K-edge X-ray absorption near edge structure (XANES) spectroscopy for iron precipitates in biomats formed in arsenic mine water

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Introduction

The role of microorganism for the uptake of hazardous elements from groundwater should be clarified. The arsenic, one of the hazardous elements, contained in mine water of the abandoned arsenic mine is taken up by the precipitates in the mine water [1]. It was found that arsenic is sorbed by the iron containing minerals in the precipitates. In order to characterize the formed iron minerals, we have measured XANES spectra using PF.

Experimental

Iron minerals

The precipitates in the mine water were collected at the abundant arsenic mine at Shimonita-town in Gunma Prefecture, Japan. As the reference iron minerals, geothite, hematite, akaganeite, $FeSO_4$, Fe(II) sorbed smectite were used in the present study.

Characterization by XANES and XRD

The K-edge X-ray absorption spectra were in fluorescence mode at the BL-27B station of the Photon Factory at the High Energy Accelerator Research Organization (KEK). Synchrotron radiation from a storage ring operated 2.5 GeV with a beam current of 100-250 mA was monochromatized with a Si(311) double crystal monochromator.

Powder X-ray diffraction (XRD) was carried out using Co-Kα radiation to compare the methodology of characterization with XANES.

Results

XRD analysis

In the XRD pattern of the precipitate, no recognizable peak appeared. This indicates that the XRD measurable crystalline phases of iron minerals were not formed.

XANES analysis

The XANES spectrum of the precipitate (Fig. 1a) indicates that absorption at the edge region (7115 – 7135 eV) was observed. Absorption features of the XANES spectrum of the precipitates corresponded to that of akaganeite shown in Fig. 1b. On the other hands, absorption features of the XANES spectrum of FeOOH, pyrite and Fe(II) sorbed on clay mineral differed from that of the precipitates. These suggest that the precipitate occurred in the biomats contains the iron minerals of akaganeite like structure.

Since no peak in XRD pattern is observed, the crystalline phase of the iron mineral is very small in size.

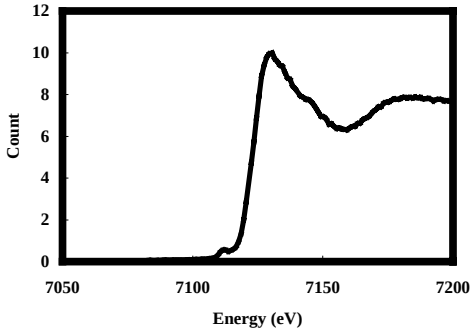

Fig1a XANES spectrum of the iron precipitates.

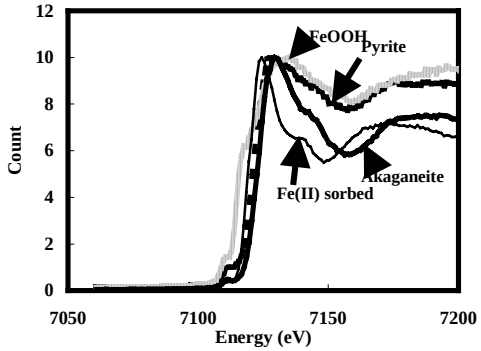

Fig. 1b XANES spectra of iron in FeOOH, pyrite, Akaganeite and Fe(II) sorbed on clay.

References

[1] T. Ohnuki et al., preparation for publication..

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