Chapter 5

Delineation of alteration zones identified from multispectral, hyperspectral data over geology for sample collection

5.1. INTRODUCTION

The alteration zones and altered minerals identified through the processing of ETM+ and Hyperion data were superimposed with the geology and toposheets of the study area in a GIS platform. After integration of alteration zones, the locations were delineated for the field verification and sampling (Figure 5.1).

Figure 5.1: Superimposition of alteration zones identified through the processing of ETM+ data over geology.
Figure 5.2: Superimposition of alteration zones identified through the processing of Hyperion over geology.

5.2. FIELD TRAVERSE AND SAMPLING

Field work in the study area was carried along and across the schist belt for the verification of results and for systematic sampling. The sampling of different rock types and soil was carried out, based on their textural, compositional and colour variations. Figure 5.3, shows traverse locations for sampling in the study area. During the field traverse different types of rocks were encountered including metabasalt, foliated metabasalt, banded iron formation, variegated argillite, sericite-phyllite, garnetiferous mica schist, conglomerate, volcanic rock, greywacke, granite, granite gneiss, quartz veins and dolerite dykes. Many old gold mines were also visited which
are located in or near the area. During field check it was noticed that the area is mainly occupied by two lithounits and these are metabasalt and argillite. Metabasalt is pillowed, foliated, schistose and massive in nature. Argillite is variegated in nature and oxidation is observed over this rock which imparts reddish to yellowish colour to this lithounit. A total of 20 rock samples were collected from the field for the generation of spectral library and spectroscopic and petrographic studies. The detailed study of the main rock types which are exposed in the area are given below stratigraphically:

5.2.1. INTRUSIVE ROCKS

The main intrusive rocks observed in the area are: quartz veins carbonate veins, porphyry quartz and dykes. The thickness of these intrusive bodies is ranging
from few cm to 3-4 m in width. These rocks are the youngest lithounit in the study area and are undeformed and intrusive in all the rocks. Basic dykes are mainly of dolerite composition and occur in the area as bouldery outcrop. NNW-SSE trending dolerite dyke was recorded south east of Gwalgiri Math and this rock was hard, compact and massive in nature. Quartz veins were also recorded south-east of Doni. The quartz vein is grey in colour, hard and compact in nature (Figure 5.4a). The rocks of the Gadag schist belt are under influence of carbonisation especially metabasalt. These carbonates occur in the form of veins and secondary filling in the metabasalt. Dolomite is also developed which gives elephant skin weathering pattern to the rock surface. At places, carbonate veins are developed as criss-cross network.

5.2.2. SERICITE-PHYLLITE

Sericite-phyllite is observed south-west of Dambal and Harogeri. This rock was very fine grained and fragile in nature. The area is highly deformed and folded and the rock is foliated and due to deformation the original rock could have converted into sericite due to alteration. This rock hosts garnet mineralization (Figure 5.4b). At places carbonate and quartz veinations and microfolding were developed. This part of the study area is identified as clay alteration zone in the ETM+ data and kaolinite altered mineral was recoreded through Hyperion data.

5.2.3. GARNETIFEROUS- MICA-SCHIST

This rock is exposed north east of Doni village along the road cutting. The surface is covered under vegetation. This rock is highly fragile, deformed and foliated. It is mainly composed of quartz and muscovite and trends N20°W and dipping 25°E. Meso-folds were observed in this rock. This rock hosts garnet mineralization and the garnet size varies between few mms and 5 mm (Figure 5.4c).

5.2.4. BANDED IRON FORMATION (BIF)

BIF is very prominently occurring in the entire study area and occupies the top of hills and due to weathering boulders of BIF were rolled down from the hills. The soil at the base of hill became red due to these rolled boulders. BIF in the study area mainly occurs in the form of banded magnetite chert/quartzite or banded hematite chert and recorded south of Doni Tanda, Kappat Gudda hill, north east of Chik
Vaddatti and west, south west of Hire Vaddatti. The rock is mostly banded magnetite quartzite and at places banded magnetite chert in nature. Weathering in BIF recorded in the form of goethite and limonite. This lithounit is known to host gold mineralization in the area. In the ETM+ data, this area was delineated as iron oxide zone whereas in the Hyperion image it was identified as hematite and goethite minerals. Folding is also well recorded within this rock (Figure 5.4d).

5.2.5. POLYMICTIC CONGLOMERATE

After metabasalt and argillite, this lithounit covers major part of the study area and is exposed around north-west of Bagewadi, Bonnikop, south-west of Murdi and south west of Guddad Budihal. This rock is sparsely exposed and occur as small mounds. This conglomerate is mainly clast supported and at places matrix percentage is more than clasts. The clasts are mainly composed of granite gneiss, dolerite, metabasalt, BIF and chert. The size of clast ranges from few cm to 15-20 cm. Clasts are elliptical to rounded in shape which indicates that the provenance of the clast is very far away. The composition of matrix is of volcanic origin. The clasts show preferred orientation which indicates that it has undergone deformation. Volcanic matrix indicates that conglomerate is concurrent to volcanism. In the Hyperion image this area mainly shows presence of carbonate (Figure 5.4e).

5.2.6. ARGILLITE AND CHLORITE-PHYLLITE

Argillite is most dominant sedimentary rock in the area and is very variegated in nature. At some places it shows reddish colour and whitish to orangish colour at other places (Figure 5.4f). At places, this rock is altered into chlorite and chlorite-phyllite (Figure 5.4g). In the study area, this rock is intruded by quartz and carbonate veins also. Argillite hosts manganese mineralization in Kappat Gudda area and other minerals such as pyrite and chalcopyrite are also found within this rock. The units mainly exposed in trenches, shows high degree of weathering and alteration. The rock is crudely foliated and at places massive in nature. The Kappat Gudda mine is picked up well in both the images. Hyperion image shows kaolinite and smectite minerals south east of Doni and south west of Dambal.
5.2.7. GREYWACKE/GRITTY GREYWACKE

In the field it is very difficult to differentiate greywacke from argillite. There is difference in grain size and greywacke is slightly coarser than argillite. This rock is fine to medium grained, yellowish to greenish and pinkish colour, schistose in nature and consists mainly of grains of quartz, feldspar and is intruded by quartz veins (Figure 5.4h).

5.2.8. AMPHIBOLITE-METABASIC

Amphibolite mainly occurs in the eastern part of the Gadag schist belt and is observed south east of Papnashi, north west of Kadampura, south of Nandi hill Matt and south west of Dambal. This rock is of blackish colour, medium to coarse grained, composed of amphiboles and plagioclase and massive to foliated in nature. At places, chlorite is developed and gives the appearance of metabasic rock. At places this rock is deformed and minerals aligned in a particular direction. The rock is highly carbonated also (Figure 5.4i). Hyperion image shows presence of antigorite mineral, south west of Dambal.

5.2.9. METABASALT

In the study area, foliated, pillowed, schistose and massive metabasalt was also recorded. This is the second most dominant lithounit in the area after argillite. Foliated metabasalt was recorded at following locations- north of Belgatti, north of Mundawada, south of Gouligiri Math, 5 km south east of Doni and west of Bagewadi. Pillowed metabasalt was recorded at Nave Bavmur. Schistose metabasalt occurs at west of Tarikop. Massive metabasalt was observed at Alginvad. Metabasalt is fine to medium grained, green to greyish in colour. Foliated metabasalt shows alteration of minerals into chlorite. Pillowed metabasalt consists of vesicles towards their margin. At places, metabasalt is highly carbonated and gives an impression of dolomite (Figure 5.4j, k & l). In the Hyperion image these areas are mainly occupied by nontronite, chlorite and prochlorite which could have formed due to weathering of metabasaltic rocks.
5.2.10. META-VOLCANIC ROCKS

This rock was mainly exposed north west of Machinhalli, Nave Bavnr and Murdi. At Murdi and Nave Bavnr, this rock is hard, compact and deep grey in colour. It contains specks of angular glass. At another place it is acidic, fine grained and foilated in nature. It was observed that the primary minerals are replaced by secondary minerals. This rock shows radiating features along with vesicles, indicating their volcanic nature. The rock is deformed and minerals are arranged in a particular direction. Emplacement of quartz veins are also present. At places, the rock is ferruginous in nature and small grooves are also present, which have developed due to removal of sulphide minerals from the surface of the rock. Carbonate veins were also recorded (Figure 5.4m). This rock was not delineated from ETM+ and Hyperion data processing because the exposures of these rocks are very less on the surface and the area is covered by vegetation. Due to less surface exposures these rocks were not picked by the 30x30 m pixels of ETM+ and Hyperion image.

5.2.11. GRANITE-GNEISS

Granite gneiss is exposed towards north, north-eastern and southern part of the area. Younger granite is also exposed south-east of Doni. The rock is medium to coarse grained, leucocratic and composed of mainly quartz, feldspar and mica (biotite) minerals. At places, the rock is intensely deformed and minerals are aligned in a particular direction. Due to deformation, the minerals are recrystallised. Flattening of minerals and sigmoidal structures were also recorded. Near the contact of schist belt, granite gneiss is intruded by several feldspathic veins (Figure 5.4n). Granite gneiss is recorded at Lakkundi, Maradi Gudda stone quarry, west of Harlapur station, north of Belhatti, Srimant Gudda and Hiranaya Gudda. In the Hyperion image, muscovite mineral is identified south east of Doni, northern and southern part of the area which are mainly occupied by the granite and granite gneiss. Microcline mineral is also delineated in the north-eastern and south-eastern part of the area, mainly occupied by granite gneiss. Remaining part of the area (north and south of schist belt) is occupied by black cotton soil which is developed over granite gneiss (Figure 5.4o). This soil is also accurately identified in the Hyperion image.
Figure 5.4 (a): Hard and compact quartz vein; (b) sericite phyllite, (c) garnetiferous mica schist, (d) folding within banded iron formation, (e) polymictic conglomerate, (f) kaolinization in argillite.
Figure 5.4(g): chlorite-phyllite, (h) foliated greywacke, (i) massive amphibolite, (j) pillowed metabasalt, (k) metabasalt intruded by carbonate veins (dolomite), (l) deformed pillowed metabasalt.
Figure 5.4 (m): Acid volcanic rock, (n) Feldpathic veins in granite-gneiss, (o) Black cotton soil
5.3 SUMMARY

The pre-field maps were prepared for the field verification after integrating the results of multispectral (ETM+) and Hyperion data with geology. Field traverses were taken along and across the GSB to validate the identified alteration zones. Different types of rocks were encountered during field checks and these are: metabasalt, foliated metabasalt, banded iron formation, variegated argillite, sericite-phyllite, garnetiferous mica schist, conglomerate, volcanic rock, greywacke, granite, granite gneiss, quartz veins and dolerite dykes. The alteration zones and altered minerals such as koalinite, hematite, goethite, smectite, antigorite, nontronite and chlorite were verified in the field. They are corroborating with sericite-phyllite, BIF, argillite, amphibolite, and metabasalt. In the Hyperion image, muscovite mineral is identified south east of Doni. The northern and southern part of the area are mainly occupied by granite and granite gneiss. Microcline mineral is also delineated north-eastern and south-eastern part of the area, mainly occupied by granite gneiss. Remaining part of the area (north and south of schist belt) is mainly occupied by black cotton soil which is developed over granite gneiss. This soil is also accurately demarcated in the Hyperion image.