

Behavior of As and its related elements to causes groundwater As contamination in the aquifer sediment of Lakshmipur, Bangladesh

*Nozomu Hirai¹, Selim Reza, Harue Masuda¹

1.Osaka City university

Introduction

Arsenic contaminated groundwater has been the worldwide problem for more than three decades, and still the problem has been remained. Arsenic contamination is the most serious in the Ganges-Bramaputra-Meghna (GBM) river basin than any other places.

Highly As-contaminated groundwater appears mainly in the reducing aquifers. On the other hand, some researchers suggested that oxidation-reaction is important at the initial stage of the arsenic dissolution. In this study, we examined an arsenic dissolution processes based on the analyses of the aquifer sediments from Lakshmipur, downstream of Ganga in Bangladesh, where arsenic contaminated groundwater appears in reducing environment.

Methods

The samples of this study are cored sediments at each 5 ft down to 130ft depth. The sediment samples were chemically treated according to the BCR method (Rauret, *et al.*1998.). The BCR method is a convenient method to analyze the chemical components that are extracted by different types of solutions; 1. Acid soluble phase (mainly weakly adsorbed on the sediment particles and in carbonate minerals), 2.Reducible phase (mainly fixed in and/or strongly adsorbed onto iron oxyhydroxides and manganese oxides), 3.Oxidizable phase (mainly fixed as organic matters but including substances easily decomposed by oxidation), 4. insoluble phase (mainly silicates and sulfide minerals). The BCR cannot use to identify substances to fix the targeted components, e. g., arsenic in this study, but is useful for estimating the dissolution process of the components. The extracted solutions were analyzed using ICP-MS. The analyzed elements were Si, Fe, Mg, Ca, As. Mineralogy and bulk sediment chemistry were analyzed using XRD and XRF, respectively. Total arsenic concentration of the bulk sediments was quantified by ICP-MS.

Result and Discussion

Fe, Mg, Ca were the highest proportion in the insoluble phase. Positive correlation between Mg and Fe, and Fe and Si in the oxidizable phase and Mg and Fe of reducible phase gave a negative correlation. Mg and Fe, and Fe and Si in the insoluble phase gave positive correlations. These observations suggest the same source(s) of Mg, Fe, and Si. Fe and Mg in the reducible phase increased with depth suggesting that Fe and Mg bearing minerals were oxidized and decompose to precipitate as or with oxides/oxyhydroxides. .

The highest proportion of As existed in the insoluble phase, following reducible and , oxidizable phases, and the amount in acid soluble phase was small compared with the other As phases. As concentrations of the reducible and insoluble phases correlated with total As concentration, implying that a primary source of As was detrital minerals such as silicates and sulfides, of which oxidation-dissolution released the As into the groundwater. The As and Fe concentrations of oxidizable and insoluble phases had a negative correlation. Thus, the As released via decomposition of As bearing Fe mineral(s) would be adsorbed onto the Fe-oxyhydroxide/oxides.

XRD analysis demonstrated that the studied sediments comprised with Fe-Mg silicates; i. e., biotite, chlorite, and amphibole. Chlorite would be decomposed with increasing depth, or with age, based on the intensity of those basic minerals. Since the chlorite from Ganga basin contained considerable As (Masuda et al., 2012), oxidation-decomposition of chlorite would also be a mechanism to release As into the groundwater. However, the As level of groundwater after the

decomposition of chlorite is controlled by the adsorption equilibrium with Fe-oxyhydroxide.

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