Transportation process of arsenic in Red River, Vietnam

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Arsenic polluted groundwater in the Asian countries, including Red River delta in Vietnam, is known to occur via dissolution of As-bearing minerals in the aquifer sediments. However, the transportation process of As in the surface water to the aquifer sediments has not been well understood until now. Arsenic host phases in Red River of Vietnam territory are studied here to clarify how to accumulate the arsenic in the downstream groundwater aquifer.

Total dissolved solids was the highest at the uppermost stream in the Vietnam territory, adjacent to China (~3 mS/m as EC), decreased at the middlestream due to dilution by inflow of water from the western tributaries, and increased again in the downstream from Hanoi. Total As concentration (dissolved when HNO_3 was added in unfiltered riverwater) was the highest in the uppermost stream (10 ppb) and decreased toward downstream (~3 ppb) due to the inflow of diluted river water from tributaies originated from western high mountain region along the main channel of Red River. About 60% of the As of river water was dissolved phases, while the other 40% associates with suspended particles. Arsenic concentration changes concordantly with Pb, which behaves with suspended particles. Smectite concentration is high in the suspended particles separated from the river water containing higher As concentration. Fe-oxyhydroxides and gibbsite are ones of major phases of suspended particles, however, the As concentration does not correlate with the total Al and Fe of the river water. Thus, the As would be adsorbed onto clay minerals, but not Fe-oxyhydroxides.

Arsenic in the riverbed sediments (~12 ppm) is fixed mainly (>90%) in the insoluble phases, such as silicates and/or sulfides. Adsorbed As onto clay minerals would be less important as an As host phase compared to the detrital phase(s), although it is rather mobile than that fixed in the detrital minerals.