Chemistry

9A, 12C/2003G085

The XAFS study of zinc in the Yatsu tideland sediments

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Introduction

In a brackish water area, where fresh water and seawater are mixed, the inside of the sediments becomes very complicated system, because sedimentation rate is quite high. There is the possibility that the chemical change in the sediments is affected by the degree of anthropogenic effect, which is largely different depending on a brackish water area of suburb. Under anaerobic environments in the sediments, the sulfate ion from seawater is reduced, and then various sulfides have been formed in the sediments. We have already studied the chemical state of heavy metals in the sediment of estuary and tideland, and revealed that several heavy metals such as iron, manganese and zinc exist in a form of sulfide [1] [2]. In order to obtain the vertical distribution of zinc sulfides, chemical state analysis of zinc by XAFS was carried out in this study.

Experimental

We collected sediments vertically in Yatsu tideland which is located at the east part of Tokyo and the tideland is assumed to be a non-polluted place. We also collected sediments vertically in Kitajukkengawa River which is urban river in Tokyo and the river is assumed to be polluted by human activity. The collected sediments were cut at every 3-5 cm length immediately, and then porewater was extracted by pressure filtration (5 atm, N_2). Approximately 300mg of each sample was mounted in a prolene film. The X-ray absorption measurement was made with synchrotron radiation by using XANES facilities on the beam line 9A and 12C. The radiation was monochromatized by Si (111) double crystals. The spectra were collected in fluorescence mode using Lytle-type detector at room temperature.

Results and Discussion

The zinc XANES spectra of each area sediment were obtained. The chemical states of zinc in the sediments were divalent in whole core of each area. But, the XANES spectra of zinc were changed a little influenced by the nearest neighbour atoms. However, the each component of Zn could not be determined from the spectrum. The partial least-squares (PLS) regression was employed to resolve Zn XANES spectra of sediments and quantify the species therein. For details of the PLS method, the papers written by Kuno et al. should be referred to [3]. Figure 1 shows vertical distribution of each component of Zn in the Yatsu-tideland and Kitajukkengawa-river sediments. The component of ZnS-like means Zn which has S ligand or the similar electronic state, and the component of $ZnSO_4$-like means Zn which has O ligand or the similar electronic state. The ZnS-like component increased in an upper part of middle layer in Yatsu tideland sediments, but in Kitajukkengawa River sediments it mainly existed from the surface part, and the proportion of the ZnS-like component was high. This difference may be explained that the surface layer of Yatsu tideland sediments exposed to the air. On the other hand, the surface layer of Kitajukkengawa River sediments was always covered with water, therefore the sediments become reducing condition from the surface layer. The high proportion of the ZnS-like component in Kitajukkengawa River sediments compared with Yatsu tideland caused by the difference of the surface water. The surface water of the Yatsu tideland mainly contains seawater which has high concentration of sulfate, whereas the surface water of Kitajukkengawa River mainly contains fresh water. Thus, the concentration of each component of Zn was determined by this method.

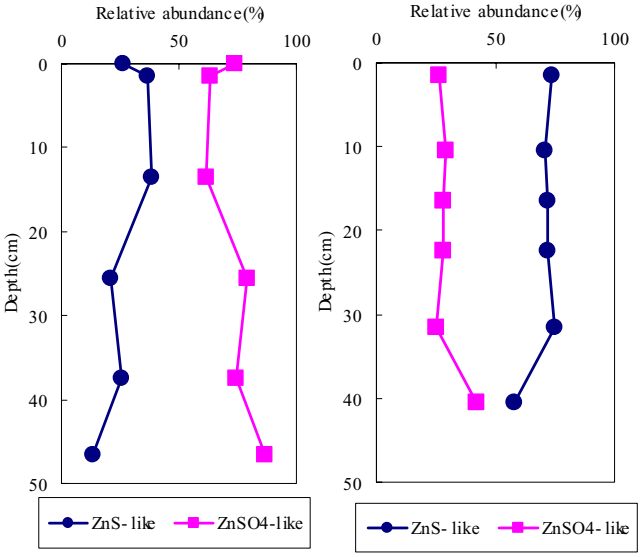

Fig. 1. The vertical distribution of two components of Zn in the Yatsu tideland (a) and Kitajukkengawa River sediment (b)

References

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