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Behavior of Zinc in the sediments on Majuro Atoll

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1 Introduction

Reef island in atoll is composed of biological remains such as foraminifera and coral gravels made from calcium carbonate ($CaCO_3$) [1] Recently, anthropogenic impacts such as heavy metal contamination have been concerned in atolls due to the urbanization of islands. However, the element behaviours in sediments have not been clarified because previous studies have been limited the study area such as sea areas or aerosol particles. Therefore, this study aims to reveal subsequent postdeposition migration behaviour Zinc (Zn), which has negative impact on aquatic species. [2]

2 Sample

Samples were collected from inland area of Laura island in Majuro Atoll, Marshall Island, which has the oldest resident history in the atoll [3]. Samples were taken based on sediment profile in the soil trench excavated in 1×1 m^2 area in the center of Laura island at various depths with different colors and grain sizes.

3 Experiment

Zinc species in the sediments were estimated through X-ray absorption near-edge structure (XANES) methods at BL-12C in Photon Factory. To investigate the insoluble spices, we prepare two kinds of samples. One is natural sample and the other one is the samples extracted with acetic acid to identify insoluble Zn. These samples were homogenized using an agate mortar before the measurement. Zn K-edge XANES was obtained using 1.0 × 0.5 mm^2 beam. Transmission mode and fluorescence mode were used for measuring standard materials and samples to obtain Zn k-edge XANES spectra, respectively. The details of the measurement are similar to those that were described by Takahashi et al. (2007). [4] The least-squares fitting of the XANES spectra with the linear combination of various reference materials was carried out using REX2000 software (Rigaku Co., Ltd., Japan).

4 Results and Discussion

The results of bulk Zn K-edge XANES are shown in Fig. 1. The spectra of original samples are shown in blue and that of residual samples after extraction are shown in purple, whereas the spectra of Zn standard materials and results of LSF results are shown in black and dotted black. These results suggested that the dominant Zn species in the bulk sediments were Zn coprecipitated with both calcite and apatite, which are insoluble in water (Fig.1). Furthermore, the samples contained water-soluble species, such as $ZnCl_2$ and $Zn(NO_3)_2{\cdot}6H_2O$. As expected, water-soluble chemical species were removed from the three samples after the extraction. Consequently, the main Zn species found after the extraction were Zn which was coprecipitated with or adsorbed on apatite as identified through XAFS analysis (Fig. 1). These results and another measurements using ICP-MS [5] suggested that approximately 50% of Zn existed as water-insoluble Zn in apatite. The coprecipitation of Zn in apatite hinders the migration of Zn into deeper layers and groundwater. This inhibition of concentrated Zn from the surface sediment is highly important in terms of their exposure to aquatic organisms and even to the residents on Majuro Atoll.

In summary, our study suggested that natural attenuation mechanism by the sediment layer has been functioning in Majuro Atoll for heavy metals such as Zn. Our study also showed that speciation analysis of such elements is important to predict their mobility and subsequent influence on the ecosystem. More details can be found from Ito et al. (2018). [5]

References

[1] T. Yasukochi *et al*., *Geomorphology*. **222**, 59 (2014).
[2] H. Clements and M. Kiffney, *Can. J. Fish. Aquat. Sci.* **52**, 1966 (1995).
[3] T. Yamaguchi *et al*., *Pac. Sci.* **63**, 4 (2009).
[4] Y. Takahashi *et al*., *Geochim. Cosmochim. Acta*. 71, 984 (2007).
[5] L. Ito *et al*., *Chemosphere*. **202**, 65 (2018).

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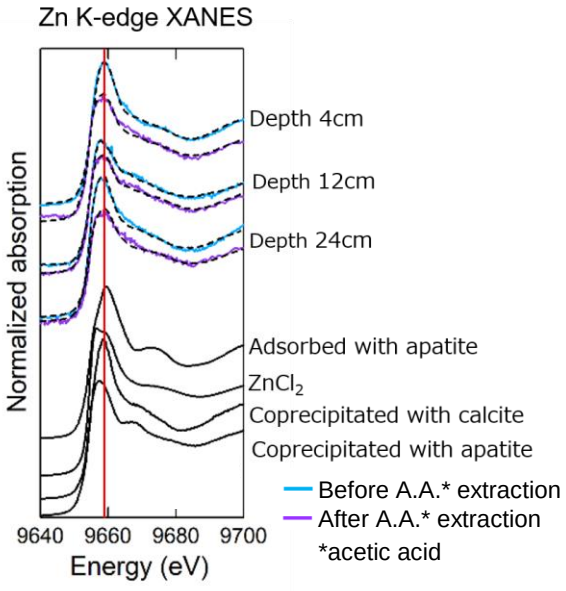

Fig. 1: Zn-K edge XANES spectra obtained from natural samples and the samples extracted with acetic acid.