

Man-made and natural radionuclides measured in the Danube River during 1991

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Abstract

Water and bed sediments sampled on principal cross-sections of the Danube River were analysed by gamma spectrometry. Cs-137 was present in low activity, while Th-232, U-238 and K-40 levels were typical of distributions normally encountered.

Introduction

Previous experimental research on the identification of man-made and natural radionuclides in the Danube River was carried out at the Polytechnical Institute of Bucharest with the objectives of determining, a) radioactive pollution at a specific time, b) estimation of the dilution capacity of the Danube River and, c) the elaboration of a mathematical model for transport of radionuclides to the Black Sea (GEORGESCU *et al.*, 1980, 1981). The aim of the present work was to identify the presence of Cs-137 ($T_{1/2}=30.2$ y) as well as U-238 and Th-232 after the Chernobyl accident.

Materials and Methods

Water (50 l) and sediments were sampled during June 1991 along major cross-sections of the Danube River and analysed for radionuclides using established procedures (GEORGESCU *et al.*, 1981). The gamma-emitting radionuclides were identified using a HPGe crystal coupled to a multi-channel analyser. Both samples and reference materials (IAEA-306) were counted in the same geometry for 18-24 hours.

Results and Discussion

Cs-137, Th-232, U-238, K-40 were identified in bed sediments (Table 1) and in unfiltered surface water (Table 2). Cs-134 ($T_{1/2}=2.07$ y) was present in the bed sediments of all the cross sections of the Danube River, but only in low activity, i.e. $<0.2-0.6$ Bq/Kg dry. It should be noted that the sediments collected on the Romanian shore (left bank of River) are composed of silty clay, which may explain the somewhat generally higher accumulation of Cs-137 and other radionuclides.

Table 1. Activity in Bq/Kg dry sediment.

Sampling Site/ Date		^{137}Cs	^{238}U	^{232}Th	^{40}K
Upstream from Bechet Km 705 17.06.91	Left bank	8.2 ± 0.7	37 ± 2	22 ± 2	326 ± 16
	Centre	3.6 ± 0.3	20 ± 2	10 ± 1	261 ± 13
	Right bank	2.2 ± 0.2	20 ± 2	12 ± 1	304 ± 15
Bechet 18.06.91	Left bank	5.6 ± 0.4	28 ± 2	20 ± 2	339 ± 17
	Centre	3.8 ± 0.3	25 ± 2	8.7 ± 1.3	260 ± 12
	Right bank	2.9 ± 0.3	18 ± 2	8.4 ± 1.3	255 ± 10

The sediments, near the right bank have a higher granulometric composition and, therefore, do not readily accommodate the radionuclides in the crystalline lattice.

Table 2. Activity (Bq/m³) of unfiltered Danube river surface water in 1991.

Sampling Site/ Date		^{137}Cs	^{238}U	^{232}Th	^{40}K
Entrance of Danube into Romania, 9.06.91	Left bank	<96	<27	<13	<95
	Centre	<48	<32	<12	<36
	Right bank	<46	<29	<14	<45
Upstream from Bechet Km 705 17.06.91	Left bank	<101	<27	<17	<99
	Centre	<55	<32	<14	<100
	Right bank	<91	<29	<15	<103
Bechet 18.06.91	Left bank	<43	<31	<9	<56
	Centre	<100	<36	<5	<115
	Right bank	<92	<29	<14	<101
Turnu-Magurele 19.06.91	Left bank	<81	<8	<10	<90
	Centre	<41	<31	<16	<105
	Right bank	<95	<31	<15	<48

Conclusions

At the time when these Danube samples were collected (June 1991), the measured radioactivity in water and bed sediments ranged within the limits of the natural fluctuation. This was also the case at the Bechet site in front of the Kozlodui Nuclear Power Plant which is located on the right bank of the Danube River.

REFERENCES

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