Effects of Iron and Sulfur on Transformation of Arsenic Species in Fluvial Sediments

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Abstract

Arsenic (As) is carcinogenic and toxic to ecosystems. The understanding for it's speciation, solubility, mobility and biotoxicity in the environment could improve the efficiency for the remediation of arsenic contamination. The common inorganic arsenic species are arsenite (AsO_3^{3-}[As(III)]) and arsenate (AsO_4^{3-}[As(V)]), and As(III) is more toxic than As(V).Studies have shown that under anaerobic conditions, the iron (hydrogen) oxidized minerals that adsorb or co-precipitate arsenic in the soil will be reduced and dissolved, which will release arsenic into the liquid phase and cause harm to the ecology. Therefore, if the influence of environmental factors on the concentration, solubility and species transformation of arsenic can be understood, it will help analyze and manage the movement and distribution of arsenic in river. Besides, numerous studies also indicated that the distribution of arsenic species is closely related to iron and sulfur in the environment. The environmental factors affect the mobility and the bindings between arsenic, iron and sulfur. Thus, this study aimed to determine the effects of sulfate and irons on the dissolution and species transformation of arsenic in fluvial sediments. Arsenic chemicals have been widely used in industrial and semiconductor manufacturing processes. Therefore, the fluvial sediments were collected from the Fazih River and the Wu River watersheds in the Taichung Industrial Park. They were amended with different sulfate-to-iron(SO_4^{2-}:Fe) molar ratios and incubated under anaerobic conditions for 30 days. Results showed that increasing addition of sulfur would cause more dissolution for arsenic and iron. The combination of sequential extraction procedure (SEP) and the X-ray absorption spectroscopy (XAS) data showed that dissolved arsenic may be released from the proportion complexed with organic matter and sorbed on poorly crystalline Fe and Al (hydr)oxides. XAS results suggested that arsenate was reduced to more toxic arsenite during the incubation period.

Keywords - Arsenic speciation; iron; sulfur; X-ray absorption spectroscopy; Sequential extraction procedure.