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HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel)	:	The Mass Distribution of Soputan Volcano Based on Gravity Data			
Nama/ Jumlah Penulis	:	3 Orang			
Status Pengusul	:	~~Penulis pertama/~~ Penulis ke 3 / Penulis Korespondesi **			
Identitas Jurnal Ilmiah	:	a.	Nama Jurnal	:	Journal of Physics and Its Applications
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		d.	Penerbit	:	Departemen Fisika Universitas Diponegoro
		e.	DOI artikel (jika ada)	:	https://doi.org/10.14710/jpa.v4i2.13230
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Semarang, 8 Maret 2023

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Unit Kerja: FSM Universitas Diponegoro
Bidang Ilmu: Fisika

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Bidang Ilmu: Fisika

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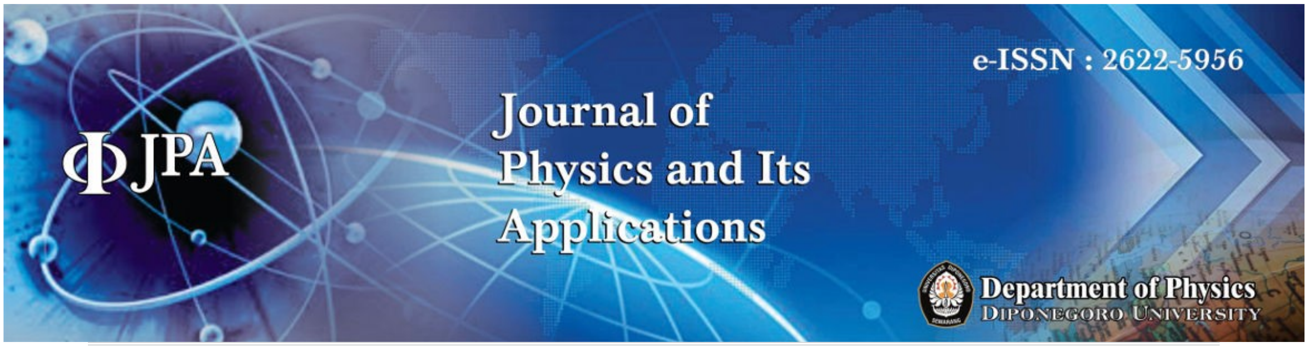

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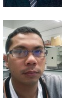
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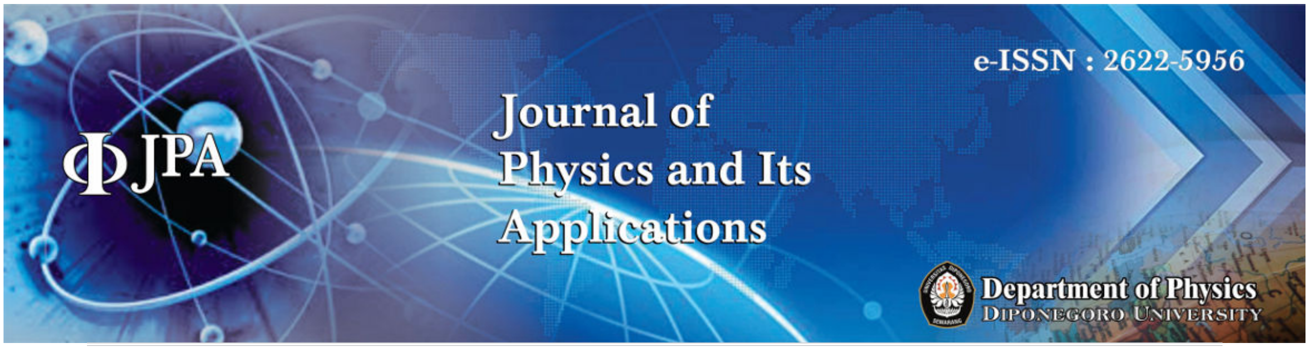

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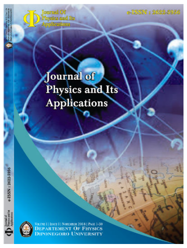

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Affi Nur Hidayah, Yuliati Herbani, Djoko Triyono, Rosari Saleh

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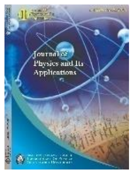

Effect of Yield Silver Nanoparticles in Enhancing Raman Signal of SERS Substrate Fabricated on Whatman Filter Paper

Affi Nur Hidayah[1,2,*], Yuliati Herbani[2], Djoko Triyono [1], and Rosari Saleh[1]

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A B S T R A C T

On Whatman Filter Paper, Surface Enhanced Raman Scattering (SERS) Substrate was created from colloidal silver nanoparticles by drop casting in varied volume colloidal nanoparticles of 3 ml and 6 ml. Using Raman Spectroscopy, SERS substrates were investigated for their ability to enhance 500 ppm of Deltamethrin pesticides Raman Signal. The number of colloidal nanoparticles is related to the volume of colloidal nanoparticles, indicating that high yields nanoparticle synthesis. The results demonstrate that fabricating SERS substrates in 6 ml increased Raman signal more than fabricating nanoparticles in 3 ml.

1. Introduction

In recent years, Surface-enhanced Raman scattering (SERS) has recently emerged as a simple, ultra-sensitive, non-destructive, and promising analytical technique for hazardous chemical detection in a variety of applications, including food contaminant detection, environmental monitoring, drug, biological entity, and explosive trace detection [1-4]. The presence of metallic nanostructure embedded in the surface amplifies the weak Raman signal that the molecules will be adsorbed and increased by SERS [5-6]. The main key to enhancing electromagnetic field in the SERS enhancement mechanism is the plasmonic characteristics of metallic nanoparticles.

Surface plasmons is a collective of surface conductive electrons excited when electromagnetic radiation interacts with metal-dielectric interface such as noble metal thin films or nanoparticles surface. There are two types of SPs : propagating SPs generated on noble metallic thin film are called surface plasmon polaritons (SPPs) and non propagating SPs generated on the surface of NPs are called localized surface plasmon resonances (LSPRs) [7-8]. The electromagnetics fields generated by SPs and localizes SPs at surface of metal nanoparticles will interacts with Raman emitted photons to provide significant enhancement of the Raman scattered photons (electromagnetic enhancement) these processes are forming the basis of SERS [9].

Metallic nanoparticles such as Au, Ag, Cu, and Bi are often utilized as SERS substrates [10-11]. Due to its narrower and sharper plasmonic width, Ag has better plasmonic than the others. Ag is also distinct from gold and platinum because of its high electrical and thermal conductivity, high primitive character, and low cost [12]. The size, shape, and properties of the nanoparticles placed into the substrate have an impact on the SERS enhancement factor [13].

Generally, SERS substrates are often prepared using conventional substrates such as silicon wafers, glass, and metal, which have limitations such as fragility, rigidity, high cost, and difficulty in solid sample collecting and manipulation efficiency [14]. As a result, alternative materials as SERS substrates must be sought. Filter paper is another option because of its versatility, low cost, and biodegradability [15].

The quality of the nanoparticles incorporated in the SERS substrate determines its performance. We fabricate silver nanoparticles in various yields in our experiment. Silver nanoparticles with a high yield embedded in Whatman filter paper are expected to improve the analyte's Raman signal more than nanoparticles with a lower yield.

Metal nanoparticles yield is metal nanoparticles concentrations assumed amount of metal atoms in the colloidal suspension. The number of nanoparticles in a colloidal suspension can determine total quantities of nanoparticle suspensions and the unit quantity of one nanoparticles which is represented from volume of colloidal suspension [16].

2. Methods

Based Using a simple and easy drop-casting method, we fabricated SERS substrate on Whatman filter paper using various volume colloidal nanoparticles of 3 ml and 6 ml.

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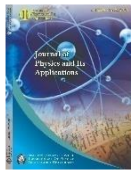

Magnetic Susceptibility of Volcanic Rocks from Pahae Julu Region, North Sumatera Province

Nurmala Dewi Siregar, Hamdi Rifai*, Syafriani, Ahmad Fauzi, and Fatni Mufit

Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Padang, Indonesia

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A R T I C L E I N F O

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A B S T R A C T

Pahae Julu is a sub-district located in North Tapanuli Regency, North Sumatra. This area is often found with volcanic material from the eruption of Mount Toba (Youngest Toba Tuff). The Youngest Toba Tuff eruption occurred ~74,000 years ago with a volume of 2,800 km^3. When there is an eruption, the lava on the earth's surface undergoes a relatively fast freezing process to form volcanic igneous rock. These rocks contain various minerals, one of which is magnetic minerals that can be used as a track record of volcanic processes from Mount Toba. However, no document records the magnetic susceptibility value of the Youngest Toba Tuff volcanic rock in the Pahae Julu area. This research aimsbfor knowing the abundance of magnetic minerals by the low-field magnetic susceptibility. To achieve this goal, the rock magnetism method is used. This way is very effective, cheap, sensitive, and non-destructive. Magnetic susceptibility measurements are done using the Bartington Magnetic Susceptibility Meter MS2B sensor. Rock samples analyzed are pumice which is the result of the Youngest Toba Tuff eruption. The results showed that the magnetic susceptibility value obtained for the sample was between 85.0 x 10^{-8}m^3/kg – 183.1 x 10^{-8}m^3/kg with an average of 119.78 x 10^{-8}m^3/kg. Based on this value, it is assumed that the magnetic mineral properties are Antiferromagnetic. The average value of χ_{fd}% obtained is 0.95%, indicating that the Youngest Toba Tuff volcanic rock in the Pahae Julu area has almost no Superparamagnetic grains.

1. Introduction

North Sumatra is a province located in the northern part of the island of Sumatra with location coordinates 1° - 4° North Latitude and 98° - 100° East Longitude. North Sumatra Province is directly adjacent to the Province of Aceh (North),Malacca Strait (East), Riau Province and West Sumatra Province (South) and Aceh Province and the Indonesian Ocean (West)[1]. Based on its geographical location, North Sumatra is traversed by the Pacific Ring of Fire which causes the area to experience frequent earthquakes and volcanic eruptions. Every volcano has eruptive or eruptive activity.

The eruption is the process of expelling material from the bowels of the earth[2]. Volcanic eruptions are divided into 2, namely effusive eruptions and explosive eruptions. An effusive eruption releases lava slowly in the form of a flow, while an explosive eruption releases lava in the form of an explosion. Explosive eruptions have occurred in several volcanoes in Indonesia. One of them is in the ancient Toba volcano thousands of years ago. The ancient Toba volcano has erupted several times and produced a caldera. Mount Toba caldera is the biggest caldera on earth (100x30 km^2) [3]. A very powerful eruption occurred three times. The first eruption occurred about 840,000 years ago in the Porsea area [4] which formed the Porsea Caldera and produced the Old Toba Tuff[5]. The second eruption about 500,000 years ago occurred in the Haranggaol area which formed the Haranggaol Caldera and produced the Middle Toba Tuff, and the third eruption which was the largest eruption occurred about 74,000 years ago which united the Toba calderas and formed the Youngest Toba Tuff[6], with the volume of volcanic material ejected reaching 2,800 km^3[7]so that the material was spread and found as far as India[8], Arabian Sea[9], and China[10][11][12]. The material is scattered in all directions caused by wind factors and settles in one place. The material deposits form rocks that contain various minerals, one of which is magnetic minerals that can be used as a track record of the volcanic process of Mount Toba.

The eruption of the Youngest Toba Tuff was very influential on regional and global climates in the

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by Rina Dwi Indriana

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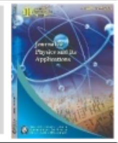

The Mass Distribution of Soputan Volcano Based on Gravity Data

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ABSTRACT

The gravity method is a passive method based on the density measurement among sediment. This method is usually applied to identify the condition of the earth's subsurface. Soputan Volcano is located in District Minahasa Tenggara. Soputan Volcano is included in type A Volcano or stratovolcano and it stands at 1783.7 MSL. This research aims to identify the distribution of subsurface mass (sediment density) of Soputan. The data used was Data from satellite GGmPlus and elevation data of ERTM which was corrected to ellipsoid reference. 3D inversion modeling applied Grablox software. The complete value of the Bouguer anomaly obtained was 110 – 162 mGal. The density result obtained from the inversion model was 2.3 g/cm^3 to 2.95 g/cm^3. The sediment that could be identified was andesite sediment and basalt sediment. Based on that result, the layer arranging Soputan Volcano consists of many variations of mass in each depth grouped into andesite, breccia, basalt, andesite-basaltic, lava, breccia, and tuff.

1. Introduction

Indonesia is one of the countries that lie in the ring of fire. The location of Indonesia could be seen from the area and geographical position where tectonic plates subduct so that Indonesia has many active volcanoes [1]. Soputan Volcano is one of 129 active volcanoes in Indonesia. It is located in Sulawesi Utara Province, 50 kilometers to the southwest of Manado [2]. Soputan Volcano is grouped in type A volcano or stratovolcano and it is 1783.7 MSL [3]. Based on the historical record from *Pusat Vukanologi dan Mitigasi Bencana Geologi* (Volcanology Center and Mitigation for Geology Disaster), Soputan Volcano exploded for the first time was in 1833 and its longest period of the explosion was 47 years while its shortest period was 1 year. The eruption characteristic of Soputan was that within one period of eruption, several eruptions occurred for several weeks to months. Soputan erupted in 1908, 1913, 1923, 1982, and 1984, 2000, and 2008.

One of the efforts to understand the behavior of the Soputan Volcano is by researching the structure beneath its surface. One of the geophysics methods, the gravity method is used to map the subsurface condition. The gravity method is a passive method based on measurement density variation of rock layering. This method is applied to identify the layering of the earth's subsurface before continuing with other geophysics methods. Generally, regional research (wide and deep) uses this method. The subsurface identification requires a subsurface model. The modeling would assist in the image of the subsurface structure related to the research purpose. One of the efforts to understand the behavior of the Soputan Volcano is by researching the structure underneath its surface. Research to determine the location of Soputan magma increased applied seismic data from 2013 to 2014. The result of the research revealed that the hypocenter was spread around the crater at the top and tended to lean to the southwest in the depth of 100 m to 8000 m beneath the dome of lava (2). They have not been many pieces of research dealing with Soputan Volcano therefore, Soputan Volcano's inversion modeling was conducted using satellite data. Other volcanic interpretations use GGmPlus data or satellite data already done in many volcanos, i.e Lamongan, Semarang, Lawu, Ungaran, etc. The satellite data is useful to use that will produce preliminary features of volcanic areas [4-9].

The use of GGmPlus for Soputan Volcano inversion modeling was conducted by modeling the local and its region. GGmPlus and ERTM Data are gravity satellite data and the current elevation has a grid of 220 m. This data is produced from the mathematical model and the existing observation data [10]. In this research, the modeling would be conducted using complete Bouguer anomaly data brought to the flat surface using Phyton programming. This research aims to obtain density variation pictures horizontally and vertically using local Bouguer anomaly data.

2. Theory

2.1. Geological of Research Area

Soputan volcano is located in Province Sulawesi Utara, 50 km to the southwest of Manado. Soputan Volcano is located in District Minahasa Tenggara and it takes place in 1783.7 MSL.

Geographically, it is located in 01°06'30 North Latitude and 124°43' East Longitude. According to the Center Volcanology and Mitigation, the geomorphological condition of Soputan Volcano and its surrounding could be categorized into three morphology units: volcano body morphology unit, hilly morphology unit, and land morphology unit [11].

Stratigraphy conditions based on the Geology Map of Soputan Volcano could be seen in Figure 1, arranged by: Kalelondeilava flows (KI), Lava sediment (Lh), Maniporoklava flows (MPI), Rindenganlava flows (RI), Sempupyroclastic flows (SEa), Soputanpyroclastic debris (Sj), Soputan Lava Flows (SOI), Silianlava flows (SNI), Soputanpyroclastic debris (SOj), Temboanpyroclastic flow (Ta), Miosenvolcanic sediment (Tmv), Tondanovolcanic sediment (TOv), and Watukolokpyroclastic flows (Wa) [11].

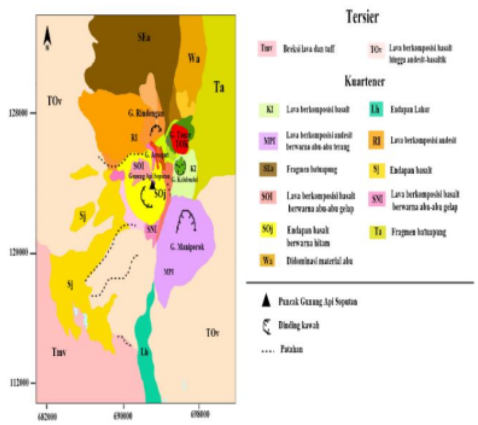

Fig.1: Geology Map of Soputan Volcano (Board of Geology)[8]

2.2. Basic Principle of Gravity Method

The basic principle of the gravity method is the law of the Newton gravity field. Newton's gravity field law explains about attracting force between 2 particles with mass and directly proportional with the result of mass and inversely proportional with the distance squared between both masses. An explanation about gravity field law could be seen in figure 2 [12].

Complete Bouguer Anomaly is the difference of observation result to its ideal model. The observation valueis the gravity field value obtained on the field, while its theoretical value is the mathematics value on the earth's homogeneous ellipsoid approach [21]. The difference from its ideal value is identified from the correction value produced. Correction value was obtained from the correction towards the latitude, topography, and the mass subsurface and around the observation point.

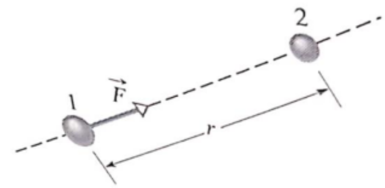

Fig.2: Attracting force between particle 1 and particle 2.

Mass is the main component of the gravity concept. Bouguer anomaly equation could be written as follows:

$$CBA = g\ obs - g\ teoritic \quad (1)$$

There is a simple Bouguer anomaly in the gravity method, also known as Free-Air Anomaly (FAA). Free Air Anomaly is an anomaly as the result of topography correction that has not accommodated the valueof subsurface mass density. Therefore, further correction is required to obtain a complete Bouguer anomaly valueas formulated by the following

$$CBA = FAA - BC + TC \quad (2)$$

CBA is Complete Bouguer Anomaly, BC is the Bouguer Correction and TC is Terrain Correction.

CBA value was the subsurface response presentation to identify the subsurface density distribution. Subsurface modeling could be done forwardly or inversely. Inversion modeling used mathematical calculation as the main process of modeling. The modeling that could be used consists of forwards modeling and inverse modeling, both in 2D and 3D. Forward modeling could be conducted using a trial-error technique that could be applied during the forward modeling to find the suitable response with the data on field or observation data. Inverse modeling could be said as the opposite of forwarding modeling since, in inverse modeling, the model parameter is obtained directly from the data [13-15]. Inverse modeling is one of the most common ways to identify subsurface density distribution. The objective of the inversion process was to estimate the physical parameter of sediment which was previously unknown [16].

The process of inversion modeling is to find model parameters resulting in a suitable response to the data observed, therefore, inverse modeling is frequently called data fitting. 3D models produced could be displayed as 2D or 3D [17-19]. Software Grablox combines two inversion methods: Singular Value Decomposition Inversion (SVD) and Occam Inversion processed at the same time [20]. Occam Method is a method to overcome non-linear issues using a linear approach. Occam Method is the result of the development of the Lavenberg-Marquardt method by adding a delta parameter for smoothing. The Occam equation could be seen in equation 3.

$$L = \begin{bmatrix} 0 & 0 & \\ -1 & 1 & \vdots \\ & \cdots -1 & 1 \end{bmatrix} \qquad (3)$$

Equation 3 could be used to calculate the model parameter on equations 4 and 5.

$$\hat{d} = d - g(m_n) + J_n m_n \qquad (4)$$

$$m_{n+1} = [J_n^T J_n + \alpha^2 L^T L]^{-1} J_n^T \hat{d} \qquad (5)$$

With d is data, m is model, g (m) is the result of data forward modeling, J is Jacobi matrix, α is smoothing factor, and L is order 1 Tikhonov regulation [17].

3. Methods

Data used in this research was secondary data in the form of satellite data GGMPlus consisted of longitude data, latitude data, and Free Air Anomaly data. The border of the research area was 682000 to 702000 E and 112000 to 132000 S. This data had 9500 observation points with the width of the research area of 20 km x 20 km. Elevation data used was ERTM data which was converted to elevation data for ellipsoid reference. The average density value used was 2.67 gr/cc. 2.67 gr/cc was the value used in GGmPlus mathematical calculation. The application used in this research was Ms. Excel 2013, Google Earth Pro, Ms. Visio 2013, Global Mapper 18, Oasis Montaj, Surfer 11, Phyton, Grablox, and Bloxer. Qualitative interpretation of complete Bouguer anomaly data was conducted in this research. The model of density value distribution uses the inversion model which is then sliced into a 2-dimensional surface (2D).

3. Results and Discussion

4.1. Complete Bouguer Anomaly

The result of data processing produced a complete Bouguer anomaly value mapped in figure 3.

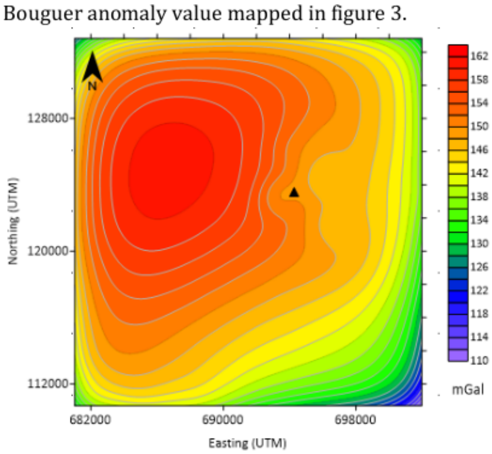

Fig. 3: Complete Bouguer Anomaly in Flat Surface.

Bouguer anomaly value in the flat surface was around 110 mGal to 162 mGal Bouguer anomaly value in the flat surface was around 110 mGal to 162 mGal. The distribution of the Bouguer anomaly value consisted of a high, medium, and low Bouguer anomaly score. The high Bouguer anomaly value stretched that its scope was quite wide in the north, west, and southwest parts of the research area. Medium Bouguer anomaly value distribution was signed by the color yellow to green. Low Bouguer anomaly value distribution has a tiny part of the scope since the color blue was only seen in the southeast part of the research location. Soputan Volcano area is located in a medium to high anomaly area. High anomaly area in volcanic areas is commonly a response of medium density sediments such as andesite-basaltic and high-density such basalt and basalt-based lava [2,6,8,19,21-22].

4.2. Quantitative Interpretation

The result of subsurface mass distribution modeling using software Grablox and Bloxer applied complete Bouguer anomaly data on a flat surface.

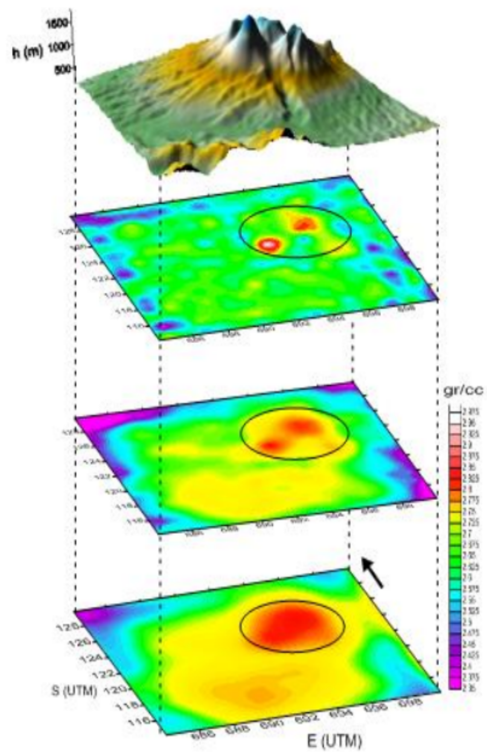

Fig. 4: Mass distribution on horizontal layer on depth 1000 m, 2000 m, and 3000 m.

The mass distribution model in the depth of 1000 m, 2000 m, and 3000 m produced 2.00 g/cc to 2.85 g/cc density as seen in Figure 4. The 3-dimensional model on the horizontal slice in 1000m depth produced the layer arranging the Soputan Volcano shown with color red yellow with the range of value 2.55 g/cm³ to 2.85 g/cm³ could be suspected as andesite sediment as the compiler. Andesite sediment has a density valueof 2.40 g/cm³ – 2.80 g/cm³. In 2000 m depth, the layers compiling Soputan Volcano are shown with the color yellow, green, and red with a range of valuefrom 2.49 g/cm3 to 2.9 g/cm3 was suspected as andesite and andesite-basaltic sediment. In 3000m depth, the layer compiling Soputan Volcano has the colors green-yellow and red. The color yellow red seems to be wider than in 2000 m depth. The compiling sediment in 3000 m is basalt sediment of Soputan Volcano. The distribution of sediment in the southern part was Tondano sediment formation. Tondano formation sediment consists of Tondano Volcanic sediment (Tov), pyroclastic Soputan debris (Sj), Silian lava flows (SNI) and Maniporok lava flows (MPI). Tondano volcanic sediment is the basic sediment of volcanism activity whose composition consists of basalt-composed lava, andesite, and basalt sediment. Andesite sediment has a density value of 2.40 g/cm³ to 2.80 g/cm³. Basalt sediment has a density value of 2.70 g/cm³ to 2.90 g/cm³. Basalt sediment with the color yellow to red starts to dominate at the depth of 2,000 m and lower. The peak area is dominated by lava sediment starting from 1,000 m and lower. Density is getting bigger as it goes deeper [2,6,8,19,21-23].

The result of modeling produced a relatively high density since the formation of its compiler sediment has a high density. Reviewing back on the contour of its Bouguer anomaly which was dominated by a high anomaly value then it could be seen the suitability between the density model and the gravity anomaly response. An object with high density would provide a bigger gravity field response than an object with low density. The response of sediment with higher density becomes more dominant than the sediment layer that becomes the compiler of the layer above it [23,24]. The width of the high-density area related to the volcanic activity had already been seen in the depth of 3000 m to the surface. The presence of a high-density zone is closely related to the presence of the crater of Maniporok and Kalelondoi.

4. Conclusion

The result of subsurface modeling of the complex area of Soputan Volcano with the density starts from 2.3 g/cm³ to 2.95 g/cm³. The result of such density value equals the geology information on the research area containing andesite sediment with the density range of 2.4 g/cm³ – 2.8 g/cm³, basalt sediment with the density range of 2.7 g/cm³ – 3.3 g/cm³, breccia sediment with the density range of 2.6 g/cm³ – 2.8 g/cm³, lava with the density range 2.8 g/cm³, and tuff with the density range 2,3 g/cm³ – 2.5 g/cm³. Grablox modeling result by marking with the density contrast from the density with a medium valueso that the density could have a lower score. Besides, the result of modeling could identify two craters of the volcano; Maniporok volcano, and Kalelondei. Based on the result, the layer compiling Soputan Volcano is andesite sediment, breccia sediment, basalt sediment, and andesite-basaltic

5. Conflict of Interest

The authors declare that they have no conflict of interest.

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