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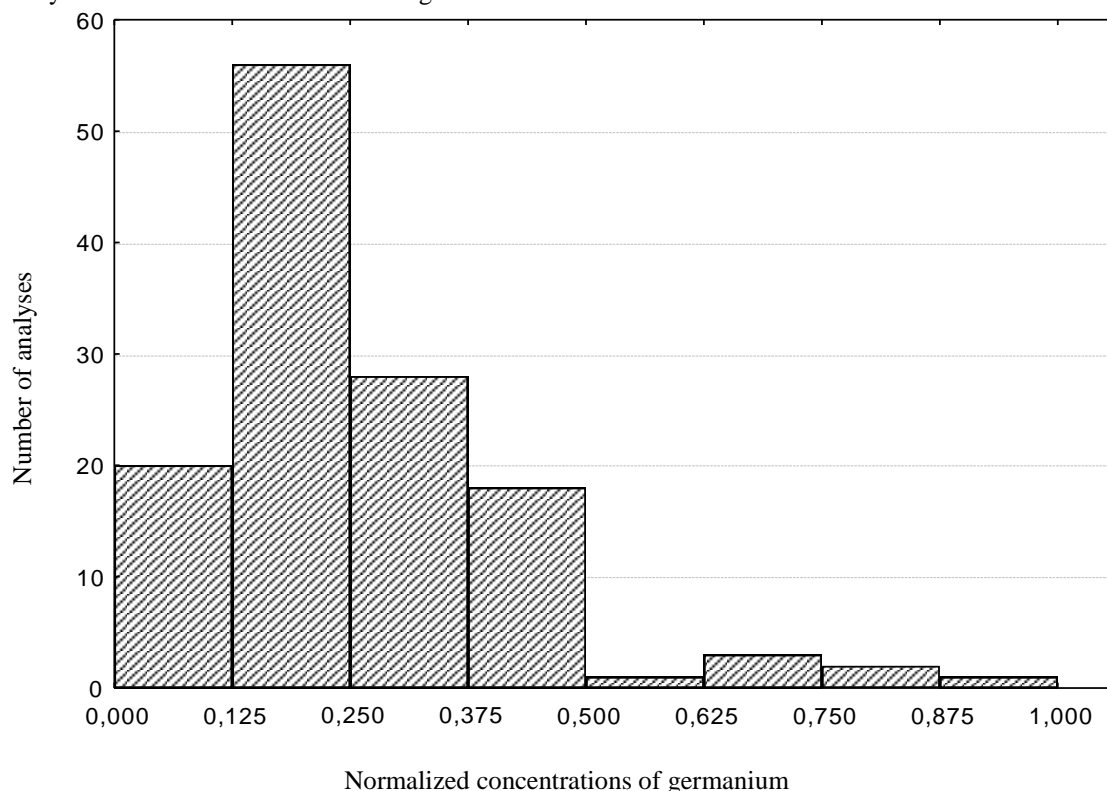
DISTRIBUTION OF GERMANIUM CONCENTRATIONS IN THE COAL SEAM C4 OF THE SAMARSKA MINE FIELD

The Samarska mine field is located within the boundaries of the Pavlohrad-Petropavlivka coal mining area of Western Donbas. According to the administrative division, the mine field is located in the Pavlohrad district of the Dnipropetrovsk region, east of the Pavlohrad city. In geological and structural terms, the mine field is limited to the southern slope of the Dnipro-Donetsk Depression, in the contact zone with the Ukrainian Crystalline Shield and extends along the southwestern edge of the Dnipro-Donetsk Depression in the southern part of the Central Graben.

The research carried out is particularly relevant to the decision of the National Security and Defense Council of Ukraine dated July 16, 2021 "On stimulating the search, extraction and enrichment of minerals that are of strategic importance for the sustainable development and defense capability of the state" and Decree of the President of Ukraine No. 306/2021, which introduces this decision is in effect. In these documents, germanium ores are included in the list of strategic importance for the sustainable development and defense capability of the state.

Previously, toxic and potentially toxic elements were mainly studied in coal seams of various geological and industrial areas of Donbas [1-3]. In works [4-6], the main regularities of the distribution of germanium over the area and in the cross-section of some coal seams of the Pavlohrad-Petropavlivka geological and industrial district of Donbas were considered.

On the diagram of the germanium distribution (Fig. 1) in the coal of the seam, it is clearly visible that its distribution is significantly different from the Gaussian or lognormal distribution.



Normalized concentrations of germanium
Fig. 1 Histogram of the distribution of normalized concentrations of germanium
in the coal seam c_4 of the Samarska mine field

The visual analysis is confirmed by analytical calculations of Shapiro-Wilk criteria, Pearson chi-square agreement, Kolmogorov-Smirnov and Lilliefors. In all cases, the results of the calculations confirmed the non-compliance of the sample with the normal or lognormal distribution law. Thus, for a more realistic assessment of the central tendency of the germanium content, instead of the values of the arithmetic mean, it is necessary to use the median value of the indicator. Some bimodality of the general nature of the distribution of germanium also draws attention. This may indicate the presence of at least two different main factors that could significantly affect its distribution in the coal seam.

Within the field of the Samarska mine, the concentration of germanium in seam c_4 varies from 1.3 g/t to 23.5 g/t. The arithmetic average value of germanium content in the seam is 7.3 ± 0.3 g/t, the median value is 6.3 g/t, the modal value is 6.7 g/t, the standard deviation is 3.7 g/t, the variance is 13.7 g/t, excess – 4.1 g/t, and asymmetry – 1.7 g/t.

As for the areas of the seam with reduced germanium concentration values (Fig. 1), it is necessary to note two features characteristic of them. First of all, all such areas are characterized by a simple structure and an increase in the total thickness of the formation, and hence an increase in the contribution to its thickness of the actual coal seams up to 100%. Secondly, from a tectonic point of view, a feature for the vast majority of these areas is the presence of small-amplitude discontinuous faults of the northeast trend.

An abnormally high content of germanium is observed only in areas of the formation where there is a combination of two features of its structure: a general decrease in the power of the actual coal layers (with a simple structure - a decrease in the total power, with a complex one - an increase in the number and/or power of partings) and the presence of small and small-amplitude tectonic disturbances, zones of increased fracturing in the north-western direction.

Abnormally low concentrations of germanium are observed in the areas of the seam where the simple structure of the seam (with a general increase in its thickness) and the presence of small and small-amplitude tectonic disturbances, zones of increased fracturing of the northeast trend are simultaneously observed.

References

1. Ishkov V.V., Kozii Ye.S. (2020). Some features of beryllium distribution in the k_5 coal seam of the "Kapitalna" mine of the Krasnoarmiyskiy geological and industrial district of Donbas. Odesa National University Herald. Geography and Geology. Vol. 25, No. 1(36), P. 214-227. [https://doi.org/10.18524/2303-9914.2020.1\(36\).205180](https://doi.org/10.18524/2303-9914.2020.1(36).205180)
2. Kozii Ye.S. (2021). Arsenic, mercury, fluorine and beryllium in the c_1 coal seam of the Blahodatna mine of Pavlohrad-Petropavlivka geological and industrial area of Western Donbas. Collection of scientific works "Geotechnical Mechanics", No 159. pp. 58-68. <https://doi.org/10.15407/geotm2021.159.058>
3. Ishkov V., Kozii Ye. (2020). Distribution of mercury in coal seam c_7^H of Pavlohradska mine field. Scientific Papers of DONNTU Series: "The Mining and Geology". No. 1(23)-2(24). P. 26-33. [https://doi.org/10.31474/2073-9575-2020-3\(23\)-4\(24\)-26-33](https://doi.org/10.31474/2073-9575-2020-3(23)-4(24)-26-33)
4. Ішков В.В., Козій Є.С., Чернобук О.І., Хоменко В.Л. (2022). Результати кластеризації ділянок різної потужності вугільного пласта c_{10}^B шахти «Дніпровська» за вмістом германію. Наукові праці Донецького національного технічного університету. Серія: «Гірничо-геологічна». 1(27)-2(28). С. 107-115. [https://doi.org/10.31474/2073-9575-2022-1\(27\)-2\(28\)-107-115](https://doi.org/10.31474/2073-9575-2022-1(27)-2(28)-107-115)
5. Ішков В.В., Козій Є.С., Козар М.А., Чернобук О.І. (2022). Розподіл германію у вугільному пласті c_4 шахти «Самарська» Павлоградсько-Петропавлівського геолого-промислового району Донбасу. Вісник Одеського національного університету. Сер.: Географічні та геологічні науки. Т. 27, вип. 2(41), С. 190-206. [https://doi.org/10.18524/2303-9914.2022.2\(41\).268761](https://doi.org/10.18524/2303-9914.2022.2(41).268761)
6. Ishkov V.V., Kozii Ye.S., Chernobuk O.I., Pashchenko P.S. (2022). The relationship of germanium concentrations and the thickness of the c_8^H coal seam of the Dniprovskaya coal mine. Collection of scientific works "Geotechnical Mechanics". No.162. pp. 165-177.