



Analysis of Resistivity Data of Wenner Alpha Configuration on Granite Prospect in 'JT' area, Central Kalimantan, Indonesia

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Received : Sep 1, 2025

Revised : Sep 25, 2025

Accepted : Sep 25, 2025

Online : Oct 14, 2025

Abstract

The need for igneous rock as a support for development is increasing in line with the rapid development of infrastructure in Kalimantan. Exploration activities are imperative and must be undertaken as soon as possible. Geological and geophysical investigations, including the resistivity method, are conducted as the initial step in exploration activities. In this study, exploration at the 'JT' area using the Resistivity method with the Wenner Alpha configuration is supported by drill hole data. There are 17 lines oriented Northwest-Southeast and North-South, with a line length of 320 meters and 6 points drill hole crossed by a Resistivity path. The processing of the Resistivity data uses the Res2Dinv software and the drill hole by the Strater4 to produce subsurface profiles. The cross-section is correlated with the drill hole profile results using CorelDRAW software. Next is 3D modeling using the Oasis Montaj software. The results obtained from this study are lithology that is interpreted based on resistivity value are soil with resistivity < 20 Ohm-m, under soil layers there are interlocutors between sandstones with claystone with resistivity of 20 - 60 Ohm-m, below that sandstones are originating from Formation Tanjung with a resistivity of 60 - 300 Ohm-m, and below that there is granite with resistivity > 300 Ohm-m. The distribution of granite in this area has very good quality in the northern region as a prospect area. The granite in the southern part has a lower resistivity value, which is thought to be weathered granite

Keywords: *Wenner Alpha, Resistivity, Granite*

INTRODUCTION

The Central Kalimantan region has three basins: the Barito Basin, the Kutai Basin, and the Tarakan Basin. This research was conducted in the Barito Basin, which has several rock formations, namely Alluvium, Dahor Formation, Warukin Formation, Tanjung Formation, Pre-Tertiary Basement Group, Berau Formation, and Montalat Formation ([Soetrisno et al., 1994](#)). Central Kalimantan has potential geological resources in the form of granite resource potential. However, it has not been processed optimally because of the absence of granite exploration and a lack of understanding of the use of granite ([Bayrak, 2013](#)).

One of the methods commonly used in determining the identification of lithology and stratigraphy of the subsurface is the Resistivity method, which is based on the nature of the resistance of rock types. Each rock has different characteristics, resulting in a variety of resistivities. The results of processing the type of resistance data obtained in the form of type resistivity are presented in the form of a cross-section of the type of resistivity. The subsurface geological data will be used as supporting data to improve the accuracy of the interpretation.

Resistivity is one of the geophysical methods used to investigate subsurface structures based on differences in rock resistivity. The basis of the resistivity method is Ohm's law, by flowing current into the earth through current electrodes and measuring its potential using potential electrodes ([Telford et al., 1990](#)). The configuration used in this study is the alpha Wenner configuration. This configuration is very good because it has a high sensitivity horizontally and is

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commonly used for Horizontal Profiling (Mapping).

Granite is a plutonic igneous rock formed by the freezing of acidic magma, which has a silica content greater than 66% ([Edwin et al., 2014](#)). Granite rocks are igneous rocks that originate below Earth's surface, which have a granitic structure and holocrystalline structure, consisting of quartz and feldspar elements, while other minerals are present in small amounts, such as biotite, muscovite, hornblende, and pyroxene ([Gusti, 2015](#)). Granite rocks in this group are distributed in Singkawang, Tawau, Sintang, and Telen. Granitoid rocks include diorite, microdiorite, granodiorite, and microgranites, which are from Upper Eocene to Lower Miocene. The main minerals that make up this group of granitoid rocks are quartz, hornblende, potassium feldspar, plagioclase, biotite, chlorite, and epidote ([Hidayat et al., 1995](#)). Granite is usually used as a building material, strengthening roads and bridges, and as a raw material for industrial needs.

In performing resource calculations, one must pay attention to certain requirements; for example, the estimated resources must reflect the exact geological conditions and characteristics of a sediment. Calculation of resources is useful for providing the quality of a sediment, and the amount of resources determines the age of the mine. Calculation of resources produces an estimate. The resource model compiled is an approach of reality, based on data/information that is owned, and still contains uncertainty ([Flygeost, 2015](#)). Calculating the resources or reserves of industrial minerals is very simple compared to other minerals. This is basically caused by the simplicity of the sediment geometry of these minerals, especially those that have been delineated by exploration activities ([Ria, 2016](#)).

Research on the use of resistivity methods to identify and estimate reserves has been widely conducted by researchers. Research at Tompotika, Wara, Palopo City, South Sulawesi. It has been carried out using the Wenner Alpha configuration resistivity method to find granite targets. The result is that granite has a resistivity value of (2682-7060) Ohm-m at a depth of 17.4 meters ([Prasetyo, 2010](#)). Research on bedrock using the resistivity method in the Sampit area, Central Kalimantan, was conducted by [Nila \(1995\)](#). The results showed that the depth of the bedrock was igneous rock of approximately 25 meters, with a high resistivity value ([Nila, 1995](#)).

The purpose of this study is to understand the processing of Resistivity data of the Wenner Alpha configuration and the interpretation of the results of processing the data. The purpose of this study was to determine the lithology in the area based on the response of resistivity and drill data, knowing the distribution of granite in the area, and to calculate granite resources and determine the prospect area for development.

LITERATURE REVIEW

Research area located "JT" at the Barito Basin, Central Kalimantan. According to [Soetrisno \(1994\)](#), the Kutai Basin is restricted to the west by the Kuching High and the Sunda Shield (Fig.1). The southern part of the Kutai Basin is divided into two, namely the Asam Sub-basin and the Pasir Sub-basin, which are in the eastern part of the Meratus mountain range, and the Barito Sub-basin, which is in the western part of the Meratus mountain range. This research area is in the Barito Sub-basin.

According to [Soetrisno \(1994\)](#), the Barito Basin has two appointments, and the sedimentation process formed during the Tertiary. The regional stratigraphy of Central Kalimantan compiled based on Figure 1 is the unit of Cretaceous Granite (Kgr), Kasale Volcanic Rock (Kvh), Pitab Formation (Ksp), Tanjung Formation (Tet), Montalat Formation (Tomm), Berai Formation (Tomb), and Warukin Formation (Tomw). The first lifting is in Late Cretaceous, which is the oldest rock. Formations that are in the first lifting are the Pitab (Ksp) Formation, Kasale Volcanic Rock (Kvh), and Cretaceous Granite (Kgr). While the second appointment is Late Miocene, which is arranged in the Tanjung Formation (Tet), Berai Formation (Tomb), and Warukin Formation

(Tomw).

Pitab Formation (Ksp): Inseparable volcanic sedimentary rocks, layered. Sedimentary rocks include dark gray siltstone, dark gray crystalline limestone, gray fine sandstone, red shale, and napkin. The layer thickness is between 20-30 cm, partially folded, volcanic rock: andesite, basalt, and amphibolite. Andesite and basalt in the form of green gray runners, transformed into clay minerals, calcite, or chlorite, xiroxene, and forsterite. Basalt with pilot and amigdaloid textures. Cretaceous Granite (Kgr): biotite granite is bright green; some are jointed. The outcrops are associated with the Haruyan Pitab and Formation Formations and are distributed in high-elevation hills. The rock variations are granodiorite, adamelit / granite gneiss, and some show graphitic texture. This unit intrusion the Pitab Formation, and is Late Cretaceous. Granite is older than the Tanjung Formation above ([Soetrisno et al., 1994](#)).

Kasale Volcanic Rock (Kvh): consists mostly of gray basalt with a pophyritic to phylotaxitic texture. Developing as a dike, sill, and stock. The result forms clay, calcite, and chlorite minerals. This unit spreads into rough and high hilly areas, its thickness reaches 50 meters, and can be correlated with the Late Cretaceous from the Haruyan Formation (Kvh).

Tanjung Formation (Tet): The oldest Tertiary sedimentary rock found in the Barito Sub-basin, where it is deposited uncovered above the Pre-Tertiary basement, and above it is the limestone of the Berai Formation. The Tanjung Formation is Eocene. The Tanjung Formation is widely exposed in the northern part of the Basin and in the east along the west wing of the Meratus mountain range. In the northern part, it is found in the upper part of the Kapuas near Kualakurun, consisting of conglomerates at the bottom followed by sandstones, coal clays, and often andesitic agglomerates, and deposited in terrestrial to paralic environments. Downstream of the Kahayan River near Pisau Island, the sediment consists of coarse sandstones, sandstone clay, coal, and thin limestones covered by shale with Discocyclus content. In the northern area of the border between Barito - Kutai cross high, in the Pararawen anticline area, the Tanjung Formation reaches a thickness of 2250 meters, consisting of sandstone, clay, and coal. Basal conglomerates were not found. Thickness decreases westward, reaching 950 meters on the Lemu River. The more westward Kualakurun, the thickness varies but generally decreases by about 500 meters.

Berai Formation (Tomb): During the Oligocene to the beginning of the Miocene, the entire area was very stable with shallow sea deposition conditions. The precipitation results from the Berai Formation are predominantly limestone exposure. The Berai Formation consists of alternating limestones with claystone, marl, and coal, some of which contain limonite and fossils of large forams. This formation is deposited in a dangkat marine environment with a thickness of 1250 meters. This formation spreads to steep areas and karst hills.

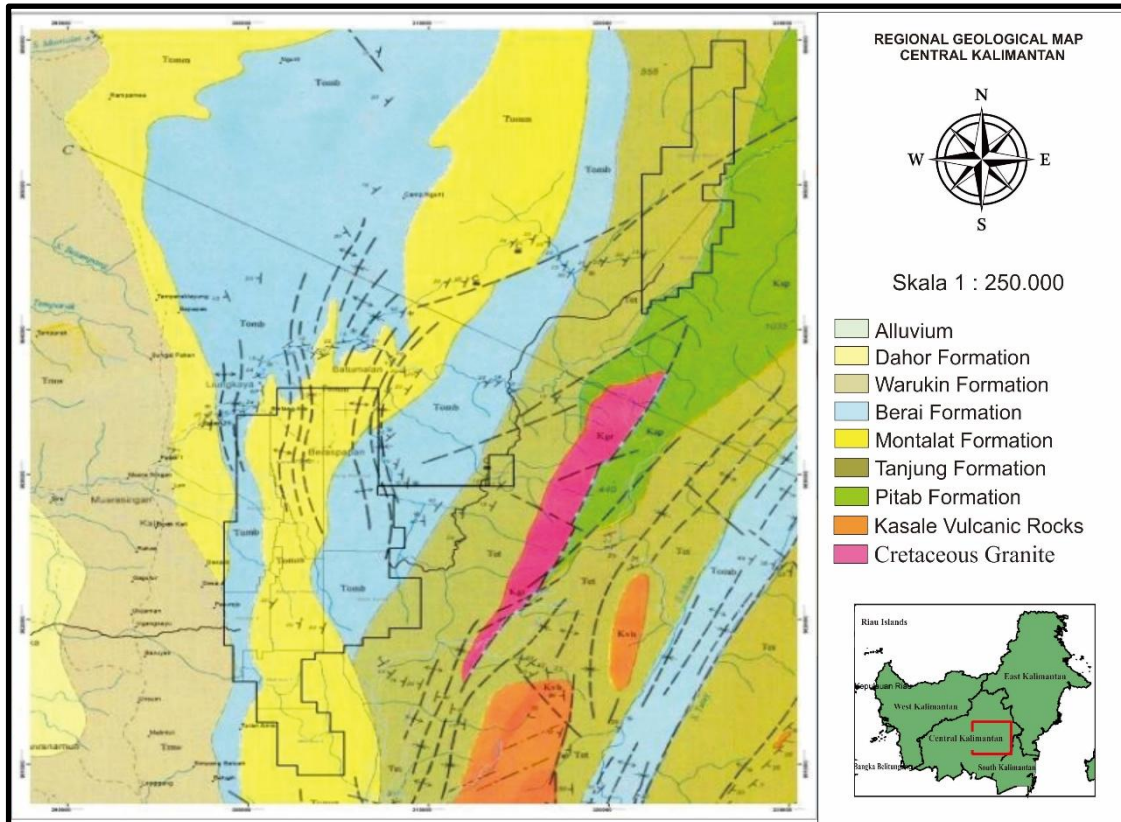


Figure 1. Geological Map of Buntok Sheet, Kalimantan ([Soetrisno et al., 1994](#)), red square is the research area

Montalat Formation (Tomm): This formation consists of a cross-layer of white quartz sandstone, local calcareous, interbedded with siltstone and coal, aged Oligocene. This formation is deposited in shallow and open seas. Thickness reaches 1400 meters. This formation interfaces with the Berai Formation with a harmonious relationship above the Tanjung Formation.

Warukin Formation (Tnw): delta regression covers the Berai Formation and Middle Miocene age. This delta may have originated from the north and northwest, and its thickness reached several thousand near the Meratus mountains. Composed of semi-compact to coarse sandstones, some intercalated conglomerates with siltstone and shale. This formation forms a harmonious relationship on the Berai and Montalat Formations.

RESEARCH METHOD

Resistivity Methods

One type of geophysical method is used to study subsurface conditions by studying the nature of electricity in rocks below the surface of the earth. The purpose of the Resistivity survey is to determine the subsurface resistivity distribution by taking measurements at the ground level. The relationship between resistivity (ρ), current (i), and potential (V) is as in equation 1.

$$\rho = K \frac{V}{I} \quad (1)$$

With K , the geometry factor. The study uses the Wenner Alpha (Fig.2) configuration with a geometry factor of $2\pi a$, where a is the spacing.

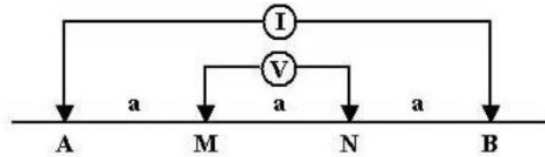


Figure 2. Wenner alpha configuration of resistivity methods, AB is the current and MN is the potential electrodes.

Survey Design

Geologic trajectories have two groups, namely 1-11 line-oriented Northwest-Southeast with a space between lines of 100 meters, and 12-17 oriented North-South lines with a space between lines of 50 meters. Each line length is 320 meters. Six drill points are passed by several paths (Fig.3)

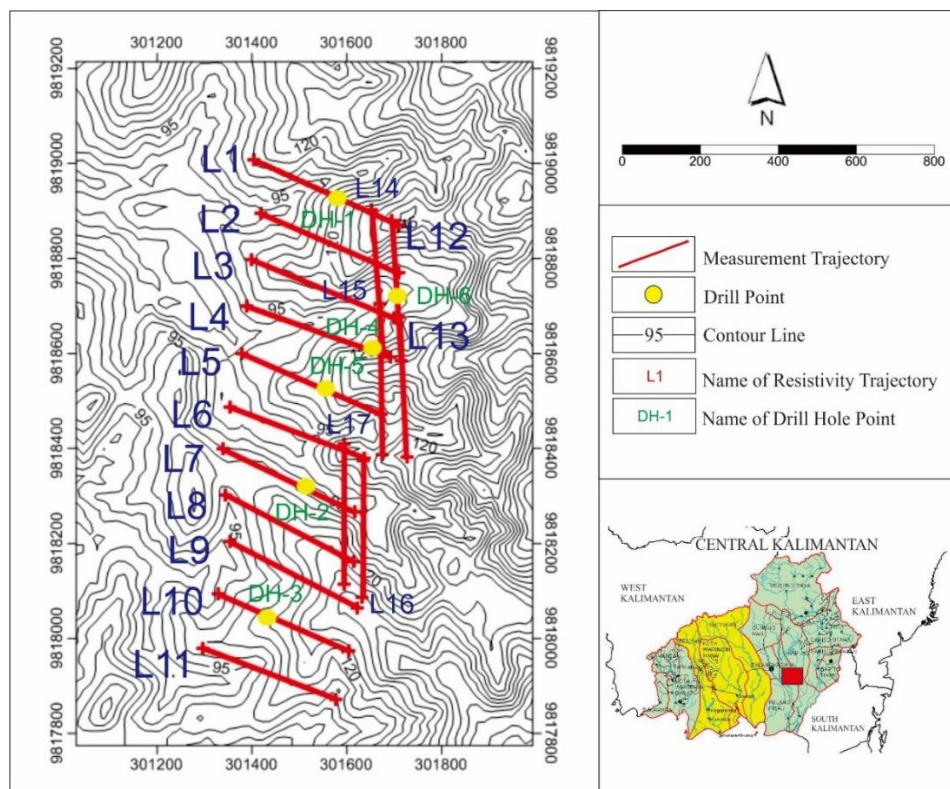


Figure 3. Resistivity line Survey Design and drill hole Points for Granite Resource Analysis Using the Wenner Alpha Configuration Method and Drill hole on the 'JT' Area, Central Kalimantan.

FINDINGS AND DISCUSSION

2D Cross-section

The results of data processing and interpretation of 2D resistivity sections of the inversion model of the two lines that pass through drill hole 1 can be seen in Figure 4.

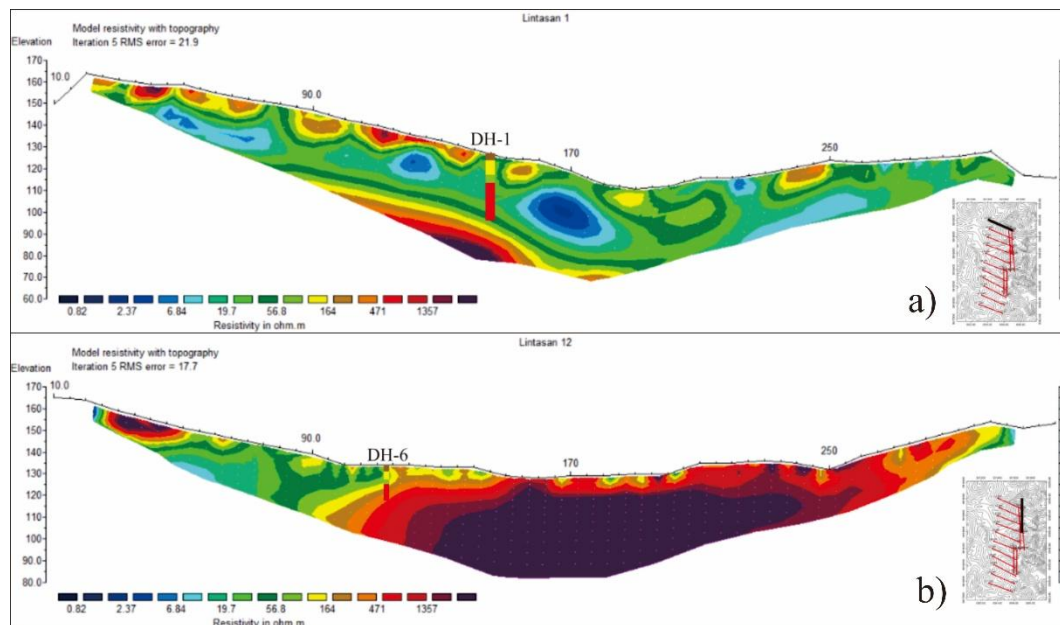


Figure 4. Cross Section 2D Resistivity Wenner Alpha Configuration Model: a). Lines 1 oriented Northwest-Southeast past the point of drill hole 1, b). Lines 12, North-South oriented past the point 6 Drill Hole.

The resistivity of the inversion results shows a value of 1 to 2100 Ohm-m, divided into four classifications: low with a value of <200 Ohm-m, medium (21-60) Ohm-m, high (60-300) Ohm-m, and very high (>300) Ohm-m. Low resistivity is interpreted as soil, medium as sandstone or claystone, high as sandstone, and very high as granite igneous rock. The classification of resistivity values and lithology interpretation is shown in Table 1.

Table 1. Classification of resistivity values in the study area.

No	Classification	Resistivity value range (Ohm-m)	Lithology
1	Low	< 20	Soil
2	Medium	21 – 60	Sandstone and claystone
3	High	60 - 300	Sandstone
4	Very High	> 300	Granite

Line 1 and the other line are divided into four ranges of resistivity, namely low, medium, high, and very high. Low resistivity is soil, and medium, which is a cross between sandstone and claystone. While the high resistivity (60 – 300) Ohm-m is sandstone, and very high resistivity is granite with a resistivity > 300 Ohm-m. The elevation of 110 meters to 100 meters has been found in the results of the drill data on granite. Maybe the granite has a low resistivity. This is estimated because of the presence of overburden or impure rock in granite. At a distance of 160-170 meters,

there is an increase in the shape of the granite. This is thought to be caused by the presence of fresh granite formations underneath.

Line 12 is also divided into four ranges of resistivity, namely low, medium, high, and very high. Low resistivity is <20 Ohm-m, which is soil, and medium is 21 - 60 Ohm-m, which is a cross between sandstone and claystone. While the high resistivity (60–300) Ohm-m is sandstone, and very high resistivity is granite with a resistivity > 300 Ohm-m. The elevation of 140 meters to 110 meters shows a high resistivity, which ranges from 60 - 300 Ohm-m. The high is the sandstone, which is in the Tanjung Formation. At a distance of 110-260 meters, there is an increase in the shape of the granite. This is thought to be caused by the formation of the distribution of fresh granite at the subsurface.

Soil resistivity values can be caused by various conditions. High resistivity is caused by porosity and water content. Loose soil has high porosity, which increases resistivity. Furthermore, dry soil conditions also increase resistivity. The range of soil resistivity overlaps with the intersection of sandstones with claystone, which is found in the medium resistivity. It can be seen that the overlapping resistivity between several types of rocks and soil is due to certain types of rock resistivity, or depending on several factors, including porosity, water saturation level, and dissolved salt concentration.

The results obtained from 2D cross-section correlation and drill hole profile are used to determine the resistivity to lithology. The determination is seen based on the lithology location of the profile, which is in the color contour resistivity. All of these results are averaged so that they can be divided into four groups. Each path that passes through a drill hole is analyzed with 4 parameters. The main parameters are the Resistivity method, lateral variation, horizontal variation, and lithology. In the Resistivity method, the resistivity can be read. In the parameters of lateral variation, there are a number of drill bits and the length of the line. In the parameters of horizontal variation, there is thickness. The last parameter is lithology, where there are four lithologies, i.e, soil, sandstone or claystone, sandstone, and granite.

Correlation of Resistivity Cross-section

The results of all 2D resistivity cross sections were obtained by correlation, which aims to see the distribution of the target rock in the study area. This is shown in Figure 5 with a cross-section oriented northwest-southeast and north-south.

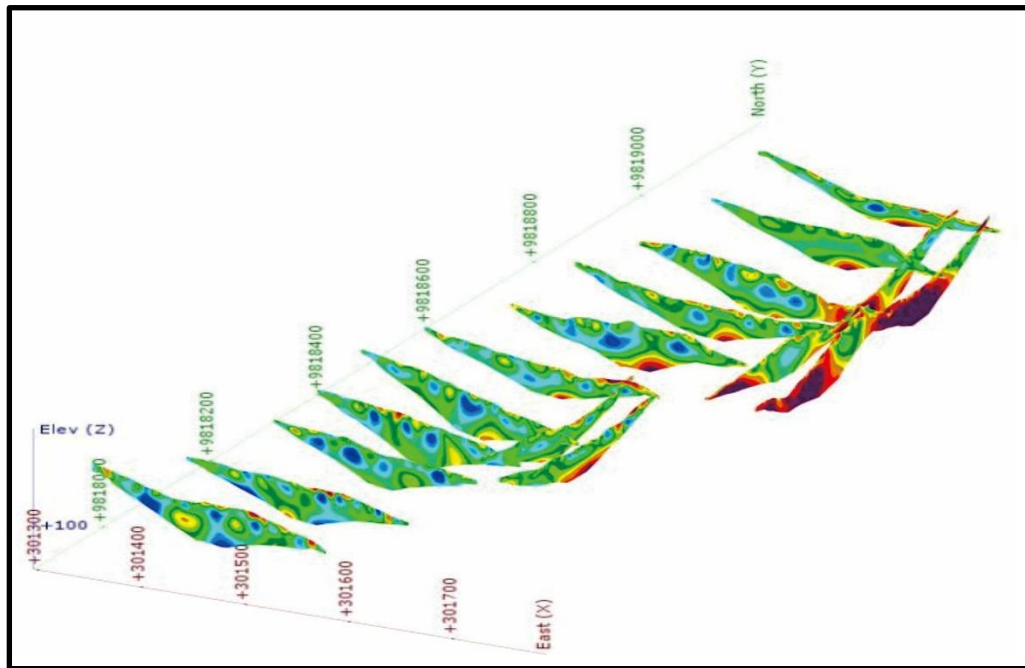


Figure 5. Correlation of All Resistivity Sections Model of Inversion of Wenner Alpha Configuration in the 'JT' Area.

Based on the results of the correlation, it can be seen that there is a clear continuity of granite found in the deepest part of several cross sections oriented to the Northwest - Southeast. The presence of the granite is found in cross-section 1 up to cross-section 5. The granite depth at the study location can be found from different elevations because granite is obtained in each cross-section, but on average, the granite is at a depth of 6 meters to 36 meters. Whereas, from cross-sections 6 to 11, the granite is only on the surface. Based on the results of the North-South oriented correlation, it can be seen below that there is continuity of granite. The presence of granite continues from the first to the last cross-section. The granite depth at the North-South oriented research site can be found at a depth of 80 meters on average, although the depth of this granite varies from one cross-section to another. The granite is also on the surface.

Aside from the continuity of granite, it can be seen that there is also the purity of other lithologies, namely soil and interrelationships between sandstones and claystones. It's just that the difference is in the thickness of the lithology from all lines. The thickness of the lithology above the granite shows the thickness of the cover layer.

The possible interpretation is also sandstones filled with fluid (water) in the study area. These sandstones filled with fluids are almost present in each cross-section that is oriented to the Northwest - Southeast. It can be seen that there is a continuous blue resistivity contour. This is what is interpreted as a sandstone filled with fluid.

The thickness of the granite obtained is from 12 meters to 30 meters in the Northwest - Southeast. Whereas granite in the North-South region has a granite thickness of around 20 meters to 80 meters. The results of this cross-sectional correlation can also determine which granite is the prospect of the development phase. The prospect of granite is granite that is in a cross-oriented section from North-South. Because it has fairly thick granite. It does not mean that the granite in the Northwest-Southeast oriented area cannot be carried out in the development stage either, but it can also be done, because the granite is also fresh granite.

3D Model of Resistivity

The 3D model is the result of 2D data processing carried out by cutting off the resistivity value. Granite has a resistivity of > 300 Ohm-m, so it can determine the volume of the granite. The 3D model distribution of granite is shown in Figure 6. The model is obtained from the Oasis Montaj software. It can be seen that the most dominant or thick distribution of granite is in the Southern region. Whereas in the northern part, the granite looks very thin and few. The resistivity range (300 – 1375) Ohm-m shown in the study area is fresh granite, because it is not easily weathered. The most dominant and thick distribution of granite is in the southern region and there are also many granites that have been released or granite in the form of blocks. Whereas in the northern part, the granite is thinner and slightly thinner, but to the east, fresh granite is found.

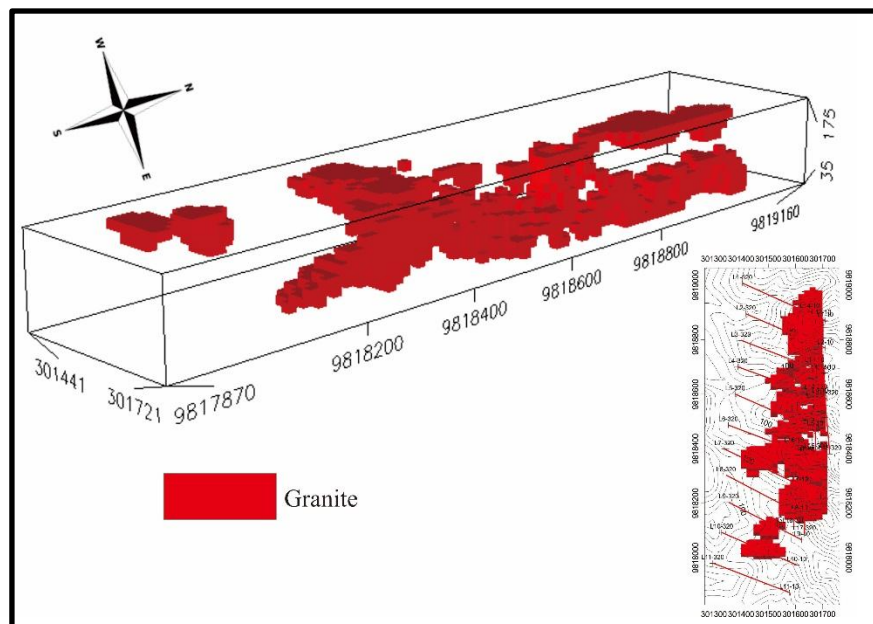


Figure 6. 3D Cut-Off granite model with resistivity > 300 Ohm-m for Granite Resource on the 'JT' area.

All parts of the granite in the North are of good quality, as shown in Figure 6. The farther south the granite is, the more it is dominated by granite with low resistivity. Even if there is weathered granite, this is because granite experiences weathering and produces loose material, so that the granite is transported to the South because it has a lower topography, which is caused by the slope of the topography of the research area. In addition, weathered granite must be on the surface because it is exposed to weather effects such as rain, heat, wind, etc. Granite below the surface is not weathered granite, but only granite that has low resistivity, because the subsurface is not affected by the influence of weather or climate. This means that weathered granite is not only the result of weathering of fresh granite underneath, but also comes from the results of fresh granite transportation in the northern part of the higher topography and the influence of weather and climate. Other factors can also influence, namely the Overburden factor where the South is thicker than in the North. The exploitation is better in the North, because in terms of the North Overburden it is better because it is thin and has a high resistivity. However, it is possible to exploit granite with low resistivity, because the granite is only exposed to impure rocks above it. But it must also be known that granite is an igneous rock that is not easily weathered. For mining, what must be taken is the fresh granite part, because it is stronger to strengthen the road. But it does not emphasize the

possibility that granite with low resistivity is not taken, with the condition that it has not experienced weathering.

CONCLUSIONS

The results of the study show that the resistivity values are classified into four, namely: low resistivity with a value of <20 Ohm-m, medium (20-60) Ohm-m, high (60-300) Ohm-m, and very high >300 Ohm-m. Lithology based on resistivity values is soil, sandstone in the Tanjung Formation mixed with clay, and granite igneous rocks with very high resistivity (>300 Ohm-m). The quality of granite rocks in the research area is very good, as shown by high resistivity values combined with the results of drill analysis. The distribution of granite rocks in the research area shows that their presence is in the north, while in the south, it is dominated by weathered granite rocks.

REFERENCES

- Bayrak, G., et al. (2014). *Granite-based glass-ceramic materials. Acta Physica Polonica A: Proceedings of the 3rd International Congress APMAS 2013*, No. 2. Turkey.
- Flygeost. (2015, November). *Understanding, terms and use of mineral resources calculation*. Retrieved July 22, 2017, from <http://www.geologinesia.com/2015/11/pengertian-syarat-dan-kegunaan-perh-calculation-sumberdaya-mineral.html>
- Gusti. (2015). *Granite profiles*. Retrieved from <https://www.tekmira.esdm.go.id/bata-mineral-and-coal-mining/granite-profiles>
- Hidayat, S., & Satrianas, D. A. (1995). *Geological map of Tarakan and Sebatik sheets, Kalimantan (Scale 1:250,000)*. Bandung: Center for Geological Research and Development.
- Loke, M. H. (2002). *Electrical imaging surveys for environmental and engineering studies*.
- Maulana, A., Edwin, M., & Kaharuddin. (2014). *Petrology and geochemistry of granitic rocks in Buttu Congo region, Polewali District, Polewali Mandar District, West Sulawesi Province: Implications for the existence of radioactive elements*. In *Proceedings of the 2014 National Geophysical Seminar* (Hasanuddin University, Makassar).
- Myers, J. S. (1997). *Geology of granite*. Western Australia: Geological Survey of Western Australia (GSWA).
- Nila, E. S., Rustandi, E., & Heryanto, R. (1995). *Geological map of Palangkaraya, Kalimantan sheet*. Bandung: Center for Geological Research and Development.
- Prasetyo, N. (2010). Potential of regional granite excavation in Tolitoli Regency, Central Sulawesi Province. *MTG Scientific Journal*, 3(2).
- Ria, M. (2017, June). *How to calculate resources or reserves of industrial minerals*. Retrieved July 22, 2017, from <http://www.matadunia.id/2016/06/cara-menghitung-sumberdaya-atau-bahan-galian-industri.html>
- Soetrisno, S., Supriatna, E., Rustandi, E., Sanyoto, P., & Hasan, K. (1994). *Geological map of Central Kalimantan and surrounding areas (Scale 1:250,000)*.
- Telford, W. M., Geldart, L. P., Sheriff, R. E., & Keys, D. A. (1990). *Applied geophysics* (2nd ed.).