BOREHOLE DEFORMATION MEASUREMENTS AND VIDEO-OBSERVATIONS OF BOREHOLES IN OPALINUS CLAY

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Three different boreholes in the Opalinus Clay formation of the Mont Terri Underground Rock Laboratory (URL Mont Terri) have been investigated in a research project conducted by the Clausthal University of Technology (TUC) in co-operation with the National Cooperative for the Disposal of Radioactive Waste (NAGRA) and the Swiss Federal Institute of Technology Zurich (ETHZ). Aim of the project was to gain a large amount of high quality and significant information that can be used to increase knowledge about and improve understanding of time-dependent load-bearing and deformation behaviour of Opalinus Clay. For this purpose an axial borehole camera and a three-arm calliper have been used. While two of the investigated boreholes (BMB 35, BMB 36) were drilled subhorizontally with an identical orientation, the longitudinal axis of the third borehole (BRC 3) is dipping into the gallery floor by an angle of 60 degrees. The subhorizontal boreholes have a length of 10 metres while the third borehole is 25 metres long. The borehole BRC 3 and the subhorizontal borehole BMB 36 are located in the shaly facies of the URL Mont Terri while the subhorizontal borehole BMB 35 is located in the sandy facies of the URL Mont Terri.

A lot of high quality information on the load-bearing and deformation behaviour of the investigated boreholes was generated by the measurement and monitoring techniques used in the project. Differences regarding load-bearing and deformation behaviour which are very likely due to the different orientation and the different facies the boreholes are located in could be detected during the investigations. The presentation includes a discussion of the results measured by the logging tool as well as the discussion of the borehole-videos that were recorded by the axial borehole camera. A part of the presentation also refers to the comparison of the two different types of information and how they can be correlated. As an example for the information gained with the axial borehole camera Figure 1 shows the time-dependent development of an exemplarily selected borehole section in borehole BRC 3.

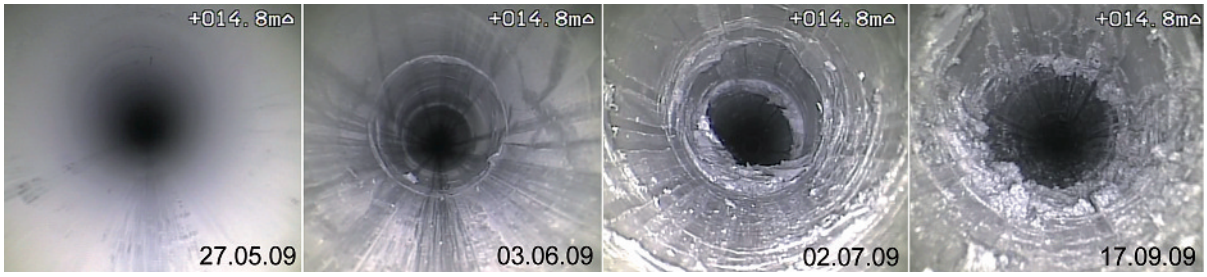

Figure 1: Time-dependent development of a borehole section in borehole BRC 3.

The four pictures that can be regarded in Figure 1 are screenshots from four different borehole-videos that were recorded by the axial borehole camera between the 27th of May and the 17th of September 2009. Figure 2 displays the time-dependent decrease of stability of the borehole wall in borehole BMB 36 within the same period of time.

The presentation deals with the visualisation and description of several observed phenomena from the inside of the investigated boreholes like the ones from the examples shown in Figure 1 and Figure 2, also including the development of a complete borehole collapse. Figure 3 displays an example for measurement results recorded with the three-arm calliper.

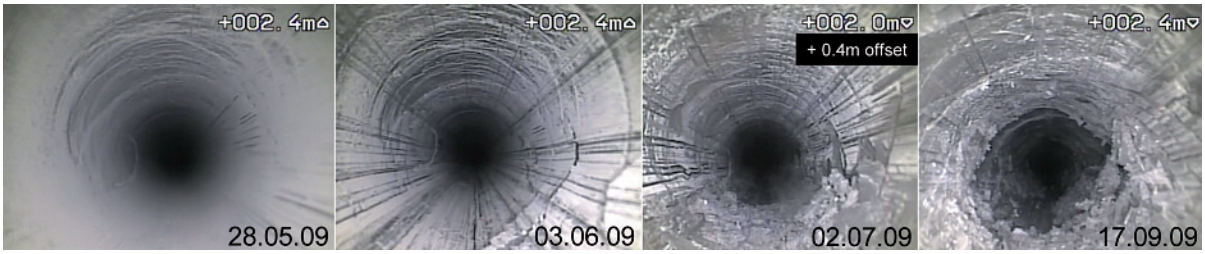

Figure 2: Time-dependent loss of stability of the borehole wall in borehole BMB 36.

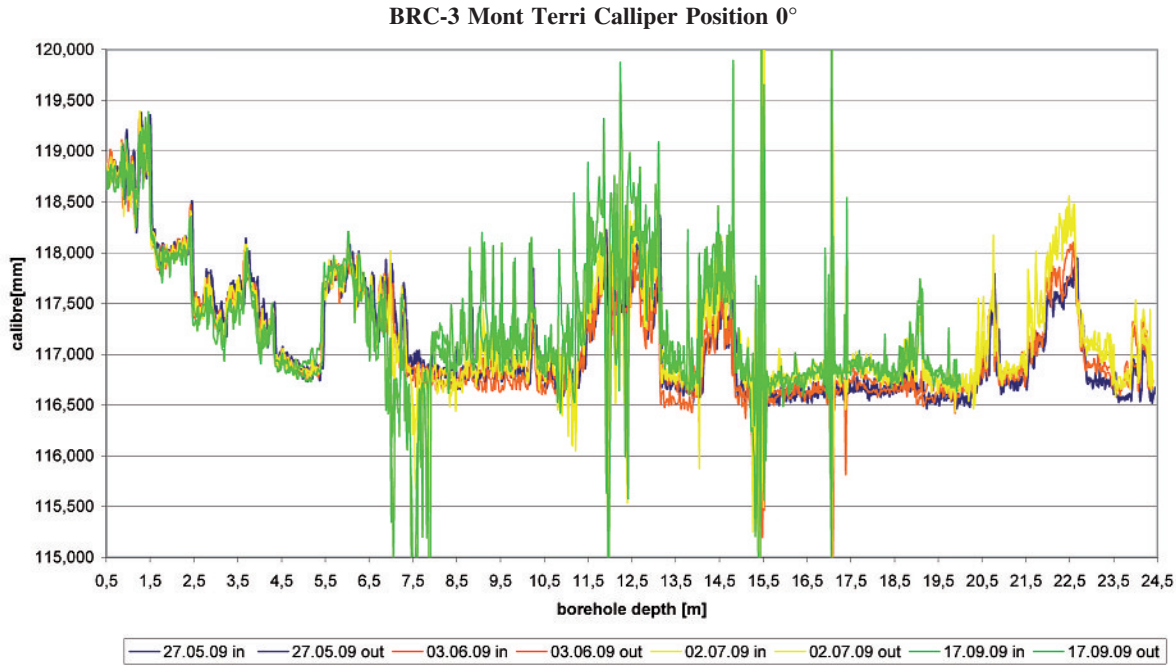

Figure 3: Comparison of measurement results recorded at different times displaying timedependent changes of the borehole contour in borehole BRC 3.

The demonstrated measurement results are part of the outcome of the logging performed with the three-arm calliper in borehole BRC 3 over the time span between the 27th of May and the 17th of September 2009. Cautiously interpreted with consideration of the information gained by the use of the axial borehole camera they give an insight into time-dependent deformations as well as into the stability behaviour of the rock mass surrounding the borehole.

In addition to measurement results and borehole-videos, results of recent numerical calculations carried out by the TUC are also part of the presentation, since the recorded borehole-videos and gained measurement results are used to adapt and further develop the simulation tool for underground openings in Opalinus Clay and claystone rock mass.

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