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ANALYSIS OF SHALLOW SUBSURFACE AT HYDROCARBON POTENTIAL AREAS IN NORTH ACEH BASED ON ELECTRICAL RESISTIVITY MODEL

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Abstract. Hydrocarbon prospect area research has been done in North Aceh at two locations. The research aims to analyze subsurface litology using resistivity method. Data acquisition of each location was presented by 330 m line survey. The acquisition process was generated by Super Sting R8/IP and modelled by EarthImager 2D. Oil and gas (NA1) resistivity section showed anomaly at 170 m (x) and 17 m (z) that was identified as minor fault. However, oil seepage was not founded on the location. Fossil locality (NA2) section showed a contrast vertical anomaly (16-90 Ωm) around 90 – 120 m that was identified as a way for the seepage.

Keywords: Hydrocarbon, North Aceh, electrical resistivity survey, resistivity

I INTRODUCTION

Oil and gas seeps are often occured in Lhokseumawe and North Aceh, particularly in the eastern third of the Quadrangle. Examples occured in the headwater of Pasee and Sawang River [1]. Based on the geological map of Lhokseumawe Quadrangle, Sumatra can also be seen that potential areas of hydrocarbon potential are approximate boundary of oil and gas (NA1) and Fossil locality (NA2). The area is located from downtown Lhokseumawe with distance ±21.7 km South West by South direction (NA1) and distance ±17.55 km South by West direction (NA2). The NA1 area consists of Geureudong Volcanic Center and Julue Rayeu Formation and NA2 consists of the Julue Rayeu Formation [2]. Although these two areas are both potential areas of hydrocarbons, but based on the direct observation in the field only in the area of NA2 the appearance of surface oil seepage found (Figure 1). Therefore, in this study shallow investigation in both areas using one geophysical method, namely electrical resistivity method is applied. Electrical resistivity survey provide a series of apparent resistivity values of subsurfarce rocks. These values are obtained at different locations along a profile by means of different electroda spacings (selected electrode array). Variations in apparent resistivity indicated the existence of zones of contrasting resistivity [3]. Electrical resistivity survey in the area of hydrocarbon potential has been done previously in the area of Rantau Perlak East Aceh, it is suspected that oil-containing layer in the area has resistivity value which ranges from 8 - 40 Ωm [4].

Figure 1. Surface oil seepage (NA2).

II METHODOLOGY

Data acquisition has been done at two locations of hydrocarbon prospects NA1 (05°01'8.00 "N.

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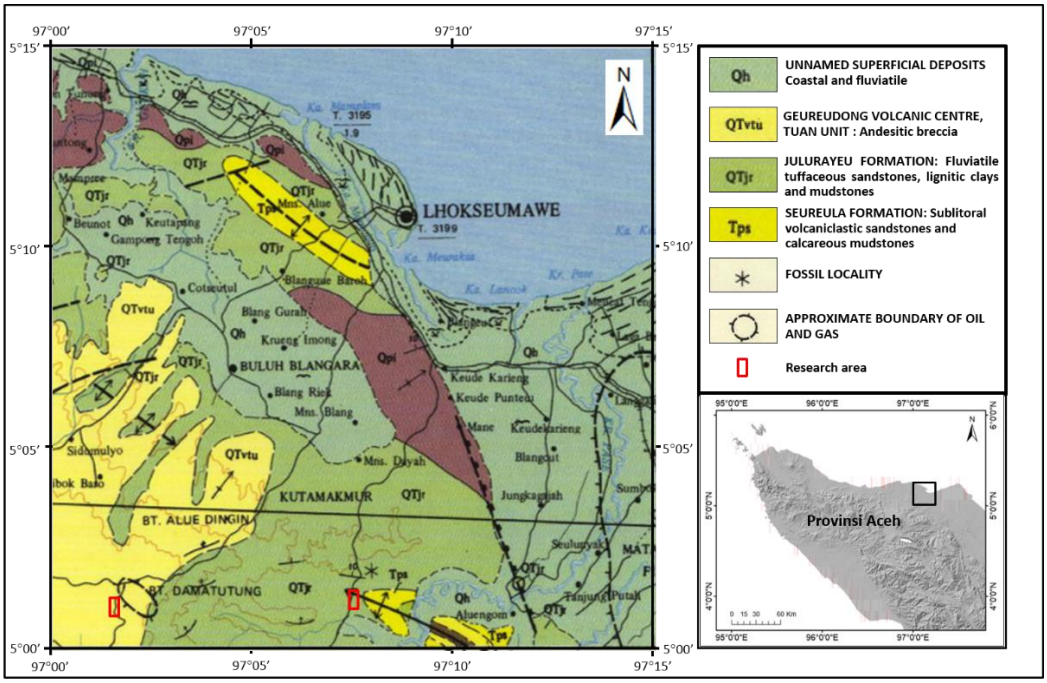

Figure 2. Geological map of research area [2].

97°01'47.72" E) and NA2 (05°01'16.87 "N 97°07'34.96" E) using the electrical resistivity method with Wenner-Schlumberger array (Figure 2). In each location measured as 1 line with a length of 330 m with a space of 6 m electrodes. The data acquisition process in this study uses SuperSting R8/IP resistivitimeter and uses EarthImager 2D software for modeling the overview of resistivity of subsurface rocks (Figure 3).

Figure 3. Resistivimeter SuperSting R8/IP

III RESULT AND DISCUSSION

The resistivity values obtained in both research areas showed in Figure 4 and 5. The resistivity cross section of NA1 shows a high value of 13-3198 Ωm, while NA2 shows a lower value of 1-500 Ωm. As for direct observation on the NA1 Line, there are many andesite found, but oil seepage on are not found on the surface. The contrast of resistivity values on the NA1 profile is seen at a depth of 9-35 m from a distance of 0 to 330 m (marked by a broken black line). High resistivity values (100-3200 Ωm) are identified as hard and solid rock layers, the dominant layer consisting of andesite and clay. This layer extends horizontally from South-North with variations in thickness from 9-35 m. While the lower layer, to a depth of 69 m, is a layer with a low resistivity value (13-100 Ωm) namely a conductive zone indicated as a clay layer. On the NA1 cross section profile, a minor fault was seen at a distance of ±170 m below the surface (±17 m depth). The occurrence of minor faults could be a pathway for hydrocarbon fluids to reach the surface. However, this minor faults is not continuous to the surface.

The NA2 is a measurement line that directed South-North and parallel to the groove. In this area, the oil seepage appears adjacent to the groove located in the eastern part of the measurement line which is ±20 m perpendicular to the 100 m position of the measurement line. The NA2 profile is generally very conductive. It is indicated from the low resistivity value in the cross section profile.

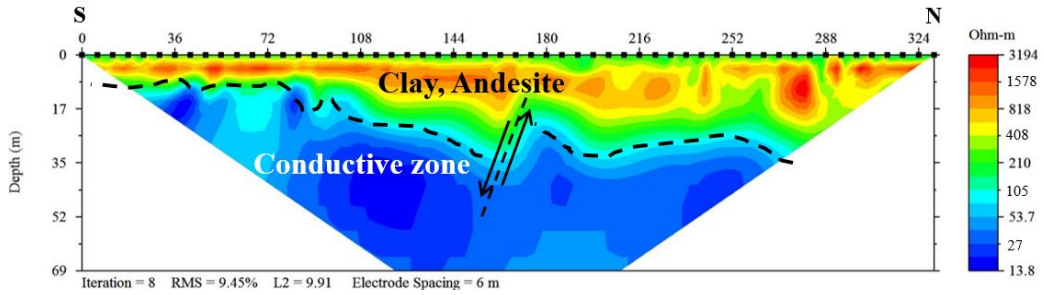

Figure 4. NA1 resistivity cross section.

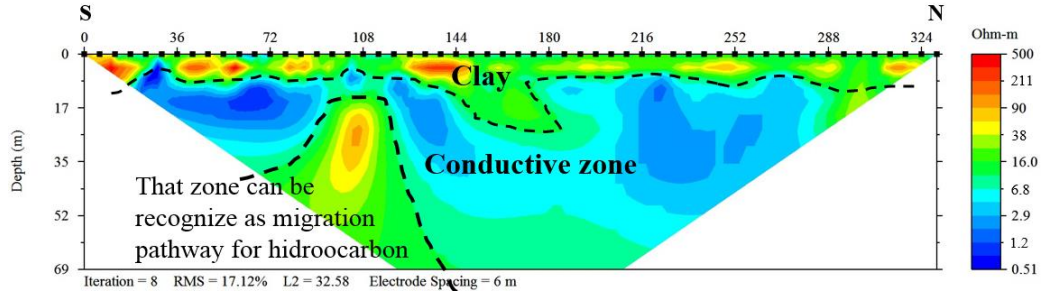

Figure 5. NA2 resistivity cross section.

The contrast of the resistivity value at NA2 is at an average depth of 10 m. The high resistivity values (16-500 Ωm) is identified as clay layers mixed with sandstone with a thickness of 10 m (depth 0 to 10 m). While the layer below is a very conductive layer (0.5-16 Ωm). The conductive zone is from a depth of 10 - 69 m and is identified as a clay layer mixed with mud rock. Indication of oil seepage pathway in NA2 resistivity cross-section was obtained at a distance of 90-120 (17 m depth) with a resistivity value (16-90 Ωm).

CONCLUSION

Based on the resistivity model obtained, the anomaly of contrast resistivity value (16-90 Ωm) that vertically found on the NA2 Line is indicated as an oil seepage path that is at a distance of 90-120 m below its surface. The position of the anomaly is in accordance with the position of the appearrance of oil seepage on the surface. While for the other hydrocarbon prospect areas, namely on the NA1 Line, the anomaly of the subsurface resistivity model is seen at a distance of ±170 m with a depth ±17 m indicated as a minor fault. Although there is a minor fault below the surface, oil seepage does not appear on the surface.

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