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RESEARCH ARTICLE

UTILIZATION OF SATELLITE GRAVITY ANOMALY DATA FOR TWO-DIMENSIONAL MODELING OF SUBSURFACE STRUCTURE OF SLAMET VOLCANO, CENTRAL JAVA, INDONESIA

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ABSTRACT

Study using the satellite gravity method has been carried out in the Slamet Volcano area, Central Java, Indonesia. The gravimetric satellite has produced gravity anomalies data which have been corrected up to free air correction. This study purposes to determine the subsurface structure of Slamet Volcano by modeling residual gravity anomalies data. Data processing which has been conducted includes bouguer correction, terrain correction, data reduction to a horizontal surface, separation of regional and residual anomalies data, modeling, and interpretation. The residual gravity anomalies data obtained from the processing range from -40.62 – 66.22 mGal. The anomalies data are modeled in two dimensions (2D) to obtain the subsurface structure model of Slamet Volcano. The 2D-subsurface models on the AB and CD trajectories show the presence of magma chamber and several lava rocks which form the body of the volcano. The rocks are interpreted as andesitic lava with a density value of 2.72 g/cm^3, andesitic-basaltic lava with a density value of 2.89 g/cm^3, basaltic lava with a density value of 2.97 g/cm^3, and magma chamber with a density value of 1.32 g/cm^3. Such low value of magma chamber density relative to the surrounding rocks, indicates that Slamet Volcano is still active.

KEYWORDS

satellite gravity method, Slamet Volcano, subsurface structure.

1. INTRODUCTION

One of the volcanoes that is still active in Central Java, Indonesia is Slamet Volcano, that is located in the border area of five regencies, i.e. Brebes, Tegal, Pemalang, Purbalingga, and Banyumas (Djafar and Nurlathifah, 2020). Slamet Volcano has four craters at the top and all of them are still active. Slamet Volcano is an active strato volcano with with 3428 m height (Harijoko et.al., 2020). Based on the data from the Department of Energy and Mineral Resources of Banyumas Regency, the depth of the magma chamber of Slamet Volcano is estimated to be between 5 – 10 km (Sumarwoto, 2014). The geology of this volcano consists of old Slamet Volcano and young Slamet Volcano. The old Slamet Volcano is located in the western, while the young Slamet Volcano is located in the eastern. The young Slamet volcano has a crater which is still active today (Arhananta et.al., 2019). Since 1825, this volcano has had the shortest resting period of 1 year and the longest resting period of 19 years (Kusumadinata, 1979). In 2019, there was an increase in alert status but no eruption has occurred. The last eruption of the volcano occurred in 2014 with a strombolian type (Triastuty et.al., 2020).

The danger arising from volcanic eruptions is very high, considering the high level of activity and the dense population around the volcano. In addition, there are many national assets such as cultural heritage and tourist sites, and centers of public economic activity, transportation facilities, agriculture, livestock, and educational facilities in the vicinity. Therefore, studies and research to minimize the impact caused by the eruption of Slamet Volcano need to be done. Pre-mitigation activities can be done through study and research to identify subsurface structure of the volcano, especially the magma chamber (Chasanah et.al., 2021). The volcano subsurface structure plays an important role in the processes that occur in it. By knowing the structure under the volcano, then the interpretation related to the volcanic activity can be well understood.

One technique to know the subsurface structure of a volcano is through processing and modeling the satellite gravity anomalies data (Hwang and, Parsons, 1995). The satellite gravity anomaly is the development of the relative gravity method. The acquisition and processing of satellite gravity field anomaly data is not carried out directly in the field, but can be accessed through an already available website. The data acquired are gravity field anomalies data which are assumed to have been corrected to free air correction. Hence, for modeling purpose, only the bougeur and terrain corrections are carried out in data processing to obtain the Complete Bouguer Anomalies (CBA) data (Maulana and Prasetyo, 2019). Furthermore, the CBA data are reduced to a horizontal surface and separated from regional anomalies data in order to obtaine residual anomalies data (Sehah et.al., 2021). The residual anomalies data can be assumed to originate from the local anomalous sources which are the target of this study.

2. LITERATURE REVIEW

2.1 Geological Setting

Slamet Volcano is a quarter volcano (Bemmelen, 1949), which occupies the westernmost part of the North Serayu Mountains. Slamet Volcano is a

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composite volcano with very large dimensions (50 – 60 km in diameter), which covers tertiary deposit units around this area (Pratomo, 2012). A composite volcano or stratovolcano is a type of volcanic body formed from lava deposits mixed by other pyroclastic materials, such as ash, sand, and hardened gravel. The top of this volcano type can continue to grow due to heaps of lava and pyroclastic that comes out during an eruption. Volcanic activity in this area is estimated to have been going on since the upper miocene era which is marked by the presence of rocks the Kumbang formation units consisting of volcanic rocks both in land and sea environments, which occupies the central part of the Java Island (Pratomo, 2012).

The stratigraphy of Slamet Volcano area consists of some geological formations (Djuri et.al, 1996). However, the three geological formations closest to this volcano are laharic deposits, lava deposits, and undifferentiated volcanic rocks. The laharic deposits (Qls) are composed of laharic materials with boulders of andesitic-basaltic volcanic rocks which are produced from old Slamet Volcano, in holocene age. Then, the lava deposits (Qvls) are composed of andesitic lava of Slamet Volcano; very porous and have lots of cracks (Iswahyudi et.al., 2018), in pleistocene age. Meanwhile the undifferentiated volcanic rocks (Qvs) consits of breccias, lava, and tuffs, in pleistocene age. The origin of all Slamet Volcano rocks is magma. Magma is a mixture of molten rock with various types of minerals and gases dissolved in it. Then, magma which comes out to the earth's surface is called lava, whereas that cools and crystallizes is called igneous rock (Gill., 2010). The geological map of the reasearch area is shown in Figure 1 (Djuri et.al., 1996).

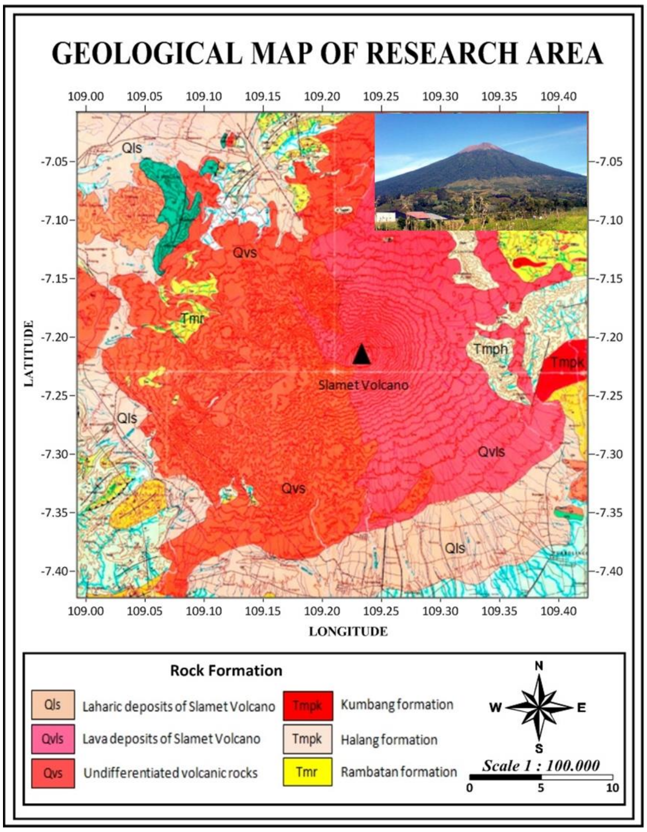

Figure 1: The geological map of the research area (Djuri et.al., 1996) inserted with an image of Slamet Volcano.

2.2 Gravity Method

The gravity method is based on Newton's law of attraction between two mass points. The value of the force between two mass points (m_1 and m_2) separated by a certain distance (r) can be writen:

$$\vec{F}(\vec{r}) = -G\frac{m_1 m_2}{r^2}\hat{r} \tag{1}$$

where F is the force (N), r is the distance between two masses points (m), m_1 and m_2 are the masses of each point or object (kg), and G is the universal gravitational constant (i.e. 6.67×10^{-11} Nm^2/kg^2). Telford et al. (1990) have explained this equation until the gravitational potential is obtained at a point (P) on the Earth's surface with the equation:

$$U_P(\vec{r}) = -\int_V \frac{G}{\left|\vec{r}^2 - \vec{r}_0^{\,2}\right|} dm = -G\int_V \frac{\rho(\vec{r}_0)}{\left|\vec{r}^2 - \vec{r}_0^{\,2}\right|} d^3\vec{r}_0 \tag{2}$$

where $\left|\vec{r}^2 - \vec{r}_0^{\,2}\right| = \sqrt{r^2 + r_0^{\,2} - 2r\,r_0\cos\gamma}$

When the volume integral is applied for the overall volume of the Earth, so the gravitational potential at the Earth's surface can be determined. While the gravity field can be acquired by differentiating the gravitational potential as shown in the following equation (Telford et.al., 1990):

$$\vec{E}(\vec{r}) = \left|-\nabla U_P(\vec{r})\right| \tag{3}$$

The Earth's gravitational field is often referred to as the gravitational acceleration and is given the symbol g. Based on Equation (3), the value of the earth's gravitational field can be written by the equation (Telford et.al., 1990):

$$g(\vec{r}) = \left|-\vec{E}(\vec{r})\right| = \left|\nabla U_P(\vec{r})\right| \tag{4}$$

Equation (4) can be stated more fully into equation (5) as shown in the equation (Telford et.al., 1990):

$$g(\vec{r}) = -G\int_V \frac{\rho(\vec{r}_0)\, z\, d^3\vec{r}_0}{(x^2 + y^2 + z^2)^{3/2}} \tag{5}$$

$$g(\vec{r}) = -G\int_V \frac{\rho(\vec{r}_0)(z_0 - z)\, d^3\vec{r}_0}{\left[(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2\right]^{3/2}} \tag{6}$$

Equation (6) shows that the value of the Earth's gravitational field is influenced by the position of latitude, longitude, altitude, and the distribution of mass in the subsurface or density of the body mass in the subsurface. Earth's gravitational field on the surface will be influenced by rocks with various densities. The geological structure also affects the variation of the gravitational field on the surface, including uneven relief of the earth's surface (rough topography). In a gravity survey method, the value of the gravitational field which is the data acquisition result is stated in gal unit (1 gal = 10^{-5} m/s^2). But the gravity anomaly data measured in the field are generally very small, in the milligal range (Lichoro, 2016).

3. Research Method

3.1 Location and Time of Research

This study has been done in April – July 2021 at Geophysics Laboratory of Jenderal Soedirman University, Purwokerto, Indonesia. The gravity anomalies data and the geographical position data have been accessed and downloaded from URL: http://topex.ucsd.edu/cgi-bin/get_data.cgi, which has been provided by the Scripps Institution of Oceanography, California University, San Diego, USA (Sandwell and Smith, 2009). The anomalies data acquired are gridded regularly in the ASCII-XYZ format in accordance with the geographical position data. The spatial resolution for latitude and longitude is 1 minute per grid, meanwhile the accuracy of the gravity anomalies data is 0.1 mGal and the altitude data is 1.0 m (Sandwell and Smith, 1997).

3.2 Research Equipment

Several equipments used in this study consist of a laptop connected to the internet to extract and download the satellite gravity anomalies data and the geographic position data, the Google Earth to acquire the boundaries of the research area, and a local geological map as a guide in modeling and interpretation. Meanwhile several softwares used consist of the Microsoft Excel 2019 for bouguer correction, the Gravity 900 for terrain correction, the Fortran 77 for processing gravity anomalies data, and the Surfer for depicting gravity anomaly contour map.

3.3 Research Procedure

Satellite data acquired from accessing are free-air gravity anomalies data. The anomalies data don't require free-air correction because the acquisition is done at the same elevation datum. The latitude correction is also not required in the processing, because the satellites have calculated the gravity values effect on differences in latitude positions. In addition, with the distance from the earth mass center to the orbital trajectory of the satellite, the difference in the gravitational acceleration value caused by the difference in latitude does not have much effect. Then, several corrections commonly applied to the gravitymeter such as equipment height correction and drift correction are also not required (Maulana and Prasetyo, 2019). Hence, only bougeur and terrain corrections were done in data processing to acquire the Complete Bouguer Anomalies (CBA) data (Putri et.al., 2019).

The CBA data acquired are still distributed on the topographic surface that are a function of position of longitude, latitude, and altitude, so that they can be written as $\Delta g(\lambda,\vartheta,h)$. Reduction of anomalies data to a horizontal surface must be done, because the data must be spread at a horizontal surface for the next processing (Blakely, 1995). One method which can be applied to reduce anomalies data to a horizontal surface is Taylor series approximation that can be expressed as equation (Blakely, 1995):

$$\Delta g(\lambda,\vartheta,h_0)^{[i+1]} = \Delta g(\lambda,\vartheta,h) - \sum_{n=0}^{\infty} \frac{(h-h_0)^n}{n!} \frac{\partial^n}{\partial h^n} \Delta g(\lambda,\vartheta,h_0)^{[i]} \quad (7)$$

The basic principle of the Taylor series is to use a derivative function at a point to extrapolate the function around that point. Hence, this method can be utilized to estimate the gravity anomaly values at points outside the observation field. Equation (7) can be stated in the form of iteration; where $\Delta g(\lambda,\vartheta,h_0)$ are CBA data which are spread on the horizontal surface. The CBA data can be estimated through an approach; i.e. $\Delta g(\lambda,\vartheta,h_0)$ data obtained from i-th iteration are used to acquire $\Delta g(\lambda,\vartheta,h_0)$ data in the (i+1)-th iteration. The iteration can be carried out sufficiently to reach convergent values (Blakely, 1995). Convergence of Equation (7) can be achieved quickly, if z_0 is placed at the average topographical elevation of the research area. For the initial guess values before iteration, $\Delta g(\lambda,\vartheta,h_0)$ on the right of Equation (7) is filled by $\Delta g(\lambda,\vartheta,h)$ data (Blakely, 1995).

The CBA data which are spread on the horizontal surface are still affected by subsurface densities originating from the deep and wide sources, that are called as regional gravity anomaly. Therefore, the regional gravity anomaly must be separated from the CBA data to obtaine the residual gravity anomalies data (Sehah et.al., 2020 and Ilapadila et.al., 2019). The regional gravity anomalies data can be obtained through the upward continuation process to a certain height, so that the anomalous data intervals have shown very small values and smooth patterns (Guo et.al., 2013). The regional gravity anomalies data obtained, then corrected to the CBA data which have been distributed on the horizontal surface to obtaine the residual gravity anomalies data as stated in the following equation (Blakely, 1995 and Sehah et.al., 2020):

$$\Delta g_{res}(\lambda',\vartheta',h_0) = \Delta g(\lambda,\vartheta,h_0) - \frac{\Delta h}{2\pi} \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \frac{\Delta g(\lambda,\vartheta,h_0)}{\sqrt{\left[(\lambda'-\lambda)^2 + (\vartheta'-\vartheta)^2 + \Delta h^2\right]^3}}\, d\lambda\, d\vartheta \quad (8)$$

The right term is the regional gravity anomalies data resulting from the upward continuation and Δh is the height of the upward continuation. The residual anomalies data are assumed to only come from the local anomalous sources which are the target of the study (Quesnel et.al., 2008). In this study, the target is the subsurface structure model of Slamet Volcano in two dimensions, including the rock layer which is thought to be the location of the magma chamber.

4. Results and Discussion

4.1 Results of Processing Data

Accessing the data has resulted satellite gravity anomalies data which are equivalent to gravity anomalies data which has been corrected up to free-air correction (Maulana and Prasetyo, 2019). These anomalies data area downloaded from the Topex website The number of gravity anomalies data which has been obtained is 648 points with a spacing of 1.8 km between points and an area of 47 km x 47 km. Free-air gravity anomalies data obtained ranged from 16.10 – 304.40 mGal. The high anomalous is concentrated in the central part of the research area, around the cone of Slamet Volcano to be precise. The research area which is Slamet Volcano and its surrounding areas has a topographical elevation ranging from 19 – 3,017 m based on the Topex data.

As explained in the Research Method section, the free-air gravity anomalies data were corrected by bouguer and terrain corrections to obtain the Complete Bouguer Anomalies (CBA) data. The bouguer correction is carried out to eliminate the mass influence located between the measurement points on the topography to the datum that is not taken into account, even though this mass greatly affects the gravity anomalies data (Telford et.al., 1990). While terrain correction aims to eliminate the effect of mass around the measurement point. This correction arises due to the influence of the topography on gravity at the measurement point (i.e. due to the difference in elevation between the station and the base station). Rough topography and large elevation differences such as mountains and/or hills around the measurement point can reduce the gravity field value. The magnitude of the terrain correction can be calculated using the Hammer Chart method (Telford et.al., 1990). The CBA contour map of the research area is shown in Figure 2, with anomalous values ranging from 8.22 – 156.58 mGal.

The CBA data obtained are still distributed on the topographic, so that the data must be reduced to a horizontal surface, so that they can be processed further. As described in the Research Method, the Taylor Series approximation was applied for this aim at the average topographic height of the study area, i.e. 513 m. CBA data obtained at an average topographical height ranged from 15.94 – 153.54 mGal. Furthermore the CBA data that have been reduced to a horizontal surface are separated from regional component of CBA data. The process of separating regional component from CBA data was carried out using the upward continuation method, as described in the Research Methods section. The upward continuation process was carried out up to an altitude of 50,000 m to obtain regional component of CBA data. The obtained regional component data of the CBA data have values ranging from 74.93 – 75.06 mGal. This regional anomaly is a component of the CBA data which provides information on sources of internal anomalies, which are very subtle and have a low frequency, such as basements, folds, and regional faults.

After the CBA data is corrected by the regional component data, the residual gravity anomalies data are obtained (Sehah et.al., 2020). This local anomaly is a component of CBA data which has high frequency and relatively complex closure representing shallow anomalous sources such as geothermal reservoirs dan magma chambers of Slamet Volcano. The data have a value ranging from -58.99 - 78.49 mGal with contour map can be seen in Figure 3. Based on this Figure 3, the residual anomalous contour map tends to indicate a local pattern. The lowest anomalous values seen below the Slamet volcano cone is estimated to be magma chamber. The gravity anomalies values which is lower than the surrounding rocks shows that the magma chamber of Slamet Volcano is relatively hot and liquid. Therefore, the magma chamber of this volcano is estimated to be still active and productive.

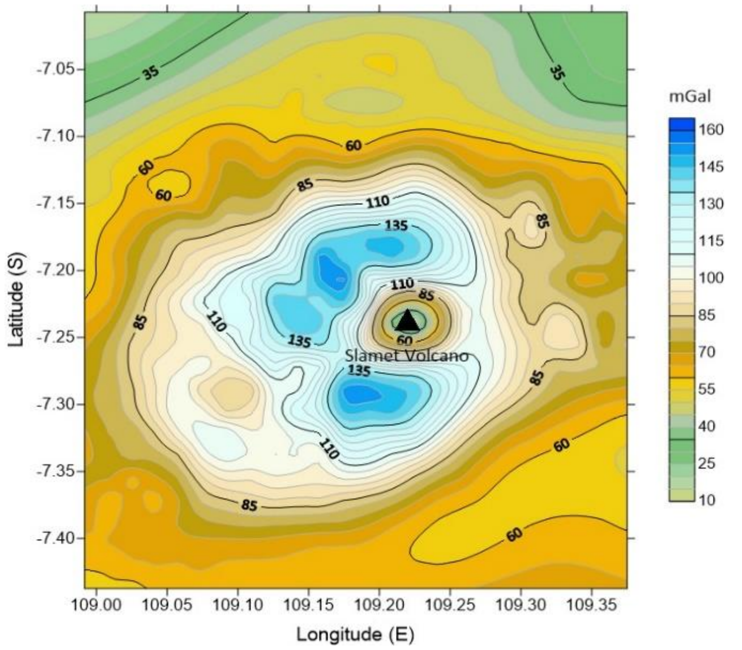

Figure 2: The Complete Bouguer Anomalies (CBA) map of Slamet Volcano area.

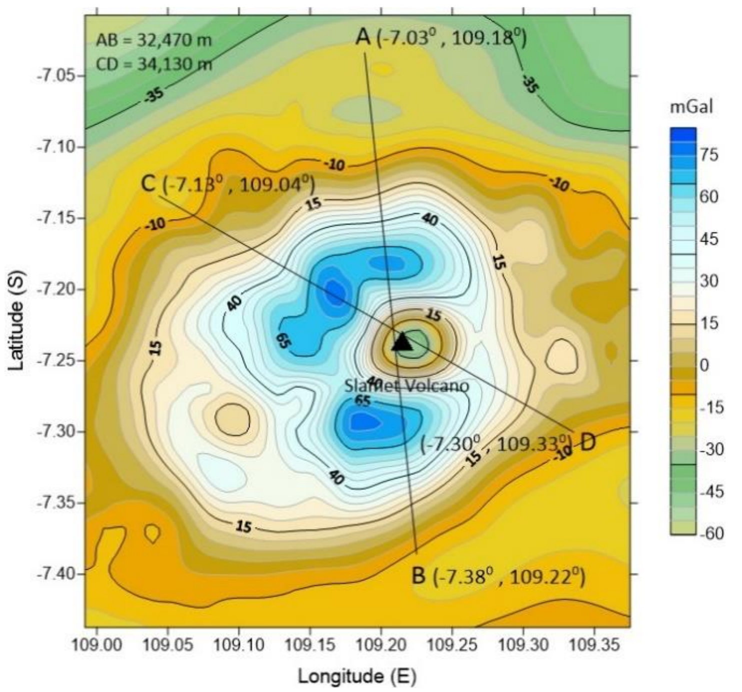

Figure 3: The residual gravity anomaly map of the research area (include the A-B and C-D trajectories for modeling).

4.2 Results of Modeling dan Interpretation

The modeling has been carried out on the residual anomalies data, because these data represent the geological structures and subsurface rocks with relatively shallow depths (not depths in a regional scale) (Quesnel et.al., 2008). This modeling aims to deliniate subsurface geological structure in two dimensions (2D), including the magma chamber of Slamet Volcano. In order the modeling results to approach the actual conditions, then geological information support is needed. The input data for this modeling is residual anomalies data that are supported by topographical data of the study area. This modeling has been done using the forward and inverse method by means of curve matching between the observation anomalous curve and the calculation anomalous curve (Guglielmetti et.al., 2021). Modeling on the anomalous data along the trajectory has resulted in a subsurface structure cross-sectional model. The trajectories modeled are the AB and CD trajectories such as shown in Figure 3. The results of 2D-modeling on these trajectories can be seen in Figure 4 and Figure 5. These figures show the location and depth of the magma chamber of Slamet Volcano and other rock layer structures. Magma chamber is a large chamber where molten rock accumulates under the earth's surface.

Two dimensional modeling has been carried out on the residual gravity anomalies data of the A-B trajectory. This trajectory stretches at geographic position of 109.18° – 109.22° E and 7.05° – 7.38° S with a length of about 32,470 m. The depth of the top of each model ranges from 0 – 2,053 m from the average topographic. Two dimensional modeling on the residual anomalies data has also been done on the C-D trajectory. This trajectory is located at position of 109.04° – 109.33° E and 7.13° – 7.30° S with a length of about 34,130 m. The top of each model has a depth of 0 – 2,110 m measured from the average topographic surface. The results of the interpretation of each model object on the AB and CD trajectories are shown in Table 1 and Table 2. The subsurface structure modeling is not carried out until the topographic surface, considering that the anomalies data is at the average topographic elevation after reduction to the horizontal surface is applied.

The modeling results show three rock formations, consisting of basaltic lava rocks with a density of 2.97 g/cm^3, basaltic-andesite lava rocks with a density of 2.89 g/cm^3, and andesite lava rocks with a density of 2.72 g/cm^3. In addition, in the center part of the volcanic body, an anomalous object

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model with a density of 1.32 g/cm³ is also obtained which can be interpreted as a magma chamber of Slamet Volcano. The density value is relatively small compared to other rocks in the Earth's crust, thus indicating that the magma is molten with high temperature. This will produce a buoyant force on the magma that tends to push it upwards. This magma is also under great pressure, and after getting enough time and pressure, it can break the rock above it to make a gap for the magma. If magma finds a gap to the surface, a volcanic eruption can occur. Magma which has reached the surface can flow along the slopes or immediately freeze at the top.

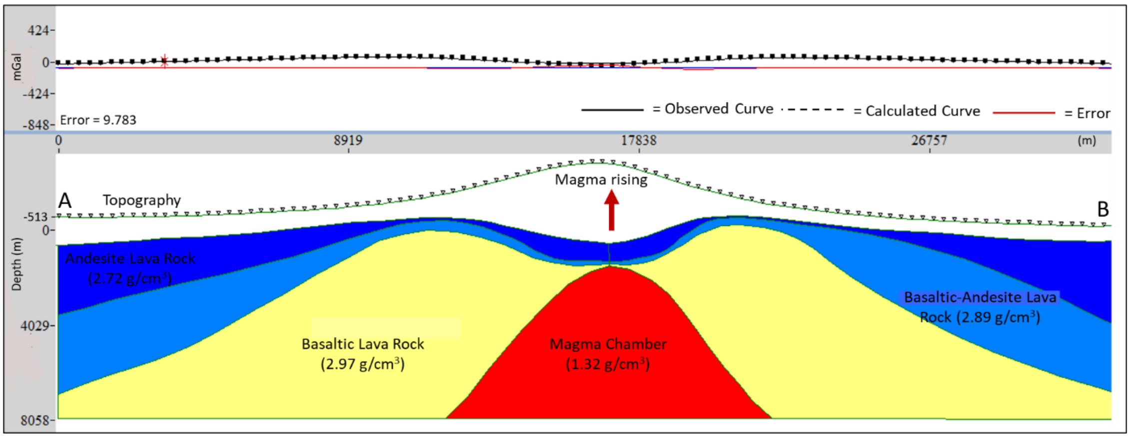

Figure 4: Schematic of modeling results of subsurface rock section of Slamet Volcano on the trajectory A-B.

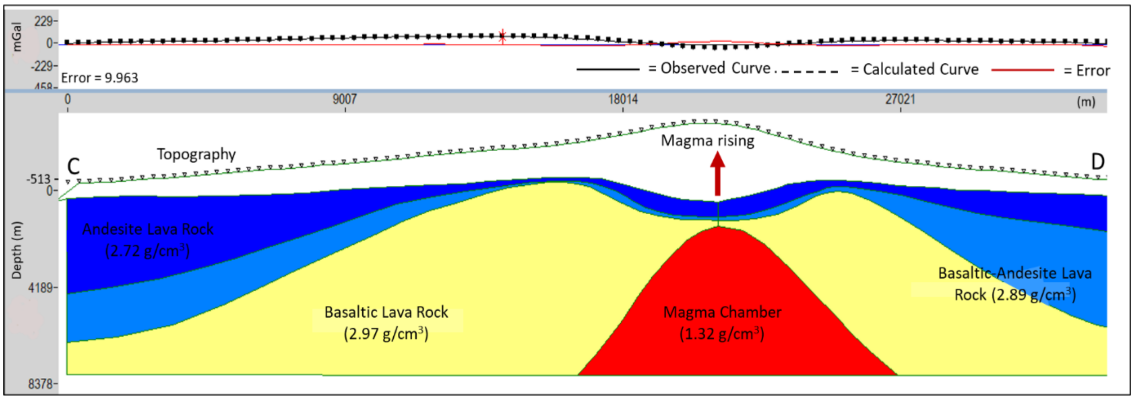

Figure 5: Schematic of modeling results of subsurface rock section of Slamet Volcano on the trajectory C-D.

Table 1: The Results of the Lithological Interpretation of the Modeling Results on the AB Trajectory

No.	Density (g/cm³)	Top Depth (m)	Lithological Interpretation
1	2,72	0	Andesitic lava
2	2,89	67	Basaltic-andesitic lava
3	2,97	255	Basaltic lava
4	1,32	2053	Magma Chamber

Note: The depth of the object is measured from the average topographic elevation of the research area.

Table 2: The Results of the Lithological Interpretation of the Modeling Results on the CD Trajectory

No.	Density (g/cm³)	Top Depth (m)	Lithological Interpretation
1	2,72	0	Andesitic lava
2	2,89	100	Basaltic-andesitic lava
3	2,97	179	Basaltic lava
4	1,32	2110	Magma Chamber

Note: The depth of the object is measured from the average topographic elevation of the research area.

4.3 Analysis and Discussion

The residual gravity anomaly contour map shows high anomaly values around the volcanic cone as shown in Figure 3. These zones are estimated to be rock zones with high density due to magma freezing in the ancient times. The rock complexes are estimated to be above the tertiary rock units in the form of Miocene marine sediment deposits which later became the basement for the Slamet Volcano area (Pratomo, 2012). The basement rocks consist of the Halang and the Rambatan formations which are unconformably overlain by volcanic deposits from the Kumbang formation in late miocene and the greenish coarse sandstone and conglomerate from the Tapak rock formation in pliocene age (Djuri et.al., 1996).

The regional stratigraphy of the the research area is assumed to be equivalent to the stratigraphy of Western North Serayu Mountains and Eastern Bogor Zone, which consist of Halang formation in the middle miocene age; dacitic, andesitic, and dioritic rock intrusions in the late miocene age; old quaternary rock formation in pleistocene age; as well as alluvial and young volcanic rocks in the holocene age (Bemmelen, 1949). Meanwhile the residual gravity anomaly contour indicates a local pattern controlled by the quaternary deposits. The deposits are dominated by volcanic rock deposits which are resulted from the eruption of Slamet Volcano, which consists of volcanic rock in the form of pyroclastic falls, both loose or petrified deposits, and basaltic lava that is spread widely. A pyroclastic fall is a uniform deposit of material which has been ejected from a volcanic eruption or plume such as an ash fall or tuff (Saucedo, et.al., 2005).

Based on the results of modeling and lithological interpretation as shown in Table 1 and Table 2, the magma chamber has a lower density (i.e. 1,32 g/cm3) than the surrounding rocks. This can cause magma to be pushed to the earth's surface, if there is sufficient pressure. Magma is an incandescent liquid found in the rock layers of the earth with a very high temperature, which is estimated to be more than 1,000°C (Anonimous, 2015). Magma which has come out of a volcano crater is called lava, which has a temperature that ranges from 700 -1,200°C (Anonimous, 2018). Lava and ash that comes out through the eruption every time in a long time will accumulate and form volcano body as shown in the results of the modeling such as Figure 4 and Figure 5. When the volcano is in the marine environment, the eruption produces basaltic lava with a density value of 2.97 g/cm3. In the next time there was a change from basaltic lava to andesitic-basaltic lava (2.89 g/cm3), until finally it became andesitic lava (2.72 g/cm3) as shown in those figures, along with changes in the volcanic environment from sea to land (Pratomo, 2012).

The modeling results show andesitic lava near the surface of Slamet Volcano with a density of 2.72 g/cm3. The andesite lava deposits are estimated to spread to the topographical surface, as shown on the geological map, except the western part of the body of the volcano. In this area, the andesite lava rocks have weathered due to exogenous forces on undifferentiated volcanic rocks. According to the geological map, the upper stratigraphy of the area consists of the andesite lava and undifferentiated volcanic rocks as shown in Figure 1 (Djuri et.al., 1996). The two formations are pleistocene in age. The modeling results show that under the andesite lava deposits, there are andesitic-basaltic lava and basaltic lava deposits. The formation of the rock deposits is estimated to be in accordance with the conditions of the volcanic environment (mainly at the eruption) in ancient times, as described in the previous paragraph.

Satellite gravity anomalies data from Topex have been successfully used to model the subsurface structure of Slamet Volcano, Indonesia. Gravity data acquisition activity was not carried out in situ, considering that this volcano is very large, with difficult field conditions and very extreme topography. The spatial resolution for the latitude and longitude of the Topex data is 1 minute per grid (Sandwell and Smith, 1997); this means that the spacing of 1 grid is about 1.8 km. Given the relatively large spatial resolution, the modeling and interpretation in this reserach is only limited to estimate the rock formations which make up Slamet Volcano, not modeling the rock types in detail. As for more detailed subsurface structure modeling, satellite gravity anomalies data from GGMplus can be applied (Apriliani et.al., 2021).

5. Conclusion

The research using the satellite gravity method to interpret the two-dimensional subsurface structure model has been carried out for the Slamet Volcano area in Central Java, Indonesia. The gravimetric satellite has resulted free-air gravity anomalies data and geographical position data of the research area. Data processing which has been carried out includes bouguer correction, terrain correction, reduction to the horizontal surface, and separation of the regional anomalies data. The results of processing data are the residual gravity anomalies data with values ranging of -40.62 – 66.22 mGal that describe the subsurface local structure of the research area. The residual anomalies data are modeled in two dimensions, so that several models of the subsurface structure of Slamet Volcano are obtained. The 2D-models under the AB and CD trajectories on the residual anomaly contour map show the presence of magma chamber and some lava rocks that form volcano body. These rocks are interpreted as andesitic lava rocks with a density value of 2.72 g/cm3, andesitic-basaltic lava rocks with a density value of 2.89 g/cm3, basaltic lava rocks with a density value of 2.97 g/cm3, as well as magma chamber with a density value of 1.32 g/cm3. The density of the magma chamber that is relatively lower than the other rocks in the earth's crust indicates that Slamet Volcano is still active.

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