Chemical speciation and solubility of heavy elements (lead, zinc, copper, arsenic and cadmium) in contaminated soil from Kamegai mine tailing, Toyama, Japan

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Heavy metals such as lead, zinc, copper, arsenic and cadmium are usually found in surface soils affected by mining or smelting activities, agricultural practices and industrial areas [1,2,3]. Hara et al., [4] showed that some heavy metals including lead, arsenic and cadmium in soil surrounding the mine tailing area in Toyama Prefecture, Japan has largely exceeded the environmental standards. The total amount of trace metals in soils is generally not sufficient to assess environmental impacts of metal contamination. Therefore, chemical forms and binding types of metals enables evaluation of their behavior and bioavailability in the soil environment.The objectives of the present study were to understand the chemical speciation of As, Zn, Cu, Pb and Cd from Kamegai mine tailing area by means of sequential extraction procedure combined with synchrotron based XAFS and electron microscope.

Thirty-two soil samples were analyzed, determining the chemical fractionation of Pb, Cd, As, Zn and Cu using by the five-step sequential extraction (SEP), X-ray absorption fine structure (XAFS), X- ray diffractometer (XRD) and scanning electron microscopy. The results of SEP showed that most of the Pb was associated with non-residual fractions, mainly in crystalline iron oxides (goethite). The Cd appeared mainly associated carbonate fraction in the roots of the dried plants in the soils. The XAFS spectra of the samples showed that Pb in the soil are adsorption forms with Fe-(hydr)oxides surface. Results of XAFS analysis showed Cd in the samples are $CdCO_3$, coprecipitated with $CaCO_3$. Zn, Cu and As appeared mainly associated with the amorphous and crystalline iron oxides. Heavy metals associated with carbonates, amorphous and crystalline iron oxides, thus being potentially more mobile to the environment if conditions were more acidic or reducing.

[1] Kaasalainen, M, and Markku Y. 2003. *Environmental Pollution*126(2): 225–33. [2] Nannoni et al. 2011. *Geoderma*161(1–2): 63–73. [3] Sterckeman et al. 2000. *Environmental pollution*107(3): 377–89. [4] Junko et al. 2014. 3(7): 193–96.

Keywords: soil, heavy metals, speciation

