ANALYSIS OF IRS 1A-LISS II AND SRTM – DIGITAL TERRAIN MODEL FOR MORPHOTECTONIC MAPPING OF AREA IN AROUND TUNGBHADRA RESERVOIR , KARNATAKA (INDIA)

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ABSTRACT: Region in and around Tungbhadra reservoir built over river Tungabhadra ,a tributary of river Krishna contains basically Dharwar super group of rocks representing one of the oldest Craton of southern India formed during Proterozoic period where igneous rocks have undergone multi phase deformations and metamorphisms giving rise to variable schist facies. Therefore this Craton assumes a unique identity for geoscientist to explore each part of it. Considering this analysis of remote sensing images as well the digital terrain modelling have been carried out for this area for understanding the morpho-tectonic. For this study contrast image enhancement, directional filtering have been applied to multi band IRS LISS II data in order to enhance spatial as well as linear features and then associated land forms have been mapped from Digital Terrain Model generated using SRTM data. This study has clearly brought out the geological and structural features in the region. Various image contrast enhancements have been carried out for improving the quality of image and then colour combinations have been prepared. After which directional filters have been applied for extracting the various directional features using ENVI software. The major lineament trends as recognised on IRS 1A LISS II image; SRTM data image shows NNW-SSE to NW-SE trends which have been enhanced by applying linear filter techniques. These lineaments reflect the important faults and major thrust belt, system of Chitradurga Boundary Faults. The drainage pattern obtained from satellite imagery is well corroborated with general structural features and reflects geological control of drainage system in the region. The study of digital terrain model suggests that the eastern part, which is characterised by hard igneous rocks known as Chitradurga granite forms high elevated land. Whereas the western part, which is highly metamorphosed represents Chitradurga schist belt and is associated with low elevated land area.

1. INTRODUCTION

Tungabhadra reservoir dam is constructed across river Tungabhadra, a tributary of river Krishna in Hospet Dt of Karnataka state, India and is shown in Figure 1. Tungabhadra river meanders through the plains to a distance of 531 km and joins with the river Krishna at Gondimalla, near the famous Alampur in Mahaboobnagar District of Andhra Pradesh and then following a eastern course joins Bay of Bengal.

Geology of area in and around Tungbhadra reservoir (see Figure 2) represents Dharwar super group of rocks. This is one of the oldest Craton (3400 to 2600 Ma) of southern India formed during Proterozoic period where igneous rocks have undergone multi phase deformations and metamorphisms giving rise to variable schist facies. (Naqvi and Rogers 1987, Drury et al., 1984; Radhakrishna, 1989). This Dharwar craton which is well known for granite -greenstone association is divided into Eastern, Kolar-type and Western Dharwar-type blocks distinguished by differences in the volcano-sedimentary supra crustal, magmatism, grades of metamorphism and temporal evolution and is probably demarcated by eastern boundary fault of Chitradurga basin (Yoshida et al., 1999). The major geological features in the Dharwar craton include the Archean–Early Proterozoic greenschist belts set in a matrix of Peninsular Gneiss–Migmatitic complex and the intrusive, younger potash-rich granites and the most characteristic structural feature of the Archean cover sequence of the Dharwar craton is the arcuate NNW–SSE trend with convexity towards the east. The present area is covered by western Dharwar which a typical Archean low-grade terrain, is characterized by the mature sediment-dominated greenstone belt of the Dharwar type. Two main divisions, viz. the older igneous Bababudan group and the Chitradurga group composed of conglomerates, quartzites, limestones, greywackes and associated with manganiferous and ferruginous cherts. Hence this craton assumes a typical region both from geological evolutionary as well as from economic mineral exploration point of view.

Therefore we have carried out the analysis and interpretation of Remote sensing images which provide synoptic view in mutlispectral mode of whole geological set-up facilitating identification, correlation and mapping of structural features over a whole geologic unit both on spatial as well as in spectral mode. It is also well-established now that such study has played a significant role in the identification of subsurface geological features from surface expressions and constitutes standard techniques for earth resources survey and mapping. (Griffiths et al., 1987; Abdelhamid & Rabba, 1994; Nonia, 2010) Further the suitably enhanced multi-spectral digital images in colour composite mode as well as linear features as extracted from images after applying directional filters providing an excellent means for mapping the distribution and geometrical patterns of lithological units and structural elements which commonly reveal the tectonic setting and also local folds and faults (Watson & Knepper, 1994; Rinaldi, 2007) which often constitutes the structural control of mineralization in a region.

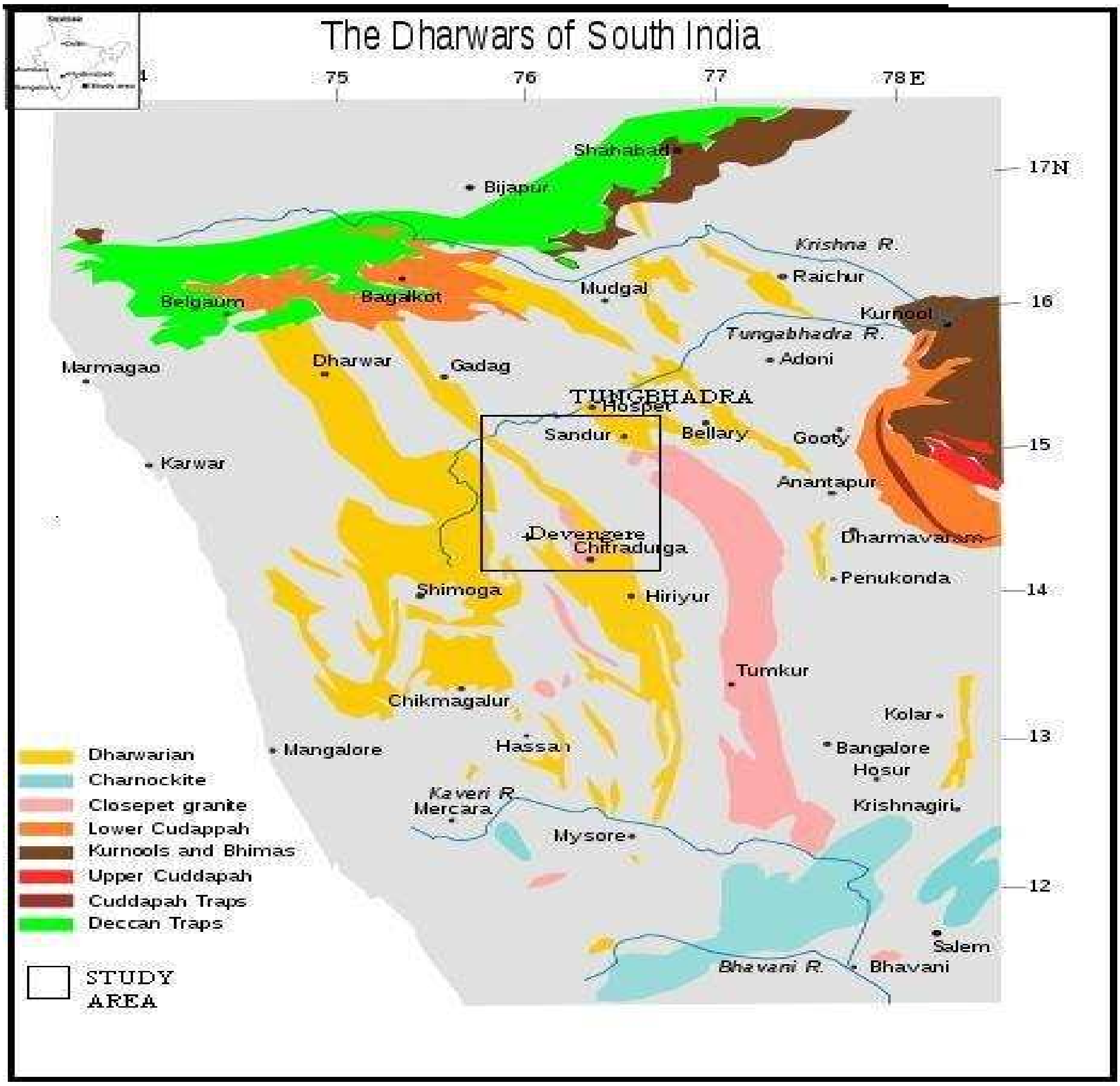

Figure 1: Showing study area in and around Tungabhadra Reservoir.

2. DATA AND METHODOLOGY

For mapping of geological features, multiband remote sensing images of IRS-1A LISS II and downloaded SRTM data of the region have been analysed and interpreted using standard as well as digitally enhanced satellite images on the basis of standard photo image interpretation techniques involving image elements and terrain elements and also by collating with other information from published geological data.

Object oriented digital image processing of multi band data have been further carried out in PCI GEOMATICA (Version 8.2), ENVI softwares and then finally different thematic maps were generated and studied in reference to SRTM Digital Terrain Model in Arc GIS environment.

Linear contrast enhancement of the IRS-1A LISS II data has been performed on individual bands then by combining 3 bands we have generated a false colour composite for better display of features as shown below as Figure 3. Later for enhancing linear features and other geological trends various directional filters have been applied and interpreted in reference to available geological map.

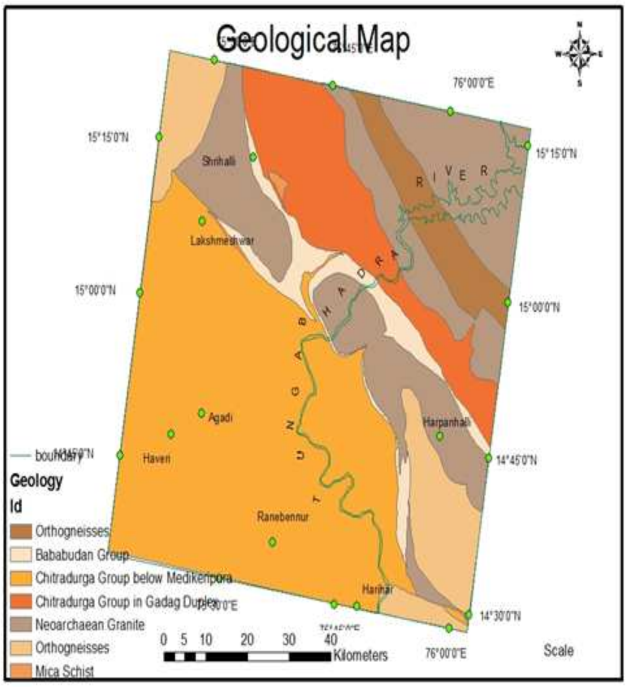

Figure 2: Geological structures and formational features map of study area (after Chadwick et at 2003)

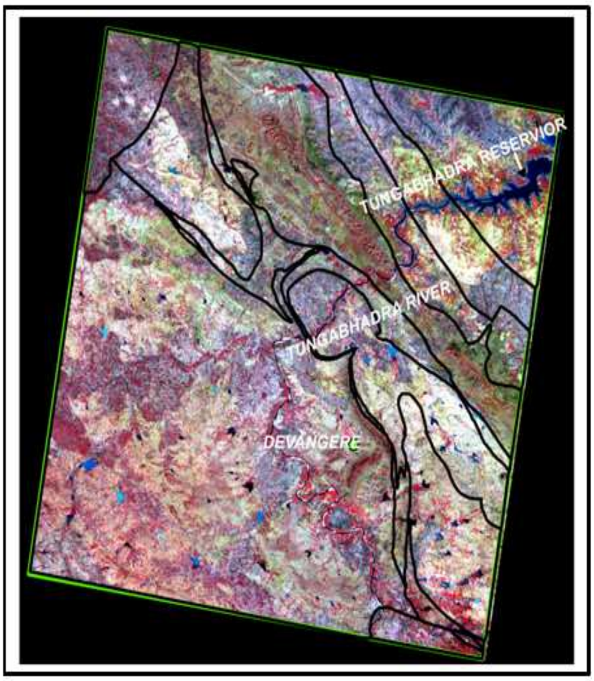

Figure 3: False Color Composite of Linearly Enhanced Images (IRS LISS II) of region in and around Tungabhadra Reservoir on which structural as well as other geological features have been overlaid.

3. RESULTS AND DISCUSSIONS

Based on our study it is interpreted that the river Tungabhadra flows in a north-easterly direction through rugged ridges formed by boulders piled on ancient granite outcroppings over the elevated plateau that dominates peninsular India, the Deccan Plateau. The river has cut through weaker rocky substrata, landscape and created a narrow gorge where granite hills confine the river in a deep ravine. The granite outcrops slowly disappear as the river flows south and the land opens into a long, broad plain ending at the rising slopes of the Sandur hills, rich in iron and manganese. Other tributaries and rivulets flow over desert to semi desert type of landscape with almost little vegetation cover and are controlled by regional structural features /trends and formational boundaries.

The major lineament trends as observed on IRS 1A LISS II image as well as on SRTM Digital terrain model are oriented as NW-SE and represents an important structural trends as major thrust belt representing Chitradurga boundary fault zone and this marks the boundary between the eastern Dharwar group of rocks and western Dharwar group of rocks.

The eastern part which is characterised by hard igneous rocks known as Chitradurga granite showing elevated terrain where as the highly metamorphosed western part which is known as Chitradurga schist belt is associated with low elevated terrain. These features are clearly demarcated on FCC and on Digital Terrain Model by elongated shape of elevation contours.

Further other rocks of different age group have been well recognised by different colour signatures on false colour composite images (see Figure 3) and also by characteristics elevation on SRTM Digital Terrain Model (DTM) (see Figure 4) as in Table1 below:

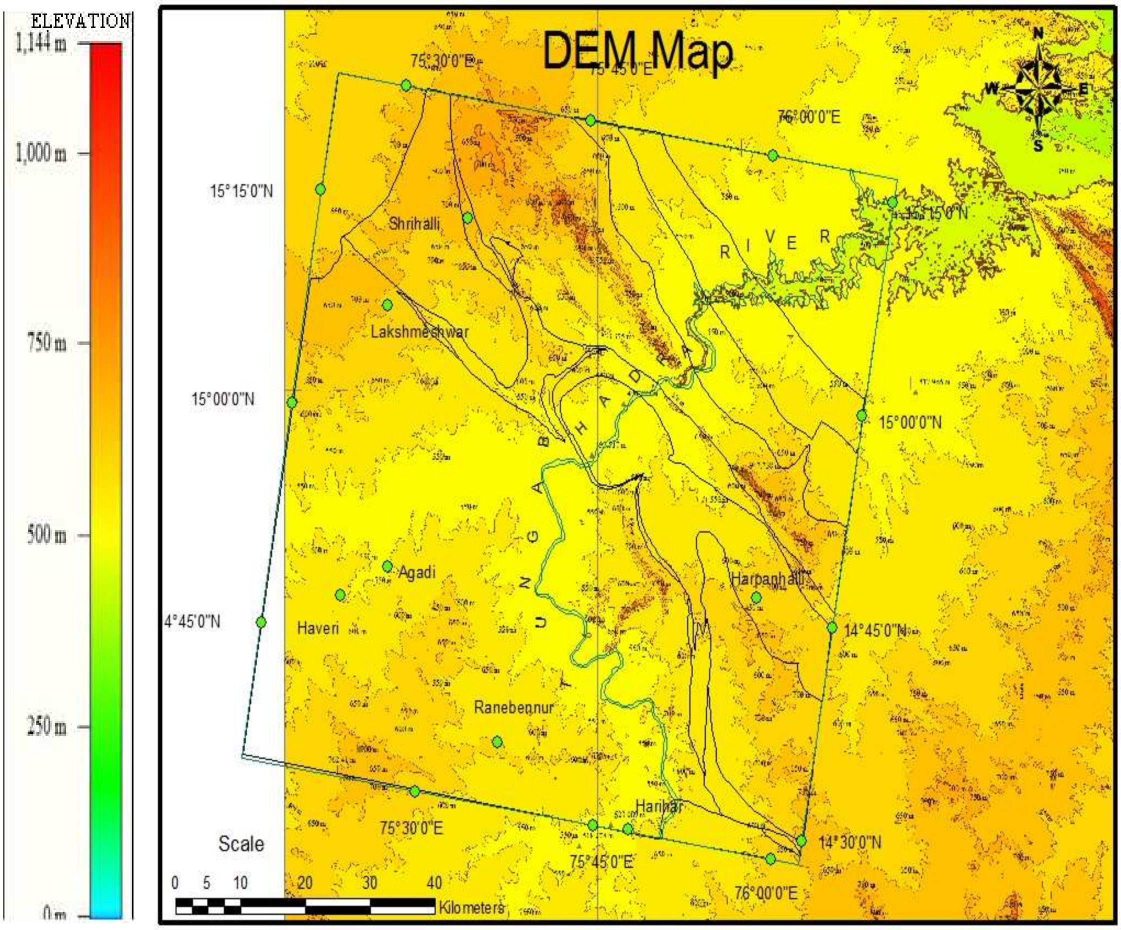

Figure 4: SRTM-DEM on which formation boundaries as well as the structural trends are overlaid.

Table 1: Showing colour signatures of various rock types and land features as observed on enhanced false colour image and corresponding elevation value as derived from SRTM DEM data.

Land / Rock Features	Tone on FCC	Elevation from DEM (m)
Chitradurga group in Gadag duplex	Green	750-950
Orthogneisses 2	Light Yellow	650-750
Mica Schist	Gray	600
Neoarchaean Granite	Blue	500
Chitradurga group below Medikeripora	Pink	450-700
Bababudan group	Purple	450-600
Orthogneisses 1	Green	450
Water	Black	350
Vegetation	Red	---

4. CONCLUSIONS

Integrated analysis of various thematic maps such as drainage, photo linear and land form including rock type information from enhanced images and their simultaneous display and analysis in GIS environment in conjunction with other collateral information has allowed rapid interpretation of geological and tectonic features in regional scale with minimum field work. Applications of various image filtering techniques have helped in better delineations of various sets of enhancing geological formational boundaries as well the structural trends lineaments Image filtering technique Significantly on false colour image all the igneous rocks of same age group were found to be of same colour in spite of different degree of metamorphism..

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