Evolution of the gas composition in the FE experiment, an unsaturated SF/HLW emplacement drift at Mt. Terri, Switzerland

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The build-up of pressure due to gas generation is a critical factor in the safety assessment of deep geological repositories. Different processes are expected to produce and/or to consume gas which will have a direct influence on the composition of the gas phase and the pressure build-up. The accuracy of the evaluation and prediction of safety-relevant processes can be increased through the quantification of gas production and/or consumption rates and the understanding of the underlying mechanisms. In this context, the Full-scale Emplacement (FE) experiment is a unique opportunity to study the evolution of the gas composition in the near-field of an emplacement tunnel conceived for spent fuel / high-level waste (SF/HLW) during the early period after closure at full scale.
Identification and quantification of processes controlling the composition of the gas phase in the near field of the FE experiment are targeted by the integration and interpretation of the following observational and experimental activities: 1) collection of data in the field by on-site monitoring of the gas composition in the FE drift by means of O_2 and H_2 sensors and a state-of-the-art on-line mass spectrometric system, 2) regular sampling of the gas phase for precise analyses (e.g., major and trace gases, noble gas isotopes, alkanes, alkenes, $\delta^{13}C_{CH4}$, $\delta^{2}H_{CH4}$), and 3) laboratory experiments which provide quantitative information on the interactions between different materials in the FE tunnel and the gas phase therein.
The present contribution aims to stimulate a scientific discussion on the conceptual/technical challenges in understanding gas exchange between different geochemical reservoirs in an engineered system such as the FE experiment.

Keywords: gas exchange, radioactive waste disposal, Opalinus Clay, bentonite, pore space

