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Generalization of Uranium Radio Features in Teaching Natural Sciences

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Abstract
In this article, I will introduce the method of generalizing the laws of radioactive decay of nuclei and scientific analysis in the teaching of natural sciences.

Keywords: Natural science, property of radionuclides, experimental studies, radioactive equilibrium, alpha spectrometric method.

INTRODUCTION

Atomic nuclear physics, with its development and its current role, plays an important role in the development of students' thinking and logical thinking. Nuclear physics, which is the youngest and most rapidly developing field of atomic and nuclear physics, is of great importance in human life and in the development of science and technology. Today, each branch of nuclear physics is being studied and developed as an independent science with its own branches. These include nuclear models, nuclear reactions, the interaction of radioactivity and nuclear radiation with matter, nuclear energy, heavy ion physics and the synthesis of very heavy elements, cosmic ray physics, elementary particles and their structure, and dozens of other fields. can be added. Phenomenological and microscopic models of the nucleus are used to study the properties of spherical or deformed nuclei composed of strongly interacting neutrons and protons. The development of heavy ion accelerators ushered in a new era in nuclear reactions. Today, the physics of heavy ions, nuclear reactions with heavy ions, and the artificial synthesis of heavy elements that do not exist in nature are developing rapidly.

As a result of general laws in the teaching of natural sciences, it is possible to give an example of the fact that in some cases separate nuclear-physical processes are inextricably linked with nature. Examples of these processes are radionuclide properties. The most important radionuclides found in nature are uranium radionuclides. These radionuclides are found in air, water, soil, plants, and even humans. Therefore, through the study of radioactive isotopes of uranium, we can further develop the generality of the laws of nature, students' interest in science, the scientific worldview, thinking, logical thinking through the teaching and scientific substantiation of natural sciences.

MAIN PART

In nature, there are three natural isotopes of the chemical element uranium - ^{234}U, ^{235}U and ^{238}U. These isotopes differ from each other in a number of physical and chemical properties. Their distribution in nature is also different ^{234}U - 0,0056%, ^{235}U - 0,71% and ^{238}U - 99,28%. These are isotopes ^{235}U and ^{238}U isotopes are long-lived isotopes that play a key role in assessing the evolution of matter formation on Earth. These isotopes are the beginnings of families of natural radioactive elements as well α and β - lead is stable under the law of decay ^{206}Pb and ^{207}Pb isotopes.

Uranium in Table 1 below ^{234}U, ^{235}U and ^{238}U some nuclear-physical properties of the isotopes are given.

Table 1 Uranium ^{234}U, ^{235}U and ^{238}U some physical properties of isotopes

U	T1/2, Year	Relative amount , %.	Comparative activity , Bk/g	E_α, кэВ, I_α (%)
^{238}U	$4,468\times10^9$	$99,2745 \pm 0,006$	$2,31*10^8$	4195 (0,77); 4150 (0,23); 4035 (0,0008)
^{234}U	$2,445\times10^5$	$0,0055 \pm 0,0005$	$7,91*10^4$	4770 (0,72); 4720 (0,28); 4603 (0,002)
^{235}U	$7,038\times10^8$	$0,7200 \pm 0,0012$	$1,24*10^4$	4400 (0,55); 4365 (0,18); 4214 (0,06); 4596 (0,05);4556 (0,04); 4414 (0,02); 4502 (0,02); 4219 (0,009); 4150 (0,009)

LITERARY REVIEW

An analysis of the scientific literature has shown that uranium isotopes $^{235}U/^{238}U$ and $^{234}U/^{238}U$ the relative amount does not always change in any natural mixture - it must be constant. This change is called the radioactive equilibrium between the uranium isotopes. It's expensive $^{234}U/^{238}U$ for the ratio - 53,41 mkg/g equal to the value. Our research has shown that the causes of this factor disorder have not been adequately studied in the literature. [1-5]

Determining the value of this value in groundwater and surface water provides an opportunity to obtain sufficient useful information about the radiation, nuclear-physical and geochemical processes occurring on the Earth and its objects.

Finding the causes of the disturbance of the radioactive balance between the natural isotopes of uranium reveals the hydrogeology, the conditions of ore formation and the scientific nature of a number of nuclear-physical processes in the nucleus of the uranium element. Given the relevance of the above points, we aimed to investigate the causes of the disruption of the natural isotopes of uranium and the radioactive balance between them.

As can be seen from Table 1, uranium ^{234}U the isotope has a very high specific activity - $2,3*10^8$ Bk/g. But the specific activity of one gram of natural uranium $1,23*10^4$ Bk/g worth. A slight increase in the amount of the isotope uranium ^{234}U leads to a sharp increase in the relative activity of any natural mixture.

RESEARCH METHODOLOGY

What are the causes of this change and what are the ways to study it? Now let's think about that. Uranium-^{234}U, ^{235}U and ^{238}U isotopes can be analyzed using mass spectrometric and alpha-spectrometric methods. We use AGILENT (Netherlands), Ortec, USA (Octets PC, Soloist) devices for mass spectrometric method and a-Analyst (Canbera USA) for alpha spectrometric method, Progress - ALFA (YoAB IIK "DOSE"). Russia). a-ANALYST (CANBERRA, USA) alpha spectrometer has the following technical and analytical parameters:

- Background value in the energy range 4-6 MeV - no more than 10 imp / h;
- Alpha - radiation recording efficiency (^{210}Po, ^{5305} keV on the power line) - 30 keV.

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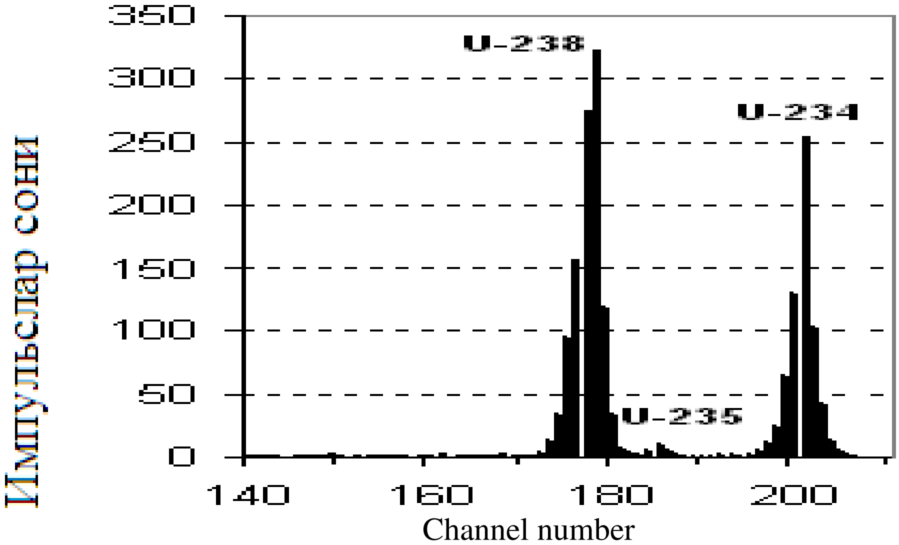

Figure 1. Characteristic alpha spectrum of natural uranium isotopes.

Figure 1 shows the characteristic alpha spectrum of natural uranium isotopes. The ratio of the activity of the sample under study to ^{234}U / ^{238}U:

$$\frac{^{234}U}{^{238}U} = \frac{S_{U-234}}{S_{U-238}} \qquad (1)$$

here S_{U-234} – ^{234}U peak area of the isotope at 100 channel width;

S_{U-238} – ^{238}U the peak area of the isotope at 100 channel widths. Under investigation ^{234}U - (mkg / g) The amount of mass is as follows:

$$M_{U\ 234} = K * \frac{S_{U\ 234}}{S_{U\ 238}} \qquad (2)$$

where K is the constant coefficient, its value - 53,41 mkg / g ga teng.

The radioactive imbalance obtained from the experiments is shown graphically in Figure 2 below.

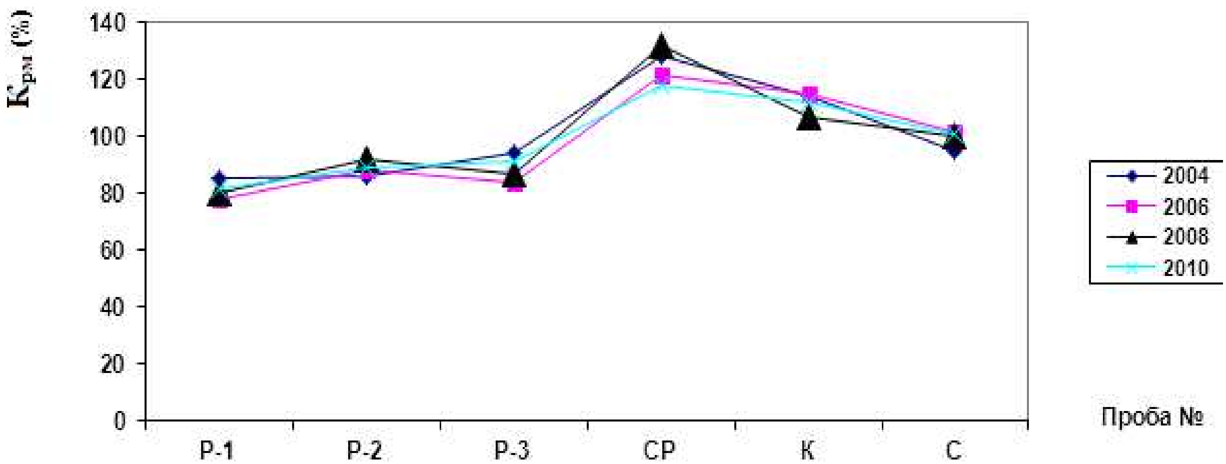

Figure 2 Graph of radioactive imbalance in water samples.

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The values obtained as a result of our scientific research are given in Table 2.

Table 2 Research results obtained by alpha-spectrometric and mass-spectrometric methods

Alpha spectrometers					MS "Sameca"	
"Ortec"	"Analyst"		" Progress-Alpha "			
52,5 ± 1,1	-	-	-	-	54 ± 2	+2,8
53,5 ± 0,8	-	-	-	-	55 ± 2	-2,8
43,3 ± 0,6	43,0 ± 1,0	- 0,7	43,1 ± 1,1	- 0,47	-	-
48,8 ± 0,6	48,4 ± 1,0	- 0,8	49,8 ± 1,0	+ 2,1	-	-
49,1 ± 0,6	48,9 ± 1,0	- 0,4	51,0 ± 0,9	+ 3,8	49,6± 2	+ 1,0
49,9 ± 0,7	50,4 ± 1,1	+ 1,0	51,4 ± 1,1	+ 3,1	-	-
50,0 ± 0,7	51,3 ± 1,2	+ 2,6	52,0 ± 1,1	+4,0	48,7± 2	- 2,6
51,4 ± 0,7	51,1 ± 1,0	- 0,6	51,77 ± 1,1	+ 0,7	-	-
51,4 ± 0,7	52,1 ± 1,2	+ 1,2	52,6 ± 1,1	+ 2,4	-	-
56,0 ± 0,7	56,6 ± 1,1	+ 1,1	56,69 ± 1,2	+ 1,2	-	-
57,0 ± 0,7	56,9 ± 1,0	- 0,2	57,16 ± 1,1	+ 0,28	-	-
58,9 ± 0,8	57,8 ± 1,1	- 1,9	55,9 ± 1,4	- 5,1	-	-
66,1 ± 0,8	67,4 ± 1,2	+ 2,0	68,4± 1,3	+ 3,5	-	-
66,6 ± 0,8	66,5 ± 1,1	+ 0,8	67,22 ± 1,1	+ 0,93	-	-
Average values		1,1		2,3		2,3

The results in Table 2 show that the radioactive equilibrium of the ^{234}U isotope did not differ significantly in some groundwater samples.

Thus, based on the analysis of the above experimental results, we can say that we have achieved our goal. The generalization of the properties of uranium radionuclides in the teaching of physics remains the most important topic in the science of nuclear physics. Because as life goes on, the achievements of science also strive for heights. Any process that takes place in nature has the most scientific significance when evaluated from the point of view of nuclear physics. The deeper we go into the nuclear age, the deeper we understand the essence of the whole universe.

ANALYSIS AND RESULTS

It is considered to be one of the families of naturally occurring radioactive elements - the uranium mother nucleus produces 15 daughter radionuclides as a result of its own decay. [6-10] has not been analyzed. If the radioactive imbalance between girl radionuclides is disturbed in terms of nuclear and physical laws, their causes are the variation of the reaction energy received by radionuclides, the age of uranium minerals, the effects of allogenic and autogenic processes, natural processes, technological processes, and so on.

It is known that the activity of the isotope ^{238}U in 1 gram of uranium in any object is calculated as follows:

$$A_{U-238} = \frac{0{,}992745 \cdot \ln 2 \cdot 6{,}022136 \cdot 10^{23}}{T_{U-238} \cdot 238} = 1{,}2347 \cdot 10^{4}\ Bк \qquad (3)$$

where 0.992745 is the relative mass of the isotope ^{238}U, g; $6.022136 \cdot 10^{23}$- Avogadro's constant; The half-life of the isotope $T_{U\text{-}238}$ - ^{238}U, s; Number of atomic masses of the isotope 238 - ^{238}U.

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The same activity is provided by the radioactively balanced isotope ^{234}U in 1 gram of natural uranium, the mass of which is found as follows (g):

$$M_{U-234} = \frac{1{,}2347 \cdot 10^4 \cdot T_{U-234} \cdot 234}{\ln 2 \cdot 6{,}02213 \cdot 10^{23}} = 53{,}41 \cdot 10^{-6} г \qquad (4)$$

where is the half-life of the isotope $T_{U\text{-}234}$ - ^{234}U, s; Number of atomic masses of the isotope 234 - ^{234}U.

With this in mind, formula (4) can be solved as follows:

$$M_{U-234} = (\frac{A_{U-234}}{A_{U-238}}) \cdot K \qquad (5)$$

bu yerda $A_{U\text{-}234}$ - $^{234\text{-}}U$ izotopining o‘lchangan aktivligi (Бк); $A_{U\text{-}238}$ - $^{238\text{-}}U$ izotopining o‘lchangan aktivligi (Bk); K - 53,41 mkg/g qiymatga ega bo‘lgan doimiy miqdor.

where the measured activity of the isotope $A_{U\text{-}234}$ - ^{234}-U (Bk); Measured activity of the isotope $A_{U\text{-}238}$ - $^{238\text{-}}U$ (Bk); K is a constant with a value of 53,41 mkg/g.

According to the literature, the radioactive balance between uranium isotopes - (%) is determined as follows:

$$K_{рм} = \frac{\alpha}{\alpha_0} \cdot 100\% \qquad (6)$$

where a is the ratio of ^{234}U to ^{238}U in the sample under study, and α_0 is the constant value of the radioactive equilibrium between the uranium isotopes – 53,41 mkg/g.

It is known that the decay of the isotope ^{238}U is given schematically as follows:

$$^{238}U \xrightarrow[4{,}5 \cdot 10^9\ year]{\alpha} {}^{234}Th \xrightarrow[24{,}1\ day]{\beta} {}^{234}Pa \xrightarrow[1{,}2\ \min]{\beta} {}^{234}U \xrightarrow[2{,}5 \cdot 10^5\ year]{\alpha} {}^{230}Th... \qquad (7)$$

As a result of the flight of an alpha particle from the nucleus, it receives a certain amount of reaction energy, and this process is analytically described by the following formula:

$$E_{U-234} = \frac{M_\alpha}{M_{U-234}} \cdot E_\alpha \qquad (8)$$

where M_α is the atomic mass of the α-particle: $M_{U\text{-}234}$ is the atomic mass of the ^{234}U isotope: E_α is the energy of the α-particle.

A histogram was constructed using the results obtained based on the above analytical formulas and experimental experiments. This histogram is shown in Figure 1

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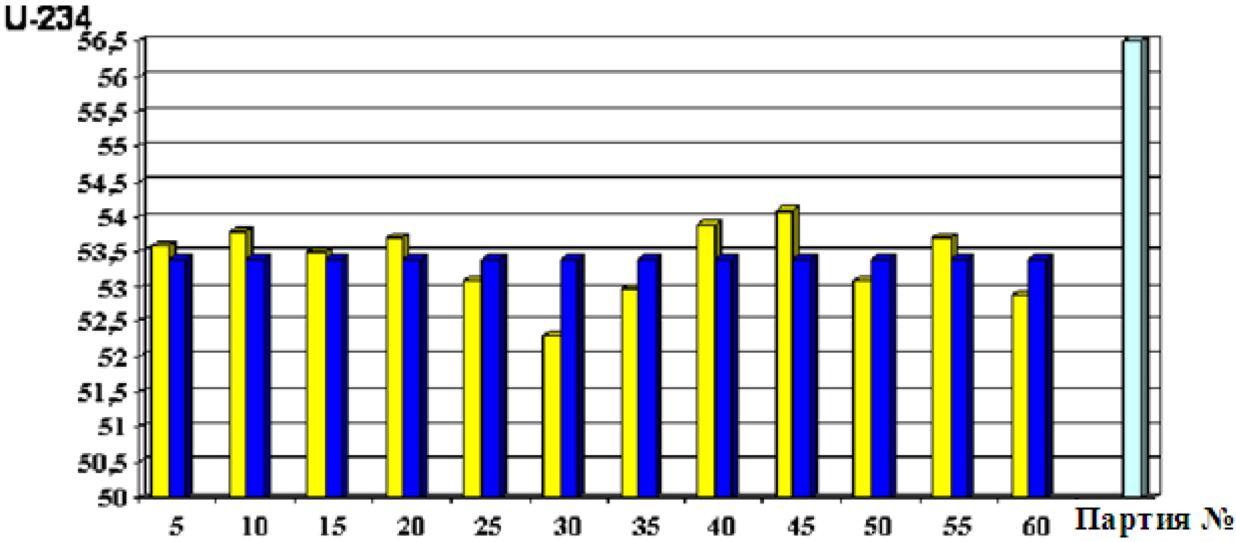

Figure 1. Changes in the amount of isopy ^{234}U during the year

- The amount of uranium in the sample taken from groundwater, - ^{234}U (constant) equilibrium amount of, - ^{234}U (normative) required amount.

CONCLUSION

Thus, in understanding the nature of geochronology in the teaching of natural sciences (physics, chemistry, biology, geology, radioecology, etc.), the processes that take place in them are based on interrelated laws. The generality of nature and the need to study it as a whole, based on the generalization of the laws of nuclear decay, based on the above experimental results, are deeply revealed and their place in the integration of sciences is determined. The mechanism of formation of radioactive elements based on the laws of nuclear decay, the formation of reaction energy in their rotation and decay, changes in the chemical bonding of radionuclides in the crystal lattice, allogenic and autogenic processes have been scientifically explained.

Teaching these concepts in the way we generalize the properties of uranium radionuclides, as we have proposed, will provide a number of conveniences to students and help them develop a scientific outlook on innovative thinking.

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