Self potential (SP) measurement in the geothermal field of *Penantian* and *Airkelinsar* Village, *Pasemah Airkeruh* District, *Empat Lawang* Regency, South Sumatra Province

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Self Potential (SP) Measurement in the Geothermal Field of *Penantian* and *Airkelinsar* Village, *Pasemah Airkeruh* District, *Empat Lawang* Regency, South Sumatra Province

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Abstract. Geophysical study using Self Potential (SP) method have been applied in the Hot Springs area at Air Kelinsar and Penantian Vilage, Empat Lawang District, South Sumatera Province. The SP measurement has been conducted on two profiles, each profile has ~720 m length trending from northwest- southwest-east crossing the geothermal manifestations (i.e. hot springs) located at the Penantian village and in the Air Kelinsar village is about ~740 meters profile length. The results show that the SP anomaly at Penantian village have a variation of -123.1 mV up to 9.4 mV and the potential anomalies in the Air Kelinsar village is about -12.8 mV up to 66.8 mV.

INTRODUCTION

One of the popular methods utilized in earth exploration is Self Potential method/SP. This SP method doesn't require artificial source to obtain measurement data on the field, thus this method is classified as a passive method in geophysics, in similar with the methods of gravitation, magnetic, and magnetotelluric. According to the measurement principle, this method is considered very simple, because we only have to measure the potential difference at a certain distance from the surface by using the sensitive voltmeter (~0.1 mV) with high impedance input (~10 – 100 MOhm). According to the result of this potential measure, the charge distribution or electric current can be modeled to give essential information regarding the ground water flow, hydro-mechanical disturbance, and geochemical model under the ground.

Based on its' age, this SP Method is considered an old one, firstly used in England (1830) by Fox, to detects sulfide veins [1]. By looking at the success of Fox in using this method to detect sulfide mineral under the ground, this method became popular thus it became the feasible method to detect the existence of mineral body and has been used in the research of the geothermal area. In its development, this method has developed into a wider application, such as to monitor the fluid movement under the ground.

Ross and Witcher (1998) were conducted a survey by using SP method at the fault line of southern Rio Grande, the result shows that negative SP anomaly is correlated with the information of geological surface that makes the location to become the reference for advanced survey with the temperature gradient drilling and the acquisition of thermal fluid sample. Ross and Witcher (1998) explained that SP method is the main instrument for geothermal exploration at the fault line of southern Rio Grande [2]. Akgun (2001) calculated the parameters of several build-shapes such as the upright cylinder and the thin sheet of anomaly resulted from SP method, these parameters were obtained from the theoretical model by using Hilbert transformation [3].

The alculated and analyze SP data by using a high-level derivative method to determine the depth and shapes of subsurface structures. The stated that the high-level numerical derivative data from SP anomaly can be utilized to interprets SP data quantitatively in determining depth, shapes and maximum regional anomaly [5].

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Based on the research conducted by Virgo [4], the geothermal manifestation such as hot springs are found in *Penantian* area reached 93 ºC temperature and in *Airkelinsar* area reached 65 °C temperature [4]. The study aimed: 1) To find a relation between the parameters of subsurface anomaly object and the potential value resulted from field measurement, 2) To modeling SP anomaly on the subsurface of hot springs manifestation area of *Air Kelinsar* and *Penantian.*

EXPERIMENTAL

Materials

The research area is located in Penantian Village, AirKelinsar Village and its surroundings. Geographically, the research area is at coordinates X : 244000-256000 abd Y : 957000-9581500 (UTM), Zona 48 Southern. The northeast is bordered by the Gumai Mountains, and the southwest is bordered by the Barisan Mountains. The Topography of the study area can be seen in the Figure 1.

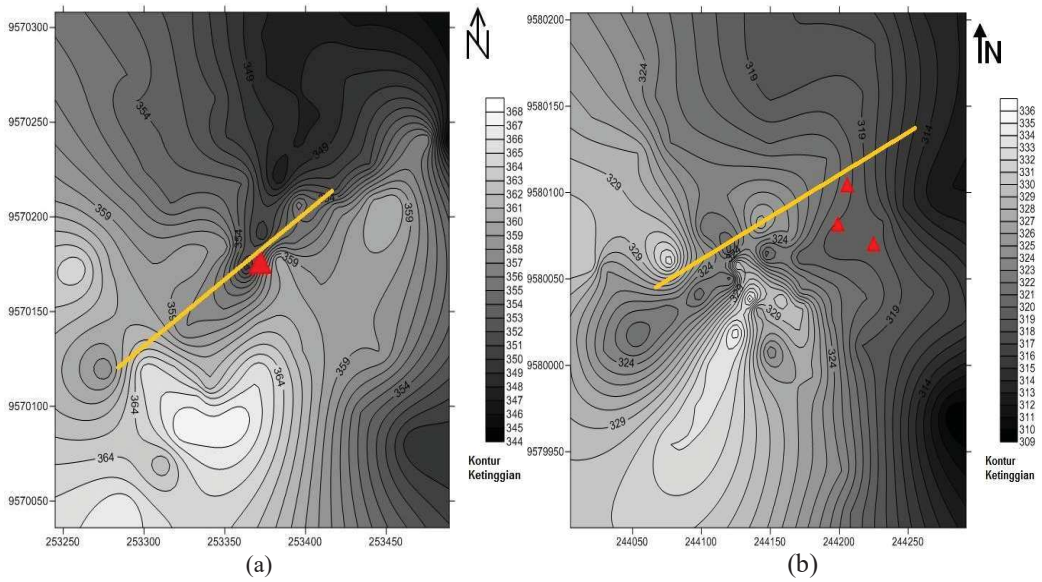

FIGURE 1. Measurement lines (Yellow line), hot springs (▲), (a) Penantian Village, (b) Airkelinsar Village

The tools used in this research are the porous pot electrode, GPSMap 76CSx Garmin for coordinate reading, Sanwa digital volt meter (DVM) to read measured potential, connector cable, roll meter for determining measurement space, geological map to design measurement trajectory, compass for determining trajectory direction, hammer and handspike to help implant the porous pot electrode under the ground, $CuSO_4$ safe tank, and stationary. Materials used in this research are cupric sulfate ($CuSO_4$) and *akuades*.

Field Data Acquisition

The measurement was conducted by measuring the potential difference between the two porous pot electrodes that planted in ~10 cm depth with the distance between the electrodes is 10m which called “station”. The SP measurement is conducted along the trajectory by moving two electrodes at the same time which the first electrode is stationed in the second electrode position and the second electrode is shifted 10 m far, space is constant along the measurement trajectory.

Data Processing

The data processing in this research begins with the correction of daily variation of trajectory SP data. The trajectory SP data that has been corrected in daily variation then being corrected again with the reference correction because this SP data is set individually in each station, therefore the SP data is shifted or arranged with past SP data as the reference. After the field SP data is being corrected in reference then the result is corrected cumulatively.

RESULTS AND DISCUSSION

The research result of the SP method utilization at geothermal source area in *Airkelinsar* Village (hot springs) shows the variation of potential value from -12.84 to 42.25 mV with trajectory distance is 740 m cutting from southwest towards the northwest of geothermal source manifestation in *Airkelinsar* Village. Based on the field survey and geological research conducted by [4], there is an andesitic rock (exposed on the surface). In this research, the location of this intrusion rock is set as the early point for collecting data, the area dispersion of this intrusion rock located in the 0-250 m distance of the measurement trajectory of SP data. This area is highlighted in yellow line as shown in Figure 1.

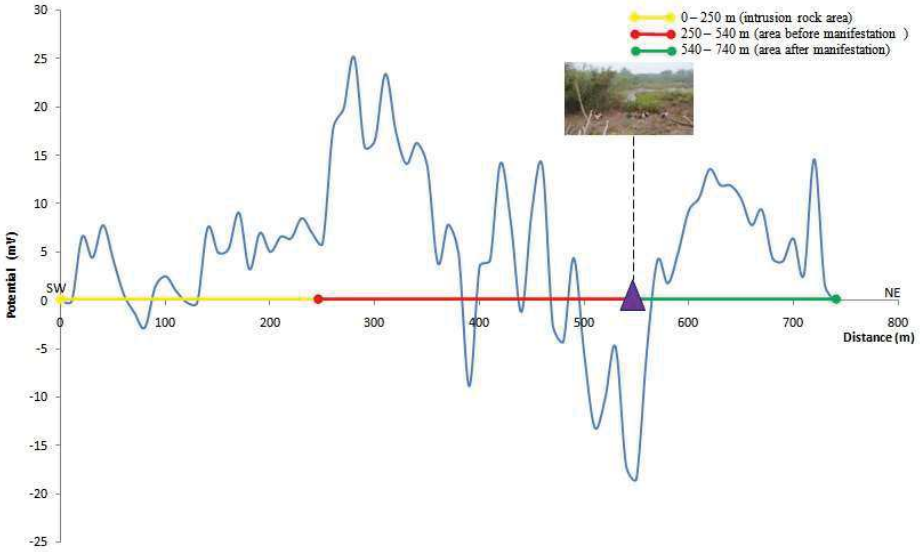

FIGURE 2. The SP Anomaly of *Airkelinsar* Village's field, ▲ is the position of the hot springs

Based on the graphic of research result in accordance to the utilization of SP method and geological research at the geothermal source in *Airkelinsar* Village, researcher can assure that there are three areas that have different anomaly pattern. These three areas related with the field geological information which are andesitic intrusion rock, area before manifestation and area after geothermal manifestation (Figure 2). In the area of andesitic intrusion rock, potential data doesn't show any anomaly, while in the 250-540 m distance, the graphic pattern of potential data shows significant change. The anomaly pattern of potential data most likely resulted from the subsurface geothermal source or the heat transfer that fills the fracture line outside manifestation area (hot spring source), characterized by the ground level that hotter than its surrounding area. For the area within 540-740 m in distance, the SP value in that trajectory is below 100 mV, this condition strengthened the indication that a chemical reaction exists in the subsurface of rock heat source that interacting with the ground water.

The research result according to the utilization of SP method at geothermal source in *Penantian* Village (hot spring) shows the variation of potential value that ranges from -5.08 mV to -123.10 mV with trajectory distance is 720 m from southwest towards northwest across manifestation of the geothermal source in *Airkelinsar* Village.

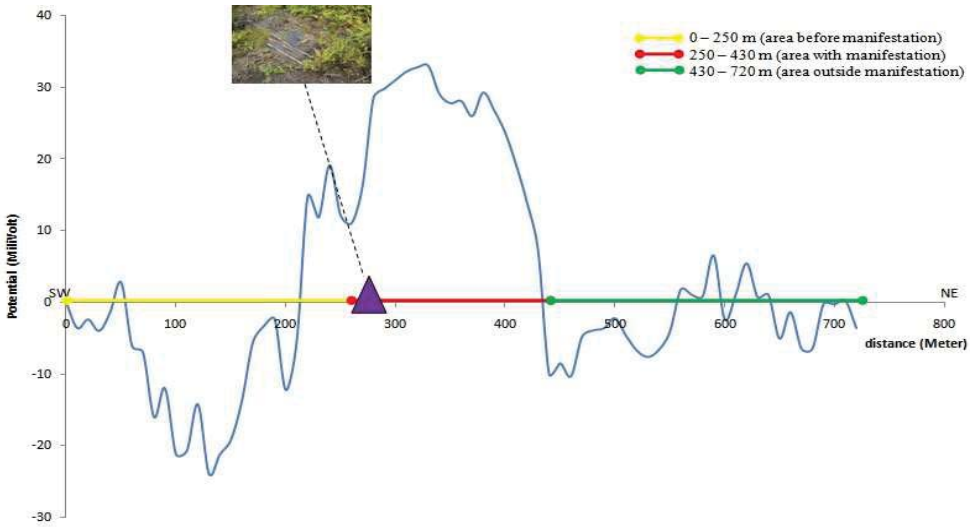

FIGURE 3. The field SP Anomaly of *Penantian* Village, ▲ spring location

This fluctuating potential data pictured the anomaly caused by the subsurface heat transfer, caused by the interaction between heat rock and groundwater is occurred and produce the convection flow of hot water which emerge towards the surface as hot spring. For the 430-720 m distance, there is no significant anomaly pattern beside the potential value in the range of -86.26 mV to 123.10 mV. As what described by Reynolds either it's positive or negative, the potential value around 100 mV is the potential value resulted from the subsurface water flow, this statement is supported by the field data information in which the area is known as wetlands that used by farmer as agriculture land with plentiful water resources.

CONCLUSION

The research result according to the utilization of SP method at geothermal source in *Penantian* Village (hot spring) shows the variation of potential value that ranges from -5.08 mV to -123.10 mV. In the Airkelinsar Village For the 430-720 m distance, there is no significant anomaly pattern beside the potential value in the range of -86.26 mV to 123.10 mV. The characteristics of SP Anomaly now can be modeled with a physics modelling approach

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