Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AGE04-P15 Room:Convention Hall Time:May 20 17:15-18:30

Sorption of heavy metals on soil and colloidal solutions and transport facilitated by soil colloids

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Heavy metals are amongst various contaminants that are released daily in the soil environment as a result of various anthropogenic activities. Soil has the ability to immobilize contaminants like heavy metal ions and sorption is a major process for the retention of heavy metals in soils. However, mobile colloids have strong ability to sorb inorganic (heavy metals, radionuclides etc.) and organic contaminants and transport these contaminants to deeper depths or groundwater. The sorption of heavy metals on soil and colloidal solutions, and transport of heavy metals facilitated by soil colloids were investigated by batch sorption and column transport experiments respectively. Batch sorption experiments of heavy metal, (Cu), were performed on red-yellow soil and colloidal solutions ($<$1 micro meter size) generated from the red-yellow soil at natural pH and low pH conditions. The results showed that at high concentration range of Cu (10 to 200 mg/L), the sorption capacity (K_d) of Cu for the soil was greater than low concentration range (0 to 10 mg/L) and high K_d values were obtained at natural pH conditions. Similarly, sorption capacity (K_d) of Cu for colloidal solutions was greater at high concentration range of Cu and natural pH conditions. However, the K_d values for colloidal solutions were much higher; 10 to 50 fold more than for the red-yellow soil. Therefore, the colloidal solutions have greater sorption affinity for Cu than soil. In column transport experiments, the colloidal fractions played a significant role in transporting Cu and almost 76% of the total applied Cu was transported by soil colloidal fractions. The mobility caused by coarse colloidal fractions (0.2-1 micro meter size) was greater, as 85 % of the total leached Cu was associated to coarse colloidal fractions. Analysis of soil after the column leaching test indicated depth dependent phenomena of Cu distribution in the soil. Therefore, this study concludes that soil colloids play an important role in facilitating heavy metal (Cu) transport through soil which may lead to contamination of groundwater.

Keywords: Sorption, Heavy metal (Cu), Soil, Colloidal fractions, Sorption capacity, Transport