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Identification of the Groundwater Existence by Geoelectrical Method

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2D geoelectrical method;
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Abstract

Research has been carried out to identify the presence of subsurface water in Selulung Village, Kintamani District, Bangli Regency using 2D geoelectric methods. The work process of this research is the first to collect data directly by using a geoelectric device with Wenner configuration. Electric currents are injected from the surface to the subsurface through the current electrodes which are put on the earth's surface. The collected data is then processed using the Res2Din software version 3.71.118. The software results in the form of 2D images are direct lateral images of subsurface structures. From the three trajectories identified, namely at the coordinates 8°12'18.7"S 115°16'08.3"E the lowest resistivity value was 178 Ohm m with a depth of 10 m which was thought to be a rock layer with surface water content. On line 2 at coordinates 8°12'16.1"S 115°16'09.7"E the resistivity value is 6 ohm.m up to 660,000 ohm.m, the maximum depth obtained is 24 m. This line is thought to be a water-bearing layer because the value of resistance is low. Line 3 which is in the coordinates 8°12'16.3"S 115°15'50.0"E the distribution of resistivity values varies from 42 - 9,400 Ohm m. This line is thought to be a water-bearing layer because the value of resistance is low.

Contents

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1 Introduction

Water is a natural resource needed by all living things. The use of water for various purposes must be carried out wisely by taking into account the interests of present and future generations. The increase in the need for clean water is always proportional to the increase in population and the times. To fulfill water needs in an area, the supply of groundwater is always linked to the quality of groundwater, cheap selling prices, and the availability of the number of groundwater reserves that are tailored to the needs of the community, especially for drinking water (Poon, 1997; Tahaikt *et al.,* 2006; Graf & Therrien, 2007).

Selulung Village is a mountainous area located in Kintamani District, Bangli Regency. It is known that Selulung Village has an area of 5.91 km^2 and has a population of approximately 2.233 people. The problem that is felt by the community is the availability of clean water needs. Therefore, it is necessary to research whether the village has sufficient potential for groundwater availability. And one way to do this is to use a geophysical method survey which is an initial research method that can be used to find groundwater sources, and it is also one way to find out the rock layer below the surface of the ground. One of the geophysical methods used to determine the subsurface conditions is the geoelectrical resistivity method (Frohlich et al., 1994; Metwaly & AlFouzan, 2013; Gyulai et al., 2010).

Resistivity Method

The resistivity method is a method used to investigate subsurface conditions by utilizing the nature of electricity in the earth's surface and how to detect it on the earth's surface (Nisa, 2012). In this case, it includes potential field magnitudes and electromagnetic fields caused by natural (passive) or artificial (active) electric current flow (Ramadan *et al.,* 1994; Simpen *et al.,* 2018). The type of resistance method works in principle by injecting an electric current into the earth through two current electrodes, giving rise to a potential difference that can be measured through two potential electrodes. This method is more effective and suitable for use in shallow explorations, rarely providing layer information at depths of more than 500 m (Mufidah, 2016; Simpen et al., 2016). The amount of resistivity is measured by flowing electric current into the earth and treating the rock layer as a current-carrying medium.

Wenner Configuration

Wener configuration is a geoelectric configuration that is composed of two current electrodes and two potential electrodes. Potential electrodes are placed on the inside and current electrodes are placed on the outside with an electrode distance of a. Measurements are made by moving all the electrodes simultaneously outward with the distance and always the same. The scheme of the Wenner configuration can be shown in Figure 1 as follows.

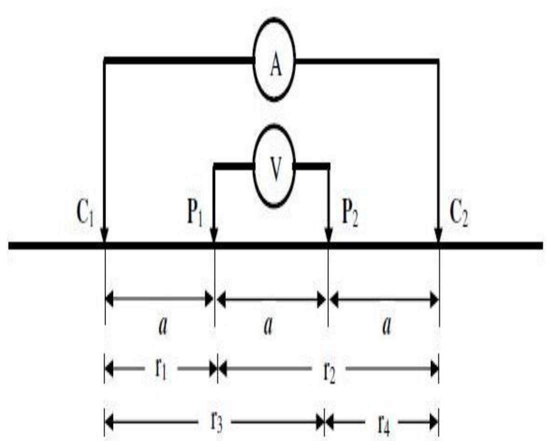


Figure 1. Wenner configuration scheme

Wenner configuration can be used in geoelectric exploration with a spacing arrangement of equal length (r1 = r4 = a and r2 = r3 = 2a). The distance between the electrode and the current is three times the distance of the potential electrode, the potential distance with the sounding point is a / 2, then the distance of each current electrode with the sounding point is 3a / 2. The depth target that can be achieved in this method is a / 2. Infield data acquisition the current and potential electrode arrangements are placed symmetrically with sounding points (Grandis, 2006; Kanata & Zubaidah, 2008; Loke, 2004).

2 Materials and Methods

The resistivity method is carried out by injecting the current to the surface of the ground and then measuring the potential difference and the magnitude of the electric current to determine the type of resistance value both from rocks and other materials. After the apparent resistivity value is obtained, then a 2-dimensional (2D) inversion model is created to read the layer anomalies that are below the surface of the area (Milsom, 2003; Rochman *et al.,* 2017). The flowchart of research as to be shown in figure 2.

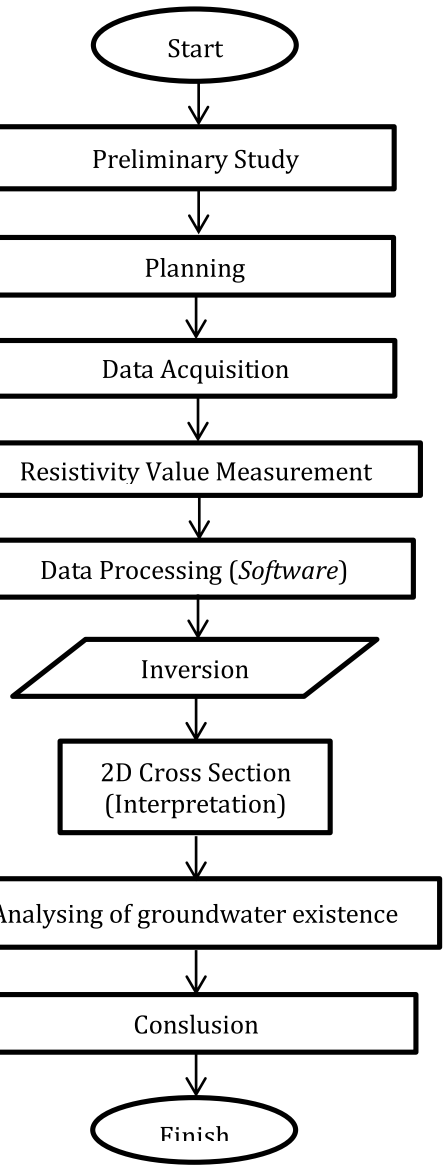


Figure 2. Research flowchart

3 Results and Discussions

Investigation Result

The subsurface investigation technique at the research site in Selulung Village was carried out by the 2-D mapping method (Reynolds, 2011; Suyono Sosrodarsono & Takeda, 2003). This method is a technique for obtaining a distribution of resistivity values that are sensitive to depth and horizontally so that a well-detailed interpretation of subsurface reconstruction will be obtained.

The measurement data is then processed using Res2DInv Ver.3.71.118 software to get the actual resistivity distribution value so that it can be obtained cross-section resistivity (Metwaly & AlFouzan, 2013; Gyulai *et al.*, 2010). The amount of resistivity value of each material is different according to the physical properties of each rock and mineral. In general, minerals and subsurface rocks are divided into materials that are good conductors, medium and bad conductors.

Data Interpretation
Line 1

Line1 is in the coordinates of 8°12'18.7"S 115°16'08.3"E. The inversion results in this path are shown in figure 3 below.

The blue layer is indicated as sandstone and it is most likely contains water that fills the pores

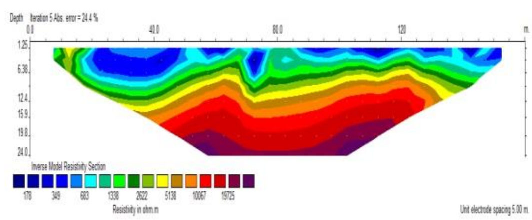
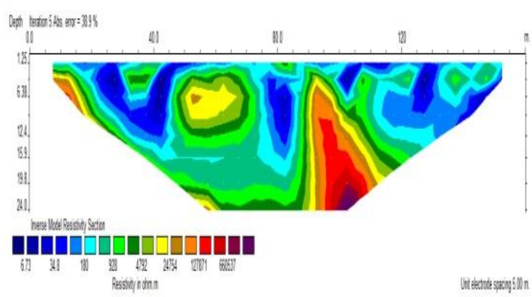


Figure 3. Inversion result on line 1

On this line the distribution of resistivity values varies from 178 Ohm m to 19,726 Ohm m, the maximum depth obtained is 24 m. The low resistivity zone on this line is in the range 178 - 683 ohm.m (series of light blue - blue) which is at the end of the track with ± 10 m depth, interpreted as sandstone and can contain water that fills the pores. The high resistivity value on line 1 is in the range of 5000 - 20,000 ohms. It is indicated by brown, orange, red and purple, with a depth of ± 10-24 m, interpreted as pillow lava rock and basalt breccias. Material below the surface of line 1 by a material with a resistivity value between 600 - 2700 ohm.m, indicated by yellow, light green, and green, interpreted as tuffaceous clay and tuffaceous sand.

Line 2
Line 2 is on 8°12'16.1"S 115°16'09.7"E. The inversion results in this path are shown in Figure 4.2 below.

The blue layer is indicated as sandstone and it is most likely contains water that fills the pores



Figurer 4. Inversion result on line 2

Online 2, the distribution of resistivity values varies from 6 ohms.m to 660,000 ohms, the maximum depth obtained is 24 m. The low resistivity zone on this line is in the range of 6 - 34.8 ohm.m (indicated by light blue - blue) with a depth between 1.25 - 16 m and is indicated as sandstone containing water (Telford *et al.,* 1990; Verhoef, 1989; Yuristina, 2015). This high resistivity value on line 2 is in the range of 24,000–660,000 ohms. It is indicated by red and purple, with a depth of about ± 12-24 m above ground level, and interpreted as cushion lava rock and Material basal breccia below the track surface 2 which are yellow, light green, and green with resistivity values between 900 - 24,000 ohm.m, and are interpreted as tuffaceous clay and tuffaceous sand.

Line 3

Line 3 is on 8°12'16.3"S 115°15'50.0"E. The inversion results in this path are shown in Figure 5 below.

The blue layer is indicated as sandstone and it is most likely contains a little water that fills the pores

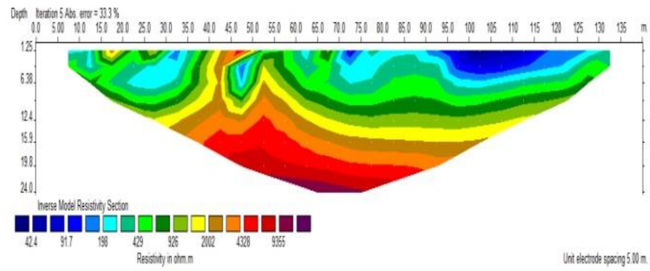


Figure 5. Inversion result on line 3

On line 3, the distribution of resistivity values varies from 42 - 9,400 Ohm m, the maximum depth obtained is 24 m. The low resistivity zone on this line is in the range 42 - 91.7 ohm.m (indicated by light blue - blue) with a depth between 1.25 - 6 m. This high resistivity value on track 3 is in the range of 4000-9,400 ohms. It is indicated by brown, red, and purple, and appears to appear very little on the surface at a distance of 42 m from the starting point of measurement, and is indicated as a lump of basal breccia. Rocks are classified as cushion lava and basal breccias are 12 - 24 m deep from the ground. Other material below the surface on line 3 with a resistivity value between 400-2000 ohm.m, looks yellow, light green, and green, interpreted as tuffaceous clay and tuffaceous sand.

4 Conclusion

From this research, it can be concluded:

1) Based on rock resistivity values from the interpretation of data in Selulung Village, the presence of sandstone has the potential to store water from the depth of 1.25 m to 16 m.
2) Rock layers containing tuffaceous sand, and tuffaceous clays begin to be seen from a depth of 12 m to 24 m.

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