Leaching behavior of heavy metal from subsurface sediment of variable depositional environment in Central Kanto Plain, Japan

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Sediment has crucial role to transfer heavy metals in subsurface environment as well as groundwater and pore water through leaching under changing environmental conditions. To understand leaching behavior of Arsenic (As), Lead, (Pb), Cadmium (Cd), Selenium (Se) and other heavy metals in subsurface sediment of different depositional environment, a four steps sequential extraction method was adopted. Total 20 samples were investigated for geochemical speciation from a pre-existing boring core of Oto area, Saitama in central Kanto plain. Boring core consists of channel fill clayey silt which content higher amount of organic matter, peat, volcanic ash mixed clayey silt, medium to coarse sandy aquifer with a thick layer of marine clayey silt and clay sediments from top to bottom respectively. Total metal concentration, mineral content and geochemical speciation concentration were determined by X-ray fluorescence(XRF), X-ray Diffractometer (XRD) and Inductive Coupled Plasma-Mass Spectrometer (ICP-MS) and Atomic Emission Spectrometer (ICP-AES). Clay minerals were precisely determined through application of heat and Ethelyn glycol treatment and XRD peak analysis. Peat and marine sediment showed pH ranges from 3 to 4.6 which is lower than other sediment. Electrical conductivity of peat and marine sediment is high which are 14.04 m S / cm and 4.85 to 9.91 m S / cm respectively. Total S concentration is relatively high in peat, surface and marine sediment which is ranges from weight percent of 2 to 5 %. Transitional clayey silt between aquifer and marine sediment at 13 m depth showed high Fe and Mn concentration which are 15 % weight percent and 262 mg / kg respectively. The geochemical analysis showed the order of leaching trends to be As > Pb > Cd > Se for all steps. Geochemical speciation order for As trends to be Fe-Mn oxide bound >> Carbonate bound > Ion exchange > water soluble, whereas for Cd trends to be Water soluble > Carbonate bound > ion exchangeable bound > Fe-Mn oxide bound. For Se geochemical speciation trends to be water soluble > ion exchangeable bound > carbonate bound > Fe-Mn oxide bound. The potential leaching percentage of As and Pb is high in surface, transitional clayey silt and marine sediment. Leaching behavior of heavy metal showed variable characteristics with sediments of different depositional environment along with variable pH, salinity, organic matter content and oxidation state.

Keywords: Leaching behavior, Heavy metal, Marine sediment, Geochemical speciation

