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Äspö Hard Rock Laboratory

PROTOTYPE REPOSITORY

Hydraulic tests during operation phase
Test campaign 10 - Interference tests

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Key words: Äspö HRL, prototype repository, hydrogeology, hydraulic tests, pressure build-up tests, interference tests, hydraulic parameters, transmissivity, storage coefficient

Abstract

The Prototype Repository Test is focused on testing and demonstrating the function of the SKB final 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 in the project but are also part of other projects.

This report describes the third interference test campaign during the operation period of the repository, performed in November of 2009.

The test campaign consisted of running 6 interference tests with one flowing section and 131 observation sections. Each test consisted approximately of a 6 hour flowing period and a 18 hour recovery period.

Sammanfattning

Huvudsyftet med prototypförvaret är att testa och demonstrera funktionen av en del av SKB's djupförvarssystem. Aktiviteter som syftar till utveckling och försök av praktiska och ingenjörsmässiga lösningar, som krävs för att på ett rationellt sätt kunna stegvis utföra deponeringen av kapslar med kärnbränsle, är inkluderade i projektet för prototypförvaret men även i andra projekt.

Denna rapport beskriver den tredje interferenstestkampanjen som genomförts under pågående drift av prototypförvaret, vilken utfördes under november 2009.

Sammanlagt genomfördes 6 stycken interfernstestser med en flödessektion och 131 observationssektioner. Varje test innehöll en 6 timmars flödesperiod med en 18 timmars återhämtning.

Executive Summary

The Prototype Repository Test is focused on testing and demonstrating the function of the SKB final 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 in the project but are also part of other projects.

This report describes the third interference test campaign during the operation period of the repository.

The test campaign consisted of running 6 interference tests with one flowing section and 131 observation sections. Each test consisted approximately of a 6 hour flowing period and a 18 hour recovery period.

The diffusivity, η, versus the distance, r, and the time lag, $t_{L,}$ versus the distance, r, are shown in Figure 1 below. The timelag t_L is defined as the time when the pressure response in an observation section section is greater than 0.1 metres. Data are from all 7 interference tests performed during the test campaign.

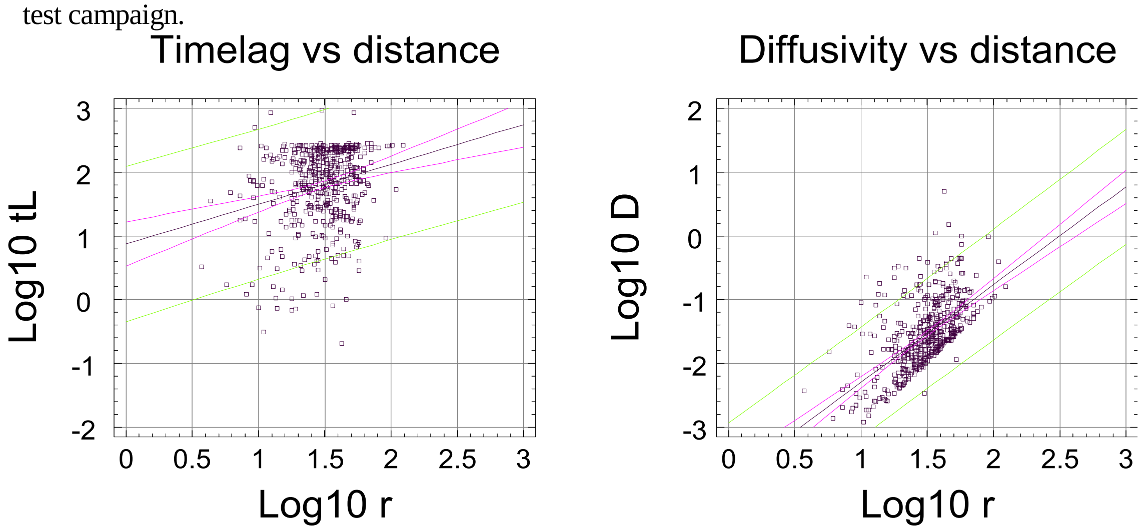


Figure 1 *Linear regression plots of time lag and diffusivity versus distance. Distance r in meters and t_L in minutes*

The equations of the regression lines in Figure 1 are

$$\mathrm{Log}_{10}\, t_L = 0.625 * \mathrm{Log}_{10}\, r + 0.873 \qquad [\mathrm{min}]$$

$$\mathrm{Log}_{10}\, \eta = 1.53 * \mathrm{Log}_{10}\, r - 3.83 \qquad [\mathrm{m}^2/\mathrm{s}]$$

The apparent increase of diffusivity by distance in Figure 1 is probably not entirely relevant. As part of the flow is more spherical than radial the time lag should increase by distance. It is however probable that some feature with high transmissivity is involved at larger distances from the source that can partly justify a linear trend. Possibly the most relevant estimates of diffusivity is for short distances, which may be up to around 10 metres. According to this the range for the diffusivity should be 0.001 – 0.1 m^2/s. However, from earlier experiences it is known that the diffusivity may become closer to 1 m^2/s for increasing transmissivities.

The storativity is not always received from a hydraulic test. In order to estimate an approximate value of the parameter a relationship between the evaluated transmissivity T_{EVAL} and the evaluated storativity S is established from the six evaluated interference tests 10:21-10:26. The results are shown in Figure 2.

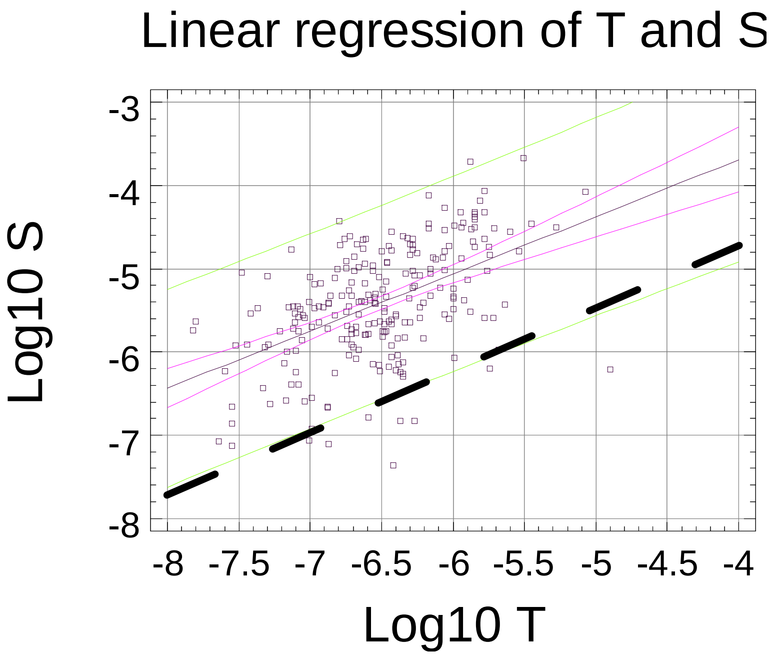


Figure 2 *Linear regression of T_{EVAL} and S. Transmissivity in m^2/s.Dotted line shows the relation S(T) from (Rhen et al. 2008).*

The equation of the regression line in *Figure 2* is

$$Log_{10} S = 0.687 * Log_{10} T_{EVAL} – 0.939$$

During the site investigations at Laxemar, (*Rhen et al. 2008),* interferencetests shows a relationsship (dotted line) as

$$Log_{10} S = 0.71 * Log_{10} T_{EVAL} – 0.0109$$

The evaluation of the transmissivity and storativity during the site investigations at Laxemar, and selected tests from the Äspö HRL, were based on the identified well-connected structures between test section and observation section judged to be situated in a 2D structure (generally a fracture zone). These observations were therefor considered to most likely represent radial flow fulfilling the conceptual model for evaluation T and S from observation sections. The evaluation of the responses seen in the interference tests at the prototype repository includes often early responses significant for evaluation response time but are likely to represent in many cases a 3D flow and thereby will the evaluations of S be overestimated in many cases in the evaluation method used.

Contents

1 Background **13**
1.1 Äspö Hard Rock Laboratory 13
1.2 Prototype repository 14
1.2.1 General objectives 14

2 Objective **15**

3 Scope **17**

4 Equipment **19**
4.1 Description of equipment 19
4.2 Pressure sensors 19
4.3 Flowmeter equipment 20

5 Execution **23**
5.1 Preparations 23
5.2 Execution of tests/measurements 23
5.2.1 Test principle 23
5.2.2 Test procedure 24
5.3 Data handling 24
5.4 Analyses and interpretation 24
5.4.1 Test borehole 24
5.4.2 Interference tests 27

6 Results **29**
6.1 General 29
6.2 Interference tests 30
6.2.1 Test 10:21 – KA3539G:2 30
6.2.2 Test 10:22 – KA3542G02:5 37
6.2.3 Test 10:23 – KA3554G01:2 44
6.2.4 Test 10:24 – KA3590G02:1 51
6.2.5 Test 10:25 – KG0021A01:3 58
6.2.6 Test 10:26 – KG0048A01:3 65
6.3 Hydraulic diffusivity 72
6.4 Storativity 72

7 References **75**

Tables

Table 3-1 Interference tests during the campaign in November 2009 17

Table 6-1 General test data for the pressure build-up test in section 15.85-17.60 m of borehole KA3539G 30

Table 6-2 Interference test results for KA3539G, 15.85 - 17.60 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 35

Table 6-3 Interference test results for KA3539G, 15.85 - 17.60 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 35

Table 6-4 General test data for the pressure build-up test in section 2.00-8.00 m of borehole KA3542G02 37

Table 6-5 Interference test results for KA3542G02, 2.00 - 8.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 42

Table 6-6 Interference test results for KA3542G02, 2.00 - 8.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 43

Table 6-7 General test data for the pressure build-up test in section 22.60-24.15 m 44

Table 6-8 Interference test results for KA3554G01, 22.60 - 24.15 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 49

Table 6-9 Interference test results for KA3554G01, 22.60 - 24.15 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 50

Table 6-10 General test data for the pressure build-up test in section 25.50-30.01 m of borehole KA3590G02 51

Table 6-11 Interference test results for KA3590G02, 25.50 - 30.01 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 56

Table 6-12 Interference test results for KA3590G02, 25.50 - 30.01 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 57

Table 6-13 General test data for the pressure build-up test in section 35.00-36.00 m of borehole KG0021A01 58

Table 6-14 Interference test results for KG0021A01, 35.00 - 36.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 63

Table 6-15 Interference test results for KG0021A01, 35.00 - 36.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 64

Table 6-16 General test data for the pressure build-up test in section 32.80-33.80 m of borehole KG0048A01 65

Table 6-17 Interference test results for KG0048A01, 32.80 - 33.80 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 70

Table 6-18 Interference test results for KG0048A01, 32.80 - 33.80 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). 71

Figures

Figure 1-1 Location of Äspö Hard Rock Laboratory 13

Figure 4-1 All pressure transducers are connected to the HMS system. In the G-tunnel there is a computer in the HMS system where logging frequencies easily can be changed. 19

Figure 4-2 Pressure transducers connections 20

Figure 4-3 The equipment for flowrate measurement with Micro Motion Coriolis mass flowmeter system 21

Figure 6-1 Flow rates during draw down in KA3539G:2. Time in minutes. 31

Figure 6-2 Plot showing r^2/t_L during recovery of KA3539G:2 (Interference test 10:21) - plan view 33

Figure 6-3 Plot showing r^2/t_L during recovery of KA3539G:2 (Interference test 10:21) - vertical view 34

Figure 6-4 Flow rates during draw down in KA3542G02:5. Time in minutes. 38

Figure 6-5 Plot showing r^2/t_L during recovery of KA3542G02:5 (Interference test 10:22) - plan view 40

Figure 6-6 Plot showing r^2/t_L during recovery of KA3542G02:5 (Interference test 10:22) - vertical view 41

Figure 6-7 Flow rates during draw down in KA3554G01:2. Time in minutes. 45

Figure 6-8 Plot showing r^2/t_L during recovery of KA3554G01:2 (Interference test 10:23) - plan view 47

Figure 6-9 Plot showing r^2/t_L during recovery of KA3554G01:2 (Interference test 10:23) - vertical view 48

Figure 6-10 Flow rates during drawdown in KA3590G02:1. Time in minutes. 52

Figure 6-11 Plot showing r^2/t_L during recovery of KA3590G02:1 (Interference test 10:24) - plan view 54

Figure 6-12 Plot showing r^2/t_L during recovery of KA3590G02:1 (Interference test 10:24) - vertical view 55

Figure 6-13 Flow rates during draw down in KG0021A01:3. Time in minutes. 59

Figure 6-14 Plot showing r^2/t_L during recovery of KG0021A01:3 (Interference test 10:25) - plan view 61

Figure 6-15 Plot showing r^2/t_L during recovery of KG0021A01:3 (Interference test 10:25) – vertical view 62

Figure 6-16 Flow rates during draw down in KG0048A01:3.Time in minutes. 66

Figure 6-17 Plot showing r^2/t_L during recovery of KG0048A01:3 (Interference test 10:26) - plan view 68

Figure 6-18 Plot showing r^2/t_L during recovery of KG0048A01:3 (Interference test 10:26) - vertical view 69

Figure 6-19 Linear regression plots of time lag and diffusivity versus distance. Distance r in meters and t_L in minutes. 72

Figure 6-20 Linear regression of T_{EVAL} and S. Transmissivity in m^2/s. 73

Figure 6-21 Linear regression of T_{EVAL} and S*. Transmissivity in m^2/s. 74

Appendices

APPENDIX 1 Interference test 10:21 in KA3539G, section 15.85 m – 17.60 m.

APPENDIX 2 Interference test 10:22 in KA3542G02, section 2.00 m - 8.00 m.

APPENDIX 3 Interference test 10:23 in KA3554G01, section 22.60 m - 24.15 m.

APPENDIX 4 Interference test 10:24 in KA3590G02, section 25.50 m - 30.01 m.

APPENDIX 5 Interference test 10:25 in KG0021A01, section 35.00 m - 36.00 m.

APPENDIX 6 Interference test 10:26 in KG0048A01, section 32.80 m - 33.80 m.

1 Background

1.1 Äspö Hard Rock Laboratory

In order to prepare for the siting and licensing of a spent fuel repository SKB has constructed an underground research laboratory.

In the autumn of 1990, SKB began the construction of Äspö Hard Rock Laboratory (Äspö HRL), see Figure 1-1, near Oskarshamn in the south-eastern part of Sweden. A 3.6 km long tunnel was excavated in crystalline rock down to a depth of approximately 460 m.
The laboratory was completed in 1995 and research concerning the disposal of nuclear waste in crystalline rock has since then been carried out.

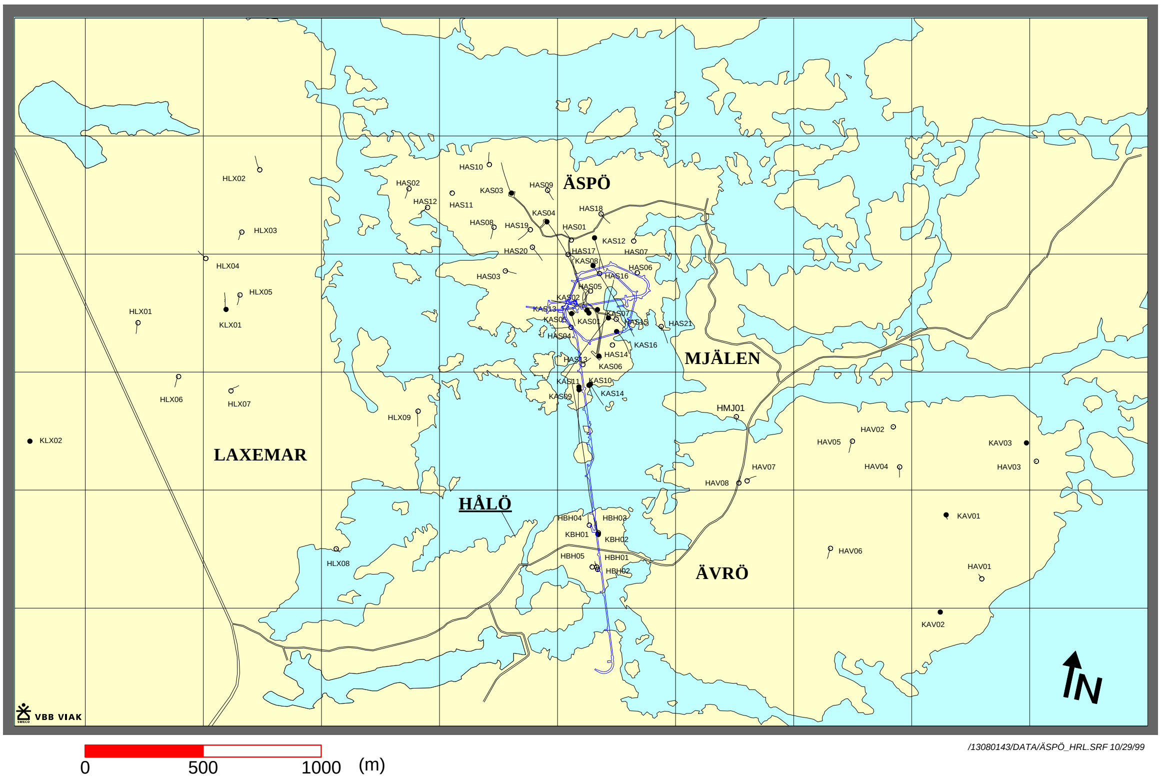


Figure 1-1 *Location of Äspö Hard Rock Laboratory*

1.2 Prototype repository

The Äspö Hard Rock Laboratory is an essential part of the research, development, and demonstration work performed by SKB in preparation for construction and operation of the final repository for spent fuel. Within the scope of the SKB program for RD&D 1995, SKB has decided to carry out a project with the designation "Prototype Repository Test". The aim of the project is to test important components in the SKB repository system in full scale and in a realistic environment.

The Prototype Repository Test is focused on testing and demonstrating the function of the SKB final 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.

1.2.1 General objectives

The Prototype Repository should simulate as many aspects as possible of a real repository, for example regarding geometry, materials, and rock environment. The Prototype Repository is a demonstration of the integrated function of the repository components. Results will be compared with models and assumptions to test their validity.

The major objectives for the Prototype Repository are:

- To test and demonstrate the integrated function of the repository components under realistic conditions in full scale and to compare results with models and assumptions.
- To develop, test and demonstrate appropriate engineering standards and quality assurance methods.
- To simulate appropriate parts of the repository design and the construction process.

The objective for the operation phase program is:

- To monitor processes and properties in the canister, buffer material, backfill and near-field rock mass

2 Objective

The objectives for the interference tests are

- to estimate the hydraulic properties, transmissivity, storativity and hydraulic diffusivity
- that they shall provide hydrogeological data useful for setting up a hydrogeological model of the rock volume around the TBM tunnel.

3 Scope

Interference tests were done using 6 boreholes in the Prototype Repository tunnel or in the G-tunnel. The tested intervals and basic test data are listed in Table 3-1. The first figure in the test number indicates this being the tenth test campaign, while the second number indicates the numbering of the interference tests. This is the third interference test campaign, the earlier interference test campaihns being number 1 and 5. The same numbering of the tests as used during test campaign 1 and 5 is used *(Forsmark et al. 2004)*, *(Forsmark, Rhén, 2005)*. Also indicated are those sections where Hydro Mechanical measurements (HM) are done.

Table 3-1 Interference tests during the campaign in November 2009

Bore hole	**Section (m)**	**HM section**	**Test no.**	**Date of test**	**Start of test**	**Flow start**	**Flow stop**	**Test stop (Next day)**
KA3539G:2	15.85-17.60	X	10:21	2009-11-10	07:30:00	08:00:00	14:00:00	08:00:00
KA3542G02:5	2.00-8.00	-	10:22	2009-11-12	07:30:00	08:00:00	14:00:00	08:00:00
KA3554G01:2	22.60-24.15	X	10:23	2009-11-17	07:30:00	08:00:00	14:00:00	08:00:00
KA3590G02:1	25.50-30.01	-	10:24	2009-11-19	07:30:00	08:10:00	14:10:00	08:10:00
KG0021A01:3	35.00-36.00	-	10:25	2009-11-18	07:30:00	08:00:00	14:00:00	08:00:00
KG0048A01:3	32.80-33.80	-	10:26	2009-11-11	07:30:00	08:00:00	14:00:00	08:00:00

In chapter 6 the results of the tests are presented.

4 Equipment

4.1 Description of equipment

A large number of boreholes were instrumented with one or several packers. In all packed-off sections, the water pressure will be measured. Each borehole section is connected to a tube of polyamide that via lead-through holes ends in the G-tunnel. All pressure transducers are placed in the G-tunnel to facilitate easy calibration and exchange of transducers that are out of order. The transducers are connected to the HMS system at Äspö Laboratory and it is a flexible system for changing the sampling frequency, see Figure 4-1. The maximum scan frequency is every 3^{rd} second. During periods with no hydraulic tests, the sampling (storing a value in the data base) frequency will be every 2^{nd} hour with an automatic increase of the sampling frequency if the pressure change since last registration is larger than 2kPa. During hydraulic tests, the sampling frequency may be up to 3^{rd} second.

Figure 4-1 *All pressure transducers are connected to the HMS system. In the G-tunnel there is a computer in the HMS system where logging frequencies easily can be changed.*

4.2 Pressure sensors

The pressure in a borehole is transmitted via a plastic tube directly to a pressure transducer, see Figure 4-2.

The pressure transducers are either of the type DRUCK PTX 500 series or DRUCK PTX 600 series with a pressure range of 0 – 50 bar (absolute).

According to the manufacturer the uncertainty for these transducers is +/-0.2 % (type500) and +/-0.08 % (type 600) of full scale (F.S) for the best straight line (B.S.L.). For the 600 series types the time drift is given to max. 0.05 % F.S., while no figure is given for the 500 series types. Normally, a pressure value is scanned once every third seconds. If the change since the latest stored value exceeds a “change value” of approximately 2 kPa the newly scanned value is stored. A value is always stored once every second hour, regardless of any changes.

Figure 4-2 *Pressure transducers connections*

4.3 Flowmeter equipment

A new kind of flowmeter, see Figure 4-3, was used in order to obtain continously flow measurements during the tests. The equipment system used was originally developed by Micro Motion, Inc. in USA, and is comprised of a sensor and a signal processing transmitter. It is called a Coriolis mass flowmeter and measures mass flow directly. The volume flow can be obtained when knowing the temperature, the pressure and finally the density of the fluid (water). The fluid enters the sensor and travels through the sensor´s flow tubes, which vibrate and twist. The twisting characteristic is called the Coriolis effect. According to Newton’s Second Law of

Motion, the amount of sensor tube twist is directly proportional to the mass flow rate of the fluid flowing through the tube.

The equipment unit consist of two flowmeters with different measurement ranges. The measurement range for the large flowmeter is 0 to appr. 36 kg/min and for the small flowmeter is 0 to approx. 1.8 kg/min.

Figure 4-3 *The equipment for flowrate measurement with Micro Motion Coriolis mass flowmeter system*

5 Execution

5.1 Preparations

Planning is an important step in the preparation stage. No other activities, which may cause pressure responses, must occur in the neighbourhood of the test area. Such activities include drilling, blasting and flowing of boreholes.

Preparations also include checking of equipment to be used in the tests. The equipment includes:

- measuring glasses of various sizes
- watches synchronized with the HMS system (only normal time)
- protocols for flow measurements
- water sampling bottles
- hand calculator
- flow rate measurement equipment with Micro Motion flowmeter system

5.2 Execution of tests/measurements

5.2.1 Test principle

The main purposes of interference tests are to:

- Estimate the hydraulic properties of water bearing hydraulic features or systems of hydraulic features
- Provide draw down and recovery data which can be used to calibrate numerical groundwater model
-

It is important to perform interference tests to obtain the effective transmissivity of a hydraulic feature. To evaluate the storativity of the feature, observations in other borehole sections than the test section are necessary and they must also intersect the hydraulic feature.

Interference tests can be rather time consuming in planning, execution, processing of data and evaluation of data. It is very important to plan interference tests and other activities, which may cause pressure responses (for example drilling) so that they do not interfere with each other. If other tests or activities cause pressure responses, they may ruin the interference test.

5.2.2 Test procedure

The following measurement cycle was used:

- Initialising of the HMS system 30 minutes before flow start with logging interval of 5 minutes
- A couple of minutes before flow start and until 5 minutes after flow start the highest logging interval of 2 seconds were used. Thereafter the logging interval was 30 seconds which was used until 30 minutes after flow start and a logging interval of 5 minutes was then used once again
- The flow was measured manually 2-3 times the first 5 minutes after flow start, 2-3 times the following 60 minutes and 3 times shortly before flow stop
- From shortly before flow stop until 5 minutes after flow stop the highest logging frequency of 2 seconds were used. Thereafter the logging frequency was 30 seconds which was used until 30 minutes after flow start and a logging frequency of 5 minutes was then used
- The valve shutting was done as swiftly as possible

5.3 Data handling

The test operator was keeping a diary during the test period. Data from the hydro tests includes:

- Daily logs in accordance with Äspö Hard Rock Laboratory routines
- Protocols from flow measurements

The project coordinator collected all data and delivered it to the data handling responsible person at Äspö for further SICADA handling.

5.4 Analyses and interpretation

5.4.1 Test borehole

The following description applies to the analysis in this report. The analysis done is for the recovery phase only.

The specific capacity is as mentioned above, Q/s, where Q is the calculated average water flow before shutting the valve and s is the maximum change of pressure, in metres, during the test. The Moye formula can be used for interpretation of stationary tests in order to get an estimate of the transmissivity

$$T_{Moye} = Q \cdot (1 + \ln(L/(2 \cdot r_w))) / (2 \cdot \pi \cdot \Delta h) \quad \text{where}$$

$\Delta h = (p_0 - p_p) / (\rho_w \cdot g)$ [m]

L = test section length [m]

r_w = borehole radius [m]

p_0 = absolute pressure in test section before start of flow period [Pa]

p_p = absolute pressure in test section before stop of flow period [Pa]

ρ_w = water density [kg/m^3]

g = acceleration of gravity [m/s^2]

While plotting the data, three different kinds of graphs were produced. The first plot is made in a linear scale. The time, date and hours is indicated on the horizontal axis. The pressure (p), expressed in bar or metres of water head is indicated on the vertical axis. The second plot is made in a semi-logarithmic diagram, where the pressure change, Δp, is plotted versus the equivalent time, dt_e, in minutes. The equivalent time, dt_e, (*Spane, Wurstner, 1993*) is defined as

$$dt_e = (t_p \cdot dt) / (t_p + dt) \qquad \textit{where}$$

t_p = the flowing time of the borehole before shutting the valve

dt = the time after shutting the valve

The pressure change Δp is calculated as

Δp = $p(dt) - p(t_p)$

p(dt) = measured pressure at time dt after shutting the valve

$p(t_p)$ = measured pressure just before shutting the valve

The third plot is made in a logarithmic diagram, where the change of pressure, Δp, is plotted versus the equivalent time, dt_e, in minutes. The derivative of the pressure is also plotted in this diagram.

The pressure normally is signed using the p and a change of pressure using a Δp. In the diagrams the pressure can be expressed in bar, kPa or in metres of water head. In the formulas below however the praxis is to use the s for the change of water head and Δs for the difference of pressure over one decade in a logarithmic diagram. The s or Δs values shall be expressed in metres before used in the formulas.

Hydrologic test analysis based on the derivative of pressure (i.e., rate of pressure change) with respect to the natural logarithm of time has been shown to significantly improve the diagnostic and quantitative analysis of slug and constant-rate discharge tests (i.e., pumping tests) (*Spane, Wurstner, 1993*). The improvement in hydrologic test analysis is attributed to the sensitivity of the derivative response to small variations in the rate of pressure change that occurs during testing, which would otherwise be less obvious with standard pressure change versus time analysis techniques. The sensitivity of pressure derivatives to pressure change responses facilitates their use in identifying the presence of wellbore storage, boundaries, and establishment of flow conditions, as e.g. radial flow, within the test data record. Specifically, pressure derivative analysis can be used to:

- *diagnostically determine formation response (homogeneous vs. heterogeneous) and boundary conditions (impermeable or constant head) that are evident during the test,*

- *determine when radial flow conditions are established and, therefore, when straight-line solution analysis of draw down data is valid, and*

- *assist in log-log type-curve matching to determine hydraulic properties for test data exhibiting wellbore storage and/or leakage effects.*

In a fracture, different flow regimes may be observed at different times, *(Horne, 1995)*. At very early time only a linear flow regime occur within the fracture. At early time, there is linear flow within the fracture and linear flow into the fracture from the rock formation. The combination of these two linear flows gives rise to a bilinear flow period. This part of the pressure response is characterized by a straight line with slope 1:4 at early time on a log-log plot of pressure drop against time. Following the bilinear flow period, finite conductivity fracture responses generally enter a transition after bilinear flow, but reach radial flow before ever achieving linear flow, recognizeable by the upward bending of the pressure response curve towards a 1:2 slope on the log-log plot. In practice, the 1:2 slope is rarely seen except in fractures where the conductivity is infinite. The above described methodology is used in chapter 6.

The tests are evaluated using the software AQTESOLV ver. 4.50, and results are reported in chapter 6 and in the executive summary. AQTESOLV is the all-in-one software package for the design and analysis of aquifer tests including pumping tests, step-drawdown tests, variable-rate tests, recovery tests, single-well tests, slug tests and constant-head tests. The software is developed by HydroSOLVE, Inc., USA.

The solution used in these analysis is the Dougherty-Babu model for a pumping test in a confined aquifer (Dougherty, Babu, 1984). The model assumes radial flow in a porous medium. AQTESOLV uses the principle of superposition in time to simulate variable-rate tests including recovery with the solution. The result consist of

- Transmissivity, T (m^2/s)
- Skinfactor, Sw (-)

It is of uttermost importance when evaluation the hydraulic tests within the scope of this report that all tests are evaluated using the <u>same approach</u> between the test campaigns. This is important to be able to evaluate the <u>relative difference</u> of the transmissivity from one test campaign to another.

It is however important as well to observe any significant changes of the pressure plot from on time to another. If changes have occurred another matching of the data to a chosen model may be necessary.

5.4.2 Interference tests

Pressure registration was made in neighbouring boreholes during the flowing and recovery phase of every interference test. In Tables 6-1 to 6-21 the results of the tests are presented. In Appendices 1 to 6 some evaluated observation sections ($r^2/t_L > 1$, see below) are presented. The mid-chainage of each bore hole section is the mid-point between the packers. The distance, r, between different bore hole sections has been calculated as the spherical distance using co-ordinates for the mid-chainage for each section. The evaluation of transmissivity $T_{EVAL,}$ and storativity S, has been made using the Theis log-log type curve method assuming radial flow. The calculation of the hydraulic diffusivity is based on radial flow (*Streltsova, 1988*) :

$$\eta = T / S = r^2 / [\ 4 \cdot t_L \cdot (\ 1 + t_L / dt) \cdot \ln(1 + dt / t_L)]$$

The time lag t_L is defined as the time when the pressure response in an observation section is greater than 0.1 metres. The pumping time is included as dt. As can be seen in equation above the diffusivity is proportional to r^2 / t_L. S^* in the rest result tables in *Chapter 6* is calculated as $S^* = T / \eta$. The values of diffusivity and storativity should be seen as approximate values as the flow dimension is not always radial. When the flow is interpreted as radial flow T_{EVAL} is shown in the table for the observation sections.

The response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m). This classification is made from drawdown pressure head plots. Two columns in the tables show $P_0 – P_f$ and $P_p – P_f$, *Tables 6-1 to 6-21*, using HMS data. These data are not always stable. Therefor for some sections where no response is noticed the value may be negative or there may exist a general pressure trend, increasing or decreasing.

The relation r^2/t_L is used as an indicator to better understand whether a pressure response really indicate a good hydraulic connection or not. A small response at a large distance may actually indicate a better connection than a larger response at a shorter distance. This classification is done using the recovery response, since the recovery response is more distinct in regard to the timelag, t_L .

In the test evaluation the following grouping is used:

- **Some** hydraulic connection: $r^2/t_L < 1$ [m^2/s]
- A **rather good** hydraulic connection: $1 < r^2/t_L < 2$[m^2/s]
- A **good** hydraulic connection: $2 < r^2/t_L < 4$ [m^2/s]
- A **very good** hydraulic connection: $4 < r^2/t_L$ [m^2/s]

6 Results

6.1 General

During two interference test campaigns in 1999, (*Forsmark T, Rhén, I, 1999, 2000)*, two major hydraulic features or system of features, one on the south side and one on the north side of the prototype repository were observed. They were evaluated regarding geometry and hydraulic parameters, such as transmissivity and storativity. The system of features strikes WNW.

The results from the now performed interference tests confirm this idea of almost vertical sets of parallel hydraulic features or system of features running in a WNW direction.

Several of the evaluated transmissivities of observation sections can certainly be discussed but may give an indication of the magnitude of the transmissivity. It is likely that only a few observation sections may be in more direct contact with the flowing section, thus giving a firmer basis for the evaluation.

The evaluated (average) diffusivity is also likely to be greater as the distance through the fracture network is in most cases probable greater than the now used spherical distance.
Due to the above mentioned uncertainties the evaluated storativity is uncertain, but should probably indicate reasonable values of the storativity for at least well-connected borehole sections

6.2 Interference tests

6.2.1 Test 10:21 – KA3539G:2

General test data for the pressure build-up test in the interval 15.85-17.60 m of borehole KA3539G are presented in Table 6-1.

Table 6-1 General test data for the pressure build-up test in section 15.85-17.60 m of borehole KA3539G

General test data			
Borehole section	KA3539G:2		
Test No	10:21		
Field crew	A. Blom (SWECO Environment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	15.85
Test section- seclow	Seclow	m	17.60
Test section length	L_w	m	1.75
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm	20091110 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091110 08:00:00
Stop of flow period		yymmdd hh:mm:ss	20091110 14:00:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20091111 08:00:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	1415	
Absolute pressure in test section before stop of flow	p_p	kPa	328	
Max absolute pressure in test section during recovery period	p_f	kPa	1562	
Maximal pressure change during flow period	dp_p	kPa	1087	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.68 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.98 \cdot 10^{-5}$
Total volume discharged during flow period	V_p	m^3	0.428

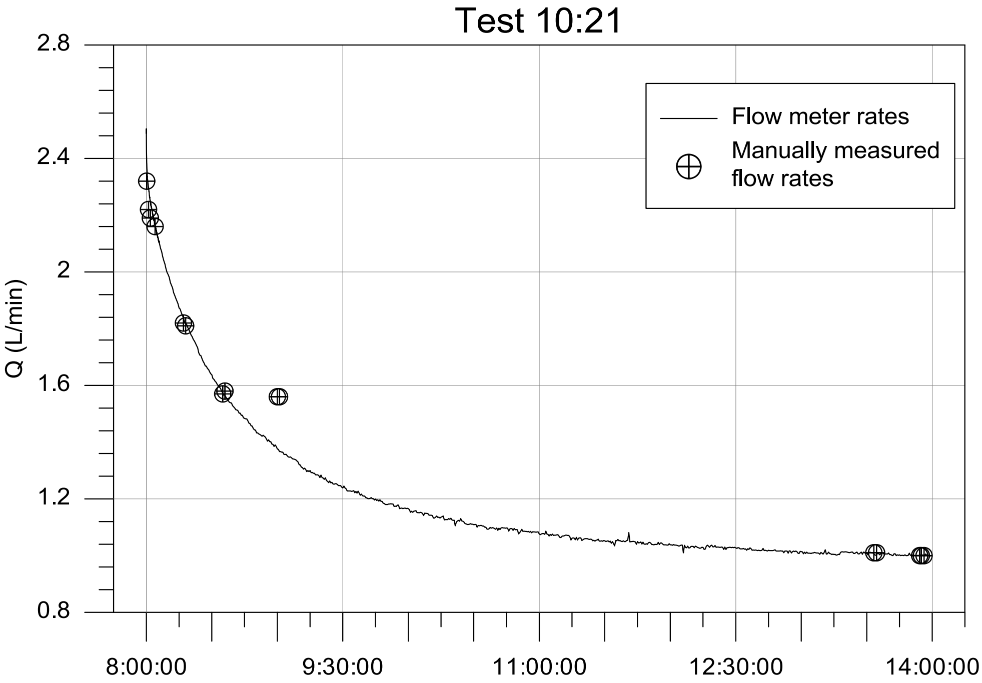


Figure 6-1 *Flow rates during draw down in KA3539G:2. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.05	minutes	Well Bore Storage (WBS)
0.05 – 0.25	minutes	Transition period
0.25 – 0.4	minutes	Radial flow period
0.4 – 0.8	minutes	Transition period
0.8 – 2	minutes	Possible linear channel flow
2 –	minutes	Transition period

Calculated parameters

Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

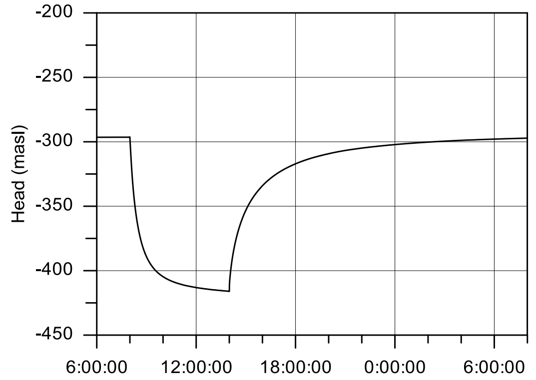
Selected representative parameters

The selected representative parameters from the test in the interval 15.85-17.60 m in KA3539G are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

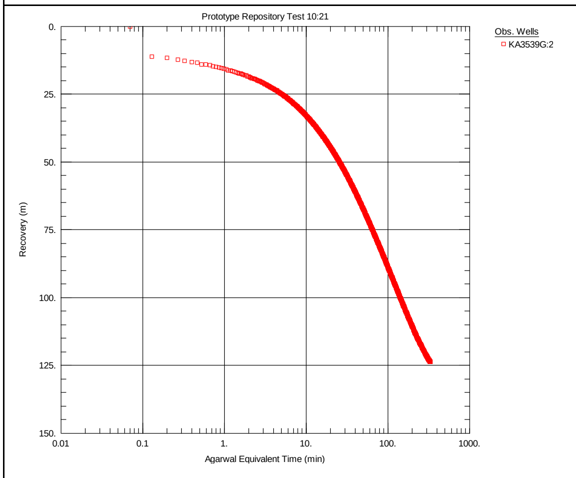
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:21
Borehole ID:	KA3539G	Test start:	2009-11-10 07:30
Test section (m):	15.85-17.60	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head

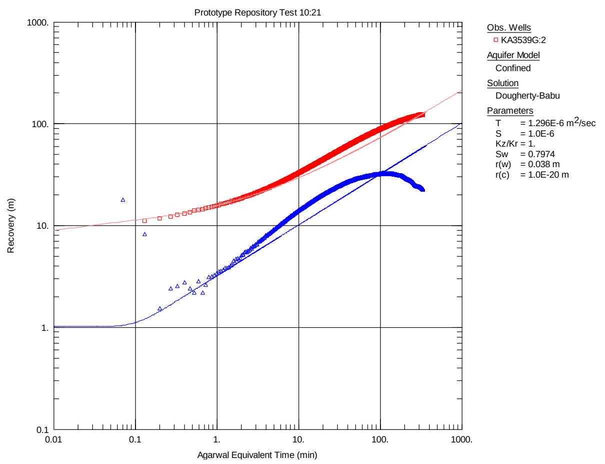


Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	1415		
p_i (kPa)			
p_p(kPa)	328	p_F (kPa)	1562
Q_p (m^3/s)	$1.68 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2
Results		**Results**	
Q/s (m^2/s)	$1.5 \cdot 10^{-7}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$1.0 \cdot 10^{-7}$	dt_{e1} (min)	0.25
Flow regime:		dt_{e2} (min)	0.4
dt_1 (min)		T (m^2/s)	$1.3 \cdot 10^{-6}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	0.8
C_D (-)			
ξ (-)			

Lin-Log plot



Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.25	C_D (-)	
dt_2 (min)	0.4	ξ (-)	0.8
T_T (m^2/s)	$1.3 \cdot 10^{-6}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: A channel flow regime is established during this test.

The test was carried out in KA3539G, section 15.85 - 17.60 metres. The flow period was for 360 minutes with a final flow of 1.32 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-2 and Figure 6-3 the r^2/t_L recordings are shown and in Table 6-2 and Table 6-3 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 1.

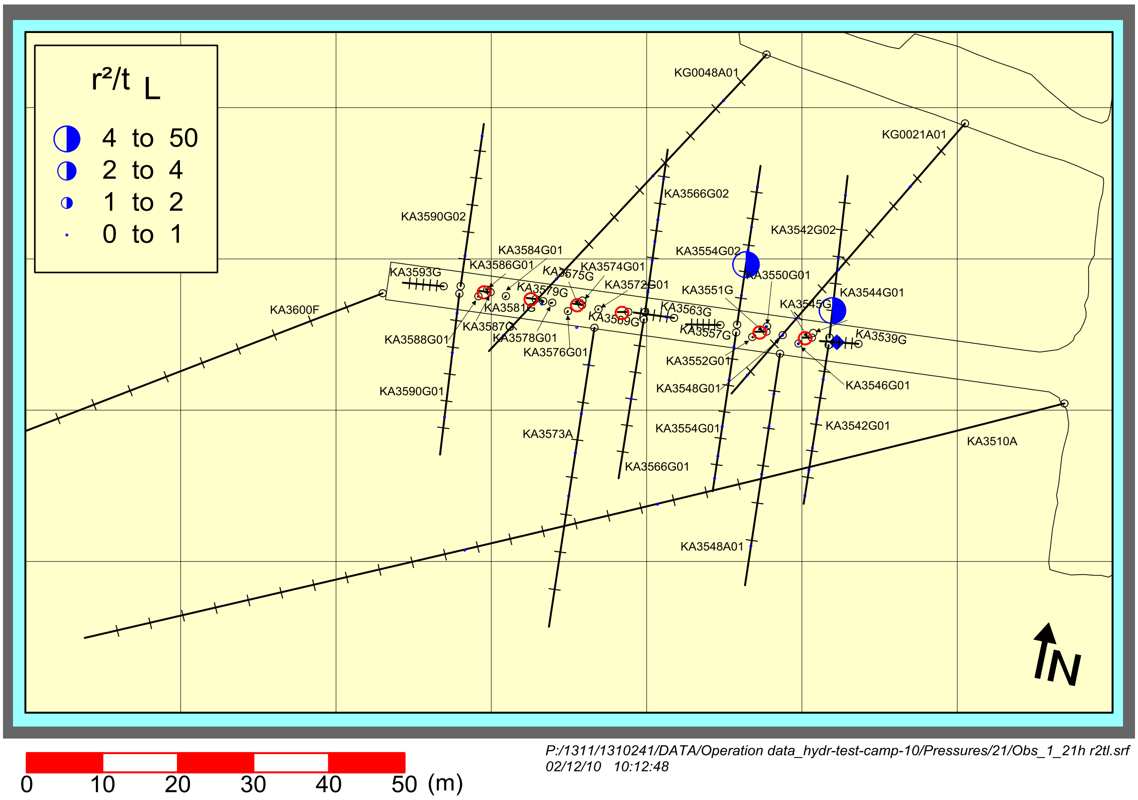


Figure 6-2 *Plot showing r^2/t_L during recovery of KA3539G:2 (Interference test 10:21) - plan view*

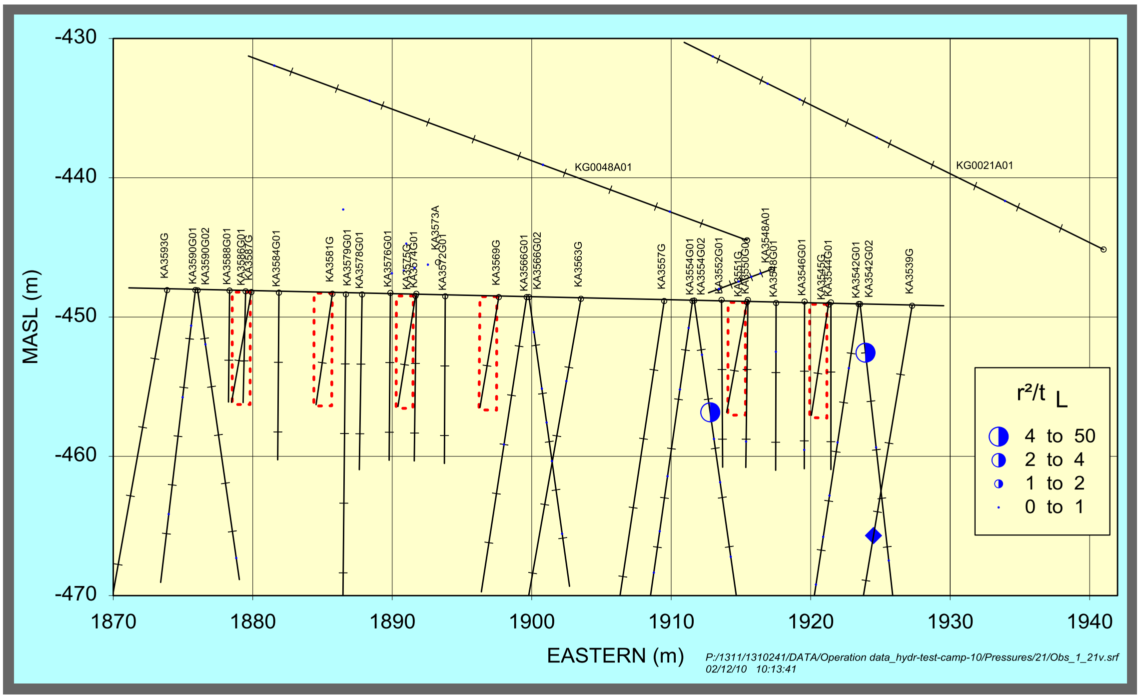


Figure 6-3 *Plot showing* r^2/t_L *during recovery of KA3539G:2 (Interference test 10:21) - vertical view*

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3554G02:4 and KA3542G02:5.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $9.1 \cdot 10^{-8} – 2.7 \cdot 10^{-7}$ m^2/s. The transmissivity of the flowing section is evaluated to be $1.3 \cdot 10^{-6}$ m^2/s with the evaluation period 0.25 – 0.4 minutes.

In the figures above the activation of the north side system of hydraulic features can be observed. There also is shown connections with the system on the south side of the repository. It can be imagined that there exists several parallel systems connected with intersecting minor systems.

When compared to an earlier test 5:21, (*Forsmark T, Rhén, I, 2005)*, the overall observations are the same.

Table 6-2 Interference test results for KA3539G, 15.85 - 17.60 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response)	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	107.10	-	-	-	-	-	-	0	0.6	0.2
KA3510A:2	110.00	124.00	117.00	86.87	-	-	-	-	-	-	0	0.0	-0.4
KA3510A:3	75.00	109.00	92.00	62.44	197.59	0.329	5.12E-02	-	-	-	1	7.2	3.7
KA3510A:4	51.00	74.00	62.50	34.61	90.73	0.220	2.74E-02	1.5E-07	7.8E-06	5.4E-06	2	24.9	18.0
KA3510A:5	4.50	50.00	27.25	15.75	-	-	-	-	-	-	2	25.2	18.2
KA3539G:1	18.60	30.00	24.30	7.56	-	-	-	-	-	-	2	1165.9	1161.5
KA3539G:2	**15.85**	**17.60**	**16.73**	**0.00**	-	-	-	**1.3E-06**	-	-	2	1086.4	1233.8
KA3539G:3	10.00	14.85	12.43	4.30	-	-	-	-	-	-	2	959.8	1028.5
KA3539G:4	4.00	9.00	6.50	10.23	-	-	-	-	-	-	2	989.7	1097.9
KA3542G01:1	27.00	30.00	28.50	21.02	63.51	0.116	1.30E-02	2.3E-07	2.3E-05	1.8E-05	2	28.2	21.6
KA3542G01:2	21.30	26.00	23.65	17.30	47.43	0.105	1.08E-02	1.6E-07	1.9E-05	1.5E-05	2	49.1	39.0
KA3542G01:3	18.60	20.30	19.45	14.62	40.33	0.088	8.65E-03	1.9E-07	2.4E-05	2.2E-05	2	55.5	44.9
KA3542G01:4	10.50	17.60	14.05	12.47	50.61	0.051	5.36E-03	1.6E-07	3.7E-05	2.9E-05	2	49.1	39.3
KA3542G01:5	3.50	9.50	6.50	13.11	48.99	0.058	6.06E-03	3.3E-08	8.9E-06	5.5E-06	2	169.8	149.4
KA3542G02:1	28.20	30.01	29.11	21.72	-	-	-	-	-	-	2	34.4	-0.5
KA3542G02:2	25.60	27.20	26.40	19.54	256.12	0.025	4.14E-03	-	-	-	2	51.8	9.1
KA3542G02:3	21.50	24.60	23.05	17.08	-	-	-	-	-	-	1	4.7	-14.0
KA3542G02:4	9.00	20.50	14.75	12.81	157.46	0.017	2.54E-03	-	-	-	2	186.2	126.2
KA3542G02:5	2.00	8.00	5.00	13.79	0.72	4.386	1.76E-01	2.7E-07	7.0E-07	1.6E-06	2	972.1	961.3
KA3543A01:1	0.65	2.06	1.36	19.51	-	-	-	-	-	-	2	191.0	180.5
KA3543I01:1	0.65	2.06	1.36	23.05	-	-	-	-	-	-	1	8.6	-0.2
KA3544G01:1	11.65	12.00	11.83	5.91	-	-	-	-	-	-	2	142.9	112.7
KA3544G01:2	8.90	10.65	9.78	7.70	-	-	-	-	-	-	2	142.6	112.6
KA3544G01:3	3.50	7.90	5.70	11.52	-	-	-	-	-	-	2	142.6	112.6
KA3546G01:1	9.30	12.00	10.65	7.90	18.52	0.056	4.43E-03	3.1E-06	2.1E-04	7.0E-04	2	12.0	23.3
KA3546G01:2	6.75	8.30	7.53	10.51	-	-	-	-	-	-	2	17.7	-19.7
KA3546G01:3	1.50	5.75	3.63	14.07	-	-	-	-	-	-	2	47.1	3.9
KA3548A01:1	21.50	30.00	25.75	34.10	87.83	0.221	2.72E-02	2.2E-07	1.0E-05	8.0E-06	2	20.5	15.4
KA3548A01:2	11.75	20.50	16.13	27.03	72.30	0.168	1.96E-02	2.0E-07	1.4E-05	1.0E-05	2	26.0	19.4
KA3548A01:3	8.80	10.75	9.78	23.38	32.14	0.283	2.60E-02	2.0E-07	9.6E-06	7.8E-06	2	57.5	46.8
KA3548A01:4	3.00	7.80	5.40	21.60	90.73	0.086	1.07E-02	5.1E-08	8.1E-06	4.7E-06	2	51.4	37.2
KA3548D01:1	0.65	2.06	1.36	21.17	-	-	-	-	-	-	2	113.6	76.8
KA3548G01:1	6.00	12.00	9.00	10.45	-	-	-	-	-	-	2	10.8	1.2
KA3548G01:2	2.00	5.00	3.50	14.97	217.79	0.017	2.74E-03	-	-	-	1	3.3	1.6
KA3550G01:1	8.30	12.03	10.17	11.54	179.28	0.012	1.88E-03	-	-	-	2	112.2	74.5
KA3550G01:2	5.20	7.30	6.25	14.16	-	-	-	-	-	-	2	111.7	74.2
KA3550G01:3	1.80	4.20	3.00	16.73	-	-	-	-	-	-	2	112.3	74.5
KA3550G05:1	1.50	3.00	2.25	15.30	-	-	-	-	-	-	0	0.2	0.0
KA3551G05:1	1.50	3.10	2.30	18.29	-	-	-	-	-	-	0	0.2	0.0
KA3552A01:1	0.65	2.06	1.36	23.17	-	-	-	-	-	-	0	0.0	0.2
KA3552G01:1	7.05	12.00	9.53	13.13	-	-	-	-	-	-	1	7.4	-1.2
KA3552G01:2	4.35	6.05	5.20	15.99	-	-	-	-	-	-	0	0.0	-2.5
KA3552G01:3	1.50	3.35	2.43	18.13	-	-	-	-	-	-	2	42.0	-0.4
KA3552H01:1	0.65	2.10	1.38	26.16	-	-	-	-	-	-	0	0.0	0.6
KA3553B01:1	0.65	2.02	1.34	22.39	-	-	-	-	-	-	2	105.4	65.9
KA3554G01:1	25.15	30.01	27.58	24.05	63.51	0.152	1.70E-02	2.3E-07	1.7E-05	1.4E-05	2	27.8	20.9
KA3554G01:2	22.60	24.15	23.38	21.48	65.60	0.117	1.33E-02	2.5E-07	2.3E-05	1.9E-05	2	28.0	21.3
KA3554G01:3	14.00	21.60	17.80	18.98	113.85	0.053	7.03E-03	7.5E-08	1.7E-05	1.1E-05	2	31.5	20.5
KA3554G01:4	5.00	13.00	9.00	18.09	138.31	0.039	5.56E-03	-	-	-	2	34.4	20.0
KA3554G01:5	1.50	4.00	2.75	19.96	232.38	0.029	4.64E-03	-	-	-	2	44.6	15.4
KA3554G02:1	22.00	30.01	26.01	22.99	90.73	0.097	1.21E-02	1.5E-08	1.8E-06	1.3E-06	2	236.8	186.4
KA3554G02:2	15.90	21.00	18.45	19.18	63.51	0.097	1.08E-02	3.8E-08	2.9E-06	3.5E-06	2	311.9	265.3
KA3554G02:3	13.20	14.90	14.05	18.07	32.14	0.169	1.55E-02	4.3E-08	3.4E-06	2.8E-06	2	312.2	265.8
KA3554G02:4	10.50	12.20	11.35	17.91	1.03	5.174	2.20E-01	9.1E-08	2.6E-07	4.1E-07	2	987.0	980.9
KA3554G02:5	1.50	9.50	5.50	18.91	9.37	0.636	4.22E-02	6.1E-08	1.8E-06	1.5E-06	2	363.5	326.5
KA3557G:1	15.00	30.04	22.52	19.27	-	-	-	-	-	-	0	0.8	-1.2
KA3557G:2	1.50	14.00	7.75	18.72	-	-	-	-	-	-	1	2.9	0.2
KA3563A01:1	0.65	2.06	1.36	30.16	-	-	-	-	-	-	2	13.6	0.5
KA3563D01:1	0.65	2.01	1.33	29.64	-	-	-	-	-	-	1	3.9	-9.6
KA3563G:1	15.00	30.01	22.51	25.67	-	-	-	-	-	-	0	-0.5	-2.2
KA3563G:2	10.00	13.00	11.50	23.91	-	-	-	-	-	-	1	1.7	0.7
KA3563G:3	4.00	8.00	6.00	24.87	179.28	0.058	8.72E-03	-	-	-	2	33.9	15.7
KA3563G:4	1.50	3.00	2.25	26.18	-	-	-	-	-	-	1	8.6	-9.9
KA3563I01:1	0.65	2.15	1.40	32.47	-	-	-	-	-	-	1	7.6	-9.8
KA3566C01:1	0.65	2.1	1.38	33.52	-	-	-	-	-	-	1	8.1	-6.4

Table 6-3 Interference test results for KA3539G, 15.85 - 17.60 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure

response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	31.95	-	-	-	-	-	-	1	2.2	-0.2
KA3566G01:2	20.00	21.50	20.75	29.56	-	-	-	-	-	-	2	13.0	-5.4
KA3566G01:3	12.00	18.00	15.00	28.29	191.29	0.070	1.08E-02	-	-	-	1	7.1	4.2
KA3566G01:4	7.30	10.00	8.65	28.22	-	-	-	-	-	-	2	13.0	-5.2
KA3566G01:5	1.50	6.30	3.90	29.09	-	-	-	-	-	-	2	13.7	-4.9
KA3566G02:1	19.00	30.10	24.55	31.05	217.79	0.074	1.18E-02	-	-	-	2	23.1	4.7
KA3566G02:2	16.00	18.00	17.00	28.67	256.12	0.053	8.90E-03	-	-	-	2	20.9	2.5
KA3566G02:3	12.00	14.00	13.00	28.15	224.96	0.059	9.45E-03	-	-	-	2	22.6	3.9
KA3566G02:4	8.00	11.00	9.50	28.16	217.79	0.061	9.69E-03	-	-	-	2	22.9	4.4
KA3566G02:5	1.30	6.00	3.65	29.15	240.04	0.059	9.66E-03	-	-	-	2	21.7	3.2
KA3568D01:1	0.65	2.30	1.48	33.50	-	-	-	-	-	-	1	6.4	-9.4
KA3572G01:1	7.30	12.03	9.67	31.95	-	-	-	-	-	-	0	-0.2	-1.5
KA3572G01:2	2.70	5.30	4.00	33.71	-	-	-	-	-	-	1	2.2	-4.2
KA3573A:1	26.00	40.07	33.04	50.85	-	-	-	-	-	-	0	0.2	0.5
KA3573A:2	21.00	24.00	22.50	44.27	138.31	0.236	3.33E-02	-	-	-	1	7.6	5.2
KA3573A:3	14.50	19.00	16.75	41.35	232.38	0.123	1.99E-02	-	-	-	1	6.2	2.2
KA3573A:4	10.50	12.50	11.50	39.26	138.31	0.186	2.62E-02	4.4E-07	2.5E-05	1.7E-05	1	7.4	4.4
KA3573A:5	1.30	8.50	4.90	37.51	129.62	0.181	2.50E-02	4.7E-07	2.4E-05	1.9E-05	1	7.6	4.7
KA3573C01:1	0.65	2.05	1.35	39.56	125.48	0.208	2.85E-02	1.1E-07	6.4E-06	3.7E-06	2	16.7	11.5
KA3574D01:1	0.65	2.05	1.35	39.23	-	-	-	-	-	-	1	1.2	-1.7
KA3574G01:1	8.00	12.03	10.02	34.15	-	-	-	-	-	-	0	-0.2	0.0
KA3574G01:2	5.10	7.00	6.05	35.17	-	-	-	-	-	-	0	0.5	-2.2
KA3574G01:3	1.80	4.10	2.95	36.26	-	-	-	-	-	-	0	0.2	0.5
KA3576G01:1	8.00	12.01	10.01	35.72	-	-	-	-	-	-	0	0.0	0.5
KA3576G01:2	4.00	6.00	5.00	37.05	-	-	-	-	-	-	0	0.2	0.0
KA3576G01:3	1.30	3.00	2.15	38.08	-	-	-	-	-	-	1	2.5	-3.0
KA3578C01:1	0.65	2.09	1.37	43.59	-	-	-	-	-	-	1	4.7	3.0
KA3578G01:1	6.50	12.58	9.54	37.98	-	-	-	-	-	-	0	0.2	0.2
KA3578G01:2	4.30	5.50	4.90	39.13	-	-	-	-	-	-	0	0.5	-1.7
KA3578H01:1	0.65	1.90	1.28	44.93	232.38	0.145	2.35E-02	-	-	-	1	6.6	2.2
KA3579D01:1	0.65	2.00	1.33	42.97	-	-	-	-	-	-	0	-0.2	0.7
KA3579G:1	14.70	22.65	18.68	38.43	-	-	-	-	-	-	0	0.2	-0.7
KA3579G:2	12.50	13.70	13.10	38.58	-	-	-	-	-	-	0	-0.2	-1.5
KA3579G:3	2.30	11.50	6.90	39.68	-	-	-	-	-	-	0	-0.5	0.2
KA3584G01:1	7.00	12.00	9.50	43.83	-	-	-	-	-	-	0	0.5	0.2
KA3584G01:2	1.30	5.00	3.15	45.39	-	-	-	-	-	-	0	-0.5	0.2
KA3588C01:1	0.65	2.04	1.35	52.74	-	-	-	-	-	-	1	7.9	5.4
KA3588D01:1	0.65	1.90	1.28	50.96	-	-	-	-	-	-	1	3.2	2.2
KA3588I01:1	0.65	1.96	1.31	53.08	-	-	-	-	-	-	1	3.7	2.9
KA3590G01:1	16.00	30.00	23.00	51.50	103.30	0.428	5.54E-02	1.3E-07	3.8E-06	2.4E-06	2	18.7	14.0
KA3590G01:2	7.00	15.00	11.00	50.52	103.30	0.412	5.33E-02	1.3E-07	3.9E-06	2.5E-06	2	18.7	14.0
KA3590G01:3	1.30	6.00	3.65	51.32	204.11	0.215	3.38E-02	1.2E-07	6.8E-06	3.5E-06	1	5.7	3.0
KA3590G02:1	25.50	30.01	27.76	53.23	232.38	0.203	3.30E-02	-	-	-	2	41.5	14.7
KA3590G02:2	15.20	23.50	19.35	51.32	-	-	-	-	-	-	2	27.8	-3.2
KA3590G02:3	11.90	13.20	12.55	50.76	-	-	-	-	-	-	0	0.5	-5.2
KA3590G02:4	1.30	9.90	5.60	51.11	247.95	0.176	2.90E-02	-	-	-	1	3.2	1.7
KA3592C01:1	0.65	2.01	1.33	56.72	-	-	-	-	-	-	1	2.7	1.7
KA3593G:1	25.20	30.02	27.61	56.84	-	-	-	-	-	-	0	0.0	0.0
KA3593G:2	23.50	24.20	23.85	55.68	-	-	-	-	-	-	1	5.7	2.5
KA3593G:3	9.00	22.50	15.75	53.99	-	-	-	-	-	-	0	0.5	-0.2
KA3593G:4	3.00	7.00	5.00	53.58	-	-	-	-	-	-	1	1.5	-4.2
KA3597D01:1	0.65	2.22	1.44	59.11	-	-	-	-	-	-	1	3.7	2.7
KA3597H01:1	0.65	2.06	1.36	61.85	-	-	-	-	-	-	1	4.7	2.9
KA3600F:1	43.00	50.10	46.55	104.01	-	-	-	-	-	-	0	0.2	-0.5
KA3600F:2	40.50	42.00	41.25	99.03	-	-	-	-	-	-	0	0.0	-0.5
KA3600F:3	20.00	39.50	29.75	88.36	-	-	-	-	-	-	1	1.2	0.2
KA3600F:4	1.30	18.00	9.65	70.36	-	-	-	-	-	-	1	1.7	-2.2
KG0021A01:1	42.50	48.82	45.66	36.54	57.62	0.386	4.20E-02	3.7E-08	1.2E-06	8.7E-07	2	126.8	104.4
KG0021A01:2	37.00	41.50	39.25	33.33	55.78	0.332	3.58E-02	8.2E-08	2.6E-06	2.3E-06	2	98.6	79.2
KG0021A01:3	35.00	36.00	35.50	31.90	54.00	0.314	3.35E-02	7.7E-08	2.9E-06	2.3E-06	2	99.6	81.4
KG0021A01:4	19.00	34.00	26.50	30.16	47.43	0.320	3.28E-02	8.5E-08	3.3E-06	2.6E-06	2	99.8	81.9
KG0021A01:5	5.00	18.00	11.50	32.99	133.89	0.135	1.89E-02	-	-	-	2	72.1	53.1
KG0048A01:1	49.00	54.69	51.85	54.62	77.15	0.645	7.65E-02	2.4E-07	3.9E-06	3.1E-06	2	24.1	18.0
KG0048A01:2	34.8	48	41.40	48.46	125.48	0.312	4.27E-02	9.7E-08	4.0E-06	2.3E-06	2	18.7	12.8
KG0048A01:3	32.80	33.80	33.30	44.80	-	-	-	-	-	-	2	31.7	22.1
KG0048A01:4	13.00	31.80	22.40	41.87	152.44	0.192	2.78E-02	-	-	-	2	51.3	30.8
KG0048A01:5	5.00	12.00	8.50	42.13	210.84	0.140	2.22E-02	-	-	-	2	50.3	26.0

6.2.2 Test 10:22 – KA3542G02:5

General test data for the pressure build-up test in the interval 2.00-8.00 m of borehole KA3542G02 are presented in Table 6-4.

Table 6-4 General test data for the pressure build-up test in section 2.00-8.00 m of borehole KA3542G02

General test data			
Borehole section	KA3542G02:5		
Test No	10:22		
Field crew	A. Blom (SWECO Envrironment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	2.00
Test section- seclow	Seclow	m	8.00
Test section length	L_w	m	6.00
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm:ss	20091112 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091112 08:00:00
Stop of flow period		yymmdd hh:mm:ss	20091112 14:00:00
Test stop (stop of pressure registration)		yymmdd hh:mm:ss	20091113 08:00:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	1525	
Absolute pressure in test section before stop of flow	p_p	kPa	97	
Max absolute pressure in test section during recovery period	p_f	kPa	1522	
Maximal pressure change during flow period	dp_p	kPa	1428	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.46 \cdot 10^{-6}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.47 \cdot 10^{-6}$
Total volume discharged during flow period	V_p	m^3	0.0317

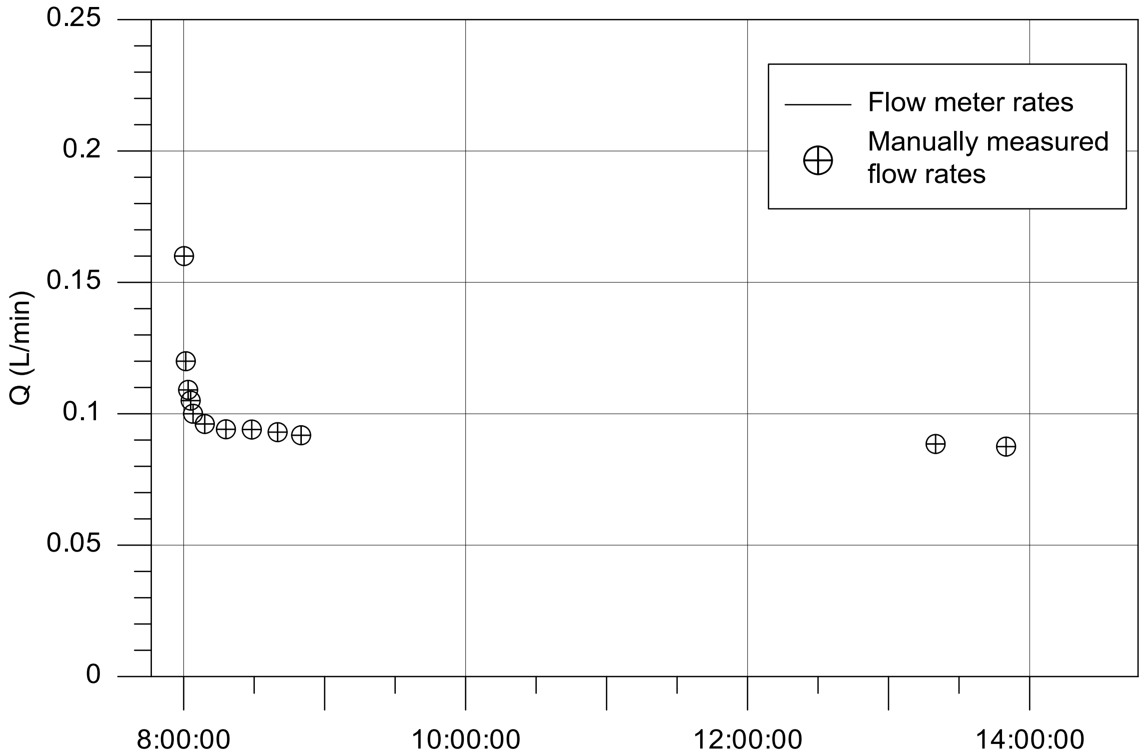


Figure 6-4 *Flow rates during draw down in KA3542G02:5. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.3	minutes	Well Bore Storage (WBS)
0.3 – 0.7	minutes	Transition period
0.7 –3	minutes	Radial flow period
3 –		Transition period

Calculated parameters

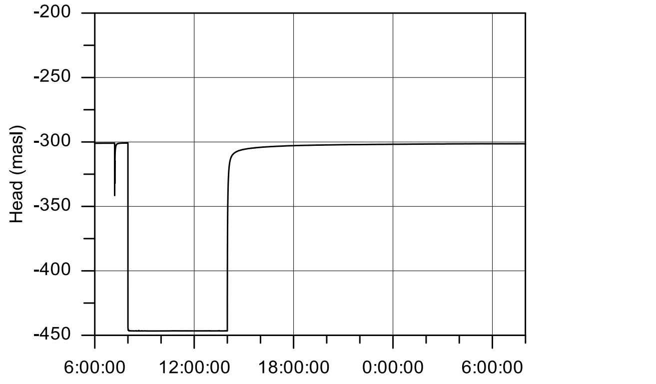
Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

Selected representative parameters

The selected representative parameters from the test in the interval 2.00-8.00 m in KA3542G02 are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

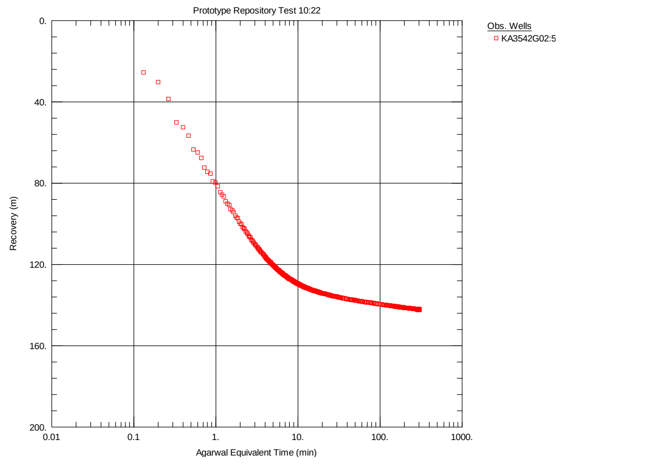
Test Summary Sheet			
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:22
Borehole ID:	KA3542G02	Test start:	2009-11-12 07:30
Test section (m):	2.00-8.00	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head



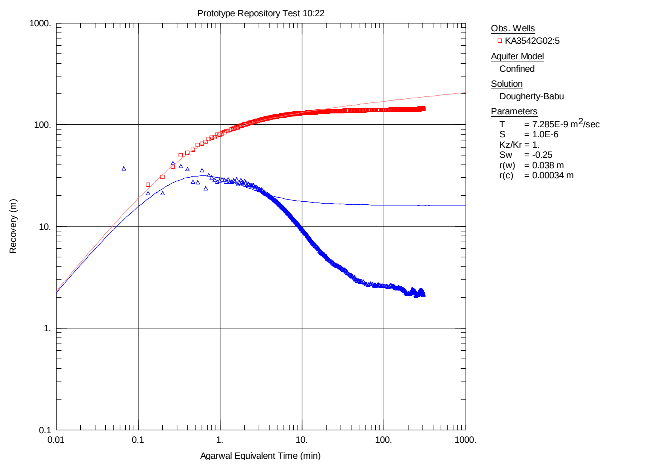
Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	1525		
p_i (kPa)			
p_p(kPa)	97	p_F (kPa)	1522
Q_p (m^3/s)	$1.46 \cdot 10^{-6}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$8.7 \cdot 10^{-9}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$1.0 \cdot 10^{-8}$	dt_{e1} (min)	0.7
Flow regime:		dt_{e2} (min)	3
dt_1 (min)		T (m^2/s)	$7.3 \cdot 10^{-9}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	-0.25
C_D (-)			
ξ (-)			

Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.			
Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.7	C_D (-)	
dt_2 (min)	3	ξ (-)	-0.25
T_T (m^2/s)	$7.3 \cdot 10^{-9}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: Evaluation period chosen for early time to give local conditions.

The test was carried out in KA3542G02, section 2.00 - 8.00 metres. The flow period was for 360 minutes with a final flow of 0.09 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-5 and Figure 6-6 the r^2/t_L recordings are shown and in Table 6-5 and Table 6-6 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 2.

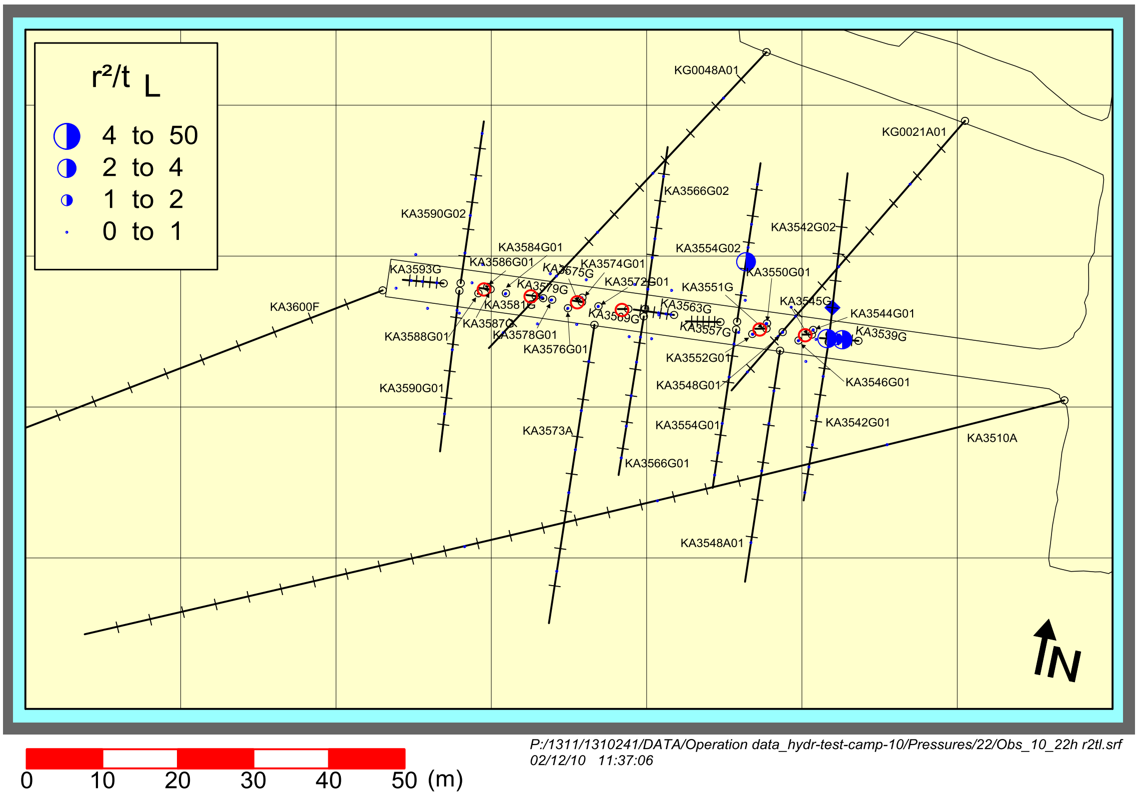


***Figure 6-5** Plot showing r^2/t_L during recovery of KA3542G02:5 (Interference test 10:22) - plan view*

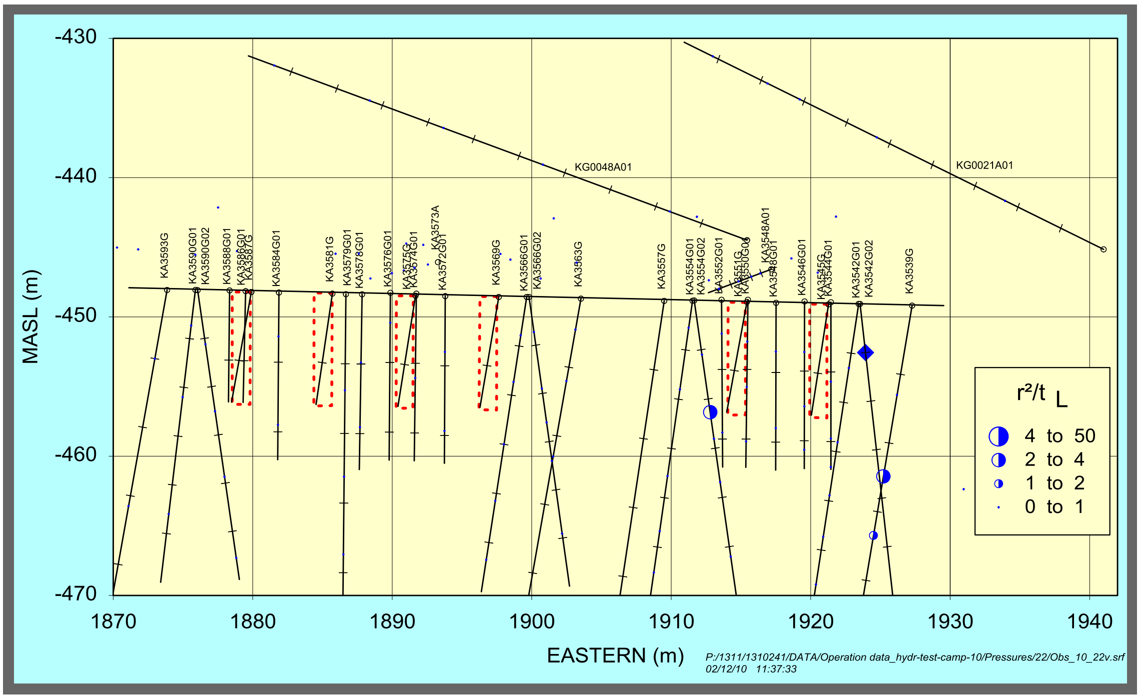


Figure 6-6 *Plot showing r^2/t_L during recovery of KA3542G02:5 (Interference test 10:22) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KG3539G:2.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection between is established between the flow section and KA3554G02:4, KG3539G:3 and KG3539G:1.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $2.3 \cdot 10^{-8} – 7.9 \cdot 10^{-8}$ m^2/s. The transmissivity of the flowing section is evaluated to be $2.4 \cdot 10^{-9}$ m^2/s with the evaluation period 0.7 – 1.3 minutes.

In this test only a few good hydraulic connections are made on the north side of the repository. When compared to an earlier test 5:22, (*Forsmark T, Rhén, I, 2005),* no connection observations are made in KA3590G02:1 and KA3566G02:1 during this test..

Table 6-5 Interference test results for KA3542G02, 2.00 - 8.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response)	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	115.01	-	-	-	-	-	-	0	-0.2	0.0
KA3510A:2	110.00	124.00	117.00	94.98	-	-	-	-	-	-	0	-0.4	0.2
KA3510A:3	75.00	109.00	92.00	70.91	221.35	0.379	6.07E-02	-	-	-	0	-0.4	4.5
KA3510A:4	51.00	74.00	62.50	43.80	221.35	0.144	2.32E-02	-	-	-	0	0.8	1.8
KA3510A:5	4.50	50.00	27.25	21.81	224.96	0.035	5.67E-03	-	-	-	0	0.8	2.0
KA3539G:1	18.60	30.00	24.30	21.01	3.43	2.144	1.14E-01	6.7E-08	2.6E-07	5.9E-07	2	81.5	70.2
KA3539G:2	15.85	17.60	16.73	13.79	3.01	1.053	5.45E-02	7.9E-08	5.7E-07	1.4E-06	2	81.4	70.4
KA3539G:3	10.00	14.85	12.43	9.94	0.75	2.203	8.89E-02	2.8E-08	1.4E-07	3.1E-07	2	126.1	122.6
KA3539G:4	4.00	9.00	6.50	5.75	1.68	0.327	1.52E-02	8.4E-08	1.8E-06	5.5E-06	2	86.1	77.1
KA3542G01:1	27.00	30.00	28.50	29.83	210.84	0.070	1.11E-02	-	-	-	0	0.98	2.2
KA3542G01:2	21.30	26.00	23.65	25.09	138.31	0.076	1.07E-02	-	-	-	1	2.2	3.9
KA3542G01:3	18.60	20.30	19.45	21.03	100.01	0.074	9.45E-03	-	-	-	1	2.7	3.9
KA3542G01:4	10.50	17.60	14.05	15.89	168.02	0.025	3.73E-03	-	-	-	1	1.7	3.7
KA3542G01:5	3.50	9.50	6.50	9.25	506.09	0.003	5.45E-04	-	-	-	1	6.9	18.6
KA3542G02:1	28.20	30.01	29.11	24.11	-	-	-	-	-	-	0	0.2	6.4
KA3542G02:2	25.60	27.20	26.40	21.39	-	-	-	-	-	-	0	0.5	8.8
KA3542G02:3	21.50	24.60	23.05	18.05	-	-	-	-	-	-	1	1.2	2.9
KA3542G02:4	9.00	20.50	14.75	9.75	-	-	-	-	-	-	2	12.3	19.2
KA3542G02:5	**2.00**	**8.00**	**5.00**	**0.00**	-	-	-	**7.3E-09**	-	-	2	1428.0	1424.8
KA3543A01:1	0.65	2.06	1.36	9.77	61.48	0.026	2.87E-03	-	-	-	2	10.0	21.3
KA3543I01:1	0.65	2.06	1.36	10.83	61.48	0.032	3.53E-03	-	-	-	0	-1.6	11.9
KA3544G01:1	11.65	12.00	11.83	9.08	39.68	0.035	3.37E-03	-	-	-	1	9.1	27.7
KA3544G01:2	8.90	10.65	9.78	7.27	43.03	0.020	2.05E-03	-	-	-	1	9.1	27.8
KA3544G01:3	3.50	7.90	5.70	4.38	35.42	0.009	8.53E-04	-	-	-	1	9.3	27.8
KA3546G01:1	9.30	12.00	10.65	9.34	16.80	0.087	6.65E-03	-	-	-	0	-4.2	40.2
KA3546G01:2	6.75	8.30	7.53	7.30	17.93	0.050	3.87E-03	-	-	-	0	-3.2	14.3
KA3546G01:3	1.50	5.75	3.63	6.19	47.43	0.013	1.38E-03	-	-	-	0	-1.2	22.6
KA3548A01:1	21.50	30.00	25.75	33.18	224.96	0.082	1.31E-02	-	-	-	0	0.6	1.8
KA3548A01:2	11.75	20.50	16.13	24.02	217.79	0.044	7.05E-03	-	-	-	1	1.2	2.0
KA3548A01:3	8.80	10.75	9.78	18.24	162.66	0.034	5.03E-03	-	-	-	1	2.7	3.3
KA3548A01:4	3.00	7.80	5.40	14.52	179.28	0.020	2.97E-03	-	-	-	1	1.8	4.3
KA3548D01:1	0.65	2.06	1.36	8.60	87.83	0.014	1.73E-03	-	-	-	1	3.3	23.1
KA3548G01:1	6.00	12.00	9.00	9.03	70.00	0.019	2.24E-03	-	-	-	0	-2.7	15.8
KA3548G01:2	2.00	5.00	3.50	7.20	240.04	0.004	5.89E-04	-	-	-	0	-0.2	1.8
KA3550G01:1	8.30	12.03	10.17	10.89	77.15	0.026	3.04E-03	-	-	-	1	3.9	24.6
KA3550G01:2	5.20	7.30	6.25	9.11	74.69	0.019	2.18E-03	-	-	-	1	4.1	24.5
KA3550G01:3	1.80	4.20	3.00	8.76	74.69	0.017	2.01E-03	-	-	-	1	4.1	24.6
KA3550G05:1	1.50	3.00	2.25	5.51	-	-	-	-	-	-	0	0.0	0.0
KA3551G05:1	1.50	3.10	2.30	10.79	-	-	-	-	-	-	0	0.2	0.4
KA3552A01:1	0.65	2.06	1.36	15.07	-	-	-	-	-	-	0	0.0	0.0
KA3552G01:1	7.05	12.00	9.53	12.28	185.18	0.014	2.08E-03	-	-	-	0	0.2	5.1
KA3552G01:2	4.35	6.05	5.20	10.97	-	-	-	-	-	-	0	0.6	-0.8
KA3552G01:3	1.50	3.35	2.43	10.98	157.46	0.013	1.86E-03	-	-	-	0	-3.9	19.7
KA3552H01:1	0.65	2.10	1.38	15.87	273.29	0.015	2.60E-03	-	-	-	0	-0.2	0.8
KA3553B01:1	0.65	2.02	1.34	12.41	850.31	0.003	6.35E-04	-	-	-	1	2.5	23.7
KA3554G01:1	25.15	30.01	27.58	31.17	217.79	0.074	1.19E-02	-	-	-	0	0.8	1.6
KA3554G01:2	22.60	24.15	23.38	27.43	221.35	0.057	9.08E-03	-	-	-	1	1.0	1.8
KA3554G01:3	14.00	21.60	17.80	22.70	188.21	0.046	7.01E-03	-	-	-	0	0.6	4.1
KA3554G01:4	5.00	13.00	9.00	16.38	217.79	0.021	3.28E-03	-	-	-	0	-0.2	5.1
KA3554G01:5	1.50	4.00	2.75	13.68	162.66	0.019	2.83E-03	-	-	-	0	-1.8	12.7
KA3554G02:1	22.00	30.01	26.01	23.98	106.70	0.090	1.17E-02	-	-	-	2	13.5	17.4
KA3554G02:2	15.90	21.00	18.45	17.81	14.76	0.358	2.66E-02	1.0E-07	2.0E-06	3.8E-06	2	31.5	36.0
KA3554G02:3	13.20	14.90	14.05	14.82	16.80	0.218	1.67E-02	9.0E-08	2.8E-06	5.3E-06	2	31.5	36.0
KA3554G02:4	10.50	12.20	11.35	13.39	1.05	2.844	1.21E-01	2.3E-08	8.4E-08	1.9E-07	2	127.1	123.6
KA3554G02:5	1.50	9.50	5.50	11.89	11.02	0.214	1.47E-02	7.6E-08	3.5E-06	5.2E-06	2	27.6	35.8
KA3557G:1	15.00	30.04	22.52	25.76	-	-	-	-	-	-	0	0.8	-1.2
KA3557G:2	1.50	14.00	7.75	16.18	-	-	-	-	-	-	0	0.6	0.4
KA3563A01:1	0.65	2.06	1.36	24.24	47.43	0.206	2.12E-02	1.2E-07	3.5E-06	5.5E-06	1	3.5	16.0
KA3563D01:1	0.65	2.01	1.33	21.82	54.00	0.147	1.57E-02	4.7E-07	8.6E-06	3.0E-05	0	-1.7	9.6
KA3563G:1	15.00	30.01	22.51	30.42	-	-	-	-	-	-	0	0.2	-1.2
KA3563G:2	10.00	13.00	11.50	23.61	217.79	0.043	6.81E-03	-	-	-	0	0.5	2.0
KA3563G:3	4.00	8.00	6.00	21.55	191.29	0.040	6.24E-03	-	-	-	0	-1.0	6.6
KA3563G:4	1.50	3.00	2.25	20.88	121.48	0.060	8.12E-03	-	-	-	0	-2.7	10.1
KA3563I01:1	0.65	2.15	1.40	24.36	117.60	0.084	1.13E-02	-	-	-	0	-2.2	9.6
KA3566C01:1	0.65	2.1	1.38	27.38	147.58	0.085	1.22E-02	-	-	-	0	-1.5	7.4

Table 6-6 Interference test results for KA3542G02, 2.00 - 8.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m^2/s)	η (m^2/s)	T_{EVAL} (m^2/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	36.84	247.95	0.091	1.51E-02	-	-	-	0	0.2	1.0
KA3566G01:2	20.00	21.50	20.75	32.62	157.46	0.113	1.65E-02	-	-	-	0	-1.7	8.1
KA3566G01:3	12.00	18.00	15.00	29.18	282.30	0.050	8.57E-03	-	-	-	0	-0.5	1.2
KA3566G01:4	7.30	10.00	8.65	26.33	125.48	0.092	1.26E-02	-	-	-	0	-1.2	8.6
KA3566G01:5	1.50	6.30	3.90	25.06	162.66	0.064	9.49E-03	-	-	-	0	-1.7	7.6
KA3566G02:1	19.00	30.10	24.55	30.73	93.72	0.168	2.11E-02	-	-	-	0	-0.5	9.4
KA3566G02:2	16.00	18.00	17.00	26.64	100.01	0.118	1.52E-02	-	-	-	0	-1.0	9.1
KA3566G02:3	12.00	14.00	13.00	25.12	100.01	0.105	1.35E-02	-	-	-	0	-0.5	9.1
KA3566G02:4	8.00	11.00	9.50	24.26	100.01	0.098	1.26E-02	-	-	-	0	-0.7	9.4
KA3566G02:5	1.30	6.00	3.65	23.94	100.01	0.096	1.22E-02	-	-	-	0	-0.7	8.9
KA3568D01:1	0.65	2.30	1.48	26.49	152.44	0.077	1.11E-02	-	-	-	0	-2.2	7.4
KA3572G01:1	7.30	12.03	9.67	30.70	264.57	0.059	9.96E-03	-	-	-	0	0.0	0.7
KA3572G01:2	2.70	5.30	4.00	30.15	197.59	0.077	1.19E-02	1.6E-08	2.3E-06	1.3E-06	0	-1.2	3.9
KA3573A:1	26.00	40.07	33.04	50.08	247.95	0.169	2.78E-02	-	-	-	0	0.0	3.0
KA3573A:2	21.00	24.00	22.50	42.26	224.96	0.132	2.13E-02	-	-	-	0	-1.0	1.7
KA3573A:3	14.50	19.00	16.75	38.54	210.84	0.117	1.86E-02	-	-	-	0	-0.5	2.5
KA3573A:4	10.50	12.50	11.50	35.61	232.38	0.091	1.48E-02	-	-	-	0	-0.7	1.7
KA3573A:5	1.30	8.50	4.90	32.78	224.96	0.080	1.28E-02	-	-	-	0	-0.7	2.0
KA3573C01:1	0.65	2.05	1.35	33.91	221.35	0.087	1.39E-02	-	-	-	0	0.2	2.0
KA3574D01:1	0.65	2.05	1.35	32.84	100.01	0.180	2.30E-02	-	-	-	0	-0.2	5.2
KA3574G01:1	8.00	12.03	10.02	32.87	-	-	-	-	-	-	0	-0.2	-0.2
KA3574G01:2	5.10	7.00	6.05	32.36	204.11	0.085	1.34E-02	-	-	-	0	-0.3	3.4
KA3574G01:3	1.80	4.10	2.95	32.29	-	-	-	-	-	-	0	0.0	0.5
KA3576G01:1	8.00	12.01	10.01	34.62	-	-	-	-	-	-	0	0.0	0.5
KA3576G01:2	4.00	6.00	5.00	34.11	-	-	-	-	-	-	0	0.0	0.2
KA3576G01:3	1.30	3.00	2.15	34.14	191.29	0.102	1.57E-02	-	-	-	0	-0.5	3.7
KA3578C01:1	0.65	2.09	1.37	38.71	247.95	0.101	1.66E-02	-	-	-	0	0.0	1.2
KA3578G01:1	6.50	12.58	9.54	36.65	232.38	0.096	1.56E-02	-	-	-	0	-0.2	2.2
KA3578G01:2	4.30	5.50	4.90	36.19	204.11	0.107	1.68E-02	-	-	-	0	-0.2	3.2
KA3578H01:1	0.65	1.90	1.28	38.84	-	-	-	-	-	-	0	-0.5	0.5
KA3579D01:1	0.65	2.00	1.33	37.29	264.57	0.088	1.47E-02	-	-	-	0	-0.2	1.2
KA3579G:1	14.70	22.65	18.68	40.16	232.38	0.116	1.88E-02	-	-	-	0	0.5	1.5
KA3579G:2	12.50	13.70	13.10	38.45	217.79	0.113	1.81E-02	-	-	-	0	0.0	2.0
KA3579G:3	2.30	11.50	6.90	37.44	232.38	0.101	1.63E-02	-	-	-	0	0.0	2.0
KA3584G01:1	7.00	12.00	9.50	42.48	197.59	0.152	2.37E-02	-	-	-	0	-0.2	3.9
KA3584G01:2	1.30	5.00	3.15	42.14	217.79	0.136	2.17E-02	-	-	-	0	-0.7	2.9
KA3588C01:1	0.65	2.04	1.35	48.57	232.38	0.169	2.75E-02	-	-	-	0	-0.2	2.0
KA3588D01:1	0.65	1.90	1.28	46.00	247.95	0.142	2.35E-02	-	-	-	0	-0.2	1.2
KA3588I01:1	0.65	1.96	1.31	47.68	282.30	0.134	2.29E-02	-	-	-	0	-0.2	1.0
KA3590G01:1	16.00	30.00	23.00	53.17	217.79	0.216	3.45E-02	-	-	-	0	0.2	2.5
KA3590G01:2	7.00	15.00	11.00	49.37	217.79	0.187	2.98E-02	-	-	-	0	0.2	2.2
KA3590G01:3	1.30	6.00	3.65	48.38	240.04	0.163	2.66E-02	-	-	-	0	-0.2	1.2
KA3590G02:1	25.50	30.01	27.76	52.77	117.60	0.395	5.31E-02	-	-	-	0	0.0	8.4
KA3590G02:2	15.20	23.50	19.35	49.82	168.02	0.246	3.67E-02	-	-	-	0	-2.7	7.9
KA3590G02:3	11.90	13.20	12.55	48.39	217.79	0.179	2.86E-02	-	-	-	0	-2.0	3.0
KA3590G02:4	1.30	9.90	5.60	47.87	210.84	0.181	2.87E-02	-	-	-	0	-0.2	2.9
KA3592C01:1	0.65	2.01	1.33	52.66	232.38	0.199	3.23E-02	-	-	-	0	0.0	1.2
KA3593G:1	25.20	30.02	27.61	59.53	-	-	-	-	-	-	0	-0.2	0.2
KA3593G:2	23.50	24.20	23.85	57.59	264.57	0.209	3.51E-02	-	-	-	0	-0.5	1.2
KA3593G:3	9.00	22.50	15.75	54.08	240.04	0.203	3.32E-02	-	-	-	0	0.0	1.5
KA3593G:4	3.00	7.00	5.00	51.06	232.38	0.187	3.04E-02	-	-	-	0	-1.7	2.5
KA3597D01:1	0.65	2.22	1.44	54.64	273.29	0.182	3.08E-02	-	-	-	0	-0.2	1.0
KA3597H01:1	0.65	2.06	1.36	57.22	256.12	0.213	3.55E-02	-	-	-	0	-0.5	1.2
KA3600F:1	43.00	50.10	46.55	102.42	-	-	-	-	-	-	0	-0.5	0.5
KA3600F:2	40.50	42.00	41.25	97.28	-	-	-	-	-	-	0	-0.7	0.2
KA3600F:3	20.00	39.50	29.75	86.21	-	-	-	-	-	-	0	-0.5	0.5
KA3600F:4	1.30	18.00	9.65	67.22	-	-	-	-	-	-	0	-1.2	1.2
KG0021A01:1	42.50	48.82	45.66	25.40	70.00	0.154	1.77E-02	7.1E-08	3.4E-06	4.0E-06	1	7.1	9.6
KG0021A01:2	37.00	41.50	39.25	20.92	45.92	0.159	1.62E-02	2.4E-07	6.7E-06	1.5E-05	1	6.1	8.3
KG0021A01:3	35.00	36.00	35.50	18.82	21.78	0.271	2.23E-02	2.8E-07	3.9E-06	1.2E-05	1	8.6	12.1
KG0021A01:4	19.00	34.00	26.50	16.40	13.83	0.324	2.37E-02	2.9E-07	3.8E-06	1.2E-05	1	9.1	13.0
KG0021A01:5	5.00	18.00	11.50	22.06	152.44	0.053	7.70E-03	-	-	-	1	1.7	5.2
KG0048A01:1	49.00	54.69	51.85	47.24	70.00	0.531	6.13E-02	6.9E-08	9.9E-07	1.1E-06	0	0.7	2.0
KG0048A01:2	34.8	48	41.40	40.10	204.11	0.131	2.06E-02	-	-	-	0	0.7	2.5
KG0048A01:3	32.80	33.80	33.30	35.70	70.00	0.304	3.50E-02	6.9E-07	4.8E-06	2.0E-05	1	1.7	5.2
KG0048A01:4	13.00	31.80	22.40	32.15	59.52	0.289	3.18E-02	3.3E-07	2.1E-06	1.0E-05	1	2.0	8.6
KG0048A01:5	5.00	12.00	8.50	32.71	224.96	0.079	1.28E-02	-	-	-	0	-0.5	4.4

6.2.3 Test 10:23 – KA3554G01:2

General test data for the pressure build-up test in the interval 22.60-24.15 m of borehole KA3554G01 are presented in Table 6-7.

Table 6-7 General test data for the pressure build-up test in section 22.60-24.15 m of borehole KA3554G01

General test data			
Borehole section	KA3554G01:2		
Test No	10:23		
Field crew	A. Blom (SWECO Environment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	22.60
Test section- seclow	Seclow	m	24.15
Test section length	L_w	m	1.55
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm:ss	20091117 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091117 08:00:00
Stop of flow period		yymmdd hh:mm:ss	20091117 14:00:00
Test stop (stop of pressure registration)		yymmdd hh:mm:ss	20091118 08:00:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	2083	
Absolute pressure in test section before stop of flow	p_p	kPa	246	
Max absolute pressure in test section during recovery period	p_f	kPa	2078	
Maximal pressure change during flow period	dp_p	kPa	1837	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.25 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.29 \cdot 10^{-5}$
Total volume discharged during flow period	V_p	m^3	0.279

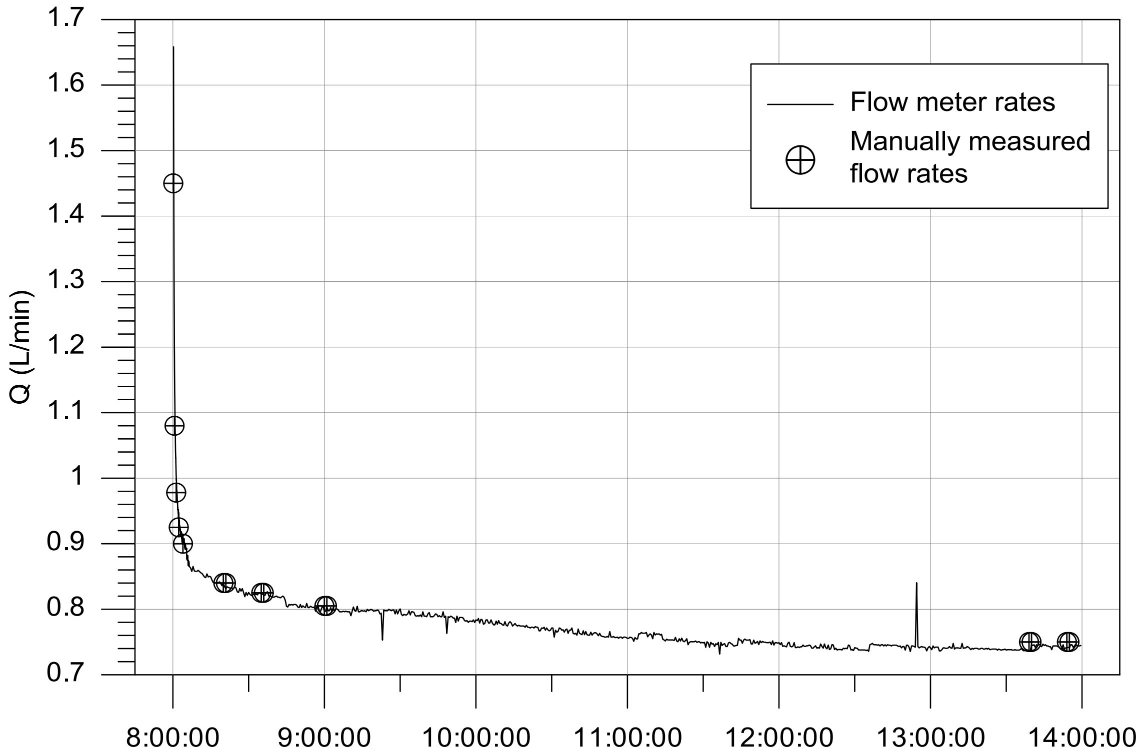


***Figure 6-7** Flow rates during draw down in KA3554G01:2. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.3	minutes	Well Bore Storage (WBS)
0.3 – 9	minutes	Transition period
9 – 13	minutes	Radial flow period
13 –		Transition period

Calculated parameters

Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

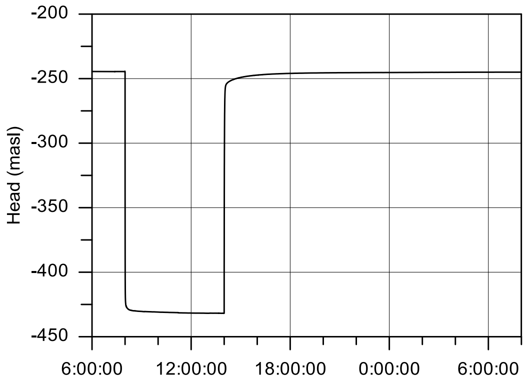
Selected representative parameters

The selected representative parameters from the test in the interval 22.60-24.15 m in KA3554G01 are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

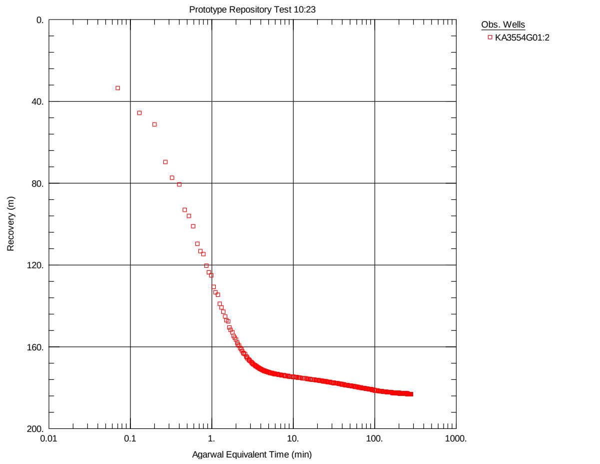
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:23
Borehole ID:	KA3554G01	Test start:	2009-11-17 07:30
Test section (m):	22.60-24.15	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head

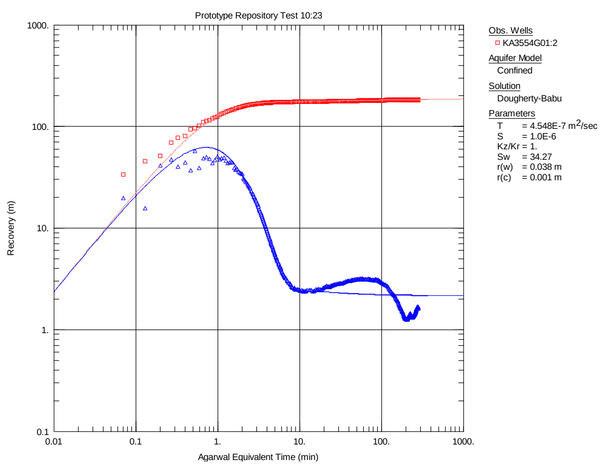


Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	2083		
p_i (kPa)			
p_p(kPa)	246	p_F (kPa)	2078
Q_p (m^3/s)	$1.25 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2
Results		**Results**	
Q/s (m^2/s)	$7.7 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$6.8 \cdot 10^{-8}$	dt_{e1} (min)	9
Flow regime:		dt_{e2} (min)	13
dt_1 (min)		T (m^2/s)	$4.5 \cdot 10^{-7}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	34
C_D (-)			
ξ (-)			

Lin-Log plot



Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	9	C_D (-)	
dt_2 (min)	13	ξ (-)	34
T_T (m^2/s)	$4.5 \cdot 10^{-7}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: The test was successful in regard to pressure response.

The test was carried out in KA3554G01, section 22.60 - 24.15 metres. The flow period was for 360 minutes with a final flow of 0.75 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-8 and Figure 6-9 the r^2/t_L recordings are shown and in Table 6-8 and Table 6-9 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 3.

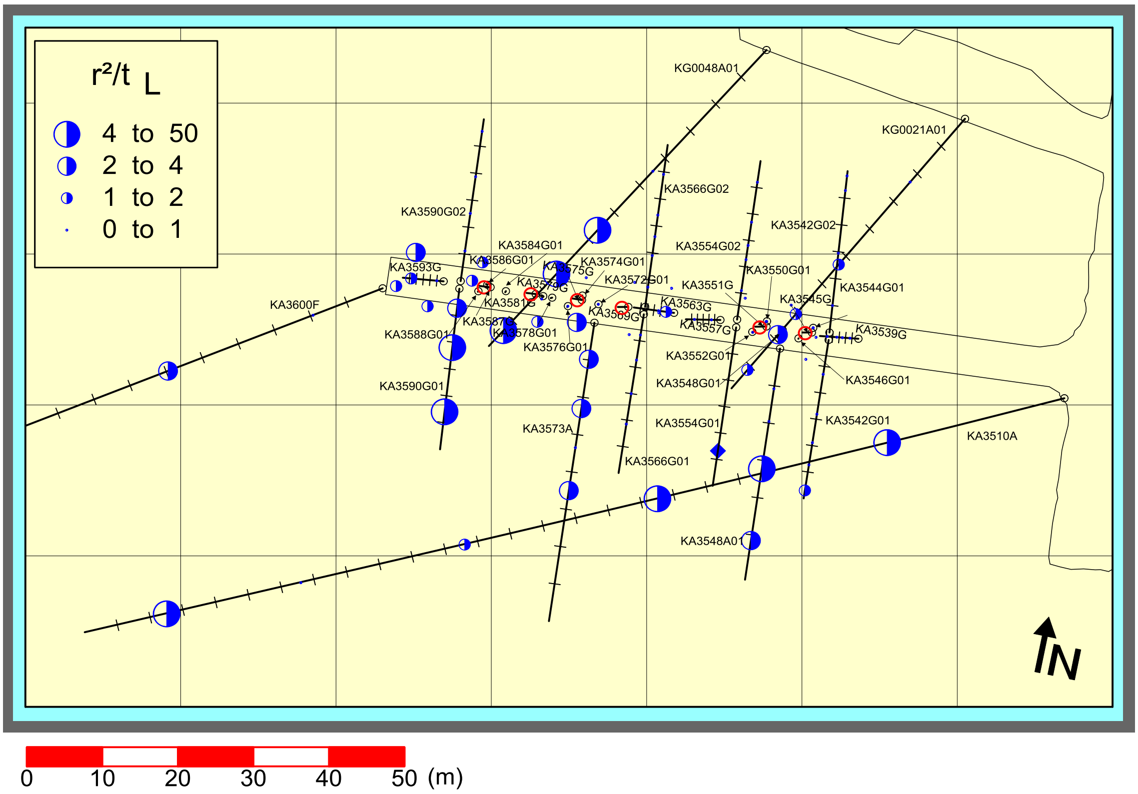


__Figure 6-8__ Plot showing r^2/t_L during recovery of KA3554G01:2 (Interference test 10:23) - plan view

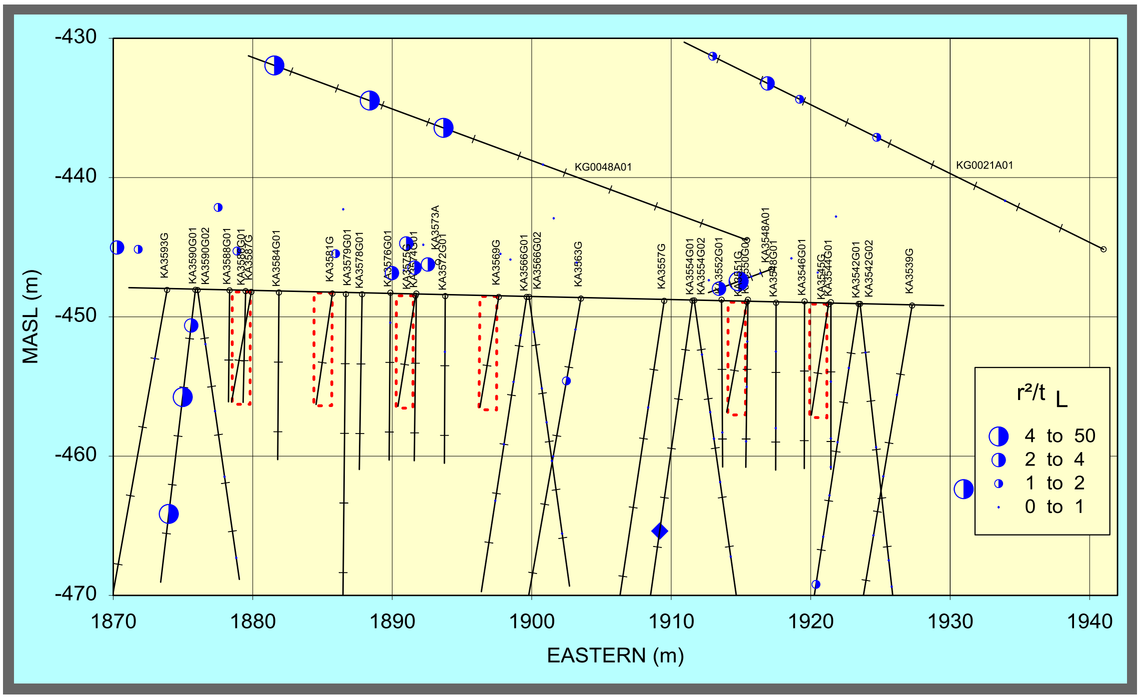


Figure 6-9 *Plot showing r^2/t_L during recovery of KA3554G01:2 (Interference test 10:23) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KG0021A01:1,2&4, KA3597H01:1, KA3593G:2, KA3592C01, KA3588I01:1, KA3588D01:1, KA3578C01:1, KA3563G:3, KA3542G01:1 and KA3510A:3.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3600F:3, KA3597D01:1, KA3590G01:3, KA3573C01:1, KA3573A:2,4&5 and KA3548A01:1 .

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KG0048A01:1-3, KG0021A01:2, KA3590G01:1&2, KA3588C01:1, KA3548A01:2 and KA3510:1,4&5.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $2.5 \cdot 10^{-7} – 1.2 \cdot 10^{-5}$ m^2/s. The transmissivity of the flowing section is evaluated to be $4.3 \cdot 10^{-7}$ m^2/s with the evaluation period 9 – 13 minutes.

In this test a section on the south side is the flow section. Noteworthy hydraulic connections are with the sections on KG0021A01 and KG0048A01, indicating features with also a vertical extension upwards. Also worth to note is the lack of hydraulic connection between the flow section and one of the closest located boreholes, KA3566G01. Apparently the horizontal extension is not a continuous one, but rather a set of interconnecting features wandering up and down in the vertical direction.

When compared to an earlier test 5:23, (*Forsmark T, Rhén, I, 2005),* the overall connection figure is the same.

Table 6-8 Interference test results for KA3554G01, 22.60 - 24.15 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response)	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	90.63	9.37	14.608	9.69E-01	1.2E-05	6.1E-07	1.3E-05	1	3.1	2.5
KA3510A:2	110.00	124.00	117.00	70.28	142.87	0.576	8.20E-02	-	-	-	1	2.2	1.4
KA3510A:3	75.00	109.00	92.00	45.63	20.41	1.700	1.38E-01	3.3E-07	1.7E-06	2.4E-06	2	40.7	37.6
KA3510A:4	51.00	74.00	62.50	17.77	0.68	7.763	3.09E-01	2.1E-06	1.0E-06	6.8E-06	2	113.5	107.6
KA3510A:5	4.50	50.00	27.25	22.02	1.14	7.101	3.07E-01	1.8E-06	6.4E-07	6.0E-06	2	113.7	107.8
KA3539G:1	18.60	30.00	24.30	22.09	54.00	0.151	1.61E-02	3.8E-07	1.7E-05	2.3E-05	2	20.1	16.7
KA3539G:2	15.85	17.60	16.73	21.48	57.62	0.134	1.45E-02	6.7E-07	3.5E-05	4.6E-05	2	19.9	16.4
KA3539G:3	10.00	14.85	12.43	22.30	63.51	0.131	1.46E-02	3.8E-07	2.8E-05	2.6E-05	2	18.6	15.2
KA3539G:4	4.00	9.00	6.50	24.66	54.00	0.188	2.00E-02	8.7E-07	2.9E-05	4.4E-05	2	19.4	15.7
KA3542G01:1	27.00	30.00	28.50	12.95	1.57	1.775	8.13E-02	3.4E-07	1.8E-06	4.2E-06	2	112.0	107.3
KA3542G01:2	21.30	26.00	23.65	11.87	4.59	0.512	2.89E-02	5.4E-07	8.3E-06	1.9E-05	2	100.9	96.5
KA3542G01:3	18.60	20.30	19.45	12.48	5.76	0.451	2.67E-02	5.2E-07	9.4E-06	1.9E-05	2	98.9	94.0
KA3542G01:4	10.50	17.60	14.05	15.06	4.74	0.797	4.53E-02	5.2E-07	5.9E-06	1.1E-05	2	100.7	96.1
KA3542G01:5	3.50	9.50	6.50	20.59	17.36	0.407	3.15E-02	5.2E-06	3.1E-05	1.6E-04	1	4.9	4.2
KA3542G02:1	28.20	30.01	29.11	40.24	264.57	0.102	1.71E-02	-	-	-	1	4.4	1.5
KA3542G02:2	25.60	27.20	26.40	38.26	256.12	0.095	1.58E-02	-	-	-	1	5.9	2.2
KA3542G02:3	21.50	24.60	23.05	35.95	-	-	-	-	-	-	1	1.5	0.5
KA3542G02:4	9.00	20.50	14.75	31.03	232.38	0.069	1.12E-02	-	-	-	2	10.3	6.6
KA3542G02:5	2.00	8.00	5.00	27.43	72.30	0.173	2.02E-02	3.1E-07	1.6E-05	1.6E-05	2	18.9	15.5
KA3543A01:1	0.65	2.06	1.36	24.89	157.46	0.066	9.59E-03	6.7E-07	7.6E-05	7.0E-05	1	4.7	4.3
KA3543I01:1	0.65	2.06	1.36	29.93	100.00	0.149	1.91E-02	9.3E-07	1.9E-05	4.9E-05	0	-0.8	5.5
KA3544G01:1	11.65	12.00	11.83	20.91	256.12	0.028	4.74E-03	-	-	-	1	2.2	1.7
KA3544G01:2	8.90	10.65	9.78	21.46	256.12	0.030	4.99E-03	-	-	-	1	2.2	1.7
KA3544G01:3	3.50	7.90	5.70	23.05	256.12	0.035	5.75E-03	-	-	-	1	2.2	1.7
KA3546G01:1	9.30	12.00	10.65	19.03	-	-	-	-	-	-	0	-0.5	-1.0
KA3546G01:2	6.75	8.30	7.53	20.22	-	-	-	-	-	-	0	0.2	-0.2
KA3546G01:3	1.50	5.75	3.63	22.23	-	-	-	-	-	-	1	2.9	8.6
KA3548A01:1	21.50	30.00	25.75	21.50	2.82	2.729	1.39E-01	3.8E-07	8.7E-07	2.7E-06	2	85.0	80.5
KA3548A01:2	11.75	20.50	16.13	18.95	0.70	8.550	3.42E-01	1.0E-06	8.6E-07	3.0E-06	2	103.4	98.7
KA3548A01:3	8.80	10.75	9.78	19.80	10.33	0.633	4.30E-02	5.9E-07	3.5E-06	1.4E-05	2	96.9	92.2
KA3548A01:4	3.00	7.80	5.40	21.50	14.76	0.522	3.88E-02	2.9E-07	5.0E-06	7.5E-06	2	80.6	75.3
KA3548D01:1	0.65	2.06	1.36	29.08	256.12	0.055	9.15E-03	-	-	-	1	1.6	1.6
KA3548G01:1	6.00	12.00	9.00	19.46	17.93	0.352	2.75E-02	2.5E-06	2.8E-05	9.1E-05	1	4.5	10.2
KA3548G01:2	2.00	5.00	3.50	22.16	70.00	0.117	1.35E-02	8.4E-06	8.4E-05	6.3E-04	1	1.4	1.4
KA3550G01:1	8.30	12.03	10.17	19.31	256.12	0.024	4.04E-03	-	-	-	1	1.8	1.4
KA3550G01:2	5.20	7.30	6.25	20.98	264.57	0.028	4.65E-03	-	-	-	1	1.6	1.4
KA3550G01:3	1.80	4.20	3.00	22.78	264.57	0.033	5.48E-03	-	-	-	1	1.8	1.4
KA3550G05:1	1.50	3.00	2.25	23.83	-	-	-	-	-	-	0	-0.8	-0.8
KA3551G05:1	1.50	3.10	2.30	22.49	-	-	-	-	-	-	0	0.0	0.0
KA3552A01:1	0.65	2.06	1.36	23.11	-	-	-	-	-	-	0	-0.8	-0.6
KA3552G01:1	7.05	12.00	9.53	17.80	17.93	0.294	2.30E-02	3.5E-06	3.5E-05	1.5E-04	1	3.9	5.5
KA3552G01:2	4.35	6.05	5.20	19.94	-	-	-	-	-	-	0	-2.0	0.2
KA3552G01:3	1.50	3.35	2.43	21.65	-	-	-	-	-	-	0	0.4	0.6
KA3552H01:1	0.65	2.10	1.38	27.77	-	-	-	-	-	-	0	0.6	1.2
KA3553B01:1	0.65	2.02	1.34	27.31	264.57	0.047	7.88E-03	-	-	-	1	1.4	1.2
KA3554G01:1	25.15	30.01	27.58	4.19	-	-	-	-	-	-	2	116.4	111.9
KA3554G01:2	**22.60**	**24.15**	**23.38**	**0.00**	-	-	-	**4.5E-07**	-	-	2	1836.9	1832.4
KA3554G01:3	14.00	21.60	17.80	5.59	-	-	-	-	-	-	2	105.0	99.9
KA3554G01:4	5.00	13.00	9.00	14.39	-	-	-	-	-	-	2	83.9	78.5
KA3554G01:5	1.50	4.00	2.75	20.64	-	-	-	-	-	-	2	26.8	23.7
KA3554G02:1	22.00	30.01	26.01	36.00	157.46	0.137	2.01E-02	-	-	-	2	14.9	10.6
KA3554G02:2	15.90	21.00	18.45	30.81	168.02	0.094	1.40E-02	-	-	-	2	14.5	10.4
KA3554G02:3	13.20	14.90	14.05	28.28	168.02	0.079	1.18E-02	-	-	-	2	14.5	10.4
KA3554G02:4	10.50	12.20	11.35	26.97	65.60	0.185	2.09E-02	5.2E-07	2.3E-05	2.5E-05	2	18.6	14.9
KA3554G02:5	1.50	9.50	5.50	24.92	185.18	0.056	8.54E-03	-	-	-	2	12.7	7.8
KA3557G:1	15.00	30.04	22.52	18.58	44.45	0.129	1.30E-02	-	-	-	0	0.4	-0.6
KA3557G:2	1.50	14.00	7.75	19.51	142.87	0.044	6.32E-03	-	-	-	1	1.4	0.6
KA3563A01:1	0.65	2.06	1.36	25.11	-	-	-	-	-	-	2	15.0	-6.2
KA3563D01:1	0.65	2.01	1.33	29.52	232.38	0.062	1.01E-02	-	-	-	1	7.4	3.0
KA3563G:1	15.00	30.01	22.51	21.80	-	-	-	-	-	-	0	0.0	-0.7
KA3563G:2	10.00	13.00	11.50	20.77	70.00	0.103	1.18E-02	-	-	-	1	2.7	3.0
KA3563G:3	4.00	8.00	6.00	22.37	4.23	1.969	1.09E-01	8.7E-07	2.8E-06	8.0E-06	2	56.5	51.4
KA3563G:4	1.50	3.00	2.25	24.12	61.48	0.158	1.75E-02	1.7E-06	4.8E-05	9.5E-05	2	13.5	8.9
KA3563I01:1	0.65	2.15	1.40	29.94	77.15	0.194	2.30E-02	1.2E-06	3.6E-05	5.1E-05	2	12.8	7.6
KA3566C01:1	0.65	2.1	1.38	27.64	50.61	0.252	2.63E-02	5.2E-07	1.7E-05	2.0E-05	2	17.7	12.3

Table 6-9 Interference test results for KA3554G01, 22.60 - 24.15 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	12.63	-	-	-	-	-	-	1	5.7	2.0
KA3566G01:2	20.00	21.50	20.75	12.50	70.00	0.037	4.29E-03	1.3E-06	1.9E-04	3.1E-04	2	13.5	8.1
KA3566G01:3	12.00	18.00	15.00	14.87	6.15	0.599	3.60E-02	1.8E-06	1.5E-05	5.1E-05	2	35.9	34.2
KA3566G01:4	7.30	10.00	8.65	19.22	65.60	0.094	1.06E-02	1.7E-06	8.6E-05	1.6E-04	2	13.5	8.4
KA3566G01:5	1.50	6.30	3.90	23.08	77.15	0.115	1.37E-02	1.6E-06	6.6E-05	1.1E-04	2	13.3	7.6
KA3566G02:1	19.00	30.10	24.55	37.30	85.03	0.273	3.33E-02	-	-	-	2	13.3	7.6
KA3566G02:2	16.00	18.00	17.00	32.57	106.70	0.166	2.17E-02	-	-	-	2	12.6	7.1
KA3566G02:3	12.00	14.00	13.00	30.53	85.03	0.183	2.23E-02	1.4E-06	3.9E-05	6.4E-05	2	12.8	7.4
KA3566G02:4	8.00	11.00	9.50	29.08	77.15	0.183	2.17E-02	1.4E-06	4.2E-05	6.5E-05	2	13.0	7.6
KA3566G02:5	1.30	6.00	3.65	27.50	77.15	0.163	1.94E-02	1.4E-06	4.7E-05	7.3E-05	2	13.0	7.6
KA3568D01:1	0.65	2.30	1.48	31.50	100.00	0.165	2.12E-02	6.7E-07	3.1E-05	3.2E-05	2	12.1	6.9
KA3572G01:1	7.30	12.03	9.67	25.80	-	-	-	-	-	-	0	0.7	-0.7
KA3572G01:2	2.70	5.30	4.00	27.93	162.66	0.080	1.18E-02	-	-	-	1	7.6	4.2
KA3573A:1	26.00	40.07	33.04	31.70	-	-	-	-	-	-	0	0.2	0.7
KA3573A:2	21.00	24.00	22.50	27.19	4.90	2.515	1.44E-01	1.3E-06	3.0E-06	9.2E-06	2	36.1	26.6
KA3573A:3	14.50	19.00	16.75	26.22	27.33	0.419	3.67E-02	7.2E-07	1.4E-05	2.0E-05	2	22.9	16.7
KA3573A:4	10.50	12.50	11.50	26.42	3.66	3.180	1.71E-01	1.9E-06	2.6E-06	1.1E-05	2	36.3	28.0
KA3573A:5	1.30	8.50	4.90	28.10	4.17	3.159	1.75E-01	1.7E-06	2.6E-06	9.6E-06	2	36.1	27.8
KA3573C01:1	0.65	2.05	1.35	32.35	6.15	2.837	1.71E-01	4.6E-07	1.5E-06	2.7E-06	2	51.6	48.4
KA3574D01:1	0.65	2.05	1.35	35.16	224.96	0.092	1.47E-02	-	-	-	1	5.4	2.9
KA3574G01:1	8.00	12.03	10.02	27.93	-	-	-	-	-	-	0	0.0	0.0
KA3574G01:2	5.10	7.00	6.05	29.17	-	-	-	-	-	-	1	2.2	-0.5
KA3574G01:3	1.80	4.10	2.95	30.46	-	-	-	-	-	-	0	0.0	0.2
KA3576G01:1	8.00	12.01	10.01	28.10	-	-	-	-	-	-	0	0.0	0.0
KA3576G01:2	4.00	6.00	5.00	29.78	-	-	-	-	-	-	0	0.2	0.0
KA3576G01:3	1.30	3.00	2.15	31.05	59.52	0.270	2.97E-02	2.0E-06	3.1E-05	6.6E-05	1	9.8	6.6
KA3578C01:1	0.65	2.09	1.37	35.06	14.76	1.388	1.03E-01	9.9E-07	4.7E-06	9.6E-06	2	19.2	18.9
KA3578G01:1	6.50	12.58	9.54	30.46	-	-	-	-	-	-	0	1.0	1.0
KA3578G01:2	4.30	5.50	4.90	31.88	-	-	-	-	-	-	1	2.2	0.2
KA3578H01:1	0.65	1.90	1.28	38.12	26.46	0.915	7.95E-02	4.9E-07	4.4E-06	6.1E-06	2	18.4	20.9
KA3579D01:1	0.65	2.00	1.33	37.77	-	-	-	-	-	-	0	-0.2	0.7
KA3579G:1	14.70	22.65	18.68	30.68	-	-	-	-	-	-	0	0.5	-0.2
KA3579G:2	12.50	13.70	13.10	30.83	-	-	-	-	-	-	0	0.5	-0.7
KA3579G:3	2.30	11.50	6.90	32.15	-	-	-	-	-	-	0	0.5	0.5
KA3584G01:1	7.00	12.00	9.50	35.36	-	-	-	-	-	-	0	1.0	-0.2
KA3584G01:2	1.30	5.00	3.15	37.26	-	-	-	-	-	-	1	2.5	2.2
KA3588C01:1	0.65	2.04	1.35	42.96	0.20	150.705	5.04E+00	2.5E-07	1.7E-06	5.1E-08	2	33.7	33.2
KA3588D01:1	0.65	1.90	1.28	44.11	23.24	1.396	1.17E-01	9.9E-07	4.3E-06	8.5E-06	2	12.8	13.0
KA3588I01:1	0.65	1.96	1.31	45.28	17.93	1.906	1.49E-01	9.9E-07	3.3E-06	6.7E-06	2	13.8	14.8
KA3590G01:1	16.00	30.00	23.00	35.60	4.45	4.752	2.66E-01	3.0E-07	6.9E-07	1.1E-06	2	78.5	74.3
KA3590G01:2	7.00	15.00	11.00	38.07	3.90	6.187	3.37E-01	3.1E-07	5.8E-07	9.2E-07	2	78.7	74.6
KA3590G01:3	1.30	6.00	3.65	41.27	12.55	2.262	1.61E-01	5.9E-07	2.6E-06	3.7E-06	2	28.6	27.6
KA3590G02:1	25.50	30.01	27.76	52.13	96.81	0.468	5.94E-02	-	-	-	2	23.8	19.2
KA3590G02:2	15.20	23.50	19.35	48.04	191.29	0.201	3.10E-02	-	-	-	2	14.8	9.8
KA3590G02:3	11.90	13.20	12.55	45.61	256.12	0.135	2.25E-02	-	-	-	1	5.2	2.2
KA3590G02:4	1.30	9.90	5.60	44.08	217.79	0.149	2.37E-02	-	-	-	1	2.5	2.5
KA3592C01:1	0.65	2.01	1.33	46.63	34.29	1.057	9.88E-02	9.9E-07	5.7E-06	1.0E-05	2	11.1	11.6
KA3593G:1	25.20	30.02	27.61	47.27	-	-	-	-	-	-	0	0.2	0.2
KA3593G:2	23.50	24.20	23.85	46.04	19.76	1.788	1.43E-01	4.6E-07	2.3E-06	3.2E-06	2	29.5	28.0
KA3593G:3	9.00	22.50	15.75	44.37	-	-	-	-	-	-	1	1.5	0.5
KA3593G:4	3.00	7.00	5.00	44.40	217.79	0.151	2.41E-02	-	-	-	1	7.1	4.9
KA3597D01:1	0.65	2.22	1.44	51.18	18.52	2.357	1.86E-01	9.3E-07	2.5E-06	5.0E-06	2	13.5	14.2
KA3597H01:1	0.65	2.06	1.36	52.32	26.46	1.725	1.50E-01	5.0E-07	2.3E-06	3.4E-06	2	19.9	19.9
KA3600F:1	43.00	50.10	46.55	88.48	-	-	-	-	-	-	1	3.4	2.5
KA3600F:2	40.50	42.00	41.25	83.83	-	-	-	-	-	-	1	3.4	2.5
KA3600F:3	20.00	39.50	29.75	74.05	36.59	2.498	2.38E-01	2.3E-06	3.7E-06	9.7E-06	1	7.4	6.6
KA3600F:4	1.30	18.00	9.65	58.49	173.55	0.328	4.93E-02	-	-	-	2	14.0	9.3
KG0021A01:1	42.50	48.82	45.66	35.94	17.93	1.201	9.38E-02	2.0E-07	1.8E-06	2.1E-06	2	60.0	55.9
KG0021A01:2	37.00	41.50	39.25	36.46	7.23	3.065	1.91E-01	5.4E-07	1.5E-06	2.8E-06	2	59.4	54.7
KG0021A01:3	35.00	36.00	35.50	37.28	17.93	1.292	1.01E-01	4.0E-07	2.7E-06	4.0E-06	2	43.3	38.4
KG0021A01:4	19.00	34.00	26.50	40.63	19.76	1.392	1.12E-01	3.8E-07	2.4E-06	3.4E-06	2	40.6	35.9
KG0021A01:5	5.00	18.00	11.50	49.43	240.04	0.170	2.78E-02	-	-	-	1	5.9	3.4
KG0048A01:1	49.00	54.69	51.85	46.20	1.00	35.579	1.51E+00	4.3E-07	1.5E-07	2.8E-07	2	97.7	92.8
KG0048A01:2	34.8	48	41.40	44.01	6.35	5.082	3.08E-01	4.1E-07	7.1E-07	1.3E-06	2	58.4	54.5
KG0048A01:3	32.80	33.80	33.30	43.96	5.06	6.365	3.67E-01	4.4E-07	5.5E-07	1.2E-06	2	67.4	62.7
KG0048A01:4	13.00	31.80	22.40	46.21	39.04	0.911	8.84E-02	3.3E-07	3.4E-06	3.7E-06	2	30.8	26.4
KG0048A01:5	5.00	12.00	8.50	52.32	-	-	-	-	-	-	1	4.7	1.7

6.2.4 Test 10:24 – KA3590G02:1

General test data for the pressure build-up test in the interval 25.50-30.01 m of borehole KA3590G02 are presented in Table 6-10.

Table 6-10 General test data for the pressure build-up test in section 25.50-30.01 m of borehole KA3590G02

General test data			
Borehole section	KA3590G02:1		
Test No	10:24		
Field crew	A. Blom (SWECO Environment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	25.50
Test section- seclow	Seclow	m	30.01
Test section length	L_w	m	4.51
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm:ss	20091119 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091119 08:10:00
Stop of flow period		yymmdd hh:mm:ss	20091119 14:10:00
Test stop (stop of pressure registration)		yymmdd hh:mm:ss	20091120 08:10:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	2302	
Absolute pressure in test section before stop of flow	p_p	kPa	482	
Max absolute pressure in test section during recovery period	p_f	kPa	2316	
Maximal pressure change during flow period	dp_p	kPa	1820	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.083 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.167 \cdot 10^{-5}$
Total volume discharged during flow period	V_p	m^3	0.252

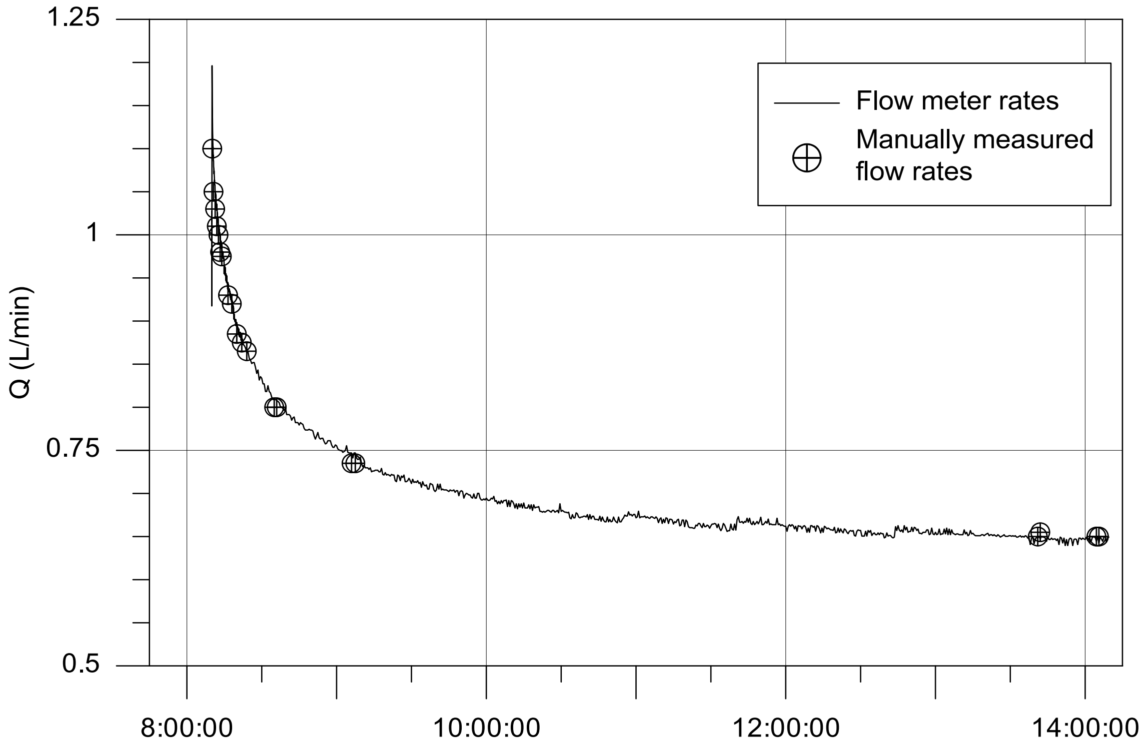


Figure 6-10 *Flow rates during drawdown in KA3590G02:1. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.15	minutes	Well Bore Storage (WBS)
0.15 – 0.4	minutes	Transition period
0.4 – 0.9	minutes	Radial flow period
0.9 – 9	minutes	Linear channel flow period
9 – 300	minutes	Transition period followed possibly by a positive boundary or high conductivity feature

Calculated parameters

Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

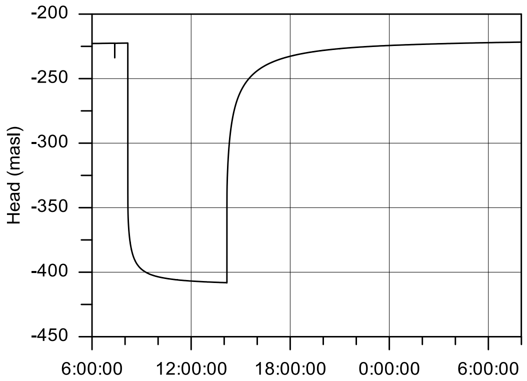
Selected representative parameters

The selected representative parameters from the test in the interval 25.50-30.01 m in KA3590G02 are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

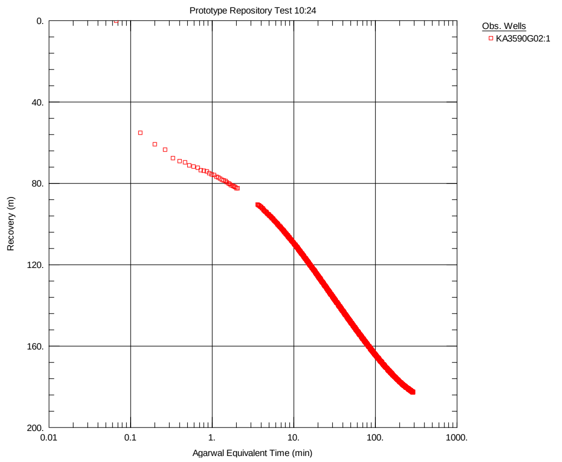
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:24
Borehole ID:	KA3590G02	Test start:	2009-11-19 07:30
Test section (m):	25.50-30.01	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head



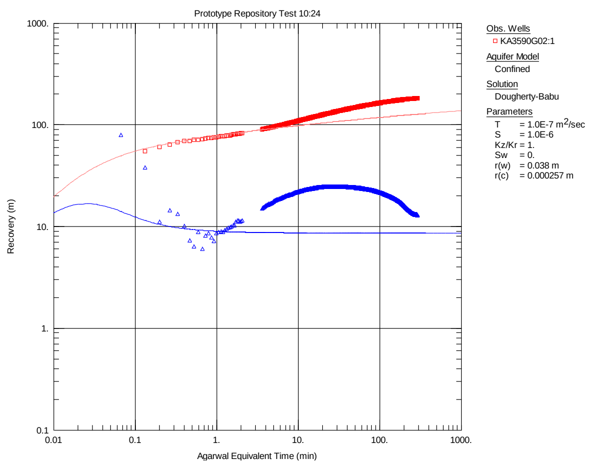
Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	2302		
p_i (kPa)			
p_p(kPa)	482	p_F (kPa)	2316
Q_p (m^3/s)	$1.08 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$5.9 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$4.8 \cdot 10^{-8}$	dt_{e1} (min)	0.4
Flow regime:		dt_{e2} (min)	0.9
dt_1 (min)		T (m^2/s)	$1.0 \cdot 10^{-7}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	0
C_D (-)			
ξ (-)			

Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.4	C_D (-)	
dt_2 (min)	0.9	ξ (-)	0
T_T (m^2/s)	$1.0 \cdot 10^{-7}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: A linear flow phase occurs during this test.

The test was carried out in KA3590G02, section 25.50 - 30.01 metres. The flow period was for 360 minutes with a final flow of 0.98 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-11 and Figure 6-12 the r^2/t_L recordings are shown and in Table 6-11 and Table 6-12 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 4.

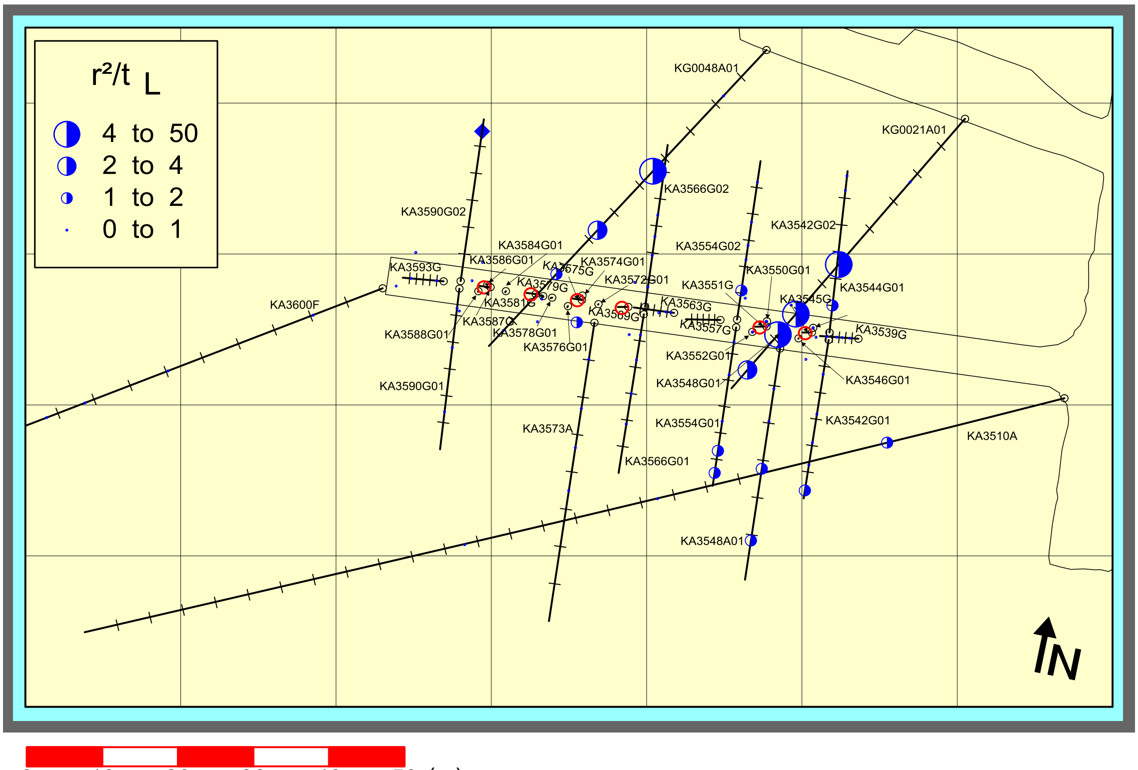


Figure 6-11 Plot showing r^2/t_L during recovery of KA3590G02:1 (Interference test 10:24) - plan view

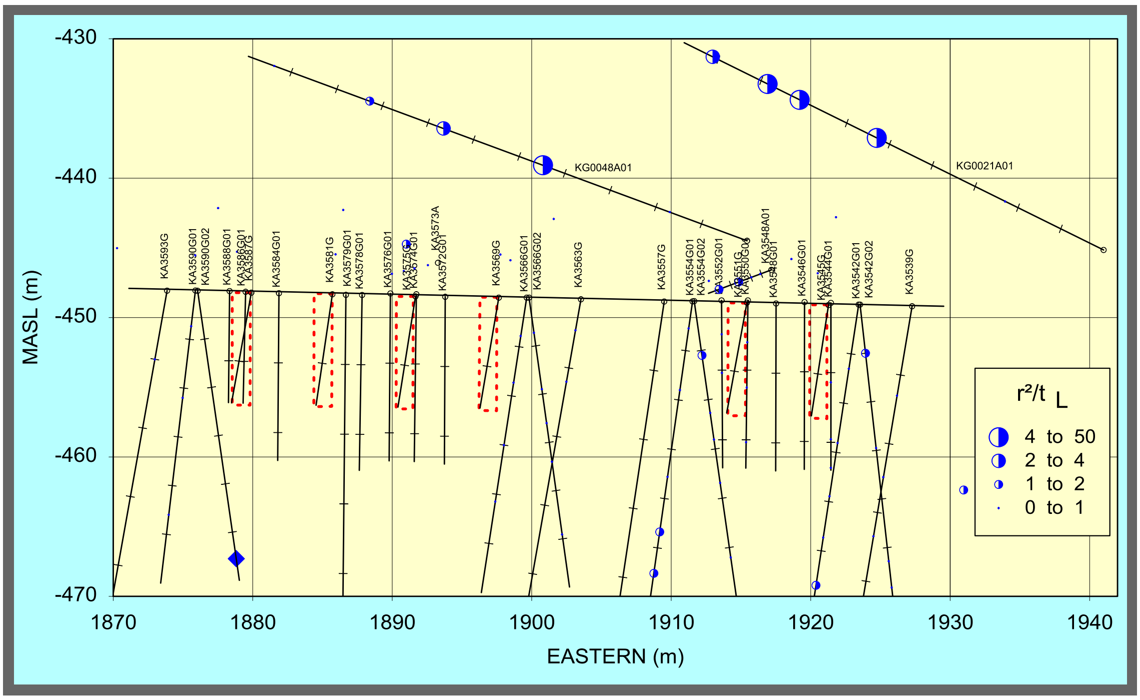


Figure 6-12 *Plot showing r^2/t_L during recovery of KA3590G02:1 (Interference test 10:24) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3573C01:1, KA3554G02:5, KA3554G01:1&2, KA3548A01:1&2, KA3542G02:5, KA3542G01:1, KA3510A:5 and KG0048A01:2.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KG0021A01:1 and KG0048A01:3.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KG0021A01:2-4 and KG0048A01:4.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $4.7 \cdot 10^{-8} – 2.6 \cdot 10^{-7}$ m^2/s. The transmissivity of the flowing section is evaluated to be $1.0 \cdot 10^{-7}$ m^2/s with the evaluation period 0.4 – 0.9 minutes.

The flow section is as indicated in earlier tests located in connection with the northern system of hydraulic features. It is in very good hydraulic connection with some of the sections of KG0021A01 and KG0048A01. This is an indication of the vertical extension of the hydraulic features system.

When compared to an earlier test 5:24, (*Forsmark T, Rhén, I, 2005)*, the overall figure is similar but this time with lesser connection observations in KA3554G02 and KA3566G02.

Table 6-11 Interference test results for KA3590G02, 25.50 - 30.01 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	90.83	-	-	-	-	-	-	0	0.8	0.6
KA3510A:2	110.00	124.00	117.00	75.59	-	-	-	-	-	-	1	1.0	0.8
KA3510A:3	75.00	109.00	92.00	61.30	113.85	0.550	7.33E-02	-	-	-	1	8.8	9.2
KA3510A:4	51.00	74.00	62.50	55.15	65.60	0.773	8.74E-02	-	-	-	2	23.1	23.3
KA3510A:5	4.50	50.00	27.25	66.67	65.60	1.129	1.28E-01	-	-	-	2	23.1	23.3
KA3539G:1	18.60	30.00	24.30	52.41	121.48	0.377	5.12E-02	-	-	-	2	26.5	33.1
KA3539G:2	15.85	17.60	16.73	53.23	117.60	0.401	5.40E-02	-	-	-	2	27.0	33.4
KA3539G:3	10.00	14.85	12.43	54.16	85.03	0.575	7.02E-02	-	-	-	2	32.4	39.0
KA3539G:4	4.00	9.00	6.50	55.96	113.85	0.458	6.11E-02	-	-	-	2	26.8	33.9
KA3542G01:1	27.00	30.00	28.50	63.20	47.43	1.404	1.44E-01	-	-	-	2	25.5	25.8
KA3542G01:2	21.30	26.00	23.65	61.04	74.69	0.831	9.77E-02	-	-	-	2	23.8	24.3
KA3542G01:3	18.60	20.30	19.45	59.42	74.69	0.788	9.26E-02	-	-	-	2	24.3	25.0
KA3542G01:4	10.50	17.60	14.05	57.72	74.69	0.743	8.74E-02	-	-	-	2	23.8	24.3
KA3542G01:5	3.50	9.50	6.50	56.13	217.79	0.241	3.85E-02	-	-	-	1	4.2	8.1
KA3542G02:1	28.20	30.01	29.11	47.40	173.55	0.216	3.24E-02	-	-	-	2	29.0	36.6
KA3542G02:2	25.60	27.20	26.40	47.43	133.89	0.280	3.91E-02	-	-	-	2	47.6	57.9
KA3542G02:3	21.50	24.60	23.05	47.68	-	-	-	-	-	-	0	0.0	-1.7
KA3542G02:4	9.00	20.50	14.75	49.27	129.62	0.312	4.32E-02	-	-	-	2	47.7	54.9
KA3542G02:5	2.00	8.00	5.00	52.77	28.23	1.644	1.45E-01	-	-	-	2	46.2	53.3
KA3543A01:1	0.65	2.06	1.36	55.41	121.48	0.421	5.72E-02	-	-	-	1	7.2	12.9
KA3543I01:1	0.65	2.06	1.36	56.51	264.57	0.201	3.38E-02	-	-	-	0	-0.8	2.0
KA3544G01:1	11.65	12.00	11.83	50.37	232.38	0.182	2.95E-02	-	-	-	1	2.5	8.8
KA3544G01:2	8.90	10.65	9.78	50.68	232.38	0.184	2.99E-02	-	-	-	1	2.7	8.6
KA3544G01:3	3.50	7.90	5.70	51.53	240.04	0.184	3.02E-02	-	-	-	1	2.5	8.4
KA3546G01:1	9.30	12.00	10.65	49.73	-	-	-	-	-	-	0	-0.5	1.0
KA3546G01:2	6.75	8.30	7.53	50.31	-	-	-	-	-	-	0	0.2	0.7
KA3546G01:3	1.50	5.75	3.63	51.29	-	-	-	-	-	-	0	-0.2	2.0
KA3548A01:1	21.50	30.00	25.75	67.16	61.48	1.223	1.36E-01	1.8E-07	1.4E-06	1.3E-06	2	20.1	20.7
KA3548A01:2	11.75	20.50	16.13	60.74	44.45	1.383	1.39E-01	2.4E-07	1.6E-06	1.7E-06	2	25.2	25.4
KA3548A01:3	8.80	10.75	9.78	57.00	77.15	0.702	8.33E-02	1.8E-07	2.0E-06	2.2E-06	2	23.9	24.7
KA3548A01:4	3.00	7.80	5.40	54.70	87.83	0.568	7.01E-02	1.3E-07	1.9E-06	1.9E-06	2	26.0	27.6
KA3548D01:1	0.65	2.06	1.36	50.76	240.04	0.179	2.93E-02	-	-	-	1	1.2	7.4
KA3548G01:1	6.00	12.00	9.00	47.72	-	-	-	-	-	-	0	-0.6	0.8
KA3548G01:2	2.00	5.00	3.50	49.09	-	-	-	-	-	-	0	-0.2	-0.2
KA3550G01:1	8.30	12.03	10.17	45.18	240.04	0.142	2.32E-02	-	-	-	1	1.2	7.2
KA3550G01:2	5.20	7.30	6.25	46.10	240.04	0.148	2.42E-02	-	-	-	1	1.0	7.1
KA3550G01:3	1.80	4.20	3.00	47.09	240.04	0.154	2.52E-02	-	-	-	1	1.2	7.4
KA3550G05:1	1.50	3.00	2.25	51.16	-	-	-	-	-	-	0	0.0	0.0
KA3551G05:1	1.50	3.10	2.30	45.89	-	-	-	-	-	-	0	-0.2	-0.4
KA3552A01:1	0.65	2.06	1.36	48.14	-	-	-	-	-	-	0	0.0	0.0
KA3552G01:1	7.05	12.00	9.53	44.77	-	-	-	-	-	-	0	-0.6	-0.8
KA3552G01:2	4.35	6.05	5.20	45.80	264.57	0.132	2.22E-02	-	-	-	0	-0.4	1.2
KA3552G01:3	1.50	3.35	2.43	46.66	264.57	0.137	2.30E-02	-	-	-	0	-1.0	4.5
KA3552H01:1	0.65	2.10	1.38	48.84	-	-	-	-	-	-	0	-0.2	0.8
KA3553B01:1	0.65	2.02	1.34	45.10	247.95	0.137	2.26E-02	-	-	-	0	0.2	6.3
KA3554G01:1	25.15	30.01	27.58	54.28	43.03	1.141	1.14E-01	2.1E-07	1.7E-06	1.8E-06	2	25.8	26.4
KA3554G01:2	22.60	24.15	23.38	52.13	43.03	1.052	1.05E-01	2.6E-07	2.1E-06	2.5E-06	2	25.8	26.2
KA3554G01:3	14.00	21.60	17.80	49.66	65.60	0.627	7.09E-02	1.5E-07	2.8E-06	2.1E-06	2	20.9	22.9
KA3554G01:4	5.00	13.00	9.00	46.90	106.70	0.344	4.49E-02	1.2E-07	3.4E-06	2.7E-06	2	18.2	18.0
KA3554G01:5	1.50	4.00	2.75	45.85	240.04	0.146	2.39E-02	-	-	-	1	4.1	7.2
KA3554G02:1	22.00	30.01	26.01	36.09	65.60	0.331	3.74E-02	-	-	-	2	53.4	59.1
KA3554G02:2	15.90	21.00	18.45	37.12	47.43	0.484	4.97E-02	5.1E-08	1.2E-06	1.0E-06	2	89.0	97.3
KA3554G02:3	13.20	14.90	14.05	38.40	47.43	0.518	5.32E-02	4.8E-08	1.2E-06	9.0E-07	2	89.0	97.5
KA3554G02:4	10.50	12.20	11.35	39.41	65.60	0.395	4.46E-02	-	-	-	2	37.4	44.8
KA3554G02:5	1.50	9.50	5.50	42.10	21.08	1.401	1.14E-01	4.7E-08	3.7E-07	4.1E-07	2	212.6	224.6
KA3557G:1	15.00	30.04	22.52	37.19	-	-	-	-	-	-	0	-0.4	-5.9
KA3557G:2	1.50	14.00	7.75	40.15	-	-	-	-	-	-	0	-0.4	-1.2
KA3563A01:1	0.65	2.06	1.36	40.23	-	-	-	-	-	-	1	3.7	-6.9
KA3563D01:1	0.65	2.01	1.33	38.43	-	-	-	-	-	-	1	2.5	0.5
KA3563G:1	15.00	30.01	22.51	31.60	-	-	-	-	-	-	0	-0.2	-6.1
KA3563G:2	10.00	13.00	11.50	33.68	-	-	-	-	-	-	0	0.0	-2.2
KA3563G:3	4.00	8.00	6.00	35.96	147.58	0.146	2.10E-02	-	-	-	2	13.3	14.0
KA3563G:4	1.50	3.00	2.25	37.90	247.95	0.097	1.59E-02	-	-	-	1	3.4	4.9
KA3563I01:1	0.65	2.15	1.40	41.11	247.95	0.114	1.88E-02	-	-	-	1	3.4	4.7
KA3566C01:1	0.65	2.1	1.38	39.50	106.70	0.244	3.18E-02	3.5E-07	1.2E-05	1.1E-05	1	9.4	11.1

Table 6-12 Interference test results for KA3590G02, 25.50 - 30.01 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Drawdown response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	46.58	-	-	-	-	-	-	1	1.2	-0.5
KA3566G01:2	20.00	21.50	20.75	43.19	217.79	0.143	2.28E-02	-	-	-	1	7.1	7.9
KA3566G01:3	12.00	18.00	15.00	40.52	121.48	0.225	3.06E-02	-	-	-	1	8.4	7.6
KA3566G01:4	7.30	10.00	8.65	38.38	224.96	0.109	1.76E-02	-	-	-	1	7.1	7.4
KA3566G01:5	1.50	6.30	3.90	37.40	204.11	0.114	1.79E-02	-	-	-	1	8.1	8.8
KA3566G02:1	19.00	30.10	24.55	24.11	87.83	0.110	1.36E-02	2.1E-07	2.0E-05	1.6E-05	2	15.3	16.5
KA3566G02:2	16.00	18.00	17.00	26.14	121.48	0.094	1.27E-02	-	-	-	2	14.0	14.8
KA3566G02:3	12.00	14.00	13.00	28.01	100.00	0.131	1.68E-02	-	-	-	2	14.5	16.0
KA3566G02:4	8.00	11.00	9.50	29.98	937.20	0.016	3.41E-03	-	-	-	2	15.5	16.7
KA3566G02:5	1.30	6.00	3.65	33.83	100.00	0.191	2.44E-02	-	-	-	2	14.5	15.8
KA3568D01:1	0.65	2.30	1.48	35.29	264.57	0.078	1.32E-02	-	-	-	1	3.4	3.4
KA3572G01:1	7.30	12.03	9.67	28.85	-	-	-	-	-	-	0	0.2	-4.9
KA3572G01:2	2.70	5.30	4.00	31.10	-	-	-	-	-	-	1	2.0	0.7
KA3573A:1	26.00	40.07	33.04	62.13	-	-	-	-	-	-	0	0.5	0.2
KA3573A:2	21.00	24.00	22.50	52.99	850.31	0.055	1.16E-02	-	-	-	1	7.1	7.6
KA3573A:3	14.50	19.00	16.75	48.24	162.66	0.238	3.52E-02	-	-	-	1	4.9	5.4
KA3573A:4	10.50	12.50	11.50	44.11	85.03	0.381	4.66E-02	-	-	-	1	7.1	8.1
KA3573A:5	1.30	8.50	4.90	39.30	90.73	0.284	3.53E-02	-	-	-	1	7.1	8.1
KA3573C01:1	0.65	2.05	1.35	36.03	20.41	1.060	8.57E-02	2.1E-07	2.0E-06	2.4E-06	2	54.5	55.8
KA3574D01:1	0.65	2.05	1.35	32.57	-	-	-	-	-	-	1	1.5	-1.5
KA3574G01:1	8.00	12.03	10.02	26.81	-	-	-	-	-	-	0	0.2	-0.2
KA3574G01:2	5.10	7.00	6.05	28.39	-	-	-	-	-	-	0	0.0	-0.7
KA3574G01:3	1.80	4.10	2.95	29.93	-	-	-	-	-	-	0	0.0	-0.2
KA3576G01:1	8.00	12.01	10.01	27.26	-	-	-	-	-	-	0	0.0	-0.2
KA3576G01:2	4.00	6.00	5.00	29.27	-	-	-	-	-	-	0	0.0	-0.7
KA3576G01:3	1.30	3.00	2.15	30.72	-	-	-	-	-	-	1	3.0	2.5
KA3578C01:1	0.65	2.09	1.37	34.12	138.31	0.140	1.98E-02	-	-	-	1	5.7	4.9
KA3578G01:1	6.50	12.58	9.54	25.58	-	-	-	-	-	-	0	0.0	-1.0
KA3578G01:2	4.30	5.50	4.90	27.62	-	-	-	-	-	-	0	0.2	-1.0
KA3578H01:1	0.65	1.90	1.28	34.33	93.72	0.210	2.64E-02	-	-	-	2	11.8	15.7
KA3579D01:1	0.65	2.00	1.33	30.00	-	-	-	-	-	-	0	-0.5	0.2
KA3579G:1	14.70	22.65	18.68	23.05	-	-	-	-	-	-	0	0.5	-3.4
KA3579G:2	12.50	13.70	13.10	23.82	-	-	-	-	-	-	0	1.0	-3.0
KA3579G:3	2.30	11.50	6.90	26.08	-	-	-	-	-	-	0	0.0	-1.2
KA3584G01:1	7.00	12.00	9.50	23.52	-	-	-	-	-	-	0	0.7	-2.2
KA3584G01:2	1.30	5.00	3.15	26.68	-	-	-	-	-	-	0	1.0	-0.5
KA3588C01:1	0.65	2.04	1.35	32.39	90.73	0.193	2.40E-02	3.5E-07	1.2E-05	1.4E-05	2	12.0	12.5
KA3588D01:1	0.65	1.90	1.28	28.05	129.62	0.101	1.40E-02	8.6E-07	5.4E-05	6.2E-05	1	3.9	3.7
KA3588I01:1	0.65	1.96	1.31	32.03	106.70	0.160	2.09E-02	1.0E-06	3.3E-05	4.8E-05	1	4.9	4.9
KA3590G01:1	16.00	30.00	23.00	37.61	57.62	0.409	4.45E-02	1.9E-07	4.8E-06	4.4E-06	2	19.7	23.6
KA3590G01:2	7.00	15.00	11.00	31.12	57.62	0.280	3.05E-02	1.9E-07	7.0E-06	6.4E-06	2	19.4	23.9
KA3590G01:3	1.30	6.00	3.65	28.94	125.48	0.111	1.52E-02	-	-	-	1	6.6	5.9
KA3590G02:1	**25.50**	**30.01**	**27.76**	**0.00**	-	-	-	**1.0E-07**	-	-	2	1820.5	1834.2
KA3590G02:2	15.20	23.50	19.35	8.41	-	-	-	-	-	-	2	994.6	1017.4
KA3590G02:3	11.90	13.20	12.55	15.21	-	-	-	-	-	-	2	11.1	8.6
KA3590G02:4	1.30	9.90	5.60	22.16	-	-	-	-	-	-	2	408.2	445.5
KA3592C01:1	0.65	2.01	1.33	32.82	-	-	-	-	-	-	1	3.2	3.2
KA3593G:1	25.20	30.02	27.61	23.17	-	-	-	-	-	-	0	-0.2	-0.2
KA3593G:2	23.50	24.20	23.85	21.94	138.31	0.058	8.18E-03	-	-	-	1	6.9	6.4
KA3593G:3	9.00	22.50	15.75	21.41	-	-	-	-	-	-	1	1.5	-0.2
KA3593G:4	3.00	7.00	5.00	25.10	264.57	0.040	6.66E-03	-	-	-	1	4.9	2.9
KA3597D01:1	0.65	2.22	1.44	28.76	110.22	0.125	1.65E-02	1.1E-06	4.8E-05	6.8E-05	1	4.2	4.2
KA3597H01:1	0.65	2.06	1.36	34.35	117.60	0.167	2.25E-02	3.6E-07	1.9E-05	1.6E-05	1	6.4	6.4
KA3600F:1	43.00	50.10	46.55	70.68	282.30	0.295	5.03E-02	-	-	-	1	1.2	0.7
KA3600F:2	40.50	42.00	41.25	65.80	282.30	0.256	4.36E-02	-	-	-	1	1.2	1.0
KA3600F:3	20.00	39.50	29.75	55.48	264.57	0.194	3.25E-02	-	-	-	1	2.5	1.7
KA3600F:4	1.30	18.00	9.65	39.07	256.12	0.099	1.65E-02	-	-	-	1	3.7	3.2
KG0021A01:1	42.50	48.82	45.66	58.85	17.36	3.325	2.58E-01	5.3E-08	2.3E-07	2.1E-07	2	151.4	162.4
KG0021A01:2	37.00	41.50	39.25	57.76	7.97	6.978	4.45E-01	1.3E-07	2.1E-07	2.9E-07	2	191.6	205.1
KG0021A01:3	35.00	36.00	35.50	57.46	4.03	13.642	7.49E-01	9.8E-08	8.7E-08	1.3E-07	2	357.5	379.9
KG0021A01:4	19.00	34.00	26.50	57.72	2.82	19.670	1.00E+00	1.4E-07	7.8E-08	1.3E-07	2	385.9	404.6
KG0021A01:5	5.00	18.00	11.50	61.16	100.00	0.623	7.99E-02	2.5E-08	5.9E-07	3.1E-07	2	44.3	49.9
KG0048A01:1	49.00	54.69	51.85	44.20	41.66	0.782	7.73E-02	2.2E-07	2.8E-06	2.9E-06	2	25.6	26.1
KG0048A01:2	34.8	48	41.40	39.07	19.13	1.330	1.06E-01	1.6E-07	1.4E-06	1.6E-06	2	63.3	64.8
KG0048A01:3	32.80	33.80	33.30	36.68	7.71	2.907	1.84E-01	1.5E-07	5.6E-07	8.1E-07	2	161.8	168.4
KG0048A01:4	13.00	31.80	22.40	36.17	0.80	27.363	1.12E+00	-	-	-	2	620.9	639.7
KG0048A01:5	5.00	12.00	8.50	40.08	185.18	0.145	2.21E-02	-	-	-	2	33.9	39.2

6.2.5 Test 10:25 – KG0021A01:3

General test data for the pressure build-up test in the interval 35.00-36.00 m of borehole KG0021A01 are presented in Table 6-13.

Table 6-13 General test data for the pressure build-up test in section 35.00-36.00 m of borehole KG0021A01

General test data			
Borehole section	KG0021A01:3		
Test No	10:25		
Field crew	A. Blom (SWECO Environment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	35.00
Test section- seclow	Seclow	m	36.00
Test section length	L_w	m	1.00
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm:ss	20091118 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091118 08:00:00
Stop of flow period		yymmdd hh:mm:ss	20091118 14:00:00
Test stop (stop of pressure registration)		yymmdd hh:mm:ss	20091118 08:00:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	2165	
Absolute pressure in test section before stop of flow	p_p	kPa	188	
Max absolute pressure in test section during recovery period	p_f	kPa	2208	
Maximal pressure change during flow period	dp_p	kPa	1977	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.07 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.19 \cdot 10^{-5}$
Total volume discharged during flow period	V_p	m^3	0.258

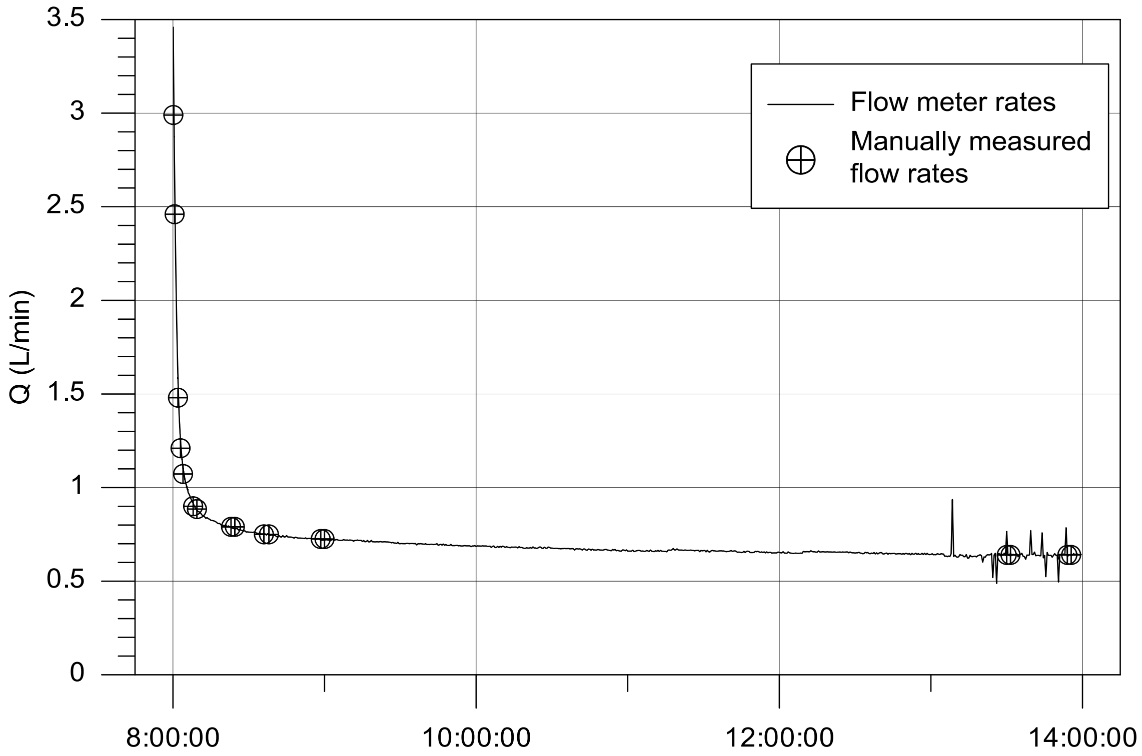


Figure 6-13 *Flow rates during draw down in KG0021A01:3. Time in minutes.*

Comments to the test

The test was successful in regard to pressure responses.

Interpreted flow regimes – flowing section

0 – 0.3	minutes	Well Bore Storage (WBS)
0.3 – 1	minutes	Radial flow period
1 –	minutes	Transition period

Calculated parameters

Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

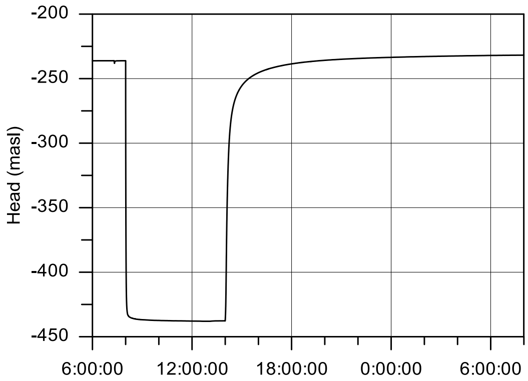
Selected representative parameters

The selected representative parameters from the test in the interval 35.00-36.00 m in KG0021A01 are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

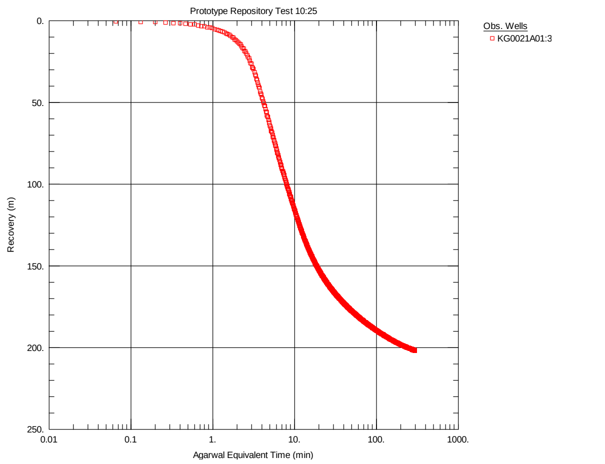
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:25
Borehole ID:	KG0021A01	Test start:	2009-11-18 07:30
Test section (m):	35.00-36.00	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head



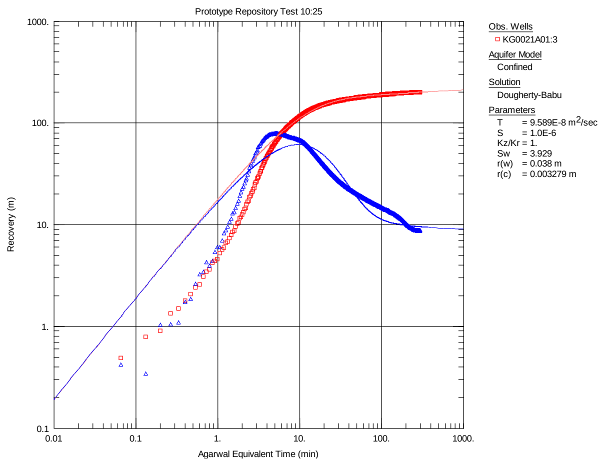
Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	2165		
p_i (kPa)			
p_p(kPa)	188	p_F (kPa)	2208
Q_p (m^3/s)	$1.07 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$5.4 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$3.1 \cdot 10^{-8}$	dt_{e1} (min)	0.3
Flow regime:		dt_{e2} (min)	1
dt_1 (min)		T (m^2/s)	$9.6 \cdot 10^{-8}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	4
C_D (-)			
ξ (-)			

Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.3	C_D (-)	
dt_2 (min)	1	ξ (-)	4
T_T (m^2/s)	$1.5 \cdot 10^{-7}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: The result may be uncertain. The change of shape of the derivative curve at 0.3 – 1 min could also be a result of a possible storativity change.

The test was carried out in KG0021A01, section 35.00 - 36.00 metres. The flow period was for 360 minutes with a final flow of 0.82 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-14 and Figure 6-15 the r^2/t_L recordings are shown and in Table 6-14 and Table 6-15 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 5.

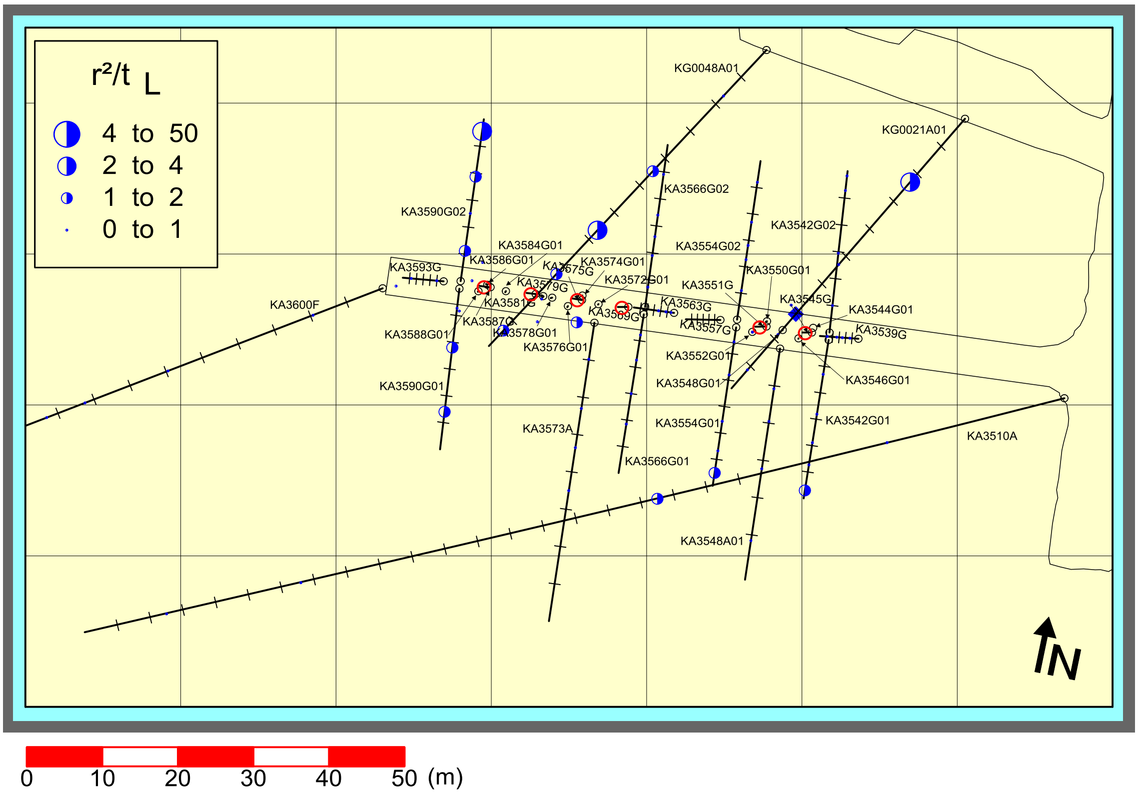


Figure 6-14 *Plot showing r^2/t_L during recovery of KG0021A01:3 (Interference test 10:25) - plan view*

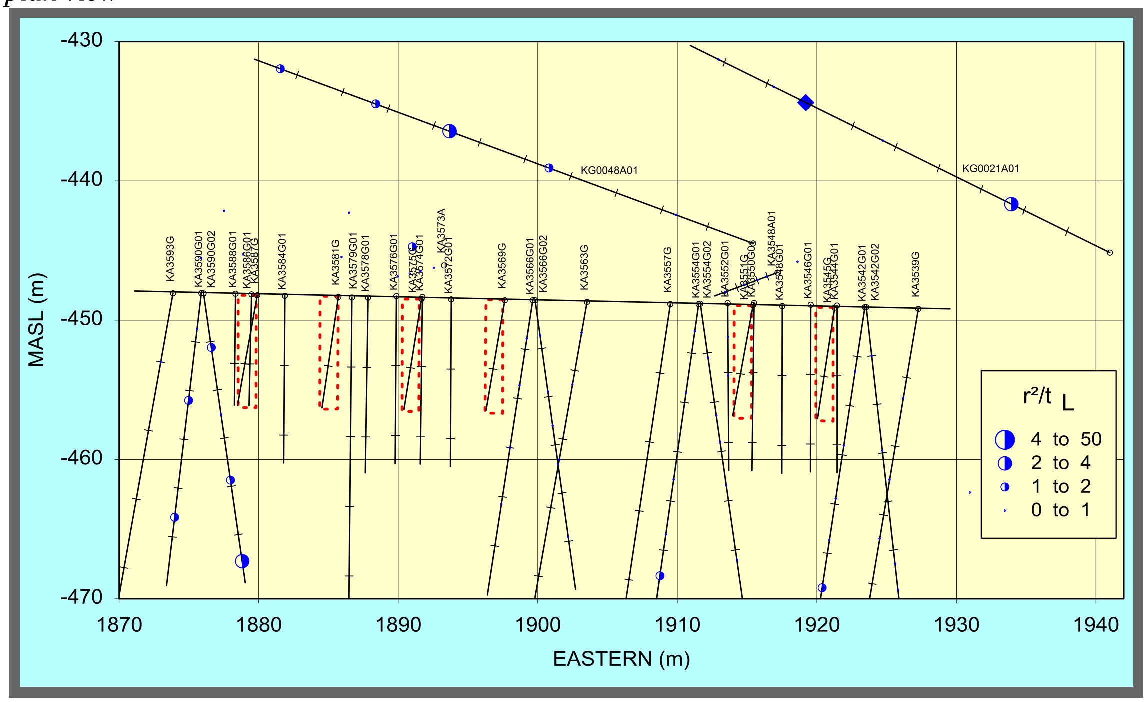


Figure 6-15 *Plot showing r^2/t_L during recovery of KG0021A01:3 (Interference test 10:25) – vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3590G02:2&4, KA3590G01:1&2, KA3573C01:1, KA3554G01:1, KA3542G01:1, KA3510A:4 and KG0048A01:1,2&4.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3590G02:1 and KG0048A01:3.

No **very good** ($4 < r^2/t_L$) hydraulic connections is found.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $2.8 \cdot 10^{-8} – 4.0 \cdot 10^{-7}$ m^2/s. The transmissivity of the flowing section is evaluated to be $9.6 \cdot 10^{-8}$ m^2/s with the evaluation period 0.3 – 1 minutes.

The flow section is situated right above the repository. It has good connection with a KG0048A01 on the same horizontal level and also with the lower sections of KA3590G02, on the north side of the repository, some 30 meters below the level of KG0048A01. To be noted is also the rather good connection with the lowest section of KA3542G01 on the south side of the repository.

When compared to an earlier test 5:25, (*Forsmark T, Rhén, I, 2005)*, the overall observations are the same.

Table 6-14 Interference test results for KG0021A01, 35.00 - 36.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	122.63	264.57	0.947	1.59E-01	-	-	-	1	1.2	1.4
KA3510A:2	110.00	124.00	117.00	103.12	264.57	0.670	1.12E-01	-	-	-	1	1.0	1.4
KA3510A:3	75.00	109.00	92.00	79.99	-	-	-	-	-	-	2	11.7	10.8
KA3510A:4	51.00	74.00	62.50	54.77	33.20	1.506	1.39E-01	2.6E-07	1.6E-06	1.8E-06	2	29.2	29.9
KA3510A:5	4.50	50.00	27.25	34.81	32.14	0.628	5.77E-02	2.6E-07	4.2E-06	4.6E-06	2	29.4	30.1
KA3539G:1	18.60	30.00	24.30	39.09	65.60	0.388	4.39E-02	9.0E-08	2.5E-06	2.1E-06	2	40.0	40.2
KA3539G:2	15.85	17.60	16.73	31.90	67.76	0.250	2.86E-02	8.2E-08	3.6E-06	2.9E-06	2	39.7	40.2
KA3539G:3	10.00	14.85	12.43	27.90	37.80	0.343	3.30E-02	1.7E-07	4.8E-06	5.1E-06	2	46.6	47.6
KA3539G:4	4.00	9.00	6.50	22.57	63.51	0.134	1.50E-02	1.0E-07	7.9E-06	6.7E-06	2	39.8	40.0
KA3542G01:1	27.00	30.00	28.50	41.96	24.80	1.183	1.01E-01	2.8E-07	2.2E-06	2.8E-06	2	32.9	33.4
KA3542G01:2	21.30	26.00	23.65	37.26	39.04	0.593	5.75E-02	1.8E-07	3.0E-06	3.1E-06	2	33.4	33.9
KA3542G01:3	18.60	20.30	19.45	33.22	32.14	0.572	5.25E-02	1.8E-07	3.5E-06	3.5E-06	2	35.3	36.1
KA3542G01:4	10.50	17.60	14.05	28.10	41.66	0.316	3.12E-02	1.4E-07	4.8E-06	4.4E-06	2	33.4	33.9
KA3542G01:5	3.50	9.50	6.50	21.17	129.62	0.058	7.97E-03	-	-	-	2	13.5	12.2
KA3542G02:1	28.20	30.01	29.11	40.04	113.85	0.235	3.13E-02	-	-	-	2	47.6	50.8
KA3542G02:2	25.60	27.20	26.40	37.48	72.30	0.324	3.77E-02	3.0E-08	1.2E-06	8.0E-07	2	73.4	80.5
KA3542G02:3	21.50	24.60	23.05	34.34	-	-	-	-	-	-	1	1.2	-2.2
KA3542G02:4	9.00	20.50	14.75	26.82	82.32	0.146	1.76E-02	-	-	-	2	51.7	53.1
KA3542G02:5	2.00	8.00	5.00	18.82	14.76	0.400	2.97E-02	-	-	-	2	69.5	71.9
KA3543A01:1	0.65	2.06	1.36	13.87	-	-	-	-	-	-	2	22.5	22.3
KA3543I01:1	0.65	2.06	1.36	9.34	-	-	-	-	-	-	0	-0.6	3.1
KA3544G01:1	11.65	12.00	11.83	26.56	-	-	-	-	-	-	2	13.2	11.5
KA3544G01:2	8.90	10.65	9.78	24.52	-	-	-	-	-	-	2	13.0	11.3
KA3544G01:3	3.50	7.90	5.70	20.47	-	-	-	-	-	-	2	13.3	11.3
KA3546G01:1	9.30	12.00	10.65	25.37	-	-	-	-	-	-	0	1.0	-2.9
KA3546G01:2	6.75	8.30	7.53	22.28	-	-	-	-	-	-	1	1.2	-2.5
KA3546G01:3	1.50	5.75	3.63	18.43	-	-	-	-	-	-	1	1.5	3.4
KA3548A01:1	21.50	30.00	25.75	33.45	33.20	0.562	5.20E-02	2.8E-07	4.5E-06	5.4E-06	2	25.4	26.4
KA3548A01:2	11.75	20.50	16.13	24.70	22.50	0.452	3.75E-02	3.4E-07	7.0E-06	9.1E-06	2	31.7	32.3
KA3548A01:3	8.80	10.75	9.78	19.40	34.29	0.183	1.71E-02	1.8E-07	1.0E-05	1.0E-05	2	35.0	35.8
KA3548A01:4	3.00	7.80	5.40	16.19	21.78	0.200	1.65E-02	1.8E-07	1.2E-05	1.1E-05	2	44.8	46.5
KA3548D01:1	0.65	2.06	1.36	11.50	240.04	0.009	1.50E-03	-	-	-	1	9.8	8.0
KA3548G01:1	6.00	12.00	9.00	23.77	-	-	-	-	-	-	0	0.0	2.5
KA3548G01:2	2.00	5.00	3.50	18.31	-	-	-	-	-	-	0	0.2	0.2
KA3550G01:1	8.30	12.03	10.17	24.88	-	-	-	-	-	-	1	9.4	7.0
KA3550G01:2	5.20	7.30	6.25	21.01	-	-	-	-	-	-	1	9.0	6.5
KA3550G01:3	1.80	4.20	3.00	17.82	-	-	-	-	-	-	1	9.4	7.2
KA3550G05:1	1.50	3.00	2.25	16.97	-	-	-	-	-	-	0	-0.2	0.0
KA3551G05:1	1.50	3.10	2.30	17.82	-	-	-	-	-	-	0	0.0	0.0
KA3552A01:1	0.65	2.06	1.36	15.35	-	-	-	-	-	-	0	0.0	0.2
KA3552G01:1	7.05	12.00	9.53	24.67	-	-	-	-	-	-	0	0.2	0.6
KA3552G01:2	4.35	6.05	5.20	20.51	264.57	0.026	4.44E-03	-	-	-	0	-0.6	1.0
KA3552G01:3	1.50	3.35	2.43	17.88	264.57	0.020	3.38E-03	-	-	-	1	3.9	1.2
KA3552H01:1	0.65	2.10	1.38	11.40	-	-	-	-	-	-	0	-0.4	0.4
KA3553B01:1	0.65	2.02	1.34	14.68	-	-	-	-	-	-	1	7.8	5.3
KA3554G01:1	25.15	30.01	27.58	41.31	22.50	1.264	1.05E-01	3.5E-07	2.4E-06	3.4E-06	2	32.5	33.4
KA3554G01:2	22.60	24.15	23.38	37.28	24.00	0.965	8.16E-02	3.3E-07	3.0E-06	4.1E-06	2	32.8	33.2
KA3554G01:3	14.00	21.60	17.80	31.99	31.11	0.548	4.98E-02	3.2E-07	5.6E-06	6.4E-06	2	28.2	28.7
KA3554G01:4	5.00	13.00	9.00	23.92	50.61	0.188	1.97E-02	2.4E-07	1.1E-05	1.2E-05	2	25.2	24.8
KA3554G01:5	1.50	4.00	2.75	18.60	197.59	0.029	4.54E-03	-	-	-	1	9.6	8.2
KA3554G02:1	22.00	30.01	26.01	37.52	162.66	0.144	2.13E-02	-	-	-	2	31.3	27.4
KA3554G02:2	15.90	21.00	18.45	30.59	16.80	0.928	7.13E-02	7.9E-08	1.0E-06	1.1E-06	2	118.2	134.0
KA3554G02:3	13.20	14.90	14.05	26.73	16.80	0.709	5.44E-02	8.8E-08	1.4E-06	1.6E-06	2	118.2	133.9
KA3554G02:4	10.50	12.20	11.35	24.44	30.12	0.331	2.98E-02	1.8E-07	5.5E-06	6.2E-06	2	52.4	53.8
KA3554G02:5	1.50	9.50	5.50	19.87	67.76	0.097	1.11E-02	-	-	-	2	106.2	90.6
KA3557G:1	15.00	30.04	22.52	39.00	-	-	-	-	-	-	0	-0.2	-2.0
KA3557G:2	1.50	14.00	7.75	24.66	-	-	-	-	-	-	0	-0.2	-0.6
KA3563A01:1	0.65	2.06	1.36	22.79	-	-	-	-	-	-	1	8.4	17.0
KA3563D01:1	0.65	2.01	1.33	20.12	-	-	-	-	-	-	1	1.5	3.9
KA3563G:1	15.00	30.01	22.51	41.40	-	-	-	-	-	-	0	0.0	-1.7
KA3563G:2	10.00	13.00	11.50	31.14	264.57	0.061	1.02E-02	-	-	-	0	0.7	1.5
KA3563G:3	4.00	8.00	6.00	26.24	90.73	0.126	1.58E-02	-	-	-	2	20.4	20.1
KA3563G:4	1.50	3.00	2.25	23.05	224.96	0.039	6.34E-03	-	-	-	1	2.7	3.7
KA3563I01:1	0.65	2.15	1.40	19.59	-	-	-	-	-	-	1	2.5	3.4
KA3566C01:1	0.65	2.1	1.38	24.30	-	-	-	-	-	-	2	10.8	11.3

Table 6-15 Interference test results for KG0021A01, 35.00 - 36.00 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	44.17	-	-	-	-	-	-	1	1.7	1.0
KA3566G01:2	20.00	21.50	20.75	38.97	240.04	0.105	1.73E-02	-	-	-	1	4.9	3.7
KA3566G01:3	12.00	18.00	15.00	34.26	82.32	0.238	2.88E-02	2.7E-07	1.1E-05	9.5E-06	2	10.8	11.1
KA3566G01:4	7.30	10.00	8.65	29.49	240.04	0.060	9.88E-03	-	-	-	1	4.9	3.7
KA3566G01:5	1.50	6.30	3.90	26.36	240.04	0.048	7.90E-03	-	-	-	1	4.9	3.4
KA3566G02:1	19.00	30.10	24.55	40.06	191.29	0.140	2.16E-02	-	-	-	1	8.1	6.7
KA3566G02:2	16.00	18.00	17.00	34.08	204.11	0.095	1.49E-02	-	-	-	1	7.6	6.2
KA3566G02:3	12.00	14.00	13.00	31.18	179.28	0.090	1.37E-02	-	-	-	1	8.1	6.4
KA3566G02:4	8.00	11.00	9.50	28.85	179.28	0.077	1.17E-02	-	-	-	1	8.4	6.4
KA3566G02:5	1.30	6.00	3.65	25.59	185.18	0.059	9.01E-03	-	-	-	1	8.1	6.2
KA3568D01:1	0.65	2.30	1.48	24.08	-	-	-	-	-	-	1	2.7	2.5
KA3572G01:1	7.30	12.03	9.67	34.87	-	-	-	-	-	-	0	0.5	-1.2
KA3572G01:2	2.70	5.30	4.00	31.26	-	-	-	-	-	-	1	2.0	2.2
KA3573A:1	26.00	40.07	33.04	47.48	-	-	-	-	-	-	0	0.5	0.5
KA3573A:2	21.00	24.00	22.50	39.46	47.43	0.547	5.62E-02	8.8E-07	9.8E-06	1.6E-05	1	9.3	10.6
KA3573A:3	14.50	19.00	16.75	35.63	125.48	0.169	2.31E-02	-	-	-	1	6.2	6.4
KA3573A:4	10.50	12.50	11.50	32.63	45.92	0.387	3.93E-02	8.5E-07	1.4E-05	2.2E-05	1	9.1	10.6
KA3573A:5	1.30	8.50	4.90	29.78	45.92	0.322	3.27E-02	8.8E-07	1.6E-05	2.7E-05	1	9.1	10.8
KA3573C01:1	0.65	2.05	1.35	30.06	10.33	1.458	9.90E-02	2.4E-07	1.6E-06	2.4E-06	2	64.1	64.1
KA3574D01:1	0.65	2.05	1.35	29.33	-	-	-	-	-	-	1	2.0	3.7
KA3574G01:1	8.00	12.03	10.02	36.64	-	-	-	-	-	-	0	0.0	0.0
KA3574G01:2	5.10	7.00	6.05	34.14	-	-	-	-	-	-	0	0.7	1.0
KA3574G01:3	1.80	4.10	2.95	32.39	-	-	-	-	-	-	0	0.2	0.2
KA3576G01:1	8.00	12.01	10.01	37.92	-	-	-	-	-	-	0	0.0	0.2
KA3576G01:2	4.00	6.00	5.00	34.94	-	-	-	-	-	-	0	0.5	0.0
KA3576G01:3	1.30	3.00	2.15	33.46	-	-	-	-	-	-	1	2.5	2.9
KA3578C01:1	0.65	2.09	1.37	35.08	70.00	0.293	3.38E-02	1.4E-06	2.1E-05	4.1E-05	1	7.9	8.1
KA3578G01:1	6.50	12.58	9.54	39.40	-	-	-	-	-	-	0	0.2	1.0
KA3578G01:2	4.30	5.50	4.90	36.76	-	-	-	-	-	-	0	0.7	1.7
KA3578H01:1	0.65	1.90	1.28	33.72	74.69	0.254	2.98E-02	2.7E-07	9.4E-06	9.1E-06	2	13.8	4.4
KA3579D01:1	0.65	2.00	1.33	33.96	-	-	-	-	-	-	0	0.0	0.7
KA3579G:1	14.70	22.65	18.68	46.30	-	-	-	-	-	-	0	0.5	0.0
KA3579G:2	12.50	13.70	13.10	42.50	-	-	-	-	-	-	0	0.7	0.5
KA3579G:3	2.30	11.50	6.90	38.79	-	-	-	-	-	-	0	0.5	0.7
KA3584G01:1	7.00	12.00	9.50	44.20	-	-	-	-	-	-	1	1.2	1.0
KA3584G01:2	1.30	5.00	3.15	41.16	-	-	-	-	-	-	1	1.7	3.2
KA3588C01:1	0.65	2.04	1.35	44.74	57.62	0.579	6.30E-02	3.4E-07	4.7E-06	5.4E-06	2	16.0	16.2
KA3588D01:1	0.65	1.90	1.28	42.34	100.00	0.299	3.83E-02	1.7E-06	2.3E-05	4.4E-05	1	5.4	5.4
KA3588I01:1	0.65	1.96	1.31	42.63	74.69	0.406	4.77E-02	1.8E-06	1.8E-05	3.7E-05	1	6.9	6.6
KA3590G01:1	16.00	30.00	23.00	55.68	36.59	1.412	1.34E-01	3.2E-07	1.8E-06	2.4E-06	2	25.1	25.9
KA3590G01:2	7.00	15.00	11.00	49.33	35.42	1.145	1.08E-01	3.1E-07	2.4E-06	2.9E-06	2	25.1	25.6
KA3590G01:3	1.30	6.00	3.65	46.55	93.72	0.385	4.85E-02	7.0E-07	1.0E-05	1.4E-05	1	9.1	9.4
KA3590G02:1	25.50	30.01	27.76	57.46	16.27	3.383	2.58E-01	2.8E-08	7.5E-08	1.1E-07	2	416.8	370.4
KA3590G02:2	15.20	23.50	19.35	52.59	31.11	1.481	1.35E-01	-	-	-	2	298.9	261.1
KA3590G02:3	11.90	13.20	12.55	49.35	264.57	0.153	2.57E-02	-	-	-	1	4.4	2.0
KA3590G02:4	1.30	9.90	5.60	46.84	20.41	1.791	1.45E-01	3.2E-07	1.6E-06	2.2E-06	2	30.2	31.7
KA3592C01:1	0.65	2.01	1.33	48.64	-	-	-	-	-	-	1	4.4	4.7
KA3593G:1	25.20	30.02	27.61	64.90	-	-	-	-	-	-	0	0.0	0.5
KA3593G:2	23.50	24.20	23.85	62.11	110.22	0.583	7.70E-02	5.4E-07	6.2E-06	7.0E-06	1	8.9	8.6
KA3593G:3	9.00	22.50	15.75	56.46	-	-	-	-	-	-	0	1.0	0.5
KA3593G:4	3.00	7.00	5.00	50.03	264.57	0.158	2.65E-02	-	-	-	1	3.4	1.7
KA3597D01:1	0.65	2.22	1.44	50.74	-	-	-	-	-	-	1	6.1	5.9
KA3597H01:1	0.65	2.06	1.36	52.17	90.73	0.500	6.23E-02	7.0E-07	8.8E-06	1.1E-05	1	8.6	8.6
KA3600F:1	43.00	50.10	46.55	98.24	256.12	0.628	1.05E-01	-	-	-	1	2.0	2.2
KA3600F:2	40.50	42.00	41.25	93.12	256.12	0.564	9.39E-02	-	-	-	1	1.7	2.0
KA3600F:3	20.00	39.50	29.75	82.09	240.04	0.468	7.66E-02	-	-	-	1	3.0	3.4
KA3600F:4	1.30	18.00	9.65	63.22	240.04	0.277	4.54E-02	-	-	-	1	4.4	4.2
KG0021A01:1	42.50	48.82	45.66	10.15	3.11	0.552	2.88E-02	-	-	-	2	327.1	348.2
KG0021A01:2	37.00	41.50	39.25	3.75	3.32	0.070	3.72E-03	-	-	-	2	396.5	418.6
KG0021A01:3	**35.00**	**36.00**	**35.50**	**0.00**	-	-	-	**9.6E-08**	-	-	2	1976.6	2019.1
KG0021A01:4	19.00	34.00	26.50	9.00	1.68	0.804	3.73E-02	-	-	-	2	583.6	635.4
KG0021A01:5	5.00	18.00	11.50	24.00	4.74	2.024	1.15E-01	-	-	-	2	67.6	66.2
KG0048A01:1	49.00	54.69	51.85	37.80	20.41	1.167	9.44E-02	4.0E-07	2.8E-06	4.3E-06	2	32.3	33.0
KG0048A01:2	34.8	48	41.40	31.27	9.37	1.739	1.15E-01	2.0E-07	1.2E-06	1.7E-06	2	74.4	74.9
KG0048A01:3	32.80	33.80	33.30	27.92	5.76	2.255	1.34E-01	7.4E-08	4.1E-07	5.6E-07	2	187.4	193.0
KG0048A01:4	13.00	31.80	22.40	26.81	9.68	1.238	8.27E-02	2.8E-08	2.2E-07	3.4E-07	2	452.6	424.6
KG0048A01:5	5.00	12.00	8.50	31.40	173.55	0.095	1.42E-02	-	-	-	2	48.6	38.3

6.2.6 Test 10:26 – KG0048A01:3

General test data for the pressure build-up test in the interval 32.80-33.80 m of borehole KG0048A01 are presented in Table 6-16.

Table 6-16 General test data for the pressure build-up test in section 32.80-33.80 m of borehole KG0048A01

General test data			
Borehole section	KG0048A01:3		
Test No	10:26		
Field crew	A. Blom (SWECO Environment)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	32.80
Test section- seclow	Seclow	m	33.80
Test section length	L_w	m	1.00
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm:ss	20091111 07:30:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20091111 08:00:00
Stop of flow period		yymmdd hh:mm:ss	20091111 14:00:00
Test stop (stop of pressure registration)		yymmdd hh:mm:ss	20091112 08:00:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	**Nomen-clature**	**Unit**	**Value**	**Comment**
Absolute pressure in borehole before start of flow period	p_0	kPa	2166	
Absolute pressure in test section before stop of flow	p_p	kPa	161	
Max absolute pressure in test section during recovery period	p_f	kPa	2167	
Maximal pressure change during flow period	dp_p	kPa	2005	

Flow data

Flow data	**Nomen-clature**	**Unit**	**Value**
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.083 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	$1.148 \cdot 10^{-5}$
Total volume discharged during flow period	V_p	m^3	0.2479

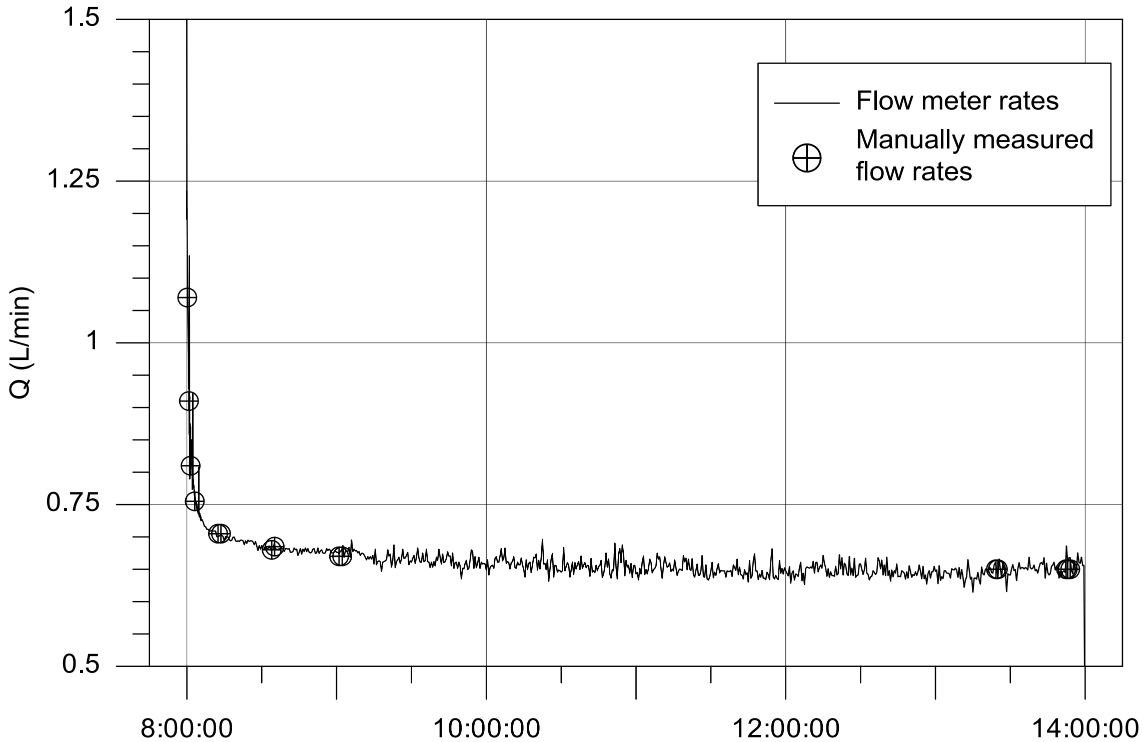


Figure 6-16 *Flow rates during draw down in KG0048A01:3.Time in minutes.*

Comments to the test

The test was successful in regard to pressure responses.

Interpreted flow regimes – flowing section

0 – 0.1	minutes	Well Bore Storage (WBS)
0.1 – 0.3	minutes	Transition period
0.3 – 0.8	minutes	Radial flow period
0.8 – 35	minutes	Transition period
35 – 70	minutes	Spherical flow period
70 –		Transition period

Calculated parameters

Quantitative analysis was made for recovery phases in lin-log- and log-log diagrams according to the methods described in Section 5.4.1.

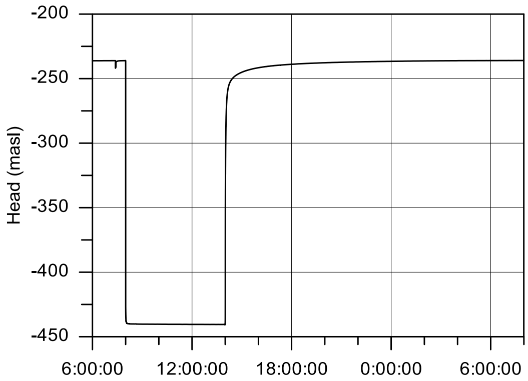
Selected representative parameters

The selected representative parameters from the test in the interval 32.80-33.80 m in KG0048A01 are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

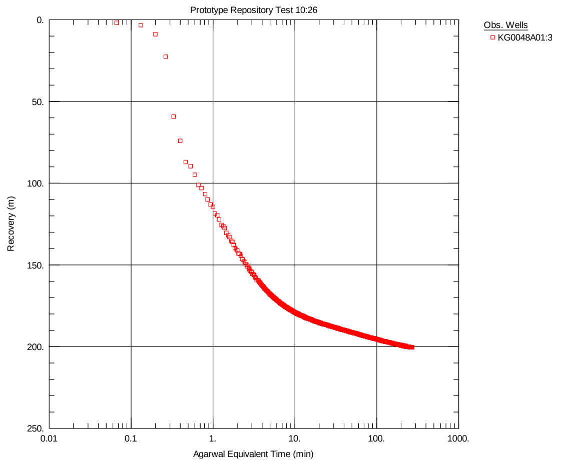
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	10:26
Borehole ID:	KG0048A01	Test start:	2009-11-11 07:30
Test section (m):	32.80-33.80	Responsible for test performance:	SWECO Environment AB A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO Environment AB T. Forsmark

Linear plot Head



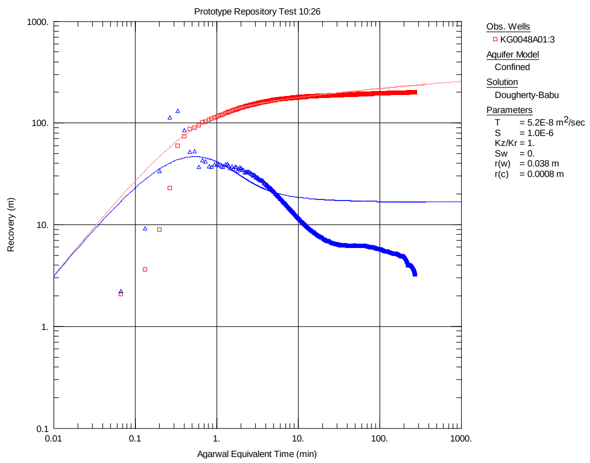
Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	2166		
p_i (kPa)			
p_p(kPa)	161	p_F (kPa)	2167
Q_p (m^3/s)	$1.07 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$5.4 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$3.1 \cdot 10^{-8}$	dt_{e1} (min)	0.3
Flow regime:		dt_{e2} (min)	0.8
dt_1 (min)		T (m^2/s)	$5.2 \cdot 10^{-8}$
dt_2 (min)		S (-)	
T (m^2/s)		K_s (m/s)	
S (-)		S_s (1/m)	
K_s (m/s)		C (m^3/Pa)	
S_s (1/m)		C_D (-)	
C (m^3/Pa)		ξ (-)	0
C_D (-)			
ξ (-)			

Log-Log plot incl. derivative- recovery period



Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.3	C_D (-)	
dt_2 (min)	0.8	ξ (-)	0
T_T (m^2/s)	$5.2 \cdot 10^{-8}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: Evaluation period chosen for early time to give local conditions.

The test was carried out in KG0048A01, section 32.80 - 33.80 metres. The flow period was for 360 minutes with a final flow of 0.65 l/min, while the pressure build-up time was 1080 minutes. In Figure 6-17 and Figure 6-18 the r^2/t_L recordings are shown and in Table 6-17 and Table 6-18 the interference test results are presented. Diagrams of evaluated bore hole sections are presented in Appendix 6.

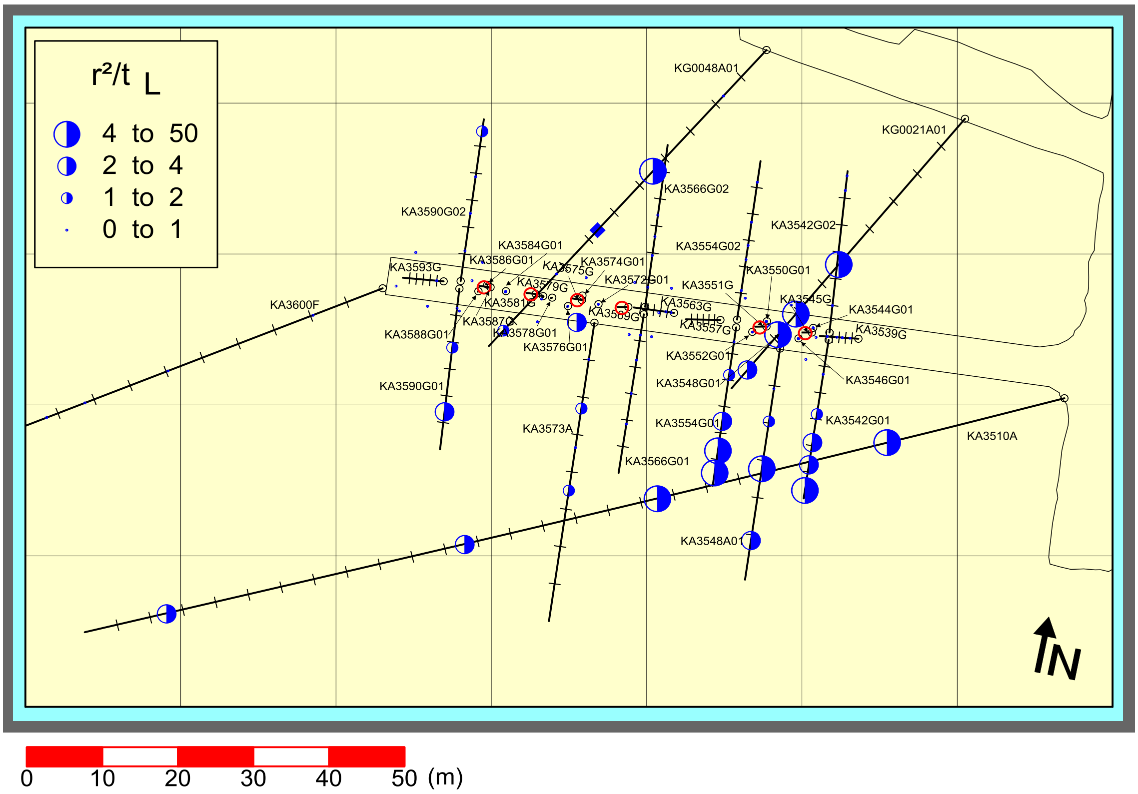


Figure 6-17 *Plot showing r^2/t_L during recovery of KG0048A01:3 (Interference test 10:26) - plan view*

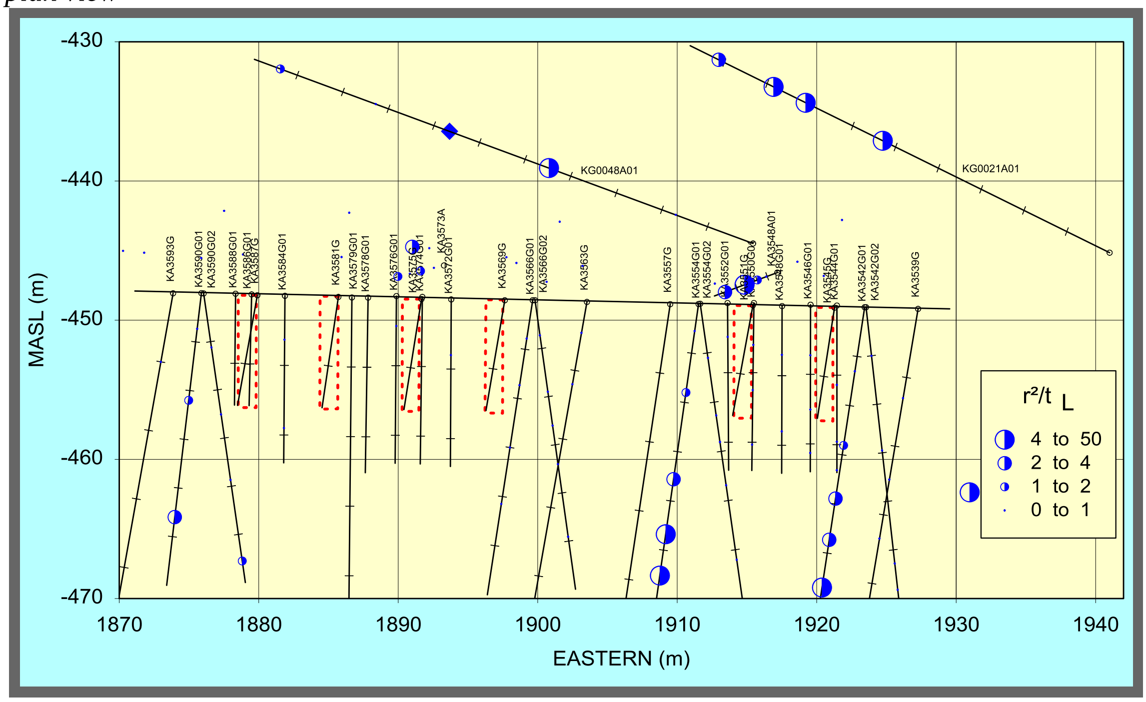


Figure 6-18 *Plot showing r^2/t_L during recovery of KG0048A01:3 (Interference test 10:26) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3590G02:1, KA3590G01:2, KA3573A:2 & 4, KA3554G01:4, KA3548A01:3, KA3542G01:4, KA3539G:3 and KA3510A2&4.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3590G01:1, KA3573C01:1, KA3554G01:3, KA3548A01:1, KA3542G01:2&3, KA3510A:1&3 and KG0021A01:1.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KA3590G02:1, KA3554G01:1&2, KA3548A01:2, KA3542G01:1, KA3510A:4&5 and KG0021A01:2-4.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $6.5 \cdot 10^{-8} – 1.3 \cdot 10^{-6}$ m^2/s. The transmissivity of the flowing section is evaluated to be $5.2 \cdot 10^{-8}$ m^2/s with the evaluation period 0.3 – 0.8 minutes.

The flow section is located above and slightly north of the repository. It is in very good connection with KA3590G02:1 on a lower level and KG0021A01 on the same level. It also has very good connection with several sections of KA3554G01 and KA3548A01 on the south side of the repository. This fits the idea of a pattern of parallel hydraulic features with interconnecting fracture systems wandering up and down in the vertical direction.

When compared to an earlier test 5:26, (*Forsmark T, Rhén, I, 2005)*, the overall figure are similar with a notably increase of the connection observations in KA3542G01.

Table 6-17 Interference test results for KG0048A01, 32.80 - 33.80 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	110.55	54.00	3.772	4.03E-01	-	-	-	1	1.0	0.8
KA3510A:2	110.00	124.00	117.00	93.01	-	-	-	-	-	-	0	0.2	-0.2
KA3510A:3	75.00	109.00	92.00	73.70	36.59	2.474	2.36E-01	4.1E-07	1.4E-06	1.7E-06	2	17.8	18.0
KA3510A:4	51.00	74.00	62.50	56.80	7.47	7.200	4.53E-01	4.0E-07	6.0E-07	8.7E-07	2	48.3	47.2
KA3510A:5	4.50	50.00	27.25	53.43	8.23	5.781	3.72E-01	3.6E-07	6.6E-07	9.7E-07	2	48.3	47.0
KA3539G:1	18.60	30.00	24.30	49.20	82.32	0.490	5.93E-02	7.6E-08	1.9E-06	1.3E-06	1	3.4	30.2
KA3539G:2	15.85	17.60	16.73	44.80	77.15	0.434	5.15E-02	7.8E-08	2.3E-06	1.5E-06	1	3.4	30.2
KA3539G:3	10.00	14.85	12.43	42.69	54.00	0.563	6.00E-02	2.2E-07	4.0E-06	3.7E-06	1	6.1	32.4
KA3539G:4	4.00	9.00	6.50	40.36	67.76	0.401	4.57E-02	1.1E-07	3.4E-06	2.4E-06	1	2.9	30.9
KA3542G01:1	27.00	30.00	28.50	54.56	6.78	7.320	4.50E-01	3.8E-07	4.4E-07	8.5E-07	2	51.8	52.8
KA3542G01:2	21.30	26.00	23.65	50.68	16.80	2.548	1.96E-01	2.1E-07	8.3E-07	1.1E-06	2	46.4	48.9
KA3542G01:3	18.60	20.30	19.45	47.48	17.93	2.096	1.64E-01	1.9E-07	9.2E-07	1.1E-06	2	46.4	48.8
KA3542G01:4	10.50	17.60	14.05	43.60	17.93	1.768	1.38E-01	2.0E-07	1.2E-06	1.4E-06	2	46.2	48.7
KA3542G01:5	3.50	9.50	6.50	38.81	36.59	0.686	6.53E-02	1.8E-06	9.6E-06	2.7E-05	0	-9.6	24.3
KA3542G02:1	28.20	30.01	29.11	46.57	157.46	0.230	3.36E-02	-	-	-	1	2.2	15.5
KA3542G02:2	25.60	27.20	26.40	44.84	121.48	0.276	3.74E-02	-	-	-	1	7.6	25.5
KA3542G02:3	21.50	24.60	23.05	42.84	-	-	-	-	-	-	0	-1.0	-1.0
KA3542G02:4	9.00	20.50	14.75	38.69	100.00	0.249	3.20E-02	-	-	-	0	-2.0	29.8
KA3542G02:5	2.00	8.00	5.00	35.70	24.00	0.885	7.48E-02	8.1E-07	5.9E-06	1.1E-05	2	12.5	39.3
KA3543A01:1	0.65	2.06	1.36	33.47	36.59	0.510	4.86E-02	-	-	-	0	-9.2	30.5
KA3543I01:1	0.65	2.06	1.36	32.15	138.31	0.125	1.76E-02	-	-	-	0	-1.4	6.8
KA3544G01:1	11.65	12.00	11.83	39.13	26.46	0.965	8.38E-02	-	-	-	0	-19.1	38.0
KA3544G01:2	8.90	10.65	9.78	37.89	25.61	0.934	8.04E-02	-	-	-	0	-18.9	38.1
KA3544G01:3	3.50	7.90	5.70	35.64	24.80	0.854	7.28E-02	-	-	-	0	-18.9	38.4
KA3546G01:1	9.30	12.00	10.65	37.54	65.60	0.358	4.05E-02	-	-	-	0	-5.4	19.4
KA3546G01:2	6.75	8.30	7.53	35.71	96.81	0.220	2.79E-02	-	-	-	0	-5.4	13.8
KA3546G01:3	1.50	5.75	3.63	33.68	45.92	0.412	4.19E-02	-	-	-	0	-10.1	23.8
KA3548A01:1	21.50	30.00	25.75	47.06	10.00	3.691	2.49E-01	4.1E-07	9.0E-07	1.6E-06	2	41.2	41.6
KA3548A01:2	11.75	20.50	16.13	39.60	5.06	5.164	2.98E-01	4.5E-07	7.6E-07	1.5E-06	2	50.4	51.0
KA3548A01:3	8.80	10.75	9.78	35.26	17.36	1.194	9.25E-02	1.9E-07	1.7E-06	2.1E-06	2	46.0	47.8
KA3548A01:4	3.00	7.80	5.40	32.65	30.12	0.590	5.31E-02	1.2E-07	2.3E-06	2.2E-06	2	43.6	48.3
KA3548D01:1	0.65	2.06	1.36	28.43	29.16	0.462	4.12E-02	2.9E-06	1.6E-05	6.9E-05	0	-17.4	35.6
KA3548G01:1	6.00	12.00	9.00	34.76	79.69	0.253	3.03E-02	-	-	-	0	-3.9	11.7
KA3548G01:2	2.00	5.00	3.50	31.64	256.12	0.065	1.08E-02	-	-	-	0	-0.6	1.0
KA3550G01:1	8.30	12.03	10.17	33.52	28.23	0.663	5.87E-02	-	-	-	0	-18.4	37.3
KA3550G01:2	5.20	7.30	6.25	31.05	24.80	0.648	5.53E-02	-	-	-	0	-18.0	37.6
KA3550G01:3	1.80	4.20	3.00	29.25	26.46	0.539	4.68E-02	-	-	-	0	-18.2	37.6
KA3550G05:1	1.50	3.00	2.25	32.67	-	-	-	-	-	-	0	0.0	0.2
KA3551G05:1	1.50	3.10	2.30	27.60	-	-	-	-	-	-	0	0.2	0.2
KA3552A01:1	0.65	2.06	1.36	25.82	-	-	-	-	-	-	0	-0.2	0.0
KA3552G01:1	7.05	12.00	9.53	32.57	-	-	-	-	-	-	0	0.4	0.0
KA3552G01:2	4.35	6.05	5.20	29.80	-	-	-	-	-	-	1	1.0	-2.9
KA3552G01:3	1.50	3.35	2.43	28.24	26.46	0.503	4.36E-02	-	-	-	0	-14.9	35.4
KA3552H01:1	0.65	2.10	1.38	23.38	-	-	-	-	-	-	0	-0.2	0.8
KA3553B01:1	0.65	2.02	1.34	23.72	29.16	0.322	2.87E-02	-	-	-	0	-17.6	36.8
KA3554G01:1	25.15	30.01	27.58	47.76	4.90	7.758	4.44E-01	4.5E-07	5.1E-07	1.0E-06	2	52.2	52.8
KA3554G01:2	22.60	24.15	23.38	43.96	4.90	6.575	3.76E-01	4.2E-07	5.8E-07	1.1E-06	2	52.2	53.0
KA3554G01:3	14.00	21.60	17.80	39.04	9.07	2.800	1.84E-01	6.2E-07	1.4E-06	3.4E-06	2	39.5	43.4
KA3554G01:4	5.00	13.00	9.00	31.73	14.76	1.137	8.44E-02	6.2E-07	3.9E-06	7.4E-06	2	31.1	37.2
KA3554G01:5	1.50	4.00	2.75	27.08	96.81	0.126	1.60E-02	-	-	-	0	-0.8	24.6
KA3554G02:1	22.00	30.01	26.01	37.57	121.48	0.194	2.63E-02	-	-	-	0	-3.3	25.4
KA3554G02:2	15.90	21.00	18.45	32.27	31.11	0.558	5.07E-02	2.3E-07	4.1E-06	4.6E-06	2	22.9	50.9
KA3554G02:3	13.20	14.90	14.05	29.63	28.23	0.518	4.59E-02	2.6E-07	4.9E-06	5.6E-06	2	22.9	51.1
KA3554G02:4	10.50	12.20	11.35	28.24	47.43	0.280	2.88E-02	-	-	-	1	8.6	34.2
KA3554G02:5	1.50	9.50	5.50	25.93	103.30	0.108	1.40E-02	-	-	-	2	49.7	55.9
KA3557G:1	15.00	30.04	22.52	38.72	-	-	-	-	-	-	0	-0.2	-2.7
KA3557G:2	1.50	14.00	7.75	27.56	-	-	-	-	-	-	0	-0.2	-0.2
KA3563A01:1	0.65	2.06	1.36	19.08	204.11	0.030	4.67E-03	-	-	-	0	-3.7	0.7
KA3563D01:1	0.65	2.01	1.33	15.61	256.12	0.016	2.64E-03	-	-	-	1	1.7	1.7
KA3563G:1	15.00	30.01	22.51	36.46	-	-	-	-	-	-	0	-1.0	-3.2
KA3563G:2	10.00	13.00	11.50	27.06	-	-	-	-	-	-	0	-0.5	0.7
KA3563G:3	4.00	8.00	6.00	22.90	57.62	0.152	1.65E-02	1.5E-07	1.0E-05	9.4E-06	2	20.6	28.3
KA3563G:4	1.50	3.00	2.25	20.44	110.22	0.063	8.34E-03	-	-	-	1	3.4	8.1
KA3563I01:1	0.65	2.15	1.40	14.98	133.89	0.028	3.90E-03	-	-	-	1	3.7	7.4
KA3566C01:1	0.65	2.1	1.38	17.02	24.80	0.195	1.66E-02	5.3E-07	1.9E-05	3.2E-05	2	17.5	20.9

Table 6-18 Interference test results for KG0048A01, 32.80 - 33.80 m. (r = aprox. distance from flowing bore hole section to observation bore hole section, t_L = time lag for a pressure response of 0.1 m to be registered in an observation section, T = transmissivity, S = storage coefficient, S^* = storage coefficient from diffusivity, η.) The drawdown response is classified as 0 = no response (< 0.1 m), 1 = some response (0.1 m - 1.0 m) and 2 = good response (> 1.0 m).

Observation borehole	Secup (m)	Seclow (m)	Mid-section (m)	r (m)	t_L (recovery) (min)	r^2/t_L (m²/s)	η (m²/s)	T_{EVAL} (m²/s)	S (-)	S^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	43.18	-	-	-	-	-	-	1	1.7	0.0
KA3566G01:2	20.00	21.50	20.75	37.28	147.58	0.157	2.25E-02	-	-	-	1	4.4	7.6
KA3566G01:3	12.00	18.00	15.00	31.68	33.20	0.504	4.67E-02	5.8E-07	8.3E-06	1.3E-05	2	16.2	16.5
KA3566G01:4	7.30	10.00	8.65	25.57	142.87	0.076	1.08E-02	-	-	-	1	4.4	8.1
KA3566G01:5	1.50	6.30	3.90	21.09	152.44	0.049	7.05E-03	-	-	-	1	4.2	7.6
KA3566G02:1	19.00	30.10	24.55	31.24	142.87	0.114	1.62E-02	-	-	-	1	5.7	9.4
KA3566G02:2	16.00	18.00	17.00	25.22	162.66	0.065	9.62E-03	-	-	-	1	4.9	8.4
KA3566G02:3	12.00	14.00	13.00	22.41	147.58	0.057	8.14E-03	-	-	-	1	5.2	8.8
KA3566G02:4	8.00	11.00	9.50	20.27	138.31	0.050	6.98E-03	-	-	-	1	5.7	9.3
KA3566G02:5	1.30	6.00	3.65	17.71	147.58	0.035	5.09E-03	-	-	-	1	5.4	8.6
KA3568D01:1	0.65	2.30	1.48	12.66	147.58	0.018	2.60E-03	-	-	-	1	4.2	6.6
KA3572G01:1	7.30	12.03	9.67	23.87	-	-	-	-	-	-	0	-0.5	-3.9
KA3572G01:2	2.70	5.30	4.00	18.84	224.96	0.026	4.23E-03	-	-	-	1	2.7	2.2
KA3573A:1	26.00	40.07	33.04	46.49	-	-	-	-	-	-	0	-0.5	0.7
KA3573A:2	21.00	24.00	22.50	36.23	13.83	1.582	1.16E-01	1.2E-06	4.2E-06	1.0E-05	2	18.4	16.0
KA3573A:3	14.50	19.00	16.75	30.70	63.51	0.247	2.77E-02	5.0E-07	1.5E-05	1.8E-05	2	12.6	11.6
KA3573A:4	10.50	12.50	11.50	25.75	11.02	1.003	6.92E-02	1.3E-06	7.5E-06	1.8E-05	2	18.7	16.7
KA3573A:5	1.30	8.50	4.90	19.75	10.67	0.609	4.17E-02	1.2E-06	1.3E-05	2.8E-05	2	18.7	16.7
KA3573C01:1	0.65	2.05	1.35	15.00	1.43	2.625	1.18E-01	2.2E-07	1.1E-06	1.9E-06	2	103.2	109.3
KA3574D01:1	0.65	2.05	1.35	10.59	256.12	0.007	1.21E-03	-	-	-	1	1.5	1.0
KA3574G01:1	8.00	12.03	10.02	23.67	-	-	-	-	-	-	0	-0.2	0.0
KA3574G01:2	5.10	7.00	6.05	20.04	-	-	-	-	-	-	0	0.5	-2.2
KA3574G01:3	1.80	4.10	2.95	17.31	-	-	-	-	-	-	0	0.2	0.5
KA3576G01:1	8.00	12.01	10.01	24.41	-	-	-	-	-	-	0	-0.2	0.0
KA3576G01:2	4.00	6.00	5.00	20.02	-	-	-	-	-	-	0	-0.5	-0.2
KA3576G01:3	1.30	3.00	2.15	17.66	100.00	0.052	6.66E-03	-	-	-	1	3.4	3.7
KA3578C01:1	0.65	2.09	1.37	16.99	25.61	0.188	1.62E-02	1.2E-06	3.2E-05	7.1E-05	2	11.1	12.1
KA3578G01:1	6.50	12.58	9.54	24.05	-	-	-	-	-	-	0	-0.7	0.5
KA3578G01:2	4.30	5.50	4.90	19.98	-	-	-	-	-	-	0	0.5	-0.5
KA3578H01:1	0.65	1.90	1.28	13.00	32.14	0.088	8.04E-03	1.8E-07	2.3E-05	2.2E-05	2	25.3	29.3
KA3579D01:1	0.65	2.00	1.33	12.18	-	-	-	-	-	-	0	-0.2	0.7
KA3579G:1	14.70	22.65	18.68	32.61	-	-	-	-	-	-	0	0.0	-1.7
KA3579G:2	12.50	13.70	13.10	27.44	-	-	-	-	-	-	0	0.0	-2.9
KA3579G:3	2.30	11.50	6.90	21.92	-	-	-	-	-	-	0	-0.5	0.0
KA3584G01:1	7.00	12.00	9.50	25.74	240.04	0.046	7.53E-03	-	-	-	0	-0.7	1.2
KA3584G01:2	1.30	5.00	3.15	20.73	264.57	0.027	4.54E-03	-	-	-	0	0.5	1.0
KA3588C01:1	0.65	2.04	1.35	22.68	24.80	0.346	2.95E-02	3.1E-07	7.9E-06	1.0E-05	2	24.8	25.8
KA3588D01:1	0.65	1.90	1.28	17.77	39.04	0.135	1.31E-02	1.4E-06	4.6E-05	1.1E-04	1	7.4	8.3
KA3588I01:1	0.65	1.96	1.31	18.40	26.46	0.213	1.85E-02	1.4E-06	3.0E-05	7.3E-05	1	9.1	9.8
KA3590G01:1	16.00	30.00	23.00	41.66	11.39	2.540	1.77E-01	3.7E-07	1.2E-06	2.1E-06	2	39.9	40.9
KA3590G01:2	7.00	15.00	11.00	31.07	10.00	1.609	1.08E-01	3.7E-07	2.1E-06	3.4E-06	2	40.1	40.6
KA3590G01:3	1.30	6.00	3.65	25.21	40.33	0.263	2.57E-02	5.6E-07	1.5E-05	2.2E-05	2	12.8	13.5
KA3590G02:1	25.50	30.01	27.76	36.68	20.41	1.099	8.89E-02	6.5E-08	7.4E-07	7.4E-07	2	180.2	145.5
KA3590G02:2	15.20	23.50	19.35	30.40	85.03	0.181	2.21E-02	-	-	-	2	113.8	86.0
KA3590G02:3	11.90	13.20	12.55	26.21	217.79	0.053	8.39E-03	-	-	-	1	7.4	4.9
KA3590G02:4	1.30	9.90	5.60	23.24	50.61	0.178	1.86E-02	5.0E-07	2.0E-05	2.7E-05	2	13.5	13.0
KA3592C01:1	0.65	2.01	1.33	25.63	54.00	0.203	2.16E-02	1.4E-06	3.1E-05	6.5E-05	1	5.9	6.9
KA3593G:1	25.20	30.02	27.61	46.42	-	-	-	-	-	-	0	-0.2	0.0
KA3593G:2	23.50	24.20	23.85	43.01	-	-	-	-	-	-	2	13.0	13.5
KA3593G:3	9.00	22.50	15.75	35.91	-	-	-	-	-	-	0	0.2	0.7
KA3593G:4	3.00	7.00	5.00	27.35	232.38	0.054	8.71E-03	-	-	-	1	3.4	2.2
KA3597D01:1	0.65	2.22	1.44	25.10	28.23	0.372	3.29E-02	1.4E-06	1.8E-05	4.3E-05	1	7.6	8.8
KA3597H01:1	0.65	2.06	1.36	27.56	32.14	0.394	3.61E-02	7.6E-07	1.3E-05	2.1E-05	2	12.0	13.0
KA3600F:1	43.00	50.10	46.55	75.88	247.95	0.387	6.39E-02	-	-	-	0	1.0	0.7
KA3600F:2	40.50	42.00	41.25	70.62	247.95	0.335	5.53E-02	-	-	-	0	1.0	0.5
KA3600F:3	20.00	39.50	29.75	59.23	70.00	0.835	9.63E-02	-	-	-	1	3.4	3.2
KA3600F:4	1.30	18.00	9.65	39.47	204.11	0.127	2.00E-02	-	-	-	1	6.2	4.9
KG0021A01:1	42.50	48.82	45.66	27.23	4.03	3.064	1.68E-01	8.3E-08	4.1E-07	5.0E-07	2	183.6	202.8
KG0021A01:2	37.00	41.50	39.25	27.23	1.21	10.171	4.45E-01	1.0E-07	1.2E-07	2.3E-07	2	232.1	251.0
KG0021A01:3	35.00	36.00	35.50	27.92	2.92	4.455	2.29E-01	1.0E-07	2.8E-07	4.4E-07	2	224.4	227.3
KG0021A01:4	19.00	34.00	26.50	31.40	2.04	8.050	3.86E-01	1.3E-07	2.2E-07	3.4E-07	2	221.2	222.5
KG0021A01:5	5.00	18.00	11.50	41.10	-	-	-	-	-	-	2	20.2	23.6
KG0048A01:1	49.00	54.69	51.85	18.55	3.66	1.567	8.43E-02	-	-	-	2	51.0	52.2
KG0048A01:2	34.8	48	41.40	8.09	1.21	0.898	3.93E-02	-	-	-	2	119.8	127.6
KG0048A01:3	**32.80**	**33.80**	**33.30**	**0.00**	-	-	-	**5.2E-08**	-	-	2	2004.6	2005.6
KG0048A01:4	13.00	31.80	22.40	10.91	0.31	6.372	2.26E-01	-	-	-	2	197.9	181.4
KG0048A01:5	5.00	12.00	8.50	24.80	185.18	0.055	8.47E-03	-	-	-	2	12.5	16.4

6.3 Hydraulic diffusivity

The diffusivity, η, versus the distance, r, and the time lag versus the distance, r, are shown in Figure 6-19 below. Data are from all 6 interference tests performed during this test campaign.

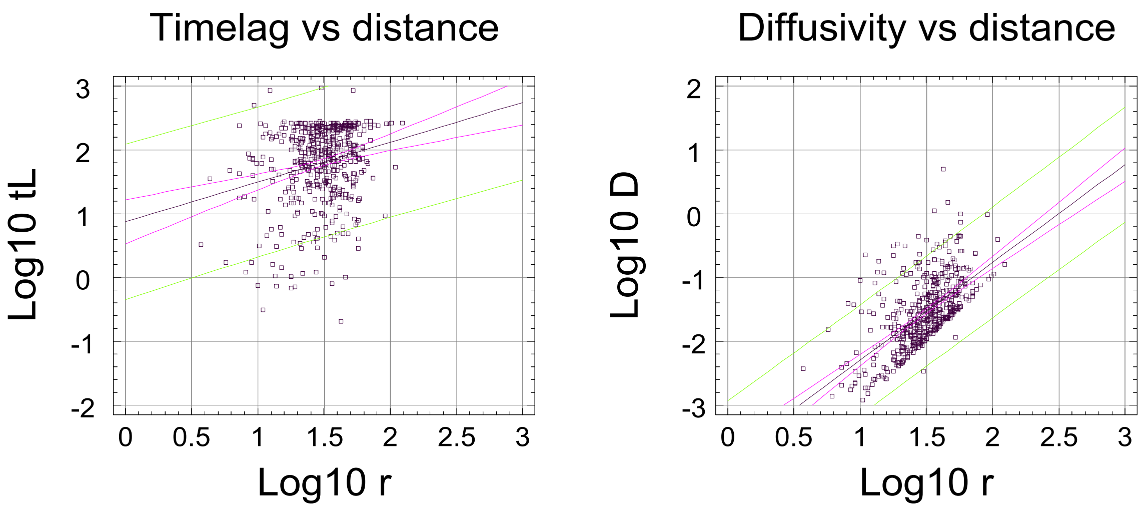


***Figure 6-19** Linear regression plots of time lag and diffusivity versus distance. Distance r in meters and t_L in minutes.*

The equations of the regression lines in *Figure 6-19* are

$$\mathrm{Log}_{10}\, t_L = 0.625 * \mathrm{Log}_{10}\, r + 0.873$$

$$\mathrm{Log}_{10}\, \eta = 1.53 * \mathrm{Log}_{10}\, r - 3.83$$

The apparent increase of diffusivity by distance in Figure 6-19 is probably not entirely relevant. As part of the flow is more spherical than radial the time lag should increase by distance. It is however probable that some feature with high transmissivity is involved at larger distances from the source that can partly justify a linear trend. Possibly the most relevant estimates of diffusivity is for short distances, which may be up to around 10 metres. According to this the range for the diffusivity should be 0.001 – 0.1 m^2/s. However, from earlier experiences it is known that the diffusivity may become closer to 1 m^2/s for increasing transmissivities (*Rhén et al. 1997*).

6.4 Storativity

The storativity is not always received from a hydraulic test. In order to estimate an approximate value of the parameter a relationship between the evaluated transmissivity T_{EVAL} and the evaluated storativity S is established from the six evaluated interference tests 10:21-10:26. The results are shown in Figure 6-20. The evaluated relations between T and S should be seen as indications or possible ranges for S.

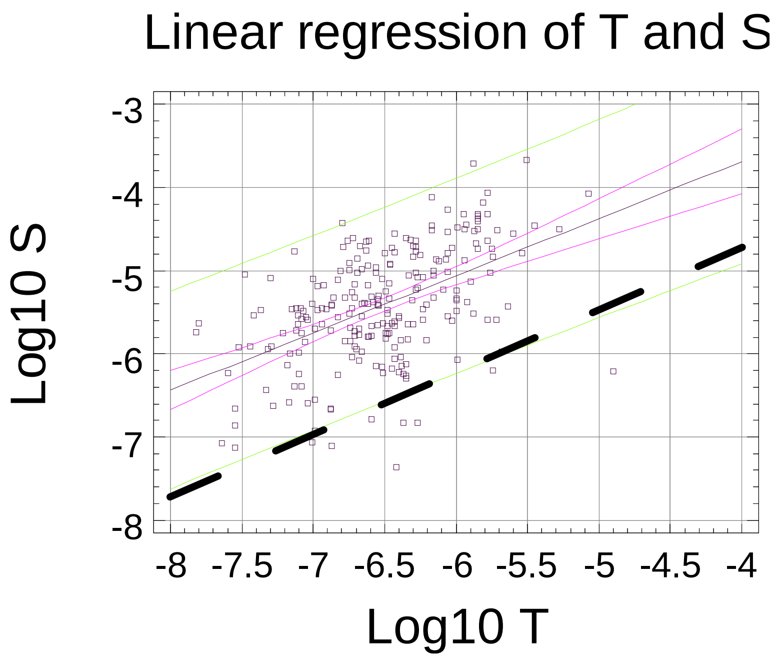


Figure 6-20 *Linear regression of T_{EVAL} and S. Transmissivity in m^2/s.Dotted line shows the relation S(T) from (Rhen et al. 2008).*

The equation of the regression line in Figure 6-20 is

$$Log_{10} S = 0.687 * Log_{10} T_{EVAL} – 0.939$$

During the siteinvestigations at Laxemar, (*Rhen et al. 2008)*, interferencetests shows a relationsship (dotted line) as

$$Log_{10} S = 0.71 * Log_{10} T_{EVAL} – 0.0109$$

The relationship between T_{EVAL} and the storativity estimated from the diffusivity, η, is shown in Figure 6-21. Results from all six tests 10:21 to 10:26 are included.

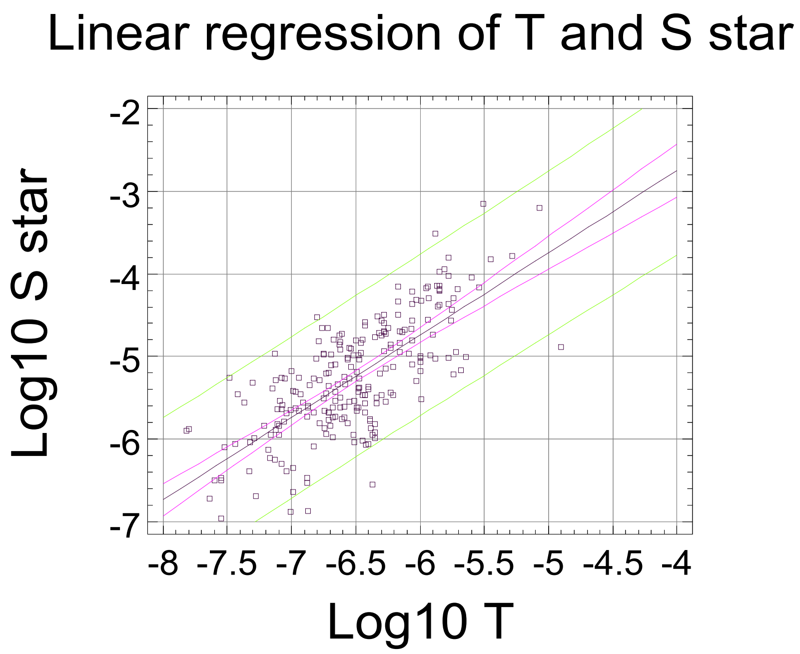


Figure 6-21 *Linear regression of T_{EVAL} and S^*. Transmissivity in m^2/s.*

The equation of the regression line in Figure 6-21 is

$$Log_{10}\, S^* = 0.998 * Log_{10}\, T + 1.24$$

7 References

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