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WATER MANAGEMENT CONSIDERATION IN THE LUBIN-GŁOGÓW CUPRIFEROUS BASIN

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Abstract: The Lubin-Głogów Cupriferous Basin is an area of intensive mining exploitation. The four active underground copper mines are: "Lubin", "Polkowice", "Sieroszowice" and "Rudna". In work are characterised topical states of hydrogeological conditions and are showed the directions of further protecting activities against hydrogeological degradation of this region. The mine-works progress, threats of water conditions and deposit's exploitation costs are dependent on the excess of the mineralized mine waters development method. The main purpose of all activities should be prevention of the ground and surface-waters against salinization. In this article drainage methods applied in copper mine and hydrogeological conditions changes caused by mining exploitation and deposit drainage were described. The purpose of research is to show hydrogeological threat which may be result of natural resources exploitation and to point at ways how to counteract these processes. Watering of natural resources deposits is an important economic problem so it requires suitable mining technology and proper water management application. Drainage of mine is most frequently made gravitationally or by mechanical pumping of water from each mine section.

Key words: natural resources exploitation, drainage, water management

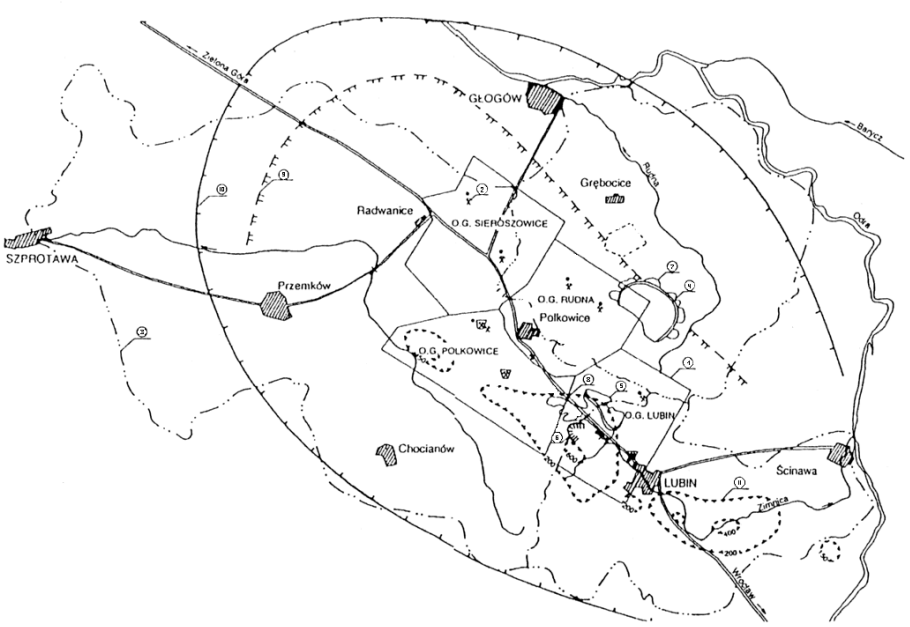
1. INTRODUCTION

The mining areas of the Lubin-Głogów Cupriferous Basin (Fig. 1) occupying 409,4 km^2 and the area under mining-works influence – 461,9 km^2. The copper ores are lying in the Permian limestone layer of the Afore-Sudety-Monocline.
In this geological unit two hydrogeological complexes are assigned:

- Cenozoic, including porous sediments of the Tertiary and Quaternary, 300-400 m depth of burial,
- Triassic-Permian, presenting fissure- and karst-waters in the spotted sandstone formation, 1000 m depth of burial.

Because the mining works in the Lubin-Głogów Cupriferous Basin many changes of the natural environment have occurred, i.e: geodynamical and seis-

mic occurrences development, landscape changes, air- and soil-pollution, threats of sedateness of builder's objects etc., the exploitation caused also the essential changes in the hydrogeological conditions.



Commentary: 1. mine-areas border, 2. mine-shaft, 3. river-reception areas border, 4. after-flotation-wastes reservoir "Żelazny Most", 5. after-flotation-wastes reservoir "Gilów", 6. filling-sand open-pit, 7. reach of the water degradation around "Żelazny Most" reservoir, 8. reach of the water degradation around "Gilów" reservoir, 9. reach of the depression crater in the Permian limestone water layer, 10. reach of the depression crater in the Tertiary water layer, 11. troughs of the subsidences

Fig. 1. Outline of the mine-areas of the Lubin-Głogów Cupriferous Basin

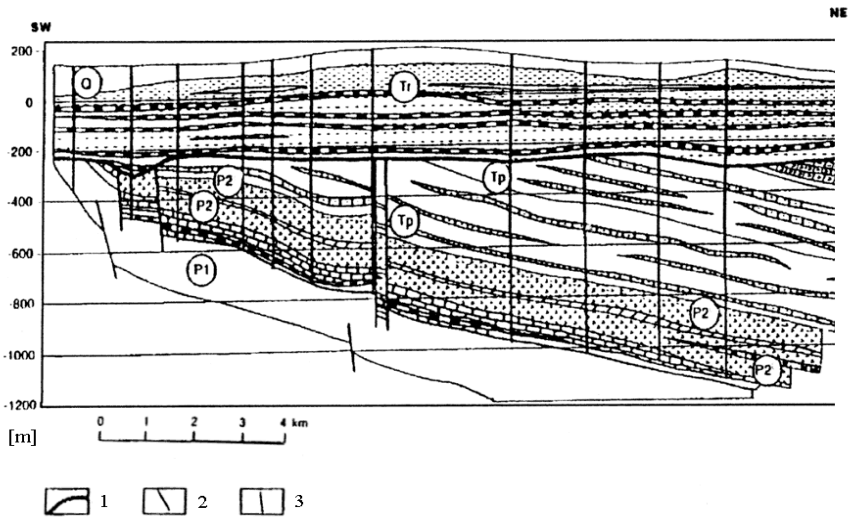
2. THE MINES INUNDATION

The hydrogeological conditions of the exploitation [Bocheńska 1988, Kleczkowski A. et. al. 1990, Kołodziejczyk 2009] are mainly determined by the Permian water level (Permian limestone – P2), Triassic (spotted sandstone – Tp) and Tertiary (Oligocene – Tr) – Fig. 2. With respect of hydrogeological conditions, the Lubin-Głogów Cupriferous Basin was divided in a strong inundated southern part and weakly inundated northern part. The difference in the inundation between both parts is as 1:250. Considerable changes of the hydrogeological conditions are noted also in vertical section. The highest water bearing is con-

nected with the P2 layer – 500-600 m b.s.l. According to the deepness, the water mineralization and chemism are changing.
The average water mineralization in the southern Lubin-Głogów Cupriferous Basin's part is 4,1 g/dm^3 and in the northern Lubin-Głogów Cupriferous Basin's part is 150 g/dm^3, what is connected with chlorides content increase.

3. THE HYDROGEOLOGICAL CONDITIONS CHANGES CAUSED BY MINING DRAINAGE

The long-term mining drainage caused hydrogeological changes [Gurwin 1977; Gurwin Poprawski 1988; Markiewicz , Fiszer, Kalisz, Czmiel 2004). In the Permian limestone layer followed the reduction in the levels of water cavities (850-950 m deeper), depression crater radius achieved 55 km (Fig. 2) and drainage area achieved about 800 km^2. The regional reduction in the levels of water cavities in the both layers: spotted sandstone and Tertiary layer achieved a maximal value 235 m, and drainage area was estimated about 1000 km^2. In the other water bearing layers the drainage effects were considerable smaller.



Commentary: 1. border of the water bearing complexes of the bed and overburden, 2. faults, 3. drillings, Q – Quaternary, Tr – Tertiary, Tp – Triassic period, P2 and P1 – Permian period

Fig. 2. The geological section across the water bearing layers of the Afore-Sudety-Monocline

At this time leaded piezometric observations are shown, that hydrodynamical relations in the drainage mines localities are not stable till yet. During the long-

term mines drainage was carried away from the orogenic belt about 550-million m^3 of water (Fig. 3). It is estimated, that till the end of mining exploitation will be carried away additionally about 1 billion m^3 of water (Fig. 4). As the result of this activity will be observed the reduction in the piezometric water level in the all water bearing layers of the Afore-Sudety-Monocline, excluded Quaternary and top-Tertiary layers.

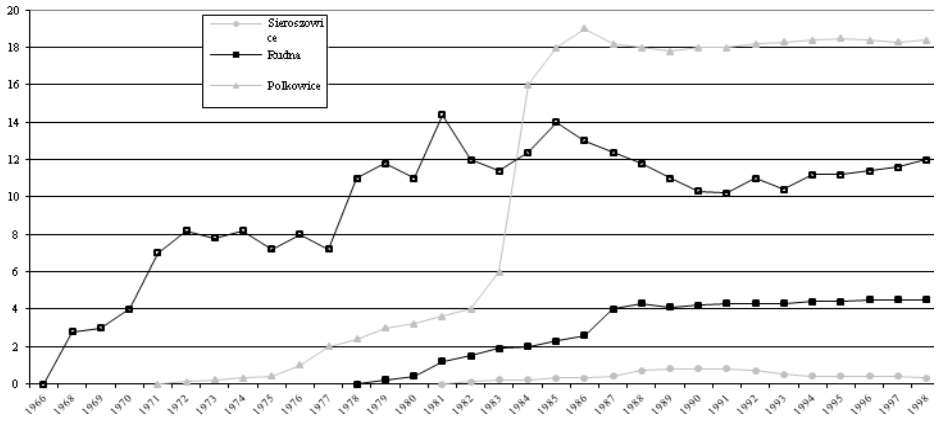


Fig. 3. Pumped away water quantities from the Lubin-Głogów Cupriferous Basin mines in the following years (on the vertical axis: water inflows from the orogenic belt - million m^3/year)

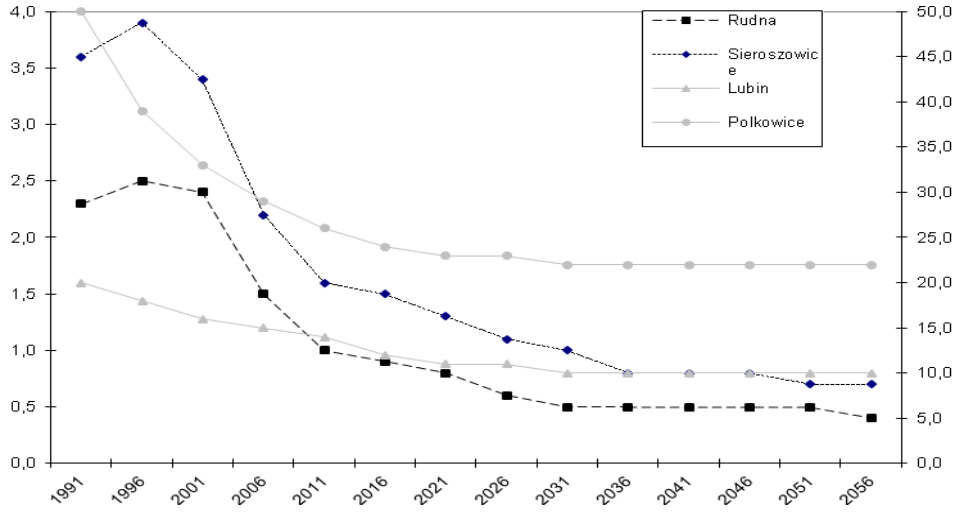


Fig. 4. Forecasting sums of the water inflows from the orogenic belt [m^3/min.] in the years 1991-2056

It in relationship with exploitation of copper in Lubin-Głogów Cupriferous Basin, in summers 1966 it "Polkowice II" – 2005 of mining area was accompanied was about 373, 7 million m^3 of water, and from mining area " the Sieroszowice And" – about 11,6 million m^3 of water [Markiewicz 1999, Markiewicz, Fiszer, Kalisz, Czmiel 2004]. The largest, caused with dehydration of mine, depression stepped out in western part of area "Polkowice II" so far and the podwęglowych of works be connected with dehydration Paleogene (Oligocene).

4. THE SUBSIDENCE OF THE TERRAIN-SURFACE

As an effect of the mines drainage was observed the subsidence of the terrain-surface and formation of the wide trough of the subsidences. The biggest subsidences were observed in the southern part of Lubin-Głogów Cupriferous Basin, where were noted the subsidental zones with depth from 300 to 650mm. However these subsidences caused not the general changes in the water relations of the Quaternary water bearing level. Only locally was observed the accumulation of the stagnated water in the formed subsidences.

5. THE INFLUENCE OF THE AFTER-FLOTATION-WASTE-RESERVOIRS

The excess of the mine-technological waters originated during the exploitation and deposit processing is gathered in the after-flotation-waste-reservoirs: "Żelazny Most" and "Gilów" and next successive carried out to the Odra-river. These reservoirs are constantly danger for the water environment, caused the infiltration of the saline waters to the fresh ground- and surface-waters.
The main terms for the environment degradation prevention, when the water is carried out to the river is strictly compliance with good proportion between salined water quantity and water flow in the river. Thanks this the water salinity limits in the river will be not exceeded.
Farm implements mine waters is large problem. The specific of conditions the hydrogeologically in mine of copper "Polkowice-Sieroszowice" creates the threat for led here the mining works and the use of suitable techniques of draining extorts. For example, in III quarter 2005 r. throw open in this mine robots be led in II and III degree of water threat, however the exploational robots - mainly in and the degree of water threat.
Intensity hydrogeological process did not undergo in last changes 15 practically; the tributary of water to mining excavations in mining area "Polkowice II" carried out the average 23,29 m^3 / the faces, and in mining area " the Sieroszowice" - 0,5 m^3 / the faces to 0,9 m^3 / min. Showed he deciding the stabilized character: 2002 r. - 25,5 m^3 / min., 2003 r. - 25,7 m^3 / min., 2004 r. - 23,1 m^3 / min., 2005 r.

- 27,5 m^3 / min. The totality, in years 1966-2005 "Polkowice II of mining area was accompanied was about 373,7 million m^3 of water, and Sieroszowice" - about 11,6 million m^3 of water.
Manyyears' draining in mine "Polkowice-Sieroszowice" it called out in individual water-bearing levels the going changes of natural hydrokinetic conditions far (tab. 1).

Tab. 1. State of water and the size of depression in main water-bearing levels in mining areas "Polkowice II" and " the Sieroszowice I"

The mining area	Number of piezometer	The ordinate of mirror water [m o.l.s.]		The depression S [m]	The pace of lowering depression ΔS [m / year]
		before 2005	2006 year		
POLKOWICE II	H-17	95,0	-317,87	412,9	10,72
	H-19	95,0	-204,60	299,6	7,78
	S-258	89,7	-255,8	345,5	8,97
	S-61	80,0	-8,56	88,6	2,30
	H-9	90,0	-36,54	126,5	3,28
	H-10	77,5	-43,99	121,5	3,16
	H-11	90,0	33,51	56,5	1,47
	H-14	80,0	-19,33	99,3	2,58
	H-15	85,0	-34,44	119,5	3,10
	H-16	79,0	-136,15	215,2	5,59
	H-18	79,0	-135,01	214,0	5,56
	H-20	70,0	13,92	56,10	1,46
	H-24	70,0	-3,35	73,3	1,90
	S-172	79,0	-147,53	226,5	5,88
	H-12	105,0	74,75	30,6	0,79
	S-59	125,5	117,35	8,2	0,21
	S-174	106,2	80,07	26,1	0,68
	S-247	105,0	-149,3	254,3	6,60
SIEROSZOWICE I	S-555	80,0	3,80	76,2	1,98
	S-560	80,0	-72,95	152,9	3,97
	S-39	78,0	-91,13	169,1	4,39
	S-69	78,0	-34,95	113,0	2,94
	S-365	78,0	-19,62	97,6	2,54
	S-453	78,0	37,82	38,2	0,99
	S-314	99,0	75,73	23,4	0,61
	S-315	104,8	81,06	23,7	0,61
	S-398	69,2	43,10	26,1	0,68

6. CONCLUSION

In respect of hydrogeological conditions Lubin-Głogów Cupriferous Basin is an extremely interesting scientifical range. The mine-works progress, threats of water conditions and deposit's exploitation costs are dependent on the excess of the mineralized mine waters development method. The main purpose of all activities should be prevention of the ground – and surface-waters against salinization.

It is possible through:

- minimization of the salts content in the technological waters using desalting installations,
- using the natural orogenic belts to the excessive waters gathering (i.e through salt-waters pumping to the absorptive geological structures left after natural gas exploitation),
- renovation of the salt-waters batching systems to the Odra-river,
- correct forecasting of the water reserves and ground water quality in the Lubin-Głogów Cupriferous Basin with regard to changes caused by exploitation.

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UWARUNKOWANIA WODNE EKSPLOATACJI MIEDZI W LUBIŃSKO-GŁOGOWSKIM OKRĘGU MIEDZIOWYM

Streszczenie: Lubińsko-Głogowski Okręg Miedziowy stanowi obszar intensywnej eksploatacji górniczej. Najbardziej zaawansowana eksploatacja jest prowadzona w obszarach górniczych: „Lubin", „Polkowice", „Sieroszowice" i „Rudna". W pracy scharakteryzowano warunki hydrogeologiczne zachodzące w tych obszarach i wskazano kierunki dalszych działań służących przeciwdziałaniu hydrogeologicznej degradacji regionu. Zawodnienie kopalń surowców naturalnych zawsze stanowi poważny problem ekonomiczny i wymaga zastosowania odpowiedniej technologii odwodnienia oraz sposobu zagospodarowania wód kopalnianych. Odwodnienie poszczególnych kopalń w Lubińsko-Głogowskim Okręgu Miedziowym najczęściej odbywa się metodą grawitacyjną, lub – poprzez mechaniczne wypompowanie wody z poziomów wydobywczych.