

ACTIVITIES OF URBINO UNIVERSITY FOR MARINE RADIOACTIVITY RESEARCH IN THE MEDITERRANEAN SEA

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Over the last ten years the General Chemistry Institute of the Urbino University (Italy) has been involved in the determination of artificial radionuclides (Plutonium and Sr-90) (TESTA *et al.*, 1990) and cosmogenic P-32 in environmental samples collected in the Mediterranean Sea area. These studies have been mainly carried out in collaboration with ENEL-CRTN (Milano), ENEA-CRAM (La Spezia) and Parma University.

The first research subject was the determination of Pu-239+240, Pu-238 and Sr-90 in sea sediment cores, surface sediments, algae and mussels. Extraction chromatography with tri-n-octylphosphine oxide (TOPO) and with di(2 ethyl hexyl)phosphoric acid (HDEHP) supported on microporous polyethylene powder (Microthene) was used for plutonium and Sr-90 (Y-90) separation, respectively (TESTA *et al.*, 1993). The determination of plutonium isotopes was obtained by alpha spectrometry after electroplating; Sr-90 was measured by counting a Y-90 oxalate source with a low background beta detector and following the Y-90 decay. The addition of Pu-242 ($E_n \alpha = 4.9$ MeV) as the yield tracer and the analysis of the relevant alpha spectrum facilitated obtaining a precise figure for the recovery of any measure. Similarly the Y-90 chemical yield was obtained by a complexometric titration of the recovered yttrium. The accuracy and reproducibility of the method were checked by multiple analyses of IAEA and NBS certified samples.

Over the period 1985-1991 six sediments cores were collected at three different sites: Gaeta Gulf (Naples), Taranto Gulf (Ionian Sea) and Western Mediterranean Sea (Algeria). The relevant results are summarized in Table I.

Table I : Plutonium and Sr-90 in some sediment cores from the Mediterranean Sea.

Site (year)	Depth m	Core length cm	Maximum concentration (h,cm)		(Bq/kg)
			Pu-239+240	Pu-238	
Gaeta Gulf A (1985)	50	10	2.2 (4-8)	0.06 (4-8)	27.4 (4-6)
Gaeta Gulf B (1985)	50	10	1.9 (6-8)	0.06 (6-8)	12.1 (0-2)
Gaeta Gulf (1989)	50	20	3.2 (12-16)	0.11 (12-16)	8.0 (8-12)
Taranto Gulf A (1989)	1500	15	1.0 (0-7)	0.03 (0-7)	-
Taranto Gulf B (1989)	2000	20	0.9 (7-11)	0.06 (7-11)	-
Algeria (1991)	2800	20	0.2 (0-2)	N-D	-

h = core horizontal section depth

Plutonium and Sr-90 were also measured in some Northern Adriatic Sea samples (algae, mussels and surface sediments). The results were as follows :

1) Algae: plutonium concentration ranged from $<3.5 \cdot 10^{-3}$ to $2.4 \cdot 10^{-2}$ Bq/kg; Sr-90 concentrations varied between 0.5 and 1.7 Bq/kg.

2) Mussels: the mean plutonium concentration was $5.4 \cdot 10^{-2}$ Bq/kg; Sr-90 concentrations were below the detection limit (0.9 Bq/kg).

3) Surface sediments: Pu-239+240 and Pu-238 concentrations (Bq/kg) ranged from $6.0 \cdot 10^{-2}$ to 1.47 and from $<1.3 \cdot 10^{-2}$ to $3.3 \cdot 10^{-2}$, respectively. The Sr-90 concentration varied between <2.4 and 6.5 Bq/kg. The ratio Pu-238/Pu-239+240 and Sr-90/Pu-239+240 were 0.039 (8 samples) and 14.5 (10 samples), respectively.

The second research subject was the establishment of chemical and radioanalytical procedures for the determination of cosmogenic P-32 with the aim to evaluate the phosphorus cycle in the marine ecosystem (LAL *et al.*, 1988). For this purpose P-32, as phosphate ion, was measured in sea water, phytoplankton and zooplankton. Because of the low P-32 concentration, large water volumes had to be analyzed by retaining the phosphate ion on XAD-7 resin supporting $Fe(OH)_3$. After elution with 6 M HCl and Fe^{3+} elimination with methyl isobutyl ketone (MIBK), phosphorus was purified by two selective precipitations as ammonium phosphomolybdate (AMP) and as $MgNH_4PO_4$. This salt was counted by a low background beta detector following the P-32 decay ($T_{1/2} = 14.3$ days). Some preliminary tests were carried out in the La Spezia Gulf (Northern Tyrrhenian Sea) where a small pilot plant with suitable filters and XAD- $Fe(OH)_3$ cartridges was checked. On the basis of the results shown in Table II, the following conclusions can be drawn. The total phosphorus concentration (3.07 mg/m^3) is in good accordance with the values reported in the literature for the Mediterranean Sea ($\sim 3 \text{ mg/m}^3$). The P-32 specific activity (302 dpm/g P) is higher than that reported by LAL *et al.* (1988) for the open ocean (100-250 dpm/g P), but this difference may be due to a river contribution in the La Spezia Gulf. The specific activity in phytoplankton+zooplankton is higher than in the dissolved inorganic phosphorus (DIP), due probably to the nonhomogeneity of the sampling site.

Table II : P-32 determination in La Spezia Gulf

Sample	Water volume (m ³)	P conc. (mg/m ³)	P-32 conc. (dpm/m ³)	Specific activity (dpm P-32/gP)
Phytoplankton + Zooplankton	100	0.09	0.03	369
Sea Water (DIP)	10	2.98	0.90	302
Total	-	3.07	0.93	-

REFERENCES

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