

Role of humic component in immobilization of plutonium onto humic-kaolinite complexes

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Humic substances (HS) are important part of natural organic matter. In terrestrial environments, a substantial part of humic materials presented by humic-clay colloids. Kaolinite is most abundant clay mineral. Actinides penetrated through aquifer or soil horizons can interact with inorganic or humic contain colloids. It was numerously reported that colloids are of particular importance for actinide transport through the porous media. The goal of this work was to evaluate a role of humic-component source in sorption of plutonium onto organo-clay colloids. Three model colloids with particle size $<1 \mu\text{m}$ were obtained. One of them was inorganic colloid (Ca^{2+} saturated kaolinite), two other colloids were organo-clay complexes (kaolinite-humic complex) with humic acids isolated from peat and leonardite. Kaolinite (Kaolin CF 70) was obtained from Caminauer Kaolinwerk GmbH, Germany. Particles $<1 \mu\text{m}$ were obtained by ultrasonic treatment and separated by centrifugation. Suspension of kaolinite was then washed and saturated with Ca^{2+} in 0.001 M CaCl_2 at pH 5.5. Part of Ca^{2+} saturated of kaolinite was used to obtain kaolinite-humic complexes by adsorption of HS. Commercially available potassium humate (Humintech Ltd, Germany) was used to isolate humic acids of leonardite. Peat humic acids were isolated from highmoor peat (Tver region, Russia). Humic-kaolinite complexes were obtained by adsorption of HS onto kaolinite and subsequent sequential desorption steps of weakly bound HS in 0.001 M CaCl_2 at pH 5.5. Sorption of plutonium onto the model colloids was studied using ultrafiltration through 30 kDa membranes. Model groundwater solution was equilibrated with Pu hydroxide during several weeks. Before ultrafiltration, the obtained plutonium containing groundwater was diluted and colloids were added to make up a total concentration of 50 mg/L. ^{239}Pu was used for these experiments. Its concentration was 1.55×10^{-9} M. Strength of plutonium sorption was estimated using fivefold washing of membranes by model groundwater without actinides. During sorption experiments, strong sorption of plutonium was observed both for coal- and peat humic-containing colloids: it was close to 100 %. Humic-kaolinite complexes displayed much higher affinity for ^{239}Pu as compared to Ca^{2+} saturated kaolinite. During desorption of actinides sorbed onto kaolinite colloids, 17 % of plutonium was released. At the same time, only 3% and 1% of ^{239}Pu (V), respectively, were desorbed from coal- and peat-humic-containing colloids. The conclusion can be made on almost irreversible sorption of plutonium of humic-kaolinites complexes under experimental conditions tested.

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