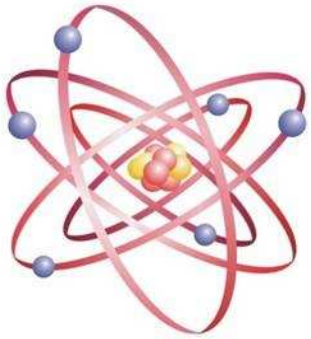

Radionuclide ratio in TENORM studies

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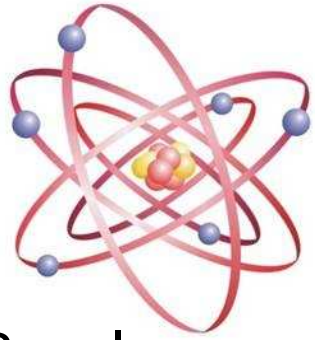
Speaker: Vasyanovich Maxim



People use planet minerals very actively. Development of any oil, coal or uranium deposit leads to wastes accumulation, which can store a huge amount of natural radionuclides.

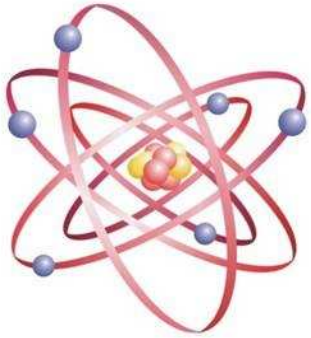
Control of the natural radionuclides content in the environment allows:

• monitor to maintain operation of the radiation facility and its individual technology systems under optimal technological regulations;

• guarantee human health protection from radiation exposure;

• provide rapid detection of changes, features of emergency situation and their causes;

• predict further changes and possible consequences for personnel and population, to determine the necessary measures to ensure the radiation safety.

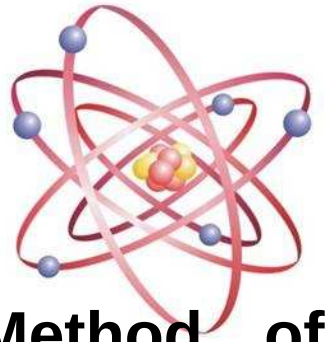


There are several reasons why this method is used:

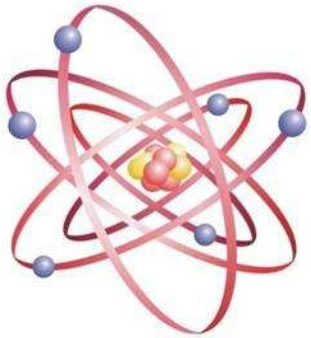
• It helps to identify TENORM with background of natural radionuclides content.

• Radionuclide ratio determines TENORM in soil samples with comparable amounts of NORM.

• This method is more informative, when isotope shift is not always indicative, for example uranium.



Method of radionuclide ratio is applied to determinate contamination with natural radionuclides. This approach consists of ratio analysis between radionuclides activities from different natural radioactive series. Approach includes research of correlations of ^{226}Ra, ^{232}Th, ^{238}U and ^{40}K activity concentrations in soil samples. Distortion of naturally formed radionuclide ratio is considered as evidence of soil contamination and can be utilized for assessment of anthropogenic contribution of natural radionuclides.



In our research, we tried to identify the TENORM in natural soil samples. These samples were selected on the territories of :

oil-producing enterprise,

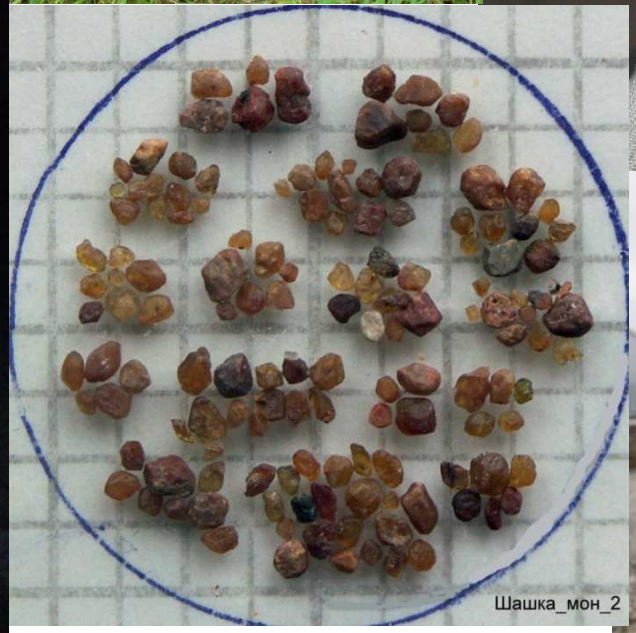
monazite concentrate storage site,

uranium processing site.

Research area

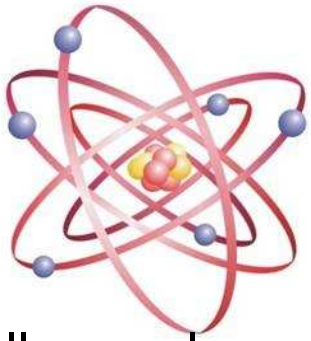
Oil producing company

Thorium monazite storage



Uranium processing facility

Materials



All samples were collected at the territory of these company with special scheme:

at the oil-producing company site: 49 samples

at the monazite concentrate storage site: 32 samples

at the uranium processing site: 23 samples

Soil samples were dried at room temperature and sieved and milled until homogeneous mass at the laboratory.

Activity concentrations of ^{238}U, ^{226}Ra, ^{232}Th, and ^{40}K in soil samples were measured with gamma spectrometry in Marinelli geometry.

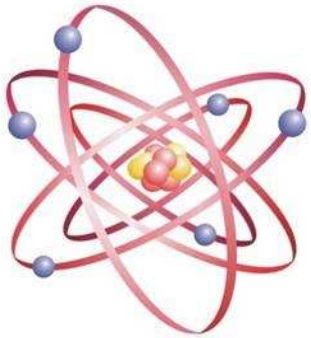
Activated charcoal was added for mitigation radon emanation in each sample.

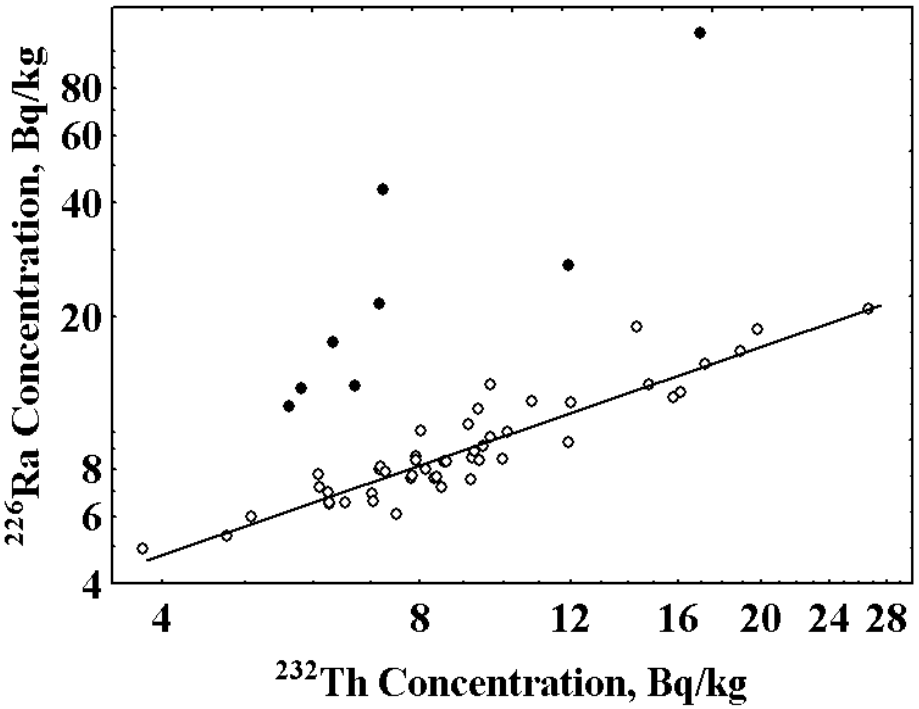
Equipment

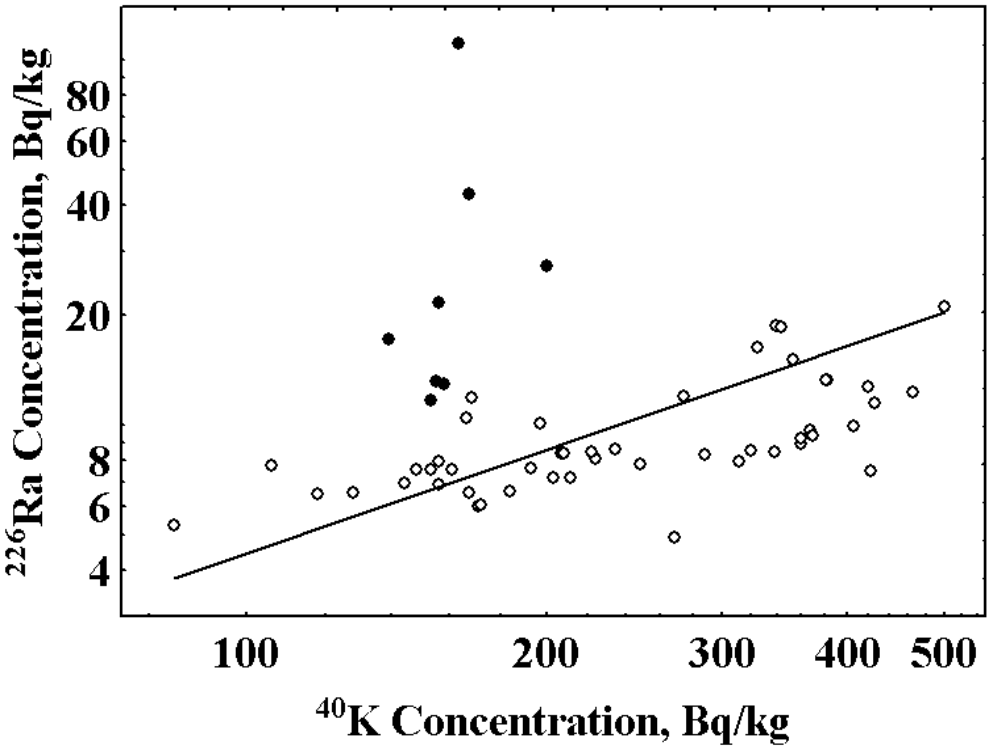
Measurements were carried out with gamma-spectrometr with HPGe detector, which has a relative detection efficiency at least 40% for energy 1.33 MeV.
Soil samples were measured with Marinelli geometry during 5.5 - 6 hours.

Such radionuclides as ^{226}Ra, ^{214}Pb, ^{214}Bi, ^{212}Pb, ^{235}U, ^{238}U, ^{40}K and ^{137}Cs were detected in the all soil samples.

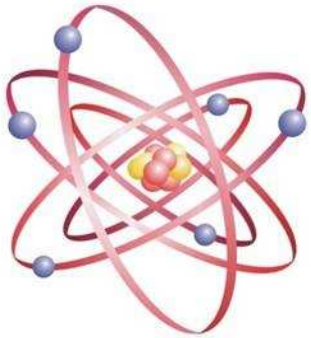
Oil-producing company site

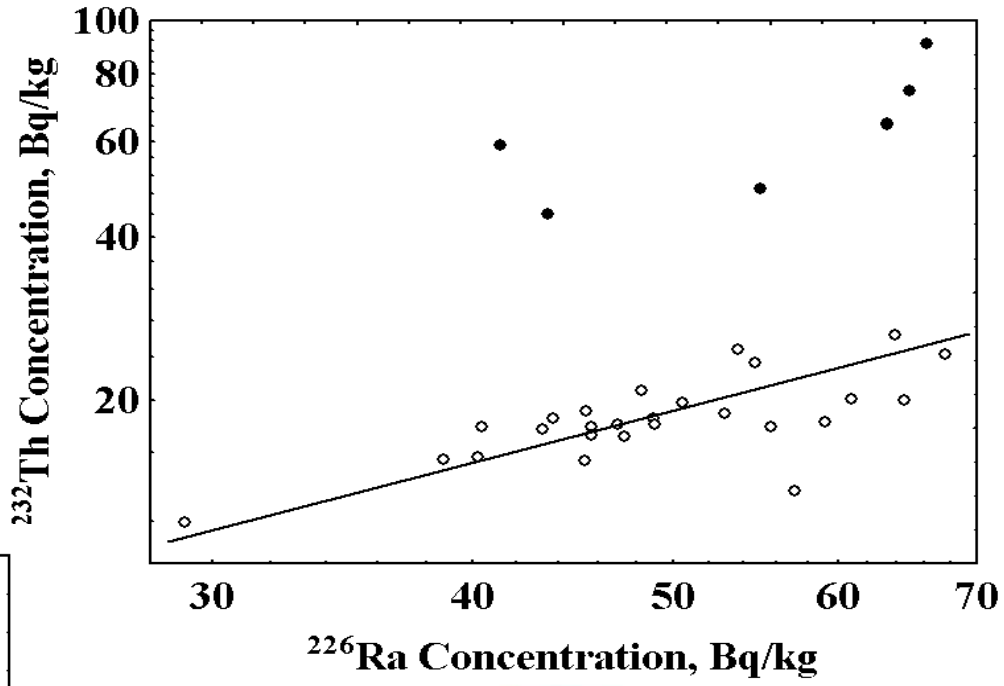


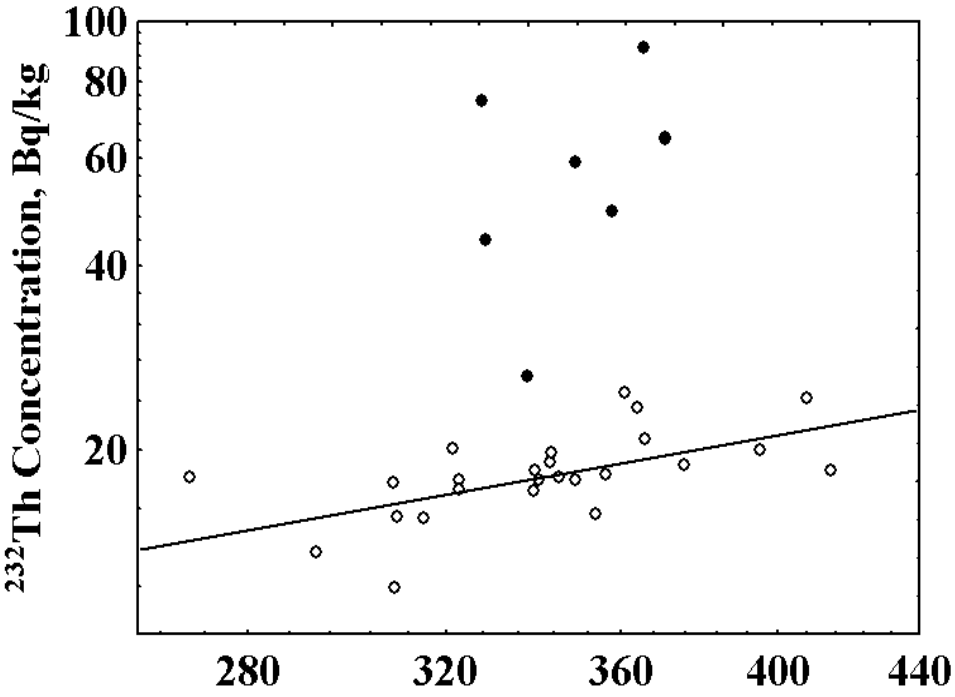




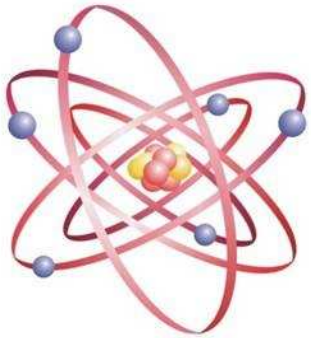
Monazite concentrate storage site

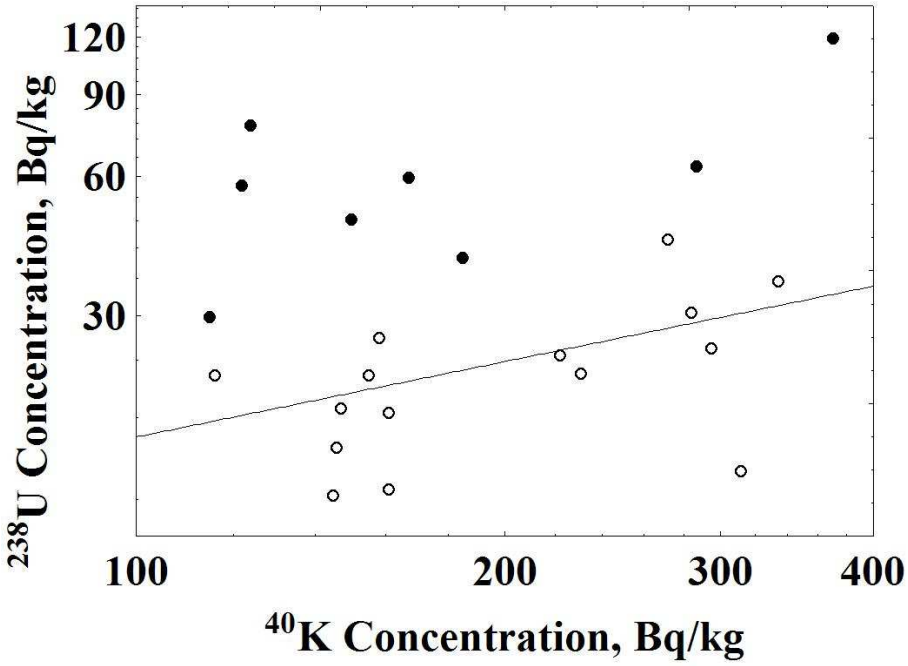


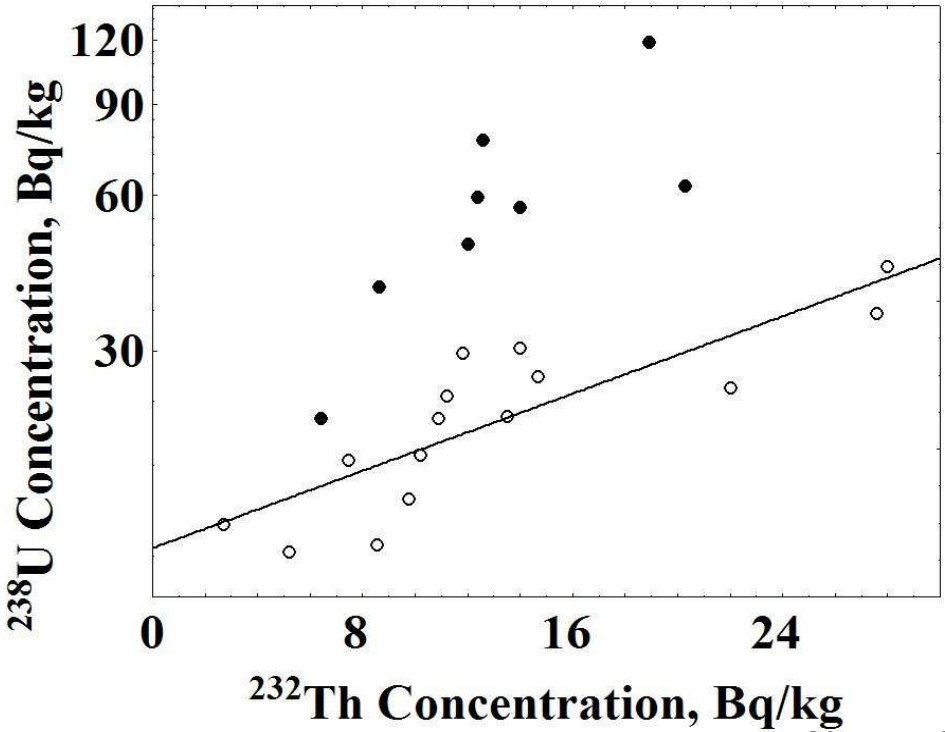




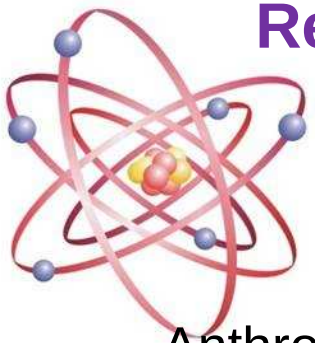
Uranium processing site







Results of radionuclide relationship in TENORM

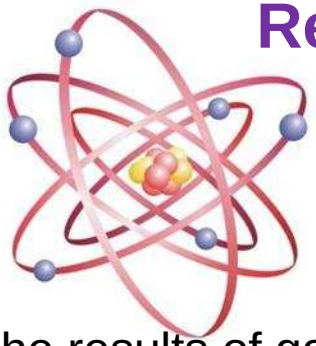


Anthropogenic contribution in the analyzed soil samples was estimated relationship between concentration such radionuclides as ^{226}Ra, ^{232}Th, ^{40}K and ^{238}U.

Results have presented in table below:

Site	Radionuclides	R^2	Radionuclide ratio with 99% confidence interval
Oil producing	^{226}Ra –^{232}Th	0.83	1.1±0.3
	^{226}Ra – ^{40}K	0.55	0.041±0.027
	^{232}Th – ^{40}K	0.2	0.039±0.034
Monazite storage	^{232}Th –^{226}Ra	0.67	0.38±0.11
	^{232}Th – ^{40}K	0.34	0.052±0.017
	^{226}Ra – ^{40}K	0.12	0.15±0.07
Uranium processing	^{238}U – ^{40}K	0.49	0.08±0.03
	^{238}U – ^{232}Th	0.75	0.91±0.38
	^{232}Th – ^{40}K	0.63	0.013±0.003

Results of radionuclide relationship in TENORM



The results of gamma-spectrometry analysis of these samples demonstrated:

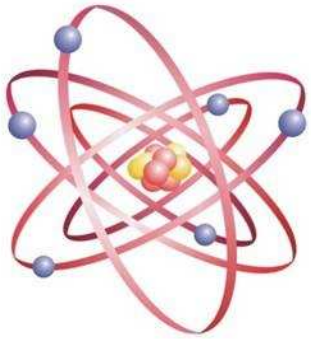
– excess of ^{226}**Ra** in soil samples taken at the **oil-producing company site**;

– excess of ^{232}**Th** in soil samples taken near the **monazite concentrate storage site**;

– excess of ^{238}**U** in soil samples taken around the **uranium processing site**.

Enterprise	Total number collected soil samples	Number of soil samples with contamination	Excess, %	Contamination reason
Oil-producing company site	49	8	66	Technological process
Monazite concentrate storage site	32	6	71	Monazite spillage
Uranium processing site	23	6	55	Technological process

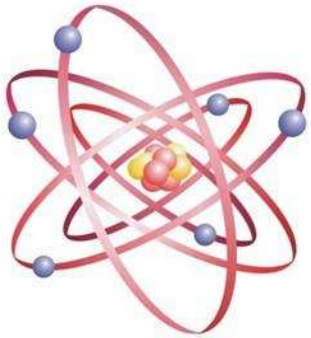
Conclusion



- Anthropogenic impacts on the environment led to formation of TENORM as a result of mining, storage and processing.

- Method of radionuclides ratio was demonstrated for calculation of soil contamination on the example such enterprises as oil-producing company site, monazite concentrate storage site and uranium processing site.

- The results of our research have shown that the radionuclide relationship uncontaminated soil samples are normally distributed. Deviation from the normal distribution occurred for some samples due to increased concentration of ^{226}Ra for oil site , ^{232}Th thorium monazite storage facility and ^{238}U for processing uranium site.



Thank you for your attention!