

## Water pollution and arsenic behavior in the Red River, North of Vietnam

INOUE, Ryo<sup>1\*</sup>

<sup>1</sup>graduate school of science,Osaka City

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Inoue,R1.Shinntani,T1.Masuda,H1.Yonezawa,G1.Truong Xuanluang2.Hang Do Thi2.  
(1 Osaka City University, 2 Hanoi University of Mining Geology)

The Red River, flowing through the northern part of Vietnam, is originated in Yunnan, China and running parallel to the Hoang Lien Son mountain range. Arsenic pollution of groundwater has been a serious problem in rural area located on the Red River delta. The sources of arsenic must be carried to the aquifer through the river, although transportation processes are not well understood. In this study, arsenic transportation process through Red River was studied from the analytical results of river water, suspended particles, river-bed sediments which were collected in the Vietnam territory. In addition, general situation and the cause of the river water pollution was considered.

Total dissolved ions of river water sample is 5.0meq/L in Lao Cai located at the upper most stream in Vietnam, 2.4meq/L in Bao Ha and 2.1meq/L in Yen Bai at middle-stream, and 3.4meq/L in Hanoi at downstream. Low concentration of dissolved solids between Lao Cai and Hanoi is due to the inflow of the surface water from Hoang Lien Son mountain range. Such an inflow is clear from the lower oxygen and hydrogen isotope ratio of river water than those of main channel waters.  $\delta^{18}\text{O}$ : -9.9~-10.0 ‰ and  $\delta^2\text{H}$ : -69 ‰ in Lao Cai.  $\delta^{18}\text{O}$ : -12.9~-13.0 ‰ and  $\delta^2\text{H}$ : -91~-92 ‰ in the branch channel in Hoang Lien Son mountain range, and  $\delta^{18}\text{O}$ : -11.6~-11.9 ‰ and  $\delta^2\text{H}$ : -82~-84 ‰ in Bao Ha and Yen Bai at middle-stream. Branch channel water in Hoang Lien Son mountain range diluted the dissolved salts and pollutants such as As and Pb. Arsenic is transported as dissolved components (~60%) and adsorbed components (~40%) in the river.

Arsenic concentration has clearly positive correlation to the XRD intensity of smectite. Weak positive correlation between arsenic and kaolinite was also found. However, there is no relationships between arsenic and iron, indicating that the arsenic doesn't behave with iron oxyhydroxides in the river. And, smectite found only in suspended particles sample of Red River main channel water, thus, the arsenic is transported with clay minerals in the Red River.

Keywords: arsenic, Red River, Vietnam, Isotope