Retention of Plutonium on Model Kaolin-Humic Complexes

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1. INTRODUCTION

In terrestrial environments a substantial fraction of humic substances (HS) exists as humic-clay colloids. Kaolinite is the most abundant clay mineral. Actinides transported through soil horizons and aquifers can sorb onto colloids containing humics. Evaluation of actinide retention onto humic-clay colloids is important for estimating actinide fate and transport in the subsurface environment, as the presence of HS in groundwater may alter the mobility sorbed actinides.

The goal of this work was to investigation the effect dissolved HS in groundwater on the plutonium retention to kaolin a humic complex.

2. MATERIALS AND METHOD

A kaolin-humic adsorption complex was used as a model for humic-clay colloids. Humic acid (HA) from brown coal were adsorbed to a suspension kaolinite colloid with particle sizes <1 μm. Kaolinite (Kaolin CF 70) was obtained from Caminauer Kaolinwerk GmbH, Germany. Particles <1 μm were obtained by ultrasonic treatment and separated by centrifugation. The kaolinite suspension was then washed and saturated with Ca^{2+} in 0.001 M $CaCl_2$ at pH 5.5. Commercially available potassium humate (Humintech Ltd, Germany) was used to isolate humic acids (HA) of leonardite. Humic-kaolinite complexes were created by adsorping HA onto kaolinite followed by subsequent sequential desorption of weakly bound HS in 0.001 M $CaCl_2$ at pH 5.5.

^{239}Pu(V) was used for these experiments. Sorption of Pu(V) onto the model colloids was studied using ultrafiltration through 30 kDa membranes. 0.001 M $CaCl_2$ solution was equilibrated with Pu(V) hydroxide during several weeks. Before ultrafiltration, colloids were added to solutions containing plutonium and then diluted giving a respective colloid and

Pu(V) concentrations of 50 mg/L and 1.55×10^{-9} M. The strength of plutonium sorption was estimated using fivefold washing of membranes with colloids using solutions of 0.001 M $CaCl_2$ and HA from brown coal in concentrations 0, 10, 25 and 50 ppm.

3. RESULTS AND DISCUSSION

Model colloids were saturated with Pu(V) and then washed with different HA -$CaCl_2$ solutions as shown on Figure 1.

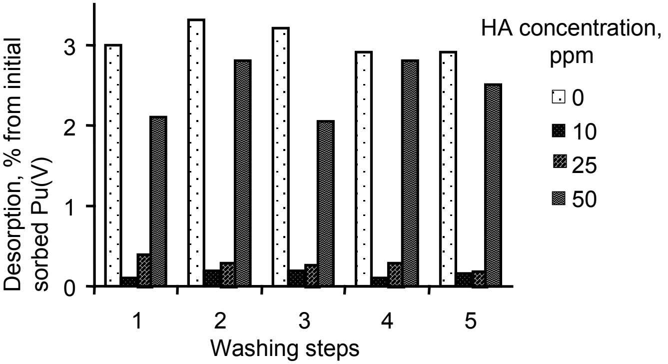

Figure 1. Desorption of Pu(V) from colloids wash in different HA-$CaCl_2$ solutions.

Each HA solution of a given concentration desorbed approximately the same quantity of Pu(V) for each washing step. This fact suggests colloid-Pu(V) systems were in equilibrium. Generally Pu(V) desorption was limited (0.1-3 % from quantity sorbed Pu(V)). The percent of Pu(V) desorped increased with increasing of HA concentration. Pu(V) complexation with HA facilitated Pu(V) desorption from colloids. However, in the absence of HA, 0.001 M $CaCl_2$ desorped the most Pu(V). Probably in absence of HA Pu(V) is partially displace by Ca^{2+} but in presence its Ca^{2+} is bounded of HA.

4. CONCLUSIONS

In this study, give evidence of Pu(V) desorption from kaolinite-humic colloids occurring via effect of HA or Ca^{2+}.

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