Radioactive contamination in marine environment by the accident of TEPCO Fukushima Dai-ichi Nuclear Power Plant.

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The accident of TEPCO Fukushima Dai-ichi Nuclear Power Plant (FNPP1) in March 2011 resulted in the release of many radioactive materials into the atmosphere. The radioactive materials deposited in the North Pacific were rapidly transported and diluted by advection and diffusion of seawater. Furthermore, water containing high concentrations of radioactive materials directly discharged into the ocean. Consequently, temporal and spatial changes in the distribution of radioactive materials in the North Pacific were larger as compared with that on land. In late March, the Japanese Government and TEPCO began monitoring of marine radioactive contamination. In addition, many valuable data were obtained during cooperative cruises of the research and training vessels belong to the government, universities, and research agencies, or volunteer ships. In June 2012, a new research project, “Interdisciplinary Study on Environmental Transfer of Radionuclides from the Fukushima Daiichi NPP Accident” started. In this project, nearly 50 researchers participated and achieved many scientific findings. The number of observational data of radiocesium (^{134}Cs and ^{137}Cs) are much larger than those of other radioactive nuclides, such as radiostrontium (^{90}Sr) and radioiodine (^{131}I). The discussion about radiostrontium and radioiodine only concerns the relative amount ratio to radiocesium. Because cesium is easily soluble in water, most of radiocesium released into the ocean exists as a dissolved form. So far, it has been revealed that (1) the total amount of atmospheric deposition and direct discharge into the North Pacific was 10-20 and 2-6 peta (10^{15}) Bq, respectively, (2) radiocesium has been spread throughout the North Pacific due to surface currents and subduction of surface water (formation of mode water) in winter, and (3) the concentration in seawater increased to more than 10^{7} Bq/m^{3} at the beginning of the accident and have decreased to almost the concentration before the accident (about 1 Bq/m^{3}) except for the area near FNPP1. The southward transport due to the formation of mode water was faster than that expected although the specific mechanism is unknown. The radiocesium concentration in seabed soils off Fukushima Prefecture increased to several hundred Bq/kg just after the accident, and it has been decreasing. Its rate of decrease, however, was slower than that of dissolved radiocesium in seawater, and the average concentration at present (about 10 Bq/kg) is still higher than the concentration before accident (about 1 Bq/kg). The radiocesium concentration in the fish collected at the coastal and offshore areas of Fukushima Prefecture was also measured at a high value of 10^{3}-10^{4} Bq/kg just after the accident, and now most of the measured data are less than 100 Bq/kg (the regulatory limit in seafood in Japan). However, these are still higher than the value before the FNPP1 accident (about 0.1 Bq/kg). This is likely to be influenced by radiocesium in the seabed soil. However, the particular route from the soil to fish body is unknown. Radiocesium activity concentration measured in the ocean at present is far below the concentration level that may directly affect the human body. Providing of scientifically-correct information on the marine radioactive contamination to the international community is one of Japan's responsibilities as a responsible country for the FNPP 1 accident. It is also important to promote geochemical studies to quantitatively discuss seawater circulation and material circulation in the North Pacific, using radioactive materials from the FNPP1 accident as tracers. Finally, I would like to propose (1) clarification of role sharing and responsibilities among operators, local governments, and the central government in monitoring of marine radioactive contamination, and (2) formulation of an efficient operation plan for limited ship-observation opportunities in the emergency.

Keywords: Fukushima Dai-ichi Nuclear Power Plant accident, radiocesium, marine radioactive contamination

