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Freshwater sediments and sludges: two important terrestrial sinks for emissions from damaged NPPs

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Surface deposition of radionuclides released from the damaged Fukushima NPPs is well documented and emissions to the Pacific Ocean and their distribution with time and space are also subject to monitoring and research. In both cases, solid matter (soil and sea sediment, respectively) acts as a sink for radioisotopes after their transport through air and water. The possible hazards from direct irradiation of workers and public and from entry of radionuclides into food chains are well recognized.

Apart from direct deposition onto soil, plants, building roofs etc., aerosols and contaminated rainwater will reach surface waters, leading to long-term deposition in freshwater sediments (and possibly to interim contamination of drinking water). In populated and industrial areas, drained rainwater will enter the wastewater collection and treatment chain if a combined rain and wastewater sewer is used. Depending on the processes in the wastewater treatment plant and chemical element and speciation, the isotopes will either concentrate in treatment sludge or be released with the effluent to rivers and lakes and their sediments.

The mentioned media may act as long-term storage for radioisotopes when disposed of properly, but can also contribute to direct irradiation of workers or public, lead to continuous releases to the environment and possibly enter the food chain in the same way as soil and sea sediments. It appears therefore essential to monitor these environmental compartments as well.

However, very few data on Fukushima-related radioisotope concentration in sludges and freshwater sediments have been published to date. We will therefore compare data for regional surface deposition and related concentrations in surface water, river sediments and sewage sludge obtained in Europe during 1986 to published data from Japan in 2011 for the most important common short-lived (I-131, half-life = 8.02 d) and long-lived (Cs-137, half-life = 30.17 yr) isotopes. As in central Europe the Chernobyl fallout was not accompanied by other catastrophic events, well documented time series of data exist.

It might become possible to estimate sludge and sediment isotope concentrations in Japan by proportionality considerations and by application of transport models when no or insufficient current data exist. Additional insight into transport processes can be obtained from ongoing investigations of medically used I-131 in wastewater and rivers. The results might help in identification and remediation of possibly emerging hazards.