ADSORPTION OF METALS IN PHYLLOSILICATE INTERLAYERS: ABIOTIC AND BIOTIC PROCESSES

KALINOWSKI, B. E., BHATTACHARYA, P. and JACKS, G. Division of Land and Water resources, the Royal Institute of Technology, Stockholm, Sweden.

Arsenic occurs naturally in a number of minerals as arsenopyrite (FeAsS), realgar (AsS) and orpiment (As2S3). Human activities have mobilized As from soils to aquatic systems making it available to fauna and flora. This has become a matter of concern in numerous settings in the world e. g. the West Bengal, where millions of people are exposed to dangerously high As levels in drinking water. In addition, there are numerous anthropogenic As sources as mine tailings, pigments, pesticides, herbicides, fungicides, fertilizers, smelter emissions and wood preservatives. Trivalent arsenic, arsenite, dominates under reducing conditions (pe + pH 8) while at oxidizing conditions the pentavalent arsenate is the dominate species. Arsenic adsorption on adsorbents as phyllosilicates, aluminum oxides and iron oxides has been studied extensively. As long as settings containing arsenic and ferric hydroxides are oxidized the leaching of arsenic remains small. Despite their significantly lower affinity for anions than Fe and Al oxides, phyllosilicates may be important adsorbents for heavy metal anions such as arsenite and arsenate because of their abundance in soils.Results from experimental weathering of phlogopite and vermiculite show that interlayer cations are replaced by Al-hydroxypolymers. This is supported by both NMR-MAS and XRD analyses, which show that tetrahedrally coordinated Al is leached out and readsorbed in the interlayer as hexacoordinated hydroxypolymers. Experiments indicate that Fe in biotite is oxidized, released to solution and used as an oxidizing agent for the remaining ferrous iron in the mineral. There are also indications that experimental dissolution of biotite at pH 1 results in formation of Fe(III)-(hydr)oxides. Arsenate may be adsorbed to the new Al/Fe-hydroxy layer because Fe(III) hydroxides have high affinity for arsenate. Leaching of As from soils is presumed to be related to microbial reduction of Fe and Mn resulting in reduction of As(V) to As(III) at neutral pH. Microbial chelators, such as siderophores may also play an important role in the mobilization of As in soils. This will be further investigated.