

# Development of Topographic-Geological Model for Iron Ore Deposits in The Kursk Magnetic Anomaly

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## ABSTRACT

*The results of the course work of SOF-MGRI students in the discipline "Information technologies in mining" on the topic "Development of a cartographic model of a given iron ore deposit of KMA based on the given geological map" are considered. Each student completed work for only one deposit and one geological map from the set of six its types. Generalization and analysis of the results of more than 20 student works with a unique combination of deposits and geological maps made it possible to draw meaningful conclusions about the presence of interrelations in the distribution of deposits over the territory of the KMA and also to make an archaeological discovery thru identification the habitat of the ancient Kursk miners.*

**Keywords:** *Anomalous magnetic field map, gravity anomalies, MIII computer simulation, geostatistics, RR model suitability criterion, ArcView/ArcGIS software systems, MAINFRAME 7.0*

## INTRODUCTION

**Purpose and tasks of the work are:** the creation of a vector-raster cartographic model for the given iron ore deposit (MPI) in the territory of Russian Kursk Magnetic Anomaly (KMA).

In the ArcView/ArcGIS software 3 tasks had to be performed:

1. Based on the initial data (ESRI/Esridata99), create a personal GIS project and the polygon of the given MPI according to the map (KMA) from the Mining Encyclopedia [1].

2. Spatial referencing a topographic map at a scale of 1:100000 to absolute geographic coordinates using an

affine transformation of coordinate and edit the created thematic layers using it.

3. Spatial referencing a given geological map at a scale of 1:200000 to absolute geographic coordinates using the ImageWarp program.

The resulting map for task 1 is shown in Fig. 1.

## 1. Vector map of iron ore deposits on the kma territory

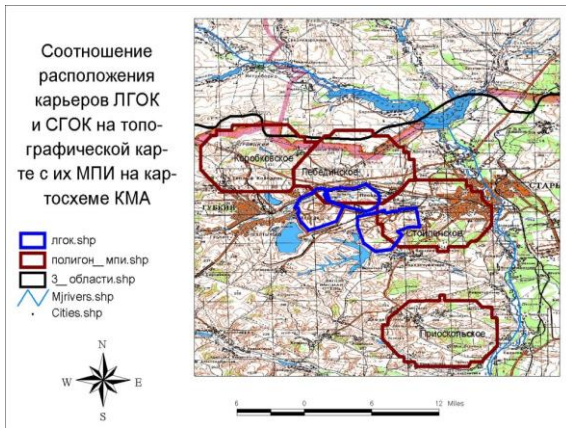


**Figure 1. The main iron ore deposits (brown ovals) of the KMA on the territory of three regions with layers of the river network and big settlements**

## Task 2. Spatial referencing of the maps by affine transformation and their analyses

**Vector and topographic data models.** The territory of the Belgorod region in geological and structural terms is located within the southwestern slope of the Voronezh anticline of the East European (Russian) platform.

**2. Comparison of the location of the pits (pits) lebedinsky (lgok) and stoilensky (sgok) on the topographic map (brown) with their designations on the map (plan, scheme) of the kma (dark blue)**



**Figure 2. The map of overlapping layers "polygons of the MPI" from the KMA map [1] and their display on the topographic map M-37-28**

The discrepancy between the images of the Lebedinsky (LGOK), Stoilensky (SGOK) and Korobkovskoye deposits on the KMA map and on the topographic map can be explained by the difference in time and "antiquity" of their production, as well as the different levels of these two cartographic products, however, they should be taken into account when modeling the MPI [2, 3].

Full unexpected results were obtained after georeferencing map N-36-36 (Fig. 3) in the vicinity of the Mikhailovsky GOK. Toponyms Ruda river and Rudka settlement were found here, indicating the possibility of the existence of ancient Kursk miners (in the development of this idea, the paper [BelogurovVP, Tosheva MS. O roli drevnekurskich rudokopov ... II-VII vekov ne/Belgorod, Constanta 2019-644 c / pp.40-45 (in Russian)] was published).

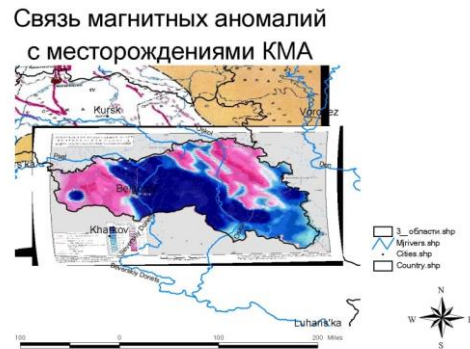
**3. The ancient village of rudka on the river ruda and caves near the old tract "simferopol highway" near the unique watershed of all three major rivers of european russia: the volga, dneiper and don, identified in fig. 3**



**Figure 3. Habitats of the Old Kursk miners. (settlement, rivers and caves)**

**4. Task 3. Spatial analyses of anomalous magnetic fields and gravity anomalies**

The hypothesis that the caves of the ancient Kursk miners may be the cause of the anomalous increase in amplitudes at seismic stations in this region, revealed in studies [4] and [5], also looks quite plausible.



**Figure 4. Map of the anomalous magnetic field of the Belgorod region**

The maps shown in fig. 4 and 5 were obtained as a result of solving problem 3.

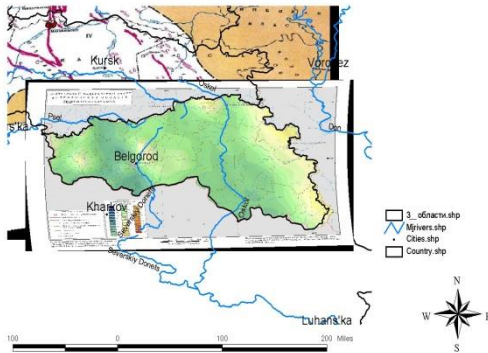
They convincingly confirm the existence of a relationship between the location of iron ore deposits and the intensity of magnetic and gravitational fields. Of particular interest is the sharp transition from the zone with the most positive values of the magnetic field intensity to the zone with the most negative values.

With a large (up to pixels) magnification of the map in Fig. 4, it can be seen that the maximum positive values of the magnetic field are closely adjacent to the most negative ones. There is one pixel between them. And

this pixel has no color, more precisely, it has the color of the paper on which the map is printed.

## 5. Relationship between gravity anomalies and kma deposits

Связь гравитационных аномалий с месторождениями КМА



**Figure 5.** Map of gravity anomalies in the Belgorod region

The Geostatistical Analyst ArcGIS geostatistical analysis module is designed for interpolation of point source data, modeling of real world objects and their spatial forecasting. It is important that the module allows you to determine five types of interpolation errors, among which the root-mean-square normalized error (RMS) of interpolation is of particular importance forecasting (RR=1) [6]. The use of this GIS technology has already shown good results in solving a number of quantitative problems in ecology [7], [8] and even in medicine.

## 6. CONCLUSION

Ordinary student coursework, done even in a simple GIS ArcView v. 3.2 show how it is possible to create a meaningful model of deposits with the help of universal GIS only according to literature data, even before expensive drilling and geochemical testing of ores.

The great Aristotle in his famous *Metaphysics* [9] wrote: "To investigate the truth is difficult in one respect, easy in another. This is evident from the fact that no one is able to achieve it properly, but also does not suffer a complete failure, and everyone says something about nature and one by one, it is true, adds nothing or little to the truth, but when all this adds up, it turns out significant amount." I never get tired of repeating this to students before the start of classes, and the results show that I am right.

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