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title: **Unscrambling the mine dewatering riddles in highly inter connected multiple mine workings in the Donbass Coal fields, Ukraine**

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Over the past century of coal mining in the Donbas Basin of eastern Ukraine, significant environmental changes have taken place, not least among them the dewatering of water saturated strata between the coal bearing seams.

The Donbas Basin is one of the major late Palaeozoic coal and methane provinces in the world. The accumulation of coal in the Basin is associated with recurring swampy coastal-marine plains, large peatbogs, transiting to shallow marine environments which resulted in accumulation of thick (up to 14 km) paralic coal-bearing Carboniferous (post-Early Visean) formation, containing more than 300 coal seams and intervening sandstones. In the Middle Carboniferous, marine limestone layers deposited in shallow sedimentary conditions, recur at regular intervals of 10–100 m, and sometimes lie directly on coal seams. The Basin hosts significant economic accumulations of coal, methane and metals, and is, in fact, one of the most intensively exploited in the Europe (Privalov et al., 2002).

The mines of the Donbass region operate at depths ranging between 220 and 1400m and the average coal mining depth is 620 m. Approximately 53% of the coal mined from the Donetsk Basin is from depth less than 600 m, and the remaining is exploited from the intervals of 600–900 m, and from 900–1,200 m. Ten mines operate at depths of 1,000 m. Generally the Carboniferous sequence contains from 10–14, to 30–40 workable seams. Major coal reserves are accumulated in coal seams with thickness of 0.6 to 1.0 m.

Aquifers in the Donbass Coalfield Basin are found in of the Quaternary deposits, at times confined by low permeability beds, and although yields are insignificant they are recharged through rainfall. Based on the example of Komsomolets Mine, major aquifers within the Palaeozoic sequence occur in the sandstone and limestone of the Carboniferous formations. Water abundance of the aquifers reduces with increasing depth, although this is counteracted by the permeable fractured zones. Coal strata occurring at depths greater than 500 to 600 meters are essentially water-free. The Chemical composition of waters changes from Ca–HCO_3, Ca–Mg–HCO_3 and Ca–Na–HCO_3 (at depths of up to 100 meters) to Cl–HCO_3 Na–Cl–SO_4 (deeper than 600 meters). Total dissolved solids increase with depth from 1300 mg/l to 1800 mg/l to 2000 mg/l to 2500 mg/l. In Skochinsky Mine, in the western part of the Basin, mineralisation may rise to 9000 mg/l.

Due to the intensity of the mining within the region, and the proximity of mine workings, over the years, access shafts and roadways between the mines have become interconnected. While the dewatering for individual mines was initially planned to provide dry working conditions for each mine, the interconnections now mean that the dewatering has to take account of groups of several mines. Further, within such a group iof mines, some have been exploited to completion and have ceased operations, others are still operating deeper or laterally displaced seams. With mine closure there is a preponderance to also reduce water pumping costs; however due to the interconnected nature and the fact that some mines are under State control, while others are in the process of being divested, the mine dewatering requirements have become increasingly complicated. The sub surface environment of mine shafts, roadways and long walls, is dewatered by collecting the aquifer water in series of underground storage tanks and then progressively pumping the water to higher elevations, finally pumping the water to the surface. As the restructuring of the Coal Sector in Ukraine proceeds, there is a requirement to make assessments of how to manage the very complicated system of dewatering.

This paper will illustrate the situation found in the mine dewatering system from Miuskaya closed mine, located close to the town of Snieznoye, which is the centre for pumping to maintain the dry

working conditions for several other currently working mines, such as Lutugina, Udarnik, Sniznianskaya, Woskhod and Remonskaya. The setting is the closed syncline of the Chistyakowo–Snieznianska sub basin, in which the hydraulic connections through the full vertical sequence is schematically illustrated in Figure 1. The plan of the location id illustrated in Figure 2.

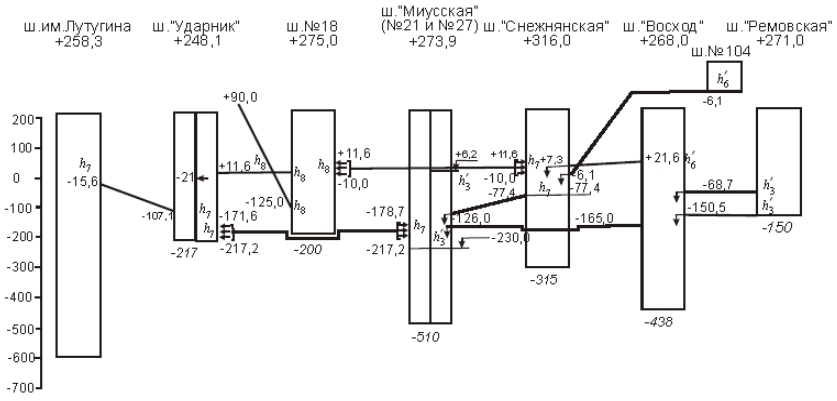

Figure 1. Schematic section of the interconnected mine dewatering system based around pumping from Miuskaya closed mine.

The Miuskaya mine shaft forms the main dewatering system for the whole complex of mines. The Remonskaya mine roadways are connected to the Wozkhod system, and the shallow aquifers feeding to the *h3* coal seams are discharged into it. Wozkhod is connected to Sniznianskakaya, which receives 125 m³/h of the flows. Between 40 to 60 m³/h arises from within Sniznianskaya, which is connected into the Miuskaya shafts. Mines no #21 and #27, shown on the plan (Figure 2) yield about 790 m³/h; the source of this large inflow is thought to be the fault that intersects the basin and the series of aquifers that are interspersed in the vertical section.

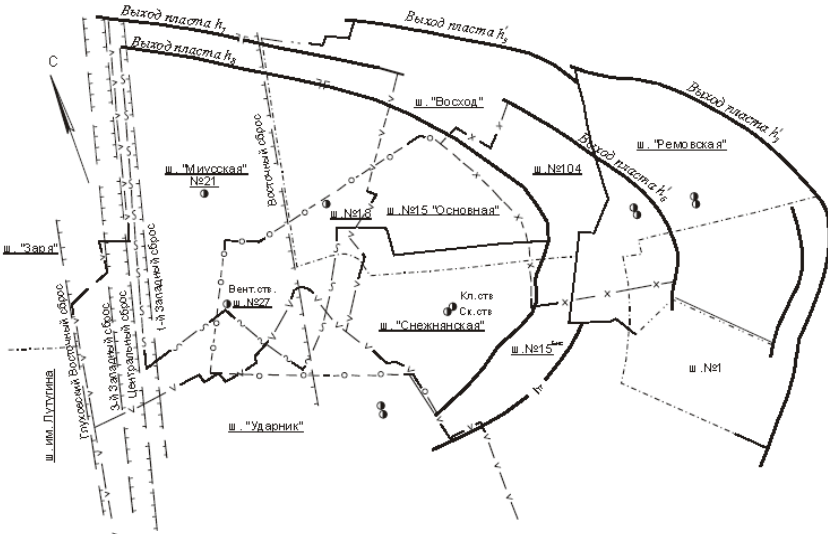

Figure 2. Plan of the Chistyakwo-Snieznianka closed syncline, showing mine locations.

The paper will discuss the assessment of the whole of the dewatering system and the solutions that have been adopted. Measures to reduce the volume of pumping, allowing the hydraulic levels to rise to acceptable depths without endangering the operations of working mines will be presented. Finally, a discussion of some of the institutional & management barriers to the operations of the Coal Sector will be outlined, as they affect the sound management of the environment.

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