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STANISŁAW Z. MIKULSKI*, BOŻENA STRZELSKA-SMAKOWSKA**

The prospective and hypothetical areas of zinc and/or lead ores in different types of deposits beyond the Upper Silesia Zn-Pb Ore District in Poland

Introduction

This article constitutes the second part of the paper (The prospective and prognostic areas of zinc and lead ores in the Upper Silesia Zn-Pb Ore District by Mikulski et al. 2013) in which the prognostic and prospective areas of Zn-Pb ore deposits in the Upper Silesia Zn-Pb Ore District were presented.

The criteria determining the prospective resources and/or hypothetical resources were adopted according to Smakowski, Szamałek (2011). They defined the criteria as follows: "Deposit/hypothetical areas (E category) shall be determined exclusively on the basis of geological evidence, direct and indirect, for example for the different types of metal ore deposits hosted by various geo-structural units or rocky formations. Deposits/prospective areas (D2 category) are defined on the basis of indications of the presence of deposits, geochemical and geophysical anomalies, or petrographic or mineralogical indicators of occurrence of raw minerals".

In Poland, the prospective areas of Zn-Pb ore deposit occurrences are considered to be the following regions: Lower Silesia, Wielkopolska, Małopolska, and the Holy Cross Mountains. This paper presents all areas excluding the documented Zn-Pb deposits in the Upper Silesia Zn-Pb Ore District. The most important types of deposits which may be

* Ph.D., D.Sc., Assoc. Prof., Polish Geological Institute-National Research Institute, Warsaw, Poland; e-mail: stanislaw.mikulski@pgi.gov.pl

** Ph.D. Eng., AGH University of Science and Technology, Cracow, Poland

expected in different geological formations are the Mississippi Valley Type (MVT), Zn-Pb mineralization located to the north of the Zawiercie region in the Upper Silesia District, stratiform-type Pb deposits in Zechstein sediments associated with copper ores, vein type polymetallic sulfide deposits (Pb, Zn-Pb, Pb-Ag, $BaSO_4$-Pb) around Variscan and post--Variscan magmatic intrusions, and metamorphosed deposits of the massive sulfides type (SEDEX).

1. Mississippi Valley Type deposits in Triassic and Devonian carbonaceous sediments to the north of the Zawiercie region

The prospective area of about 2,000 km^2 stretches north from the documented deposits of zinc and lead ores in the Zawiercie region (Fig. 1). Four prospective regions are emphasized:

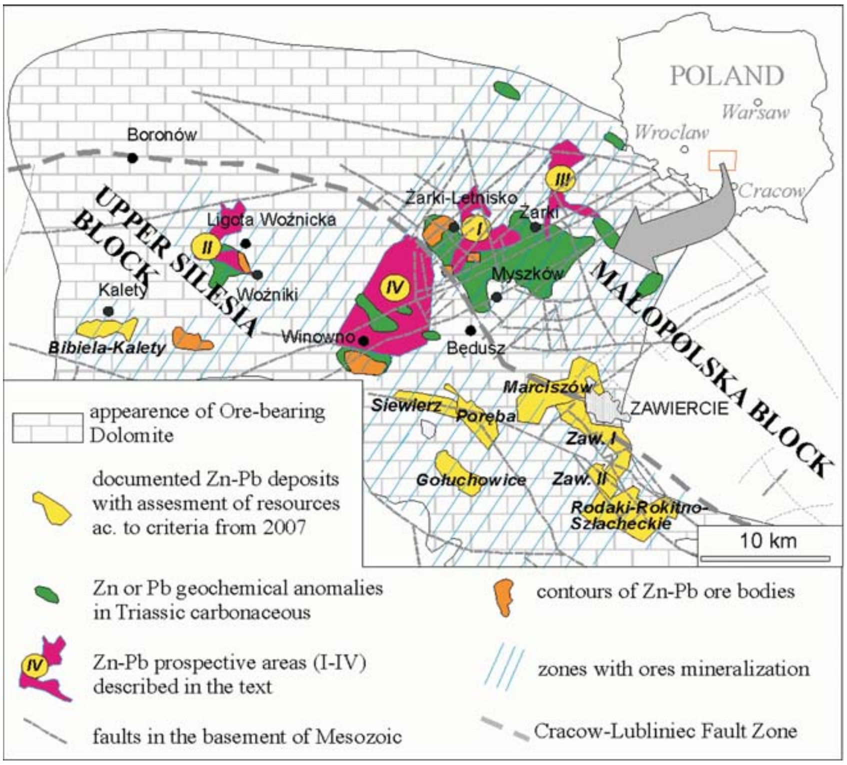

Fig. 1. The location of the Zn-Pb ore deposit prospective areas and geochemical Zn and Pb anomalies in boreholes located north of the documented Zn-Pb sulfide deposits in the Zawiercie region (ac. Mikulski et al. 2011, modified)

Rys. 1. Lokalizacja obszarów perspektywicznych złóż rud Zn-Pb oraz anomalii geochemicznych Zn i Pb w rdzeniach wiertniczych zlokalizowanych na północ od udokumentowanych złóż rud siarczkowych Zn-Pb regionu zawierciańskiego (wg Mikulski i in. 2011, zmieniony) area I to the NW of Myszków, area II near Woźniki, area III near Żarki, and area IV SE of Koziegłowy (Strzelska-Smakowska et al. 2008a). The prospective areas I and III are part of the Permian-Mesozoic cover that overlies the Małopolska Block. Areas II and IV, as well as the documented deposits of Zn-Pb ores, are located in the Permian-Mesozoic sediments cover lying on the Upper Silesian Block.

The geology of this region has been determined by more than 1,000 boreholes (Przeniosło, Wołkowicz 1993). In the vicinities of Zawiercie, Myszków, and Mrzygłód the density of the boreholes grid was suitable for exploration of deposits in C_1 and C_2 categories (indicated and inferred). In other parts of the region, the holes are located at a distance from each other of about 4–5 km. Prospective areas of Zn-Pb ores were set in the Middle Triassic Ore-bearing Dolomite. Zinc mineralization also occurs in Diplopora Dolomites over ore--bearing dolomite. Maps of the probability of metal concentrations and ore occurrences were constructed with the use of geo-statistical indicator kriging (Strzelska-Smakowska et al. 2008a, b). The boundaries of the prospective areas constitute the specified isoline of high probability (assumes 90%) of zinc appearance at a minimum concentration of 0.5%. Due to its low threshold of metals, such a high probability limit was considered to be the most appropriate. The selection of prospective areas considered the size and concentration of the field's anomalies and the degree of their recognition (number of boreholes).

In 4 designated prospective areas (I-IV), zinc is the predominant metal in Ore-bearing Dolomite and the only one in the Diplopora Dolomites. The ratio of zinc concentration to lead is greater than in the explored deposits. In area II near Woźniki, zinc occurs almost exclusively. To the east and southeast of that area, the share of lead increases. The relationship of the metals concentration in designated prospective areas to the Triassic tectonic features, and especially to faults lying in N-S and NNW-SSE directions are visible in areas II, IV and III (Fig. 2).

As in other parts of the Upper Silesia district, major ore minerals are sphalerite, galena, pyrite, and less frequently marcasite, and rarely chalcopyrite (Przeniosło et al. 1974; Strzelska-Smakowska 1993). Most often they occur in fractures or in small caverns as fine grains (up to a few millimeters in size), usually in strongly karstified and porous varieties of Ore-bearing Dolomite or Diplopora Dolomites. In the more concise dolomites, pyrite and less commonly sphalerite form veinlets up to a few mm thick. Sulfides are accompanied usually by megacrystals of calcite, and less commonly dolomite or barite. In the direction to the west and north of documented deposits of the Zawiercie region, a tendency of ore mineralization location is noticed in the higher parts of the profile of Triassic sediments.

The most promising areas seem to be areas I and IV (Table 1). Based on criteria used in Poland for defining ore (Zn+Pb content as sulphides over 2 %), a few, isolated islets of the small sizes only ("ore deposit regions") were distinguished surrounding the individual boreholes. The large range of mineralization in the profile of Ore-bearing Dolomite, and probably nest-like shapes of ore bodies should be noted (Table 1). Hence the resources in the studied areas were classified as prospective (D category) and hypothetical (E category). It would be appropriate to carry out further research, for example, by geophysics methods

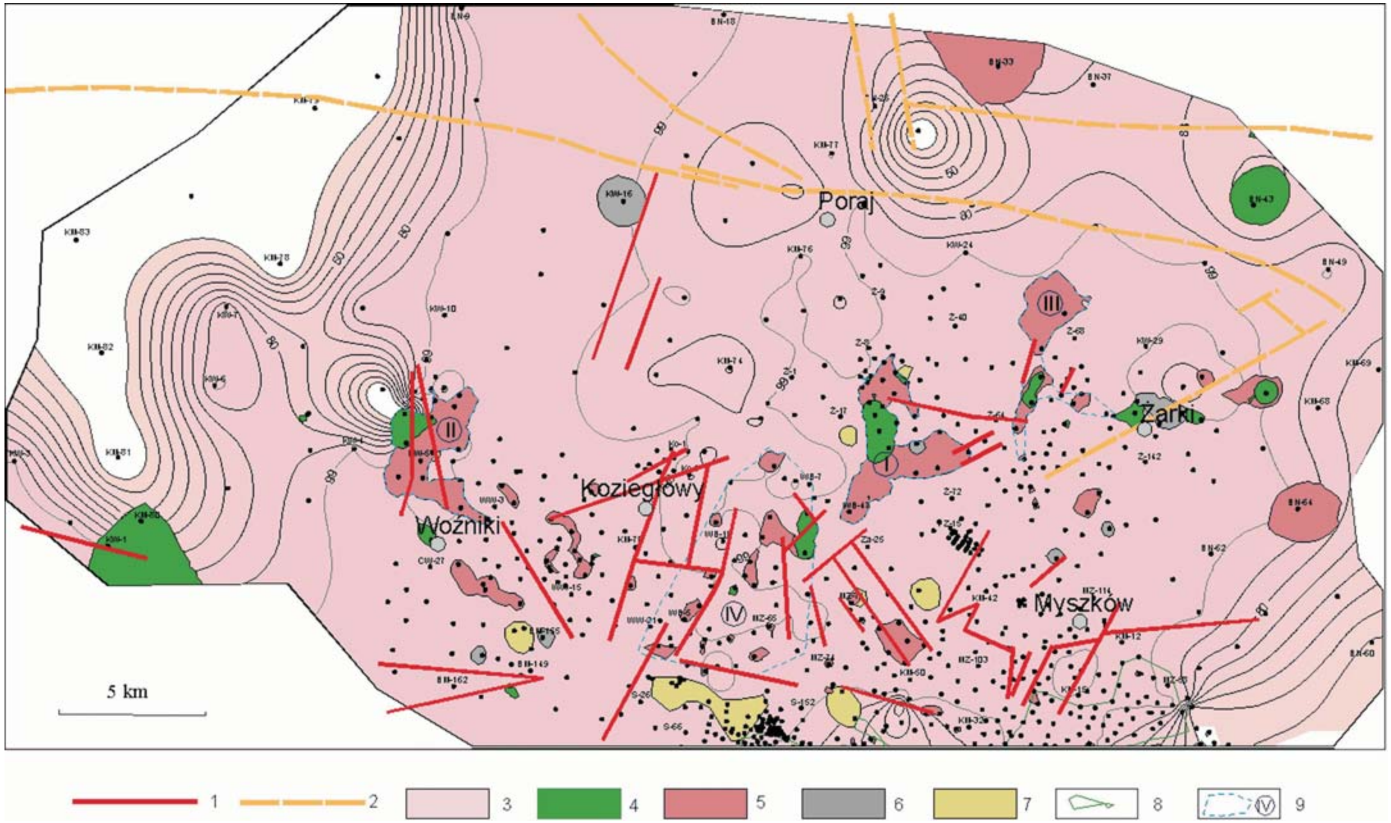

Fig. 2. Fields of Zn geochemical anomalies in relation to Ore-bearing Dolomite share in the Lower Muschelkalk and Triassic tectonics
1 – Triassic fault; 2 – faults in the top of Paleozoic (without Permian); 3 – shares of Ore-bearing Dolomite in Lower Muschelkalk;
Fields with Zn geochemical anomaly: 4 – in Diplopota Dolomites, 5 – in Ore-bearing Dolomite, 6 – in Roethain;
7 – Paleozoic island in the top of Lower Muschelkalk; 8 – deposit area; 9 – prospective areas
(after Strzelska-Smakowska et al. 2008b)

Rys. 2. Pola anomalii geochemicznych cynku na tle udziału dolomitu kruszconośnego w dolnym wapieniu muszlowym i tektoniki triasu
(wg Strzelska-Smakowska i in. 2008b)

TABLE 1

The characteristic of the prospective areas in the northern part of the Upper Silesian-Cracow area

TABELA 1

Charakterystyka obszarów perspektywicznych w północnej części obszaru śląsko-krakowskiego

Characteristics of the area	Area I	Area II	Area III	Area IV
Compactness Number of boreholes Surface	Compact? 20 12 km^2	Compact? 14 10 km^2	6 fields 11 5.5 km^2 (2 fields)	12 fields 17 –
***DK** (Ore-bearing Dolomite) **zinc mineralization**				
Vertical extension of ore mineralization*	54.1–168.6 m	130.0–251.0 m	168.7–403.6 m	75.0–195.9 m
Number of ore-bearing horizons in profile	1–10	1–5	1–2	1–6
Thickness of horizons	0.3–3.25 m	0.2–2.9 m	0.1–0.9 m	0.2–4.3 m
Number of horizons in profile with contents of Zn >1%	1–6 in 9 boreholes	1–3 in 6 boreholes	1–2 in 2 boreholes	1 in 3 boreholes
Number of horizons in profile with contents of Zn >2%	1–7 in 5 boreholes	1 in 2 boreholes	1 in 1 borehole	1–3 in 10 boreholes
***DK** (Ore-bearing Dolomite) **lead mineralization**				
Number of ore-bearing horizons in profile	1–3 in 8 boreholes	1 in 2 boreholes	1–3 in 8 boreholes	1–4 in 7 boreholes
Thickness of horizons	0.4–1.8 m	0.2–0.3 m	0.1–0.8 m	0.4–4.3 m
Number of horizons in profile with contents of Pb >1%	1 in 2 boreholes	1 in 1 borehole	2 in 1 borehole	1–3 in 3 boreholes
Number of horizons in profile with contents of Pb>2%	2 in 2 boreholes	absent	1–2 in 3 boreholes	1 in 4 boreholes
***DD** (Diplopora Dolomite) **zinc mineralization**				
Vertical extension of Zn mineralization	48.5–128.2 m	142.0–201.5 m	222.2–285.5 m	101.0–101.6
Number of ore-bearing horizons in profile	1–4 in 10 boreholes	1–2 in 3 boreholes	1 in 2 boreholes	1 in 1 borehole
Thickness of horizons	0.4–3.0 m	0.3–1.0 m	0.4–0.5 m	0.6 m
Number of horizons in profile with contents of Zn >1%	1 in 4 boreholes	absent		
Number of horizons in profile with contents of Zn >2%	1 in 1 borehole	absent		
***DD** (Diplopora Dolomite) **lead mineralization**	absent			

DK – Ore-bearing Dolomite; **DD** – Diplopora Dolomites

* Depth from the highest top to the lowest bottom in borehole

(inductive polarization – IP; Retman, Wierchowiec 2008), particularly in area IV where the distance between the positive boreholes ranges from 1 to 3 km. Successful results of a geophysical survey could form the basis for further exploration by drillings.

2. Ore deposits accompanying granitoids in the contact zone of the Małopolska and Upper Silesia Blocks

Carboniferous igneous intrusions in Ediacarian and Lower Paleozoic clastic rocks occur in the contact zone of the Małopolska Block with the Upper Silesia Block, accompanied by numerous manifestations of ore mineralization and the only Cu-Mo-W deposit of the porphyry type in Myszków known at present. Molybdenite mineralization in the marginal and apical zones of intrusion is locally accompanied by sulfides of Zn and Pb (Oszczepalski et al. 2010). Sphalerite-galena mineralization occurs in the form of impregnation and veinlets within the clastic rocks, as well as in the granitoids and porphyries. However, compared to the Zn-Pb ore mineralization hosted by Triassic carbonate rocks that directly cover the folded basement, sphalerite-galena mineralization is much poorer. Fields with higher average content of zinc and lead are located both on the Upper Silesia Block (where the highest concentrations are registered) and on the Małopolska Block. The occurrences of Zn-Pb mineralization in the Upper Paleozoic rocks of the Upper Silesia Block formed numerous Zn-Pb sulfide bodies of thickness within 0.5-30 m (Gałkiewicz et al. 1960; Śliwiński 1964; Ekiert 1971; Gładysz, Śliwiński 1979; Smakowski, Wielgomas 1986; Kurek 1988).

Zinc and lead mineralization is located mostly in the Devonian dolomite breccias and less commonly in Permian conglomerates and Triassic sandstones on the Upper Silesian Block, where samples of Zn+Pb >2% content occur in 7 boreholes (Oszczepalski et al. 2008). On this block, there are 4 distinct areas with higher average zinc content (0.2-2.5% Zn) among Devonian and Permian sediments in the region of Łazy, Poręba, Klucze, and Siewierz (Fig. 3). Similarly, as in the case of zinc, fields with the largest average lead concentrations (within 0.1–3%) are on the Małopolska Block, near Żarki-Kotowice and on the Upper Silesian Block, where they occur in the vicinity of Siewierz, Poręba, Łazy, and Klucze (Fig. 4). The maximum content of zinc and lead in the examined samples (2–15%) were revealed in the vicinity of Poręba, Łazy, Klucze, and Siewierz. Ore mineralization in breccia occurs in the form of matrix, veinlets, and dispersed grains (less often in the form of colloform crusts), and is represented by sphalerite and galena in the company of pyrite, marcasite, and chalcopyrite.

It is estimated that in Devonian rocks, up to several percent of zinc and lead ores occurs (Kurek 1988). However, the industrial importance of these resources is difficult to determine at present due to insufficient exploration. The ore findings in Devonian rocks, although numerous and meeting the economic criteria, are dispersed and generally difficult to be considered as prospective. The situation in the Klucze deposit is preferable, where Zn-Pb deposits in the Triassic layer occur in the overburden of ore-bearing Devonian sediments.

The breccias are mineralized within different stratigraphic horizons, from the Devonian to the Middle Triassic. The extraction of ores from Devonian sediments, as resources in the Triassic, seems viable.

Less rich are small areas with Zn-Pb mineralization (with average content approx. 0.1% of Zn and Pb) in the Ediacarian-Paleozoic basement on the Małopolska Block, found in

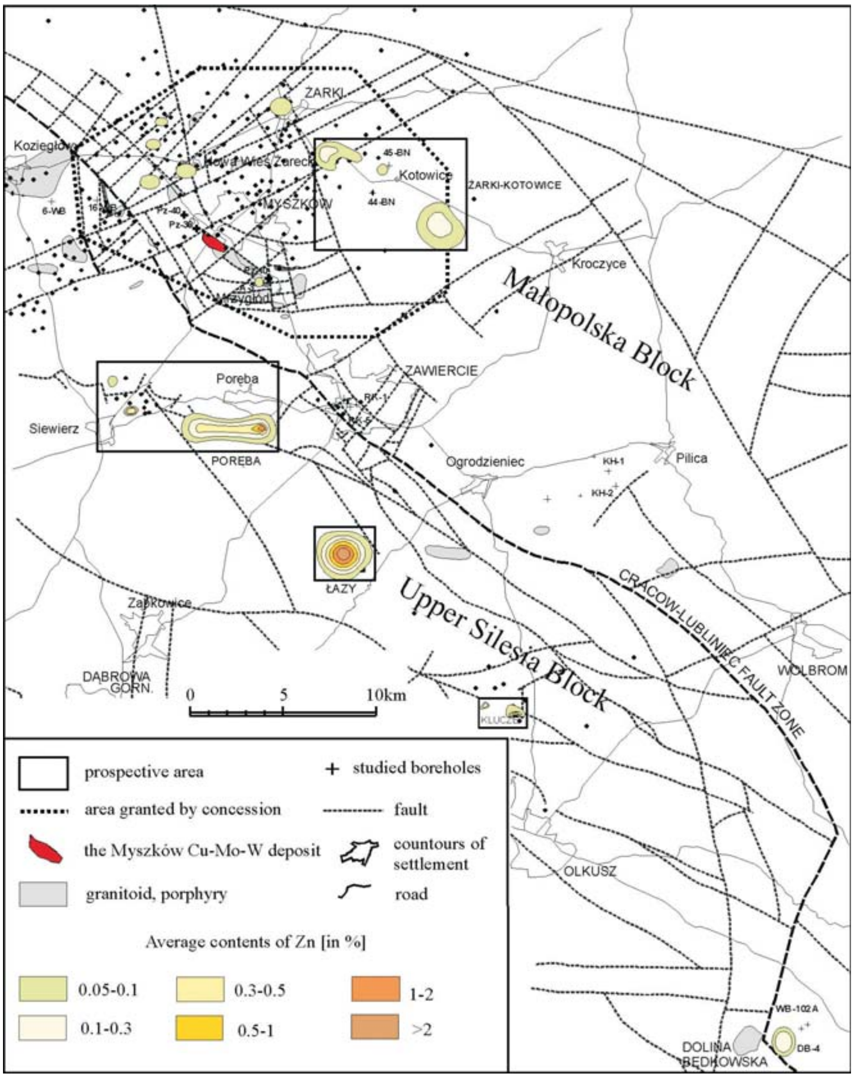

Fig. 3. Map of Zn mineralization (Oszczepalski et al. 2008, modified) along with the prospective areas for the Zn-Pb deposits hosted by Devonian and Permian carbonates in the contact zone of the Upper Silesia and Małopolska blocks

Rys. 3. Mapa wystąpień mineralizacji cynkiem (Oszczepalski i in. 2008, zmodyfikowana) wraz z obszarami perspektywicznymi dla złóż Zn-Pb w utworach węglanowych dewonu i permu w strefie kontaktowej bloku górnośląskiego i małopolskiego individual boreholes in the area SE of Żarki, in the Będkowska Valley, and in the broad surroundings of the Myszków deposit (Oszczepalski et al. 2008).

The high zinc content on the Małopolska Block (within the limits of 0.8–4%) was revealed in samples of granite (regions of Myszków and Pilica), Ediacarian metaclaystones (Będkowska Valley and Żarki), and Silurian metamudstones (Zawiercie). The highest lead

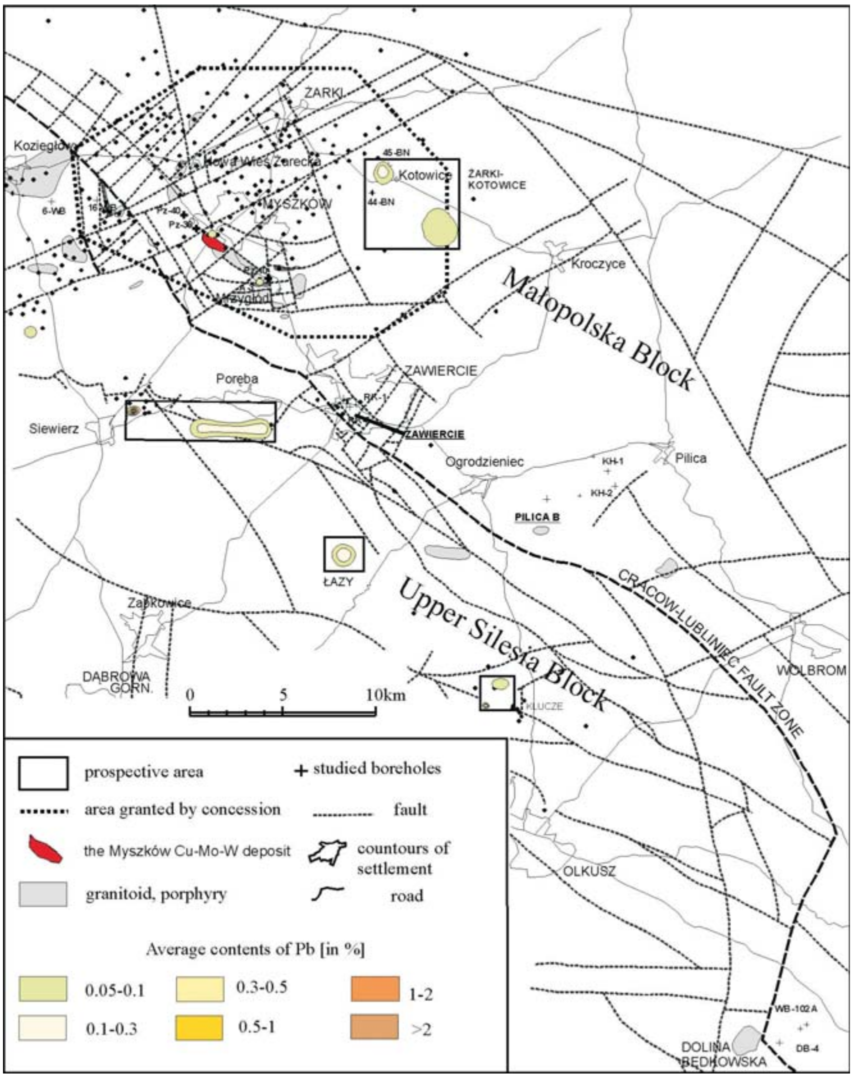

Fig. 4. Map of Pb mineralization (Oszczepalski et al. 2008, modified) along with the prospective areas for the Zn-Pb deposits hosted by Devonian and Permian carbonates in the contact zone of Upper Silesian and Małopolska blocks

Rys. 4. Mapa wystąpień mineralizacji ołowiem (Oszczepalski i in. 2008, zmodyfikowana) wraz z obszarami perspektywicznymi dla złóż Zn-Pb w utworach węglanowych dewonu i permu w strefie kontaktowej bloku górnośląskiego i małopolskiego content (0.5–2.5%) occurs sporadically in Ediacarian metaclaystones (Będkowska Valley) and granites (around Myszków). Lead generally occurs with zinc, but concentrations of Pb are lower compared to Zn. In metamorphic Ediacarian and Silurian rocks, galena and sphalerite occur usually in the company of chalcopyrite and pyrite, forming impregnation--veinlet type ore mineralization, while in granites the molybdenite-chalcopyrite-pyrite-cassiterite-bornite association dominates (Mikulski et al. 2012). The richest Zn-Pb mineralization appears on the edge of the porphyry Mo-Cu-W deposits, due to the zonal distribution of metals (e.g. Podemski et al. 2001; Lasoń 2003).

3. Zechstein copper formation

In the Zechstein copper-bearing formation, lead and zinc are present in the vertical profile and appear in the horizontal spread of profiles. Ore mineralization with zinc and lead sulfides may coincide with concentrations of copper, but studies have also found the presence of a distinct horizon or vast flat lenses with dominant lead mineralization and/or zinc mineralization over a copper mineralization zone (Konstantynowicz 1965; Harańczyk 1966; Niśkiewicz 1967; Paulo 1976; Banaś et al. 1985, 2007; Piestrzyński 1996; Oszczepalski, Rydzewski 1997; Pieczonka 2011; Pieczonka et al. 2007).

Currently, KGHM Polska Miedź S.A. recovers lead largely due to requirements for environmental protection. Annual production of raw lead in 2007 was approx. 15.7 thousand t. The average content of Pb in the copper ores is 0.14%. Copper-bearing shale contains an average of 0.67%, carbonate ore 0.11% and sandstone ore 0.01% (Kijewski, Jarosz 1987; Sobierajski et al. 1996). The annual supply of lead from copper concentrates amounts to 25–32 thousand t (Pluciński et al. 1996). Kijewski and Tomanik (1998) estimate that annually, along with copper ore, approx. 13 to 19 thousand t lead is extracted in the Rudna mine and from approx. 5 to 15 thousand t lead in the Lubin mine.

Concentrations of zinc in the form of sphalerite in copper-bearing shale in the deposit zone do not exceed 1%, it is not possible to extract Zn concentrates, and during metallurgical processes zinc is lost (Smakowski et al., ed. 2011).

On the Fore-Sudetic Monocline within the Odra lineament, several prospective areas were distinguished with an elevated presence of zinc and lead (>1%) as minerals in Cu-Ag ores (Gospodarczyk, Bossowski 1986). The main factors conditioning the occurrence of galena-sphalerite mineralization were displayed by the zonal distribution of Cu, Pb, and Zn mineralization in the vertical profile as well as in the horizontal spread in the immediate vicinity of reduced and oxidized facies in the Zechstein sediments.

The Metallogenic atlas of the Zechstein copper formation in Poland (Oszczepalski, Rydzewski 1997) summarizes data on the distribution of Cu, Zn, and Pb in over 750 boreholes drilled during the second half of the 20th century. A number of anomalous Pb and Zn areas were recognized which deserve special attention as the locations of probable fields of rich Pb-Zn mineralization at depths up to 2 km around the Lubin-Sieroszowice mining area on the Fore-Sudetic Monocline, on the Żary Perycline (SW from Zielona Góra), in the North-Sudetic Basin (around the Konrad and Lena-Nowy Kościół abandoned deposits), and to the north of Zgorzelec. The thickness of lead and zinc bearing intervals in the most interesting anomalous areas range from 5 to 50 m, while the concentration of lead changes from 10 to 100 kg/m^2, and zinc from 5 to 50 kg/m^2. In other areas of the Polish Lowland the elevated content of Zn and Pb in the Zechstein copper formation should not be considered prospective due to the great depth (>2 km) of occurrence of galena-sphalerite mineralization.

The occurrence of zinc blende reported from Jurassic dolomitized limestones in the immediate vicinity of a salt dome near Inowrocław in the uplifted central parts of the Kujawy Anticlinorium was considered to be an indicator of possible ore mineralization rather than of industrial importance (Krajewski 1957, 1960).

4. Paleozoic and Mesozoic formations in the Holy Cross Mountains

These deposits and numerous ore occurrences are located mainly in the Paleozoic basement of the western part of the Holy Cross Mountains and in their Mesozoic surroundings (Fig. 5). Among them, the most important are the calcite vein deposits (locally also barite veins) with galena hosted by Devonian sediments (Chęciny, Kielce, Łagów and others), the impregnation of galena in Zechstein conglomerates (region of Nieczulice and Chybice), and the galena impregnation in sandstones of the Lower Triassic (Szczukowskie Górki; Rubinowski 1971). Due to low zinc and copper content, these deposits should be classified as deposits of Pb, Ba-Pb, and Zn-Pb. Those contain small ore resources of lead, although with a high concentration of this metal (sometimes up to 40–50% in veins). Their occurrences were recognized only to 30–50 m depth. Chalcopyrite is rather rare in calcite or barite-galena veins.

In addition, numerous Zn-Pb ore manifestations have been found in Zechstein sediments of the western margin of the Paleozoic basement of the Holy Cross Mountains. However, due to the insufficient degree of their drilling, it would be difficult to estimate the size of the Zn-Pb resources. The publication of *Zasoby…* from 1993 (Bąk, Przeniosło, ed. 1993) prequalified the Zn-Pb resources to the ore occurrences; however *Zasoby…* from 1986 (Bolewski, Gruszczyk, ed. 1986) selected 5 prospective areas of approx. 39 km^2 (Fig. 5).

The most interesting selections were the galena ± sphalerite impregnations in the Zechstein sediments (synclines: Kajetanów and Gałęzice), the lower Triassic – Roethian sandstones (Piekoszowa Syncline), Muschelkalk limestones (Strawczyn Anticline), and marly-clay sediments of the Devonian along the section from Dąbrowa to Porzecze (e.g. including the abandoned deposit in Miedziana Góra). The Roethian carbonate sediments and Muschelkalk limestones displayed the impregnation of sphalerite, galena, and pyrite of metal content to 0.5% Zn and 0.15% Pb (Rubinowski 1986).

In Zechstein conglomerates and Triassic sandstones in Nieczulice near Rudki, intensive, disseminated galena mineralization occurs with a maximum concentration in individual

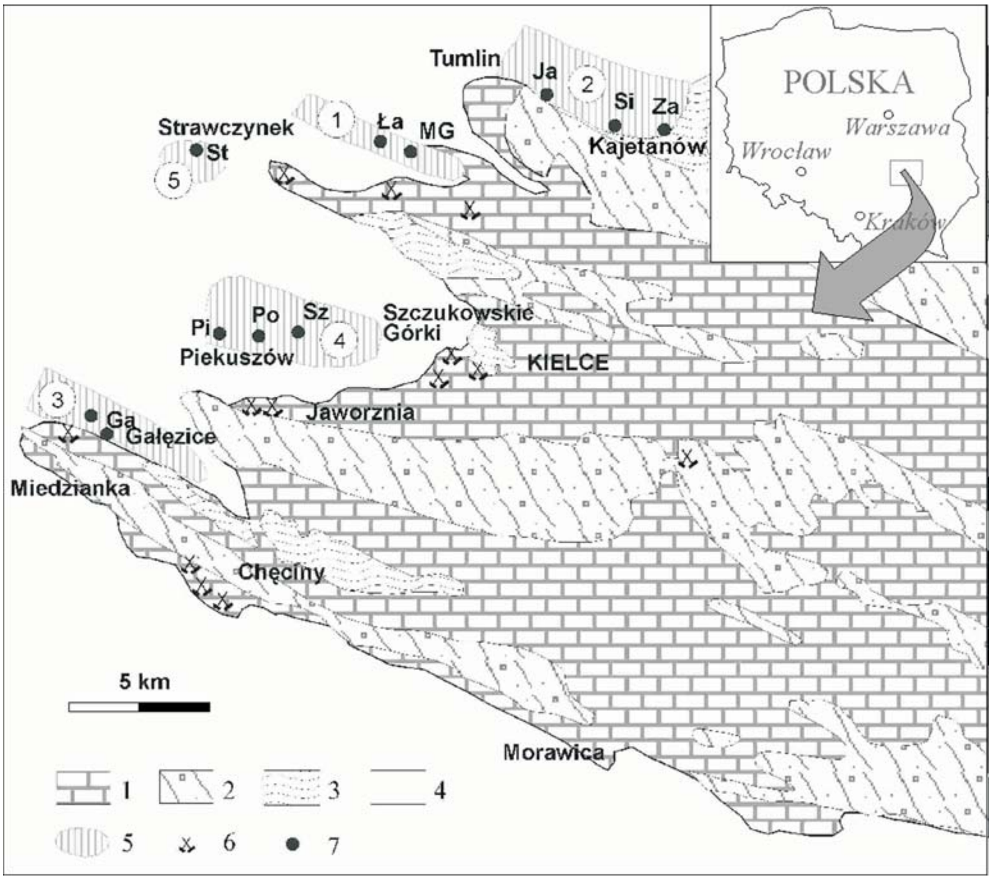

Fig. 5. Location of the prospective areas for Pb, Pb-Ba, Zn-Pb, and Cu-Pb deposits in the Holy Cross Mountains (Rubinowski 1986)

1 – sandstones, shale clays, and mudstones of older Paleozoic and Lower Devonian; 2 – limestones, dolomites, and marls of Middle and Upper Devonian; 3 – conglomerates, limestones, dolomites, and marls of Permian; 4 – Mesozoic cover rocks; 5 – prospective areas for Zn±Pb ores; 6 – place of the former exploitation of lead ores; 7 – boreholes with Zn±Pb mineralization: Os – Ostojów IG-1; Za – Zaciszowice IG-1, Si – Siodła IG-1, I – Jaworzna IG-1, MG – Miedziana Góra IG-1, Ła – Ławeczno IG-1 and IG-2, St – zone of the Strawczyn deposit, Pi – Piekoszów IG-1, Po – Podzamcze IG-1 and IG-2, Sz – Szczukowice IG-2, Ga – Gałęzice IG-6: Prospective areas: (1) formation of polymetallic sulfides of the Miedziana Góra type in Devonian carbonates; (2) formations of Zn, Pb, and Cu sulfides in Zechstein sediments in the Kajetanów Syncline and in the Piekoszów Syncline (3); (4) formation of disseminated Pb sulfides, locally associated with Zn and Cu minerals, and barite in clastic sediments of Lower Triassic in the Piekoszów Syncline; (5) formation of disseminated Zn sulfides locally in association with galena and barite in carbonates and marls sediments of Roethian and Muschelkalk in the Strawczyn Anticline

Rys. 5. Lokalizacja obszarów perspektywicznych dla wystąpień złóż Pb, Pb-Ba, Zn-Pb i Cu-Pb w regionie świętokrzyskim (wg Rubinowski 1986) samples up to approx. 2.4% Pb and 0.34% Zn (Nieć 1966; Rubinowski 1971). Similar manifestations are known from Zygmuntówka Hill. Moreover, Givetian limestones on Skiby Hill and Ołowianka Hill also displayed zones impregnated by galena and malachite. The first of them was the subject of exploitation in the beginning of the 19th century but recently only poor mineralization left.

5. Paleozoic and Mesozoic formation in Sudetes and on the Fore-Sudetic

In the Sudetes, silver-bearing galena ores were subject to exploitation from the middle ages to the early 20th century. Lead ore (galena) was mined mainly from small sulfide ± quartz ± calcite ± barite vein type deposits with limited content of Zn, Cu, and Fe (Srebrna Góra, Bolesławów, Radzimowice, Miedziana Góra, Czarnów, Lutynia, Marcinków, Boguszów, and others) (Konstantynowicz 1965; Fedak, Lindner 1966; Dziekoński 1972; Paulo 1972; Jerzmański 1976; Mikulski 2005, 2007, 2010; Paulo, Strzelska-Smakowska 2000). The deposits of sulfide ores have a polymetallic character and are associated with tectonic zones, mainly within the folded and metamorphosed rocks of the Paleozoic basement and in the zones of their intimate contact with late-Variscan granitoid intrusions. In these zones, both in the Sudetes and on the Fore-Sudetic Block many such deposits formed, but only those outcrops at the surface were discovered and exploited. The depth of the operations in most deposits does not exceed 200 m. The chances of finding new, polymetallic vein type deposits are significant, though due to their vein form and low resources considerably limited.

Another type of zinc-lead deposits, which can be expect in Lower Paleozoic volcanic complexes of Lower Silesia, can be volcanic deposits of the SEDEX-type. In Wieściszowice a pyrite deposit has been documented (Jaskólski 1964) in the vicinity of which other deposits of a polymetallic type could form, for example massive sulfides with a high percentage of pyrite, sphalerite, and galena (e.g. in the volcanic formation from Leszczyniec). Similarly, in the Eastern Sudetes on the Polish side of the border deposits of massive sulfides can be expected similar to those occurring in the Czech Republic in the Paleozoic rocks in Zlaté Hory or Horní Benešov (Cwojdziński et al. 2008).

Insufficient cataloging of the deep geological structure of the Sudetes and Fore-Sudetic Block does not allow for assessment of the possibilities of occurrence of the small but relatively wealthy and genetically diverse Zn and Pb sulfide ores at greater depth and in the vicinity of formerly operational mines.

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OBSZARY PERSPEKTYWICZNE I HIPOTETYCZNE RUD CYNKU I / LUB OŁOWIU W RÓŻNYCH TYPACH ZŁÓŻ W POLSCE (Z WYŁĄCZENIEM GÓRNOŚLĄSKIEGO OKRĘGU RUD ZN-PB)

S ł o w a k l u c z o w e

Złoża rud Zn-Pb, zasoby, obszary perspektywiczne i hipotetyczne

S t r e s z c z e n i e

Największe szanse na udokumentowanie zasobów perspektywicznych złóż rud Zn-Pb w Polsce występują w obszarze o powierzchni około 2000 km^2 usytuowanym na północ od udokumentowanych złóż siarczkowych Zn-Pb regionu zawierciańskiego. Wydzielone zostały tam cztery rejony perspektywiczne dla wystąpień złóż rud siarczkowych Zn-Pb typu Mississippi Valery Type (MVT) w utworach węglanowych triasu (wapień muszlowy) i dewonu. Za najbardziej obiecujący uznano obszar na NW od Myszkowa oraz obszar na SE od Koziegłowów.

Jednak ze względu na słabe rozpoznanie wiertnicze zasoby rud Zn-Pb są trudne do oszacowania. Celowe jest przeprowadzenie dalszych prac geofizycznych (np. metodą IP), które w przypadku pozytywnych wyników należałoby rozpoznać wierceniami.

W cechsztyńskiej formacji miedzionośnej na monoklinie przedsudeckiej (wokół obszaru złożowego Lubin--Sieroszowice), na peryklinie Żar (na SW od Zielonej Góry) i w niecce północnosudeckiej (wokół złóż Konrad i Lena-Nowy Kościół oraz na N od Zgorzelca) znanych jest kilka obszarów występowania bogatej mineralizacji Pb-Zn. Jednak ze względu na dużą głębokość zalegania mineralizacji, okruszcowanie to może stanowić jedynie kopalinę towarzyszącą wydobywaną przy okazji eksploatacji rud Cu-Ag. Jednak pomimo znacznych zasobów cynk jak dotychczas nie jest odzyskiwany w procesach przeróbczych jak i metalurgicznych przez KGHM Polska Miedź S.A.

Liczne drobne wystąpienia mineralizacji Zn-Pb i Pb w Sudetach, G. Świętokrzyskich oraz w strefie kontaktu bloku małopolskiego z górnośląskim nie mają znaczenia ekonomicznego jednak stanowią ważne przesłanki dla dalszych poszukiwań, które mogą doprowadzić do odkrycia złóż siarczkowych Zn i/lub Pb, różnorodnych pod względem genetycznym (stratoidalne, hydrotermalne żyłowe i/lub brekcje, kontaktowo-metasomatyczne, SEDEX) jak i zasobowym.

THE PROSPECTIVE AND HYPOTHETICAL AREAS OF ZINC AND/OR LEAD ORES IN DIFFERENT TYPES OF DEPOSITS BEYOND THE UPPER SILESIA ZN-PB ORE DISTRICT IN POLAND

Key words

Zn-Pb ore deposits, resources, prospective and hypothetic areas

Abstract

The best chance to document new Zn-Pb ore deposit resources in Poland appear in the area of about 2,000 km^2 located to the north of the documented Zn-Pb deposits of the Zawiercie region in the Upper Silesia Ore District. Four prospective regions were isolated for the occurrence of Zn-Pb sulfide deposits of the Mississippi Valley Type (MVT) hosted by carbonaceous sediments of Middle Triassic (Muschelkalk) and Devonian. Of these, the most promising seem to be areas NW of Myszków and SE of Koziegłowy. However, due to poor drilling recognition the Zn-Pb ore resources are difficult to quantify. It would be appropriate to carry out further geophysical work (e.g. IP method) and, in the case of positive results, the anomalous areas should be the subject of drilling prospecting.

The Zechstein copper formation on the Fore-Sudetic Monocline around the Lubin-Sieroszowice deposits, the Żary Pericline, the North-Sudetic Basin (around the deposits Konrad and Lena-Nowy Kościół), and localities north of Zgorzelec display a few areas of rich Pb-Zn mineralization. However, due to the great depth of Pb-Zn ores deposition, they may only be considered as accompanying raw materials exploited on occasion during Cu-Ag ore extraction. Despite the considerable resources of zinc, so far this metal has not been recovered during tailings and metallurgical processing by KGHM Poland Copper S.A.

The numerous minor occurrences of Zn-Pb and Pb sulfides in the Sudetes, Holy Cross Mountains, and contact zone of the Małopolska and Upper Silesian blocks do not have economic importance, though they constitute important grounds for further exploration which may lead to the discovery of Zn and/or Pb sulfides deposits, variable either for genetic type (stratoidal, hydrothermal veins and/or breccia, contact-metasomatic and SEDEX) or raw mineral resources.