Understanding the Mechanisms of Lead, Copper, and Zinc Retention by Phosphate Rock. (S11-cao733002-oral)

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Abstract:

The solid-liquid interface reaction between phosphate rock (PR) and metals (Pb, Cu, and Zn)was studied. Phosphate rock has the highest affinity for Pb, followed by Cu and Zn, with sorption capacities of 131, 114, and 83.2 mmol kg-1 PR, respectively. In the Pb-Cu-Zn ternary system, competitive metal sorption occurred with sorption capacity reduction of 15.2%, 48.3%, and 75.6% for Pb, Cu, and Zn, respectively. A fractional factorial design showed the interfering effect in the order of Pb>Cu>Zn. Desorption of Cu and Zn was sensitive to pH change, increasing with pH decline, whereas Pb desorption was decreased with a strongly acidic TCLP extracting solution (pH=2.93). The greater stability of Pb retention by PR can be attributed to the fact that P-induced formation of fluoropyromorphite [Pb10(PO4)6F2] (i.e. irreversibly chemisorbed) was primarily responsible for Pb immobilization (up to 78.3%), which was confirmed by XRD and SEM. The other 21.7% of Pb retained by PR was via surface adsorption or complexation, compared to 74.5% for Cu and 96.7% for Zn. Solution pH reduction during metal retention and flow calorimetry analysis both supported the hypothesis of retention of Pb, Cu, and Zn by surface adsorption or complexation. Flow calorimetry indicated that Pb and Cu adsorption onto PR was exothermic, while Zn sorption was endothermic. Our research further demonstrated that PR could be used effectively to remove Pb from wastewater or remediate Pb-contaminated soil and sediments.

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