

STRENGTHENING AND STRESS RELAXATION OF OPALINUS CLAY

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In the framework of the EU-project NF-PRO (e.g. RTDC-5, Synthesis Report, D-N^o 5.2.3), special emphasis was put on the investigation and modelling of near-field processes in a candidate host rock: http://project.nf-pro.org/workspaces/rtdc5/deliverables/d5_2_3_rtdc_5_synthesis_report_final_version.

The coupled TMHC-processes under consideration mainly concern the interaction between the host rock in and near to the EDZ and the waste products in its immediate vicinity. With respect to long-term safety analyses, there is no doubt that a sound process understanding is required. However, safe disposal also requires a suitable multi-barrier-system. This has to consist of technical and geo-technical barriers (e.g. container and backfill) but also of a strong geological barrier.

Comparing the self-sealing capacity of the candidate host rocks, i.e. salt, clay and crystalline rock formations, where underground rooms will be inevitably backfilled only in part for technical reasons, in a salt formation convergence by viscous deformation provokes the re-establishing of a tight system, whereas in a crystalline rock formation long-term isolation has to be guaranteed solely by the technical and geo-technical components.

This work is concentrated on the question, whether convergence and reduction of open space by long-term creep will take place also in a claystone formation, where laboratory investigation on Opalinus Clay from the Mont Terri Rock Laboratory was performed for this purpose.

Several results from the work on the long-term deformation behaviour of claystone exist already. Nevertheless, to the author's knowledge the sound proof of a time-dependent and non-dilatant viscous deformation in the undisturbed far-field of claystone is still missing. Results from the rock laboratory at the Mt. Terri site yield hints for an anisotropic state of in-situ stresses, which may continue to exist in the undisturbed far-field for the long lasting periods of geological times.

Consequently, demands on concepts for backfilling and closure of a repository in a claystone formation as well as model calculations for safety analyses generally do not take into account convergence by viscous deformation, which would result from stress re-distribution at underground openings.

Although there is some doubt, whether Opalinus Clay is creeping at all, some very long lasting laboratory tests were performed on this item in the author's laboratory. A nearly linear dependence of the long-term creep rate on the deviatoric stress was found. In recent work, the technique of stress-relaxation was used. For this, strengthening by strain rate controlled deformation was stopped, i.e. the strain was kept constant for a long time, and the relaxation of the stress was measured. In course of this technique, the deformability which may result from artefacts is ruled out as far as possible by compaction and strengthening. Then, the stress relaxation - if any - will be maintained by true long-term deformation processes which should be active and responsible for any convergence in an at least only partly backfilled mine.

In this contribution, the results of the laboratory work and their discussion will be presented.