

Concentration ^{137}Cs and discrimination coefficient in benthos organisms in the dump sites for solid radioactive waste in Kara sea

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INTRODUCTION

Within the framework of the Joint Russian-Norwegian Commission for Cooperation in the Environmental Sector, International Atomic Energy Agency and European Union joint expeditions have been conducted to investigate radioactive contamination of Northern Seas. The main conclusion was that the dumping of radioactive waste does not influence the general level of radioactive contamination in the Kara Sea. Radiation doses from existing contamination would be negligible.

However, local effects in the vicinity of the dumping sites could not be excluded, and it was necessary to undertake detailed investigations in these regions, and assess leaching and its consequences.

The present report summarized the results of investigation radioactive contamination of the benthos organisms and plant in the Ambrosimov Bay, Stepovogo Bay, Tsivolki Bay and nearest regions of Kara sea

MATERIALS AND METHODS

Radioactive contamination of the benthos organisms and plant of the Ambrosimov Bay, Stepovogo Bay, Tsivolki Bay and nearest regions of Kara sea were under investigation during 73 and 81 cruises R/V Professor Shtokman (2005-2006y) (Fig.1). The samples of biota were taken with trawl in the dump sites for solid radioactive waste.

The samples of sediment were taken with a bottom sampler «Ocean – 50». Measurement of ^{137}Cs in samples of biota and sediment performed by means of gamma-spectrometer with a detector made of super pure germanium GC-3020 with a relative efficiency of 30% (Co-60 line - 1,332 Mev) and a resolution of 1,8 Kev. To inspect the dumped objects underwater video camera and underwater gamma-spectrometer were used. Direct measurements of ^{137}Cs in the bottom sediments were performed *in situ* with gamma-spectrometer.

Concentration ^{137}Cs in groups of animals and plants, dominating in trawling samples was defined.

RESULTS AND CONCLUSIONS

Maximum ^{137}Cs concentration was found in *Motocyrihus rinkii* - 3.19 Bk/w.w.kg, *Ophiocten*, *Stegophiura* – 2.96 Bk/w.w.kg (Ambrosimov Bay) and *Saduria sabini* - 2.37 Bk/w.w.kg (Stepovogo Bay). ^{137}Cs concentration for Astartidae (*Astarte borealis*, *Astarte elliptica*) – 1.19 Bk/w.w.kg, *Bathycarca glacialis* – 1.58 Bk/w.w.kg, *Laminaria* – 1.77 Bk/w.w.kg (Fig. 2).

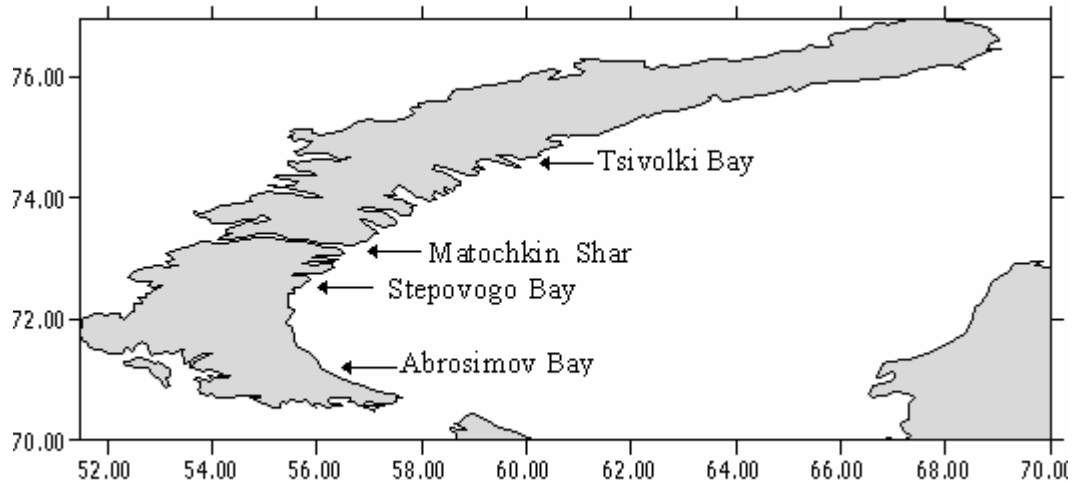


Fig. 1. Sampling sites of the R/V Professor Shtokman (2005-2006y) Expedition

It is not revealed influences of the raised concentration of ^{137}Cs in Abrosimov Bays and Stepovogo Bay on qualitative structure of bottom communities. Benthos communities of investigated areas correspond ones described in the literature for coastal areas of Kara sea. In benthos of the investigated Bays it is found concentration of ^{137}Cs up to 3.19 Bk/kg of wet weight. The greatest concentration in benthos of Abrosimov Bay and Stepovogo Bays: Holothurian *Myriotrochus rinkii*, Isopoda *Saduria sabini*, Ophiura *Ophiocten sericeum* and *Stegophiura nodosa* are found.

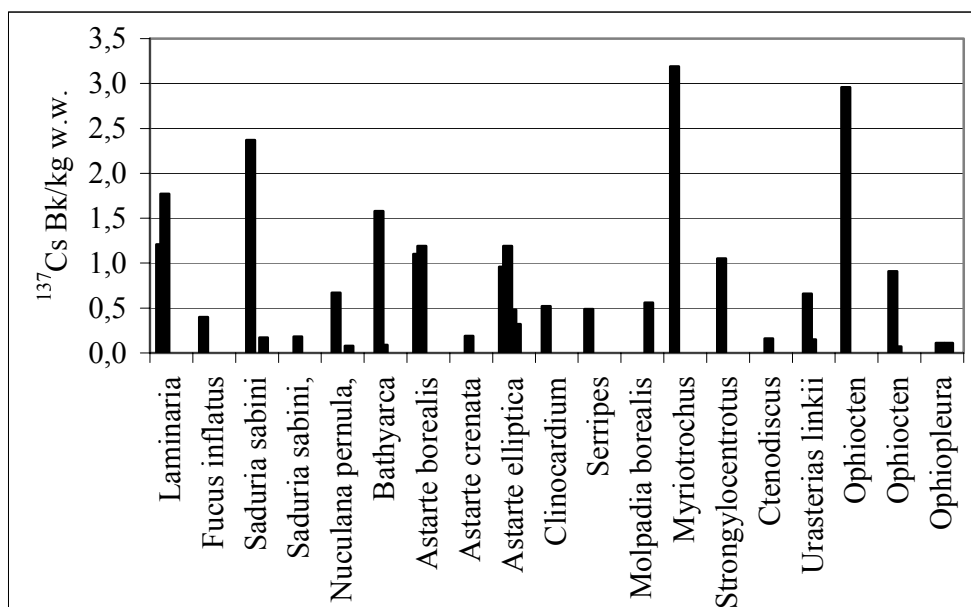


Fig. 2. Maximum ^{137}Cs concentration in seaweeds and animals, dominating in trawling samples from the Ambrosimov Bay, Stepovogo Bay, Tsiivolki Bay and nearest regions of Kara sea.

Concentrations of ^{137}Cs in benthos on the stations located in the center of Abrosimov Bay and Stepovogo Bay and adjoining to underwater radioactive objects are higher then in the open sea opposite to Bay. Thus, local effects in the vicinity of the dumping sites take place.

The average concentration of technogenic ^{137}Cs in benthos organisms in Abrosimov Bay and Stepovogo Bay is also higher than in open part of the Kara sea and in other areas of a shelf of the Arctic seas. The best indicators of radioactive pollution among the investigated benthos species were brown seaweed *Laminaria saccharina* and Isopoda *Saduria sabini*.

Comparing our data with received in 1992 - 1994 in Abrosimov Bay and Stepovogo Bay (Salbu et al., 1997), it is possible to conclude, that concentration of ^{137}Cs in benthos organisms decreases non-uniformly. So, concentration of ^{137}Cs in *Fucus inflatus* decreased in 7 - 7.5 times, whereas in *Laminaria saccharina* approximately in 2 times. Unfortunately, to perform detailed comparison it is not obviously possible, as detailed radiological researches benthos in these areas earlier it was not spent.

The concentration factors (Kd) for seaweeds and animals were calculated (table. 1)

The greatest factors of accumulation of ^{137}Cs are found out at holothurian *Myriotrochus rinkii*, brown seaweed *Laminaria saccharina* and Isopoda *Saduria sabini*.

In the surface layers of sediment concentration ^{137}Cs (up to 40 Bk/kg) has been registered. Near to an exit from the Bay the concentrations were 8 - 10 Bk/kg. Maximum concentration ^{137}Cs have been found out in layer 10 - 12 cm in Abrosimov Bay (150 Bk/kg) and in layer 4 - 6 cm in Stepovogo Bay (100 Bk/kg). Average concentrations of ^{137}Cs in seawater in these Bays are similar and on the average equal approximately 3.2 Bk/m³.

In the surface layer of sediment from Tsivolki Bay concentration of ^{137}Cs were 5 - 10 Bk/kg. Maximum of concentration was in layers 6 - 8 cm. Average concentration of ^{137}Cs in seawater was 1.86 Bk/m³.

Table 1. The concentration factors for seaweeds and animals

Species	Kd
Phaeophyta	
<i>Laminaria saccharina</i>	559
<i>Fucus inflatus</i>	128
Crustacea Isopoda	
<i>Saduria sabini</i>	598
Bivalvia	
<i>Nuculana pernula, Leionucula tenuis</i>	212
<i>Bathyarca glacialis</i>	193
<i>Astarte borealis</i>	376
<i>Astarte elliptica</i>	376
<i>Clinocardium ciliatum</i>	115
<i>Serripes groenlandicus</i>	152
Echinodermata	
<i>Myriotrochus rinkii</i>	994
<i>Strongylocentrotus droebachiensis</i>	332
<i>Urasterias linkii</i>	132
<i>Ophiocten sericeum, Stegophiura nodosa</i>	373
<i>Ophiocten sericeum, Ophiacantha bidentata</i>	156

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