GEOCHEMICAL PERTURBATIONS IN THE CONTACT BETWEEN CONCRETE AND BENTONITE AFTER 13 YEARS OF INTERACTION AT MICROMETRIC TO CENTRIMETRIC SCALE

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The FEBEX experiment was performed in a gallery of the Grimsel Test Site (GTS, Switzerland) for 18 years as a demonstration for the technical capability to manufacture and assemble the engineered barriers of a repository for high level radioactive waste and to monitor the thermo-hydro-mechanical conditions over its lifetime. In this experiment, two metallic heaters were surrounded by a compacted FEBEX-bentonite barrier and hosted horizontally in a granitic drift. A concrete plug was used to seal the drift. The geochemical study of interactions between the system barriers was performed after the dismantling of the experiment.

After 5 years of operation, the heater closer to the gallery entrance was switched off and extracted. Then, a new sprayed concrete plug was applied to seal the drift. This study presents the geochemical perturbations observed at the µm to cm scale from the interface between the bentonite and the concrete plug after 13 years of interaction making use of well-preserved selected samples recovered by the overcoring technique [1].

The overcoring technique maintain the consistency of the interface of both materials, concrete and bentonite, without fractures. Cylindrical samples are later embedded in resin and radially cut into 4 equivalent subsamples for further analyses.

Three different subsamples, named CC-32-4-OC, CC-32-5-OC and CC-32-6-OC, were analyzed by numerous techniques for mineralogical and physical-chemical characterization (e.g. XRD, SEM-EDX, BET specific surface, ^{13}C and ^{18}O isotopes, TG, soluble salts).

A chemical gradient in the interface is observed at the micrometric scale, mainly by accumulation of Ca at the concrete side and Mg at the bentonite side. At centimetric scale, the mineralogical alteration is dominated by precipitation of calcium carbonates in concrete and magnesium silicates in bentonite. Nevertheless, migration of soluble species, mostly chloride and sulfate in concrete and redistribution of cations associated to exchangeable cations in bentonite, is observed at larger scale.

The representativeness of the study of three overcoring samples confirm with higher confidence previous results observed in hand-picked samples whose interfaces were not fully preserved. The geochemical perturbations after 13 years of concrete-bentonite interaction reaches a limited impact far from the millimetric scale.

References

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