



ANALYSIS OF SHALLOW SUBSURFACE STRUCTURE AT GEOTHERMAL AREA OF IE JUE USING RESISTIVITY METHOD

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Abstract. It has been conducted a geo-electrical resistivity survey at geothermal area of Ie Jue, Aceh Besar. The survey aims to measure resistivity value in the area. It is expected that the values of resistivity will image the subsurface structure in the area. In addition geological features in the area are shown after we process it. The data acquisition in this study was acquired using a SuperSting R8/IP resistivitymeter and its data processing using EarthImager 2D software to get the image of resistivity pseudosection. The two lines of measurement crossed the surface geothermal manifestation. Each line has 330 m in length, and 56 electrodes with electrode space of 6 m. The result of resistivity pseudosection model interpreted based on geological condition and observation in the area. Resistivity pseudosection model shows the study is water-saturated ($<64.0 \Omega\text{m}$) to a depth of ± 65 m and a highly conductive zone ($0.6\text{-}3.5 \Omega\text{m}$) with a thickness of 30-50 m. This conductive layers below the embodied surface at a distance of 158-160 m on the IJ-Y1 line and at a range of 130-185 m on the IJ-Y2 line. This conductive zone is indicated as a weak zone where geothermal fluids are transported to the surface.

Keywords: Geothermal, Ie Jue, geo-electrical resistivity survey, resistivity

1 INTRODUCTION

Around Seulawah Agam volcano, the existence of geothermal manifestations appears at several locations; Heutz Crater, Cempaka Crater, Ie Jue, Ie Broek, and Ie Seu'um. One of them, Ie Jue is a geothermal area traversed by the fault and consists of volcanic rock formations of Lam Teuba in the form of andesitic to dacitic volcanic, pumiceous breccias, tuffs, agglomerates, ash-flows and lahars/mudflows contained in the rock formations [1]. Manifestations in the geothermal area of Ie Jue are directly observed in the form of fumaroles, steaming ground and mud pool. Unlike the others geothermal manifestations, the manifestation is in the form of hot springs [2]. We then conducted the geo-electrical resistivity

survey to prove the manifestation by measuring the resistivity value. Resistivity method measures geo-electrical properties of the rock by injecting electric current flow into the ground [3,4]. Then by measuring 2D using Wenner-Schlumberger array, we get the variation of rock resistivity value both laterally and vertically. This resistivity value can be modeled in the form of 2D or 3D pseudosection, so that the surface of the research area is obtained based on the value of the physical parameters. This overview of shallow subsurface structure can be the latest information in the effort to develop geothermal potential location around Seulawah Agam, especially for Ie Jue area. Marwan et al and Asrillah et al have conducted the gravity and magnetic method to determine the sub-surface

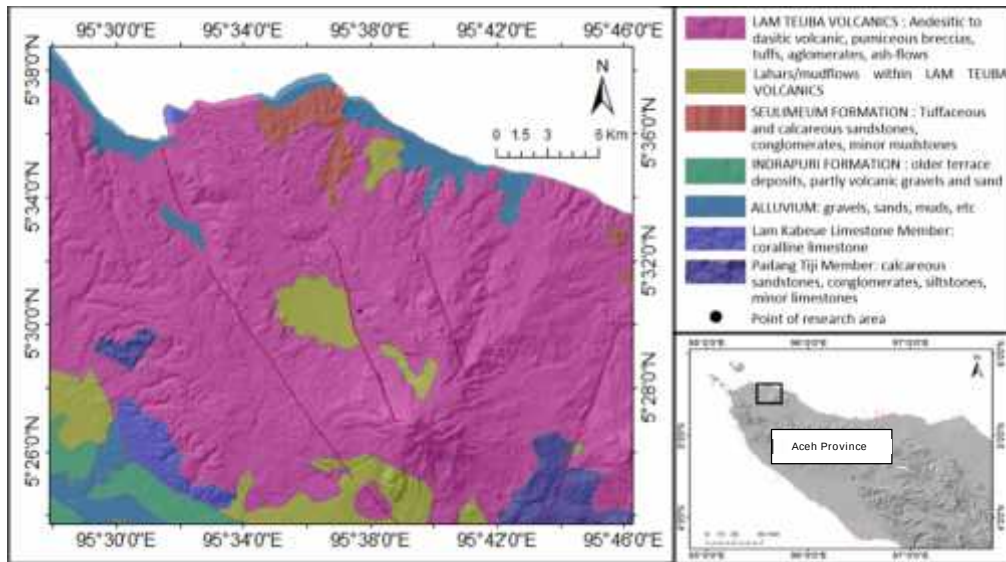


Figure 1 Geological map of the research area modified from the geological map of Banda Aceh [1]. The map shows the surface lithology distribution along the research area. The lithology mainly consists of volcanic rocks

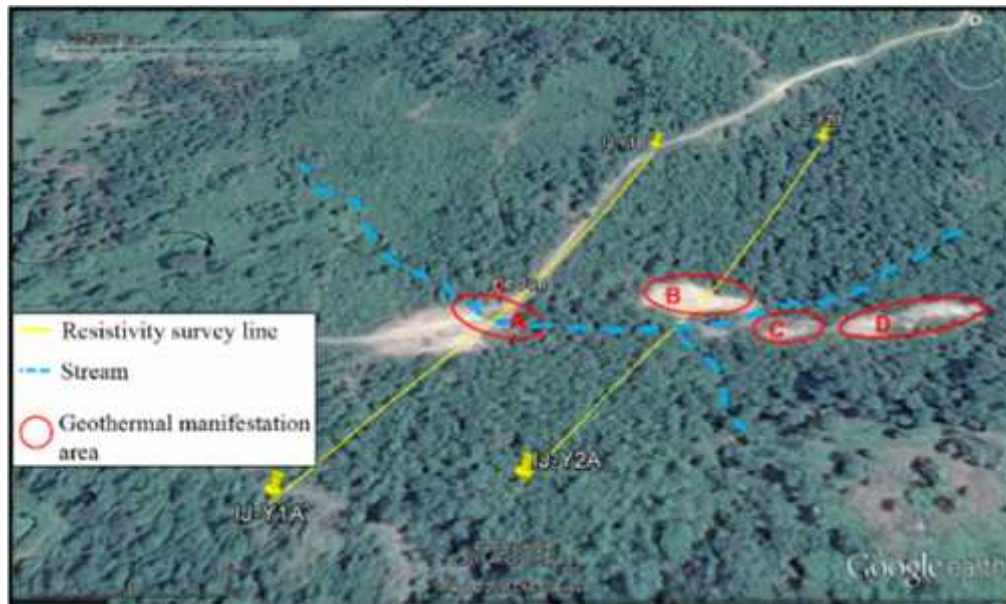


Figure 2 The location of which the geoelectrical cables lay. The first line is IJ-Y1 and second is IJ-Y2. The lines across the geothermal prospect

of Seulawah volcano and Ie Jue [5,6]. They conclude the possibility of local fault which associates with geothermal manifestation. Measurements using resistivity methods have been common in the geothermal area to determine more detail shallow subsurface structure. For example, in the geothermal field Ie Seu'um explains that the possibility of hot spring flows ($<5 \Omega\text{m}$) in Ie Seu'um is controlled by fault (Seulimum segment) [2]. As for the Ie Jue area, resistivity measurements have been performed using the Very Low Frequency (VLF) method, where the resistivity model obtained is a more resistive layer covered by a conductive layer near the surface ($10-60 \Omega\text{m}$) [7].

II METHODOLOGY

The research was conducted on Ie Jue geothermal manifestation area and administratively located in Meurah Village, Seulimum Subdistrict, Aceh Besar District Aceh Province (Figure 1). The data acquisition process at that location uses the resistivity method of the Wenner-Schlumberger array. The two lines of measurement crossed the surface geothermal manifestation. The spacing between line is 100 m and 56 electrodes with electrode space of 6 m. These two lines oriented from the Southwest-Northeast with the coordinates of the initial and final positions of IJ-Y1 (791114.95E 609192.77 N and 791300 E 609464 N) and the starting and ending

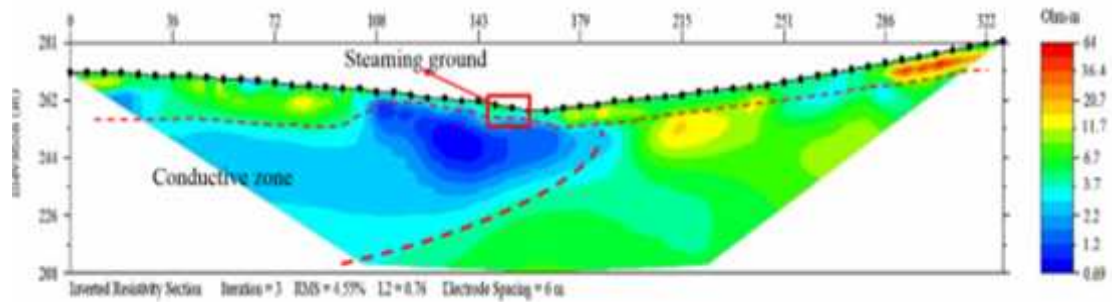


Figure 3 Resistivity pseudosection IJ-Y1

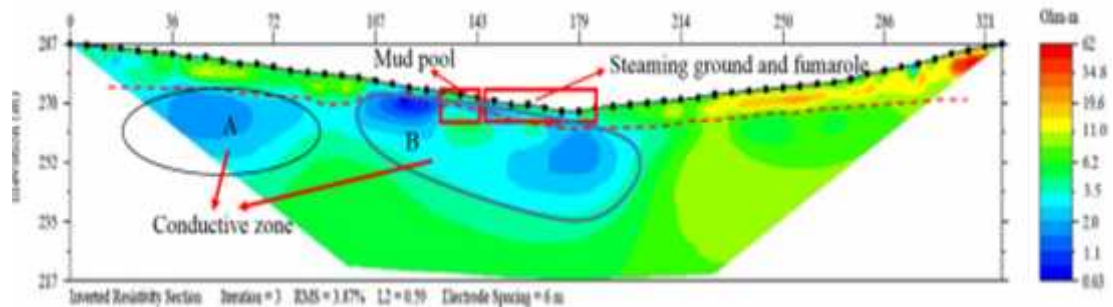


Figure 4 Resistivity pseudosection IJ-Y2

positions of IJ-Y2 (791213.91 E 609189.24 N and 791402.74 E 609460.65 N) 46 N zone in UTM system. The data acquisition process on both lines is done using Resistivity meter SuperSting R8/IP, while data processing is done using EarthImager 2D software to obtain the resistivity pseudosection.

III RESULT AND DISCUSSION

The resistivity pseudosection model was interpreted based on the resistivity value of the geology area [2] and cover field observations. The observation in the field shows that in the location of Ie Jue there are geothermal manifestations that appear are steaming ground (A), steaming ground in the west and fumaroles on the eastern (B), mud pool (C) and mud pool heat accompanied by gas bubbles (D). The resistivity pseudosection model obtained the subsurface layer of the geothermal area of Jue and a water-saturated layer up to a depth of ± 65 m. The resistivity value obtained is $< 64 \Omega\text{m}$, but is typically in the range of 6 Ωm . A more resistive layer (6-64 Ωm) is seen in the uppermost layer with a thickness of ± 10 m. This layer is a non-dense surface layer composed of clays mixed with andesite and volcanic breccia. While the value of resistivity is low (conductive), that is with the resistivity value of 0.6-3.5 Ωm which is imaged by blue (conductive zone). This layer is below the surface of the appearance of the manifestation (158-160 m distance on IJ-Y1 line and at a distance of 130-185 m on IJ-Y2 line) with variations in depth from ± 2 downwards (thickness 30-50 m). It indicates that this layer

is a weak zone consisting of weathered rock so that the geothermal fluids leakage to surface. In both pseudosections (Figure 3 and 4) can be seen that the manifestation appears to be on a low topography. They show areas of contrast resistivity values are almost thinner. In addition, field mapping indicates the possibility position of the hot thermal. This becomes the initial indicator of faults appearance. However, this needs geophysical methods to prove the appearance. On the other hand, based on the low resistivity of subsurface rocks, the subsurface layer of the geothermal area of Ie Jue indicates very good aquifer spot.

CONCLUSION

The resistivity pseudosection image provides information that the subsurface layer of Ie Jue is generally a water-saturated layer ($< 64 \Omega\text{m}$) to a depth of ± 65 m. Manifestation arises from the presence of a weak zone layer below the surface which is indicated by a very low resistivity value (0.6-3.5 Ωm).

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