

ALGORITHM OF GEOLOGICAL ENVIRONMENT TRANSFORMATION ON THE EXAMPLE OF GEMSTONE OBJECTS OF UKRAINE

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Abstract. This work is performed in order to develop an algorithm for transforming the geological environment, which received environmental problems due to man-made load, to the geological environment as part of the noosphere, identifying the most attractive aesthetic aspect of existing or spent mineral deposits.

From the standpoint of ecological aesthetics, examples of the use of spent mineral deposits for socio-cultural human needs are considered. Developed and implemented environmental and aesthetic projects have different levels of recognition and scale – from the creation of museums in the workings of former mines, the conversion of former quarries into arenas for music – to the construction of five-star hotels in former building stone quarries. A combination of aesthetic, environmental and economic aspects for the sustainable development of such facilities is shown. Some complex mineral deposits of Ukraine are considered, where certain types of gemstone raw materials are found, in particular jaspilites at Kryvbas iron ore quartzite deposits. Some decorative and artistic characteristics of jaspilites, possibilities of their textures for creation of a mosaic and large-scale interior compositions as a whole, and also historical role of this stone for economy of the country are shown.

The proposed algorithm for transforming the geological environment for mineral deposits of Ukraine that contain resources of gemstones has three main vectors of sustainable development: aesthetic (preservation of geological heritage, attraction of waste as educational, scientific and tourist facilities, creation of museum exhibits of gemstones, etc.), ecological (restoration of agricultural land or damaged forest fund) and economic (receipt in the state budget by developing and adopting a state program of development in the field of extraction and circulation of gemstones, improving existing legislation, business development).

Keywords: geological environment, mineral deposits, gemstones, ecological aesthetics.

Introduction. The geological environment is the part of the earth's crust (rocks, soils, sediments, groundwater, etc.) that interacts with elements of the landscape, atmosphere and surface waters and may be affected by man-made activities [1]. In the 20th and early 21st centuries, with increasing human activity in terms of anthropogenic impact, we can state the fact of significant violations of environmental ecology and changes in geological and climatic conditions, including increased content of greenhouse gases in the atmosphere and, consequently, rising surface temperatures and the ocean (global warming).

Ukraine has a strong mineral resource base, including significant resources of gemstones. The explored deposits of amber, piezoquartz, topaz, beryl and other varieties are potential targets of financial revenues to the national budget, domestic development and entry into the foreign market of gems and jewelry.

The vast majority of gemstone raw material varieties in Ukraine are part of mineral deposits, which are complex in nature. These include jaspilites at iron quartzite, topaz and beryl deposits in piezoquartz deposits, graphic pegmatites in ceramic pegmatite deposits, amber, halite deposits, and others. Active development of mineral deposits, both open and underground, leads to the formation of dips, floods, harms the environment (Fig. 1).

Methods. The world's leading mining countries are actively working to address environmental issues by using the geological environment both as a tool for profit and as a way to solve environmental problems. To find ways to overcome the ecological crisis of

our time, researchers are increasingly turning to the artistic understanding of nature. Today's environmental challenges, on the one hand, form new demands on art, create new social discourse and new projections of their artistic understanding, and on the other hand, change art itself, generating new directions, styles and forms of art. These issues are within the competence of environmental aesthetics [2]. Some researchers introduce the concept of geoaesthetics as a project of aesthetic understanding of nature through geological phenomena [3].



a)

b)

Figure 1 – Ecological problems in the deposits of ferrous quartzites of Kryvbas (a) and ceramic pegmatites in the Zaporizhzhia region (b)

The history of the origin, development and modern directions of ecological aesthetics is most thoroughly presented in English-language literature in a work that has long been a classic. [4].

Results and discussion. Spent mineral deposits can be grouped into two main categories:

- Abandoned without further human intervention;
- Arranged and used by people for their cultural and other needs.

Developed and implemented environmental and aesthetic projects of different levels of recognition and scale demonstrate society's understanding of existing problems and opportunities for sustainable development of regions, including the receipt of income from the tourism business. Here are some examples of how sustainable development projects are being implemented in different countries (mostly), which to some extent aim at a harmonious existence in the geological environment.

The St. Margaret's sandstone quarry is one of the oldest in Europe. The material from it was used for the construction of St. Stephen's Cathedral in Vienna. The quarry is the UNESCO World Heritage List. In 1959 the first European symposium of sculptors was held here. Numerous stone sculptures made by craftsmen from around the world create a unique design of the surrounding area. Between the "first discovery" of the quarry as a unique venue for an opera festival made by artistic director Wolfgang Werner in 1997, and the massive expansion of this natural arena lies a ten-year path to success. Currently, about 220,000 visitors come here every year to watch the performances on this unique stage (Fig. 2).

Dalhala is an open-air theater located in a former limestone quarry, which is now used as a place for summer music. It is located near the city of Dalarna, central Sweden. The quarry operated until 1990. The open-air theater was opened in 1995 and currently has 4,800 seats. Its acoustic qualities do not lose in comparison with the best open stages of Europe.



Figure 2 – St. Margarethen Arena (Austria)

The municipal stadium in the city of Braga in northern Portugal was nicknamed the "Quarry Stadium" because it was built inside an inactive quarry, as seen from one side. The stadium was designed by architect Eduardo de Mour for the Euro-2004 sports competition and has been awarded many prizes.

In the early sixties of the last century, residents of one of the districts of Helsinki decided to build a parish church. The Suomalainen brothers' project won the design competition. They proposed a very interesting concept of a building that had never existed in Helsinki - "The Church in the Rock". Their decision was one of the cheapest: not to build the walls of the temple, but to punch a hole in the top of the hill with dynamite and cover it with a dome. Thus, the budget of the church was even less than the amount allocated for the construction of a regular school. Today, the amazing church is visited by about half a million tourists each year. And that's not counting those who come to organ and chamber concerts.

In 2019, a unique five-star hotel opened in Shanghai - a 19-storey Songjiang InterContinental. The new building is located in a former quarry, where granite was mined for road and construction works. The depth of the quarry is 80 m. The main decorative element of the building is a transparent glass waterfall that flows down the walls in the center of the building. The hotel project has won five international architectural awards (Fig. 3).

Another well-known projects of world recognition are, in particular, the Royal Mining Salts "Wieliczka" and "Bochnia", which have the status of the UNESCO

World Heritage. The objects illustrate the historical stages of development of mining technology in Europe, from the 13th to the 20th century. Galleries, underground chambers, located and decorated in a way that reflects the social and religious traditions of miners, tools and machines give outstanding evidence of the socio-technical system involved in underground rock salt mining. Halit carving masterpieces - interiors, sculptures - will forever be remembered by visitors of the mines.



Figure 3 – Songjiang InterContinental Hotel (China) before and after construction

The Sterling Hill mine began operating around 1739 and produced more than 11 million tons of zinc over more than 200 years of operation. When it closed in 1986, it was the last operating mine in New Jersey, but now the mine has become a popular attraction – about 75,000 people visit it annually, since the Hawk brothers restored the historic site as a museum in 1990. Among the most impressive parts of the mine tour on Sterling Hill – a walk through the Rainbow Tunnel. Much of the route is illuminated by ultraviolet light, which causes an explosion of glow, neon red and green colors from the exposed zinc ore in the walls containing the mineral willemite.

The results of our research on gemstones in Ukraine. Analysis of the features of some existing and spent mineral deposits in Ukraine has shown that their most striking aesthetic aspect is the gemstones, the resources of which are known at these sites. Research conducted by us and our colleagues in previous years has shown significant potential for the use of associated agate reserves in basalt deposits, chalcedony deposits of nickel-containing weathering crust, graphic pegmatites in feldspar deposits, epidotes (unakites), colored quartz and collectible stones in block granite deposits, and some others.

In our opinion, the greatest scientific and practical interest is the huge industrial reserves of jaspilite in iron ore deposits, in particular in Kryvyi Rih, where, in addition, industrial and social infrastructure is well-developed [5, 6]. One of the dominants of aesthetics and artistic characteristics of the jaspilite is determined by the variety of its colors and textural patterns. The latter is characterized by dynamics, movement, direction. The alternation of opaque multi-colored layers allows you to create numerous jewelry and decorative arts. The patterns we have formed allow us

to take into account the possibilities of jasper textures to create a mosaic, when the repetition of the natural pattern of the stone can be used to enhance individual elements of the product, and size - to create large-scale interior compositions.

By taking into account the historical role of the jaspilite, its importance for the country's economy and high decorative properties, in the early 2000s we designed artistic projects of the Jaspilite Room as a monument to this unique stone. The second volume of the monograph "Gemstones of Ukraine", dedicated to the stone that played a crucial role in the Dnieper region, presents five art projects of the Jaspilite Room in classical and gothic styles, as well as in art nouveau style. The implementation of this idea will be a continuation of the national traditions and culture of gemstone in the country. Of course, other varieties of gemstones in Ukraine are also waiting to be realized.

Today, it is necessary to attract big business to invest in projects that will be recognizable around the world and will serve as a kind of tourist attraction. The task of researchers is to ensure that investors understand the new opportunities that are emerging in this area. This can be done through the identification of aesthetic aspects in geological objects, scientific support in the creation of cultural and educational centers. Such centers should be investment-attractive, highly aesthetic, and environmentally sound. The motto and inspiration of those who will create these architectural masterpieces should be the awareness that there is no such thing anywhere in the world, only in Ukraine.

Further development of the mineral resource base of gemstones of Ukraine is impossible without taking into account the positions of aesthetics, ecology and economy (Fig. 4).

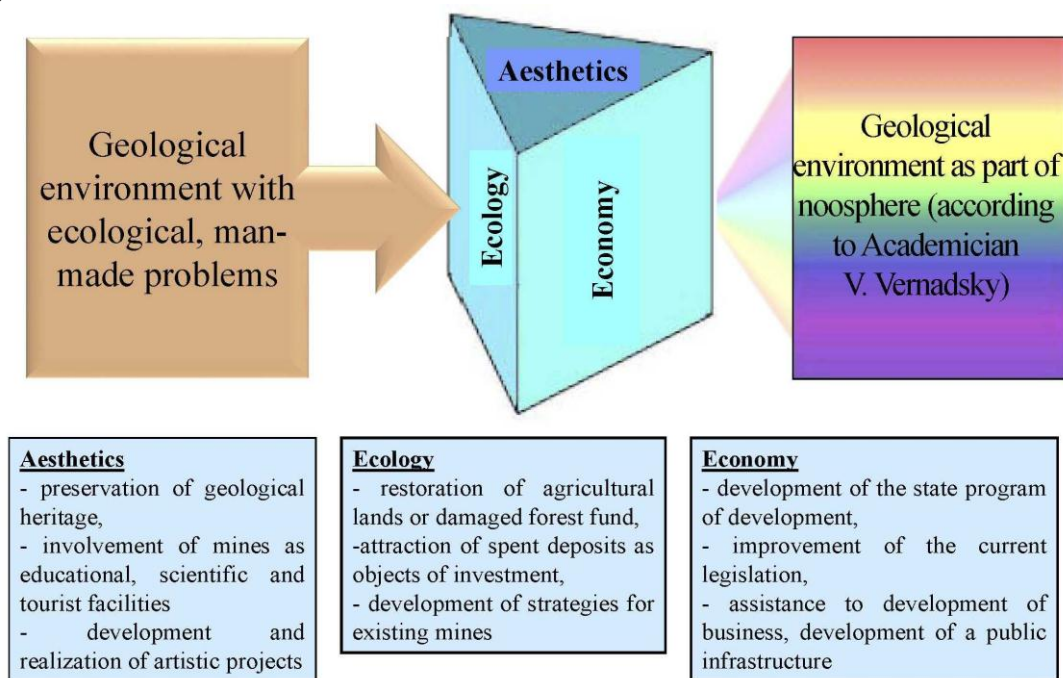


Figure 4 – Schematic representation of the algorithm for the transformation of the geological environment (according to Academician V. Vernadsky)

In fact, there is a qualitative transition from the environment with environmental and man-made problems to the geological environment as part of the noosphere (according to Academician V. Vernadsky): "We live in an unprecedented new, geologi-

cally bright era. Man by his work – and his conscious attitude to life – transforms the earth's crust – the geological area of life – the biosphere. It transforms it into a new geological state; by human labor and consciousness the biosphere passes into the noosphere.

Conclusion. The algorithm of geological environment transformation combines economic, ecological and aesthetic aspects. Aesthetic development is aimed at preserving the geological heritage, attracting mines as educational, scientific and tourist sites, development and implementation of art projects of museum exhibitions of gems. The ecological vector of development involves the restoration of agricultural land or damaged forest resources, the involvement of spent deposits as objects of investment, including for medical and health purposes, and directly develop strategies for existing mines with taking into account modern developments in environmental aesthetics. Finally, the economic vector of development aims to fill the country's budget by developing and adopting a state program for the development of this segment of the economy, improving existing legislation in the field of mining and circulation of gemstones, promoting entrepreneurship and education, science and culture.

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АЛГОРИТМ ТРАНСФОРМАЦІЇ ГЕОЛОГІЧНОГО СЕРЕДОВИЩА НА ПРИКЛАДІ ОБ'ЄКТІВ КОЛЬОРОВОГО КАМІННЯ УКРАЇНИ

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Анотація. Метою роботи є розробка алгоритму перетворення геологічного середовища, що отримало екологічні проблеми внаслідок техногенного навантаження, на геологічне середовище як частину ноосфери, визначивши найбільш привабливий естетичний аспект на діючих або відпрацьованих родовищах корисних копалин.

З позицій екологічної естетики розглянуто приклади використання відпрацьованих родовищ корисних копалин для соціальних-культурних потреб людини. Розроблені і реалізовані еколого-естетичні проекти мають різний рівень визнання і масштаб – від створення музеїв у виробках колишніх шахт, переобладнання колишніх каменоломен на арени для виконання музичних творів – до будівництва п'ятизіркових готелів у колишніх кар'єрах з ви-

добування будівельного каменю. Показано поєднання естетичних, екологічних і економічних аспектів для сталого розвитку таких об'єктів. Розглянуто деякі комплексні родовища корисних копалин України, де зустрічаються певні різновиди каменесамоцвітної сировини, зокрема джеспіліти на родовищах залізорудних кварцитів Кривбасу. Показано деякі декоративно-художні характеристики джеспілітів, можливості їх текстурного рисунку для створення мозаїки та масштабних інтер'єрних композицій у цілому, а також історичну роль цього каменю для економіки країни.

Запропонований алгоритм трансформації геологічного середовища для родовищ корисних копалин України, що містять ресурси кольорового каміння, має три основні вектори сталого розвитку: естетичний (збереження геологічної спадщини, залучення відпрацьованих виробок як освітніх, наукових і туристичних об'єктів, створення музейних експозицій з кольорового каміння тощо), екологічний (відновлення земель сільськогосподарського призначення або пошкодженого лісового фонду, протидія підтопленням територій) та економічний (надходження до бюджету країни шляхом розробки і прийняття державної програми розвитку у сфері видобутку та обігу кольорового каміння, удосконалення діючого законодавства, розвитку підприємництва).

Ключові слова: геологічне середовище, родовища корисних копалин, кольорове каміння, екологічна естетика.

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