CS-137 DISTRIBUTION IN LAGOON ENVIRONMENT OF NORTHERN ADRIATIC AFTER CHERNOBYL ACCIDENT

C. GIOVANI, R. PADOVANI[1],
G. MATTASSI[2], A. ZANELLO[2], C. ZANATA[2], L. ZANATA[2]
[1] Servizio di Fisica Sanitaria, USL 7, Udine, Italy
[2] Servizio di Igiene ambientale, USL 8, Palmanova, Italy

In 1991 the authors undertook a long-term program for monitoring environmental radioactivity in the Northern Adriatic, in order to evaluate the post-Chernobyl diffusion of artificial radionuclides in areas close to coasts and lagoons between Grado and Punta Tagliamento. This program involves periodic sampling of surface sediments and algae taken during different seasons. The main aims of this study were: 1) measurement of the post-Chernobyl radiocaesium distribution in the lagoon and coastal environment of the region Friuli-Venezia Giulia; 2) evaluation of the grain-size distribution effect on radiocaesium absorption in sediments; 3) the correlation of radiocaesium distribution between sediments and algae.

The first results of this work, which derive from the analysis of the Cs-137 concentration in sediment samples collected in 1991 (GIOVANI *et al.*, 1992; GIOVANI *et al.*, 1994a), allowed us to discern four different areas in the selected environment: 1) river mouth with the highest detected values; 2) lagoons; 3) marine area close to lagoon inlets with the lowest concentrations; 4) external marine area also with high values.

Figure 1 shows the distribution of Cs-137 concentrations in surface sediments in 1992. In this case it is also possible to delineate the same areas that have been previously identified. Samples collected along the Cormor river and in front of one portion of Marano lagoon during 1992 give further information about the radiocaesium distribution in this type of environment. The river samples are the most contaminated of all, while those samples collected far from the coast show low Cs-137 activities.

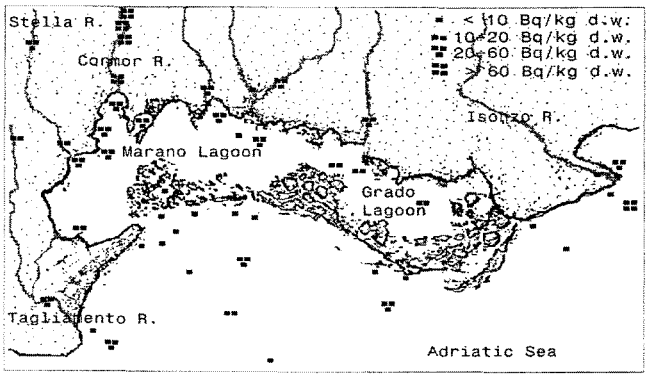

Figure 1. Cs-137 distribution in sediments (Bq/kg d.w.) in November 1992.

Cs-137 concentrations in surface sediments collected in 1991, 1992 and 1993 versus the silt-clay fraction percentage (diameter > 63 µm) are shown in Fig.2. It is noted that where the silt-clay fraction percentage is high, the concentration is also high. In order to investigate the correlation between algae and the sediment Cs-137 content, the genus *Ulva* was chosen because of its abundance in the sampling area. Cs-137 concentration in *Ulva* samples and Cs-137 in sediments in 1991 showed a significantly positive correlation (r = 0.880; p < 0.1 %) (GIOVANI *et al.*, 1994b).

The significance of the correlation between Cs-137 content in algae and in sediments confirms the role of this kind of organism as a biological indicator of radiocontamination as well as for conventional pollutants.

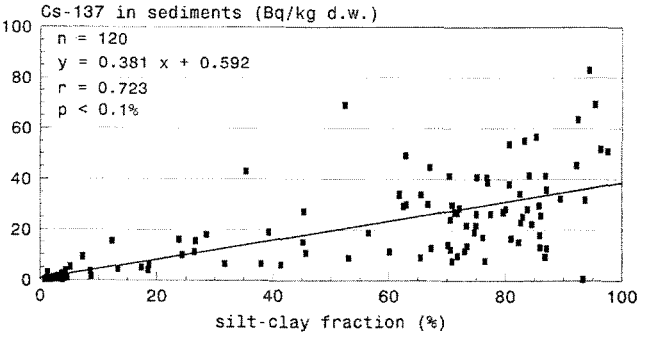

Figure 2. Cs-137 concentration vs grain-size in sediments of 1991, 1992 and 1993 samplings. (% of the fraction > 63 µm).

REFERENCES

GIOVANI C., DARIS F., MATTASSI G., PADOVANI R., ZANELLO A., 1992. Cs-137 and I-131 Distribution in Lagoonal and Coastal Environment in Northern Adriatic - Rapp.Comm.Int Mer Medit, 33:337

GIOVANI C., GODEASSI M., MATTASSI G., PADOVANI R., ZANELLO A., 1994a. Cs-137 Distribution in Sediments of Grado and Marano Lagoons (Northern Adriatic) - paper presented at the Seminar on The Radiological Exposure of the Population of the European Community from Radioactivity in the Mediterranean Sea, Rome, 17-19 May, in press

GIOVANI C., MATTASSI G., PADOVANI R., ZANELLO A., ZANINI S., 1994b. Distribution of Artificial Radiocontamination in Lagoon Environment of Northern Adriatic - paper presented at the International Seminar on Freshwater and Estuarine Radioecology, Lisbon, 21-25 March 1994, in press.

ENVIRONMENTAL LEVELS OF AMERICIUM-241 IN TWO MEDITERRANEAN SEASTARS

Jean-Claude GUARY[1], Scott W. FOWLER[2] and Thomas M. BEASLEY[3]
[1] Institut Nal des Sciences et Techniques de la Mer, B.P. 324, Cherbourg, France
[2]IAEA Marine Environment Laboratory, P.O. Box 800, MC-98012, Monaco
[3] Dept of Energy, Environ. Measurements Lab., 376 Hudson Str., NewYork 10014-3621, USA

Previous works (GUARY, 1980) have clearly shown that the tissue distribution of ^{241}Am in seastars is strongly dependent on the uptake pathway. As was the case for plutonium (GUARY *et al.*, 1982), it is of interest to examine the distribution of fallout ^{241}Am in Mediterranean seastars in order to define the accumulation pathway of this radionuclide in natural environments, taking into account that these organisms, with few exceptions, have been found to contain the highest concentrations of transuranium elements among all marine invertebrates examined to date. Two asteroids collected off Monaco, *Coscinasterias tenuispina* and *Marthasterias glacialis*, were dissected and analysed for ^{241}Am by standard chemical extraction techniques and alpha-spectrometry (BALLESTRA, 1980). *C.tenuispina* (n >100, 15 g average wet weight) was immature (gonad index = 1.3) and sexes were not visually identifiable. *M. glacialis* (n = 25, 50 g average wet weight) was mature and gonad index averaged 12 for males and 21 for females.

The results reported in Table 1 show the following :

i) the highest concentrations of ^{241}Am (C.F. = $3x10^4$) are found in the body wall which contains 84-94% of the total body burden of ^{241}Am in the two seastars.

ii) the internal organs (pyloric caeca, gut and gonads) are able to concentrate ^{241}Am to high levels ($4x10^3$ - $2.9x10^4$) although these tissues account for no more than a few per cent of the total americium body burden except gonads during the reproductive period, and particularly male gonads of *M. glacialis*. In the latter case, the fraction of total ^{241}Am fixed in gonads increases to 12% (C.F. = $2.6x10^4$).

These results confirm the very high americium concentrating ability of these marine invertebrates. If we compare these data with our previous results on plutonium accumulation in seastars (GUARY *et al.*, 1982), it appears that ^{241}Am is concentrated to a greater extent (10 times) than $^{239+240}$Pu in the tissues of these asteroids. The greater bioavailability of Am could be due to a higher percentage of particulate ^{241}Am compared to plutonium in northwestern Mediterranean waters (HOLM *et al.*, 1980).

Our experimental radiotracer studies (not shown) have demonstrated that assimilation and input through the food chain can be substantial (GUARY, 1980); however, repetitive ingestion of this radionuclide results in increased ^{241}Am excretion rates which tend to limit the buildup of this radionuclide in seastar tissues. Furthermore, our radiotracer experiments have demonstrated that when asteroids are exposed to ^{241}Am in sea water, the resultant tissue distribution of ^{241}Am closely approximates that found in seastars contaminated in the natural environment (GUARY, 1980).

Thus, we conclude from these studies that in a natural environment, seastars mostly accumulate their americium body burden directly from water.

Table 1. Concentration and distribution of 241Am in two Mediterranean seastars collected in Jan-Feb. 1978.1s errors are based on propagated counting errors.

Tissue	Wet/dry weight ratio	^{241}Am (mBq kg wet^{-1})	Total body burden ^{241}Am (%)	C.F. *
Coscinasterias tenuispina				
Body wall	3.8	63.6 ± 7.0	94.2	30 000
Pyloric caeca	4.1	27.4 ± 3.0	3.7	13 000
Gut	4.3	61.8 ± 11.8	1.9	29 000
Gonad	3.8	8.5 ± 3.7	0.2	4 000
Whole animal	-	59.9 ± 14.4	100	28 000
Marthasterias glacialis				
Body wall	3.3	62.9 ± 5.6	83.8 (♂) - 88.7 (♀)	30 000
Pyloric caeca	4.6	12.2 ± 1.5	3.4 (♂) - 4.1 (♀)	5 800
Gut	5.0	37.0 ± 3.7	0.7 (♂) - 0.8 (♀)	17 500
Male gonad	5.8	54.8 ± 2.6	12.1	26 000
Female gonad	5.2	13.7 ± 1.5	6.4	6 500
Whole animal **	-	55.5 (♂) - 44.4 (♀)	100	26 000 (♂) - 21 000 (♀)

* Concentration factors (C.F.) were calculated using reported ^{241}Am concentrations in Mediterranean coastal sea water (2.1 µBq l-1) where the seastars were collected (FUKAI *et al.*, 1976).
** Values for reconstituted animal are approximate because separate analyses for males (♂) and females (♀) were not performed for all organs.

ACKNOWLEDGEMENTS.

The IAEA Marine Environment Laboratory operates under an agreement between the International Atomic Energy Agency and the Government of the Principality of Monaco.

REFERENCES

BALLESTRA, S., 1980. Radioactivité artificielle et environnement marin. Etude relative aux transuraniens ^{238}Pu, $^{239+240}$Pu, ^{241}Pu et ^{241}Am en Méditerranée. Thèse Doct. Etat-Sciences, Univ. de Nice, 217 p.

FUKAI, R., BALLESTRA, S. and HOLM, E., 1976. ^{241}Americium in Mediterranean surface waters. *Nature, Lond.*, 264 : 739-740.

GUARY, J.C., 1980. Recherches sur les transferts et la fixation du plutonium, de l'americium et du neptunium dans le milieu marin. Thèse Doct. Etat-Sciences, Univ. Aix-Marseille II, 303 p.

GUARY, J.C., FOWLER, S.W. and BEASLEY, T.M., 1982. Routes of plutonium uptake and their relation to biomagnification in starfish. *Mar.Pollut.Bull.*,13 : 99-102.

HOLM, E., BALLESTRA, S., FUKAI, R. and BEASLEY, T.M., 1980. Particulate plutonium and americium in Mediterranean surface waters. *Oceanol. Acta*, 3 : 157-160.

R