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Identification of Andesite Resource Potential In Kalirejo Area, Kokap Sub-District, Kulon Progo Using Resistivity Method

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Abstract. In the last five years, the need for materials to build infrastructure in Kulon Progo Regency has increased with the construction of an international airport. In the construction process, strong earth or rock materials are needed to make buildings resistant to earthquakes, one of which is andesite rock. This study aims to determine andesite rocks' resources using a three-dimensional model based on the value of resistivity in Kalirejo district Kokap Kulon Progo. The research was conducted by geological and geophysical survey. Based on data on the distribution of rocks in the research area included in the intermediate igneous rocks, andesite. These rocks are intrusions that develop in research areas. Petrography analysis is used to determine the types of minerals in andesite rocks and determine which levels of rock changes have changed or not to affect the strength of rocks. These rocks are intrusions that develop in research areas. Geophysical survey is by resistivity method using configuration dipole-dipole with five lines, and each stretch is 200 m. Based on three-dimensional model resistivity, fresh andesite is at a depth of between 5-10 m. Value of andesite resistivity is more than 668 Ωm, while the value of weathered andesite resistivity ranges from 256-536 Ωm and andesite resources about 332,580 tons.

Keywords: Andesite, Geoelectric, Kalirejo, Resources

1. Introduction

In the Long-Term Development Plan of Kulon Progo Regency in 2005-2025, competitive and growing economic competitiveness makes the economy's structure more advanced and reliable. Sectors that support the economy are industrial, tourism, agriculture, marine, natural resources, and services. One that supports this is the business and investment in Kulon Progo equivalent to other developed areas (Pemerintah Kabupaten Kulon Progo, 2007). Until 2020, Kulon Progo Regency has had an investment in airports located in Temon District. To support the integration of Airport facilities, The Kulon Progo Regency government needs other facilities. Based on this, it is necessary to have material availability information to support the implementation of development. One of the critical materials is andesite. Andesite is a type of volcanic igneous rock used in construction such as building foundation raw materials, paving, and bridge construction. Its utilization is needed andesite rocks that have not experienced weathering (fresh), while most of the andesite rocks exposed on the surface have experienced weathering with different levels. Andesite is also a suitable aggregate-making material (Black, 2009). Andesite aggregates provide good density and contribute to a low coefficient of heat may value on concrete (Mackechnie, 2004). Based on this, it is necessary to have information about the presence of andesite in the area around Kulon Progo. One of the sciences to know the existence of andesite is geophysics. Geophysics is a science that studies the earth based on the magnitude of physics (Kearey *et al.*, 2002).

Rocks having superior physical properties, such as hardness, density, and water and weather resistance, can be utilized appropriately for infrastructure since they are resistant to damage. Andesite is one of the rocks with a solid physical characteristic (Sariisik *et al.*, 2011). Due to its vast chemical content of silica (SiO2) 62.30 percent, it is one of the mined rocks with a vast potential for civilization since it can be utilized as the primary material of buildings, bridges, roads, trains, and other structures (Chalikakis *et al.*, 2011). Andesite is found in andesite intrusive rock units in the research region, ranging from hypersthenic andesite to augite-hornblende andesite and trachyandesite (Rahardjo *et al.*, 1995). Because these rocks can also be connected with lava flow igneous rock types, miners must know that not all intrusive rock units are intrusive rocks. Miners must understand the distinctions between intrusive and lava rocks, thick but not widely spread, and lava rocks are broad but thin. This difference leads to discrepancies in potential resource calculations (Purwasatriya, 2013).

Geophysical exploration is one of the first surveys that can be carried out. In the discipline of geosciences, geophysical exploration is one of the sciences. Geophysical exploration can help with geological mapping, possible mining sites, and disaster-prone locations, among other things (Hu *et al.*, 2007). The Geoelectric method is one of the geophysical approaches used to calculate the potential area of building material or substance (Galletti *et al.*, 2013). The geoelectric method is a geophysical technique that uses the electrical properties of rocks, namely rock resistivity. Rocks are generally poor/resistant conductors of electricity, although their qualities and compositions vary, resulting in a wide range of resistivity levels (Phillips, 2006). Geoelectrical techniques can be used to assess the exploitability of these deposits as an alternative to high-cost drilling programs (Lugo *et al.*, 2008). The resistivity value is used to discriminate between different types of rocks. The Geoelectric Method's 3D modeling of rock resistivity is projected to provide an overview of the pattern of mountain rock distribution (Woodruff *et al.*, 2015). Its rock resistivity measures the electrical inhibition of rock. The lower the current that can flow in a conductor, the higher the resistivity rating of the rock, and vice versa (Hrenovic *et al.*, 2009). The non-invasive nature of this procedure and its inexpensive cost are both positives (Guinea, 2010).

2. Research Method

Field research activities were carried out in Kalirejo Village, Kokap District, Kulon Progo Regency, Yogyakarta. Performance of early-stage activities in secondary data in regional geological maps of Yogyakarta sheets and early geological surveys to determine geoelectric stretches' location. This research was done by mapping the surface and sub-surface by describing and grouping rocks based on geology and rock resistivity. Based on the mapping results, there is a unit of rocks in the form of andesite. Research conducted with geological and geophysical surveys, the flow of research can be seen in Figure 1.

Geoelectric measurements have been carried out as many as five lines with the dipole-dipole array. The geoelectric line is 200m by $1 \leq n \leq 6$. Geoelectric measurement is in 3 vertical lines and two horizontal lines. Measurements are carried out using a tool called Naniuara NRD 300. While data processing using RES2DINV software and 3D Modeling software. Dipole-dipole is the array in a geoelectric method that will produce good imaging vertically and laterally (Octova, 2017; Dentith, 2014). 3D modeling of rock resistivity with the Geoelectric Method is expected to provide an overview of andesite rock distribution patterns. Modeling is significant in exploring andesite rocks to assess the potential and resources of andesite rocks in research areas. Method tomography resistivity will continuously develop with increased measurement depth and accuracy (Yan, 2012). The resistivity method shows promising results in the determination of excavation materials (Mostafaie, 2015). Because the resistivity of rocks varies, Telford (1976) defines resistivity as follows in Table 1.

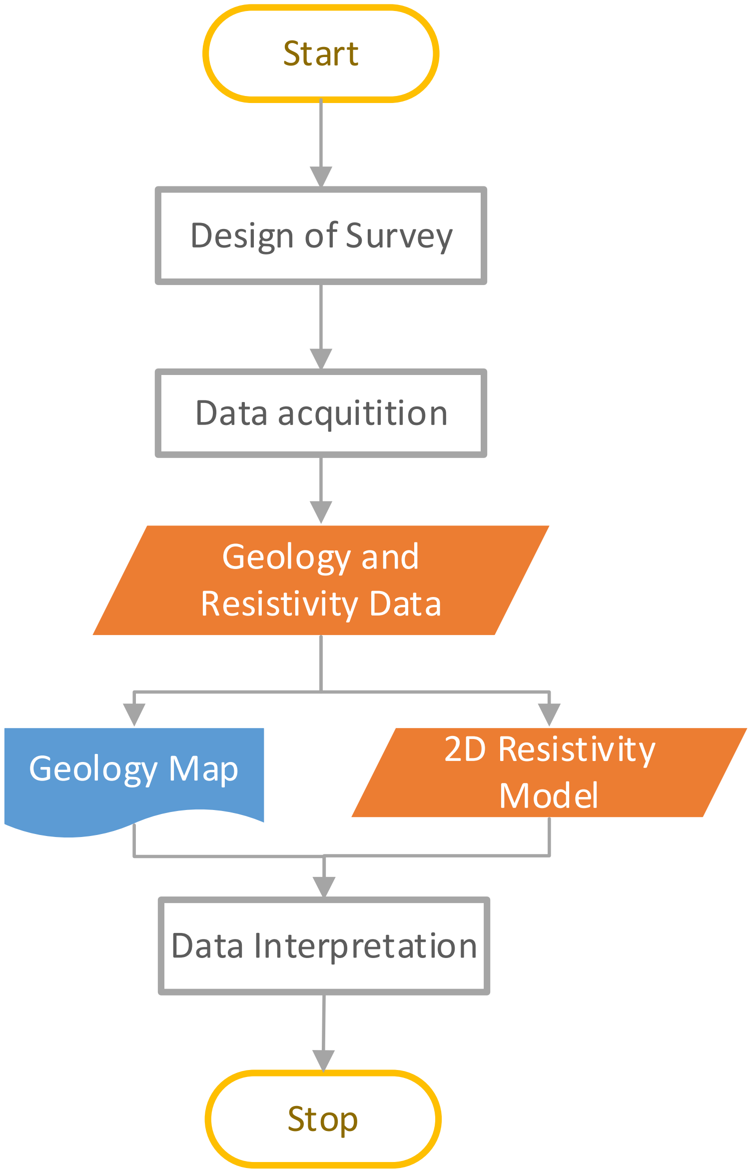

Figure 1. Flowchart of the research.

Table 1. Material Variations of the Earth (Rocks) (Guinea, 2010)**.**

No	Name of rock	Resistivity (Ωm)
1	Air	0
2	Clay	1 – 100
3	Ground Water	0.5 – 300
4	Old Breccia / Gravel	100 – 600
5	Old Andesite / Dry Gravel	600 – 10.000

The survey location map can be seen in Figure 2 below.

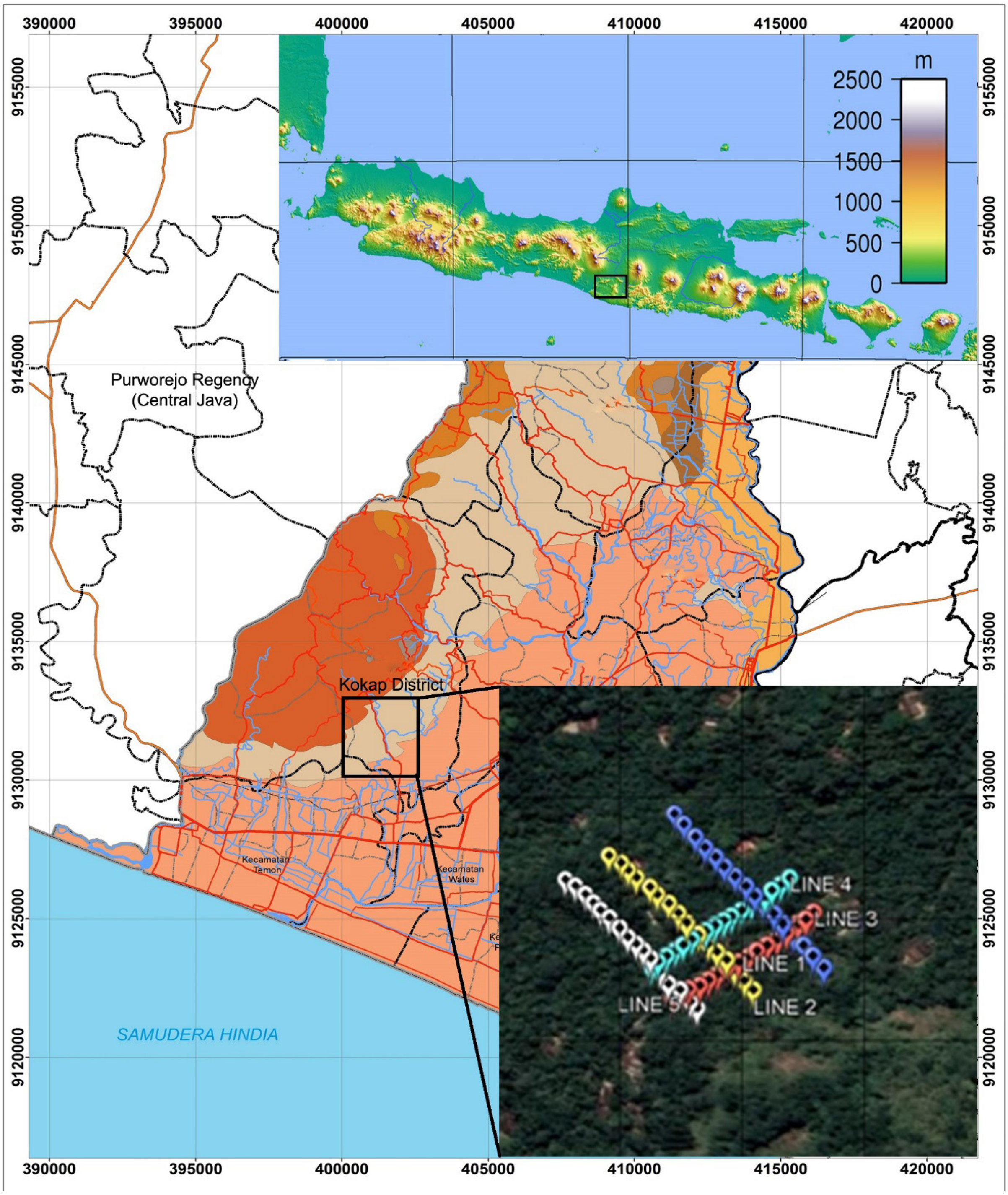

Figure 2. Survey location.

3. Results and Discussion

3.1. Results

The Kulon Progo Mountains are defined as large domes with flat peaks and steep slopes. The dome's core consists of three old andesite volcanoes, whose former magma chambers are now open (Harjanto, 2011). Elephant Mountain, located in the dome's center, is two of the oldest volcanoes that produce Hypersthenic Augite Andesite rock. Mount Ijo produces basaltic andesite pyroxene. Mount Menoreh was the youngest volcano to make andesite hornblende on Aug. Determination of 6 units of formations in the Kulon Progo Mountains from old to young, namely: Central-Oligoceous Nanggulan Formation, Kaligesing Formation, Dukuh Formation, Jonggrangan Central Miosen Formation, Central-Late Miosen Sentolo Formation, and Alluvium (Van Bemmelen, 2009). Kulon Progo Volcanokano stratigraphy Based on Analysis through topographic and morphological maps, satellite imagery, absolute age assessment data, and field observation, the stratigraphy of the research area consists of three hills (Ijo, Jonggrangan, and Sigabug) and two volcanic hills (Kukusan and Pence) (Harjanto, 2011). The geological observations show that the study area is dominated by andesites, as seen in Figure 3.

Inversion 2D modeling is done using the smoothness-constrained least square method that is the basis of the RES2DINV software algorithm. 2D modeling provides lateral variations of resistivity values but total resistivity values for horizontal directions (Hersir, 2013). The electrical properties of rocks are influenced by ionic concentration, surface conduction, fluid saturation, porosity, and pore connectivity (Oh *et al.*, 2014). Inversion is a 2D cross-section resistivity model that provides information on the variation of resistivity value (prisoner type) below the measurement point. Based on the results of the inversion shown in Figure 4 obtained resistivity value response (electrical resistance) with a value of more than 779 Ωm is indicated by purple in the cross-section where there is andesite, the value of resistivity (electrical resistance) with a value of 300-400Ωm is indicated by yellow to orange in the cross-section is weathered andesite.

Based on the results of the inversion shown in Figure 5 response data obtained resistivity value (electrical resistance) with a value of more than 1500 Ωm indicated by purple color on a cross-section of fresh Andesite resistivity value (electrical resistance) with a value of 400-600Ωm indicated by yellow to orange on the weathered Andesite cross-section.

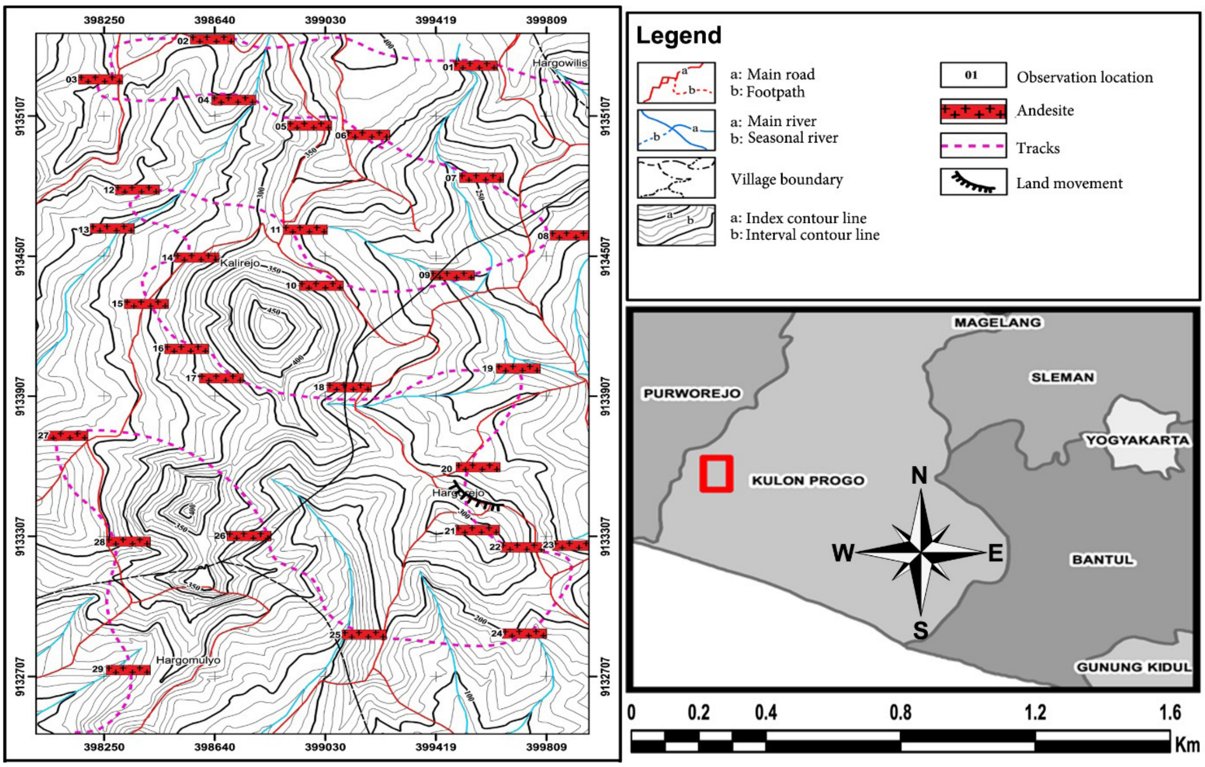

Figure 3. Local Geology Map.

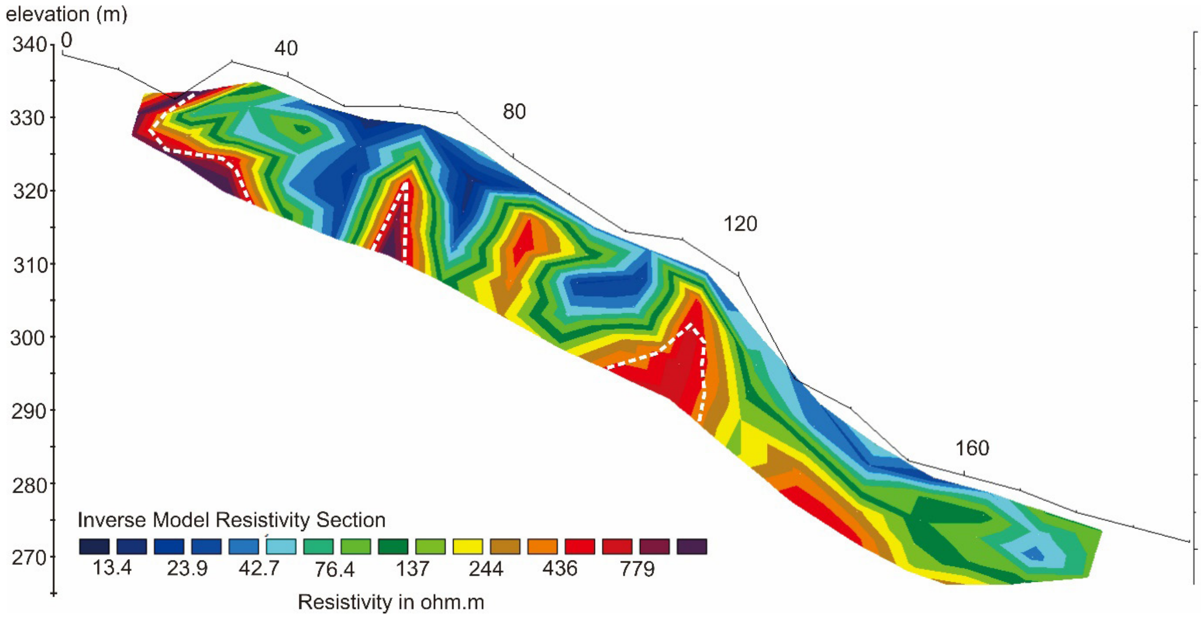

Figure 4. Resistivity Modeling Line Interpretation 1.

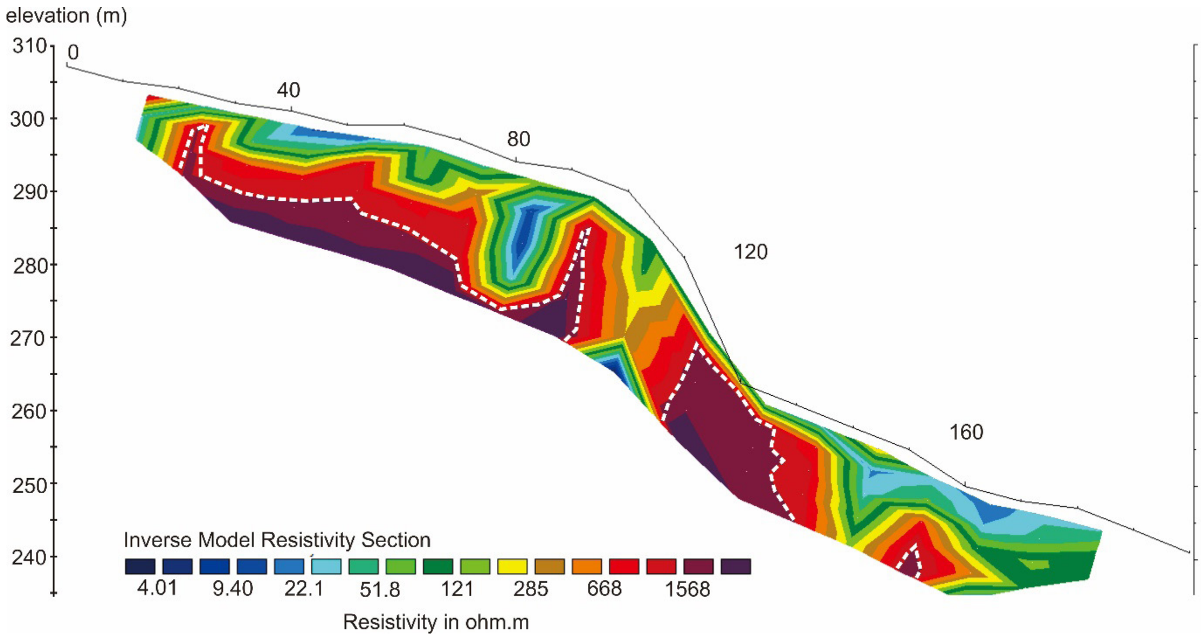

Figure 5. Resistivity Modeling Line Interpretation 5.

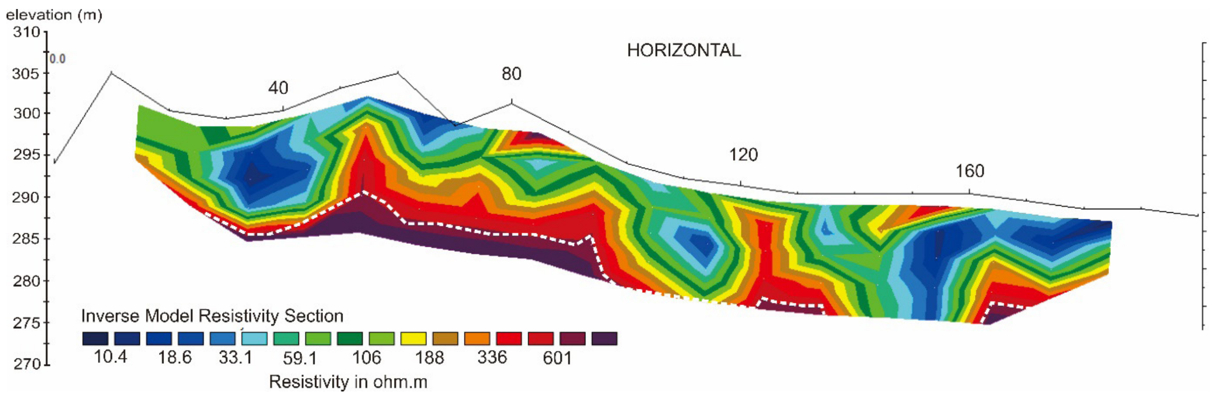

Figure 6. Resistivity Modeling Line Interpretation 4.

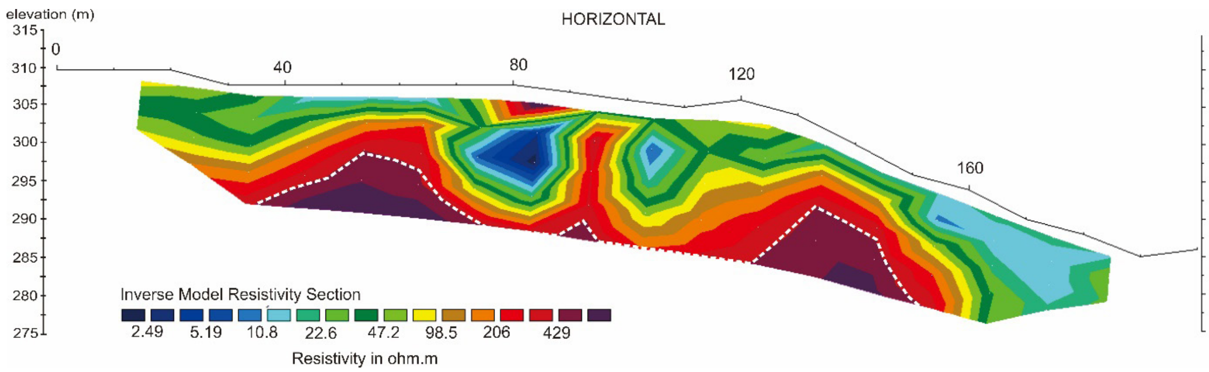

Figure 7. Resistivity Modeling Line Interpretation 3.

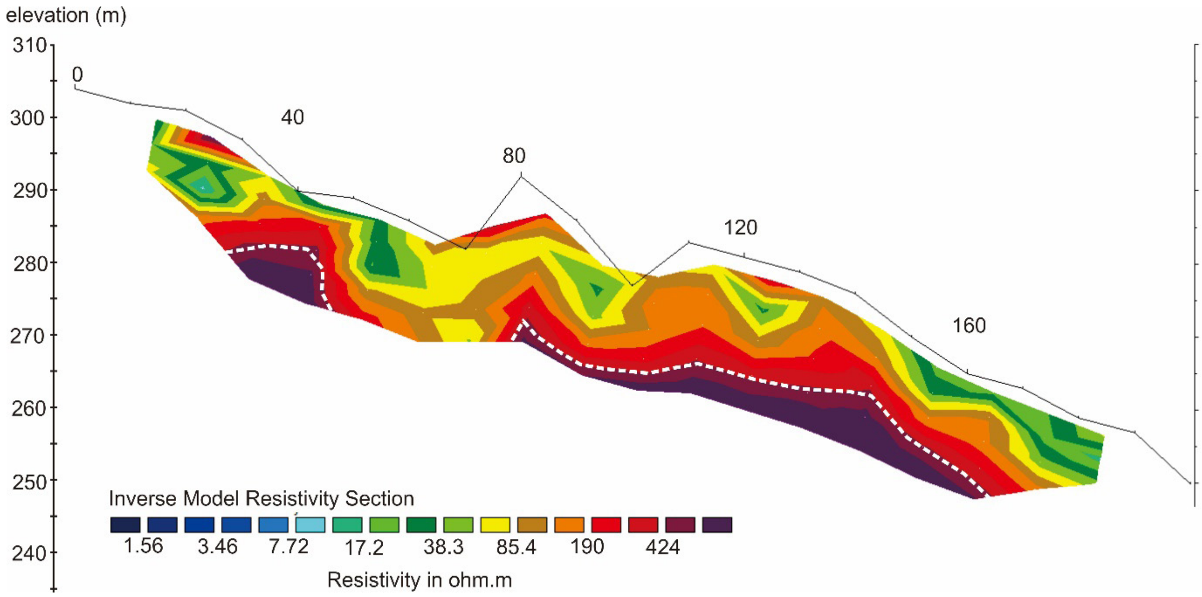

Figure 8. Resistivity Modeling Line Interpretation 2.

This 4th line is a horizontally pointed stretch. Based on the results of inversion shown in Figure 6 obtained the response of resistivity value (electrical resistance) with a value of more than 700 Ωm indicated by purple color on a cross-section that is fresh andesite, resistivity value (electrical resistance) with a value of 300-400 Ωm is indicated by yellow to orange in the cross-section is weathered andesite.

Line 3 (Figure 7) is also a horizontally pointed stretch. Based on the inverse shown in Figure 6, the overall response obtained is andesite, where the resistivity value (electrical resistance) with a value of more than 500 Ωm is indicated in blue to purple. The breccia is visible from about 10m and stretches for 100m, and there is still continuity.

Based on the inverse results shown in Figure 8, the overall response obtained is andesite, where the resistivity value (electrical resistance) with a value of more than 500 Ωm is indicated in blue to purple. The andesite is visible from a depth of about 10m and stretches for 80m.

3.2. Discussion

Based on data on the distribution of rocks in the research area included in the intermediate igneous rocks, andesite. These rocks are intrusions that develop in research areas. Petrography analysis is used to determine the types of minerals in andesite rocks and determine which levels of rock changes have changed or not to affect the strength of rocks.

The petrography analysis of andesite rocks has a porphyritic texture. Fenokris with crystal size > 0.1 mm consists of plagioclase, pyroxene, hornblende.

Plagioclase is 56%, on Plane Polarized Light (PPL) observation, minerals show colorless, euhedral-subhedral crystal shape, 1-way hemisphere, low relief. On Cross Polarized Light (XPL) observations of weak birefringence 0.009-0.011 first-order white interference color, extinction angle 260, Plagioclase dominated by An 48 labradorite, albeit twin, also Carlsbad-albeit found. The percentage of pyroxene is 11%. On Plane Polarized Light (PPL) observations, minerals showed grey to brownish color, anhedral-subhedral crystal shape, high relief, 2-way hemispheres. On Cross Polarized Light (XPL) observations, birefringence is medium 0.037-0.040 second-order, parallel blackout angle. The percentage of hornblende is 8%, on Plane Polarized Light (PPL) observations is greyish-brown, high relief indicates weak pleochroism. Medium-high replacement with the 2-way angled slit. On Cross Polarized Light (XPL) shows yellowish-brown color, medium relief, n> balsam, BF 0.033-0.059, parallel blackout, long-slow orientation (Prastowo *et al.,* 2019). Based on petrographic analysis data, rocks in the research area, including Andesite-Basaltic type and seen from the geography of this rock, is very good without any effect of changes seen from the pore value of rocks are very small so that it can be used as building supporting materials (Sadjab *et al.*, 2020).

Based on the geoelectric measurement of polished-polished configuration, obtained andesite 3D model as in Figure 9. Based on the andesite 3D model tends to spread to the southeast-northwest. The andesite volume of 144,600 m^3. The distribution of andesite is seen in Figure 9 with light blue color, and the position of the data with a red dot is a data point of resistivity measurement. Andesite resources are obtained by multiplying the volume by the mass of the andesite type, which is 2.3 tons/m^3. A large amount of andesite resources in the research area is 332,580 tons. The result of another research showed Kokap area is dominated by Andesite rock; research was also conducted about the potential of andesite resources in the kokap area, using a geoelectric method (Purwasatriya, 2013; Giamboro & Hidayat, 2016; Prastowo, 2017). Differences in measurement methods lead to differences in potential resource determination (Triani *et al.*, 2021). This proves that the high area of Kokap area, Kulon Progo is dominated by andesite rocks. The rocks around Mount Ijo Kokap Kulon Progo are Andesite and Dasit, where dacite is considered to have intruded andesite in the central Miosen period (Irzon, 2018).

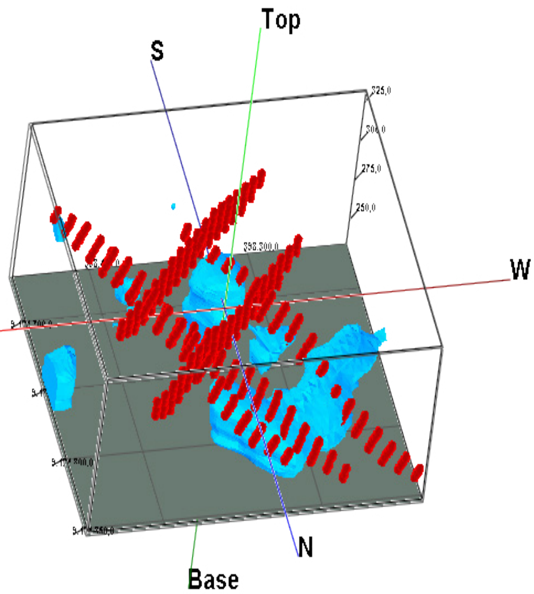

Figure 9. 3D Modelling Resistivity.

4. Conclusion

The working principle of the geoelectric method is done by injecting an electric current into the ground through a pair of electrodes and measuring the potential difference with another pair of electrodes. When an electric current is injected into a medium and the potential difference (voltage) is measured, the resistance value of the medium can be estimated. Based on geoelectric measurements of the dipole-dipole configuration, a 3D model of ndesite tends to spread to the southeast-northwest with an andesite volume of 144,600 m^3. Andesite resources are obtained by multiplying the volume by the density of ndesite, which is 2.3 tons/m^3. Distribution of andesite resistivity value (> 500 m) through a cross-section of 3D resistivity models tends to spread flat under the measuring trajectory with a depth of about 10-15 meters and a resource of about 332.580 tons. The results of other studies show that the Kokap area is dominated by Andesite rocks.

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