Identification of the Distribution of Andesite Rocks Using the Geoelectric Method of Resistivity in Buluri Village, Ulujadi District, Palu City

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Abstract. Research has been carried out on the identification of andesite rock distribution using the geoelectric method of resistivity in Buluri Village, Ulujadi District, Palu City. This study aims to identify the distribution of andesite rocks using the *Automatic Array Scanning* (AAS) measurement method with Wenner configuration and processed using *Res2DInv software.* Data collection was carried out on 4 measuring lines with a length of 144 m for Tracks 1, 2, and 3 and 120 m for Tracks 4. The measurement results showed that the resistivity values of 200 m–1256 m were identified as andesite rocks. The presence of andesite rocks is evenly distributed in the study area with a thickness ranging from 2–15 m. These rocks can be found on the ground surface (in the form of outcrops) to a depth of 23 m bgl and are in the form of lumps to gravel that are embedded or mixed with other rocks.

Keywords: Andesite Rocks · Geoelectric resistivity · Wenner Configuration

1 Introduction

Currently, the Indonesian government is promoting a sustainable infrastructure development program in rural and urban areas. For the success of the program, various kinds of raw materials for construction structures are needed for infrastructure development, one of which is rock. Good rock as a raw material for construction can be seen from its physical properties, such as hardness, compressive strength, shear strength, adhesion, and so on. Based on the genesis, these rocks come from the freezing of magma or sedimentation of hard grains cemented by silica. When viewed from the mineral content, it also has low clay content and high silica so that its physical properties do not change when it reacts with fluids. One type of rock that meets the requirements as a raw material for construction is andesite rock [1]. Andesite is an extrusive volcanic igneous rock commonly found in lava flows that rise to the surface and experience rapid cooling [2]. These rocks can also be found above the subduction zone which is formed after the process of melting or melting of the oceanic plate due to subduction [3].

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One of the potential areas for andesite minerals is Buluri Village [4], which is administratively located in Ulujadi District, Palu City. Based on the Palu Sheet Review Geological Map, the rock formation in this area is in the Tinombo Ahlburg Formation (Tt). This formation consists of shale, sandstone, conglomerate, limestone, radiolarian chert, and volcanic rock or intrusive rock. This formation was deposited in a marine environment and is thought to be of Middle Eocene to Upper Eocene age. The Buluri Village area which is located on the Donggala Peninsula has the oldest distribution of intrusive rocks in the form of andesite and small basalt. This intrusion indicates channels of volcanic (volcanic) rock in the Tinombo Ahlburg Formation [5]. To determine the distribution of andesite rocks in this area, it is necessary to conduct research using geophysical methods.

2 Methods

This study uses the geoelectric method of resistivity with a Wenner configuration. The resistivity geoelectric method is a geoelectric method that uses changes in the resistance value of rock types in the earth to determine subsurface conditions. The basic principle of this method is to inject electric current into the ground using a pair of current electrodes (C1 and C2), then use a pair of potential electrodes (P1 and P2) to measure the potential difference so that the value of the specific resistance of a medium can be known [6]. The difference in the value of the potential difference from the 2 points of placement of the potential electrode is the measured potential value [7]. The arrangement of the electrodes for the measurement of the geoelectric method can be seen in Fig. 1.

The research location is in Buluri Village, Ulujadi District, Palu City, Central Sulawesi Province. Geographically, this location is located at coordinates 0° 49′ 48″ – 0° 49′ 52″ South Latitude and 119° 48′ 12″ – 119° 48′ 18″ East Longitude. The description of the research location can be seen in Fig. 2.

The measurement data consists of the current value (I), potential difference (ΔV), electrode spacing (α), geometry factor (K), and apparent resistivity (ρα) with a total of 92 data obtained in each measurement path. The number of tracks is 4 pieces, where each stretch consists of 25 electrodes. The distance between the electrodes (α) on Tracks 1, 2

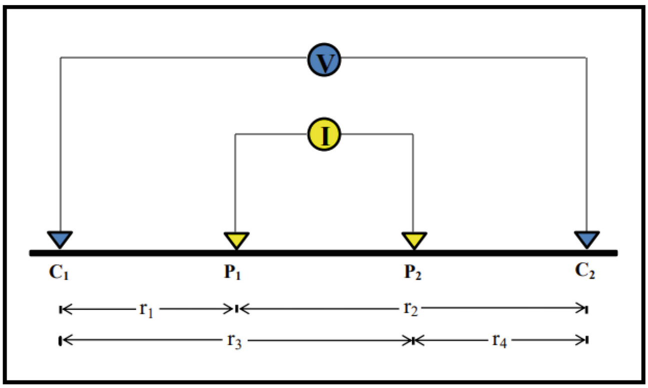

Fig. 1. The arrangement of the electrodes in the measurement of the geoelectric method [6].

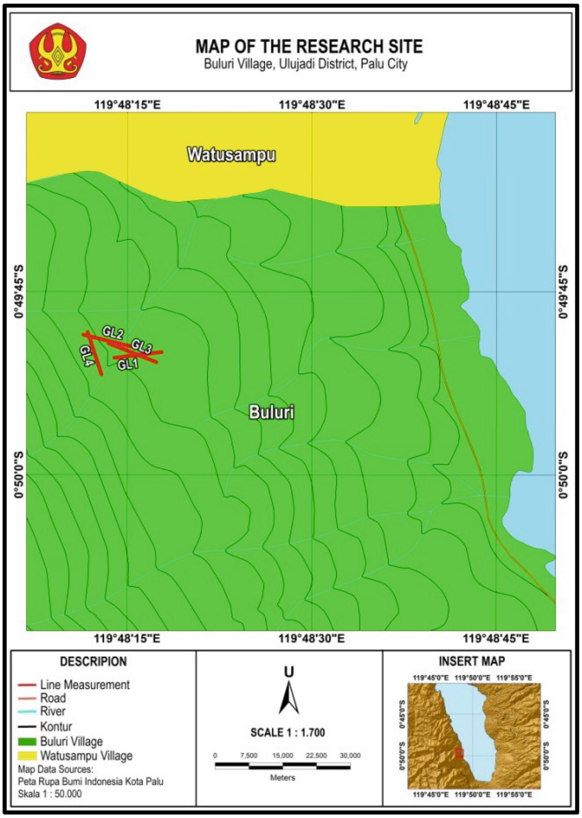

Fig. 2. Map of the research location

and 3 used is 6 m so that the length of the stretch is 144 m and 5 m on Track 4 so that the length of the stretch is 120 m. In addition to the measurement data recorded by the geo-resistivitimeter measuring instrument, elevation measurements of each electrode were also carried out using GPS. The measurement data is then processed using the Res2DInv software to obtain a cross-sectional model of the type barriers and topographical descriptions on each track. Furthermore, to support the interpretation stage, the cross-section is correlated with supporting data related to the research location including geological conditions in the field, the value of rock-type barriers, and the results of previous studies around the research area.

3 Results and Discussion

To obtain the distribution of andesite rocks at the research site, a correlation analysis was carried out between the resistivity values obtained and the rock outcrops at the study site. Based on the results of these correlations, the types of rocks in the research location can be interpreted as follows:

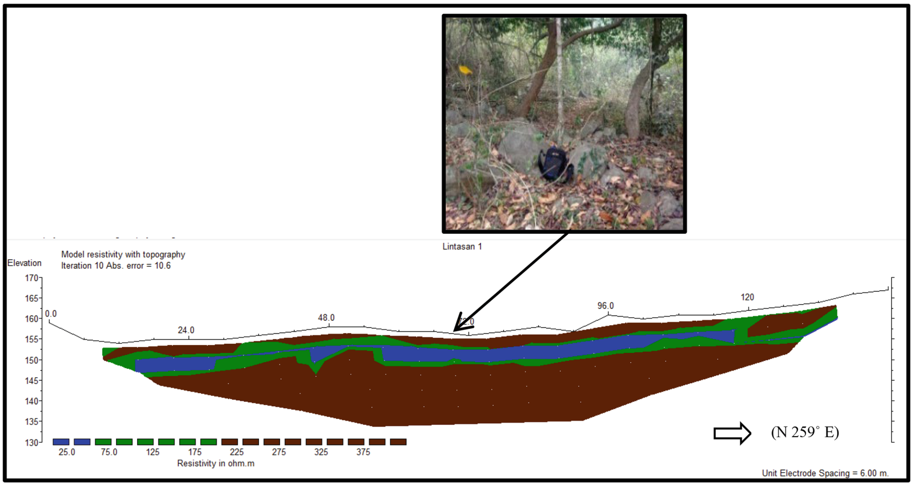

Fig. 3. 2D cross-section of Track 1 type obstacle with topographic correction and rock outcrop.

a. The resistivity values less than 50 Ωm are assumed to be clay layers which are shown in blue.
b. The resistivity values ranging from 50 Ωm–200 Ωm are thought to be sandstone and limestone indicated in green.
c. The resistivity values ranging from 200 Ωm–1256 Ωm are thought to be andesite, which is indicated by brown color.

3.1 Track 1

In this trajectory, andesite rock outcrops can be found on the surface, precisely at meters 67–76 (Fig. 3). The andesite rocks in this track are evenly distributed along the track. The 2D cross-section of the resistivity (Fig. 3) shows the presence of andesite rocks with varying thicknesses and interspersed by layers of sandstone, claystone, and limestone. On this track, there are indications of andesite rocks along the track from ground level to a depth of 6 m bgl, with varying thicknesses of ±3–6 m and at a depth of ±7 m bgl–23 m bgl, with a thickness of ±14 m.

3.2 Track 2

In this trajectory, andesite rock outcrops can be found on the surface, precisely at meters 9 and 129 (Fig. 4). The andesite rocks in this trajectory are spread fairly evenly along the trajectory to the west of the study site. The 2D cross-section of the resistivity (Fig. 4) shows the presence of andesite rocks with varying thicknesses and interspersed by layers of sandstone, claystone, and limestone. In this trajectory, there are indications of andesite rocks, namely at 9–14 m from the ground surface to a depth of 6 m bgl, with a thickness of ±6 m. At meters 15–36 at a depth of ±3 m bgl–13 m bgl, with a thickness of ±10 m, then at meters 33–54 at a depth of ±3 m bgl–7 m bgl, with a thickness of ±4 m. At meters 43–64 at a depth of ±19 m bgl–23 m bgl, with a thickness of ±5 m, and at meters

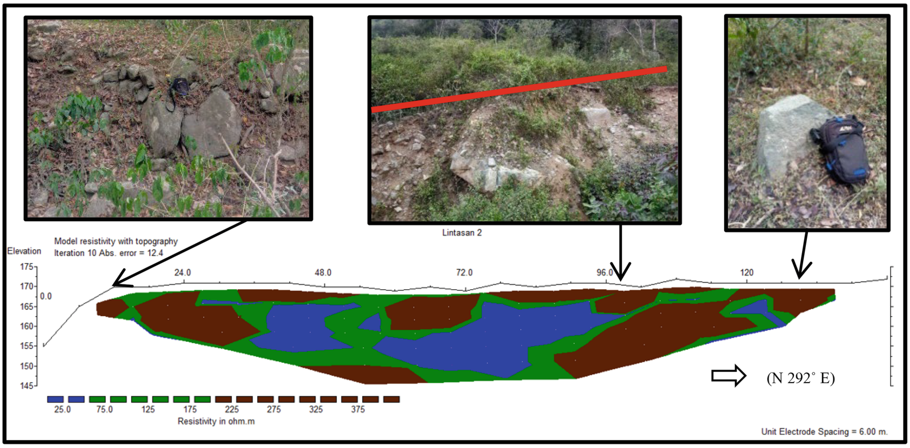

Fig. 4. 2D cross-section of Track 2 type obstacle with topographic correction and rock outcrop.

58–135 from above ground level to a depth of 23 m bgl, with varying thicknesses of ±2–10 m.

3.3 Track 3

In this trajectory, andesite rock outcrops can be found on the surface, precisely at meter 68 (Fig. 5). The andesite rocks in this trajectory are fairly evenly distributed along the trajectory to the southeast of the study site. The 2D cross-section of the resistivity (Fig. 5) shows the presence of andesite rocks of varying thickness and interspersed by layers of sandstone, claystone, and limestone. In this trajectory, there are indications of andesite rocks, namely at 9–20 m at a depth of ±2 m bgl–10 m bgl, with a thickness of ±6 m. At meters 23–74 at a depth of ±3 m bgl–22 m bgl, with a thickness of ±14 m. At meters 58–75 from above ground level to a depth of 5 m bgl, with a thickness of ±5 m, and at meters 77–135 at a depth of ±3 m bgl–23 m bgl, with varying thicknesses of ±2–12 m.

3.4 Track 4

In this trajectory, andesite rock outcrops can be found on the surface, precisely at 110 m (Fig. 6). The andesite rocks in this trajectory are fairly evenly distributed along the trajectory to the north of the study site. The 2D cross-section of the resistivity (Fig. 6) shows the presence of andesite rocks of varying thickness and interspersed by layers of sandstone, claystone, and limestone. In this trajectory, there are indications of andesite rocks, namely at 7–30 m at a depth of ±2 m bgl–7 m bgl, with a thickness of ±5 m. At meters 38 – 57 at a depth of ±3 m bgl–19 m bgl, with a thickness of ±15 m, and at meters 58–113 from above ground level to a depth of 19 m bgl, with a thickness of ±4–14 m.

The distribution map of andesite rock can be seen in Fig. 7.

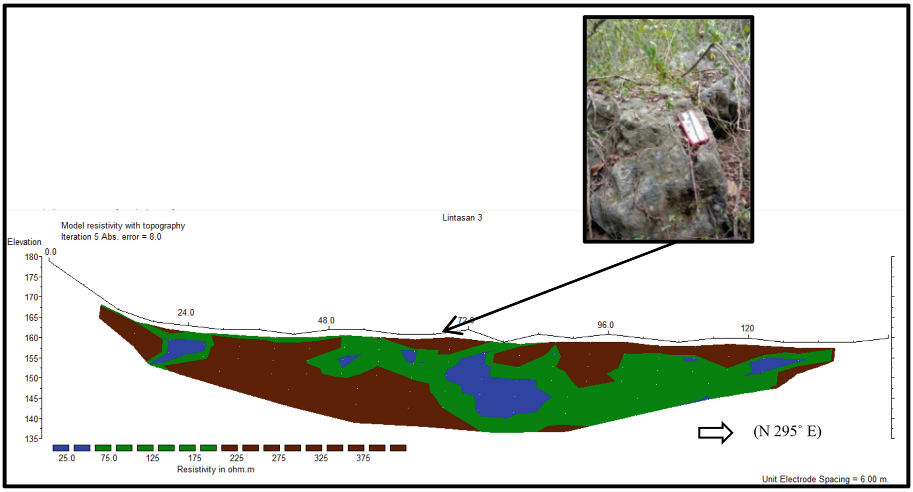

Fig. 5. 2D cross-section of track 3 type obstacle with topographic correction and rock outcrop.

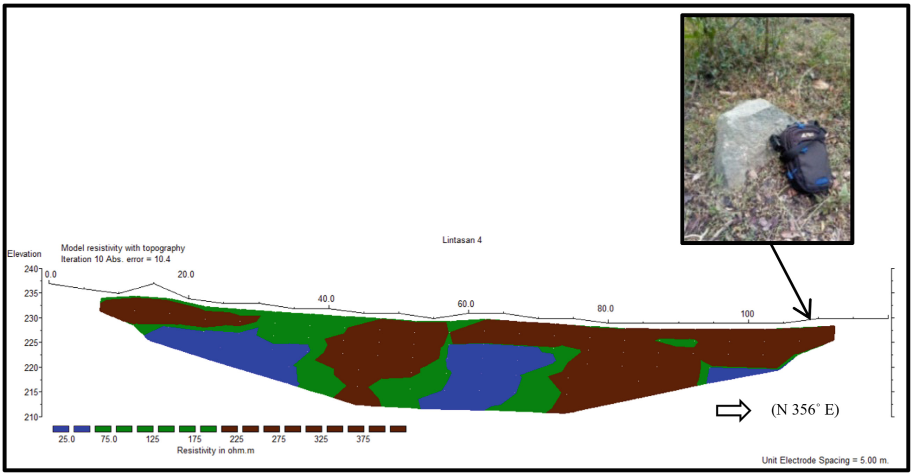

Fig. 6. 2D cross-section of Track 4 type obstacle with topographic correction and rock outcrop.

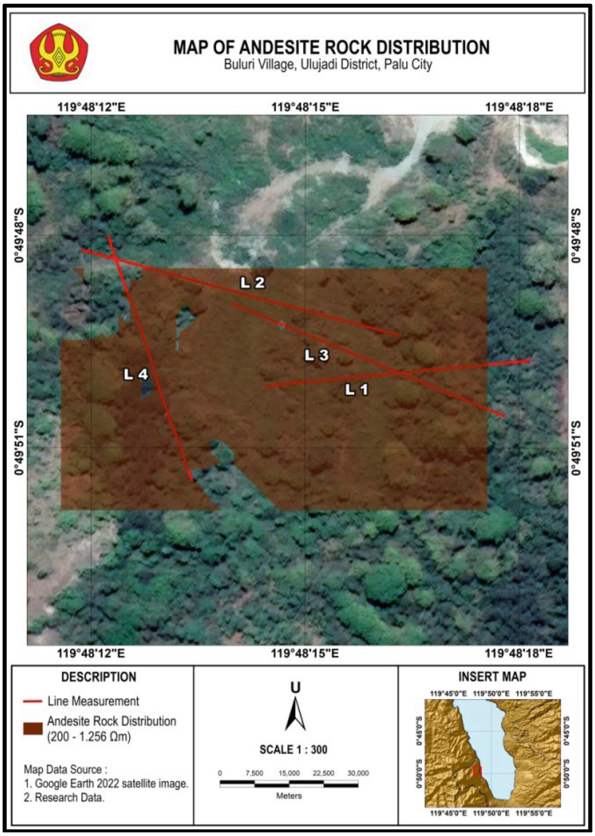

Fig. 7. Map of andesite rock distribution at the research site.

4 Conclusion

Based on the results and the analysis and interpretation of research data, it can be concluded that the andesite rock type resistance value in Buluri Village, Ulujadi District, Palu City is 200 Ωm–1256 Ωm. The existence of andesite rocks is spread evenly in the research location with a thickness ranging from 2–15 m. These rocks can be found on the ground surface (in the form of outcrops) to a depth of 23 m bgl and are shaped boulders to gravel embedded or mixed with other rocks.

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