Examination of the Curie point depth inverse problem's stability

Проверка на устойчивостта на решението на обратната задача за определяне на дълбочината до точката на Кюри

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Абстракт. Определянето на дълбочината до точката на Кюри по геомагнитни данни представлява сложна обратна задача от методите на потенциалните полета. Намирането на координатите на долната повърхност на магнитните смутители често е свързано с получаване на многозначни решения, обусловени от големият брой параметри за оптимизация. Поради тази причина задачата за намиране на границата на магнитоактивната част от литосферата се решава в спектралното пространство като се използва връзката между наклона на радиално усреднения енергетичен спектър на вертикална призма и дълбочината до долната ѝ повърхност. За да се достигне до тази връзка влиянието на редица други параметри се усреднява или приема за незначително. Настоящата работа представя моделиране на магнитното поле и неговият енергетичен спектър на система от намагнитени правоъгълни призми за проверка на качеството на решението на обратната задача за определяне на дълбочината до долната им граница.

Key words: Curie point depth, spectral analysis, geomagnetic, forward modeling

Calculation of the Curie point depth using geomagnetic data is a complex potential field inverse problem. It has been solved in the frequency domain using the relation between the slope of radially averaged power spectrum and depth to the bottom of an ensemble of magnetized rectangular prism (Spector, Grant, 1970). A number of approximations have been made to the expression in order to obtain a straight relation between the spectrum's plot and Curie point depth. This work presents the results from a forward modeling of the magnetic field of a system of rectangular prisms and comparison of the Curie point depth results with the real parameter of the bodies.

Methods

For the purposes of the present research we built a model composed of 6 vertical rectangular prisms (Fig. 1) having constant magnetization and equal

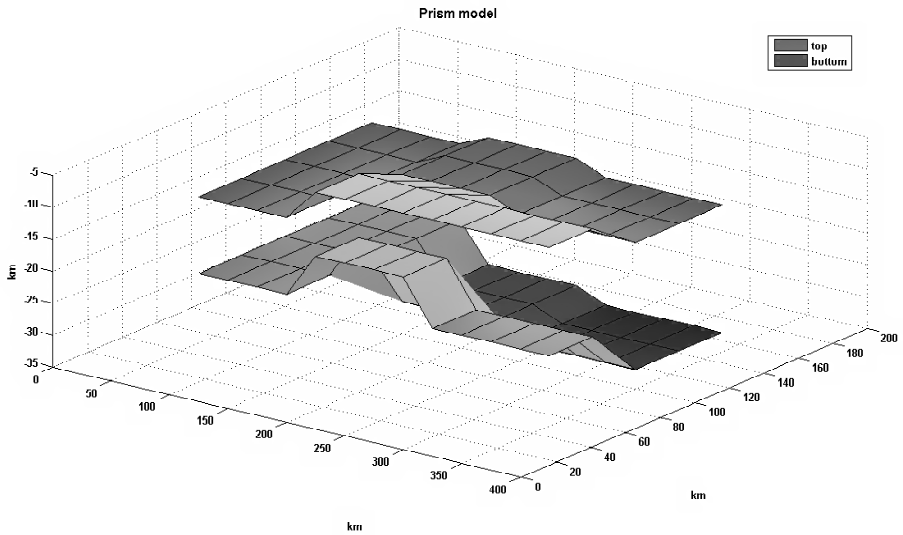

Fig. 1. Experimental model consists of 6 vertical rectangular prisms having different depths to the top and bottom

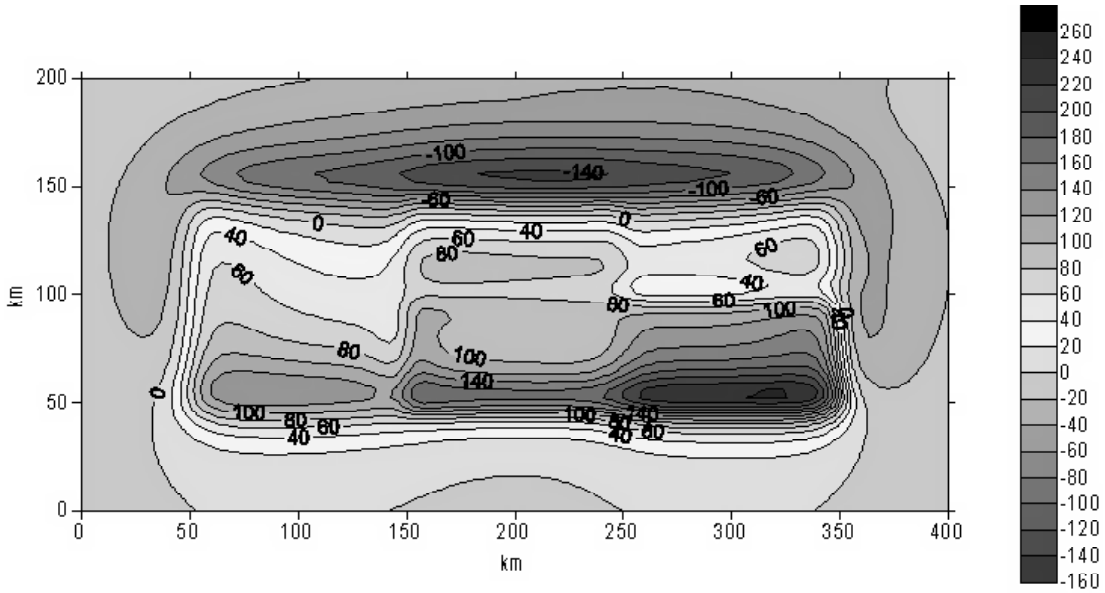

Fig. 2. Calculated geomagnetic field of the model ΔT (ηT)

horizontal dimensions, but varying in depth of the top and bottom surfaces.

The process of forward modeling involved calculation of the magnetic field, separation of the territory into square blocks (test were made with different dimensions of the blocks), transformation of the data in the frequency domain and calculation of the radially averaged power spectrum for each block (Fig. 2).

Depth to the top and bottom surface of the prisms was determined using the slope of radially averaged power spectrum for separate blocks as was described by Okubo et al. (1985). Several tests were applied solving that inverse problem.

1. Applying "reduction to the pole" before data transformation in the spectral domain /direct calculation without this procedure;

2. Using blocks with different dimensions: 200x200 km, 180x180 km, 150x150 km, 120x120 km, 100x100 km.

Results

Numerical experiments which were applied show insignificant differences between results obtain with and without reduction to the pole. That proves the important advantage of the algorithm bearing in mind frequent manifestation of rocks' remnant magnetization in geothermal regions.

Tests related to the blocks' size revealed the most appropriate dimensions to be the smallest which is comparable to the bodies' cross-section — 150x150 km. Results prove the reliability of analyzing geomagnetic data to delineate the bottom of magnetically active part in certain region which are assumed to correspond to Curie point transition depths within the lithosphere.

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