Arsenic behavior and transport in groundwater

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1. Introduction

Groundwater arsenic (As) problem in Bangladesh is a serious environmental problem, where about 40 million people live in regions affected by As enrichment. Sources of As in the environment can be both natural as well as anthropogenic. A primary source of As in nature is the oxidation of As-sulphides like arsenopyrite, FeAsS, and As-rich pyrite and that was widely accepted at the beginning. An alternative theory, known as the Fe oxyhydroxide reduction, is now widely accepted as the principal mechanism of As mobilization in the groundwater of the alluvial aquifers (Nickson et al., 2000). Arsenic mobilization in groundwater also appears to be activated by intensive extraction of groundwater for irrigation and application of phosphate fertilizer (Acharyya et al., 2000). It is therefore evident that As mobilization in Bangladesh groundwater is a complex natural geochemical processes. So before developing a transport model, it is necessary to know the behaviors of contaminants with arsenic into the aquifers as well as different geological conditions. So the objective of this research is to identify the key chemical parameters for wide spreading arsenic contamination and to develop a numerical transport model considering hydrogeologial and geochemical parameters and verify with actual situations.

2. Materials and Methods

Firstly three study areas were chosen, Nawabganj (A), Faridpur (B) and Lakshmipur (C) which is shown in Fig. 1 and primary data has taken from British Geological Survey (BGS) and Mott MacDonald, 1999. BGS and other some researchers described the relationship between As and phosphorus (P) with very simple way and BGS showed that there is a positive relationship with them which is presented in Fig. 2. But the study areas data showed a wide range of P concentration and the trend was not similar with variable concentration of P. So it was important to analyze P and As relationship more precisely. In this study P was classified into different concentration levels as very low (P <0.01), low (P 0.01≤ to <0.3), medium (P 0.3≤ to <0.5), high (P 0.5≤ to <2.0) and very high (P 2≤ to more) (all P concentrations were in mg/L) and observed the relationships with As. In one research of BGS (1999) had taken P as low (0.008 mg/L) and high (0.8 mg/L) but this study's classification made by considering the actual situation of three areas.

3. Results and Discussion

The relationship between arsenic and P for all study areas was observed. In general it was observed that there was a positive correlation between P and As. But when it was checked according to different classified levels of P, the trends were not same in all classified levels. For instance, for together all areas data, it showed that at low P level, there was a positive correlation but it was negative in very high P level (Fig. 3). Again considering the study area A separately, it also revealed that for high P level, arsenic was negatively correlated and it was opposite for low level of P which is shown in Fig. 4 and area B also followed the same trend and for very high level P it was highest negative correlation with As which is shown in Fig. 5. But the situation was different in the area C as this area is located in the coastal belt and due to effect of excess salt; the reaction with other minerals was different from the other areas. The correlation coefficients between As and P for all conditions are presented in Table 1.

Fig. 1: Map showing study areas

Table 1: Correlation coefficients between As and P with different classified levels

	No. of Data	All level	Low P	Medium P	High P	Very high P
All Areas	263	0.103	0.176	-0.087	0.047	-0.204
A	125	0.158	0.234	-0.134	-0.046	-
B	64	0.137	-0.173	0.387	-0.252	-0.524
C	74	0.591	-0.141	0.441	0.549	0.685

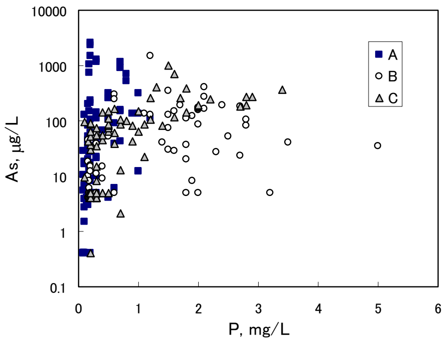

Fig. 2: Relationship between As and P for all areas

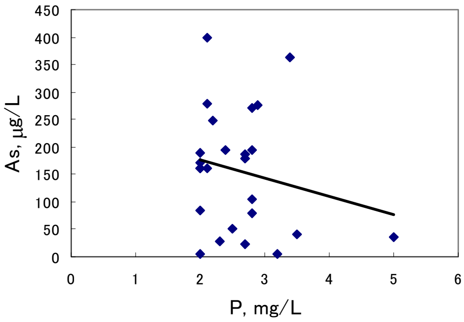

Fig. 3: Relationship between As and P at very high level for all areas

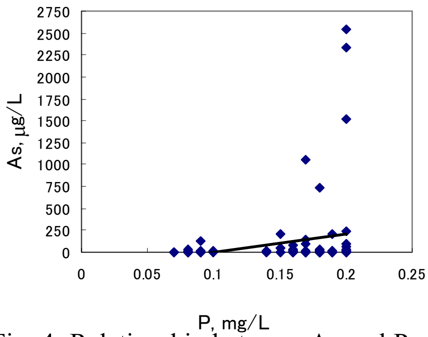

Fig. 4: Relationship between As and P at low level (for area A)

4. Conclusion

Overall relationships showed that in maximum cases there was a positive correlations with As and P at all and low levels for all locations and negative correlations with As and P at high and very high level except the area C. The effect of salt water on the relation between P and As might be appeared for the high P.

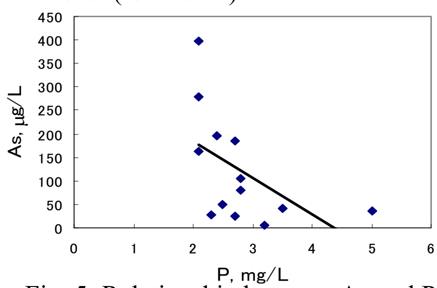

Fig. 5: Relationship between As and P at very high level (for area B)

Reference

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