Chapter 2

Geological Setting

2.1 INTRODUCTION

Peninsular India is geologically complex and highly deformed terrain (Figure 2.1). It is broadly divided into the Deccan Volcanic Province towards the northern part and Dharwar Craton towards the southern part. The oldest rocks date back to 3300-3400 m.y. (Ramakrishnan et al, 2010). The region exhibits rich mineralization along different geological and structural units, some of which are already being exploited whereas much of it remains still unexplored, largely due to complex terrain and poor access.

The following sections cover the regional geology of the two broader units of Peninsular India i.e. Eastern and Western Dharwar Craton, followed by the detailed synthesis of geology and mineralization of the Gadag schist belt.

2.2 DHARWAR CRATON

Dharwar Craton is one of the best explored and studied terrains of Peninsular India, and is remarkable for its younger granites, grey gneisses, charnockites and greenstone/schist belts. The Craton is divided into two main tectonic blocks (Chinnaiah, 2014), viz. the Western Block and Eastern Block, renamed respectively as the Western Dharwar Craton (WDC) and the Eastern Dharwar Craton (EDC) by Rogers (1986). The WDC and EDC are split by the Chitradurga Shear Zone (CSZ) situated at the eastern margin of the Chitradurga schist belt and are not very far away from the western margin of Closepet Granite (Figure 2.1). There is transition zone between Chitradurga Shear Zone and Closepet Granite and this contact is not sharp. The simplified stratigraphy after Ramakrishnan and Vaidyanadhan, 2010 of the WDC and EDC of Dharwar Craton is given in table 2.1a.

The grey gneiss complex which covers the whole Craton was known as 'Peninsular Gneiss' earlier. The term 'Peninsular Gneiss' (>3000 Ma) is proposed to be restricted to WDC in view of its composition, mutual relationship with the associated supra-crustal rocks, critical differences in age, and geographic distribution in separate tectonic block. The dominantly granitic terrain of EDC is known as the Dharwar
Batholith (>2500 Ma), after Chadwick et al. (2000). The major differences between WDC and EDC are summarised in table 2.1b.

Table 2.1a: Simplified stratigraphy of WDC and EDC of Archaean Dharwar Craton (after Ramakrishnan and Vaidyanadhan, 2010).

<table>
<thead>
<tr>
<th>Age</th>
<th>Western Dharwar Craton (WDC)</th>
<th>Eastern Dharwar Craton (EDC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2500-2600 Ma</td>
<td>Younger granite (Chitradurga, Arsikere) charnockite</td>
<td>Younger granite/gneiss (Closepet and equivalents) charnockite</td>
</tr>
</tbody>
</table>
| 2600-2800 Ma | Chitradurga Group  
Bababudan Group                                      | Dharwar Supergroup  
Kolar Group  
Yashwantpur Formation                                      |
| ~3000 Ma   | Peninsular Gneiss                                                | Enclaves of older gneiss                                        |
| 3100-3300 Ma | Sargur Group                                                    | (?) Warangal Group                                               |
| 3300-3400 Ma | Gorur gneiss                                                     | (?) Salem Group                                                  |

Table 2.1b: The essential differences between WDC and EDC (after Ramakrishnan and Vaidyanadhan, 2010)

<table>
<thead>
<tr>
<th>Western Dharwar Craton (WDC)</th>
<th>Eastern Dharwar Craton (EDC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dharwar schist belts are large with volcanics, subordinate sediments.</td>
<td>1. Dharwar greenstone belts are narrow, with dominant pillowed basalts.</td>
</tr>
<tr>
<td>2. Peninsular Gneiss (&gt; 3000 Ma) basement having angular unconformity with the Dharwar marked by QPC. Basement gneiss inliers within schist belts.</td>
<td>2. Dharwar Batholith (2500-2700 Ma) intrusive on all sides. Diapiric gneiss domes common.</td>
</tr>
</tbody>
</table>
| 3. Three fold succession of:  
(i) Basalt-arenite-BIF  
(ii) Shelf facies at the margin and homotaxial pillowed basalt-BIF in deeper waters.  
(iii) Greywackes-BIF-volcanics | 3. Three fold succession of:  
(i) Rare shelf sediments disrupted into screens at the belt margins.  
(ii) Pillowed volcanics, greywackes, BIF.  
(iii) Felsic volcanics, volcanogenic conglomerate (Champion Gneiss). |
4. Older sequence (Sargur Group) as a narrow belts and enclaves, abundant in the south.

5. Intermediate pressure (kyanite-sillimanite type) metamorphism.

4. Older sequence (Warangal Group) mostly as enclaves in the northeast and Salem Group (?) in the south.

5. Low pressure (andalusite-sillimanite type) metamorphism.

2.3 LITHOSTRATIGRAPHY

In the Archaean and Proterozoic era the entire geological history of the Karnataka is confined. Rest of the periods from Cambrian to Recent are barely represented excluding some minor sediments of Recent age. These sediments are exposed along the west coastal margin. The northern part of Karnataka is covered by Deccan Trap (Figure 2.1), representing an unusual eruption of volcanic activity during Cenozoic era (Radhakrishan and Vaidyanadhan, 2011). Generalized regional lithostratigraphy of the Dharwar Craton is presented below, followed by a brief description of major groups.

2.3.1 ANCIENT SUPRACRUSTAL ENCLAVES (SARGUR TYPE)

The oldest rock of Karnataka is grey gneisses and ranging in age from 3400-3000 m.y. These gneisses contain enclaves of older group of sediments and associated with igneous intrusive which are formed, metamorphosed amphibolitic and granulitic grade of rocks. These enclaves of the grey gneisses were named as ‘Ancient Supracrustals and belonging to the Sargur Group (Figure 2.1) (Radhakrishan and Vaidyanadhan, 2011).

In WDC following are the important belts of Sargur Group: Holenarsipur, Nuggihalli, Aladahalli, Kalyadi, Krishnarajpet and Ghattihosahalli (GSI, 2006). Fuchsite quartzite with layers of chromite and barite, corundum, staurolite, marbles and calc-silicate rocks, serpentinised komatiites, biotite schists with garnet, kyanite, sillimanite, cordierite, banded iron formation and chromite-bearing ultramafic complexes etc. are the main rock type of Ancient Supracrustals (Radhakrishan and Vaidyanadhan, 2011).
2.3.2 OLDER AND YOUNGER GNEISS COMPLEXES

The grey gneisses known as ‘Older Gneiss Complex’ or ‘Peninsular Gneiss’ were formed due to numerous tectono-thermal events and large influx of sialic materials between 3400-3000 m. y. ago. These gneisses are the basement for a prevalent belt of schist (Radhakrishan and Vaidyanadhan, 2011).
In the EDC mostly gneissic rocks of younger group are found and are composed of granodiorite and granite, representing remobilized older crust with profuse this is known as ‘Younger Gneiss Complex’ (Figure 2.1). The age is recorded from 2700 to 2500 m. y. for this group of rocks. The younger granite of Karnataka occurring mainly in the EDC is recently renamed as ‘Dharwar Batholith’ (Radhakrishan and Vaidyanadhan, 2011).

2.3.3 AURIFEROUS SCHIST BELTS (KOLAR TYPE)

These rocks occur in association with intrusive and are basic igneous rock of basaltic composition. They show igneous characteristics with subordinate sedimentary rocks intercalations. The auriferous disposition of these rocks is most typical feature and is well developed in the EDC part. ‘Kolar schist belt’ is an archetypical representative these auriferous schist belts (Figure 2.1). The ‘Auriferous Schist Belt’ is largely volcanic in nature and gold bearing and it separates them from the more widespread schist belts in the WDC. The WDC have a higher % of sediments and resting unconformably on the older gneissic basement (Figure 2.1, Radhakrishan and Vaidyanadhan, 2011).

2.3.4 LARGER SCHIST BELTS (DHARWAR TYPE)

Larger schist belts are the prominent schistose rocks of Karnataka known as ‘Dharwar Supergroup’ and are of Late Archaean age, ranging from 2900 to 2600 m. y. This Supergroup is broadly divided into two: (1) Bababudan Group: which is mainly igneous of nature and hosts the main iron formation; (2) Chitradurga Group: which is a more widespread schistose rock, sedimentary in character, composed of quartzite, conglomerate, greywacke, limestone. These rocks are associated with maganiferous and ferruginous cherts (Figure 2.1, Radhakrishan and Vaidyanadhan, 2011).

2.3.5 YOUNGER GRANITE (CLOSEPET GRANITE)

The end of Dharwar cycle was manifested by a fresh eruption of granitic activity about 2600 m. y. ago. These granites trending north-south as a thin belt and 50 km wide (Figure 2.1, Radhakrishan and Vaidyanadhan, 2011). and extended from Bilgi in the north, forming the basement to Kaladgi Supergroup upto Sivasamudram
in the south. These granites are marked as “Closepet Granite” (GSI, 2006). The name ‘Closepet Granite’ has been given to coarse to medium, pink and grey granites, monzonites and monzo-granites traversed by fine grained pink and grey types, pegmatite and aplites. The coarse grained porphyritic granite is the characteristic rock type of this class. This rock has large-sized porphyroblast of pink and grey potash feldspar. This younger potassic granite is mark a major-geo-suture amalgamating two distinct crustal blocks i.e. WDC and EDC of Late Archaean age (Figure 2.1). Intra-crustal melting at the end of the Archaean age due to the collision of these two blocks resulted emplacement of granites along the line of junction of above mentioned blocks (Radhakrishan and Vaidyanadhan, 2011).

Chitradurga granite, J. N. Kote granite, Hosadurga granite, Banawara granite and Karwar granite have similar composition, texture and geological history. These granites are equivalent and coeval to younger granite. Other important event is the emplacement of pink granite known as Chamundi granite which 800 m. y. old and is the youngest pluton, reported so far in Karnataka (Figure 2.1, GSI, 2006).

2.3.6 GRANULITES

‘Charnockite’ is exposed at the southern tip of Karnataka and is pyroxene-bearing granulite. This rock is formed due to transformation of the older gneisses through influx of fluid rich in CO₂ which leads to development of orthopyroxene. The orthopyroxene impart bluish-grey colour to these rocks (Figure 2.1). Formation of Charnockite formation and emplacement of Younger (Closepet) Granite is coeval (Radhakrishan and Vaidyanadhan, 2011).

This rock is confined to a 30 km wide transition zone between low grade gneissic terrain in the north and high grade granulite terrain in south. These rocks occupy Male Mahadeswara and Biligiri Rangan hills in Mysore district of Karnataka, and southern part of Coorg district of Tamil Nadu and their regional trend is northwest to southeast (GSI, 2006).

2.3.7 YOUNGER INTRUSIVES - DYKE SWARMS

Dykes were formed at the end of the Archaean, trending N-S and E-W and traversing rocks of earlier age (Figure 2.1). These dykes are composed of dolerite and belong to different ages. The majority of the dykes are younger than 2400 m. y.
Besides dolerites, a number of alkaline dykes which are younger (800 m.y.) were also reported from the southern parts of Karnataka (Radhakrishan and Vaidyanadhan, 2011).

Due to crustal extension and fractures these dykes were emplaced and were grouped into three chronological order: (i) Older metamorphosed varieties of >2600 m. y. old; (ii) Younger un-metamorphosed dykes which are doleritic to gabbroic in nature and their general trend is ENE-WSW and (iii) Felsite, alkaline and porphyry dykes. These dykes are considered to be the youngest and associated to plutonic activity of Chamundi granite dating 800 m. y. (GSI, 2006).

2.3.8 PROTEROZOIC SEDIMENTATION (KALADGI AND BHIMA BASINS)

Belgaum, Bijapur, Bidar and Gulburga districts of northern Karnataka were once depressed below sea and created an extensive basin of deposition. The sediments deposited in the basins were recognized as the ‘Kaladagi and Bhima’ of Proterozoic age. ‘Kaladagi and Bhima’ were named after the town of Kaladagi in Bijapur district and Bhima river see figure 2.1 (Radhakrishan and Vaidyanadhan, 2011). The Kaladgi Supergroup consists of principally carbonates and argillites with small amount of siliciclasts. The sediments of Bhima Group are rich in limestone inter-bedded with argillite and the base of basin is marked by less developed arenite and rudite (GSI, 2006).

The ‘Great Eparchean Unconformity’ is separating Kaladagi sediments from the underlying schistose and granitic rocks of Archaean age (Radhakrishan and Vaidyanadhan, 2011). It is assumed that the sediments of Kaladgi and Bhima extended further north and their northerly extension lie buried under a thick cover of Deccan Trap which is of much younger period (Radhakrishan and Vaidyanadhan, 2011).

2.3.9 DECCAN TRAP

Remarkable volcanic activity took place at the end of Cretaceous and at the beginning of Tertiary era (65 m. y. ago). Horizontal sheets of lava piled one upon the other over a thickness of approximately 2 km and extended over an area of 500,000 sq. km. Northern part of Karnataka, mainly Belgaum, Bidar, Bijapur and Gulbarga districts are covered by these traps (Figure 2.1). Sedimentary intercalations known as
‘Inter-trappean beds’ were found in between the flows of traps and evident that these were deposited in inland lakes. The available age data indicates that this volcanic activity was rapid, continuous without any interval and was of short duration and not exceeded more than one m. y. (Radhakrishan and Vaidyanadhan, 2011).

2.3.10 LATERITES

Laterite is found as capping over the Deccan Trap and the magnificent development of the laterite is seen around Bidar district of Karnataka (Figure 2.1). The extensive capping of residual and detrital laterite covers narrow coastal belt and the steep edge of the Western Ghat (Radhakrishan and Vaidyanadhan, 2011).

Laterization started due to exposure of rocks for a prolonged period and suitable climatic conditions. Their thickness ranges from a few cm to 60 m. The laterite is grouped into two - based on their elevation level (i) at +600 m elevation which are confined to Western Ghats and are homogenous and less sandy in nature (ii) other fringing the west coast and these are gravelly to sandy in texture and appears to be transported (GSI, 2006).

2.4 STRUCTURES AND METAMORPHISM

The Dharwar Craton is structurally complex and highly deformed terrane. It has undergone several phases of deformations which have resulted in the development several folds, faults and lineaments of regional level (Figure 2.1). The most salient feature of the Dharwar Craton is the disposition of sub-parallel to curvilinear schistose belt formations, whose regional trend swings from N-S in the southern to NW-SE in the northern part. The regional trend of the foliation is also parallel to the regional trend of these greenstone belts. Thus, the parallel alignment of greenstone belts and concordant fabric elements in the schistose formations and migmatitic gneisses point to similar structural evolution of these rocks (GSI, 2006).

2.4.1 FOLD

Three different phases of fold formation were reported from Dharwar Craton. The earliest fold (F1) is tight, isoclinal with thick hinge and thinning out limbs. The F1 folds are generally rootless and of meso-scale (GSI, 2006). The recent structural studies show that N-S trending tight folds are coaxially refolded by a second phase of deformation (Ramakrishnan and Vaidyanadhan, 2010). The F1 folding is
accompanied by the development of penetrative foliation or schistosity (S1) and greenschist to lower granulite facies metamorphism at different crustal levels (GSI, 2006). The second folding (F2) is upright and which have rotated the earlier folds (F1) and (S1) foliation and has resulted in the development of crenulations or close spaced fracture cleavage (S2). Most of the major fold hinges with N-S to NW-SE trending axial planes are due to F2 (GSI, 2006). The third phase of deformation produced more open type of folds (F3) of lower intensity and warps on transverse axial planes, i.e. ENE-WSW to WNW-ESE directions (GSI, 2006). The E-W to NE-SW swing in the alignment of the greenstone belts as seen in the Gadag belt can be attributed to this folding episode deformation (Ramakrishnan and Vaidyanadhan, 2010, GSI, 2006).

2.4.2 FAULTS, LINEAMENTS AND SHEAR ZONES

Joints and shear zones of brittle to ductile character are generally parallel to the axial planes of F2 and F3 folds. The gold mineralization in Kolar Gold Field, Hutti, Gadag and Javanahalli belts are hosted by shear zones which are parallel to axial planes of F2. Shear zones and faults trending E-W and ENE-WSW to WNW-ESE has the greenstone belts, gneisses, younger granites, Purana Basins and Deccan flows. Some major lineaments have already been reported and these are (GSI, 2006):

i. Cauvery lineament- trends WNW-ESE.
ii. Krishna lineament- trends ENE-WSW.
iii. Vedavathi lineament- trends ENE-WSW.
iv. Tunga-Hemavathi lineament- trends NNW-SSE.
v. Arkavathi lineament- trends N-S.
vi. Dharwar-Tungabhadra lineament- trends ENE-WSW.
vii. Lakshmanthirtha lineament- trends NE-SW.
viii. Kabini Lineament- trends ENE-WSW.
ix. Kumadvati-Narihalla lineament- trends ENE-WSW.
x. Kaiga-Mothimakki lineament- trends NNW-SSE.

2.5 MINERALIZATION

Dharwar Craton is famous for its wealth of gold, manganese, magnetite ore and limestone. Other substantial resources are: chromite, hematite, dolomite, bauxite, quartz and silica sand, clays, titaniferous-vanadiferous magnetite, talc and steatite etc.
(GSI, 2006). Late Archaean schist belts of WDC are composed of Banded Iron Formation (BIF) and at places these BIFs are associated with volcanism, are found to be gold bearing (Radhakrishnan and Vaidyanadhan, 2011).

2.6 PHYSIOGRAPHY

The surface of the Dharwar Craton is uneven to hilly in nature. There are 3 major easterly flowing rivers which are draining the vast area and these rivers are: (i) Krishna and its tributaries: Ghataprabha, Tungabhadra, Malaprabha, Bhima and Vedavati. These rivers are draining the northern and central part of Dharwar Craton, (ii) in the north Manjira river of the Godavari basin and (iii) Cauvery river with its tributaries-Simsha, Hemavathi, Kabini and Arkavati. These rivers are draining southern part of Dharwar Craton (GSI, 2006). There are several westerly flowing streams and these are: Kalinadi, Sharavati and Netravati. The river courses are mostly aligned in two directions (i) ENE-WSW to WNW-ESE, (ii) N-S to NNW-SSE. These streams correspond to the major faults, lineaments, joints and shear zones (GSI, 2006).

The Dharwar Craton generally shows dendritic to sub-dendritic drainage pattern. Strong structural control on the drainage pattern is indicated by straight courses and sharp turns of many rivers. The state experiences humid tropical to semi-arid climate for most part of the year. In the coastal plain and Western Ghats the annual rainfall is about 300 to 500 cm and eastern plateau receives about 80 cm. The Western Ghats are densely forested whereas plateau is in general devoid of dense forest (GSI, 2006).

2.7 GEOLOGY OF THE STUDY AREA

The study area is situated in Karnataka and falling in Gadag, Mundargi and Shirhatti districts. The area is the northern continuity of Chitradurga schist belt of Western Dharwar Craton and known as Gadag schist belt (GSB). Present area covers parts of Survey of India toposheets (SOI): 48M/11, 12, 15 and 16 (Figure 2.2). Dharwar Craton is a well exposed granite-greenstone terrane and formed the basement of most of peninsular India (Glorie et al., 2014). The WDC exposes the rocks of Peninsular Gneissic Complex (PGC) and volcano-sedimentary assemblage rocks. These are belonging to Chitradurga Group of Dharwar Supergroup, ranging in
age from Archaean to lower Proterozoic and are intruded by several dolerite dykes of lower Proterozoic age (Figure 2.2). Oldest rock exposed in the area is ultramafic belongs to Sargur Group and youngest rock units are quartz veins (Chakrabarti et al., 2006). The stratigraphy of the area is given in the table 2.2.

Table 2.2: Stratigraphic succession of Gadag schist belt (after Beeraiah and Sengupta, 1998)

<table>
<thead>
<tr>
<th>Quartz Vein</th>
<th>Post-tectonic intrusives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabbro, dolerite</td>
<td></td>
</tr>
<tr>
<td>Grey Granite, pink granite</td>
<td></td>
</tr>
<tr>
<td>Quartz porphyry</td>
<td></td>
</tr>
</tbody>
</table>

| Sericite phyllite, garnetiferous mica schist    | Hiryur Formation          |
| Banded ferruginous chert                        | CHITRADURGA GROUP         |
| Banded maganiferous chert                       | DHRWAR SUPERGROUP         |
| Limestone                                       |                           |
| Polymictic conglomerate                         |                           |
| Metabasalt                                      |                           |
| Argillite-chlorite phyllite                     |                           |
| Grit-greywacke                                  |                           |
| Para-amphibolite                                |                           |

| Metabasics                                      |                          |
| Metavolcanics (massive, schistose, pillowed and vesicular basalts, acid volcanics, agglomerate) | Ingaldhal Formation |
|                                                | CHITRADURGA GROUP        |
|                                                | DHRWAR SUPERGROUP        |

| Gneissic/ gneissic granite                      | Peninsular Gneissic Complex |
|                                                |                            |
| Ultramafics                                    | Sargur Group               |

The GSB is mainly composed of metavolcanic and metasedimentary rocks. GSB is also location of ancient gold mines and mining activity from British period. Geological Survey of India (GSI) thoroughly explored the western part of the GSB between Nagavi in the north and Sangli in the south for gold bearing tract and the reported old mines are located 15 to 25 km south of Gadag city (Vasudev, 2009). The GSB trends NW-SE with a strike length of around 50 km and with maximum width of around 22 km is between Shirahatti and Dambal (Figure 2.2). The schist belt consists of basalt, banded ferruginous chert, conglomerate, basaltic andesite, rhyolite-rhyodacite with limestone. Quartz porphyries, sills, dykes of gabbro and dolerite and quartz veins are intrusive phase in the belt. These intrusive rocks are trending NNW-SSE to NW-SE and NNE-SSW (Chakrabarti et al., 2006). The most abundant sedimentary rocks in GSB are greywacke and polymictic conglomerate (Table 2.2 &
Figure 2.2). These rocks are interbanded with chert, BIF and dolomitic limestone. Among the volcanic-basaltic and andesitic are the most abundant rocks. To the north-east and south-west margins of GSB gneiss and granite rocks are exposed. The contact between the gneissic rocks and the rocks of the GSB is commonly sharp and at places this contact is marked by quartz-feldspathic veining and faulting (Chakrabarti et al., 2006). In the western art of the GSB metavolcanic rocks are dominant whereas polymictic conglomerate, gritty schist and garnetiferous mica schists are occurring in the core of the synform (Figure 2.2). Actinolite schist and sericite phyllite are major rocks in the eastern part of the belt (Chakrabarti et al., 2006).

The area is known for volcano-sedimentary sequences and the study area is mainly occupied by the sedimentary rocks. In the study area, mainly eight types of rock are exposed and these include: (i) sericite-phyllite/quartz chlorite schist, (ii) ferruginous chert/banded hematite quartzite, (iii) greywacke/argillite, (iv) gritty schist, (v) polymictic conglomerate, (vi) actinolite schist/amphibolite, (vii) metavolcanics and (viii) granite gneiss (Figure 2.2).

2.7.1 PHYSIOGRAPHY OF STUDY AREA

The area is mainly drained by two major rivers i.e. Malaprabha and Tungabhadra. The overall drainage network is exhibiting dendritic to sub-dendritic pattern (Figure 2.3). The area falls in the semi-arid tract and the annual rainfall received is commonly < 750 mm. The terrain of the area is plain to gently undulating and varies in altitude. From December to February month the area witnesses winter season. During April to May temperature reaches up to 42° C and from December to January temperature will go down up to 16° C. Principal crops in the area are: jowar, sunflower, groundnut, cotton and wheat other crops like paddy, ragi, turgram etc (Nagaraja, 2009).

2.7.2 STRUCTURES

The GSB is folded into an overturned synclinal fold (Ahmed, 1961). Three deformation phases of fold i.e. D1, D2 and D3 have been reported in the area. The D1 produced very tight asymmetric to isoclinals folds with a pervasive axial plane schistosity (S1) which is also the dominant schistosity on a regional scale. The D1 and D2 are nearly co-axial producing type-III interference pattern. The D2 effected D1
axial planes and produced open to tight upright folds with axial planes striking NNW to NW. The D2 produced kink bands on S1, boudins on quartz lenses and a set of mesoscopic folds having varying orientation. The D3 produced puckers and warps on all scales with vertical axial plane striking NE to E; the axis of which plunges down the dip of the schistosity (S1) with varying amount of plunge (Chakrabarti et al., 2006).

In recent studies carried out in GSB, quartz vein orientations were analysed using 3-D Mohr circle construction by Tridib and Manish (2013). This study reveals that the metabasalts has developed a NW-SE striking fabric which is related to NE-SW compression that led to regional D1/D2 deformation and the development of NW-SE structural elements. Plunge direction varies from NW to SE in the metabasalt and this is due to D3 deformation that took place under NW-SE compression and is known to have resulted in development of warps, dome-basin interference pattern as well as NE-SW striking deep-seated faults in the Gadag schist belt.

2.7.3 MINERALIZATION IN THE AREA

The area is gifted by significant gold mineralization (Deb, 2014) and is known for economic minerals like gold and iron ore (Figure 2.3). Extensive works in the auriferous zones of the GSB have been carried out in the past as well as in the recent years. Several abandoned gold mines are seen in the following areas: Kabuliyatkatti, Attikatti, Hosur and Yelisirur etc. (Figure 2.3). In ancient times, the ferruginous chert bands of Gadag belt have also been worked for low grade iron ore (Chakrabarti et al., 2006). Gold and sulphide-gold lodes are hosted by the metabasalt, and at the contact of metabasalt and greywacke/phyllite (Vasudev, 2009).

Gold mineralisation in the study area is mainly confined in western part of the GSB (Figure 2.3). The mineralization in the area is mainly structure–controlled and the deposit is hydrothermal-epigenetic lode (Chakrabarti et al., 2006). There are three lodes which are reported from the area, known as-the Eastern lode, the Main Kabuliyaatkatti lode and the Western Hosur group of (Chakrabarti et al., 2006). In the study area, the old mines and ancient workings were dotted along four roughly parallel zones, trending NNW-SSE, and spreading over an area of 12 km by 10 km. They are classified by Chakrabarti et al., 1993, into four groups:

1. Western Hosur-Yelisirur-Venkatapur Group.
3. Eastern Group (Kabuliyatkatti North lodes).

The auriferous tract of the study area consists of metavolcanic metasedimentary, younger basic intrusives and quartz veins. Sheared and brecciated rocks with wall-rock alteration such as sericitisation, carbonatisation, chloritisation, prophyllitisation and silicification host gold mineralization in the area (Chakrabarti and Sugavanam 1991). The auriferous quartz-carbonate veins contain a stringers and dissemination of sulphides like pyrite, pyrrhotite, arsenopyrite and chalcopyrite. The mineralisation is controlled by F2 related shears and marked by wall rock alteration like chloritisation, sericitisation, biotitisation, carbonatisation and silicification (Beeraiah and Sengupta, 1998).
Figure 2.2: Geology of the Study Area (GSI)
Figure 2.3: Drainage pattern and structures of the study area