EGU21-700
https://doi.org/10.5194/egusphere-egu21-700
EGU General Assembly 2021

3D Predictive HM-modeling in the heterogeneous Opalinus Clay of the Mont Terri rock laboratory and validation with monitoring data from a mine-by test

Chao Li[1], David Jaeggi[2], Christophe Nussbaum[3], and Paul Bossart[4]
[1]INTERA Inc. Swiss Branch, Wettingen, Switzerland (cli@intera.com)
[2]Swiss Federal Office of Topography Swisstopo, Wabern, Switzerland (david.jaeggi@swisstopo.ch)
[3]Swiss Federal Office of Topography Swisstopo, Wabern, Switzerland (christophe.nussbaum@swisstopo.ch)
[4]Swiss Federal Office of Topography Swisstopo, Wabern, Switzerland (paul.bossart@swisstopo.ch)

The Mont Terri rock laboratory began in 1996 with 8 niches, followed by a research tunnel in 1998. Since then the laboratory has been expanded every 10 years, mainly in the shaly facies of the Opalinus Clay. In March 2018, south of the existing laboratory, the Mont Terri Project Partners initiated another extension «Gallery 18» of the Mont Terri rock laboratory mainly located in sandy facies of the Opalinus Clay. In October 2019 the extension was finished, resulting in more than 500 m of additional galleries and niches for new experiments. In the frame of this extension, for the first time a heterogeneous mine-by test, comprising a sheet of sandy facies and carbonate-rich sandy facies sandwiched between shaly facies was conducted in the rock laboratory. This so-called MB-A experiment (hydro-mechanical characterization of the sandy facies before and during excavation) consists of two lateral niches for instrumentation and monitoring and a test gallery of 30 m length oriented perpendicular to the latter. The instrumentation based on 26 boreholes with lengths up to 40 m consists of pore pressure transducers, extensometers, inclinometers and stress monitoring stations. It was finished several months before excavation of the test section was started in order to assure equilibration close to the initial conditions. Excavation of the test gallery running parallel to bedding strike was carried out in May 2019 in 20 days.

Elastic predictive modeling is performed in 3D to estimate the hydro-mechanical behavior of the rock mass during a sequential excavation according to effective daily advances and as-is sensor locations. The modeling results are compared with monitoring data. The calculation predicts a rotation of the early time near-field pore pressure reduction from perpendicular to parallel to bedding for late times. In general, monitored peak pore water pressures were higher than predicted, with a remarkable phase shift depending on distance and spatial position with respect to the drift. Monitored deformations were clearly underestimated with the elastic calculation. The overall behavior of the excavation in the sandy facies was unexpectedly not so different from former excavations in shaly facies.

A parametric study was performed to assess key parameters of potential effects of excavation on the hydromechanical responses of the excavation. It is concluded that adapted constitutive laws

are needed in order to properly predict the hydromechanical response in stiffer claystone, such as for instance the sandy and carbonate-rich sandy facies of the Opalinus Clay.