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On site measurement of radiation dose around the radiation-contaminated surface soil

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On site measurement of radiation dose is a useful tool for mineral exploration of uranium resources. Based on the contribution airborne and carborne mapping, many world-class uranium mineral deposits were discovered in north America and Africa.

We attempted to measure radiation dose around the radiation-contaminated surface soil, caused by the nuclear accident at the TEPCO Fukushima No.1 nuclear Power Plant. Four nuclear reactors went out of control and caused large scale radioactive pollution. The measurements were performed on March 26th and April 2nd, 2011, based on the idea that the radiation dose caused by Iodine-131 (half-life 8 days) will be the best radionuclide tracer for mapping of radiation-contaminated surface soil.

We used Geiger-Muller counter, Cesium iodide (CsI) scintillation counter, ionization chamber type survey meter, and gamma-ray spectrometer, for measuring radiation dose around the radiation-contaminated surface soil at service areas (SA) and parking areas (PA) along Jyo-ban highway (from Chiyoda PA to Yotsukura PA) and Ban-etsu highway (from Sashio PA to Abukumakogen SA).

The radiation dose increased with approaching the TEPCO Fukushima No.1 nuclear Power Plant. The radiation dose of March 26th around the surface soil at Hitachi-chuo PA (98km away from the Fukushima No.1 nuclear Power Plant) were 5.3 microSV/hour and 1.7 microSV/hour by the ionization chamber type survey meter and Cesium iodide scintillation counter, respectively. Meanwhile, their radiation dose of April 2nd were 2.7 microSV/hour and 0.8 microSV/hour, respectively. The radiation dose of March 26th around the surface soil at Yunotake PA (49km away from the Fukushima No.1 nuclear Power Plant) were 40.4 microSV/hour and 7.8 microSV/hour by the ionization chamber type survey meter and Cesium iodide scintillation counter, respectively. Meanwhile, their radiation dose of April 2nd were 22.2 microSV/hour and 3.6 microSV/hour, respectively. The radiation dose measured by the ionization chamber type survey meter is significantly higher than the Cesium iodide scintillation counter, because the ionization chamber type survey meter is capable to measure both beta and gamma rays, whereas the Cesium iodide scintillation counter can monitor only gamma rays.

These data suggest that the radiation came mainly from the beta and gamma rays caused by the disintegration of Iodine-131. The gamma ray spectral graph obtained by the 2 inch NaI(Tl) scintillation gamma-ray spectrometer also suggest the gamma rays of Iodine-131 is the major source of the gamma rays.

The radiation dose of April 2nd around the surface soil at the Usuishi elementary school playground in Iitate village, Fukushima prefecture were extremely high (93.3 microSV/hour) by the ionization chamber type survey meter, suggesting the radioactive contamination of the rainwater made surface soil radioactive.

Keywords: Fukushima No.1 nuclear Power Plant, Geiger-Muller counter, Cesium iodide scintillation counter, ionization chamber type survey meter, gamma-ray spectrometer, radiation-contaminated surface soil