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Äspö Hard Rock Laboratory

Inventory of instrumentation used in Äspö HRL

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August 2002

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**Äspö Hard Rock
Laboratory**

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author(s) and do not necessarily coincide with those of the client.

Abstract

This report is an inventory of instruments installed in Äspö hard rock laboratory. The aim is to provide an overview of different types and measuring principles that are used and gather some experience of the performance of the different instruments. The data has been gathered from installation reports, sensor reports and personal communication with persons involved in installation and maintenance of the instruments. Detailed information can be found in the reports cited and from the personnel involved.

Sammanfattning

Denna rapport är en inventering av de olika instrument som är installerade i Äspö berglaboratorium. Målet är att få en översikt över de olika instrument och mätprinciper som används och att samla driftserfarenheter. Informationen har samlats från installationsrapporter, datarapporter och samtal med de som installerat och underhåller instrumenteringen. Detaljerad information om de olika instrumenten finns i de refererade rapporterna och kan fås av berörd personal.

Brief explanation of the tables

Table 1 is the result of the inventory. The table is divided to the following columns:

Process/parameter.

The inventory is sorted by the parameter or process measured in order to arrange instruments measuring similar properties.

Instrument/Method.

This column describes the type of instrument or sensor that is used, in some cases with the manufacturer.

Used in Experiment (# used).

The following abbreviations for the different experiments have been used:

BaPT	Backfill and Plug Test
CRT	Canister Retrieval Test
LOT	LOng Term test of buffermaterial
PR1	Prototype Repository Section 1
HMS	Hydro Monitoring System
TRUE	Tracer Retention Understanding Experiment
LTDE	Long Term Diffusion Experiment

The total number of instruments used in the experiment is given in parentheses.

Operating Range.

Describes the range the equipment is specified for (in some cases not applicable).

Datalogging.

Describes the method that the readings are acquired with. In most cases an automated data logger.

Performance.

Describes how the equipment has been performing in the experiment. In some cases this cannot be tested while the experiment is running.

In Table 2 the references have been given. They are combined within each experiment since most of the data is gathered from several sources.

Table 1. Summary of instruments used in Äspö Hard Rock Laboratory

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Thermal Evolution	Heraeus Electro-Nite AB, Type K Thermocouple	BaPT (2)	-200-1260 °C	Automated	No problems reported
	BICC, type K Thermocouple	CRT (32)	-200-1260 °C	Automated	No problems reported
	BICC, type K Thermocouple	CRT (40) In Rock	-200-1260 °C	Automated	No problems reported
	BICC Optic Fiber FTR	CRT (2) on canister	-200-500 °C	Automated	Problems with data acquisition and calibration
	BICC, typ K Thermocouple	LOT (120)	-200-1260 °C	Datascan logger	Four failures, probably caused by corrosion.
	Pentronic, Type K Thermocouple	PR1 (117)	-200-1260 °C	Automated	Two failures
	BICC Optic Fiber FTR	PR1 (8) on canister	-200-500 °C	Automated	Problems with data acquisition and calibration
Displacement	CT Communicating Vessel	PR1 (4)	0-1 m	Automated	Inconsistent data, fluid has been exchanged in one case. Under investigation and development.
	Roctest FOD-25	PR1 (6)	± 12.5 mm	Automated	No problems reported
Pressure (Total)	Glötzl Hydraulic E10/20 KF 50 VA24 mod A, F	BaPT (9 mod A, 4 mod B)	0-5 MPa	Automated	There have been some problems with the Data Acquisition System but it has been repaired. Two of the cells are not working
	Roctest Vibrating Wire TPC-0	BaPT (8)	0-4 MPa	Automated	One is not working

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Pressure (Total) (cont)	Geokon Vibrating Wire 4500TIX-10MPa	CRT (21)	0-10 MPa	Automated	One failure
	Kulite BG-200-0234C- 100BarSG	CRT (6)	0-10 MPa	Automated	Two failures, two with improbable readings
	Roctest Fiber Optic Pressure Transducer FOP	LOT (20)	0 – 10 MPa	Automated	No problems reported
	Geokon Vibrating Wire 4500TI-1500	LOT (10)	0-10 MPa	Datascan logger	Electric interference between sensors.
	Kulite BG-200-0234C- 100BarSG & 150BarSG	PR1 (28)	0-10 MPa 0-15 MPa	Automated	Three failures, one with questionable readings
	Geokon Vibrating Wire 4800-1X-15MPa & 20 MPa	PR1 (42)	0-15 MPa 0-20 MPa	Automated	One failure
	Pore Water Pressure	Glötzl Hydraulic P4 S 50L VA	BaPT (18)	0-5 MPa	Automated
Druck PTX 1400		BaPT (16)	0-4 MPa	Automated	No problems reported

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Pore Water Pressure (cont)	Geokon Vibrating Wire 4500TIX-10MPa	CRT (11)	0-10 MPa	Automated	No problems reported
	Kulite ETM-206-500T- 50BarSG	CRT (2)	0-5 MPa	Automated	No problems reported
	Druck PTX 1400	LOT (15)	0-4 MPa	Datascan logger	No problems reported
	Kulite ETM-206-500T- 50BarSG	PR1 (25)	0-5 MPa	Automated	No problems reported
	Geokon Vibrating Wire 4500TIX-750X	PR1 (26)	0-5 MPa	Automated	One failure
Water Pressure	Druck PTX 1400	BaPT (79)	0-4 MPa	Automated	Seven have stopped working and been exchanged
	Druck PTX 5xx or 6xx multiplex or individual	HMS (187)	0-5 MPa	Automated	No sensor problems reported. Low frequency when measurements are multiplexed.
	Druck PTX 520 or 620	LTDE (6)	0-5 MPa	Automated	No problems reported
Flow	Weir Druck PTX510 Ultrasonic EXAC- /STA-270	HMS (21)	0-100 mbar 0,2-0,7 m	Automated	Druck pressure meter exchanged due to offset drift jumps in registration and incomplete compensation for air pressure

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Flow (cont)	Endress+Hauser Induktiv Promag 33A	LTDE (1)	0-1 l/min	Automated	No problems reported
	Brooks Instrument Variable Area B M/T 3750A	TRUE (5)	Unknown	Automated	No problems reported
	Micro motion /Fisher rosemount Elite sensor CMF 010 M with amplifiers	BaPT (4)		Datascan logger	No problems reported
	Micromotion Coriolis M64348/02	TRUE (1)	Unknown	Automated	No problems reported
Flowregulator	Brooks-Flomega Thermal Flowmeter 5881/B1A1C5C000	TRUE (9)	0-100 g/h	Automated	No problems reported
Water saturation	Wescor Psychrometers PST-55	BaPT (27)	95,5-99,6 %RH	Automated	None seems to have failed before saturation
	Resistivity probes ClayTech	BaPT (10)	5-12 % water ratio	Automated	Three of the probes are not working
	Tubes with filter. Water saturation indicators	BaPT (38)	Saturation	Manual	No problems reported

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Water saturation (cont)	Wescor Psychrometers PST-55	CRT (26)	95,5-99,6 %RH	Automated	No problems reported
	Vaisala HMP 237	CRT (28)	0-100 %RH	Automated	Two failures, two with improbable readings
	Vaisala HMP 237	LOT (20)	0-100 %RH	Datascan logger	When fully saturated the sensor cavities where flooded and the sensor stopped working.
	Wescor Psychrometers PST-55	PR1 (45)	95,5-99,6 %RH	Automated	Three failures
	Vaisala HMP 237	PR1 (40)	0-100 %RH	Datascan logger	Five failures
	Rotronic Capacitivity Spez Clay	PR1 (34)	0-100 % RH	Automated	Five failures
Hydraulic conductivity	ENRESA	BaPT (13)			Three sensors broke during installation
Rock Stress	Geokon Mod 4350 VW Biaxial Stressmeter Vibrating Wire	CRT (8)	0-70 MPa	Automated Campbell CR10X	No problems reported
	Geokon Mod VCE 4200 Strainmeter Vibrating Wire	CRT (8)	0-3000 μ e	Automated Campbell CR10X	No problems reported
Chemical properties	Hydrochemical sampling device CT	PR1 (8)		Manual sampling	No problems reported

Process/ Parameter	Instrument/ Method	Used in Experiment (# used)	Operating Range	Datalogging	Performance
Chemical properties (cont)	Hydrochemical sampling device CT	PR1 (12)		Sampling when excavated	No problems reported
	Copper electrodes	PR1 (6)			No problems reported
	Electric conductivity	HMS (11)		Automated	No problems reported
	Eh meter Rosemount Model 1054	TRUE (1)		Automated	No problems reported
	Electric Conductivity Kemotron mod 802	TRUE (1)		Automated	No problems reported
Power	Wattmeter	LOT (5)	0-2 kW	Datascan logger	No problems reported
	Wattmeter	CRT (1)	0-5kW	Datascan logger	No problems reported
	Wattmeter	PR1 (4)	0-5kW	Datascan logger	No problems reported

Table 2. References.

Abbr.	Experiment	References: (PC = personal communication with, CT = Clay Technology AB)
BaPT	Backfill and Plug Test	Sensor data report IPR-02-10, David Gunnarsson et al 2002 ClayTechnology AB, PC David Gunnarsson CT
CRT	Canister Retrieval Test	Canister retrieval test, Sensor data report, IPR-01-24 Reza Goudarzi et al, 2001, PC Torbjörn Sandén CT, PC Reza Goudarzi CT
LOT	Long Term test of buffermaterial	Long term test of buffer material, Final report on the pilot parcels. Ola Karnland et al, 2000 ClayTechnology AB, PC Ola Karnland CT
PR1	Prototype Repository section 1	Prototype Repository, Instrumentation for gas and water sampling in buffer and backfill. Tunnel section I, Ignasi Puigdomenech et al, 2001, IPR-01-62, Instrumentation of buffer and backfill in Section I, Roland Pusch et al, 2001, IPR-01-60, PC Torbjörn Sandén CT, PC Reza Goudarzi CT
HMS	Hydro Monitoring System	Hydro Monitoring Program, Report for 2000, IPR-01-29 Göran Nyberg et al, 2001, PC Tomas Karlsson SKB
TRUE	Tracer Retention Understanding Experiment	Instrumentation CD, Anders Winberg CONTERRA, PC Anders Winberg
LTDE	Long Term Diffusion Experiment	Instrumentation CD, Anders Winberg CONTERRA, PC Anders Winberg