Geological Mapping through Geospatial Technologies in the district of Visakhapatnam, Andhra Pradesh, India

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Abstract-A geological map gives primary data for analyzing both past and present day to day processes affecting a region on the Earth. This kind of information is vital for providing information relating to geology that can aid to minimize damage and death caused by geologic hazards such as earthquakes and landslides. For the present investigation, thematic maps of geology have been generated from the IRS-ID-LISS III, 2004 and standard visual interpretation methods have been followed,to portray on-screen digitations of the features. This study shows that three major rock types are exposed in the area, out of which khondalite is the major rock types followed by Quartzite and thenCharnockite latter two types of rocks occur as intrusive bodies into the country rock. The structural trend of rocks is NNE-SSW however, local variations are observed at places. These features play a prominent role in relation to drainage development and erosion in the area.

Keywords:geological, hazards, khondalite, quartzite, charnockite

1. INTRODUCTION

GIS is a new and effective tool in geological mapping. It becomes easy for surveyors to create 3D maps of any area with precise and desired scaling. The results provide accurate measurements, which helps in several fields where geological map is required. In the present analysis, the thematic layers of geology have been studied to identify the geological vulnerable areas along the road management. Standard visual interpretation techniques as per the norms given by NRSA have been followed and delineated on screen digitations of features. These values are obtained to understand the rock and soil behavior in sub-aerial erosions. The road constructed along the sea shore, thus the influence of marine activity on the road is also explored to locate areas vulnerable under marine conditions. The rocks along the coast are observed as khondalite, leptynite, belongs to metamorphic group. In general, the trend coincides with the trend of Eastern Ghats. The khondalite appears red to brown color rich in sillimanite, garnets and occasional occurrence of graphite, biotitic, etc. in subordinate amount. Huge red kanker or talus material has been observed along the road cutting. This material is liable to slide on to the road. Bad land topography is famous in the area. Highly gullied land masses with sparse vegetation, red soils, and quick sands are the characteristic features of the area. A number of non-perennial streams erode the area into bad land topography.

2. STUDY AREA

The area of investigation is located in between $17^{0}73^{1}$- $17^{0}80^{1}$ Northern latitude and $83^{0}32^{1}$-$83^{0}45^{1}$ Eastern longitudes. Geographically, the study area is located along the sea coast of Bay of Bengal and comes under the Eastern Ghats Mobile Belt (EGMB) covering an area about 236 km^{2}, out of which approximately half of the area cover is under the jurisdiction of GVMC and rest comes under the Bheemili municipality. The study area is a part of Visakhapatnam and Bheemili municipalities. Bheemili is a town and mandal headquarters in Visakhapatnam district, Andhra Pradesh. The 25 kilometers stretch of road from Visakhapatnam along the coastline to Bheemili is a picturesque. The study is confined to recent expansion of four lane roads connecting Visakhapatnam and Bheemili. The road lay adjacent to the sea coast of Bay of Bengal and is under the natural vagaries of sea coast on one side; land and its natural activities on the other side render the road vulnerable. Recently; IT Parks, Rama Naidu Cinema Studio, several resorts and urban built-up lands came into existence. These anthropogenic activities have altered the topography along the road system. The traffic load is increasing year after year. In view of the traffic load recent road expansion has been taken up in place of old road network. This activity has led to cutting of hill flanks, foothills, sea sand dunes, culverts, drainages and highly denuded land forms etc

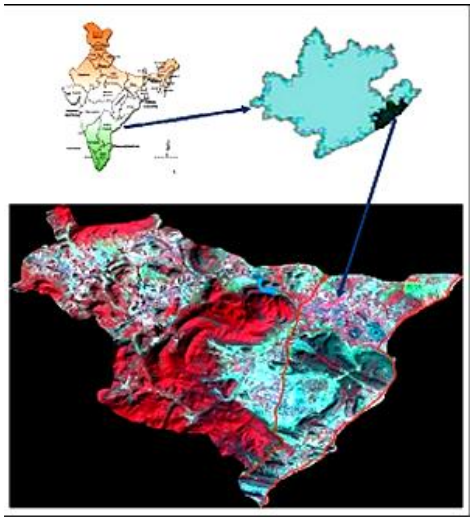

Figure1: Location Map of the Study Area as viewed on IRS 1D LISS III, 2004.

3. METHODOLOGY

The investigation zone covers 2 sequences of the Survey of India (SOI) toposheets, they are 65 O/5 and 65 O/2 on 1: 50000 scale. These toposheets are geo-rectified and projected to polyconic projection (the Metric system units – meters are used as in the present study). The Visakhapatnam toposheet map has been scanned and saved in .jpg format and then it is imported into image format which is then referenced to polyconic projection using ERDAS IMAGINE 9.1 software. The study area boundary is digitized and overlaid on Mosaic; demarked the study area boundary on 1:50000 toposheet and later verified by ground truthing. Necessary corrections were made and checked in the field with the help of GPS. Image processing was carried out for IRS – ID LISS –III (23.5m resolution) - dated April, 2004 (satellite imagery shown in Figure 1). After applying necessary image enhancement, Geology map has been generated using the GSI Visakhapatnam District map 2001.In the present study, the following weight

classes were assigned on the basis of rock type which in turn its ease to weathering cohesiveness and erosion. The following weight classes assigned to the rock types in which khondalite country rock is considered in the GIS analysis. (Table 1). The area covered under each class is given in Table 2. The geology map of the area is shown in Figure. 2.

Table 1.Weight classes assigned to the rock types

Rock type	Weight class
Khondalite	1
Active beach	2
Charnockite	Restricted
Quartzite	Restricted
Laterite	Restricted
Sandstone	Restricted

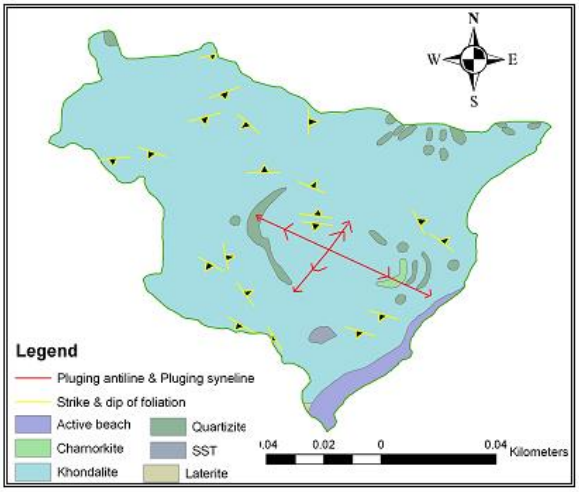

Figure 2: Geology Map of Study Area(Source: GSI map, Visakhapatnam dist.)

4. RESULTS AND DISCUSSIONS

Geology map has been generated using the GSI Visakhapatnam District map 2001. Three major rock types are exposed in the area, out of which khondalite (219.85 km^2) is the major rock type followed by Quartzite (7.11km^2) and Charnockite (0.81km^2). Charnockite and quartzite occur as intrusive bodies into the country rock.

Table 2. Spatial distribution of rock types in the study area.

Type of Geological Feature	Area in Sq Km
Total Area of Active Beach	7.270
Total Area of Charnockite	0.810
Total Area of Khondalite	219.850
Total Area of Laterite	0.110
Total Area of Quartizite	7.110
Total Area of SST	0.813
Total Study Area	**235.963**

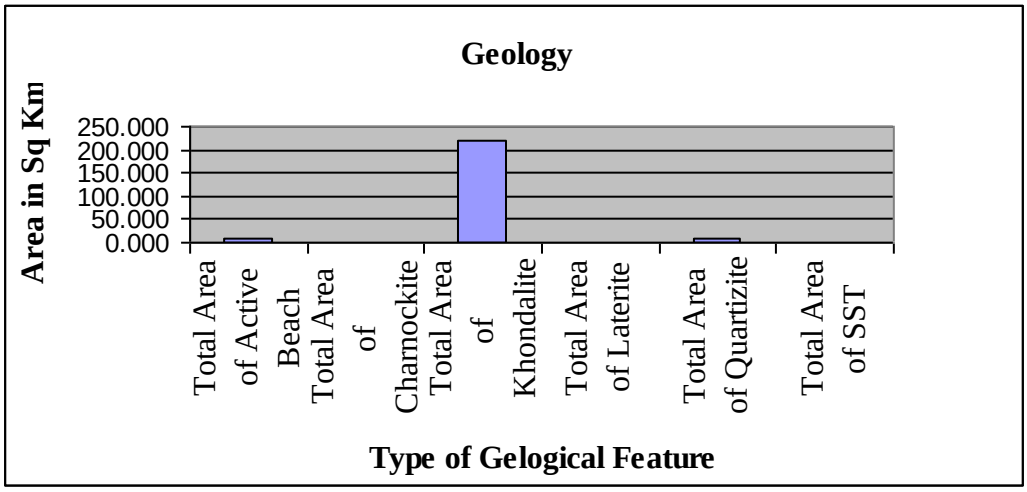

Figure 3. Geological features of the study area in sq.km

The area is covered with khondalite suite of rocks belonging to Archaean age. Hills are composed of khondalite suite of rock. The isolated hillocks are formed at the foot hill area and are composed of Charnockite and Quartzite rock types. These rocks are later intrusive into the country rock. The strike of the rocks is NNE-SSW and thus coincides with the general trend of the Eastern Ghats Figure 2. However, local variations are also identified (Sriramadas, 1964; Chetty*et al,* 2002).

Khondalite is susceptible to easy weathering which leads to soil formation. All the hills contain thick soil cover and support semi-evergreen deciduous forest. The rock appears as pinkish red color and it is the parent rock for red soils. Khondalite is composed of garnets, sillimanite, feldspars, graphite, etc. as an abundant mineral. The rock shows gneissic with banded structure. Disintegration and decomposition of rocks lead to soil formation and various other depositions like bad land topography, laterite soils, etc.

Charnockite rock occurs as intrusive bodies and act as dykes and ledges in the area. These rocks are hard and appear grey in color. The Charnockite is composed of augite, hypersthene, feldspars, hornblende and mafic minerals.

Recent deposits like river alluvium covered the lower reaches of Peddageddariver. This alluvium appears as black to brown in color and it is supporting extensive agriculture particularly paddy, vegetables and millets in the area. A number of bad land topography with calcareous nodules and sparse vegetation were exposed near the foothills. A famous bad and topography namely Erramattidibbalu is characteristically developed near INS Kalinga which is depositing sand and silt to the road.

These areas are covered with red soil and supporting scrub and plantation. The geological succession of the study area is given below (Table 3.)

Laterite is a product of weathered khondalite; it is yellowish to reddish in color. It is generally ferruginous and hard on the surface containing numerous cavities. But it is gravely at depths, thickness of the laterite capping ranges from 1 to 3 meters.

Table 3. The geological succession of the study area.

Recent	Coastal alluvium, River alluvium and residual soils
Sub-recent	Laterite & Laterite capping
Archaeans	Khondalite suite of rocks intruded by charnockite, Quartzite, pegmatite and Quartz veins

5. CONCLUSION

Khondalite is susceptible to easy weathering which leads to soil formation. All the hills contain thick soil cover and support semi-evergreen deciduous forest. The rock appears as pinkish red color and it is the parent rock for red soils. Khondalite is composed of garnets, sillimanite, feldspars, graphite, etc as abundant minerals. The rock shows gneissic with banded structure. A number of bad land topography with calcareous nodules and sparse vegetation were exposed near the foothills. Atopography namely Erramattidibbalu is characteristically developed near INS Kalinga which is depositing sand and silt to the road.

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REFERENCES

[1]. Bhardwaj, V. R. (2010). Geo Chemistry of Lower Vindhya Classic Sedimentary Rocks of North Western India Shield: Implications for Composition and Weathering History of Proterozoic Continental Crust. Journal of Asia Earth Sciences. Vol.39, Issue 1-2, PP.51-61.

[2]. Chetty, T.R.K., Vijay,P., Suresh, B.V.V. and Vijaya Kumar, T. (2002). GIS and the tectonics of the Eastern Ghats, India. GIS Dev, Vol. 16, No.12,pp.21- 24.

[3]. Ganesh Raj, K., Paul, M.A., Hegde, V.S., and Nijagnnappa, R., 2001. Lineaments and seismicity Of Kerala- A Remote Sensing based analysis. Jour. Of the Indian Society .of Remote Sensing, Vol.29, No.4, pp. 203 -211

[4]. JagadeeswaraRao, P., Harikrishna, P., and SuryaprakasaRao, B., 2006. Studies on silt deposition in Gambhiram reservoir-A Remote Sensing Approach. Jonr of Indian Geophysics union, Vol.10, No.4, pp. 285 - 292.

[5]. Jensen, J.R (1996). Introductory Digital Image Processing – A Remote sensing Perspective, (second edition), Pretice Hall, New York, USA.

[6]. LIllesand T.M. and Kieffer, R.W. (1994). Remote Sensing and Image interpretation, 3rd edition, John Wiley & sons.

[7]. Marble, D.F., Peuquet, D.J., Boyle, A.R., Bryant, N., Calkins, H.W., Johnson, T. and Zobrist, (1983). Geographic Information Systems and Remote sensing, American Society of Photogrammetry, Falls Church, Virginia.

[8]. O'Leary, D.W., Friedman, T.D. and H.A., (1976). Lineament, linear, lineation, some proposed new standards for old terms. Bull. Geol. Sci. Amer, Vol.87, pp. 1463- 1469.

[9]. Poesen JW, Torri D, Bunte K. (1994). Effects of rock fragments on soil erosion by water at different spatial scales: a review. Catena, Vol.23, pp: 141-166.

[10]. Qiming Zhou, (1995). The Integration of GIS and Remote Sensing for Land Resource and Environment Management" Proceedings of United Nation ESCAP Workshop on Remote Sensing and GIS for Land and Marine Resources and Environment Management, School of Geography, The University of New South Wales Sydney, NSW 2052, Australia., Vol.13, No.17, pp. 43-55.

[11]. Sharp, R.P. and Malin, M.C. (1975). Channels on Mars. Bulletin of the Geological Society of America, Vol. 86, pp. 593-609.

[12]. Swain, P.H. and Davis, S.M. (1978). Remote Sensing: The Quantitative Approach. McGraw Hill Book Company, New York, pp.396