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福島第一原発事故後の堆積物中における粒径別の放射性セシウム存在量分布とその挙動
The distributions and behavior of radiocaesium according to grain sizes in sediments after the FDNPS accident

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The Fukushima Dai-ichi Nuclear Power Station (FDNPS) accident in March 2011 led to releases of large amounts of artificial radionuclides including ^{134}Cs and ^{137}Cs (radiocaesium) into the environment (ocean, atmosphere and land). As of February 2015, based on TEPCO's monitoring data, ^{137}Cs activities in seawater had exponentially decreased more than 10 times compared to the activities before the FDNPS accident. However, the activities in sediments have decreased more slowly than those in seawater and they have had large fluctuations. Some controversy remains about the radiocaesium transition process from seawater to sediments and its behavior after accumulation. In soil and sediments, the radiocaesium activities for finer grain sizes tend to be higher because specific surface areas of smaller grains are larger (e.g. He and Walling, 1996). Therefore, it is necessary to consider the differences of grain size composition in sediments in order to compare distributions of lateral and vertical radiocaesium activities and inventories in coastal sediments, which are commonly of several grain sizes. This study was aimed at elucidating spatial variation and the behavior of radiocaesium activities and inventories for different grain sizes in sediments collected in the Fukushima coastal area in May 2014.

The sediments were divided into four classes based on grain sizes using several mesh sizes: granules (grain size larger than 2 mm); very coarse to coarse sand particles (1 to 2 mm); coarse to very fine sand particles (0.063 to 1 mm); and silt particles (smaller than 0.063 mm). Radionuclides were measured for each grain size class using high-purity gamma ray spectrometry and then corrected to the sampling date.

In collected sediments, the only artificial radionuclides detected were radiocaesium. In the surface layer of sediments (0-5 cm), the percentage ranges were: granules, 0 to 23 %; very coarse to coarse sand particles, 0 to 39 %; coarse to very fine sand particles, 38 to 98 %; and silt particles, 0 to 46 %. The^{137}Cs activities for coarse to very fine sand particles and silt particles ranged from 8.5 to 609 Bq kg^{-1}-dry and 18 to 1487 Bq kg^{-1}-dry, respectively and the latter particle activities were higher than those for the former particles in most layers. The ^{137}Cs inventories for coarse to very fine sand particles ranged from 972 to 3285 Bq m^{-2} and those in the water depth range of 100 to 150 m were highest. The ^{137}Cs inventories for silt particles ranged from 1387 to 31321 Bq m^{-2} and they decreased with increasing water depth.The fractions of ^{137}Cs inventories in the uppermost layer of sediments (0-3 cm) to those in the surface layer of sediment (F'$_{0-3}$) for coarse to very fine sand particles and silt particles were 0.33 to 0.88 and 0.24 to 0.77, respectively. The F'$_{0-3}$ values for silt particles were lower than those for coarse to very fine sand particles. It appeared that silt particles more easily adsorbed radiocaesium that had been transported to a deep sediment layer compared to coarse to very fine sand particles.

He, Q., and Walling, D., E. (1996) Journal of Environ. Radioact, 20 (2), 117-137.

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