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SULPHUR ISOTOPE COMPOSITION OF SULPHATE MINERALS FROM THE LUBIN COPPER MINE, SW POLAND

INTRODUCTION

Sulphate minerals frequently occur in copper (polymetallic) deposits of the Kupferschiefer Formation on the Fore-Sudetic monocline. Besides anhydrite representing sulphate facies of Zechstein evaporates belonging to the level of the Lower Werra Anhydrite, lying above the deposit, there were also found numerous occurrences of barite, anhydrite and gypsum associated with ore mineralization. Sulphur isotopic composition of these sulphates has not been thoroughly investigated so far, nevertheless it may provide a potential source of information necessary to explain some aspects of the genesis of copper deposits.

MATERIAL AND METHODS

Forty-one samples of sulphate minerals collected in the area of the Lubin mine were used for the isotopic studies. Barite samples were purified of possible sulphide admixture with aqua regia. Other sulphates were dissolved and precipitated to barium sulphate, which was subsequently transformed into SO_2 with the use of $NaPO_3$ and V_2O_5. Sulphur isotopic ratios were determined on modified MI-1305 mass spectrometer at Institute of Physics at Marie Curie - Sklodowska University in Lublin. Accuracy of the measurement exceeded 0,1‰. Isotopic ratios are expressed as $\delta^{34}S$ notations with respect to the CDT standard.

RESULTS

The analysed samples of the Zechstein evaporates were collected from the bottom part of anhydrite layer localised several tens of metres above the Kupferschiefer. They were mostly represented by fine-crystalline gypsum, which partly replaced anhydrite. Their sulphur isotopic composition is quite homogeneous (the values of $\delta^{34}S$ vary from 10,50 to 11,34‰; with the mean value of 10,99‰). Those values well correspond with typical composition of Zechstein evaporates. Very similar values (average 11,25‰) were also obtained for gypsum which forms lenses and pockets in Zechstein Limestone lying below the anhydrite horizon above the Kupferschiefer. Its sulphur isotope composition also indicates evaporatic origin although gypsum may have developed later as a result of replacement and recrystallization.

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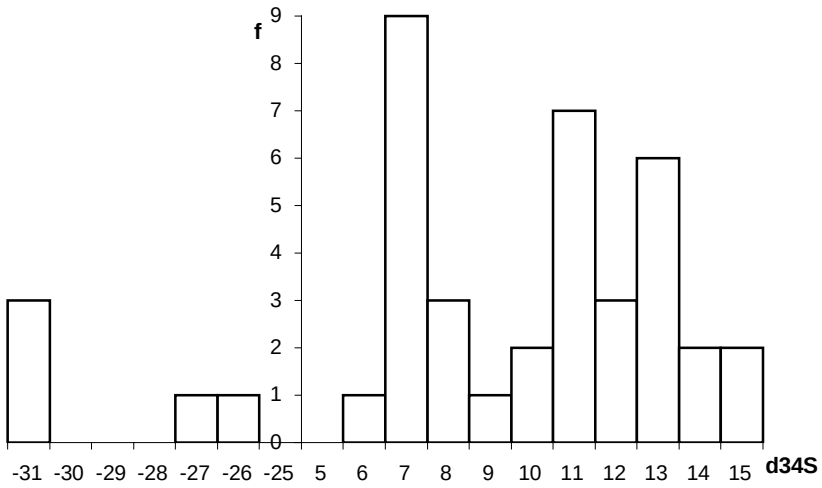

Fig. 1 Histogram of sulphur isotope composition of sulphate minerals, Lubin copper mine.

Barite, which is commonly found in the deposit, constitutes the majority of the analysed sulphate samples. It occurs within the Boundary Dolomite bed below the level of Kupferschiefer as well as in the higher lying limestones and dolomites of Zechstein Limestone. This barite forms veins and nests ranging from several millimetres to one metre in lengths. The veins are usually discordant to the rock stratification and often localised in fault zones. Their origin is referred to as epigenetic (Strengel – Martinez, 2001). Veins are composed of coarse-grained barite, which occassionally develops druses of euhedral crystals filling the caverns. At times barite is associated with calcite. Some veins are composed mainly of gangue minerals, whereas the others are more or less mineralised. Barite is accompanied by: chalcocite, chalcopyrite, bornite, digenite, tennantite-tetrahedrite as well as other rare minerals. The amount of these sulphides varies from microscopically recognisable traces to veins mostly composed of sulphide minerals. Sulphide-barite veins occur mainly in the around of Kupferschiefer. More abundant sulphide mineralization in Lubin mine is also attached to the part of marly Zechstein Limestone of 7-8 metre thickness, directly above Kupferschiefer. With growing distance from the Kupferschiefer, up and down the profile, the content of sulphides in barite veins decreases. In the upper part of the Zechstein Limestone as well as in the bottom of the Boundary Dolomite the veins become barren.

Barite from the sulphide veins is characterized by quite homogeneous isotopic composition of sulphur. The values of $\delta^{34}S$ are from 6,91 to 7,57‰ (with the mean value of 7,29‰ for 10 samples). More scattered and generally higher values of $\delta^{34}S$ were found in barite from the barren veins. Their $\delta^{34}S$ values range from 8,18 to 15,66‰ (with the mean value of 12,66‰ for 18 samples). Isotopically heavier sulphur was found both in barite veins from Zechstein Limestone above the Kupferschiefer (the mean value of 12,38‰ for 15 samples) and from Boundary Dolomite below the Kupferschiefer (the mean value of 14,09‰ for 3 samples).

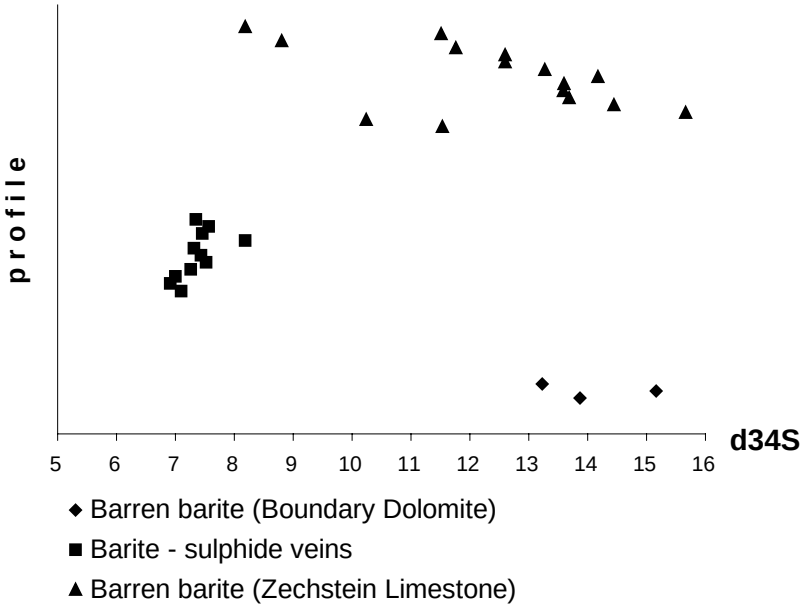

Fig. 2. Dependence of sulphur isotope ratios in barite on its position in geological profile and degree of mineralization.

Sulphur isotopic composition of barite may reflect the evolution of composition of parent hydrothermal solutions. Enrichment in heavier sulphur isotope of barren barite occurring at the edges of stratoidal ore body we interpret as a result of changes in redox potential of parent solutions rather than an evidence of derivation of sulphur from many sources.

Different isotopic composition of sulphur was found in sulphate minerals resulting from sulphide oxidation. In the old mine workings efflorescences and crusts of secondary sulphates such as chalcantite and epsomite are found. Those minerals reveal isotopically very light sulphur, typical of sulphide from the deposit (Sawłowicz, 1989). The value of $\delta^{34}S$ is –30,31‰ for chalcantite (the average for 3 samples) and –25,97‰ for epsomite (the average for 2 samples). They are the result of negligible sulphur isotopes fractionation in process of oxidation.

REFERENCES

STRENGEL-MARTINEZ M., 2001: Geneza utworów żyłowych towarzyszących polimetalicznym złożom rud miedzi monokliny przedsudeckiej. Doctor thesis, Arch. IGP (unpubl.).

SAWŁOWICZ Z., 1989: Isotopic composition of C, O, S in the organic-rich copper-bearing shale from the Kupferschiefer in Poland. Arch. Miner., 44 (1), 5-19.