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Kochubiivka mine: history of formation and development prospects on the territory of Kryvyi Rih landscape and technical system

Kryvyi Rih landscape and technical system is a unique system that has undergone the process of technogenesis, transforming natural landscapes into anthropogenic ones. Kryvyi Rih iron ore basin was the basis for its formation in the city of Kryvyi Rih, Dnipropetrovsk region. It has significant industrial reserves of iron ore. The studies have shown that the most common anthropogenic landscapes in this system are agricultural, settlement, industrial, water management, forestry, transport, and others. However, the most significant landscapes are mining landscapes. While studying the history of the system formation, it is necessary to take into account the sites already mined and to investigate their origin and potential impact on Kryvyi Rih landscape and technical system. Using as an example the study of Kochubiivka mine, we can analyze the history of this post-mining facility, identify its features, and suggest possible ways of its optimization.

The purpose of the research is to study the history of Kochubiivka mine, to substantiate the landscape organization, as well as physical and geographical characteristics of the mine, to analyze the possibility of using the mine in educational and tourist activities, to consider possible prospects for the development of Kochubiivka mine.

Main material. The article analyzes the history of Kochubiivka mine, focused on its landscape, which consists of a quarry, a dump and five adits. The optimization measures that will contribute to the future development of this mine are detailed and substantiated.

The scientific value of this article lies in the fact that it explores the industrial heritage of Kryvyi Rih landscape and technical system on the example of Kochubiivka mine. It substantiates the history of the mine formation, provides development prospects, and singles out Kochubiivka mine as a vivid example of the two-tiered landscape structure of anthropogenic landscapes of this post-mining facility on the territory of Kryvyi Rih landscape and technical system.

Conclusions and further research: The study made it possible to analyze the history of formation and development prospects of Kochubiivka mine. We used the web-based mapping services Google Maps and Google Earth to analyze the mine, develop maps and characterize its territorial location and landscape structure. The authors defined the need to take optimization measures, to improve and promote the Kochubiivka mine for tourist and speleological activities on the territory of Kryvyi Rih landscape and technical system. It also highlighted the presence of two-tiered anthropogenic landscapes on the example of Kochubiivka mine, which will serve as a basis for further research.

Keywords: *Kochubiivka mine, mining landscapes, Kryvyi Rih landscape and technical system, history of formation, open pit, dump, adits, development prospects.*

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Introduction. The Kryvyi Rih landscape-technical system is a unique system known for its active development of technogenesis, which has transformed natural landscapes into anthropogenic ones in a short time. The city of Kryvyi Rih, Dnipropetrovsk region has formed and developed this system based on the Kryvyi Rih iron ore basin, which has extremely large commercial reserves of iron ore - more than 18 billion tonnes. According to Denysyk G.I. [2] and Zadorozhnia H.M. [2], the most common group of anthropogenic landscapes in the KLTS is agricultural (61.2% of the region area), settlement - 13.1%, industrial - 11.5%, water management - 8.1%, forestry - 3.5%, transport - 2%, other - 0.6%. However, the mining landscapes are the most important in the background on the territory of the KLTS. Therefore, the history of the Kryvyi Rih landscape and technical system's formation does not ignore currently exhausted (post-mining) mining facilities. Therefore, there is a question of their origin,and how they may affect the KLTS in the future. The author carried out the study on the example of Kochubiivka mine.

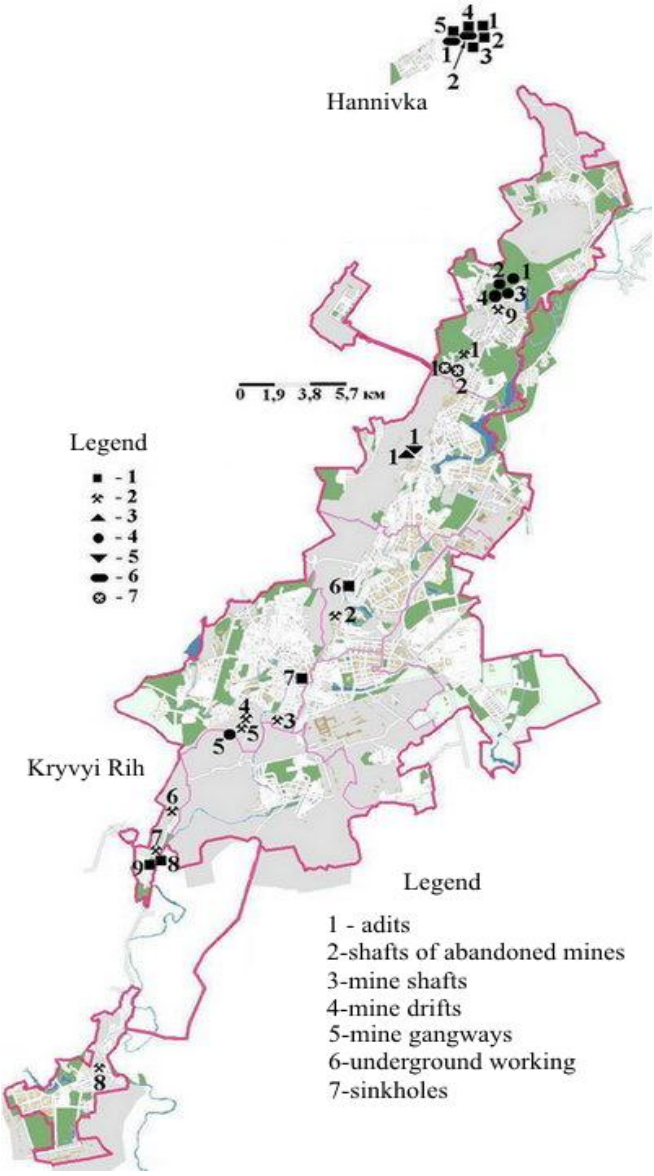

Fig.1. Speleological objects of the KLTS [5]

Thus, using Kochubiivka mine, it is possible to analyze the history of the formation of a certain post-mining facility, to determine the two-tiered nature of the mine and its features, and to propose promising areas for its optimization.

Background studies. A number of scientists worked in the field of anthropogenic landscapes: F. M. Milkov [11], G. I. Denysyk [2,3], T. A. Klevtsov [9], E. A. Ivanov [12], G. I. Rudko [12], I. P. Palamarchuk [12], Hudzevych [14], and others. The works of V. L. Kazakov [3,4], and E. A. Ivanov [12], G. M. Zadorozhnia [2], S. V. Yarkov [3], T. S. Koptieva [6,7,15] highlight the study of quarries and dumps in more detail. Few works are devoted to the study of Kochubiivka mine, but Kazakov V.L. [5] in his study of speleological objects of Kryvyi Rih focused on this mine, as well as a number of popularised excursions conducted by Kryvyi Rih local historians.

The purpose of the article is to study the history of formation of the Kochubiivka mine, to substantiate the landscape organisation, physical and geographical characteristics of the mine, to analyse the possibility of using it in educational and tourist activities, and to consider prospects for its development.

Summary of the main material. The Kryvyi Rih landscape-technical system has formed large areas of mining landscapes over the active period of 150 years of technogenesis.

The mining industry is responsible for the formation and shaping of mines.

Through the expeditionary research conducted from 2006 to 2010 by V. L. Kazakov [5],we know that the KLTS has several speleological objects of different type. There are several of them in the KLTS, such as adits, shafts of abandoned mines, mine quarries, mine drifts, mine shanks, underground workings (chambers) and sinkholes. In total, there are 9 of them on the territory of the KLTS, 5 of which are Kochubiivka adits, 30-40 metres long. There are 4 other short adits (25-15 metres) in other quarries (Fig.1). All the adits belong to the pre-revolutionary period, and are easy to pass, but some places require climbing [5].

According to the geological dictionary, a mine is 1) A place where minerals are extracted by underground or open-pit mining. 2) A mining enterprise that extracts and processes minerals. It consists of several mines or quarries united by common administrative, technical and economic management. Synonymous with mine [1].

Kochubiivka mine is located in Ukraine, in Dnipropetrovsk region, Petrykiv district, north of the city of Kryvyi Rih, near the village of Hannivka, within the Kryvyi Rih landscape and technical system, has the following geographical coordinates: 48.27'29" N 33°52' 79 "E (Fig.2).

The climate of the Kochubiivka mine is temperate continental. The average January temperature is -6°C,

Legend: 1 - Hannivskyi quarry, 2 - Pershotravnevy quarry, 3 - sludge storage facility, 4 - Kochubiivka mine

Fig.2. The location of Kochubiivka mine

the average July temperature is +22°C, and the average annual temperature is +10°C. The highest amount of precipitation falls in June - July - up to 67 mm, the lowest in February - March - 25 mm, and the annual precipitation is up to 483 mm.

G. I. Denysyk and H. M. Zadorozhnia [2] built the taxonomic system of mining landscapes and the structure of the KLTS mining landscapes (Fig.3).

Kochubiivka mine belongs to the open pit and dump landscape complex, a type of terrain of plateau-like multi-tiered dumps with loose dumps - Kochubiivka dump. Loose dumps are created by filling loose rocks, mostly loose and water-bearing, composed mainly of limestone, clay, marl, and loam. The loose dumps have significant soddenness and active development of herbaceous and woody vegetation [6]. In turn, the Kochubiivka adits belong to the mine type of mining landscapes. The mine type was formed, respectively, from the closed development of iron ore deposits and is divided into two subcategories: mine-failure and mine-sedentary type of terrain, thus Kochubiivka adits belong to the mine-sedentary type of terrain. In terms of mining activity, Kochubiivka mine is a landscape complex with an open pit, a dump and 5 adits (Fig.4).

The mine-sedentary type of terrain arises because of brown iron ore extraction and is associated with the geological and geomorphological features of the territory. F. M. Milkov [11] refers mine cavities to the class of industrial landscapes, a subclass of mining landscapes, a type of underground mine landscapes:

– adits (horizontal passages);

– shafts (vertical passages);

– crosscuts (horizontal passages from the shaft to the deposit);

– drifts (horizontal passages along the ore deposit);

– shanks with sections, horizons, transition wells (vertically descending passages for ore passage downwards);

– mining chambers (three-dimensional rounded chambers).

According to the geological dictionary, an adit is a horizontal or slightly inclined underground mine workings that have direct access to the surface, mainly on a mountain slope. It services underground operations [1].

Tunnels are usually used to service mines, they are located close to adits. The tunnels are laid at an angle to the ground surface to make it easier to remove iron ore from the mine.

According to the geological dictionary, shaft tunnels [from the German stollen – pillar] are horizontal or gently inclined underground mine opening which has a direct exit on the surface, mainly on the mountain slope. It maintains underground works [1].

Tunnels usually maintain mines and they are located not far from the shaft tunnels. Tunnels are laid

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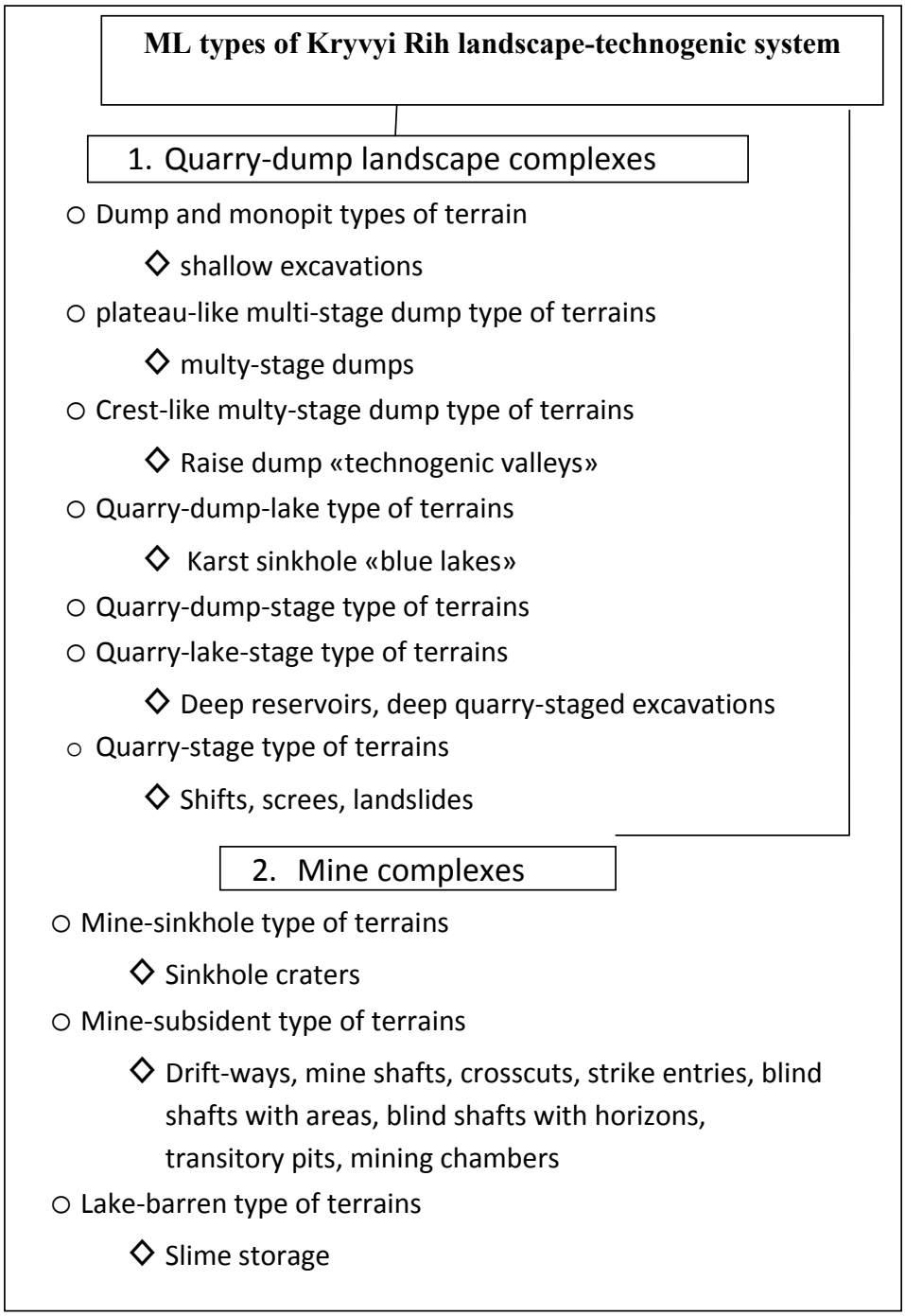

Fig.3. Types diversity of mining landscapes of the KLTS

at an angle to the ground, so that it was convenient to take iron ore out of the mine.

The Kochubiivka mine is named after the Kochubei family. They were known as Cossack officers, gained significant status and acquired the status of nobility. The family has its roots in the Crimean Tatar ethnic group. The founder of the Kochubei family was Bey Kachuk, who migrated from Crimea to the Left Bank and took the name Viktor after being baptised and enrolled in the Zaporizhzhia army. Viktor Kochubei inherited all these lands from his relative, Count Bezborodko [10].

After receiving his inheritance, Mr. Kochubei began open-pit mining in 1904, extracting iron ore from a single narrow seam. The deposit was 1.5-3.0 metres thick. The open pit was the basis of a small mine, and Kochubiivka open pit operated with delays and for a short time. In 1904-1906, they mined 39 thousand tonnes of ore, and in 1913-1914, – 11.5 thousand tonnes of ore. The short duration of the quarry operation was due to the fact that profitability was rather low and the conditions of iron ore extraction were very difficult. Workers used crowbars, chisels and manually loaded iron ore into trolleys.

Kochubiivka mine has been out of operation since 1915. The open pit is 185 m long and 35 m deep. It has a narrow slit-like shape with steep, sometimes rocky and precipitous slopes. Nearby, there is an old dump, with 5 shaft tunnels and open high underground workings, as well as the depression on the site of an old mine [10]. Kochubiivka dump was formed in 1904, simultaneously with the quarry.

The dump consists of overburden of loams and clays. It is an uneven hill of 8 m high, with sloping slopes of 160 m long. During the period of 108 years, the surface of the dump has overgrown with steppe vegetation, including bitter wormwood, creeping wheatgrass, garden spurge, horsetail, field thistle, poplar, goat willow, white acacia, feather grass and gorse. The dump is not reclaimed, but over the time, the processes have taken place which have contributed to this.

After the completion of ore extraction and rock filling, the surface of the dump underwent a succession of processes that contribute to the natural recovery

Legend:

— Kochubiivka mine boundaries

Fig.4. Landscape structure of the Kochubiivka mine

Fig.5. Kochubiivka quarry [10]

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and development of the dump. At the initial and key stage, variety of plants seeded the surface of the dump, such as feather grass, fescue, herbs and other steppe species. These plants played an important role in fixing the overburden and preventing its erosion. Thus, the Kochubiivka dump is a typical example of nature self-regeneration in an anthropogenic landscape (Fig.5).

The Kochubiivka mine includes the Kochubiivka adits. These are unique man-made caves where iron ore was mined with picks, crowbars and dynamite (Fig. 6).

The five entrances leading to them start from the bottom of the Kochubiivka quarry.

They have a straightforward and branched structure. The total length of all underground passages is 250 meters. The adits run across the length of the open pit and were sinking during the mine's operation to explore parallel iron ore deposits. The adits have narrow and squat openings. The ceilings are up to 1.5 meters high.

Fig.6. Kochubiivka adits [8]

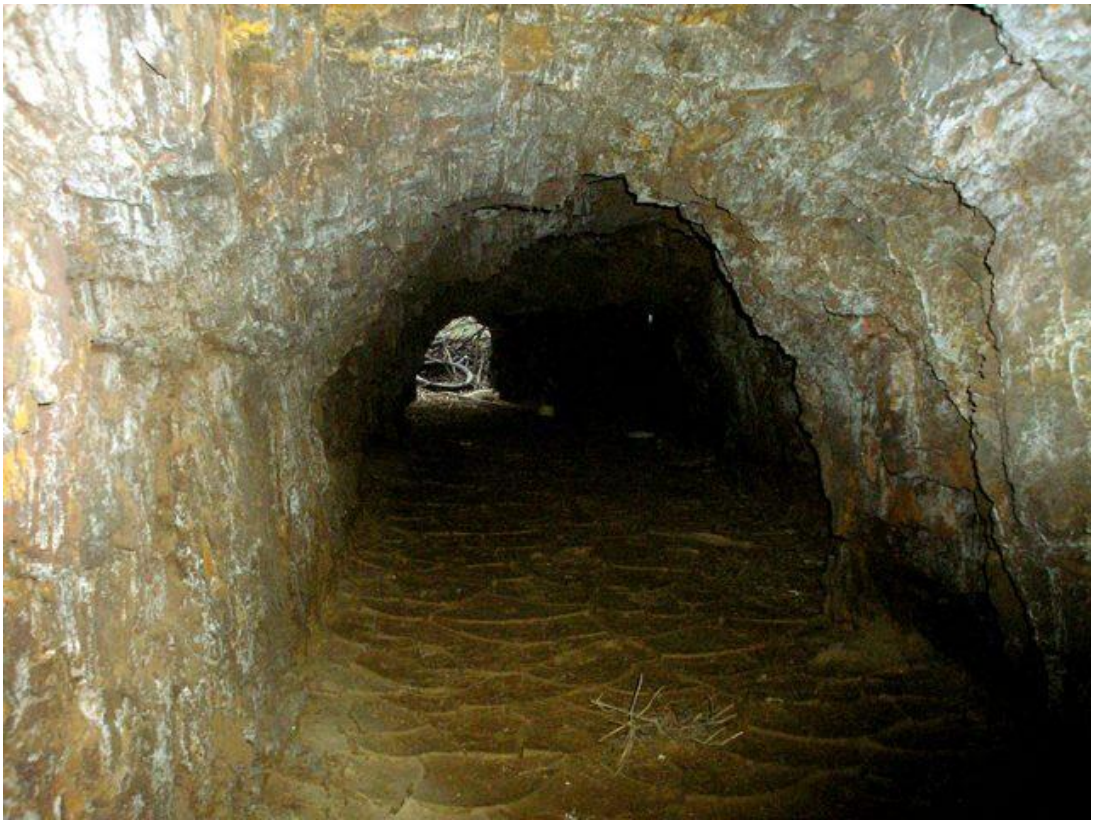

Fig.7. Walls of the Kochubiivka adits with limonite shale [8]

Old nails for hanging miners' lanterns are visible in the ceiling [10]. The walls of the adits are an exposed geological structure of the Kryvyi Rih folded structure - limonite shale (Fig.7).

During the study of the Kochubiivka mine, we discovered underground workings, which are 2-storey horizontal cavities. There is a cliff at the entrance, and the workings are connected into a single chamber up to 12 meters high. Dead ends in both horizontal workings cut off the darkness of the dungeons. We can see horizontal balcony faces. These underground workings are an example of iron ore mining in ancient times [10].

Kochubiivka mine is a vivid example of the two-tiered anthropogenic landscapes of the KLTS, the surface tier being determined by the Kochubiivka open pit and dump, and the underground tier by the Kochubiivka adits, which will provide further productive research of this area.

Thus, the Kochubiivka mine is a complex anthropogenic independent organisation in terms of its landscape complex, which is unique for studying the functioning of the post-mining syste. However, the mine is currently not maintained and has derivative processes that lead to its degradation. Kochubiivka mine requires attention and a certain range of optimization measures to improve the state of the post-mining system. The mine attracts a large number of tourists, which offers a great prospect for it to become more popular and visited by foreign tourists in the future. A major obstacle to visiting the mine is its long distance from settlements and lack of infrastructure.

Therefore, taking into account all of the above factors, we can see the mine development prospects as follows:

1. To equip special laboratories where you can rent measuring instruments, flashlights, protective tales, overalls, first aid kits, etc.

2. To organize places for geological practice for applicants from different parts of Ukraine.

3. To arrange a place for camping.

4. To organize places for public catering.

5. To arrange and organize the infrastructure of the mine territory, namely access and parking for vehicles. To develop a strategy for cognitive and speleotourism.

Conclusions. For 150 years, the Kryvyi Rih landscape-technical system has been actively involved in mining activities, which has led to significant changes in natural landscapes. Expeditionary research by V.L. Kazakov from 2006 to 2010 revealed 9 speleological sites in the system, such as adits, mines, chambers and others. Kochubiivka mine, which is part of the Kryvyi Rih landscape and technical system, was developed in the early 20th century but stopped production in 1915. The discovered underground chambers and adits testify to the ancient methods of iron ore extraction. The mine is in a state of self-development, but has the potential for further development and promotion, especially as a tourist destination. To do this, it is necessary to improve the infrastructure, organize visitor facilities, create the necessary conditions and attract foreign tourists. We can do this by establishing the necessary laboratories, camping and catering facilities. It is also necessary to develop the infrastructure to the mine and create a strategy for the development of educational and speleotourism.

REFERENCES:

1. Geological dictionary. Available at: https://geodictionary.com.ua/node/3886 (accessed 19.11.2022) [in Ukrainian].

2. Denysyk, G.I., Zadorozhnia, H.M. (2013). Derivative processes and phenomena in the zones of technogenesis: monograph. Vinnytsya: Vega, 220 [in Ukrainian].

3. Denysyk, G.I., Kazakov, V.L., Yarkov, S.V. (2012) Syngenesis of vegetation cover in landscapes of technogenesis zones: monograph. Vinnytsia: Edelweiss and K, 240 [in Ukrainian].

4. Kazakov, V.L. (2007) Anthropogenic landscapes of Kryvyi Rih: history of development, structure. Geographical studies of Kryvbas: Materials of departmental research topics. Kyiv: Publishing House, 2, 27-35 [in Ukrainian].

5. Kazakov, V.L. (2011). Potential of speleological objects of Kryvbas for the purposes of sports speleotourism. Humanitarian Bulletin of Pereiaslav-Khmelnytskyi H. Skovoroda State Pedagogical University. Special issue,135-143 [in Ukrainian].

6. Koptieva, T.S. (2021). Mining landscapes of Kryvyi Rih landscape technical system. Man and the environment. Problems of Neoecology, 35, 18-26. DOI: https://doi.org/10.26565/1992-4224-2021-35-02 [in Ukrainian].

7. Koptieva, T. (2021) Zhovtnevyi granite quarry: history of formation and development prospects. Problems of Continuous Geographical Education and Cartography, 33, 78-83. DOI: https://doi.org/10.26565/2075-1893-2021-33-09 [in English].

8. Kochubiivskyi mine [Available at: http://krt.dp.ua/ua/spadshchina/54-kochubejivskij-rudnik (accessed 17.11.2022) [in Ukrainian].

9. Klevtsov, T.A. (1970). Anthropogenic relief of the Kryvyi Rih iron ore basin and its classification. Physical Geography and Geomorphology, 1, 55-60 [in Russian].

10. Travelling through the "Mysteries of Kochubiivskyi Adits". Available at: http://www.irm.kr.ua/uk/gm/2-un/691-mandruyuchi-taemnitsyami-kochubejivskikh-shtolen (accessed 11.11.2022) [in Ukrainian].

11. Milkov, F.N. (1973). Man and Landscapes. Essays on anthropogenic landscape studies: a monograph. Moscow: Mysl, 224 [in Russian].

12. Rudko, G.I., Ivanov, E.A., Palamarchuk, I.P. (2019). Mining geosystems of the Western region of Ukraine: monograph. Kyiv - Chernivtsi: Bukrek, 1, 464. DOI: https://doi:10.13140/RG.2.2.27811.71207 [in Ukrainian] .

13. Google Maps. Available at: https://www.google.com.ua/maps/@48.253829, 33. 4941535,17z?entry=ttu [Accessed 14.11.2022) [in English].
14. Rybalova, O., Korobkova, H., Hudzevych, A., Artemiev, S., & Bondar, O. (2022). Risk assessment for public health from air pollution in the industrial regions of Ukraine. Visnyk of V. N. Karazin Kharkiv National University, Series «Geology. Geography. Ecology», 56, 240-254. DOI: https://doi.org/10.26565/2410-7360-2022-56-18 [in Urrainian].
15. Koptieva T. S. History of the formation of Kryvyi Rih landscape technical system. Man and the environment (2022). Problems of Neoecology, 37, 37-46. DOI: https://doi.org/10.26565/1992- 4224-2022-37-03 [in English].

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КОЧУБІЇВСЬКИЙ РУДНИК: ІСТОРІЯ ФОРМУВАННЯ ТА ПЕРСПЕКТИВИ РОЗВИТКУ НА ТЕРИТОРІЇ КРИВОРІЗЬКОЇ ЛАНДШАФТНО-ТЕХНІЧНОЇ СИСТЕМИ

Криворізька ландшафтно-технічна система є унікальною системою, що проходила процес техногенезу, перетворюючи природні ландшафти в антропогенні. Вона сформувалася в місті Кривий Ріг Дніпропетровської області на основі Криворізького залізорудного басейну, який має значні промислові запаси залізних руд. Дослідження показали, що найпоширеніші антропогенні ландшафти в цій системі - сільськогосподарські, селитебні, промислові, водогосподарські, лісогосподарські, транспортні та інші. Однак, найбільш значущі ландшафти - гірничопромислові. Вивчаючи історію формування системи, необхідно враховувати гірничовидобувні об'єкти, які вже відпрацьовані, і досліджувати їх походження та потенційний вплив на Криворізьку ландшафтно-технічну систему. На прикладі дослідження Кочубіївського рудника можна проаналізувати історію формування цього постмайнінгового об'єкта, визначити його особливості і запропонувати можливі шляхи оптимізації.

Мета – дослідити історію формування Кочубіївського рудника, обґрунтувати ландшафтну організацію та фізико-географічні характеристики рудника, проаналізувати можливість використання рудника в пізнавальній та туристичній діяльності, розглянути можливі перспективи розвитку Кочубіївського рудника.

Основний матеріал. У статті проаналізовано історію формування Кочубіївського рудника, акцентована увага на ландшафтному комплексі Кочубіївського рудника, який складається з кар'єру, відвалу та п'ятьох штолень. Деталізовано і обґрунтовано оптимізаційні заходи, які сприятимуть майбутньому розвитку Кочубіївського рудника.

Наукове значення даної статті полягає в тому, що вона досліджує індустріальну спадщину Криворізької ландшафтно-технічної системи на прикладі Кочубіївського рудника, обгрунтовує історію формування рудника, надає перспективи розвитку і виокремлює Кочубіївський рудник як яскравий приклад двоярусної ландшафтної структури антропогенних ландшафтів даного постмайнінгового об'єкта на території Криворізької ландшафтно-технічної системи.

Висновки і подальші дослідження. Виконане дослідження дозволило проаналізувати історію формування та перспективи розвитку Кочубіївського рудника; був здійснений аналіз рудника; за допомогою картографічних веб - сервісів: Google Maps та Google Earth були розроблені карти і здійснена характеристика територіального розміщення та ландшафтної структури Кочубіївського рудника. Виявлено необхідність залучення оптимізаційніх заходів покращення і популяризації у туристичній і спелеостичній діяльності Кочубіївського рудника на території Криворізької ландшафтно-технічної системи. Також виокремлено наявність двоярусності антропогенних ландшафтів на прикладі Кочубіївського рудника, що у майбутньому слугуватиме подальшим дослідженням.

Ключові слова: *Кочубіївський рудник, гірничопромислові ландшафти, Криворізька ландшафтно-технічна система, історія формування, кар'єр, відвал, штольні, перспективи розвитку.*

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ:

1. Геологічний словник. [Електрон. ресурс]. – Режим доступу: https://geodictionary.com.ua/node/3886 (дата звернення 19.11.2022 р.).
2. Денисик Г.І., Задорожня Г.М. Похідні процеси і явища в зонах техногенезу: монографія. - Вінниця: Вега, 2013. - 220 с.
3. Денисик Г.І., Казаков В.Л., Ярков С.В. Сингенез рослинного покриву у ландшафтах зон техногенезу : монографія. Вінниця: ПП «Едельвейс і К», 2012. 240 с.
4. Казаков В.Л. Антропогенні ландшафти Криворіжжя: історія розвитку, структура. Географічні дослідження Кривбасу: Матеріали кафедральних науково - дослідницьких тем. К.: Видавничий дім, 2007.- Вип.2. - С. 27–35.
5. Казаков В.Л. Потенціал спелеологічних об'єктів Кривбасу для цілей спортивного спелеотуризму. Гуманітарний вісник ДВНЗ «Переяслав-Хмельницький державний педагогічний університет ім. Г. Сковороди. 2011. Спец. випуск. С.135-143.

6. Koptieva T.S. Mining landscapes of Kryvyi Rih landscape technical system. Людина та довкілля. Проблеми неоекології. 2021. Вип. 35. С. 18–26. DOI: https://doi.org/10.26565/1992-4224-2021-35-02

7. Koptieva T. Zhovtnevyi granite quarry: history of formation and development prospects. Проблеми безперервної географічної освіти і картографії. 2021. Вип. 33. С. 78–83. DOI: https://doi.org/10.26565/2075-1893-2021-33-09

8. Кочубіївський рудник. [Електрон. ресурс]. – Режим доступу: http://krt.dp.ua/ua/spadshchina/54-kochubejivskij-rudnik (дата звернення 17.11.2022 р.).

9. Клевцов Т.А. Антропогенный рельеф Криворожского железорудного бассейна и его классификация. Фізична геогр. і геоморфологія. - 1970. - Вип.1. - С. 55-60.

10. Мандруючи «Таємницями Кочубіївськими штольнями» [Електрон. ресурс]. – Режим доступу: http://www.irm.kr.ua/uk/gm/2-un/691-mandruyuchi-taemnitsyami-kochubejivskikh-shtolen (дата звернення 11.11.2022 р.)

11. Мильков Ф.Н. Человек и ландшафты. Очерки антропогенного ландшафтоведения: монография . - М: Мысль, 1973. - 224 с.

12. Рудько Г.І., Іванов Є.А., Паламарчук І.П. Гірничопромислові геосистеми Західного регіону України: монографія. Київ – Чернівці: Букрек. - 2019. Т.1. - 464 с. DOI: https://doi: 10.13140 / RG.2.2.27811.71207

13. Google Maps. [Електронний ресурс]. – Режим доступу: https://www.google.com. ua/maps/@48.253829,33.4941535,17z?entry=ttu дата звернення 14.11.2022 р.)/

14. Rybalova O., Korobkova H., Hudzevich A., Artemiev S., Bondar O. Risk assessment for public health from air pollution in the industrial regions of Ukraine // Visnyk of V.N. Karazin Kharkiv National University, series “Geology. Geography. Ecology». 2022. № 56. С. 240-254. DOI: https://doi.org/10.26565/2410-7360-2022-56-18.

15. Koptieva T.S. History of the formation of Kryvyi Rih landscape technical system. Людина та довкілля. Проблеми неоекології. 2022. Вип. 37. С. 37–46. DOI: https://doi.org/10.26565/1992- 4224-2022-37-03.

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