^{137}Cs CONCENTRATION IN BED LOAD SEDIMENTS FROM THE DANUBE RIVER AND THE BLACK SEA DURING 1993

Iulia I. GEORGESCU[1], Gheorghe BARAN[1], Ana PANTELICA[2], Maria SALAGEAN[2]

[1] University Politehnic, Fac. Chem. Techn. Bucharest, Romania

[2] Institute of Physics and Nuclear Engineering, MG-6, Bucharest, Romania

In a previous study mathematical modelling of man-made radionuclides transfered and transported in the Danube river was undertaken by GEORGESCU (1986). This paper presents data on the variability of ^{137}Cs transported by the bed load sediments of the Danube river, Danube Delta and the Black Sea during 1993.

Sampling of the bed load sediments was performed simultaneously with hydrological and solid discharge measurements made during specific hydrological periods, i.e. during spring, summer and autumn at high and relatively low flow rates in the following cross-sections: Svinitza, Orsova, before the Turnu-Severin dam, Bechet (in front of the Kozlodui Nuclear Power Plant), Giurgiu, Ceatal-Izmail (beginning of the Danube Delta), Chilia and Sulina (Danube Delta) and Portitza and East Constantza in the Black Sea. About 2 kg of each sediment sample were dried in an electric oven at 105°C, homogenized and analyzed by gamma spectrometry with a HPGe detector for 18-20 h.

The ^{137}Cs activity in the sediments sampled is presented in Table 1. Concerning the presence of ^{134}Cs, it was only identified at locations with higher ^{137}Cs activities, e.g. up to 24±1 Bq/kg ^{134}Cs at Sulina.

Table 1. Contamination by ^{137}Cs of bed load sediments from the Danube river, Danube Delta and Black Sea during 1993.

Location and date of sampling		Activity Bq/kg (dry)	Location and date of sampling		Activity Bq/kg (dry)
Svinitza	8.04	114 ± 3	Ceatal-Izmail	24.04	1.6 ± 0.5
	8.08	107 ± 5		30.08	13.5 ± 1.9
Orsova	8.04	81 ± 2	Chilia km. 3	5.09	9.6 ± 0.8
	18.08	193 ± 10			
Turnu-Severin	9.05	3.4 ± 0.5	Sulina*	16.07	17.0 ± 0.7
	19.08	< 0.6	Sulina**	30.05	171 ± 5
Bechet km. 705	17.04	4.8 ± 0.4	Portitza	18.04	50 ± 2
	31.08	3.1 ± 0.3		19.07	22.4 ± 0.7
Bechet km. 678	17.04	2.8 ± 0.3	East Constantza	5.06	125 ± 6
	21.08	2.0 ± 0.5		13.07	253 ± 5
Giurgiu	13.04	2.1 ± 0.3			
	23.08	1.0 ± 0.2			

*) 2.5 nautical miles from Sulina **) 26 m depth in the Black Sea in front of Sulina Port.

With respect to the ^{137}Cs radioactivity levels, the Danube river and Black Sea coast can be divided into the following zones: Svinitza-Orsova (1st zone), Turnu-Severin dam - Ceatal-Izmail (2nd zone), Danube Delta (3rd zone) and Black Sea (4th zone). The lowest and nearly constant values were observed in the second zone where there are no important pollution sources of ^{137}Cs.

In the first zone which includes the entrace of the Danube into Romania, ^{137}Cs activities are about 50-100 times higher than those observed in the second zone. The highest ^{137}Cs activities were measured at the mouth of Danube river (Sulina) as well as south of the Danube Delta at Portitza and Constantza on the Black Sea. This may be explained by contaminated waters being transported in a southerly direction by the northeast marine currents.

To calculate radionuclide transport by the bed load sediments between two time intervals, the following relation has been used :

$$C_i = Q_b^i \cdot C_b^i, \quad i = 1,2 \text{ (time periods)} \qquad (1)$$

$$C = \frac{C_1 + C_2}{2} \cdot \Delta t \qquad (2)$$

where Q_b is solid discharge (kg/s) C_b is activity (Bq/kg) and Δt is the time interval between the two measurements. For example, at the Giurgu cross section with Q_b^1 = 18,4 kg/s, Q_b^2 = 10 kg/s, C_b^1 = 2,1 Bq/kg, C_b^2 = 1,0 Bq/kg (see table 1), the total transported ^{137}Cs activity, during 132 days is 2,7 x 10^8 Bq.

Spatial and temporal variation of the natural radioactive series U-Ra and Th will be the subject of a separate paper (GEORGESCU, in prep.).

ACKNOWLEDGEMENTS.
The authors are indebted to Dr.C.BONDAR of the Institute of Meteorology and Hydrology, Bucharest, who furnished the samples and the corresponding hydrological data.

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