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Neutronactivation Analysis and Hydrogeochemistry of Natural Waters of the Republic of Karakalpakstan

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Abstract: ***In the article there have been studied anthropogenic changes in the state of the biosphere of the Aral sea region connected with changes in the elementary composition of natural waters of the region. The investigation of the value of CE (enrichment coefficient) for these objects is of a great importance. The value of EC and WMC characterizes the degree of enrichment and migration abilities of chemical elements in the object. The analysis was carried out by the method of neutron activation. In an average content there have been received more than 30 chemical elements in the composition of natural waters.***

Keywords: Karakalpakstan, water, neutron-activation analysis, chemical composition, region of the ecological disaster, intensity, subsoil waters, coefficient, river waters, collector waters.

1. Introduction

For the period from 2005 to 2015 in the water abstraction of Samanbay there were selected about 30 tests of the river and collector water and after the appropriate test preparation there was done a poliylementary instrumental neutron-activation analysis of tests for the content of 30 and more chemical elements. The results of the analysis are presented in table 1. The enrichment coefficient [1] for these elements are accounted according to the formula:

$$EC = \frac{C_x K_{on}}{C_{on} K_x} \qquad (1)$$

where $\mathbf{C_x}$ and $\mathbf{C_{on}}$ – the content of comparing and reference-input element in the investigating objects, in accordance, $\mathbf{K_x}$ и $\mathbf{K_{on}}$ – the content of comparing and reference-input element in the crust of earth. The coefficient of water migration [1] was accounted according to the formula:

$$WMC = \frac{m_x 100\%}{a n_x} \qquad (2)$$

where $\mathbf{m_x}$ – the content of an element in water, gr/l, mg/l and etc., **a** – mineralization of water in gr/l, $\mathbf{n_x}$ – the content of an element X in lithosphere in percentage (%).

The value of EC and WMC characterizes not only the degree of enriching and migration abilities of chemical elements in the object but the origin of elements in environment.

As an element of comparison (a reference-input element) for the account of EC we have chosen the content of scandium in the crust of earth, because scandium is considered to be the element that has soil and lithogenous origin. Usually for a reference-input element aliminium, iron and scandium are used [2].

Anthropogenic changes of the state of biosphere of the Aral seaside are connected with the change of elementary composition of natural waters of the region, that's why the study of value of EC for these objects is one of the actual issues. The change of meaning of EC for the river and drainage-collector waters is given in table 1. The comparison of the dimension of EC of the river and drainage waters and separate elements shows that the value of EC changes within one-two mathematical orders. The received results can be divided into three groups: EC>1 EC<1and EC=1. Group EC>1 contains the following elements: Na, Cl, K, Fe, Zn, As, SE, Br, Rb, Mo, Ag, Cd, Sb, Sm, Eu, Yb, W, Hg, U. Each element of this group relates to anthropogenic or geochemical anomalies by origin.

In group EC<1 we deal with a group of elements Cr, Co, Cs, Ba, La, Ce, Hf, Th and etc., that relate to natural by origin. It should be emphasized the fact that the meaning of the enrichment coefficient for the river and drainage-collector water differs from each other, and it proves that the processes of forming an elementary composition of these waters have some differences by origin.

Thus, the elementary composition of the river waters is formed under the influence of the composition of soil-forming kinds that are determinant , and the composition of drainage-collector waters are formed not only by the composition of mountain kinds but also of agricultural soils that contact with water. It is the last process that became the basis of the technology of soils' washing by water for elimination of dirty things.

In the result of the study of the drainage-collector water we've got the following meanings of the coefficient of enriching: EC>1 Na, K, Cr, Fe, Co, Zn, As, Se, Br, Mo, Ag, Cd, Sb, Ba, La, Ce, Eu, Yb, W, Au, Hg, U. In this case, practically for all elements under investigation, the content of the above-mentioned elements is ten times higher in collector waters, that's why the meaning of EC is higher than in the river water. In the process of soils' washing the composition of the collector water is enriched (foils) by the above-mentioned elements, and the meaning of EC for some elements is two-three times higher in mathematical order than for the river water (for example, for Cr, Fe, Co, As and etc.).

As for group EC<1 (Cs, Sm, Hf, Th) it is observed the ceasing of their content in the process of soils' washing. These elements in the composition of the collector waters are of natural origin.

The considerable contamination of the composition of the river and collector waters by Na, Cl, K and other elements has brought to the whole ecological anthropogenic pollution of the Aral seaside, and it is connected first of all with the drying of the Aral sea.

In the results of this research work about the content of wide spectrum of chemical elements in natural waters, bottom – dwelling deposits and airborne dust we can see that the formation of elementary composition of each component of objects of environment in the region is determined by the structure of airborne dust that rises from the aquatorium of the Aral sea, desert-saliniferous territories of the region, downthrow of drainage-collector waters into the bed of rivers, and also by washing of surface contamination by rainfalls that flow into the beds of rivers and channels and from there into agrosoils.

Table 1: The average values of the enrichment coefficient and water migration coefficient of chemical elements in the river and collector waters of Karakalpakstan.

	The Amudarya river			Collector		
	C_p мkg/l	EC	CWM	$C_к$мkg/L	EC	WMC
Na мgr/l	180,0	36,0	3,85	600	48,0	13,0
Cl мgr/l	127	3735,3	396,9	-	-	-
K мgr/l	90,0	18,0	1,91	400	32,0	8,7
Sc	2,0	1,0	0,04	5,0	1,0	0,26
Cr	0,9	0,05	0,006	20,0	0,48	0,13
Fe мgr/l	400	4,3	8,6	1000,0	4,3	1,15
Co	0,8	0,22	0,23	40,0	4,44	33,6
Zn	40,0	2,41	0,26	700,0	16,8	45,0
As	2,8	8,23	1,20	2,4	2,82	8,24
Se	0,9	90,0	9,78	3,0	120,0	3260,9
Br	8,0	4,93	2,0	4,0	0,98	13,65
Rb	60,0	2,0	0,21	40,0	0,8	0,014
Mo	4,0	20,0	2,14	50,0	10,0	13,9
Ag	0,2	14,3	1,63	3,0	85,7	23,1
Cd	0,8	3,0	3,33	3,0	4,6	12,5
Sb	2,0	20,0	2,10	3,6	14,4	4,0
Cs	0,3	0,41	0,04	0,4	0,21	0,058
Ba	50,0	0,38	0,041	600,0	1,85	0,50
La	4,0	0,69	0,07	5,0	0,34	0,28
Ce	4,0	0,29	0,03	6,0	0,17	0,46
Sm	0,3	1,88	0,02	0,4	0,88	0,093
Eu	2,0	7,69	0,83	0,7	1,7	8,88
Yb	0,2	3,03	0,33	0,4	6,01	6,06
Hf	0,06	0,30	0,05	0,1	0,50	0,053
W	8,0	30,7	0,4	6,0	23,1	2,5
Au	0,06	69,8	8,10	0,03	34,88	3,75
Hg	0,8	48,2	5,30	2,0	120,4	12,9
Th	0,7	0,27	0,02	0,3	0,12	0,012
U	0,7	1,4	0,15	2,0	4,0	0,43

Thus, the elements found out in the composition of the river and drainage waters are of natural and anthropogenic origin. As it is emphasized in the work [3], separate elements, for example such elements as Au, ZnAs, Sb, Ag, Se, have a geochemical origin, that's why we've got high values of the enrichment coefficient for these elements.

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