Fukushima-derived radiocesium in the western subtropical gyre of the North Pacific Ocean in 2015/2016

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Accident of Fukushima-Dai-ichi Nuclear Power Plant (FNPP1) on 11 March 2011 resulted in a large amount release of radiocesium (^{134}Cs and ^{137}Cs) into the North Pacific Ocean. Oceanographic observations have revealed that the Fukushima-derived radiocesium deposited on and discharged directly into coastal area of Japan is transported eastward in surface layer along the North Pacific Current (Kumamoto et al., 2016). In addition, radiocesium deposited on an area south of the Kuroshio/Kuroshio Extension Current had been transported southward to about 15 north degree through subsurface layer due to subduction of the subtropical mode water (STMW) by the end of 2014 (Kumamoto et al., 2014). On the other hand, in coastal areas of nuclear power plants in Hokkaido, Niigata, Ishikawa, Fukui, Shimane, Saga, Kagoshima, Ehime, and Shizuoka prefectures, activity concentration of radiocesium in surface seawater was increasing between 2011 and 2015 (NSR, 2016). Aoyama et al. (2017) also reported increase in radiocesium activity in surface seawater in the coastal area. Contribution of the Kuroshio Current water is relatively large in these coastal area where the activity concentration of radiocesium increased. These results suggest that the Fukushima-derived radiocesium spread into the western subtropical area has returned to the coastal area of Japan along a clockwise subtropical gyre current. However, temporal and spatial variation in the Fukushima-derived radiocesium in the western subtropical gyre is not clear. In 2015/2016 we measured vertical profile of radiocesium in seawater from surface to 800 m depth in the western subtropical area south of the Kuroshio/Kuroshio Extension Current. Seawater samples (10-20 liter) were collected using a bucket or Niskin Sampler during research cruises of KS15-14 (October 2015), KH16-03 (June 206), and KM16-08 (September 2016). In a laboratory, the seawater sample was acidified using nitric acid and then radiocesium in the seawater was concentrated onto ammonium phosphomolybdate (AMP). Radiocesium in the AMP was measured using gamma-ray detectors. Uncertainty of the radiocesium measurement was estimated to be about 8 %. A vertical profile of activity concentration of ^{134}Cs, which corrected to the FNPP1 accident date for radioactive decay, in 30-32 north degree/144-147 east degree in 2015 and 2016 was compared to that observed in 2014 (Kumamoto et al., 2017). In surface mixing layer between surface and about 100m depth, ^{134}Cs increased from about 1 Bq/m^3 in 2014 to about 1.5-2.5 Bq/m^3 in 2015/2016. In subsurface maximum layer (300-400 m depth), whose water density agrees with that of STMW, 3-4 Bq/m^3 of ^{134}Cs activity concentration did not change between 2014 and 2016. According to Kumamoto et al. (2017), in 34 north degree/147-150 east degree just south of the Kuroshio/Kuroshio Extension Current, decay-corrected activity concentration of ^{134}Cs in the surface mixed layer increased from below the detection level (about 0.1 Bq/m^3) in 2012 to about 1 Bq/m^3 in 2014 while the concentration in the subsurface layer decreased from about 16 Bq/m^3 in 2012 to 3-4 Bq/m^3 in 2014. These observational results clearly suggest that the Fukushima-derived radiocesium transported southward due to subduction of STMW has come back to the northern subtropical area south of Japan along the clockwise subtropical gyre current. If the other sources (e.g. riverine water input) are negligible, the ^{134}Cs increase in surface seawater from 2012 to 2016 (from less than 0.1 Bq/m^3 to about 1.5-2.5 Bq/m^3) was probably derived from entrainment of the subsurface maximum into the surface mixed layer. We will show additional data of dissolved radiocesium in coastal area of Japan in 2015/2016 in the coming presentation. This work was partially supported by Grant-in-Aid for Scientific Research on Innovative Areas, the Ministry of Education,

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