Magnetotelluric Ore Exploration near Irota, NE Hungary

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Summary

Irota is situated in the Cserehát, NE Hungary. Magnetotelluric (MT) measurements were performed in the wooded area between Irota and Gadna, in cooperation with the Geological and Geophysical Institute of Hungary and the University of Miskolc (Institutional Department of Geology and Mineral Deposits, Institutional Department of Geophysics). The main purpose of the measurements was to specify the depth of the Paleozoic basement and to point out occasional resistivity inhomogenities in the basement. Based on the previous information the area is prospected for base and precious mineralization. In the last years restarted mineral exploration of the area signifies the up-to-dateness of this work. The MT measurements were performed in the last two years. Field data were collected along three sections at 26 stations. Data processing was carried out using WinGLink software. Apparent resistivity and impedance phase graphs were produced after the estimation of the impedance tensor. The nonlinear conjugate gradients algorithm was used for 2D inversion. The result of the inversion was compared with earlier collected geological and geophysical data (drilling, magnetic, seismic, geoelectric measurements. To understand this phenomenon more precisely, further geophysical investigations (MT, IP) and more accurate models are needed.

Introduction

The MT project (as a part of the CriticEl project) was realized in cooperation with the Geological and Geophysical Institute of Hungary and the University of Miskolc (Institutional Department of Geology and Mineral Deposits, Institutional Department of Geophysics). The measurements were carried out on three occasions during 2013 and 2014.

The wooded area between Irota and Gadna villages is located in the Cserehát, NE Hungary (Figure 1). The Cserehát consists of metamorphosed Paleozoic rocks and Cenozoic sediments. Based on previous information the area is prospected for base and precious mineralization. Furthermore, REE minerals (monacite, xenotime) were described (Földessy, 2014) in the near-surface young sediments.

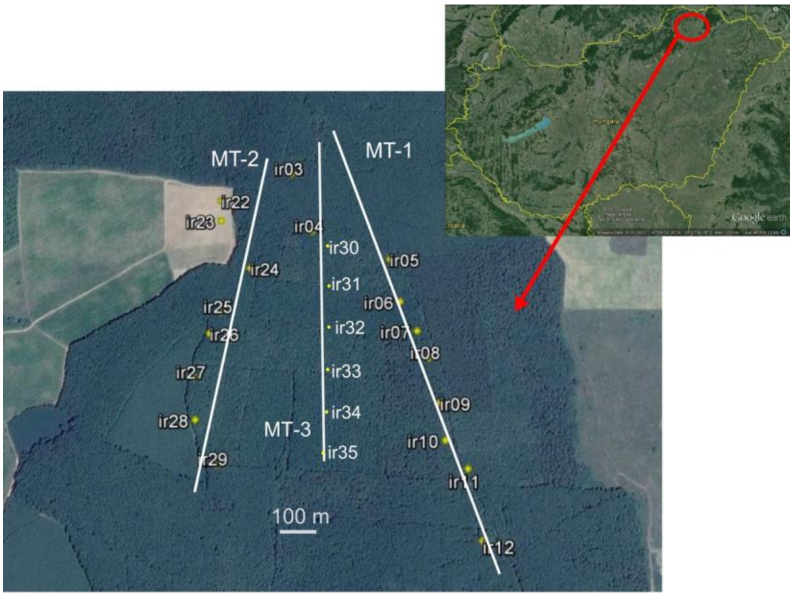

Figure 1 *The satellite picture of the exploration area with the location of the measured points (ir03–ir12, ir22–ir29, ir30–ir35) and profiles (MT-1, MT-2 and MT-3).*

Data collection, data processing

MT measurements were performed along three profiles (MT-1, MT-2 and MT-3). MT signals were recorded at 24 stations (Figure 1) altogether. The measurements were carried out with Metronix GMS-06 24-Bit MT-System. The recordings were registered in three (LF1, free, LF2) frequency bands, with 4096, 512 and 64 Hz sampling frequencies. The registration time at one station was about one hour. Data processing was implemented using WinGLink software. With the statistical spectral analysis of the raw MT data (time series), the elements of the impedance tensor were calculated. The nonlinear conjugate gradients algorithm (Rodi and Mackie, 2001) was used for the 2D inversion of the three sections.

Results

A significant low resistivity zone appears obviously on the image of the MT-1 profile (Figure 2), at a depth of about 400–500 meters under the stations ir06, ir07 and ir08. This zone probably contains sulphide mineralization according to drillhole (Fv-1, Gad-1) information. The top of this conductive body can be found in 500 m depth. From the succession of the Felsővadász-1 well the depth of the Paleozoic Basement was extrapolated along the section. As we can see, the resistivity of the Paleozoic Basement is about 100–200 Ωm on the picture of the MT-1 section. But it is decreasing below -300 m (above sea level) and can be lower than 50 Ωm.

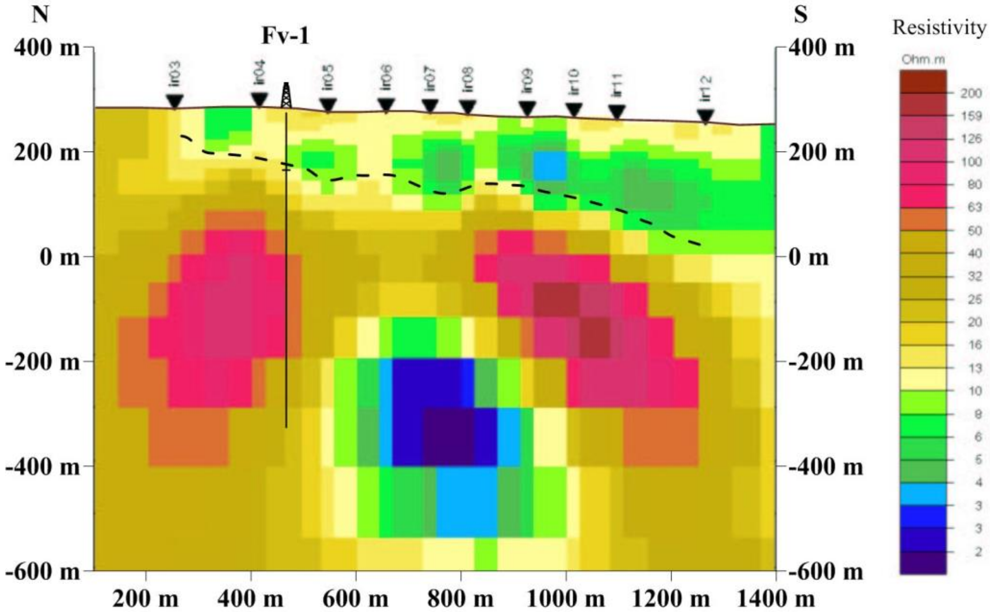

Figure 2 *2D inversion model of the MT-1 section. Fv-1 indicates a borehole, which penetrated pyrrhotite containing zones. Dashed line indicates the Paleozoic basement, the boundary of the Neogene and Paleozoic rocks.*

Conclusions

With the measuring of the other two MT profiles (MT-2, MT-3), it became possible to build a 3D geophysical model. It has a great importance, because the geoelectric structure of the exploration area shows significant 3D effect, therefore the 2D approximation is uncertain. The 3D inversion using the WSINV3DMT code (Siripunvaraporn *et al*., 2005) based on the 24 station data is in progress currently.

Furthermore, the resistivity frequency dispersion effect can play an important role in this MT project. The electrical dispersion is a known phenomenology, which can influence the MT response especially in the 10^{-2}–10^{2} Hz frequency band (Esposito and Patella, 2009). Dispersion-affected zones can occur in fractured rock bodies, which have undergone diffusive alteration due to the uprising hot fluids. The signals of hydrothermal processes appear in the exploration area of Irota as well. Therefore, the processing and interpretation of MT data should be refined in respect of the electrical dispersion (IP) effect.

Acknowledgements

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