

CONCENTRATIONS OF NATURAL AND ARTIFICIAL RADIONUCLIDES IN MARINE SAMPLES FROM SELECTED AREAS AROUND THE GREEK PENINSULA

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Abstract Concentration of natural radionuclides of the ^{238}U and ^{232}Th series, ^7Be , ^{40}K as well as ^{137}Cs have been determined in sea plants, algae, fish and sediment samples collected from coastal marine areas around the Southeastern Greek Peninsula, including representative reference stations and potential sites for nuclear power plant installations.

Résumé Les concentrations de radioisotopes des séries des ^{238}U et ^{232}Th , de ^7Be et ^{40}K ainsi que le radioisotope artificiel ^{137}Cs ont été déterminés dans les échantillons d'algues, de phanérogames marines et de sédiments récoltés dans les régions côtières du Sud-Est de la péninsule Grecque, qui comportent les sites de référence et les sites probables pour l'installation de centrales nucléaires.

Introduction A project entitled "Behaviour of long lived radionuclides in coastal marine ecosystems" has been carried out since September 1983 as a part of the scientific program of the Nuclear Technology Dept. of NRC "Demokritos", with additional support from the European Communities under Contract BIO.F.557.83(GR) and in collaboration with the Greek Institute of Oceanographic and Fisheries Research. A sampling network has been established around the Greek peninsula which includes representative reference stations as well as five potential sites for nuclear power plant installations.

Methods and Materials Sea water, sediments, sea plants, algae and fish were collected from each sampling area twice a year during the cold and the warm periods. Various methods were applied for the determination of the concentrations of natural and artificial radionuclides.

The samples were treated by a dry ashing procedure at approximately 400°C , homogenized mechanically and measured by a HpGe gamma spectrometry system. All spectra were analyzed by a specialized computer program.

The present work includes the results from the first three sampling sites in the Southeastern Aegian region.

Results Results of the radionuclide measurements are given in Table 1. The concentrations of ^{234}Th in fish flesh were on the order of or lower than 0.5 pCi/g ash, while concentrations up to two orders of magnitude higher were found in sea plants and algae (150) pCi/g ash in Posidonia oceanica, 100 pCi/g ash in Corallina sp.). In this case the activity was due to ^{234}Th which decays with $t(1/2)$ of 24d.

The concentrations of radon decays products in fish and algae did not exceed 0.5 pCi/g ash, while the concentrations of ^{208}Tl in algae were typically several times higher, probably due to accumulation of ^{228}Th .

TABLE 1
CONCENTRATIONS OF NATURAL RADIONUCLIDES AND ^{137}Cs IN MARINE SAMPLES FROM THE EASTERN PART OF THE GREEK PENINSULA DETERMINED BY GAMMA SPECTROMETRY

	SPECIES	$^{234}\text{Th}^+$	^{214}Bi	^{228}Ac	^{208}Tl	^7Be	^{40}K	^{137}Cs
ALGAE	<u>Cystoseira sp.</u>	23-48	0.12-0.20	ND-0.5	0.12-0.5	ND-3.8	44-97	ND
	<u>Corallina sp.</u>	56-99	0.1-0.3	ND	0.5-0.8	1.4-3.6	3-27	ND-0.03
	<u>Padina pavonica</u>	14-20	0.1-0.4	ND	0.2-0.7	0.7-1.4	11-28	0.05-0.09
	<u>Stypocaulon scoparium</u>	52	0.45	0.7	0.8	20	31	0.1
S. PLANTS	<u>Posidonia oceanica</u>	150	0.13	0.6	0.4	ND	19	0.08
FISH	<u>Trachurus trachurus</u>	ND	ND	ND	0.14	ND	41	0.14
	<u>Maena sp.</u>	0.5-1.1	0.14-0.43	ND	ND	ND	32-42	0.08-0.16
	SEDIMENT	0.4-1.2	0.15-0.86	0.12-1.1	0.07-1.4	ND-0.25	1.2-5.5	0.01-0.05
DETECTION LEVELS	Ash	0.5	0.1	0.13	0.09	0.23	0.7	0.03
	Sediment	0.2	0.03	0.04	0.03	0.07	0.23	0.01

ND : Not detected or value below the detection level for 95% confidence limit.

+ ; The activity in algae and sea plants is due to ^{234}Th which decays with half life time of 24.1 days.

The concentrations of ^{228}Ac varied between less than 0.1 for fish and most of the algae and 0.7 pCi/g ash for the sea plant Posidonia oceanica and the alga Stypocaulon scoparium. This finding indicates significant differences in the accumulation of radium (here ^{228}Ra).

Concentrations of ^7Be up to 20 pCi/g ash were found in algae samples collected after a prolonged period of rainfall. ^{40}K concentrations varied from 3.0 to 97.0 pCi/g ash in algae and from 32.0 to 42.0 pCi/g ash in fish.

The concentrations of ^{137}Cs in sediment were between 10.0 and 50.0 fCi/g, whereas in fish they varied from 80.0-160.0 fCi/g ash. The latter values are slightly lower than those we determined in fish during the period 1981-1982 in samples collected from some other locations in Greece.

^{137}Cs concentrations in algae varied from 10.0 to 100.0 fCi/g ash.

- References
1. Methodology for assessing impacts of radioactivity on aquatic ecosystems. TRS N° 190 IAEA Vienna, 1979
 2. S. Danali-Cotsaki and H. Florou, "A Study on the concentrations of MFP and of ^{137}Cs in the Greek marine environment". Rapp. Comm. Int. Expl. Scient. Mer Médit. (in press).

Discussion

I. GEORGESCU: What is the ratio of the dry weight to ash weight of the alga Cystoseira?

H. FLOROU: The wet weight/dry weight ratio is about 10% (mean value). The biological materials lose water continuously after sampling, thus experimentally the ratio varies between 7-14%, depending on the time between sampling and ashing. We believe that it is more reliable to express the results on a dry weight basis.

J.-C. GUARY: Do you think that the dry ashing procedure at 400°C is valid for measuring ^{137}Cs ? Is there no risk of losing the radionuclide at this temperature?

H. FLOROU: The range of temperatures from 450-550°C is considered to be an upper limit for Cs as well as for other radionuclides in environmental samples (TRS No. 118, pp. 88-89). We did not test the dry ashing procedure for losses of ^{137}Cs . We believe that a period of 4 hours at 400°C minimizes the losses of this radioisotope.

