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Identification of magnetic anomalies in subsurface area of Sinabung mountain

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Abstract. This research was conducted by using geomagnetic methods. It aims to identify cross section anomalies and subsurface models. Measurements using a PPM (Proton Precession Magnetometers) Elsec 770 types data collection is done randomly with 27 measurement points. Data analysis was performed using 11 surfers to get a contour map and Mag2DC software to get the magnetic anomaly cross section. The results showed that the anomalous cross section with the geomagnetic method has the lowest value of 18.45 nT and the highest value reached 64.92 nT. From the anomaly, it was found that the value of vulnerability obtained is 0.0004, 0.00018, 0.0002 emu where subsurface layer model consists of dolomite and limestone.

1. Introduction

Mount Sinabung is a type of volcano located in Karo, North Sumatra, Indonesia. It is classified into types strato volcano not far from the residence of the population. This is the second highest peak in North Sumatra. It is nearby with Sibayak Mountain and has a height of 2,451 meters. The mountain is not erupted since 1600, suddenly, it was reactivated by the eruption in 2010. The last eruption occurred since 2013 until now. It causing major problems. people had to evacuate and leave the shelter and land in dangerous zone eruption.

The eruption of Mount Sinabung history occurred on August 29, 2010 at approximately 12:15, Mount Sinabung produced lava mixed with stones. This mountain status was raised to be careful. At least 12,000 people have been evacuated and accommodated in 8 locations. Sinabung mountain ash tends to glide from southwest to northeast. These bursts of volcanic ash up to 5,000 meters in the air. Then, slowly return to subside [1]. No casualties were reported, but thousands of people were forced to evacuate to a safe area. As a result of this event, the status of Mount Sinabung is raised to level 3 into standby. After a fairly high activity for a few days, another problem is when the eruption occurred, agricultural land crop failure due to damaged canal caused by volcanic ash struck. By looking at the effects of the eruption of Mount Sinabung, researchers interested in conducting research to find out what kind of rocks that form the surface of the mountain with geomagnetic method.

Geophysics magnetic methods in the application depends on accurate measurement of the local geomagnetic field anomalies generated by variations in the intensity of magnetization in the rock formations. The intensity of geomagnetic induction depends on the magnetic susceptibility of rocks, magnetic force, and intensity of the permanent. The value of magnetic susceptibility depends on the type of material, positive to negative for the paramagnetic and diamagnetic property. Magnetic

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susceptibility is the most basic parameters in the study of magnetic rocks. The magnetic response of rocks and minerals determined by the number and susceptibility of magnetic material in them. The equation for the total field is proportional to H, where the symbol is called the permeability of the material in a vacuum, because there is no magnetic material, then = 0, so it is called the vacuum permeability of 4π x 10-7 Wb / am [2]. The value of magnetic susceptibility in a vacuum is equal to zero because the only real things that can be magnetized. magnetic susceptibility can be interpreted as the degree of magnetism of a material [3].

Data anomalies of the total magnetic field from the continuity result would be reduced to the poles to localize the area with maximum anomalies above anomaly body causes the object, it makes interpretation easier. pole reduction is done by making the angle of the object to 900 and its declination 00 [4]. This is because the magnetic poles, the Earth's magnetic field and the magnetic induction point to down. Data reduction of these poles, qualitative interpretation can be done. This reduction is done by using Magpickc program, IGRF International abbreviation Geomagnetic Reference Field. This is a reference geomagnetic field. Basically, the value IGRF is a strong value of the main magnetic field of the earth (Ho). One type is a sedimentary rock, has very little magnetic susceptibility compared with igneous or metamorphic rock tend to have higher magnetic content. The most magnetic survey is used to map geological structures on or within the bedrock (crystalline rock beneath layers of sediment) or to detect the presence of magnetic minerals directly. In a survey of geothermal (geothermal), magnetic methods used to identify the type of igneous or hot rock that acts as a heat source. In broad outline, there are two systems of heat sources, they are a system of active volcanoes and volcanic systems other than [5] geothermal area with the type of active volcanoes have a high temperature during 1800. High temperatures will cause the low value of magnetic anomalies. The most magnetic survey is used to map geological structures on or within the bedrock (crystalline rock beneath layers of sediment) or to detect the presence of magnetic minerals directly. In a survey of geothermal (geothermal), magnetic methods used to identify the type of igneous or hot rock that acts as a heat source. In broad outline, there are two systems of heat sources, they are a system of active volcanoes and volcanic systems other than. Geothermal area with the type of active volcanoes have a high temperature during 1800. High temperatures will cause the low value of magnetic anomalies [4]. The most magnetic survey is used to map geological structures on or within the bedrock (crystalline rock beneath layers of sediment) or to detect the presence of magnetic minerals directly. In a survey of geothermal (geothermal), magnetic methods used to identify the type of igneous or hot rock that acts as a heat source

Research on magnetic anomalies that have been made for modeling using magnetic data from the measurement results in the area Arjuno Welirang Mountain. It aims to identify magnetic anomalies produced in geothermal resources allows prospects subsurface area can be predicted.

2. Research Methodology

2.1. Time and Location

Geographically, lies between 2º50' Karo-3º19 'North Latitude and 97º55'-98º38' East Longitude with an area of 2,127.25 km2 or 2.97 percent of the area of North Sumatra Province. The geographic location of research lies between 3008'45.61 North latitude and 980 east longitude 20'12.54 on 60 points from implant village, sub district Tiganderket. This study was carried out about 2 months from February to March 2017.

2.2. Equipment and Materials

2.2.1. Research Tools

PPM (Proton protezione magnetometer), Casio stopwatch, compass, Meter, Battery, DNS GARMIN, Stationary, Transmitter.

2.2.2. Materials Research

The research material was the location of the sampling point.

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2.3. Procedures for Research

1. Viewing locations and shooting area will be an area of research.
2. Determine the coordinates of the reference point in the study area using GPS (global positioning system)
3. Determine basis points (base) in the area to be surveyed by determining anomalies
4. Make measurements using geomagnetic 770 PPM elsec type.
5. Process the data found in the geomagnetic elsec 770 PPM Type.
6. Analyzing the data by mag2DC software.
7. Distinguish the type of resistance value based on the anomalies and color to see the vulnerability.

3. Results and Discussion

Field data obtained during geomagnetic field measurements using the method in the form of magnetic values of each point. magnetic data collection aims to observe the total magnetic field (H) of the Earth at some point. The data was obtained by the induced magnetic objects where the value of the magnetic field (H) shall be reduced by the value of the magnetic field induces so will result in the value of the magnetic field called a magnetic anomaly (ΔH) .the data time Earth's magnetic field at the base station and time of data the earth's magnetic field is not the same, so adapted to the times in the data base that is adjacent. Field measurement data in the form of total Earth's magnetic field is still mixed with the International Geomagnetic Reference Field magnetic main earth (IGRF) and magnetic every day.

To get the total value of the magnetic anomaly, the following correction is made, such as the daily correction, correction IGRF and topographic correction.

3.1. Result

3.1.1. Earth's Magnetic Anomaly distribution pattern

Anomalies in the magnetic field of the calculated results can be displayed in the form of a contour map using software anomaly surfer 11. It can be seen in the following figure 1.

Figure 1 shows the survey area with low anomaly at the point (D3), which is an anomaly 18,45nT and high (D25), i.e. 64.97 nT. The low value of magnetic anomalies obtained in the survey area are interpreted as areas closely related to the formation of geothermal manifestations in the area.

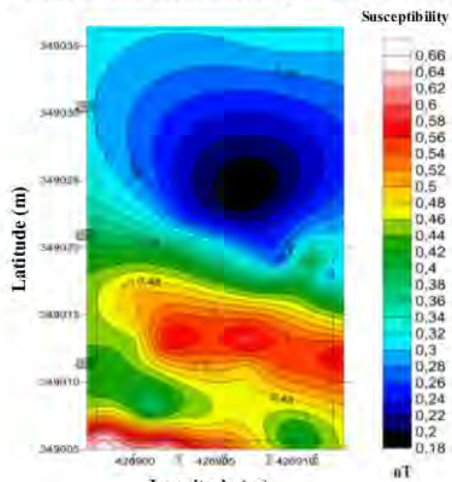

Figure 1. The distribution pattern anomalies in Earth Magnet Survey Location.

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3.1.2 Rocks Susceptibility (K)
Susceptibility of calculation results can be displayed in the form of a map of vulnerability contour using software surfer 11 that shown in figure 2.

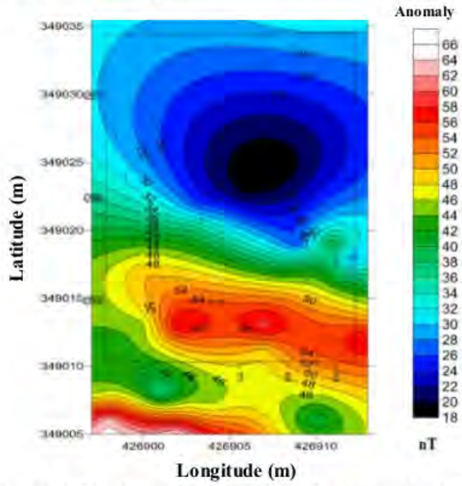

Figure 2. Contour susceptibility Map in implant Village.

From the picture above shows a survey of geothermal area in implant Village with vulnerability from lowest to highest, is: 0.18498 x 103 to 0.64922 x 103. Values obtained in the area of vulnerability of this survey will be used to determine the type of rock in the area subsurface survey.

3.2. Discussion
3.2.1. Geomagnetic Data Interpretation
The first step in modelling is to make an incision or anomalous section of the anomalous magnetic stripe low to high anomaly, it can be seen from the bottom figure 3.

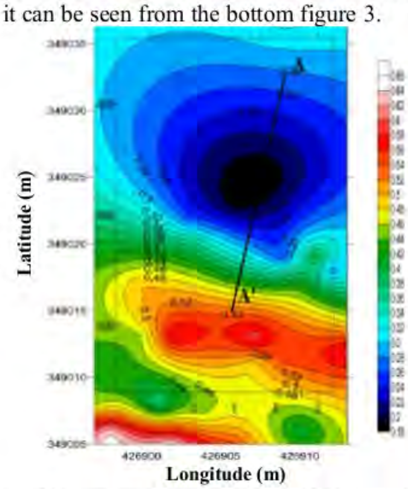

Figure 3. Contour Anomaly Map With incision AA'.

The picture above shows the incision AA susceptibility decided by geological area of research and qualitative interpretation. AA 'incision goes from the northeast to the southwest. Quantitative

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interpretation aims to determine the lithology of the study area. Lotology can be determined by the value of the vulnerability being modelled.

3.2.2. Part Model geomagnetic use Mag2DC

Lotology can be determined by the value of the vulnerability being modelled. This interpretation is done by modelling using software Mag2DC, resulting in the following drawings in figure 4.

Figure 4 shows a model cross-section AA 'where there are x - axis and y - axis. X - axis path distance value, negative y - axis depth value, a dotted line on the curve is observed anomalous value, while the line was squeezing the dotted line is an anomaly modelling. Modelling results obtained vulnerability value indicates the type of sedimentary rock with susceptibility value (0.0004; 0.00018; 0.0002) emu.

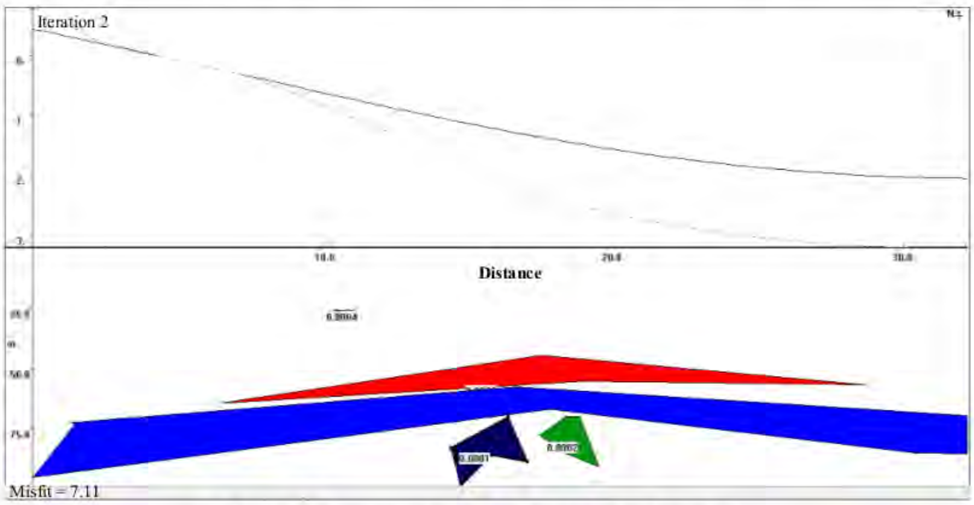

Figure 4. Geomagnetic Section Model using Mag2DC.

4. Conclusion

The values of the magnetic anomalies in the study area ranged between 18.45nT at coordinates 426 908 349 025 N and E to 64.75 nT at coordinates 426 902 349 005 N and E. Based on the value of vulnerability in the region of the village of implant, the type of rock found in the area of reserch is 0, 0004, 0.00018, 0.0002 nT where subsurface models consist of dolomite, limestone or part of sedimentary rocks.

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