GEOLOGICAL INTERPRETATION OF THANJAVUR DISTRICT, TAMIL NADU USING GEOGRAPHIC INFORMATION SYSTEM.

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Abstract
The present study is a plain topography. The district can be broadly divided into four geological zones viz. Mineral resources locally exploited are restricted to brick and tile clays, Kankar and salt, and Vallam gravels. The secondary informations are collected from geological survey of India. The Cuddalore Formation in general are capped by laterite and lateritic soil, which at places is quite thick as noticed south of Thanjavur up to Pattukkottai. The Marine Formation (East Coast Formation) comprises grey brown, medium to fine sands with occasional heavy mineral concentration for a stretch of about 4km between Agniar and Ambular river mouths along the Palk Bay. The northern part of Thanjavur and southern part of Pattukkottai are occupied by the Quaternary sediments of the Cauveri Delta and the Agniar river. The geological details are analyzed into GIS techniques.

Key words: Geology, Minerals, GIS, Thanjavur and Tamil Nadu.

INTRODUCTION
The study area is underlain by various geological formations ranging in age from the oldest Achaean to the recent alluvium. Most of the study area is covered by alluvium and sedimentary rocks. The general description of the various geological formations occurring in the district is briefed in the following paragraphs. In between, there are semi consolidated formations of Mesozoic and Tertiary ages. Detailed reviews about these rocks appear in the works on the upper cretaceous and lower Eocene rocks of India by Rama Rao (1940) the Jurassic formations of Kutch by Ranjith (1942), cretaceous rocks of south India, Rama Rao (1956), and some aspects of Dharwar geology by Pichamuthu (1947). The sedimentary section contains a number of transgressive and regressive episodes. The lithology varies from conglomerate, and sandstone. A general stratigraphy of the study area is marked.

Aims And Objectives
The aims are identified into the geological features and the main objectives are
1. To understand the general topography of the study area
2. To identified the geological features
3. To identified the mineral resources in the study area.

II. Study Area
Thanjavur district covers an area of 3,396.57 sq km. The area under investigation lies in between the Long. 78° 45’ 50” E to 79° 35’ 55” E and Lat. 10° 10’ 0” N to 11° 10’ 6” N. The study area has totally 14 SOI toposheets and the map scales’ of 1:50,000. Thanjavur district is a Rice bowl of Tamilnadu, and Rapid urbanization also developed. The district’s are devided into 8 taluks and 14 blocks. The district is bounded in the north by Tiruchirappalli, Perambalur and Ariyalur district in the north. Cuddalore district in the North East Tiruvarur and Nagapattinam district in the east, Palk Strait in the south and Pudukkottai, Tiruchirappalli district in the west. The terrain forms a part of the Cauvery delta. Except in the western part around Orathanadu and southern part of Pattukottai, the area represents monotonous plains of the Cauveri delta. The area around Orathanadu and South of Thanjavur town represents lateritic soil covered. The study area is well connected to transportation facilities and infrastructure facilities also. The location map of the study area is shown in fig.(1)
MATERIALS AND METHODS

The materials are collected into secondary sources of the information. The geological resources of the data’s are available into geological survey of India, Chennai. The maps are prepared by GIS techniques.

ANALYSIS

(i)Geology and Minerals

The district can be broadly divided into four geological zones viz. Mineral resources locally exploited are restricted to brick and tile clays, Kankan and salt, and Vallam gravels. Occurrences of Oil drilled by (ONGC 1993) and lignite (by MEC) are recorded in the area.

1)The western and southern zones from a laterite country. The latitites/laticritic soil occur at places over the crystalline rocks viz. migmatic gneisses (Archaean) and also sedimentary formations comprising fossil ferrous sandy calcareous clay and limestone of Upper Cretaceous age and gits, ferruginous sandstone and gravel of Mio-Pliocene age.

2)The fluviial deposits (flood plains) of Cauveri and Agniar rivers.

3)The fluvo-marine deltaic sediments.

4)The coastal sediments of marine/Aeolian regions fringing the Palk Strait. Granitic gneisses, migmatic gneisses are seen in the Grand Anicut canal section near Budalur Railway Station. Greyish black, medium to fine grained, compact, quartz magnetite rock is seen 30° w Thiruvengadamplai. west of Thanjavur town, trending NNW-SSE. Presence of granitic rock beneath the laterite was recored in well sections along Thanjavur-Trichchiappalli road on the high ground about 1.5km southwest of Tirumalaisamudram. Weathered Upper Cretaceous rocks represented by fossiliferous sandy calcareous rocks represented by fossiliferous sandy calcareous clay and limestone (equivalent of Sillakudi Formation. Ariyalur Group) are exposed below the black loamy soil near Kavirayarpatti in the Grand Anicut canal and under a bed of Kankan in a cutting near Munniyankulapatti.

Tertiary rocks (Cuddalore Formation) comprising gits, ferruginous sandstone, mottled sandstones capped by latitites and latitic soil are well exposed near Vallam. Intercalated pebbles bed consisting of rounded pebbles is seen amidst the gits and latitites in a quarry east of Vagraithirtham, south of Vallam. These beds are popularly known as “Vallam Gravels”. Stream section at the foot of the Vallam high ground exposes red, yellow ochereous and variegated clays. The rocks of Cuddalore Formation in general are capped by latitites and latitic soil, which at places is quite thick as noticed south of Thanjavur up to Pattukkottai.

The northern part of Thanjavur and southern part of Pattukkottai are occupied by the Quaternary sediments of the Cauveri Delta and the Agniar river. These sediments are fluviial (erosional and depositional) fluvo-marine and marine in origin. The thickness of the Quaternary sediments as inferred from the lithology of boreholes drilled by ONGC, CGWB and PWD at a number of places varies from 30 to 80m. However, towards Orattanadu and Pattukkottai the thickness is considerably reduced, varying from 5 to 7m only, occurring as a thin layer over the Cuddalore Formation. The borehole data clearly indicated the thickening of quaternary sediments from west to east. The fluviial deposits of the Cauveri and its distributaries, and Agniar river comprise sand, silt and clay admixtures.

The deltica plains (Nagappattinam Formation) comprise dark black clays, grey brown silt, sandy clays, clayey muds stretching between Murungapallam in the west to Maravakkadu in the east in a NE-SW direction for a stretch of 6km and a width of 2km with an intervelling high flat topped narrow linear mounds representing strand lines. This comprises grey brown sandy clay as seen as huge mounds (Teri-sand mounds). In the Agniar basin, prominent Chenier ridges representing strand lines with intervelling palaeo tidal flats are seen at Thiruvaipadi, Kalavirayal, Vichchur and north of Adirampattinam areas. The Marine Formation (East Coast Formation) comprises grey brown, medium to fine sands with occasional heavy mineral concentration for a stretch of about 4km between Agniar and Ambular river mouths along the Palk Bay.

The major portion of Thanjavur district is covered by Cauvery alluvium and reported to have potential for mineral wealth, Vallam stones, laterite sand stone, kankan and yellow ochre have been reported from the district quartz crystals rolled in to pebbles occur in the tertiary formation. Iron ore is found to exist in the neighborhood of Vallam – Vallam are in Thanjavur taluk and yield laterate of fine quality pebbles of transparent quartz occur in conglomeratic sandstones near vallam.

Kankan and tuffaceous lime stones occur under red soil laterite ranging in the thickness from 0.30 to 1.0m Kankan layers are also notices in stream sectors. The important occurrences are seen in the grand anicut canal cutting between kurvadiapatti and Budur and also in the neighborhood of Tirumalai samudrem. The kankan is 48.42% to 52.72% and low in magnesia.

(2) Geological Formations

Archaean Formation

Small exposures of Archaean rocks, also known as basement of crystalline rocks are seen in the western part of the area near Sengiappatti village. They consist mainly of gneisses, schists, granites and chamockites, intruded at places by pegmatite veins. The rocks are weathered mantle ranges in thickness between 10 and 12m. They exhibit well developed 2 directional joints. The general trend of Foliation of this formation is Northeast Southwest with steep easterly dip. In the sub-stratum in the delta of the district, the basement rocks were encountered only in the upstream in the delta of the district, the basement in the central part of the delta is estimated between 3000 and 4000 meters.

Cretaceous Formation

The cretaceous formation occurs in a narrow belt adjacent to the Archaean basement near Vallam. They overlie the faulted Archaean basement rock. They consist mainly of reddish and yellowish calcareous sandstone. The formation is deposited in marine environment and is fossiliferous. In aerial photographs, this formation is recognized by the presence of dentic drainage pattern rise to lighter tone.

(3)Tertiary Formation

Eocene

The Eocene formations do not crop out anywhere in the district. They are encountered in the bore holes drilled by the board and other agencies at depths of about 130m in the western part and at
about 450m in the central and eastern parts of the district. The formation included integrated beds of silts, clays, shale's, sandy clays and occasionally lime stones which were deposited in a wedge like structure with its thickest end towards the sea. In the western part of the district in the area around Oratha nadu and further north, these formations are more sandy in nature indicating fluvial to littoral condition of deposition. But towards the eastern part of the area, the formation becomes, much finer with increasing proportion of clay and clayey marls. The dip of these formations is 1°30' E and their overall thickness in the coastal region is more than 1800 meters.

**Miocene**

Exposures of the formation of Miocene age are found near west of Grand Anicut Canal in Thanjavur taluk overlying the older cretaceous formation. The formation consists mainly friable, variegated course (white, gray, and green) to fine- grained clay- bound sandstone with gravel. The thickness of these formations ranges from less than a meter in the west to about 600 m in the east.

On the basis of faunal evidences, the Miocene formation was classified into lower Miocene as the one unit, and upper and middle Miocene as the second unit. The second unit of upper and middle Miocene deposits consist clay-bound fine sands. There is no out crop of the second unit. Their thickness increases from West to East from 0 to 180 m.

The lower Miocene unit contains two distinct Zones namely the Burdigalain and the Aquitanian (the lower zone). The out crop of Aquitanian zone consists of the sandy and gravelly deposits typical of deltaic facies and a similar formation occur in the area west of line joining the Okkanadu-kilayur and Ottagadu. The Cauvery and Vennar sub-basins in the eastern part of the above area is mainly composed of clay and clay-bound sands. In the South eastern part of the district near Vedaranayam the deposits grade into coralline limestone. The thickness of Aquitanian deposits increases from 33m near Thanjavur in the west to about 120m along the coast where the deposits occur at depths varying from 420 to 540m below land surface. The out crop of the Burdigalain the upper zone, consist chiefly of sandy clays with minor intercalated lenses of the clay sand. The thickness of the Burdigalain deposits varies from about 30m in the west of the district to about 200 m in the coastal region to four meters in the west. It consists chiefly of sandy clays with minor intercalated lenses of the clayey sand.

**Pliocene**

The exposures of Pliocene exists in the whole of new delta area and a small area west of Grand Anicut canal covering whole of Pattuottai, Peravurani, Orathanadu. The main lithological units are sands, and sandy clay with gravel beds. They form a flat terrain marked by a net of wide, shallow and long depressions, which are the remnants of the old drainage. Most of the area is blanketed by reworked lateritic gravel which in turn, is overlain by the windblown grey sands.

These formations are underlines the quaternary deposits in the Cauvery and Vennar sub-basins. In the sub-stream, Pliocene is composed of sandy deposited with a major clay intercalation towards the east; it was deposited in fluvial and semi marine environments. The fluvial deposits occur beneath the Cauvery River and extend 10 to 15 km on either side of its present course. The semi-marine deposits occur in vennar sub-basin and partly non-delta dams covering Thiruthuraipoonadi Nagapattinam, Vedaranayam part of Muthupet and thickness of Pliocene deposits increase from 50m in the new delta area to above 75m along the coast in a depth ranging from 40 to 50m. The transition from Pliocene to quaternary in vennar sub basin is marked by red mottled clay down to depth of about 35m below ground surface.

**Quaternary Formation**

The formation of this group occupies the entire Cauvery sub-basin and almost the whole of Vennar sub-basin. They are fluval and semi-marine in origin. The fluval deposits consist of clean sands intercalated with brown and black clay deposits, partly confined the coarser deposit beneath. The semi-marine sandy clay deposits of the Vennar sub-basin are about 50m in thickness near the coast. Quaternary deposits are confined to the coastal area and flood plains of major rivers. The Quaternary sediments are expected to have been resulted from the erosive action of various natural agents like wind and river. The sediments consist of clay, silt and sand.

**Table. (1) General stratigraphy of the study area**

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Age</th>
<th>Stage</th>
<th>MorphoStratigraphic Unit</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caino Zoic</td>
<td>Quaternary</td>
<td>Recent</td>
<td>Alluvium and Laterites</td>
<td>Beach, Barrier dune, tidal flat, estuary, lagoon, strand plain</td>
<td>Soils, Alluvial Coastal and river sands, clays, kankar and laterites</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tertiary</td>
<td>Sand, clay and minor limestone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pudukkudi</td>
<td>Mud flat deposit, Cuddalore formation</td>
<td>Sand, sandstone, gravel with clay and limestone</td>
</tr>
<tr>
<td></td>
<td>Tertiary</td>
<td></td>
<td>Cuddalore Formati</td>
<td>Channel bar and bed load deposit, point bar deposit, Palaeo channel deposit</td>
<td></td>
</tr>
<tr>
<td>Miocene</td>
<td></td>
<td></td>
<td></td>
<td>Eocene</td>
<td>Sand, Silt sand clays</td>
</tr>
<tr>
<td>Meso Zoic</td>
<td>Cretaceous</td>
<td></td>
<td>Kuppa kkudi Formati</td>
<td>-</td>
<td>Calcaceous, sandstone, clays, silty marls and siltstones.</td>
</tr>
<tr>
<td>Archaean complex</td>
<td>Eastern Ghat</td>
<td>-</td>
<td>-</td>
<td>Gnassic complex and Horn blende Granities</td>
<td></td>
</tr>
</tbody>
</table>
The sedimentation has taken place under fluvial, fluvial-marine, and alluvial environments. As a result, typical deltaic and coastal landforms with distinct differences in composition, leading to the recognition of various morpho-stratigraphic units have been developed.

The Quaternary formation in the Vennar sub-basin is characterized by a thin lower layer of sandy horizon separated by a clay bed from a top layer of sandy zone between 8 to 12 m. The lower thin layer of sands occurs mainly in the eastern part of Vennar sub-basin. The upper sands zone is semi-confined by the deposit of grey silt of 8 m thickness. The fluvial deposits consisting of clean sands intercalated with brown and black clays occur on Cauvery river course. The thickness of these deposits is about 12 m at Ground Anicut at the western end of study area and increases in the easterly direction to about 40 m near the coast.

![Fig.(2)Geological Map Of The Study Area](image)

**Table. (1) Geological Resource In Thanjavur District**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Geology and Mineral Resources of Thanjavur dt</th>
<th>Area in sq.km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flood basin alluvium</td>
<td>1152.01</td>
</tr>
<tr>
<td>2</td>
<td>Unclassified Genesis</td>
<td>130.01</td>
</tr>
<tr>
<td>3</td>
<td>Ariyalar formation</td>
<td>24.12</td>
</tr>
<tr>
<td>4</td>
<td>Cuddalore sand stone</td>
<td>1558.71</td>
</tr>
<tr>
<td>5</td>
<td>Fluvio marine</td>
<td>186.00</td>
</tr>
<tr>
<td>6</td>
<td>Mango marine</td>
<td>120.00</td>
</tr>
<tr>
<td>7</td>
<td>Marine</td>
<td>196.52</td>
</tr>
<tr>
<td>8</td>
<td>Channel swamp</td>
<td>8.10</td>
</tr>
<tr>
<td>9</td>
<td>Salt marsh</td>
<td>15.13</td>
</tr>
<tr>
<td>10</td>
<td>Sand clay</td>
<td>3.02</td>
</tr>
<tr>
<td>11</td>
<td>Barrier dunes</td>
<td>1.45</td>
</tr>
<tr>
<td>12</td>
<td>Channel log</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3396.57</td>
</tr>
</tbody>
</table>

**(4) Geo-hydrology**

Thanjavur district forms the central part of the Cauveri Delta and part of Agniar Vellar basins. The present needs for irrigation is mostly served by surface water from Mettur Dam, anicuts and a number of irrigation tanks. The groundwater exploration has revealed the presence of good quality water in the major part of the area except in eastern and southeastern part of the district. Groundwater occurs in semi-confined conditions in the deeper Miocene aquifers. The chemical quality of water of different aquifers systems vary gradually in a deteriorating trend from west to east and south eastern parts of the district. The groundwater yield in major part of the district is 25-40.

The district forms the heart of the Cauveri Delta with a gently undulating terrain. The district is devoid of hills. In the Cauveri Delta the drainage is sub-dentritic. In the Agniar sub-basin, the streams are all empirical. The landforms are delineated under erosional and depositional region. The erosional region is manifested in the form pediplains and badlands. The depositional region comprises the floodplains of the Cauveri and Agniar rivers. In the deltaic area, palaeotidal flats, deltaic fluvial plains and paleodune flats typing the fluvio-marine region. The marine region comprises beach tidal flats, mangrove swamps and strandlines. A progradation of the coast in the form of Chenniar ridges is also seen in the coastal in the form of Chenniar ridges are noted in the form of barrier dunes along the beach and Teri-sand in the interior areas.

**CONCLUSION**

Thanjavur district is devisible into four parts on the basis of geology and three basis of river basins and water shed conditions. The ground water potential also high level occurs in the study area. The river basins are namely Cauvery river basin, Vennar river basins and Grand anicut canal basins. The district is full of overall latterite formations are occur. The major deltaic regions exposed along the major rivers are intricately faulted into papanasam area. In this area was deposited on erosional surface developed in pre-Pliocene time on the Cretaceous rocks. The drainage trends were west to east. The principals of thickest sediments of the study area, which is chiefly calcareous silty sandstone and thin persistent shale layers and which includes much sand and gravel. The upland plains and "pediment" slopes are mantled by Pleistocene deposits, which are chiefly loess in the uplands, undercut by coarse quartzes sand and gravel at the edge of the "pediment".

Alluvium and Pleistocene deposits beneath flood plains and low terraces yield small to abundant amounts of hard and in many places strongly mineralized water to domestic, livestock, and irrigation wells. The principal development of ground water in the study area at the present time is for livestock and domestic use because paddy farming, cattle-raising, and general farming rather than irrigation are the dominant economic activities. Geologically the study area is highly latterite formations of highly rich in alluvium, so the groundwater potential and surface irrigation is greatly in the future.

**Acknowledgement**

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to permit to utilize the resources available including the software.

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