ABSTRACT

Today the demand for mineral exploration is increased and the need of the hour is to employ the latest and advanced remote sensing technologies in the search of minerals of economic value. In the present study, ETM+ and Hyperion satellite data sets were processed to identify the altered minerals and alteration zones in the GSB of Karnataka. FCC, band ratio, PCA and Crosta techniques were applied to ETM+ data to delineate the alteration zones. Clay, iron oxide (ferrous & ferric) and hydroxyl alteration zones were demarcated in the area by the processing of ETM+ data. Hyperion data have 3D data sets, which provide image analysis for identification of altered minerals and spectroscopic studies both. Hyperion processing includes FLAASH correction, MNF, PPI, n-D visualization and SAM classification. Total 31 endmembers were generated from the processing of Hyperion image. The mineral composition of these 31 endmembers was recognized and based on similarity in their absorption features they were grouped in to 12 numbers. Based on the SAM, SFF and BE classification techniques, total 11 altered minerals and one soil are identified in the area and these include: goethite, hematite, smectite, chlorite, calcite, antigorite, nontronite, kaolinite, muscovite, prochlorite, microcline and greyish brown loam. Spatial distribution of each altered minerals was also calculated in term of percentage. These identified endmembers were supplied for the SAM classification to delineate the altered mineral spatial distribution in the area. The alteration zones identified from both data sets were also compared. It was found that the zones delineated from both data shows similarity, but Hyperion image is able to discriminate mineral compositions whereas ETM+ is unable to delineate it.

To validate the interpreted results from ETM+ and Hyperion data processing, field verification was carried out. Systematic sampling along and across the GSB was done. During field verification it was observed that the alteration zones identified from Hyperion image were more accurate compared to ETM+. Total 20 representative rock samples were collected from the study area for the generation spectral signatures and petrographic studies. The spectral signatures were generated through ASD Spectroradiometer instrument which is covering the wavelength region from 0.35 to 2.5 µm, similar to the wavelength of Hyperion image. The analysis of the 20 spectral signatures was carried out and based on the similarity in their absorption characters
they were grouped into 12. Based on three classifications these signatures were classified into 12 which include 11 altered minerals and one greyish brown loam (soil).

Petrographic studies of few samples were also carried out to validate the results of spectroscopic analysis. Detailed analysis of spectral signature indicates that the spectroscopic study gives much better and accurate information on the mineral composition of the samples compared to conventional methods like petrographic study, especially in the case of highly altered and fine grained minerals.

During field verifications, it was observed that the effect of oxidation, presence of carbonate veins and replacement of primary minerals by secondary carbonate minerals in the area. These effects were clearly visible in the spectral signatures of the samples containing iron oxides and carbonates. To identify the iron oxide minerals, ore petrography is required, but the exact iron oxides can be delineated from spectroscopic study. Other than obtaining information of mineralogy, the compositions of the soils were also accurately derived. Hornblende host gold mineralization collected from an alteration zone identified in the area. Based on the above studies and mineral occurrences, following alteration zones were delineated in the study area: propylitic (chlorite, clinochlore), phyllic (muscovite), argillic (montmorillonite), advanced argillic (kaolinite), dolomitization (dolomite) and oxidation (goethite, hematite).

These altered minerals were supplied for the re-classification of the Hyperion image in order to delineate the spatial distribution. The spatial distributions of each mineral were calculated in percentage and maximum by montmorillonite (8.9 %) and minimum by kaolinite, muscovite, dolomite, anorthite and hornblende show spatial distribution (< 1 %) recorded. Results of SAM classification of Hyperion image performed before and after field validation were also compared and it shows that out of 12 minerals (minerals and soil) 7 are well matched and these are: goethite, hematite, chlorite, kaolinite, muscovite, calcite/dolomite and greyish brown loam.