ON THE CHEMICAL AND RADIOACTIVE CONTENT OF DANUBE RIVER SAMPLES COLLECTED IN FEBRUARY-MARCH 2000

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Abstract

Water, sediment and fish samples collected from the Danube river mouth in Romania (km 1073) to Giurgiu (km 493) were analysed for heavy metals and radioactivity content. Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn, Cl-, CN-, and ^{3}H in water, ^{137}Cs, ^{226}Ra, ^{228}Ra, and ^{40}K in sediments, fish, and water, as well as ^{90}Sr and ^{238}U in fish samples have been determined. The results obtained were correlated with the gold mining events in N-W Romania, in January 2000.

Key words: Danube river, heavy metals, radioactivity, fish, water, sediment.

Introduction

The aim of this paper was to investigate the contribution of the Tisa tributary river to the heavy metal and radionuclide concentrations in the Danube River in Romania, after the gold mining events at Baia Mare (N-W Romania), in January 2000. Fish species *Alburnus alburnus, Acipenser ruthenus, Carasius auratus, Cyrinus carpio, Ctenopharingodon idaella, Perca fluviatilis, Rutilus rutilus*, and *Silurus glanis* were analyzed along with surface water and bed load sediment samples. The collection sites were: Moldova Noua (km 1073), Bazias (km 1072.4), Port Corabia (km 633), Corabia (km 629.5), and Giurgiu (km 493).

Experimental

Atomic Absorption Spectrometry (AAS) (Varian 250 PLUS spectrophotometer) and Energy Dispersive X-ray Fluorescence (EDXRF) methods were used to determine heavy metal concentrations in water and fish samples, respectively. EDXRF was performed by means of the ^{238}Pu and ^{241}Am excitation sources and an X-ray tube. Man-made and natural radioactivity was investigated by γ-ray spectrometry on sediment, fresh fish, and water residue [1], and by ,-ray spectrometry on ashed fish and water samples [2]. ^{238}U content in calcined fish ash samples was analyzed by fission and alpha track methods [3].

Results and discussion

Table 1 presents Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn, CN- and Cl- concentrations in water samples determined by AAS (in $\mu g\ L^{-1}$). Tables 2 and 3 include ^{137}Cs, ^{226}Ra (^{238}U series), ^{228}Ra (^{232}Th series) and ^{40}K activity concentrations in sediment (in Bq kg^{-1}) and fish samples (in Bq kg^{-1} fresh), respectively. Tables 4 and 5 contain ^{90}Sr and ^{238}U activity concentrations in fish (in Bq kg^{-1} fresh), and of ^{3}H, ^{137}Cs, ^{226}Ra, ^{228}Ra and ^{40}K in water samples (in Bq L^{-1}), respectively. Detection limits in the tables were calculated with a probability of 3σ.

It could be observed (Tables 1-5), that the concentration values obtained are similar to the levels determined in Danube samples during the last few years [1, 3-5].

Ag, Ba, Br, Ca, Cd, Cl, Cu, Fe, Ga, K, Mn, Pb, Se, Sn, Sr and Zn contents of the fish samples were investigated by EDXRF. Concentrations were found to be similar to those obtained by AAS for Cd, Cr, Cu Pb and Zn during July1999 - October 2000 [5].

In conclusion, no pollution with heavy metals and man-made radioactivity was observed in the samples collected along the Danube River, from Moldova Noua (km 1073, the river mouth in Romania) downstream to Giurgiu (km 493), about two months after the gold mining events at Baia Mare.

Table 1. Elemental concentrations in Danube water, determined by AAS (μg L^{-1}).

Sample site/ Date	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
km 1031/ 16.02.00	4	5	34	0	147	0	16	65
km 1073/ 23.03.00	6	22	11	22	43	2	43	18
km 1073/ 29.03. 00	10	0	10	0	1	17	50	10
km 633/ 29.03.00	9	14	20	14	65	14	75	30
km 493/ 28.03.00	14	0	9	0	0	9	64	24
km 493/ 29.03.00	4	15	8	57	0	20	57	15
km 493/ 29.03.00	4	43	11	43	11	7	57	7
km 493/ 30.03.00	22	22	17	24	24	4	22	24

Average concentration values in water samples (in mg L^{-1}): 19.162 (Cl^-), and 0.017 (CN^-)

Table 2. Activity concentrations in Danube sediments, by γ-ray spectrometry (Bq kg^{-1}).

Radio-Nuclide	Km 1073/ 20.03.00	Km 1072.4/ 24.03.00	Km 633/ 29.03.00	km 629.5/ 29.03.00	Km 493/ 28.03.00	Km 493/ 29.03.00	Km 493/ 30.03.00
^{137}Cs	4.4 ± 0.6	1.8 ± 0.3	1.4 ± 0.2	2.4 ± 0.5	0.6 ± 0.2	1.6 ± 0.3	1.6 ± 0.3
^{226}Ra	35.6 ± 1.6	9.6 ±1.1	8.5 ± 0.8	13.3 ±1.3	12.2 ± 1.1	13.5 ±1.5	12.6 ± 1.0
^{228}Ra	33.4 ± 2.7	11.6±0.9	11.9 ±0.7	16.7 ±1.0	15.5 ± 1.0	15.0 ±1.2	13.6 ± 0.9
^{40}K	463 ± 23	270 ± 11	366 ± 12	390 ± 25	350 ± 11	425 ±13	400 ±14

Table 3. Activity concentrations in Danube fish, by γ-ray spectrometry (Bq kg^{-1} fresh).

Fish species / Sample site	^{137}Cs	^{226}Ra	^{228}Ra	^{40}K
Carasius auratus / km 493	0.3 ± 0.3	< 0.9	< 0.7	108 ± 10
Carasius auratus (scales) / km 493	2.3 ±0.8	< 5.7	< 3.7	80 ±28
Alburnus alburnus / km 493	< 0.4	< 1.1	< 0.8	101 ± 10

Table 4. ^{90}Sr and ^{238}U activity concentrations in Danube fish (Bq kg^{-1} fresh).

Radionuclide	Cyrinus carpio (km1073)	Perca fluviatilis (km1073)	Silurus glanis-head (km 1073)	Carasius auratus (km 633)
^{90}Sr	< 0.85	< 1.15	2.3 ± 1.0	< 1.8
^{238}U	0.40 ± 0.08	0.22 ± 0.04	1.03 ± 0.21	0.33 ± 1.4

Table 5. Activity concentrations in Danube water (Bq L^{-1}).

Sample site/ Data	^{3}H	^{137}Cs	^{226}Ra	^{228}Ra	^{40}K
Km 1031 /16.02.00	< 6	0.0127±0.0053	< 0.018	< 0.015	< 0.098

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