Sediment fingerprinting by using the Ag-110m: Cs-137 ratio along the main rivers draining the Fukushima radioactive pollution plume

Caroline Chartin, Olivier Evrard, Yuichi Onda, Jérémy Patin, Irène Lefèvre, Sophie Ayrault, Hugo Lepage, Philippe Bonté

Geophysical Research Abstracts
Vol. 15, EGU2013-2935, 2013
EGU General Assembly 2013

Sediment fingerprinting by using the Ag-110m: Cs-137 ratio along the main rivers draining the Fukushima radioactive pollution plume

Caroline Chartin (1), Olivier Evrard (1), Yuichi Onda (2), Jeremy Patin (2), Irène Lefèvre (1), Sophie Ayrault (1), Hugo Lepage (1), and Philippe Bonté ()

(1) Laboratoire des Sciences du Climat et de l'Environnement, UMR 8212, GIF-SUR-YVETTE, France, (2) Department of Environmental Radionuclide Transfer, Center for Research in Isotopes and Environmental Dynamics, University of TSUKUBA, Japan

During the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident, large quantities of radionuclides were released into the environment between 12 and 19 March 2011. Even though about 80% of these emissions were transported offshore and out over the Pacific Ocean, 20% were deposited as wet and dry deposits on soils of Fukushima Prefecture on 15–16 March. In particular, 6.4 PBq of Cs-137 were modeled to have deposited on Japanese soils over a distance of 70 km to the northwest of the Fukushima Dai-ichi nuclear power plant. As most radionuclides are strongly sorbed by fine particles, and their mineralogical clay and organic matter fractions, they are likely to be redistributed within the landscape in association with soil and sediment particles transported by erosion processes and runoff. Based on a spatial analysis of the gamma-emitting radionuclides present in the environment respectively eight and thirteen months after the accident, we aim to provide a radioactive tracer to investigate the temporal evolution of the contaminant dispersion across Fukushima Prefecture.

For this purpose, sediments were collected along rivers draining the main contamination plume in Fukushima Prefecture (i.e, Rivers Kutchibuto, Mano, Nitta and Ota) in November 2011 and April 2012.These campaigns directly followed the main hydro-sedimentary events that occurred in this region, i.e. the typhoon season (July and September-October) and the snowmelt (March 2012). The river sediment activities in gamma-emitting radionuclides were then compared to the initial activities measured in soils provided by the Japanese Ministry of Education, Culture, Sport, Science and Technology (MEXT).

The initial fallout patterns in 110mAg appeared to differ from those of the main contamination plume defined mainly by radiocaesium fallout (i.e. Cs-134+137). The Ag-110m:Cs-137 ratio was then used to trace the spatial origin of contaminated sediment collected in rivers. Sediments collected within the coastal plain in November 2011 were locally composed of 50 to 100% of particles originated from inland mountains ranges that were exposed to the highest initial radionuclide fallout. Typhoons of the summer 2011 have then largely contributed to the dispersion of the contamination. In addition, the spatial analysis of river sediment contamination in April 2012 demonstrates that the spring snowmelt amplified significantly the flush of sediment deposited on the riverbed after the summer typhoons.

Consequently, export of contaminated particles appears to be particularly fast in those mountainous catchments submitted to a very erosive climate. Our results have then important implications suggesting that coastal rivers may have become a perennial source of radioactive contaminants to the Pacific Ocean off Fukushima Prefecture.