Five years monitoring activity on radioactive cesium in seawater after the Fukushima Dai-ichi Nuclear Power Plant Accident

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Introduction

After the Fukushima Dai-ichi nuclear power plant accident, many studies had been reported the oceanic dispersion patterns of radioactive Cs derived from this accident.

Here, we summarize the dispersion pattern of Fukushima-derived radiocesium in the North Pacific and temporal change in the concentration of $^{137}$Cs in seawater near the Fukushima site, based on the observational data obtained during five years.

Main topics are as follows;
- eastward dispersion in surface seawater
- southward intrusion with mode waters
- temporal changes in $^{137}$Cs in coastal seawater

References updated from last WS @Qingdao (PICES2015)
Oceanic background

major sea surface and subsurface seawater movements associated with FNPP studies

Kaeriyama (in press)
Monitoring activity on seawater by FRA

ca. 4,000 samples were analyzed

137Cs in surface seawater (Bq/m³)
Eastward dispersion in surface seawater
Eastward dispersion in surface seawater

Data were cited from Aoyama et al. (2013a); Aoyama et al. (2013b); Aoyama et al. (2015b); Buesseler et al. (2012); Charette et al. (2013); Inoue et al. (2012a); Inoue et al. (2012b); Inoue et al. (2012c); Kaeriyama et al. (2013); Kaeriyama et al. (2014); Kaeriyama et al. (2015); Kaeriyama (2015); Kaeriyama (this study); Kamenik et al. (2013); Kim et al. (2012); Kumamoto et al. (2013); Kumamoto et al. (2014); Kumamoto et al. (2015a); Kumamoto et al. (2015b); Ramzaev et al. (2014); Smith et al. (2014).
Southward intrusion with mode water
Southward intrusion with mode water

Subtropical mode water: 25.0–25.6 $\sigma_\theta$
Central mode water: 26.0–26.6 $\sigma_\theta$

Kaeriyama et al. (2016)
Southward intrusion with mode water

Source term estimation of Fukushima-derived radiocesium ($^{134}$Cs or $^{137}$Cs)

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*based on Aarkrog (2003)

Total amount of Fukushima-derived $^{137}$Cs: 15–20 PBq

$^{137}$Cs in STMW in Oct–Nov 2012: 4.2 PBq
Southward intrusion with mode water

year to year variation of $^{137}\text{Cs}$ in STMW

$^{134}\text{Cs}$ was detected in STMW

Kaeriyama et al., Goldschmidt2016Yokohama
Southward intrusion with mode water

$^{137}$Cs in STMW in the area south of Japan islands had been decreased from 0.63 PBq in 2012 to 0.35 PBq in 2015
Southward intrusion with mode water

The updated schematic view of FNPP-derived radio active cesium in mode waters

coastal area off the FNPP
coastal area off the FNPP

(a) Map showing locations of FNPP, Sendai Bay, Iwasawa, Onahama, and Hasaki. 
(b) Graph showing the decrease in $^{137}$Cs concentration over time (Days from 1st Jan 2011) with background level ($< 2.0 \text{ Bq/m}^3$). Points and curves represent measurements at various locations: NRA_T1, NRA_T12, NRA_T18, Iwasawa, Onahama, off Fukushima, Sendai Bay, Hasaki. Data from Kaeriyama (in press).
Onahama station (south of FNPP)

in preparation

Kaeriyama (unpublished)
updated from Kaeriyama et al. (2015)
Possible continuous source of radioactive Cs from land through river

Results of 2014 observation

Desorption from particle

Dilution curve

Kakehi et al. (2016)
Oceanic dispersion of Fukushima-derived radiocesium had been well documented during five years from the accident. Key features:

1. Eastward dispersion in surface water north area of Kuroshio Extension
2. Subsurface intrusion with mode waters

Future perspective: the destination of Fukushima-derived radiocesium in mode waters

Coastal area off Fukushima
The concentration of $^{137}$Cs are still higher than those before accident has been declining, but continuous monitoring should be done.

Future perspective: Small but continuous input of Fukushima-derived radiocesium through river should be continuously studied, such as how many, dissolved and/or particulate, bioavailable particulate, and so on.
Thank you for your attention

References


