HYPERSPECTRAL REMOTE SENSING APPROACH FOR LITHOLOGICAL AND MINERAL MAPPING : A CASE STUDY AT MOYAR – BHAVANI SHEAR ZONE

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Keywords: *Remote Sensing, Mineral Mapping, Lithology*

Introduction

The term Hyperspectral Remote Sensing – 'Hyper' refers 'too many' and "Spectral" refers to the large number of measured wavelength bands. They provide ample spectral information to identify and distinguish spectrally unique materials. Hyperspectral imagery provides the potential for more accurate and detailed information, extraction than any other type of conventional remote sensing data. Imaging spectroscopy (Goetz et al., 1985) in Hyperspectral imaging is concerned with the measurement, analysis, and interpretation of spectra acquired from a given scene (or specific object) at a short, medium or long distance by an airborne or satellite sensor. Modern study was conducted by Rajendran, et.al (2008) by attempting hyperspectral tools for discrimination of different minerals of Nainarmalai region of part of Namakkal District of Tamilnadu using the TM sensor images on board the satellite LANDSAT 5 and also pointed out the Minimum Noise Fraction (MNF), Pixel Purity Index (PPI) functions applied for the different lithology such as quartzite, pyroxene granulite and hornblende biotite gneiss are discriminated well and shows a strong correlation with landscape. S. Sanjeevi (2008) has targeting limestone and bauxite deposits in southern india by spectral unmixing of hyperspectral image data.In the present study JPL spectral library signatures were used as spectral signatures of different type of rocks and minerals. Subsequently the Advance Spaceborne Tharmal Emission and Reflectance Radiometer (ASTER) data were used for the lithological classification of the study area.

The shear zones transecting the South Indian shield was first recognized by Drury et al (1980) on the basis of LANDSAT imagery. The supracrustal rocks include a shallow water facies association of metapelites and quartzites, ferruginous quartzites, calc–silicate rocks and marbles, mafic and ultramafic amphibolites and granulites. These are associated with large and small lenses of dismembered, granulite facies layered anorthosite–gabbro–pyroxenite–chromitite bodies, such as the classic Sittampundi and Bhavani complexes. The Bhavani complex is dominented by the presence of layers of ultramafic rocks chiefly composed of Leucogabbro, Anorthosite with Chromite layers, Pyroxinites and Peridotite. These rock bodies trend in E-W direction showing parallel to the trend of main shear of Bhavani – Moyar Shear Zone. In the present study, Thenkalmalai of Sirumugai region was considered for the Region of interest (ROI), which was selected from the ASTER data.

Methodology

The study has been done using the following data and instrument:

1. ASD Spectroradiometer
2. ASTER 1B data
3. ASTER Spectral Library (JPL)
4. Geological map of Tamilnadu.

The methodology which was adopted for the study was illustrated in the figure 1.

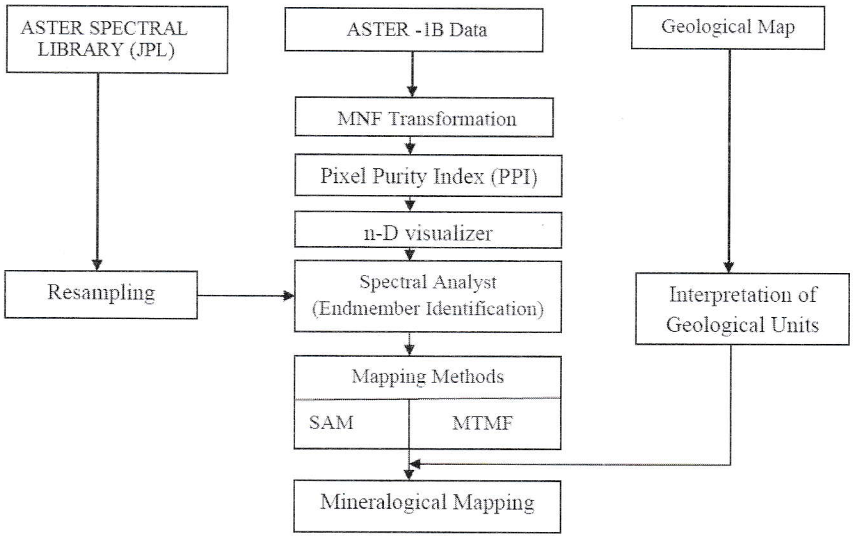

Figure 1

ASTER scene of the study area was acquired on 23-dec-2011. ASTER covers a wide spectral region with 14bands from the visible to the thermal infrared with high spatial, spectral and radiometric resolution. It obtains image in the 3 channels in VNIR (0.52-0.86 μm) and an additional backward telescope for stereo, 6 channels in SWIR (1.6-2.43 μm) and 5 channels in TIR region (8.1-11μm), useful for the mapping variations in the silica content of the rock (Moghtaderi et al, 2007). The VNIR band has 15 m resolution and SWIR and TIR bands are having 30m and 90 m resolution respectively. The Aster 1B data is geometrically and radiometrically corrected.

Silicates are the most common mineral groups in crustal rocks, which show characteristic spectral bands in the TIR region due to the presence of SiO_4 tetrahedron. Si-O stretching phenomenon in silicates dominate 8-12μm region. General trends of the spectra of common silicate minerals are outlined as follows:

1. In the region 7-9 maximum peaks are occurred and its location migrates systematically with the composition. From the band 7 to 9 it varies from felsic to ultramafic respectively.
2. In the region 8.5-12 μm an intense silicate band occurs, centered around 10 μm, its exact position is sensitive to the silicate structure and shifts from nearly 9 μm to 11.5 μm.
3. In the 12-15 μm region absorption bands of silicates and aluminium silicate structure of tectosilicate type.

To identify and map quartz, pyroxenite and other mafic minerals, band ratioing techniques were developed based on the shapes of laboratory reference spectra and applied to the TIR region in ASTER Level 1 radiance at sensor products. In this study we used different indices such as quartz index, mafic index and carbonate index. The emissivity spectra of different rocks (a.Carbonate Rock, b. Quartzose rocks, c. Granite, d. Diorite, e. Gabbro and f. Peridotite with spectra convolved to ASTER TIR bandpasses. (After Ninomiya et. al, 2005) have been illustrated in the figure 2.

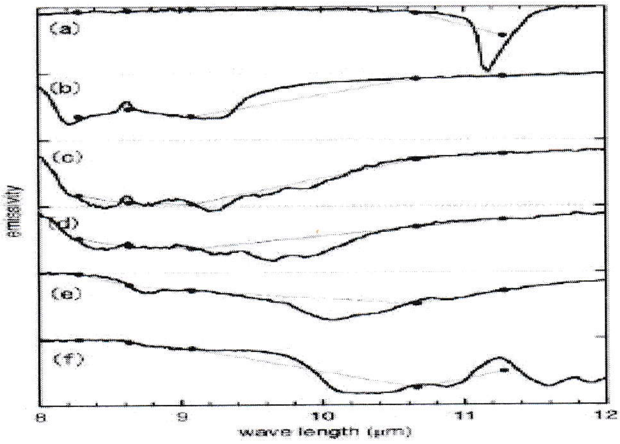

Figure 2

The other parameters which is used in the methodology are Minimum Noise Fraction(MNF), Pixel Purity Index (PPI), n-D Visualization, Spectral Angle Mapper (SAM), Mixture-Tuned Matched Filtering (MTMF).

Conclusion

In the present study by using ASTER data Thenkalmalai area was classified lithologically which were later conform with field checkup. The particular region of interest was dominantly composed of ultramafic rocks sequences. The lithology was identified as a linear body trending E-W direction parallel to the major shear zone. The different lithological units can be differentiated which ranges in dimension more than 5 meters. Thus the region of interest exhibits gabbro, pyroxinite, peridotite as linear lensoidal bodies interbanded with one another.

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