Possibility of F1NPS-derived radio-caesium in fish of Eastern China Sea as bio-indicator for ocean tracer

Yutaka Tateda,[1,]* Hyoe Takata,[1] Yayoi Inomata, [2] Yasunori Hamajima, [2]and Tatsuo Aono [3]

[1]Fukushima University, 960-1296 Fukushima, Japan
[2]Kanazawa University, 923-1224, Ishikawa, Japan
[3]Fukushima Institute for Research, Education and Innovation, 960-1295,Fukushima, Japan

* *e-mail: r454@fukushima-u.ac.jp*

The radio-caesium in environment around Japan after the Fukushima-Dai-ichi Nuclear Power Station (F1NPS) accident, were reported, and was demonstrated to be depurated enough as below the seafood safety regulatory level. Although data was accumulated around Japan main land, it was not enough data from the Eastern China Sea (ECS), where the F1NPS-derived radio-caesium was suggested to be transported to mid layer water by the Subtropical Mode Water (STMW), Central Mode Water (CMW) and to surface water by North Equatorial Current (NEC) (Kumamoto et al., 2018; Aoyama et al., 2019; Takata et al., 2018; Huang et al., 2021) for the ECS. In this study, the necessary issues is extracted by data evaluation and pre-examination of radio-caesium levels in biota and seawater in the ECS waters, to check the feasibility of bio-indicator application as tracer for ocean circulation, from the viewpoint from global distribution and temporal level records collected from ECS for further understanding (Inomata and Aoyama, 2023). As a result, the released radio-caesium to Pacific Ocean by the F1NPS accident was confirmed to be brought to the ECS followed by go around to Sea of Japan (SOJ)(Inoue et al., 2020). On the other hand, F1NPS-derived ^{137}Cs radioactivity concentration in surface water off Okinawa was estimated to be 0.3 mB l^{-1} in 2020. The measured ^{137}Cs radioactivity concentration in fish muscle collected off Ishigaki, Okinawa was approximately <0.31-0.88 Bq kg-ww^{-1} in 2024, being greater than expected radioactivity levels extrapolated from the exponential decrease before 2010. Therefore, depuration delay might be contribution from F1NPS-derived ^{137}Cs, whereas, it was not clear the supply source to be STMW or ECS. The ^{137}Cs radioactivity concentrations in open water surface fish reported around Taiwan, demonstrated the similar depuration delay, and suggested remaining issue to be source identification of global fallout or NEC brought radio-caesium. Possible way to verify supply source to ECS waters could be data of ^{134}Cs, however, the radioactivity levels in seawater decreased below the detection limit due to radioactivity decay during 14 years. Since fish muscle has concentration ratio (CR) of 100 for piscivorous fish, which may enable detection of ^{134}Cs in 2025.

Reference

Kumamoto et al., 2018, Time evolution of Fukushima-derived radiocesium in the western subtropical gyre of the North Pacific Ocean by 2017. J. Radioanal. Nuclear Chem., 318, 2181–2187

Aoyama et al., 2019, Fukushima radionuclides in the marine environment from coastal region of Japan to the Pacific Ocean through the end of 2016. Progress Nuclear Sci. Technol., 6, 1-7

Takata et al., 2018, Appearances of Fukushima Daiichi Nuclear Power Plant-Derived ^{137}Cs in Coastal Waters around Japan: Results from Marine Monitoring off Nuclear Power Plants and Facilities, 1983−2016. Environ. Sci. Technol., 52, 2629−2637

Huaong et al., 2021, Radiocesium in the Taiwan Strait and the Kuroshio east of Taiwan from 2018 to 2019. Sci Report, 11, 22467

Inomata and Aoyama, 2023, Evaluating the transport of surface seawater from 1956 to 2021 using ^{137}Cs deposited in the global ocean as a chemical tracer. Earth Syst. Sci. Data, 15, 1969–2007

Inoue et al., 2020, Circulation paths of ^{134}Cs in seswater southwest of Japan in 2018 and 2019. J. Environ. Radioactivity, 106382