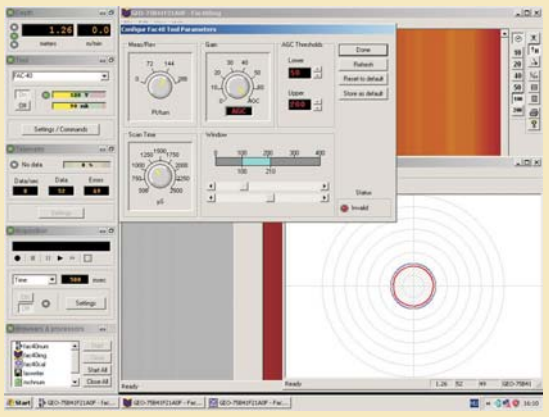
Geo-Log measures by Advanced Logic Technology probes (ABI, OBI, HPF), software (ALTLogger) and interpretation by WellCAD

Measurements in the tunnel initial borehole

Acquisition system software

The ALT Logger is a universal power for probe measurement data acquisition and digital signal communication, but with a special module the Geo-Log acoustic, nuclear and analog type communication probes shall be fitted as well.

The acquisition system ALTLogger software runs on Windows OS. The core of the graphical user interface is called the Dashboard and consists of multiple threads running concurrently and handling specific system tasks. The dashboard is also the operator's control panel. It is used to select and control all systems functions and to monitor data acquisition.



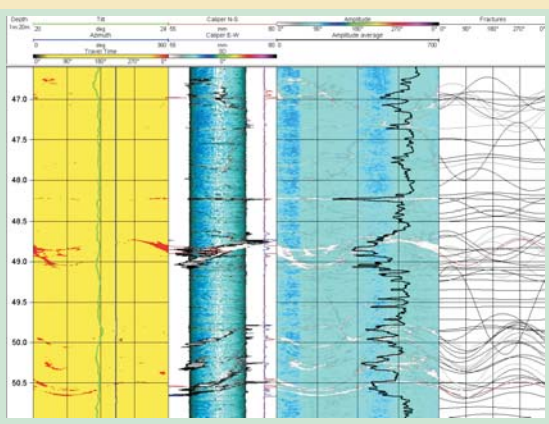
The ALTLogger control panel

Summary

The Geo-Log took part in the exploration work for selecting the site for small and medium-level radioactive waste deposits. During the tunnel drive and the construction of the storage chamber more than 10000 m logging were done. The electric, acoustic and natural gamma measurements were performed on instruments developed by the borehole wall acoustic and optical measurements and high sensitivity flow measurements in the ALT and measuring probes shall be fitted with data acquisition. The table describes the instrumentation and measurement conditions, as well as some typical measurement results.

Inside the tunnel

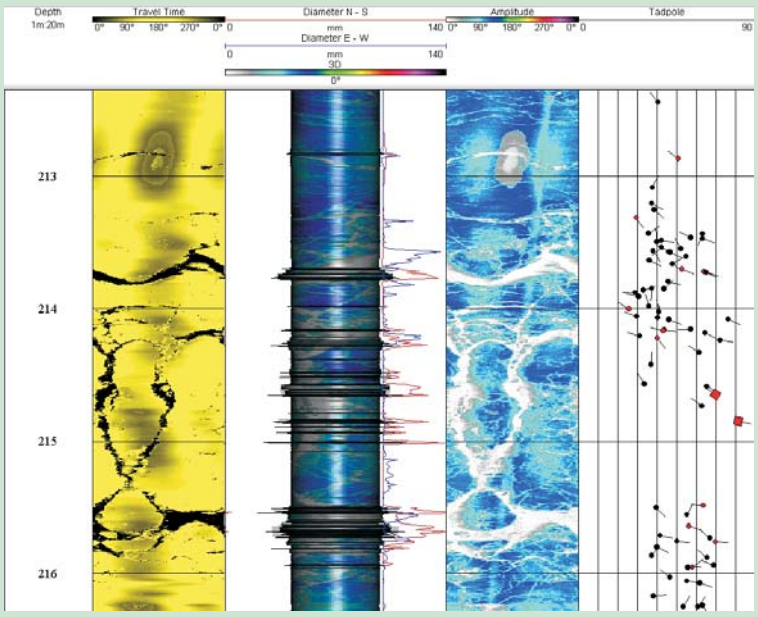
Probe insertion of horizontal drilling



Inside the measurement unit

Acoustic BoreHole TeleViewer (BHTV)

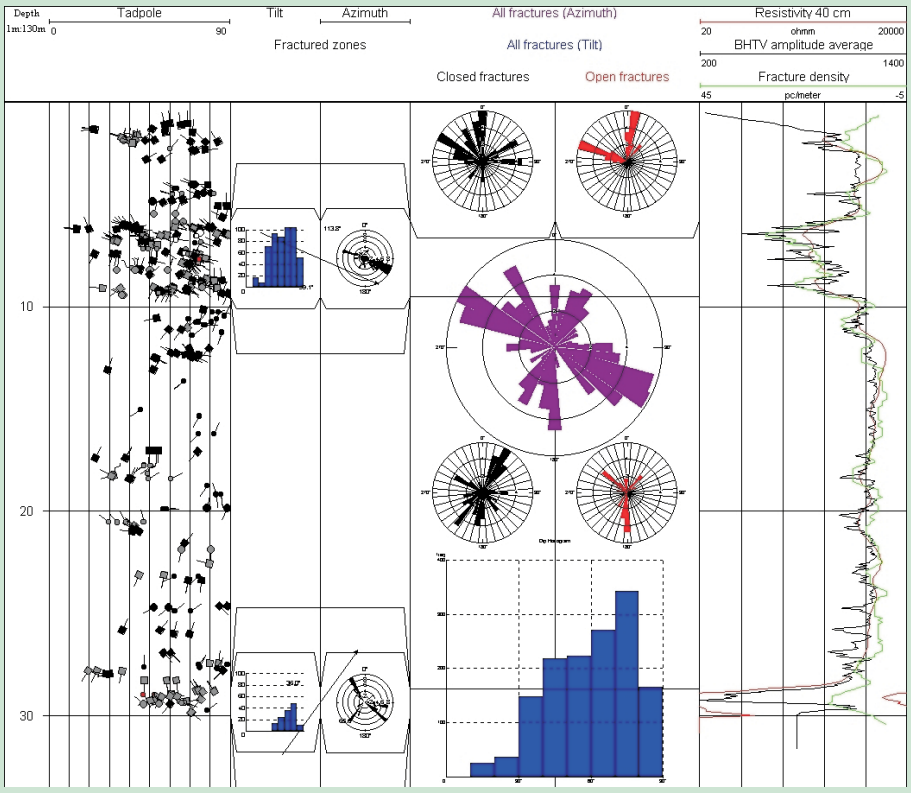
The acoustic borehole televiewer generates two kinds of the borehole wall's image. One of these is based on the measurement of the travel time of the reflected signal. That image shows the open fractures mainly or the closed ones which are harder than their environment (yellow column) The second image comes from the amplitude recording of the reflection. This image is more detailed because it is representative for all the mineralogical differences and for the structure of the rock, which is caused by the changing of hardness. The fractures which are broken out formerly and they are completely closed now can be detected too (blue column). In the third column the 3 dimensional image of the borehole wall, the cylinder jacket, can be seen.



With the application of FAC-40 and ABI-40 probes we have undertaken almost 10 000m probing in 50 drillings. In the same period of time probing of ~3000 m in ~ 40 surface drillings have been realized with the ABI-40 probe. The measurements provided very important proxies for tectonic and hydrogeological interpretations, in subsurface explorations they assisted well the geotechnical interpretation and guided the driving. Fracture density and average amplitude sections were constructed from the number of fractures the amplitudes, which both could be well correlated with the resisitivity sections and could characterize in even better resolution the geotectonic state of the rocks (Figure on the right handside, right handside field). The fractures were evaluated from different viewpoints (open, closed, whole sinus) supporting the hydrogeological interpretations. Fracture statistics were prepared for different intervals. These measurements were indispensable in fitting the cores to the right depth and also rotating the cores into the real directions. The spatial position and precise diameter of drilling were also constrained based on these measurements. The centering the ABI probe raised considerable challenges in 96 mm diameter almost horizontal drillings, however, a tool was developed which operated effectively and safely. During the several thousand meters of probing there was no loss of instruments (however, its was also due to seasoned operators and good luck).

Application:

- fracture detection and interpretation
- detection of thin beds
- determination of bedding dip
- lithological characterisation
- high resolution caliper measurements

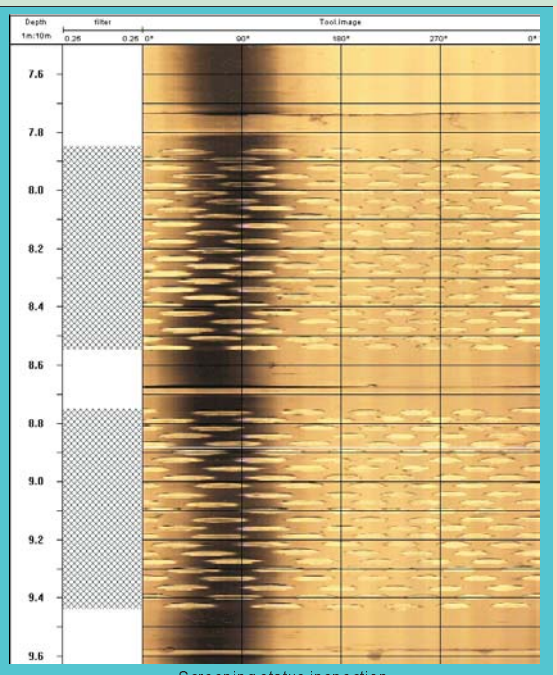


Slimhole optical televiewer

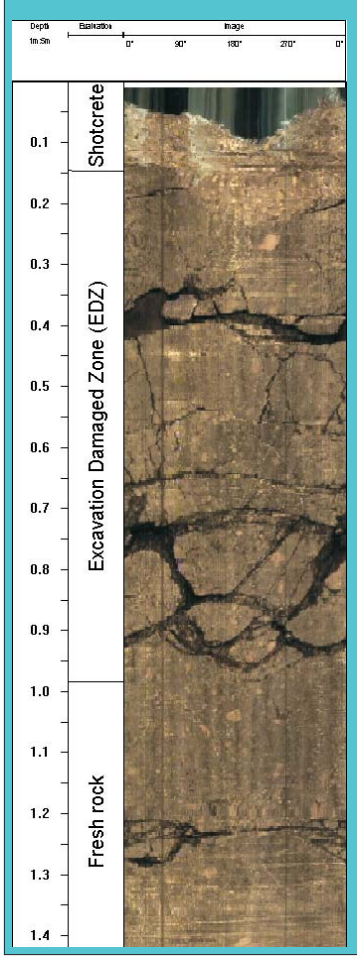
The tool generates a continuous oriented 360° image of the borehole wall using an optical imaging system. (downhole CCD camera which views a image of the borehole wall in a prism).
The tool includes an orientation device consisting of a high-precision 3 axis magnetometer and 3 accelerometers, thus, allowing accurate borehole deviation data to be obtained during the same logging campaign (accurate and precise orientation of the image).

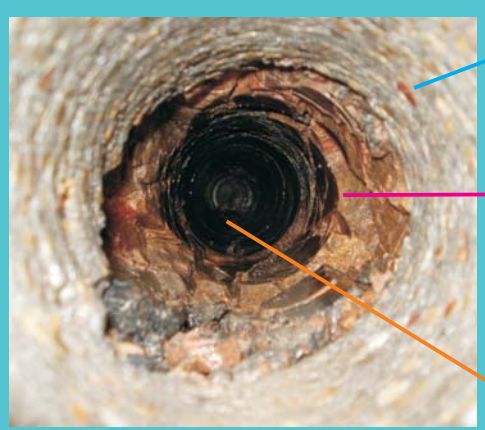
Optical and acoustic televiewer data are complimentary tools especially when the purpose of the survey is structural analysis. A common data display option is the projection on a virtual core that can be rotated and viewed from any orientation.

Actually, an optical televiewer image will complement and even replace coring survey and its associated problem of core recovery and orientation.

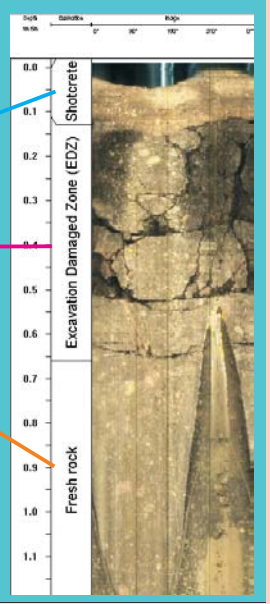


Screening status inspection



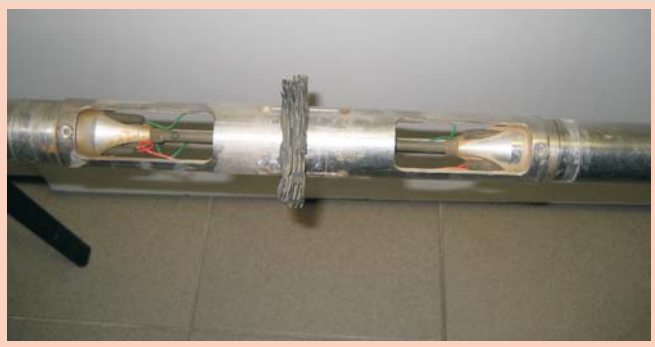


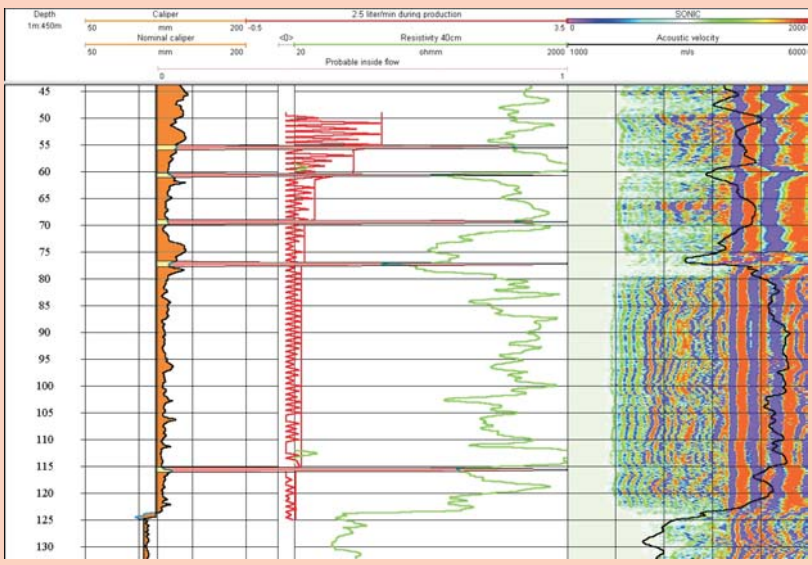
The advantage of the probe is that it can be used in dry bores, thus, at the front of driving it can be utilized in upward directed geotechnical drillings for constraining the depth of the damaged zone and also the thickness of the cement.



High resolution Heat-Pulse Flowmeter (HPF)

- resolution 0.1 to 3.5 liters/min
- measurement at stationary position
- activation of heat grid to heat packet of water
- movement of heated water packet if flow in well
- monitoring difference in T between sensors
- measurement of time difference between activation and greatest T measurement
- calculation of rate of flow and direction





In the fractures of the stiff granite body there is only a 10 l/hour influx of water, thus, traditional probes with paddles cannot be utilized. Excellent measurements have been undertaken, nevertheless, with HPF probes in 96 and 76 mm sized drillings. The drillings were produced by a 2" pump from a depth of 40-60 m, while the flux measurement were undertaken by an upright probe in 1 or 2 meters separation with the complete closing of the drillings with packers. The locations of water influx coincide reasonably well with the fractured zones and fissures indicated by the acoustic and electronic sections.

Pumping and HPF measurement