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Äspö Hard Rock Laboratory

Prototype Repository

Hydraulic tests and deformation measurements during operation phase, test campaign 1, interference test

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April 2004

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Keywords: Äspö HRL, Prototype Repository, hydrogeology, hydraulic tests, interference tests, hydraulic parameters, transmissivity, storage coefficient

Abstract

The Prototype Repository project is focused on testing and demonstrating the function of the SKB deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included in the project but are also part of other projects.

This report describes the first interference test campaign during the operation period of the Prototype Repository.

The test campaign consisted of running 7 interference tests with one flowing section and 131 observation sections. Each test consisted approximately of a 6 hours long flowing period and a 18 hours long recovery period.

Sammanfattning

Huvudsyftet med prototypförvaret är att testa och demonstrera funktionen av en del av SKB:s djupförvars system. 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 prototyp förvaret men även i andra projekt.

Rapporten beskriver den första interferenstestkampanjen under Prototypförvarets driftperiod.

Testkampanjen bestod av 7 interferenstester med en flödessektion och 131 observationssektioner. Varje test bestod approximativt av en 6-timmars flödesperiod och en 18-timmars återhämtningsperiod.

Executive Summary

The Prototype Repository project is focused on testing and demonstrating the function of the SKB deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included in the project but are also part of other projects.

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

The test campaign consisted of running 7 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 versus the distance, r, are shown in *Figure 1* below. Data are from all 7 interference tests performed during the test campaign.

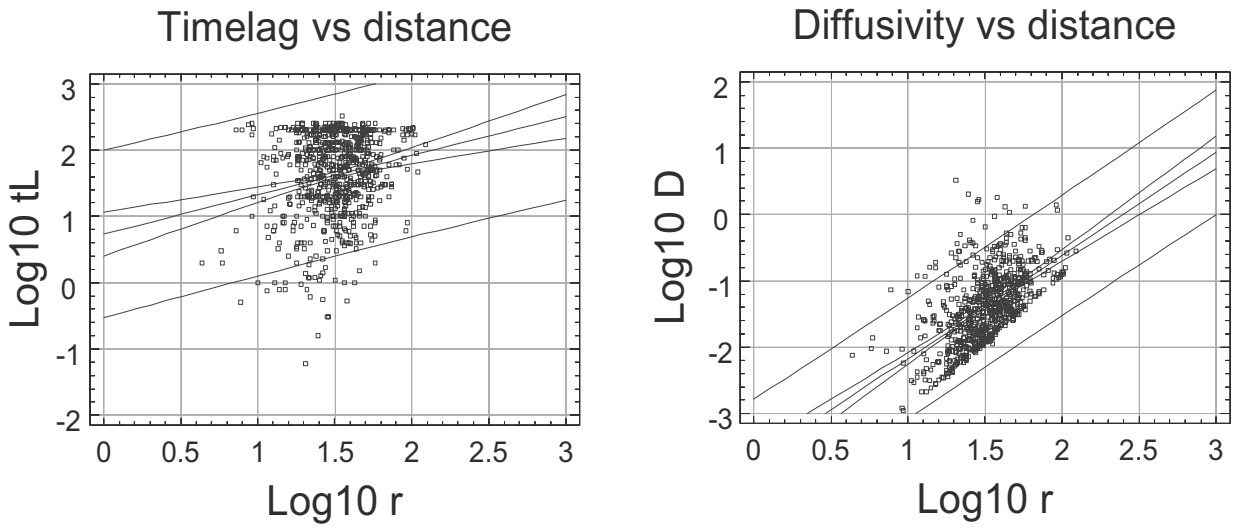

Figure 1 *Linear regression plots of time lag and diffusivity versus distance. Distance r in meters and t_L in minutes*

The equations of the regression lines in *Figure 1* are

$$\text{Log}_{10}\, t_L = 0.591 * \text{Log}_{10}\, r + 0.734$$

$$\text{Log}_{10}\, \eta = 1.553 * \text{Log}_{10}\, r - 3.723$$

The apparent increase of diffusivity by distance in *Figure 1* is probably not relevant. As part of the flow is more spherical than radial the time lag should increase by distance. 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 seven evaluated interference tests 1:21-1:27. The results are shown in *Figure 2.*

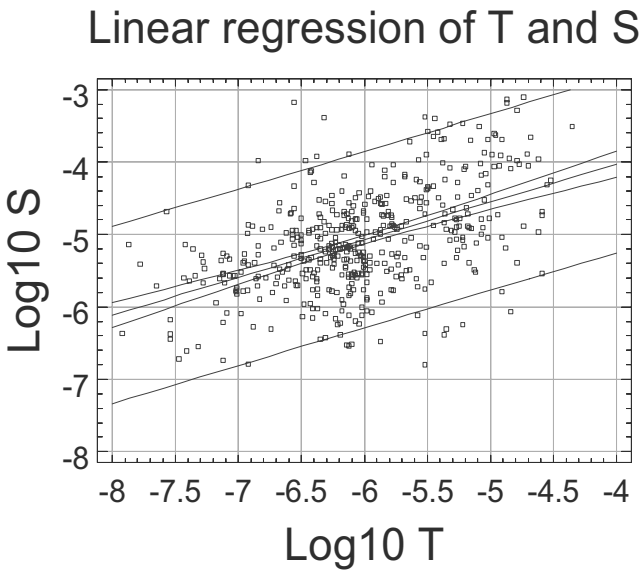

Figure 2 *Linear regression of T_{EVAL} and S. Transmissivity in m^2/s.*

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

$$Log_{10}\ S = 0.520 * Log_{10}\ T_{EVAL} - 1.948$$

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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.

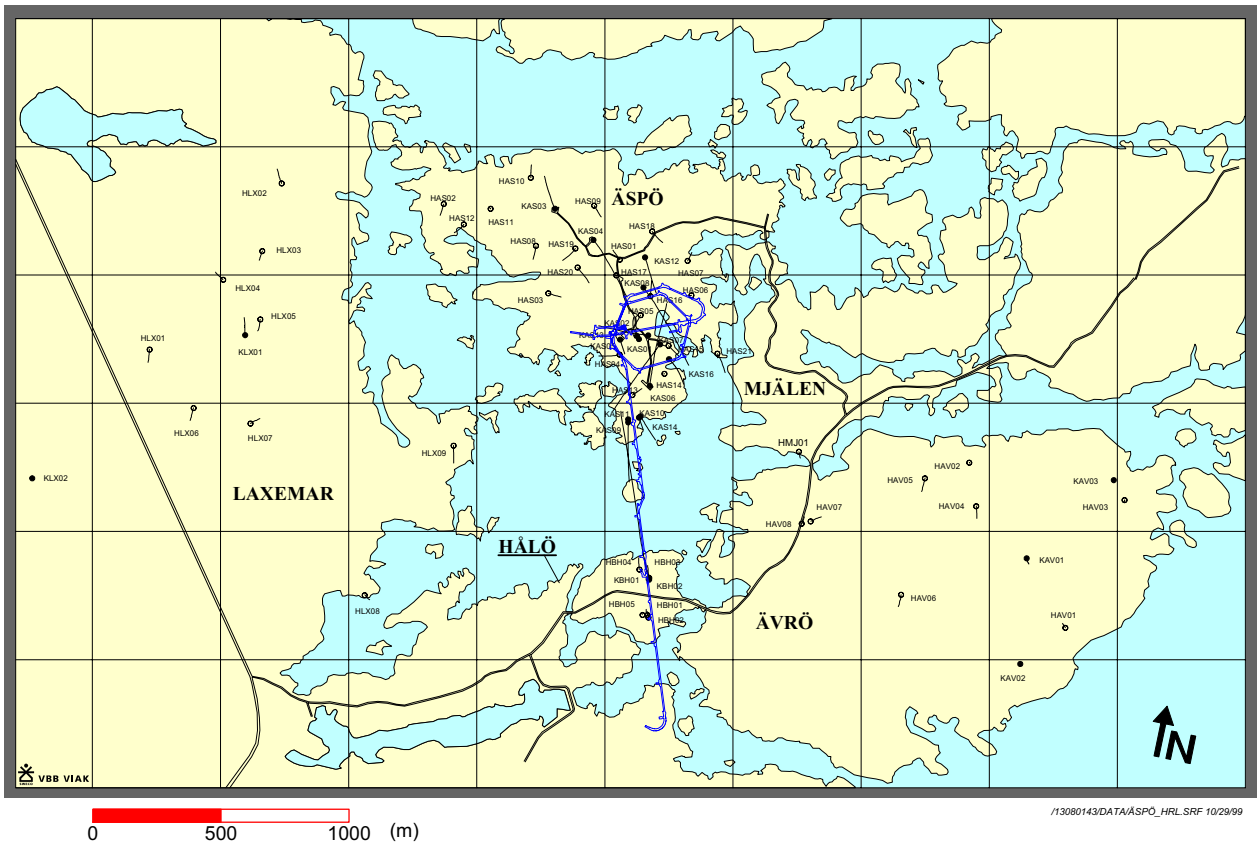


Figure 1-1 *Location of Äspö Hard Rock Laboratory*

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 deep 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 deep 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 deep repository system. Activities aimed at contributing to development and testing of the practical, engineering measures required to rationally perform the steps of a deposition sequence are also included. However, efforts in this direction are limited, since these matters are addressed in the Demonstration of Repository Technology project and to some extent in the Backfill and Plug Test.

1.2.1 General objectives

The Prototype Repository should simulate as many aspects as possible 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 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 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 objective for the interference tests is

- 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 7 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 first test campaign, while the second number indicates the chronological order of the interference tests. Tests 1:1-1:13 were single hole tests done during the same period in May 2003, see *Forsmark T, 2003*. Also indicated are those sections where Hydro Mechanical measurements (HM) are done.

Table 3-1 Interference tests during the campaign in May 2003

Bore hole	Section	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	1:21	2003-05-09	06:40:00	08:40:00	14:50:00	06:30:00
KA3542G02:5	2.00-8.00	-	1:22	2003-05-10	06:55:00	08:55:00	14:55:00	08:30:00
KA3554G01:2	22.60-24.15	X	1:23	2003-05-11	08:35:00	10:35:00	16:35:00	09:41:00
KA3590G02:1	25.50-30.01	-	1:24	2003-05-12	07:41:00	09:41:00	15:41:00	09:40:00
KG0021A01:3	35.00-36.00	-	1:25	2003-05-13	07:40:00	09:40:00	15:40:00	09:40:00
KG0048A01:3	32.80-33.80	-	1:26	2003-05-14	07:40:00	09:40:00	15:40:00	09:40:00
KA3573A:4	10.50-12.50	-	1:27	2003-05-15	07:40:00	09:40:00	15:40:00	09:40:00

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 3rd second. During periods with no hydraulic tests, preliminary the sampling (storing a value in the data base) frequency will be every 2nd 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 3rd 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 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 two 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 Deformation measurements

During storage of nuclear waste in the rock mass the temperature will increase due to the heat loss from the canisters with spent fuel. This will increase the rock stresses and the fractures will close, *see Rhen et al, 2004.*

It is of great interest to investigate the magnitude of this effect on the fracture transmissivity since the fracture transmissivity is essential of two reasons. First, enough transmissivity is needed to provide the bentonite buffer with water if no artificial moistening of the buffer is arranged. Secondly, the transmissivity should be as low as possible in order to minimise the hydraulic contact with the canisters. The increased temperature will decrease the transmissivity, which in principal is positive in perspective of Safety Assessment. The last effect is however limited in time and may not be of any greater importance in Safety Assessment.

In order to investigate the hydro mechanical response of the fractures as a result of the increased thermal load, two different approaches are considered.

The first approach is to measure the change of the fracture width as function of temperature and time. The displacement is both measured for the intact rock as for a section with one or more fractures.

The second approach implies that the mechanical response is evaluated indirect by using the results from hydraulic tests. Hydro tests will be performed in the same sections as the mechanical measurements are made, *see Table 3-1*.

Displacement measurements will be made continuously. Hydraulic tests will be made a number of times during the operation period for the ten measurement sections. Most tests will be made during the first years of operation when the largest displacements are expected to be measured.

4.3.1 Measurement equipment

In order to measure the fracture deformation (and to separate the fracture deformation from the deformation of the intact rock) due to the increased temperature a measurement equipment has been developed.

The equipment consists of two hydraulic packers, which hydraulically isolate the test section. Between the packers three anchors are placed. These anchors are fixed to the borehole wall and in the sections between the anchors sensors (strain gage) are mounted. These sections are called mechanical measurement sections. The sensors will register any relative movement between the anchors; *see Figure 4-3 and 4-4*. The temperature is also measured in each sensor by a thermistor.

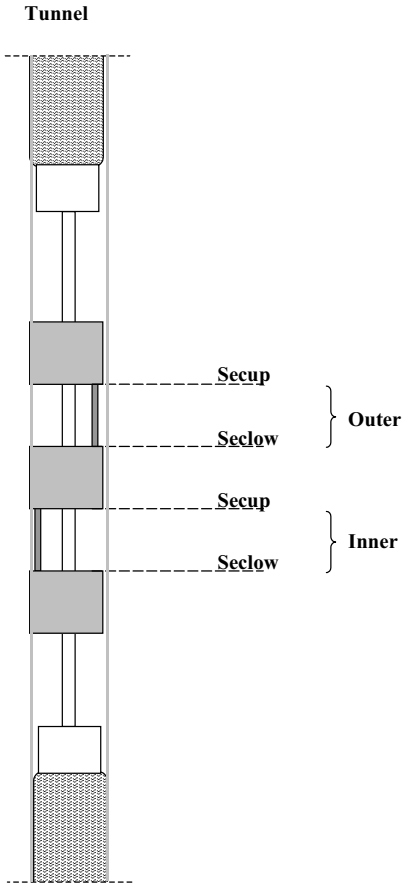


Figure 4-3 *A schematic figure, that shows the different parts of the test equipment and also the definitions of the terms outer and inner.*

The deformation is measured in two sections in each borehole. One mechanical measurement section is placed over a fracture (or fractures) and the other mechanical measurement section is placed over intact rock. That makes it possible to separate the fracture deformation from the deformation of the intact rock.

Of all boreholes in the prototype tunnel, ten are equipped as described above. Five of the measurement sections are placed over a single fracture and the rest are placed over two-six fractures, *see Table 4-1*.

Since hydraulic packers isolate the test sections and the test sections have contact with the tunnel (atmospheric pressure) via tubes and valves it is possible to perform hydraulic tests in the sections.

Table 4-1 Data of the measurement sections (sensors, length, number of fractures etc).

Label	Cable mark	Sensor S/N	Position	Secup	Seclow	Section length (m)	Number of fractures
KA3539G-2-1	HRA 1121	3511	Inner	16.77	16.97	0.20	2
KA3539G-2-2	HRA 1122	3510	Outer	16.47	16.67	0.20	0
KA3542G01-3-1	HRA 1231	3513	Inner	19.47	19.67	0.20	0
KA3542G01-3-2	HRA 1232	3512	Outer	19.17	19.37	0.20	1
KA3542G02-2-1	HRA 1321	3515	Inner	26.50	26.70	0.20	1
KA3542G02-2-2	HRA 1322	3514	Outer	26.20	26.40	0.20	0
KA3544G01-2-1	HRA 1621	3509	Inner	9.82	10.02	0.20	1
KA3544G01-2-2	HRA 1622	3508	Outer	9.52	9.72	0.20	0
KA3546G01-2-1	HRA 1721	3517	Inner	7.67	7.87	0.20	1
KA3546G01-2-2	HRA 1722	3516	Outer	7.37	7.57	0.20	0
KA3548A01-3-1	HRA 1831	3526	Inner	9.70	10.15	0.45	2
KA3548A01-3-2	HRA 1832	3518	Outer	9.40	9.60	0.20	0
KA3550G01-2-1	HRA 2121	3527	Inner	6.10	6.70	0.60	6
KA3550G01-2-2	HRA 2122	3519	Outer	5.80	6.00	0.20	0
KA3552G01-2-1	HRA 2521	3521	Inner	5.25	5.45	0.20	0
KA3552G01-2-2	HRA 2522	3520	Outer	4.95	5.15	0.20	2
KA3554G01-2-1	HRA 2821	3525	Inner	23.54	23.80	0.26	2
KA3554G01-2-2	HRA 2822	3522	Outer	23.24	23.44	0.20	0
KA3554G02-4-1	HRA 2941	3524	Inner	11.40	11.60	0.20	0
KA3554G02-4-2	HRA 2942	3523	Outer	11.10	11.30	0.20	1
KG0010B01-1-1	-	3238	Inner	3.66	3.86	0.20	-
KG0010B01-1-2	-	3507	Outer	3.36	3.56	0.20	-

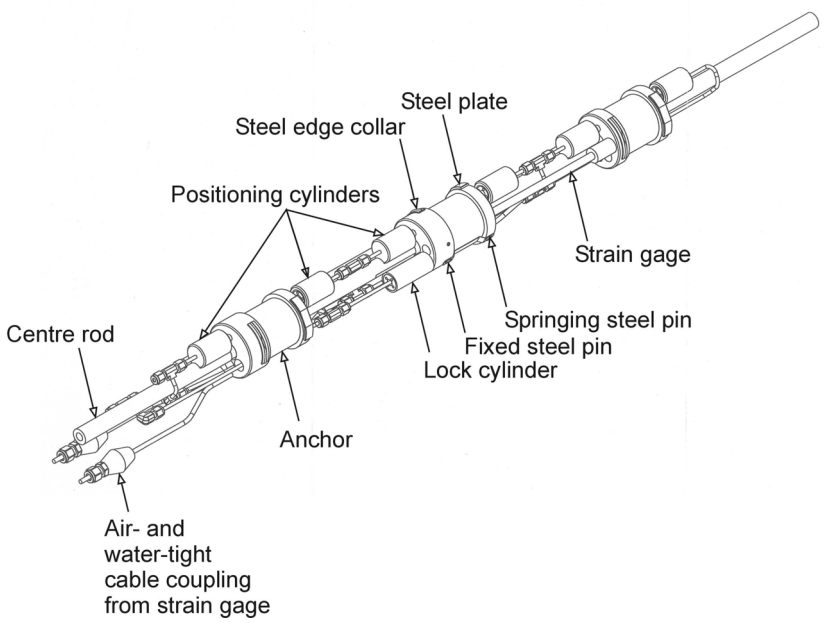


Figure 4-4 *A detailed figure of the three anchors, sensors (strain gage), positioning cylinder etc.*

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 included

- measuring glasses of various sizes
- synchronizing watches with the HMS system (only normal time)
- protocols for flow measurements
- water sampling bottles
- hand calculator

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 logger frequency 5 minutes
- A couple of minutes before flow start and until 5 minutes after flow start 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 used
- 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 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 test 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

When plotting the data, three different kinds of graphs can be 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, is defined as

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

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(tp)
p(dt)	=	measured pressure after shutting the valve
p(tp)	=	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). 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.

The software DERIV is used to produce the derivative. DERIV is software for converting slug and constant-rate discharge test data and type curves to derivative format. The software has features that permit the smoothing of noisy test data, accounts for pressure derivative end-effects, and can be used to convert slug test data to equivalent constant-rate test responses.

Two different geohydrological parameters of the borehole can easily be evaluated. These parameters are:

- the specific capacity, Q/s (m^2/s)
- the transmissivity, T (m^2/s)

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.

To evaluate the transmissivity, T, the following methodology should be used:

The flow regime can be estimated from the logarithmic plot. In most cases the flow can be said to be radial to the borehole approximately 1.0-1.5 decades after the time the curve has left the 1:1 curve. The 1:1 curve indicates the well bore storage, WBS. The transmissivity is then calculated with Jacob's semi logarithmic approximation of Theis well function

$T = 0.183 \cdot Q / \Delta s$

Q = the average flow rate before shutting the valve (m^3/s)
Δs = the pressure change in metres during a decade along the straight line (radial flow period) in the semi logarithmic diagram.

Sometimes both the logarithmic and the semi logarithmic diagrams indicate a more complicated flow regime than described above (WBS, transition, radial flow) and in these cases it is necessary to decide what part of the curve and what evaluation method that is appropriate for estimating the hydraulic properties.

The Moye formula can be used for interpretation of stationary tests in order to get an estimate of the transmissivity

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

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

5.4.2 Interference tests

Pressure registration was made in neighbouring bore holes 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 7* some evaluated observation sections ($r^2/t_L > 1$, see below) are presented. The mid-chainage of each bore hole section has been calculated as the weighted average point of the inflow of water to the bore hole section. 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:

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

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 table 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 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 therefore 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 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.

In the test evaluation the following grouping is used:

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

6 Results

6.1 General

During two interference test campaigns in 1999, reported in *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

6.2 Interference tests

6.2.1 Test 1:21 – 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	1:21		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
Test equipment system	HMS		
General comment	Single hole 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	20030509 06:40:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030509 08:40:00
Stop of flow period		yymmdd hh:mm:ss	20030509 14:50:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030510 06:30:00
Total flow time	t_p	min	370
Total recovery time	t_F	min	940

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	2445.6	
Absolute pressure in test section before stop of flow	p_p	kPa	741.6	
Absolute pressure in test section at stop of recovery period	p_f	kPa	2419.1	
Maximal pressure change during flow period	dp_p	kPa	1704.0	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$3.24 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

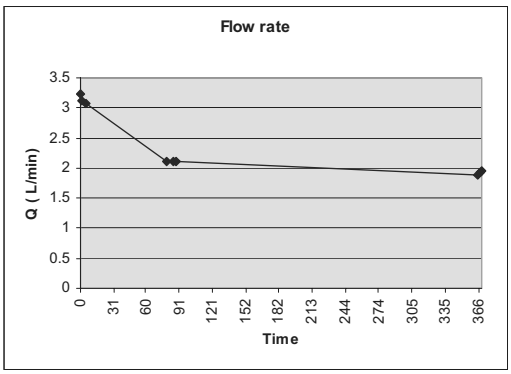


Figure 6-1 *Flow rates during draw down in KA3539G:2. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.1 minutes	Well Bore Storage (WBS)
0.1 – 0.2 minutes	Transition period
0.2 – 0.8 minutes	Radial flow period
0.8 – 40 minutes	Linear channel flow
40 – 300 minutes	Constant pressure flow boundary

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.

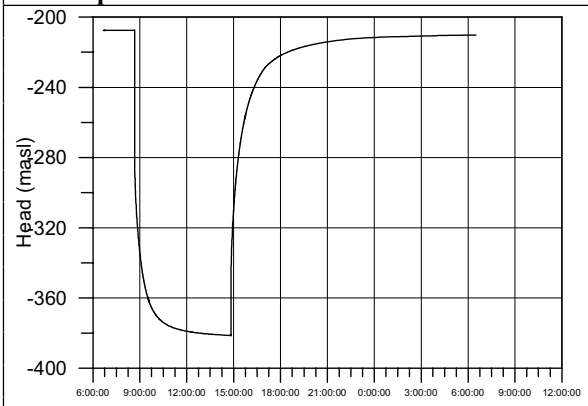
Selected representative parameters

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

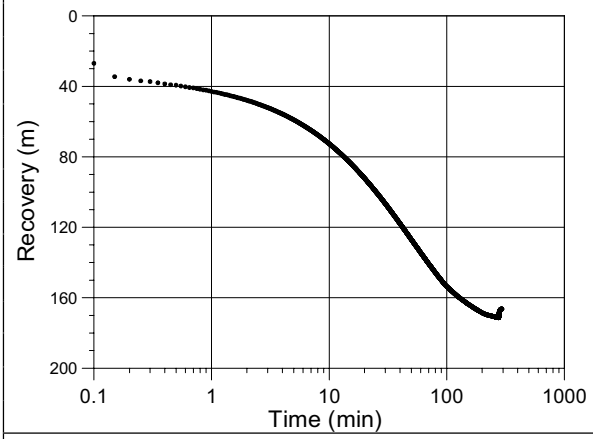
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:21 (Single hole test 1:13)
Borehole ID:	KA3539G	Test start:	2003-05-09 06:40
Test section (m):	15.85-17.60	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

Linear plot Head



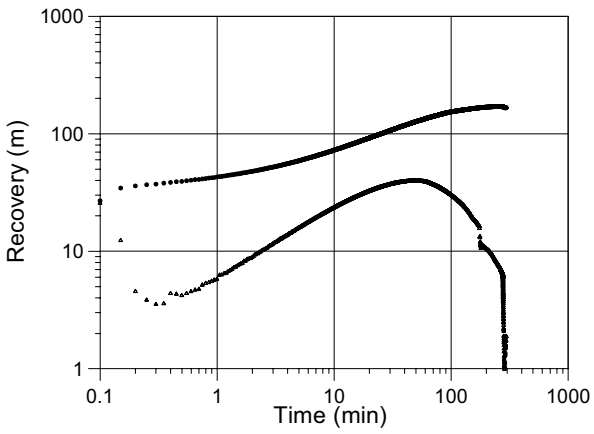
Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	2445.6		
p_i (kPa)			
p_p(kPa)	741.6	p_F (kPa)	2419.1
Q_p (m^3/s)	$3.24 \cdot 10^{-5}$		
tp (min)	370	t_F (min)	940
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$1.9 \cdot 10^{-7}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$1.3 \cdot 10^{-7}$	dt_{e1} (min)	0.2
Flow regime:		dt_{e2} (min)	0.8
dt_1 (min)		T (m^2/s)	$7.0 \cdot 10^{-7}$
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 (-)	1.5
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)	0.2	C_D (-)	
dt_2 (min)	0.8	ξ (-)	1.5
T_T (m^2/s)	$7.0 \cdot 10^{-7}$		
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 370 minutes with a final flow of 1.94 l/min, while the pressure build-up time was 940 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*.

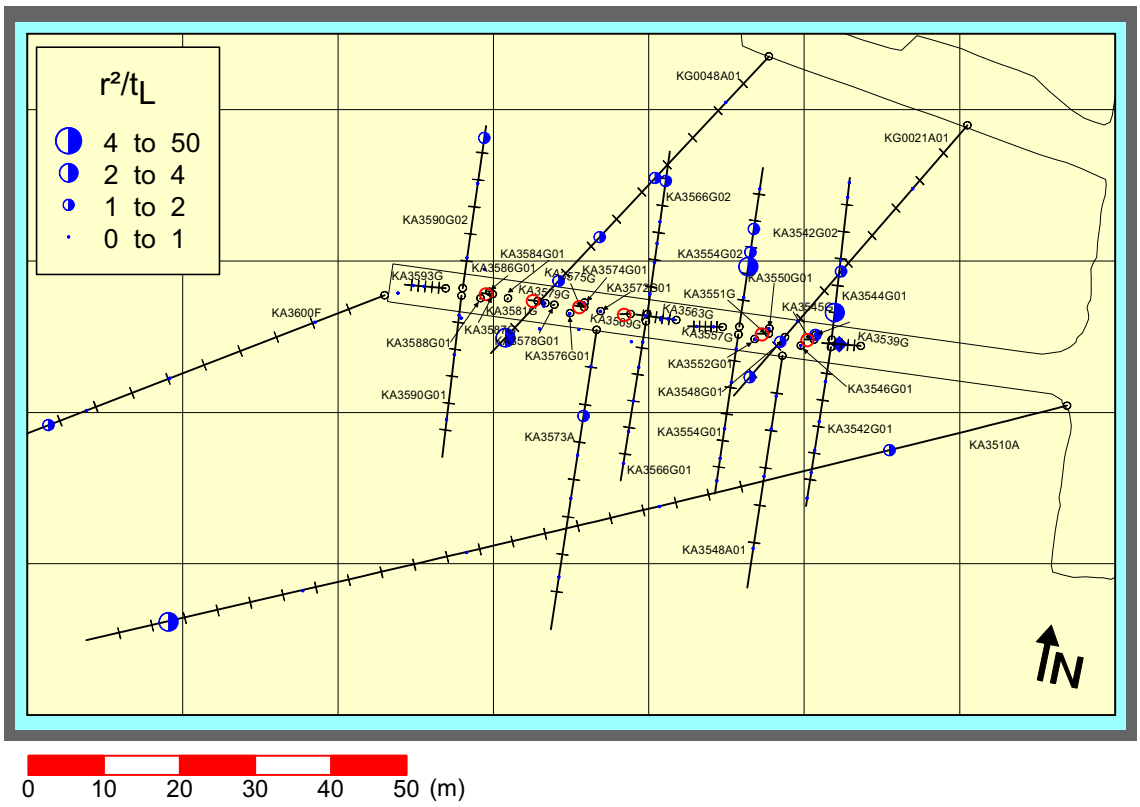


Figure 6-2 *Plot showing r^2/t_L during flowing of KA3539G:2 (Interference test 1:21) - plan view*

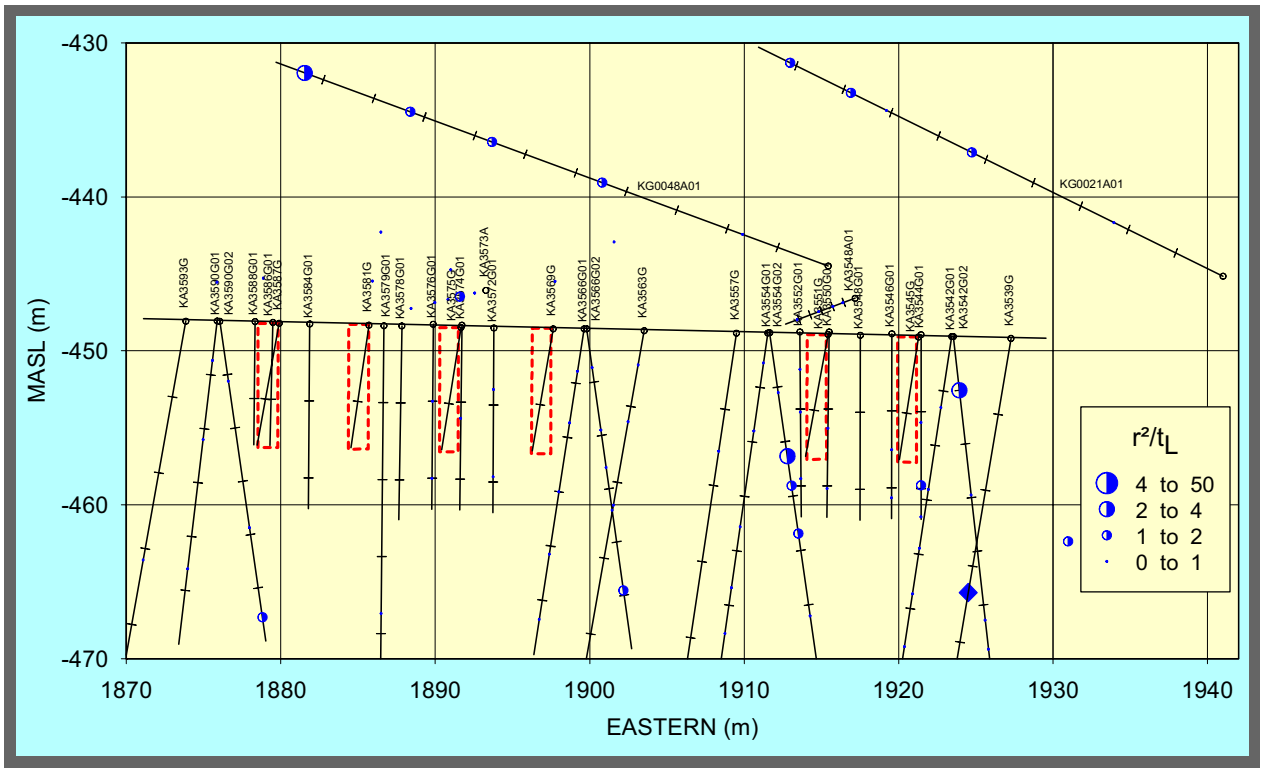


Figure 6-3 *Plot showing r^2/t_L during flowing of KA3539G:2 (Interference test 1:21) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3590G02:1, KA3573A:4, KA3566G02:1, KA3554G02:2-3 (2 sections), KA3544G01:2, KG0048A01:2-4 (3 sections), KG0021A01:1,2,4 (3 sections), KA3510A:5.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3554G02:4, KA3542G02:5, KG0048A01:1 and KA3510A:1.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $7.5 \cdot 10^{-8} – 2.6 \cdot 10^{-5}$ m^2/s. The transmissivity of the flowing section is evaluated to be $7.0 \cdot 10^{-5}$ m^2/s with the evaluation period 0.2 – 0.8 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.

The good response in the bottom section of KA3510A is worth to note.

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	107.10	90	2.124	2.62E-01	5.3E-06	1.1E-05	2.0E-05	1	3.1	3.7
KA3510A:2	110.00	124.00	117.00	86.87	170	0.740	1.10E-01	5.9E-07	7.8E-06	5.3E-06	1	2.2	3.3
KA3510A:3	75.00	109.00	92.00	62.44	85	0.764	9.26E-02	5.5E-07	7.4E-06	5.9E-06	2	11.2	10.8
KA3510A:4	51.00	74.00	62.50	34.61	44	0.454	4.52E-02	3.9E-07	1.2E-05	8.7E-06	2	29.4	27.0
KA3510A:5	4.50	50.00	27.25	15.75	2.5	1.654	8.21E-02	1.8E-05	1.3E-05	2.2E-04	2	59.5	50.3
KA3539G:1	18.60	30.00	24.30	7.56	0.05	19.074	5.35E-01	-	-	-	2	1494.5	1468.5
KA3539G:2	**15.85**	**17.60**	**16.73**	**0.00**	-	-	-	**7.0E-05**	-	-	**2**	1704.0	1677.5
KA3539G:3	10.00	14.85	12.43	4.30	0.05	6.162	1.73E-01	-	-	-	2	1208.5	1175.6
KA3539G:4	4.00	9.00	6.50	10.23	0.05	34.894	9.79E-01	-	-	-	2	1330.3	1298.4
KA3542G01:1	27.00	30.00	28.50	21.02	20	0.368	2.94E-02	1.5E-06	3.5E-05	5.2E-05	2	36.6	34.6
KA3542G01:2	21.30	26.00	23.65	17.30	8	0.623	3.96E-02	9.5E-06	4.9E-05	2.4E-04	2	78.8	72.7
KA3542G01:3	18.60	20.30	19.45	14.62	8	0.445	2.82E-02	5.5E-06	5.3E-05	1.9E-04	2	97.7	90.6
KA3542G01:4	10.50	17.60	14.05	12.47	6	0.432	2.57E-02	3.0E-05	5.6E-05	1.2E-03	2	86.7	80.1
KA3542G01:5	3.50	9.50	6.50	13.11	44	0.065	6.49E-03	3.7E-07	7.2E-05	5.7E-05	2	60.5	57.6
KA3542G02:1	28.20	30.01	29.11	21.72	200	0.039	6.09E-03	-	-	-	2	-49.6	38.8
KA3542G02:2	25.60	27.20	26.40	19.54	200	0.032	4.93E-03	-	-	-	2	-146.3	50.8
KA3542G02:3	21.50	24.60	23.05	17.08	-	-	-	-	-	-	0	3.2	-5.6
KA3542G02:4	9.00	20.50	14.75	12.81	110	0.025	3.25E-03	1.3E-08	7.2E-06	4.1E-06	2	212.3	178.8
KA3542G02:5	2.00	8.00	5.00	13.79	0.8	3.964	1.61E-01	3.3E-07	1.1E-06	2.1E-06	2	1024.1	989.5
KA3543A01:1	0.65	2.06	1.36	19.51	-	-	-	-	-	-	0	1734.1	-1720.4
KA3543I01:1	0.65	2.06	1.36	23.05	-	-	-	-	-	-	0	1735.5	-1719.7
KA3544G01:1	11.65	12.00	11.83	5.91	2	0.291	1.39E-02	6.1E-06	8.0E-05	4.4E-04	2	80.9	128.6
KA3544G01:2	8.90	10.65	9.78	7.70	0.5	1.976	7.47E-02	1.4E-06	5.6E-06	1.9E-05	2	1166.4	1136.4
KA3544G01:3	3.50	7.90	5.70	11.52	7	0.316	1.94E-02	1.1E-07	5.4E-06	5.8E-06	2	727.8	701.7
KA3546G01:1	9.30	12.00	10.65	7.90	200	0.005	8.07E-04	2.7E-07	6.7E-04	3.4E-04	1	-0.7	2.5
KA3546G01:2	6.75	8.30	7.53	10.51	65	0.028	3.17E-03	1.8E-05	8.0E-04	5.8E-03	1	1.7	4.4
KA3546G01:3	1.50	5.75	3.63	14.07	-	-	-	-	-	-	0	2.0	-1.0
KA3548A01:1	21.50	30.00	25.75	34.10	21	0.923	7.46E-02	3.0E-06	1.9E-05	4.1E-05	2	32.8	30.9
KA3548A01:2	11.75	20.50	16.13	27.03	20	0.609	4.86E-02	3.9E-06	3.2E-05	8.0E-05	2	34.6	32.5
KA3548A01:3	8.80	10.75	9.78	23.38	12	0.759	5.31E-02	2.7E-06	2.3E-05	5.2E-05	2	78.7	73.2
KA3548A01:4	3.00	7.80	5.40	21.60	24	0.324	2.72E-02	9.9E-07	2.6E-05	3.6E-05	2	80.4	74.3
KA3548D01:1	0.65	2.06	1.36	21.17	-	-	-	-	-	-	0	1734.6	-1719.8
KA3548G01:1	6.00	12.00	9.00	10.45	-	-	-	-	-	-	0	-0.6	0.4
KA3548G01:2	2.00	5.00	3.50	14.97	-	-	-	-	-	-	0	0.6	-0.4
KA3550G01:1	8.30	12.03	10.17	11.54	55	0.040	4.30E-03	1.4E-05	6.6E-04	3.2E-03	2	-4.7	13.7
KA3550G01:2	5.20	7.30	6.25	14.16	90	0.037	4.58E-03	1.4E-05	7.5E-04	3.0E-03	1	0.6	4.5
KA3550G01:3	1.80	4.20	3.00	16.73	-	-	-	-	-	-	0	-4.3	-2.0
KA3550G05:1	1.50	3.00	2.25	15.30	-	-	-	-	-	-	0	0.0	0.8
KA3551G05:1	1.50	3.10	2.30	18.29	-	-	-	-	-	-	0	-0.2	0.8
KA3552A01:1	0.65	2.06	1.36	23.17	-	-	-	-	-	-	0	1736.3	-1717.1
KA3552G01:1	7.05	12.00	9.53	13.13	210	0.014	2.15E-03	4.8E-07	4.1E-04	2.2E-04	1	0.8	1.8
KA3552G01:2	4.35	6.05	5.20	15.99	85	0.050	6.08E-03	-	-	-	2	-5.5	-1.0
KA3552G01:3	1.50	3.35	2.43	18.13	80	0.068	8.15E-03	-	-	-	1	9.0	-6.8
KA3552H01:1	0.65	2.10	1.38	26.16	-	-	-	-	-	-	0	1732.4	-1723.0
KA3553B01:1	0.65	2.02	1.34	22.39	-	-	-	-	-	-	0	1733.2	-1721.7
KA3554G01:1	25.15	30.01	27.58	24.05	20	0.482	3.85E-02	2.8E-06	3.3E-05	7.4E-05	2	36.6	34.2
KA3554G01:2	22.60	24.15	23.38	21.48	20	0.385	3.07E-02	3.6E-06	4.7E-05	1.2E-04	2	36.6	34.4
KA3554G01:3	14.00	21.60	17.80	18.98	20	0.300	2.40E-02	1.6E-05	1.0E-04	6.7E-04	2	39.9	35.2
KA3554G01:4	5.00	13.00	9.00	18.09	20	0.273	2.18E-02	1.7E-05	9.4E-05	7.9E-04	2	40.9	36.2
KA3554G01:5	1.50	4.00	2.75	19.96	150	0.044	6.33E-03	-	-	-	2	11.9	13.3
KA3554G02:1	22.00	30.01	26.01	22.99	45	0.196	1.96E-02	4.6E-08	2.7E-06	2.3E-06	2	313.1	283.6
KA3554G02:2	15.90	21.00	18.45	19.18	4	1.532	8.35E-02	2.6E-05	1.8E-05	3.1E-04	2	322.3	297.0
KA3554G02:3	13.20	14.90	14.05	18.07	4	1.361	7.42E-02	2.6E-05	2.1E-05	3.5E-04	2	322.7	296.9
KA3554G02:4	10.50	12.20	11.35	17.91	2	2.672	1.27E-01	3.9E-07	1.8E-06	3.1E-06	2	1057.2	1023.8
KA3554G02:5	1.50	9.50	5.50	18.91	7	0.852	5.24E-02	2.1E-07	3.3E-06	4.1E-06	2	423.5	403.4
KA3557G:1	15.00	30.04	22.52	19.27	50	0.124	1.28E-02	9.5E-06	2.0E-04	7.4E-04	2	-7.2	16.1
KA3557G:2	1.50	14.00	7.75	18.72	80	0.073	8.69E-03	3.8E-06	2.6E-04	4.4E-04	2	-4.1	11.2
KA3563A01:1	0.65	2.06	1.36	30.16	-	-	-	-	-	-	0	-0.2	0.3
KA3563D01:1	0.65	2.01	1.33	29.64	-	-	-	-	-	-	0	1.5	1.0
KA3563G:1	15.00	30.01	22.51	25.67	65	0.169	1.89E-02	2.9E-08	6.8E-07	1.5E-06	2	-6.6	15.2
KA3563G:2	10.00	13.00	11.50	23.91	140	0.068	9.55E-03	3.1E-06	2.6E-04	3.3E-04	1	-1.5	5.2
KA3563G:3	4.00	8.00	6.00	24.87	100	0.103	1.31E-02	1.3E-07	1.3E-05	9.8E-06	2	34.9	34.2
KA3563G:4	1.50	3.00	2.25	26.18	130	0.088	1.21E-02	8.0E-06	3.1E-04	6.7E-04	1	-15.5	4.2
KA3563I01:1	0.65	2.15	1.40	32.47	240	0.073	1.19E-02	-	-	-	1	-0.5	1.2
KA3566C01:1	0.65	2.1	1.38	33.52	50	0.375	3.88E-02	9.2E-06	6.9E-05	2.4E-04	1	6.2	4.9

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	31.95	200	0.085	1.32E-02	-	-	-	1	3.4	3.4
KA3566G01:2	20.00	21.50	20.75	29.56	70	0.208	2.38E-02	5.5E-07	2.7E-05	2.3E-05	2	17.7	15.3
KA3566G01:3	12.00	18.00	15.00	28.29	80	0.167	1.98E-02	5.5E-07	3.5E-05	2.8E-05	2	14.3	12.0
KA3566G01:4	7.30	10.00	8.65	28.22	210	0.063	9.92E-03	-	-	-	1	1.0	2.2
KA3566G01:5	1.50	6.30	3.90	29.09	200	0.071	1.09E-02	-	-	-	1	5.9	6.6
KA3566G02:1	19.00	30.10	24.55	31.05	9	1.785	1.16E-01	7.5E-08	6.2E-07	6.4E-07	2	525.9	492.9
KA3566G02:2	16.00	18.00	17.00	28.67	18	0.761	5.91E-02	9.7E-08	1.8E-06	1.6E-06	2	235.6	222.3
KA3566G02:3	12.00	14.00	13.00	28.15	32	0.413	3.75E-02	7.0E-08	2.5E-06	1.9E-06	2	201.5	183.6
KA3566G02:4	8.00	11.00	9.50	28.16	210	0.063	9.88E-03	-	-	-	2	25.8	14.8
KA3566G02:5	1.30	6.00	3.65	29.15	25	0.566	4.81E-02	2.3E-06	2.9E-05	4.9E-05	1	8.6	6.4
KA3568D01:1	0.65	2.30	1.48	33.50	-	-	-	-	-	-	0	-0.2	0.5
KA3572G01:1	7.30	12.03	9.67	31.95	215	0.079	1.25E-02	-	-	-	1	-1.7	1.2
KA3572G01:2	2.70	5.30	4.00	33.71	250	0.076	1.24E-02	-	-	-	1	-0.2	1.0
KA3573A:1	26.00	40.07	33.04	50.85	130	0.331	4.55E-02	1.3E-06	3.3E-05	3.0E-05	1	3.7	4.9
KA3573A:2	21.00	24.00	22.50	44.27	50	0.653	6.76E-02	1.5E-06	1.9E-05	2.3E-05	2	11.8	12.0
KA3573A:3	14.50	19.00	16.75	41.35	65	0.438	4.91E-02	9.8E-07	2.0E-05	2.0E-05	2	12.6	12.3
KA3573A:4	10.50	12.50	11.50	39.26	25	1.027	8.72E-02	1.2E-06	1.1E-05	1.4E-05	2	32.4	30.7
KA3573A:5	1.30	8.50	4.90	37.51	80	0.293	3.49E-02	2.7E-06	5.3E-05	7.9E-05	1	6.1	7.1
KA3573C01:1	0.65	2.05	1.35	39.56	30	0.869	7.76E-02	8.9E-07	1.0E-05	1.1E-05	2	27.5	26.0
KA3574D01:1	0.65	2.05	1.35	39.23	-	-	-	-	-	-	0	0.0	0.5
KA3574G01:1	8.00	12.03	10.02	34.15	-	-	-	-	-	-	0	-0.2	-0.2
KA3574G01:2	5.10	7.00	6.05	35.17	250	0.082	1.35E-02	-	-	-	1	0.0	0.7
KA3574G01:3	1.80	4.10	2.95	36.26	-	-	-	-	-	-	0	0.0	0.5
KA3576G01:1	8.00	12.01	10.01	35.72	80	0.266	3.16E-02	8.3E-06	9.5E-05	2.6E-04	2	-4.4	11.1
KA3576G01:2	4.00	6.00	5.00	37.05	240	0.095	1.55E-02	-	-	-	1	-0.2	1.0
KA3576G01:3	1.30	3.00	2.15	38.08	-	-	-	-	-	-	0	-0.2	0.7
KA3578C01:1	0.65	2.09	1.37	43.59	75	0.422	4.93E-02	3.1E-06	4.5E-05	6.4E-05	1	5.4	6.6
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	-0.2	0.5
KA3578H01:1	0.65	1.90	1.28	44.93	120	0.280	3.76E-02	-	-	-	2	13.3	10.3
KA3579D01:1	0.65	2.00	1.33	42.97	-	-	-	-	-	-	0	0.0	0.5
KA3579G:1	14.70	22.65	18.68	38.43	210	0.117	1.84E-02	-	-	-	1	-1.0	1.5
KA3579G:2	12.50	13.70	13.10	38.58	-	-	-	-	-	-	0	-1.2	-0.2
KA3579G:3	2.30	11.50	6.90	39.68	-	-	-	-	-	-	0	1.0	0.7
KA3584G01:1	7.00	12.00	9.50	43.83	-	-	-	-	-	-	0	0.0	0.7
KA3584G01:2	1.30	5.00	3.15	45.39	-	-	-	-	-	-	0	0.0	0.5
KA3588C01:1	0.65	2.04	1.35	52.74	55	0.843	8.97E-02	5.3E-07	6.9E-06	5.9E-06	2	11.8	11.1
KA3588D01:1	0.65	1.90	1.28	50.96	140	0.309	4.34E-02	1.1E-05	8.7E-05	2.5E-04	1	-33.6	5.6
KA3588I01:1	0.65	1.96	1.31	53.08	-	-	-	-	-	-	0	0.7	0.7
KA3590G01:1	16.00	30.00	23.00	51.50	50	0.884	9.15E-02	5.3E-07	6.2E-06	5.7E-06	2	26.8	23.9
KA3590G01:2	7.00	15.00	11.00	50.52	45	0.945	9.49E-02	5.6E-07	6.6E-06	5.9E-06	2	27.1	23.6
KA3590G01:3	1.30	6.00	3.65	51.32	80	0.549	6.53E-02	1.0E-06	1.6E-05	1.6E-05	1	10.1	8.9
KA3590G02:1	25.50	30.01	27.76	53.23	34	1.389	1.28E-01	2.8E-07	2.3E-06	2.2E-06	2	63.9	58.7
KA3590G02:2	15.20	23.50	19.35	51.32	90	0.488	6.01E-02	7.8E-08	2.1E-06	1.3E-06	2	58.5	48.4
KA3590G02:3	11.90	13.20	12.55	50.76	-	-	-	-	-	-	0	3.4	-0.2
KA3590G02:4	1.30	9.90	5.60	51.11	90	0.484	5.96E-02	2.1E-06	3.1E-05	3.6E-05	1	4.9	6.6
KA3592C01:1	0.65	2.01	1.33	56.72	-	-	-	-	-	-	0	-0.2	0.5
KA3593G:1	25.20	30.02	27.61	56.84	-	-	-	-	-	-	0	-0.2	0.5
KA3593G:2	23.50	24.20	23.85	55.68	85	0.608	7.37E-02	4.4E-07	8.8E-06	6.0E-06	2	12.8	10.6
KA3593G:3	9.00	22.50	15.75	53.99	150	0.324	4.63E-02	2.6E-06	5.7E-05	5.6E-05	1	-0.5	3.4
KA3593G:4	3.00	7.00	5.00	53.58	-	-	-	-	-	-	0	3.7	1.0
KA3597D01:1	0.65	2.22	1.44	59.11	-	-	-	-	-	-	0	0.0	0.7
KA3597H01:1	0.65	2.06	1.36	61.85	200	0.319	4.94E-02	8.0E-07	2.5E-05	1.6E-05	1	1.2	1.7
KA3600F:1	43.00	50.10	46.55	104.01	170	1.061	1.57E-01	4.4E-07	4.5E-06	2.8E-06	1	2.2	3.4
KA3600F:2	40.50	42.00	41.25	99.03	175	0.934	1.40E-01	6.4E-07	6.3E-06	4.6E-06	1	2.2	3.4
KA3600F:3	20.00	39.50	29.75	88.36	140	0.930	1.30E-01	1.6E-06	1.3E-05	1.2E-05	1	3.4	4.4
KA3600F:4	1.30	18.00	9.65	70.36	180	0.458	6.90E-02	-	-	-	1	5.9	5.9
KG0021A01:1	42.50	48.82	45.66	36.54	16.3	1.365	1.03E-01	2.0E-07	2.1E-06	1.9E-06	2	124.5	115.9
KG0021A01:2	37.00	41.50	39.25	33.33	17	1.089	8.33E-02	2.1E-07	2.6E-06	2.5E-06	2	110.2	102.6
KG0021A01:3	35.00	36.00	35.50	31.90	20	0.848	6.77E-02	3.8E-07	4.8E-06	5.6E-06	2	68.2	63.0
KG0021A01:4	19.00	34.00	26.50	30.16	14	1.083	7.88E-02	7.5E-07	6.9E-06	9.5E-06	2	56.8	53.3
KG0021A01:5	5.00	18.00	11.50	32.99	31	0.585	5.27E-02	7.0E-07	1.3E-05	1.3E-05	2	32.5	29.0
KG0048A01:1	49.00	54.69	51.85	54.62	20	2.487	1.99E-01	1.7E-06	5.4E-06	8.4E-06	2	33.0	30.8
KG0048A01:2	34.8	48	41.40	48.46	30	1.305	1.16E-01	8.4E-07	6.5E-07	7.2E-06	2	28.2	26.5
KG0048A01:3	32.80	33.80	33.30	44.80	30	1.115	9.95E-02	7.4E-07	6.5E-06	7.4E-06	2	33.9	32.5
KG0048A01:4	13.00	31.80	22.40	41.87	21	1.392	1.13E-01	5.8E-07	4.6E-06	5.1E-06	2	51.7	48.8
KG0048A01:5	5.00	12.00	8.50	42.13	80	0.370	4.40E-02	-	-	-	2	26.7	25.5

6.2.2 Test 1:22 – 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	1:22		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
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	20030510 06:55:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030510 08:55:00
Stop of flow period		yymmdd hh:mm:ss	20030510 14:55:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030511 08:30:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1055

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	2323.3	
Absolute pressure in test section before stop of flow	p_p	kPa	129.5	
Absolute pressure in test section at stop of recovery period	p_f	kPa	2330.4	
Maximal pressure change during flow period	dp_p	kPa	2193.8	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.83 \cdot 10^{-6}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

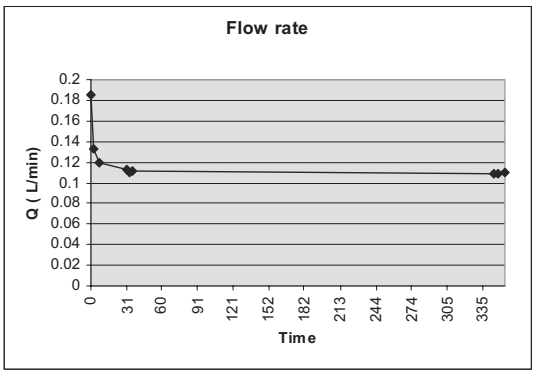


Figure 6-4 *Flow rates during draw down in KA3542G02:5. Time in minutes.*

Comments to the test

The test was successful in regard to pressure response.

Interpreted flow regimes – flowing section

0 – 0.2 minutes	Well Bore Storage (WBS)
0.2 – 0.3 minutes	Transition period
0.3 – 3 minutes	Radial flow period
3 – 100 minutes	Transition period
100 – 300 minutes	Larger scale radial flow

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.

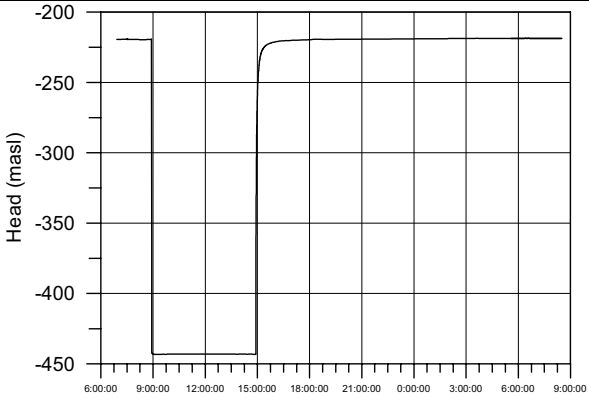
Selected representative parameters

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

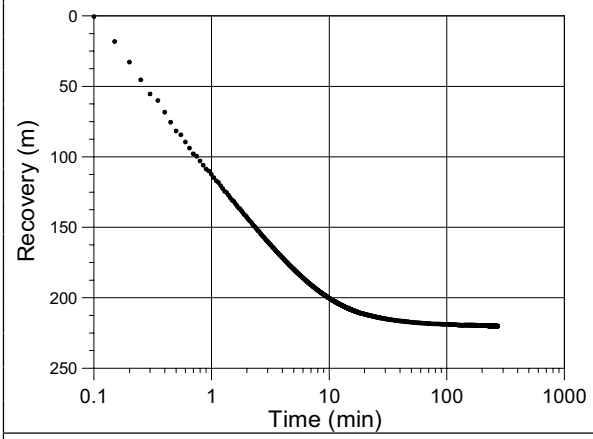
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:22
Borehole ID:	KA3542G02	Test start:	2003-05-10 06:55
Test section (m):	2.00-8.00	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

Linear plot Head



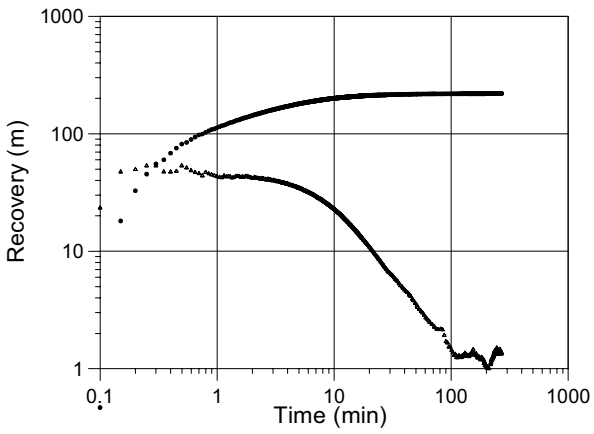
Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	2323.3		
p_i (kPa)			
p_p(kPa)	129.5	p_F (kPa)	2330.4
Q_p (m^3/s)	$1.83 \cdot 10^{-6}$		
tp (min)	360	t_F (min)	1055
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		Results	
Q/s (m^2/s)	$8.3 \cdot 10^{-9}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$7.1 \cdot 10^{-9}$	dt_{e1} (min)	0.3
Flow regime:		dt_{e2} (min)	3
dt_1 (min)		T (m^2/s)	$3.2 \cdot 10^{-9}$
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 (-)	-1.6
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)	3	ξ (-)	-1.6
T_T (m^2/s)	$3.2 \cdot 10^{-9}$		
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 KA3542G02, section 2.00 - 8.00 metres. The flow period was for 360 minutes with a final flow of 0.11 l/min, while the pressure build-up time was 1055 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*.

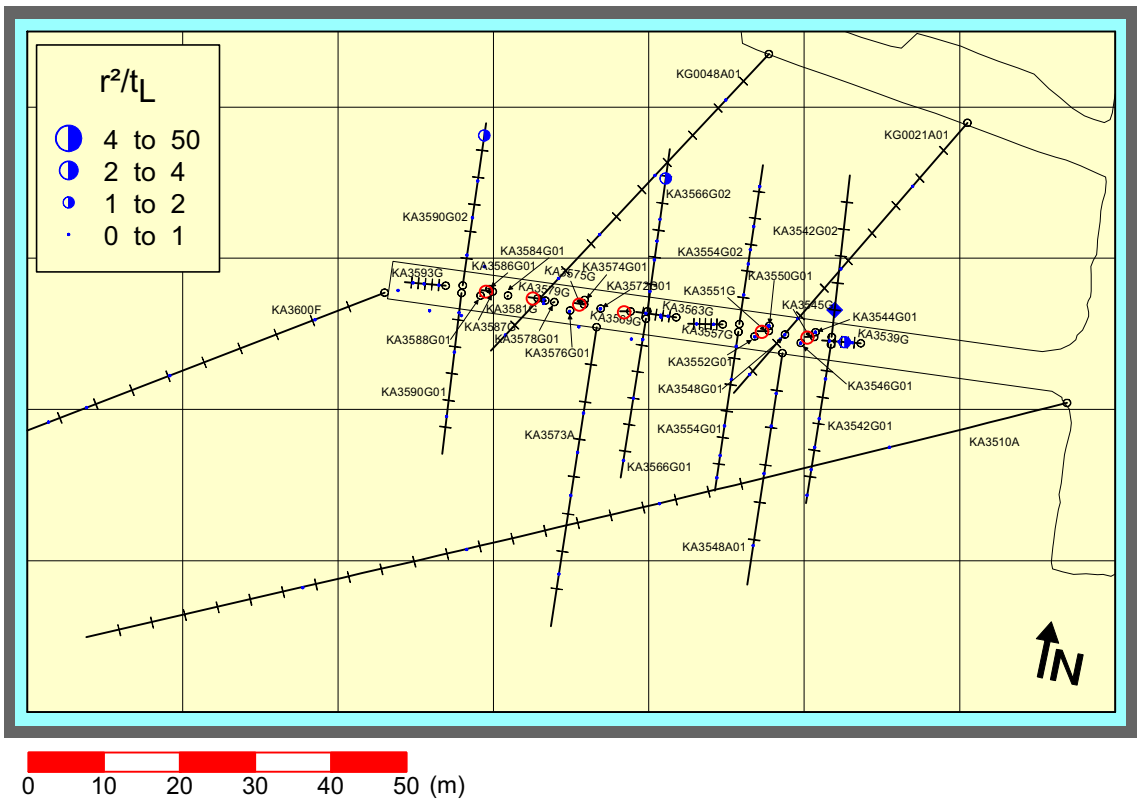


Figure 6-5 *Plot showing r^2/t_L during flowing of KA3542G02:5 (Interference test 1:22) - plan view*

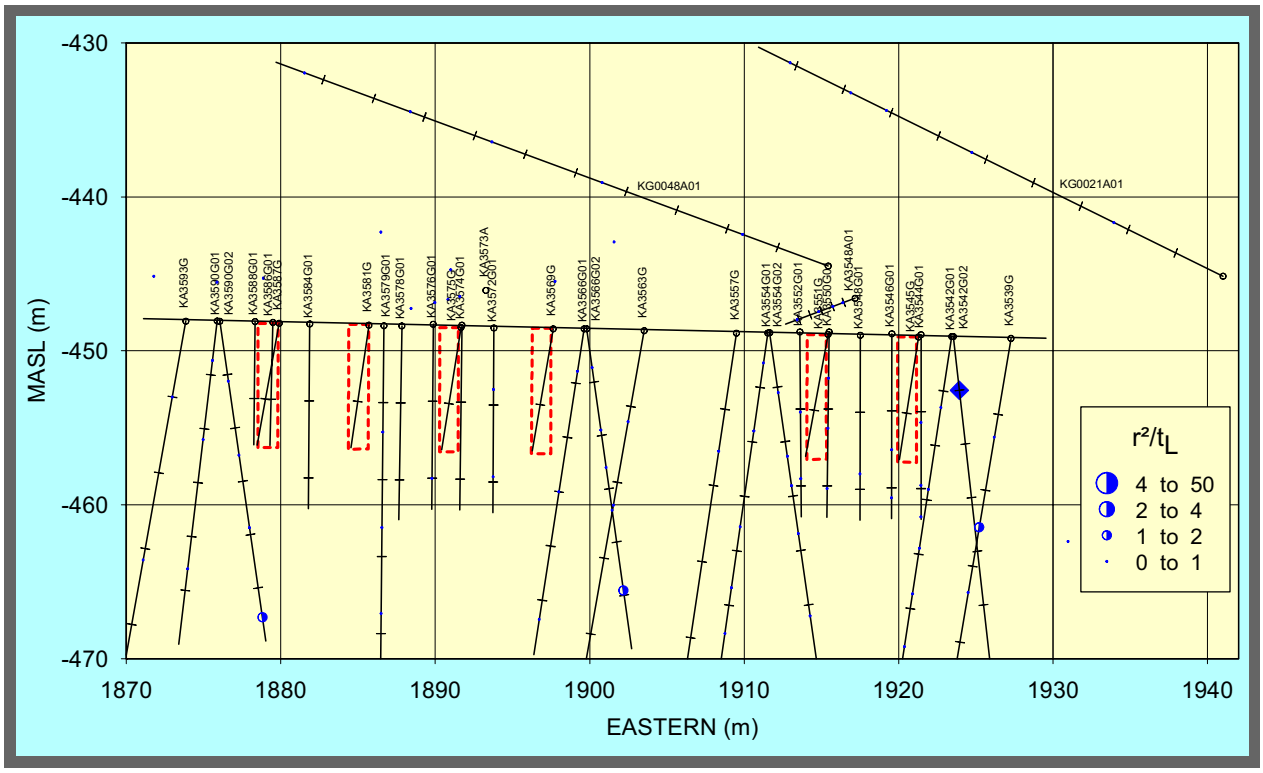


Figure 6-6 *Plot showing r^2/t_L during flowing of KA3542G02:5 (Interference test 1:22) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3590G02:1, KA3566G02:1 and KG3539G:3.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $3.8 \cdot 10^{-8} – 6.6 \cdot 10^{-7}$ m^2/s. The transmissivity of the flowing section is evaluated to be $3.2 \cdot 10^{-9}$ m^2/s with the evaluation period 0.6 – 3 minutes.

In this test only a few rather good hydraulic connections are made on the north side of the repository.

Table 6-5 Interference test results for KA3542G02, 2.00 - 8.00 m. Prototype section II (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, $\tilde{\eta}$) 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).

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	115.01	-	-	-	-	-	-	0	-0.2	0.6
KA3510A:2	110.00	124.00	117.00	94.98	210	0.716	1.13E-01	-	-	-	1	-0.4	1.6
KA3510A:3	75.00	109.00	92.00	70.91	200	0.419	6.54E-02	-	-	-	1	-0.6	1.6
KA3510A:4	51.00	74.00	62.50	43.80	150	0.213	3.07E-02	1.2E-07	3.8E-06	3.9E-06	1	0.4	3.3
KA3510A:5	4.50	50.00	27.25	21.81	110	0.072	9.50E-03	1.2E-07	1.0E-05	1.2E-05	1	0.6	4.9
KA3539G:1	18.60	30.00	24.30	21.01	9	0.817	5.37E-02	4.3E-07	1.8E-06	8.0E-06	2	47.4	53.3
KA3539G:2	15.85	17.60	16.73	13.79	4	0.793	4.35E-02	8.1E-08	8.4E-07	1.9E-06	2	47.8	53.5
KA3539G:3	10.00	14.85	12.43	9.94	1	1.646	6.97E-02	1.3E-07	5.2E-07	1.9E-06	2	98.8	106.5
KA3539G:4	4.00	9.00	6.50	5.75	3	0.183	9.48E-03	1.1E-07	4.1E-06	1.2E-05	2	49.6	56.2
KA3542G01:1	27.00	30.00	28.50	29.83	130	0.114	1.58E-02	7.6E-08	5.5E-06	4.8E-06	1	1.2	3.9
KA3542G01:2	21.30	26.00	23.65	25.09	90	0.117	1.45E-02	4.2E-07	1.2E-05	2.9E-05	1	2.5	5.4
KA3542G01:3	18.60	20.30	19.45	21.03	70	0.105	1.21E-02	2.9E-07	1.1E-05	2.4E-05	1	3.2	5.9
KA3542G01:4	10.50	17.60	14.05	15.89	85	0.050	6.05E-03	4.4E-07	3.0E-05	7.3E-05	1	2.5	5.6
KA3542G01:5	3.50	9.50	6.50	9.25	20	0.071	5.74E-03	1.2E-06	2.9E-05	2.1E-04	1	0.2	8.3
KA3542G02:1	28.20	30.01	29.11	24.11	0.14	69.198	2.20E+00	-	-	-	2	-3.7	11.3
KA3542G02:2	25.60	27.20	26.40	21.39	0.11	69.341	2.14E+00	-	-	-	2	-5.6	13.0
KA3542G02:3	21.50	24.60	23.05	18.05	0.13	41.747	1.32E+00	-	-	-	2	-1.0	11.5
KA3542G02:4	9.00	20.50	14.75	9.75	0.26	6.089	2.10E-01	-	-	-	2	2.0	23.1
KA3542G02:5	**2.00**	**8.00**	**5.00**	**0.00**	-	-	-	**3.2E-09**	-	-	**2**	2193.8	2201.0
KA3543A01:1	0.65	2.06	1.36	9.77	-	-	-	-	-	-	0	17.6	-3.3
KA3543I01:1	0.65	2.06	1.36	10.83	-	-	-	-	-	-	0	17.2	-3.3
KA3544G01:1	11.65	12.00	11.83	9.08	10	0.137	9.25E-03	3.6E-07	1.1E-05	3.9E-05	2	-14.9	63.7
KA3544G01:2	8.90	10.65	9.78	7.27	6	0.147	8.79E-03	8.6E-07	1.1E-05	9.7E-05	2	45.5	48.7
KA3544G01:3	3.50	7.90	5.70	4.38	2	0.160	7.66E-03	3.2E-07	8.3E-06	4.1E-05	2	61.2	72.5
KA3546G01:1	9.30	12.00	10.65	9.34	210	0.007	1.10E-03	-	-	-	1	0.5	1.7
KA3546G01:2	6.75	8.30	7.53	7.30	200	0.004	6.93E-04	-	-	-	1	-3.2	3.2
KA3546G01:3	1.50	5.75	3.63	6.19	-	-	-	-	-	-	0	1.2	-0.2
KA3548A01:1	21.50	30.00	25.75	33.18	130	0.141	1.95E-02	2.7E-07	1.0E-05	1.4E-05	1	0.8	3.7
KA3548A01:2	11.75	20.50	16.13	24.02	130	0.074	1.02E-02	5.6E-07	2.2E-05	5.5E-05	1	1.0	3.7
KA3548A01:3	8.80	10.75	9.78	18.24	70	0.079	9.13E-03	6.1E-07	1.9E-05	6.6E-05	1	2.5	5.7
KA3548A01:4	3.00	7.80	5.40	14.52	75	0.047	5.52E-03	2.1E-07	2.1E-05	3.8E-05	1	3.5	6.6
KA3548D01:1	0.65	2.06	1.36	8.60	-	-	-	-	-	-	0	17.2	-3.5
KA3548G01:1	6.00	12.00	9.00	9.03	250	0.005	9.00E-04	-	-	-	1	-0.4	1.4
KA3548G01:2	2.00	5.00	3.50	7.20	-	-	-	-	-	-	0	0.8	-0.6
KA3550G01:1	8.30	12.03	10.17	10.89	80	0.025	2.96E-03	2.7E-07	4.7E-05	9.3E-05	2	-4.5	13.9
KA3550G01:2	5.20	7.30	6.25	9.11	170	0.008	1.21E-03	1.5E-07	1.1E-04	1.2E-04	1	-1.0	3.5
KA3550G01:3	1.80	4.20	3.00	8.76	240	0.005	8.73E-04	-	-	-	1	-0.2	2.5
KA3550G05:1	1.50	3.00	2.25	5.51	-	-	-	-	-	-	0	-0.2	0.6
KA3551G05:1	1.50	3.10	2.30	10.79	-	-	-	-	-	-	0	-0.2	0.6
KA3552A01:1	0.65	2.06	1.36	15.07	-	-	-	-	-	-	0	17.2	-3.3
KA3552G01:1	7.05	12.00	9.53	12.28	175	0.014	2.16E-03	2.7E-08	2.1E-05	1.2E-05	1	-0.6	4.7
KA3552G01:2	4.35	6.05	5.20	10.97	18	0.111	8.71E-03	-	-	-	1	-2.5	9.6
KA3552G01:3	1.50	3.35	2.43	10.98	-	-	-	-	-	-	0	1.4	-6.3
KA3552H01:1	0.65	2.10	1.38	15.87	-	-	-	-	-	-	0	17.0	-3.5
KA3553B01:1	0.65	2.02	1.34	12.41	-	-	-	-	-	-	0	17.0	-3.5
KA3554G01:1	25.15	30.01	27.58	31.17	120	0.135	1.82E-02	8.1E-07	1.3E-05	4.4E-05	1	1.0	3.9
KA3554G01:2	22.60	24.15	23.38	27.43	110	0.114	1.50E-02	2.7E-07	1.1E-05	1.8E-05	1	1.0	3.9
KA3554G01:3	14.00	21.60	17.80	22.70	20	0.429	3.45E-02	-	-	-	1	-0.8	1.4
KA3554G01:4	5.00	13.00	9.00	16.38	20	0.224	1.80E-02	-	-	-	1	-1.6	1.2
KA3554G01:5	1.50	4.00	2.75	13.68	140	0.022	3.15E-03	-	-	-	1	1.0	3.3
KA3554G02:1	22.00	30.01	26.01	23.98	51	0.188	1.97E-02	4.1E-08	2.3E-06	2.1E-06	2	5.9	21.3
KA3554G02:2	15.90	21.00	18.45	17.81	10	0.529	3.56E-02	1.2E-07	1.6E-07	3.4E-06	2	20.7	31.1
KA3554G02:3	13.20	14.90	14.05	14.82	10	0.366	2.47E-02	1.7E-07	2.5E-06	6.7E-06	2	20.7	31.1
KA3554G02:4	10.50	12.20	11.35	13.39	3.2	0.933	4.89E-02	2.9E-08	3.5E-07	5.9E-07	2	92.7	101.3
KA3554G02:5	1.50	9.50	5.50	11.89	12	0.196	1.38E-02	1.1E-07	4.2E-06	8.2E-06	2	22.1	29.9
KA3557G:1	15.00	30.04	22.52	25.76	49	0.226	2.34E-02	5.2E-07	6.2E-06	2.2E-05	2	-5.7	17.6
KA3557G:2	1.50	14.00	7.75	16.18	60	0.073	8.01E-03	6.9E-07	2.1E-05	8.6E-05	2	-3.7	11.6
KA3563A01:1	0.65	2.06	1.36	24.24	-	-	-	-	-	-	0	0.0	0.3
KA3563D01:1	0.65	2.01	1.33	21.82	-	-	-	-	-	-	0	0.0	0.7
KA3563G:1	15.00	30.01	22.51	30.42	60	0.257	2.83E-02	4.8E-07	5.8E-06	1.7E-05	2	-5.2	16.2
KA3563G:2	10.00	13.00	11.50	23.61	200	0.046	7.25E-03	3.8E-08	7.3E-06	5.3E-06	1	-1.0	3.9
KA3563G:3	4.00	8.00	6.00	21.55	72	0.108	1.25E-02	-	-	-	1	4.7	6.9
KA3563G:4	1.50	3.00	2.25	20.88	-	-	-	-	-	-	0	0.2	1.0
KA3563I01:1	0.65	2.15	1.40	24.36	220	0.045	7.19E-03	-	-	-	1	0.7	0.5
KA3566C01:1	0.65	2.1	1.38	27.38	250	0.050	8.27E-03	-	-	-	1	0.5	1.0

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, $\tilde{\eta}$) 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).

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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	36.84	170	0.133	1.99E-02	7.3E-08	4.3E-06	3.7E-06	1	-2.5	3.7
KA3566G01:2	20.00	21.50	20.75	32.62	-	-	-	-	-	-	0	-23.1	-1.2
KA3566G01:3	12.00	18.00	15.00	29.18	200	0.071	1.11E-02	-	-	-	1	-0.2	0.7
KA3566G01:4	7.30	10.00	8.65	26.33	-	-	-	-	-	-	0	-24.6	-49.9
KA3566G01:5	1.50	6.30	3.90	25.06	170	0.062	9.19E-03	4.4E-08	6.3E-06	4.8E-06	1	10.8	3.7
KA3566G02:1	19.00	30.10	24.55	30.73	10	1.574	1.06E-01	3.8E-08	2.4E-07	3.6E-07	2	37.4	50.2
KA3566G02:2	16.00	18.00	17.00	26.64	28	0.422	3.73E-02	9.4E-08	1.7E-06	2.5E-06	2	10.6	18.2
KA3566G02:3	12.00	14.00	13.00	25.12	50	0.210	2.19E-02	7.5E-08	2.9E-06	3.4E-06	2	6.1	16.2
KA3566G02:4	8.00	11.00	9.50	24.26	200	0.049	7.66E-03	-	-	-	1	3.9	4.9
KA3566G02:5	1.30	6.00	3.65	23.94	200	0.048	7.46E-03	-	-	-	1	0.0	3.2
KA3568D01:1	0.65	2.30	1.48	26.49	-	-	-	-	-	-	0	0.2	0.2
KA3572G01:1	7.30	12.03	9.67	30.70	200	0.079	1.23E-02	-	-	-	1	0.2	2.5
KA3572G01:2	2.70	5.30	4.00	30.15	230	0.066	1.07E-02	-	-	-	1	0.5	1.2
KA3573A:1	26.00	40.07	33.04	50.08	200	0.209	3.26E-02	-	-	-	1	0.0	2.0
KA3573A:2	21.00	24.00	22.50	42.26	200	0.149	2.32E-02	-	-	-	1	0.0	2.2
KA3573A:3	14.50	19.00	16.75	38.54	200	0.124	1.93E-02	-	-	-	1	0.5	2.5
KA3573A:4	10.50	12.50	11.50	35.61	135	0.157	2.19E-02	4.3E-07	9.2E-06	2.0E-05	1	1.0	3.7
KA3573A:5	1.30	8.50	4.90	32.78	-	-	-	-	-	-	0	-0.5	-0.7
KA3573C01:1	0.65	2.05	1.35	33.91	130	0.147	2.04E-02	8.6E-08	4.6E-06	4.2E-06	1	1.0	3.7
KA3574D01:1	0.65	2.05	1.35	32.84	-	-	-	-	-	-	0	0.0	0.0
KA3574G01:1	8.00	12.03	10.02	32.87	-	-	-	-	-	-	0	0.0	0.5
KA3574G01:2	5.10	7.00	6.05	32.36	-	-	-	-	-	-	0	0.5	0.3
KA3574G01:3	1.80	4.10	2.95	32.29	-	-	-	-	-	-	0	0.2	0.2
KA3576G01:1	8.00	12.01	10.01	34.62	75	0.266	3.13E-02	3.6E-07	4.4E-06	1.2E-05	2	-4.7	12.5
KA3576G01:2	4.00	6.00	5.00	34.11	-	-	-	-	-	-	0	0.5	0.5
KA3576G01:3	1.30	3.00	2.15	34.14	-	-	-	-	-	-	0	0.5	0.2
KA3578C01:1	0.65	2.09	1.37	38.71	-	-	-	-	-	-	0	-0.2	-0.2
KA3578G01:1	6.50	12.58	9.54	36.65	-	-	-	-	-	-	0	0.7	-0.5
KA3578G01:2	4.30	5.50	4.90	36.19	-	-	-	-	-	-	0	0.2	0.0
KA3578H01:1	0.65	1.90	1.28	38.84	90	0.279	3.47E-02	-	-	-	1	1.7	0.2
KA3579D01:1	0.65	2.00	1.33	37.29	-	-	-	-	-	-	0	0.5	0.2
KA3579G:1	14.70	22.65	18.68	40.16	200	0.134	2.10E-02	-	-	-	1	0.7	1.7
KA3579G:2	12.50	13.70	13.10	38.45	200	0.123	1.92E-02	-	-	-	1	1.0	1.5
KA3579G:3	2.30	11.50	6.90	37.44	200	0.117	1.82E-02	-	-	-	1	1.2	-0.7
KA3584G01:1	7.00	12.00	9.50	42.48	-	-	-	-	-	-	0	0.2	-0.5
KA3584G01:2	1.30	5.00	3.15	42.14	-	-	-	-	-	-	0	0.5	0.2
KA3588C01:1	0.65	2.04	1.35	48.57	100	0.393	5.04E-02	-	-	-	1	2.2	1.2
KA3588D01:1	0.65	1.90	1.28	46.00	100	0.353	4.52E-02	-	-	-	1	-1.2	6.4
KA3588I01:1	0.65	1.96	1.31	47.68	-	-	-	-	-	-	0	0.2	0.2
KA3590G01:1	16.00	30.00	23.00	53.17	175	0.269	4.05E-02	-	-	-	1	0.2	3.4
KA3590G01:2	7.00	15.00	11.00	49.37	180	0.226	3.42E-02	-	-	-	1	-0.2	3.2
KA3590G01:3	1.30	6.00	3.65	48.38	240	0.163	2.66E-02	-	-	-	1	-0.7	0.7
KA3590G02:1	25.50	30.01	27.76	52.77	40	1.160	1.13E-01	6.6E-07	1.3E-06	5.8E-06	1	3.4	7.9
KA3590G02:2	15.20	23.50	19.35	49.82	70	0.591	6.81E-02	2.9E-07	2.0E-06	4.2E-06	1	1.0	7.9
KA3590G02:3	11.90	13.20	12.55	48.39	200	0.195	3.05E-02	-	-	-	1	-0.5	2.2
KA3590G02:4	1.30	9.90	5.60	47.87	200	0.191	2.98E-02	-	-	-	1	1.0	1.0
KA3592C01:1	0.65	2.01	1.33	52.66	250	0.185	3.06E-02	-	-	-	1	0.5	0.5
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	200	0.276	4.31E-02	-	-	-	1	-1.5	1.0
KA3593G:3	9.00	22.50	15.75	54.08	200	0.244	3.80E-02	-	-	-	1	-1.0	2.9
KA3593G:4	3.00	7.00	5.00	51.06	200	0.217	3.39E-02	-	-	-	1	-0.7	2.2
KA3597D01:1	0.65	2.22	1.44	54.64	-	-	-	-	-	-	0	0.2	0.2
KA3597H01:1	0.65	2.06	1.36	57.22	250	0.218	3.61E-02	-	-	-	1	0.2	0.5
KA3600F:1	43.00	50.10	46.55	102.42	220	0.795	1.27E-01	-	-	-	1	-0.5	1.5
KA3600F:2	40.50	42.00	41.25	97.28	210	0.751	1.19E-01	-	-	-	1	0.0	1.7
KA3600F:3	20.00	39.50	29.75	86.21	210	0.590	9.33E-02	-	-	-	1	-0.5	1.5
KA3600F:4	1.30	18.00	9.65	67.22	200	0.377	5.88E-02	-	-	-	1	-0.5	2.0
KG0021A01:1	42.50	48.82	45.66	25.40	40	0.269	2.63E-02	3.3E-07	4.3E-06	1.3E-05	1	5.2	8.1
KG0021A01:2	37.00	41.50	39.25	20.92	40	0.182	1.78E-02	4.2E-07	6.8E-06	2.3E-05	1	4.7	7.6
KG0021A01:3	35.00	36.00	35.50	18.82	24	0.246	2.08E-02	7.3E-07	5.8E-06	3.5E-05	1	4.7	8.1
KG0021A01:4	19.00	34.00	26.50	16.40	15	0.299	2.23E-02	9.7E-07	4.9E-06	4.4E-05	1	4.4	8.1
KG0021A01:5	5.00	18.00	11.50	22.06	100	0.081	1.04E-02	-	-	-	1	3.0	4.7
KG0048A01:1	49.00	54.69	51.85	47.24	140	0.266	3.76E-02	9.1E-08	2.7E-06	2.4E-06	1	0.7	3.4
KG0048A01:2	34.8	48	41.40	40.10	120	0.223	3.02E-02	3.2E-07	5.2E-06	1.0E-05	1	1.0	3.9
KG0048A01:3	32.80	33.80	33.30	35.70	80	0.266	3.19E-02	-	-	-	1	2.0	4.9
KG0048A01:4	13.00	31.80	22.40	32.15	26	0.662	5.73E-02	8.6E-07	2.7E-06	1.5E-05	1	3.7	6.9
KG0048A01:5	5.00	12.00	8.50	32.71	133	0.134	1.87E-02	2.2E-08	2.0E-06	1.2E-06	1	1.5	5.9

6.2.3 Test 1:23 – 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	1:23 (Also tested as single hole test 1:2)		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
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	20030511 08:35:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030511 10:35:00
Stop of flow period		yymmdd hh:mm:ss	20030511 16:35:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030512 09:41:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1026

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	3662.6	
Absolute pressure in test section before stop of flow	p_p	kPa	490.3	
Absolute pressure in test section at stop of recovery period	p_f	kPa	3664.9	
Maximal pressure change during flow period	dp_p	kPa	3172.3	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$2.34 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

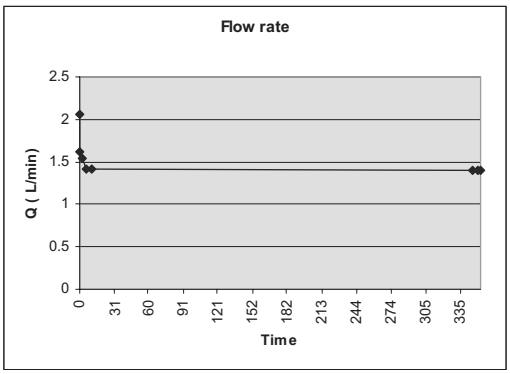


Figure 6-7 *Flow rates during draw down in KA3554G01:2. Time in minutes.*

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 – 40 minutes	Radial flow period
40 – 50 minutes	Transition period
50 – 250 minutes	Spherical flow 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.

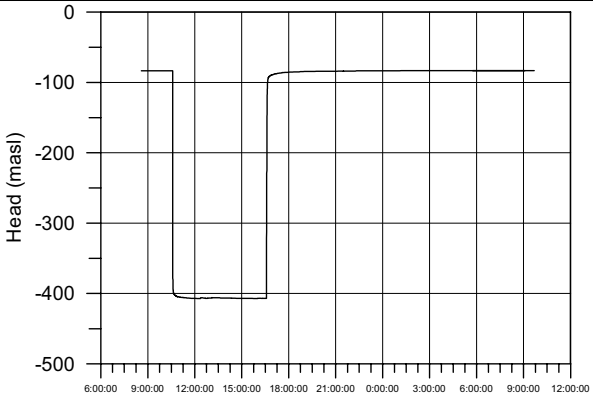
Selected representative parameters

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

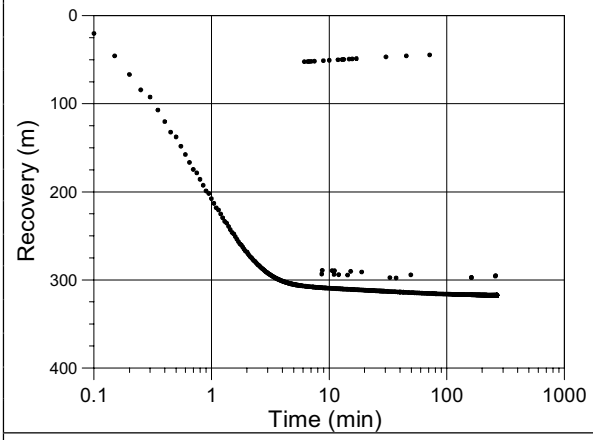
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:23 (Also tested as single hole test 1:2)
Borehole ID:	KA3554G01	Test start:	2003-05-11 08:35
Test section (m):	22.60-24.15	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

Linear plot Head



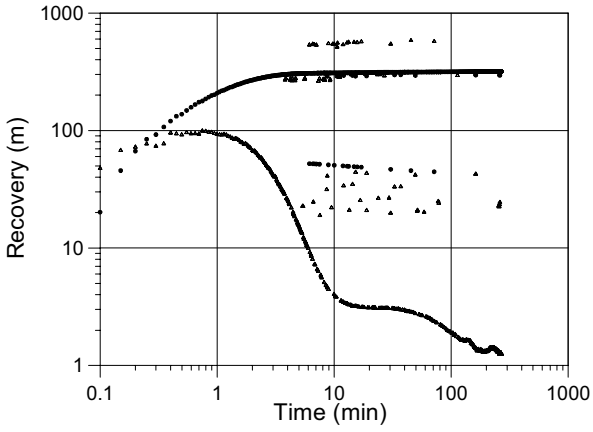
Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	3662.6		
p_i (kPa)			
p_p(kPa)	490.3	p_F (kPa)	3664.9
Q_p (m^3/s)	$2.34 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1026
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		**Results**	
Q/s (m^2/s)	$7.4 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$4.7 \cdot 10^{-8}$	dt_{e1} (min)	9
Flow regime:		dt_{e2} (min)	40
dt_1 (min)		T (m^2/s)	$6.0 \cdot 10^{-7}$
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 (-)	43
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)	9	C_D (-)	
dt_2 (min)	40	ξ (-)	43
T_T (m^2/s)	$6.0 \cdot 10^{-7}$		
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 1.40 l/min, while the pressure build-up time was 1026 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*.

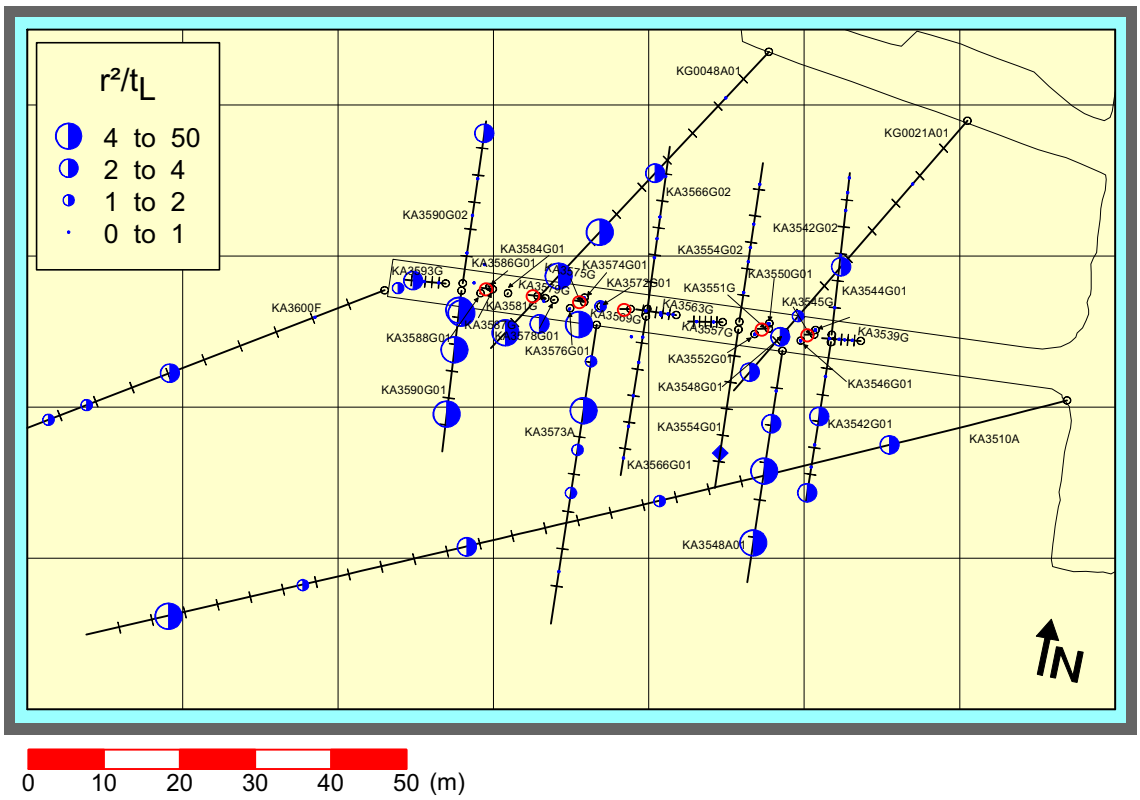


Figure 6-8 *Plot showing r^2/t_L during flowing of KA3554G01:2 (Interference test 1:23) - plan view*

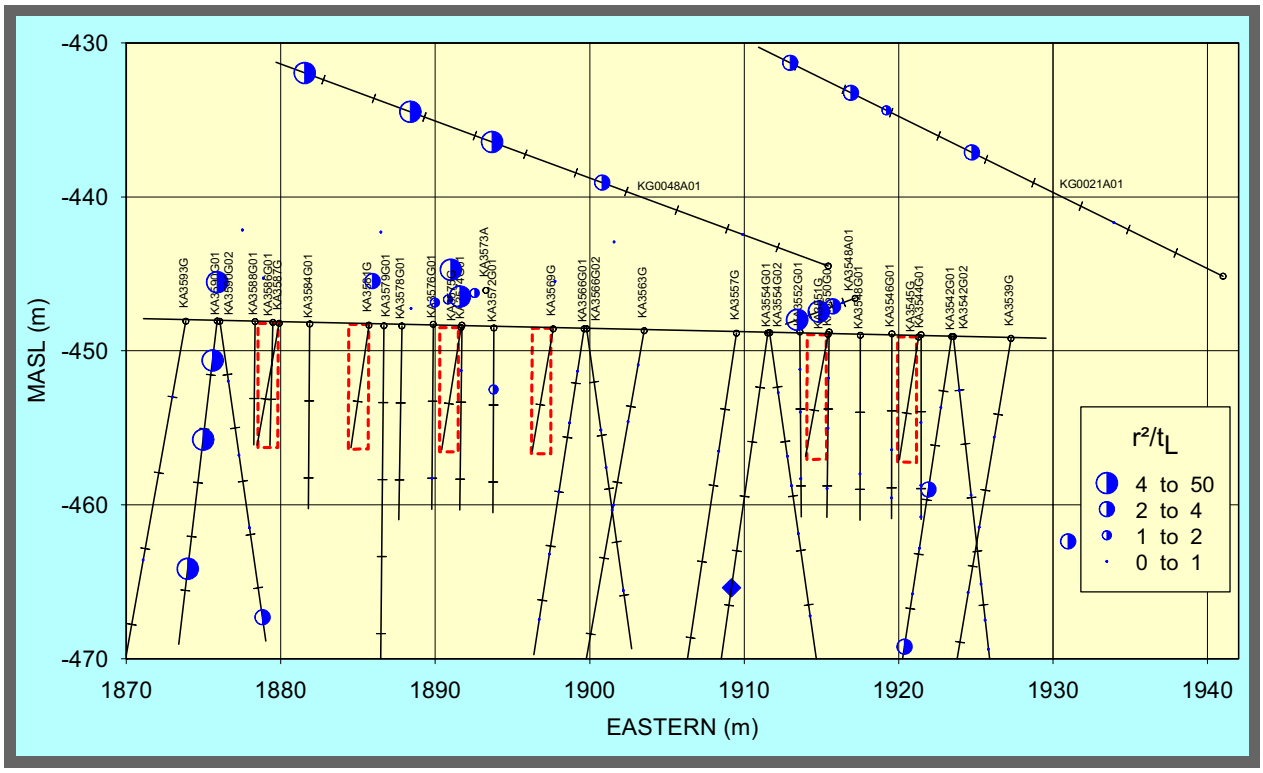


Figure 6-9 *Plot showing r^2/t_L during flowing of KA3554G01:2 (Interference test 1:23) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3600F:1-2, KA3597H01:1, KA3573A:2-3, KA3572G01:2 and KA3510A:2 & 4.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3600F:3, KA3593G:2, KA3590G02:1, KA3578C01:1, KA3548A01:3, KA3542G01:1 & 4, KG0021A01:1-4, KG0048A01:4 and KA3510A:3 & 5.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KA3590G01:1-3, KA3588C01:1, KA3573C01:1, KA3573A:4, KA3548A01:1-2, KG0048 A01:2-3 and KA3510:1.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $4.3 \cdot 10^{-7} – 1.4 \cdot 10^{-5}$ m^2/s. The transmissivity of the flowing section is evaluated to be $6.0 \cdot 10^{-7}$ m^2/s with the evaluation period 9 – 40 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.

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	90.63	6	22.818	1.36E+00	1.4E-05	8.8E-07	1.0E-05	1	5.5	6.3
KA3510A:2	110.00	124.00	117.00	70.28	60	1.372	1.51E-01	4.9E-06	1.1E-05	3.2E-05	1	4.3	5.1
KA3510A:3	75.00	109.00	92.00	45.63	13.6	2.552	1.86E-01	8.9E-07	2.9E-06	4.8E-06	2	31.5	32.5
KA3510A:4	51.00	74.00	62.50	17.77	3.2	1.644	8.61E-02	1.1E-06	5.1E-06	1.3E-05	2	106.7	109.2
KA3510A:5	4.50	50.00	27.25	22.02	2.3	3.515	1.73E-01	6.2E-07	5.7E-07	3.6E-06	2	110.8	114.9
KA3539G:1	18.60	30.00	24.30	22.09	49	0.166	1.72E-02	4.9E-07	2.9E-05	2.9E-05	2	22.3	51.0
KA3539G:2	15.85	17.60	16.73	21.48	20	0.385	3.09E-02	1.4E-06	2.6E-05	4.5E-05	2	25.0	52.7
KA3539G:3	10.00	14.85	12.43	22.30	24	0.345	2.92E-02	1.3E-06	2.7E-05	4.6E-05	2	22.6	54.5
KA3539G:4	4.00	9.00	6.50	24.66	21	0.482	3.93E-02	1.5E-06	2.1E-05	3.9E-05	2	23.6	50.8
KA3542G01:1	27.00	30.00	28.50	12.95	1	2.795	1.18E-01	1.0E-06	2.8E-06	8.8E-06	2	100.2	102.4
KA3542G01:2	21.30	26.00	23.65	11.87	4.8	0.490	2.79E-02	1.4E-06	1.9E-05	5.0E-05	2	86.7	89.8
KA3542G01:3	18.60	20.30	19.45	12.48	6	0.433	2.59E-02	8.7E-07	1.6E-05	3.4E-05	2	80.5	83.4
KA3542G01:4	10.50	17.60	14.05	15.06	1	3.781	1.60E-01	1.3E-05	6.5E-06	8.3E-05	2	84.5	87.0
KA3542G01:5	3.50	9.50	6.50	20.59	27	0.262	2.29E-02	1.2E-05	8.8E-05	5.1E-04	2	4.9	12.3
KA3542G02:1	28.20	30.01	29.11	40.24	200	0.135	2.11E-02	-	-	-	1	3.4	8.8
KA3542G02:2	25.60	27.20	26.40	38.26	200	0.122	1.90E-02	-	-	-	1	4.2	9.6
KA3542G02:3	21.50	24.60	23.05	35.95	173	0.124	1.87E-02	1.2E-05	2.0E-04	6.6E-04	1	-2.9	6.6
KA3542G02:4	9.00	20.50	14.75	31.03	160	0.100	1.47E-02	-	-	-	2	8.9	20.7
KA3542G02:5	2.00	8.00	5.00	27.43	30	0.418	3.76E-02	8.5E-07	1.6E-05	2.3E-05	2	21.9	54.5
KA3543A01:1	0.65	2.06	1.36	24.89	-	-	-	-	-	-	0	0.4	-9.8
KA3543I01:1	0.65	2.06	1.36	29.93	-	-	-	-	-	-	0	0.6	-24.4
KA3544G01:1	11.65	12.00	11.83	20.91	21	0.347	2.83E-02	-	-	-	2	-13.5	48.3
KA3544G01:2	8.90	10.65	9.78	21.46	32	0.240	2.20E-02	1.1E-06	3.4E-05	4.9E-05	2	21.1	46.0
KA3544G01:3	3.50	7.90	5.70	23.05	75	0.118	1.39E-02	-	-	-	2	12.0	49.9
KA3546G01:1	9.30	12.00	10.65	19.03	200	0.030	4.71E-03	-	-	-	1	0.2	-0.2
KA3546G01:2	6.75	8.30	7.53	20.22	100	0.068	8.74E-03	-	-	-	1	2.7	7.6
KA3546G01:3	1.50	5.75	3.63	22.23	-	-	-	-	-	-	0	1.0	-1.0
KA3548A01:1	21.50	30.00	25.75	21.50	1.18	6.528	2.84E-01	1.7E-06	1.7E-06	6.0E-06	2	88.3	90.5
KA3548A01:2	11.75	20.50	16.13	18.95	0.95	6.300	2.64E-01	1.3E-06	1.5E-06	5.1E-06	2	92.9	95.8
KA3548A01:3	8.80	10.75	9.78	19.80	3.2	2.042	1.07E-01	1.0E-06	2.2E-06	9.7E-06	2	84.6	88.1
KA3548A01:4	3.00	7.80	5.40	21.50	12.7	0.607	4.33E-02	7.2E-06	3.5E-05	1.7E-04	2	69.2	76.5
KA3548D01:1	0.65	2.06	1.36	29.08	-	-	-	-	-	-	0	0.2	-9.8
KA3548G01:1	6.00	12.00	9.00	19.46	250	0.025	4.18E-03	-	-	-	1	-0.4	1.2
KA3548G01:2	2.00	5.00	3.50	22.16	-	-	-	-	-	-	0	0.6	-0.4
KA3550G01:1	8.30	12.03	10.17	19.31	70	0.089	1.02E-02	1.1E-05	2.3E-04	1.1E-03	2	-4.5	17.0
KA3550G01:2	5.20	7.30	6.25	20.98	200	0.037	5.72E-03	-	-	-	1	-1.0	2.9
KA3550G01:3	1.80	4.20	3.00	22.78	170	0.051	7.60E-03	-	-	-	1	-1.2	3.3
KA3550G05:1	1.50	3.00	2.25	23.83	-	-	-	-	-	-	0	0.2	-0.2
KA3551G05:1	1.50	3.10	2.30	22.49	-	-	-	-	-	-	0	0.2	0.0
KA3552A01:1	0.65	2.06	1.36	23.11	-	-	-	-	-	-	0	0.6	-9.6
KA3552G01:1	7.05	12.00	9.53	17.80	100	0.053	6.77E-03	4.8E-06	3.3E-04	7.0E-04	1	-1.2	9.0
KA3552G01:2	4.35	6.05	5.20	19.94	20	0.331	2.66E-02	8.5E-06	6.6E-05	3.2E-04	2	8.8	23.7
KA3552G01:3	1.50	3.35	2.43	21.65	170	0.046	6.86E-03	-	-	-	1	-2.7	2.7
KA3552H01:1	0.65	2.10	1.38	27.77	-	-	-	-	-	-	0	0.6	-9.8
KA3553B01:1	0.65	2.02	1.34	27.31	-	-	-	-	-	-	0	0.4	-9.8
KA3554G01:1	25.15	30.01	27.58	4.19	0.12	2.442	7.62E-02	8.9E-06	1.3E-05	1.2E-04	2	103.1	106.8
KA3554G01:2	**22.60**	**24.15**	**23.38**	**0.00**	-	-	-	6.0E-07	-	-	**2**	3172.3	3174.6
KA3554G01:3	14.00	21.60	17.80	5.59	0.06	8.668	2.49E-01	5.3E-07	2.8E-07	2.1E-06	2	175.8	169.3
KA3554G01:4	5.00	13.00	9.00	14.39	0.06	57.483	1.65E+00	4.8E-07	3.7E-08	2.9E-07	2	170.6	159.5
KA3554G01:5	1.50	4.00	2.75	20.64	0.05	141.986	4.00E+00	-	-	-	2	20.1	26.4
KA3554G02:1	22.00	30.01	26.01	36.00	90	0.240	2.98E-02	-	-	-	2	17.2	29.5
KA3554G02:2	15.90	21.00	18.45	30.81	50	0.316	3.30E-02	7.9E-07	2.1E-05	2.4E-05	2	16.2	32.5
KA3554G02:3	13.20	14.90	14.05	28.28	55	0.242	2.60E-02	7.5E-07	2.7E-05	2.9E-05	2	15.9	32.3
KA3554G02:4	10.50	12.20	11.35	26.97	38	0.319	3.07E-02	4.8E-07	1.5E-05	1.6E-05	2	20.9	64.5
KA3554G02:5	1.50	9.50	5.50	24.92	80	0.129	1.55E-02	-	-	-	2	16.8	34.0
KA3557G:1	15.00	30.04	22.52	18.58	72	0.080	9.29E-03	4.0E-06	2.0E-04	4.4E-04	2	-6.7	14.5
KA3557G:2	1.50	14.00	7.75	19.51	90	0.071	8.76E-03	3.6E-06	2.3E-04	4.1E-04	2	-4.3	10.6
KA3563A01:1	0.65	2.06	1.36	25.11	-	-	-	-	-	-	0	0.7	0.2
KA3563D01:1	0.65	2.01	1.33	29.52	-	-	-	-	-	-	0	0.5	0.5
KA3563G:1	15.00	30.01	22.51	21.80	112	0.071	9.37E-03	2.3E-06	1.9E-04	2.4E-04	2	-6.4	11.5
KA3563G:2	10.00	13.00	11.50	20.77	179	0.040	6.09E-03	3.6E-06	4.0E-04	6.0E-04	1	-0.5	3.9
KA3563G:3	4.00	8.00	6.00	22.37	16.8	0.496	3.81E-02	4.9E-07	1.0E-05	1.3E-05	2	49.9	69.1
KA3563G:4	1.50	3.00	2.25	24.12	140	0.069	9.79E-03	-	-	-	1	0.2	1.0
KA3563I01:1	0.65	2.15	1.40	29.94	210	0.071	1.13E-02	-	-	-	1	0.5	0.0
KA3566C01:1	0.65	2.1	1.38	27.64	16.3	0.781	5.95E-02	1.0E-06	1.1E-05	1.7E-05	2	12.6	10.8

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	12.63	79	0.034	4.02E-03	3.0E-06	4.2E-04	7.6E-04	1	7.9	6.6
KA3566G01:2	20.00	21.50	20.75	12.50	71	0.037	4.25E-03	6.9E-07	1.9E-05	1.6E-04	2	50.7	50.0
KA3566G01:3	12.00	18.00	15.00	14.87	8	0.460	2.94E-02	8.0E-07	1.5E-05	2.7E-05	2	45.0	45.2
KA3566G01:4	7.30	10.00	8.65	19.22	30	0.205	1.85E-02	-	-	-	1	41.3	19.9
KA3566G01:5	1.50	6.30	3.90	23.08	100	0.089	1.14E-02	-	-	-	2	24.8	18.7
KA3566G02:1	19.00	30.10	24.55	37.30	79	0.294	3.51E-02	-	-	-	2	16.7	42.6
KA3566G02:2	16.00	18.00	17.00	32.57	58	0.305	3.32E-02	-	-	-	2	19.2	28.8
KA3566G02:3	12.00	14.00	13.00	30.53	100	0.155	1.99E-02	-	-	-	2	14.5	23.1
KA3566G02:4	8.00	11.00	9.50	29.08	220	0.064	1.03E-02	-	-	-	1	2.7	3.0
KA3566G02:5	1.30	6.00	3.65	27.50	-	-	-	-	-	-	0	3.2	0.7
KA3568D01:1	0.65	2.30	1.48	31.50	-	-	-	-	-	-	0	0.5	0.2
KA3572G01:1	7.30	12.03	9.67	25.80	-	-	-	-	-	-	0	9.6	-2.0
KA3572G01:2	2.70	5.30	4.00	27.93	7.9	1.645	1.05E-01	7.2E-06	1.2E-05	6.8E-05	2	-40.6	189.6
KA3573A:1	26.00	40.07	33.04	31.70	20	0.838	6.74E-02	4.3E-06	2.0E-05	6.4E-05	1	8.6	9.3
KA3573A:2	21.00	24.00	22.50	27.19	6.2	1.988	1.20E-01	9.7E-07	4.2E-06	8.1E-06	2	30.0	31.2
KA3573A:3	14.50	19.00	16.75	26.22	10	1.146	7.72E-02	5.4E-07	4.8E-06	7.0E-06	2	34.2	35.2
KA3573A:4	10.50	12.50	11.50	26.42	1.4	8.311	3.73E-01	3.0E-06	1.8E-06	8.2E-06	2	86.4	89.1
KA3573A:5	1.30	8.50	4.90	28.10	9.5	1.385	9.22E-02	2.3E-06	8.8E-06	2.5E-05	2	16.0	15.7
KA3573C01:1	0.65	2.05	1.35	32.35	3	5.813	3.01E-01	6.8E-07	1.1E-06	2.3E-06	2	59.4	64.1
KA3574D01:1	0.65	2.05	1.35	35.16	-	-	-	-	-	-	0	0.2	-0.2
KA3574G01:1	8.00	12.03	10.02	27.93	-	-	-	-	-	-	0	35.9	-2.0
KA3574G01:2	5.10	7.00	6.05	29.17	-	-	-	-	-	-	0	0.2	-0.7
KA3574G01:3	1.80	4.10	2.95	30.46	130	0.119	1.65E-02	-	-	-	1	-5.9	2.9
KA3576G01:1	8.00	12.01	10.01	28.10	100	0.132	1.69E-02	1.4E-06	7.7E-05	8.5E-05	2	-5.2	11.8
KA3576G01:2	4.00	6.00	5.00	29.78	-	-	-	-	-	-	0	0.5	-0.5
KA3576G01:3	1.30	3.00	2.15	31.05	-	-	-	-	-	-	0	0.7	-0.2
KA3578C01:1	0.65	2.09	1.37	35.06	10	2.048	1.38E-01	2.7E-06	6.9E-06	2.0E-05	2	13.8	13.3
KA3578G01:1	6.50	12.58	9.54	30.46	-	-	-	-	-	-	0	0.0	-1.5
KA3578G01:2	4.30	5.50	4.90	31.88	-	-	-	-	-	-	0	0.7	-0.5
KA3578H01:1	0.65	1.90	1.28	38.12	36	0.673	6.38E-02	4.5E-07	6.3E-06	7.0E-06	2	30.5	27.1
KA3579D01:1	0.65	2.00	1.33	37.77	-	-	-	-	-	-	0	0.7	0.0
KA3579G:1	14.70	22.65	18.68	30.68	-	-	-	-	-	-	0	1.0	-1.5
KA3579G:2	12.50	13.70	13.10	30.83	-	-	-	-	-	-	0	0.5	-3.0
KA3579G:3	2.30	11.50	6.90	32.15	-	-	-	-	-	-	0	0.5	-1.5
KA3584G01:1	7.00	12.00	9.50	35.36	-	-	-	-	-	-	0	1.0	-1.0
KA3584G01:2	1.30	5.00	3.15	37.26	-	-	-	-	-	-	0	0.7	-0.2
KA3588C01:1	0.65	2.04	1.35	42.96	5.1	6.031	3.48E-01	1.0E-06	1.3E-06	3.0E-06	2	28.0	21.6
KA3588D01:1	0.65	1.90	1.28	44.11	200	0.162	2.53E-02	2.7E-07	2.0E-05	1.0E-05	1	-0.5	2.7
KA3588I01:1	0.65	1.96	1.31	45.28	100	0.342	4.38E-02	-	-	-	1	2.0	1.0
KA3590G01:1	16.00	30.00	23.00	35.60	4.3	4.912	2.73E-01	4.3E-07	9.5E-07	1.6E-06	2	75.3	76.1
KA3590G01:2	7.00	15.00	11.00	38.07	4	6.039	3.31E-01	4.9E-07	8.1E-07	1.5E-06	2	75.0	76.8
KA3590G01:3	1.30	6.00	3.65	41.27	7	4.056	2.51E-01	2.1E-06	3.2E-06	8.4E-06	2	32.0	31.0
KA3590G02:1	25.50	30.01	27.76	52.13	18	2.516	1.97E-01	8.3E-07	3.0E-06	4.2E-06	2	25.6	29.7
KA3590G02:2	15.20	23.50	19.35	48.04	47	0.818	8.38E-02	-	-	-	2	19.4	24.1
KA3590G02:3	11.90	13.20	12.55	45.61	200	0.173	2.71E-02	-	-	-	1	6.6	4.9
KA3590G02:4	1.30	9.90	5.60	44.08	100	0.324	4.15E-02	-	-	-	1	2.9	1.7
KA3592C01:1	0.65	2.01	1.33	46.63	-	-	-	-	-	-	0	0.2	-0.2
KA3593G:1	25.20	30.02	27.61	47.27	-	-	-	-	-	-	0	0.7	0.0
KA3593G:2	23.50	24.20	23.85	46.04	10	3.533	2.38E-01	8.0E-07	2.1E-06	3.4E-06	2	41.8	41.3
KA3593G:3	9.00	22.50	15.75	44.37	150	0.219	3.15E-02	-	-	-	1	-0.2	3.4
KA3593G:4	3.00	7.00	5.00	44.40	130	0.253	3.50E-02	-	-	-	1	9.6	8.1
KA3597D01:1	0.65	2.22	1.44	51.18	-	-	-	-	-	-	0	0.2	0.0
KA3597H01:1	0.65	2.06	1.36	52.32	42	1.086	1.08E-01	6.6E-06	2.0E-05	6.2E-05	1	3.7	3.4
KA3600F:1	43.00	50.10	46.55	88.48	75	1.740	2.05E-01	5.6E-06	1.3E-05	2.8E-05	1	3.7	4.4
KA3600F:2	40.50	42.00	41.25	83.83	60	1.952	2.15E-01	8.5E-06	1.0E-05	3.9E-05	1	3.9	4.7
KA3600F:3	20.00	39.50	29.75	74.05	31	2.948	2.68E-01	6.2E-06	6.8E-06	2.3E-05	1	5.9	6.9
KA3600F:4	1.30	18.00	9.65	58.49	80	0.713	8.55E-02	-	-	-	2	17.7	18.4
KG0021A01:1	42.50	48.82	45.66	35.94	10	2.152	1.45E-01	1.9E-06	5.5E-06	1.3E-05	2	50.7	55.4
KG0021A01:2	37.00	41.50	39.25	36.46	10	2.216	1.49E-01	9.7E-07	3.6E-06	6.5E-06	2	45.6	50.5
KG0021A01:3	35.00	36.00	35.50	37.28	16	1.448	1.10E-01	7.8E-07	4.3E-06	7.1E-06	2	28.8	33.5
KG0021A01:4	19.00	34.00	26.50	40.63	11	2.501	1.72E-01	1.4E-06	4.0E-06	8.3E-06	2	25.3	29.7
KG0021A01:5	5.00	18.00	11.50	49.43	42	0.970	9.61E-02	1.3E-06	9.9E-06	1.4E-05	2	9.3	13.3
KG0048A01:1	49.00	54.69	51.85	46.20	1.5	23.719	1.08E+00	7.5E-07	2.9E-07	7.0E-07	2	85.4	88.1
KG0048A01:2	34.8	48	41.40	44.01	3.2	10.087	5.28E-01	6.5E-07	6.0E-07	1.2E-06	2	60.4	64.5
KG0048A01:3	32.80	33.80	33.30	43.96	4	8.053	4.41E-01	1.4E-06	1.2E-06	3.1E-06	2	47.0	50.2
KG0048A01:4	13.00	31.80	22.40	46.21	11	3.235	2.23E-01	1.6E-06	3.3E-06	7.3E-06	2	26.6	30.3
KG0048A01:5	5.00	12.00	8.50	52.32	90	0.507	6.30E-02	-	-	-	2	9.3	14.5

6.2.4 Test 1:24 – 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	1:24		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
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	20030512 07:41:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030512 09:41:00
Stop of flow period		yymmdd hh:mm:ss	20030512 15:41:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030513 09:40:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1079

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	3377.8	
Absolute pressure in test section before stop of flow	p_p	kPa	1043.7	
Absolute pressure in test section at stop of recovery period	p_f	kPa	3384.2	
Maximal pressure change during flow period	dp_p	kPa	2334.1	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.83 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

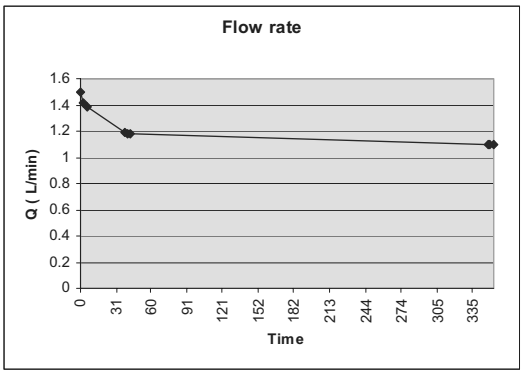


Figure 6-10 *Flow rates during drawdown in KA3590G02:1. Time in minutes.*

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 – 0.3 minutes	Transition period
0.3 – 0.8 minutes	Radial flow period
0.8 – 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.

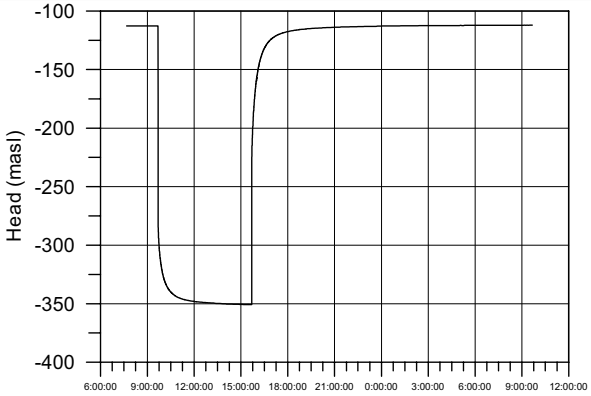
Selected representative parameters

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.

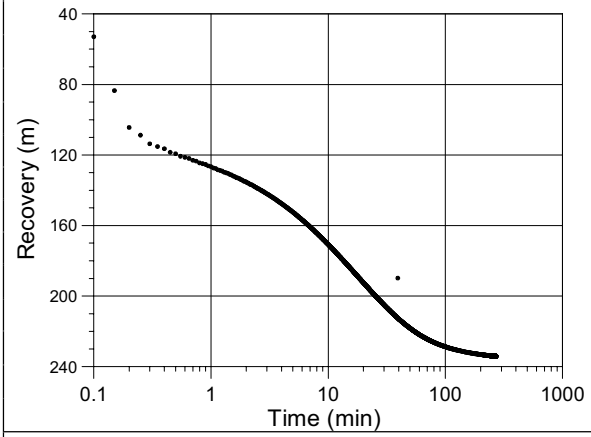
Test Summary Sheet

Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:24
Borehole ID:	KA3590G02	Test start:	2003-05-12 07:41
Test section (m):	25.50-30.01	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

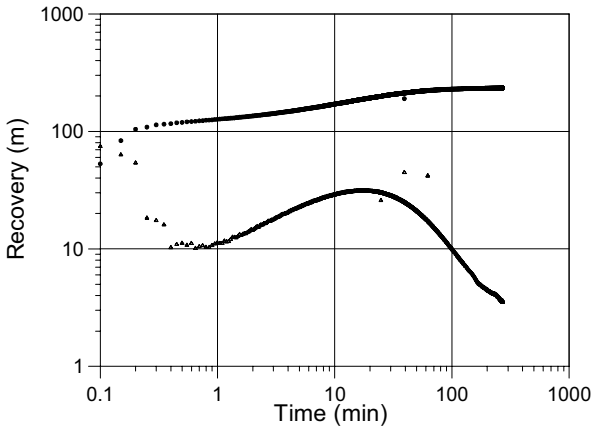
Linear plot Head



Lin-Log plot



Log-Log plot incl. derivative- recovery period



Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	3377.8		
p_i (kPa)			
p_p(kPa)	1043.7	p_F (kPa)	3384.2
Q_p (m^3/s)	$1.83 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1079
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)	$7.8 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$6.3 \cdot 10^{-8}$	dt_{e1} (min)	0.3
Flow regime:		dt_{e2} (min)	0.8
dt_1 (min)		T (m^2/s)	$1.3 \cdot 10^{-7}$
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 (-)	0.9
C_D (-)			
ξ (-)			

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 (-)	0.9
T_T (m^2/s)	$1.3 \cdot 10^{-7}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: A successful 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 1.10 l/min, while the pressure build-up time was 1079 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*.

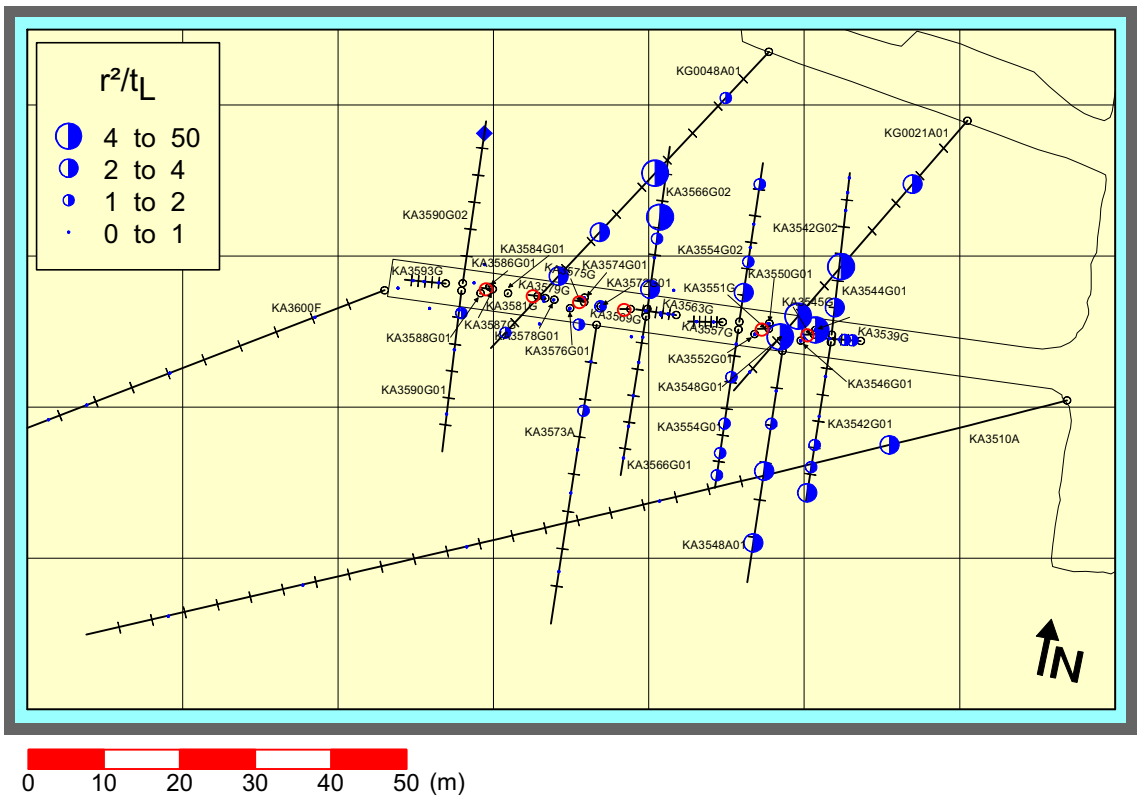


Figure 6-11 *Plot showing r^2/t_L during flowing of KA3590G02:1 (Interference test 1:24) - plan view*

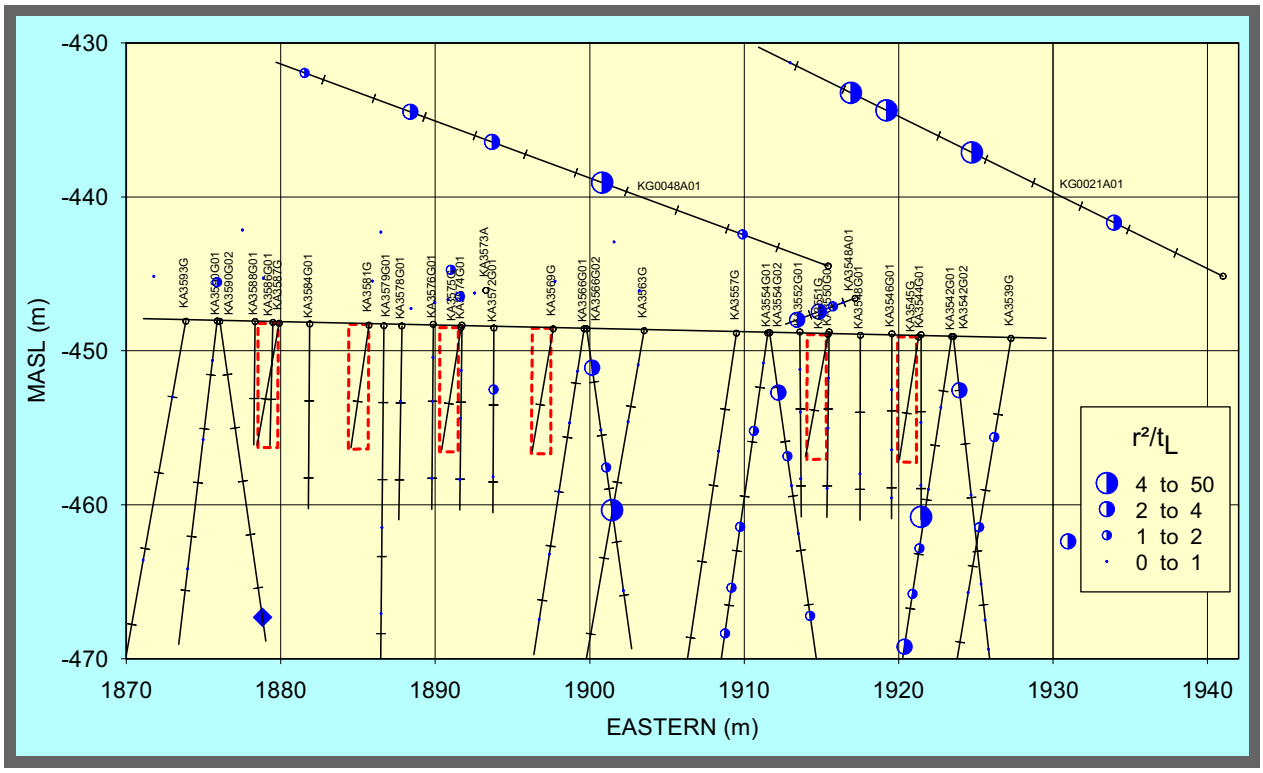


Figure 6-12 *Plot showing r^2/t_L during flowing of KA3590G02:1 (Interference test 1:24) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3588C01:1, KA3573C01:1, KA3573A:4, KA3572G01:2, KA356602:3, KA3554 G02:1&4, KA3554G01:1-4, KA3548A01:3, KA3542G01:2-3, KA3593G:3-4 and KG0048 A01:1&5.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3566G02:5, KA3554G02:5, KA3548A01:1-2, KA3542G02:5, KA3542G01:1, KA3510 A:5, KG0021A01:5 and KG0048A01:2&3.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KA3566G02:2, KA3544G01:1, 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 $2.9 \cdot 10^{-8} – 1.3 \cdot 10^{-6}$ m^2/s. The transmissivity of the flowing section is evaluated to be $1.3 \cdot 10^{-7}$ m^2/s with the evaluation period 0.3 – 0.8 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. At the same time it is in very good connection with two holes, KA3544G01:1 and KA3566G02:2, located almost directly below, approximately 30 meters, KG0021A01 and KG0048A01 respectively. This is an indication of the vertical extension of the hydraulic features system.

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	90.83	200	0.687	1.07E-01	-	-	-	1	0.8	0.6
KA3510A:2	110.00	124.00	117.00	75.59	200	0.476	7.43E-02	-	-	-	1	0.4	1.0
KA3510A:3	75.00	109.00	92.00	61.30	75	0.835	9.83E-02	5.9E-07	6.1E-06	6.0E-06	1	5.7	6.1
KA3510A:4	51.00	74.00	62.50	55.15	62	0.818	9.09E-02	2.4E-07	3.3E-06	2.7E-06	2	15.1	14.3
KA3510A:5	4.50	50.00	27.25	66.67	30	2.469	2.22E-01	7.3E-07	2.6E-06	3.3E-06	2	18.6	18.2
KA3539G:1	18.60	30.00	24.30	52.41	110	0.416	5.49E-02	-	-	-	2	55.9	38.0
KA3539G:2	15.85	17.60	16.73	53.23	50	0.944	9.85E-02	-	-	-	2	60.8	44.1
KA3539G:3	10.00	14.85	12.43	54.16	30	1.630	1.47E-01	3.0E-07	2.0E-06	2.0E-06	2	67.5	53.0
KA3539G:4	4.00	9.00	6.50	55.96	50	1.044	1.09E-01	-	-	-	2	58.4	44.2
KA3542G01:1	27.00	30.00	28.50	63.20	28	2.378	2.10E-01	7.9E-07	2.6E-06	3.7E-06	2	18.9	17.4
KA3542G01:2	21.30	26.00	23.65	61.04	50	1.242	1.30E-01	2.5E-07	2.3E-06	1.9E-06	2	21.4	19.1
KA3542G01:3	18.60	20.30	19.45	59.42	42	1.401	1.39E-01	3.5E-07	2.4E-06	2.5E-06	2	23.8	21.3
KA3542G01:4	10.50	17.60	14.05	57.72	58	0.957	1.04E-01	3.7E-07	3.3E-06	3.6E-06	2	21.4	19.2
KA3542G01:5	3.50	9.50	6.50	56.13	200	0.263	4.10E-02	-	-	-	1	3.2	2.0
KA3542G02:1	28.20	30.01	29.11	47.40	170	0.220	3.29E-02	-	-	-	2	32.6	30.2
KA3542G02:2	25.60	27.20	26.40	47.43	170	0.221	3.29E-02	-	-	-	2	40.5	37.8
KA3542G02:3	21.50	24.60	23.05	47.68	250	0.152	2.51E-02	-	-	-	1	-1.0	0.7
KA3542G02:4	9.00	20.50	14.75	49.27	110	0.368	4.85E-02	-	-	-	2	91.8	87.8
KA3542G02:5	2.00	8.00	5.00	52.77	17	2.730	2.10E-01	4.2E-07	1.5E-06	2.0E-06	2	76.9	59.7
KA3543A01:1	0.65	2.06	1.36	55.41	-	-	-	-	-	-	0	2.3	-12.5
KA3543I01:1	0.65	2.06	1.36	56.51	-	-	-	-	-	-	0	2.5	-12.3
KA3544G01:1	11.65	12.00	11.83	50.37	10	4.229	2.85E-01	-	-	-	2	-11.0	44.1
KA3544G01:2	8.90	10.65	9.78	50.68	65	0.659	7.43E-02	-	-	-	2	54.6	36.1
KA3544G01:3	3.50	7.90	5.70	51.53	100	0.442	5.67E-02	-	-	-	2	53.6	30.0
KA3546G01:1	9.30	12.00	10.65	49.73	170	0.242	3.62E-02	-	-	-	1	0.0	-1.0
KA3546G01:2	6.75	8.30	7.53	50.31	220	0.192	3.07E-02	-	-	-	1	-2.0	0.7
KA3546G01:3	1.50	5.75	3.63	51.29	220	0.199	3.19E-02	-	-	-	1	0.5	-0.5
KA3548A01:1	21.50	30.00	25.75	67.16	30	2.506	2.25E-01	8.7E-07	2.5E-06	3.8E-06	2	17.4	16.4
KA3548A01:2	11.75	20.50	16.13	60.74	27	2.278	1.99E-01	7.9E-07	2.8E-06	4.0E-06	2	18.6	17.6
KA3548A01:3	8.80	10.75	9.78	57.00	41	1.321	1.30E-01	4.0E-07	2.9E-06	3.1E-06	2	21.7	20.2
KA3548A01:4	3.00	7.80	5.40	54.70	58	0.860	9.37E-02	2.2E-07	3.0E-06	2.4E-06	2	21.9	22.1
KA3548D01:1	0.65	2.06	1.36	50.76	-	-	-	-	-	-	0	2.5	-12.3
KA3548G01:1	6.00	12.00	9.00	47.72	240	0.158	2.59E-02	-	-	-	1	-0.6	3.5
KA3548G01:2	2.00	5.00	3.50	49.09	-	-	-	-	-	-	0	0.8	-2.9
KA3550G01:1	8.30	12.03	10.17	45.18	110	0.309	4.08E-02	-	-	-	2	-3.5	14.1
KA3550G01:2	5.20	7.30	6.25	46.10	135	0.262	3.67E-02	-	-	-	1	-0.4	3.7
KA3550G01:3	1.80	4.20	3.00	47.09	140	0.264	3.73E-02	-	-	-	1	-0.6	4.3
KA3550G05:1	1.50	3.00	2.25	51.16	-	-	-	-	-	-	0	0.4	-0.6
KA3551G05:1	1.50	3.10	2.30	45.89	-	-	-	-	-	-	0	0.4	-0.2
KA3552A01:1	0.65	2.06	1.36	48.14	-	-	-	-	-	-	0	2.5	-12.1
KA3552G01:1	7.05	12.00	9.53	44.77	130	0.257	3.56E-02	-	-	-	1	-2.5	7.6
KA3552G01:2	4.35	6.05	5.20	45.80	45	0.777	7.86E-02	-	-	-	1	-4.7	2.3
KA3552G01:3	1.50	3.35	2.43	46.66	100	0.363	4.65E-02	-	-	-	1	-0.4	2.3
KA3552H01:1	0.65	2.10	1.38	48.84	-	-	-	-	-	-	0	2.3	-12.3
KA3553B01:1	0.65	2.02	1.34	45.10	-	-	-	-	-	-	0	2.3	-12.3
KA3554G01:1	25.15	30.01	27.58	54.28	30	1.637	1.47E-01	7.1E-07	3.5E-06	4.8E-06	2	19.0	17.4
KA3554G01:2	22.60	24.15	23.38	52.13	26	1.742	1.51E-01	7.1E-07	3.7E-06	4.7E-06	2	18.4	17.8
KA3554G01:3	14.00	21.60	17.80	49.66	34	1.209	1.13E-01	5.0E-07	4.1E-06	4.4E-06	2	15.8	7.4
KA3554G01:4	5.00	13.00	9.00	46.90	35	1.047	9.85E-02	5.7E-07	5.0E-06	5.8E-06	2	14.7	3.9
KA3554G01:5	1.50	4.00	2.75	45.85	200	0.175	2.73E-02	-	-	-	1	3.9	2.7
KA3554G02:1	22.00	30.01	26.01	36.09	13	1.669	1.20E-01	1.1E-07	8.2E-07	8.8E-07	2	185.6	187.0
KA3554G02:2	15.90	21.00	18.45	37.12	30	0.765	6.89E-02	9.6E-08	1.6E-06	1.4E-06	2	107.2	102.1
KA3554G02:3	13.20	14.90	14.05	38.40	28	0.878	7.74E-02	9.8E-08	1.5E-06	1.3E-06	2	107.1	102.0
KA3554G02:4	10.50	12.20	11.35	39.41	20	1.294	1.04E-01	3.8E-07	2.6E-06	3.7E-06	1	90.2	64.5
KA3554G02:5	1.50	9.50	5.50	42.10	10	2.954	1.99E-01	3.4E-08	1.9E-07	1.7E-07	2	382.8	406.9
KA3557G:1	15.00	30.04	22.52	37.19	100	0.231	2.96E-02	-	-	-	2	-6.1	9.8
KA3557G:2	1.50	14.00	7.75	40.15	100	0.269	3.44E-02	-	-	-	2	-3.9	9.4
KA3563A01:1	0.65	2.06	1.36	40.23	-	-	-	-	-	-	0	0.5	0.0
KA3563D01:1	0.65	2.01	1.33	38.43	200	0.123	1.92E-02	-	-	-	1	4.9	4.2
KA3563G:1	15.00	30.01	22.51	31.60	130	0.128	1.77E-02	-	-	-	1	-6.4	7.6
KA3563G:2	10.00	13.00	11.50	33.68	200	0.095	1.48E-02	-	-	-	1	-0.7	2.0
KA3563G:3	4.00	8.00	6.00	35.96	120	0.180	2.43E-02	-	-	-	2	17.7	18.7
KA3563G:4	1.50	3.00	2.25	37.90	190	0.126	1.94E-02	-	-	-	1	0.5	0.7
KA3563I01:1	0.65	2.15	1.40	41.11	200	0.141	2.20E-02	-	-	-	1	0.5	0.0
KA3566C01:1	0.65	2.1	1.38	39.50	35	0.743	6.98E-02	2.1E-06	1.5E-05	3.1E-05	1	6.6	5.9

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	46.58	130	0.278	3.85E-02	-	-	-	1	0.7	1.5
KA3566G01:2	20.00	21.50	20.75	43.19	65	0.478	5.39E-02	1.4E-06	1.8E-05	2.6E-05	1	8.9	-2.0
KA3566G01:3	12.00	18.00	15.00	40.52	75	0.365	4.30E-02	2.5E-06	3.2E-05	5.8E-05	1	7.6	4.7
KA3566G01:4	7.30	10.00	8.65	38.38	130	0.189	2.61E-02	-	-	-	2	2.2	111.3
KA3566G01:5	1.50	6.30	3.90	37.40	130	0.179	2.48E-02	-	-	-	2	-0.2	6.9
KA3566G02:1	19.00	30.10	24.55	24.11	11	0.880	6.07E-02	1.2E-07	1.7E-06	1.9E-06	2	190.6	180.2
KA3566G02:2	16.00	18.00	17.00	26.14	2.3	4.953	2.43E-01	1.8E-07	4.9E-07	7.5E-07	2	645.7	681.1
KA3566G02:3	12.00	14.00	13.00	28.01	12.5	1.046	7.44E-02	2.9E-08	4.1E-07	3.9E-07	2	482.7	501.1
KA3566G02:4	8.00	11.00	9.50	29.98	105	0.143	1.86E-02	-	-	-	2	199.3	206.4
KA3566G02:5	1.30	6.00	3.65	33.83	8	2.384	1.52E-01	7.9E-07	2.8E-06	5.2E-06	2	18.2	16.7
KA3568D01:1	0.65	2.30	1.48	35.29	-	-	-	-	-	-	0	0.2	-0.2
KA3572G01:1	7.30	12.03	9.67	28.85	170	0.082	1.22E-02	-	-	-	1	-4.4	4.4
KA3572G01:2	2.70	5.30	4.00	31.10	10	1.612	1.09E-01	-	-	-	2	-48.8	50.0
KA3573A:1	26.00	40.07	33.04	62.13	125	0.515	7.04E-02	-	-	-	1	2.2	2.5
KA3573A:2	21.00	24.00	22.50	52.99	50	0.936	9.77E-02	1.2E-06	8.6E-06	1.2E-05	1	6.9	6.9
KA3573A:3	14.50	19.00	16.75	48.24	60	0.646	7.12E-02	1.4E-06	1.3E-05	2.0E-05	1	7.1	7.1
KA3573A:4	10.50	12.50	11.50	44.11	23	1.410	1.18E-01	9.4E-07	5.1E-06	8.0E-06	2	18.9	18.2
KA3573A:5	1.30	8.50	4.90	39.30	50	0.515	5.37E-02	-	-	-	1	4.4	2.7
KA3573C01:1	0.65	2.05	1.35	36.03	11	1.967	1.36E-01	1.0E-06	3.8E-06	7.5E-06	2	33.9	31.0
KA3574D01:1	0.65	2.05	1.35	32.57	-	-	-	-	-	-	0	0.0	-0.5
KA3574G01:1	8.00	12.03	10.02	26.81	220	0.054	8.71E-03	-	-	-	1	-0.2	1.2
KA3574G01:2	5.10	7.00	6.05	28.39	220	0.061	9.77E-03	-	-	-	1	0.5	0.0
KA3574G01:3	1.80	4.10	2.95	29.93	170	0.088	1.31E-02	-	-	-	1	-0.5	1.5
KA3576G01:1	8.00	12.01	10.01	27.26	80	0.155	1.86E-02	2.1E-06	6.8E-05	1.1E-04	2	-3.7	11.6
KA3576G01:2	4.00	6.00	5.00	29.27	250	0.057	9.45E-03	-	-	-	1	0.2	-0.2
KA3576G01:3	1.30	3.00	2.15	30.72	250	0.063	1.04E-02	-	-	-	1	0.5	-0.2
KA3578C01:1	0.65	2.09	1.37	34.12	55	0.353	3.79E-02	-	-	-	1	3.9	1.7
KA3578G01:1	6.50	12.58	9.54	25.58	-	-	-	-	-	-	0	1.7	-1.7
KA3578G01:2	4.30	5.50	4.90	27.62	225	0.057	9.10E-03	-	-	-	1	0.2	-0.2
KA3578H01:1	0.65	1.90	1.28	34.33	55	0.357	3.83E-02	1.5E-07	5.3E-06	3.8E-06	2	25.3	21.6
KA3579D01:1	0.65	2.00	1.33	30.00	-	-	-	-	-	-	0	0.2	0.0
KA3579G:1	14.70	22.65	18.68	23.05	250	0.035	5.86E-03	-	-	-	1	1.5	-1.5
KA3579G:2	12.50	13.70	13.10	23.82	250	0.038	6.25E-03	-	-	-	1	0.5	-2.0
KA3579G:3	2.30	11.50	6.90	26.08	-	-	-	-	-	-	0	2.2	-1.2
KA3584G01:1	7.00	12.00	9.50	23.52	-	-	-	-	-	-	0	1.7	-2.0
KA3584G01:2	1.30	5.00	3.15	26.68	-	-	-	-	-	-	0	0.2	-0.2
KA3588C01:1	0.65	2.04	1.35	32.39	10	1.749	1.18E-01	-	-	-	2	12.0	12.0
KA3588D01:1	0.65	1.90	1.28	28.05	130	0.101	1.40E-02	-	-	-	1	-0.7	27.0
KA3588I01:1	0.65	1.96	1.31	32.03	230	0.074	1.20E-02	-	-	-	1	0.7	0.5
KA3590G01:1	16.00	30.00	23.00	37.61	27	0.873	7.62E-02	8.7E-07	4.4E-06	1.1E-05	2	15.0	14.5
KA3590G01:2	7.00	15.00	11.00	31.12	30	0.538	4.84E-02	7.9E-07	1.2E-05	1.6E-05	2	14.5	14.5
KA3590G01:3	1.30	6.00	3.65	28.94	100	0.140	1.79E-02	1.5E-06	6.3E-05	8.1E-05	1	5.2	3.2
KA3590G02:1	**25.50**	**30.01**	**27.76**	**0.00**	-	-	-	1.3E-07	-	-	**2**	2334.1	2340.5
KA3590G02:2	15.20	23.50	19.35	8.41	0.01	117.830	2.81E+00	-	-	-	2	1045.2	1072.7
KA3590G02:3	11.90	13.20	12.55	15.21	0.01	385.580	9.19E+00	-	-	-	2	16.5	14.8
KA3590G02:4	1.30	9.90	5.60	22.16	0.05	163.702	4.61E+00	-	-	-	2	585.3	622.7
KA3592C01:1	0.65	2.01	1.33	32.82	230	0.078	1.26E-02	-	-	-	1	0.5	0.0
KA3593G:1	25.20	30.02	27.61	23.17	-	-	-	-	-	-	0	0.0	-0.2
KA3593G:2	23.50	24.20	23.85	21.94	80	0.100	1.20E-02	-	-	-	1	6.6	4.2
KA3593G:3	9.00	22.50	15.75	21.41	130	0.059	8.13E-03	-	-	-	1	0.5	2.9
KA3593G:4	3.00	7.00	5.00	25.10	170	0.062	9.23E-03	-	-	-	1	7.9	5.2
KA3597D01:1	0.65	2.22	1.44	28.76	-	-	-	-	-	-	0	0.2	-0.2
KA3597H01:1	0.65	2.06	1.36	34.35	200	0.098	1.53E-02	-	-	-	1	1.5	1.0
KA3600F:1	43.00	50.10	46.55	70.68	200	0.416	6.50E-02	-	-	-	1	1.0	1.5
KA3600F:2	40.50	42.00	41.25	65.80	190	0.380	5.85E-02	-	-	-	1	1.2	1.7
KA3600F:3	20.00	39.50	29.75	55.48	130	0.395	5.46E-02	-	-	-	1	2.2	2.5
KA3600F:4	1.30	18.00	9.65	39.07	130	0.196	2.71E-02	-	-	-	1	4.2	4.4
KG0021A01:1	42.50	48.82	45.66	58.85	130	0.444	6.15E-02	3.3E-07	7.5E-07	5.3E-06	2	58.3	57.3
KG0021A01:2	37.00	41.50	39.25	57.76	8	6.951	4.44E-01	5.9E-07	6.9E-07	1.3E-06	2	73.1	73.1
KG0021A01:3	35.00	36.00	35.50	57.46	5	11.004	6.32E-01	4.8E-07	3.7E-07	7.7E-07	2	104.8	106.5
KG0021A01:4	19.00	34.00	26.50	57.72	2	27.763	1.33E+00	1.3E-06	3.3E-07	1.0E-06	2	117.5	121.4
KG0021A01:5	5.00	18.00	11.50	61.16	17	3.667	2.82E-01	8.1E-07	1.7E-06	2.9E-06	2	40.8	42.1
KG0048A01:1	49.00	54.69	51.85	44.20	22	1.480	1.22E-01	9.6E-07	5.1E-06	7.8E-06	2	19.2	18.5
KG0048A01:2	34.8	48	41.40	39.07	11	2.313	1.59E-01	1.1E-06	3.2E-06	6.8E-06	2	33.6	31.2
KG0048A01:3	32.80	33.80	33.30	36.68	6.5	3.450	2.10E-01	3.7E-07	1.1E-06	1.8E-06	2	71.1	70.1
KG0048A01:4	13.00	31.80	22.40	36.17	1	21.806	9.23E-01	7.9E-07	3.0E-07	8.5E-07	2	206.7	210.4
KG0048A01:5	5.00	12.00	8.50	40.08	20	1.339	1.08E-01	-	-	-	2	41.7	43.7

6.2.5 Test 1:25 – 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	1:25		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
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	20030513 07:40:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030513 09:40:00
Stop of flow period		yymmdd hh:mm:ss	20030513 15:40:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030514 09:40:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	3300.2	
Absolute pressure in test section before stop of flow	p_p	kPa	219.0	
Absolute pressure in test section at stop of recovery period	p_f	kPa	3289.4	
Maximal pressure change during flow period	dp_p	kPa	3081.2	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.81 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

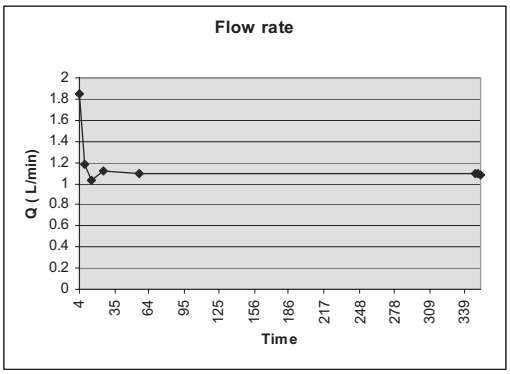


Figure 6-13 *Flow rates during draw down in KG0021A01:3. Time in minutes.*

Comments to the test

The test was successful in regard to pressure responses.

Interpreted flow regimes – flowing section

0 – 0.7 minutes	Well Bore Storage (WBS)
0.7 – 1 minutes	Transition period
1 – 2 minutes	Radial flow period
2 – 200 minutes	Transition period
200 – 300 minutes	Larger scale radial flow 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.

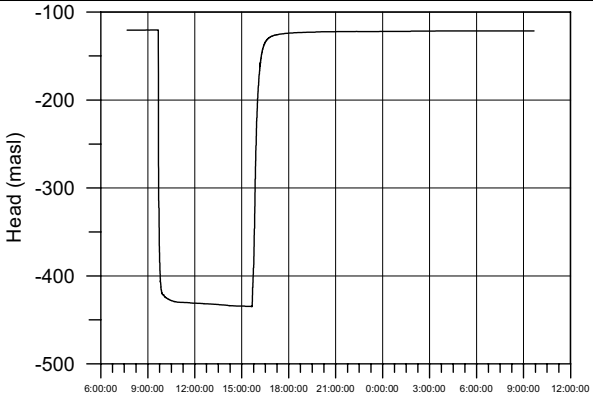
Selected representative parameters

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

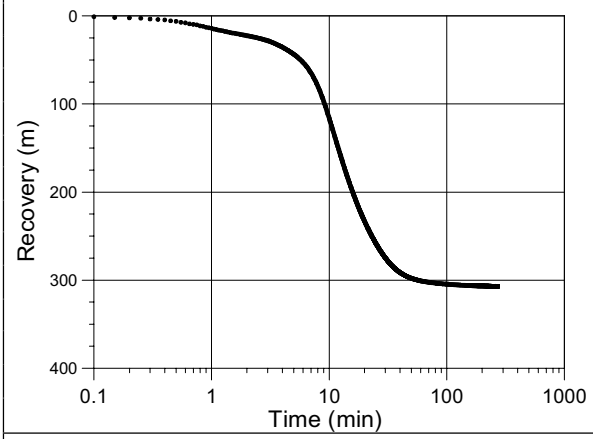
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:25
Borehole ID:	KG0021A01	Test start:	2003-05-13 07:40
Test section (m):	35.00-36.00	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

Linear plot Head



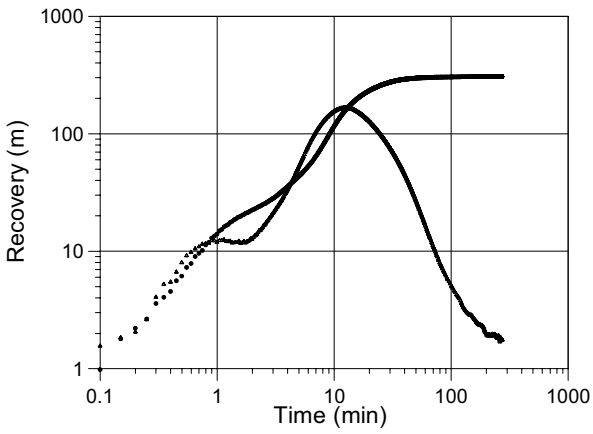
Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	3300.2		
p_i (kPa)			
p_p(kPa)	219.0	p_F (kPa)	3289.4
Q_p (m^3/s)	$1.81 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		Results	
Q/s (m^2/s)	$5.9 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$3.3 \cdot 10^{-8}$	dt_{e1} (min)	1
Flow regime:		dt_{e2} (min)	2
dt_1 (min)		T (m^2/s)	$1.2 \cdot 10^{-7}$
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 (-)	-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)	1	C_D (-)	
dt_2 (min)	2	ξ (-)	-4
T_T (m^2/s)	$1.2 \cdot 10^{-7}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: The result may be uncertain. The change of shape of the derivative curve at 1 – 2 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 1.09 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*.

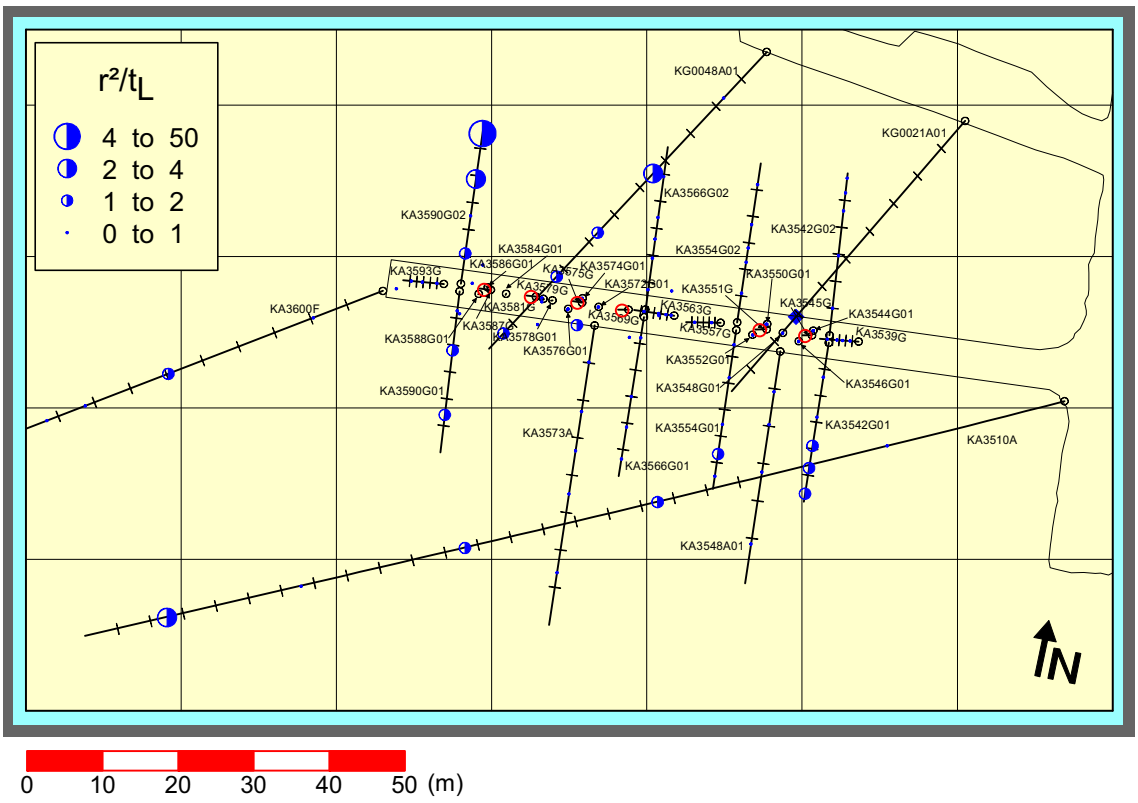


Figure 6-14 *Plot showing r^2/t_L during flowing of KG0021A01:3 (Interference test 1:25) - plan view*

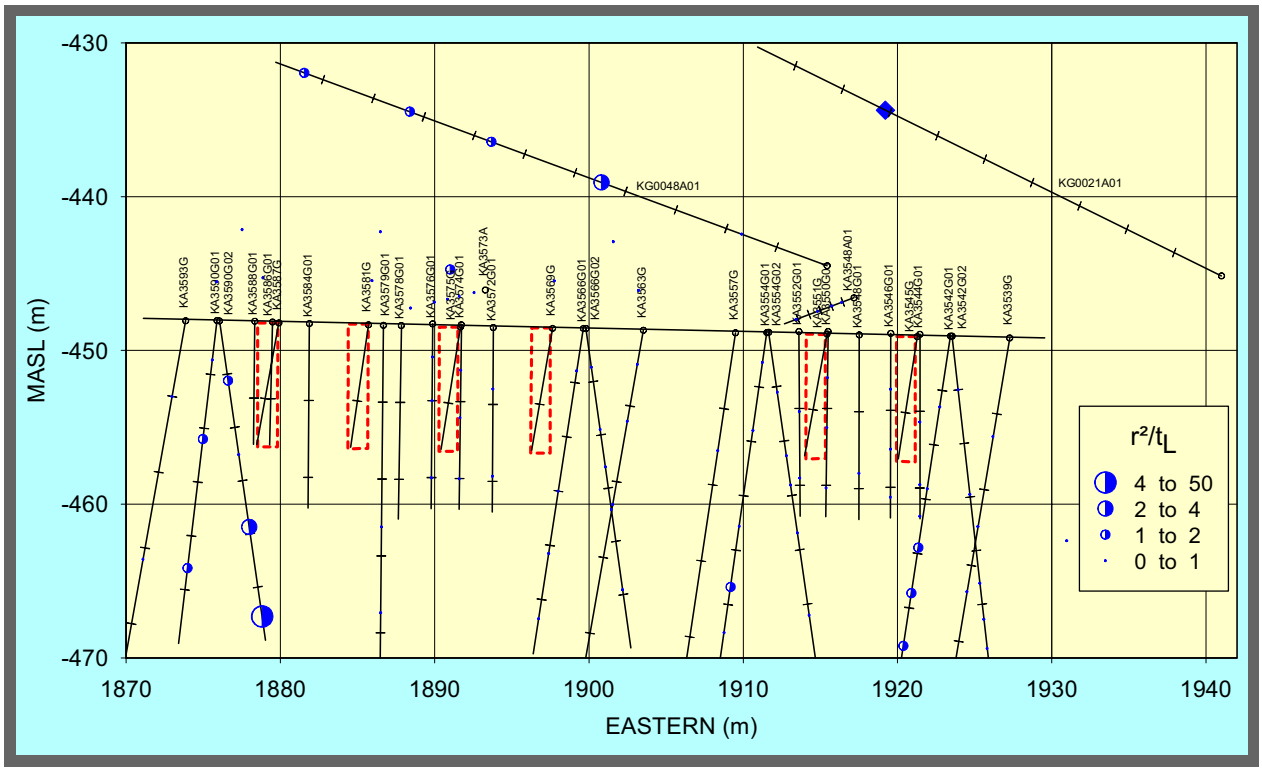


Figure 6-15 *Plot showing r^2/t_L during flowing of KG0021A01:3 (Interference test 1:25) – vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3600F:3, KA3590G02:4, KA3590G01:1-2, KA3573C01:1, KA3554G01:2, KA3542G01:1-3, KA3510A:3-4 and KG0048A01:1-3.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3590G02:2, KA3510A:1 and KG0048A01:4.

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

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $4.8 \cdot 10^{-8} – 5.3 \cdot 10^{-6}$ m^2/s. The transmissivity of the flowing section is evaluated to be $1.2 \cdot 10^{-7}$ m^2/s with the evaluation period 1 – 2 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 three lower sections of KA3542G01 on the south of the repository.

Also noteworthy is the good connection with the bottom section of KA3510A approximately 120 meters from the flow section.

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	122.63	120	2.089	2.82E-01	5.3E-06	8.5E-06	1.9E-05	1	0.6	1.0
KA3510A:2	110.00	124.00	117.00	103.12	210	0.844	1.33E-01	-	-	-	1	0.2	1.0
KA3510A:3	75.00	109.00	92.00	79.99	60	1.778	1.96E-01	1.0E-06	4.3E-06	5.1E-06	1	6.1	7.2
KA3510A:4	51.00	74.00	62.50	54.77	50	1.000	1.04E-01	3.5E-07	3.3E-06	3.3E-06	2	15.9	17.4
KA3510A:5	4.50	50.00	27.25	34.81	23	0.878	7.34E-02	5.6E-07	5.5E-06	7.7E-06	2	20.4	22.3
KA3539G:1	18.60	30.00	24.30	39.09	65	0.392	4.42E-02	-	-	-	2	31.9	38.8
KA3539G:2	15.85	17.60	16.73	31.90	30	0.565	5.09E-02	1.9E-07	3.7E-06	3.8E-06	2	36.5	42.9
KA3539G:3	10.00	14.85	12.43	27.90	20	0.649	5.22E-02	2.5E-07	3.8E-06	4.8E-06	2	44.9	51.8
KA3539G:4	4.00	9.00	6.50	22.57	19	0.447	3.54E-02	2.2E-07	7.8E-06	6.2E-06	2	38.0	42.0
KA3542G01:1	27.00	30.00	28.50	41.96	22	1.334	1.10E-01	5.8E-07	3.9E-06	5.3E-06	2	19.6	21.4
KA3542G01:2	21.30	26.00	23.65	37.26	20	1.157	9.30E-02	3.2E-07	2.9E-06	3.5E-06	2	34.4	36.8
KA3542G01:3	18.60	20.30	19.45	33.22	14	1.314	9.63E-02	2.3E-07	1.9E-06	2.4E-06	2	48.3	51.8
KA3542G01:4	10.50	17.60	14.05	28.10	21	0.626	5.11E-02	3.1E-07	4.7E-06	6.1E-06	2	37.6	40.1
KA3542G01:5	3.50	9.50	6.50	21.17	100	0.075	9.58E-03	2.1E-07	2.7E-05	2.2E-05	2	12.5	15.9
KA3542G02:1	28.20	30.01	29.11	40.04	110	0.243	3.20E-02	3.7E-08	2.5E-06	1.2E-06	2	19.9	26.8
KA3542G02:2	25.60	27.20	26.40	37.48	107	0.219	2.86E-02	5.4E-08	3.4E-06	1.9E-06	2	23.6	30.9
KA3542G02:3	21.50	24.60	23.05	34.34	218	0.090	1.44E-02	-	-	-	1	-4.9	4.7
KA3542G02:4	9.00	20.50	14.75	26.82	95	0.126	1.59E-02	5.1E-08	5.1E-06	3.2E-06	2	33.2	41.3
KA3542G02:5	2.00	8.00	5.00	18.82	14	0.422	3.09E-02	1.0E-07	3.0E-06	3.4E-06	2	65.6	72.2
KA3543A01:1	0.65	2.06	1.36	13.87	-	-	-	-	-	-	0	4.1	3482.3
KA3543I01:1	0.65	2.06	1.36	9.34	-	-	-	-	-	-	0	4.1	3482.9
KA3544G01:1	11.65	12.00	11.83	26.56	20	0.588	4.73E-02	-	-	-	2	-12.5	47.3
KA3544G01:2	8.90	10.65	9.78	24.52	44	0.228	2.29E-02	1.4E-07	7.0E-06	6.3E-06	2	32.0	35.4
KA3544G01:3	3.50	7.90	5.70	20.47	60	0.116	1.28E-02	4.5E-07	1.7E-05	3.5E-05	2	25.3	31.0
KA3546G01:1	9.30	12.00	10.65	25.37	174	0.062	9.27E-03	-	-	-	1	-0.2	0.7
KA3546G01:2	6.75	8.30	7.53	22.28	168	0.049	7.33E-03	-	-	-	1	1.2	7.6
KA3546G01:3	1.50	5.75	3.63	18.43	132	0.043	5.96E-03	-	-	-	1	0.0	0.5
KA3548A01:1	21.50	30.00	25.75	33.45	23	0.811	6.77E-02	8.8E-07	7.6E-06	1.3E-05	2	18.2	19.0
KA3548A01:2	11.75	20.50	16.13	24.70	24	0.424	3.58E-02	6.0E-07	1.2E-05	1.7E-05	2	19.0	20.5
KA3548A01:3	8.80	10.75	9.78	19.40	16	0.392	2.97E-02	2.8E-07	7.0E-06	9.3E-06	2	39.7	42.3
KA3548A01:4	3.00	7.80	5.40	16.19	15	0.291	2.17E-02	2.4E-07	1.0E-05	1.1E-05	2	53.0	54.4
KA3548D01:1	0.65	2.06	1.36	11.50	-	-	-	-	-	-	0	3.9	3482.3
KA3548G01:1	6.00	12.00	9.00	23.77	230	0.041	6.63E-03	-	-	-	1	-0.2	1.6
KA3548G01:2	2.00	5.00	3.50	18.31	-	-	-	-	-	-	0	0.6	-0.4
KA3550G01:1	8.30	12.03	10.17	24.88	70	0.147	1.70E-02	-	-	-	2	-6.3	16.0
KA3550G01:2	5.20	7.30	6.25	21.01	163	0.045	6.66E-03	7.6E-07	1.3E-04	1.1E-04	1	-1.0	3.3
KA3550G01:3	1.80	4.20	3.00	17.82	180	0.029	4.46E-03	-	-	-	1	-0.4	8.6
KA3550G05:1	1.50	3.00	2.25	16.97	-	-	-	-	-	-	0	0.2	0.4
KA3551G05:1	1.50	3.10	2.30	17.82	-	-	-	-	-	-	0	0.2	0.0
KA3552A01:1	0.65	2.06	1.36	15.35	-	-	-	-	-	-	0	4.1	2950.7
KA3552G01:1	7.05	12.00	9.53	24.67	100	0.101	1.30E-02	6.9E-07	6.5E-05	5.3E-05	1	-3.7	8.8
KA3552G01:2	4.35	6.05	5.20	20.51	200	0.035	5.47E-03	-	-	-	2	4.9	18.2
KA3552G01:3	1.50	3.35	2.43	17.88	-	-	-	-	-	-	0	-3.1	-4.7
KA3552H01:1	0.65	2.10	1.38	11.40	-	-	-	-	-	-	0	4.1	3482.6
KA3553B01:1	0.65	2.02	1.34	14.68	-	-	-	-	-	-	0	3.9	3482.7
KA3554G01:1	25.15	30.01	27.58	41.31	30	0.948	8.53E-02	4.5E-07	4.0E-06	5.3E-06	2	18.0	19.4
KA3554G01:2	22.60	24.15	23.38	37.28	23	1.007	8.42E-02	5.8E-07	5.1E-06	6.9E-06	2	19.5	20.9
KA3554G01:3	14.00	21.60	17.80	31.99	23	0.742	6.20E-02	7.0E-07	7.2E-06	1.1E-05	2	11.7	24.8
KA3554G01:4	5.00	13.00	9.00	23.92	20	0.477	3.83E-02	7.3E-07	1.3E-05	1.9E-05	2	8.8	26.4
KA3554G01:5	1.50	4.00	2.75	18.60	180	0.032	4.86E-03	1.2E-07	4.8E-05	2.4E-05	2	4.3	8.4
KA3554G02:1	22.00	30.01	26.01	37.52	65	0.361	4.07E-02	1.3E-07	4.1E-06	3.3E-06	2	32.1	39.1
KA3554G02:2	15.90	21.00	18.45	30.59	17	0.918	7.07E-02	1.4E-07	1.9E-06	2.0E-06	2	76.5	79.3
KA3554G02:3	13.20	14.90	14.05	26.73	17	0.700	5.40E-02	1.4E-07	2.6E-06	2.7E-06	2	76.3	79.3
KA3554G02:4	10.50	12.20	11.35	24.44	23	0.433	3.62E-02	9.3E-08	2.7E-06	2.6E-06	2	54.8	61.6
KA3554G02:5	1.50	9.50	5.50	19.87	37	0.178	1.70E-02	5.3E-08	4.2E-06	3.1E-06	2	70.2	76.3
KA3557G:1	15.00	30.04	22.52	39.00	80	0.317	3.80E-02	-	-	-	2	-5.5	15.1
KA3557G:2	1.50	14.00	7.75	24.66	100	0.101	1.30E-02	-	-	-	2	-4.1	9.8
KA3563A01:1	0.65	2.06	1.36	22.79	-	-	-	-	-	-	0	0.2	0.2
KA3563D01:1	0.65	2.01	1.33	20.12	200	0.034	5.26E-03	4.2E-07	1.2E-04	8.0E-05	1	1.2	2.2
KA3563G:1	15.00	30.01	22.51	41.40	70	0.408	4.71E-02	1.5E-06	2.7E-05	3.2E-05	2	-5.9	13.3
KA3563G:2	10.00	13.00	11.50	31.14	180	0.090	1.36E-02	3.1E-06	1.3E-04	2.2E-04	1	-0.5	3.4
KA3563G:3	4.00	8.00	6.00	26.24	72	0.159	1.85E-02	1.5E-07	1.2E-05	8.3E-06	2	25.1	14.5
KA3563G:4	1.50	3.00	2.25	23.05	200	0.044	6.91E-03	-	-	-	1	0.2	0.5
KA3563I01:1	0.65	2.15	1.40	19.59	250	0.026	4.23E-03	-	-	-	1	0.0	0.7
KA3566C01:1	0.65	2.1	1.38	24.30	37	0.266	2.54E-02	3.1E-06	4.3E-05	1.2E-04	1	6.4	5.2

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	44.17	150	0.217	3.13E-02	4.3E-07	2.0E-05	1.4E-05	1	1.0	3.2
KA3566G01:2	20.00	21.50	20.75	38.97	51	0.496	5.21E-02	7.5E-07	1.2E-05	1.4E-05	1	3.0	8.9
KA3566G01:3	12.00	18.00	15.00	34.26	65	0.301	3.40E-02	7.2E-07	2.0E-05	2.1E-05	1	7.1	7.1
KA3566G01:4	7.30	10.00	8.65	29.49	-	-	-	-	-	-	0	60.5	-10.3
KA3566G01:5	1.50	6.30	3.90	26.36	200	0.058	9.04E-03	-	-	-	1	2.0	7.6
KA3566G02:1	19.00	30.10	24.55	40.06	33	0.811	7.49E-02	1.1E-07	1.7E-06	1.5E-06	2	55.6	62.5
KA3566G02:2	16.00	18.00	17.00	34.08	25	0.774	6.62E-02	6.6E-08	1.2E-06	1.0E-06	2	86.2	92.3
KA3566G02:3	12.00	14.00	13.00	31.18	50	0.324	3.38E-02	5.3E-08	2.1E-06	1.6E-06	2	65.1	75.9
KA3566G02:4	8.00	11.00	9.50	28.85	125	0.111	1.52E-02	9.8E-09	1.6E-06	6.4E-07	2	20.4	46.0
KA3566G02:5	1.30	6.00	3.65	25.59	65	0.168	1.89E-02	-	-	-	1	5.4	9.4
KA3568D01:1	0.65	2.30	1.48	24.08	-	-	-	-	-	-	0	0.0	0.2
KA3572G01:1	7.30	12.03	9.67	34.87	100	0.203	2.60E-02	1.7E-06	5.2E-05	6.5E-05	1	-3.7	5.6
KA3572G01:2	2.70	5.30	4.00	31.26	80	0.204	2.44E-02	1.4E-05	8.1E-05	5.9E-04	1	-4.4	6.4
KA3573A:1	26.00	40.07	33.04	47.48	80	0.470	5.64E-02	5.5E-06	3.3E-05	9.8E-05	1	2.2	3.4
KA3573A:2	21.00	24.00	22.50	39.46	38	0.683	6.58E-02	1.7E-06	1.3E-05	2.6E-05	1	7.1	8.4
KA3573A:3	14.50	19.00	16.75	35.63	40	0.529	5.17E-02	1.6E-06	1.9E-05	3.2E-05	1	7.6	8.9
KA3573A:4	10.50	12.50	11.50	32.63	20	0.887	7.14E-02	6.8E-07	6.5E-06	9.6E-06	2	19.4	20.9
KA3573A:5	1.30	8.50	4.90	29.78	32	0.462	4.23E-02	3.1E-06	2.7E-05	7.2E-05	1	5.4	3.9
KA3573C01:1	0.65	2.05	1.35	30.06	12.5	1.205	8.58E-02	4.5E-07	3.6E-07	5.2E-06	2	30.2	31.4
KA3574D01:1	0.65	2.05	1.35	29.33	-	-	-	-	-	-	0	0.0	-0.2
KA3574G01:1	8.00	12.03	10.02	36.64	200	0.112	1.75E-02	1.7E-06	9.1E-05	9.7E-05	1	-0.5	1.5
KA3574G01:2	5.10	7.00	6.05	34.14	200	0.097	1.52E-02	-	-	-	1	0.2	0.2
KA3574G01:3	1.80	4.10	2.95	32.39	170	0.103	1.54E-02	1.2E-06	9.0E-05	7.5E-05	1	0.0	1.7
KA3576G01:1	8.00	12.01	10.01	37.92	81	0.296	3.56E-02	3.1E-06	4.2E-05	8.6E-05	2	-3.7	11.3
KA3576G01:2	4.00	6.00	5.00	34.94	240	0.085	1.39E-02	-	-	-	1	0.2	0.2
KA3576G01:3	1.30	3.00	2.15	33.46	250	0.075	1.23E-02	-	-	-	1	0.2	0.5
KA3578C01:1	0.65	2.09	1.37	35.08	320	0.064	1.13E-02	6.4E-06	2.4E-05	5.7E-04	1	4.4	3.0
KA3578G01:1	6.50	12.58	9.54	39.40	-	-	-	-	-	-	0	0.5	-2.0
KA3578G01:2	4.30	5.50	4.90	36.76	-	-	-	-	-	-	0	0.0	0.0
KA3578H01:1	0.65	1.90	1.28	33.72	58	0.327	3.56E-02	2.7E-07	8.4E-06	7.5E-06	2	17.2	17.0
KA3579D01:1	0.65	2.00	1.33	33.96	-	-	-	-	-	-	0	0.2	0.2
KA3579G:1	14.70	22.65	18.68	46.30	170	0.210	3.14E-02	-	-	-	1	0.0	2.2
KA3579G:2	12.50	13.70	13.10	42.50	160	0.188	2.76E-02	1.2E-08	4.3E-07	4.3E-07	1	-1.0	2.2
KA3579G:3	2.30	11.50	6.90	38.79	-	-	-	-	-	-	0	1.2	-1.0
KA3584G01:1	7.00	12.00	9.50	44.20	-	-	-	-	-	-	0	1.2	-1.2
KA3584G01:2	1.30	5.00	3.15	41.16	-	-	-	-	-	-	0	0.0	-0.2
KA3588C01:1	0.65	2.04	1.35	44.74	34	0.981	9.15E-02	8.3E-07	6.6E-06	9.1E-06	1	2.9	7.1
KA3588D01:1	0.65	1.90	1.28	42.34	160	0.187	2.74E-02	9.2E-07	3.8E-05	3.3E-05	1	-0.5	2.7
KA3588I01:1	0.65	1.96	1.31	42.63	240	0.126	2.07E-02	-	-	-	1	0.2	0.7
KA3590G01:1	16.00	30.00	23.00	55.68	32	1.614	1.48E-01	4.2E-07	2.4E-06	2.8E-06	2	16.0	17.5
KA3590G01:2	7.00	15.00	11.00	49.33	28	1.448	1.28E-01	5.6E-07	3.4E-06	4.4E-06	2	16.5	17.5
KA3590G01:3	1.30	6.00	3.65	46.55	70	0.516	5.95E-02	1.7E-06	1.7E-05	2.8E-05	1	5.4	5.2
KA3590G02:1	25.50	30.01	27.76	57.46	8.8	6.252	4.08E-01	7.6E-08	1.8E-07	1.9E-07	2	119.0	121.4
KA3590G02:2	15.20	23.50	19.35	52.59	17	2.711	2.09E-01	4.8E-08	2.8E-07	2.3E-07	2	101.8	108.2
KA3590G02:3	11.90	13.20	12.55	49.35	174	0.233	3.51E-02	-	-	-	1	1.2	4.2
KA3590G02:4	1.30	9.90	5.60	46.84	20	1.828	1.47E-01	1.1E-06	4.1E-06	7.5E-06	1	9.8	4.2
KA3592C01:1	0.65	2.01	1.33	48.64	-	-	-	-	-	-	0	0.2	0.2
KA3593G:1	25.20	30.02	27.61	64.90	-	-	-	-	-	-	0	0.0	0.0
KA3593G:2	23.50	24.20	23.85	62.11	71	0.905	1.05E-01	7.3E-07	6.6E-06	6.9E-06	1	6.4	5.9
KA3593G:3	9.00	22.50	15.75	56.46	200	0.266	4.15E-02	-	-	-	1	-0.2	2.7
KA3593G:4	3.00	7.00	5.00	50.03	200	0.209	3.26E-02	-	-	-	1	0.5	2.7
KA3597D01:1	0.65	2.22	1.44	50.74	-	-	-	-	-	-	0	0.2	0.0
KA3597H01:1	0.65	2.06	1.36	52.17	200	0.227	3.54E-02	-	-	-	1	1.2	1.2
KA3600F:1	43.00	50.10	46.55	98.24	200	0.804	1.26E-01	-	-	-	1	0.7	2.0
KA3600F:2	40.50	42.00	41.25	93.12	170	0.850	1.27E-01	-	-	-	1	1.0	2.2
KA3600F:3	20.00	39.50	29.75	82.09	100	1.123	1.44E-01	-	-	-	1	1.5	2.7
KA3600F:4	1.30	18.00	9.65	63.22	150	0.444	6.40E-02	-	-	-	1	3.7	4.7
KG0021A01:1	42.50	48.82	45.66	10.15	3.2	0.537	2.81E-02	3.1E-08	1.7E-06	1.1E-06	2	261.9	270.7
KG0021A01:2	37.00	41.50	39.25	3.75	1.4	0.167	7.50E-03	3.4E-08	1.0E-05	4.6E-06	2	326.3	333.9
KG0021A01:3	**35.00**	**36.00**	**35.50**	**0.00**	-	-	-	1.2E-07	-	-	**2**	3081.2	3070.4
KG0021A01:4	19.00	34.00	26.50	9.00	2	0.676	3.23E-02	6.3E-08	3.1E-06	1.9E-06	2	189.0	190.3
KG0021A01:5	5.00	18.00	11.50	24.00	6	1.600	9.57E-02	5.0E-07	3.2E-06	5.2E-06	2	61.0	65.7
KG0048A01:1	49.00	54.69	51.85	37.80	18	1.323	1.03E-01	7.2E-07	4.6E-06	7.0E-06	2	19.7	21.2
KG0048A01:2	34.8	48	41.40	31.27	13	1.254	9.01E-02	4.2E-07	3.2E-06	4.7E-06	2	30.7	32.9
KG0048A01:3	32.80	33.80	33.30	27.92	8.8	1.476	9.64E-02	1.5E-07	1.3E-06	1.5E-06	2	68.9	72.5
KG0048A01:4	13.00	31.80	22.40	26.81	5.8	2.066	1.23E-01	6.5E-07	2.7E-06	5.3E-06	2	135.8	137.5
KG0048A01:5	5.00	12.00	8.50	31.40	37	0.444	4.24E-02	8.6E-08	2.7E-06	2.0E-06	2	52.2	57.2

6.2.6 Test 1:26 – 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 KG0021A01

General test data			
Borehole section	KG0048A01:3		
Test No	1:26		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
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	20030514 07:40:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030514 09:40:00
Stop of flow period		yymmdd hh:mm:ss	20030514 15:40:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030515 09:40:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	3505.5	
Absolute pressure in test section before stop of flow	p_p	kPa	195.5	
Absolute pressure in test section at stop of recovery period	p_f	kPa	3503.6	
Maximal pressure change during flow period	dp_p	kPa	3310.0	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$1.70 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

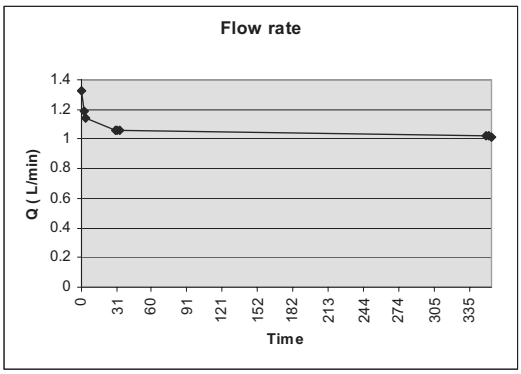


Figure 6-16 *Flow rates during draw down in KG0048A01:3.Time in minutes.*

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 – 0.25 minutes	Transition period
0.25 – 0.9 minutes	Radial flow period
0.9 – 20 minutes	Transition period
20 – 70 minutes	Spherical flow period
70 – 280 minutes	Constant pressure boundary or feature with high conductivity

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.

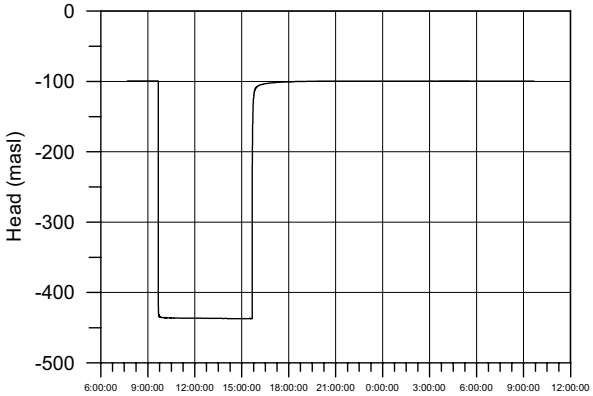
Selected representative parameters

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.

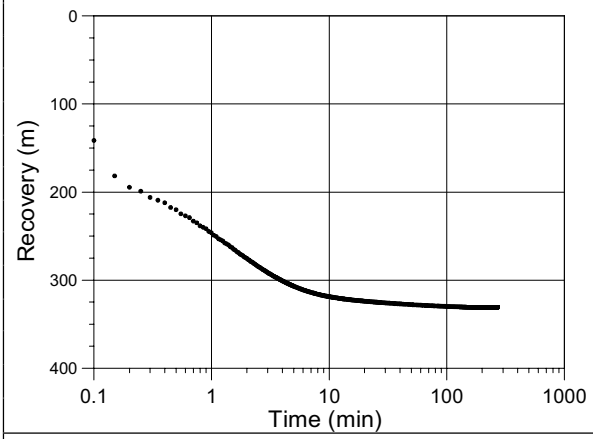
Test Summary Sheet

Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:26
Borehole ID:	KG0048A01	Test start:	2003-05-14 07:40
Test section (m):	32.80-33.80	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

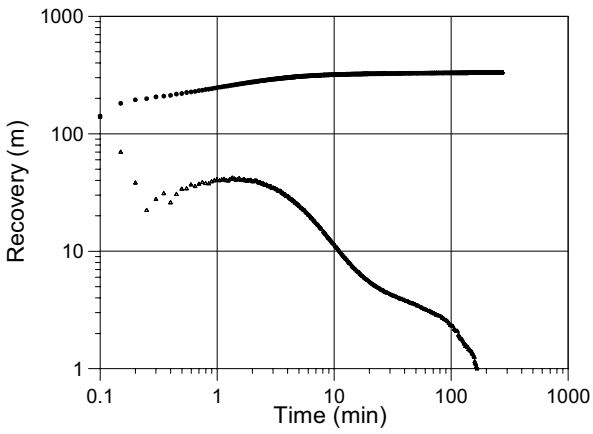
Linear plot Head



Lin-Log plot



Log-Log plot incl. derivative- recovery period



Flow period		**Recovery period**	
Indata		**Indata**	
p_0 (kPa)	3505.5		
p_i (kPa)			
p_p(kPa)	195.5	p_F (kPa)	3503.6
Q_p (m^3/s)	$1.70 \cdot 10^{-5}$		
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)	$5.1 \cdot 10^{-8}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$2.9 \cdot 10^{-8}$	dt_{e1} (min)	0.25
Flow regime:		dt_{e2} (min)	0.9
dt_1 (min)		T (m^2/s)	$3.8 \cdot 10^{-8}$
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 (-)	-0.7
C_D (-)			
ξ (-)			

Interpreted formation and well parameters.

Flow regime:	Radial	C (m^3/Pa)	
dt_1 (min)	0.25	C_D (-)	
dt_2 (min)	0.9	ξ (-)	-0.7
T_T (m^2/s)	$3.8 \cdot 10^{-8}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: The test indicates a possible high conductivity feature during the later part of the period.

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 1.02 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*.

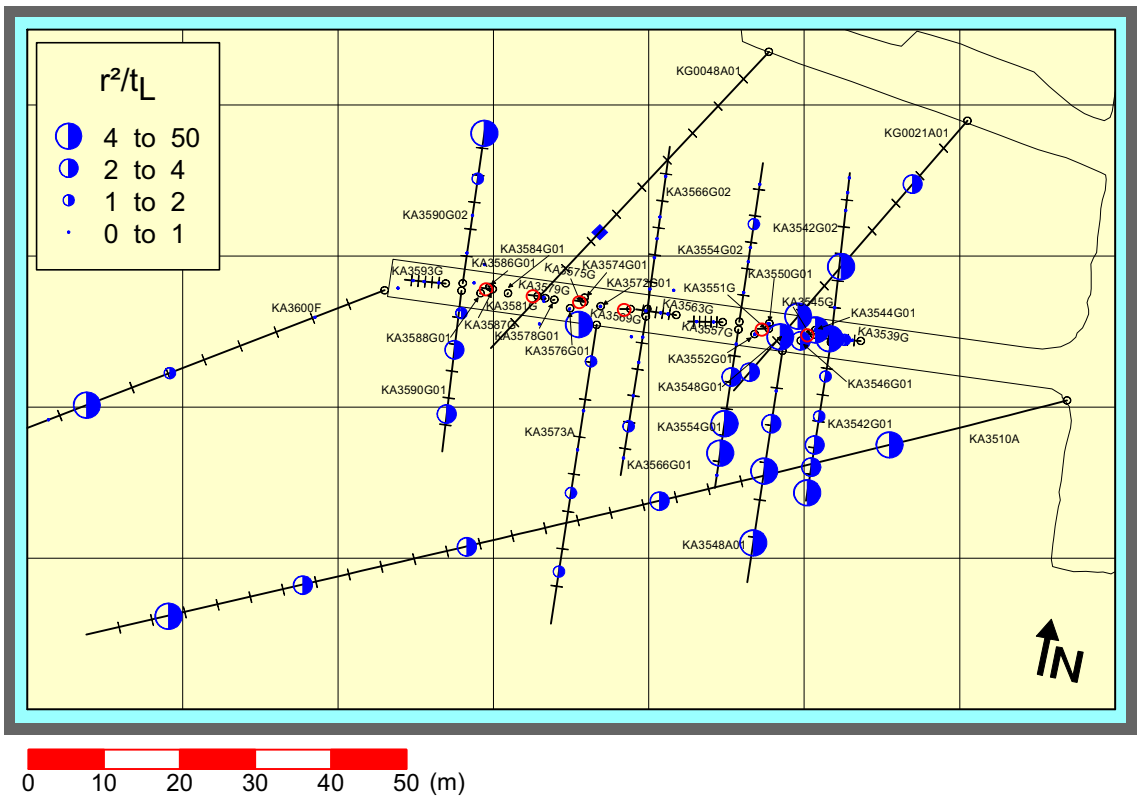


Figure 6-17 *Plot showing r^2/t_L during flowing of KG0048A01:3 (Interference test 1:26) - plan view*

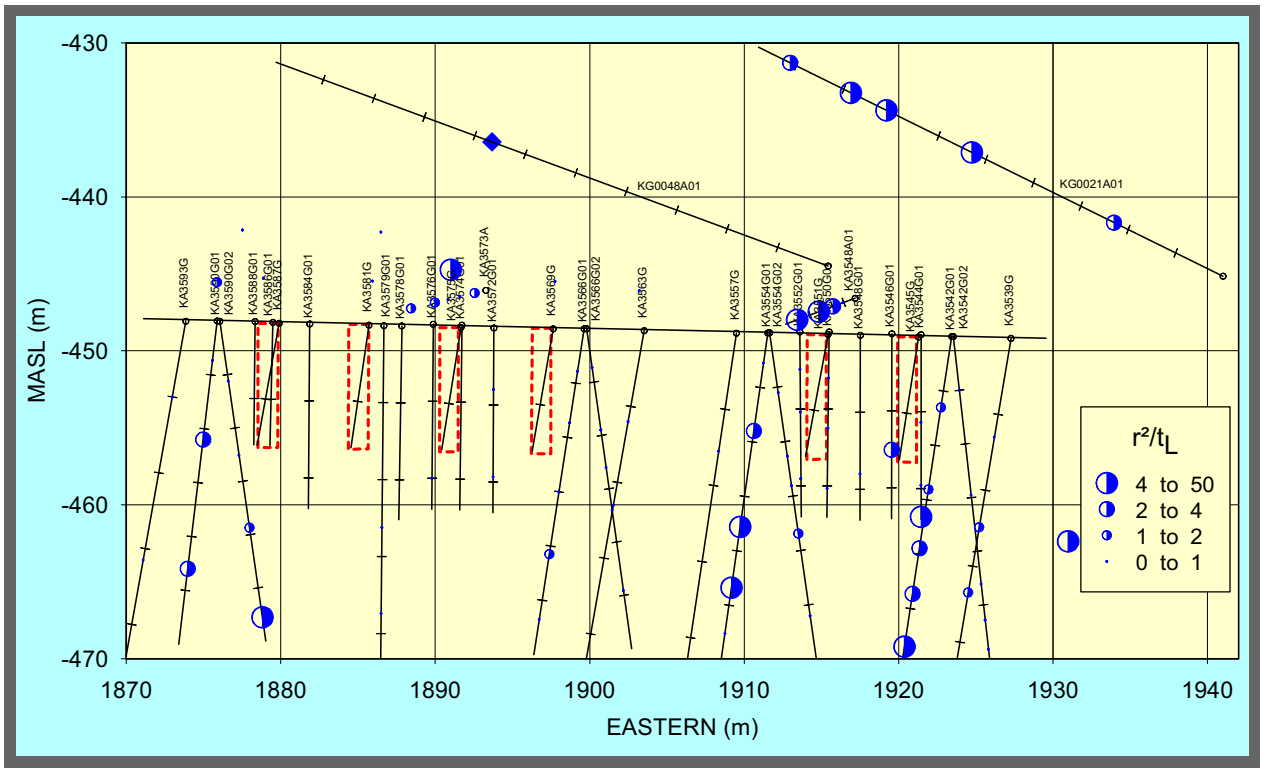


Figure 6-18 *Plot showing r^2/t_L during flowing of KG0048A01:3 (Interference test 1:26) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3600F:3, KA3590G02:2, KA3588C01:1, KA3573A:1-2 & 5, KA3566G01:2, KA3554 G02:2, KA3542G01:4-5 and KA3539G:2-3.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3590G01:1-2, KA3554G01:4, KA3548A01:3, KA3546G01:2, KA3542G01:2-3, KA3510 A:2-4 and KG0021A01:1 & 5.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KA3600F:2, KA3590G02:1, KA3573C01:1, KA3554G01:2-3, KA3548A01:1-2, KA3544 G01:1, KA3542G01:1, KA3539G:1, KA3510A:1 & 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 $1.9 \cdot 10^{-7} – 9.7 \cdot 10^{-6}$ m^2/s. The transmissivity of the flowing section is evaluated to be $3.8 \cdot 10^{-8}$ m^2/s with the evaluation period 0.25 – 0.9 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 KA3542G01, 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.

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	110.55	47	4.334	4.44E-01	9.7E-06	8.9E-06	2.2E-05	1	1.0	1.4
KA3510A:2	110.00	124.00	117.00	93.01	51	2.827	2.97E-01	8.7E-06	1.2E-05	2.9E-05	1	0.4	1.4
KA3510A:3	75.00	109.00	92.00	73.70	28	3.233	2.85E-01	7.5E-07	1.9E-06	2.6E-06	2	11.0	12.1
KA3510A:4	51.00	74.00	62.50	56.80	26	2.068	1.79E-01	2.4E-07	1.2E-06	1.4E-06	2	28.4	27.8
KA3510A:5	4.50	50.00	27.25	53.43	5.3	8.979	5.23E-01	9.7E-07	7.7E-07	1.8E-06	2	32.9	32.9
KA3539G:1	18.60	30.00	24.30	49.20	7	5.764	3.57E-01	7.5E-06	3.1E-06	2.1E-05	2	16.2	16.0
KA3539G:2	15.85	17.60	16.73	44.80	30	1.115	1.00E-01	6.2E-07	5.0E-06	6.2E-06	2	17.2	18.9
KA3539G:3	10.00	14.85	12.43	42.69	22	1.381	1.14E-01	9.8E-07	5.7E-06	8.6E-06	2	18.9	22.3
KA3539G:4	4.00	9.00	6.50	40.36	30	0.905	8.14E-02	6.2E-07	6.2E-06	7.6E-06	2	16.4	19.4
KA3542G01:1	27.00	30.00	28.50	54.56	4.4	11.274	6.30E-01	9.1E-07	5.9E-07	1.4E-06	2	34.9	32.4
KA3542G01:2	21.30	26.00	23.65	50.68	13.5	3.172	2.30E-01	6.0E-07	1.6E-06	2.6E-06	2	31.9	30.4
KA3542G01:3	18.60	20.30	19.45	47.48	13.8	2.723	1.99E-01	5.3E-07	1.7E-06	2.7E-06	2	32.1	31.2
KA3542G01:4	10.50	17.60	14.05	43.60	17.9	1.770	1.38E-01	4.2E-07	2.2E-06	3.0E-06	2	31.4	29.0
KA3542G01:5	3.50	9.50	6.50	38.81	23	1.091	9.12E-02	3.6E-06	1.3E-05	3.9E-05	1	0.5	2.9
KA3542G02:1	28.20	30.01	29.11	46.57	100	0.362	4.64E-02	2.9E-07	9.1E-06	6.3E-06	2	7.9	11.0
KA3542G02:2	25.60	27.20	26.40	44.84	107	0.313	4.10E-02	-	-	-	2	9.1	13.7
KA3542G02:3	21.50	24.60	23.05	42.84	100	0.306	3.92E-02	-	-	-	1	-4.2	4.9
KA3542G02:4	9.00	20.50	14.75	38.69	107	0.233	3.05E-02	8.0E-08	5.0E-06	2.6E-06	2	13.5	18.2
KA3542G02:5	2.00	8.00	5.00	35.70	110	0.193	2.55E-02	1.3E-06	4.0E-06	5.0E-05	2	24.6	27.3
KA3543A01:1	0.65	2.06	1.36	33.47	-	-	-	-	-	-	0	1733.7	-681.7
KA3543I01:1	0.65	2.06	1.36	32.15	-	-	-	-	-	-	0	1735.3	-681.2
KA3544G01:1	11.65	12.00	11.83	39.13	4	6.380	3.50E-01	7.3E-07	3.0E-07	2.1E-06	2	-5.6	36.5
KA3544G01:2	8.90	10.65	9.78	37.89	56	0.427	4.61E-02	-	-	-	2	14.3	14.5
KA3544G01:3	3.50	7.90	5.70	35.64	27	0.784	6.85E-02	-	-	-	2	11.3	12.8
KA3546G01:1	9.30	12.00	10.65	37.54	-	-	-	-	-	-	0	1.0	-3.9
KA3546G01:2	6.75	8.30	7.53	35.71	10	2.125	1.43E-01	6.8E-06	4.1E-06	4.7E-05	1	-5.9	-7.6
KA3546G01:3	1.50	5.75	3.63	33.68	-	-	-	-	-	-	0	1.0	-1.2
KA3548A01:1	21.50	30.00	25.75	47.06	4	9.226	5.06E-01	1.0E-06	9.0E-07	2.1E-06	2	32.4	31.5
KA3548A01:2	11.75	20.50	16.13	39.60	3.9	6.701	3.65E-01	1.0E-06	1.4E-06	2.8E-06	2	34.0	33.4
KA3548A01:3	8.80	10.75	9.78	35.26	10	2.072	1.40E-01	7.4E-07	2.8E-06	5.3E-06	2	32.5	32.1
KA3548A01:4	3.00	7.80	5.40	32.65	29	0.613	5.46E-02	2.8E-07	5.0E-06	5.1E-06	2	27.2	27.0
KA3548D01:1	0.65	2.06	1.36	28.43	-	-	-	-	-	-	0	1734.0	-682.7
KA3548G01:1	6.00	12.00	9.00	34.76	200	0.101	1.57E-02	-	-	-	1	-0.8	2.2
KA3548G01:2	2.00	5.00	3.50	31.64	-	-	-	-	-	-	0	0.2	-0.6
KA3550G01:1	8.30	12.03	10.17	33.52	50	0.375	3.91E-02	-	-	-	Plotta om	-5.5	15.1
KA3550G01:2	5.20	7.30	6.25	31.05	100	0.161	2.06E-02	2.0E-05	8.9E-05	9.6E-04	1	-0.8	4.3
KA3550G01:3	1.80	4.20	3.00	29.25	200	0.071	1.11E-02	-	-	-	1	0.2	3.1
KA3550G05:1	1.50	3.00	2.25	32.67	-	-	-	-	-	-	0	0.2	0.6
KA3551G05:1	1.50	3.10	2.30	27.60	-	-	-	-	-	-	0	-0.2	0.4
KA3552A01:1	0.65	2.06	1.36	25.82	-	-	-	-	-	-	0	3429.0	-1.2
KA3552G01:1	7.05	12.00	9.53	32.57	100	0.177	2.27E-02	1.1E-06	4.0E-05	4.9E-05	1	-3.5	8.4
KA3552G01:2	4.35	6.05	5.20	29.80	120	0.123	1.67E-02	2.8E-07	2.3E-05	1.7E-05	1	-20.9	-25.2
KA3552G01:3	1.50	3.35	2.43	28.24	210	0.063	1.00E-02	-	-	-	1	-0.4	7.0
KA3552H01:1	0.65	2.10	1.38	23.38	-	-	-	-	-	-	0	1733.6	-682.3
KA3553B01:1	0.65	2.02	1.34	23.72	-	-	-	-	-	-	0	1734.8	-681.4
KA3554G01:1	25.15	30.01	27.58	47.76	44	0.864	8.68E-02	1.1E-06	8.4E-07	1.3E-05	2	34.2	34.0
KA3554G01:2	22.60	24.15	23.38	43.96	4.8	6.711	3.82E-01	9.5E-07	1.0E-06	2.5E-06	2	34.2	34.0
KA3554G01:3	14.00	21.60	17.80	39.04	5.9	4.305	2.57E-01	9.8E-07	1.7E-06	3.8E-06	2	30.7	31.5
KA3554G01:4	5.00	13.00	9.00	31.73	7	2.398	1.49E-01	9.5E-07	2.7E-06	6.4E-06	2	29.2	29.5
KA3554G01:5	1.50	4.00	2.75	27.08	200	0.061	9.54E-03	-	-	-	1	6.1	3.7
KA3554G02:1	22.00	30.01	26.01	37.57	58	0.406	4.42E-02	3.1E-07	7.4E-06	7.1E-06	2	18.8	22.9
KA3554G02:2	15.90	21.00	18.45	32.27	16	1.084	8.22E-02	8.6E-07	5.6E-06	1.0E-05	2	30.9	34.8
KA3554G02:3	13.20	14.90	14.05	29.63	16	0.915	6.94E-02	7.7E-07	6.3E-06	1.1E-05	2	30.9	34.8
KA3554G02:4	10.50	12.20	11.35	28.24	20	0.664	5.34E-02	9.5E-07	9.4E-06	1.8E-05	2	22.5	27.6
KA3554G02:5	1.50	9.50	5.50	25.93	30	0.373	3.36E-02	7.6E-08	2.8E-06	2.2E-06	2	70.8	78.1
KA3557G:1	15.00	30.04	22.52	38.72	70	0.357	4.11E-02	-	-	-	2	-5.9	14.3
KA3557G:2	1.50	14.00	7.75	27.56	80	0.158	1.90E-02	-	-	-	1	-3.7	8.6
KA3563A01:1	0.65	2.06	1.36	19.08	-	-	-	-	-	-	0	0.2	-0.7
KA3563D01:1	0.65	2.01	1.33	15.61	80	0.051	6.09E-03	3.8E-07	7.7E-05	6.3E-05	1	7.9	8.6
KA3563G:1	15.00	30.01	22.51	36.46	80	0.277	3.32E-02	-	-	-	2	-6.1	11.3
KA3563G:2	10.00	13.00	11.50	27.06	160	0.076	1.12E-02	-	-	-	1	-1.2	1.7
KA3563G:3	4.00	8.00	6.00	22.90	75	0.117	1.37E-02	-	-	-	2	14.7	13.5
KA3563G:4	1.50	3.00	2.25	20.44	-	-	-	-	-	-	0	0.3	-1.0
KA3563I01:1	0.65	2.15	1.40	14.98	-	-	-	-	-	-	0	0.7	-1.0
KA3566C01:1	0.65	2.1	1.38	17.02	7	0.690	4.27E-02	1.6E-06	1.4E-05	3.9E-05	2	13.8	11.8

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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	43.18	114	0.273	3.63E-02	-	-	-	1	2.7	1.5
KA3566G01:2	20.00	21.50	20.75	37.28	19	1.219	9.67E-02	8.9E-07	5.6E-06	9.2E-06	2	17.0	11.6
KA3566G01:3	12.00	18.00	15.00	31.68	22	0.760	6.28E-02	1.4E-06	1.1E-05	2.2E-05	2	14.3	11.8
KA3566G01:4	7.30	10.00	8.65	25.57	17	0.641	4.94E-02	-	-	-	1	7.4	-6.9
KA3566G01:5	1.50	6.30	3.90	21.09	85	0.087	1.07E-02	-	-	-	2	10.1	10.6
KA3566G02:1	19.00	30.10	24.55	31.24	28	0.581	5.12E-02	5.8E-07	8.8E-06	1.1E-05	2	27.3	30.5
KA3566G02:2	16.00	18.00	17.00	25.22	16	0.663	5.02E-02	1.4E-07	2.5E-06	2.8E-06	2	88.6	95.7
KA3566G02:3	12.00	14.00	13.00	22.41	36.5	0.229	2.18E-02	6.6E-07	4.0E-05	3.0E-05	2	78.9	88.7
KA3566G02:4	8.00	11.00	9.50	20.27	107	0.064	8.37E-03	1.6E-08	3.9E-06	2.0E-06	2	55.1	73.8
KA3566G02:5	1.30	6.00	3.65	17.71	200	0.026	4.08E-03	-	-	-	2	10.8	11.3
KA3568D01:1	0.65	2.30	1.48	12.66	-	-	-	-	-	-	0	0.2	-0.7
KA3572G01:1	7.30	12.03	9.67	23.87	130	0.073	1.01E-02	-	-	-	1	-2.0	1.7
KA3572G01:2	2.70	5.30	4.00	18.84	130	0.045	6.30E-03	-	-	-	1	-0.5	-0.2
KA3573A:1	26.00	40.07	33.04	46.49	31	1.162	1.06E-01	6.8E-06	1.2E-05	6.4E-05	1	3.4	3.4
KA3573A:2	21.00	24.00	22.50	36.23	12	1.823	1.28E-01	1.8E-06	4.9E-06	1.4E-05	2	12.0	11.8
KA3573A:3	14.50	19.00	16.75	30.70	16	0.982	7.45E-02	1.5E-06	8.5E-06	2.1E-05	2	13.5	12.6
KA3573A:4	10.50	12.50	11.50	25.75	31	0.356	3.24E-02	1.9E-06	2.7E-06	6.0E-05	2	34.6	34.4
KA3573A:5	1.30	8.50	4.90	19.75	4	1.625	8.90E-02	4.8E-06	8.3E-06	5.4E-05	2	10.6	9.8
KA3573C01:1	0.65	2.05	1.35	15.00	0.8	4.688	1.91E-01	7.5E-07	1.4E-06	3.9E-06	2	60.2	55.5
KA3574D01:1	0.65	2.05	1.35	10.59	-	-	-	-	-	-	0	-0.2	-0.5
KA3574G01:1	8.00	12.03	10.02	23.67	-	-	-	-	-	-	0	-0.5	0.7
KA3574G01:2	5.10	7.00	6.05	20.04	-	-	-	-	-	-	0	0.2	-1.5
KA3574G01:3	1.80	4.10	2.95	17.31	-	-	-	-	-	-	0	0.0	-0.2
KA3576G01:1	8.00	12.01	10.01	24.41	60	0.166	1.82E-02	4.8E-06	8.4E-05	2.6E-04	2	-3.7	12.0
KA3576G01:2	4.00	6.00	5.00	20.02	-	-	-	-	-	-	0	0.5	-1.5
KA3576G01:3	1.30	3.00	2.15	17.66	-	-	-	-	-	-	0	0.2	-1.7
KA3578C01:1	0.65	2.09	1.37	16.99	6	0.802	4.80E-02	5.2E-06	1.6E-05	1.1E-04	1	8.6	7.4
KA3578G01:1	6.50	12.58	9.54	24.05	-	-	-	-	-	-	0	0.2	-2.7
KA3578G01:2	4.30	5.50	4.90	19.98	-	-	-	-	-	-	0	0.2	-1.0
KA3578H01:1	0.65	1.90	1.28	13.00	14	0.201	1.47E-02	8.6E-07	3.2E-05	5.8E-05	2	57.1	64.2
KA3579D01:1	0.65	2.00	1.33	12.18	-	-	-	-	-	-	0	0.2	-1.0
KA3579G:1	14.70	22.65	18.68	32.61	130	0.136	1.89E-02	-	-	-	1	-0.3	-1.0
KA3579G:2	12.50	13.70	13.10	27.44	125	0.100	1.37E-02	-	-	-	1	-0.2	-1.2
KA3579G:3	2.30	11.50	6.90	21.92	-	-	-	-	-	-	0	0.0	-2.9
KA3584G01:1	7.00	12.00	9.50	25.74	-	-	-	-	-	-	0	0.7	-2.9
KA3584G01:2	1.30	5.00	3.15	20.73	-	-	-	-	-	-	0	0.2	-0.7
KA3588C01:1	0.65	2.04	1.35	22.68	7.3	1.174	7.34E-02	2.1E-06	8.1E-06	2.9E-05	2	14.2	20.1
KA3588D01:1	0.65	1.90	1.28	17.77	130	0.040	5.60E-03	-	-	-	2	0.5	16.2
KA3588I01:1	0.65	1.96	1.31	18.40	60	0.094	1.04E-02	-	-	-	1	1.7	0.2
KA3590G01:1	16.00	30.00	23.00	41.66	8	3.615	2.31E-01	7.8E-07	1.5E-06	3.4E-06	2	29.5	27.1
KA3590G01:2	7.00	15.00	11.00	31.07	7	2.298	1.42E-01	9.7E-07	2.9E-06	6.8E-06	2	29.3	27.8
KA3590G01:3	1.30	6.00	3.65	25.21	27	0.392	3.43E-02	2.8E-06	2.8E-05	8.1E-05	1	9.8	7.6
KA3590G02:1	25.50	30.01	27.76	36.68	3.6	6.229	3.34E-01	6.6E-07	8.9E-07	2.0E-06	2	73.7	76.2
KA3590G02:2	15.20	23.50	19.35	30.40	11.4	1.351	9.40E-02	1.9E-07	1.6E-06	2.0E-06	2	66.4	70.6
KA3590G02:3	11.90	13.20	12.55	26.21	100	0.114	1.47E-02	1.2E-07	1.4E-05	8.2E-06	2	10.1	10.6
KA3590G02:4	1.30	9.90	5.60	23.24	13.8	0.652	4.76E-02	5.0E-06	2.2E-05	1.1E-04	1	10.1	-2.2
KA3592C01:1	0.65	2.01	1.33	25.63	-	-	-	-	-	-	0	0.5	-1.5
KA3593G:1	25.20	30.02	27.61	46.42	-	-	-	-	-	-	0	0.2	-0.5
KA3593G:2	23.50	24.20	23.85	43.01	32	0.964	8.83E-02	9.5E-07	7.6E-06	1.1E-05	2	12.5	10.8
KA3593G:3	9.00	22.50	15.75	35.91	200	0.107	1.68E-02	2.7E-06	1.1E-04	1.6E-04	1	-0.5	1.7
KA3593G:4	3.00	7.00	5.00	27.35	160	0.078	1.14E-02	3.9E-07	5.3E-05	3.4E-05	1	4.7	3.7
KA3597D01:1	0.65	2.22	1.44	25.10	-	-	-	-	-	-	0	0.2	-1.2
KA3597H01:1	0.65	2.06	1.36	27.56	60	0.211	2.32E-02	-	-	-	1	2.7	0.2
KA3600F:1	43.00	50.10	46.55	75.88	100	0.960	1.23E-01	5.4E-06	1.6E-05	4.4E-05	1	1.0	1.5
KA3600F:2	40.50	42.00	41.25	70.62	20	4.156	3.34E-01	8.4E-06	1.6E-05	2.5E-05	1	1.2	1.7
KA3600F:3	20.00	39.50	29.75	59.23	50	1.169	1.22E-01	5.4E-06	1.3E-05	4.4E-05	1	2.2	3.0
KA3600F:4	1.30	18.00	9.65	39.47	85	0.305	3.73E-02	9.8E-07	2.2E-05	2.6E-05	1	6.6	6.6
KG0021A01:1	42.50	48.82	45.66	27.23	4.2	2.943	1.63E-01	5.4E-07	1.7E-06	3.3E-06	2	56.9	56.9
KG0021A01:2	37.00	41.50	39.25	27.23	1.7	7.268	3.37E-01	7.6E-07	7.8E-07	2.2E-06	2	67.7	68.5
KG0021A01:3	35.00	36.00	35.50	27.92	3	4.330	2.24E-01	3.9E-07	9.5E-07	1.7E-06	2	68.1	69.1
KG0021A01:4	19.00	34.00	26.50	31.40	1.1	14.938	6.43E-01	6.4E-07	4.1E-07	1.0E-06	2	71.5	72.8
KG0021A01:5	5.00	18.00	11.50	41.10	9	3.128	2.05E-01	4.2E-06	4.0E-06	2.1E-05	2	25.3	32.7
KG0048A01:1	49.00	54.69	51.85	18.55	3	1.912	9.88E-02	1.9E-06	5.2E-06	1.9E-05	2	35.0	34.5
KG0048A01:2	34.8	48	41.40	8.09	0.65	1.679	6.63E-02	1.7E-06	6.2E-06	2.5E-05	2	61.8	57.4
KG0048A01:3	**32.80**	**33.80**	**33.30**	**0.00**	-	-	-	3.8E-08	-	-	**2**	3310.1	3308.1
KG0048A01:4	13.00	31.80	22.40	10.91	1	1.983	8.39E-02	5.4E-07	4.3E-06	6.5E-06	2	75.6	76.1
KG0048A01:5	5.00	12.00	8.50	24.80	30	0.342	3.08E-02	7.6E-07	1.7E-05	2.5E-05	2	24.3	25.0

6.2.7 Test 1:27 – KA3573A:4

General test data for the pressure build-up test in the interval 10.50-12.50 m of borehole KA3573A are presented in *Table 6-19*.

Table 6-19 General test data for the pressure build-up test in section 10.50-12.50 m of borehole KA3573A

General test data			
Borehole section	KA3573A:4		
Test No	1:27		
Field crew	J. Magnusson, A. Blom (SWECO VIAK)		
Test equipment system	HMS		
General comment	Interference test		
	Nomen-clature	Unit	Value
Test section- secup	Secup	m	10.50
Test section- seclow	Seclow	m	12.50
Test section length	L_w	m	2.00
Test section diameter	$2 \cdot r_w$	mm	76
Test start (start of pressure registration)		yymmdd hh:mm	20030515 07:40:00
Packer expanded		yymmdd hh:mm:ss	-
Start of flow period		yymmdd hh:mm:ss	20030515 09:40:00
Stop of flow period		yymmdd hh:mm:ss	20030515 15:40:00
Test stop (stop of pressure registration)		yymmdd hh:mm	20030516 09:40:00
Total flow time	t_p	min	360
Total recovery time	t_F	min	1080

Pressure data

Pressure data	Nomenclature	Unit	Value	Comment
Absolute pressure in borehole before start of flow period	p_0	kPa	3666.3	
Absolute pressure in test section before stop of flow	p_p	kPa	3495.0	
Absolute pressure in test section at stop of recovery period	p_f	kPa	3667.3	
Maximal pressure change during flow period	dp_p	kPa	171.3	

Flow data

Flow data	Nomen-clature	Unit	Value
Flow rate from test section just before stop of flowing	Q_p	m^3/s	$3.90 \cdot 10^{-5}$
Mean (arithmetic) flow rate during flow period	Q_m	m^3/s	-
Total volume discharged during flow period	V_p	m^3	-

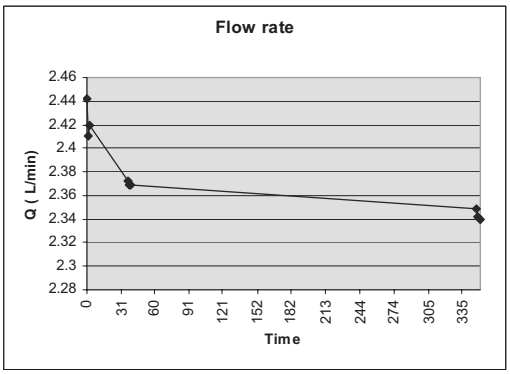


Figure 6-19 *Flow rates during draw down in KA3573A:4. Time in minutes.*

Comments to the test

The test was successful in regard to pressure responses, though the maximum response in the tests section during flow and recovery periods was approximately 170 kPa only.

Interpreted flow regimes – flowing section

0 – 0.1 minutes	Well Bore Storage (WBS)
0.1 – 0.15 minutes	Transition period
0.15 – 0.4 minutes	Radial flow period
0.4 – 3 minutes	Transition period
3 – 20 minutes	Linear channel flow
20 – 200 minutes	Transition period
200 – 300 minutes	Constant pressure boundary or feature with high conductivity

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.

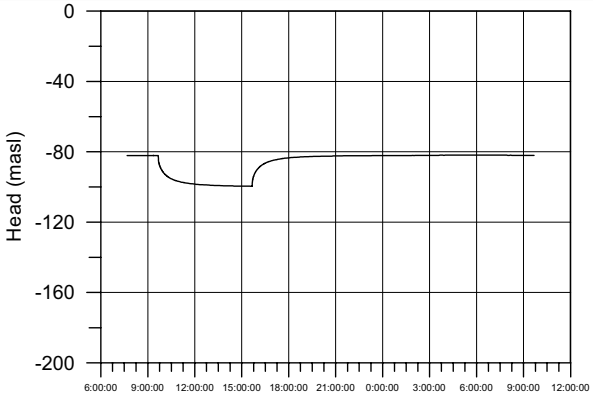
Selected representative parameters

The selected representative parameters from the test in the interval 10.50-12.50 m in KA3573A are presented in the Test Summary Sheet below. The selected parameters are derived from the recovery period.

Test Summary Sheet

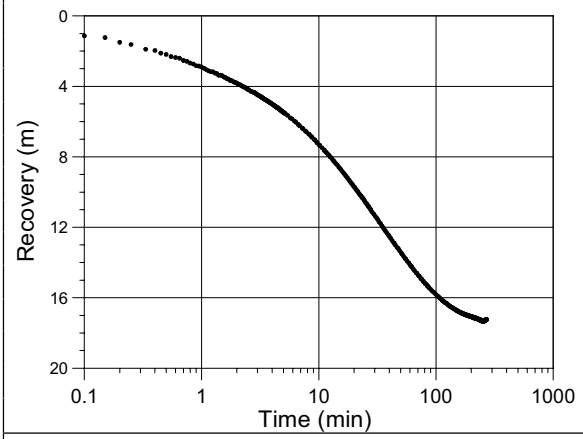
Project:	PROTOTYPE	Test type:	PBT
Area:	ÄSPÖ	Test no:	1:27
Borehole ID:	KA3573A	Test start:	2003-05-15 07:40
Test section (m):	10.50-12.50	Responsible for test performance:	SWECO VIAK AB J. Magnusson/A. Blom
Section diameter, $2 \cdot r_w$ (m):	0.076	Responsible for test evaluation:	SWECO VIAK AB T. Forsmark

Linear plot Head



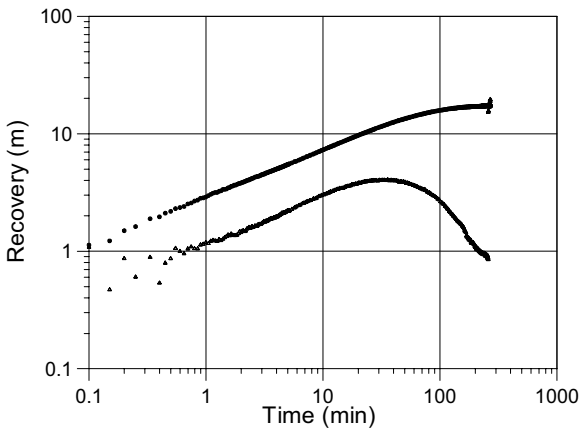
Flow period		Recovery period	
Indata		**Indata**	
p_0 (kPa)	3666.3		
p_i (kPa)			
p_p(kPa)	3495.0	p_F (kPa)	3667.3
Q_p (m^3/s)	$3.90 \cdot 10^{-5}$		
tp (min)	360	t_F (min)	1080
S*		S*	$1 \cdot 10^{-6}$
EC_w (mS/m)			
Te_w(gr C)			
Derivative fact.		Derivative fact.	0.2

Lin-Log plot



Results		Results	
Q/s (m^2/s)	$2.3 \cdot 10^{-6}$	Flow regime:	Radial
T_{Moye}(m^2/s)	$1.5 \cdot 10^{-6}$	dt_{e1} (min)	0.15
Flow regime:		dt_{e2} (min)	0.4
dt_1 (min)		T (m^2/s)	$4.9 \cdot 10^{-6}$
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 (-)	-4.5
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)	0.15	C_D (-)	
dt_2 (min)	0.4	ξ (-)	-4.5
T_T (m^2/s)	$4.9 \cdot 10^{-6}$		
S (-)			
K_s (m/s)			
S_s (1/m)			

Comments: The test indicates a possible high conductivity feature during the later part of the period.

The test was carried out in KA3573A:4, section 10.50 - 12.50 metres. The flow period was for 360 minutes with a final flow of 2.34 l/min, while the pressure build-up time was 1080 minutes. In *Figure 6-20* and *Figure 6-21* the r^2/t_L recordings are shown and in *Table 6-20* and *Table 6-21* the interference test results are presented. Diagrams of evaluated bore hole sections are presented in *Appendix 7*.

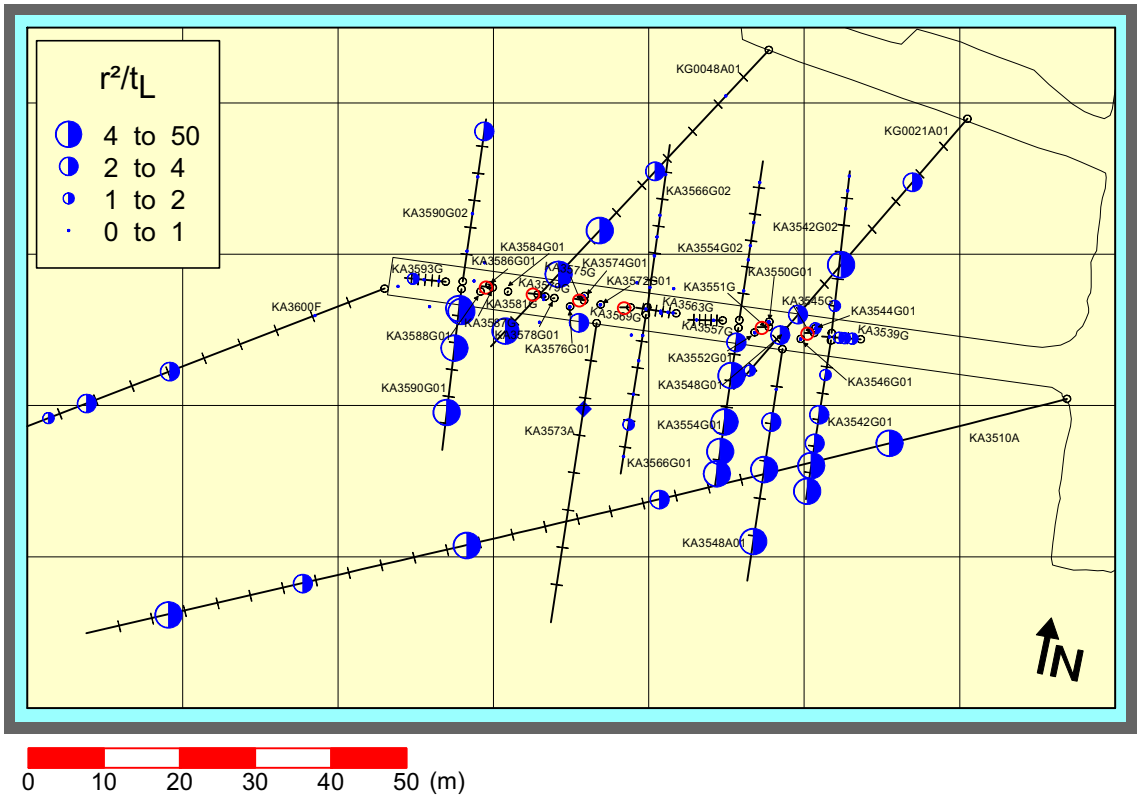


Figure 6-20 *Plot showing r^2/t_L during flowing of KA3573A:4 (Interference test 1:27) - plan view*

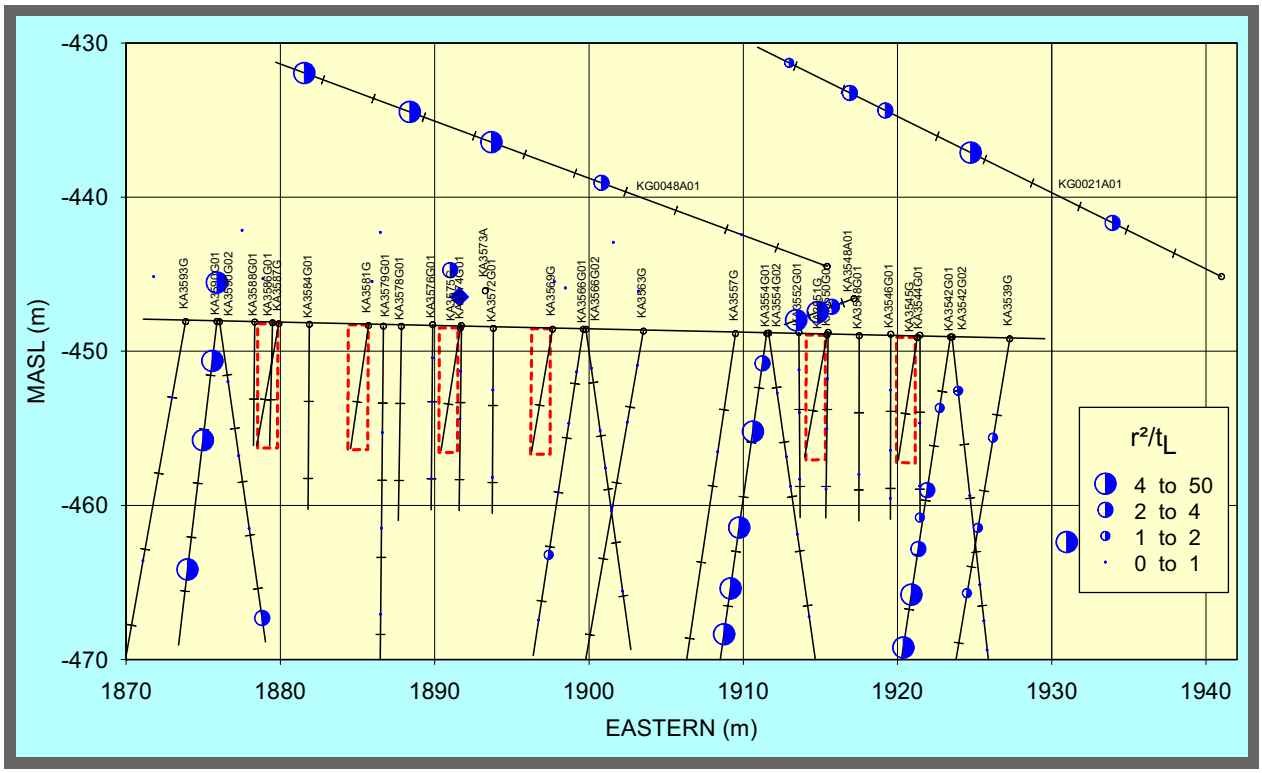


Figure 6-21 *Plot showing r^2/t_L during flowing of KA3573A:4 (Interference test 1:27) - vertical view*

This test indicates a **rather good** ($1 < r^2/t_L < 2$) hydraulic connection between the flow section and KA3600F:1, KA3593G:2, KA3566G01:2, KA3544G01:1, KA3542G02:5, KA3542 G01:5, KA3539G:2-4 and KG0021A01:1.

A **good** ($2 < r^2/t_L < 4$) hydraulic connection is established between the flow section and KA3600F:2-3, KA3590G02:1, KA3573C01:1, KA3554G01:5, KA3548A01:3, KA3542 G01:3-4, KA3510A:2 & 4, KG0021A01:2-3 &5 and KG0048A01:4.

A **very good** ($4 < r^2/t_L$) hydraulic connection is apparent between the flow section and KA3590G01:1-3, KA3588C01:1, KA3554G01:1-4, KA3548A01:1-2, KA3542G01:1-2, KA3510A:1,3 & 5, KG0021A01:4 and KG0048A01:1-3.

The transmissivity of the observation sections with $r^2/t_L > 1$, i.e. the sections mentioned above is within the range $7.0 \cdot 10^{-7} – 2.6 \cdot 10^{-5}$ m^2/s. The transmissivity of the flowing section is evaluated to be $4.9 \cdot 10^{-6}$ m^2/s with the evaluation period 0.15 – 0.4 minutes.

The flow section is located south of the repository. It has good or very good connection both westward (KA3590G01) and eastward (KA3554G01, KA3548A01 and KA3542G01). Notably only some minor hydraulic connection with the closest located borehole, KA3566G01, exists. This is in concordance with the analysis of test 1:23. The rock volume between KA3554G01 and KA3573A appears to have no hydraulic features of any magnitude.

Table 6-20 Interference test results for KA3573A, 10.50 - 12.50 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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3510A:1	125.00	150.00	137.50	92.88	8	17.973	1.15E+00	1.2E-05	1.6E-06	1.1E-05	1	7.4	8.4
KA3510A:2	110.00	124.00	117.00	74.35	31	2.972	2.70E-01	6.0E-06	9.1E-06	2.2E-05	1	6.1	6.5
KA3510A:3	75.00	109.00	92.00	53.71	7	6.869	4.25E-01	2.6E-06	2.4E-06	6.0E-06	2	54.8	54.6
KA3510A:4	51.00	74.00	62.50	36.95	6	3.792	2.27E-01	3.0E-06	4.8E-06	1.3E-05	2	128.6	129.4
KA3510A:5	4.50	50.00	27.25	42.70	1	30.387	1.29E+00	1.6E-05	4.1E-06	1.3E-05	2	140.9	141.3
KA3539G:1	18.60	30.00	24.30	42.48	70	0.430	4.95E-02	-	-	-	2	29.5	25.0
KA3539G:2	15.85	17.60	16.73	39.26	16	1.605	1.22E-01	4.3E-06	1.5E-05	3.5E-05	2	38.0	35.1
KA3539G:3	10.00	14.85	12.43	37.98	20	1.202	9.67E-02	1.9E-06	1.3E-05	2.0E-05	2	35.8	30.2
KA3539G:4	4.00	9.00	6.50	36.97	20	1.139	9.16E-02	1.8E-06	1.2E-05	2.0E-05	2	37.3	34.4
KA3542G01:1	27.00	30.00	28.50	38.25	0.52	46.902	1.79E+00	3.0E-06	4.2E-07	1.7E-06	2	146.4	149.3
KA3542G01:2	21.30	26.00	23.65	35.88	4	5.363	2.94E-01	1.8E-06	2.7E-06	6.1E-06	2	125.7	127.4
KA3542G01:3	18.60	20.30	19.45	34.25	5	3.910	2.25E-01	1.5E-06	3.1E-06	6.8E-06	2	117.3	117.8
KA3542G01:4	10.50	17.60	14.05	32.82	5.3	3.388	1.97E-01	1.0E-06	3.3E-06	5.1E-06	2	121.9	122.6
KA3542G01:5	3.50	9.50	6.50	32.28	17	1.022	7.87E-02	8.9E-06	3.0E-05	1.1E-04	2	5.6	10.0
KA3542G02:1	28.20	30.01	29.11	51.43	200	0.220	3.44E-02	-	-	-	1	3.9	5.6
KA3542G02:2	25.60	27.20	26.40	49.31	200	0.203	3.16E-02	-	-	-	1	6.1	6.1
KA3542G02:3	21.50	24.60	23.05	46.79	40	0.912	8.91E-02	2.8E-05	4.9E-05	3.2E-04	1	-3.7	4.7
KA3542G02:4	9.00	20.50	14.75	41.04	160	0.175	2.58E-02	-	-	-	2	13.8	15.3
KA3542G02:5	2.00	8.00	5.00	35.61	20	1.057	8.50E-02	1.7E-06	1.3E-05	2.0E-05	2	34.4	29.0
KA3543A01:1	0.65	2.06	1.36	29.63	-	-	-	-	-	-	0	127.1	2760.7
KA3543I01:1	0.65	2.06	1.36	31.87	-	-	-	-	-	-	0	127.1	2761.5
KA3544G01:1	11.65	12.00	11.83	34.79	11	1.833	1.26E-01	-	-	-	2	-13.0	34.3
KA3544G01:2	8.90	10.65	9.78	33.99	31	0.621	5.64E-02	5.5E-07	1.1E-05	9.8E-06	2	30.7	26.8
KA3544G01:3	3.50	7.90	5.70	32.74	75	0.238	2.80E-02	3.2E-07	1.6E-05	1.1E-05	2	17.7	14.3
KA3546G01:1	9.30	12.00	10.65	32.20	40	0.432	4.22E-02	-	-	-	1	-2.2	0.0
KA3546G01:2	6.75	8.30	7.53	31.08	50	0.322	3.36E-02	-	-	-	1	-7.1	4.2
KA3546G01:3	1.50	5.75	3.63	30.06	200	0.075	1.18E-02	-	-	-	1	-1.2	0.5
KA3548A01:1	21.50	30.00	25.75	28.02	0.3	43.616	1.54E+00	4.4E-06	4.9E-07	2.9E-06	2	142.1	143.8
KA3548A01:2	11.75	20.50	16.13	24.59	0.16	62.962	2.04E+00	4.3E-06	4.1E-07	2.1E-06	2	149.6	151.1
KA3548A01:3	8.80	10.75	9.78	24.22	2.5	3.911	1.95E-01	1.9E-06	3.8E-06	9.6E-06	2	124.5	125.1
KA3548A01:4	3.00	7.80	5.40	24.93	15	0.691	5.15E-02	3.9E-07	7.1E-07	7.6E-06	2	96.2	89.6
KA3548D01:1	0.65	2.06	1.36	30.30	-	-	-	-	-	-	0	126.7	-1282.8
KA3548G01:1	6.00	12.00	9.00	30.18	220	0.069	1.10E-02	-	-	-	1	-0.8	1.6
KA3548G01:2	2.00	5.00	3.50	28.55	-	-	-	-	-	-	0	-0.2	0.4
KA3550G01:1	8.30	12.03	10.17	29.21	50	0.284	2.97E-02	1.4E-05	1.1E-04	4.8E-04	2	-6.1	17.4
KA3550G01:2	5.20	7.30	6.25	27.81	200	0.064	1.01E-02	-	-	-	1	-1.0	3.3
KA3550G01:3	1.80	4.20	3.00	27.03	200	0.061	9.50E-03	-	-	-	1	-0.8	5.9
KA3550G05:1	1.50	3.00	2.25	30.30	-	-	-	-	-	-	0	0.2	0.0
KA3551G05:1	1.50	3.10	2.30	25.09	-	-	-	-	-	-	0	0.2	0.0
KA3552A01:1	0.65	2.06	1.36	21.23	-	-	-	-	-	-	0	-0.4	-0.2
KA3552G01:1	7.05	12.00	9.53	27.00	75	0.162	1.91E-02	2.1E-05	2.2E-04	1.1E-03	2	-3.9	9.8
KA3552G01:2	4.35	6.05	5.20	25.39	50	0.215	2.24E-02	4.1E-06	9.9E-05	1.8E-04	2	-15.6	12.3
KA3552G01:3	1.50	3.35	2.43	24.70	150	0.068	9.77E-03	-	-	-	1	0.4	-6.6
KA3552H01:1	0.65	2.10	1.38	23.03	-	-	-	-	-	-	0	126.8	2760.6
KA3553B01:1	0.65	2.02	1.34	25.69	-	-	-	-	-	-	0	127.0	-1467.6
KA3554G01:1	25.15	30.01	27.58	29.09	0.3	47.007	1.66E+00	6.0E-06	5.8E-07	3.6E-06	2	147.7	148.6
KA3554G01:2	22.60	24.15	23.38	26.42	0.55	21.155	8.14E-01	2.6E-06	7.7E-07	3.2E-06	2	147.6	148.4
KA3554G01:3	14.00	21.60	17.80	23.57	1.2	7.719	3.37E-01	1.6E-06	1.8E-06	4.8E-06	2	135.9	143.7
KA3554G01:4	5.00	13.00	9.00	21.40	1.2	6.363	2.78E-01	2.0E-06	2.5E-06	7.1E-06	2	132.3	143.2
KA3554G01:5	1.50	4.00	2.75	21.97	4	2.011	1.10E-01	1.1E-05	1.9E-05	1.0E-04	2	14.9	10.6
KA3554G02:1	22.00	30.01	26.01	42.93	75	0.410	4.82E-02	1.9E-07	6.4E-06	3.9E-06	2	27.6	27.2
KA3554G02:2	15.90	21.00	18.45	36.42	40	0.553	5.40E-02	6.6E-07	1.3E-05	1.2E-05	2	27.0	27.2
KA3554G02:3	13.20	14.90	14.05	32.84	40	0.449	4.39E-02	7.4E-07	1.6E-05	1.7E-05	2	27.2	27.0
KA3554G02:4	10.50	12.20	11.35	30.75	40	0.394	3.85E-02	4.5E-07	1.2E-05	1.2E-05	2	34.8	29.3
KA3554G02:5	1.50	9.50	5.50	26.61	60	0.197	2.17E-02	1.8E-07	1.3E-05	8.4E-06	2	30.7	30.9
KA3557G:1	15.00	30.04	22.52	30.97	60	0.266	2.93E-02	2.4E-05	1.1E-04	8.1E-04	2	-6.1	13.3
KA3557G:2	1.50	14.00	7.75	22.79	100	0.087	1.11E-02	4.4E-05	3.1E-04	4.0E-03	1	-3.3	6.7
KA3563A01:1	0.65	2.06	1.36	13.15	-	-	-	-	-	-	0	-0.3	0.5
KA3563D01:1	0.65	2.01	1.33	19.72	240	0.027	4.42E-03	-	-	-	1	0.2	1.2
KA3563G:1	15.00	30.01	22.51	28.88	100	0.139	1.78E-02	-	-	-	2	-7.1	11.3
KA3563G:2	10.00	13.00	11.50	21.22	100	0.075	9.62E-03	-	-	-	1	-0.7	4.7
KA3563G:3	4.00	8.00	6.00	18.68	35	0.166	1.56E-02	-	-	-	2	51.6	37.8
KA3563G:4	1.50	3.00	2.25	17.74	200	0.026	4.09E-03	-	-	-	1	0.2	2.2
KA3563I01:1	0.65	2.15	1.40	16.52	200	0.023	3.55E-03	-	-	-	1	-0.7	1.2
KA3566C01:1	0.65	2.1	1.38	11.61	75	0.030	3.53E-03	6.3E-06	8.7E-05	1.8E-03	2	19.9	19.9

Table 6-21 Interference test results for KA3573A, 10.50 - 12.50 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 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^* (-)	Response (0 = no, 1 = some, 2 =good response	Po - Pp (kPa)	Pf - Pp (kPa)
KA3566G01:1	23.50	30.01	26.76	22.48	90	0.094	1.16E-02	4.3E-06	2.1E-04	3.7E-04	2	10.8	10.1
KA3566G01:2	20.00	21.50	20.75	17.82	3.5	1.513	8.07E-02	5.7E-06	1.6E-05	7.1E-05	2	68.7	68.4
KA3566G01:3	12.00	18.00	15.00	14.34	10	0.343	2.31E-02	1.3E-06	3.2E-05	5.6E-05	2	54.1	53.1
KA3566G01:4	7.30	10.00	8.65	12.60	30	0.088	7.94E-03	-	-	-	2	37.6	53.6
KA3566G01:5	1.50	6.30	3.90	13.28	70	0.042	4.84E-03	3.4E-07	1.0E-04	7.0E-05	2	20.6	23.6
KA3566G02:1	19.00	30.10	24.55	37.94	60	0.400	4.40E-02	3.6E-07	1.1E-05	8.3E-06	2	27.1	26.6
KA3566G02:2	16.00	18.00	17.00	30.76	32	0.493	4.52E-02	5.2E-07	1.3E-05	1.2E-05	2	34.0	35.9
KA3566G02:3	12.00	14.00	13.00	27.04	80	0.152	1.83E-02	2.6E-07	1.9E-05	1.4E-05	2	25.6	28.3
KA3566G02:4	8.00	11.00	9.50	23.85	170	0.056	8.33E-03	-	-	-	2	13.8	13.0
KA3566G02:5	1.30	6.00	3.65	18.79	80	0.074	8.83E-03	1.6E-05	5.1E-04	1.8E-03	1	-1.5	7.1
KA3568D01:1	0.65	2.30	1.48	18.08	250	0.022	3.60E-03	-	-	-	1	0.0	0.7
KA3572G01:1	7.30	12.03	9.67	18.21	220	0.025	4.02E-03	-	-	-	1	-4.4	0.2
KA3572G01:2	2.70	5.30	4.00	15.23	220	0.018	2.81E-03	-	-	-	1	-3.0	1.0
KA3573A:1	26.00	40.07	33.04	21.54	8	0.966	6.17E-02	7.4E-06	3.1E-05	1.2E-04	2	14.5	15.0
KA3573A:2	21.00	24.00	22.50	11.01	2	1.010	4.83E-02	1.6E-05	3.2E-05	3.4E-04	2	54.1	54.8
KA3573A:3	14.50	19.00	16.75	5.25	3	0.153	7.92E-03	2.1E-05	2.2E-04	2.6E-03	2	63.0	64.3
KA3573A:4	**10.50**	**12.50**	**11.50**	**0.00**	-	-	-	**4.9E-06**	-	-	**2**	171.4	172.4
KA3573A:5	1.30	8.50	4.90	6.59	5	0.145	8.33E-03	8.9E-06	1.8E-04	1.1E-03	2	23.3	21.6
KA3573C01:1	0.65	2.05	1.35	11.56	0.75	2.970	1.20E-01	1.2E-05	9.1E-06	1.0E-04	2	105.4	107.4
KA3574D01:1	0.65	2.05	1.35	17.42	-	-	-	-	-	-	0	-0.2	0.0
KA3574G01:1	8.00	12.03	10.02	19.07	-	-	-	-	-	-	0	-2.0	-0.2
KA3574G01:2	5.10	7.00	6.05	16.90	220	0.022	3.47E-03	-	-	-	1	-1.5	-0.3
KA3574G01:3	1.80	4.10	2.95	15.71	200	0.021	3.21E-03	-	-	-	1	-1.0	0.7
KA3576G01:1	8.00	12.01	10.01	17.99	75	0.072	8.47E-03	6.0E-06	3.4E-04	7.0E-04	2	-3.4	11.6
KA3576G01:2	4.00	6.00	5.00	15.23	220	0.018	2.81E-03	-	-	-	1	-0.7	0.5
KA3576G01:3	1.30	3.00	2.15	14.22	220	0.015	2.45E-03	-	-	-	1	-0.7	0.5
KA3578C01:1	0.65	2.09	1.37	12.84	7	0.393	2.43E-02	4.4E-06	5.8E-05	1.8E-04	2	19.2	17.7
KA3578G01:1	6.50	12.58	9.54	18.99	-	-	-	-	-	-	0	-0.5	-0.7
KA3578G01:2	4.30	5.50	4.90	16.61	-	-	-	-	-	-	0	-0.7	0.0
KA3578H01:1	0.65	1.90	1.28	15.94	19	0.223	1.77E-02	2.1E-06	6.2E-05	1.2E-04	2	45.0	50.9
KA3579D01:1	0.65	2.00	1.33	18.60	-	-	-	-	-	-	0	-0.2	0.5
KA3579G:1	14.70	22.65	18.68	25.97	40	0.281	2.75E-02	1.2E-05	1.2E-04	4.3E-04	1	-2.0	2.7
KA3579G:2	12.50	13.70	13.10	21.78	37	0.214	2.04E-02	8.9E-06	1.3E-04	4.3E-04	1	-3.0	-0.2
KA3579G:3	2.30	11.50	6.90	18.03	35	0.155	1.46E-02	6.9E-06	2.0E-04	4.7E-04	1	-0.2	-1.0
KA3584G01:1	7.00	12.00	9.50	21.48	-	-	-	-	-	-	0	-0.2	-0.2
KA3584G01:2	1.30	5.00	3.15	18.97	-	-	-	-	-	-	0	-0.5	0.2
KA3588C01:1	0.65	2.04	1.35	20.36	1.38	5.008	2.24E-01	2.3E-06	3.2E-06	1.0E-05	2	49.9	50.9
KA3588D01:1	0.65	1.90	1.28	23.20	61	0.147	1.63E-02	1.1E-05	2.4E-04	6.6E-04	1	-4.2	6.6
KA3588I01:1	0.65	1.96	1.31	22.44	25	0.336	2.87E-02	1.9E-05	1.3E-04	6.8E-04	1	2.5	2.9
KA3590G01:1	16.00	30.00	23.00	24.96	1.1	9.443	4.06E-01	2.7E-06	1.9E-06	6.5E-06	2	135.2	134.9
KA3590G01:2	7.00	15.00	11.00	20.68	0.8	8.909	3.64E-01	3.4E-06	2.2E-06	9.4E-06	2	136.1	135.1
KA3590G01:3	1.30	6.00	3.65	21.22	1.85	4.056	1.91E-01	4.1E-06	2.6E-05	2.2E-05	2	38.2	38.4
KA3590G02:1	25.50	30.01	27.76	44.11	11.2	2.895	2.01E-01	2.1E-06	4.8E-06	1.1E-05	2	44.0	44.5
KA3590G02:2	15.20	23.50	19.35	36.80	24	0.940	7.95E-02	6.3E-07	7.0E-06	8.0E-06	2	37.9	38.1
KA3590G02:3	11.90	13.20	12.55	31.29	170	0.096	1.43E-02	-	-	-	1	6.9	7.1
KA3590G02:4	1.30	9.90	5.60	26.28	42	0.274	2.72E-02	1.0E-05	1.3E-04	3.8E-04	1	4.4	0.0
KA3592C01:1	0.65	2.01	1.33	24.03	240	0.040	6.57E-03	-	-	-	1	0.5	1.0
KA3593G:1	25.20	30.02	27.61	40.46	-	-	-	-	-	-	0	0.0	0.5
KA3593G:2	23.50	24.20	23.85	37.50	14	1.674	1.23E-01	7.0E-07	4.5E-06	5.7E-06	2	49.7	48.7
KA3593G:3	9.00	22.50	15.75	31.71	100	0.168	2.15E-02	-	-	-	1	0.5	3.7
KA3593G:4	3.00	7.00	5.00	26.00	120	0.094	1.27E-02	-	-	-	2	9.3	9.6
KA3597D01:1	0.65	2.22	1.44	29.74	-	-	-	-	-	-	0	-0.5	0.7
KA3597H01:1	0.65	2.06	1.36	29.19	20	0.710	5.71E-02	8.0E-06	4.0E-05	1.4E-04	1	5.9	7.6
KA3600F:1	43.00	50.10	46.55	68.86	40	1.976	1.93E-01	4.4E-06	1.2E-05	2.3E-05	1	5.9	6.1
KA3600F:2	40.50	42.00	41.25	63.93	31	2.197	2.00E-01	6.6E-06	1.3E-05	3.3E-05	1	6.2	6.4
KA3600F:3	20.00	39.50	29.75	53.46	15	3.176	2.37E-01	6.1E-06	8.3E-06	2.6E-05	2	10.3	10.1
KA3600F:4	1.30	18.00	9.65	36.70	55	0.408	4.38E-02	3.2E-07	9.7E-06	7.3E-06	2	31.5	31.0
KG0021A01:1	42.50	48.82	45.66	26.71	6	1.982	1.19E-01	9.7E-06	1.7E-05	8.2E-05	2	81.0	81.0
KG0021A01:2	37.00	41.50	39.25	30.19	4.5	3.375	1.90E-01	7.8E-06	7.6E-06	4.1E-05	2	78.0	77.0
KG0021A01:3	35.00	36.00	35.50	32.63	6	2.958	1.77E-01	2.4E-05	1.1E-05	1.3E-04	2	48.0	49.5
KG0021A01:4	19.00	34.00	26.50	39.36	5	5.165	2.97E-01	5.3E-06	4.8E-06	1.8E-05	2	44.2	44.7
KG0021A01:5	5.00	18.00	11.50	52.11	20	2.263	1.82E-01	5.5E-06	6.0E-06	3.0E-05	2	17.2	15.0
KG0048A01:1	49.00	54.69	51.85	20.45	0.06	116.204	3.34E+00	3.0E-06	1.6E-07	9.0E-07	2	162.5	163.5
KG0048A01:2	34.8	48	41.40	21.72	0.62	12.684	4.97E-01	2.6E-05	2.9E-06	5.2E-05	2	106.5	108.7
KG0048A01:3	32.80	33.80	33.30	25.75	1.3	8.500	3.76E-01	7.4E-06	3.2E-06	2.0E-05	2	86.6	88.5
KG0048A01:4	13.00	31.80	22.40	33.59	7	2.686	1.66E-01	3.1E-06	6.6E-06	1.9E-05	2	45.8	47.1
KG0048A01:5	5.00	12.00	8.50	45.44	60	0.574	6.32E-02	6.6E-07	1.2E-05	1.0E-05	2	15.9	15.9

6.3 Hydraulic diffusivity

The diffusivity, η, versus the distance, r, and the time lag versus the distance, r, are shown in *Figure 6-22* below. Data are from all 7 interference tests performed during the test campaign.

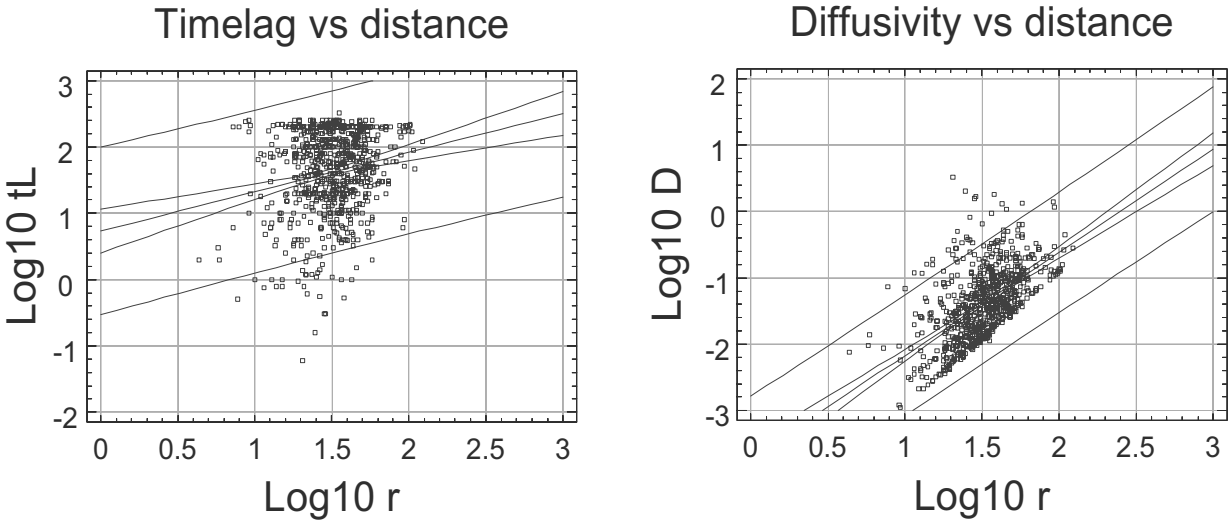


Figure 6-22 *Linear regression plots of time lag and diffusivity versus distance*

The equations of the regression lines in *Figure 6-22* are

$$\text{Log}_{10}\, t_L = 0.591 * \text{Log}_{10}\, r + 0.734$$

$$\text{Log}_{10}\, \eta = 1.553 * \text{Log}_{10}\, r - 3.723$$

The apparent increase of diffusivity by distance in *Figure 6-22* is probably not relevant. As part of the flow is more spherical than radial the time lag should increase by distance. 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.

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 seven evaluated interference tests 1:21-1:27. The results are shown in *Figure 6-23.* The evaluated relations between T and S should be seen as indications or possible ranges for S.

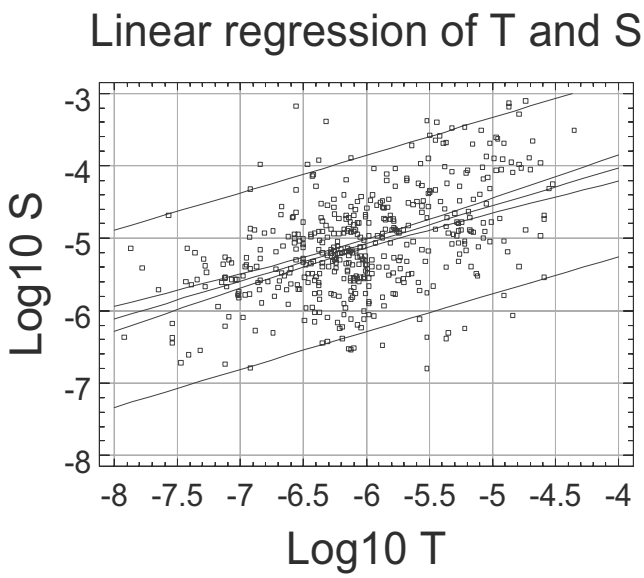


Figure 6-23 *Linear regression of T_{EVAL} and S.*

The equation of the regression line in *Figure 6-23* is

$$\text{Log}_{10}\ S = 0.520 * \text{Log}_{10}\ T_{EVAL} - 1.948$$

The relationship between T_{EVAL} and the storativity estimated from the diffusivity, η, is shown in *Figure 6-24.* Results from all seven tests 1:21 to 1:27 are included.

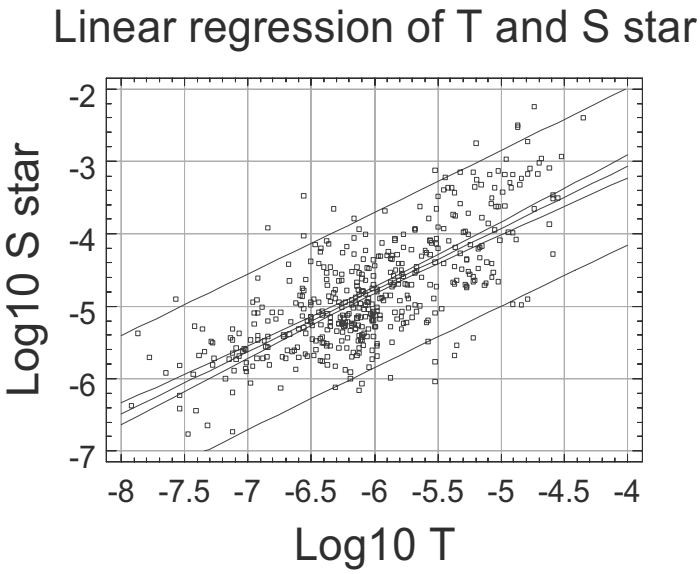


Figure 6-24 *Linear regression of T_{EVAL} and S*.*

The equation of the regression line in *Figure 6-24* is

$$\text{Log}_{10}\ S^* = 0.854 * \text{Log}_{10}\ T + 0.345$$

6.5 Deformation measurements

Deformation measurements started 2003-05-06. However due to technical malfunction no loggings of the measurements were done between 2003-05-08 09:00:00 and 2003-05-09 17:58:00. Therefore recordings from one test only exist, the test in KA3554G01:2 (Test 1:23). The measurements from this test are shown below. The measurements were made hourly. The times are not in normal time but in Swedish summertime (HMS time + 1 hr). Only an overview of deformations is given in this section. Evaluation of the deformations will be made in a separate report.

A negative value of deformation corresponds to a compression.

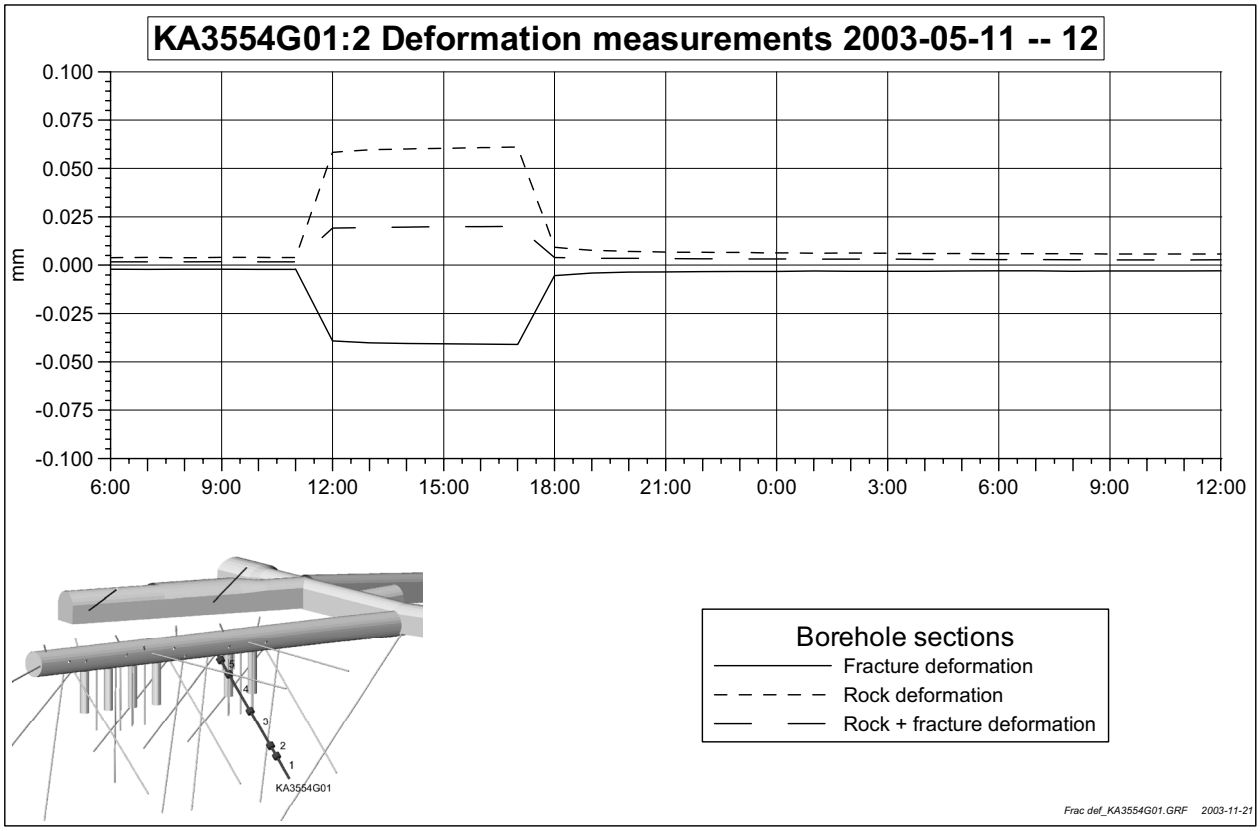


Figure 6-25 *Deformation measurements in KA3554G01:2 (hourly measurements).*

References

Forsmark T, Rhén I, 1999. Äspö HRL - Prototype repository Hydrogeology – Interference test campaign 1 after drill campaign 3. SKB IPR-00-07.

Forsmark T, Rhén I, 2000. Äspö HRL - Prototype repository Hydrogeology – Interference test campaign 2 after drill campaign 3. SKB IPR-00-21.

Forsmark T, Rhén I, 2004. Äspö HRL - Prototype repository– Hydraulic tests during operation phase. Test campaign 1. Single hole tests. SKB IPR-04-17.

Rhen I, Alm P, Forsmark T, 2004. Äspö HRL – Prototype repository - Measurements of flow into tunnels, water pressure, in the rock and Hydro mechanical responses in boreholes during the operation phase of the Prototype Repository. SKB IPR-XX-XX. (in prep)

Appendix 1

Interference test 1:21 in borehole KA3539G, section 15.85 m – 17.60 m

Date: 2003-05-09 Field Crew: A. Blom / J. Magnusson
Borehole length: 30.01 m Borehole diameter: 76 mm

Flowing borehole: KA3539G, section #2: 15.85 – 17.60 m

Valve opened: 20030509 08:40.00 Valve closed: 20030509 14:50.00

End of Test: 20030510 06:30

Total flowing time : 370 min Tot. Pr. Build-up time: 940 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

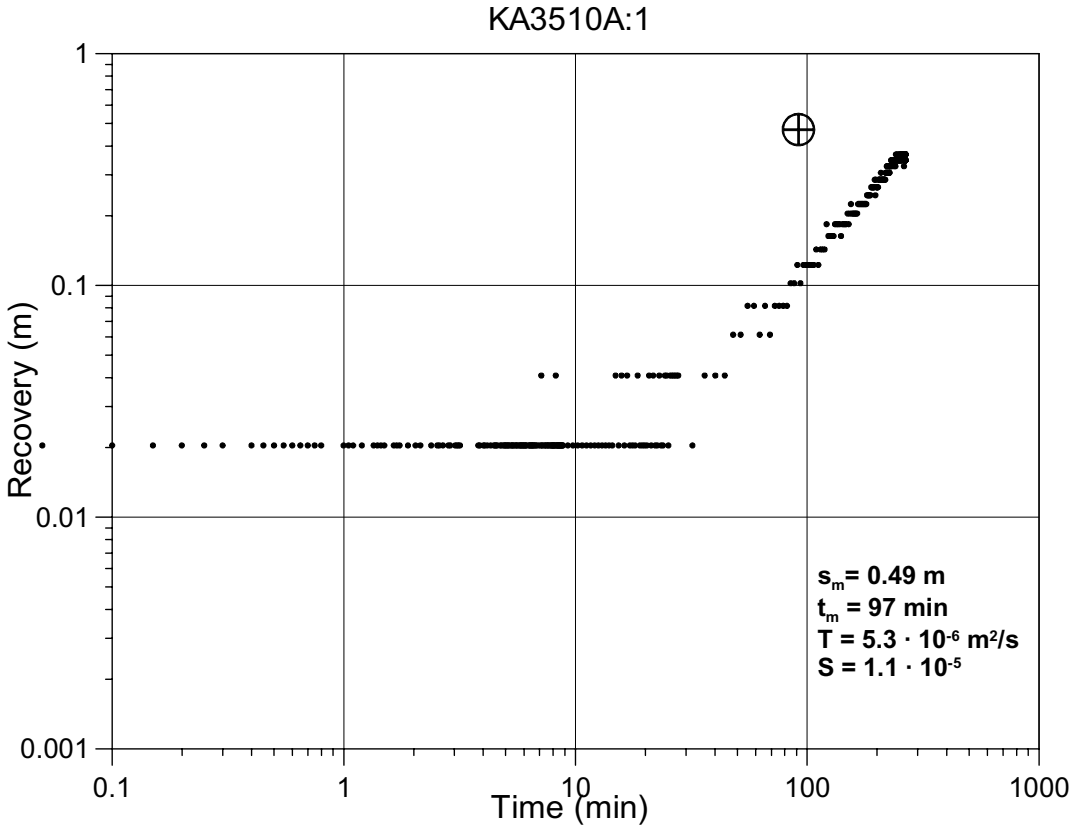
Manually measured flow rates of KA3539G, section 15.85 m – 17.60 m are presented in the table below:

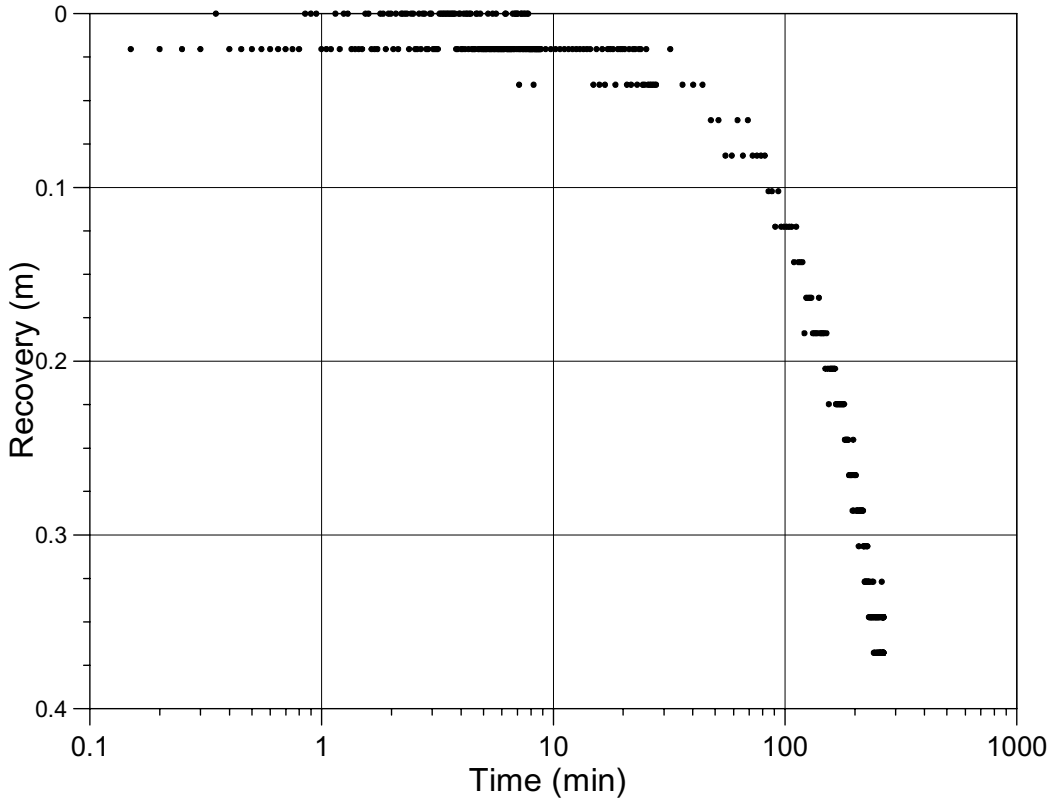
Table Manually measured flow rates, Interference test in KA3539G, section 15.85 m – 17.60 m. Prototype Repository, May 9 2003

Time	Flow rate (l/min)
08:40:15	3.228
08:41:30	3.110
08:44:00	3.063
10:00:00	2.118
10:06:00	2.109
10:08:00	2.099
14:46:00	1.879
14:47:00	1.929
14:49:00	1.942

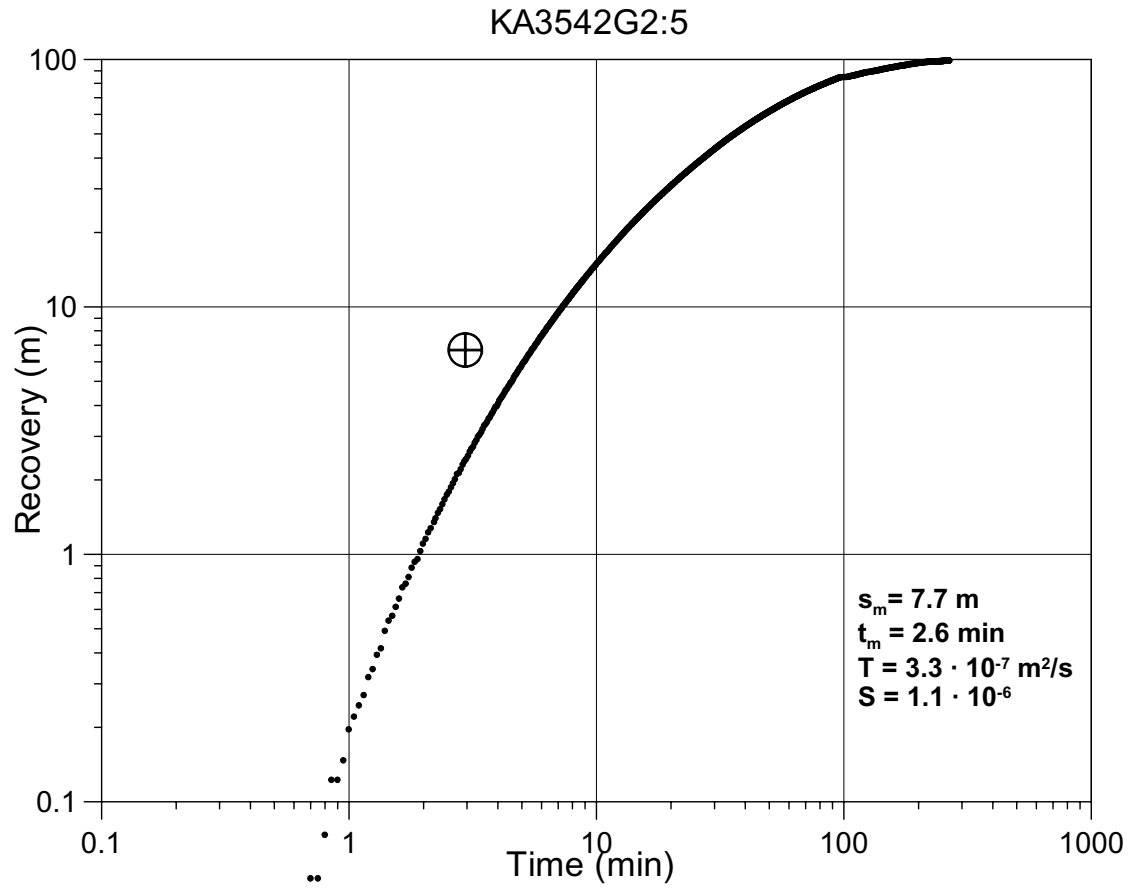
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

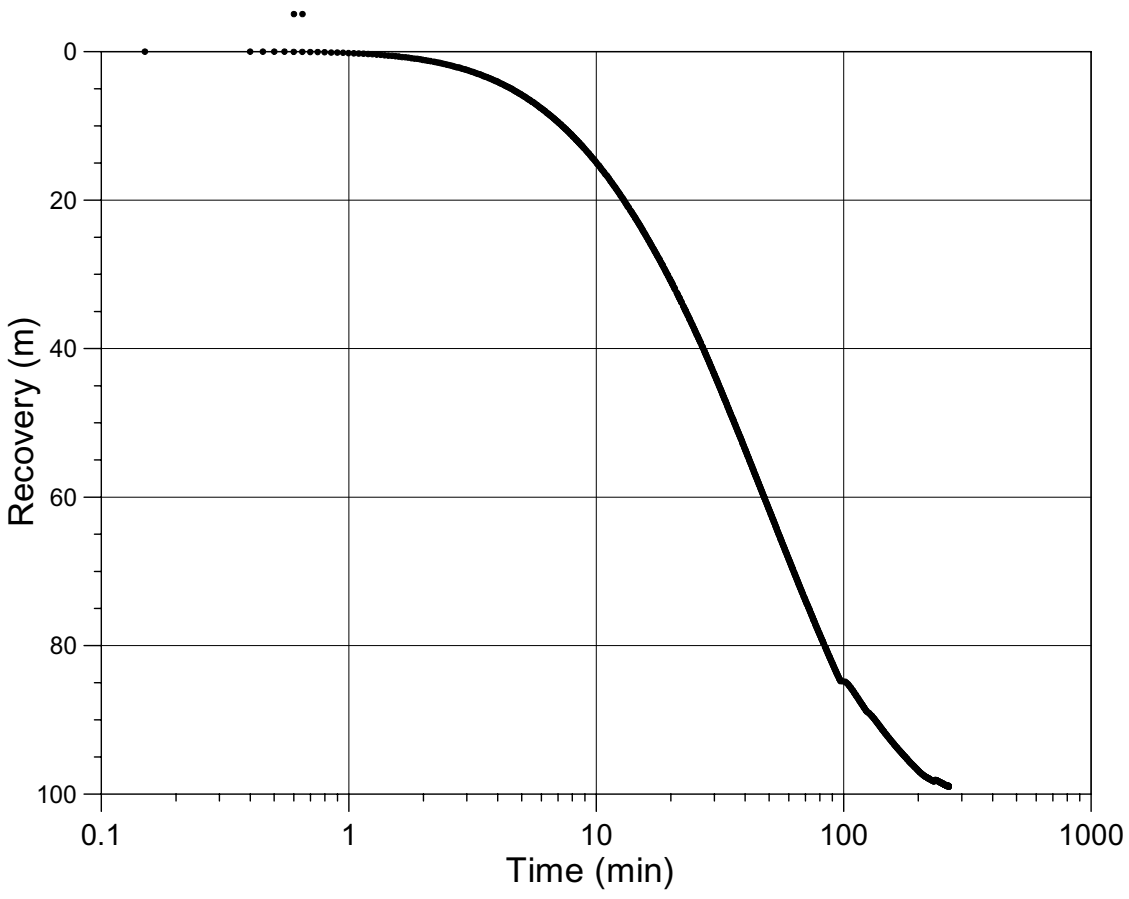
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



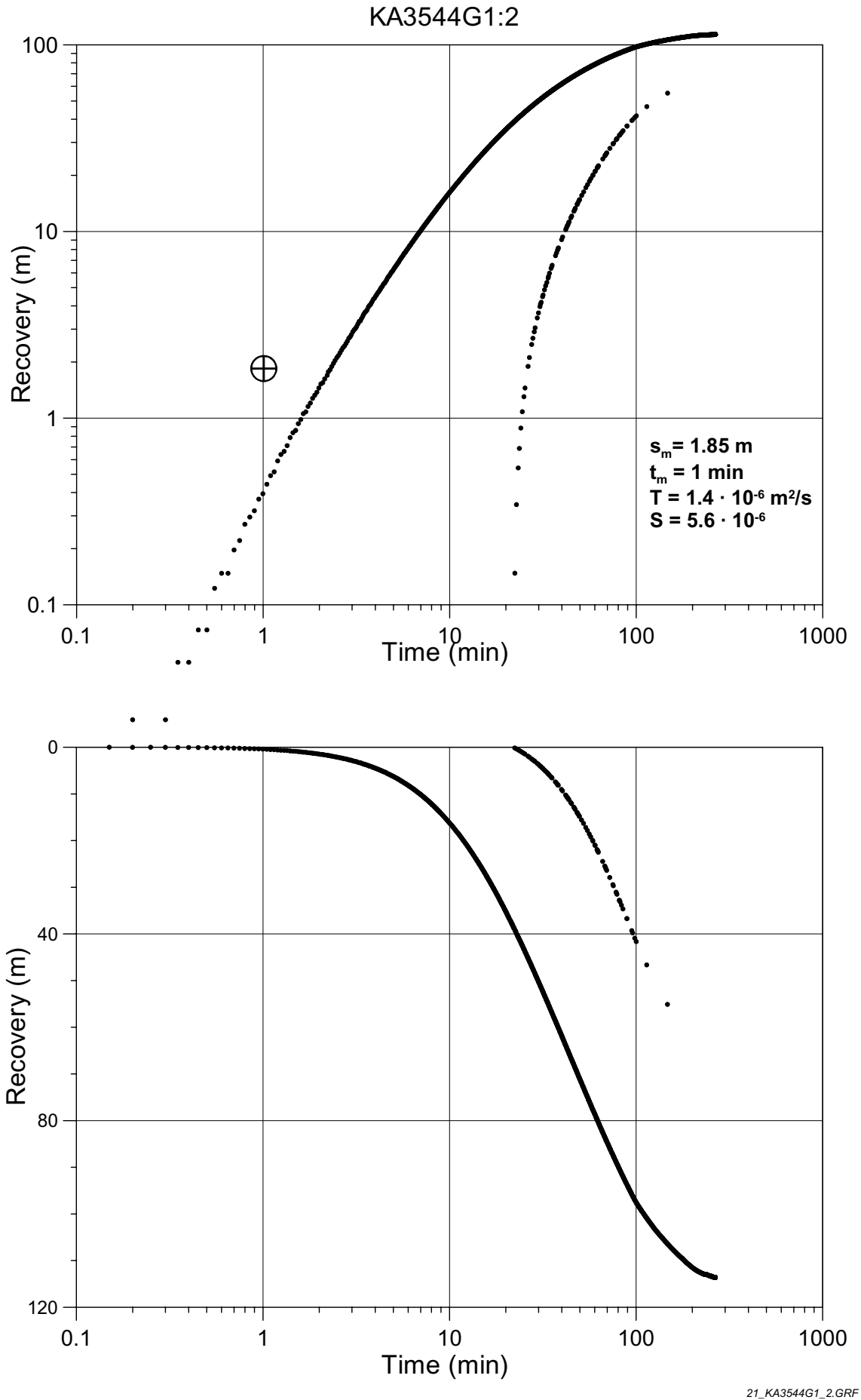


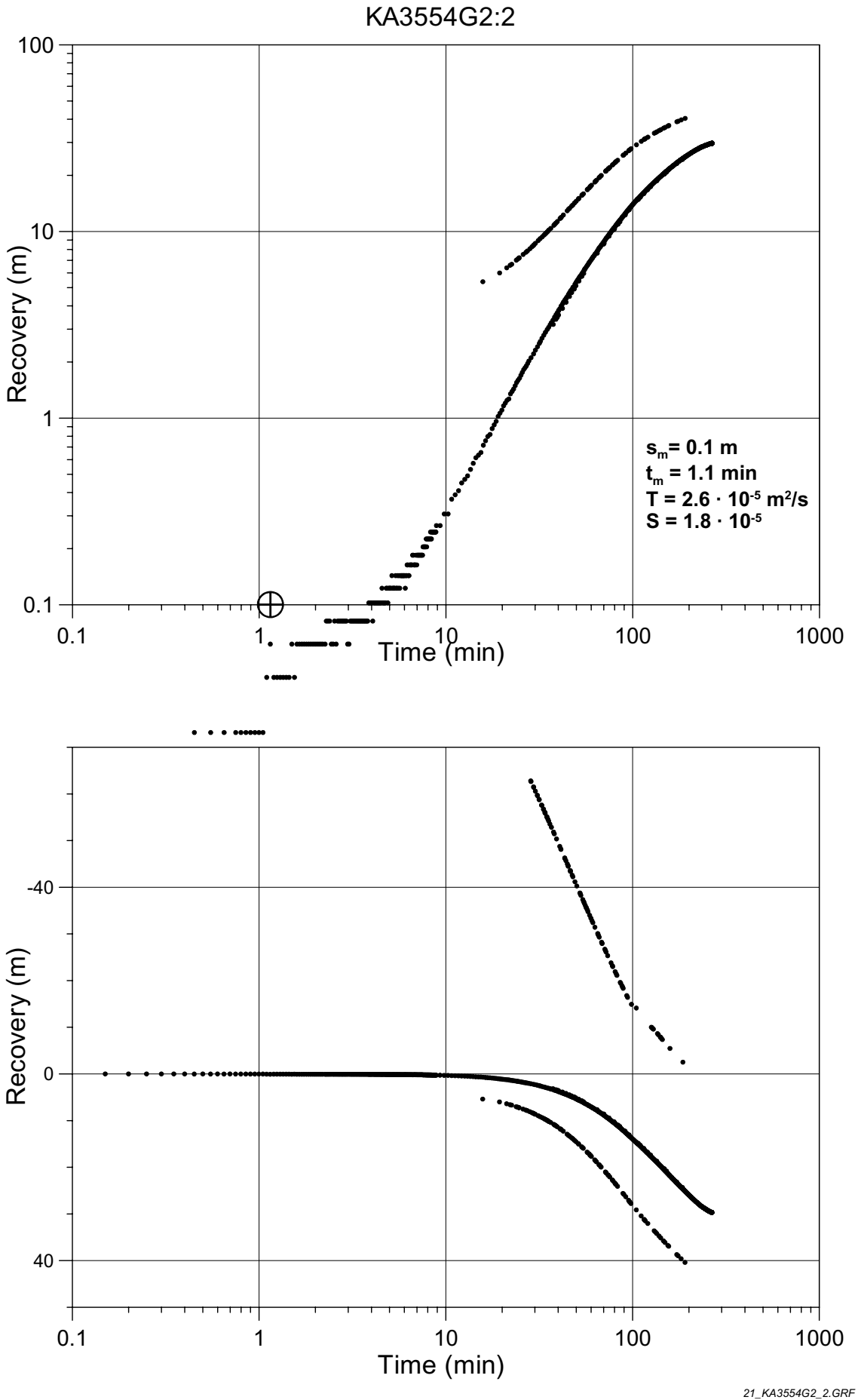
21_KA3510A_1.GRF 2003-10-15

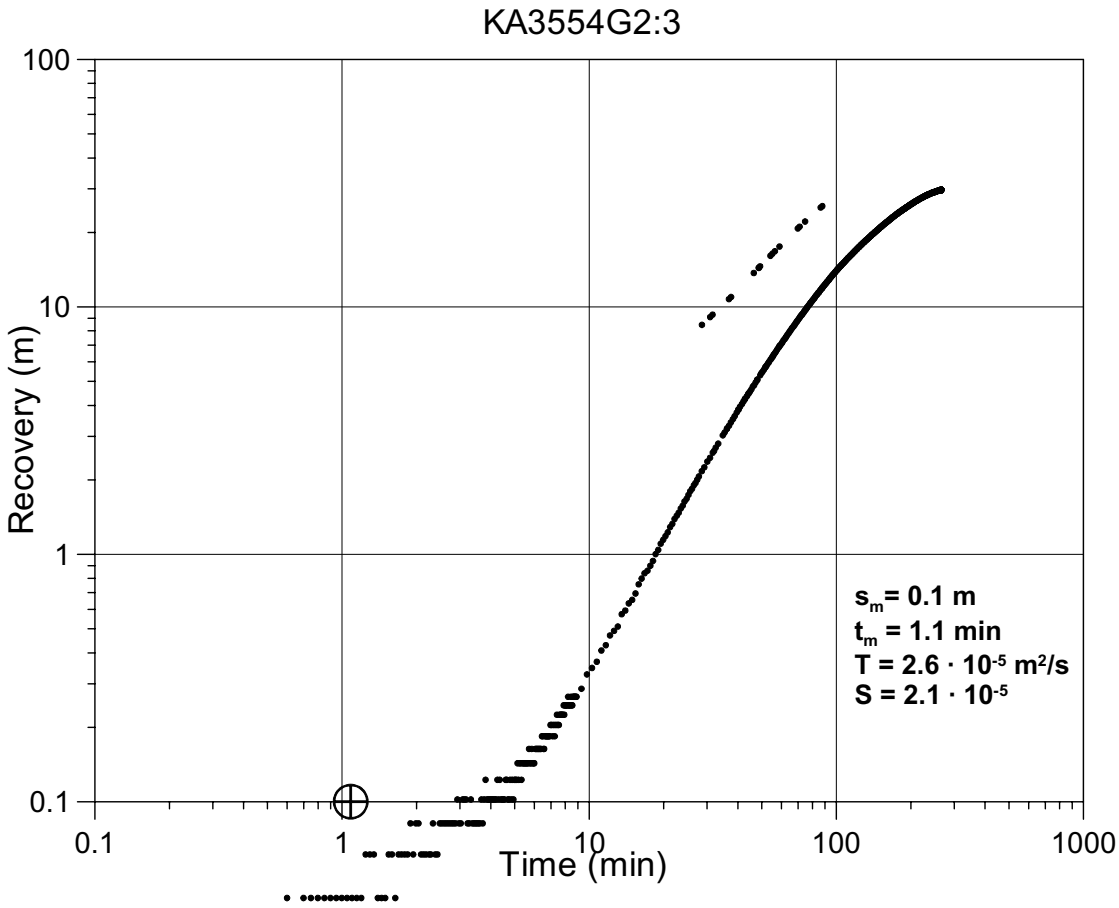


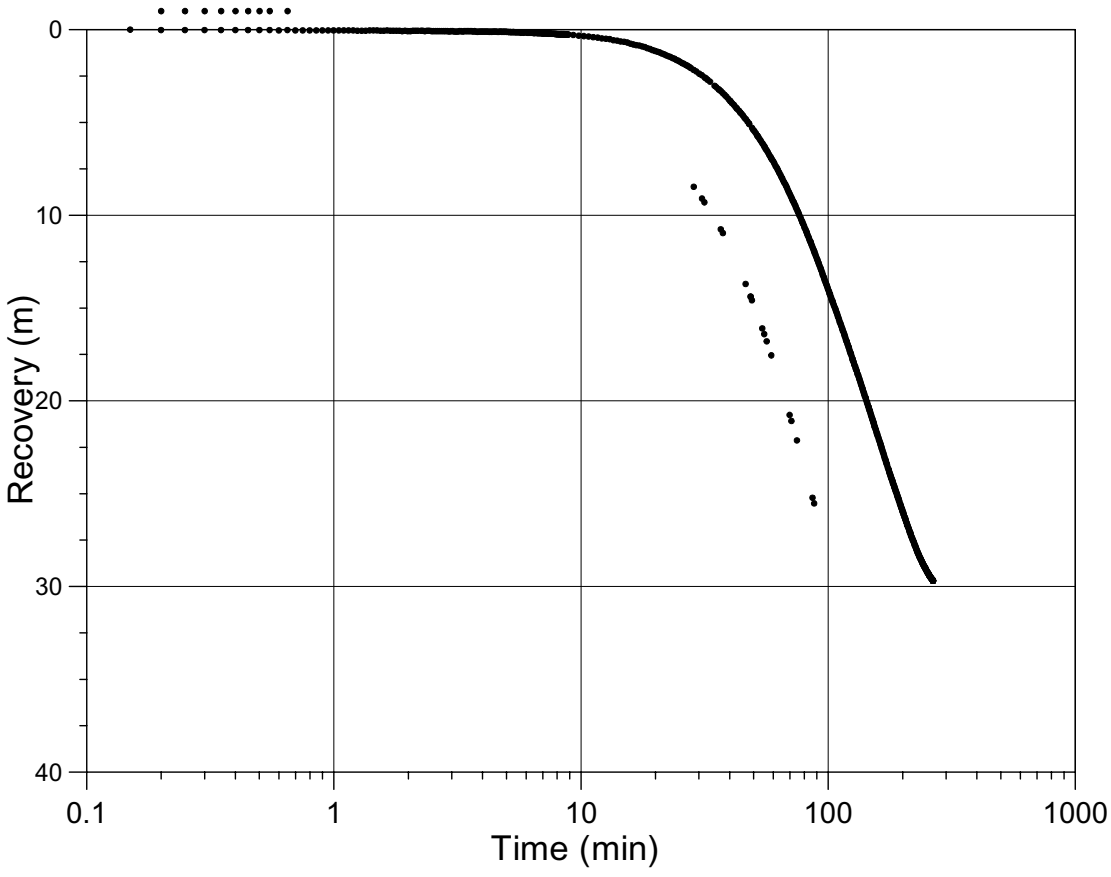


21_KA3542G2_5.GRF 2003-10-20

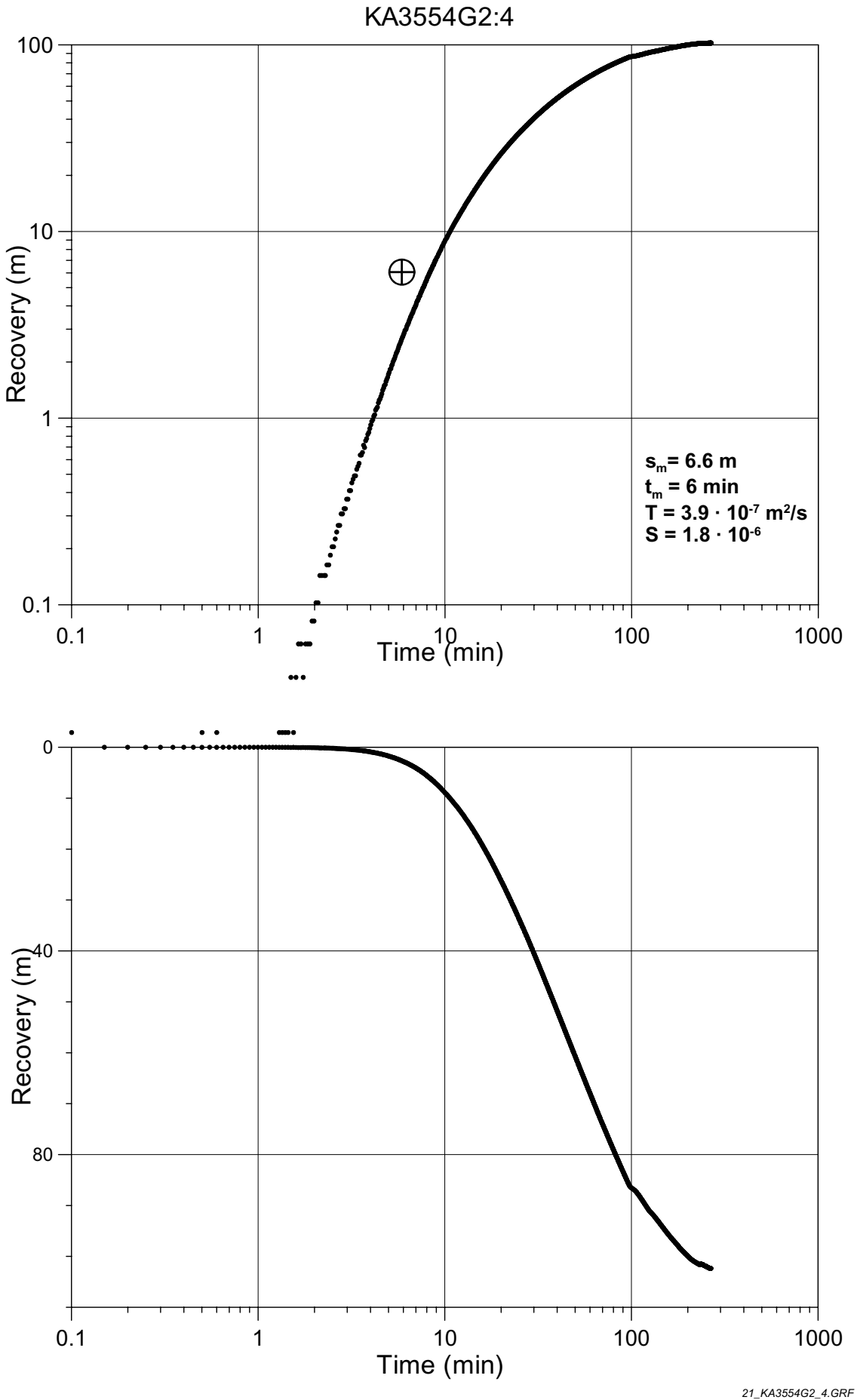

KA3544G1:2
Recovery (m)
Time (min)
s_m= 1.85 m
t_m = 1 min
T = 1.4 · 10^{-6} m^2/s
S = 5.6 · 10^{-6}
21_KA3544G1_2.GRF 2003-10-20


KA3554G2:2
100
10
1
0.1
Recovery (m)
s_m= 0.1 m
t_m = 1.1 min
T = 2.6 · 10^{-5} m^2/s
S = 1.8 · 10^{-5}
0.1
1
10
100
1000
Time (min)
-40
0
40
Recovery (m)
0.1
1
10
100
1000
Time (min)
21_KA3554G2_2.GRF 2003-10-20

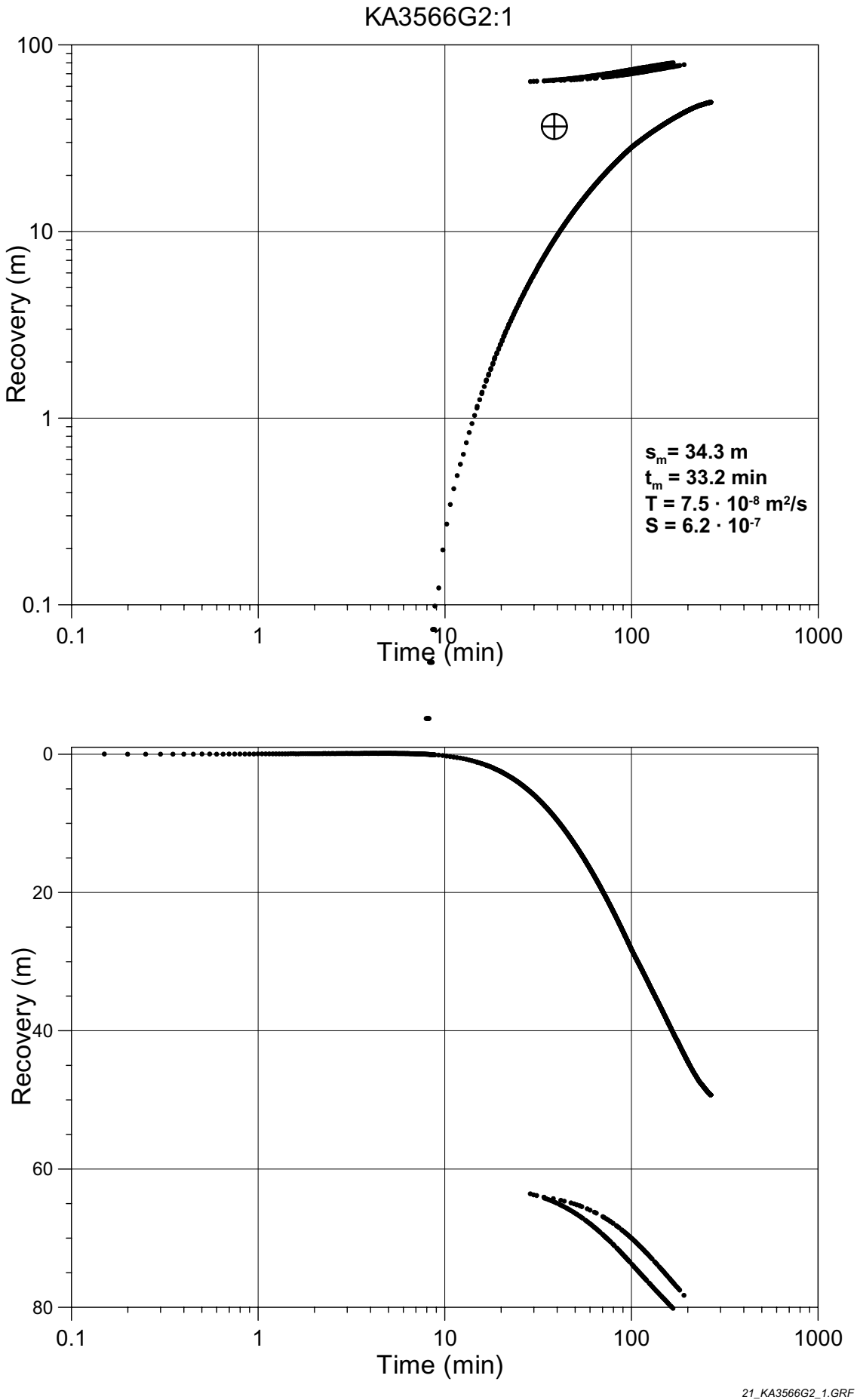


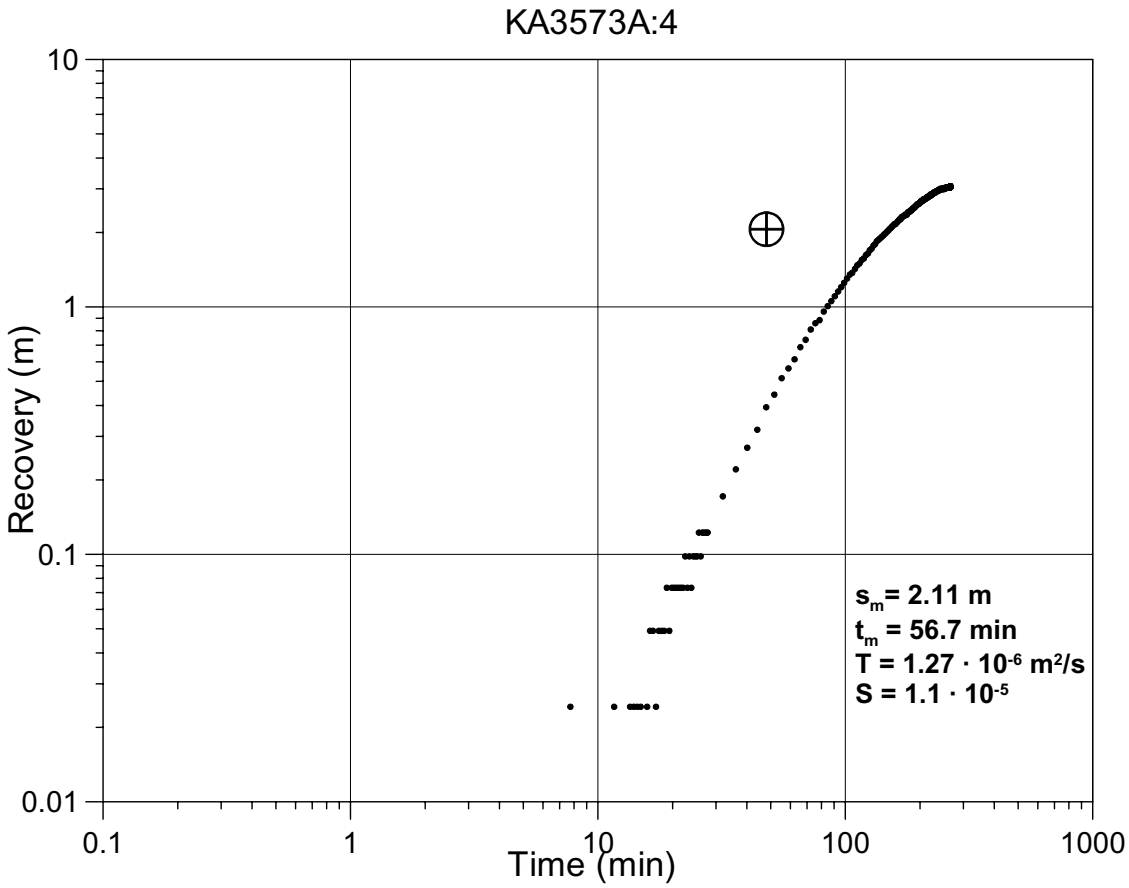


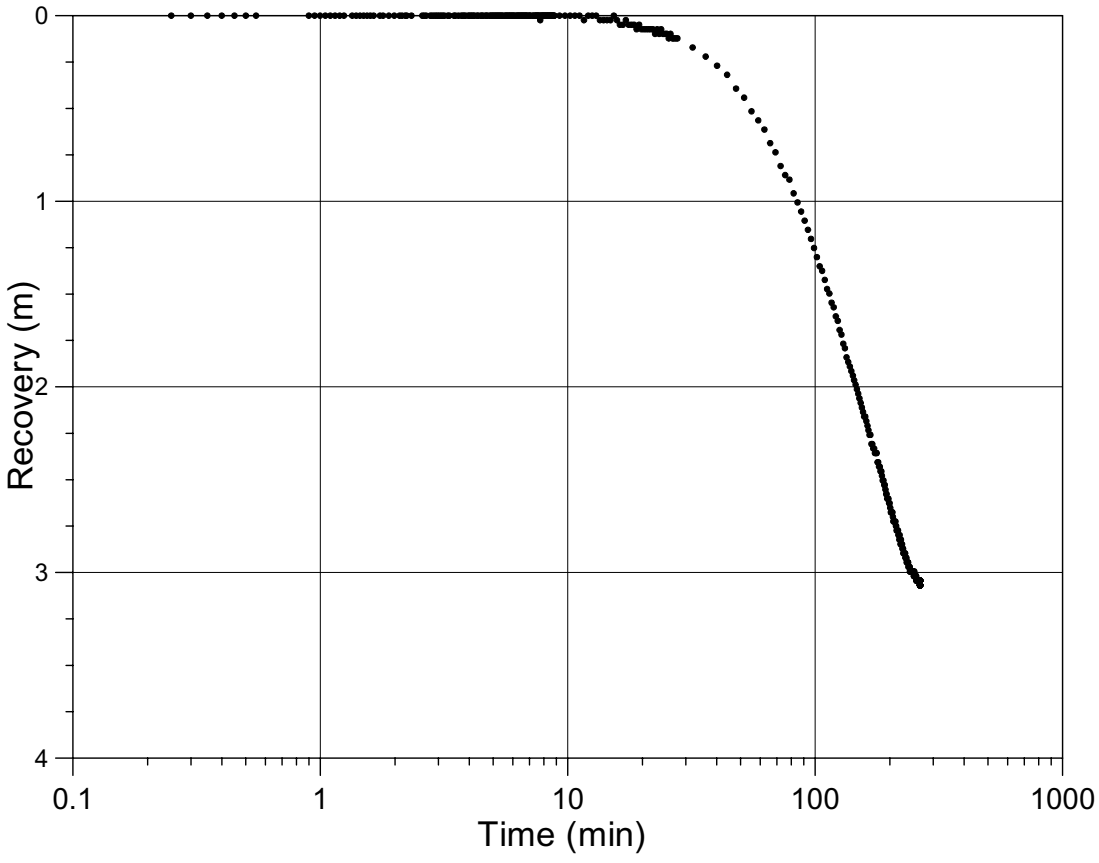
21_KA3554G2_3.GRF 2003-10-20



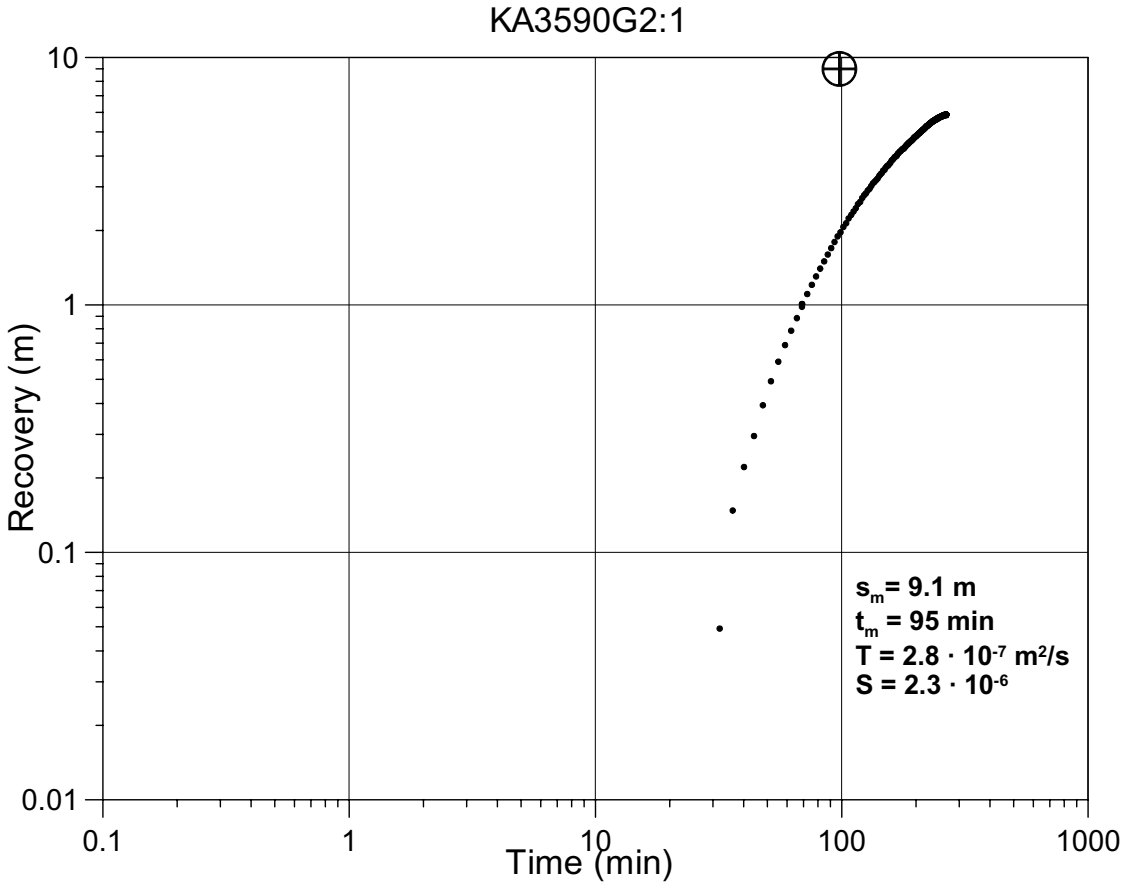
21_KA3554G2_4.GRF 2003-10-20

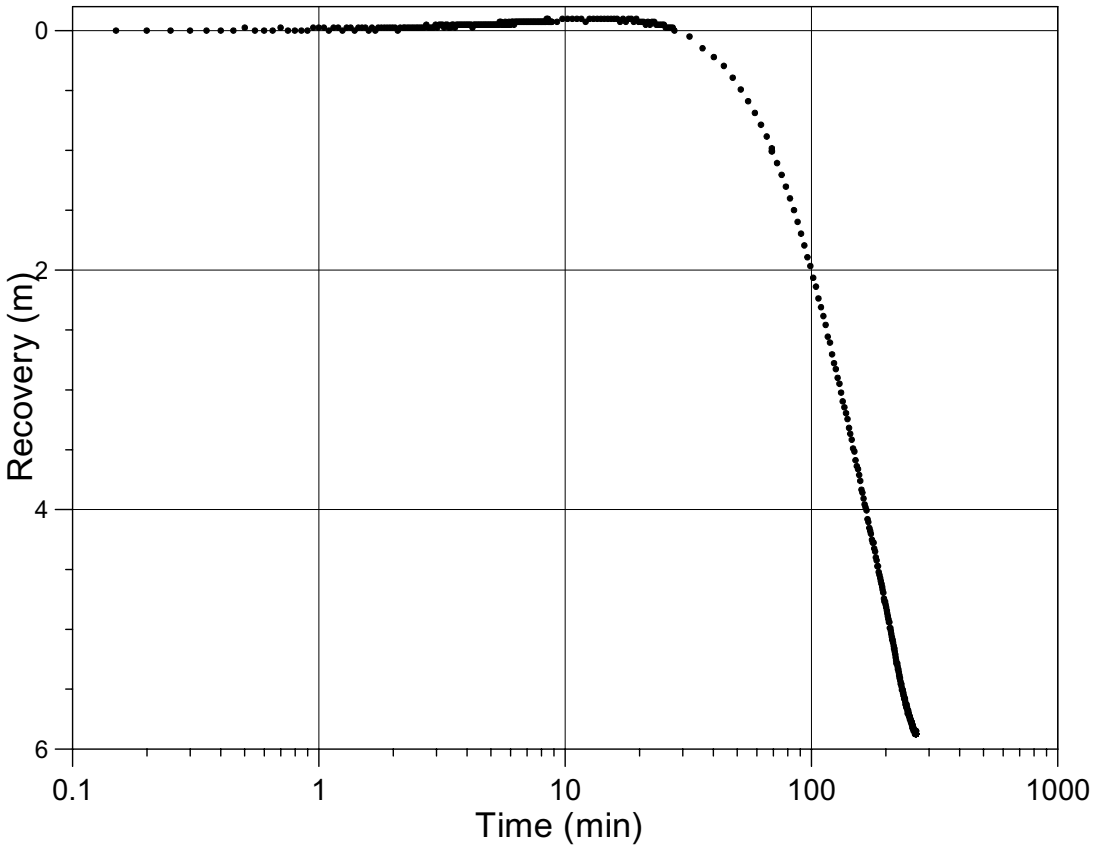

KA3566G2:1
Recovery (m)
Time (min)
s_m= 34.3 m
t_m = 33.2 min
T = 7.5 · 10^{-8} m^2/s
S = 6.2 · 10^{-7}
21_KA3566G2_1.GRF 2003-10-21



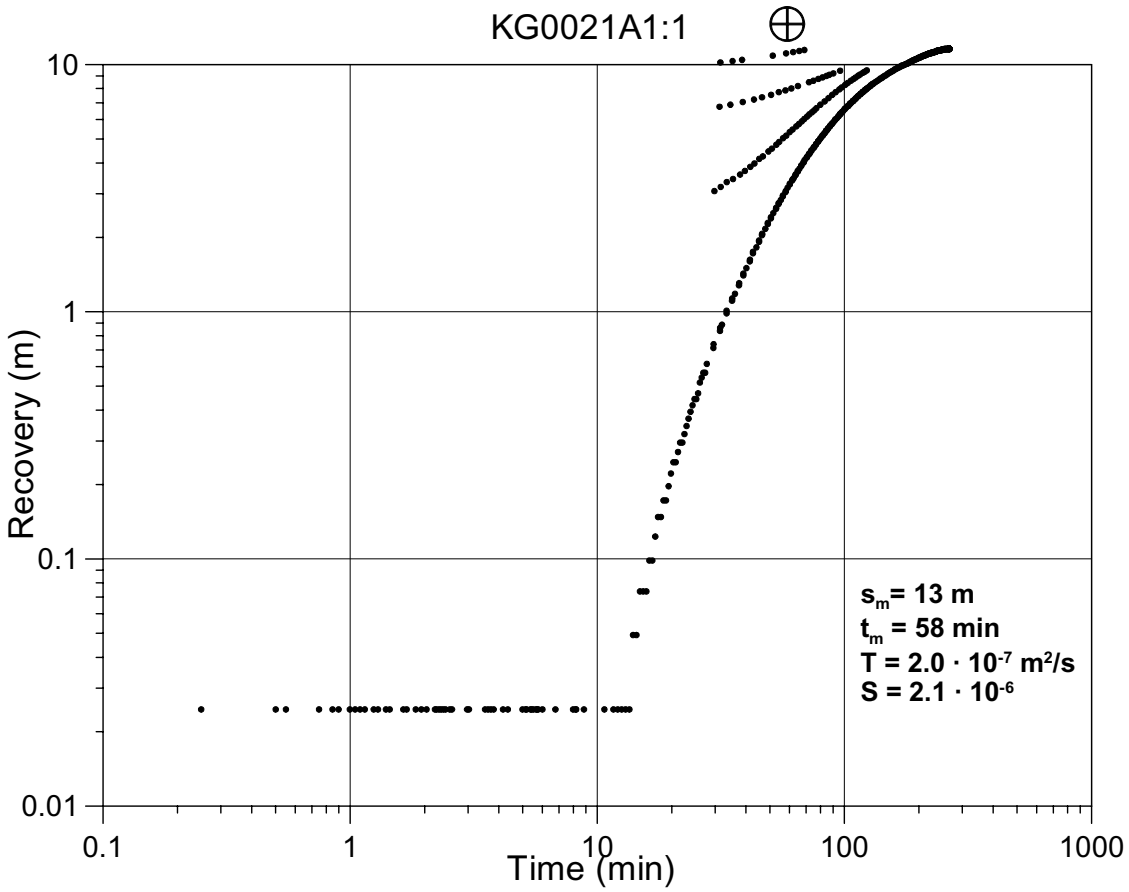


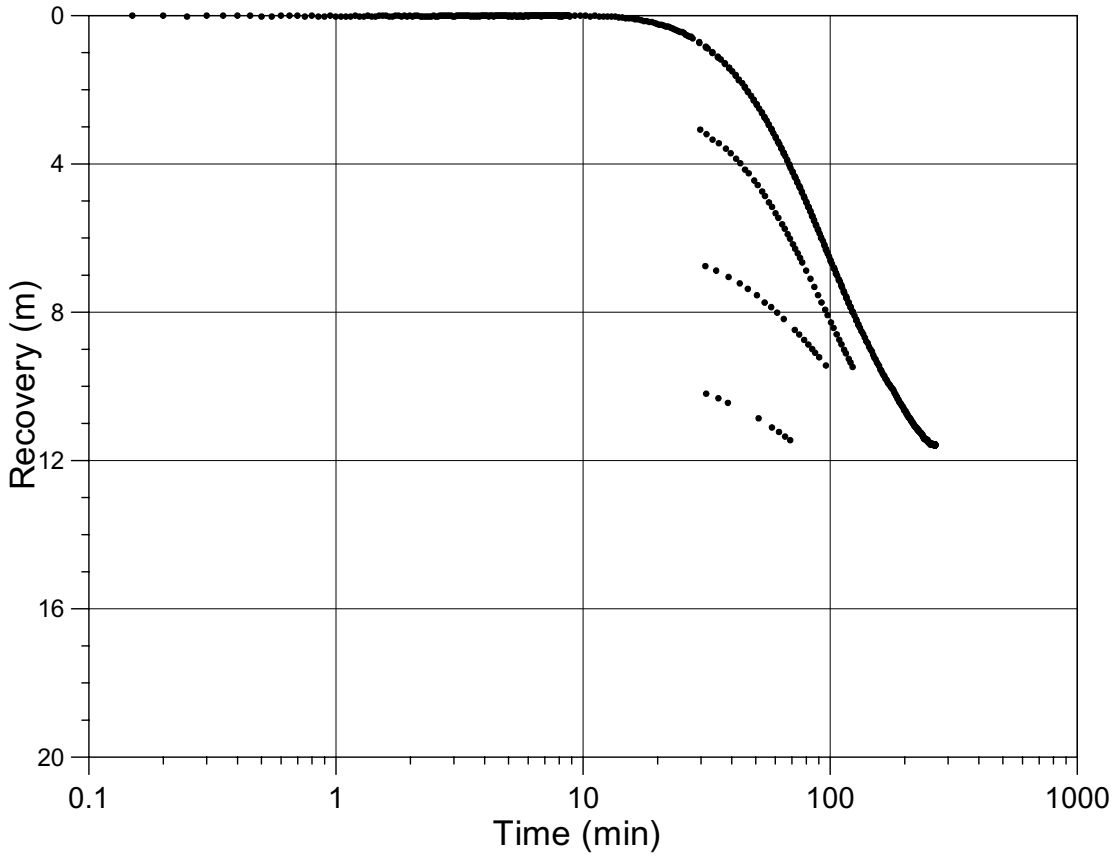
21_KA3573A_4.GRF 2003-10-21



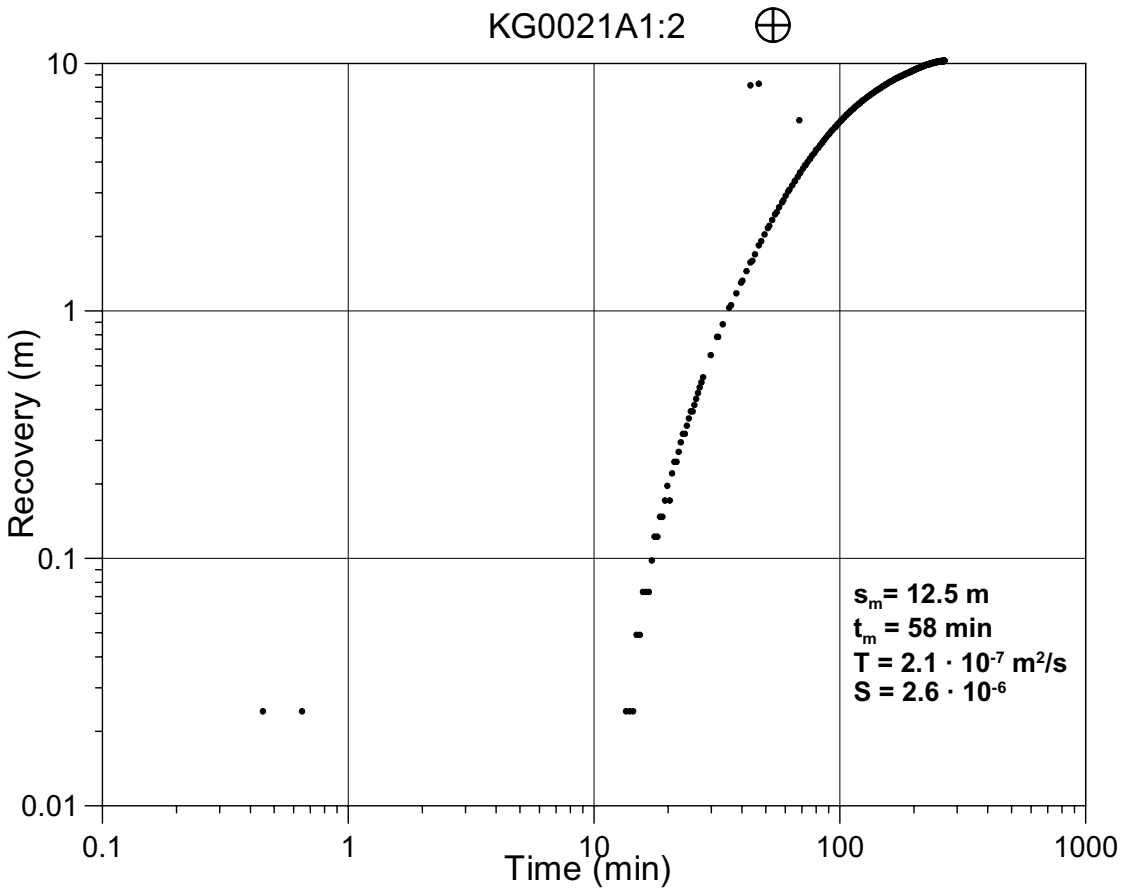


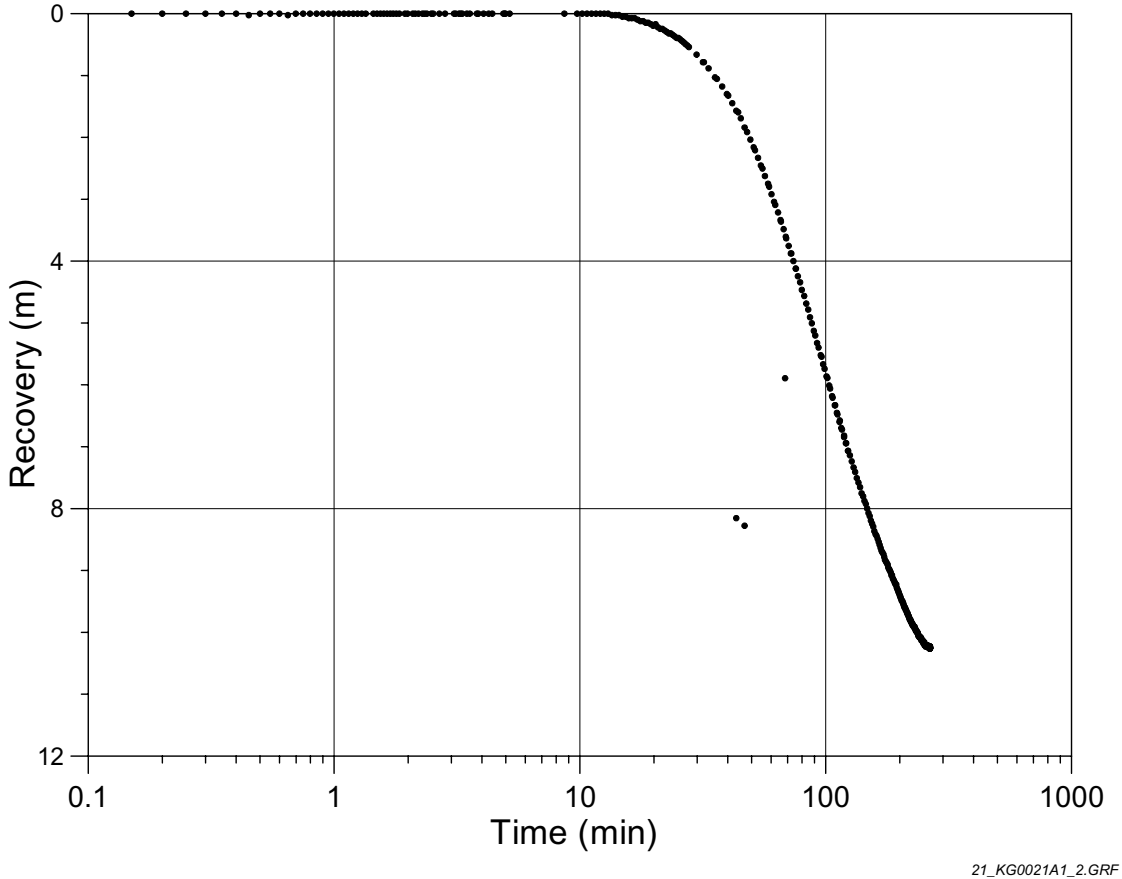
21_KA3590G2_1.GRF 2003-10-21



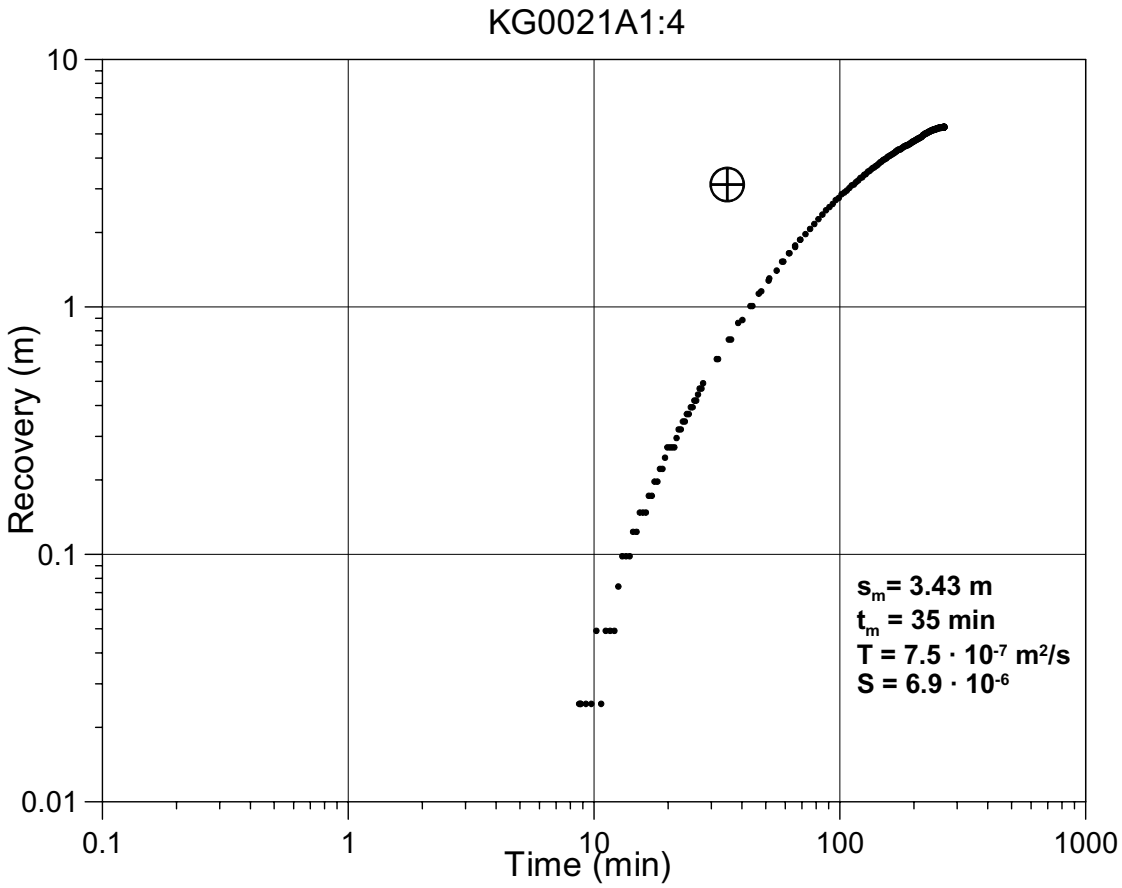


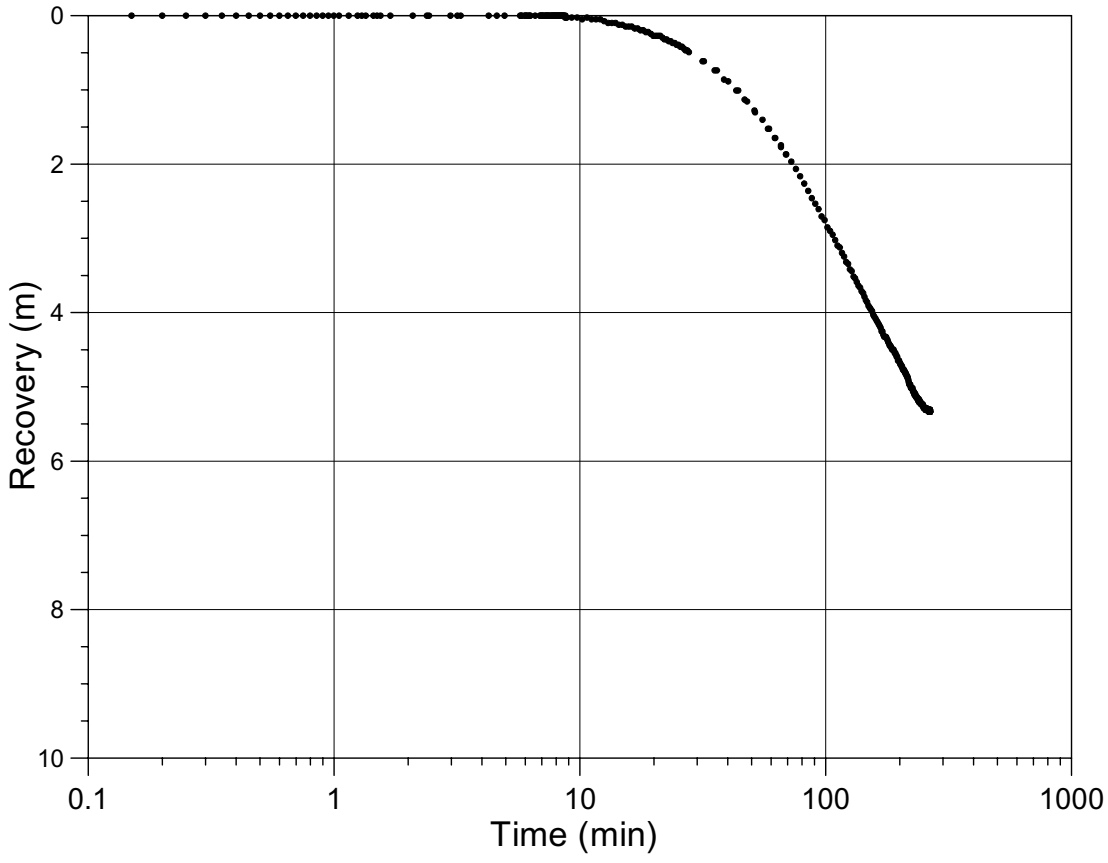
21_KG0021A1_1.GRF 2003-10-21





21_KG0021A1_2.GRF 2003-10-21





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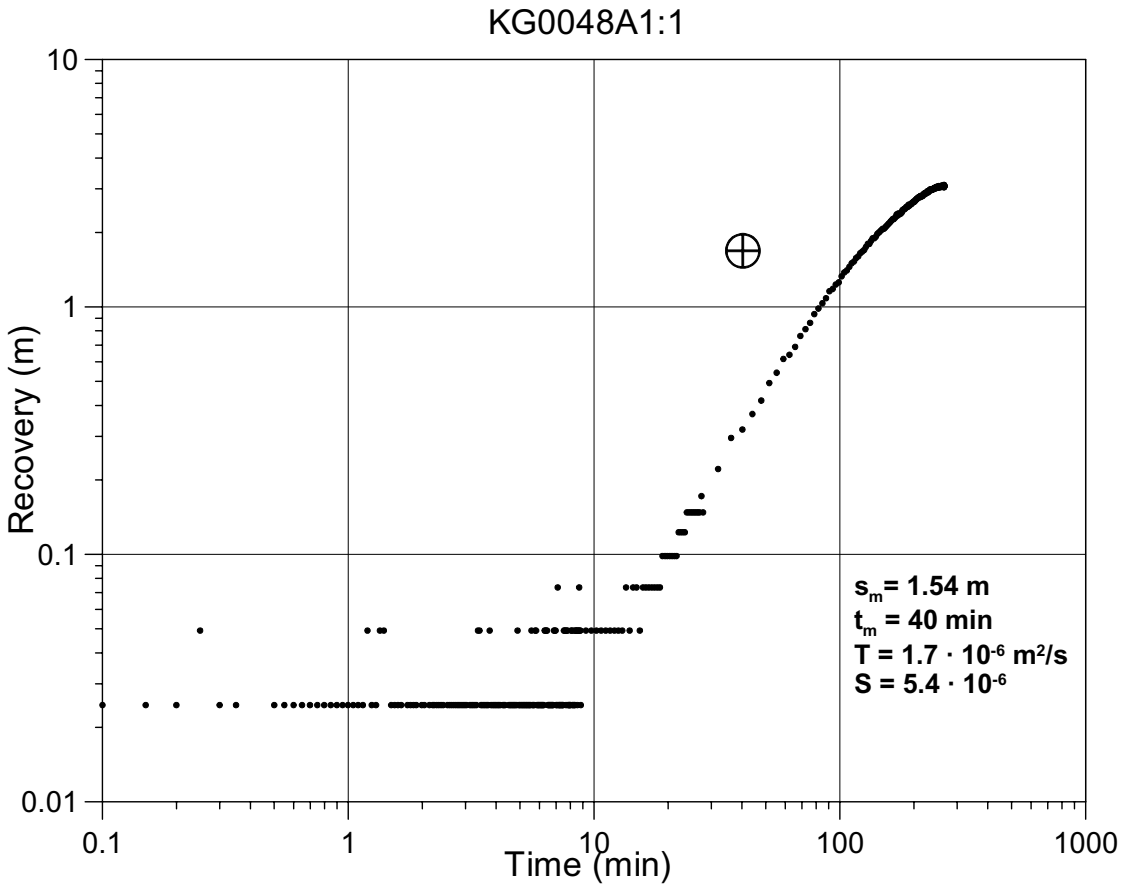
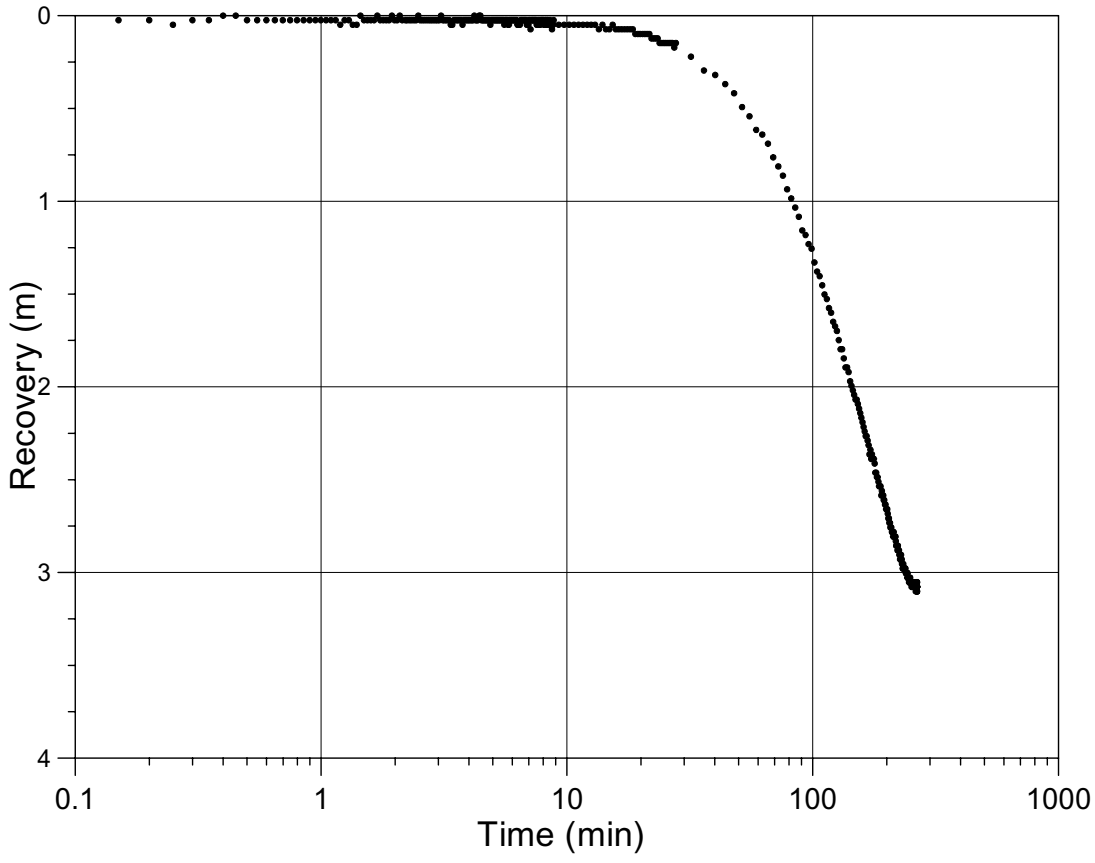
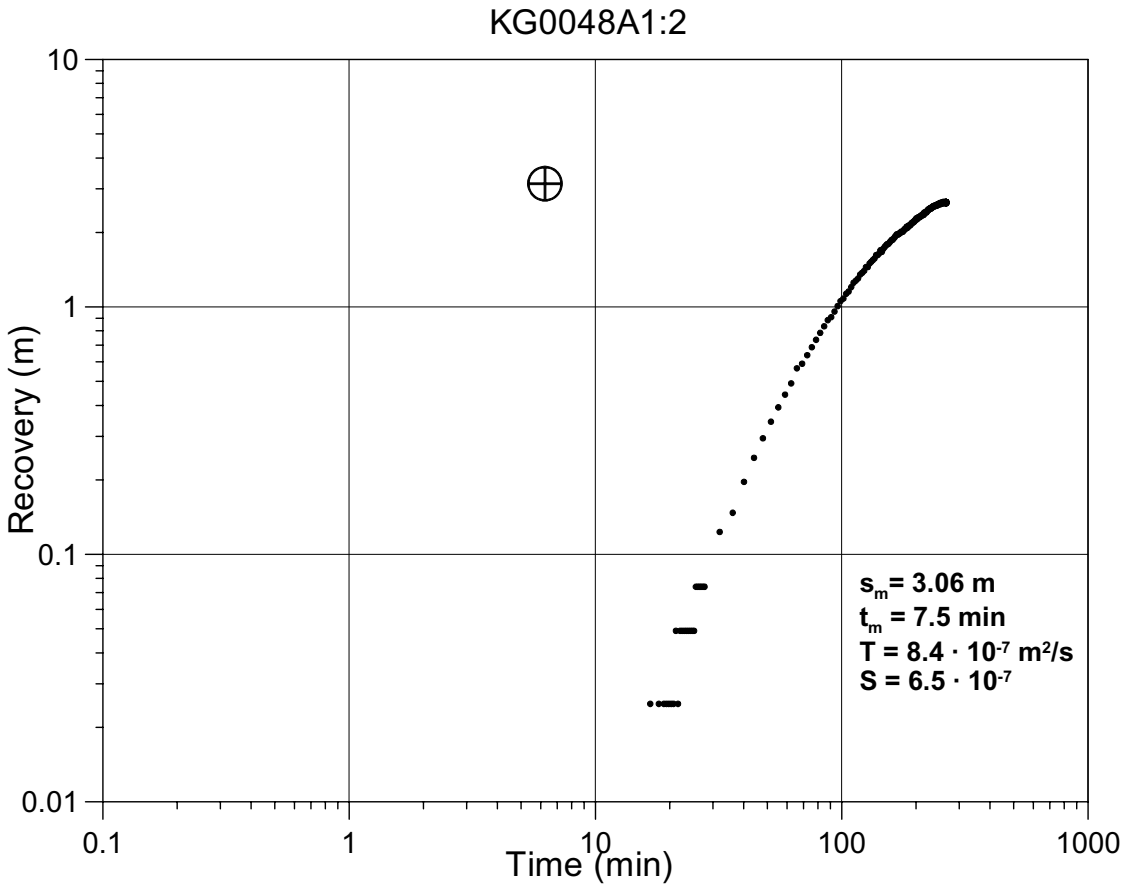
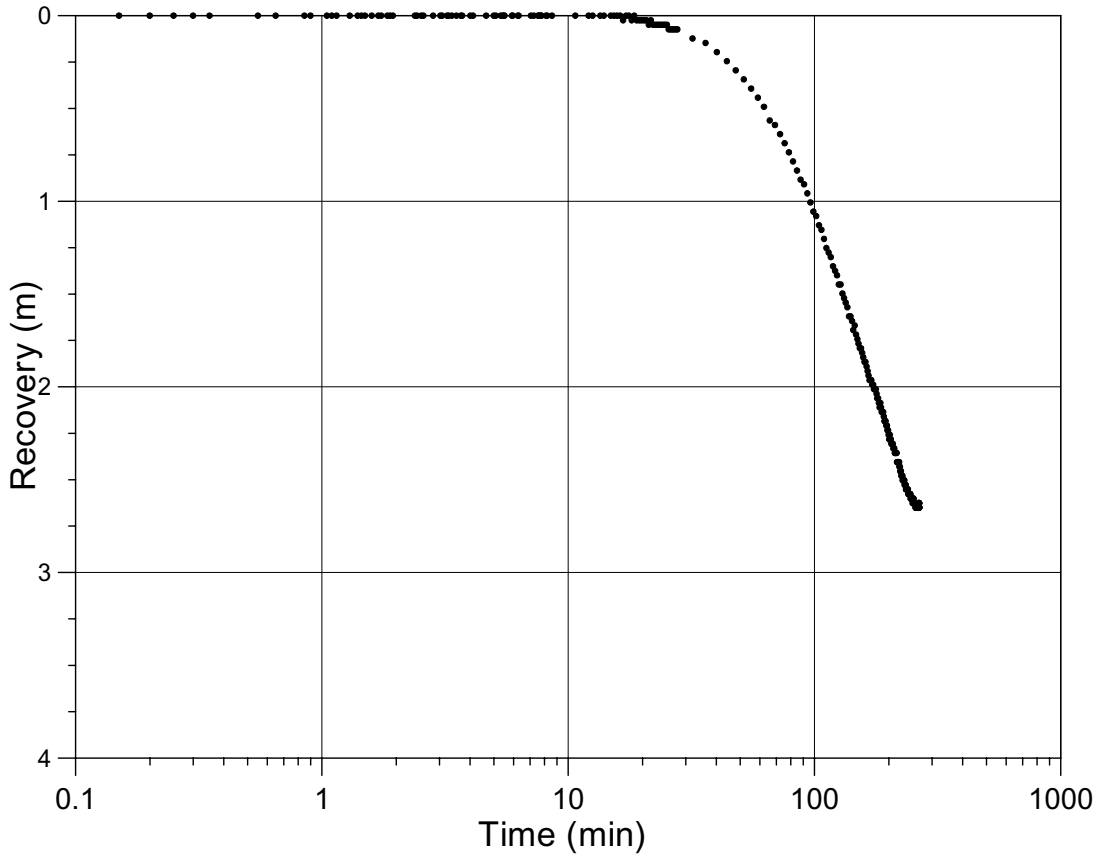


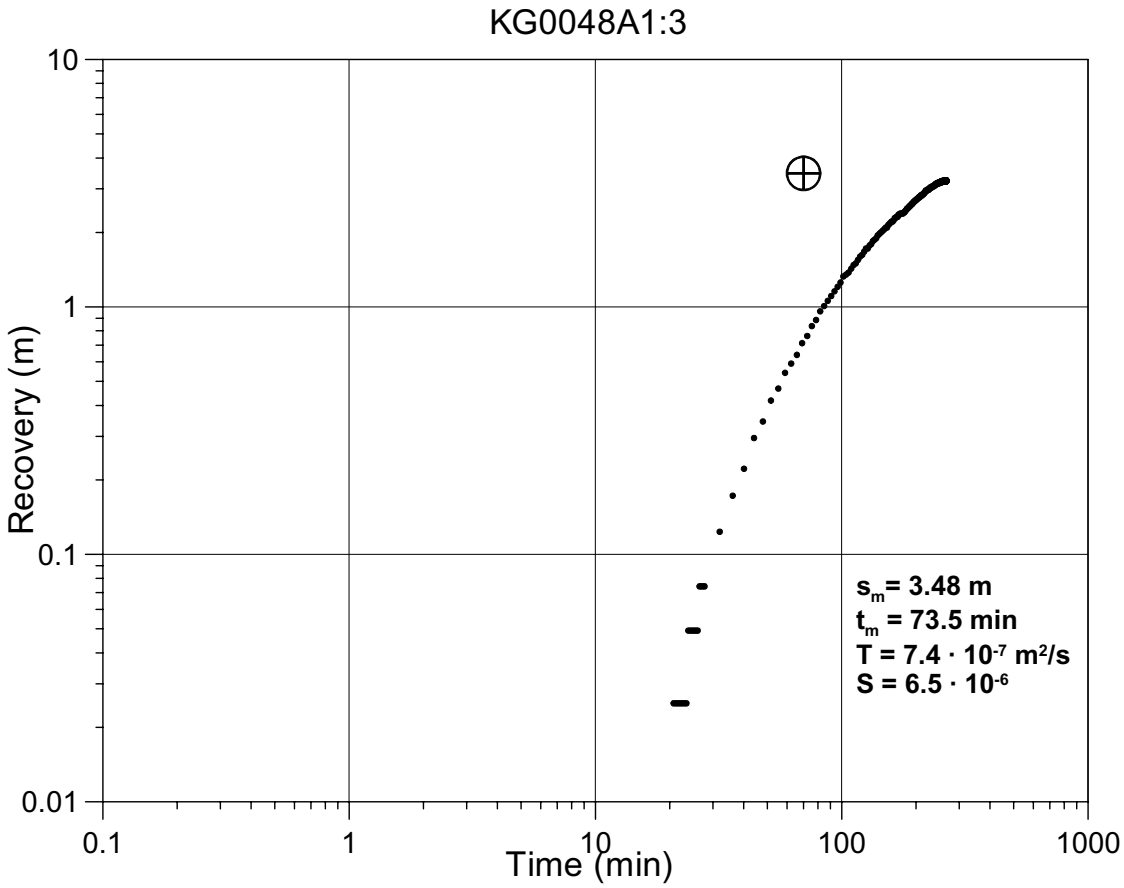


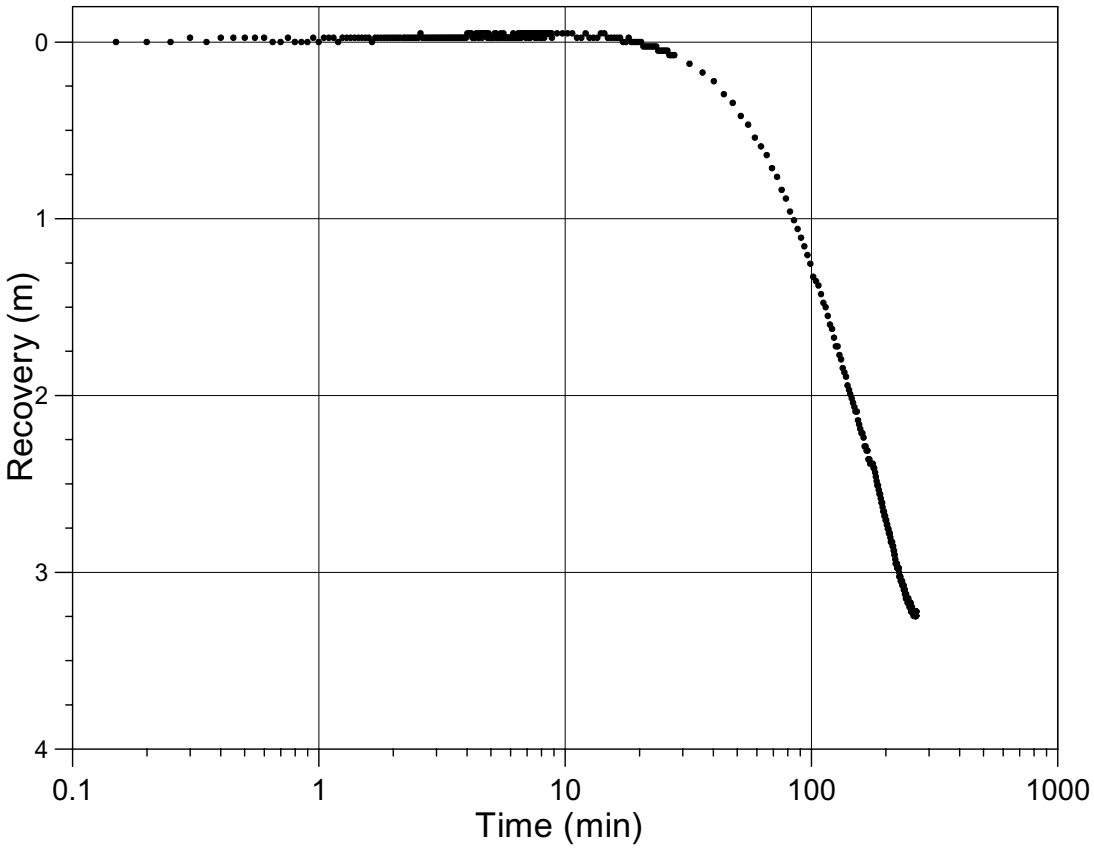
21_KG0048A1_1.GRF 2003-10-21



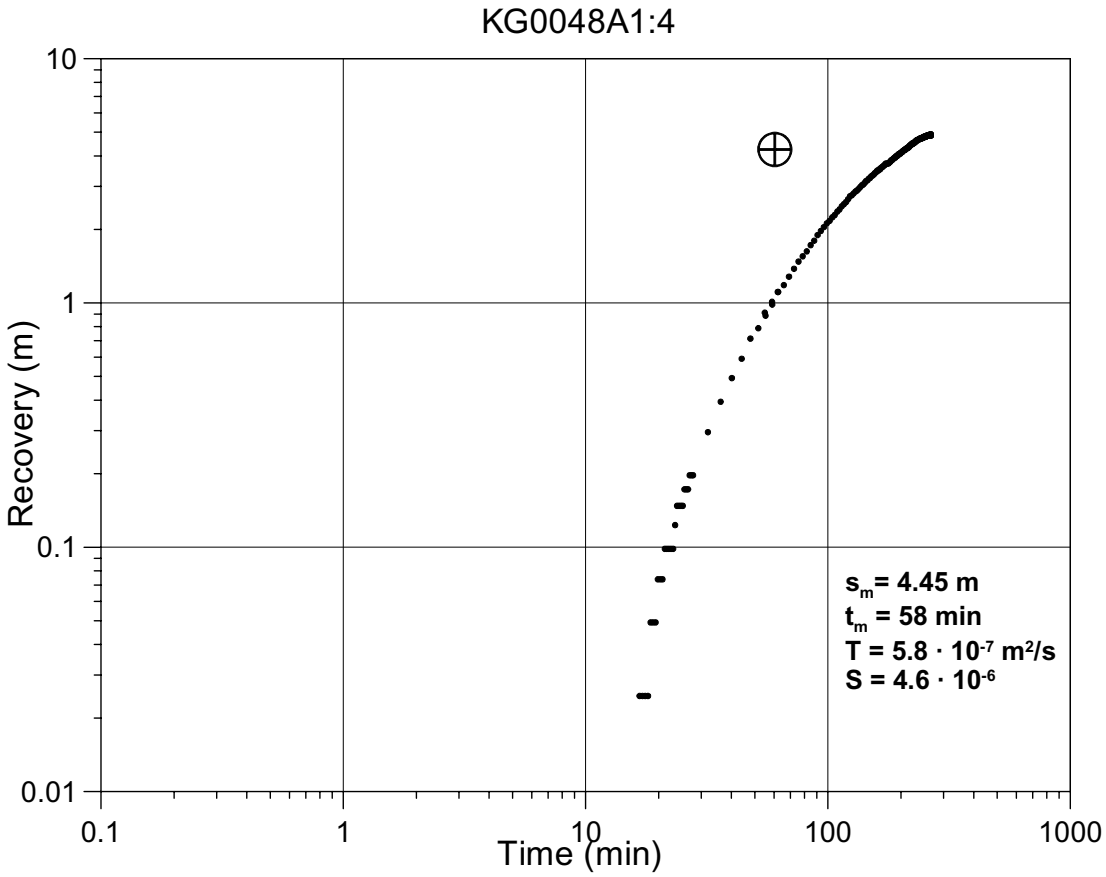


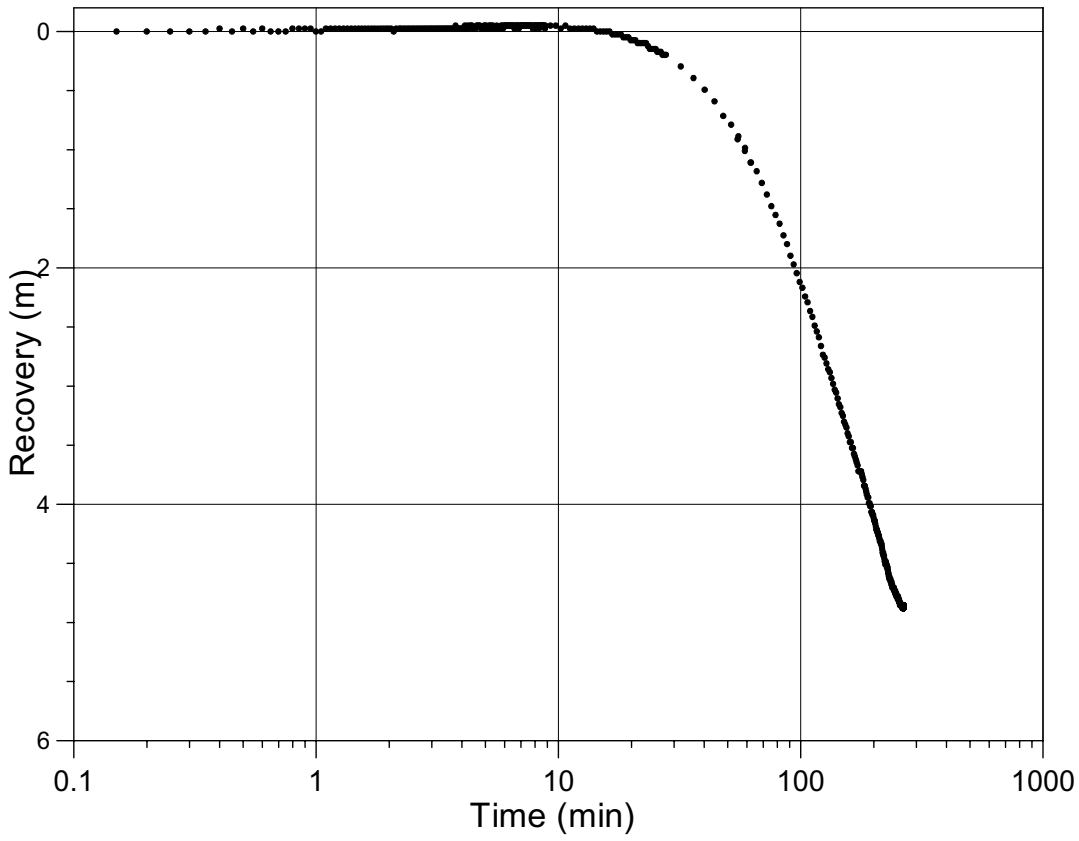
21_KG0048A1_2.GRF 2003-10-21





21_KG0048A1_3.GRF 2003-10-21





21_KG0048A1_4.GRF 2003-10-21

Appendix 2

Interference test 1:22 in borehole KA3542G02, section 2.00 m – 8.00 m

Date: 2003-05-10 Field Crew: A. Blom / J. Magnusson
Borehole length: 30.01 m Borehole diameter: 76 mm

Flowing borehole: KA3542G02, section 5: 2.00 – 8.00 m

Valve opened: 20030510 08:55.00 Valve closed: 20030510 14:55.00

End of Test: 20030511 08:30

Total flowing time : 360 min Tot. Pr. Build-up time: 1080 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

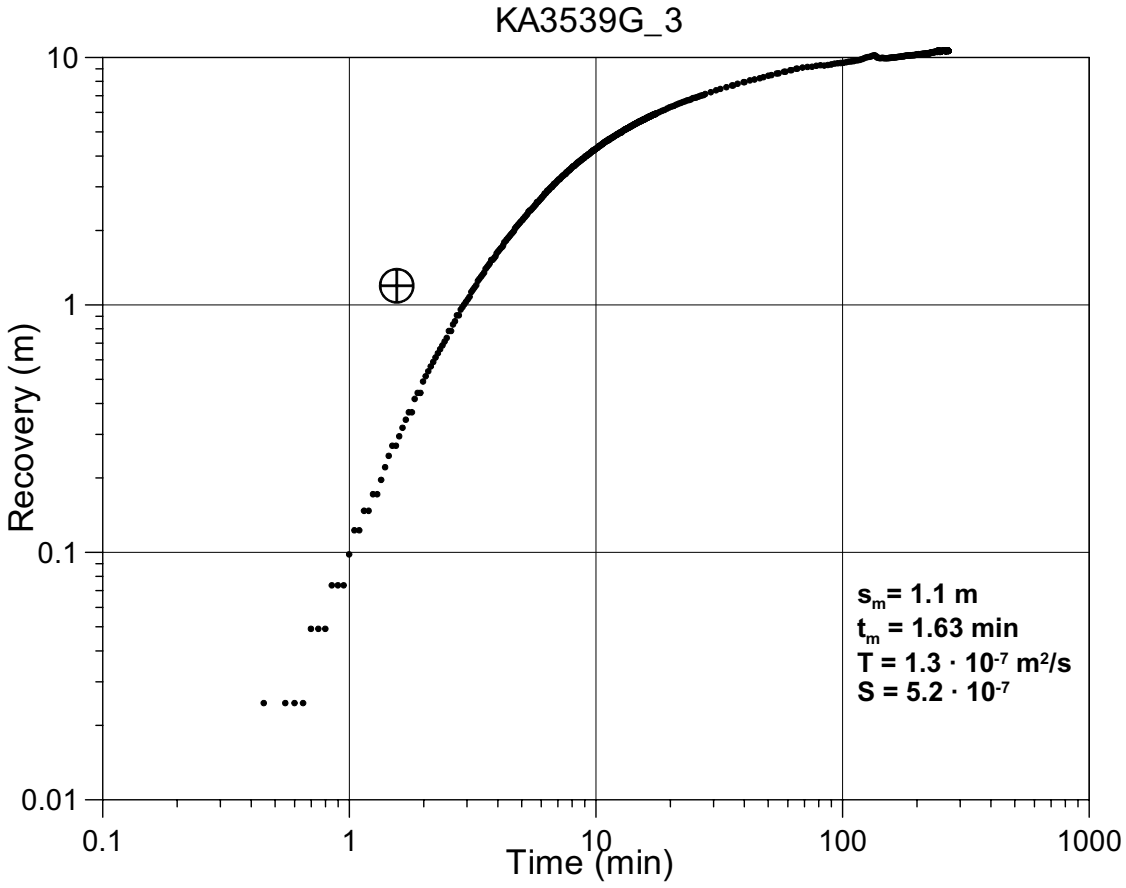
Manually measured flow rates of KA3542G02, section 2.00 m – 8.00 m are presented in the table below:

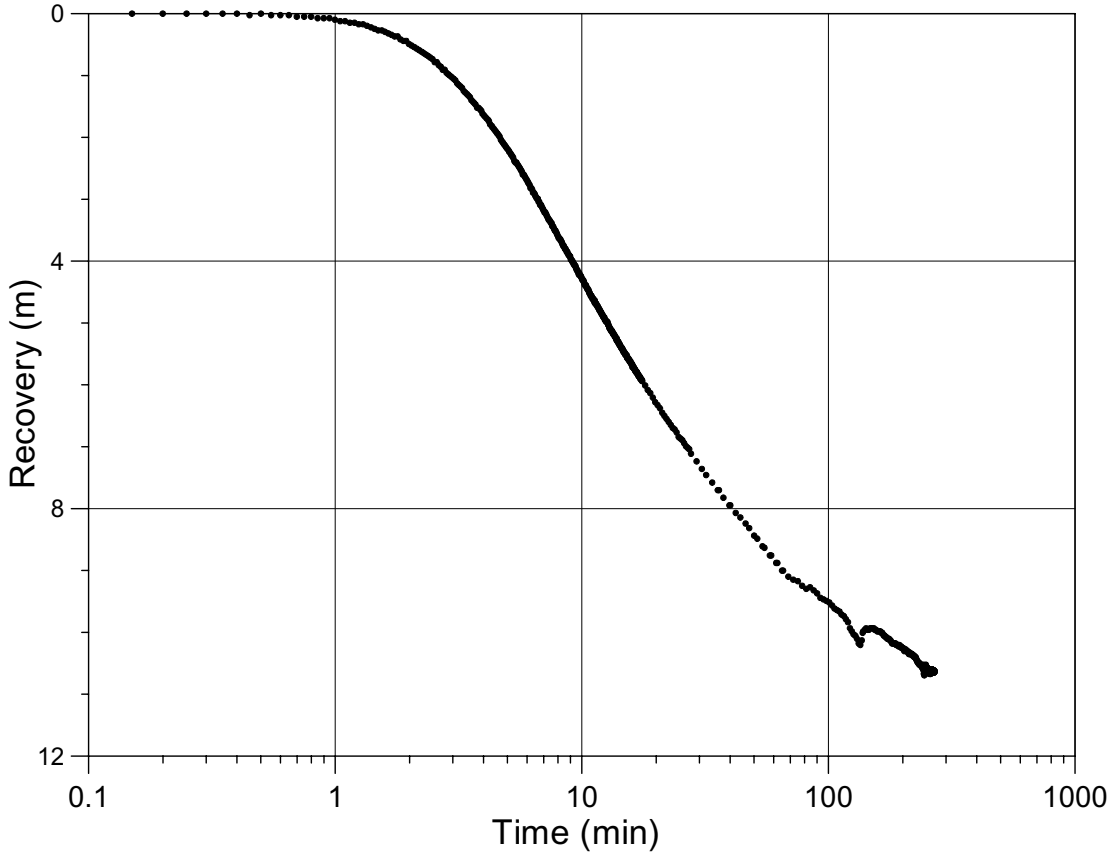
Table Manually measured flow rates, Interference test in KA3542G02, section 2.00 m – 8.00 m. Prototype Repository, May 10 2003

Time	Flow rate (l/min)
08:55:15	0.185
08:57:30	0.133
09:02:30	0.120
09:26:00	0.113
09:29:00	0.110
09:31:00	0.112
14:39:00	0.108
14:44:00	0.108
14:49:00	0.110

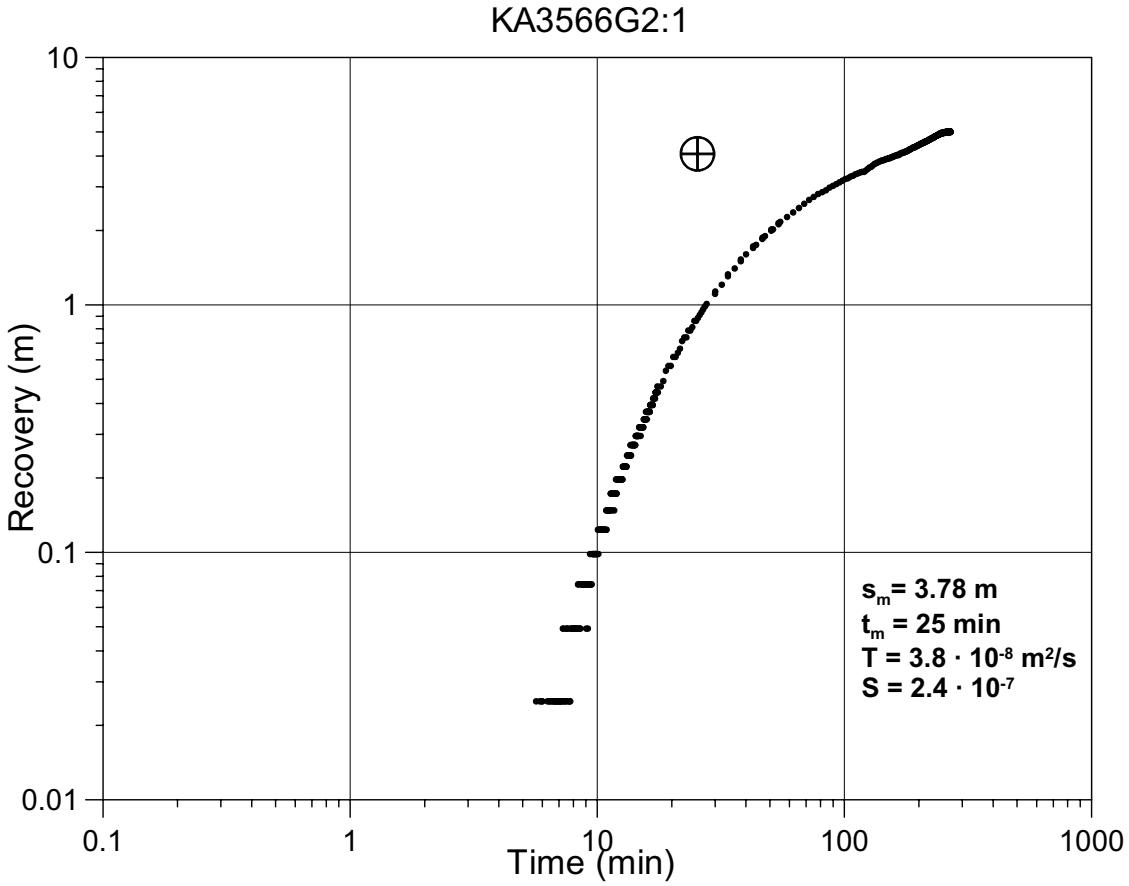
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

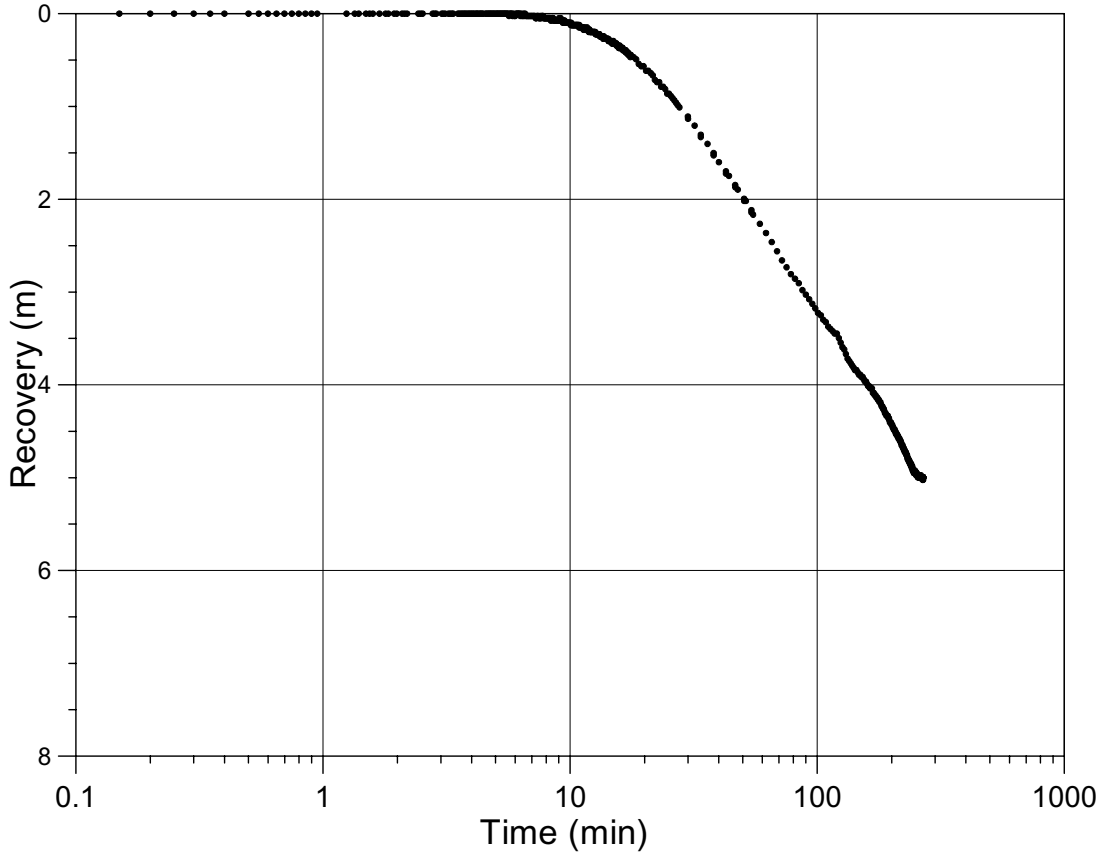
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



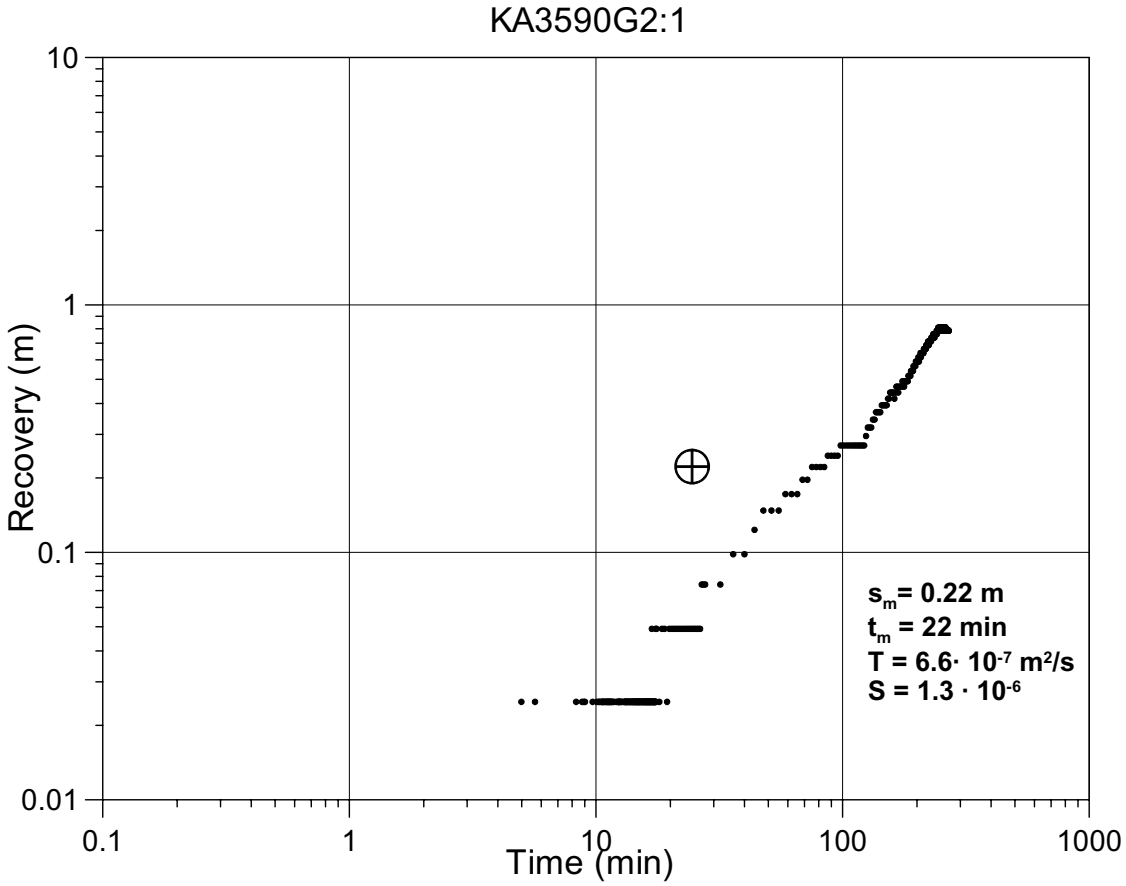


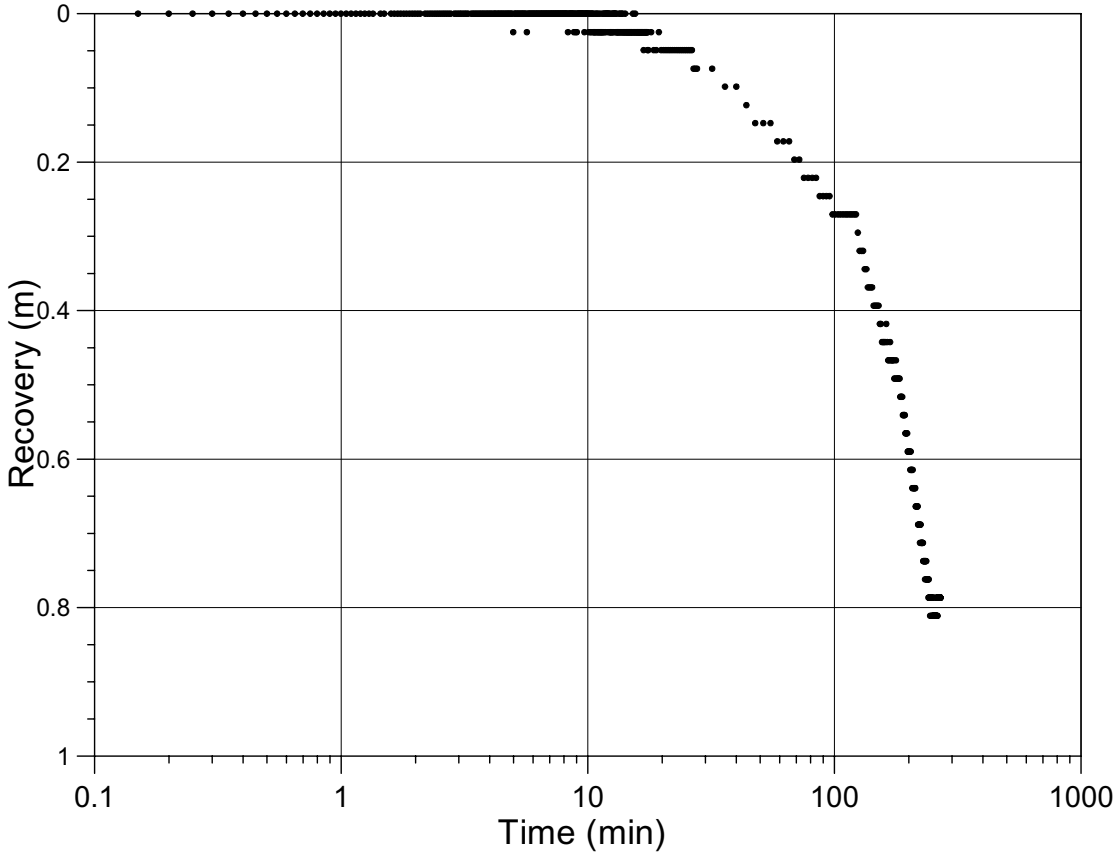
22_KA3539G_3.GRF 2003-10-21





22_KA3566G2_1.GRF 2003-10-22





22_KA3590G2_1.GRF 2003-10-22

Appendix 3

Interference test 1:23 in borehole KA3554G01, section 22.60 m – 24.15 m

Date: 2003-05-11 Field Crew: A. Blom / J. Magnusson
Borehole length: 30.01 m Borehole diameter: 76 mm

Flowing borehole: KA3554G01, section 2: 22.60 – 24.15 m

Valve opened: 20030511 10:35.00 Valve closed: 20030511 16:35.00

End of Test: 20030512 09:41

Total flowing time : 360 min Tot. Pr. Build-up time: 1026 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

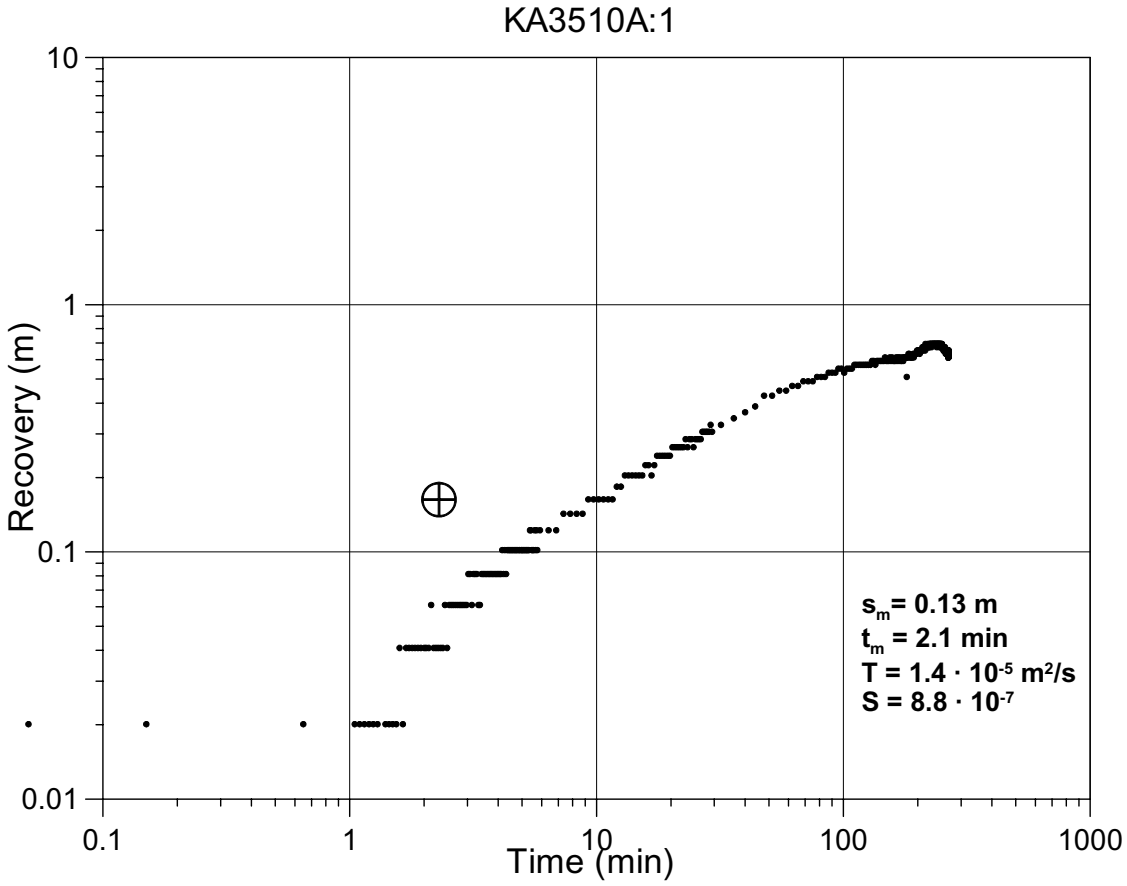
Manually measured flow rates of KA3554G01, section 22.60 m – 24.15 m are presented in the table below:

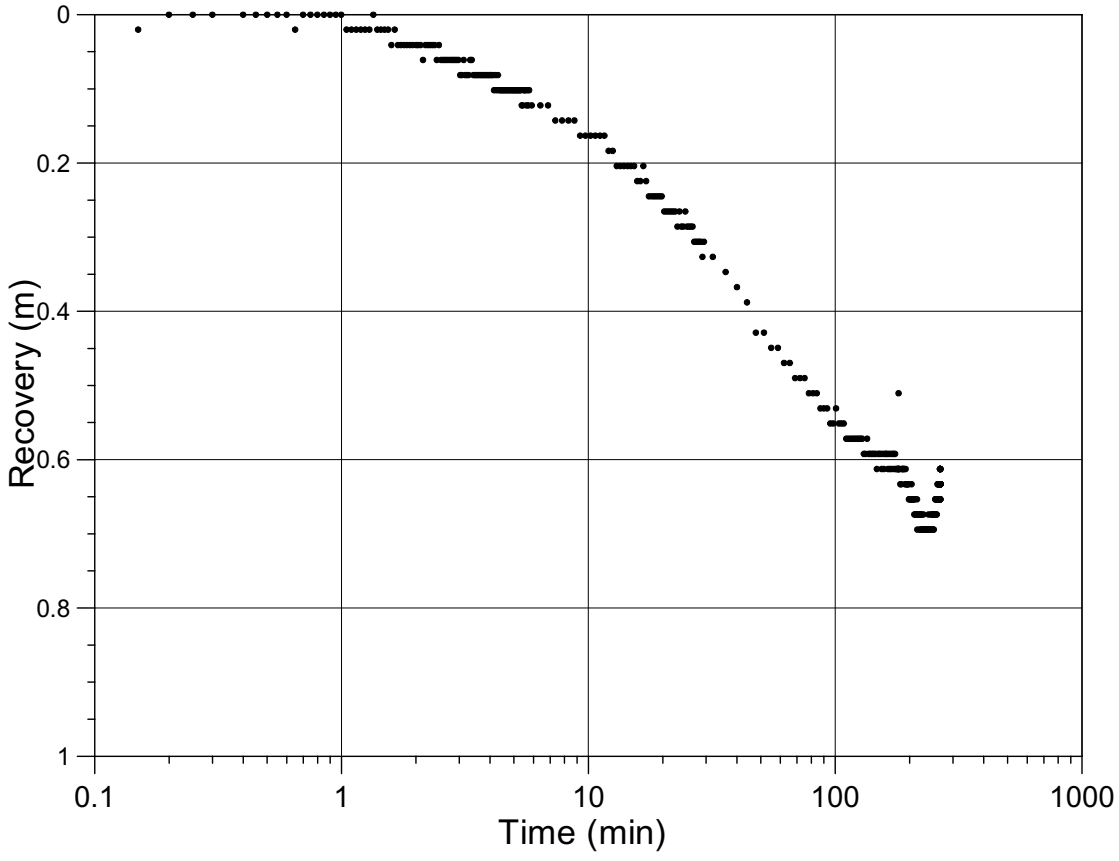
Table Manually measured flow rates, Interference test in KA3554G01, section 22.60 m – 24.15 m. Prototype Repository, May 11 2003

Time	Flow rate (l/min)
10:35:00	2.060
10:35:30	1.615
10:37:00	1.535
10:40:00	1.417
10:35:00	1.421
16:21:00	1.407
16:25:00	1.400
16:27:00	1.402

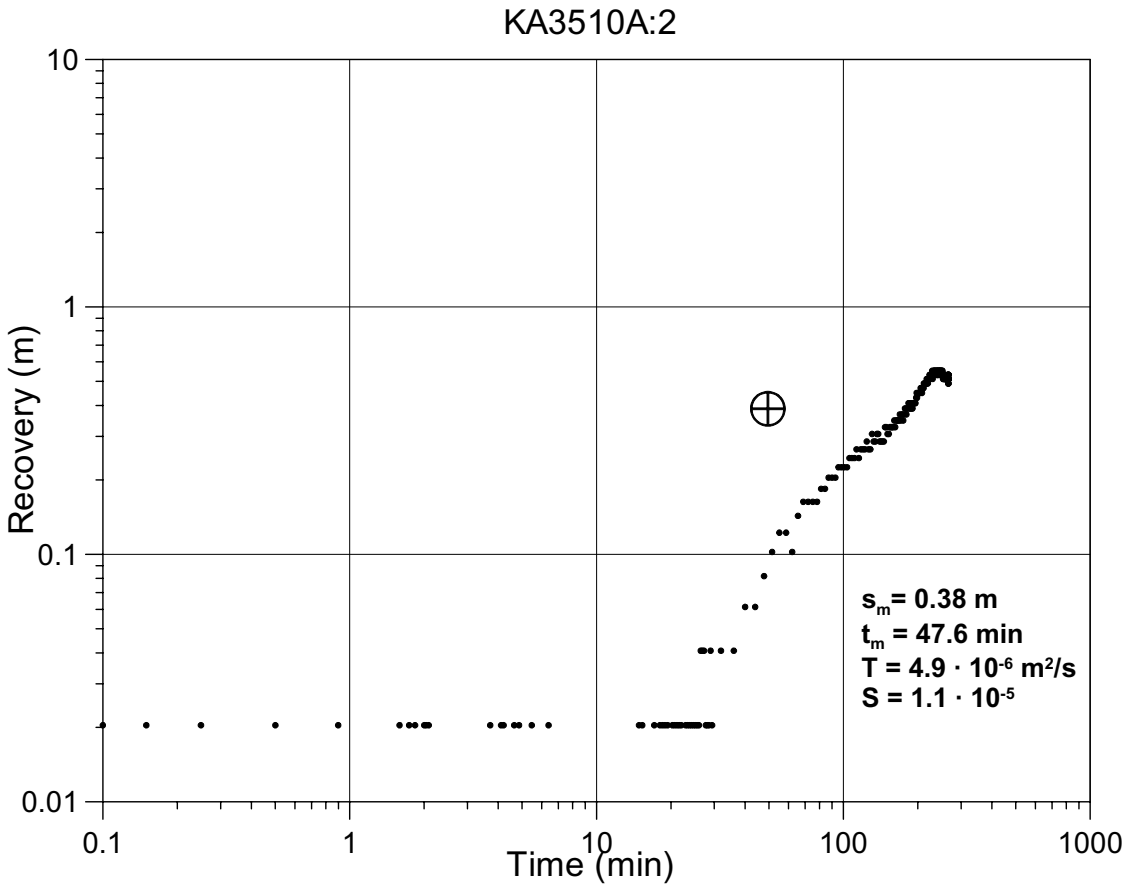
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

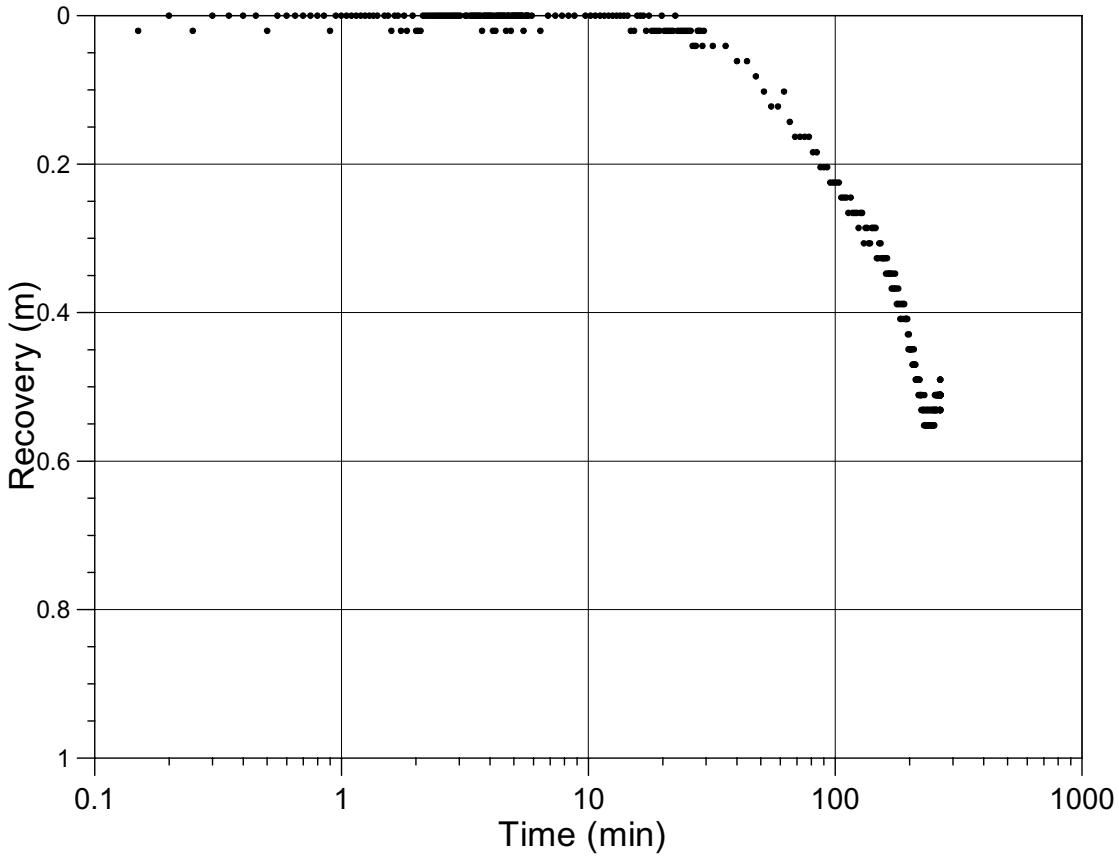
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



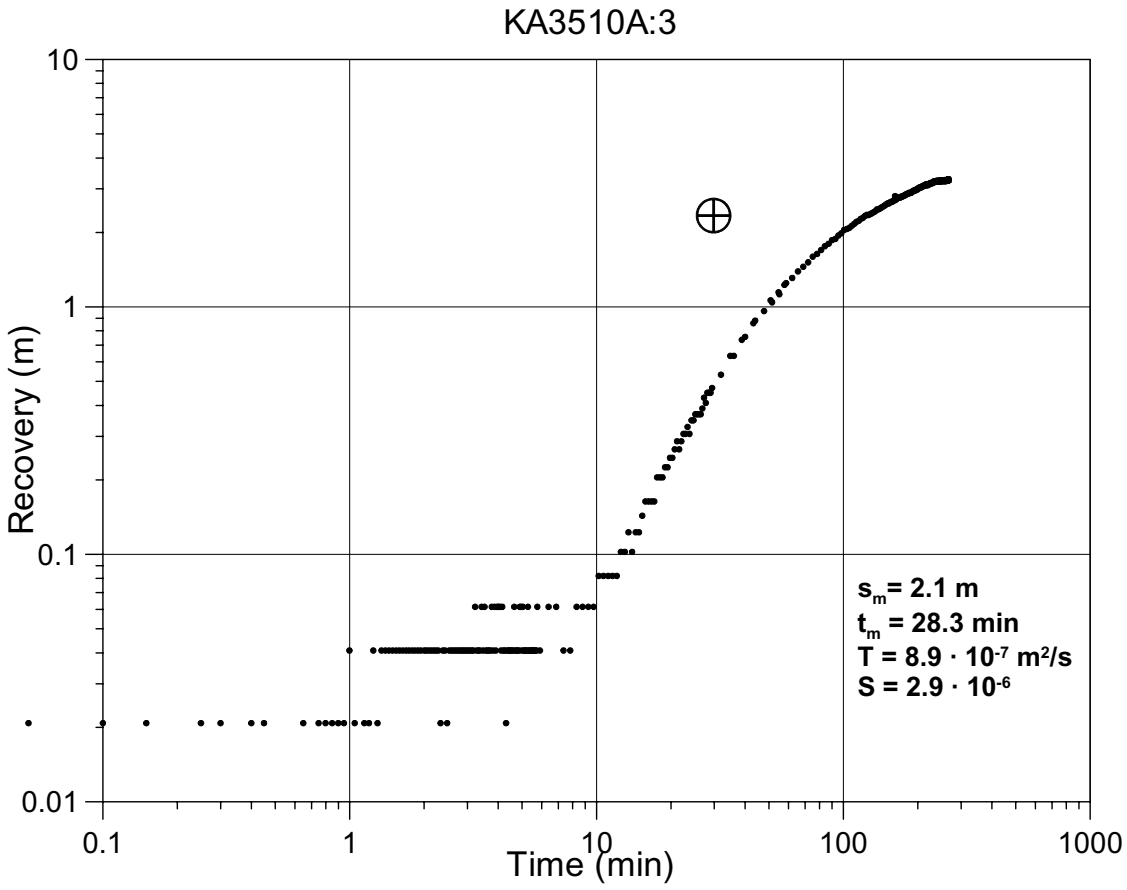


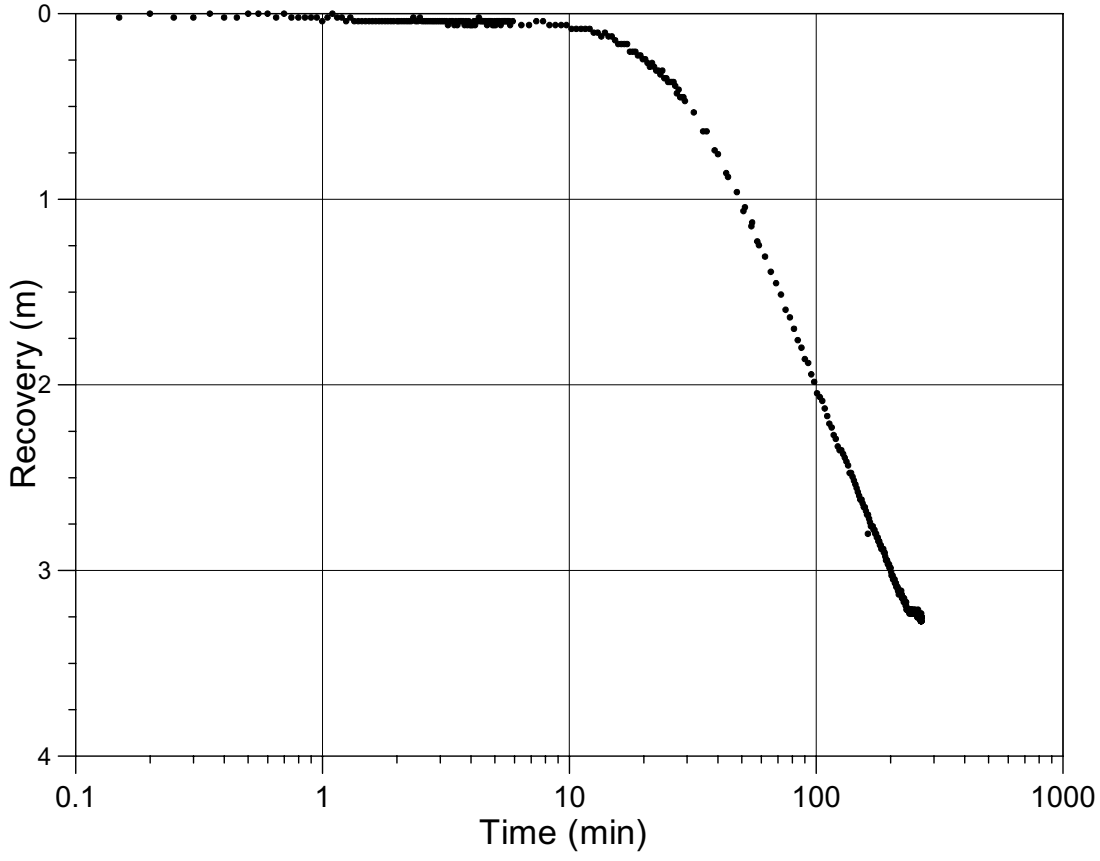
23_KA3510A_1.GRF 2003-10-22



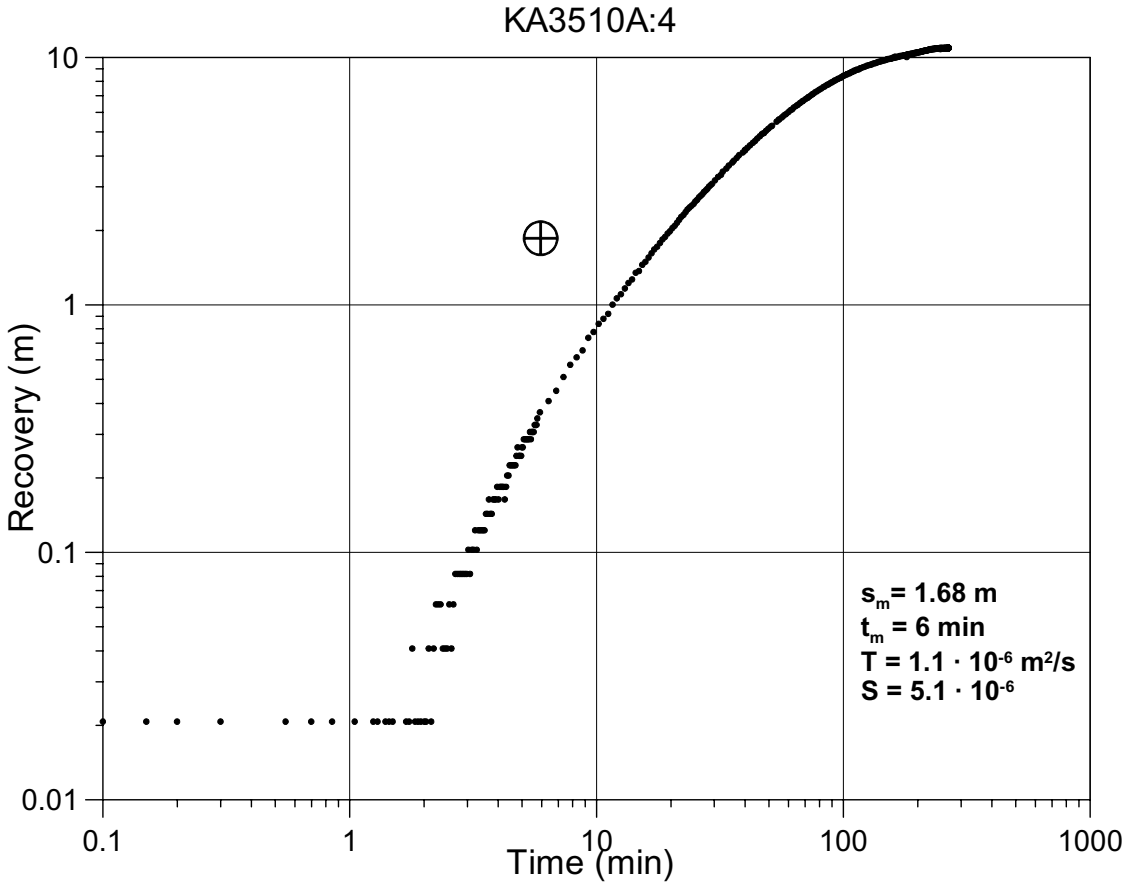


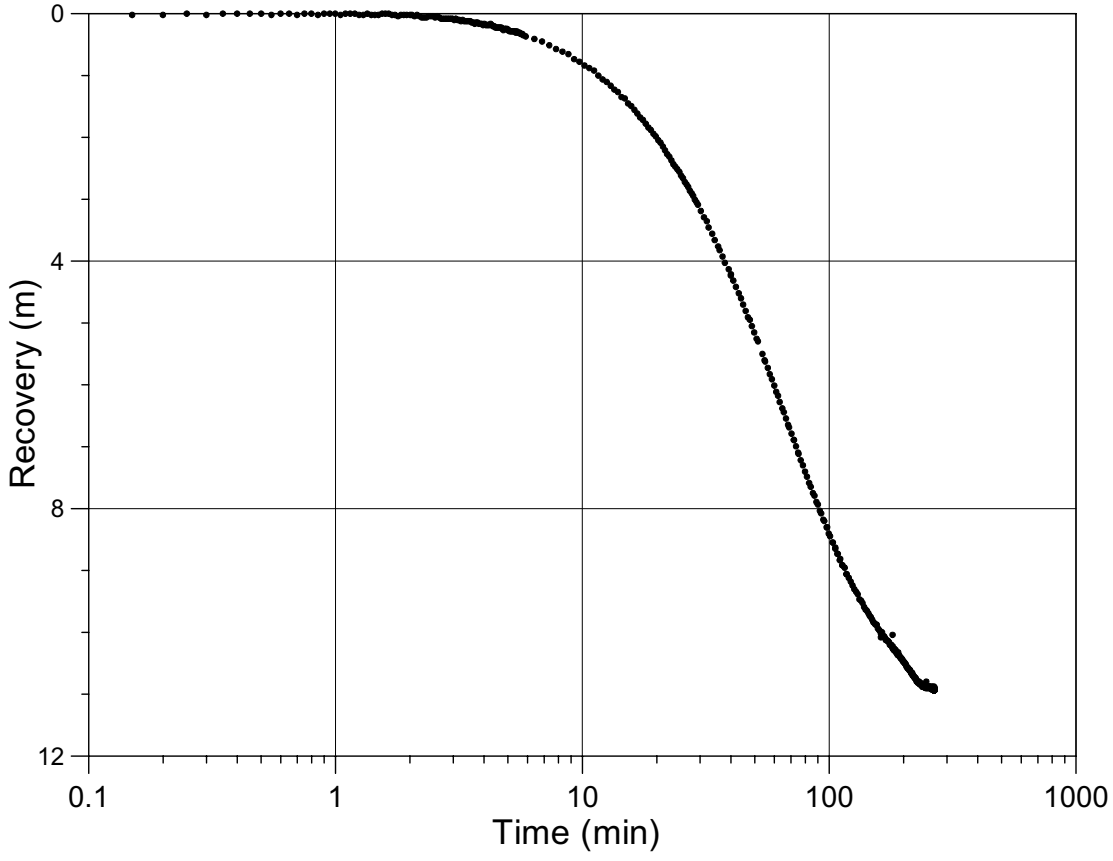
23_KA3510A_2.GRF 2003-10-22



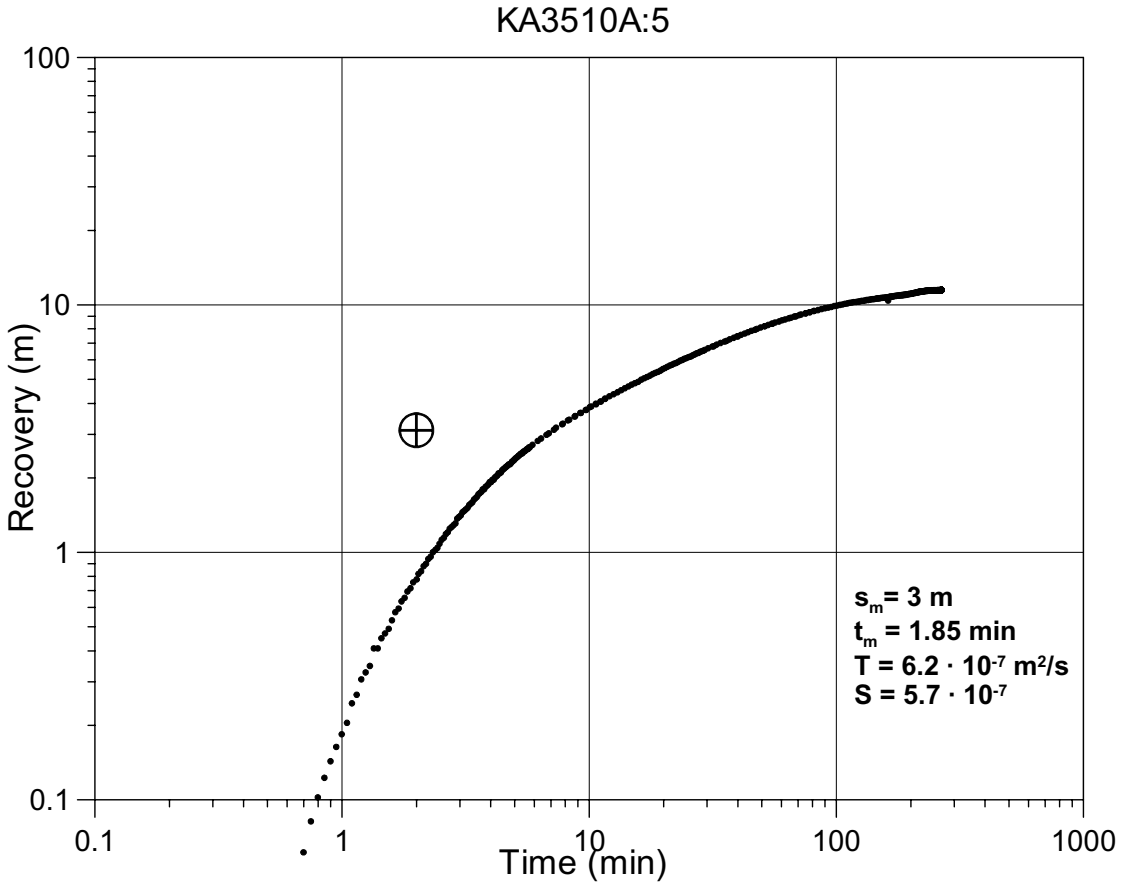


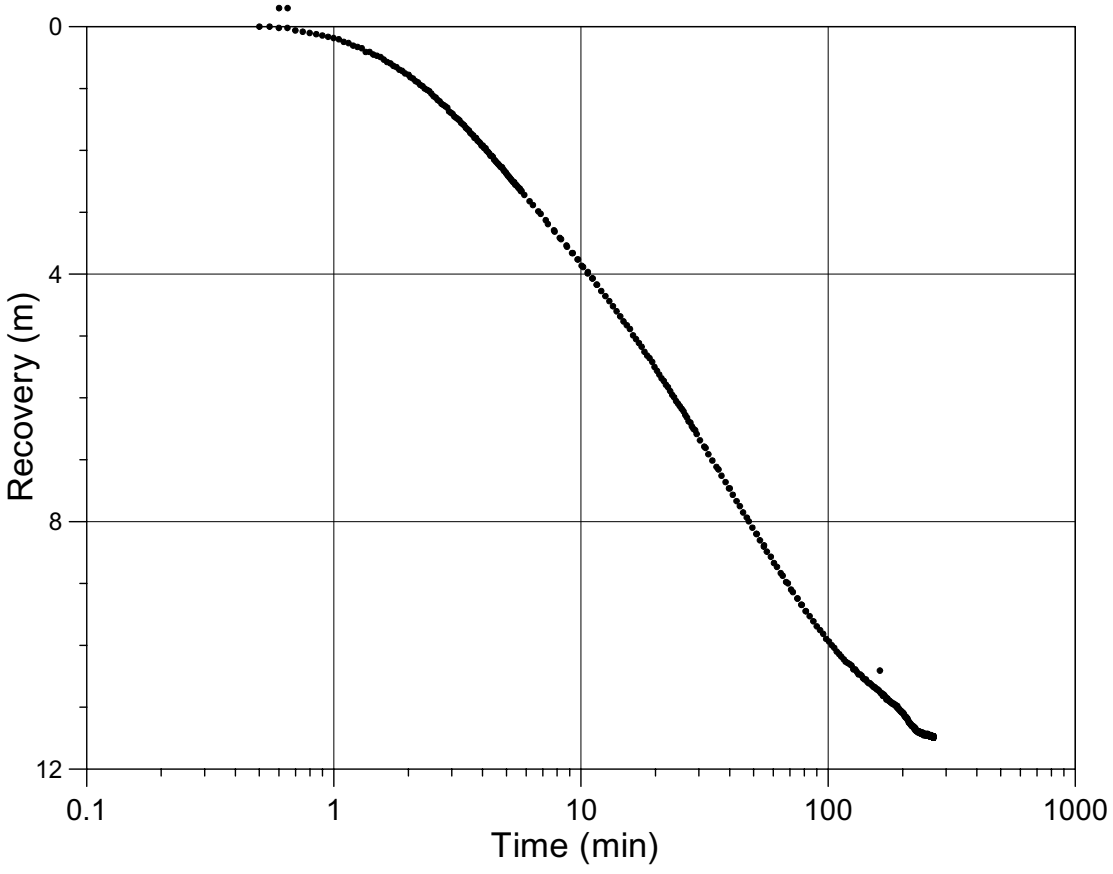
23_KA3510A_3.GRF 2003-10-22



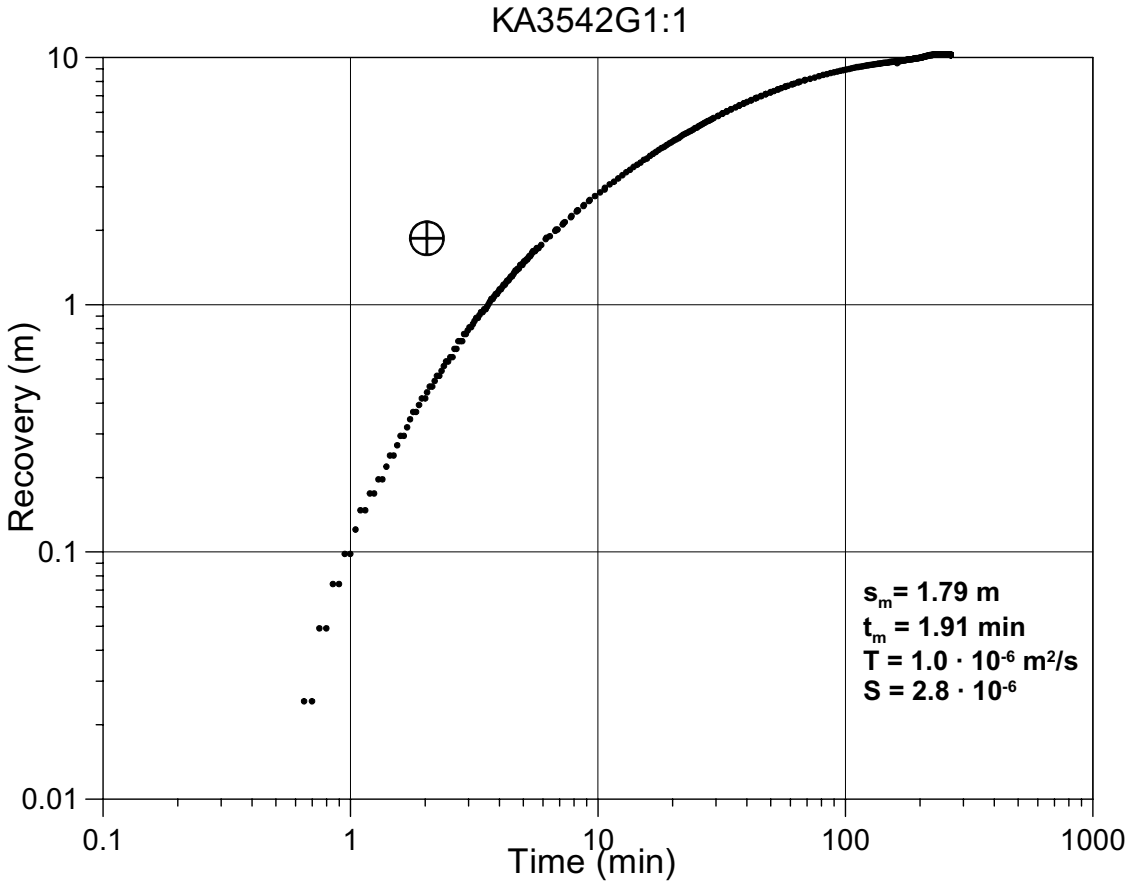


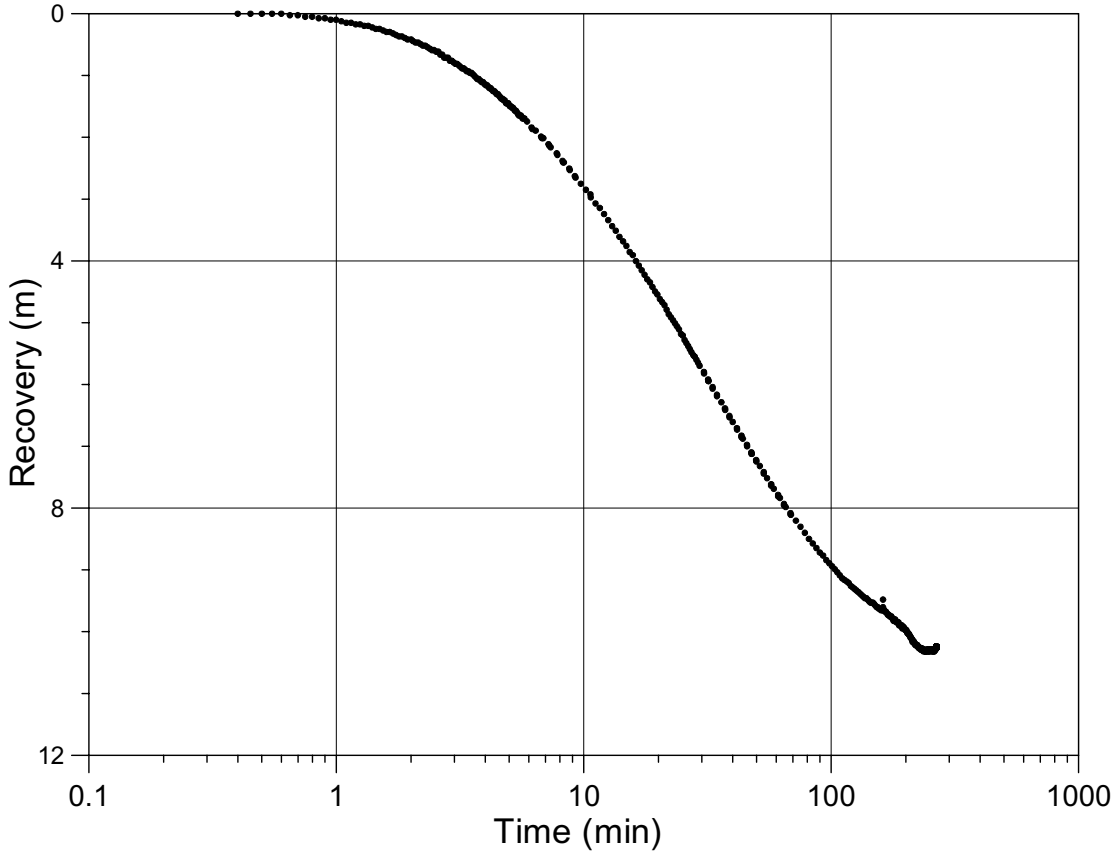
23_KA3510A_4.GRF 2003-10-22



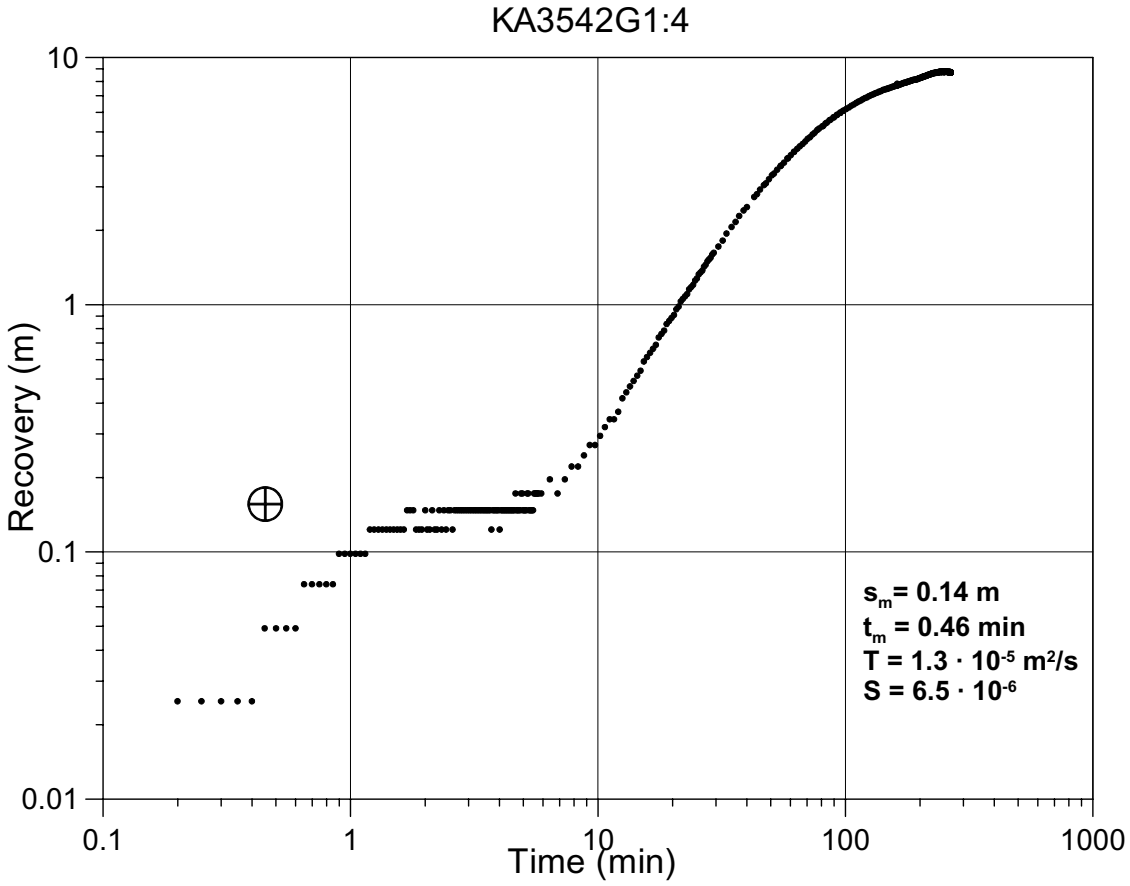


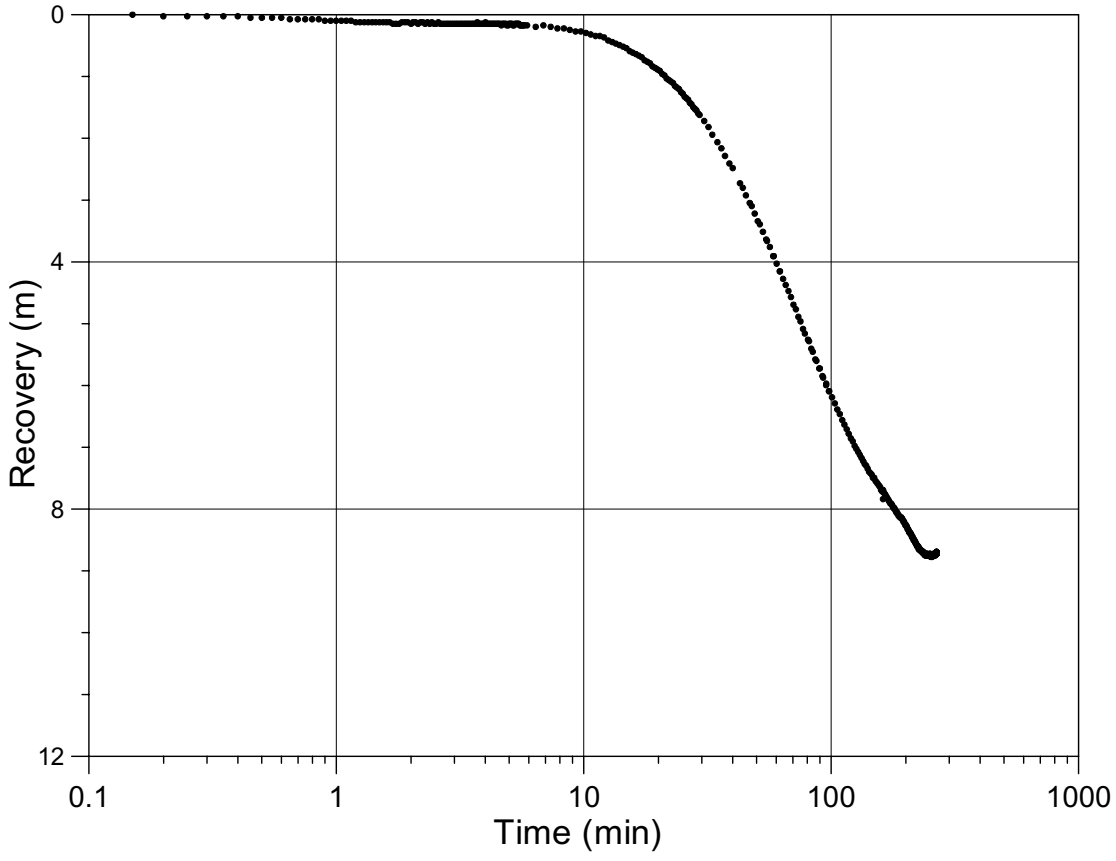
23_KA3510A_5.GRF 2003-10-22



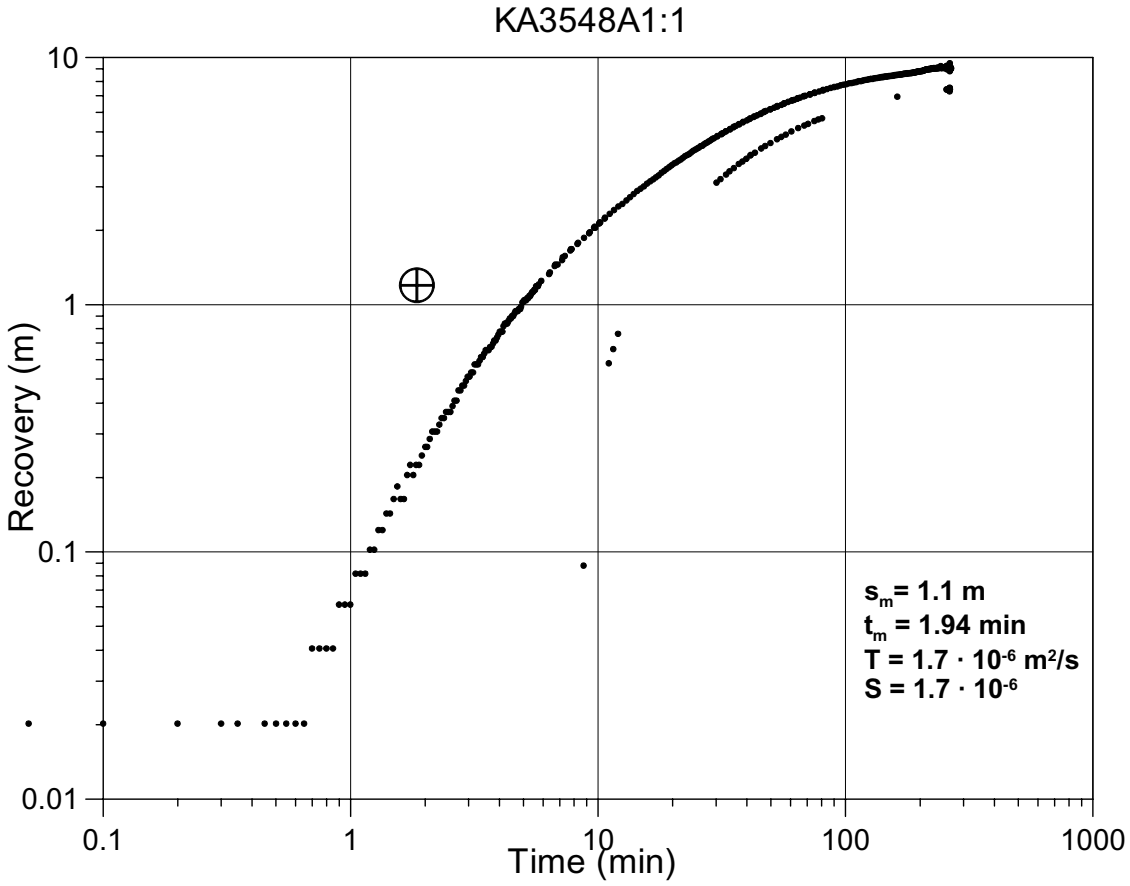


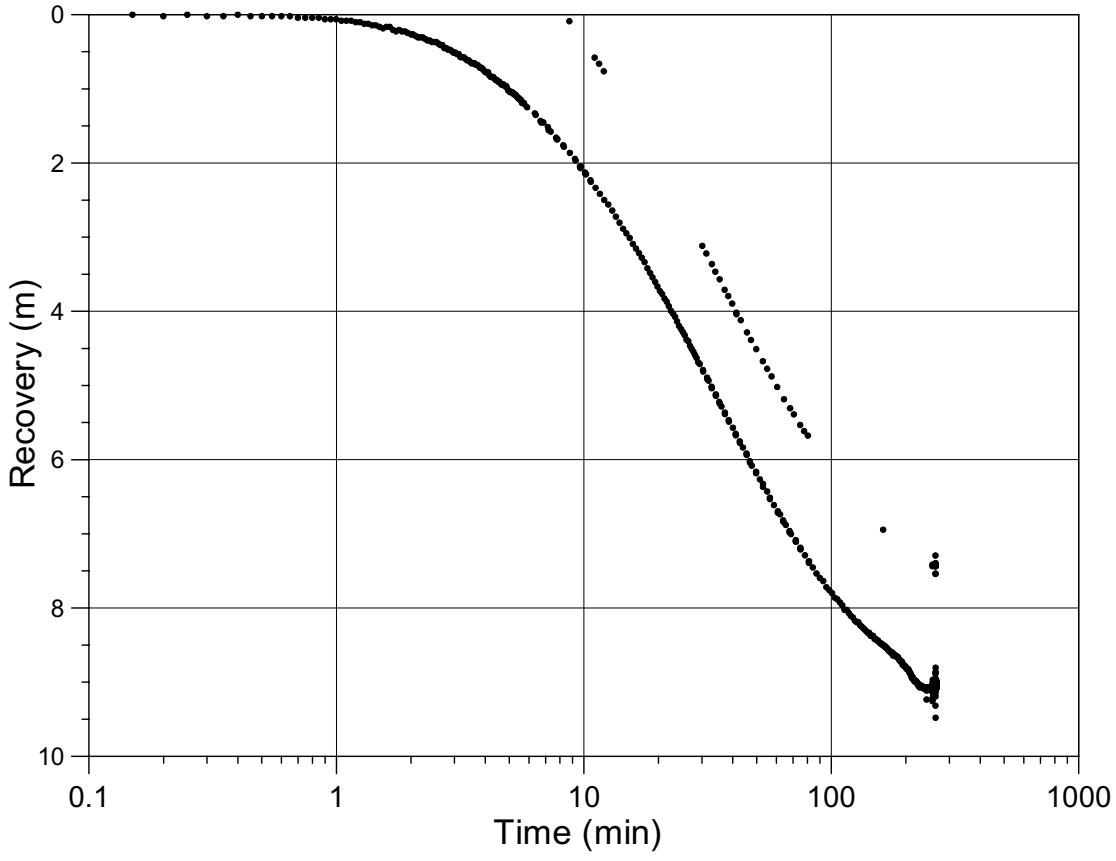
23_KA3542G1_1.GRF 2003-10-22



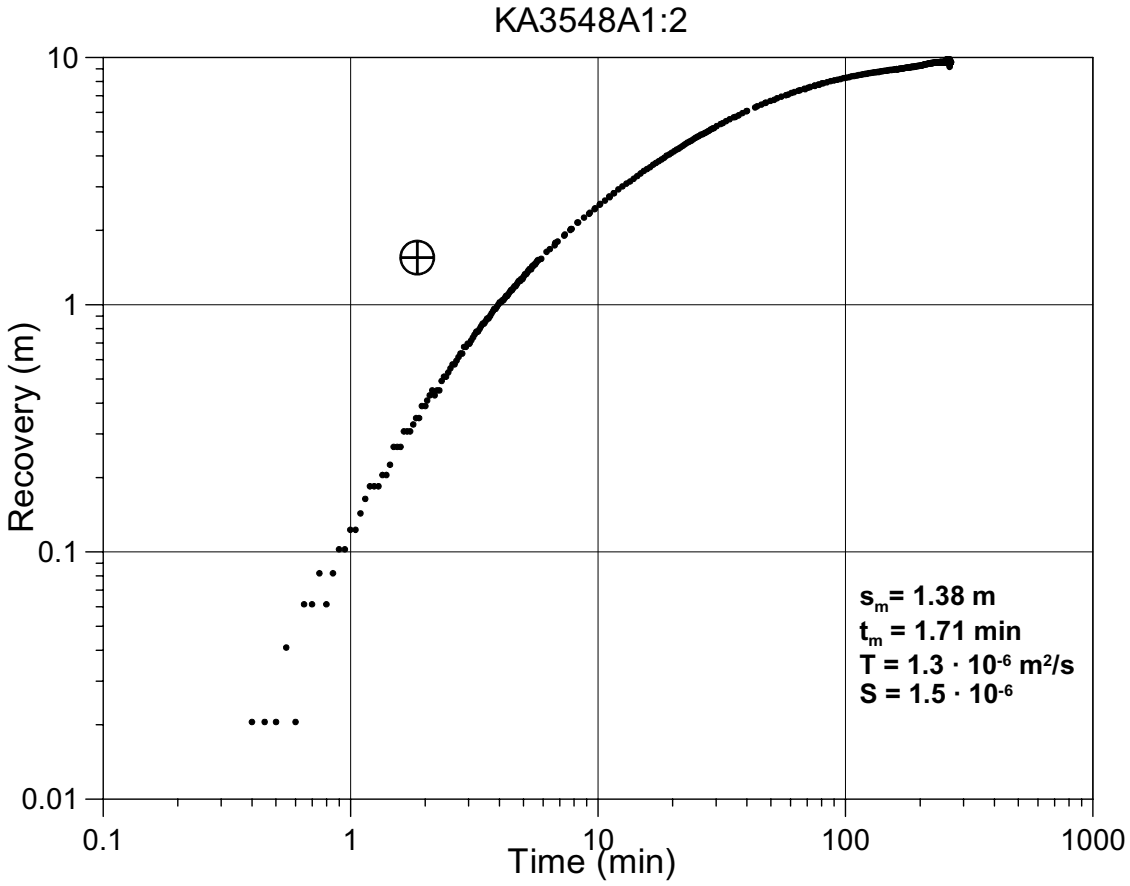


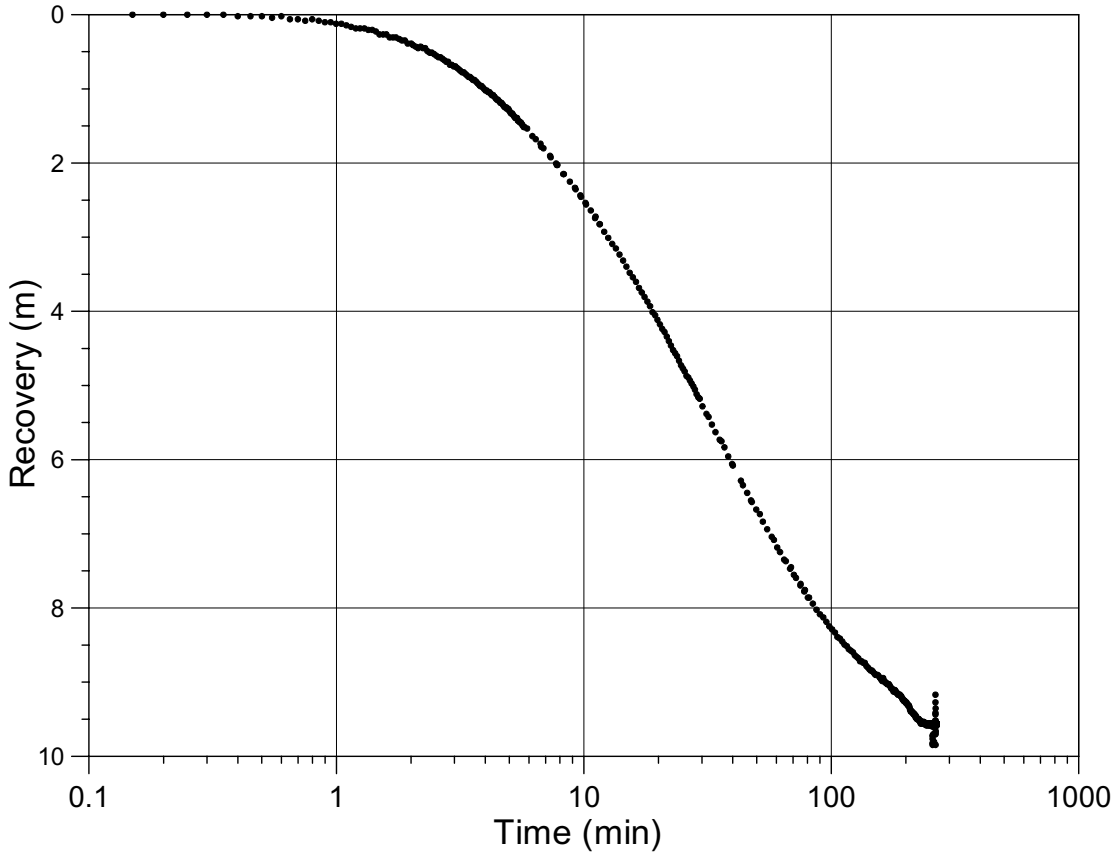
23_KA3542G1_4.GRF 2003-10-22



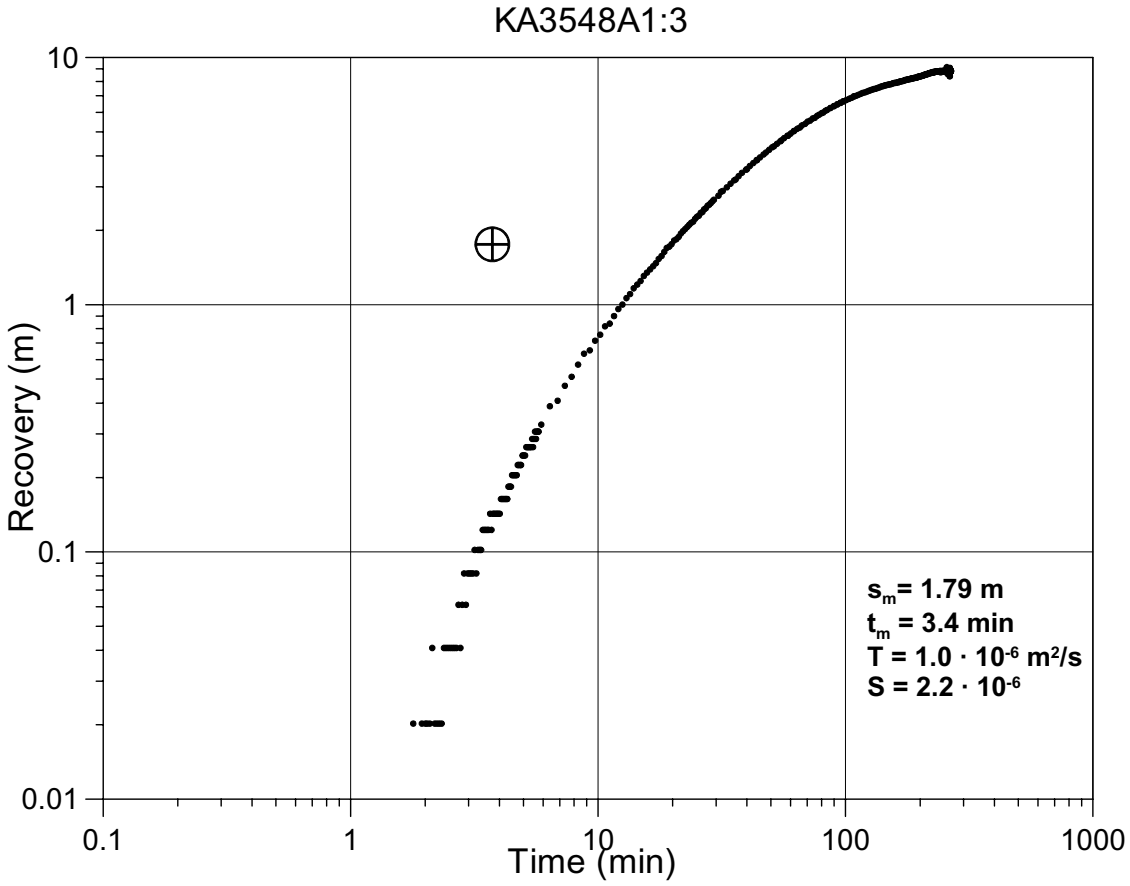


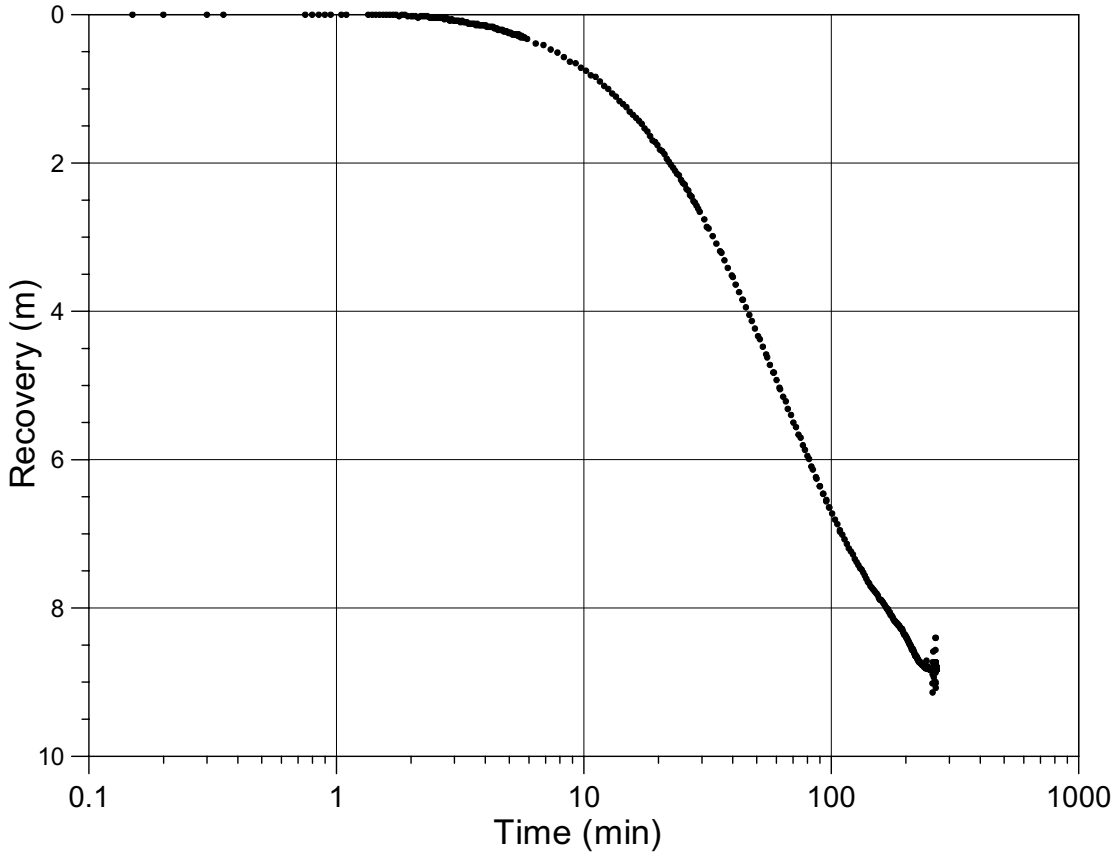
23_KA3548A1_1.GRF 2003-10-22



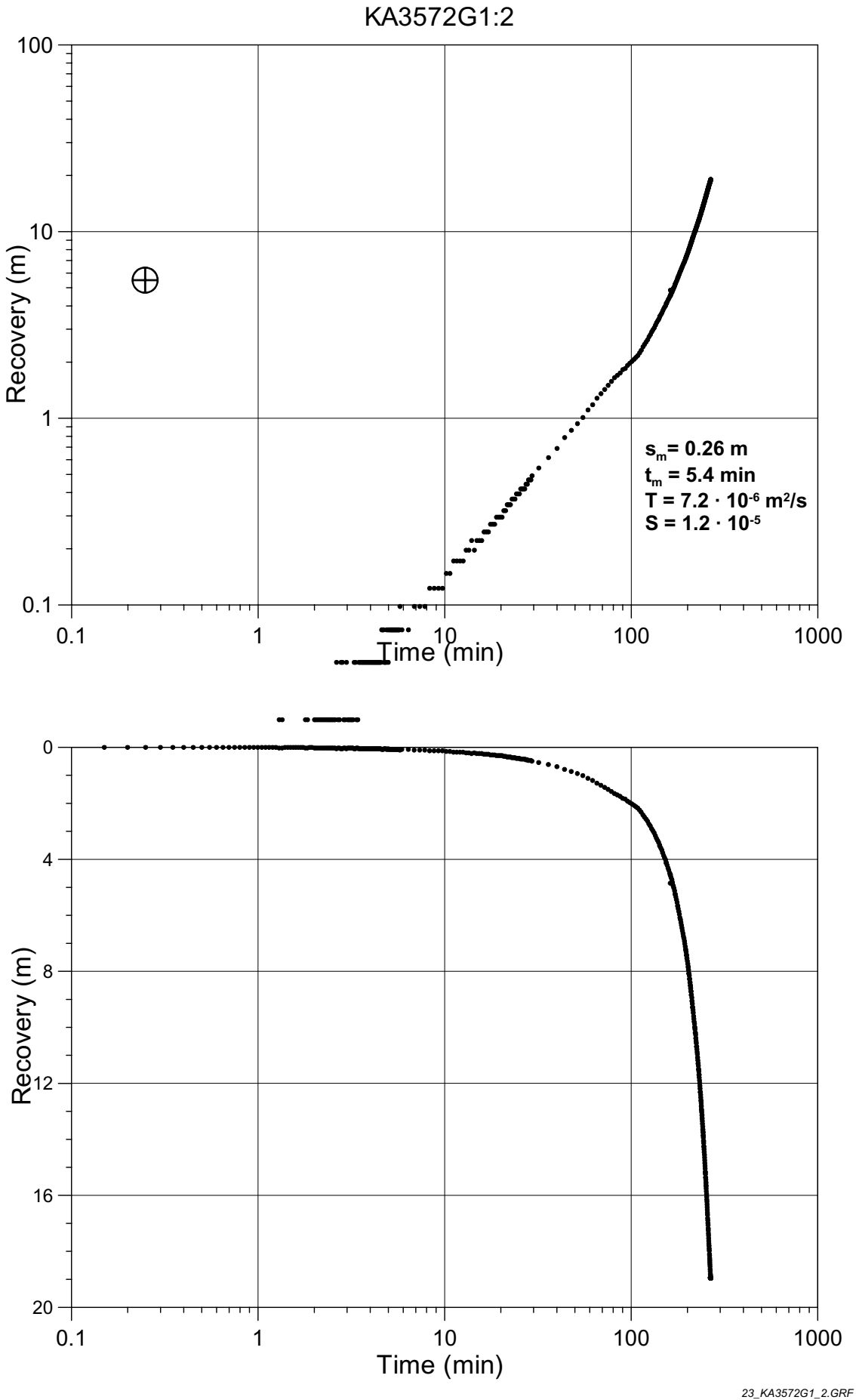


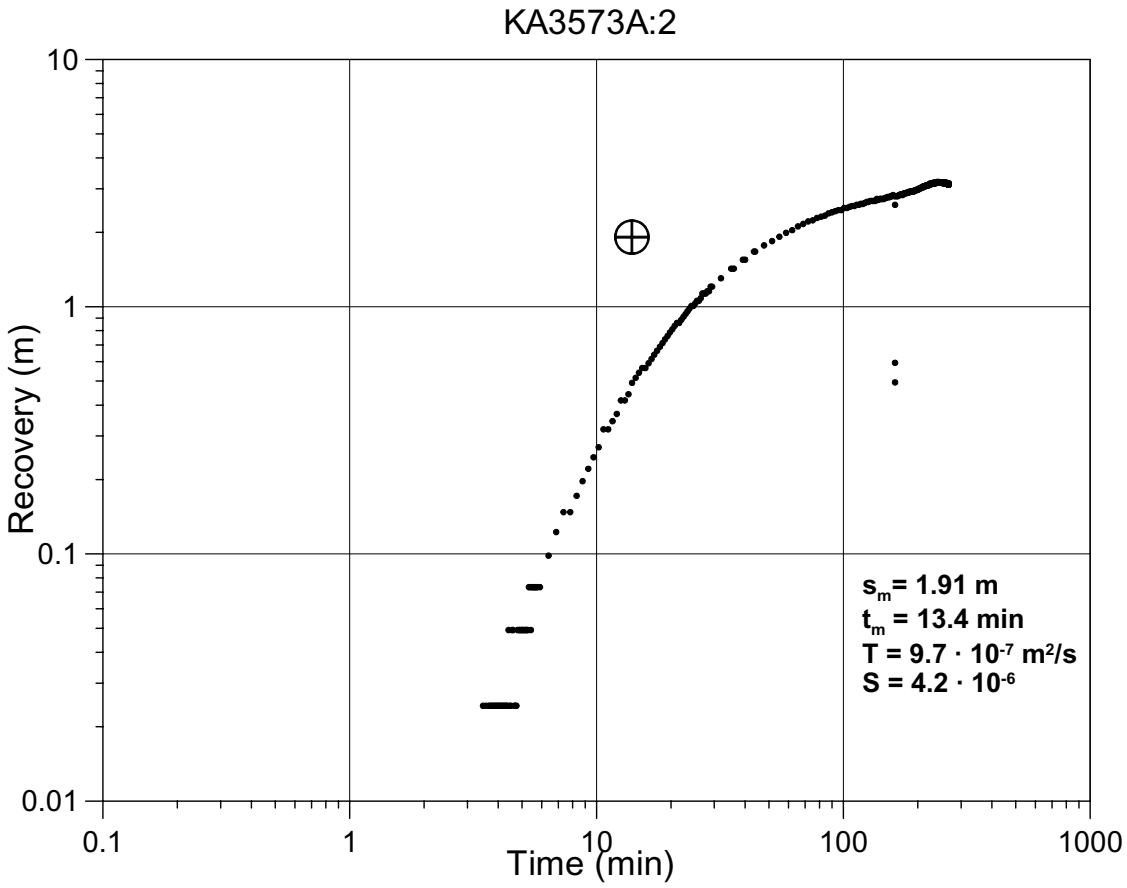
23_KA3548A1_2.GRF 2003-10-22

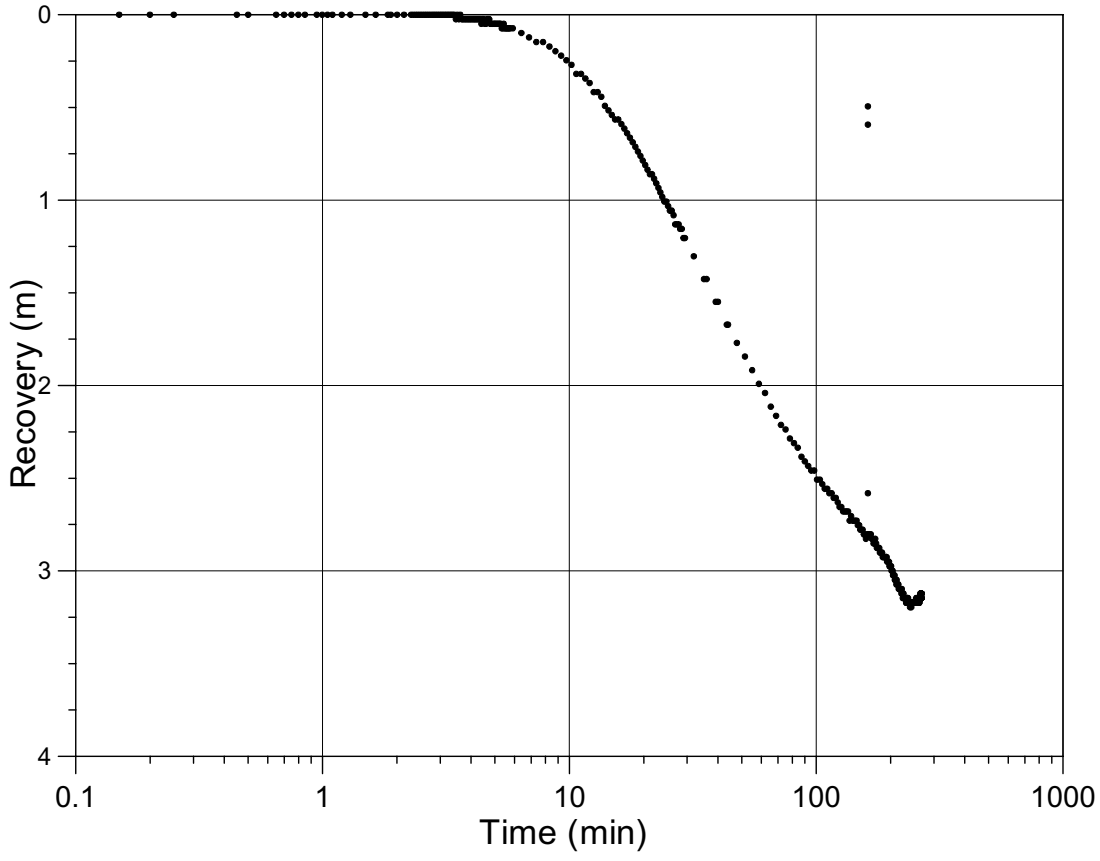




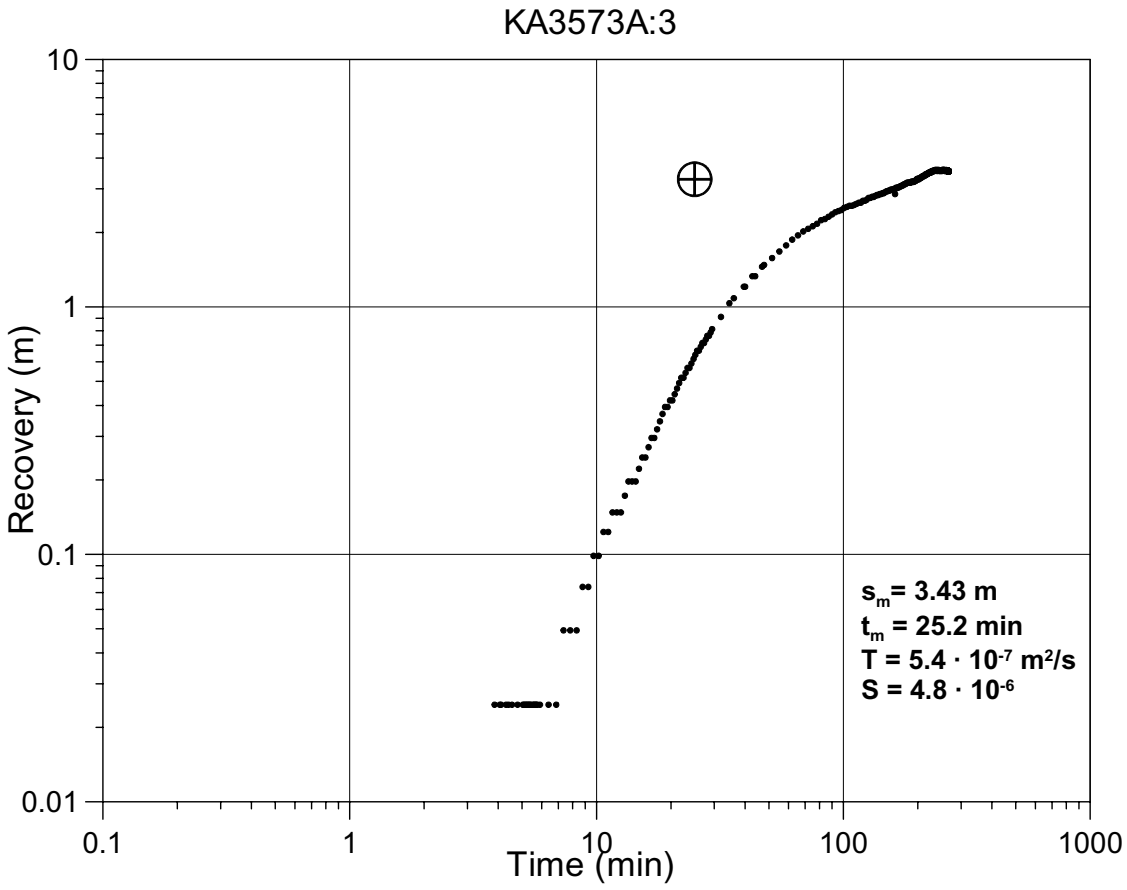
23_KA3548A1_3.GRF 2003-10-22

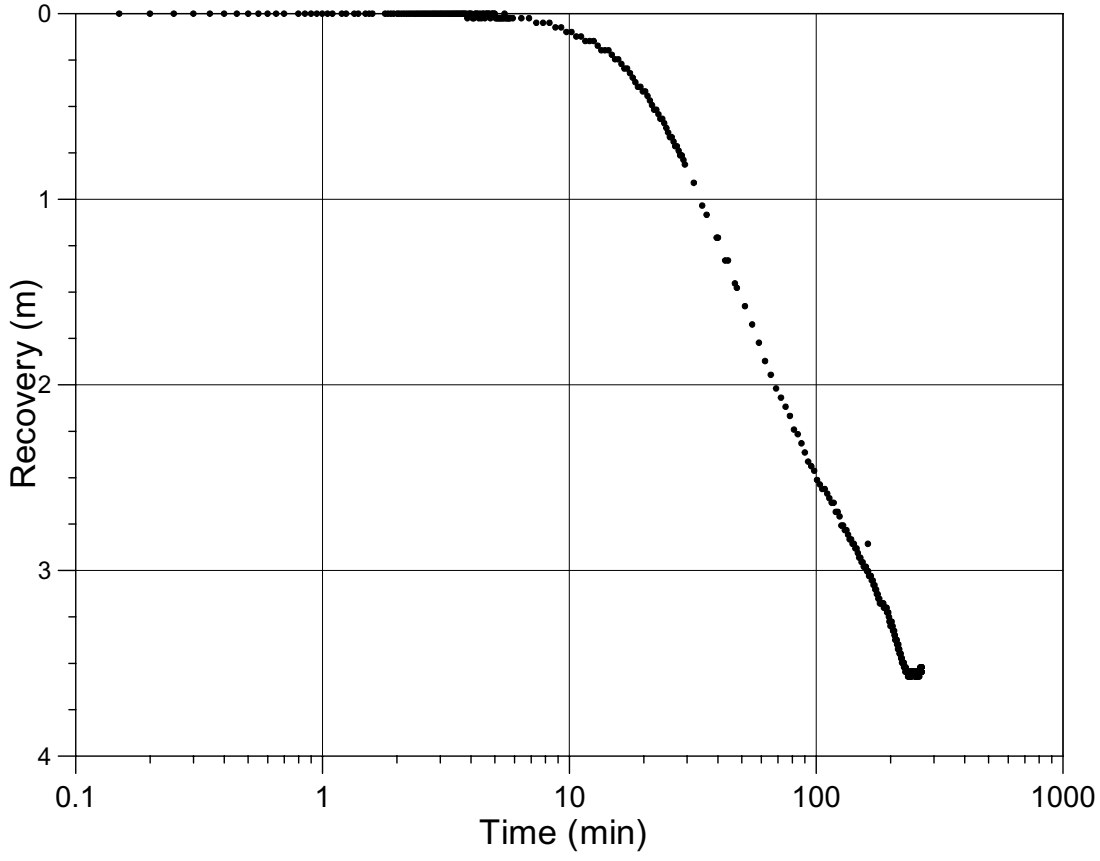

KA3572G1:2
Recovery (m)
Time (min)
s_m= 0.26 m
t_m = 5.4 min
T = 7.2 · 10^{-6} m^2/s
S = 1.2 · 10^{-5}
23_KA3572G1_2.GRF 2003-10-23



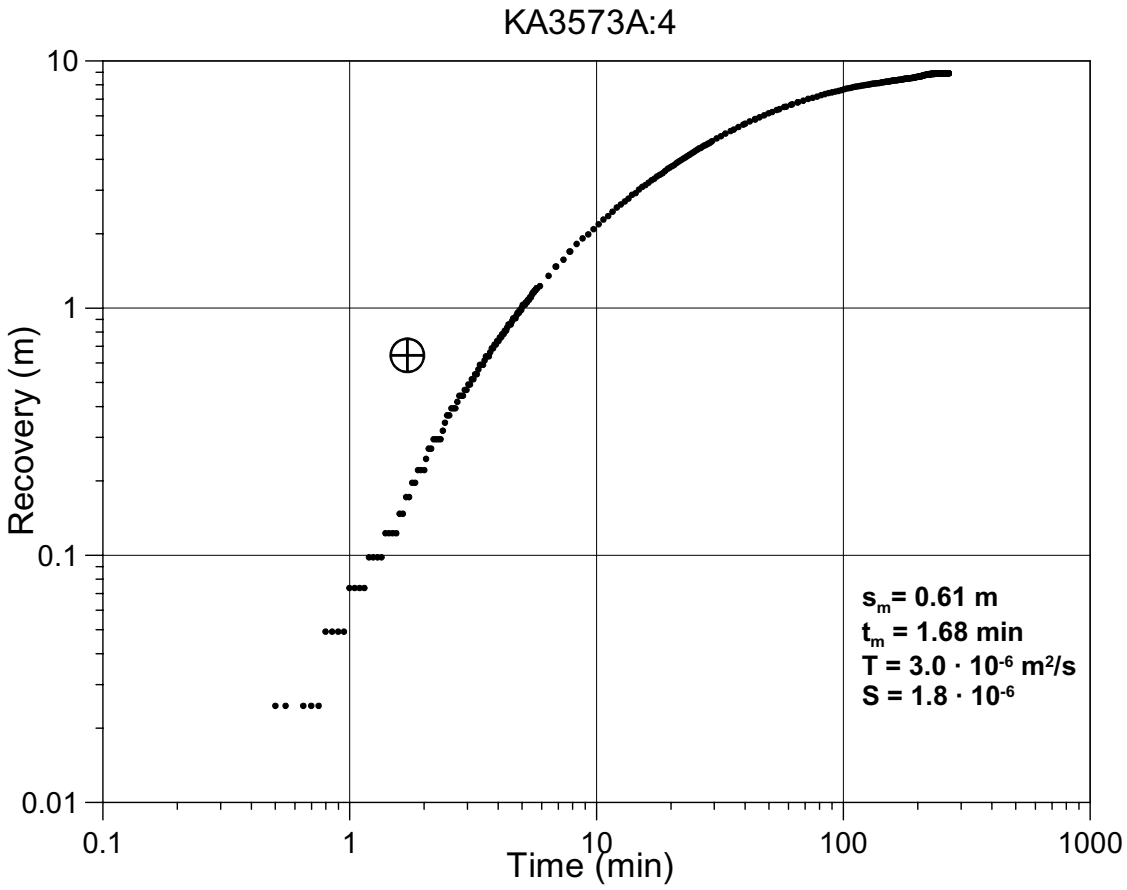


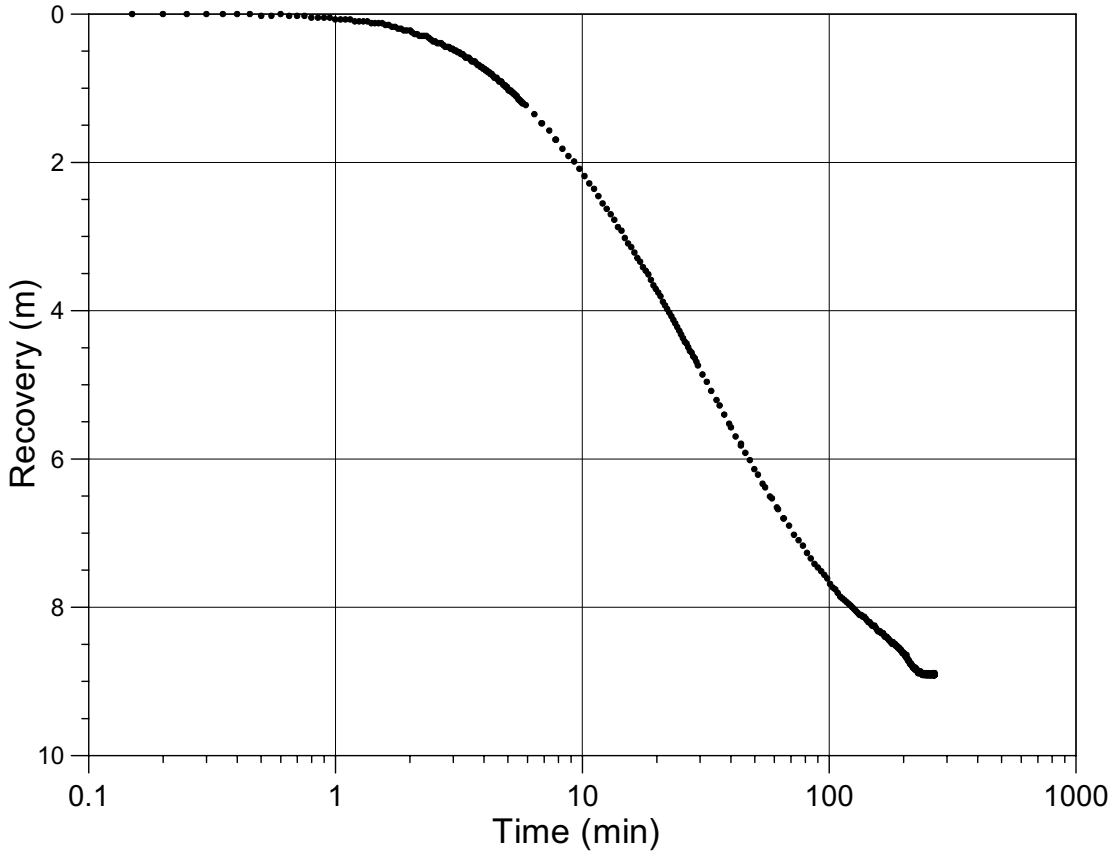
23_KA3573A_2.GRF 2003-10-23



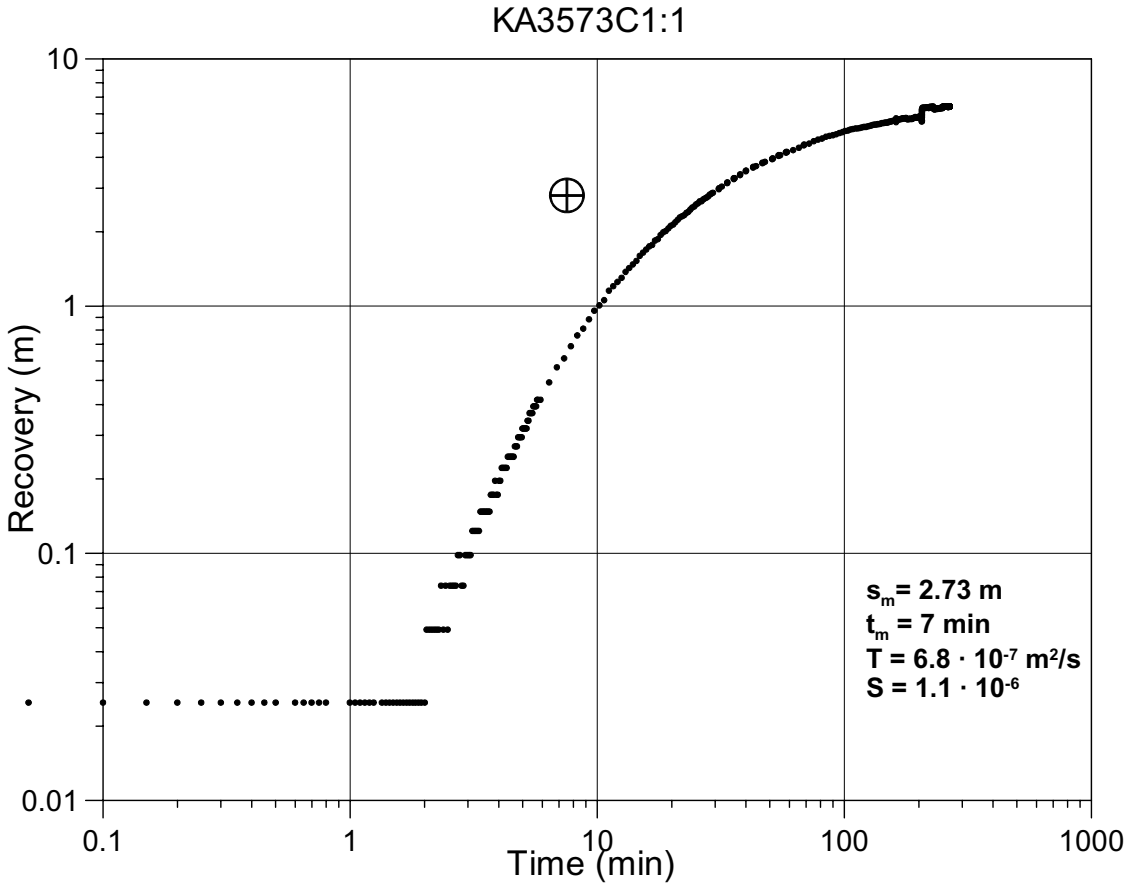


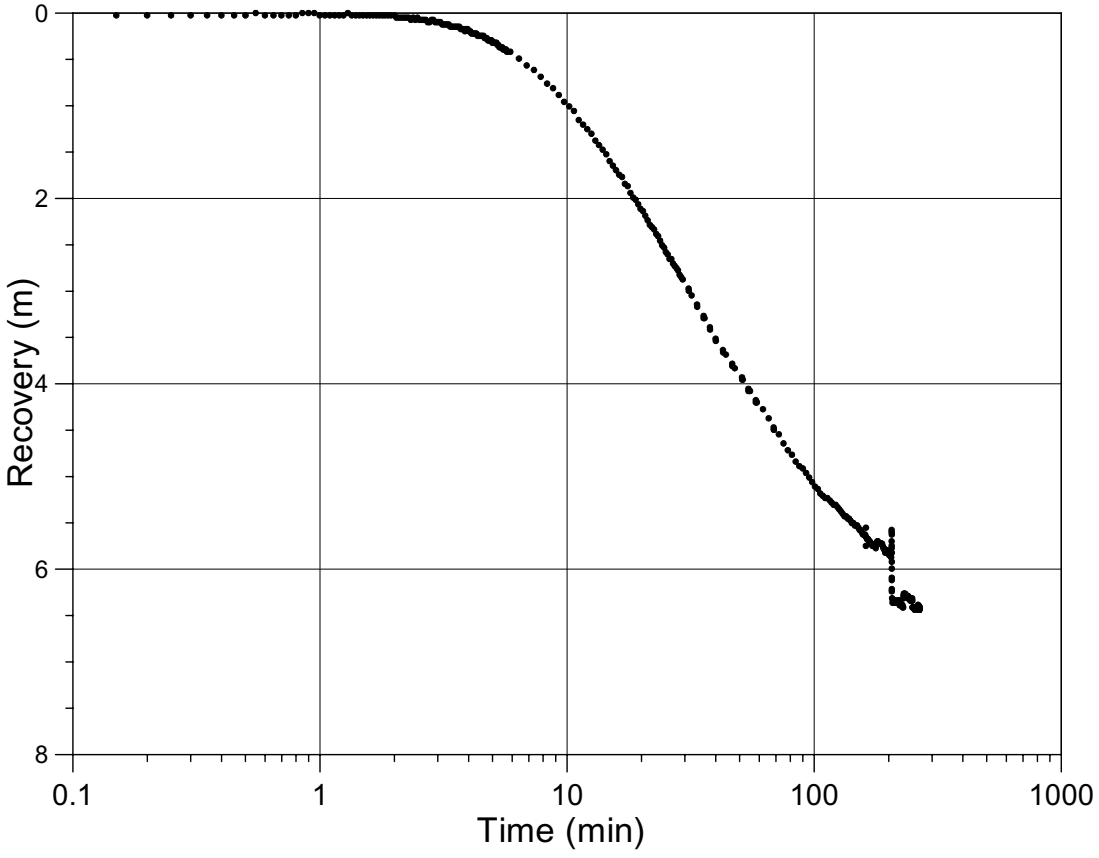
23_KA3573A_3.GRF 2003-10-23



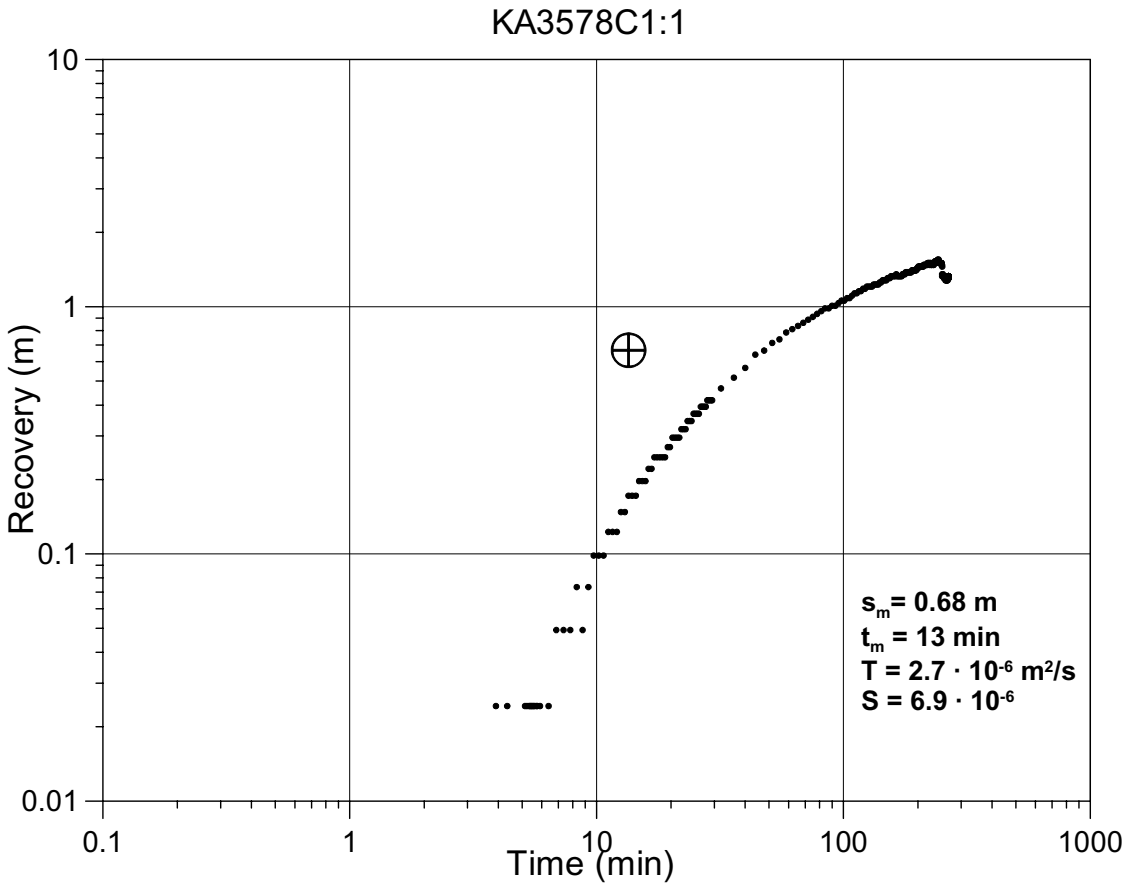


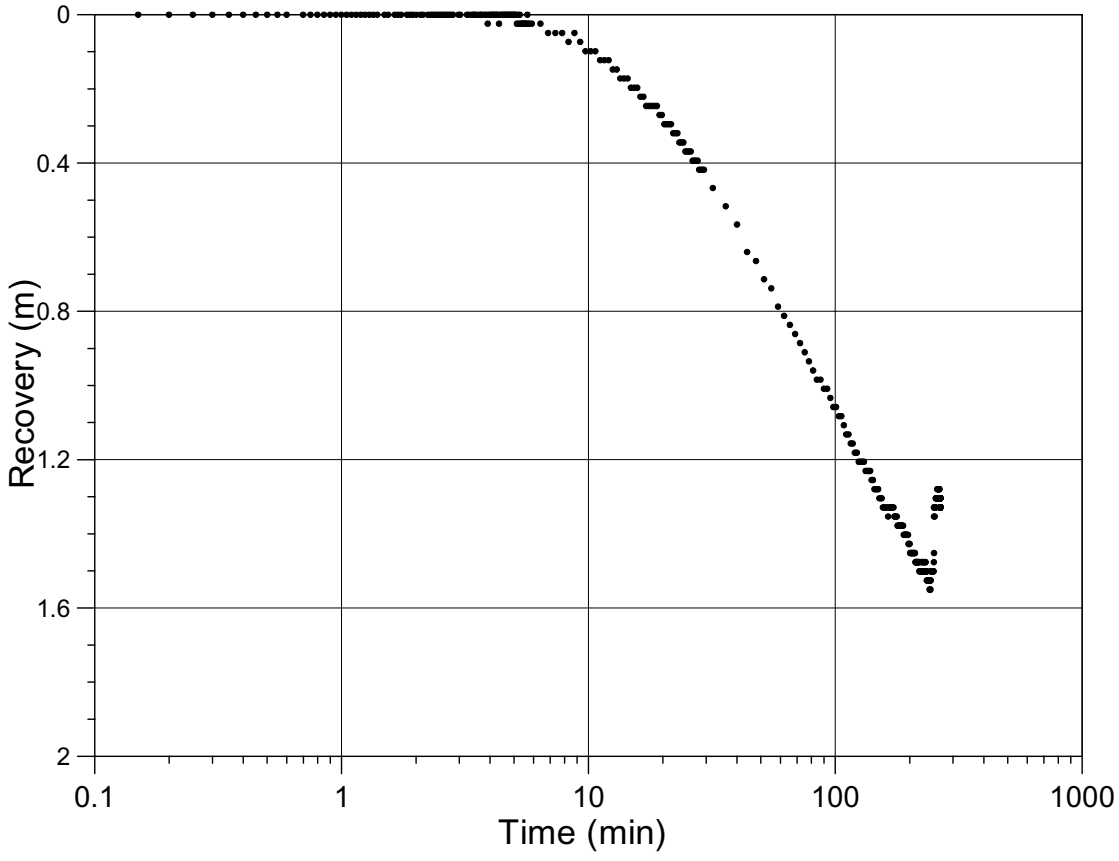
23_KA3573A_4.GRF 2003-10-25



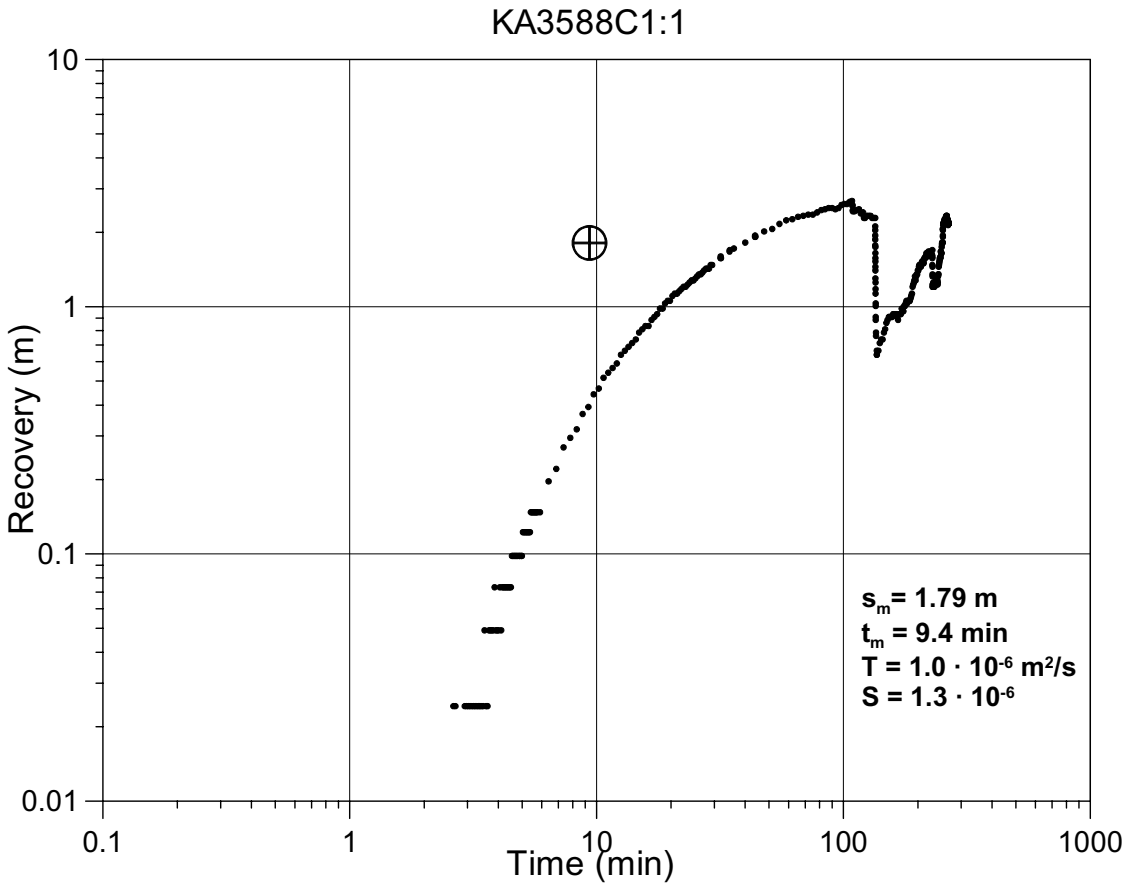


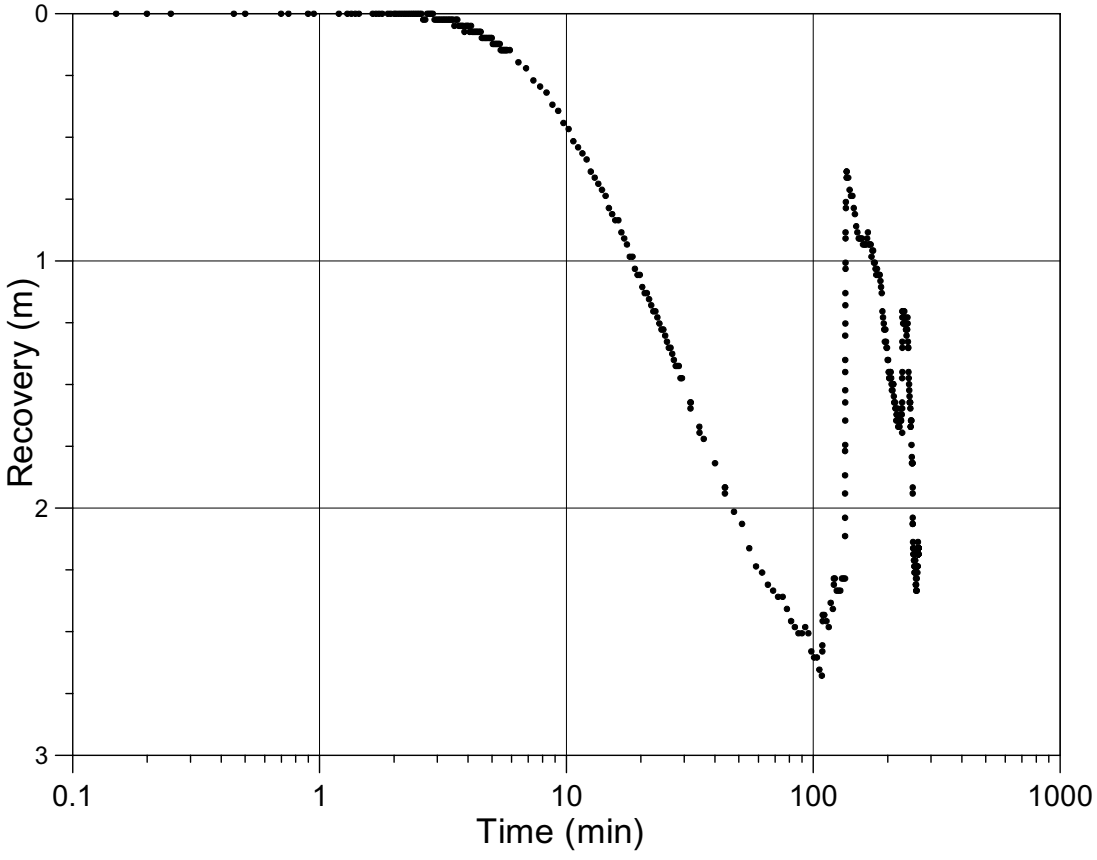
23_KA3573C1_1.GRF 2003-10-25



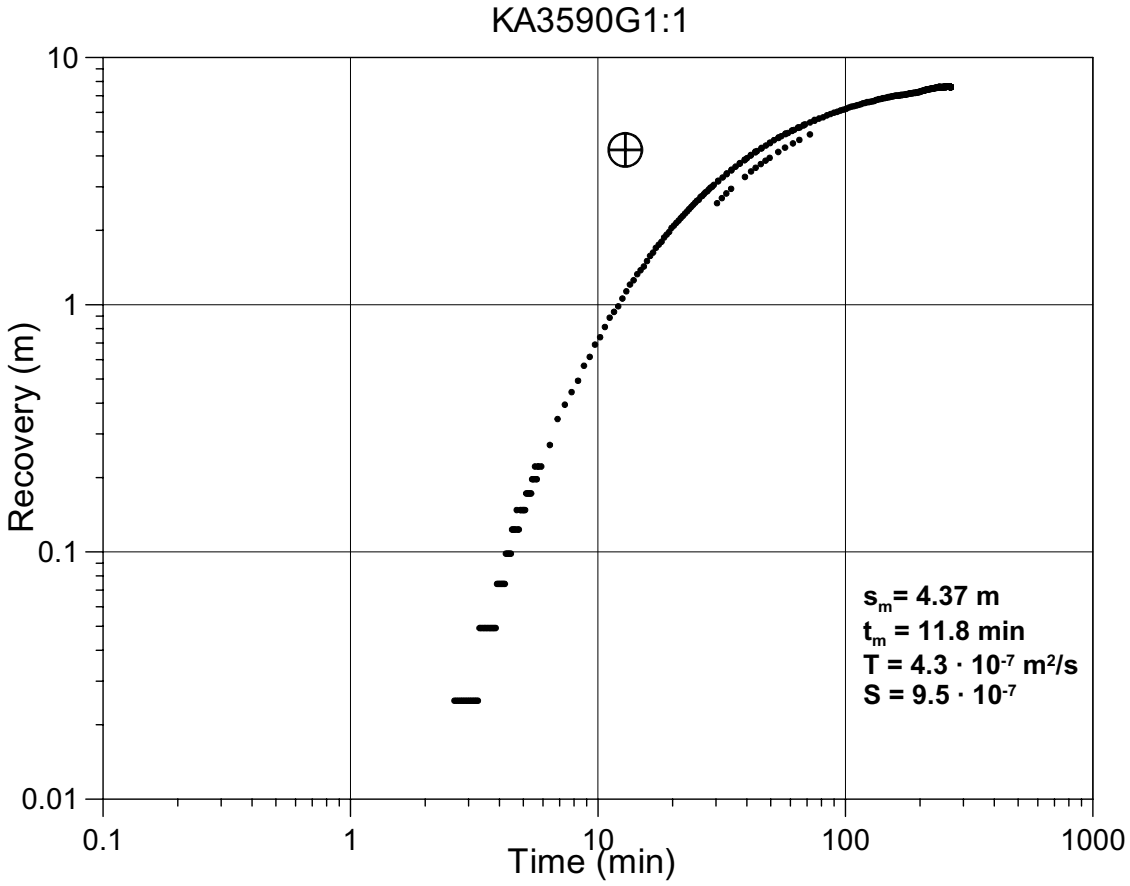


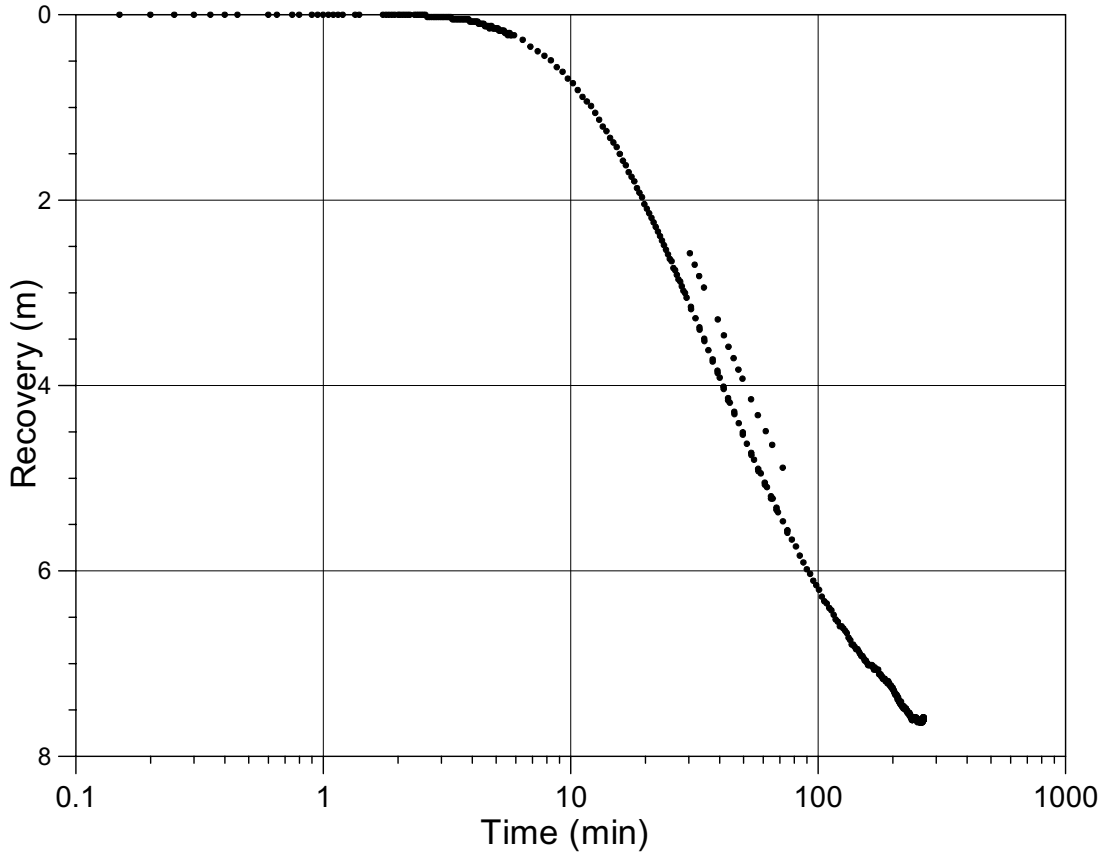
23_KA3578C1_1.GRF 2003-10-25



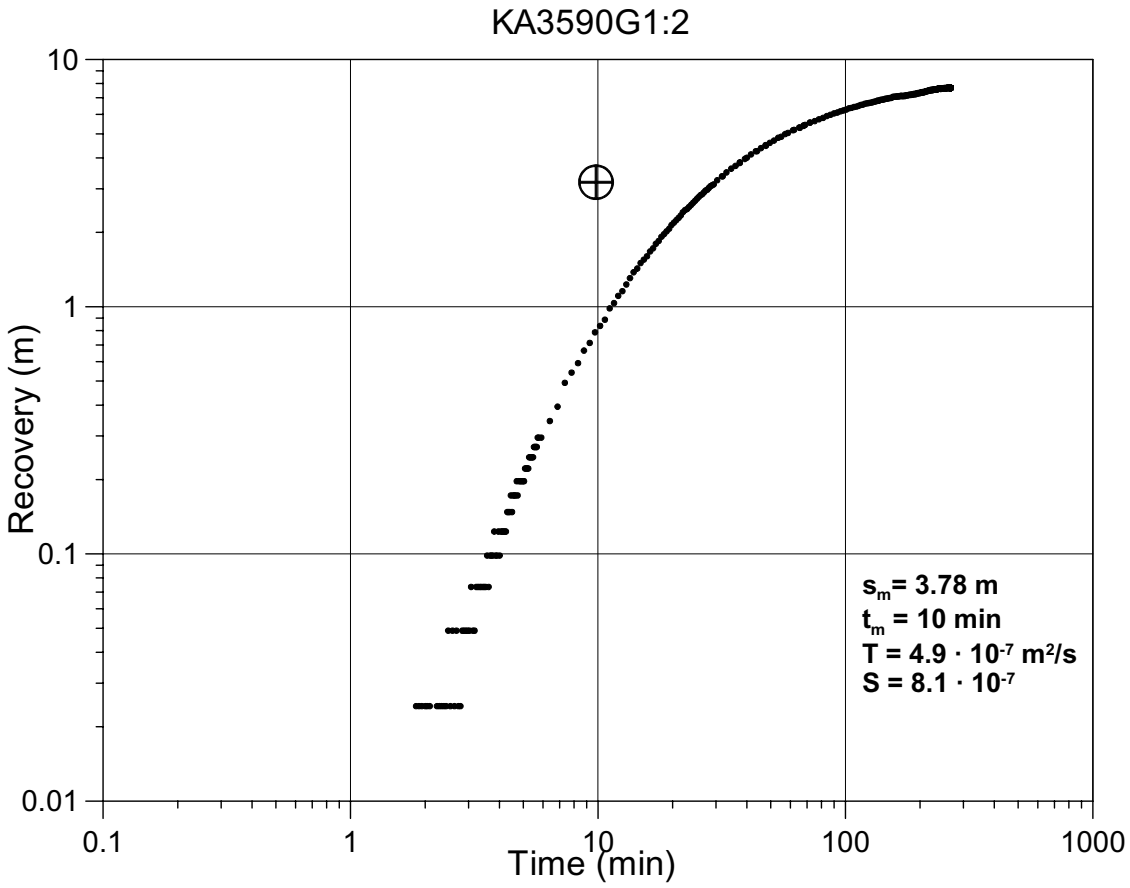


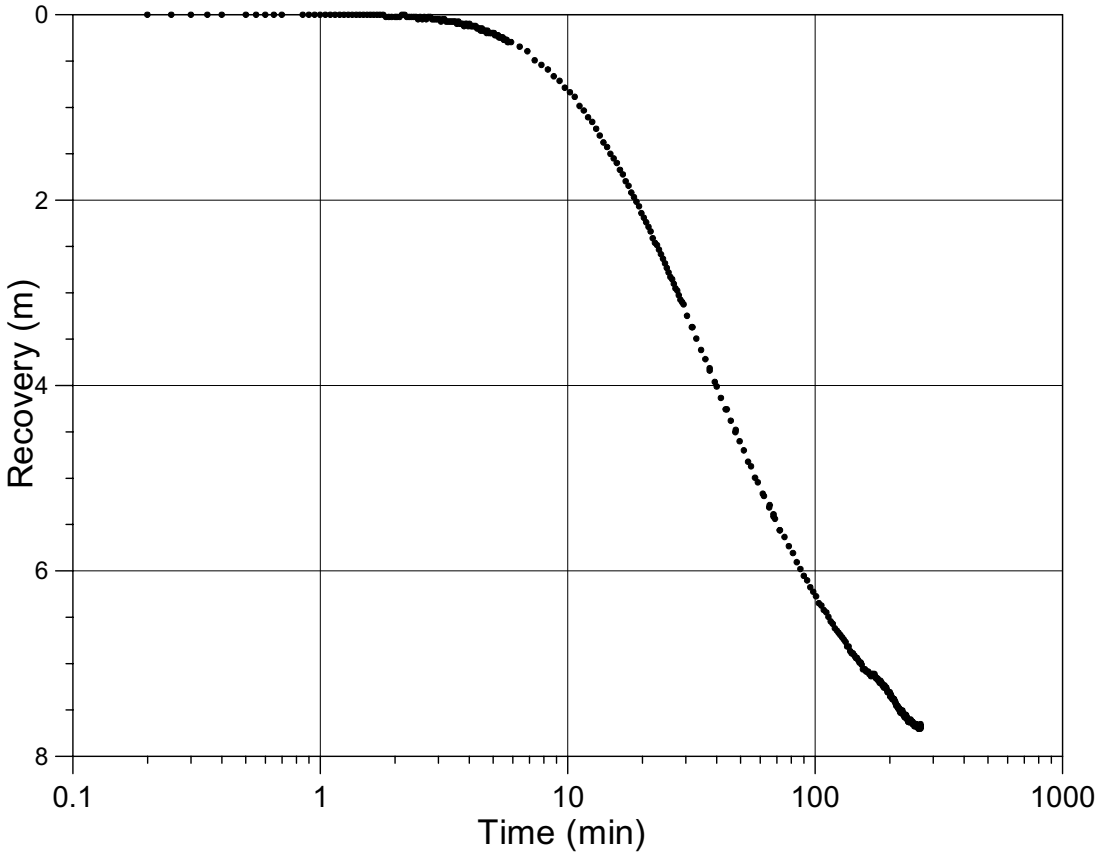
23_KA3588C1_1.GRF 2003-10-25



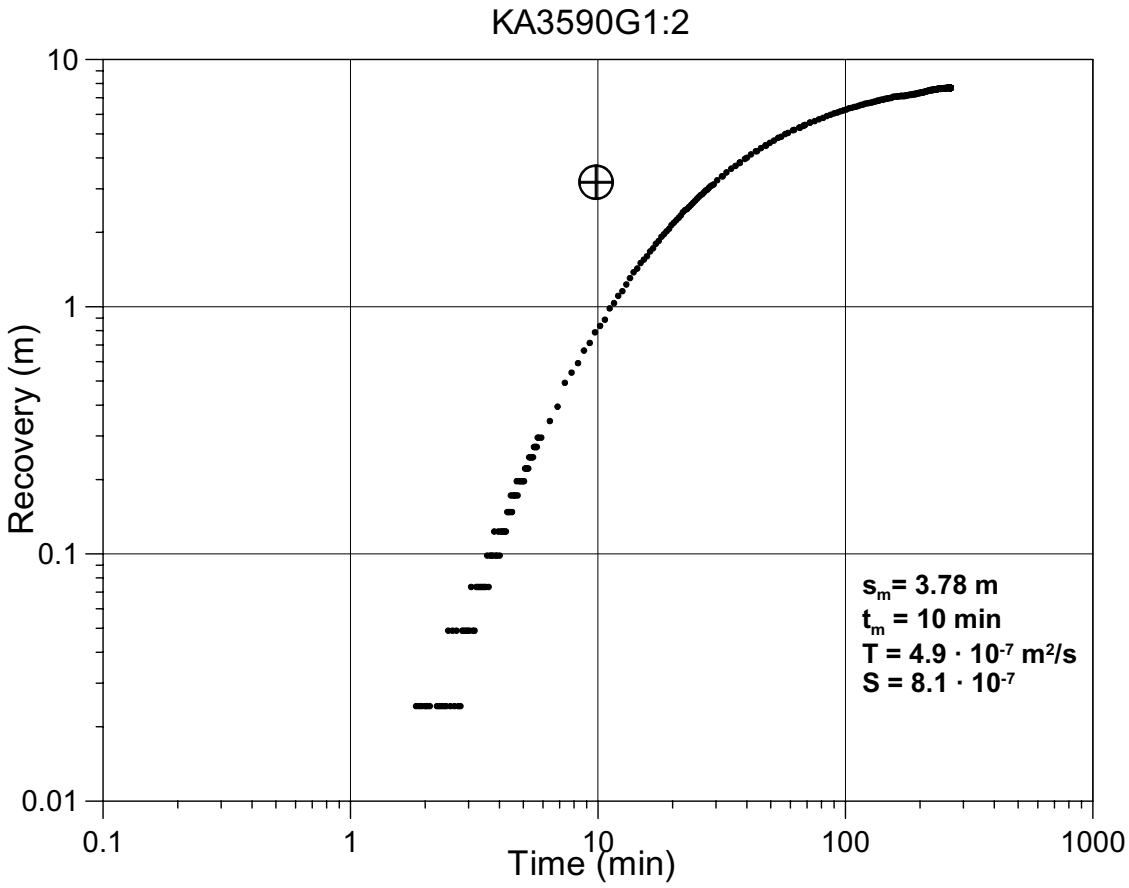


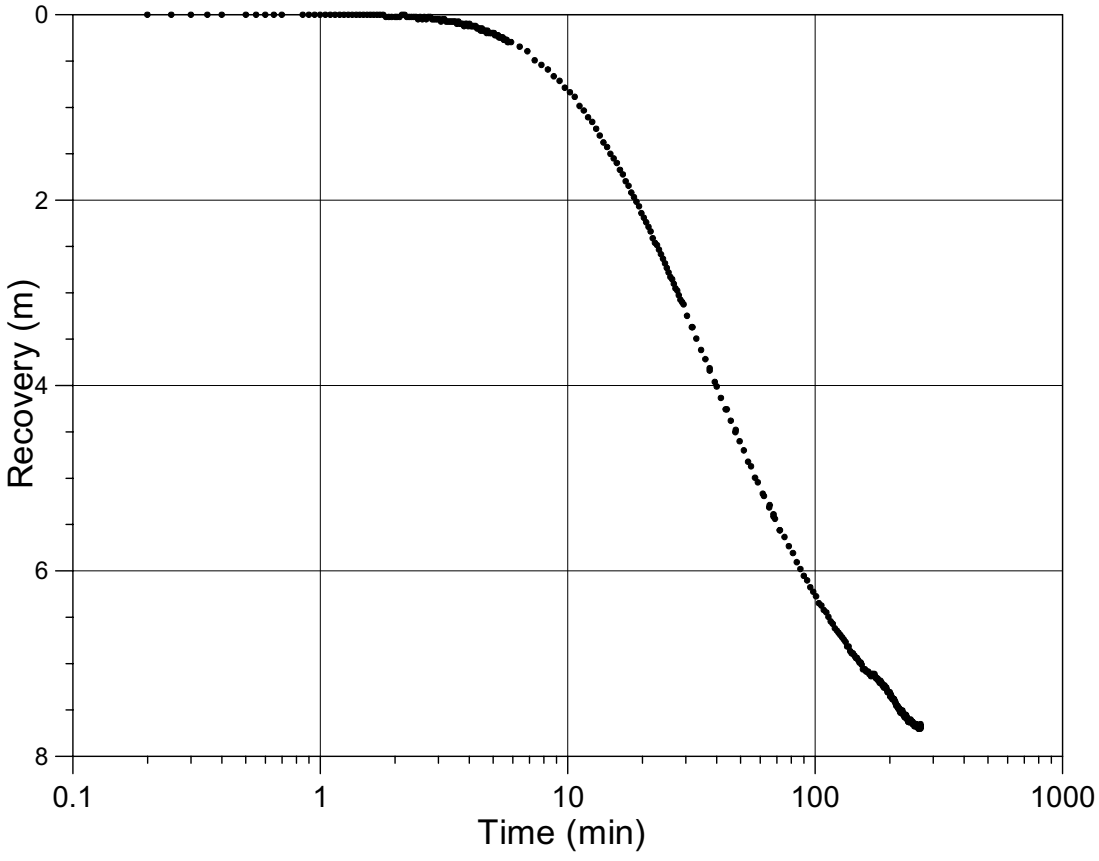
23_KA3590G1_1.GRF 2003-10-25



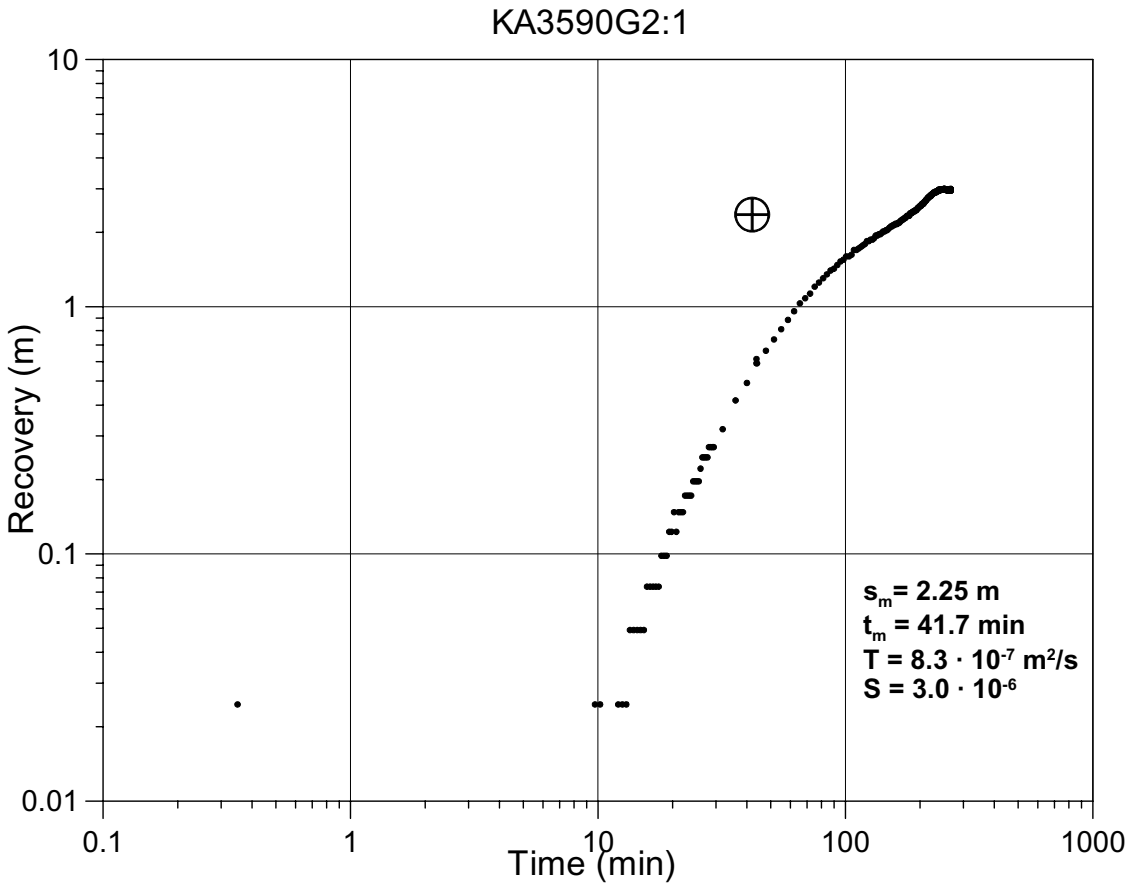


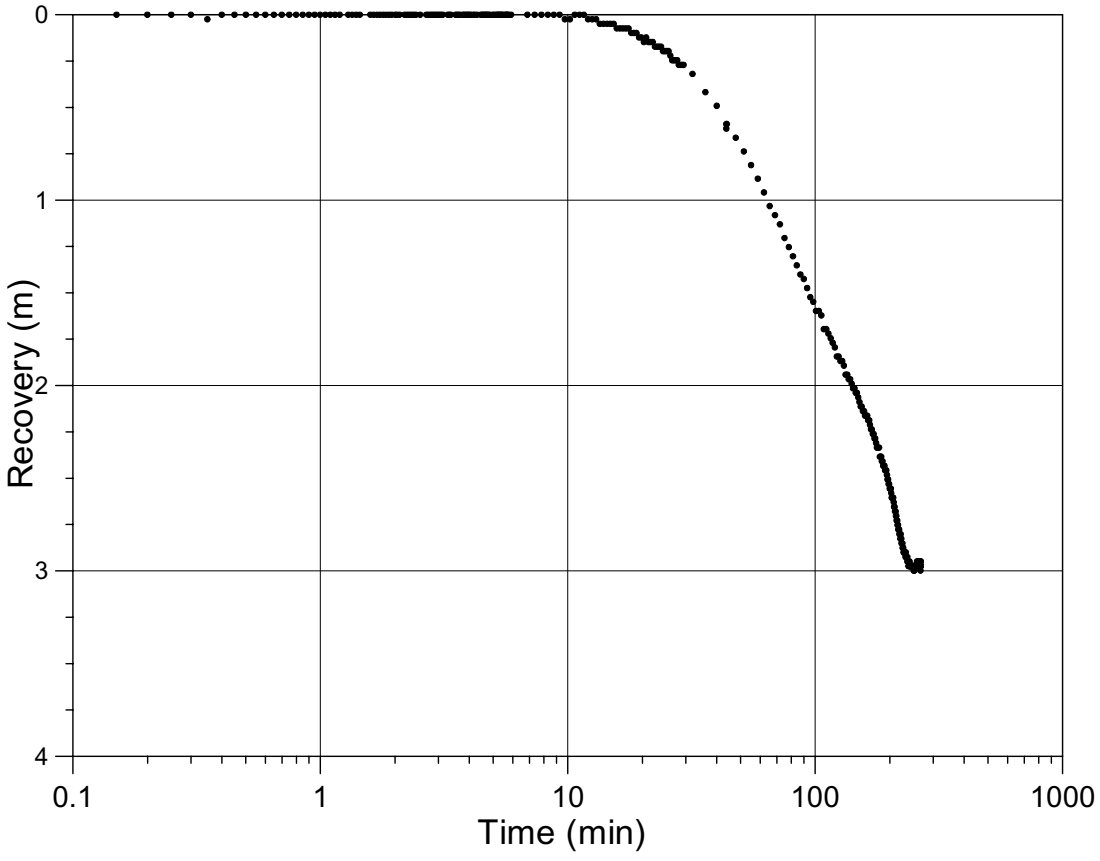
23_KA3590G1_2.GRF 2003-10-25





23_KA3590G1_2.GRF 2003-10-25





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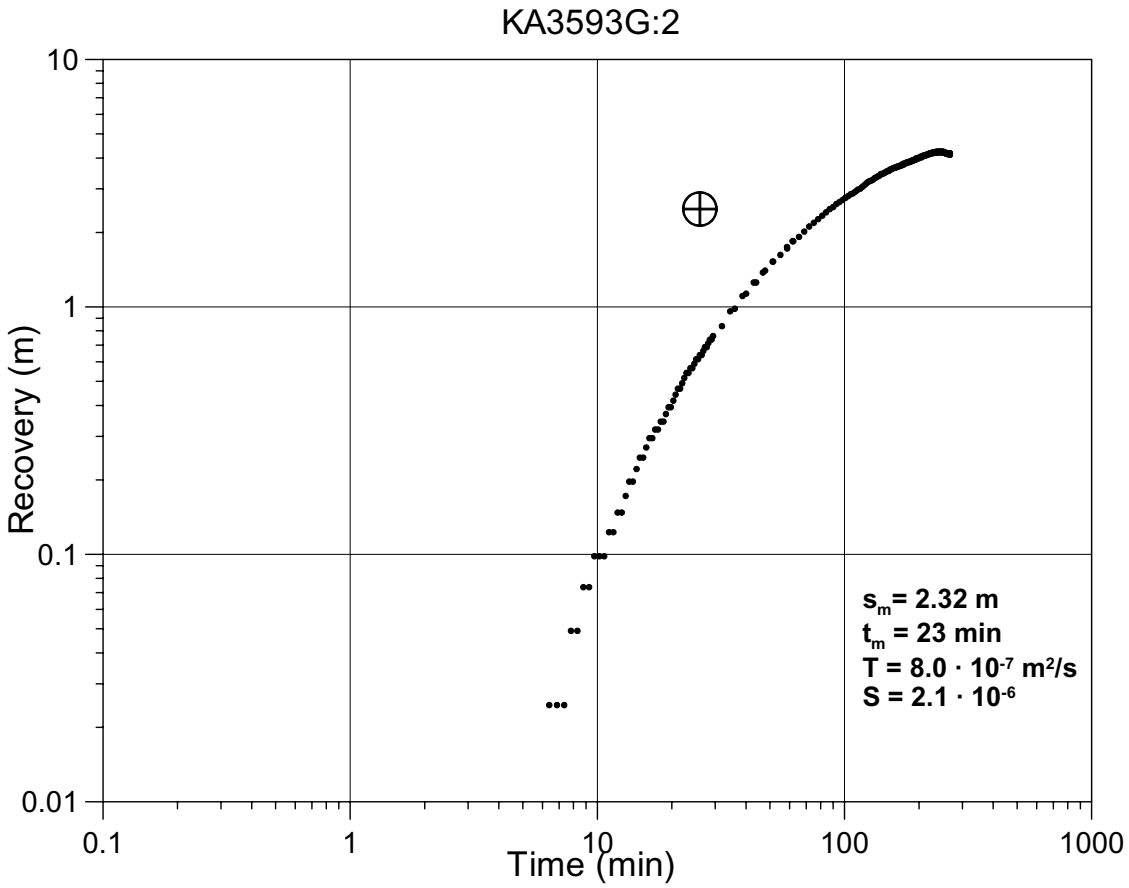
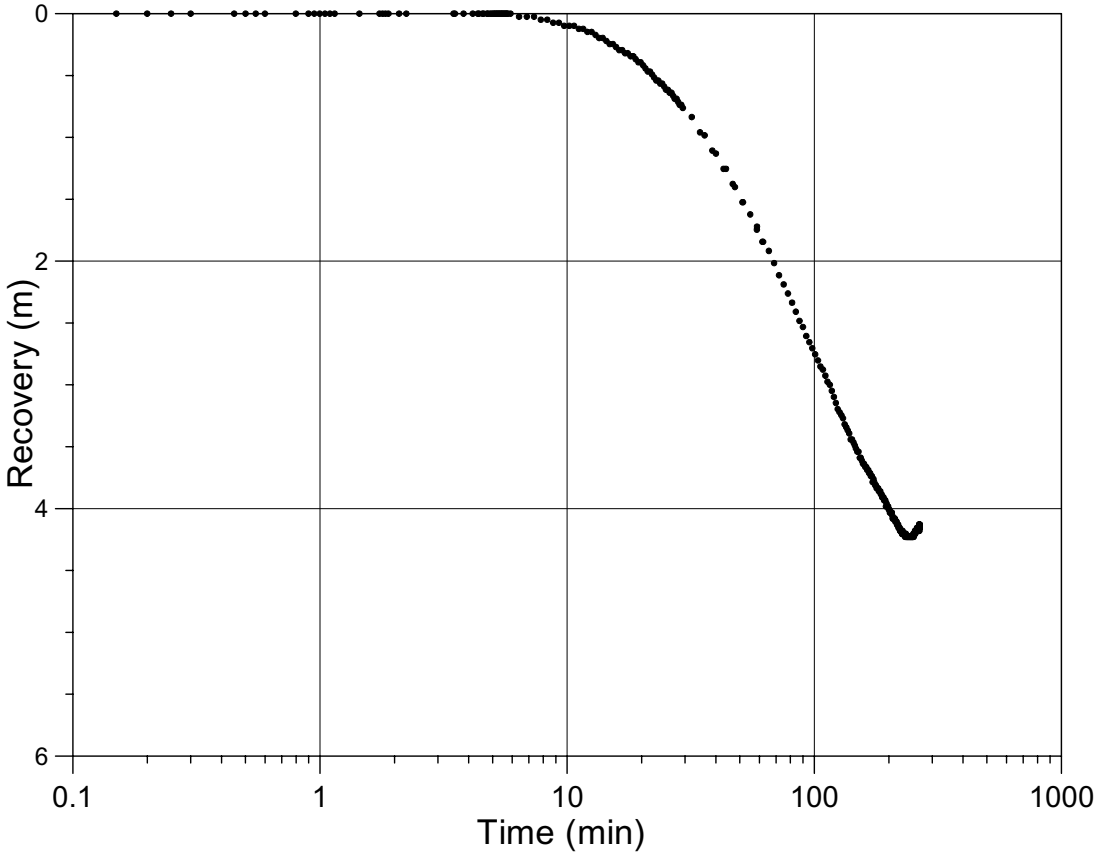
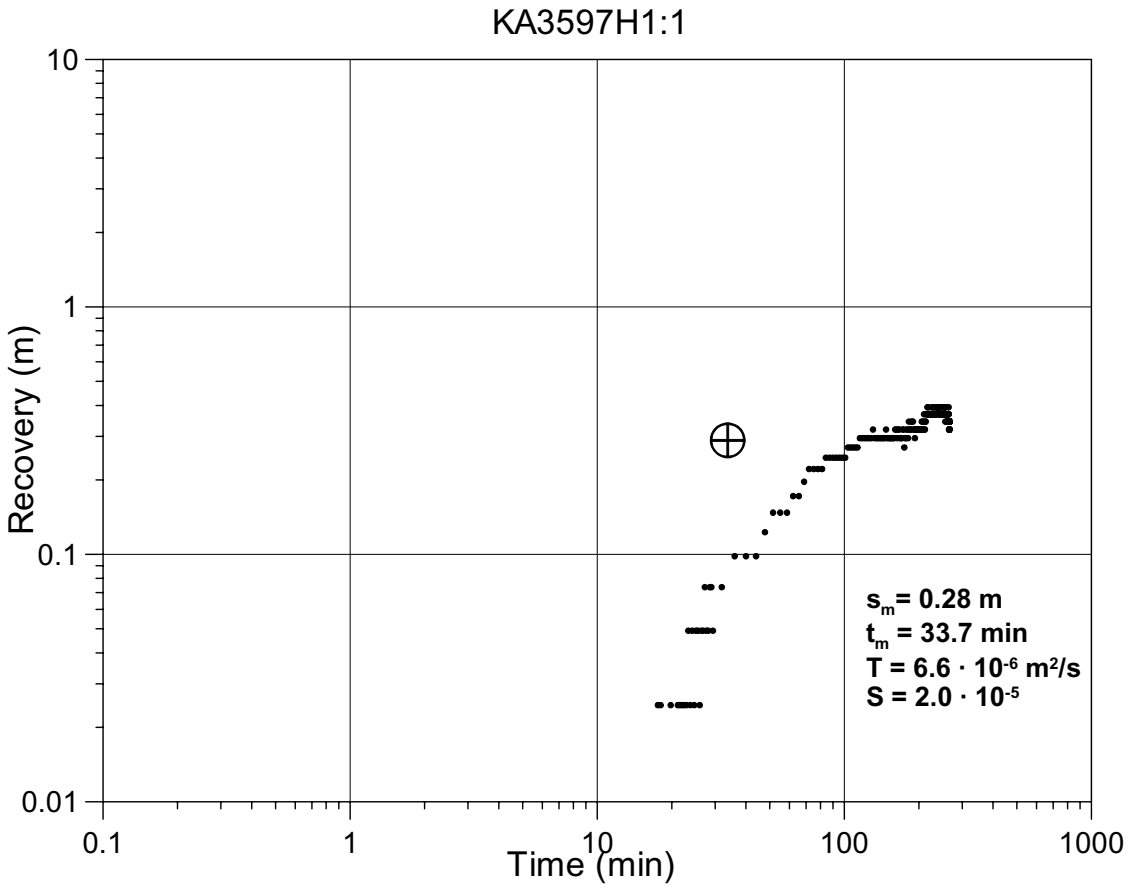
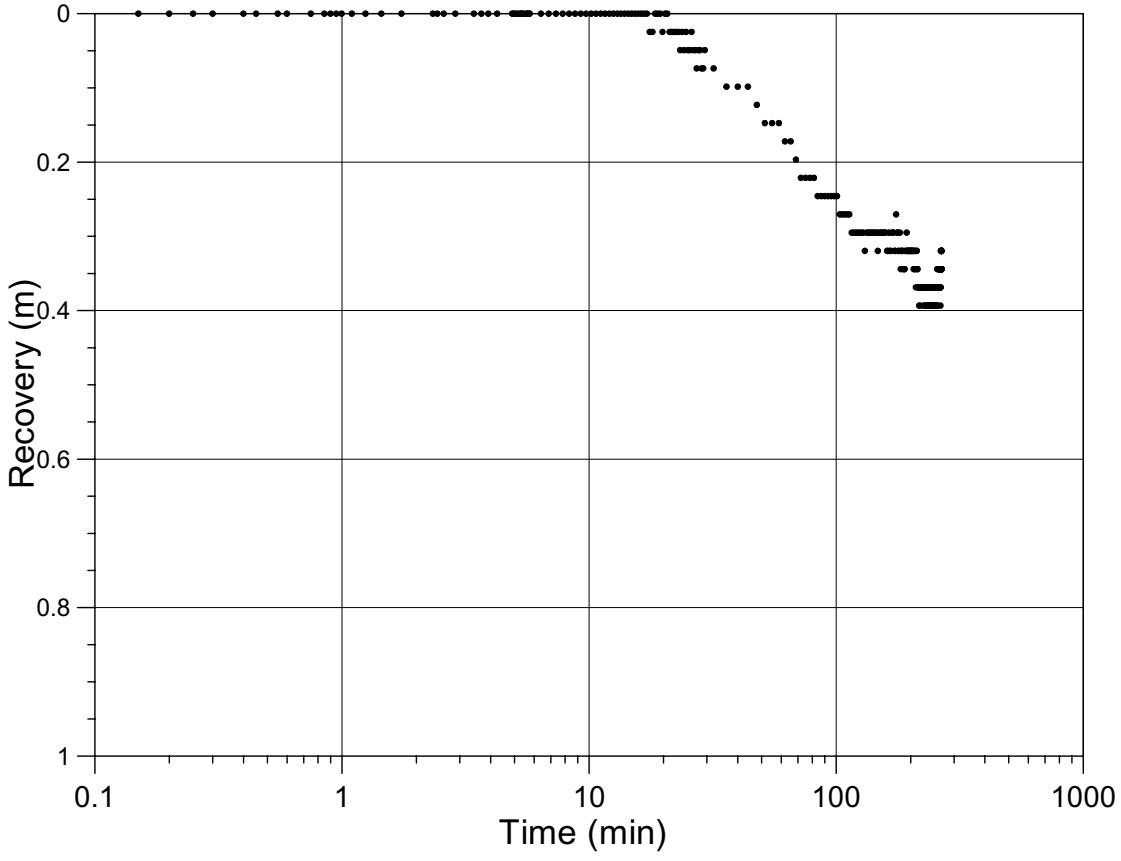


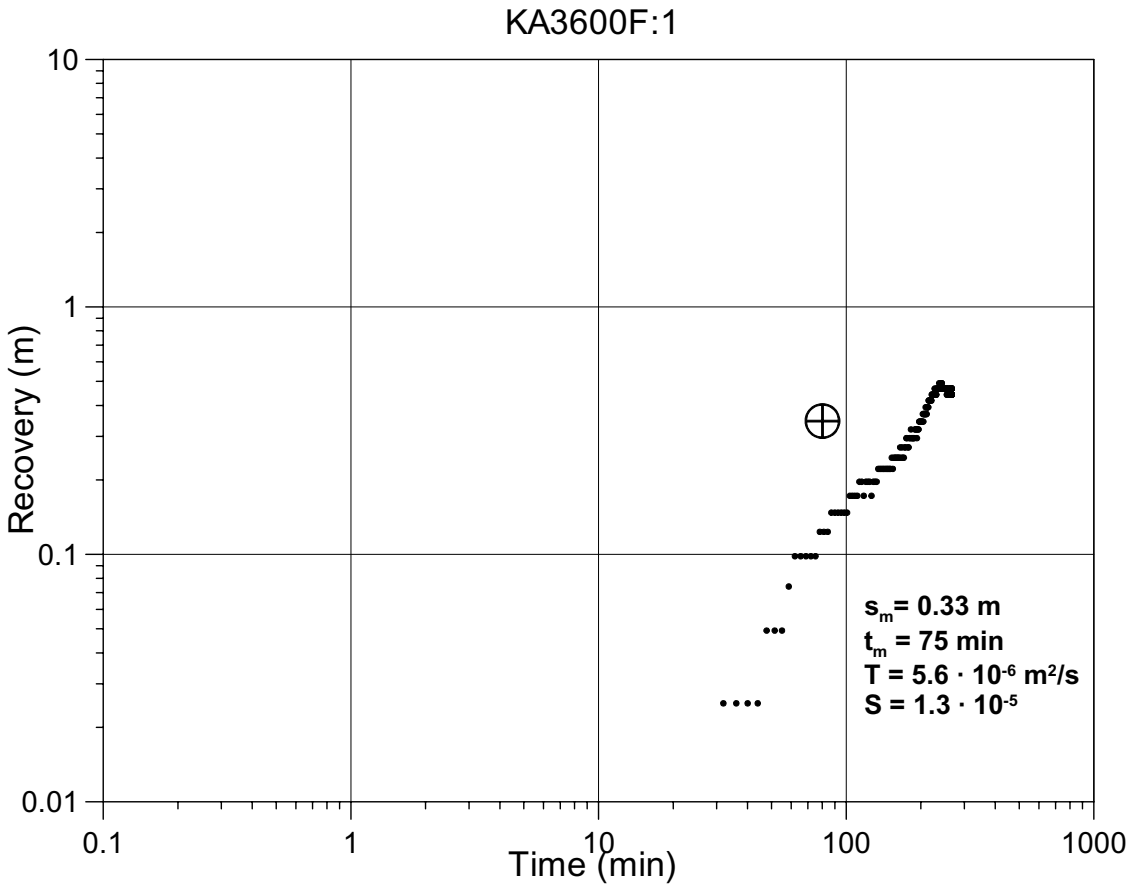


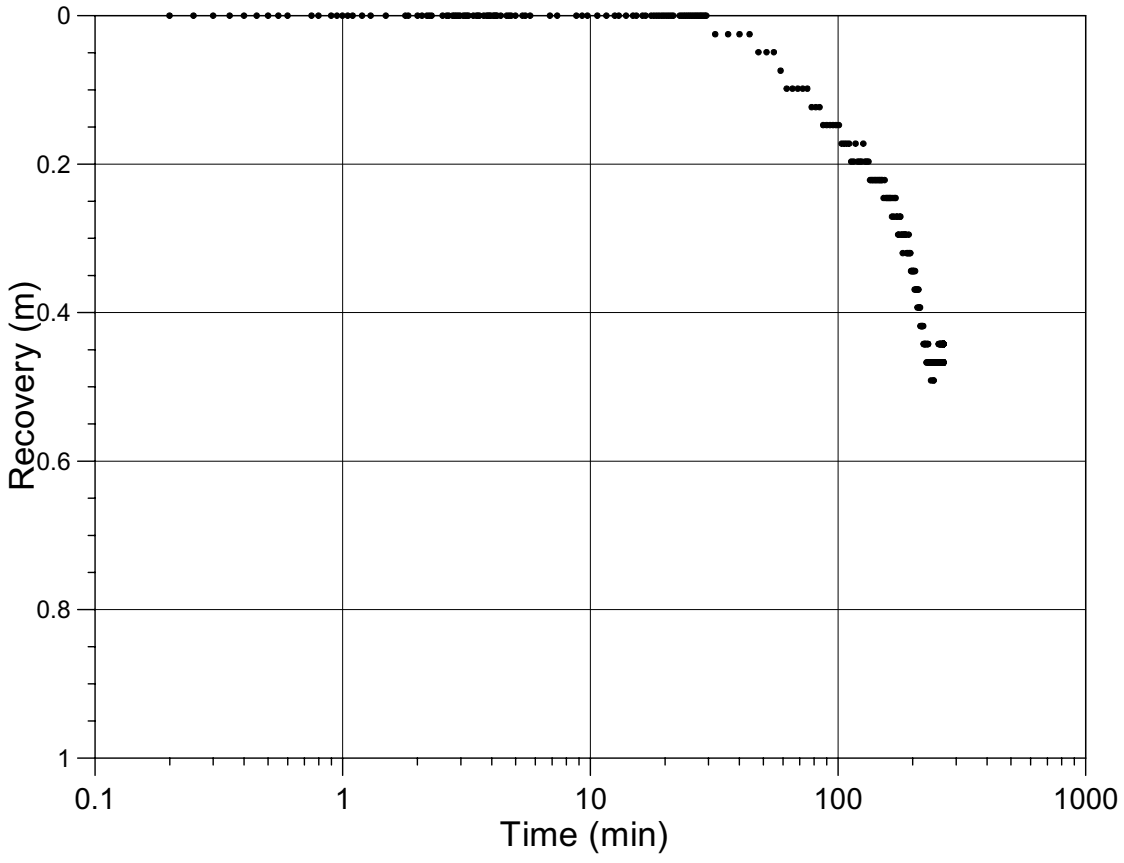
23_KA3593G_2.GRF 2003-10-25



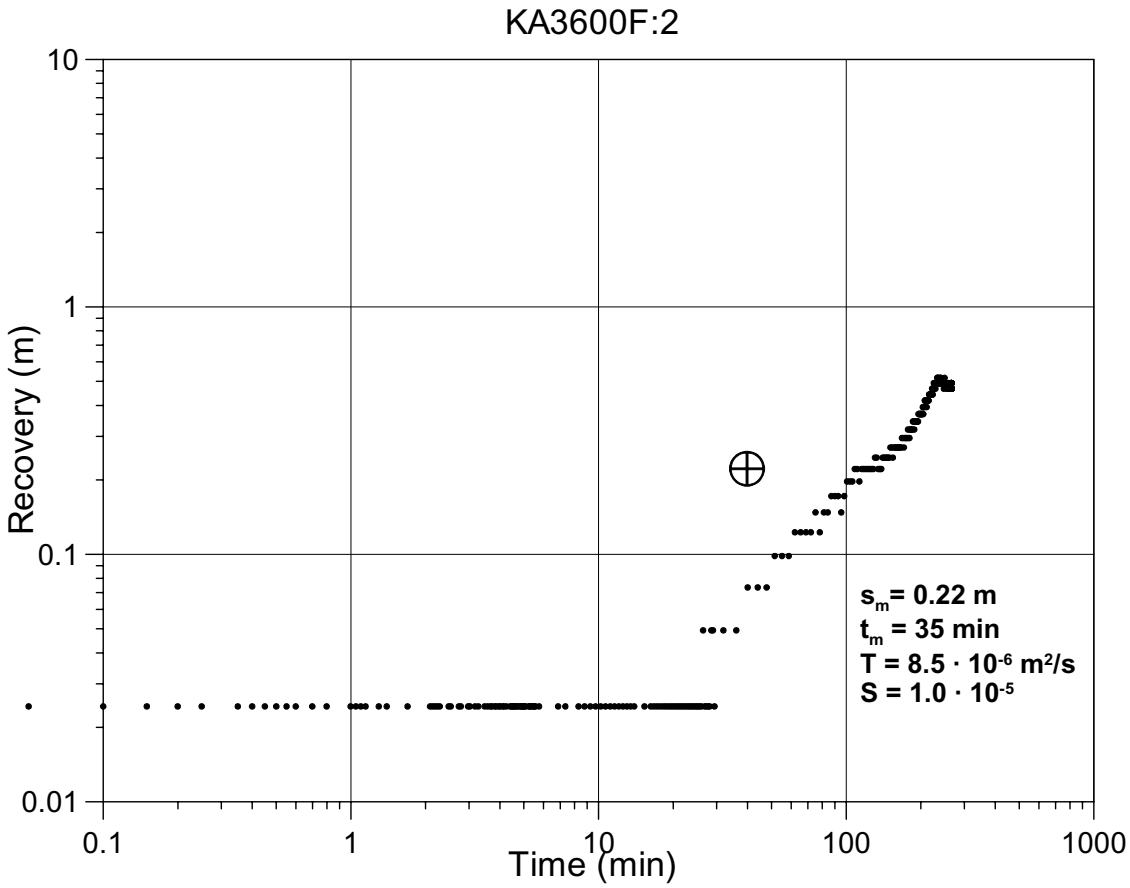


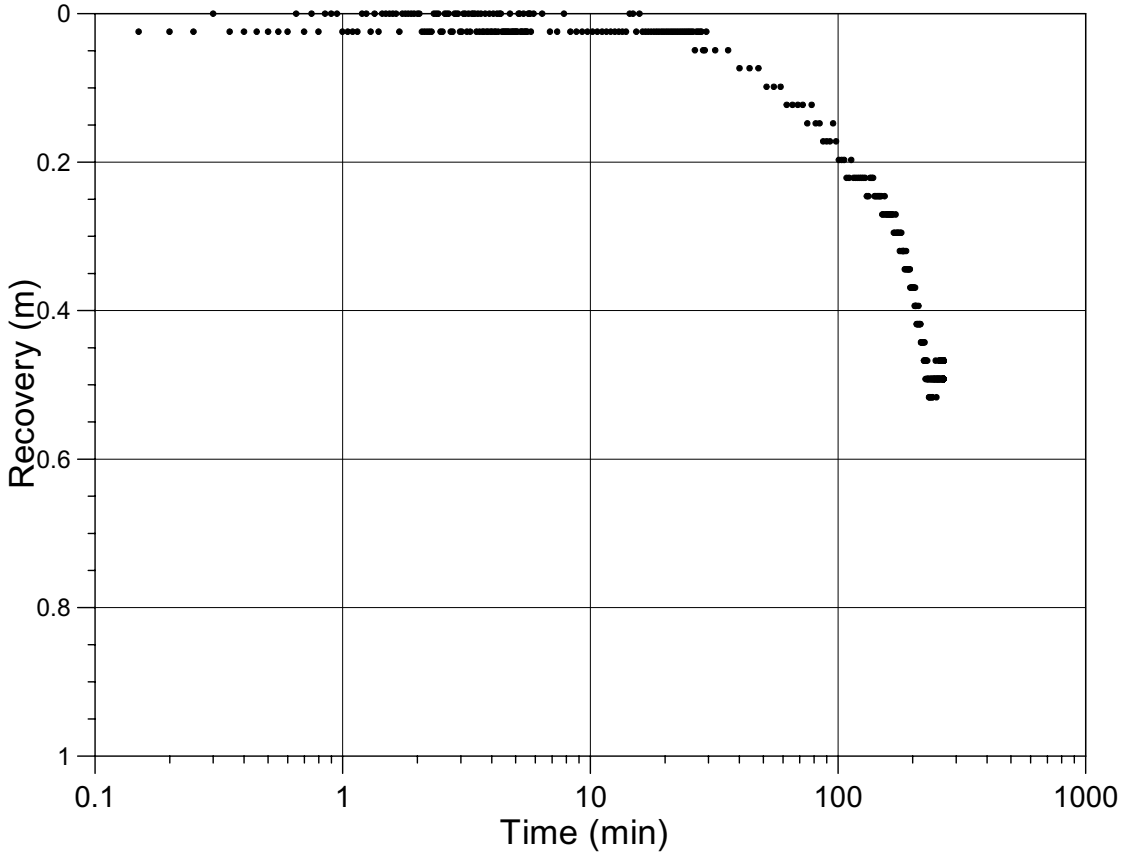
23_KA3597H1_1.GRF 2003-10-25



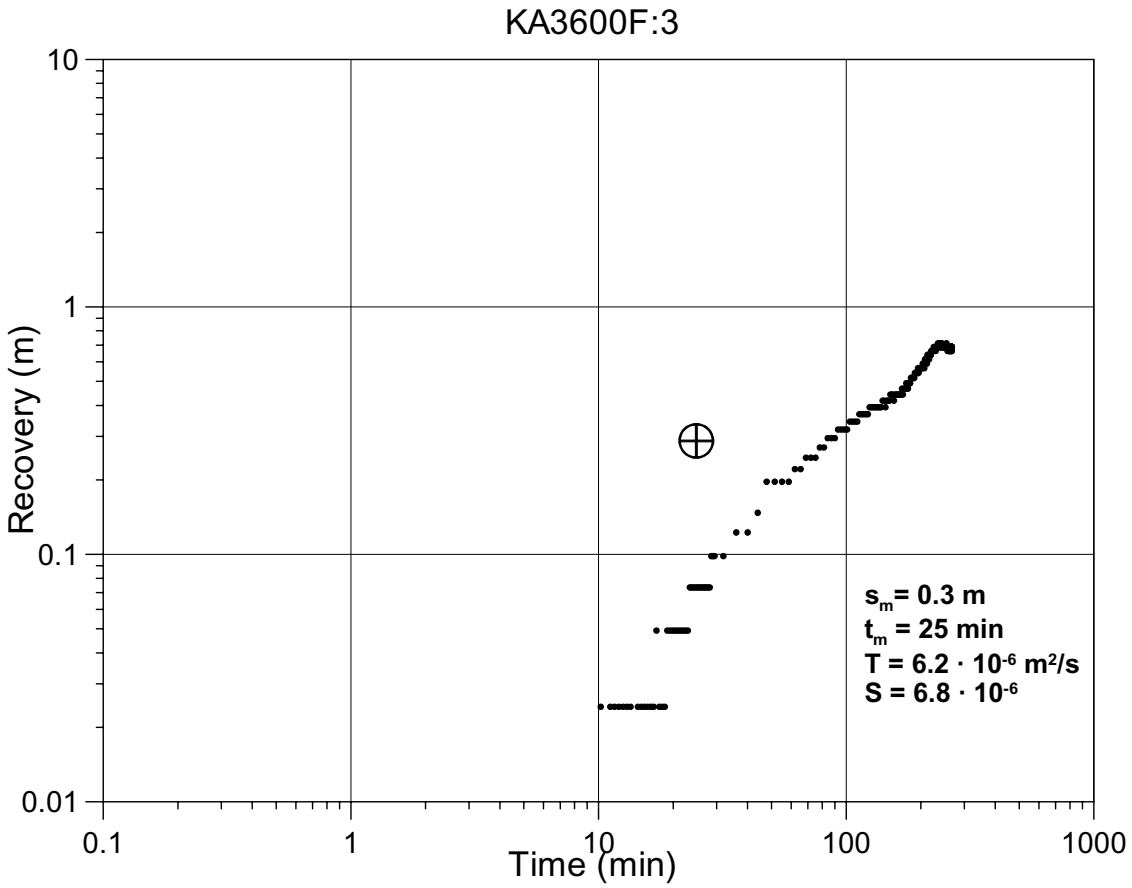


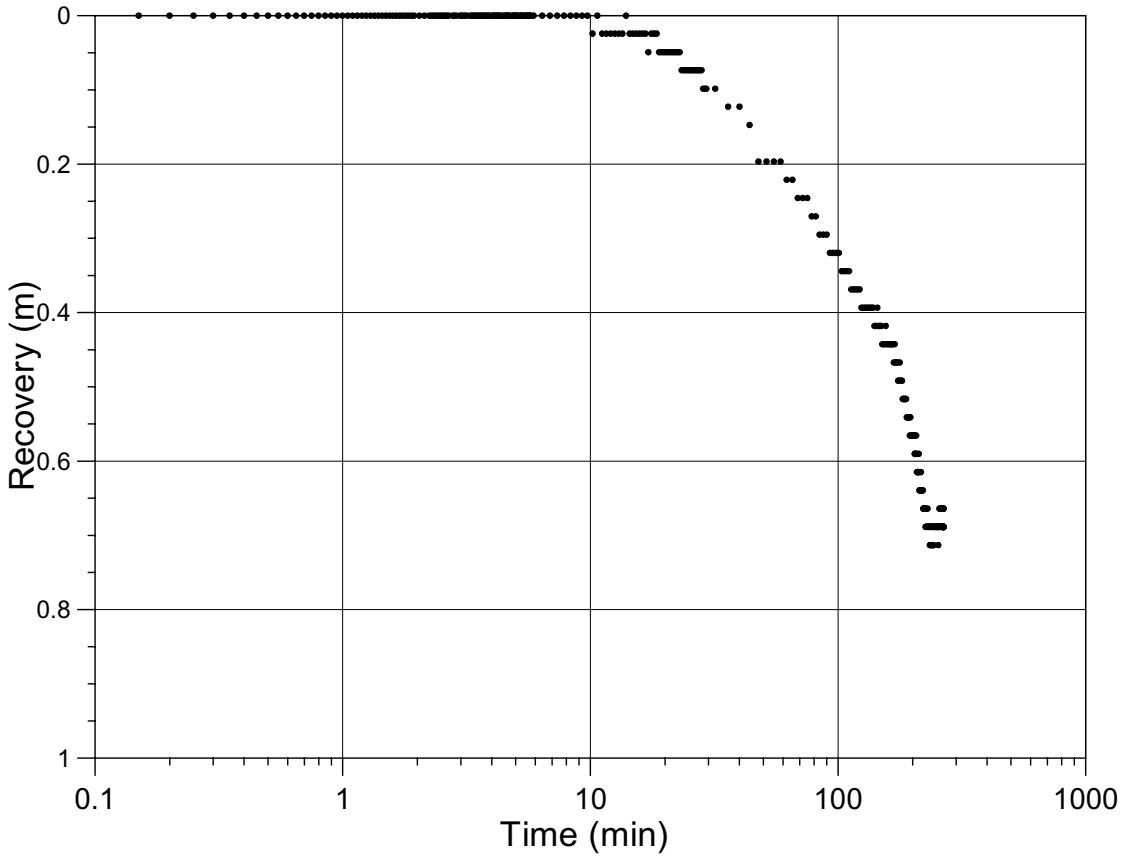
23_KA3600F_1.GRF 2003-10-25



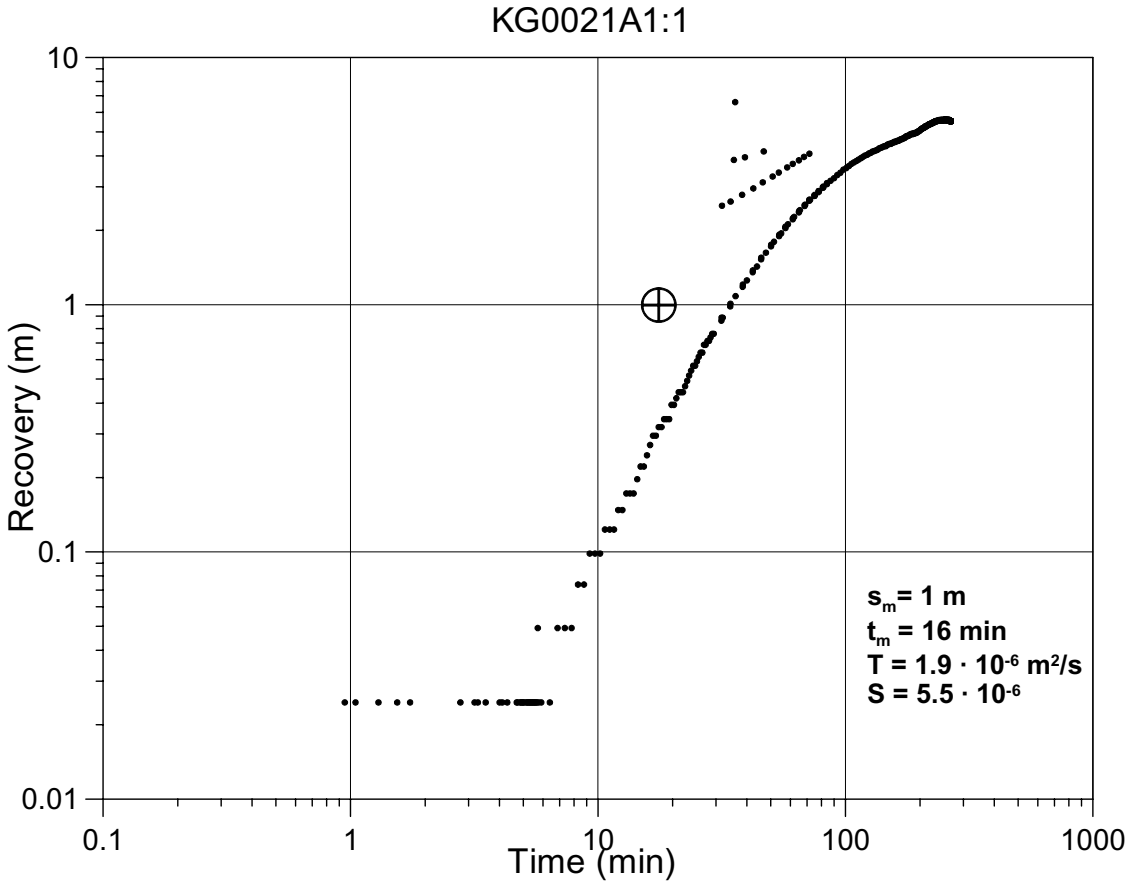


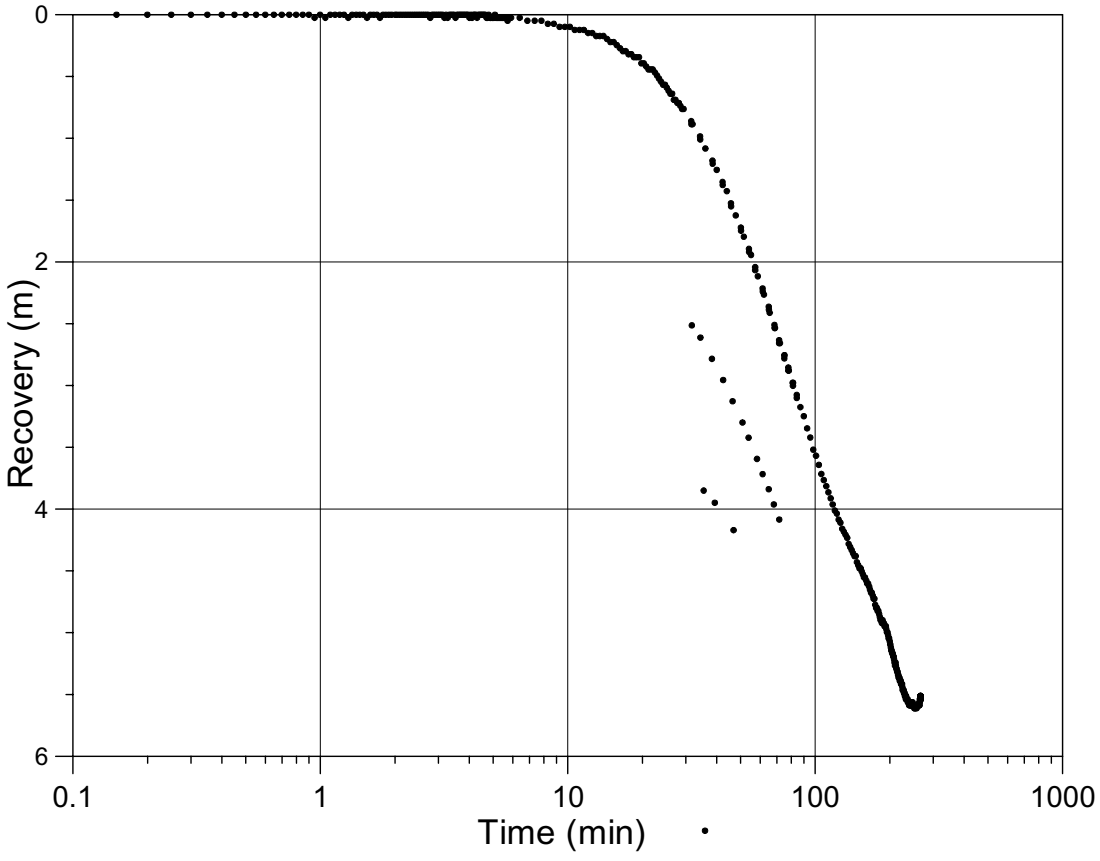
23_KA3600F_2.GRF 2003-10-25



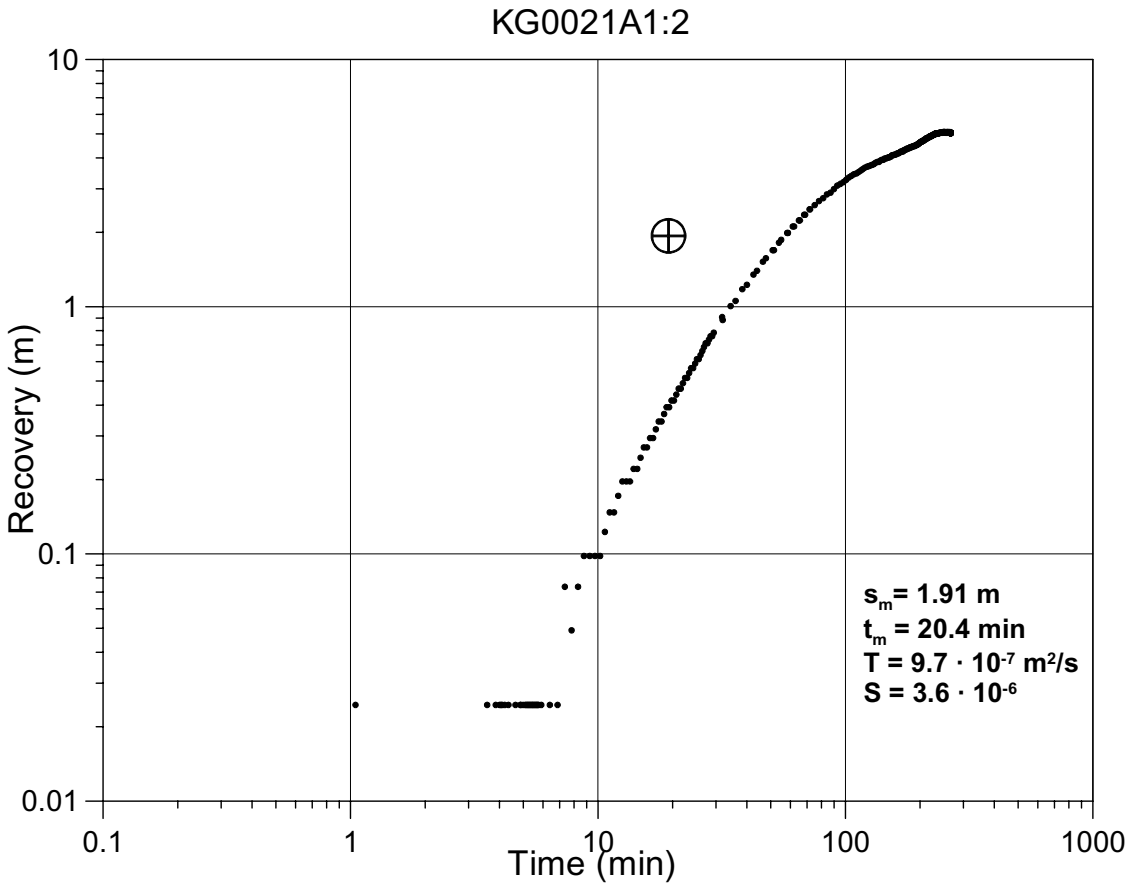


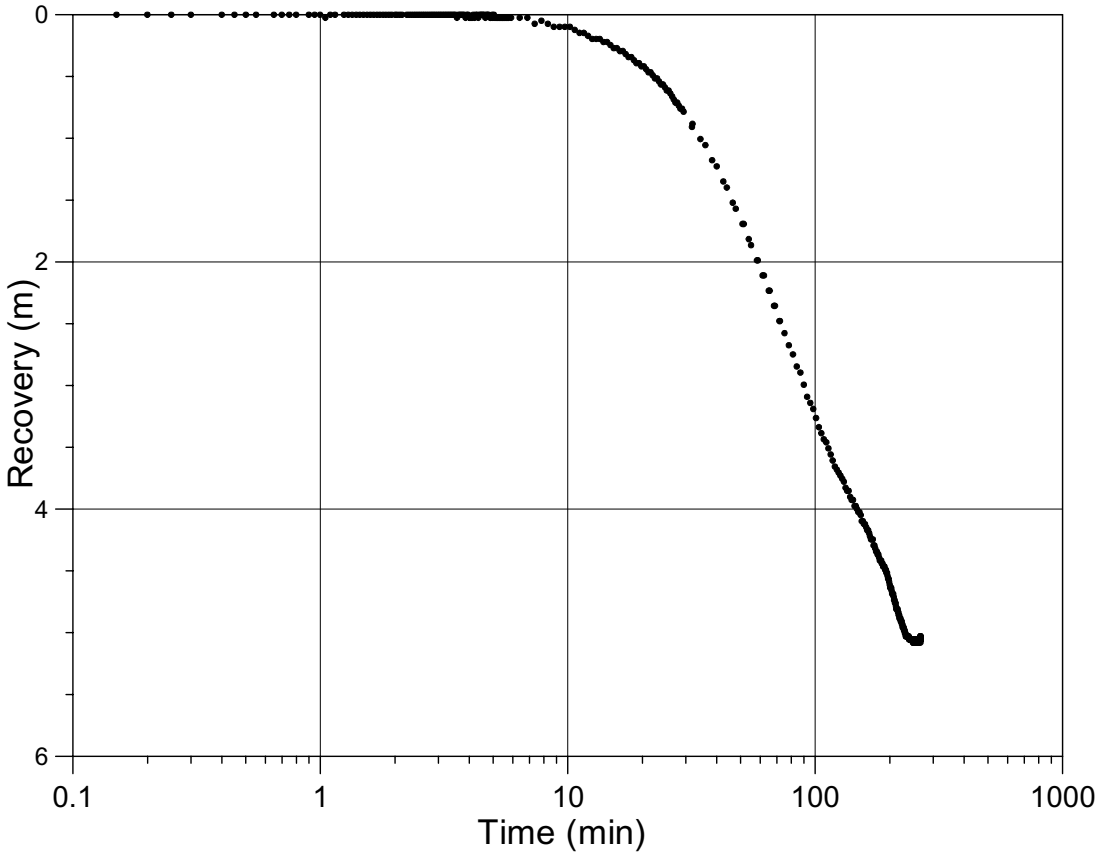
23_KA3600F_3.GRF 2003-10-25





23_KG0021A1_1.GRF 2003-10-25





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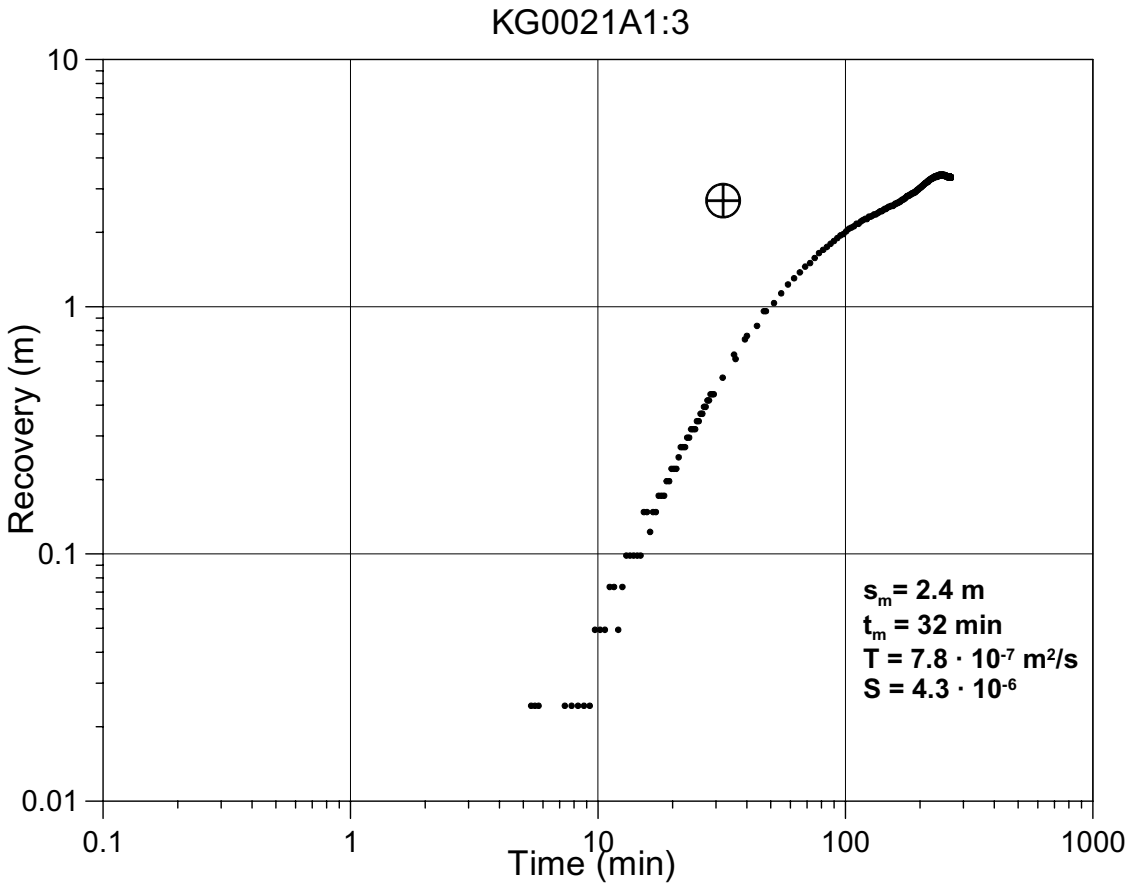
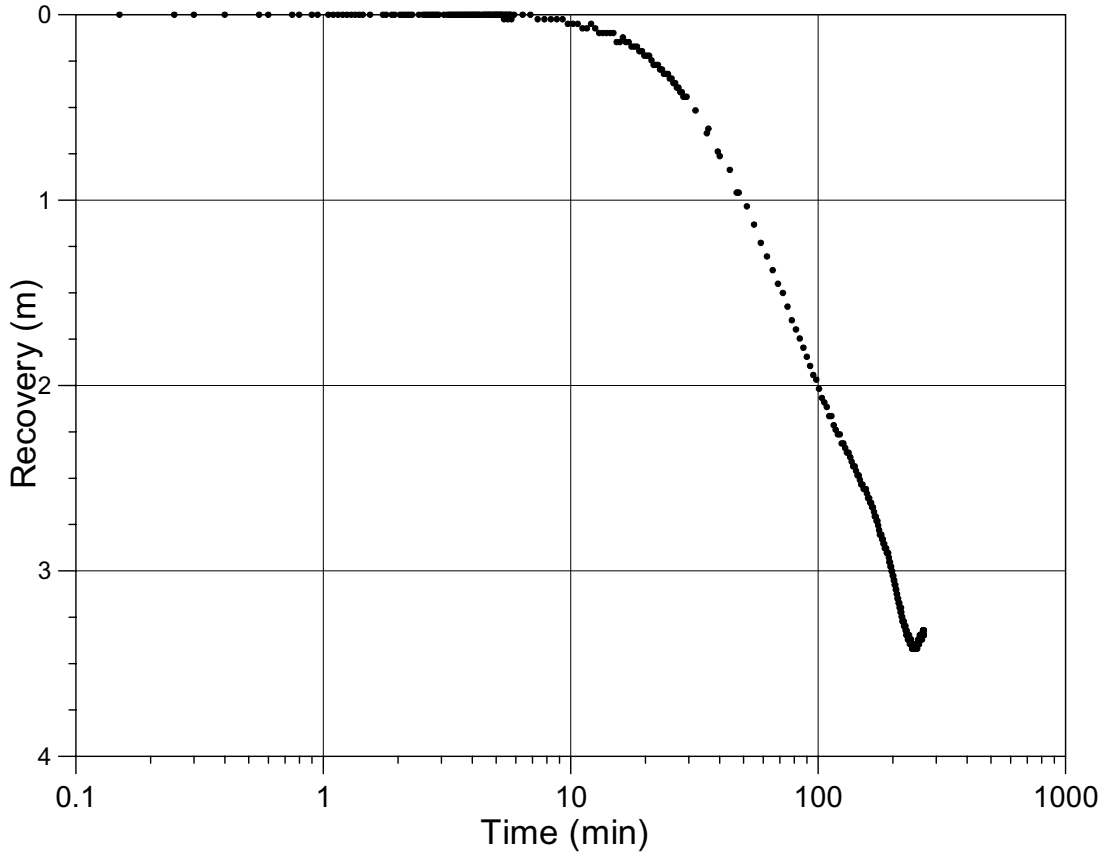
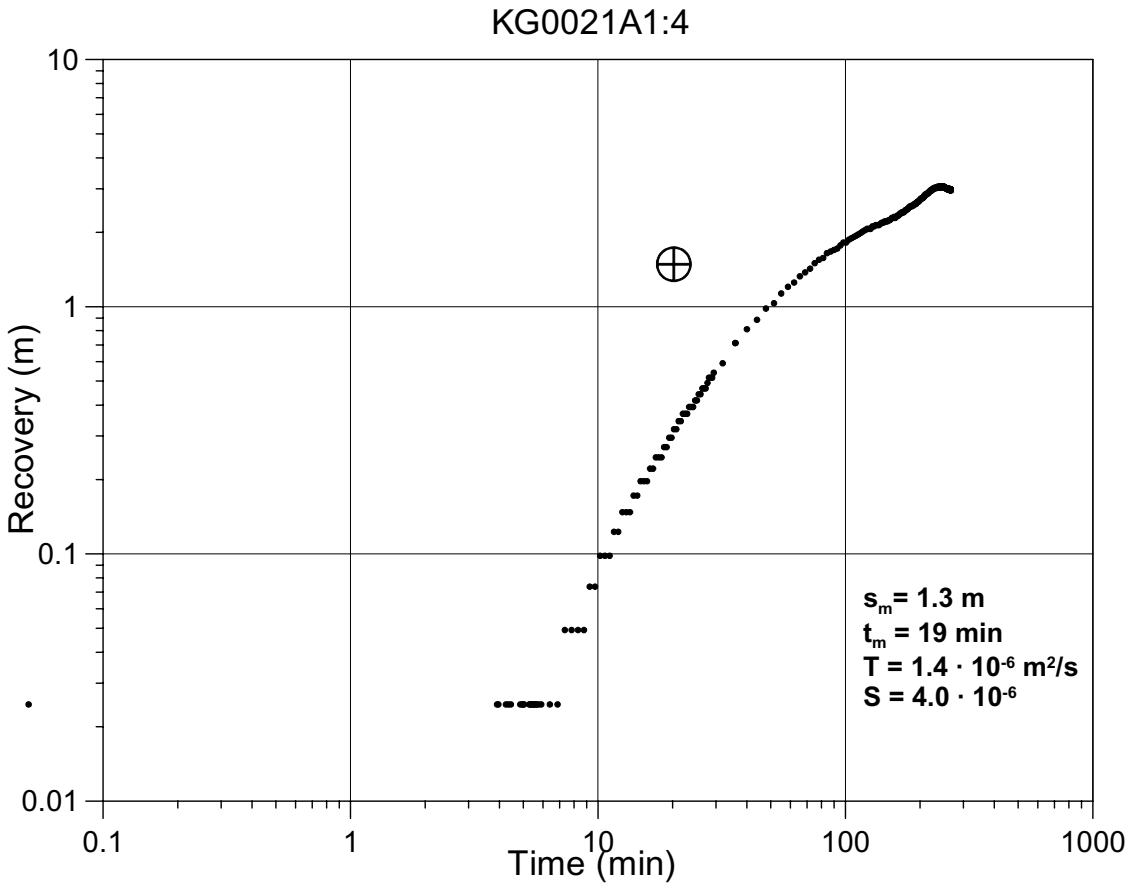
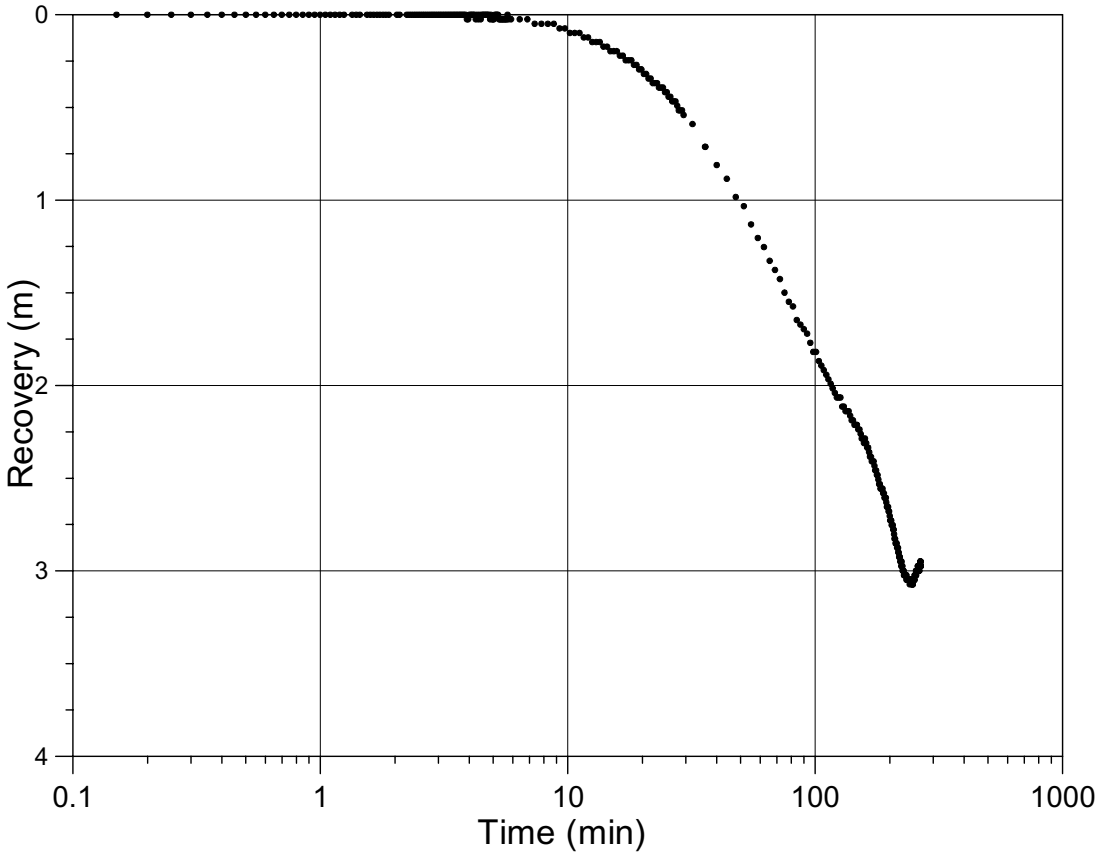


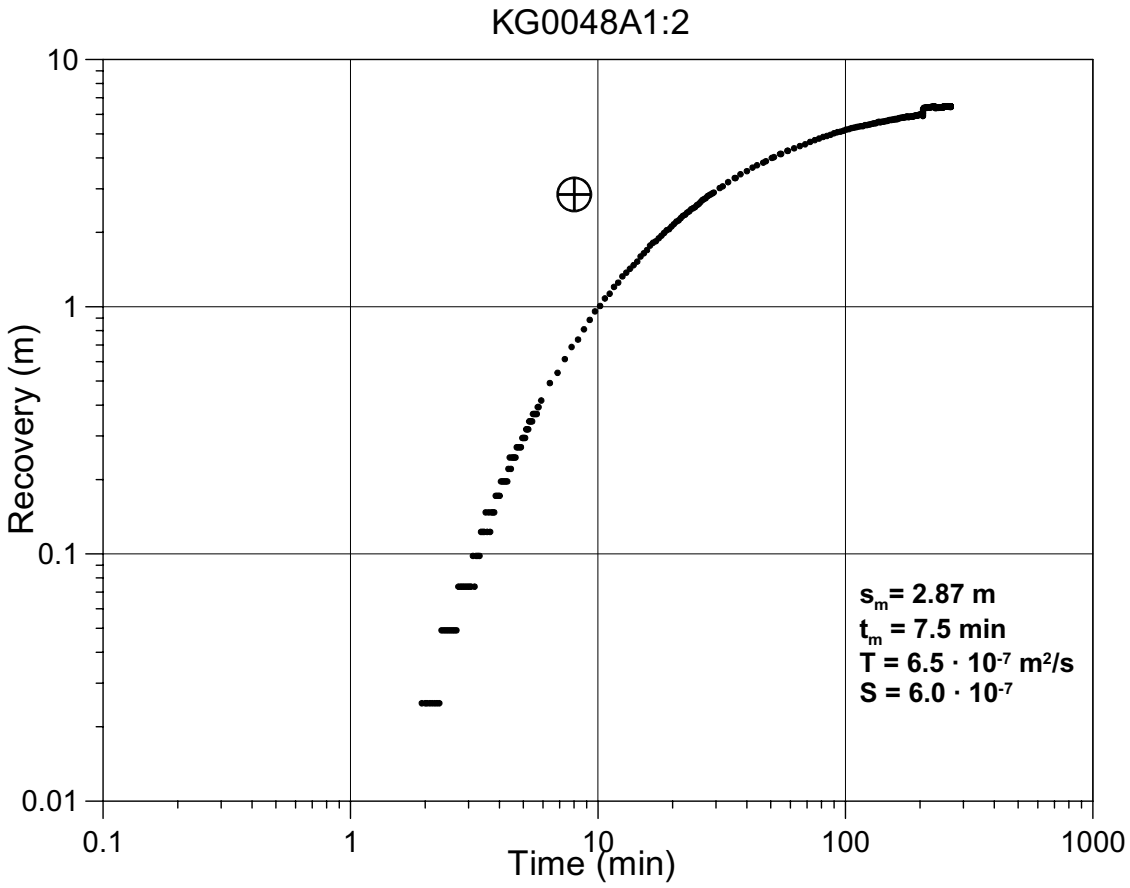


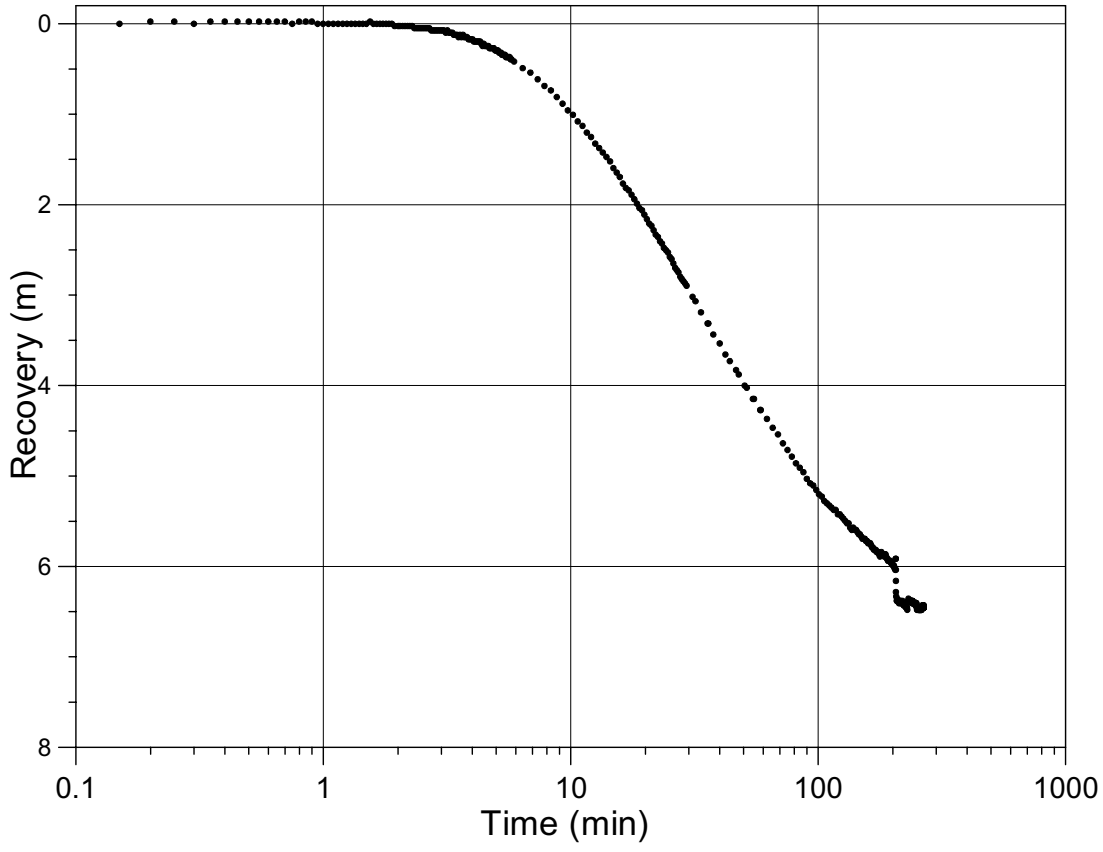
23_KG0021A1_3.GRF 2003-10-25



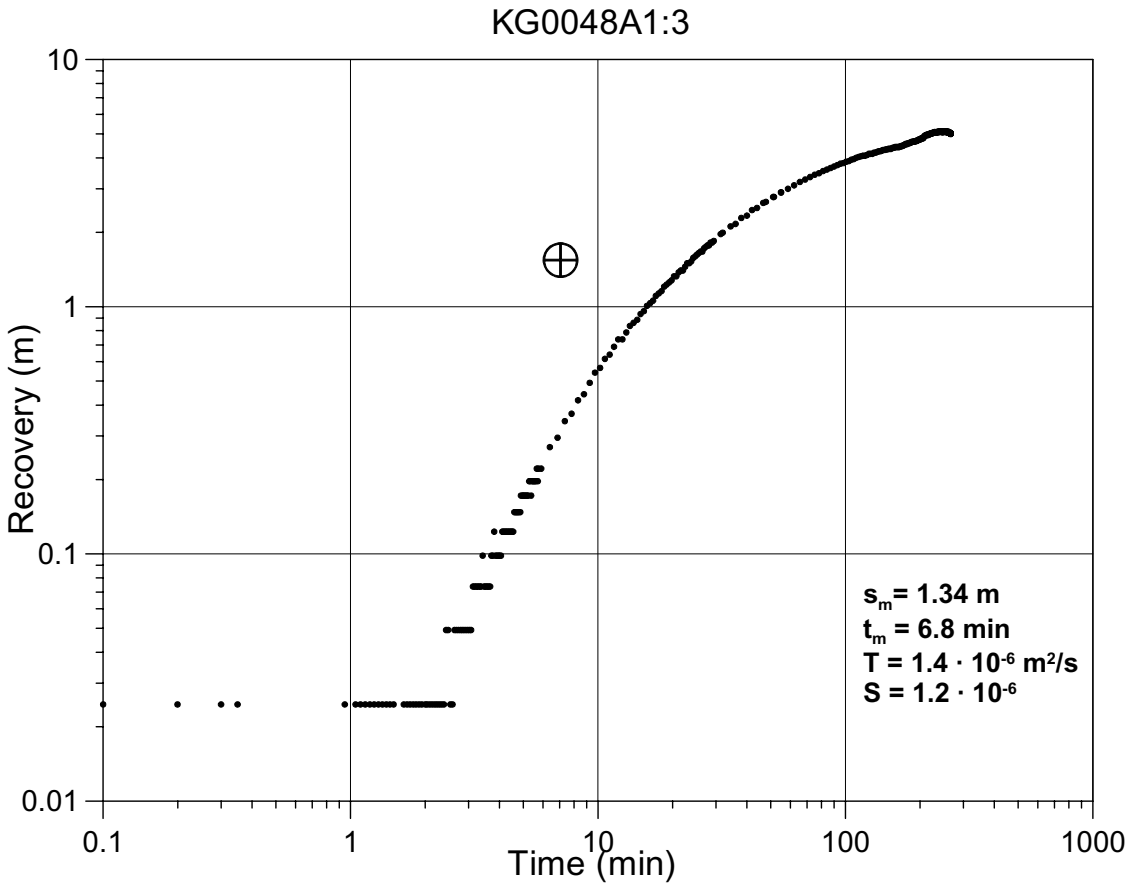


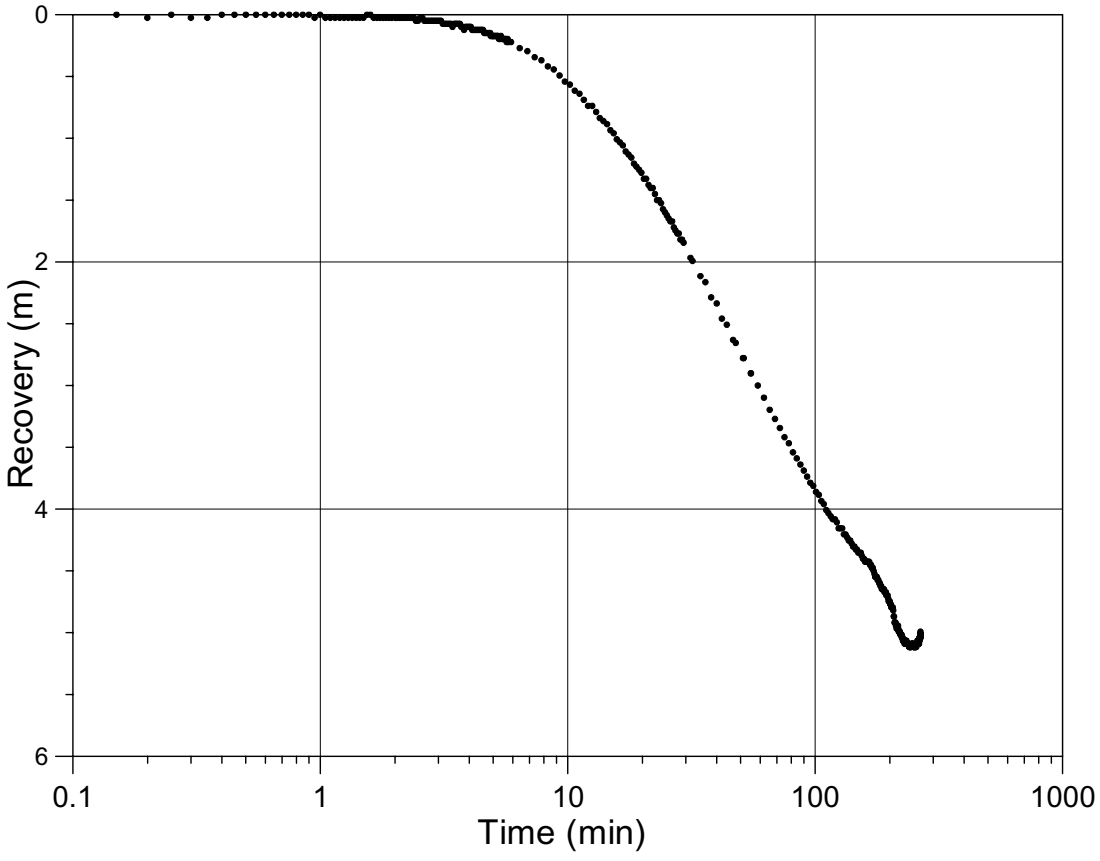
23_KG0021A1_4.GRF 2003-10-25



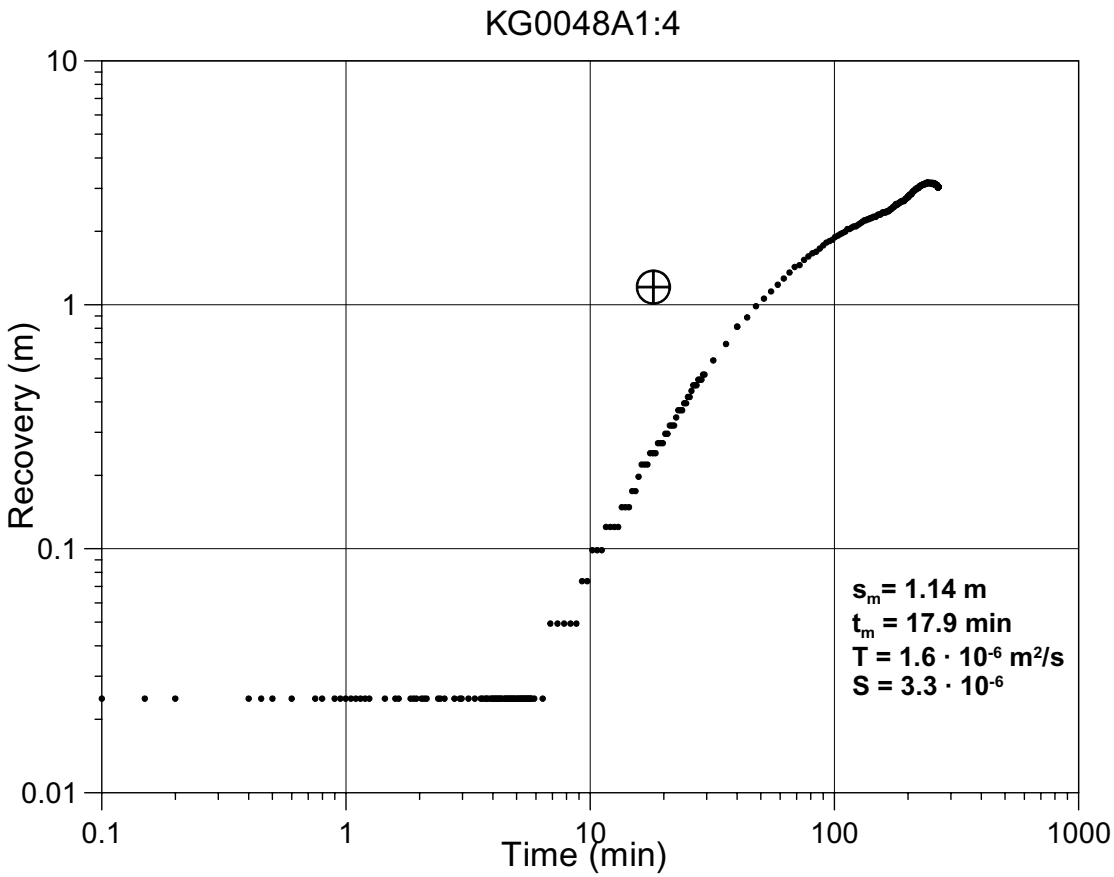


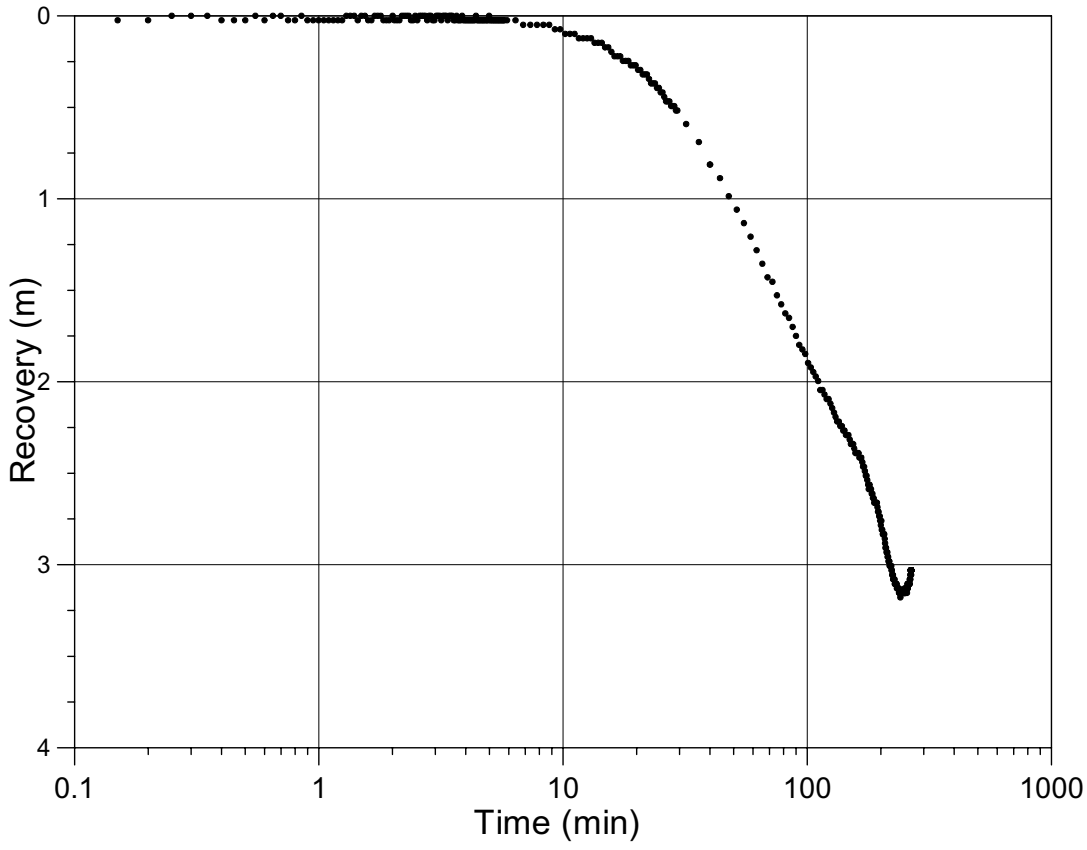
23_KG0048A1_2.GRF 2003-10-25





23_KG0048A1_3.GRF 2003-10-25





23_KG0048A1_4.GRF 2003-10-25

Appendix 4

Interference test 1:24 in borehole KA3590G02, section 25.50 m – 30.01 m

Date: 2003-05-12 Field Crew: A. Blom / J. Magnusson
Borehole length: 30.01 m Borehole diameter: 76 mm

Flowing borehole: KA3590G02, section 1: 25.50 – 30.01 m

Valve opened: 20030512 09:41.00 Valve closed: 20030512 15:41.00

End of Test: 20030513 09:40

Total flowing time : 360 min Tot. Pr. Build-up time: 1079 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

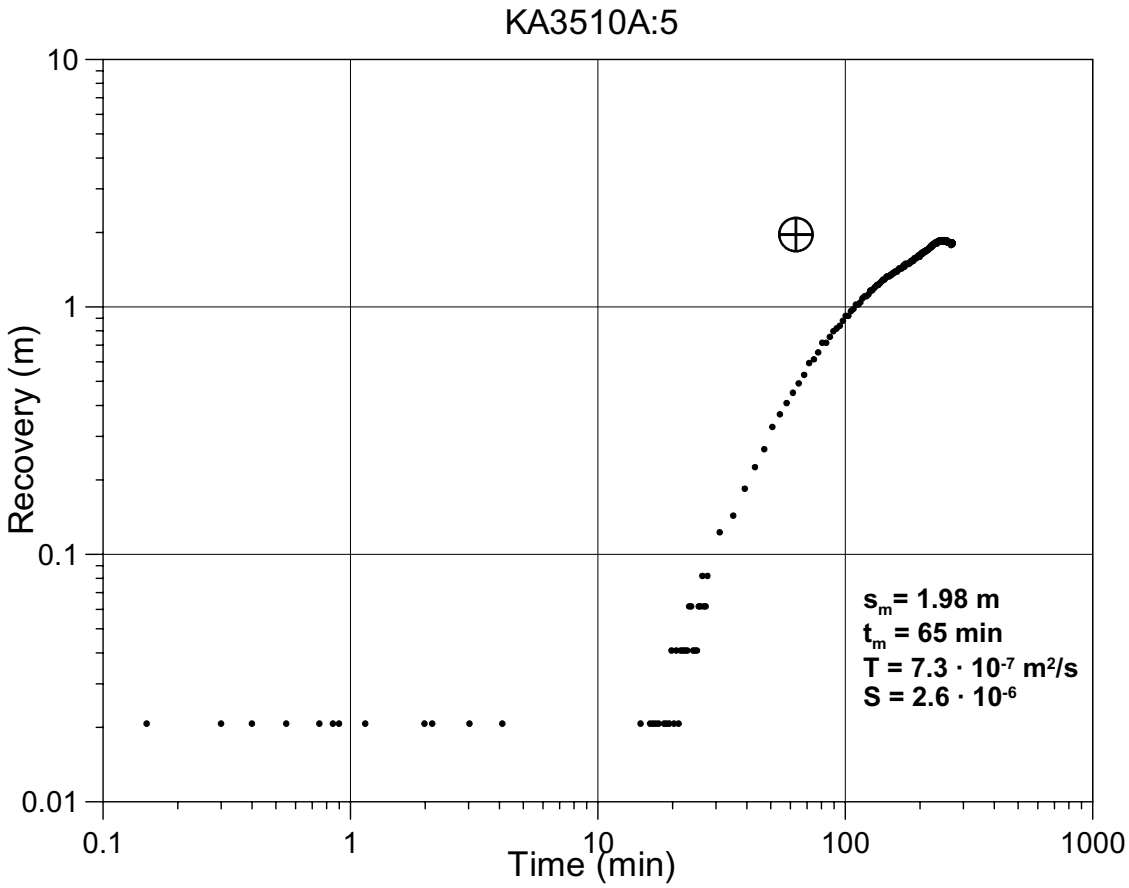
Manually measured flow rates of KA3590G02, section 25.50 m – 30.01 m are presented in the table below:

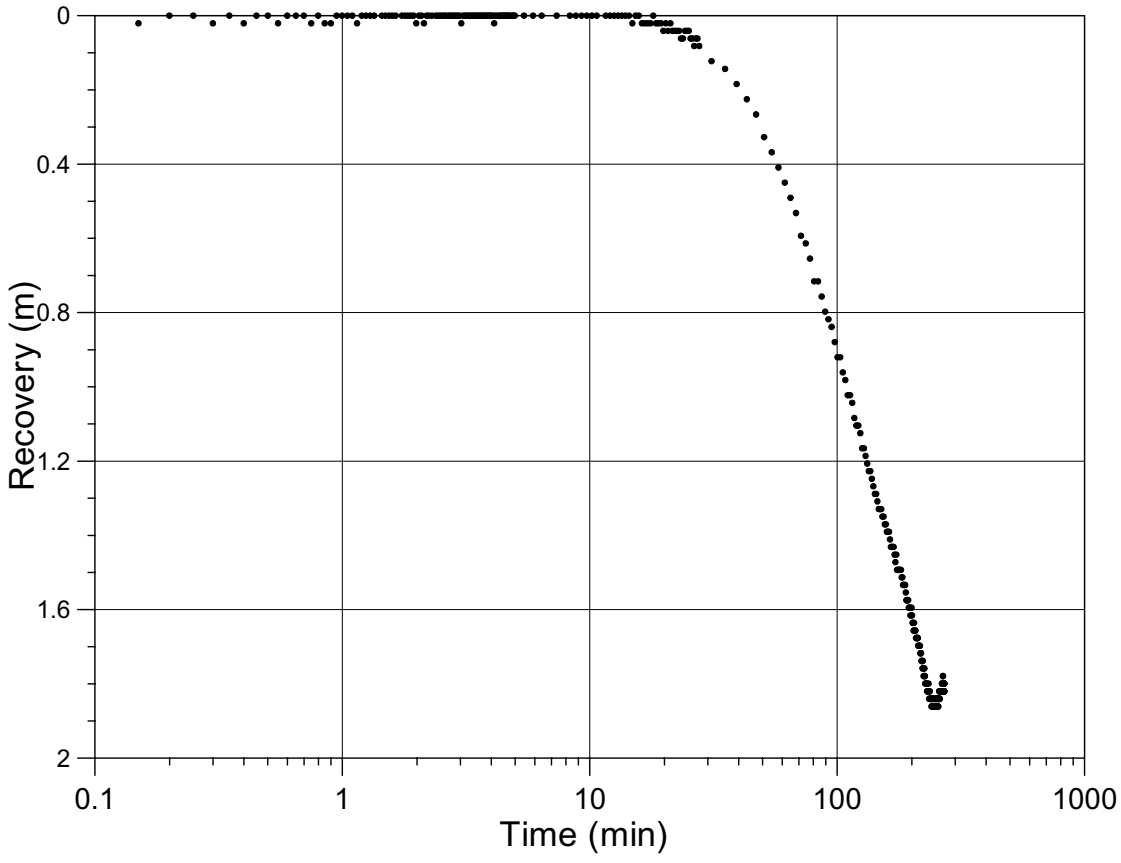
Table Manually measured flow rates, Interference test in KA3590G02, section 25.50 m – 30.01 m. Prototype Repository, May 12 2003

Time	Flow rate (l/min)
09:41:30	1.500
09:44:00	1.414
09:46:00	1.380
10:19:30	1.188
10:21:30	1.184
10:23:10	1.184
15:29:00	1.094
15:31:00	1.097
15:33:00	1.100

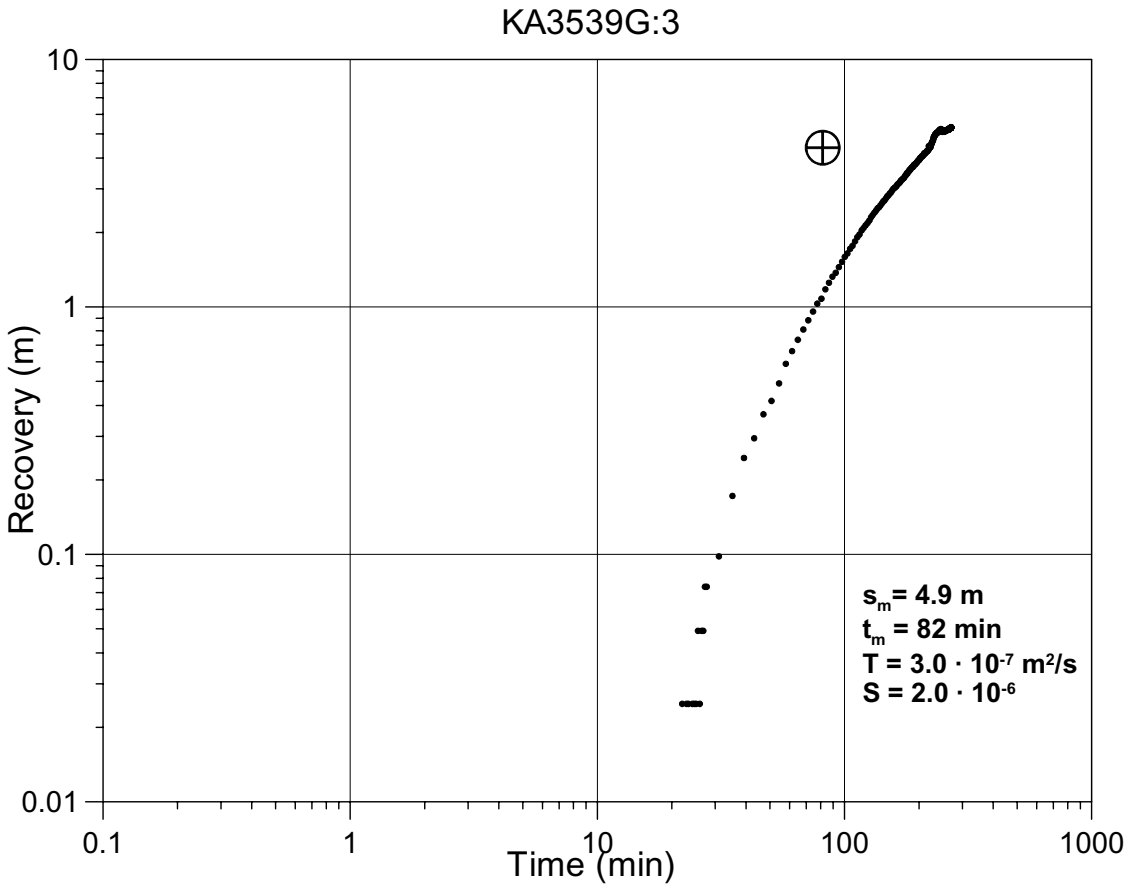
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

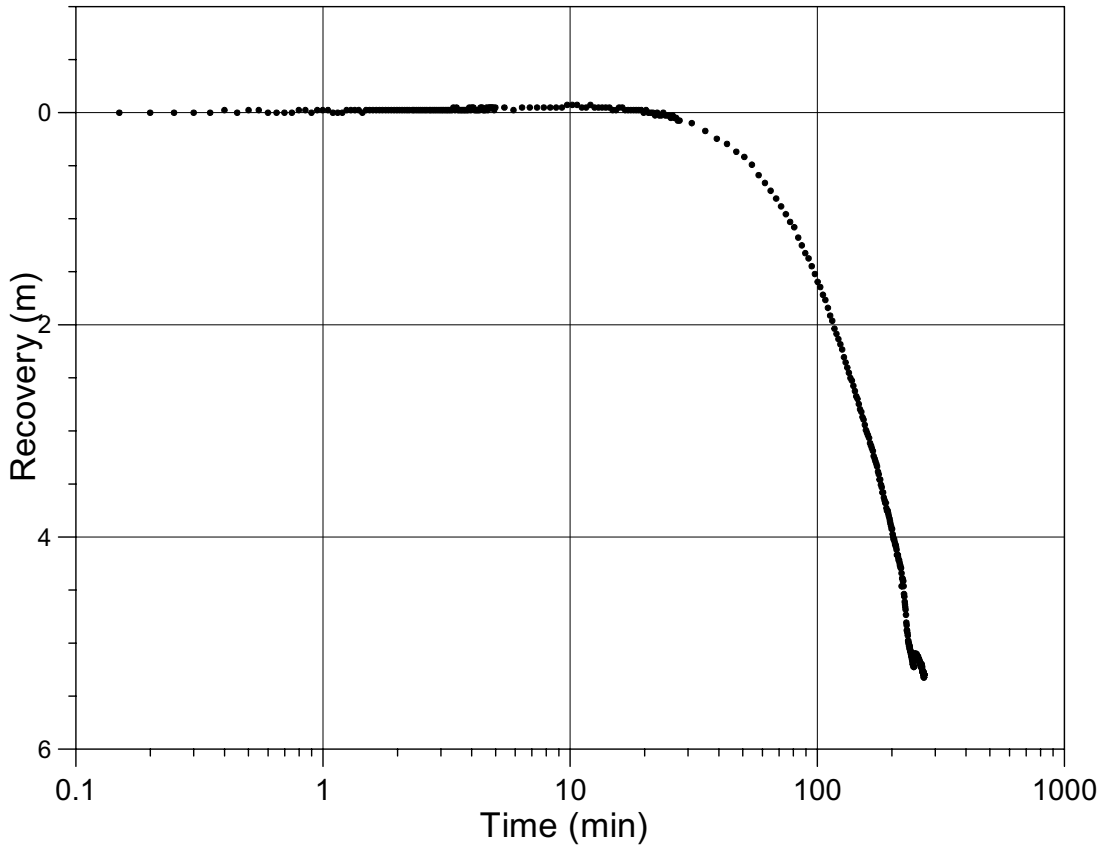
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



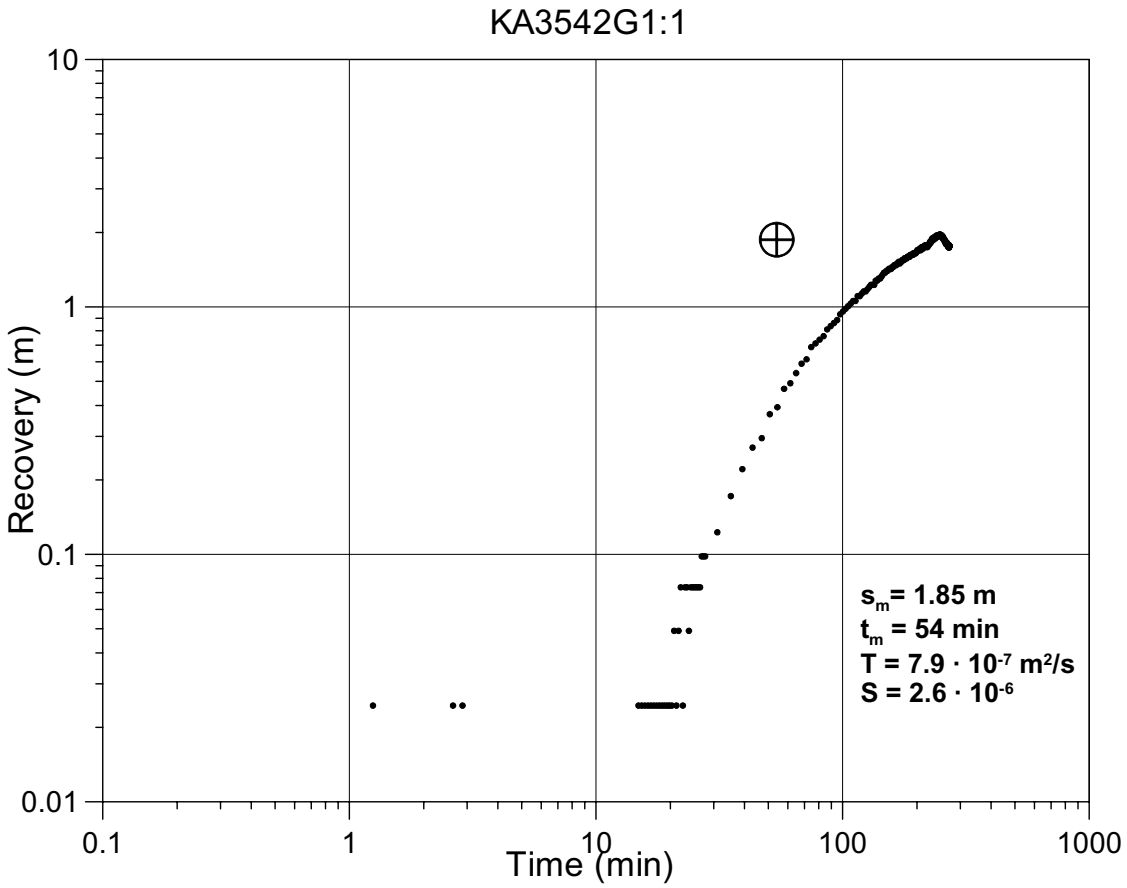


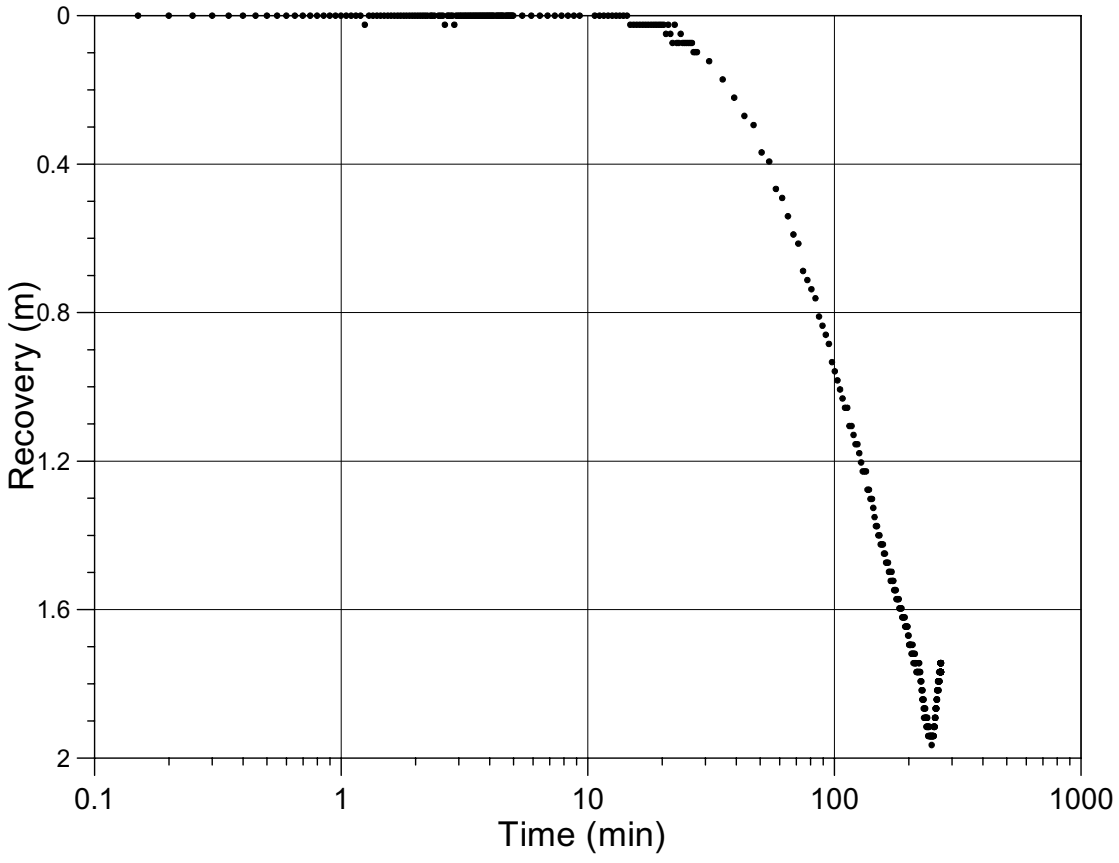
24_KA3510A_5.GRF 2003-10-25



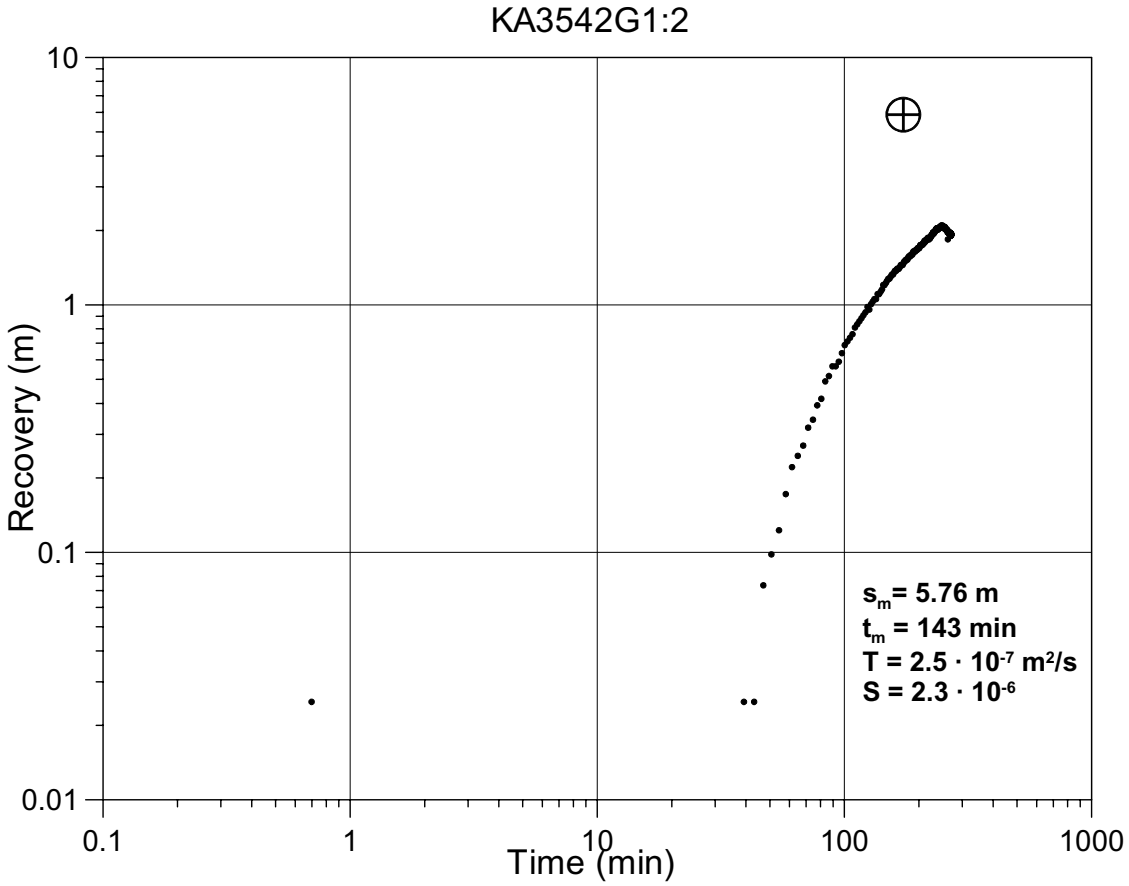


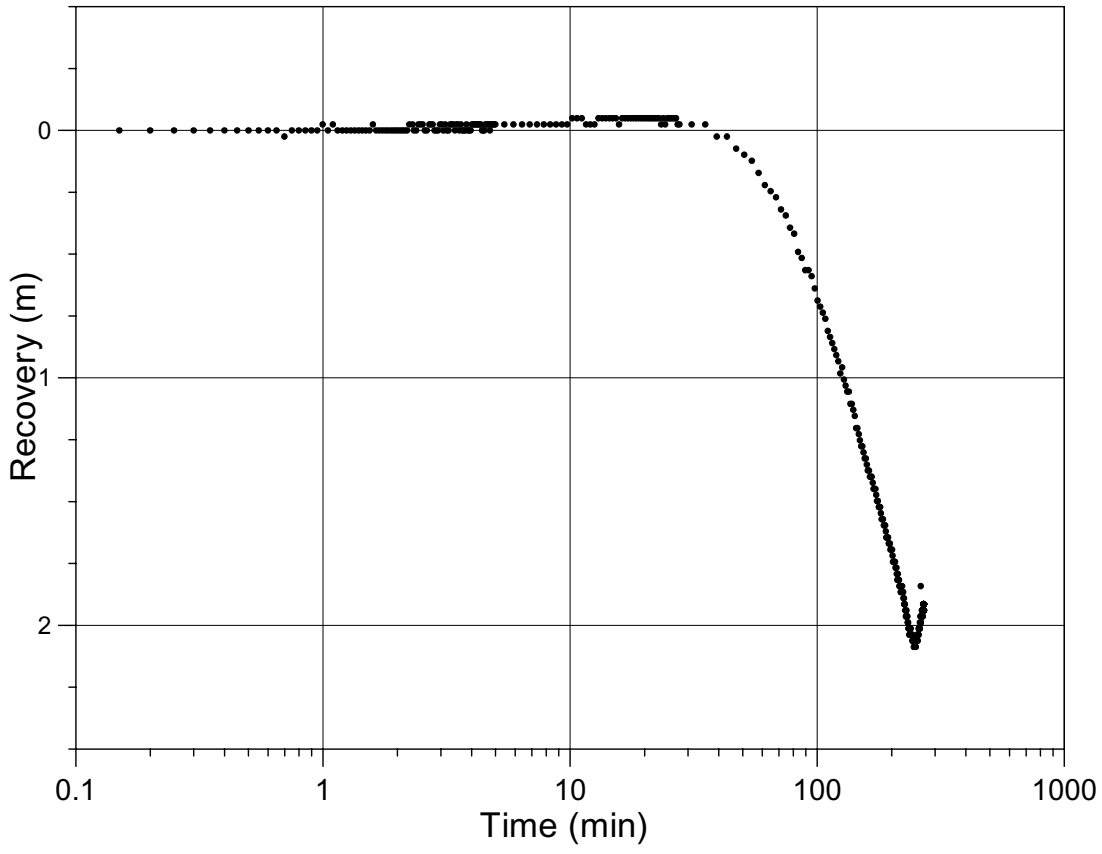
24_KA3539G_3.GRF 2003-10-25



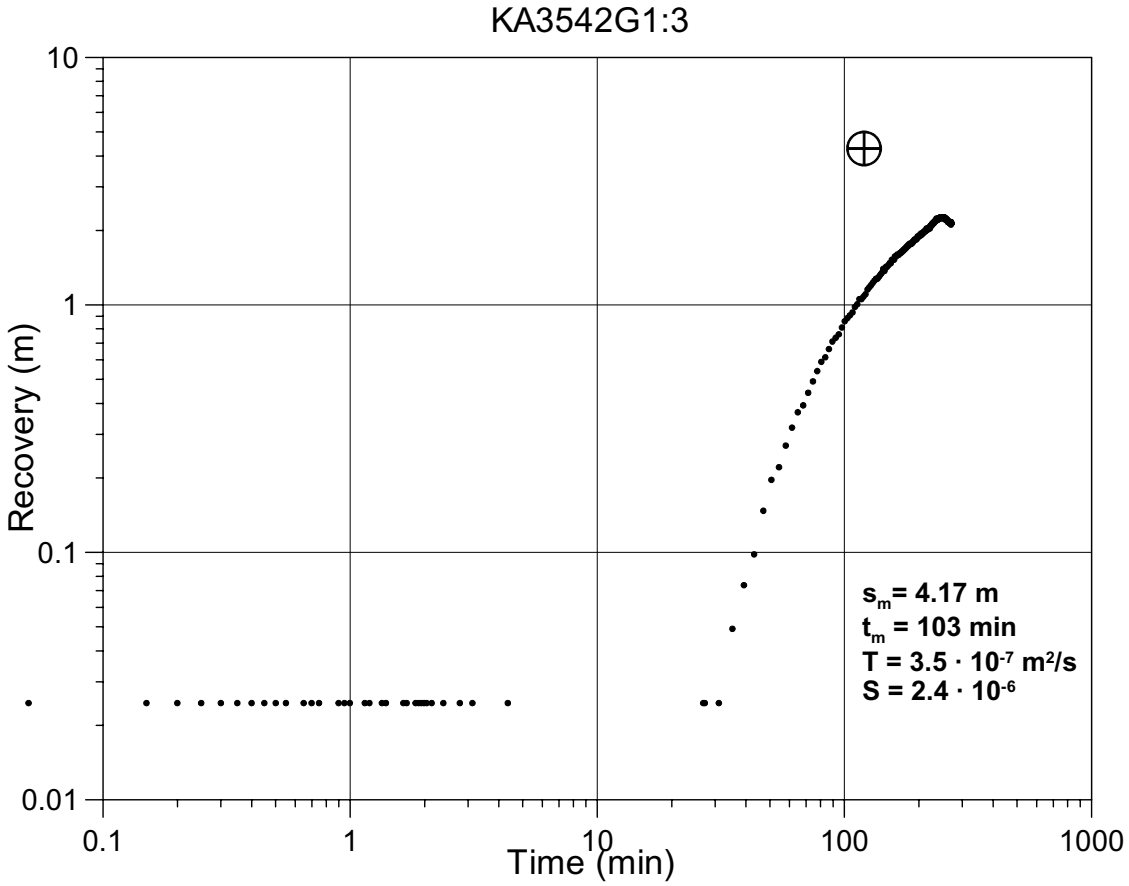


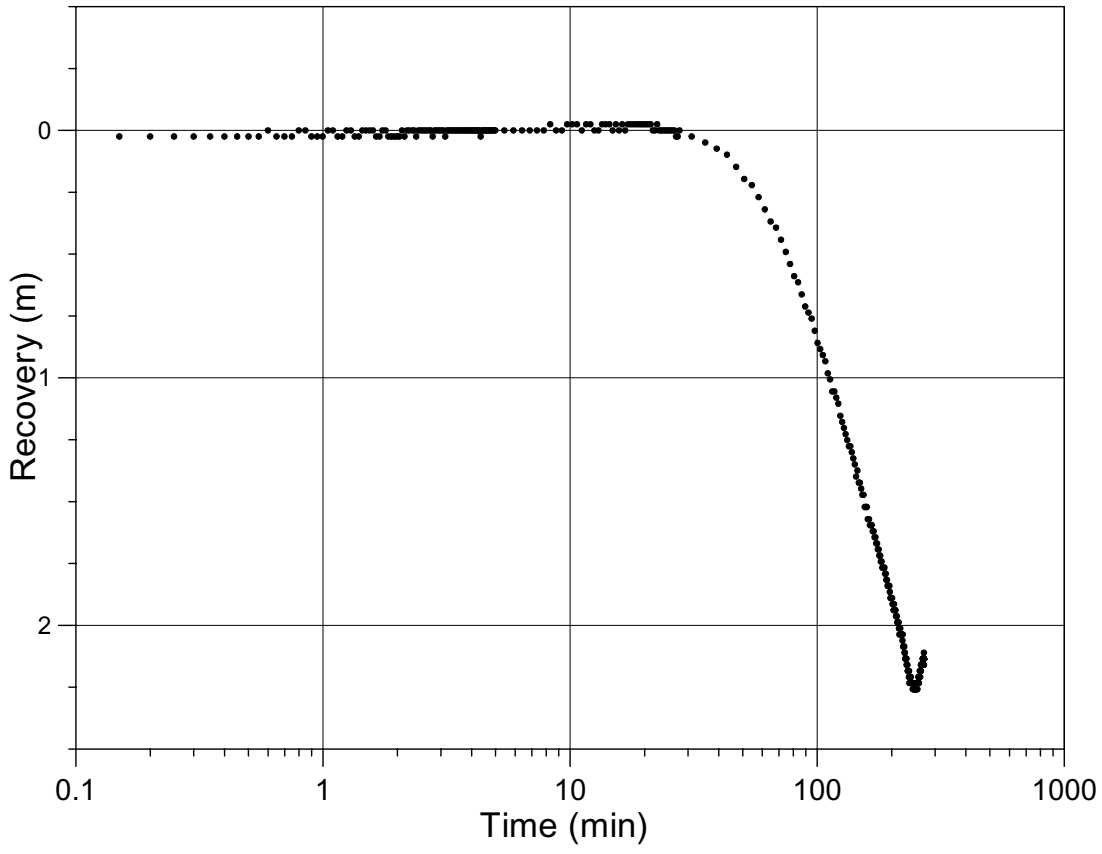
24_KA3542G1_1.GRF 2003-10-25



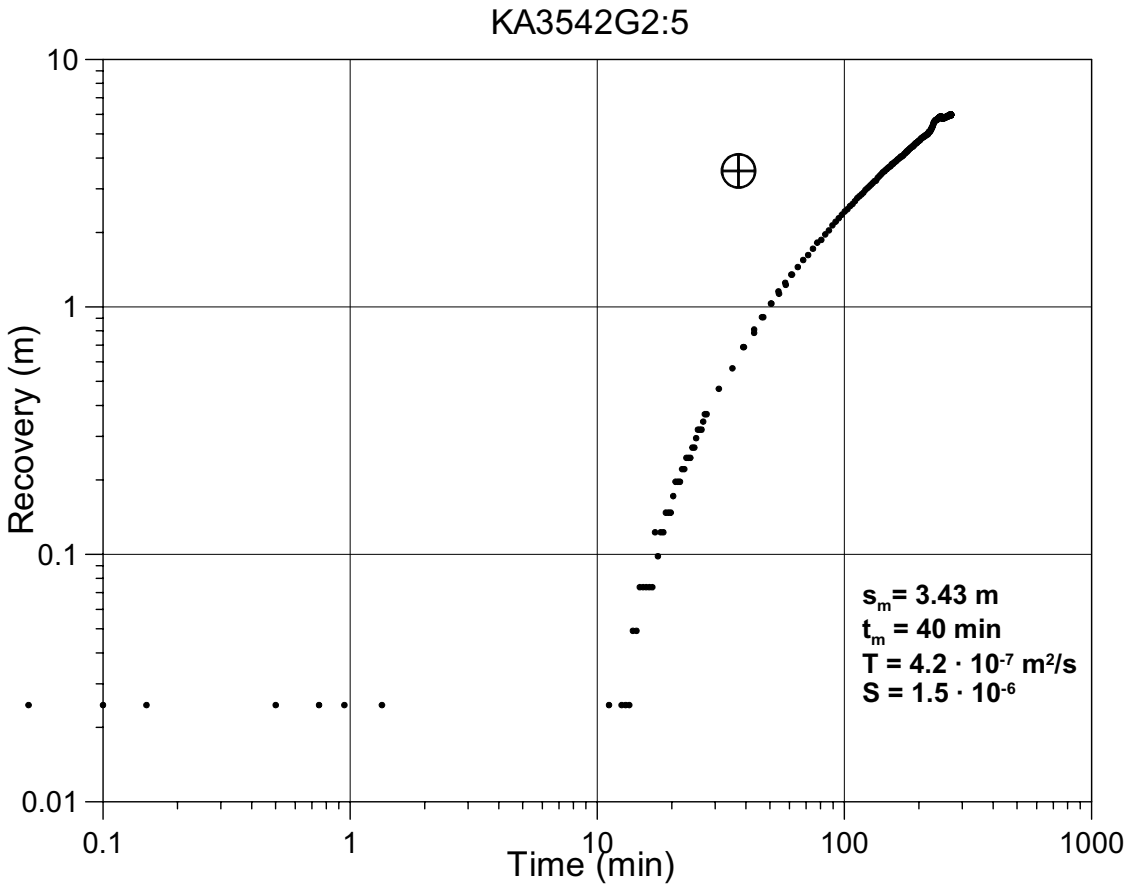


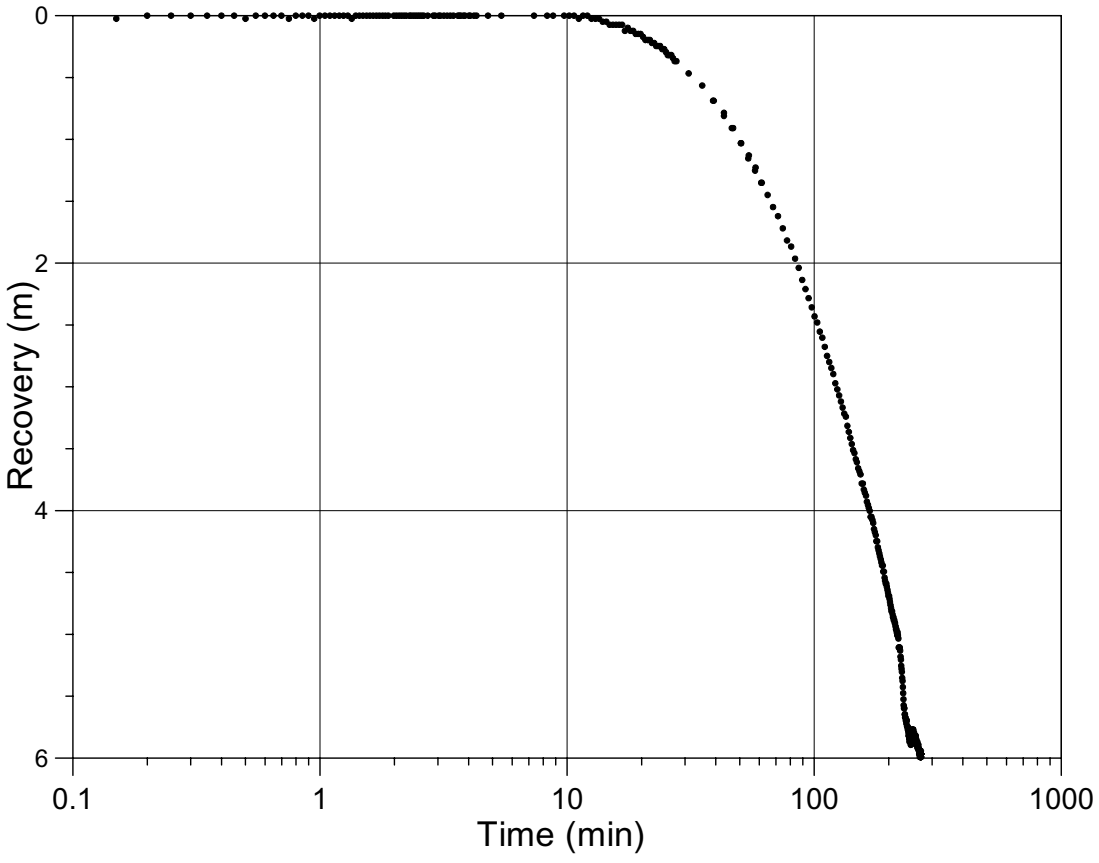
24_KA3542G1_2.GRF 2003-10-25



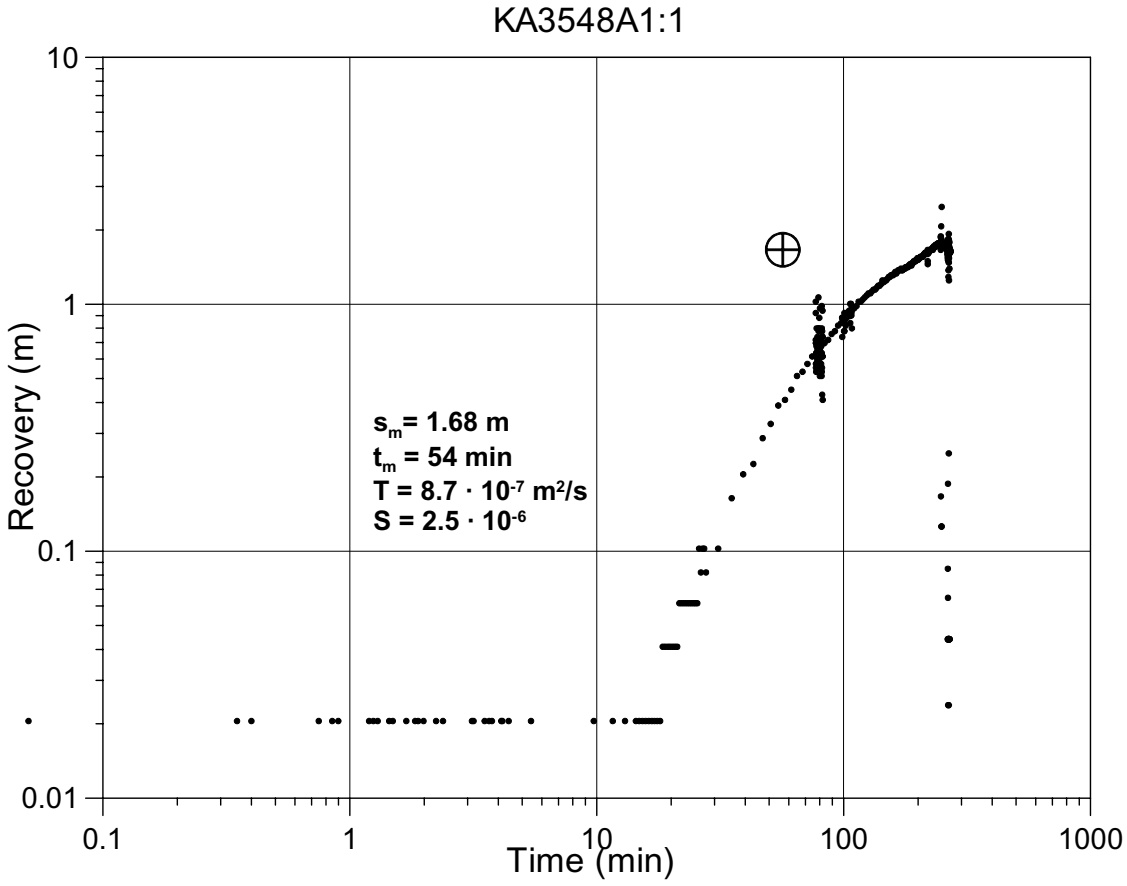


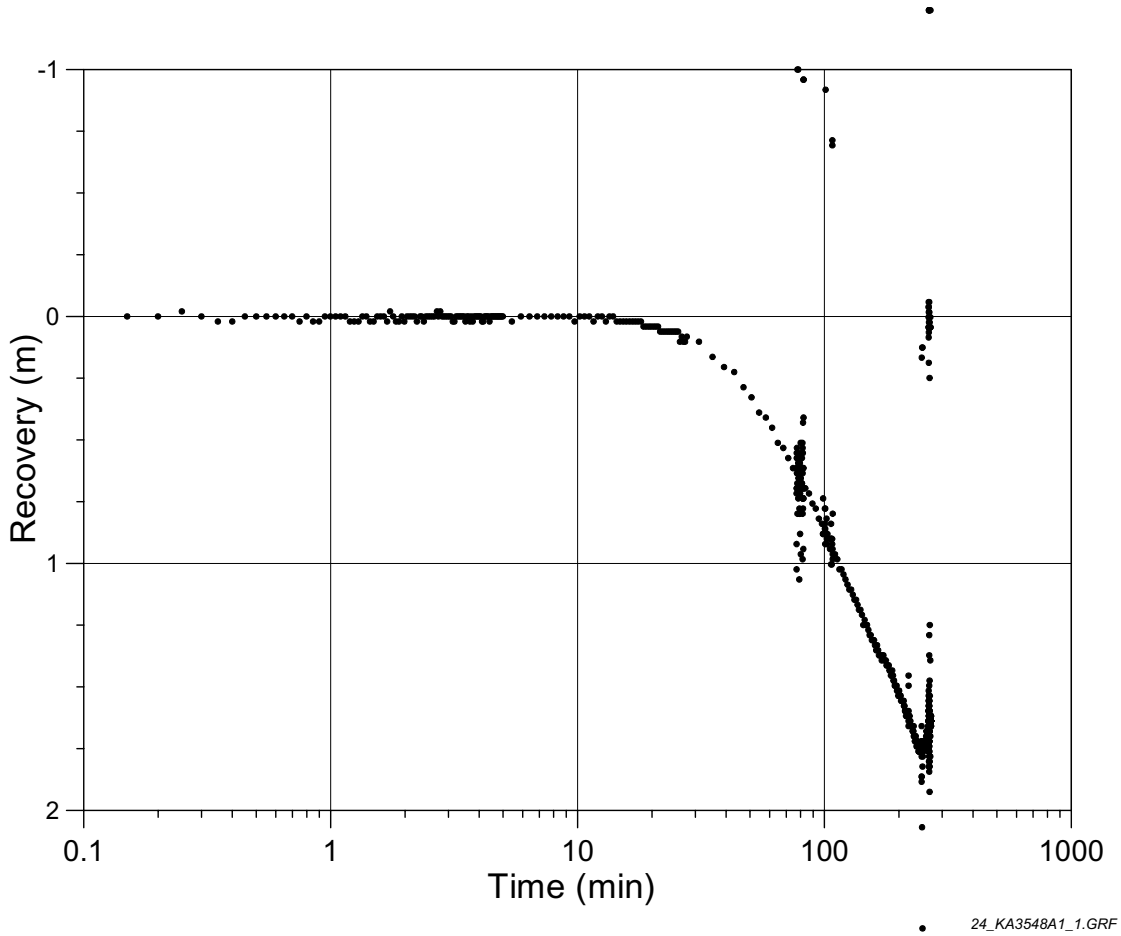
24_KA3542G1_3.GRF 2003-10-25



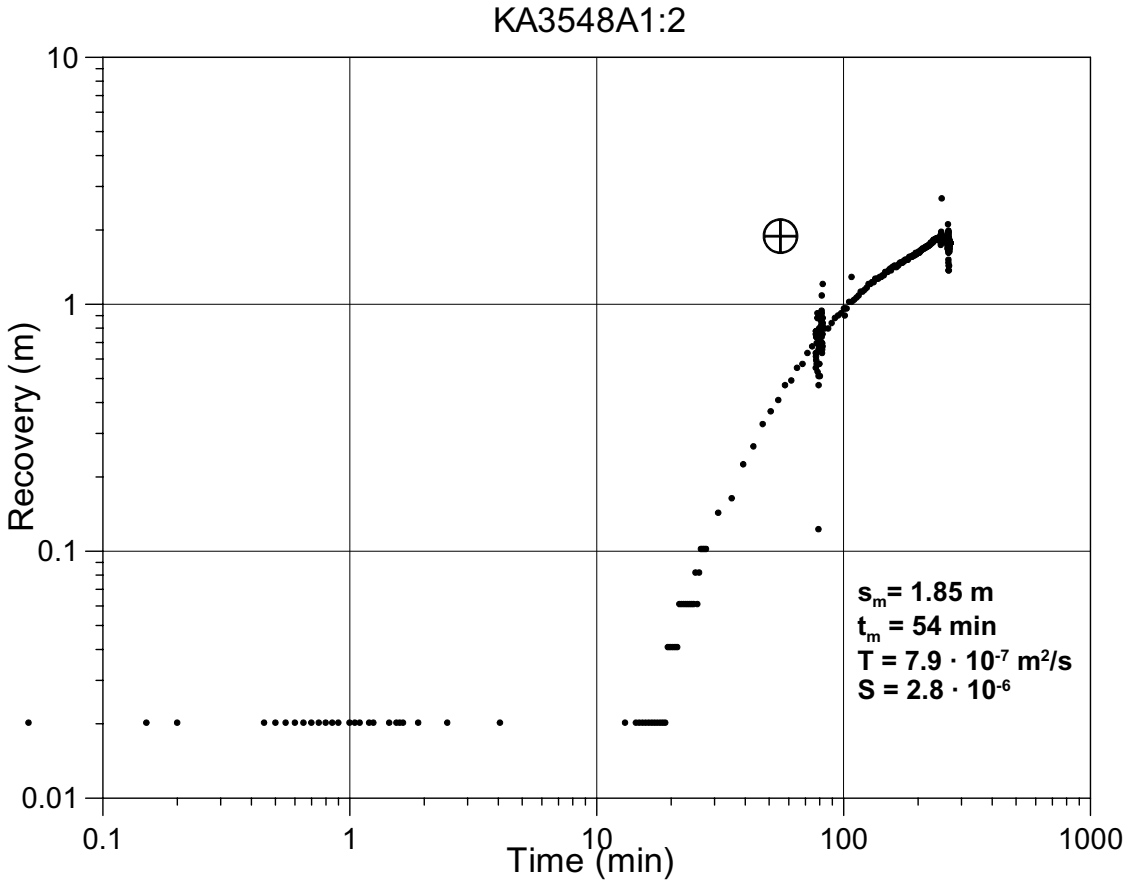


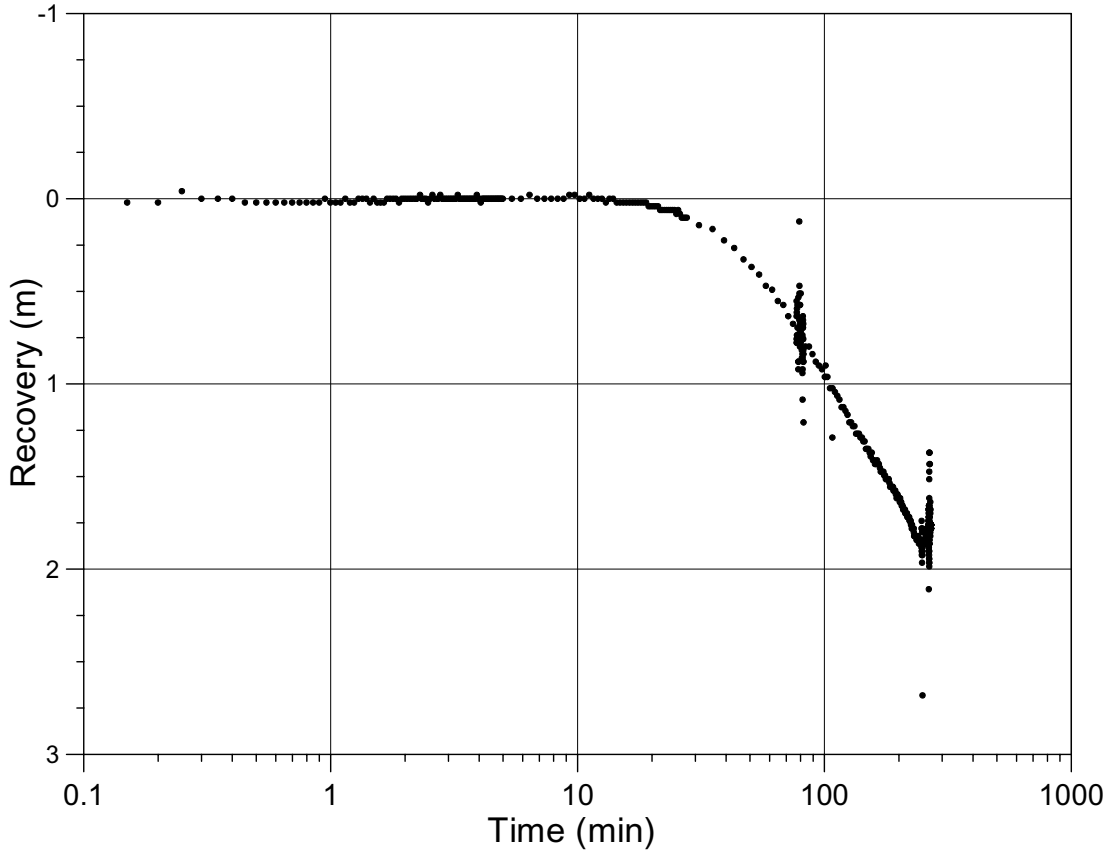
24_KA3542G2_5.GRF 2003-10-25





24_KA3548A1_1.GRF 2003-10-25





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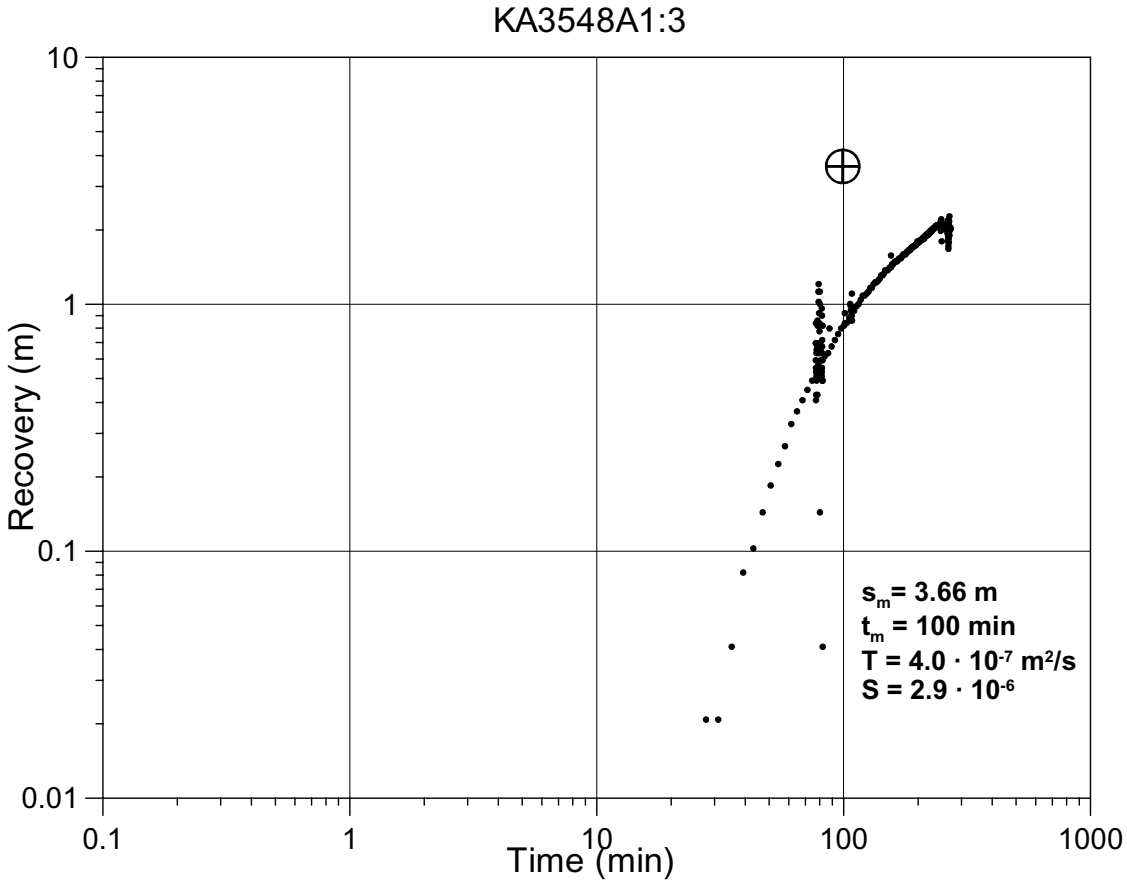
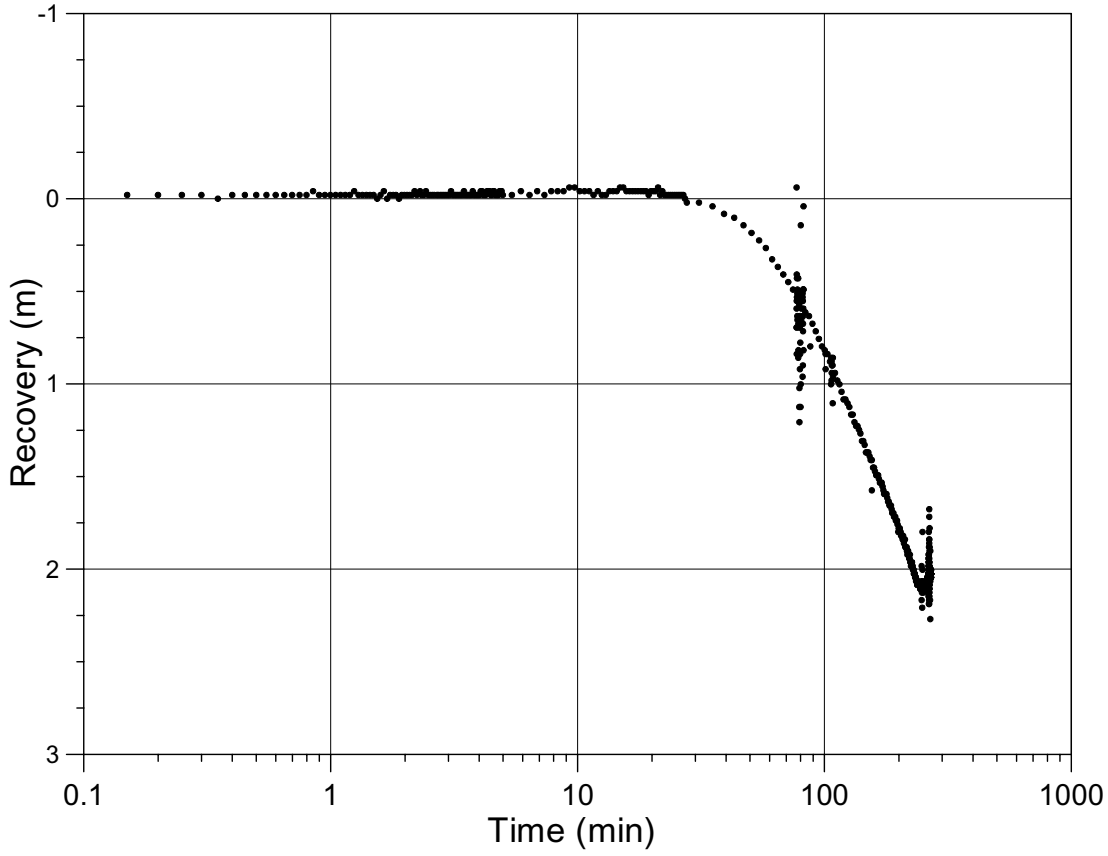
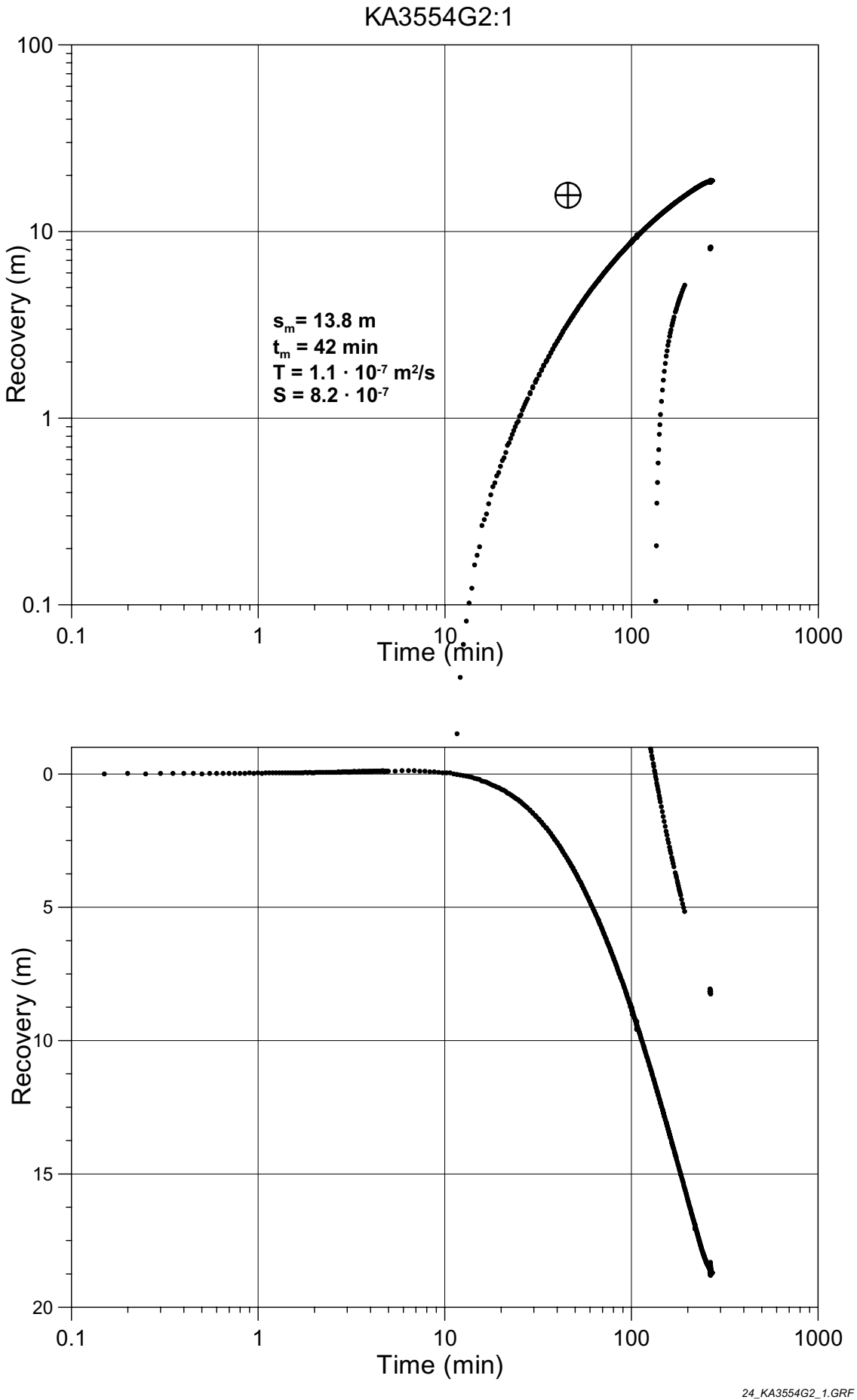
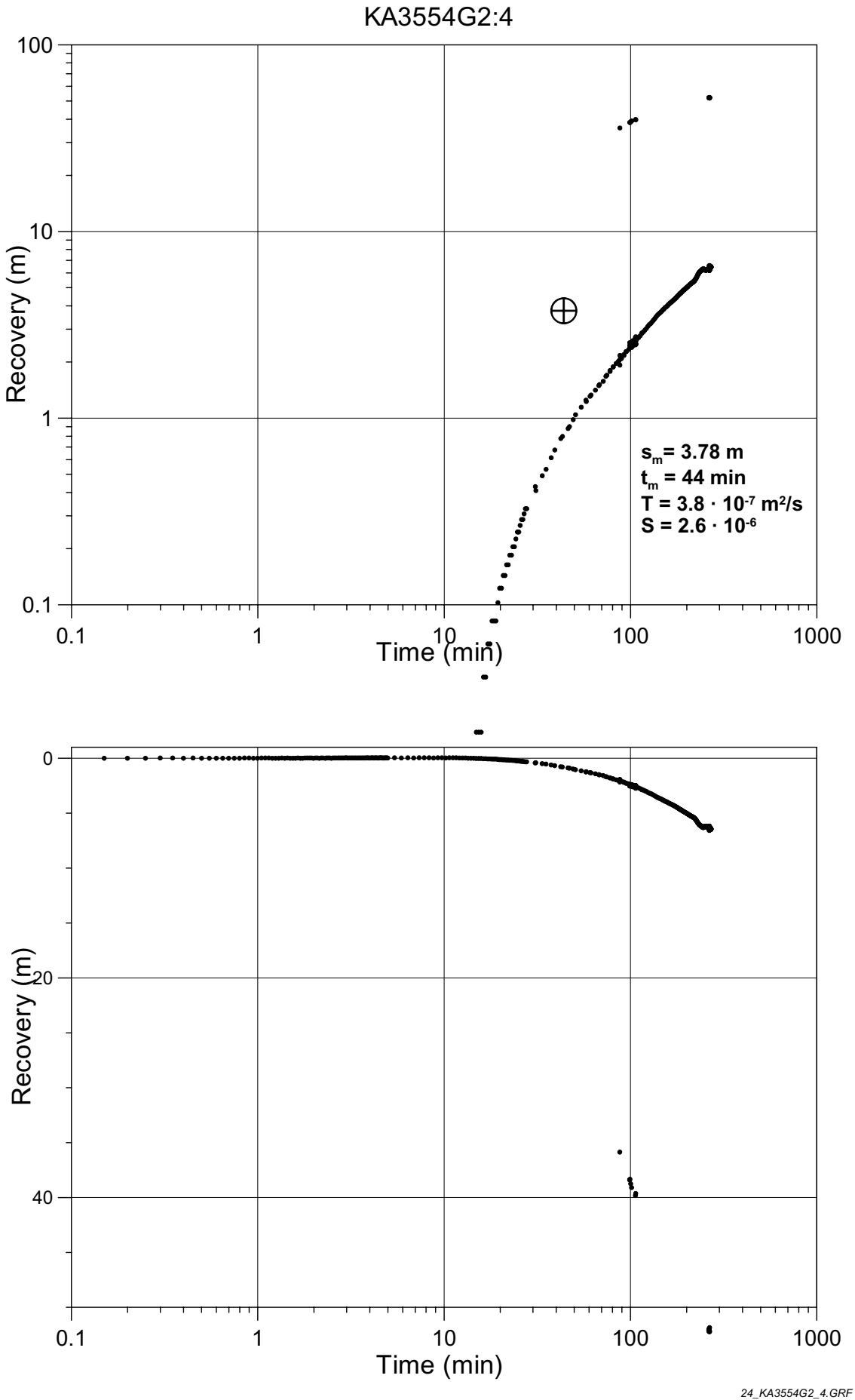
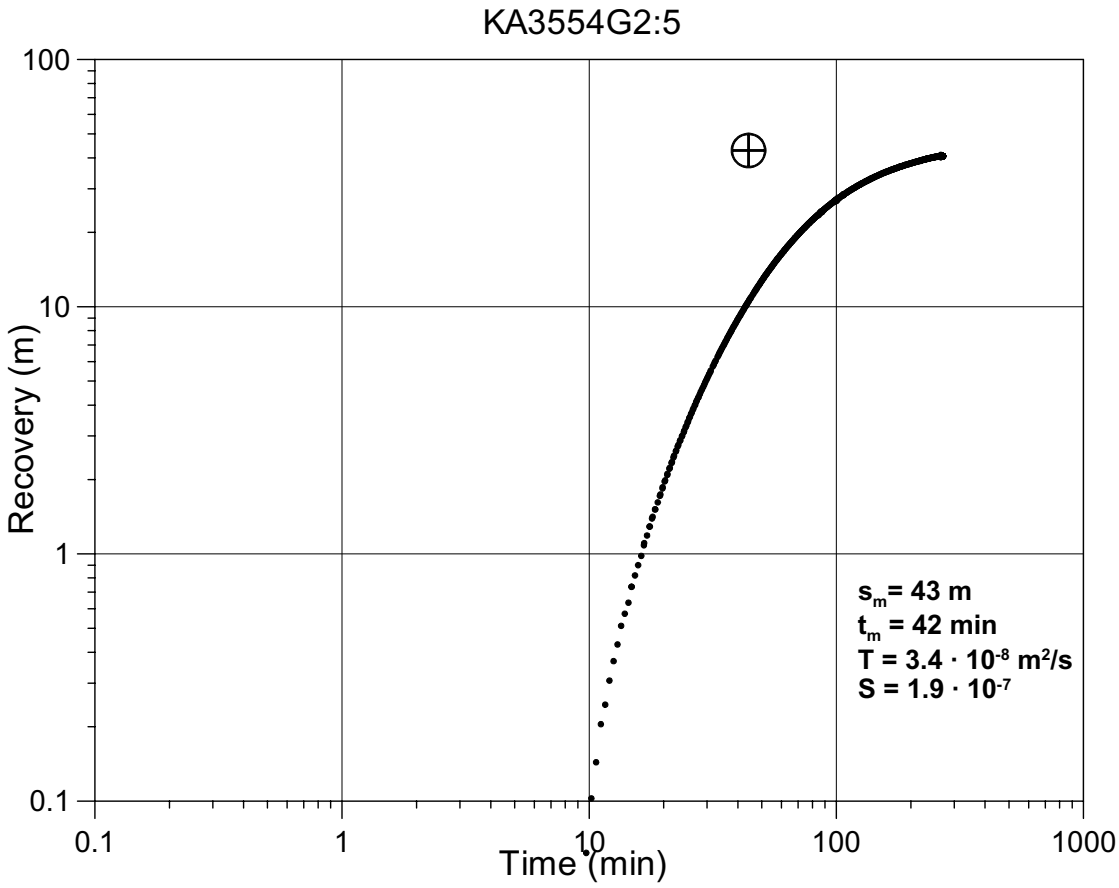


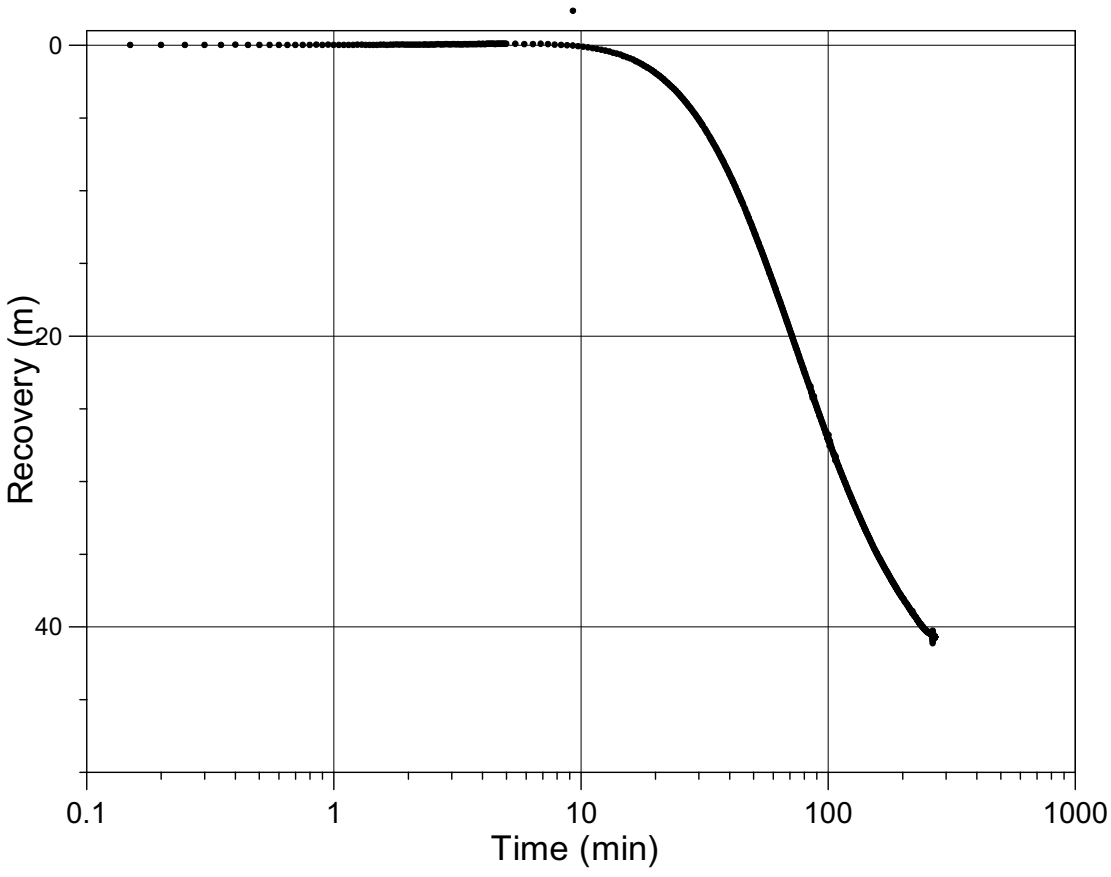


24_KA3548A1_3.GRF 2003-10-25

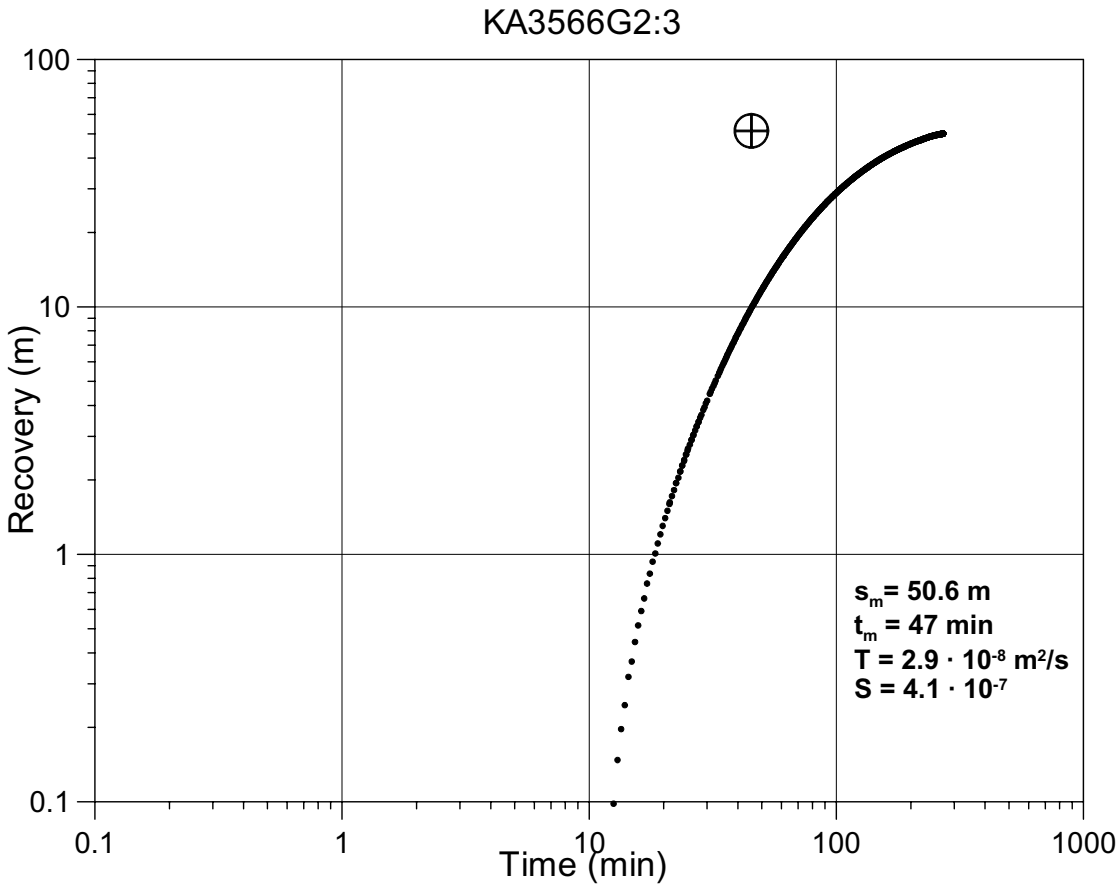

KA3554G2:1
Recovery (m)
Time (min)
s_m= 13.8 m
t_m = 42 min
T = 1.1 · 10^{-7} m^2/s
S = 8.2 · 10^{-7}
24_KA3554G2_1.GRF 2003-10-25

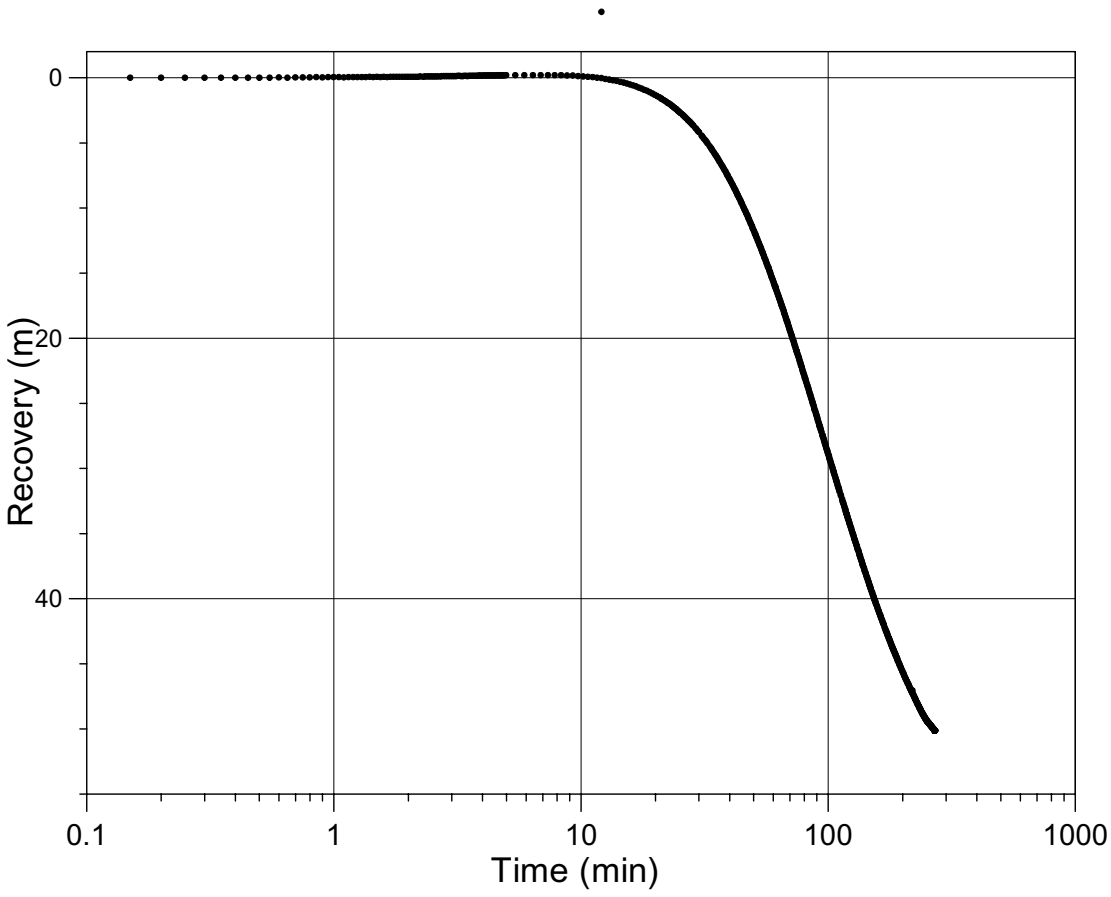

KA3554G2:4
Recovery (m)
Time (min)
s_m= 3.78 m
t_m = 44 min
T = 3.8 · 10^{-7} m^2/s
S = 2.6 · 10^{-6}
24_KA3554G2_4.GRF 2003-10-25



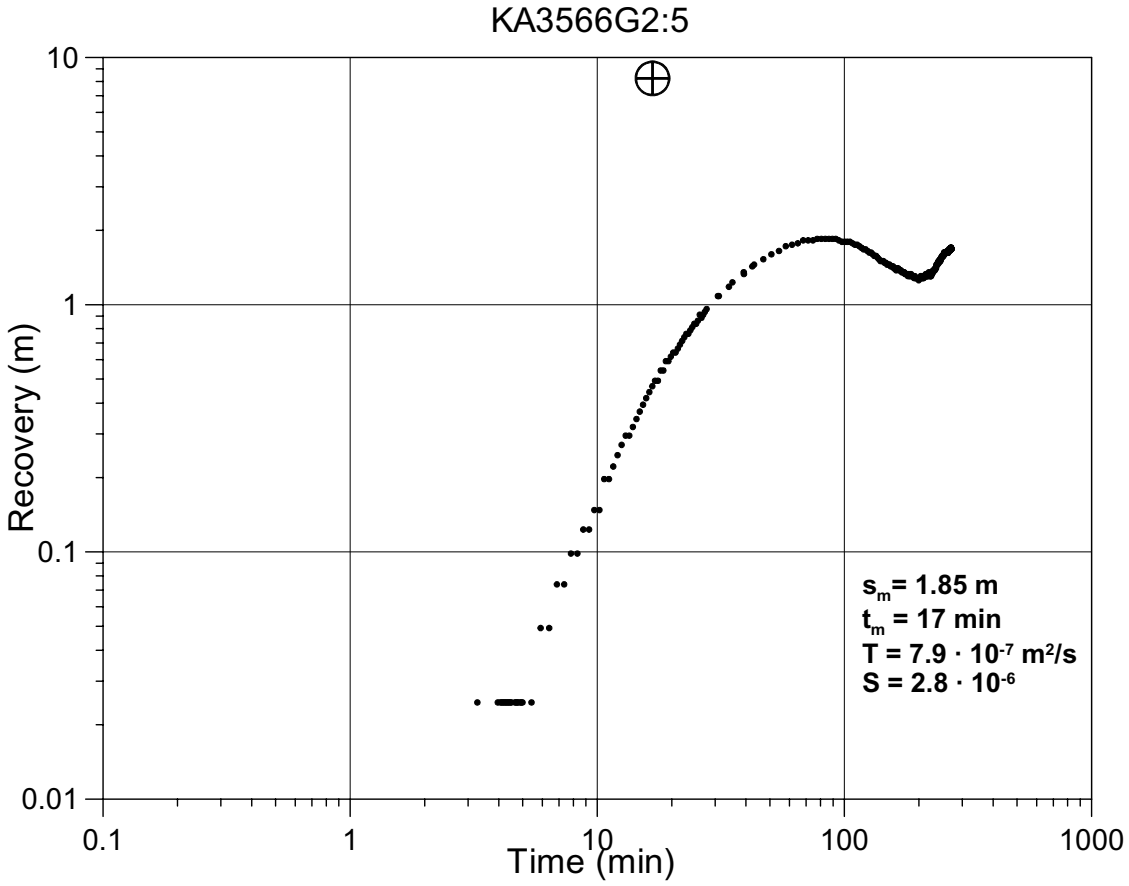


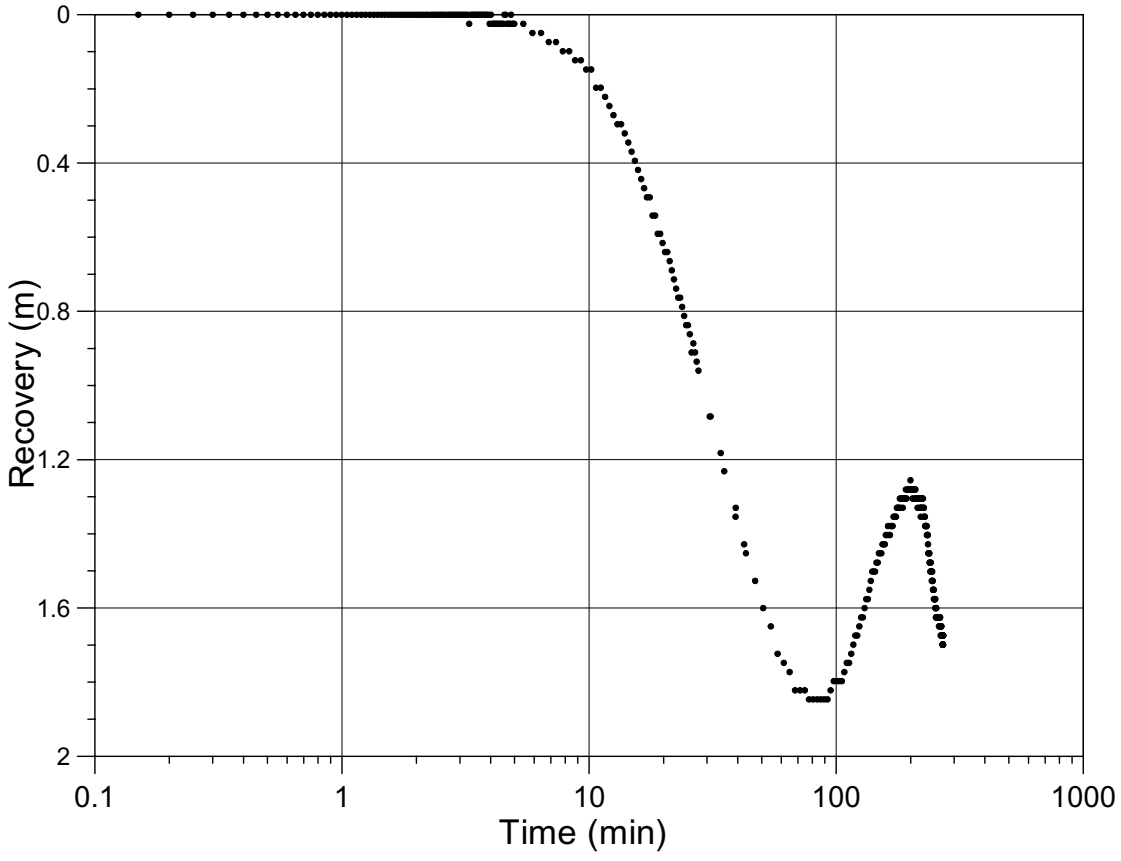
24_KA3554G2_5.GRF 2003-10-25



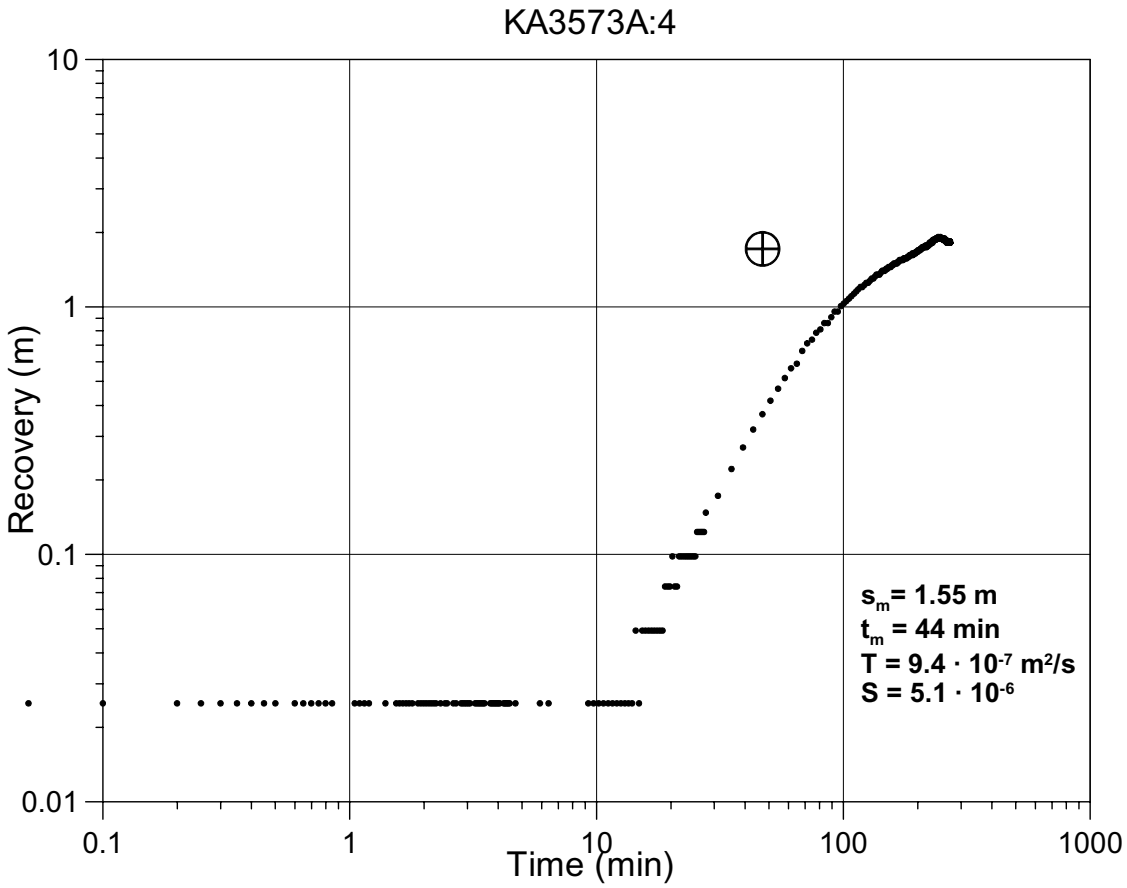


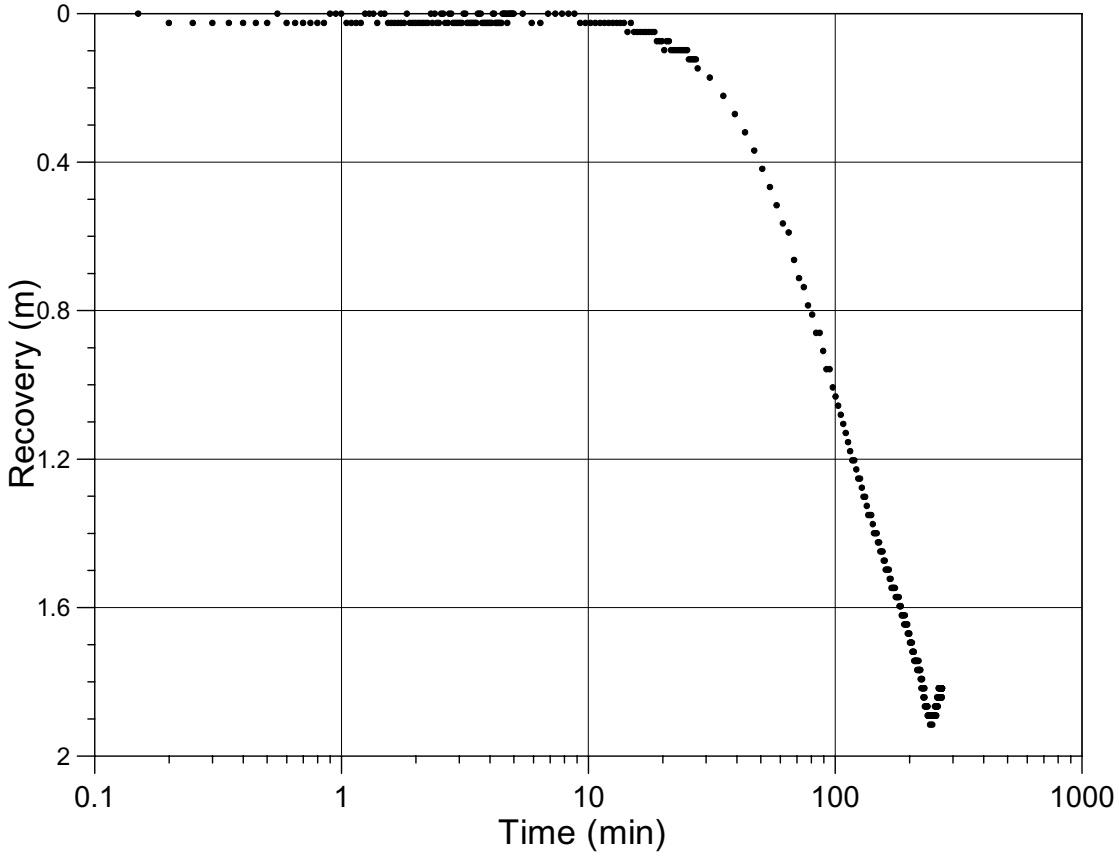
24_KA3566G2_3.GRF 2003-10-29



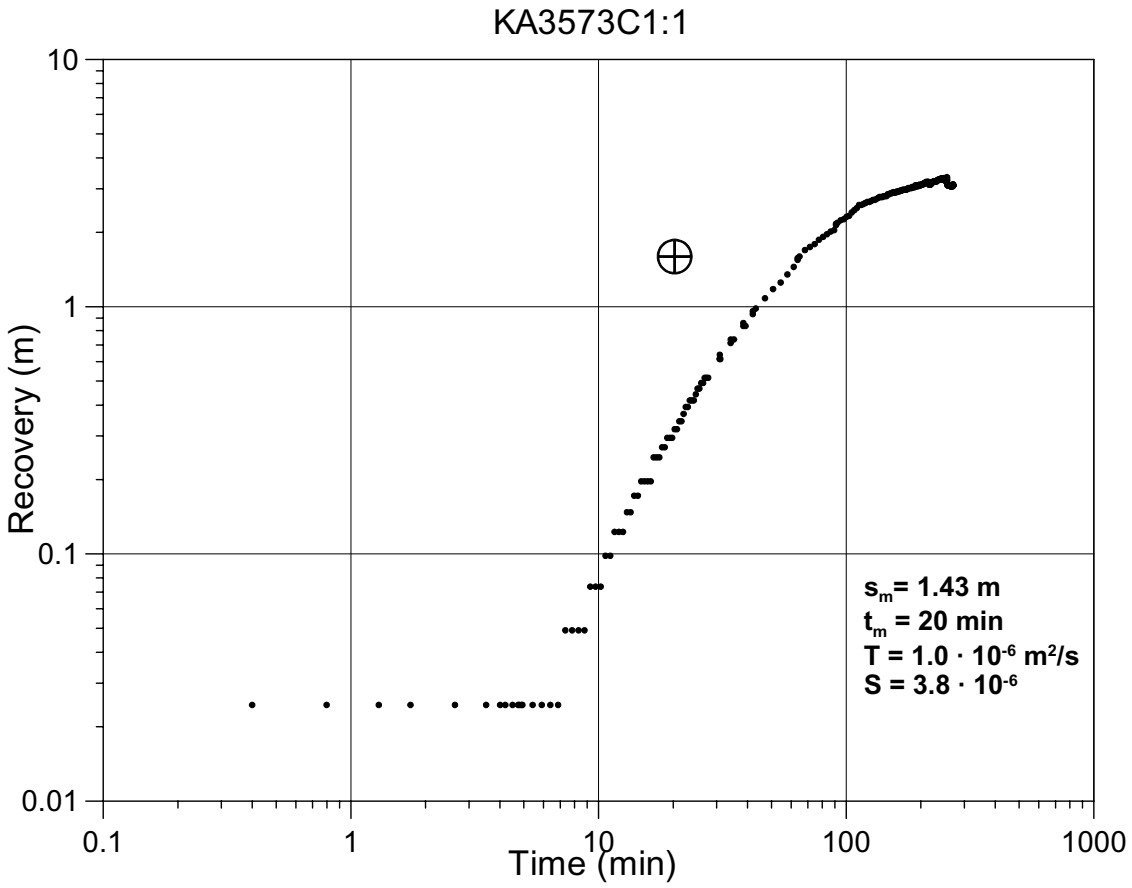


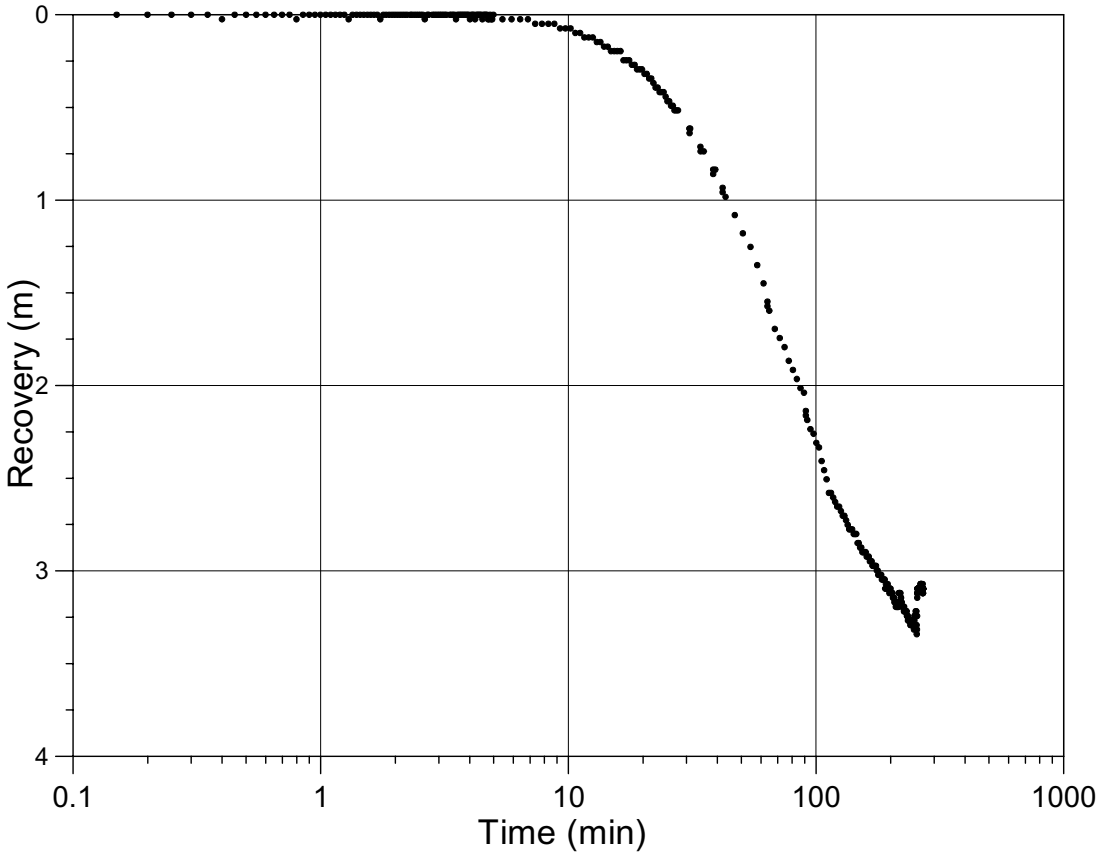
24_KA3566G2_5.GRF 2003-10-29



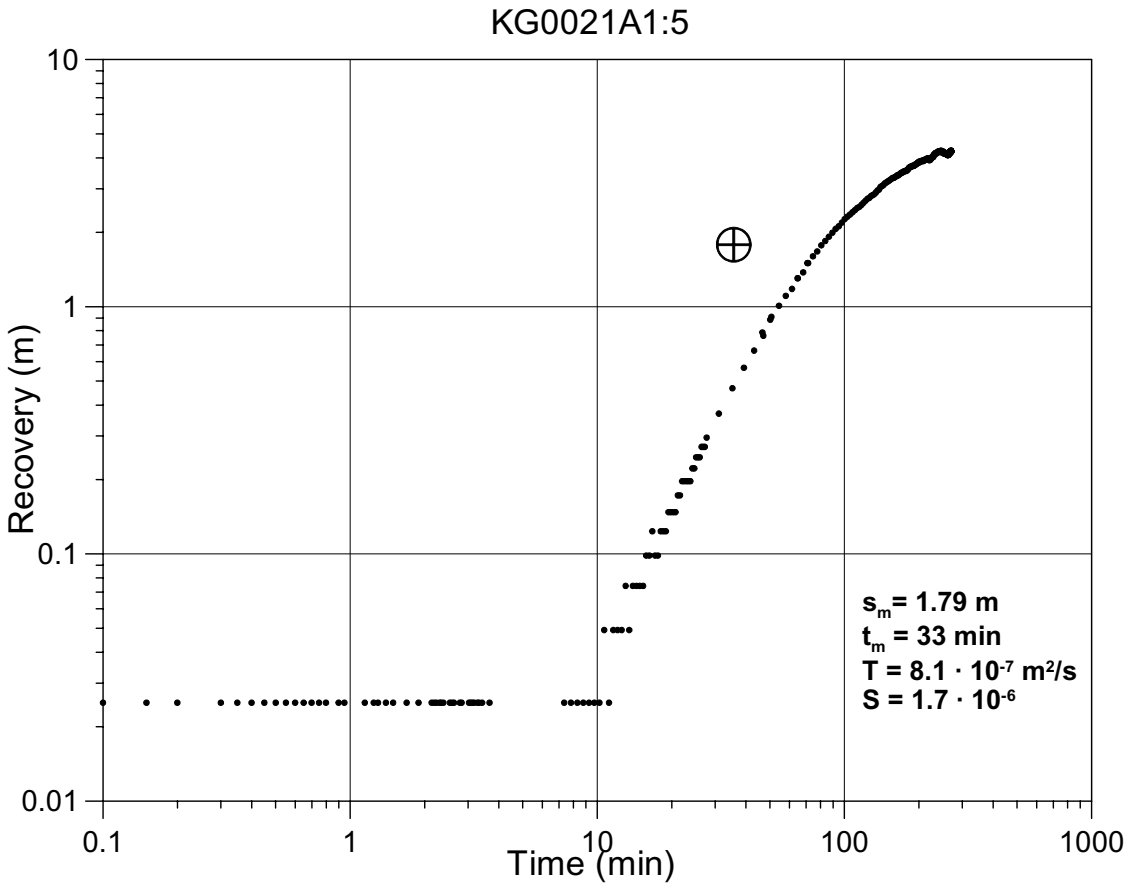


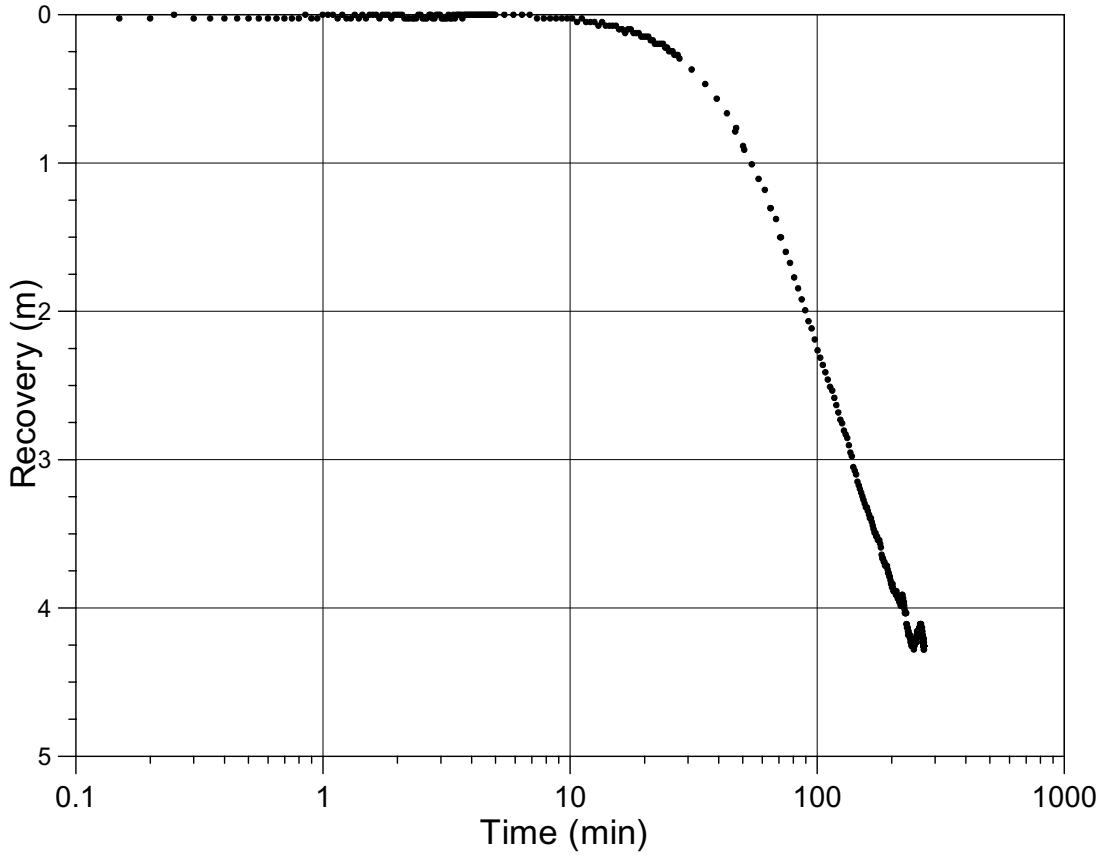
24_KA3573A_4.GRF 2003-10-29



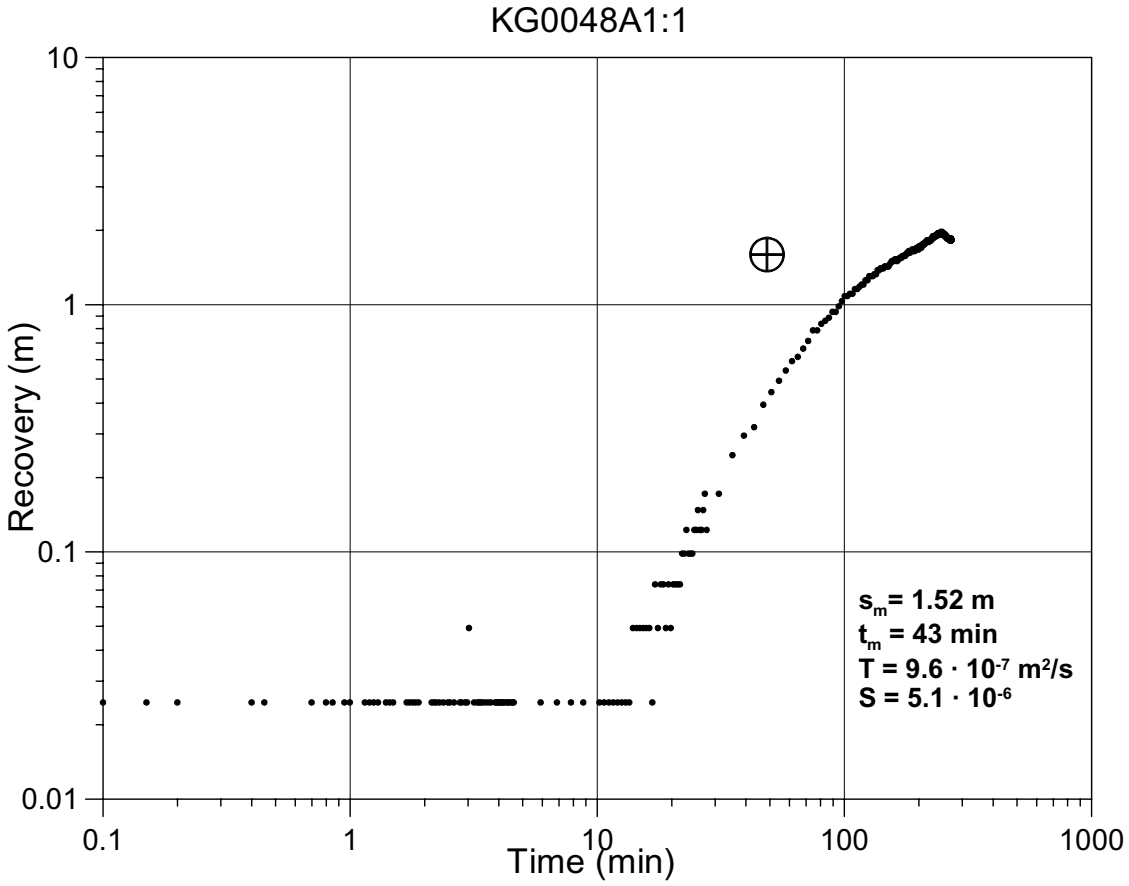


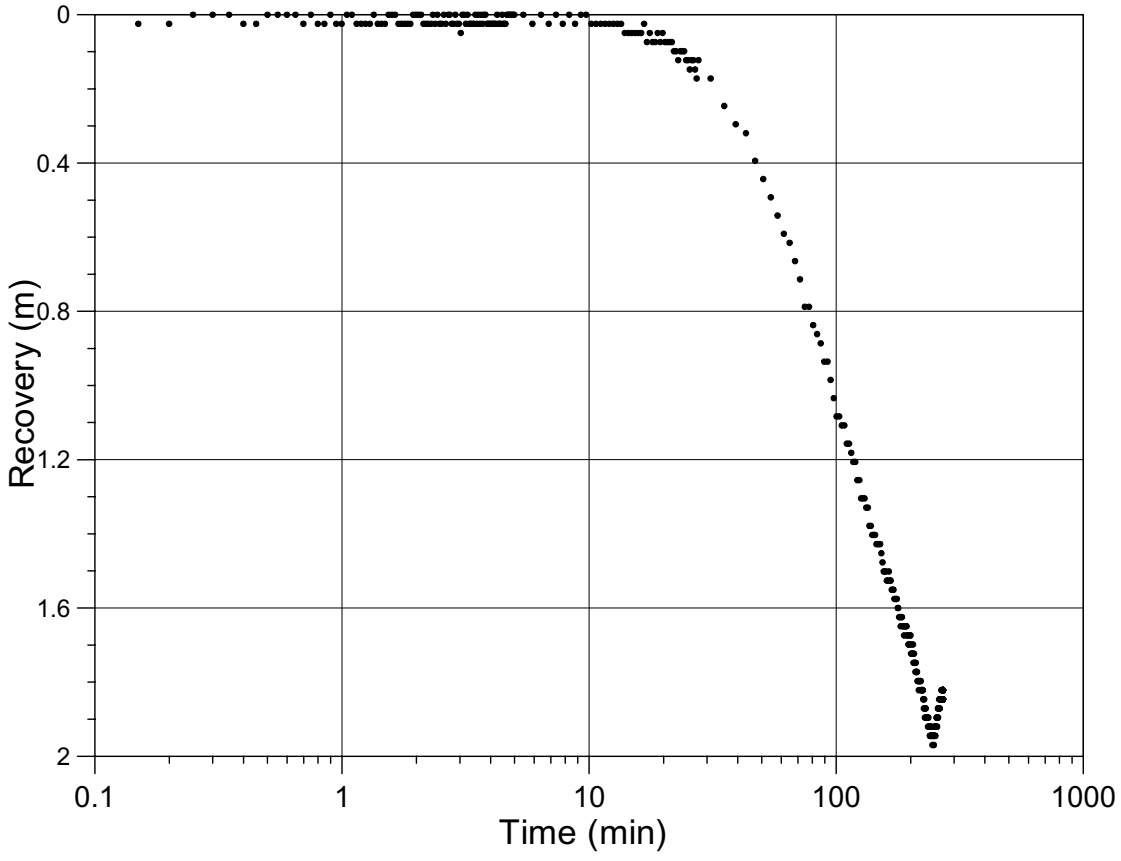
24_KA3573C1_1.GRF 2003-10-29



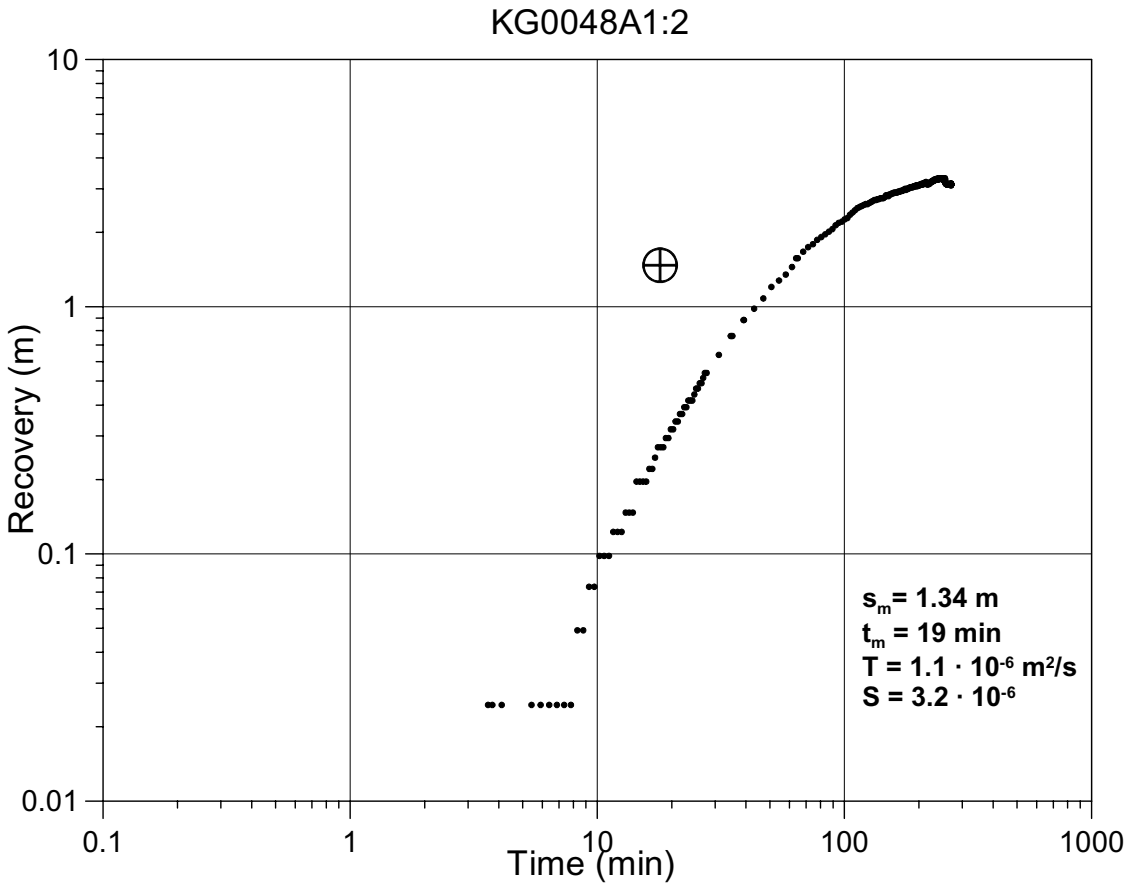


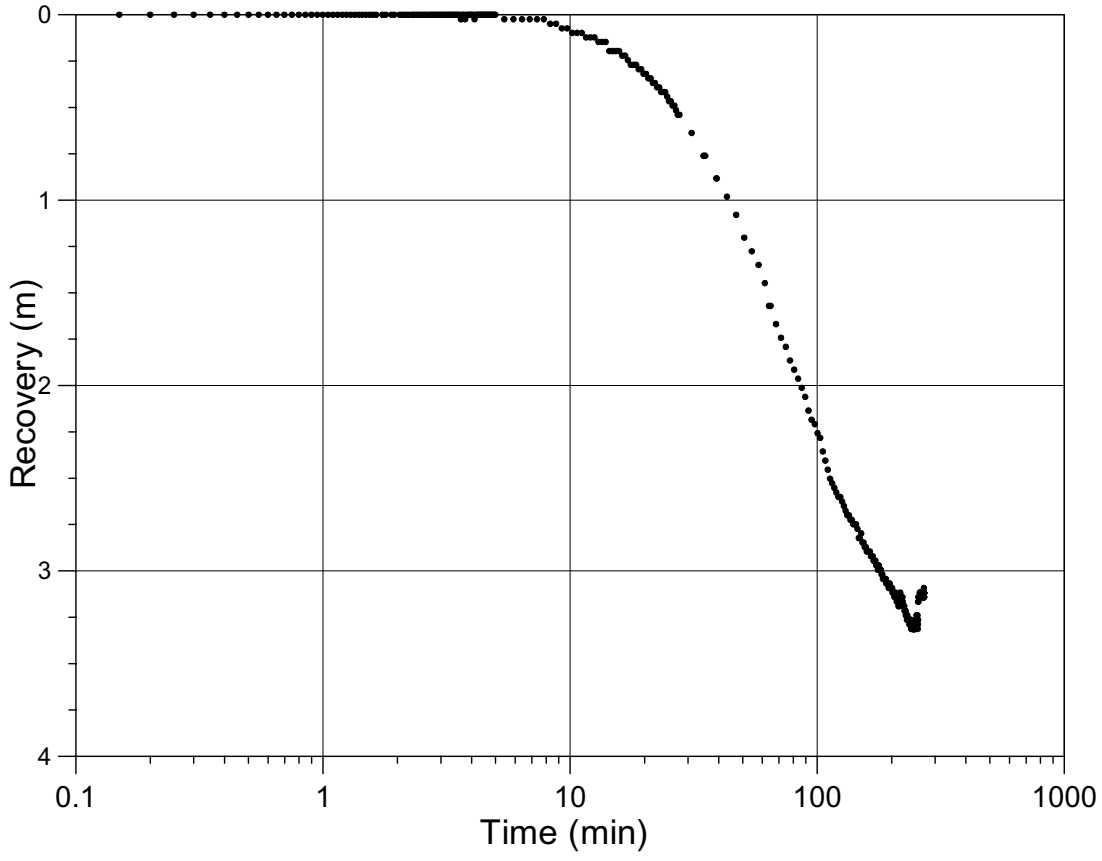
24_KG0021A1_5.GRF 2003-10-31



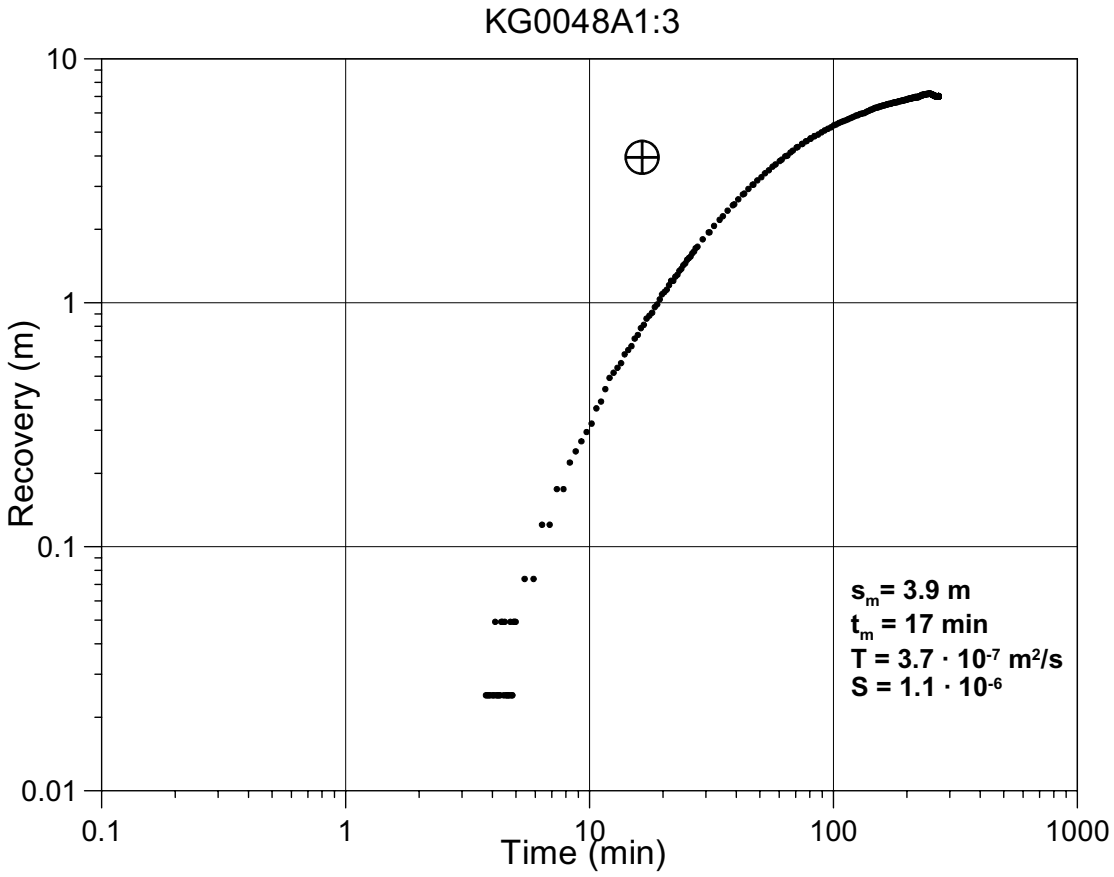


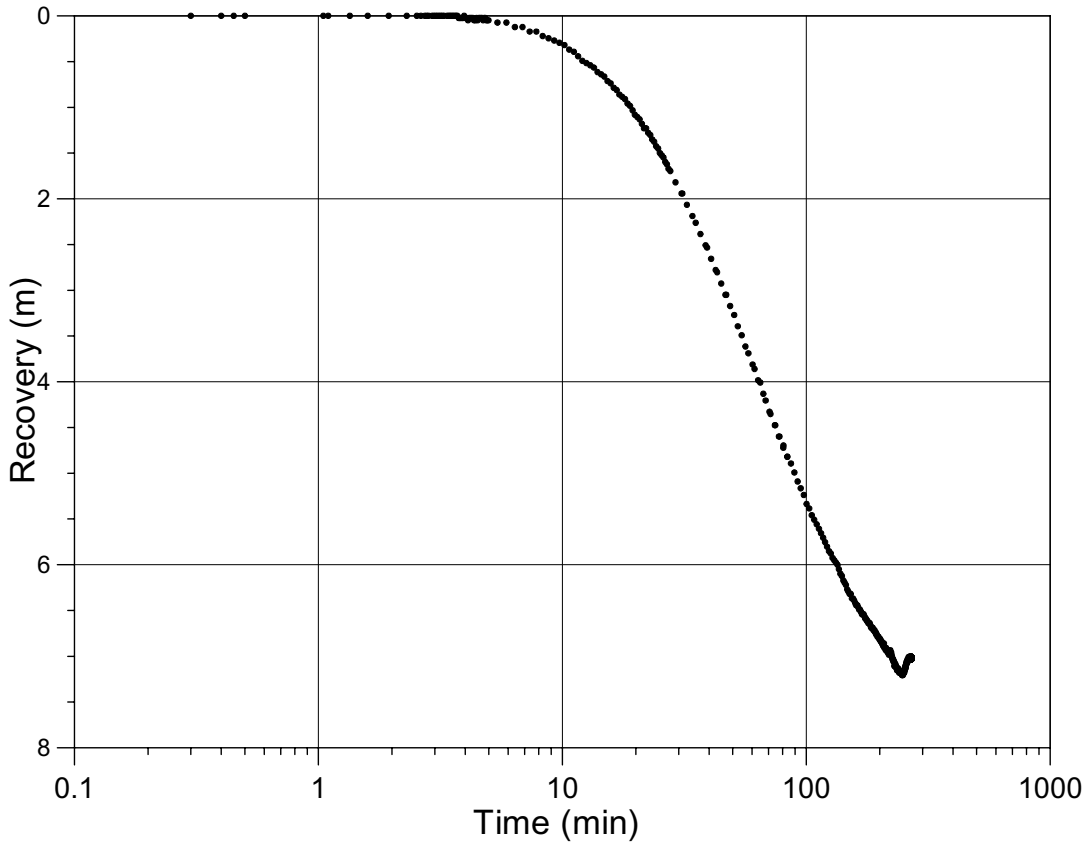
24_KG0048A1_1.GRF 2003-10-31





24_KG0048A1_2.GRF 2003-10-31





24_KG0048A1_3.GRF 2003-10-31

Appendix 5

Interference test 1:25 in borehole KG0021A01, section 35.00 m – 36.00 m

Date: 2003-05-13 Field Crew: A. Blom / J. Magnusson
Borehole length: 48.82 m Borehole diameter: 76 mm

Flowing borehole: KG0021A01, section 3: 35.00 m – 36.00 m

Valve opened: 20030513 09:40.00 Valve closed: 20030513 15:40.00

End of Test: 20030514 09:40

Total flowing time : 360 min Tot. Pr. Build-up time: 1080 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

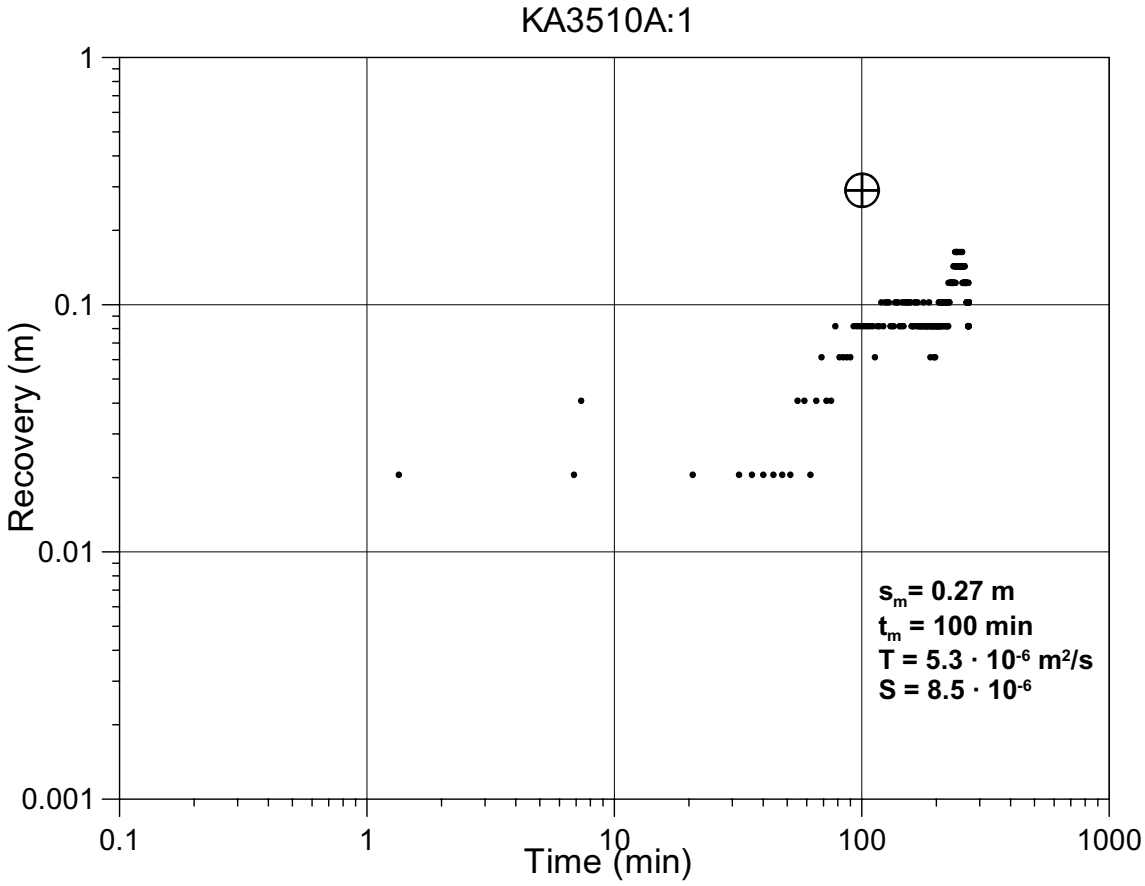
Manually measured flow rates of KG0021A01, section 35.00 m – 36.00 m are presented in the table below:

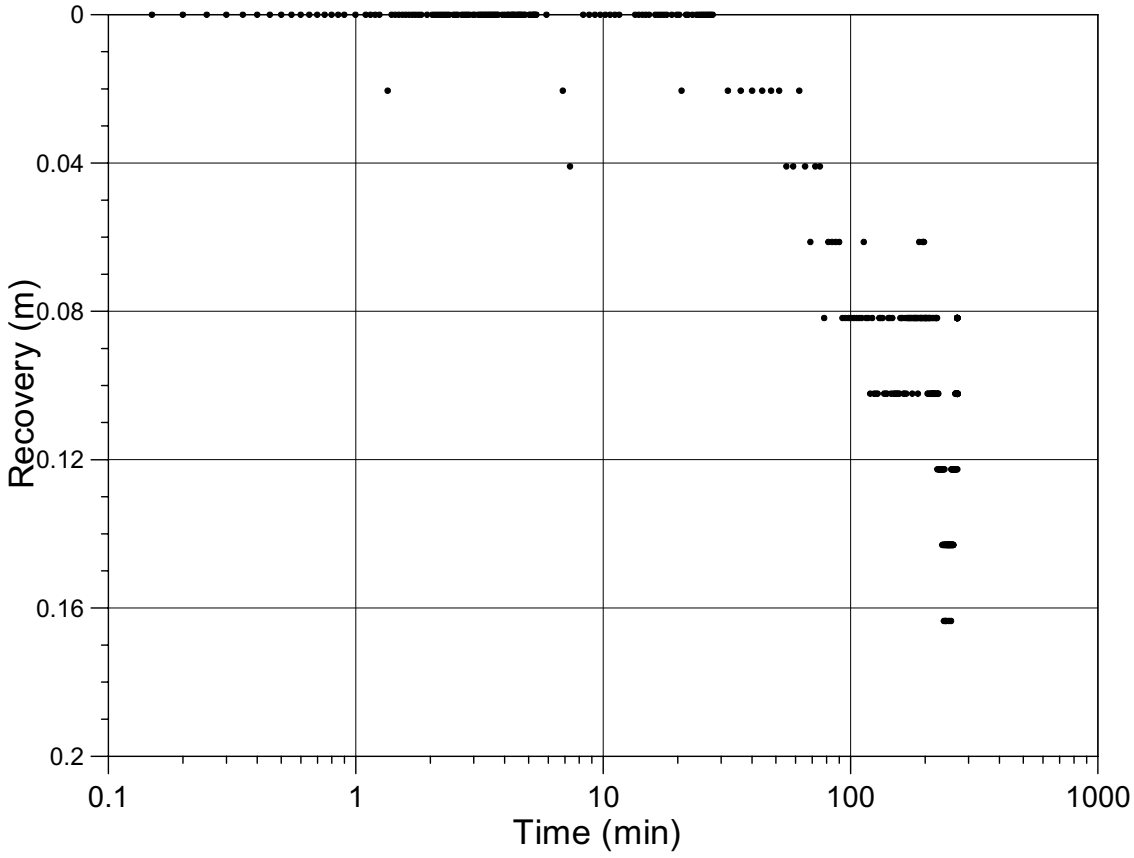
Table Manually measured flow rates, Interference test in KG0021A01, section 35.00 m – 36.00 m. Prototype Repository, May 13 2003

Time	Flow rate (l/min)
09:40:30	5.279
09:41:30	4.159
09:44:10	1.850
09:49:00	1.185
09:54:30	1.035
10:05:00	1.123
10:36:30	1.088
15:28:30	1.095
15:30:30	1.090
15:32:30	1.086

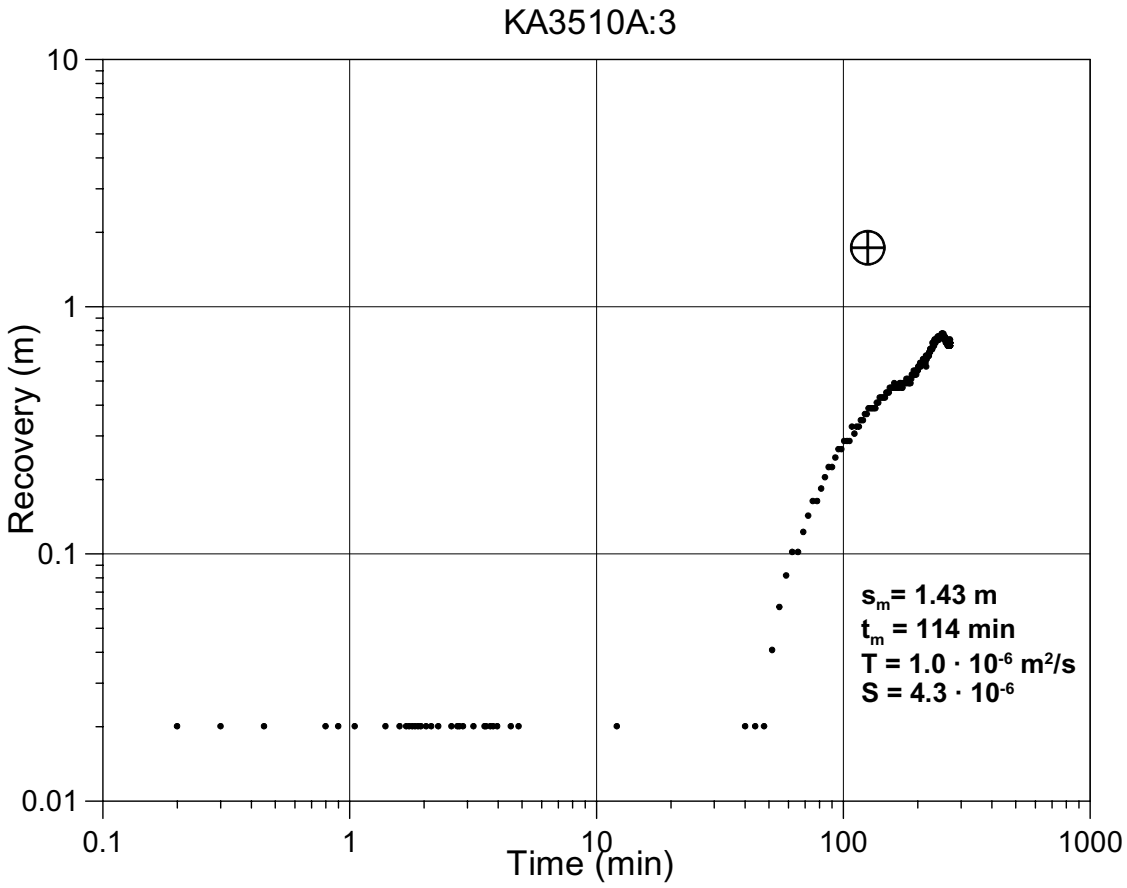
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

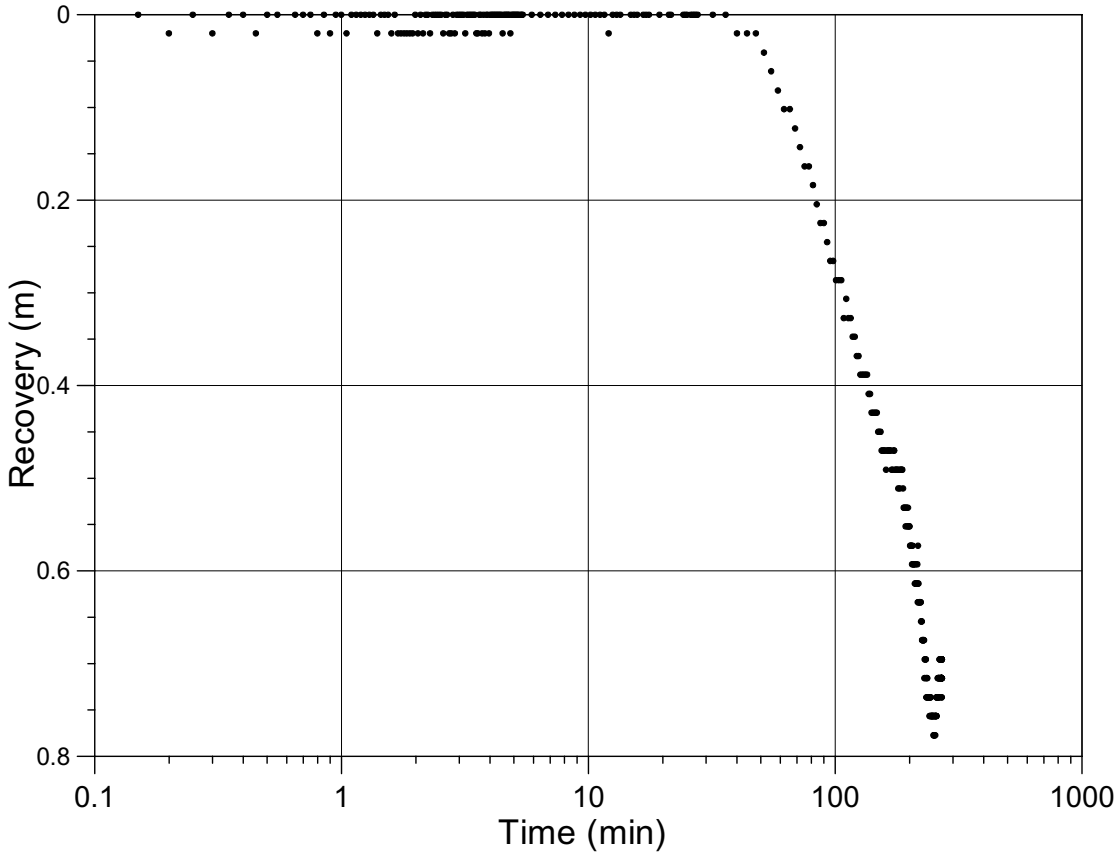
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



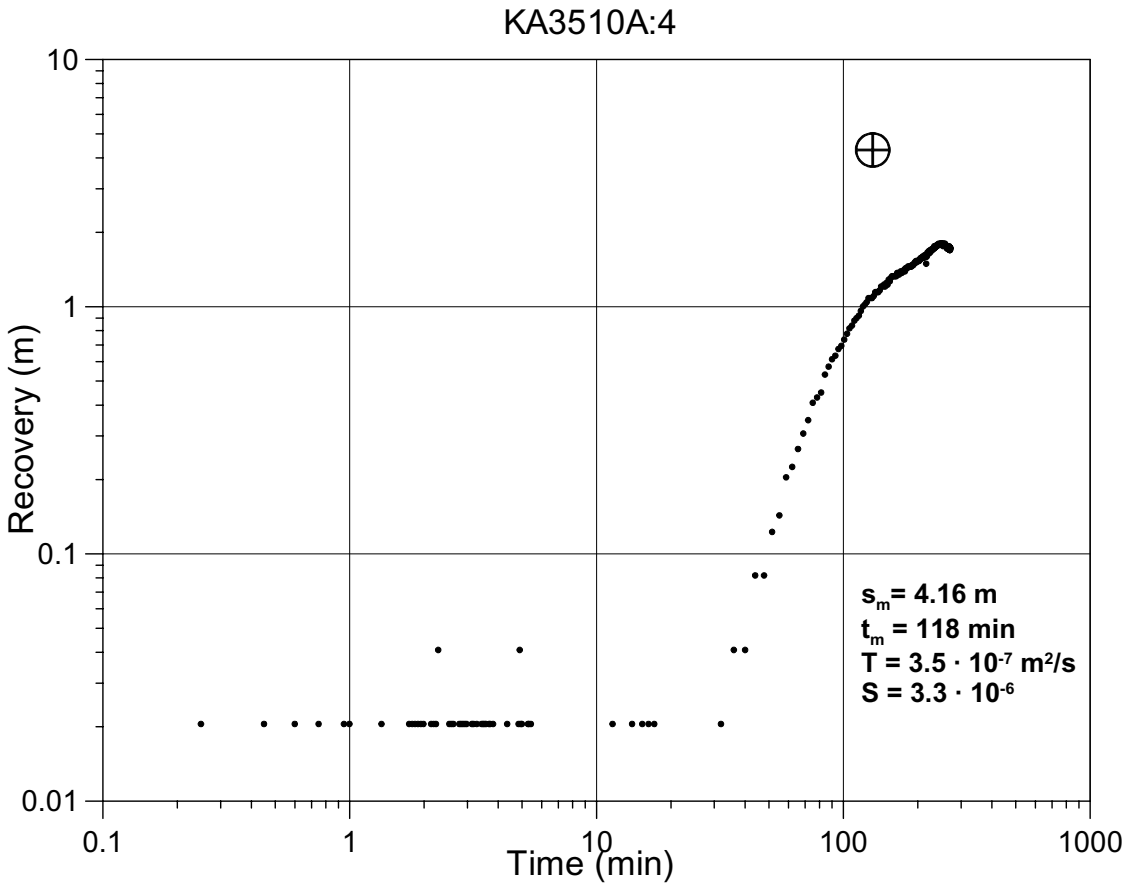


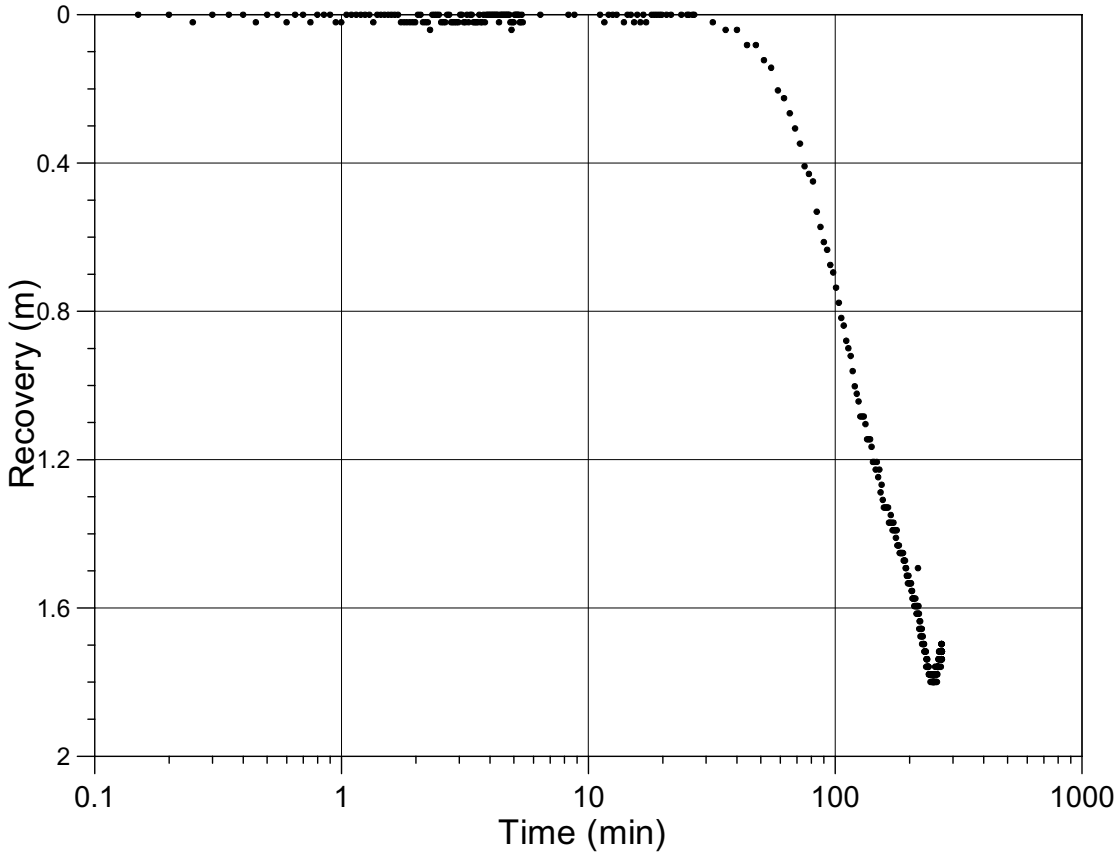
25_KA3510A_1.GRF 2003-10-31



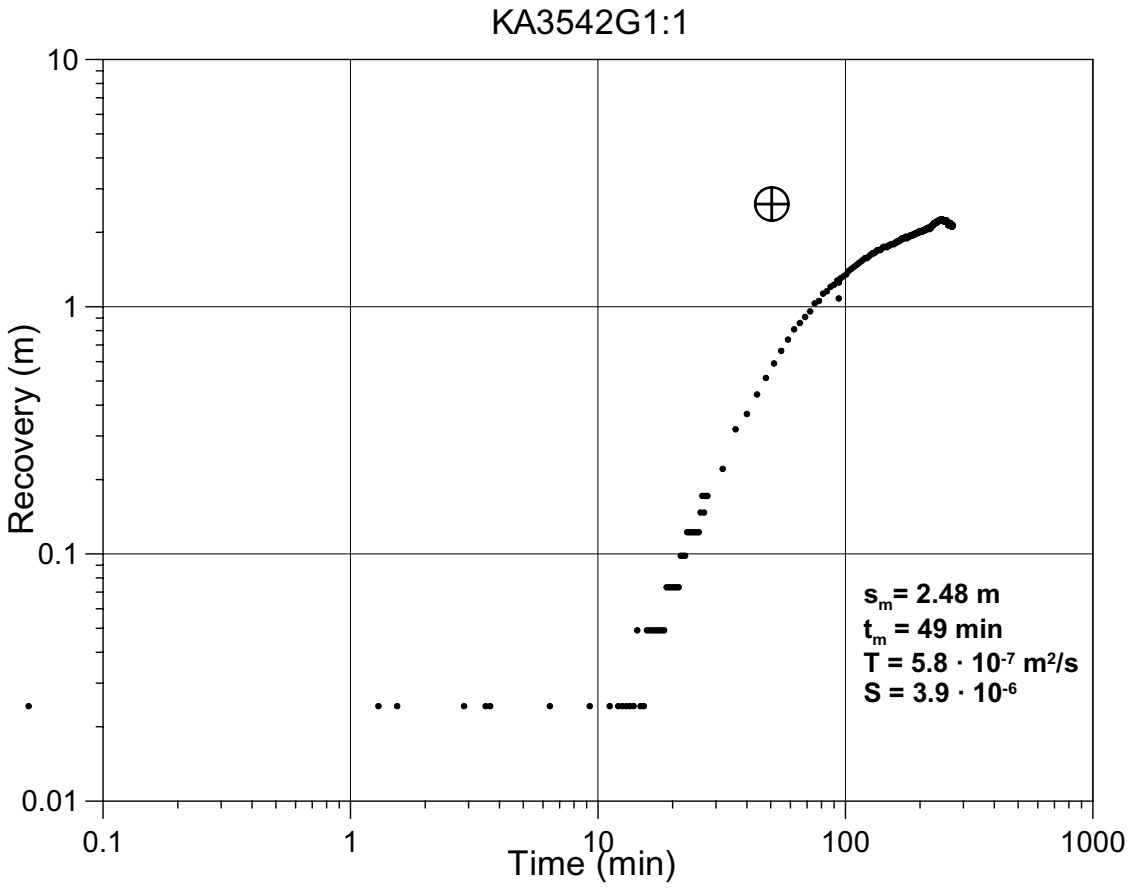


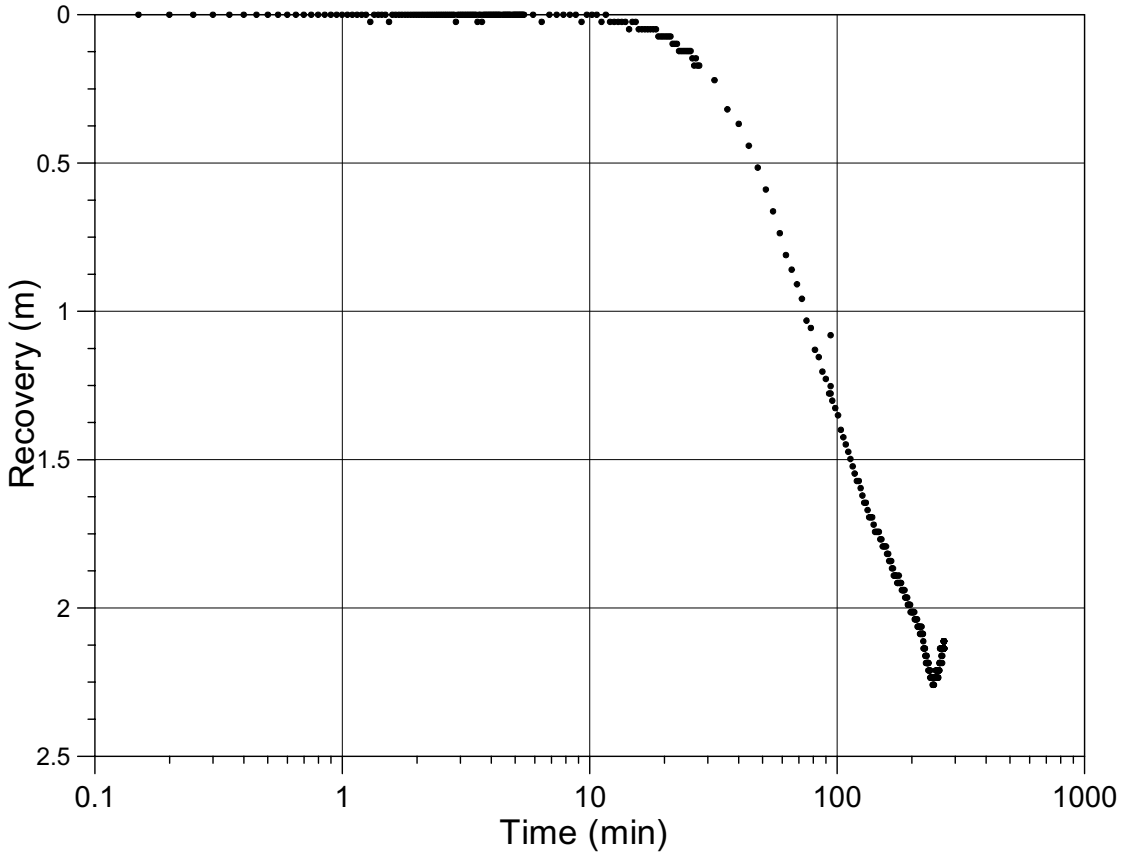
25_KA3510A_3.GRF 2003-10-31



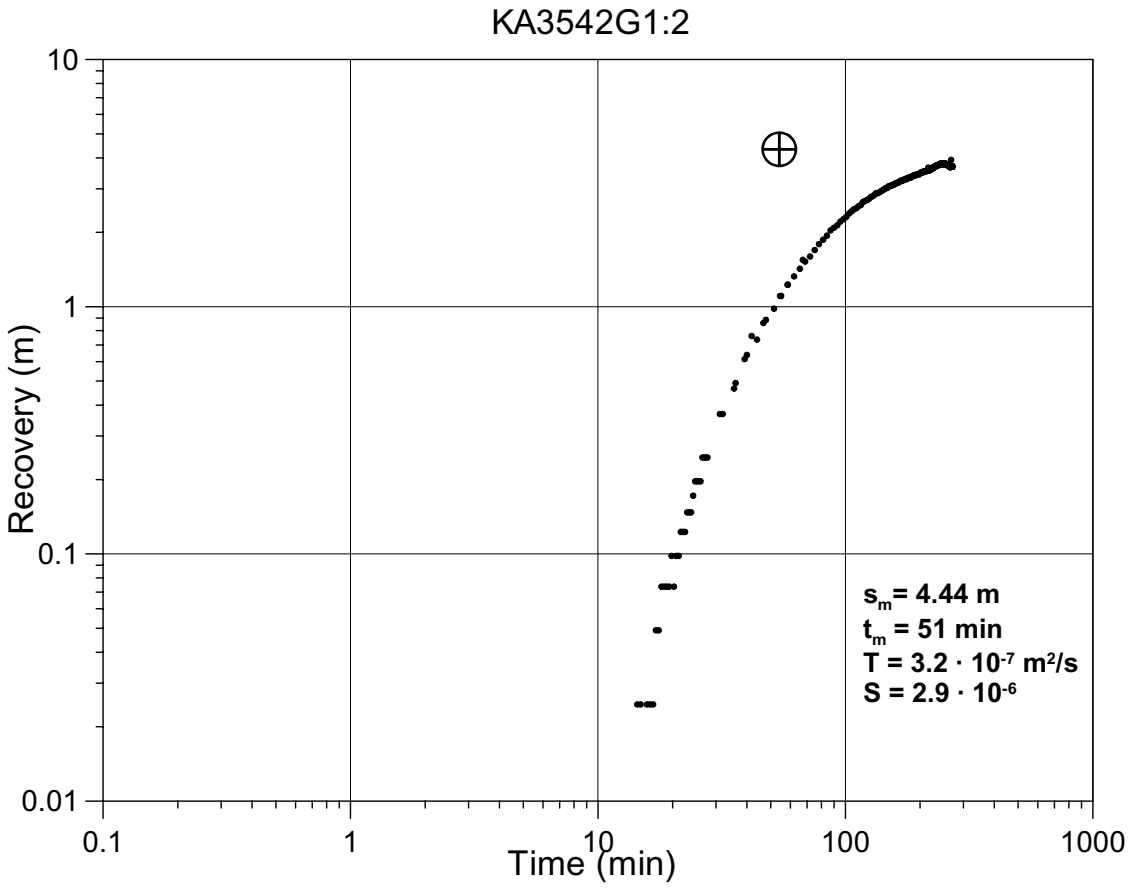


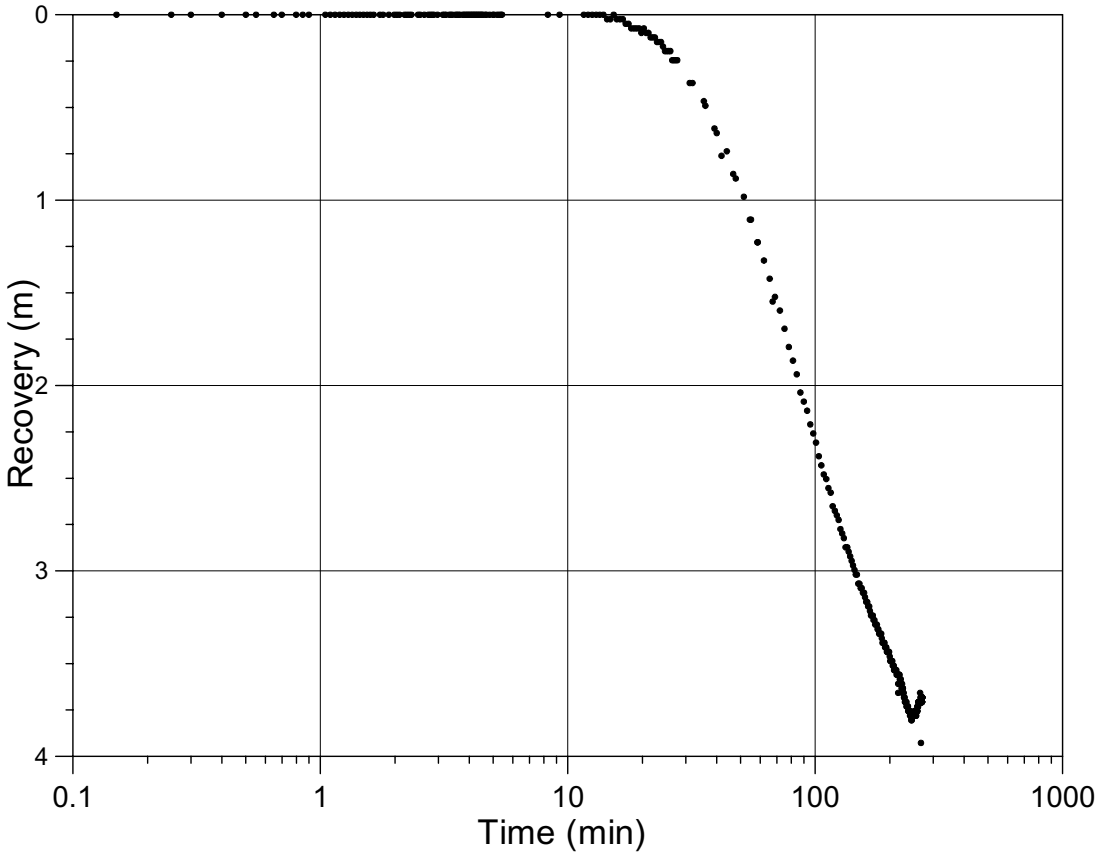
25_KA3510A_4.GRF 2003-10-31



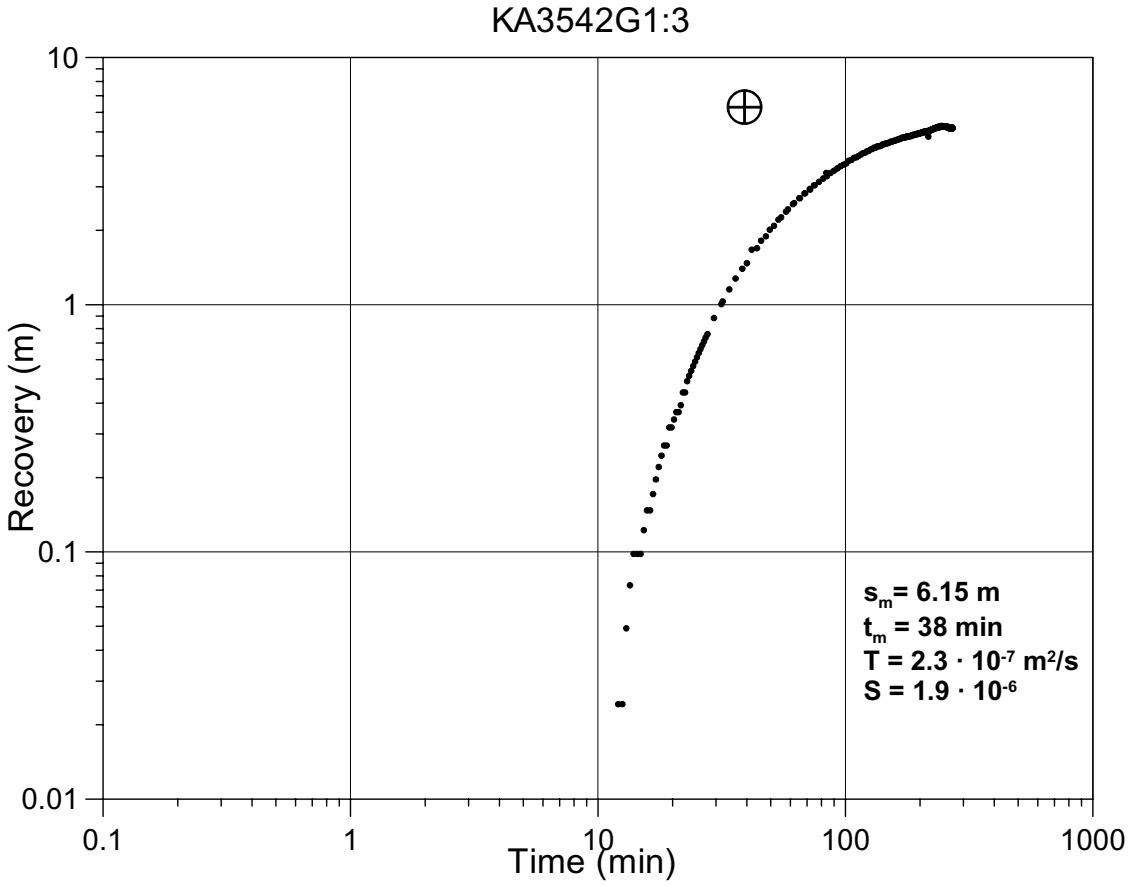


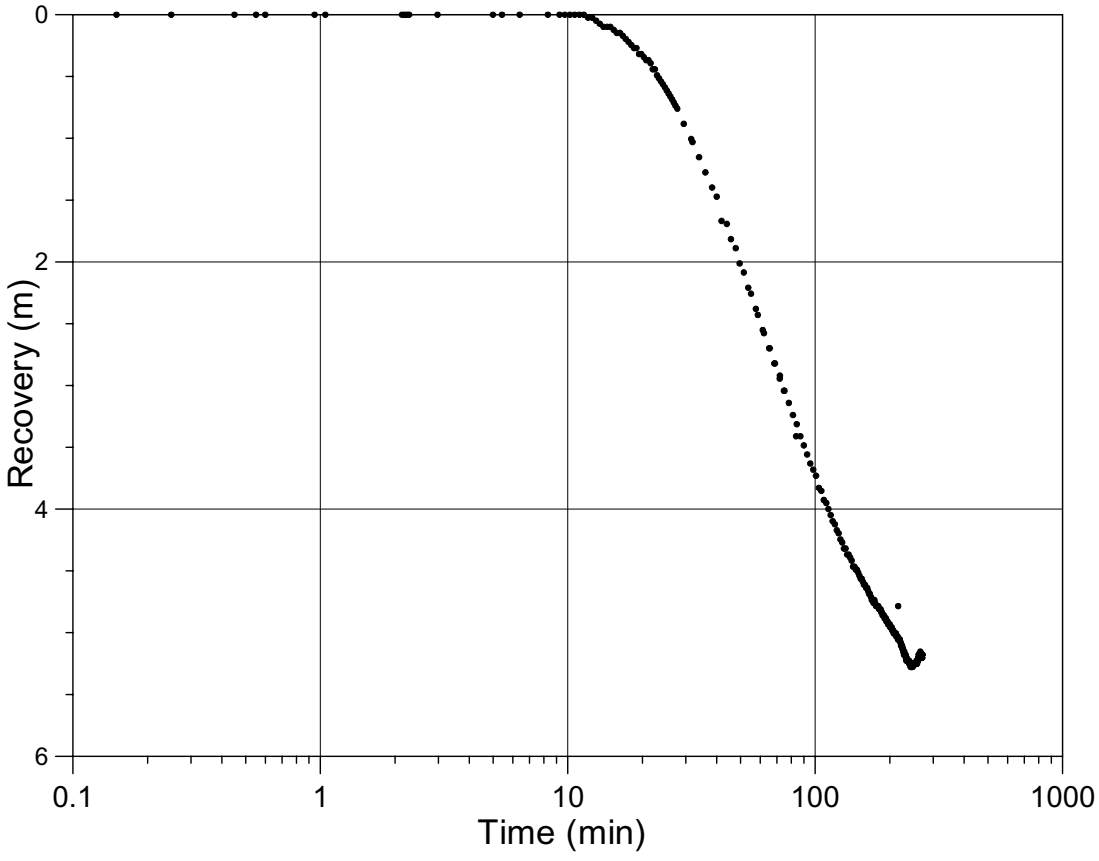
25_KA3542G1_1.GRF 2003-10-31



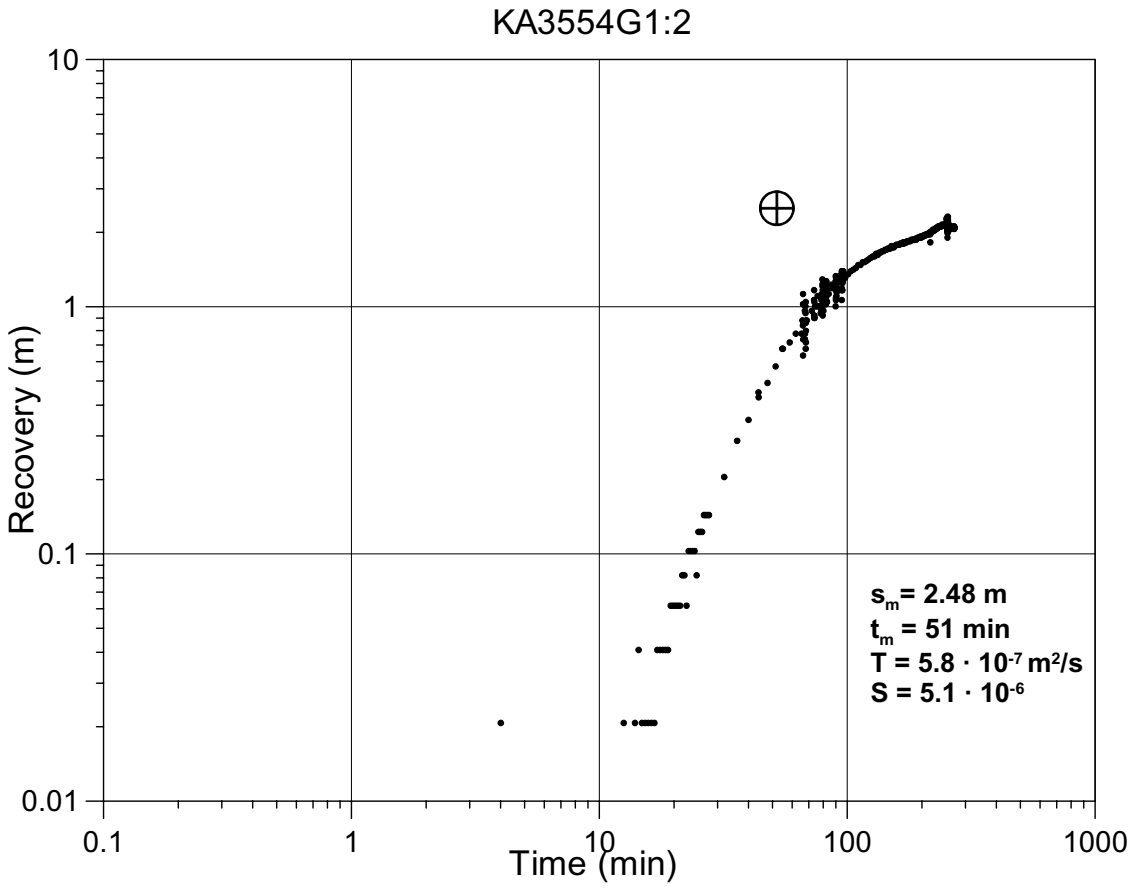


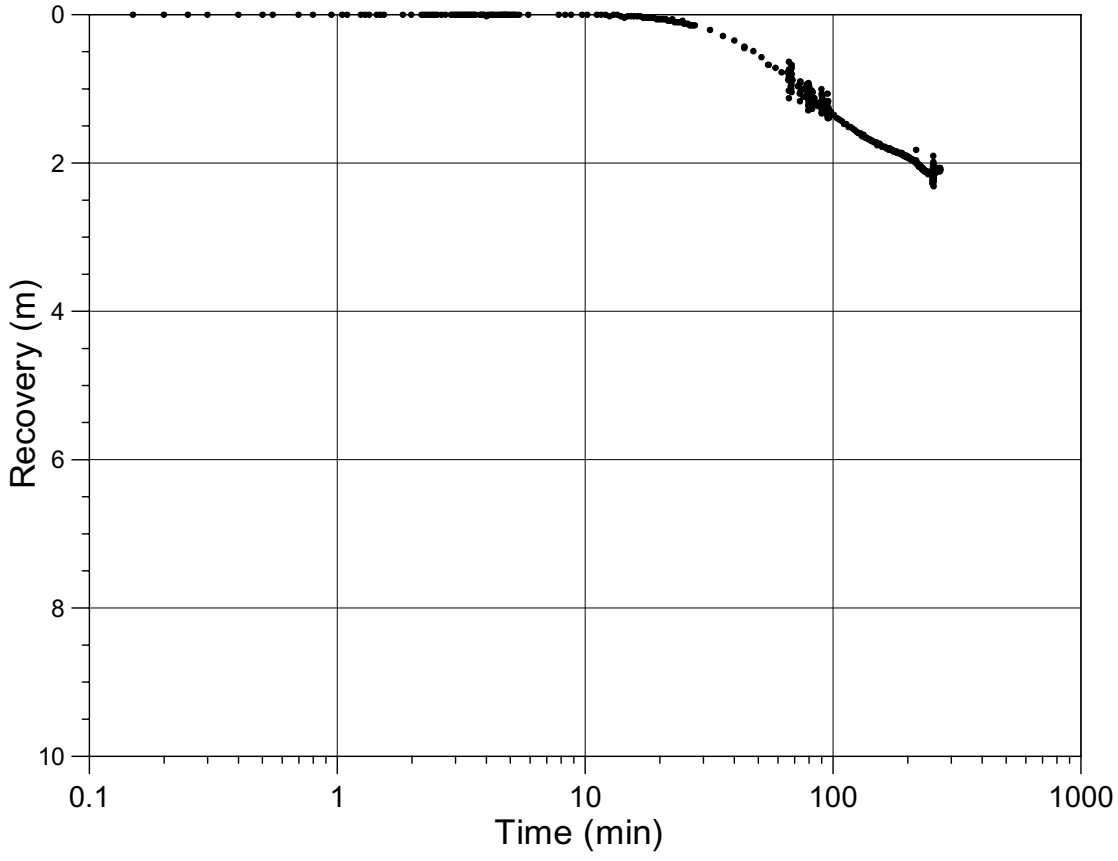
25_KA3542G1_2.GRF 2003-10-31





25_KA3542G1_3.GRF 2003-10-31





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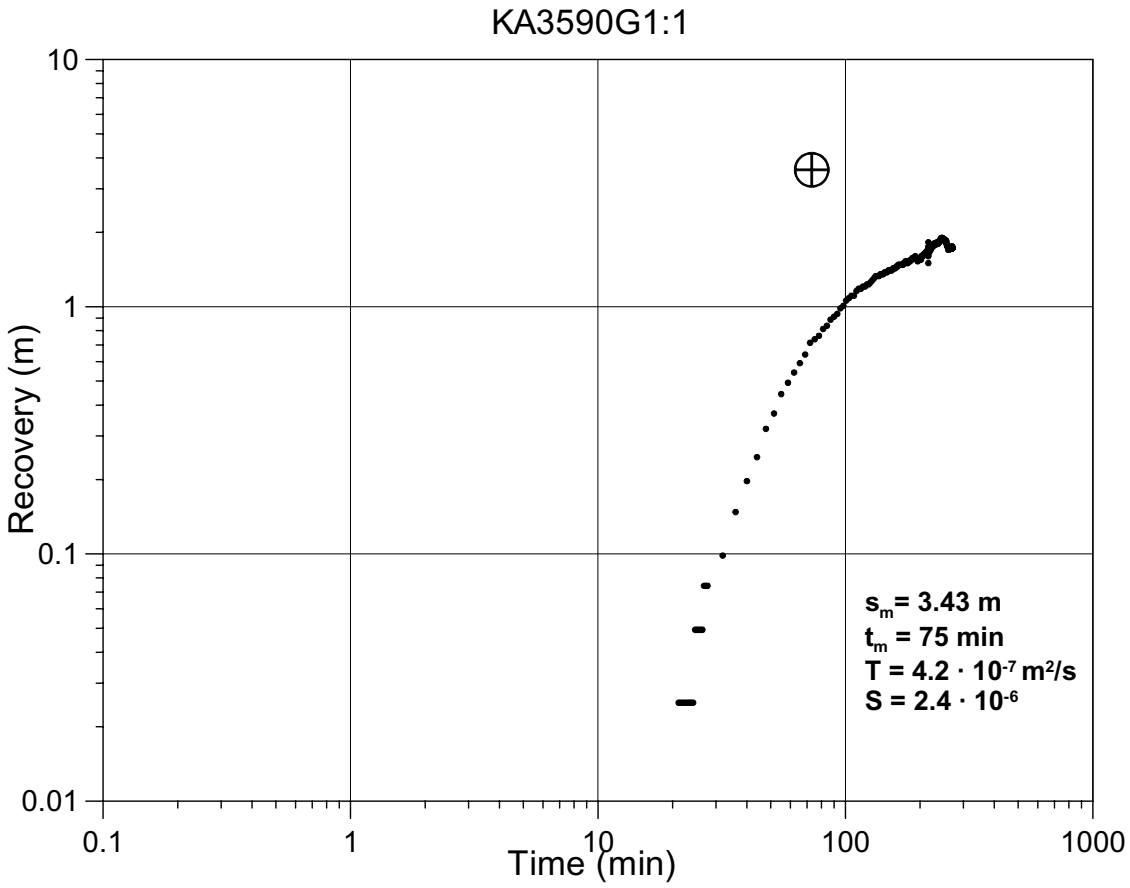
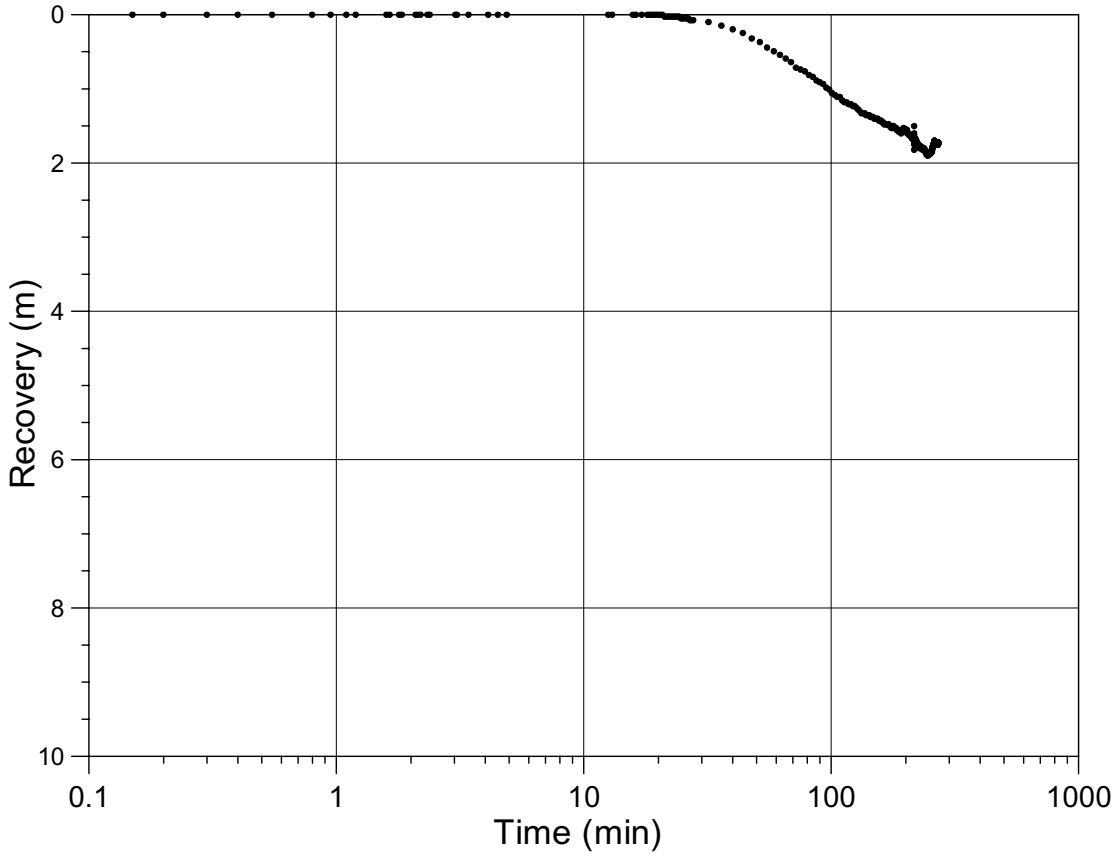
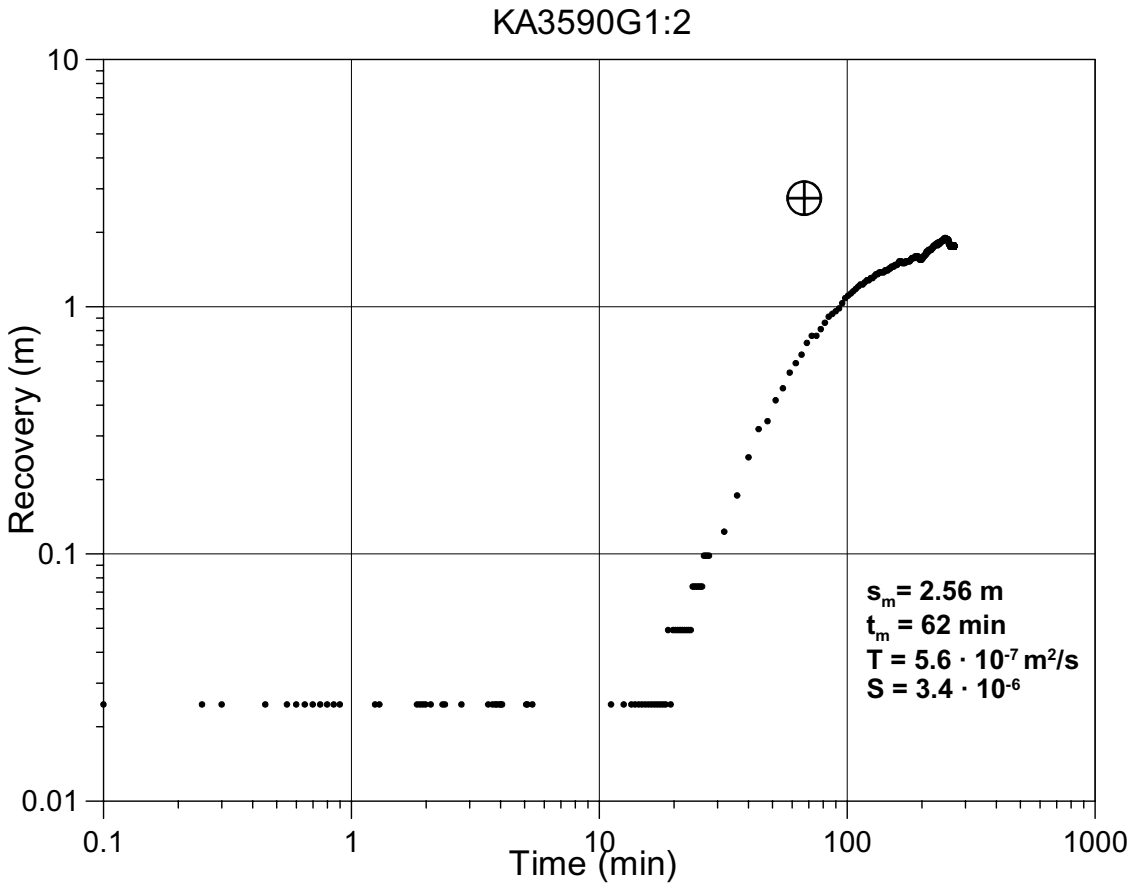
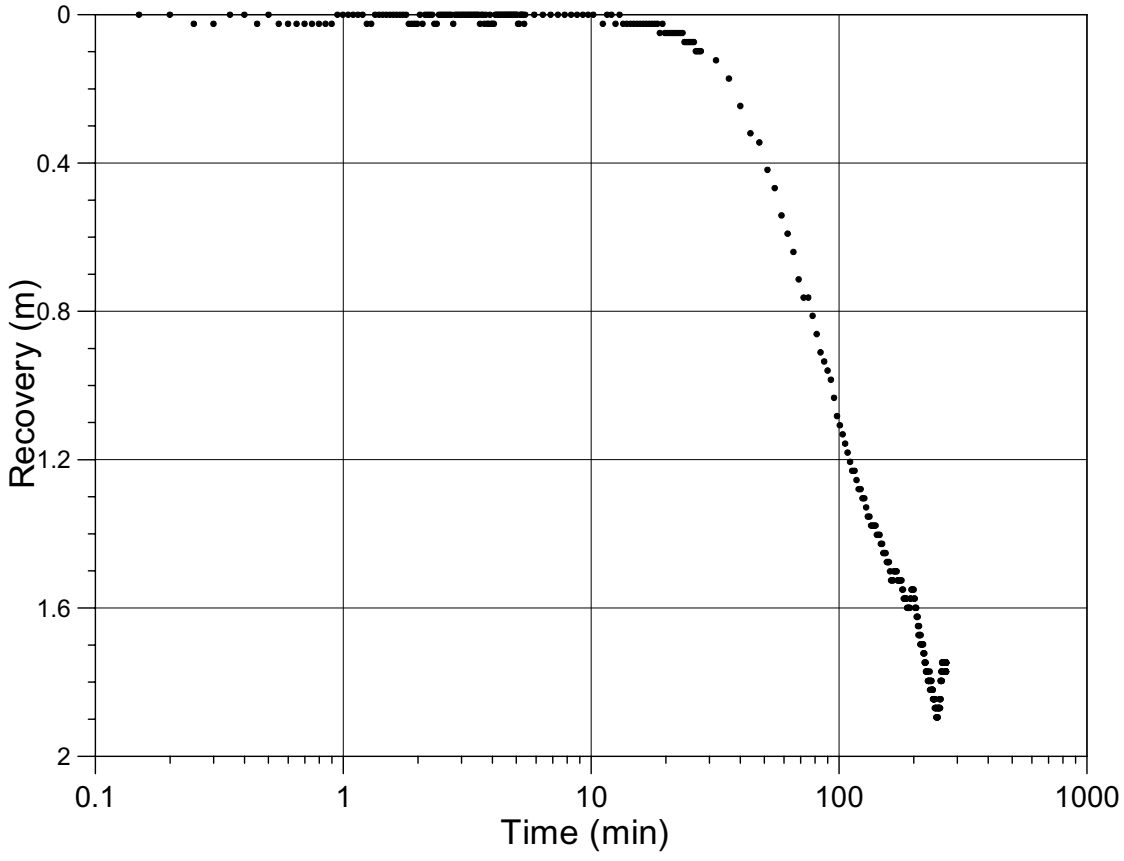




25_KA3590G1_1.GRF 2003-11-03





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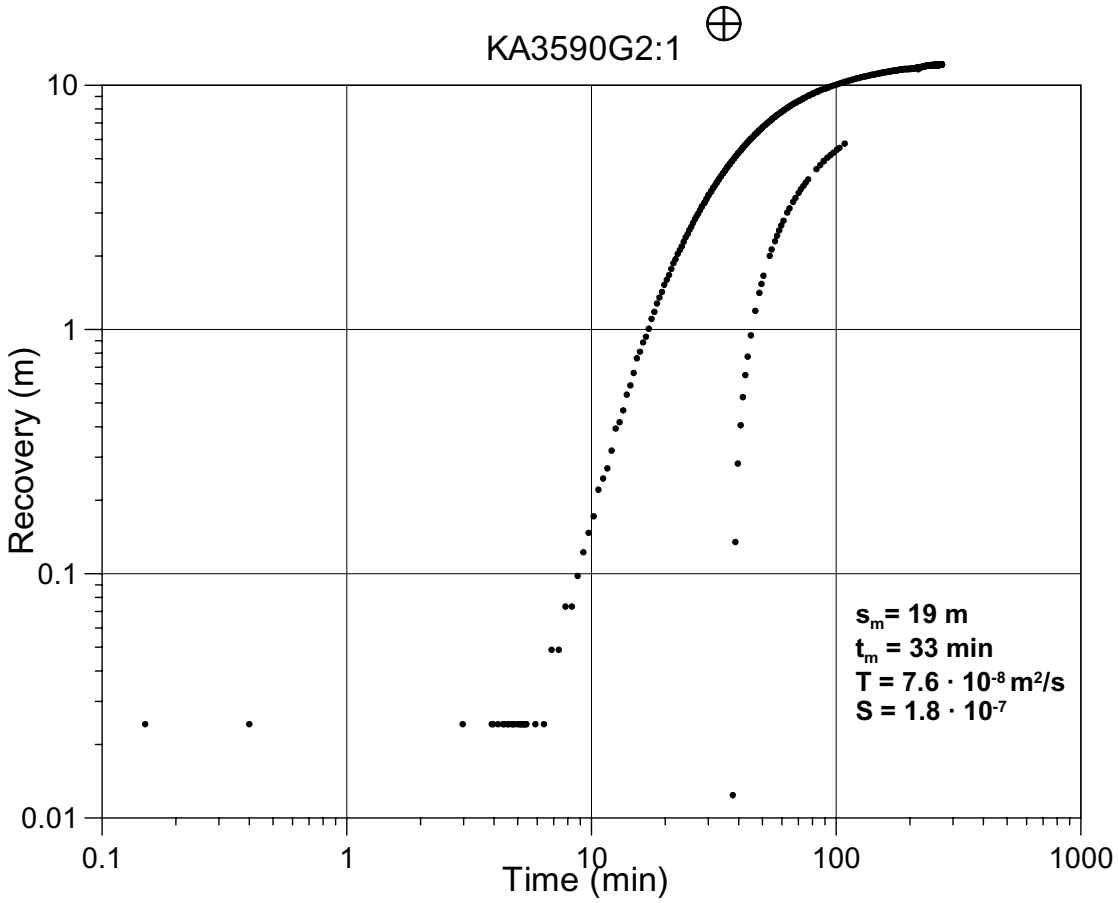

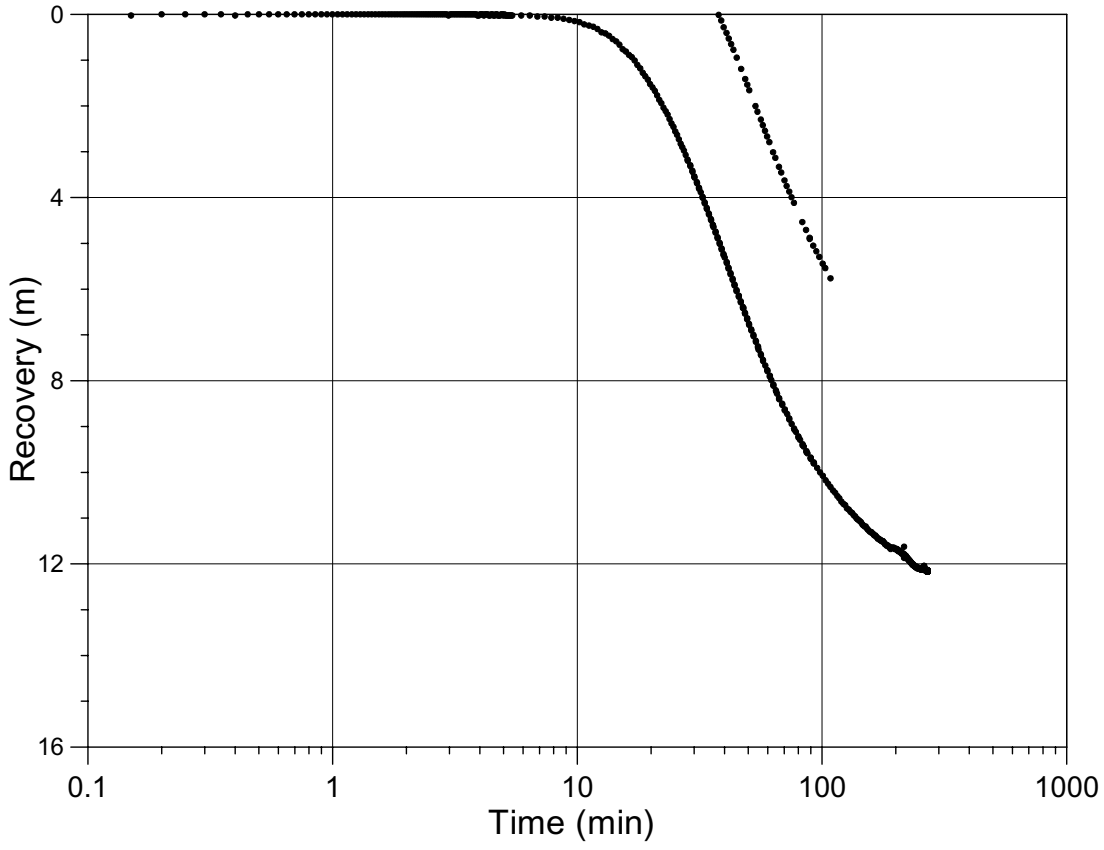

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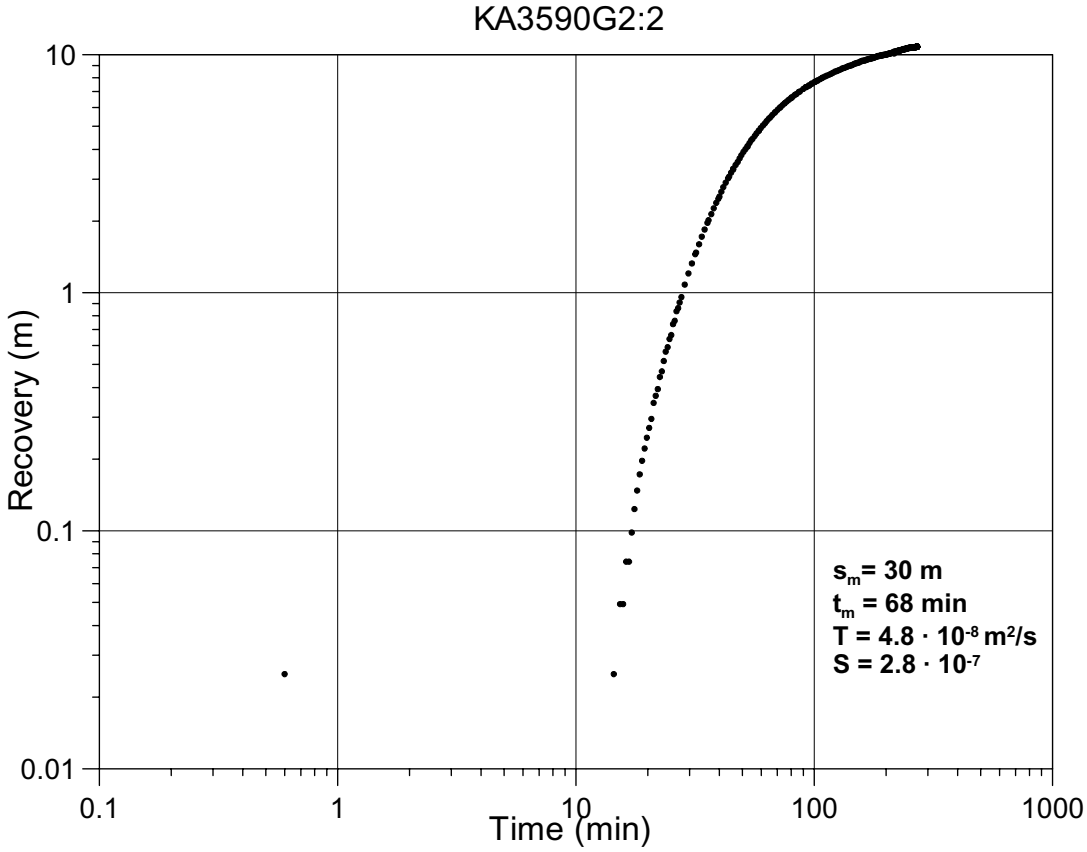

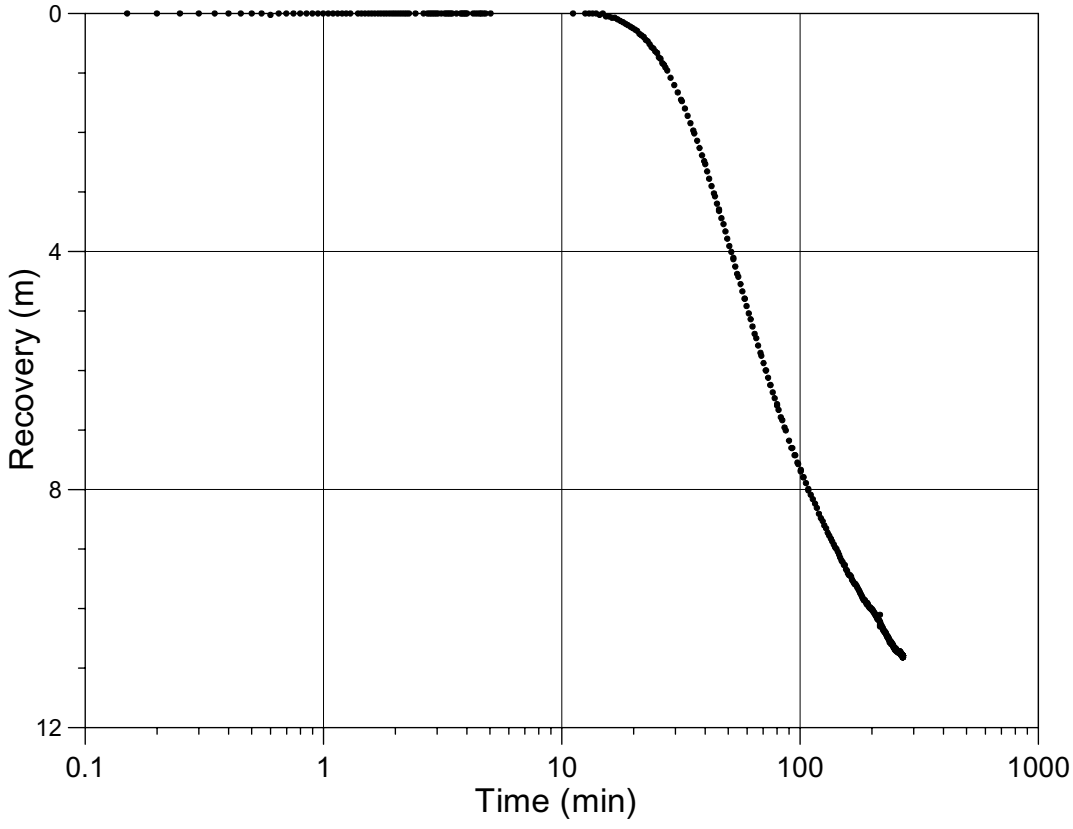

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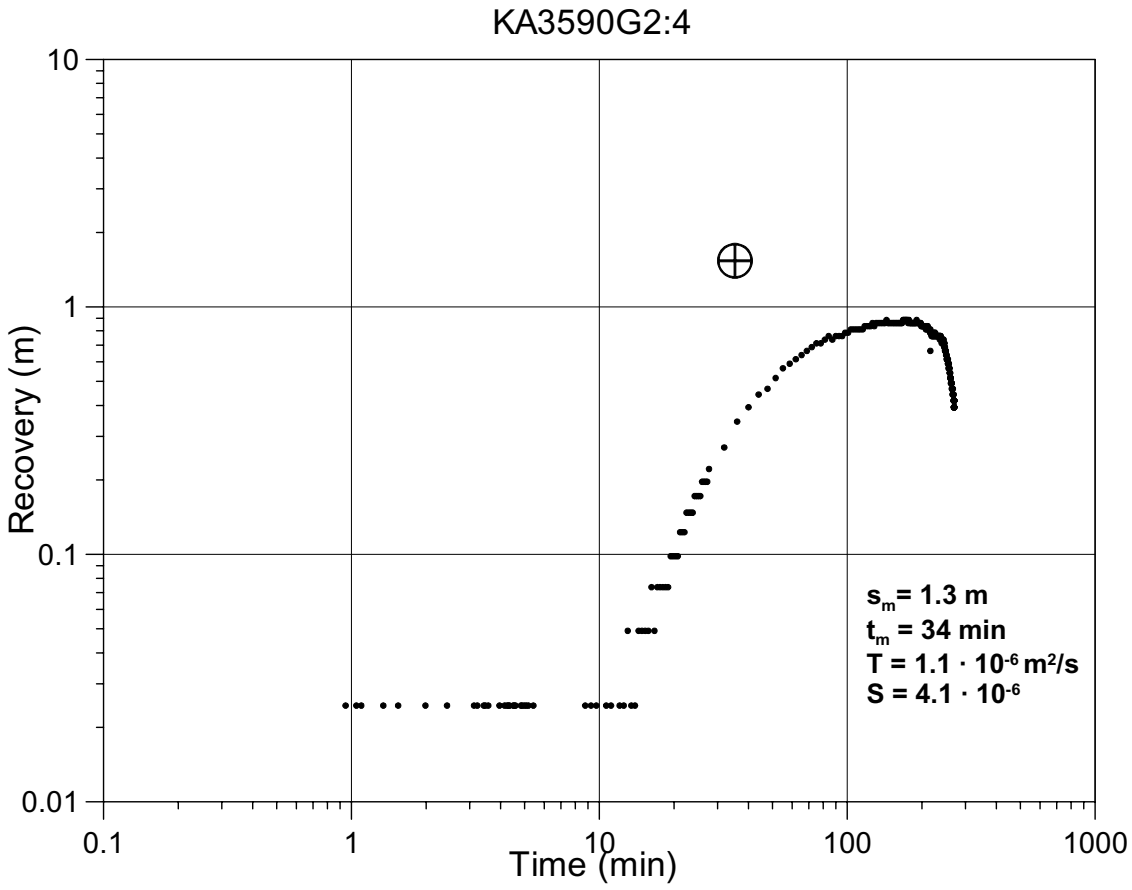
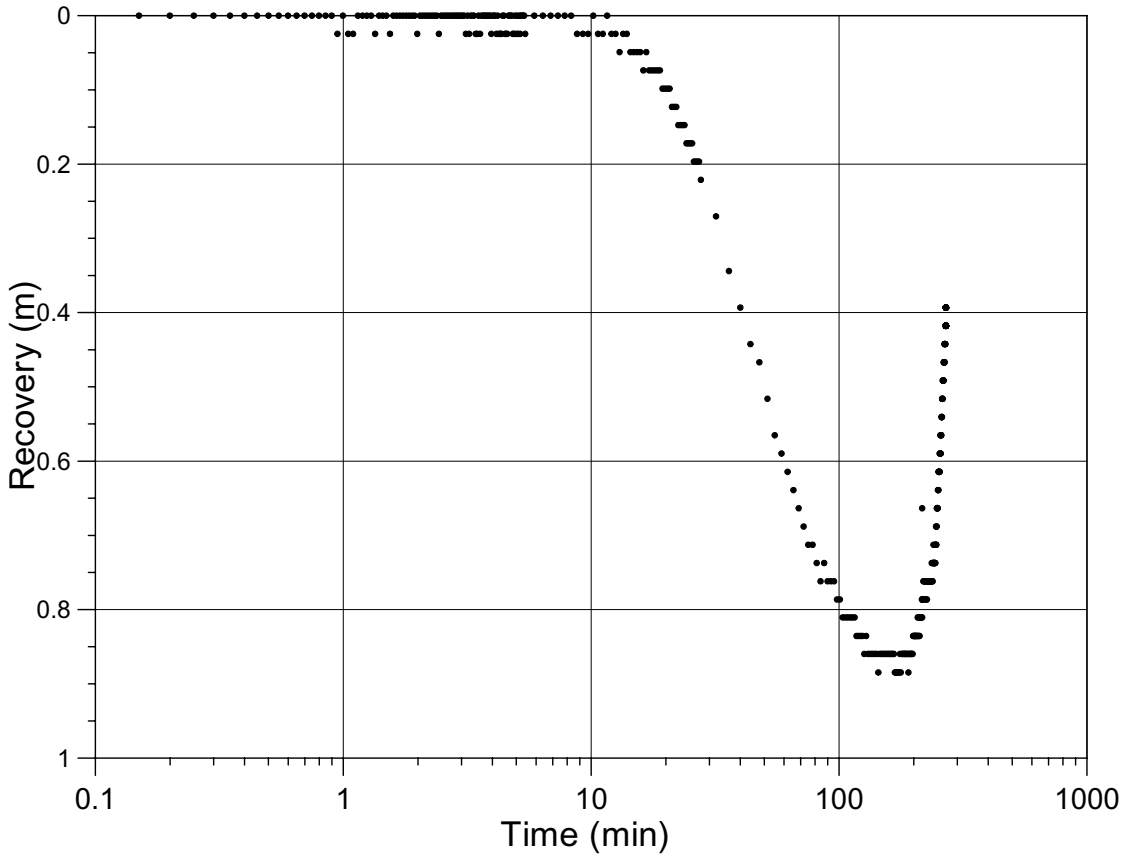
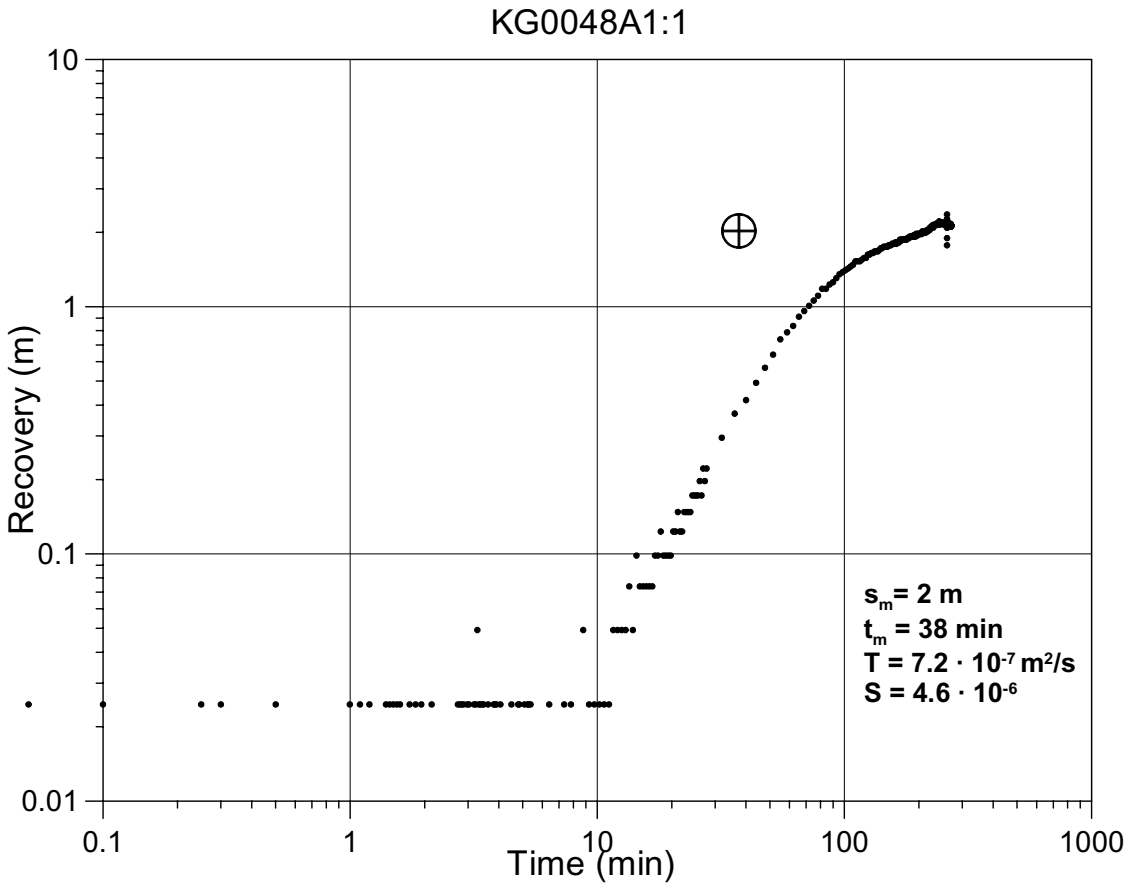
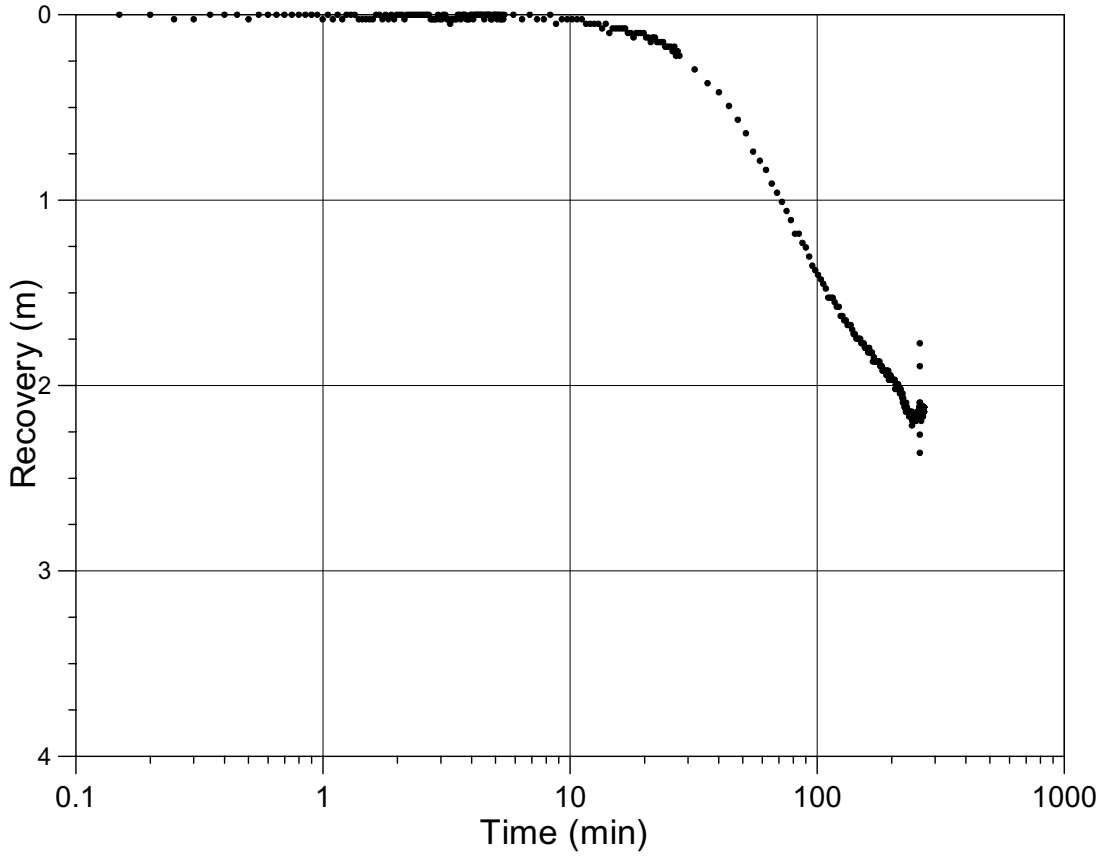


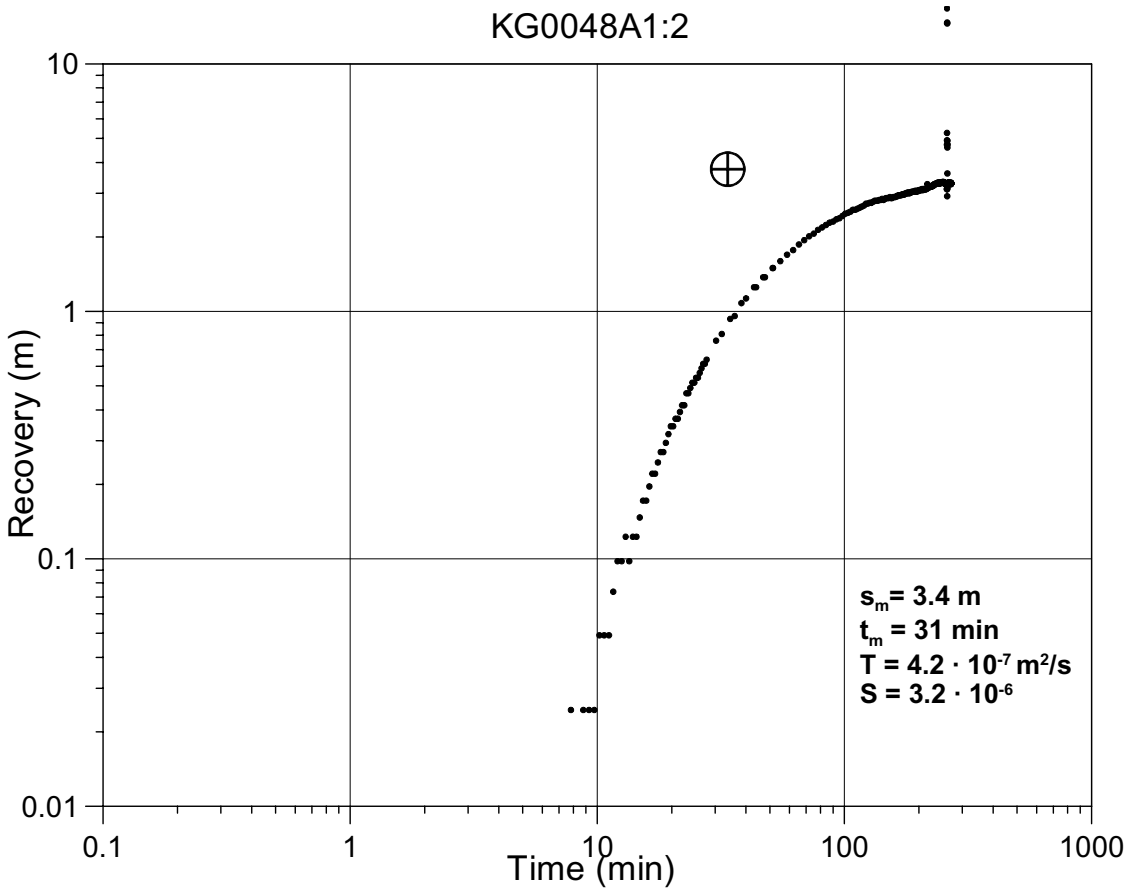


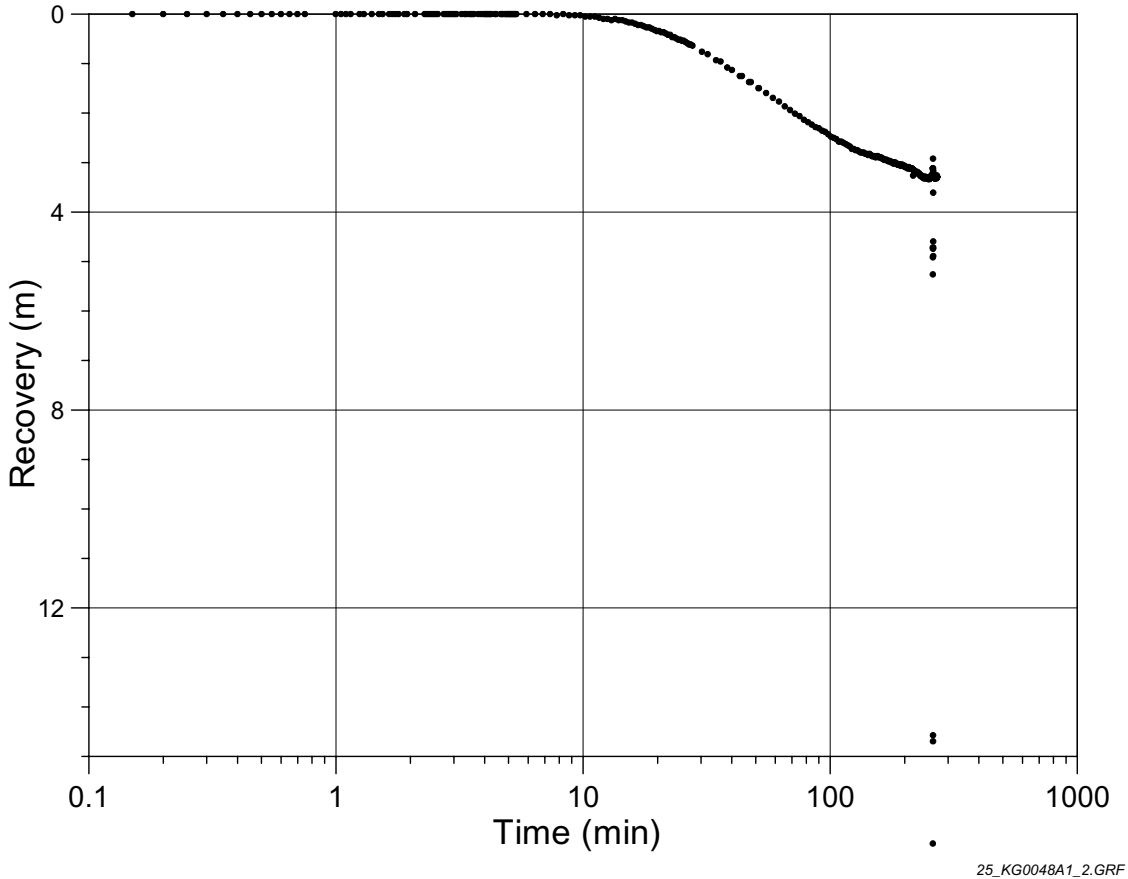
25_KA3590G2_4.GRF 2003-11-03





25_KG0048A1_1.GRF 2003-11-03





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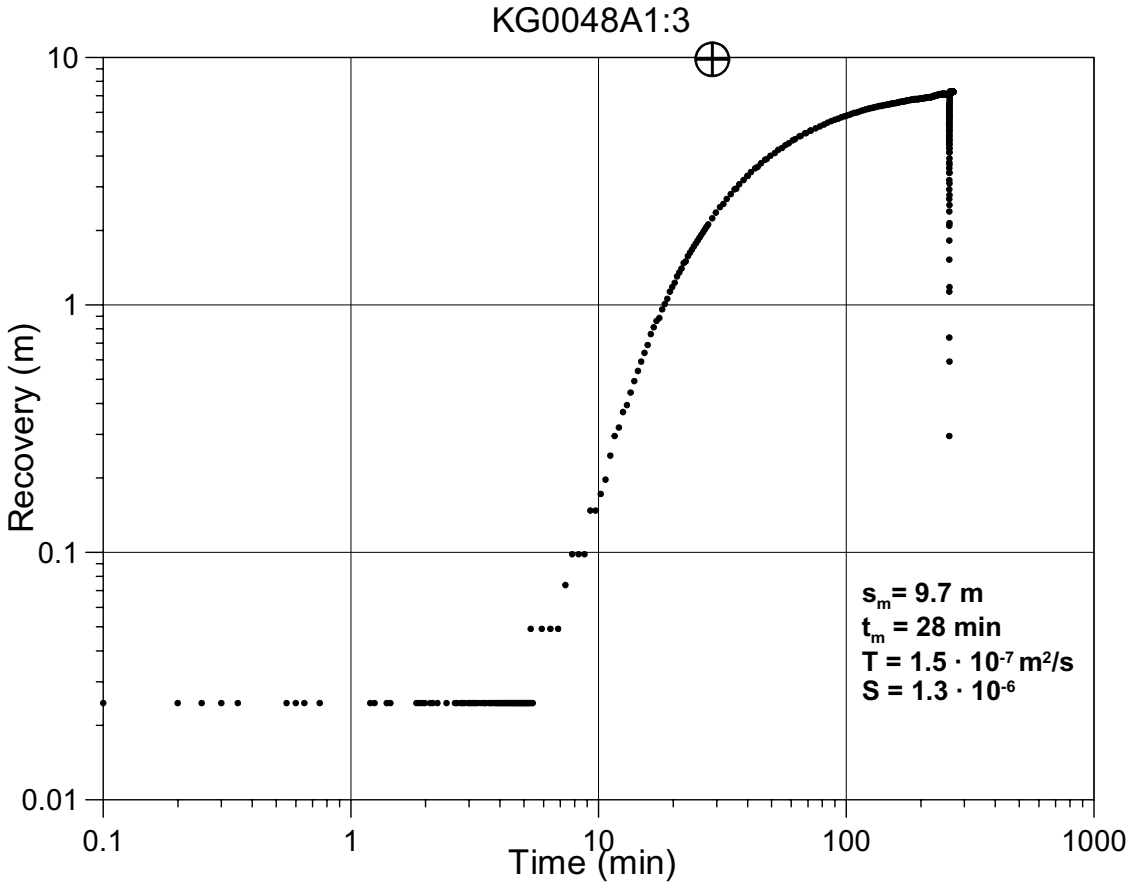
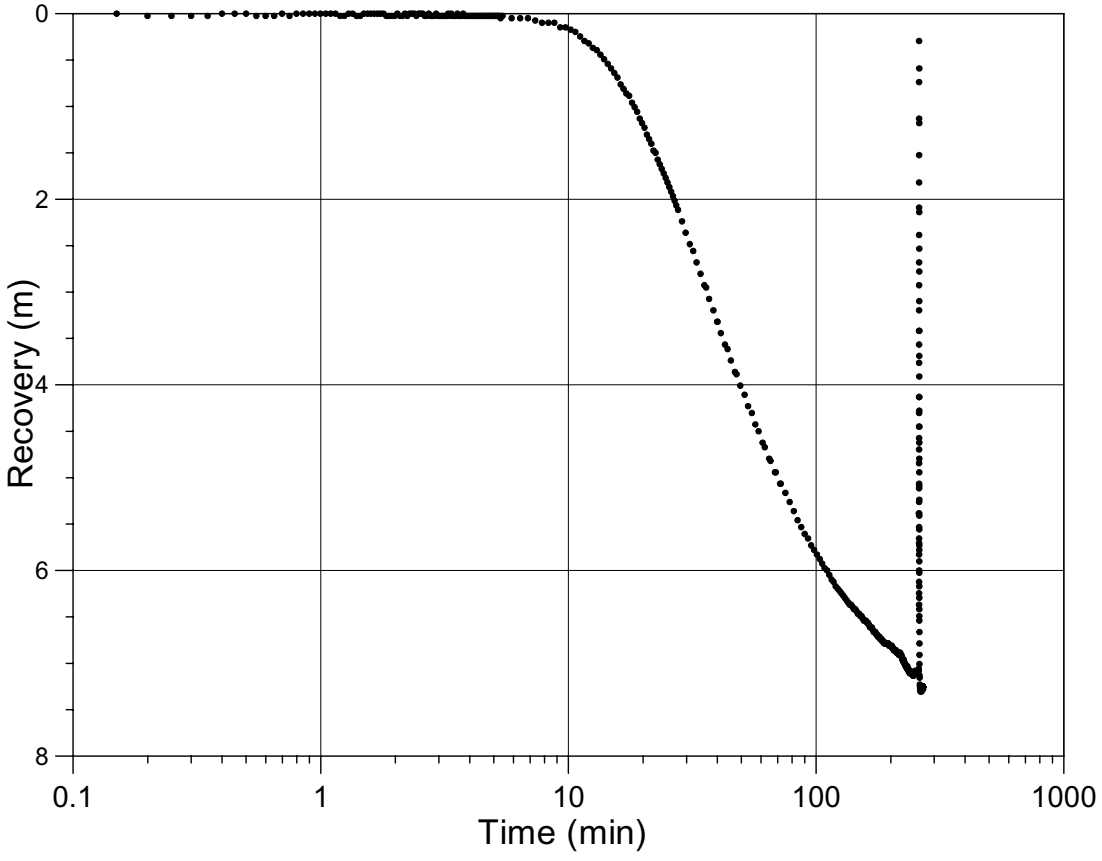
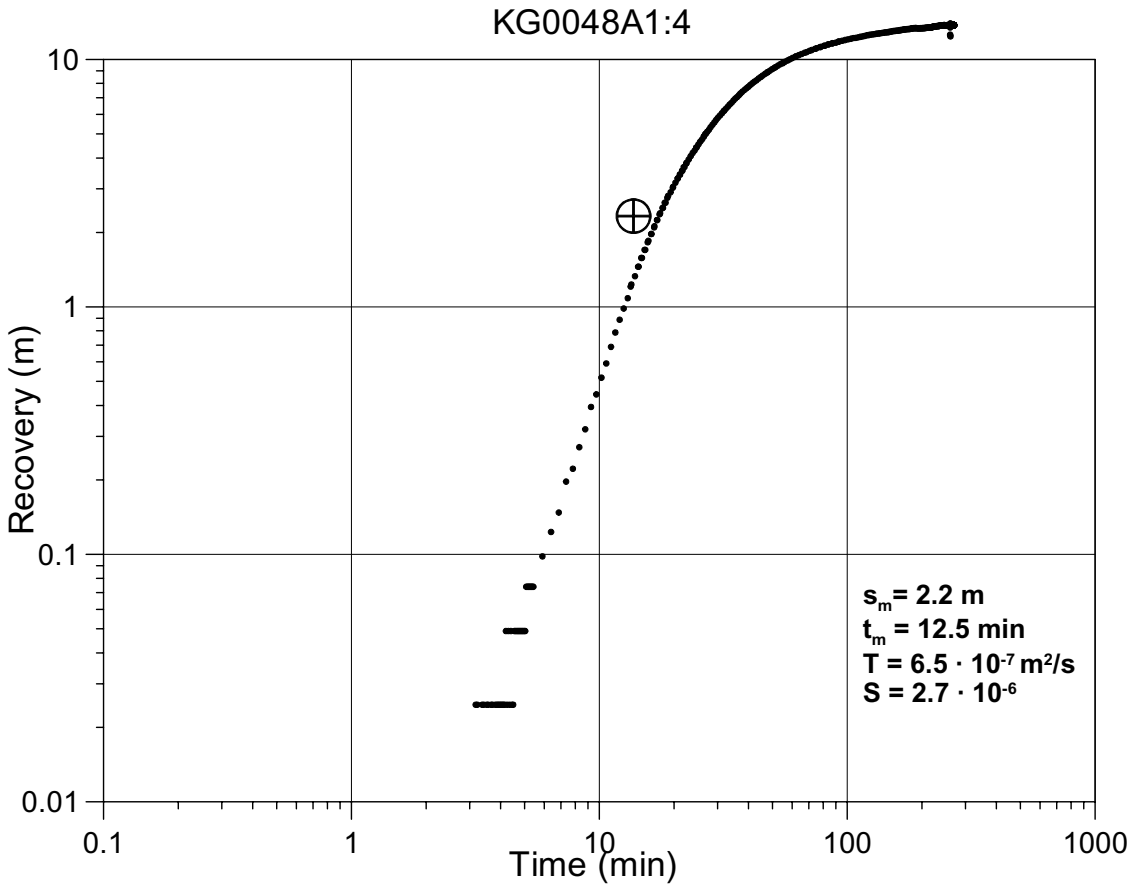
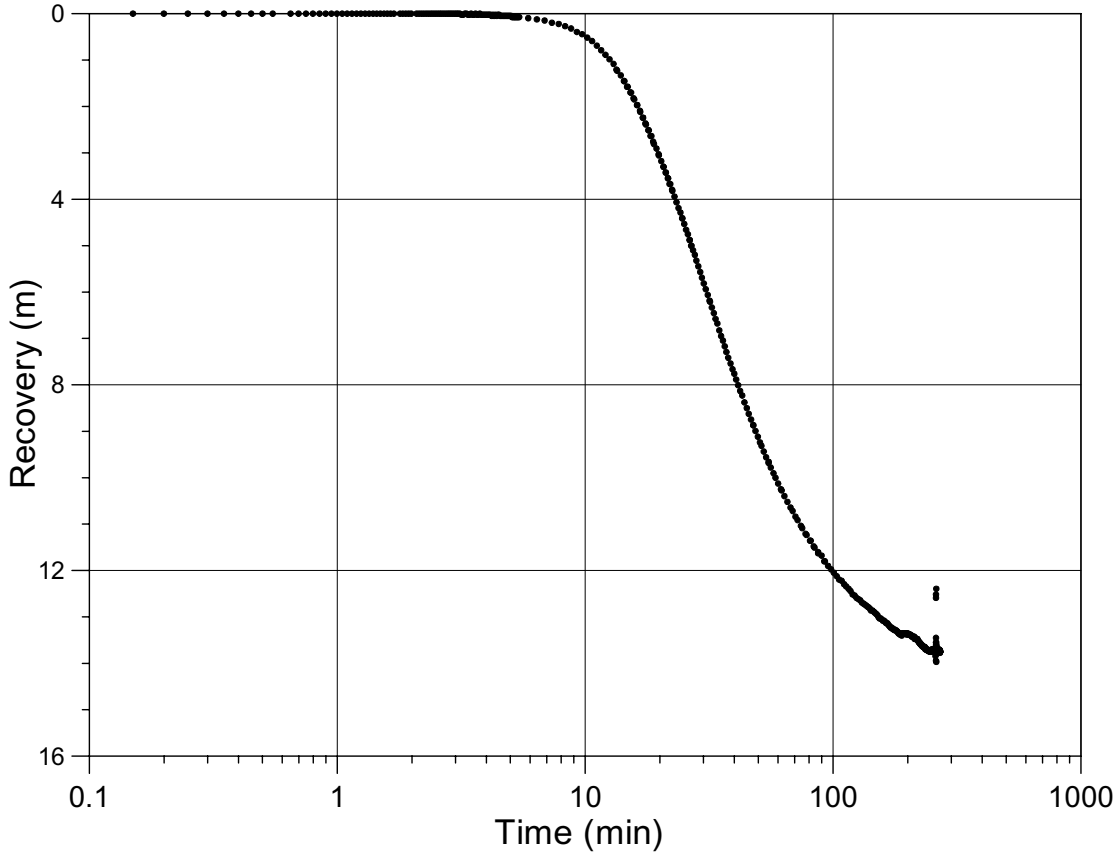




25_KG0048A1_3.GRF 2003-11-03





25_KG0048A1_4.GRF 2003-11-03

Appendix 6

Interference test 1:26 in borehole KG0048A01, section 32.80 m – 33.80 m

Date: 2003-05-14 Field Crew: A. Blom / J. Magnusson
Borehole length: 54.69 m Borehole diameter: 76 mm

Flowing borehole: KG0048A01, section 3: 32.80 m – 33.80 m

Valve opened: 20030514 09:40.00 Valve closed: 20030514 15:40.00

End of Test: 20030515 09:40

Total flowing time : 360 min Tot. Pr. Build-up time: 1080 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

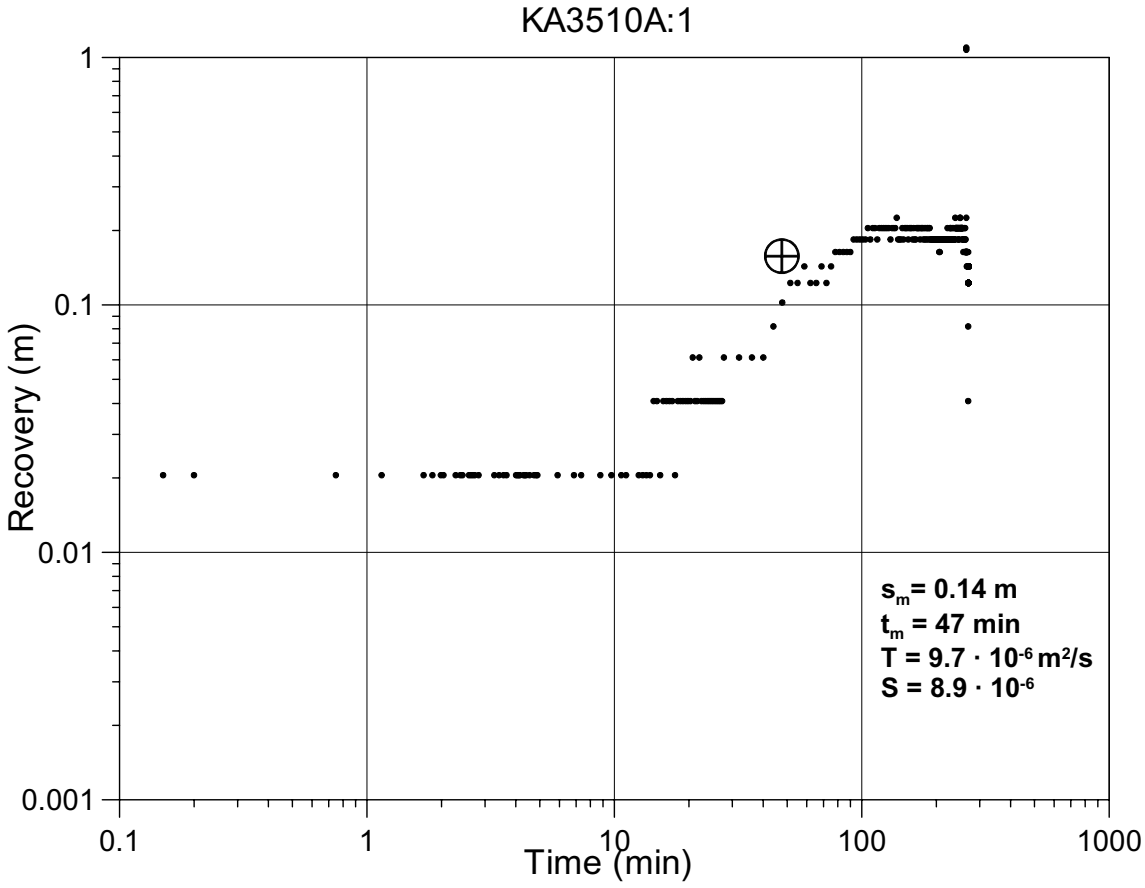
Manually measured flow rates of KG0048A01, section 32.80 m – 33.80 m are presented in the table below:

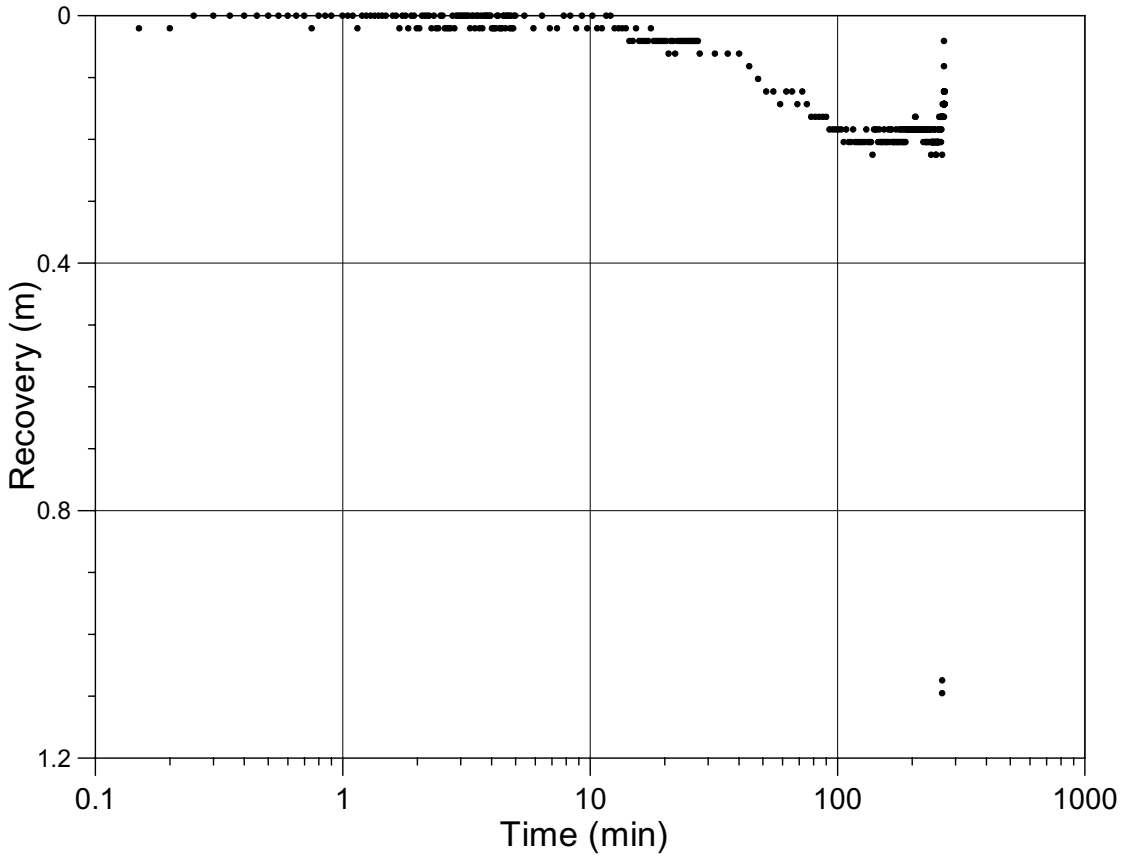
Table Manually measured flow rates, Interference test in KG0021A01, section 32.80 m – 33.80 m. Prototype Repository, May 14 2003

Time	Flow rate (l/min)
09:40:40	1.329
09:42:15	1.186
09:44:00	1.139
10:09:00	1.060
10:11:00	1.059
10:13:00	1.060
15:29:30	1.021
15:31:30	1.020
15:33:30	1.018

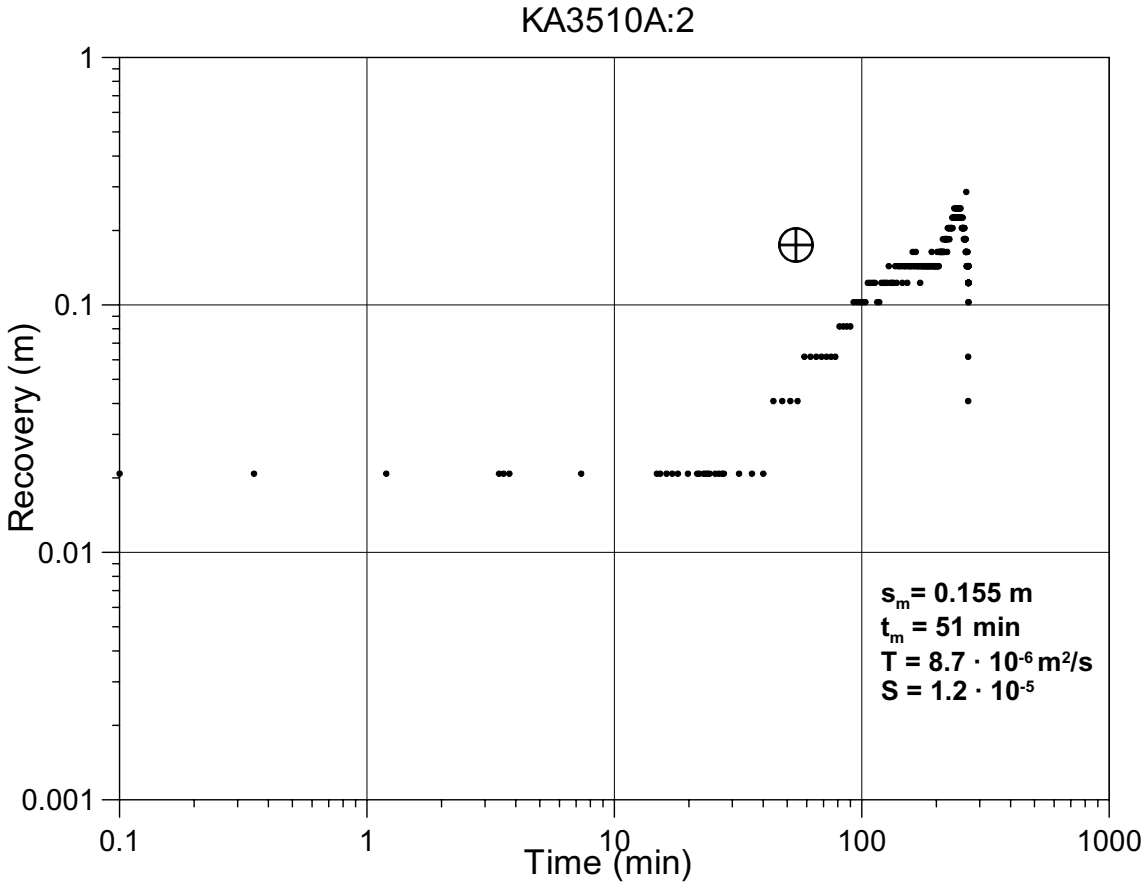
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

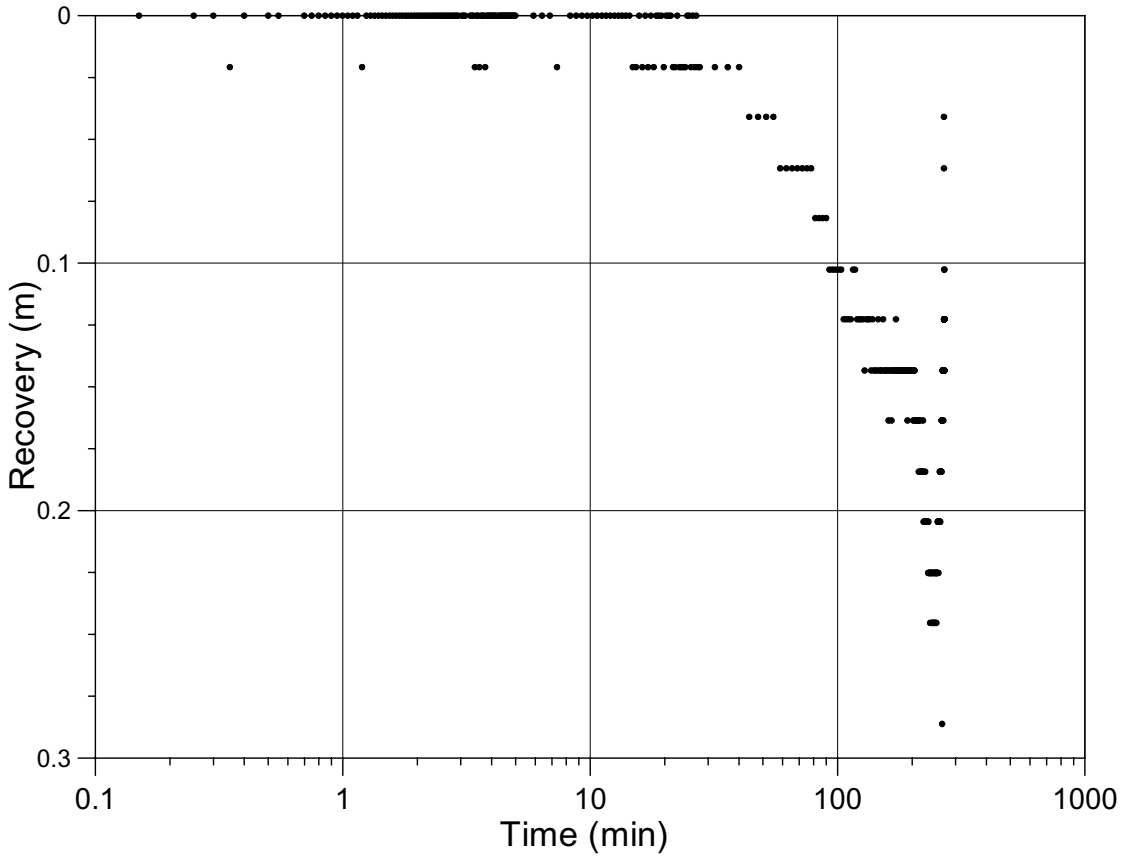
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



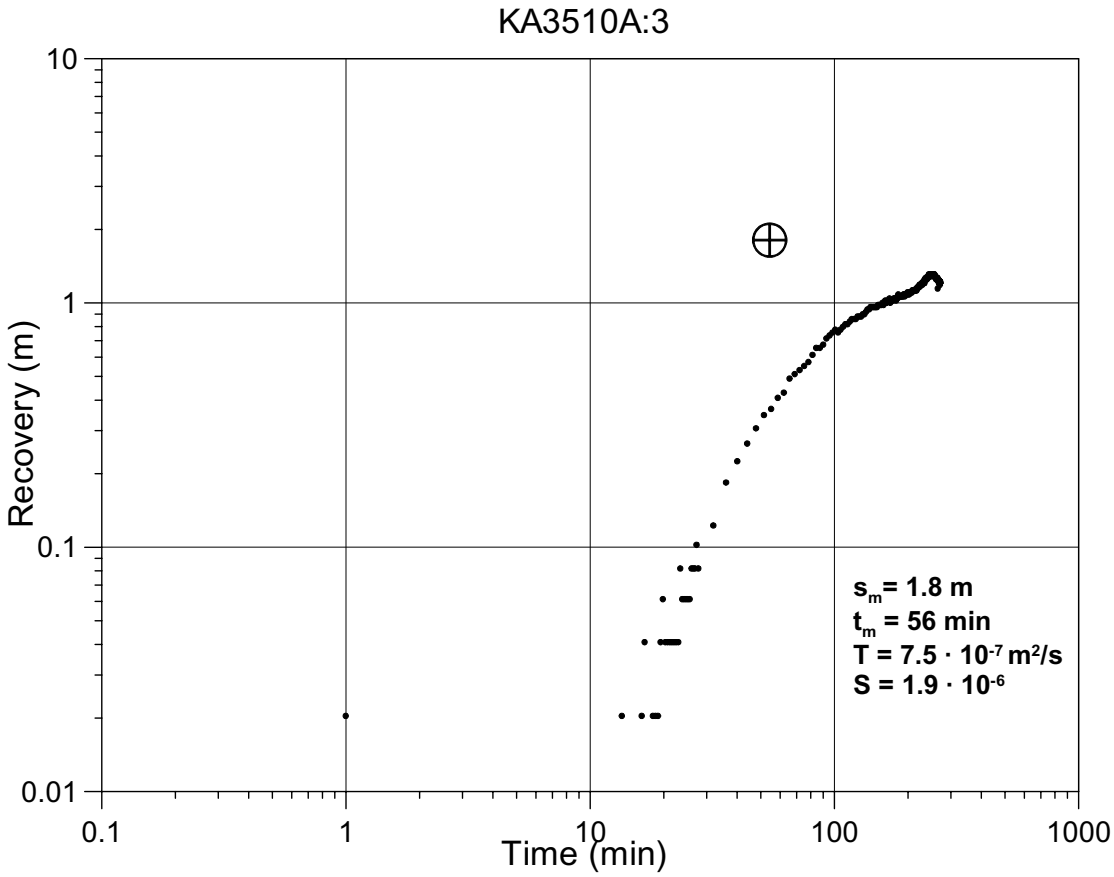


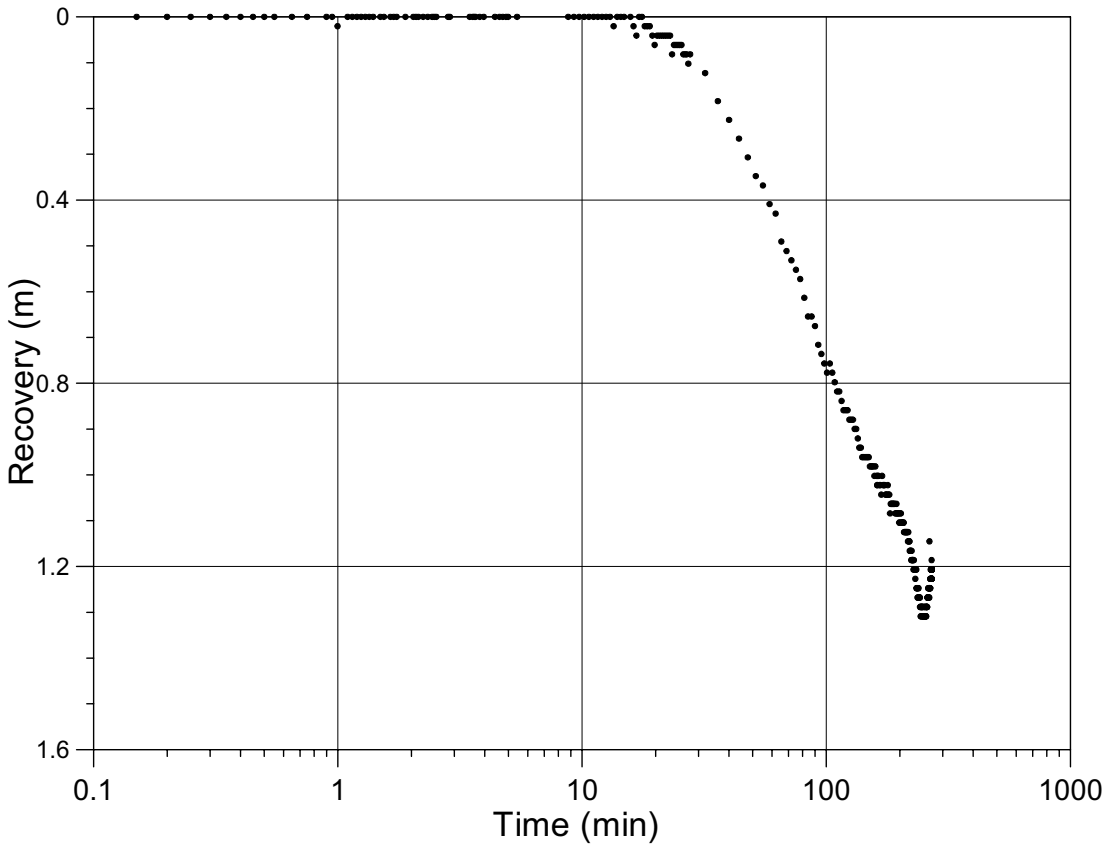
26_KA3510A_1.GRF 2003-11-03



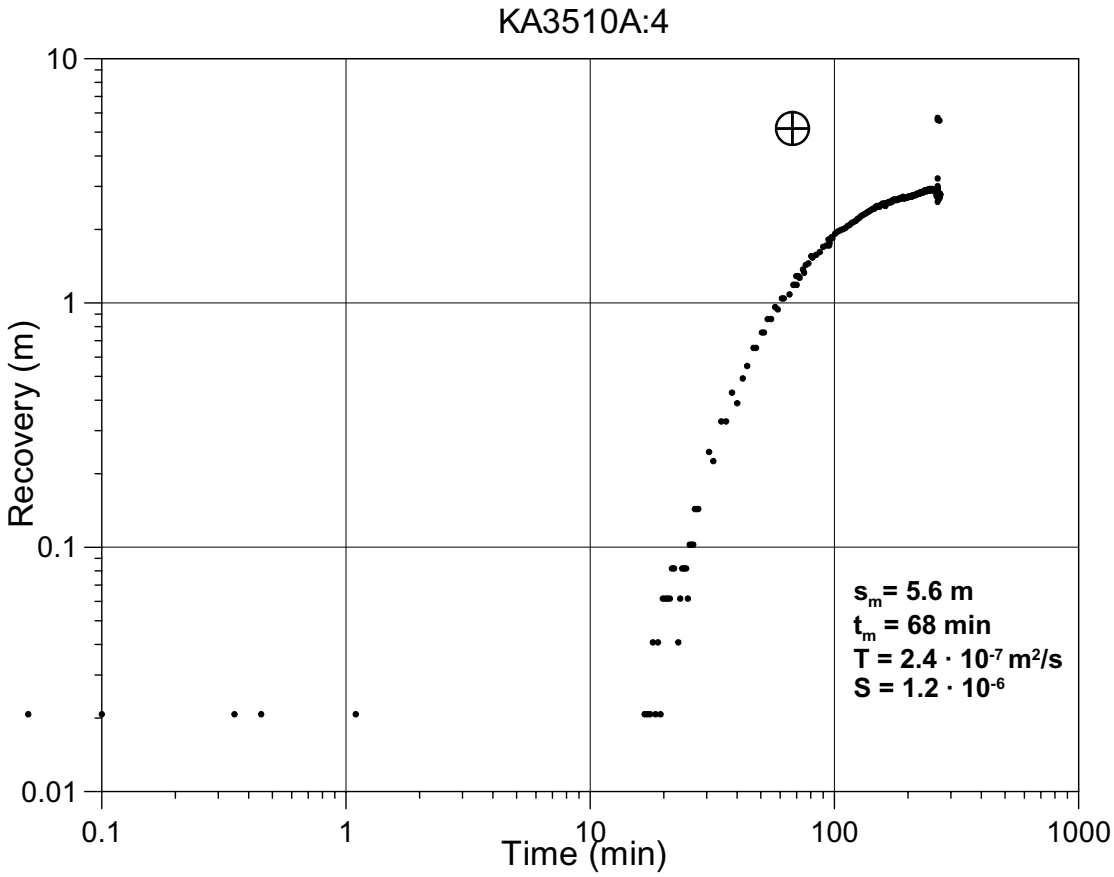


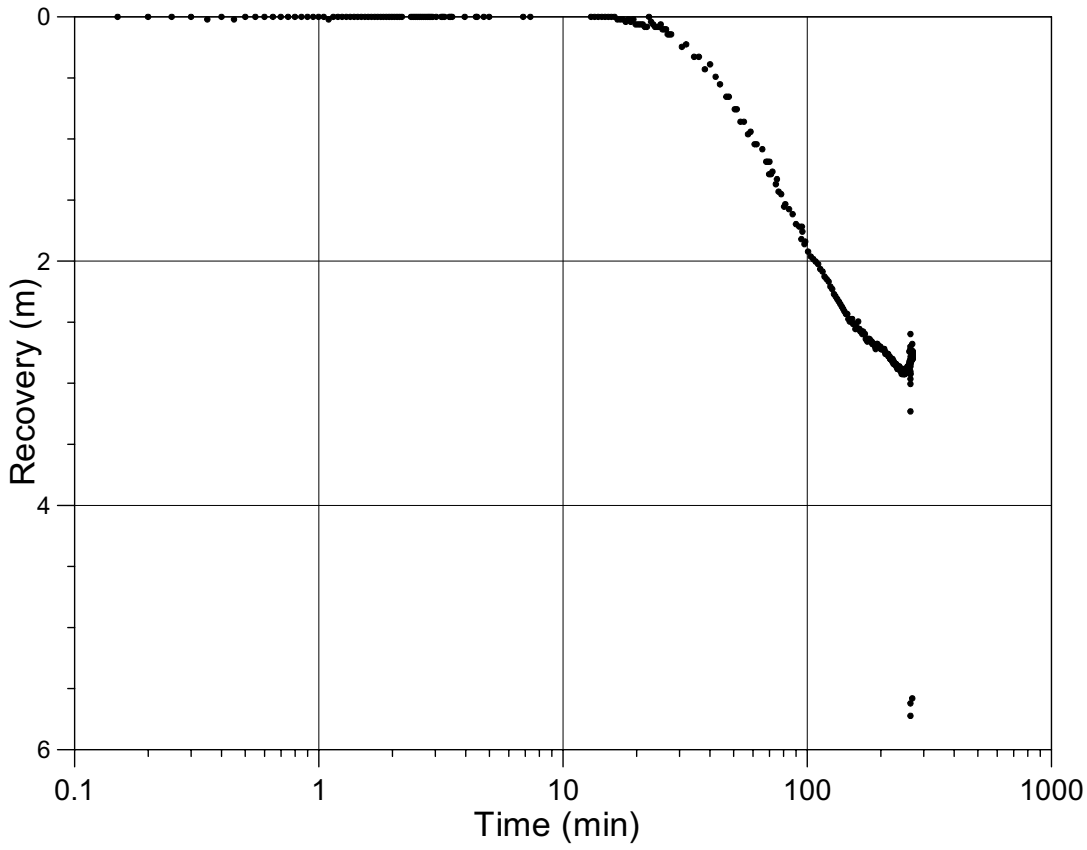
26_KA3510A_2.GRF 2003-11-03



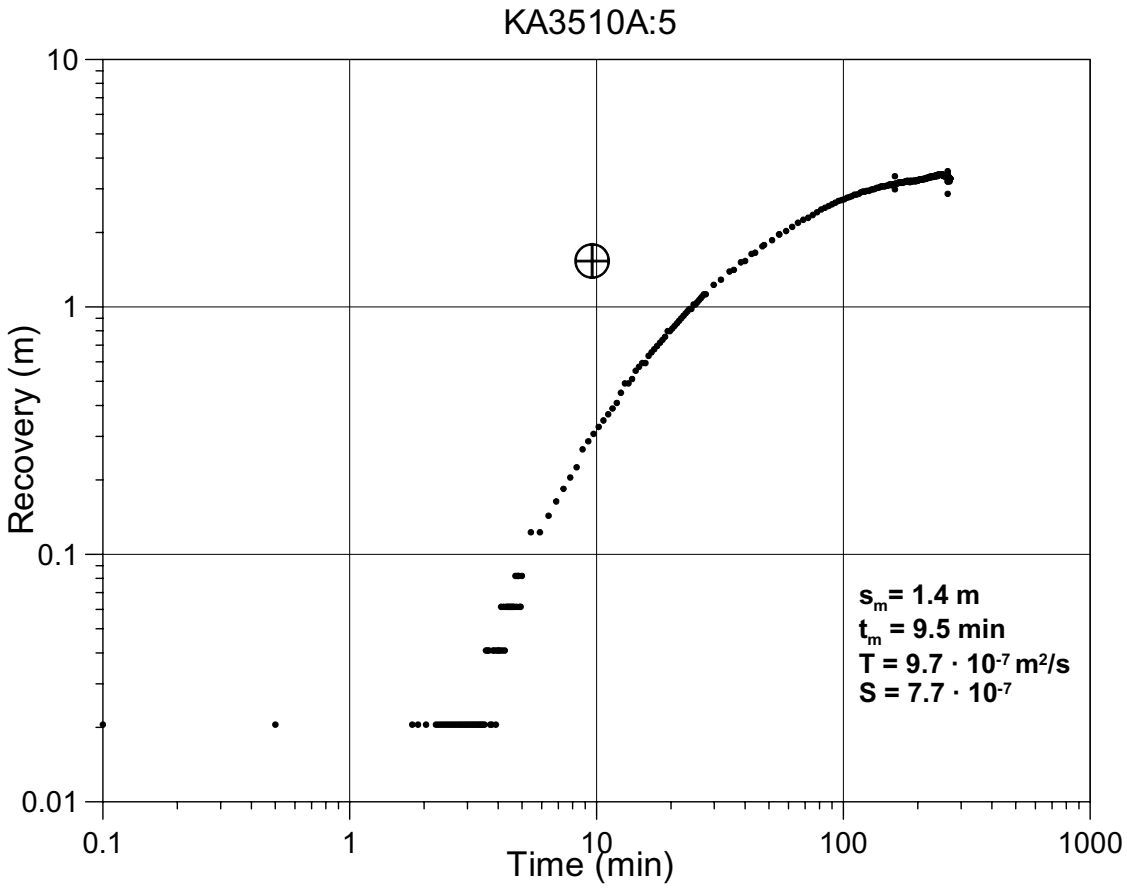


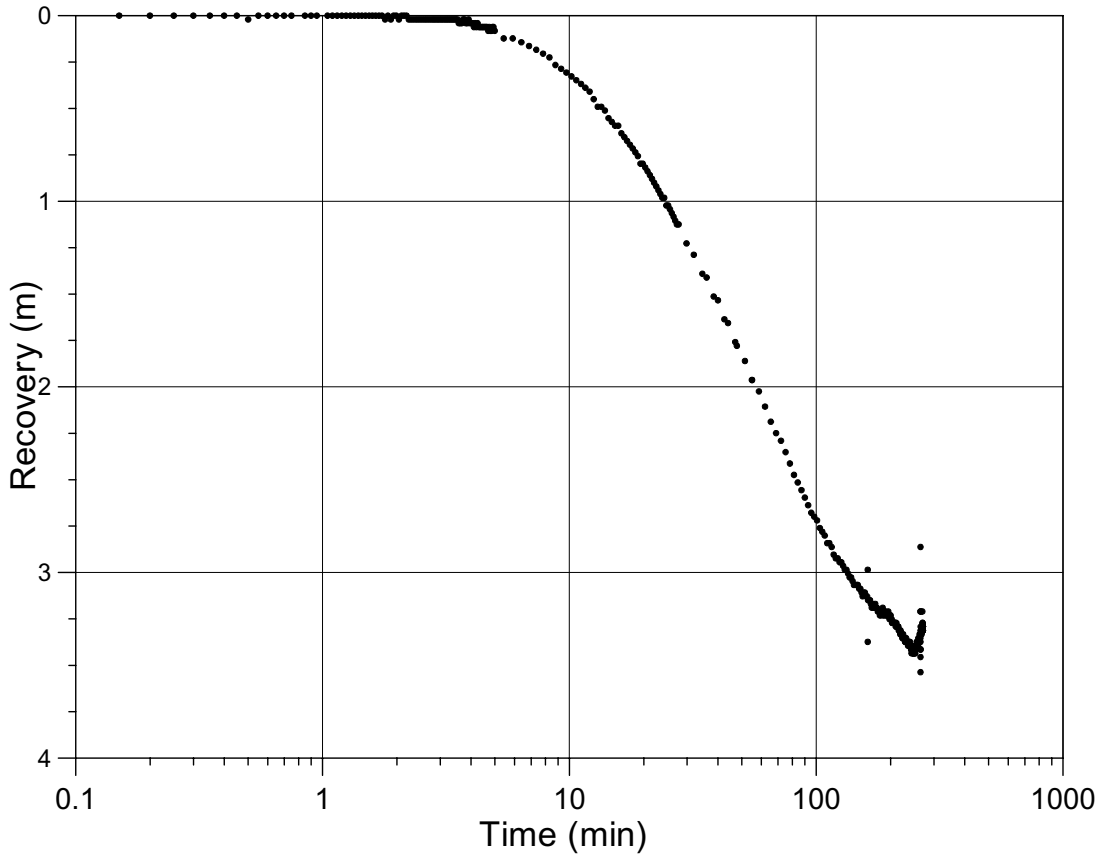
26_KA3510A_3.GRF 2003-11-03



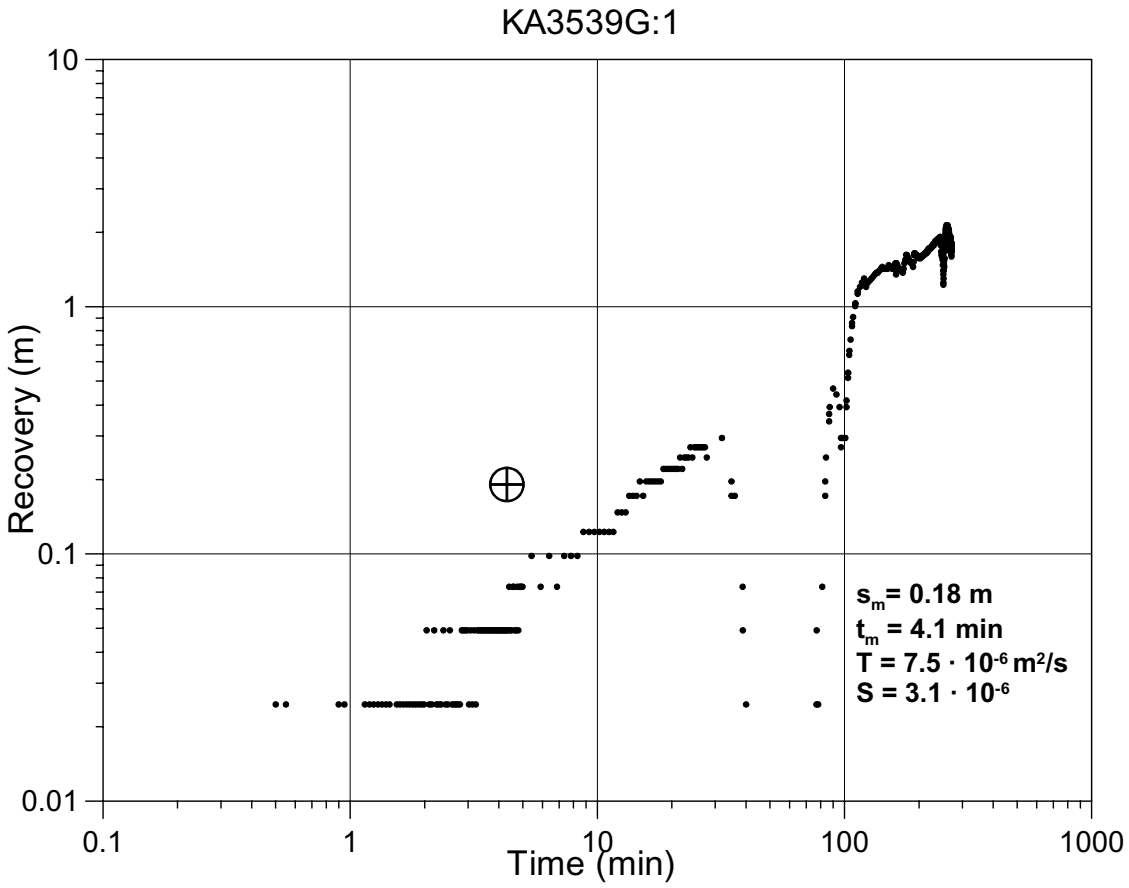


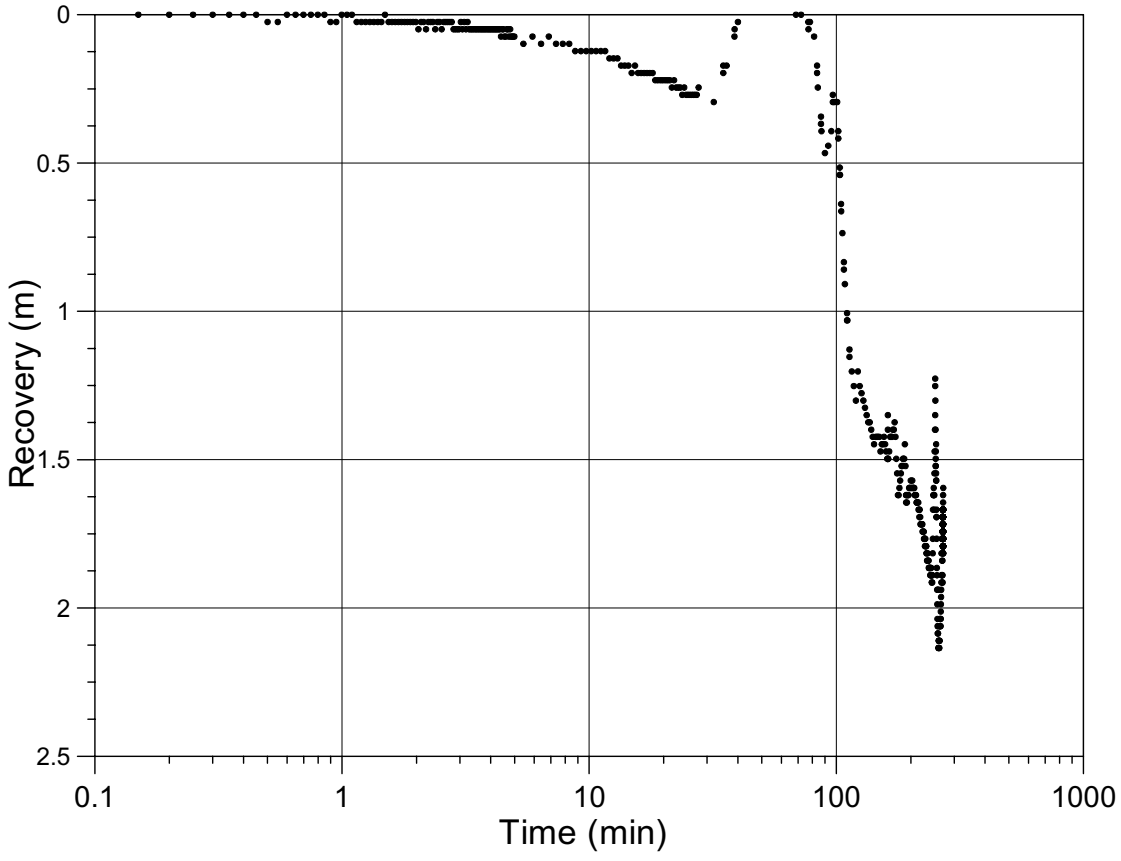
26_KA3510A_4.GRF 2003-11-03



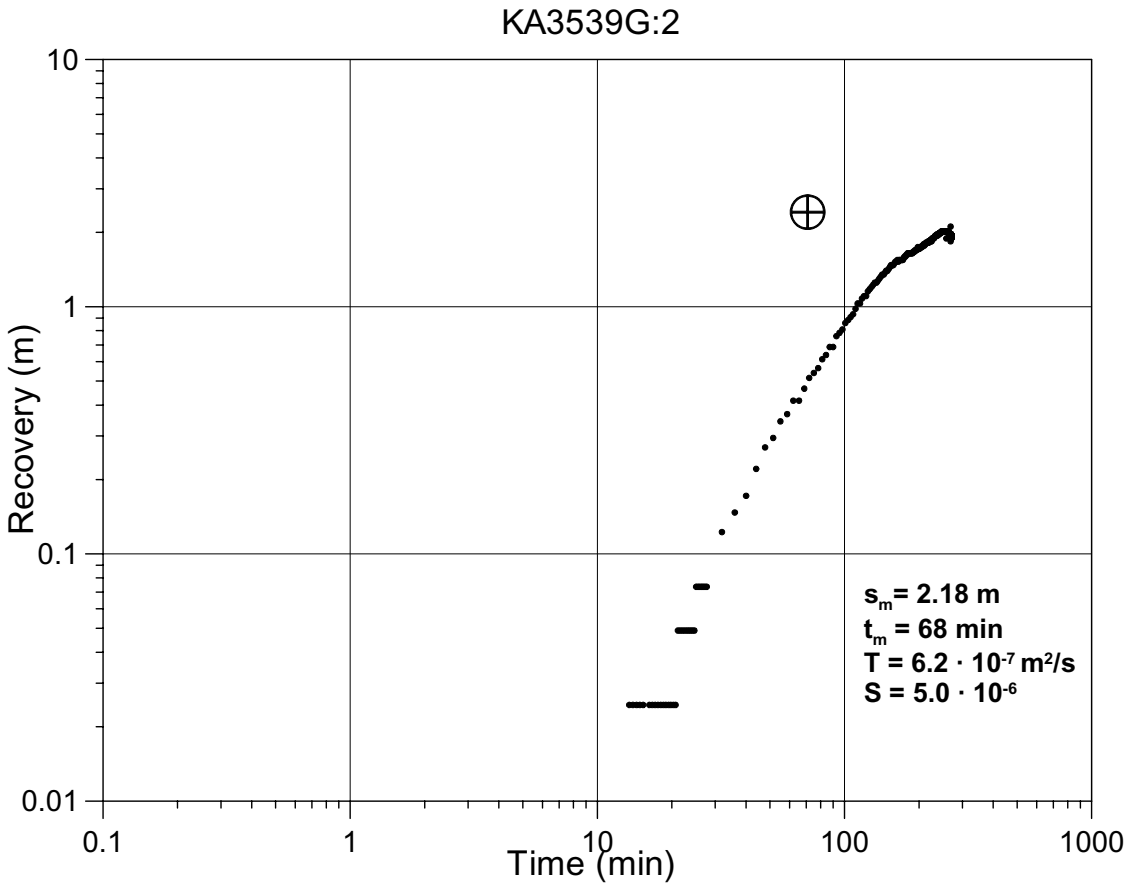


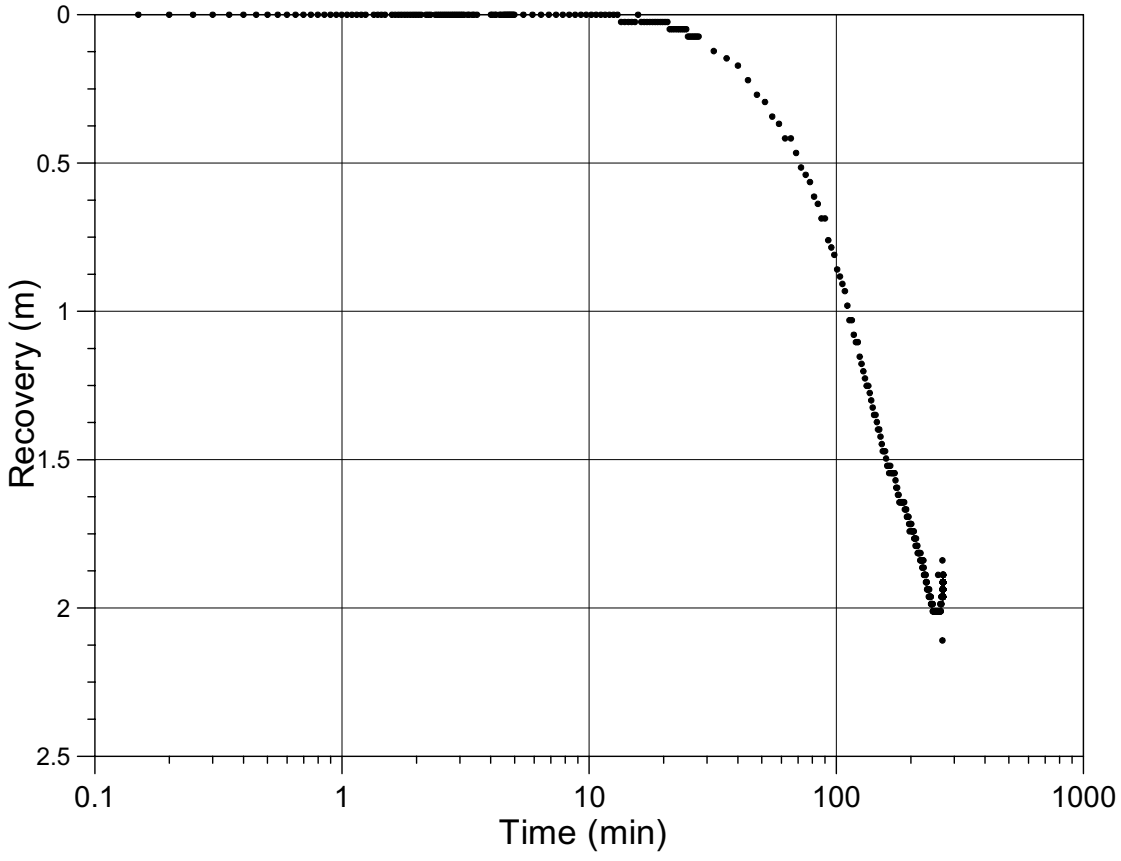
26_KA3510A_5.GRF 2003-11-03





26_KA3539G_1.GRF 2003-11-04





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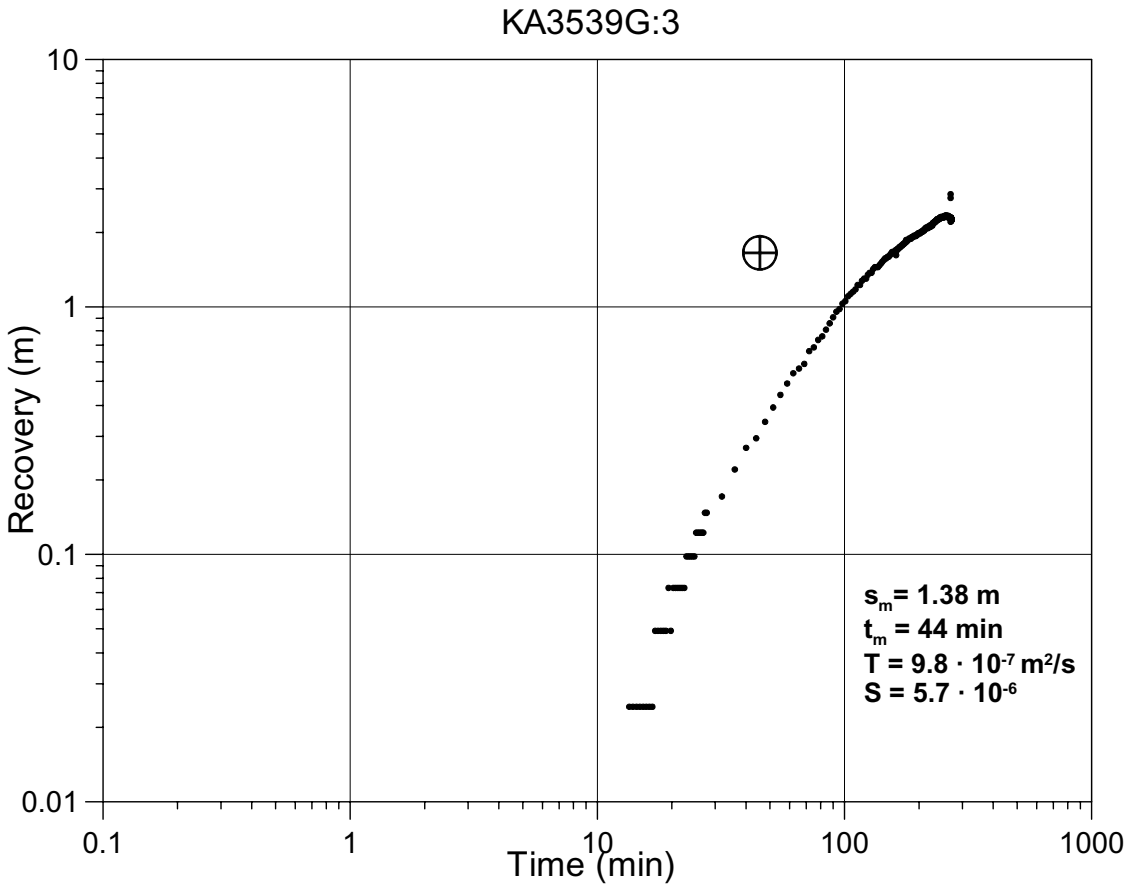

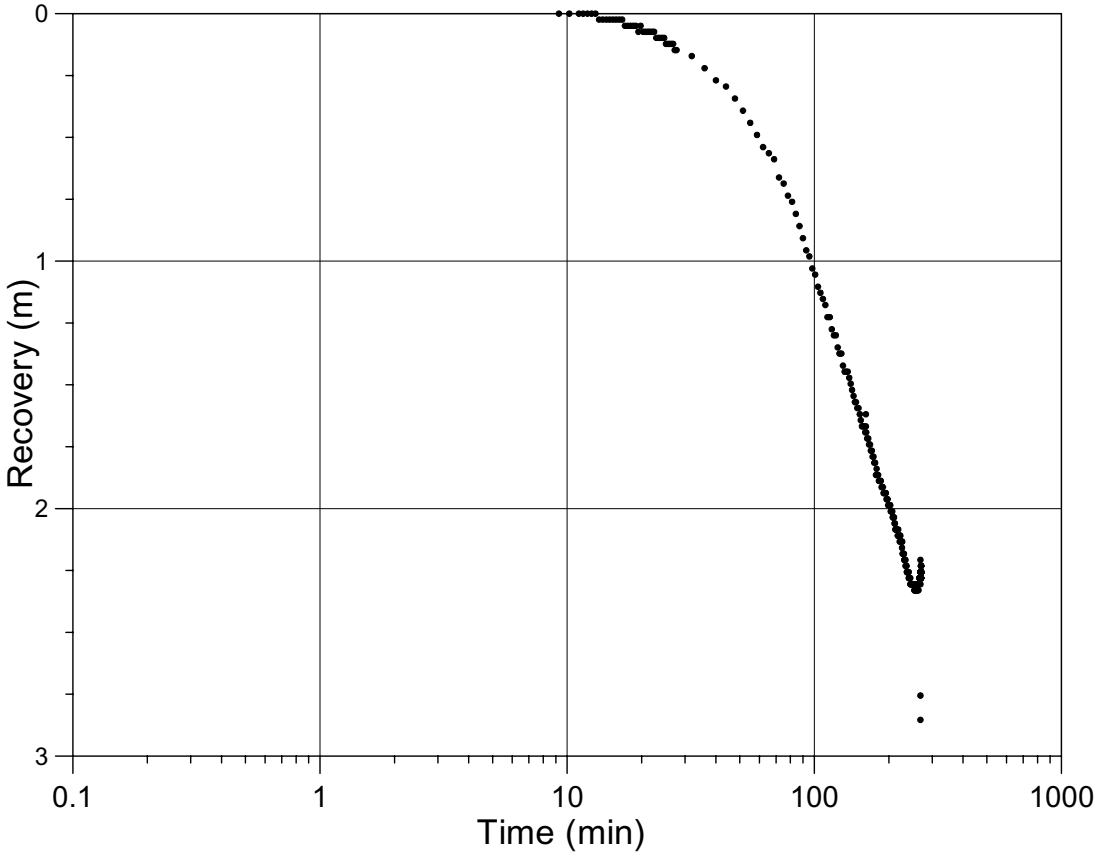

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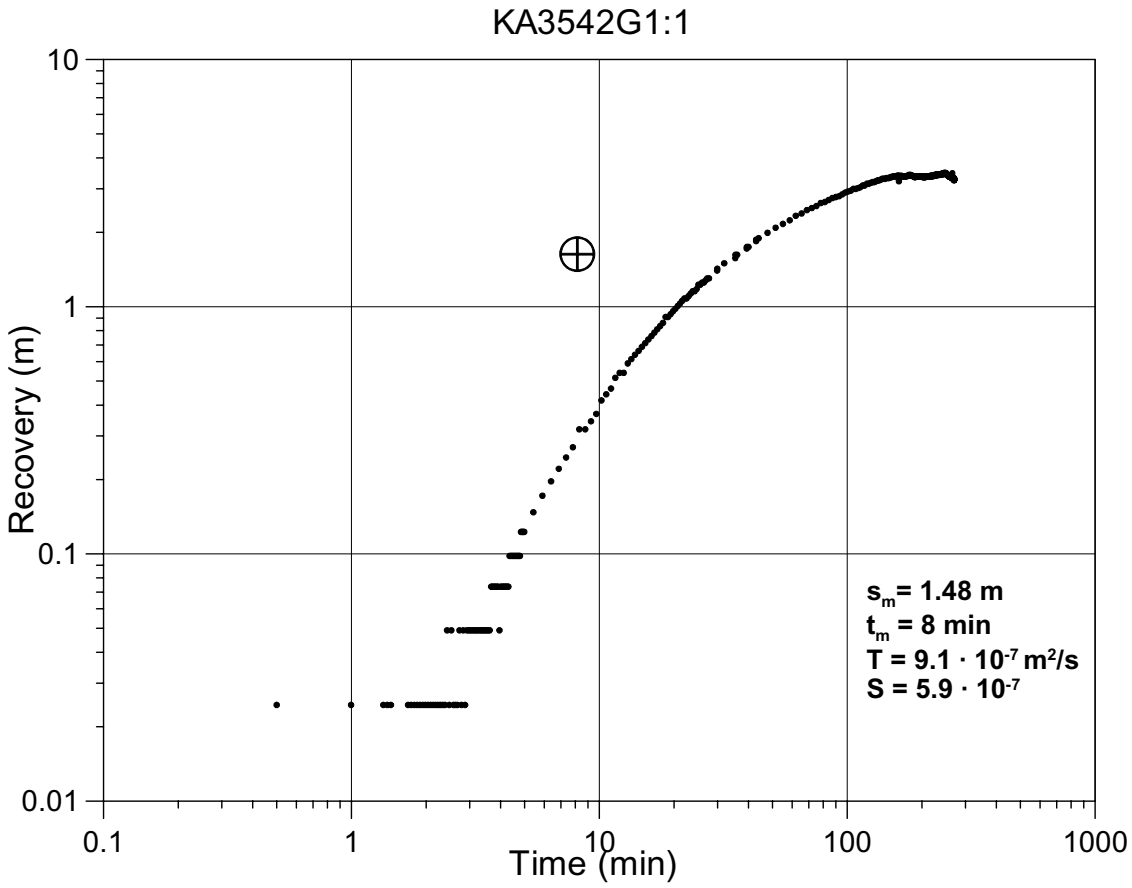

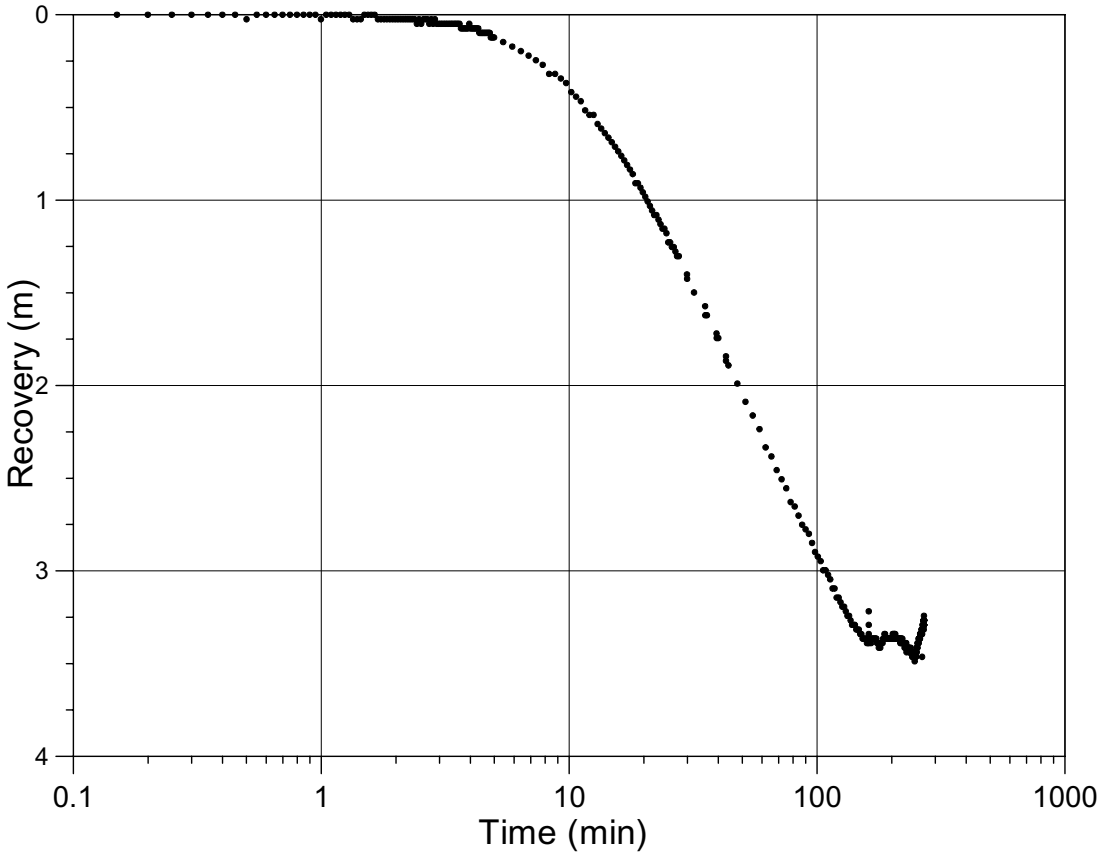

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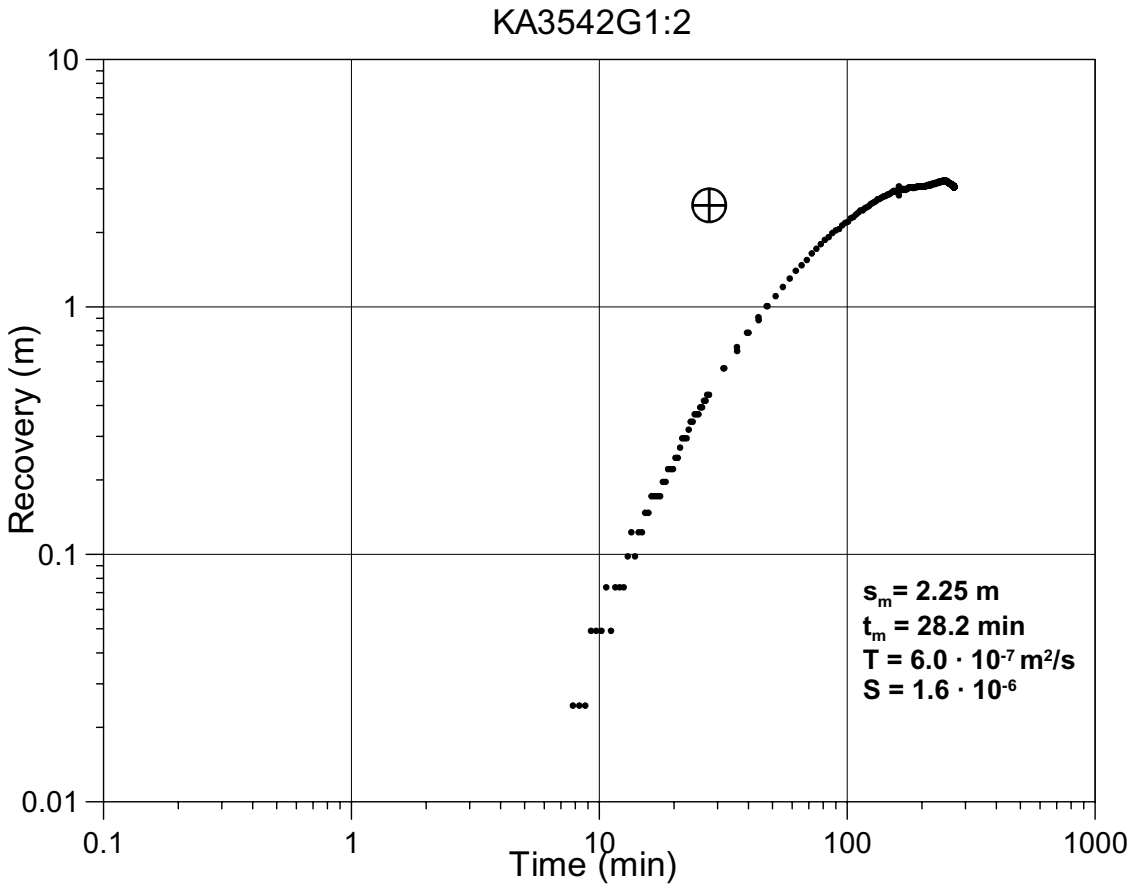

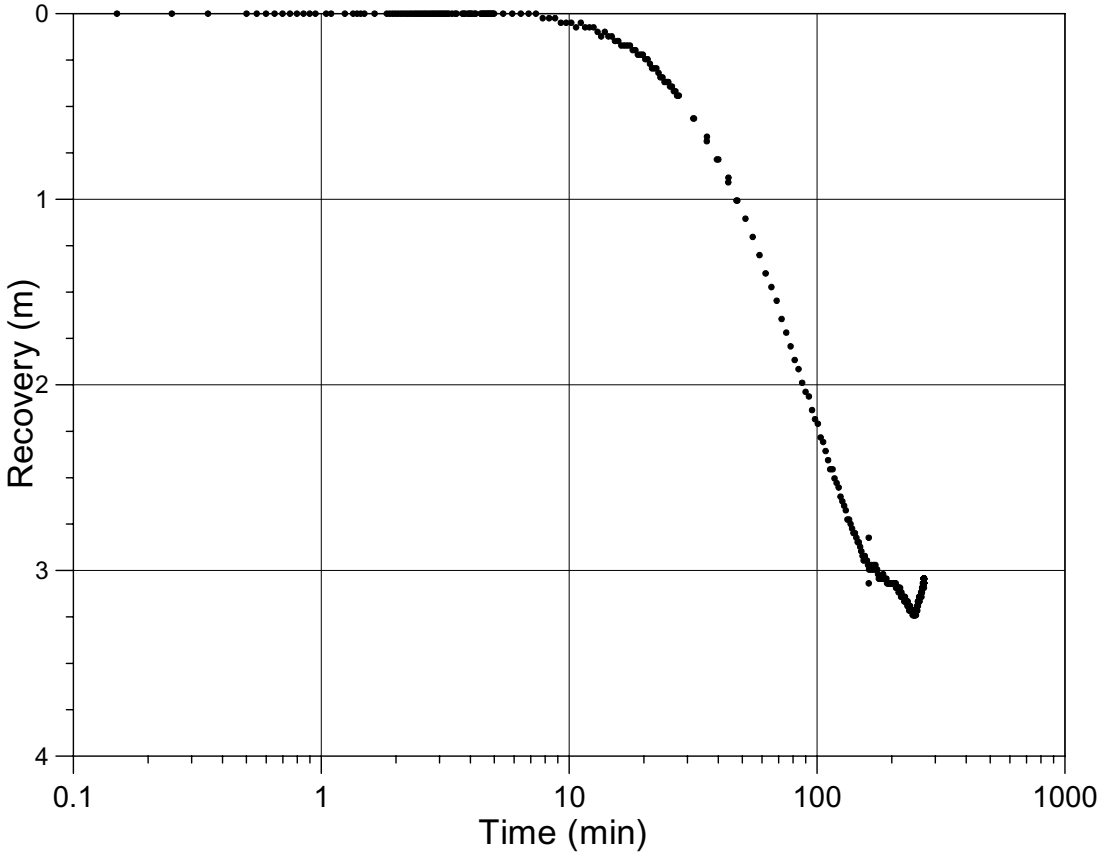

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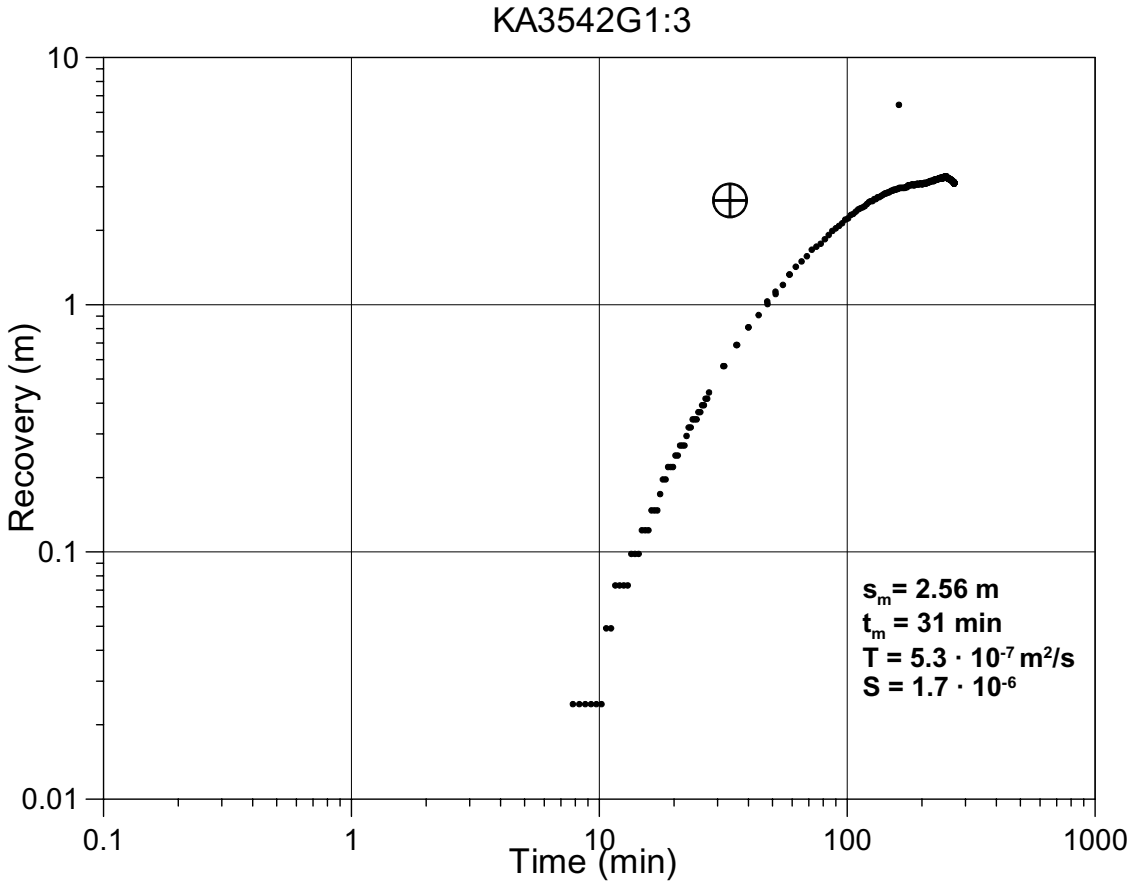

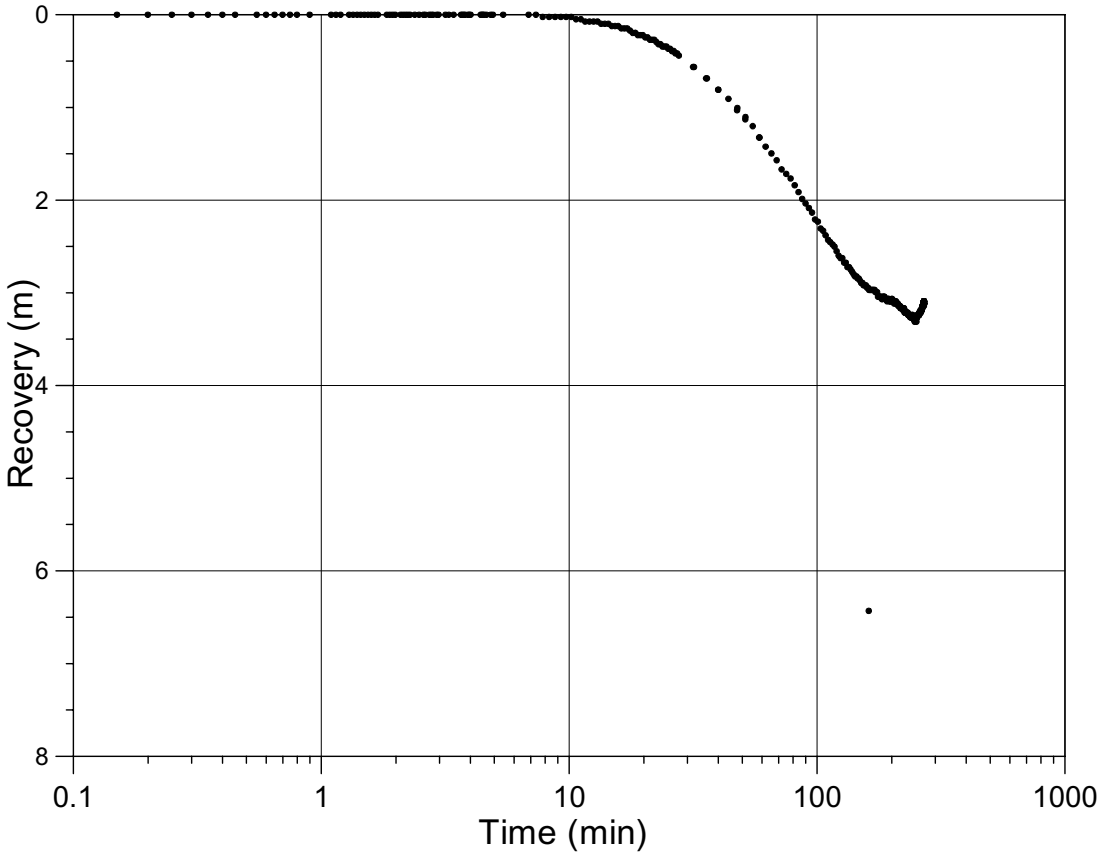

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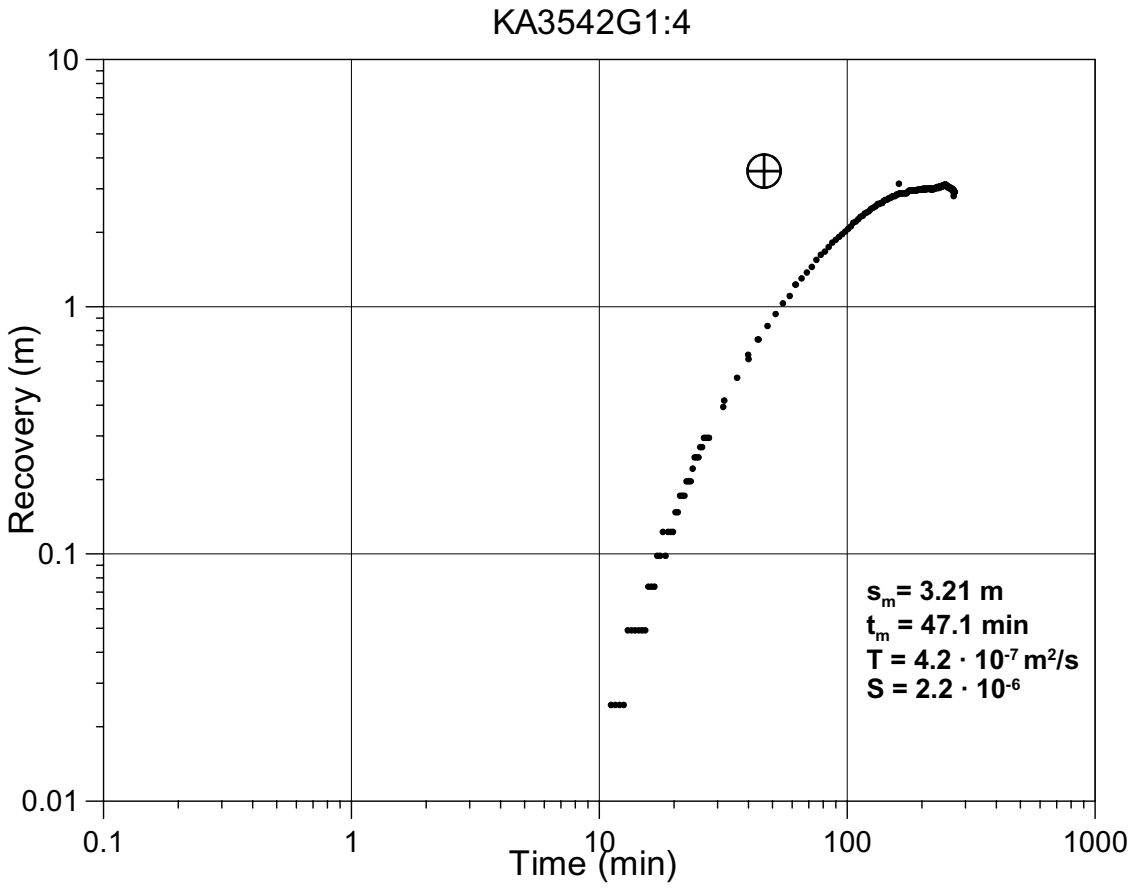

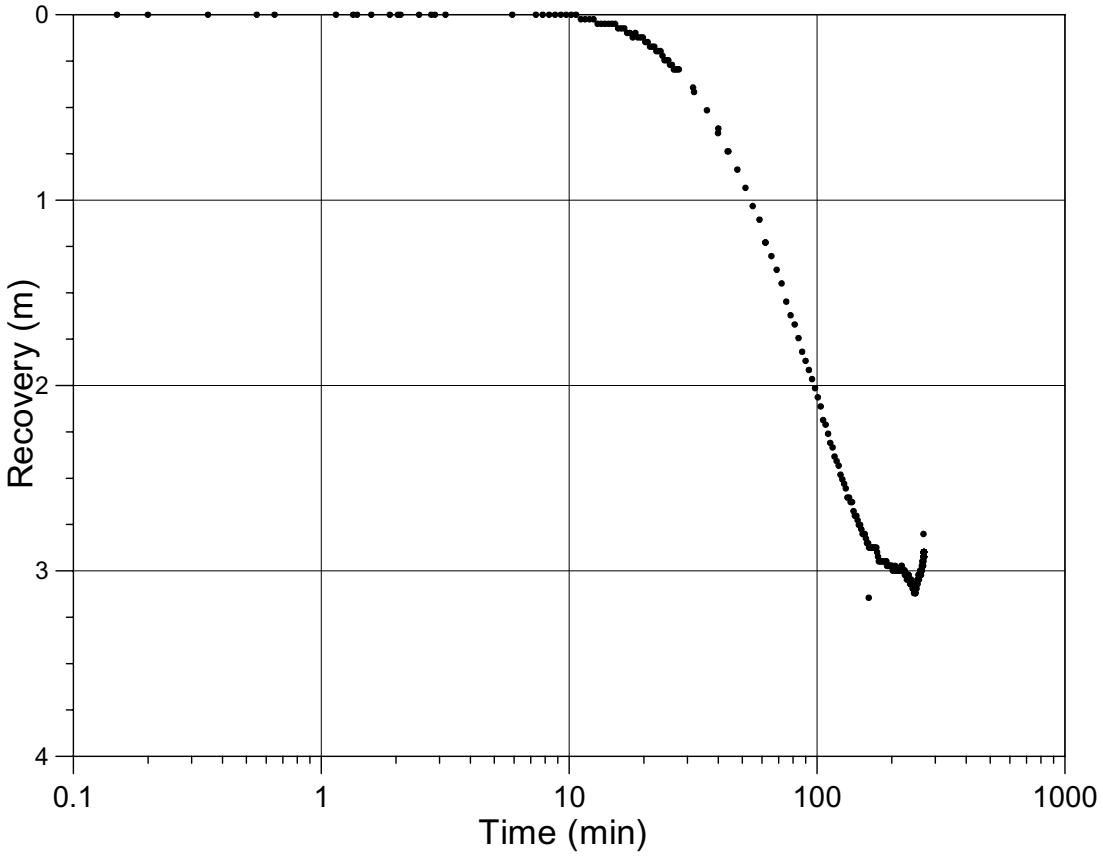

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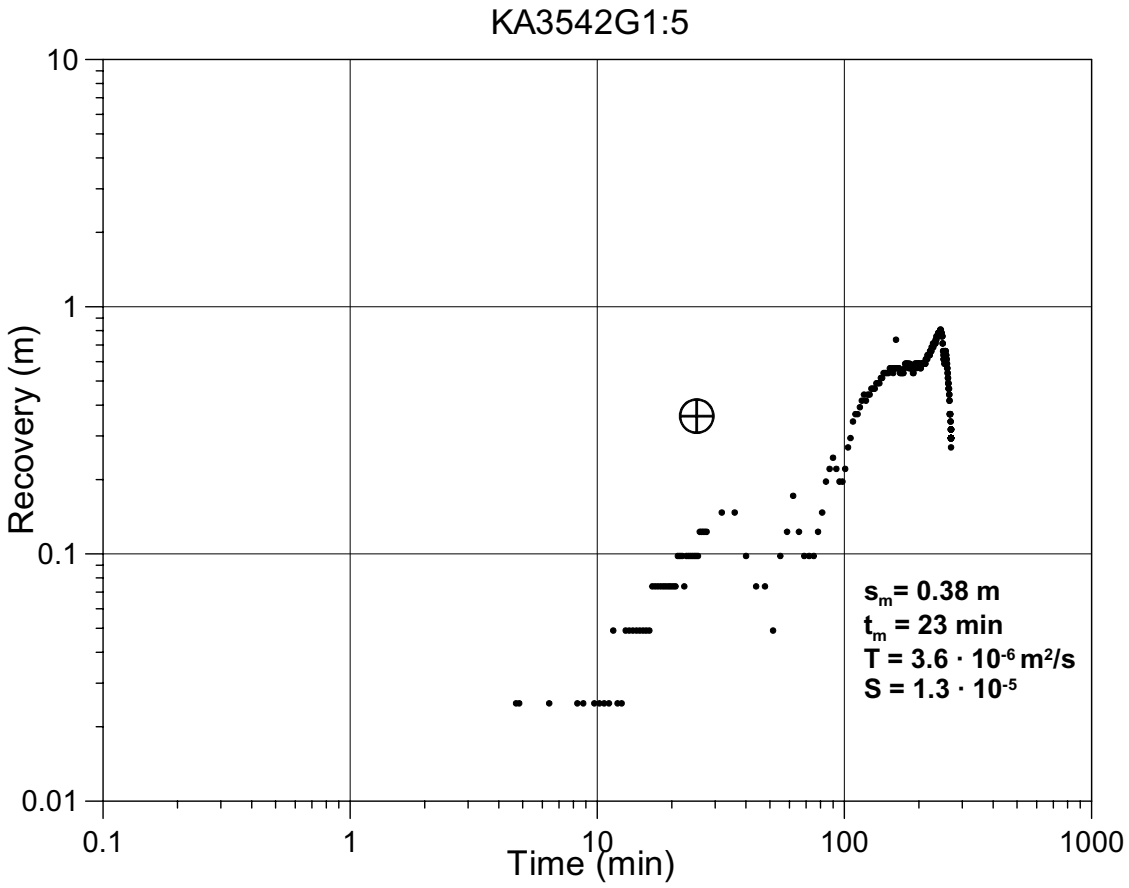

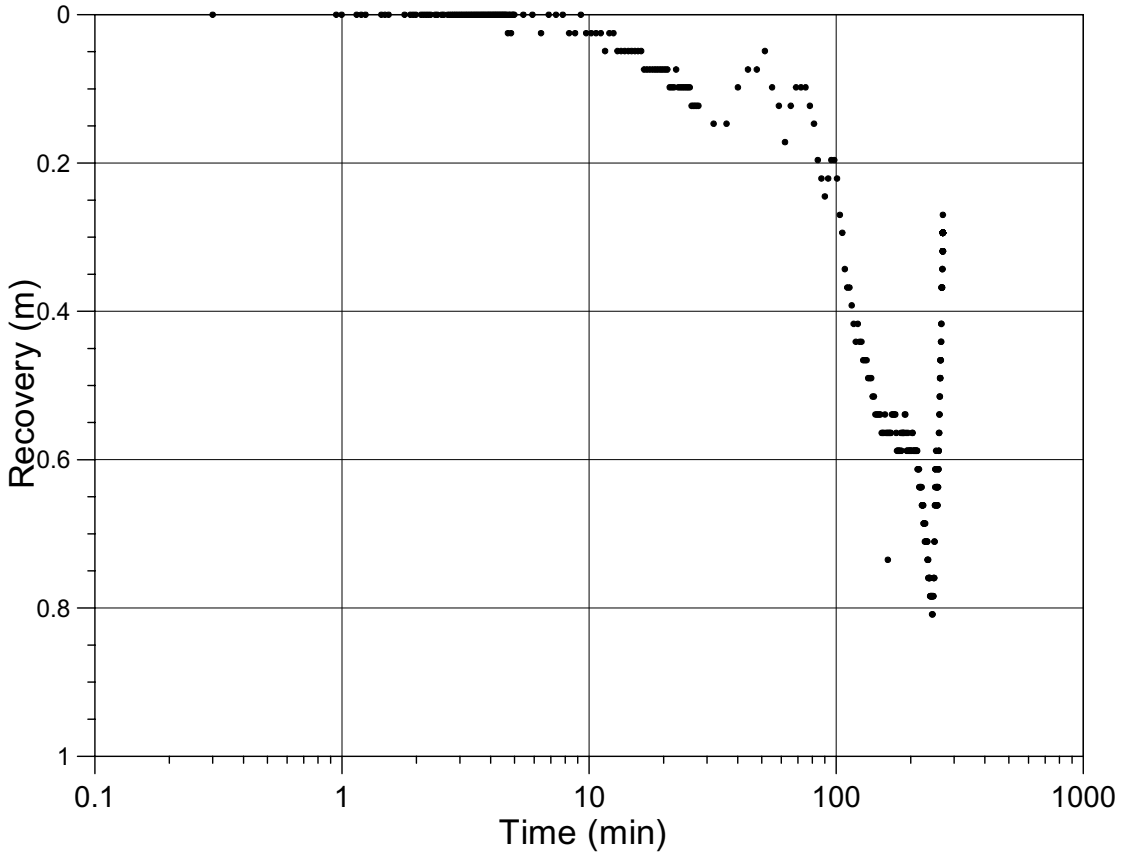

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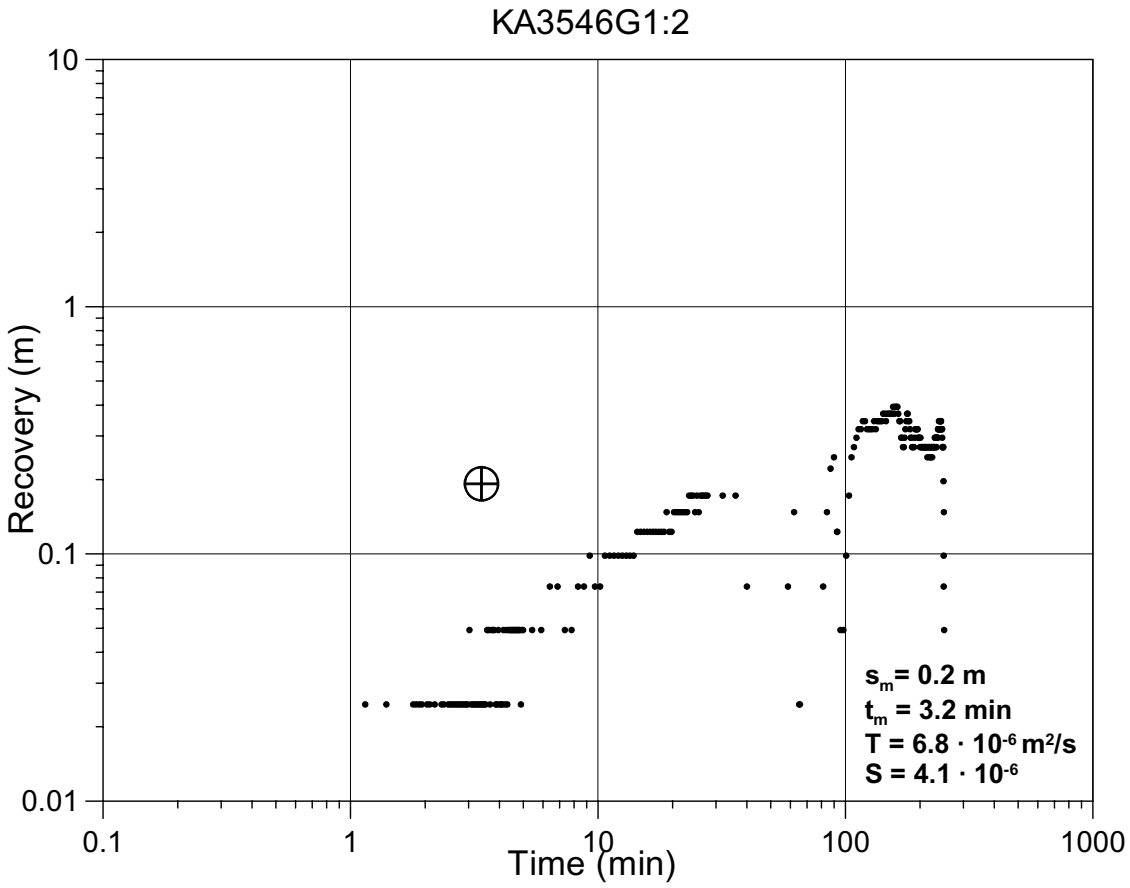

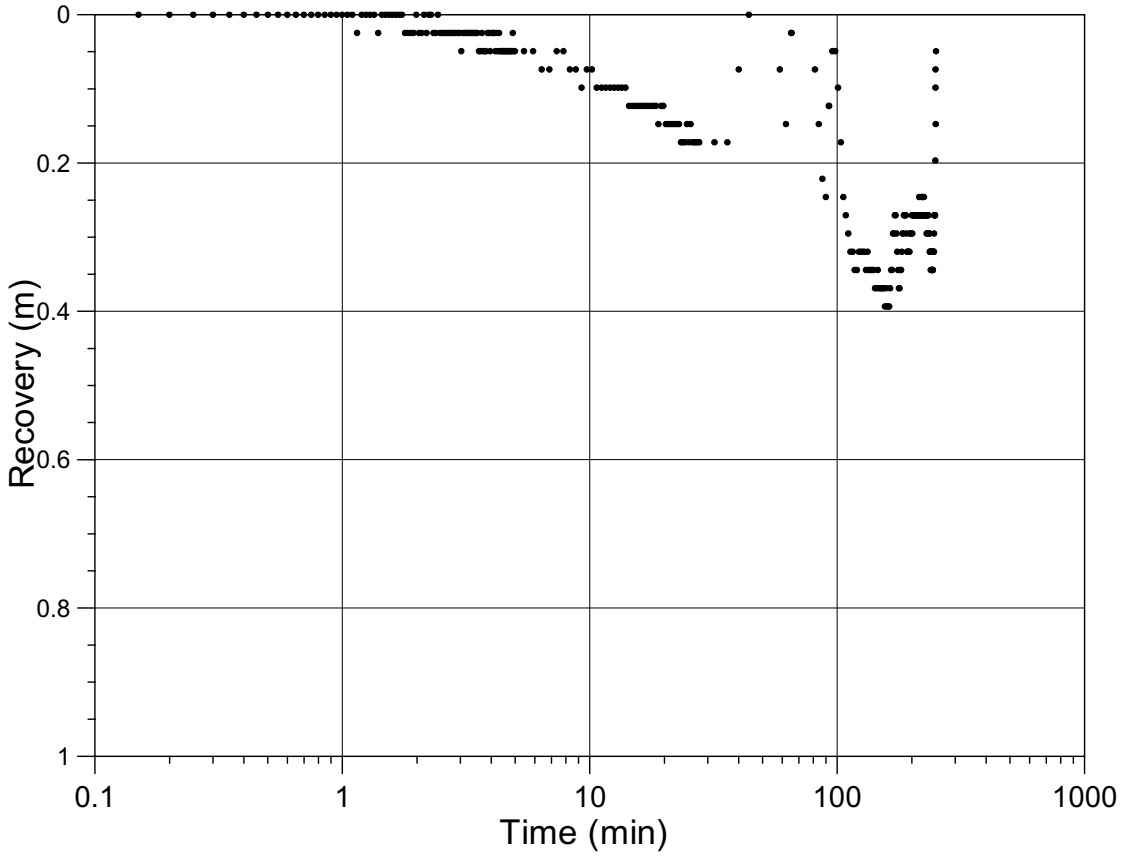

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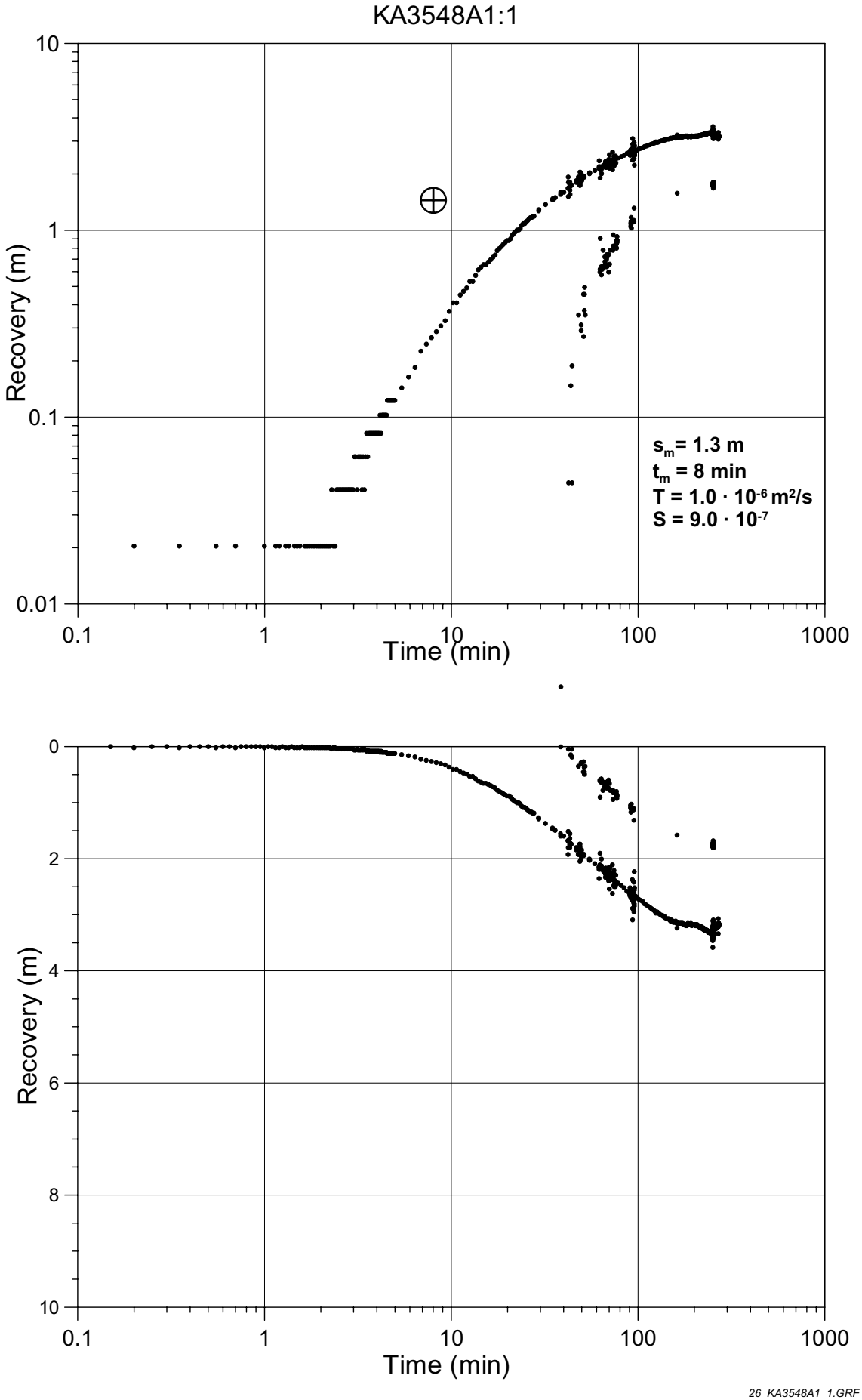
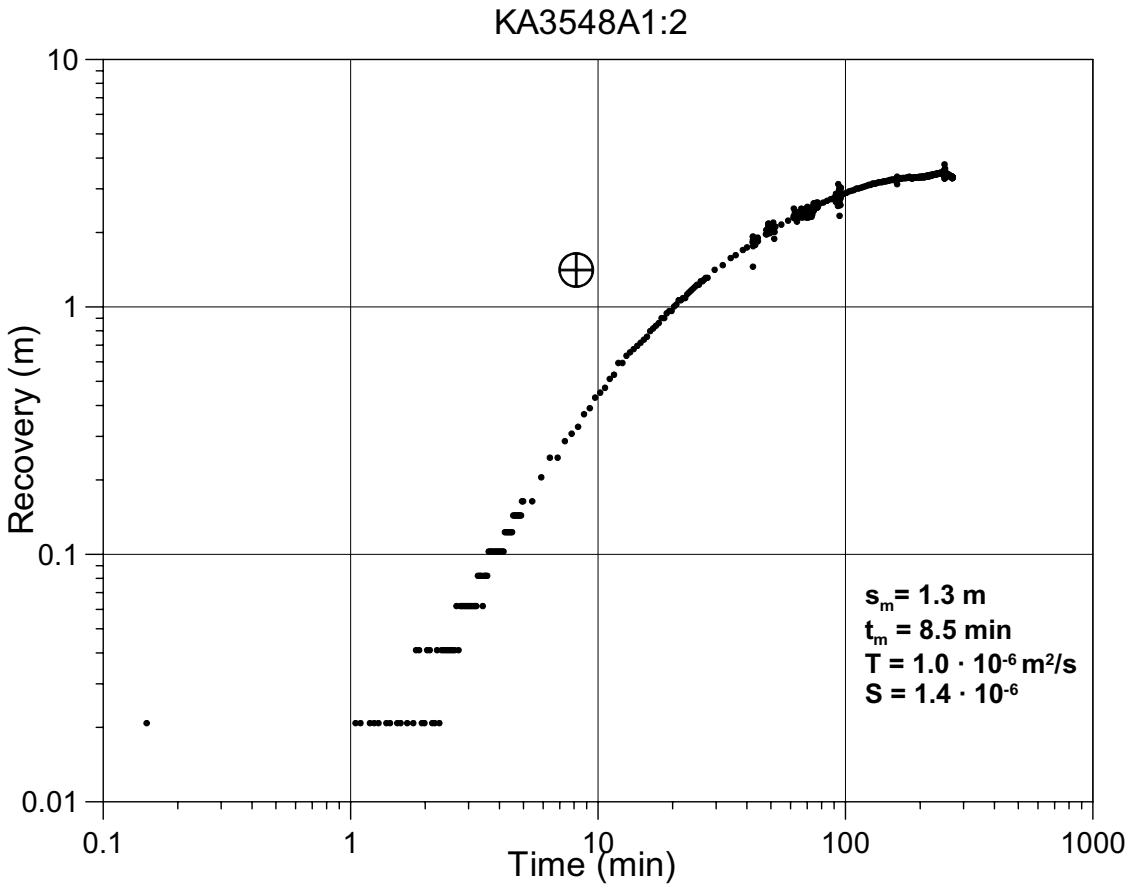
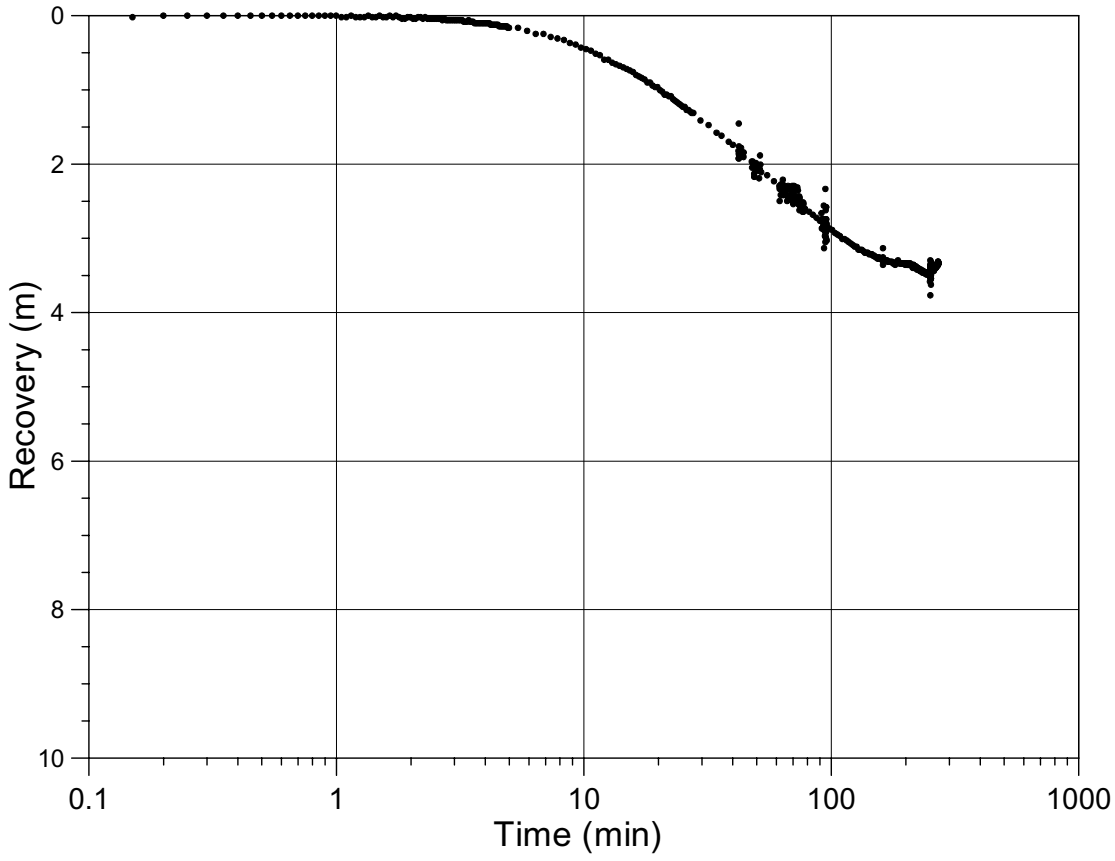

KA3548A1:1
Recovery (m)
Time (min)
s_m= 1.3 m
t_m = 8 min
T = 1.0 · 10^{-6} m^2/s
S = 9.0 · 10^{-7}
26_KA3548A1_1.GRF 2003-11-07





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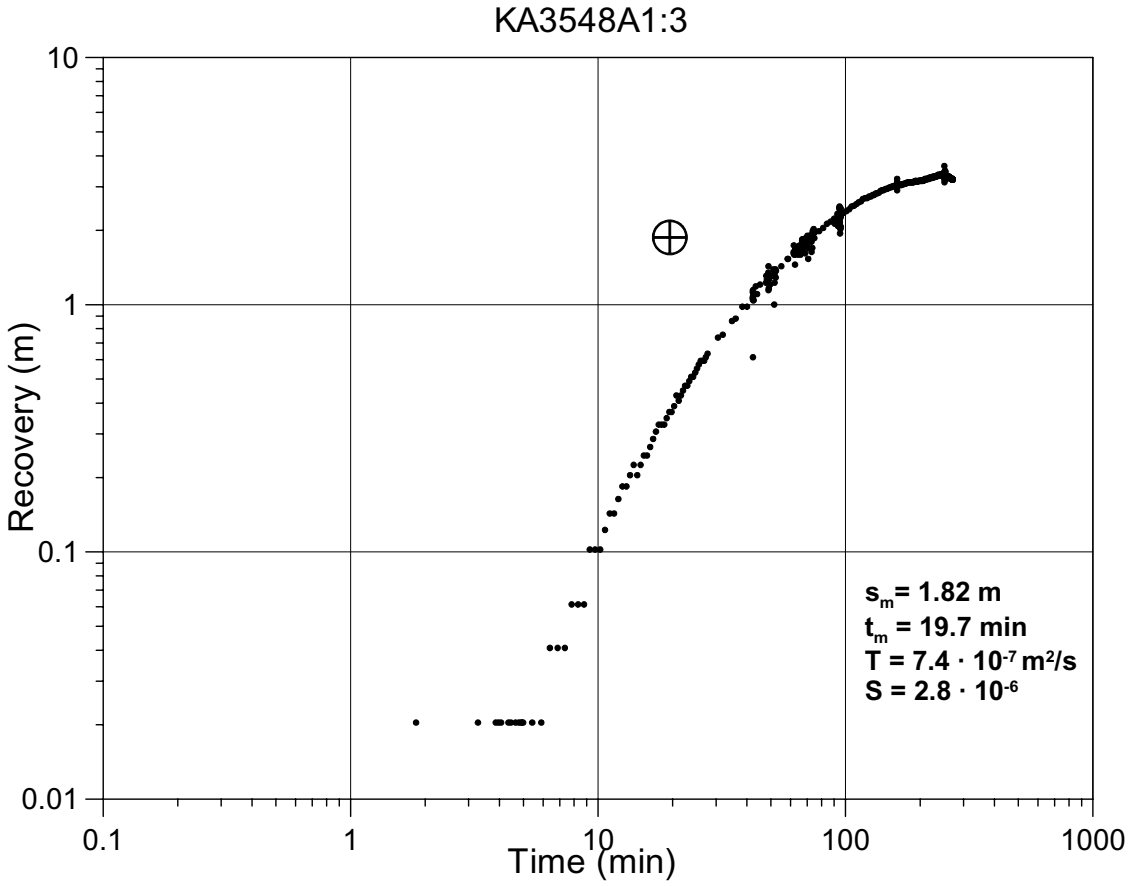
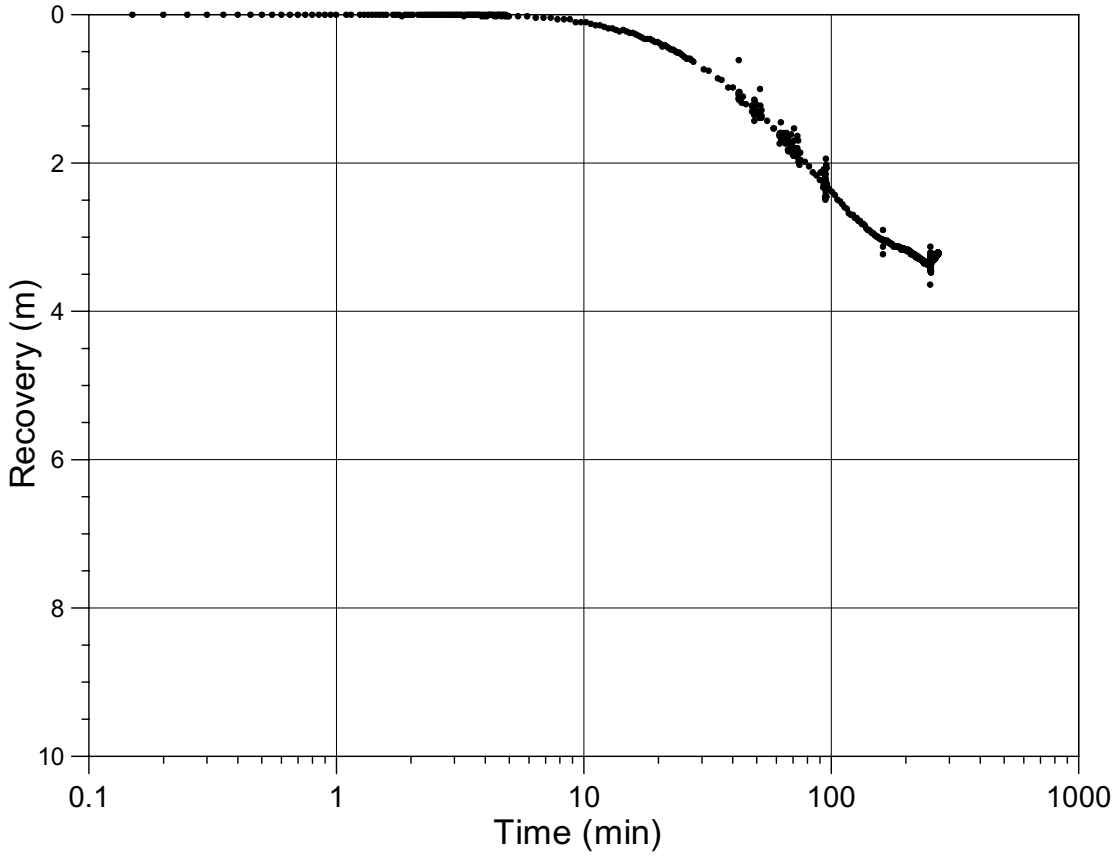
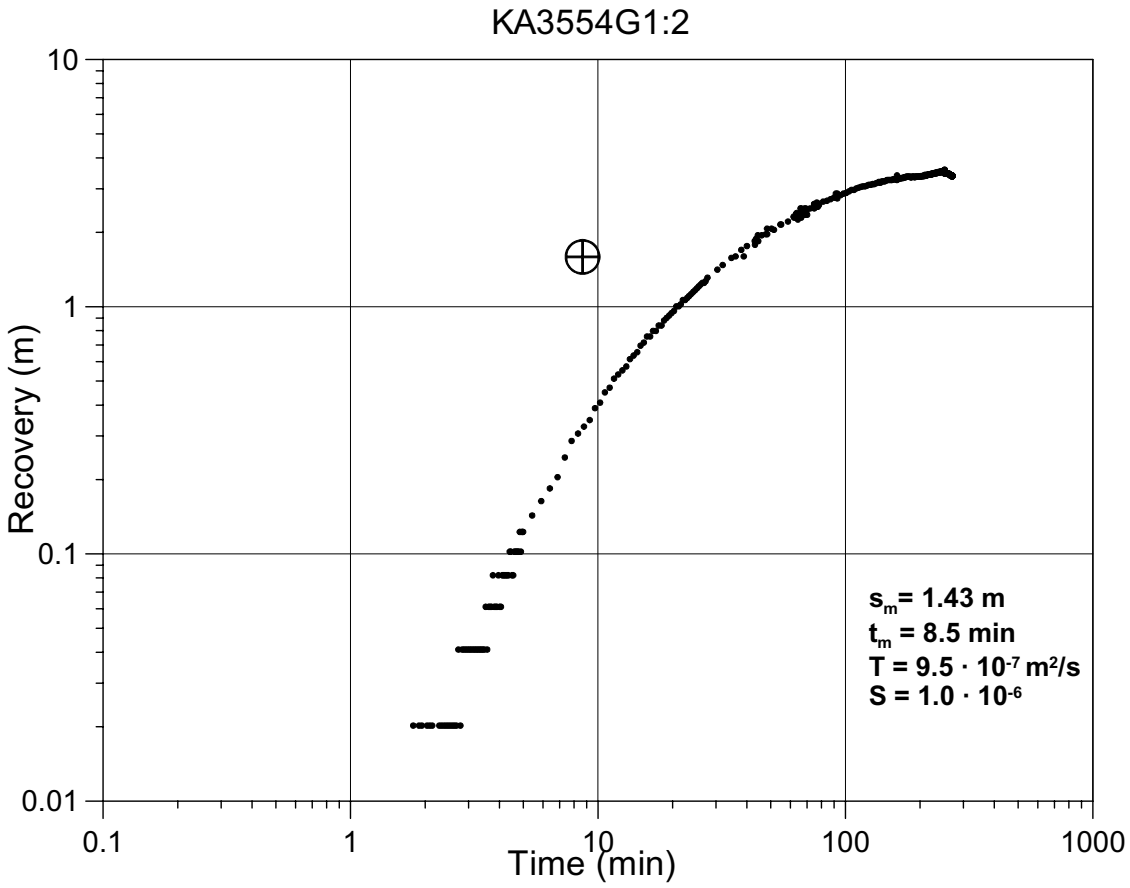
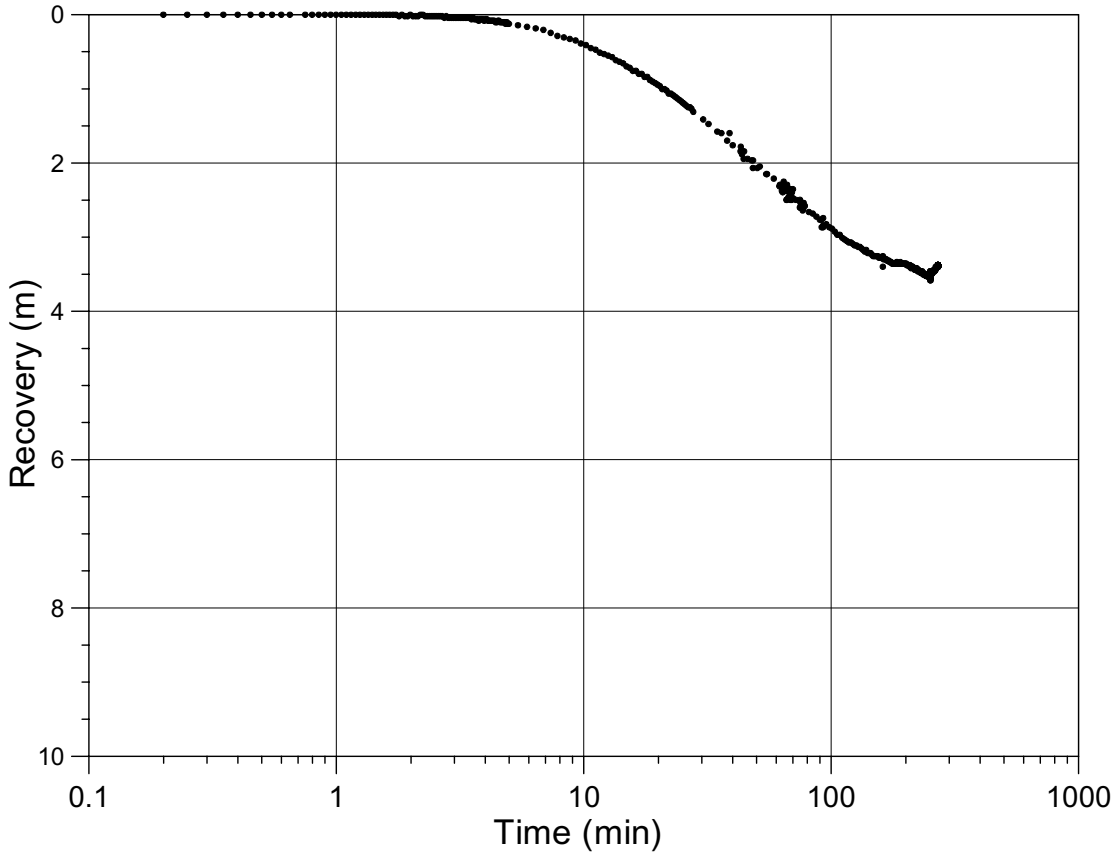


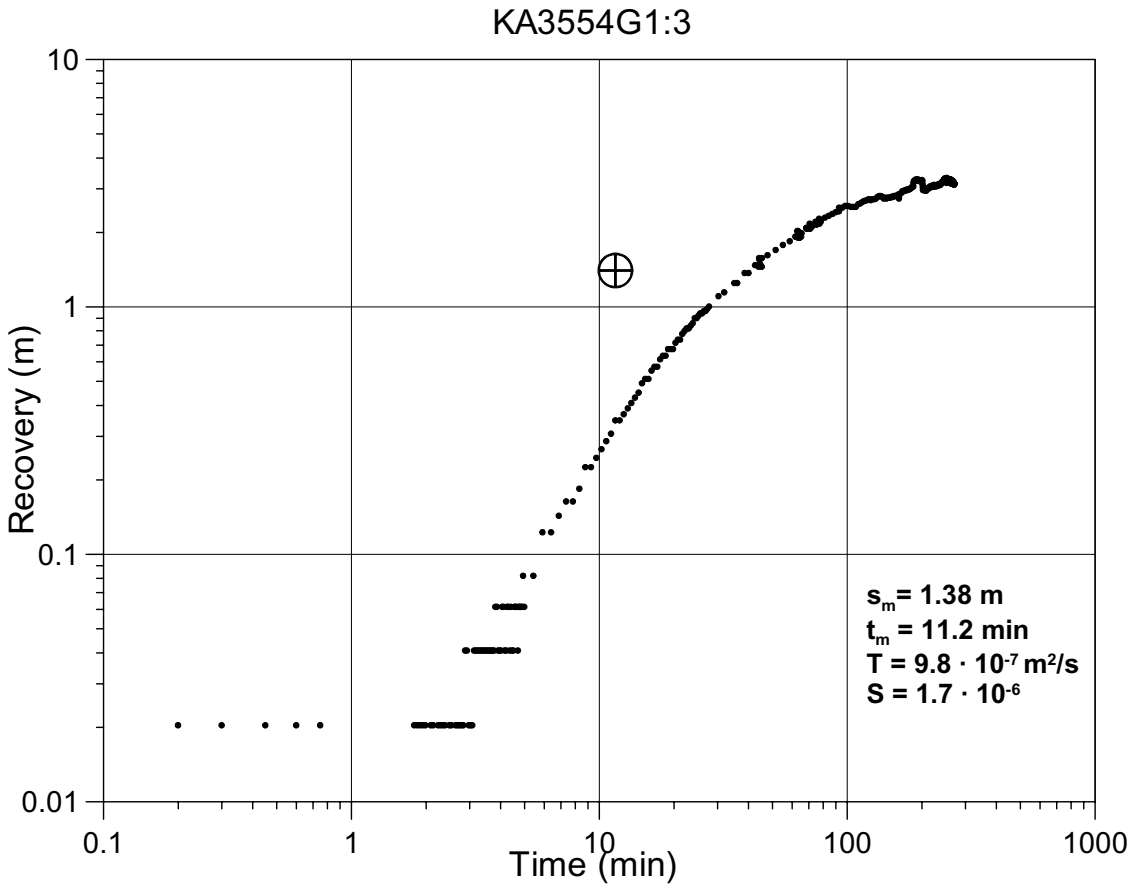


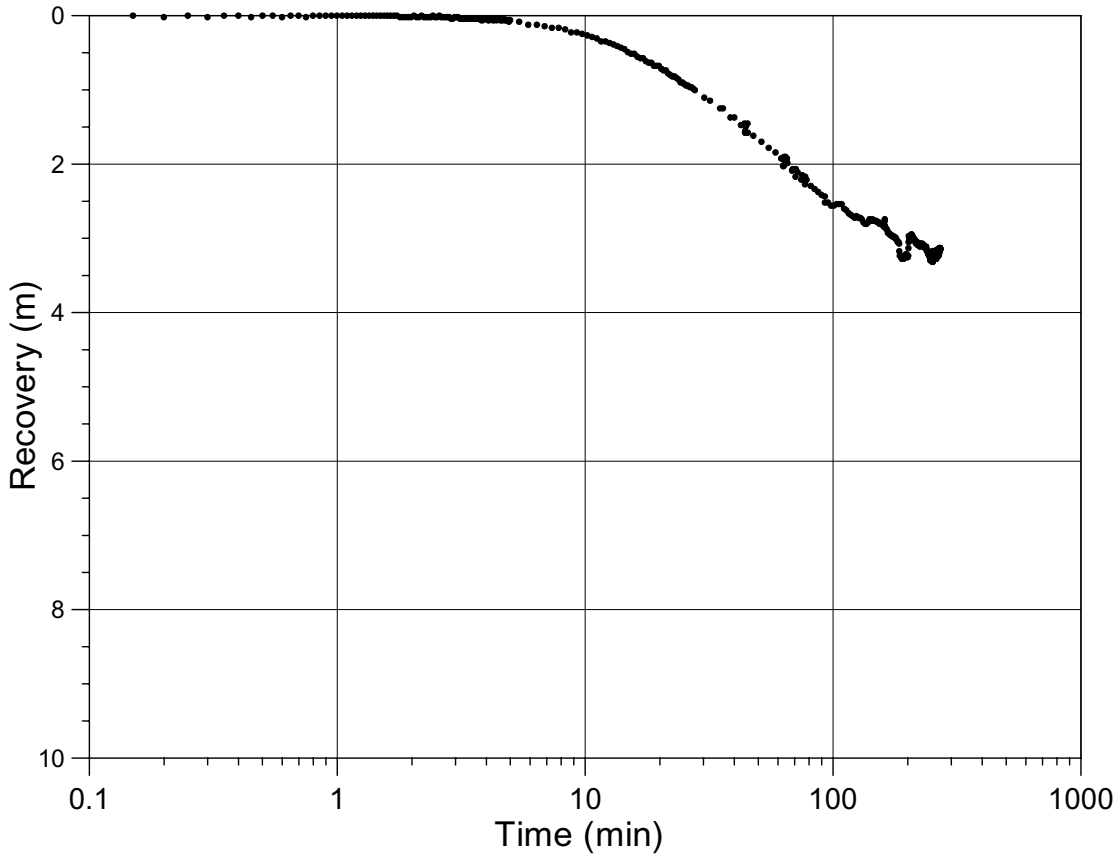
26_KA3548A1_3.GRF 2003-11-07



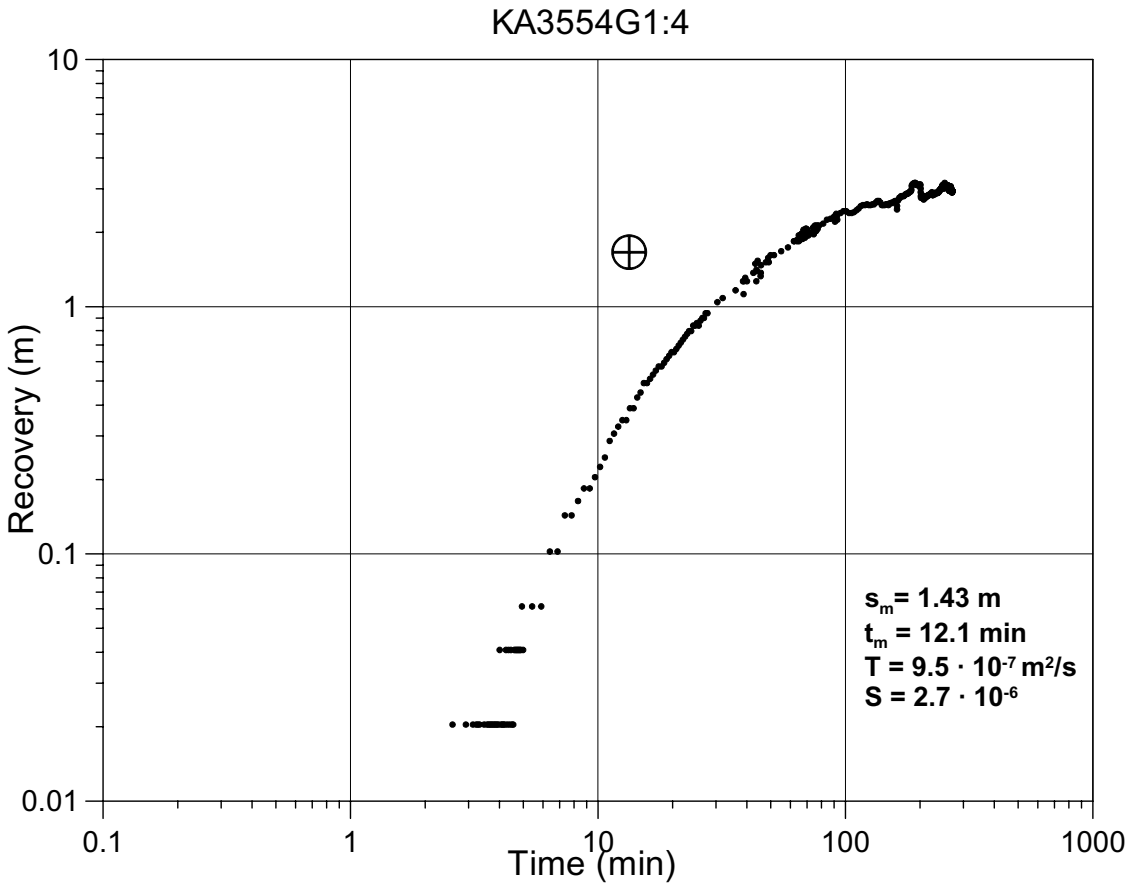


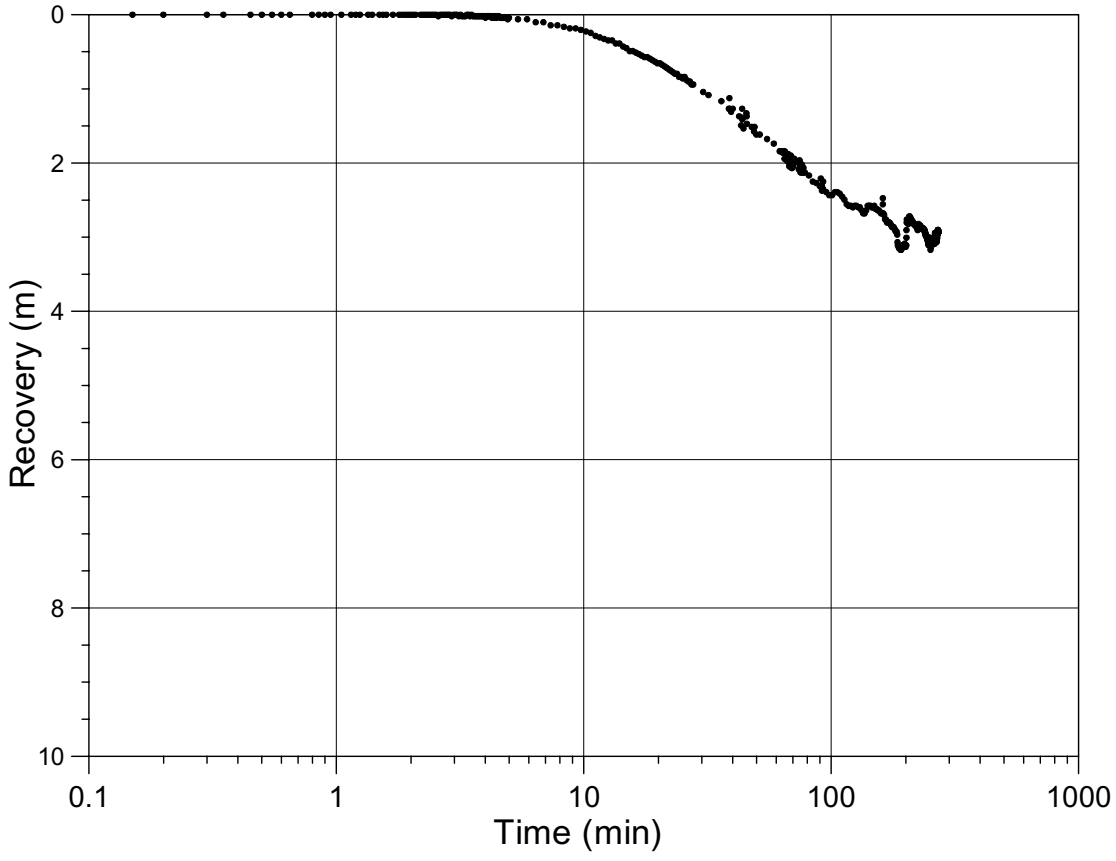
26_KA3554G1_2.GRF 2003-11-12





26_KA3554G1_3.GRF 2003-11-12





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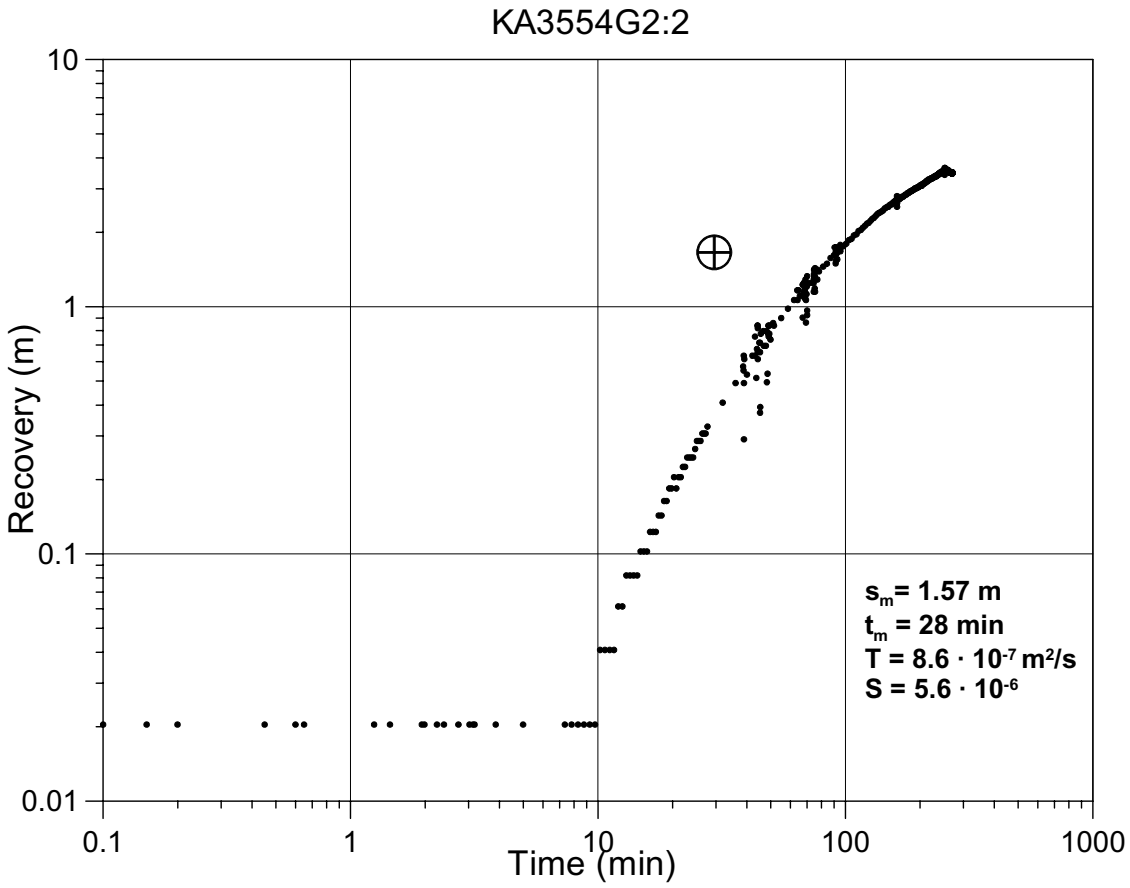

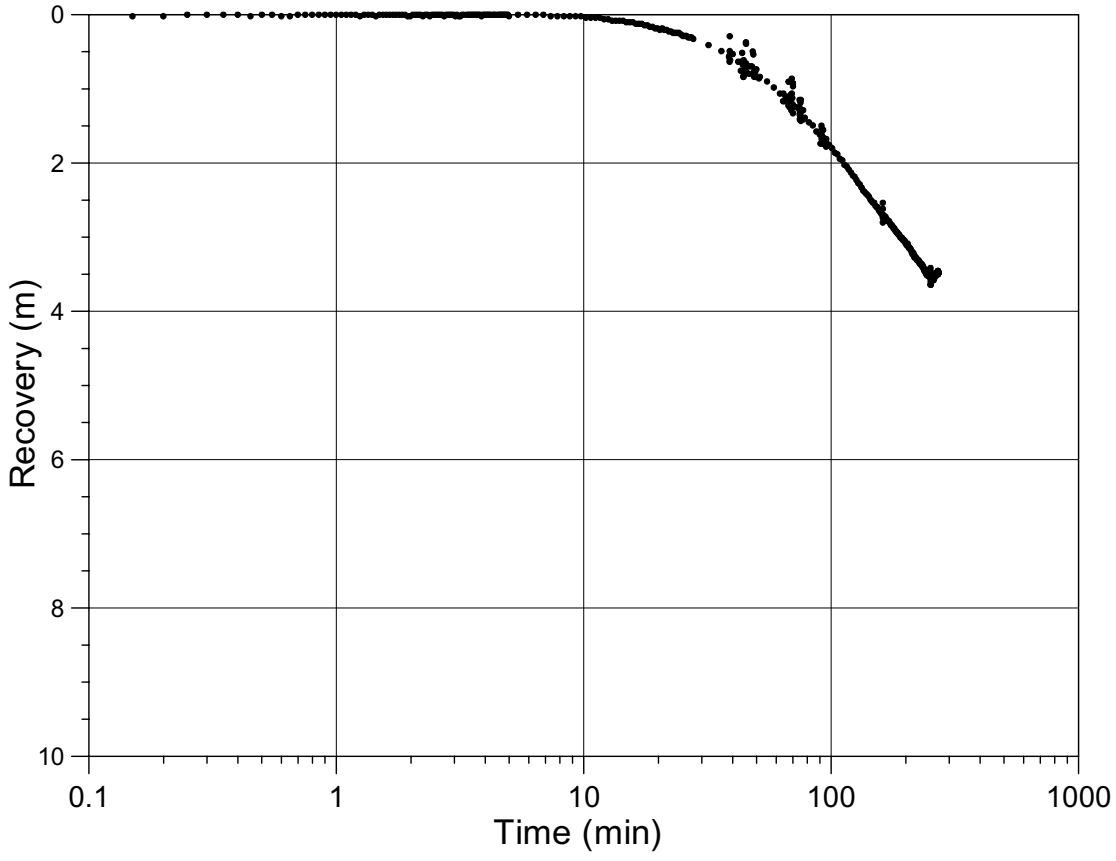

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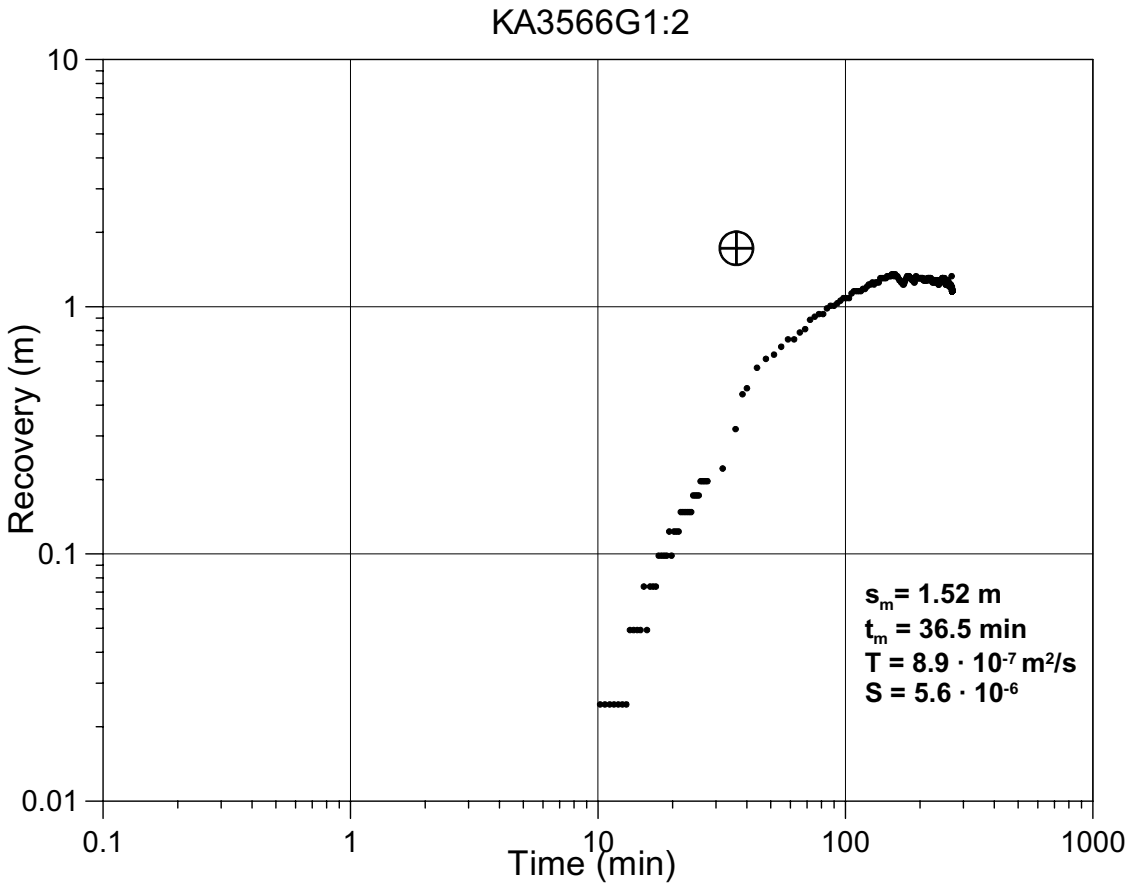

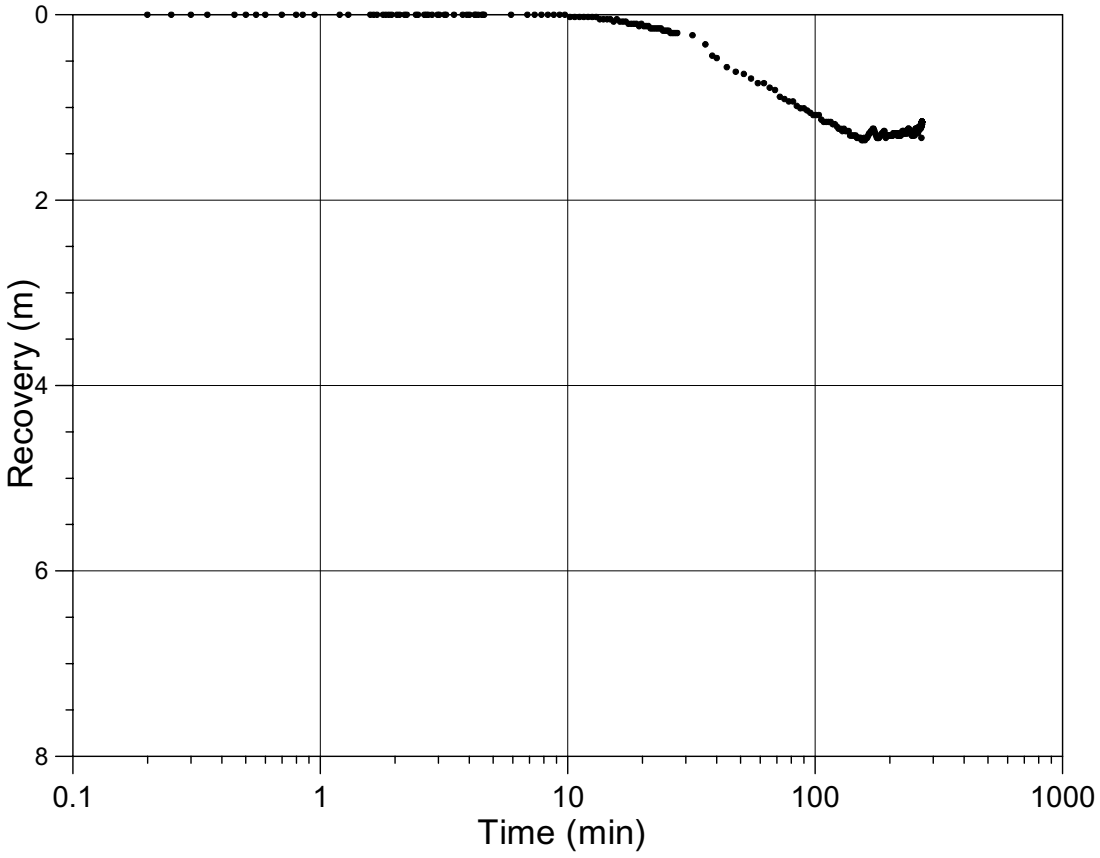

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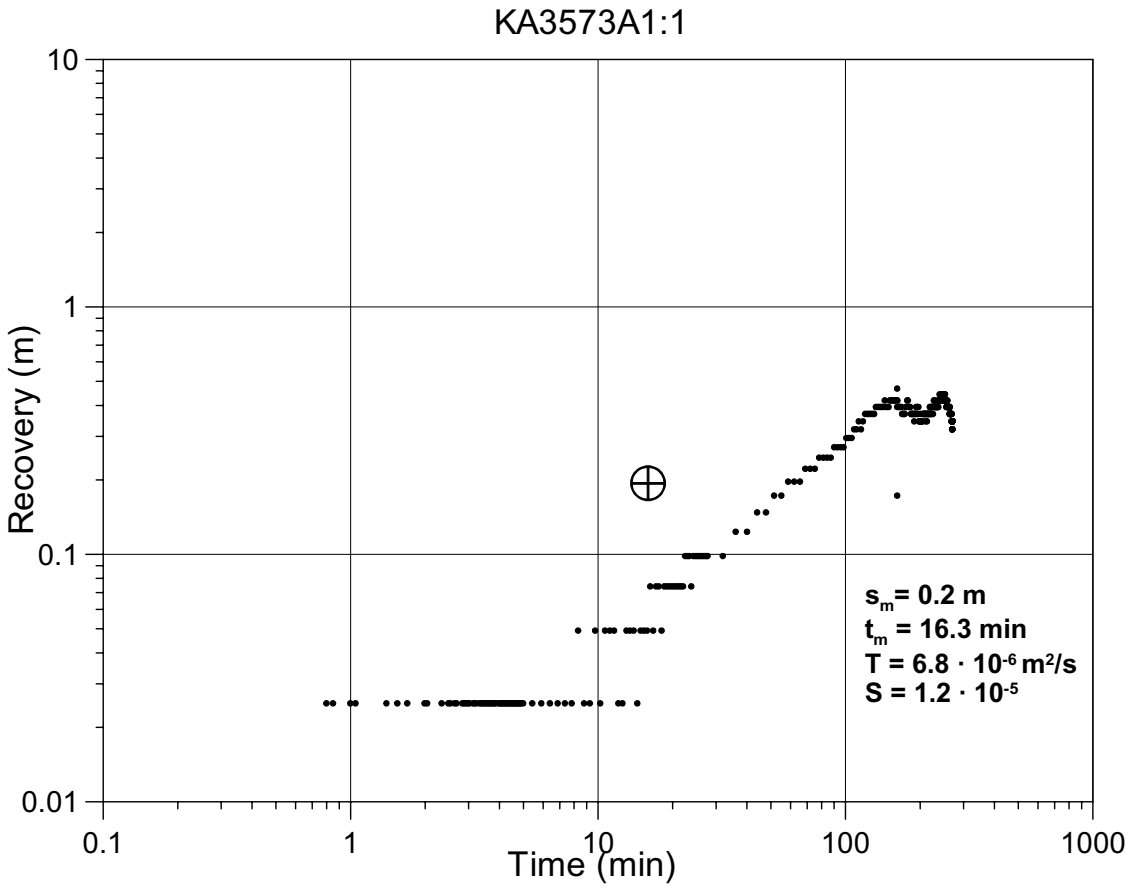
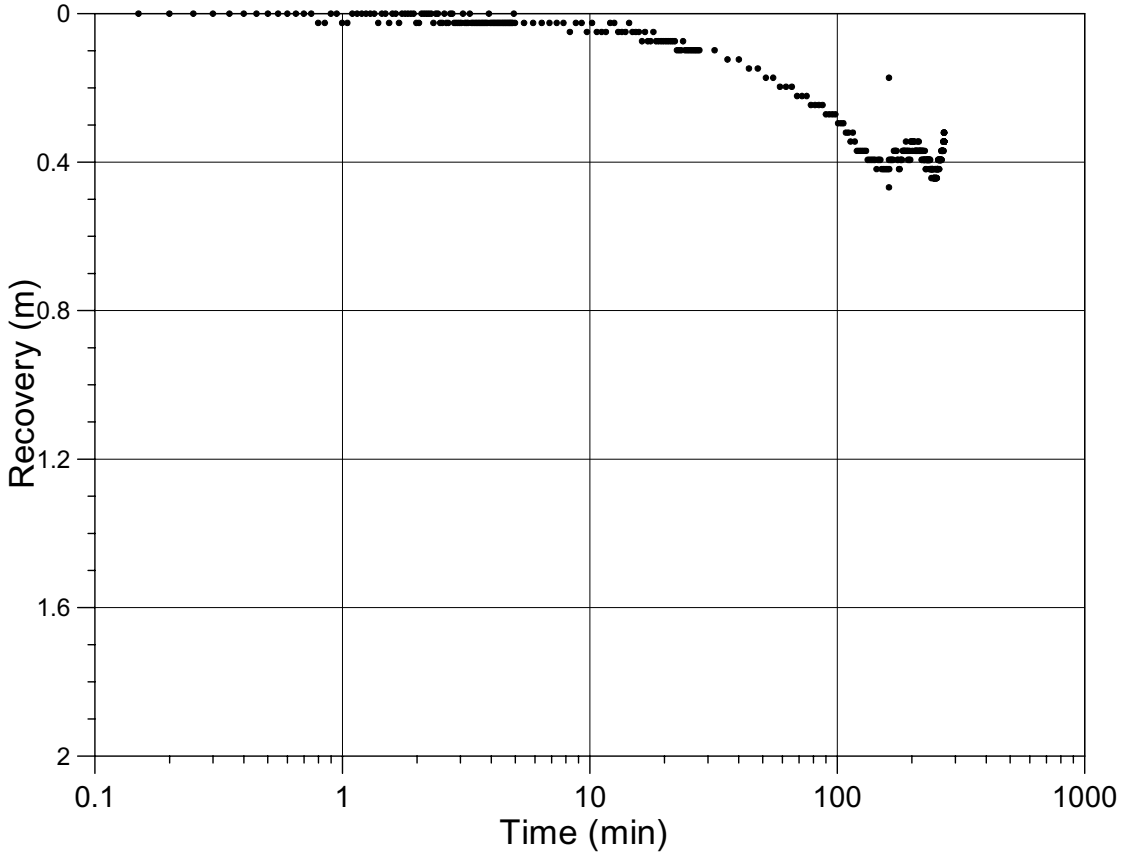
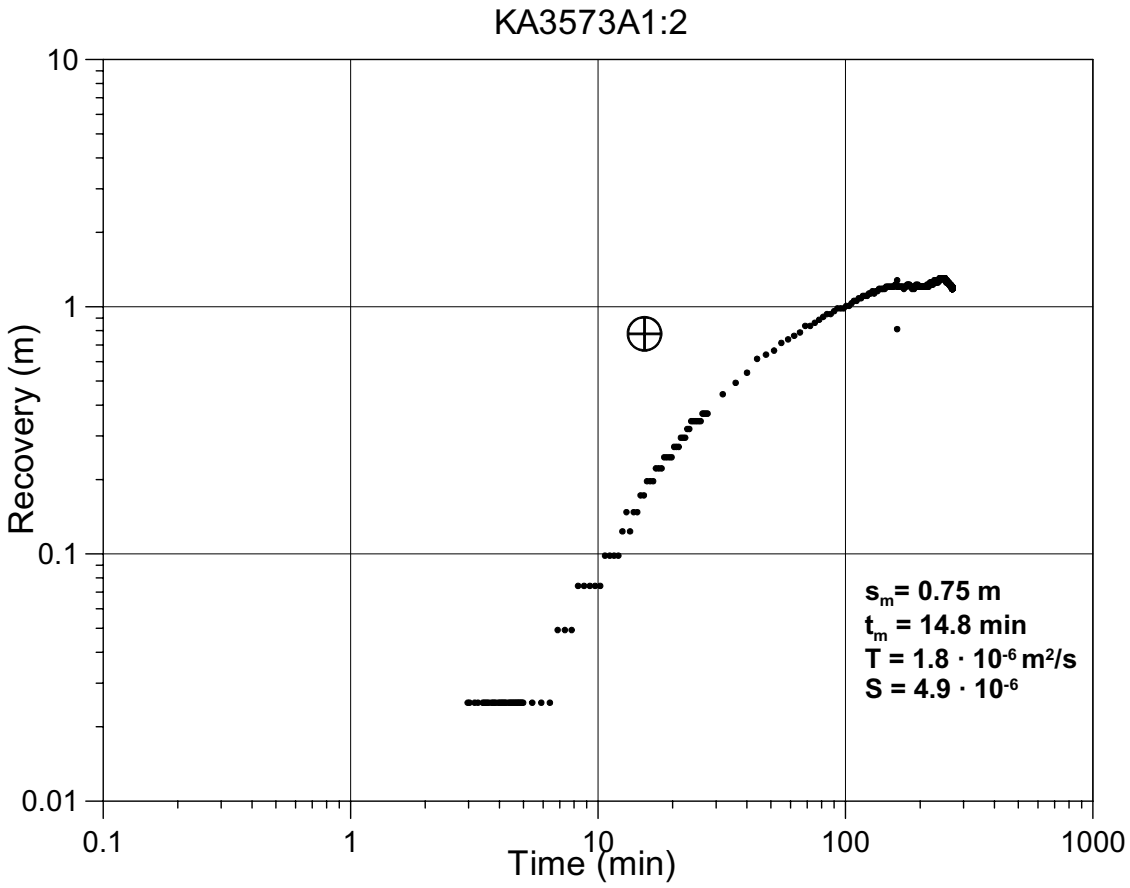
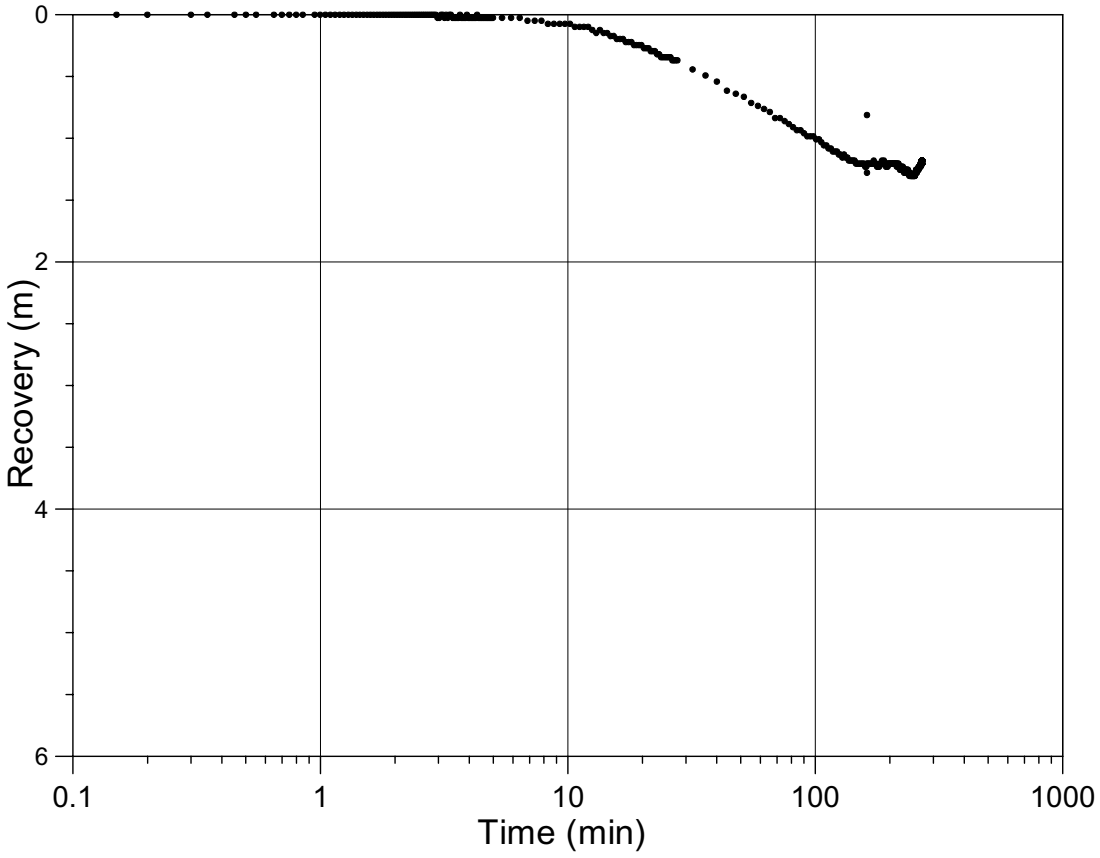




26_KA3573A1_1.GRF 2003-11-14





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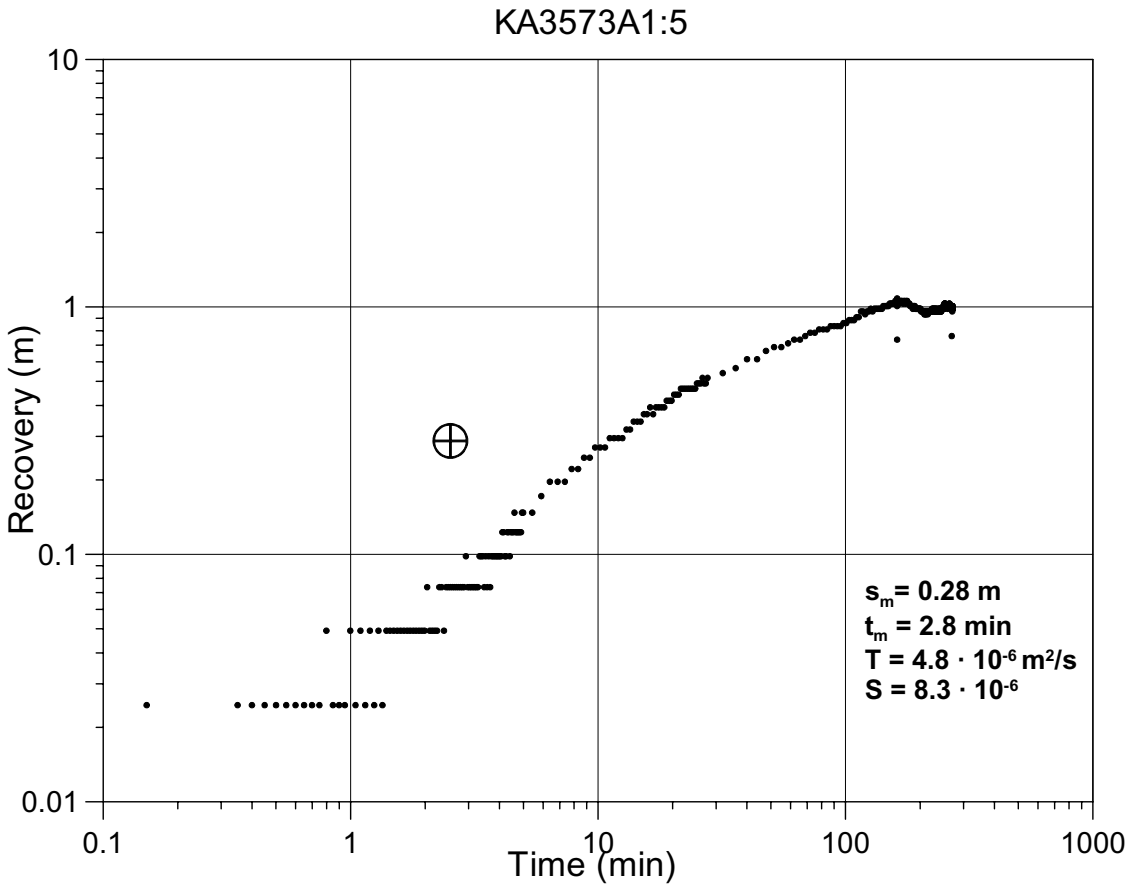

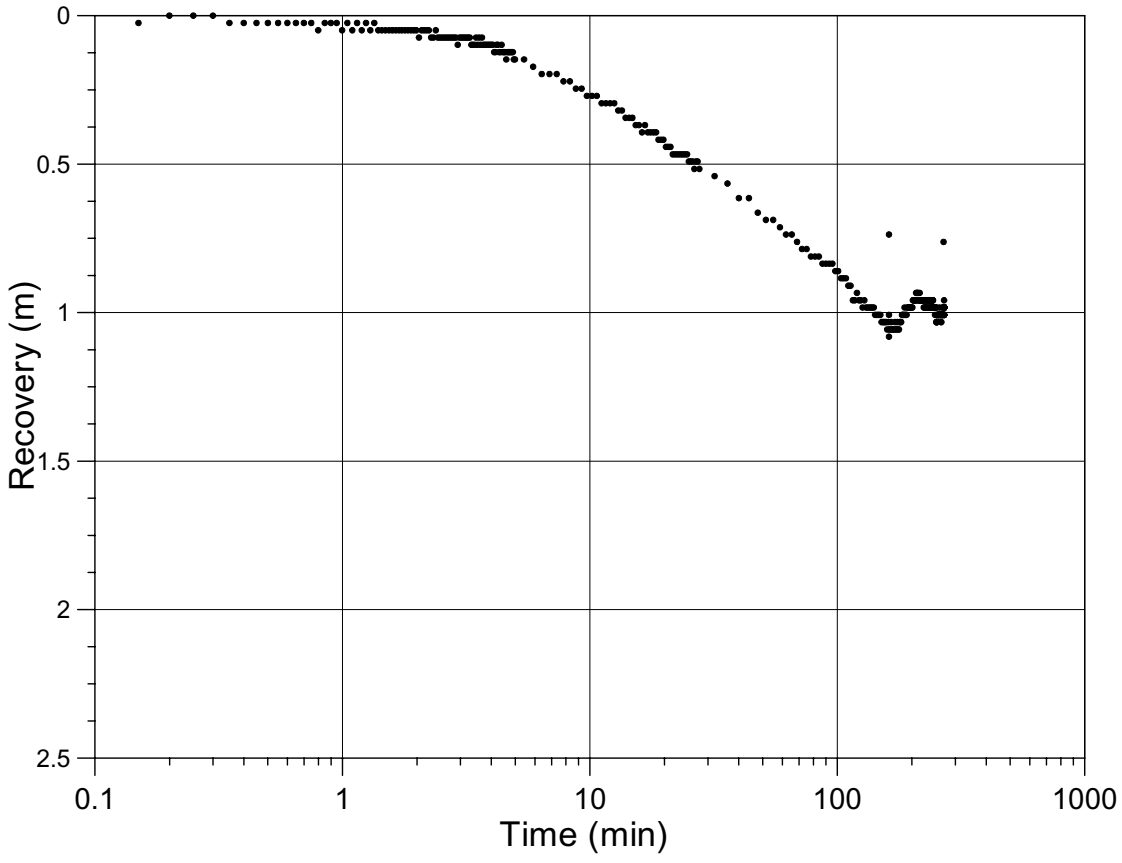

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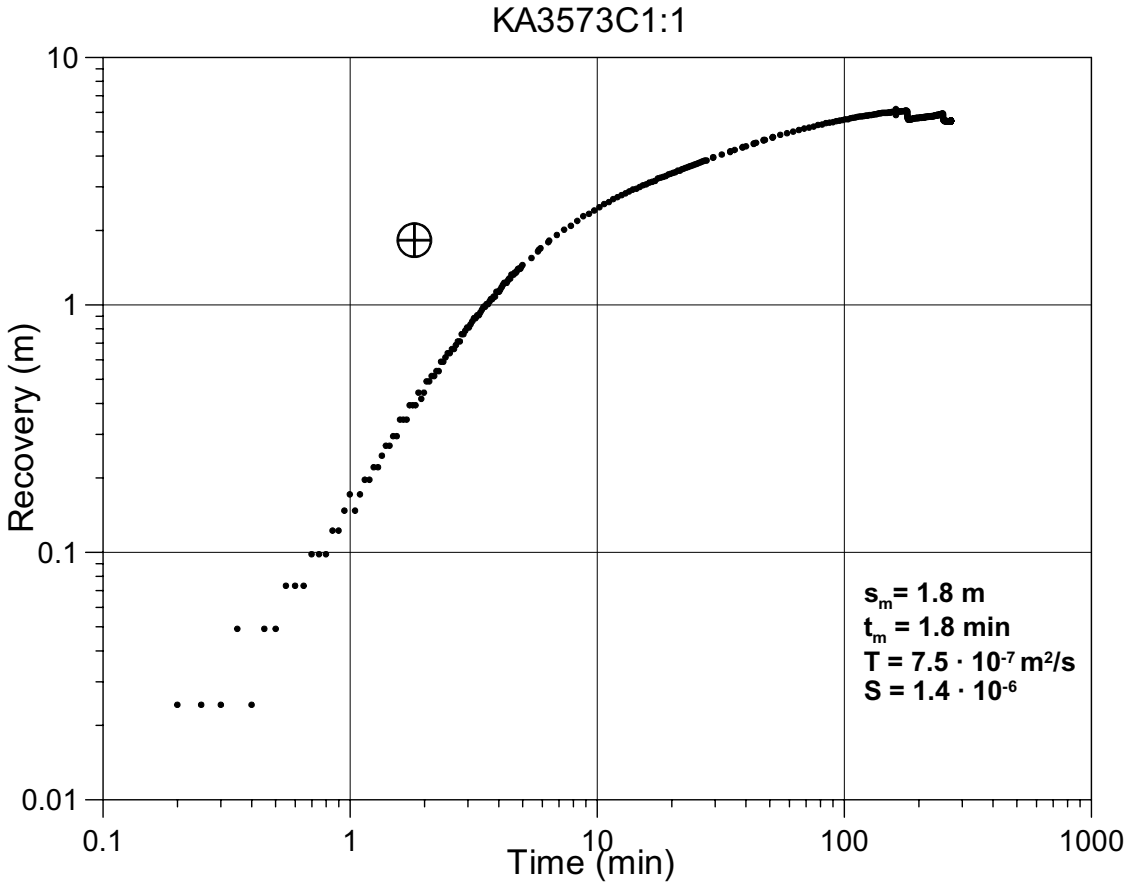

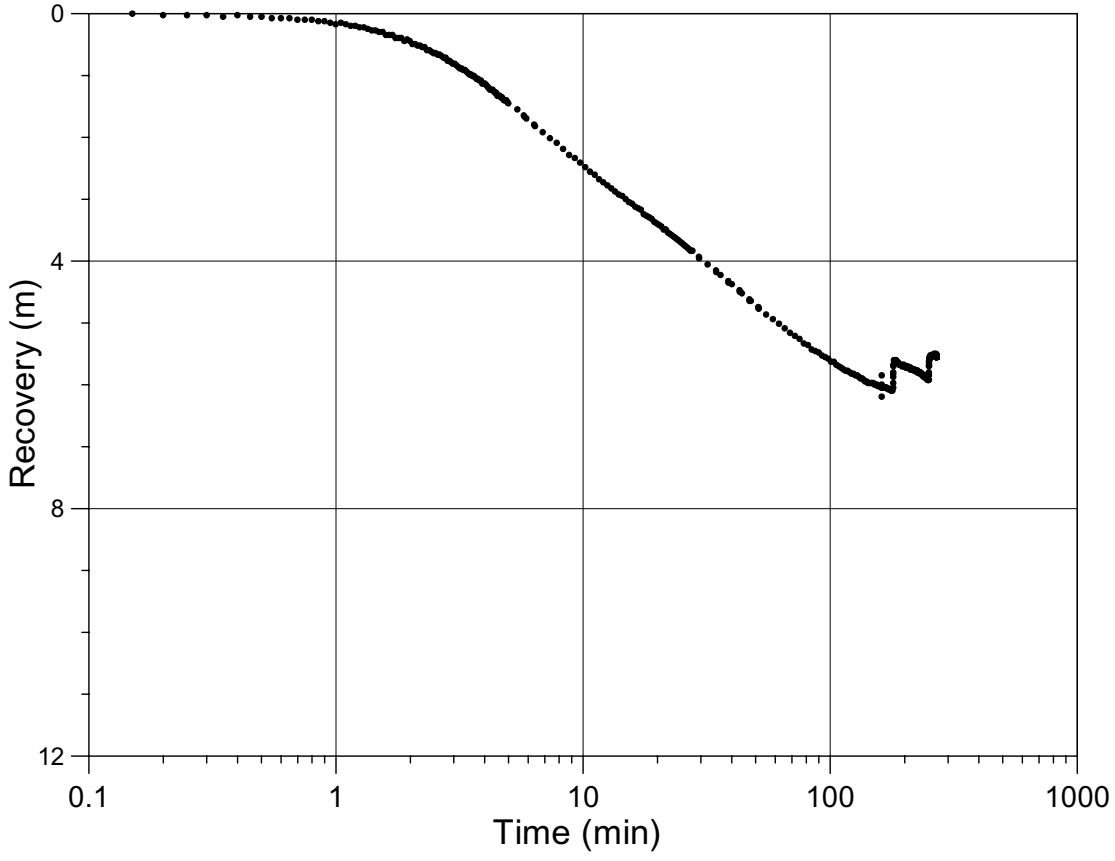

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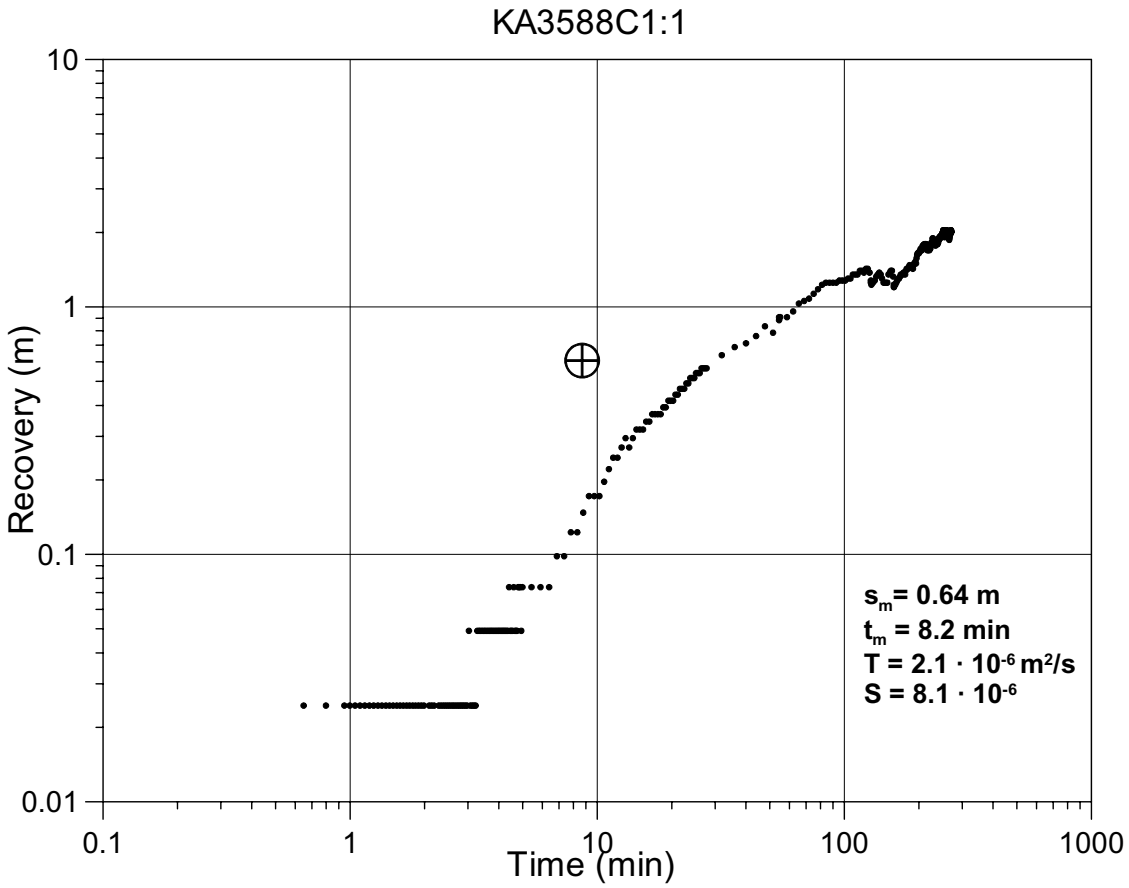

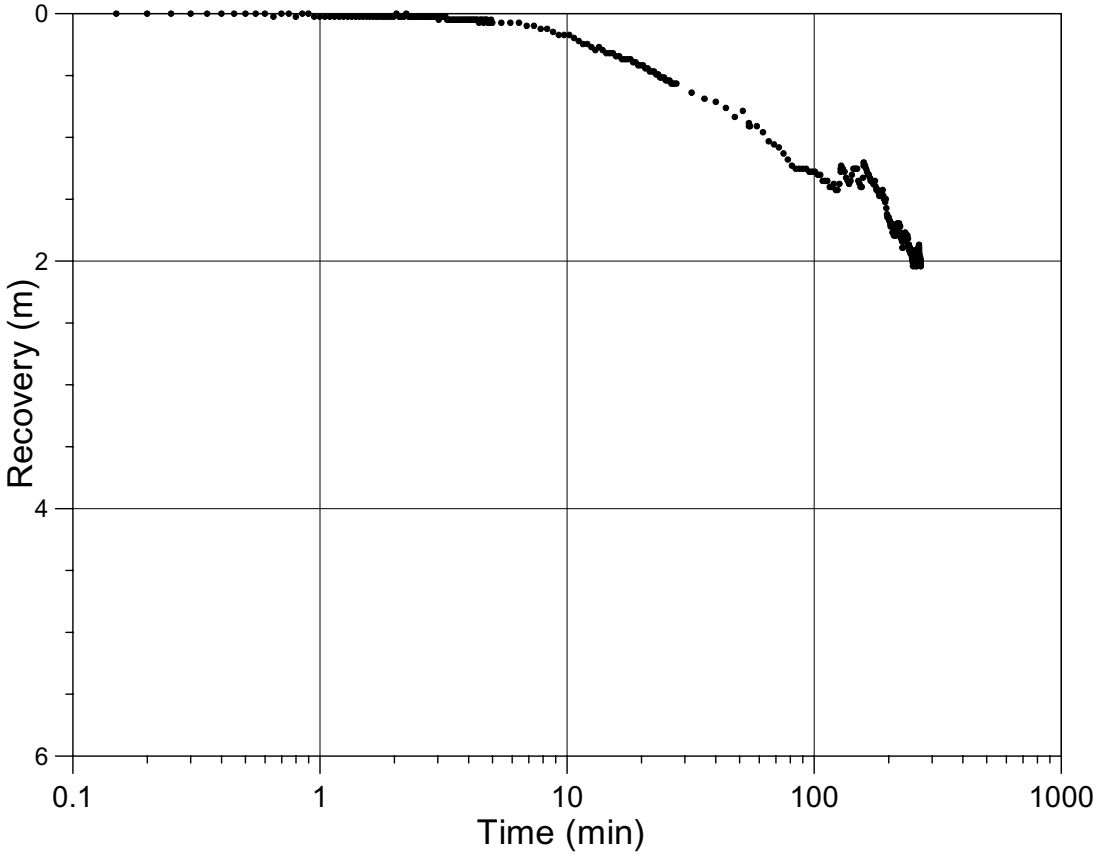

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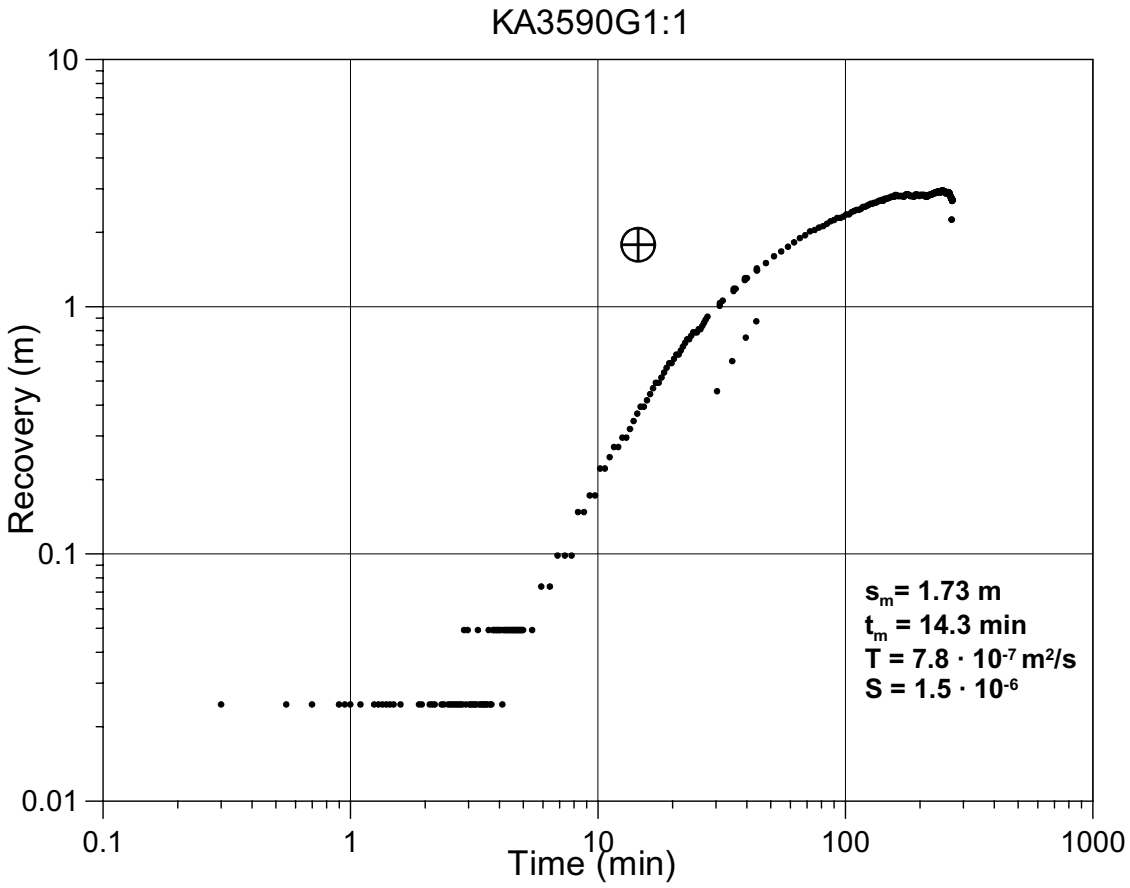

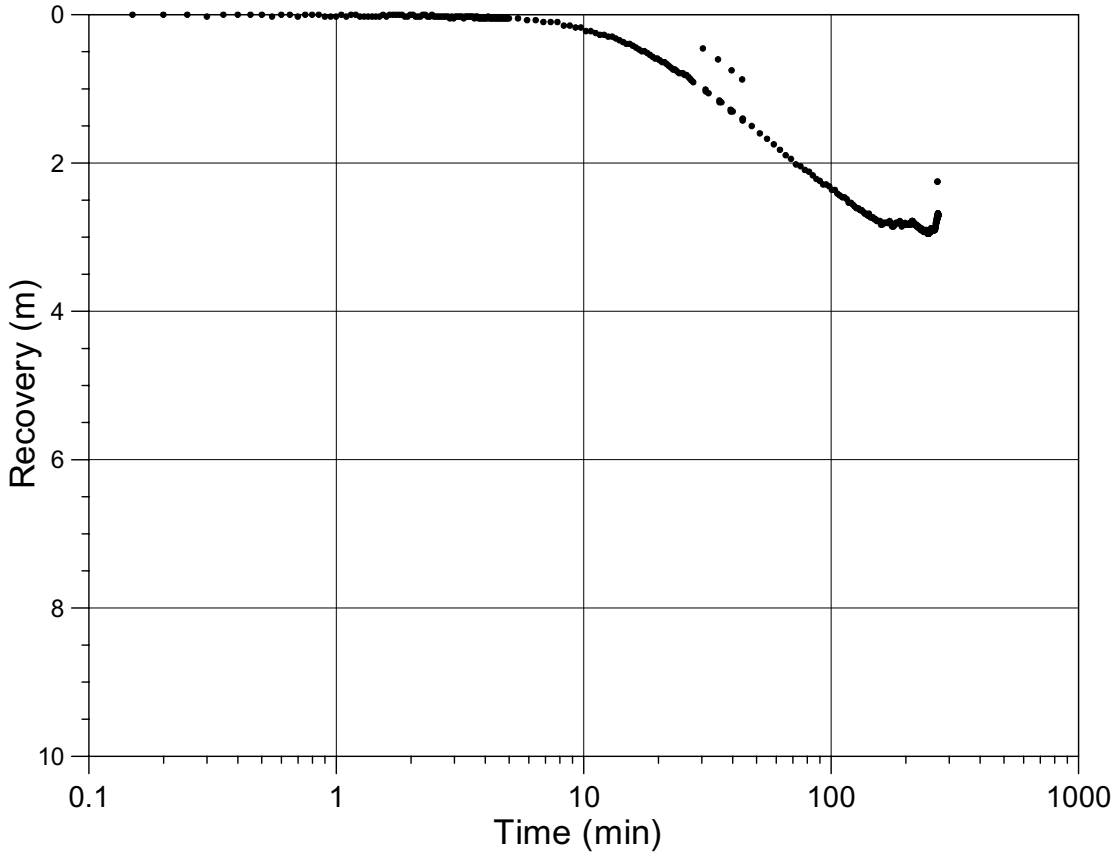

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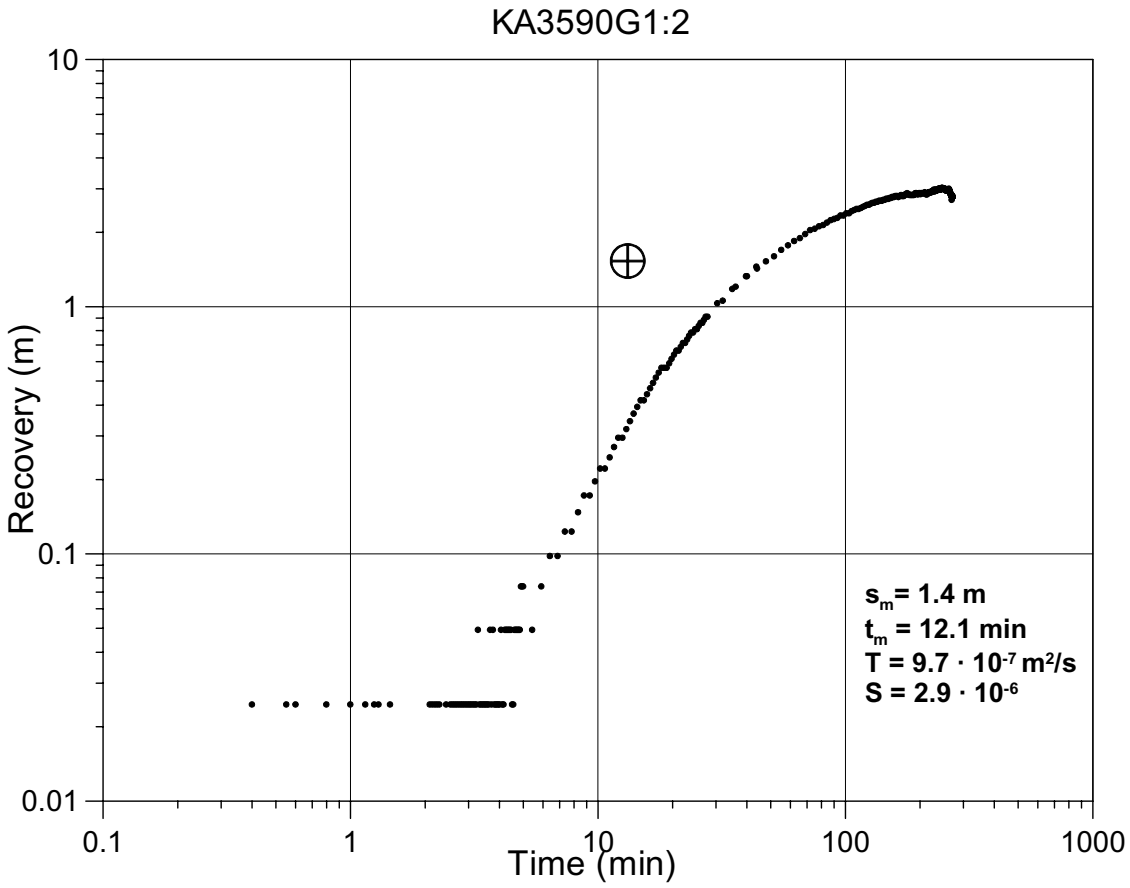

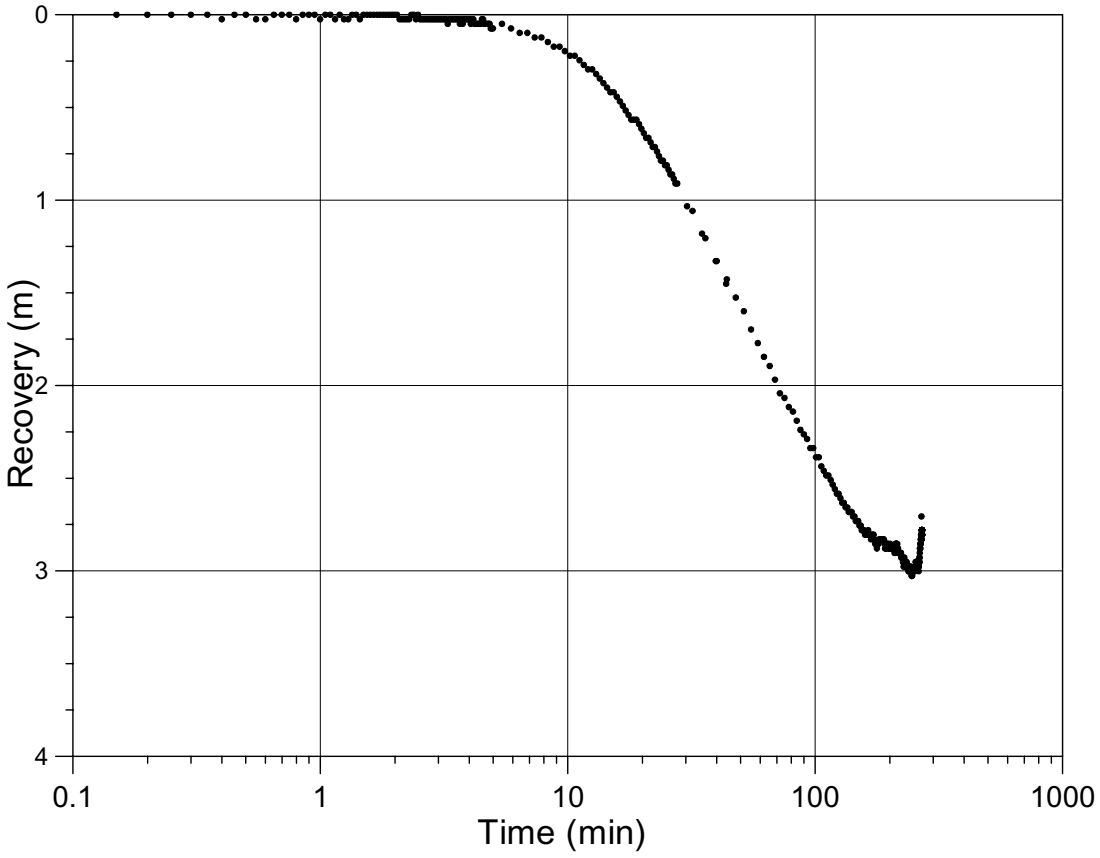

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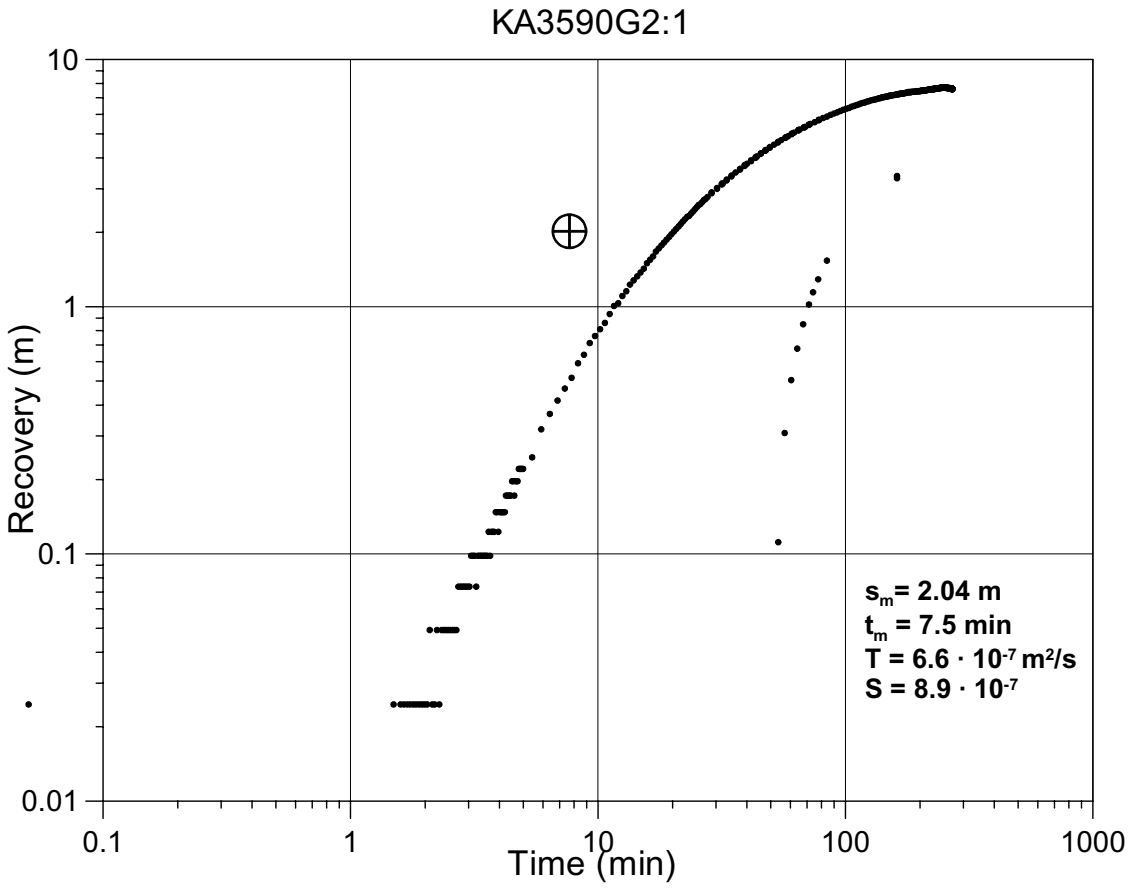

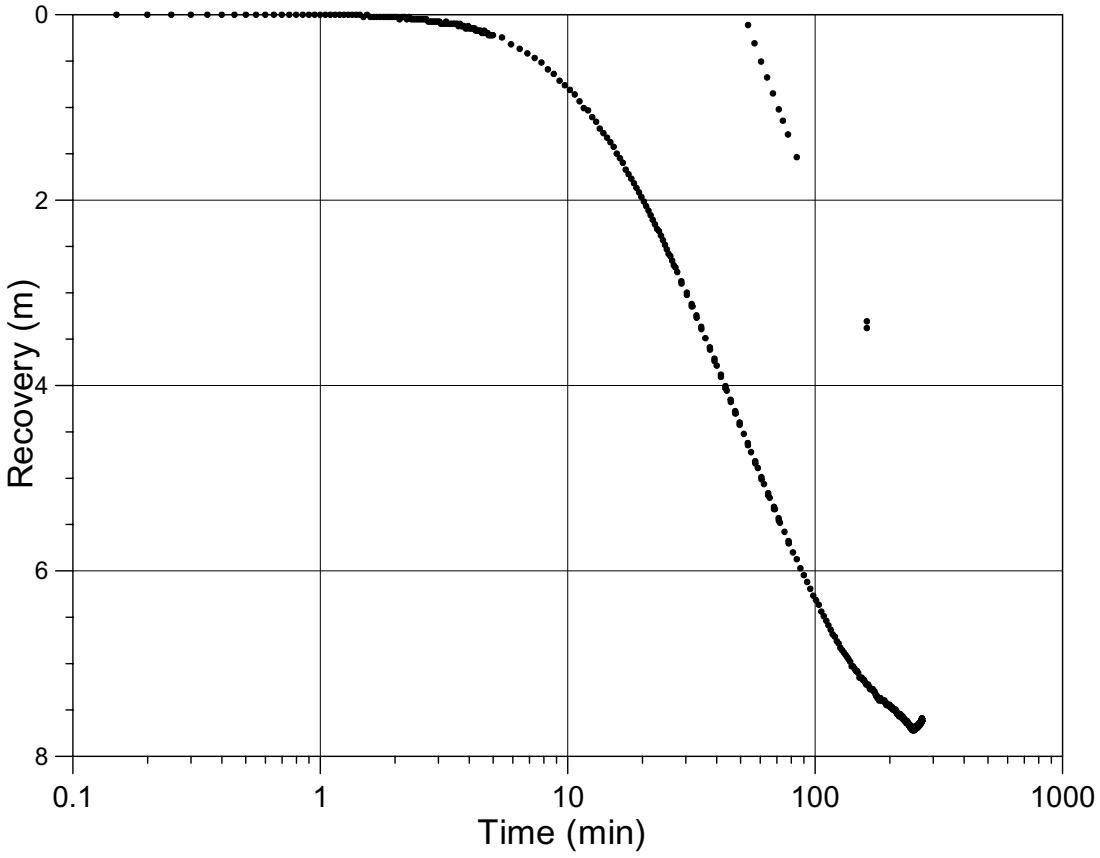

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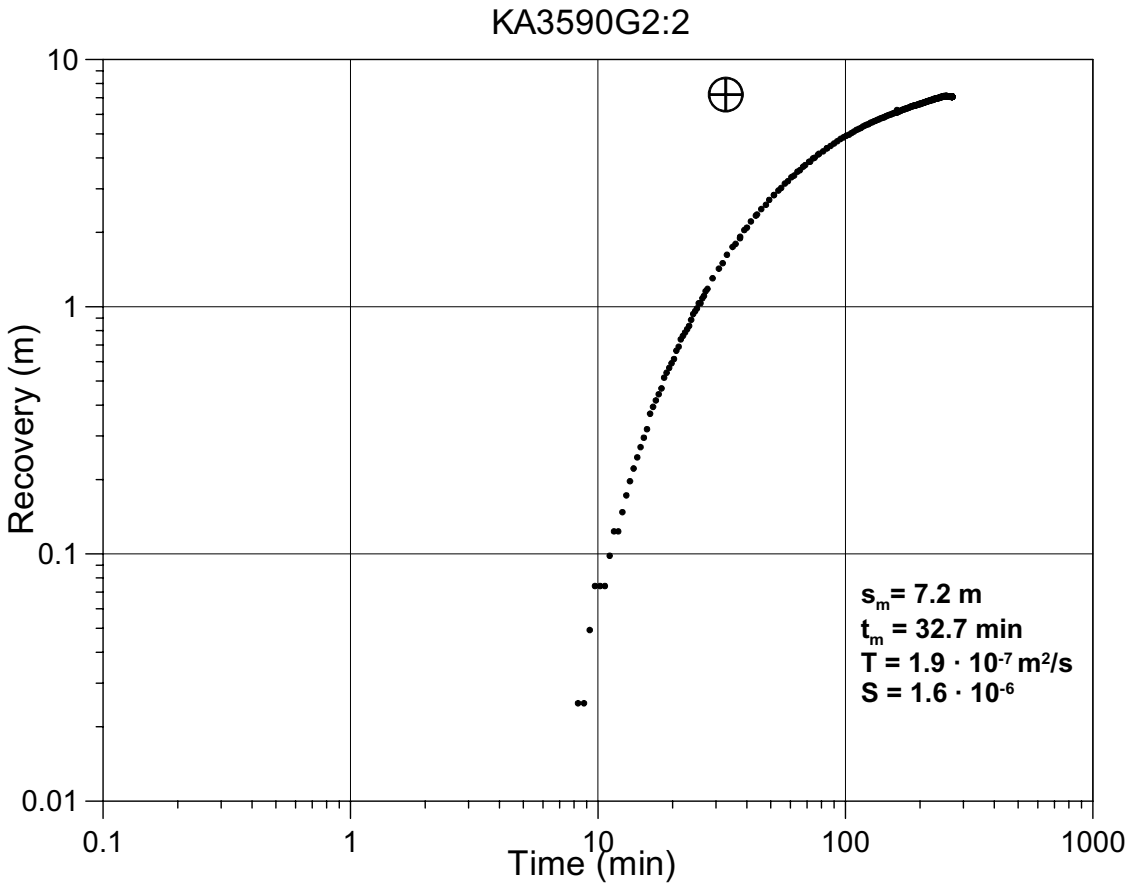

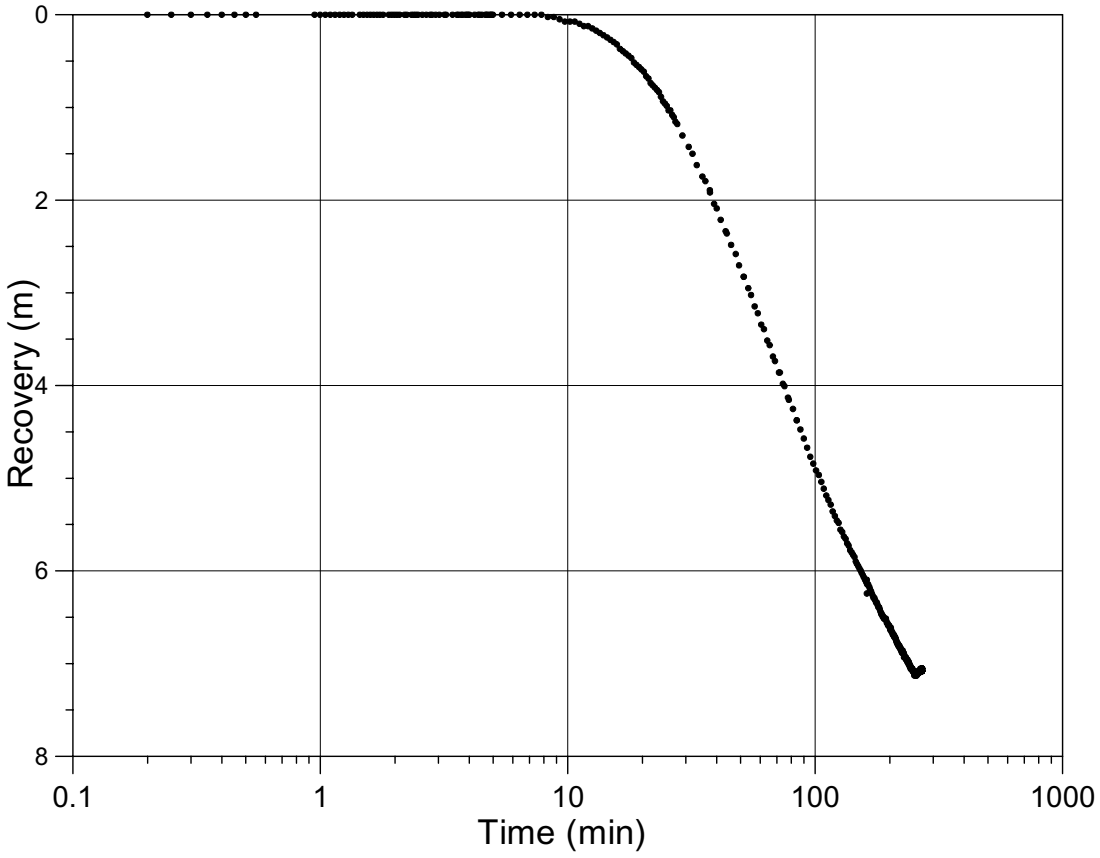

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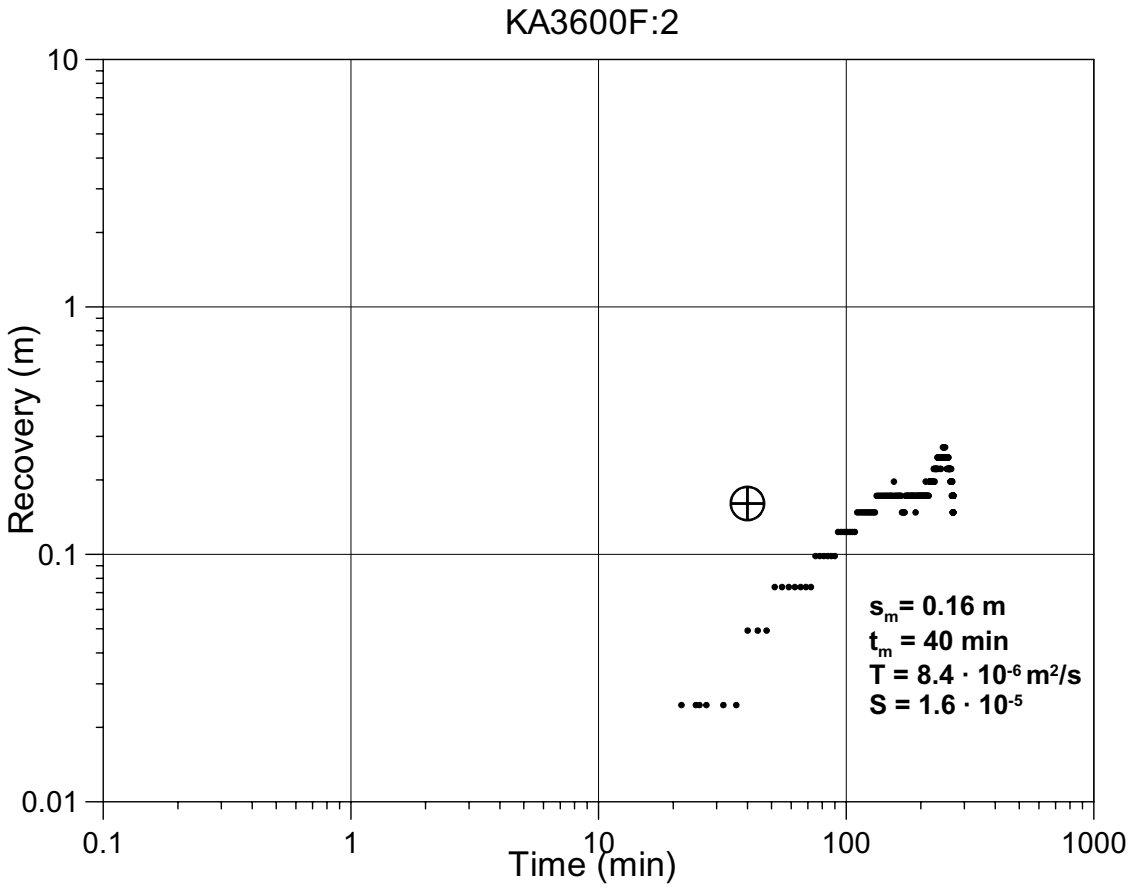
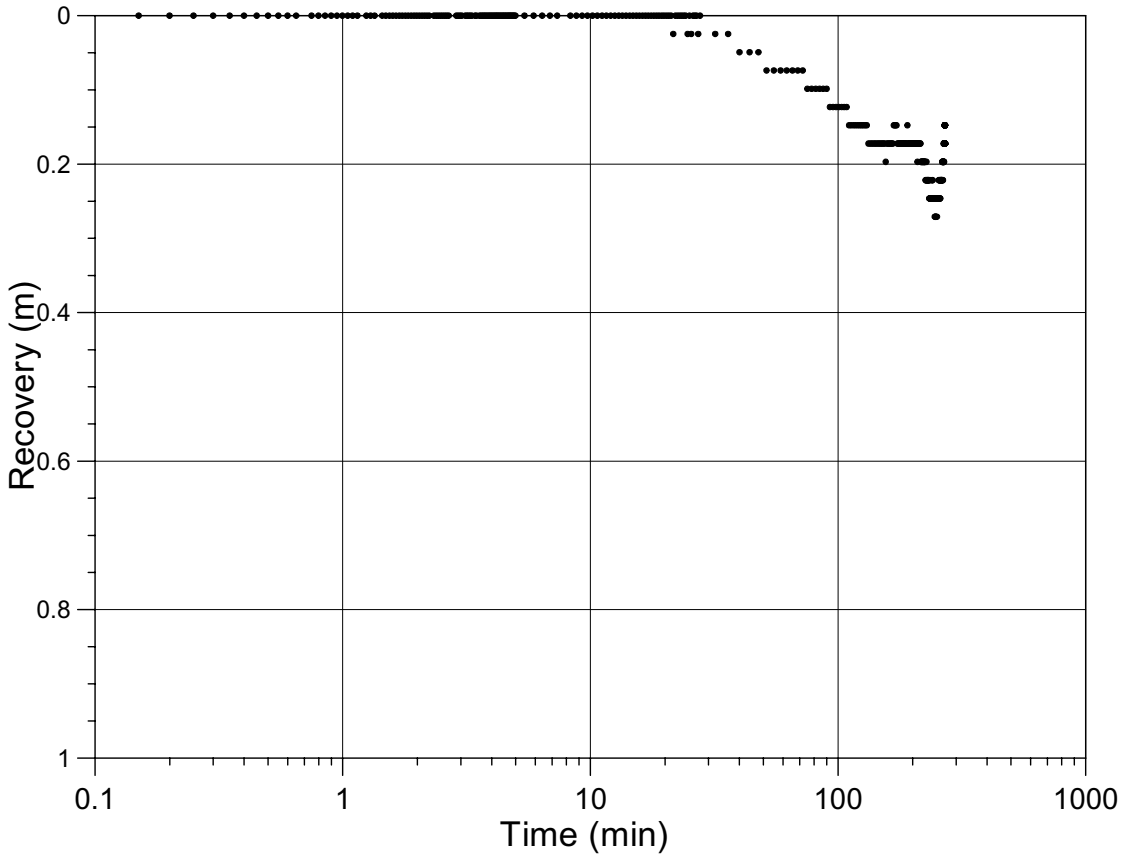
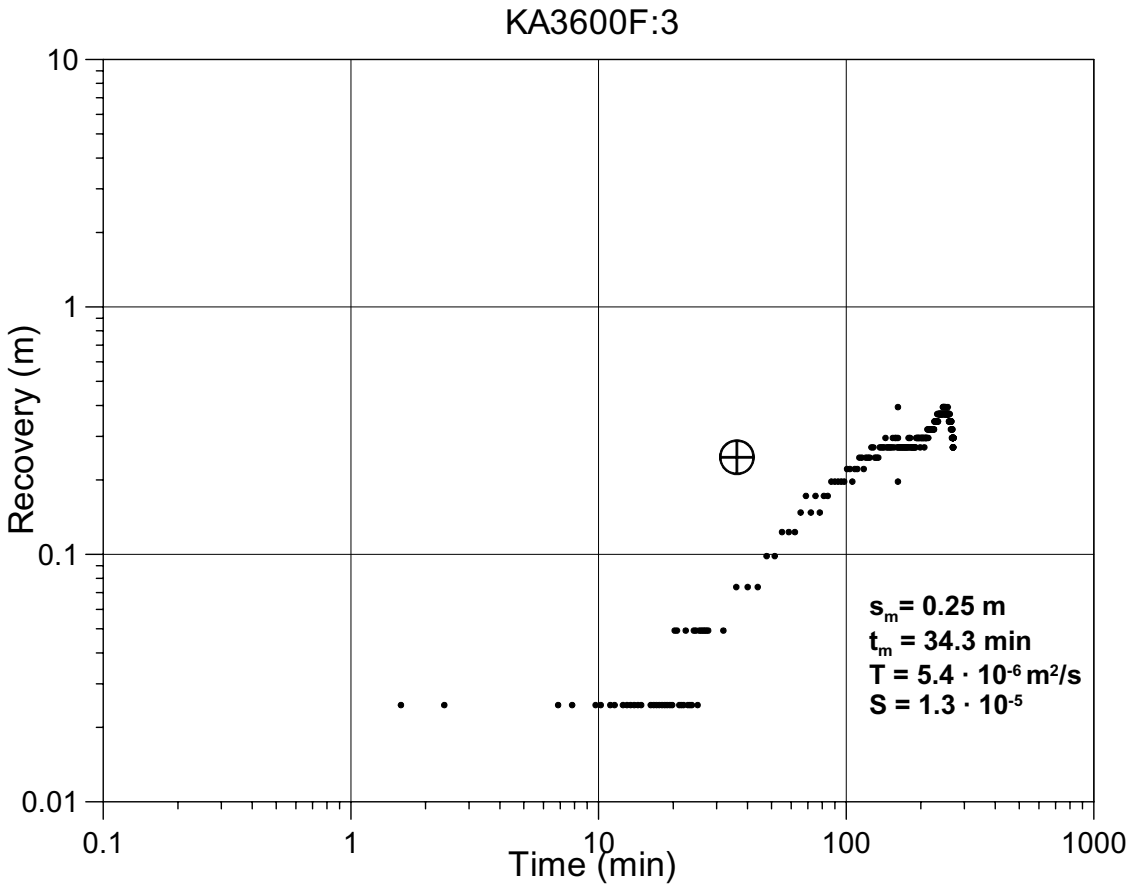
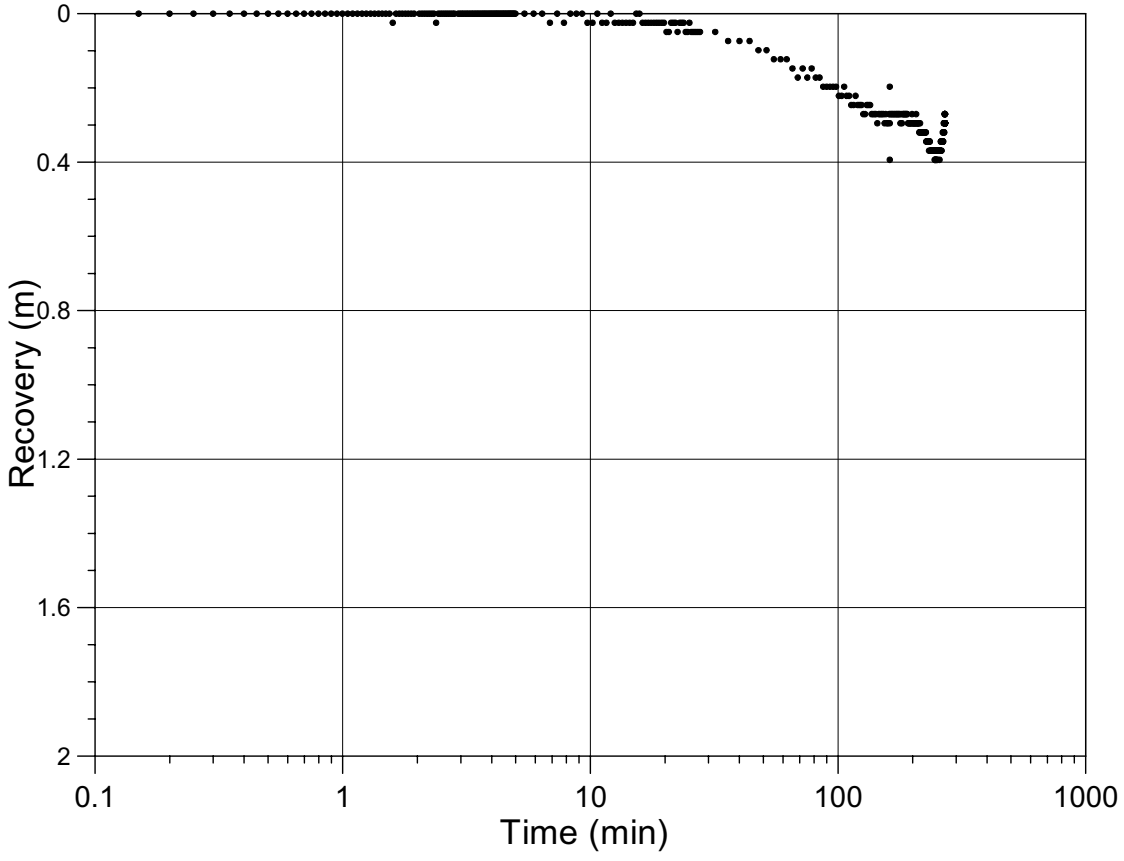




26_KA3600F_2.GRF 2003-11-14





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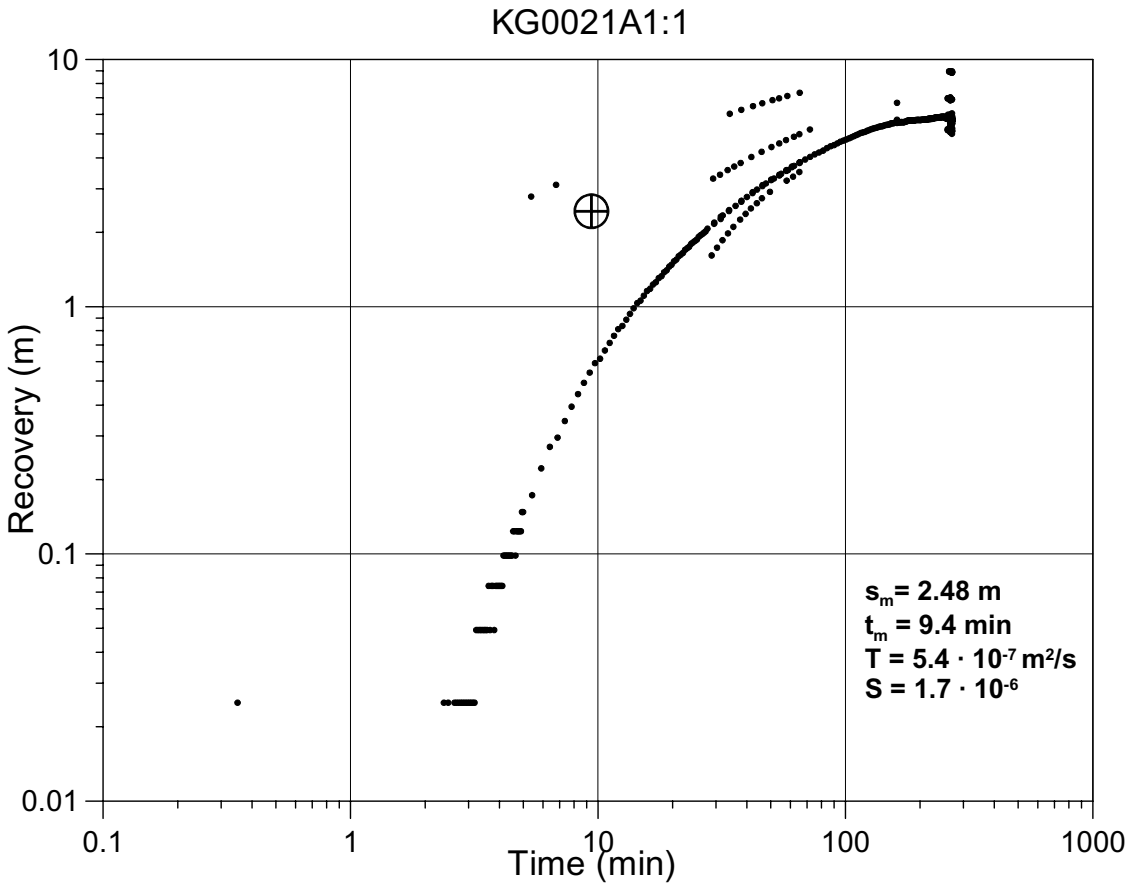

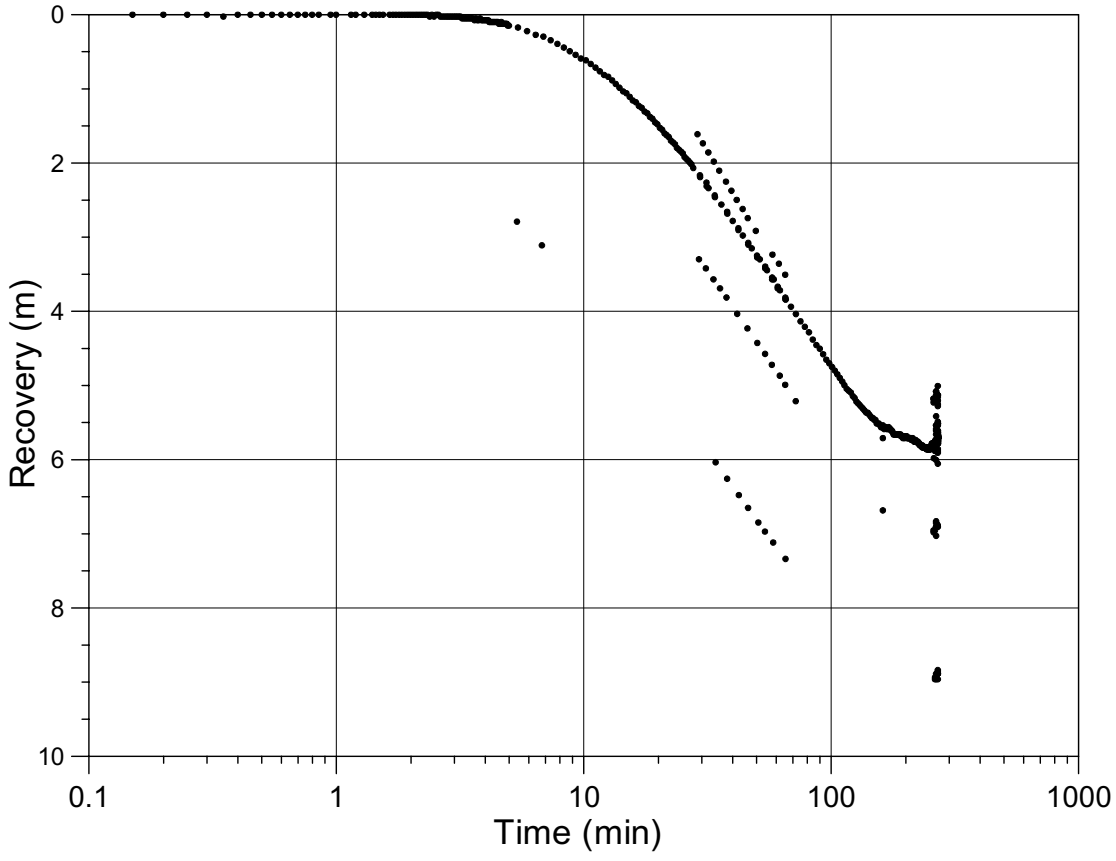

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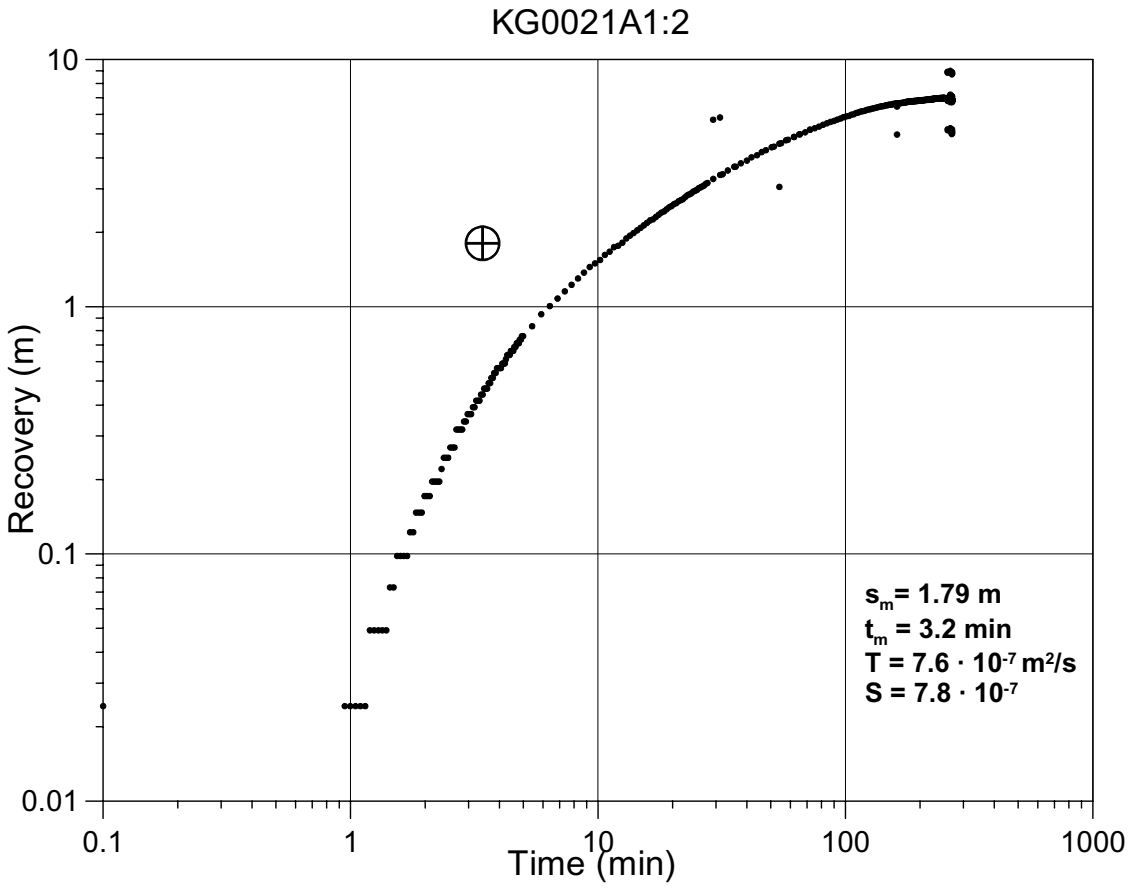

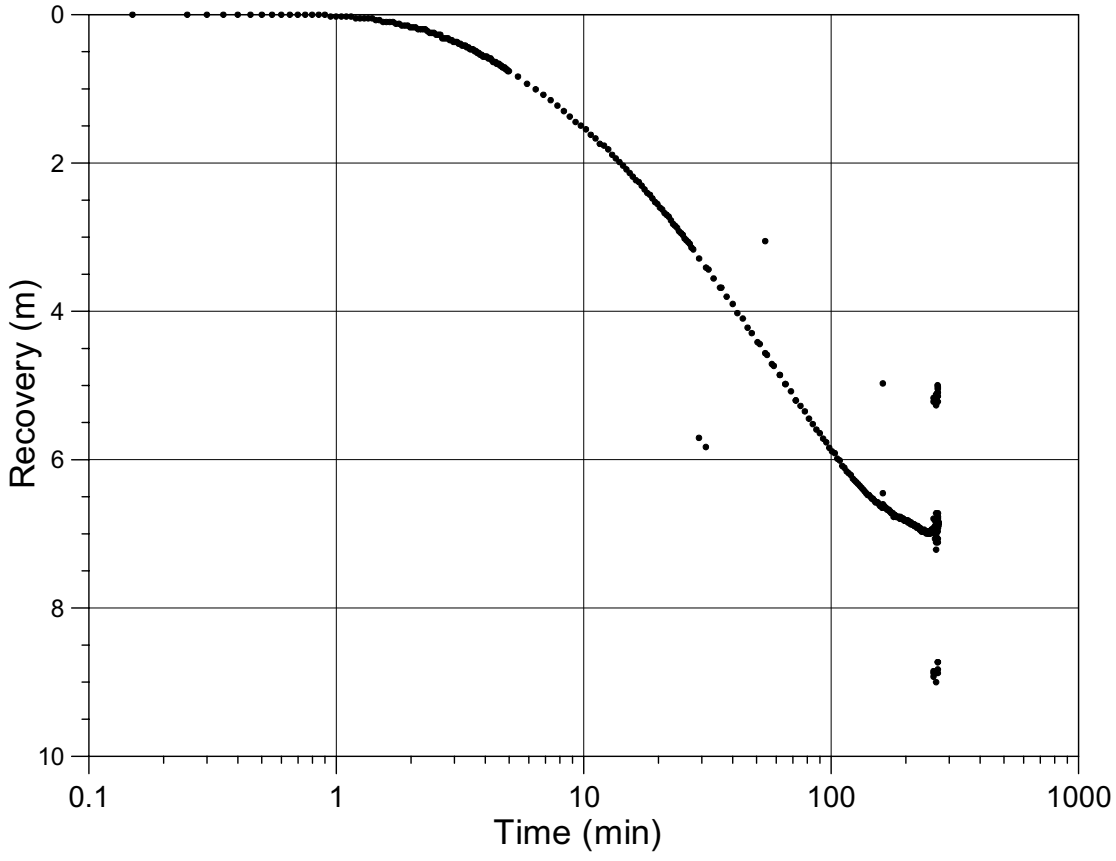

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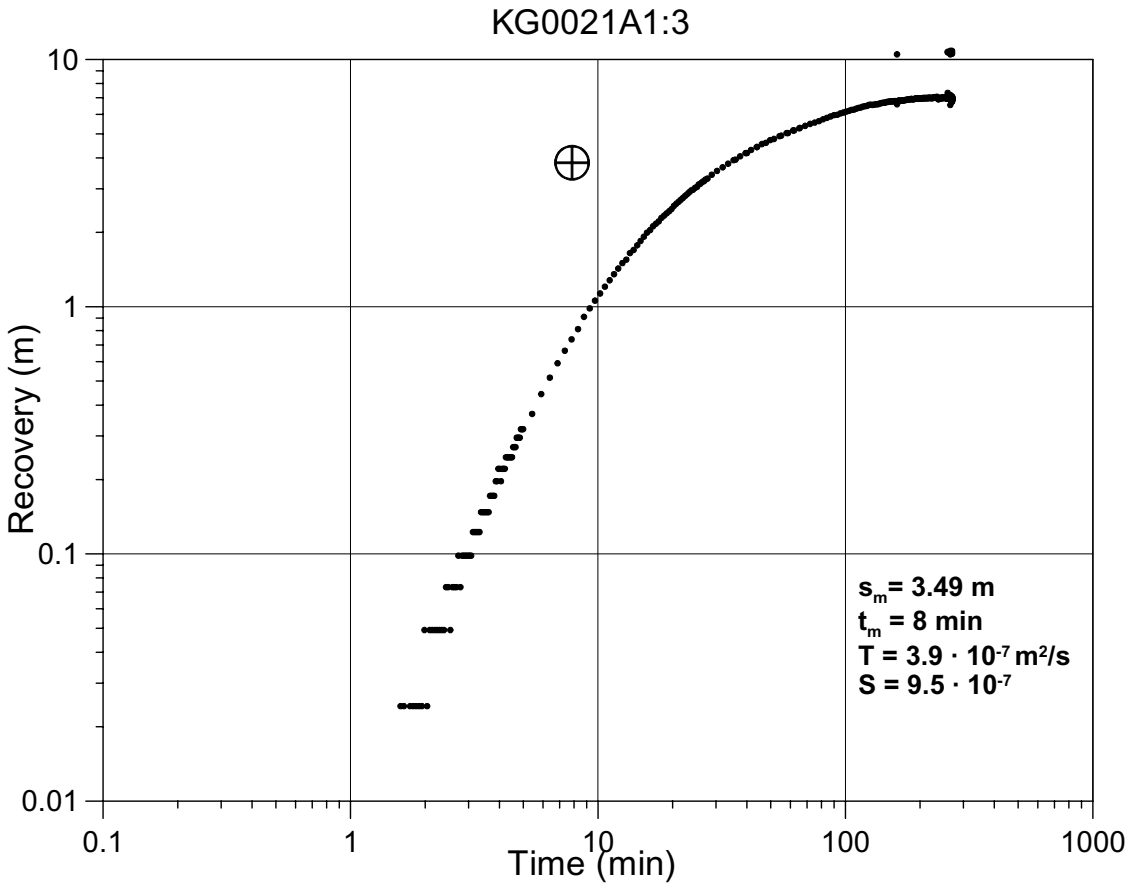
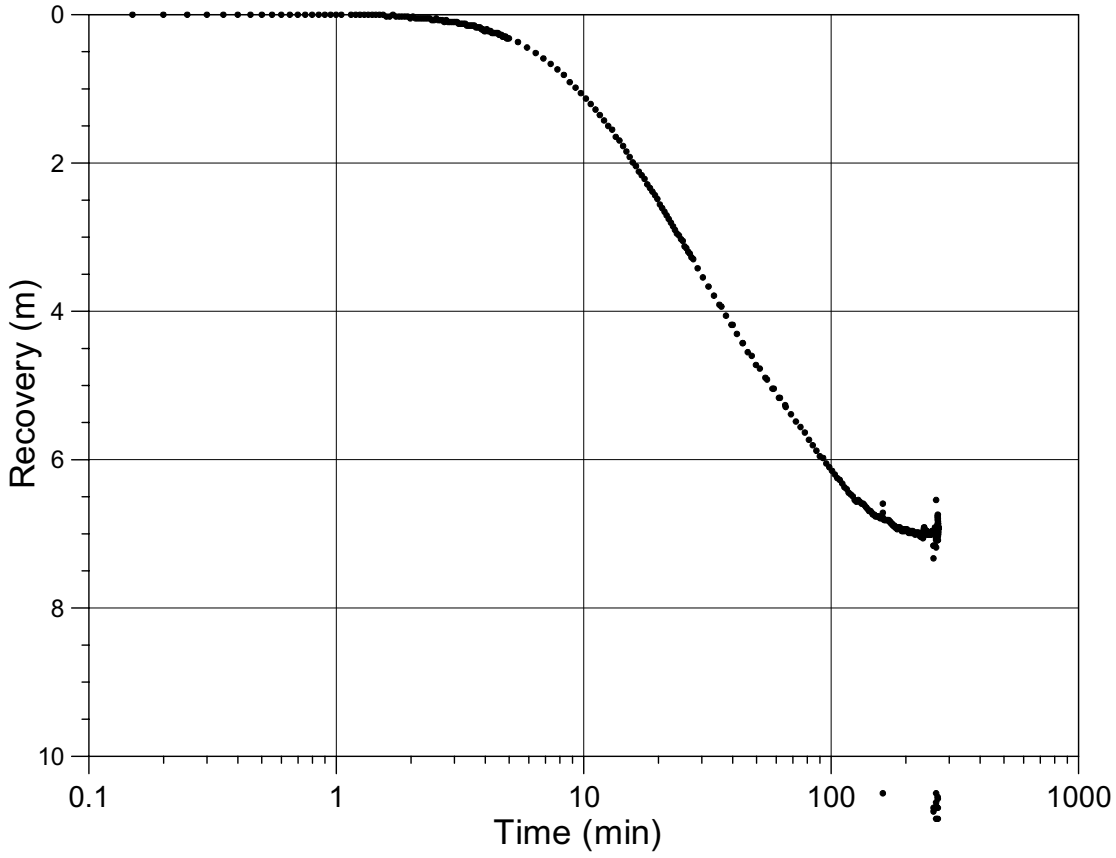
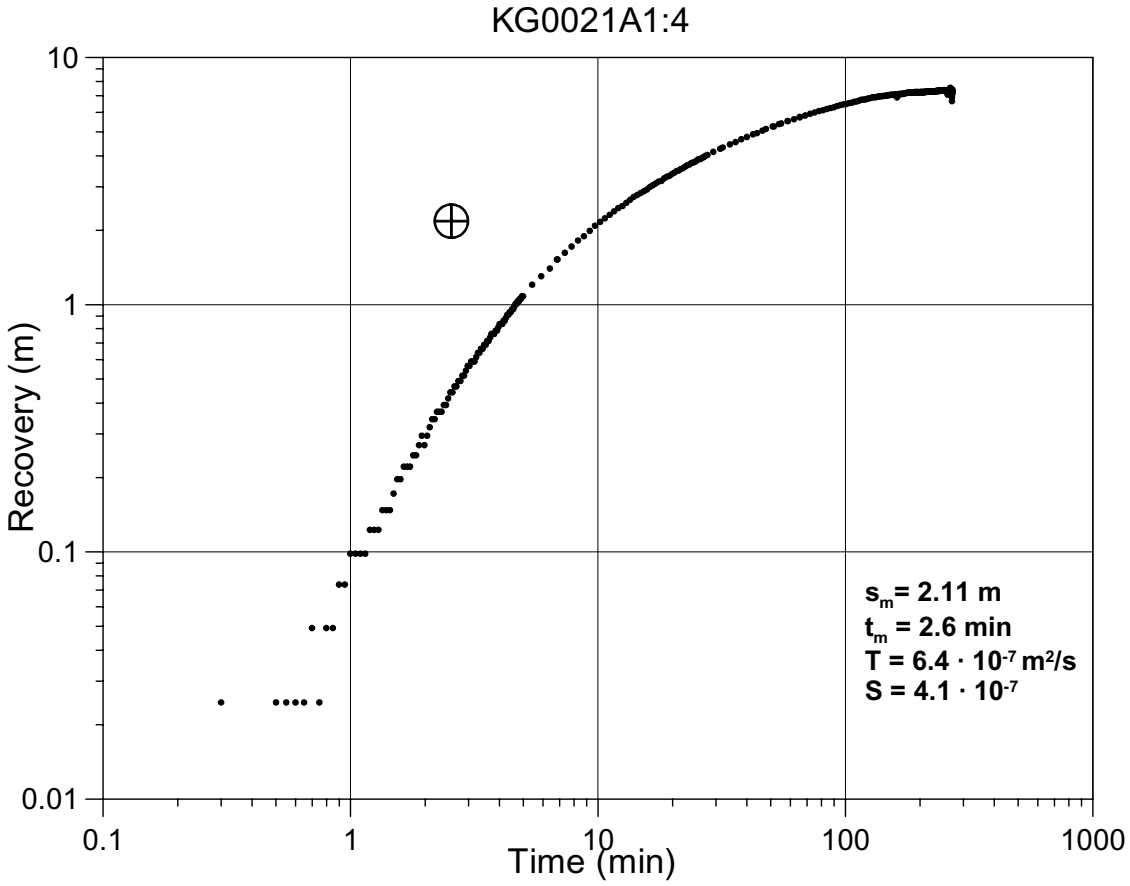
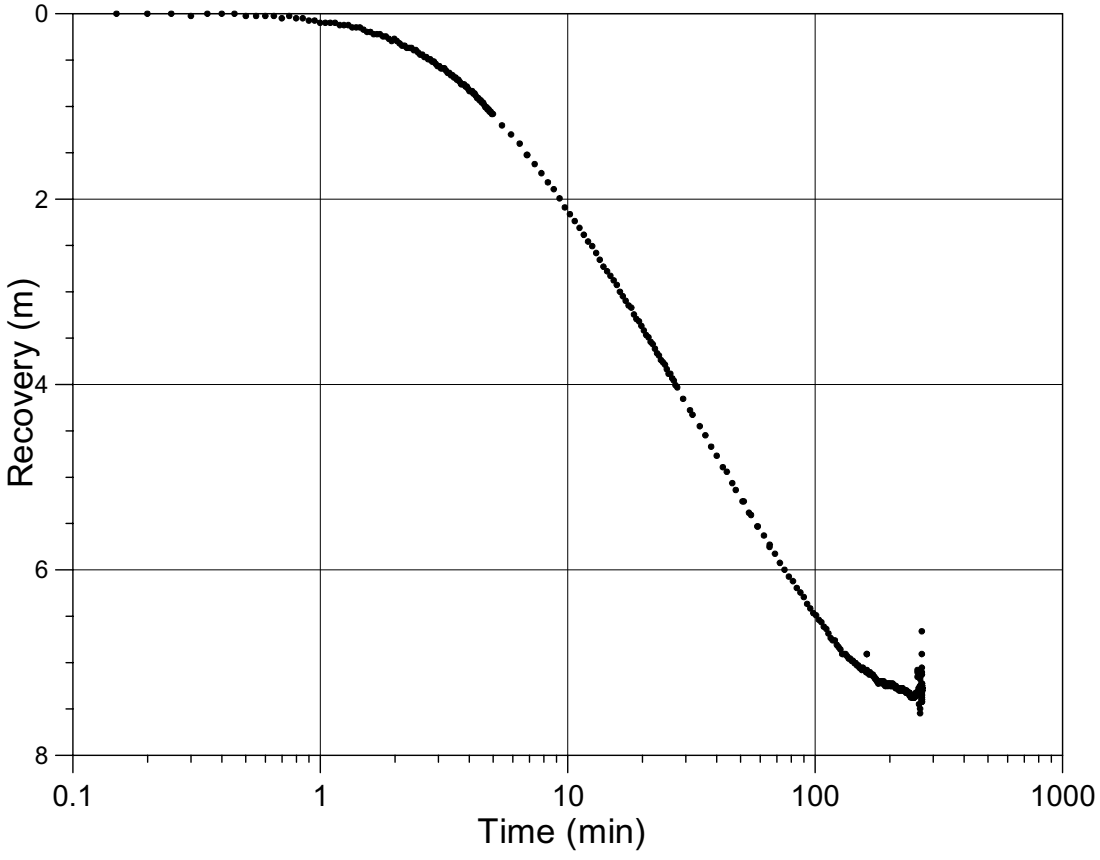


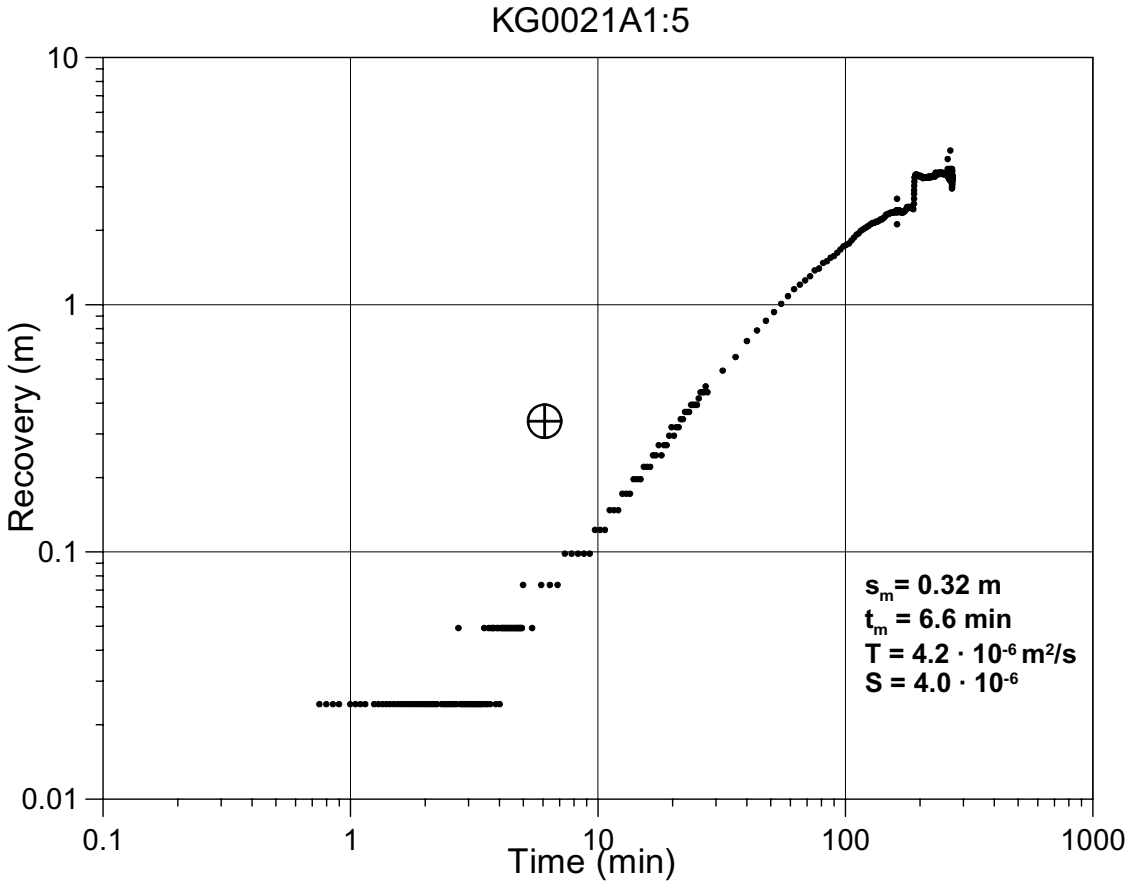


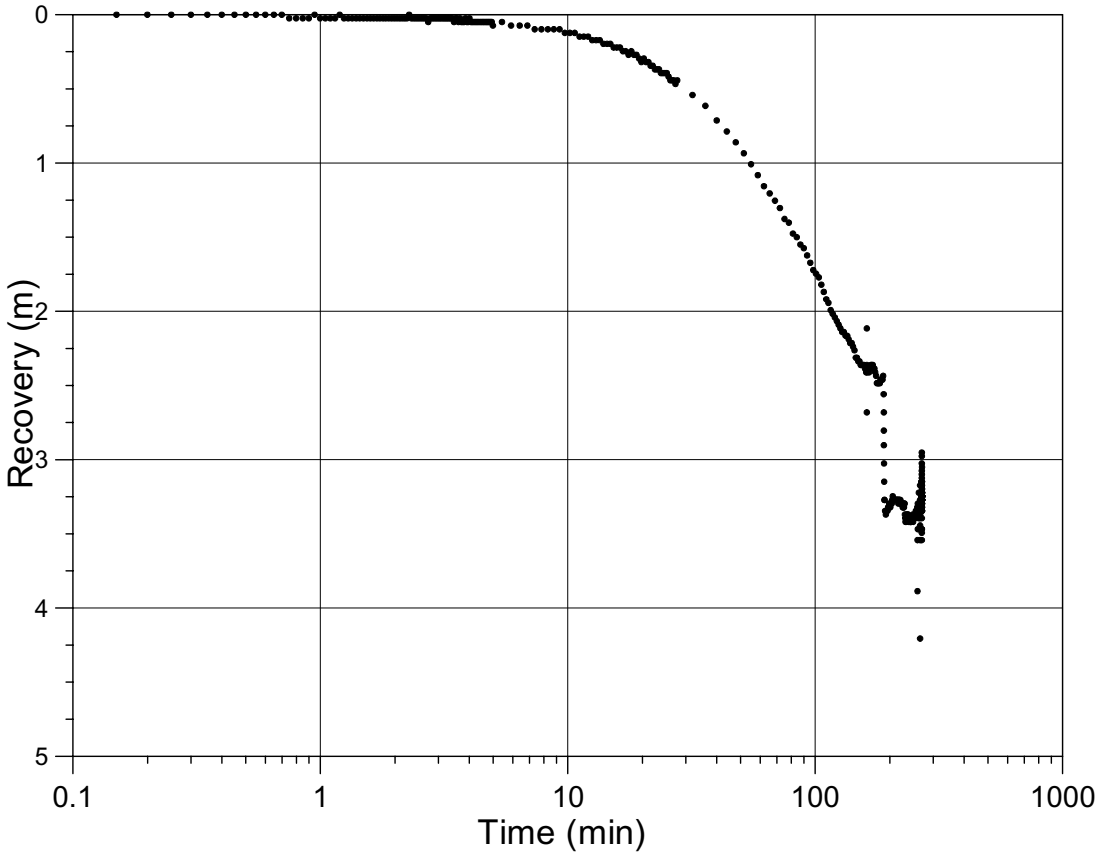
26_KG0021A1_3.GRF 2003-11-16





26_KG0021A1_4.GRF 2003-11-16





26_KG0021A1_5.GRF 2003-11-16

Appendix 7

Interference test 1:27 in borehole KA3573A, section 10.50 m – 12.50 m

Date: 2003-05-15 Field Crew: A. Blom / J. Magnusson
Borehole length: 40.07 m Borehole diameter: 76 mm

Flowing borehole: KA3573A, section 4: 10.50 m – 12.50 m

Valve opened: 20030515 09:40.00 Valve closed: 20030515 15:40.00

End of Test: 20030516 09:40

Total flowing time : 360 min Tot. Pr. Build-up time: 1080 min.

The test was performed as an Interference test. Pressure responses were monitored in 132 borehole sections including the flow section.

Flow data

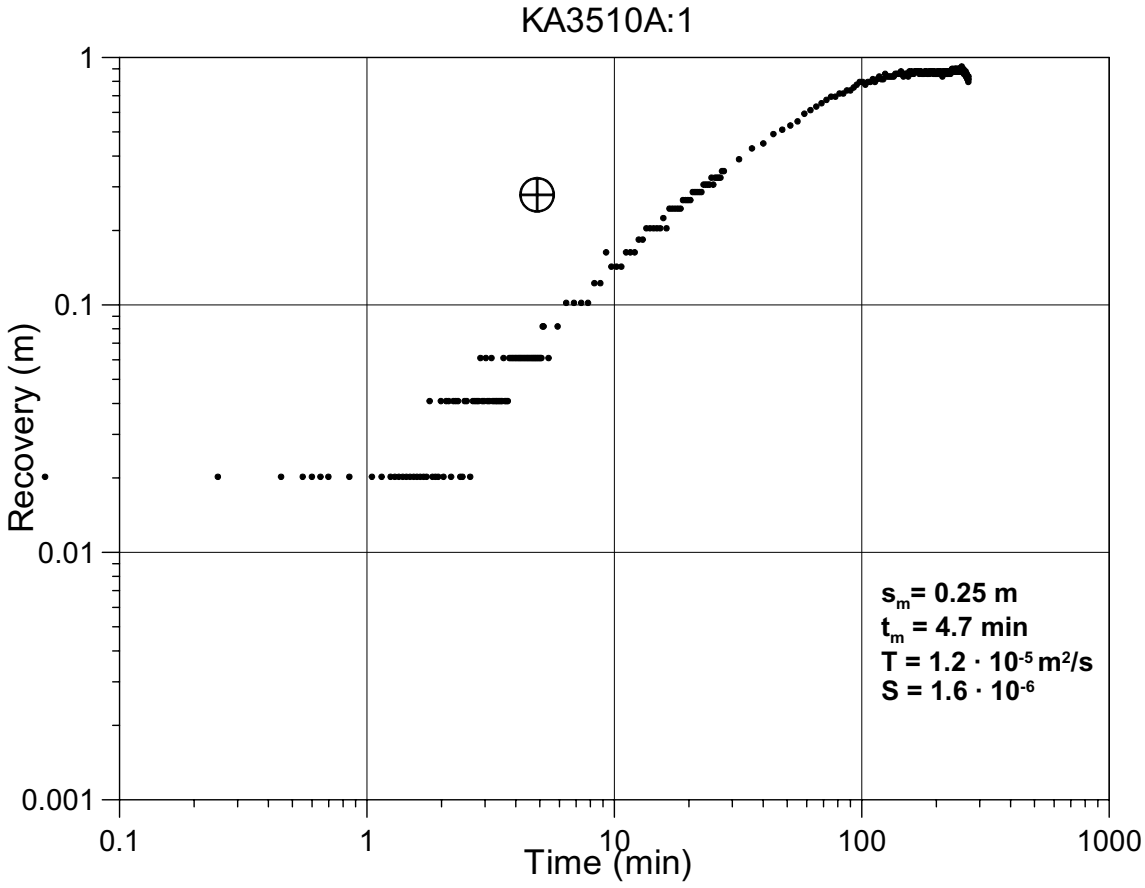
Manually measured flow rates of KA3573A, section 10.50 m – 12.50 m are presented in the table below:

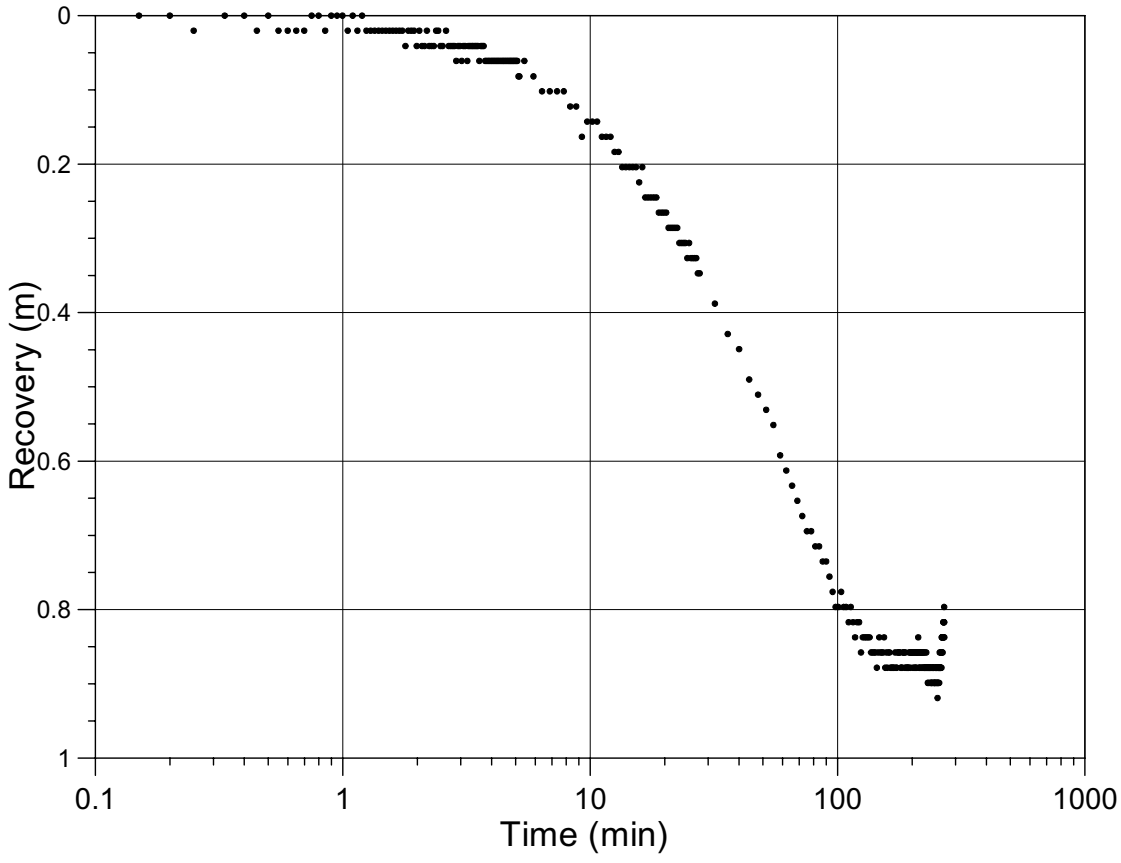
Table Manually measured flow rates, Interference test in KA3573A, section 10.50 m – 12.50 m. Prototype Repository, May 15 2003

Time	Flow rate (l/min)
09:40:30	2.442
09:41:30	2.410
09:43:00	2.420
10:17:00	2.372
10:18:00	2.369
10:19:00	2.369
15:27:30	2.349
15:29:00	2.342
15:31:00	2.340

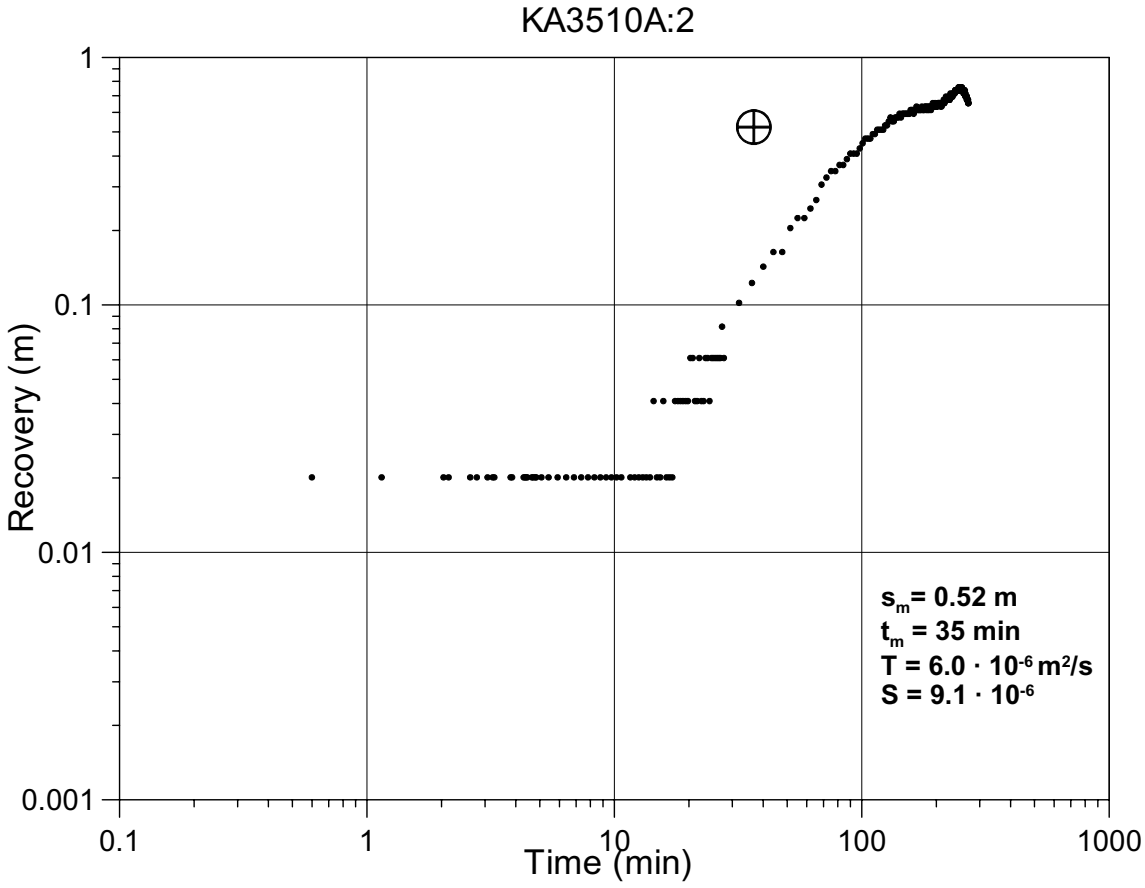
Due to initial technical problems with the pressure transducers some of the pressure plots show data that are not relevant to the evaluation. It is the curve with most of the data points that is the relevant pressure curve in those cases.

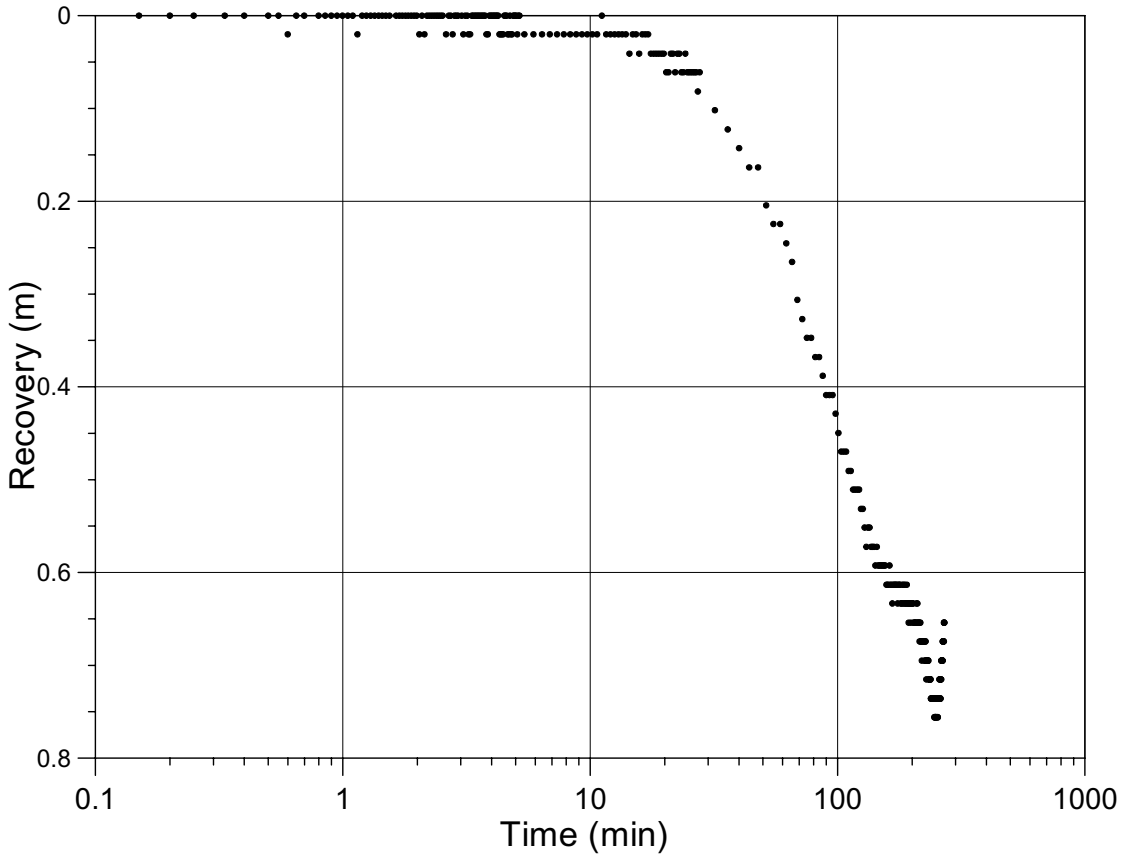
In all cases the matchpoint used is consistent with $p_D = 1$ and $t_D = 1$.



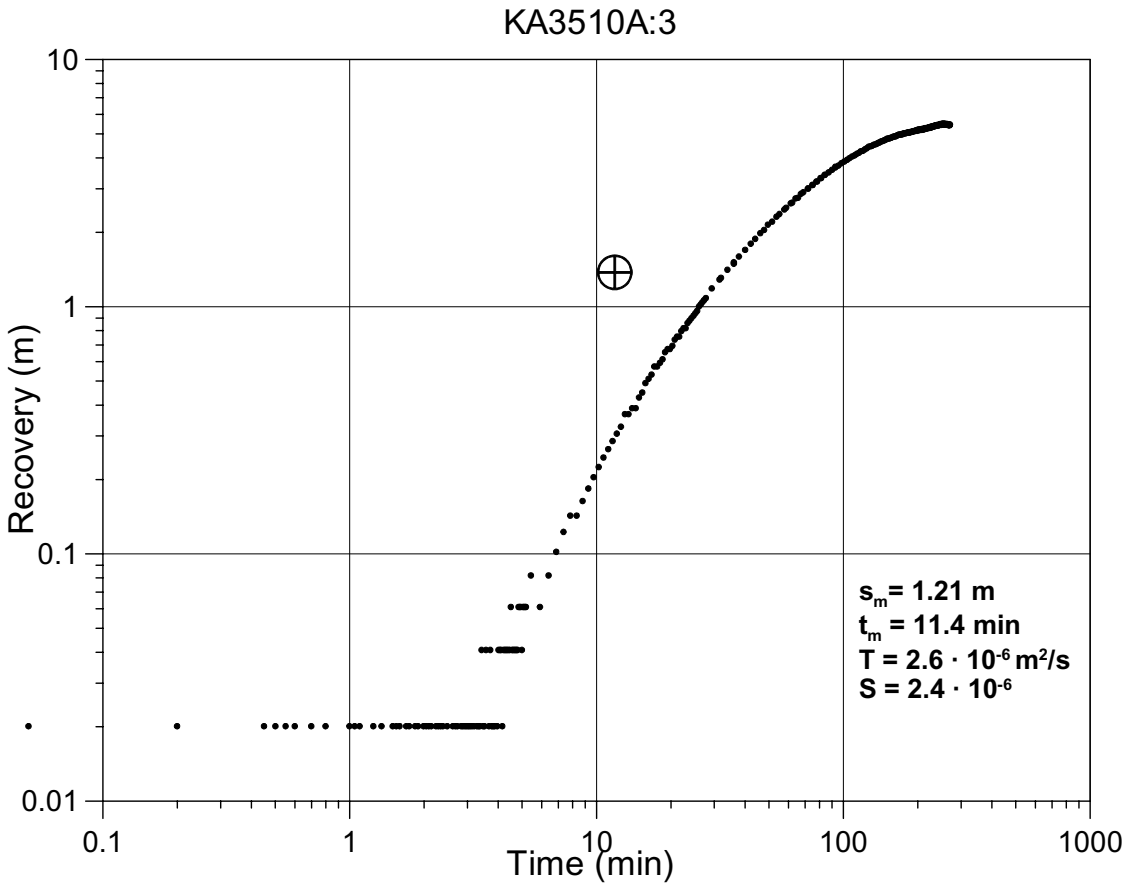


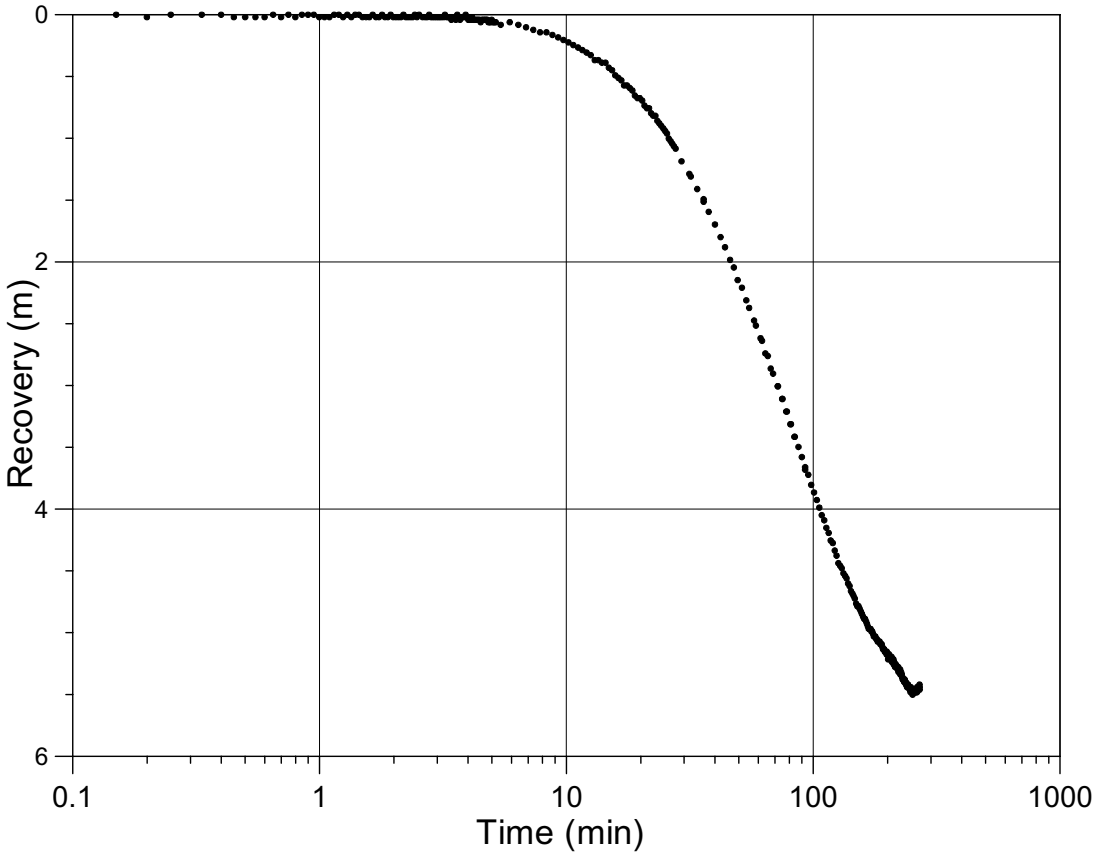
27_KA3510A_1.GRF 2003-11-16



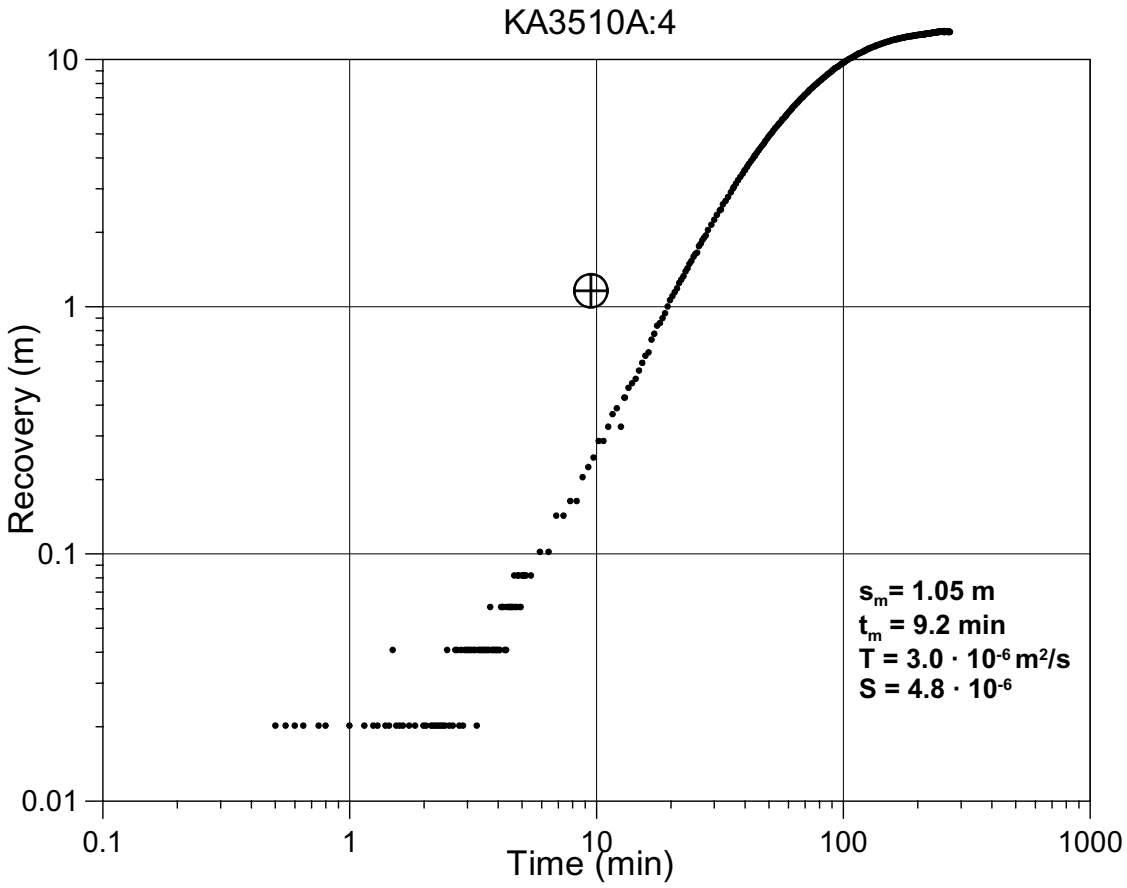


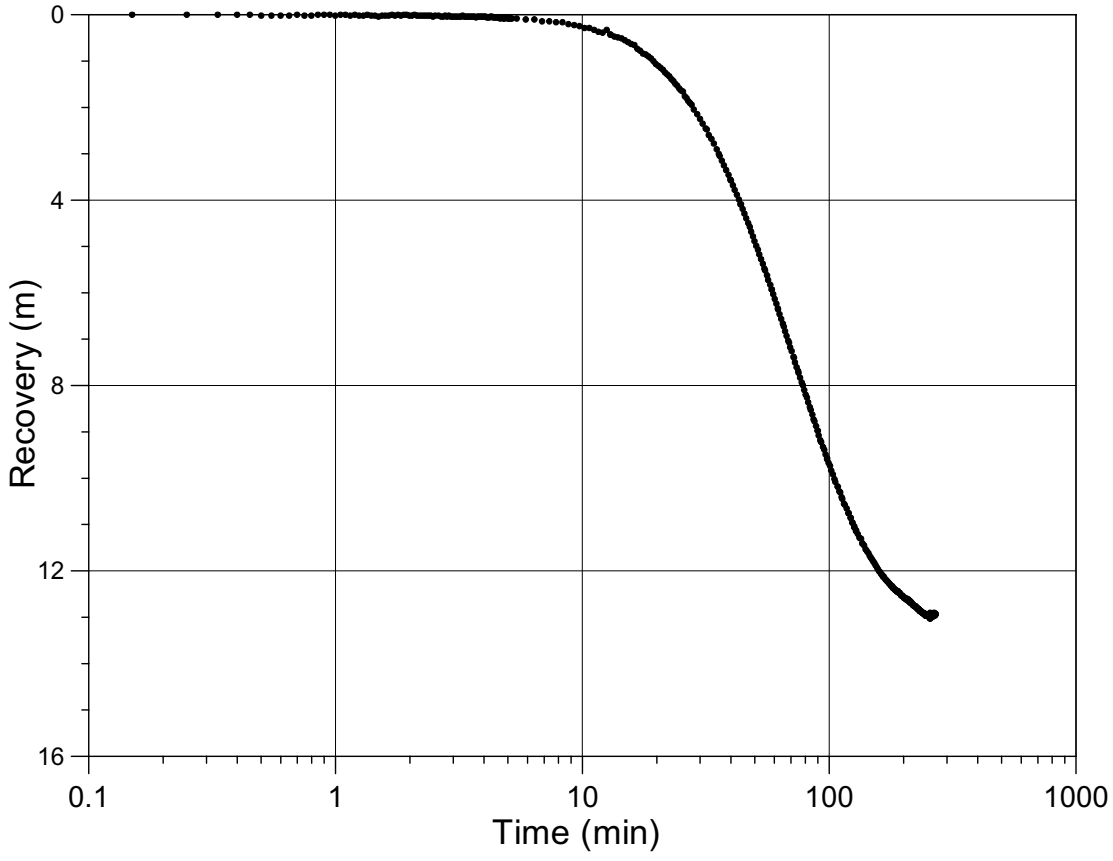
27_KA3510A_2.GRF 2003-11-16



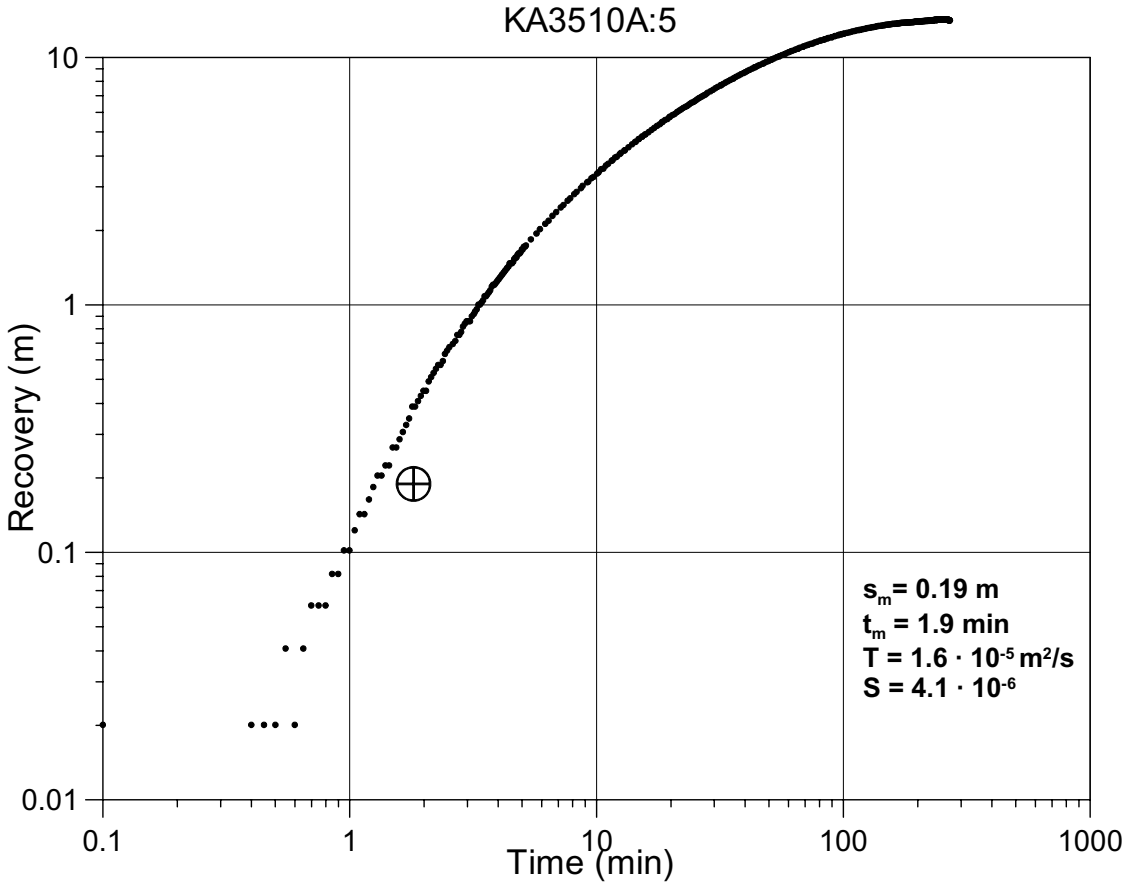


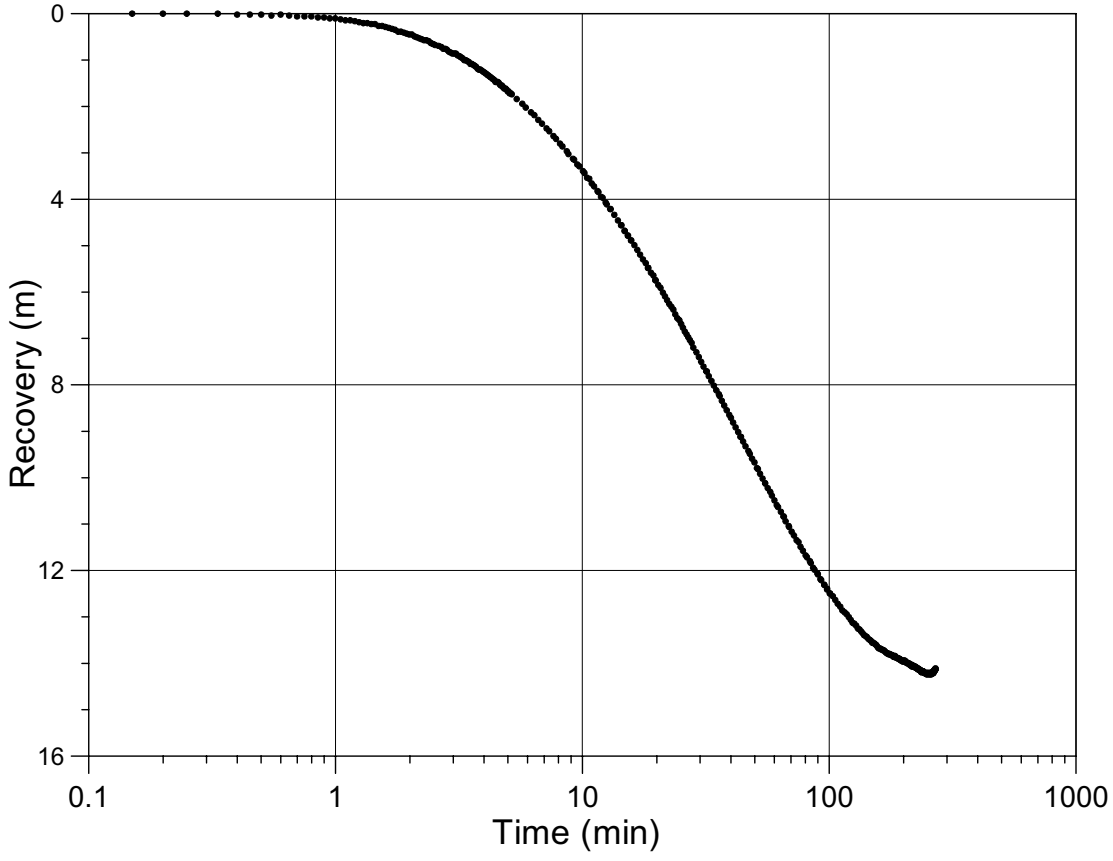
27_KA3510A_3.GRF 2003-11-16



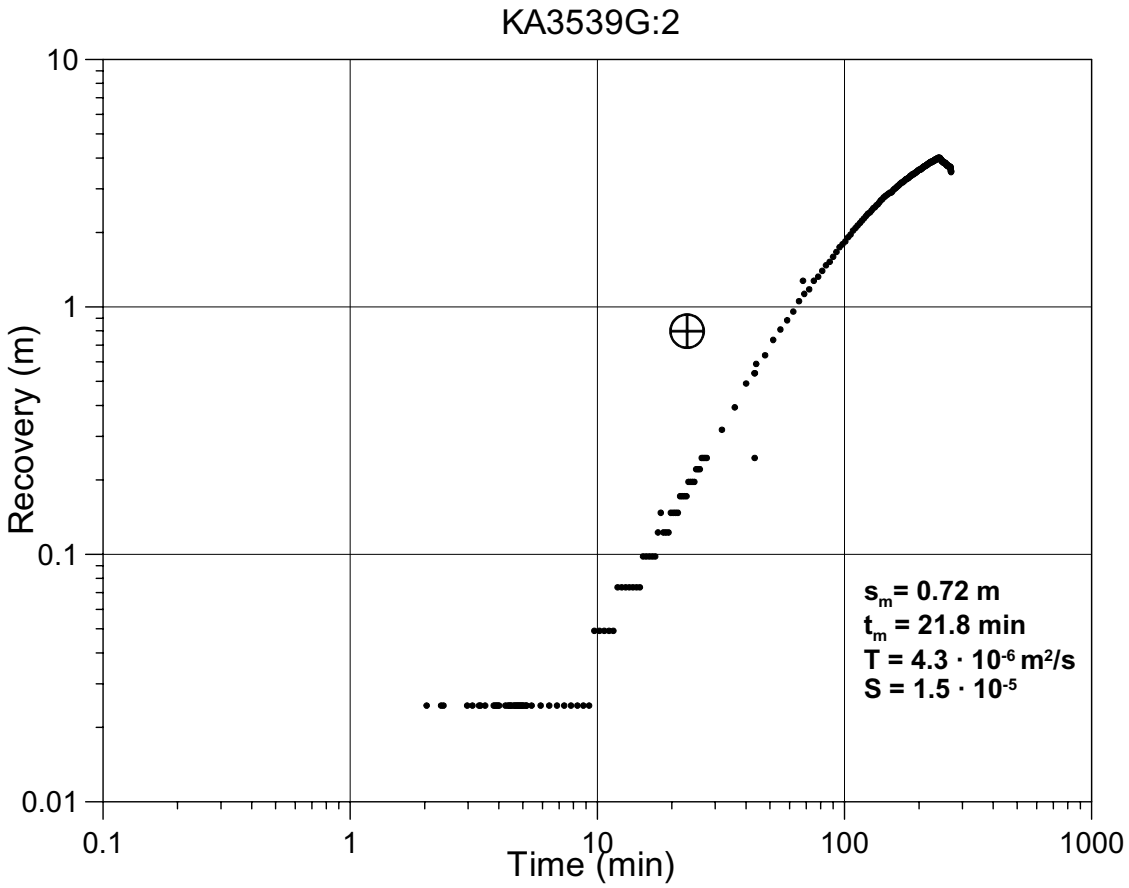


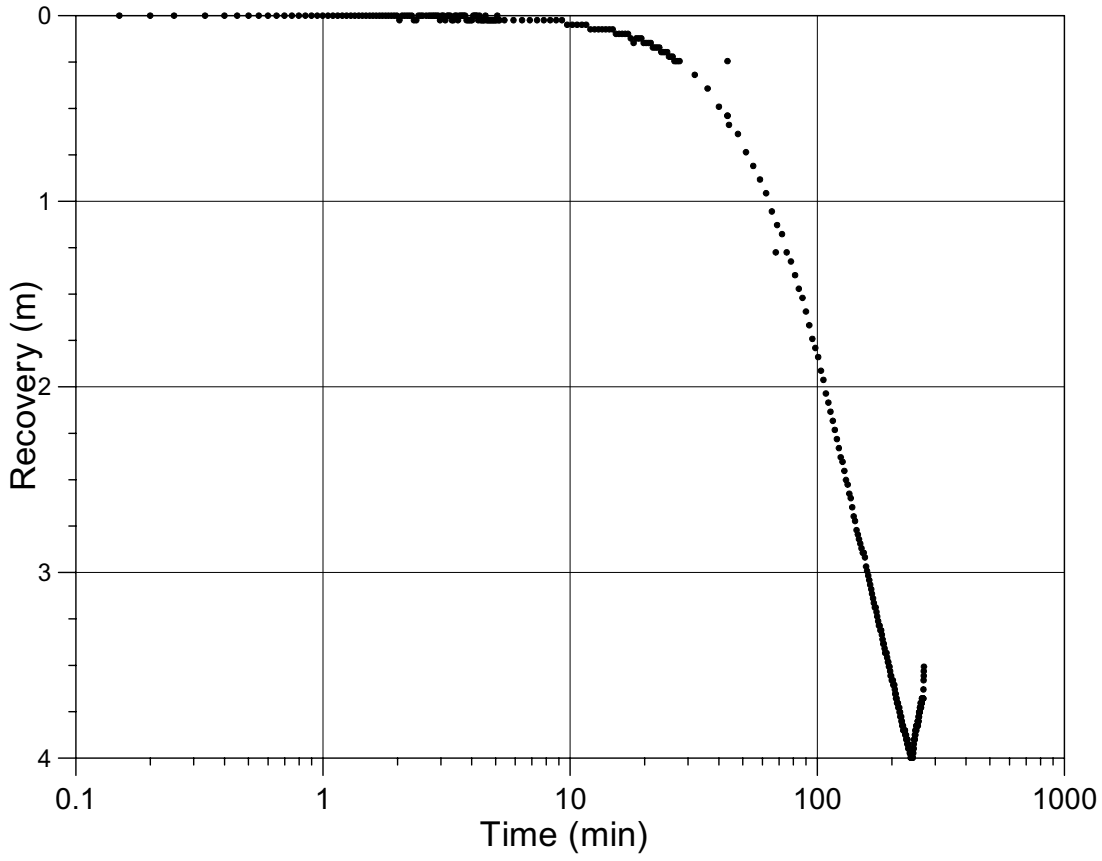
27_KA3510A_4.GRF 2003-11-16



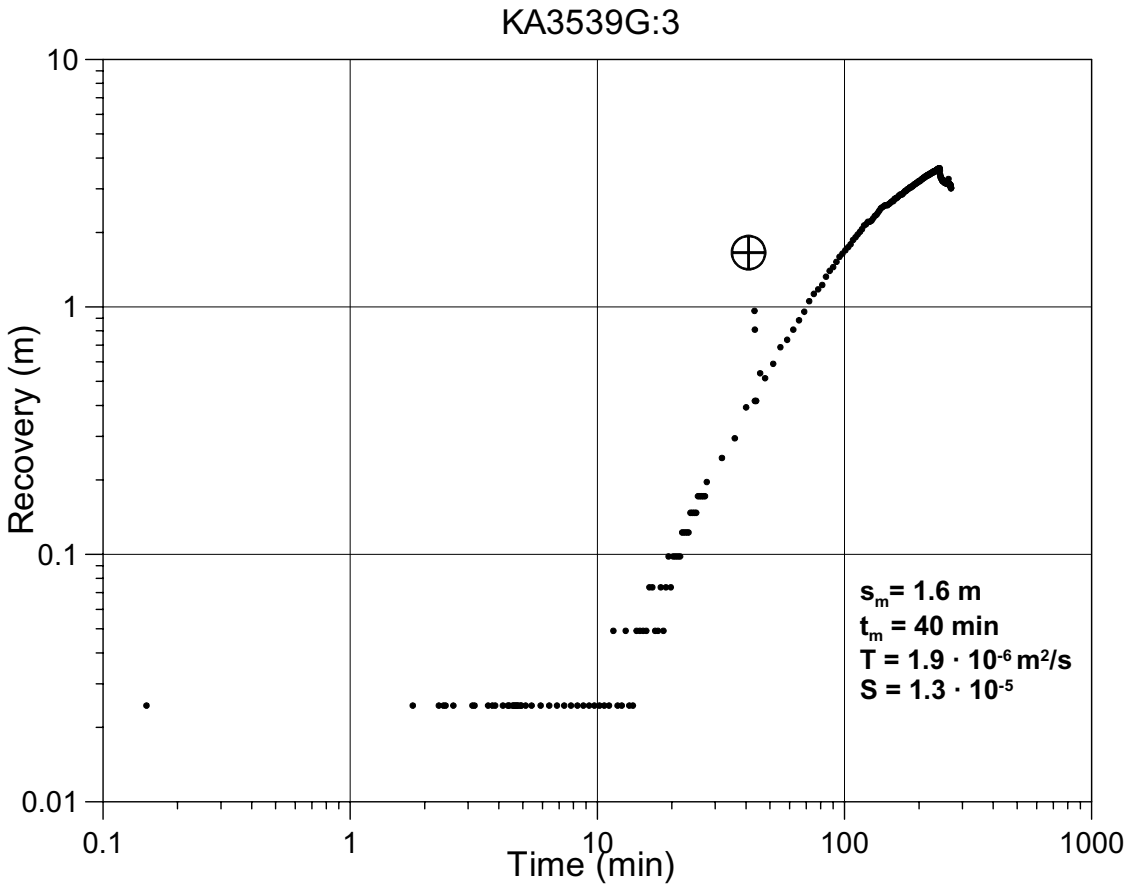


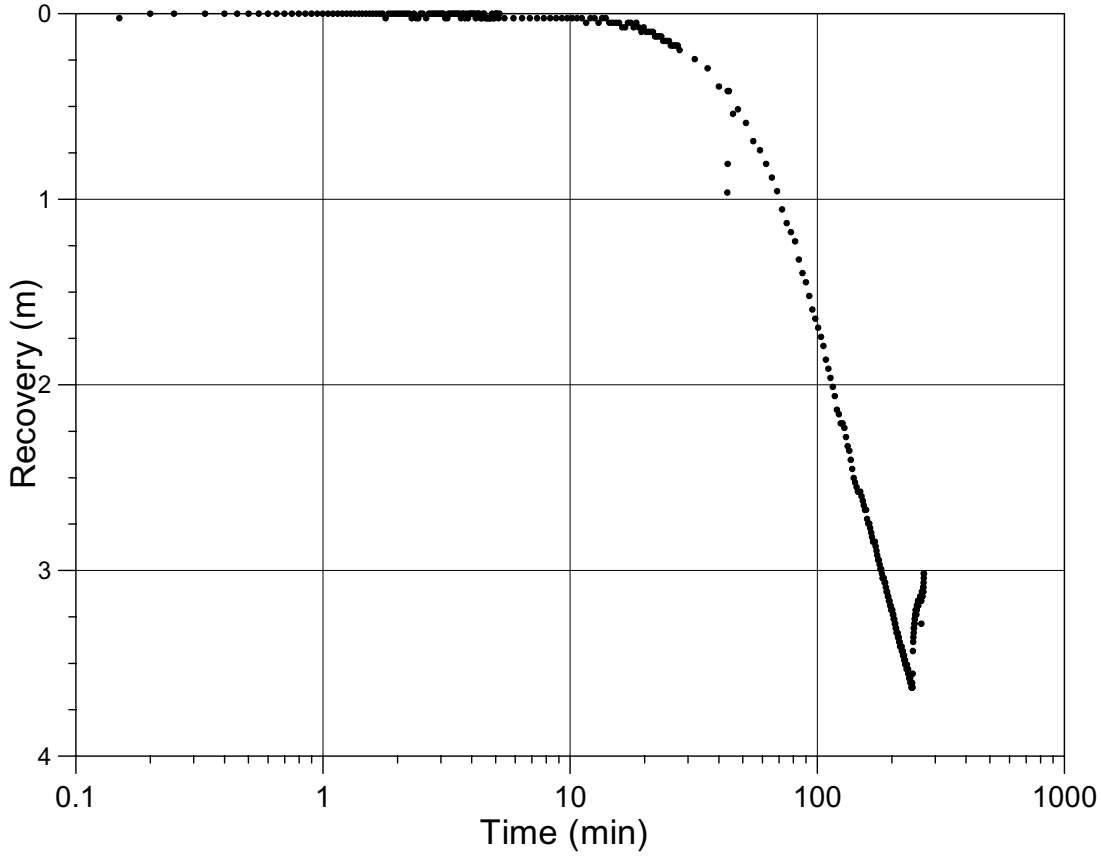
27_KA3510A_5.GRF 2003-11-16



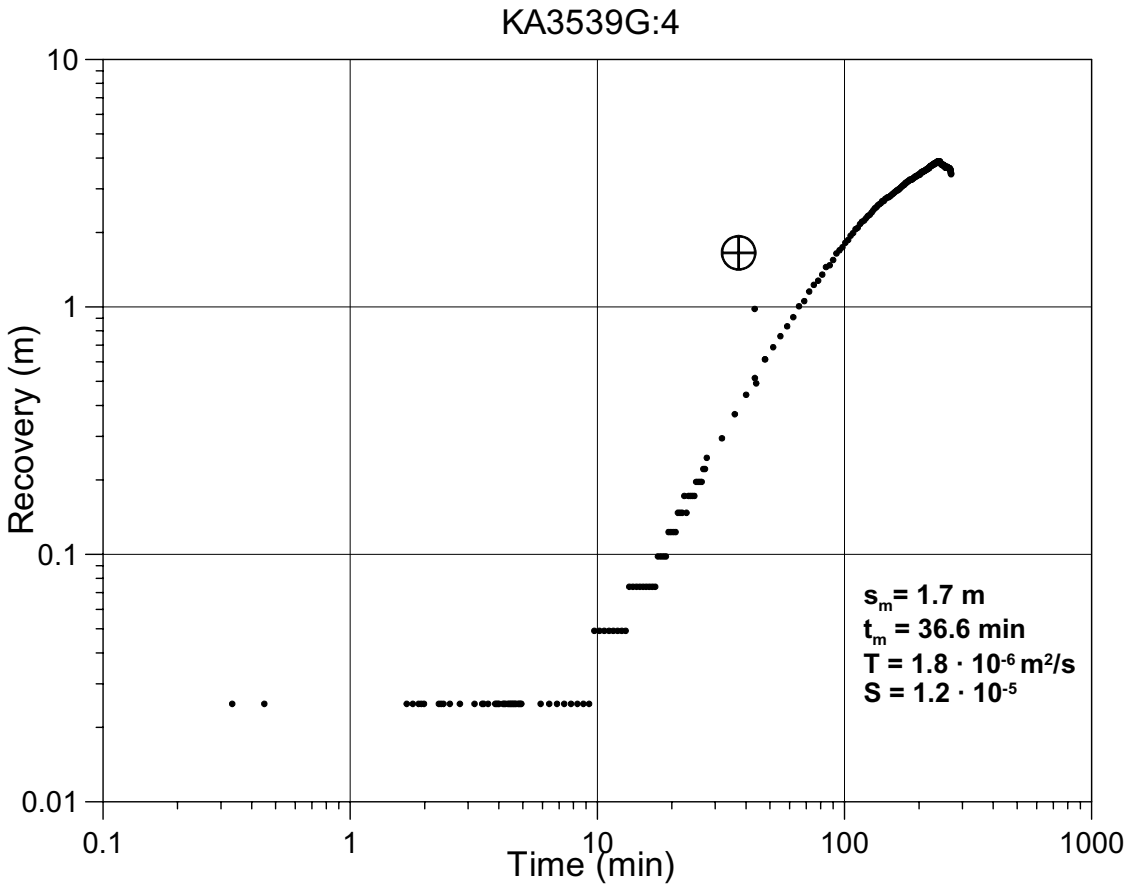


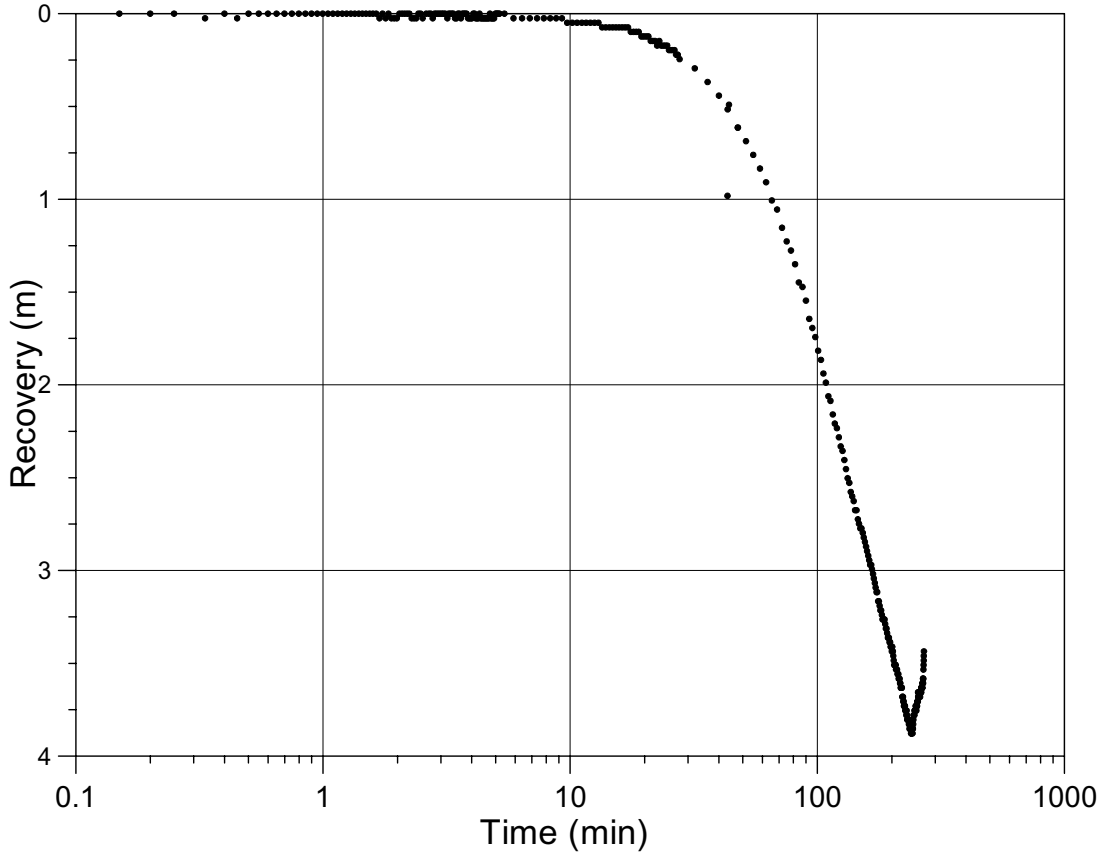
27_KA3539G_2.GRF 2003-11-16



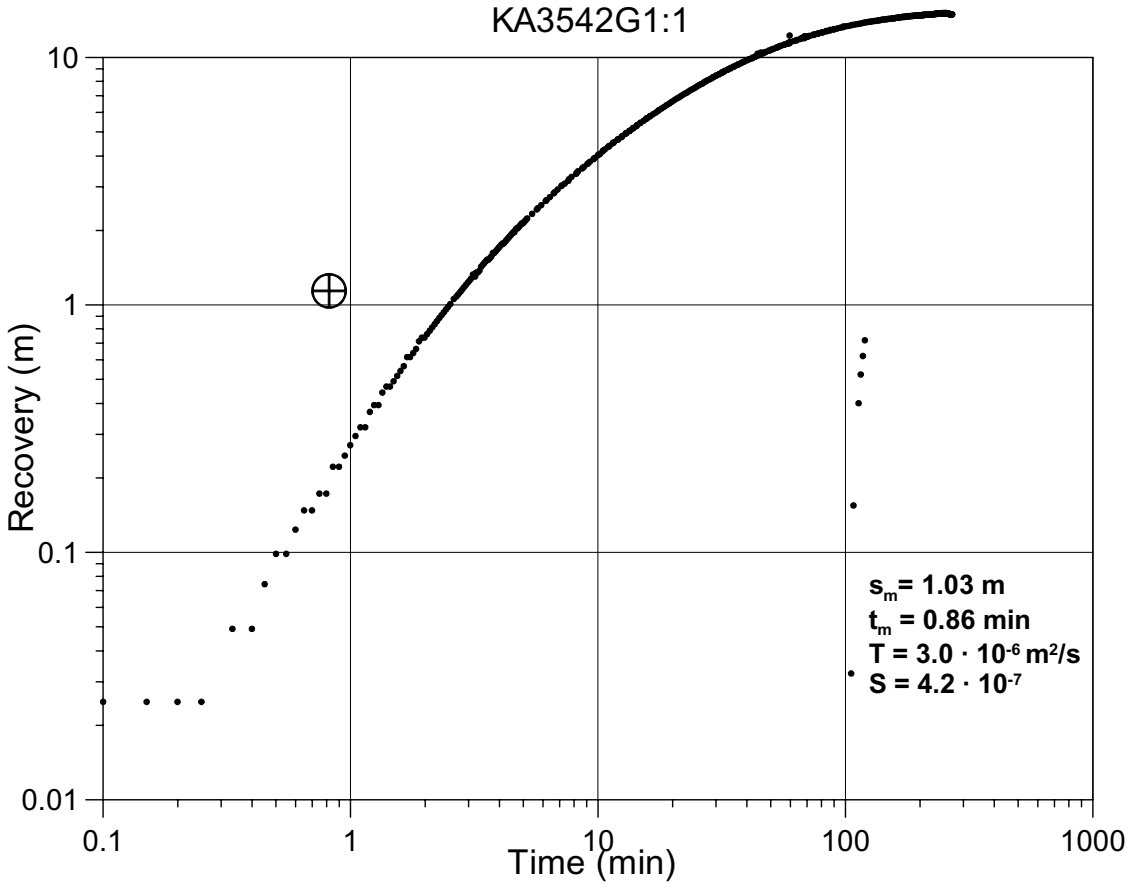


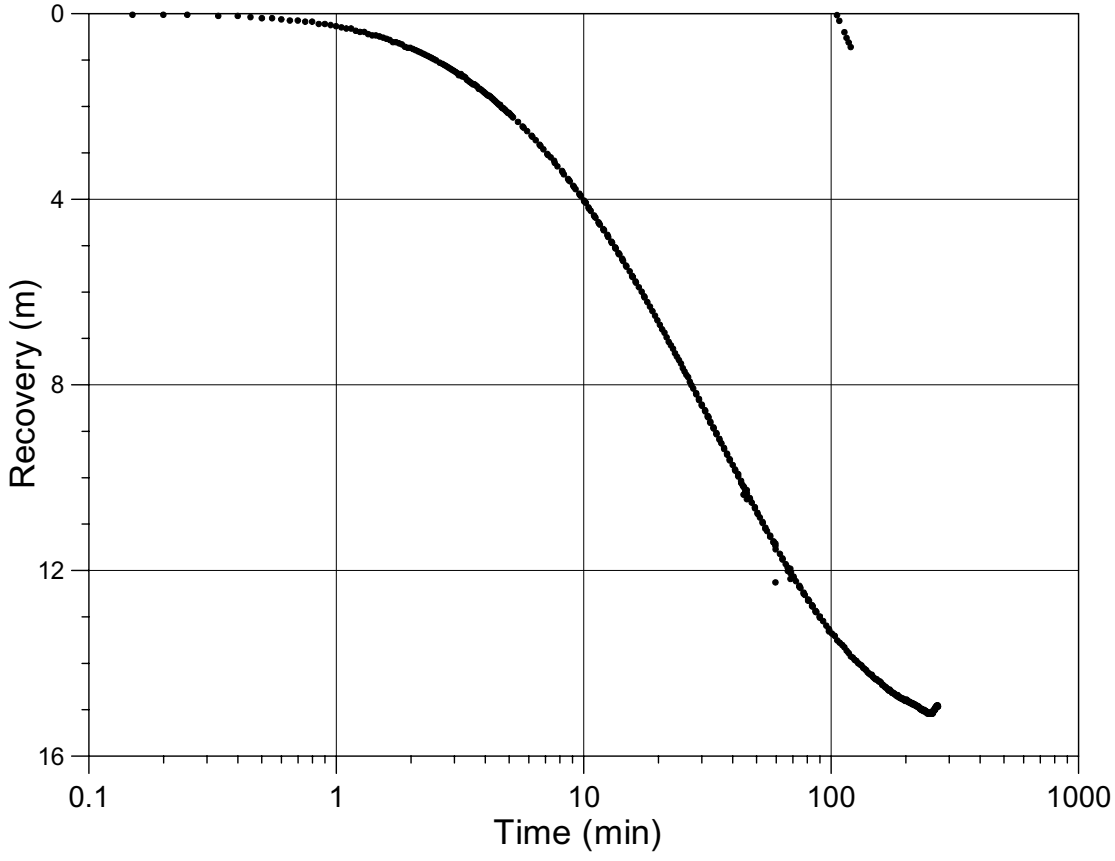
27_KA3539G_3.GRF 2003-11-16



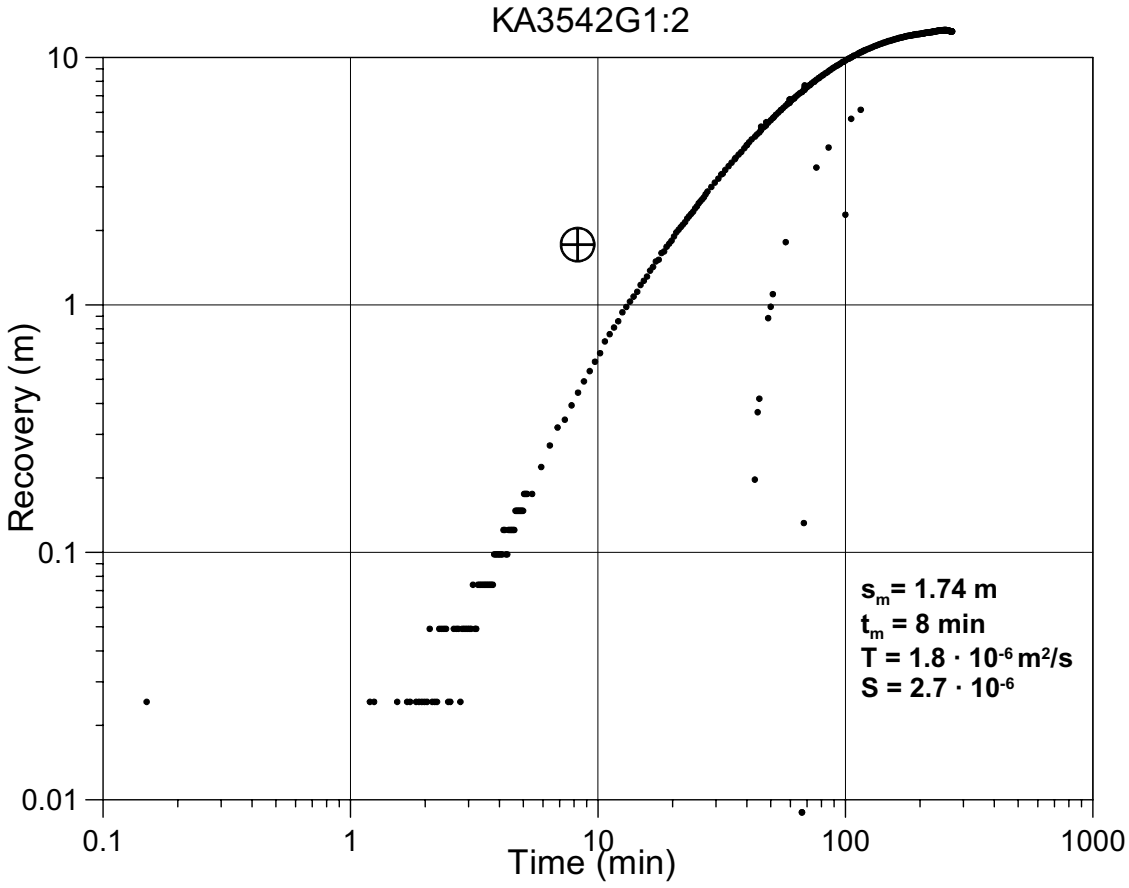


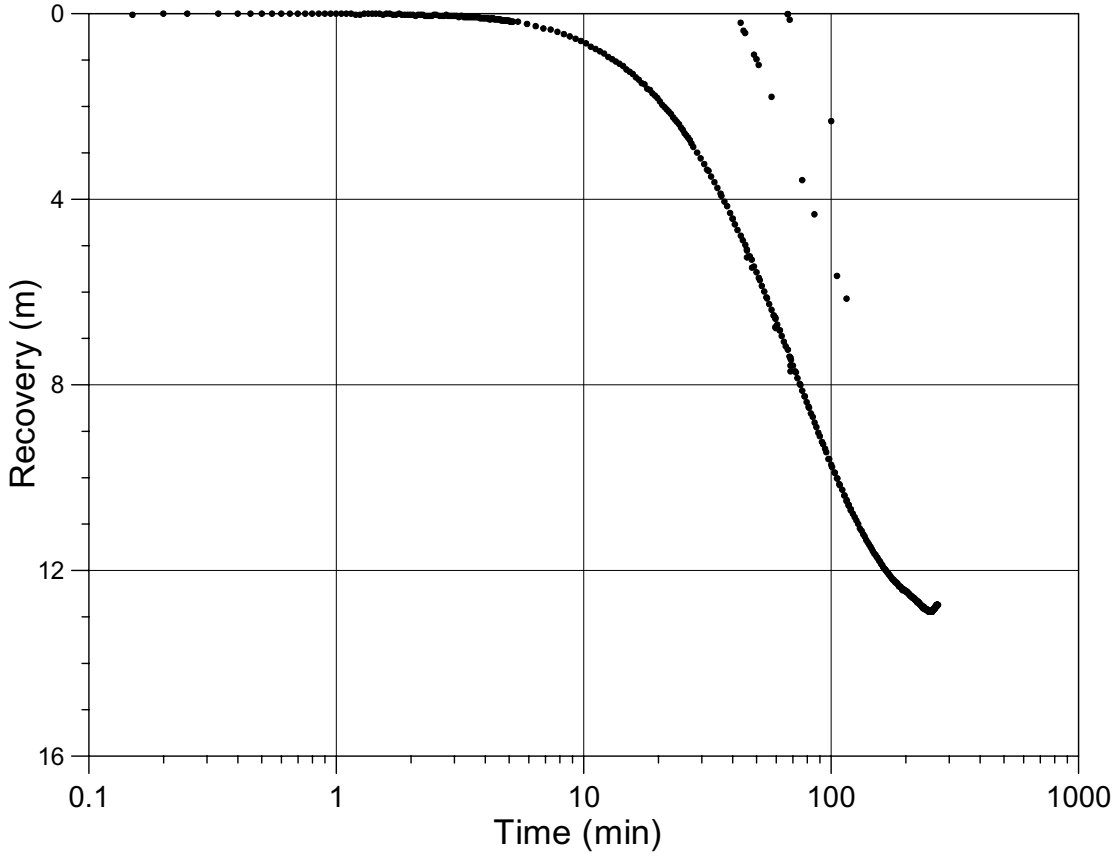
27_KA3539G_4.GRF 2003-11-16



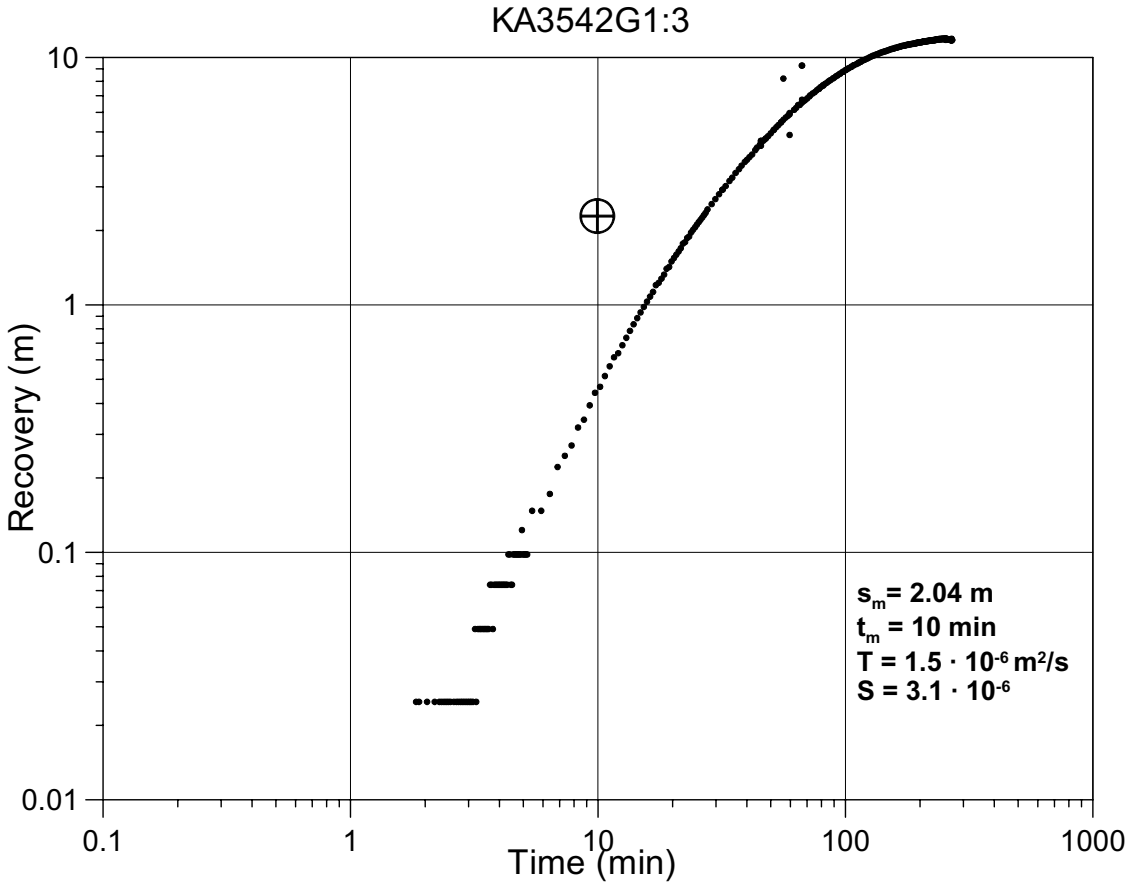


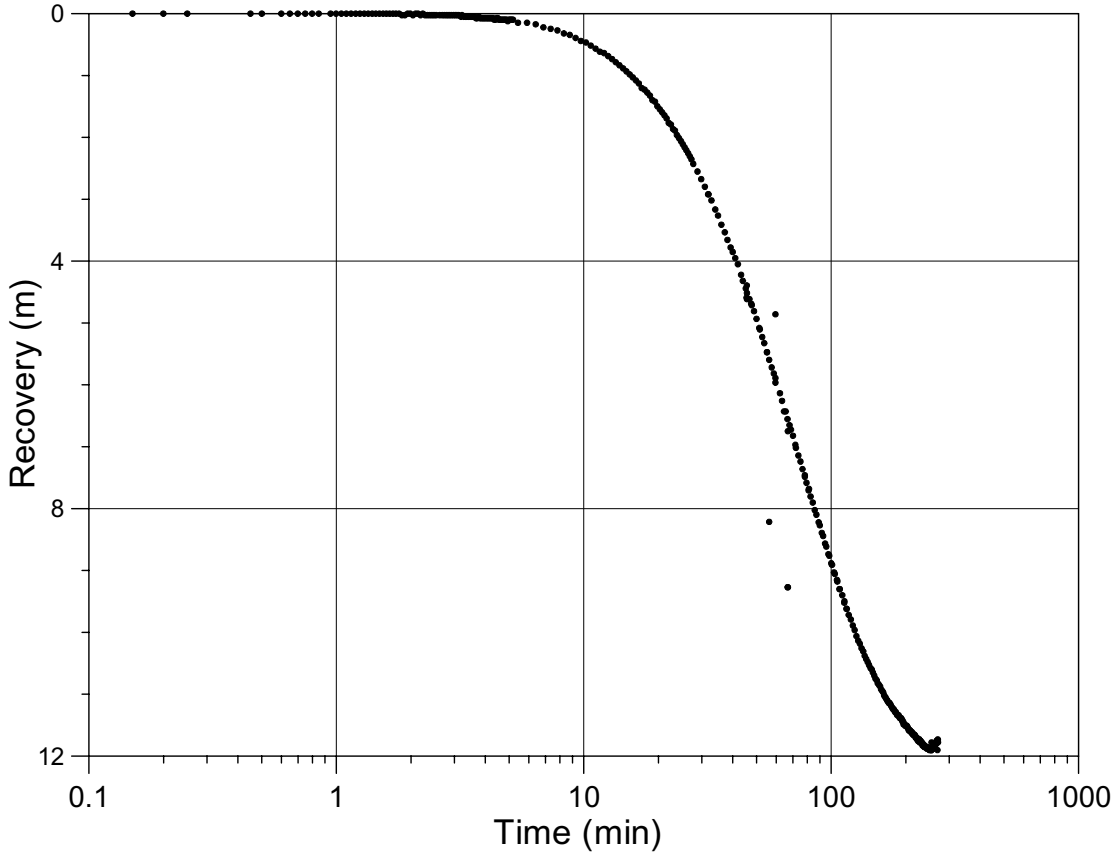
27_KA3542G1_1.GRF 2003-11-16



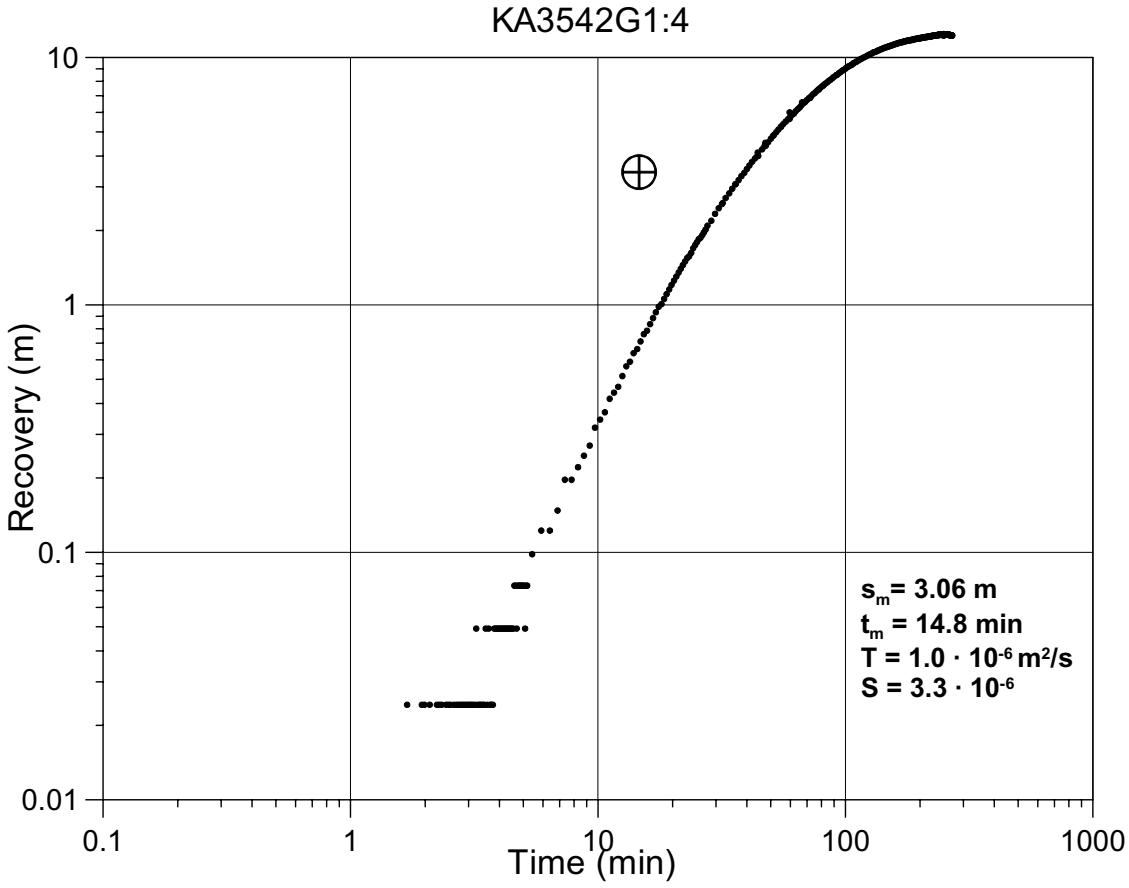


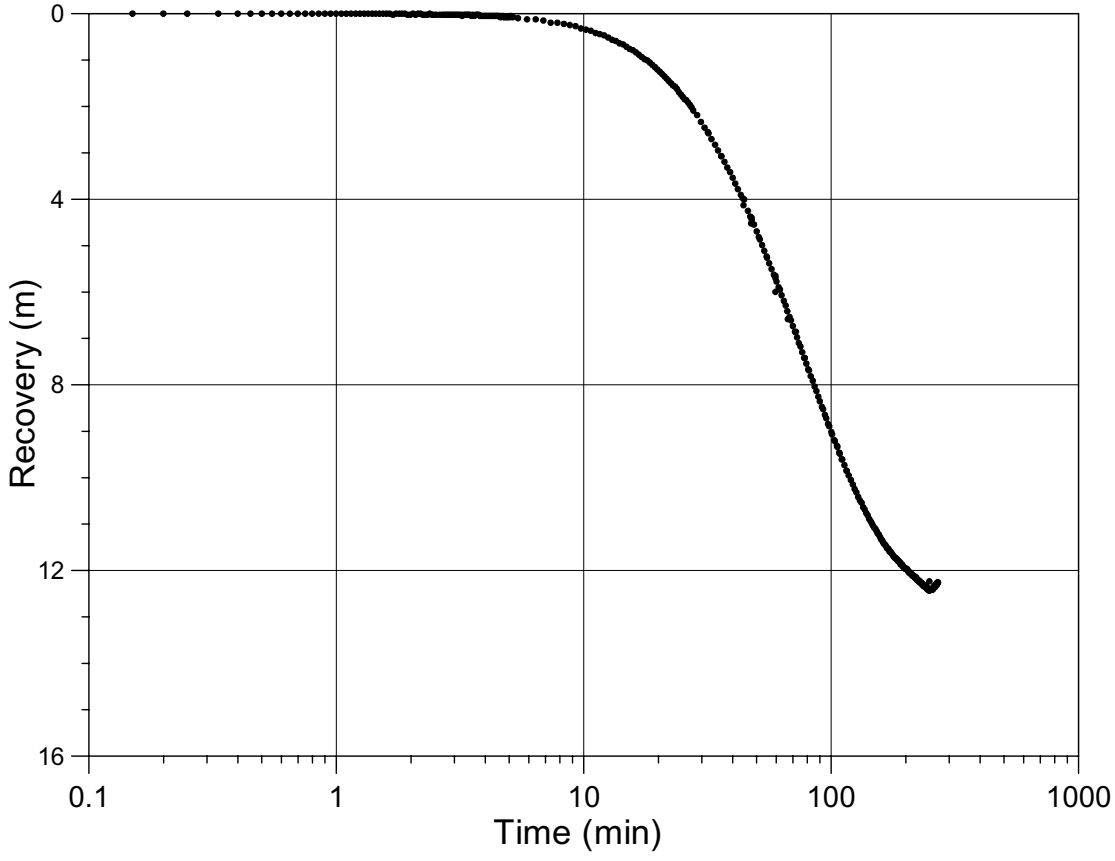
27_KA3542G1_2.GRF 2003-11-16



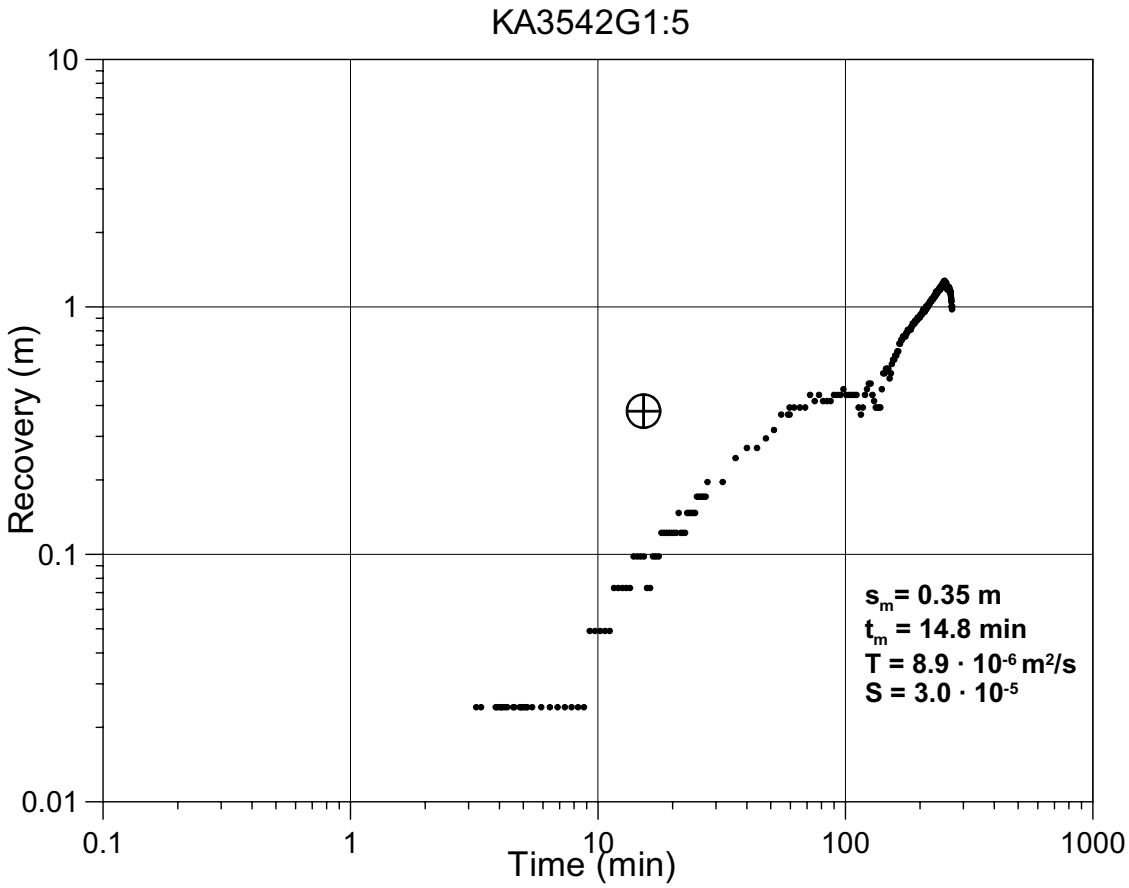


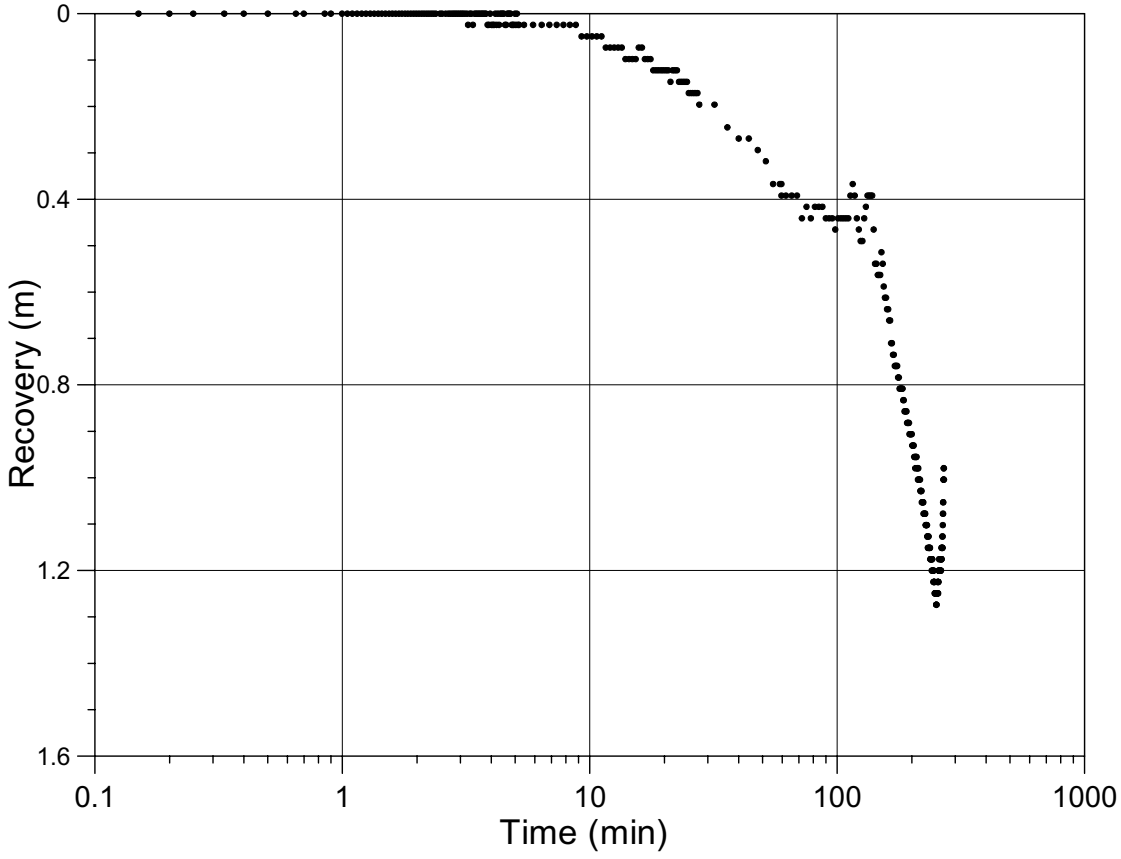
27_KA3542G1_3.GRF 2003-11-16



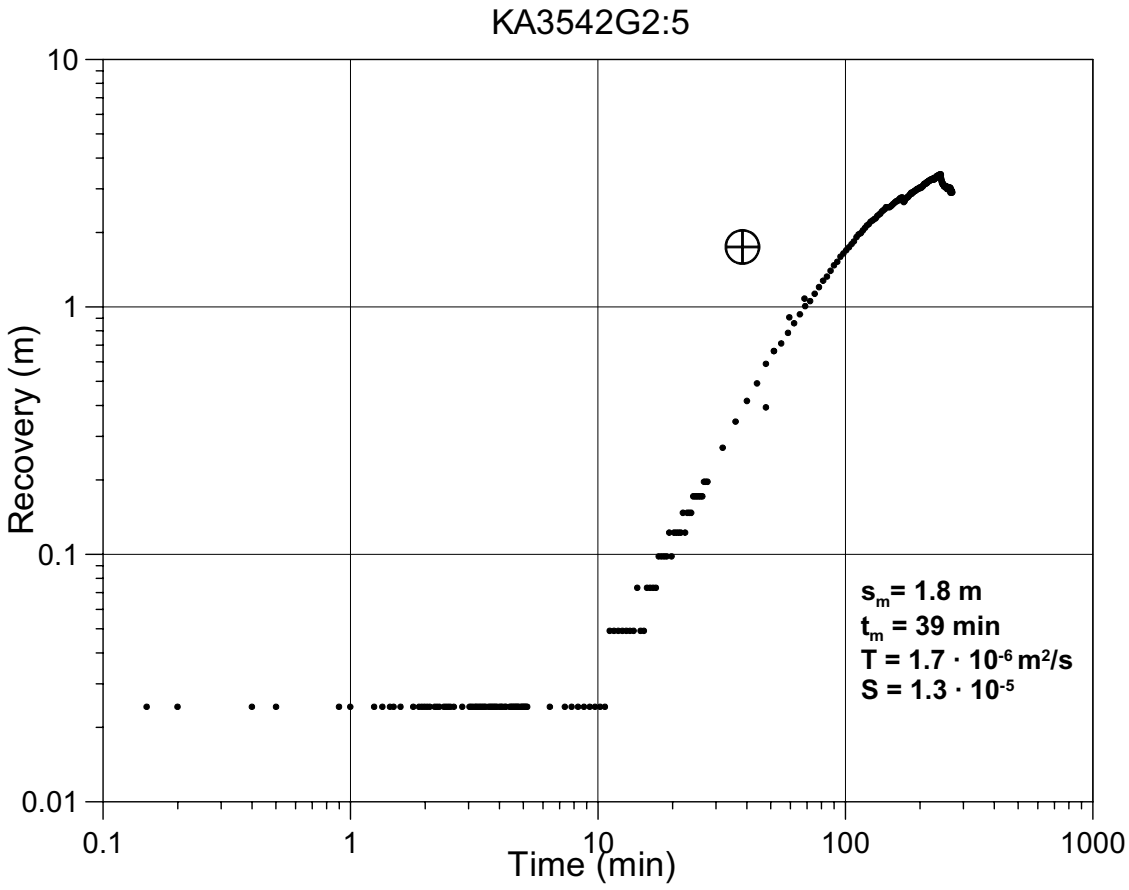


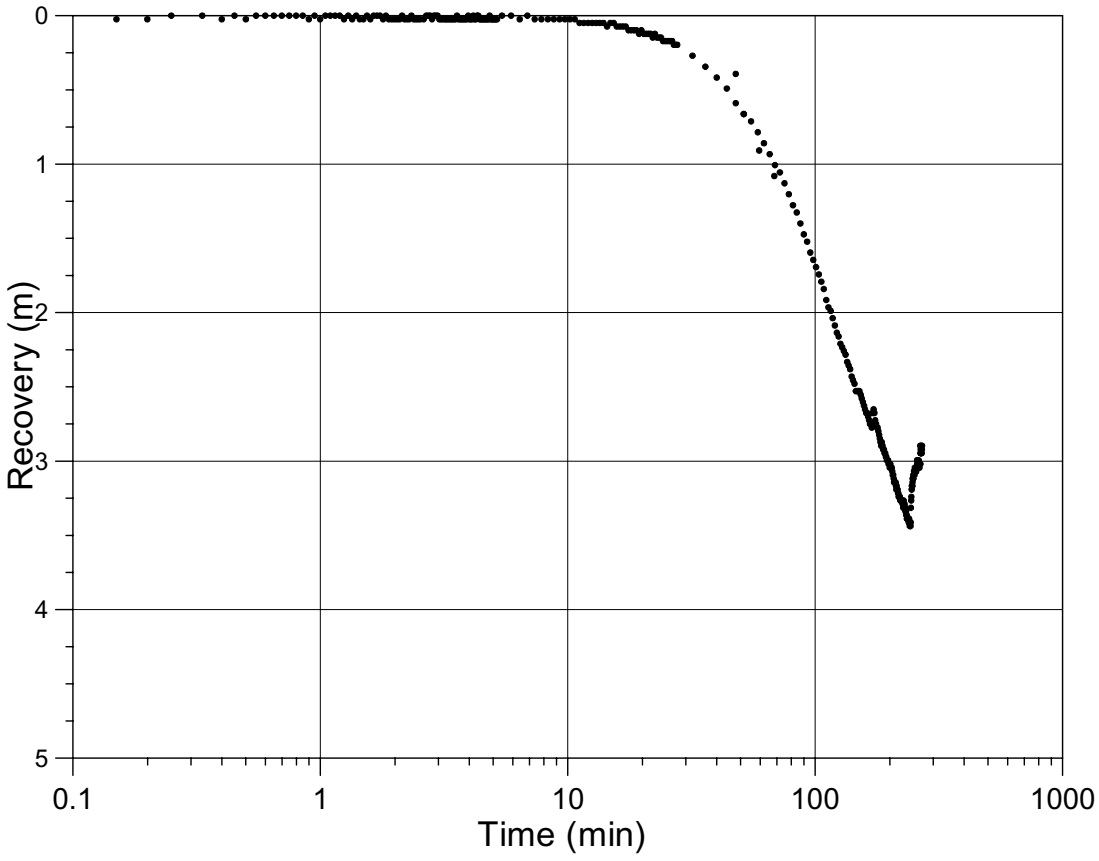
27_KA3542G1_4.GRF 2003-11-16



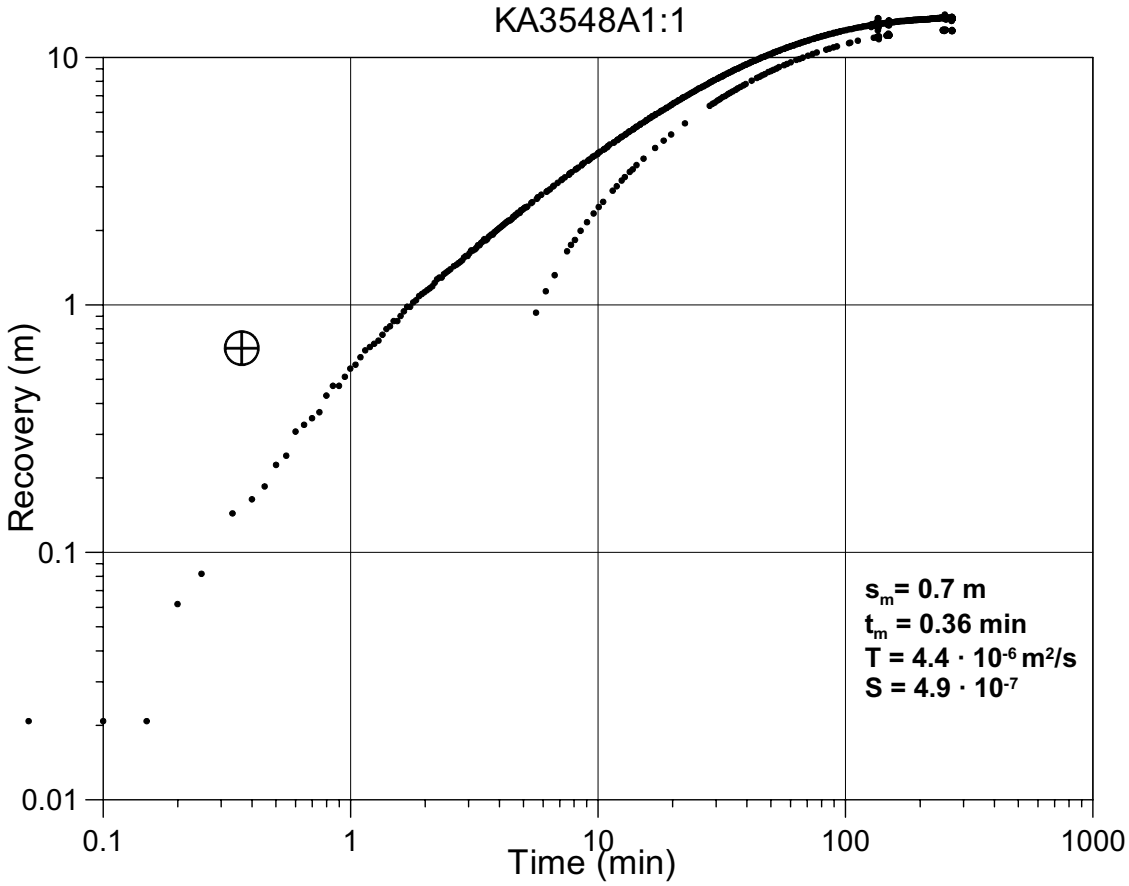


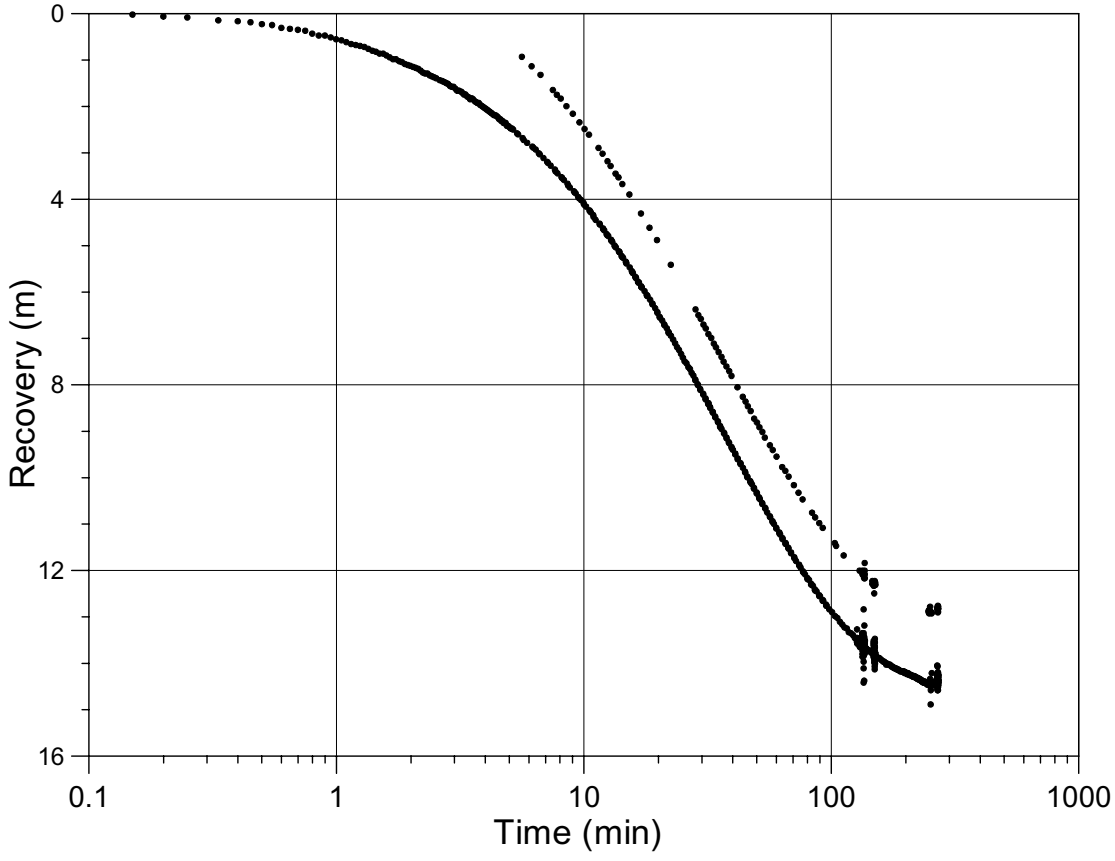
27_KA3542G1_5.GRF 2003-11-16



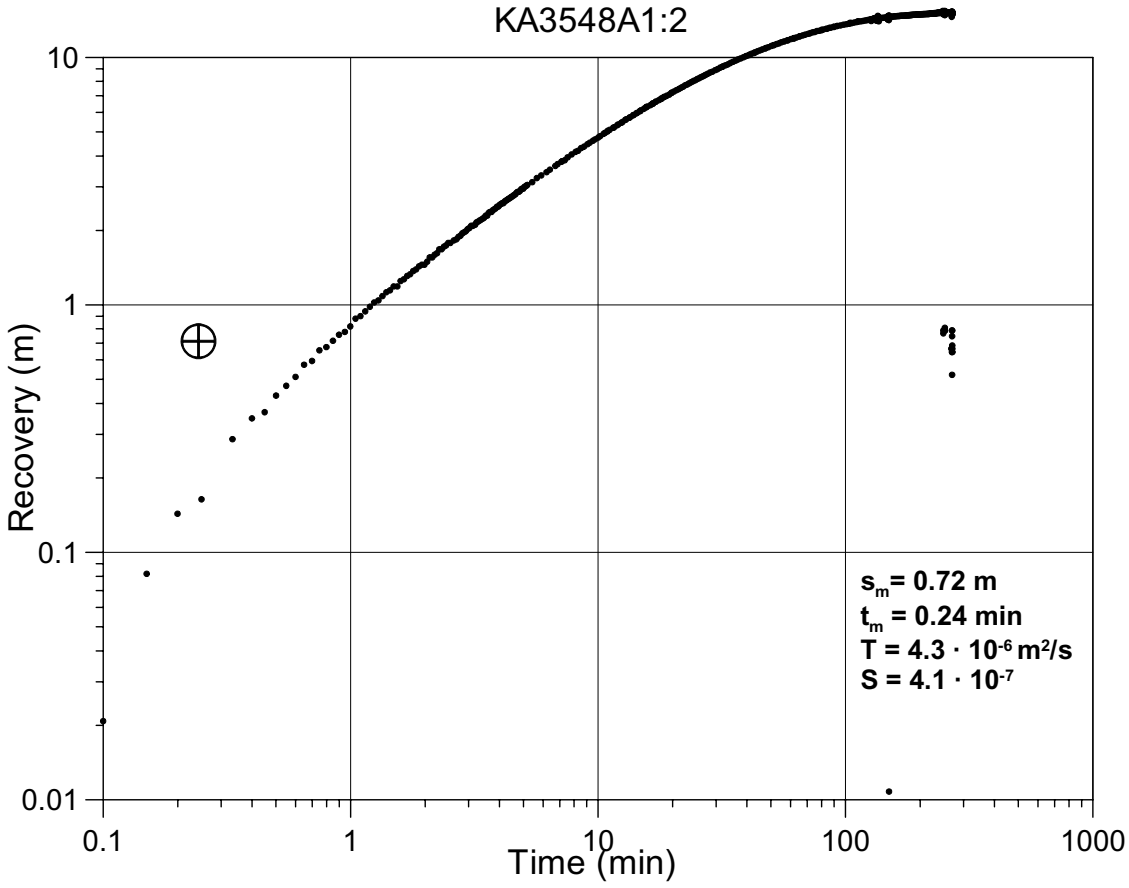


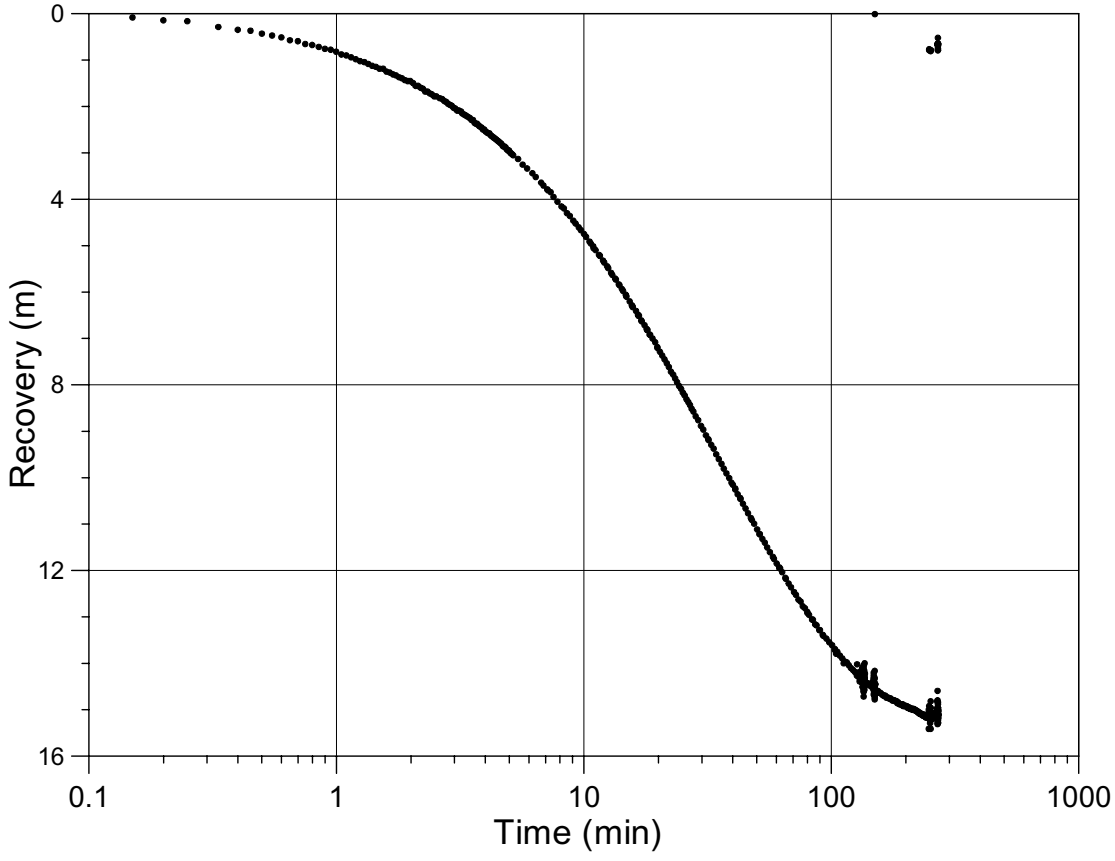
27_KA3542G2_5.GRF 2003-11-16



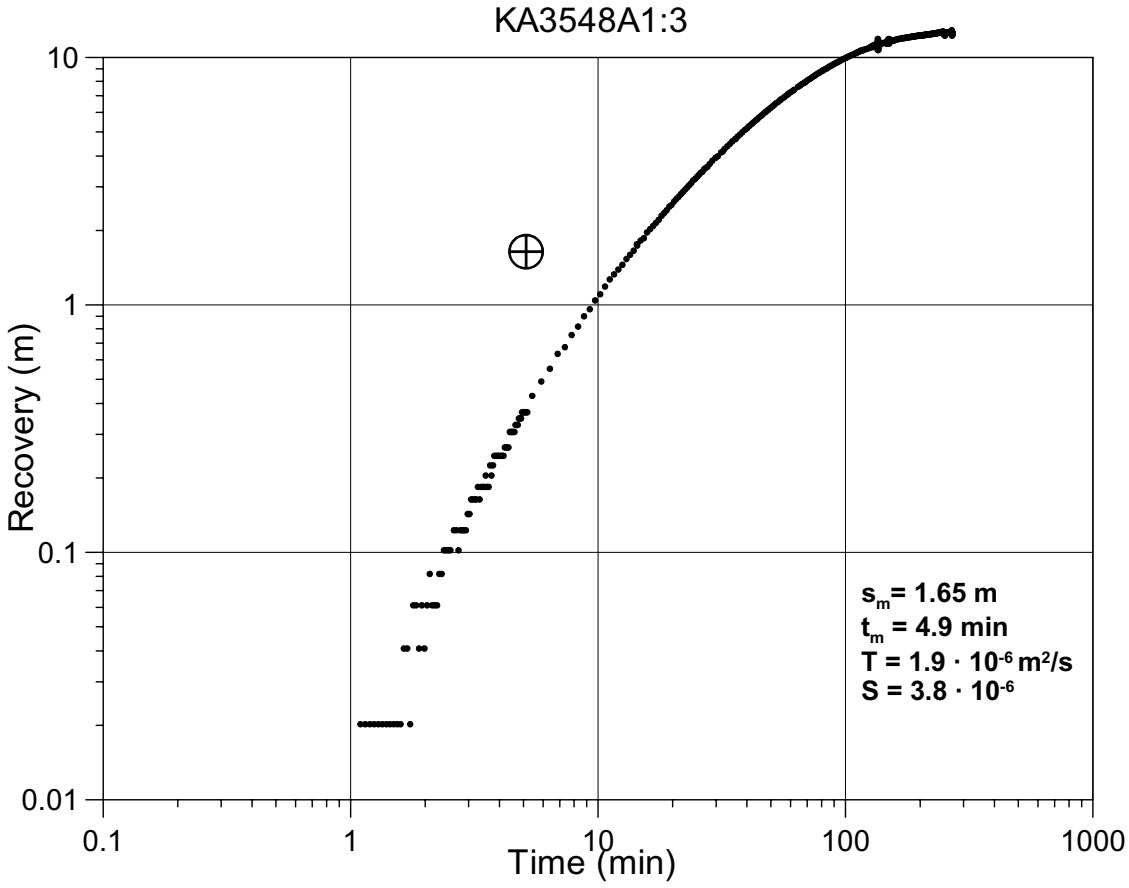


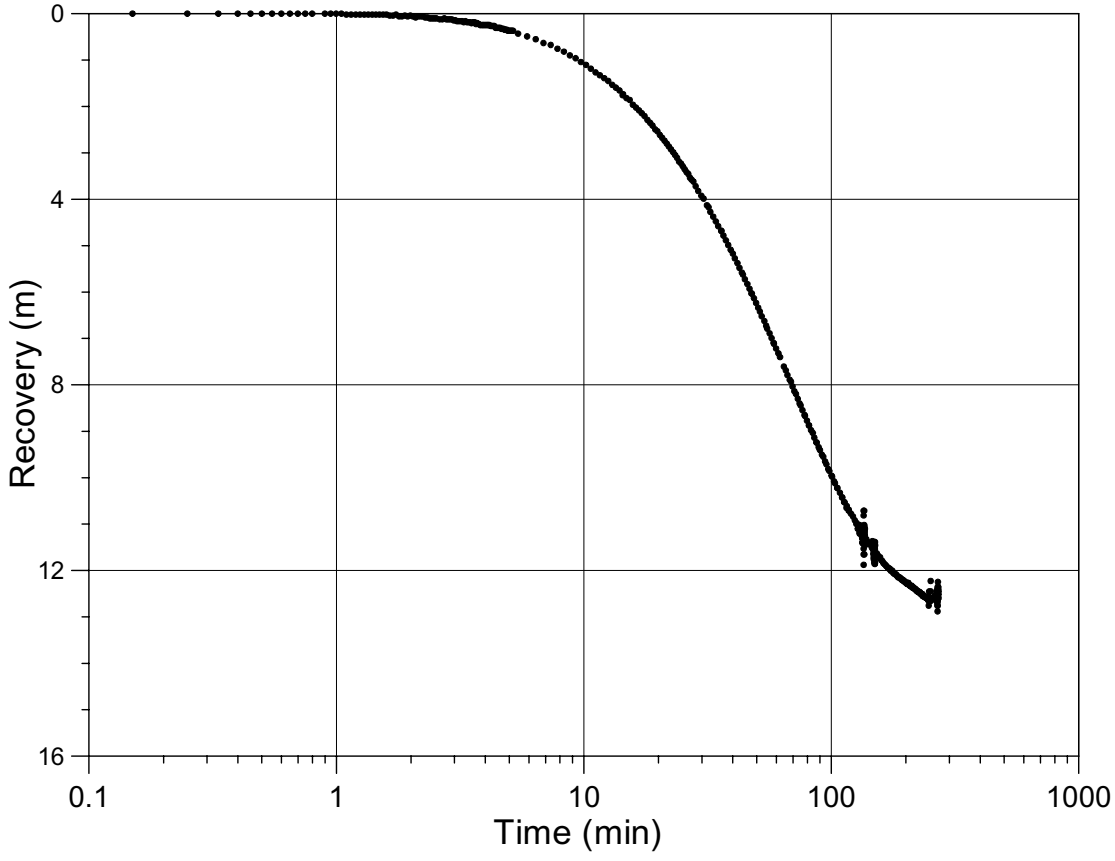
27_KA3548A1_1.GRF 2003-11-16



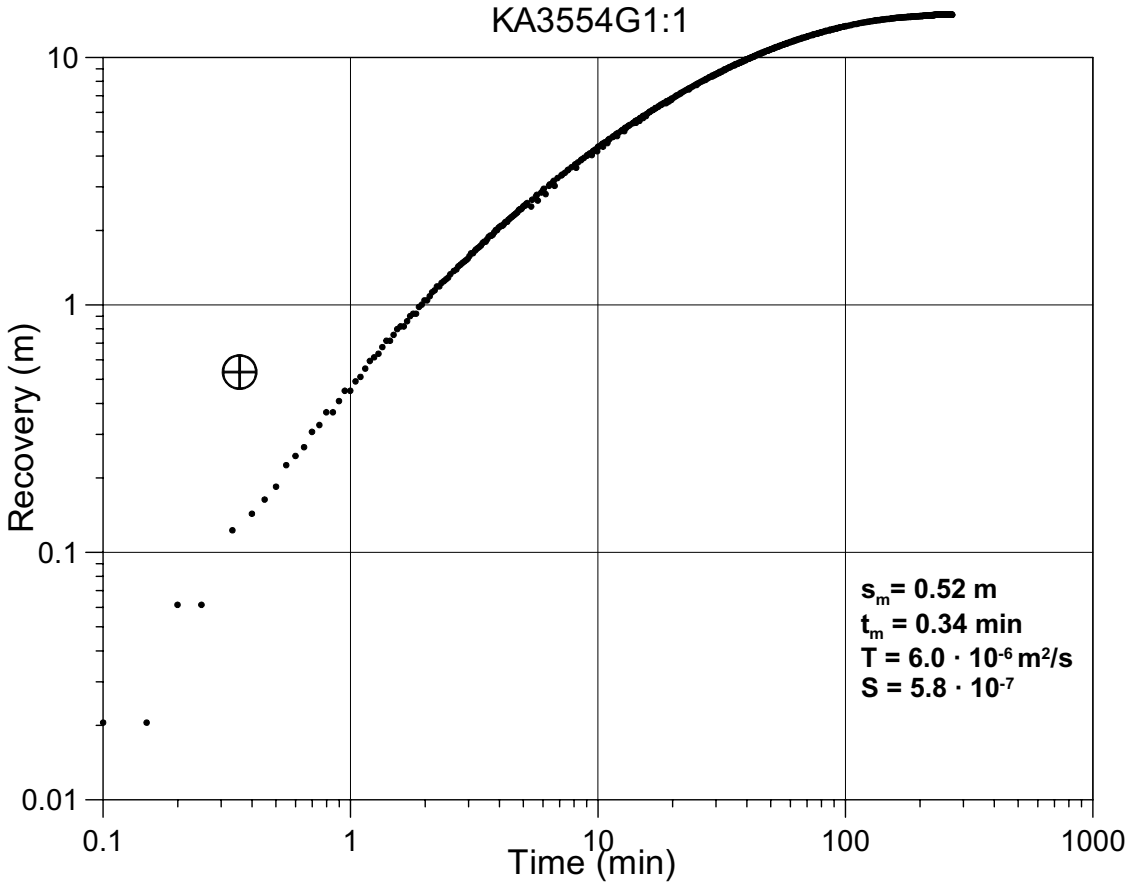


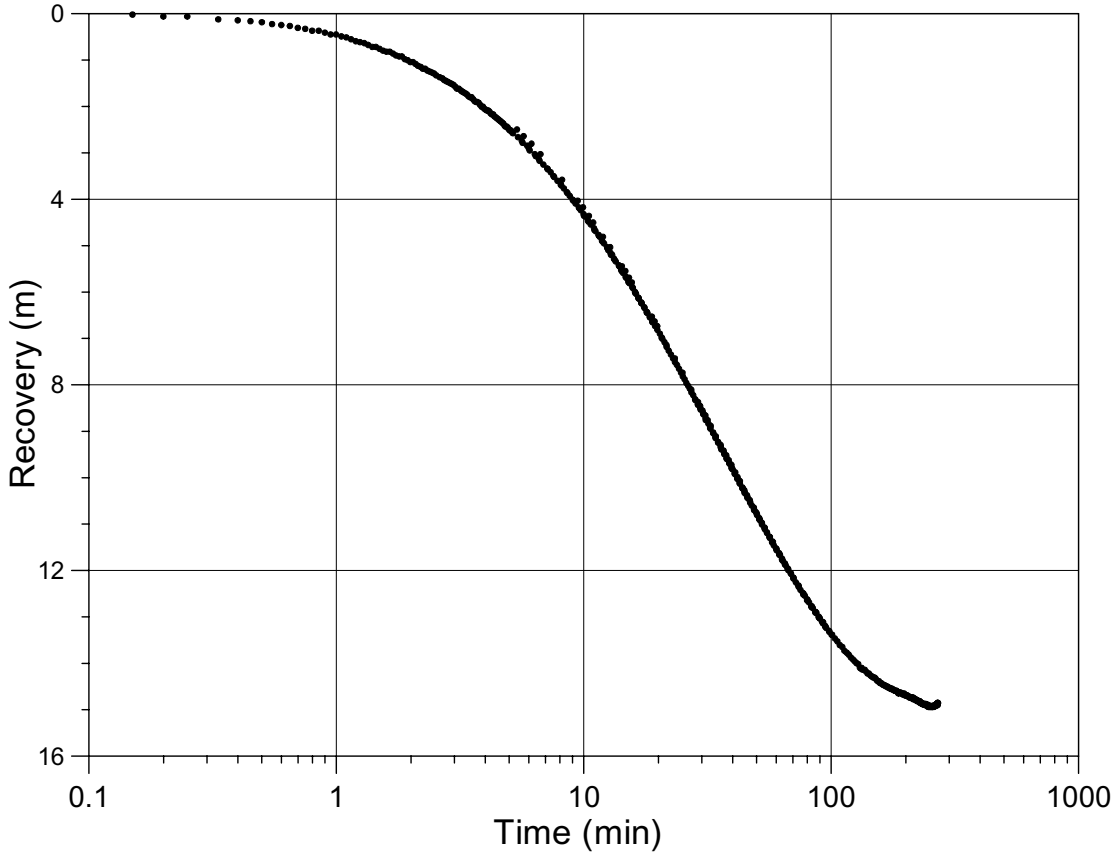
27_KA3548A1_2.GRF 2003-11-18



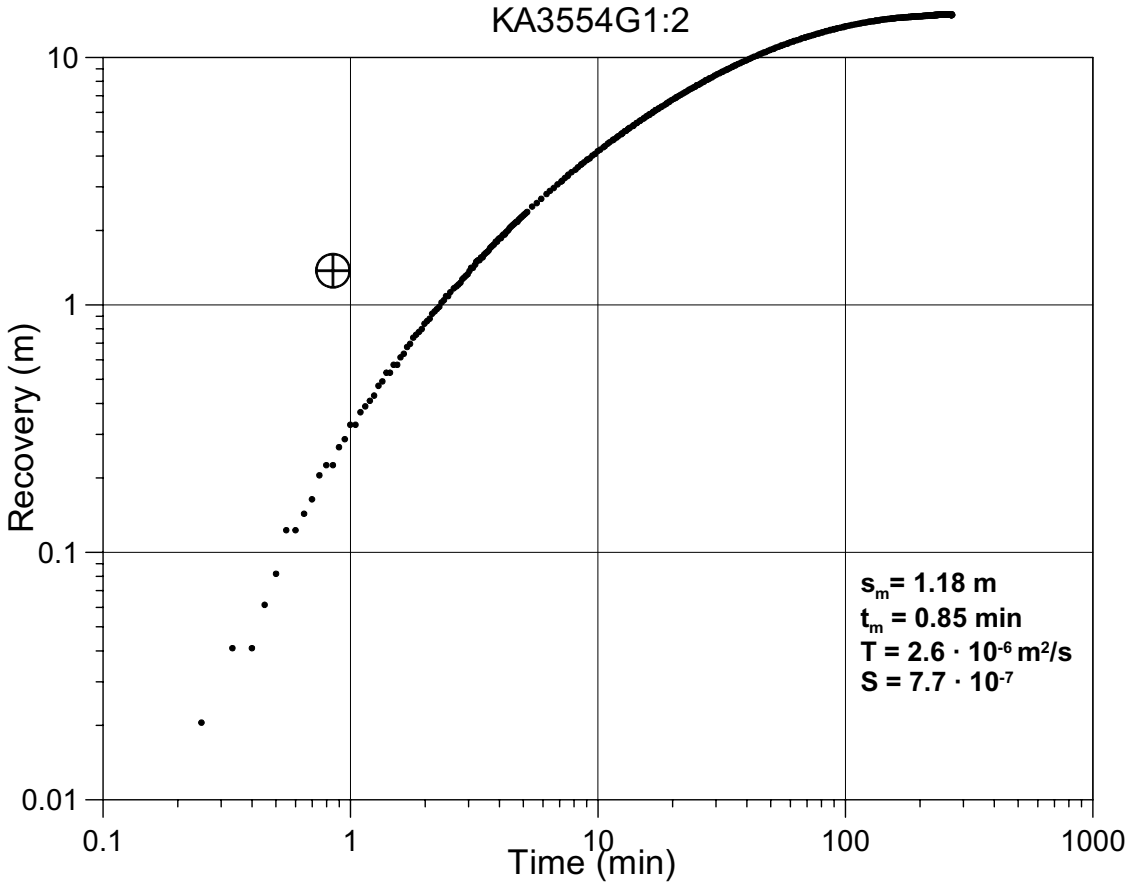


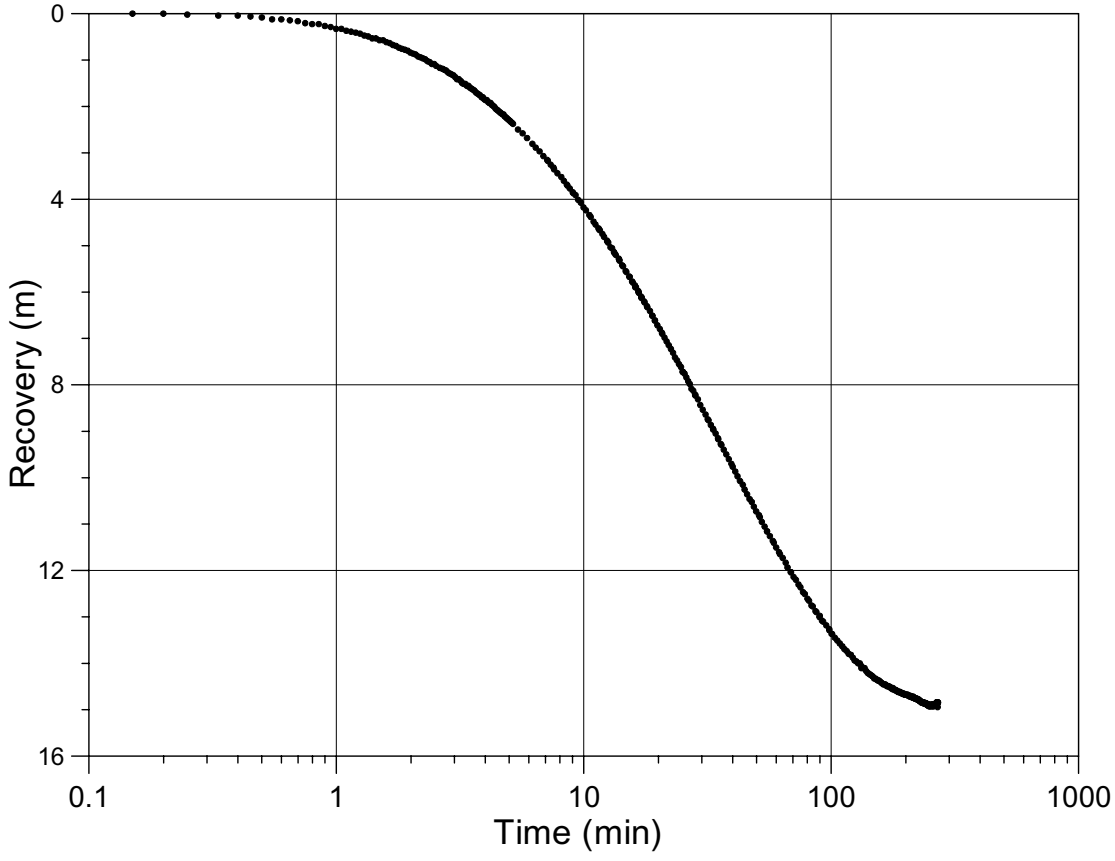
27_KA3548A1_3.GRF 2003-11-18





27_KA3554G1_1.GRF 2003-11-18





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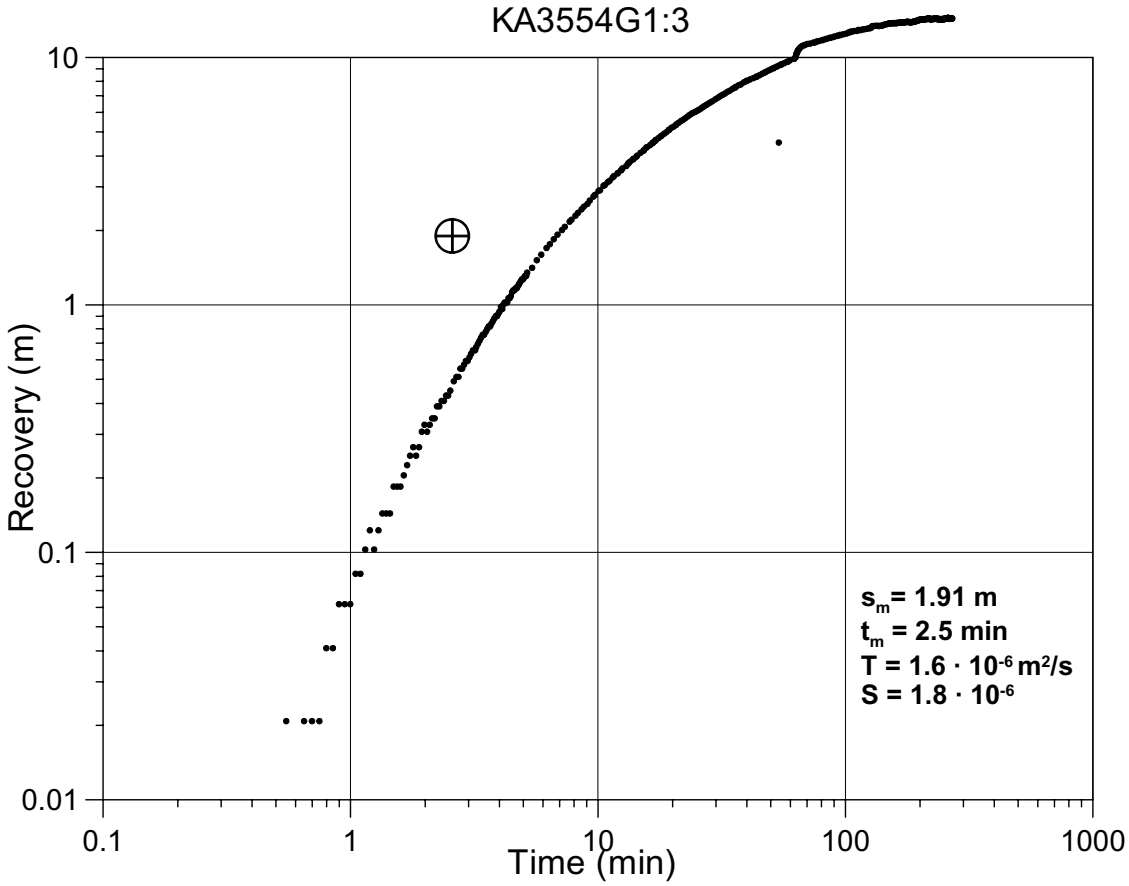

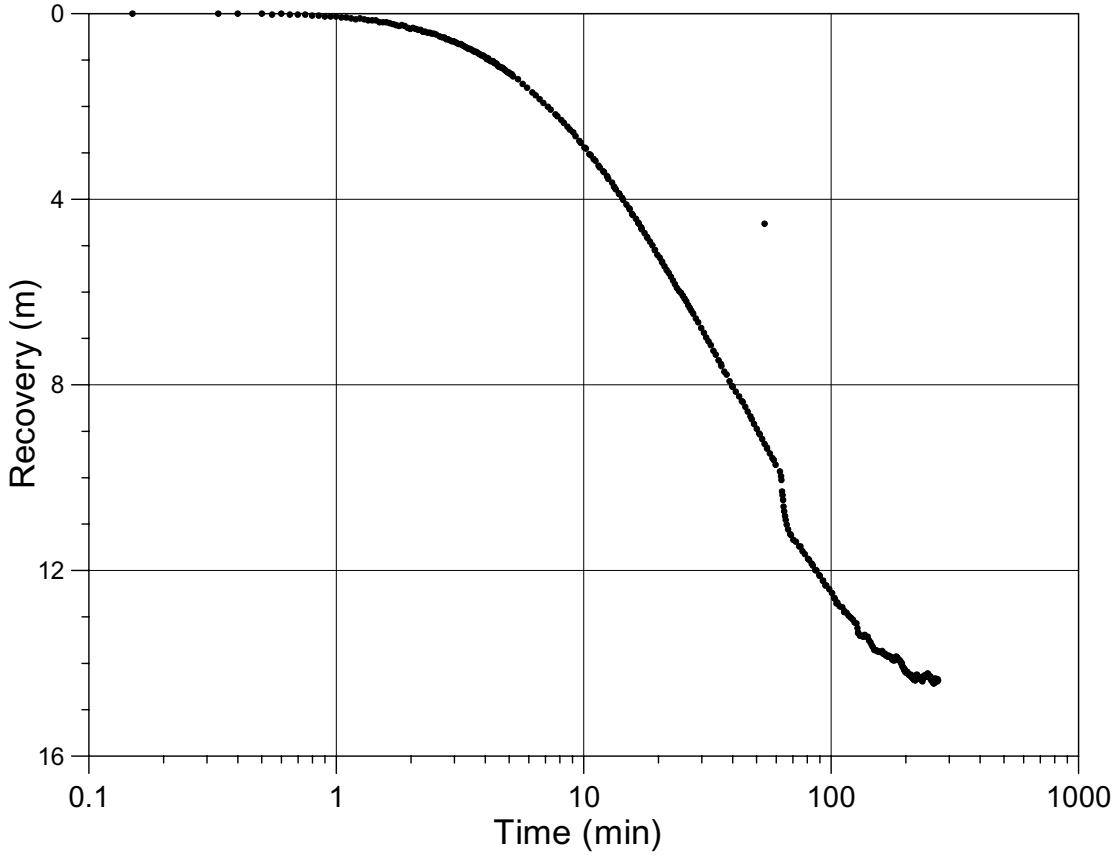

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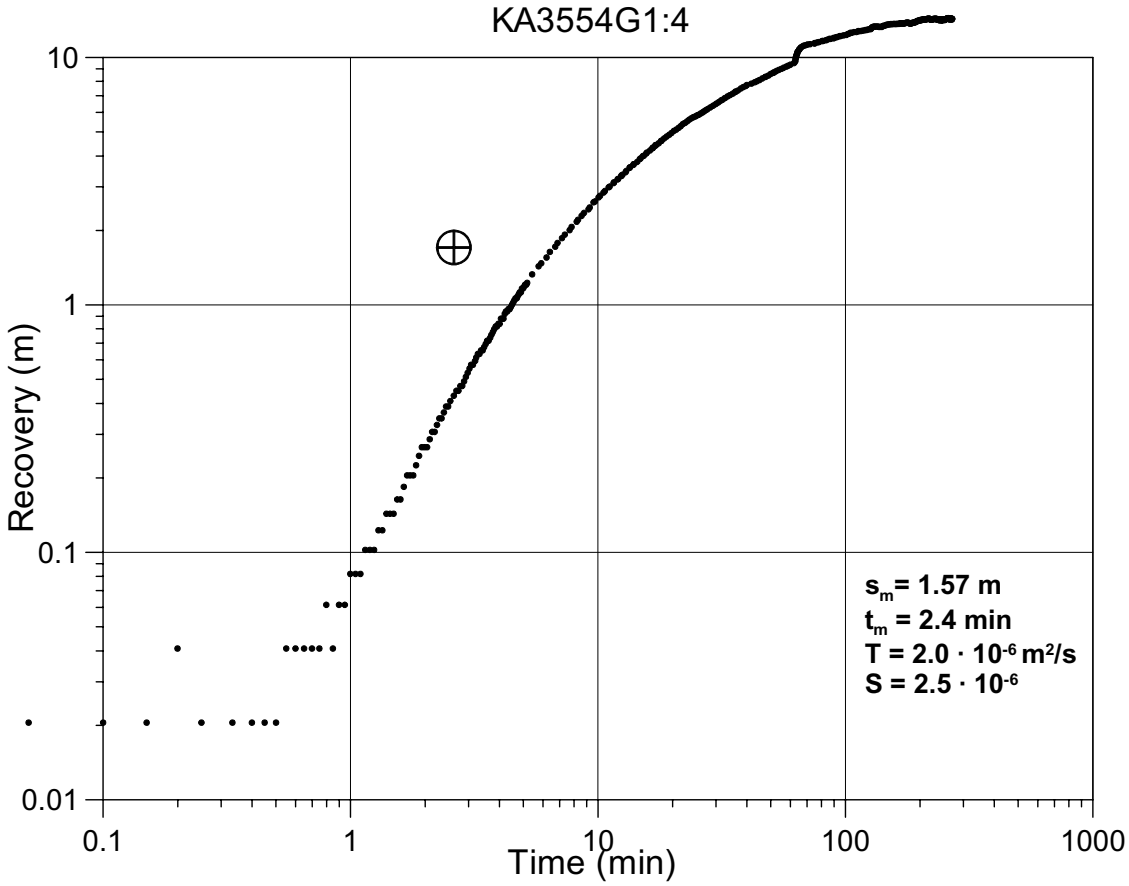
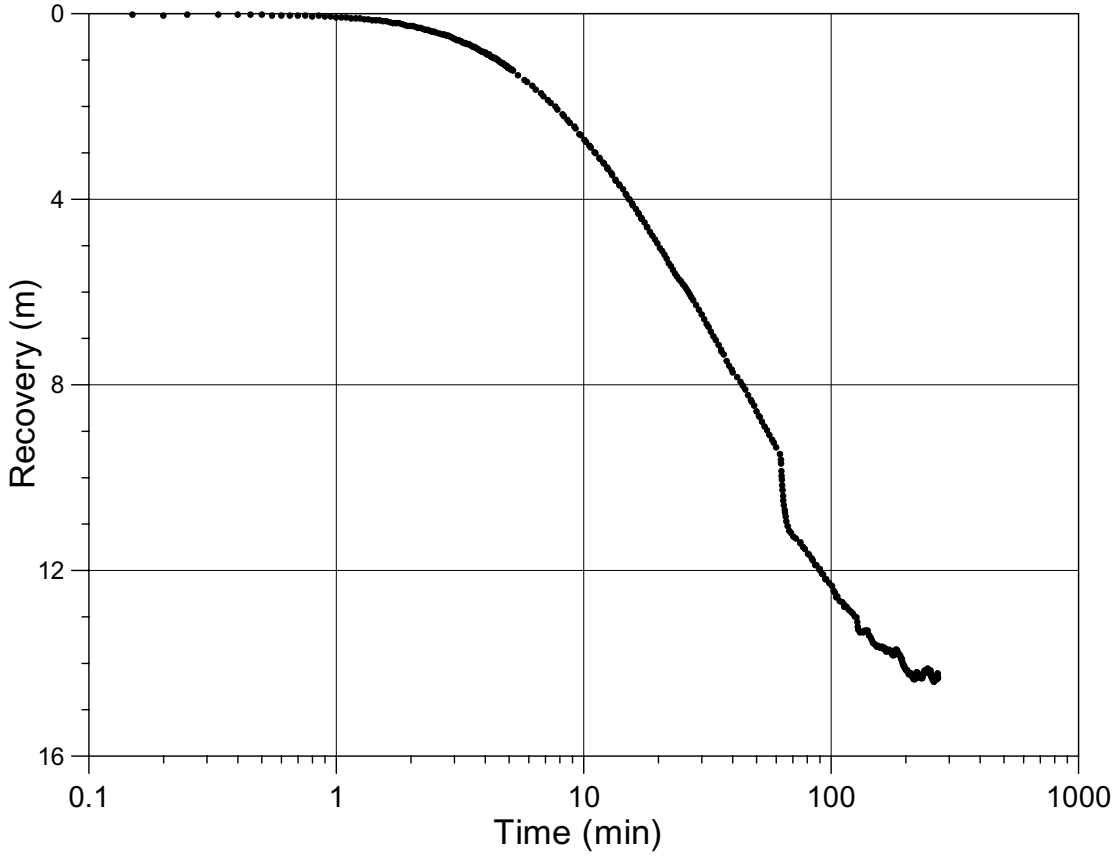
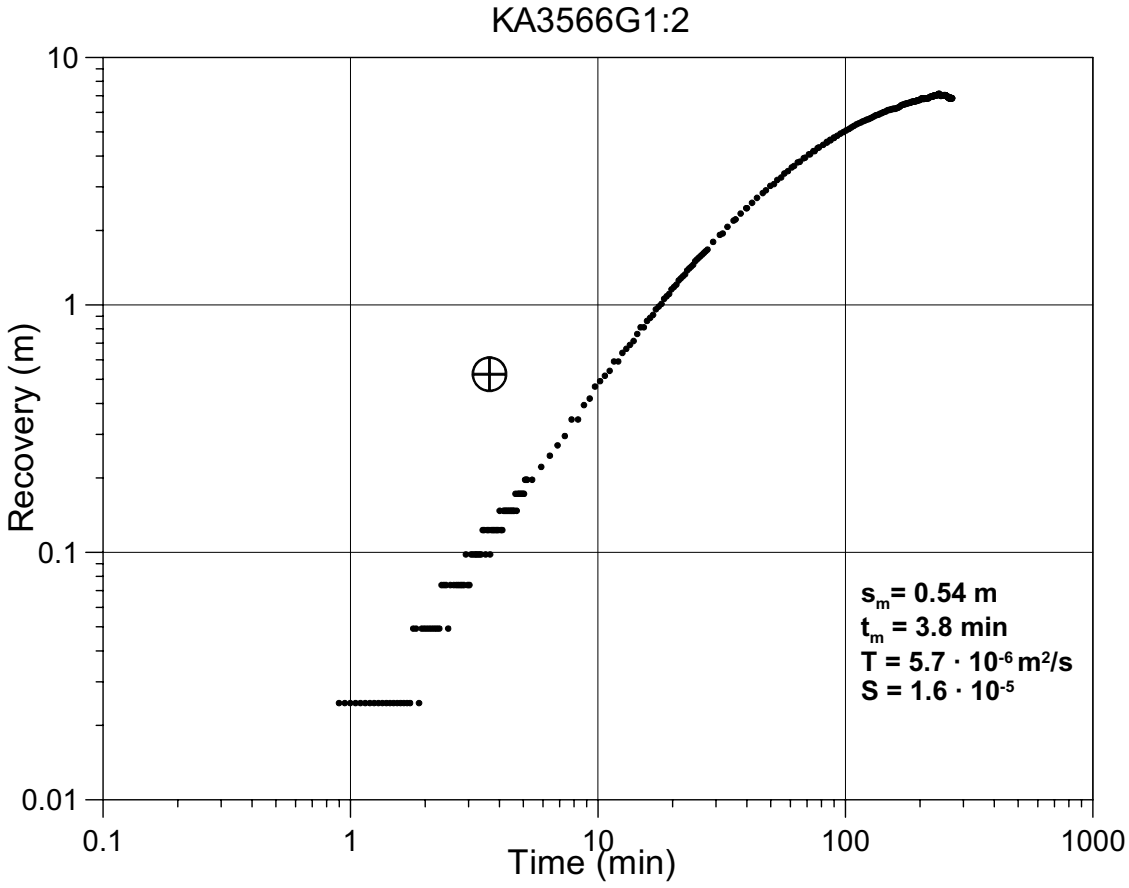
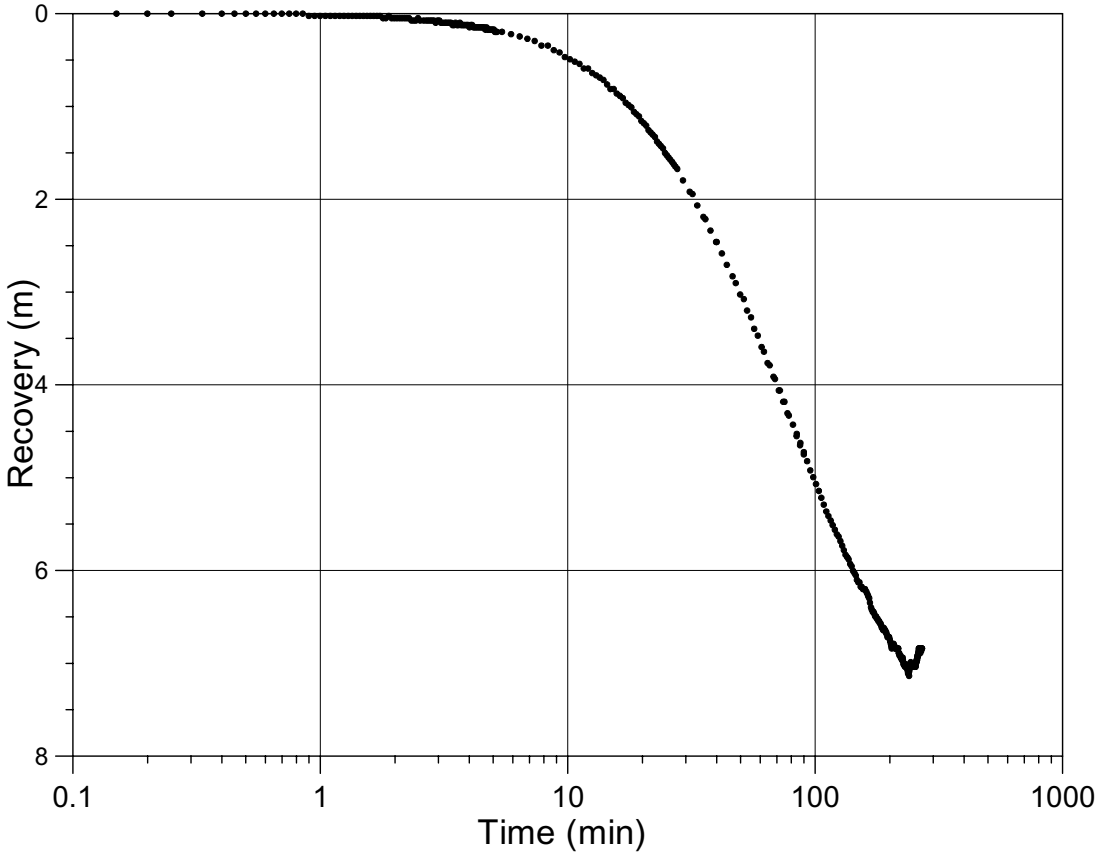


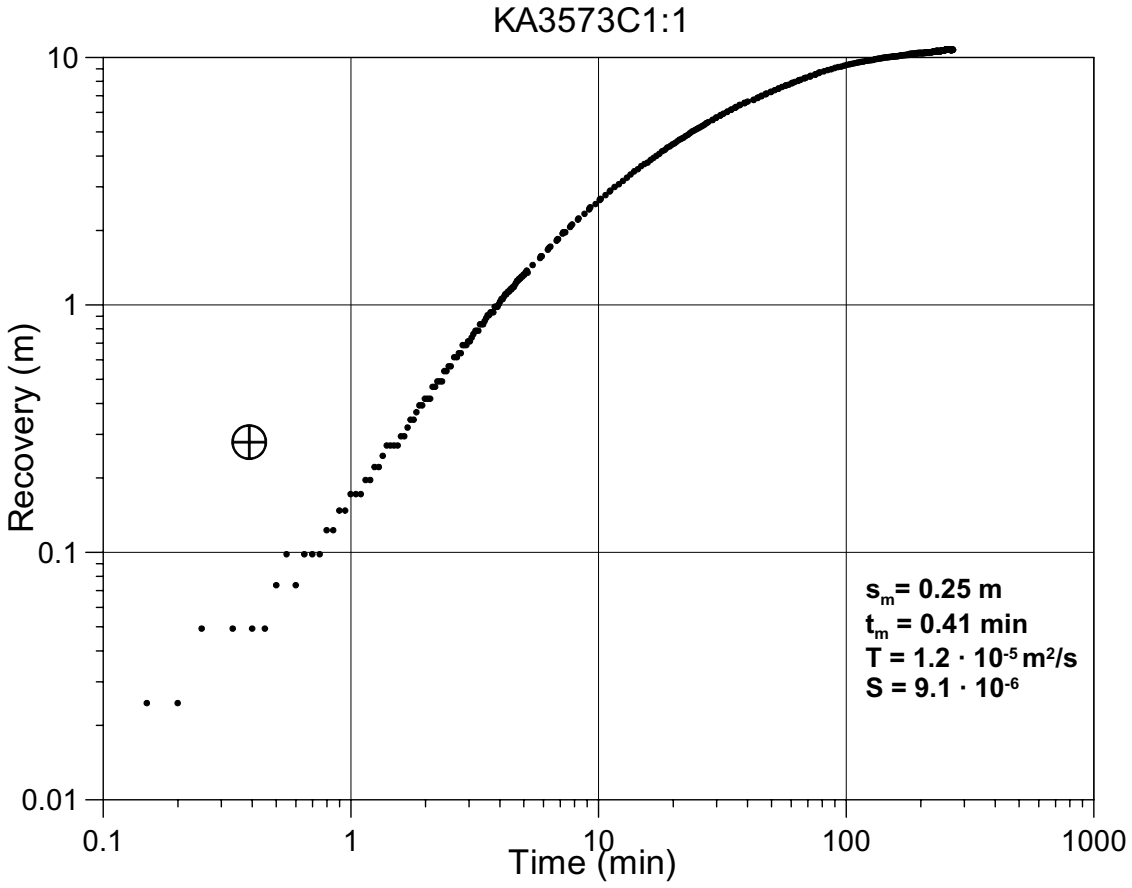


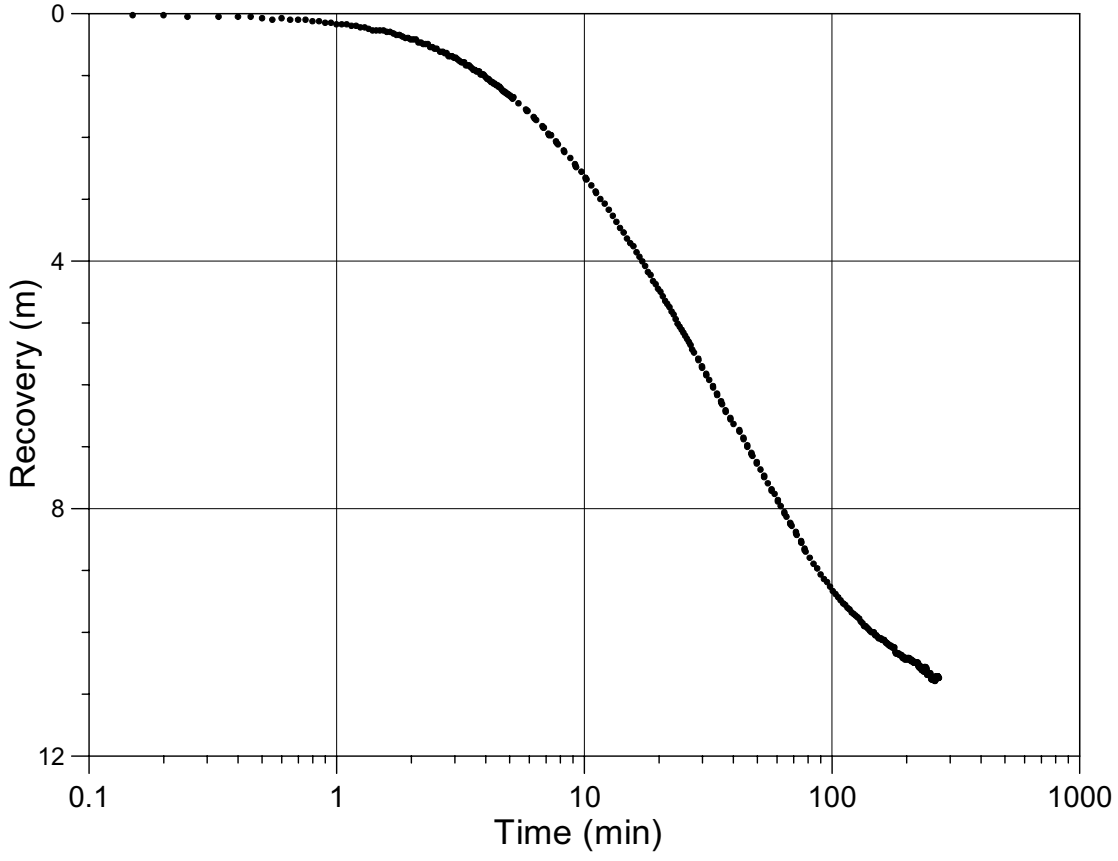
27_KA3554G1_4.GRF 2003-11-18



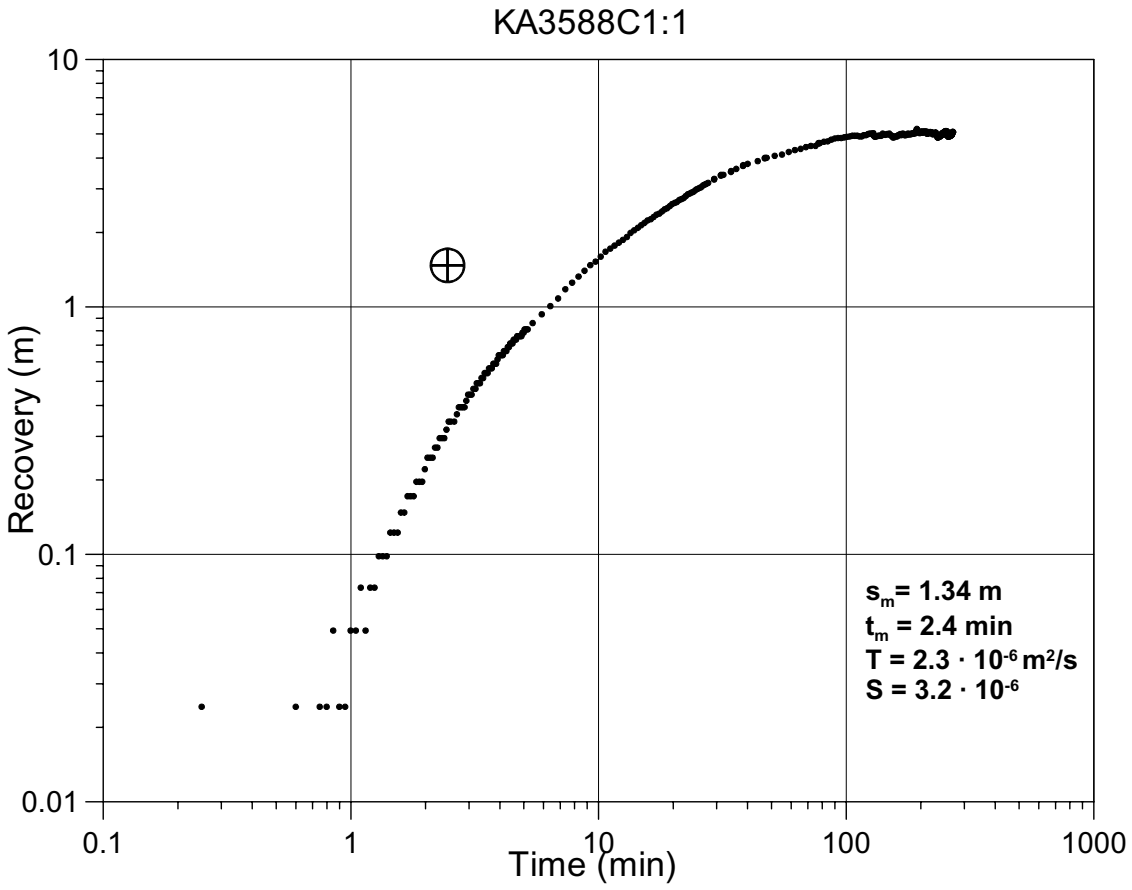


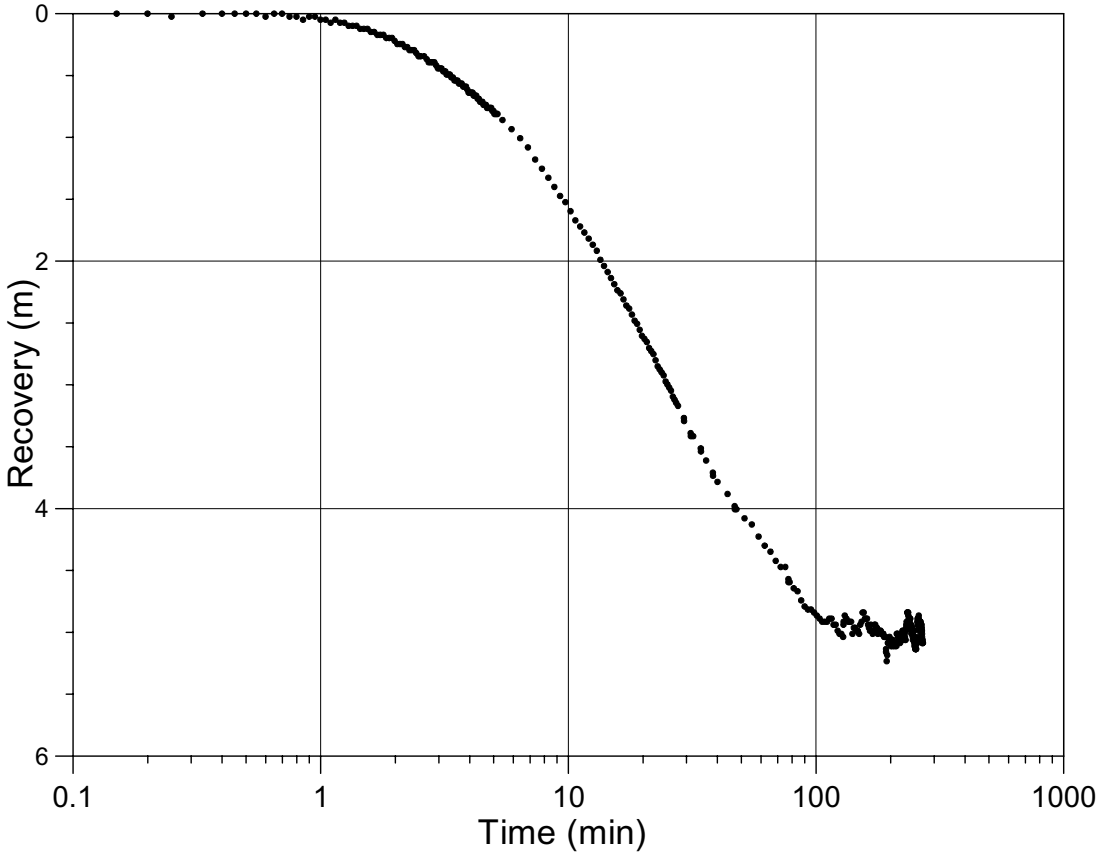
27_KA3566G1_2.GRF 2003-11-19



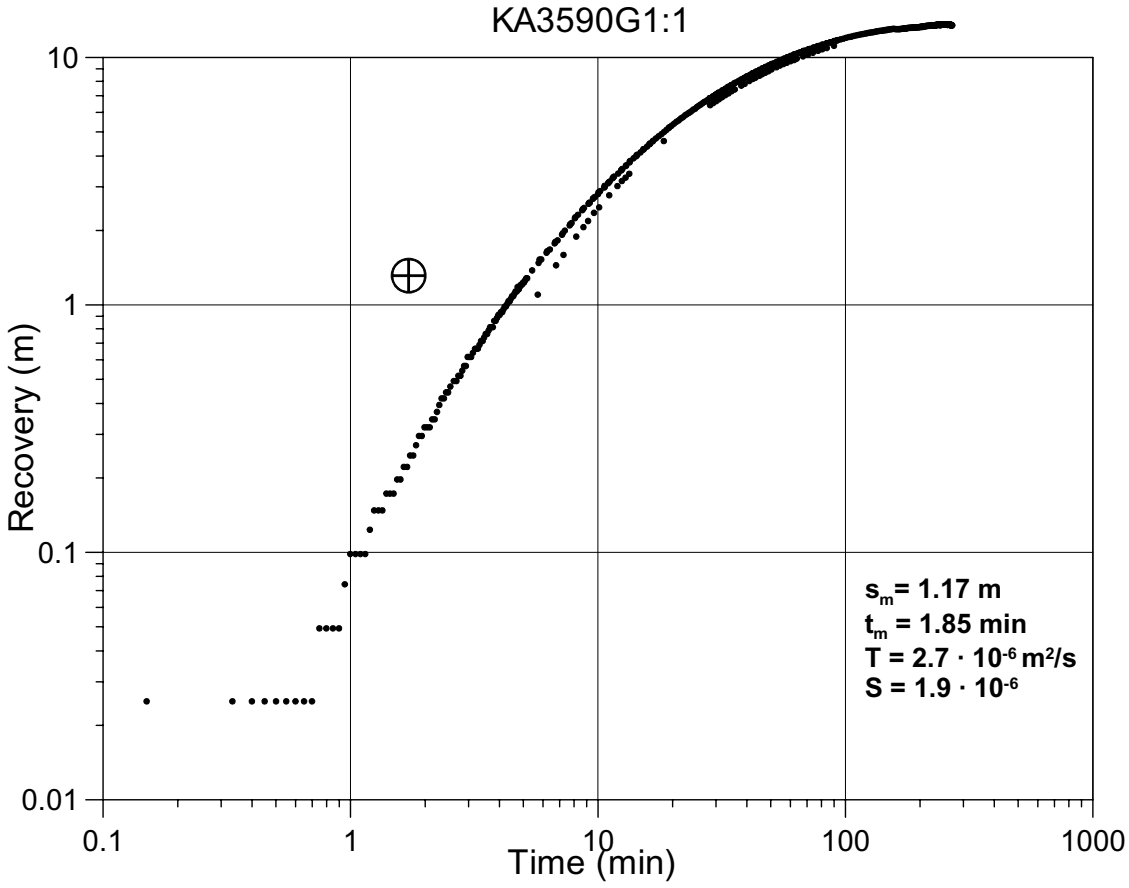


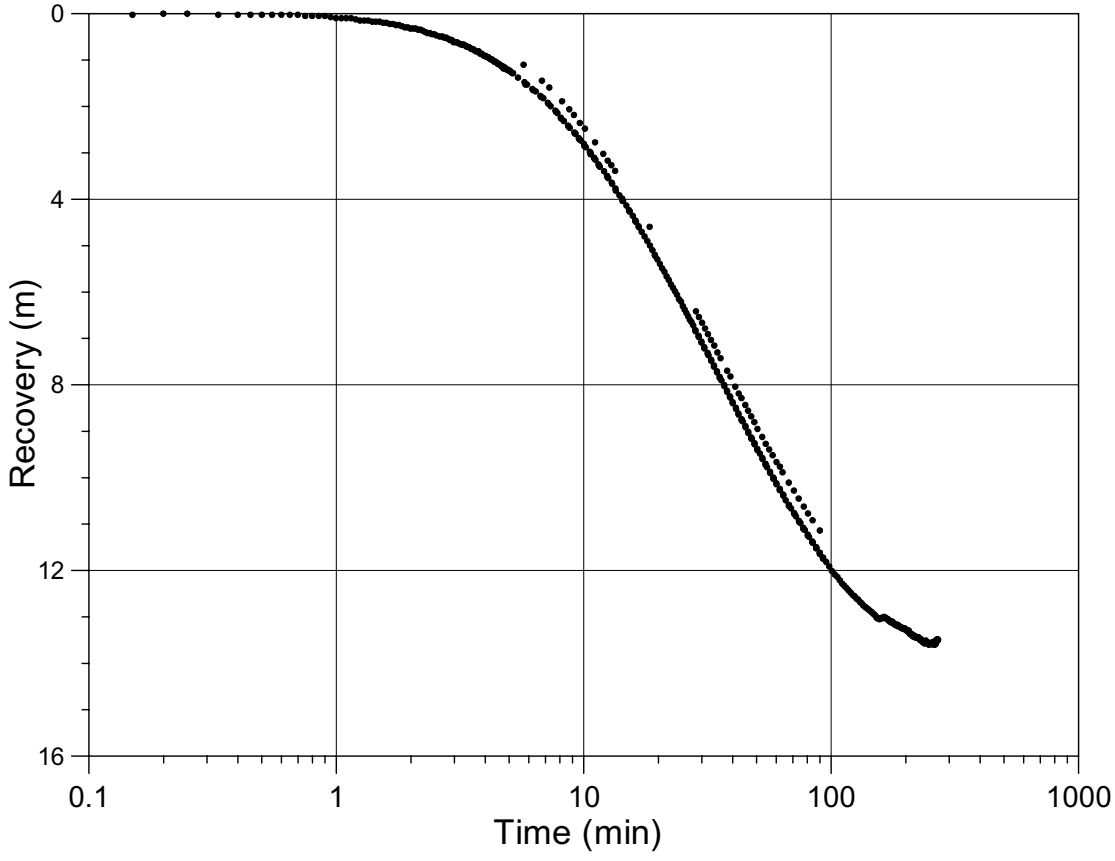
27_KA3573C1_1.GRF 2003-11-19



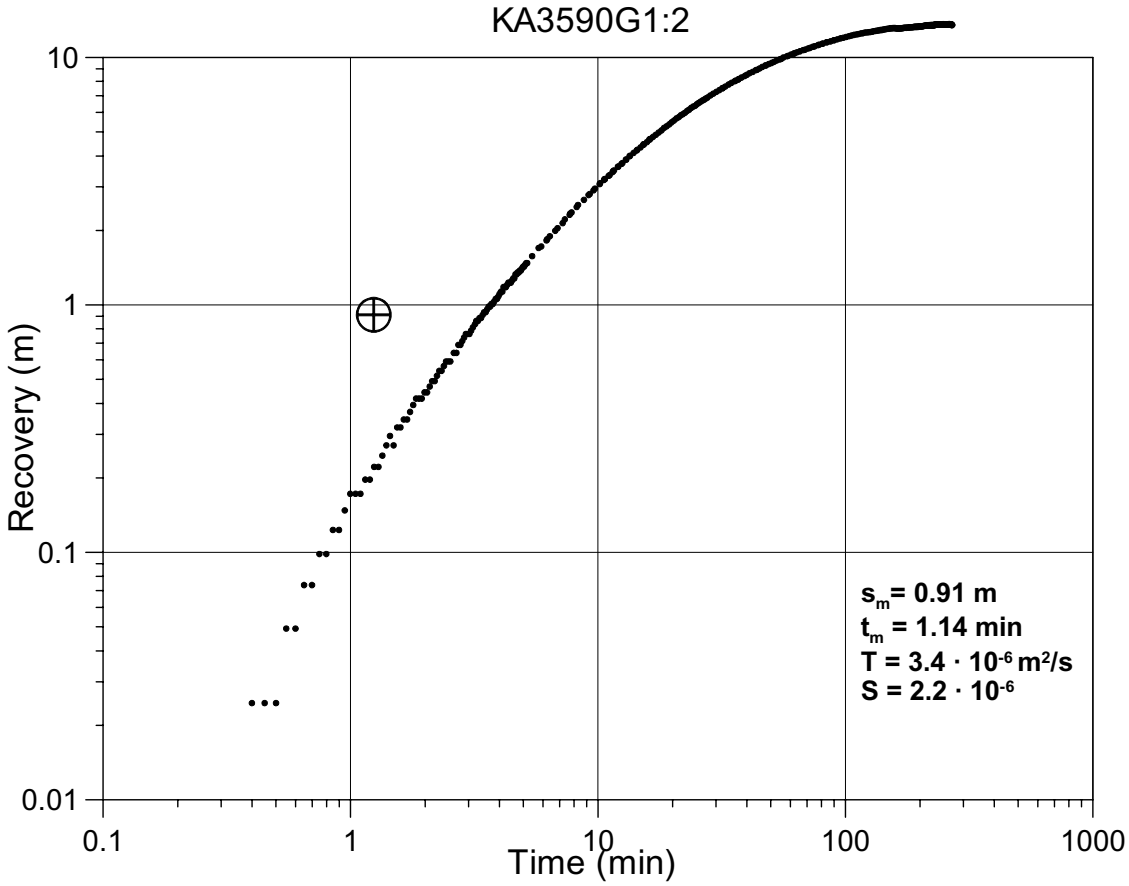


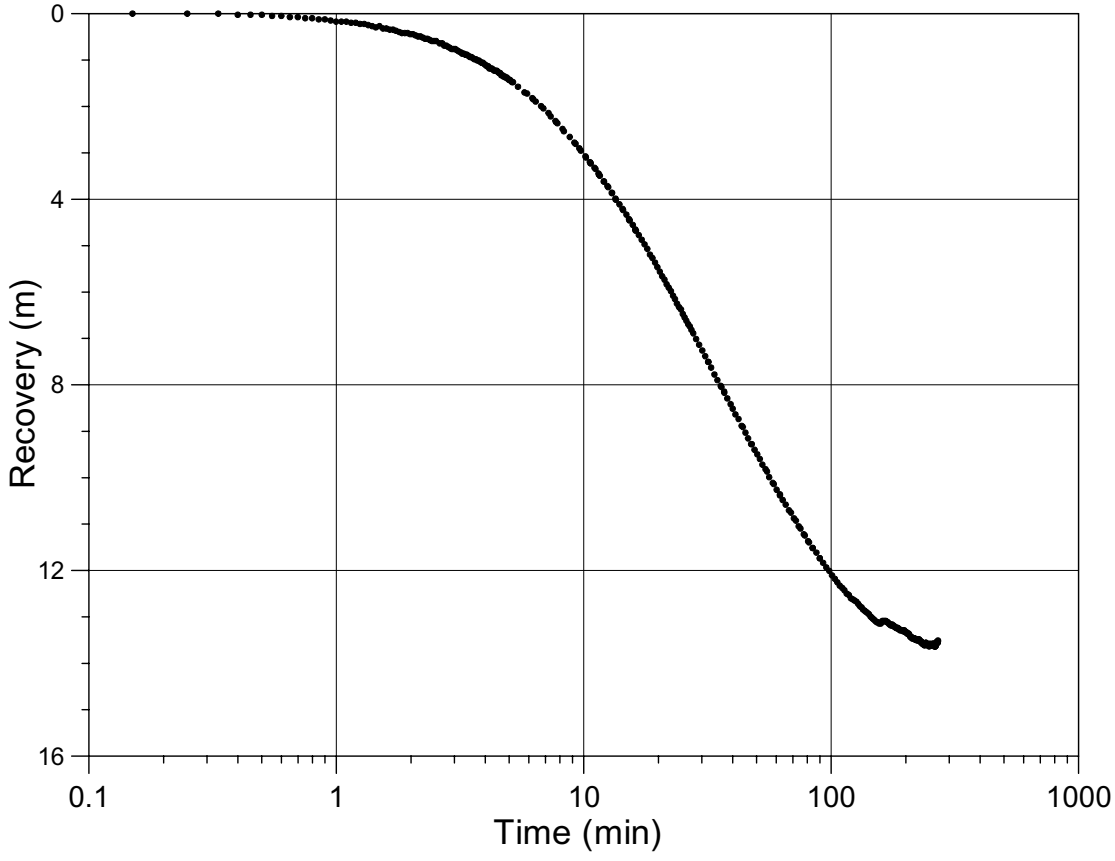
27_KA3588C1_1.GRF 2003-11-19





27_KA3590G1_1.GRF 2003-11-19





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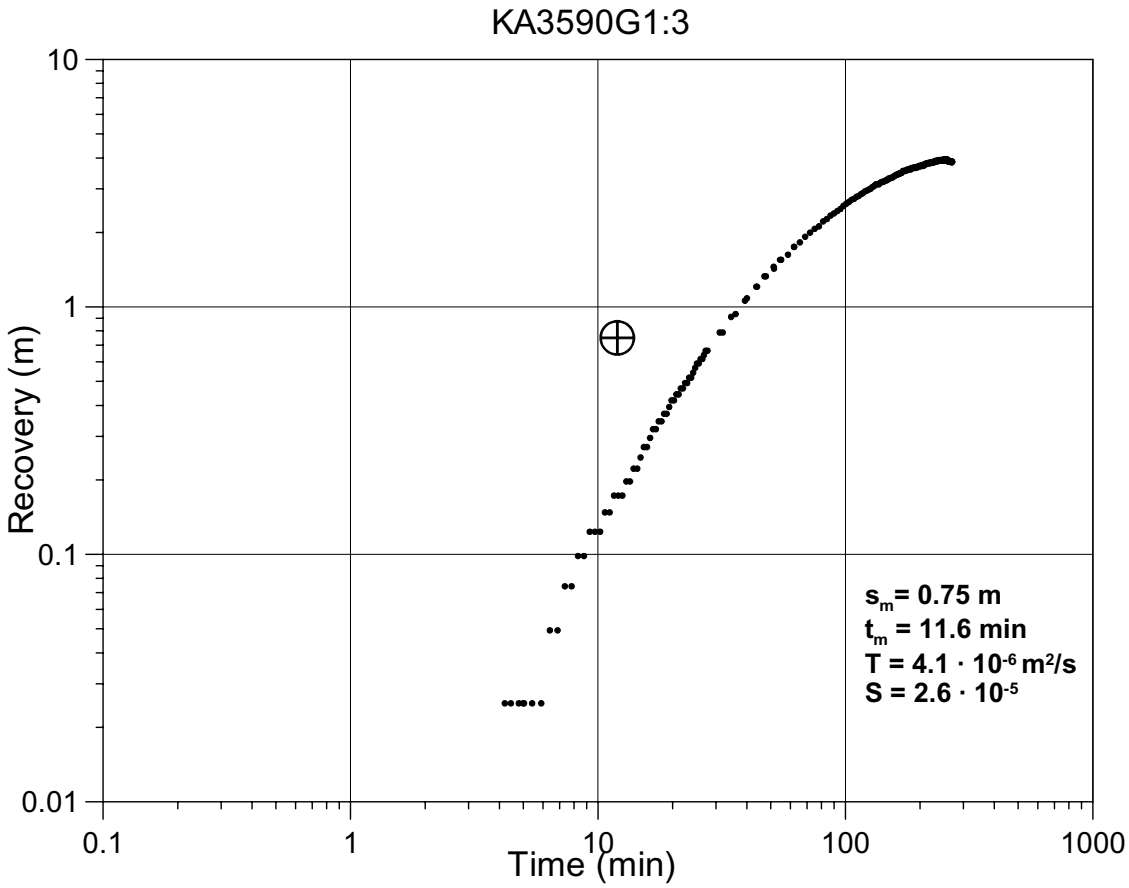

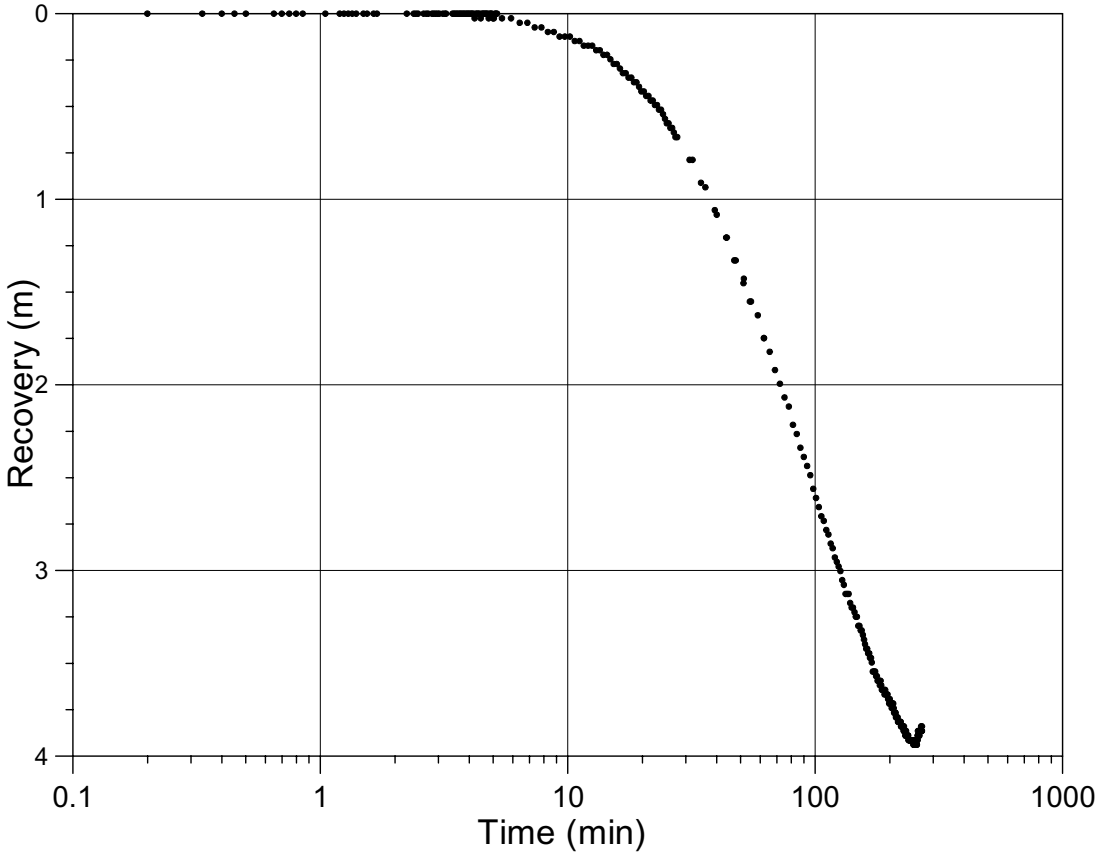

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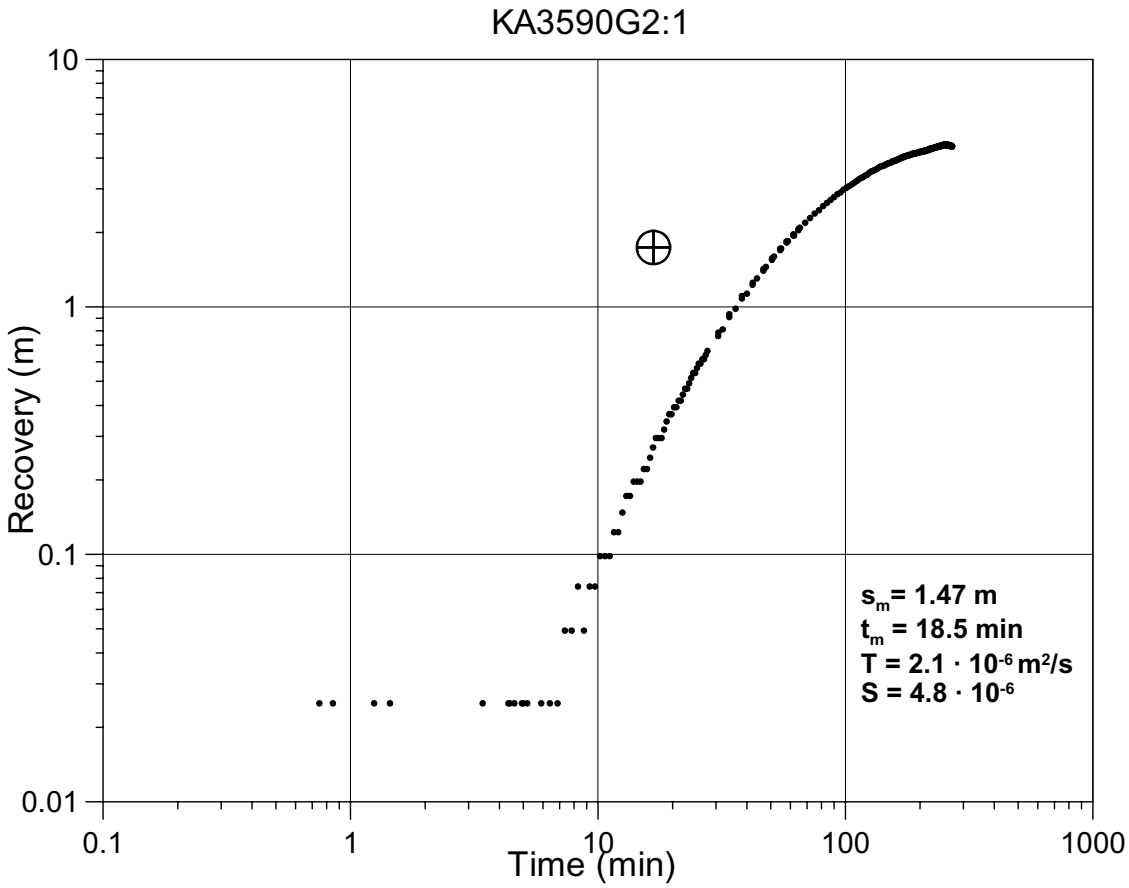

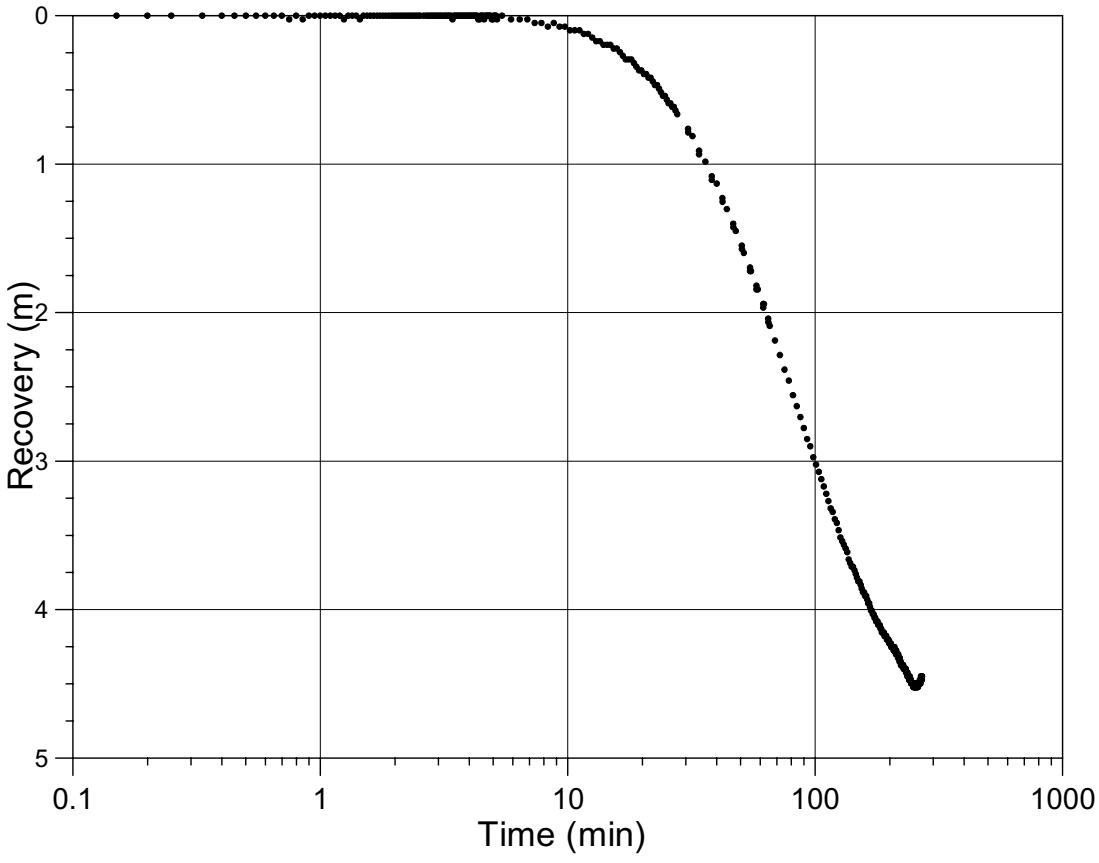

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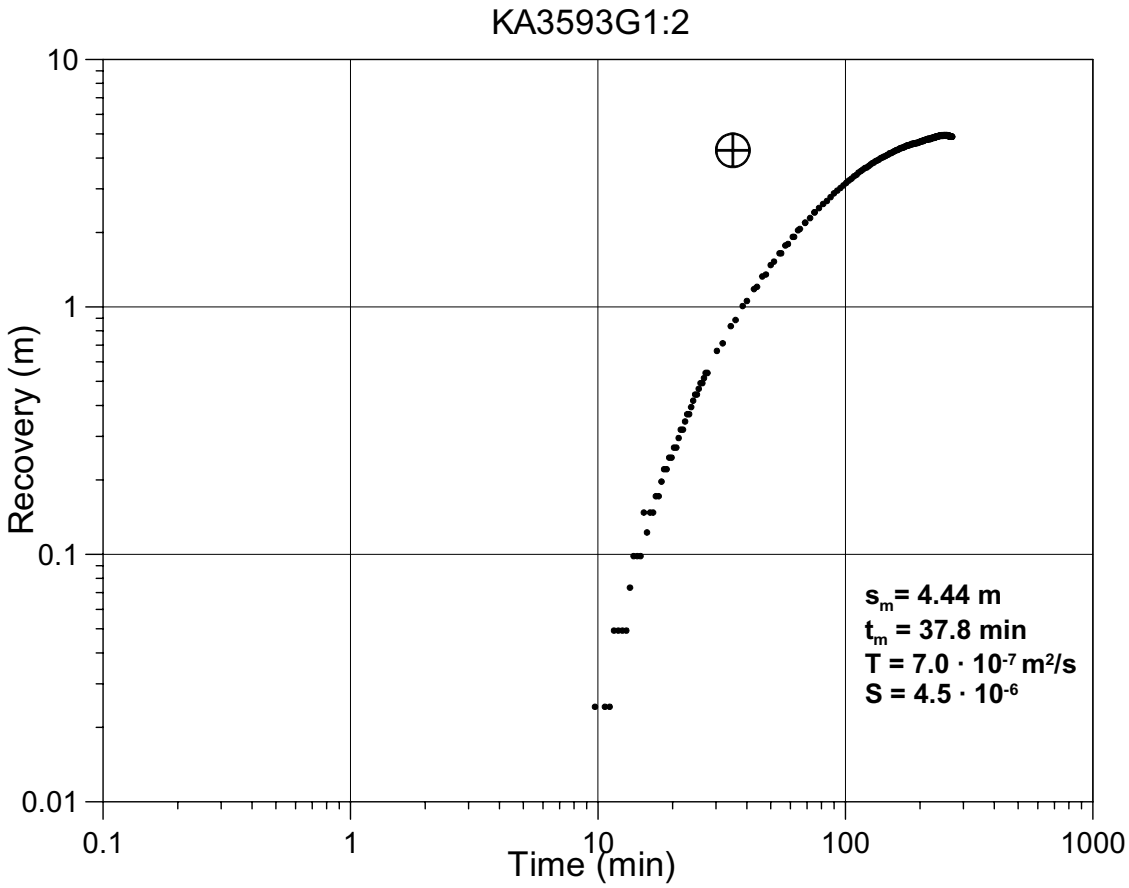

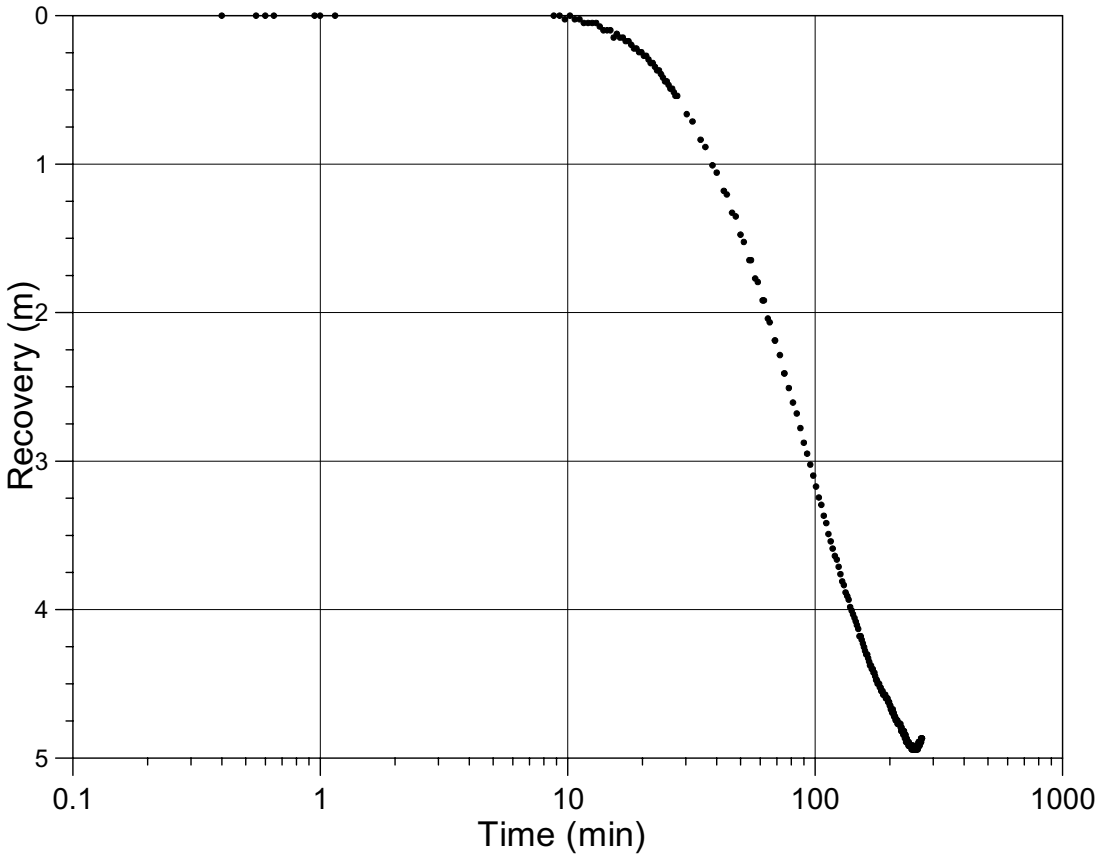

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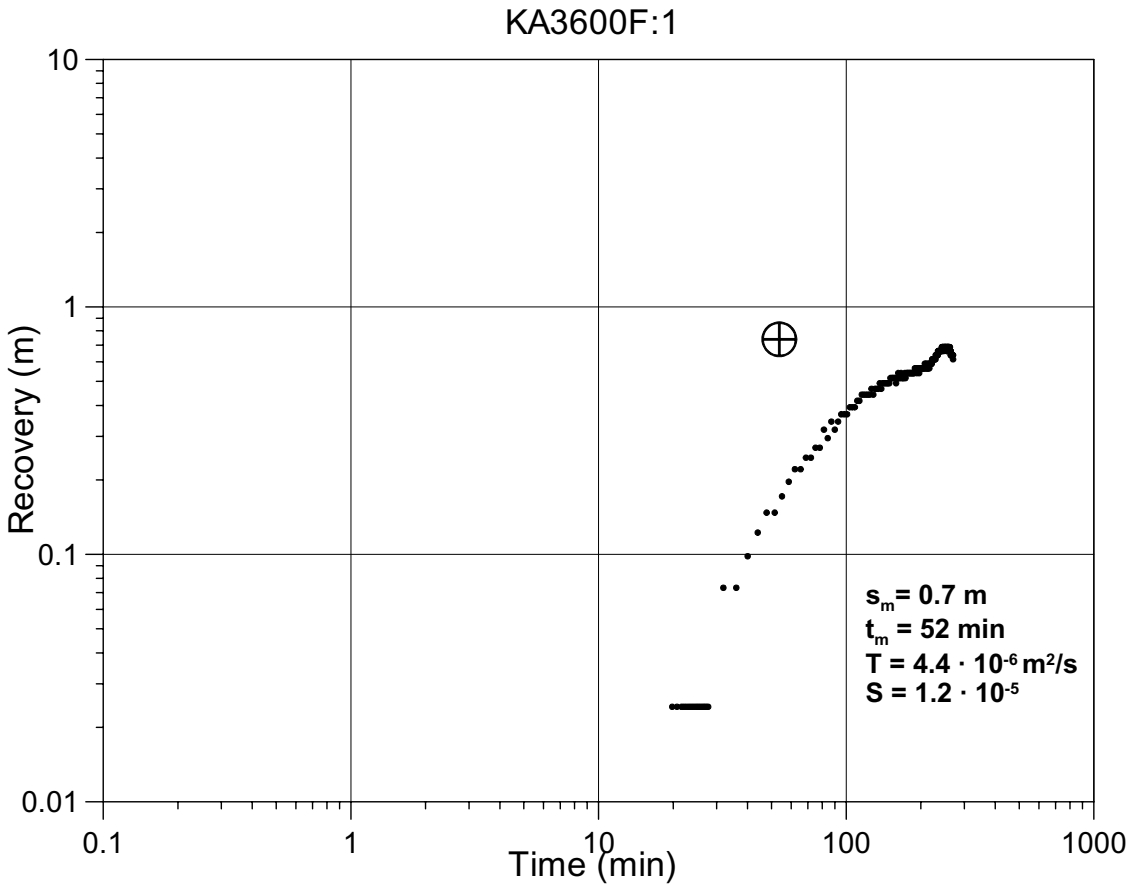
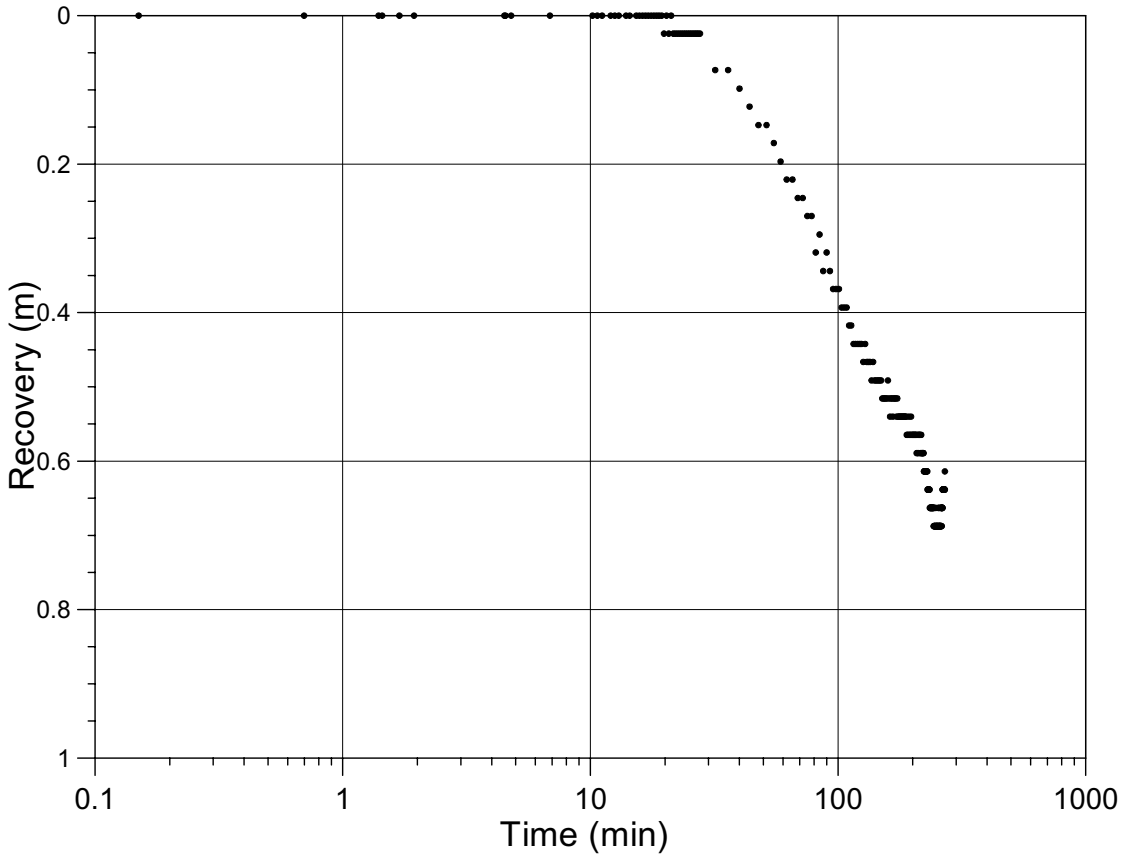
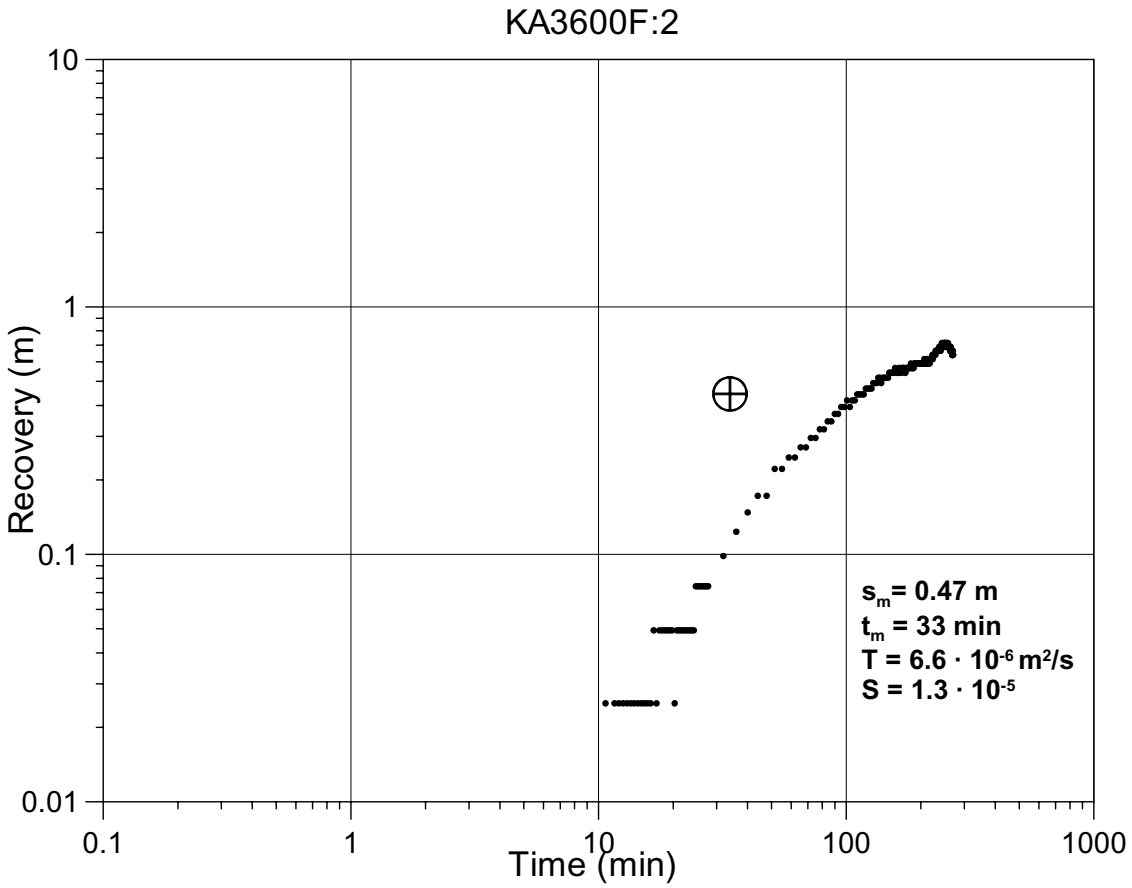
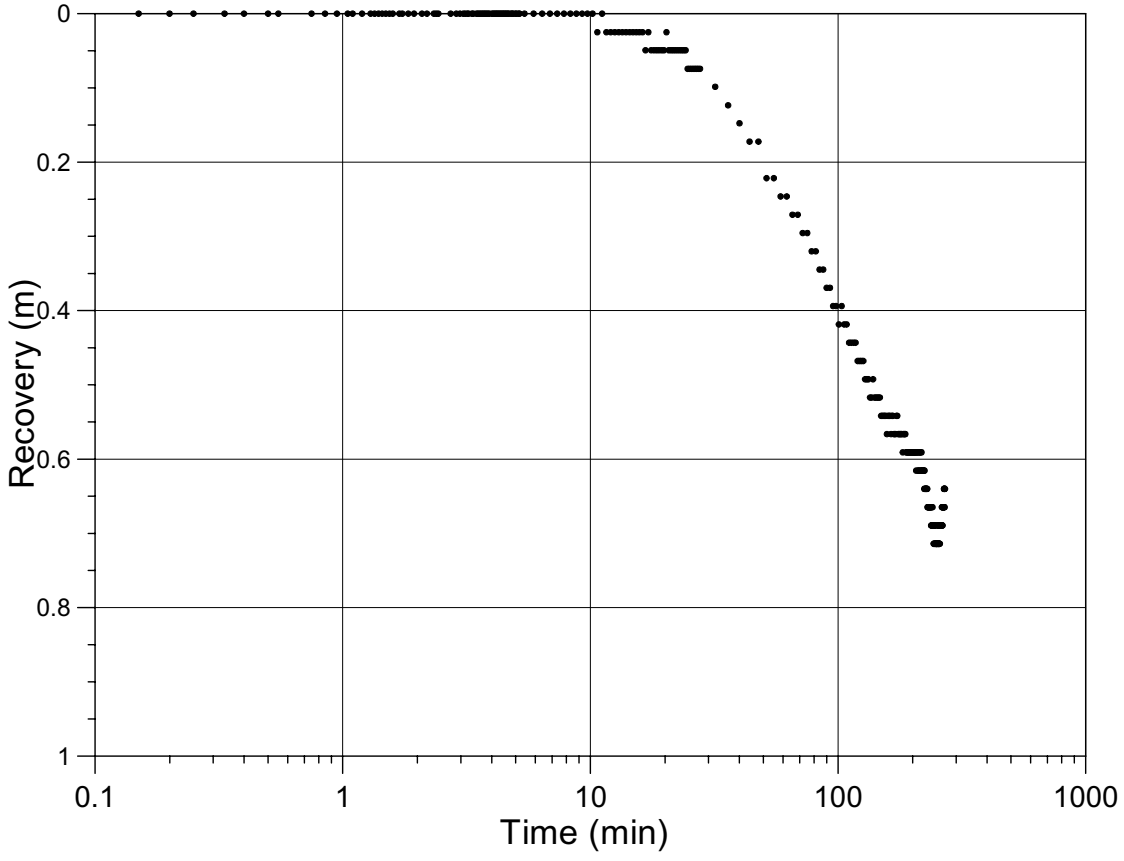




27_KA3600F_1.GRF 2003-11-19





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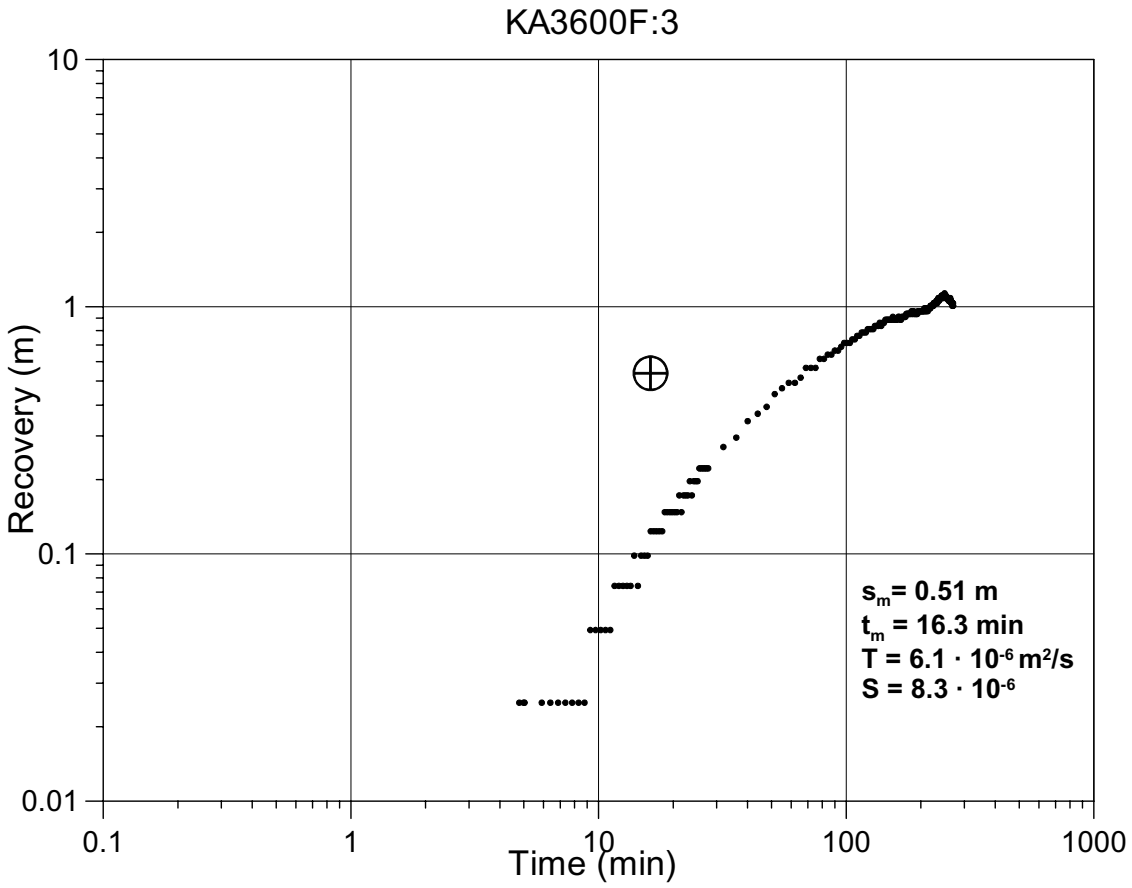
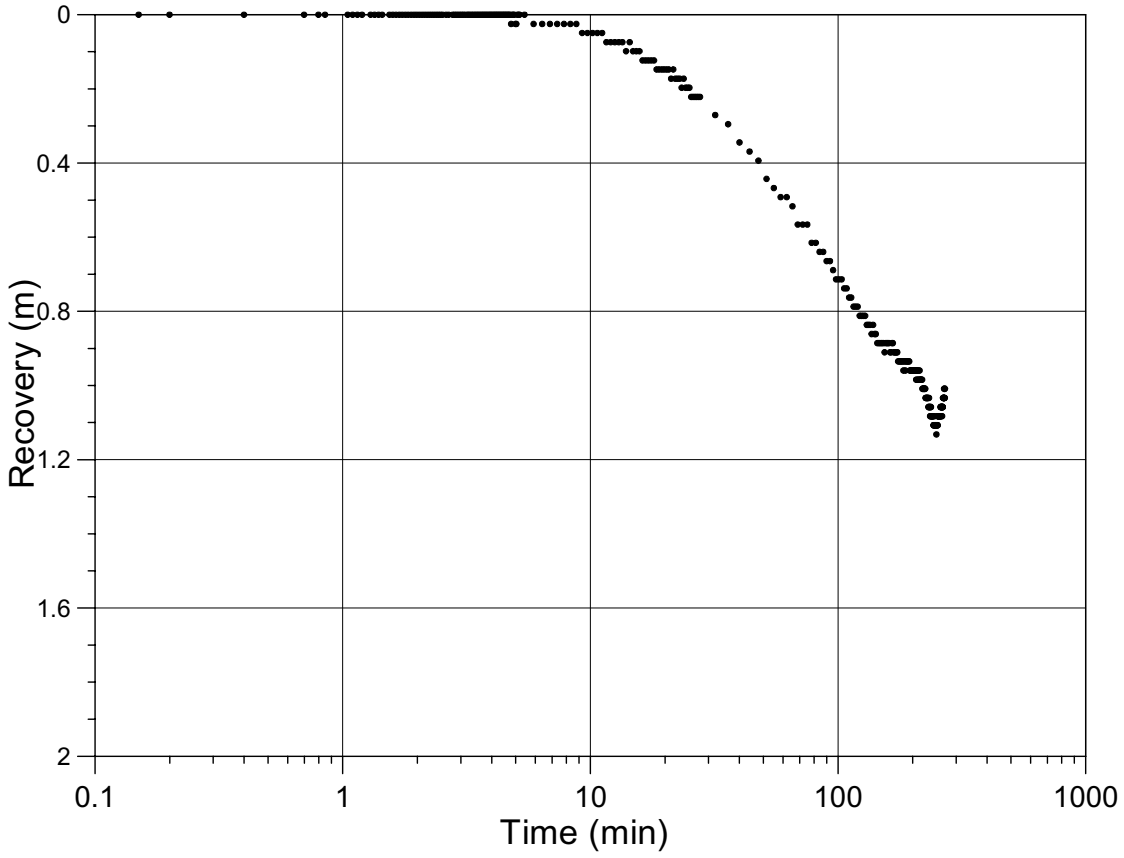
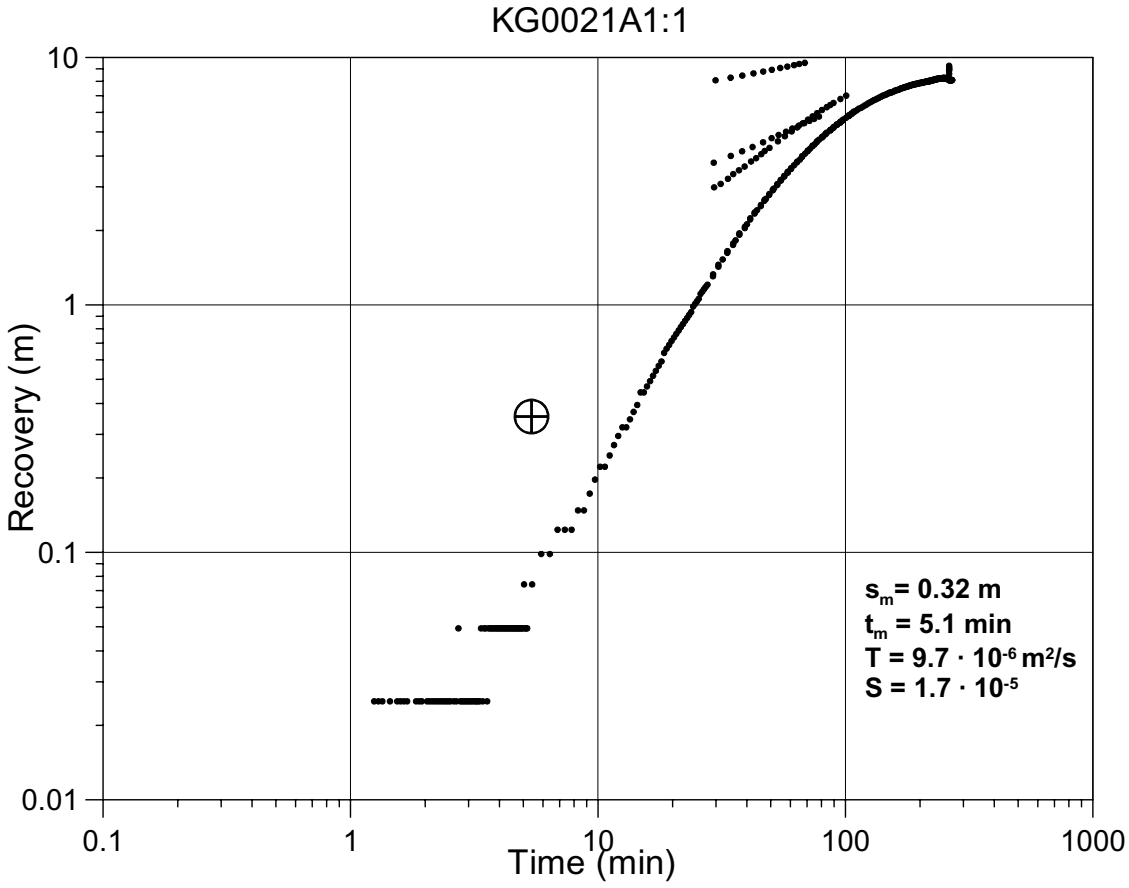
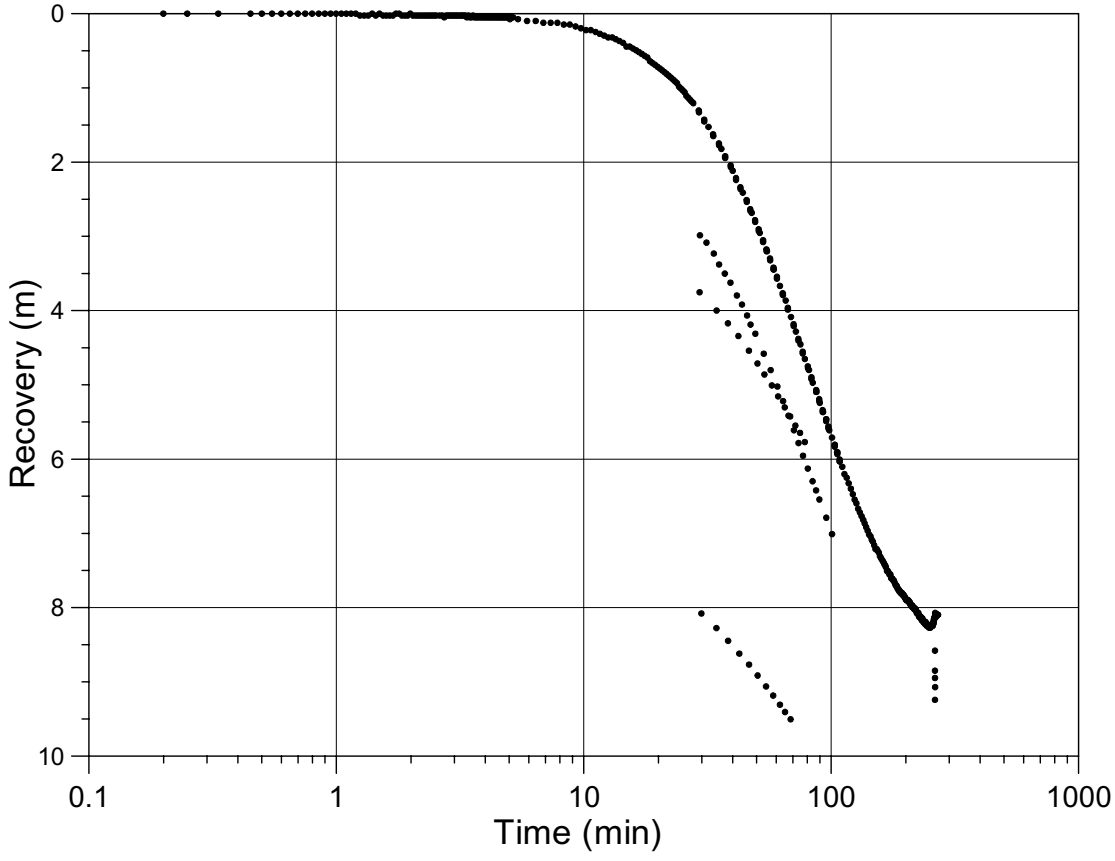


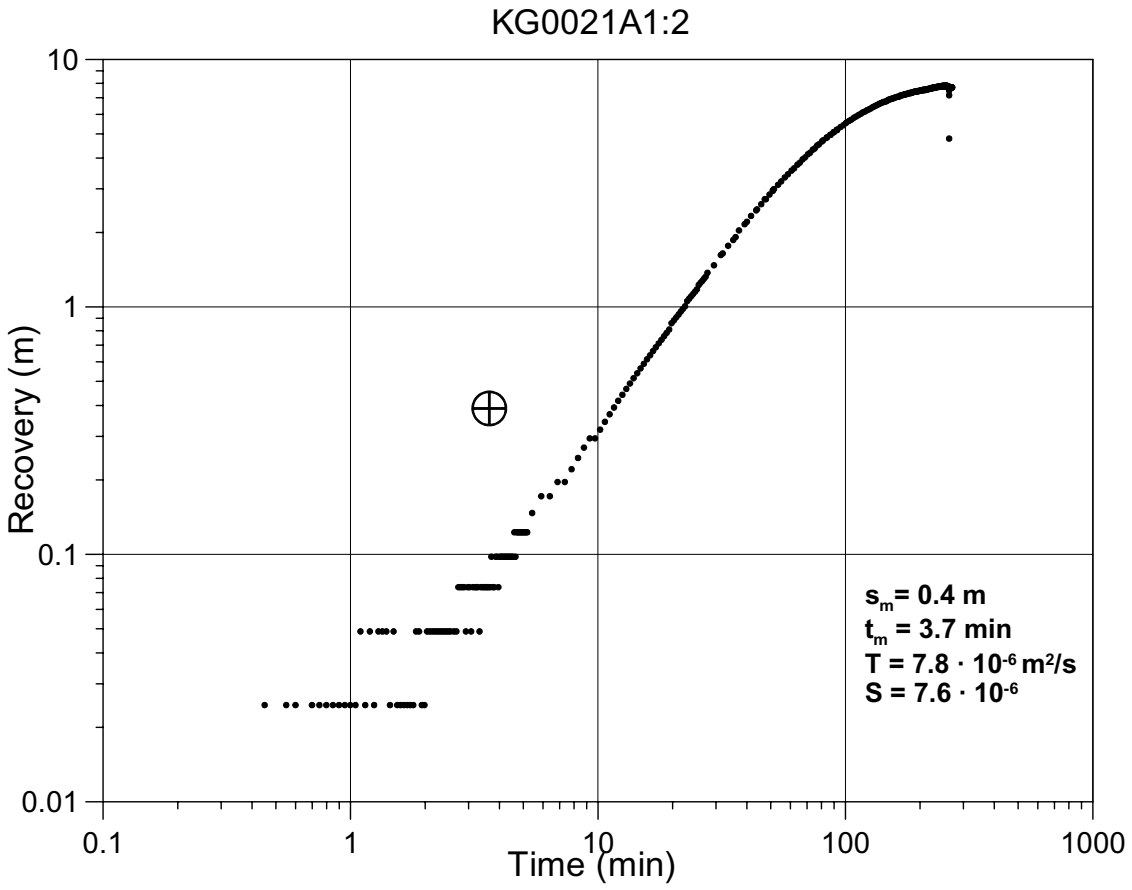


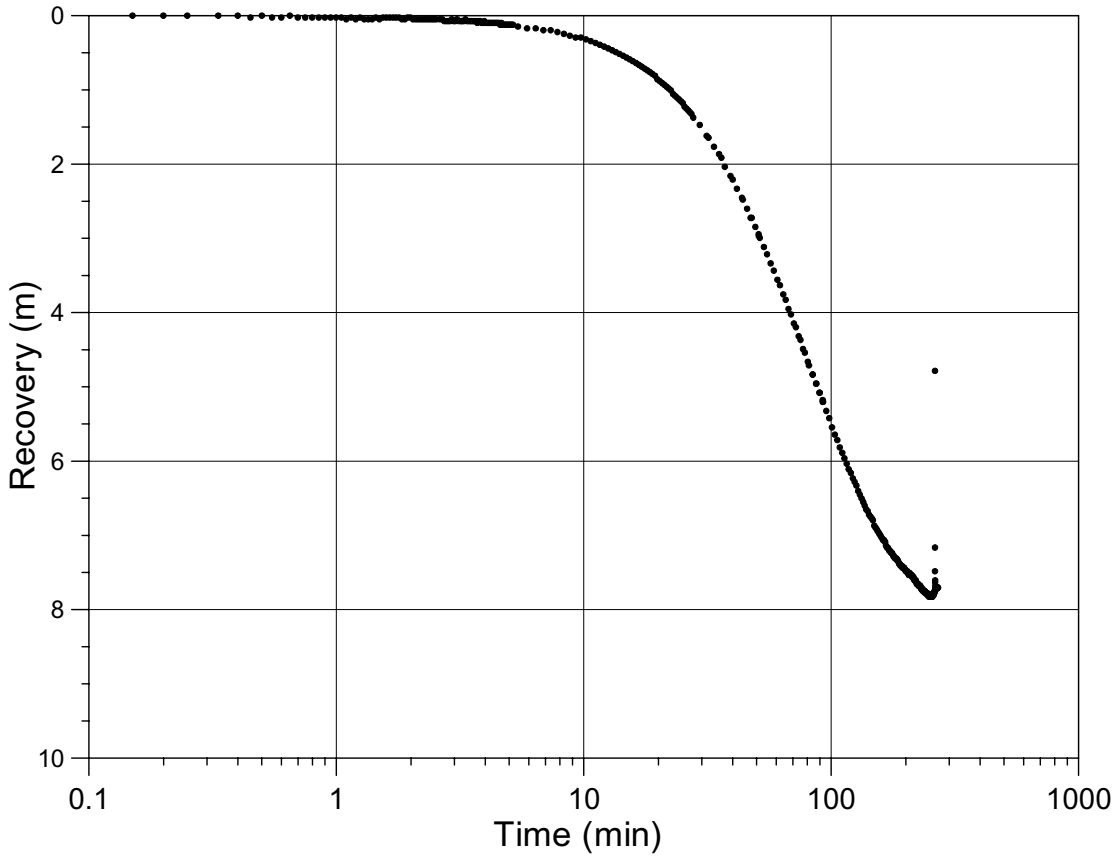
27_KA3600F_3.GRF 2003-11-19





27_KG0021A1_1.GRF 2003-11-19





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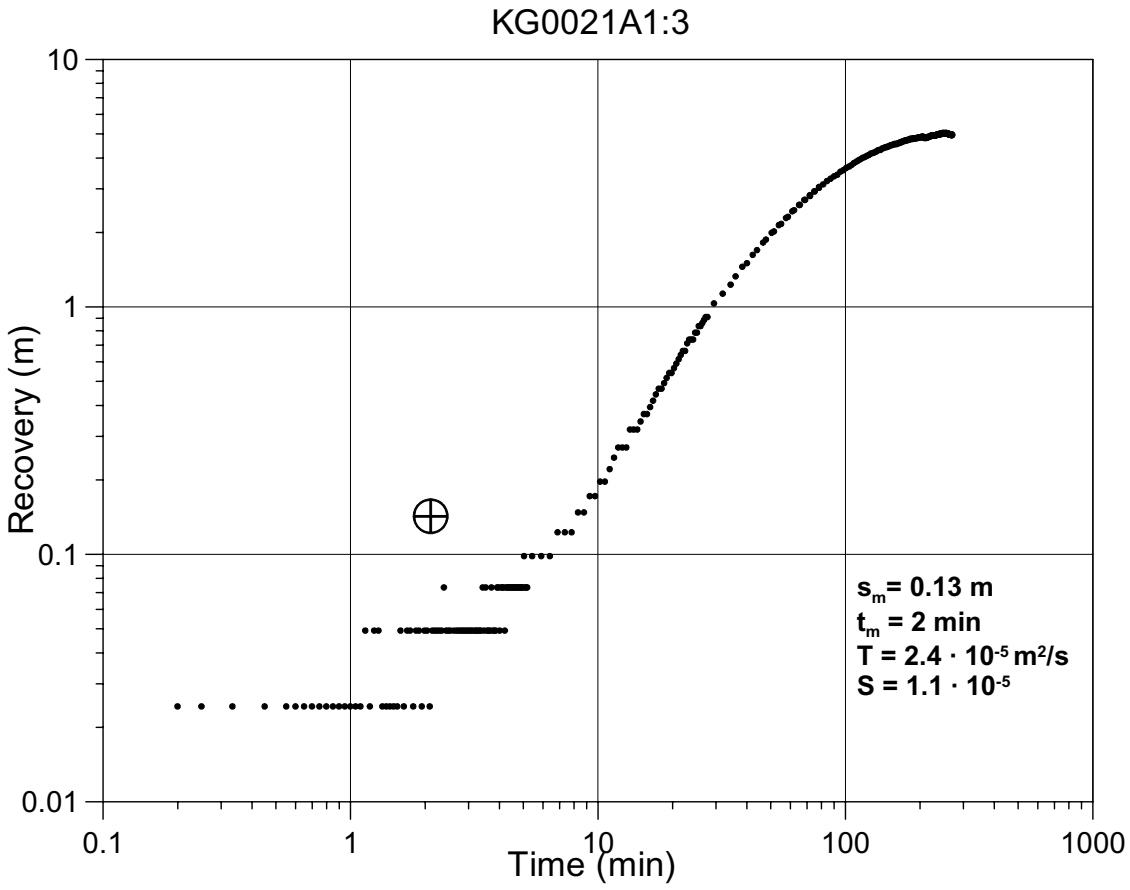

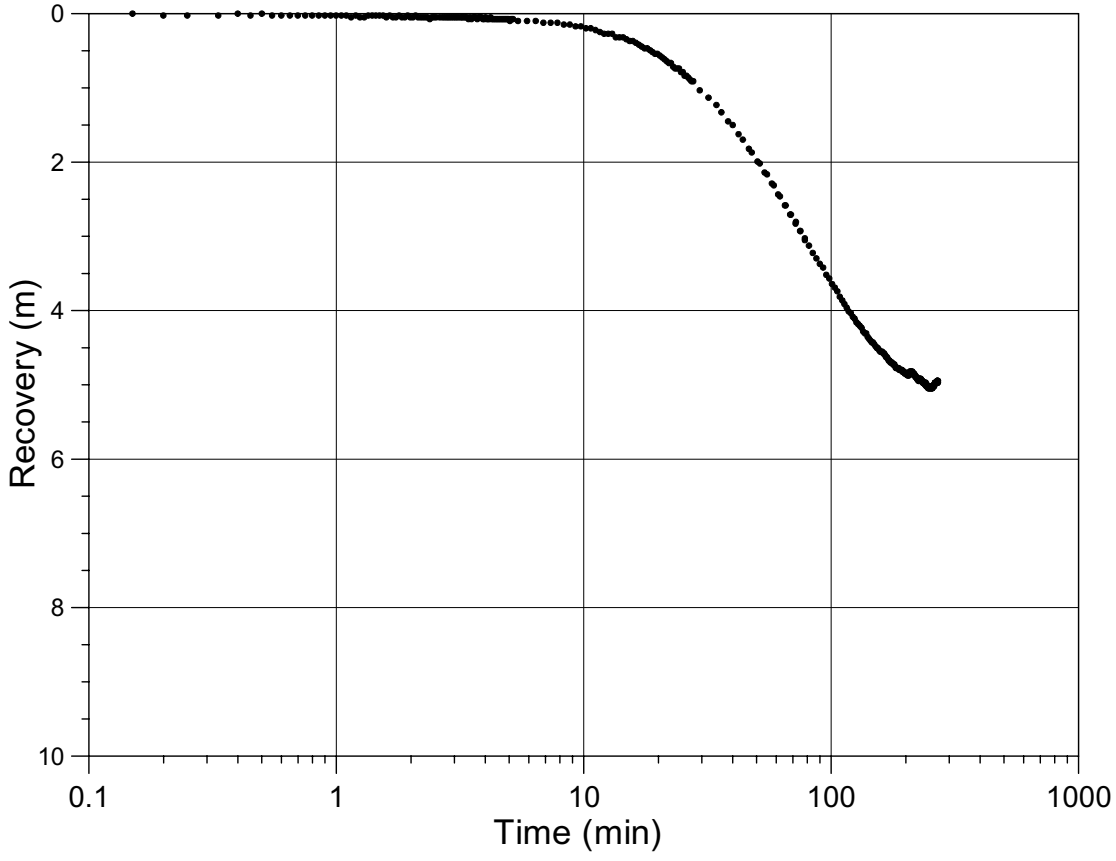

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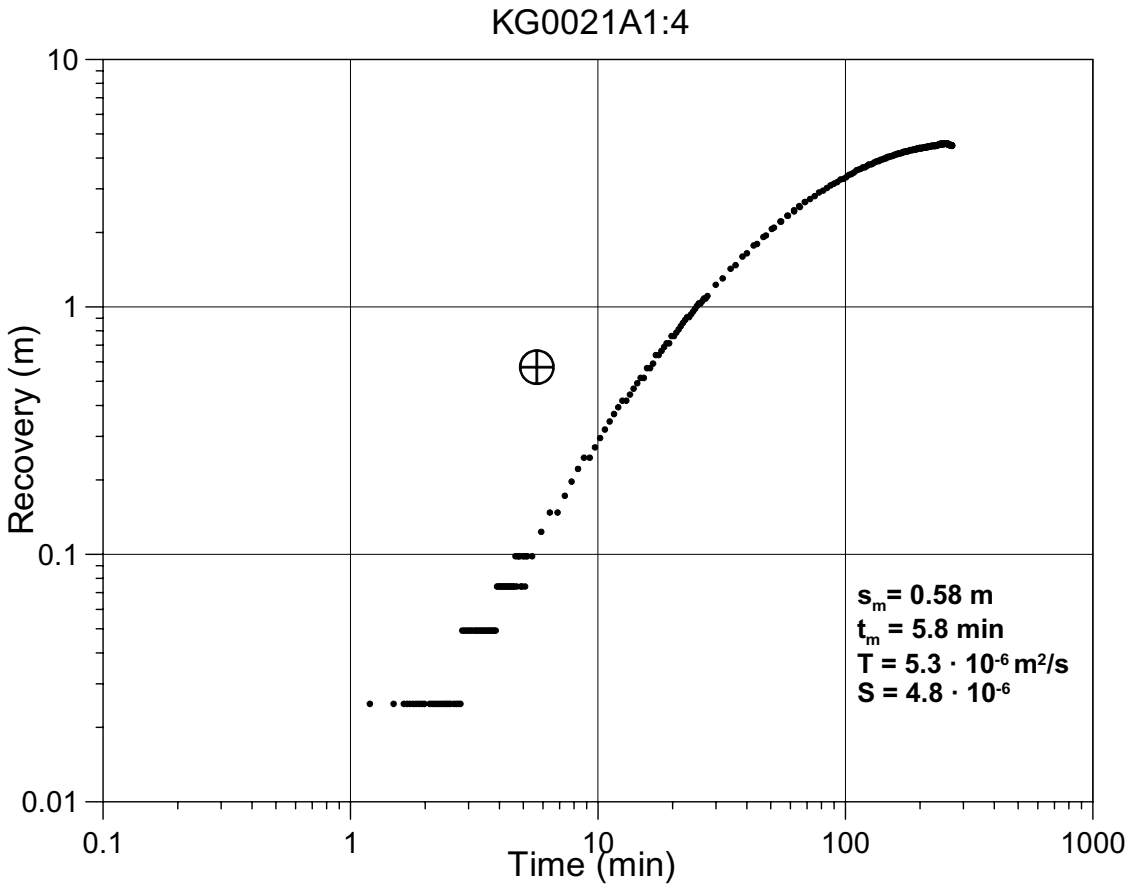
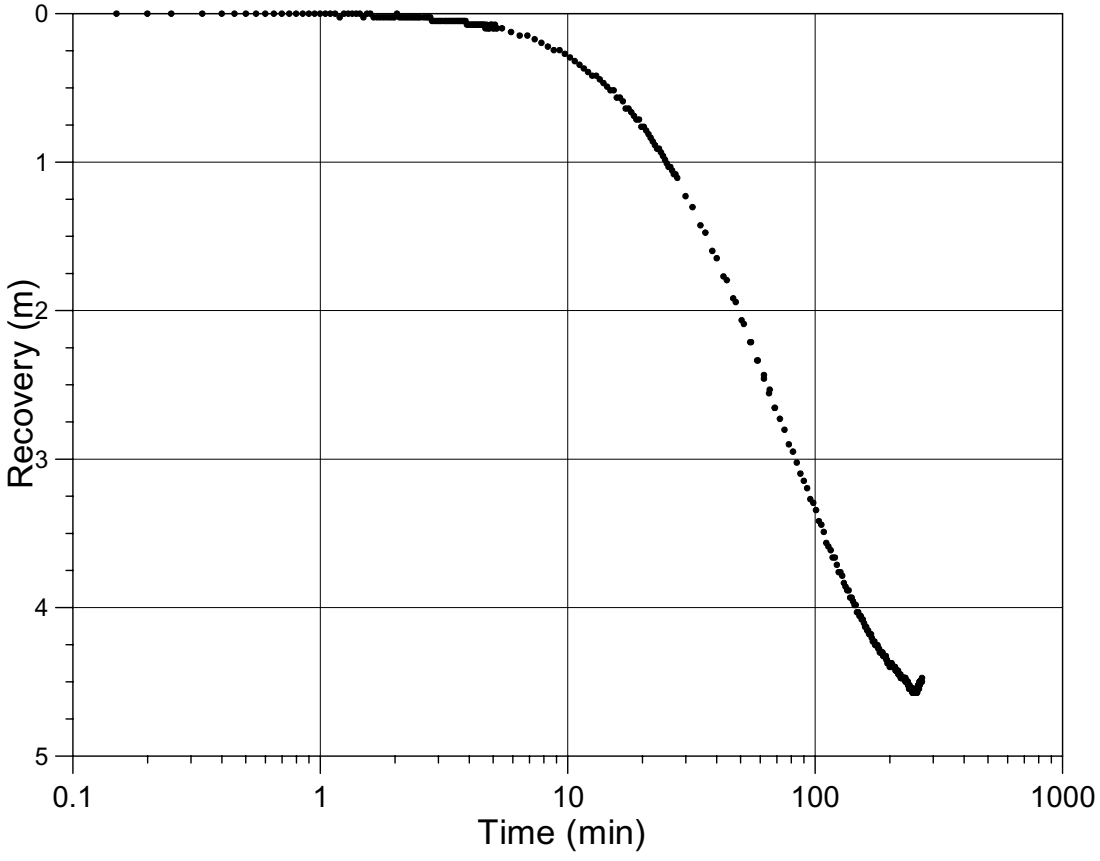
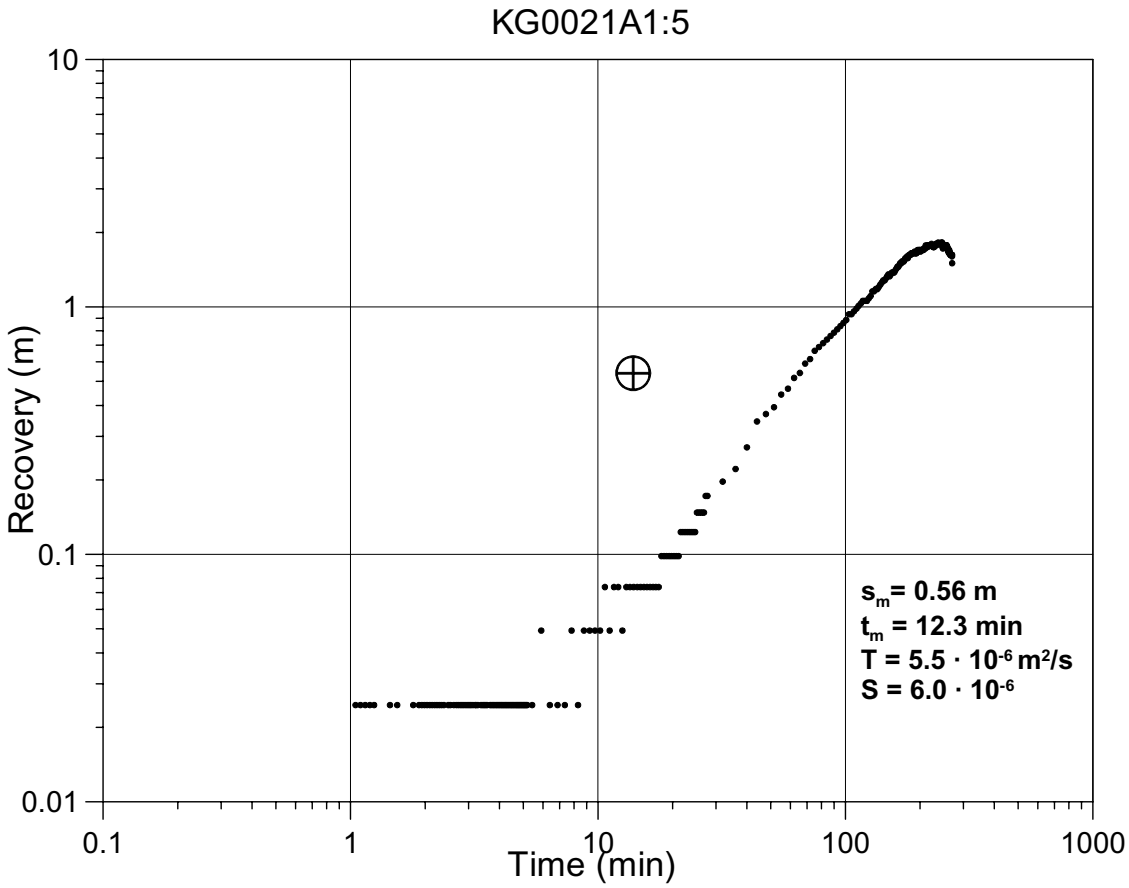
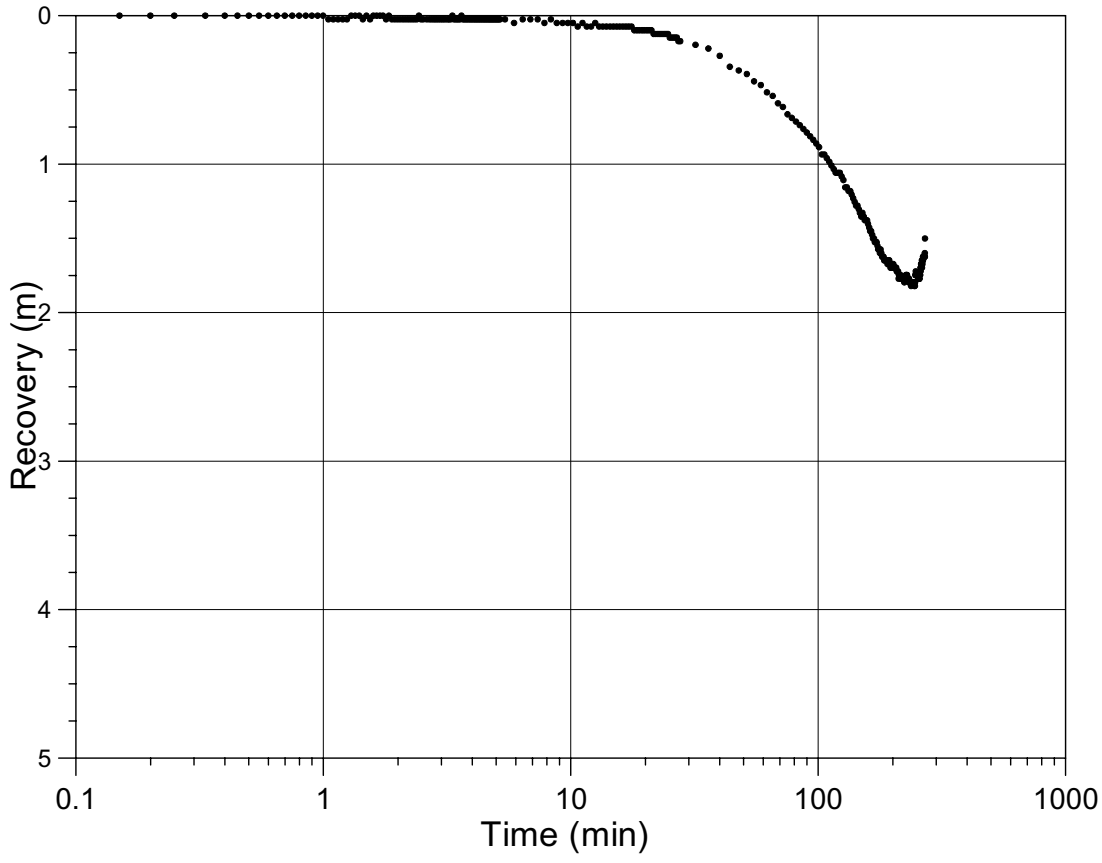


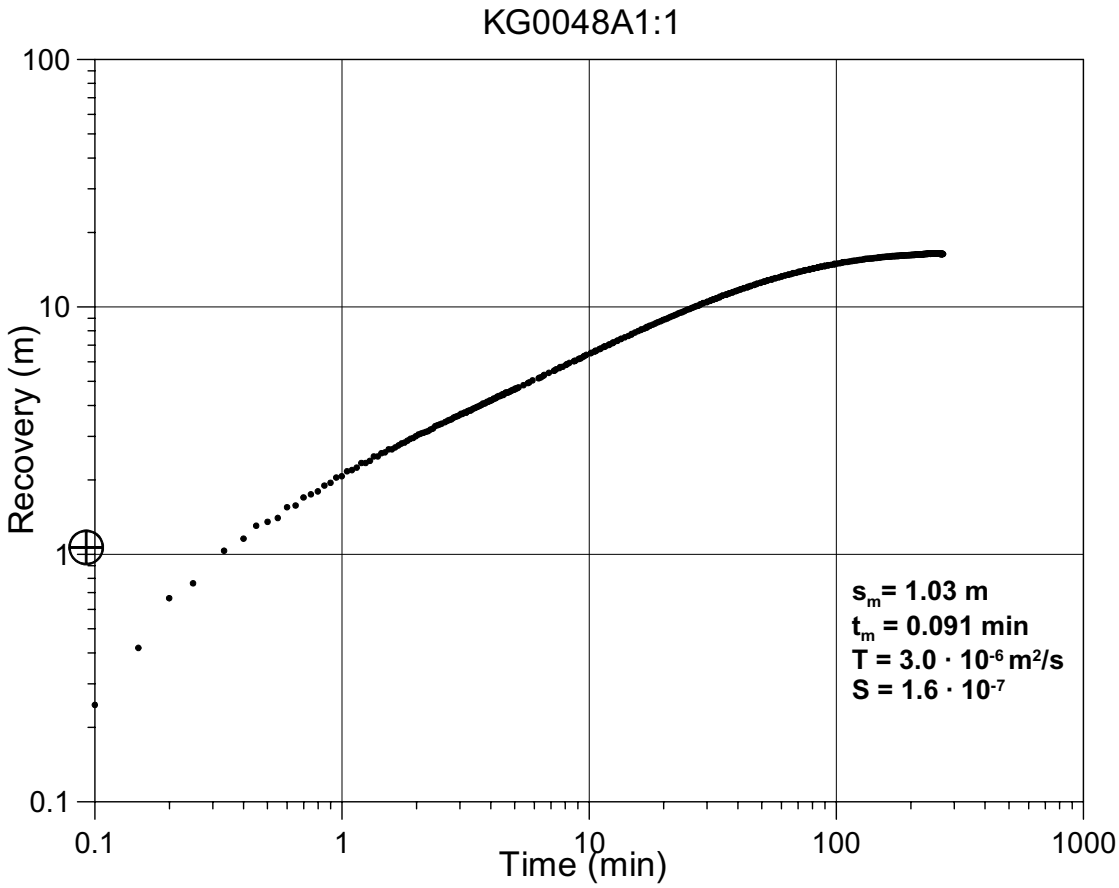


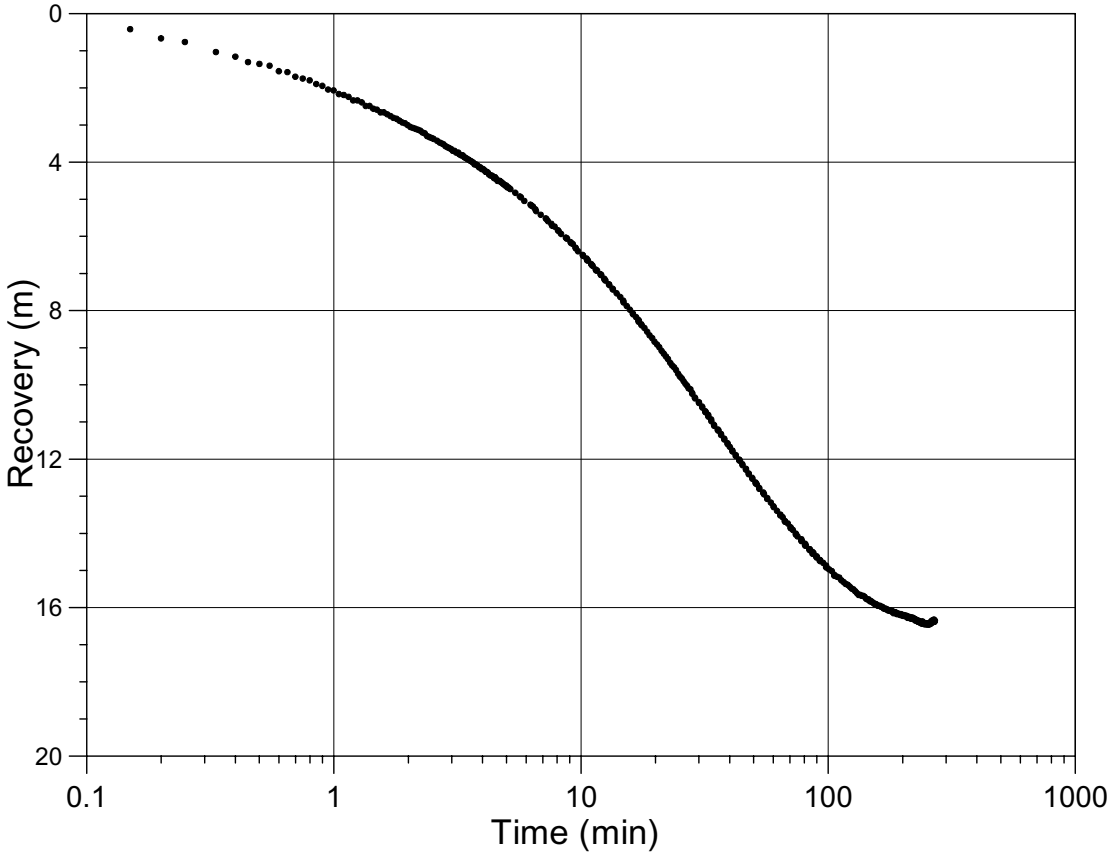
27_KG0021A1_4.GRF 2003-11-19



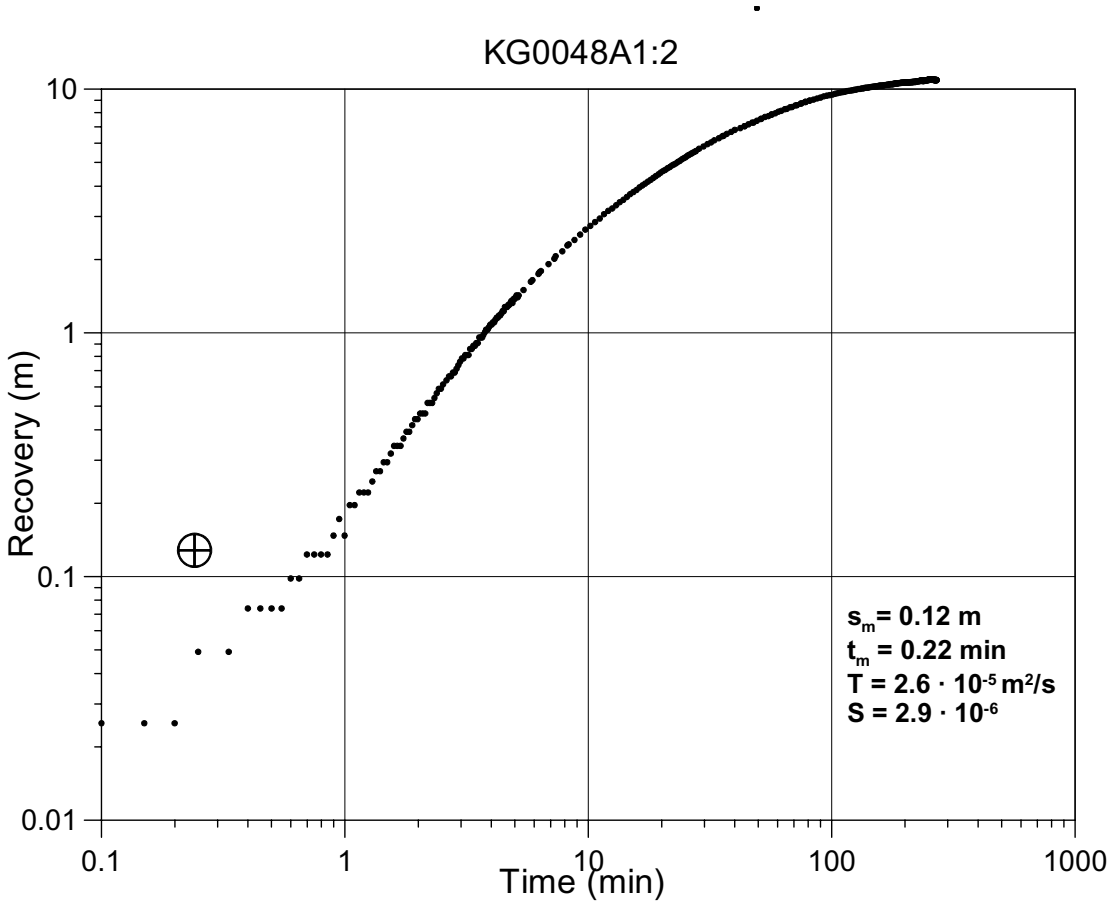


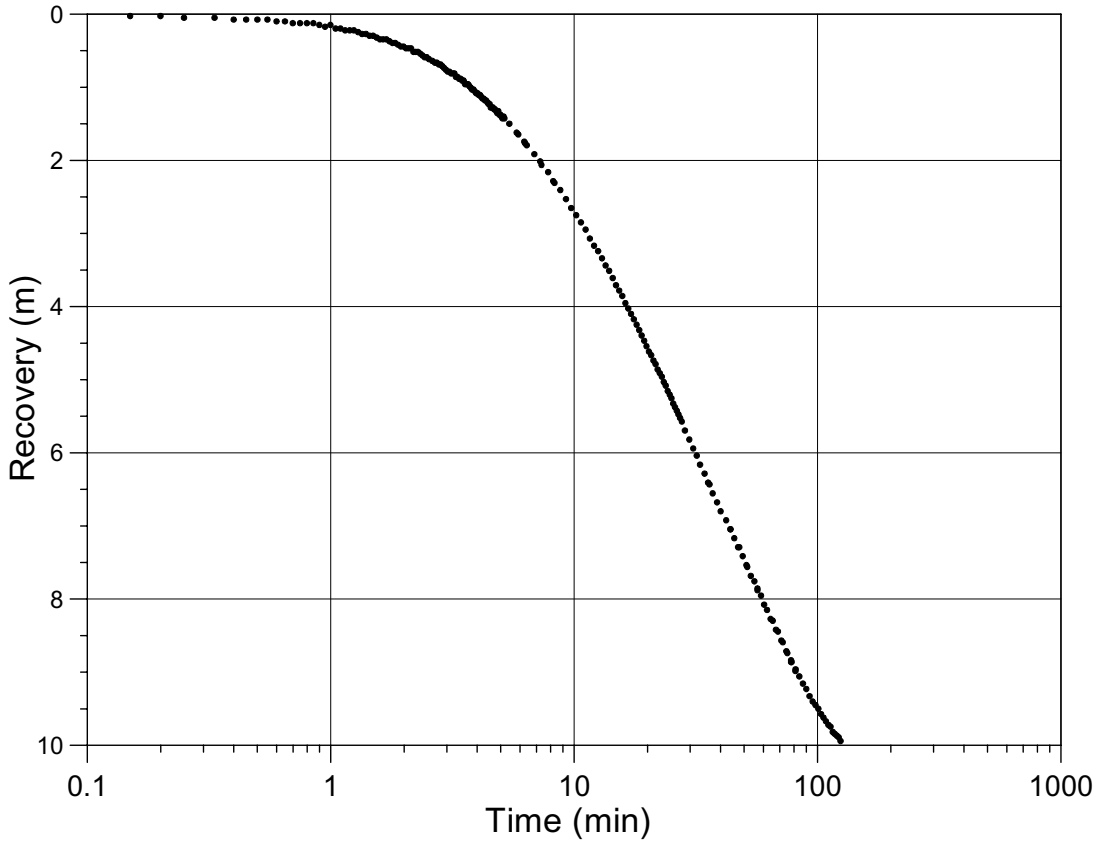
27_KG0021A1_5.GRF 2003-11-19



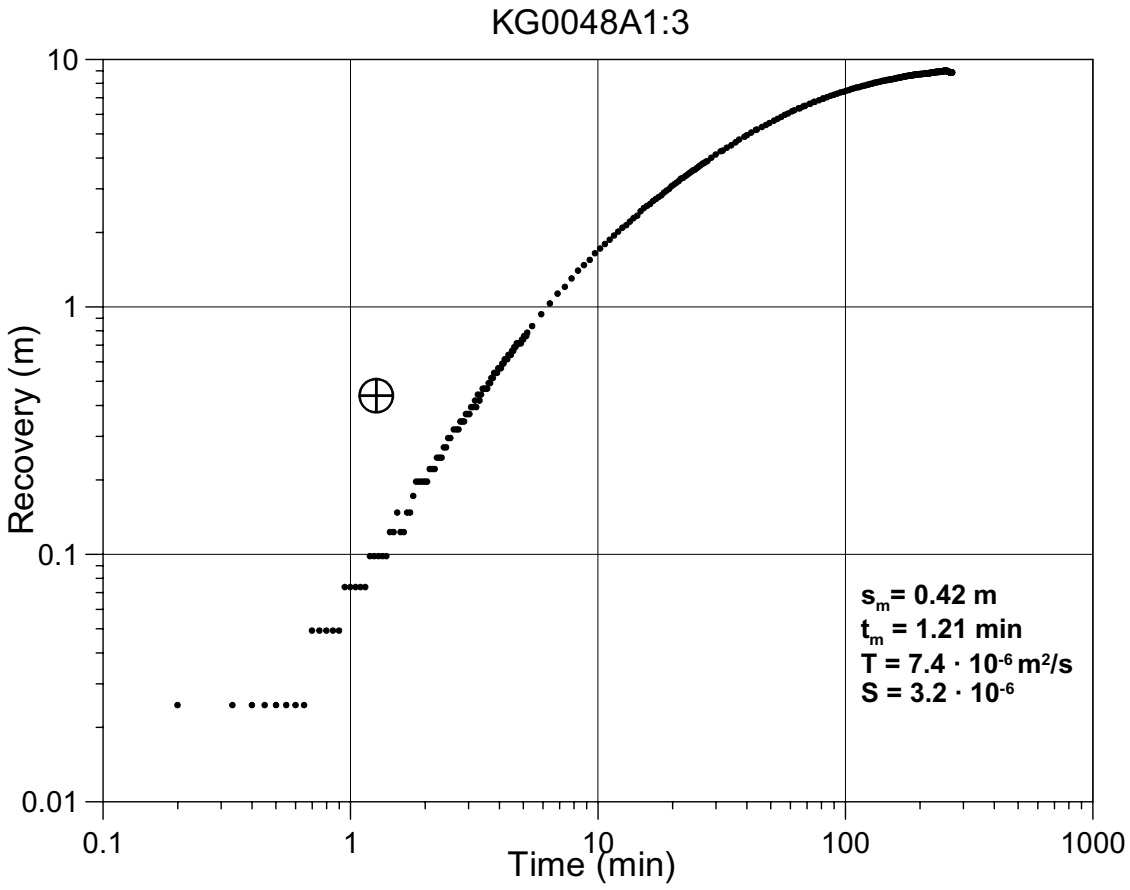


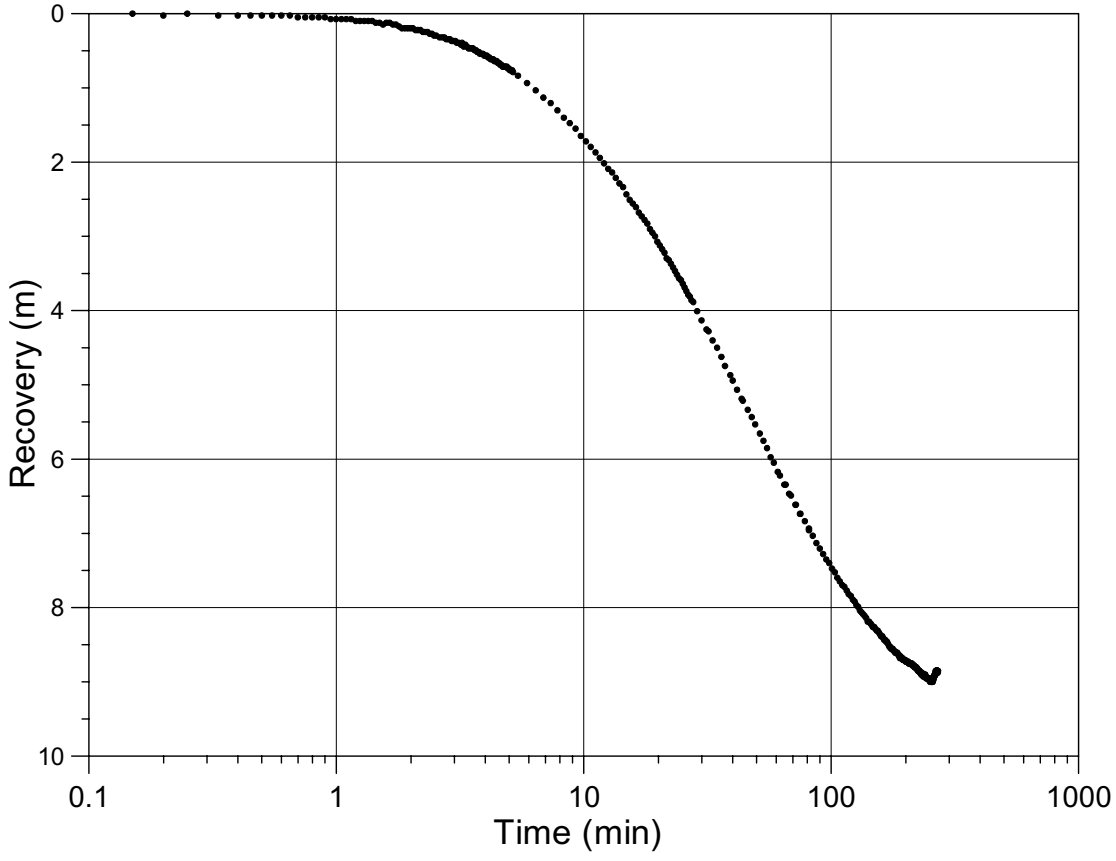
27_KG0048A1_1.GRF 2003-11-19





27_KG0048A1_2.GRF 2003-11-19





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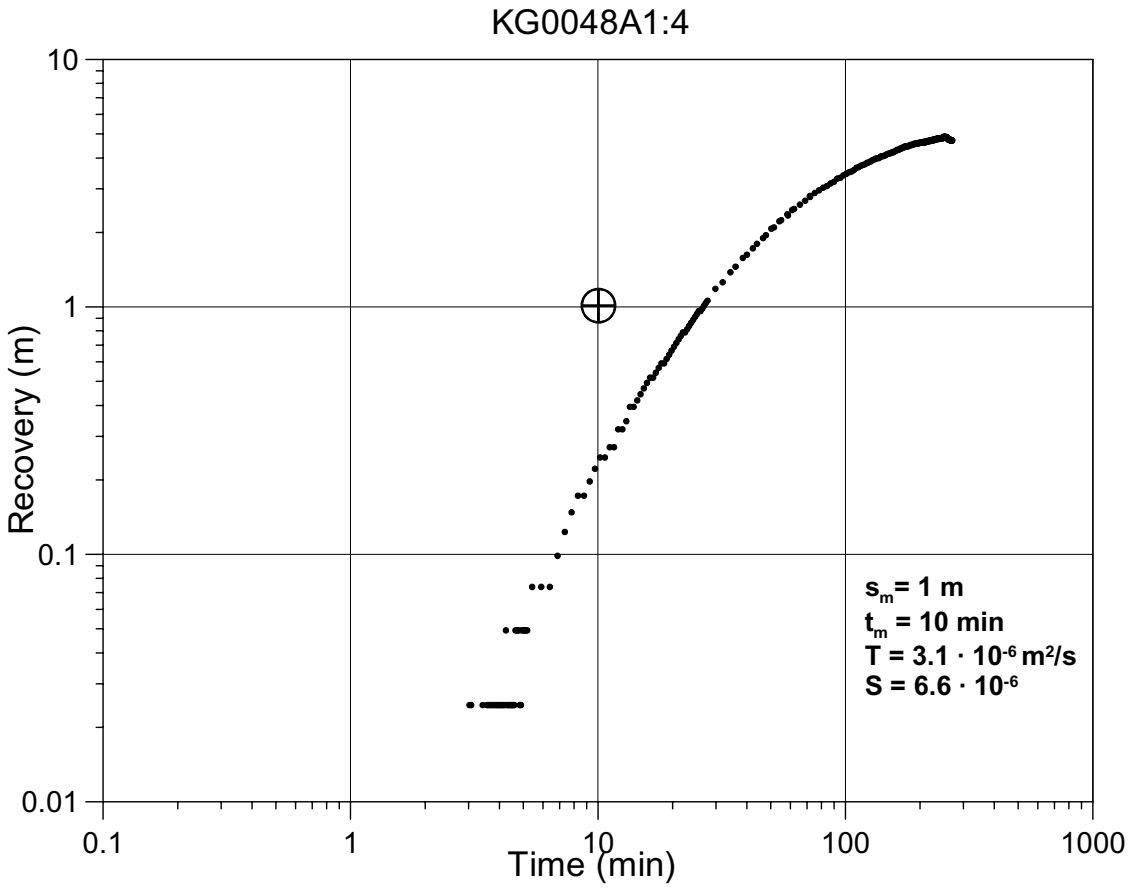

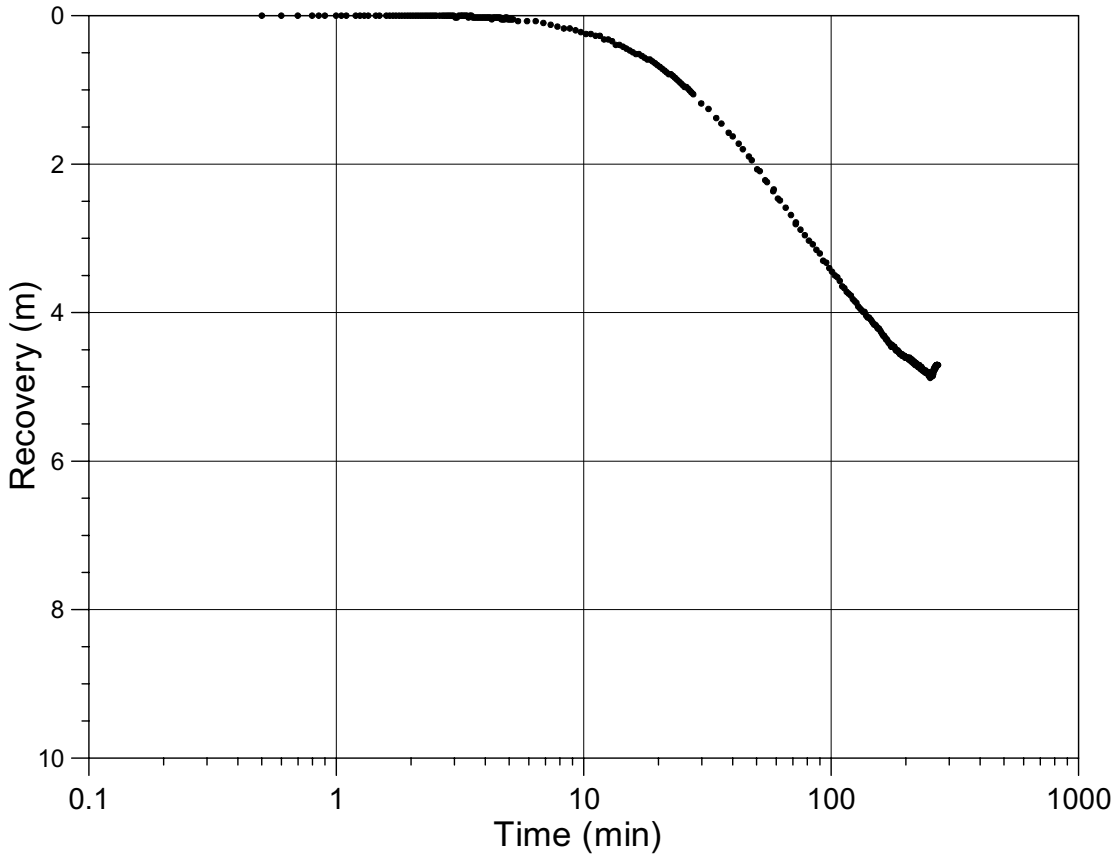

27_KG0048A1_4.GRF 2003-11-19