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Radioactive Contamination of the Romanian Black Sea Coast during 1989

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Abstract

Samples of bottom sediments, mussels, the polychaete Melina palmata and macrophytes were sampled from north to south along the Black Sea Romanian coast during 1989. Gamma spectrometry with a Ge(Li) detector was used to investigate the fission product ^{137}Cs and the natural long-lived families of U-Ra and Th. The highest contamination was found at Portitza in front of the Lagoon Razelm, south of the Danube delta.

Introduction

The aim of this work is to investigate the presence of ^{137}Cs ($T_{\frac{1}{2}}$=30 y) and the long-lived nuclides of the natural U-Ra and Th families in bottom sediments, mussels and macrophytes of the Black Sea Romanian coast. It must be emphasized that the marine samples have been collected on approximately the same geographical coordinates in the aerobic-anaerobic zone of the Black Sea, for more than 20 years, when this marine environmental radioactive study began in the Polytechnical Institute of Bucharest. In this manner it is possible to obtain an overall insight about the changes in radioactivity in marine samples after the Chernobyl accident on 26 April 1986.

Materials and Methods

At the end of March 1989, the macrophytes Enteromorpha l. and Ceramium r. were collected on the sea-side at North Eforie and Mangalia. During June 1989, the bivalves Mytilus galloprovincialis and Mya arenaria were sampled together with the corresponding bottom sediments from north to south as follows: Sulina, Sf. Gheorghe, Portitza in front of Lagoon Razelm, and Constantza. Alga, sediment, mussels of about 5cm length after separation of soft tissues from the shell, as well as the polychaete Melina palmata (only at Portitza) were dried at 105°C, and ground to a fine powder. Radioanalysis was performed by gamma spectrometry using a Ge(Li) detector coupled to a multichannel analyzer and counting for 28 to 42 hours. At the Portitza sampling site, the following characteristics were: position 44°29'N, 29°20'E, offshore D=17.3 marine miles; water depth h=40 m; liquid discharge of Danube, Q=6830 m^3/s; on the bottom: water temperature = 6.5°C, salinity S=18.23‰, current velocity V=8 cm/s, current direction α=100°.

TABLE 1. Concentration of radionuclides in marine Black Sea Romanian coast samples during March-June 1989, in $Bq.Kg^{-1}$/dry.

Sample	^{134}Cs	^{137}Cs	^{238}U	^{232}Th	^{40}K
Sediment (Sulina)	1.9±0.5	33± 2	21± 2	22± 2	400± 25
Sediment (Sf.Gheorghe)	4.8±0.5	39± 2	14± 2	16± 2	312± 20
Sediment (Portitza)	0.8±0.5	119± 5	43± 3	58± 3	1100± 60
Sediment(Constantza)	5 ± 1	42± 2	18± 1	15± 2	310± 20
Soft tissue *Myt.g.* (Sulina)	9 ± 2	64± 5	22± 3	15± 5	285± 45
Soft tissue *Myt.g.* (Sf.Gheorghe)	6 ± 4	27± 5	< 30	< 40	250± 40
Soft tissue *Myt.g.*	6 ± 3	35± 5	< 2	< 46	745± 50
Soft tissue *Mya a.*	4.3 ±1.4	35± 3	8± 6	17± 3	275± 25
Melina palmata(Polychaete) (Portitza)	31 ± 2	247±12	40±14	50± 5	780± 50
Soft tissue *Myt.g.*	3 ±0.6	26± 2	< 6	6± 3	185± 25
Soft tissue *Mya a.* (Constantza)	< 4	23± 2	< 12	< 18	443± 44
South Eforie	15± 6	34±10	55±30	< 107	1044± 40
Enteromorpha l. Mangalia	2.7±0.6	19± 1	8.3±1.7	6.6±2.2	468± 25
South Eforie	< 14	61±15	38± 9	46±11	607± 35
Ceramium r. Mangalia	< 12	30± 7	< 45	< 24	530± 40

Results and Discussion

From the results shown in Table 1, the following conclusions can be drawn: (1) the higher concentration of ^{137}Cs at Portitza is explained by the presence of illite and kerogen in the fine silty clays which were confirmed by XR, EPR and IR studies (1,2); (2) the radioactivity due to ^{137}Cs, rapidly decreased in marine samples collected during 1989 on the Romanian Black Sea shore.

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Radioactive Contamination of the Turkish Eastern Black Sea Coast due to Chernobyl Accident

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The released massive quantities of radionuclides (Cs-134, Cs-137, Ce-141, Ce-144, Ru-103, Ru-106, No-95 etc.) to the lower atmosphere from the Chernobyl Nuclear Power Station on April 26, 1986, have environmental radioecological implications that extend to the future.

Some studies have been carried out to investigate radioactivity in sediment and some species of economic importance (Georgescu et al., 1988 a,b).

The behaviour of Chernobyl radionuclides in the Black Sea is given in Fig.1. As shown in Fig.1. some radionuclides detected in the surface waters were very rapidly removed to the sediment trap at 1071 meters within less than two months.

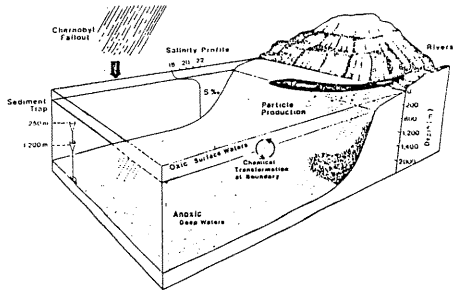

Fig.1. Behaviours of some Chernobyl radionuclides (Ken O. Buesseler, Woods Hole, USA)

Trachurus mediterraneus, Mugil saliens, Engraulis encrasicholus ponticus, Mytilus galloprovincialis, Enteromorpha linza and **Cystoceira barbata** were chosen to monitor Cs-134, Cs-137 in the Trabzon littoral region of Turkey. All samples were dried and powdered. Radioactivity counting was performed by gamma spectrometry (Tennelec) coupled to a Germanium detector.

According to the data presented in Table 1, radioactivity levels varied with species, location and trophic level. For example, Cs-134 and Cs-137 ranged between 3-20 and 5-130 Bq/kg dry weight, respectively.

TABLE 1. Concentrations of radionuclides in selected samples from the Trabzon littoral region. (Bq/kg in dried material)

Samples	Cs-134	Cs-137
M. saliens	20	107
T. mediterraneus	9	47
E.e. ponticus	3	5
M. galloprovincialis	12	130
E. linza	9	35
C. barbata	4	27

Mussels have a high capacity to accumulate heavy metals and radionuclides from ambient waters (Tunçer and Yaramaz, 1986) and gray mullets are omnivores. Both species tend to accumulate excessive amounts of radionuclides; thus, the highest levels of Cs-137 were found in **M.** saliens and **M.** galloprovincialis and the lowest activity was detected in **E.e.** ponticus.

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