Deep geological disposal of used nuclear fuel: Studies on irradiated MOX and related model systems

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This presentation will provide an overview on recent studies on spent nuclear fuel behaviour under deep geological repository. The joint experimental and modelling program includes studies of single effects in simplified UO_2-model systems as well as corrosion/ leaching studies on spent UO_2 and MOX fuels. Corrosion experiments apply reducing conditions, and are addressing instant release and long-term matrix corrosion in synthetic clay pore solution and cementitious pore waters. In addition to the analysis of radionuclides released/leached the irradiated fuel material was characterised by optical microscopy, SEM and EPMA.

Single effect studies on simplified UO_2-based model systems are aiming at a refined understanding of the effect of Ln-doping (fission lanthanides), Cr-doping (as in modern fuels), alpha-doping with Pu-238 (addressing the threshold value for alpha-radiolysis driven matrix corrosion) and Pd-based epsilon-particles (possible link to H_2-effect) on the structure, microstructure and dissolution/corrosion behaviour. Advanced characterization methods provided in-depth information on long-range as well as short-range ordering phenomena and microstructural aspects in these materials. Accelerated dissolution experiments on pure and Cr-doped pellets using H_2O_2 to mimic oxidative radiolytic dissolution of UO_2 will be discussed.

Complementary experiments on irradiated nuclear fuel samples and on related simplified model systems for single effect studies as well as an integration of experiment and simulation offer new opportunities to unravel the complexity of used nuclear fuel behaviour in waste repository systems.