



NEUTRON ACTIVATION ANALYSIS IN ENVIRONMENTAL STUDIES

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P. Bode, J. J. M. de Goeij, '*Activation Analysis*', Encyclopedia of Environmental Analysis and Remediation, J. Wiley & Sons, New York, **1998**, ISBN 0-471-11708-0, pp 68–84

The method is based upon the conversion of stable atomic nuclei into radioactive nuclei by irradiation with neutrons and the subsequent detection of the gamma radiation emitted during the decay of these radioactive nuclei. Activation by neutrons may result in radionuclides from all elements (that have radioactive daughter products) present in the sample, with sometimes strongly different production rates

Diagram illustrating the process of neutron capture by a target nucleus followed by the emission of gamma rays.



NAA features the following advantages:

- high sensitivity to a majority of elements;
- ✓ good selectivity;
- a possibility of simultaneously determining a large number of elements;
- ✓ independence of the results on the form of chemical compounds;
- A nondestructive nature, which allows avoiding the risk of contamination of samples with reagents or their incomplete dissolution;
- easy procedure for preparation of samples for analysis.

The disadvantages of NAA are:

- necessity of using nuclear reactors;
- problems arising from storage and disposal of nuclear waste;
- time required for analysis.



NAA ~ 55 elements

Reactor and Radioanalytical complex REGATA





Experimental facility REGATA at IBR-2 reactor



Transport capsules for irradiation



Ch1-Ch4 –irradiation channels, S- intermediate storage, DCV- directional control valves, L- loading unit, RCB- radiochemical glove-cell, U- unloading unit, SU- separate unit, SM- storage magazine, R- repacking unit, D- detector, CB- control board, R1-R3- the rooms where the system is located.

Scientific directions

Passive biomonitoring





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Active biomonitoring



Preparation of moss bags for exposure



Anastasiya Sergeeva



Water quality monitoring

Pavel Nekhoroshkov



Water quality monitoring Baikal











Alteration of As concentration in the Baikal sponges *L.baikalensis* by heigh

Alteration of Cu concentration in the Baikal sponges *L.baikalensis* by heigh



Wastewater treatment





Elemental composition of industrial effluent

Element	Sr	Ni	Cu	Zn	Ba	рН
Concentration, µg/L	340	839	58	49843	35	6.0





Efficiency of metal ions removal from industrial effluent at different initial pH (at T 20 °C; sorbent dosage 10 g/L; adsorption time 1h)



Removal of zinc ions from industrial effluent at different sorbent dosage (at T 20 °C; adsorption time 1h)







MINISTERUL CERCETĂRII, INOVĂRII ȘI DIGITALIZĂRII

Production of Mineral–Organic Hybrid Adsorbent for Metal Removal from Industrial Wastewater

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President of International Jury Prof.Dr.Eng. Mohd Mus afa Al Bakri ABDULLAH



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President of Exhibition

Prof.Dr. Ion SANDU

INTERNATIONAL PEDERATION

Assessment of soil and sediments pollution



Investigated area location in the Tajikistan map (A); Altitude (meter) of investigated area respectively by sampling points (B); soil and sediment sampling sites of Zarafshon valley (C).



Normalized data of unexposed soil and sediment (A) samples; as well as, soil and sediment exposed by anthropogenic impacts (B).



Values of CF and PLI of unexposed soil (A) and sediments (B), as well as soils (C and D) and sediments (E and F) related to anthropogenic impact.

Control of quality and safety of foodstuffs



Golden Delicious



Record



Ialovenschii Ustoicivii

5 TF_{L/S} TF_{F/S} 4 TF_{F/L} 3 Ц 2 1. 0 Na Mg Cl K Sc Ca Cr V Mn Ni Fe Co Zn As Br Sr Rb Mo Sb Ba Cs La Sm Ta Th U Elements

Apple

Transfer factors in system soil-leaf-apple

Leaves-soil: K (TF_{L/S}=3.1), Zn (TF_{L/S}=2.1), Sr (TF_{L/S}=1.9), and Mo (TF_{L/S}=1.1) and Ca (TF_{L/S}=0.96). Fruits-soil: K (TF_{F/S}=1.6) and U (TF_{F/S}=2.1). Fruits- leaves: TF> 1.0 was obtained for Na, Cl, and Cr.



Transfer factors in the system soil-leaf-stone-plum

Leaves-soil: Ca (TF_{L/S}=1.5), Br (TF_{L/S}=1.5), Sr (TF_{L/S}=1.2), and K (TF_{L/S}=1.1). Fruits-soil: K (TF_{F/S}=1.5) and Rb (TF_{F/S}=1.9). Fruits-leaves: TF_{F/L} values for Na, K, Sc, Zn, Rb, Sb, Sc, Sm, and Th were greater than 1.0.



Leaves-soil: Ca ($TF_{L/S} = 3.3$), Sr ($TF_{L/S} = 2.8$) and U ($TF_{L/S} = 1.0$). Grapes-soil: K (*TF* 0.92).

From leaves in grapes are accumulated Cl, K, Sc, V, Ta, and Th.



	Apple			Plum			Grape			
Element	C mg/kg f.w.	DIM, mg/day	HQ, mg/kg/da y	C mg/kg f.w.	DIM, mg/day	HQ, mg/kg/da y	C mg/kg f.w.	DIM, mg/day	HQ, mg/kg/da y	R _f D, mg∕day
Cr	3.9	1.2	0.01	0	0	0	0.48	0.1	0.004	105
Со	0.5	0.1	0.05	0.7	0.2	0.07	0.6	0.2	0.06	3
Fe	78	23	0.4	151	45	0.75	8.8	2.6	0.04	10-60
Mn	8.1	2.4	0.5	2.2	0.6	0.1	1.7	0.5	0.1	0.5-5.0
Ni	6.7	2.0	1.4	1.4	0.4	0.3	1.8	0.2	0.2	1.4
V	0.6	0.2	0.1	0	0	0	1.3	0.4	0.3	1.8
Zn	33	9.9	0.7	25	7.5	0.5	6.4	1.9	0.1	15

Soybean enriched with iron and magnesium



Fe (A) and Mg (B) content in seedlings grown from seed incubated in FeSO4 and MgSO4 solutions



Antioxidant activity of seedlings grown from seeds incuabated in $FeSO_4$ (A) and $MgSO_4$ (B) solutionswith Fe or Mg at concentration 0 (control, black bars), 100 (cream-color bars) and 500 mgl⁻¹ (white bars) measured after 24, 48 and 72 h. 31

Nanotoxicology

APPLICATION OF NANOPARTICLES









Experiment design

To study uptake of AgNPs (8.7 nm) both for mothers and the offspring experimental females were drinking the AgNPs solution with concentration of 25 μ g/ml since one week before pregnancy and to the end of lactation (one month after birth).







Silver content in the lungs of female mice and their offspring



Silver content in the liver of female mice and their offspring



Silver content in the kidneys of female mice and their offspring



Silver content in the brain of female mice and their offspring (including silver in blood vessels)



Examples of movement pattern of animal with different types of behavior in the Morris test: 1 – directional search, 2 – random searching, 3 – thigmotaxis (strategy of incapable individuals).



The amount of titanium in feces constituted 74 \pm 7 µg/g

The total distance to platform during first three days of learning

	Groups of	The total distance to platform, cm							
	on their cognitive abilities	Day	/1	Da	y2	Day3			
		Mean	SD	Mean	SD	Mean	SD		
Experiment	Capable (1)	21849	-	109313	-	20614	-		
	Intermediate (7)	28112	15240	167693	100467	152688	76041		
Control	Capable (5)	25551	10602	14002	8287	9428	5023		
	Intermediate (6)	31029	9437	25871	11168	30319	7150		

The disturbance of the mechanisms in brain responsible for spatial orientation and change of spatial memory in mice administrated with TiO_2NPs was identified.

Thank you for attention!