URANIUM AND RADIUM IN THE NARYN AND MAILUU-SUU RIVERS OF THE KURKHUZ REPUBLIC

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Introduction

As a result of the mining and processing of the radioactive and other materials on the territory of the Kyrgyz Republic a number of tailing dumps and heaps have been constructed. Besides, on the territory of the Republic there are the enterprises, which also may negatively impact on the ecological situation in Kyrgyzstan, as well as in the adjacent states – Uzbekistan and Kazakhstan. The toxic ingredients of these enterprises can get on the territory of the adjacent states with the waters of the big rivers of Kyrgyzstan, i.e. Naryn and Mailuu-Suu, which spring from the territory of Kyrgyzstan, and then pass the territories of Uzbekistan and Kazakhstan. To a certain degree, funding of three Projects, they are: Kr-072 (it is already finished), Kr-715 and Kr-850, (which are being implemented), and which is made through the ISTC, has assisted in solving these problems. Somehow these Projects are related to the study of the spatial and temporal migration of the toxic ingredients.

Experimental Validation

The researches included:

- water, soil and bottom sediments sampling;
- determination of the in situ γ-radiation dose;
- α-spectrometric determination of the activity ratio of $^{234}U/^{238}U=\gamma$, and uranium concentration ($n \cdot 10^{-6}$ g/l);
- scintillation and semi-conducting γ-spectrometry for determination of the radionuclides, the decay of which is accompanied by γ-emanation (in Bq/kg).

The laboratories of the Institutes of the Nuclear Physics of Uzbekistan and Kazakhstan performed measurements on the semi-conductor γ-spectrometers. Detail information on these analyses is presented in the Data Report. Sandia National Laboratories, the Energy Department of the USA.[1].

Results and Discussion

The sampling sites for studying the transboundary toxins transport correspond to the sampling sites of the «Navruz» Project. Detail information on this Project is on the Web-site: http://www.cmc.sandia.gov/Central/centralasia.html. In the Table below there are the figures of the ratios of the α-activity $^{234}U/^{238}U=\gamma$, and the uranium content for the water samples, as well as the uranium and radium content (in Bq/kg) of the riverside soils and bottom sediment samples, (at the sites where they were), in the water sampling sites. The dose rate in the sites

is up to 10-16 μR/h, and is up to 150-200 μR/h in the sites of outcropping of the tailing dumps of the Western Mining and Chemical Plant (ZGKhK, Mailuu-Suu).

Table

Results of uranium and radium measurements in the Naryn and Mailuu-Suu rivers

# of sample	Site of sampling	$^{234}U/^{238}U = \gamma$	$C_U \cdot 10^{-6}$ g/l*	^{238}U (Bq/kg)		^{226}Ra (Bq/kg)	
		W	W	S	B	S	B
1	Chong-Naryn river	1.53±0.05	0.90	36.2	-	63.1	-
2	Kich-Naryn river	1.52±0.05	1.24	21.3	-	47.6	-
3	River Naryn before town Naryn	1.86±0.05	0.54	26.0	-	52.5	-
4	River At-Bashi before it flows into river Naryn	1.69±0.05	0.85	20.1	-	30.3	-
5	River Naryn after confluence with At-Bashi river	1.61±0.05	0.85	26.1	-	50.2	-
6	River Chichkan before it flows in the Toktogul reservoir	1.27±0.03	1.29	24.2	-	53.0	-
7	River Naryn before it flows in the Toktogul reservoir	1.70±0.02	1.9	29.7	-	59.1	-
8	The Toktogul reservoir	1.86±0.02	1.0	29.1	-	47.6	-
9	River Naryn after the Toktogul reservoir	1.77±0.02	1.0	31.5	-	63.7	-
10	River Naryn in the region of the Tashkumyr town	1.88±0.02	0.9	31.3	-	54.7	-
11	River Sere-Suu	1.39±0.07	0.37	35.0	20.1	59.8	34.9
12	River Mailuu-Suu	1.31±0.04	1.2	24.2	31.1	51.9	45.3
13	River Mailuu-Suu in the town near the transformers producing plant	1.05±0.02	3.1	18.1	18.2	37.5	32.7
14	River Mailuu-Suu after the Mailuu town	1.06±0.04	2.1	26.1	21.2	53.1	31.9
15	River Mailuu-Suu at the border with Uzbekistan	1.32±0.02	1.8	18.2	10.2	47.5	21.9

* - The error of the uranium content measurement is about 5 %.

S – soil; B – bottom sediments; W – water.

The results of the $^{234}U/^{238}U=\gamma$ activity ratio and the uranium content are given in the earlier publications [2,3]. Therefore, here we give only the results of the uranium and radium measurements in the riverside soils (see the Fig.).

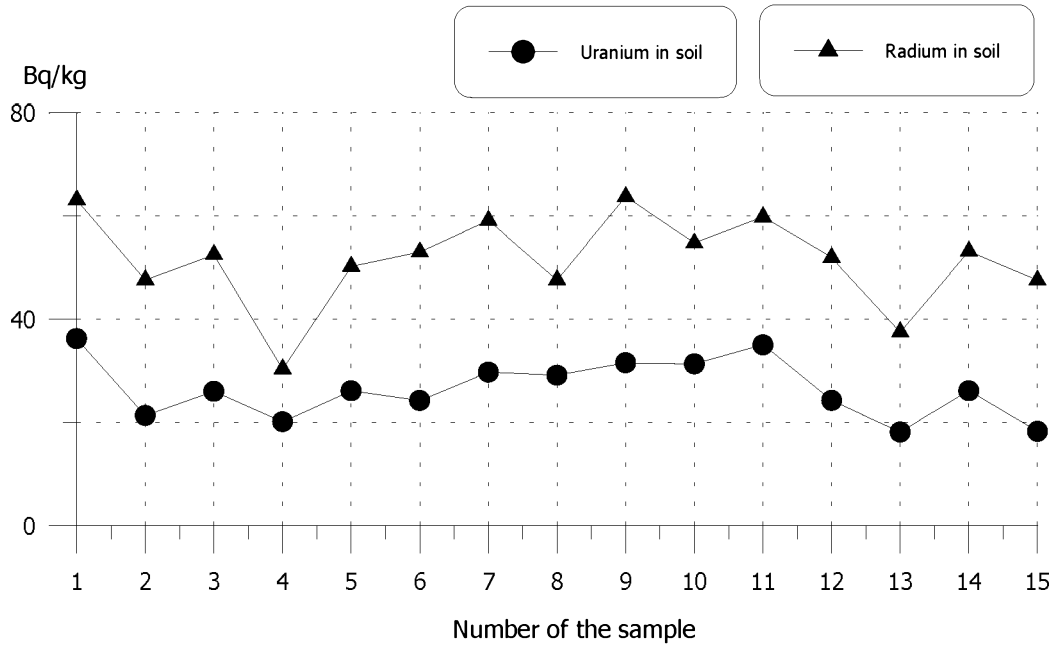


Fig. Uranium and Radium in the riverside soils of the Naryn and Mailuu-Suu rivers.

From the Table and the Figures it is evident that the uranium content in the riverside soils varies from 18 to 36 Bq/kg, and radium 30 to 63 Bq/kg. No anomalous uranium and radium concentrations down-stream the Mailuu-Suu River are observed. On the contrary, there is a trend toward the decrease of uranium and radium concentrations in the soils and bottom sediments of the Mailuu-Suu river (see the Table). Hence, the observed increase of the uranium concentration in the waters of the Mailuu-Suu river on the territory of Uzbekistan [4,5] is not attributed the uranium transport from the tailing dumps of the Western Mining and Chemical Plant. On the territory of Uzbekistan the increase of the uranium concentration occurs by the mechanisms that are similar for the rivers of the Chui valley in the Kyrgyz Republic [6].

It is possible to comment on the obtained results in the following way.

Sample 11 – riverside soil and bottom sediments of the "pure" tributary of the Mailuu-Suu river, i.e the Sary-Suu river. Apparently, the obtained values of the uranium and radium concentrations in this point may be taken as the "background" values for region of the research as a whole. Sample 12 characterizes the same parameters for the riverbed of the Mailuu-Suu river, which washes the rocks with the increased uranium content. Higher radium concentration, as against the uranium one, (in Bq/kg), is attributed to the mechanism of

α-decay, as a result of which the area of disorder is formed, where the initial crystalline structure is dislocated. The above area is predominantly dissolved by the washing liquids, therefore in the aqueous solutions the excess of the daughter isotope is observed. Further down-stream, in the bottom sediments, the trend in decrease of the radium concentration is observed, as well as minor uranium concentration fluctuations. No "anomalous" values of this parameter are observed. The decrease of the radium concentration is explained by its high

absorption capacity in comparison with uranium. In other words, the radium compounds are less soluble, and migrate to a lesser distance than the uranium ones.

Conclusion

1. The uranium content in the water of all sampling sites does not exceed $3 \cdot 10^{-6}$ g/l, i.e by order of magnitude less than in the wares of the Chui valley; in the soils and bottom sediments it does not exceed 35 Bq/kg, that is much less than the maximum concentration limit (MCL).
2. The radium concentration in the soils and bottom sediments in the region under research is not more than 60 Bq/kg.
3. By the change of the uranium and radium concentration in the waters, bottom sediments and the riverside part of the Naryn and Mailuu-Suu rivers the obtained results indicate the lack of transboundary transport of these components from the territory of Kyrgyzstan.
4. The hazard may be presented by the mudflows, which are provoked by the change of the landscape relief as a result of the raw material processing and formation of dumps.

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