

Hydrogeological characterisation of Mont-Terri's carbonate aquifers, canton of Jura Switzerland

Impermeable and ductile clay units are a prime option for geological radioactive waste disposal, multiple sites are investigated worldwide. In the canton of Jura, Switzerland, a motorway tunnel crosses through an anticline where the Opalinus Clay Formation, a target for radioactive waste disposal, is outcropping. From the tunnel's reconnaissance gallery, extensions have been dug out to create the Mont-Terri Rock Laboratory, located entirely in the clay layer. It is a generic underground research laboratory where over a hundred experiments on the Opalinus Clay have been performed and are still ongoing. Compared to the surrounding units, understanding of the target unit is substantially more advanced. In order to improve effectiveness of the future disposal site, improved characterisation and understanding of the surrounding layers is necessary. This study, which aims to characterise the hydrogeological regime of the south eastern section of the anticline, is encompassed in the Hydrogeological Survey experiment (HS) and is therefore part of the long-term hydrogeological data collection at the Mont-Terri site.

For the investigation of the hydrogeological regime we estimate the impact of the tunnel on groundwater flow patterns with a 2D conceptual model, and the extent and mean elevation of the tunnel's watershed. Then, the behaviour of the four main aquifers of the anticline are analysed through continuous values of discharge, electrical conductivity and temperature over 18 months. We also use fortnightly major ion data from each of the aquifers over the same period. Statistical data treatment such as cross-correlations and Principal Component Analysis are performed.

Though the methods cited here above, we were able to determine hydrochemical water type and estimate response and residence times for four carbonate aquifers. First, the Keuper aquifer has a response time of 2 day and a residence time of 3 to 4 days, the Stafelegge has a residence time superior to four days and we were unable to determine the response time, whereas the Hauptrogenstein aquifer has a response time of 2 days and residence time which is less than three days. The last aquifer surveyed, the Saint-Ursanne Formation one, has a response time of 1 to 2 days and a residence time of 3 to 4 days. All the aquifers have calcic-carbonated waters except the Stafelegge which has chlorinated-sodic saline waters. The main characteristics of each aquifer are reported in Figure 1.

Perspectives for further studies of the hydrogeological characterisation of the Mont-Terri anticline will require an enhancement of the data acquisition system in the security gallery and hourly precipitation station setup. Also, several tracer tests from the surface in order to confirm hypothesis and investigate the degree of karstification and its influence of groundwater flow over the anticline are a necessary. Before proceeding to the conception of a three-dimensional groundwater flow model, investigation to a regional scale (at the opposite of the local scale in this study) is a mandatory next step.

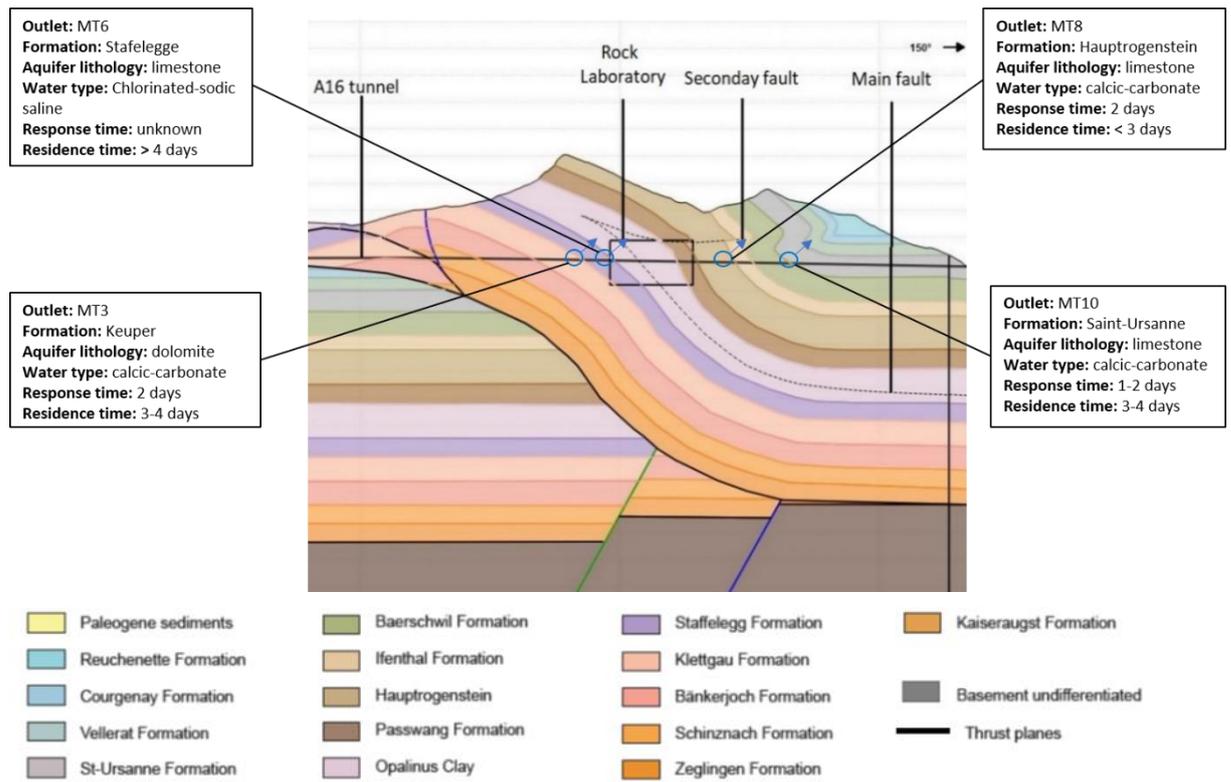


Figure 1 : Summary cross section with the main characteristics of the aquifer formations and their outlets.