BEHAVIOUR OF $^{239,240}$Pu AND $^{241}$Am IN THE BALTIC SEA; MEASUREMENTS AND INTERPRETATION IN 1980–1984

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Concentrations of $^{239,240}$Pu and $^{241}$Am in filtered seawater, particulate fraction and sediment were measured. Methods for determination of these nuclides were critically checked and a new rapid method for $^{241}$Am in sediment was developed. Due to seasonal variation a significant decrease of plutonium and americium concentrations in surface water takes place in summer. Americium is more efficiently associated with particulate matter than plutonium. From May 1980 to September 1984 soluble plutonium in the water was reduced to about half. The residence half-time of $^{239,240}$Pu in the water of Baltic Sea is of the order of 5 years. About similar concentrations of $^{239,240}$Pu and $^{241}$Am were found in particulates in water as in the surface layer of the sediment. The average $K_d$-values for plutonium and americium were $10^5$ and $10^5 - 10^6$ ml/g, respectively.

1. Introduction

The behaviour of transuranic elements plutonium and americium in the water of the Baltic Sea and its Gulfs have been studied since 1979 (1). The first phase of the investigations was to develop analytical methods for determination of the $^{239,240}$Pu and $^{241}$Am concentrations in the water and especially to investigate the distribution of plutonium and americium between filtered seawater and the particulate fraction.

The Baltic Sea and its Gulfs is a shallow brackish water area. The salinity of water samples collected varied between 3 - 8 % in surface waters and 7 - 13 % in bottom waters. The highest sampling depth of our study has been 235 m. In the Baltic Sea there is also a large seasonal variation in temperature. Thus, the conditions in the Baltic Sea are very different from those existing in the locations studied as possible deep-sea dumping sites. This gives an opportunity to consider the effect of some factors on behaviour of transuranic elements in marine environment.

In the present report the effect of season, salinity and depth on the distribution of $^{239,240}$Pu and $^{241}$Am in the Baltic Sea is...
described. In addition, the distribution coefficients for these radio-
nuclides in the particulate matter of water and in the surface layer of
bottom sediments have been calculated.

Due to the low concentrations of plutonium and americium in water and
sediment samples special attention was paid to development and modifi-
cation of analytical methods. Most of the methods reported in litera-
ture for determination of americium in environmental samples are
tedious. In the present paper a short and simple method for
determination of americium in sediment is described.

To eliminate or decrease losses of chemical yield which take place in
determination of plutonium and americium, the final step of
the separation procedure was changed. To prepare the samples for alpha-
spectrometric determination CeF$_4$ or NdF$_3$ co-precipitation and
filtration through a membrane filter was used instead of electro-
deposition.

2. Materials and methods

2.1. Samples

Water and sediment samples have been collected in the Baltic Sea during
the years 1979 - 1984. Figure 1 indicates the locations of the sampling
stations. Collections of water and particulate samples has been
described earlier (1).

The water samples were filtered through Millipore cartridge filter,
pore size 0.30 μm. No effect of pore size, in the range of 0.22 -
0.50 μm, on the concentrations and distribution coefficients of
plutonium and americium was found. The sediment samples have been taken
with a gravity corer having an inner diameter of 21 cm (2). The cores
were split into transverse sections of 1.5 - 5 cm.