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Subsurface Interpretation of the Sembalun Area, East Lombok using the Gravity Method

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Abstract*— The Sembalun area in UTM coordinates is located atEast hanging 452120,3 to 437998,9 and Northing 9062924 to 9085495 and belongs to the UTM 50S zone which is located on Lombok Island, West Nusa Tenggara. The purpose of this study is to determine the presence of subsurface geological structures in the Sembalun area, East Lombok. The geophysical method used in this research is method gravity namely by finding the distribution of density values and finding values Complete Bouguer Anomaly (CBA) which will be used to perform 2D modeling of subsurface geological structures in the study area using software Grablox. The data used in this research is secondary data in the form of GGMplus 2013 satellite imagery data gravity disturbance and Earth Residual Terrain Model (ERTM2160). The results obtained from this study include the rock density obtained by the parasnis method of 2.815 g/cm^3. The fault structure is in the North to Southwest of the study area and there is also a caldera in the middle of the study area (between Sembalun Bumbung and Sembalun Lawang). Manifestations in the form of hot springs are in the south (close to Mount Pusuk). The results of 2D modeling with Grablox are dominant with high density indicating that the study area is dominated by andesitic lava rock.

***Keywords*— Sembalun, GGMplus, ERTM2160, Method Gravity, 2D modeling**

I. INTRODUCTION

Indonesia is a country located between three active earth plates, namely the Pacific plate, Indo-Australian plate, and Eurasian plate where the plates are always actively moving and interacting. In addition, Indonesia also has many volcanoes so that it is included in the ranks of active volcanoes in the world (The Ring of Fire) [1]. Therefore, Indonesia has enormous potential in the field of geothermal energy. Geothermal energy can be utilized as alternative energy and facilitate us in our daily lives [2].

Geophysical methods have an important role in subsurface research. One of them is the gravity method, which is able to analyze and interpret the subsurface structure of geothermal areas. The gravity method was chosen for this research because the gravity method has advantages in conducting an initial survey. This is because it is able to provide detailed information about geological structures and density contrasts [3].

In this study, researchers will use secondary data taken from the GGMplus (Global Gravity Model Plus) satellite. This research refers to research that has been conducted by [4-7]. The difference between this research and the research above is in data collection. Previous research used primary data where the data was taken directly at the research location, but for this study using secondary data that can be taken through GGMplus satellite data. The GGMplus gravity model is the result of research by Curtin University (Perth, Western Australia) and the Technical University of Munich (Germany) which contains estimates of gravity disturbance, gravity acceleration, gravity disturbance, and vertical component deflection. To obtain the elevation data, researchers used ERTM2160 satellite data.

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II. METHODS

This research was conducted by taking secondary GGMplus data from September 2022 to April 2023. The data generated from GGMplus in the form of air correction values (Gravity Disturbance) and also elevation used for further processing using Ms. Excel and also with the help of Oasis Montaj software. After obtaining the results of gravity correction, continue to look for rock density with the parasynthesis method and get CBA (Complete Bouguer Anomaly). The results of the CBA are processed again with gradient analysis to see the boundaries of rock contact in the subsurface. In addition, the results of CBA are used to perform 2D modeling with the help of Grablox software [8].

III. RESULT AND DISCUSSION

The calculation of topographic correction and free air correction results from secondary data as in Figures 1 and 2. Figure 1 shows the topographic map of the study area with altitudes between 218 - 2899 m. For Figure 2 shows the free air correction map with a value range between 123 - 427 mGal.

After making topographic corrections and also free air corrections, it is necessary to process rock density in order to be able to produce CBA values. The value of rock density using the parasnis method [9] is as shown in Figure 3. Figure 3 explains that the average rock density is 2.81 gr/cm^3. based on geological information, the area is dominated by basaltic andesite rocks. After obtaining the rock density, it is able to get the CBA value as shown in Figure 4. the CBA value is between 85.9 mGal to 168.3 mGal. A low anomaly value indicates that the area has a low density or rock density, while a high anomaly value indicates that the area has a high density or rock density. To find out more about rock contact boundaries, it is necessary to do a gradient analysis process.

Figures 5 and 6 are the FHD (First Horizontal Derivative) and FVD (First Vertical Derivative) which aim to determine the location of the rock contact boundary in the study area. For FHD itself, it has a value between 0.001335 mGal/m to 0.048789 mGal/m where the maximum value is in the East to West of the study area. Meanwhile, FVD has a value between -0.048339 mGal/m to 0.023602 mGal/m with the minimum value indicating the contact boundary of rock lithology in the study area. The modeling was done in 2D with CBA data input. This study was conducted with 5 incision passes as shown in Figure 7.

Figure 8 is the result of the Horizontal direction incision by passing through the manifestation in the form of a hostpring (M1). In addition, there is also an indication of a fault or as a contact boundary of rock lithology and is indicated by a black line. Figure 9 is the result of a horizontal incision and shows a fault with a black line symbol. The fault is located on Mount Batujang.

Figures 10, 11 and 12 show the vertical incision where the incision is in the form of incision A-A', B-B', and E-E'. Figure 10 incision A-A' shows the manifestation of a hotspring (M1) and also the presence of a fault located to the south of the study area. In addition, there is also a manifestation in the form of a caldera located in the center of the study area (between Sembalun Lawang and Sembalun Bumbung). Figure 11 incision B-B' shows a fault located in the East of the study area. Figure 12 incision E-E' passes through a manifestation in the form of a fault and also a caldera located in the center of the study area. From the previous journal, this research has same result that in this area has some fault from North to Sorth and this area has caldera between Sembalun Bumbung and Sembalun Lawang. The previous journal uses primary data and this research use secondary data but the result is almost same.

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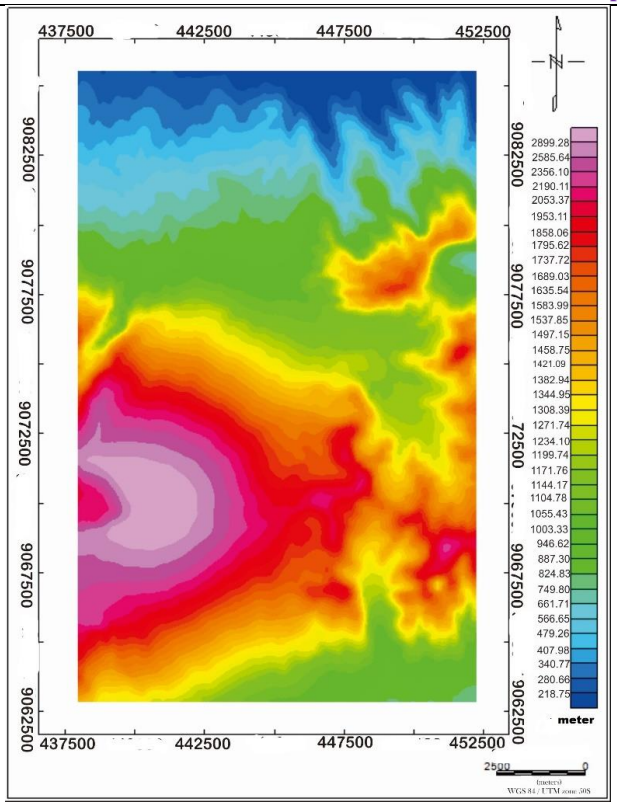

Figure 1 Topographic Map

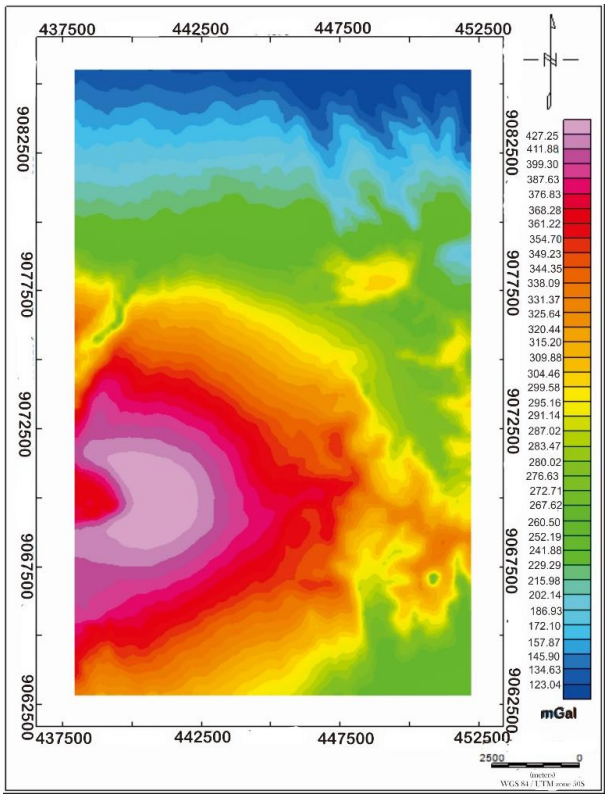

Figure 2 Free Air Correction Map

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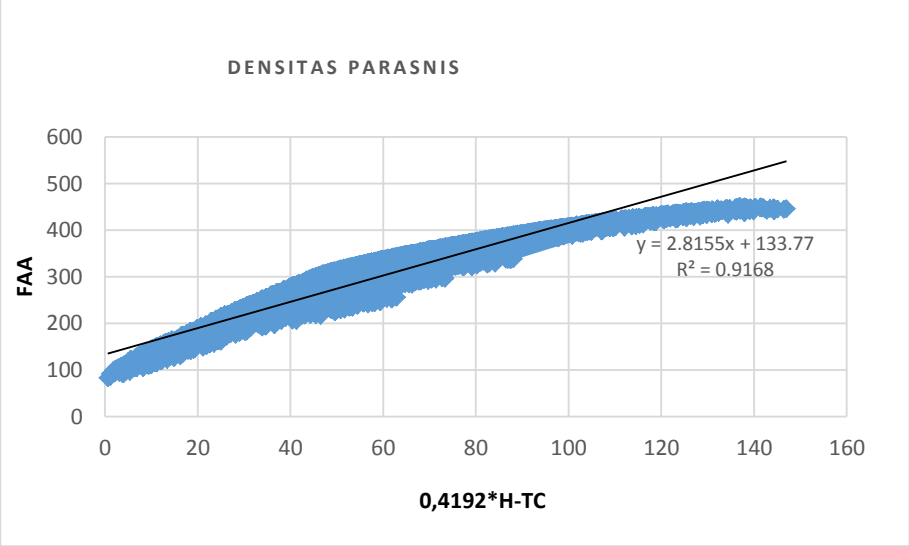

Figure 3 Linear graph of average density by parasnis method

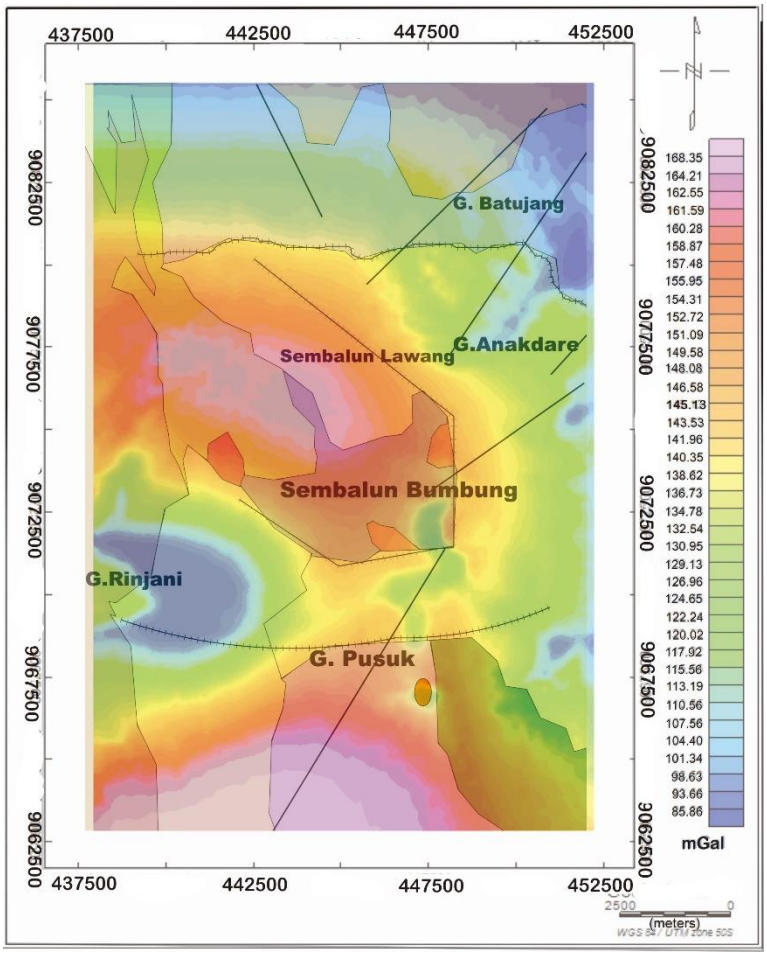

Figure 4 CBA Map

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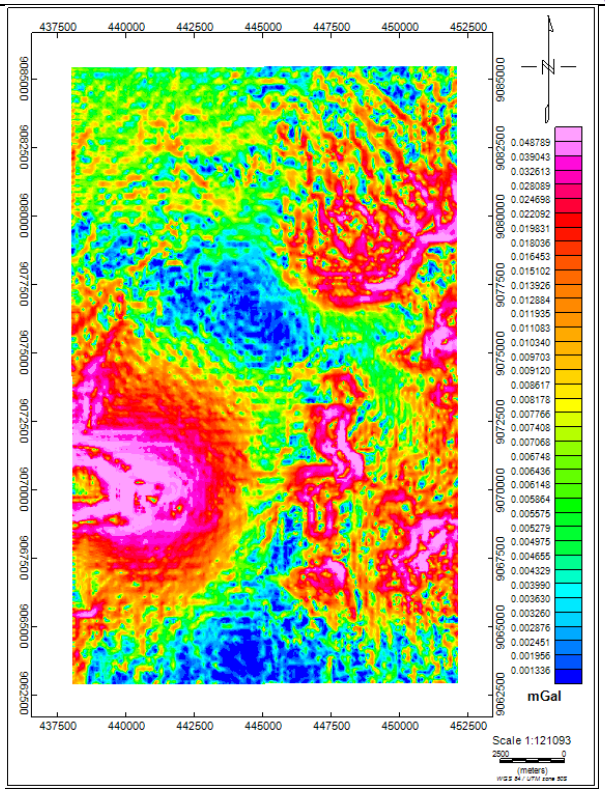

Figure 5 FHD

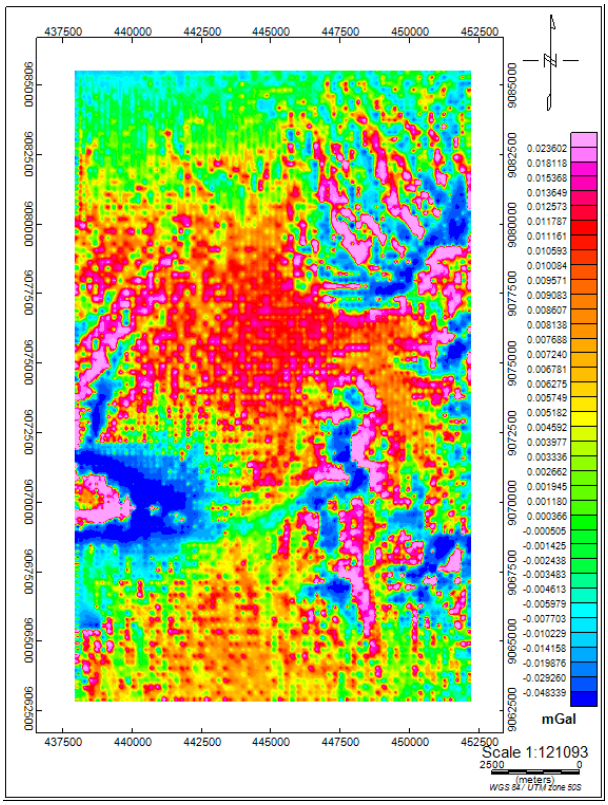

Figure 6 FVD

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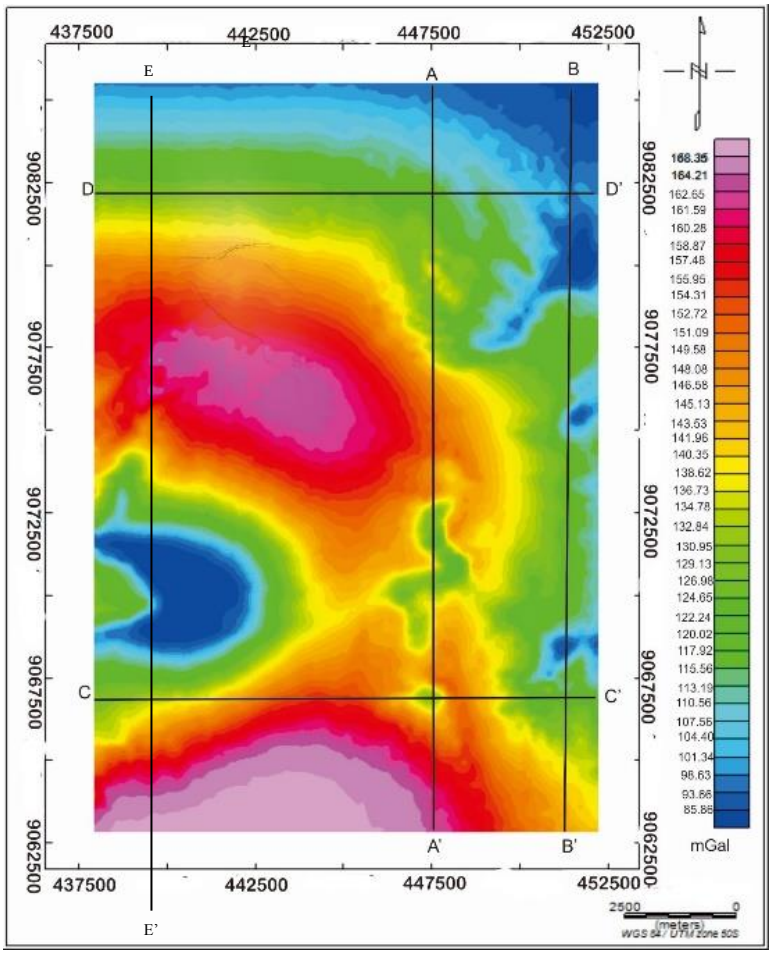

Figure 7 Modeling incision

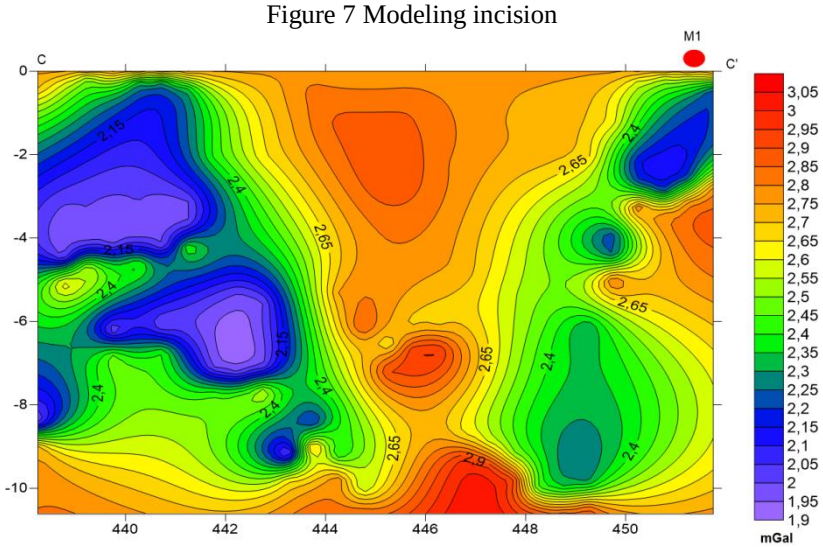

Figure 8 C-C'

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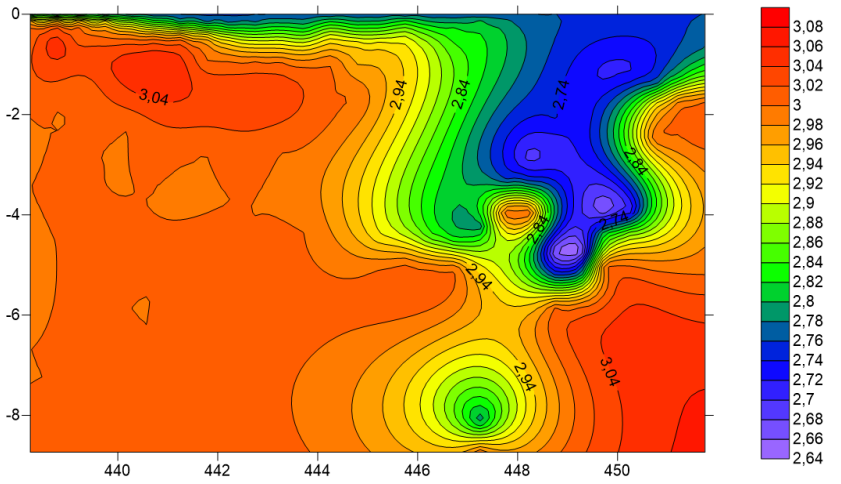

Figure 9 D-D'

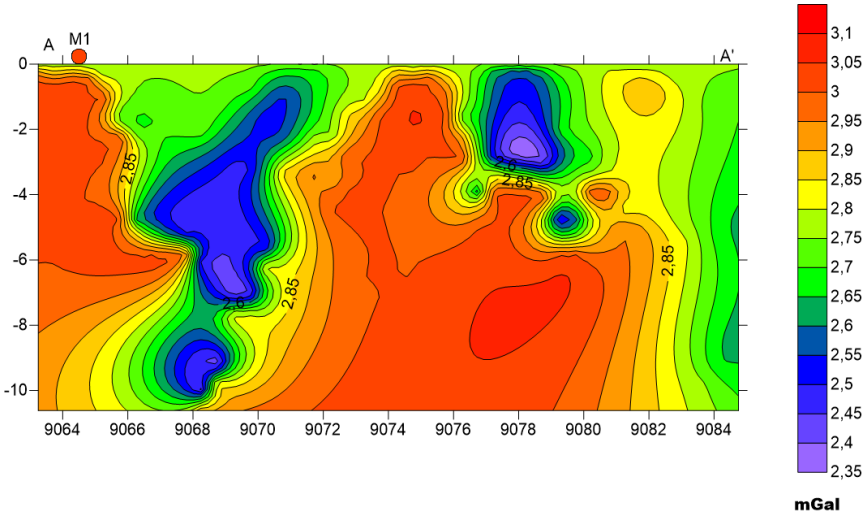

Figure 10 A-A'

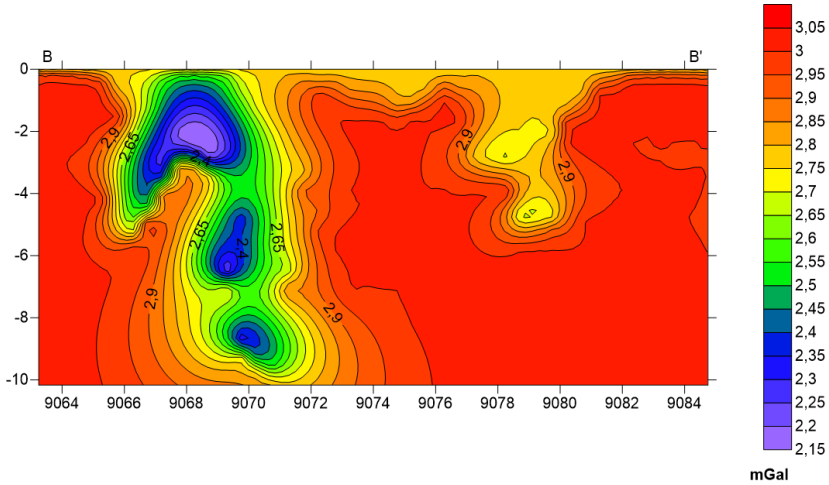

Figure 11 B-B'

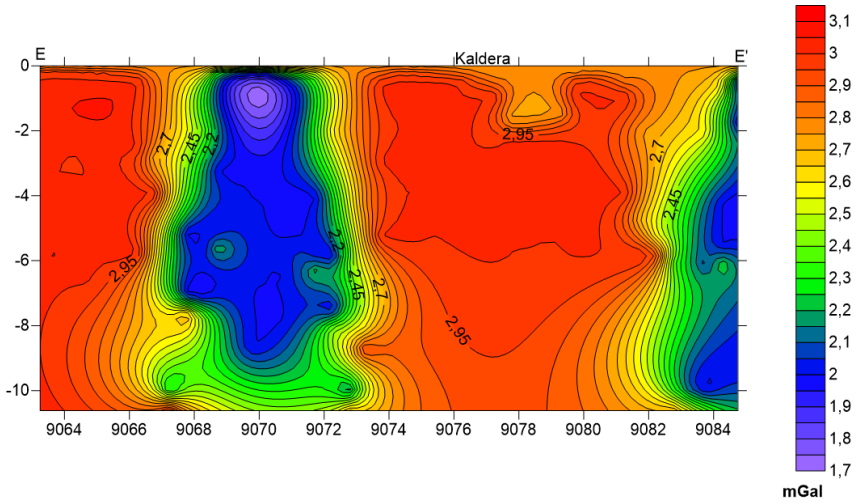

Figure 12 E-E'

IV. CONCLUSIONS

Based on the results of data processing and modeling, it can be concluded that the Sembalun area, East Lombok, West Nusa Tenggara is an area with a subsurface layer dominated by andesite rock with a value of 2.81 g/cm^3. The results of subsurface 2D modeling with the help of Grablox software show that areas with high density indicate areas with a dominance of lava rock. In addition, the 2D modeling results show that there are suspected faults or contact boundaries of rock lithology in the north to south of the study area. The existence of a caldera can also be seen in the middle of the research area where more precisely between Sembalun Lawang and Sembalun Bumbung.

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