Abstract

The study area extends from Sinurpet to Vanjure (10° 49' to 10° 59' N and 79° 49' to 79°51' E) along the coast of Karaikal along the East Coast of India. A study on its the geomorphology, sedimentology, geochemistry, light and heavy mineral contents have been conducted to find out the origin of the sediments.

This region consists of almost entirely coastal alluvial soil, which is highly valuable for the cultivation of paddy and pulses.

The landforms are represented by erosional and depositional processes like deltaic alluvial plain, beach, beach ridges, beach ridge plain, sand dunes, sand spit, paleo channel, deltaic plain, mudflats, river canal and lagoon. The soil of the study region is classified as black, ferruginous and arenaceous. They are again subdivided into clays, loam and sands. The main branches of Cauvery below Grand Anicut are the Kodamurutti, Arasalar, Virasolanar and the Vikramanar. Although Arasalar and its branches spread through Karaikal, the waters of Kodamurutti and Virasolanar also meet the irrigation needs of the region.

The level of humidity and the pattern of cloudiness and surface winds are the same as in Pondicherry. Although slight variations in the month wise occurrence of depressions and storms are noticeable, thunder-storms generally occur during April to November, particularly in April, September and October.

Geological formations of the study area are completely covered by a thick mantle of alluvium and no exposures are met with anywhere. The
following is the geological succession of the formations: Recent and Sub-recent ... Blown sands, alluvium, Pliocene ... Karaikal beds, Mio-Pliocene ... Cuddalore formations.

In order to understand the nature of Quaternary landforms, their depositional environment and associated heavy and light mineral assemblages, an assortment of studies like interpretation of geomorphic features from aerial photos and satellite imagery and sample collection from the beach environments were carried out. During the course of field work, different parameters like lithological, textural changes, nature of different tributaries, soil types and the post confirmation of different landforms, as inferred from field work, were taken into account.

From the geomorphology of the study area, it is found out that most of the landforms are aggradational. The landforms are oriented along the coastline with the formation of canal, back water body, abandoned river channels, tidal creek and four river namely Arasalar, Nandalar, Tirumalairajanar, Puravadairajanar. The economically viable Beach sand is deposited in front of the sea and act as a barrier to these Rivers. The overall geology suggests that the study area is made up of sedimentary deposits of age ranging from Mio-Pliocene to Recent. The presence of abandoned river channel of Arasalar River gives a clue for the transportation history of the beach sand deposits.

The samples collected from beach were sieved after pre-treatment, at Quarter phi interval for arriving at various textural parameters. Sieved fractions were separated into light and heavy fractions using bromoform separation technique. The separated heavies and lights were then, mounted in the medium of Canada balsam for further microscopical observations. Using
the distinct optical properties, the various heavy and light minerals were identified.

The grain size analysis throws up interesting results. The fine nature of beach sediments () indicates the deposition of recycled sediments of Mesozoic and Tertiary age inspite of the fresh discharge from Arasalar and Thirumalarajanar river. The entire beach sediments are dominated by fine sands indicating the role of Aeolian transportation. In contrast the dominance of medium to fine sediments in alluvium indicates the inundation of flood water in fluvial environment.

The frequency curves exhibit many samples unimodal to bimodal pattern and few samples shows polymodal pattern. These variations are accordance with the influence of different natural processes in that region. The samples of beach sediments show a uniform trend of well sorted nature barring a few exceptions. The analyzed samples indicate the presence of dominantly positive skewness, in other words it is predominantly fine skewed i.e. the tails are skewed better. The skewness directs the attention to the finer present in the tails. The prominent fine to coarse skewed nature suggests the probability of multi-source and multi-agent role.

Based on the bivariant plots of Mean Vs Standard deviation, Mean Vs Skewness, Mean Vs Kurtosis, Skewness Vs Standard deviation, Skewness vs kurtosis is the distinct separation of beach sediments. The CM pattern of the beach sediments are concentrates at PQ and QR segments. This illustrates the mode of deposition of sediments by means of graded suspension and rolling. The presence of graded suspension has been attributed to the major role played by the relief sediments. Here also the contribution of southern
oceanic sediments probably of Pleistocene to Holocene shelf sediments, relief nature may be mentioned. Here the samples show a clear scattering at PQ and QR segments, indicates a type of deposition by beach with fluvial influence.

The Visher diagram of the samples of the study area is characterized by traction, saltation and suspension population. Visher diagrams depict a wave shadow environment for the Northern sector, whereas the central sectors show double saltation populations characteristic of beaches, and the southern sector is characterized by a more truncated population characteristic of a plunge zone, which is a high energy environment.

In the study area the average heavy mineral assemblages are represented by Zircon (10.07 %), Garnet (10.80 %), Kyanite (3.02 %), Actinolite (3.00 %), Biotite (1.64 %), Chlorite (24.99 %), Epidote (8.91 %), Glauophane (0.66 %), Hornblende (0.47 %), Hyperstherne (0.86%), Muscovite (0.51 %), Rutile (1.77 %), Sillimanite (0.53 %), Staurolite (1.42 %), Topaz (2.70 %), Tourmaline (0.82 %), Tremolite (0.52 %) and opaque minerals has (27.33%). In these assemblages, few locations nearer to Akkaravatam which lies middle portion of the study area represent the typical granular minerals, having higher density. The result of grain size studies has also substantiated a higher energy condition for those areas. The suite of heavy mineral found in the Keezhayur region again reconfirms this inference. Hence, the present study is the heavy minerals assemblages by multi environmental conditions.

Geochemically, these beach sediments are characterized by moderate contents of SiO$_2$ (60.05 -82.93%, average 72.31 ± 6.57%) and Al$_2$O$_3$ (8.31–
16.89%, 12.42 ± 3.90%), and low contents of Fe$_2$O$_3$ (1.05– 9.15%, 4.15 ± 2.38), MnO (0.08 - 4.74%, 0.89 ±1.47), MgO (0.11– 5.99%, 2.30 ±1.58), Na$_2$O%, (0.40-8.80, 2.53 ±1.67), K$_2$O%, 0.04-2.36, 0.78 ± 0.54), TiO$_2$%, 0.00-0.98, 0.16 ± 1.71%) and P$_2$O$_5$% - 0.00-0.93, 0.14 ±) due to their high quartz contents and lesser mafic components. The low CaO contents (0.27 - 9.11%, 2.44 ± 1.97) indicate that all the samples have very low carbonate component other elements have no such a significant concentrations. All the other major elements spread very minor in all the locations of the study area. P$_2$O$_5$ an TiO$_2$ have very low value in all the samples Quartz diorite and granodiorite could be the source rocks for the beach sediments.

Trace elements is concerned the maximum of Sr- 9.915 ppm, followed by V-380.821 ppm, Cr – 121.223 ppm, Co-55.217 ppm, Ni-64.164 ppm, Cu-67.962 ppm, Zn-560.204 ppm, Ga- 18.607 ppm, Rb- 33.83 ppm, Sr- 406.419 ppm, Y- 205.429 ppm, Zr- 4481.836 ppm, Nb- 97.122 ppm, Cs- 0.482 ppm, Ba- 691.018 ppm.

The elements plotted against the concentration of REE shows very lower level of concentration in all the samples in the study area. LREE plotted against HREE shows very low concentration of HREE in the beach sand samples of the study area indicates the enrichment of LREE compared to HREE.

Geochemically, in the study area beach sediments are derived from Quartz diorite and granodiorite could be the source rocks.

The beach sand corresponds to the composition of Fe-sand, Litharenite and greywacke.
These studies reveal that the variation in geomorphology texture, mineralogy and geochemistry of the sediments are useful in characterizing the sediments in different environments and multi sources rocks.