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Advances in Applied Science Research, 2015, 6(12):76-84

ISSN: 0976-8610
CODEN (USA): AASRFC

Classification and specification of lineaments using gis and remote sensing techniques for western Cauvery delta, Thanjavur and Thiruvarur districts, Tamil Nadu, India

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ABSTRACT

Detailed geological structure study of western Cauvery delta in Thanjavur and Thiruvarur district induced new idea about different types, classification and specification of Lineaments. In delta region, generally rift causes development of much subsequent fracture system. This fracture system has identified through geo information techniques and classified as Micro and Macro level lineaments based on their length, orientation, Azimuth principle and arrangement of vegetation. Lineament study is used to identify past tectonic trends and seismic risk assessment also lineament classification map much useful for Earth quake resistant design engineers and it is differ from seismicity map. For this study GIS and Remote Sensing techniques contribute major role and IRS PS LISS IV satellite image has used.

Key words: Azimuth, IRS P6 LISS IV, Lineaments, GIS, Remote Sensing and Tectonic.

INTRODUCTION

The study of lineaments has its origin in Great Britain where systematic mapping of fractures were performed in the beginning of the 19th century. In 1903 Hobbs introduced the term Lineament in his basic work “lineaments of the Atlantic border regions”. He described Lineaments as “significant lines in the Earth’s face and stated that the more important lineaments as: crests of ridges or boundaries of elevated areas, drainage lines, coast lines and boundaries of geological formation of petro graphic type or line of outcrops. In 1911 Hobbs reinterpreted for instance Kjerulfs observations from 1880 and in1912 wrote “significant lines in the landscape which reveal the hidden architecture (Sven Tiren 2010). The regional extent of lineaments was also emphasized by, e.g., Hills (1972), Hobbs et al. (1976) and Ramsay and Huber (1987). Some of the authors classified the lineaments based on their performance (wheeler, 1983) in which lineaments with the strongest expression i.e. width, length and image contrast are classified as most predominant. Based on the inferred hydrological function in 1990, waters have classified the lineaments. Classification of lineaments is further complicated by the variation of hydrological properties along their length (wise, 1983), linear feature are formed in many way (Drury, 1993, lineament parameters such as position, Length, Azimuth and Class (per sander, 1997) and some of idea on this concept were provided by sander.Neo-tectonic movements traced by drainage and sediment logical patterns and displacement strata mapped as linear feature (Barbara Theiler, 2009). Lineaments has modified by ground water flow in delta basin (Ramasamy SM, 2006). Study area mainly occupied by undissected Mio-Pliocene and mio-pliocene sediments, exhibiting fragmentation of the sandstone in to small buttes and minor fractures (Ramasamy SM, 2006). It is intra Cratonic rift basin types.

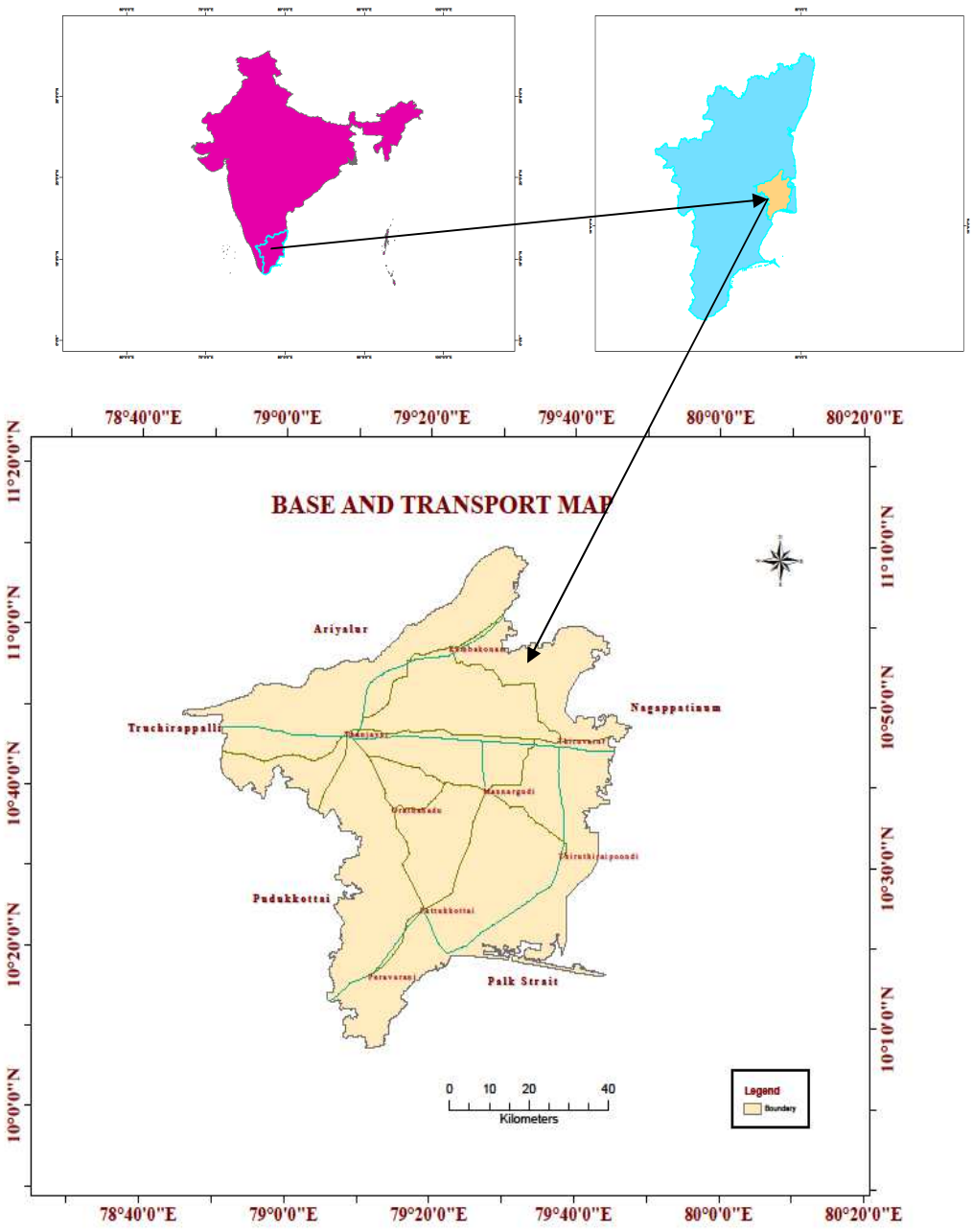

Fig : 1 Key map –Base and Transport Map

The initial rifting cause the formation of NE-SW horst-Graben features. Subsequent drifting and rotation caused the development of NW-SE cross faults (Subramanian, Dec-2012). North directed greatest principal stress/compressive force which were responsible for the movement of the Indian plate towards north (Ramasamy SM, 1995).Geological structures will be extracted from various advance sources such as satellite image and vertical aerial photographs. Satellite image produce better information then conventional aerial photographs (Lillesand and keifer, 1999). Present investigation is direction, position and length of lineaments is identified from IRS P6 LISS IV satellite image and plotted classification and specification of lineament map with help of Arc MAP 10.1 for study area. Using SPT sampling techniques soil sample has collected from this site for ground truth. The collected soil sample has tested with help of the geo-technical investigation for further studies.

1.2. Study Area.

The study area named as western Cauvery delta covers with 5902 sq km (Fig.1) with 24 blocks and mainly covered with agriculture region. It is bounded by 78°45'30''E - 10° 07'40'' N to 79°49'20''E - 11° 06'20'' N and it covers 15 Survey of India top sheet number is 58 J13,J14,N1, N2,N3,N4,N5,N6,N7,N8,N9,N10,N11,M8,and M12.The districts are well connected with well conditioned paved roads as well as with Railway track (Fig 1). Western Cauvery basin covered Nagapatinum in eastern side, Palk Strait in south side, Pudukkotai and trichirappalli district in western side and Ariyalur district in North side. Relief of the terrain is increased from east to west side and the maximum elevation observed about 73.22 m (GPS data) on vallam upland. Entire Cauvery basin indicates typical fan shaped delta having with lots of drainage with various drainage orders. The major distributaries are Cauvery and GA Canal. Humid and tropical climate occurs and 33.3º in April and 22.5º in January of the year.

1.3 Geology of the study area.

Cauvery basin begin with Rejuvenation of rifting and evolution of delta basin distinct three stages, a. Late Jurassic – Early cretaceous rift stage, b. Late cretaceous and c. Post cretaceous. Western Cauvery basin is occupied with Hornblend-biotite gneiss age of recent to late Pleistocene in west side, sandstone with clay covered in south western part. North and east part of study area fully occupied with fluvial landforms. South side fluvial-marine geology overlain by marine (Fig.2). Archean rocks are exposure in very little as well as basement having crystalline rocks in west part of the study area.

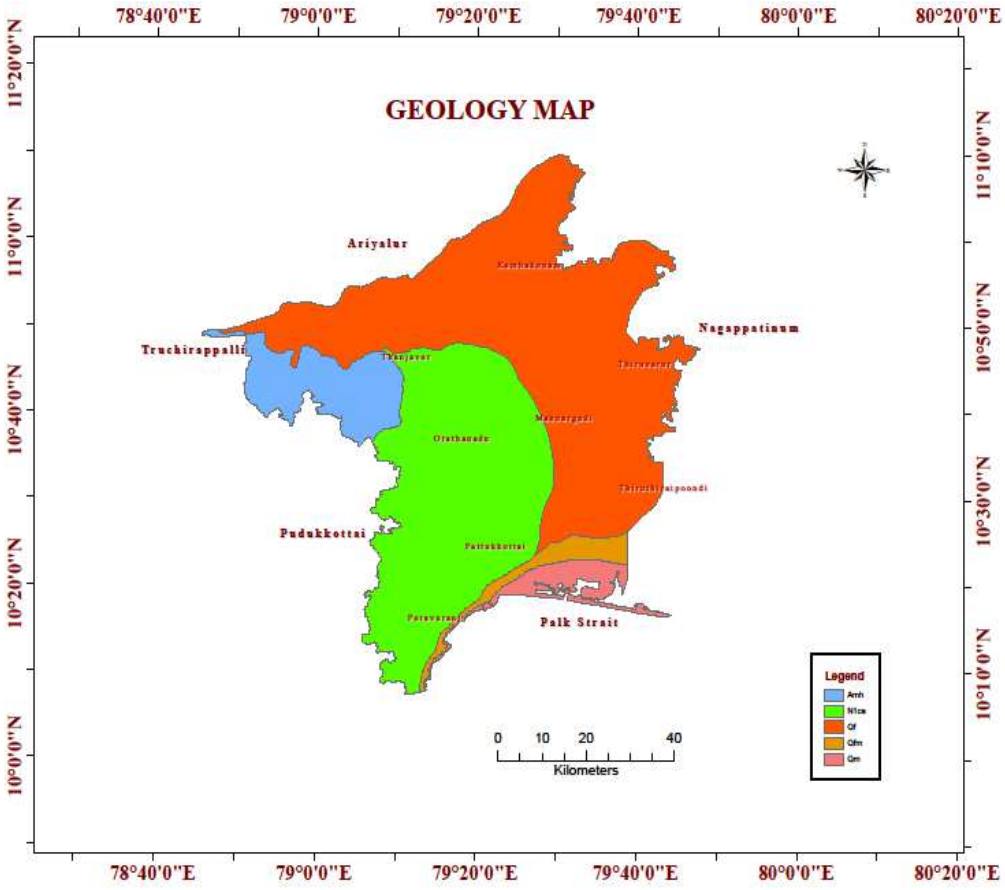

Fig: 2 - Geology map

MATERIALS AND METHODS

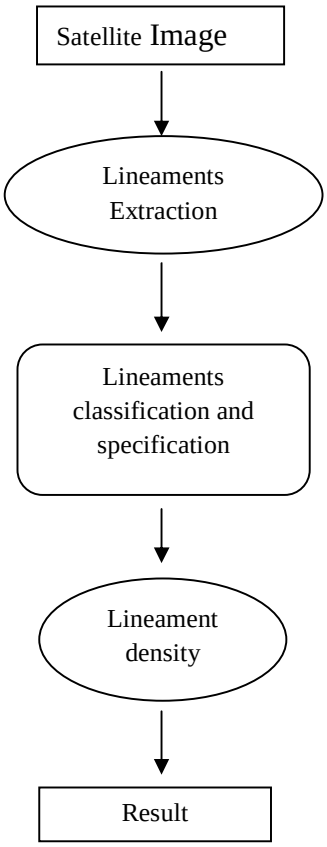

Fig: 3- Methodology Flow chart

The lineaments are interpreted IRS P6 LISS IV image on scale of 1; 50,000. Lineaments are extracted based on arrangement of vegetation, river course straightness and plane of weakness and interpreted lineaments are classified based on their length.

RESULT AND DISCUSSION

Individually mapped and classified the Lineaments based on Length (Ganapathy G.P 2010), small shape and medium shape (Rukieh, 1996) in to two types as Macro level and Micro level from satellite image. Lineament may represent the plane of weakness (Yusuf.N 2011), linear structures, and arrangement of vegetation based on their length, orientation, and Azimuth principle.

Specification of Lineaments (Table: 1)

L Types	Co Ordinates		Length	Seg Brg	NLI	Direction
	Origin Point	End Point				
MAL1	10º56’51’’N 79º 15’15’’E	10º56’51’’N 79º15’15’’E	31.9	62 º18’ 03’’	7	NE - SW
MAL2	10º56’10’’N 79º 16’51’’E	11º01’28’’N 79º24’51’’E	25.7	360 º0’00’	1	NE - SW
MAL3	10º56’31’’N 79º 20’32’’E	10º55’48’’N 79º40’14’’E	35.9	92º05’32’’	5	E - W
MAL4	10º50’21’’N 78º 53’35’’E	10º53’48’’N 79º11’40’’E	33.7	78º58’05’’	3	NE - SW
MAL5	10º53’03’’N 79º 10’51’’E	10º53’05’’N 79º31’32’’E	37.8	87º39’12’’	9	E - W
MAL6	10º50’20’’N 79º 09’03’’E	10º48’40’’N 79º26’54’’E	32.41	95º15’07’’	5	E - W
MAL7	10º56’51’’N 79º 15’15’’E	10º56’51’’N 79º15’15’’E	36.4	79º15’15’’	5	NE - SW

The classified two types of lineaments patterns are oriented in NE – SW, E – W and NW - SE direction. Also SEG BRG and Total bearings are computed and tabulated using Glopper Mapper. The length of the lineaments various from 5 km to 70 km are calculated in the study area. Above 25 km length of lineaments are classified as Macro level (MAL) and less than this are classified as Micro levels (MIL). In this way around 31 segments are plotted as Macro levels lineaments (Fig.4) and 623 segments are identified as Micro lineaments levels (Fig.5). Total 654 lineaments are identified (Fig.6).

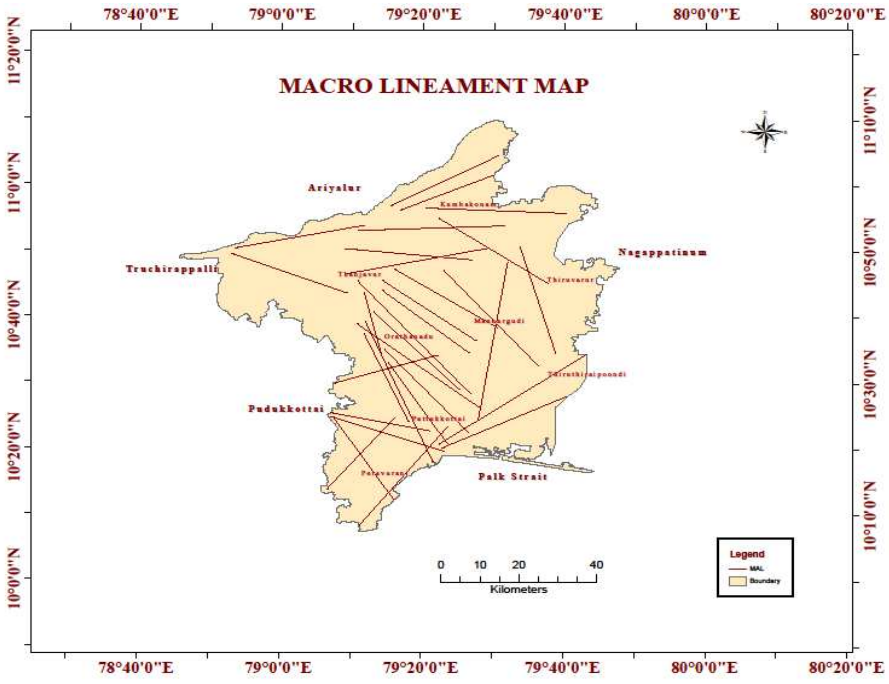

Fig: 4 Macro Lineament Map

Lineaments Density map generated for Macro level (Fig.7) and Micro level lineaments (Fig.8) using ARC Map 10.1. Macro level and Micro level lineaments shape file (MIL.Shape and MAL. Shape) are taken as input file for generation of density map and output cell size is optionally given as a value is 412.022415. The lineament layers are

classified in quantile method as five groups and color ramp range is selected for Micro and Macro lineament density is tabulated.

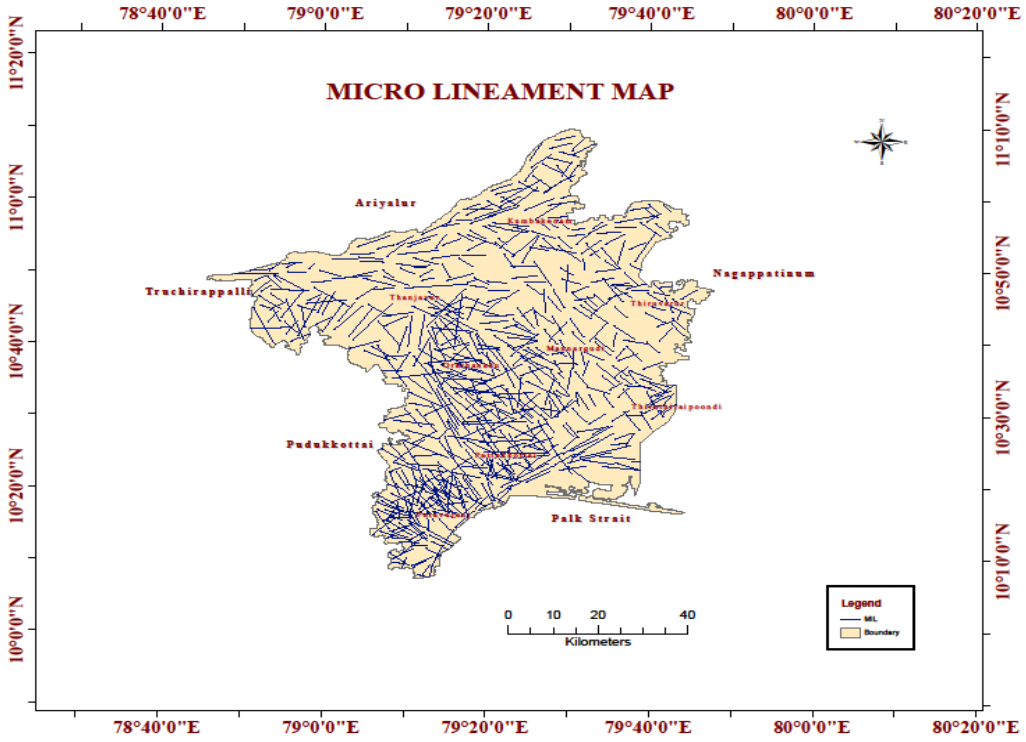

Fig: 5 Micro Lineament Map

South west and central part of western Cauvery delta, density and frequency of lineaments are distributed in high range also intersection of lineaments is very high.

Classified Lineament density value(Table: 2)

S.No	MIL Density Value		MAL Density Value	
	From	To	From	To
1	0		0	
2	0	0.3029643	0	0.151466
3	0.30296432	0.4796935	0.1514659	0.201954
4	0.47969351	0.7321638	0.2019545	0.306298
5	0.73216378	2.1459973	0.3062976	0.858307

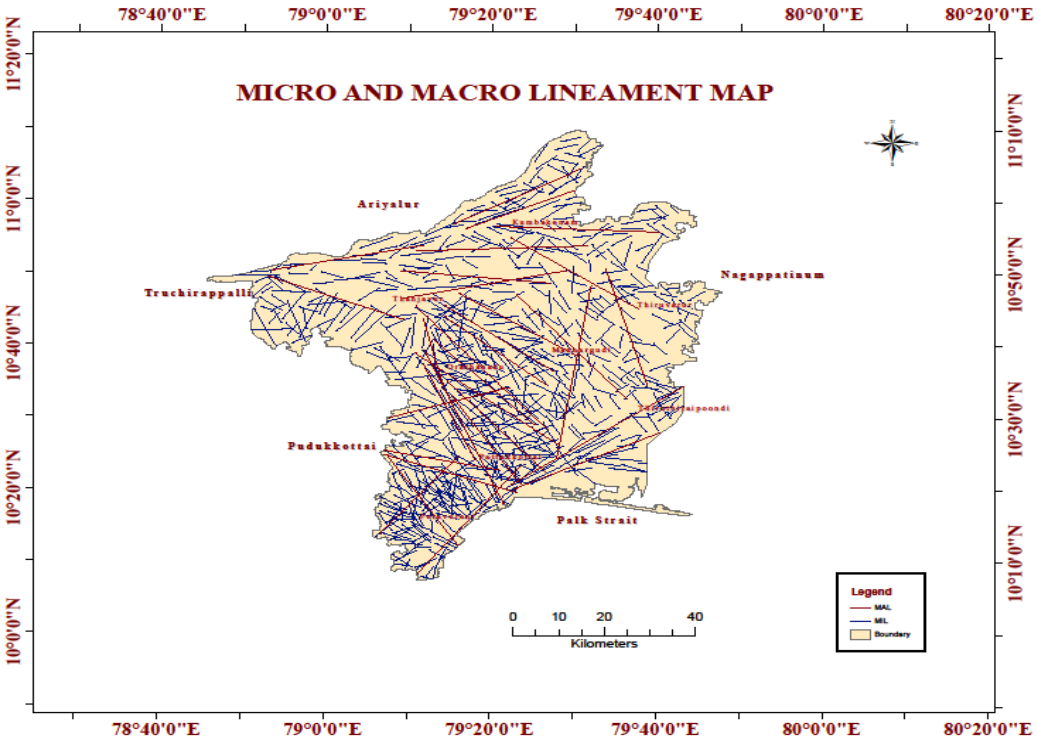

Fig: 6 Micro and Macro Lineaments

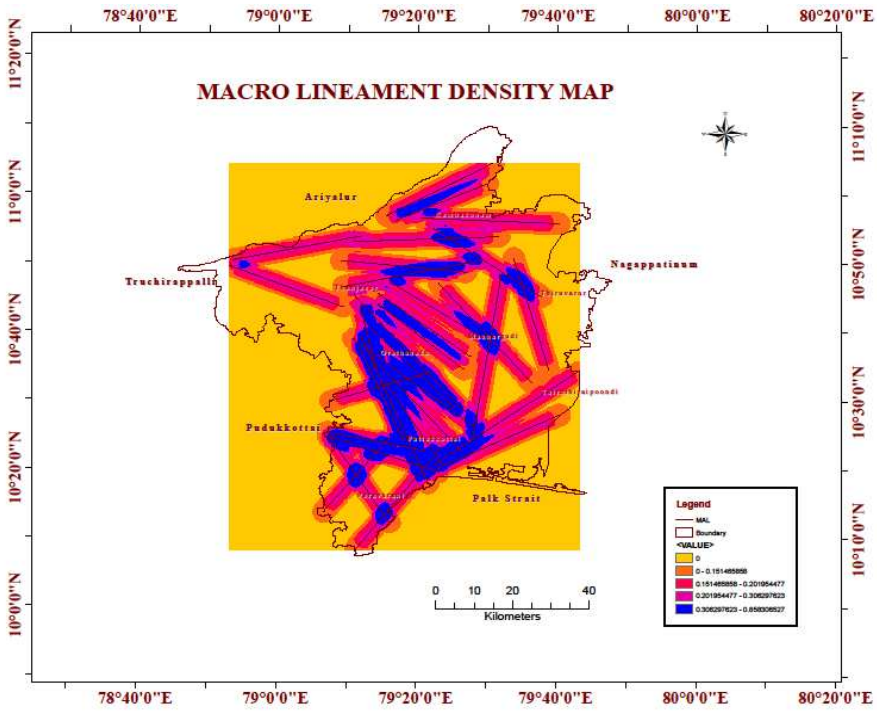

Fig: 7 MAL Density Map

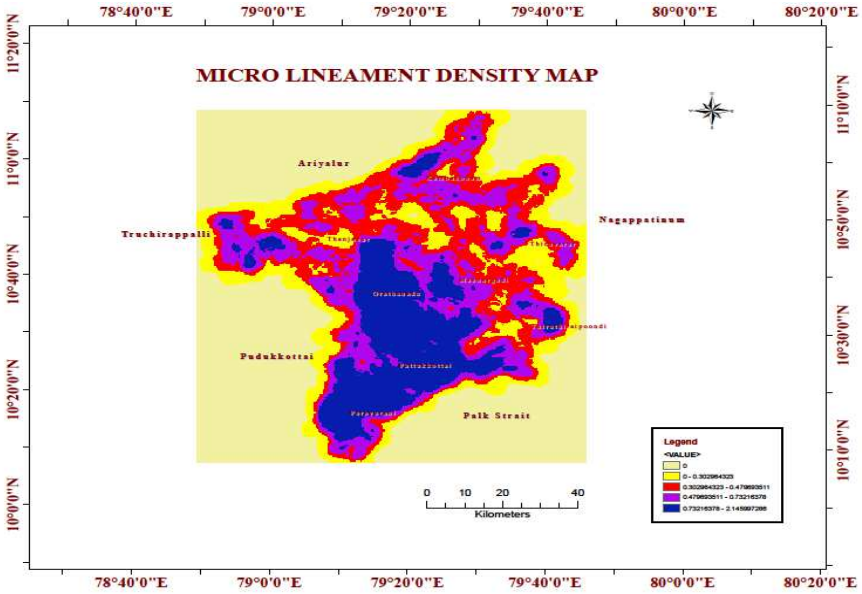

Fig: 8 MIL Density Map

3.1 Specification of Lineaments.

Lineaments specification is explained based on the length, direction and orientation. The starting point and end point of lineaments co ordinate are observed also Seg Brg and Total bearing are measured.

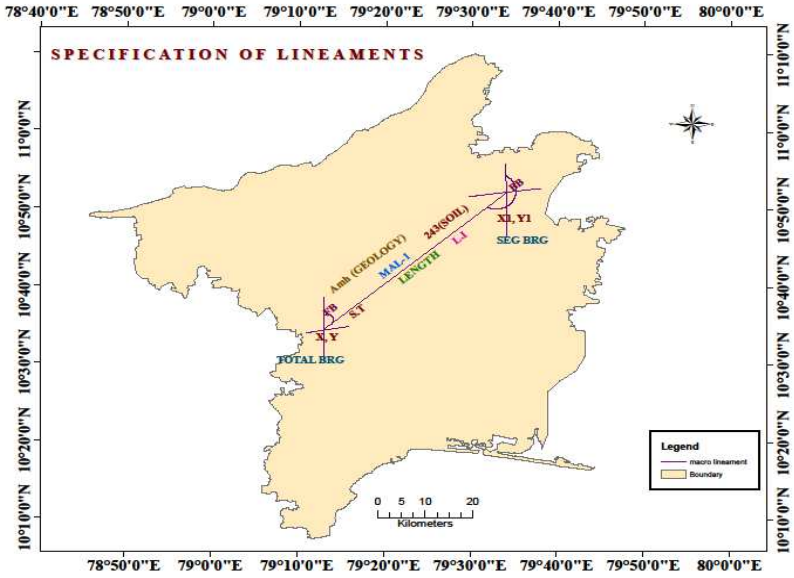

Fig: 9 Lineament Specification map

MAL – 1 – Macro Lineament, FB – Fore Bearing, BB – Back Bearing, S.T -Soil Types, L-Length,(X, Y)-Origin Point Co Ordinates,(X^1, Y^1)-End Point Co Ordinates, SEG BRG-Seg Bearing, LI-Lineament Intersection, Amh-Hornblende- biotite gneiss (Geology code), 253-Calcareous cracking Clay soils (Soil types).

CONCLUSION

Lineament classification and specification map based on their length is one of the important criteria for earth quake resistance design engineers and it is differ from seismicity map. Orientation and bearings are calculated by global

mapper and tabulated. Length of the each macro lineaments are measured and mapped. Most of the lineaments are oriented in NE – SW direction and some of lineaments are oriented E – W and NW – SE direction. Geo informatics techniques best adopted method to classify the different types of lineaments. From this finding of lineaments may understand about (1) classification of lineaments based on length and (2) specification of lineaments.

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