Ten years behavior of radiocaesium derived from TEPCO Fukushima Dai-ichi Nuclear Power Plant accident in surface water in the adjacent seas of the North Pacific Ocean

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After the accident at TEPCO Fukushima Dai-ichi Nuclear Power Plant, hereafter FNPP1, the caesium-137 radioactivity concentration of caesium-137 in surface water increased sharply in a wide area in the western North Pacific Ocean, and then dropped sharply or gradually decreased according to the distance from the FNPP1. In the marginal seas of the North Pacific Ocean (Sea of Japan and East China Sea), a delay was observed in the increase in the concentration of caesium-137 radioactivity concentration, and the characteristics of time change were different from those in the North Pacific Ocean. An apparent characteristic of caesium-137 radioactivity concentration was a gradual decrease from 2012 in the Ogasawara region which locates in the subtropical gyre, and recently it is about the same as or lower than caesium-137 activity concentration in surface water in the Sea of Japan. However, in the southern part of the Sea of Japan, caesium-137 activity concentration reached its maximum in 2016 and then gradually decreased until 2020. The other situation was observed eg. the activity concentration of caesium-137 remained almost unchanged from 2017 to 2020 at around the Yonaguni Island, which is the entrance to the East China Sea from the North Pacific. The apparent half-life due to advection-diffusion after radioactive decay correction was 18.9 years for the Ogasawara region for the period 2012-2020 and 12.3 years for 2016-2020, while it is slightly longer at 22.4 years for 2016-2020 in the southern part of the Sea of Japan. On the other hand, in the vicinity of Yonaguni Island, there is no change or a slight increase in 2017-2020. Also, the 134Cs / 137Cs ratio increased in the vicinity of Yonaguni Island, reaching ca. 0.5 in 2020, which is about the same as those observed at Ogasawara and the Sea of Japan. These transports mainly follow the subtropical gyre. Regarding the transport of radioactive caesium to the northern part of the East China Sea and the Sea of Japan, a part of the radioactive cesium derived from FNPP1 in the subtropical mode water moved to the west, reached the bottom of the East China Sea, and then abducted to the surface layer and transported to the Sea of Japan. The transportation process by the main route of the subtropical gyre is considered to have taken longer than the shortcut to the Sea of Japan via the ocean interior of the North Pacific as mentioned above.

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