Sorption properties of beidelittic mineral for major inorganic elements (Na^+, Ca^{2+}, Mg^{2+} and K^+)

One of the processes used by mining activity to extract metals from natural rocks is to leach these rocks with very acidic solutions. This is the case for example for Uranium extracted from "roll front" deposits. Using such process could lead to a significant variation of the physico-chemical parameters of the geological system. One important challenge of such process is then to think about the rehabilitation of the mining sites after the production step. In this context, industrials and academic researchers must have tools to predict with a good confidence the evolution of the geological system in both space and time. Important parameters have to be predicted, in particular rocks physical properties as well as the chemical composition of the fluids diffusing or percolating inside.

In the framework of its PhD, Mr. Valentin Robin found that smectites, and in particular clays like beidellite (clay mineral with tetrahedral charge), were systematically present in U-ore bearing sandstones used by mining industry (in Kazakhstan). Moreover, Valentin Robin showed that these minerals have a significant impact on chemical composition of interstitial waters due to the strong sorption properties of these minerals (high specific surface area and cationic exchange capacity). Such significant impact has been established particularly for major inorganic cations (Na^+, Ca^{2+}, H^+, Mg^{2+} and K^+) which are always present in natural waters at relative high concentrations. At this time, prediction of the chemical composition of the waters has been performed with selectivity coefficients found in literature for smectites, which were unfortunately mainly montmorillonite (clay mineral with octahedral charge).

The aim of this study is to obtain different selectivity coefficients between two cations (example: Na^+ and Mg^{2+}) for a <0.1 or <1 µm beideillite. First, these latter size fractions will have to be extracted from sandstones interesting uranium-mining industry. Then, the work will be devoted to acquire experimentally sorption isotherms between two selected cations on these size fractions. Experimental data will be interpreted using a geochemical code in order to propose selectivity coefficients values and compared with literature data on smectites. Finally the effect of these selectivity coefficients on the chemical evolution of the interstitial water percolating through the geological system of interest during a hypothetical rehabilitation step will be tested.

This proposal is devoted for student in first or second year in "Master Argiles" or IMACS, with an interest for both geology and inorganic chemistry.

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