The origin of radioactive cesium deposited in the Abukuma River estuary and its sedimentation process

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Abukuma River was through contaminated area by radiocesium released from the Fukushima Daiichi Nuclear Power Station accident, flows into Pacific Ocean at Miyagi Prefecture. Abukuma River plays an important role in the transport process of radioactive material into the ocean from the radioactive contamination area. In this study, spatiotemporal distribution of radiocesium in the sediment collected from the Abukuma River estuary was investigated. We have estimated the spill source and transport process of radiocesium absorbed onto sedimentary material deposited in Abukuma River estuary.
Sampling site was set up 22 points in the 500 m mesh in the Abukuma estuary. The sediment samples were collected from 19 sites on March 20, 2013, and 22 sites on September 2, 2013, and 6 sites on January 26, 2014. It was to evaluate the depositional environment of the sediment from the time change of the water quantity in the Abukuma River estuary. Water level of Abukuma River in past 3 months from March 2013 and January 2014 was almost constant. On the other hand, water levels were varied drastically by “Heisei 25 Yamagata Heavy Rain” before 2 months from September 2013. In this result, it is assumed that the sediment collected on March 2013 and January 2014 was deposited in Abukuma River estuary during steady-state. Although the sediment collected on September 2013 was precipitated in the estuary are probably transferred from the land by flood. The concentration of radiocesium of sediment that may have precipitated at the flooding was high. On the other hand, that in steady-state showed a lower. Therefore, we investigated the relationship between the particle size of sediment and radiocesium concentration. The flood sediment had a small particle size, but particle size of steady-state sediment was large than flood sediment. Relationship of the concentration of radiocesium and the particle size of sediment in Abukuma River estuary was in accordance with the inverse square law.
This suggest the radiocesium is absorbed on the specific surface area of the sediment particle. It is not contradictory that the radiocesium penetrate to the surface layer of particle such as clay mineral and absorbed with ion exchange. The particle size of typical flood sediment was 10-70 μm and the concentration of radiocesium was 300-10000 Bq/kg. On steady-state sediment, it was 100-600 μm and 10-800 Bq/kg. From the result, the atom numbers of radiocesium adsorbed on the sediment particle was calculated. The values were $0.8\text{-}8\times10^{10}$ n/m^2 in the particle of 10-20 μm average diameters, and $0.2\text{-}3\times10^{10}$ n/m^2 in 100-200 μm. The atom numbers of radiocesium adsorbed for the individual particles was also calculated. The number was 3-500 atoms in the particle of 10-20 μm average diameters, and 300-10000 atoms in 100-200 μm particle. The adsorption atom numbers of radiocesium per the specific surface area of the sediment particles differed clearly in the steady-state sediment and the flood sediment. It means that the outflow origin of the flood sediment and the steady-state sediment deposited in the Abukuma River estuary is different. The outflow origin of radioactive contaminated particles from the catchment area of Abukuma River was estimated by the geochemical method. The concentration of some major and minor elements such as iron, calcium, titanium, mercury and lead between the flood sediment and the steady-state sediment was much different. It was considered that this difference reflects the difference of outflow source in comparison with the Geochemical Map. The major source of radiocesium accumulated in the

Abukuma River estuary was estimated to be highly contaminated particles in the middle basin in which was transferred in the flood caused by heavy rain. In the steady state, a highly contaminated particles is blocked in many dams in the river.

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