pump to push the solution. The column was then equilibrated with one free column volume of HCl 8.5 N. After the fixation of the 3.5 liters of liquid waste and scrubbing with one free column volume of HCl 8.5 N, the americium was eluted with 1.5 liters of 0.5 N. The result was a pure americium solution from which the oxalate precipitation has been directly performed without any pH adjustment.

The use of DHDECMP allowed us to recover americium from a liquid waste for which there were no other alternate solutions. We pointed out two factors of main importance. On the one hand, the solubility of HCl in the extractant can give serious troubles. On the other hand the very strong salting-out effect is of great help to recycle a liquid waste of complex composition. Numerous complementary studies must be undertaken. However the bidentate organo-phosphorus extraction can already be used in a lot of cases.

1 J. Navratil *et al.*, *ACS Symposium Series* 117, 1980.

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Detection Limits for some Transuranic Nuclides Using Low-Energy Photon Spectrometry

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During the past 40 years, artificially produced transuranium nuclides have been introduced in the aquatic systems as consequences of atmospheric fallout from nuclear testing and of controlled release from nuclear reprocessing plants; the study of the behaviour of long-lived transuranic elements in oceanic media is of a great importance from the projected development of breeder technology.

Usually, picocurie amounts of these isotopes are mainly determined in environmental samples by α spectrometry after tedious radiochemical separations. Otherwise, we tested [1] the availability of non-destructive low-energy photon spectrometry to measure activity levels of fission products after a nuclear test; in actual experiments, we attempted to give the sensitivities attained by this method for transuranic elements.

The activities were measured with a X-ray spectrometer which consists to a 200 mm^2 area, 10 mm depth planar HPGe detector; the pulses given by the linear amplifier were analysed on a 4096 channels MCA. The energy resolution (FWHM) obtained with this system was better than 180 eV at Fe K_α line.

The samples used for counting were:

a) standard activity sources of ^{241}Am, ^{243}Am and ^{244}Cm provided by L.M.R.I. or by I.A.E.A.

b) brown algae *Fucus vesiculosus* coded AGI/1: intercalibration sample provided by the International Laboratory of Marine Radioactivity (I.A.E.A.).

c) many surface sediments from Nord Cotentin (France).

Standard solutions of transuranic elements were electroplated on stainless disks using the Talvitie's method [2]; as concerns solid samples, accurately weighted quantities were packed in thin plastic containers. The samples were counted for time intervals between 50 and 360 ks. The absolute efficiency of the HPGe system was plotted against energy using counting runs with well known ^{152}Eu, ^{133}Ba and ^{241}Am sources.

The Minium Detectable Activity (MDA) attained by low-energy photon or X-ray spectrometry is related to the branching ratio $\Gamma = N_\gamma/N_\alpha$ or $X = N_x/N_\alpha$ of the isotope under consideration. The MDA (in pCi) is calculated from the formula:

$$\mathrm{MDA} = \frac{27.02 N_p}{\Gamma \cdot \epsilon \cdot t}$$

with t = counting time (s); ϵ = absolute detection efficiency.

The net peak area N_p and the substracted background area N_γ were related by: $N_p \geqslant 3\sqrt{N_b}$. The Table gives the MDA obtained in this method:

^{241}Am		^{243}Am		^{244}Cm		^{237}U	
59.54	1.2	74.67	0.7	42.84	15.3	59.54	1.2
NpL_β	2.5	NpL_α	2.6			NpL_β	2.5
E(keV)	MDA	E(keV)	MDA	E(keV)	MDA	E(keV)	MDA

1 G. Ardisson, *Trends Anal. Chem.*, *1*, No. 12, 281 (1982).
2 N. A. Talvitie, *Anal. Chem.*, *44* 280 (1972.

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Behaviour of Transuranic Elements in Marine Food Chains[†]

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In general actinides are present as relatively insoluble compounds in the marine environment and are therefore not considered biologically mobile. Their

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