Preliminary Investigation of Geothermal Potential in Pawam Site, Rokan Hulu, Indonesia

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Abstract. The site of research area is located in the back arc basin of Sumatra. It has the potential for the hot springs. This research used a Dipole-dipole array of geoelectrical resistivity method. The length of the survey line varies due to in the research location there are many buildings that become tourist attractions. The results showed that the subsurface structure consisted of silt, sandstone and meta sediment. The resistivity distribution shown that there was found the silt layer of soft wet mud in the hot spring zone. The distribution pattern of hot spring in this site is an overflow flow type. The flow is controlled by a fault zone. The direction of this flow is west of the river flow.

1. Introduction
Geothermal potential in Indonesia is estimated at 40% of the total in the world, but only 3% of this potential has been utilized [1]. There are several geothermal prospect areas that have not been or very rarely studied, so that there is a lack of information about the geothermal system in the area. The heat that comes from magma spreads to the rock by conduction or convection processes. Water that is heated by a heat source has a lighter density than cold water so that it tends to move upwards, while cold water has a heavier density and tends to move downward due to the influence of gravitational forces [2].

The geothermal system is a system that generally consists of several main components, namely heat sources, reservoirs, cap rock, hot fluid, and recharge areas, and there is a geological structure in the form of faults which, if possible, can cause hot water. flows back to the surface through these faults to form geothermal manifestations on the surface [3,4].

One of the areas of the geothermal prospect area is Pawan Village. Administratively, Pawan village is located in Rambah sub-district, Rokan Hulu district, Riau province and is close to the western part of the island of Sumatra. The existence of geothermal potential in this area is marked by the manifestation of geothermal on the surface in the form of hot springs, some of which have been used as hot spring tourism objects, such as the hot springs of Suaman Pawan and Hapanasan. The existence of hot springs in the area still needs further research so that the utilization of geothermal energy can really be utilized as much as possible. Therefore, it is necessary to conduct research in the geothermal potential area of Pawan to obtain information about the distribution pattern of geothermal energy in the area. The method used in this research is the Geoelectric method. Geoelectrical resistivity method has been widely used to investigate the groundwater problem such as in the landfill area [5], in the coastal area [6] and for the landslide study that is triggering by groundwater movement [7].

The aim of this research is to analyze the distribution pattern of geothermal manifestations in the form of hot water using the Geoelectric method in Pawan Village. The geoelectric method is one of a group of geophysical methods used to study subsurface conditions by studying the nature of electric
currents in rocks below the earth's surface. This method is generally used for shallow exploration of about 300 - 500 m. Geoelectric identification of subsurface objects is carried out by studying rock types that are composed of rock remains, minerals, fossils, and plants or shells [8].

2. Methodology
The research was conducted in several stages, namely literature study, field survey stage, interpretation and conclusions. The main tool used in this study is a resistivity meter (Naniura). The number of trajectories in this study amounted to 5 trajectories with the direction perpendicular to the hot springs with varying lengths based on the conditions of the research location.

Data collection using the Dipole-dipole configuration (Figure 1) is done by moving the two potential electrodes away from the current electrode. Where in this study the potential electrodes will be moved 3n, with n = 1 - 22. During data collection, data quality control was carried out to get good data. The image of the measurement results is at the midpoint between the C1P1 electrode, where the surface image is obtained horizontally and vertically [9]. The arrangement of the electrodes and their displacement can be seen in Figure 1. The measurement results are then processed using Res2DInv software to get an overview of the results of the 2D resistivity cross section.

3. Results and Discussion
The length of survey lines 1 to 4 are as follows: 108, 78, 78 and 102 m, respectively. The results of the 2D resistivity cross section interpretation on each path are relatively the same. The resistivity interpretation and the distribution of hot water manifestations can be seen in Figure 2, Figure 3, Figure 4 and Figure 5.

![Figure 2. The geoelectrical resistivity model of line 1](image-url)
Figure 3. The geoelectrical resistivity model of line 2

Figure 4. The geoelectrical resistivity model of line 3

Figure 5. The geoelectrical resistivity model of line 4

Track 4 is marked with dark blue and light blue images, there is a soft wet silt layer as shown in Table 2. For line 5 there is no distribution of hot water manifestations because the resistivity obtained is quite large, namely 18.80 Ωm in the dark blue image, by Therefore, the dark blue image is interpreted as infiltration of pond water. According to the field conditions, track 5 is on the edge of the fish pond.

Surface water in this study is coated with silt, which is a soft wet silt layer which is interpreted as a distribution site for hot water manifestations because this layer is a layer originating from the weathering process of silica rock by carbonic acid and geothermal activity, this rock has watertight properties which can only store water but cannot drain it during the time. Generally, the low resistivity value in non-volcanic areas is higher than the low resistivity value in volcanic environments, which is <20 ohm-m, while in non-volcanic areas the low resistivity value is <50 ohm-
Based on the results of geological data measurements and with the geological map of the study area, the hot spring area of Pawan Village, Rokan Hulu Regency, the constituent rocks are sedimentary rock, silt rock, clastic, and sandstone which are Sihapas formations. The results of the resistivity section on the trajectory are then converted in the form of a hot water manifestation distribution model. This model provides information about the distribution direction of hot water manifestations in the study area.

4. Conclusion
Based on the results of the study, it was concluded that the interpretation of the 2D resistivity section on each path was relatively the same. The distribution of hot water manifestations in Line 1 to 4, it is obtained that the distribution of hot water manifestations is at a depth of about 2.61 - 5.12 m with a resistivity value of 2.6 - 10.4 Ωm is found in the silt layer, which is a soft wet silt marked with a dark blue image and light blue, there is a soft wet silt layer, while line 5 there is no distribution of hot water manifestations because the resistivity obtained is quite large, namely 18.80 Ωm in the dark blue image, therefore the dark blue image is interpreted as pool water infiltration. this is in accordance with field conditions. The direction of distribution of hot water manifestations is spread laterally, namely the West is the direction of river flow.

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