Lineament Analysis by Remote Sensing and GIS Techniques for Groundwater and Mineral Exploration in and around Lingala and Pendlimarri Mandal's of Kadapa District, A.P, India

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Abstract

Exploration groundwater, mineral resources and their proper exploitation requires lineament analysis. current studies were agreed out to expose the capability of structural features in the exploration and give emphasis to the significance of geospatial system likeRemote Sensing (RS) and Geographic Information System (GIS) techniques for proficient groundwater and mineral resources exploration and organization. The studies demonstrate the use of LANDSAT ETM+ imagery for mapping and analyses of lineaments. Image processing techniques relating linear/edge enhancement and directional filtering were applied on the image to enhance the edging of the linear characteristics used to extract lineament its relationship map using the lineament representation. ArcGIS 10.2 is used to create lineament analysis and to create rose diagram. Results showed that most promising sites for groundwateras well as mineralresources were dependent relative on the consistent factors of lithology, topography, and geologic formation. However, the field data of groundwater wells and active mining sites would contribute to refining the final locations of the most promising sites.The study has led to the explanation of sections of sustainable mineral and ground water resources. Present study revealed the intersections of E-W and N-S lineament trends are productive towards the exploration natural resources.

***Keywords**: Groundwater and Mineral exploration, Lineaments, LANDSAT ETM+, Remote Sensing, and GIS.*

I. INTRODUCTION

As far as the exploration part, the geologist has been concerned in linear features of the earth's crust ever since the early on epoch. The linear characteristics, like are fold, faults, and fractures, gives intimation about the interior for exploration of minerals and ground water resources. Using visual interpretationon the satellite image, determining the lineaments is difficult and in some cases emotional yet with experienced mediator (Maina et.al. 2017). In any case, there are programming models and advanced mapping which makes it simple to get lithological and structural data viably; this can be accomplished on the ground utilizing lineament analysis.Lineaments are the landscape surface articulation of cracks, jointing and other straight geographical wonders that happen any place from the territory surface down to conceivably grate depths (Cracknell and Heyes, 1993). With regards to Remote Sensing the Lineaments are long, regularly inconspicuous, liner plans of different topographic, tonal, geographical and even geophysical and geochemical highlights (Drury and Walker, 1987). Remote detecting method gives a way to local comprehension of groundwater framework. Its information gives data on spatial examples groundwater subordinate vegetation or salinization. The understanding of remotely detected information for direct highlights mapping is a basic piece of earth asset investigation programs in hard rock territory. Remote Sensing with its points of interest of spatial, apparition, and momentary accessibility of information covering enormous and in open regions inside brief time has turned into an exceptionally convenient apparatus in surveying, checking, and saving mineral and groundwater assets. The focal point of this work is identified with lineament investigation utilizing remote detecting and GIS methods to distinguish the regions of mineral and groundwater abnormalities and collections for simple exploitation in Lingala and Pendlimarri mandals of Kadapa region, Andhra Pradesh.

II. STUDY AREA

The Lingala and Pendlimarri mandals are located in the topographical map of 57J02, 57J03, and 57/J11, of Survey of India. Total area of the mandals is 886.08sq km.The study lies within the area of intersection of 14°28'44.735"N 78°6'11.535"E and 14°59'59.236"N 79°1'1.39"E respectively and situated in the Kadapa district, Andhra Pradesh. The location of the Lingala and Pendlimarrimandal with reference to the Kadapa district and Andhra Pradesh is given in (Fig. 1). The areas are totally composed of quartzite of Gulcheru fomation, dolomites and basic flows of dolerites from Vempalli formation, from Vempalle, shales of Tadipatri formation. Most of the area is covered with Tadipatri shales.

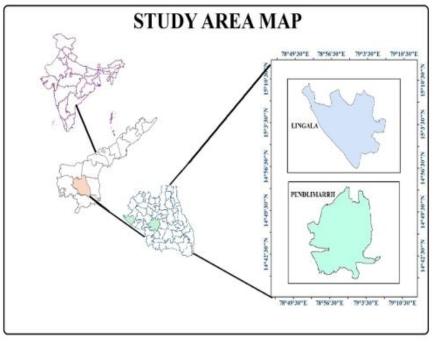

Fig. 1 Location map.

III. METHODOLOGY

The following data produce were used in the study area:

1) Remote Sensing image

2) Arc GIS (9.2)

3) Survey of India Toposheets on Scale 1:50,000.

4) Observations of Field

5) Laboratory work like, Preparing, and integrating different thematic layers viz. Geology,

Geomorphology Lineament, lineament density maps.The present study involves the use of satellite imagery, its analysis and development, their advantages in the field of mineral exploration, the preparation of different thematic layers based on GIS province. Thematic maps prepared to geomorphology, geology, lineament, and lineament density are arranged. The imagery used in the present study composed of Landsat 7 ETM + (Fig-3). In the Lineament mapping, lineaments were delineating by visual interpretation of false colour composite (FCC), which is multiple with the image to enhance the interpretation. Additional visual analysis was obtained by using linear compare extend analysis of the image and the combination of directional image filtering procedures followed by the pre-processing ground truth and GPS points. The lineament mapping is helped by the presence of the geomorphological highlights, for example, adjusted shortcoming, overlap, joints, edges and valleys, relocation of edge lines, straight lines and stream sections, straight drinage channel fragments, articulated breaks in crystalline rock masses, and adjusted depressions (Hung, 2005,Koch and Mather, et.al, 1997). The investigation was acutely keen on geologically significant lineaments, which may speak to joints, fauts and, in all probability, shear zones (Koch and Mather 1997, Juhari and Ibrahim 1997, Juhari and Ibrahim 1997, Solomon and Ghebreab 2006). The investigation of the field information in the perception of the prospect images (Yassaghi, 2006).

IV. RESULT AND DISCUSSION

Lineament studies intentional to mineral exploration frequently require mapping. The extraction of data from Remote Sensing images provides sufficient information about the probable lineament aided mineralization. The map of lineaments includes faults, fractures, and joints which are essential equipment that may expose points of mineral development. In particular, mineral formation either by igneous, metamorphic, or sedimentary is mostly controlled by the lineaments consequent to joints faults and fractures (Pothiraj et al 2013). Satellite image provide synoptic view of geology, geomorphology and structures, thus it is easy to make map that is more reliable. In turn these maps are verified with field truth in study area. This will provide the access to the corresponding mapped geological lineaments. These lineaments derived from the images are perfectly relative to the structural features in the field (Sarra Ouerghi Hermi et.al 2017). Application of edge enhancement technique to the satellite image will readily expel geological lineaments in the study part.

A. Geology

The two mandals under the study part of Cuddaph Supergroup falling within Papaghni group, Chitravati groups of lower Cuddapahs and Kurnool group of upper Cuddapahs. The geology of the study region comprises several lithounits of igneous, metamorphic, and sedimentary origin. The Archaean comprising of Peninsular Gneissic Complex (PGC) which is overlain by Cuddapah basin rocks, classified as Cuddapah Supergroup. Lithologically this study area comprises quartzite, dolomite, and shale rocks along with basic intrusive volcanic flows. Geologically the iron ore mineralization in the study area consists of dolomites, quartzite, ferruginous shale, iron rich mud-stone, brittle banded haematite iron ore bearing laterites belonging to the Gulcheru and Vempalle formations of Papaghni group, Pulivendla quartzite and Tadipatri shale formations of Chitravathi group of lower Cuddapah Supergroup and Banganapalle and Nandyal shale formation of Kurnool group, the lithology of the study area also includes the basic intrusive (Fig-2).

Distribution of lithounits in study area

S no	Mandal	Lithounits
1	Lingala	Gulcheru quartzite, Vempalle dolomite, Pulivendlaquartzite, volcanic flows, Tadipatri shale.
2	Pendlimarri	Gulcheru quartzite, Vempalle dolomite, Banganapalle quartzite

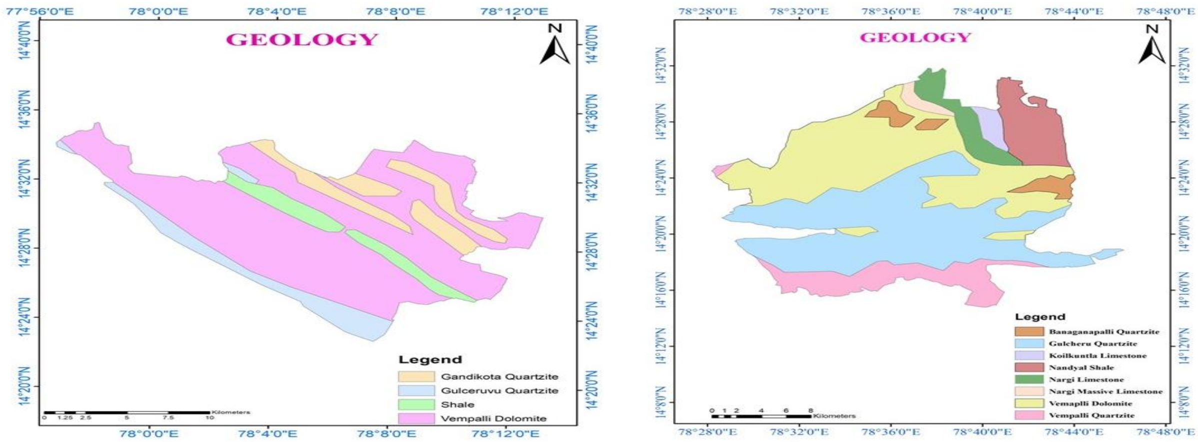

Fig. 2 Geology

B. Geomorphology

Geomorphological features in the study area can be described as pediment, pediplain, structural hill, residual hill, and structural valley. In Lingala mandal water bodies, Dolomite deposits in Lingala, Gunakanapalle, Chinnakuddala, Ippatla, villages are present within structural hills and structural valleys. Quartzites of Gulcheru formation and Pulivendla formation are making structural hills and Vempalli dolomites and Tadipatri shales are forming the structural valleys. In Pendlimarri mandal geomorphology is classified as denudational hills, structural hills,Pedipalains, and Residual hills (Fig-3). Denudational hills and pediplains are present in Chabali, Machanuru, Thummaluru, Chinnadasaripalle, Pagadalapalle, and Nandimandalam villages. Residual hills are seen in Nandimandalam Village (Fig-3).

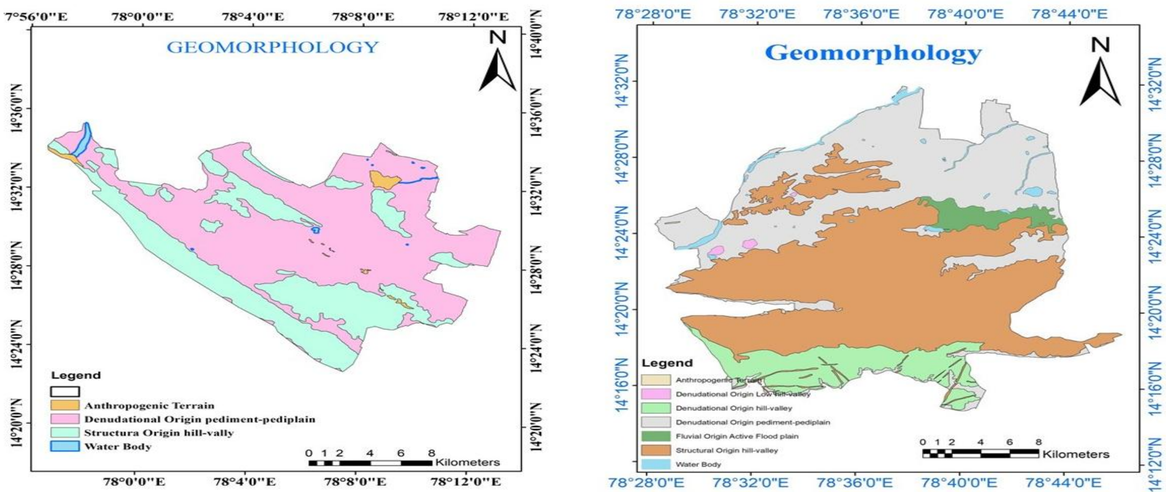

Fig. 3 Geomorphology

C. Lineaments

Lineaments like joints, cracks, and blames are topographically significant and might be the technique ways for mineral investigation and groundwater development (Sankar, 2002). Proximity of lineaments may go about as water path for ground water development which results in expanded auxiliary porosity and consequently, can fill in as mineral and groundwater approaching zone (Obi Reddy et al., 2000). Lineaments make available some insight into development and capacity of groundwater (Erhan Sener et al., 2005) and in this method is significant aide for groundwater exploration. As of late, numerous groundwater investigation ventures were effectively done by lineament mapping (Teeuw, 1995). Lineaments are enormous scale direct highlights which communicates it as far as geography which is a declaration of the fundamental topography. From the beginning perspective such highlights incorporates valleys constrained by collapsing, blaming, and jointing, slope as these straight highlights are normally connected with separation and distortion. They give the pathways to mineral and groundwater developments (Ravindran et al., 1995).

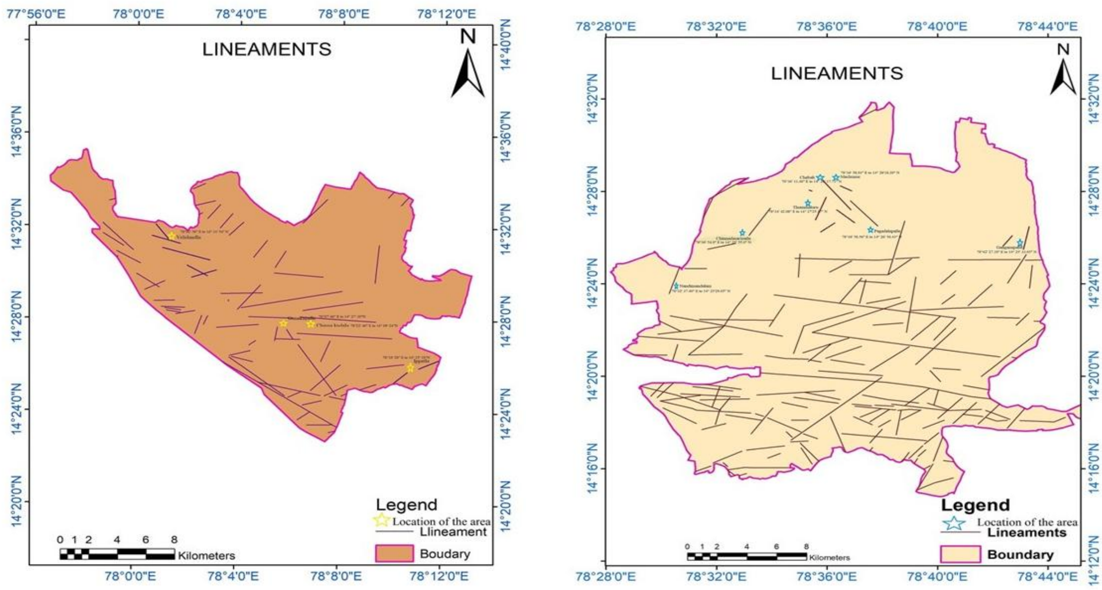

Fig. 4 Lineaments

Linearity's are considerable in rocks where optional penetrability and porosity rule the inter granular character and these auxiliary openings impact stable, ground water developments. The break zones frames an entangled system of high transmissivity and goes about as ground water resourses in enormous in rock mass cracked zones. In the satellite photograph distinguishing proof of lineaments/direct highlights unquoted effectively because of the concise view, accessibility of information in various different groups and receptivity. Lineaments of difficult to reach territories can be mapped on a satellite image; the lineaments can be effectively distinguished by visual explanation (Ganesh Raj, 1994). Dykes and edges like wise show up as direct information which can be corrected by reconciliation of ground consider. Optional porosity is bestowed by joints and breaks in the territories of upper lineament thickness. The accomplished utilization of surface, example, and affiliation, further checked by field examines number of mega and smaller scale lineaments are distinguished from the satellite symbolism (Gupta, 2003) and divided at a 1: 50,000 map scale (Fig. 4).

D. Lineament Density

The line or lineament around in the study area has changingextent. Based on the application and extent of lineaments, a lineament density map is prepared. Lineaments delineate using satellite images were improved into zones of different lineament densities, viz., high, moderate, and low to zero using spatial density analysis in the GIS domain (Fig. 5).

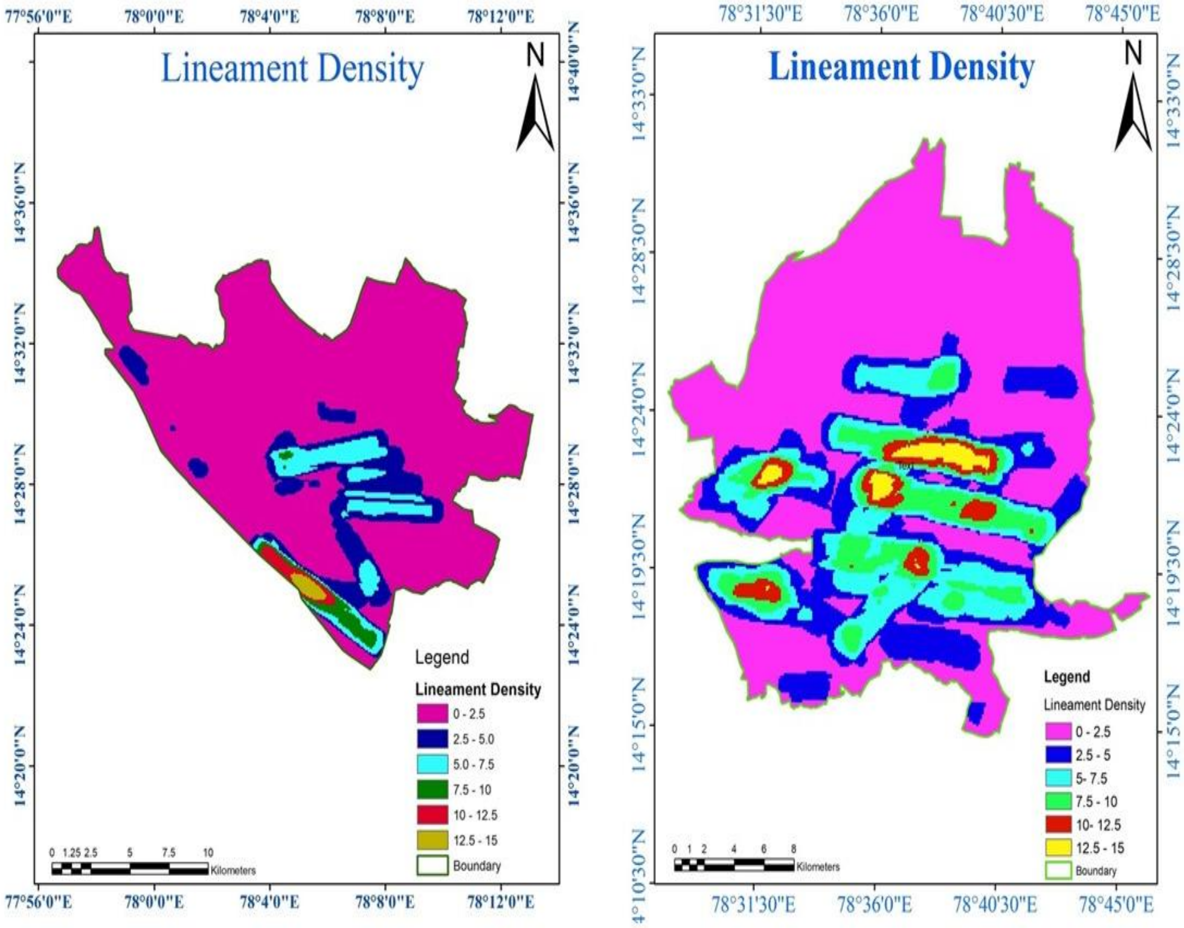

Fig. 5 Lineament density

The line-density map reveals the potential for obtaining groundwater in the basin. According to (Mabee Stephen et al., 1994), from a study of the regional scales analysis for fractured bedrock aquifers concluded that of wells located on or near fracture-related lines. Higher porosity and hydraulic conductivity zones are associated with lineaments (Subba Rao 1999, Prathap Reddy 1999 andKukillaya et al). Generally, it is expected that the thickness of weathered zone has a control on the availability of groundwater. Lineaments have been recognized from the groundwater prospecting point of view.

Lineament thickness might be characterized as the summed length of lineaments inside a specific unit region of the pattern (Karcz et.al, 1978). Quantitative preamble and understanding of lineament disseminations, particularly in connection to mineral provisions, can be proficient by first processing the lineament densities at network interims over the investigation zone and along these lines showing the information as a lineament map. Such a guide could be contrasted and the accessible mineral guide of the territory to see whether any parallel exists between recognizable patterns and known mineral stores, and to figure on the potential regions of scan for new mineral stores. This technique has been connected to additionally examine and decipher the lineament map appeared (figure 4). The summed length of the lineaments was isolated by the investigation region to get a lineament thickness map. The mineral events can be acquired by the assessment of the present maps with past lineament appropriations maps of a best territory, arranged from Landsat imagery. A comparative appear at the lineament thickness map (Fig.5) and the lithological map (Fig.2) uncovered some amazing relationship between the territories of high lineament densities and the regions of known essential mineral events. The zones of high mineral densities spread pieces of the examination territory. These are where real minerals, for example, dolomite, magnetite, hematite, barytes, asbestos, lime stone, steatite, and soapstone. Are either being mined at present or are recommended by observation land and geomorphological work. They likewise fall along the South-West North - West Kadapa.

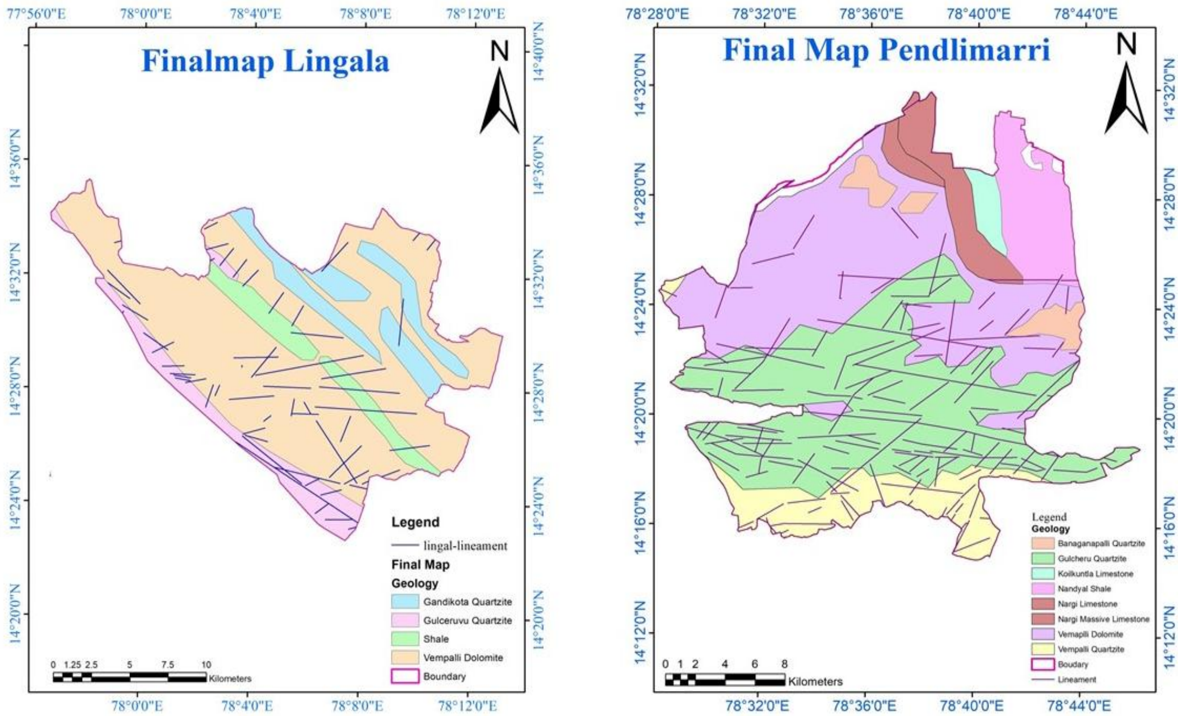

Fig. 6. Finalization map

V. CONCLUSION

The study has verified the importance of lineament mapping to estimate the mineralization and provincial groundwater potential zones in a natural basement terrain by concerning the combination of remote sensing and GIS techniques. The combination of thematic maps of geology, geomorphology, structural and GIS analysis of lineament density yield groundwater potential zones and mineralized zones in the study region. The results of the analyzed lineament/fracture indicated that the area has alteredmega and microfractures whose structural trends are mostly in the north-south and east-west directions.

The cross-cutting lineaments are comparatively high in areas around the central, north-eastern, and south-western parts of the study area, but comparatively low in the other areas. The zones of high lineament connectionthickness are possible zones for groundwater prospecting in the study region and hence, it is evident that the detailed lineament mapping for quantitative evaluation of mineralized zones and possible groundwater zones is highly preferable. The areas of high mineral density where major minerals such as dolomite, hematite, magnetite, barytes, asbestos, lime stone, steatite and soap stone are either being mined at present or recommended by exploration geological and geomorphological work. They also fall along the South-West North -West Kadapa.

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