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Identification Of Surface Sublayer Structure And Potentials Of Aquifer Using Geolectric Method Of Configuring Schlumberger In Pinabetengan Village

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Abstract

The important role of water for the survival of every living thing is an asset that must remain in existence. In a groundwater exploration activity basically an investigation effort is needed as a first step. This research was conducted with the aim of investigating subsurface resistivity values, hydrostatigraphy, and looking for areas that have the potential to store ground water based on the value of rock resistivity. The results of schulumberger geoelectric measurements are done using IPI2WIN software and software surfer 10. The results of the interpretation in the research area in Pinabetengan Village show that the groundwater potential is at a depth of 38 meters where the offensive tuffaceous layer is rather solid at the price of type resistance 77.71 - 82.15 ohm-meters which are at depths above 38 meters, at the measuring points with pbt-1 and pnbt-2 notation potentially as aquifers.

Keywords: Aquifer, Geoelectric, Resistivity, Schlumberger.

1. Introduction

Water is an abundance of natural resources, where water can be found in every place on the Earth's surface. Water is also an important natural resource that is needed by every living creature. For human water needs absolute, almost all human activities require water, for human water needs is very important for daily life needs such as eating, drinking, bathing and others (Atmaja, Waridad.,2011). Water utilization in a variety of interests must be done wisely by blaciting the interests of the present generation and future generations. As an effort to fulfill the needs of water in daily life, groundwater supply is always associated with a healthy soil water condition, cheap and available in a quantity as needed.

Groundwater is one of the sources of water that can overcome the problem of lack of clean water in the life of everyday living creatures. The water we use has undergone a meteoric cycle, which is through the evaporation process (precipitation) from the sea, the lake, and the river, and then condenses in the atmosphere, and then the rain that drops to the Earth's surface. The rain water that descended to the surface of the earth is directly flowing on the surface of the Earth (run off) and some are absorbed beneath the surface of the Earth (infiltration) (Hadian and Abdurrahman,2006). Groundwater as one of the potential water sources received attention in relation to the fulfillment of the needs of drinking water, especially drinking water in an area, groundwater supply is always associated with healthy soil water condition, cheap and Available in the amount as needed. Groundwater is one good water resource for drinking, because there are various advantages compared with other water. Travis (1997) in Sudarmadji (1990) suggests that the benefit of using groundwater as a clean water are: a) relatively better quality compared to surface water and not influenced by the season, b) larger and easier to obtain groundwater reserves , and c) do not require a tandon and transmission network to distribute it, so the cost is cheaper. Groundwater characteristics are very influential in the condition of aquifer.

Aquifer is a layer of soil that has water content flowing through the air cavity into the underground (Herlambang,1996). Groundwater is stored in a container (aquifer), which is a water-saturated geological formation that has the ability to save and pass sufficient amounts of water and economical (Tood,1980).

Efforts to get an arrangement on the Earth's layer, we must conduct research activities under ground level. Through the layers below the ground surface can be used to determine the presence of water (aquifer). Groundwater cannot be directly observed through the surface of the Earth, ground level research is the beginning of research to be able to provide a picture of the location of the groundwater presence.

There are several ground level investigation methods can be done among them: geological method, seismic method, method of gravity, Geoelectric method. The Geoelectric method is a geophysical method that can be used to identify the presence of groundwater aquifer below the surface. The value of the rock-type prisoner relies on rock formations, temperature, constituent mineral composition, porosity and shape of pores, fluid saturation, and the electric conductivities of fluid formations. Increased ion concentration in fluid increases fluid conductivity and lowers the value of its resistance which affects the overall rock. The type of prisoner used is OHM meter (Hasanudin,2009). Some previous research proved that the influence of water content will reduce the value of the prisoner type of rock, the small decrease in the type of prisoner value depends on the water content in the stone pores (rock porosity) (Santoso , 2002).

Of these methods, researchers use geoelectric methods which are one of the geophysical methods that study the nature of the electric current in the earth and how to detect layers of aquifer beneath the surface. One part of this method is the method of Geoelectric by analyzing the data structure below the surface of the Earth based on the contrast of the type prisoner in this case using resistivity method. To get the structured data beneath the surface, a subelectric measurement of the Schlumberger configuration of the type of prisoner by doing sounding in the research area.

Based on the background, this research aims to identify groundwater aquifer using a subelectric method of prisoner of Schlumberger configuration type in Pinabetengan village of West Tompaso district Minahasa province of North Sulawesi

METHOD

Description of groundwater

Groundwater is a part of water in nature that lies at the surface of the land. Groundwater formation follows a cycle of water circulation in the earth, called the recycling of Hydology, which is the natural process that takes place in the water in nature, which is experiencing a sequential and continuous transfer (Kodoatie,2012). Groundwater is the water moving in the soil contained in the chambers between the grains of the soil that formed it and in the cracks of the rocks. The former is called water on the lining and the latter is called the Fissure water (Mori, at all,1999).

The presence of groundwater depends largely on the magnitude of rainfall and the amount of water that can penetrate into the soil. Other factors influencing are the local lithology (rocks) and geological conditions. Loose sandy soil conditions or high permeability rocks will facilitate the infiltration of rainwater into rock formations. And conversely, rocks with a strong and compact sementation have the ability to permeate small water.

In this case most rainfall will flow as runoff and continue to the sea. Another factor is the change of open land into settlements and industry, as well as logging without control. It will affect the infiltration especially if there is a recharge area (Usmar, at all, 2006)

Characteristics of ground Water aquifer

Groundwater is part of a geological cycle that takes place in nature, and is found in rocks that are below the surface covering the tide, spreading and movement of groundwater with an emphasis on its relation to geological conditions An area (Danaryanto, at all. 2005)

Type of Geoelectric prisoner method

The method used in this geoelectric survey is the type of geoelectric resistance. A type of prisoner geoelectric Survey is basically to know the spread and difference of prisoners type soil/rocks under the surface in both vertical and horizontal soil. The price of a rock type prisoner parameter depends on several dominant factors such as rock material, mineral content and rock electrolyte content. From the value of prisoners the acquired type is then compiled with local geological conditions, so it can be interpreted
About the type of stone, and the possibility of a rock lining that acts as a layer of water carrier (aquifer).

The principle of a type of prisoner geoelectric survey is to inject an electrical current into the earth through two current electrodes so that it will cause tension at both points. There are different types of rock layers that are traversed by electric current, causing voltage difference between both points. This voltage difference can be measured at ground level with the receiver tool (V) through two potential electrodes.

How Geoelectric Works

Generally, the Geoelectric method that is often used is using 4 electrodes located in a straight line as well as symmetrical against the midpoint, which is 2 pieces of current electrode (AB) on the outside and 2 pieces of Bentegangan electrode (MN) on the inside . The combination of the distance of AB/2, distance of MN/2, the amount of electrical current flowing as well as the electrical voltage that occurs will be obtained a price of a pseudo-type prisoner (' Apparent resistivity '). Called pseudo-type prisoners because of the counted type of prisoners is a combination of many rocks layers under the surface of electric current traversed. . (Rasniardhi Muhammad,. 2014).

If a set of false-type prisoner measurements from AB's shortest distance to the longest is depicted on a double logarithm chart with a distance of AB/2 as the X-axis and pseudo-type prisoner as the Y-axis, a data curve shape will be obtained Geoelectric. From the curve the data can be calculated and suspected the nature of the rocks layer beneath the surface.

Schlumberger Configuration

In Schlumberger configuration ideally the distance MN made detail, so the distance MN theoretically unchanged. But due to limited sensitivity of measuring instruments, when the distance of AB is relatively large then MN distance should be changed. MN distance change should be no greater than 1/5 distance of AB. Then the calculation is done to determine the price of a prisoner type ρa, ie the result of the geometry factor K with potential comparisons and current with the formulation (Telford, 1990 in Rasniardhi M., Dkk2014).

$$\rho\alpha = K\,\frac{\Delta V}{I} \qquad (1)$$

$$\rho\alpha = \frac{\pi}{4I}\left[\frac{(AB)^2-(MN)^2}{MN}\right]\Delta V \qquad (2)$$

Where:
Pα = Semu type prisoner
I = Great Flow
Δ V = Potential Difference
K = Geometry factor

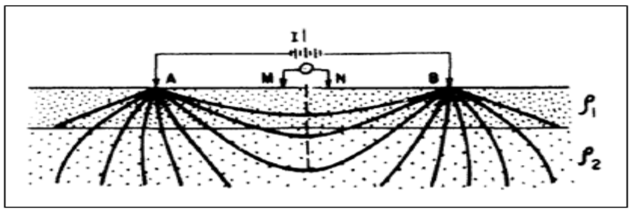


Figure 1. Schlumberger configuration (Telford,1990)

In order for the voltage readings on the MN electrodes are trusted, then when the AB relative distance is relatively large should the MN electrode distance is enlarged. The consideration of MN electrode distance change against the AB electrode distance is when the electrical voltage readings in multimeters are so small.

Measurement of resistivity in the direction of Verticalor VES is one of the method of Geoelectric resistivity to determine the soil resistivity change to the depth aiming to learn variations in rock resistivity below the surface of the Earth Vertical (Telford W. M, Ey al, 1990)

RESULTS AND DISCUSSION

Result of type of inmate geoelectric measurement.

The measurement was done on 8 November 2018, 2 (two) measuring points respectively PNBT-1 in the coordinates N 1 ° 10 ' 10.88226 ", E 124 ° 47 ' 17,009 ' ' and PNBT-2 at the coordinate N 1 ° 10 ' 9.19171", E 124 ° 47 ' 18.29294 ' ' located in the village Pinabetengan to West Tompaso's Run (AB/2) is 100 – 125 meters. Weather conditions were sunny and cloudy.

The pseudo-type prisoner curve has a volatility-down curve characteristic with a measured type of prisoner price between 77.71 ohm-meter – 2291 ohm-meter.

Data on the measurement results and Data on the type of geoelectric resistance calculation are showed in table 1 and table 2.

Table 1. Geoelectric Data Line 1

AB/2 (Meter)	V (Mv)	I (Ma)	R (Ω)	$\rho\alpha$ (Ωm)
1.5	448.7	9.993	44.903	282.124
2	174	9.992	17.818	205.153

2.5	94.26	9.99	9.4363	177.8538
3	64.7	9.998	6.7481	178.0671
4	37.88	9.99	3.7922	187.6182
5	26.3	9.987	2.6339	204.7603
6	13.980	9.984	1.401	157.2637
8	8.397	9.984	0.8411	168441.7
10	5.968	9.982	0.5978	187358.8
12	5.416	9.98	0.5426	245.0789
15	4.647	9.98	0.4567	328.7696
15	3.682	9.977	0.369	23.18802
20	3.015	9.977	0.3022	0.035602
25	11.55	9.976	1.1579	0.218236
30	8.243	9.974	0.8264	227.182
30	16.8	9.974	1.6448	211.6654
40	9.016	9.972	0.9041	213.031
50	4.519	9.971	0.4533	170.8578
60	2.784	9.971	0.2791	153.5036
75	1.161	9.968	0.1621	101.0826
75	5.297	9.97	0.5313	166.9109
100	2.084	9.968	0.2091	123.1518
125	1.076	9.967	0.108	101.7464

According to table 1, measurements for line 1 begin at a length of AB/2 = 1.5 meters and MN/2 = 0.5 meters of Sampaai at a length of AB/2 = 125 meters and Mn/2 = 25 meters with 23 sounding points.

Table 2. Geoelectric Data Line 2

AB/2 (Meter)	V (Mv)	I (Ma)	R (Ω)	$\rho\alpha$ (Ωm)
1.5	522.5	9.993	44.903	328.5264
2	164.3	9.992	17.818	193.7164
2.5	132.3	9.99	9.4363	249.6293
3	88.49	9.988	6.7481	243.5418
4	47.82	9.987	3.7922	236.8506
5	32.76	9.988	2.6339	255.055
6	24.96	9.984	1.401	280.7798
8	14.99	9.987	0.8411	300.6956
10	10.02	9.984	0.5978	314.5668

12	12.51	9.984	0.5426	566.0887
15	11.26	9.982	0.4567	796.6314
15	32.29	9.98	0.369	203.3518
20	18.73	9.98	0.3022	0.221166
25	12.3	9.977	1.1579	0.232407
30	8.313	9.976	0.8264	229.1112
30	18.28	9.974	1.6448	230.3121
40	3.862	9.972	0.9041	91.25174
50	3.387	9.971	0.4533	128.0583
60	2.723	9.971	0.2791	150.1402
75	1.292	9.968	0.1621	112.4881
75	15.39	9.97	0.5313	484.9459
100	2.349	9.968	0.2091	138.8117

Based on Table 2, measurements for line 2 begin at a length of AB/2 = 1.5 meters and MN/2 = 0.5 meters up to a length of AB/2 = 100 meters and Mn/2 = 25 meters with 22 points sounding. Interpreted through the vertical cross section of line 1 that can be seen in Figure 1.

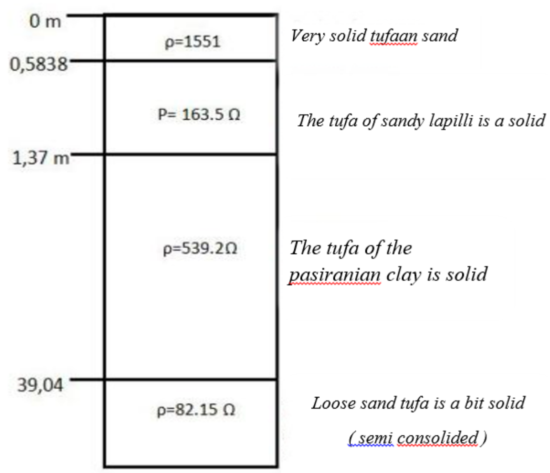
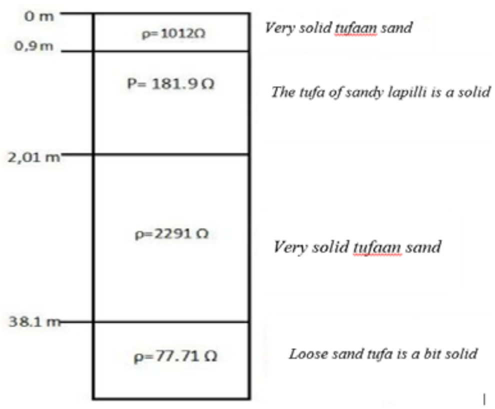


Figure 1. Geoelectric Vertical Section Pnb-1

The following sections can be explained as follows:

Soil cover, depth up to 0.5838 meters, has a 1551 ohm-meter type prisoner price, interpreted as a layer of the sandy tufa is very solid. The second coat, the depth of 0.5838 – 1.37 meters, the price of the type 163.5 ohm-meter, interpreted as the tufa of the Sandy – Lapili, consolidated. The third layer, the depth 1.37 – 39.04 meters, the price of the prisoner type 539.2 ohm-meter, interpreted as the tufa of the Sandy – Lapili, consolidated. The fourth layer, the depth of 39.04 meters to infinity, the price of the 82.15 ohm-meter prisoner, interpreted as a semi-consolidated.

It is interpreted through the vertical cross section of line 2 which can be seen in Figure 2.



Picture 2. Geoelectric Vertical Section Pnb-2

The cross section can be explained as follows:
Soil cover, depth up to 0.9 meters, has a 1012 ohm-meter type prisoner price, interpreted as a layer of the sandy tufa is very solid. The second coat, the depth of 0.9 – 2.01 meters, the price of the type 181.9 ohm-meter, interpreted as the tufa of the Sandy – Lapili, consolidated. The third coat of depth is 2.01 – 38.1 meters, the price of the 2291 ohm-metre type, interpreted as the sandy tufa coating is very solid. The fourth layer, the depth of 38.1 meters to infinity, the price of the 77.71 ohm-meter prisoner, interpreted as a semi-consolidated.

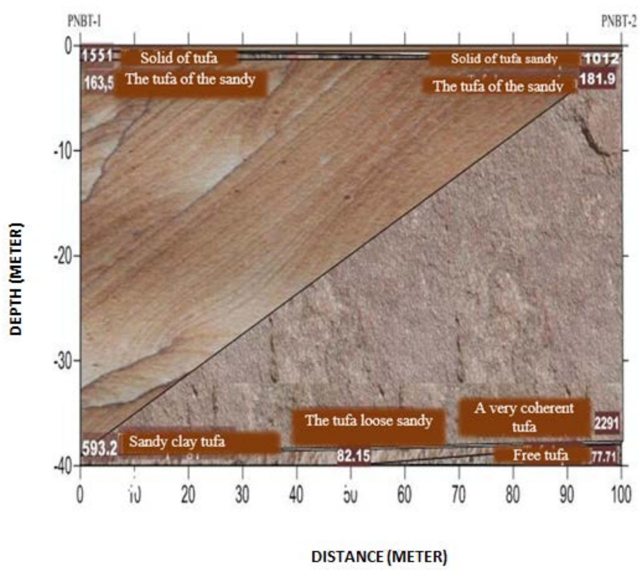


Fig. 3. Surface bottom section of PNB-1 and Pnb-2

Based on the cross section modeling in Figure 3 consists of several layers when viewed at its resistence value, but the composition of the stone structure consists of a solid tufa, a passport, a loose tufa.

Each layer has a different resistivity value that is depth to 0.9 meters, has a resistivity 1551-1012 Ωm in the interpreted as a very solid layer of tufa sand, the depth of 1.37-2.01 meters has resistivity 163-181,9 Ωm Interpreted as tufa of the passivity, the depth of 38.01 – 39.04 meters has a resistivity of 539.2-22 91 Ωm in the interpretation as a very solid tufa, the detected depth has a resistance of 77.1 – 82.15 Ωm in interpreted as Tufa Sandy.

Dimensions of Aquifer

Based on the results of the analysis of the two curves above, it can be interpreted that the unreliable tufa layer of the post-relatively solid with the price of the 77.71 – 82.15 ohm-meter resistance can function as an aquifer.

Whereas, compared with the grouping of the distressed aquifer in the water basin of Manado by Suroto BSc, DKK (1985) where the upper group of aquifer is depressed at an area of 37 – 100 meters and 83 – 99 meters then it is likely at the measuring point PNBT – 1 and PNBT-2 can be found water at depths above 38 meters.

Conclusion

1. Based on research conducted to interpret the subsurface layer with the Schlumberger Geoelectric configuration method in Pinabetengan village consists of several layers with the type of rocks that compose in the research area is A solid, tufa of clay, and a clay loam. Where each layer has varying thickness and resistivity value
2. The berootensi coating contains groundwater in the village Pinabetengan at a depth of 38 meters where the Tufa-type layer of the post that is loose-solid with the price of prisoners types 77.71-82.15 ohm-meter in depth above 38 Meters, at a measuring point with PNBT – 1 notation and PNBT – 2 potentially as aquifer.

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