Molecular Understanding of the Mobility of Arsenic in the Sediments: An EXAFS and XANES Study

Jiin-Shuh Jean (簡錦樹)[1], Bibhash Nath[1], and Chun-Jung Chen (陳俊榮)[2]

[1]Department of Earth Sciences, National Cheng Kung University, Tainan, Taiwan
[2]National Synchrotron Radiation Research Center, Hsinchu, Taiwan

The mobility of dissolved arsenic is oxidation-state sensitive. As^{III} is commonly considered as more mobile in groundwater (Korte and Fernando, 1991). Sorption on different mineral surfaces is one of the principal processes that regulate the dissolved As in the aquatic environment (Anderson et al., 1975). Among the As-enriched phases in sediments, Fe-oxyhydroxides are known to play a prominent role in arsenic cycling (Aggett and O'Brien, 1985). Aqueous As speciation of groundwater in West Bengal (India) and SW Taiwan was established to show the dominance of As^{III} in groundwater (Gault et al., 2005; Nath et al., 2008). As for arsenic in aquatic phase, selective chemical extraction is often used to determine the dominant associations with the several likely solid phases using different extractants. Central to the establishment of the dominant mode of As release is the reliable elucidation of the sediment-phase chemical speciation of As. X-ray absorption spectroscopy (XAS) has been used widely recently as a technique for determining the solid-phase speciation of As in geological media, in part because of the difficulties associated with sequential extraction techniques (Smedley and Kinniburgh, 2002) but also because XAS has the potential to provide information on coordination environment and oxidation state. It provides structural and electronic information about As species in insoluble precipitates, as coated on mineral particles and in fine-grained primary minerals (Foster et al., 1998). X-ray absorption near-edge structure spectroscopy (XANES) provides information on As oxidation state whilst extended X-ray absorption fine structure (EXAFS) elucidates the coordination environment, the distance to neighbouring atom and the number, in addition to the oxidation state. In order to understand the solid phase speciation of As in natural sediments, this study examined the As-bearing sediments from India and Taiwan using the 17C1 W20 EXAFS beam line at NSRRC.

In this period of experiment we did XANES study of the As-enriched sediment to identify/quantify different As species in sediment. In NSRRC, during August 2007, lytle detector was used for the said purpose. We used 3 shifts and tried to establish the calibration data for the detection of different As species in sediments. Figure 1 below shows the calibration results for As(III) and As(V) species with concentration 100 mg/L. We also did calibration curve for different range of concentrations (e.g., 30, 100, 300 and 1000 mg/L). However, due to low sensitivity of the detector, we could not run our sample (unknown) for As speciation. Therefore, in our next beam line we will use more sensitive detector (germanium) that is available with NSRRC.

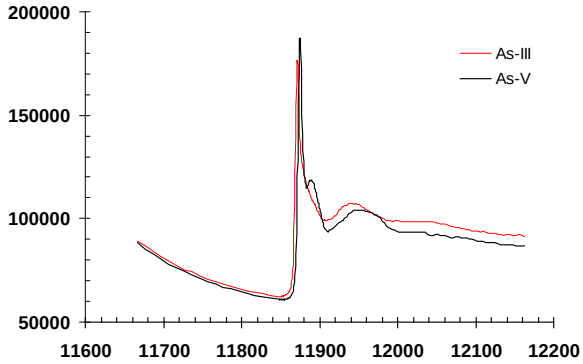

Figure 1. Calibration spectra of As(III) and As(V) containing 100 mg/L.

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