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DISTRIBUTION AND GEOCHEMICAL CONDITIONS OF HEAVY METALS IN SOILS IN AROUND ALMALYK MINING AND INDUSTRIAL AREA

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Abstract: In accordance with the internationally recognized "Concept of Sustainable Development," special attention is paid to the need to begin a global solution to environmental problems at the local, national and regional levels with environmental protection and rational use of natural resources. Technological progress has exceeded the rate of use of natural resources and pollution of the environment by pollutants. As a result, the natural balance is disrupted. The expansion of the activities of mining enterprises leads to the pollution of atmospheric air, soil and drinking water. In this regard, the need to carry out geoecological research in these areas shows the urgency of the work.
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1. Introduction

Solving environmental problems in ensuring sustainable development of industrial areas is one of the urgent issues of today. This is especially true for solid waste that accumulates in mining districts, that is, in areas where mineral extraction and processing enterprises are located. In areas where the mining industry is developed, environmental change is associated with surface mining, where 2/3 of the annual amount of mined rock is discarded as tailings at metal processing plants, and much of it is not used. As a result, there is pollution of geosystems with chemical elements, exceeding the maximum allowable concentration of harmful components several times [7].

2. Analysis and results

Soils are an integral part of the natural environment and embody the information about natural and chemical changes of the environment that occurred throughout the period of technogenesis. They require detailed ecological and geochemical studies and constant observation, unlike any other component of the natural environment. In the areas where various industrial enterprises, especially chemical and metallurgical enterprises are located and directly adjacent to them, man-made changes often occur, heavy metals exceed the permissible limit, pollution, erosion and deflation of the soil layer are observed due to the dissolution of heavy metal compounds in the soil under the influence of acid rain. Restoration of the soil layer, which has been subjected to such a man-made impact, requires huge expenditures of labor and funds.

Open tailings ponds of ore processing plants, enterprises of metallurgical, chemical and other industries in the territory of mining areas have a negative impact on the ecological state of the environment.

Mineralogical and geochemical studies conducted by geochemists show that the amount of harmful metals in the soil samples is at a level slightly higher than the maximum allowable concentration. In such conditions, it is necessary to determine the laws of distribution of heavy metals throughout the basin, as well as to study and analyze the balance mechanism of the geosystem and its biological components.

An increase in the amount of heavy metals in geosystems can be harmful and even dangerous for living organisms. Infiltration of heavy metals into the soil occurs both naturally (weathering of rocks and minerals, erosion processes, volcanic activity) and technogenic (mining and processing of ores, fuel combustion, under the influence of vehicles, agriculture, etc.) way.

Indicators of soil pollution with heavy metals include the amount of metals in its content, the nature of metals, their chemical and harmful properties, the form of chemical compounds, etc.

Soil stability to pollution depends on its granulometric composition, amount of organic matter, acid-alkaline and oxidizing-reducing conditions, activity of microbiological and biochemical processes, etc. Soil, unlike other components of the natural environment, not only accumulates in itself harmful components, but also acts as a natural shield, controlling the migration of chemical elements in the atmosphere, hydrosphere and living organisms. The high content of heavy metals in the soil not only harms living organisms and plants in it, but also poses a threat to human health through food products grown in contaminated soils.

Heavy metals and their compounds that have fallen into the soil accumulate, disperse or pass into other forms depending on the characteristics of this geosystem, the characteristics of geochemical barriers. When heavy metals are integrally associated with the soil component, their negative impact on the soil and environment is negligible. In the conditions where the natural balance in the soil has changed, it becomes possible for heavy metals to become a soil solution, and the level of their impact on plants and living organisms through the soil increases dramatically [1].

In the conditions where the natural balance in the soil has changed, it becomes possible for heavy metals to become a soil solution, and the level of their impact on plants and living organisms through the soil increases dramatically. The degree of contamination of soils and plants depends on: the form of chemical compounds of elements in the soil; the presence of elements that form complex compounds with heavy metals and products and have the opposite effect on their effects; the processes of adsorption and desorption; the number of metallochemical forms corresponding to the soil and soil-climatic conditions.

It is known that the high content of lead, zinc, copper, cadmium, molybdenum, tungsten and other heavy metals has a significant impact on the geochemical conditions and environmental situation of this place. In this case, the degree of harmful effects of the elements depends on the forms of their occurrence. Mobile, i.e. quickly soluble in water, various compounds of toxic elements (salts, acids, etc.), as well as their ionic forms are quite active, and even their small amount poses a great danger to a living organism. Its forms in the form of hardly soluble compounds (minerals, oxides, etc.), on the contrary, pose little risk. Therefore, studying the forms of their occurrence combined with determining the amount of toxic elements in soil, water, plants, and organisms in areas exposed to technogenic impact is one of the main indicators of assessing the ecological situation.

Our research object is located in the middle reaches of the Akhangaran River basin, the largest industrial area of our republic. Large enterprises of gold, non-ferrous metals, coal mining, construction industry products and electricity production operate here. Multisectoral agriculture, consisting of cereals, melons, fruits and vegetables, etc., also occupies an important place.

N.E. Shukurov (2013) conducted mineralogical and geochemical study of soil samples taken from the impact zone of Almalyk mining and smelting complex in order to identify heavy metals in soils subjected to technogenic impact. As a result of research conducted on the basis of separation of soil samples into separate fractions and the use of the latest modern analytical equipment, the amount and forms of their occurrence of heavy metals were determined [3].

The following figure shows soil sampling sites around Almalyk mining and industrial area (Fig.1).

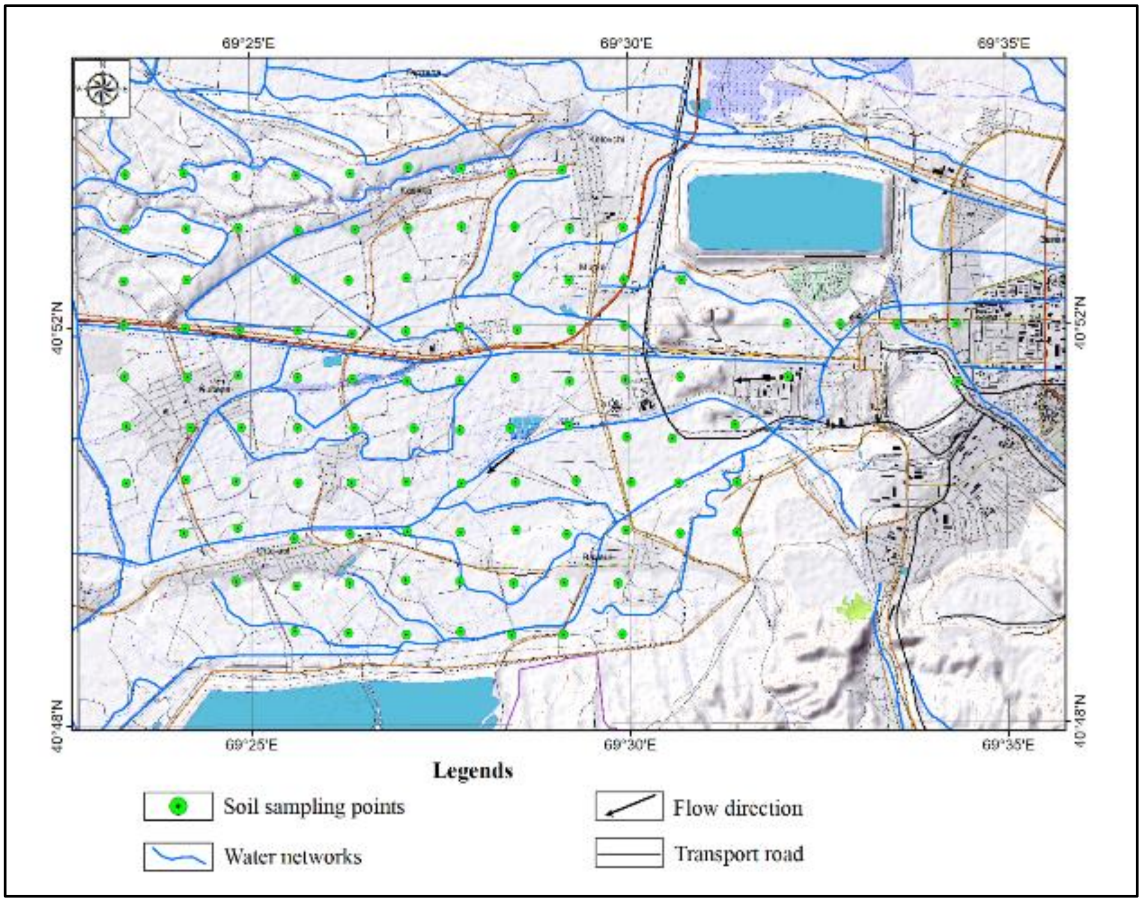

Fig.1. Soil sampling sites

The obtained soil samples were analyzed using modern analytical methods. The results showed that the content of heavy metals always increases with proximity to the source of pollution and decreases with distance from it. The table below shows the distribution of heavy metals in the soils of Almalyk mining region (Table 1).

Table 1. Distribution of heavy metals in soils of Almalyk mining district

Sample number		Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Pb	Th	U
XIV/1	Profile I-I	24	149	43	13	16	1634	781	14	164	169	20	87	8	714	395	12.1	3.6
IX/1		18	120	28	13	20	1519	229	14	178	202	22	123	12	676	115	14.1	4.7
V/1		14	94	57	14	29	87	138	18	156	162	31	219	19	703	57	19.1	3.8
I/1		17	108	82	14	37	129	223	14	109	184	26	166	14	610	72	11.5	2.4
XIV/1	Profile II-II	24	149	43	13	16	1634	781	14	164	169	20	87	8	714	395	12.1	3.6
XI/9		12	90	58	13	28	125	138	17	159	154	32	196	18	698	60	18.7	5.5
VIII/9		11	78	46	10	22	83	111	17	157	183	29	197	18	719	52	18.2	3.5
VI/10		11	80	47	11	23	77	132	16	158	170	29	197	18	712	54	18.7	4.5
II/11		18	107	92	15	37	53	99	12	96	197	25	210	13	557	28	11.8	2.3
XIV/1	Profile III-III	24	149	43	13	16	1634	781	14	164	169	20	87	8	714	395	12.1	3.6
X/12		13	92	63	14	30	66	117	18	154	152	33	191	18	718	57	16.8	5.1
XVI/10		13	88	56	13	26	143	222	17	159	167	31	198	19	766	104	19.1	4.1
XIV/12		7	71	24	7	8	18	59	15	168	178	26	289	18	738	33	18.5	3.4
XII/12		8	77	41	10	20	48	104	18	167	172	28	198	18	756	49	18.7	2.9
XIV/1	Profile IV-IV	24	149	43	13	16	1634	781	14	164	169	20	87	8	714	395	12.1	3.6
XIII/2		15	98	95	17	36	2946	1599	3	92	237	28	151	10	667	573	9.9	4
X/3		14	114	85	14	45	195	644	16	127	201	31	174	14	847	218	12.6	4.7
VII/4		11	89	56	10	21	187	664	15	116	212	22	173	12	792	367	9.1	4.8
IV/5		14	83	53	12	24	108	776	14	115	218	23	183	14	680	522	11.8	4
II/6		15	98	78	11	31	51	154	14	103	183	25	197	14	595	43	12.1	2.5
XIV/1	Profile V-V	24	149	43	13	16	1634	781	14	164	169	20	87	8	714	395	12.1	3.6
XIII/3		17	95	81	14	38	3137	1855	3	86	237	27	151	11	627	629	10	4.6
XII/4		13	93	60	13	29	127	684	16	134	202	25	187	13	813	115	14.1	3.3
XI/5		14	104	83	14	39	84	328	15	113	200	26	185	13	690	113	12.5	2.1
VIII/7		17	109	89	18	41	46	119	13	94	219	24	187	13	572	34	11	2.8

Based on the above table, the results were analyzed and mapped using ArcGIS software.

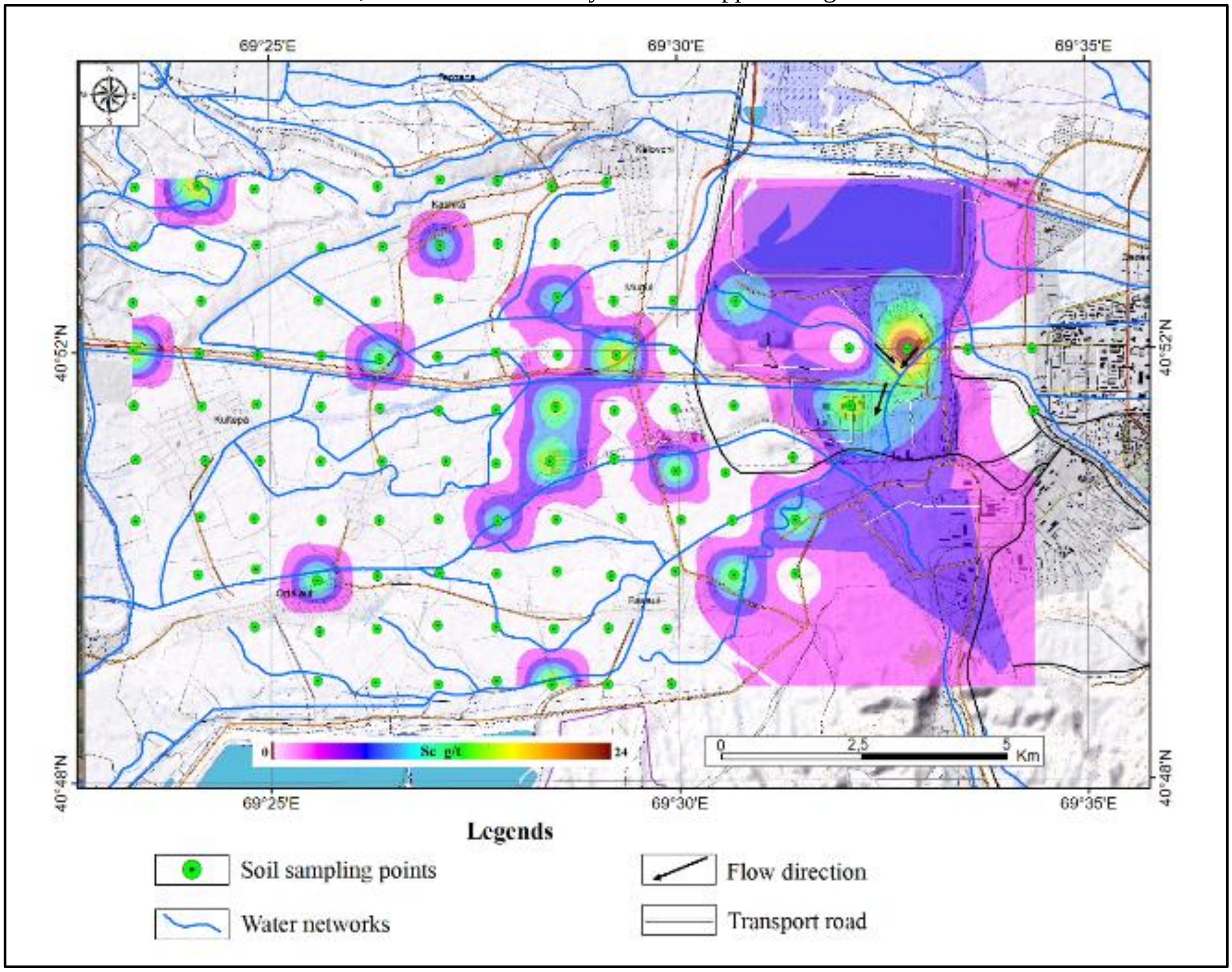

Fig.2. Distribution of the element scandium along the Gejigen network

As can be seen from the figure, the element scandium is distributed in large quantities around the Koriz channel Near this area is Almalyk mining and smelting complex. Almalyk mining and smelting complex (AGMK) with its numerous mining facilities (open pits, dumps, tailings ponds, mud accumulators) is the main source of air and soil pollution by heavy metals in Almalyk industrial area.

Anthropogenic sources of scandium (Sc) in the environment are various branches of industrial production. Rare earth elements and associated scandium wastes enter the air environment of industrial buildings at various stages of the technological process of their production and processing, as well as during their industrial application: during loading and unloading from reactors, filters, furnaces, as a result of operation of evaporation tanks, extractors, electrolyzers, certain types of devices. Scandium was first detected in the human body in 1935 by L.P. Vinogradov. The main way of entry of scandium into the human body is breathing; the distribution of various rare earth elements in the tissues of the body is not the same. Lighter ones accumulate in the liver in significant quantities, and heavier ones accumulate in bone tissue. Some of the rare earth elements remain in the lungs and lead to desquamative pneumonia, the formation of granulomatous nodules, and later the development of inflammatory phenomena in the peribronchial zones of the lungs [8].

3. Conclusions

In short, the impact of heavy metals on soil ecology depends on their mobility and solubility. Clayey soils with high adsorption capacity and soils rich in organic matter (especially in the top soil layers) can retain these elements. This property is typical for soils with carbonate and neutral reaction. The content of harmful compounds in these soils is much lower than in loamy soils with acidic properties. Heavy metals trapped in the colloidal and organic parts of the soil limit biological activities.

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