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Identification Study Volume Coal by Inversion Modelling 3D Gravity at Sanggau, West Borneo

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Abstract. Inversion modelling 3D gravity has been applied to identify volume of the coal. Inversion modelling 3D gravity used inversion *singular value decomposition* (SVD) and inversion Occam on Bouguer Anomaly. Volume is measured by software Voxler. The Result from inversion of model 3D can show coal layer with density 1.32 g/cm^3 on Low Land Ketungau at West Side of the map. The volume of coal at Sanggau Map is predicted to be $37.425.694,24 \text{ m}^3$. The Research can be used as preliminary model for geophysics.

1. Introduction

Coal is an important energy resource and a very economical trading commodity. Based on the latest data from the Geological Agency of the Ministry of Energy and Mineral Resources (ESDM), Indonesia's coal reserves reached 26.2 billion tons. Kalimantan is listed as the region that holds the largest coal reserves, namely 14.9 billion tons, followed by Sumatra (11.2 billion), and Sulawesi (0.12 million). In the Kalimantan region, the largest reserves are in East Kalimantan by 7.5 billion tons, South Kalimantan by 4.2 billion tons and Central Kalimantan 2.1 billion tons. Meanwhile, South Sumatra is the region that has the largest reserves in the Sumatra region with reserves of 8.9 billion tons, followed by Jambi at 1.1 billion tons.

Gravity method is a geophysical method that can model subsurface structures. 3D inversion technique is carried out to model the density of subsurface sections because the gravity method has ambiguity properties so that 3D inversion can reduce the ambiguity properties in the distribution of rock density variations. Determination of the volume of a rock has a very important role so that the results obtained from 3D inversion can be predicted for rock volume using Voxler software. This study aims to identify the volume of coal using 3D inversion modeling.

2. Methodology

This study uses gravity survey data that was carried out in 1993 for the Sanggau Sheet area, Kalimantan [1]. Geological Map of Sanggau area is shown in Figure 1. In general, the main struktur of Sanggau area is West – Northwest inline with regional struktur which dominan at west and central Kalimantan that form a prism that is made from greywacke Late Cretaceous - Early Tertiary in the North and Schwaner Batolite in Early Cretaceous - Late Cretaceous in the South. Among these two rock bodies are Melawi Basin and Ketungau which are Tertiary and separated by the Pre-Tertiary Semitau Ridge.



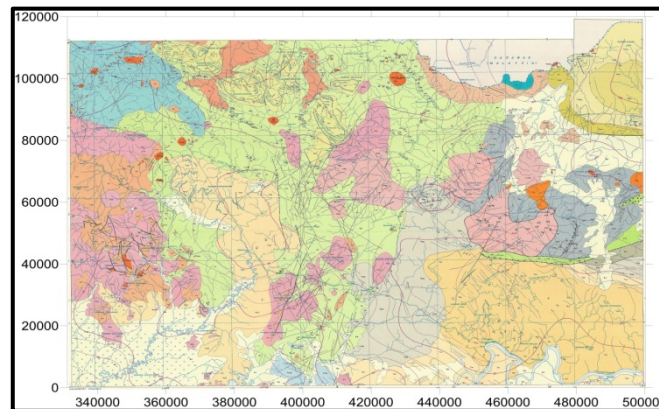


Figure 1. Geological Map of Sanggau area (Supriatna S, etc. 1993)

The research area is located in the northwestern part of West Kalimantan Province, precisely between the equator $01^{\circ}00'$ L.U. and $109.30'$ - $111.00'$ B.T.

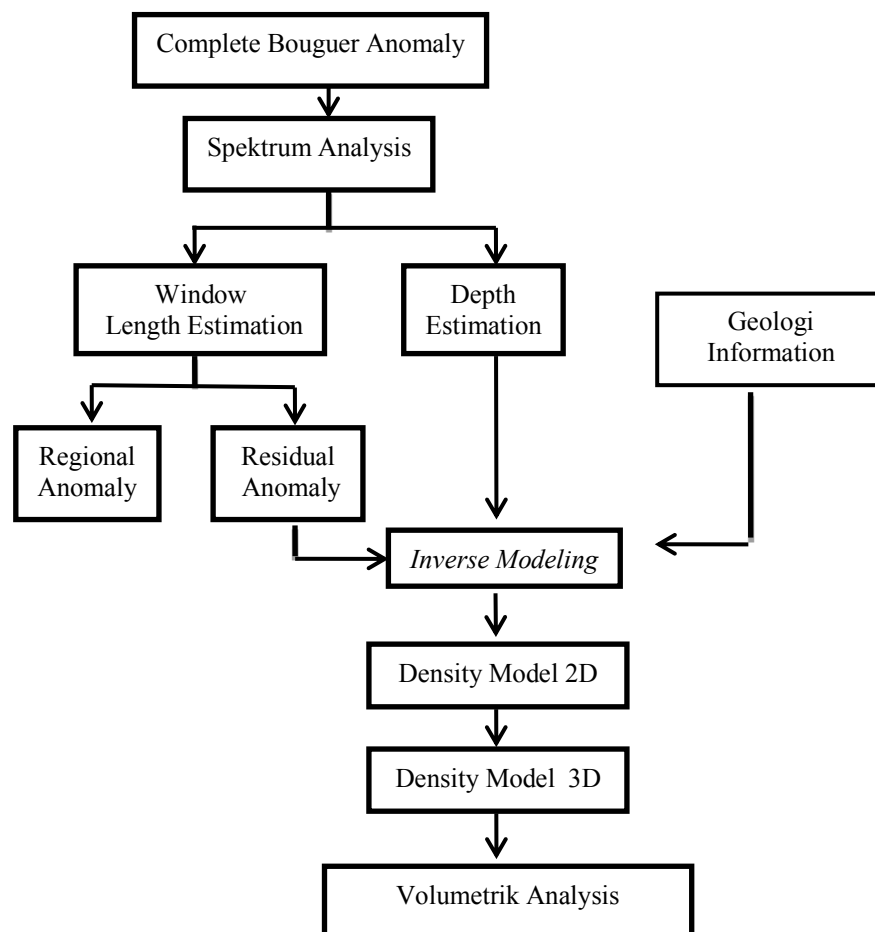


Figure 2. Research Flow Chart

The Research Flow chart is presented in figure 2. Data processing separates bouguer anomalies into residual anomalies and regional anomalies using moving average separation techniques and spectrum analysis. Backward modeling techniques (inverse modeling) are used to interpretation

The gravity data obtained is 317 data with an area of 170 km x 105 km is shown in Figure 3.

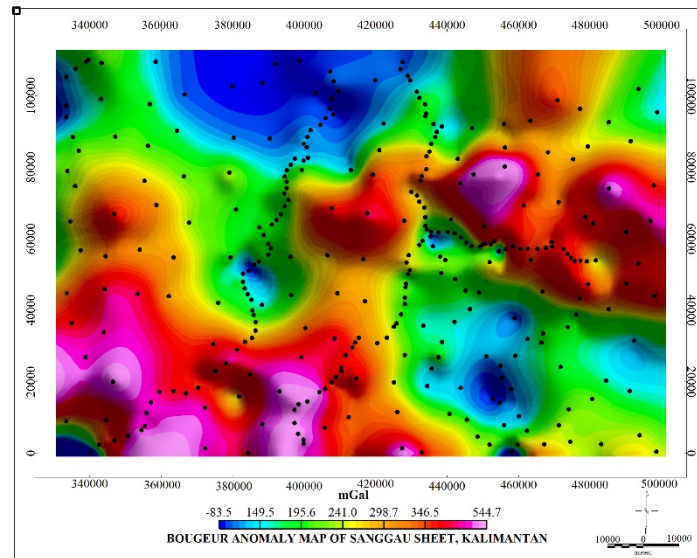


Figure 3. The pattern of bouguer anomalies and the gravity survey point of the Sanggau Sheet, West Borneo

2D density model is obtained from the result of inversion of residual anomaly map by filter with moving average. The inversion process of residual anomaly maps is done using Grablox 16 software with a density value of bouguer is 2.67 g/cm^3 and the parameter range is between $2 - 4 \text{ g/cm}^3$. The inversion results obtained have RMS data is 0.0438462, the RMS model is 0.0438462, and Lagrange is 1. From the results of the inversion the residual anomaly map is obtained to a depth of $<3 \text{ km}$. 2D density models can represent rock density in Sanggau Sheet which is correlated with rock types based on geological maps. The results of inversion are as follows

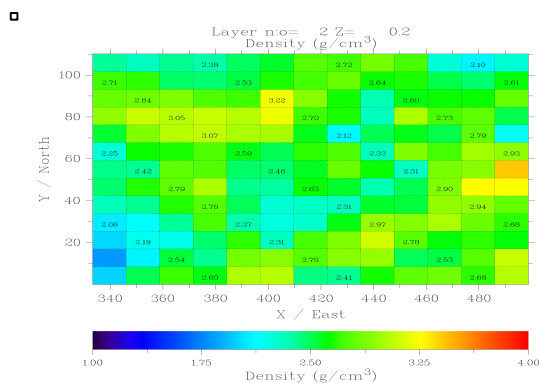


Figure 4. Subsurface when $Z = 0.2 \text{ km}$

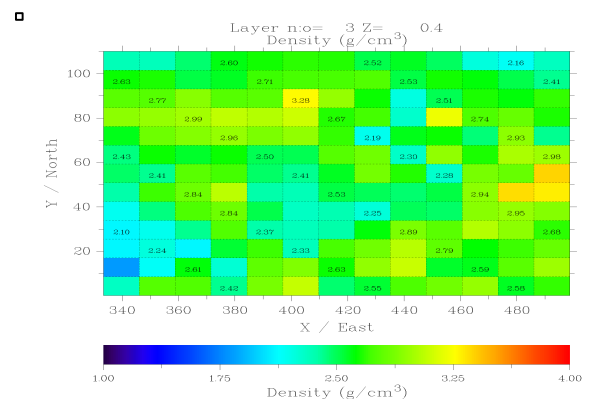


Figure 5. Subsurface when $Z = 0.4 \text{ km}$

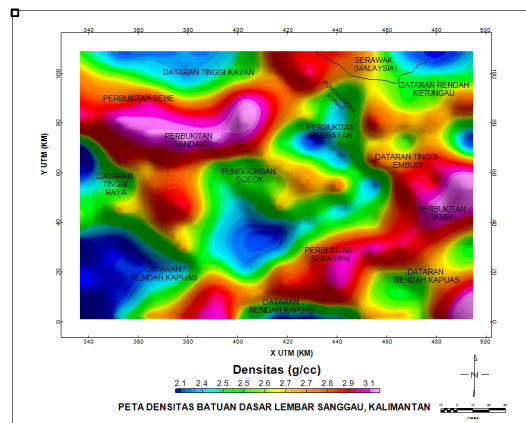


Figure 6. Basement density map of Sanggau Sheet, Kalimantan

Based on the density map on bedrock (Figure 6) it is classified as having 3 density zones, namely zones with low density zones, mid density zones and high density zones. Low density zones that have values between 1.3 - 2.76 g/cm³ which are marked with dark blue to yellow are predicted as sandstones in the Kayan Plateau, Greater Highlands, Kapuas Lowlands, Punggungan Sosok, Kembayan Hills, and Ketungau Lowlands. Medium density zones that have a range of values between 2.50 - 2.81 g/cm³ which are marked with light green to yellow are predicted to be granite in the Behe Hills, Porcupine Hills, Sekayam Hills, Sarawak (Malaysia), Jambu Hills and Emboi's High Hills. High density zones which have a range of values between 2.7 - 3.3 g/cm³ which are marked in yellow until purple is predicted as basal in the Sekayam Hills, Guava Hills, Hedgehog Hills, and Behe Hills [2].

The 3D inversion research method uses singular value decomposition (SVD) inversion technique and Occam inversion with input data in the form of Bouguer anomaly map. Estimation of the depth of the 3D model is obtained from the results of spectrum analysis in the form of the depth of regional anomalies [3]. The inversion process for Bouguer anomalies was carried out using Grablox 1.6 [4] software with a Bouguer density value of 2.67 g/cm^3 and a range of parameters between $1\text{--}4 \text{ g/cm}^3$. The inversion process is carried out with several optimization stages namely basic optimization (Base), density (density), Occam density (Occam-d), height of block (Heights) and Occam block height (Occam-h). The inversion technique uses Grablox 1.6 software then to model 3D using Voxler software.

3. Result and Discussion

The inversion results obtained have an RMS of 0.063 and the RMS model is 0.020 and Lagrange is 1. The inversion results in the form of a 2D density cross section at each depth and then combined into a 3D model using Voxler software. From the inversion results, bougeur anomalies map was obtained to a depth of <30,831 km. 3D density models can represent rock densities in the Sanggau Sheet which is correlated with rock types based on geological maps. 3D inversion result is shown in Figure 7.

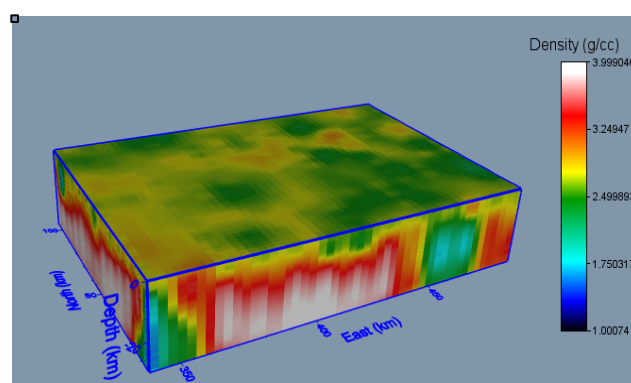


Figure 7. 3D inversion model results of the Sanggau Sheet gravity method, West Borneo

The volume of coal can be seen from the parameter density 1.2-1.5 g/cm³ by evenly flattening it to 1.32 g/cm³ [4]. The volume of coal can be determined using the Voxler software shown in Figure 8.

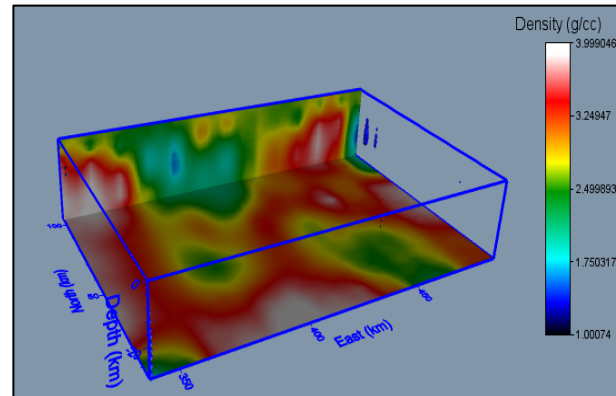


Figure 8. Coal volumetric 3D model

Coal density has a range between 1.2-1.5 g/cm³ indicated by the colour of blue. However, for the determination of the volume of sandstone with evenly distributed descent, it was obtained 1.32 g/cm³. The volume of coal with density is 1.32 g/cm³, it is estimated that 37.425.694,24 m³ is predicted to be in the Lowland Ketungau.

4. Conclusions

Inversion modelling 3D gravity used inversion *singular value decomposition* (SVD) and inversion Occam on Bouguer Anomaly. Volume is measured by software Voxler. The Result from inversion of model 3D can show coal layer with density 1.32 g/cm³ on Low Land Ketungau. The volume of coal at Sanggau Map is predicted to be 37.425.694,24 m³. The Research can be used as preliminary model for geophysics.

References

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