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Transport of Fukushima-derived radiocaesium to the ocean interior by sinking particle

Makio Honda[1*], Kawakami, Hajime[2], Nagao, Seiya[3], Watanabe, Shuichi[4], Saino, Toshiro[5]

[1]Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology, [2]Mutsu Insitute of Oceanography, Japan Agency for Marine-Earth Science and Technology, [3]Institute of Nature and Environmental Technology, Kanazawa University, [4]Mutsu Insitute of Oceanography, Japan Agency for Marine-Earth Science and Technology, [5]Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology

The 2011 Tohoku-Oki Earthquake, occurred on 11 March 2011, and the tsunami it caused seriously damaged the Fukushima Daiichi Nuclear Power Plant (FNPP1). Large quantities of artificial radionuclides were emitted from FNPP1. At two stations in the western North Pacific, K2 in the subarctic gyre and S1 in the subtropical gyre, time-series sediment traps were collecting sinking particles when the FNPP1 accident occurred. Radiocesium (134Cs and 137Cs) derived from FNPP1 accident was detected in sinking particles collected at 500 m by late March 2011 and at 4810 m by early April 2011 at both stations. The sinking velocity of 134Cs and 137Cs was estimated to be from 8 to 36 m/day between the surface and 500 m and >180 m /day between 500 m and 4810 m. 137Cs specific activity varied from 0.14 to 0.25 Bq/g dry weight. These values are higher than those of surface seawater, suspended particles, and zooplankton collected in April 2011. The total 137Cs flux by late June at K2 and by late July at S1 was from 0.5 to 1.7 Bq/m2 at both depths. Compared with 137Cs input to both stations by April 2011, estimated from the surface 137Cs activity and mixed layer depth and by assuming that the observed 137Cs flux was constant throughout the year, the estimated removal rate of 137Cs from the upper layer (residence time in the upper layer) was from 0.3 to 1.5%/year (68 to 312 years). The estimated removal rates and residence times are comparable to previously reported values. Based on preliminary results of 134Cs analysis on sinking particle collected at 4810 m of K2 between August 2011and June 2012, the maximum 134Cs flux and concentration were observed between May and Jun 2011 and decreased gradually thereafter. However 134Cs was still detected and the ratio of 134Cs to 137Cs was close to one in sinking particle collected in April 2012. Total 134Cs flux at 4810 m of K2 by April 2012, at about one year after FNPP1 accident, was estimated to be higher than 2.5 Bq/m2. Assuming that the 134Cs inventory (atmospheric 134Cs input) at K2 was 450 Bq/m2, removal rate of 134Cs from the upper layer (residence time in the upper layer) was $>$ 0.6%/year ($<$ 180 years) and comparable to previous estimate. At 4810 m of S1, highest 134Cs specific activity was found in December 2012 and about half a year later than that at 4810 m of K2. Although flux collected at 4810 m of S1 were not always sufficient for analysis, the 134Cs was detected by early February 2012. In June-July 2012, seafloor sediments at K2 and S1 were collected. Analysis of radiocesium in the seafloor sediment and sinking particle collected by sediment trap is still ongoing. During 2013 JPGU meeting, Fukushima derived radiocesium flux in sinking particle and inventory of radiocesium in the seafloor sediment will be discussed.

Keywords: Fukushima Daiichi Nuclear Power Plant, Artificial radiocaesium, Western North Pacific, Sinking particle, Sediment trap, 2011 Tohoku-Oki Earthquake