

## Study On Geology And Geomorphology

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**Abstract:** The greater part of the study area is covered with metamorphic crystalline rocks of Archaean age belonging to the Charnockite-Khondalite group. Overlying the Archaeans are the fossiliferous Upper Cretaceous formations mainly occurring around 10 km N.W of Vrindhachalam and between the Red hills of Pondicherry and the high ground of Tiruvakkarai. Overlying the Cretaceous rocks are the Cuddalore formations of MioPliocene age. These comprise sandstone of often-ferruginous pebble bed, sand and clay with lignite seams at places and silicified wood at other places. These in turn, are overlain by the rocks of the Coromandal formation of Holocene age occurring as long linear bands along the northeastern coast around Marakkanam. During sub recent to recent times, there has been the deposition of alluvium, coastal sands and lateritic soil.

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### Introduction

In spite of the frequent onslaught by the dynamically changing seasonal processes and frequent disaster like cyclone, the coastal regime still remains as an attractive piece of land on the terrestrial surface, owing to its ever moisture regimes, flourishing agricultural fields, highly charged natural resources and the ever enjoyable beach resorts. Hence, the coastal zone has become an interesting area warranting regular monitoring so that the population as well as the natural resources can be well protected. Of the total length of 7,500 km India's coastline, most of the regions are under sustained erosion and subjected to various changes. Different types of coastal landforms are being resulted from the action of variety of natural agents. These landforms speak indirectly the tale of their origin and the turbulences, they have undergone since their formation. In the coastal region of India, East coast is differing from West coast in the nature of geomorphic landforms and evolution. The East coast is indented with major river deltas like Ganges, Godavari, Bhramaputra, Cauvery, etc., whereas the West coast is characterized by the absence of river deltas. Moreover, East coast constitutes alluvial deposits and extensively developed beaches. On the contrary the West coastline shows highly irregular nature with cliffed pocket beaches and wave eroded beaches. Coastal regions have attracted researcher's attention due to the increasing and imminent threat of sea level rise and its possible implications (Ahmad, 1972).

The present landforms are expected to be the product of the process of deposition alone. Paleo-barriers and paleo-tidal flats form about 50% of the

coastal landforms of the study area. Paleo-barriers occur in discontinuous patches from Urani in the south and Marakkanam in the north, aligning almost parallel to the shore. They are enriched with the occurrence of silica sands (white sands), in Marakkanam area, they are overlain by 'Teri' (Teri in Tamil = Waste) sand dunes of aeolian origin. These paleo-barriers are underlain by flat, silty clay formations designated as 'paleo-tidal flats' (Anbarasu, 1994). The exposed paleo-tidal flat regions are being intensively used for cultivation. In this area, three lagoons namely, Kaliveli, Yedayantittu kaliveli and Mudaliyarkuppam lagoon are noticed (Baskaran et.al. 2004). As paleo-tidal flats and recent mudflats surround the lagoons, these flats serve as an area for the artificial panning of salt. It is an area of major production of salt next to Tuticorin in Tamilnadu. Two parallel beach ridges are found throughout the length of the coast. Near Marakkanam, beach ridges raised up to a height of 10 m are observed. Cuddalore sandstone uplands are found to occur in the north and northwest of Kaliveli lagoon, the uplands in the north is overlain by a gravel deposit that forms a high ground. The deltaic alluvial plain present in this area are the weathered and eroded materials of underlying sedimentary rocks, intermingling with those derived from minor ephemeral streams.

### Beach

This landform that occurs continuously throughout the total length of the study area ranging in width from 100m to 500m. The dominant wave actions with large amount of input of sediments derived through longshore littoral currents make the beaches as the most dynamic landforms of the study

area. The beach of Chinnakalpet near Kunimedu is famous for tourist interest.

### **Beach ridges and Swales**

Beach ridges are defined as linear sandy-shelly swash deposits with intervening sandy plain occurring parallel or sub-parallel to the shore formed by periodic wave impounding action (Short et. al., 1989). 42 Similar to beaches, beach ridges (two series) are also found to occur along the entire stretch of the coast of the study area. While the recent beach ridge occurring at berm is perfectly parallel to the shore, the older beach ridges (possibly of middle Holocene age) are slightly deviating towards southwest (Anbarasu 1994) The beach ridges of this area are slightly deviating from the shoreline configuration and they help in surmising the evolution of shoreline. Though the beach ridges form geomorphic indication for progradation, it is an area of retrogradation due to present transgression and these beach ridges were formed during the earlier regression, following the middle Holocene transgression maximum. Swales are narrow linear depressions with clay and silty clay deposits occurring between the beach ridges. Swales have been converted into narrow linear backwaters and lagoons.

### **Paleo-barriers and Paleo-tidal flats**

The barriers that were developed in front of the embayed coast during last interglacial transgression are well-preserved inland from 1 to 2 km away from the present shore. They are designated here as paleobarriers. The occurrence of this Paleo - barrier is observed in detached patches between Urani and Mudaliyarkuppam, which are underlain by paleo-tidal flats. The height of these paleo-barriers is just 1 to 2 m from the 43 adjoining paleo-tidal flats and they extend up to a width of 1.5 - 2 km with a flat surface. Another distinguishing character is its grain size, which is ranging from fine sands to pebble while the beach ridges composed of fine to medium sand. The paleo-barriers occurring between Urani and Mudaliyarkuppam contain a unique concentration of white sands in two layers with intervening lagoonal clay. The mudflats were developed during last interglacial and Holocene transgression are designated here as paleo-tidal flats. The area between Urani and Mudaliyarkuppam exhibits well-preserved paleo-tidal flats. They are found to occur underlying the paleo-barriers, but as they are wider than the paleo-barrier, the exposures are found encircling the paleo-barrier at 1 or 2 m below the surface. They have a width in the E-W direction up to 4 km and a length in the N-S direction up to 30 km. These paleo-tidal flats are being actively utilized for the cultivation of wet crops. Surprisingly, cultivation is done in this area mainly

using the natural irrigation from small surficial ponds, which gets water through seepage from the adjoining paleo-barriers. Since the paleo-barriers are made up of unconsolidated white sands, the rain water percolating through them seeps at the periphery and gets stored in the surficial ponds constructed on mud flat which does not permit water to percolate downward.

### **Abandoned River Channels**

Abandoned river channels are stream channels that have been abandoned by cut off process i.e. abandoning only meandering loop or by avulsion i.e. the sudden abandonment of a part or the whole of a channel course (Reineck and Singh, 1986). Generally cut-off processes are associated with sedimentation and sea-level oscillations and avulsion is associated, either with tectonism when the sudden abandonment of whole of a channel course or with the filling up the channel due to extreme increase in the rate of sedimentation and reduction in depth. Abandoned channels of Gingear by avulsion processes are noticed. Three abandoned channels are observed in the north of the present river course indicating the southerly migration of the river. The mouth of the northernmost abandoned channel is found to occur at southeastern corner of the Kaliveli lagoon. The second abandoned channel, found to occur in the area west and south of Cuddalore sandstone upland, has its mouth just at Pondicherry town and the third avulsion channel, abandoned just a few centuries back has its mouth at Ariyankuppam which served as a Roman port in 17th century.

### **Mud flats**

Mud flat is a flat area containing a fluid to plastic mixture of finely divided particles of solid materials mainly silt, clay and water. They are always associated with the sheltered environment like lagoons, estuaries 45 and other embayment. The difference between the forms of sheltered environment and open coast are not of morphological changes, but of changes in sediments. Mud flat is observed in the study area around Marakkanam. The mud flat, occurring in these areas is of local nature extending up to 2 km E-W and up to 4 km N-S. The thickness of the clay and silt goes up to 5 m. The barrier beaches occurring in the seaward side of the backwaters create a sheltered environment, which has favoured the development of mud flat.

### **Cuddalore Sandstone Upland**

Cuddalore sandstone upland is a miopliocene formation found to occur in Marakkanam area. These Cuddalore sandstones develop uplands invariably with laterite capping. These uplands are formed due to differential erosion that results in the

occurrence of laterite capping which is more resistant to erosion than the adjoining formations. The height ranges from 10 – 15 m. The top of the upland is generally horizontal or gently sloping towards east.

#### **Gravel high land**

The highland with extraordinary concentration of gravels, pebbles, cobbles and shingles with coarse sand matrix in an unconsolidated manner located at about 3 km west of Marakkanam has been reported by 46 Anbarasu (1994) as gravel high land. The gravel high land is associated with laterites and underlain by Cuddalore sandstone. It is inferred that the removal of clay, silt and fine sand from the Cuddalore sandstone, by rain and wind actions has favoured the concentration of the remaining coarse sand to gravel fractions to form the gravel high land. The size of the materials is ranging from 2 mm to 15 cm. The blown up materials have been deposited over paleo-barriers in the east forming 'teri' sand dunes. The gravel high land extends up to 3 km in the E-W and up to 5 km in the N-S. The top surface encompassing 20 m contour is a flat to gently sloping terrain towards sea. It is bordered in the west by Archaean pediment high and in the east by Cuddalore sandstone uplands and Kaliveli lagoon.

#### **Teri sand dunes**

Teri sand dunes are dunes that have been formed by orange to red sands (Sanjeevi (1996)). They are observed only in the area around Marakkanam. They occur overlying the white sands of paleo-barriers. These teri sands contain minerals similar to other coastal dunes viz., quartz, plagioclase, sillimanite, zircon, garnet and other opaque minerals. The origin of similar Teri sands of Ramanathapuram area in the southern Tamilnadu is explained by two hypothesis viz., detrital and in situ. Foote (1883), Dowie (1940), Ahmed (1972) and Loveson (1994) support the detrital origin postulating that the sands in already reddened condition have been transported by wind action. Zeuner and Allchin (1956) and Gardner (1981), favouring the in situ origin, suggested the weathering in situ of garnet (almandine) has reddened the dunes. In the study area these 'teri' sands occur overlying the white sands with a sharp contact. If the reddening of dunes had been the result of in situ weathering the contact between 'teri' sands and white sands would have been gradational as the reddening process continues downward. The sharp contact between 'teri' sands and white sands is possible only when the 'teri' sands are deposited over white sands in already reddened condition.

#### **Lagoons and Tidal creeks**

Lagoon can be defined as a shallow body of seawater as a pond or lake, separated from the sea by barriers with a narrow inlet. The study area is characterized by numerous Late Quaternary lagoons generally confined on the west by range of features like deltaic plain, Cuddalore sandstone upland, Archaean pediment high etc., and on the sea ward by barriers. All these lagoons have been completely isolated from Bay of Bengal except with narrow openings in one or more places. The important lagoons are located at Kaliveli, Yedayantittu Kaliveli and Mudaliyarkuppam. All the lagoons are associated with mudflats. The geomorphic characters and sedimentary sequence indicate that all these lagoons have the expansion during quaternary transgressive phases and shrinking during subsequent regressive phases of the sea. Kaliveli exhibits the typical characters of expansion and shrinking. A relict lagoonal beach of Kaliveli is still observed in its western margin. The barriers developed during the expansion stage have been well preserved and are designated as paleo-barriers. These barriers are being commercially exploited for unique concentration of silica sands. The shrinking of the lagoons, since the close of the Holocene transgression, has also been aided by in filling of sediments. A peculiar relation is observed in the study area between lagoons and abandoned channels of rivers by locating channel fill deposits, it is found that they have their end points invariably at a lagoon indicating that these lagoons had served as places of river mouths in the past. For example, the abandoned channel of river Gingear at Ariyankuppam and at Kaliveli lagoon. Tidal creeks are inlets, through which water flows to and from a lagoon or other backwaters during high and low tides, respectively. Tidal creeks are found in Mudaliyarkuppam. The creeks occur in Mudaliyarkuppam are interconnected through backwaters and lagoons to a length of few kilometers. Similar to lagoons, the width of the tidal creeks also gets enlarged and reduced during high and low tides, respectively

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