SINTECHCOM: Science, Technology and Communication Journal
Vol. 5, No. 1, October 2024, pp. 1-6, DOI: 10.59190/stc.v5i1.284

Identification of the thickness and depth of coal seams using the Schlumberger configuration geoelectric method in Petai Village, Singingi Hilir District, Kuantan Singingi Regency

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ABSTRACT

The identification of the thickness and coal seam depth using the Schlumberger configuration geoelectric method in Petai Village, Singingi Hilir District, Kuantan Singingi Regency, Riau Province has been investigated. This study aims to determine the subsurface structure and its depth. The method used in this study is the one-dimensional Schlumberger configuration geoelectric method by processing data using Progress software. The data obtained are (I) and potential difference (V). Based on the results of data processing, the information on rock layers at the research site is obtained. The resistivity value of rocks on track 1 ranger from 2272.23 – 1317.96 Ohm-m with a depth of up to 19.05 meters. The lithology layers identified the resistivity values obtained for track 1 are sand and dry gravel. The resistivity value of the second trajectory range 1188.91 – 1491.29 Ohm-m with a depth of up to 17.00 meters. The lithology layers identified the resistivity values obtained for track 2 are top soil, coal and sandstone. The resistivity value of the third trajectory range 4986.17 – 347.81 Ohm-m with a depth of up to 11.43 meters. The lithology layers identified the resistivity values obtained for track 3 include sandstone, coal and sand. The result of the interpretation of track 1, track 2 and track 3 obtained the subsurface layers and its depth at the research location.

ARTICLE INFO

Article history:

Received Aug 9, 2024
Revised Sep 16, 2024
Accepted Oct 21, 2024

Keywords:

Coal
Geoelectric
Progress Software
Resistivity
Schlumberger

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1. INTRODUCTION

Energy is something that all living things need every day. Energy from oil and natural gas is generally used to meet human needs [1, 2]. As a result of ongoing exploitation, energy reserves produced from oil and natural gas continue to decrease, causing various parties to look for other energy sources, one of which is energy obtained from coal [3-5].

Coal, which is composed of organic and inorganic components, is one of the alternative fossil energy sources that has quite large reserves in Indonesia [6, 7]. Coal is formed from the remains of plants and animals that have died and been buried. The remains of plants and animals then undergo decomposition and sedimentation and also undergo chemical and physical processes so that the carbon atoms contained in them increase [8-10].

The existence of coal in Petai Village is a potential that can be explored and utilized by the village to improve the village's economy [11, 12]. This research area is access to the coal mining area owned by PT. Manunggal Inti Artamas (MIA), so that it is possible that there is coal in the area. The results of the survey conducted stated that there were coal outcrops in the area. The geoelectric method is one of the methods used to measure the width and depth of coal layers [13-15].

The geoelectric method is one of the geophysical methods that describes the presence of rocks or materials below the surface of the earth such as the depth and thickness of the rock layer based on its electrical properties [16, 17]. This method is used to determine changes in the resistivity of rock layers below the surface of the earth by injecting electric current into the ground. This electric current injection uses 2 current electrodes and 2 potential electrodes that are inserted into the ground at a certain distance, so that it will cause a difference in electrical voltage in the ground [18-20].

There are two methods of geoelectric measurement, namely the sounding method and the mapping method [21, 22]. The sounding method aims to determine vertical changes in the resistivity of subsurface rocks, while the mapping method determines the resistivity of rocks horizontally. The method used in this study is the sounding method so that a vertical image of the subsurface is obtained [1, 23, 24].

The principle of this method is to use the concept of electric current propagation in a heterogeneous earth medium with a ratio between the measured potential difference and the amount of electric current injection that reflects the resistivity value below the earth's surface [25-27]. Interpretation of geoelectric data is needed to explain the appearance of subsurface images. Each rock layer has its own resistivity value and unique properties [28, 29].

In the geoelectric method, there are several configurations, one of which is the Schlumberger configuration. This Schlumberger configuration is widely used in sounding procedures so that vertical subsurface images are obtained. The weakness of this configuration is that the voltage read on the potential electrode is small when the current electrode is very far away. The advantage of this configuration is that it is able to detect the inhomogeneity of rock layers.

2. RESEARCH METHODS

Before collecting data in the field, a review of the research area was first carried out. The next stage is to conduct a direct field survey which aims to determine the environmental conditions around the area to be studied and also to determine the data collection path points. Furthermore, geoelectric data collection is carried out using the sounding method.

This study uses a set of resistivity meter equipment, cables, batteries, GPS (Global Positioning System), hammers, meters, 4 electrodes with details of 2 current electrodes and 2 potential electrodes. The data processing uses Progress software which is carried out in the earth laboratory of the Physics Department, University of Riau.

The geoelectric method with the Schlumberger configuration can be seen in Figure 1 which is used for data collection in the field. There are three paths with a length of path one of 100 meters, path two of 100 meters, path three of 70 meters. Because the geography of the research area is hilly and uneven, it causes differences in the length of the path. The path is located around the outcrop. The data is processed using Progress software to obtain a 1D subsurface image. The last step is data interpretation.

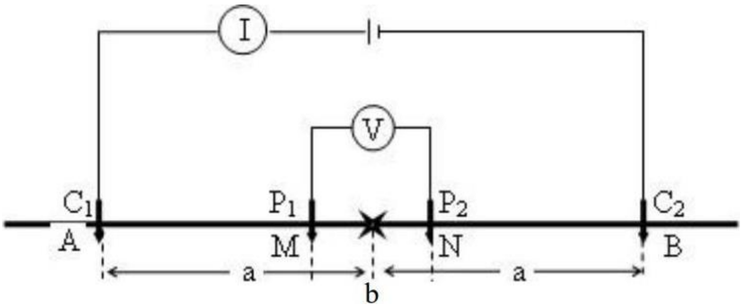

Figure 1. Schlumberger configuration electrode arrangement.

3. RESULTS AND DISCUSSIONS

The data measurement process in the field was carried out at 3 track points with the first track being 100 meters long, the second track 100 meters and the third track 70 meters. The data obtained was then converted into apparent resistivity and the results were processed using Progress software so that the actual apparent resistivity value was obtained and could display the layers of the subsurface structure with different resistivity values.

The results of the calculation and data processing with Progress software using the Schlumberger configuration resistivity geoelectric method obtained an RMS-error value of 5.4717% with a readable layer depth reaching 19.05 meters, with the resistivity values obtained ranging from 2272.23 – 1317.96 Ohm-m which is interpreted as a layer of dry sand and gravel (see Figure 1).

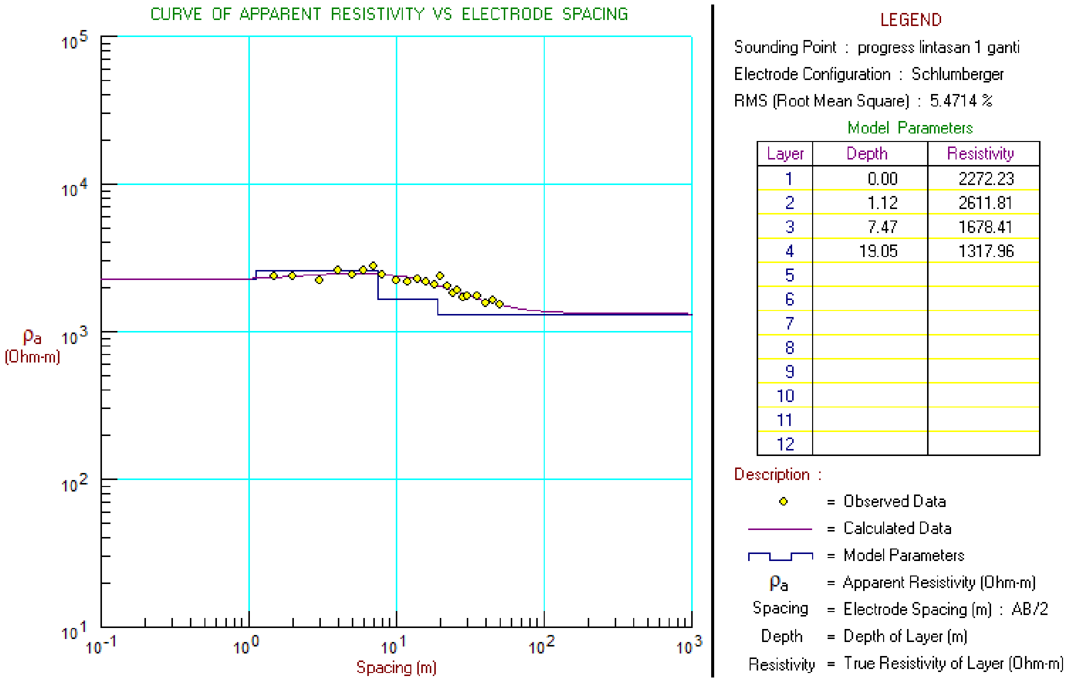

Figure 2. Data processing interface using progress track 1.

The results of the measurement of the data from path 2 processed using Progress software are shown in Figure 3. The RMS-error value on path 2 is 6.0707% with a maximum depth that can be read reaching 17 meters which is identified as a layer of topsoil, coal and sandstone. The coal layer is located at a depth of 1.60 – 2.61 meters below the surface.

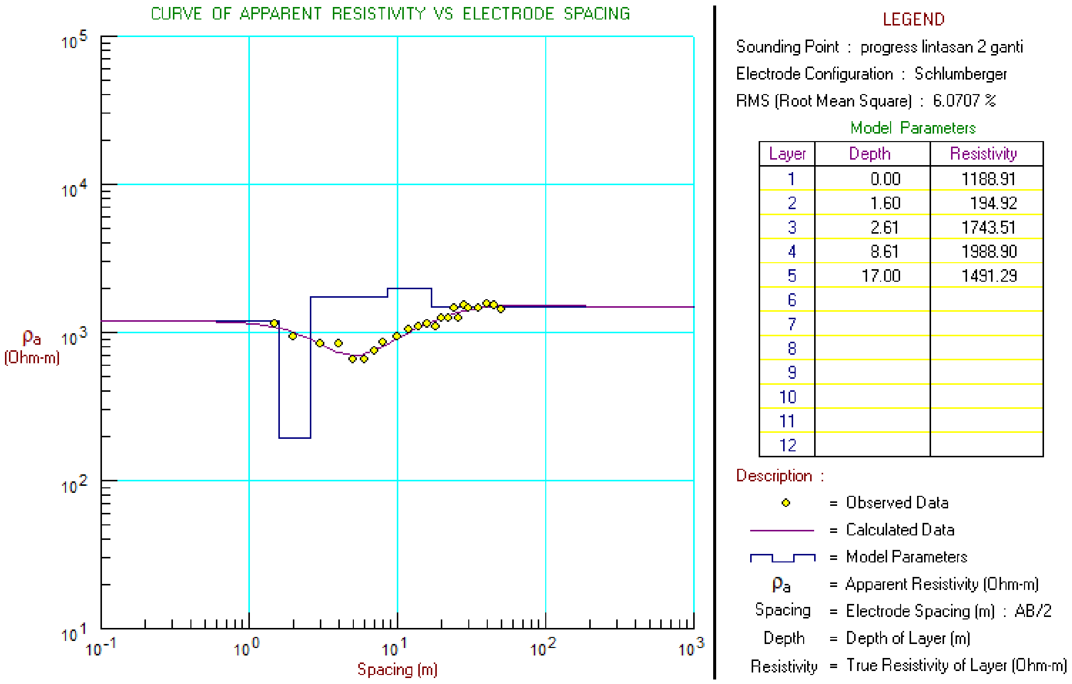

Figure 3. Data processing interface using progress path 2.

The results of the measurement of path 3 and processed using Progress software can be seen in Figure 4. The RMS-error value on path 3 is 21.583% with a maximum depth that can be read reaching 11.43 meters which is identified as a layer of sand, coal and sandstone. The coal layer is located at a depth of 2.11 – 11.43 meters below the surface. Hilly terrain, cliffs, and river flows are challenges in this study, making it difficult to obtain geoelectric data.

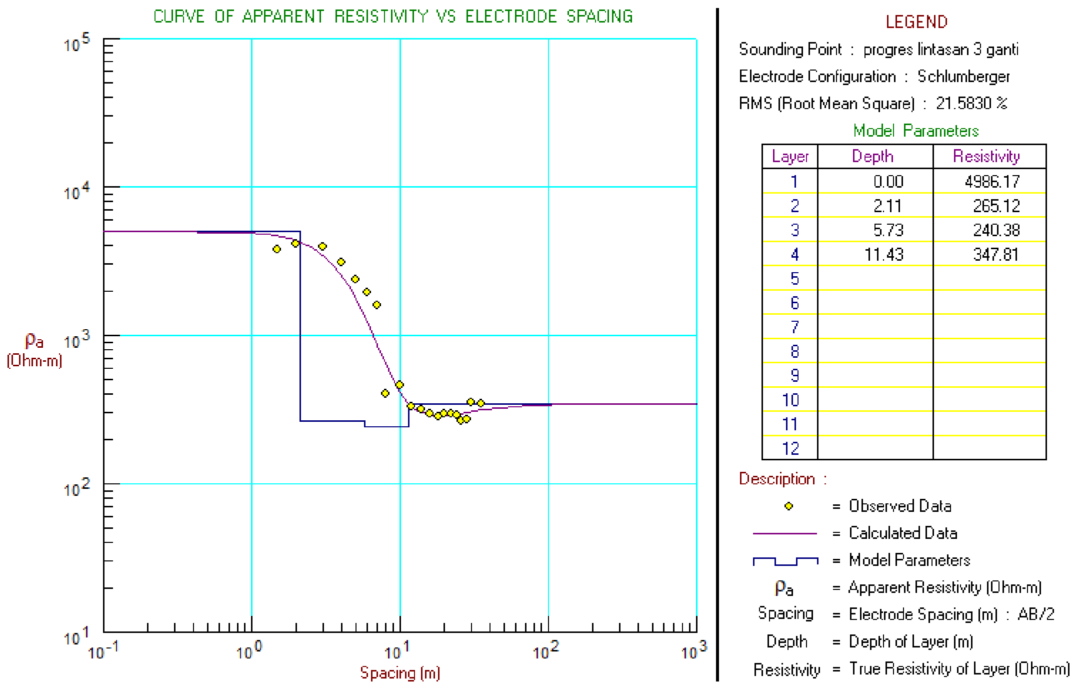

Figure 4. Data processing interface using progress path 3.

4. CONCLUSION

Based on the results of resistivity value measurements, it is interpreted that for path 1 the resistivity value ranges between 2272.23 – 1317.96 Ohm-m with a depth of 19.05 meters, for path 2 the resistivity value ranges between 1188.9 – 1491.29 Ohm-m with a depth of 17 meters, for path 3 the resistivity value ranges between 4986.17 – 347.81 Ohm-m with a depth of 11.43 meters. The lithology layers identified from the results of the resistivity values obtained for path 1 are dry sand and gravel, for path 2 are top soil, coal and sandstone, for path 3 are sandstone, coal and sand.

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