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Audio Magnetotelluric to Characterize Geothermal Prospect in Pacitan

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ABSTRACT

AMT (Audio Magneto Telluric) research is done by measuring the fluctuations in the magnetic field and also electric field which has recorded on Earth's surface. The survey is located in Kasihan Village as the part of Non-Seismic Practical work of Geophysics students 2010. There is a normal fault associated with igneous intrusions and above of that has identified as a surface layer unit, referred as a layer of alluvium. From the distribution of resistivity, the data interpolation of each sounding measurement can be made to geological model of the area for each line oh survey. The model has four lithology, which are: alluvium (resistivity 1.58 to 15.85 Ωm), sandy conglomerate rock (resistivity 25.12 to 158.49 Ωm),bottom layer is volcanic sandstone (resistivity 398.11 to 1000 Ωm) that is intruded by igneous intrusion. The reason why the topography of Pengajaran peak is higher than the surrounding areas is because composed by mostly dense igneous rocks (resistivity 1584.90 to 10,000 Ωm). The igneous rocks are also visible in several places around of Pengajaran peak. The research is being following up with the interpretation of Geothermal prospect in the area by analyzed the presence of intrusion in the geologic model from the AMT survey.

Keywords: Audiomagnetotelluric, resistivity, geological model, intrusion

INTRODUCTION

Desa Kasihan, Tegalombo, Pacitan is located in the series of South Mountain that has a complex geological structure. This location is at 4026'- 4029'36'' BT and 806'-807'30''LS. The mountains were lined all over with a relatively flat morphology with loose contours. This area is estimated by fault structures based on information of existing geological maps. In normal conditions, the existence of fault is causing the difference in lithology in two different blocks position. so that by measuring prices rock resistivity can be determined where the fault. The method that can be used is Audio Magnetoteluric. In the AMT method, the parameter used is resistivity of rock characterized by lower value for better conductive rock. Resistivity value can describe the conditions in the subsurface laterally and vertically. The Purpose of this study is to determine the potential distribution of heat source through the value of the resistivity.

MATERIAL AND METHOD

The tools used in the retrieval data is Stratagem with 26716-01 version REV.D. The data that we obtained from field measurements are the result of true rho Stratagem inversion and depth of the transformation Bostick. Bostick inversion method (Jones,1983) is a quick and easy way to estimate the resistivity - type variation with depth soundings directly from the curve - type pseudo resistivity. The method is derived from the analytic relationship between resistivity, frequency and depth of investigation or skin depth. While the data stored by the instrument and the Matlab, software is opened with the data Rho apparent, Coherence, Phase, and Frequency.

Fig 1. Point measurement using RBI maps

The survey was conducted in two lines with 12 points each of his line. Line with N 130^0 E with the distance between its points is 250 m, while the distance is 1 kilometer. The data is performed by results process gridding, data recorded in the field and 1D inversion process. The result of processing then used to interpret the line with geological maps.

Fig 2. point measurement using geological maps

RESULTS AND DISCUSSION

The AMT survey will give resistivity value of all over the survey area as depth function and it is plotted as a contour map by Surfer 11. There are four major areas in the resistivity contour map. From surface to deeper layer there are blue, green, yellow and red areas. It is clearly seen that the resistivity is increase by the increased depth. The explanation of this phenomenon is about the characteristic of the lithology of each layer.

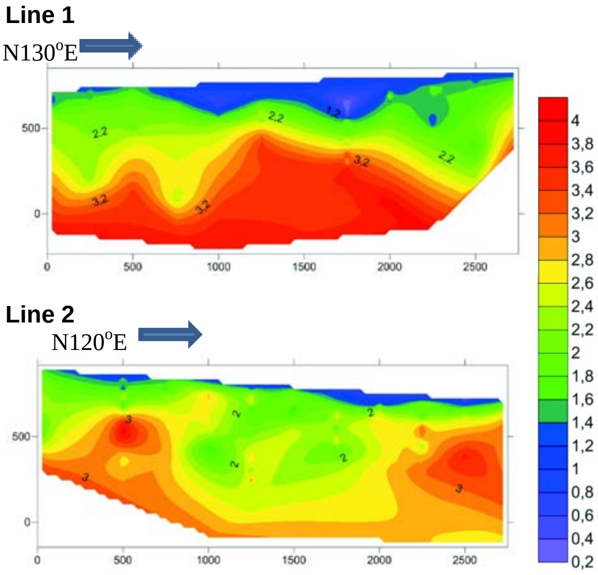

Fig 3. The Resistivity contour maps as depth function for each survey line.

There are four zones in the resistivity contour maps, from blue until red zone. The maps show great relation between resistivity and depth. It are clearly seen that as the depth increase, the resistivity also increase. That phenomenon can be described by law of deposition. There is a geology principle that deeper layer is older than the upper layer. The upper layer will give pressure towards the prior layer so it makes that prior layer compacted. As the layer compacted or well consolidated, the water content of that layer is less than the near-surface layer. Water has physical properties as conductors. The consolidated layer has less water content and it makes the resistivity of that layer higher than the unconsolidated upper layer that enriched in water.

Resistivity contour map also images the geology structure. As seen in first line resistivity contour map, in green layer from point 1000m to 2000m there is an undulation that here interpreted as horst structure. Horst structure built by two faults that exist in two sided of the area. The area has higher elevation than the other because of the normal fault (see the geology model of line one).

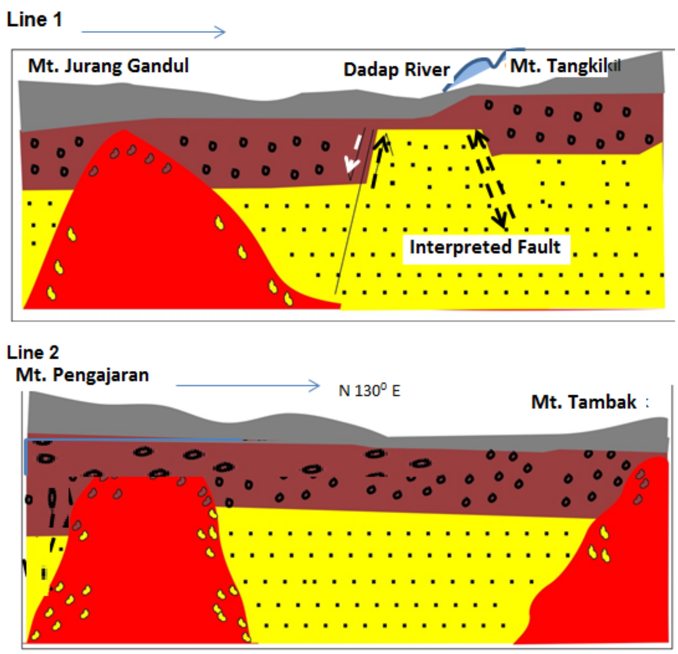

Fig 4. The Geology Model for each survey line.

The model has four lithology, which are: alluvium (resistivity 1.58 to 15.85 Ωm) in the top layer with a characteristic not perfectly consolidated because the attrition rate is quite high. The alluvium approached several sources of water. Then the next layer is a sandy conglomerate rock (resistivity 25.12 to 158.49 Ωm) with fragments of igneous rock that surrounded by the sand matrix. The bottom layer is volcanic sandstone (resistivity 398.11 to 1000 Ωm) that is intruded by igneous intrusion. This is the reason why the topography of Pengajaran peak is higher than the surrounding areas because composed by mostly dense igneous rocks (resistivity 1584.90 to 10,000 Ωm).

This lithology division is clearer seen when the survey goes to Dadap River, Kasihan Village where we can see the exposure of sandstone contact with igneous rock and surrounded by conglomerate. In the other hand, there are various kinds of free pebbles along the river.

The discontinuity of resistivity value in resistivity contour map that indicated as fault exist in a layer that interpreted as volcanic sandstone also be seen in the river as the declining layer.

Intrusion indicates the presence of magma that becomes the major source of sub surface heat. The potential heat referred as geothermal prospect. From this AMT survey, this area has an interesting thing to make deeper research about magma existence and location. Furthermore, there is geology structure that support geothermal setting for that area if proved. Micro-seismic may become the suitable method for following study.

CONCLUSIONS

The survey area is located in Kasihan Village composite by mostly lithology of sandy conglomerate rock and volcanic sandstone. There is geology structures of normal fault associated with intrusion that intruded the volcanic sandstone. The structure covered by unconsolidated layer called alluvium. The presence of intrusion make deeper analyze about possibility of magma existence as major heat source for geothermal prospect.

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