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A beach groundwater impact due to wave and tidal study using 2D eri technique in Van island, Gulf of Mannar, Tamilnadu, India

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ABSTRACT

The present study is aim to find out the a beach groundwater induced due to the Wave and Tidal impact in Van island, Gulf of Mannar, Tamilnadu. The Island is located near the away from 5km from Thoothukudi down of NE direction. The study area was studied using 2D ERI (Electrical Resistivity Imaging) study for wave and tidal impact in the Van Island. The electrical method five profiles were used to monitoring the water induced area were observed in the Island. The lithostratigraphical sequence map was prepared from 2D ERI technique. The studies were carried out using resistivity meter, cable, electrodes and Res2DINVsoftware. The electrical method, we find out the geological formation of the study area such as beach sand with shell material and limestone, calcareous sandstone were identified in the Island. The high wave and low tidal activity is creating the clay deposits are enriched in the surrounding region of Island. The following study used to compare the coastal upliftment in neotectonic activity in the gulf of mannar coast were computed with the Island and coastal terrace formation.

Keyword: Van Island, Gulf of Mannar, Beach Ground water, 2D ERI, Resistivity.

INTRODUCTION

The study area Van Island is located in between N80 50'- E780 13' covered area of 16,00 (Ha), Circumference (m) 2,015. The study area made up of calcareous sediments and dead skeletons of coral species. The elevation of the Van Island varies from 0.5 to 1.5m above MSL. To the study influence of the tides and waves in the beach groundwater condition around the island a continuous monitoring of the beach groundwater dynamics using 2D electrical resistivity imaging technique was conducted in the five corner of Van island (Fig.1). The hydrodynamic movement along the beach groundwater induced by the waves and tides is monitored through the

2D electrical resistivity imaging technique at Van island, located 5km east of the Tuticorin town in the Gulf of Mannar (Fig.1).

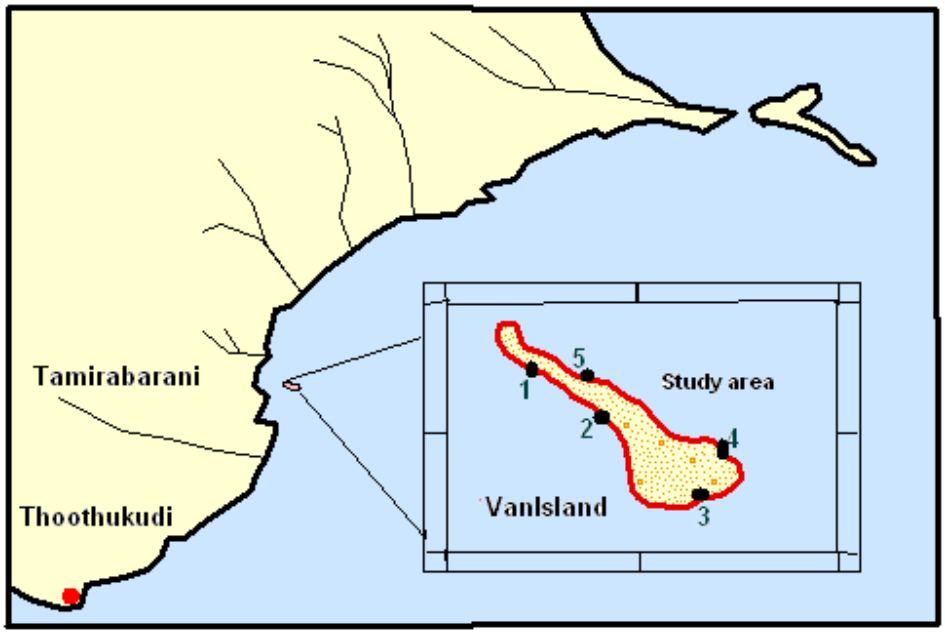

Fig.1 Location map for Continuous monitoring of the 2D electrical resistivity imaging study at Van island.

For the resistivity monitoring a profile to a length of 80m with electrodes interval of 2, 4, 6, 10, 12 and 14 m with help of CRM -500 aquameter, multicore cable and electrode (Fig.2)were used to study the Van Island. The Van Island is formed by the complex physical and biological process started from the interglacial period to present day. The coral reef zonations are unique creative supporting the ecosystem. The islands are formed with the filling up of sediments above the sea level. The island is covered with vegetation and dunes developed from the eroded wind deposits. The dune height varies from 0.5m to 1m. About 93 species of corals are reported in the van island area[8].

The breakwaters of the Tuticorin harbour were constructed in the open ocean to the south of the Van island. After the construction of the breakwaters of the harbour the wave pattern, wave direction and current movements have been completely changed in the vicinity of the island [11]. The diffracted and refracted waves around the breakwater changed the hydrodynamics around the island. To study the impact of the tides and waves in Van island for a tidal cycle the continuous monitoring and recording of data through 2D electrical resistivity imaging profile in the island were carried out. [7],[12], has carried water quality studies in islands and coastal environments. The hydrogeological geometry of the subsurface is used to detect the contrast of saline and freshwater bodies and their response to tides [15]. [2],[6], [4],[5], worked the Geophysical study for saline water intrusion in a coastal aquifer.

The impact of tidal and wave forces into the beach groundwater

External forces which act on water in the subsurface include gravity, pressure from the atmosphere and overlying water, and molecular attraction between solids and water. In the beach and near the shore region wind generated waves [9] tides and sea level fluctuations cause

shoreline changes resulting in erosion and accretion along the shore, most of which can be explained with the parameters like wave steepness, sediment fall velocity and gradient of the beach [3]. The morphology of a beach depends on various parameters. At a particular time, the formation of a beach-state is the function of its sediment characteristics, beach topography and the immediate and antecedent wave, tide and wind conditions.

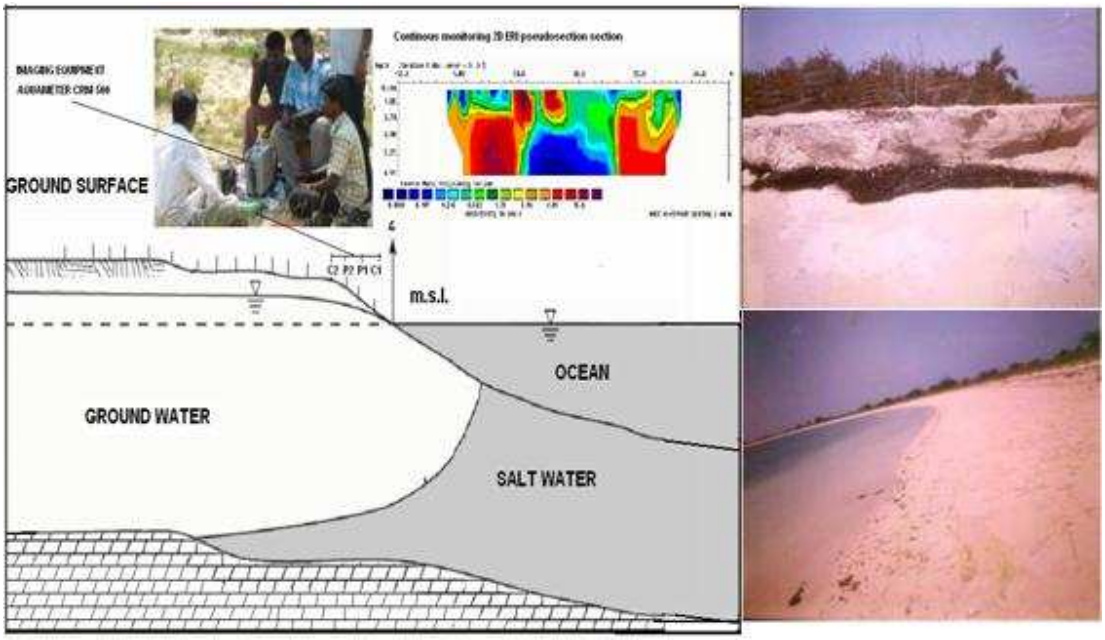

Fig. 2 The diagram show cross section of the experimental site perpendicular to the coast, coastal erosion and beach width and 2D electrical resistivity imaging profile was installed for survey.

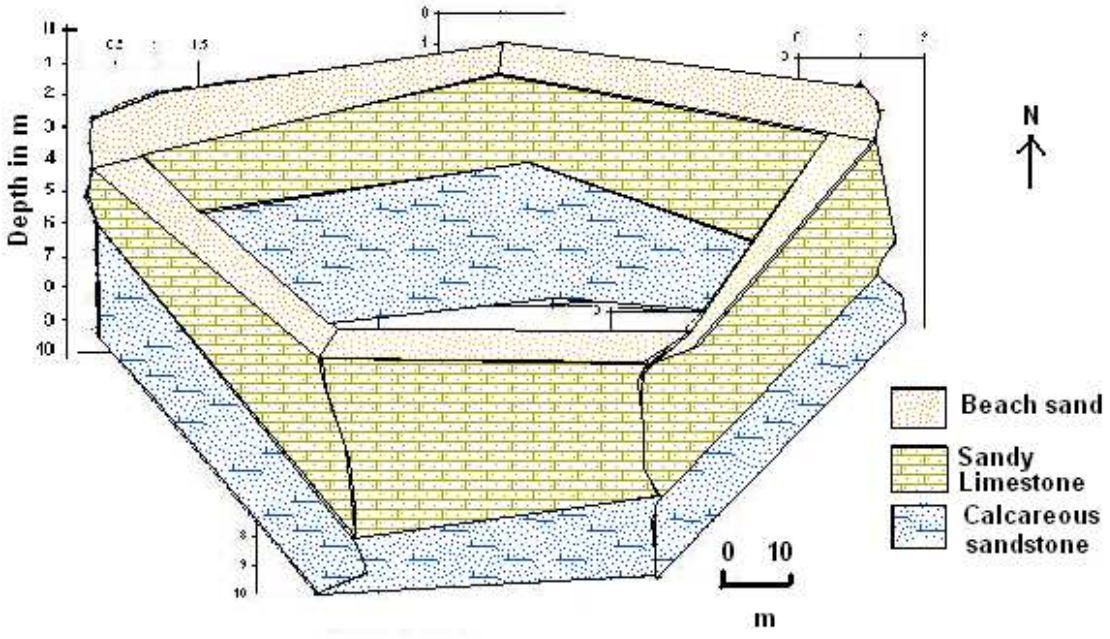

Fig.3. Lithostratigraphic sequence using 2D ERI study

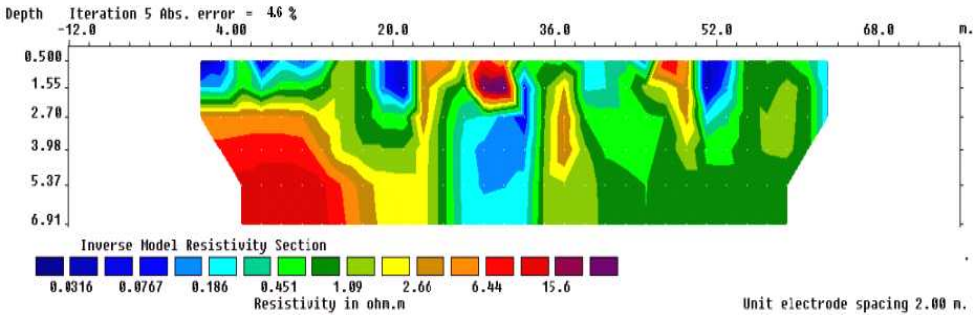

Fig. 4.1 Pseudosection shows resistivity study of saltwater intrusion at Van islands profile1

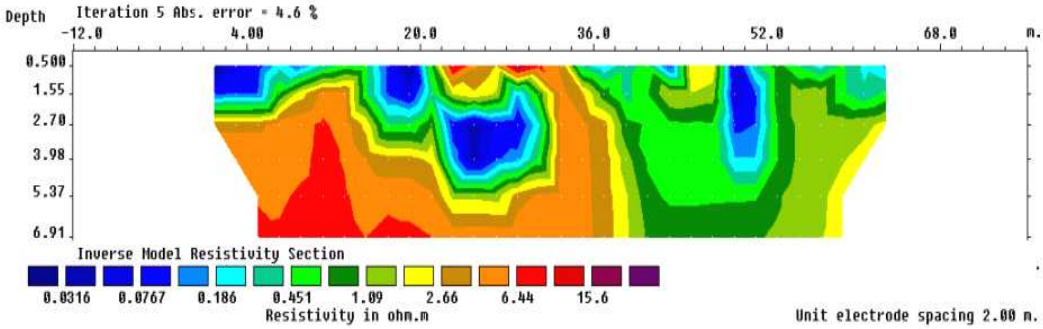

Fig. 4.2 Pseudosection shows resistivity study of saltwater intrusion at Van islands profile 2

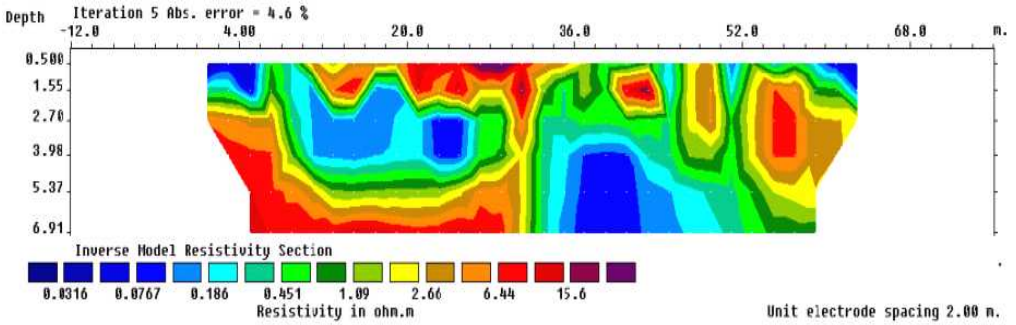

Fig. 4.3 Pseudosection shows resistivity study of saltwater intrusion at Van islands profile 3

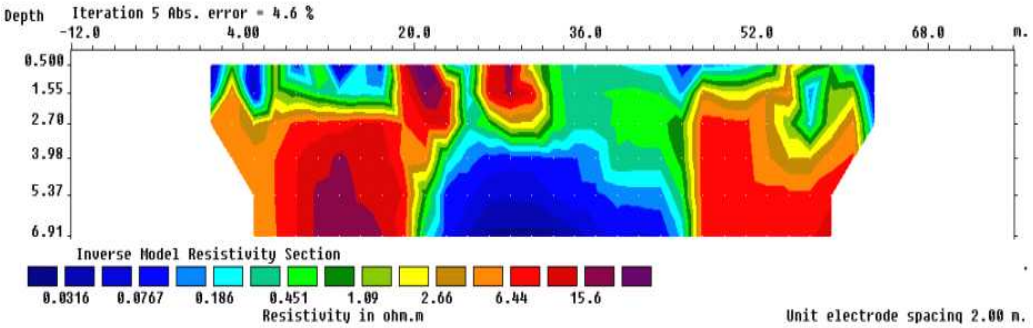

Fig. 4.4 Pseudosection shows resistivity study of saltwater intrusion at Van islands profile 4.

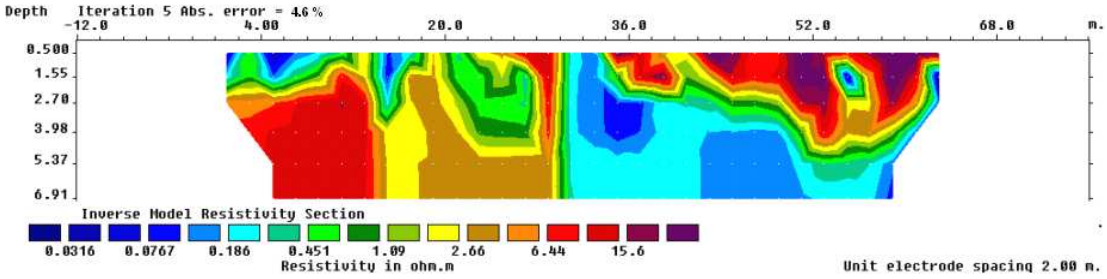

Fig. 4.5 Pseudosection shows resistivity study of saltwater intrusion at Van islands profile 5.

Water level measurements and tidal variation in the experimental site

The rise in the water level, which is virtually, hydrostatically in nature is generally ignored, and induces the coastal aquifer turning saline. The saline water intrusion and saline water zonations in the coastal area and coastal erosion would occur due to increase of sea level rise in the coastal areas [14]. Displacement pseudosections time bound variation salinity structure description should be made for each curve.

Resistivity imaging studies pseudosection interpretations

The monitoring of seawater infiltration into the beach groundwater of the Van island through Electrical resistivity imaging study reveals the following subsurface information (Fig3.). The movement of the seawater into the landward side of the island is delineated by the inversion resistivity values of pseudosection (Figs. 4.1,4.2,4.3,4.4 and 4.5).The pseudosection plotted for the data recorded shows the seawater with a range of resistivity values from 0.0316 to 1.09 Ohm.m. This section exhibits isolated batches of the seawater intrusion. The pseudosection for the data obtained the salinity structure. The pseudosection recorded for the data shows that the saltwater is identified through the inversion resistivity that ranges from 0.0136 to 1.09 Ohm.m. The size of the of salinity structure is increased from the seaward to the landward side. The resistivity that ranges from 2.66 to 15.6 Ohm.m can be accounted for sand dunes and sand deposits. In the upper part of the beach, it is composed of coral skeletons and other coarse grained materials. The high tide water percolated through these sediments were easily drained out. As a result of that the electrical resistivity study reveal high resistivity values in the upper part of the beach in these section. The decrease in the resistivity value down through the vertical is understood to be the product of an increase in saline content [13],[1].

CONCLUSION

In the beach and near the shore region, wind generated waves and tides induce the hydrodynamic change of groundwater in the beach. Van island, in the Gulf of Mannar located 5 km east of Tuticorin and monitored 2D electrical resistivity imaging technique with five profile length of 80 m to study the beach groundwater fluctuation caused by oceanic oscillations. The pseudosections plotted for the data obtained for the experimental periods reveal the landward movement of salinity structures. The disappearance and the development of new salinity structures clearly correspond with the sea level fluctuation contemplating on the hypothesis of the rise and fall of the beach groundwater table which are exerted by oceanic movement. Thus it is evident that the water which exists in the surface layer is hyper saline and no freshwater zone is identified in the locations.

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