1. Introduction
Contamination of the earth’s ecosystems by potentially toxic metals/metalloids is a global problem in the industrialization era. The health impacts of pollution from the ingestion of potentially toxic metals/metalloids through respiration, foods, and drinking water are often long-term. Algeria is, nowadays, confronted with such risk under rapid industrialization and economic development. The Oued El Harrach river basin, one of the most industrialized zones in Algeria, has been studied. In the course of field survey, it was observed that various kind of solid wastes such as municipal and industrial solid wastes were disposed illegally in the river bed and along the river bank. It is also observed that industrial waste water and sewerage water were directly discharged into river stream. The mismanagement of waste and waste water has raised environmental pollution.

2. Samples and Analytical Methods
Sediment and water samples have been collected from selected sites shown in Figure 1. For the sediment samples, a 15.0 gm sample split was digested in 90 mL aqua regia (HCl-HNO3-H2O) at 95°C for one hour. The solution is diluted to 300 mL with distilled water and used for the chemical analysis. The aqua regia digestion of sediment extracts only a fraction of the major elements (pseudo-total analysis) because silicates are not completely dissolved with this method. Owing to this limitation, results are total to near total for trace and base metals and possibly partial for rock-forming elements such as Na, Mg, Al, K, Ca, Mn, and Fe. However, environmentally concerned components like heavy metals or potentially toxic metals/metalloids not bound to silicates are efficiently dissolved, which is indicative for the assessment of toxicity. The water samples were prepared for pH<2.0 with HNO3 and used for chemical analysis. Chemical analysis was made by an ICP-AES and ICP-MS.

3. Results of the Sediment Analysis
The results of analysis of sediment samples from AG-1, 2 and 3 collected in 2003 (see Figure 1), are shown in Figure 2. Based on the results, it was apparent that the concentrations of mercury (Hg) in sediments or sludge are extraordinary high level above international criteria (2 to 3 mg/kg).
Concentration levels of other potentially toxic metals/metalloids such as Cu, Pb, Zn, Ni, Co, Mn, As Cd, Sb, Cr, Ba, and Se, also indicated more or less above the environmental quality standard levels, which means there is undoubtedly a sediment contamination by potentially toxic metals/metalloids in the Oued El Harrach river.

**Figure 2:** Bar diagram shows the concentration of each potentially toxic metals/metalloids at AG-1, 2, and 3 (see Figure 1). Various marks of plot are show different values of NOAA criteria and environmental quality standards, where if the bar diagram exceed a plot, the concentration is more or less above the threshold values.

### 4. Results of Water Analysis

Five water samples were collected from Oued El Harrach river and the other two were from Oued Smar, tributary of the Oued El Harrach river, in 2004 (Figure 1). The results of water analysis confirmed that not only stream sediment but river water suffered severe potentially toxic metals/metalloids contamination. In particular, the concentration of Hg in river water is extraordinary high level (Figure 3). The Hg concentration of waste water in a chlorine factory using mercury electrodes, Baba Ali (No.8 of Figure 3) indicates 4.42 mg/L that is several hundred times larger than effluent limit in Algeria and international community. The contamination of mercury is probably caused by the direct discharge of industrial wastewater and waste into river stream without treatment.

**Figure 3:** Spatial variation of concentration of Hg from the chlorine factory of Baba Ali to the estuary of Oued El Harrach river, Algier. The sample IDs in horizontal axis indicate the site ID of 2004 in Figure 1. No.8 shows the data of waste water collected from the chlorine factory of Baba Ali.
5. Mechanism of Water/Sediment Pollution and Environmental Risk

A model of sediment and water contamination of Oued El Harrach is illustrated in Figure 4. First, the pollutants, mercury and other potentially toxic metals/metalloids, are discharged to Oued El Harrach river with un-treated waste water and/or solid waste. Second, the pollutants migrate into the river water/sediments and proliferate widely, where dilution and partially immobilization of the pollutants happen through forming water dissolved chemical forms as the following chemical/mineralogical/biological processes: Hg can be bonded with abundant organic matters and settled in the river bottom, however the bonding state is probably not very stable. Most of dissolved Hg can be adsorbed and/or cation-exchanged by clay minerals, that was confirmed by mineralogical study. Under an anoxic condition, Hg can be precipitated as a sulfide (HgS), which partially immobilize the Hg. Biomineralization by bacteria possibly contributes the immobilization of Hg, where Hg is mineralized as an impurity of iron oxides. The sediment particles, in the aggregate, are cemented and partly fixed. In spite of the ‘natural buffer’ effect mentioned above, however, a great amount of pollutants are still in water dissolved forms and eventually flowing out the Bay of Alger, where the contaminant possibly migrates into organisms and food chain in ecosystem. If the mercury forms an organic mercury compound like methyl-mercury, it can easily migrate and accumulate in the body of organisms.

6. Concluding Remarks

(1) The preliminary study of our collaboration unveiled extraordinary high concentration of Hg in Oued El Harrach sediments and water, Alger. Other heavy metal/metalloid pollution, such as As, Cu, Pb, Cr, and Cd, was also detected in the river water and sediments.

(2) Mercury pollution is particularly non-permissible levels. Immediate counter-measure is recommended.

(3) These pollutions are probably caused by the discharge of un-treated industrial waste/wastewater into the Oued El Harrach river.

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