Source of arsenic in the Red River, northern Vietnum, estimated by lead isotopes

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Red River originates in southern China and flows out from northern Vietnam to the ocean. Red color suspended matters, which are mainly transported in the rainy season, are the name of this river. Arsenic contaminated groundwater appears in the Holocene aquifer of its downstream delta. The arsenic has been believed to be adsorbed onto Fe-oxyhydroxides in the aquifer sediments. In this report, the arsenic transportation process was traced based on the analyses of riverwaters, suspended particles and riverbed sediments of Red River in Vietnam territory. Total arsenic concentration of main channel water was as high as 40 ppb in the dry season at the uppermost location near the border to China, and >60 % of the arsenic was as dissolved component. In the rainy season, total arsenic concentration was <10 ppb. The total arsenic concentration of riverbed sediment ranges within 30 to 50 ppm, and most of the arsenic was in insoluble phases such as silicates and/or sulfides. The arsenic concentration gave highly positive correlation with lead concentration of the riverbed sediments, indicating the same source(s) of these elements. The lead isotopes gave the isochrons for 800Ma, i. e., Precambrian age. Precambrian rocks exposures in the source area of Red River in China territory. The arsenic was plausibly derived from this rock body or surrounding sedimentary formations including detrital materials derived from the Precambrian rock body. Although sulfide ore deposits occur along the Red River in China and Vietnam, the lead isotopes evidenced that the ore deposits were not the arsenic source. In conclusion, the arsenic in the Red River delta was transported by the detrital minerals derived from hinterland rock bodies.