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ABOUT MONITORING OF METAL IMPURITY IN ENVIRONMENTS OF AREAS OF INTENSIVE ANTHROPOGENOUS INFLUENCE OF GEORGIA

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INTRODUCTION

The work purpose was carrying out of research of pollution of environments of the basic mining areas of Georgia: Madneuli copper-pyrites and barite-polymetallic deposits; the Chiatura manganous deposit; the Luhumi arsenical deposit.

In the course of work the special attention was given to revealing of laws of accumulation of heavy toxic impurity in natural waters and soils, and also working out of methods and recommendations about their clearing of pollution.

In the course of work have been used: field geochemical, hydrogeochemical methods and soil science methods; modern supersensitive analytical equipments; laboratory trials of definition of means of clearing of waters and soils from heavy metals, etc.

1. MAINTENANCES OF METAL MICROIMPURITY IN RIVER WATERS OF INVESTIGATED AREAS

According to the received results, in investigated areas the surrounding environment, as a whole, is considerably polluted by heavy toxic metals which basic sources are the mining enterprises located in these areas [1,2].

It has been revealed that all basic investigated waterways – the rivers Kazretula, Mashavera, Kvirila and Luhumi - under average maintenances in their waters of heavy metals considerably exceed average indexes of the rivers of a planet. Depending on structure of ores, the actual maintenance of investigated heavy metals in these rivers from 40 000 to 25 times is exceeded by their maintenances in the rivers of a planet (tab.1).

Results of the analysis of tests from different water points show that the most polluted waters are directly connected with sites of working out of deposits, territories of an arrangement of concentrating factories and places of warehousing of rocks, a waste and tails of processing of ores, etc. where concentration of investigated metals makes from 3 to 10 maximum concentration limits, and 10 maximum concentration limits in certain cases there are more.

Thus, the highest concentration of all studied elements (Cu, Zn, Fe, Mn, Pb, Co, Cd, Ni) are marked in Madneuli area. Here maintenance Ni above 10 maximum concentration limits are found out in 13% of tests, and Pb - in 58% of tests. In Chiatura area concentration Mn from 5 - 10 maximum concentration limits and above 10 maximum concentration limits are revealed in 35%, and Fe, approximately, in 40%.

It is established that except technogenic sources of impurity of heavy metals, their certain share is connected with the natural sources extended in investigated areas.

The actual maintenance ($C_{act.}$) heavy metals in tests was compared with their maximum concentration limit (mcl), established by the International Organization of Public health services and Ministry of Health of Georgia for territory of the country (tab.2).

The material presented in the table gives evident representation about pollution of natural waters of studied areas by defined elements. It is revealed that despite presence of self-cleaning of river waters, transportation of heavy metals in a suspension and the dissolved form occurs on big enough distances. As a result of it ecological danger not only near to the pollution centers, but also more low on a current - in areas of the settlements using these waters for an irrigation of agricultural grounds is created. It is obvious that imperfection of methods of clearing of industrial waters creates conditions of pollution of natural waters heavy metals. For example, concentration of the majority of investigated metals in the tests taken from the pipeline of Madneuli mountain-concentrating industrial complex after filtering, in hundreds and more time exceed their maximum concentration limit. The effect of clearing on filtering installation for Cu and Zn makes about 70-80 %, and for Co, Ni and Pb it is much less. Considering presence of high concentration of investigated microcomponents in these waters, becomes clear that such clearing is rather ineffective. The similar conclusions should be made and in cases of concentrating factories of Chiatura and Luhumi deposits.

Table 1. Comparisons of average maintenances of microimpurity in the river of Kazretula around settlement with their average Planetary values

Impurity	Concentration, mg/l	Relations

	In the river Kazretula, C_1	In the Planetary rivers, C_0	C_1/ C_0
Cu	280.0	0.007	40000
Zn	108.0	0.02	5400
Cd	0.72	0.0002	3600
Fe	75.0	0.07	1071
Mn	9.87	0.01	987
Co	0.09	0.0003	300
Ni	0.05	0.002	25
Pb	3.1	0.001	3100

Table 2. Distributions of sizes of concentration of impurity of metals in tests of waters of Madneuli ore region

Elements	Quantity of tests on gradation of concentration				
	< mcl	1-3 mcl	3-5 mcl	5-10 mcl	> 10 mcl
Cu	21	-	-	-	10
Zn	23	1	1	-	6
Cd	22	-	-	-	9
Pb	11	1	1	-	18
Fe	14	9	1	-	7
Mn	16	2	1	3	9
Co	7	2	3	11	8
Ni	19	7	1	-	4

2. RESEARCH OF POLLUTION OF THE SOIL LAYER BY METAL MICROIMPURITY

Studying of pollution of a soil layer in research areas occurred in parallel to studying of a condition of natural waters. Soil sampling covered the areas adjoining the mining and mountain-concentrating enterprises. Besides, the part of tests was is taken from the nearest agricultural grounds.

As a result of research it is established that soils of Madneuli, Chiatura and Luhumi mining regions are to some extent polluted by heavy metals. On occasion pollution reaches a critical condition. The most polluted soils are in the places located close to manufactures of working out and enrichment of deposits. Results of the microcomponental analysis of tests of soils of investigated regions show that depending on structure of ores, fiziko-geographical and chemical processes of degree of their pollution by that or other element considerably differ.

For example, in Madneuli area an indicator of pollution of a soil cover heavy metals - Q, received as a result of calculation of the given relation:

$$Q = C_{av} / C_{mcl} ,$$

where C_{av} (mg/kg) – average concentration of the given element in investigated tests, and C_{mcl} - its maximum concentration limit, shows that it concerns a category of moderately polluted soils.

Besides, it is established that here soils in the highest degree are polluted by the elements connected with working out of a copper pyrites deposit. The maintenance of this group of elements in the majority of tests from 1 to 3 maximum concentration limits. And in them of 25 % - concentration Cu above 10 maximum concentration limits. By the high maintenance it is characterized Co, which concentration in more than 50 % of tests makes from 5 to 10 maximum concentration limits and in 35 % of the selected tests - above 10 maximum concentration limits. It is noted as well high enough maintenance Ni, which concentration in more, than 60 % of tests are from 1 to 5 maximum concentration limits.

In Chiatura area from all analysed tests of soils, only in individual tests the maintenance of heavy metals is below maximum concentration limit.

Researches have revealed that soils of mountain areas of area of research more often and in higher degree are polluted by impurity Mn, Cu, Zn, Co, Ni which concentration repeatedly exceed maximum concentration limit of these elements in soils (tab. 3). Their sources basically are manganous ores and breeds in which their presence is established.

Table 3. Heavy metals in soils of Chiatura ore area

The maintenance of microcomponents, mg/kg							
Mn	Fe	Cu	Zn	Pb	Cd	Co	Ni
Uplands Sareki							
1500	166	50	37	25	1.3	71	55
Uplands Merjevi							

34500	68	40	50	20	1.3	64	100
Uplands Darkveti							
31250	75	44	70	19	0.8	61	85
Uplands Itkvisi							
5830	87	41	70	16	0.7	41	26
Uplands Shukruti							
8700	35	33	50	14	0.8	32	27
Uplands Mgvimevi							
7700	60	50	120	31	2,0	55	35
Uplands Zeda Rgani							
9000	50	20	50	20	1.3	35	22
Uplands Perevisa							
10500	65	32	120	31	1.3	45	40
Park of the city of Chiatura							
16250	70	28	68	27	1.3	56	60
Uplands Pasiati							
14930	51	18	26	14	0.6	27	51
Uplands Rgani							
18348	68	28	33	15	0.9	40	49
Uplands Bunikauri							
7750	92	15	29	19	0.5	31	35
Uplands Merevi							
126208	75	17	35	13	0.7	33	29
Uplands Tabagrebi							
17240	48	13	31	17	1.0	27	28
Uplands Qveda Rgani							
19000	58	40	60	17	1.0	52	50
Uplands Darkveti							
4000	92	43	57	17	0.9	50	28
Uplands Sareki							
33000	93	75	77	36	0.5	70	87
c. of Chiatura							
10000	80	20	80	28	1.0	31	26

It is revealed that in manganous ores and rocks containing them minerals which structure includes impurity of toxic metals, are, basically, in forms insoluble in water. Nevertheless, presence of manganese and some other heavy metals in tests of soils (and also waters) area, allows to assume that their migration occurs in the form of soluble in water of the metallorganic form which is the basic form of migration of manganese, and in certain cases as well other heavy metals.

In Luhumi area the main reason of pollution of soils heavy metals, is imperfection of methods of enrichment and processing of arsenical ores on is mountain-chemical plant (MCP). The basic part of tests of soils has been selected on the areas adjoining to MCP and its shops of roasting of ores. Other part was is taken from agricultural grounds.
Results of the microcomponental analysis of tests of soils of the given area are presented to tab.4.

It is necessary to notice that high maintenance Cu noted by us in tests of soils of all region, speaks not only presence of this element at candle ends of arsenical ores and a waste of concentrating factory MCP, but also presence of a mineral of this element ores of the polymetallic deposit located to the north from MCP. Besides source Cu can be and rocks on which region soils were formed.

It is known that in soils with sour and neutral reaction what the soil of Luhumi region is, Cu it is taken out by water in appreciable quantity, but some part of this element in the form of an organic complex is fixed in soil and is a little accessible to plants. This circumstance explain existence of high concentration of copper in soils of the Luhumi area [2]. Thus, in all considered areas in pollution of a soil cover by heavy metals the dominant role is played by the technogenic factors connected with work of the mining and mountain-concentrating enterprises. Besides natural processes, such as aerations and washout of polymetallic and sulphidic ores and the rocks containing heavy metals aren't excluded also.

Table 4. Maintenances of impurity of heavy metals in soils of Luhumi ore area

The maintenance of microcomponents, mg/kg /Place of sampling of soil							
Mn	Fe	Cu	Zn	Cd	Pb	Ni	Co
Territory of shop of arsenic of preparations							
375	2200	12000	83	1,10	5,5	16,2	12,0
Site of manufacture of monocrystals							
340	75	100	10	1,10	1,3	6,0	5,0
Area under crops near to manufacture							
545	2200	2000	51	0,87	3,7	12,5	10,0
Site of electrolysis							
300	75	100	3,0	0,75	0,9	40,0	3,0
Area under crops of village							
375	2700	16000	38	0,87	2,9	12,5	10,0
Northern river bank							
100	1200	13500	5,0	0,30	-	8,0	8,2
Corn field							
370	200	5000	6,5	0,25	-	2,5	4,0
Grapes plantation							
170	350	9000	6,0	0,25	-	4,0	6,0
Village pasture							
170	415	7500	4,5	0,33	0,5	4,0	6,0
Village pasture							
280	500	9000	9,5	0,32	0,5	4,0	5,7
Between villages							
200	1250	12000	4,0	0,32	0,5	7,0	8,2
In 300 m above merge of the rivers Luhuni and Rioni							
280	150	6000	6,5	0,25	2,0	2,5	4,5
River bank Abarula							
238	1920	12450	8,6	0,4	0,8	7,9	10,0

Along with pollution studying by heavy metals of environment of considered regions, in the given work attempt of working out of methods of improvement of environment is undertaken. Revealing of methods and materials for clearing of waters and soils of heavy toxic metals at a certain stage of technology of working out of deposits was thus provided.

The spent laboratory trials show that for these purposes the modified and activated natural sorbents which deposits are available in Georgia have appeared the most effective. Their absorbing ability for the majority of the studied chemical elements (except Mn and Co) is very high (from 85 % to 100 %). CONCLUSION

Thus, in all considered areas in pollution of a soil cover by heavy metals the dominant role is played by the technogenic factors connected with work of the mining and mountain-concentrating enterprises. Besides aren't excluded both natural factors and processes, such as aerations and washout of polymetallic and sulphidic ores and rocks, содеожащих heavy metals.

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საქართველოს ინტენსიური ანთროპოგენური ზემოქმედების ბუნებრივი გარემოს მეტალური მიკრომინარევების მონიტორინგის შესახებ./სვანიძე ზ, გუნია გ, სვანიძე ლ./საქართველოს ტექნიკური უნი-

ვერსიტეტის ჰიდრომეტეოროლოგიის ინსტიტუტის შრომათა კრებული-2013.-ტ.119.-გვ.213-217-ინგლ., რეზ. ქართ., ინგლ., რუს.

კვლევის მიზანს საკვლევი რაიონების ბუნებრივ გარემოში მძიმე ტოქსიკური მეტალების დაგროვების კანონზომიერების კომპლექსური კვლევები და მათი ეკოლოგიური მდგომარეობის გაუმჯობესების მეთოდებისა და რეკომენდაციების დამუშავება წარმოადგენდა.

კვლევის პროცესში მიღებულია შემდეგი შედეგები: საკვლევი რაიონების ზედაპირულ წყლებში და ნიადაგებში დადგენილია რიგი მძიმე მეტალის, მათ შორის, Cu, Cd, Pb, Zn და Fe, Mn, Co, Ni კონცენტრაციების სიდიდეები; შესწავლილია ამ ნივთიერებათა განაწილება საკვლევ ბუნებრივ გარემოში და შეფასებულია მათი ფაქტობრივი მნიშვნელობების შეფარდება საქართველოს ტერიტორიასათვის დადგენილ ზღვრულად დასაშვებ კონცენტრაციებთან; შესწავლილია მადნების საბადოების ექსპლუატაციისა და გამდიდრების არეალების გავლენის ქვეშ მდებარე რეგიონების ზედაპირულ წყლებში და ნიადაგებში მძიმე მეტალებით დაბინძურების მიზეზები და სიდიდეები; გამოკვლეულია ატმოსფერული ჰაერის ნაკადით საკვლევი მიკრომინარევების გადატანის პროცესები; საქართველოში მოპოვებული, მოდიფიცირებული და აქტივიზირებული ბუნებრივი სორბენტების გამოყენებით საკვლევი ბუნებრივი გარემოს რეაბილიტაციისა და გაჯანსაღების მეთოდები და რეკომენდაციებია დამუშავებული.

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The work purpose is complex research of laws of accumulation of heavy toxic metals in surrounding environments of the specified areas and working out of methods and recommendations about improvement of their ecological condition.

In the course of research following results are received:

Concentration of heavy metals (Cu, Cd, Pb, Zn, Fe, Mn, Co, Ni) in waters and soils of investigated areas are established; Their distributions in these environments are revealed and their actual maintenances are compared with maximum permissible concentration for territory of Georgia; The reasons and pollution degrees are established by heavy metals of natural waters and soils of the regions which are in an area of influence of operation of deposits and enrichments of ores; Process of carrying over of investigated microimpurity by air streams of atmosphere is investigated; Methods and recommendations about rehabilitation and improvement of environment with application of the modified and made active natural sorbents which deposits are in Georgia are developed.

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О МОНИТОРИНГЕ МЕТАЛЛИЧЕСКИХ ПРИМЕСЕЙ ПРИРОДНЫХ СРЕД РАЙОНОВ ИНТЕНСИВНОГО АНТРОПОГЕННОГО ВОЗДЕЙСТВИЯ ГРУЗИИ./Сванидзе З.С., Гуния Г.С., Сванидзе Л.С./Сб. Трудов Института Гидрометеорологии Грузинского Технического Университета.-2013.-т.119.-с.213-217- Анг.,Рез.Груз.,Анг., Рус.

Целью работы является комплексное исследование закономерностей накопления тяжелых токсичных металлов в окружающих природных средах указанных районов и разработка методов и рекомендаций по улучшению их экологического состояния. В процессе исследования получены следующие результаты:установлены концентрации тяжелых халькофильных (Cu, Cd, Pb, Zn) и сидерофильных (Fe, Mn, Co, Ni) элементов в водах и почвах исследуемых районов; выявлены их распределения в этих средах и сопоставлены их фактические содержания с предельно допустимыми концентрациями для территории Грузиивыявлены причины и степени загрязнения тяжелыми металлами природных вод и почв регионов, находящихся в ареале влияния эксплуатации месторождений и обогащения руд; исследован процесс переноса исследуемых микропримесей воздушными потоками атмосферы; разработаны методы и рекомендации по реабилитации и оздоровлению окружающей среды с применением модифицированных и активизированных природных сорбентов, месторождения которых находятся в Грузии.