POTENCY OF SOIL WATER IN MASINAM ISLAND BASED ON THE ROCK RESISTIVITY VALUE

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ABSTRACT

Groundwater is water that is contained in soil layers or rocks that are located below the soil surface. The resistivity or geoelectric method is used to obtain an anomaly of material under the surface using electrical properties. 2 Dimensional Geoelectric Measurements are carried out as many as 5 Tracks. From the results of the analysis based on surface data, the resistivity distribution value in the study area can be interpreted to obtain 3 rock packages with low, medium and high types of resistance. If it has low resistance (smaller than 45 Ωm), the lithology in this package is claystone, this layer is interpreted as not being able to store water and tends to easily escape the water. While the value of the medium type of resistance (45 µm to 200 Ωm) has good porosity. The lithology of this package is interpreted as sandstone. Lithology at high resistivity values (greater than 200 Ωm), is interpreted as limestone. This limestone layer is presumed to have undergone a karstification process and presumably, this layer has the potential to be a good aquifer that can accommodate enough water and drain at a certain time.

Keyword : resistivity, groundwater, limestone

INTRODUCTION

Masinam Island is an island that has an area of 400 ha, with a total of 800 inhabitants, relying on water derived from ground water and groundwater lenses for terrestrial and domestic ecosystems. The amount of rainfall ranges from 2000-2500 mm / year, while significant groundwater uptake through evapotranspiration can occur on this closed island.

The problem in the field is the difficulty of evaluating refilling and absorbing water by direct methods in the field and involving a lot of uncertainty (Jocson et al., 2002; Sanford, 2002; Conte, 2007). Regarding the geometry and configuration of aquifers, the Center for Geological Environment (2007) provides a limitation that determining the lateral and vertical boundaries of a groundwater basin will show the geometry of a groundwater basin. Determination of lateral and vertical flows of aquifers and non aquifers shows aquifer system configurations. Parhusip (2001) added that the review of groundwater has a fairly wide scope, including types of aquifers, aquifer parameters that show aquifer characteristics, and their use and quality.

One method used in subsurface exploration is the geophysical method. The use of geophysical methods for subsurface exploration is carried out to obtain a qualitative and quantitative picture. The geoelectric method is used to determine the resistivity of earth materials. The conditions of the subsurface electrical properties are related to various geological parameters, namely: porosity, a water content in rocks (Telford et. Al, 1990; Loke, 2006).

GEOLOGY OF RESEARCH AREAS

West Papua Bird's Head Physiography has six types of landscapes as a result of complex geological processes (Figure 1). The six landscapes that are broadly defined as the physiography of the Sorong area include: rough hills of rough hilly terrain, inter-mountain valleys of inter-mountain valleys having two valleys which are influenced by faults in the northeastern part of Papua (Restu, 2017).

These hills and physiographic karst mountains develop in limestones exposed in the Morait Mountains and in the southwest, central and western Batanta Island, and on Mansuar Island. The area is in the form of a bulge with a narrow, elongated notch which is a typical pattern of raised reefs. This low physiographic hilly area extends to the west including Salawati Island (Dow and Hartono, 1982; Restu, 2017).

This hilly area occupies a path that runs west - southwest which covers the central part of Papua, which is around the Klasaman and Klamogun areas. Around the Klasaman the area consists of hilly areas that resemble carcasses. Alluvium Plateau Physiography is located at an elevation of 0-50 meters above sea level covering the southern part of Papua, the east, south, and southwest, Salawati Island, and a number of islands in the Sele

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Strait. This physiographically lifted coral reef forms all or certain parts of the island that belongs to the Schildpad Islands, Mainfield, Boo, Fam, Kofiau, and Doif (Dow and Hartono, 1982, Restu, 2017).

The pre-collision bird head lithology arrangement is considered as part of the Indo-Australian Continent, can be illustrated through the tectonic and stratigraphic development of the northern Indo-Australian continental basin. Two tendencies toward the basin are found in the northern part of the continental crust, namely the Paleozoic Basin (600 - 400 million) and the Mesozoic Basin (around 200 million). This shows that there were two rifting periods. The Paleozoic Expansion, this division was not followed by a break-up, but by the general decline and transgression of the sea, formed the deposition of the rift system. The Mesozoic expansion is shown by the tipuma formation as a syn-rift deposit in the Jurassic Triassic, followed by continental breakdown and shifting of the Indian Continent and the formation of passive margin environmental deposition. Structural control in the study area came from the Sorong Fault structure which was directed to the east-east which then continued with the north-southwest direction of the Ransiki Fault System (Restu, 2017). The composition of rocks in the research area can be separated into 2 rock units (Restu 2017), which consists of carbonate sandstone and alluvial deposits.

A. Carbonate Sandstone

The distribution of fine-grained, easily weathered coated carbonate sandstones, including claystone, laminated sedimentary structure and large-scale crossbedding, mineral calcarenit located on Masinam Island, forms a natural betang in the form of relatively long isolated North-South hills, carbonated sandstones based on Miocene relative age - Plistocene with a depositional environment in the form of shallow sea to the litoral followed by the growth of reefs and local mixes of rags between materials from older formations, in some places there are defined caves. At the upper elevation, there are limestone reefs, local sandstones intermittent with claystone (Restu, 2017).

B. Alluvial deposits

The spread of alluvial deposits is in the coastal area of Masinam Island and forms a plains landscape. This sediment generally in the form of coral limestone material, composed of coral deposits, which are quarterly in age (Restu, 2017).

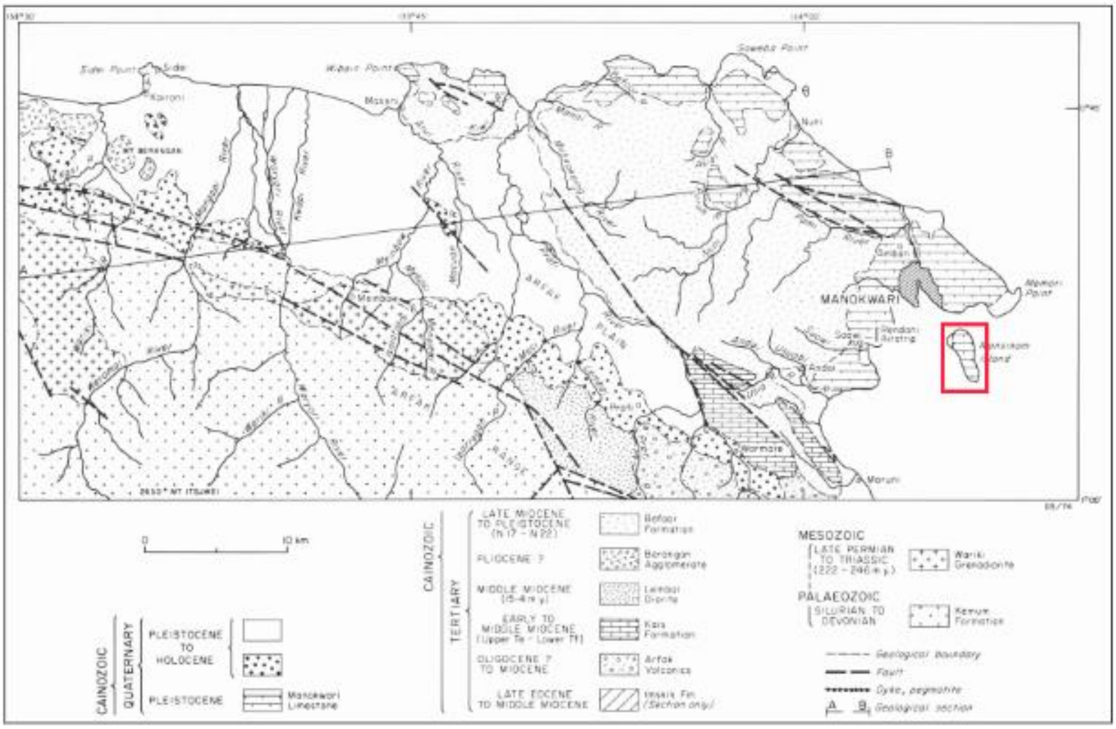

Figure 1. Manokwari regional geology

RESEARCH METHOD

The research method used is 2D Geoelectric Method. This method measures the apparent resistivity in a lateral direction. Measurements are made by removing potential electrodes and currents according to the design and

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configuration that has been determined at the time before going to the field. To find out the subsurface geological characteristics in need of a basic principle used in geoelectric estimation is by flowing electric current into the earth so that electric fields emerge around both current electrodes A and B. This geoelectric probe includes detecting the potential field magnitude, electromagnetic fields and electric currents that flow in the earth both naturally (passive methods) and due to injection of current into the earth (active method) from the surface. If the conditions on the earth's surface are homogeneous, isotropic, the same stress will occur in all places, but because the conditions below the earth's surface are in fact not homogeneous, the stresses that arise are different in each place. This voltage or potential difference is measured on the ground surface through two potential electrodes M and N, these two electrodes are connected to a receiver (Mardiana, 2006; Satuti et al 2010).

RESULTS

The results of field observations are obtained using the software. The output of 2D geoelectric data processing is a cross section along the path that describes the resistivity value and depth of the distribution of the value. Acquisitions from this research area were carried out in 5 measurement paths. (Figure 2).

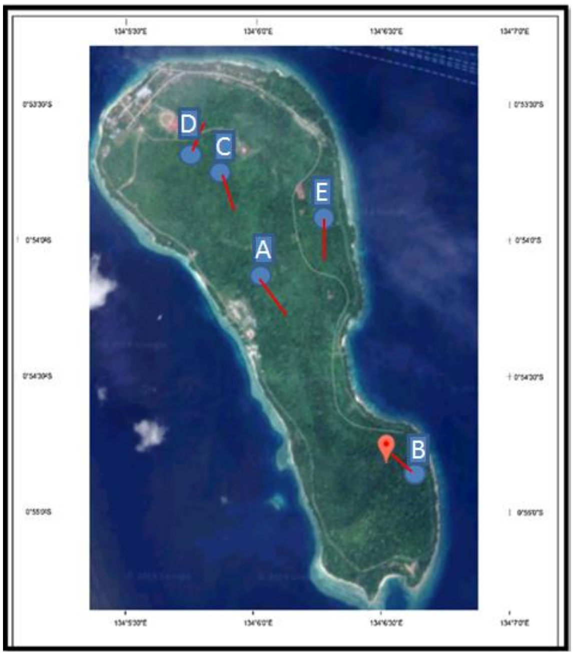

Figure 2. Acquisition of trajectories in the study area

Data collection on track A starts from the northwest - southeast. Data processing results on track A are obtained by two-dimensional lateral crossings as shown in Figure 3. Based on Figure 3 it can be seen that on track A this consists of several constituent rocks. In processing results, the range of resistivity values obtained can be divided into 3, namely low resistivity values (0.064 Ωm - 0.79 Ωm), medium resistivity values (0.79 Ωm - 34.2 Ωm) and high resistivity values (34.2 Ωm - 420 Ωm). Low resistivity values that have a value range of 0.064 Ωm to 0.79 Ωm, can be interpreted as claystone. While the medium resistivity value which has a value range of 0.79 Ωm to 34.2 Ωm can be interpreted as sandstone. On track A as shown in Figure 3, there is a high resistivity with a range of 34.2 Ωm - 420 Ωm. Based on the resistivity value of the rock, it is interpreted to be limestone.

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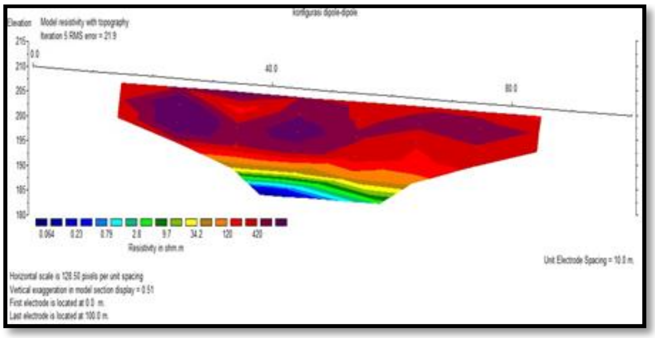

Figure 3. resistivity map of path A

Based on Figure 4, it can be seen that on track B it consists of several constituent rocks. Data collection on track B is northwest - southeast. In the processing results, the range of resistivity values obtained can be divided into 3 namely low resistivity values (1.2 Ωm - 8.5 Ωm), medium resistivity values (8.5 Ωm - 413 Ωm) and high resistivity values (413 Ωm - 1091 Ωm). The low resistivity value which has a range of 1.2 Ωm to 8.5 Ωm, can be interpreted as claystone. While the medium resistivity value which has a range of 8.5 Ωm to 413 Ωm can be interpreted as sandstone. On track B as shown in Figure 4, there is a high resistivity with a range of 413 Ωm - 1091 Ωm, based on the resistivity value of the rock it is interpreted to be limestone.

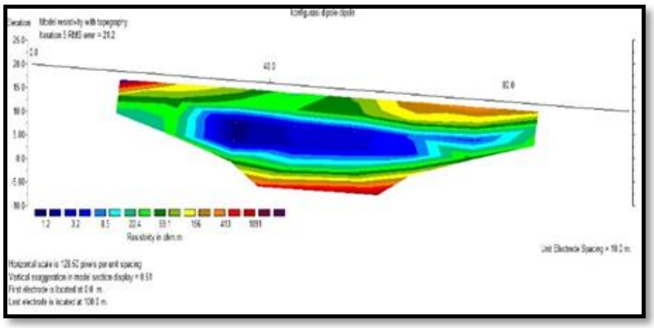

Figure 4. resistivity map of path B

Data retrieval on track C starts from the northwest - southeast. The resistivity map in path C of the study area has a low resistivity value (6.4 μm - 25.9 Ωm), an intermediate resistivity value (25.9 Ωm - 209 Ωm) and a high resistivity value (209 Ωm - 844 Ωm). The low resistivity value on the C path is interpreted as claystone. While the intermediate resistivity value is interpreted as sandstone. On path C as shown in Figure 5, there is a high resistivity with a range of 209 μm - 844 Ωm, based on the resistivity value of the rock it is interpreted to be limestone.

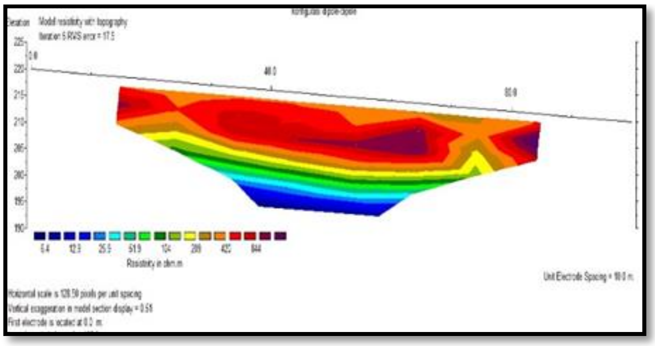

Figure 5. resistivity map of path C

The resistivity map on track D in the study area has a low resistivity value with a range of 15.5 Ωm to 44.1 Ωm which is interpreted as claystone, medium resistivity value with a range of 44.1 Ωm to 212 Ωm interpreted as sandstone and high resistivity value with a range of 212 Ωm to 605 Ωm is interpreted as limestone found to dominate in the Northeast - Southwest part of the study area.

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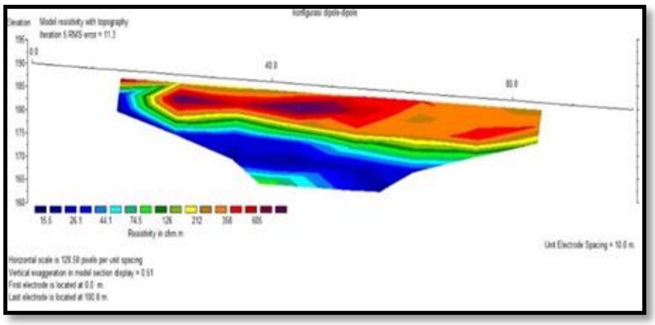

Figure 6. resistivity map of path D

Pathway resistivity map E in the study area has a low resistivity value with a range of 7.6 Ωm to 29.7 Ωm interpreted as claystone, medium resistivity value with a value of 29.7 Ωm to 228 Ωm interpreted as sandstone and high resistivity value with a range of 228 Ωm to 889 Ωm which is found to dominate in the North-South part of the research area interpreted as limestone.

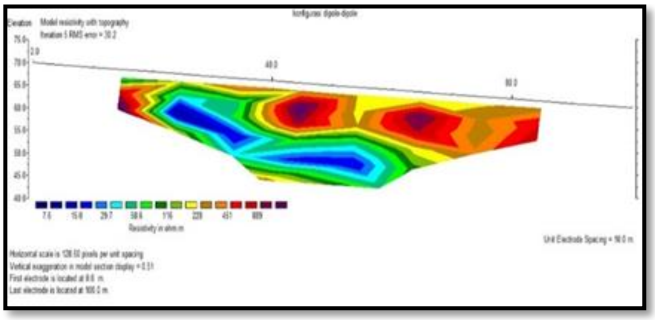

Figure 7. resistivity map of path E

The result of inversion data processing is divided into several ranges of resistivity values that describe a layer represented by certain colors. Each color layer interprets a rock package. In this research there were 3 rock packages with low, medium and high types of resistance. From the results of analysis based on surface data, the resistivity value of rocks in the study area can be interpreted as follows:

- The value of resistance (<45 Ωm) is interpreted as having high porosity, soft and permeable (except impermeable clay stones), the lithology in this package is claystone. So that this layer cannot store water and tends to easily escape the water.
- The value of the medium type of resistance (45 Ωm <M <200 Ωm) of the lithology in this package is sandstone, interpreted as having good porosity.
- High resistance type (> 200 Ωm) Lithology in this package is interpreted as limestone. This limestone layer is thought to have undergone a karstification process and it can be said that this layer has the potential to be a good aquifer that can accommodate enough water and drain at a certain time.

DISCUSSION

Based on the discussion described above, then:

- Further hydrogeological studies and drilling are needed to determine rock lithology of the study area.
- For detailed mapping, it is necessary to measure 1-D geoelectric with a tight distance and supported by 2-D geoelectric measurements.

CONCLUSION

Based on the resistivity value, the rocks in the study area are grouped into 3 packages, namely:

- The value of a small type of resistance with a value of less than 45 Ωm, is interpreted as claystone.
- The value of medium type resistors with a range of 45 Ωm to 200 Ωm, interpreted as sandstones.
- High resistance values above 200 Ωm are interpreted as limestones.

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