RADIOBIOGEOCHEMICAL ASSESSMENT OF THE SOIL NEAR THE ISSYK-KUL REGION

B. Kaldybaev, B. Djenbaev
Biology & Pedology Institute of National Academy of Science Kyrgyz Republic
k_bakyt@rambler.ru; bekmamat2002@mail.ru

Soil is one of the main natural resources, providing for the sustainable development of the country. For environmentally well founded and balanced use and protection of land resources is necessary to create the optimal structure of arable farming, minimizing negative impacts on the land of diverse agricultural activities. In this connection, we have been tasked to assess the current radiobiogeochemical condition of soil near the Issyk-Kul region. Determination of chemical elements in the soil was conducted by the methods of X-ray fluorescence analysis and radionuclide by the methods of instrumental gamma spectrometry. The results of research were given, that:

1. Concentration of humus in the soil near the Issyk-Kul varies within the limit of typical for the type of soil in the present region (2,29-4,32 %).
2. Macro and microelements are contained in different concentration in the soil, not enough (Ti, Cr, Mn, Fe, Ni, Ga, Sr, Y, Zr, Nb, Bi), within the limit of norm (N, P, K, Ca, Cu, Zn , Ge, Br, Rb, Mo, Ba, La, Ce), the accumulation of the weak characteristic for (V, As, Sb, Nd, Pb, U, Th, Ra), the average (Co, Cs), strong (Sn). Isotopes of radioactive elements (^{238}U, ^{232}Th, ^{226}Ra, ^{40}K) are characterized by weak accumulation in the soil.
3. It was exposed the positive correlation dependence between the concentration of humus, absorption capacity and the concentration of chemical elements in soils for: Ti, V, Cr, Mn, Fe, Sr, Mo, Ba. In the case of Sr ($r=0,55$; $p<0,05$), and Ba ($r=0,6$; $p<0,05$) is correct. For other chemical elements and radionuclide the correlation dependence is negative.

In the distant past (at the end 40 years of XX century), Kyrgyzstan was the largest producer of uranium oxide for the defense industry of the USSR. In the country a number of enterprises of mining and processing of uranium ore were worked it is technogenic uranium plot "Kadji-Say", it is located on the southern shore of lake Issyk-Kul. Mining Enterprise Ministry of Medium Machine Building of the USSR by uranium ore processing operation have been worked from 1948 to 1969, he was subsequently converted into electro technical factory. Uranium oxide was extracted from uranium-containing ash brown coals. Production wastes were buried, forming tailings, with a total volume of 400 thousand m^3. On the territory of the tailings the level of exposure dose of gamma radiation varies within the limit of 100-300 mR/h in some places up to 1000 mR/h. In the surface of the soil layer of tailing radioactive elements were contained in different concentrations:

The high concentration of U (76 mg/kg), the specific activity of ^{238}U/^{234}Th total 851,6 Bq/kg. A lot of ^{226}Ra (3800 Bq/kg), it was broken radioactive balance between ^{234}Th/^{226}Ra, indicating the presence of uranium leaching processes. The high concentration of thorium ^{228}Ac (97,7 Bq/kg), ^{235}U (39,5 Bq/kg) (table 1). Low activity of the artificial radionuclide ^{137}Cs (2,1 Bq/kg), which is typical for mountainous terrain.

Nonradioactive element-indicators:

The high concentration of Co-112 mg/kg, the concentration of clark (Cc-14). The high concentration of As-49 mg/kg (Cc-9,8); Mo-17 mg/kg (Cc-8,5); Pb-50 mg/kg (Cc-5); V-232 mg/kg (Cc-2,32). Within the limit of norm concentration: Cu-30 mg/kg (Cc-1,5) and Zn-79 mg/kg (Cc-1,58); The low concentration: Ni-17 mg/kg (Cc-0,42) and Bi-12 mg/kg (Cc-0,24) (table 2).

Table 1 – *Radioactive activity of radionuclide on the surface layer of the soil of tailings (Bk/kg)*

^{234}Th 851,6±9,2	^{226}Ra 3789,6±2	^{214}Pb 2946,1±7	^{214}Bi 2675,8±6	^{210}Pb 3337,2±16	^{228}Ac 97,7 ± 2,0	^{224}Ra 146,2 ± 12,1
^{212}Pb 109,4 ± 1,0	^{212}Bi 87,4 ± 5,5	^{208}Tl 97,9 ± 1,9	^{235}U 39,5 ± 0,9	^{227}Th 162,9 ± 2,9	^{40}K 890 ± 11	^{137}Cs 2,1 ± 0,4

Table 2 – *The concentration of chemical elements in the tests from the surface layer of the tailings*

K, % 1,7 ± 0.3	Ca, % 4,6 ± 0.3	Ti, % 0,28 ± 0,05	V, мг/кг < 232	Cr, mg/kg 50 ± 11	Mn, % 0,049 ± 0,010	Pb, mg/kg 50 ± 11
Fe, % 2,85 ± 0,17	Co, mg/kg < 112	Ni, mg/kg 17 ± 5	Cu, mg/kg 30 ± 10	Zn, mg/kg 79 ± 10	Ga, mg/kg 32 ± 10	Bi mg/kg < 12
Ge, mg/kg < 11	As, mg/kg < 49	Se, mg/kg 0,6	Br, mg/kg < 6	Rb, mg/kg 135 ± 9	Sr, mg/kg 314 ± 20	U, mg/kg 76 ± 7
Y, mg/kg 38 ± 4	Zr, mg/kg 207 ± 14	Nb, mg/kg 13 ± 2	Mo, mg/kg 17 ± 3	Sn, mg/kg < 560	Sb, mg/kg < 264	Th, mg/kg 18 ± 4
Cs, mg/kg < 88	Ba, mg/kg 690 ± 83	La, mg/kg < 67	Ce, mg/kg 71 ± 39	Pr, mg/kg < 71	Nd, mg/kg < 68	

That's way, the results of research have shown that on the surface layer of soil of the tailing between the radioactive elements contain the high concentrations of uranium and radium and accompanying non-radioactive elements, such as selenium, cobalt, arsenic, lead and vanadium.