

COASTAL GEOMORPHOLOGY OF RAMANATHAPURAM DISTRICT, TAMIL NADU - A REMOTE SENSING PERSPECTIVE

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ABSTRACT

The present paper discusses the results of a geomorphological investigation carried out for the coastal areas of Ramanathapuram district, Tamil Nadu using high resolution satellite images. Geomorphological mapping has led into the detection of peculiar landforms such as abandoned channels, deltaic lobes, inter lobe depressions and, beach ridges. The critical analyses of the same have indicated that the coastal areas of Ramanathapuram district have had a very dynamic evolution during the Quaternary period and that neotectonism seems to have played a significant role in the evolution and also in providing the present day configuration to this part of the Tamil Nadu coast.

Keywords Tamil Nadu, India, Ramanathapuram, Geology, Geomorphology

Introduction

Coastal zones play a pivotal role in nation's economy by virtue of the available natural resources, productive habitats and rich biodiversity. Currently, coastal zones are assuming greater importance owing to higher concentration of population, rapid urbanization and accelerated industrial development. But, at the same time, coastal areas possess very fragile environment and unique landforms formed by the interactions of fluvial, fluvio-marine, aeolian and marine geomorphic processes. The rapid developmental activities that are taking place in the coastal zones have already created several ecological problems such as saltwater intrusion, beach erosion and land subsidence, and they have adversely affected the fragile coastal environment. Hence, there is an urgent need to save the fragile coastal environment and carry out various developmental activities in a sustainable manner.

The coastal zones of Ramanathapuram district, Tamil Nadu are among the richest in the country in terms of biodiversity and highly sensitive with respect to the availability of various fragile ecosystems such as coral reefs; mudflats; salt flats and mangroves. Currently, these fragile ecosystems are being severely threatened by various anthropogenic activities and as a result require various ecofriendly management plans and programs. For framing effective management plans a detailed knowledge on the geomorphology of an area is very essential as landforms provide vital information, not only on the palaeo processes responsible for its formation, but also on the resource potential and environmental constraints of an area. Hence, in the present study it has been aimed to bring out detailed information on the geomorphic setup of the Ramanathapuram coast and therefrom infer the various ongoing dynamic processes and its control over the various environmental problems of the area.

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Study area

The study area (Fig. 1) is located in the southeastern part of Tamil Nadu coast in between $9^{\circ}05' - 9^{\circ}50'$ N latitudes and $78^{\circ}10' - 79^{\circ}27'$ E longitudes and covers an area of around 2213.72 sq. km. It is covered in the following Survey of India toposheets nos. 58 K/11, K/12, K/14, K/15, K/16, 58 O/3 and 58 O/4 on 1: 50,000 scale. The district has a coastline of 271 km, of which 141 km comes under Gulf of Mannar and the rest under the Palk Bay.

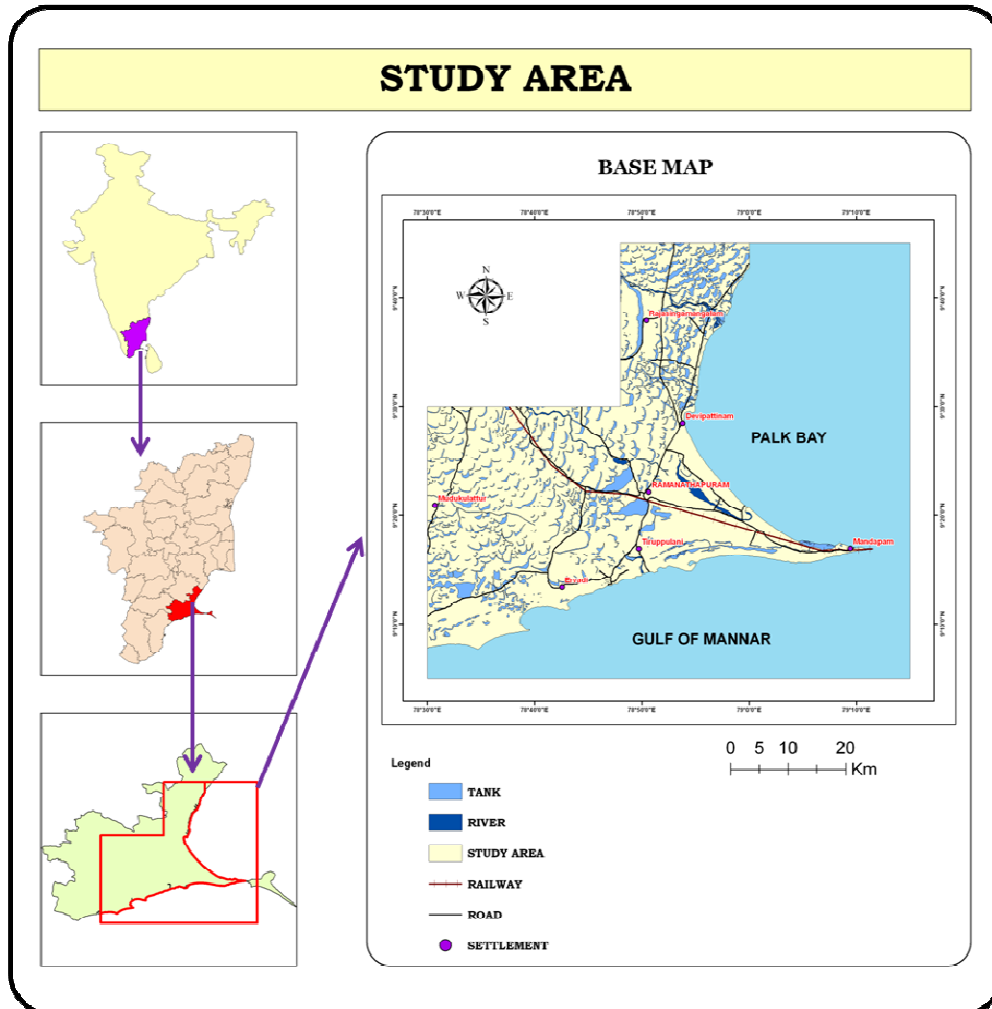


Fig.1 The Study Area

Aim and Objectives

The aim of the study is to infer the geomorphic evolution to the Ramanathapuram district coast; to identify the causative factors for the various environmental problems; and to suggest suitable remedial measures.

Materials and Methods

Initially, a base map was prepared using the Sol topographic sheets. Geology map (Fig.2) of the study area was prepared by using the available geology map of Tamil Nadu prepared by GSI. Subsequently, a geomorphology map (Fig.3) was prepared using IRS 1C LISS III satellite images through visual interpretation. For landform classification, the classification system proposed by the Space Application Centre (SAC), Govt. of India was adopted (SAC, 1991). To identify the lineaments and faults of the study area, a lineament map was initially prepared using the satellite images by studying the drainage pattern, vegetation alignment, soil tonal changes etc. and subsequently the same was also verified with the help of a shaded relief map. Using the GEBCO bathymetry data, a bathymetry map was prepared for the offshore regions of the study area and the same was used to construct the offshore profiles, for selected important locations. In addition, various collateral data were also used to bring out the pattern of geomorphic evolution and also to identify the environmental problems of the study area.

Results and Discussion

Regional Tectonic Set Up

The Pre-Cambrian terrain of Tamil Nadu is extensively fractured and deeply faulted particularly in the northern and central part of the state. The details of the major faults, shear zones and dislocation zones have been brought out by Vemban *et al.* (1977) based on available geological ground truth. These lineaments, shears and fracture zones of Tamil Nadu have been reactivated during the Quaternary period, as evidenced by the neo-tectonic activity, recurrent seismic activity and geothermal manifestations along these zones (Gopalakrishnan and Varadan 1996).

The coastal zone of Tamil Nadu has a series of block faulted pericratonic basins where the Phanerozoic sediments have been deposited. The basin architecture is of horst - graben type which includes several depressions separated by sub - surface basement ridges (Sastri *et al.* 1981). The study area is located in the southern end of the Cauvery basin. Mandapam - Delft ridge is the prominent ridge bounded by faults with large throws on either side. The horst extends southwestward across Pamban Island into the Gulf of Mannar, beyond 9^o south latitude. Thin Cretaceous sediments are present over the ridge in the off-shore area while a large thickness of sediment appears to have been removed by erosion from large part of the ridge. Mesozoic is completely absent in the onshore part of the ridge as known from drilling (ONGC, 1993).

Geology

Major part of the district is covered by fluvial, fluvio-marine, aeolian and marine sediments of Quaternary period. The Tertiary sandstone (Cuddalore Formation) comprises of pinkish, yellowish, reddish (variegated colours) medium to coarse grained sandstone and clay stone. It is overlain by thin alluvium and exposed towards north of Vaigai River (Fig.2).

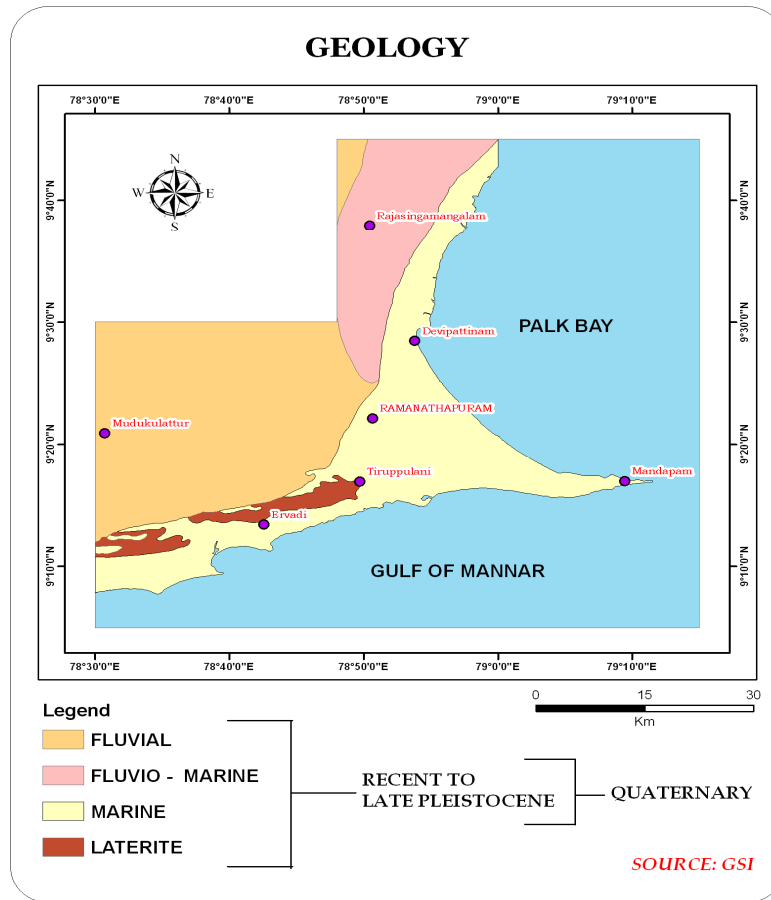


Fig.2. Geology of the Study Area

Geomorphology

The geomorphology study indicates that the sea has transgressed over the region two times first during inter glacial event (1,25,000 years BP) and the next during Middle Holocene event (6000 years BP). The two series of beach ridges - older and younger - denotes the formation of ridges during the two transgressive events. Banerjee (2000) has also recorded these late Pleistocene and Holocene transgressive events. These transgressive events played a major role in the evolution of coastal landforms and alluvial plains associate with the Vaigai river delta. These transgressive events have also induced the shifting of the Vaigai river course and there by facilitated the river to change the regime of sedimentation. The occurrence of palaeo deltas one in the north and the other in the south corroborates such changes in the regime of sedimentation. Thanikachalam (2003) while estimating the erosion and accretion along the coast of the region using Remote sensing and GIS technique has also observed the absence of sedimentation in the region.

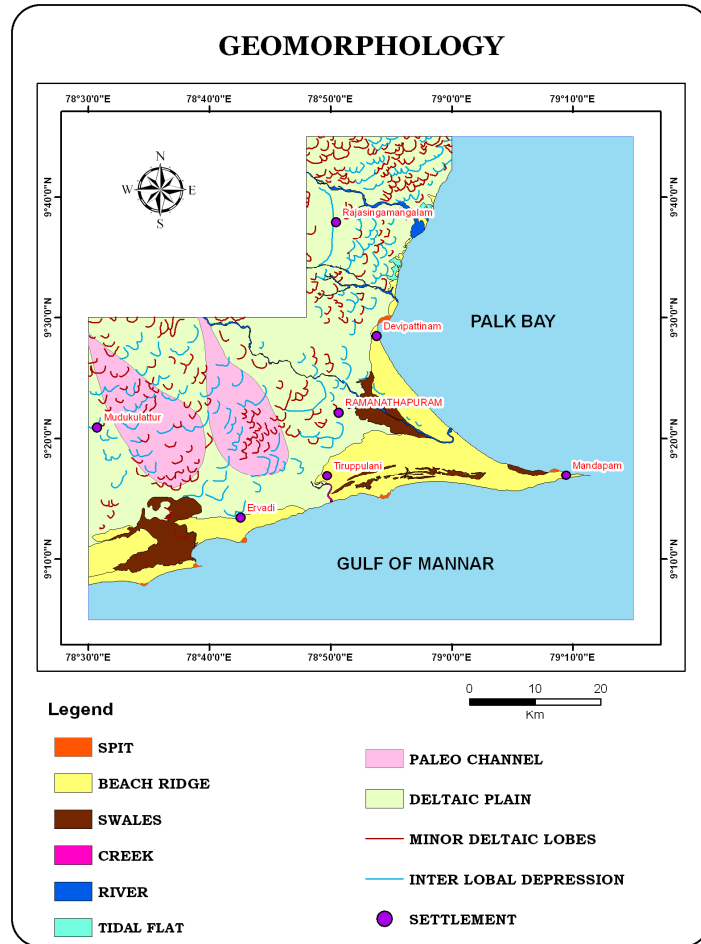


Fig.3 Geomorphology of the Study Area

Bathymetry

The GEBCO bathymetry data was used to determine the depth of the sea surrounding Ramanathapuram district (Fig.4).

Bathymetric Profiles

From the 3D visualization of the bathymetric data, the offshore profiles are drawn to elucidate the surface structures under the ocean. Six profiles were collected in the study area as shown in (Fig. 5).

Lineaments and Faults

In general, lineament can be defined as a long linear or curvilinear feature which formed by tectonic movements. According to Ramasamy (1987) lineament is defined as a long linear or curvilinear feature which are structurally or tectonically controlled.

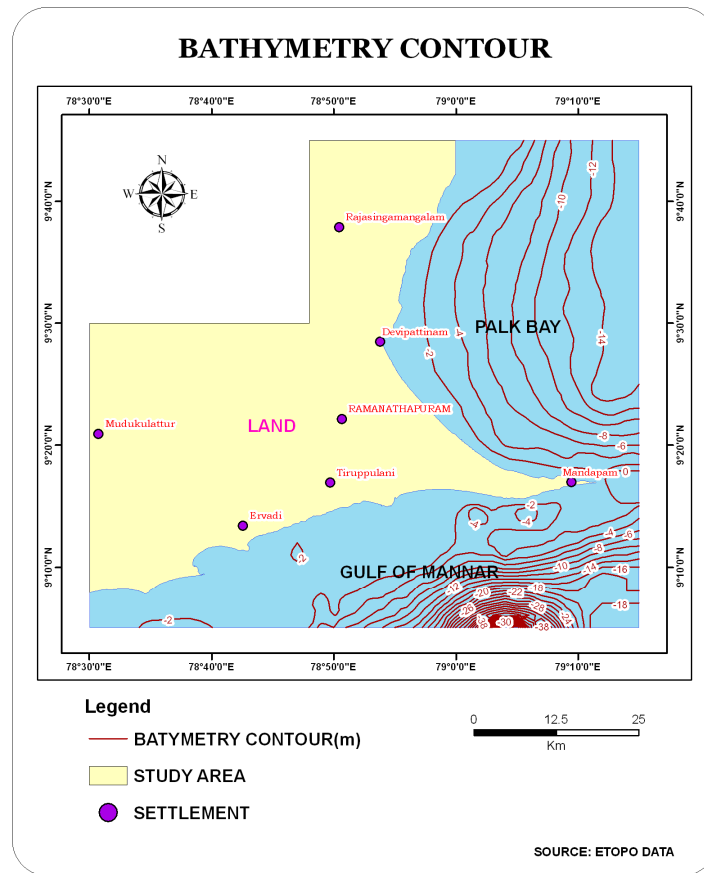


Fig. 4 Bathymetry Contour

The lineament were mapped by visual interpretation using IRS LISS III data, later the lineaments were updated by FCC imagery of Landsat ETM data and SRTM data (Fig. 6). The DEM of the study area was used for validation of the interpreted lineaments. The fault maps were deduced from the seismo tectonic atlas of India and added with the lineament map.

Summary and Conclusion

To understand the geomorphic evolution and other related environmental problems in Ramanathapuram district the present study was undertaken.

To generate the basic ideas of the terrain and also natural resources, various thematic maps (lineament map, land use land/cover map, geomorphology map, geology map, slope map, bathymetry contour map, off shore bathymetry profile, inundation map, sediment fill map, gravity map, gravity dem, aster dem, littoral current of pre North-East map, littoral current map of North-East) are prepared by duly analysed of the visual interpretation of the satellite data and collateral data the basic ideas and natural resources (river, palaeo channel, etc.,) are prepared.

The critical analyses of the geomorphology map have shown the existence of the numerous paleo channels and deltaic lobes, which indicate that this part of the coast had very dynamic geomorphic evolution.

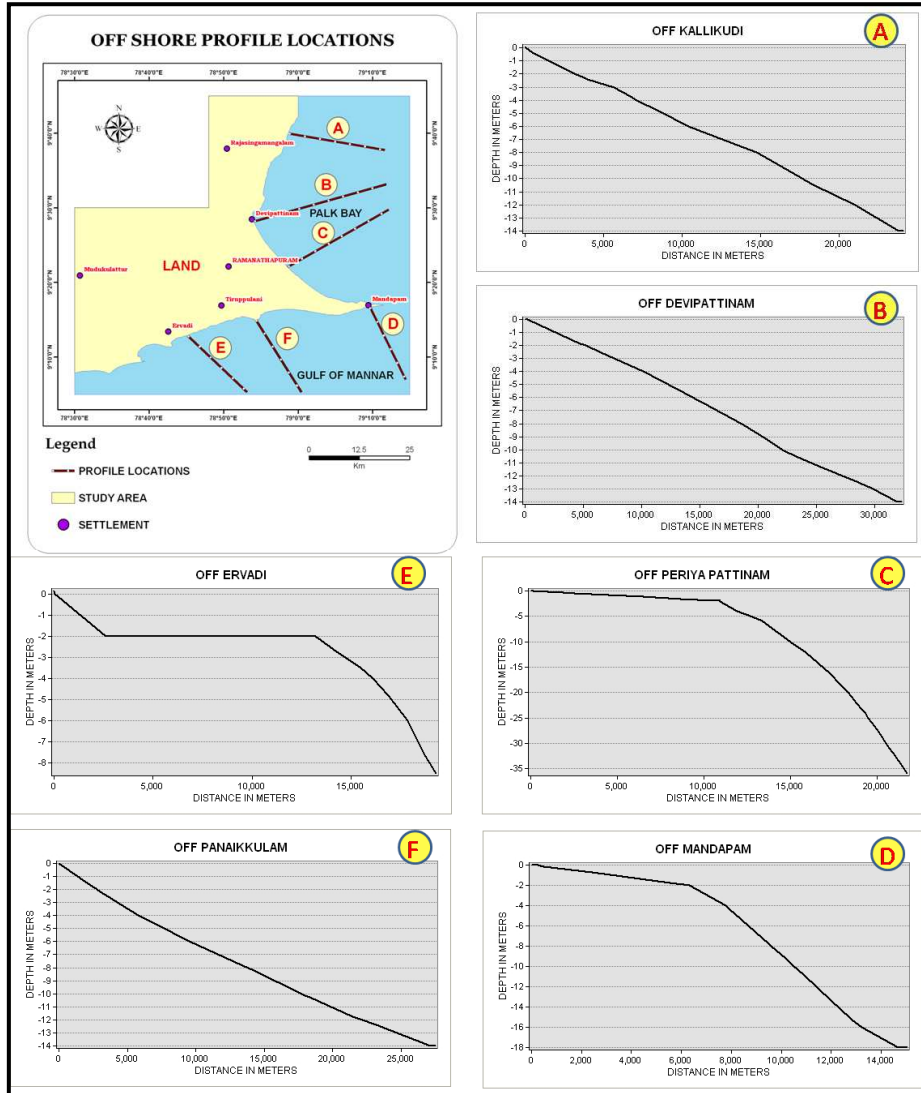


Fig. 5 Offshore Profile

The interlobal depressions which are present in thousands in entire Ramanathapuram district coast and are at present utilized for storage of rain water, indicates these interlobal depressions are originated due to gradual and systematic sea level fall that induced both eustatic sea level fall as well as due to ongoing tectonic movements (Neotectonism) in the study area.

Several earlier workers Ramasamy (1992), Ramasamy and Balaji (1995), Ramasamy and Ramesh (1999) have mentioned that these part of the coast area has been subjected

to upliftment due to the presence of East - West trending cymatogenic arch which trends from cochin in the west coast to Ramanathapuram in the east coast.

The bundles of beach ridges observed in the pro delta region of the Vaigai River indicate the dynamic sea level fall in this region.

Thus the varieties of environmental problems observed in the study area are preferential migration of rivers; and simultaneous cymatogenic arching and complementary deepening with E-W orientation arch which only played a major role in the geomorphic evolution and the present configuration in Ramanathapuram district coast in Tamil Nadu.

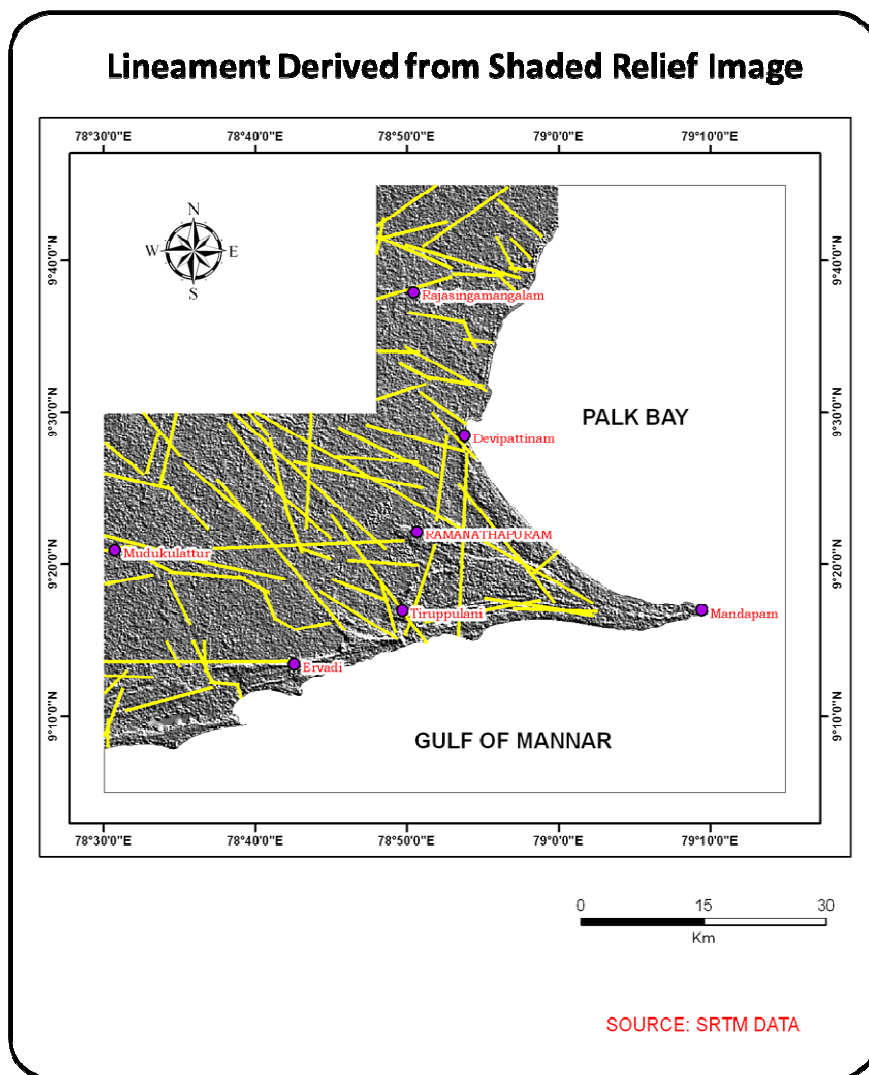


Fig.6 Lineament Derived from Shaded relief image

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