Competitive adsorption of Pb(II) and Cd(II) on bacteria-montmorillonite composite

HUIHUI DU[12], WENLI CHEN[1] AND QIAOYUN HUANG[12]*

[1]State Key Laboratory of Agricultural Microbiology, Huazhong Agricultural University, Wuhan 430070, China (*correspondance: qyhuang@mail.hzau.edu.cn)

[2] Key Laboratory of Arable Land Conservation (Middle and Lower Reaches of Yangtze River), Ministry of Agriculture, College of Resources and Environment, Huazhong Agricultural University, Wuhan 430070, China

The characteristics and mechanisms of competitive adsorption of trace metals on bacteria-associated clay mineral composites are rare, despite their being among the most common organic-mineral complexes in geological systems. The competitive adsorption of Pb(II) and Cd(II) on the composites of bacterial cells (*Pseudomonas putida*) with montmorillonite was investigated through adsorption–desorption experiment, isothermal titration calorimetry (ITC), and synchrotron micro X-ray fluorescence (μ-XRF) techniques. Stronger competition was observed on clay mineral than on bacteria–clay composite because more non-specific sites accounted for heavy metal adsorption on clay mineral surface. Heavy metals tended to react with bacterial fractions in the composite, which was verified by the higher correlation of Cd (and Pb) with Zn (R^2 = 0.41) than with Si for the elemental distribution (R^2 = 0.10) (Fig. 1). ITC results showed that inner-sphere adsorption was the main binding mechanism for Cd and Pb on bacteria, clay, and their composite. Competitive adsorption exhibited a lower entropy change (ΔS) at the metal–sorbent interfaces compared with single–metal adsorption, revealing that Cd and Pb shared common adsorption sites of the sorbent. The competitive effect on bacteria–clay composite was found to be helpful for a better understanding of the chemical behaviors of heavy metals in multi-metal contaminated environments.

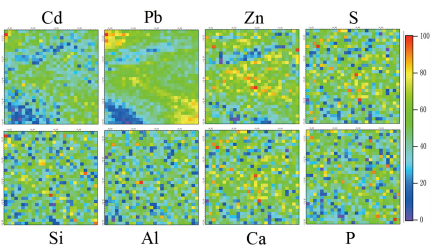

Figure 1: Elemental distribution in bacteria-montmorillonite composite.