DOI: https://doi.org/10.30836/igs.iies.2024.29

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CHANGES IN GEOLOGICAL ENVIRONMENT IN THE DISPUTED LANDS WITHIN THE ALMAZNO-MAREVSKY GEOLOGICAL-INDUSTRIAL AREA

Extraction of coal in the mines "Pervomaisk", "Rodina", "Golubovskaya", "Gornaya", "Raduha" "Carbonit" within the boundaries of the Almazno-Marevsky geological-industrial area located within the urbanized territories, such as Pervomaisk, Zolote, Hirske and Kalinove led to changes in the geological environment, disruption of natural dynamics and the emergence of dangerous man-made and engineering-geological processes with corresponding environmental consequences (Figure 1).

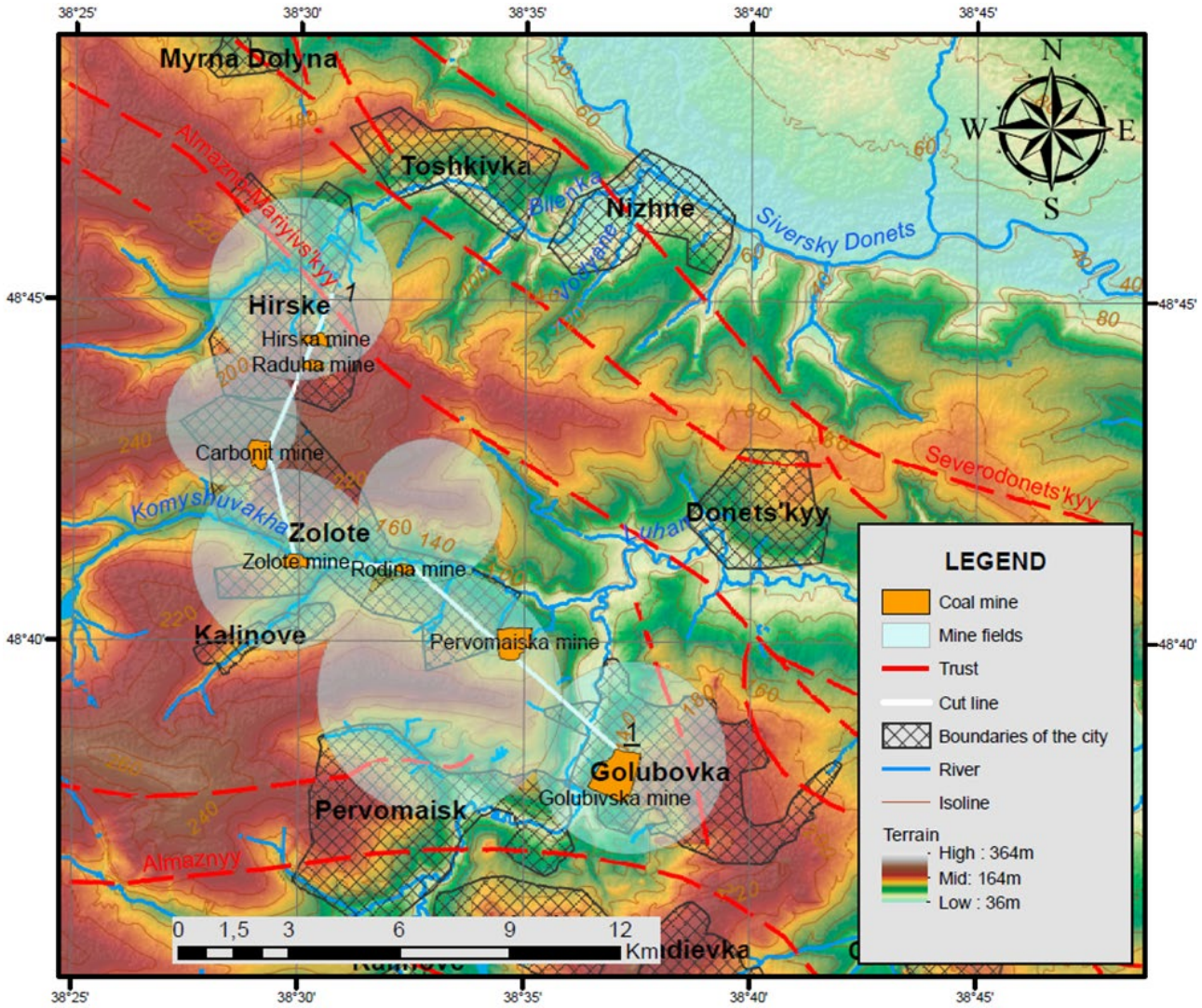

Fig. 1. Plan of the study territory of the Almazno-Marievsky geological-industrial area

The studied territory belongs to the Dnipro-Donetsk seismotectonic province [1] and has a shaking intensity 6 level on the Richter scale. In terms of geostructure, the territory is located in the zone of shallow folds of the Almazno-Mariivska synclinoria of the Donetsk fold structure, next to the Almazno-Mariivskii, Almaznii and Severodonetskii thrusts.

According to geomorphological zoning, territory belongs to the structural-denudational, strongly undulating elevated plain (some places with ridge-hollow relief), which occupies almost the entire territory, and is densely dissected by valleys and gorges of the Lugan' and Komyshuvakha rivers. The elevation difference in the relief ranges from +80 m to +250 m.

Taking into account that the lower boundaries of the geological research environment is determined by the depth of technogenic development territory [2], it was established that its thickness in the studied territory is 480 - 970 m with absolute marks from -330 to -720 m (Figure 2.), where coal deposits are spread, which are interlayered with argillites and siltstones, alternating with clayey and silty shales, sandstones and limestones, which contain thin layers of coal and are covered with quaternary deposits from the surface, mainly in places of river valleys.

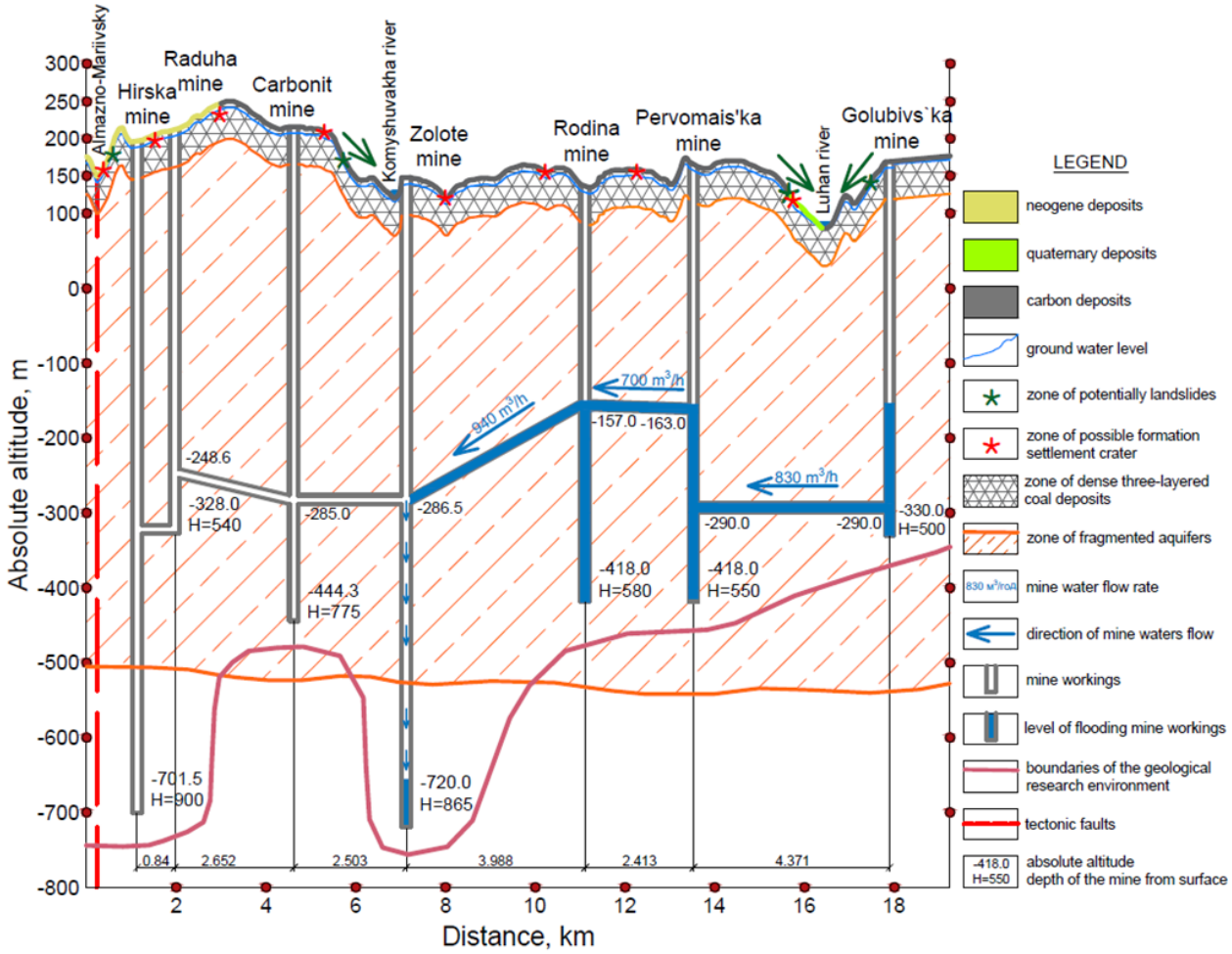

Fig. 2. Cut line 1-1 Figure 1. Geological environment of the Almazno-Marievsky geological-industrial area

Today, shutting down coal industrial enterprises as a result of military operations led to the uncontrolled flooding mines "Pervomaiska", "Rodina", "Golubivska", the flooding level of which is at the absolute mark of -163 m, which are dangerous due to the fact that they are in the zone fragmented aquifers and have a hydraulic connection with the "Zolote", "Girska", "Raduga", "Carbonite" mines, which are at risk of the next flooding. Mine water, passing through the mine at a speed of up to 940 m^3/h, is subject to various types of pollution and is characterized by increased mineralization, in particular, the presence of sulfates and chlorides, as well as a high level iron and other heavy metals [3-4].

The hydrogeological conditions of the study territory are caused by the fact that throughout the entire area of distribution of the aquifer in quaternary deposits, along the Lugan and Komyshuvakha rivers, recharge is carried out due to the infiltration of atmospheric precipitation, flood waters and the influx of water from bedrock and has a hydraulic connection with the underground lower deposits [5].

Therefore, threat of mine waters through spillage into the zone of fragmented aquifers, and further expansion in groundwater between the populated areas of Pervomaisk, Zolote, Girske, Golubivka and Kalinov poses serious threats of an environmental and man-made nature. Metals from polluted groundwater can enter the human body through agricultural products and well drinking water [6-7].

If mine waters rise to the surface zone of dense three-layered coal deposits, flooding of territories, subsidence of the surface, and activation of landslides will occur (Figure 2.) [8-9]. Shift of rocks in ravines and gullies of river valleys can lead to the opening of previously existing sources of groundwater, which leads to increased suffusion and activity of shear masses throughout the shear massif and on its slopes [10].

The influence of fractures and the decrease in strength due to the flooding of mine workings are the main factors of the intensity of the occurrence of cracks in coal seams, which leads to the release of methane and the development of deformations of the earth's surface and an increase in rock pressure in the massif, at the same time, with the development of engineering and geological processes, rock pressure becomes more dangerous, since the process of deformations along the mine decreases, but the stresses in individual areas increase [11]. Earthquakes can cause the growth of microcracks underground along mine workings [12].

The ratio of weak and solid rocks has a significant impact on the nature of deformations of the earth's surface [13]. The depth of the working space and methods of controlling rock pressure are key factors that in the future will determine the height of the spread of landslide zones, depth and width of the development of subsidence troughs and rock deformations. Due to the abrupt cessation of the activities of coal enterprises, there is no possibility of controlling roof subsidence and managing rock pressure.

Analysis of the above-mentioned changes in the geological environment provide the basis for a more detailed study of the impact uncontrolled flooding of coal mines. Integrated and differentiated risk assessment will make it possible to quantify the risk under worst-case scenarios and identify objects with the most likely degree of damage and specify the list of objects within the settlements of Pervomaisk, Zolote, Girske, Golubivka and Kalinov that may be damaged as a result of one of the engineering-geological hazardous processes [14].

Determining the boundaries of the geological environment within the Almazno-Marievsky geological-industrial area provides an understanding of the connection between mines that are flooded due to the abrupt cessation of the activities of coal enterprises, which will entail the development of processes such as deformation of the surface and underground space, the release of methane, the occurrence of local earthquakes, and the ingress of contaminated mine waters into underground and ground water, as well as into the Lugan and Komyshuvakha rivers.

References

1. Kushnyr A.N. Tectonic earthquakes of the Donbas anomaly of electrical conductivity, their possible connections. Geodynamics. – 2011. – № 2 (11). P. 150-152.
2. Demchyshyn M.G. Technogenic impacts on the geological environment of Ukraine. – K.: IGS NAS of Ukraine, 2004.
3. Shiv K., Kumar N. Ground Water Contamination in Coal Mining Areas: A Critical Review. International Journal of Engineering and Applied Sciences, vol. 3, № 2, Feb. 2016.
4. Carreras H.A., Wannaz E.D., Pignata M.L. Assessment of human health risk related to metals by the use of biomonitors in the province of Cordoba, Argentina. Environ. Pollut, 2009, pp.157-117.
5. Explanatory Note to the Hydrogeological Map of the USSR at a Scale of 1:200000, Donbas Series, Letter M-37-XXXIII, Kyiv 1975.
6. Haroon G., Khoiyangbam R., Ahmad S., Zuber S. Trace Metal Levels in the Muscle Tissues of Ctenopharyngodon Idella (Grass Carp) and Ophiocephalus (Snake Headed Fish) of Antiya Tal of Jhansi City (U.P.). International Journal of Applied Environmental Sciences. V (4), 505–512, 2010.
7. Tarasenko I. Chemical composition of groundwater in abandoned coal mines: Evidence of hydrogeochemical evolution. Applied Geochemistry, 2022.
8. Gojković Z., Kilibarda M., Brajović L., Marjanović M., Milutinović A., Ganić A. Ground Surface Subsidence Monitoring Using Sentinel-1 in the “Kostolac" Open Pit Coal Mine. Remote Sensing. 2023; 15(10):2519.
9.Shang H., Zhan H-Z., Ni W-K., Liu Y., Gan Z-H., Liu S-H. Surface Environmental Evolution Monitoring in Coal Mining Subsidence Area Based on Multi-Source. Remote Sensing Data. Front. Earth Sci. 2022; 10:790737.
10. Demchyshyn M., Anatskyi O. The path of aquifer development on the slopes of the Dnieper and Lybid valleys. ISSN 0367–4290. Geol. Journ. 2009. № 3.
11. Medyantsev A. Displacement of rocks and the earth's surface under the influence of mine workings. Novocherkassk: Novocherkassk Polytechnic Publishing House. Inst., 1976. – 83 p.
12. Külekçi G. Damages caused by earthquakes to mines and underground spaces and minimizing these damages. International Journal of Advanced Natural Sciences and Engineering Researches (IJANSER), 7(10), 199-206.
13. Avershin S. Displacement of Rocks in Underground Excavations. Ugletekhizdat Publ., 1947. – 245 p.
14. Shekhunova S.B., Kril T.V. Geological and economic risk assessment for territories of hazardous geological and technogenic processes (exemplified by Solotvyno township). Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu. 2022, (2): 079-085.