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## GERMANIUM AND LEAD CONNECTION IN COAL SEAM C6H
## OF "TERNIVSKA" MINE OF WESTERN DONBAS

The relevance of research the content of germanium in coal seams is due to the possibility of its industrial extraction and use as a valuable accompanying component. For an objective geological and economic assessment of the possibility of simultaneous extraction of germanium from coal, waste and products of its processing and planning of the most effective organizational and technical measures in this regard, it is first of all necessary to have information about the nature of distribution and the level of concentration of this element in coal.

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.

Recent achievements. Previously, toxic and potentially toxic elements were mainly studied in coal seams of various geological and industrial areas of Donbas [1-5]. In works [6-8], 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, at the same time, the analysis of the relationship between germanium and lead in the coal seam $c_6^H$ of the "Ternivska" mine field previously not performed.

The purpose of the work is to investigate the relationship between the content of germanium and lead in the coal seam $c_6^H$ of the "Ternivska" mine.

Research methodology. The factual basis of the work was the results of 72 analyzes of germanium in coal performed after 1983 in the central certified laboratories of production geological exploration organizations of Ukraine from the material of reservoir samples obtained by production and research enterprises and organizations. In a number of cases, they were supplemented with analyzes of reservoir samples taken by the furrow method from duplicate cores and mine workings in the period from 1983 to 2021.

The content of germanium and lead was determined by quantitative emission spectral analysis. Seven percent of duplicate samples were sent to internal laboratory control. Ten percent of duplicate samples were subjected to external laboratory control. The quality of the results of the analyzes (correctness and reproducibility) was evaluated as the significance of the average systematic error, which is tested using the Student's test, and the significance of the average random error, which is tested using the Fisher's test. Since the above-mentioned errors at the significance level of 0.95 are not significant, the quality of the analyzes is recognized as satisfactory.

In order to bring the raw data to the same scale, as a rule, they are normalized in one way or another. The normalization procedure was carried out similarly to the one given in the works.

Research results. Within the field of the "Ternivska" mine, the concentration of germanium in the c6n layer varies from 5.6 g/t to 29.5 g/t. The average arithmetic value of germanium content in the layer is $13.7 \pm 0.5$ g/t. The concentration of lead in the layer varies from 2.36 g/t to 10.2 g/t, with the average arithmetic value of the content per layer being $6.86 \pm 0.4$ g/t.

According to the results of the correlation analysis, a statistically significant direct relationship was established between the concentrations of germanium and lead in the coal seam $c_6^H$, which is characterized by a correlation coefficient of 0.51. Based on the results of the regression analysis, a linear regression equation was calculated between the content of lead and germanium (Fig. 1):
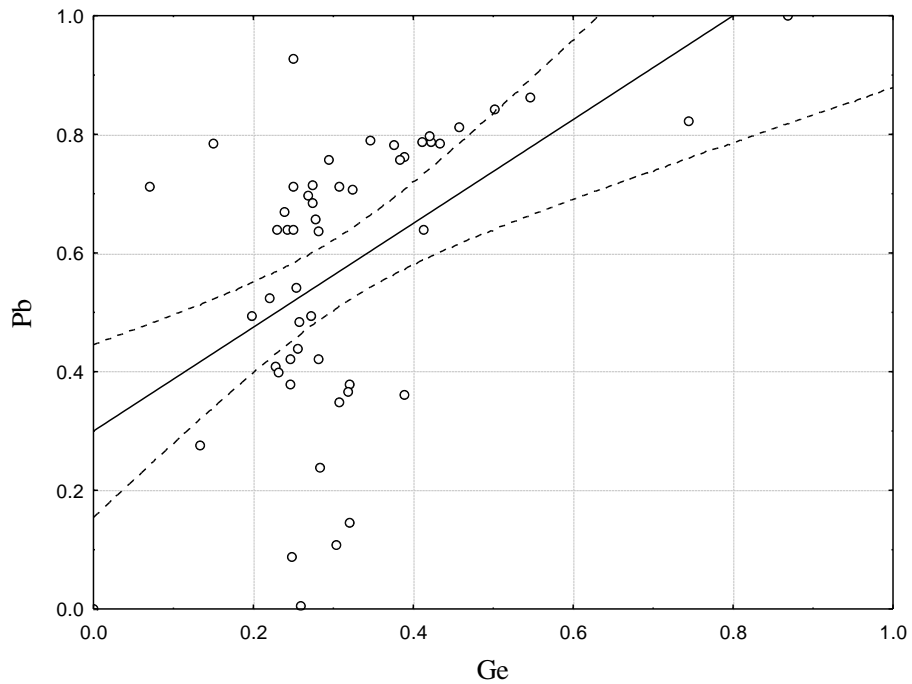
$$Pb = 0.2999 + 0.875 \times Ge$$

Fig. 1. The graph of the regression equation between the normalized value of germanium and lead content in the coal seam $c_6^н$ of the "Ternivska" mine of the Western Donbass

The analysis of the performed studies allows to formulate the conclusion that in the areas of the formation near discontinuities where coal could undergo epigenetic hydrothermal mineralization, joint accumulation of lead and germanium in sulfide form is possible.

**References**

1. Ішков В.В., Козій Є.С. (2021). Розподіл арсену та ртуті у вугільному пласті $k_5$ шахти "Капітальна", Донбас. Мінералогічний журнал. Т. 43, № 4. С. 73-86. https://doi.org/10.15407/mineraljournal.43.04.073

2. Kozii Ye.S. (2021). Toxic elements in the $c_1$ coal seam of the Blahodatna mine of Pavlohrad-Petropavlivka geological and industrial area of Donbas. Collection of scientific works "Geotechnical Mechanics", No. 158. pp. 103-116.https://doi.org/10.15407/geotm2021.158.103

3. 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

4. Ishkov V., Kozii Ye. (2020). Distribution of mercury in coal seam $c_7^н$ 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

5. Ishkov V.V., Kozii Ye.S. (2020). Some features of beryllium distribution in the $k_5$ coal seam of the "Kapitalna" mine of the Krasnoarmiiskyi 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

6. Ішков В.В., Козій Є.С., Чернобук О.І., Хоменко В.Л. (2022). Результати кластеризації ділянок різної потужності вугільного пласта $c_{10}^в$ 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

7. Ishkov V.V., Kozii Ye.S., Chernobuk O.I., Pashchenko P.S. (2022). The relationship of germanium concentrations and the thickness of the $c_8^н$ coal seam of the Dniprovska coal mine. Collection of scientific works "Geotechnical Mechanics". No.162. pp. 165-177.

8. В.В., Козій Є.С., Чернобук О.І. (2022). Аналіз впливу потужності вугільного пласта $c_8^н$ шахти Дніпровська на вміст германію. Збірник наукових праць НГУ. № 70. С. 76-90. https://doi.org/10.33271/crpnmu/70.076

8. 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