

HYDROGEOLOGICAL CHARACTERISTICS
OF THE LOWER SILESIAN COAL BASIN

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ABSTRACT

The Lower Silesian Coal Basin is one of the smaller mining areas in Poland in which there are 5 coal-mines. The hydrogeological conditions in this basin are not difficult. The Upper Carboniferous formation are represented by the complex sandstones and conglomerates with thinner layers of claystones and mudstones with coal seams. The overburden of Carboniferous deposits is formed with Permian and Quaternary sediments. The Carboniferous layers are recharged with atmospheric and surface waters infiltrating into rock massive. The area of direct infiltration is the predominant part of the Coal Basin. The coal mining since over hundred years caused pretty complete dewatering of the Carboniferous rock massive. The oscillations in amount of precipitation cause changes in water inflow to mine workings and plays important role in controlling the relation between amount of water inflow to the mines and precipitation. The chemical composition of mine waters is connected with its origin and the length of water migration paths through abandoned workings.

The Lower Silesian Coal Basin is situated in the border part of the inner Sudeten trough. It forms a deep Carboniferous syncline, opened eastward. The area of outcrops of Carboniferous beds in the north - eastern part of the syncline is called the Wałbrzych region and the similar area in the south-eastern part of the syncline is defined as the Nowa Ruda region. Following stratigraphic series take part in formation of the syncline: Carboniferous, Permian and Quaternary.

The Upper Carboniferous formation is represented by the complex of sandstones and conglomerates with thinner layers of claystones and mudstones within occur coal seams. It is divided into two series, namely the bottom series called wałbrzyskie beds (Namurien A) and the upper series called żaclerskie beds (Westphalien A and B). Between these two series occur the barren measures białokamińskie beds (Namurien B and C).

The roof part of Carboniferous forms glinickie beds (Westphalien C and D) and ludwikowickie beds (Stephanien) composed of conglomerates, sandstones, mudstones and claystones. The carboniferous deposits are intruded by numerous porphyrous veins and cut with faults of significant vertical displacement. The faults are in majority parallel to the border of the Carboniferous syncline.

The base of Upper - Carboniferous strata form the Lower - Carboniferous shaly deposits and the metamorphic rocks of older bedrocks. The overburden of Carboniferous deposits is formed with Permian conglomerates, sandstones and red-brown shales (Rotliegendes). The Permian deposits are overlaid by Quaternary sands, gravels and clays, which occur chiefly in the river valleys and surface depressions.

In the Wałbrzych region occur two asymmetric synclines: the eastern one - sobięcińska and the western one - gorecka. The two synclines are divided by the diapir anticline of Chełmiec. This anticline has been formed as an effect of the porphyry intrusion, that partly cutted the Carboniferous layers and partly penetrated between them. Because of the complicated tectonics the dips of layers in this region vary from nearly horizontal to very steep. For instance in the eastern part of gorecka syncline overturned beds occur.

In the Nowa Ruda region the Carboniferous outcrops form two parallel synclinal zones. These zones are shifted one to another along the big fault of about 1000 m vertical displacement, situated parallelly to the border of the chief Carboniferous syncline.

In the Carboniferous deposits of both regions sandstones and conglomerates prevail over claystones and mudstones. The content of coarse - grained material amounts to:

17 + 65% in wałbrzyskie beds,

80 + 100% in białokamięskie beds,

50 + 100% in żaclerskie beds. (Augustyniak, 1970).

The Carboniferous sandstones and conglomerates are usually weakly cemented and fragile. They are usually coarse - grained and have high porosity (up to 25%) and permeability.

From the hydrogeological point of view the Carboniferous layers have good permeability and storativity properties. The high water conductivity of the layers is augmented by the strongly developed faulty tectonics and the prolonged mining. Alike to the fault' fractures, the porphyry intrusions intersecting Carboniferous deposits form the ways of hydraulic contact between particular layers.

The Carboniferous layers are recharged with atmospheric and surface waters infiltrating into rock massive. The infiltration of waters is facilitated by the synclinal structure of the basin as well as the numerous fractures and fissures of the tectonic and mining origin.

In the Wałbrzych region the permeable Carboniferous deposits are almost completely uncovered and on the predominant part of the area they outcrop on the ground surface. In this part the waters from precipitation and from local streams may infiltrate directly into the rock massive.

In the Nowa Ruda region the area of direct infiltration, where

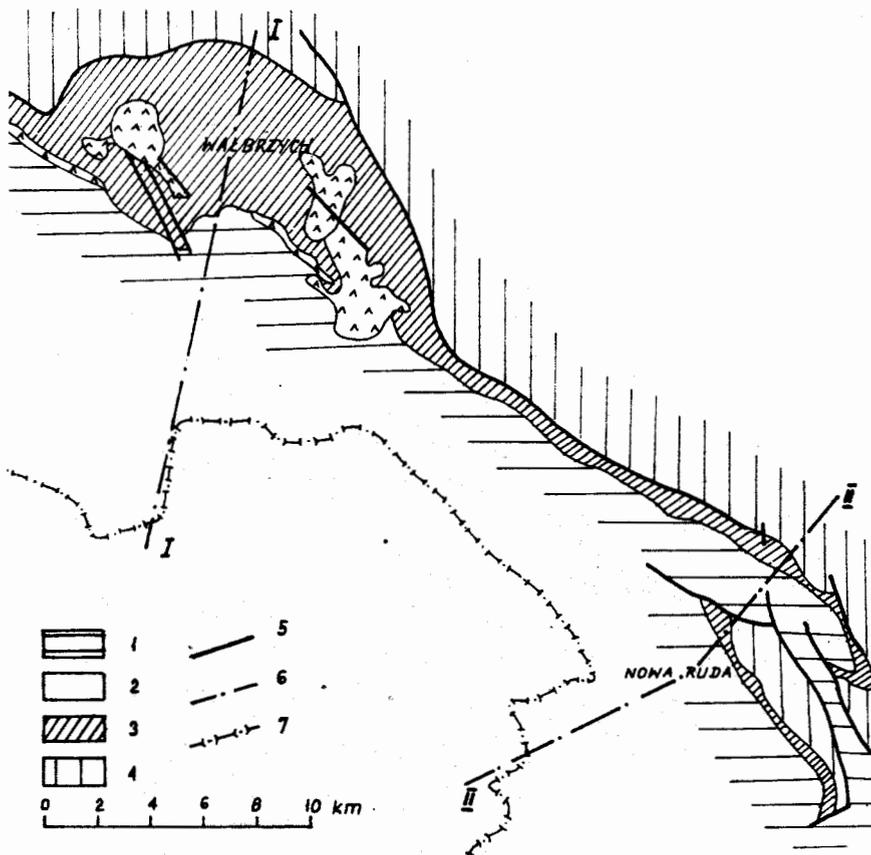


Fig. 1. Geological sketch of the Lower Silesian Coal Basin

1 - non-productive sediments of Upper Carboniferous and of younger formations, 2 - vulcanites in Upper Carboniferous, 3 - productive formations of Upper Carboniferous (Namurien A, B, C and Westfalien A, B), 4 - formations of Lower Carboniferous and the crystalline bedrock, 5 - fault, 6 - line of schematic cross-section, 7 - national boundary

the Carboniferous outcrop are covered with thin Quaternary overburden is small. In the remaining part of the region the Carboniferous deposits are covered with thick series of Permian sandstones and claystones (Rotliegendes) which fill the Carboniferous syncline. The water infiltration in this part is rendered more difficult.

The coal mining carried out in presented hydrogeological conditions since over hundred years caused pretty complete dewatering of the Carboniferous rock massive. The Carboniferous layers being cut with mining working are in general dry; the small quantities of water inflow to the workings as the longwalls advance.

The water intrushes appear sporadically in proximity of contact zones with porphyry intrusions. These intrushes, of variable discharge, originate from the long distance fissure circulation. Thus the quantity of water in Carboniferous depends chiefly on precipitation depth and on the flow rate in surface water-courses. The mean annual precipitation on the coal basin area is higher than average in Poland and amounts to 770 mm. The land topography is highly diversified, what permits the quick outflow of the precipitation waters. There are a lot of hills; their altitudes in southern part of the basin reaches up to 700 m above sea level, while the maximum relative elevation is 200 m. The underground retention of precipitating water is estimated at about 40%.

The oscillations in amount of precipitations cause changes in water inflow to mine workings. The water inflow into the mines in the Wałbrzych region have reached 10 - 17 m³/min. The changes of the flow rate in this region are larger than in coal mines in Nowa Ruda region, in which the water inflow have reached 3 - 7 m³/min. The large changes of flow rate into the coal mines in the Wałbrzych region is caused among others by so called gobs' retention (Opyrchał and others, 1972). Abandoned workings form underground retention reservoirs where increased amount of precipi-

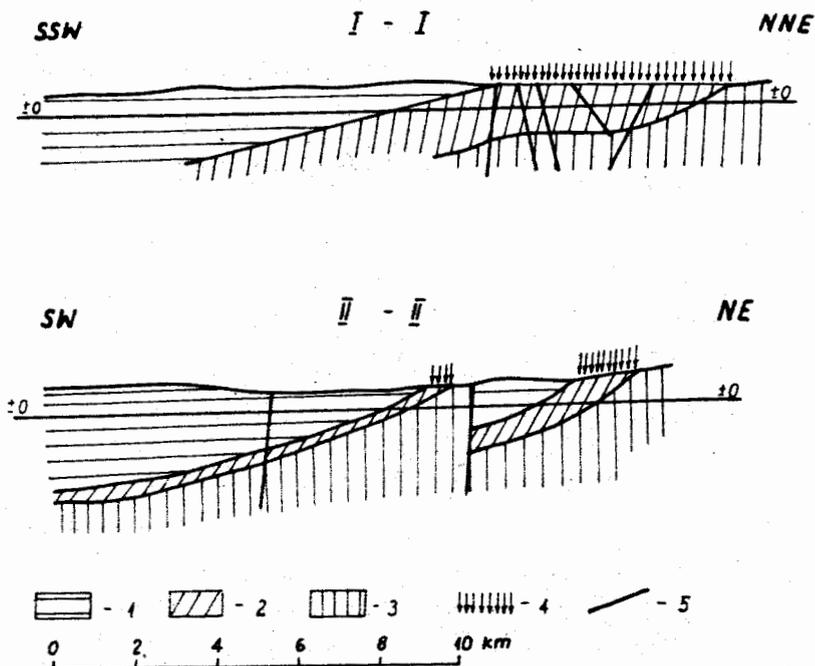


Fig. 2. Schematic cross-sections of the Lower Silesian Coal Basin
 1 - non-productive sediments of Upper Carboniferous and of younger formations, 2 - productive formations of Upper Carboniferous (Namurien A, B, C and Westfalien A, B), 3 - formations of Lower Carboniferous and the crystalline bedrock, 4 - the area of waters infiltration, 5 - fault

pituation water is collected. After some time the water outflows to active workings through the net of tectonic and postexploitation fissures. Widely spread network of old workings that occur down to depth of over 500 m, plays important role in controlling the relation between amount of water inflow to the mines and pre-

precipitation. Therefore in the Wałbrzych region, where the direct infiltration area is very large and the rock massive is intersected by numerous old workings, the correlation between the precipitation rate and mine water inflow is more close, than in the Nowa Ruda region, where the infiltration area is not so large and the old workings are less numerous.

The chemical composition of mine waters is connected with its origin. The general mineralization increases with depth, changing from some decimal to about 8 g/dm^3 . The infiltrating waters have a low content of free CO_2 ; the content of SO_4^{2-} ion increases as the pathes of water migration through old workings become longer.

With depth and mineralization increase, the chemical type of water changes from $\text{HCO}_3\text{-SO}_4\text{-Ca-Mg}$ to $\text{SO}_4\text{-Na}$ and locally to $\text{SO}_4\text{-Cl-HCO}_3\text{-Na}$. The different chemical feature have the long-way circulation waters, associated with the porphyry intrusions. These waters, often having pharmaco-dynamical qualitie, are in general of $\text{HCO}_3\text{-Ca-Na-Mg}$ or $\text{HCO}_3\text{-Na}$ type and contain the free CO_2 reaching 2 g/dm^3 . Usually they don't contain the SO_4^{2-} ion or its content is very low.

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