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Temporal change of Fukushima-derived Cs-137 in the sediments in the waters off Fukushima and nearby Prefectures

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The ^{137}Cs derived from the Fukushima Daiichi nuclear power plant accident in seawater has been transported to the open ocean with currents and its concentration has decreased exponentially from about 200 Bq/L to several mBq/L, a little higher than the pre-accident level, in the outside of 30 km radius of the nuclear power plant. The nuclide in the sediments, however, has not shown such a steep temporal change. Thus, its distribution pattern and temporal change should be systematically studied for a long time in order to access quantitatively the impact of the accident to the coastal environment. In addition, it is necessary to explore the mechanism for temporal change of the distribution in the sediments to predict the environmental recovery in the area. Soon after the accident, Marine Ecology Research Institute has been monitoring the water off Fukushima and nearby Prefectures for the radioactivities under the contract with Ministry of Education, Culture, Sports, Science and Technology (currently with the Nuclear Regulation Authority). We will introduce the distributions of Fukushima-derived ^{137}Cs in the bottom sediments and their temporal change, and factors controlling the changes.

Methods

In the coastal waters off Miyagi, Fukushima, Ibaraki and Chiba Prefectures, bottom sediments were retrieved using a multiple corer. From May to June 2011, sediments were collected at 12 sites six times. After that, the sites were increased. Now the sampling is done 4 times a year at 32 sites. Surface 3 cm of cores were used to study the surface distributions of ^{137}Cs. Vertical profiles of ^{137}Cs in the sediments were also studied at selected sites. Additional parameters such as sediment grain size, contents of organic material and elemental composition were also measured.

Results

The concentrations of ^{137}Cs in the surface sediments shows wide variation ranging from 0.8 to 540 Bq/kg-dry; Almost all of the data exceeded the level of pre-accident 5yr-average (0.87 +/- 0.41 Bq/kg) in the waters off Fukushima Pref. Proximity of the sampling site did not necessarily correspond to the higher values.

The temporal change of surface concentrations do not indicate steep decrease as that of seawater as a whole and the concentration at each sampling site varies so that it is not evident to see the temporal trend. However, geometric means calculated from Sept., 2011 to Nov. 2014 reveal the exponential decline trend from 47 Bq/kg to 17 Bq/kg.

Spatial variation of surface ^{137}Cs concentration and its temporal change would be ascribed to several factors. The former may be related to grain size distribution of the sediment, chemical composition, riverine input from the land, and pathway of polluted water after the accident, and the latter desorption of Cs from the sediments, resuspension and subsequent lateral transportation, and bioturbation. The temporal change of vertical distributions of ^{137}Cs do not show significant increase of the nuclide in the deeper layer, suggesting that bioturbation may not be the main factor for the surface decrease.

The detail of the spatiotemporal changes of ^{137}Cs in the sediments and the relevant factors will be presented in the talk.

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Keywords: Fukushima nuclear power plant accident, Cs-137, bottom sediment