercalations and quartz-carbonate veins are also showing sulphides. The SEM analysis of these samples indicated the presence of gold grains (Fig.5.96). It occurs as independent grains along the chert layers of BIF in close association with argentite and chlorite. Presence of monazite, rutile and galena are also identified as part of mineral assemblage. The actinolite rich metabasalt of the





**Fig. 5.98b and 5.98c.** Phase diagrams of OM-06 and OM-19 showing different silicate phases



**Fig 5.98d and 5.98e.** Phase diagram of OM-02 and OM-16 prepared by SEM showing different mineral phases.

### **vii) Pitting and trenching**

Trenching was extensively carried out to know the strike continuity and actual width of quartz vein and BIF and to delineate the mineralization zone by collecting samples systematically across the strike.

A total of 116 cu. m trenching was carried out in 15 trenches and 111 samples were collected. Trenching was carried out at an interval varying from 350m-400m. All the trench samples were collected mainly from the trench floors making 5-10 cm wide and 3-5 cm deep groove/ channels. The length of samples varied from 50 cm to 2.0 m, depending on the change of lithology, intensity of suspected mineralization and alteration. The trench log data and sampling details of trenches are enclosed in Annexure- III&IV and trench sections are shown in Plate-X

Groove samples weighing about 2 kgs collected, crushed and powdered by iron mortar & pestle and sieved to – 120 fractions. The powdered samples were then subjected to coning and quartering and were packed with 250 g each. One set was kept as duplicate samples and another set sent to the Chemical Division, SU. K&G, GSI, SR, Bangalore for chemical analysis of Au and other associated elements by AAS.

### **viii) Sampling**

Systematic bed rock and trench sampling is carried out in the study area to delineate the mineralization zone. The bedrock samples were mostly collected from the alteration zones within BIF. The sampling interval was kept 400m. The sample width varies according to the width and nature of alteration zones. Bedrock samples were also collected from the mineralized giant quartz veins. Bed rock samples collected by chip sampling. Trench samples were collected from trenches of 1m depth and 1m width. The trenches were made to check the mineralization zone and to assess the strike continuity and width. Channel and groove samplings was done along the trench floor.

Apart from the bedrock samples 30 stream sediment samples were collected from the second and higher order streams . The sediments were collected in three different fractions such as 80, 120 and 200. All the fractions were panned for gold and 120 fraction sent for chemical analysis. The unit cell samples (12 numbers) collected during NGCM, FS 2012-13 corresponding to the anomalous composite values were analysed to locate the source. The analytical results are given in the annexure

All the samples, including bedrock, stream sediment and trench samples were analyzed by GT-AAS and AAS-Flame method to detect Au and other associated elements respectively.

## ix) Discussion of results of chemical analysis of samples

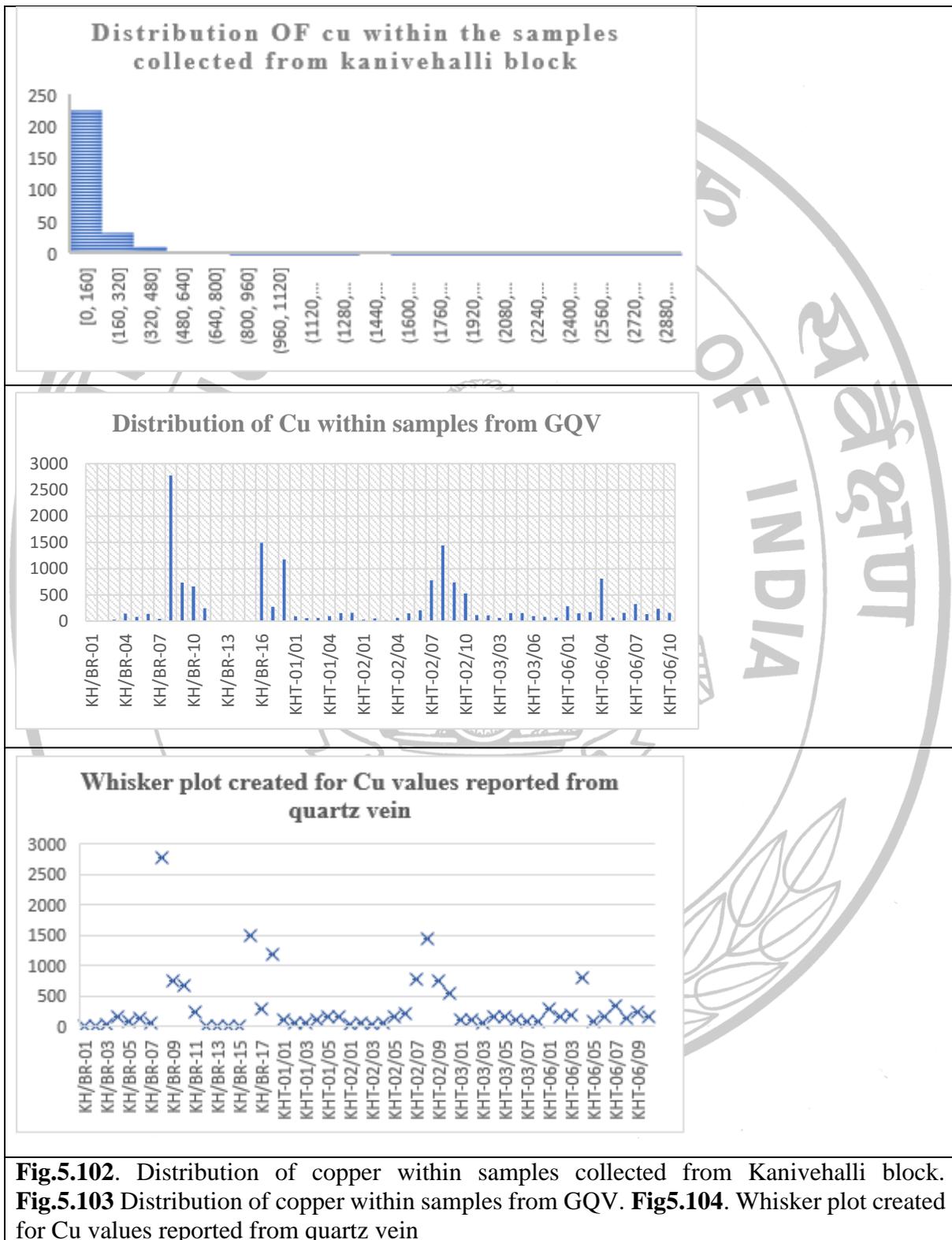
A total of 172 bed rock samples and 111 trench samples were collected during the investigation for analyzing gold and associated elements. The samples were submitted for the analysis of 13 elements including Au, Cu, Pb, Zn, Ni, Co, As, Cd, Sb, Bi, Mo, Cr and Ag. Analysis of all samples are received and the details are given in Annexure-I, II, III and IV. The Au radical was analyzed by GTA-AAS method and other base metals are analyzed by AAS-Flame method. The samples collected during the work were submitted to Chemical Division, SU: K&G, Bangalore for analyzing gold and associated base metals. The petrochemical samples were sent to Chemical Division, Hyderabad for analysis of REE by ICP-MS and major oxides and trace elements by XRF. 27 selected samples were sent for check analysis to the Chemical Division, Hyderabad and the details are given in Annexure XV.

Among the 283 bedrock samples (BRS+PTS) analyzed, 60 samples reported Au values above detection limit. According to the diagram showing distribution of gold values the Au values range from 25ppb to 2080ppb and 13 samples were analyzed to get significant Au values >100ppb (Fig 5.99). The diagram shows that the Au values are forming a skewed distribution with clustering of high values. This indicates the discontinuity in gold values. Since the data of path finder elements such as As, Sb, Bi and associated metal Ag are not available no meaningful correlation can be made for Au. The Au values in the block cannot be correlated to the available trace-metals data except that for Zn (Fig 5.100). The Au and Zn shows clustering near the Au values <100ppb, however the anomalous Au values can't be correlated with Zn. The whisker plot prepared for Au shows one anomalous value and two extreme outlier values whereas Zn shows three anomalous values (Fig.5.101).

A few encouraging Cu values are reported from the giant quartz veins of Hombalagatti. Most of the samples collected from the area shows copper values above detection limit (>10ppm). The distribution diagram prepared for Cu (Fig5.102) shows that the maximum number of samples show Cu values <500ppm. 228 samples have Cu values <160ppm and 45 samples have Cu values in the range of 160ppm to 500ppm. All the other values >500ppm represents samples collected from the quartz vein. The Fig5.103 Shows the distribution of Cu within the samples collected from the quartz veins near Hombalagatti. The skewed distribution shows number of anomalous values for copper. The whisker plot prepared for Cu (Fig5.104.) shows maximum samples are falling within the range of 300ppm Cu. Considering this as background value the Cu assay >500ppm were taken as anomalous values for this distribution. The value >2000ppm considered as the outlier. The correlation of Cu with other metals could not prepared as most of the trace-metals are below detection limit.



of mineralisation due to its association with Au and Ag. This has to be further confirmed by fluid inclusion studies. The ore mineral assemblage of chalcopyrite, arsenopyrite, pyrite, galena and argentite also suggest a mesothermal-hypothermal origin.



**Fig.5.102.** Distribution of copper within samples collected from Kanivehalli block. **Fig.5.103** Distribution of copper within samples from GQV. **Fig.5.104.** Whisker plot created for Cu values reported from quartz vein

The correlation matrix and descriptive statistics of the samples were prepared (Annexure XVI). It is observed that the gold values of both bedrock and trench samples shows weak positive correlation with As, Sb and Zn. The gold values reported from the bedrock samples can be correlated to the Bi and Pb positively whereas the same elements have a negative correlation within the trench samples. This may be due to the less mobility of these elements as the trench samples are collecting from a little weathered rock profile in comparison to the BRS. The copper values show positive correlation with Zn, Ni, Co and Bi in bedrock samples and Ni, Co and Bi in trench samples. The Mean value of gold in bedrock samples is 50 ppb, copper is 115ppm whereas the trench samples show a lesser Mean value for gold 0.027ppb and higher Mean value for copper (164.27ppm).



## CHAPTER-6

### MINERAL PROSPECT

The mineralization in the area is associated with two different geological setups. The gold mineralization is found to be associated with the schist belt rocks such as BIF, Meta-argillite and quartz-chlorite schist. The giant quartz reefs intruded into the granite gneiss of PGC host copper mineralization. Both the mineralization is different in their occurrence, assemblage and alteration and hence both the occurrences described separately.

#### **I. A Surface indications of Cu mineralization.**

The Cu values in the area are associated with the Giant Quartz Veins (GQV) and are observed north of Hombalagatti village. The ENE-WSW trending 10-15m wide and >2km long giant quartz veins are emplaced within PGC and are found to be rich in Cu. The Cu values of samples collected from the quartz veins are varying from 10 ppm to 2700ppm. Three major quartz reefs are identified North of Hombalagatti and are continuing for a strike length of 4-5km with an average width varying from 5-15m. Though incidences of malachite and sulphides are noted within all the three reefs, the eastern most quartz reef was found to be prospective during current study due to the continues values reported and due to the presence of comparatively high degree of alteration. The mineralised eastern most quartz reef is characterised by the presence of malachite and Fe stains (Fig.6.1). Presence of chalcopyrite is noticed as stringers and clusters within the Fe stained white-smoky quartz vein along with disseminated pyrite and arsenopyrite. The other significant minerals noticed as alterations are epidote and K-feldspar. Epidote occurs as veins as well as mineral aggregates. Orthoclase is observed as pink grains and white powdery material (clay) along fracture planes. The quartz vein is massive white to smoky in colour, sheared at places (at contacts with PGC) with Fe encrustations (Fig.6.2).

The first and second quartz reefs from west of Hombalagatti Block are not as mineralised as the major eastern most quartz reef. The quartz reef 1 starts from SE of Hombalagatti (Plate.I) where it occurs as jointed quartz vein with ferruginous encrustations and fine disseminations of sulphides. The malachite stains are observed only at a few broken joint surfaces (Fig.6.3). The reef pinches towards the village and reappears near small pond north of the village where it is smoky and characterised by the presence of chalcopyrite. Further north it forms a ridge with width 20-30m. The quartz on this ridge is white massive to jointed with presence of ferruginous stains and goethite. Brecciation is noticed at places (Fig.6.4). The brecciated quartz is found embedded in a ferruginous matrix. The brecciated/ fragmented part

of quartz vein is characterised by goethite encrustations and hematite veins. It is observed that the presence of sulphides is restricted to the smoky part of the vein and malachite stains are not pervasive. Presence of K feldspar-clay-epidote alteration is noted along both the quartz reefs at west of the mineralised quartz reef. The south western contact of the western most quartz reef at places shows layers of green flaky minerals, possible chlorite and dextrally displaced later quartz veinlets (Fig6.5).



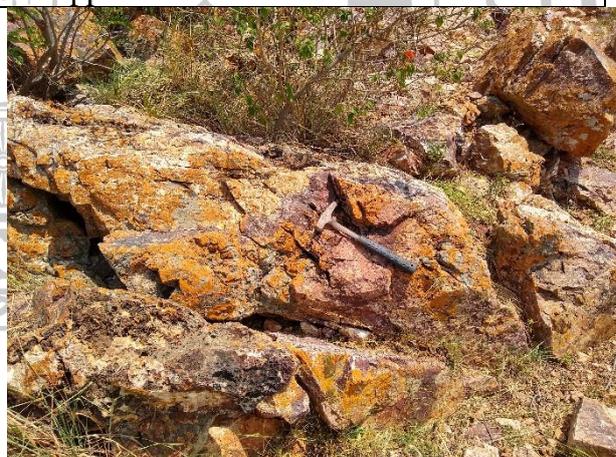
**Fig.6.1** Fe encrustations along with malachite stains observed within quartz vein



**Fig.6.2** Massive jointed ferruginous quartz vein exposed along the Kakadakalli-Harappanahalli road section



**Fig.6.3** Malachite stains observed within the quartz vein north west of Hombalagatti.



**Fig.6.4** Brecciated quartz vein observed near Hombalagatti.

### **I.b Surface indications of Au mineralization**

The Au mineralisation in the area of investigation is associated with the schist belt rocks. Based on the anomalous stream sediment values during NGCM, presence of sulphides and different alterations in the field, small zones of probable Au mineralization are identified at different parts of the block. The BIF related Au mineralization is characterised by limonite and carbonate alterations. The BIF (3-5m wide and 1.5km long) mapped north of Chigateri

reported gold values on analysis (ranging from 25ppb to 80ppb) and is marked by the presence of intense limonitisation (Fig 6.6). The band is traversed by numerous quartz veinlets both along and across the strike (Fig.6.7). Gash veins are observed within the BIF (Fig6.8). Presence of oxidised pyrite is noted along the chert layers. The macroscopic fold hinges formed by the BIF north of Nichchapur village also reported gold values. The BIF is highly limonitised where the hematite layers are altered by limonite. Quartz veins are seen traversing the rock everywhere. Visible sulphides are not observed within the BIF. The BIF east of Kakadahalli is characterised by the presence of bornite (fig 6.9). The BIF is highly oxidised with goethite encrustations (Fig6.10). At places the rock is covered with thin Fe encrustations. Presence of pyrite is noted along the chert layers of BIF bands on the ridge west of Kanivehalli. The small BIF exposed along the western flanks of eastern ridge is highly altered, oxidised, brecciated and traversed by numerous quartz veins. The western most BIF observed at the northern part of the area is also shows evidences of hydrothermal alterations. Presence of quartz veins, sericite and limonite are noticed along this band. Oxidised sulphides are seen within the BIF and presence of very thin gash veins are noticed along the chert layers (Fig6.11)).

Apart from the quartz reef and BIF the metabasalt of the area also shows disseminations of sulphides and alterations at places, though none of them yielded any gold values. The metabasalt north of Chigateri and northwest of Bhavihalli shows silicified outcrops with disseminated sulphides at places. These are massive, hard rocks with goethite encrustations at places. Such zones are observed along the contacts of metabasalt and phyllite and are characterised by the presence of quartz veins with or without sulphides. Development of chlorite and carbonates are also noticed.

The argillite/phyllite/quartz-chlorite schist of the area is also showing alteration zones marked by carbonates (ferroan-dolomite, ankerite and calcite) and chlorite development (Fig6.12). The quartz-carbonate veins and ferroan-dolomite lenses present in such zones carry sulphides along and at the margin of the veins as disseminations. The samples collected from this zone yielded no encouraging values. At the same time the folded quartz veins found associated with the ferruginous argillite and metabasalt yielded value upto 2080ppb (Fig.6.13)



**Fig.6.5** Quartz vein-lets intruded into the GQV. The veinlet is dextrally folded.



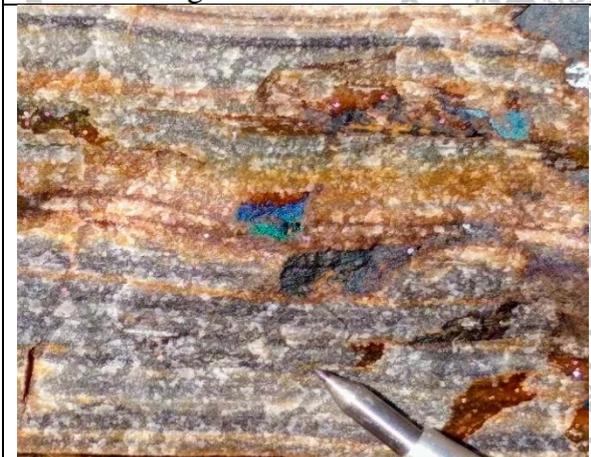
**Fig.6.6** Limonitised BIF with quartz veinlets



**Fig6.7** Silicified BIF with quartz veins intruded along and across the BIF



**Fig.6.8** Gossanized BIF with gash veins



**Fig.6.9** Bornite and covellite observed within the BIF east of Kakadahalli



**Fig.6.10** Development of goethite noted on BIF east of Kakadahalli

## **II.Mode of occurrence**

### **II.a Mode of occurrence of Cu**

The Cu values reported from the area is closely associated with chalcopyrite, which is the major Cu ore mineral identified during the studies. Presence of chalcocite, bornite and covellite are also identified as replacement during the ore microscopic studies (Fig6.14). The Cu bearing sulphides mostly occur as stringers and disseminations along the fracture planes and grain boundaries of quartz vein (fig6.15). The mineralized zone in the field can be identified by the presence of malachite encrustations on the quartz reef. In field the sulphides noted mostly within the smoky as well as iron dusted white quartz vein (Fig 6.16).

### **II.b Mode of occurrence of gold**

Two different mode of occurrences of gold is noticed in the area associated with two different mineral systems. The first mineral system is associated with the GQV of Hombalahatti where presence of gold is noted with Cu. Gold is occurring as free grains in native form within the quartz vein. Presence of Ag and Cu (in the form of chalcopyrite and chalcocite) is observed during SEM analysis. It is observed during the analysis that gold is occurring in native form (as free grains) of size varying from 0.5 microns to 4 microns within the fractures and cavities of quartz. However, none of the samples collected from GQV (Giant Quartz Vein) reported Au values. The ore mineral assemblages identified in the mineralized zone are chalcopyrite, galena, arsenopyrite and chalcocite representing high sulphidation system.

The second mode of occurrence is associated with the hydrothermally altered BIF and associated quartz veinlets of Hiriya Formation, where gold is found along with pyrite and arsenopyrite. The quartz veins within the meta-argillite and metabasalt are also found to be carrying same mineral assemblages but have not yielded gold values in analysis. The assemblage and alterations in the form of chlorite and carbonate indicates low sulphidation epithermal system which has to be confirmed by fluid inclusion studies.

Another noteworthy association is noticed along the chert layers of BIF. The samples collected from chert layers characterised by the presence of sulphides (mostly pyrite) are showing moderate gold values (upto 80ppb) and during SEM analysis gold grains are identified within the chert layers. The major sulphide seen associated with the free milling gold is pyrite.



**Fig.6.11** Gash-veins of quartz developed along the chert layers.



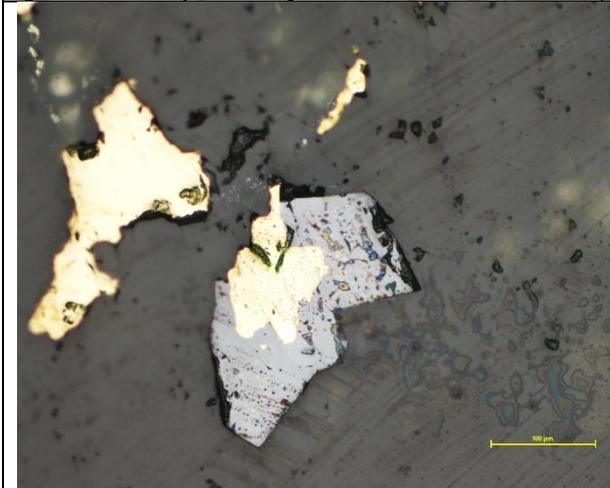
**Fig.6.12** Alteration zone observed within meta-argillite marked by the presence of quartz and carbonate veins



**Fig.6.13** Ferruginous argillite with folded quartz veins yielded gold values.



**Fig.6.14** Chalcopyrite and covellite observed within the quartz vein.



**Fig.6.15** Disseminations of chalcopyrite and chalcocite observed within quartz.



**Fig.6.16** Smoky quartz with disseminations of chalcopyrite.

### III Nature of Mineralization

As described in the beginning two different types of mineralisation is noticed in the area. The Cu mineralisation observed along the giant quartz veins (GQV) north of Hombalagatti is epigenetic structurally controlled vein copper deposit with the association of Au and Ag. The thermo-barometry of the fluid has to be determined by fluid inclusion studies to confirm the nature of mineralization. The ore mineral assemblage of chalcopyrite, arsenopyrite, pyrite, galena and argentite also suggest a mesothermal-hypothermal origin.

The Au mineralization in the schist belt rocks are epigenetic except at the chert layers of BIF. The gold values associated with the chert layers having sulphide disseminations can be syngenetic, which are later remobilised to form veins cutting along and across the BIF. Epigenetic sulphides are noticed along the quartz veinlets within metabasalt, BIF and contact of meta-argillite and meta-basalt.

### IV. Details of mineralised zone

Though number of alteration zones were identified during the mapping and targeted for gold, the only prospective zone demarcated so far is associated with the giant quartz reef north of Hombalagatti. The samples collected from the zone yielded Cu values ranging from 200ppm to 2700ppm. The values are found to be continuous for a strike of 800m to 1 km with average width of 2m. The mineralized zone is characterised by the presence of malachite stains. The quartz vein also shows K-feldspar and epidote alterations along with Fe dusting at places. The ore assemblage observed at field includes chalcopyrite, pyrite and arsenopyrite present as disseminations and small stringers within the quartz.

The gold mineralization in the area lacks strike continuity except at few places. The important zones observed are

- 1.) The BIF (4-5m wide) mapped northwest of Chigateri shows a continuous strike over 400m. with values ranging from **60ppb to 192ppb** (05 values above 25ppb)
- 2.) Sporadic occurrence is noticed along the fold hinges north of Nichchapur and the values are <100ppb with a maximum of **80ppb gold**.
- 3.) Sporadic occurrence of gold values is reported from the samples collected from the old working near the contact of Meta-argillite and meta-basalt. The five samples collected here yielded values **238ppb, 2080ppb, 1744ppb, 60 ppb, 34ppb** respectively. The value has no strike continuity.
- 4.) The BIF north west of Kanivehalli shows mineralization for a strike length about 400m. with values ranging from **36 ppm 402 ppb**.

5). The Cu mineralization in the quartz vein north west of Hombalagatti is continuous for 800m. with values **0.2775%, 0.149%, 0.117% and 0.144%**. All the values are calculated over 1m width (Fig.6.17).

The average width and grade of mineralization zone varies as follows

- 1). The gold mineralization associated with Chigateri BIF has a strike length about 400m with weighted average **0.12g/t/2m and 0.10g/t/2m**
- 2.) The BIF north west of Kanivehalli has gold values over a strike length of 400m with weighted average **0.17g/t/4m**. All the other gold values are reported from the area are found to be sporadic nature
- 3). The Cu mineralization in the quartz vein is found to be continuous for 800m with values **0.2775%, 0.149%, 0.117% and 0.144%**. over 1m width.

#### **V. Alteration zones and its relevance with mineralization**

Alteration zones are the marker horizons to identify an area of potential mineralisation. The nature of alteration zones varies with respect to the lithology, processes involved in mineralisation and nature of hydrothermal fluid. Hence the study of alteration zones helps to identify the genesis, environment and P-T conditions under which the ore deposit was formed. Alteration zones occur as different halo around an ore body according to the pattern of elemental/mineral dispersion. Each halo represents a specific mineral assemblage or geochemical signatures which heavily depend upon the mobility of elements.

The important alterations observed associated with the copper mineralization is in the form of carbonate (malachite). Though not very prominent, Fe alterations and K-feldspar alteration also observed at a few places. The Fe alteration map prepared using ASTER shows a linear pattern along the sheared contact of schist belt and PGC and not showing any notable zone along the quartz vein (Plate: V). Whereas the silica alteration map prepared (Plate. VII) has picked up the GQVs as a linear zone.

Chlorite and carbonate alterations were found to be the major alterations associated with the gold mineralization. The chlorite alteration map (Plate IV) shows a linear patch within quartz-chlorite schist and the samples collected have not yielded any significant values. Similarly the carbonate-epidote-chlorite alteration map prepared (Plate VI) indicates that the alteration is wide spread covering all the lithounits except granite gneiss and no specific zones could be traced.

As mentioned above the copper mineralization within the GQV is characterised by K-feldspar and Fe oxide alterations. Presence of epidote and Chlorite is also noted during petrological as well as SEM analysis. The other important mineral identified is barite. Barite is

considered as the highly stable sulphate in oxidising environment. It is said to be formed during fractional crystallization of silicate magmas when barium becomes concentrated in the residual silicate liquid (Craig et.al, 2017). It is also concentrated in silicate liquids produced by partial melting. Similarly, presence of bismoclite in quartz vein indicates a hypogene environment. It can also be a part of high sulphidation epithermal deposits (Francisco, 2016).

#### **vi). Genetic model for copper mineralization near Hombalahatti**

Copper is a nonferrous basemetal and its average concentration in the earth crust is about 50ppm. Copper deposits are found in various geological environments including hydrothermal deposits, porphyry deposits, magmatic and supergene deposits etc. Apart from the above-mentioned types there are number of other deposits which are generally are of less economic importance. The copper mineralization associated with the quartz veins in Hombalahatti belongs to the second category. The field observations and ore mineral assemblage suggests that the mineralization is possibly related to the “vein copper deposits”. The mineralization in vein style deposits are characterized by the irregular distribution of sulphides mostly as patches of disseminations along with the gangue minerals (British Geological Survey). Copper commonly occurs in veins associated with quartz, gold, silver, antimony and at times uranium. The dominant copper mineral in vein copper is chalcopyrite. Vein copper deposits are relatively small deposits both in tonnage and grade and considered as the sources of for first copper production in the world. The importance of vein copper deposits diminished with change in economics and improved extraction techniques.

Though vein copper deposits can occur in many host rocks in diverse geological environments two important subtypes are recognised based on the associated intrusive rocks. The first sub-type associated with mafic intrusives are referred as Churchil Type and the second type is generally associated with intermediate to felsic intrusives and often referred as Alwin Type (Kirkham et.al, 1996). The association of Hombalahatti quartz vein with the granophyre of intermediate composition (dioritic to granodioritic) suggests it may belong to the second category. The mineralization might have formed from the magmatic hydrothermal fluids expelled from the associated intrusion. The enrichment of copper can be aided by the hypogene leaching by meteoric water (Brimhall,1979)

#### **Genetic model for gold mineralization**

The gold mineralization in the area found to be hosted by different lithounits such as BIF (Chigaterri), ferruginous phyllite and quartz vein (west of Bhavihalli). It is structurally

controlled epigenetic gold mineralization where the shear has remobilized the gold and formed occurrences along favourable geological structures (such as fold hinges and lithocontacts). The gold occurrences associated with the schist belt rocks (BIF, Meta-argillite) is structurally controlled epigenetic mineralization falling within the broad category of orogenic gold deposits. The model widely used for BIF hosted Au is that the mineralization may form due to deformation focusing metamorphogenic or magmatic hydrothermal fluids, from depth, into a chemically and structurally (brittle- ductile transition zone) favourable depositional environment, late in the orogenic cycle (Kersewill, 1993,). Another model emphasizes a syngenetic origin for the widespread anomalous gold values (in BIF), similarity of the geological environments to currently active submarine exhalative systems and the association with chemically precipitated sedimentary strata.

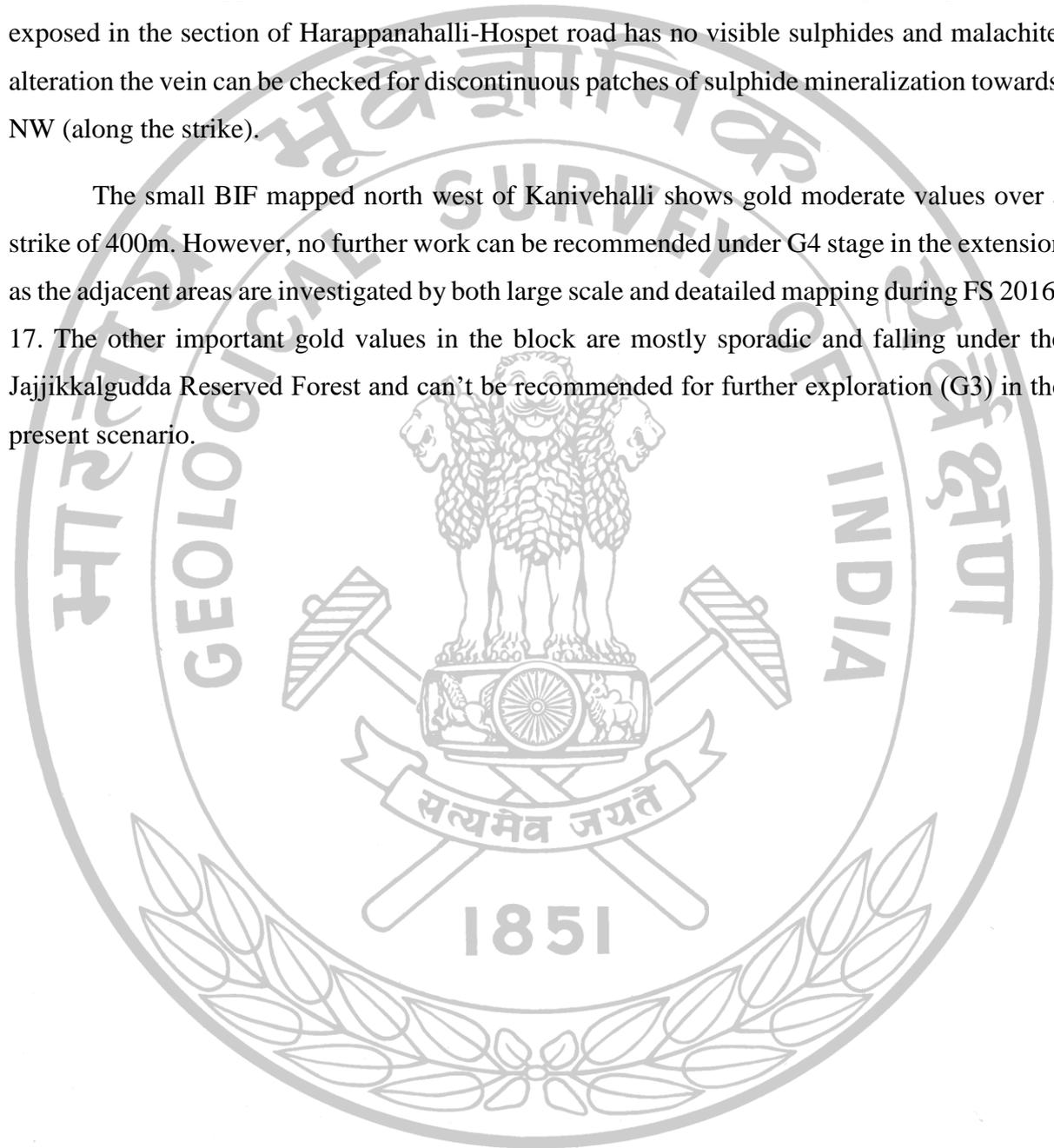


## CHAPTER-7

### RECOMMENDATION

It is noted during field traverses that the mineralised quartz vein near Hombalahatti is occurring as discontinuous band towards WNW to the adjacent toposheet (48N/13). Hence the continuity of the copper mineralization can be checked towards WNW. Though the quartz vein exposed in the section of Harappanahalli-Hospet road has no visible sulphides and malachite alteration the vein can be checked for discontinuous patches of sulphide mineralization towards NW (along the strike).

The small BIF mapped north west of Kanivehalli shows gold moderate values over a strike of 400m. However, no further work can be recommended under G4 stage in the extension as the adjacent areas are investigated by both large scale and detailed mapping during FS 2016-17. The other important gold values in the block are mostly sporadic and falling under the Jajikkalgudda Reserved Forest and can't be recommended for further exploration (G3) in the present scenario.



## CHAPTER-8

### CONCLUSION

“Reconnaissance survey for gold in Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka” is a spin off item of NGCM carried out during F.S 2012-13. The project was taken up as a G4 investigation to assess the gold mineralization in the area. An area of 100 sq.km was mapped along with the collection of 172 bedrock samples and 111 trench samples, 55 petrological samples and 22 petrochemical samples and 42 stream sediment samples. 10 selected samples were analyzed using EPMA and SEM and 06 samples are submitted for FIS. The analytical results of 283 samples for Au, Pb, Zn, Co, Cu, Cr and Ni were received and analysis of Ag, As, Bi, Mo and Sb are pending with the lab. The major oxides and trace elements of petrochemical analysis were received whereas the REE analysis is pending.

The project area forms a part of Chitradurga schist belt and exposes rock types PGC, Hiriya Formation of Chitradurga Group and younger intrusives. The major rock types exposed in the mapped area are argillite with intercalations of felsic tuff, metabasalt, BIF, conglomerate, amphibolite and younger gabbro and quartz veins.

The granite gneiss exposed in the south western and north eastern part of the area is composed of quartz, feldspar and biotite with accessory minerals such as garnet and epidote. The contact of gneiss at both south west and north eastern part is sheared. The rock is migmatitised at places. Enclaves of Sargur amphibolite are noticed within the gneiss. The schist belt succession starts with the metabasalt of Hiriya Formation of Chitradurga Group. The rock is fine grained, massive to foliated and composed of quartz, actinolite and chlorite. Mappable and non-mappable units of BIF, dolomite and limestone are observed within the metabasalt. The meta-basalt is overlaid by the argillite-BIF sequence to the east. The meta-argillite in the area is reclassified and new lithounits such as quartz-chlorite schist, quartz-sericite schist and ferruginous phyllite are demarcated based on the field observations and petrological studies during current work. The metabasalt of Hiriya Formation occur as patches within the quartz-actinolite/tremolite schist exposed at the eastern contact of argillite. Presence of varioles are reported from the metabasalts of the area during the current work. A gradual transition from metabasalt to tremolite schist and to amphibolite is observed towards east of the study area. The contact of amphibolite and granite gneiss at east is marked by the presence of EMSZ (Eastern Margin Shear Zone). Mappable and non-mappable enclaves of sheared Sargur Amphibolite is identified within PGC. The major intrusives mapped in the area are meta-gabbro and dolerite. These rocks cut across all the major lithounits of the area. The intrusive porphyritic rock exposed north west of Hombalagatti is found to be of dioritic to grano-dioritic

in composition. The rock is characterised by large fragments of quartz within a fine-grained matrix. The rock is marked as dolerite in previous report is possibly a granophyre with chemical composition ranging within ADR field. The mineralized quartz vein is cutting across the dyke. Quartz veins of different generations are the major acidic intrusives observed within the area.

The area forms a regional fold within the block with closure south of Nichchapur (outside the block). The overturned F2 synformal fold plunge towards north west with shallow dips. The two ridges running parallel to each other represent two limbs of the fold and shows fold asymmetry defined by BIF. The major planar feature observed in the area are the axial planar cleavage of the F2 fold. Bedding and pillow structures are the two important primary structures observed within the block. The eastern part of the block is characterized by a prominent shear zone widely known as Chitradurga Marginal Shear Zone (CMSZ) and Main Boundary Shear Zone (MBSZ). The shear zone is marked by the development of mylonite, winged porphyroblasts, stretching lineation and grain size reduction.

The area displays two type of mineralization including the quartz vein hosted copper and epigenetic gold mineralization hosted by BIF and meta-argillite. The samples collected from the zone yielded Cu values ranging from 200ppm to 2700ppm. The values are found to be continuous for a strike of 800m to 1 km with average width of 2m. The mineralized zone is characterised by the presence of malachite stains. The quartz vein also shows K-feldspar and epidote alterations along with Fe dusting at places. The ore assemblage observed at field includes chalcopyrite, pyrite and arsenopyrite presenting as disseminations and small stringers within the quartz. Sporadic occurrence of gold values is reported from the samples collected from the old working at the contact of Meta-argillite and meta-basalt. The five samples collected here yielded values **238ppb, 2080ppb, 1744ppb, 60 ppb, 34ppb** of Au respectively. The value has no strike continuity. The Cu mineralisation observed along the giant quartz veins (GQV) north of Hombalagatti is epigenetic and can be considered as a hypothermal vein-fracture filling kind of mineralisation due to its association with Au and Ag. The gold values associated with the chert layers having sulphide disseminations can be syngenetic, which are later remobilised to form veins cutting along and across the BIF.

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## LOCALITY INDEX

Sl. No.	Locality	Latitude	Longitude	Toposheet
1	Bhavihalli	14° 50' 32"	76° 4' 41"	57 B/01
2	Chigateri	14° 49' 10"	76° 05' 30"	57 B/01
3	Hombalagatti	14° 47' 27"	76° 2' 0.28"	57 B/01
4	Kakadahalli	14° 49' 01"	76° 00' 47"	57 B/01
5	Kanivehalli	14° 52' 22"	76° 00' 58"	57 B/01
6	Konkana-Hosuru	14° 52' 21"	76° 03' 31"	57 B/01
7	Nandibevuru	14° 54' 30"	76° 03' 08"	57 B/01
8	Nichchapur	14° 46' 42"	76° 03' 37"	57 B/01
9	Singaratotta	14° 49' 45"	76° 00' 6.9"	57 B/01



**SYNOPSIS OF WORK DONE**

**Appendix 1**

1.Title of the report	Reconnaissance survey for Gold in Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka.		
2.Item No./Code No	M2APMM/MEP/NC/SR/SU-KG/2018/18818		
3.Field Season	2018-19		
4.Date of commencement	19.09.2018		
5.Date of completion	21.03.2019		
8. Analysis carried out quantitative	Anindya Bhattacharya, Director -08 days		
	Nimmy K.C,Sr.Geologist- 129 days		
	Hima K. Reghunath, Sr. Geologist-126 days		
	Reconnaissance survey using ASTER	720 sq.km	
	Large Scale Mapping(scale 1:12,500)	100 sq.km	
	Trenching (cu.m)	116 cum	
	Samples (Nos.)		
	PTS	111	
	BRS	172	
	PCS	22	
	SSS	42	
	PS	37	
Ore Microscopy	22		
FIS	06		
9. Expenditure	GTA-AAS	Au	
	Flame-AAS	Cu, Pb, Zn, Ni, Co, As, Cd, Sb, Bi, Mo, Cr, Ag (12 elements)	
	XRF	28 elements (Major oxides - SiO <sub>2</sub> , TiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , MnO, MgO, CaO, Na <sub>2</sub> O, K <sub>2</sub> O, P <sub>2</sub> O <sub>5</sub> , LOI and Trace elements - Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb, Ba, Hf, Pb, Th and U)	
	ICP-AES	Nil	
	XRD	Nil	
10. Other information,	Head		
	POL	Nil	
	Wages	Rs. 2,26,495	
	OC	Rs.61,079	
	Total	<b>2,87,574</b>	
Signatures of the Officers	(NIMMY K.C.) Sr.Geologist	(HIMA K REGHUNATH) Sr.Geologist	
Approved By			

**FIVE POINT PROFORMA****Appendix 2**

Title of the report	:	Reconnaissance survey for Gold in Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka.
Names of the Authors	:	Nimmy K.C, Sr.Geologist Hima K. Reghunath, Sr.Geologist
Background of the investigation at whose instance or with what particular objective in view the investigation was undertaken	:	Project was taken up to assess the gold mineralization and its control in Kanivehalli and adjoining area.
Whether the item of Investigation was included in the approved programme for the year concerned. If so particulars such as item no. and page reference.	:	M2APMM/MEP/NC/SR/SU-KG/2018/18818
Date of commencement of the investigation with month and year, and exact number of days spent by the officers in investigation	:	Date of commencement: 19-09-18 i) Nimmy K.C- 129days ii) Hima K Reghunath -126days
Brief comments by the Director/Supervisory officer on the conclusion and recommendation by the authors with the suggestion for implementing the same.	:	The conclusions and recommendations of the project has been very well drawn from field, laboratory and chemical analysis. The recommendations for checking Cu & Au potentiality towards west is a very important contribution and needs to be implemented by taking up new project proposals collating all available data.
Please state specifically how the results of the investigation were achieved compared with the objective for which it was undertaken	:	The objective of the study has been well achieved and an assessment for Au potentiality has been done. moreover, beyond the stated objective, the officers have made assessment for Cu potentiality of the area. The geological map of the study area has been revised based on modern mapping techniques and new interesting lithologies with interpreted chronostratigraphic relationships have been assessed.

Place: Bangalore  
Date:

Signature :  
Name:  
Designation :

**INFORMATION SHEET FOR BIBILOGRAPHY**

**Appendix 3**

1.Title of the report	:	Reconnaissance Survey for gold in Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka
2.Authors' Name	:	Nimmy K.C,Sr.Geologist Hima K. Reghunath, Sr.Geologist
3.Item No/Code	:	M2APMM/MEP/NC/SR/SU-KG/2018/18818
4.Field season	:	2018-19
5.Type of document	:	Final Report
6.Identification of Confidentiality	:	
7.Name of the region/division/project	:	Southern Region SU: Karnataka and Goa Project:GOLD
8. Name of the Beneficiary	:	
9. Date of Publication	:	

**10.Abstract:** “Reconnaissance survey for gold in Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka” is a spin off item of NGCM carried out during F.S 2012-13. The project was taken up as a G4 investigation to assess the gold mineralization in the area. An area of 100 sq.km was mapped along with the collection of 172 bedrock samples and 111 trench samples, 55 petrological samples and 22 petrochemical samples and 42 stream sediment samples. 10 selected samples were analyzed using EPMA and SEM and 06 samples are submitted for FIS. The analytical results of 283 samples for Au, Pb, Zn, Co, Cu, Cr and Ni were received and analysis of Ag, As, Bi, Mo and Sb are pending with the lab. The major oxides and trace elements of petrochemical analysis were received whereas the REE analysis is pending.

The project area forms a part of Chitradurga schist belt and exposes rock types PGC, Hiriya Formation of Chitradurga Group and younger intrusives. The major rock types exposed in the mapped area are argillite with intercalations of felsic tuff, metabasalt, BIF, conglomerate, amphibolite and younger gabbro and quartz veins.

The granite gneiss exposed in the south western and north eastern part of the area is composed of quartz, feldspar and biotite with accessory minerals such as garnet and epidote. The contact of gneiss at both south west and north eastern part is sheared. The rock is migmatitised at places. Enclaves of Sargur amphibolite are noticed within the gneiss. The schist belt succession starts with the metabasalt of Hiriya Formation of Chitradurga Group. The rock is fine grained, massive to foliated and composed of quartz, actinolite and chlorite. Mapable and non-mapable units of BIF, dolomite and limestone are observed within the metabasalt. The meta-basalt is overlaid by the argillite-BIF sequence to the east. The meta-argillite in the area is reclassified and new lithounits such as quartz-chlorite schist, quartz-sericite schist and ferruginous phyllite are demarcated based on the field observations and petrological studies during current work. The metabasalt of Hiriya Formation occur as patches within the quartz-actinolite/tremolite schist exposed at the eastern contact of argillite. Presence of varioles are reported from the metabasalts of the area during the current work. A gradual transition from metabasalt to tremolite schist and to amphibolite is observed towards east of the study area. The contact of amphibolite and granite gneiss at east is marked by the presence of EMSZ (Eastern Margin Shear Zone). Mapable and non-mapable enclaves of sheared Sargur Amphibolite is identified within PGC. The major intrusives mapped in the area are meta-gabbro and dolerite. These rocks cut across all the major lithounits of the area. The intrusive porphyritic rock exposed north west of Hombalagatti is found to be of dioritic

to grano-dioritic in composition. The rock is characterised by large fragments of quartz within a fine-grained matrix. The rock is marked as dolerite in previous report is possibly a granophyre with chemical composition ranging within ADR field. The mineralized quartz vein is cutting across the dyke. Quartz veins of different generations are the major acidic intrusives observed within the area.

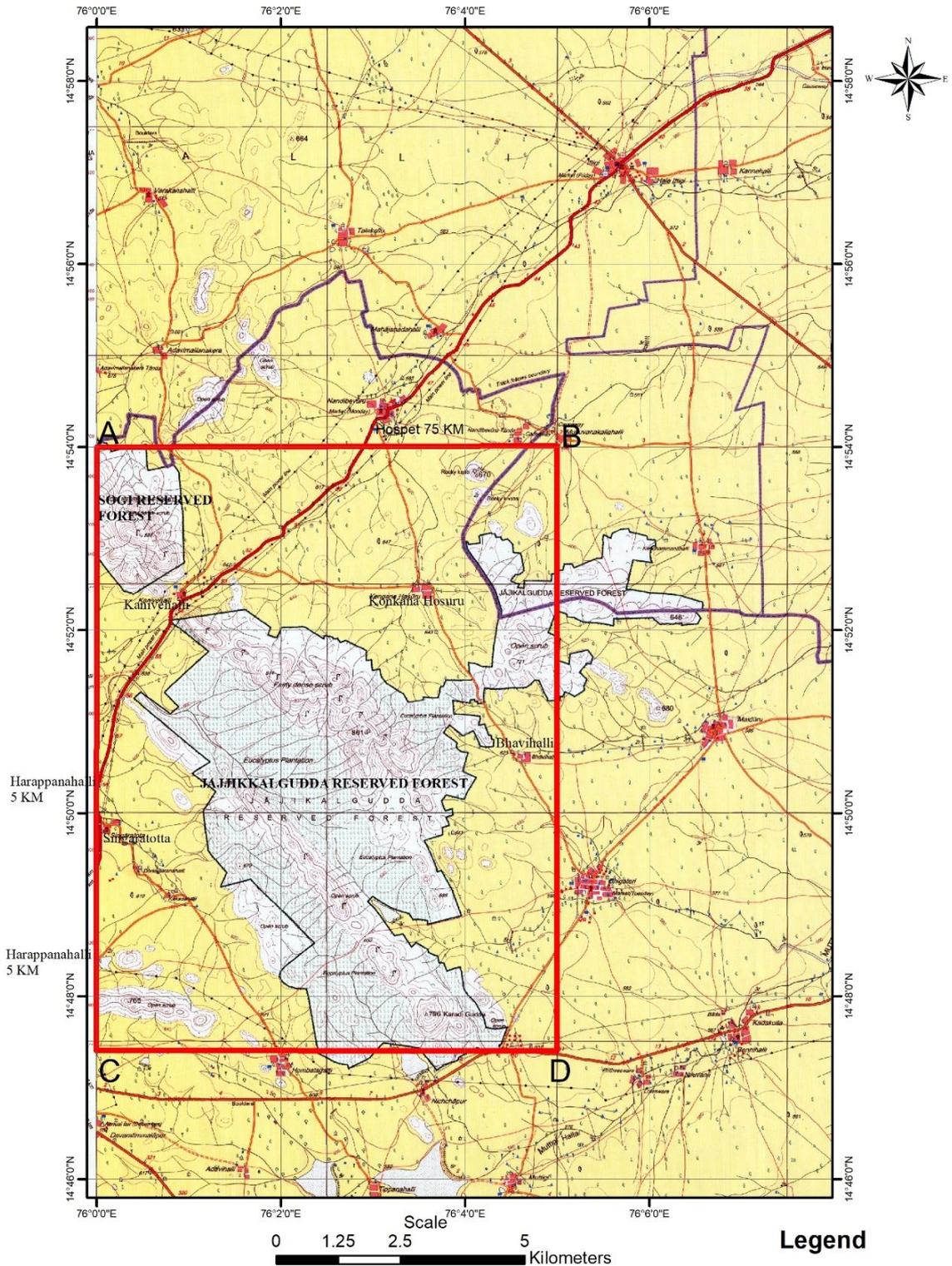
The area forms a regional fold within the block with closure south of Nichchapur (outside the block). The overturned F2 synformal fold plunge towards north west with shallow dips. The two ridges running parallel to each other represent two limbs of the fold and shows fold asymmetry defined by BIF. The major planar feature observed in the area are the axial planar cleavage of the F2 fold. Bedding and pillow structures are the two important primary structures observed within the block. The eastern part of the block is characterized by a prominent shear zone widely known as Chitradurga Marginal Shear Zone (CMSZ) and Main Boundary Shear Zone (MBSZ). The shear zone is marked by the development of mylonite, winged porphyroblasts, stretching lineation and grain size reduction.

The area displays two type of mineralization including the quartz vein hosted copper and epigenetic gold mineralization hosted by BIF and meta-argillite. The samples collected from the zone yielded Cu values ranging from 200ppm to 2700ppm. The values are found to be continuous for a strike of 800m to 1 km with average width of 2m. The mineralized zone is characterised by the presence of malachite stains. The quartz vein also shows K-feldspar and epidote alterations along with Fe dusting at places. The ore assemblage observed at field includes chalcopyrite, pyrite and arsenopyrite presenting as disseminations and small stringers within the quartz. Sporadic occurrence of gold values is reported from the samples collected from the old working at the contact of Meta-argillite and meta-basalt. The five samples collected here yielded values **238ppb, 2080ppb, 1744ppb, 60 ppb, 34ppb** respectively. The value has no strike continuity. The Cu mineralisation observed along the giant quartz veins (GQV) north of Hombalagatti is epigenetic and can be considered as a hypothermal vein-fracture filling kind of mineralisation due to its association with Au and Ag. The gold values associated with the chert layers having sulphide disseminations can be syngenetic, which are later remobilised to form veins cutting along and across the BIF.

1851

LOCATION MAP OF KANIVEHALLI AND ADJOINING AREA  
 DAVANGERE AND BELLARY DISTRICTS, KARNATAKA  
 SHOWN IN PARTS OF SOI TOPOSHEET 57B/01

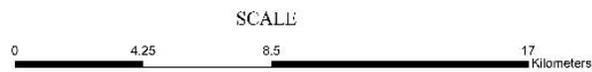
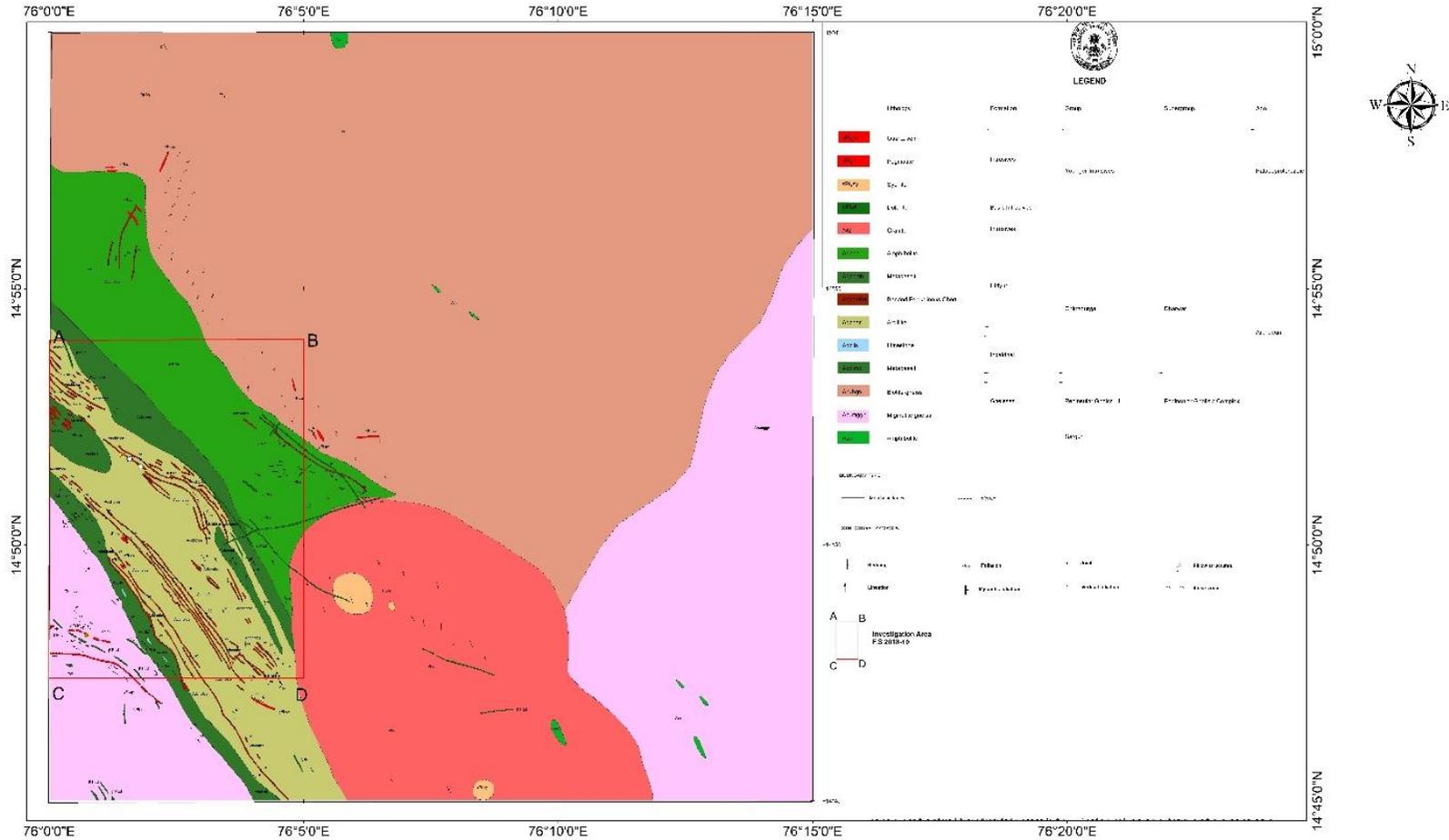
Plate: I



**Legend**  
 A B Investigation Area  
 C D FS 2018-19

# REGIONAL GEOLOGICAL MAP SHOWING KANIVEHALLI AND ADJOINING AREA, DAVANGERE AND BELLARY DISTRICTS, KARNATAKA

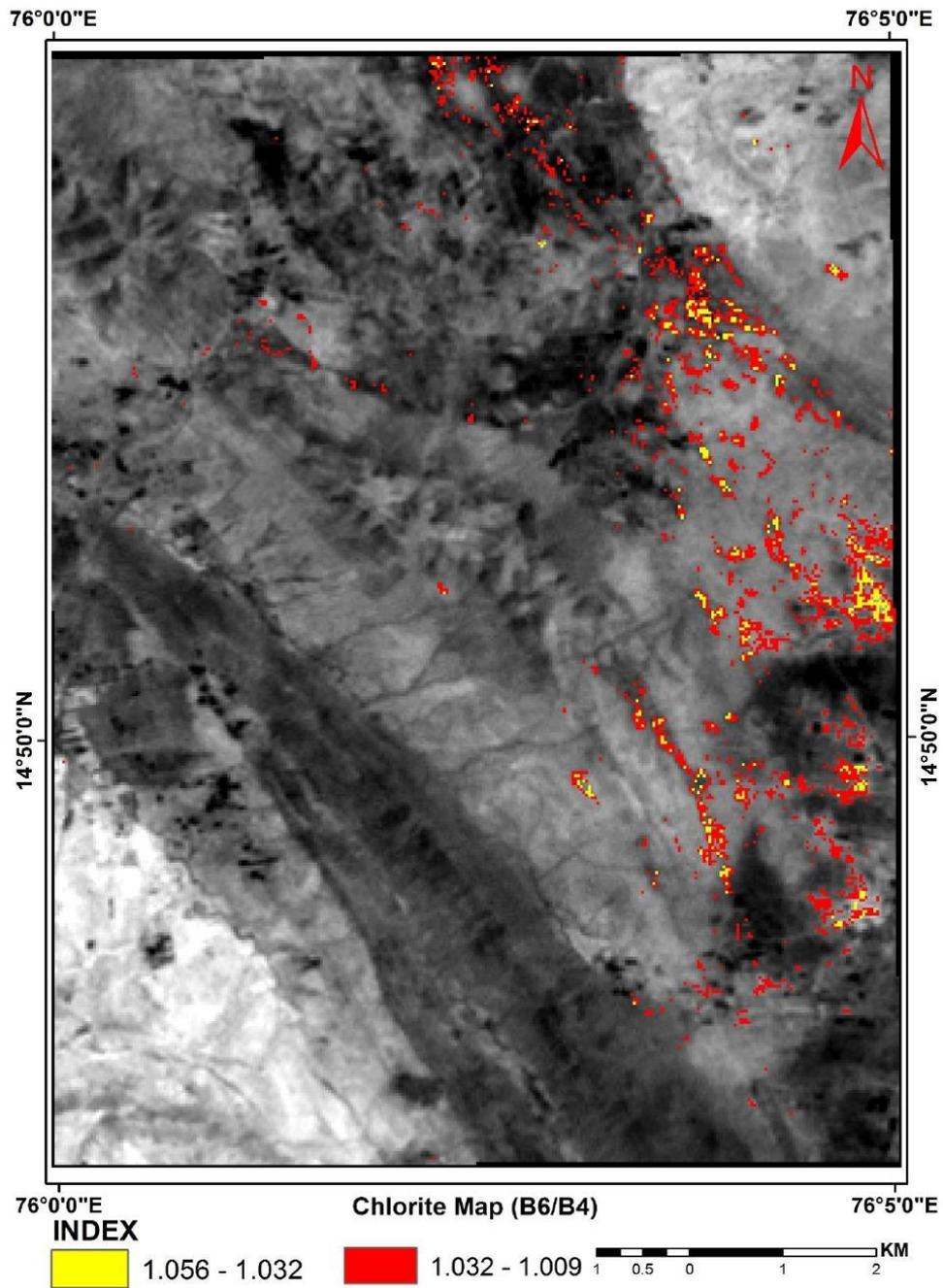
**Plate II**





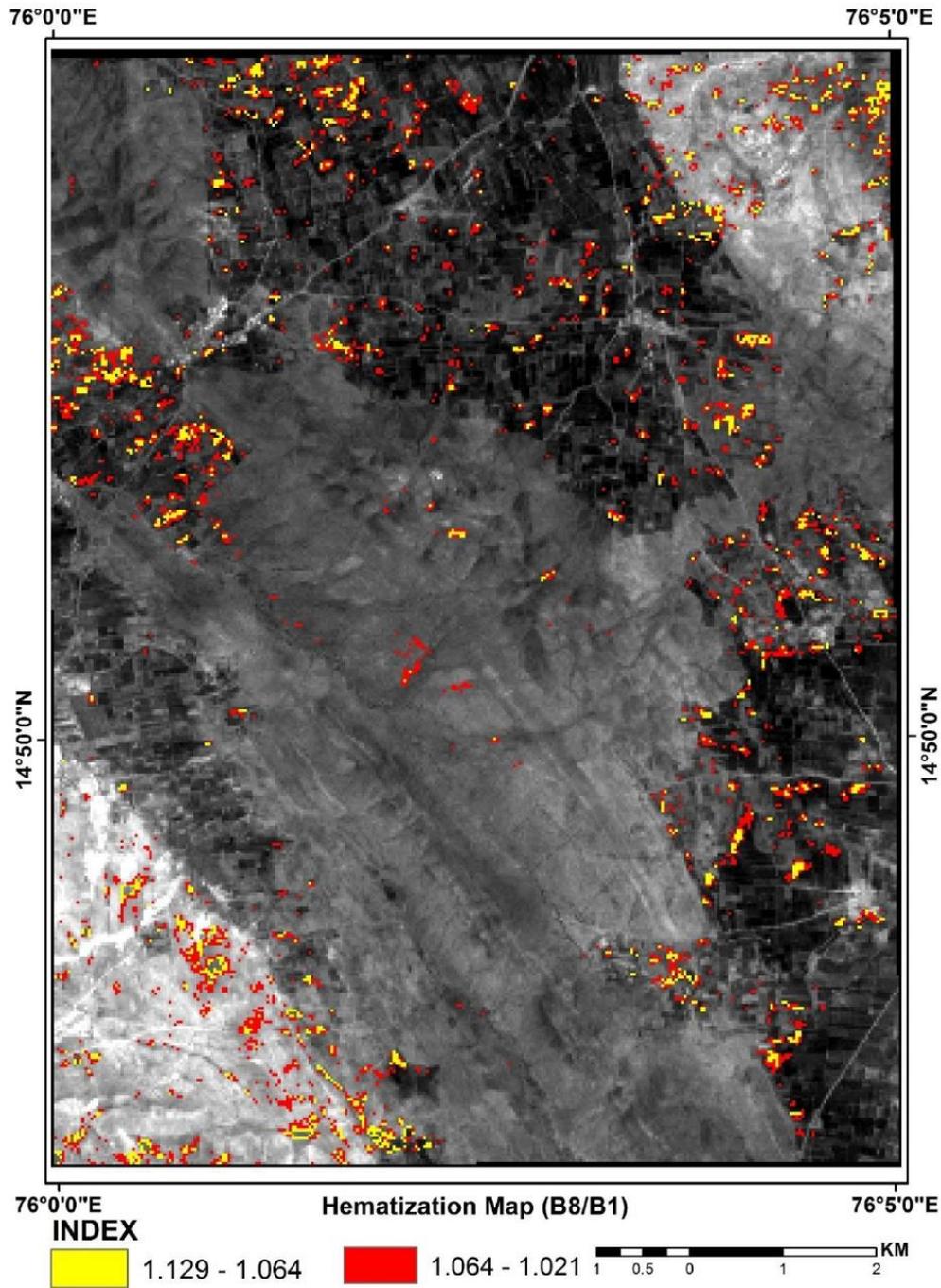
Chlorite alteration map of Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka, FS 2018-19

Plate: IV



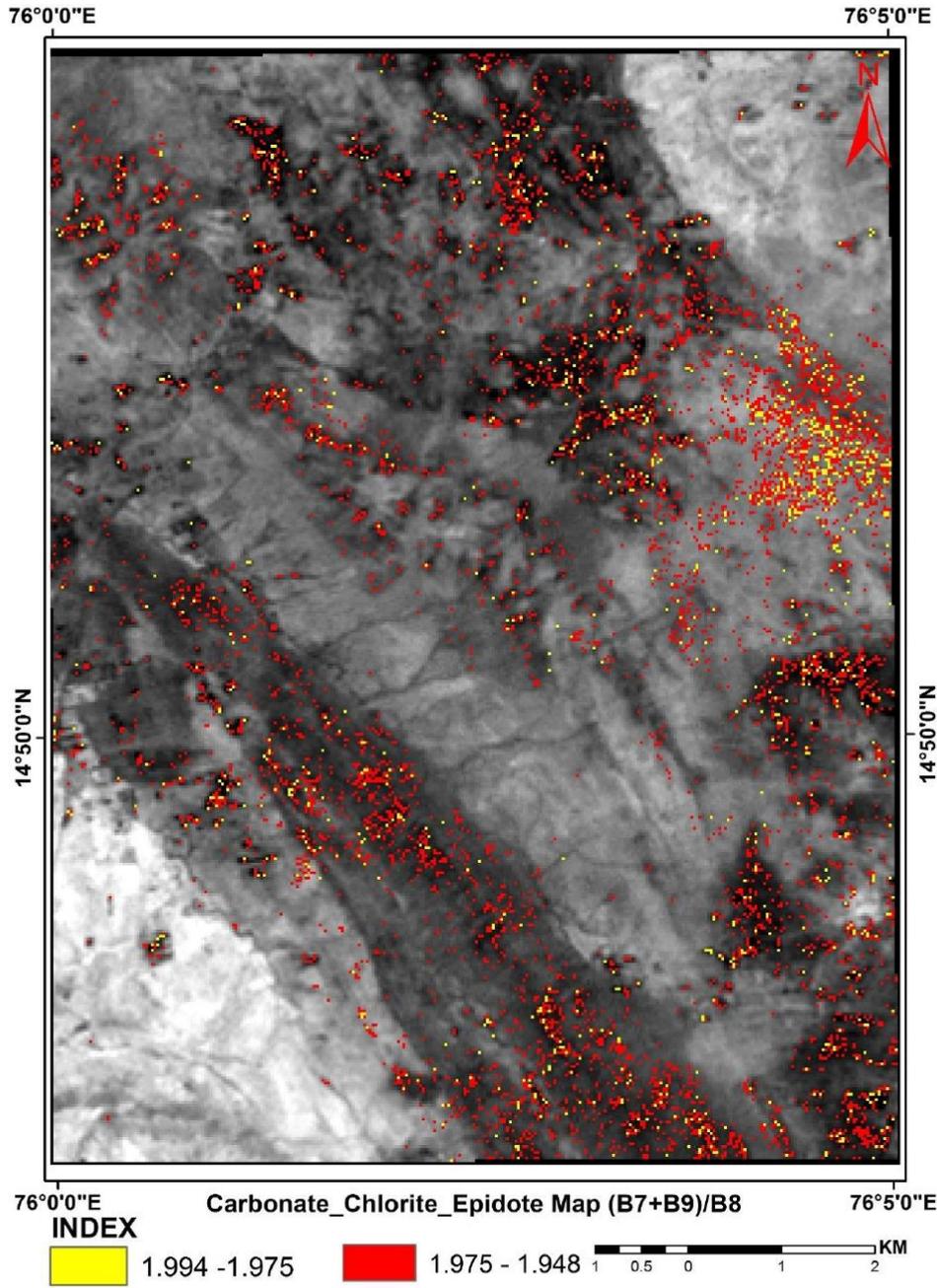
Fe-alteration map of Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka, FS 2018-19

Plate: V



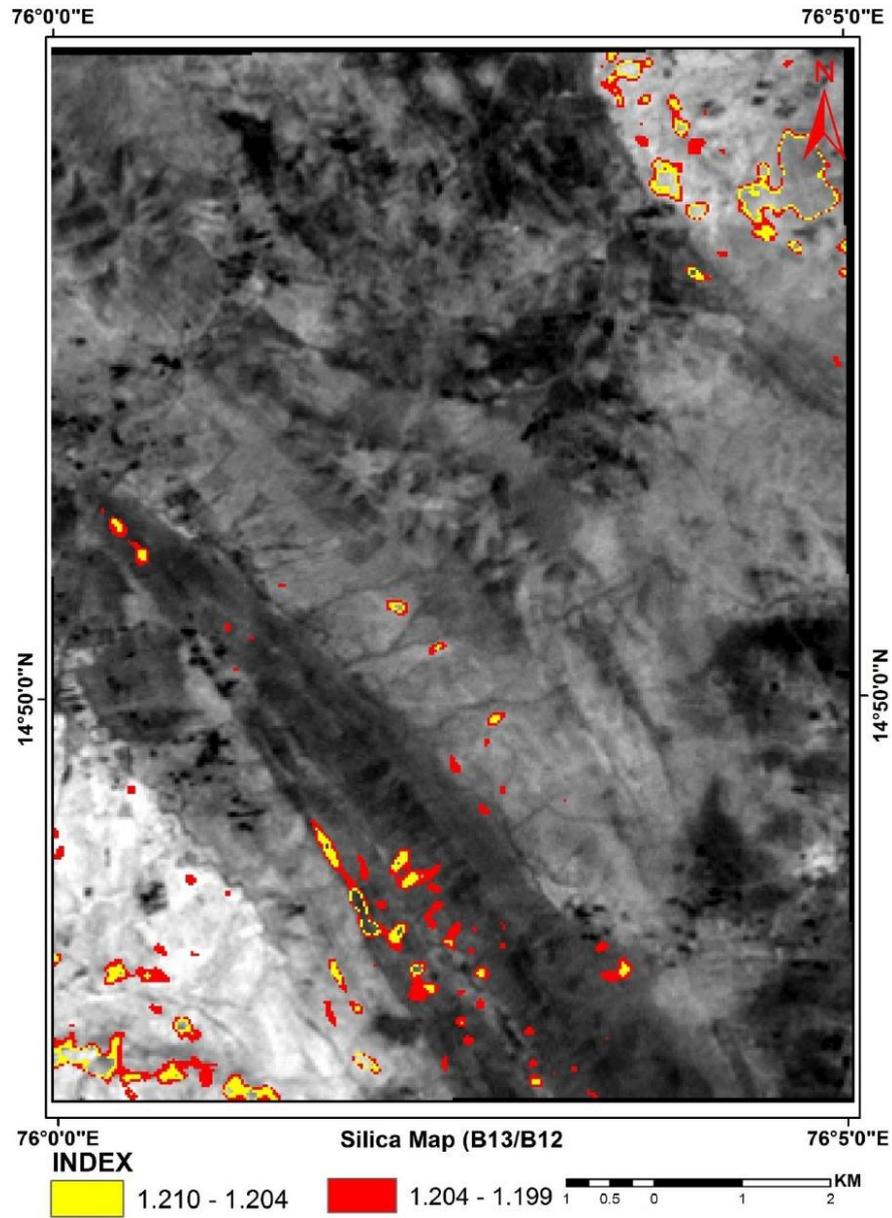
Carbonate-chlorite-epidote alteration map of Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka, FS 2018-19

Plate: VI



Silica alteration map of Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka, FS 2018-19

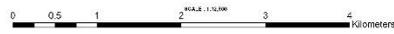
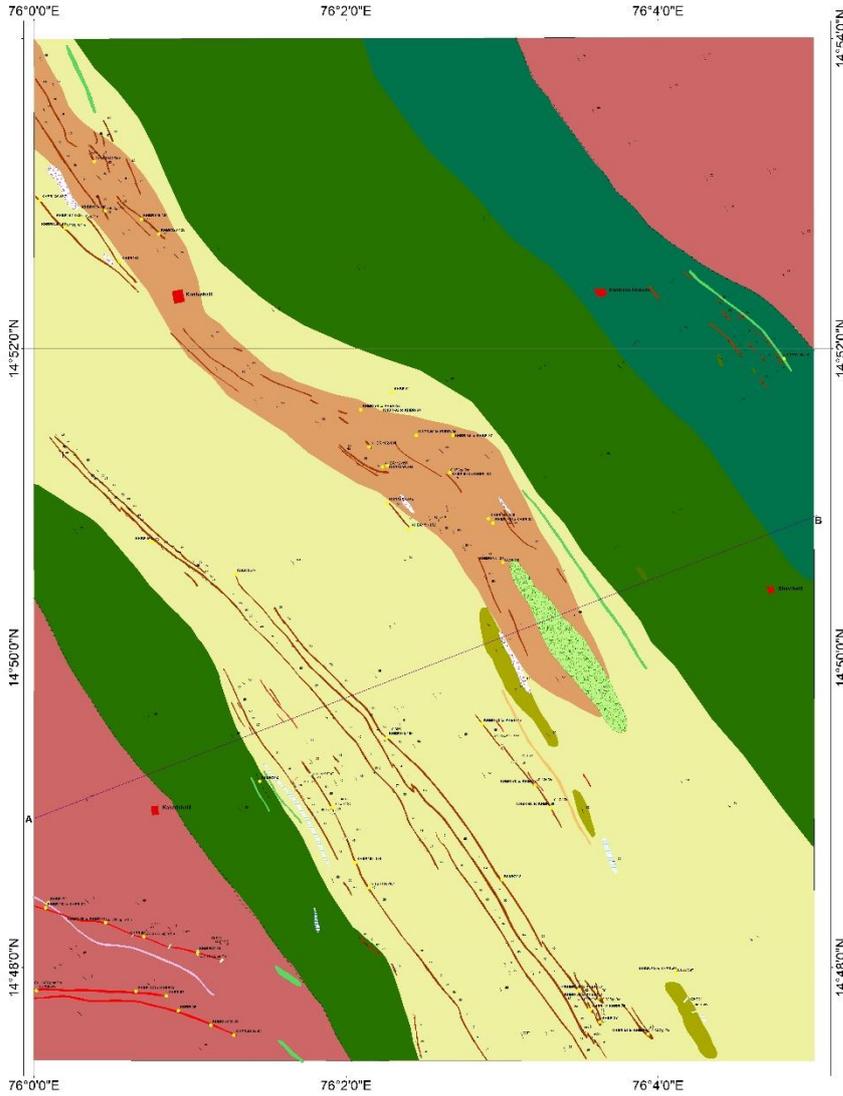
Plate: VII





LARGE SCALE GEOLOGICAL MAP OF KANIVEHALLI AND ADJOINING AREA, DAVANGERE AND BELLARY DISTRICTS, KARNATAKA  
SOI TOPOSHEET NO. 57B/01

Plate VIII



Geological cross-section along section line A-B



Legend

Lithology	Formation	Group	Supergroup	Age				
Quartz vein	Acidic intrusives	Younger intrusives	Dharwar	Proterozoic				
Granophyre								
Dolerite								
Gabbro								
Amphibolite								
Treruginous argillite								
Conglomerate								
Quartz chlorite schist								
Quartz sericite schist								
Dolomite					Hiriyur	Chitradurga	Dharwar	Archean
Meta argillite								
BIF								
Mud								
Metabasalt/metabasic pillowed metabasalt								
Granite gneiss	Gneisses	Peninsular Gneissic Complex	Peninsular Gneissic Complex					

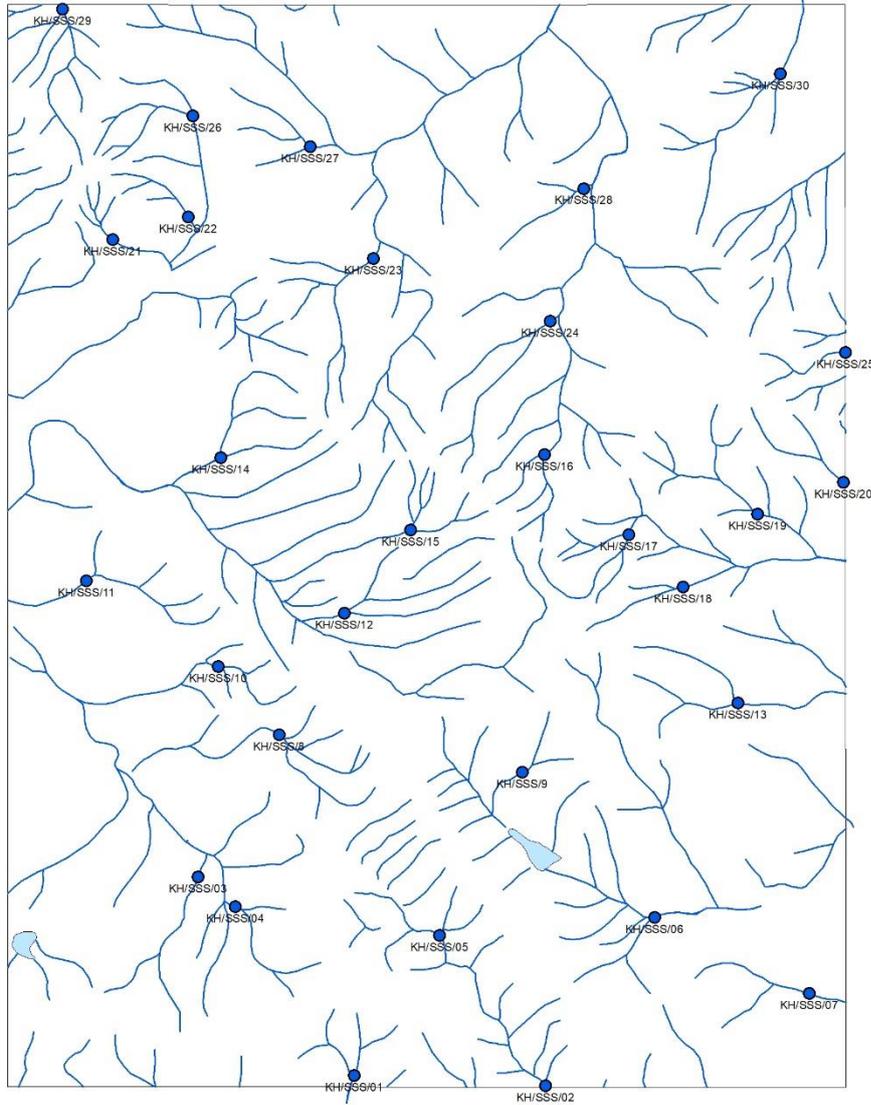
  

Structural Symbols	Geochemical Sample locations
Boudin	Red soil samples
S1 foliations	Tram
S2 foliations	Village
Shear zone	
Plunge	

Mapped by  
Nimmy K. C. Senior Geologist  
Hima K. Regunath, Senior Geologist  
FS 2018-19  
Reference: SOI toposheet

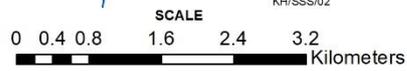


**DRAINAGE MAP OF KANIVEHALLI AND ADJOINING AREA SHOWING STREAM  
SEDIMENT SAMPLE LOCATIONS, DAVANGERE AND BELLARY DISTRICTS,  
KARNATAKA, FS 2018-19**



**Legend**

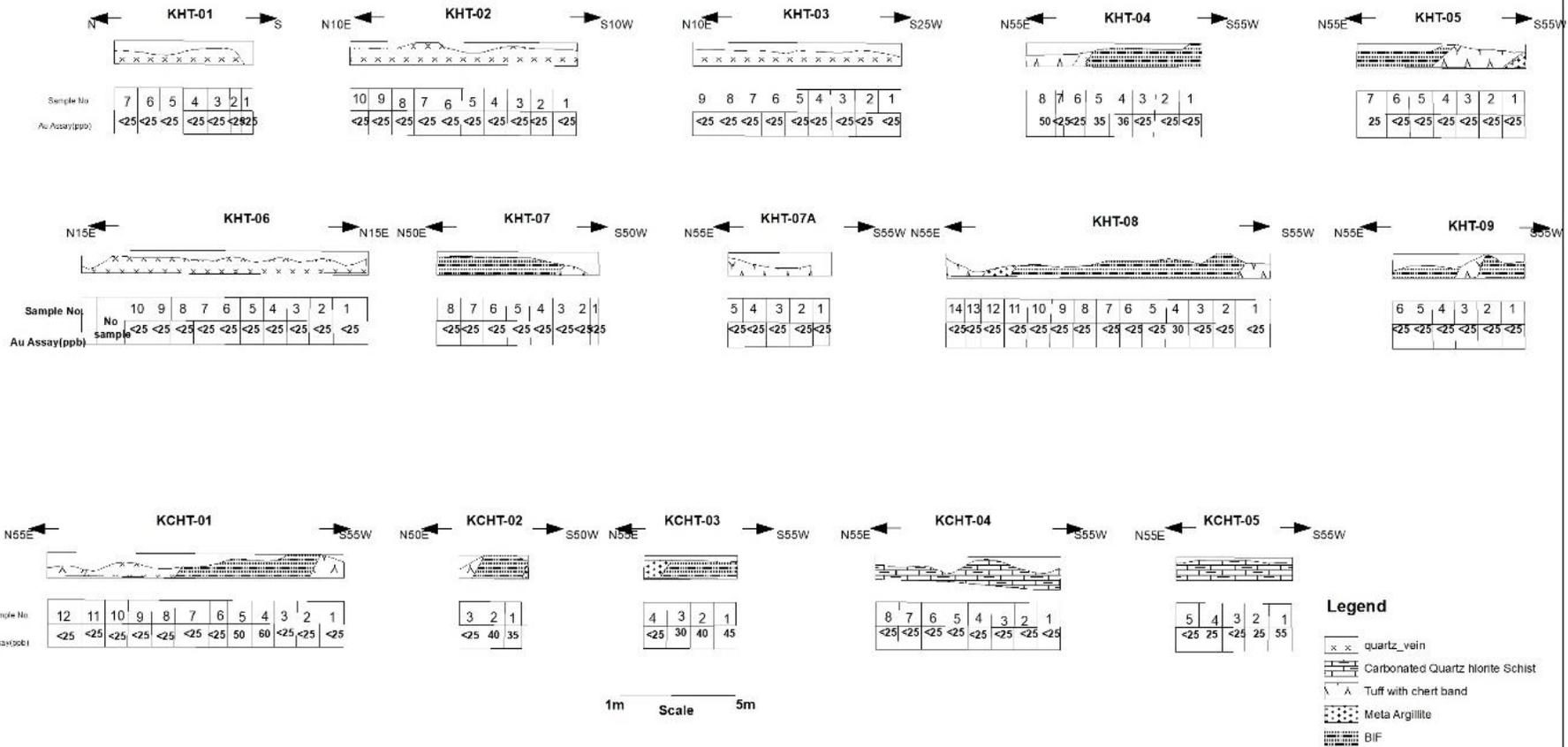
-  sample location
-  stream
-  Pond
-  Block Boundary





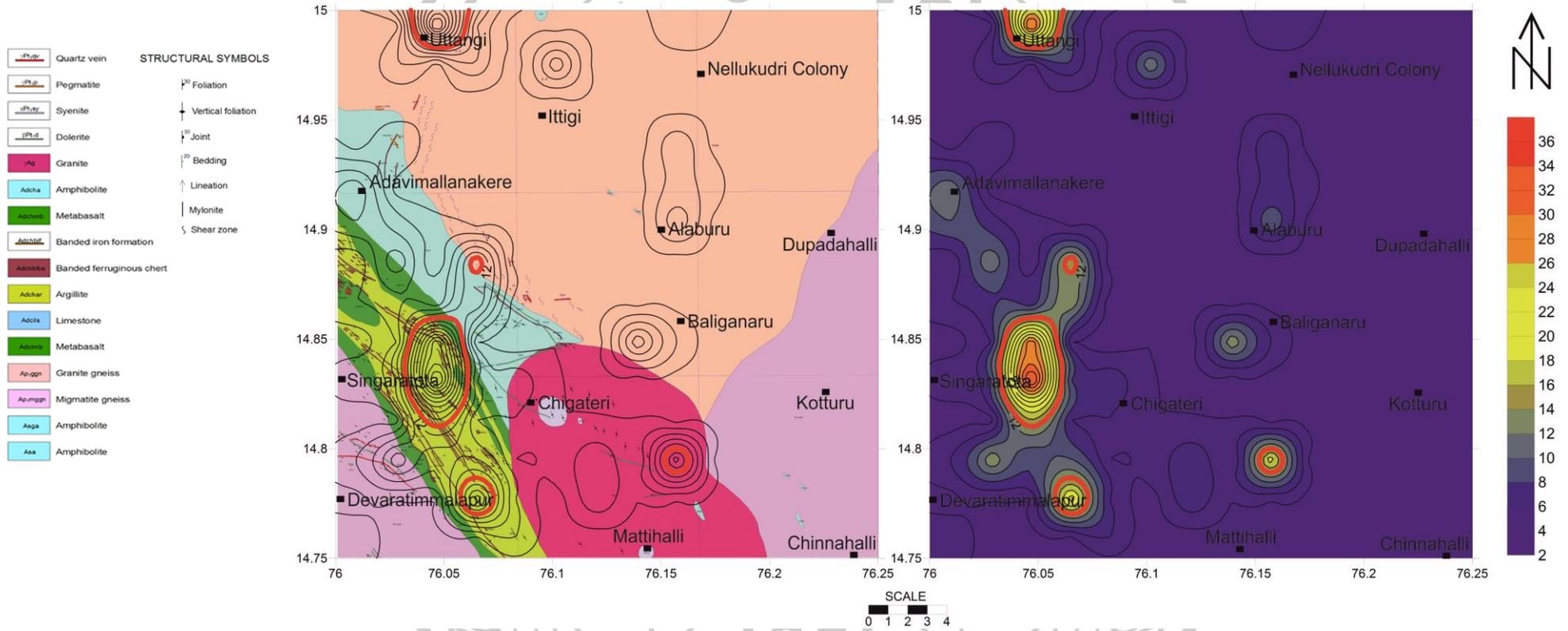
PLATE; X

**TRENCH SECTIONS OF KANIVEHALLI AND ADJOINING AREA,  
DAVANGERE AND BELLARY DISTRICTS, KARNATAKA,  
M2APMM/ME/SR/SU-KG/2018/18818  
FS.2018-19**



GEOCHEMICAL ANOMALY MAP OF GOLD IN TOPOSHEET T NO.57B/01, PARTS OF BELLARY AND DAVANGERE DISTRICTS KARNATAKA PREPARED DURING FS 2012-13

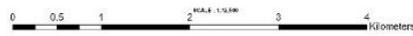
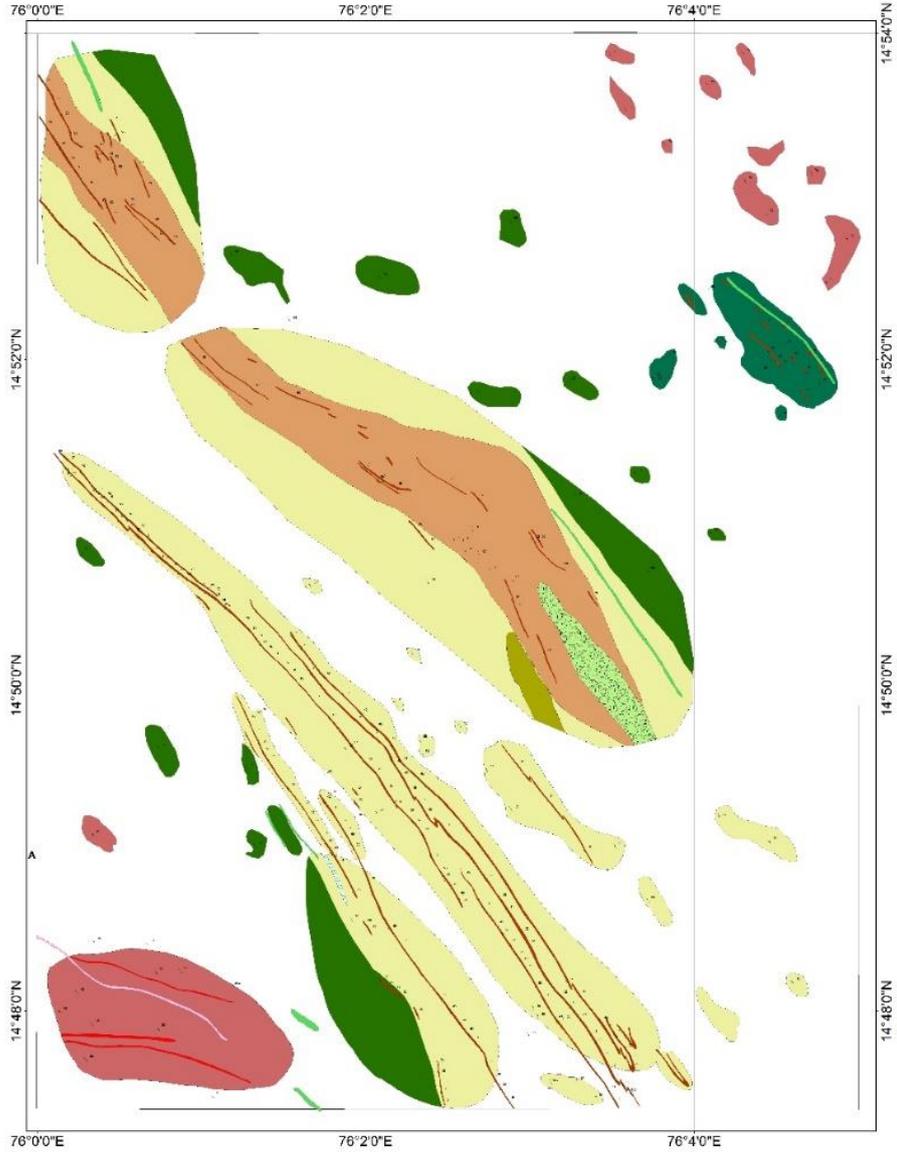
Plate: XI





OUTCROP MAP OF KANIVEHALLI AND ADJOINING AREA,  
DAVANGERE AND BELLARY DISTRICTS, KARNATAKA

Plate XII



Legend

Lithology	Formation	Group	Supergroup	Age
Quartz vein	Acidic intrusives	Younger intrusives	Uttaravur	Proterozoic
Granodiorite				
Diorite	Basic intrusives	Chimaraung	Uttaravur	Proterozoic
Gabbro				
Amphibolite	Hiriyur	Chimaraung	Uttaravur	Proterozoic
Ferruginous argillite				
Conglomerate	Gnesses	Poncharale Gneissic Complex	Poncharale Gneissic Complex-I	Archaean
Quartz chlorite schist				
Quartz sericite schist	Gnesses	Poncharale Gneissic Complex	Poncharale Gneissic Complex-I	Archaean
Dolomite				
Mica-schist	Gnesses	Poncharale Gneissic Complex	Poncharale Gneissic Complex-I	Archaean
Mica-schist				
Marble	Gnesses	Poncharale Gneissic Complex	Poncharale Gneissic Complex-I	Archaean
Metabasaltic and/or metabasaltic schist				
Granite gneiss	Gnesses	Poncharale Gneissic Complex	Poncharale Gneissic Complex-I	Archaean
Granite gneiss				

Structural Symbols  
 I Folding    S1 foliations    S2 foliations

Maped by  
 Nimmy K. C. Senior Geologist  
 Himu K. Regunath, Senior Geologist  
 FS 2018-19

Reference: SOI toposheet



**Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts,**

**ANNEXURE I**

SL. NO	Sample No	Latitude Longitude	Width (m) (m)	Description	Au (ppb)
1	KH/BR-01	14 47 33.8 76 01 16.9	1.2	Dull white to smoky quartz vein with disseminated very fine sulphides. Pyrite and arsenopyrite are observed.	<25
2	KH/BR-02	14 47 33.8 76 01 16.9	1.2	White to smoky quartz vein with disseminated sulphides.	<25
3	KH/BR-03	14 47 37.3 76 01 14.2	2	Slightly fragmented quartz vein with goethite encrustations.	<25
4	KH/BR-04	14 47 37.3 76 01 14.2	1	Slightly ferruginous quartz vein with pyrite and arsenopyrite disseminations	<25
5	KH/BR-05	14 47 37.3 76 01 14.2	1.4	Quartz vein with ferruginous encrustations and malachite stains.	<25
6	KH/BR-06	14 47 46.4 76 00 57	1	Grey quartz with malachite and disseminated pyrite and chalcopyrite grains.	<25
7	KH/BR-07	14 47 48.2 76 00 55.6	1.7	Quartz vein with malachite stains and chalcopyrite disseminations	<25
8	KH/BR-08	14 48 15.7 76 00 43.4	1	Quartz vein with malachite stains.	<25
9	KH/BR-09	14 48 21.2 76 00 30.6	1	Pyritiferous chert band within ferruginous phyllite	<25
10	KH/BR-10	5	1	Smoky quartz vein with chalcopyrite disseminations and malachite stains on the surface	<25
11	KH/BR-11	14 48 21.2 76 00 30.6	1	White to smoky quartz with chalcopyrite	<25
12	KH/BR-12	14 47 50.8 76 00 39.2	1	White to smoky quartz vein with very fine disseminations of pyrite and suspected arsenopyrite	<25

**Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts,**

**ANNEXURE I**

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
13	KH/BR-13	14 47 50.8 76 00 39.2	1	White to smoky quartz vein with pyrite	<25
14	KH/BR-14	14 47 50.8 76 00 39.2	1	Smoky quartz vein with disseminated pyrite, chalcopyrite and suspected arsenopyrite.	<25
15	KH/BR-15	14 47 50.8 76 00 39.2	1.5	Smoky quartz vein with fine pyrite, chalcopyrite disseminations	<25
16	KH/BR-16	14 47 53.1 76 00 00	grab sample	White quartz vein with malachite stains	<25
17	KH/BR-17	14 48 10.1 76 01 7.6	1.5	Smoky quartz with chalcopyrite and pyrite	<25
18	KH/BR-18	14 48 10.1 76 01 7.6	1.5	Smoky quartz vein with chalcopyrite and pyrite. A few specks of arsenopyrite noted at places	<25
19	KH/BR-19	14 47 39.2 76 03 33.4	1	Highly oxidised, limonitised BIF with smoky quartz veins	<25
20	KH/BR-20	14 47 39.2 76 03 33.4	1	Oxidised BIF with smoky quartz	<25
21	KH/BR-21	14 47 39.2 76 03 33.4	1	Limonitised BIF with smoky quartz vein	<25
22	KH/BR-22	14 47 39.2 76 03 33.4	1	-do-	<25
23	KH/BR-23	14 47 39.2 76 03 33.4	1	-do-	<25
24	KH/BR-24	14 47 39.2 76 03 33.4	1	Slightly limonitised chert rich BIF	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts,

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
25	KH/BR-25	14 47 39.2 76 03 33.4	1	-do-	<25
26	KH/BR-26	14 47 39.2 76 03 33.4	1	-do-	<25
27	KH/BR-27	14 47 39.2 76 03 33.4	2.2	Chert rich BIF , limonitised and oxidised.	<25
28	KH/BR-28	14 48 25.2 76 00 5.1	1	Slightly ferruginous smoky quartz vein with Fe encrustations and pale pink mineral spots.	<25
29	KH/BR-29	14 48 25.2 76 00 5.1	1	Ferrugenous smoky quartz with Fe encrustations, epidote and pink spots.	<25
30	KH/BR-30	14 48 25.2 76 00 5.1	1	White quartz vein with flesh red colour mineral .	<25
31	KH/BR-31	14 48 25.2 76 00 5.1	1	Whitish to dull quartz vein with flesh red colour mineral.	<25
32	KH/BR-32	14 48 25.2 76 00 5.1	1	Smoky quartz with chalcopryite and pink mineral. Stains of azurite noted	<25
33	KH/BR-33	14 48 25.2 76 00 5.1	1	White quartz vein with flesh red colour mineral .	<25
34	KH/BR-34	14 48 25.2 76 00 5.1	1	White quartz vein with flesh red colour mineral and epidote vein.	<25
35	KH/BR-35	14 48 25.2 76 00 5.1	1	White quartz vein with chalcopryite specks.	<25
36	KH/BR-36	14 47 44.7 76 03 39.2	1	Highly oxidised Fe rich BIF with goethite and smoky quartz veins.	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
37	KH/BR-37	14 47 44.7 76 03 39.2	1	Limonitised BIF with sericite and square shaped cavities	<25
38	KH/BR-38	14 47 44.7 76 03 39.2	1	Oxidised BIF with altered pyrite.	<25
39	KH/BR-39	14 47 46.7 76 03 30	1	Limonitised BIF	50
40	KH/BR-40	14 47 46.7 76 03 30	1	Limonitised BIF with specks of oxidised pyrites.	25
41	KH/BR-41	14 47 46.7 76 03 30	1	Limonitised BIF with goethite encrustations	43
42	KH/BR-42	14 47 46.7 76 03 30	1	Chert rich limonitised BIF	25
43	KH/BR-43	14 47 46.7 76 03 30	1	Limonitised chert rich BIF	<25
44	KH/BR-44	14 47 46.7 76 03 30	1	Chert rich slightly limonitised BIF with fine oxidised pyrite along chert layers.	41
45	KH/BR-45	14 47 46.7 76 03 30	1	Chert rich limonitised BIF with a few oxidised pyrite	<25
46	KH/BR-46	14 47 46.7 76 03 30	1	Highly limonitised BIF with goethite encrustations. Square shaped cavities were observed	25
47	KH/BR-47	14 47 46.7 76 03 30	1	Limonitised BIF with goethite encrustations.	80
48	KH/BR-48	14 47 46.7 76 03 30	1	Limonitised BIF with a few specks of oxidised pyrite	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
49	KH/BR-49	14 47 46.7 76 03 30	1	Highly oxidised limonitised BIF with specks of oxidised pyrite/	<25
50	KH/BR-50	14 47 46.7 76 03 30	1	Limonitised BIF	<25
51	KH/BR-51	14 47 35.8 76 03 57.2	1	Oxidised BIF with square shaped pits. The samples collected from the immediate contact of argillite are carbonatised.	<25
52	KH/BR-52	14 47 35.8 76 03 57.2	1	Oxidised BIF with limonite at places. Thin smoky quartz veinlets are seen within a few sample chips	<25
53	KH/BR-53	14 47 35.8 76 03 57.2	1	Oxidised BIF with thin smoky quartz veinlets	25
54	KH/BR-54	14 47 35.8 76 03 57.2	1	Highly oxidised, limonitised Fe rich BIF	50
55	KH/BR-55	14 47 35.8 76 03 57.2	1	Oxidised BIF with limonite and goethite	66
56	KH/BR-56	14 47 35.8 76 03 57.2	1	Oxidised, limonitised BIF	<25
57	KH/BR-57	14 47 35.8 76 03 57.2	1	Oxidised chert rich BIF. Limonitised at places	46
58	KH/BR-58	14 47 58.1 76 4 6.8	1	Carbonatised argillite with quartz carbonate veins carrying sulphides.	<25
59	KH/BR-59	14 47 58.1 76 4 6.8	1	Limonitised BIF	25
60	KH/BR-60	14 47 58.1 76 4 6.8	1	Limonitised BIF	56

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
61	KH/BR-61	14 47 58.1 76 4 6.8	1	Limonitised BIF	25
62	KH/BR-62	14 47 58.1 76 4 6.8	1	Limonitised BIF	33
63	KH/BR-63	14 47 58.1 76 4 6.8	1	Limonitised BIF	216
64	KH/BR-64	14 47 58.1 76 4 6.8	1	Limonitised BIF	176
65	KH/BR-65	14 47 58.1 76 4 6.8	1.4	Limonitised BIF	132
66	KH/BR-66	14 49 4 76 03 19.7	1	Limonitised BIF with disseminated magnetite and quartz veins	51
67	KH/BR-67	14 49 4 76 03 19.7	1	Highly limonitised BIF with quartz veins	<25
68	KH/BR-68	14 49 4 76 03 19.7	1	Highly altered BIF with disseminated oxidised pyrites.	35
69	KH/BR-69	14 49 4 76 03 19.7	1	Highly oxidised altered BIF with pyrite and quartz veins	174
70	KH/BR-70	14 49 11.8 76 03 13.6	1	Limonitised BIF with quartz veins	192
71	KH/BR-71	14 49 11.8 76 03 13.6	1	-do-	60
72	KH/BR-72	14 49 35.2 76 02 54.6	1	Highly limonitised BIF with quartz veins and oxidised pyrite.	<25
73	KH/BR-73	14 49 35.2 76 02 54.6	1	Limonitised BIF with quartz veins.	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
74	KH/BR-74	14 49 35.2 76 02 54.6	1	-do-	<25
75	KH/BR-75	14 49 35.2 76 02 54.6	1	-do-	<25
76	KH/BR-76	14 50 52.3 76 02 56.5	1.8	Oxidised ferruginous Phyllite with quartz veins	<25
77	KH/BR-77	14 50 52.3 76 02 56.5	1.8	-do-	<25
78	KH/BR-78	14 50 52.3 76 02 56.5	1	Pyritiferous chert band within ferruginous phyllite	<25
79	KH/BR-79	14 50 52.3 76 02 56.5	1	Limonitised BIF with quartz vein	<25
80	KH/BR-80	14 50 52.3 76 02 56.5	2	BIF with small quartz vein	<25
81	KH/BR-81	14 50 52.3 76 02 56.5	2	Limonitised BIF	<25
82	KH/BR-82	14 50 52.3 76 02 56.5	2	BIF with thin layers of phyllite	<25
83	KH/BR-83	14 50 52.3 76 02 56.5	2	Slightly limonitised BIF	<25
84	KH/BR-84	14 51 26.2 76 02 41.1	2	Ferruginous Phyllite with chert band	<25
85	KH/BR-85	14 51 26.2 76 02 41.1	2	Ferruginous Phyllite with chert band	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
86	KH/BR-86	14 51 26.2 76 02 41.1	2	Ferruginous Phyllite with chert band	<25
87	KH/BR-87	14 51 26.2 76 02 41.1	1	Ferruginous Phyllite with chert band	<25
88	KH/BR-88	14 51 36.1 76 2 27	1	Highly oxidised BIF with goethite and peacock blue and green stains. The samples are intruded by quartz veinlets	80
89	KH/BR-89	14 51 36.1 76 2 27	1	Highly oxidised, limonitised and slightly carbonatised BIF	60
90	KH/BR-90	14 51 36.1 76 2 27	1	Highly oxidised, limonitised and slightly carbonatised BIF	65
91	KH/BR-91	14 51 42.8 76 02 17.7	0.6	Ferruginous chert with brecciated smoky quartz vein. Samples are limonitised	45
92	KH/BR-92	14 51 37.5 76 02 13.5	1.6	Ferruginous Phyllite with smoky quartz veins	<25
93	KH/BR-93	14 51 37.5 76 02 13.5	1.6	Ferruginous Phyllite with smoky quartz veins	<25
94	KH/BR-94	14 51 36.2 76 02 5.6	2	Highly oxidised lateritised ferruginous phyllite	<25
95	KH/BR-95	14 51 36.2 76 02 5.6	2	Highly oxidised lateritised ferruginous phyllite	<25
96	KH/BR-96	14 51 36.2 76 02 5.6	2	Highly oxidised limonitised Fe rich massive ferruginous Phyllite with sericite	<25
97	KH/BR-97	14 51 36.2 76 02 5.6	1	Oxidised limonitised ferruginous phyllite	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
98	KH/BR-98	14 51 11.8 76 02 39.9	2	Whitish powdery chert with limonitised phyllite	<25
99	KH/BR-99	14 51 11.8 76 02 39.9	2	Chert with quartz vein. Red powdery material observed	120
100	KH/BR-100	14 51 11.8 76 02 39.9	2	Brecciated chert rich BIF with development of limonite and goethite.	26
101	KH/BR-101	14 51 11.8 76 02 39.9	1	White powdery chert with yellowish stains.	<25
102	KH/BR-102	14 51 24.4 76 02 9.9	0.8	Chert rich BIF with quartz vein. Presence of limonite and reddish material noted. Samples are brecciated with development of goethite	<25
103	KH/BR-103	14 51 24.4 76 02 9.9	1.3	-do-	<25
104	KH/BR-104	14 51 24.4 76 02 9.9	1.5	-do-	<25
105	KH/BR-105	14 51 14.6 76 02 15.9		Limonitised silicified chert rich BIF with oxidised pyrites	<25
106	KH/BR-106	14 51 14.6 76 02 15.9	1	BIF with thick chert bands and intercalations of ferruginous Phyllite. The samples at places traversed by quartz veins. Oxidised pyrites, specks of magnetite and cavities with red stains are noticed	<25
107	KH/BR-107	14 51 14.6 76 02 15.9	1	BIF with intercalations of ferruginous Phyllite. The chert part is sericitised and has square shaped cavities.	<25
108	KH/BR-108	14 51 14.6 76 02 15.9	1	Altered BIF with sericite and Fe oxide stains. Quartz veins are seen intruded into ferruginous argillite intercalations	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
109	KH/BR-109	14 51 14.6 76 02 15.9	1	Ferruginous phyllite with chert	<25
110	KH/BR-110	14 51 14.6 76 02 15.9	1	Ferruginous chert	<25
111	KH/BR-111	14 51 14.6 76 02 15.9	1	Chert with cubical cavities of pyrite	<25
112	KH/BR-112	14 51 14 76 02 14	1	Chert rich BIF with intercalations of ferruginous Phyllite. Oxidised pyrite are seen along quartz veins	<25
113	KH/BR-113	14 51 14 76 02 14	1	Chert rich BIF with quartz veins	<25
114	KH/BR-114	14 51 14 76 02 14	1	Chert rich BIF with oxidised pyrite at places	<25
115	KH/BR-115	14 51 14 76 02 14	1	Chert dominant BIF with oxidised pyrite	<25
116	KH/BR-116	14 51 14 76 02 14	1	Chert dominant BIF with oxidised pyrite	<25
117	KH/BR-117	14 51 14 76 02 14	1	Chert dominant BIF with white quartz veins intruded along and across the strike	<25
118	KH/BR-118	14 51 55.9 76 04 48.4	1	Highly oxidised BIF with quartz veins and bornite stains. Malachite stains are observed within the BIF	<25
119	KH/BR-119	14 51 55.9 76 04 48.4	1	-do-	<25
120	KH/BR-120	14 47 03 76 01 58.6	1.5	White quartz vein with oxidised chalcopyrite at places.	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
121	KH/BR-121	14 47 03 76 01 58.6	1.1	Quartz vein with oxidised chalcopryrite and stains of malachite noted at places	<25
122	KH/BR-122	14 47 03 76 01 58.6	1.5	-do-	<25
123	KH/BR-123	14 53 12.4 76 00 23.2	2	Limonitised BIF with Fe stains	<25
124	KH/BR-124	14 53 12.4 76 00 23.2	2	Limonitised chert rich BIF	<25
125	KH/BR-125	14 53 12.4 76 00 23.2	1.5	-do-	<25
126	KH/BR-126	14 53 12.4 76 00 23.2	1.5	Limonitised BIF with intercalations of ferruginous phyllite	<25
127	KH/BR-127	14 52 44.3 76 00 48	1.5	Highly oxidised chert rich BIF with quartz veinlets	<25
128	KH/BR-128	14 52 44.3 76 00 48	1.5	-do-	<25
129	KH/BR-129	14 52 50 76 00 41.3	2	Ferruginous Phyllite with chert. Samples are limonitised and chert has disseminations of greyish white mineral with metallic luster.	<25
130	KH/BR-130	14 52 50 76 00 41.3	2	-do-	<25
131	KH/BR-131	14 51 44.1 76 01 43.5	1	Greenish slightly ferruginous phyllite with thin white quartz veins. Development of sericite and magnetite noticed.	238
132	KH/BR-132	14 51 44.1 76 01 43.5	1	-do-	2080

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
133	KH/BR-133	14 51 44.1 76 01 43.5	1	-do-	1744
134	KH/BR-134	14 51 44.1 76 01 43.5	1.5	Sericitised phyllite	60
135	KH/BR-135	14 51 44.1 76 01 43.5	1.3	Ferruginous phyllite collected from oldworking. White patches of sericite noticed.	34
136	KH/BR-136	14 52 58.7 76 00 3.9	1	Highly oxidised BIF intruded by quartz veinlets. Limonites and Fe oxides are noted and oxidised sulphides are seen along the quartz veins.	<25
137	KH/BR-137	14 52 58.7 76 00 3.9	1	Limonitised BIF with quartz veins carrying oxidised pyrite.	<25
138	KH/BR-138	14 52 53.2 76 00 27.4	1	Limonitised chert intruded by quartz veins. Phyllite intercalations are noted.	<25
139	KH/BR-139	14 52 53.2 76 00 27.4	1	Highly oxidised, limonitised BIF with chert and gossanised outcrop of ferruginous phyllite with quartz veinlets. Oxidised pyrites are noted.	<25
140	KH/BR-140	14 52 53.2 76 00 27.4	1	Highly oxidised BIF	402
141	KH/BR-141	14 52 33.5 76 00 32	2	Highly limonitised oxidised BIF traversed by numerous white quartz veinlets. Sericite development noted at places	<25
142	KH/BR-142	14 52 50 76 00 17.6	1.6	Highly limonitised carbonatised BIF intruded by thin quartz veinlets in all direction. Gash veins/extensional fracture fillings noted	164
143	KH/BR-143	14 52 50 76 00 17.6	1.6	-do-	96
144	KH/BR-144	14 52 46.6 76 00 12	1	Oxidised limonitised BIF with thin quartz veinlets. Fe oxides and its stains are noticed along the square shaped cavities.	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts, Karnataka

ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
145	KH/BR-145	14 52 46.6 76 00 12	1	Oxidised, limonitised BIF with box work. Number of quartz veinlets are seen and development of sericite is noticed within the phyllitic part	140
146	KH/BR-146	14 52 46.6 76 00 12	1	Limonitised BIF with thin quartz veinlets.	36
147	KH/BR-147	14 52 46.6 76 00 12	1.5	Limonitised BIF with thin quartz veinlets. Phyllitic intercalations noted.	<25
148	KH/BR-148	14 50 54 76 02 54.7	2	Highly oxidised ferruginous phyllite with limonite and goethite.	<25
149	KH/BR-149	14 50 54 76 02 54.7	2	-do-	<25
150	KH/BR-150	14 50 54 76 02 54.7	grab samples	Highly oxidised BIF with limonite and goethite.	<25
151	KH/BR-151	14 50 51.8 76 02 25.5	1	Oxidised BIF with limonite and numerous quartz veinlets. Quartz veins are characterised by presence of black mineral with metallic lusture.	<25
152	KH/BR-152	14 50 51.8 76 02 25.5	1	-do-	<25
153	KH/BR-153	14 51 2.6 76 02 16.1	1	Purple colored phyllite with with chert and quartz vein. Small magnetite grains are noted.	<25
154	KH/BR-154	14 51 2.6 76 02 16.1	1	Chert rich BIF with quartz vein. Chert part is seen with triangle shaped grains.	<25
155	KH/BR-155	14 49 3 76 01 57.1	1	Highly brecciated oxidised sample with goethite development. Stains of bornite and azurite are also noticed within the rectangular cavities. Peacock green and blue stains are also noted on the surface.	<25

Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts,

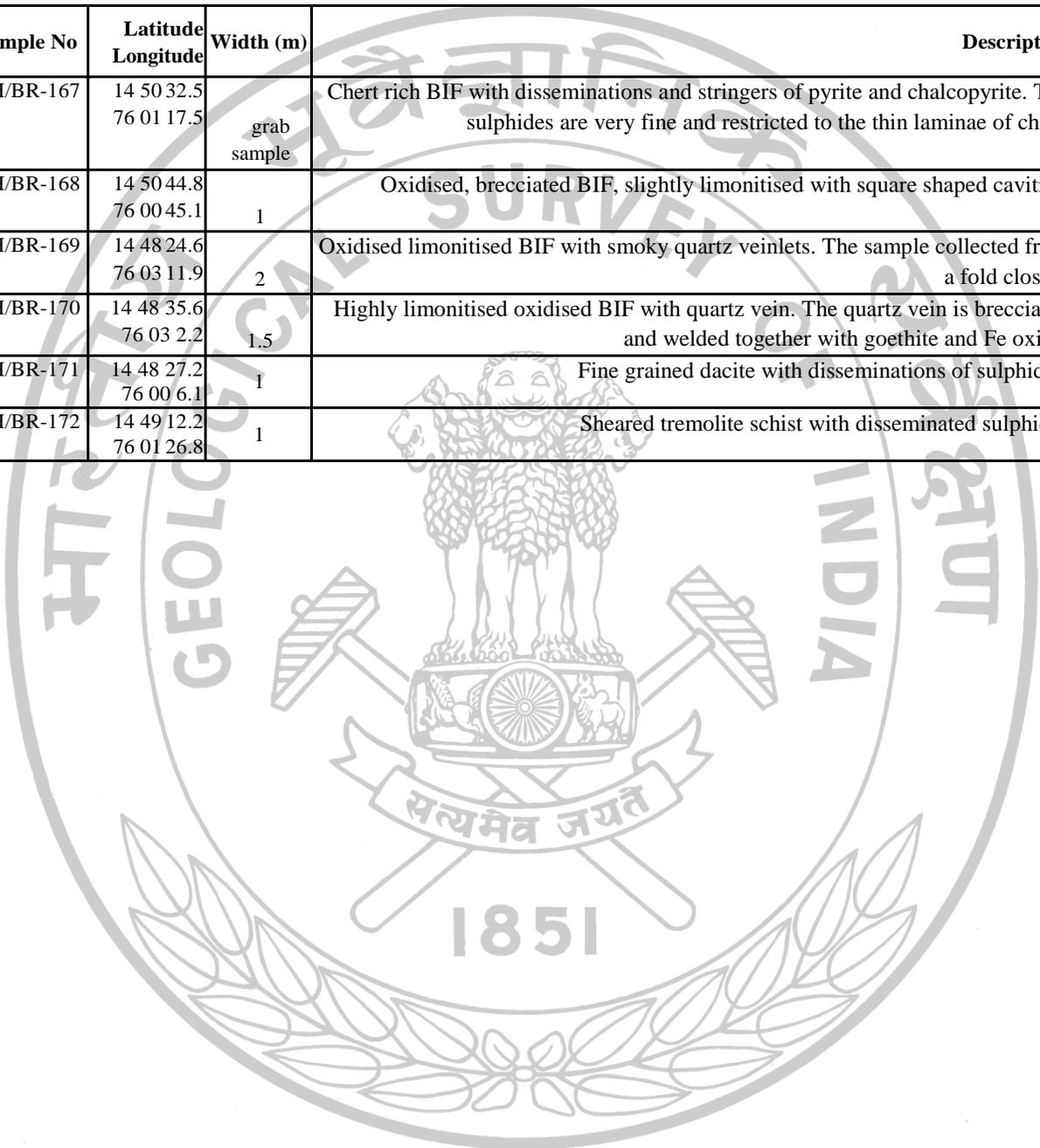
ANNEXURE I

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
156	KH/BR-156	14 48 34.5 76 02 9.8	1	Highly brecciated oxidised BIF traversed by smoky quartz veins. The samples are limonitised and thickness of quartz veins varies from 2cms to 12cms.	<25
157	KH/BR-157	14 48 34.5 76 02 9.8	1	Limonitised BIF with sheared smoky quartz. Development of goethite noticed on quartz vein.	<25
158	KH/BR-158	14 48 34.5 76 02 9.8	1	Brecciated, limonitised BIF with smoky quartz veins.	<25
159	KH/BR-159	14 48 34.5 76 02 9.8	1	Chert dominant limonitised BIF intruded by quartz vein.	<25
160	KH/BR-160	14 48 34.5 76 02 9.8	1	Brecciated smoky quartz vein with chert dominant layer of BIF. The samples are limonitised and encrustations of goethite noticed.	<25
161	KH/BR-161	14 48 34.5 76 02 9.8	1	Brecciated BIF with thin layers of tuff having magnetite crystals. Square shaped cavities with red powder noticed.	<25
162	KH/BR-162	14 48 36.8 76 02 2.5	1.5	Brecciated chert rich BIF with goethite and limonite noticed at places. Thin layers of Mn noticed at places.	<25
163	KH/BR-163	14 48 36.8 76 02 2.5	1.5	Chert rich BIF with goethite encrustations and Mn layers noticed at places.	<25
164	KH/BR-164	14 48 36.8 76 02 2.5	1	Chert rich BIF with development of goethite, light bluish veins and white siliceous nodules at places.	<25
165	KH/BR-165	14 49 31.3 76 02 17.3	2.3	Highly oxidised BIF with quartz veins	<b>86</b>
166	KH/BR-166	14 49 31.3 76 02 17.3	2.4	Highly oxidised, brecciated BIF with quartz veins.	<25

**Analytical results of bed rock samples for Gold in Kanivehalli adjoining areas, Davangere and Bellary Districts,**

**ANNEXURE I**

SL. NO	Sample No	Latitude Longitude	Width (m)	Description	Au (ppb)
167	KH/BR-167	14 50 32.5 76 01 17.5	grab sample	Chert rich BIF with disseminations and stringers of pyrite and chalcopyrite. The sulphides are very fine and restricted to the thin laminae of chert.	<25
168	KH/BR-168	14 50 44.8 76 00 45.1	1	Oxidised, brecciated BIF, slightly limonitised with square shaped cavities.	30
169	KH/BR-169	14 48 24.6 76 03 11.9	2	Oxidised limonitised BIF with smoky quartz veinlets. The sample collected from a fold closure	<25
170	KH/BR-170	14 48 35.6 76 03 2.2	1.5	Highly limonitised oxidised BIF with quartz vein. The quartz vein is brecciated and welded together with goethite and Fe oxide.	<25
171	KH/BR-171	14 48 27.2 76 00 6.1	1	Fine grained dacite with disseminations of sulphides.	<25
172	KH/BR-172	14 49 12.2 76 01 26.8	1	Sheared tremolite schist with disseminated sulphides	<25



Sl no.	Sample No.	Cu	Pb	Zn	Ni	Co	Cr	Mn	Ag	Cd	Mo	Bi	Sb	As
		All values in ppm												
1	KH/BR-01	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.10	<0.20	<1.0
2	KH/BR-02	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.10	<0.20	<1.0
3	KH/BR-03	30	10	<10	<10	<10	40	<10	<10	<100	0.52	<0.20	<1.0	<1.0
4	KH/BR-04	145	15	25	<10	<10	<10	<10	<10	<100	0.52	<0.20	4.03	<1.0
5	KH/BR-05	85	<10	50	<10	<10	20	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
6	KH/BR-06	140	<10	<10	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
7	KH/BR-07	45	<10	<10	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
8	KH/BR-08	2775	<10	<10	<10	<10	30	<10	<10	<100	0.33	<0.20	1.61	<1.0
9	KH/BR-09	735	<10	<10	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
10	KH/BR-10	665	<10	<10	<10	<10	<10	<10	<10	<100	0.11	<0.20	<1.0	<1.0
11	KH/BR-11	245	<10	<10	<10	<10	<10	<10	<10	<100	0.10	<0.20	<1.0	<1.0
12	KH/BR-12	<10	<10	<10	<10	<10	<10	<10	<10	<100	0.28	<0.20	<1.0	<1.0
13	KH/BR-13	<10	<10	<10	<10	<10	<10	<10	<10	<100	0.17	<0.20	<1.0	<1.0
14	KH/BR-14	<10	<10	<10	<10	<10	<10	<10	<10	<100	0.35	<0.20	1.09	<1.0
15	KH/BR-15	<10	<10	<10	<10	<10	<10	<10	<10	<100	0.16	<0.20	<1.0	<1.0
16	KH/BR-16	1490	<10	<10	<10	<10	<10	<10	<10	<100	0.13	<0.20	<1.0	<1.0
17	KH/BR-17	275	15	10	<10	<10	<10	<10	<10	<100	0.21	<0.20	<1.0	<1.0
18	KH/BR-18	1175	<10	15	<10	<10	<10	<10	<10	<100	0.30	<0.20	<1.0	<1.0
19	KH/BR-19	40	20	95	30	20	40	<10	<10	<100	0.16	1.23	29.45	<1.0
20	KH/BR-20	30	25	75	25	15	<10	<10	<10	<100	<0.10	1.25	46.69	<1.0
21	KH/BR-21	25	<10	60	15	<10	<10	<10	<10	<100	<0.10	0.61	22.86	<1.0
22	KH/BR-22	45	10	55	20	15	<10	<10	<10	<100	<0.10	0.62	47.78	<1.0
23	KH/BR-23	45	15	105	35	15	<10	<10	<10	<100	<0.10	1.27	55.95	<1.0
24	KH/BR-24	<10	10	45	20	<10	<10	<10	<10	<100	<0.10	0.42	12.33	<1.0
25	KH/BR-25	20	<10	80	40	<10	<10	<10	<10	<100	<0.10	0.40	25.00	<1.0
26	KH/BR-26	20	20	125	40	15	<10	<10	<10	<100	<0.10	0.47	26.94	<1.0
27	KH/BR-27	30	20	65	25	<10	20	<10	<10	<100	<0.10	2.45	209.67	<1.0
28	KH/BR-28	125	<10	15	15	<10	<10	<10	<10	<100	<0.10	<0.20	1.42	<1.0
29	KH/BR-29	60	<10	15	10	<10	<10	<10	<10	<100	0.68	<0.20	<1.0	<1.0
30	KH/BR-30	45	<10	15	<10	<10	<10	<10	<10	<100	0.28	<0.20	<1.0	<1.0
31	KH/BR-31	45	<10	15	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
32	KH/BR-32	60	<10	15	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
33	KH/BR-33	30	<10	15	<10	<10	<10	<10	<10	<100	<0.10	<0.20	<1.0	<1.0
34	KH/BR-34	60	<10	15	<10	<10	<10	<10	<10	<100	0.23	<0.20	<1.0	<1.0
35	KH/BR-35	165	<10	10	<10	<10	<10	<10	<10	<100	0.40	<0.20	<1.0	<1.0
36	KH/BR-36	<10	20	230	40	80	<10	<10	<10	<100	<0.10	<0.20	13.03	<1.0
37	KH/BR-37	10	15	310	65	45	<10	<10	<10	<100	<0.10	0.43	23.37	<1.0
38	KH/BR-38	25	10	250	70	35	<10	<10	<10	<100	<0.10	0.37	23.77	<1.0
39	KH/BR-39	120	<10	135	25	25	<10	<10	<10	<100	<0.10	1.26	83.76	<1.0
40	KH/BR-40	35	<10	75	20	10	<10	<10	<10	<100	<0.10	0.21	8.17	<1.0
41	KH/BR-41	20	<10	60	<10	<10	15	<10	<10	<100	0.17	0.27	5.76	<1.0
42	KH/BR-42	35	<10	80	<10	<10	15	<10	<10	<100	0.17	0.29	4.85	<1.0
43	KH/BR-43	55	<10	95	20	<10	15	<10	<10	<100	0.12	0.43	6.06	<1.0
44	KH/BR-44	25	<10	75	10	<10	15	<10	<10	<100	0.15	0.56	7.86	<1.0
45	KH/BR-45	25	<10	50	15	<10	25	<10	<10	<100	0.20	1.64	18.80	<1.0
46	KH/BR-46	50	<10	160	25	<10	35	<10	<10	<100	<0.1	0.65	19.08	<1.0
47	KH/BR-47	35	<10	115	15	<10	15	<10	<10	<100	<0.1	0.65	5.66	<1.0
48	KH/BR-48	30	<10	85	15	<10	15	<10	<10	<100	<0.1	0.43	4.43	<1.0
49	KH/BR-49	60	<10	90	15	<10	10	<10	<10	<100	<0.1	0.75	5.13	<1.0
50	KH/BR-50	125	<10	195	25	<10	10	<10	<10	<100	<0.1	1.74	4.17	<1.0
51	KH/BR-51	65	<10	410	100	25	15	<10	<10	<100	0.41	1.97	201.90	<1.0
52	KH/BR-52	65	<10	310	95	20	15	<10	<10	<100	0.22	3.88	295.28	<1.0
53	KH/BR-53	95	<10	310	80	20	10	<10	<10	<100	0.11	3.06	341.42	<1.0
54	KH/BR-54	65	<10	705	110	30	10	<10	<10	<100	0.15	4.00	424.98	<1.0
55	KH/BR-55	40	<10	475	90	20	10	<10	<10	<100	<0.1	5.67	421.87	<1.0
56	KH/BR-56	105	<10	330	75	<10	<10	<10	<10	<100	0.34	2.64	185.36	<1.0
57	KH/BR-57	40	<10	95	<10	<10	<10	<10	<10	<100	0.31	2.31	81.45	<1.0
58	KH/BR-58	15	<10	30	<10	<10	<10	<10	<10	<100	0.14	6.55	15.59	<1.0
59	KH/BR-59	20	<10	<10	<10	<10	<10	<10	<10	<100	0.14	<0.20	3.08	<1.0
60	KH/BR-60	20	<10	50	<10	<10	<10	<10	<10	<100	0.16	0.78	6.13	<1.0
61	KH/BR-61	15	<10	40	<10	<10	<10	<10	<10	<100	0.17	1.13	5.90	<1.0
62	KH/BR-62	10	<10	35	<10	<10	<10	<10	<10	<100	0.22	1.48	2.07	<1.0
63	KH/BR-63	<10	<10	30	<10	<10	<10	<10	<10	<100	0.22	1.56	3.69	<1.0
64	KH/BR-64	10	<10	45	<10	<10	<10	<10	<10	<100	0.22	1.5	5.60	<1.0
65	KH/BR-65	<10	<10	35	<10	<10	<10	<10	<10	<100	0.17	1.08	2.42	<1.0
66	KH/BR-66	<10	<10	30	<10	<10	<10	<10	<10	<100	0.19	1.66	24.69	<1.0
67	KH/BR-67	<10	<10	20	<10	<10	<10	<10	<10	<100	0.16	2.96	17.86	<1.0
68	KH/BR-68	15	<10	50	<10	<10	<10	<10	<10	<100	0.20	1.63	29.89	<1.0
69	KH/BR-69	15	<10	45	<10	<10	<10	<10	<10	<100	0.21	2.12	120.73	<1.0
70	KH/BR-70	15	<10	35	<10	<10	<10	<10	<10	<100	0.23	5.78	2379.12	<1.0
71	KH/BR-71	<10	<10	35	<10	<10	<10	<10	<10	<100	<0.1	4.59	795.45	<1.0
72	KH/BR-72	<10	<10	25	<10	<10	<10	<10	<10	<100	0.12	1.83	22.73	<1.0
73	KH/BR-73	<10	<10	40	<10	<10	<10	<10	<10	<100	0.12	1.12	3.00	<1.0
74	KH/BR-74	<10	<10	25	<10	<10	<10	<10	<10	<100	0.11	1.42	3.41	<1.0
75	KH/BR-75	10	<10	25	<10	<10	25	<10	<10	<100	0.13	1.30	2.09	<1.0
76	KH/BR-76	50	<10	85	<10	<10	135	<10	<10	<100	0.15	2.82	252.14	<1.0
77	KH/BR-77	45	<10	55	<10	<10	210	<10	<10	<100	0.18	3.05	194.48	<1.0
78	KH/BR-78	25	<10	<10	<10	<10	90	<10	<10	<100	0.14	2.83	14.21	<1.0

79	KH/BR-79	30	<10	25	<10	<10	10	<10	<10	<100	<0.1	0.51	3.42
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Analytical results of bed rock samples for base metals of Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka. ANNEXURE II

Sl no.	Sample No.	Cu	Pb	Zn	Ni	Co	Cr	Mn	Ag	Cd	Mo	Bi	Sb	As
80	KH/BR-80	15	<10	25	<10	<10	15			<10	<100	<0.1	2.55	5.52
81	KH/BR-81	15	<10	<10	<10	<10	<10			<10	<100	<0.1	0.63	1.83
82	KH/BR-82	30	<10	30	<10	<10	80			<10	<100	0.12	0.60	4.17
83	KH/BR-83	10	<10	20	<10	<10	15			<10	<100	<0.1	<0.20	2.15
84	KH/BR-84	35	<10	70	45	<10	125			<10	<100	<0.1	2.11	18.81
85	KH/BR-85	15	<10	185	130	<10	95			<10	<100	0.11	1.63	20.56
86	KH/BR-86	10	<10	80	35	<10	100			<10	<100	0.11	1.2	19.41
87	KH/BR-87	10	<10	130	80	<10	90			<10	<100	0.11	2.45	22.32
88	KH/BR-88	60	<10	220	15	25	145	150	<10	<10	<100	0.39	16.11	97.31
89	KH/BR-89	25	<10	95	70	<10	<10	300	<10	<10	<100	0.19	0.67	13.72
90	KH/BR-90	50	<10	130	20	<10	15	420	<10	<10	<100	0.14	0.59	13.14
91	KH/BR-91	125	<10	205	20	30	<10	380	<10	<10	<100	<0.1	2.48	94.50
92	KH/BR-92	195	<10	295	50	35	130	310	<10	<10	<100	<0.1	1.48	18.24
93	KH/BR-93	130	<10	255	65	25	210	1800	<10	<10	<100	<0.1	1.26	19.16
94	KH/BR-94	95	<10	245	65	15	65	670	<10	<10	<100	0.24	119.68	1225.40
95	KH/BR-95	130	<10	390	90	120	<10	750	<10	<10	<100	0.11	47.18	414.78
96	KH/BR-96	355	<10	590	170	500	45		<10	<10	<100	0.18	30.13	380.82
97	KH/BR-97	365	<10	785	205	490	25		<10	<10	<100	<0.1	37.62	341.08
98	KH/BR-98	75	<10	125	80	50	<10		<10	<10	<100	<0.1	6.96	29.33
99	KH/BR-99	165	<10	150	120	140	20		<10	<10	<100	<0.1	19.27	29.45
100	KH/BR-100	3015	<10	880	125	2430	30		<10	<10	<100	<0.1	8.66	143.57
101	KH/BR-101	95	<10	165	130	140	30		<10	<10	<100	<0.1	4.22	67.64
102	KH/BR-102	80	<10	335	280	30	30		<10	<10	<100	<0.1	91.10	170.38
103	KH/BR-103	150	<10	350	290	50	60		<10	<10	<100	<0.1	120.00	359.28
104	KH/BR-104	475	<10	325	215	95	65		<10	<10	<100	<0.1	77.26	684.18
105	KH/BR-105	65	<10	70	80	30	55		<10	<10	<100	<0.1	17.77	130.01
106	KH/BR-106	65	<10	50	35	15	115		<10	<10	<100	0.44	13.89	151.14
107	KH/BR-107	75	<10	65	60	15	155		<10	<10	<100	0.46	41.58	203.17
108	KH/BR-108	75	<10	50	70	25	75		<10	<10	<100	0.30	40.26	140.00
109	KH/BR-109	90	<10	80	80	30	120		<10	<10	<100	0.32	38.30	167.50
110	KH/BR-110	50	<10	45	55	15	80		<10	<10	<100	0.20	9.76	97.44
111	KH/BR-111	65	<10	60	65	35	140		<10	<10	<100	0.16	22.59	154.75
112	KH/BR-112	20	<10	35	45	50	35		<10	<10	<100	0.18	8.08	17.36
113	KH/BR-113	25	<10	35	25	20	90		<10	<10	<100	0.17	5.75	3.14
114	KH/BR-114	30	<10	35	45	30	65		<10	<10	<100	0.15	9.67	46.52
115	KH/BR-115	10	<10	20	35	30	30		<10	<10	<100	<0.1	6.77	22.69
116	KH/BR-116	10	<10	20	10	10	40		<10	<10	<100	0.11	5.63	3.36
117	KH/BR-117	<10	<10	15	15	<10	20		<10	<10	<100	0.10	4.67	43.94
118	KH/BR-118	75	<10	10	10	<10	<10		<10	<10	<100	0.32	<0.20	2.53
119	KH/BR-119	75	<10	15	<10	<10	<10		<10	<10	<100	0.30	<0.20	1.60
120	KH/BR-120	75	<10	10	10	<10	<10		<10	<10	<100	0.10	<0.20	1.32
121	KH/BR-121	90	<10	35	35	<10	<10		<10	<10	<100	<0.1	<0.20	1.10
122	KH/BR-122	15	<10	30	15	<10	<10		<10	<10	<100	<0.1	<0.20	1.06
123	KH/BR-123	10	<10	25	20	15	15		<10	<10	<100	<0.1	<0.20	4.63
124	KH/BR-124	20	<10	40	35	10	15		<10	<10	<100	<0.1	<0.20	6.97
125	KH/BR-125	70	<10	75	40	25	35		<10	<10	<100	0.14	<0.20	8.19
126	KH/BR-126	10	<10	35	30	20	30		<10	<10	<100	0.22	0.34	5.01
127	KH/BR-127	15	<10	30	20	10	10		<10	<10	<100	0.14	0.59	6.03
128	KH/BR-128	<10	<10	25	15	10	30		<10	<10	<100	<0.1	0.42	6.75
129	KH/BR-129	35	<10	30	20	10	70		<10	<10	<100	<0.1	0.23	6.62
130	KH/BR-130	30	<10	35	30	<10	130		<10	<10	<100	<0.1	<0.20	8.94
131	KH/BR-131	110	<10	125	130	30	40		<10	<10	<100	0.78	15.37	13.48
132	KH/BR-132	115	<10	120	190	20	55		<10	<10	<100	0.41	12.10	9.55
133	KH/BR-133	125	<10	185	240	35	60		<10	<10	<100	0.33	9.26	4.97
134	KH/BR-134	125	<10	145	195	40	40		<10	<10	<100	0.12	19.92	510.11
135	KH/BR-135	120	<10	150	165	25	20		<10	<10	<100	0.40	3.12	1608.16
136	KH/BR-136	<10	<10	60	<10	<10	10		<10	<10	<100	0.22	3.67	757.73
137	KH/BR-137	<10	<10	35	<10	<10	<10		<10	<10	<100	0.14	4.90	602.75
138	KH/BR-138	50	<10	30	<10	<10	<10		<10	<10	<100	0.13	4.35	339.59
139	KH/BR-139	70	<10	25	<10	<10	30		<10	<10	<100	0.12	3.67	531.01
140	KH/BR-140	105	<10	30	<10	<10	30		<10	<10	<100	0.30	29.53	1883.39
141	KH/BR-141	15	<10	600	125	50	<10		<10	<10	<100	<0.1	30.19	496.30
142	KH/BR-142	<10	<10	165	90	<10	<10		<10	<10	<100	<0.1	6.67	153.78
143	KH/BR-143	<10	<10	160	15	<10	<10		<10	<10	<100	<0.1	10.53	128.90
144	KH/BR-144	<10	<10	55	<10	<10	<10		<10	<10	<100	<0.1	2.86	868.48
145	KH/BR-145	<10	<10	45	<10	<10	<10		<10	<10	<100	<0.1	2.19	958.51
146	KH/BR-146	25	<10	45	<10	<10	<10		<10	<10	<100	<0.1	8.46	261.18
147	KH/BR-147	<10	<10	30	<10	<10	<10		<10	<10	<100	<0.1	6.85	191.86
148	KH/BR-148	25	<10	15	<10	<10	240		<10	<10	<100	0.14	5.90	119.47
149	KH/BR-149	75	<10	65	<10	<10	115		<10	<10	<100	<0.1	3.05	106.37
150	KH/BR-150	145	<10	105	<10	<10	80		<10	<10	<100	<0.1	3.21	294.66
151	KH/BR-151	<10	<10	20	<10	<10	<10		<10	<10	<100	<0.1	3.68	178.58
152	KH/BR-152	<10	<10	20	<10	<10	<10		<10	<10	<100	<0.1	8.73	13.70
153	KH/BR-153	<10	<10	40	<10	<10	<10		<10	<10	<100	<0.1	6.01	11.51
154	KH/BR-154	<10	<10	35	<10	<10	<10		<10	<10	<100	<0.1	7.64	6.68
155	KH/BR-155	55	<10	95	<10	<10	<10		<10	<10	<100	<0.1	0.37	7.72
156	KH/BR-156	65	<10	110	40	<10	<10		<10	<10	<100	<0.1	0.42	4.27

157	KH/BR-157	65	<10	100	55	<10	<10			<10	<10	<100	0.13	0.27	37.71
158	KH/BR-158	230	<10	175	<10	30	<10			<10	<10	<100	0.12	2.15	25.60
<b>Sl no.</b>	<b>Sample No.</b>	<b>Cu</b>	<b>Pb</b>	<b>Zn</b>	<b>Ni</b>	<b>Co</b>	<b>Cr</b>	<b>Mn</b>	<b>Ag</b>	<b>Cd</b>	<b>Mo</b>	<b>Bi</b>	<b>Sb</b>	<b>As</b>	
All values in ppm															
159	KH/BR-159	35	<10	20	<10	<10	<10			<10	<10	<100	0.23	<0.2	3.50
160	KH/BR-160	165	<10	250	130	10	<10			<10	<10	<100	0.44	0.43	85.95
161	KH/BR-161	235	<10	110	60	<10	<10			<10	<10	<100	0.33	0.36	49.52
162	KH/BR-162	70	<10	150	60	30	<10			<10	<10	<100	0.31	0.57	32.00
163	KH/BR-163	55	<10	145	40	<10	<10			<10	<10	<100	<0.1	0.26	15.53
164	KH/BR-164	75	<10	40	<10	<10	<10			<10	<10	<100	0.10	<0.2	2.97
165	KH/BR-165	45	<10	60	<10	<10	<10			<10	<10	<100	0.19	<0.2	14.37
166	KH/BR-166	100	<10	220	15	<10	<10			<10	<10	<100	0.28	1.5	127.12
167	KH/BR-167	25	40	60	15	<10	<10			<10	<10	<100	0.37	0.51	12.30
168	KH/BR-168	15	35	160	25	20	<10			<10	<10	<100	<0.1	0.47	16.68
169	KH/BR-169	45	40	180	65	25	140			<10	<10	<100	0.23	0.67	31.30
170	KH/BR-170	350	40	85	65	15	20			<10	<10	<100	0.45	3.08	43.62
171	KH/BR-171	25	30	75	145	25	<10			<10	<10	<100	<0.1	0.94	39.30
172	KH/BR-172	70	35	55	70	15	<10			<10	<10	<100	0.12	0.25	2.02

Not Analysed



Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

TRENCH NO. : KHT-01						
Length : 06m		Width: 1m		Depth: 1m		
				Co-ordinates: 14° 48' 10", 76° 01' 7.5"		
Trend: N-S			Strike of rock unit: E-W			
No. of samples collected: 06			Sampling from west to east			
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0.5	1	0.5	White quartz vein with epidote veins and malachite spots. Oxidised pyrites are noted	<0.025	NA
2	1	2	1	White to smoky quartz vein with malachite stains	<0.025	
3	2	3	1	Smoky quartz vein with epidote and malachite stains	<0.025	
4	3	4	1	Slightly ferruginous quartz vein with malachite stains	<0.025	
5	4	5	1	Smoky quartz vein with malachite and chalcopryrite	<0.025	
6	5	6	1	Smoky quartz vein with black prismatic mineral within quartz	<0.025	

TRENCH NO. : KHT-02						
Length : 09.8m		Width: 1m		Depth: 1m		
				Co-ordinates: 14 48' 12.05", 76 00' 55.2"		
Trend: N10E-S10W			Strike of rock unit:			
No. of samples collected: 10			Sampling from west to east			
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	Weathered quartz vein	<0.025	NA
2	1	2	1	Weathered quartz vein	<0.025	
3	2	3	1	White quartz vein with epidote	<0.025	
4	3	4	1	White quartz vein with epidote	<0.025	
5	4	5	1	Smoky quartz vein with Fe encrustations	<0.025	
6	5	6	1	Smoky quartz vein with Fe encrustations. A few specks of pyrite are noted.	<0.025	
7	6	7	1	Quartz vein with white powder, epidote vein and malachite encrustation.	<0.025	
8	7	8	1	Smoky quartz vein with Fe encrustations. Malachite, pyrite and epidote are	<0.025	
9	8	9	1	Limonitised quartz with pyrite and epidote	<0.025	
10	9	9.8	0.8	Smoky quartz with malachite and epidote vein	<0.025	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

				TRENCH NO. : KHT-3		
Length : 9m		Width: 1m		Depth: 1m		
				Co-ordinates: 14° 48' 15.6", 76° 00' 43.8"		
Trend: S25W-N25E				Strike of rock unit:		
No. of samples collected: 8				Sampling from west to east		
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	0	1	1	White to smoky quartz with a few specks of chalcopyrite and oxidised pyrite.	<0.025	NA
2	1	2	1	Smoky quartz with white powdery material at broken surface	<0.025	
3	2	3	1	White smoky quartz with black metallic mineral	<0.025	
4	3	4	1	White smoky quartz with black metallic mineral	<0.025	
5	4	5	1	Smoky quartz vein	<0.025	
6	5	6	1	White smoky quartz with black metallic mineral	<0.025	
7	6	7	1	Smoky quartz with altered chalcopyrite	<0.025	
8	7	8	1	Smoky quartz with altered chalcopyrite	<0.025	

				TRENCH NO. : KHT-04		
Length : 7.6m		Width: 1m		Depth: 1m		
				Co-ordinates: 14° 48' 59.7" , 76° 01' 49.7"		
Trend: S55W/N55E				Strike of rock unit:		
No. of samples collected: 8				Sampling from west to east		
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	0	1	1	Highly oxidised BIF with limonite and various iron encrustations. smoky quartz veinlets are observed.	<0.025	NA
2	1	2	1	Oxidised BIF with smoky quartz vein and Fe encrustations	<0.025	
3	2	3	1	Chert dominant oxidised BIF with a few cavities of oxidised sulphides	<0.025	
4	3	4	1	Chert rich BIF with smoky quartz veins	0.035	
5	4	5	1	Chert rich oxidised BIF with cm size quartz veins.	0.036	
6	5	5.8	0.8	Smoky quartz vein	<0.025	
7	5.8	6.3	0.5	Grey phyllite	<0.025	
8	6.3	7.6	1.3	Limonitised chert band	0.05	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

TRENCH NO. : KHT-05						
Length : 7.3m		Width: 1 m		Depth: 1 m		
Trend: N65E/S65W				Co-ordinates: 14° 49' 10.6", 76° 01' 43"		
No. of samples collected: 7			Strike of rock unit:			
			Sampling from west to east			
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	0	1	1	Smoky limonitised quartz vein associated with tuffaceous material	<0.025	NA
2	1	2	1	Sericite rich fissile tuffaceous rock with thin smoky quartz veinlets	<0.025	
3	2	3	1	BIF interlayered with tuff and traversed by numerous smoky quartz veinlets	<0.025	
4	3	4	1	Limonitised chert rich BIF with quartz vein and oxidised pyrite	<0.025	
5	4	5	1	Limonitised BIF	<0.025	
6	5	6	1	Limonitised BIF with quartz veins	<0.025	
7	6	7.3	1.3	Limonitised BIF with quartz veins	0.025	

TRENCH NO. : KHT-06						
Length : 12.7		Width: 1		Depth: 1		
Trend: N15°E				Co-ordinates: 14° 48' 8.6", 76° 01' 13.1"		
No. of samples collected: 10			Strike of rock unit:			
			Sampling from west to east			
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	1.5	2.5	1	Smoky quartz with specks of chalcopyrite	<0.025	NA
2	2.5	3.5	1	Smoky quartz with chalcopyrite and epidote development	<0.025	
3	3.5	4.5	1	Smoky quartz vein with epidote and altered chalcopyrite	<0.025	
4	4.5	5.5	1	Smoky quartz vein with fine disseminations of chalcopyrite. Development of sericite and epidote noted with ferruginous encrustations	<0.025	
5	5.5	6.5	1	Smoky quartz vein with fine disseminations of chalcopyrite. Development of	<0.025	
6	6.5	7.5	1	Smoky quartz vein with chalcopyrite	<0.025	
7	7.5	8.5	1	Smoky quartz vein with chalcopyrite	<0.025	
8	8.5	9.5	1	Smoky quartz vein with chalcopyrite	<0.025	
9	9.5	10.5	1	Smoky quartz vein with chalcopyrite	<0.025	
10	10.5	11.7	1.2	Smoky quartz vein with chalcopyrite	<0.025	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

TRENCH NO. : KHT-07						
Length : 7		Width: 1m		Depth: 1m		
Trend: N50°E				Co-ordinates: 14 49 13.7, 76 01 50.5		
No. of samples collected: 7			Strike of rock unit:			
			Sampling from west to east			
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	0.4	1	0.6	White to buff coloured tuffaceous rock with feldspar and quartz.	<0.025	NA
2	1	2	1	White to buff coloured tuffaceous rock with feldspar and quartz.	<0.025	
3	2	3	1	Highly oxidised, limonitised brecciated BIF with brecciated quartz veinlets. Square	<0.025	
4	3	4	1	Limonitised brecciated BIF. Sericites noted at places.	<0.025	
5	4	5	1	Limonitised, brecciated BIF	<0.025	
6	5	6	1	Limonitised, brecciated BIF	<0.025	
7	6	7	1	Limonitised, brecciated BIF with quartz veinlets.	<0.025	

TRENCH NO. : KHT-07A						
Length : 4.4m		Width: 1m		Depth: 1m		
Trend: N55E-S55W				Co-ordinates: 14° 49' 13.6", 76° 01' 50.8"		
No. of samples collected: 4			Strike of rock unit:			
			Sampling from west to east			
Sl no.	Sampling length		True	Sample Description	Assay	Weighted
	From(m)	To(m)	Width(m)		(g/t)	Average(g/t/m)
1	0.8	1.8	1	Grey chert with intrusions of quartz veinlets. Very fine square shaped cavities with	<0.025	NA
2	1.8	2.8	1	Grey chert with intercalations of tuff layers.	<0.025	
3	2.8	3.8	1	Limonitised grey chert with square shaped cavities at places.	<0.025	
4	3.8	4.4	0.6	Limonitised grey chert.	<0.025	

TRENCH NO. : KHT-08						
Length : 14m		Width: 1m		Depth: 1m		
Trend: S55W-N55E				Co-ordinates: 14° 49' 3.8" 76° 01' 57.1"		
No. of samples collected: 14			Strike of rock unit:			
			Sampling from west to east			

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1.5	1.5	White to grey tuffaceous argillite with chert intercalations. Samples are limonitised at places	<0.025	NA
2	1.5	2.5	1	Oxidised limonitised BIF with thin quartz veins. Presence of Mn noted	<0.025	
3	2.5	3.5	1	Oxidised BIF with limonite. Development of goethite is noticed.	<0.025	
4	3.5	4.5	1	Oxidised limonitised BIF with quartz veins at a few places. Development of goethite and bornite stains is noted.	0.025	
5	4.5	5.5	1	Oxidised BIF with smoky quartz vein. The quartz vein is brecciated at places.	<0.025	
6	5.5	6.5	1	Oxidised BIF with limonite at places. The BIF is brecciated and traversed by smoky quartz	<0.025	
7	6.5	7.5	1	Highly oxidised brecciated BIF with brecciated smoky quartz vein. Development of	<0.025	
8	7.5	8.5	1	Highly oxidised limonitised ferruginous argillite. Thin layers of chert noticed with limonite. Sericite development is noted.	<0.025	
9	8.5	9.5	1	Highly oxidised limonitised ferruginous argillite	<0.025	
10	9.5	10.5	1	Oxidised sericitised BIF with brownish red colour. Sericite is seen on the surface	<0.025	
11	10.5	11.5	1	Limonitised BIF with thin chert layers.	<0.025	
12	11.5	12.5	1	Sericitised ferruginous Phyllite with thin chert layers at places	<0.025	
13	12.5	13.2	0.7	Buff coloured fine grained tuff/sericite Phyllite with smoky quartz and chert.	<0.025	
14	13.2	14	0.8	Oxidised BIF with tuff. Goethite seen developed along the surface of chert rich BIF.	<0.025	

				TRENCH NO. : KHT-09		
Length : 5.7 m		Width: 1m		Depth: 1m		
				Co-ordinates: 14° 48' 52.1", 76° 02' 3.2"		
Trend: S55W-N55E			Strike of rock unit:			
No. of samples collected: 6			Sampling from west to east			
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	Limonitised chert rich BIF with ferruginous phyllite	<0.025	NA
2	1	2	1	Brecciated BIF with smoky quartz vein. Limonitised at places.	<0.025	
3	2	3	1	Chert rich BIF with thin layers of tuffaceous rock.	<0.025	
4	3	4	1	Chert rich BIF with thin layers of tuffaceous rock.	<0.025	
5	4	5	1	Limonitised chert with goethite and peacock green stains.	<0.025	
6	5	5.7	0.7	tuffaceous phyllite	<0.025	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

TRENCH NO. : KCHT-01						
Length : 12.8m			Width: 1m		Depth: 1m	
Trend: S55W- N55E					Co-ordinates: 14° 49' 20".6" , 76° 03' 6.5"	
No. of samples collected: 12				Strike of rock unit:		
				Sampling from west to east		
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	foliated grey argillite with white quartz vein	<0.025	NA
2	1	2	1	silicified BIF bands with quartz vein and pyrite .	<0.025	
3	2	3	1	oxidised , limonitised and sericitised BIF	<0.025	
4	3	4	1	oxidised , limonitised and sericitised BIF with cubical cavities	0.06	
5	4	5	1	highly limonitised BIF	0.05	
6	5	5.8	0.8	grey argillite with white quartz vein	<0.025	
7	5.8	7.3	0.5	Oxidised chert rich BIF with square shaped cavities. Magnetite crystals observed	0.045	
8	7.3	8.3	1	White massive limonitised quartz vein with intercalations of argillite	<0.025	
9	8.3	9.3	1	Limonitised quartz vein	<0.025	
10	9.3	10.3	1	Limonitised quartz vein with square shaped cavities	0.03	
11	10.3	11.3	1	Limonitised massive quartz vein. Samples show Fe encrustations. Sericite alteration noted	0.04	
12	11.3	12.8	1.5	Limonitised argillite	<0.025	
TRENCH NO. : KCHT-2						
Length : 3m			Width: 1m		Depth: 1m	
Trend: S60W-N60E					Co-ordinates: 14° 49' 28.2" , 76° 03' 00.8"	
No. of samples collected: 3				Strike of rock unit:		
				Sampling from west to east		
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0.3	1	0.7	Highly oxidised BIF with thin quartz veins. Chlorite schist intruded by quartz veins is seen at the contact.	0.035	NA
2	1	2	1	Limonitised BIF with quartz veinlets	0.04	
3	2	3	1	Carbonatised khaki green argillite	<0.025	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

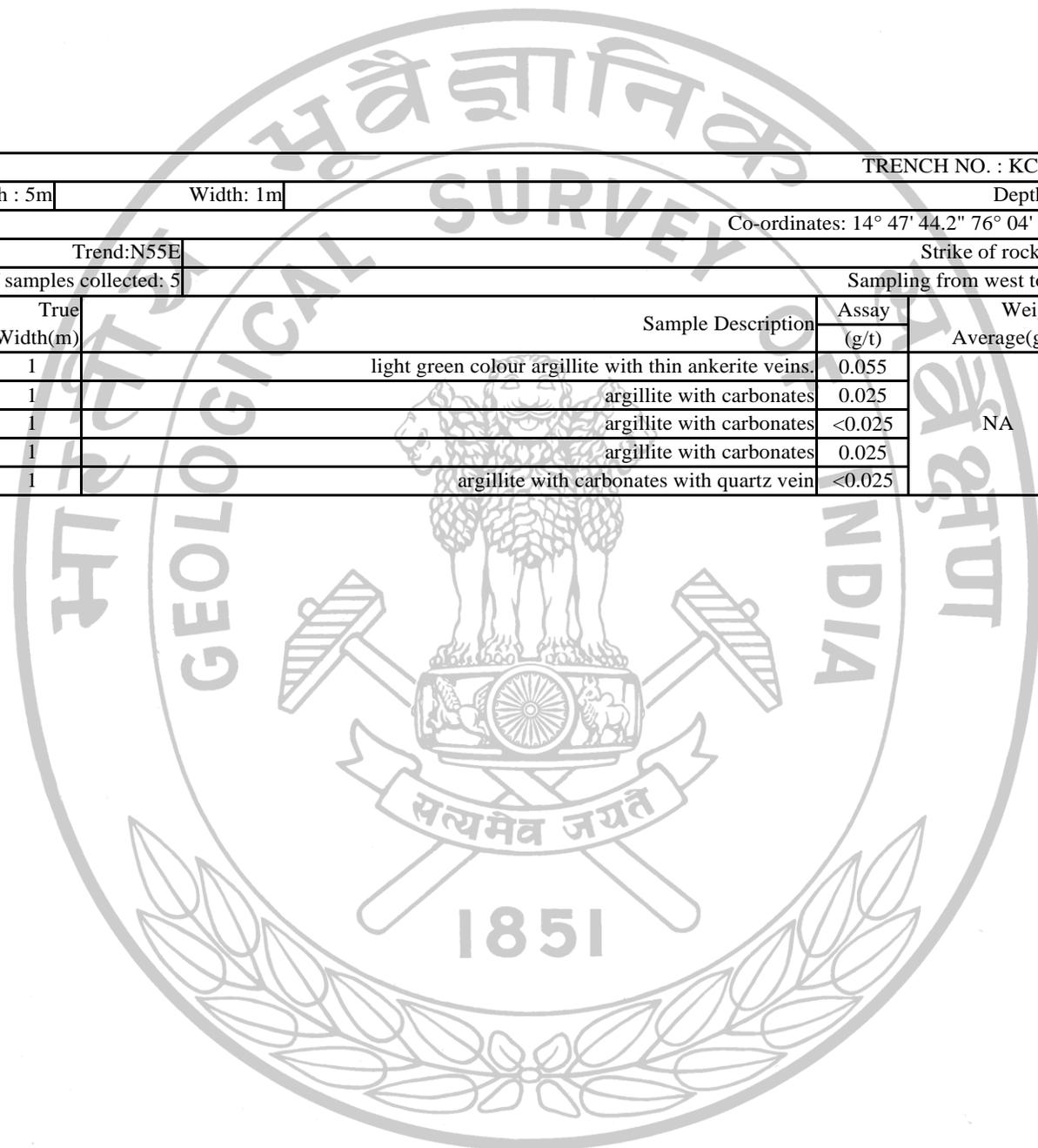
TRENCH NO. : KCHT-3						
Length : 4m		Width: 1m		Depth: 1m		
Co-ordinates: 14° 49' 28.5", 76° 03' 00.9"						
Trend: N55E-S55W				Strike of rock unit:		
No. of samples collected: 4				Sampling from west to east		
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	Limontised BIF with quartz veinlets	0.045	NA
2	1	2	1	Limontised oxidised BIF with thin quartz veinlets. Square shaped cavities with peacock blue and green stains observed within BIF. Quartz veins are characterised by magnetite	0.04	
3	2	3	1	Limontised BIF with quartz veinlets	0.03	
4	3	4	1	Limontised argillite with quartz vein	<0.025	

TRENCH NO. : KCHT-4						
Length : 8m		Width: 1m		Depth: 1m		
Co-ordinates: 14° 47' 56", 76° 4' 6.9"						
Trend: N55E				Strike of rock unit:		
No. of samples collected: 8				Sampling from west to east		
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	light green colour argillitewith thin ankerite veins	<0.025	NA
2	1	2	1	argillite with carbonates	<0.025	
3	2	3	1	argillite with carbonates	<0.025	
4	3	4	1	argillite with carbonates	<0.025	
5	4	5	1	argillite with carbonates with quartz vein	<0.025	
6	5	6	1	argillite with carbonates	<0.025	
7	6	7	1	argillite with carbonates	<0.025	
8	7	8	1	argillite with carbonates with quartz vein	<0.025	

Analytical results of trench samples for Gold in Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Annexure III

				TRENCH NO. : KCHT-5		
Length : 5m		Width: 1m		Depth: 1m		
				Co-ordinates: 14° 47' 44.2" 76° 04' 13.4"		
Trend:N55E				Strike of rock unit:		
No. of samples collected: 5				Sampling from west to east		
Sl no.	Sampling length		True Width(m)	Sample Description	Assay (g/t)	Weighted Average(g/t/m)
	From(m)	To(m)				
1	0	1	1	light green colour argillite with thin ankerite veins.	0.055	NA
2	1	2	1	argillite with carbonates	0.025	
3	2	3	1	argillite with carbonates	<0.025	
4	3	4	1	argillite with carbonates	0.025	
5	4	5	1	argillite with carbonates with quartz vein	<0.025	



**Analytical results of trench samples for base metals and associated elements of Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.**

**ANNEXURE IV**

Sl. No.	Sample No.	Cu	Pb	Zn	Ni	Co	Cr	Mn	Ag	Cd	Mo	Bi	Sb	As
		All Assay values are in ppm												
1	KHT-01/01	95	<10	<10	<10	<10	50		<10	<10	<100	<0.10	0.21	<1.0
2	KHT-01/02	60	<10	<10	<10	<10	15		<10	<10	<100	0.20	0.42	<1.0
3	KHT-01/03	65	<10	<10	<10	<10	20		<10	<10	<100	0.10	<0.20	<1.0
4	KHT-01/04	100	<10	<10	<10	<10	20		<10	<10	<100	<0.10	0.23	<1.0
5	KHT-01/05	155	<10	<10	<10	<10	10		<10	<10	<100	0.19	0.24	<1.0
6	KHT-01/06	160	<10	<10	<10	<10	15		<10	<10	<100	0.30	0.38	1.03
7	KHT-02/01	30	<10	10	<10	<10	<10		<10	<10	<100	0.36	<0.20	1.52
8	KHT-02/02	55	<10	15	<10	<10	<10		<10	<10	<100	0.16	<0.20	<1.0
9	KHT-02/03	20	<10	<10	<10	<10	<10		<10	<10	<100	0.15	0.27	<1.0
10	KHT-02/04	65	<10	15	15	<10	20		<10	<10	<100	0.78	0.25	<1.0
11	KHT-02/05	150	<10	15	<10	<10	<10		<10	<10	<100	0.38	<0.20	1.20
12	KHT-02/06	210	<10	10	<10	<10	<10		<10	<10	<100	1.12	<0.20	<1.0
13	KHT-02/07	780	<10	10	<10	<10	<10		<10	<10	<100	1.07	<0.20	1.12
14	KHT-02/08	1445	<10	65	50	30	110		<10	<10	<100	0.94	<0.20	<1.0
15	KHT-02/09	740	<10	40	20	10	45		<10	<10	<100	0.41	<0.20	1.62
16	KHT-02/10	530	<10	<10	<10	<10	<10		<10	<10	<100	7.98	0.23	3.03
17	KHT-03/01	115	<10	10	15	<10	<10		<10	<10	<100	0.17	<0.20	1.14
18	KHT-03/02	110	<10	<10	15	<10	<10		<10	<10	<100	0.16	<0.20	<1.0
19	KHT-03/03	65	<10	10	<10	<10	<10		<10	<10	<100	<0.10	<0.20	<1.0
20	KHT-03/04	155	<10	<10	<10	<10	<10		<10	<10	<100	0.38	<0.20	1.24
21	KHT-03/05	155	<10	<10	15	<10	<10		<10	<10	<100	0.46	<0.20	1.21
22	KHT-03/06	100	<10	15	15	<10	<10		<10	<10	<100	0.32	<0.20	<1.0
23	KHT-03/07	85	<10	<10	<10	<10	<10		<10	<10	<100	0.47	<0.20	<1.0
24	KHT-03/08	70	<10	<10	<10	<10	<10		<10	<10	<100	0.52	<0.20	<1.0
25	KHT-04/01	490	<10	150	90	20	<10		<10	<10	<100	<0.1	0.97	38.15
26	KHT-04/02	195	<10	50	40	<10	<10		<10	<10	<100	<0.1	0.78	14.39
27	KHT-04/03	235	<10	30	30	<10	40		<10	<10	<100	<0.1	1.20	19.80
28	KHT-04/04	565	<10	60	60	<10	<10		<10	<10	<100	<0.1	0.26	10.16
29	KHT-04/05	315	<10	35	25	<10	<10		<10	<10	<100	<0.1	0.26	9.16
30	KHT-04/06	15	<10	<10	10	<10	<10		<10	<10	<100	<0.1	<0.2	1.88
31	KHT-04/07	<10	<10	<10	15	<10	<10		<10	<10	<100	<0.1	0.22	<1.0
32	KHT-04/08	125	<10	200	15	<10	<10		<10	<10	<100	<0.1	0.22	5.20
33	KHT-05/01	225	<10	40	40	<10	15		<10	<10	<100	0.13	0.24	5.77
34	KHT-05/02	65	<10	<10	<10	<10	<10		<10	<10	<100	<0.1	<0.2	5.61
35	KHT-05/03	75	<10	20	25	15	<10		<10	<10	<100	<0.1	0.34	13.00
36	KHT-05/04	230	<10	55	55	100	<10		<10	<10	<100	0.16	0.84	21.05
37	KHT-05/05	215	<10	15	<10	<10	<10		<10	<10	<100	0.37	1.34	18.52
38	KHT-05/06	290	<10	15	20	<10	<10		<10	<10	<100	0.34	1.24	45.59
39	KHT-05/07	410	<10	80	25	<10	<10		<10	<10	<100	0.38	1.86	32.89
40	KHT-06/01	285	<10	<10	10	<10	<10		<10	<10	<100	0.47	<0.20	4.39
41	KHT-06/02	150	<10	<10	<10	<10	<10		<10	<10	<100	0.66	<0.20	4.76
42	KHT-06/03	175	<10	<10	25	<10	<10		<10	<10	<100	2.42	<0.20	5.15
43	KHT-06/04	810	<10	10	<10	<10	<10		<10	<10	<100	0.62	<0.20	5.17
44	KHT-06/05	70	<10	<10	25	<10	<10		<10	<10	<100	0.21	0.41	5.24
45	KHT-06/06	160	<10	<10	25	<10	<10		<10	<10	<100	0.20	0.89	4.29
46	KHT-06/07	330	<10	<10	40	<10	<10		<10	<10	<100	0.17	0.76	3.05
47	KHT-06/08	135	<10	25	<10	<10	<10		<10	<10	<100	0.79	0.78	4.61
48	KHT-06/09	235	<10	110	10	<10	<10		<10	<10	<100	1.80	0.71	3.94
49	KHT-06/10	160	<10	120	20	<10	<10		<10	<10	<100	1.28	0.55	3.57
50	KHT-07/01	200	45	20	20	<10	<10		<10	<10	<100	0.19	1.28	26.59
51	KHT-07/02	35	45	<10	15	<10	<10		<10	<10	<100	<0.1	1.19	26.42
52	KHT-07/03	460	35	45	45	15	<10		<10	<10	<100	0.48	2.84	29.76
53	KHT-07/04	540	35	95	50	15	<10		<10	<10	<100	0.16	0.68	8.48

54	KHT-07/05	440	30	75	45	<10	<10
55	KHT-07/06	430	35	140	55	15	<10
56	KHT-07/07	250	30	85	45	<10	<10

<10	<10	<100	<0.1	0.60	10.42
<10	<10	<100	<0.1	0.35	12.20
<10	<10	<100	<0.1	0.46	5.80



**Analytical results of trench samples for base metals and associated elements of Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.**

**ANNEXURE IV**

Sl. No.	Sample No.	Cu	Pb	Zn	Ni	Co	Cr	Mn	Ag	Cd	Mo	Bi	Sb	As
		All Assay values are in ppm												
57	KHT-07A /01	<10	30	<10	15	<10	<10		<10	<10	<100	<0.1	0.32	4.89
58	KHT-07A /02	<10	35	<10	<10	<10	<10		<10	<10	<100	<0.1	<0.2	<1.0
59	KHT-07A /03	<10	95	<10	<10	<10	<10		<10	<10	<100	<0.1	<0.2	<1.0
60	KHT-07A /04	15	70	45	35	<10	<10		<10	<10	<100	0.10	0.25	1.73
61	KHT-08/01	45	75	35	20	<10	35		<10	<10	<100	0.21	1.15	4.85
62	KHT-08/02	60	45	150	30	35	<10		<10	<10	<100	0.16	0.92	8.39
63	KHT-08/03	140	45	145	85	15	<10		<10	<10	<100	0.23	0.55	7.90
64	KHT-08/04	160	35	320	125	40	<10		<10	<10	<100	0.28	1.11	23.19
65	KHT-08/05	180	30	365	160	35	55		<10	<10	<100	0.22	0.73	12.25
66	KHT-08/06	105	55	340	110	30	<10		<10	<10	<100	0.21	0.40	8.14
67	KHT-08/07	25	60	285	70	15	<10		<10	<10	<100	0.22	0.42	34.87
68	KHT-08 /08	120	45	295	70	20	<10		<10	<10	<100	0.13	0.61	33.11
69	KHT-08 /09	75	35	340	85	25	<10		<10	<10	<100	0.1	0.79	35.14
70	KHT-08 /10	240	30	75	35	15	<10		<10	<10	<100	0.14	0.44	36.68
71	KHT-08 /11	225	30	80	40	<10	<10		<10	<10	<100	0.13	0.63	28.05
72	KHT-08/12	155	20	65	40	<10	<10		<10	<10	<100	0.14	1.02	29.69
73	KHT-08/13	220	15	45	30	<10	<10		<10	<10	<100	0.20	0.32	7.90
74	KHT-08/14	140	25	145	50	<10	<10		<10	<10	<100	0.18	<0.2	14.80
75	KHT-09/01	185	45	35	20	<10	<10		<10	<10	<100	0.13	<0.2	10.33
76	KHT-09/02	240	40	25	20	<10	<10		<10	<10	<100	0.20	0.40	18.97
77	KHT-09/03	260	30	25	15	<10	<10		<10	<10	<100	0.15	0.23	19.42
78	KHT-09/04	195	65	20	25	<10	35		<10	<10	<100	0.20	0.21	24.50
79	KHT-09/05	240	60	55	50	<10	<10		<10	<10	<100	0.13	0.46	8.17
80	KHCHT-01/01	25	<10	50	80	20	<10	870	<10	<10	<100	<0.1	5.60	30.22
81	KHCHT-01/02	20	<10	65	25	<10	<10	425	<10	<10	<100	0.12	2.09	15.24
82	KHCHT-01/03	<10	<10	45	<10	<10	<10	530	<10	<10	<100	<0.1	1.15	4.94
83	KHCHT-01/04	<10	<10	30	<10	<10	<10	690	<10	<10	<100	<0.1	1.55	18.25
84	KHCHT-01/05	10	<10	35	<10	<10	<10	970	<10	<10	<100	<0.1	1.44	18.95
85	KHCHT-01/06	30	<10	55	<10	10	15	660	<10	<10	<100	<0.1	9.51	153.45
86	KHCHT-01/07	75	<10	95	35	<10	<10	480	<10	<10	<100	0.10	4.37	44.76
87	KHCHT-01/08	<10	<10	40	20	<10	<10	600	<10	<10	<100	<0.1	2.00	41.15
88	KHCHT-01/09	45	<10	35	<10	<10	<10	750	<10	<10	<100	0.11	2.30	24.91
89	KHCHT-01/10	40	20	65	<10	<10	<10	890	<10	<10	<100	0.11	4.02	101.52
90	KHCHT-01/11	25	<10	40	<10	<10	<10	650	<10	<10	<100	<0.1	2.03	42.17
91	KHCHT-01/12	25	<10	95	<10	10	<10	910	<10	<10	<100	<0.1	2.98	28.58
92	KHCHT-02/01	<10	<10	35	65	<10	55	810	<10	<10	<100	0.26	1.20	3.13
93	KHCHT-02/02	<10	<10	25	<10	<10	<10	555	<10	<10	<100	0.11	1.35	3.40
94	KHCHT-02/03	25	<10	70	<10	15	<10	320	<10	<10	<100	<0.1	2.37	17.82
95	KHCHT-03/01	15	<10	35	60	<10	75	600	<10	<10	<100	0.10	1.75	9.25
96	KHCHT-03/02	20	<10	50	<10	<10	<10	370	<10	<10	<100	<0.1	1.36	9.28
97	KHCHT-03/03	20	<10	45	<10	<10	<10	340	<10	<10	<100	<0.1	1.63	7.64
98	KHCHT-03/04	30	<10	80	<10	<10	<10	560	<10	<10	<100	<0.1	2.80	29.80
99	KHCHT-04/01	50	<10	85	60	25	25	1670	<10	<10	<100	<0.1	5.21	12.49
100	KHCHT-04/02	35	<10	65	40	20	100	900	<10	<10	<100	<0.1	13.23	6.66
101	KHCHT-04/03	30	<10	40	35	10	65	1230	<10	<10	<100	<0.1	14.05	6.88
102	KHCHT-04/04	45	<10	45	25	20	<10	1300	<10	<10	<100	<0.1	14.93	4.05
103	KHCHT-04/05	50	<10	100	30	40	<10	1450	<10	<10	<100	<0.1	11.84	3.51
104	KHCHT-04/06	55	<10	60	100	<10	110	1950	<10	<10	<100	<0.1	7.99	4.13
105	KHCHT-04/07	40	90	65	25	25	<10	1840	<10	<10	<100	<0.1	9.69	6.00
106	KHCHT-04/08	25	<10	50	30	20	35	1790	<10	<10	<100	<0.1	4.59	8.23
107	KHCHT-05/01	195	25	95	65	35	95		<10	<10	<100	<0.1	25.29	114.83
108	KHCHT-05/02	185	35	115	55	45	<10		<10	<10	<100	<0.1	84.49	95.12

Not Analysed

Anal

109	KHCHT-05/03	70	30	155	45	35	<10
110	KHCHT-05/04	40	35	165	15	45	<10
111	KHCHT-05/05	110	35	110	110	55	<10

<10	<10	<100	<0.1	38.13	78.68
<10	<10	<100	<0.1	18.43	73.91
<10	<10	<100	<0.1	28.31	85.85



**Whole rock analysis of samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnata ANNEXURE V**

Sample No.	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Total Fe as Fe <sub>2</sub> O <sub>3</sub>	Total Mn as MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	Ba	Ga	Sc	V	Th	Pb	Ni	Co	Rb	Sr	Y	Zr	Nb	Cr	Cu	Zn
	(%)										(ppm)or (mg/kg)															
KH/PCS-01	43.15	16.91	9.46	0.40	6.73	13.54	1.59	0.19	0.34	0.05	<50	14	29	145	<4	13	70	28	3	135	12	36	7	187	33	60
KH/PCS-02	45.15	11.55	17.41	0.16	3.31	8.49	2.93	<0.10	1.92	0.19	<50	21	48	422	6	6	10	34	<5	83	39	148	10	46	36	137
KH/PCS-03	55.80	18.07	10.17	0.07	3.01	0.40	1.18	3.66	0.63	0.11	862	16	19	177	6	11	75	19	122	50	31	129	11	273	58	97
KH/PCS-04	56.68	17.19	9.63	0.09	3.62	0.54	1.83	2.53	0.72	0.10	642	14	17	179	5	15	60	20	92	101	26	119	12	234	52	90
KH/PCS-05	49.81	11.90	13.56	0.18	7.50	9.81	1.85	0.25	0.70	0.08	<50	14	32	224	8	8	138	42	<5	99	20	49	5	407	68	131
KH/PCS-06	53.92	15.80	16.34	0.11	3.00	1.34	1.60	1.16	1.13	0.05	327	10	42	391	7	8	122	44	44	74	27	87	9	291	121	128
KH/PCS-07	75.08	17.35	0.80	0.01	0.10	0.17	1.27	3.70	<0.01	0.03	896	24	<3.5	<20	5	13	3	4	121	36	27	74	9	95	6	<10
KH/PCS-08	48.24	11.30	15.11	0.17	7.78	8.62	1.50	0.16	0.71	0.08	<50	20	44	242	8	13	84	38	<5	112	22	69	<5	350	97	129
KH/PCS-09	47.33	11.97	14.65	0.30	7.25	8.71	1.02	0.16	0.93	0.09	77	12	36	299	4	7	116	47	<5	82	25	66	6	261	161	134
KH/PCS-10	62.53	12.47	7.06	0.10	3.29	4.11	2.61	2.23	0.45	0.08	555	19	12	87	6	21	86	20	104	178	29	130	10	218	73	95
KH/PCS-11	46.02	18.60	9.12	0.12	7.02	9.13	2.78	0.40	0.19	0.05	<50	12	15	64	<4	8	177	30	5	164	10	21	6	289	28	102
KH/PCS-12	67.44	12.78	4.26	0.06	1.90	2.87	3.06	3.09	0.27	0.06	250	20	6	49	10	27	37	10	126	130	44	120	10	233	40	54
KH/PCS-13	67.61	13.00	4.31	0.07	1.63	2.76	3.23	3.23	0.30	0.08	315	22	4	47	7	31	43	12	155	137	54	141	17	212	43	74
KH/PCS-14	53.55	15.35	10.39	0.14	4.48	8.38	2.60	1.32	0.70	0.11	157	14	22	171	<4	11	133	32	104	234	25	93	7	285	87	108
KH/PCS-15	49.64	9.17	14.48	0.24	7.18	12.72	1.83	0.20	0.89	0.09	<50	20	32	230	6	14	463	69	<5	260	16	70	6	873	122	131
KH/PCS-16	50.69	11.22	14.73	0.23	6.23	9.65	2.74	0.21	1.10	0.09	57	18	34	293	4	13	120	59	<5	242	20	79	7	110	186	144
KH/PCS-17	53.35	8.95	14.63	0.20	7.95	9.29	1.39	0.42	1.02	0.11	108	16	25	214	<4	11	216	59	15	193	18	101	8	674	155	121
KH/PCS-18	60.28	12.33	16.13	0.18	1.75	0.29	0.25	2.02	0.83	0.12	145	16	21	227	11	15	94	33	63	54	40	114	13	153	101	131
KH/PCS-19	55.13	11.74	14.53	0.20	6.35	3.88	2.59	0.15	0.90	0.11	<50	17	22	226	<4	14	106	40	<5	241	26	97	9	188	107	111
KH/PCS-20	48.90	10.32	16.53	0.24	4.39	10.72	2.27	0.42	1.45	0.15	158	20	33	308	5	4	56	42	11	118	37	126	10	117	83	163
REPEAT	48.89	10.30	16.48	0.24	4.12	10.65	2.17	0.42	1.38	0.15	157	18	31	307	4	4	54	41	10	117	36	125	10	110	81	162
OBTAINED	50.61	17.11	11.82	0.17	5.05	9.66	3.06	0.78	1.25	0.29	232	16	32	369	<4	5	39	23	14	405	28	101	<5	60	207	94
CERTIFIED	51.00	16.90	11.88	0.16	5.20	9.86	2.82	0.78	1.45	0.29	251	21	33	383	1	6	39	36	13	395	27	98	2	60	198	106
KH/PCS-21	68.90	15.63	1.54	0.04	0.54	1.43	5.02	3.29	0.15	0.06	1490	17	<3.5	<20	6	31	11	5	90	386	11	118	8	200	12	36
KH/PCS-22	59.21	15.73	5.27	0.10	2.17	4.82	4.96	2.84	0.58	0.31	1609	27	5	82	8	28	28	14	60	1170	21	190	11	184	20	85

REE data of samples of Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

ANNEXURE VI

Sample No.	Be	Ge	Sn	La	Ce	Pr	Nd	Eu	Sm	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
	Concentrations in ppm (mg/Kg)																			
KH/PCS-01	0.45	0.93	<5	11.36	23.32	2.66	9.59	0.73	1.58	0.25	1.54	1.56	0.30	0.92	0.14	0.90	0.13	<0.2	<0.2	<0.5
KH/PCS-02	0.54	1.64	<5	10.32	27.98	4.26	11.29	1.85	5.65	1.22	7.11	8.11	1.58	4.73	0.75	4.85	0.73	2.43	0.35	<0.5
KH/PCS-03	2.16	1.70	<5	28.60	58.35	6.71	25.59	1.20	4.81	0.78	4.69	4.64	0.90	2.74	0.43	2.73	0.41	2.31	0.64	2.20
KH/PCS-04	1.58	1.46	<5	37.41	64.39	7.96	29.66	1.30	5.18	0.71	4.70	4.10	0.76	2.20	0.35	2.23	0.34	1.84	0.50	2.31
KH/PCS-05	<0.3	1.24	<5	2.67	6.50	1.01	5.24	0.67	1.65	0.44	2.42	3.13	0.65	1.99	0.31	2.01	0.31	<0.2	<0.2	<0.5
KH/PCS-06	0.81	2.23	<5	13.48	28.12	3.53	15.39	1.17	3.51	0.73	4.14	4.83	0.97	2.82	0.47	2.91	0.45	0.60	<0.2	1.03
KH/PCS-07	2.31	1.46	<5	12.18	21.90	3.56	18.40	0.49	2.34	0.63	2.64	3.25	0.55	1.61	0.26	1.62	0.24	1.23	1.83	3.25
KH/PCS-08	0.46	1.47	<5	10.71	21.91	2.83	12.51	0.62	2.37	0.51	2.82	3.22	0.63	1.82	0.29	1.86	0.27	<0.2	<0.2	0.74
KH/PCS-09	0.42	1.11	<5	4.07	9.88	2.02	11.91	0.87	1.89	0.56	2.66	3.47	0.68	2.03	0.33	2.18	0.34	<0.2	<0.2	<0.5
KH/PCS-10	1.13	1.02	<5	29.73	55.66	6.51	24.44	0.91	4.77	0.81	4.87	4.97	0.97	2.79	0.43	2.53	0.38	1.82	0.23	1.83
KH/PCS-11	0.40	1.07	<5	7.45	17.96	3.49	10.61	0.64	1.28	0.46	1.32	1.71	0.22	0.65	0.10	0.64	0.10	<0.2	<0.2	<0.5
KH/PCS-12	1.85	1.08	<5	23.81	49.36	5.55	22.10	0.68	4.45	1.01	5.30	6.96	1.38	4.27	0.71	4.52	0.69	2.07	1.16	5.85
KH/PCS-13	1.81	1.03	<5	28.70	57.18	6.40	24.02	0.71	5.12	1.11	5.89	7.64	1.57	4.99	0.83	5.49	0.79	1.99	1.42	5.50
KH/PCS-14	0.71	1.30	<5	18.19	37.13	4.34	17.34	1.01	3.32	0.56	3.41	3.38	0.65	1.88	0.29	1.79	0.27	0.30	<0.2	0.92
KH/PCS-15	0.47	1.56	<5	6.23	14.96	2.47	13.08	1.05	2.65	0.56	3.13	3.28	0.59	1.60	0.23	1.46	0.21	<0.2	<0.2	<0.5
KH/PCS-16	0.60	1.55	<5	8.31	19.39	2.77	13.33	1.15	3.17	0.65	3.81	3.94	0.73	2.05	0.29	1.85	0.26	0.22	<0.2	<0.5
KH/PCS-17	0.80	1.46	<5	17.92	37.17	4.65	19.77	1.29	4.22	0.67	4.25	3.96	0.71	1.95	0.29	1.78	0.25	0.90	<0.2	0.99
KH/PCS-18	1.01	1.47	<5	30.80	62.10	7.23	28.66	1.62	5.62	1.04	6.16	6.79	1.30	3.93	0.61	3.81	0.60	3.47	0.51	2.56
KH/PCS-19	0.87	1.25	<5	17.03	34.98	4.27	18.12	1.03	3.83	0.72	4.24	4.69	0.91	2.71	0.42	2.67	0.40	1.48	0.25	1.12
KH/PCS-20	0.84	1.21	<5	15.99	35.38	4.49	19.91	1.56	4.81	1.13	6.09	7.59	1.53	4.65	0.73	4.59	0.73	1.65	0.31	0.67
KH/PCS-21	1.38	0.60	<5	17.89	37.91	3.71	13.24	0.71	2.24	0.21	1.46	1.15	0.22	0.65	0.10	0.69	0.11	1.00	0.36	1.46
KH/PCS-22	1.76	1.00	<5	74.95	148.76	16.07	62.34	2.39	9.45	0.89	6.46	4.25	0.69	1.86	0.27	1.59	0.24	2.55	0.28	1.68



Analytical results of stream sediment samples of Kanivehalli and adjoining areas ,Davangere

and Bellary Districts, Karnataka.

ANNEXURE VII

Sl no.	Sample No.	co-ordinates			Cu	Pb	Zn	Ni	Co	Cr	Au
		latitude	longitude								
1	KH /SSS-01	14 47 34	76 2 3.7	argillite	60	25	65	115	25	<10	<25
2	KH /SSS-02	14 47 30.6	76 03 11.56	argillite	50	20	60	75	30	<10	<25
3	KH /SSS-03	14 48 45.3	76 01 7.86	Granite gneiss	30	20	40	45	<10	<10	<25
4	KH /SSS-04	14 48 35	76 01 20.8	Granite gneiss	45	30	45	75	20	<10	<25
5	KH /SSS-05	14 48 24.7	76 02 34.5	Meta basalt	55	45	55	70	25	<10	<25
6	KH /SSS-06	14 48 31.2	76 03 50.9	Argillite/BIF	100	35	105	110	45	<10	<25
7	KH /SSS-07	14 48 3.5	76 04 46.8	Argillite	75	35	70	75	35	<10	<25
8	KH /SSS-08	14 49 37	76 01 36.6	Metabasalt	70	40	70	75	35	<10	<25
9	KH /SSS-09	14 49 23	76 03 04	Argillite	80	30	80	80	45	<10	30
10	KH /SSS-10	14 49 48	76 04 21.45	Argillite	85	30	75	100	45	75	<25
11	KH /SSS-11	14 50 32.6	76 00 28.1	Metabasalt	45	<10	50	65	25	<10	<25
12	KH /SSS-12	14 50 20	76 2 0.6	Argillite	50	35	55	75	25	<10	150
13	KH /SSS-13	14 49 48.5	76 4 21.1	Amphibolite	85	40	75	85	40	<10	<25
14	KH /SSS-14	14 51 16.9	76 01 15.7	Argillite	65	35	65	70	35	<10	80
15	KH /SSS-15	14 50 50.8	76 02 24.2	Argillite	55	35	60	75	35	<10	<25
16	KH /SSS-16	14 51 18.3	76 03 11.9	Metabasalt	95	25	85	85	50	<10	<25
17	KH /SSS-17	14 50 49	76 03 42.3	Metabasalt	120	35	110	120	55	65	<25
18	KH /SSS-18	14 50 30	76 04 1.2	Metabasalt	110	40	90	95	45	<10	<25
19	KH /SSS-19	14 50 56.3	76 04 28.3	Metabasalt	105	25	110	85	40	<10	<25
20	KH /SSS-20	14 51 7.6	76 04 59.1	Amphibolite	110	35	75	110	45	<10	<25
21	KH /SSS-21	14 52 35	76 00 37.37	BIF	95	30	95	95	50	<10	<25
22	KH /SSS-22	14 52 43.4	76 01 4.7	BIF	90	30	140	110	55	30	<25
23	KH /SSS-23	14 52 28.6	76 02 10.2	Metabasalt	210	50	25	140	105	<10	30
24	KH /SSS-24	14 52 6.4	76 03 13.6	Metabasalt	110	45	185	205	65	35	<25
25	KH /SSS-25	14 51 55	76 05 00	Amphibolite	95	25	120	110	45	160	<25
26	KH /SSS-26	14 53 19.8	76 01 5.8	Argillite/BIF	90	30	65	110	50	45	<25
27	KH /SSS-27	14 53 9.5	76 01 48	Argillite/BIF	125	35	80	95	55	85	<25
28	KH /SSS-28	14 52 54	76 03 25.6	Metabasalt	120	30	90	85	50	<10	<25
29	KH /SSS-29	14 53 58.6	76 00 19.5	Argillite	110	35	95	100	55	<10	<25
30	KH /SSS-30	14 53 35	76 04 36	Amphibolite	35	45	105	95	20	<10	<25
31	KH /SSS-30A	14°47'31.4"	76°1'25"	Argillite/BIF	60	35	65	50	20	<10	<25
32	KH /SSS-30B	14°47'32.9"	76°1'59.6"	-do-	40	25	60	75	20	<10	<25
33	KH /SSS-30C	14°48'15.2"	76°0'16.5"	-do-	30	40	50	75	15	<10	<25
34	KH /SSS-30D	14°48'16.9"	76°1'41.1"	-do-	50	30	35	55	25	<10	<25
35	KH /SSS-45A	14°48'26.4"	76°2'39.7"	-do-	95	35	45	105	55	15	<25
36	KH /SSS-45B	14°48'46.5"	76°3'7.8"	-do-	70	35	110	120	25	110	<25
37	KH /SSS-45C	14°49'7.5"	76°2'19.8"	-do-	50	40	85	85	20	<10	<25
38	KH /SSS-45D	14°48'55.4"	76° 3'1"	-do-	65	40	65	65	30	<10	40
39	KH /SSS-59A	14°49'25.2"	76°3'11.2"	-do-	70	30	55	70	35	<10	<25
40	KH /SSS-59B	14°49'29.3"	76°3'11.2"	-do-	75	40	90	95	40	<10	25
41	KH /SSS-59C	14°50'18.3"	76°2'21.4"	-do-	70	35	105	105	35	<10	35
42	KH /SSS-59D	14°50'18.2"	76°3'17.6"	-do-	75	40	95	110	45	<10	60



Mineral Chemistry of Chlorite from samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts,  
Karnataka.

ANNEXURE VIII

Formula	8 / 1 .	9 / 1 .	10 / 1 .	11 / 1 .	16 / 1 .	17 / 1 .	18 / 1 .	19 / 1 .	6 / 1 .	7 / 1 .	8 / 1 .	9 / 1 .	10 / 1 .	31 / 1 .
Sample No	PS-6	PS-6	PS-6	PS-6	PS-6	PS-6	PS-6	PS-6	PS-14	PS-14	PS-14	PS-14	PS-14	PS-14
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OH*	16.00	16.00	16.00		16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Total	36.04	35.94	35.94	35.94	35.91	36.00	35.95	35.91	35.95	36.05	36.01	35.99	35.98	35.90
Oxidized	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Fe/Fe+Mg	0.41	0.41	0.40	0.43	0.41	0.42	0.42	0.40	0.35	0.35	0.35	0.35	0.30	0.35
Variety	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	ripidolite	pycnochlor	ripidolite
Al total	5.04	5.36	5.02	5.41	5.26	5.18	5.18	4.97	5.23	5.23	5.37	5.21	4.47	5.18
Al iv (1)	2.54	2.64	2.49	2.66	2.55	2.61	2.55	2.42	2.58	2.59	2.64	2.59	2.17	2.51
Al iv (2)	2.54	2.64	2.49	2.66	2.55	2.61	2.55	2.42	2.58	2.59	2.64	2.59	2.17	2.51
Al vi	2.50	2.72	2.53	2.75	2.71	2.56	2.63	2.55	2.65	2.64	2.72	2.61	2.30	2.66
Si	5.46	5.36	5.51	5.34	5.45	5.39	5.45	5.58	5.42	5.41	5.36	5.41	5.83	5.49
Fe/Fe+Mg	0.41	0.41	0.40	0.43	0.41	0.42	0.42	0.40	0.35	0.35	0.35	0.35	0.30	0.35
Rock types	PS-6: Metabasalt(Kakkadahalli), PS-14: Metabasalt(kakkadahalli east),PS-7 Metabasalt(Chigateri),PS-5404,5403:Granophyre(Hombalagahtti)													



Mineral Chemistry of Chlorite from samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts,  
Karnataka.

ANNEXURE VIII

34 / 1 .	40 / 1 .	1 / 1 .	11 / 1 .	17 / 1 .	20 / 1 .	21 / 1 .	22 / 1 .	6 / 1 .	7 / 1 .	11 / 1 .	21 / 1 .	22 / 1 .	23 / 1 .	2 / 1 .
PS-14	PS-14	PS-7	PS-7	PS-7	PS-7	PS-7	PS-7	PS-5404	PS-5404	PS-5404	PS-5404	PS-5404	PS-5404	PS-5403
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
35.96	35.93	35.98	35.93	36.06	35.93	35.96	36.07	35.88	35.96	35.93	35.95	35.96	35.93	35.95
yes														
0.36	0.34	0.64	0.61	0.65	0.63	0.65	0.65	0.35	0.34	0.35	0.36	0.34	0.35	0.52
ripidolite														
5.19	5.03	5.37	5.18	5.50	5.28	5.45	5.48	5.25	5.05	5.32	5.44	5.24	5.16	4.81
2.54	2.45	2.67	2.50	2.76	2.59	2.67	2.69	2.59	2.53	2.61	2.67	2.59	2.53	2.41
2.54	2.45	2.67	2.50	2.76	2.59	2.67	2.69	2.59	2.53	2.61	2.67	2.59	2.53	2.41
2.65	2.58	2.70	2.68	2.75	2.69	2.78	2.78	2.67	2.51	2.72	2.77	2.65	2.63	2.40
5.46	5.55	5.33	5.50	5.24	5.41	5.33	5.31	5.41	5.47	5.39	5.33	5.41	5.47	5.59
0.36	0.34	0.64	0.61	0.65	0.63	0.65	0.65	0.35	0.34	0.35	0.36	0.34	0.35	0.52

Mineral Chemistry of epidote from samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

ANNEXURE IX

Formula	5 / 1 .	8 / 1 .	13 / 1 .	25 / 1 .	1 / 1 .	3 / 1 .	4 / 1 .	5 / 1 .	29 / 1 .	37 / 1 .	1 / 1 .	2 / 1 .	3 / 1 .	8 / 1 .	13 / 1 .	2 / 1 .	7 / 1 .	13 / 1 .	21 / 1 .
Sample No	PS-5404	PS-5404	PS-4	PS-7	PS-14	PS-14	PS-14	PS-14	PS-14	PS-14	PS-19	PS-19	PS-19	PS-19	PS-19	PS-6	PS-6	PS-6	PS-6
Rock type	Granophyr	Granophyr	metabas al																
SiO <sub>2</sub>	38.26	38.09	38.02	37.25	38.85	38.68	38.45	38.63	39.18	38.60	38.78	40.55	38.42	38.76	40.81	38.28	38.29	38.65	37.79
TiO <sub>2</sub>	0.08	0.11	0.05	0.11	0.12	0.19	0.17	0.18	0.06	0.09	0.40	0.45	0.29	0.02	0.23	0.09	0.09	0.14	0.01
Al <sub>2</sub> O <sub>3</sub>	28.71	28.66	23.55	20.80	28.75	28.81	28.75	29.03	28.79	28.50	24.28	22.17	26.78	27.83	25.61	28.23	27.10	28.19	28.16
Cr <sub>2</sub> O <sub>3</sub>	0.68	1.33	0.00	0.03	0.03	0.05	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00
FeO	5.24	5.16	11.59	12.06	5.63	5.96	5.78	5.39	5.24	5.67	9.28	9.80	7.00	6.33	6.62	5.67	6.98	6.59	5.58
MnO	0.17	0.14	0.04	0.17	0.12	0.07	0.09	0.05	0.24	0.15	0.12	0.17	0.12	0.14	0.10	0.11	0.16	0.03	0.12
Na <sub>2</sub> O	0.03	0.05	0.23	0.01	0.05	0.14	0.06	0.02	0.05	0.02	0.05	0.07	0.07	0.03	0.06	0.02	0.01	0.03	0.02
K <sub>2</sub> O	0.01	0.03	0.00	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.01	0.06	0.03	0.01	0.01	0.02
MgO	0.06	0.05	0.01	1.26	0.05	0.03	0.04	0.02	0.01	0.01	0.85	2.77	0.16	0.03	1.43	0.05	0.00	0.04	0.02
CaO	24.50	24.28	23.17	23.70	25.82	25.89	25.82	25.91	25.94	25.66	23.28	22.32	24.15	24.42	23.49	24.13	24.47	24.67	24.05
Total	97.80	97.94	96.67	95.53	99.50	99.90	99.30	99.29	99.59	98.72	97.06	98.34	97.04	97.57	98.41	96.66	97.12	98.37	95.76
Comment	epidote	epidote	epidote	epidote	epidote	epidote	epidote	epidote	epidote	epidote	zoisite	epidote	zoisite	zoisite	epidote	zoisite	zoisite	zoisite	zoisite
Si	0.689	0.844	0.55	0.399	0.85	0.919	0.562	0.76	0.378	0.552	0.95	1.01	1.02	0.57	0.90	0.572	0.683	0.341	0.574
Ti	0.433	0.384	0.31	0.178	0.36	0.273	0.159	0.65	0.325	0.311	0.12	0.12	0.18	1.45	0.21	0.320	0.248	0.124	0.224
Al	1.137	1.390	0.93	0.884	1.43	1.522	0.927	1.28	0.850	0.927	1.87	2.29	1.82	0.98	1.78	0.962	1.159	0.773	0.995
Fe+3	1.533	1.900	1.15	0.375	1.79	1.863	1.229	1.72	1.149	1.146	1.21	1.27	1.71	1.07	1.70	1.178	1.220	0.814	1.053
Mn	0.163	0.242	0.15	0.092	0.29	0.413	0.457	0.13	0.130	0.150	0.32	0.25	0.34	0.17	0.39	0.210	0.925	0.925	0.291
Mg	0.116	0.169	0.56	0.003	0.17	0.232	0.286	0.78	0.779	0.561	0.01	0.00	0.06	0.19	0.01	0.115	0.173	0.173	0.291
Ca	0.656	0.807	0.51	0.382	0.78	0.834	0.511	0.70	0.696	0.506	0.96	1.12	0.99	0.55	0.96	0.553	0.652	0.652	0.547
Na	10.630	7.781	12.89	17.963	8.00	7.122	13.141	7.17	14.340	12.895	8.89	7.07	6.80	8.92	7.42	13.255	10.639	21.278	13.401
K	0.000	0.000	0.00	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000
H	1.000	1.000	1.00	1.000	1.00	1.00	1.000	1.00	1.000	1.000	1.00	1.00	1.00	1.00	1.00	1.000	1.000	1.000	1.000
Total	16.36	14.52	18.05	21.28	14.68	14.18	18.27	14.18	19.65	18.05	15.34	14.13	13.93	14.91	14.36	18.17	16.70	26.08	18.38

Mineral Chemistry of Feldspar from

ANNEXURE X

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

Formula	1 / 1.	5 / 1.	27 / 1.	28 / 1.	29 / 1.	30 / 1.	33 / 1.	18 / 1.	19 / 1.	20 / 1.	21 / 1.	22 / 1.	30 / 1.
sample No.	PS-6	PS-6	PS-6	PS-6	PS-6	PS-6	PS-6	PS-14	PS-14	PS-14	PS-14	PS-14	PS-14
Rock types:	PS-6: Metabasalt(Kakkadahalli), PS-14: Metabasalt(kakkadahalli east),PS-4: Metabasalt (Kongana Hosusru), PS-7 Metabasalt(Chigateri)												
SiO <sub>2</sub>	64.22	65.13	67.91	66.36	67.01	66.2	64.45	60.91	65.14	60.65	61.09	64.26	64.17
TiO <sub>2</sub>	0	0.08	0.03	0	0	0	0.01	0.01	0.03	0	0	0	0
Al <sub>2</sub> O <sub>3</sub>	17.77	17.96	20.42	21.25	20.6	21.27	18.04	24.87	21.96	24.35	24.69	22.69	22.62
Cr <sub>2</sub> O <sub>3</sub>	0	0	0	0	0	0.01	0	0.01	0.02	0	0.01	0	0
FeO	0	0.04	0.24	0.25	0.25	0.3	0.21	0.28	0.24	0.19	0.27	0.4	0.15
MnO	0.08	0	0	0	0.06	0.04	0.03	0	0	0.02	0	0.01	0
Na <sub>2</sub> O	0.38	0.4	11.42	11.08	11.43	11.34	0.29	8.03	10.95	8.66	8.34	10.26	9.6
K <sub>2</sub> O	15.69	16.06	0.08	0.07	0.14	0.07	16.11	0.09	0.05	0.08	0.07	0.04	0.1
MgO	0.01	0	0	0.02	0.01	0	0	0	0	0.1	0	0	0.01
CaO	0	0.01	1.2	2.18	1.48	1.76	0.02	6.93	2.4	5.84	6.5	3.68	4.45
NiO								0	0	0	0	0.08	0.06
BaO								0.03	0	0.05	0.01	0	0.03
P <sub>2</sub> O <sub>5</sub>								0	0	0	0.01	0.02	0.03
Total	98.16	99.68	101.31	101.22	100.97	101	99.17	101.15	100.77	99.94	101	101.44	0.03
Comment	orthoclase	orthoclase	albite	albite	albite	albite	orthoclase	albite	albite	albite	albite	albite	0.03
Si	16.16	3.015128	2.943369	2.890682	2.92185	2.890399	3.004867	15.06	2.853965	2.704858	2.697645	2.809799	2.810457
Al	16.9711	0.980007	1.043194	1.091066	1.058726	1.094625	0.991373	19.81029	1.134048	1.280002	1.285091	1.169411	1.167712
Ti	0	0.002785	0.000978	0	0	0	0.000351	0.005082	0.000989	0	0	0	0
Fe	0	0.001549	0.0087	0.009108	0.009117	0.010955	0.008188	0.158252	0.008794	0.007087	0.009971	0.014627	0.005494
Mn	0.054907	0	0	0	0.002216	0.001479	0.001185	0	0	0.000756	0	0.00037	0
Mg	0.012079	0	0	0.001299	0.00065	0	0	0	0	0.006648	0	0	0.000653
Ca	0	0.000496	0.05573	0.101752	0.069147	0.082339	0.000999	5.018159	0.11267	0.279075	0.307555	0.172416	0.208833
Na	0.59702	0.035906	0.959749	0.935867	0.966374	0.960049	0.026217	10.52236	0.930241	0.74888	0.714104	0.869886	0.815261
K	16.21572	0.94833	0.004423	0.003889	0.007786	0.003898	0.958047	0.07758	0.002794	0.004551	0.003943	0.002231	0.005586
Total	50.01082	4.984201	5.016142	5.033663	5.035867	5.04409	4.991228	50.65707	5.044194	5.031856	5.018658	5.041554	5.016111
Or	96.44901	96.30337	0.433643	0.373438	0.746317	0.372594	97.23769	0.49673	0.267209	0.440758	0.384435	0.21358	0.54254
Ab	3.550994	3.646259	94.10214	89.85686	92.626	91.75775	2.6609	67.37286	88.95829	72.53035	69.62783	83.27994	79.17612
An	0	0.050373	5.46422	9.769707	6.627686	7.869659	0.101408	32.13041	10.7745	27.02889	29.98774	16.50648	20.28134

Mineral Chemistry of Feldspar from

ANNEXURE X

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

32 / 1 .	35 / 1 .	38 / 1 .	41 / 1 .	16 / 1 .	17 / 1 .	18 / 1 .	19 / 1 .	20 / 1 .	8 / 1 .	9 / 1 .	10 / 1 .	17 / 1 .	18 / 1 .	19 / 1 .
PS-14	PS-14	PS-14	PS-14	PS-4	PS-4	PS-4	PS-4	PS-4	PS-7	PS-7	PS-7	PS-5404	PS-5404	PS-5404

PS-5404:Granophyre(Hombalagahtti)

63.72	52.33	65.93	62.69	58.75	58.38	58.07	55.36	56.54	68.67	68.56	67.66	61.4	62.19	63.16
0.01	0	0	0	0	0.02	0	0.01	0	0	0.05	0.11	0	0.03	0
22.62	29.15	21.28	23.52	26.67	26.1	26.14	26.46	26.8	19.42	19.97	19.58	24.37	23.44	23.18
0	0	0.02	0	0	0	0	1.27	0	0.02	0	0	0.01	0	0.01
0.16	0.81	0.25	0.21	0.33	0.13	0.14	0.28	0.15	0.29	0.47	0.42	0.22	0.08	0.01
0	0	0.01	0	0	0.07	0	0.02	0	0.03	0	0	0	0	0.05
9.39	4.58	10.73	8.76	6.99	6.87	7.11	6.42	6.3	12.05	12.26	12	8.75	8.79	9.31
0.06	0.16	0.09	0.07	0.09	0.06	0.07	0.11	0.06	0.02	0.04	0.03	0.1	0.1	0.09
0	0.12	0.01	0	0.02	0.02	0.01	0.01	0.01	0.02	0	0.01	0	0	0
4.29	12.91	2.56	5.71	8.51	8.4	8.33	9.2	9.22	0.15	0.02	0.08	5.89	5.3	4.3
0.05	0	0	0.02	0	0.01	0.05	0	0	0	0.04	0	0.03	0	0
0.05	0	0.03	0	0	0.02	0	0.01	0	0.03	0	0	0	0	0
0	0	0.02	0									0	0	0
100.36	100.06	100.94	100.98	101.36	100.09	99.91	99.14	99.08	100.69	101.4	99.89	100.77	99.93	100.1
albite														
2.810754	2.386367	2.883082	2.75846	15.61	2.611483	2.604153	2.524376	2.560848	12.29	2.966985	2.970662	14.78	2.760942	2.790732
1.176083	1.566835	1.096841	1.219843	21.12331	1.376137	1.381715	1.422152	1.430741	15.74804	1.01864	1.013286	19.44275	1.22657	1.207223
0.000332	0	0	0	0	0.000673	0	0.000343	0	0	0.001627	0.003632	0	0.001002	0
0.005903	0.030892	0.009143	0.007728	0.185451	0.004863	0.005251	0.010678	0.005682	0.16686	0.017011	0.015422	0.124538	0.00297	0.00037
0	0	0.00037	0	0	0.002652	0	0.000773	0	0.017483	0	0	0	0	0.001871
0	0.008158	0.000652	0	0.020034	0.001334	0.000669	0.00068	0.000675	0.020512	0	0.000655	0	0	0
0.202768	0.630822	0.119952	0.269215	6.127236	0.402621	0.400271	0.449511	0.447459	0.110577	0.000927	0.003764	4.271825	0.25212	0.203582
0.803144	0.404979	0.909818	0.7474	9.107489	0.595882	0.618251	0.567641	0.553285	16.07484	1.028764	1.021605	11.48399	0.75667	0.797639
0.003376	0.009307	0.00502	0.003929	0.077139	0.003423	0.004004	0.006398	0.003466	0.017551	0.002208	0.00168	0.086336	0.005663	0.005072
5.004133	5.037359	5.02557	5.007283	52.25066	4.999429	5.016117	5.028333	5.002157	44.45674	5.037554	5.030706	50.21111	5.005937	5.006838
0.334482	0.890501	0.485125	0.384967	0.503784	0.341686	0.391586	0.625073	0.345178	0.108319	0.213972	0.163584	0.544978	0.558206	0.504061
79.57534	38.74998	87.92294	73.23549	59.47995	59.47363	60.46312	55.45808	55.09655	99.20923	99.69615	99.46997	72.49008	74.58899	79.26508
20.09018	60.35952	11.59194	26.37954	40.01627	40.18468	39.14529	43.91685	44.55827	0.682448	0.089873	0.36645	26.96494	24.8528	20.23086



**Mineral Chemistry of Amphiboles from  
samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.**

**ANNEXURE XI**

Zn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Li* (not im	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.01	1.97	2.03	2.02	2.03	2.02	2.00	1.77	1.85	1.96	1.99	1.98	1.93	
Na	0.07	0.08	0.06	0.07	0.08	0.08	0.11	0.21	0.21	0.22	0.12	0.25	0.06	
K	0.03	0.02	0.03	0.02	0.03	0.03	0.05	0.04	0.02	0.04	0.02	0.02	0.00	
Ba	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
OH*	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
Total	17.09	17.04	17.12	17.11	17.14	17.11	17.14	17.01	17.08	17.23	17.14	17.25	16.99	
Calculation	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$									
Amphibole	Ca	Ca	Ca	Ca	Ca									
(Ca+Na) (B)	2.01	2.00	2.03	2.02	2.03	2.02	2.00	1.97	2.00	2.00	2.00	2.00	1.99	
Na (B)	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.21	0.15	0.04	0.01	0.02	0.06	
(Na+K) (A)	0.10	0.07	0.10	0.09	0.11	0.11	0.16	0.04	0.08	0.23	0.14	0.25	0.00	
Mg/(Mg+F)	0.63	0.65	0.59	0.66	0.61	0.64	0.61	0.78	0.71	0.65	0.70	0.63	0.75	
Fe <sup>3+</sup> /(Fe <sup>3+</sup> +A)	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.94	0.67	0.46	0.25	0.22	0.73	
Sum of S <sub>2</sub>	12.98	12.98	12.99	12.99	13.00	12.98	12.98	13.00	13.00	13.00	13.00	13.00	13.00	
Amphibole														
								ferrian-						
	actinolite	magnesio-	actinolitic	actinolitic	actinolite	magnesio-	actinolite							
								hornblende	hornblende		hornblende		hornblende	

**Mineral Chemistry of Amphiboles from**

**ANNEXURE XI**

**samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.**

Formula	11 / 1 .	12 / 1 .	13 / 1 .	14 / 1 .	15 / 1 .	16 / 1 .	23 / 1 .	24 / 1 .	25 / 1 .	26 / 1 .	27 / 1 .	28 / 1 .	33 / 1 .
sample NO	PS-14												
SiO <sub>2</sub>	49.74	49.96	51.75	49.57	50.27	52.89	50.91	46.63	55.57	49.65	47.81	50.02	51.17
TiO <sub>2</sub>	0.13	0.19	0.02	0.11	0.06	0.06	0.20	1.62	0.03	0.67	0.57	0.40	0.65
Al <sub>2</sub> O <sub>3</sub>	7.07	6.32	5.69	7.11	6.64	4.98	5.23	8.07	1.47	5.67	7.33	5.74	4.57
Cr <sub>2</sub> O <sub>3</sub>	0.04	0.06	0.03	0.09	0.01	0.00	0.03	0.10	0.05	0.06	0.05	0.04	0.04
FeO	12.96	12.94	11.36	13.08	13.11	11.49	12.97	13.59	9.70	13.65	15.13	14.18	12.00
MnO	0.28	0.16	0.24	0.24	0.19	0.29	0.04	0.18	0.22	0.22	0.13	0.17	0.37
Na <sub>2</sub> O	0.91	0.87	0.63	0.81	0.89	0.54	0.88	1.31	0.18	0.83	1.17	0.83	0.58
K <sub>2</sub> O	0.29	0.23	0.21	0.31	0.23	0.16	0.25	0.46	0.03	0.19	0.31	0.23	0.24
MgO	13.82	14.47	15.05	14.06	14.29	15.69	14.75	13.93	17.76	13.91	12.99	13.85	15.43
CaO	13.09	13.14	13.65	13.14	12.77	13.33	12.66	12.67	13.41	12.69	12.64	12.79	13.02
NiO	0.00	0.01	0.09	0.07	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.06	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00
P <sub>2</sub> O <sub>5</sub>	0.03	0.02	0.01	0.00	0.03	0.00	0.01	0.03	0.03	0.01	0.05	0.00	0.00
Total	98.37	98.37	98.73	98.58	98.51	99.44	97.92	98.61	98.45	97.68	98.25	98.31	98.07
Comment	amphibole												
No. of oxyg	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Structural													
Si	7.19	7.21	7.38	7.14	7.22	7.47	7.34	6.76	7.83	7.23	6.98	7.24	7.36
Al iv	0.81	0.79	0.62	0.86	0.78	0.53	0.66	1.24	0.17	0.77	1.02	0.76	0.64
Al vi	0.40	0.28	0.34	0.35	0.34	0.30	0.23	0.13	0.08	0.20	0.24	0.22	0.13
Ti	0.01	0.02	0.00	0.01	0.01	0.01	0.02	0.18	0.00	0.07	0.06	0.04	0.07
Cr	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
Fe <sup>3+</sup>	0.01	0.12	0.00	0.14	0.22	0.01	0.17	0.36	0.00	0.19	0.31	0.21	0.15
Fe <sup>2+</sup>	1.56	1.44	1.36	1.43	1.36	1.35	1.39	1.29	1.14	1.47	1.53	1.51	1.29
Mn	0.03	0.02	0.03	0.03	0.02	0.03	0.00	0.02	0.03	0.03	0.02	0.02	0.05
Mg	2.98	3.11	3.20	3.02	3.06	3.30	3.17	3.01	3.73	3.02	2.83	2.99	3.31
Ni	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00



**Mineral Chemistry of Amphiboles from  
samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.**

**ANNEXURE XI**

Zn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Li* (not im)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.03	2.03	2.09	2.03	1.96	2.02	1.96	1.97	2.03	1.98	1.98	1.98	2.01	
Na	0.26	0.24	0.17	0.23	0.25	0.15	0.25	0.37	0.05	0.23	0.33	0.23	0.16	
K	0.05	0.04	0.04	0.06	0.04	0.03	0.05	0.09	0.01	0.04	0.06	0.04	0.04	
Ba	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
OH*	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
Total	17.34	17.32	17.24	17.31	17.25	17.19	17.25	17.42	17.07	17.25	17.36	17.26	17.21	
Calculation	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	$\sum 13$	
Amphibole	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	Ca	
(Ca+Na) (B)	2.03	2.03	2.09	2.03	2.00	2.02	2.00	2.00	2.03	2.00	2.00	2.00	2.01	
Na (B)	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.03	0.00	0.02	0.02	0.02	0.00	
(Na+K) (A)	0.31	0.29	0.21	0.28	0.25	0.18	0.25	0.42	0.05	0.25	0.36	0.26	0.21	
Mg/(Mg+Fe)	0.66	0.68	0.70	0.68	0.69	0.71	0.69	0.70	0.77	0.67	0.65	0.66	0.72	
Fe <sup>3+</sup> /(Fe <sup>3+</sup> +A)	0.02	0.30	0.00	0.29	0.39	0.03	0.42	0.73	0.00	0.49	0.57	0.49	0.54	
Sum of S2	13.00	13.00	12.94	13.00	13.00	13.00	13.00	13.00	12.99	13.00	13.00	13.00	13.00	
Amphibole														
	magnesio-	magnesio-	actinolitic	magnesio-	magnesio-	actinolitic	actinolitic	magnesio-	actinolite	magnesio-	magnesio-	magnesio-	actinolitic	
	hornblende	hornblende	hornblende	hornblende	hornblende	hornblende	hornblende	hornblende		hornblende	hornblende	hornblende	hornblende	

Mineral Chemistry of Amphiboles from

ANNEXURE XI

samples of Kanivehalli and adjoining areas, Davangere and Bellary Districts, Karnataka.

Formula	36 / 1	5 / 1	6 / 1	7 / 1	8 / 1	9 / 1	10 / 1	11 / 1	12 / 1	14 / 1	15 / 1	21 / 1	10 / 1
sample NO	PS-14	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-4	PS-5404

rock types

SiO <sub>2</sub>	50.32	42.75	42.78	46.51	42.64	42.83	48.74	49.48	44.15	43.93	51.76	44.44	55.05
TiO <sub>2</sub>	0.35	0.43	0.37	0.29	0.44	0.48	0.22	0.21	0.39	0.40	0.14	0.46	0.02
Al <sub>2</sub> O <sub>3</sub>	6.39	13.38	12.69	8.73	13.46	12.97	6.87	5.61	12.51	12.50	5.52	11.66	2.04
Cr <sub>2</sub> O <sub>3</sub>	0.06	0.07	0.15	0.06	0.05	0.04	0.11	0.09	0.07	0.00	0.01	0.02	0.12
FeO	12.28	18.74	18.64	17.77	18.83	19.42	17.00	16.84	19.31	18.30	14.25	18.89	10.48
MnO	0.23	0.33	0.30	0.35	0.29	0.40	0.38	0.31	0.26	0.27	0.36	0.27	0.51
Na <sub>2</sub> O	0.75	1.31	1.47	0.93	1.40	1.45	0.73	0.59	1.09	1.21	0.27	1.22	0.26
K <sub>2</sub> O	0.26	0.30	0.25	0.13	0.23	0.21	0.13	0.14	0.26	0.19	0.10	0.16	0.04
MgO	14.43	7.10	7.65	9.87	7.40	7.51	10.87	11.02	7.83	7.67	11.76	8.28	17.01
CaO	13.30	12.09	12.14	11.80	11.75	11.89	12.20	12.15	12.14	12.40	13.49	12.17	12.05
NiO	0.04	0.04	0.14	0.00	0.00	0.00	0.05	0.09	0.01	0.01	0.05	0.03	0.00
BaO	0.00	0.00	0.00	0.00	0.04	0.00	0.05	0.00	0.00	0.01	0.01	0.00	0.00
P <sub>2</sub> O <sub>5</sub>	0.06												0.00
Total	98.47	96.54	96.59	96.44	96.51	97.19	97.35	96.53	98.01	96.90	97.70	97.60	97.58
Comment	amphibole												
No. of oxyg	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Structural													
Si	7.25	6.50	6.51	6.95	6.45	6.45	7.21	7.38	6.58	6.64	7.53	6.65	7.77
Al iv	0.75	1.50	1.49	1.05	1.55	1.55	0.79	0.62	1.42	1.36	0.47	1.35	0.23
Al vi	0.33	0.90	0.78	0.49	0.85	0.76	0.41	0.37	0.77	0.87	0.48	0.70	0.11
Ti	0.04	0.05	0.04	0.03	0.05	0.05	0.02	0.02	0.04	0.05	0.02	0.05	0.00
Cr	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01
Fe <sup>3+</sup>	0.00	0.10	0.18	0.40	0.32	0.37	0.22	0.12	0.32	0.00	0.00	0.27	0.38
Fe <sup>2+</sup>	1.48	2.28	2.20	1.82	2.06	2.07	1.89	1.98	2.08	2.31	1.73	2.10	0.85
Mn	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.03	0.03	0.04	0.03	0.06
Mg	3.10	1.61	1.73	2.20	1.67	1.69	2.40	2.45	1.74	1.73	2.55	1.85	3.58
Ni	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.00



### Mineral Chemistry of Amphiboles from

ANNEXURE XI

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

Formula	12 / 1 .	13 / 1 .	14 / 1 .	15 / 1 .	16 / 1 .	20 / 1 .
sample NO	PS-5404	PS-5404	PS-5404	PS-5404	PS-5404	PS-5404
<b>rock types</b>						
SiO <sub>2</sub>	54.96	53.80	45.38	54.51	54.41	55.46
TiO <sub>2</sub>	0.11	0.08	2.24	0.09	0.32	0.07
Al <sub>2</sub> O <sub>3</sub>	1.26	3.26	10.53	1.81	2.11	0.91
Cr <sub>2</sub> O <sub>3</sub>	0.10	0.08	0.49	0.09	0.06	0.05
FeO	11.96	11.40	12.37	11.14	10.32	9.91
MnO	0.30	0.47	0.23	0.39	0.33	0.35
Na <sub>2</sub> O	0.20	0.42	1.20	0.24	0.27	0.14
K <sub>2</sub> O	0.04	0.04	0.20	0.02	0.06	0.02
MgO	16.61	16.34	12.39	16.76	17.02	17.56
CaO	12.18	11.86	11.87	12.39	12.48	12.32
NiO	0.05	0.09	0.00	0.03	0.00	0.00
BaO	0.02	0.00	0.00	0.00	0.00	0.01
P <sub>2</sub> O <sub>5</sub>	0.05	0.00	0.02	0.00	0.04	0.01
Total	97.82	97.84	96.92	97.47	97.43	96.80
Comment	amphibole	amphibole	amphibole	amphibole	amphibole	amphibole
No. of oxyg	23.00	23.00	23.00	23.00	23.00	23.00
<b>Structural f</b>						
Si	7.79	7.59	6.64	7.75	7.73	7.89
Al iv	0.21	0.41	1.36	0.25	0.27	0.11
Al vi	0.01	0.13	0.45	0.05	0.09	0.04
Ti	0.01	0.01	0.25	0.01	0.03	0.01
Cr	0.01	0.01	0.06	0.01	0.01	0.01
Fe <sup>3+</sup>	0.40	0.54	0.26	0.32	0.22	0.25
Fe <sup>2+</sup>	1.02	0.80	1.25	1.00	1.01	0.93
Mn	0.04	0.06	0.03	0.05	0.04	0.04
Mg	3.51	3.44	2.70	3.55	3.61	3.72
Ni	0.01	0.01	0.00	0.00	0.00	0.00

Mineral Chemistry of Amphiboles from

ANNEXURE XI

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

Zn	0.00	0.00	0.00	0.00	0.00	0.00
Li* (not im	0.00	0.00	0.00	0.00	0.00	0.00
Ca	1.85	1.79	1.86	1.89	1.90	1.88
Na	0.05	0.11	0.34	0.07	0.07	0.04
K	0.01	0.01	0.04	0.00	0.01	0.00
Ba	0.00	0.00	0.00	0.00	0.00	0.00
Sr	0.00	0.00	0.00	0.00	0.00	0.00
Pb	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00
OH*	2.00	2.00	2.00	2.00	2.00	2.00
Total	16.91	16.92	17.24	16.96	16.99	16.92
Calculation	$\Sigma 13$					
Amphibole	Ca	Ca	Ca	Ca	Ca	Ca
(Ca+Na) (B)	1.91	1.91	2.00	1.95	1.97	1.92
Na (B)	0.05	0.11	0.14	0.07	0.07	0.04
(Na+K) (A)	0.01	0.01	0.24	0.00	0.01	0.00
Mg/(Mg+F	0.78	0.81	0.68	0.78	0.78	0.80
Fe <sup>3+</sup> /(Fe <sup>3+</sup> +A	0.99	0.80	0.37	0.86	0.72	0.86
Sum of S2	13.00	13.00	13.00	13.00	13.00	13.00
Amphibole						
	actinolite	actinolite	magnesio-	actinolite	actinolite	actinolite
			hornblende			

Mineral Chemistry of Clino-pyroxenes from

ANNEXURE XII

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

Sample No	PS-5403									
Rock type	granophyre									
SiO <sub>2</sub>	51.02	50.24	50.84	51.41	53.19	51.66	51.11	52.71	51.80	
TiO <sub>2</sub>	0.10	0.16	0.12	0.08	0.16	0.07	0.00	0.16	0.18	
Al <sub>2</sub> O <sub>3</sub>	0.68	1.82	0.86	0.95	0.44	0.23	0.38	0.49	0.45	
Cr <sub>2</sub> O <sub>3</sub>	0.15	0.52	0.08	0.07	0.08	0.13	0.04	0.01	0.01	
FeO	15.20	13.04	13.96	15.75	9.80	15.36	16.68	11.69	16.85	
MnO	1.05	0.72	0.98	0.68	0.26	0.74	0.56	0.23	0.24	
MgO	8.13	9.79	8.92	8.49	17.15	9.16	10.37	15.06	10.56	
CaO	23.93	23.10	23.90	23.05	19.49	23.92	21.16	20.26	20.91	
Na <sub>2</sub> O	0.39	0.40	0.37	0.37	0.16	0.27	0.19	0.25	0.27	
K <sub>2</sub> O	0.02	0.02	0.02	0.04	0.00	0.03	0.00	0.04	0.01	
Total	100.85	99.93	100.19	100.93	100.84	101.69	100.51	100.90	101.37	
comment	C-pyroxene									
Formula (corr.)	6(O)									
Si	1.96	1.92	1.95	1.97	1.95	1.96	1.96	1.95	1.96	
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
Al	0.03	0.08	0.04	0.04	0.02	0.01	0.02	0.02	0.02	
Cr	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fe <sup>3+</sup>	0.07	0.08	0.08	0.04	0.08	0.08	0.08	0.09	0.06	
Fe <sup>2+</sup>	0.42	0.34	0.37	0.46	0.22	0.41	0.45	0.27	0.47	
Mn	0.03	0.02	0.03	0.02	0.01	0.02	0.02	0.01	0.01	
Mg	0.47	0.56	0.51	0.48	0.94	0.52	0.59	0.83	0.60	
Ca	0.98	0.95	0.98	0.95	0.77	0.97	0.87	0.80	0.85	
Na	0.03	0.03	0.03	0.03	0.01	0.02	0.01	0.02	0.02	
K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
Mg/(Mg+Fe <sub>2</sub> )	0.53	0.62	0.58	0.51	0.81	0.56	0.57	0.75	0.56	
Fe <sup>2+</sup> /(Fe <sup>2+</sup> +Fe <sup>3+</sup> )	0.86	0.81	0.83	0.91	0.73	0.83	0.84	0.76	0.89	
Al/(Al+Fe <sup>3+</sup> +Cr)	0.29	0.46	0.33	0.48	0.19	0.11	0.17	0.20	0.25	
Tri. plots										
En	0.25	0.30	0.27	0.26	0.49	0.27	0.31	0.44	0.31	
Fs	0.22	0.18	0.20	0.24	0.11	0.21	0.24	0.14	0.25	

Mineral Chemistry of Clino-pyroxenes from

ANNEXURE XII

samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.

Wo	0.53	0.51	0.53	0.50	0.40	0.51	0.45	0.42	0.44
A(+aqw)	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C(+aqw)	0.51	0.49	0.51	0.49	0.39	0.50	0.44	0.41	0.43
(FM)(+aqw)	0.47	0.47	0.47	0.50	0.59	0.48	0.54	0.57	0.55
Mole fractions									
XSi (T)	0.98	0.96	0.98	0.98	0.98	0.98	0.98	0.98	0.98
XAl (T)	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
XAl (M1)	-0.01	0.00	-0.01	0.01	-0.03	-0.03	-0.03	-0.03	-0.01
XFe3 (M1)	0.07	0.08	0.08	0.04	0.08	0.08	0.08	0.09	0.06
XFe2 (M1)	0.42	0.33	0.38	0.45	0.18	0.40	0.40	0.23	0.42
XMg (M1)	0.47	0.54	0.52	0.47	0.76	0.51	0.53	0.70	0.53
XFe2 (M2)	-0.01	0.01	0.00	0.01	0.04	0.00	0.05	0.04	0.06
XMg (M2)	-0.01	0.01	-0.01	0.01	0.18	0.00	0.07	0.13	0.07
XCa (M2)	0.98	0.95	0.98	0.95	0.77	0.97	0.87	0.80	0.85
XNa (M2)	0.03	0.03	0.03	0.03	0.01	0.02	0.01	0.02	0.02
Sodic pyx:	Ca-Mg-Fe								
Final name:	diopside	diopside	diopside	diopside	augite	diopside	diopside	augite	augite

**Mineral Chemistry of sulphides from**

**ANNEXURE XIII**

**samples of Kanivehalli and adjoining areas ,Davangere and Bellary Districts, Karnataka.**

DataSet/Point	S	Co	Ni	Fe	Zn	Pb	Ag	Cu	As	Au	Bi	Te	Total	Mineral
13 / 1 .	34.54	0	0	29.09	0.08	0	0	35.09	0	0	0.07	0	98.87	Chalcopyrite
14 / 1 .	34.92	0.01	0	29.28	0.1	0	0	34.25	0	0	0.07	0	98.62	Chalcopyrite
15 / 1 .	35.35	0.06	0	28.88	0	0	0	34.11	0	0	0.07	0	98.47	Chalcopyrite
2 / 1 .	35.35	0	0	30.48	0.03	0	0	32.7	0	0	0.05	0	98.61	Chalcopyrite
3 / 1 .	53.81	0.01	0.05	46.18	0	0	0.05	0.1	0.14	0	0.15	0	100.49	Pyrite
4 / 1 .	37.38	0	0	30.21	0.05	0	0	32.47	0	0	0	0	100.12	Chalcopyrite
8 / 1 .	35.78	0.04	0	29.69	0	0	0.01	32.97	0.01	0	0.1	0	98.59	Chalcopyrite
9 / 1 .	34.91	0	0	30.03	0.27	0	0	32.74	0.01	0.06	0.01	0.02	98.05	Chalcopyrite
14 / 1 .	36.23	0	0.03	30.57	0	0	0	32.24	0	0	0.08	0	99.14	Pyrite
15 / 1 .	54.02	0.02	0.05	45.85	0	0	0	0	0	0	0.03	0	99.98	Pyrite
1 / 1 .	54.52	0	0.05	45.43	0	0	0	0.03	0.02	0	0.06	0	100.1	Pyrite
2 / 1 .	54.57	0	0	46.21	0	0	0	0.01	0.01	0	0.08	0	100.87	Pyrite
3 / 1 .	54.18	0.05	0	45.77	0	0	0	0	0	0	0.06	0	100.06	Pyrite
4 / 1 .	54.27	0.05	0	45.46	0.03	0	0	0.05	0.03	0	0.2	0	100.09	Pyrite
5 / 1 .	55.01	0.02	0	45.67	0	0	0	0.02	0	0	0.18	0	100.9	Pyrite
6 / 1 .	33.4	0.04	0	3.01	0.02	0	0.05	63.12	0.01	0	0	0	99.65	Covellite
7 / 1 .	54.32	0	0.07	45.8	0	0	0	0	0	0	0.03	0	100.22	Pyrite
8 / 1 .	54.31	0	0	46	0.02	0	0.02	0	0.03	0	0	0.02	100.41	Pyrite
9 / 1 .	54.32	0.04	0	45.82	0.02	0	0	0.02	0	0	0.04	0.02	100.26	Pyrite
10 / 1 .	54.74	0	0	46.71	0	0	0	0	0.01	0	0.04	0	101.51	Pyrite
11 / 1 .	53.91	0.03	0	45.07	0	0	0	0.07	0	0.08	0.11	0	99.28	Pyrite
12 / 1 .	53.7	0	0	45.22	0	0	0	0.06	0.01	0	0.19	0.01	99.19	Pyrite
13 / 1 .	54.54	0	0.03	46.14	0.06	0	0	0	0.03	0	0.11	0	100.91	Pyrite

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**Details of Fluid inclusion studies carried out on the quartz vein samples collected from Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka. ANNEXURE XIV**

Sample No	Inclusion	Class	Shape	Te	Tm_	Th_	EqWt%	Density
No	Type				ice	total	NaCl	
<b>KH/BR08/FI-01</b>								
1	V+L	Primary	Irregular	-42	-14.7	175	18.36	1.03
2	V+L	Primary	Irregular	-40	-13.5	170	17.33	1.02
3	V+L	Primary	Facted	-39	-13.8	180	17.59	1.02
4	V+L	Primary	Facted	-38	-14.1	181	17.85	1.02
5	V+L	Primary	Irregular	-39	-12.9	165	16.79	1.02
6	V+L	Primary	Irregular	-40	-13.5	168	17.33	1.02
<b>KH/BR120/FI-05</b>								
7	V+L	Primary	Irregular	-41	-12.5	162	16.42	1.02
8	V+L	Primary	Irregular	-42	-11.2	160	15.17	1.01
9	V+L	Primary	Irregular	-41	-10.9	161	14.87	1.01
10	V+L	Primary	Irregular	-36	-10.8	166	14.77	1.01
11	V+L	Primary	Irregular	-38	-10.1	168	14.05	1
12	V+L	Primary	Irregular	-30	-12.6	145	16.51	1.04
13	V+L	Primary	Irregular	-28	-12.1	148	16.05	1.03
14	V+L	Primary	Irregular	-35	-12.8	149	16.7	1.04
15	V+L	Primary	Irregular	-30	-11.9	155	15.86	1.02
16	V+L	Primary	Irregular	-35	-10.5	148	14.46	1.02
17	V+L	Primary	Irregular	-34	-11.8	141	15.76	1.04
18	V+L	Primary	Irregular	-30	-11.5	140	15.47	1.03
19	V+L	Primary	Irregular	-33	-12.1	145	16.05	1.03
<b>KH/L1085/FI-06</b>								
20	V+L	Primary	Irregular	-44	-17.2	148	20.35	1.07
21	V+L	Primary	Irregular	-43	-18.1	135	21.02	1.08
22	V+L	Primary	Irregular	-45	-17.9	138	20.87	1.08
23	V+L	Primary	Irregular	-46	-15	141	18.61	1.06
24	V+L	Primary	Irregular	-45	-10.2	137	14.15	1.03
25	V+L	Primary	Facted	-46	-18.9	138	21.59	1.08
26	V+L	Primary	Facted	-47	-19	139	21.66	1.08
27	V+L	Primary	Facted	-43	-23.5	149	24.58	1.1
28	V+L	Primary	Facted	-42	-24.1	145	24.94	1.1
29	V+L	Primary	Facted	-45	-22.1	148	23.72	1.09
30	V+L	Primary	Facted	-46	-20	149	22.35	1.08
31	V+L	Primary	Irregular	-45	-22	135	23.66	1.1
32	V+L	Primary	Irregular	-47	-19	131	21.66	1.09
33	V+L	Primary	Irregular	-42	-21	132	23.01	1.1
34	V+L	Primary	Irregular	-44	-17	130	20.2	1.08
35	V+L	Primary	Irregular	-45	-15	133	18.61	1.06
36	V+L	Primary	Irregular	-37	-16.1	139	19.5	1.07
37	V+L	Primary	Irregular	-39	-15.2	138	18.78	1.06
38	V+L	Primary	Irregular	-41	-15.9	135	19.34	1.07
39	V+L	Primary	Irregular	-45	-18.1	141	21.02	1.08

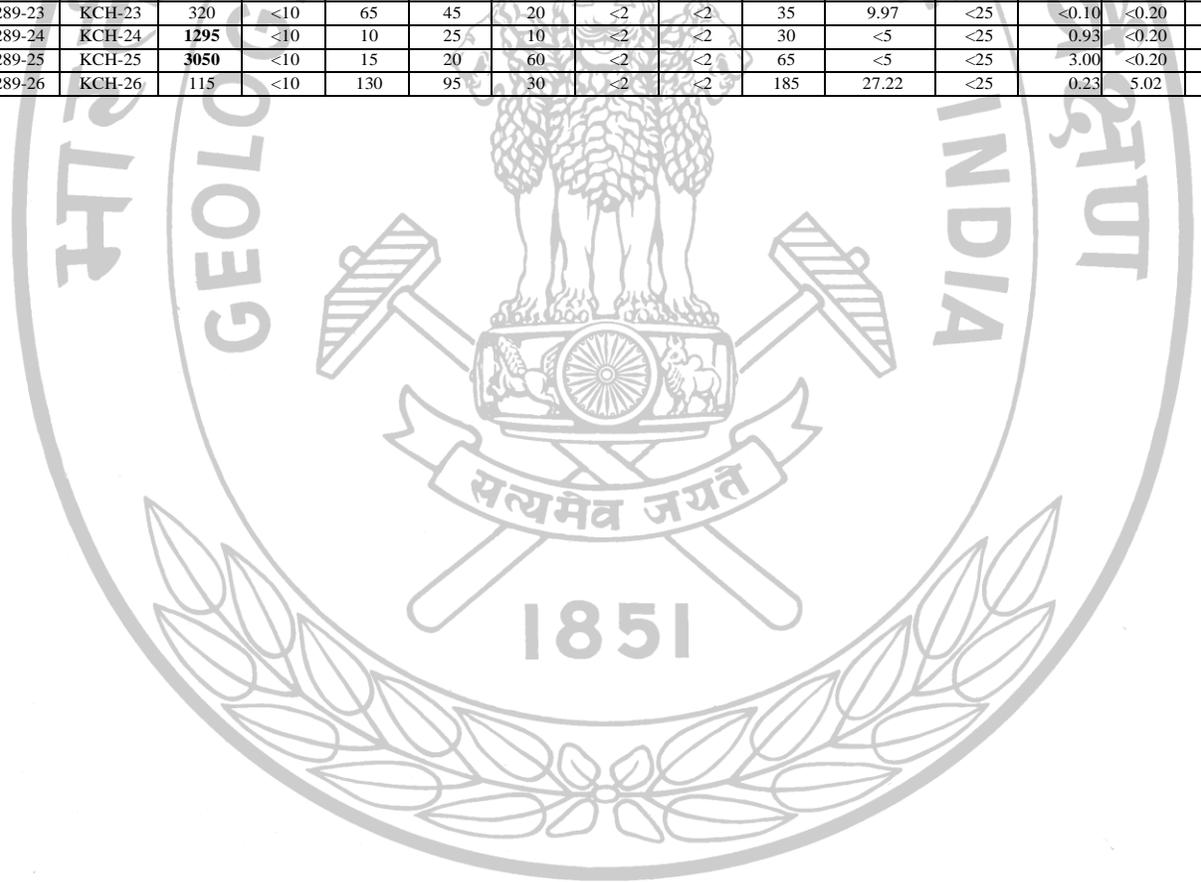
40	V+L	Primary	Irregular	-38	-15.9	145	19.34	1.06
41	V+L	Primary	Irregular	-41	-14.5	138	18.2	1.06
42	V+L	Primary	Irregular	-35	-14.8	139	18.45	1.06
43	V+L	Primary	Facted	-36	-13.9	142	17.68	1.05



Check analysis of selected samples from Kanivehalli and adjoining area,  
Davangere and Bellary Districts, Karnataka

ANNEXURE XV

Sl. No:	Sample No	Cu(ppm)	Pb(ppm)	Zn(ppm)	Ni(ppm)	Co(ppm)	Cd(ppm)	Ag(ppm)	Cr(ppm)	As	Au	Bi	Sb	Mo
PR 9289-01	KCH-01	20	<10	175	45	30	<2	<2	65	11.19	<25	<0.10	<0.20	1.74
PR 9289-02	KCH-02	160	<10	35	25	20	<2	<2	50	26.02	<25	<0.10	1.56	4.58
PR 9289-03	KCH-03	205	<10	65	55	15	<2	<2	140	7.40	<25	<0.10	0.25	4.25
PR 9289-04	KCH-04	<b>845</b>	<10	30	15	10	<2	<2	35	<5	<25	1.51	<0.20	3.32
PR 9289-05	KCH-05	145	<10	170	190	65	<2	<2	445	<b>3151.42</b>	<b>1.45 ppm</b>	0.12	40.76	3.35
PR 9289-06	KCH-06	95	<10	170	150	65	<2	<2	380	<b>557.17</b>	<25	<0.10	22.97	3.77
PR 9289-07	KCH-07	15	<10	525	115	65	<2	<2	35	<b>238.55</b>	<25	<0.10	15.44	4.97
PR 9289-08	KCH-08	10	<10	215	65	35	<2	<2	60	56.40	<25	<0.10	7.16	3.56
PR 9289-09	KCH-09	30	<10	65	40	30	<2	<2	60	174.06	<25	<0.10	21.11	3.54
PR 9289-10	KCH-10	80	<10	65	45	20	<2	<2	140	16.36	<25	0.12	0.37	3.89
PR 9289-11	KCH-11	<b>2330</b>	<10	<b>715</b>	<b>705</b>	<b>1170</b>	<2	<2	110	53.41	<25	<0.10	7.42	4.39
PR 9289-12	KCH-12	95	<10	245	125	25	<2	<2	220	44.98	<25	0.40	14.64	4.12
PR 9289-13	KCH-13	35	<10	100	40	45	<2	<2	550	9.67	<25	<0.10	0.40	2.49
PR 9289-14	KCH-14	10	<10	70	55	20	<2	<2	80	6.05	<25	<0.10	1.12	3.51
PR 9289-15	KCH-15	110	<10	390	100	20	<2	<2	55	95.47	<25	0.16	1.96	6.22
PR 9289-16	KCH-16	45	<10	150	55	10	<2	<2	55	41.92	<b>46</b>	0.20	1.45	4.34
PR 9289-17	KCH-17	20	<10	70	40	40	<2	<2	40	<5	<25	<0.10	0.68	3.98
PR 9289-18	KCH-18	10	<10	45	30	20	<2	<2	30	<5	<b>44</b>	<0.10	0.98	4.69
PR 9289-19	KCH-19	20	<10	50	50	20	<2	<2	45	229.20	<25	<0.10	1.63	3.58
PR 9289-20	KCH-20	25	<10	65	25	35	<2	<2	60	7.22	<25	<0.10	0.26	2.88
PR 9289-21	KCH-21	30	<10	85	25	20	<2	<2	20	5.93	<25	<0.10	<0.20	2.85
PR 9289-22	KCH-22	25	<10	40	35	20	<2	<2	20	19.29	<25	<0.10	1.58	3.10
PR 9289-23	KCH-23	320	<10	65	45	20	<2	<2	35	9.97	<25	<0.10	<0.20	4.60
PR 9289-24	KCH-24	<b>1295</b>	<10	10	25	10	<2	<2	30	<5	<25	0.93	<0.20	4.02
PR 9289-25	KCH-25	<b>3050</b>	<10	15	20	60	<2	<2	65	<5	<25	3.00	<0.20	5.80
PR 9289-26	KCH-26	115	<10	130	95	30	<2	<2	185	27.22	<25	0.23	5.02	3.63



**Descriptive statistics and correlation matrix of of the elements analysed for samples from Kanivehalli  
and adjoining area, Davangere and Bellary Districts, Karnataka**

A ANNEXURE XVI

Parameter	Cu	Pb	Zn	Ni	Co	Cr	Ag	Cd	Mo	Bi	Sb	Au
	all in ppm											
Mean	115.523	7.09302	103.808	38.9244	34.2151	28.7209	4.25291	4.72941	50	0.1736	6.65163	50.8256
Standard Error	26.4503	0.53747	10.7563	4.1585	14.6412	3.33827	0.13566	0.08386	0	0.00885	1.31038	15.9277
Median	40	5	50	15	5	5	5	5	50	0.12	1.26	12
Mode	5	5	5	5	5	5	5	5	50	0.1	0.2	12
Standard Deviation	346.893	7.04891	141.067	54.5383	192.018	43.781	1.7791	1.09343	0	0.11604	17.1855	208.89
Sample Variance	120335	49.6872	19899.9	2974.42	36870.9	1916.78	3.1652	1.19558	0	0.01346	295.341	43635.1
Kurtosis	49.5686	16.6944	10.4854	5.93309	144.131	6.26952	1.95339	13.3233	0	6.19165	25.5942	77.0827
Skewness	6.71544	4.00074	2.94757	2.3361	11.6561	2.44955	-1.97855	-3.8685	0	2.2625	4.76589	8.61116
Range	3010	45	875	285	2425	235	5	5	0	0.68	119.8	2068
Minimum	5	5	5	5	5	5	0	0	50	0.1	0.2	12
Maximum	3015	50	880	290	2430	240	5	5	50	0.78	120	2080
Sum	19870	1220	17855	6695	5885	4940	731.5	804	8600	29.86	1144.08	8742
Count	172	172	172	172	172	172	172	170	172	172	172	172

	Cu	Pb	Zn	Ni	Co	Cr	Ag	Cd	Bi	Sb	As	Au
Cu	1											
Pb	-0.02849	1										
Zn	0.28142	0.00179	1									
Ni	0.10711	0.05267	0.64473	1								
Co	0.63719	-0.02449	0.56637	0.25329	1							
Cr	-0.01124	-0.00786	0.06092	0.16431	0.01692	1						
Ag	-0.202	-0.09608	0.21663	0.20699	0.05956	0.19037	1					
Cd	-0.31345	0.01711	0.1697	0.1561	0.0381	0.10301	0.60342	1				
Bi	0.06734	0.14659	-0.04882	0.09746	-0.06156	-0.08345	-0.01124	-0.13475	1			
Sb	0.03715	-0.02997	0.36832	0.59756	0.09557	0.21773	0.1541	0.09408	0.04	1		
As	-0.01803	0.12767	0.18649	0.17644	0.03282	0.01702	0.16185	0.10389	0.07366	0.34973	1	
Au	-0.01099	0.11952	0.03188	0.33306	-0.00737	0.04857	0.07851	0.04655	0.22691	0.0354	0.05981	1

**Descriptive statistics and correlation matrix of the elements analysed for samples from Kanivehalli and adjoining area, Davangere and Bellary Districts, Karnataka**

Parameter	Cu	Pb	Zn	Ni	Co	Cr	Ag	Cd	Mo	Bi	Sb	As	Au
	all in ppm												ppb
Mean	164.279	17.2072	61.7117	29.3694	11.4414	13.5135	5	5	50	0.32721	3.30937	17.2423	0.02717
Standard Error	19.5473	1.92688	7.27614	2.81865	1.30736	2.09675	0	0	0	0.0767	0.92062	2.41778	0.00062
Median	105	5	40	20	5	5	5	5	50	0.13	0.6	7.9	0.025
Mode	5	5	5	5	5	5	5	5	50	0.1	0.2	1	0.025
Standard Deviation	205.943	20.301	76.6589	29.6963	13.7739	22.0907	0	0	0	0.80811	9.69936	25.4729	0.00654
Sample Variance	42412.7	412.129	5876.59	881.871	189.722	487.998	0	0	0	0.65304	94.0776	648.869	4.3E-05
Kurtosis	14.175	2.80647	5.69229	3.72027	15.7771	9.21216	0	0	0	74.7126	46.4177	10.0101	10.6218
Skewness	3.14813	1.76044	2.33401	1.77594	3.38384	3.06785	0	0	0	8.10609	6.18905	2.91655	3.28711
Range	1440	90	360	155	95	105	0	0	0	7.88	84.29	152.45	0.035
Minimum	5	5	5	5	5	5	5	5	50	0.1	0.2	1	0.025
Maximum	1445	95	365	160	100	110	5	5	50	7.98	84.49	153.45	0.06
Sum	18235	1910	6850	3260	1270	1500	555	555	5550	36.32	367.34	1913.89	3.016
Count	111	111	111	111	111	111	111	111	111	111	111	111	111

Cu	1												
Pb	-0.06822	1											
Zn	-0.00906	0.35272	1										
Ni	0.12193	0.30128	0.72877	1									
Co	0.05774	0.18765	0.4744	0.52009	1								
Cr	0.19035	-0.09296	0.0191	0.30031	0.10645	1							
Bi	0.28677	-0.13043	-0.10513	-0.13033	-0.09148	-0.04067	1						
Sb	-0.08787	0.1146	0.153	0.20007	0.46221	0.11823	-0.08494	1					
As	-0.08706	0.13344	0.27135	0.19743	0.3563	0.01428	-0.13311	0.56466	1				
Au	-0.12717	-0.13992	0.05376	-0.14302	-0.00024	-0.11346	-0.09409	0.3221	0.31364	1			

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**Title of Project - Proposal for Gold Exploration in Kanivihalli Block, Davangere District, Karnataka State for G3 Stage Mineral Exploration under NMET**

**NQT table**

S.N	Nature of work	Quantum	Unit
<b>A</b>	<b>Geological Mapping Other Geological Work &amp; Surveying</b>		
	Geological mapping, (1:4,000 scale) & Trenching , drilling work		
i	Charges for Geologist per day (Field) for geological mapping & trenching work, drilling work	1,080	day
ii	Labours Charges; Base rate	2,160	day
iii	Charges for Geologist per day (HQ)	180	day
<b>B</b>	<b>Ground Geophysical Survey</b>		
i	Ground magnetic	6,000	Station
ii	Resistivity Profiling (Station interval 200m.)	60	line km
iii	Geophysicist party days (Field)	120	per day
iv	Labours Charges	60	day
v	Geophysicist party days (HQ)	30	per day
<b>C</b>	<b>Survey work</b>		
i	DGPS Survey for BH fixation & RL determination	40	Per Point of observation
ii	Charges of Surveyor (1 party) for topographic survey	720	one surveyor per day
iii	Labours Charges for survey work;	2,880	day
<b>D</b>	<b>Trenching/Pitting</b>		
i	Pit up to 2.0 m depth	400	per cu.m
ii	Trenching	400	per cu.m
	<b>Review</b>		
<b>E</b>	<b>Phase 1 Drilling (In-house)</b>		
i	Total Drilling 1500 m; 6 BH (250 m avg depth)	1500	m
ii	Land / Crop Compansation (in case the BH falls in agricultural Land)	6	per BH

iii	Concrete pilar construction (12"x12"x30")	6	per BH
iv	Transportation of Drill Rig & Truck associated per drill	8000	km
v	Monthly Accomodation Charges for drilling Camp	12	month
vi	Drilling Camp Setting Cost	2	Nos
vii	Drilling Camp Winding up Cost	2	Nos
viii	Approach Road making for rugget/hilly terrain	5	km
ix	Drill Core Preservation	800	per meter
<b>Review</b>			
<b>F</b>	<b>2nd Phase DRILLING (In-house)</b>		
i	Drilling up to depth of 200 m (Very Hard Rock); 400m spacing; 30 BH	6000	m
ii	Land / Crop Compansation (in case the BH falls in agricultural Land)	30	per BH
iii	Concrete pilar construction (12"x12"x30")	30	per BH
iv	Transportation of Drill Rig & Truck associated per drill	16000	km
v	Monthly Accomodation Charges for drilling Camp	36	month
vi	Drilling Camp Setting Cost	4	Nos
vii	Drilling Camp Winding up Cost	4	Nos
viii	Approach Road making for rugget/hilly terrain	10	km
ix	Drill Core Preservation	2,000	per meter
<b>G</b>	<b>LABORATORY STUDIES</b>		
1	<b>Chemical Analysis</b>		
	<b>Geochemical Sampling-Surface samples (Bedrock/Channel /Soil/Stream sediment)</b>		
i	Au by Fire Assay	150	Nos
ii	XRF / Whole Rock Analysis	30	Nos
iii	ICPMS	400	Nos

iv	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	150	Nos
	<b>Surface Check samples (10% External)</b>		
i	Au by Fire Assay	15	Nos
ii	XRF / Whole Rock Analysis	3	Nos
iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	15	Nos
	<b>Trench &amp; Check Samples from Trench</b>		
	<b>Trench samples</b>		
i	Au by Fire Assay	200	Nos
ii	XRF / Whole Rock Analysis	10	Nos
iii	ICPMS	400	Nos
iv	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	100	Nos
	<b>Trench Check samples (10% External)</b>		
i	Au by Fire Assay	20	Nos
ii	XRF / Whole Rock Analysis	1	Nos
iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	10	Nos
	<b>BH Core samples</b>		
i	Au by Fire Assay	500	Nos
ii	XRF / Whole Rock Analysis	30	Nos
iii	ICPMS	1,000	Nos
iv	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	200	Nos
	<b>BH Core samples (10%External)</b>		
i	Au by Fire Assay	50	Nos
ii	XRF / Whole Rock Analysis	3	Nos
iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	20	Nos
iv	sampler	314	man days

<b>H</b>	<b>Physical &amp; Petrological Studies</b>		
i	Preparation of standard polish section	200	Nos
ii	study of polished section	200	Nos
iii	Digital Photographs	200	Nos
iv	SEM Studies	50	per hour
v	EPMA studies	50	per hour
	<b>Geotechnical Laboratory</b>		
i	Specific gravity of rock sample	50	per sample
ii	Porosity	50	per sample
iii	Uniaxial compressive strength	50	per sample
iv	Tensile Strength	50	per sample
v	Young's Modulus of Elasticity	50	per sample
vi	Poisson's Ratio	50	per sample
vii	Bulk Density	50	per sample
	<b>Resource Modelling by using Surpac</b>	<b>36 BH</b>	
<b>I</b>	<b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>	1	<b>5 Hard copies with a soft copy</b>
<b>J</b>	<b>Geological Report Preparation</b>	<b>1.00</b>	<b>5 Hard copies with a soft copy</b>

Manpower Deployment Gold Exploration in Kanivihalli Block, Davangere District, Karnataka State for G3 Stage Mineral Exploration under NMET					
Activity	Type of Job	Geologist HQ (mandays)	Geologist (mandays)	Labour (mandays)	Sampler (mandays)
Geological Mapping, sampling and pitting	Field	15	1089	2160	
Remote sensing	Desktop	40			
Topographic survey	Field		720	2880	
Laboratory Studies	Field+desktop	30			
Petrographic Studies	Desktop	15			413
<b>Review</b>					
Geophysical Survey	Field		20		
Core drilling, minerology and chemical assay	Field	30		288	72
Report Preparation and Recommendation	Desktop	30			
Discussion with State authorities and NMET	Desktop				

**Preliminary Exploration (G3 Stage) for Gold in Kanivihalli Block, Davangere District, Karnataka, Area 30 sq. km, 36 No.of BH, Total 7500m drilling; Schedule timeline- 18 months Review: After 6 Months and 12months]**

S. No.	Item of Work *	Unit *	Rates as per NMET SoC 2020-21	Estimate d Cost of the Proposal	Qty. (b)	Total Amount (Rs) (a*b)	Remarks
			So C-Item No. *				
<b>A</b>	<b>Geological Mapping Other Geological Work &amp; Surveying</b>						
	Geological mapping, (1:4,000 scale) & Trenching , drilling work						
i	Charges for Geologist per day (Field) for geological mapping & trenching work, drilling work	day	1.2	11,000.00	1,080	11,880,000	<b>6 teams; each teams for 180 man days</b>
ii	Labours Charges; Base rate	day	5.7	526.00	2,160	1,136,160	Amount will be reimbursed as per the notified rates by the Central

							Labour Commissioner or respective State Govt. whichever is higher.
iii	Charges for Geologist per day (HQ)	day	1.2	9,000.00	180	1,620,000	6 teams; each team 30 days
	<b>Sub Total- A</b>					<b>14,636,160</b>	
<b>B</b>	<b>Ground Geophysical Survey</b>						
i	Ground magnetic	Station	3.2a	1,800.00	6,000	10,800,000	50 m station interval; 100m line interval; in 30 sq km area
ii	Resistivity Profiling (Station interval 200m.)	line km	3.6a	58,880.00	60	3,532,800	500 m line interval
iii	Geophysicist party days (Field)	per day	3.18	11,000.00	120	1,320,000	2 geophysicists, 2 months
iv	Labours Charges	day	5.7	526.00	60	31,560	
v	Geophysicist party days (HQ)	per day	3.18	9,000.00	30	270,000	
	<b>Sub Total- B</b>					<b>15,954,360</b>	
<b>C</b>	<b>Survey work</b>						
i	DGPS Survey for BH fixation & RL determination	Per Point of observation	1.6.2	19,200	40	768,000	36 BH points; 4 corner points
ii	Charges of Surveyor (1 party) for	one surveyor per day	1.6.1 a	8,300	720	5,976,000	6 surveyor parties, each party 120 days

	topographic survey						
iii	Labours Charges for survey work;	day	5.7	526.00	2,880	1,514,880	
	<b>Sub-Total C</b>					<b>8,258,880</b>	
<b>D</b>	<b>Trenching /Pitting</b>						
i	Pit up to 2.0 m depth	per cu.m	2.1.2	3,800	400	1,520,000	50 pits (2*2*2)
ii	Trenching	per cu.m	2.1.3	3,800	400	1,520,000	10 trenches (10*2*2)
	<b>Sub-Total D</b>					<b>3,040,000</b>	
	<b>Review</b>						
<b>E</b>	<b>Phase 1 Drilling (In-house)</b>						
i	Total Drilling 1500 m; 6 BH (250 m avg depth)	m	2.2.1.5a	12,650.00	1500	18,975,000	To drill across BHQ (very hard rock)
ii	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	20000	6	120,000	
iii	Concrete pillar construction (12"x12"x30")	per BH	2.2.7a	2,000	6	12,000	as per actual
iv	Transportation of Drill Rig & Truck associated per drill	km	2.2.8	36	8000	288,000	(2 rigs, 2 trucks)-Two way; Kolkata to Harpanahalli 2000; 2*4000 km (to and fro)
v	Monthly Accomoda	month	2.2.9	50000	12	600,000	12*2 camps

	tion Charges for drilling Camp						
vi	Drilling Camp Setting Cost	Nos	2.2.9 a	2500 00	2	500,000	
vii	Drilling Camp Winding up Cost	Nos	2.2.9 b	2500 00	2	500,000	
viii	Approach Road making for rugged/hilly terrain	km	2.2.1 0b	3220 0	5	161,000	
ix	Drill Core Preservation	per meter	5.3.0	1590	800	1,272,000	
	<b>Sub Total E</b>					<b>22,428,000</b>	
<b>Review</b>							
<b>F</b>	<b>2nd Phase DRILLING (In-house)</b>						
i	Drilling up to depth of 200 m (Very Hard Rock); 400m spacing; 30 BH	m	2.2.1. 5a	12,65 0.00	6000	75,900,000	To drill across BHQ
ii	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	2000 0	30	600,000	
iii	Concrete pillar construction (12"x12"x30")	per BH	2.2.7 a	2,000	30	60,000	as per actual

iv	Transportation of Drill Rig & Truck associated per drill	km	2.2.8	36	16000	576,000	(4 additional rigs, 4 trucks)-Two way; Kolkata to Harpanahalli 2000; 4*4000 km (to and fro)
v	Monthly Accommodation Charges for drilling Camp	month	2.2.9	5000 0	36	1,800,000	12*3 camps
vi	Drilling Camp Setting Cost	Nos	2.2.9 a	2500 00	4	1,000,000	
vii	Drilling Camp Winding up Cost	Nos	2.2.9 b	2500 00	4	1,000,000	
viii	Approach Road making for rugged/hilly terrain	km	2.2.1 0b	3220 0	10	322,000	
ix	Drill Core Preservation	per meter	5.3.0	1590	2,000	3,180,000	
	<b>Sub Total F</b>					<b>84,438,000</b>	
<b>G</b>	<b>LABORATORY STUDIES</b>						
1	<b>Chemical Analysis</b>						
	<b>Geochemical Sampling-Surface samples (Bedrock/Channel/Soil/Stream sediment)</b>						
i	Au by Fire Assay	Nos	4.1.5 a	2,380	150	357,000	
ii	XRF / Whole	Nos	4.1.1 5a	4,200	30	126,000	

	Rock Analysis						
iii	ICPMS	Nos	4.1.1 4	7,731	400	3,092,400	
iv	Determination of mercury in rock or soil samples (by Cold Vapour Technique )	Nos	4.1.1 0	1,060	150	159,000	
	<b>Surface Check samples (10% External)</b>					-	
i	Au by Fire Assay	Nos	4.1.5 a	2,380	15	35,700	
ii	XRF / Whole Rock Analysis	Nos	4.1.1 5a	4,200	3	12,600	
iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique )	Nos	4.1.1 0	1,060	15	15,900	
<b>Trench &amp; Check Samples from Trench</b>						-	
	<b>Trench samples</b>					-	
i	Au by Fire Assay	Nos	4.1.5 a	2,380	200	476,000	
ii	XRF / Whole Rock Analysis	Nos	4.1.1 5a	4,200	10	42,000	
iii	ICPMS	Nos	4.1.1 4	7,731	400	3,092,400	
iv	Determination of mercury in rock or soil samples (by Cold Vapour	Nos	4.1.1 0	1,060	100	106,000	

	Technique )						
	<b>Trench Check samples (10% External)</b>					-	
i	Au by Fire Assay	Nos	4.1.5 a	2,380	20	47,600	
ii	XRF / Whole Rock Analysis	Nos	4.1.1 5a	4,200	1	4,200	
iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique )	Nos	4.1.1 0	1,060	10	10,600	
	<b>BH Core samples</b>					-	
i	Au by Fire Assay	Nos	4.1.5 a	2,380	500	1,190,000	
ii	XRF / Whole Rock Analysis	Nos	4.1.1 5a	4,200	30	126,000	
iii	ICPMS	Nos	4.1.1 4	7,731	1,000	7,731,000	
iv	Determination of mercury in rock or soil samples (by Cold Vapour Technique )	Nos	4.1.1 0	1,060	200	212,000	
	<b>BH Core samples (10% External)</b>					-	
i	Au by Fire Assay	Nos	4.1.5 a	2,380	50	119,000	
ii	XRF / Whole Rock Analysis	Nos	4.1.1 5a	4,200	3	12,600	

iii	Determination of mercury in rock or soil samples (by Cold Vapour Technique)	Nos	4.1.1 0	1,060	20	21,200	
iv	Samples mandays	one sampler per day	0	5,100	413	2,108,213	
	<b>Sub Total G</b>					<b>19,097,413</b>	
<b>H</b>	<b>Physical &amp; Petrological Studies</b>					-	
i	Preparation of standard polish section	Nos	4.3.1	2,353	200	470,600	
ii	study of polished section	Nos	4.3.4	4,232	200	846,400	
iii	Digital Photographs	Nos	4.3.7	280	200	56,000	
iv	SEM Studies	per hour	4.4.2	2,940	50	147,000	
v	EPMA studies	per hour	5.4.1	8,540	50	427,000	
	<b>Geotechnical Laboratory</b>						
i	Specific gravity of rock sample	per sample	4.8.1	1,605	50	80,250	
ii	Porosity	per sample	4.8.2	2,547	50	127,350	
iii	Uniaxial compressive strength	per sample	4.8.4	6,160	50	308,000	
iv	Tensile Strength	per sample	4.8.5	2,745	50	137,250	

v	Young's Modulus of Elasticity	per sample	4.8.7	5,500	50	275,000	
vi	Poisson's Ratio	per sample		5,000	50	250,000	
vii	Bulk Density	per sample	4.8.3	1,568	50	40,141,825	
	<b>Sub Total H</b>					<b>43,266,675</b>	
	<b>Resource Modelling by using Surpac</b>			<b>120000</b>	<b>36</b>	<b>4,320,000</b>	1,20,000 per BH
<b>H</b>	<b>Total A to G</b>					<b>215,439,488</b>	
<b>I</b>	<b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>	<b>5 Hard copies with a soft copy</b>	<b>5.1</b>	2% of approved project cost or 5 lakh whichever is lower		<b>500,000</b>	EA will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.
<b>J</b>	<b>Geological Report Preparation</b>	<b>5 Hard copies with a soft copy</b>	<b>5.2</b>	iv) Detailed exploration with cost of work exceeding ₹ 300 lakh: A minimum of ₹ 9 lakh or 3% of the value of work which		<b>2,000,000</b>	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.

				ever is more subject to a maximum amount of ₹ 20 lakh and ₹ 10,000/- per each additional copy.			
K	Peer review Charges		As per EC decision			30,000	
L	<b>Total Estimated Cost without GST</b>					<b>217,969,488</b>	
M	<b>Provision for GST (18%)</b>					<b>39,234,508</b>	GST will be reimburse as per actual and as per notified prescribed rate
N	<b>Total Estimated Cost with GST</b>					<b>257,203,995</b>	
	<b>or Say Rs. In Lakhs</b>					<b>2,572.04</b>	
<b>Note:</b>							
1	<b>Strict adherence to the Ministry of Finance's and GFR guidelines is mandatory. Every transaction must adhere to GFR rule 21.</b>						
2	<b>In case of delay/non- performance, the appropriate action will be taken by competent authority against delinquent agency as per prevailing govt. of India rules/guidelines on procurement.</b>						
3	<b>If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of excusion of the project by NEA on its own, a Certifiante regarding non outsourcing of any component/project is required.</b>						
4	<b>Necessary efforts should be made to minimize any adverse impact on the environment during exploration activities.</b>						
5	<b>Any item of work not mentioned above shall be added as per SoC.</b>						
*	<b>SoC Item No, Unit and Rate for each item of work must be as mentioned in the SoC.</b>						

# GEOLOGICAL MAP ON 1:50K IN KANIVIHALLI G3 BLOCK WITH LOCATION INDEX

75°59'0"E 76°0'0"E 76°1'0"E 76°2'0"E 76°3'0"E 76°4'0"E 76°5'0"E 76°6'0"E

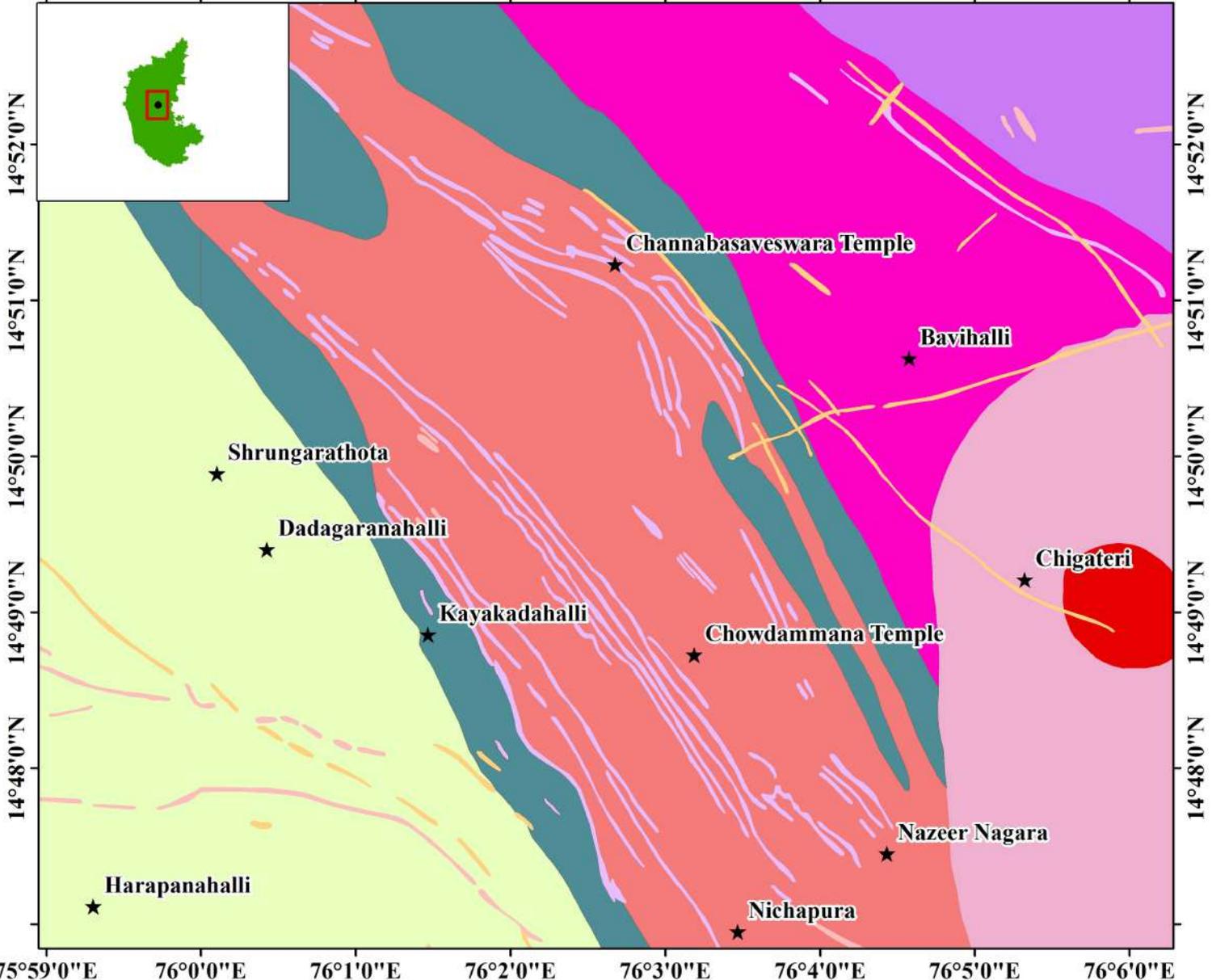
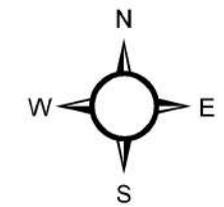


Plate 1



## Legend

★ Known Location

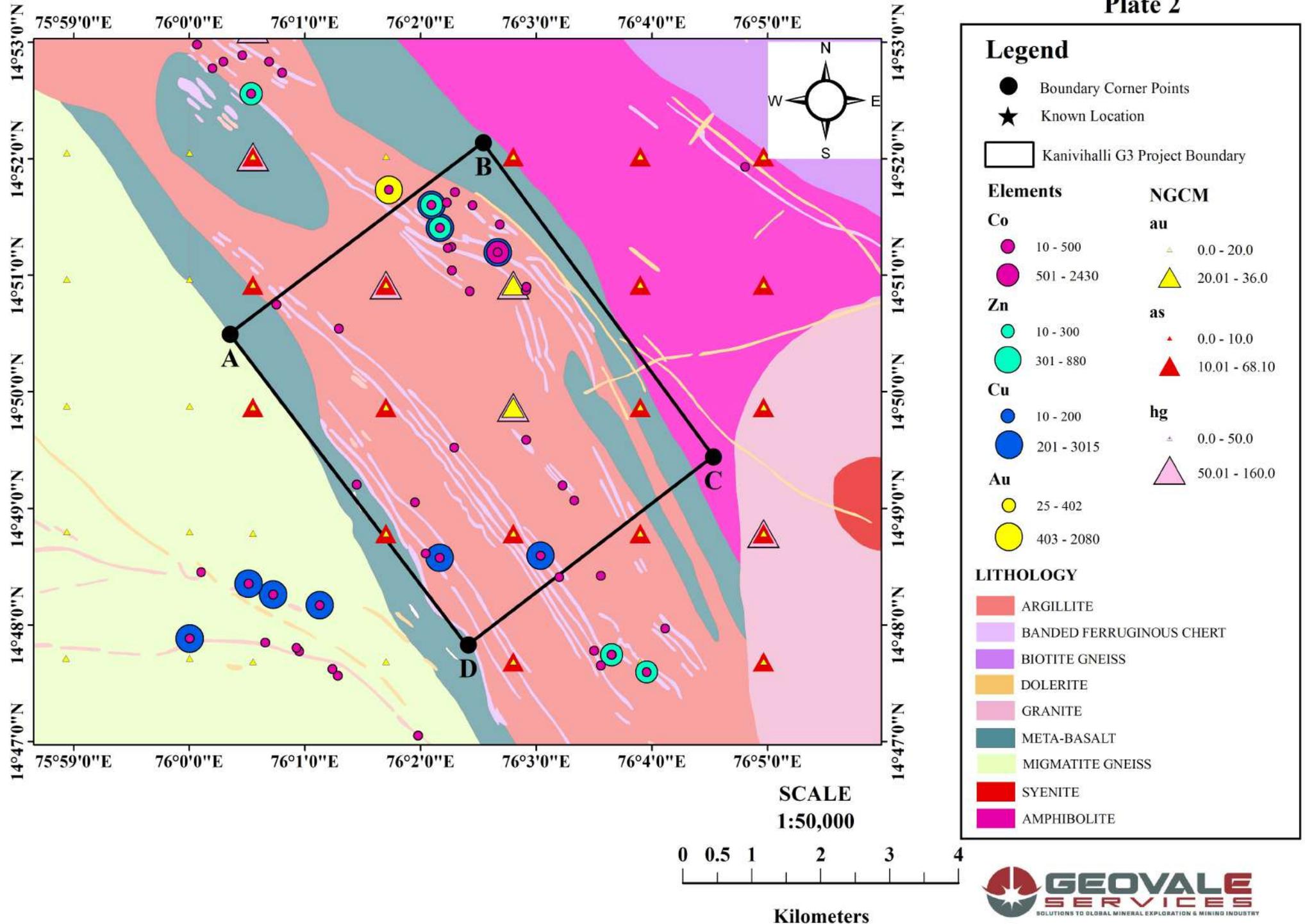
### LITHOLOGY

- ARGILLITE
- BANDED FERRUGINOUS CHERT
- BIOTITE GNEISS
- DOLERITE
- GRANITE
- META-BASALT
- MIGMATITE GNEISS
- SYENITE
- AMPHIBOLITE

75°59'0"E 76°0'0"E 76°1'0"E 76°2'0"E 76°3'0"E 76°4'0"E 76°5'0"E 76°6'0"E

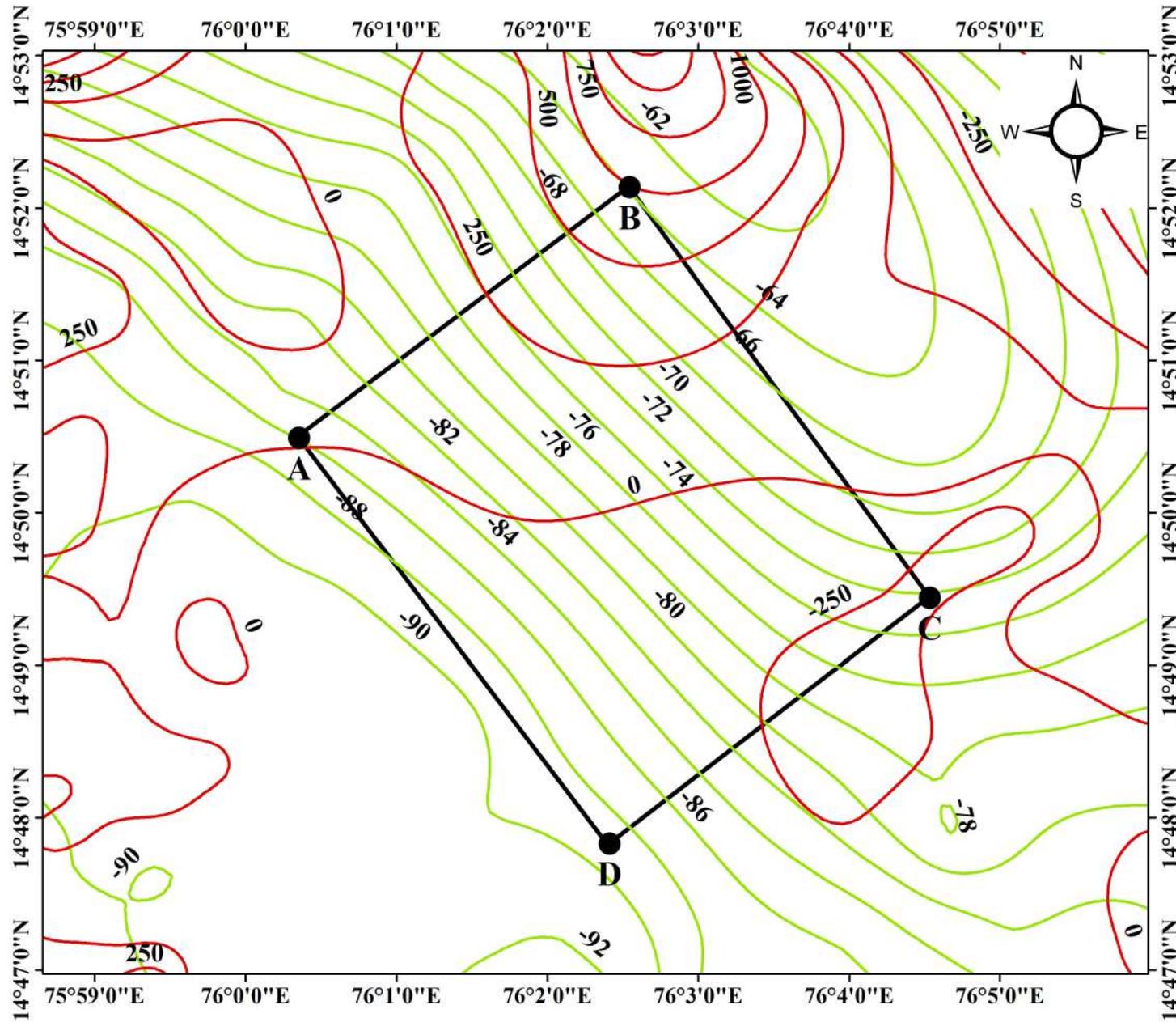
# PROPOSED BLOCK BOUNDARY IN KANIVIHALLI G3 BLOCK OVER GEOCHEMICAL MAP

Plate 2



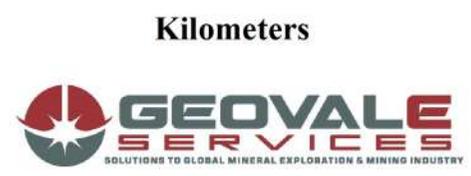
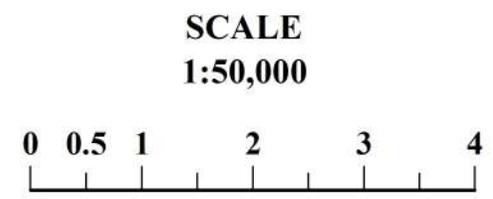
# PROPOSED BLOCK BOUNDARY IN KANIVIHALLI G3 BLOCK OVER GROUND GEOPHYSICAL (NGPM) MAP

Plate 3



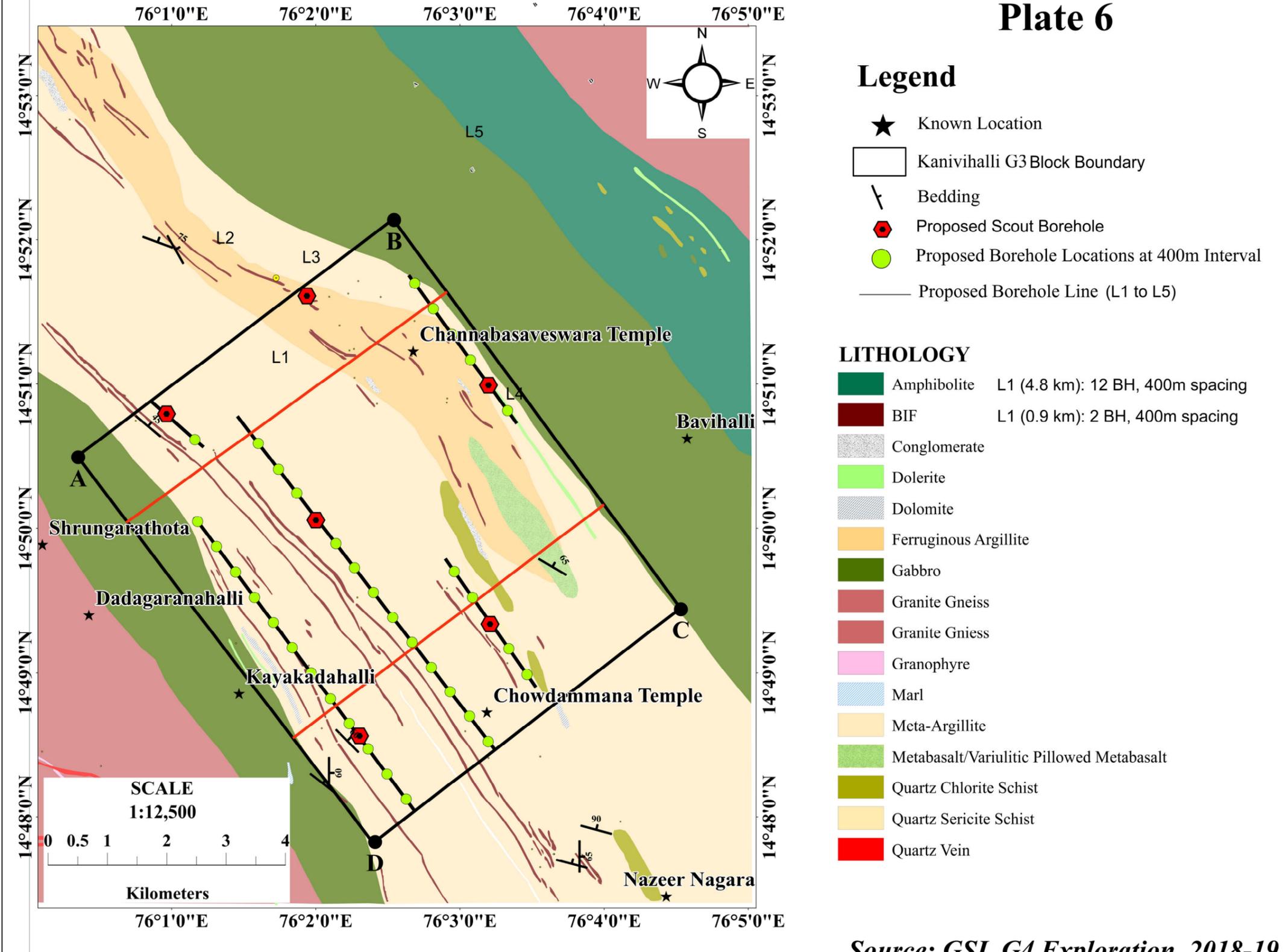
**Legend**

- Boundary Corner Points
- ★ Known Location
- Kanivihalli G3 Project Boundary
- Magnetic Anomaly Contour
- Bouguer Anomaly Contour



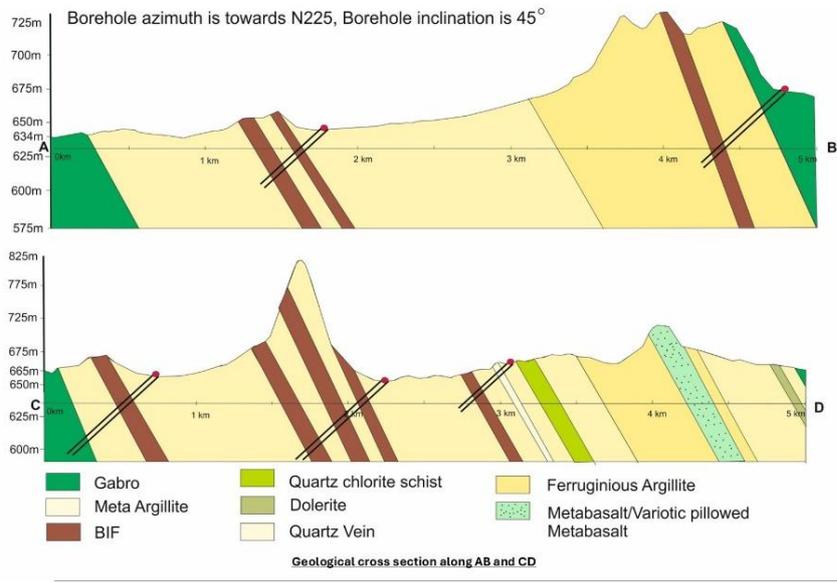
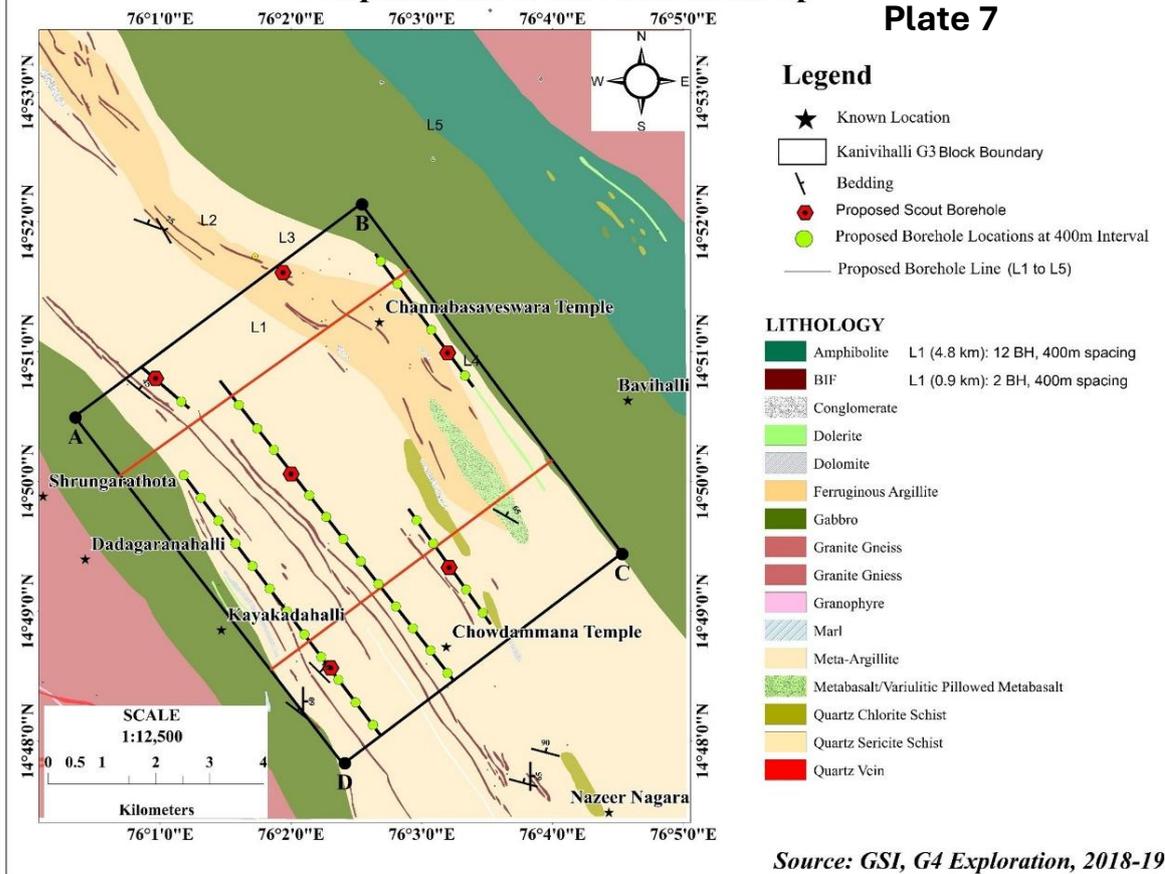
# Proposed borehole Location Map

## Plate 6



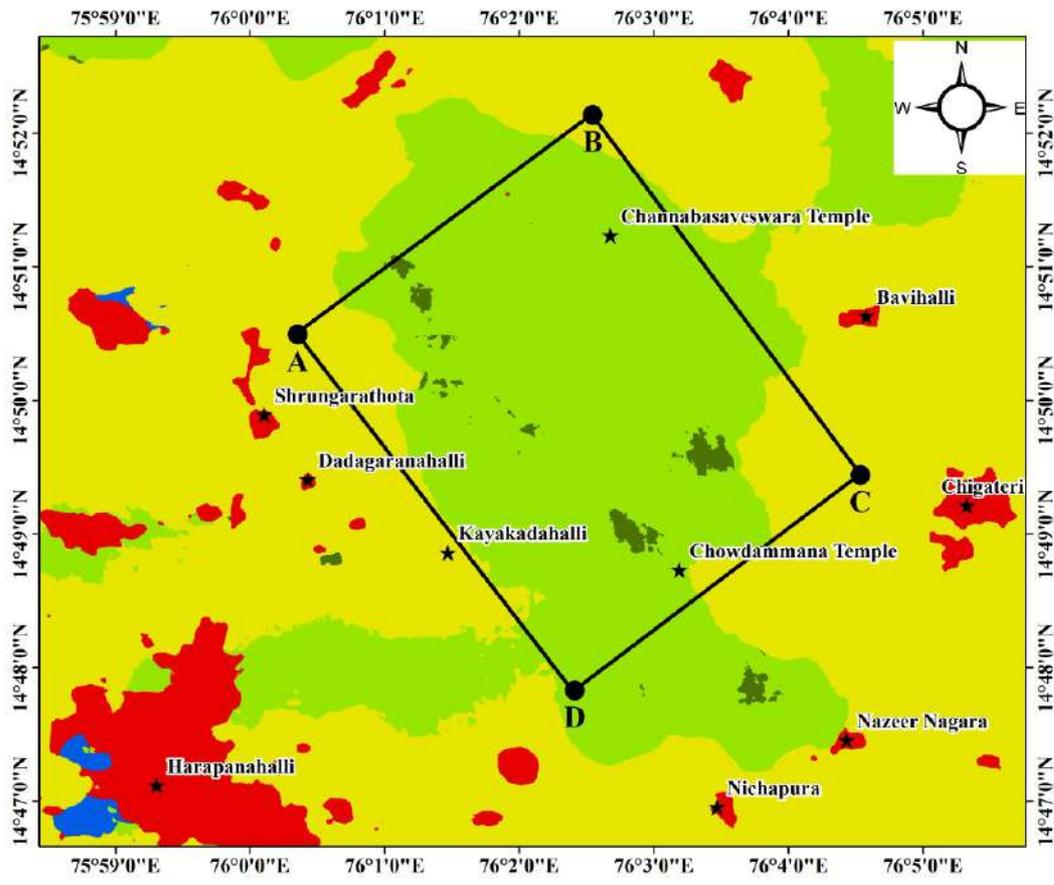
# Proposed borehole Location Map

Plate 7



**PROPOSED BLOCK BOUNDARY IN KANIVIHALLI G3 BLOCK OVER LANDUSE LANDCOVER MAP**

**Plate 8a**

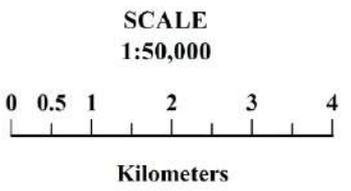


**Legend**

- ★ Known Location
- Kanivihalli G3 Project Boundary
- Boundary Corner Points

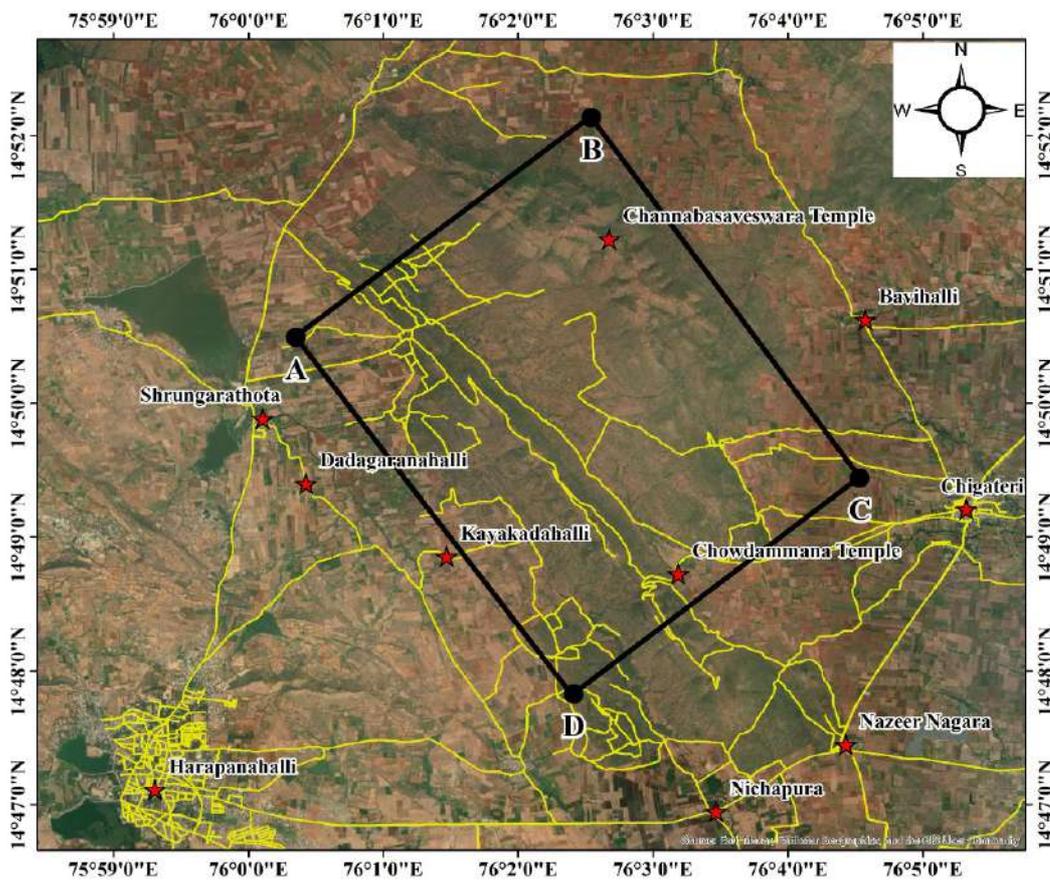
**LULC Classes**

- Waterbody
- Vegetation
- Cropland
- Built-Up
- Rangeland



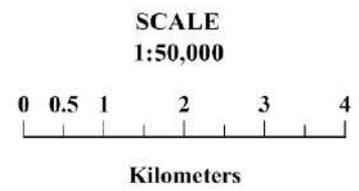
# PROPOSED BLOCK BOUNDARY IN KANIVIHALLI G3 BLOCK OVER ACCESSIBILITY MAP

Plate 8b



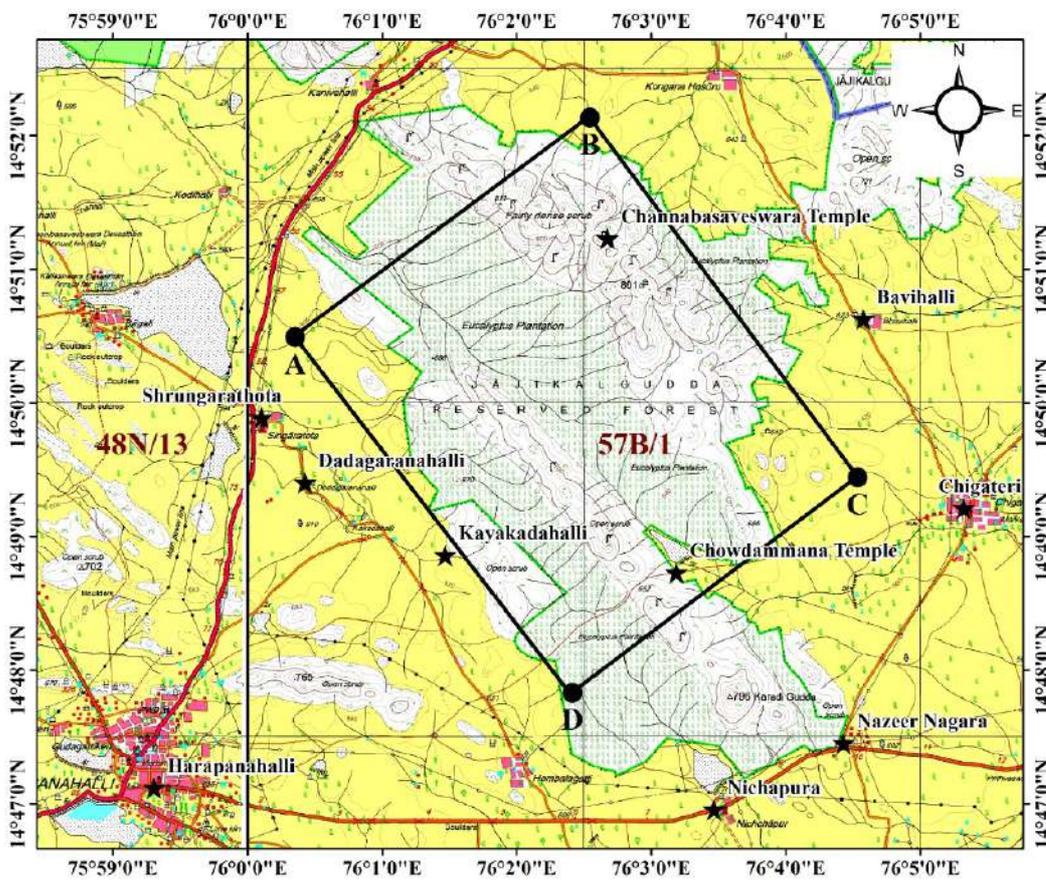
**Legend**

- Boundary Corner Points
- ★ Known Location
- Kanivihalli G3 Project Boundary
- Road Networks



# PROPOSED BLOCK BOUNDARY IN KANIVIHALLI G3 BLOCK OVER TOPOGRAPHY MAP

Plate 9



**Legend**

- Boundary Corner Points
- ★ Known Location
- Kanivihalli G3 Project Boundary

