Chemical speciation of heavy metal elements in indoor dust by XAFS spectroscopy

H. YAMADA[1]*, H. QIN[2] AND Y. TAKAHASHI[1].

[1] Hiroshima University, Hiroshima 739-8526, Japan (*correspondence : m120941@hiroshima-u.ac.jp)
[2] Institute of Geochemistry, CAS

It is recently concerned that indoor dust can be a source of chemical materials which lead to adverse health effects for children. However, heavy metals in indoor dust have been poorly studied in Japan and China. Our previous study showed that lead (Pb), zinc (Zn), and antimony (Sb) were highly concentrated in indoor dust. Lead has been used for various industrial products, but low-level Pb exposure which leads to adverse health effect for children is concerned. Zinc is an essential element for living organisms, but can be a toxic if ingested excessively. The toxicity of Sb, which is recently recognized as an emerging element found environment, largely depends on the chemical state, especially the oxidation state. Thus, it is important to identify the chemical species of Pb, Zn, and Sb to understand their origins and assess their health effects for children. In this study, X-ray absorption fine structure (XAFS) was performed to identify the chemical species of heavy metal elements included in indoor dust and their origins.

The indoor dust was collected by a vacuum cleaner and, for comparison, soil outside of the same house was collected. The particle size fraction used for the analysis was smaller than 180 μm, the particle range of which can be ingested by children. Lead L_{III}-edge XAFS spectra for indoor dust samples in could be fitted with that of $PbCrO_4$, which was identified only in the indoor dust. It is suggested that the source of $PbCrO_4$ which may be derived from pigment possibly used in some materials indoors. Antimony K-edge bulk XANES and μ-XANES spectra of the indoor dust showed that the chemical state of Sb in most of the particles was Sb(V) which has a toxicity lower than Sb(III). Zinc K-edge bulk XANES spectra of the indoor dust collected suggested presense of ZnS originated from indoor materials.

Pu isotope in water column of the Sea of Okhotsk

MASATOSHI YAMADA[1]*, JIAN ZHENG[2] AND TATSUO AONO[3]

[1] Department of Radiation Chemistry,Institute of Radiation Emergency Medicine, Hirosaki University, Hirosaki, Japan, (*correspondence: myamada@cc.hirosaki-u.ac.jp)
[2] Research Center for Radiation Protection, National Institute of Radiological Sciences, Chiba, Japan (jzheng@nirs.go.jp)
[3] Fukushima Reconstruction Support Headquarters, National Institute of Radiological Sciences, Chiba, Japan (t_aono@nirs.go.jp)

The Sea of Okhotsk is a marginal sea of the weatern North Pacific Ocean, lying between the Hokkaido Island, the Sakhalin Island, the Kamchatka Penninsula, Kuril Islands and the Siberian coast, and is a highly productive marine ecosystem. Anthropogenic radionuclides such as ^{239}Pu (half-life: 24,100 yr), ^{240}Pu (half-life: 6,560 yr) and ^{241}Pu (half-life: 14.325 yr) mainly have been released into the environment as the result of atmospheric nuclear weapons testing. The objectives of this study are to measure the ^{239}Pu and ^{240}Pu concentrations and ^{240}Pu/^{239}Pu atom ratios in seawater from the Sea of Okhotsk and to discuss the transport processes of Pu.

Seawater samples were collected at Stn. CM-06 in the Sea of Okhotsk with acoustically triggered quadruple PVC large-volume sampling bottles during the Canis Minor Expedition of the R/V Hakuho-Maru. The ^{239}Pu and ^{240}Pu concentrations and ^{240}Pu/^{239}Pu atom ratios were measured with a double-focusing SF-ICP-MS, which was equipped with a guard electrode to eliminate secondary discharge in the plasma and to enhance overall sensitivity [1].

The ^{239}Pu and ^{240}Pu concentrations were 1.3 – 1.5 mBq m^{-3} in the surface water and they increased with depth; a broad maximum was identified at 1,000 – 2,000 m depth. The atom ratio of ^{240}Pu/^{239}Pu showed no notable variation from surface water to deep water of 3,000 m depth. The atom ratios in water column of the Sea of Okhotsk were higher than the mean global fallout ratio of 0.18. However, the atom ratios were slightly lower than those observed in the Japan Sea and the western North Pacific Ocean. The Bikini close-in tropospheric fallout Pu could be transported to the Sea of Okhotsk by ocean currents.

[1] Zheng & Yamada (2007) *Anal. Sci.* **23**, 611-615.

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