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Äspö Hard Rock Laboratory

Prototype Repository

Hydraulic tests in exploratory holes
Drill campaign 2

Bengt Gentzschein

Geosigma

May 1998

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Foreword

This International Progress Report is one out of seven reports presenting the results from the hydrogeological field characterisation work prior to boring of the six deposition holes in the Prototype Repository tunnel in the Äspö Hard Rock Laboratory. The field investigations have been conducted in seven test campaigns between November 1997 and August 1999. The results from each campaign are described in a separate report and the following seven ones have been published.

Gentzschein, B. 1997: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Pilot Holes. Drill campaign 1.
SKB International Progress Report IPR 99-27, December 1997.

Gentzschein, B. 1998: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. Drill campaign 2.
SKB International Progress Report IPR 99-28, May 1998.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. Drill campaign 3a. SKB International Progress Report IPR 99-29, June 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. Drill campaign 3b. SKB International Progress Report IPR 99-30, June 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. Injection Tests.
SKB International Progress Report IPR 99-31 , May 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. interference Tests A after drill campaign 3
SKB International Progress Report IPR 99-32, May 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository.
Hydraulic Tests in Exploratory Holes. interference Tests B after drill campaign 3
SKB International Progress Report IPR 99-33, November 1999.

The reports include technical specifications and description of the equipment used, measurement procedures, results of the flow and pressure measurements, relevant test data and all the background data necessary for interpretation and evaluation of field data.

Each test produces a great number of diagrams showing responses in test sections or observation boreholes caused by pressure draw-downs. Each report comprises between 120 and 600 diagrams sorted in appendices after the describing text. Due to the great number, the diagrams are not included in the printed versions of the reports. But the reports, including the diagrams are also stored as Word documents on a CD-R. In addition each diagram is stored as a file (GIF – format). The Word-documents, converted to PDF-format, as well as the diagram-files are available at the Äspö Hard Rock Laboratory.

Abstract

The Prototype Repository in the Äspö Hard Rock Laboratory aims at simulating conditions in the future Deep Repository as realistically as possible. Some of many tasks are to observe the water saturation and homogenisation of the bentonite buffer and the backfill, and their interaction with the rock as well as to compare developed codes and material models with the observations. These tasks among other things need information on the hydraulic properties of the rock. The geohydraulic characterisation of the rock around the Prototype Repository is made in three stages. Each stage is intended to contribute to more details useful for determination of the localisation of the deposition holes and the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are focused on:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

This International Progress Report is report number 2 out of seven in a series which presents the results from stage 2, i e hydrogeological characterisation in pilot and exploratory holes, which have been obtained during seven test campaigns between November 1997 and August 1999. More precisely the present International Progress Report presents the results from the hydraulic tests in the 10 pilot holes and 10 of the short exploratory holes, which are situated in the tunnel interval 3/539 m – 3/593 m. These 10 short, i e 8 m to 12 m, vertical to subvertical holes were drilled in October 1997. (The first report concerned studies in the 10 pilot holes before boring the 10 short holes.)

Packers were installed in all 20 holes and the groundwater pressure was measured several times. The result was readings between 0 and 2.8 MPa. The flow rate was measured in the 10 new holes as well as the pressure build-up. The highest flow rate was 60 ml/min in the outermost hole, but generally the flow rate was much lower, one to two orders of magnitude. When the flow rate exceeded 10 ml/min an interference test was performed by measuring the pressure responses in the five to six nearest drill holes. Six such interference tests were performed. The flow rates were also measured in one-meter sections and interference tests were made when these flow rates exceeded 10 ml/min. Five such interference tests were made.

Sammanfattning

Prototypförvaret i Äspölaboratoriet byggs för att simulera förhållandena så naturnära som möjligt i det framtida djupförvaret. Några av många uppgifter är att observera bentonitbuffertens och återfyllens vattenmättnad och homogenisering liksom den interaktion mellan materialen och berget som sker, samt att jämföra utvecklade koder och materialmodeller med de gjorda observationerna. För dessa uppgifter behöver bl a bergets hydrauliska egenskaper kunna beskrivas. Denna geohydrauliska karakteriseringen av berget omkring Prototypförvaret görs i tre steg. Varje steg ska bidra med mer användbar detaljinformation om lokalisering av deponeringshål samt randvillkor och bergegenskaper som behövs för tolkning av framtida observationer. De tre stegen inriktas på:

Kartering av tunneln
Pilot-och undersökningshål
Deponeringshål

Denna International Progress Report utgör rapport nummer 2 av sju i en serie som presenterar resultaten från Steg 2, dvs de hydrogeologiska karakteriseringar i pilot-och undersökningshål som gjorts i sju testkampanjer mellan november 1997 och augusti 1999. Mer precist redovisar föreliggande International Progress Report resultaten från mätningar i de 10 pilothålen och de 10 korta undersökningshålen, vilka borrats i tunnelintervallet 3/539 m – 3/593 m. Dessa 10 korta, dvs 8 m till 12 m, vertikala till subvertikala hål borrades i oktober 1997. (Den första rapporten redovisade resultaten från testerna i de 10 pilothålen innan de 10 korta hålen borrades.)

Manschetter installerades i alla 20 hålen och grundvattentrycket mättes flera gånger. Tryck mellan 0 och 2,6 MPa erhölls. Inflödet mättes liksom tryckets uppbyggnadsförlopp i de 10 nya hålen. Som mest mättes ett inflöde på 60 ml/min, i det yttersta hålet men flödet var i regel betydligt lägre, en till två storleksordningar. När inflödet var större än 10 ml/minut gjordes interferenstester med tryckförändringar i de närmaste fem till sex borrhålen. Sex sådana interferenstester genomfördes. Därefter mättes flödet i varje metersektion och interferenstester gjordes i de metersektioner där flödet var större än 10 ml/min. Fem sådana interferenstester blev genomförda.

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1. Background

Within the scope of SKB's program for RD&D 1995, SKB has decided to carry out a project named "Prototype Repository" at the Äspö Hard Rock Laboratory. The aim of the project is to test important components in SKB's deep repository system in full scale and in a realistic environment.

The Prototype Repository is focused on testing and demonstrating the function of SKB's deep repository system. Activities aimed at contributing to development and testing of the practical engineering measures required to rationally perform the steps of a deposition sequence are also included. However, efforts in this direction are limited, since these matters are addressed in the Demonstration of Repository Technology project and to some extent in the Backfill and Plug test.

The characterisation of the test site, located in the TBM-excavated part of the Äspö HRL tunnel, will be made in three stages. Each stage is intended to contribute to more details useful for the determination of the localization of the deposition holes and also the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

Stage 1 is completed and stage 2 has been divided into three drilling campaigns:

1. Drilling of pilot holes
2. Drilling of exploratory holes-short boreholes
3. Drilling of exploratory holes-long boreholes

Ten pilot holes were drilled between October 14th and October 20th 1997. in the tunnel interval 3/539 m - 3/593 m. Hydraulic tests were performed in these boreholes in November 1997. Ten of the short exploratory boreholes were drilled in the tunnel interval 3/544 m - 3/588 m between March 16th and March 24th 1998. This report describes the hydraulic tests that were carried out in the exploratory holes.

2. Objectives

2.1 General objectives

The Prototype Repository should simulate a real repository in as many aspects as possible. The Prototype Repository is a demonstration of the integrated function of the repository components. Results will be compared with models and assumptions to their validity.

The major objectives for the Prototype Repository are:

- To demonstrate the integrated function of a full-scale prototype of the repository system
- To provide a full-scale reference for testing/scrutinization of models, experiments and assumptions
- To develop, test and demonstrate appropriate engineering standards and quality standards and quality assurance systems.
- To demonstrate technology for monitoring of the repository system

The objectives for the characterization program are:

- To provide a basis for determination of localization of the deposition holes
- To provide data on boundary and rock conditions to enable interpretation of experimental data

2.2 Objectives of hydraulic tests - drill campaign 2

The objectives of the exploratory holes is to obtain data for prediction of the characteristics in the deposition holes, data for modelling and to quantify the criteria needed for validation of the suitability of the position for canister deposition. Acceptance of a canister position is based on scrutinization of characterization data such as fracturing, permeability and stability of the borehole wall.

The objectives for the hydraulic tests in the short exploratory holes are:

- The hydraulic tests in the short exploratory holes should be fairly simple in order to test a methodology that possibly can be useful as a robust engineering process in the deep repository when investigating each canister position.
- the tests shall provide hydraulic data useful for a first judgment of if the position can be used for deposition of a canister.

3. Scope

The ten exploratory boreholes are vertical or subvertical. The length of the boreholes KA3588G01 and KA3586G01 is 8.00 m. The length of the remaining eight holes is about 12 m. The nominal diameter is 76 mm. The date of drilling is presented in Table 3.1

Prior to the hydraulic tests mechanical packers were installed in the exploratory holes(see Table 3.1). Packers were also installed in the earlier drilled pilot boreholes (Table 3.2). The groundwater pressure was measured both in the exploratory holes and in the pilot holes a number of times during the test period.

Table 3-1 Drilling data and packer installation data for the exploratory holes.

Borehole	Date of drilling	Date/time of packer installation (borehole closed)	Measurement section (m)
KA3544G01	980324	980327 16:12	0.50 - 12.00
KA3546G01	980323	980327 16:12	0.50 - 12.00
KA3548G01	980323	980327 16:12	0.50 - 12.01
KA3550G01	980322	980327 16:11	0.50 - 12.03
KA3552G01	980321	980327 16:11	0.50 - 12.01
KA3572G01	980320	980327 16:08	0.50 - 12.00
KA3578G01	980319	980327 16:07	0.50 - 12.58
KA3584G01	980318	980327 16:04	0.50 - 12.00
KA3586G01	980317	980327 16:00	0.50 - 8.00
KA3588G01	980316	980327 15:58	0.50 - 8.00

Table 3.2 Drilling data and packer installation data for the pilot holes.

Borehole	Date of drilling	Date/time of packer installation (borehole closed)	Measurement section (m)
KA3539G	971018	980327 16:13	0.50 - 8.04
KA3545G	971020	980327 16:12	0.50 - 8.04
KA3551G	971017	980327 16:11	0.50 - 8.04
KA3557G	971016	980327 16:10	0.50 - 8.04
KA3563G	971016	980327 16:10	0.50 - 8.04
KA3569G	971015-16	980327 16:09	0.50 - 8.04
KA3575G	971015	980327 16:08	0.50 - 8.04
KA3581G	971015	980327 16:05	0.50 - 8.04
KA3587G	971014	980327 16:02	0.50 - 8.04
KA3593G	971014	980327 15:57	0.50 - 8.04

The packer of borehole KA3584G01 was lowered 0.71 m 98-04-01.

After the packer installation the ground water pressure of the boreholes stabilized during four days.

Pressure build-up tests of the entire boreholes (i.e. the interval from 0.50 m to the borehole bottom) were carried out between the 1st and 5th of April. If the water flow rate exceeded 10 ml/minute an interference test was performed by monitoring the pressure responses in the five or six of the adjacent boreholes. Further more the ground water pressure of the three boreholes KA3510B, KA3573A and KA3600A was measured. A list of tests is shown in Table 3.3

Table 3-3 A list of hydraulic tests conducted in the entire exploratory boreholes. Prototype Repository - drill campaign 2, April 1998

Borehole	Date of test	Type of test	Observation boreholes
KA3544G01	980403	I	KA3546G01, KA3548G01, KA3550G01, KA3552G01 KA3539G, KA3545G, KA3510B, KA3573A, KA3600A
KA3546G01	980404	I	KA3544G01, KA3548G01, KA3550G01, KA3552G01 KA3545G, KA3551G, KA3510B, KA3573A, KA3600A
KA3548G01	980403	I	KA3544G01, KA3546G01, KA3550G01, KA3552G01 KA3545G, KA3551G, KA3510B, KA3573A, KA3600A
KA3550G01	980403	I	KA3544G01, KA3546G01, KA3548G01, KA3552G01 KA3551G, KA3557G, KA3510B, KA3573A, KA3600A
KA3552G01	980402	I	KA3544G01, KA3546G01, KA3548G01, KA3550G01 KA3551G, KA3557G, KA3510B, KA3573A, KA3600A
KA3572G01	980402	PBT	
KA3578G01	980404	PBT	
KA3584G01	980405	PBT	
KA3586G01	980401	PBT	
KA3588G01	980401	I	KA3584G01,KA3586G01,KA3581G,KA3587G, KA3593G, KA3510B, KA3573A, KA3600A

PBT = Pressure Build-Up Test, I = interference Test

Flow logging of the ten exploratory holes was performed between April 7 and April 21. A double packer system with 1 m packer spacing was used. Ten or six (KA3586G01 and KA3588G01) double packer sections of each borehole were measured. A section covering the bottom of every hole was measured using a single packer tool.

If the flow rate of the measurement section exceeded 10 ml/min a pressure build-up test was performed.

Since the packer gable and the packer pipe extend c. 0.3 m below the 1 m sealing part of the packer the lowest double packer interval possible to measure was positioned c. 1.30 m from the borehole end. The section limits were different in the boreholes respectively, since the borehole depths varied, see Table 6.2. In all, flow measurements were carried out in 102 intervals.

In five sections a flow rate > 10ml/min was measured and a pressure build-up test was conducted. The five sections were:

KA3544G01: 9.70 - 10.70 m
KA3548G01: 5.70 - 6.70 m
KA3550G01: 5.70 - 6.70 m
KA3552G01: 4.70 - 5.70 m
KA3588G01: 4.70 - 5.70 m

4. Equipment used

When measuring the borehole pressures and carrying out the pressure build-up tests and interference tests, the boreholes were shut in by mechanically operated packers manufactured by Livinstone AB. The sealing rubber length of the packers was 0.15 m. The length of the packer system was c. 1.5 m.

A valve arrangement, including a pressure gauge for manual reading, and a sealing BAT rubber disc mounted in a nozzle, was connected on the inner packer pipe

The pressure transducers used were Druck PTX 1400. The pressure range was 60 bar. On the transducer housing a hypodermic needle was mounted. When connecting the transducer to the valve arrangement on the packer pipe, the needle penetrated the rubber disc, enabling a hydraulic communication between the measurement section and the transducer. The ”BAT-connections” and the transducers were positioned on top of the packers, just below the closing valve, see Table 4-1

Table 4-1 Level of pressure transducers above the tunnel floor during pressure measurements of the entire exploratory holes, April 1998.

Borehole	Level above tunnel floor (m)	Comment
KA3544G01	1.51	
KA3546G01	1.47	
KA3548G01	1.42	
KA3550G01	1.35	
KA3552G01	1.37	
KA3572G01	1.42	
KA3578G01	1.47	
KA3584G01	1.46	0.76 m from 98-04-02
KA3586G01	1.47	
KA3588G01	1.39	
KA3539G	1.48	
KA3545G	1.48	
KA3551G	1.48	
KA3557G	1.46	
KA3581G	1.50	
KA3587G	1.46	
KA3593G	1.47	

Pressure data were stored using the data logger BORRE MDL ver. 2.2, manufactured by IPA-konsult AB. The software of the logger is very flexible concerning sampling intervals etc. A measurement sequence can be started either by a temporarily connected computer or by using the key pad at the front of the data logger. Pressure values are shown on the computer screen during the measurements. The key pad enables three measurement options. The option ”SLOW” initiates one hour interval measurement and ”FAST” a 5 minutes interval. The ”SEQ” option is usually used during hydraulic testing. This option has stepwise increase in measurement intervals starting with 2 seconds (if one channel is used). After 30 minutes and onwards the measurement interval is three minutes. These ”SLOW”, ”FAST” and ”SEQ” options can easily be reprogrammed from the computer.

During the interference tests two data loggers and seven pressure transducers were used in the exploratory boreholes.

Water flow rates higher than 1-2 ml/min were measured using graduated cylinders and a stop watch. Lower rates were achieved by letting the water flow through a vertical mounted Tecalan hose and measure the rise of the water level. A Tecalan hose with the inner diameter 4 mm was used.

The outflow level above the floor of the tests respectively is listed in Table 4.3.

The down-hole equipment used for the flow logging and the PBT’s of a feature in the exploratory holes consisted of two inflatable polyurethane packers, separated by a pipe, a pipe string and two pressure lines. The sealing length of each packer is 1.0 m and they are inflated using water pressurized by nitrogen. The pipe between the packers and a by-pass opening at the upper gable of the outer packer equalize the ground water pressure on both sides of the measurement section. One of the two pressure hoses (polyamide) is connecting the packers and the pressurizing system. The second pressure hose establishes hydraulic contact between the measurement chamber and a transducer positioned outside the borehole.

The pipe string is made of aluminum with threaded pipe joints of stainless steel. The outer/inner diameter is 33/21 mm and the length of individual pipe segments is 1 m .

The test tool and the pipe string were lowered into the borehole using a manually operated winch.

The packer inflation influences the accuracy of the flow measurements. The generated flow in a double packer section caused by the packers used in the exploratory hole tests have been tested in the laboratory, cf. Lindström (1997). The results show that after 30 minutes of inflation, the flow is c. 0.5 ml/min. and after 40 minutes the generated flow is c. 0.4 ml/min. Consequently, the effect of packer creep induced flow is most pronounced for low-conductive test sections., see Figure 4.1

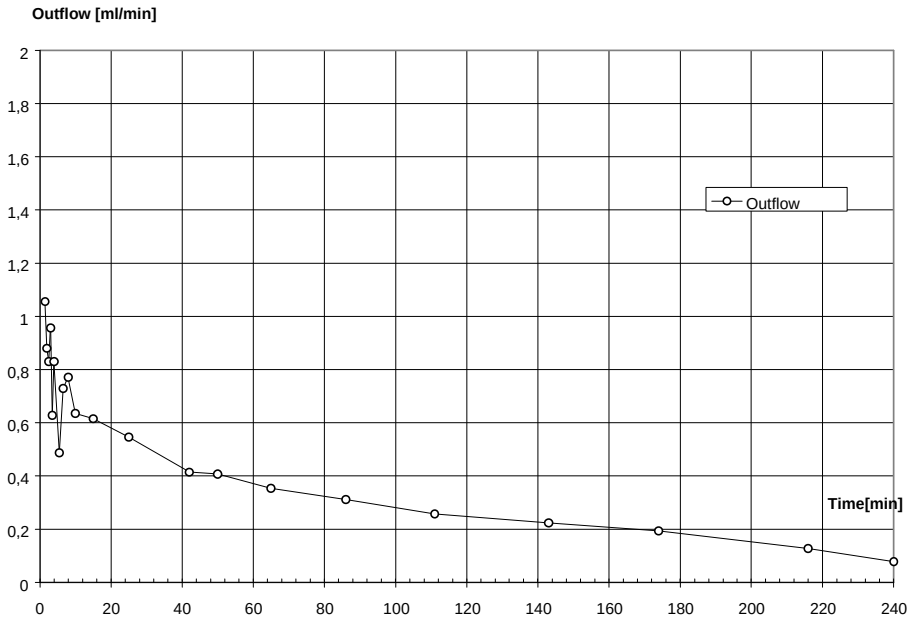

Figure 4.1 Generated flow caused by inflation of double packers PUR 72. Elapsed time from start of inflation, from Lindström 1997.

When flow logging the pilot holes in November 1997 flow rates lower than the minimum rates of the laboratory tests were observed. This was somewhat confusing and not easy to explain. In order to study if the function of the packers had been changed by age or by use, the laboratory tests were repeated in April 1998. The same packers used in the November measurements and later used in the exploratory holes were tested in the laboratory. However the result of the new tests was similar to the data achieved at the first test. After 30 to 40 minutes of packer inflation the flow generated by the packer expansion was measured to 0.48 - 0.44 ml/min. see Table 4.2.

Table 4-2 Generated flow caused by inflation of double packers PUR 72. Laboratory tests 98-04-02

Elapsed time (min)	Squeezed volume (cumulative) (ml)	Generated flow (ml/ min)
0	0	0
2	56.00	28.00
2.5	56.26	0.53
3	56.58	0.63
3.5	56.87	0.58
4	57.16	0.58
4.5	57.44	0.58
5	57.75	0.60
6	58.31	0.57
7	58.85	0.54
8	59.42	0.57
9	59.94	0.53
10	60.50	0.55
15	63.08	0.52
20	65.61	0.50
30	70.37	0.48
40	74.80	0.44
50	78.95	0.41
60	82.84	0.39

Table 4-3 Outflow level above the floor. Tests in (short) exploratory holes, April 1998. Prototype Repository, drill campaigns 2

Borehole	Section (m)	Date	Test No	Outflow level above floor (m)
KA3588G01	0.50-8.00	980401	1	1.60
KA3586G01	0.50-8.00	980401	2	1.60
KA3572G01	0.50-12.00	980402	3	1.60
KA3552G01	0.50-12.01	980402	4	1.60
KA3550G01	0.50-12.03	980403	5	1.60
KA3544G01	0.50-12.00	980403	6	1.60
KA3548G01	0.50-12.01	980403	7	1.60
KA3546G01	0.50-12.00	980404	8	1.60
KA3578G01	0.50-12.58	980404	9	1.60
KA3584G01	1.21-12.00	980405	10	0.89
KA3544G01	9.70-10.70	980407	11	0.93
KA3548G01	5.70- 6.70	980414	12	0.93
KA3550G01	5.70- 6.70	980415	13	0.97
KA3552G01	4.70- 5.70	980416	14	0.97
KA3588G01	4.70- 5.70	980421	15	0.75

5. Performance

5.1 Pressure measurements

The ground-water pressure of the exploratory holes was at one occasion measured using pressure transducer, data logger and a portable PC. The transducer was connected to the ”BAT-connection” of the boreholes respectively and the logger value, displayed on the PC-screen, was noted. The pressure was calculated using the calibration constants. Before the measurements, the borehole pressures were stabilized for about four days.

The borehole pressures were at several occasions also achieved by reading the pressure gauges mounted on the valve adapters.

5.2 Pressure build-up tests of the entire boreholes and interference tests.

Before the measurements, the borehole pressures were stabilized for about four days

The test cycle was performed as follows:
- the pressure transducers and the data loggers were connected, see chapter 4, to the flowing borehole and to the two nearby observation boreholes.
- the logarithmic scanning option (”SEQ”) of the loggers was initiated
- The valve of the flowing borehole was opened and the flow was measured during 30 - 240 minutes
- the logarithmic scanning option (”SEQ”) of the loggers was restarted
- the valve was closed and the pressure build-up was registered during 15 - 120 minutes.
- The data loggers were switched off.
- transfer to next borehole and reconfiguration of the monitoring equipment.

The duration of the drawdown and the recovery respectively varied depending on the flow, the lower flow rate, the longer drawdown/recovery.

The flow rate was measured using graduated cylinders or a Tecalan hose, see chapter 4.

The data loggers were programmed to measure with the highest sample rate during the first three minutes of the flow phase and recovery phase respectively.
Thereafter the sampling interval was 20 seconds. Since 2-4 transducers were connected to each data logger the lowest measurement interval was 3-5 seconds

If the flow rate exceeded 10 ml/min the test was performed as an interference test. If the flow was less, the test was evaluated as an pressure build-up test in the flowing borehole.

5.3 Flow meter logging with double packers

Shortly before the measurement of a exploratory hole the mechanical packer was removed and the double packer section was assembled.

If the flow rate of a 1m-section was less than 10 ml/min a measurement cycle was performed as follows:

- the double packer section was lowered to the first position.
- start of the packer inflation and data logger (SEQ)
- the packers stabilized for 30 minutes
- the packer pipe was filled with water and if necessary a Tecalan hose was mounted on the top of the packer pipe
- low measurements during 5 minutes
- packer deflation
- transfer to next borehole section

The flow logging started in the bottom of the borehole. Thereafter the the packers were lifted 1m for the next test.

When the double packer measurements were completed, the lower packer was removed. The bottom of the borehole was measured with a single packer in the same way as described above.

The flow rate was measured using graduated cylinders or a Tecalan hose, see chapter 4.

5.4 Pressure build-up test of a feature in the exploratory boreholes

If the flow rate of a 1m-section was greater than 10 ml/min a pressure build-up test was carried out. A test cycle was performed as follows:

- start of the packer inflation and data logger (SEQ)
- the packers stabilized for c. 5 minutes
- the packer pipe was filled with water
- flow measurements during 60 minutes
- the logarithmic scanning option (”SEQ”) of the loggers was restarted
- the valve was closed and the pressure build-up was registered during 120 minutes.
- packer deflation
- transfer to next borehole section

The flow rate was measured using graduated cylinders and a stop watch.

6. Results

6.1 Pressure measurements

The results of the pressure measurement are listed in Table 6.1

Table 6-1 Borehole pressures (kPa) measured by pressure gauges or pressure transducer and data logger in the exploratory boreholes for the Prototype Repository, drill campaign 2

Date: Time	980330 17:00	980331 13:30	980331 13:30	980406 11:35	980414 09:00	980421 08:05
Borehole	(press. gauge)	(press. gauge)	(pr.tran-sducer)	(press. gauge)	(press. gauge)	(press. gauge)
KA3539G	2450	-	-	2400	2440	2470
KA3545G	2220	-	-	2360	2350	2380
KA3544G01	2750	2740	2680	2740	2740	2740
KA3546G01	1970	1970	1913	2050	2020	2030
KA3548G01	2200	2190	2134	2220	2220	2220
KA3551G	780	980	898	1580	1890	1880
KA3550G01	2270	2260	2288	2280	2300	2350
KA3552G01	1280	1280	1064	1310	1260	1240
KA3557G	380	400	321	400	430	410
KA3563G	80	45	64	90	230	370
KA3569G	600	600	497	610	620	630
KA3572G01	0	0	293	0	0	0
KA3575G	0	0	42	0	0	10
KA3578G01	0	0	39	0	0	0
KA3579G	1490	1560	-	1660	1800	1870
KA3581G	0	0	-6	0	0	0
KA3584G01	0	0	-2	0	90	0
KA3587G	1460	1490	1420	1600	1600	1620
KA3586G01	0	90	198	370	490	-
KA3588G01	2180	2180	2050	2200	2200	2200
KA3593G	2200	2210	2150	2210	2230	2230

At one occasion the borehole pressures were measured by pressure gauges and the transducer at the same time. As can be seen in Table 6.1 there is a small discrepancy between the two methods. The pressure values measured by the data logger/transducer system should, however, be more reliable since the system was calibrated some days before the exploratory hole measurements.

6.2 Pressure build-up tests of the entire boreholes and interference tests.

Appendices A1 - A10 contain the diagrams for each test. The different types of diagrams are:

- Lin-Lin plots for the whole test sequence
- Lin-Log plots for the draw-down phase and the Pressure build-up
- Log-Log plots for the draw-down phase and the Pressure build-up
- Derivative plots for the recovery

The pressure build-up is plotted versus the equivalent time, dt_e, in minutes. The equivalent time is defined as:

$$dt_e = \frac{t_p \cdot dt}{t_p + dt}$$ where

t_p = time in minutes when the test section was open
dt = elapsed time after shutting the valve to the test section.

In the following details and important test data for each test are described
The abbreviations used are

- Po = Initial pressure before opening of the valve
- Pp = Pressure just before closing the valve
- Pf = Pressure at the end of the pressure build-up period

Borehole KA3544G01, section 0.50 m - 12.00 m

Date:	98-04-03	Field Crew:	B. Gentzschein
Borehole length:	12.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3544G01		
Valve opened:	980403 131000	Valve closed:	980403 135403
Total flowing time :	44 min	Tot. Pr. Build-up time	47 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3546G01, KA3548G01, KA3550G01, KA3552G01, KA3539G, KA3545G, KA3510B, KA3573A and KA3600A.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3544G01	2687.4	3.4	2676.4
KA3546G01	1933.7	1858.3	1941
KA3548G01	2100.3	2019.8	2106.9
KA3550G01	2269.9	2177.3	2274.9
KA3552G01	1039.6	1036.3	1051.7
KA3539G	2332.5	2277.1	2289.0
KA3545G	2265.4	2058.6	2266.5
KA3510B	4157.8	4158.0	4158.3
KA3573A:1	4106.7	4106.9	4106.3
KA3573A:2	4032.6	4032.2	4031.9
KA3600A:1	4145.6	4145.8	4145.6
KA3600A:2	4123.8	4123.8	4123.5

Manually measured flow rates of KA3544G01 are presented in the table below.

Time	Flow rate (l/min)
13:11	0.068
13:14	0.063
13:18	0.0625
13:23	0.0605
13:29	0.060
13:35	0.0595
13:40	0.0595
13:52	0.0595

Borehole KA3546G01, section 0.50 m - 12.00 m

Date:	98-04-04	Field Crew:	B. Gentzschein
Borehole length:	12.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3546G01		
Valve opened:	980404 090700	Valve closed:	980404 110702
Total flowing time :	120 min	Tot. Pr. Build-up time:	122 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3544G01, KA3548G01, KA3550G01, KA3552G01, KA3545G, KA3551G, KA3510B, KA3573A and KA3600A.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3546G01	2022.1	1.8	1925.3
KA3544G01	2699	2676.5	2695.8
KA3548G01	2232.1	1441.9	2153
KA3550G01	2337.5	1744.3	2266
KA3552G01	1094.5	700.6	1035
KA3545G	2325	1623.4	2251.6
KA3551G	1324.1	1329.6	1336.3
KA3510B	4157.8	4157.8	4157.6
KA3573A:1	4105.4	4105.4	4105.4
KA3573A:2	4031.9	4030.3	4031.5
KA3600A:1	4145.2	4145.2	4144.7
KA3600A:2	4122.9	4123.1	4122.9

Manually measured flow rates of KA3546G01 are presented in the table below.

Time	Flow rate (l/min)
09:08	0.015
09:11	0.013
09:14	0.0118
09:18	0.011
09:27	0.0102
09:30	0.010
09:45	0.0095
10:00	0.009
10:15	0.0088
10:25	0.0085
10:45	0.0086
11:00	0.0086
11:06	0.0085

Borehole KA3548G01, section 0.50 m - 12.01 m

Date:	98-04-03/04	Field Crew:	B. Gentzschein
Borehole length:	12.01 m	Borehole diameter:	76 mm

Flowing borehole: KA3548G01
Valve opened: 980403 151900 Valve closed: 980403 162005
Total flowing time : 61 min Tot. Pr. Build-up time 977 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3544G01, KA3546G01, KA3550G01, KA3552G01, KA3545G, KA3551G, KA3510B, KA3573A and KA3600A.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3548G01	2149.0	1.8	2222.5
KA3544G01	2690.5	2661.7	2698.3
KA3546G01	1969.7	849.2	2031.3
KA3550G01	2303.4	1093.4	2338.7
KA3552G01	1062.5	742.5	1094.7
KA3545G	2279.4	1295.1	2325
KA3551G	1229.7	1231.5	1320.2
KA3510B	4157.3	4157.8	4157.3
KA3573A:1	4106.9	4106.9	4105.5
KA3573A:2	4032.1	4032.6	4031.9
KA3600A:1	4144.9	4145.2	4145.2
KA3600A:2	4123.3	4123.1	4123.1

Manually measured flow rates of KA3548G01 are presented in the table below.

Time	Flow rate (l/min)
15:20	0.0275
15:22.30	0.021
15:27	0.018
15:33	0.0165
15:39	0.015
15:45	0.0145
15:52	0.0135
16:00	0.013
16:08	0.013
16:16	0.0125

Borehole KA3550G01, section 0.50 m - 12.03 m

Date:	98-04-03	Field Crew:	B. Gentzschein
Borehole length:	12.03 m	Borehole diameter:	76 mm

Flowing borehole: KA3550G01
Valve opened: 980403 092801 Valve closed: 980403 103002
Total flowing time : 62 min Tot. Pr. Build-up time 94 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3544G01, KA3546G01, KA3548G01, KA3552G01, KA3551G, KA3557G, KA3510B, KA3573A and KA3600A.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3550G01	2259.1	2	2157.1
KA3544G01	2695.0	2649.7	2690.1
KA3546G01	1936.0	778.9	1821.4
KA3548G01	2114.3	390.6	1989.6
KA3552G01	1057.3	755.1	980.5
KA3551G	1242.3	1238.4	1238.4
KA3557G	342.5	340.7	341.4
KA3510B	4158.3	4158.5	4158.3
KA3573A:1	4106.9	4108.2	4106.7
KA3573A:2	4033.0	4032.8	4032.6
KA3600A:1	4145.8	4145.8	4145.8
KA3600A:2	4124.0	4123.6	4124.0

Manually measured flow rates of KA3550G01 are presented in the table below.

Time	Flow rate (l/min)
09:29	0.056
09:33	0.034
09:40	0.0265
09:46	0.0225
09:53	0.0205
10:00	0.020
10:08	0.0185
10:16	0.018
10:24	0.0175
10:28.30	0.0175

Borehole KA3552G01, section 0.50 m - 12.01 m

Date:	98-04-02	Field Crew:	B. Gentzschein
Borehole length:	12.01 m	Borehole diameter:	76 mm

Flowing borehole:	KA3552G01		
Valve opened:	980402 1851	Valve closed:	980402 195500
Total flowing time :	64 min	Tot. Pr. Build-up time	747 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3544G01, KA3546G01, KA3548G01, KA3552G01, KA3551G and KA3557G. The boreholes KA3510B, KA3573A and KA3600A were monitored only during the recovery phase..

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3552G01	1066.7	2.5	1082.6
KA3544G01	2697.8	2694.4	2698.1
KA3546G01	1981.8	1660.5	1998.3
KA3548G01	2186.8	1987.3	2206.9
KA3550G01	2351.9	2224.7	2360.6
KA3551G	1139.9	1147.7	1235.9
KA3557G	327.1	321.7	341.4
KA3510B	-	-	4158.2
KA3573A:1	-	-	4106.9
KA3573A:2	-	-	4032.8
KA3600A:1	-	-	4146.1
KA3600A:2	-	-	4124.2

Manually measured flow rates of KA3552G01 are presented in the table below.

Time	Flow rate (l/min)
18:52	0.027
18:55	0.014
19:00	0.012
19:09	0.0105
19:16	0.010
19:22	0.010
19:30	0.0095
19:38	0.009
19:45	0.009
19:50	0.009

Borehole KA372G01, section 0.50 m - 12.00 m

Date:	98-04-02	Field Crew:	B. Gentzschein
Borehole length:	12.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3572G01		
Valve opened:	980402 110801	Valve closed:	980402 150802
Total flowing time :	240 min	Tot. Pr. Build-up time	122.8 min.

The test was performed as a single hole test. No other boreholes were monitored.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3572G01	295.6	4.5	250.5

Manually measured flow rates of KA3572G01 pressure build-up test are presented in the table below.

Time	Flow rate (l/min)
11:11	$1.1 \cdot 10^{-3}$
11:20	$7.6 \cdot 10^{-4}$
11:39	$6.4 \cdot 10^{-4}$
12:43	$5.5 \cdot 10^{-4}$
13:34	$5.4 \cdot 10^{-4}$
13:56	$5.2 \cdot 10^{-4}$
14:24	$5.0 \cdot 10^{-4}$
14:50	$5.0 \cdot 10^{-4}$
15:04	$5.2 \cdot 10^{-4}$

Borehole KA3578G01, section 0.50 m - 12.58 m

Date:	98-04-04	Field Crew:	B. Gentzschein
Borehole length:	12.58 m	Borehole diameter:	76 mm

Flowing borehole:	KA3578G01		
Valve opened:	980404 1400	Valve closed:	980404 180000
Total flowing time :	240 min	Tot. Pr. Build-up time	948 min.

The test was performed as a single hole test. No other boreholes were monitored.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3578G01	55.4	2.3	47.4

Manually read flow rates of KA3578G01 pressure build-up test are presented in the table below.

Time	Flow rate (l/min)
14:02.30	$7.4 \cdot 10^{-4}$
14:10	$3.5 \cdot 10^{-4}$
14:25	$2.2 \cdot 10^{-4}$
14:50	$1.4 \cdot 10^{-4}$
15:15	$1.1 \cdot 10^{-4}$
15:45	$8.8 \cdot 10^{-5}$
16:15	$7.6 \cdot 10^{-5}$
16:45	$7.6 \cdot 10^{-5}$
17:15	$7.6 \cdot 10^{-5}$
17:45	$7.6 \cdot 10^{-5}$

Borehole KA3584G01, section 1.21 m - 12.00 m

Date:	98-04-05	Field Crew:	B. Gentzschein
Borehole length:	12.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3584G01		
Valve opened:	980405 1014	Valve closed:	980405 142900
Total flowing time :	255 min	Tot. Pr. Build-up time	180 min.

The test was performed as a single hole test. No other boreholes were monitored.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3584G01	50.8	3.0	20.7

Manually measured flow rates of KA3584G01 pressure build-up test are presented in the table below.

Time	Flow rate (l/min)
10:16	$3.2 \cdot 10^{-5}$
10:26	$2.2 \cdot 10^{-5}$
10:37	$1.1 \cdot 10^{-5}$
10:57	$1.2 \cdot 10^{-5}$
11:33.30	$1.4 \cdot 10^{-5}$
12:05.30	$1.3 \cdot 10^{-5}$
13:51.30	$1.1 \cdot 10^{-5}$
14:23.30	$1.1 \cdot 10^{-5}$

Initially the packer was positioned 0.50 m down in KA3578G01. Then no flow at all could be observed and a negative pressure was measured when the borehole was shut in. For this reason the packer was lowered 0.71 m the 2nd of April.

Borehole KA3586G01, section 0.50 m - 8.00 m

Date:	98-04-01	Field Crew:	B. Gentzschein
Borehole length:	8.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3586G01		
Valve opened:	980401 154502	Valve closed:	980401 195600
Total flowing time :	251 min	Tot. Pr. Build-up time	774 min.

The test was performed as a single hole test. No other boreholes were monitored.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3586G01	254.7	1.3	64.8

Manually read flow rates of KA3586G01 pressure build-up test are presented in the table below.

Time	Flow rate (l/min)
15:52.30	$5.8 \cdot 10^{-5}$
16:09.30	$3.5 \cdot 10^{-5}$
16:26.30	$2.8 \cdot 10^{-5}$
17:04.30	$2.0 \cdot 10^{-5}$
17:38.30	$1.8 \cdot 10^{-5}$
19:08.30	$1.8 \cdot 10^{-5}$
19:31.30	$1.0 \cdot 10^{-5}$
19:51.30	$1.0 \cdot 10^{-5}$

Borehole KA3588G01, section 0.50 m - 8.00 m

Date:	98-04-01	Field Crew:	B. Gentzschein
Borehole length:	8.00 m	Borehole diameter:	76 mm

Flowing borehole:	KA3588G01		
Valve opened:	980401 1056	Valve closed:	980401 115600
Total flowing time :	60 min	Tot. Pr. Build-up time	84 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3588G01, KA3584G01, KA3586G01, KA3581G, KA3587G, KA3593G, KA3510B, KA3573A and KA3600A.

Pressure data

Borehole	Po (kPa)	Pp(kPa)	Pf(kPa)
KA3588G01	2071.9	3.8	2052.1
KA3584G01	1.5	0.6	-0.5
KA3586G01	270.8	272.1	275.2
KA3581G	2.0	1.7	1.9
KA3587G	1430.7	1433.3	1437.9
KA3593G	2152.2	2080.0	2132.9
KA3510B	4157.1	4157.1	4156.9
KA3573A:1	4104.8	4104.6	4104.2
KA3573A:2	4031.1	4030.3	4030.3
KA3600A:1	4144.2	4143.6	4143.8
KA3600A:2	4121.9	4121.7	4121.7

Manually measured flow rates of KA3588G01 pressure build-up test are presented in the table below.

Time	Flow rate (l/min)
10:56.30	0.023
10:59	0.024
11:04	0.0235
11:09	0.024
11:15	0.024
11:21	0.024
11:26	0.023
11:38	0.023
11:45	0.0235
11:53	0.023

6.3 Flow meter logging with double packers

The result of the flow logging is presented in Table 6.2.

Table 6-2 Results of flow logging in the exploratory boreholes for the Prototype Repository, drill campaign 2.

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3544G01	980407	9.70-10.70	0.048	PBT
KA3544G01	980407	8.70-9.70	1.5×10^{-4}	
KA3544G01	980407	7.70-8.70	7.7×10^{-4}	
KA3544G01	980407	6.70-7.70	1.5×10^{-4}	
KA3544G01	980407	5.70-6.70	1.1×10^{-3}	
KA3544G01	980407	4.70-5.70	8.8×10^{-5}	
KA3544G01	980407	3.70-4.70	0.0024	
KA3544G01	980407	2.70-3.70	3.8×10^{-5}	
KA3544G01	980407	1.70-2.70	8.8×10^{-5}	
KA3544G01	980407	1.00-2.00	5.0×10^{-5}	
KA3544G01	980407	10.70-12.00	2.5×10^{-5}	Single packer test
KA3546G01	980408	9.70-10.70	1.4×10^{-4}	
KA3546G01	980408	8.70-9.70	5.0×10^{-4}	
KA3546G01	980408	7.70-8.70	0.008	
KA3546G01	980408	6.70-7.70	1.8×10^{-4}	
KA3546G01	980408	5.70-6.70	1.4×10^{-4}	
KA3546G01	980408	4.70-5.70	9.0×10^{-4}	
KA3546G01	980408	3.70-4.70	0.0012	
KA3546G01	980408	2.70-3.70	1.0×10^{-5}	
KA3546G01	980408	1.70-2.70	1.3×10^{-5}	
KA3546G01	980408	1.00-2.00	5.0×10^{-5}	

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3546G01	980408	10.70-12.00	3.3×10^{-5}	Single packer test
KA3548G01	980414	9.70-10.70	2.3×10^{-5}	
KA3548G01	980414	8.70-9.70	7.1×10^{-5}	
KA3548G01	980414	7.70-8.70	2.8×10^{-5}	
KA3548G01	980414	6.70-7.70	3.3×10^{-5}	
KA3548G01	980414	5.70-6.70	0.011	PBT
KA3548G01	980414	4.70-5.70	2.5×10^{-4}	
KA3548G01	980414	3.70-4.70	5.3×10^{-5}	
KA3548G01	980414	2.70-3.70	1.3×10^{-4}	
KA3548G01	980414	1.70-2.70	2.0×10^{-5}	
KA3548G01	980414	1.00-2.00	3.5×10^{-5}	
KA3548G01	980415	10.70-12.01	2.0×10^{-5}	Single packer test
KA3550G01	980415	9.70-10.70	2.2×10^{-4}	
KA3550G01	980415	8.70-9.70	3.5×10^{-5}	
KA3550G01	980415	7.70-8.70	3.0×10^{-5}	
KA3550G01	980415	6.70-7.70	4.5×10^{-5}	
KA3550G01	980415	5.70-6.70	0.015	PBT
KA3550G01	980415	4.70-5.70	2.3×10^{-4}	
KA3550G01	980415	3.70-4.70	2.3×10^{-5}	
KA3550G01	980415	2.70-3.70	1.8×10^{-4}	
KA3550G01	980415	1.70-2.70	8.0×10^{-5}	
KA3550G01	980415	1.00-2.00	5.5×10^{-5}	
KA3550G01	980416	10.70-12.00	4.3×10^{-5}	Single packer test
KA3552G01	980416	9.70-10.70	4.5×10^{-5}	
KA3552G01	980416	8.70-9.70	1.3×10^{-4}	
KA3552G01	980416	7.70-8.70	7.3×10^{-5}	

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3552G01	980416	6.70-7.70	3.0×10^{-5}	
KA3552G01	980416	5.70-6.70	4.5×10^{-5}	
KA3552G01	980416	4.70-5.70	0.0078	PBT
KA3552G01	980416	3.70-4.70	5.5×10^{-5}	
KA3552G01	980416	2.70-3.70	2.5×10^{-5}	
KA3552G01	980416	1.70-2.70	3.3×10^{-5}	
KA3552G01	980417	1.00-2.00	6.3×10^{-5}	
KA3552G01	980417	10.70-12.01	1.5×10^{-5}	Single packer test
KA3572G01	980417	9.70-10.70	1.1×10^{-4}	
KA3572G01	980417	8.70-9.70	2.1×10^{-4}	
KA3572G01	980417	7.70-8.70	2.1×10^{-4}	
KA3572G01	980417	6.70-7.70	3.4×10^{-4}	
KA3572G01	980417	5.70-6.70	1.3×10^{-4}	
KA3572G01	980417	4.70-5.70	2.0×10^{-4}	
KA3572G01	980417	3.70-4.70	8.8×10^{-4}	
KA3572G01	980417	2.70-3.70	3.4×10^{-4}	
KA3572G01	980417	1.70-2.70	2.0×10^{-5}	
KA3572G01	980417	1.00-2.00	1.0×10^{-5}	
KA3572G01	980417	10.70-12.00	1.6×10^{-4}	Single packer test
KA3578G01	980418	10.25-11.25	2.8×10^{-5}	
KA3578G01	980418	9.25-10.25	6.9×10^{-4}	
KA3578G01	980418	8.25-9.25	5.9×10^{-4}	
KA3578G01	980418	7.25-8.25	4.5×10^{-4}	
KA3578G01	980418	6.25-7.25	1.3×10^{-5}	
KA3578G01	980418	5.25-6.25	2.8×10^{-4}	

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3578G01	980418	4.25-5.25	4.5×10^{-4}	
KA3578G01	980418	3.25-4.25	3.7×10^{-4}	
KA3578G01	980418	2.25-3.25	1.2×10^{-4}	
KA3578G01	980418	1.25-2.25	3.5×10^{-5}	
KA3578G01	980418	11.25-12.58	7.6×10^{-5}	Single packer test
KA3584G01	980419	9.70-10.70	2.3×10^{-5}	
KA3584G01	980419	8.70-9.70	2.3×10^{-5}	
KA3584G01	980419	7.70-8.70	2.0×10^{-5}	
KA3584G01	980419	6.70-7.70	3.3×10^{-5}	
KA3584G01	980419	5.70-6.70	3.8×10^{-5}	
KA3584G01	980419	4.70-5.70	1.5×10^{-5}	
KA3584G01	980419	3.70-4.70	1.5×10^{-5}	
KA3584G01	980420	2.70-3.70	1.3×10^{-5}	
KA3584G01	980420	1.70-2.70	1.0×10^{-5}	
KA3584G01	980420	1.00-2.00	2.5×10^{-5}	
KA3584G01	980420	10.70-12.00	1.0×10^{-5}	Single packer test
KA3586G01	980420	5.70-6.70	4.5×10^{-5}	
KA3586G01	980420	4.70-5.70	5.3×10^{-5}	
KA3586G01	980420	3.70-4.70	5.3×10^{-5}	
KA3586G01	980420	2.70-3.70	2.3×10^{-5}	
KA3586G01	980420	1.70-2.70	7.1×10^{-5}	
KA3586G01	980420	1.00-2.00	1.0×10^{-5}	
KA3586G01	980420	6.70- 8.00	2.3×10^{-5}	Single packer test
KA3588G01	980421	5.70-6.70	3.8×10^{-4}	
KA3588G01	980421	4.70-5.70	0.0206	PBT

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3588G01	980421	3.70-4.70	7.6×10^{-5}	
KA3588G01	980421	2.70-3.70	6.2×10^{-5}	
KA3588G01	980421	1.70-2.70	5.5×10^{-5}	
KA3588G01	980421	1.00-2.00	7.6×10^{-5}	
KA3588G01	980421	6.70- 8.00	2.5×10^{-5}	Single packer test

6.3 Pressure build-up test of a feature in exploratory boreholes

In five of the flow logged sections flow rates equal to or greater than 0.010 l/minute were measured. In these sections the measurement was extended to a pressure build-up test.

Appendicies B1 - B5 contain the diagrams for each test. The different types of diagrams are:

- Lin-Lin plots for the whole test sequence
- Lin-Log plots for the Pressure build-up
- Log-Log plots for the Pressure build-up
- Derivative plots for the recovery

In the Lin-Log and Log-Log plots a time correction has been performed, see section 6.2

In the following details and important test data for each test are described
Flowing time = time between packer inflation and valve closing

Borehole KA3544G01, section 9.70 m - 10.70 m

Date:	98-04-07	Field Crew:	B. Gentzschein
Borehole length:	12.00 m	Borehole diameter:	76 mm

Packer inflation:	980407 085800	Valve closed:	980407 10:04.00
Flowing time :	66 min	Tot. Pr. Build-up time:	172 min

Pressure just before closing the valve (Pp, kPa): 8.1
Pressure at the end of the recovery (Pf, kPa) : 2663.7

The pressure transducer used was lying on the tunnel floor.
The height of the water flow outlet was 0.93 m above the tunnel floor.

Manually measured flow rates, during pressure build-up test in KA3544G01, 9.70 - 10.70 m, are presented below.

Time	Flow rate (l/min)
09:09	0.050
09:16	0.0485
09:28	0.0485
09:38	0.048
09:46	0.048
09:55	0.048
10:02	0.048

Borehole KA3548G01, section 5.70 m - 6.70 m

Date:	98-04 -14	Field Crew:	B. Gentzschein
Borehole length:	12.01 m	Borehole diameter:	76 mm
Packer inflation:	980414 1240	Valve closed:	980414 13:46.00
Flowing time :	66 min	Tot. Pr. Build-up time:	120 min

Pressure just before closing the valve (Pp, kPa): 9.2
Pressure at the end of the recovery (Pf, kPa) : 2073.8

The pressure transducer used was lying on the tunnel floor.
The height of the water flow outlet was 0.93 m above the tunnel floor.

Manually measured flow rates, during pressure build-up test in KA3548G01, 5.70 - 6.70 m, are presented below.

Time	Flow rate (l/min)
12:46	0.015
12:55	0.0135
13:02	0.013
13:09	0.0122
13:15	0.0122
13:23	0.012
13:31	0.0118
13:37	0.0114
13.43	0.011

Borehole KA3550G01, section 5.70 m - 6.70 m

Date:	98-04 -15	Field Crew:	B. Gentzschein
Borehole length:	12.03 m	Borehole diameter:	76 mm
Packer inflation:	980415 1405	Valve closed:	980415 15:10.00
Flowing time :	65 min	Tot. Pr. Build-up time:	120 min

Pressure just before closing the valve (Pp, kPa): 8.3
Pressure at the end of the recovery (Pf, kPa): 2171.7

The pressure transducer used was lying on the tunnel floor.
The height of the water flow outlet was 0.72 m above the tunnel floor.

Manually measured flow rates, during pressure build-up test in KA3550G01, 5.70 - 6.70 m, are presented below.

Time	Flow rate (l/min)
14:10	0.0213
14:16.30	0.0185
14:23	0.0172
14:30	0.0163
14:38	0.0161
14:45	0.0155
14:53	0.0153
15:00	0.015
15:07	0.015

Borehole KA3552G01, section 4.70 m - 5.70 m

Date:	98-04 -16	Field Crew:	B. Gentzschein
Borehole length:	12.01 m	Borehole diameter:	76 mm
Packer inflation:	980416 1332	Valve closed:	980416 14:37.00
Flowing time :	65 min	Tot. Pr. Build-up time:	120 min

Pressure just before closing the valve (Pp, kPa): 6.9
Pressure at the end of the recovery (Pf, kPa): 1025.9

The pressure transducer used was lying on the tunnel floor.
The height of the water flow outlet was 0.72 m above the tunnel floor.

Manually measured flow rates, during pressure build-up test in KA3552G01, 4.70 - 5.70 m, are presented below.

Time	Flow rate (l/min)
13:37	0.010
13:44	0.009
13:51	0.0084
13:58	0.0081
14:10	0.0079
14:20	0.0080
14:30	0.0079
14:35	0.0078

Borehole KA3588G01, section 4.70 m - 5.70 m

Date:	98-04 -21	Field Crew:	B. Gentzschein
Borehole length:	8.00 m	Borehole diameter:	76 mm

Packer inflation:	980421 192822	Valve closed:	980421 10:33.00
Flowing time :	64.6 min	Tot. Pr. Build-up time:	120 min

Pressure just before closing the valve (Pp, kPa): 8.8
Pressure at the end of the recovery (Pf, kPa): 2091.3

The pressure transducer used was lying on the tunnel floor.
The height of the water flow outlet was 0.75m above the tunnel floor.

Manually measured flow rates, during pressure build-up test in KA3588G01, 4.70 - 5.70 m, are presented below.

Time	Flow rate (l/min)
09:33:30	0.0239
09:40:30	0.0239
09:47	0.0239
09:54	0.021
10:01	0.021
10:08	0.021
10:15	0.021
10:22	0.0209
10:29	0.0208
10:32	0.0206

7. References

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Lindström, D. 1997: True Block Scale Prototype Experiment. Packer and Prototype Dummy. Apr. 1997 , SKB TN-97-15b

Rhén, I. and Nilsson, L., 1991: Pressure build-up tests in sounding boreholes - performance and evaluation. SKB-Technical Document No. 25-91-010

Appendices

The following appendices are not included as hard copies in the report, but stored at CD-ROM which is available at Äspö Hard Rock Laboratory.

APPENDIX A1: Diagrams of the interference test in exploratory hole KA3544G01, 0.50 12.00 m, and diagrams of pressure responses in KA3546G01,KA3548G01, KA3550G01, KA3552G01, KA3539G and KA3545G.

APPENDIX A2: Diagrams of the interference test in exploratory hole KA3546G01, 0.50-12.00 m, and diagrams of pressure responses in KA3544G01, KA3548G01, KA3550G01, KA3552G01, KA3545G and KA3551G

APPENDIX A3: Diagrams of the interference test in exploratory hole KA3548G01, 0.50-12.01 m, and diagrams of pressure responses in KA3544G01, KA3546G01, KA3550G01, KA3552G01, KA3545G and KA3551G.

APPENDIX A4: Diagrams of the interference test in exploratory hole KA3550G01, 0.50-12.03 m, and diagrams of pressure responses in KA3544G01, KA3546G01, KA354848G01, KA3552G01, KA3551G and KA3557G

APPENDIX A5: Diagrams of the interference test in exploratory hole KA3552G01, 0.50-12.01 m, and diagrams of pressure responses in KA3544G01, KA3546G01, KA3548G01, KA3550G01, KA3551G and KA3557G.

APPENDIX A6: Diagrams of the pressure build-up test in exploratory hole KA3572G01, 0.50-12.00 m.

APPENDIX A7: Diagrams of the pressure build-up test in exploratory hole KA3578G01, 0.50-12.58 m

APPENDIX A8: Diagrams of the pressure build-up test in exploratory hole KA3584G01 1.21-12.00 m.

APPENDIX A9: Diagrams of the pressure build-up test in exploratory hole KA3586G01 0.50-8.00 m.

APPENDIX A10: Diagrams of the interference test in exploratory hole KA3588G01, 0.50- 8.00 m, and diagrams of pressure responses in KA3584G01, KA3586G01, KA3581G, KA3587G and KA3593G**.**

APPENDIX B1: Diagrams of the pressure build-up test in exploratory hole KA3544G01, 9.70 - 10.70 m.

APPENDIX B2: Diagrams of the pressure build-up test in exploratory hole KA3548G01, 5.70 - 6.70 m.

APPENDIX B3: Diagrams of the pressure build-up test in exploratory hole KA3550G01, 5.70 - 6.70 m**.**

APPENDIX B4: Diagrams of the pressure build-up test in exploratory hole KA3552G01, 4.70 - 5.70 m.

APPENDIX B5: Diagrams of the pressure build-up test in exploratory hole KA3588G01, 4.70 - 5.70 m.

APPENDIX C1
DATA FILES

Table C:1 A list of data files of data stored by the Borre data logger (*.BOR-files), calibration files and converted pressure data files. Hydraulic tests in exploratory boreholes in the Prototype Repository, drill campaign 2, April 1998.

Flowing Borehole	Date Of Test Start	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files " *.HYF-files"	Pressure files " *.BOR-files"	Calibration files "*.CAL*-files"
KA3588G01	980401	10:56-13:20	0.50-8.00	**1**	KA3588G01	PR2#1_43.HYF	PR2#1_43.BOR	BORRE43.CAL
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3584G01	PR2#1_40.HYF	PR2#1_40.BOR	BORRE40.CAL
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3586G01	PR2#1_40.HYF	PR2#1_40.BOR	BORRE40.CAL
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3581G	PR2#1_40.HYF	PR2#1_40.BOR	BORRE40.CAL
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3587G	PR2#1_43.HYF	PR2#1_43.BOR	BORRE43.CAL
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3593G	PR2#1_40.HYF	PR2#1_40.BOR	BORRE40.CAL
KA3586G01	980401	15:44-08:50	0.50-8.00	**2**	KA3586G	PR2#2_43.HYF	PR2#2_43.BOR	BORRE43.CAL
KA3572G01	980402	11:07-17:11	0.50-12.00	**3**	KA3572G01	PR2#3_43.HYF	PR2#3_43.BOR	BORRE43.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	**4**	KA3552G01	PR2#4_43.HYF	PR2#4_43.BOR	BORRE43.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3544G01	PR2#4_40.HYF	PR2#4_40.BOR	BORRE40.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3546G01	PR2#4_40.HYF	PR2#4_40.BOR	BORRE40.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3548G01	PR2#4_40.HYF	PR2#4_40.BOR	BORRE40.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3550G01	PR2#4_43.HYF	PR2#4_43.BOR	BORRE43.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3551G	PR2#4_40.HYF	PR2#4_40.BOR	BORRE40.CAL
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3552G01	PR2#4_43.HYF	PR2#4_43.BOR	BORRE43.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	**5**	KA3550G01	PR2#5_43.HYF	PR2#5_43.BOR	BORRE43.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3544G01	PR2#5_40.HYF	PR2#5_40.BOR	BORRE40.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3546G01	PR2#5_40.HYF	PR2#5_40.BOR	BORRE40.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3548G01	PR2#5_40.HYF	PR2#5_40.BOR	BORRE40.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3552G01	PR2#5_43.HYF	PR2#5_43.BOR	BORRE43.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3551G	PR2#5_40.HYF	PR2#5_40.BOR	BORRE40.CAL
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3557G	PR2#5_43.HYF	PR2#5_43.BOR	BORRE43.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	**6**	KA3544G01	PR2#6_43.HYF	PR2#6_43.BOR	BORRE43.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3546G01	PR2#6_40.HYF	PR2#6_40.BOR	BORRE40.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3548G01	PR2#6_40.HYF	PR2#6_40.BOR	BORRE40.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3550G	PR2#6_43.HYF	PR2#6_43.BOR	BORRE43.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3552G	PR2#6_43.HYF	PR2#6_43.BOR	BORRE43.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3539G	PR2#6_40.HYF	PR2#6_40.BOR	BORRE40.CAL
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3545G	PR2#6_40.HYF	PR2#6_40.BOR	BORRE40.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	**7**	KA3548G01	PR2#7_43.HYF	PR2#7_43.BOR	BORRE43.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3544G01	PR2#7_40.HYF	PR2#7_40.BOR	BORRE40.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3546G01	PR2#7_40.HYF	PR2#7_40.BOR	BORRE40.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3550G01	PR2#7_43.HYF	PR2#7_43.BOR	BORRE43.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3552G01	PR2#7_43.HYF	PR2#7_43.BOR	BORRE43.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3545G	PR2#7_40.HYF	PR2#7_40.BOR	BORRE40.CAL
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3551G	PR2#7_40.HYF	PR2#7_40.BOR	BORRE40.CAL

Flowing Borehole	Date Of Test Start	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files ” *.HYF-files”	Pressure files ” *.BOR-files”	Calibration files “*.CAL*-files”
KA3546G01	980404	09:06-13:09	0.50-12.00	**8**	KA3546G01	PR2#8_43.HYF	PR2#8_43.BOR	BORRE43.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3544G01	PR2#8_40.HYF	PR2#8_40.BOR	BORRE40.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3548G01	PR2#8_40.HYF	PR2#8_40.BOR	BORRE40.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3550G01	PR2#8_43.HYF	PR2#8_43.BOR	BORRE43.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3552G01	PR2#8_43.HYF	PR2#8_43.BOR	BORRE43.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3545G	PR2#8_40.HYF	PR2#8_40.BOR	BORRE40.CAL
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3551G	PR2#8_40.HYF	PR2#8_40.BOR	BORRE40.CAL
KA3578G01	980404	14:00-09:48	0.50-12.58	**9**	KA3578G01	PR2#9_43.HYF	PR2#9_43.BOR	BORRE43.CAL
KA3584G01	980405	10:13-17:29	1.21-12.00	**10**	KA3584G01	PR2#0_43.HYF	PR2#0_43.BOR	BORRE43.CAL
KA3544G01	980407	08:58-12:56	9.70-10.7	**11**	KA3544G1	PR2#11.HYF	FLOFIL#5.BOR	BORRE40.CAL
KA3548G01	980414	12:40-15:46	5.70-6.70	**12**	KA3548G2	PR2#12.HYF	FLOFIL#5.BOR	BORRE40.CAL
KA3550G01	980415	14:05-17:10	5.70-6.70	**13**	KA3555G1	PR2#13.HYF	FLOFIL#5.BOR	BORRE40.CAL
KA3552G01	980416	13:32-16:37	4.70-5.70	**14**	KA3552G2	PR2#14.HYF	FLOFIL#5.BOR	BORRE40.CAL
KA3588G01	980421	09:28-12:33	4.70-5.70	**15**	KA3588G1	PR2#15.HYF	FLOFIL#5.BOR	BORRE40.CAL

Table C:2 Data files (text files) created of data logger data, hydraulic tests in exploratory boreholes for the Prototype Repository, drill campaign 2, April 1998.

Flowing Borehole	Date Of Test Start	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files Draw-down	Pressure files Recovery	Flow rate files
KA3588G01	980401	10:56-13:20	0.50-8.00	**1**	KA3588G01	01PD3588.TXT	01PB3588.TXT	01FD3588.TXT
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3584G01	01PD3584.TXT	01PB3584.TXT	
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3586G01	01PD3586.TXT	01PB3586.TXT	
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3581G	01PD3581.TXT	01PB3581.TXT	
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3587G	01PD3587.TXT	01PB3587.TXT	
KA3588G01	980401	10:56-13:20	0.50-8.00	1	KA3593G	01PD3593.TXT	01PB3593.TXT	
KA3586G01	980401	15:44-08:50	0.50-8.00	**2**	KA3586G	02PD3586.TXT	02PB3586.TXT	02FD3586.TXT
KA3572G01	980402	11:07-17:11	0.50-12.00	**3**	KA3572G	03PD3572.TXT	03PB3572.TXT	03FD3572.TXT
KA3552G01	980402	18:50-08:22	0.50-12.01	**4**	KA3552G01	04PD3552.TXT	04PB3552.TXT	04FD3552.TXT
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3544G01	04PD3544.TXT	04PB3544.TXT	
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3546G01	04PD3546.TXT	04PB3546.TXT	
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3548G01	04PD3548.TXT	04PB3548.TXT	
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3550G01	04PD3550.TXT	04PB3550.TXT	
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3551G	04PD3551.TXT	04PB3551.TXT	
KA3552G01	980402	18:50-08:22	0.50-12.01	4	KA3552G01	04PD3557.TXT	04PB3557.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	**5**	KA3550G01	08PD3550.TXT	08PB3550.TXT	05FD3550.TXT
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3544G01	05PD3544.TXT	05PB3544.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3546G01	05PD3546.TXT	05PB3546.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3548G01	05PD3548.TXT	05PB3548.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3552G01	05PD3552.TXT	05PB3552.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3551G	05PD3551.TXT	05PB3551.TXT	
KA3550G01	980403	09:27-12.04	0.50-12.03	5	KA3557G	05PD3557.TXT	05PB3557.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	**6**	KA3544G01	06PD3544.TXT	06PB3544.TXT	06FD3544.TXT
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3546G01	06PD3546.TXT	06PB3546.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3548G01	06PD3548.TXT	06PB3548.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3550G	06PD3552.TXT	06PB3552.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3552G	06PD3552.TXT	06PB3552.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3539G	06PD3539.TXT	06PB3539.TXT	
KA3544G01	980403	13:09-14:41	0.50-12.00	6	KA3545G	06PD3545.TXT	06PB3545.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	**7**	KA3548G01	07PD3548.TXT	07PB3548.TXT	07FD3548.TXT
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3544G01	07PD3544.TXT	07PB3544.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3546G01	07PD3546.TXT	07PB3546.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3548G01	07PD3548.TXT	07PB3548.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3550G01	07PD3550.TXT	07PB3550.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3552G01	07PD3552.TXT	07PB3552.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3545G	07PD3545.TXT	07PB3545.TXT	
KA3548G01	980403	15.18-08:37	0.50-12.01	7	KA3551G	07PD3551.TXT	07PB3551.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	**8**	KA3546G01	08PD3546.TXT	08PB3546.TXT	08FD3546.TXT
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3544G01	08PD3544.TXT	08PB3544.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3548G01	08PD3548.TXT	08PB3548.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3550G01	08PD3550.TXT	08PB3550.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3552G01	08PD3552.TXT	08PB3552.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3545G	08PD3545.TXT	08PB3545.TXT	
KA3546G01	980404	09:06-13:09	0.50-12.00	8	KA3551G	08PD3551.TXT	08PB3557.TXT	
KA3578G01	980404	14:00-09:48	0.50-12.58	**9**	KA3578G01	09PD3578.TXT	09PB3578.TXT	09FD3578.TXT
KA3584G01	980405	10:13-17:29	1.21-12.00	**10**	KA3584G01	10PD3584.TXT	10PB3584.TXT	10FD3584.TXT

Flowing Borehole	Date Of Test Start	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files Draw-down	Pressure files Recovery	Flow rate files
KA3544G01	980407	08:58-12:56	9.70-10.7	**11**	KA3544G1		11PB39G1.TXT	11FD39G1.TXT
KA3548G01	980414	12:40-15:46	5.70-6.70	**12**	KA3548G2		12PB39G2.TXT	12FD39G2.TXT
KA3550G01	980415	14:05-17:10	5.70-6.70	**13**	KA3555G1		13PB45G1.TXT	13FD45G1.TXT
KA3552G01	980416	13:32-16:37	4.70-5.70	**14**	KA3552G2		14PB45G2.TXT	14FD45G2.TXT
KA3588G01	980421	09:28-12:33	4.70-5.70	**15**	KA3588G1		15PB93G1.TXT	15FD93G1.TXT

Table C:3 Data files from flow logging in exploratory boreholes for the Prototype Repository, drill campaign 2, April 1998.

Flowing Boreholes	Start Date of Measurements (YYMMDD hh:mm)	Stop Date of Measurements (YYMMDD hh:mm)	Observation Boreholes	Pressure files (data logger files)	Flow rate file (manually measured flow rates)
KA3544G01 KA3546G01 KA3548G01 KA3550G01 KA3552G01 KA3572G01 KA3578G01 KA3584G01 KA3586G01 KA3588G01	980407 08:59	980421 16:02	KA3544G01 KA3546G01 KA3548G01 KA3550G01 KA3552G01 KA3572G01 KA3578G01 KA3584G01 KA3586G01 KA3588G01	FLOFIL#5.HYF FLOFIL#5.BOR BORRE40.CAL	FLOTAB.TXT