CAESIUM-137 IN BALTIC SEA SEDIMENTS SINCE THE CHERNOBYL ACCIDENT

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The Baltic Sea was the sea most affected by the Chernobyl accident, because the first radioactive clouds from Chernobyl travelled north and caused high deposition in the Baltic Sea region [1]. The distribution pattern of Chernobyl-derived ^{137}Cs in the catchment area of the Baltic Sea was very scattered, with the highest deposition values occurring in the areas surrounding the Gulf of Bothnia and the Gulf of Finland. The highest ^{137}Cs concentrations in bottom sediments also occurred in these gulfs, but the scattered nature was further emphasized as a consequence of river discharges, sea currents and different sedimentation rates on hard and soft bottoms. Our first attempts to estimate total ^{137}Cs in Baltic Sea sediments were made in the early 1990s [2,3]. The present report contains a revised estimate based on a larger quantity of sediment data than the previous estimates.

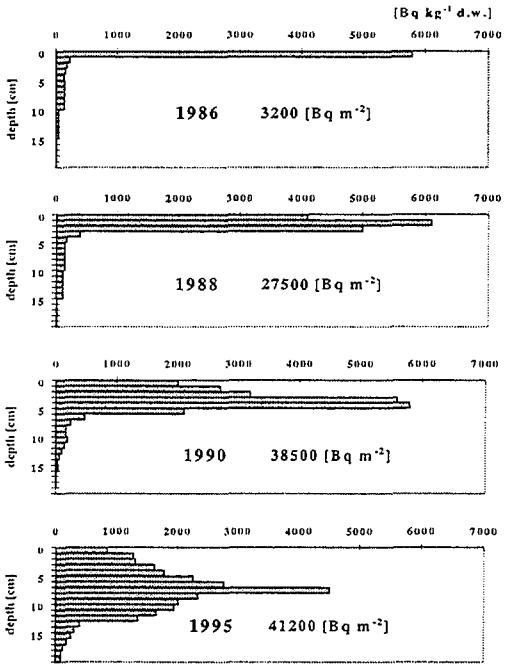


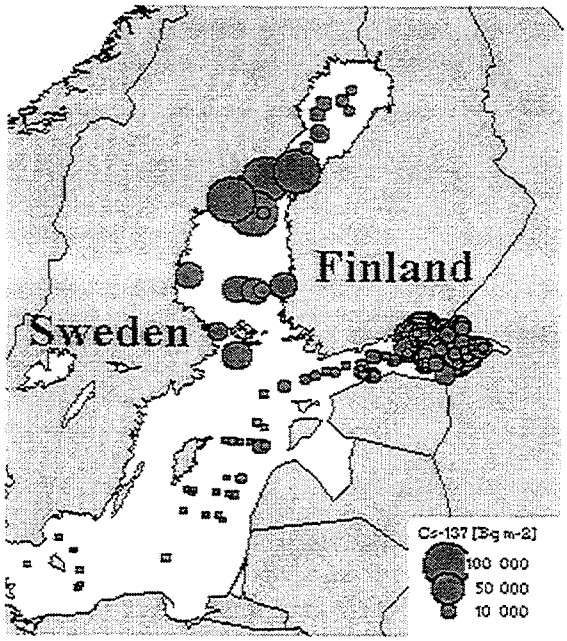
FIG.1. Vertical distribution and total amount of ^{137}Cs in 1986-1995 at a coastal station on the Gulf of Finland.

Sediment data were collected in 1993-1997 by STUK and FIMR during voyages of the R/V ARANDA. The total number of sampling stations was 129 (180 cores). The samples were taken with a GEMINI Twin Corer and ^{137}Cs activity was measured gammaspectrometrically. The activity concentrations were time-corrected to April 26, 1996. The mean content of ^{137}Cs [Bq m^{-2}] in the soft and hard sediment of various sub-basins was multiplied by the area of soft and hard bottom in each [4] measured planimetrically from maps of Quaternary deposits in the Baltic Sea [5]. An empirical ratio of 1:20 was used to calculate ^{137}Cs values for hard bottoms [2]. Positively skewed distribution of the data led in some cases to a strong influence of individual results on mean values. In these cases some stations or a certain portion of maximum and minimum values were omitted because of statistical considerations.

The results show that Chernobyl-derived caesium has continued to sink to the bottom of the sea during the 1990s (Fig.1). The proportion represented by the Bothnian Sea is clearly dominant in the total Baltic Sea inventory of ^{137}Cs (Fig. 2, Tables I and II). The highest amounts of ^{137}Cs were found in the northern Bothnian Sea (116 300 Bq m^{-2}) and in the

TABLE I. TOTAL AMOUNTS OF ^{137}Cs [Bq m^{-2}] IN SEDIMENTS OF DIFFERENT SUB-BASINS AND THE NUMBER OF SAMPLING STATIONS. (*=SELECTED OBSERVATIONS USED IN CALCULATIONS)

	Gulf of Finland	Bothnian Bay	Bothnian Sea	Baltic Proper
mean*	18600	8700	34600	2100
median	15200	8600	35100	1900
max	78100	98700	116300	10200
min	1400	4300	7800	600
Station	79	8	12	30



southernmost area of the Bothnian Bay (98 700 Bq m^{-2}), but the areal representativeness of these maxima remained unverified in the present study. According to our new estimate, the total value for ^{137}Cs in sediment was 2.14 PBq in 1996 (Table 2). This value is about double our estimate from 1991 and is almost equal to that estimated for Baltic Sea water by the HELCOM/MORS Group [6]. The marked increase in the estimated value resulted from increased information on ^{137}Cs in sediments and the fact that Chernobyl-derived caesium has continued to sink to the bottom of the sea. Nevertheless, more information is still needed about the distribution pattern of ^{137}Cs in certain sub-basins, e.g. the northern Bothnian Sea.

FIG.2. Total amounts of Cs-137 [Bq m^{-2}] at sampling stations in different parts of the Baltic Sea.

TABLE II. INVENTORIES OF ^{137}Cs IN DIFFERENT SUB-BASINS OF THE BALTIC SEA BASED ON SURFACE AREAS OF SOFT AND HARD BOTTOMS [km^2] IN EACH

Sea area	Bottom type	[km^2]	1991 inventory [Bq]	1998 inventory [Bq]	Portion of the total in 1998
Bothnian Bay	soft	16000	4.80E+13	1.39E+14	
	hard	21000	3.15E+12	9.12E+12	
	soft+hard	37000	5.12E+13	1.48E+14	7 %
Bothnian Sea	soft	40000	6.64E+14	1.38E+15	
	hard	39000	3.24E+13	6.74E+13	
	soft+hard	79000	6.96E+14	1.45E+15	67 %
Gulf of Finland	soft	16000	2.43E+14	2.98E+14	
	hard	14000	1.06E+13	1.30E+13	
	soft+hard	30000	2.54E+14	3.11E+14	15 %
Baltic Proper	soft	106000	2.23E+14	2.20E+14	
	hard	122000	1.28E+13	1.27E+13	
	soft+hard	228000	2.36E+14	2.32E+14	11 %
Baltic Sea	soft	178000	1.18E+15	2.04E+15	
	hard	196000	5.90E+13	1.02E+14	
	soft+hard	374000	1.24E+15	2.14E+15	100 %

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