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„Geological structure of the 'Zawiercie 3' zinc and lead ore deposit, based on additional geological recognition. ”

Abstract

Deposits of the Silesia – Kraków area were one of richest zinc-lead Mississippi Valley type deposits in the world (i.a. Taylor et al., 2009, Leach et al., 2010). The mining of silver-bearing lead ores was carried out in this area before the 12th century and from the turn of the 18th and 19th century also zinc ores were exploited. Out of the ten Zn-Pb mines active in the post-war era, located in the Bytom, Chrzanów and Olkusz regions, limited mining activity (after more than 40 years of underground operations – despite significant increments from additional geological and mining recognition) (i.a. Retman, 2006), will be continued in Poland only in the Olkusz-Pomorzany mine over the next few years (Paulo et al., 2015a).

The prospect of ending mining in several of Zn-Pb's ore mines worldwide (including Brunswick and Perseverance in Canada, Lisheen in Ireland, Century in Australia), which were decisive during the last 20 years of supply stabilization and a negative assessment of a new deposits development possibilities contributed to the increase of zinc and lead prices on world markets since 2004 as well as to further price appreciation in recent years. The above factors caused verification at the Polish market (Nieć et al., 2006a) and then the reduction of economic criteria for Zn-Pb ores in the areas where deposits are not yet exploited and therefore changes in the methodology of resource calculation and criteria for economic evaluation of deposits (Nieć et al., 2006b, 2006c; 2008). The above factors significantly increased interest of geological companies (Canadian, Irish, American and Australian) in resuming metallic ores exploration in Poland. The near-end of Zn-Pb ore exploitation in the Olkusz-Pomorzany mine and the Laski deposits unrealized development plans (ZGH Bolesław SA - Stalprodukt SA Capital Group) mean that the underground exploitation of Zn-Pb ore in Poland is possible in the Zawiercie region – which is the only area of possible mining exploitation.

The dissertation survey area consists of fragments of unexploited Zn-Pb ore deposits mostly located in the Triassic and also Devonian formations of Zawiercie in Silesia-Kraków Monocline: ‘Marciszów’ and ‘Rodaki – Rokitno Szlacheckie’ (Przeniosło et al., 2008c; Preidl et al., 2007), especially the ore deposit ‘Zawiercie 3’ (along with adjacent areas), documented in the areas of ‘Zawiercie I’ and ‘Zawiercie – Obszar Zawiercie II’ (Przeniosło et al., 2008a, 2008b), which as a result of additional geological recognition executed since 2010 to 2013, currently is the largest Zn-Pb ore deposit in Poland (Retman et al., 2014c). A total of 1019 surface boreholes were made in the study area, among the above 801 boreholes contain geological data since 1953 to 1988 (Piekarski, 1955; Wielgomas, 1964, 1970, 1980; Wielgomas et al., 1968; Preidl et al., 1978; Rogoż et al., 1975; Rogoż, 1976, 1985, 1990), while another 218 boreholes contain new data from geological recognition done since 2010 to 2013 (Retman et al., 2014c). The aim of the thesis was the reinterpretation of the above mentioned geological data, goaling to more detailed description of geological structure and the increase of Zawiercie deposit area economic value in terms of potential mining development, and compare it with a new data from 252 drill holes. The work covers three main research topics:

1. Reinterpretation of the faults run in Triassic formations, made on the basis of mutual spatial relationship between synsedimentary contact of unmetasomatised carbonate

of the Rethian and Lower Gogolin beds in the 300 out of 1019 documenting boreholes. The reinterpretation, made on this basis for the first time in Zawiercie area, allowed to determine 77 main faults with 10-130 m throw, in 5 age groups within 74 tectonic blocks developed along the dominant directions NW-SE and WNW-ESE and grouped in 5 tectonic units of a higher order, divided by tectonic zones with 20-100 m throw. The reinterpretation of the faults run in Triassic formation, makes it possible to indicate directions and to specify the location of future exploration surveys and to properly calculate resources located in tectonic zones

2. Detailed analysis of Zn-Pb sulphide mineralization symptoms, performed to assess the possibility of documenting additional ore resources, especially in areas identified by using less than the average (for the Zawiercie 3 deposit [Retman et al., 2014c]) recognition boreholes grid, which contain numerous sulphide mineralization symptoms or/and single, isolated economic boreholes. Reinterpretation of sulphide mineralization symptoms presence with 0.5% Zn+Pb cut-off, made through justified recalculation in relation to description and core recovery of geological profiles in 1019 boreholes, allowed to determine the wealth deposit of 53 prognostic areas located along the NW-SE/WNW-ESE and NE-SW/NNE-SSW directions, referring to the geometry of the main tectonic deformations in the upper Paleozoic structure as well as to the fault zones reinterpreted in the Triassic formation. The amount of additional Zn-Pb ore resources, possible to be recognized after concentrating borehole grid in the contact zones of both directions in the richest prognostic areas of the DK1 level, were determined in the SW part of the area. Additionally recognition of that areas may determine much higher economic value of Zawiercie deposit area as well as the ways of potential first working.

3. Chemical analysis of silver, cadmium, arsenic, thallium, gallium and germanium (5167 chemical analysis in total) and among the others, iron, nickel and cobalt was dozen more times numerous analysis in relation to the analysis of Zn-Pb sulfide ores of the studied area done previously. The analysis, carried out by accredited laboratories and by using modern methods in the last stage of geological recognition, allowed to estimate low contents of undesirable components (cadmium, arsenic, thallium, iron) in economic resources of ‘Zawiercie 3’ deposit and relatively high, beneficial silver content affecting the additional value of potential final concentrates. A dominant relationship between silver concentration and sphalerite-type ores in DK1 and DK2 ore-bearing dolomites was found, which constitute of about 99% part of the total deposit resources that is confirmed by the results of sulphide ore enrichment studies in which more than 3 times higher silver contents accumulate in sphalerite concentrates.

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