UDC 621.039.538-03,691.1/6

RADIOECOLOGICAL ASSESSMENT OF RIVER WATERS OF CENTRAL REGIONS OF AZERBAIJAN

A.A. Garibov[1], A.C. Mikayilova[2], F.Y. Humbatov[2], J.A. Nagiyev[1]
[1]National Nuclear Research Center
[2]Institute of Radiation Problems of ANAS
B. Vakhabzadeh str., 9, AZ 1143, Baku, Azerbaijan; e-mail: mikayilova.a.c@gmail.com

*The article reviews the distribution of natural uranium radionuclides occuring in natural isotopic ratios of uranium, in water samples taken from rivers of central regions of Azerbaijan. Quantity of radionuclides (^{226}R , ^{228}Ra, ^{40}K, ^{137}Cs) in water samples has been determined through the use of qamma-spectrometric methods. Activity of radionuclides (^{226}Ra, ^{228}Ra, ^{40}K,) in river water samples changes within intervals ^{226}Ra (*0.14*Bq/l*-0.95*Bq/l*),^{228}Ra(*0.18*Bq/l*-0.58*Bq/l*) and ^{40}K (*5.6*Bq/l*-34.6*Bq/l*).*

Keywords: *river water, gamma-spectrometer, marinelly, radionuclide.*

INTRODUCTION

The environment is exposed to pollution by different factors, and the most dangerous is radionuclide pollution. It should be noted that the impact of radioactive pollution on ecology varies to threaten environment security. Radiation sources include two groups – natural and anthropogenic [1]. Sun rays, i.e. rays that come from outer space, mining beams, scattered radiations of radionuclides in the soil, water and air contribute to the natural radiation of the Earth. The Earth's natural radiation background is based on the aggregate of radionuclides in soil, water and air to include ^{40}K, ^{238}U, ^{232}Th, and their fission products. It should be noted that the initial geological source of the most radionuclide background is upper layers (facets, shale, sandstone, etc.) of lithosphere which always arises under the impact of saprophyte microflora of soils, water and air [2]. Irrigation (water for agriculture or growing crops) is probably the most important use of water (except for drinking and filling up swimming polls, etc.) across the world. The South Caucasus region is a unique place for environmental chemists and geochemists worldwide from prospects of research into geography, geology and natural/artificial effect. Radioecological conditions of the above-stated areas come as a result of mainly natural processes. Impact of irrigation, fertilization and other contributing factors has its effect on the formation of radioecological situation of these areas and agrotechnical processes of plant-growing.

The above-stated goes to show that the quantity of radium isotopes in the irrigation and pasture is higher than cultivated lands. This testifies to the fact that radium isotopes in top layers of the soil are washed out as a result of irrigation processes in agriculture. Along with elements of natural radioactivity, there are also isotopes of artificial and cosmic origin (^{137}Cs, ^{7}Be) on grasslands to comply with natural sedimentation processes in the atmosphere. Main source of irrigation waters in the Central lowland zone is the Kura and Aras rivers.

It should be noted that various aspects of radionuclide content in rivers and canals that flow into the Central lowland zone and bottom sediment of the area in question, as well as artesian waters have been examined. Rivers crossing this zone and connected to other water basins originate in southern slopes of the Major Caucasus and Karabakh and Murovdag ranges.

The said rivers come out as geological and mineralogical information-carrying medium of territories where rivers arise from. The Kura and Arasrivers are exposed to the

impact of anthropogenic and natural factors of areas where rivers stem from and flow .

These waters are also used for irrigation of the reviewed areas [3]. Thus, the analysis of water and bottom sediments of these rivers makes it possible to describe the role of these factors in transport processes of each radionuclide.

MATERIALS AND METHODS

Drinking water radioactivity is caused by the presence of natural and technically obtained radionuclides in rivers and lakes, as well as underground water sources (subsoil water, artesian wells, and springs). From their impact on humans, the most important natural radionuclides are K-40, U-238, U-235, Th-232m as well as products of their radioactive disintegration: Ra-226, Rn-222.

When these radionuclides get into human organism together with drinking water, a source of internal alpha, beta- and gamma-irradiation sets in there [4].

Main source of irrigation water in the Central lowland zone is Kura and Aras rivers. Rivers pass from this zone and join to other water basins take their sources from south slope of the Great Caucasus Mountains and range of Karabakh and Murovdagh. Those rivers place a role of carriers of geological and mineralogical information of the territory where they took their sources. Kura and Arax rivers are affected by industrial and natural factors of their sources and areas they cross. These waters are used for irrigation of the reviewed areas. So, analysis of waters flowing from these rivers is important to get radioecological information about a reviewed area.

As the main water-supply system of the South Caucasus, waters of the Kura river flow across the central regions of Azerbaijan and are used for drinking and irrigation. It originates in Turkey from springs on the northeastern slopes of Kizil-Giadik, 2720 meters above the sea level. It flows across Georgia to get into the territory of Azerbaijan on the border with Georgia and further to the Caspian Sea. Its length is 1515 km and watershed area is 188000 km^2 [5].

The main sources of Mingachevir water reservoir are Kura and Alazan rivers. It is not possible to analyze radionuclide composition of obtained samples.

The reason is that the concentration of radionuclides in ground waters is lower than the sensitivity of the gamma-spectrometer device. This problem can be solved intensifying thickening river and canal waters. A number of methods (evaporation, extraction, sorption, etc.) were also used in order to solve the problem [6].

Fig. 1 cites a map of the reviewed area where water samples were taken.

Water samples are taken from various areas to identify the content of radionuclide in the Central Aran zone. Preparation of water samples was based on standard methods.

The date and name of the places in question are noted after taking samples. Also, exposure dose power was determined in a place where samples were taken. Soil samples are taken in a sufficient quantity to fill 1 liter container.

Samples are prepared for analysis as follows:

- Mass of special 1 liter empty Marinelli container with its lid is adjusted to HP Ge gamma–spectrometric measurement is determined exactly once again;
- The containers are filled with samples and samples are closed hermetically with a special lid;
- Samples are prescribed exactly for mass of container;
- The samples inside the containers are designed for the mass and weight of empty and full containers;
- Samples are kept in Marinelli containers closed hermetically for a month to reach radioactive equilibrium;
- Samples are analyzed via gamma spectroscopy system with HP Ge germanium detector.

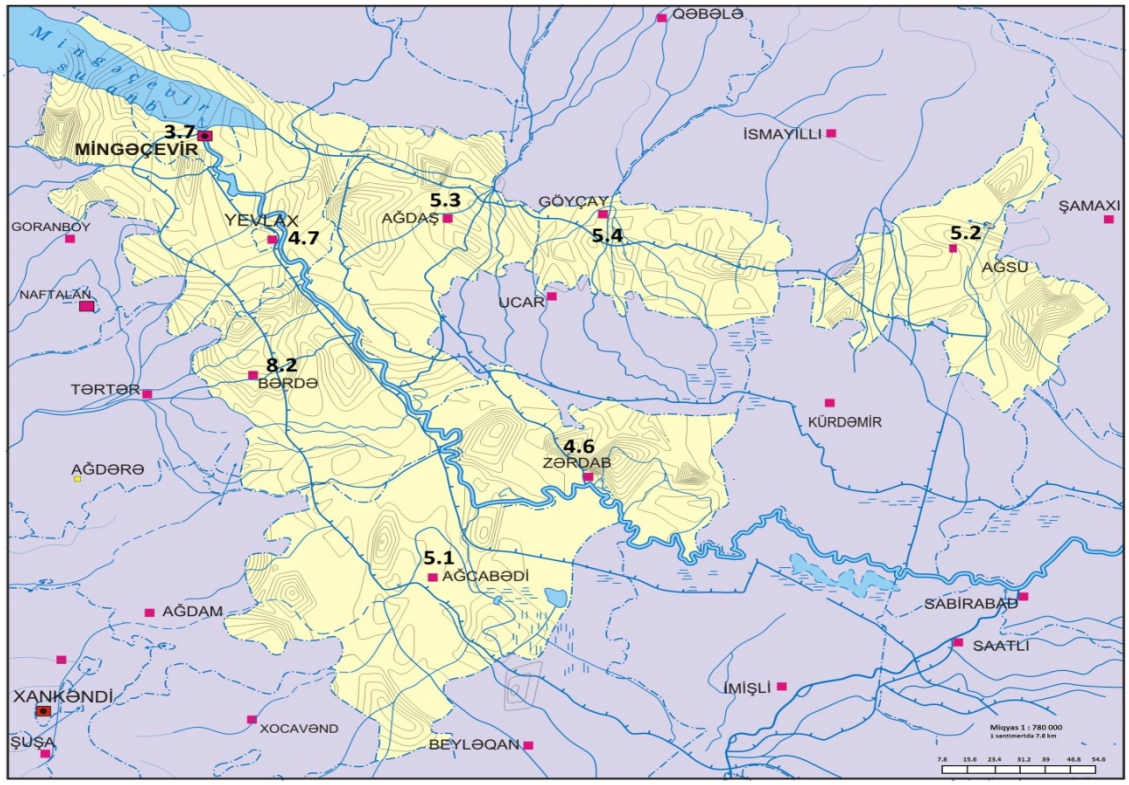

Fig. 1. A map of the reviewed area

River waters are polluted because of human factor impact and as a result of drainage of salty underground waters in plain areas where the salinity grows, the chemical structure becomes complicated and the water type changes. Fig. 2 shows gamma spectroscopy and radionuclide content of river water taken from the reviewed area.

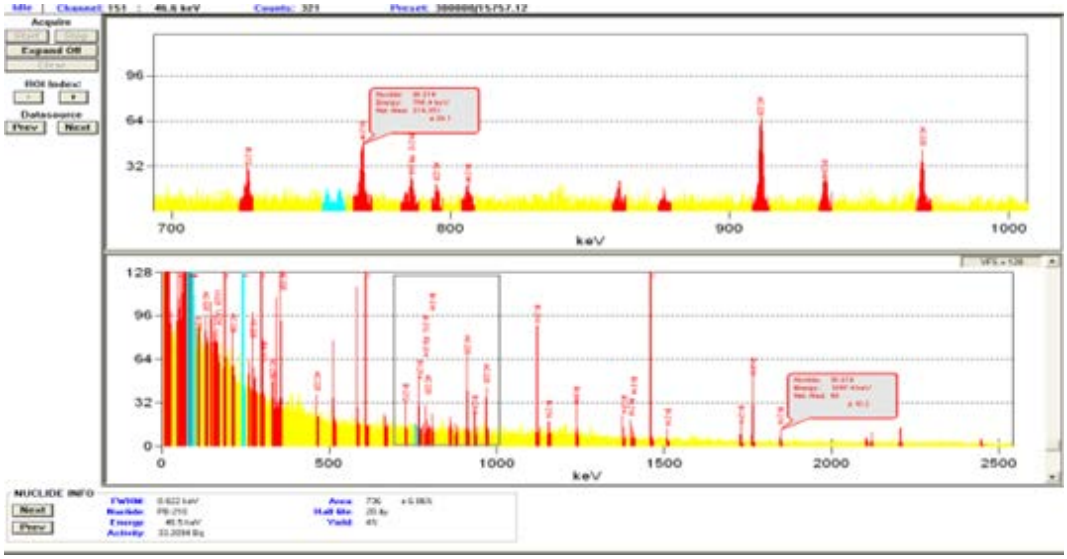

Fig. 2. Gamma spectroscopy and radionuclide content of river water.

RESULTS

Results of the reviewed samples are shown in Table 1.

Table 1. Results of radionuclide analysis

Rivers	Specific activity Bk/l			Annual radionuclide debut Ci/l			
	^{226}Ra	^{228}Ra	^{40}K	^{226}Ra	^{228}Ra	^{40}K	A_{eff}
	Permissible limit						
	0,5Bk/l	0,2Bk/l	22Bk/l				
Kura	0.36±0.12	0.39±0.25	12.5±0.2	247.5	202.5	4252.8	889.2
Akhsuchay	0.22±0.11	0.25±0.01	6.9±1.5	0.5	0.5	15.0	2.5
Goychay	0.41±0.23	0.19±0.11	5.8±0.3	5.2	2.4	73.7	14.9
Alicanchay	0.38±0.04	0.58±0.13	34.6±0.3	4.1	3.2	90.5	16.2
Turyanchay	0.95±0.32	0.18±0.03	5.6±0.6	4.5	0.8	26.3	7.8
İncachay	0.31±0.13	0.03±0.01	5.8±0.1	0.3	0.03	5.3	0.8
Xacınchay	0.28±0.12	0.08±0.01	9.6±0.2	1.1	0.9	14.5	3.3
Kuraakçhay	0.14±0.05	0.34±0.08	8.5±0.6	0.4	1.0	25.4	4.0
Qarqarchay	0.41±0.21	0.37±0.23	6.4±0.3	0.8	0.8	13.2	3.0
Tartarchay	0.64±0.11	0.37±0.12	6.06±0.64	10.4	6.0	98.6	27.0

It can be seen from the table that samples of radionuclide content in river water samples were much lower than in accordance with the current standards, with the exception of samples from the Turyankai and Tartarhai rivers.

REFERENCES

1. Guidebook on Nuclear Techniques in Hydrology. International atomic energy agency. VIENNA. 1983. 434 pp.
2. Sansone U., Chang Kyu Kim, Kis-Benedek G., Schorn R., Zeiller E., Qaribov A., Huseynov V., Chupov A. Natural and anthropogenic radionuclides in the rivers of Azerbaijan. *Journal of Radioanalytical and Nuclear Chemistry*. Academiai Kiado, Budapest. 2008, nol. 277, no. 2, pp. 357-364.
3. Abbasov Sh.M., Suleymanov B.A., Mikayilova A.C., Lisnova E.V. Concentration of radionuclides in samples taken from Upper Karabakh and Upper Shirvan canals. Ninth Baku International Congress. Baku, Azerbaijan Republic, 7-9 June, 2007.pp. 460-462.
4. Mikayilova A.C. Gamma-spectrometric determination of natural radionuclides in soil and water samples taken from central Aran zone. Abstracts collection on new challenges in the European area: International Baku Form, 20-25 May, 2013, Baku, pp. 250-251.
5. John E. Moerlins, Mikhail K. Khankhasayev, Steven F. Leitman, Ernazar J. Makhmudov. “Transboundary Water Resources: A Foundation for Regional Stability in Central Asia”, The NATO Science for Peace and Security Program, 2008, 313 pp.
6. Qaribov A.A., Suleymanov B.A., Mikayilova A.C. Determination of natural radionuclides in drinking and agricultural water. *Kimya Problemleri - Chemical Problems*. 2012, no. 1, pp. 96-99. (İn Azerbaijan).

РАДИОЭКОЛОГИЧЕСКАЯ ОЦЕНКА РЕЧНЫХ ВОД ЦЕНТРАЛЬНЫХ РАЙОНОВ АЗЕРБАЙДЖАНА

А.А. Гарибов[1], А.Дж. Микаилова[2], Ф.Ю. Гумбатов[2], Дж.А. Нагиев[1]

[1]Национальный центр ядерных исследований
[2]Институт радиационных проблем Национальной АН Азербайджана
AZ 1143, Баку, ул. Б. Вахабзаде, 9; e-mail: mikayilova.a.c@gmail.com

В предлагаемой статье исследовано распределение естественных радионуклидов, встречающихся в естественных изотопных соотношениях урана, в образцах воды, которые были взяты из рек центральных районов Азербайджана. Количество радионуклидов (226R, 228Ra, 40K, 137Cs) в образцах воды, определено методом гамма-спектрометрии. Активность радионуклидов (226Ra, 228Ra, 40K,) в образцах речных вод изменяется в интервале ^{226}Ra (0.14Bq/l-0.95Bq/l), ^{228}Ra(0.18Bq/l-0.58Bq/l) и ^{40}K (5.6Bq/l-34.6Bq/l.

Ключевые слова: *образцы воды, естественные радионуклиды, метод гамма-спектрометрии, активность радионуклидов*

AZƏRBAYCANIN MƏRKƏZİ RAYONLARINDAN GÖTÜRÜLMÜŞ ÇAY SUYU NÜMUNƏLƏRİNİN RADİOEKOLOJİ QİYMƏTLƏNDİRİLMƏSİ

A.A. Qəribov[1], A.C. Mikayılova[2], F.Y. Humbətov[2], C.A. Nağıyev[1]

[1]Milli Nüvə Tədqiqatları Mərkəzi
AMEA-nın Radiasiya Problemləri İnstitutu
AZ 1143, Bakı, B.Vahabzadə küç., 9; e-mail: mikayilova.a.c@gmail.com

Təqdim olunan məqalədə Azərbaycanın Mərkəzi Aran Rayonları ərazisindəki çaylardan götürülmüş su nümunələrində uran, torium və onların parçalanma məhsulları olan təbii mənşəli radionuklidlərin paylanması tədqiq edilmişdir. Su nümunələrində radionuklidlərin (226R, 228Ra, 40K, 137Cs) miqdarı qamma-spektrometrik üsulla müəyyən edilmişdir. Tədqiqat ərazisində radionuklidlərin (226Ra, 228Ra, 40K) aktivliyi ^{226}Ra (0.14Bq/l-0.95Bq/l), ^{228}Ra(0.18Bq/l-0.58Bq/l) və ^{40}K (5.6Bq/l-34.6Bq/l) intervalında dəyişir.

Açar sözlər: *su nümunələri, təbii mənşəli radionuklidlər, qamma-spektrometrik üsulu, radionuklidlərin aktivliyi*

Received 05.11.2017.