Effects of solid-to-solution ratio on Cu and Zn adsorption onto natural sediment

KAZUHITO MIZUTANI AND TAO CHENG

Department of Earth Sciences, Memorial University of Newfoundland, 300 Prince Philip Drive, St. John's, Newfoundland and Labrador, A1B 3X5, Canada

Adsorption of heavy metal ions to natural sediments in the subsurface influences the fate and transport of heavy metals. Laboratory batch experiments, in which sediment samples are mixed with heavy metal-spiked solution, are frequently used to study adsorption and to determine distribution coefficients (K_D) for heavy metals. However, the solid-to-solution ratio (SSR) in most laboratory experiments is much lower than that of natural sediments in aquifers. Therefore, it is questionable if these experiments can accurately mimic heavy metal adsorption in the natural environment. The objective of this study was to investigate if SSR influences the adsorption of heavy metals onto natural sediment, and if SSR controls the leaching of multivalent cations and dissolved organic carbon (DOC). Cu and Zn adsorption onto a natural sediment and component leaching were examined using batch experiments at SSRs of 25 and 250 g/L. Results showed that Cu and Zn adsorption was SSR dependent under certain conditions, caused by complex interactions between the sediment, leached multivalent cations, and DOC. Leached Al and Fe was found to influence Cu adsorption, while Zn adsorption was influenced by Al and Ca. This study verified that DOC, Al, and Fe leaching is SSR independent and solubility controlled, while Mg and Ca leaching is SSR dependent and cation-exchange controlled. This study demonstrated that the K_D of heavy metals determined by batch experiments could be used for simulating heavy metal adsorption in natural environments under certain conditions, but should be used with caution.

Atlantic Geology, 2016, Volume 52
Geological Association of Canada Newfoundland and Labrador Section ABSTRACTS – 2016 Spring Technical Meeting
doi: 10.4138/atlgeol.2016.005