



Geochemical Fractionations and Mobility of Arsenic, Lead and Cadmium in Sediments of the Kanto Plain, Japan.

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Lowland alluvial and floodplain sediment play a major role in transferring heavy metals and other elements to groundwater through sediment water interaction in changing environmental conditions. However identification of geochemical forms of toxic elements such as arsenic (As), lead (Pb) and cadmium (Cd) requires risk assessment of sediment and subsequent groundwater pollution. A four steps sequential extraction procedure was applied to characterize the geochemical fractionations of As, Pb and Cd for 44 sediment samples including one peat sample from middle basin area of the Nakagawa river in the central Kanto plain. The studied sediment profile extended from the bottom of the river to 44 m depth; sediment samples were collected at 1m intervals from a bored core. The existing sedimentary facies in vertical profile are continental, transitional and marine. There are two aquifers in vertical profile; the upper aquifer (15-20m) contains fine to medium sand whereas medium to coarse sand and gravelly sand contain in lower aquifer (37-44m). The total As and Pb contents were measured by the X-Ray Fluorescence analysis which ranged from 4 to 23 mg/kg of As and 10 to 27 mg/kg of Pb in sediment profile. The three trace elements and major heavy metals were determined by ICP/MS and ICP/AES, and major ions were measured by an ion chromatograph. The marine sediment is mainly Ca-SO₄ type. The Geochemical analysis showed the order of mobility trends to be As > Pb > Cd for all the steps. The geochemical fractionations order was determined to be Fe-Mn oxide bound > carbonate bound > ion exchangeable > water soluble for As and Pb whereas the order for Cd is carbonate bound > Fe-Mn oxide bound > ion exchangeable > water soluble. The mobility tendency of Pb and Cd showed high in fine silty sediment of marine environment than for those from continental and transitional environments. In the case of As, the potential mobility is very high (>60%) in the riverbed sediments and clayey silt sediment at 13m depth which is just above the upper aquifer. This potential mobility may pose a threat to upper aquifer and riverbed aquatic system. The overall geochemical analysis revealed that the dissolution of Fe-Mn oxide is the most effective mechanism for As, Pb in groundwater however the mobility of Cd is mainly carbonate bound. In the present study, the pollution level is much below from leaching environmental standards (0.01 mg/L) for all three elements and the total content is within the natural abundance of As, Pb and Cd in sediment. The potential mobility of these elements in oxidized fine silty sediment and the possible further effect to the aquifer suggest that shallow groundwater abstraction should be restricted to protect seasonal groundwater fluctuation. Moreover marine sediment containing high total toxic element contents and mobility tendency at changing oxidation and reduction environments requires proper management when sediments are excavated for construction purpose.