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Radiocaesium derived FNPP1 accident in the ocean interior of the western North Pacific Ocean through 2016

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134Cs and 137Cs, hereafter radiocaesium, were released to the North Pacific Ocean by two major pathways, direct discharge and atmospheric deposition released from the TEPCO Fukushima Dai-ichi Nuclear Power Plant (FNPP1) accident in 2011. Activities of radiocaesium released from FNPP1 accident were measured as vertical profiles at 11 stations in 2011, at 14 stations in 2012, at 13 station in 2015 and at 6 stations in 2016 in the North Pacific Ocean to study transport processes in the ocean interior of the North Pacific Ocean. The major pathway from surface to ocean interior after injected in the ocean surface can be considered subduction of central mode water (CMW) and subduction of subduction of subtropical mode water (STMW) at potential densities of 26.1–26.3 for CMW and 25.1–25.3 for STMW, respectively.
In June 2012 at 34°N–39°N along 165°E corresponding to the formation region of central mode water (CMW) located north of the Kuroshio Extension, 134Cs activity showed a maximum at around potential density= 26.3 kg m−3. 134Cs activity was higher in CMW than in any of the surrounding waters, including STMW. These observations also indicate that the most effective pathway by which FNPP1-derived radiocaesium is introduced into the ocean interior on a 1-year time scale is CMW formation and subduction. In June-July 2015 at 36 deg. N–44 deg. N along 165 deg. E and June 2016 at 38-40N, 165-170 deg. E, there are only very week signal of subduction of Fukushima derived radiocaesium at in the CMW formation region, which means that subducted radiocaesium might have moved eastward from this region.
In June 2012, 134Cs activity reached a maximum of 6.12 ± 0.50 Bq m−3 at a 151-m depth (potential density, 25.3 kg m−3) at 29 deg. N, 165 deg. E. This subsurface maximum, which was also observed along 149°E, might reflect the southward transport of FNPP1-derived radiocaesium in association with the formation and subduction of subtropical mode water (STMW) from the region south of the Kuroshio Extension. In June 2015, FNPP1 derived radiocaesium spread over the entire subtropical gyre between 20 deg. N to 32 deg. N along 165 deg. E. In the south of Kuroshio Extension at 30 deg. N to 32 deg. N, 144 deg. E to 147 deg. E, 134Cs activity showed maximum at STMW, of which depth is around 400 meters, in 2014, 2015 and 2016. 134Cs activity , of which activities were decay corrected to March 2011, at 400 meters depth at this region were almost stable during these three years and the activities were 3.60 ± 0.80 Bq m−3 in June 2014, 3.65 ± 0.89 Bq m−3 in October 2015, 3.82 ± 0.85Bq m−3 in June 2016, respectively. This might indicate that FNPP1 derived radiocaesium subducted into ocean interior due to STMW formation are already recirculated to south of Kuroshio Extension in the subtropical gyre.