

Exploration of Freshwater Movement in Palaeo River and Coastal Environmental Study Using 2D ERI Study in Zirconium Complex, Atomic Energy, Pazhayakayal, Thoothukudi

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Abstract: The case study of palaeo river freshwater channel was identified in the coastal area near Zirconium complex, Atomic energy, Pazhayakayal, Thoothukudi. The 2D ERI techniques were used to explore coastal aquifer and geomorphological condition. The palaeo river channel was identified in the past 300 years branches from Tamirabarani River. The study area was covered by soil, caliche deposit, highly clay deposit, mud flat, geological and palaeo geomorphologic condition. The palaeoriver channel is contains with freshwater aquifer flow direction identified through 2D ERI technique The six profiles study were conducted using 2ERI with Wenner array to determine by obtained range of resistivity (salt water, clay deposit 1-5 ohm.m, calchie or sandstone deposit 10-100 ohm, freshwater aquifer 100-120 ohm).

Key words: Palaeo river % 2D ERI % Thoothukudi % Zirconium complex % Grounwater movement % Apparent resistivity

INTRODUCTION

The geological, geophysical studies were carried out at near Zirconium Complex, Department of Atomic Energy, Pazhayakayal, Tuticorin to identify the under groundwater flow movement using 2D ERI (Electrical Resistivity Imaging) technique. The study area lies between the latitudes N 8° 41' 9.7"-N 8° 42' 40.9" and longitudes E 78° 7' 23.0"-E 78° 7' 54.1'', exactly at the coastline of Bay of Bengal (Fig. 1) An attempt was made to decipher water flow movements [1], Karanth [2], Parasnis [3], Suresh Babu *et al.* [4], Renolds, [5] and hydraulic status in the palaeo river channel. The lithology of the area is mainly composed of coastal sand, laterites soil, kankar, clays and fossiliferous calcareous sandstones. The study area is located at 400m away from the sea and the adjoining geo features like bays, lagoons, estuaries, dunes, beach widths, backshore widths, mud banks are also taken into consideration for this study [6].

Instrumentation and Method: The use of 2D ERI technique is easily to identify the water flow movement in the coastal aquifer and palaeoriver channel in the Zirconium Complex, 2D the electrical resistivity imaging

techniques adopting the Wenner configuration by using the CRM 500 resistivity meter, multi-core cables, stainless steel electrodes and RES2DINV software were used. The Wenner array is a common electrical resistivity method used to find out the horizontal and vertical resistivity changes below the surface of water [7, 8]. The geometrical factor of this array is $2Aa$ [9]. Among the common arrays, the Wenner array has the strongest signal strength [11-12].

Beach profiles were surveyed for topographical variations using Auto-level from high water line to a distance of 400m towards the study area. The electrical resistivity imaging studies were carried out from six locations. A length of 150metre with electrode interval varied from 5, 10, 15, 20, 25, 30 and 35m respectively in the landward side. The stainless steel electrodes of 30 nos pierced at a depth of 15 to 20cm into the sandy layer with an interval of 5m connected with multi-core cables. The Wenner array is a common electrical resistivity method used to find out the vertical resistivity changes below the surface of water [7]. The Extensive developments of coastal dunes in the study area reflect the possible sediment supply. The topographical variation using auto level in that area were measured for beach face

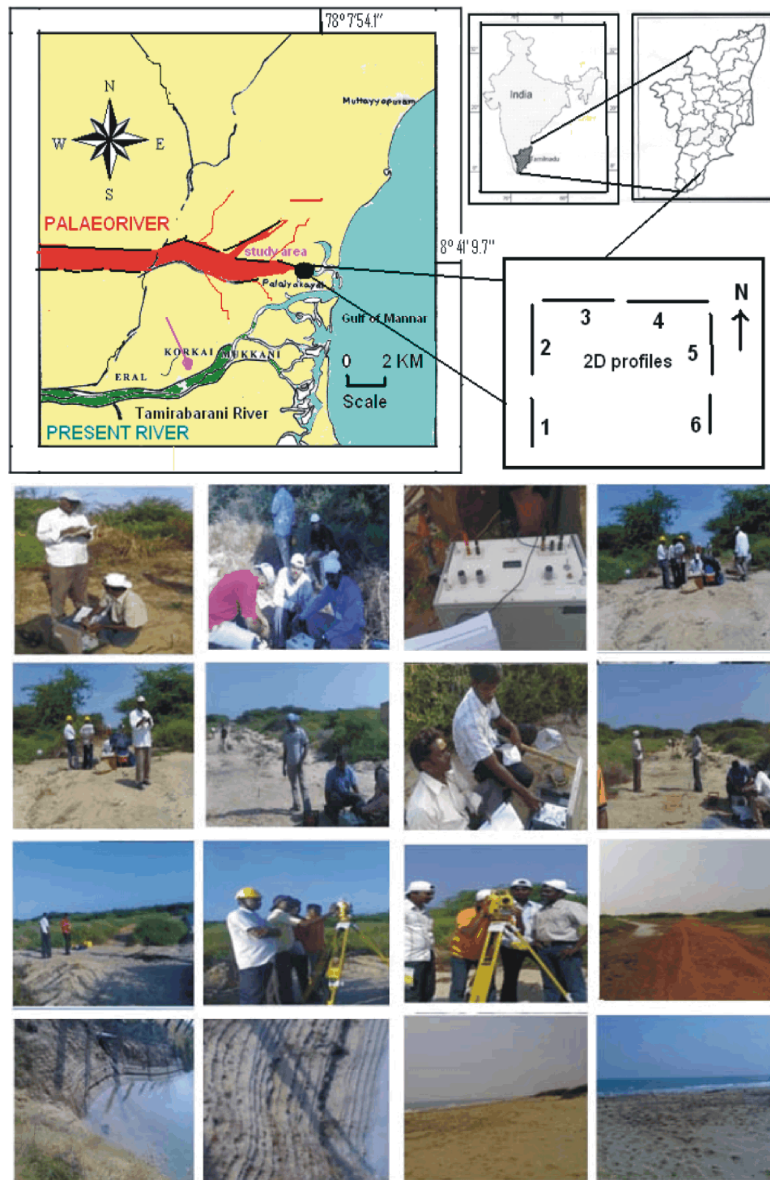


Fig. 1: Location map of the study area; 2D Electrical Resistivity Imaging data collections and nearest geological feature

slope, back shore width and average dune heights. The average backshore elevations of the study area measured as 2.5m from MSL.

2ERI Interpretation

2D ERI Profile 1: This Profile tends from W to E to a length of 150m and shows the high resistivity zone which is in between 130 and 685 ohm.m encircled calcareous sandstone. The high resistivity zone indicates the presence of hard and compact rock calcareous sandstone. The freshwater zones are obtained from the sandstone formation. The low resistivity zone falls below the 0.966

ohm.m which indicates upto a depth of 16m from subsurface. The geometry of the low resistivity zone implies the presence of saltwater (Fig. 2.1).

2D ERI Profile 2: This profile starts from South to North direction, 150m distance from northern part of the study area. The low resistivity zones from 0.8998 to 6.8 ohm.m with dark blue to light blue colour are seen at the centre. These low resistivity layers are engulfed by the saltwater below 6m from the surface. These low resistivity zones can be interpreted with clay rich soil upto the depth of 2.5m (Fig. 2.2).

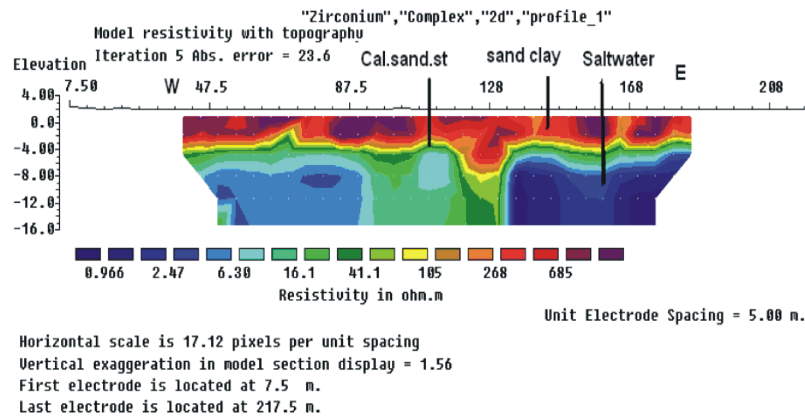


Fig. 2.1: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

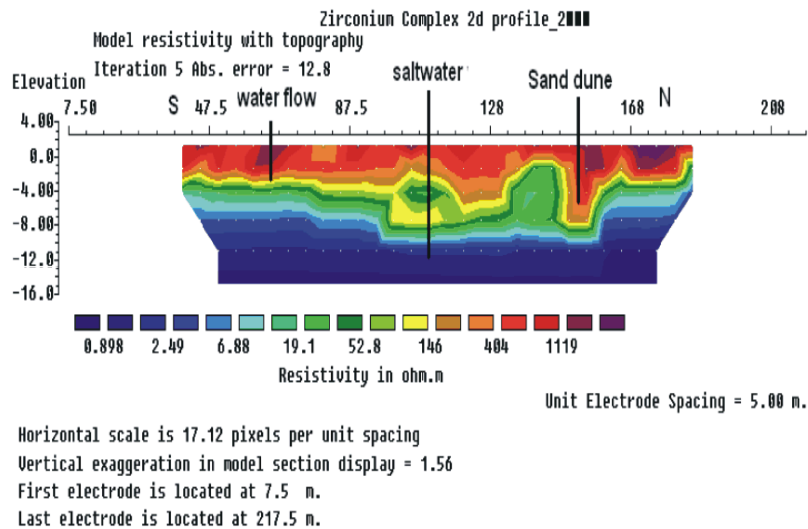


Fig. 2.2: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

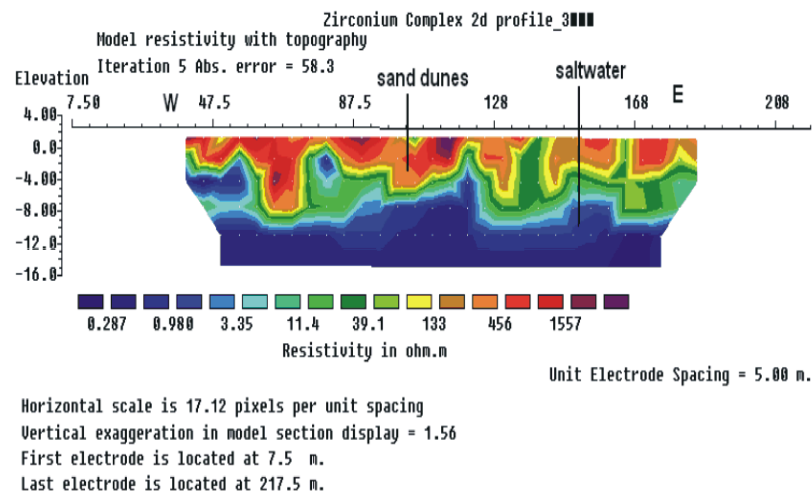


Fig. 2.3: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

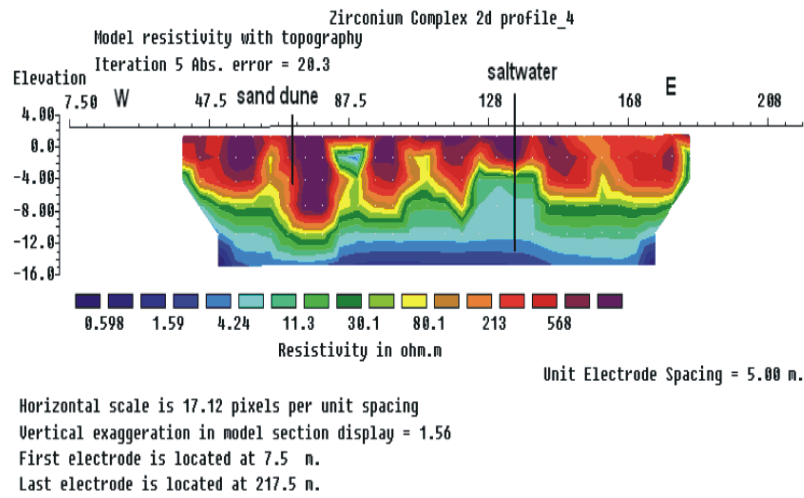


Fig. 2.4: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

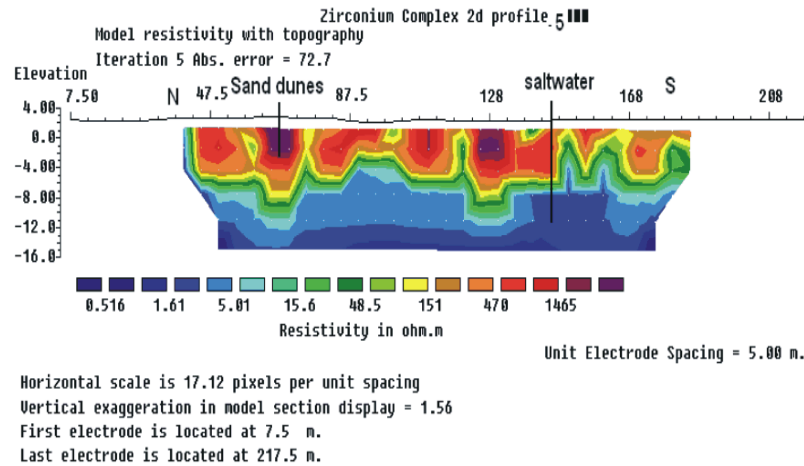


Fig. 2.5: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

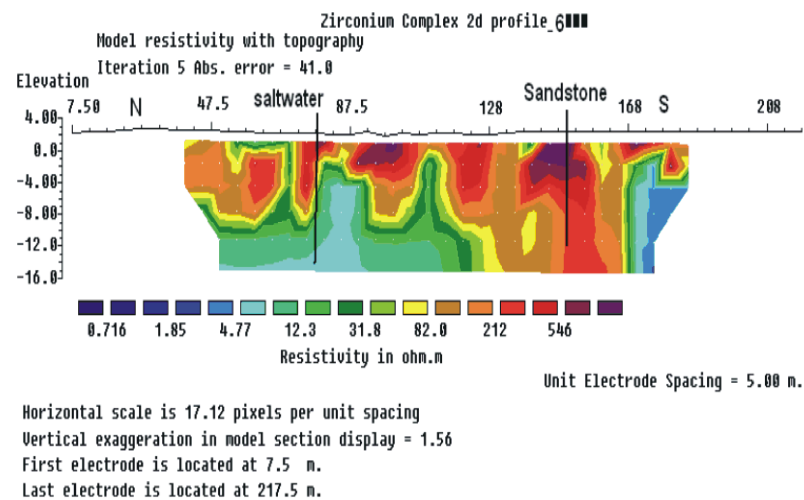


Fig. 2.6: 2D electrical resistivity imaging and environmental impact and ground water moment study at Zirconium Complex, Pazhayakayal

2D ERI Profile 3: The third profile is positioned 40m apart from the second profile in NE part of the study area and tends to a distance of 150m. In this part, the high resistivity zones with the value ranges from 140 to 1119 ohm.m which indicates the exposure and the downward extension of the hard and compact sandstone. The intermediate beds between the low resistivity beds and high resistivity zone exhibit the resistivity variations from 0.287-3.35 to 100 ohm.m (Fig. 2.3).

D ERI Profile 4: The profile 4 tends from W-E to a length of 150 m in the middle of the experimental site. The water flow movement from west to east is found downwards. The upper the layer and at the depths of 3.5 to 7.5 m are indication of saltwater by the low resistivity ranges from. 0581 to 4.21 ohm.m. The admixture of the clay soil in the middle sandstone layer exhibits comparatively high resistivity values of 20 to 100 ohm.m (Fig. 2.4).

2D ERI Profile 5: The 2D inversion resistivity pseudosection profile 5 tends S-N direction to a length of 150m. The pseudosection image basically shows three differentiation layers. First layer contains clay and kankar which measures low resistivity ranges from 6.88 to 52

Ohm.m. The Second lower layer is having high resistivity ranges from 12-82.5 Ohm-m that is interpreted to characterize the sandstone and silt stone layer respectively. The Third layer of lower resistivity ranges from 0.088 to 6.88 Ohm.m which represents the saltwater (Fig. 2.5).

2D ERI Profile 6: The profile 6 trends from S-N direction to a length of 150m. The inversion resistivity pseudosection displays the upper layer sand, clay and kankar deposits which have the resistivity ranging from 12.3 to 82.8 Ohm.m. The range of resistivity of the saltwater horizon in the profile varies from 0.716 to 4.77 Ohm-m which represents intermediate layer (Fig. 2.6).

CONCLUSION

The geophysical investigations of six 2d profiles have been carried out to assess the subsurface hydrogeological condition to a depth about 15 m (Table 1) Based on the interpretation of geoelectical data, the following conclusions are drawn (Fig. 3). The survey was conducted at six 2D Profiles to a length of 150m. 2D pseudosection were constructed for each sites and they

Table 1: Summaury of 2D ERI interpreataion

Geological Foramtion	Profile1 (W-E)	Profile 2 (S-N)	Profile 3 (W-E)
Sand, Clay and Sandstone	6.30-41.1 Ohm.m	6.88-52.8 Ohm.m	6.88-100 Ohm.m
Freshwater table	105 Ohm.m	100-120 ohm	100-200 ohm
Calcareous S.st	130-685 above	146-1119 above	140-1557 above
Saltwater	0.966-6.30 Ohm.m	0.8998-6.88 Ohm.m	0.287-3.35 Ohm.m
Geological Foramtion	Profile 4 (W-E)	Profile 5 (S-N)	Profile 6 (S-N)
Sand, Clay and Sandstone	11.4-100 Ohm.m	6.88-52.8 Ohm.m	12.3-82.3 Ohm.m
Freshwater table	100-200ohm.m	100-120ohm	100-120ohm.m
Calcareous S.st	150-568above	140-1179above	140-546above
Saltwater	0.598-4.24 Ohm.m	0.898-6.88 Ohm.m	0.716-4.77 Ohm.m

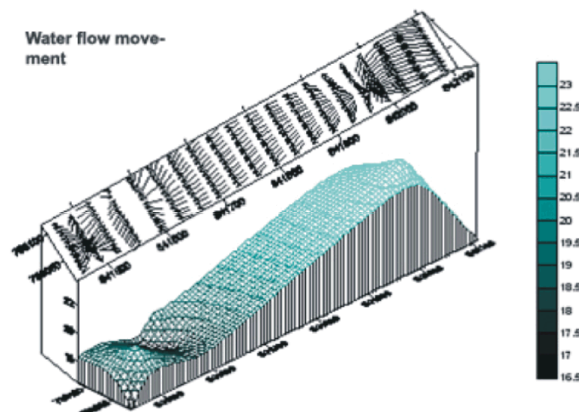


Fig. 3: Shows the freshwater flow movement direction in feet

show a zones of high resistivity between 150 and 400 ohm.m which is encircled by a calcareous sandstone. The low resistivity zone falls below the 0.966 ohm.m which indicates saltwater upto a depth of 16m from subsurface. The geometry of the low resistivity zone implies the presence of saltwater. The pseudosections plotted from the data obtained for the study area reveal the saltwater movement of salinity structures. The study based on the constructed 2D pseudosection profiles (Fig. 2.1 to 2.6) a perfect subsurface lithounits (Rocks) and flow movements of the groundwater were established compared with bore hole data at Zirconium Complex, Pazhayakayal, Tamilnadu.

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