THE RADIOECOLOGY STUDY OF THE BIOSPHERE TERRITORY OF ISSIK-KUL

B.M.Djenbaev, U.S Abdijapar., A.B.Shamshiev, B.Jolboldiev, A.A.,Jalilova
Institute of Biology & Pedology of NAS the KR 720071; 265,Chui Avenue, Bishkek, Kyrgyz Republic
Tel: 996 312 655687, 657943; fax: 996 312 243607, E-mail: bekmamat2002@mail.ru

1.INTODUCTION

It is known fact that the geochemistry of elements in biosphere are the history of there's migration and concentration in different systems of sphere of our planet. By Fresman (11) the geochemistry of any element depend on endogen and eczogen factors of migration. Endogens – they are chemical property of elements, determined by theirs position in Periodic system, i.e. a structure of atom. The eczogen factors of migrations are geochemical features of environment - temperature, pressure, oxidation-reduction and pH conditions, etc. In territory of Kyrgyzstan there are natural-technogenic territories where studying and monitoring radionuclides are necessary. One of such territory is a hollow of Issyk-Kul. The Issyk-Kul hollow is located at height of 1600-1700 m above sea level, between mountain ranges Terskey and Kungey Ala-Too. On classification this landscape is belong to mountain-valley (5, 8, 9, 10).

The geochemical conditions of the Issyk-Kul hollow are so – outputs of the granites ($3{,}9x10^{-4}$ %), presence of the carbon-siliceous slates ($1{,}07x10^{-3}$ %), has been enriched by uranium, determining the highest contents of the uranium in soils of the hollow and in the Issyk Kul lake are also can be form of basis for compiling of the biogeochemical uranium provinces (7). So, main source of uranium soil and natural waters of Issyk-Kul hollow can be granites and slates with the highest contents of the uranium. At aeration of these breeds easily mobile connections of six-valent uranium which concentrate in B horizons of humus, and also enrich natural water and waters Issyk Kul lake by uranium.

By estimations of scientific biogeochemists and geochemists hollow of the Issyk Kul is a natural uranium biogeochemical province (2). However uranium ores consists other microelements (2, 4). In the given uranium region the biogeochemistry of uranium, etc. microelements are studied poorly. Considering the social and economic and ecological importance of subregion of Issyk-Kul for republic and value of uranium for alive organisms, we have aim - to research biogeochemistry of uranium in territory hollow of Issyk Kul.

2. METHODS OF RESEARCHES

The gathering of the samples of soils, natural waters, plants and animals we are spent by view of geochemical landscape and meteorological conditions. Processing of samples carried out in laboratory of biogeochemistry of Biology and Soil Institute of National Academic Science of Kyrgyz Republic with use of soil and geological maps by consultation of geologists. The equipments used during researches were Radon radiometer RRA--01m-03, Dosimeter-radiometer DKS-96, Sampling system POU-04, Photo-electro-colorimeter (SPECOL), etc. Distribution and processing of the received information were made on special software of PC.

During process of researches were selective measurements of a level of radiation and uranium in the given subregion and tails. Gathered the samples of soils, water and plants in different places for the further research in laboratory conditions.

3. RESULTS OF RESEARCHES

Ecological and biogeochemical researching of uranium (a level of radiation) was spent around of Issyk Kul Lake. More detailed research was exposed southern and southwest coast of Issyk Kul where uranium technogenic province of Kadji-Say is situated (it is located on southern of Issyk Kul lake, at height of 1978,9 m above sea level and territory is 31,5km2). Here functioned the combine of mining on ore uranium from 1948 to 1969.

As a result of storm rains and natural influence, in August, 1998 the isolation layer and dam of uranium deposit if Kadji-Say was destroyed, and the radiating background of its some places was 1700-1800 mcR/hour, that has caused alarm of public Issyk-Kul oblast and the nature protection organizations (1, 2). The uranium deposits of Kadji-Say was covered and blocked by isolation soil by helps of the international projects (financial sources) In 2005, but the protective dam under influence of natural factors and anthropogenous influences in some place of deposits has started to collapse, washing out by high waters leading to carrying out of radioactive materials on a surface.

Uranium waste is located in 2,5 km to the east from inhabited settlement, but natural factors (rains, underground waters, landslips) are dangerous for ecology of Issyk Kul lake and the nearest settlements. But after closing of mining combine of the Kadji-Say a lot of not conserving radioactive-industrial waste in coastal of Dzhili-Bulak, underwent intensive destruction, carry of its part to a exit of natural boundary. The reason was frequent storm rains. For 40 years there was an intensive raising a coastal part in area of industry zone. It was made by formation of terraces in highest natural boundaries of Dzhil-Bulak. On the kept terraces it is possible to meet here and there the radioactive-industrial waste, combined by ashed material mixed up with gravel material. The part of radioactive ashes achieved to Issyk Kul Lake, but it is not so important, because that is makes a drop in the sea for Issyk Kul Lake (we shall remind, that in the lake contains about 100 thousand tons of uranium) (1, 2, 3, 5, 6, 14).

By radiometric shooting turn out that a level of radiation in hollow of the Issyk-Kul and in around territory of the Kadji-Sai settlement is low and about from 15 up to 47 nZv/hour (table.1).

Table 1. The level of gamma background in hollow of the Issyk-Kul

Places of gathered	Pressure	Humidity	T of air	T of waters	pH	Gamma-background	
						On surface of the soil	Surfaces of ground at height of 1 m
Settlement Kara-Oy	709 mm hg	35%	22 °C	18,5 °C	8,5	150-200 nZv/hour	100 Zv/hour
town Cholpon-Ata	709 mm hg	35%	22 °C	-	-	200 nZv/hour	- 150 - 200 – 220 nZv/hour
Settlement Bulan-Sogotu	-	-	-	17,5 °C	8,15	150 nZv/hour	100 nZv/hour
r. Kichi Ак-suu	709 mm hg	44%	22 °C	13,2 °C	7,94	160 nZv/hour	150-170 nZv/hour
r. Tup	-	-	-	18,8 °C	8,12	170 nZv/hour	140 nZv/hour
r. Kara-Kol	-	-	-	15,8 °C	8,05	-	-
Settlement. Ак-Терек	-	-	-	17,5 °C	8,24	470 nZv/hour	320 nZv/hour

Soil. The soil of region is light brown with low humus, about from 0,8 up to 2,0 % with decrease. Light-brown soils are with carbonate on surface, and for carbonates structure it is characteristic that distribution of the CO_2 almost uniform with some tendency of increase from up to down. The maximum of accumulation of carbonates is visible on depth 40-50 sm. Light-brown soils are possess alkaline reaction. The pH is equal 8,0-8,5 on all soil structure (4, 9).

In province of Kadji-Say and around territory the soil and covered ground are characterized by the various contents of uranium -from $0{,}1 \cdot 10^{-6}$ g/g to $35{,}0 \cdot 10^{-6}$ g/g. The analysis of 20 samples of soils and ground has shown, that on the uranium deposit in the upper horizon of a covered ground (0,20 sm) the contents of uranium about from 1,1 up to $2{,}6 \cdot 10^{-6}$ g/g, and with depth it is increased a few - to $3{,}0 \cdot 10^{-6}$ g/g. there is more concentration of uranium in the average zone of Uranium deposits, where has the contents of uranium in the upper horizon of a soil equally $4{,}2 \cdot 10^{-6}$ g/g, and in the bottom of horizon, on depth of 40-60 sm consist - $35{,}0 \cdot 10^{-6}$ g/g or in 8,3 times above (2, 7, 9) (Tab. 2).

Table 2. The level of gamma-background in technogenic uranium subregion of Kadji-Say

Places of selection	On a surface of ground	Surfaces of ground at height of 1 m
Channel of the river in area of waste	150-200 nZv/hour	150-200-220 nZv/hour
Отстойник № 3	200 nZv/hour	150 nZv/hour
Factory on processing coal shlags	200 nZv/hour	150 - 200 - 220

		nZv/hour
The upper located waste, industrial zone	220-240 nZv/hour	200 nZv/hour
Above a tail deposit in area with high gamma-background, industrial zone	1,4 nZv/hour	220 nZv/hour
Residential zone	200 nZv/hour	150 nZv/hour

At around of a boarding house the "Khan-Saray" what is located on below horizon of tail deposit the average contents of uranium in soil is above, than on tail deposit ($6{,}3 \cdot 10^{-6}$ g/g). The concentration of uranium in territory of a boarding house on depth of 20-40 cm is high and makes 17,0-20,0·10-6 g/g. In our opinion, radionuclides of uranium tail deposits are migrating with underground waters downwards to lake and collecting in soil of boarding house.

According to other researchers (7), the increased content of uranium in light-brown soils of southern coast of Issyk Kul is also noted (from 1,5·10-6 up to $3{,}3 \cdot 10^{-6}$ г/г). The resource of uranium in soils of the hollow of the Issyk-Kul is rocks. The influence of rocks on a level of the contents of uranium in soils determined by carrying of products of destruction of breeds, enriched uranium, and their participation in soil formation, especially low-power soils of hollow.

Water. As it was noticed above, the geochemical province of Kadji-Say is located near to a resort zone of Issyk Kul lake, and the contents of uranium in water here has the important ecological value. According to some authors (2, 7, 12, 13) quantity of uranium in waters of the rivers Tone, Ак-Suu in hollow of Issyk-Kul makes $5{,}6 \cdot 10^{-6}$ g/l, and in river Jergalan about (depend on seasonally and places of selection) from $2{,}8 \cdot 10^{-6}$ to $1 \cdot 10^{-5}$ g/l i.e. the main waters of wells and the rivers a hollow of Issyk-Kul contain in 10, and in some cases it is in 100 times more uranium, than water from black earth and not from black earth zones.
The small river Kadji-Say is proceeds on area of a deposit with the middle-annual charge about 0,01 $м^3$/sec. The quality of water is well but it is not suitable for drink (Табл.3).

Table 3. The concentration of radionuclides in water of uranium provinces of Issyk Kul

№	Points of selection	General uranium Bq l^{-1}	$^{234}U/^{238}U$	Total - (Gross - α) Bq l^{-1}	^{226}Ra Bq l^{-1}
1	Issyk Kul lake, a settlement the Kara-Oy	1,79±0,18	1,13±0,05	1,80	0,013
2	settlement Bulan Sogottu	0,09±0,01	-	0,10	0,002
3	river Kichi-Ак-Suu	0,17±0,02	-	0,20	0,009
4	river Tup	0,23±0,02	-	0,23	0,016
5	river Karakol	0,21±0,02	-	0,25	0,005
6	Issyk-Kul lake, settlement Ак-Terek	0,56±0,06	-	0,60	0,02
7	Kadji-say, a stream №1	4,21±0,42	1,49±0,05	4,5	0,007
8	Kadji-Say, a stream №2	10,2±1,02	1,30±0,05	10,0	0,005
9	Issyk Kul lake, settlement Kadji-Say a mouth of the river	1,69±0,17	1,52±0,05	1,67	0,015

Plant: the plant cover is rarefied, and about from 5 to 10 % and only on some places- about 50 %. In territory of a province it is revealed, collected and incorporated in a herbarium about 58 species of the plants belonging to 47 sorts and 20 families (2, 4).

The plant cover of uranium tail deposits is in two forms: in the higher and southern part growing- different plants of Estragon with domination of Wormwood an Estragon (Artemisia dracunculus). According to observation, a plant cover of tail deposits is in a stage of developing. The plant in rather «a clean zone» is presented by flora of a under construction of boarding house the "Khan-Saray" which located in 1,5 km from Kadji-Say. This plant is a little cultivated.

From Grassy plants the Lucerne (Medicago) and Melilotus from family of Fabacea have low concentration of uranium at high factors of discrimination - 210,0-630,0. From the other plants the Marrubium alternidens accumulates a lot of uranium in stems, i.e. almost as much, how many it is (uranium) contained in soil. The uranium has greater sizes - 301,5 by coefficient of enrich. The Echium vulgare had high contents of uranium is - $0{,}52 \cdot 10^{-6}$ g/g at low to coefficient of discrimination is - 12,1.

On the surface of uranium tail deposits founded 10 sorts of plants of desert type: Ulmus pinnato-ramosa, Elaeagnus songorica, Caragana Turfanica, Peganum harmala, Akantholimon alatavicum, Natraria sibirica, Clematis songorica... The contents of uranium in the listed plants was small and changed about $0,02\text{-}0,31 \cdot 10^{-6}$ g/g at coefficient of enrich is - from 1,0 to 15,5 and coefficient of discrimination is - from 17,8 to 240,0.

4. CONCLUSION

The hollow of Issyk-Kul is biospheric territory and on coast of lake placed resort Cholpon-Ata and tourist bases, so there is a beware of radioactive pollution of "a pearl of Kyrgyzstan» (Issyk-Kul lake) among the public. Result of researches have shown, that biogeochemistry of radio nuclides in foothill and both coastal zones of southern and southwest of Issyk-Kul are under the control, except territory of natural and technogenic sites. The results of researches are so: the raising of radioactivity anomalies of three types marks the level of a background in a hollow:

1) The natural anomalies of a radioactivity are connected with rare nearness layers of under the plate of radioactive brown coals of Jurassic period.
2) Technogenic anomalies are in hundreds times exceeding of background, covering by concrete wall over the tails and deposits with grey fine-grained of substance.
3) Technogenic anomalies (their activity is in tens times above a background) are in the cascade from four deposit tails with the flat surface, going down downwards on a valley from a mine field. An average radioactivity, by scintillation spectrometry of λ and gamma background (DKS-96) is not high (in norm). It is as a radiogeochemical background (which for uranium-radii it is determined by values between 35 and 55 Bq/kg).

Growing of plants in the environment with the high concentration of uranium not only is accompanied by change of theirs bioproductivity, also causes of morphological variability. The infringement of pigmentation of a flower at various sorts of plants is most often shown in area of Issyk Kul. The Astragalus borodinii is has morphological variability of splitting of a sheet plate. The Peganum garmala and Potentilla argentea - instead of usual 5 petals have 6-7 and their bifurcation. But other plants are intensive growing and developing (Caragana, Scutellaria, Peganum, and Peganum harmala).

By the results of the research work the common level of external radiation in researched territory and level of uranium are about limits of the norm, except of some technogenic territories.

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