What are the main sources of Fukushima-derived radionuclides to the ocean off Japan five years later?

V. SANIAL[1], K. BUESSELER[1], M. CHARETTE[1], N. CASACUBERTA[2], M. CASTRILLEJO[3], P. HENDERSON[1], X. JUAN DIAZ[3], J. KANDA[4], P. MASQUE[3,5], S. NAGAO[6], J. NISHIKAWA[7], S. OTOSAKA[8] AND S. PIKE[1]

[1]Woods Hole Oceanographic Institution, USA
[2]Laboratory of Ion Beam Physics, ETH-Zürich, Switzerland
[3]Universitat Autònoma de Barcelona, Spain
[4]Tokyo University of Marine Science and Technology, Japan
[5]School of Science. Edith Cowan University, Australia
[6]Kanazawa University, Japan
[7]Tokai University, Japan
[8]Japan Atomic Energy Agency, Japan

On March 11, 2011, an earthquake followed by a tsunami triggered an unprecedented nuclear accident at the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) leading to large releases of radionuclides to the ocean, in particular the isotopes of cesium (^{137}Cs & ^{134}Cs). Cs activities in the coastal ocean off Japan dropped by orders of magnitude within one month after the accident but have remained relatively constant over the past 5 years exceeding background values. That being said, we observed, and Japanese data confirm, a significant increase in Cs activities in coastal waters during fall 2015.

However, our highest Cs activities in October 2015 were not found in the ocean, but in groundwater samples underlying coastal beaches 35 km South from the FDNPP. This may be due to sorption of the extremely contaminated waters on to beach sands/clays early after the accident and subsequent desorption back in to the ocean.

Groundwater has been infiltrating the FDNPP reactor buildings and transforming into highly contaminated radioactive water; massive efforts attempt to store the wastewater in 1000's of tanks and to remove radioactive contaminants prior to release. Over the past 5 years, TEPCO has acknowledged accidental inputs to the local aquifer. Submarine groundwater discharge (SGD), which is widely recognized to be an important vector for the transport of chemicals from land to ocean, is thus a non-negligible path for tranport of Fukushima-derived radionuclides to the ocean.

We will present naturally occuring radium isotope data, in seawater and in surficial aquifers in the surrounding area of the FDNPP. Ra data are used to quantify the flux of Cs associated to SGD and to estimate the residence time of enriched Cs coastal waters off Japan. Strontium (^{90}Sr) data will also help to constain the origin of Cs enrichment.