Transfer Rate of Radionuclides between Chemical Species in Sea Water, and Their Incorporation into Phytoplankton

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Abstract

Radionuclides, which are released from nuclear industry facilities and deposited on the surface of water expanses such as lakes and oceans, are considered to be initially in ionic forms, and then they are removed from the water system as particulates after various chemical and biological reactions. This study aims to clarify the transformation rate of ionic radionuclides to various chemical forms and the effects of environmental parameters, such as salinity and microorganism activities, etc., on this rate, by adding the stable elements, Th and U to water samples. We have already reported results for fresh water and brackish water samples. Results for a seawater sample are presented here.

A seawater sample was collected from the coast at Rokkasho. An aliquot of a solution of lanthanoids and Th as ionic forms was added to the sample. After being allowed to stand for a predetermined period from 10 min up to 2 weeks, the particulate fraction in the sample was collected through a filter which had a pore size of 0.22 μm. The molecular size of organic materials binding the elements in the filtrate was analyzed with an ultra-filter with a cut-off size of 10 kDa. The target element concentrations in the particulate and filtrates fractions were analyzed by ICP-MS. Most of the added lanthanoids were found in <10 kDa fractions. The proportion of the particulate fraction of lanthanoids was less than 1 % in all time periods. Initial proportions of Th in particulate and >10 kDa fraction were 6% and 40%, respectively. The particulate fraction then increased to 17% at 1 d after the addition, and then decreased to 6% at 14 d.

Since microorganism activity is considered as one of the parameters affecting transformation of chemical form, the effect of phytoplankton on the transformation was investigated by adding target elements in ionic forms to aliquots of the incubation medium for *Anabaena curva*, which is the predominant species of the fresh water lake Ichiyanagi. An aliquot of a solution of ionic lanthanoids, Th and U or inorganic iodine as I^- or IO_3^- was added to the medium sample. After allowing this to stand for a predetermined period from 1 to 9 d, the medium samples were separated into three fractions using the method described above. Most of the added light lanthanoids and Th were changed to a particulate fraction less than 1 d after the addition. On the other hand, almost all of the added I^- and IO_3^- was retained in the <10 kDa fraction throughout the experimental period. Although the chemical form of iodine added as IO_3^- was retained as IO_3^- in the <10 kDa fraction, the added I^- was gradually oxidized to IO_3^-, and after 9 days, this reached 15% of the amount of added I.

The same experiment will be carried out for phytoplanktons in brackish water and seawater in the next financial year. To decide species to be used for the experiment, the species composition of phytoplanktons was surveyed in the brackish lake, Obuchi, and along the seacoast at Rokkasho. Dominant species in each of these water expanses were separated and their cultivation methods were established.

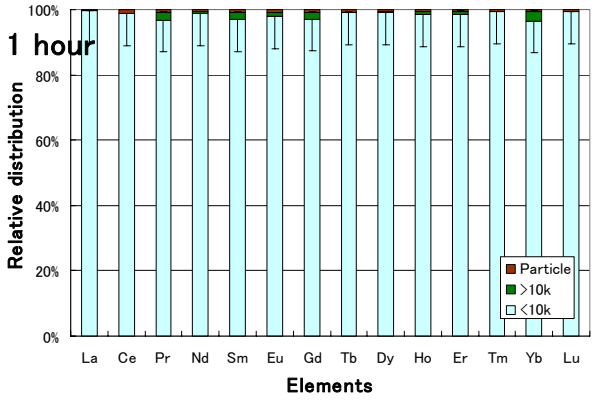

Fig. 1 Relative speciation of lanthanoids added to the sea water sample collected from the coast at Rokkasho

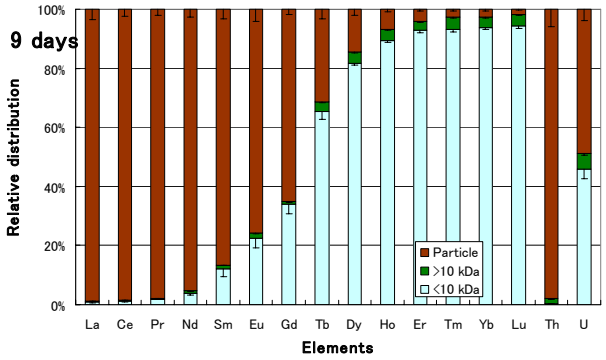

Fig. 2 Relative speciation of lanthanoids and Th, U 9 days after adding to the incubation medium of *Anabaena curva*

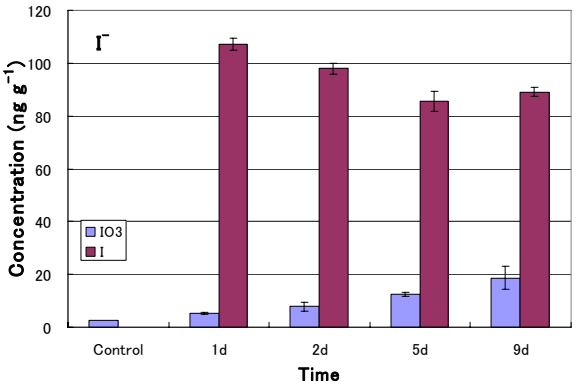

Fig. 3 Concentration of iodine and iodate in the incubation medium of *Anabaena curva* with added I^-