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SULPHIDE MINERALIZATION IN UPPER WESTPHALIAN COAL SEAMS FROM THE EASTERN PART OF THE UPPER SILESIAN COAL BASIN

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Abstract: Morphologically diversified sulphide mineralization has been found in No. 301 and 302 coal seams (Westphalian B). The main sulphide is pyrite which forms veinlets cross-cutting the sedimentary fabrics of the coal, encrusts the cellular structures and intergrowths with oxysulphides. Two generations of pyrites were observed: the preceding and the following the oxysulphides. Pyrite composition is stoichiometric, rare admixtures are up to(in wt.%): Mn - 0.19, Co - 0.48, Ni - 0.42 and As - 1.41.

Iron oxysulphides contain up to 35.06 wt.% oxygen. Their composition varies between FeS_2O and FeS_2O_3. Increased contents of As (up to 1.46 wt.%) and Pb (up to 0.96 wt.%) were detected.

1. Introduction

The Upper Westphalian coal seams from the eastern part of the Upper Silesian Coal Basin (USCB) show relatively high contents of sulphur. In several seams from the Siersza mine average total sulphur (S_t^a) is about 2.5 wt.% [1]. Analyses of some other seams show even higher values.

The following paper presents results of studies on sulphur-carrying mineralization in No. 301 and 302 hard-coal seams (Westphalian B, Cracov Sandstone Series) worked at the Siersza and Jaworzno mines (Fig. 1). The funds for the project were provided by the Committee of Scientific Research (KBN).

2. Sulphide mineralization in No. 301 and 302 seams

Results of studies on mineralization in No. 301 seam from the Siersza mine have already been reported during XXth Symposium "Geology of Coal-bearing Strata in Poland" and published in the Proceedings [2]. Below, data obtained from No. 302 seam at the Jaworzno mine are presented with the reference to the earlier work.

Both studied coal seams have thicknesses of about 2.4 meters. No. 301 seam includes 12 tonstein intercalations whereas No. 302 seam - only 2 such interbeds.

From morphological point of view mineralization in both seams is similar. Three macroscopically discernible types were observed:

1. veins,
2. mineralized fusain fragments,
3. isolated sulphide nests, inclusions and aggregates.

Sulphide veins are usually perpendicular to the bedding but oblique and parallel orientations were also noticed. The veins are en echelon, parallel and show variable spacings. Thickness varies from a fraction of millimeter up to 2 centimeters. Thinnest veinlets are observed in vitrinite shrinkage cracks (Fig. 2, distance

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from the bottom 120 and 220 centimeters) and do not continue to the surrounding lithotypes. Thicker veins penetrate into the adjacent coal (Fig. 2, distance 35 and 45 centimeters from the bottom). The length of veins perpendicular and oblique to the bedding observed at the surfaces of side of works and mine faces varies from several millimeters to 30-60 centimeters with the most common values between a dozen and about 30 centimeters. Density of veins
is different in the coal seams, in tonstein interbeds and in over- and underlying strata.

Thin veinlets are more common in those parts of the seams in which the vitrinite-rich lithotypes occur (i.e. clarain-vitrain, vitrain-clarain, durain-clarain, Fig. 2, distances 35 and 140 centimeters from the bottom) but are very rare in dull coals (clarain-durain, durain). The thick veins seem to be unrelated to the lithotypes.

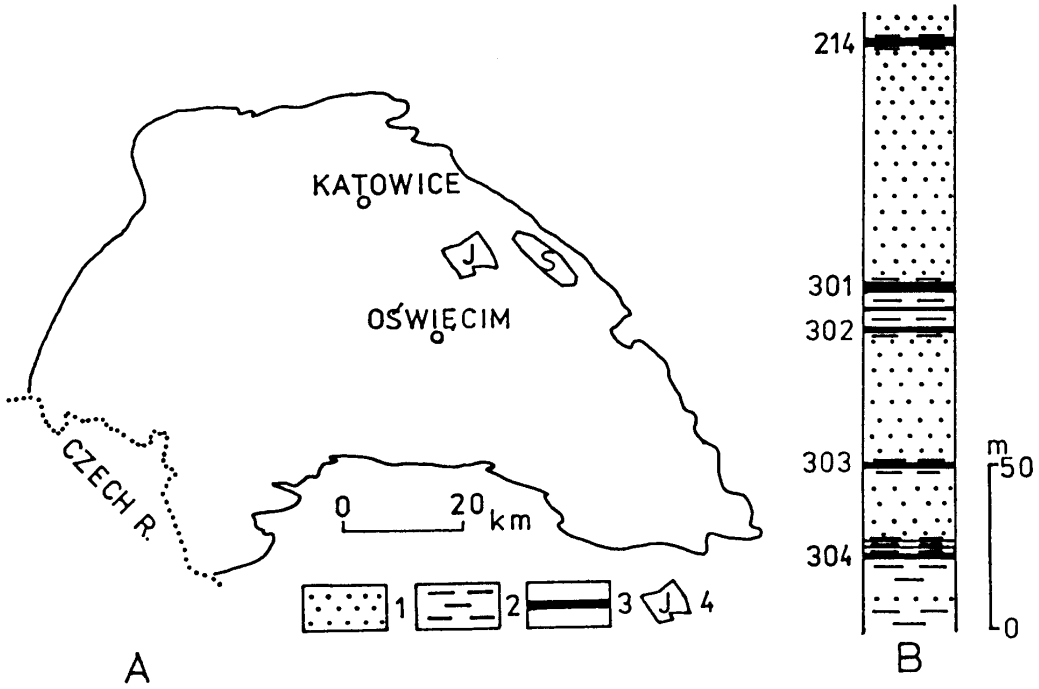

Fig.1. Localization of the Jaworzno and Siersza coal mines in the Upper Silesian Coal Basin (A) and stratigraphic position of the No. 302 and No. 301 coal seams (B). 1- sandstone, 2- claystone, mudstone, 3- coal seams (214 - 304 No. coal seams), 4- J: Jaworzno. S: Siersza coal mines.

Veins parallel to the bedding gradually pinch out. The perpendicular and oblique ones either pinch out or bifurcate. Sporadically observed cross-veins originated from contemporaneous precipitation of sulphides in the two, usually perpendicular fracture systems (Fig. 2, distance 190 centimeters from the bottom).

Both studied seams contain large amounts of fusain. Fig. 2 illustrates only the largest accumulations of this lithotype. Fusain forms fine shreds which accumulate in some parts of the seam and larger fragments which are unmineralized. Accumulations of large fragments were also noted. Some widespread accumulations (Fig. 2, distance 10 and 74 centimeters from the bottom) ale called ”fusain horizons”, other form small lenses. Such forms can be impregnated with sulphides (Fig. 2, distance 74 centimeters from the bottom). In No. 301 seam fusain is partly mineralized along a short distance at the contact with sulphide vein (cross-cutting of vein and fusain have not been observed) whereas other fusain horizon is completely mineralized although is does not contact the veins at the visible exposure surface.

Locally, small amounts of fine nests and inclusions of massive-textured sulphides were observed
at the topmost or bottommost parts of the seams (Fig. 2) or at the contacts with the enclosing rocks.

3. Sulphide mineralization in wall-rocks

Small sulphide accumulations of massive texture elongated concordantly with the bedding were rarely noticed in claystones both over- and underlying the coal seams. Similar forms were occasionally encountered also in clayey interbeds within the seams (e.g. tonsteins). However, the veins were not found in neither over- nor seams. Numerous veins do not continue from the coal to the tonsteins (Fig. 2, distance 66 centimeters from the bottom).

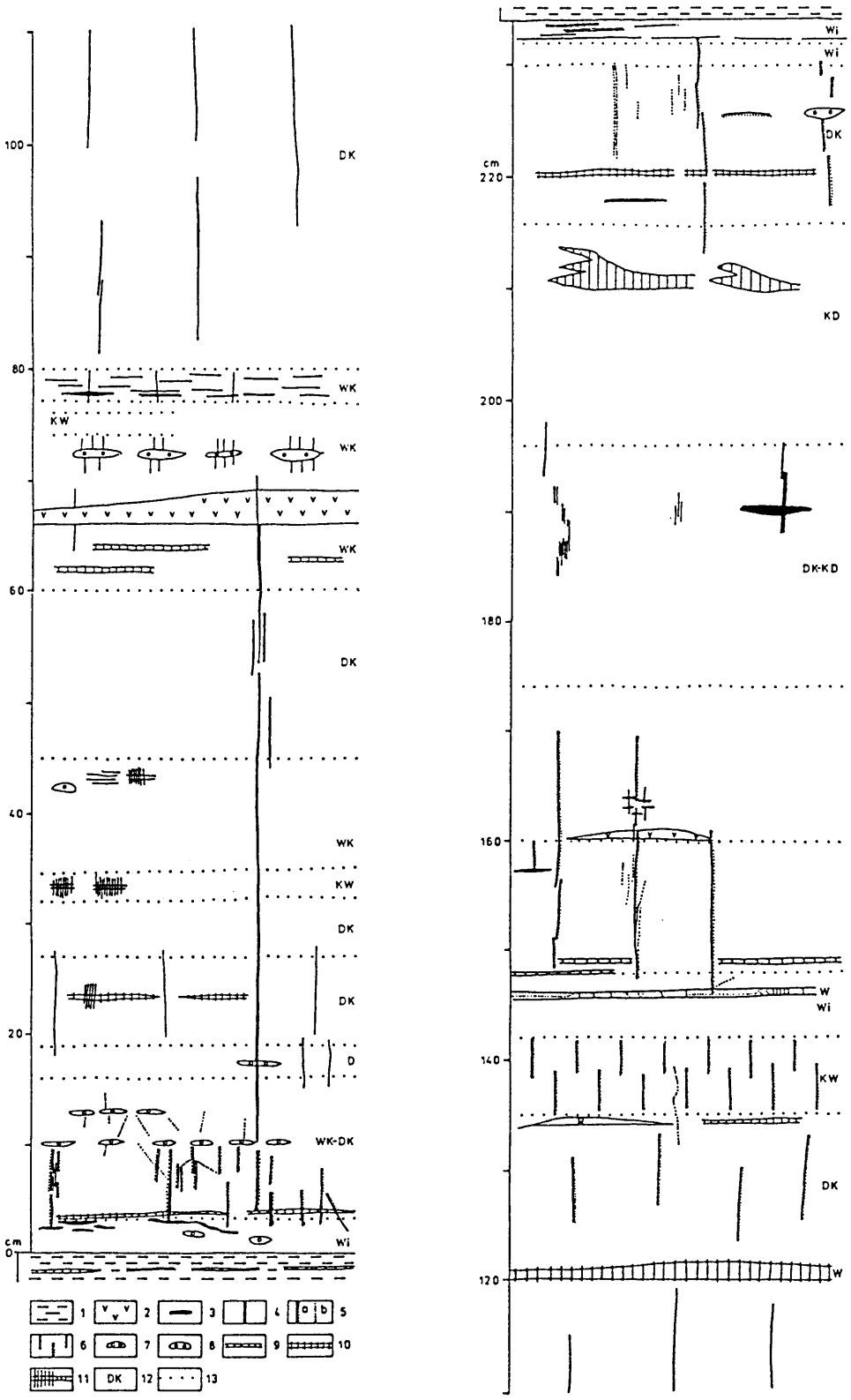

Fig.2. Sulphide and oxysulphide mineralization in No.302 coal seam from the Jaworzno mine. 1- claystone, 2- tonstein, 3- iron sulphide inclusion, 4- veinlets mainly of the iron sulphide, 5- iron sulphide and oxysulphide (a) or oxysulphide veilets (b), 6- coal with frequently iron sulphide and oxysulphide veinlets, 7- non-mineralized (soft) fusain, 8- mineralized (hard) fusain, 9- vitrain, 10- vitrain with thin sulphide and/or oxysulphide veilets, 11- mineralized coal, 12- lithotypes: W- vitrain, KW- clarain-vitrain, WK- vitrain-clarain, DK- durain-clarain, D- durain, R- retinite, Wi- clayey coal, 13- boundaries of lithotypes.

underlying claystones. Also the veins which cut the coal seams do not continue into the enclosing rocks. Rarely, the veins cross-cut the tonstein interbeds but thicknesses of such structures are much lower than those from the coal

4. Sulphide mineralogy and geochemistry

The principal sulphide present in No. 301 seam is pyrite. Two generations were distinguished under the microscope. The older generation is optically highly inhomogenic and intergrown with coal matter, clay minerals, quartz and dolomite. The younger generation is optically homogenic and commonly composed of marcasite instead of pyrite. Veinlets of younger generation cross-cut the older pyrite as well as the oxysulphides. The oxysulphides are, in turn, younger than older pyrite.

Chemical composition of pyrite is very close to stoichiometric FeS_2. Detectable admixtures are rare and include (in. wt.%): Co - <0.03-0.48, Ni - <0.03-0.33, As - <0.06-1.41 and Pb - <0.08-1.18. Most of studied grains did not reveal detectable amounts of trace elements.

Oxysulphides show variable optical properties under the reflected light. Relfectance changes from 17 to 35%. Species of chemical composition close to FeS_2O_3 have low reflectance whereas those close to FeS_2O show R values about 30%. Various oxysulphides form usually a mixture of submicroscopic grains which influences the observed reflectance. Main trace elements detected in oxysulphides are (in wt.%): Cl - <0.05-0.64, Co - <0.03-0.28, Ni - <0.03-0.26, Cu - <0.03-0.53, Zn - <0.05-0.81, As - <0.06-1.46 and Pb - <0.08-0.96. Hence, oxysulphides are more enriched in trace elements in comparison with pyrite.

Organic matter intergrown with sulphides reveals increased amounts of the following elements (in. wt.%): Al_2O_3 - 1.06-5.78, SiO_2 - 0.16-1.23, CaO - 0.12-4.12, ZnO - <0.03-0.74, As_2O_3 - <0.08-1.48, Fe_2O_3 - 0.65-5.19 and S - 0.76-4.95.

Carbonates which coexist with sulphides are later than the hosting coal.

5. Genesis

The age of sulphide mineralization found in the coal seams is variable. Impregnations of macerals, e.g. fusinite, semifusinite (hard fusain), coal-sulphide intergrowths elongated parallelly to the bedding of lenses and infillings of shrinkage cracks in vitrinite were formed in the first stage, during diagenesis. The sulphide veins formed in the second stage when degree of coal diagenesis was close to the recent. It is evidenced by the lack of the effects of coal compaction on cross-cutting sulphide veins. In the third stage sulphides were transformed into oxysulphides due to weathering. In some areas oxysulphides occur in the same amounts or even prevail over sulphides in the vein composition.

References

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