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Research Article

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Modeling the Manyas-Turkey Depression Area with the Dykes Approach

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Abstract Calculation of structure parameters is an important issue when modeling potential anomaly maps in geophysics. It is desired to model the underground geological structure by calculating parameters such as the upper depth, lower depth and width of the geological structure that causes the underground anomaly from the sections taken from the potential source anomaly maps. In this study, valley-shaped structures can be modeled by calculating the gravity value of many dyke-shaped structures on the earth. In this proposed system, we can find the structure depth accurately. The depression area of the Manyas region, located in the northwest of Turkey, was chosen as the study area.

Keywords Dyke structures, Gravity anomaly, modelling, Manyas region,

1. Introduction

In the solution of geophysical problems, it is an important issue to determine the parameters of the structures that cause the anomalies in the underground and to model them. The most important issue in geophysical modeling is to determine the dimensions of the geological structure. It is necessary to determine the depth of the upper surface, the depth of the lower surface, and the dimensions of the structure of the geological structures that create geophysical anomalies. We consider this as modeling the geological structure. It has played an important role in modeling structures with various shapes [1]. In the Talwani method, the corners of the disturbing masses were changed by least squares [2]. Determined the underground density distribution using the iteration inversion technique [3]. They modeled the structures using the Forced Neural Network method in modeling the geological structures from the gravity anomaly maps [4 and 5]. They modeled underground geological structures from gravity anomalies of two-dimensional arbitrary structures [6, 7, 8]. It has introduced a rapid method for the interpretation of gravity anomalies of buried valley-shaped structures underground [9]. They made an inversion approach on the gravity profile using Backus-Gilbert inversion techniques [10]. They used singular value separation (SDV) to solve the problems in Gravity and Seismic methods [11]. They used the Fourier Transform method to calculate the density distribution in the gravity method [12]. They modeled two-dimensional geological structures using the Genetic Algorithm method [13].

n this study, the gravity anomaly map made by the Mineral Research and Exploration (MTA) institution in the Manyas depression area in the North West Anatolian region of Turkey was used. The geological structure in the Manyas depression region was modeled using the gravity anomaly of the vertical dyke.

By taking advantage of the gravity anomalies of covered buried valley-shaped geological structures, the depths of the dykes are calculated one by one and the geological structure is modeled.

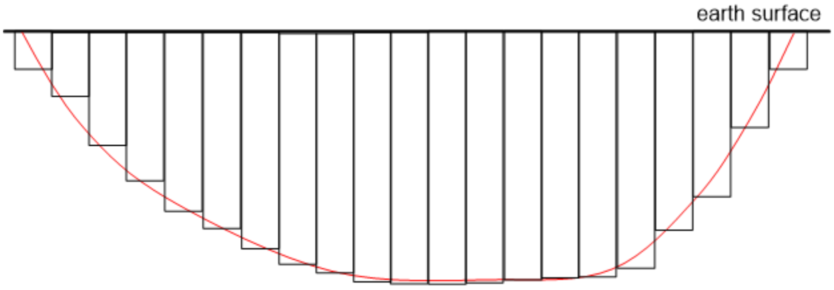

Figure 1: Representation of a buried valley as thin dykes

The density contrast of the geological structure can be approximately estimated. The structure can be modeled by combining valley-shaped structures with vertical dyke structures. The formula given here for dyke-shaped structures is taken from [14].

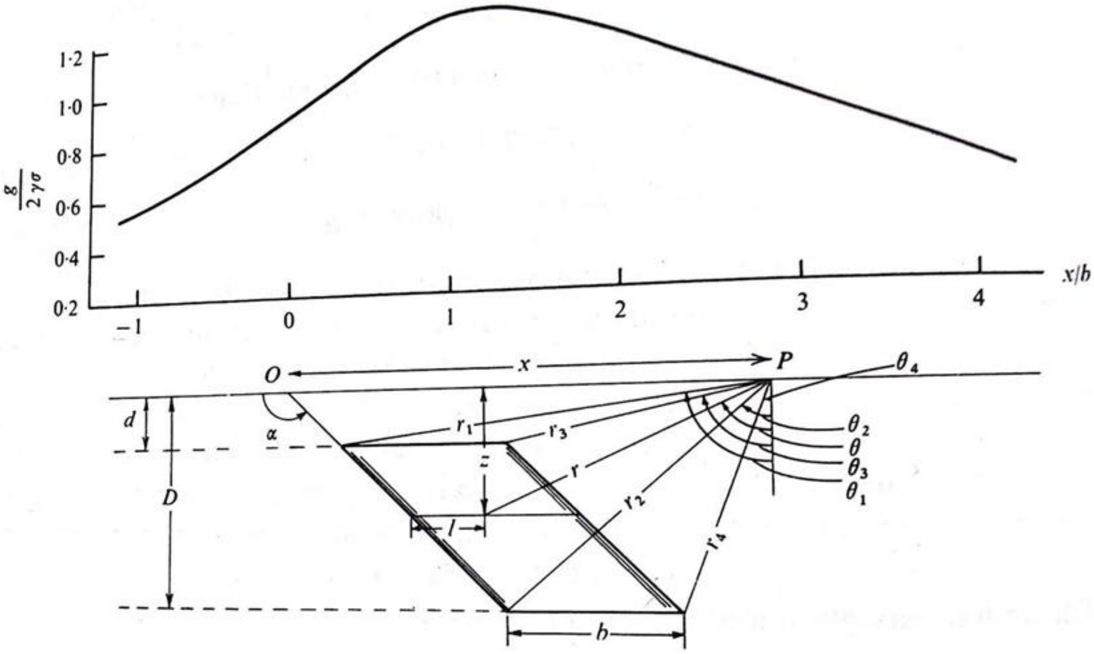

Figure 2: Gravity effect of a thick prism of infinite strike length [14].

If the prism outcrops, d=0

$$g = 2\gamma\sigma\left[\frac{x}{2}sin^2\alpha.\,log\left\{\frac{x-b^2}{x^2}\frac{D^2+\left(x+Dcot\alpha\right)^2}{D^2+\left(x-b+Dcot\alpha\right)^2}\right\}+\frac{b}{2}sin^2\alpha.\,log\left\{\frac{D^2+(x-b+Dcot\alpha)^2}{x-b^2}\right\}-xsin\alpha cos\alpha\left\{tan^{-1}\left(\frac{x-b}{D}+cot\alpha\right)-tan^{-1}\left(\frac{x}{D}+cot\alpha\right)\right\}-bsin\alpha\ cos\alpha\left\{\frac{\pi}{2}-tan^{-1}\left(\frac{x-b}{D}+cot\alpha\right)\right\}-D\left\{tan^{-1}\left(\frac{x-b}{D}+cot\alpha\right)-tan^{-1}\left(\frac{x}{D}\right)+cot\alpha\right\}\right].$$

İf $\alpha=90^0$, this is further simplified to:

$$g = 2\gamma\sigma\left[\frac{x}{2}log\left\{\frac{(x-b)^2}{x^2}\frac{D^2+x^2}{D^2+x-b^2}\right\}+\frac{b}{2}log\left\{\frac{D^2+(x-b)^2}{(x-b)^2}\right\}-D\left\{tan^{-1}\left(\frac{x-b}{D}\right)-tan^{-1}\left(\frac{x}{D}\right)\right\}\right]$$

Geology of Manyas Lake Area

Geomorphology: Manyas lake is in the north of Manyas town and 10 mt altitude of sea level. It is 12 km width and 18 km length, about 200 squared km area. It is very shallow and the water tastes very soft. The base and around is composed of neogen lime-stones, n
eogen and pre-neogen hills form an interesting topology [15].

Geology: Manyas Lake is generally surrounded by neogen limestones and alluvions layers. In recent years, there occurred metamorphic shiest and marvels related to Paleozoic period. Jura and upper cretasine lime-stones are also observed [15].

Techtonic : Manyas Region takes place at Gönen–Bursa depressions (Figure 3). This structure is surrounded by West Anatolian in the south and by Mudanya mountains on the north neogen region. Many faults is formed around the lake and they are related to north Anatolian fault system. Marmara is formed at the Pliocene period but Manyas is younger and assumed to be formed at Quaternary [15].

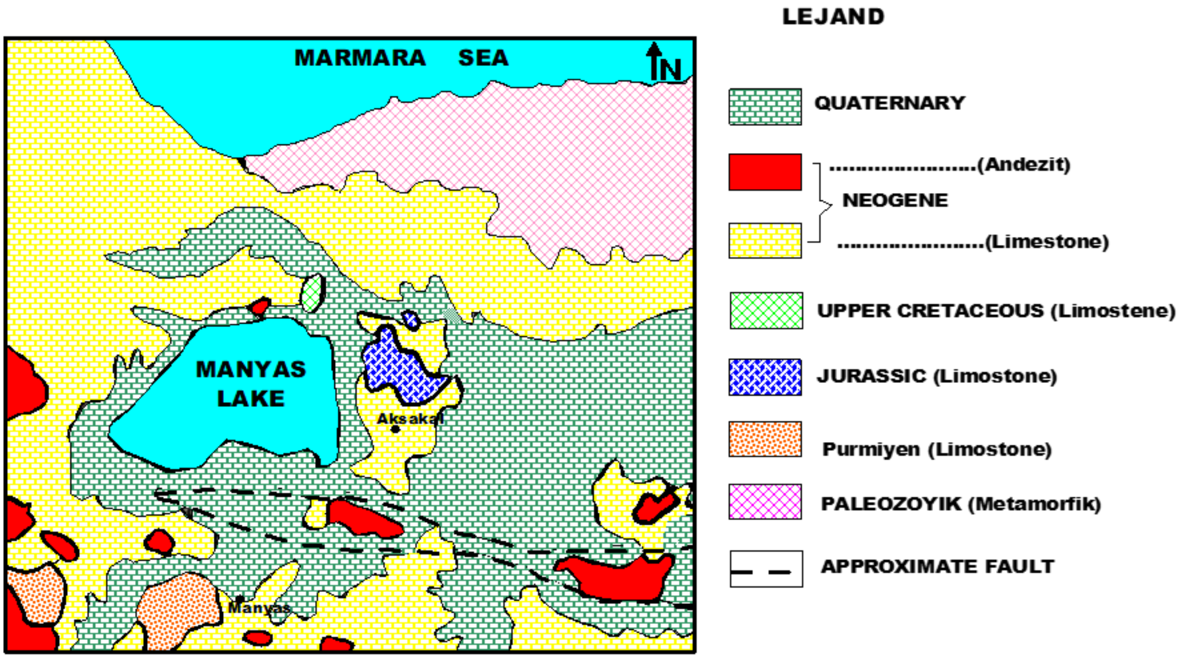

Figure 3: Geology map of manyas regional (MTA).

Gravity anomaly map of Manyas depression area

Negative anomaly closure observed on the Bouguer anomaly map (Figure 4) of the Manyas depression area determines the location of the mentioned depression on the southern shore of the lake. The contour formed with the lowest gravity value also reflects the deepest part of the depression. The closure of the gravity anomaly contours in the south of the lake indicates that the depression may have a bowl-shaped sediment-filled structure. A residual anomaly map was obtained from the Bouguer anomaly map (Figure 5). On the residual anomaly map, only the negative anomaly value limited to the zero contour is drawn. It was determined in the south of the lake of the Manyas depression area. The increase in gravity towards north and south shows large values. The area where the anomaly is located has a topography close to the lake level. When the anomaly increases in the north and south are examined, it is clearly seen that they are in the form of typical fault anomalies [16].

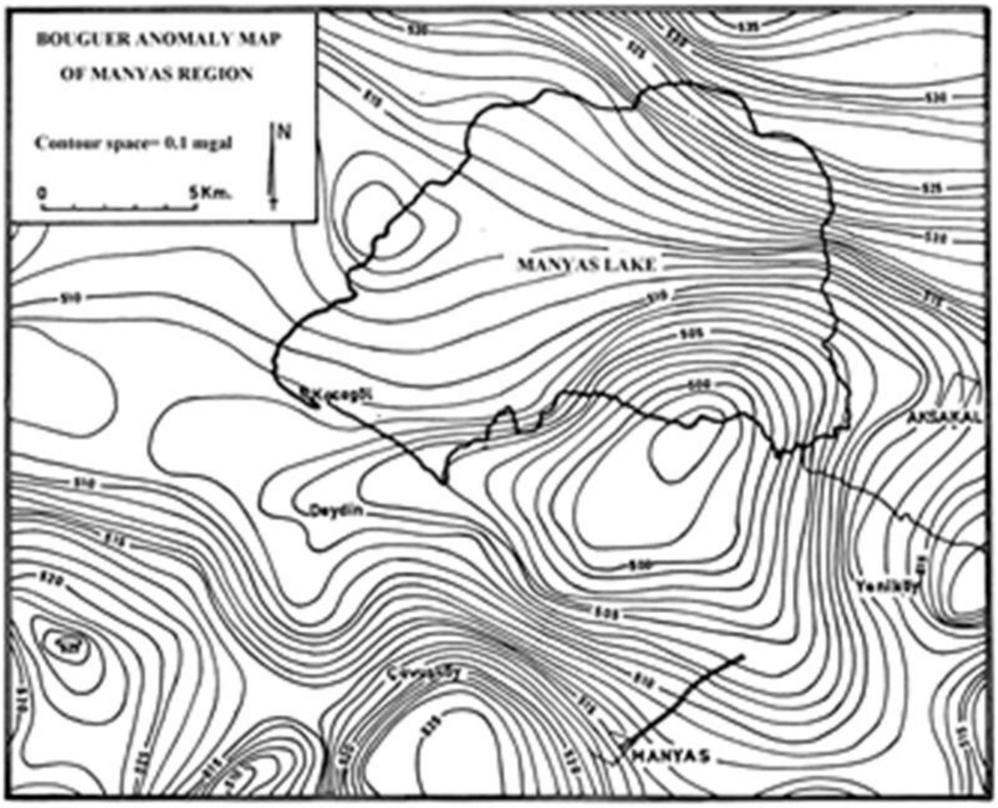

Figure 4: Bouguer anomaly map of Manyas region (MTA).

When the residual anomaly map is examined, it is seen that the anomaly closure depression in the south of the lake has a bowl-shaped structure. AB section was taken from the residual anomaly map. Obtained anomaly section is given in figure 6.

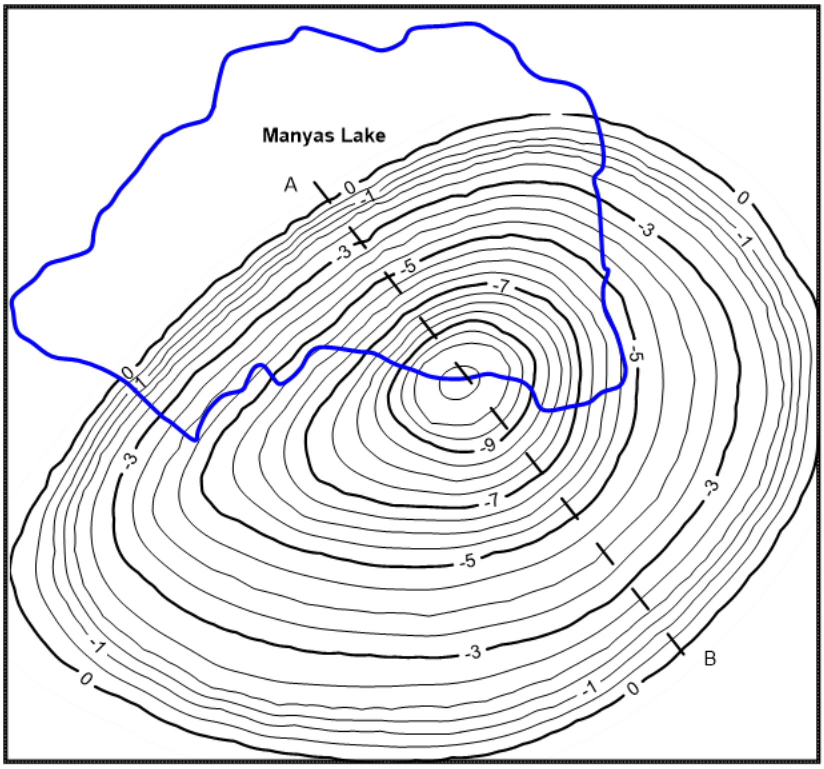

Figure 5: Regional anomaly map of Manyas region

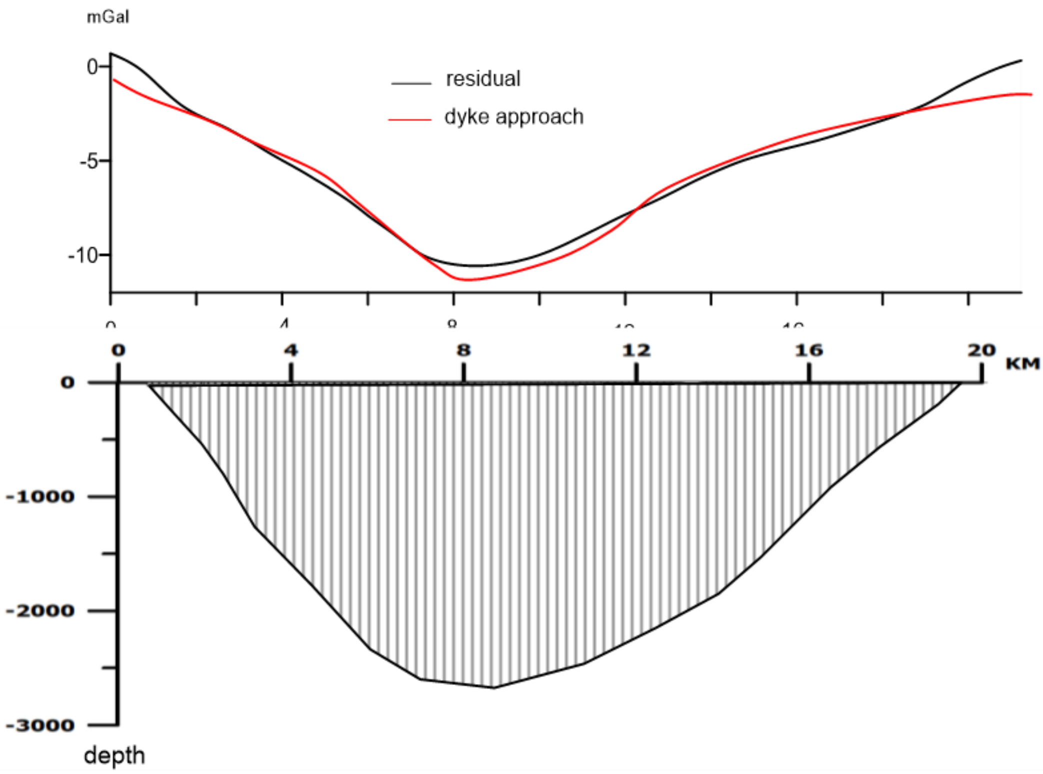

Figure 6: Model structure obtained using the dyke approach method with the AB section taken from the Manyas depression area obtained from the residual anomaly map.

In evaluating gravity anomaly data in geophysical studies, it is important to calculate gravity anomalies created by geological structures with models. If there is no homogeneous density and the shape of the structure forming the anomaly cannot be determined geometrically, it may be more difficult to reach the model structure from gravity anomalies. For this reason, while gravity anomalies are analyzed with mathematical models during calculations, geological models are assumed to have constant density until today. In gravity studies, when modeling valley-shaped structures, dyke slices can be represented by coming together. Here, by thinning the thickness of the dyke slices and increasing their number, a more precise calculation of buried valley-shaped geological structures will be achieved. In studies using the dyke method, the density must be chosen very carefully. The zero line in the anomaly must be determined well. It is necessary to distinguish regional and residual anomalies very well from Bouguer anomaly maps. In this study, it is assumed that one of the possible faults located in the south of the lake and another fault passing in the north affect the formation of the valley. It has been estimated that a depression of approximately 2700 meters has formed between these two faults.

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