Study of Groundwater in the Rock Area Using Geoelectric Survey

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Abstract. Investigation of underground water becomes very important because it involves human life. The difficulty experienced by the community is the limited potential of underground water, this is due to the uneven distribution of underground water in an area. The purpose of this study is to investigate the presence of groundwater in subsurface rock areas. Groundwater investigations around the bedrock have been successfully carried out using the geoelectric method. The geoelectric survey with Schlumberger configuration was carried out in the investigation area. The results of the study have been observed zones that contain groundwater around rocks with varying thicknesses of 73.25 meters and 119 meters.

1. Introduction
Payung Sekaki District with the potential for population growth with an average growth of 4% per year will have an impact on increasing groundwater uptake. The thing that must be considered for groundwater management is the ground water extraction rate [1]. So that the availability of groundwater potential data is very important. Geologically the layer of rock that contains groundwater is related to igneous rock conditions, and soil permeability [2,3].

The condition of igneous rock greatly influences the thickness of the surrounding sedimentary rock layers [4]. Thin sedimentary layers usually correlate with igneous rock conditions that are near the surface, or even cannot be found [5]. Potential underground water in an area is determined by the thickness of the sedimentary layer, so to get shallow groundwater or deep ground water is closely related to the existence of basic rocks [6].

Geoelectric methods for groundwater exploration have been widely researched [7,8], so that groundwater potential studies can be reported in full. This geoelectric study can also illustrate the geomorphology of the investigation area [9,10]. Based on geoelectric information can illustrate whether the groundwater potential in an area is in good condition or lacking [11,12].

This article will discuss the results of geoelectric studies on the presence of groundwater around the bedrock using the Schlumberger rule geoelectric method, where these results can be used as reference material for other regions that have similar geological conditions.

2. Methodology
The first step that must be done is observation to find the location of geoelectric measurements using Google earth. Furthermore, a geoelectric investigation using the Schlumberger rule is conducted. The total length for one track is 300 meters, while in the investigation two tracks are used. Then the measured data are electric current, electric voltage and electrode distance, then this data is processed to
get apparent resistivity values, which are then processed with Progress software to get the true resistivity. The results of this measurement will be used for underground water exploration studies around rocks.

3. Results and discussion

The results of the survey and geoelectric measurements in Akap are carried out in the direction of the East-West geoelectric line with coordinates N: 0° 29’ 55.03”, and E: 101° 23’ 32.89”, the graph of data processing results is obtained. Figure 1.

![Figure 1](image_url)

**Figure 1.** The results of geoelectric modeling based on measurement data and data models in the Akap area of Payung Sekaki District.

Based on Figure 1, there can be seen five layers of rock. Resistivity The first layer is 38.4 Ωm having a thickness of 6.65 m which is clay. Resistivity The second layer is 94.1 Ωm having a thickness of 73.25 m, is interpreted as a layer of sandy loam containing surface water or shallow aquifers. The third layer with a resistivity of 707 with a thickness of 155.1 m, this layer is interpreted as an alluvium layer. The fourth layer with a resistivity of 102 Ωm with a thickness of 119 m, this layer is interpreted as a layer of sand or unconfined aquifer. And the fifth layer with a large resistivity of 3000 Ωm is the bedrock layer.

The results of geoelectric measurements in Labuh Baru, Payung Sekaki District were conducted in the direction of the North-South geoelectric line with coordinates N: 0° 30’ 41.59”, and E: 101° 25’ 42.99”, then obtained graphs of data processing results as shown in Figure 2.
Based on the inversion results with Progress 3.0 software in Figure 2, there were five layers of rock. The first layer resistivity value is 47.48 $\Omega\text{m}$ with a thickness of this layer is 9.5 m, which is interpreted as a layer of clay. The second layer has a resistivity value of 95.05 $\Omega\text{m}$ with a thickness of 74.93 m which is interpreted as a layer of sandy loam containing surface water or shallow aquifers. The third layer with a resistivity of 654.9 $\Omega\text{m}$ with a thickness of 156.77 m, this layer is interpreted as an alluvium layer. The fourth layer with a resistivity of 93.45 $\Omega\text{m}$ with a thickness of 114.8 m, this layer is interpreted as a layer of sand or unconfined aquifer. And the fifth layer with a large resistivity of 3000 $\Omega\text{m}$ is the bedrock layer.

Based on the geological map of the Pekanbaru sheet, the formation layer in the Payung Sekaki District area is geologically old alluvium. As a reference for the interpretation of the geological formations of this area is the Minas formation (Qpmi) consisting of gravel, distribution of crust, sand and clay. Located in the members of the Kuantan formation (Puku) consisting of tuff and clay alluvium sand which is a present sediment in the form of young alluvium and old alluvium consisting of gravel, sand, clay, peat, plant residues and peat.

Underground water reserves in Payung Sekaki District Pekanbaru City are obtained from the following calculation results, where underground water reserves are determined based on the thickness of the underground water layer by calculating the area of Payung Sekaki District.

a) Shallow underground water

The results of the interpretation that the thickness of the shallow underground water layer in Payung Sekaki District is between 73.25 m to 74.93 m with an area of 51.36 Km$^2$ or 5.136 x 10$^9$ m$^2$, then shallow underground water reserves in Payung Sekaki District between 37.62 x 10$^{10}$ m$^3$ to 38.48 x 10$^{10}$ m$^3$.

b) Deep underground water

The results of the interpretation of the thickness of the deep underground water layer in Payung Sekaki District are between 114.8 m to 119 m with an area of 51.36 Km$^2$ or 5.136 x 10$^9$ m$^2$, then get deep underground water reserves in Payung Sekaki District, Pekanbaru City between 58.96 x 10$^{10}$ m$^3$ to 61.12 x 10$^{10}$ m$^3$. 

Figure 2. The results of geoelectric modeling based on measurement data and data models in the Labuh Baru area of Payung Sekaki District.
4. Conclusion
Studies conducted using the geoelectric exploration method Schlumberger rules have explained the geohydrological conditions of an area. The lithology structure of subsurface rocks (geomorphology) can also be demonstrated, and the presence of groundwater can also be clearly demonstrated along with its thickness, so that the potential of groundwater in the area under study can also be determined.

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