3. Introduction

In this chapter, the geological setting and spatial relationship of the lithounits of the Devarnarsipur ultramafic-mafic complex, the mode of occurrence of different lithological units their contact and structural relations are given. Variations within a single lithounit and the associated V-Ti magnetite ore deposits and Peninsular gneisses are discussed.

3.1. Geological setting

Ultramafic-mafic rocks carrying V-Ti magnetite layers in Devarnarsipur area of Shimoga schist belt, are designated as “Devarnarsipur ultramafic-mafic complex” in the present research work. The layered complex consists of ultramafic rocks namely chromite-bearing dunite, pyroxenite and hornblendite and mafic rocks namely gabbro-anorthosites with V-Ti magnetite ore (bands/layers) are encountered over an area of about fifty sq. km. The layered complex intrudes the supracrustal rocks of the Chitradurga-group of Dharwar-Supergroup consisting of meta-sediments represented by quartz-chlorite-carbonate schist, quartzites with inter-bands of phyllites encountered as overlying the basement gneisses complex of the Peninsular gneissic complex (Table-3.1); The V-Ti magnetite ore bands are located, near Devarnarsipur village. The ore bands are exposed as detached bands on the Western margin of the ultramafic rock formation, the ore bodies run in N.W.-S.E. and N.E.-S.W. directions respectively with dip angle varying from 40° to 70° to East and West direction respectively. Five major V-Ti magnetite ore bodies are encountered as discontinuous bands exposed prominently as ridges around Devarnarsipur Village (Map.3.2
and 3.3) which are classified into three groups with respect to the position of Devarnarsipur village as are divided into three deposits based on their position with respect to Devarnarsipur Village as 1) Northern, 2) Southern and 3) South-Eastern bands.

The Northern bands are exposed to the N.W. of the village over a small extent. The length of the bands ranges from 10 to 90 m. with 4 to 8 meters in width and the bands are elevated 0.5 to 1 meter from the surface, the ore is massive, brownish in colour, and moderately magnetic.

The Southern bands is confined to low mounds located to the south of the village, the individual bands range from 25 to 110 m in length and 3 to 25 m. in width and are elevated from 1 to 2 meters from the surface. The ore is hard compact, medium to coarse grained, brownish to steel grey in colour highly magnetic.

The South-Eastern bands located to South of the Devarnarsipur village confined to the plain ground as detached bands. The ore body is grey in colour, fine to medium grained non-magnetic, weathered and composed of more of pyroxene and contain chromium oxide.

V-Ti magnetite ore bodies of the study area, show gradational relationship with the constituent ultramafic rocks as reported at Bushveld Igneous Complex (Willemse, 1969). The host rocks and ore bodies have been subjected to deformation resulting in the development of two sets of joints.

The major rock types present in the study area are dunite, gabbro-anorthosite suit of rocks, talc-maic schist, pyroxenite, steatite, quartzite and V-Ti –magnetite ore bodies, the stratigraphic sequence of the Devarnarsipur area is given in the table 3.1.
3.2. Lithostratigraphy of Devarnarsipur area

The following stratigraphic succession is proposed by the author in the research work for Devarnarsipur area.

Quartz veins
Dolerite dykes

Layered igneous complex
Gabbros / Gabbroic anorthosite, with V-Ti Magnetite Layers
Chromite-bearing Dunite /
Pyroxenite with hornblendite

Dharwar supracrustal Sequence
Phyllites
Quartz-chlorite-carbonate-schists
Quartzites

---------------------------------------------Unconformity--------------------------------------------------

Basement Peninsular Gneiss

Table 3.1 Lithostratigraphy of Devarnarsipur area

The Ultramafic and mafic complex of the Devarnarsipur area occurs as enclaves in the peninsular gneisses over an area of fifty sq.km These Ultramafic complexes are overlay on Chitradurga group.

In 1974, a drilling exploration a drilling program was undertaken by Department of Mines and Geology, Karnataka state (Channappa and Raghuveera) which indicated the presence of pyroxenite, Talc-mica Schist and Steatite presence. Bore-hole data of Devarnarsipur area reveled alternating layer of gabbro-anorthosite layers and parallel & closely spaced bands/layers of V-Ti-magnetite. Filed relation of ultramaftics indicates that they are intrusive into the quartz-chlorite-calcite schists of the Chitradurga group.
3.2.1. Peninsular Gneiss Complex

The gneisses of the Devarnarsipur area were designated as Shimoga granites in the earlier geological-map prepared by Slater in 1906 (Map.3.1. Mysore Geology Department Records Vol-VI Plate-II) which covers parts of Shimoga and Kadur Districts.

The Peninsular gneisses are widely distributed and occupy a large portion of the study area. The gneiss forms the basement for overlying Chitradurga group of Dharwar Supergroup; Gneiss of the study area are exposed as small mounds, they are medium to coarse grained with well developed gneissic foliation. Gneisses show grey to greyish white colour and typical exposures are found about 300 meters south and south-west of Erehalli Village as discontinues patches (Fig.3.1 and 3.2), in agriculture plains, showing the effects of deformation and weathering resulting in the development of two sets of joints (Fig. 3.3), wherein the Gondi right bank canal makes a U-shaped turn. Ridges of gneissic exposure (Fig.3.4) are found about 1 kilometer north-east of Antaragange and at 600 meters north-west of Kachagondanahalli another dome of granitic-gneiss which are been quarried locally on small scale (Fig.3.5) are found. The granitic gneiss shows gneissosity and banded nature alternating with leucocratic and mesocratic (Fig.3.6) minerals and hosts a cross cutting pink pegmatite vein. Gneisses of low-lying areas forming small ridges and outcrops with well developed foliation and gneissic texture are exposed near Gourapura village (Fig.3.7 and 3.8)

Field relations between the granitic gneisses and low grade supracrustal (represented by quartz-chlorite-calcite schists, interbeded with quartzites) reveal that the gneisses exhibit unconformable relationship with overlying quartz-chlorite-calcite schist, which is observed in several places of the study area.
3.2.2. Quartzite

In Devarnarsipur area quartzite form the prominent meta-sedimentary units of the Chitradurga Group of the Dharwar Supergroup in the Shimoga schist belt, well exposed outcrops of quartzite occurs as discontinuous bands of variable length and width at several places and are found interspersed with the quartz-chlorite-calcite schists and are intruded into granitic gneisses of the study area. Quartzite bands are exposed and interspersed with schists and associated with the basement granitic gneiss of the study area; they have been subjected to deformation leading to development of joints.

A quartzite band is exposed, at 1.km east of Devarnarsipur village with a variable length (6 to 10 meters) & width (3 to 4 meters) trending north-east to south-west on a small hillock (Fig.3.9). A prominent quartzite band (Fig.3.10) is exposed at 500 meters south-east of Antaragange village. Another outcrop of quartzite is exposed near K.T.Aalemane, 0.5 Km North-east of Bohvi colony (Fig.3.11 & 3.12) showing three prominent joint sets leading to sugar cube like structure. Various random joints are also present, producing a highly jointed structure at many places. A sheet like exposure of weathered quartzite was found at 50 meters due East from the road running from Antaragange to Kachagondanahalli at 700 meters north-west of Antaragange village (Fig.3.13), showing the presence of prominent two sets of joints with many random joints, subjected to weathering process.

3.2.3. Schists

The metasedimentary units are represented by schists that occurs as discontinuous and parallel bands exhibiting variable dips and strikes. A outcrop exhibiting schistose fabric with bands of quartz vein is shown (Fig3.14).
The Supracrustal rocks are well exposed in the agricultural fields, road and railway cuttings. The schists of Devarnarsipur area are classified on their mineral assemblages, as 1. Quartz-chlorite-calcite schist and 2. Quartz-chlorite schist

3.2.3.1 Quartz-chlorite-calcite schist

Quartz-chlorite-calcite schist is extensively distributed type of schist in study area, an outcrop exposed at 0.5 km due-west from Devarnarsipur Village (Fig.3.15), occurs as discontinuous patches and parallel bands. The mineral assemblage of quartz + chlorite + calcite in the schists of the study area indicate that the rocks were metamorphosed under green schist facies suggesting that they are formed at moderate pressures and relatively lower temperatures. The mineralogy of quartz-chlorite-calcite schist rock is composed essentially of quartz, chlorite and calcite, with minor amounts of magnetite crystals. Parallelism of flakes of chlorite, lenticular grains of quartz and calcite, contribute to the overall schistosity of the rock.

3.2.3.2 Quartz-chlorite schist

Quartz-chlorite schist of the study area, are exposed on the connecting road towards Devarnarsipur village (Fig.3.16 and 3.17) very near to village, it exhibit schistose texture with fine to medium grained fabric, light green to brownish colour and is highly weathered. The rock having green shades of colour are fine grained with chlorite. It also shows well developed schistosity, to the parallel arrangement of quartz and chlorite. Minor amounts of magnetite porphyroblasts and accessory calcite occurs. Chlorite occurs as flakes, aligned parallel to the plane of schistosity.
3.2.4. Ultramafic Mafic Complex

Ultramafic bodies associated with gabbro-anorthosites enclosing the V-Ti magnetite ore bodies are recorded in many place of the study area. Primary igneous layering and cumulus textures are preserved in these bodies. Outcrops of unaltered dunite rock is encountered with a dip of 45° on the small ridges at 200m north of Gunisharapura (Fig.3.18 and 19), an chromite bearing dunite with millimeter to centimeter scale igneous layering consisting of chromite, olivine and pyroxene is encountered as a parallel band to hillock at a distance of 1.km south-east to Devarnarsipur village, with very steep dip of 80° to 85° (Fig.3.20).

Another outcrop is exposed at 800.meters south of Gourapura village, where the outcrop extends over an area of 150.sq.meters near Kanchipur temple (Fig.3.21), which exhibits a Chromite bearing dunite rock showing feebly developed igneous layer and exhibits a steep dip of 75° along east-west in direction (Fig.3.22).

Weathering and altering effect on ultramafic rocks are noted in exposure of the study area, a vein-magnesite-chromite bearing dunite body is exposed at 500meter. to southeast of Devarnarsipur (Fig.3.23) and a metamorphosed Serpentinised-chromite bearing dunite bodies are recorded near Kanchipur temple (Fig.3.24).

Small exposure of tremolite-actinolite schist was encountered at north of Devarnarsipur village about 150.meter in agriculture filed; near to V-Ti-magnetite ore deposits (Fig.3.25). Tremolite-actinolite schists are closely associated with serpentinites.

Talc-chlorite schist is exposed along small water channel which is located south of the Devarnarsipur village entrance. These outcrops are of mapped and presented in the 1974 report from Department of Mines and Geology, Karnataka state, by Channappa and Raghувeer.
Hornblendite occurs closely associated with dunite and pyroxenite in the form of mounds with steep dips an exposed of Hornblendite was encountered at southeast of Devarnarsipur village (Fig.26).

3.2.5. GABBRO-ANORTHOSITE SUITE

Gabbro-anorthosite suite extending for a few hundreds of kilometers in length and 40-50 kilometers of width from south of Mysore through Nuggihalli and Shimoga (including Devarnarsipur area) to North Kanara and further beyond to Ratnagiri in Maharashtra occur along a prominent arcuate zone in Karnataka. This arcuate zone broadly defines a progressive vertical zonation of the crust from north-west to south-east, with the younger supracrustal rocks in the north and the ancient supracrustal belts associated with high-grade gneisses in the south. This zone embraces significant chromiferous ultramafic belts and has been recognized earlier as a prominent geotectonic feature of the Karnataka craton (Pichamuthu, 1956; Srinivasan and Srinivas, 1972; Swami Nath et al. 1976).

Anorthosites of this arcuate zone have been grouped under the following two tectonic associations,

(i) Anorthosites of mafic ultramafic complexes and

(ii) Anorthosites of layered type in Archaean high-grade terrain (Ramakrishnan. et.al., 1978)

In the Karnataka craton, ultramafic-mafic complexes (with minor anorthositic components) occur in the high grade terrain. Significantly all the occurrences are confined to the north-south major arcuate belt in the high pressure western block (Rollison et. al., 1981) and are localized along a major lineament; the absence of anorthositic rocks in the intermediate pressure eastern tectonic block is strikingly conspicuous. The two blocks separated by an east-dipping late Archaean thrust, have suffered different P-T histories and
represent two distinctive basic types of metamorphism possibly reflecting an original difference in crustal thickness (Leelanandam and Narasimha Reddy, 1988).

A number of gabbro-anorthositic bodies of varying dimensions are found in many places in study area. They are highly deformed and metamorphosed under lower amphibolite facies metamorphism; they contain several lenses and bands of V-Ti-magnetite and disseminations of sulphides in the study area. These rocks with V-Ti--magnetite ore bodies are emplaced as lensoid bodies into the quartz-chlorite-calcite schists.

The gabbro-anorthosite suite of rock occurs as parallel bands, patches and lenses at many places, major exposure was found north of Devarnarsipur village along the Gondi right bank canal trending south-east to north-west.

Based on their mineralogy these rocks are classified as magnetite-gabbro, gabbro, anorthositic gabbro, gabbroic anorthosite and anorthosite. They exhibit a mutually gradational relationship as revealed by the bore-hole logs in the study area Channappa and Raghuveera (1974).

3.2.5.1. Magnetite-gabbro

Magnetite-gabbros are feebly visible on the surface and recognized in drill cores samples. Plagioclase and V-Ti-magnetite are the essential constituents with small amounts of hornblende, pyrite and chalcopyrite. The V-Ti-magnetite crystals get segregated to form bands/layers in the rock. Pyrite and chalcopyrite occur as disseminations throughout the rock.

3.2.5.2 Gabbro

The gabbro outcrops occurs in north of Devarnarsipur village along the Gondi right bank channel about 600 meter various sizes of boulder are noticed still further north-east at
about 1km of Devarnarsipur study area. It consists essentially of plagioclase and hornblende with minor magnetite and calcite.

### 3.2.5.3 Anorthositic gabbro

With a decrease in the content of hornblende, the gabbroic rock grades on to anorthositic-gabbro, it is composed essentially of plagioclase with subordinate amounts of hornblende and accessory minerals like magnetite and calcite.

### 3.2.5.4 Gabbroic anorthosite

Anorthositic gabbro grades on to gabbroic anorthosite, with a decrease in the amount of hornblende. Plagioclase is the chief constituent with a small amount of hornblende and accessories like magnetite and chalcopyrite.

### 3.2.5.5 Anorthosite

Anorthosite is composed principally of plagioclase with accessories like hornblende, calcite, magnetite, pyrite and chalcopyrite. Anorthositic gabbro, gabbroic anorthosite and anorthosite bodies are well exposed as patches and parallel bands all along the Gondi Right bank Channel of Devarnarsipur village more prominently on the north part of the village, bordering the V-Ti-magnetite ore bands.

In the study area, demarcation of boundaries between the exposures of gabbroic-anorthosite suite of rock types (Fig. 3.27, 3.28, 3.29 and 3.30) without thin section studies examination was not carried out so in the thin section studies they are described based on mineral assemblage in detailed in the next chapter.
3.2.6. V-Ti-Magnetite Deposits

Exploration for the recovery of V-Ti--magnetite deposits in Karnataka, based on detailed surveys has been reported in recent years. These deposits occur within the early Precambrian gabbro-anorthosite members and spatially associated with ultramafic-mafic rocks emplaced in the formal plat miogeosynclinal sediments of the Dharwar greenstone belts

the formal plat or miogeosynclinal tectonic setting of V-Ti--magnetite deposits are proposed on their spatial association with quartzite-limestone phyllite assemblage (Vasudev and Srinivasan, 1979) Such an association is unique to the 'Dharwar type' greenstone belts and they are not reported in 'Keewatin type' greenstone belts as distinguished by Ramakrishnan et. al. (1976).

Substantial deposits of V-Ti-magnetite ores occur in Shimoga district of Karnataka. These deposits are grouped into three blocks as follows i) Sakrebail-Umblebail block, ii) Devarnarsipur block and iii) Ubrani block by Naganna, et al. (1976), earlier workers on these blocks mainly estimated the ore reserves; subsequently Slater (1906), Jayaram (1915, 1920), Smeeth and Sampath Iyengar (1916), Venugopal (1921), Lakshmana Roa (1939), Channappa and Subramany (1973) and Channappa and Raghuveera (1974), Vasudev and Srinivasan, (1979), among others investigated these deposits.

In Devarnarsipur area, V-Ti-magnetite deposits occurs in isolated mounds attaining elevation from 612 m to 630 m MSL and are associated with gabbro-anorthosite suite of rocks. The V-Ti magnetite deposits are folded and exposed discontinuously over a length of 10 to 110m with width ranging from 5 to 25m in the southeastern part of the Shimoga schist belt, (Channappa and Raghuveera 1974). The V-Ti--magnetite deposits with the gabbro-anorthosite suite of rocks exhibit intrusive relationship with quartz-chlorite-calcite schists. Several V-Ti-magnetite ore bodies occur as lenticular bodies and confined to an area of about 50.sq.km; They are exposed as discontinuous bands on the western margin of ultramafic rock.
formation, as indicated in the Map.3.2; The ore bands run in a NW-SE and NE-SW directions and exhibits varying dip ranging from $40^\circ$ to $70^\circ$ towards east and west direction respectively.

The ore exposed is mixed up with Ultrabasic material in some places. The ore bodies are confined to the magnetite-gabbro which grades on to gabbro, gabbroic anorthosite and anorthosite with depletion of chloritized hornblende and magnetite.

An Exploration drilling program was undertaken by the Department of Mines and Geology of Karnataka by Channappa and Raghuveera (1974); at Devarnarsipur which indicated that, ore bands exhibits folded nature and form anticlines and synclines, on closer examination the data indicated that the ore body is made up of several individual, linear, discontinuous bands with bent or overturned ends. The ore bodies in the area seem to have been subjected to lateral pressure which resulted in occurrence of lenticular ore bodies, indicating that the ore bodies are conformable layered type.

The Five exposures of V-Ti magnetite ore deposits are encounter in the study area which are divided into three deposits namely Northern, Southern and South-Eastern deposits based on their location with respect to Devarnarsipur village, V-Ti magnetite ore bodies occur as massive to crystalline, brownish in colour and non-magnetic to magnetic in nature with effects of weathering in the field.

The Northern ore bands are exposed at north-west part of the Devarnarsipur village over a slightly elevated land from the surface with the length ranging from 10 to 90 meter and width of 4 to 8 meters (Fig3.31 and 3.32). The Northern bands are massive, brownish in colour, and are moderately magnetic, these bands constitute a minor source of ore reserves.

The Southern ore bands are exposed at south of Devarnarsipur village on the mounds of low elevation but higher than the northern deposits and forms a main source of ore the ore bands range in length from 25 to 110 meters with the width of 3 to 25 meters (Fig35 and 36).
The ore is compact, hard, medium to coarse grained, brownish to steel grey in colour, and are highly magnetic and exhibits stains of malachite.

The South-eastern ore bands exposed on the comparatively on plain land about 500 meters of south-east of the Devarnarsipur village as detached bands. The ore bodies are grey in colour, fine to medium grained, non-magnetic and are subject to weathering and composed of more of pyroxene and also appear to contain chromium oxide(Fig33 and 34). Mineralogical studies of V-Ti-magnetite deposits of study area reveal that they are composed of both oxide and sulphide assemblages.

Megascopic identification of the mineral assemblage in the hand specimen of massive V-Ti-magnetite ore was not attempted as these minerals are fine grained and some of them are highly altered, so the collected samples were subjected to ore microscopic studies and detailed description are given the chapter-V.

3.3 Details of drilling exploration

To work-out the quality and quantity of ore reserves of V-Ti-magnetite deposits in Devarnarsipur area, a detailed investigation was taken up by The Department of Mines and Geology of Karnataka. The area measuring 2.sq.km was surveyed, along with the drilling by putting up three bore holes of total depth 422.03 meters and chip samples of the ores are collection from 4 trenches sunk in the study area.

3.4. Ore Reserves Estimate

The detailed survey investigation by the Department of Mines and Geology of Karnataka, reports the ore in study area are in small extent and good in quality, chemical analysis yielded V$_2$O$_5$ and TiO$_2$ components ranging from 0.28 to 1.05 and 0.30 to 13.90,
respectively. The surface extent of the ore body have actually been measured. The specific gravity of the ore is 4.6 and 0.3. O.M. float ore is spread around on an area of about one hectare. Ore reserves estimated as 2.5 lakh tonnes, based on the actually extent of the ore bodies to presumed depth of 6 to 15 meters in the area.
Map 3.1 Geological Map of parts of Shimoga and Kadur. From Mysore Geological Department (H.K.Slater 1906 Records Vol-IV plate-II)
Map. 3.2. Geological Map of Devarnarsipur area
Map 3.3 Geological Map of Devaranarasipur area with Google-Earth Image
Fig: 3.1, Field photograph showing Gneissic outcrop about 350 meters south-east of Erehalli Village in agriculture plains.

Fig: 3.2, Field photograph, showing a small mound of granitic gneissic exposure about 300 meters south of Erehalli village
Fig: 3.3, An exposure of gneissic rock south of Erhalli Village showing the effects of deformation and weathering resulting in the development of two sets of joints.

Fig: 3.4, Field photograph showing ridge of granitic gneissic exposure in the middle of paddy field, about 300 meters east of the road from Antaragange.
Fig: 3.5, Field photograph showing Domal masses of Granitic gneiss exposed in quarried at small scale outcrop at about 600 meters North-East of Kachagondanahalli

Fig: 3.6, Field photograph of close-up view of Granite gneiss exhibiting gneissic texture. Note; the presence of cross cutting pink pegmatitic vein
Fig 3.7, Field photograph of Granite gneiss in close-up view near Gourapura Village showing well developed mafic bands which are folded due to metamorphism.

Fig 3.8, Close-up view of basement peninsular gneiss exhibiting well developed gneissic texture with light and dark bands variation near Gourapura Village. Note the presence of quartz vein with varying thickness in between the gneissic bands.
Fig 3.9, Field photograph of Quartzite which shows two sets of joint exposed at 1 km east of Devaranarasipur village on the small hillock

Fig 3.10, Field photograph of Quartzite outcrop exposed at 500 meters south-east of Antaragange village, subjected to high weathering
Fig 3.11, Close-up view of jointed Quartzites with three prominent joint sets, leading to from sugar cube like structure, producing a highly jointed structure at K.T.Aalemane.

Fig 3.12, Field photograph of Quartzite exposure found at K.T.Aalemane. 0.5 Km North-east of Bohvi colony which trends in NNE -SSW which shows 3 sets of joints.
Fig: 3.13, Field photograph of weathered quartzite sheet exposure found about 50 meters East from the road running from Antaragange to Kachagondanahalli. Note the presence of two sets of joints.

Fig 3.14, Field photograph of typical Schist exhibiting the foliated structure in an outcrop near Devaranarasipur village located towards north as a single bolder.
Fig 3.15, Field photograph of Quartz-chlorite-calcite schist encountered at 0.5 km due-west from Devarnarasipura Village.

Fig 3.16, Field photograph of Quartz-chlorite Schist exposed which are exposed towards south-east direction of Devaranarasipur village, which exhibit schistose texture and highly weathered.
Fig 3.17, Field photograph showing close-up view of Quartz-chlorite Schist exhibiting schistose texture with fine to medium grained light green to brownish in colour and highly weathered.

Fig 3.18, Field photograph showing unaltered dunite body with 45° dip near Gunisharapur exposed at about 200 meter north on small hillock.
Fig 3.19, Close-up view of chromite bearing dunite exposed at about 200 meter east of Gunisharapur village.

Fig 3.20, ultramafic rock of chromite bearing dunite with millimeter to centimeter scale igneous layering consisting of chromite, olivine and pyroxene exposed at a distance of 1.km south-east to Devaranarasipur village
Fig 3.21, Close-up view of ultramafic rock, of chromite bearing dunite near Kanchipur temple, showing feebly developed igneous layers.

Fig 3.22, Field photograph of Ultramafic rock of chromite bearing dunite exposed near Kanchipur temple, shows steep dip of 75° trending almost east-west in direction.
Fig 3.23, Altered and weathered vein-magnesite-chromite bearing dunite body is exposed at 500 meter. to southeast of Devarnarasipura

Fig 3.24, Serpentinised-chromite bearing dunite bodies are recorded near Kanchipur temple, Note the multiple joints development.
Fig 3.25, Field photograph of ultramafic rock of tremolite-actinolite-schist, encountered at 150 meter north of Devarnarasipura village.

Fig 3.26, Field photograph of ultramafic rock of Hornblendite, exposed at south east of Devarnarasipura village.
Fig 3.27, Field photograph showing boulders of Gabbro exposed at west of Devanarasipura village which trends is NNW in a paddy field.

Fig 3.28, Field photograph of a prominent exposure of Gabbro exposed at Gondi right bank channel at about 600 meter north of Devaranarasipur village.
Fig 3.29, Field photograph showing boulders of Gabbro exposed at Gondi right bank channel at about 1.Km north of Devaranarasipur village.

Fig 3.30, Field photograph showing boulders of Gabbro exposed at south west of Gourapura village which trends is NNW
Fig 3.31, Field photograph showing boulders of V-Ti magnetite ores exposed at north-west part of the Devarnarasipura village.

Fig 3.32, Field photograph showing close up view of V-Ti magnetite ores exposed at north-west part of the Devarnarasipura village.
Fig 3.33, Field photograph showing V-Ti magnetite ores exposed at South-Eastern part of the Devarnarasipura village.

Fig 3.34, Field photograph showing close up view of V-Ti magnetite ores exposed at north-west part of the Devarnarasipura village. Note the effect of weathering on the ores.
Fig 3.35, Field photograph showing boulders of V-Ti- magnetite on southern part of Devarnarasipura village on a small hillock at 624 meter MSL elevation. Note the development 2 sets of joints.

Fig 3.36, Field photograph showing boulders of V-Ti- magnetite on southern part of Devarnarasipura village on the top of small hillock at 630 meter MSL elevation. Note the development joints.