Radioactivity of some plankton and sea water samples collected in the Taranto Gulf (Ionian Sea)

by

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Introduction

During the past years a lot of measurements were carried out, by the CISE Radiochemistry Service in connection with the Parma Zoology Institute, to determine the radioactive components present in different marine samples. Results and comments concerning such samples (plankton, sediment water, alghae molluska, ecc.) collected around the Italian coasts on the Ligurian-Tyrrhenian and Adriatic Seas during the 1960 ÷ 1968 period, have been fully reported in pertinent publications.

To determine important fission products (Sr^{90}, Cs^{137}, Ce^{144}, Pm^{147}, Eu^{155}, Zr^{95}), activation products (Co^{60}, Fe^{59}, Mn^{54}, Sb^{125}), and some natural radionuclides (K^{40}, Ra^{226}, Th^{232}, Th^{230}, U^{238} and U^{234}) contained always at low levels in such samples, appropriate radiochemical methods of analyses were set up and are described in technical reports.

Recently, continuing such monitoring of the marine environment, our attention was directed to consider some samples coming from the Taranto Gulf. In the framework of the radioecological research performed by the Institute of Zoology of Parma University [1], the opportunity was given of analysing the radioactive contamination of some plankton and sea water samples collected in this zone.

Aim of this work is to determine the main radioactive components of such samples. Therefore, employing specific methods already used [2,3], and sligtly modifying them, determinations of the Sr^{90}, Ra^{226}, Cs^{137}, Ce^{144}, Pm^{147}, Eu^{155}, Zr^{95}, Mn^{54}, Sb^{125} contents in such samples were carried out.

Experimental

In Table 1 peculiar data of the considered samples are presented. Collections were performed 1 mile offshore the coast in front of the Sinni river mouth (long 16° 42' 20'', lat 40° 08' 00''). The amount of ash weight on dry plankton is 43.15 p. 100 and 60.25 p. 100 for the T.P1 and T.P2 samples, respectively.

Other information on salinity, conditions of sample collection and preliminary treatment is presented in the main radioecological paper [1].

Separation methods (diagrams of which are outlined in slides 1 and 2 respectively) used to analyse plankton and sea water samples were checked and performed on sample aliquots in a suitable laboratory (at μCi level) by using radioactive tracers; radiochemical analyses of such samples were carried out in low level (at pCi) laboratory to avoid any possible contamination.

Measurements of the final sources were made by gamma spectrometry (3″ × 3″ NaI connected with a 400-channel analyser) and by low background beta device using, where necessary, the beta absorption technique; Ra^{226} determinations were obtained by ionization chamber. Separation yields for each considered radionuclide were determined by traced trials, and values are presented in Table 2; yield values for Sr^{90} and for radioactive rare earths were confirmed by determining the initial and the final contents of strontium and of rare earth elements : range data reported are in brackets in Table 2.

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Results

Data obtained concerning the radioactivity content of plankton and sea water samples, are presented in Table 3; results are reported as pCi/g ash and pCi/m^3 referred to the collection date. Owing to the very low radioactivity level for some sources it was not possible to determine the radioactivity amount present in them; therefore, some values reported in Table 3 (such as Zr^{95}, Sb^{125}, Mn^{54}) were calculated for both plankton and sea water samples on the basis of the gamma detection threshold for each source and taking into account the separation yields, the analysed sample amounts, and the corresponding decays from collection to measurement date. Moreover, for other radionuclides (Eu^{155} and Cs^{137}) some radioactivity data resulted to be lower than the beta detection threshold and are reported only as « indicative values ». For this reason, some determinations (quoted as " not res " in table) were not performed.

To complete the 1969 monitoring of the Taranto Gulf — which was the aim of our researches — some sediment samples collected at different depths in front of the Sinni river mouth are also under examination.

As for the plankton and sea water samples, a comparison among the radioactivity data available at present and concerning also other seas is reported in Table 4. In particular, observing the Sr^{90} and Cs^{137} data contained in marine water, it appears that the Adriatic-Ionian samples are slightly more contaminated that the ones collected in the Ligurian-Tyrrhenian Seas. Besides, Ionian sea water samples do not present any reduction of radioactivity, in the period from 1968 to 1969, as in the case of samples from the other seas.

Finally, it is remarkable that the 1968-1969 radioactivity levels (on average) markedly decrease everywhere for all considered radionuclides : 5 ÷ 6 times for sea water and 30 ÷ 40 times for plankton samples, compared with those collected during the 1963-1964 period [4].

TABLE 1

	Plankton samples (ashes)		*Sea water samples*	
Denomination	P.T1 (1)	P.T2 (2)	A.T1	A.T2
Considered quantities	5.37 g	24.55 g	100 l	200 l
Collection date	10.VII.68	10.XI.69	10.VII.68	10.XI.69
	(mg/g)		(mg/l)	
K concentration	11.30	14.72	439	489
Ca »	17.05	20.35	521	471
Sr »	6.33	2.53	7.9	8.4

(1) High content of zooplankton
(2) High content of fitoplankton

TABLE 2

	Plankton yields %	Sea water yields %
Strontium	74 (70÷80)	64 (58÷70)
Rare Earths (Ce, Pm, Eu)	89 (85÷95)	78 (80÷90)
Caesium	93	98
Zirconium	97	—
Manganese	93	—
Antimony	88	86
Radium (barium)	92	85

TABLE 3

Radioisotopes considered	*Plankton samples (pCi/g ash)*		*Sea water samples (pCi/m³)*	
	P.T1	P.T2	A.T1	A.T2
Sr^{90}	0.40	0.16	284	289
Cs^{137}	$\sim$ 0.15 (*)	not res	not res	302
Ce^{144}	not res	26.5	not res	241
Pm^{147}	not res	4.2	not res	48
Eu^{155}	not res	$\sim$ 0.27 (*)	not res	< 40
Zr^{95}	< 3.7	< 8.5	not res	not res
Mn^{54}	not res	< 0.5	not res	< 75
Sb^{125}	not res	< 2.2	< 390	< 270
Ra^{226}	0.03	0.66	18.4	22.3

(*) Indicative value, not confirmed by beta absorption measurements owing to the very low activity of the source.

TABLE 4

			Sr^{90}	Cs^{137}	Ce^{144}	Pm^{147}	Eu^{155}	Ra^{226}
SEA WATER pCi/m³	Ligurian Sea	1967	39.5	—	29.2	62.6	18.7	27.6
		1968	144.3, 229*	382*	53.1	64.2	< 25	66.3
		1969	127*, 187*	206*, 223*	—	—	—	—
	Tyrrhenian Sea	1968	151*	327*	—	—	—	—
		1969	110*	235	—		—	—
	Adriatic Sea	1968	438*	395*	—	—	—	—
		1969	211*	353*	—	—	—	—
	Ionian Sea	1968	284, 278*	324*	—	—	—	18.4
		1969	313*, 289	520*, 302	241	48	< 40	22.3
PLANKTON (pCi/g)ash	Ligurian Sea	1967-1968	0.31	—	4.08	5.31	< 0.2	1.83
	Ionian Sea	1968	0.40	$\sim$ 0.15	—	—	—	0.03
		1969	0.16	—	26.5	4.2	$\sim$ 0.27	0.66

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