Innovative Postgraduate Education in The Field of Environment Protection: Methods and Tools

MENV PRO
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MENVIPRO project implementation perspectives in the context of student learning outcomes

Ecogeochemical research of soils in Abovyan park

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Ecologycal passport of Yerevan Botanical Garden

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Project-based interdisciplinary education

It is an active learning method where students participate in a project while learning.

This method makes it possible to identify their strengths and weaknesses.

Students face real problems during lessons and offer their own solutions

During the project, the participants communicate with specialists from different fields, acquire new skills and acquaintances.

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Ecogeochemical research of soils in Abovyan park

MODERNITY

High level of heavy metal pollution in Yerevan

GOALS

Assessment of

- heavy metals content
- activity of gamma-radiating radionuclides in soils
- health risk of Abovyan Park in Yerevan.

OBJECTIVES

- Obtaining a geochemical characterization of soil pollution with heavy metals
- Obtaining a sanitary-hygienic state of soils
- Health risk assessment of heavy metal contents in soils
- Assessment of the activity of gamma emitting radionuclides
- Assessment of Excess Lifetime cancer risk due to radionuclides in soil

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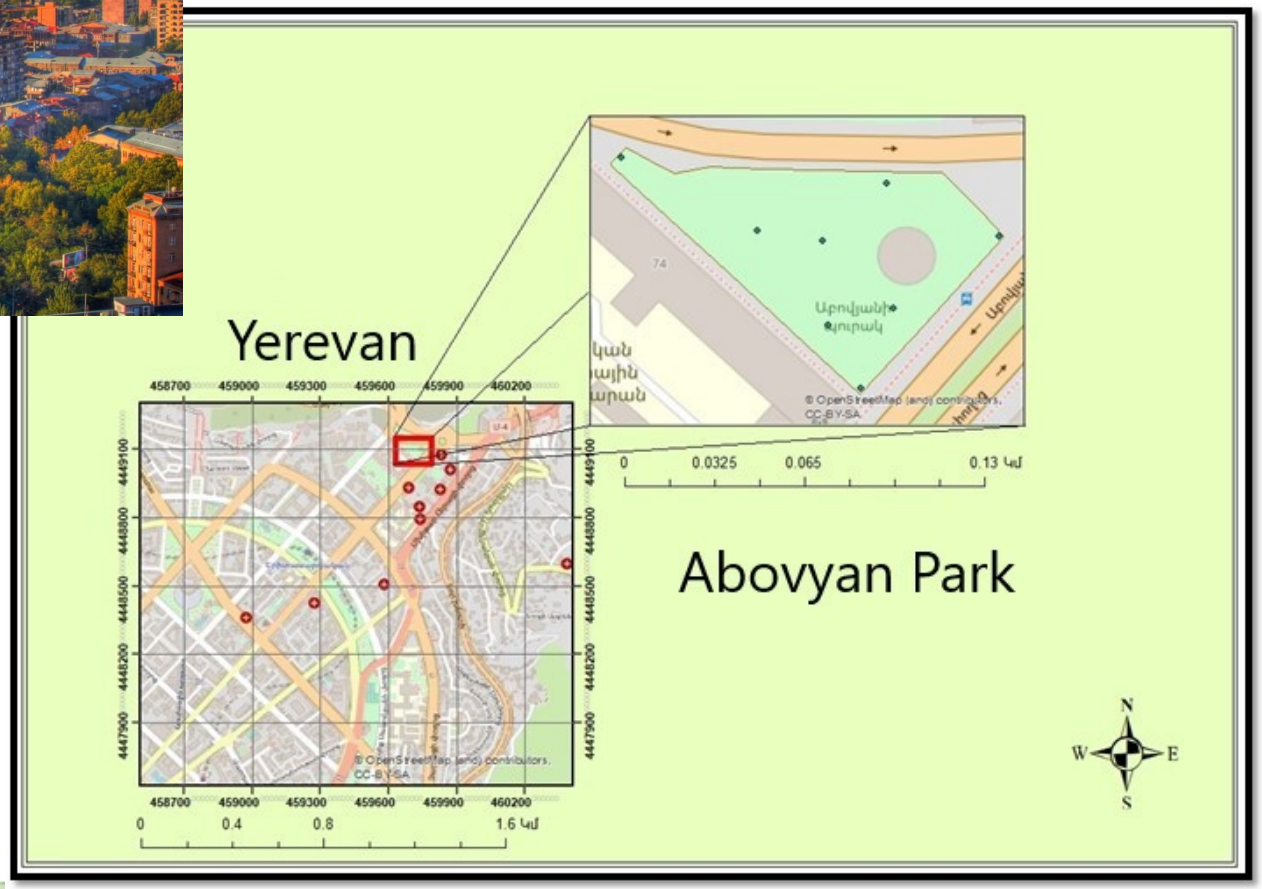
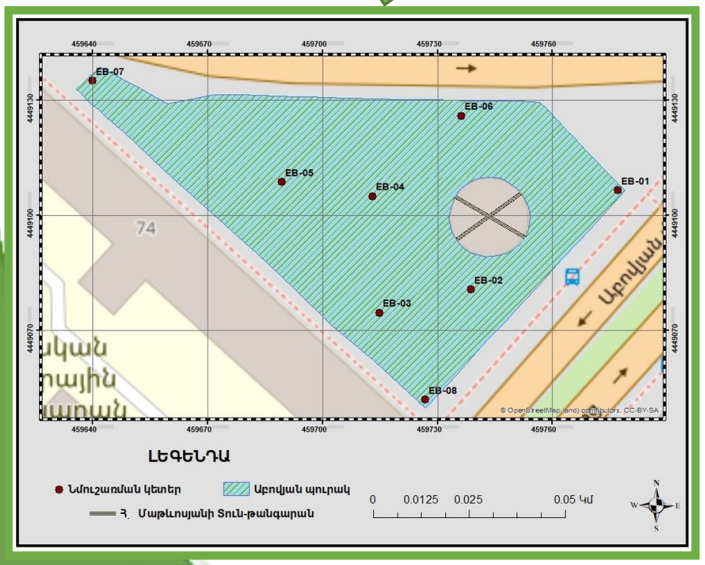
Research Object

The object of research is Abovyan Park (Yerevan), which is located at the intersection of Abovyan and Teryan heavy traffic roads and occupies an area of 0.578 ha



Material and methods

1. Preparatory stage



2. Field and laboratory works

Cr, V, Ti, Mo, As, Zn, Cu, Co, Fe, Mn, Pb, Ba

3. Cameral stage

$$EF = \frac{C_i/C_{ref}}{C_b/C_{ref}(\text{fon})}$$

$$I_{geo} = \log_2 C_n/1{,}5*B_n$$

$$Ra_{eq}=C_{Ra}+1{,}43C_{Th}+0{,}077C_K$$

$$ELCR=AEDE\times DL\times RF$$

RESULTS AND DISCUSSUTION

DESCRIPTIVE STATISTIC PARAMETERS

		Cr	V	Ti	Mo	As	Zn	Cu	Co	Fe	Mn	Pb	Ba
N	Valid	6	6	6	6	6	6	6	6	6	6	6	6
	Missing	1	1	1	1	1	1	1	1	1	1	1	1
Mean		157.5	86.5	4509.8	4.1	13.6	238.5	77.0	15.9	38882.0	922.2	63.6	450.2
Median		155.0	86.0	4564.0	4.2	13.4	228.0	67.7	15.9	38698.5	932.5	58.4	456.5
Std. Deviation		17.5	2.7	147.8	0.8	1.0	59.4	25.5	0.8	2000.1	24.5	35.5	17.4
Variance		304.7	7.1	21859.4	0.6	1.1	3523.0	648.7	0.6	4000519.5	599.0	1257.9	301.4
Skewness		.008	.999	-1.480	-.275	1.121	1.202	.494	-1.038	.443	-1.047	1.368	-.764
Std. Error of Skewness		.845	.845	.845	.845	.845	.845	.845	.845	.845	.845	.845	.845
Kurtosis		-1.019	.601	1.772	-2.328	2.257	1.940	-1.377	1.366	-.545	-.576	3.248	-1.690
Std. Error of Kurtosis		1.741	1.741	1.741	1.741	1.741	1.741	1.741	1.741	1.741	1.741	1.741	1.741
Minimum		133.0	84.0	4243.0	3.0	12.3	172.7	45.9	14.5	36467.0	883.0	21.6	426.0
Maximum		178.0	91.0	4627.0	4.9	15.4	344.0	111.0	16.6	41909.0	944.0	129.0	466.0
CV		11.08	3.08	3.28	19.71	7.68	24.89	33.07	4.90	5.14	2.65	55.79	3.86

CORRELATION

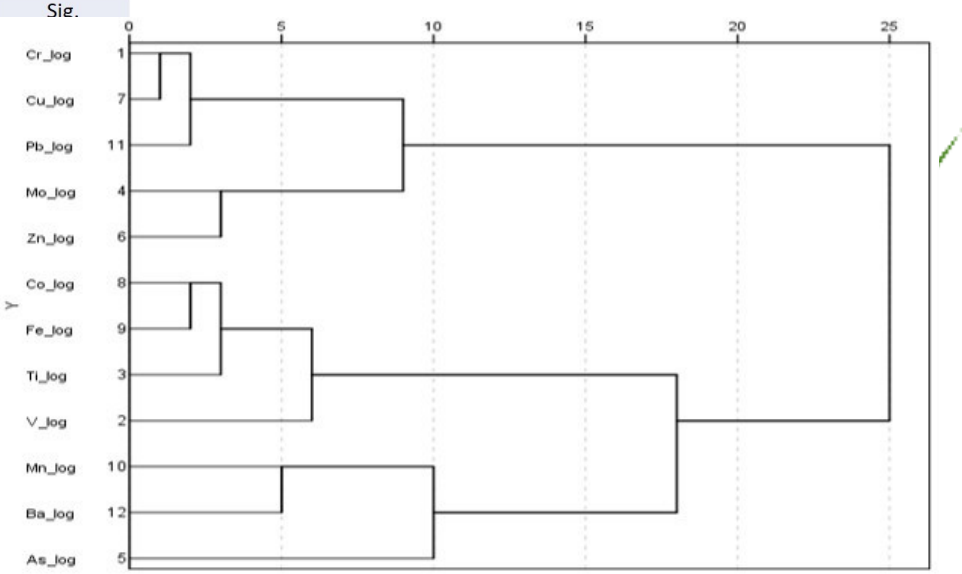
		Cr	V	Ti	Mo	As	Zn	Cu	Co	Fe	Mn	Pb	Ba
Cr	Pearson Correlation	1											
V	Pearson Correlation	.234	1										
Ti	Pearson Correlation	.039	.688	1									
Mo	Pearson Correlation	.513	-.112	.337	1								
As	Pearson Correlation	.358	.018	.254	.127	1							
Zn	Pearson Correlation	.628	-.040	.160	.720	-.007	1						
Cu	Pearson Correlation	.958**	.099	.116	.728	.389	.717	1					
Co	Pearson Correlation	-.055	.304	.770	.549	-.145	.542	.100	1				
Fe	Pearson Correlation	.271	.500	.701	.358	.062	.682	.301	.826*	1			
Mn	Pearson Correlation	-.020	.437	.133	-.547	-.004	.101	-.210	.103	.537			
Pb	Pearson Correlation	.807	.181	-.082	.445	-.176	.817*	.750	.156	.449	.19		
Ba	Pearson Correlation	.701	.370	-.215	-.244	.260	.186	.474	-.447	.100	.51		

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

NORMALITY TEST

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Cr	.224	6	.200*	.916	6	
V	.241	6	.200*	.891	6	
Ti	.287	6	.134	.829	6	
Mo	.285	6	.138	.873	6	
As	.238	6	.200*	.923	6	
Zn	.204	6	.200*	.923	6	
Cu	.269	6	.199	.886	6	
Co	.257	6	.200*	.881	6	
Fe	.202	6	.200*	.959	6	
Mn	.308	6	.079	.849	6	
Pb	.331	6	.039	.855	6	
Ba	.276	6	.169	.838	6	

CLUSTER ANALYSIS



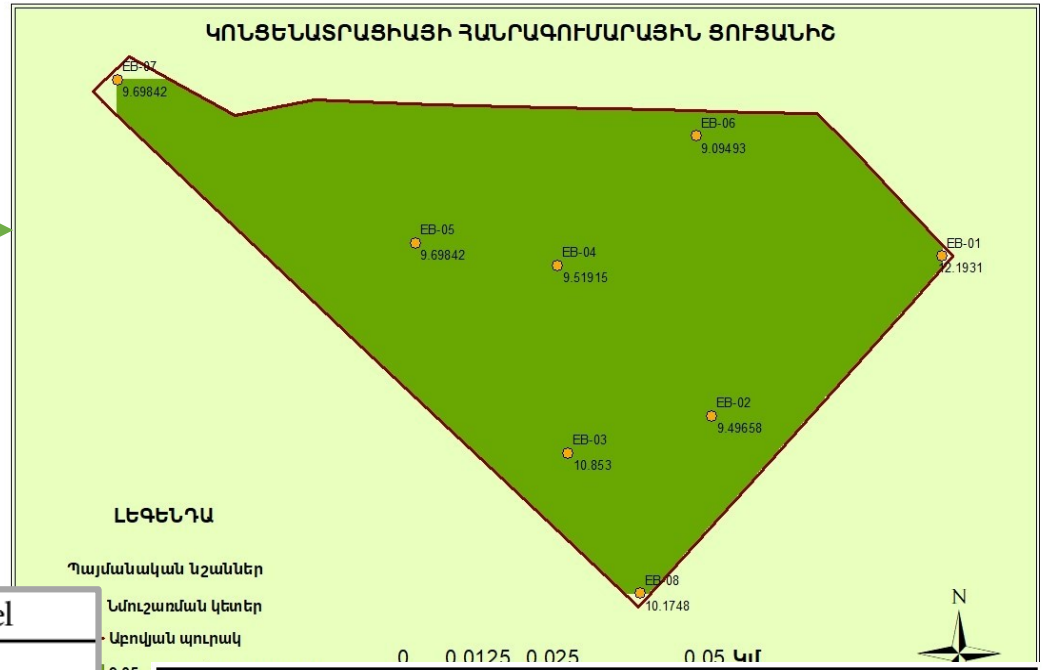
RESULTS AND DISCUSSUTION

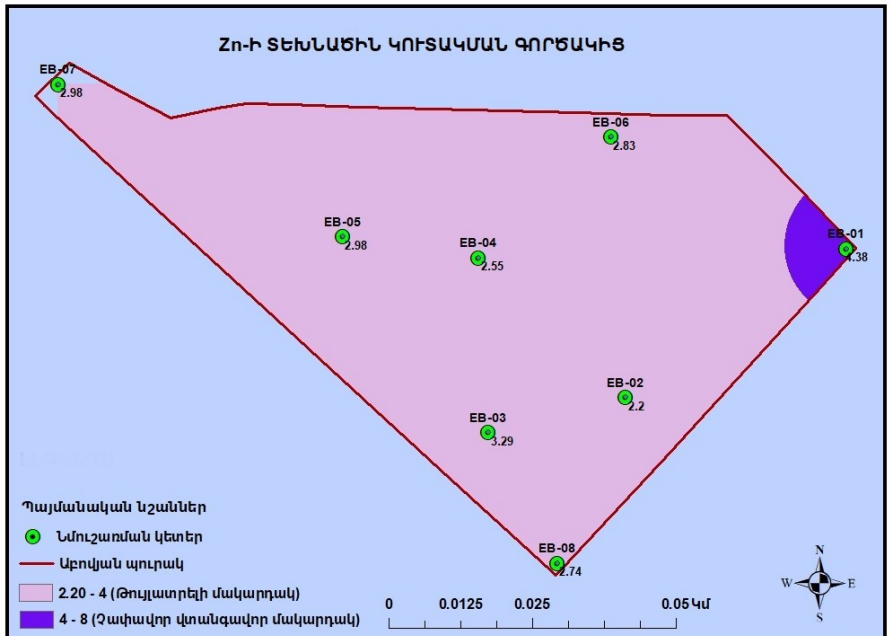
Kc, Zc, Igeo, EF, RI, HI

Geoaccumulation index (Igeo)

	Cr	V	Mo	As	Zn	Cu	Co	Fe	Mn	Pb	Ba
EB-01	0.76	0.36	0.84	3.65	1.55	0.81	-0.50	-0.46	-0.32	4.16	-0.40
EB-02	0.56	0.41	0.37	3.68	0.55	0.12	-0.58	-0.57	-0.34	2.80	-0.42
EB-03	0.75	0.32	0.90	3.90	1.13	0.89	-0.58	-0.57	-0.39	3.15	-0.43
EB-04	0.56	0.29	0.19	3.71	0.77	0.11	-0.69	-0.66	-0.34	3.09	-0.39
EB-05	0.48	0.29	0.84	3.57	0.99	0.23					
EB-06	0.34	0.32	0.50	3.74	0.92	-0.39					
EB-07	0.48	0.29	0.84	3.57	0.99	0.23					
EB-08	0.66	0.36	0.64	3.79	0.84	0.50					

Igeo Class	Igeo value	Contamination level
0	Igeo ≤ 0	Uncontaminated
1	0 < Igeo < 1	Uncontaminated/moderately contaminated
2	1< Igeo < 2	Moderately contaminated
3	2 < Igeo < 3	Moderately/strongly contaminated
4	3 < Igeo< 4	Strongly contaminated
5	4 < Igeo< 5	Strongly/extremely contaminated
6	5 < Igeo	Extremely contaminated





The Geoaccumulation Index (Igeo) for assessing contamination levels in soil

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RESULTS AND DISCUSSUTION

	Cr	V	Mo	As	Zn	Cu	Co	Fe	Mn	Pb	Ba
Max	178	91*	4.9	15.4	344	111	16.6**	41909	944	129	456
Min	130	84	3	12.3	172.7	45.9	14.5	36467	883	21.6	426
Mean	157.5	86.5	4.1	13.6	238.5	77	15.9	38882	922.2	63.6	450.2
Back.	70.1	45.8	1.75	0.69	78.4	40	15.6	38304	788	4.8	407
MAC	90	150	132	10	220	132	5	-	1500	65	-
Mean geochemical series											
As $_{(19.7)}$- Pb(13.1)- Zn (3.0)- Mo (2.3) - Cr (2.2)-V, Cu(1.9)- Mn(1.2)- Ba(1.1)-Fe, Co(1.0)											
Minimum geochemical series											
As $_{(17.8)}$- Pb(4.3)- Zn (2.2)- Cr (1.9)- V(1.8)-Mo (1.7)- Cu, Mn(1.1)- Ba, Fe (1.0)											
Maximum geochemical series											
Pb(26.9)- As $_{(22.3)}$- Zn (4.4)- Mo, Cu (2.8) - Cr (2.5)-V (2.0)- Mn(1.2)- Ba, Fe, Co(1.1)											
Mean sanitary hygienic series											
Co(3.2)- Cr (1.8)-As $_{(1.4)}$- Pb, Zn (1.1)											
Min sanitary hygienic series											
Co(3)- Cr (1.4)-As $_{(1.3)}$											
Max sanitary hygienic series											
Co(3.3)- Cr, Pb(2)- Zn (1.6)- As $_{(1.5)}$											

Description of geochemical an sanitary hygienic indices of soil.

Radiological indices of soils of Abovyan Park

	RaEq Բp/կգ	Hex	Hin	ODRA,	AEDE, մՉկ/ժ	ELCR	AGED, մՉկ/ժ
Sample 1	80.5	0.22	0.28	40.3	0.05	1.73E-04	0.27
Sample 2	98.5	0.27	0.34	49.0	0.06	2.10E-04	0.33
Mean	89.5	0.2	0.3	44.6	0.05	1.92E-04	0.3
Global mean	370	1	1	59	0.07	2.90E-04	0.3

CONCLUSIONS

- ✓ The content of heavy metals in the soil of Abovyan Park in Yerevan was studied, and the Summary Concentration Index (SCI) for 8 samples fell in the range of 8-16, which according to the SCI scale corresponds to a low level.

- ✓ According to the anomaly coefficient (Kc), the background excess only in the contents of As and Pb. A maximum value of 22.3 was recorded for As in sample 3, and 27 for Pb in sample 1.

- ✓ The health risk assessment showed that in Abovyan Park the level of non-carcinogenic risk is high (> 4) for children and a medium (1-4) for adults.

- ✓ The natural radionuclides are in the accepted range for the soils of Armenia (UNSCEAR), and only the average activity of K-40 is slightly higher. The radiological indices, dose and excess lifetime cancer risk do not exceed the global average values. The artificial Cs-137 radionuclide was also found in the soil, the presence of which is also documented by other studies conducted in Yerevan.

Ecologycal passport of Yerevan Botanical Garden

Purpose

- Compile the ecological passport of the Yerevan Botanical Garden

task

- Geochemical survey and mapping of the Botanic Garden
- Identification of contaminants and sources of contamination in soil
- Identification of features of distribution of heavy metals and radionuclides in garden soil and road dust

The project implementation process. Implemented stages

Initial stage

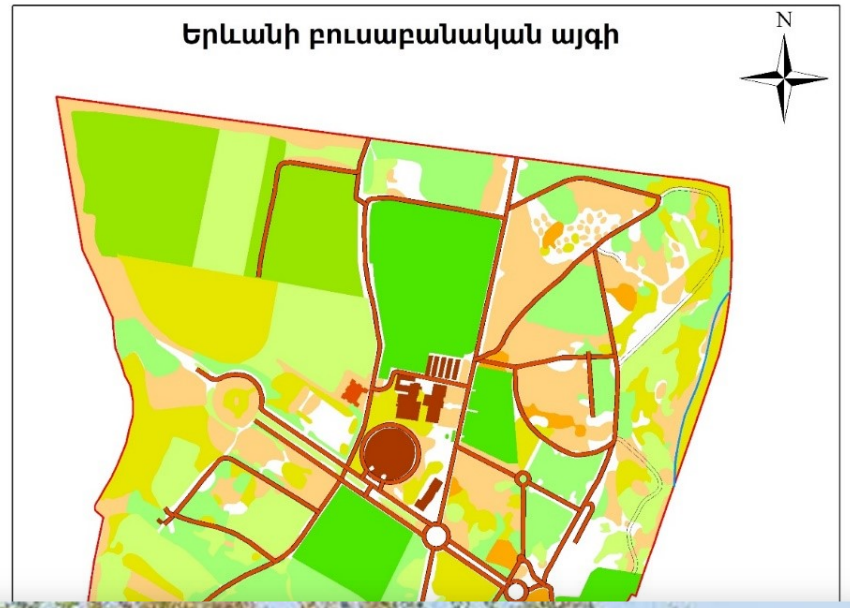
- ✓ Collection and study of information about the sampling area
- ✓ Studying similar research
- ✓ Field work planning

Mapping works

- ✓ Digitization of the botanical garden map
- ✓ Compilation of the sampling network

Field work

- ✓ Soil and dust sampling
- ✓ Sample pretreatmen



Project implementation process. Further stages

Laboratory works

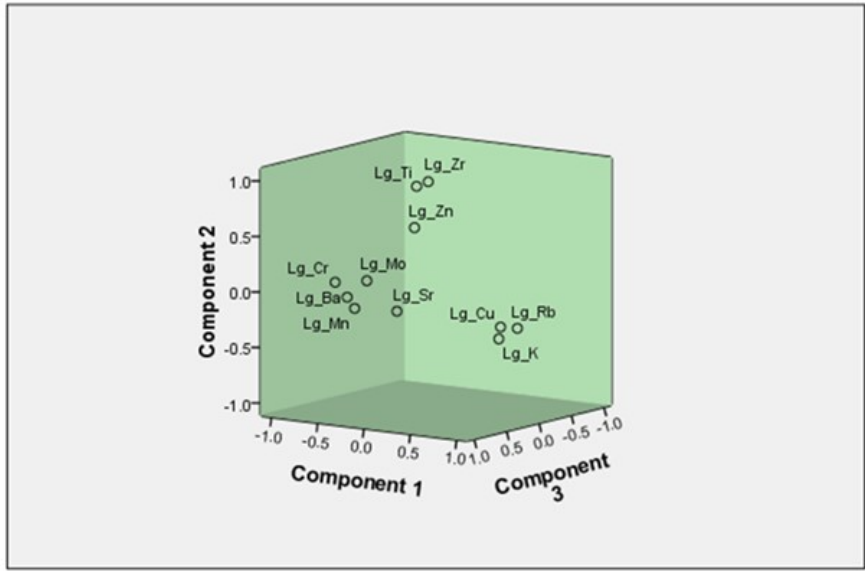
- Sample preparation
- X-ray fluorescence analysis
- Gamma spectrometry

Data analysis

- Statistics (correlation component analysis)
- Calculation of ecological indicators

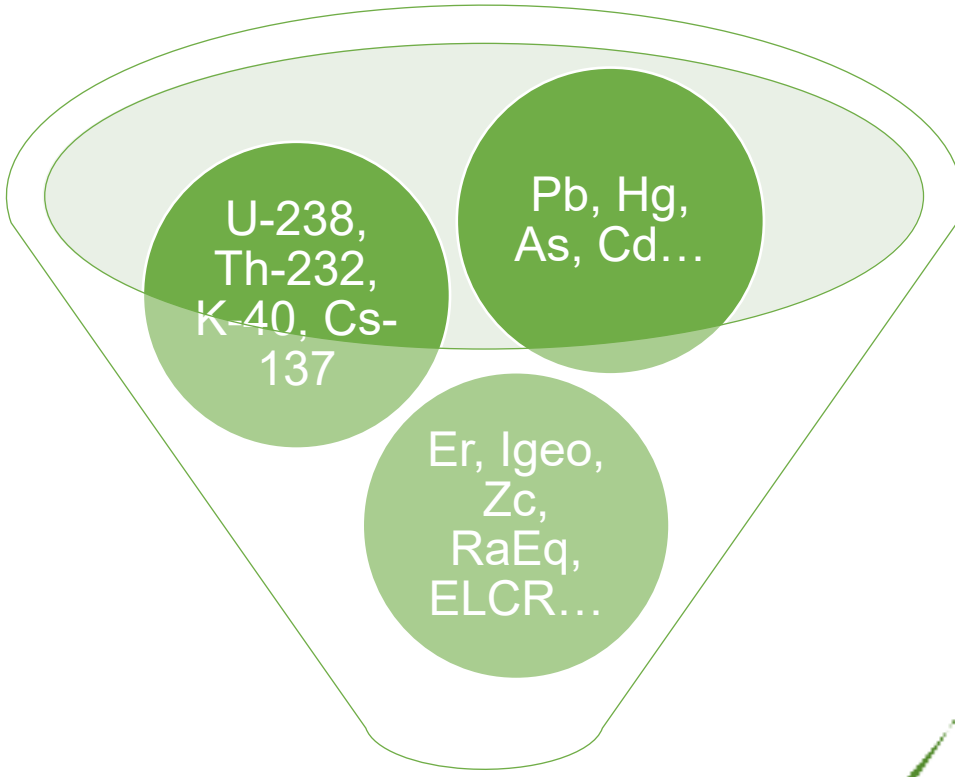
Summary of the Results

- Compilation of maps
- Summary and presentation of results



Expected results

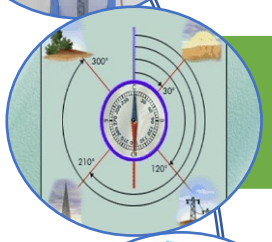
- Geochemical maps
  - *Spatial distribution of chemical elements and radionuclides*
- Geochemical evaluation.
  - *Quantitative characterization of multi-element contamination*
  - *Primary pollutants of soil and dust*
  - *Other geochemical parameters*
- Potential Environmental Risk Assessment
- Assessment of the radioecological situation



Geochemical and radioecological assessment of the area

Interdisciplinarity

Environmental Monitoring and Measuring Devices



Ecological Cartography

Environmental Statistics

Environmental Geochemistry

Environmental Radiation Protection

THANK YOU !