

# Estimation of Curie point depths of the Moesian platform using geomagnetic data interpretation

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## Introduction

One of the interesting geophysical boundaries within the Earth's lithosphere is the surface which separates magnetically active part of the earth crust from nonmagnetic. The aim of the present research is to determine the variations of the depth to this boundary on the basis of geomagnetic observations on the territory of Moesian platform.

As far as the anomalous magnetic field contains the influence of sources distributed at different depths within the earth crust, determination of the bottom of magnetic layer comprises a complicated inverse problem. For the purpose of effective separation, the problem in the world scientific experience has been solved using transformation of the data in frequency domain.

As is known at the Curie point temperature ferromagnetic rocks loose their magnetization, become paramagnetic and their ability to generate detectable magnetic anomalies disappears. Thus the deepest level in the crust containing materials which create discernible signatures in a magnetic anomaly map is generally interpreted as the bottom of the magnetic layer or the depths to the Curie point. Consequently, it may be possible to locate a point on the isothermal surface by determining the depth to the bottom of a polarized rock mass from the solution of the inverse magnetic problem. The method can provide valuable information about the regional temperature distribution at depths not easily examined using other methods.

## Methods

Magnetic anomalies are analyzed for estimating the depths to the bottoms of magnetized bodies in the crust. These depths, when contoured for the entire area, should provide a picture of the spatial variation of the Curie isotherm level. This picture should correlate to a significantly high degree with various known indices of geothermal activity in the area under

consideration. The practical importance of the study on this correlation lies in the possibility of establishing a useful reconnaissance method, based on geomagnetic data, for rapid, regional geothermal exploration.

The mathematical model which most of the analysis in the world scientific literature is based on, is a collection of random samples from a uniform distribution of rectangular prisms, each having a constant magnetization. The model was introduced by Spector and Grant (1970), and has proven very successful in estimating average depths to the top of magnetized bodies using the slope of magnetic anomaly's radial averaged power spectrum. The algorithm estimates  $x_0$ ,  $y_0$  and  $z_0$ , the coordinates of the centroid and depth to the top  $z_t$  of the source distribution, by computing least-squares fit to the radial frequency of the Fourier transform in the lowest part of the spectrum. The depth to the bottom (Curie point depth) is  $z_b = 2z_0 - z_t$ .

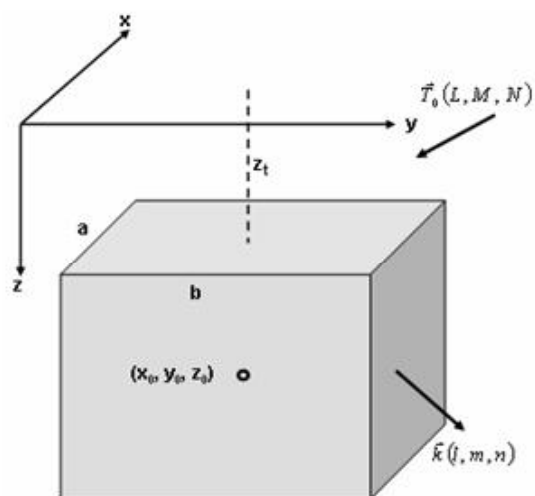


Fig. 1. Rectangular, vertical-slided parallelepiped: an interpretation model

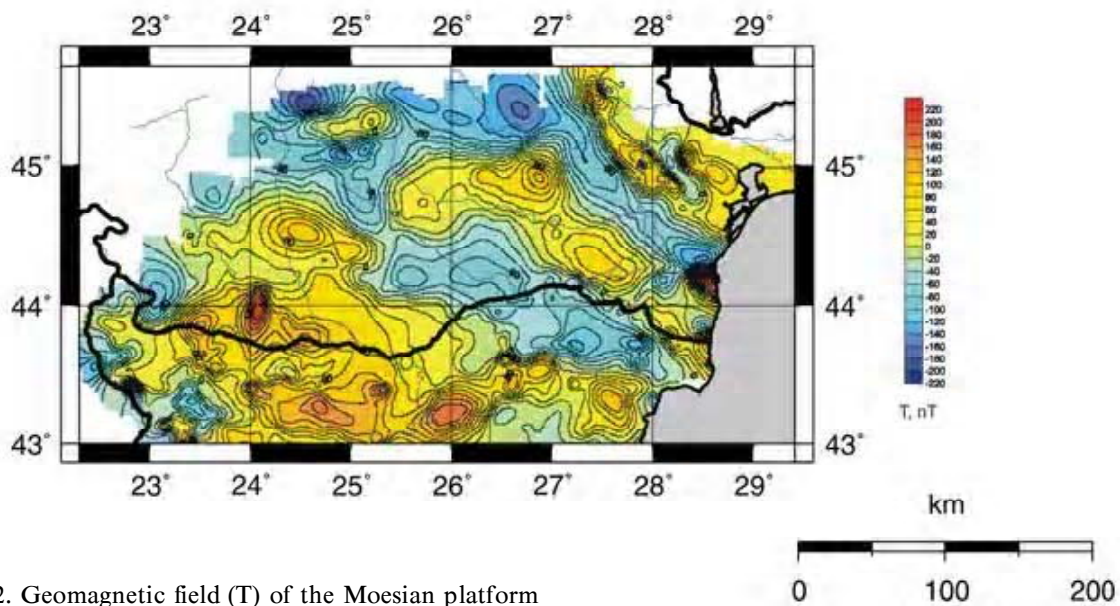


Fig. 2. Geomagnetic field (T) of the Moesian platform

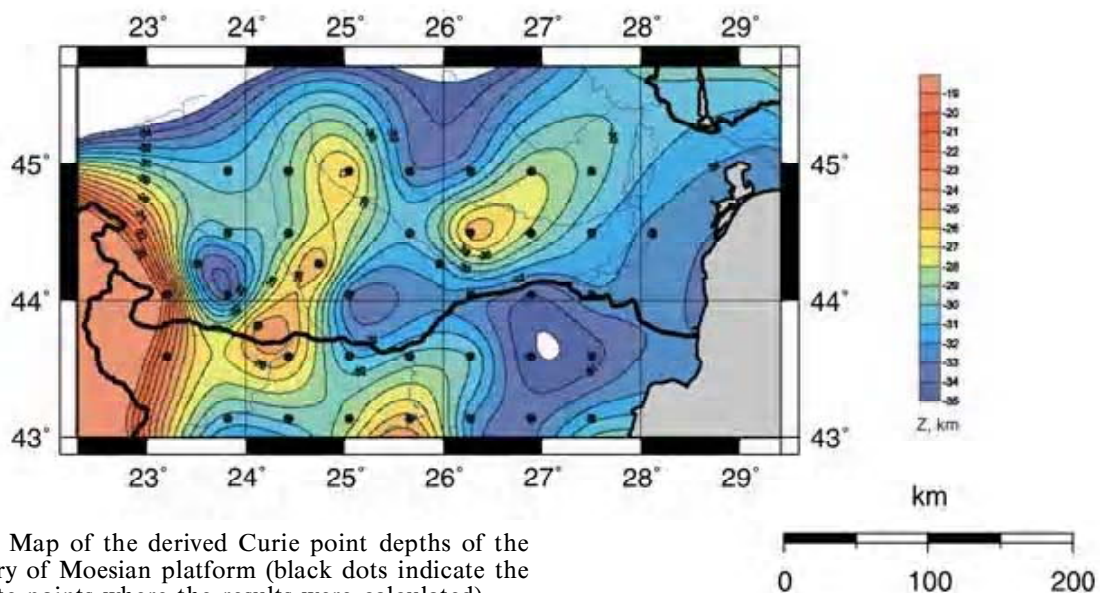


Fig. 3. Map of the derived Curie point depths of the territory of Moesian platform (black dots indicate the separate points where the results were calculated)

### Data

The Bulgarian and Southern Romanian data for the present research are prepared by digitizing scanned published analogue maps (Grigorov, 1961; Pchelarov, 1985). Then, the separate data sets were transformed to a specified coordinate system to be compiled as a uniform grid and geomagnetic map.

In order to define the optimal parameters for the filtration and the size of the separate blocks for following calculation processes, the log averaged spectra of different field's transformations were analyzed.

The main data grid was divided into overlapping square blocks 150x150km in size and the depth

to the Curie point for each block was calculated from the log averaged spectrum.

### Results

As was expected, depths to the Curie point have a range values around 30 km in the main part of the territory. Three anomalous zones having values between 22 and 26 km were delineated. A good correlation with the heat flow of the Bulgarian part of the Moesian platform was found and no strong correlation with the main Romanian faults was observed. An attempt to relate these first results to the present geological situation was made.

## References

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Bulgaria and Southern Romania. — *Bulgarian Geophysical Journal*, v. XI, No 1.  
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## Пресмятане на дълбочините до температурата на Кюри на територията на Мизийската платформа по геомагнитни данни

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**Резюме.** Спектралният анализ на геомагнитни данни е техника, която успешно се прилага за изчисляване на дълбочината до магнитните източници в земната кора (т.нар. дълбочина до точката на Кюри). Оценката на този параметър, комбинирана с допълнителна регионална геоложка и геофизична информация внася яснота при съставянето на модели на съвременните тектонски процеси и може да се използва като незажисим критерий при геотермални проучвания.

Математическият модел, на който се базират изчисленията, е въведен от Spector and Grant (1970) и представлява изчисляване на полето на набор от правоъгълни призми, всяка от които е с постоянно намагнитване. Дълбочината до точката на Кюри се пресмята от наклона на ради-

ално усреднения енергетичен спектър на изчисленото поле.

За целите на това изследване е съставена сборна карта от български и румънски магнитни данни. Изследваният район е разделен на квадратни блокове с размери 150x150 km и изчислените стойности за дълбочината до точката на Кюри са отнесени към централната точка на всеки блок.

Стойностите, които се получават за дълбочините до точката на Кюри на територията на Мизийската платформа варират между 28 и 32 km. Очертават се няколко аномални зони с дълбочини в интервала 22—26 km. Резултатите са анализирани и съпоставени с данни за топлинния поток и геотермалния градиент на територията на България.