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Analysis of Clam Hill Site in Aceh Tamiang Using Geo-electric Method

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Abstract. The clam hill site is a prehistoric relic which is a pile of million pieces of shells. Disclosure of the fact the formation of the clam site is essential to study. The purpose of this research is to analyze the subsurface area of the Clam Site in Aceh Tamiang. The Wenner-Schlumberger as a type geo-electric method is used in this research which contains six passes. The length of the track is 155 m using 32 electrodes with a distance between the electrodes 5 m. Res2Dinv Software and Surfer 11 software are used to process the geo-electric data. The results of the analysis obtain the resistivity value of the pile of the shell is between 19,5 Ωm to 4768 Ωm which is different from the surrounding resistivity of 0 to 29.800 Ωm . The surrounding site is dominated by beach and river surface deposits in the form of clay, sand, and gravel with low soil and rock carrying capacity. According to archaeology, heaps of shells come from the remnants of ancient human civilization in Aceh Tamiang.

1. Introduction

The Clam Hill site is a prehistoric relic that is a pile of millions of shells leftover from ancient human civilization in Aceh. The Clam Hill is a historical tourism site located in Aceh Tamiang District, precisely in Mosque of Bendahara Sub-district. The Clam Hill which has thousands of years of age makes it increasingly forgotten, moreover due to a lack of local government attention to maintenance and preservation. The Clam Hill site is in a very worrying condition because it has been exploited by local people by taking calcium from the shells which have an impact on the reduction in the height of the clam hill from 7 meters, now leaving only 3.5 meters, and part of the surface has been covered with soil and weeds [1].

The inheritance of The Clam Hill site within the plantation is still to be a question of what and why The Clam Hill site appears. Problem identification is seen from The Clam Hill site layer area so that the presence of The Clam Hill site can be identified. Methods and measuring devices that can measure physical parameters related to subsurface structures by using the Geo-electric Method [2]; [7].

The geo-electric method is one of the methods that used to investigate subsurface structures. The Geo-electric Method uses the value of resistivity under the surface to determine and study the types of layers and the number of layers below the surface [3]; [8]. Geophysical methods detect bedding areas by analyzing the distribution pattern of the subsurface layer of clay with resistivity values of 0-100 Ωm , tuffa with resistivity values of 200-1,000 Ωm and soil layers with the resistivity of 250-500 Ωm [2]; [9].



2. Theory

2.1. Description of The Clam Hill Site

The Clam Hill site is located in Aceh Tamiang bordering to North Sumatra. The Clam Hill site is located in the Bendahara Sub-district which is a low-lying downstream area where the Yu river sediments flowing from upstream. Brackish water from the Yu river reaches The Clam Hill site so that the sediment soil is wet.

The Clam Hill is a pile of shells with a height of almost 4 meters with an area of around 80 m². Clams in the area, there are clotted and petrified. The results of archaeologist's research, the height of The Clam Hill is seven meters before, but now increasingly reduced. Experiencing exploration to a height of only about three to four meters [4].

2.1.1. Wenner-Schlumberger Configuration

Sounding measurement is a measurement of the subsurface with the aim to determine changes in electrical resistivity vertically downward. The Schlumberger configuration in Figure 1. gives the advantage of detecting non-homogeneity of rock layers on the surface. The Schlumberger configuration in Figure 2 for the apparent electrical resistivity of a half-space medium is determined by the equation:

$$\rho_a = K \frac{V}{I} \quad (1)$$

with:
$$K = \frac{2\pi}{\left(\frac{1}{a-b} - \frac{1}{a+b} - \frac{1}{a+b} + \frac{1}{a-b}\right)}; \quad a = \frac{A}{2}, b = \frac{M}{2}$$

AB = distance current electrode (m); MN = distance of potential electrode (m); K = geometric factors as functions a and b.

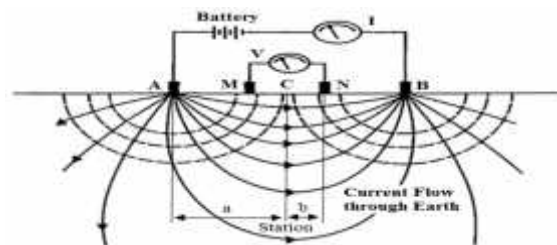


Figure1. Schlumberger Configuration

The Wenner configuration provides information on changes in electrical resistivity horizontally, and a measurement technique known as profiling. The arrangement of the electrodes in the Wenner and Schlumberger configurations is given in Figure2.

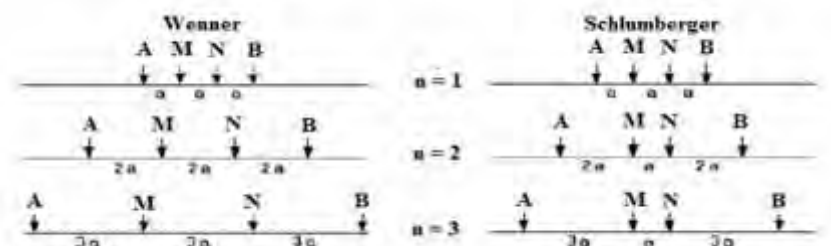


Figure 2. The arrangement of the electrodes in the Wenner and Schlumberger configurations

The Wenner – Schlumberger configuration is a hybrid between the Wenner configuration and the Schlumberger configuration. Schlumberger configuration is the configuration most often used in sounding studies. The Wenner – Schlumberger configuration has wider horizontal data coverage than the Wenner configuration. A comparison between the data coverage in the Wenner configuration and the Wenner – Schlumberger configuration is given in Figure 3.

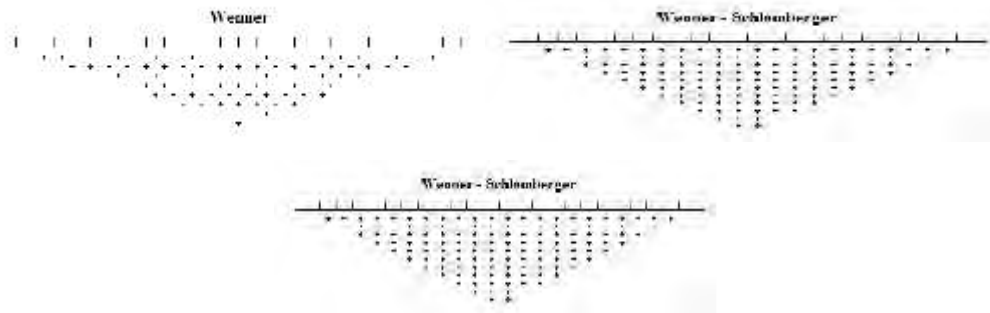


Figure 3. Comparison of Data Coverage between the Wenner and Wenner-Schlumberger Configurations.

3. Research Methodology

3.1. Place and Time of Research

The research was carried out in the Mesjid Village, Bendahara Sub-district, Aceh Tamiang District (Figure 4). Processing of data in the Earth Physics Laboratory, Medan State University.



Figure 4. Research Location

3.2. Field Data Collection

Research Area at The Clam Site located in Mesjid Village, Bendahara Sub-district, Aceh Tamiang District. Measurement of soil resistivity with a Geo-electric (Resistivity meter) type ARES-G4 v4.7. Field data collection using the geo-electric method with the Resistivity Metr ARES-G4.v47 (Automatic Resistivity System) serial number SN: 0609135. Determination of the path taken in the Bukit Kerang site area using a compass and Global Position System (GPS) map 76CSx in UTM coordinates with a length of 155 meters. 6 tracks were taken. Each path consists of 32 electrodes with a distance between the electrodes of 5 meters (Figure 5).

GPS data is processed using Surfer 11 to show the topography of the study area according to coordinates and elevation. Processing data obtained from ARES Geoelectric data using Software Res2Dinv to obtain a 2-Dimensional cross-section along the trajectory.

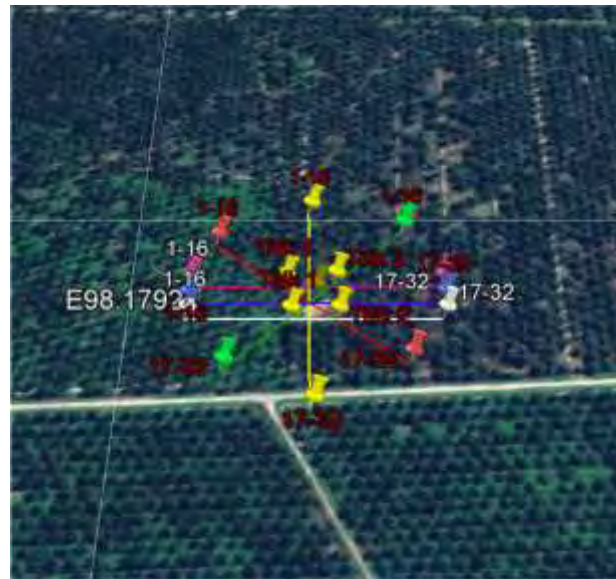


Figure 5. Tracks of Data Collection

4. Result and Discussion

4.1. Topographic of The Clam Site

Bendahara Subdistrict is located at coordinates $04^{\circ}43'32.00''$ $-05^{\circ}06'57.00''$ NL and $96^{\circ}41'28.00''$ $-97^{\circ}39'34.00''$ EL with an area of $132,535 \text{ km}^2$. Data on the coordinates and elevation of the study area using GPS were processed using *Surfer 8*. The topography of the study area is shown in Figure 7. The research area is a plantation area in which there are hills formed from shells. The study area has an elevation of 11 masl - 22 masl. The Clam Hill site has a height of about 3 to 4 meters appearing at the surface of the ground, the rest is underground.

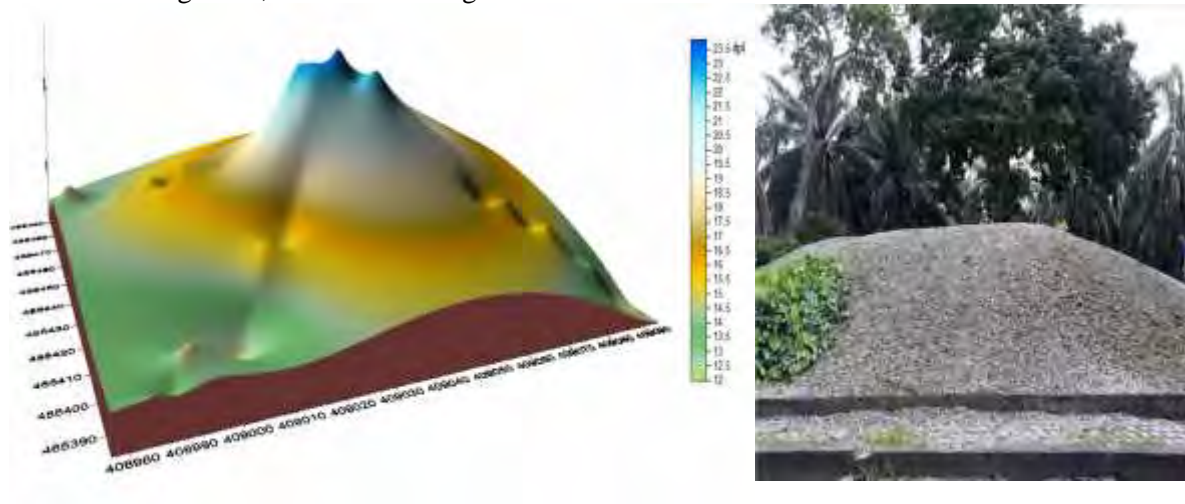


Figure 6. Topographic of The Clam Site

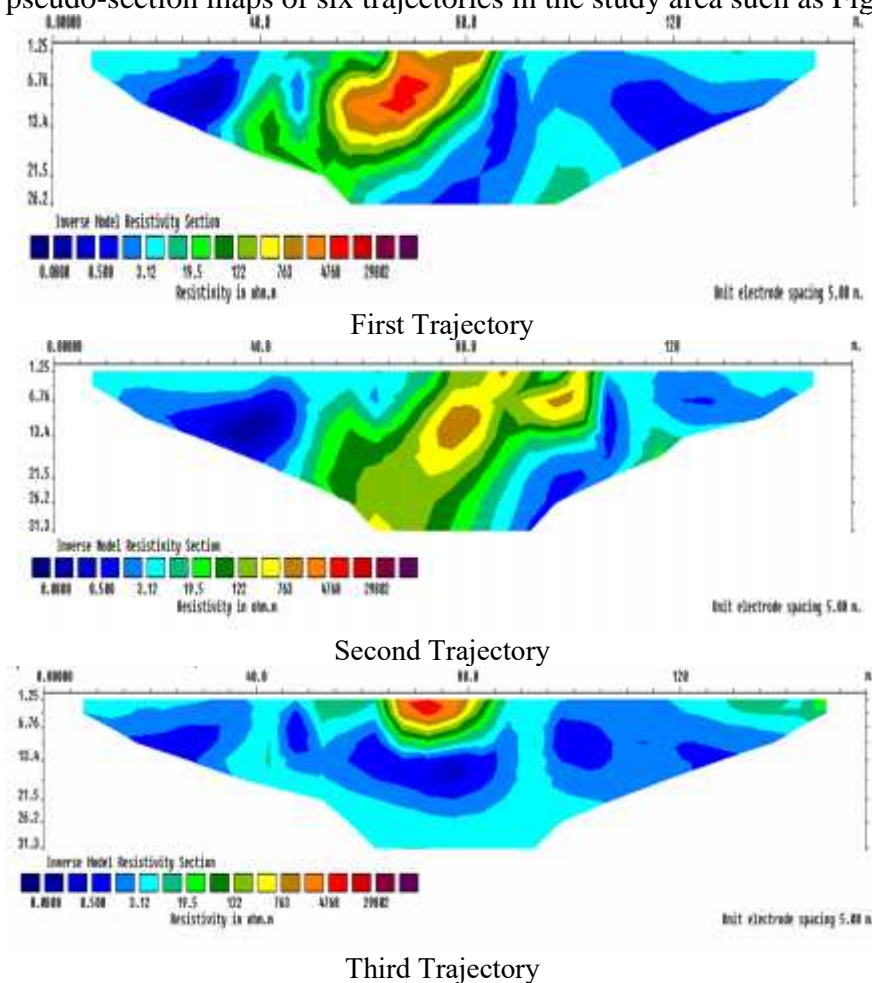
Shells at The Clam Hill site are sediment of clams from the gastropod and pelecypods classes which are weathered, lumpy and petrified (Figure 8). The condition of the Clam Hill site looks damp even though it is already on the fence and is limited by a block so that the pile of clam shells does not collapse. Stagnant water in between oil palm trees still dominates the area around The Clam Hill site which naturally accelerates the weathering process with temperatures of 22° - 32° C with humidity of 65-95% [5].



Figure 7. Condition of Shells in The Clam Hill Site

4.2. Result of Geo-electric

The results of geoelectric data are used to determine subsurface patterns of the cliff hill site area by looking at rock resistivity. The distribution of subsurface rocks was obtained from a pseudosection map of the results of the inversion model with Res2DinV software. The results of resistivity pseudo-section maps of six trajectories in the study area such as Figure 8.



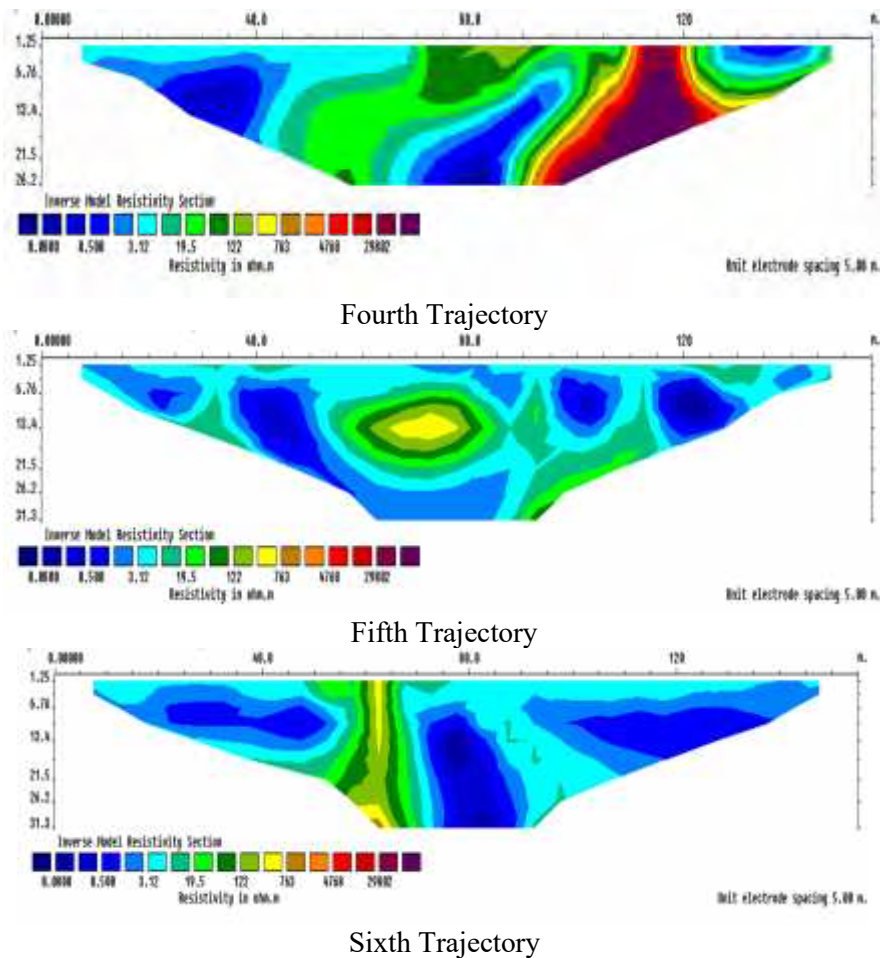


Figure 8. Map of Resistivity Pseudoseksi

The resistivity pseudo-section map in Figure 8 was identified according to the resistivity value. The data shows that the resistivity value of The Clam Hill Site area has a resistivity value from 0 - 29,802 Ω m. Types of sub-surface soil bedding identified according to the resistivity values are described in Table 1.

Table 1. Identification of Resistivity Value of The Clam Hill

No.	Colour	Resistivity (Ω m)	Kind of Layers
1		0 - 0.5	Ground Water
2		1,8 – 122	Clay, Claystone, Gravel, Alluvium
3		442,5 – 4768	Alluvium, Sand
4		17.285 – 29802	Dry Gravel

The analysis results obtained in Table 1 show the layers of the study area are dominated by water, clay, sand, and gravel originating from coastal and river [6]. Layers of water and clay marked in blue are in the top layer to the subsurface. The study area is a brackish water area with environmental conditions changing from mangrove forests to oil palm. The color green to red with a high resistivity

value of 440-171725 Ωm is an alluvium and sand layer derived from rocks in the form of shell deposition which is weathered, lumpy and petrified.

The rock layer in the form of shell deposits looks clearly different from the surrounding area which is sediment from the beach and river. The deposition of shellfish is insitu, so it is estimated that it was a layer that originated from community waste several thousand years ago. Archaeological deposits of shells are derived from the remnants of ancient human civilization in Aceh Tamiang [4].

5. Conclusion

The results showed that The Clam Hill Site area is an area in the lowlands. Geo-electrical analysis showed that the type of bedding at The Clam Hill Site area was weathered shells with resistivity values of 19.5 Ωm - 4768 Ωm different from the surrounding resistivity of 0-29,800 Ωm which were dominated by coastal and river surface deposits in the form of clay, sand and gravel with a resistivity value of 19.5 Ωm - 29m - 4768 Ωm low soil and rock bearing.

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