

Artificial gamma emitters in Black Sea bottom water and sediment off the Danube Mouths in 1986-1987

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Abstract

Data are presented regarding the variation of Cs-137 and Cs-134 levels in sea water and sediment sampled on the 10 m and 20 m isobaths off-shore from the Danube mouths in 1986 - 1987. Sediment/water concentration factors for Cs-137 and activity ratios for Chernobyl derived radionuclides in sediment are also given.

Résumé

On présente des données sur la variation des concentrations en Cs-137 et Cs-134 dans l'eau et les sédiments marins prélevés en points situés sur les isobathes de 10 m et 20 m devant les embouchures de Danube au cours des années 1986-1987. Les facteurs de concentration sédiment/eau pour Cs-137 et les rapports des activités pour radionucléides en provenance de Tchernobyl, en sédiment, sont également exposés en ce travail.

In view of assessing the impact of the Tchernobyl accident on the Romanian coastal benthic region, in 1986 radioactivity measurements were initiated on marine water and sediment sampled at locations situated on the 10 metres (m) and 20 m constant depth lines. In 1987 measurements were repeated for the profiles defined by the mouths of the two southern branches of the Danube (points 1 - 4 in Fig. 1).

Evaporation residue resulted from unfiltered water sampled at 1 m above the sea floor, and sediment, dried to constant weight at 110°C, were analysed by gamma spectrometry using Ge(Li) detectors.

The variation of Cs-134 and Cs-137 concentrations in water and sediment off-shore from the Danube mouths in 1986-1987 is illustrated in Fig. 1. At lesser depths the two radioisotopes show an important depletion in 1987 as compared to 1986, in both water and sediment. At greater depths radiocaesium levels increase in sediment and decrease slightly in water.

Values of the sediment/water concentration factor (equal to the ratio between radionuclide concentrations in sediment and water) for Cs-137, presented also in Fig.1, vary in the accepted range [1,2], depending mainly on the dimension and composition of sediment particles [1,3].

Activity ratios for some fission and activation products in sediment sampled in September 1986 (extreme values are given in Table 1) compare well with those in Chernobyl derived atmospheric deposition. Values are presented in Table 1 for deposition collected at a station on land, located approximately 4 km northwest of sampling point 3 (see Fig. 1), between April 30 and May 12, 1986 [4], decay - corrected to sediment sampling time.

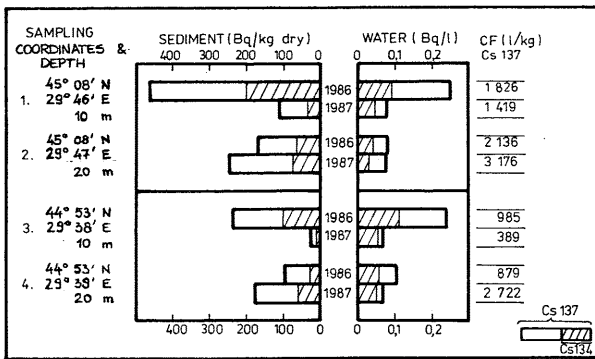


FIG. 1 Cs-137 and Cs-134 levels in sea water and sediment in 1986-1987. Sediment/water concentration factors (CF) for Cs-137. Concentration values are decay-corrected to sampling time : 1986.09.15, 1987.07.31.

TABLE 1

Sample	Activity ratio					
	Cs-137 Cs-134	Cs-137 Zr-95	Ru-106 Ru-103	Ru-106 Cs-137	Cs-137 Sb-125	Ce-144 Cs-137
Sediment	2.3-3.6	0.33-1.9	1.8-2.1	1.4-2.6	11-16	0.18-0.63
Deposition	2.5	0.36	1.7	2.2	14	0.18

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Natural and artificial gamma radioactivity off the Romanian Black Sea Coast during 1986-1987

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ABSTRACT

Concentrations of gamma emitting radionuclides in Black Sea sediment, water, macrophyta, mollusca and fish samples have been measured during 1986-1987.

RESUME

On a déterminé les concentrations des radionucléides gamma émetteurs dans échantillons de sédiment, d'eau de mer et de certaines macrophytes, mollusques et poissons de la mer Noire, pour les années 1986-1987

The survey and monitoring (IAEA,1965) of natural and artificial radioactivity in the marine environment along the Romanian Black Sea coast, initiated since 1980 (BOLOGA et al.,1985; DOVLETE and BOLOGA,1986), was continued in 1986-1987.

MATERIALS AND METHOD

Environmental and biota samples were collected nearshore between Mamaia (44°15' N) and Vama Veche (43°45' N). Sea water samples were also collected up to 30 nautical miles (water depth 50 m) offshore from the Danube Delta (Sulina, Mila 9 and Sf. Gheorghe) and on the east-Constantza transection. For comparative purposes fish samples from the east-central and south-eastern Atlantic Ocean have also been collected.

A total of 114 samples of sediment (dry), sea water (salt), macrophyta, mollusca (shell and soft part) and fish (ash) were analyzed gamma spectrometrically using a CANBERRA computer-based multichannel analysis system consisting of Ge(Li) detectors, associated modular electronics and 8100 MCA. Counting times ranged between 20,000 and 300,000 seconds/sample. Spectra were analyzed with a PDP-11/04 computer, using improved SPECTRAM III codes.

RESULTS AND CONCLUSIONS

Among natural radionuclides the most common is K-40, with concentrations up to 396 Bq/kg in sediment, 8 Bq/l in water, 159 Bq/kg fresh weight in macrophyta (*Cladophora sericea*), 107 Bq/kg f.w. mollusca (*Mya arenaria*, soft part) and 293 Bq/kg f.w. in fish (*Engraulis encrassicolus ponticus*). Ac-228 reached concentrations of 6.3 Bq/kg in sediment, 156 Bq/kg f.w. in *Bryopsis plumosa* and 3.3 Bq/kg f.w. in *Trachurus mediterraneus ponticus*, and Ra-226 of 59 Bq/kg in sediment and 381 Bq/kg f.w. in *Bryopsis plumosa*.

The previously notified marked trend towards lower fission product levels along the Romanian Black Sea coast between 1981 and 1985 was interrupted by the nuclear accident in Ukraine on April 26, 1986. Thus, during May 1986 Chernobyl-derived radionuclides (e.g. Izrael et al.,1987) were identified in the atmosphere, some of them, namely Mn-54, Co-60, Zr-95, Nb-95, Ru-103, Ru-106, Ag-110m, Sb-125, I-131, Cs-134, Cs-137, Ba-140, La-140, Ce-141, Ce-144, being also detected in marine

Table 1. Highest annual concentrations for some of the artificial gamma emitters identified in Black Sea sediment (Bq/kg), water (Bq/l) and biota (Bq/kg f.w.) samples.

SAMPLE	Co-60	Ru-106	Ag-110m	Cs-134	Cs-137	Ce-144
Sediment 1986	<NDA	22±15	<NDA	14±2	30±4	470±11
1987	<NDA	<NDA	<NDA	7±1	19±2	7± 4
Sea water 1986	<NDA	0.3±0.1	<NDA	0.23±0.02	0.9±0.4	0.4±0.3
1987	<NDA	<NDA	<NDA	0.07±0.02	0.13±0.01	<NDA
Macrophyta 1986	NO DATA	N.D.	N.D.	N.D.	N.D.	N.D.
1987	144±30	<NDA	<NDA	56±15	170±15	<NDA
Mollusca 1986	<NDA	22± 7	7± 3	2.3±0.4	4 ± 2	<NDA
1987	0.4±0.3	7± 2	2.2±0.4	2.2±1.0	3.3±0.7	<NDA
Fish 1986	22± 1	126± 7	<NDA	13± 1	29.6±0.7	226± 7
1987	3.7±0.7	<NDA	18.5±0.4	3.7±0.7	11± 1	<NDA

It follows that both the environmental radioactivity significantly decreased in all components in 1987 as compared to 1986, and the highest Cs-134 and Cs-137 concentrations are in all edible biota below 'action levels' for food (FAO, 1986).

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