A Study on Influence of Isomorphous Substitution in Magnetite on its Adsorption Behavior of Pb(II)

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Abstract: Surface adsorption capacity of minerals affects the fate and transport of heavy metals in environmental systems. In this work, adsorption of Pb(II) on magnetites with transition metal substitutions, e.g., Cr, Mn, Co and Ni, which are common in natural magnetite, is studied in terms of adsorption capacity, mechanism and chemical environment. The substitution increases surface site density markedly, while pH_{pzc} does not change obviously. The Pb(II) adsorption is improved with increasing pH. Inner-sphere complexation is the dominated adsorption mode, as the adsorption is well fitted by Langmuir model and not suppressed by the presence of background electrolyte. The substitutions improve the adsorption capacities in the order of Co < Mn < Ni < Cr. Pb(II) species on magnetite surface, in the geometries of terdentate binuclear corner-sharing, independent of the adsorption capacity. The relationship between surface and adsorption properties is discussed in terms of adsorption mechanism and active site density. The results of this study are helpful for understanding mechanism of magnetite-group minerals in attenuation of heady metals, and the fate of Pb(II) in aquatic and soil environment.

Keywords: isomorphous substitution; magnetite; Pb(II); adsorption; XAFS