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Simulation of Selenite and Strontium breakthrough in a column of goethite coated sand

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Based on previous batch adsorption experiments and an associated surface complexation model [1] we have attempted to simulate the breakthrough curves of selenite and strontium in columns filled with a goethite coated sand. It was found to be necessary to add reactions involving a silica type surface (representing the part of the sand surface not coated by goethite) to obtain a good fit to the experimental data both for binary (Se/goethite) and ternary (Se/Sr/goethite) systems. The proposed adsorption model is a CD-MUSIC type approach for Se and Sr adsorption on goethite and was derived from a wide range of uptake data backed up by X-ray absorption spectroscopic results. No ternary surface complexes were observed in the ternary system and enhanced adsorption of Sr was due to electrostatic effects only. The coated sand could thus be expected to exhibit further electrostatic effects, which became obvious in the initial simulation tests of the column data. Streaming potential data on the goethite coated sand revealed a net decrease of the point of zero charge of the coated sand relative to the point of zero charge of the bare goethite. Also differences in behavior were observed for two coating preparations with initially varying goethite to sand ratios.

[1] Zhe Nie, Nicolas Finck, Frank Heberling, Tim Pruessmann, Chunli Liu, Johannes Lu¨tzenkirchen, Adsorption of selenium and strontium on goethite: EXAFS study and surface complexation modeling of the ternary systems, Environmental Science & Technology, 51(1017), 3751-3758.