Radionuclide sorption reversibility studies on different compacted bentonite derived clay nanoparticles

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Compacted bentonite is considered to be suitable as geotechnical barrier in the context of high level radioactive waste repositories in crystalline host rocks. Montmorillonite is the dominant clay mineral of most bentonites which is characterized by its swelling abilities favouring clogging of water bearing fractures and thereby contributing to a safe enclosure of the waste. In the case of a canister failure due to corrosion or mechanical stress radionuclides get in contact with the surrounding bentonite buffer under porewater conditions and sorption will occur. One of the evolution scenarios in the Scandinavian countries are future glaciation periods and the intrusion of diluted glacial meltwater down to repository depths. Thereby the compacted bentonite will come in contact with low mineralized groundwater via water conducting features (fractures) causing bentonite swelling, gel formation and clay colloid/nanoparticle release at the bentonite-water interface. Radionuclide bearing bentonite colloids/nanoparticles may leave the repository due to advective transport. Therefore, the bentonite erosion process with respect to the safety assessment of a deep radioactive waste repository in crystalline host rock has to be investigated in two perspectives; (a) quantification of the erosion rate, characterization of the eroded material and its mobility and (b) the interaction of the eroded material with radionuclides.

Different bentonites are used for colloid generation and characterized concerning colloid size, size distribution, mineralogy and concentration via Laser Induced Breakdown Detection (LIBD), s-Curve-LIBD, ICP-OES, ICP-MS and ESEM-EDX. Radionuclide sorption and reversibility studies on bentonite colloids are carried out under bentonite porewater conditions followed by desorption studies under natural granitic Grimsel ground water conditions. Radionuclide cocktails are used containing Cm or Eu for time resolved laser fluorescence spectroscopy (TRLFS) and other radionuclides (Se, Tc, Cs, U, Np, Pu, Am, Th) in accordance to the Long term In situ Test (LIT) in the framework of the Colloid Formation and Migration (CFM) project at the Grimsel Test Site (GTS, Switzerland) (www.grimsel.com).