Arsenic (V) and chromium (VI) removal from aqueous solution by adsorption on natural clay-rich rock

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A geological disposal in Gault clay (France) is planned for low activity, long-lived nuclear waste. Storage in a undergroung shallow site should ensure both radioactive and hazardous chemical elements sequestration. This study focused on As(V) and Cr(VI) retention on the Gault Clay under different environmental storage conditions.

A serie of batch sorption tests were performed under oxic/anoxic conditions with various composition of aqueous solutions. Experimental results were used to develop and calibrate a surface complexation model using CHESS™ and to improve our understanding of processes adsorption.

Clay rock sample caracterisation by XRD reveals a wide variety of minerals as well as Quartz, Kaolinite, Illite, Goetite**.** Batchs results show a high removal of As (77% in oxic conditions and 83% in anoxic conditions) and the geochemical model suggest that sorption on iron oxides (Goetite) is the principal process of As sequestration. The chemical environment have an impact on As removal, especially in the presence of phosphates which compete with As for iron oxides sorption sites. Low Cr removal is observed in oxic conditions (9%) but the percentage rises to 47% in anoxic ones. Sorption is a minor process and removal of Cr in anoxic conditions can be explained by the reduction of hexavalent chromium and precipitation of trivalent chromium (Cr_2O_3, $MgCr_2O_4$…). Reduction of Cr(VI) is also very sensitive to acid pH. Thus the removal of Cr at pH 4 in oxic conditions is close to 90 %.

This research revealed As and Cr behaviour in natural Gault clay sample, processes of removal from garbage leachate and significance of chemistry environment and thermodynamics conditions. Columns tests and simulations with HYTEC™ will be mained to understanding the transport mechanisms of this pollutants.