Identification Of Sediment Thickness Using The Geomagnet Method in Beleka and Dasan Tapen Villages, Gerung District, West Lombok Regency

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Abstract: Gerung is one of the sub-districts in West Lombok Regency. Based on data from BNPB the Gerung sub-district area is an area that is vulnerable to the natural phenomenon of earthquakes, because the soil in this area has a softer texture so that when vibrations occur, the vibrations will be stronger. Geologically, this alluvium formation is very vulnerable to the natural phenomenon of earthquakes because it is related to the thickness of the sediment. This research aims to determine the thickness of sedimentary rocks in the Gerung District. One of the Geophysical Methods used in this research is the Geomagnetic Method. Based on the 2-Dimensional modeling of the AA' - FF' Incision, it consists of five rock layers, namely the first layer includes Silt Rock, the second layer includes Sand Rock, the third layer includes Clay, the fourth layer includes Breccia Rock and the fifth layer includes Lava Rock. The composition of the five rock layers, layers including sedimentary rock is found in the first layer to the fourth layer. The results of the research for sediment thickness from the six incisions ranged from 405 m – 485 m. Based on the results of this research, it can be concluded that Beleka Village and Dasan Tapen Village it is composed of five rock layers with a dominant sediment thickness of 485 m, namely at the AA' incision in the western part of Beleka Village.

Keywords: Earthquake; Sediment Thickness; Geomagnetic Method; Anomaly Value; Lithological Structure and Susceptibility

Introduction

Lombok Island is one of the areas prone to natural phenomena of earthquakes. Lombok Island is flanked by the subduction of the Australian Plate in the south and the Australian Flores fault in the north. The Flores fault extends from the west-east north of Bali Island to the north of the island in Nusa Tenggara. As a result of the pressure exerted by the subduction of the Australian Plate south of Lombok Island, the long-established Flores fault reactivated, which is a sudden re-movement that resulted in devastating shocks on Lombok Island in August 2018. Administratively,

Lombok Island consists of five regencies or cities, namely, East Lombok, Central Lombok, North Lombok, West Lombok, and Mataram City. Based on the geological map (Mangga, 1994), the region in West Lombok and Mataram City consists of the Aluvium Formation This research was conducted in one of the sub-districts in West Lombok Regency, namely Gerung Sub-district with the more dominant alluvium formation.

Geologically, this alluvium formation is very vulnerable to the natural phenomenon of earthquakes because it is related to sediments which consist of two

parameters, namely the type of sediment and the thickness of the sediment. Therefore, to determine the level of earthquake vulnerability in an area, it is necessary to conduct research related to sediment thickness. Sediment thickness is one of the factors that cause local site effects during earthquakes. Sediment thickness is a part that needs to be considered in determining the location of development because it will affect the durability and safety of the building later. Sediment thickness is important to study because it is related to earthquake shaking. If the sediment layer is thick, there will be the repetition of waves, so later the waves will be reflected repeatedly from top to bottom so that in that area the earthquake will be felt longer or called multireflection or repeated reflection.

Based on this description, a study can be conducted that aims to determine the thickness of sediments in the Gerung District area using the geomagnetic method. Therefore, the title proposed in this research is Identification of Sediment Thickness Using Geomagnetic Method in Beleka Village and Dasan Tapen Village, Gerung District, West Lombok Regency. The purpose of this study is to determine the constituent rocks and the thickness of the sedimentary layer in Gerung District, West Lombok Regency using the geomagnet method.

Method

Research conducted to identify the thickness of sediments was conducted in Beleka Village and Dasan Tapen Village, Gerung District, West Lombok Regency. The tools used in this study are a set of PPM (Proton Precession Magnetometer) units of the GEM - 197 v7.0 type used to measure the total magnetic field value of the earth, a GPS (Global Positioning System) to determine the position (longitude and latitude), elevation and measurement location points, a laptop used to process data, and there are stationery used to record the measurement results. In this study, measurements were made at 156 points with a space of 100 meters at the research location. The stages carried out in this study are for the first stage carried out is a literature study, location survey and tool preparation. Furthermore, for the second stage, data acquisition was carried out at the research location. This data acquisition was carried out from July 8, 2023 - July 9, 2023. Then the third stage carried out in this study is data processing. The data processing carried out is daily correction, IGRF correction, reduction to the pole and upward continuation which is done to separate regional anomalies from residuals. The next stage is data interpretation where at this stage it is carried out after obtaining the results.

Result and Discussion

Based on the research conducted, geomagnetic data was obtained in Gerung District, West Lombok Regency. Geomagnetic data is processed to obtain measurement results obtained from field magnetic field values and position data (UTM X, UTM Y). After initial data processing, the results will obtain the total magnetic anomaly value, reduction to the pole, regional anomaly, and residual anomaly in Oasis Montaj 6.4.2. as follows:

1. Total Magnetic Anomaly Value

This total magnetic field anomaly is obtained from data processing on daily correction and IGRF correction that has been done before. The corrected data is then displayed in the form of a magnetic anomaly contour map. The Total Magnetic Field Anomaly Map in Figure 1 is an anomaly resulting from a combination of Residual Anomaly and Regional Anomaly. Based on Figure 1, there are colors on the contour map which are the values of the magnetic field anomalies.
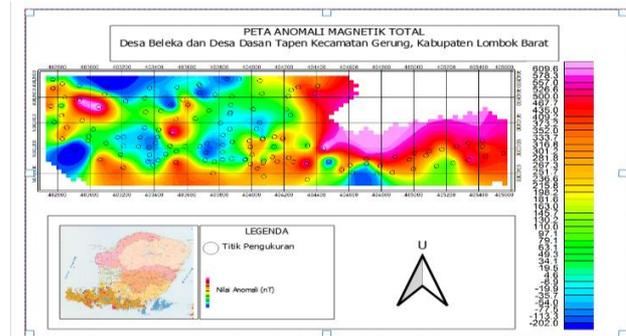

Figure 1. Map Total Magnetic Anomaly Value

2. Reduction to Poles

Reduction to the poles is done to localize areas with maximum or minimum intensity directly above the object causing the anomaly. Reduction to the Pole is done by changing the parameters of the earth's magnetic field value in the research area to conditions at the pole, namely by transforming the appearance of the dipole into a monopole. After reduction to the pole, the magnetic anomaly value on the contour becomes larger, for more details can be seen in Figure 2 below.
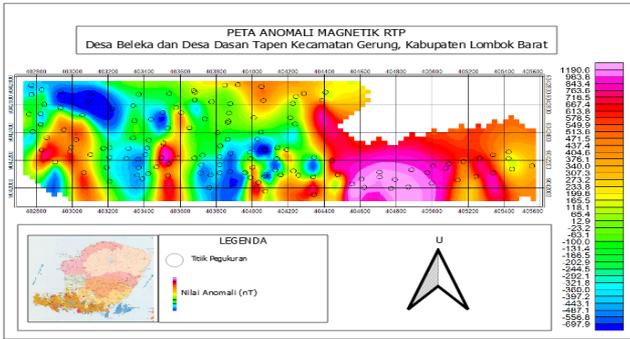
Figure 2. Map of Magnetic Anomalies Reduced to Poles
Based on Figure 5.3, it can be seen that the magnetic anomaly value is larger after the reduction to the poles.

3. Upward Continuation

Upward Continuation is a process that aims to separate magnetic anomalies. In the upward continuation process, a regional magnetic anomaly will be generated, where the regional anomaly value will be used to obtain the residual anomaly value which is the target of the research survey. Based on the research location, after the upward continuation is carried out with several heights that have been tried the results of the contour look constant at an altitude of 500m. The contour map of the upward continuation can be seen in Figure 3 below
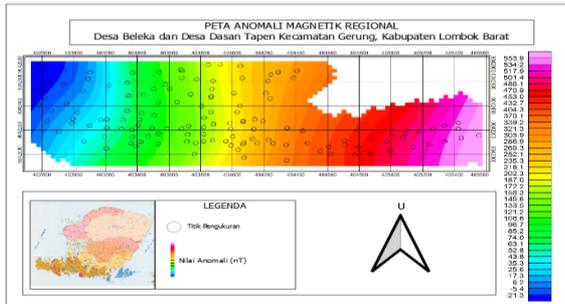

Figure 3. Regional Magnetic Anomaly Map

After obtaining the regional magnetic anomaly, it is necessary to find the residual anomaly value. Residual anomalies are the effect or response of shallow magnetic anomalies. The residual magnetic anomaly is obtained from the subtraction between the total magnetic anomaly and the regional magnetic anomaly. The residual magnetic anomaly is used as the basis for modeling, for more details the residual magnetic anomaly map can be seen in Figure 4 below.
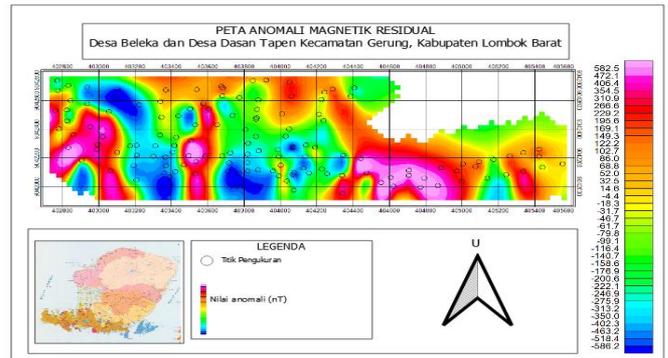

Figure 4. Residual Magnetic Anomaly Map

4. Magnetic Anomaly Modeling

After performing several data processing processes, modeling is then carried out to obtain results following the objectives of the study. Modeling is done by making incisions in several specific lines following the objectives of the study. The incisions are used to clarify the subsurface lithology. In this study, there are 6 incisions, namely AA', BB', CC', DD', EE' and FF' as shown in Figures 5 and 6.
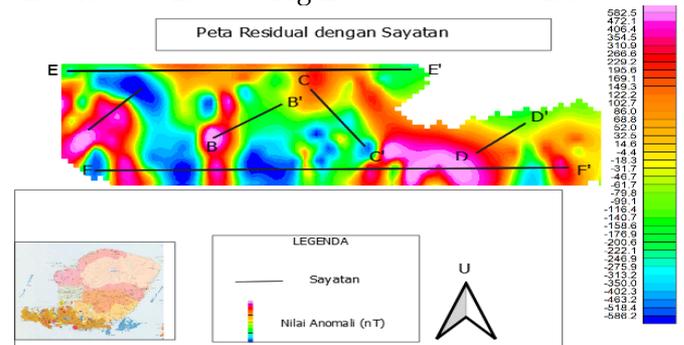

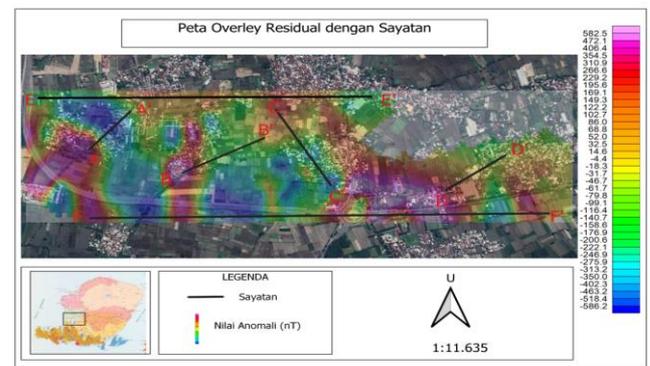Figure 5. Modeling Incision on Residual Map

Figure 6. Residual Overlay Map with Incision

In 2D modeling, it is done by trial and error method, by changing model parameters such as susceptibility value, length, and depth in 2D model. Here are some 2D models with a depth of 500 m.
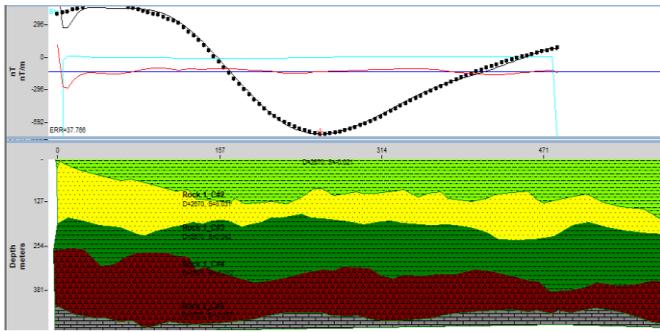
Figure 7. Pemodelan 2D pada Sayatan AA'

Based on the modeling in Figure 6, it can be seen that the modeling consists of five layers. The first layer has a susceptibility value of 0.021 (SI), the layer is estimated to include siltstone at a depth of 0 m - 179 m. The second layer has a susceptibility value of 0.031 (SI), estimated to include Sandstone at a depth of 11m - 234m. Then the third layer has a susceptibility value of 0.042 (SI), estimated to be included in Clay Rocks at a depth of 157 m - 380 m. The fourth layer in the modeling has a susceptibility value of 0.052 (SI) which is estimated to include Breccia Rock with a depth of 290 m - 485 m and the last in the fifth layer has a susceptibility value of 0.077 (SI) which is estimated to include igneous rocks, namely Lava rock at a depth of 424 m - 500 m. The modeling in Figure 6 is a susceptibility value of 0.077 (SI) which is estimated to include igneous rocks at a depth of 424 m - 500 m . The modeling in Figure 6 is modeling for incision AA', then for the susceptibility value and depth for modeling on incision BB' - FF' can be seen in Table 1 below.

Table 1. Susceptibility Values of Rocks in the Research Area

Sayatan	Suseptibilitas (SI)	Litologi batuan	Kedalaman (m)
AA'	0,021	Silt	0 – 179
	0,031	Sandstone	11 – 234
	0,042	Clay	157-380
	0,052	Breksi	290-485
	0,077	Lava	424-500
BB'	0,003	Silt	0 – 84
	0,029	Sandstone	20 – 225
	0,049	Clay	
	0,060	Breksi	235 – 405
	0,070	Lava	337 – 500
CC'	0,001	Silt	0 – 151
	0,032	Sandstone	7 – 224
	0,045	Clay	164 – 366
	0,055	Breksi	283 – 464
	0,081	Lava	338 – 500
DD'	0,001	Silt	0 – 131
	0,032	Sandstone	93 – 209
	0,047	Clay	191 – 370
	0,073	Breksi	302 – 444
	0,084	Lava	372 – 500
EE'	0,020	Silt	0 – 151
	0,035	Sandstone	42 – 284
	0,045	Clay	182 – 340
	0,055	Breksi	282 – 417
	0,074	Lava	364 – 500
FF'	0,022	Silt	0 - 128
	0,034	Sandstone	34 - 242
	0,057	Clay	118 - 362
	0,076	Breksi	252 - 465
	0,096	Lava	336 - 500

Based on Table 1, it can be seen that rocks that include sediments are in the first layer to the fourth layer, namely siltstone, sandstone, clay and breccia rock. As for the fifth layer, it does not include sedimentary rocks because these rocks include igneous rocks. From Incision AA' to Incision FF'have different depths, so the thickness of each incision has a different thickness. The thickness of the sediments in the incisions can be seen in Table 2 below

Table 2. Sediment thickness at the incision at the research location

Sayatan	Sedimentary Rock	Thickness Layer	
AA'	Silt	0 – 179	
	Sandstone	11 – 234	
	Clay	157 – 380	485
	Breksi	290 - 485	
BB'	Silt	0 – 84	
	Sandstone	20 – 225	
	Clay	137 – 271	405
	Breksi	235 - 405	
CC'	Silt	0 – 151	
	Sandstone	7 – 224	
	Clay	164 – 366	464
	Breksi	283 - 464	
DD'	Silt	0 – 131	
	Sandstone	93 – 209	
	Clay	191 – 370	444
	Breksi	302 - 444	
EE'	Silt	0 – 151	
	Sandstone	42 – 283	
	Clay	182 – 340	417
	Breksi	282 - 417	
FF'	Silt	0 – 128	

Sandstone	34 – 242	
Clay	118 – 362	465
Breksi	252 - 465	

Based on table 2, it can be seen that the thickness of sediment in the research location is different. The smallest sediment thickness is in the area with the BB 'incision of 405 m, then for the medium-value sediment thickness is in the area with the FF 'incision with a sediment thickness of 465 m, and for the largest sediment thickness is in the area with the AA 'incision amounting to 485 m.

Conclusion

Based on the in terpretation results obtained, it can be concluded that the results of 2D modeling at the research location there are five types of constituent rock layers, namely, siltstone, sandstone, clay, breccia rock and lava rock. Then for the thickness of sediments at the research location in the AA 'incision to FF' incision has a sediment thickness that ranges from 405 m - 485 m. Of the six modeling on each incision, the incision that has a very large thickness is in the western part of Beleka Village with incision AA'.

Acknowledgments

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