Gaining novel insight into uranium-containing Fukushima Daiichi derived fallout

P.G. MARTIN [1*], D.A. RICHARDS [2], Y. YAMASHIKI [3] AND T.B. SCOTT [1]

[1] University of Bristol, Interface Analysis Centre, School of Physics, Bristol, BS8 1TL, UK
[2] University of Bristol, School of Geographical Sciences, Bristol, BS8 1SS, UK
[3] University of Kyoto, Graduate School of Advanced Integrated Studies in Human Survivability, Kyoto, Japan.
(*correspondence: peter.martin@bristol.ac.uk)

Over the five years since the INES Level 7 rated accident at the Fukushima Daiichi Nuclear Power Plant (FDNPP), a considerable effort has been made in the remediation of large contaminated areas; with an even greater focus being directed to the understaninding of the physical properties and environmental behaviour of this contamination. However, this work has centred on the analysis of the medium-lived fission product isotopes of cesium, Cs-134 and Cs-137, with half-lives of 2.065 and 30.17 years respectively, with limited work on the longer-lived and frequently forgotten species such as uranium.

Using surface sediment and organic samples collected from Iitate Village, located on the main plume line 35 km north-west of the FDNPP, individual sub-micron uranium-containing particles were extracted from the material using combined high-resolution electron microscopy and in-situ nano-manipulation with an electron polymerising adhesive.

Through initial synchroton radiation μ-XAS analysis of this particulate at the Diamond Light Source (UK), it has been observed that the particles extracted are comparable to a reference Uraninite material – strongly indicating their provenance as spent fuel originating from the Fukushima reactors. In addition to these uranium containing particles, comparable sized fragments composed of fission and activation products are found within the bulk samples. The size of these particles, in the order of 200 – 500 nm, are consitent with those encounted by Abe et al [1] observed to occur as nuclei in the centres of larger micron-sized spherical particles collected some distance from the reactor site, composed predominantly of cesium.

The small size of these fragments has strong implications for both humans and animals in the affected regions, with their size being conducive to inhalation and internal exposure.

[1] Abe et al (2013), Analytical Chemistry 86, 8521-8525.