HOLOCENE SEA LEVEL CHANGES : IMPACTS IN THE CAVERY - PALK BASIN AND IT'S SURROUNDINGS.

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Introduction

Since the inception of the origin of the planet earth, its surface, having become subjected to various impacts, has got changed up to now by endogenic and exo genic processes. But man is able to acquire information of earth's surface of only 600 million years from the geological time scale. Nevertheless geological history of only 100 millions years has been recognized to be trustworthy.

Due to the effects of the endonogenic processes, great changes had taken place on the crust during the geological periods. (movements of land masses, mountain buildings and formation of sea floor etc.) these changes still take place on the earth. As the evidences of such changes that took place on the earth, have gone to rack and ruin, an explanation of morphological aspects has been given on the basis of some fresh evidences obtained later on.

In the meantime, geologists and geomorphologists have shown their interest in investigating into matters relating to various morphological aspects and its complex processes throughout the geological periods.

The climatic changes have been one of the basic factors for the occurrence of the morphological changes of earth's surface throughout the geological periods. But the same climatic condition did not prevail long. This condition was subjected to change from time to time. As a result of this, long glacial and inter glacial periods appeared on the earth surface during the geological periods. These types of different climatic conditions have been found in low and high latitude regions. During the period of glaciation a large portion on earth's surface was covered with glaciers and during the period of warm, the above portion melted bringing about sea level rise and this occurred alternately. When wet and dry conditions appeared in the tropical regions, glaciating and inter glaciating occurred in the temperate regions. The differences of temperature which are the features of the geo - atmosphere, had been the basic factors for such climatic changes.

The table - 1 given below shows briefly the pattern of climatic changes in the geological periods.

The Geological Time Scale

Period	Epoch	Duration	* B.P	Climate
		(Millions of years)		
Quarternary	Recent	0.025	0.025	Warm
	Pleistocene	1	1	Glacial
	Pliocene	11	11	Cool
	Miocene	1.6	28	Moderate
Cenozoic Tertiary	Oligocene	11	39	Moderate to warm
	Eocene	19	58	Moderate becoming
	Paleocene	17	75	Warm
ALPINE MOUNTAIN REVOLUTION				
Mesozoic	Cretaceous	60	130	Moderate
	Jurassic	30	165	Warm & equable
	Triassic	40	20	Warm & equable
APPALACHIAN MOUNTAIN REVOLUTION				
Paleozoic	Permian	25	230	Glacial at first becoming Moderate
	Pennsylvanian	25	255	Becoming glacial
	Mississippian	25	280	Warm at first
	Devonian	45	325	Moderate becoming Warm, glacial
	Silurian	35	360	Warm
	Ordovician	65	425	Glacial, moderate to warm
	Cambrian	80	505	Cold becoming warm

Table -01 continue.....

SECOND GREAT REVOLUTION			
Proterozoic	Varangian	20	?	Glacial
			2000	
	Sturdien	20		Glacial
	Gnejso	20	1500	Glacial
		?	?	?

FIRST GREAT REVOLUTION			
	?	?	?
Archeozoic Huronian	20	2300	Glacial
	?	?	?

* Beginning from Present (After Brooks 1949 : Dodson 1964 : John Gribbin 1978)

In the geological era, the so - called 'Pleistocene' (1.0 million years B.P) period consisted of four glacial and three inter - glacial periods. During these glacial periods the sea level seemed to be very low than the present level. The temperate regions in today's Europe, Asia, and North America had been greatly affected by these glaciation processes.

In the geological era, it is stated that the warm climate gradually began to increase during the 'recent' period (0.025 million years B.P). Consequently there was the gradual increase in the rise of sea level too in this period. The last glacial maximum (LGM) has caused a low sea level of 150 meter - 100 meter from the present sea level. The post - glacial transgression (PGT) appears to have started around 17000 - 18000 years B.P. Following the PGT the sea level began to increase considerably, approximately 15000 years before present. This is called 'Holocene sea level rise'. [Olemon and Robert, 1989]

The conclusions of researches conducted in the Mediterranean region

and the tropical regions with regard to the Holocene sea level changes are available. But the investigations as to how the Holocene sea level changes had caused impacts in small regions, such as Cavery - Palk region, are not yet carried out. The present study attempts to correlate the conclusions of researches about the Holocene sea level changes made in the similar tropical regions to the Cavery - Palk and it's surrounding regions. In this respect, it is expected that details regarding the condition existed prior to the Holocene period and the interpretation of the morphological aspects could be obtained.

Some important findings of the Holocene period sea level changes

The above conclusion has become a key to regain the past geographical history of the tropical regions especially the regions which are surrounded by sea. It is learnt through the studies of morphological aspects of coast which have been made in the South Indian regions that PGT appears to have started around 17000 - 18000 years B.P **[Krishna Rao, Bhanumurthy and Swamy, 1990; Kameswara Rao and Desikan, 1990; loveson and Rajamanikam, 1987, 1989]**.

It is confirmed from some studies that the sea level of the Mediterranean sea as well tropical sea was about 80.0 meters below the present level during the same period. (PGT) **[Fair bridge, 1961; Walcot, 1972; Pirazzoli, 1987]**.

In addition, the researchers who made studies concerning the sea level changes of the Holocene period, have revealed their findings as follows,

1) The sea level was about 10.0 meters below the present level in 7000 years B.P [Davies, 1987].

2) At many locations of the tropical, sub tropical coasts the sea level remained within 3.0 - 5.0 meters from the present sea level during 6000 - 4000 Years B.P. (during the mid Holocene). **[Fair bridge, 1961]**.

3) The sea levels must have increased by at least 6.0 meter during 6000 - 2000 years B.P **[Krishna Rao and Desikan, 1990]**.

4) In the interpretation of C - 14 dates of geologic samples from the western and southern Sri Lanka coasts, a study recently (Katupotha, 1992 b) in dicates that the mid Holocene sea level was at least 1.5 meter above the present sea level.

5) As evidenced from C - 14 dates of shells embedded in emerged reef patches and corals the climatic changes have occurred after the mid Holocene (around 3700 years B.P) high sea level. Further, C - 14 dates of shell deposits along the southern coast in the Hambantota district also prove that such changes have occurred during the late Holocene. **[Hubbs et al. 1962; Katupotha, 1988 b, 1988 c; Katupotha and Wijayananda, 1989].**

In this respect, while correlating the above findings of sea level studies to the Cavery - Palk region, meaningful explanation regarding the past and present morphological aspects can be obtained.

Formation of Cavery - Palk basin and it's present state

The cavery - palk basin lies between the latitude 9 - 0' - 10, 35' N and Longitude 79 - 0' - 81 - 0' E within India and Northern Sri Lanka.

It is learnt that Cavery - Palk basin appears to have started to form from the late cretacious period - (80 Million years ago). Some geological studies indicate that there is very close relationship with Indian ocean floor development and cavery palk basin formation.

There are three major periods of ocean floor spreading recognized in the Indian ocean. Initial rifting and rotation of East Antarctica from India commenced in the early cretaceous (130 million years ago) along a pre - existing older Pre Cambrian Lineament (PBF) [Fig. 1] This NE SW line, was part of a series of triple junctions - (Curray and Moore 1974; Burke & Dewey, 1973) which were the loci of subsequent spreading, separation and rotation of antarctica from India.

By the late cretaceous (80.0 Ma) ocean floor spreading along transform fault was developed in the Bay of Bengal in a direction normal to the emerging eastern continental margin of India (Curray and Moore, 1974). The spreading direction was, in part, controlled by rejuvenated older NW lineaments within the Indian Pre - Cambrian, as is shown in the theory of Wilson (1965). These older N W lineaments Parallel, and in many cases can be extended in to these early transform directions. [Fig. 2] Relative transport of Sri Lanka in a direction normal to the emerging Indian coast along these transform faults caused the

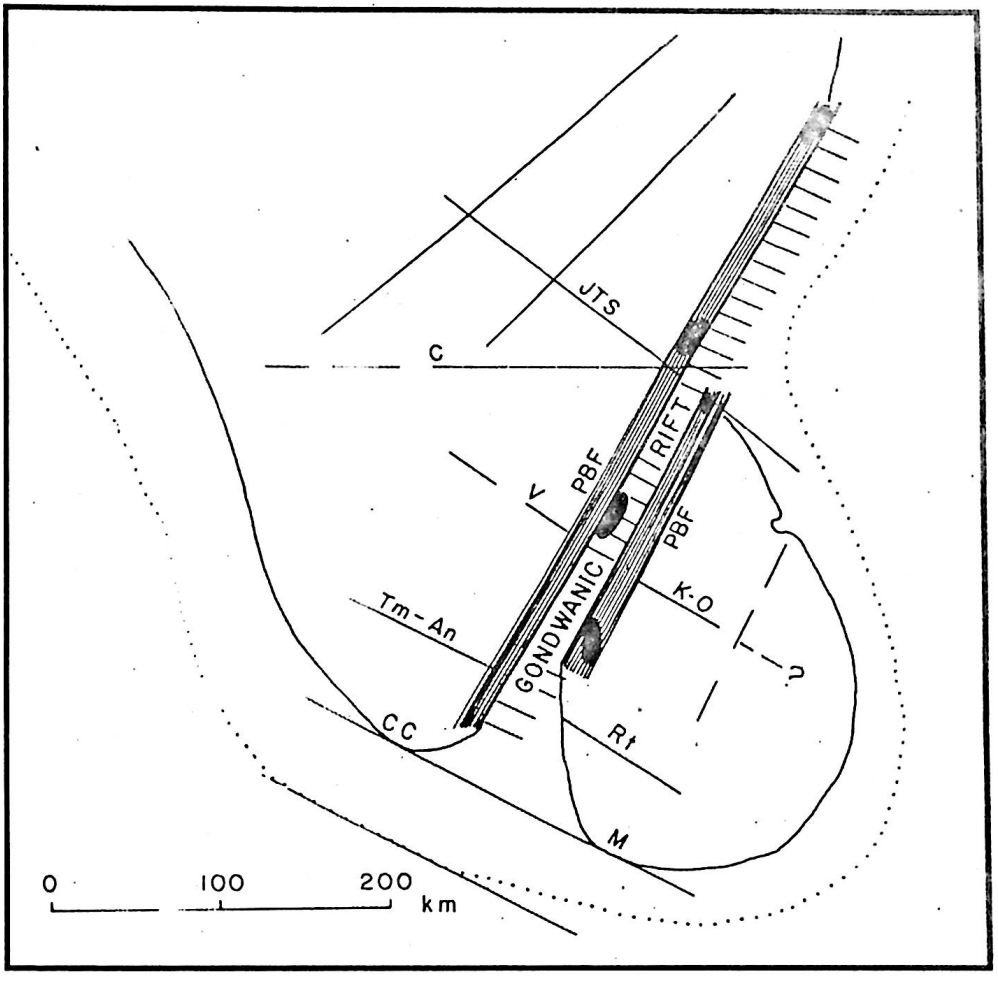

Fig: 1

Jurassic palaeotectonic map of South India and Sri Lanka showing the Gondwanic rift along the pre cambrian proto-boundary fault (PBF). Gond wanic deposits of South India and Sri Lanka (shaded) show a common alignment along the rift structure.

Katz. M.B. 1972

separation of Sri Lanka from India. This separation was in the order of about 200 Km and led to the development of the NE - SW Cavery - basin.

The rejuvenated N W lineaments (JTS). (CC - M), (Rt) - (Tm - An) and (V) - (K - O) are considered Proto - Transform direction and the line of separation is considered the N E - S W (PBF). Sri Lnka rotated counter - clockwise away from S E India along the bounding N W lineaments which developed into transform directions in the bay of Bengal - East Indian Ocean by late cretaceous times (80.0 Ma) [curry and Moore, 1974]. During this time cretaceous sediments were being deposited in the Cauvery - Palk basin troughs which were aligned in a N W - S W direction (Sastri & Raiverman, 1968) A complete section of lower cretaceous (105 Ma) - Upper cretaceous (65 Ma) shallow water marine sediments is recognized (Banerji, 1973).

The second phase of ocean floor spreading occurred during Paleocene (65 Ma) when the relative direction of spreading changed from NE - SW to essentially NS (curray & Moope, 1974). A series of latitudinal spreading ridges developed South of India in the central Indian ocean, with meridianal transform faults. India was now transported northerly in a collision course with Asia (Sclater & fisher, 1974). Sri Lanka was still coupled with India although major NS transform faults, the Indrani and the Indra fault zone (80.0 E long). [Owen, 1976], apparently controlled the relative northerly drift of Sri Lanka. The Indrani fault zone on extension to the North, line up with a prominent NS lineament, observable on space photos and LANDSAT imagery that separates SE India from NW Ceylon (sastri & Raiverman, 1968), the karaikal Chilaw (K - C) lineament [Fig. 3].

The third phase of sea floor spreading commenced in the Oligocene (30 Ma) when NW trending spreading ridges were being formed SE of India in the southern Arabian sea. (Mckenzie & sclater, 1973). A series of NE trending transform faults accommodated the spreading direction which was now to the NE. These directions were again a possible manifestation of fundamental NE lineaments in the Indian Precambrian (Eremenko, 1980; Grady, 1971; Katz, 1978). Relative movement along these transform faults may have further adjusted Sri Lanka relative to India.

During the movement of the land masses (Sri Lanka - India) through the

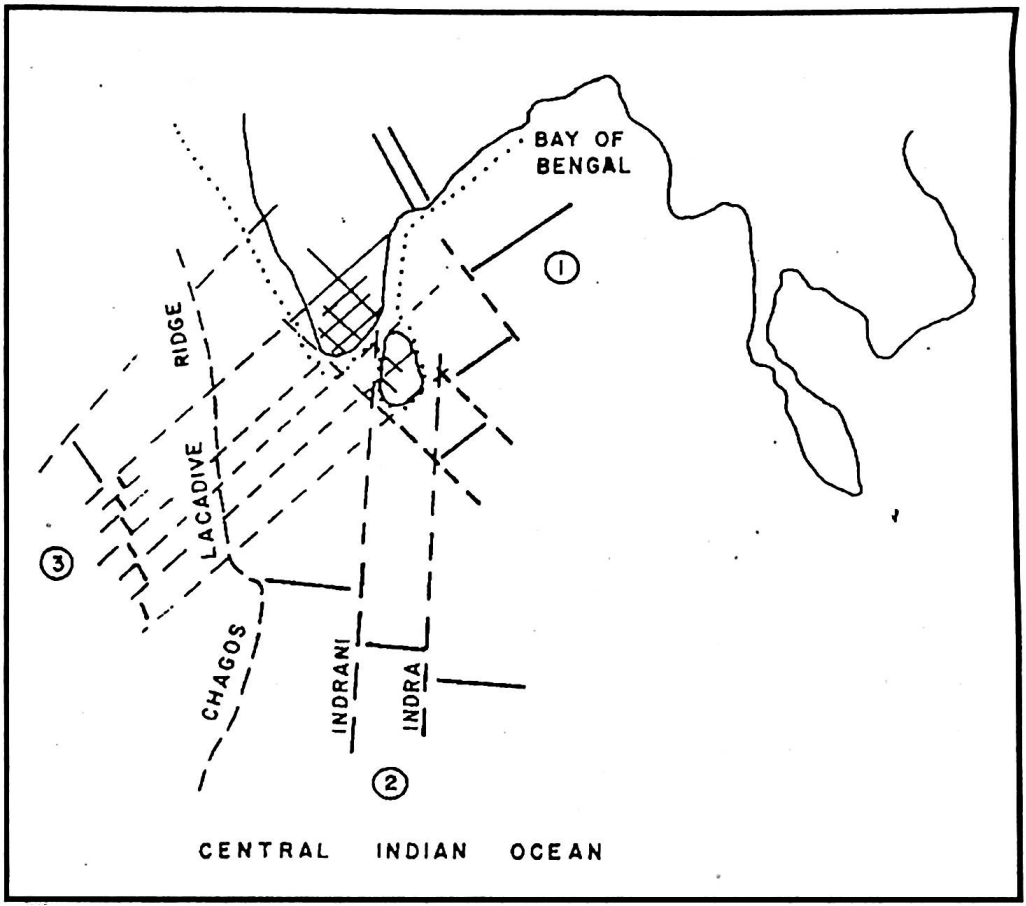

Fig: 2

Tectonic elements of South India - Sri Lanka and the evolution of the Indian Ocean.

Stage - (1) Late cretaceous
Stage - (2) Late paleocene
Stage - (3) Miocene

[After Mc Kenzie & Sclater, 1973:
Sclater & Fisher, 1974:
Curray & Moore, 1974:
Owen, 1976 :
Johnson, Powell & veevers, 1976]

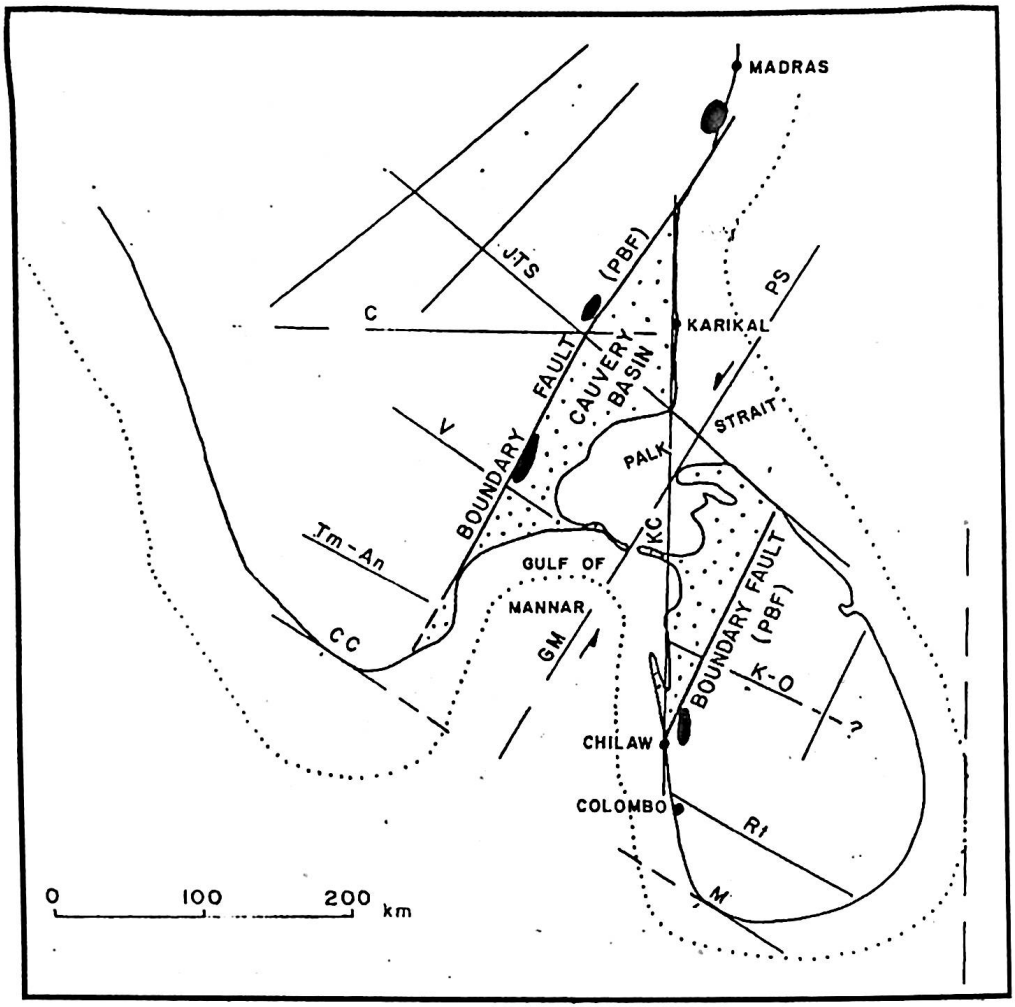

Fig: 3

Tectonic map of South India - Sri Lanka. Shaded pattern, Gondwanic sediments; speckled pattern cretaceous - Tertiary sediments.

(After Eremenko, 1968; Vitanage, 1972)

sea floor spreading processes, Cauvery - Palk basin gradually came in to existence. In accordance with the above findings, we assume that the natural valleys and their parallel ridges have been found in the NE - SW, N - S, NW - SE directions in the Caury - Palk basin. The above said natural valleys afforded an opportunity in the basin during the above said periods.

From the cretaceous period up to now, apart from the endogenic processes, complicated exogenic processes have taken place in the tropical regions as well as Cauvery - Palk regions. During the climatic changes. wet, dry conditions had been prevailing alternatively in these regions. During the Miocene period (warm, climate prevailed) about. 20 million years ago, an arm of the Tethys sea stretched down the west coast of India, a long narrow gulf of which gradually encroached on the peneplained land surface between India and Ceylon. [Fig. 4]. The gulf served the extreme portion of the Indian mainland and turned Ceylon, for the first time, into an island (Cooray, 1967). The sea here was comparatively shallow. In its warm waters grew extensive coral reef which harboured a rich fauna, and limestone of several hundreds feet, calcareous clay, and sand accumulated on the floor of the sea. This submarine depression, during which the northwestern margins of Ceylon were under the sea, recorded in the thick limestone bed of Jaffna and in the Karikal and Warkali beds of South India.

When the tertiary period throughout the earth was marked by a great mountains - building episode, the Miocene rocks were hardly affected by them. All that happened was a slight warping of the surface and a slow but continuous uplift of the seafloor whereby the nearly horizontal Miocene limestone, once at the bottom of the sea, is now exposed in cliffs of 20.0 meter to 25.0 meter of height in the Jaffna and North - west coasts. At the same time the present north eastern coast of Tamil Nadu, south India was also uplifted by these processes. These Miocene rocks dip gently westwards to form the bed of the shallow palk strait between Ceylon and India, the sea being only about 10 meters deep in places.

As the warmth of the sea continued in this basin, layers of lime dense deposits had been laid down in favor of the structural pattern of the bedrock. At present it is specifically mentioned that the river valleys developed on both sides of the Cauvery - Palk basin are formed in

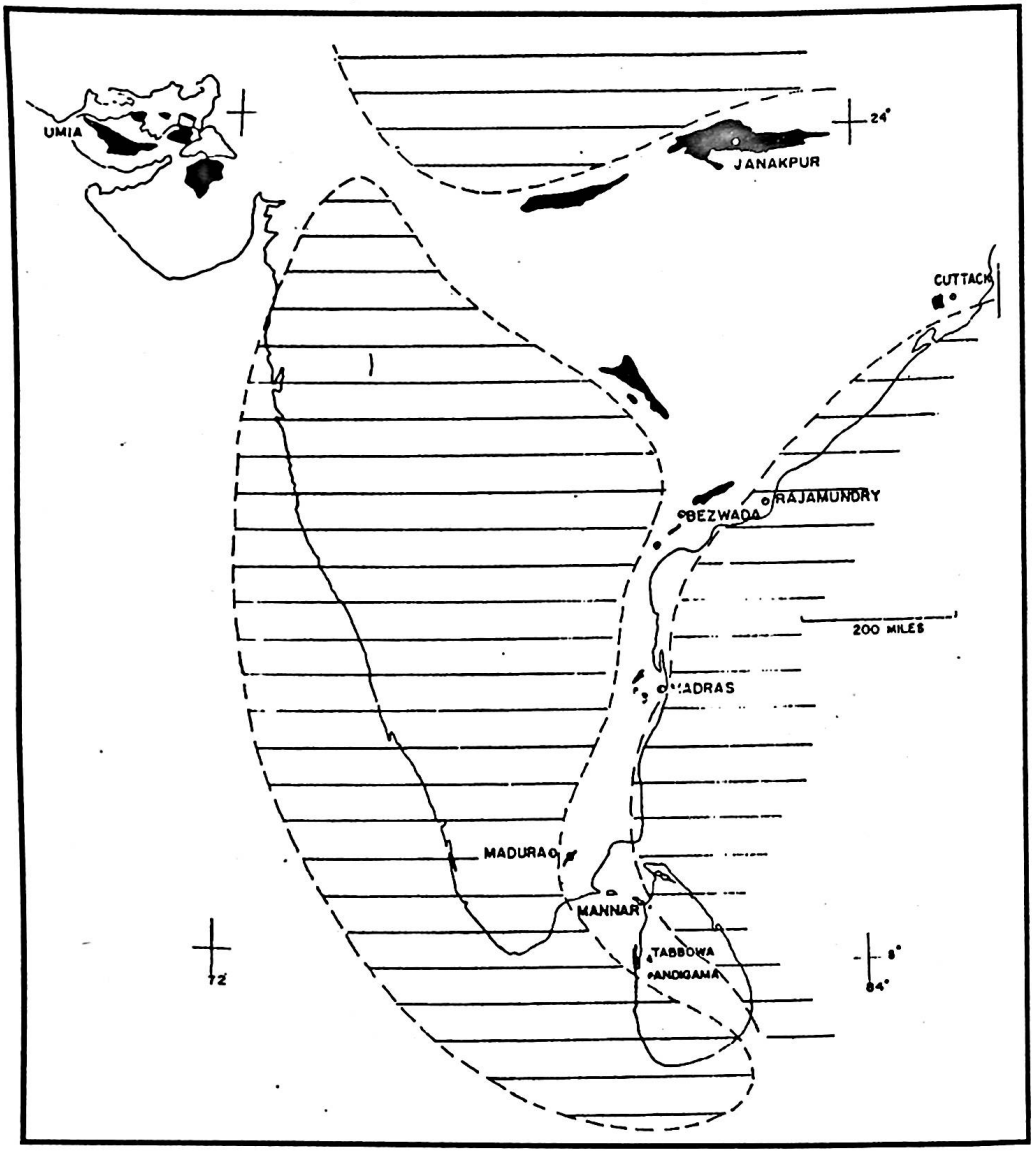

Fig:4

Distribution of Jurassic rocks of peninsular India and Ceylon (from the geological map of India, 1957)

(Approximate extent of Landmass shown by horizontal ruling)

(P.G.Cooray, 1967)

the NW - SE direction. It is also noteworthy that these river valleys related to the direction of the fault zone, were developed in the third stage of India ocean floor spreading processes. The rivers flow through these valleys mentioned above and reached the Cauvery - Palk basin.

The entire Cavurys Palk basin is seen existing on the continental shelf region. In considering the depth this continental shelf region has been obviously divided in to three categories:-

1. **Regions above the depth of 10.0 meters.**

This region is divided into two small regions.

1.1. Palk Peninsula.

1.2. Elongated depression formed in the West - East ward direction which is seen parallel to the northern coast of the Jaffna peninsula, and the continuity of the formation of the depression is seen parallel to the eastern coast of the Jaffna peninsula.

This elongated depression has an area of 900 sq. kms approximately. The Palk Bay has an area of approximately 5580 sq. kms.

2. **Region of depth of 5.0 - 10.0 meters**

In the above said region itself, the Palk Bay is seen between point calimere (Kodikarai) of India and the Jaffna peninsula. This Portion is formed wide among the areas mentioned previously. In the other places, it is found narrow around the Palk Bay and the East of the Jaffna peninsula. (fig.. the depth of Palk Bay)

3. **Region below the depth of 5.0 meters**

The region consists of a narrow portion from Mandapam point to point calimere (Kodikarai) in South - Western coast of south India, a narrow portion of Northern, Western coast of Jaffna peninsula, and a considerable wider portion of North - western part of Jaffna peninsula.

The Islands, excepts delft, adjoing the Jaffna peninsula lie in the isodepth region of 5.0 metre. The other islands like Mannar, Eranativu and Rameswaram also lie in the 5.0 meters isodepth region. But the Island namely Katchativu lies above the 10.0 meter isodepth reigion. It is also noted that a elongated depression is observed in the NW - SW direction between the island of delft and other Islands. (fig. 5)

The extent of the region which is below the 10.0 meters isodepth from the coast of Cauvary - Palk basin, has been calculated as 8190 sq. kms approximately. In accordance with the distance to wards sea from some places of costal region of Cauvary - Palk basin, the variations of depth are calculated. These calculations are now useful to study the Physical conditions of the above area.

Table :- 2.1

Depth of sea towards east from North - Western point of Vadamarachchi (near Pointpedro) of the Jaffna Peninsula.

Distance from coast (kms)	Depth of sea (in meters)
0.0 - 1.0	10.0 >
1.0 - 4.5	10.0 - 20.0
4.5 - 10.5	10.0 >
10.5 - 25.5	10.0 - 20.0
25.5 - 34.5	20.0 - 30.0
34.5 - 40.5	30.0 - 50.0
40.5 - 61.5	50.0 - 200.0 and over.

estimated - STBR - 2000.

Table :- 2.2

Depth of sea towards east from Point Calimer, (Kodikarai) South India.

Distance from coast (kms)	Depth of sea (in kilo meters)
0.0 - 2.0	5.0 >
2.0 - 12.0	5.0 - 10.0
12.0 - 29.0	10.0 - 20.0
29.0 - 35.0	20.0 - 30.0
35.0 - 42.0	30.0 - 50.0
42.0 - 55.0	50.0 - 100.0
55.0 - 75.0	100.0 - 200.0 and over.

estimated : STBR - 2000.

Table :- 2.3

Depth of sea towards west from Devil Point of North western coast Sri Lanka

Distance from coast (kms)	Depth of sea (in kms)
00.0 - 1.0	5.0 >
1.0 - 4.0	5.0 - 10.0
4.0 <	10.0 - 20.0

estimated : STBR - 2000.

Table :- 2.4

Depth of sea towards west from 'Palavi Bay' of the North Western coast of Sri Lanka.

Distance from coast (kms)	Depth of sea (in meters)
0.00 - 6.0	5.0 >
6.00 - 27.0	5.0 - 10.0
27.0 <	10.0 - 20.0

estimated : STBR - 2000.

Table :- 2.5

Depth of sea towards west, from the coast between 'Devil Point' and Mannar island of North Western coast of Sri Lanka

Distance from coast (kms)	Depth of sea (in meters)
0.00 - 1.5	1.0 >
1.5 - 8.0	1.0 - 5.0
8.0 - 27.0	5.0 - 10.0

estimated : STBR - 2000.

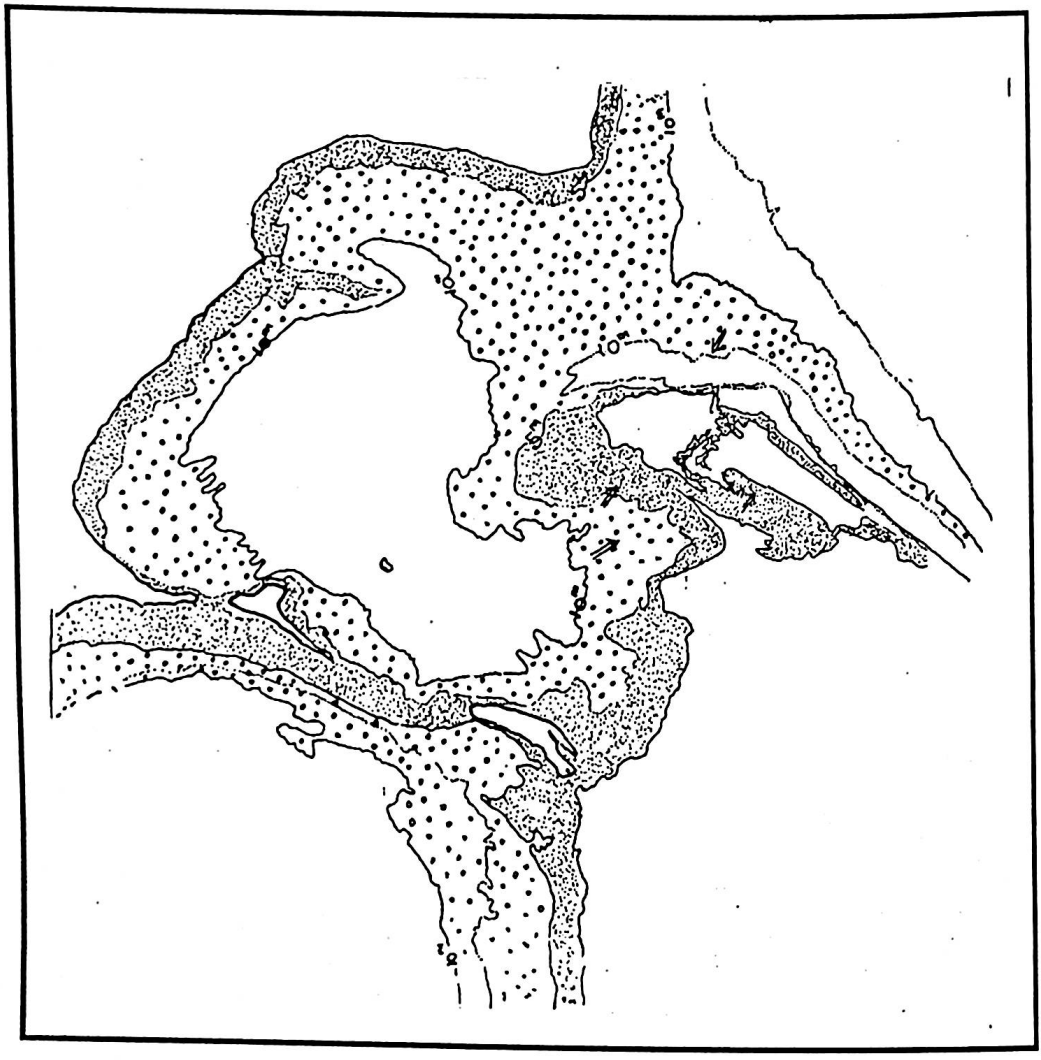

Fig:5

The present depth variation of the present Cavery - Palk regions.

Katupotha, (1992) concludes through his studies that mid - holocene sea level in Sri Lanka was at least 1.5 meter above present level with three episodes as follows.

a) 6240 - 5130 BP (First episode of high sea level)
b) 4390 - 3930 BP (Second episode of high sea level)
c) 3280 - 2270 BP (Third episode of high sea level)

In view of the above findings certain assumptions are possible.

1. The present configuration of cavery palk basin and adjoining Jaffna Peninsula with islands, Rameswaram island, Manner island ect. have been formed during the mid - Holocene sea level rise episode. (around 6000 years B.P.)
2. Following these high sea level episode, the former drainage basin submerged and bays and lagoons created. The Jaffna lagoon was created during these episode. The former coastal plains have been changed into continental shelf regions.
3. Between mid - Holocene and late Holocene (6600 - 2270 years B.P). periods further sea level rise took place in the cavery - palk region and it surroundings. During this period, most part of the present Jaffna Peninsula and its adjoining islands were submerged and also a part of the North western part of present Sri Lanka, and coastal regions of Southeastern part of south India including Rameswaram - Manner link were submerged.
4. As far as Northern Sri Lanka is concerned lower part (below 5.0 meter) of the valigamam, Vadamarachchi and Thenmarachchi would have sunk into the sea then. The present in land lagoon area also may have been formed during this period.
5. The well known red soil presently found in Jaffna seems to have been the residual soil of some type of formerly existing red soil in the same region. During the sea level rise between mid - Holocene and late Holocene period most of the red soil deposits were washed away.

So, an assumption could be made possible that the present boundary of the spatial distribution of the red soil in Jaffna region, may have been the Holocene maximum sea level boundary

of this region. This could serve as convincing explanation for the existence of the Jaffna red soil.

The Thenmarachchi, Vadamarachchi, Poonakari sand deposits may have been brought and deposited by the sea and wind during the Holocene periods.

Correlating the research findings of holocene sea level changes to Cauvery - Palk region and subsequent morpohological perspectives.

The sea level was about 120.0 meter below the present sea level during the last - Glacial Maximum (LGM). The past glacial transgressions (PGT) appears to have started around 18000 - 17000 years B.P. During the course of this process the sea level was 80.0 meters below the present level. While relating the above mentioned facts to the Cauvery - Palk regions, we intend to consider that the present 80.0 meters isodepth line above the said aera may have been the former coast lines. (Fig. 6) In this stage the whole Cauvery - Palk region seems to have been a land area. (Presently coverd by sea).

Wayland (1919) Deraniyagala (1986) reveal that desert like conditions occurred during the LGM in much of the low country of Sri Lanka. The desert like conditions of the low country is very similar to the Pleistocene aridity in tropical Africa, Australia and Asia as described by Kolla and Biscauve (1977) and Williams (1985). In accordance with that fact it is learnt that there were immense dry climate conditions in the Cavery - Palk basin and the whole region were coated mainly by wind blown sand during this period. In the Cavery - Palk regions there may have been dry valleys and a land of ripple marked surface. The valleys may have existed in the NE - SW, S - N, NW-SE direction. It can be assumed that these valleys are the manifestation of the base rocks. It is noteworthy to mention that present valleys have been formed in the NW - SE directions.

In the view of Davies, 1987), the tropical sea level was about 10.0 meters below the present sea level around 7000 years B.P. Further, the present level reached around 6000 years B.P in many tropical and sub tropical regions. During the period of 1000 years (7000 - 6000 years B.P) the sea level increased by 10.0

meters. While relating the facts to Cavery - Palk basin, we have come to an assumption that the 10.0 meter isodepth line of present Cavery - Palk region, may have been the coastline in those days (7000 years B.P). Further, 5.0 meter isodepth line was the coast line formed in 6500 years B.P. (at the rate of 1.0 cm increase in 500 years period.) [fig. 7, 8].

With the aid of the reconstructed maps of the former coast lines of the present Cavery - Palk basin. I tend to present assumptions regarading the past morphological aspects of Cavery - Palk region and its surroundings.

1. The reconstructed map reveals that the present Palk Bay would have come into existence like a lake between south India and North Western and North Sri Lanka. The rivers from South India and Northern Sri Lanka flew into this lake.
2. It is also revealed that both the present delta region of the Cavery - region and larger portion of the present Jaffna region would have been the land.
3. During this period, there must have been several river valleys formed in the Cavery-Palk region. On or more of which from South India seems to have rushed across the elongated derpession which was formed in the West to East and North west to Southeast directions of the present Northern, and Eastern coast of Jaffna Peninsula.
4. The present submerged 'Pedro bank' region may have been the land area (or delta region) whic was parallel to the river valley at the time.
5. The present rivers of the dry zone of Sri Lanka may have flown through their former valleys which were formed in the Cavery - Palk region at that time and the present Jaffna lagoon also a part of the former river valley. The river valleys of Southeastern part of South India also may have extended further into the present continental shelf region.
6. The present islands of Jaffna including delft seem to be an integrated land area. Several low - lying ridges, well marked troughs, deltas may have developed on the land area. The area around Manner, Pampan island and Ramesveram would have been band of land with intermittent river valleys which were in the direction of NW- SE, N-S, and NE-SW.

Reconstructed map shows that the present 5.0 meter isodepth line in cavery palk basin was the outer limit

of the above mentioned basin in 6500 years B.P.In this stage, rivers had lost their own valleys further. This sea level rise caused the rivers to fill their valleys and discharge their loads over the submerged peneplain. The map further reveals that the island delft was separated from the Northern Sri Lanka. The Ramesvaram Manner band of land seems to have been a land bridge between South India and Sri Lanka with some intermittent river valleys.

Most of the studies have concluded that at many locations of tropical sub tropical coasts present sea level reached it hights around 6000 years B.P.Afterwards, the sea level was rising continuosly. But the rate of rise varied from time to time. Fairbridge (1961) adds that the sea level was 3.0 - 5.0 meters above the present level during the period of 6000 year - 4000 year B.P. Krishna Rao and Desikan studies (1990) suggest that the sea level in the Indian ocean has risen from 1.0-6.0 meter in the period of 6000-2000 year B.P.

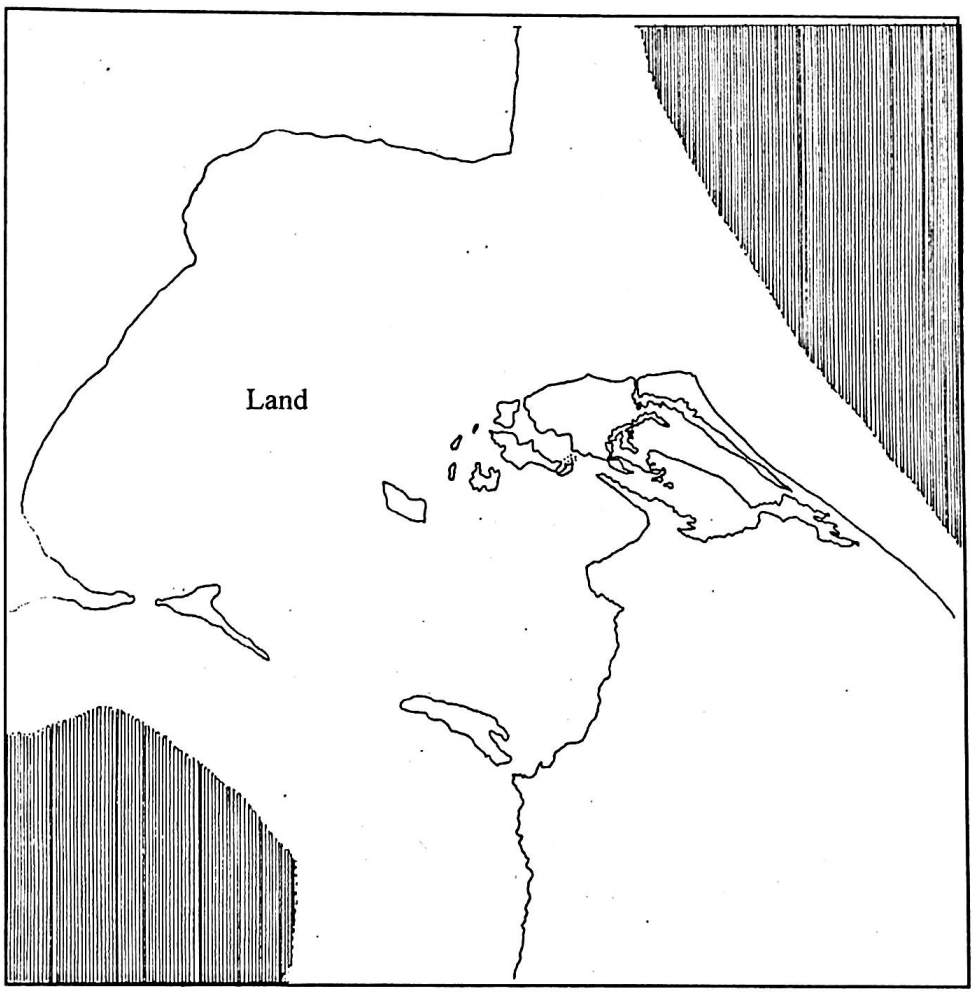

Fig:6 The PGT appears to have started around 18000-17000 years B.P.During the course of this processes the sea level was 80.0 meter below the present level. The present 80.0 meters isodepth line of the Cavery-Palk region may have been the coastline in those days. (See Text).

Fig:7 In the view of Davies, 1987, the tropical sea level was about 10.0 meters below the present sea level around 7000 years B.P. The present 10.0 meters isodepth line of the Cavery-Palk region may have been the coastline in 7000 years B.P. (See Text)

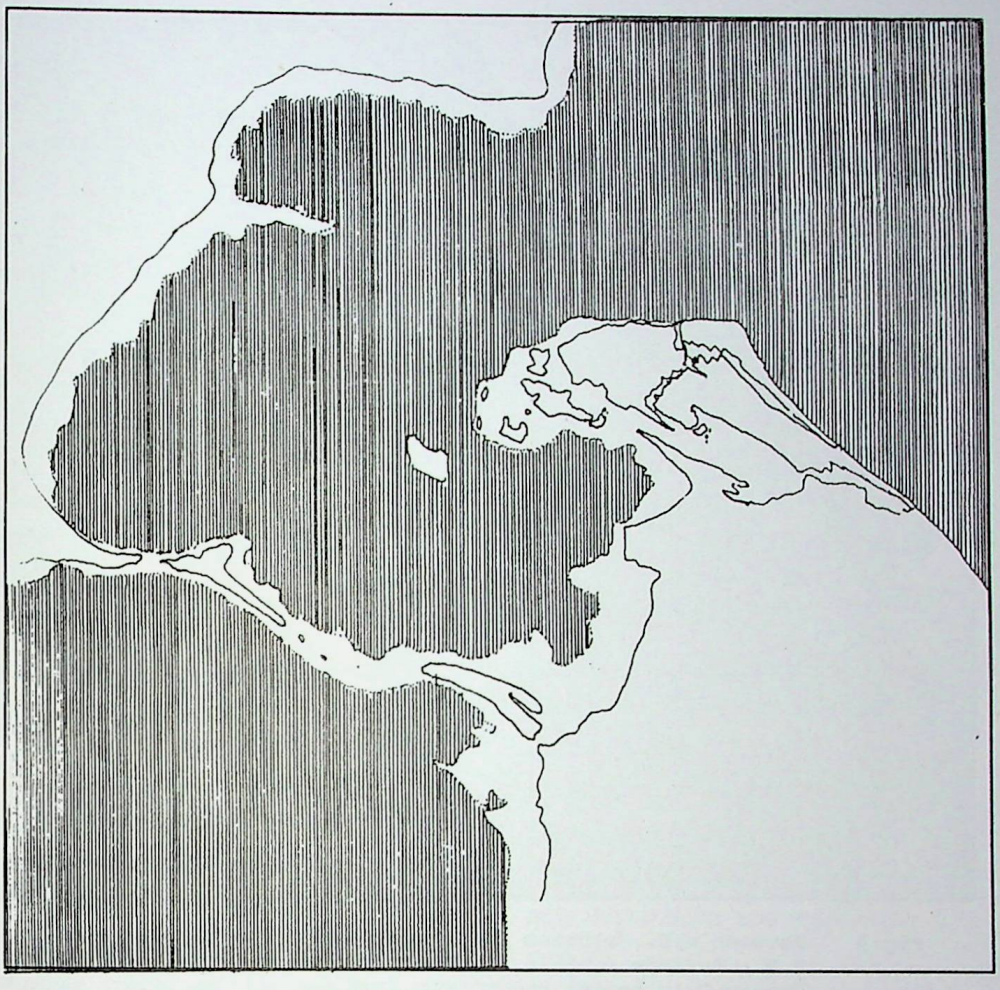

Fig:8 5.0 meters isodepth line was the coast line formed in 6500 years B.P (at the rate of 1.0 cm increase in 500 years time). (See Text)

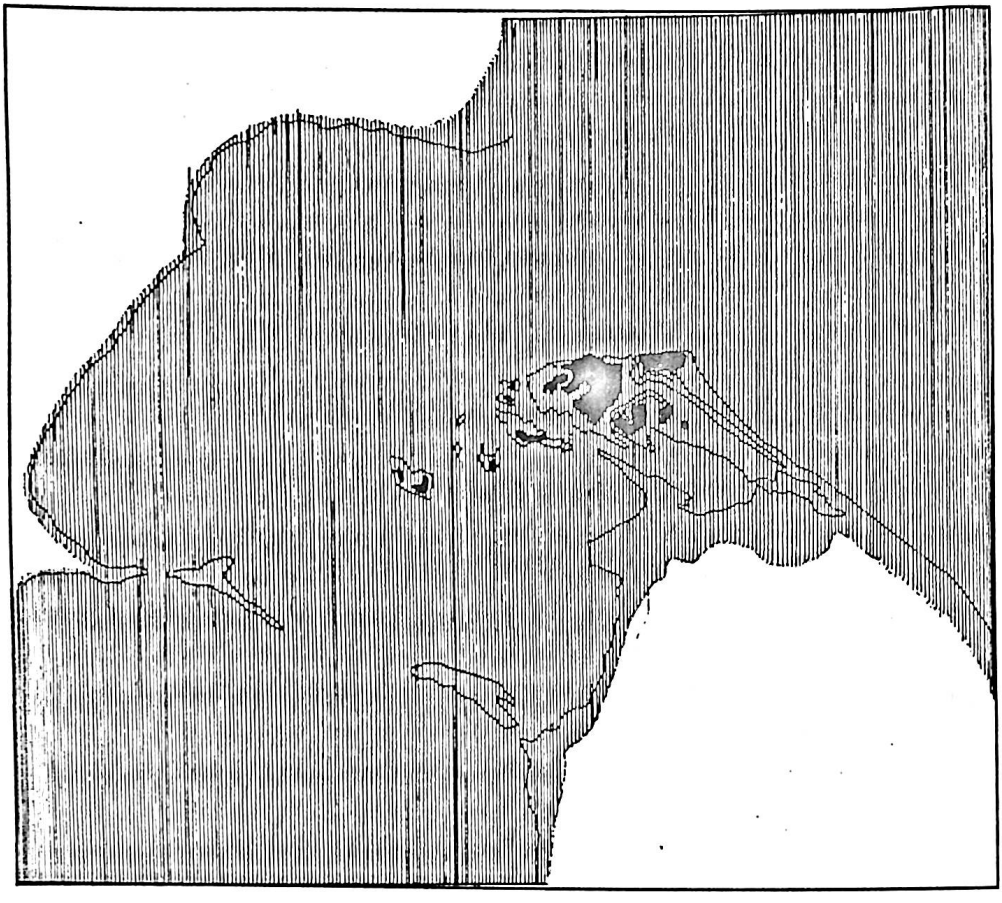

Fig:9 Between mid. Holocene and late Holocene (6500-2270 years B.P) Periods further sea level rise took place in the Cavery-Palk region and itssurroundings. During this period most of the present coastal regions around Cavery-Palk regions were submenged. (See Text)

Krishna Rao and Desikan studies (1990) suggest that the sea level in the Indian ocean has risen from 1.0 - 6.0 meter in the peiod of 6000 - 2000 year B.P.Katupotha, (1992) concludes through his studies that mid - Holocene sea level in Sri Lanka was at least 1.5 meter above present level with three episodes as follows.

a) 6240 - 5130 BP (First episode of high sea level).

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1. The present configuration of cavery palk basin and adjoining Jaffna Peninsula with islands, Rameswaram island, Manner island ect. have been formed during the mid - Holocene sea level rise episode. (around 6000 years B.P).
2. Following these high sea level episode, the former drainage basin. submerged and bays and lagoons were created. The Jaffna lagoon was created during these episode. The former coastal plains have been changed into continental shelf regions.
3. Between mid - Holocene and late Holocene (6600-2270) years B.P). periods further sea level rise took place in the cavery - palk region and its surroundings. During this period, most part of the present Jaffna Peninsula and its adjoining islands were submerged and also a part of the North western part of present Sri Lanka, and coastal regions of Southeastern part of South India including Rameswarm - Manner link were submerged. (fig.9).
4. As far as Northern Sri Lanka is concerned lower part (below 5.0 meter) of the valigamam, Vadamarachchi and Themarachchi would have sunk into the sea then. The present inland lagoon area also may have been formed during this period.
5. The well known red soil presently found in Jaffna seems to have been the residual soil of some type of formerly existing red soil in the same region. During the sea level rise between mid - Holocene and late Holocene period most of the red soil deposits were washed away.

So, an assumption could be made possible that the present boundary of the spatial distribution of the red soil in Jaffna region, may have been the Holocene maximum sea level boundary of this region. This could serve as convincing explanation for the existence of the Jaffna red soil.

The Thenmarachchi, Vadamarachchi, Poonakari sand deposits may have been brought and deposited by the sea and wind during the Holocene periods.

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