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The distribution of radioactive strontium in coastal area of Fukushima Prefecture, Japan

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At National Institute for Environmental Studies, Japan, cryogenically archived environmental samples in Environmental Time Capsule Program can be utilized for a retrospective study of an environmental pollutant. In March 2011, radioactive strontium (Sr-89 and 90) was accidentally released from Fukushima Dai-ichi Nuclear Power Plants (NPP), Japan, to both atmospheric and marine environments, similar to radioactive cesium. Although it has been considerably interested in abundance and dynamics of radioactive strontium in environment, they have been poorly understood. In this study, we determined the distribution of radioactive strontium in coastal environment of Fukushima Prefecture based on analyzing Sr in the collected bivalves.

Field sampling was performed at coastal area of Ibaraki Prefecture (Oarai town), Fukushima Prefecture (Iwaki city, Hirono town, Minamisoma and Soma city), Miyagi Prefecture (Ishinomaki city), and Aomori Prefecture (Higashidori village) from June to August 2011 and in May 2012. Soft tissue of bivalve samples was digested using nitric and hydrochloric acid at 180 degree C. Seawater sample was concentrated by carbonate precipitation, and then the precipitates were dissolved in nitric acid. Separation of strontium from these digested and concentrated samples was performed using crown ether resin. Radio activities of Sr-89 and 90 and radioactive yttrium (Y-90) were measured by low background gas flow counter.

Sr-90 activities of bivalves in 2011 were decreased with increasing the distance from NPP. The highest Sr-90 activity of the measured bivalves in 2011 was 0.17 Bq/kg at Hirono town, approximately 23 km south from NPP. Ratios of Sr-90 concentration between bivalves and seawater were 2.9 at Iwaki city, 48 km south from NPP, and 1.2 at Soma city, 37 km north from NPP. This indicates a relatively high tendency of bioconcentration of Sr-90 in bivalves. Sr-90 / Cs-137 activity ratio of bivalve was 0.0008 - 0.0015 in each sampling site of Fukushima Prefecture. Overall, our results suggest that concentration of the Sr-90 tended to be higher at south and near NNP site as well as Cs-137. Sr-90 actives of bivalves in 2012 also tended to be higher at south than north sites from NPP, but lower than that in 2011. Sr-90 / Cs-137 activity ratio of bivalve was 0.017 at Hirono town and 0.011 at Iwaki city in 2012. These results show the decrease of Sr-90 of bivalve from 2011 to 2012 and the difference in residence time between Sr-90 and Cs-137 in bivalves. Consequently, our results suggest that radioactive strontium derived from Fukushima Dai-ichi NPP in coastal area of Fukushima Prefecture was distributed to the south, probably as a result of the southward direction of oceanic current.

Keywords: Radioactive strontium, the Fukushima accident, Bivalve