

EXAFS analysis of cesium in the sediment at Akagi Onuma

Takamasa Nagahashi^{1,*}, Haruaki Matsuura¹, Shun Imagawa¹,
Takafumi Uchiyama¹, Kyuma Suzuki², Shun Watanabe², Hajime Arai²,
Kin-ichi Tsunoda³, Masanobu Mori⁴ and Yukiko Okada¹

¹Cooperative Major in Nuclear Energy, Tokyo City University,
1-28-1 Tamazutsumi, Setagaya-ku, Tokyo, 158-8557, Japan

²Gunma Prefectural Fisheries Experimental Station,
13, Shikishima-cho, Maebashi, Gunma, 371-0036, Japan

³Gunma University, 1-5-1, Tenjin-cho, Kiryu, Gunma, 376-8515, Japan

⁴Kochi University, 2-5-1, Akebono-cho, Kochi, Kochi, 780-8520, Japan

1 Introduction

In the Lake Akagi Onuma, exceeding radioactivity of cesium over the standard value had been still detected from the lake water and aquatic lives due to the Fukushima Daiichi Nuclear Power Plant accident. Currently radioactivity of water decreased under the standard value, but a decreasing trend of the radioactivity of cesium of the lake was being slowly after 2015.

Since the continuous survey of the lake shows that dissolved Cs is dominant of radioactivity at a bottom of lake, we think that radioactive cesium might be eluted from bottom of lake sediment. Thus, in order to elucidate releasing mechanism of cesium from the sediment, we have investigated the local structure of cesium in sediment by EXAFS.

2 Experiment

We have collected the lake sediments in each depth fraction by the core sampler at central points of Akagi Onuma. Samples were freeze-dried, cut every 1 cm or 2 cm and milled with a mortar.

Samples in the environment can not be used as such for EXAFS experiments, thus 1M CsCl solution was added to lake sediment and stirred for 1 hour, precipitated for 1 hour to 24 hours to adsorb cesium, filtrated from the liquid and dried. EXAFS measurement was carried out at High Energy Accelerator Research Organization Photon Factory BL-27B, in transmission mode, using CsL_{III}-absorption edge.

3 Results and Discussion

Radioactivity of cesium in the lake sediment tends to gradually decrease until the depth of 20 cm from the surface of the bottom, but radioactivity of that in deeper than 20 cm has been scattered. Cesium dissolved in water is bonded via oxygen of 8 water molecules. In addition, cesium ion specifically adsorbed by clay minerals such as layered silicates forms much stabilized as an inner-sphere complex than hydrated state in solution.

Figure 1 shows that structure functions of Cs adsorbed sediments in each fraction, compared with that of Cs adsorbed in one of clay minerals. The peak of the first neighbor is a bond with oxygen of hydrated water, i.e., 2.8

Å. The peak of the second neighbor is considered to be oxygen of the clay minerals, i.e., 4.1Å. The coordination number of second neighbor of sediments with high radioactivity was higher than that of sediments with low radioactivity. It is found that the identification of second coordination is closely related to radioactivity.

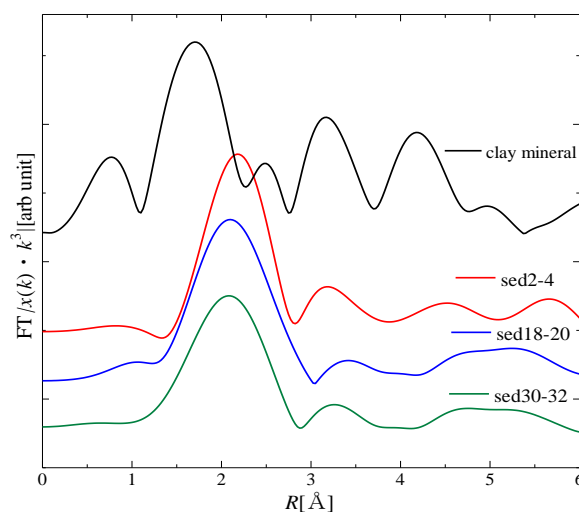


Fig. 1: Structure functions of Cs-adsorbed sediments and clay mineral in wet sample.

Acknowledgement

This work was financially supported by the JSPS KAKENHI Grant Number JP26292100, JP18K04995.

References

- [1] Y. Okamoto et al., Transactions of the Atomic Energy Society of Japan, vol.13, No.3, 113-118, (2014)
- [2] K. Suzuki et al, The Japanese Society of Fisheries Science, 82, 774-776 (2016)

* g1781013@tcu.ac.jp