APPLICATION OF RESISTIVITY IMAGING TO RECOGNITION OF GEOLOGICAL STRUCTURE IN THE AREA OF SHALLOW Zn-Pb ORE BODIES (PRELIMINARY STUDY)

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ABSTRACT:
Depletion of exploited mineral ore resources and their constant price increase have contributed to active interest in recognition and exploitation of new workable deposits. Exploration work which has been carried out in the vicinity of non-exploited ore areas such as Klucze, Zawiercie and Laski results in confirmation of Zn-Pb commercial deposits. In this region Zn-Pb ores occur in the Devonian and Triassic carbonate formation at a depth of 70 - 80 metres under the surface. Geological recognition is based on the analysis of data taken from bore-holes. To determine the mode of the ores occurrence and service conditions, it is necessity to work out a spatial image of overburden structure. For this reason resistivity measurements with highly distributed LUND Imaging System were introduced in the area of Zawiercie I. The studies were carried out according to three measuring protocols: Schlumberger, Wenner and dipole-dipole. The measurements were performed along three parallel six-hundred-metre profiles. The resistivity cross sections were elaborated using Res2D software. The results of the geophysical research were correlated with the data taken from bore-holes in order to testing the efficiency of applied geoelectrical methods. The study showed a significant diversification of geoelectric characteristics of the rockmass and thus it allowed to recognise accurately the overburden structure of the deposit and to locate precisely zones of faulting. In future, the applied geoelectrical methods are certainly to be used for localization ore bodies at a considerable depth range.

KEYWORDS: resistivity imaging, geophysics ore recognition, Zawiercie Zn-Pb ore deposits.

Introduction
Zn-Pb ore deposits have been exploited in the Silesia-Kraków region (south Poland) for over a hundred and fifty years. Twenty new deposit areas were recognized and documented as a result of geological investigations in the years 1950-1989. The geological setting in the deposit areas was investigated with the use of borehole log data. The best recognition of the deposit geological setting was possible within areas of deep and open-pit mining of Bytom, Olkusz, Chrzanów and Jaworzno regions. The deposits mined occur in calcareous Triassic rocks and may be classified as Mississippi Valley (MVT) type deposits (Heijlen et al., 2003, Szuwarzyński 1996).
Deposits of a particular interest with respect to the resources and the geological structure have been discovered near Zawiercie town (Kurek, 1993; Cabala, 2002). The Zawiercie area is the only region where no mining of Zn-Pb ores has been performed yet. The investigations of the Zawiercie I deposit geological setting (Fig. 1) were entirely based on the interpretation of borehole log data. At the Zawiercie I and II deposit area no geophysical investigations have been carried out until now to support identification of geological structure parts significant for the ore mineralization distribution. The following elements are of a particular interest: the relief structure of the top of Paleozoic strata, karst systems and the presence of the ore bearing dolomite.

The investigations were aimed at testing the pseudotomographic resistivity imaging as a supplementary tool to facilitate interpretation of log data from boreholes drilled in calcareous rocks.

Fig. 1 Location area of investigation in Zawiercie I Zn-Pb ore deposits. Z-1,Z-2,Z-3 – profile of geophysical investigation. ZL 8-19 – bore-hole location. A-B, C-D – geological cross-section.

Geological setting of the Zawiercie I deposit within elevations of Devonian rocks

in original text
Geoelectrical investigations within metal ore deposit areas

The influence of geological factors on the rock resistivity in the study area

Conclusions

Methods

Geological investigations

The investigations of the geological structure of the deposit was based on 108 boreholes drilled during several periods of the documentation research carried at the deposit (1953-1989), and on the bench studies of drilling cores. The drilling and documentation work was performed by the ‘Przesiębiorstwo Geologiczne’ (Geological Company) in Kraków.

Surveying

The geophysical survey line location was performed with the use of GPS methods (a receiver gpsmap 60 CS). In order to present the borehole locations, their co-ordinates were transformed from the archival system 65 to the system WGS 84. Field measurements with the GPS device made it possible to precisely determine geophysical survey lines overlapping with borehole locations.

Geophysical investigations

Geoelectrical measurements were performed on 3 parallel, 600-meter-long survey lines (Fig. 1). The distance between the survey lines was 100 m.

In the study, the authors used a multi-electrode apparatus LUND Imaging System with a measuring unit SAS-4000 and a selector ES464 produced by the Swedish company ABEM. The system makes it possible to perform a quick high-definition geoelectrical investigation of the rock mass. Field investigation data were processed with a specialist software Res2Dinv, which uses advanced inversion algorithms in the modelling.

The measurement array of each survey line consisted of 61 electrodes placed along the survey line at 10-meter separations. The measurements were performed in the following arrays: Schlumberger, Wenner and dipol-dipol.

Results

Conclusions
References


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