NATURAL RADIOACTIVITY AND ^{137}CS IN SURFACE SEDIMENTS OF THE BAY OF ALGIERS, ALGERIA.

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Abstract

Samples of surface (0-15cm) marine sediments of different nature, namely sand, muddy sand and fine sand were collected in the Bay of Algiers during August 1993 using a Van Veen type grab. They were analysed directly by gamma spectrometry for uranium and thorium series radionuclides and ^{137}Cs. Samples analysed contained relatively high activities of natural radionuclides, 8-66, 7-41, and 127-447 Bqkg $^{-1}$ for uranium and thorium series and ^{40}K, respectively, and ^{137}Cs concentrations ranged from 0.5-6.9 Bq kg^{-1} dry weight. The concentrations of natural and artificial radionuclides in sediments appear to depend on the grain size composition of sediment samples.

Keys-words: radioactivity, sediments, Algerian Basin

Introduction

Different radioactive sources may contribute to the introduction of radioactivity into the marine environment. In addition to the artificial radioactivity, natural radionuclides can occur, by weathering and recycling of terrestrial minerals and rocks, in the sea floor (anthigenic rocks) and in sea water to give rise to ^{40}K, ^{87}Rb, uranium and thorium series [1]. Therefore within the framework of the radiological monitoring programme for the Algerian littoral, surface sediment samples were collected from the Bay of Algiers, located in the central part of the Algerian coast, and analysed to measure activity in Bq kg^{-1} dry weight of ^{137}Cs, ^{40}K, ^{238}U and ^{232}Th daughters.

Experimental

The semi-circular Bay of Algiers is delimited in the east by the "Cap Matifou" and in the west by the "Pointe Pescade" as shown in Figure 1 [2]. Surface sediment samples of about 2 kg were collected with a Van Veen type grab in 14 nearshore stations during August 1993 (see Fig. 1) at depths ranging from 10 m to 60 m. The samples were stored in plastic bottles, labelled, and brought to the laboratory to be oven dried at 100°C, crushed and homogenised for direct counting by gamma spectrometry. Radionuclide measurements were made on a GeLi detector of 20% relative efficiency and (FWHM) resolution of 1.8 keV at 1332 keV gamma-energy of ^{60}Co. The detection efficiency of GeLi was determined using an IAEA 500 cm^3 sealed Marinelli beaker filled with a solid material of density 1, and contaminated with a radioactive source of ^{152}Eu of 11655 Bq on 01/03/91. The concentrations of ^{40}K, ^{238}U and ^{232}Th daughters were measured using the gamma-ray of highest emission probability for each radionuclide. The beakers were put in contact with the top of the detector and counted for 57600 s, which is statistically enough to give reliable results. To enhance the credibility of our results, our laboratory took part in several intercomparison exercises organised by the IAEA laboratories (Monaco and Seibersdorf), the main samples analysed were IAEA-134/135/300/315/326/327. Our results were in agreement with those reported by the IAEA, particularly in the range (300-1700) keV, however, between (0-300) keV, corrections should be brought to improve the results.

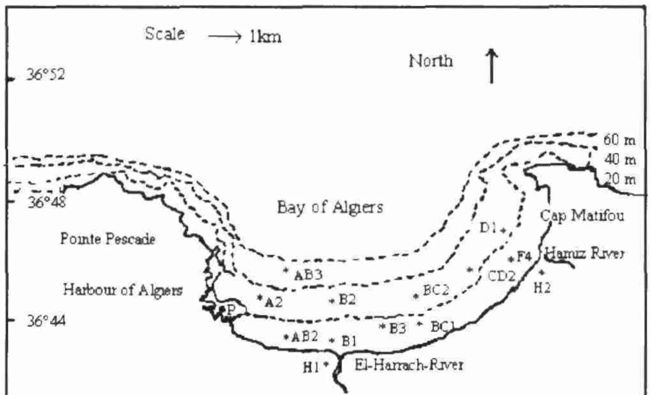

Figure 1. Sampling locations in the Bay of Algiers.

Results and discussion

Radionuclide concentrations in Bq kg^{-1} dry weight are given in Table 1. The description of sediment samples according to grain-size composition is given in Table 2. The sampling points H_1 and H_2 were located at the mouth of rivers and the others inside the Bay. The radioactivity at the sampling points H_1 and H_2, outside the Bay, is much lower than that inside the Bay. This is due to the grain size composition of sediments further offshore which is coarse sand at these stations. The range of concentrations of the main natural radionuclides recorded in the whole samples, ^{226}Ra and ^{40}K are 25 ± 3.4 - 66.5 ± 7.5 and 127 ±24.0-447± 49.0, Bq kg^{-1} dry weight, respectively. However, for artificial radioactivity, ^{137}Cs concentrations measured in the sediments depend on the grain size of the sample and ranged from the minimum detectable activity, 0.5 ± 0.2, Bq kg^{-1} dry weight, to 6.9 ± 0.9, Bq kg^{-1} dry weight. Activities of ^{137}Cs in Bq kg^{-1} dry weight recorded in this Bay are of the same order than those measured in the Bay of Ghazaouet [3], which range from 0.7 ±0.1 - 8.5 ± 1.9 but are much higher compared with those obtained for the Bay of Zemmouri 0.5 ± 0.1 - 1.5 ±0.2 Bq kg^{-1} dry weight [4]. The concentrations of natural and artificial radionuclides reported in this work were also compared with published values and found to be in the same order as those reported in the literature [5-7]. The origin of ^{137}Cs, appears to be most likely from nuclear weapons tests and the Chernobyl accident. This study enabled us to monitor the site, to determine the uptake of radio-

Table 1. Concentrations in Bq kg^{-1} dry weight of ^{137}Cs, ^{40}K, and ^{238}U and ^{232}Th daughters in surface sediments of the Bay of Algiers.

	Activity in Bq kg^{-1} dry weight						
Samp. point	^{226}Ra	^{214}Pb	^{214}Bi	^{228}Ac	^{212}Pb	^{40}K	^{137}Cs
A_2	40 ± 5	13 ± 1	14 ± 2	19 ± 2	32 ± 3	331 ± 37	7.0 ± 1
P	66 ± 8	20 ± 2	18 ± 2	29 ± 3	41 ± 4	447 ± 49	6.2 ± 0.7
AB_2	44 ± 5	18 ± 2	16 ± 2	25 ± 2	36 ± 4	388 ± 42	2.0 ± 0.3
AB_3	30 ± 4	15 ± 2	14 ± 2	21 ± 3	33 ± 3	353 ± 40	0.7 ± 0.3
B_1	46 ± 5	17 ± 2	16 ± 2	22 ± 3	35 ± 3	334 ± 37	1.5 ± 0.2
B_2	32 ± 4	14 ± 2	14 ± 2	18 ± 3	30 ± 3	302 ± 34	1.3 ± 0.4
B_3	53 ± 6	19 ± 2	17 ± 2	23 ± 3	34 ± 3	298 ± 34	1.4 ± 0.2
BC_1	43 ± 5	16 ± 2	15 ± 2	20 ± 3	33 ± 3	318 ± 36	1.1 ± 0.2
BC_2	49 ± 6	17 ± 2	16 ± 2	23 ± 3	37 ± 4	356 ± 39	1.1 ± 0.3
CD_2	33 ± 4	14 ± 2	16 ± 2	20 ± 3	34 ± 3	291 ± 34	1.1 ± 0.2
D_1	29 ± 4	9 ± 1	8 ± 1	7 ± 1	15 ± 2	191 ± 24	1.4 ± 0.2
F_4	47 ± 5	18 ± 2	17 ± 2	25 ± 3	37 ± 4	342 ± 38	0.6 ± 0.3
H_1	25 ± 3	11 ± 1	12 ± 2	14 ± 2	25 ± 2	285 ± 35	1.1 ± 0.2
H_2	25 ± 3	11 ± 1	11 ± 1	10 ± 2	21 ± 2	127 ± 24	< LD