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Chemical Behavior of Long-Lived Fission and Activation Products in the Near Field of a Nuclear Waste Repository and the Possibilities of their Retention (Vespa II)

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To ensure a reliable and long-term safety assessment of high-level radioactive waste disposal, it is essential to study the physico-chemical properties of the radionuclides within spent nuclear fuel as well as their transport behavior expected under conditions of the near- and far-field of a nuclear waste repository. Among the radionuclide inventory, long-lived mobile fission products are of high concern since they can strongly contribute to the total biosphere dose from spent nuclear fuel disposal. The collaborative project VESPA "Chemical Behavior of Long-Lived Fission and Activation Products in the Near Field of a Nuclear Waste Repository and the Possibilities of their Retention - Phase II" aims to investigate the solubility and the immobilization of Tc-99, I-129, Cs-137, and Se-79. In particular, the focus is set on (1) the source term, evaluating, e.g., the I-129 inventory together with the instant release fraction and its speciation; (2) the effect of geochemical conditions in the near-field, i.e. T, p, Eh, pH, on the processes of surface redox-mediation and secondary mineral phase formation; (3) the solution chemistry, determining solubility products, complex formation and activity coefficients of Tc(IV) in presence of anions and small organic molecules, and Se(IV), Se(0), Cs(I) and I(-I) at elevated temperature; and (4) the retention behavior of I, Se and Tc on layered double hydroxides (LDH) and Fe-corrosion products. Finally, safety analysis calculations link the obtained results and provide an enhanced confidence in predictive risk assessments.

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