
SOLEXPERTS
Swiss Precision Geomonitoring

6. CONCLUSIONS

Impression packer survey results emphasized the heterogeneity of the EDZ under the rock floor. The fracture trace (depth and dip) provide valuable information on the geometry of the fracture network. The impressions also confirm previous findings that the major portion of the EDZ lies in the first 0.5 meters of rock from the tunnel wall.

Pneumatic tests were a suitable method to obtain gas permeability estimations of all intervals. Withdrawal tests were not successful in evaluating cross-hole connections due to the extremely small pressure changes in the very high permeability fractures. As a result, the connection mapping was performed using injection tests despite the possibility of fracture opening or dessication. Permeability changes were observed over the course of injection as evidenced by dropping injection pressures with time (for example between BEZ-A5i2 and BEZ-A9i1, or increasing permeability in interval BEZ-A6i1 between extraction and injection test). We believe these are dessication effects rather than deformation effects as the injection pressures were limited to 1.5 kPa well below the overburden weight. The tests confirm the observations obtained by impression packer: the first meter from the tunnel floor can be defined as a zone of relative high permeability (until 9.4×10^{-11} m^2). The permeability decreases towards the lower intervals (2.8×10^{-13} to less than 10^{-16} m^2). Pneumatic tests with mmps confirm this decrease.
The permeability distribution within the upper first “meter” intervals is not homogeneous, where permeabilities vary between 5×10^{-14} and 9.4×10^{-11} m^2.

In general cross-hole responses followed immediately the source signal, which allowed quite short testing time of about 15 minutes. Cross-hole responses were observed in the whole test zone between the intervals located in the first meter. Connections exist over distance of 3.3 meters (BEZ-A8i1 to BEZ-A4i1), which have never been shown in previous experiment at Mont Terri laboratory. The test zone is also more fracture due to the blasting excavation method. The previous experiment were realised in gallery excavated with a round header or pneumatic hammer technique. Cross-hole tests confirm the high heterogeneity of the EDZ at a metric scale, which leads difficulties to estimates the average permeability at a gallery scale.
The lower intervals (depth between 1 m to 2m) are not connected to other intervals.

The results presented here are based on drill and blasted tunnel walls that may be more damaged than mechanically excavated situations. Future testing plans call for saturating the EZ_A area and repeating the tests with water, whose higher viscosity will result in slower , more analysable cross-hole responses. Other tests are also being planned for machine-excavated tunnels.

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