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POLYMETALLIC MINERALISATION OF ROCKS FROM VARIOUS "ORE DEPOSITS" OF THE KŁODZKO AREA – PROSPECTS FOR ORE DETECTION

Abstract: The metamorphic rocks of the eastern part of the Orlica-Śnieżnik Dome comprise some polymetallic ore deposits: e.g. Złoty Stok, Lutynia, Travna, Marcinków, Kletno, Janowa Góra as well as numerous ore mineral occurrences in Orłowiec, Karpno, Mąkolno, Nowy Waliszów, Bolesławów. This ore mineralisation is supposed to be the effect of hydrothermal magmatic fluids. In order to determine the origin of the fluids ore microscopy as well as S^{32} and S^{34} isotope analyses were carried out on samples from the chosen "ore deposits". Samples of galenite (Lutynia, Marcinków) and pyrrhotite (Złoty Stok) were used for the sulphur isotope investigations. Ore minerals occurring in Lutynia and Marcinków contain sulphur what suggests their pseudohydrothermal origin whereas the ones present in the Złoty Stok deposit are clearly of juvenile character. The presence of a batholite may be assumed on the depth of 1-1.5 km that was the source of energy necessary to mobilise ore-bearing hypabyssal fluids. The batholite may offer great prospects for detection of typical magmatic and postmagmatic ore deposits, i.e. pegmatitic, skarn, pneumohydrothermal, located in the epi- and acrobatholitic zones.

Keywords: ore minerals, vein rocks, ore mineralisation, ore-bearing, pseudohydrothermal solutions, polymetallic deposits, polymetallic fluids

INTRODUCTION

In the metamorphic rocks of the eastern part of the Orlica-Śnieżnik Dome there occur disused polymetallic "ore deposits" e.g. Złoty Stok, Lutynia, Travna, Marcinków, Kletno, Janowa Góra (Traube 1888, Petrascheck 1933, Banaś 1964, Świętnicka-Goldsztejn 1976, Wołkowicz 1996, Muszer 1997) as well as numerous ore minerals occurrences as Orłowiec, Karpno, Mąkolno, Nowy Waliszów, Bolesławów (Hintze 1904, Petrascheck 1933). The rocks in these localities are generally represented by vein and lenticular-vein rocks or tectonic breccias. Many "deposits" and local occurrences are associated with systems of old, mainly Variscian, dislocations (Banaś 1965, Don 1964, Don et al. 1990, Muszer 1997). The presence of ore mineralisation in the rocks of this part of the Orlica-Śnieżnik Dome poses a problem of the origin of the hydrothermal fluids. The fluids may be of juvenile character (hydrothermal sensu stricto), meteoric or postmetamorphic (related to regional metamorphism processes).

This research aimed at the determination of the origin of the polymetallic fluids in chosen localities of the research area as well as at presenting the concept for ore

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prospecting in the area of the eastern part of the Orlica-Śnieżnik Dome.

MATERIAL AND METHODS

In order to determine the origin of the hypabyssal hydrothermal fluids microscopic investigations of ore minerals and S^{32} and S^{34} isotope analyses were carried out on samples from chosen "deposits", i.e. Lutynia, Marcinków and Złoty Stok. Samples of galenite (Lutynia, Marcinków) and pyrrhotite (Złoty Stok) were used for the studies. Polished samples were prepared from the ore-bearing rocks using diamond polishing pastes and standard Struer-polishing cloths. Then the samples were investigated in a reflected light by means of a microscope to measure basic optical and physical diagnostic properties of the ore minerals (Uytenbogaardt, Burke 1971; Ramdohr 1975, Piestrzyński 1992, Muszer 2000). To confirm the microscopic identification of the ore minerals a Nikon photometer (Photometer P101), SiC-858 and metallic Si as reflectivity standards and a PMT-3 microhardness tester were used. Point analyses were carried out using a Philips scanning electron microscope SEM-515. Point analyses were performed in the Institute of Low Temperatures and Structure Research at the Polish Academy of Sciences in Wrocław. Isotopic composition of sulphur was investigated in the Mass Spectroscopy Laboratory at the Institute of Physics, Maria Curie – Skłodowska University in Lublin.

RESULTS AND DISCUSION

Mineral succession observed in galenite-sphalerite ore-bearing rocks from the area near Lutynia (Philipp mine) shows features of precipitation from liquid-gaseous solutions. In quartz, quartz-calcite veins and tectonic breccias primary ore minerals: arsenopyrite, löllingite, pyrite, chalcopyrite, sphalerite, galenite, freibergite and haematite and secondary ones: acanthite, goethite, anglesite, cerusite, pyromorphite, mimetesite, covellite and malachite were detected (Muszer 1997).

Ore mineralisation of the breccias and veins accompanying the faulting zones near Marcinków may be disseminated or is developed in the forms of small local incrustations and nests. Galenite is a major ore constituent accompanied by sphalerite. Rutile, pyrite, arsenopyrite, bravoite, gersdorffite, chalcopyrite, bournonite and freibergite are present in the investigated rocks in minor amounts. Weathering led to the formation of zoned covellite-anglesite-cerusite aggregates, hydrated Cu carbonates (malachite, azurite), marcasite and goethite. According to Wołkowicz (1996) the ore mineralisation of the veins are related to the hydrothermal activity originated from the same source as the igneous rocks known from the Lądek-Śnieżnik metamorphic complex.

Telescoping of ore minerals paragenesis near Złoty Stok is related to various stages of ore-forming processes. The sedimentary-metamorphic stage is associated with ilmenite, rutile, magnetite, pentlandite, chalcopyrite, pyrrhotite, sphalerite, löllingite, arsenopyrite and pyrite. Tungstates, native bismuth, gold, copper, platinum and silver, galenite, löllingite, arsenopyrite, pyrite, chalcopyrite,

haematite, pyrrhotite, magnetite, uraninite, glaucodot and cubanite are related to the pneumohydrothermal and hydrothermal stages (Muszer 1997).

Sulphur isotope analyses of galenite from Lutynia and Marcinków (Fig. 1) showed highly negative values of S^{34} vs. S^{32} with the average close to –10 for both localities. In the samples from Lutynia and Marcinków δS^{34} ranged from –10.7 to –9.6 and from –10.5 to –9.5 respectively. The results indicate unequivocally that sulphur in galenite from Lutynia and Marcinków could not come from postmagmatic juvenile fluids related to a hypabyssal intrusion. The analyses of sulphur content in pyrrhotite from Złoty Stok showed δS^{34} between –2.28 and +0.85. The presented results indicate that sulphur in sulphides and sulpharsenites from the Złoty Stok deposit may be of mixed nature. A part of the sulphur could be juvenile (postmagmatic), related to the magma of the Kłodzko-Złoty Stok granitoids while the rest may be a result of incorporation of older generations of sulphur-bearing ore minerals by the migrating magma.

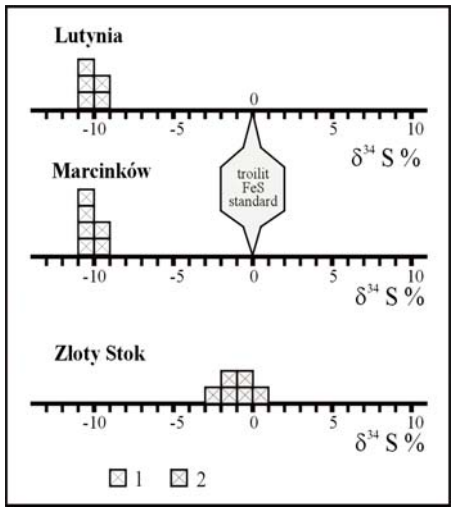

Fig. 1. Diagram of sulphur content in galenite (Lutynia, Marcinków) and pyrrhotite (Złoty Stok). 1- galenite analysis, 2 – pyrrhotite analysis.

CONCLUSIONS

The presence of mesothermal ore minerals in Marcinków and Lutynia may suggest the possible presence of higher temperature ore mineralisation in the rocks below the ground level. Metals and sulphur present in the sulphides come from the rocks of the Stronie Formation. Nevertheless the process that initiated the migration of metals is not related to the fluids generated during regional metamorphism. The fluids containing metals are younger and used Variscian dislocations as migration paths in the surrounding rocks. Heat necessary for the mobilisation of metals and sulphur is associated with a batholite probably present at the depth about 1-1.5 km. The presence of the granitic batholite under the Lądek-Śnieżnik metamorphic complex was already postulated by Bederke (1927). The batholite offers great prospects for discovering ore deposits of typical magmatic or postmagmatic character, i.e. pegmatitic, skarn and pneumohydrothermal deposits located in the epi and acrobatholitic zones.

Ore mineralisation in the Złoty Stok area is different. It was formed in clearly higher temperatures than the occurrences described above and its position is clearly asymmetric in relation to the batholite. Juvenile and hypabyssal fluids may suggest the presence of similar mineralisation type under the Bardzkie Mts. in the form of pneumohydrothermal veins. Evidence of the presence of such ore minerals in the

metasomatically altered rocks is found in Bardo Śląskie (Mikulski 1998).

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