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# Application of RS and GIS for Land Use/Land Cover, Geomorphological Studies in Nalgonda District, Telangana, India

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**Abstract** The Land Sat 8 ETM+ satellite image of an area 17579 sq.km. Corresponding to the Nalgonda District and Ramadugu study region (1200 sq.km) in the northwestern part of Cuddapah basin, Telangana State was analyzed to determine the geological/structural configuration, land use land cover and geomorphology of the regions. The disposition of various faults, other lineaments and thirteen (1 to 13) radial drainage structures in the region were delineated. The findings are significant in view of the paucity of structural data in the region and form a geo structural data base for prognostication of lamproites.
**Keywords** *Domal Structures; Geomorphology; Lineaments; Satellite Image; Structural Configuration*

## 1. Introduction

Remote sensing a relatively new resource evaluation tool in geophysical surveys proves to be invaluable. The main advantage accruing from image interpretation is the ‘overview’ it affords. Linear features running for long distances such as dykes, fractures, joints, and faults are often indicators of mineral/groundwater resources. These features sometimes escape notice on ground as local morphological features such as weathering or vegetation cover and/or cultural features such as roads and buildings dominate them at places. The continuity of such partially obliterated features can very easily be traced from aerial photographs or satellite images and coupled together with other ground geophysical information can prove to be a valuable exploration tool.

The present work strategy consists of image analysis and interpretation to understand the LAND SAT 8 ETM map landuse, landcover, geomorphology and lineament studies of Nalgonda district and detailed structural and geomorphological studies, and prevailed drainage pattern with a view to compare with reported resources of Lamproites at Ramadugu, Somavari gudem and Vattikodu study region.

## 2. Data Base

The data have been collected from NRSC, Balanagar, Hyderabad and freely available on net source. The primary data collected are Survey of India (SOI) topo sheets at scale of 1:50,000 and 1:250,000 (Toposheet No's 56 K, 56 L, 56 O and 56 P) and multi spectral Satellite Imagery of the LANDSAT 8 ETM, 29-10-2011. Resolution 28.5 m number of band are 8 and path 144 and row is 48 of Nalgonda district.

The Land Sat 8 ETM+ satellite image of an area 17579 sq.km. Corresponding to the Nalgonda District and Ramadugu study region (1200 sq.km) in the northwestern part of Cuddapah basin, Telangana State was analyzed to determine the geological/structural configuration, land use land cover and geomorphology of the regions. The disposition of various faults, other lineaments and thirteen (1 to 13) radial drainage structures in the region were delineated. The findings are significant in view of the paucity of structural data in the region and form a geo structural data base for prognostication of lamproites

## 3. Study Area

The Nalgonda district is located in the northeastern part of the Proterozoic Cuddapah basin is located between latitudes $16^{o}$ 15' N to $17^{o}$ 45' N and longitudes $78^{o}$ 45' E to $80^{o}$ E lies in the State of Telangana, India (Figure 1). The district covers an area of 17,579 Sq.km and is bounded on the north by Medak and Warangal districts, on the east by Khammam and Krishna districts, on the south by Guntur and Mahabubnagar districts. In the southern part of the district along the northern bank of Krishna River the rocks of Archaean Peninsular Gneissic complex are unconformable overlain by sedimentary rocks of 1100-600 Ma, constituting the Cuddapah super group and Kurnool group. The geological formations (GSI, 1999) in the district comprises migmatites, granites granodiorite, tonalite-trondhjemite suite of rocks and hornblende-biotite schist, metabasalts, meta-rhyolite and banded hematite quartzite and Dharwar super group are exposed as linear belts near Peddavura on the Hyderabad-Nagarjuna sagar road and also around Fathepur village of Miryalaguda Mandal.


***Figure 1:*** *Location Map of Study Area*

### 3.1. Image Processing and Analysis

The present study evaluates the effect land use land cover and structural studies in Nalgonda District. The work strategy consists of Image analysis and interpretation, detail analysis and methodology shown in Figure 2. The special database consists of survey of India (SOI) top maps and Indian Remote sensing Satellite images. The base map serves the purpose of demarcating district boundary,

natural and cultural features and for geo-referencing. The precision geo-coded data, Land Sat 8 ETM multi spectral scanning radiometer with eight bands and being capable of providing high resolutions were prepared using several band combinations and as many band rationing/indexing techniques mentioned by several authors (Goetz, 1975; Chavez et al., 1982; Singer, 1980; Miller and Pearson, 1971; Price, 1995) techniques of image information of the earth's surface. The ETM acquires the image data in visible (band1: 0.45-0.515µm, band 2: 0.525-0.605µm, band 3: 0.63-0.69µm), near-infrared (band 4: 0.75-0.90µm), mid-infrared (bands 5: 1.55-1.75µm and band 7: 2.09-2.35µm), far-infrared (band6: 10.4-12.5µm) and panchromatic (band 8: 0.52-0.9µm). The spatial resolution is 15m in the panchromatic band, 30m in the visible, near infrared, and mid-infrared bands, 60m in the far-infrared band and each scene represents the Earth in 183 by 170 kilometers. The data of satellite pass-over the area on 29-10-2011 and the standard data product corresponds to a scene with path/row numbers 144/48. Subsequently the image was geo-referenced and analyzed using appropriate software modules of ERDAS 9.1 and ArcGIS 9.2 software's are used for digital image processing and statistical analysis (Short, 1982; Hammond and McCullough, 1980; Castleman, 1978). Geometrical rectification for satellite data was done using ground control points (GCPs) extracted from the base map. The ground control points considered include road junctions, intersection of the drainage lines and manmade features. That allows one to display process, enhance, analyze and output raster as well as vector data for various applications. Landsat 8 ETM image of Nalgonda district is shown in Figure 3.

Visual interpretation of the satellite image analyses data have been used for preparation of land use land cover, lineaments maps of Nalgonda district and geomorphological map of the Ramadugu study area.

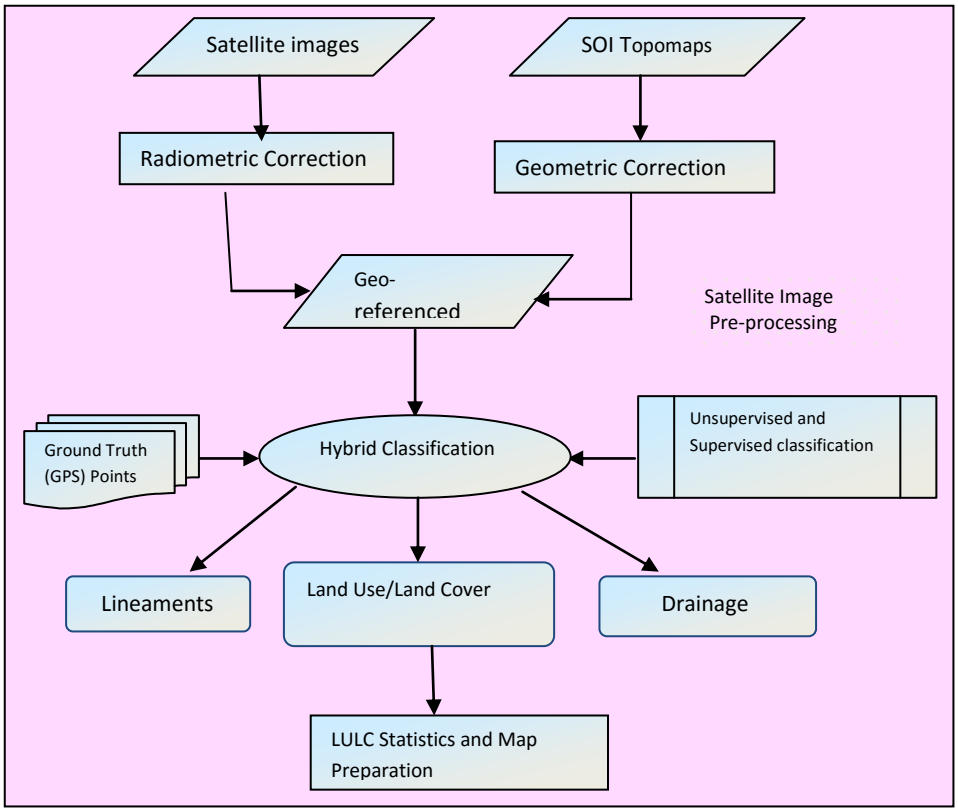


***Figure 2:*** *Shows the Flow Chart of Detailed Analysis of the Study Area*

### 3.2. Land Use/Land Cover

The present classification is done with the help of Landsat 8 ETM Geocoded imageries to 1:250,000 scale by visual interpretation techniques.

The Nalgonda district situated in the heart of the Deccan Plateau is located between latitudes 16$^{o}$ 15' N to 17$^{o}$ 45' N and longitudes 78$^{o}$ 45' E to 80$^{o}$ E, covering an area of more than 17579 Sq.km (Figure 3), at present district consists of fifty nine (59) mandals with 1175 Gram Panchayats. The entire district stands on pink and gray granites, these granite hills are spread all over the district and surrounding areas. Rivers Musi and Krishna rivers, which are the southerly flowing tributaries of the easterly flowing Krishna River. The Musi River begins in Anantagiri Hills near Vikarabad, Ranga Reddy district, 90 km to the west of Hyderabad and joins Krishan River near Wazirabad in Nalgonda district. Telangana is separated from Andhra Pradesh by the Krishna River, which acts as a geographical divider between the two. The Krishna River is the third longest river of the country. The river Krishna starts forming the delta downstream of Utsapalle village, once a famous gravel diamond-mining centre. The land use Land cover is made in to ten conventional divisions in the present study (1) Agricultural (2) canal (3) fallow land (4) forest (5) habitation (6) open land (7) plantation (8 ) river(9) road and (10) water body based on the colour, tone and texture shown in Figure 4.

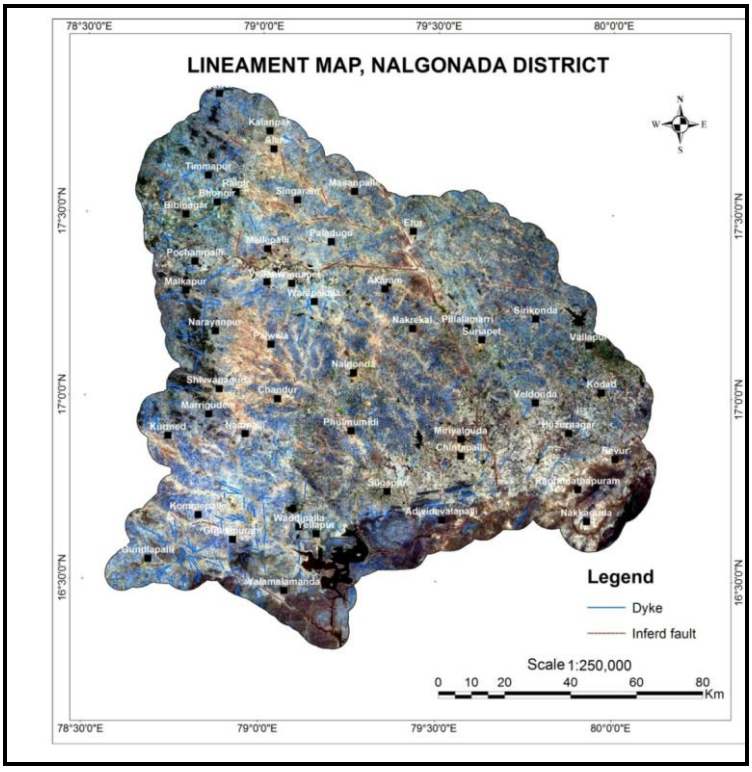


***Figure 3:*** *Landsat 8 ETM Image of Nalgonda District*

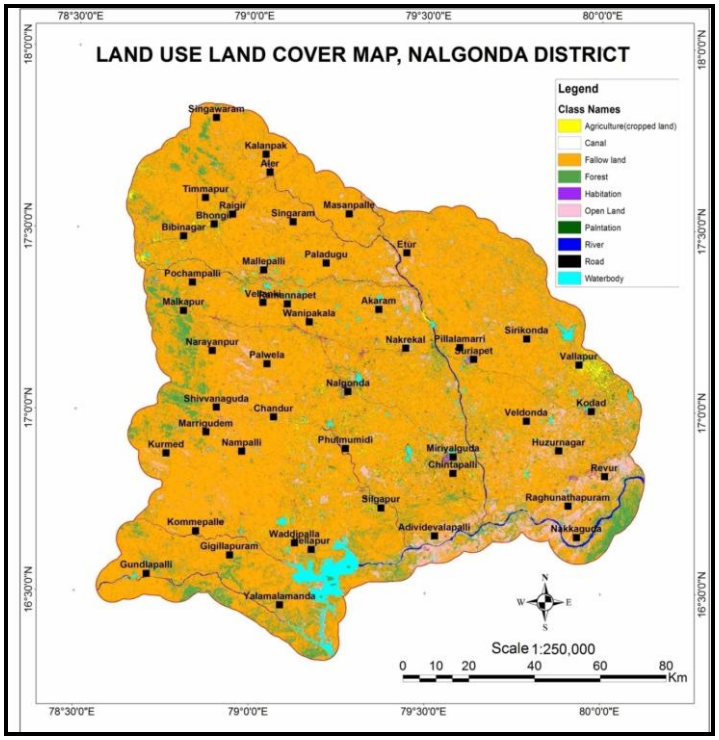


***Figure 4:*** *Land Use Land Cover map of Nalgonda District*

The land use/land cover statistics of Nalgonda district for 2011 shown in Table 1.

***Table 1:*** *Land Use Land Cover statistics of Nalgonda District*

| S. No. | Class Name | Area(Ha) | Area (Sq.Km) |
|---|---|---|---|
| 1. | Agriculture(Cropped land) | 27512 | 275 |
| 2. | Canal | 352 | 4 |
| 3. | Fallow land | 1391953 | 13920 |
| 4. | Forest | 169548 | 1695 |
| 5. | Habitation | 6999 | 70 |
| 6. | Open land | 107173 | 1072 |
| 7. | Plantation | 12281 | 123 |
| 8. | River | 10906 | 109 |
| 9. | Road | 1163 | 12 |
| 10. | Water body | 25860 | 259 |

Essentially the image has an intermediate tonal quality with fairly well distributed tonal unit agriculture /cropped land (yellow), canal (white), fallow land (yellow grey), forest (light green), Habitation (cyan to magenta), open land (pink), plantation (thick green), river (sky blue), road (black) and water body (light greenish). Further sub-classification of the landscape is guided by variations within these tonal units. Thus, light green signatures surrounding darker green tones correspond to weathered granite.

**1) Agriculture (Cropped Land)**

All the cultivated land with cropped (yellow color) is considered in this class in the district area the cropped lands have wet and dry cultivated lands. The areal extent of this land covered is 275Sq.km. Most of the land agricultural land in the study area is supported by peninsular gneissic complex.

**2) Canals**

Physiographically, the study area represents a pediplain with inselbergs and regional hills, which irrigated by a network of Nagarjuna Sagar canal only 4 sq.km, which has been caused the silty of the stream/river course in the Musi and Halia River drainage basin. Even some of the major stream course in the vicinity of canals turned out to be shallow marshy lands due to the continued anthropogenic activities.

**3) Fallow Land**

This class consists of areas of intensive use with much of the land occupied by man - made structures. This class consists of dense urban, low sub urban village, sub urban these are appearing in bluish ash tone having very coarse texture. It is defined as an area occupied by 13920 sq.km. However, due to non-agricultural use and which has a cover of buildings, roads and communications, utilities in association with water, vegetation and vacant lands.

**4) Forest**

Forest land are represent NNW-SSE trending structural hills in the western side of the Nalgonda district, sparse forest land located in an undulating terrain composed predominantly of granites, area occupied by the forest land is 1695 sq.km and the area to the north of Krishna is a pediplain terrain while its south is hilly terrain occupied by the Nallamala reserved forest.

**5) Habitation**

Habitations in the district were fluoride affected 70 sq.km. Out of 59 mandals 48 mandals are affected by fluoride, only 11 mandals are not effected by fluoride (Venkateshwarlu et al., 2014). High concentration of fluoride presence is up to 8 ppm in certain villages, Munugode, Nalgonda, Marriguda, Chandur, Chityal Nampally, Narayanpur, Narketpally, Choutuppal, Chinthapally, Peddavura and Tipparthy are severely affected mandals in the district, 1175 Gram Panchayats and about 32100 habitations in the district.

**6) Open Land**

Open or barren lands are of 1072 sq.km. Quasi open and open have little or no vegetation and limited to support vegetative communities due to human activity, areas such as agricultural, extractive and industrial land uses may be classed as barren land, therefore these areas must be explored very closely through the use of supplemental such as aerial photographs and topographical sheets included in this category are the sub categories of gardens, exposed rock and disturbed land, play grounds. They appeared in pale yellow colors fine textured.

An analysis of the nature and rate of land use change and its associated impact on groundwater quality is essential for a proper understanding of the present environmental problems.

**7) Plantation**

It describes mostly the natural vegetation occupied by 123 sq.km, which includes Grass lands, shrub, and mixed vegetation are sub categories. These areas become evident when large scale imagery is used. These areas generally appear in pale pinkish to bright red and dark reddish tone having smooth to mottled texture depending on the nature of plants, their distribution density, and moisture content.

**8) River**

Major rivers include Krishna, Dindi, Peddavagu, Aleru, Halia, Konga and Palleru, which form part of the Krishna river basin, total area covered is 109 sq.km, all the streams generally flow in southeastern direction and join the Krishna River. The district receives 50-70 cm rainfall per annum and experiences semi-arid climate. When we look at the Nalgonda district region, we find that the major river system draining this area consists of the Musi and its tributaries including Aleru vagu. For ease of examination, the region can be divided into the northwestern, northern, northeastern, eastern, southeastern, southern, southwestern, western and the central regions of Nalgonda Town.

**9) Road**

The total roads occupied in the district (12 sq.km) usually the built up roads lies in all types of terrain and waste lands in association with road, rail and artifact.

**10) Water Bodies**

The classification of water bodies (259 sq.km) is dependent upon scale and resolution characteristics of the remote sensing imagery used for interpretation. In some instances, a water body may be large enough to be identified as such or the water body may contain submerged or emergent vegetation. In this case that water body will be identified under the wetlands category. Water bodies are however very fine textured with their tone ranging from pale to cyan to almost black depending on the depths and turbidity.

### 3.3. Structural Analysis

The analysis of lineaments mapped from remote sensing data is a common reconnaissance tool for structural evaluation and follow-up geo -investigations. The relief, slope, extent of weathering, type of weathered material and overall assemblage of different land form is defined as Geomorphology which play an important role in modeling the land use land cover and structural (Sarala, 2013) elements associated with lineaments include fault zones, fractures (joint zones), and fault axes, linear igneous intrusions, apart from major features were delineated from geological map, satellite Imagery and field visits.

Geologically all faults, folds, joints, fractures etc. are considered to be lineaments. The drainage of the study area is easily visible on the Landsat 8 Satellite Image. These can be identifiable through remote sensing using lithological displacement, drainage pattern which follows faults (Trellis drainage pattern), bedding planes, folds which could be identifiable through its litho- logic similarities in the curvilinear bed, faults scraps, emplacement of dykes through fault planes, weathering pattern through joints. Many emphasized the importance of lineament interpretations and digital lineament analysis (Kutina, 1969; Katz, 1982; Liu et al., 2000) in localizing the major structural configuration of the region shown in Figure 5.

In buried pediments where granitic rocks with little soil cover and pediplains where soil cover is much high, these lineaments are not visible much through visual interpretation. Apart from the lithological composition of rocks the other element of geological interpretation is structural studies. However, through subjective (Moore and Waltz, 1983) a manual procedure is sometimes more reliable than their detection in the field. Structural interpretation in the present study has been lineaments, limited to limit mapping.

The present study area Nalgonda district is dominated by presence of biotitic granite associated with NW-SE and SW-NE. N-S and E-W directions and prominent linear features were inferred in Figure 5.

Seven linear-deep-seated faults are running NW-SE, N-S, E-W and NE-SW trending deep faults/fractures as well as margins of basic dykes which have persisted through time and influence the geological history of the area. Some of these lineaments correlate/or coincident with mapped structures such as faults, shear zones, dykes and foliation. There are eight deep seated regional faults have been identified on the satellite image, F1 fault is falling at south western side of the Nalgonda district running from South Yellapur to Gigivapuram trending E-W direction, F2 is located the N-S direction runs from west of Adavidevarapally to Silgapur, F3 trending from NE-SW side of Raghunathapur to Sirikond, F4 is long length trending in the NW-SE direction from waddipalli to Singawarm. Fault F5 (E-W), F6 NW-SE of Chintapalli to Miryalguda, F7 trending E-W of Nakerekal north to Sirikond and F8 is in between Nakrekal–Pulimamidi to Etur are trending in the E-W, NW-SE.E-W and N-S directions respectively.

The lamproites of Jaggayyapeta Lamproites field (Chalapathi Rao et al., 2004; Ramadass et al., 2015) occur in close spatial association with NNW-SSE and WNE-ESE trending dolerite dykes and fracture system and is mostly emplaced at the contact between dolerite and granite/gneisses.

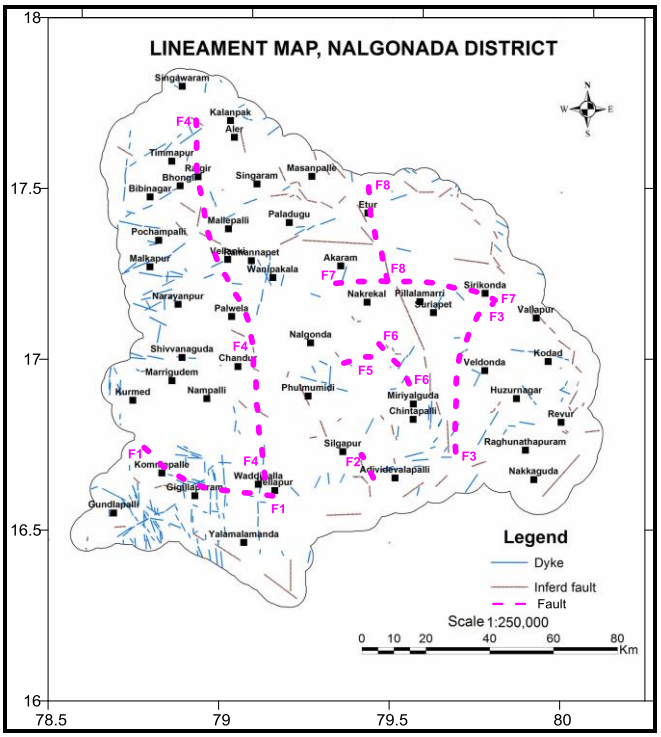


***Figure 5:*** *Lineament map of Nalgonda District*

### 3.4. Ramadugu Study Area

The study area is situated in and around Ramadugu in Nalgonda district, the area is well known for the recent discovery lamproites clusters (Sridhar et al., 2005) are located north western part of Dharwar craton. Figure 6, Land Sat 8 ETM+ image (1:50,000 Scale) covering an area of approximately 1200 sq.km (Longitudes $79^0$ 5' to $79^0$ 25'and Latitudes $16^0$ 42' to $16^0$ 58') was digitally processed and visually interpreted to elucidate the structural fabric and geomorphology of the region comprising the geology and lineaments.

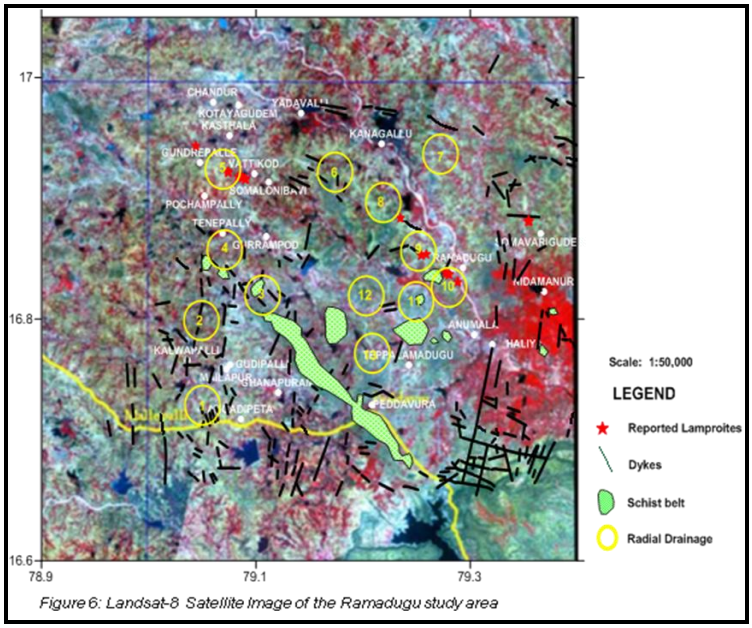


***Figure 6:*** *Landsat-8 Satellite Image of Ramadugu Area*

The geomorphology map of the Ramadugu falls in Topo Sheet No. E44T1, E44T2 and E44T5 in parts of Nalgonda district of Telangana State is shown in Figure 7. The maximum elevation is varying from 242m to 150m south of Ramadugu village and north western side of Halia River.

There are number of dykes of dolerite, reefs of quartz and multiple fracture systems commonly trending N-S and ENW-WSE and NW-SE. The NW-SE trending dykes oldest followed by N-S and ENE–WSW trending dykes (Sridhar and Rau, 2005). These dykes run for tens of kilometers intermittently. The width of the dykes varies from less than a meter to 20 m. These dykes are massive and are mostly doleritic in composition, quartz veins traverse older rock unit and trend N-S and N 30$^{o}$ E, S 30$^{o}$ W, N 60$^{o}$ E-, S 60$^{o}$ W and N 75$^{o}$ W and S75$^{o}$ E are common in the area.

All of dykes in the region are associated with the younger granites and granitoids. The overall drainage is dendritic to sub-dendritic, dendritic homogenous nature of the area and controlled by numerous joints and fractures. The general slope of the area is observed t rending toward the south east. The Peddavagu-Aliya River is also showing the flood plains in the study area even through this stream is dry throughout the year except few days after rains.

Ramadugu study areas there are seven (f1-f7) fault/lineament (Figure 6) have been identified. The fault/lineament f1 is observed is located in south western part of the study area which is contact zone between the younger granites and granite, graneodorite granite gneiss. The fault f2 indicating the contact between the western margin of Peddavura schist and granite, graneodorite granite gneiss. f3 is observed near Tenepalli it is abutting the north western part of the schist belt from the biotite gneiss. The fault f4 is trending in NE-SW direction, fault f5 (NW-SE) and f6 (NE-SW) are the important tectonic lineaments/fault zones in the study area which are highly disturbed nature. The emplacement of lamproites near Somvarigudem, Marepalli, Yacharam and Ramadugu regions are associated within fault/shear environment of f5 & f6. The f7 is separating the Lamporites of Vattikod from Gudrapalli Lamporites. The reactivation of these major crustal lineaments in this region, probably during upliftment of the Nallamala sub basin, caused mantle up-wrapping and facilitated the emplacement of mineralization (lamproites) (Alok Kumar et al., 2013) close to the E-W and the NNW-SSE trending faults/fractures.

The domal (radial) structures are reflected in the geomorphology of the region as elevated circular drainage pattern of the region from which the disposition and various geomorphological units are identified. The major drainage of the region is provided by the river Krishna and its tributaries. The well-developed weathered layer along with the final drainage density (Figure 7) give rise to numerous ponds in this region. Topographic highs and lows in turn ware indicated by regions of circular or radial alignment of the drainage. Such radial structures taken in conjunction with faulted zones are contact between dolerite dykes, granite and gneisses are potential zones for lamproites indicators

Domal/radial structures are reflected in the geomorphology of the study region is elevated circular features, the Remote sensing approach to locate potential lamproites/kimberlites zones is to delineate region of domal geomorphology that is characterize by topography highs, higher intern and indicated by region of circular and radial alignment of the drainage. The general slope of the area is observed trending towards the south east Thus lineaments that fall within the migmatite gneisses show a concordant relation with the regional Dharwarian trend, i.e., NW-SE, whereas lineaments that fall over the biotite granites show both parallel as well as transverse relation, i.e., NW-SE, WNW-ESE, E-W, ENE-WSW and N-S.

Circular or radial alignment of the drainage structures taken in conjunction with the contact zone between the dyke environment and granitic gneisses and implying the involvement of distinct deep – seated faults/fractures in controlling their lamproite emplacement. Thirteen main circular zones have been identified numbered 1 to 13 details are given in Table 2. Among these seven zones (1, 2, 3, 7, 11, 12 and 13) no lamproites have been reported.

Zone five (5) is located at west of Vattikod region has already reported ten clusters of lamproites (Alok kumar et al., 2014) which is passing through the fault f6 and f7 trending in the NW-SE direction, most of these lamporites are emplaced at the contact zone between the Alkali Feldspar granite and biotite gneiss granitic–gneiss basement and in dolerite dykes.

Zone 6 is situated in between Samulonibavi and Kanagalu in Pulavay block reported few lamproites, similarly zone 8 represented by one lamproites near west of Marepally village, Zone 9 occurring east of Yacharam, this is the smallest zone reported two lamproites (Sridhar et al., 2005) and Zone 10 and zone 11 are located around Ramadugu passing through the NW-SE trending fault f5 has reported occurrence of Lamproites (Sridharar et al., 2005; Chalapathi Rao, 2013), which represents eight lamproites occur as dykes. Lamproites at Somavarigudem occur in close association with dolerite dykes and fault contact environment is observed in lamproite emplacement in the study area.

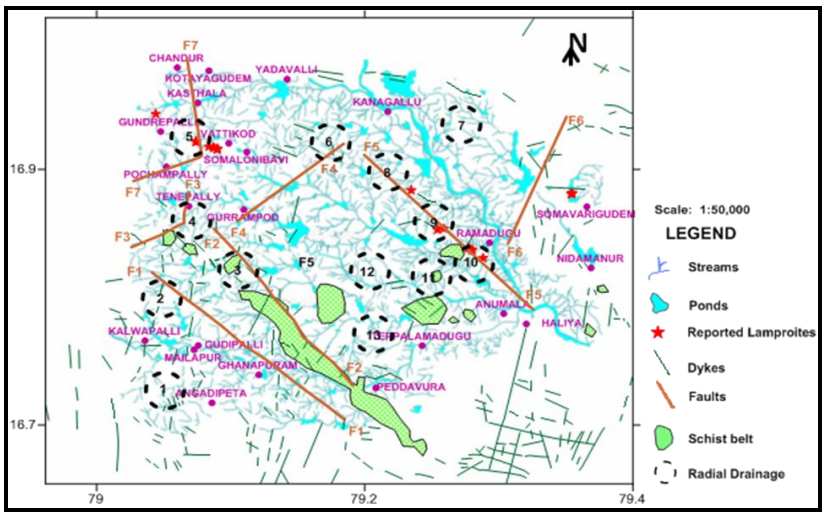


***Figure 7:*** *Drainage and Lineaments Pattern of the Ramadugu Study Area*

***Table 2:*** *Identified Circular Zones in Ramadugu Study Area*

| Circle No. | Location | Latitude in Degrees | Longitude in Degrees | Remarks |
|---|---|---|---|---|
| 1. | Angadipet | 16.72775724 | 79.05033432 | --- |
| 2. | Kalwapalle (North) | 16.79823752 | 79.04795858 | f1 fault( NW-SE) |
| 3. | Gurramphad (South) | 16.82041109 | 79.10576824 | f2 fault( NW-SE) |
| 4. | Between Tenepalle and Gurramphad | 16.85842293 | 79.07171598 | f2 fault (NW-SE) & f3 (NE-SW) |
| 5. | Vattikodu | 16.92510555 | 79.06955147 | Reported 9 Lamproite bodies (Alok Kumar et al., 2013) f7(NE-SW to N-S) fault |
| 6. | Between Samuloribai and Kanagalu | 16.92098407 | 79.17387278 | Reported Intrusive Lamproite bodies (Alok Kumar et al., 2013),fault f4 (NE-SW ) |
| 7. | East of Kanagalu | 16.93365468 | 79.27286193 | --- |
| 8. | Marepalle | 16.89671022 | 79.21720719 | Reported one lamproite , fault f59NW-SE) |
| 9. | Yacharam | 16.85763101 | 79.25227219 | Reported two Lamproite bodies (Chalapathi Rao et al., 2014) fault-f5(NW-SE) |
| 10. | Ramadugu (South west) | 16.82667477 | 79.27968791 | Reported 10 Lamproite bodies (Sridhar et al., 2005) Fault f 5 (NE-SE) |
| 11. | In between Ramadugu-Anumala | 16.81436376 | 79.24844205 | --- |
| 12. | -- | 16.81933294 | 79.20229964 | --- |
| 13. | Teppalamadugu | 16.76972864 | 79.20713314 | ---- |

## 4. Results and Discussion

Remote sensing Land Sat 8 satellite image analysis of the Nalgonda district facilitated preliminary elaboration of the land use land cover and structural elements, orientation and disposition of lineaments, dykes, minor/major shear zones and structural features. Lineament map (Figure 7) brought seven deep seated faults F1 to F7 lineaments, fractures and dyke NW-SE, NE-SW, N-S and E-W trends, which are responsible for the emplacement of the lamproites at contact between granite gneiss and dolerite dykes.

From geomorphic analysis of the drainage pattern in the Ramadugu region, thirteen (1 to 13) domal structures and seven faults f1 to f7 were identified. These structures in conjunction with the tectonic framework of the region indicated favorable location for lamproites.

Ramadugu lamproites occur as dykes, Lamproites at Somavarigudem and Vattikod occur in close association with dolerite dykes and fault region a contact environment is observed in lamproite emplacement in the study area.

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## References

Alok Kumar, A., Ahmed, S., Priya, R., and Sridhar, M. *Discovery of Lamproites Near Vattikod Area, NW Margin of the Cuddapah Basin, Eastern Dharwar Craton, Southern India.* Journal of the Geological Society of India. 2013. 82; 307-312.

Castleman, K.E., 1978: The Gray Level Histogram, Digital Image Processing, Prentice-Hall, Englewood, Cliffs, New Jersey. 68-84.

Chalapathi Rao, N.V., Alok Kumar, Samarendra Sahoo, Dongre, A.N., and Debojit Talukdar. *Petrology and Petrogenesis of Mesoproterozoic Lamproites from the Ramadugu Field, NW Margin of the Cuddapah basin, Eastern Dharwar Craton, Southern India.* Lithos. 2014. 196-197; 150-168.

Chavez, P.S, Jr., Berlin, G.L., and Sowers, L.B. *Statistical Method for Selecting Landsat MSS Ratios.* Journal of Applied Photographic Engineering. 1982. 8 (1) 23-30.

Geological Survey of India, 2009: District resource map of Nalgonda district, Andhra Pradesh, 1:250,000 scale.

Goetz, A.F.H, 1975: *Application of ERTS Images and Image Processing to Regional Geologic Problems and Geologic Mapping in Northern Arizona.* JPL Technical Report 32-1597, Jet Propulsion Laboratory, Pasadena, C.A.

Hammond, R., and McCullagh, P.S. Quantitative Techniques in Geography, Oxford, England, Clarendon Press.

Katz, M., 1982: *Lineament Analysis of Landsat Imagery Applied to Mineral Exploration. In Mineral Exploration Techniques in Tropical Forest Areas.* Edited by Laming, D.I.C. and Gibbs, A.K. Hiden Wealth. 157-166.

Kutina, J. *Hydrothermal Ore Deposits in the Western United States: A New Concept of Structural Control of Distribution.* Science. 1969. 165; 1113-1119.

Liu, C.C., Sousa, M.D.A Jr., and Gopinath, T.R. *Regional Structural Analysis by Remote Sensing for Mineral Exploration, Paraiba State, Northeast Brazil.* Geocarto International. 2000. 15 (1) 70-77.

Miller, L.D. and Pearson, R.L. *Areal Mapping Program of the IBP Grassland Biome, Remote Sensing of the Productivity of the Short Grass Prairie as Input Into Bio System Model.* 7th Proceedings of the International Symposium. Remote Sensing of Environment. 1971. 1; 175-2005.

Moore, G.K., and Waltz, F.A. *Objective Procedures for Lineament Enhancement and Extraction*. Photogramm Eng Remote Sens. 1983. 49; 641-647.

Price, J.C. *Examples of High Resolution Visible to Near Infrared Reflectance Spectra and a Standardized Collection for Remote Sensing Studies.* International Journal of Remote Sensing. 1995. 16; 993-1000.

Ramachandran, C., Kesavamani, M., and Prasad, R.M.C. *A Geophysical Prognostication of Primary Diamond Deposits in Peninsular India.* Jour. Geophysics. 1997. 20 (4) 155-178.

Ramadass, G., Satish Kumar, K., and Sri Ramulu, G. *Emplacement of Lamproites in North Western Margin of Cuddapah Basin (EDC), Nalgonda District (TS)- Regional Gravity Evidence.* Pelagia Research Library. 2015. 6 (8) 189-198.

Ramadass, G, Subhash Babu A., and Udaya Laxmi, G. *Structural Analysis of Airborne Radiometric data for Identification of Kimberlites in Parts of Eastern Dharwar Craton.* International Journal of Science and Research. 2013. 4; 2375-2380.

Reddy, T.A.K., Sridhar, M., Ravi, S., and Chakravarty, V. *Petrology and Geochemistry of the Krishna Lamproites Field, Andhra Pradesh.* Journal of the Geological Society of India. 2003. 61; 131-140.

Sarala, C., 2013: *Landuse/Land Cover and NDVI Analysis is for Halia Catchment.* IJARET. 4 (5) 126-133.

Short, N.M., 1982: *The Landsat Tutorial Workbook, Basis of Satellite Remote Sensing, Washington, DC. NAASA.* Scientific and Technical information Brands, NASA. 174-175.

Singer, R.B. 1980: *Near Infrared Spectral Reflectance of Mineral Mixtures, Systematic Combinations of Pyroxenes, Olivine and Iron Oxide.* PSD Publications. No.258, MIT, Cambridge, MA.

Sridhar, M. and Rau, T.K., 2005: *Discovery of a New Lamproite Field- Ramadugu Lamproite Field (RLF), Nalgonda district, Andhra Pradesh.* Proceedings of Group Discussion on Kimberlites and related rocks. Geol. Soc. India, Bangalore. 55-57.

Venkateshwarlu, M.M., Rasheed, M.A, Reddy, U.V.B., and Kiran Kumar, A. *Assessment of Ground Water Quality in and around Miryalaguda area, Nalgonda District of Andhra Pradesh.* International Journal of Environmental Sciences. 2014. 4 (2) 259-260.