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Forsmark site investigation

Single-hole injection tests and pressure pulse tests in borehole KFM08B

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Abstract

Borehole KFM08B is a core-drilled borehole, approximately 200 m long, within the site investigation area in Forsmark. The borehole is inclined c 60 degrees from the horizontal plane, and is cased to about 5.6 m. These upper 5.6 m have a diameter slightly larger (93 mm) than the rest of the borehole, where the diameter is about 77 mm. However the inner diameter of the casing is 78 mm, thereby being approximately in agreement with the diameter at the rest of the borehole.

This report presents injection tests and pressure pulse tests performed using the pipe string system PSS3 in borehole KFM08B and the test results. Pressure pulse tests were performed instead of injection tests in sections where the flow rate was assumed to be below or close to the measurement limit for injection tests.

The main aim of the injection tests and pressure pulse tests in KFM08B was to characterize the hydraulic conditions of the rock adjacent to the borehole on a 5 m measurement scale. Hydraulic parameters such as transmissivity and hydraulic conductivity together with the dominating flow regime and possible outer hydraulic boundaries, were determined using analysis methods for stationary as well as transient conditions.

During most of the injection tests, some period with pseudo-radial flow could be identified from the injection period, making a relatively straight-forward transient evaluation possible. A transient evaluation, either from the injection period or the recovery period, could be made for all injection tests in KFM08B. The pressure pulse tests were evaluated using a stationary evaluation method. For 7 of 10 pressure pulse tests a transient evaluation was also possible, however the values from the transient evaluation were not regarded as representative.

The injection tests provide a database for statistical analysis of the hydraulic conductivity distribution along the borehole. Basic statistical parameters are presented in this report.

Sammanfattning

Borrhål KFM08B är ett ca 200 m långt, lutande kärnborrhål, som borrats inom platsundersökningarna i Forsmarksområdet. Borrhålets lutning är ca 60 grader från horisontalplanet och borrhålet är försett med ett foderrör till ca 5.6 m. Dessa övre 5.6 meter har en något större diameter (93 mm) än resten av borrhålet där diametern är ca 77 mm. Foderrörets innerdiameter är dock 78 mm och överensstämmer därmed nästan med det övriga borrhålets diameter.

Denna rapport beskriver genomförda injektionstester och pulstester med rörgångssystemet PSS3 i borrhål KFM08B samt resultaten från desamma. Pulstester genomfördes i stället för injektionstester i några sektioner där flödet befarades hamna under mätgränsen för injektionstester.

Huvudsyftet med injektionstesterna och pulstesterna var att karaktärisera de hydrauliska förhållandena av berget i anslutning till borrhålet i 5 m mätskala. Hydrauliska parametrar såsom transmissivitet och hydraulisk konduktivitet tillsammans med dominerande flödesregim och eventuella yttre hydrauliska randvillkor,bestämdes med hjälp av analysmetoder för såväl stationära som transienta förhållanden.

Under de flesta tester kunde en viss period med pseudoradiellt flöde identifieras från flödesperioden, vilket möjliggjorde en standardmässig transient utvärdering. Transient utvärdering, antingen från flödesfasen eller från återhämtningsfasen, kunde göras för alla injektionstester i KFM08B. Pulstesterna utvärderades med en stationär metod. Transient utvärdering var också möjlig för 7 av 10 pulstester, men värdena från den transienta utvärderingen ansågs inte vara representativa.

Resultaten från injektionstesterna utgör en databas för statistisk analys av den hydrauliska konduktivitetens fördelning längs borrhålet. Viss statistisk analys har utförts inom ramen för denna aktivitet och grundläggande statistiska parametrar presenteras i rapporten.

Contents

1 Introduction

Injection tests and pressure pulse tests were carried out in borehole KFM08B at Forsmark, Sweden, during June 2005 by GEOSIGMA AB. The borehole KFM08B is a core drilled borehole within the on-going site investigation in the Forsmark area. It is c 200 m long, inclined c 60 degrees from the horizontal and cased to c 5.6 m depth. The upper cased 5.6 m have a diameter of approximately 93 mm whereas the inner diameter of the casing is 78 mm, and the part of the borehole below this depth has a diameter of approximately 77 mm. The location of the borehole is shown in Figure 1-1.

This document reports the results obtained from the injection tests and pressure pulse tests in borehole KFM08B. In some sections, for which a flow rate below or close to the measurement limit for injection tests was expected, pressure pulse tests were carried out instead of injection tests. The activity is performed within the Forsmark site investigation. The work was carried out in compliance with the SKB internal controlling documents presented in Table 1-1. Data and results were delivered to the SKB site characterization database SICADA, where they are traceable by the activity plan number.

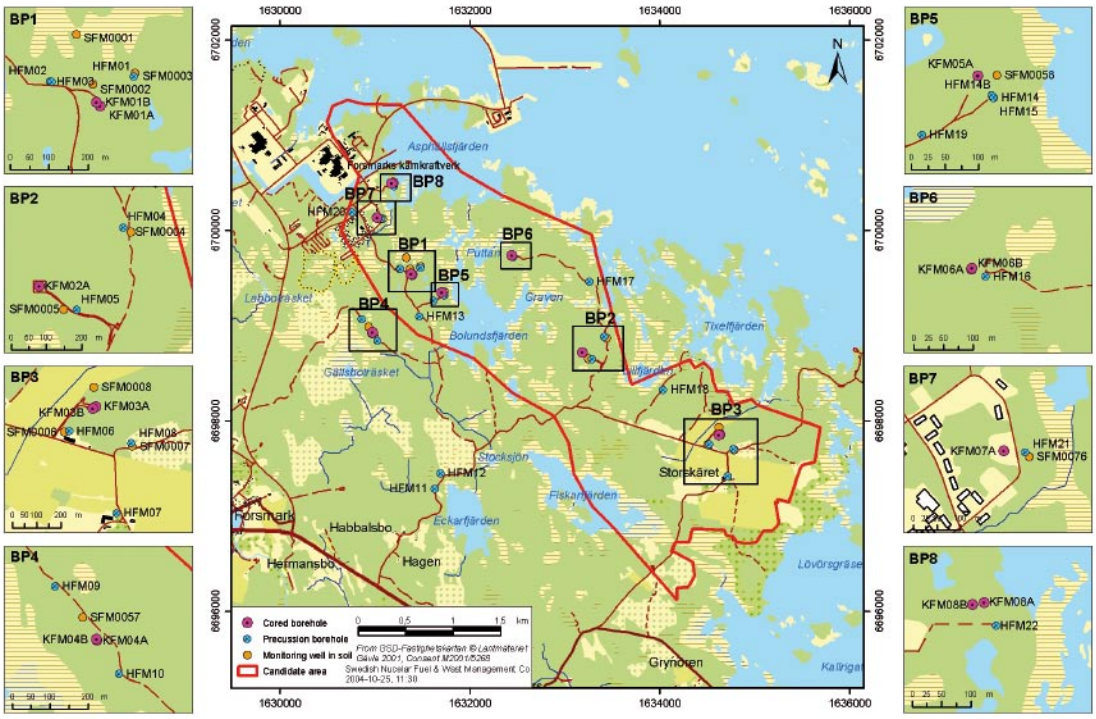

__Figure 1-1.__ The investigation area at Forsmark including the candidate area selected for more detailed investigations. Borehole KFM08B is situated at drill site DS8.

Table 1-1. SKB internal controlling documents for performance of the activity.

Activity Plans	Number	Version
Hydraulic injection tests in borehole KFM08B with PSS3.	AP PF 400-05-004	1.0
Method descriptions	**Number**	**Version**
Mätsystembeskrivning (MSB) – Allmän del. Pipe String System (PSS3).	SKB MD 345.100	1.0
Mätsystembeskrivning för: Kalibrering, PSS3.	SKB MD 345.122	1.0
Mätsystembeskrivning för: Skötsel, service, serviceprotokoll, PSS3.	SKB MD 345.124	1.0
Metodbeskrivning för hydrauliska injektionstester.	SKB MD 323.001	1.0
Instruktion för analys av injektions- och enhålspumptester.	SKB MD 320.004	1.0
Instruktion för rengöring av borrhålsutrustning och viss markbaserad utrustning.	SKB MD 600.004	1.0

2 Objectives

The main aim of the injection- and pressure pulse tests in borehole KFM08B was to characterize the hydraulic properties of the rock adjacent to the borehole on a 5 m measurement scale. The primary parameter to be determined was hydraulic transmissivity from which hydraulic conductivity can be derived. Other hydraulic parameters of interest were flow regimes and outer hydraulic boundaries. These parameters were analysed using transient evaluation on the test responses during the flow- and recovery periods.

The results of the injection tests provide a database which can be used for statistical analyses of the hydraulic conductivity distribution along the borehole. Basic statistical analyses are presented in this report.

3 Scope

3.1 Borehole

Technical data of the tested borehole are shown in Table 3-1 and in Appendix 4. The reference point of the borehole is defined as the centre of top of casing (ToC), given as "Elevation" in the table below. The Swedish National coordinate system (RT90) is used for the horizontal coordinates together with RHB70 for the elevation. "Northing" and "Easting" refer to the top of the boreholes.

Table 3-1. Technical data of borehole KFM08B (printout from SKB database, SICADA).

Borehole length (m)	200.540				
Drilling period(s)	**From date**	**To date**	**Secup (m)**	**Seclow (m)**	**Drilling type**
	2005-01-03	2005-01-26	0.000	200.540	Core drilling
Starting point coordinate	**Length (m)**	**Northing (m)**	**Easting (m)**	**Elevation**	**Coord system**
	0.000	6700492.750	1631173.270	2.250	RT90-RHB70
Angles	**Length (m)**	**Bearing**	**Inclination (– = down)**		
	0.000	270.450	–58.850		
Borehole diameter	**Secup (m)**	**Seclow (m)**	**Hole diam (m)**		
	0.000	5.580	0.093		
	5.580	200.540	0.076		
Core diameter	**Secup (m)**	**Seclow (m)**	**Core diam (m)**		
	4.920	200.540	0.051		
Casing diameter	**Secup (m)**	**Seclow (m)**	**Case in (m)**	**Case out (m)/in (m)**	
	0.000	5.580	0.077	0.090/0.078	

3.2 Tests performed

The injection tests and pressure pulse tests in borehole KFM08B, performed according to Activity Plan AP PF 400-05-004 (SKB internal controlling document), are listed in Table 3-2. The injection- and pressure pulse tests were carried out with the Pipe String System (PSS3). The test procedure and the equipment is described in the measurement system description for PSS (SKB MD 345.100, SKB internal controlling document) and in the corresponding method descriptions for hydraulic injection tests (SKB MD 323.001, Metodbeskrivning för Hydrauliska injektionstester, SKB internal controlling document).

Some of the tests were not performed as intended because the time required for achieving a constant head in the test section was judged to be too long, or in other cases, equipment malfunctions caused pressure and/or flow rate disturbances. Whenever such disturbances were expected to affect data evaluation, the test was repeated. Test number (Test no in Table 3-2) refers to the number of tests performed in the actual section. For evaluation, only data from the last test in each section were used.

Pressure pulse tests were performed instead of injection tests in sections where the transmissivity was expected to be below or near the measurement limit for injection tests. It is appropriate to perform a pressure pulse test when the corresponding flow rate at the end of an injection period of 20 minutes duration is less than c 1.5 mL/min. To decide whether an injection test or a pressure pulse test should be carried out in a particular section, a so called diagnostic test was conducted during the packer inflation period. The diagnostic test involves closing the test valve after 5 minutes of packer inflation and observing the pressure in the test section during the following 5 minutes. This diagnostic test was used to decide if a pressure pulse test should be performed. Such a test was made if the pressure increase after 5 minutes exceeded c 20 kPa. Otherwise an injection test was carried out. A pressure pulse test is performed similar to an injection test, the differences being a longer time for packer inflation, a shorter injection time (2 minutes) and a longer recovery period, see Table 5-1a and Table 5-1b.

At two positions in the borehole two of the sections are partly overlapping (sections 7.0–12.0 and 9.0–14.0 and sections 164.0–169.0 and 166.0–171.0). The reason for this was to avoid placing the packers over large fractures which can damage them, and still be able to perform tests along the whole borehole.

3.3 Equipment checks

The PSS3 equipment was fully serviced, according to SKB internal controlling documents (SKB MD 345.124, service, and SKB MD 345.122, calibration), in May 2005.

Functioning checks of the equipment were performed during the installation of the PSS equipment at the test site. In order to check the function of the pressure sensors, the air pressure was recorded and found to be as expected. While lowering, the sensors showed good agreement with the total head of water ($p/\rho g$). The temperature sensor displayed expected values in both air and water.

Simple functioning checks of down-hole sensors were done at every change of test section interval. Checks were also made continuously while lowering the pipe string along the borehole.

Table 3-2. Single-hole injection tests and pressure pulse tests performed in borehole KFM08B.

Borehole	Test section		Section length	Test type[1)]	Test no	Test start date, time	Test stop date, time
Bh ID	secup	seclow		(1–6)		YYYYMMDD hh:mm	YYYYMMDD hh:mm
KFM08B	7.00	12.00	5.00	3	1	20050608 18:17	20050609 09:26
KFM08B	9.00	14.00	5.00	3	1	20050609 09:50	20050609 11:14
KFM08B	14.00	19.00	5.00	3	1	20050609 11:30	20050609 13:15
KFM08B	19.00	24.00	5.00	3	1	20050609 13:31	20050609 14:46
KFM08B	24.00	29.00	5.00	3	1	20050609 15:00	20050609 16:14
KFM08B	29.00	34.00	5.00	3	1	20050609 16:28	20050609 17:50
KFM08B	34.00	39.00	5.00	3	1	20050610 08:19	20050610 09:41
KFM08B	39.00	44.00	5.00	3	1	20050610 09:51	20050610 11:06
KFM08B	44.00	49.00	5.00	4B	1	20050610 11:16	20050610 13:05
KFM08B	49.00	54.00	5.00	3	2	20050620 11:17	20050620 12:31
KFM08B	54.00	59.00	5.00	3	1	20050610 14:00	20050610 15:15
KFM08B	59.00	64.00	5.00	3	1	20050610 15:25	20050610 16:38
KFM08B	64.00	69.00	5.00	4B	1	20050610 16:46	20050610 18:32
KFM08B	69.00	74.00	5.00	4B	1	20050613 09:06	20050613 10:25
KFM08B	74.00	79.00	5.00	3	2	20050620 09:43	20050620 10:57
KFM08B	79.00	84.00	5.00	4B	1	20050613 12:44	20050613 14:33
KFM08B	84.00	89.00	5.00	3	1	20050613 14:48	20050613 16:07
KFM08B	89.00	94.00	5.00	3	1	20050613 16:17	20050613 17:33
KFM08B	94.00	99.00	5.00	3	2	20050620 08:16	20050620 09:31
KFM08B	99.00	104.00	5.00	3	1	20050614 07:03	20050614 08:36
KFM08B	104.00	109.00	5.00	3	2	20050617 15:20	20050617 16:35
KFM08B	109.00	114.00	5.00	4B	1	20050614 10:30	20050614 11:31
KFM08B	114.00	119.00	5.00	4B	1	20050614 11:42	20050614 13:52
KFM08B	119.00	124.00	5.00	4B	2	20050617 13:20	20050617 15:06
KFM08B	124.00	129.00	5.00	3	1	20050615 08:22	20050615 09:37
KFM08B	129.00	134.00	5.00	3	2	20050617 11:32	20050617 13:07
KFM08B	134.00	139.00	5.00	4B	1	20050615 10:49	20050615 12:34
KFM08B	139.00	144.00	5.00	4B	1	20050615 12:50	20050615 14:36
KFM08B	144.00	149.00	5.00	3	1	20050615 14:45	20050615 16:00
KFM08B	149.00	154.00	5.00	4B	1	20050615 16:08	20050615 17:23
KFM08B	154.00	159.00	5.00	3	1	20050616 08:10	20050616 09:23
KFM08B	159.00	164.00	5.00	3	1	20050616 09:33	20050616 10:49
KFM08B	164.00	169.00	5.00	3	1	20050616 10:58	20050616 12:12
KFM08B	166.00	171.00	5.00	3	1	20050616 12:31	20050616 13:46
KFM08B	171.00	176.00	5.00	3	1	20050616 13:55	20050616 15:08
KFM08B	176.00	181.00	5.00	3	1	20050616 15:23	20050616 16:38
KFM08B	181.00	186.00	5.00	3	1	20050616 16:48	20050616 18:02
KFM08B	186.00	191.00	5.00	3	1	20050617 08:19	20050617 09:34
KFM08B	191.00	196.00	5.00	3	1	20050617 09:45	20050617 11:02
KFM08B	171.00	176.00	5.00	3	1	20050616 13:55	20050616 15:08
KFM08B	176.00	181.00	5.00	3	1	20050616 15:23	20050616 16:38
KFM08B	181.00	186.00	5.00	3	1	20050616 16:48	20050616 18:02
KFM08B	186.00	191.00	5.00	3	1	20050617 08:19	20050617 09:34
KFM08B	191.00	196.00	5.00	3	1	20050617 09:45	20050617 11:02

[1)] 3: Injection test, 4B: Pressure pulse test.

4 Description of equipment

4.1 Overview

4.1.1 Measurement container

All of the equipment needed to perform the injection tests is located in a steel container (Figure 4-1). The container is divided into two compartments; a data-room and a workshop. The container is placed on pallets in order to obtain a suitable working level in relation to the borehole casing.

The hoisting rig is of a hydraulic chain-feed type. The jaws, holding the pipe string, are opened hydraulically and closed mechanically by springs. The rig is equipped with a load transmitter and the load limit may be adjusted. The maximum load is 22 kN.

The packers and the test valve are operated hydraulically by water filled pressure vessels. Expansion and release of packers, as well as opening and closing of the test valve, is done using magnetic valves controlled by the software in the data acquisition system.

The injection system consists of a tank, a pump and a flow meter. The injection flow rate may be manually or automatically controlled. At small flow rates, a water filled pressure vessel connected to a nitrogen gas regulator is used instead of the pump.

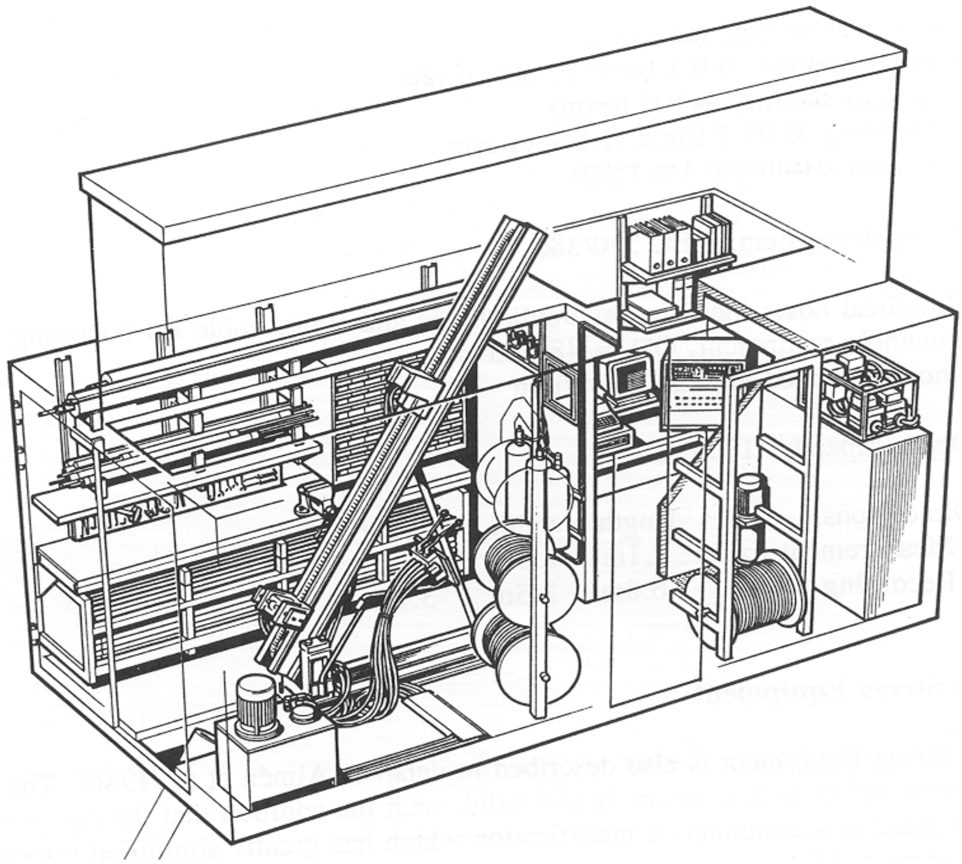

Figure 4-1. *Outline of the PSS3 container with equipment.*

4.1.2 Down-hole equipment

A schematic drawing of the down-hole equipment is shown in Figure 4-2. The pipe string consists of aluminium pipes of 3 m length, connected by stainless steel taps sealed with double o-rings. Pressure is measured above (P_a), within (P) and below (P_b) the test section, which is isolated by two packers. The groundwater temperature in the test section is also measured. The hydraulic connection between the pipe string and the test section can be closed or opened by a test valve operated by the measurement system.

At the lower end of the borehole equipment, a level indicator (calliper type) gives a signal as the reference depth marks along the borehole are passed.

The length of the test section may be varied (5, 20 or 100 m).

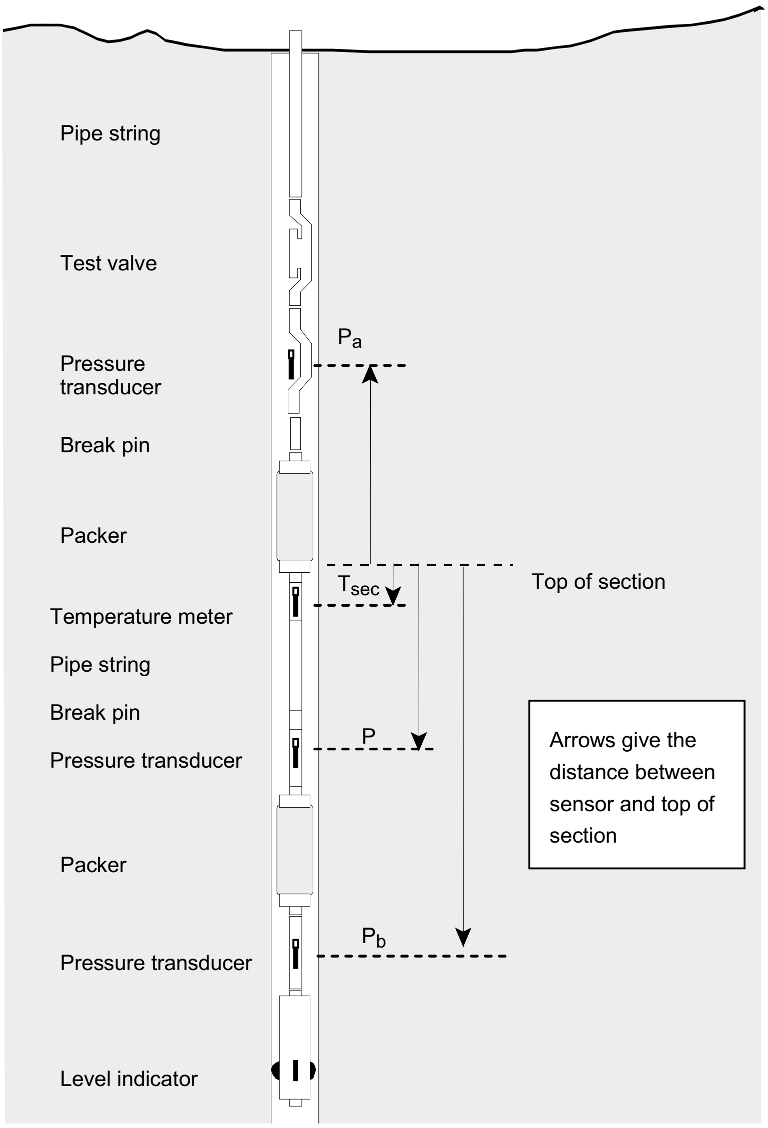

Figure 4-2. *Schematic drawing of the down-hole equipment in the PSS3 system.*

4.2 Measurement sensors

Technical data for the measurement sensors in the PSS system together with corresponding data of the system are shown in Table 4-1. The sensors are components of the PSS system. The accuracy of the PSS system may also be affected by the I/O-unit, cf Figure 4-3, and the calibration of the system.

The sensor positions are fixed relative to the top of the test section. In Table 4-2, the position of the sensors is given with top of test section as reference (Figure 4-2).

Table 4-1. Technical data for sensors together with estimated data for the PSS system (based on current experience).

Technical specification					
Parameter		**Unit**	**Sensor**	**PSS**	**Comments**
Absolute pressure	Output signal	mA	4–20		
	Meas range	MPa	0–13.5		
	Resolution	kPa	< 1.0		
	Accuracy[1)]	% F.S	0.1		
Differential pressure, 200 kPa	Accuracy	kPa		< ±5	Estimated value
Temperature	Output signal	mA	4–20		
	Meas range	°C	0–32		
	Resolution	°C	< 0.01		
	Accuracy	°C	±0.1		
Flow Qbig	Output signal	mA	4–20		
	Meas range	m^3/s	$1.67 \cdot 10^{-5}$–$1.67 \cdot 10^{-3}$		The specific accuracy
	Resolution	m^3/s	$6.7 \cdot 10^{-8}$		is depending on actual
	Accuracy[2)]	% O.R	0.15–0.3	< 1%	flow
Flow Qsmall	Output signal	mA	4–20		
	Meas range	m^3/s	$1.67 \cdot 10^{-8}$–$1.67 \cdot 10^{-5}$		The specific accuracy
	Resolution	m^3/s	$6.7 \cdot 10^{-10}$		is depending on actual
	Accuracy[3)]	% O.R	0.1–0.4	0.5–20	flow

[1)] 0.1% of Full Scale. Includes hysteresis, linearity and repeatability.

[2)] Maximum error in % of actual reading (% o r).

[3)] Maximum error in % of actual reading (% o r). The higher numbers correspond to the lower flow.

Table 4-2. Position of sensors in the borehole and displacement volume of equipment in the test section.

Parameter	**Length of test section (m)**
	5
Equipment displacement volume in test section [1)]	3.6
Total volume of test section [2)]	23
Position for sensor P_a, pressure above test section, (m above secup) [3)]	1.89
Position for sensor P, pressure in test section, (m above secup) [3)]	–4.12
Position for sensor T_{sec}, Temperature in test section, (m above secup) [3)]	–0.98
Position for sensor P_b, pressure below test section, (m above secup) [3)]	–7.01

[1)] Displacement volume in test section due to pipe string, signal cable, sensors and packer ends (in litre).

[2)] Total volume of test section (V= section length·π·d^2/4).

[3)] Position of sensor relative top of test section. A negative value indicates a position below top of test section, (secup).

4.3 Data acquisition system

The data acquisition system in the PSS equipment contains a standard office PC connected to an I/O-unit (Datascan 7320). Using the Orchestrator software, pumping and injection tests are monitored and borehole sensor data are collected. In addition to the borehole parameters, packer and atmospheric pressure, container air temperature and water temperature are logged. Test evaluation may be performed on-site after a conducted test. An external display enables monitoring of test parameters.

The data acquisition system may be used to start and stop the automatic control system (computer and servo motors). These are connected as shown in Figure 4-3. The control system monitors the flow regulator and uses differential pressure across the regulating valve together with pressure in test section as input signals.

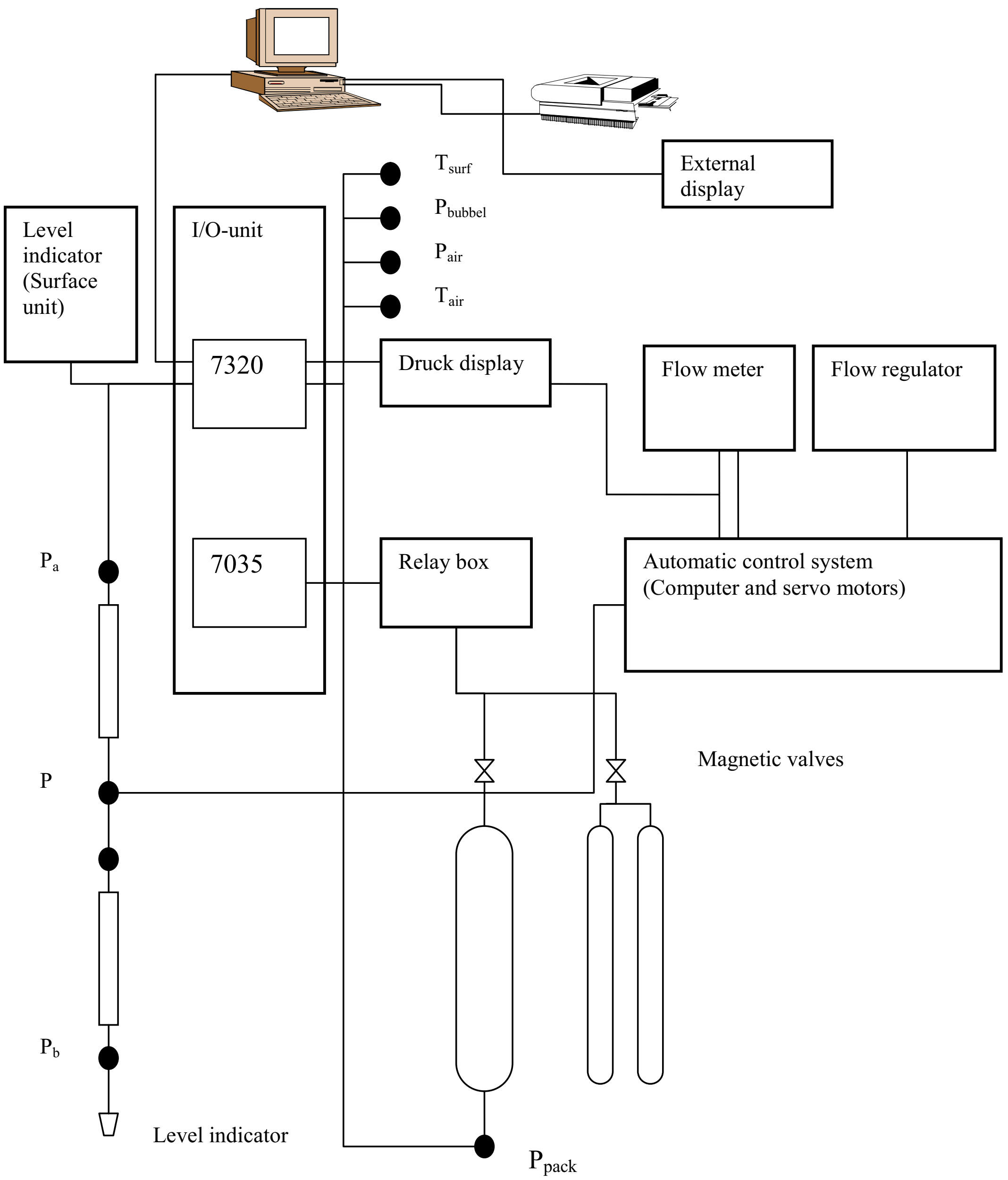

Figure 4-3. *Schematic drawing of the data acquisition system and the automatic control system in PSS.*

5 Execution

5.1 Preparation

5.1.1 Calibration

All sensors included in PSS are calibrated at the Geosigma engineering service station in Uppsala. Calibration is generally performed prior to each measurement campaign. Results from calibration, e.g. calibration constants, of sensors are kept in a document folder in PSS. If a sensor is replaced at the test site, calibration constants are altered as well. If a new, un-calibrated, sensor is to be used, calibration may be performed afterwards and data re-calculated.

5.1.2 Functioning checks

Equipment functioning checks were performed during the establishment of PSS at the test site. Simple function checks of down-hole sensors were done while lowering the pipe string along the borehole.

5.1.3 Cleaning of equipment

Cleaning of the borehole equipment was performed according to the cleaning instruction (SKB MD 600.004, see Table 1-1), level 1.

5.2 Test performance

5.2.1 Test principle

Two kinds of test were performed in KFM08B, injection tests and pressure pulse tests. The injection tests in KFM08B were carried out while maintaining a constant head of generally 200 kPa (c 20 m water column) in the test section. Before start of the injection period, approximately steady-state pressure conditions prevailed in the test section. After the injection period, the pressure recovery was measured.

Pressure pulse tests were carried out instead of injection tests in some low-conductive sections, where the flow rate was expected to be close to or below the measurement limit for injection tests. The pressure pulse tests in KFM08B were performed by introducing a pressure pulse to the isolated test section. The pulse was accomplished by applying a pressure of c 200 kPa to the pipe string above the test section and then opening the test valve. After 2 minutes the valve was closed and the pressure recovery in the test section was measured.

Pressure pulse tests showing a continuing pressure increase, due to packer expansion, after the pulse (during the recovery period), were interrupted after c 10 minutes and no transient evaluation was made, but only a steady-state evaluation.

5.2.2 Test procedure

Generally, the tests were performed according to the Activity Plan AP PF 400-05-004. Exceptions to this are presented in Section 5.5.

A test cycle of a regular injection test includes the following phases: 1) Transfer of down-hole equipment to the next section, 2) Packer inflation, 3) Pressure stabilisation, 4) Injection, 5) Pressure recovery and 6) Packer deflation.

When the transmissivity in a section was expected to be low, a diagnostic test was conducted to decide whether to perform a pressure pulse test or an injection test. A test cycle in these cases includes the following phases: 1) Transfer of down-hole equipment to the next section, 2) Packer inflation, 3) Closing of test valve after five minutes, 4) Observing the pressure during further five minutes, 5) Deciding which test to conduct, 6) Opening of test valve, 7) Continuing packer inflation, 8) Pressure stabilisation, 9) Injection or pulse, 10) Pressure recovery and 11) Packer deflation. The test phases are the same regardless if a pressure pulse test or an injection test is decided to be performed, but the duration of the different phases differs according to Tables 5-1a and 5-1b.

The criterion used to decide which test to perform was that a pressure pulse test was made if the pressure increased 20 kPa or more during test phase 4 above. Otherwise an injection test was carried out.

Table 5-1a. Packer inflation times, pressure stabilisation times and test times used for the injection tests in KFM08B.

Test section length (m)	Packer inflation time (min)	Time for pressure stabilisation (min)	Injection period (min)	Recovery period (min)	Total time/test (min)[1)]
5	25	5	20	20	70

[1)] Exclusive of trip times in the borehole.

Table 5-1b. Packer inflation times, pressure stabilisation times and test times used for the pressure pulse tests in KFM08B.

Test section length (m)	Packer inflation time (min)	Time for pressure stabilisation (min)	Pulse period (min)	Recovery period (min)	Total time/test (min)[1)]
5	40	20	2	40	102

[1)] Exclusive of trip times in the borehole.

5.3 Data handling

With the PSS system, primary data are handled using the Orchestrator software (Version 2.3.8). During a test, data are continuously logged in *.odl-files. After the test is finished, a report file (*.ht2) with space separated data is generated. The *.ht2-file (mio-format) contains logged parameters as well as test-specific information, such as calibration constants and background data. The parameters are presented as percentage of sensor measurement range and not in engineering units. The report file in ASCII-format is the raw data file delivered to the data base SICADA.

The *.ht2-files are automatically named with borehole id, top of test section and date and time of test start (as for example __KFM08B_0007.00_200506081817.ht2). The name differs slightly from the convention stated in Instructions for analysis of injection and single-borehole pump test, SKB MD 320.004.

Using the IPPLOT software (Version 3.0), the *.ht2-files are converted to parameter files suitable for plotting applying the code SKB-plot and analysis with the AQTESOLV software.

A backup of data files was created on a regular basis by CD-storage and by sending the files to the Geosigma office in Uppsala by a file transfer protocol. A file description table is presented in Appendix 1.

5.4 Analysis and interpretation

5.4.1 General

As described in Section 5.2.1, the injection tests in KFM08B were performed as transient constant head tests followed by a pressure recovery period. From the injection period, the (reciprocal) flow rate versus time was plotted in log-log and lin-log diagrams together with the corresponding derivative. From the recovery period, the pressure was plotted versus Agarwal equivalent time in lin-log and log-log diagrams, respectively, together with the corresponding derivative. The routine data processing of the measured data was done according to the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004).

For pressure pulse tests the standard transient evaluation is performed in a lin-log diagram showing the normalized recovery H/H_0 versus elapsed recovery time during together with the corresponding derivative. The recovery is generally normalized with respect to H_0, which is the initial pressure in the borehole section before the packers are expanded. In addition, a stationary evaluation method, accounting for the packer generated flow, was also used for evaluation of the pressure pulse tests, see Section 5.4.4.

For evaluation of the test data, no corrections of the measured flow rate and absolute pressure data (e.g. due to barometric pressure variations or tidal fluctuations) have been made. For short-time single-hole tests, such corrections are generally not needed, unless very small pressure changes are applied. No subtraction of the barometric pressure from the measured absolute pressure has been made, since the length of the test periods are short relative to the time scale for barometric pressure changes. In addition, pressure differences rather than the pressure magnitudes are used by the evaluation.

5.4.2 Measurement limit for flow rate and specific flow rate

The estimated standard lower measurement limit for flow rate for injection tests with PSS is c 1 mL/min ($1.7 \cdot 10^{-8}$ m^3/s). However, if the flow rate for a test is close to, or below, the standard lower measurement limit, a test-specific estimate of the lower measurement limit of flow rate can be made. The test-specific lower limit is based on the measurement noise level of the flow rate before and after the injection period. The decisive factor for the varying lower measurement limit is not unambiguously identified, but it might be of both technical and hydraulic character. Since pressure pulse tests were conducted in sections with a possible low transmissivity, none of the injection tests in KFM08B had a flow rate below or close to the standard lower measurement limit. Hence, no test specific estimate of the lower measurement limit for the flow rate was made.

The lower measurement limit for transmissivity is defined in terms of the specific flow rate (Q/s). The minimum specific flow rate corresponds to the estimated lower measurement limit of the flow rate together with the actual injection pressure during the test. The intention during this test campaign was to use a standard injection pressure of 200 kPa (20 m water column). However, for some test sections in KFM08B, the actual injection pressure was considerably different. The injection pressure exceeded 300 kPa for two tests, and for four of the tests the injection pressure was below 100 kPa. A low injection pressure is often the result of a test section of low conductivity due to a pressure increase, caused by packer expansion, before the injection start. A highly conductive section may also result in a low injection pressure due to limited flow capacity of PSS. Since the flow rate never was below the standard lower measurement limit for the injection tests in KFM08B, it is not necessary to calculate any test specific lower measurement limits for the specific flow rate either.

The lower measurement limit for flow rate corresponds to different values of the steady-state transmissivity, T_M, depending on the section length used in the factor C_M in Moye's formula (Equation 5-2), as described in the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004). Only 5 m section lengths were used in borehole KFM08B. The standard lower measurement limit for flow rate of 1 mL/min ($1.7 \cdot 10^{-8}$ m^3/s) together with the value of C_M ($C_{M,\,5m} = 0.83$) for a five metres test section results in the lower measurement limits for steady-state transmissivity (T_M) of $1.3 \cdot 10^{-9}$ m^2/s, $6.7 \cdot 10^{-10}$ m^2/s and $4.5 \cdot 10^{-10}$ m^2/s for injection pressures 100 kPa, 200 kPa and 300 kPa respectively.

To define the lower measurement limit of transmissivity for pressure pulse tests with the PSS, further consideration of the packer generated flow is necessary. Since the packers generate a small, but not negligible, flow throughout the test period, the estimated transmissivities from the transient evaluation of pressure pulse tests will be underestimated in low-transmissivity sections because no correction is normally made for the packer generated flow. In the stationary evaluation, the packer generated flow is taken into account (see Section 5.4.3 for a further discussion). Among other potential problems, the stationary evaluation has an inherent risk of overestimating the transmissivity, since the tests have a limited duration and true stationary conditions, in fact, never prevail. In addition, the uncertainty and variations in the assumed packer generated flow from test to test is being ignored.

The selected, most representative transmissivity from the pressure pulse tests corresponds to the calculated transmissivity from the stationary evaluation. However, no transmissivity values lower than $5 \cdot 10^{-11}$ m^2/s are reported. The latter value is considered as the practical lower measurement limit of transmissivity from pressure pulse tests considering the effects of packer compliance. Due to the increased uncertainty of estimated transmissivities from pressure pulse tests, all these values are assigned Value type –1 in the SICADA database, i.e. below the measurement limit.

The practical upper measurement limit of hydraulic transmissivity for the PSS system is estimated from a flow rate of c 30 L/min ($5 \cdot 10^{-4}$ m^3/s) and an injection pressure of c 1 m. Thus, the upper measurement limit for specific flow rate is $5 \cdot 10^{-4}$ m^2/s. However, the practical upper measurement limit may vary, depending on e.g. depth of the test section (friction losses in the pipe string).

5.4.3 Qualitative analysis

Initially, a qualitative evaluation of actual flow regimes, e.g. wellbore storage (WBS), pseudo-radial flow regime (PRF), pseudo-spherical flow regime (PSF) and pseudo-stationary flow regime (PSS), respectively, was performed for the injection tests. In addition, indications of outer boundary conditions during the tests were identified. The qualitative evaluation was mainly interpreted from the log-log plots of flow rate and pressure together with the corresponding derivatives. No flow regimes were identified for the pressure pulse tests.

In particular, time intervals with pseudo-radial flow, reflected by a constant (horizontal) derivative in the test diagrams, were identified. Pseudo-linear flow may, at the beginning of the test, be reflected by a straight line of slope 0.5 or less in log-log diagrams, both for the measured variable (flow rate or pressure) and the derivative. A true spherical flow regime is reflected by a straight line with a slope of –0.5 for the derivative. However, other slopes may indicate transitions to pseudo-spherical (leaky) or pseudo-stationary flow. The latter flow regime corresponds to almost stationary conditions with a derivative approaching zero.

The interpreted flow regimes can also be described in terms of the distance from the borehole:

- **Inner zone:** Representing very early responses that may represent the fracture properties close to the borehole which may possibly be affected by turbulent head losses. These properties are generally reflected by the skin factor.
- **Middle zone:** Representing the first response from which it is considered possible to evaluate the hydraulic properties of the formation close to the borehole.
- **Outer zone:** Representing the response at late times of hydraulic feature(s) connected to the hydraulic feature for the middle zone. Sometimes it is possible to deduce the possible character of the actual feature or boundary and evaluate the hydraulic properties of the features.

Due to the limited resolution of, in particular, the pressure sensor, the derivative may some times erroneously indicate a false horizontal line by the end of recovery periods with pseudo-stationary flow. Apparent no-flow (NFB) and constant head boundaries (CHB), or equivalent boundary conditions of fractures, are reflected by an increase/decrease of the derivative, respectively.

5.4.4 Quantitative analysis

Injection tests

A preliminary steady-state analysis of transmissivity according to Moye's formula (denoted T_M) was made for the injection period for all injection tests in conjunction with the qualitative analysis according to the following equation:

$$T_M = \frac{Q_p \cdot \rho_w \cdot g}{dp_p} \cdot C_M \qquad (5\text{-}1)$$

$$C_M = \frac{1 + \ln\left(\frac{L_w}{2r_w}\right)}{2\pi} \qquad (5\text{-}2)$$

Q_p = flow rate by the end of the flow period (m^3/s)

ρ_w = density of water (kg/m^3)

g = acceleration of gravity (m/s^2)

C_M = geometrical shape factor (–)

$dp_p = p_p - p_i$ (Pa)

r_w = borehole radius (m)

L_w = section length (m)

From the results of the qualitative evaluation, appropriate interpretation models for the quantitative evaluation of the tests were selected. When possible, transient analysis was made on both the injection and recovery periods of the tests.

The transient analysis was performed using a special version of the test analysis software AQTESOLV, which enables both visual and automatic type curve matching. The quantitative transient evaluation is generally carried out as an iterative process of manual type curve matching and automatic matching. For the injection period, a model based on the Jacob and Lohman (1952) solution /1/ was applied for estimating the transmissivity and skin factor for an assumed value on the storativity when a certain period with pseudo-radial flow could be identified. The model is based on the effective wellbore radius concept to account for non-zero (negative) skin factors according to Hurst, Clark and Brauer (1969) /2/.

In borehole KFM08B, the storativity was calculated using an empirical regression relationship between storativity and transmissivity, see Equation 5-3 (Rhén et al. 1997) /3/. Firstly, the transmissivity and skin factor was obtained by type curve matching on the data curve using a fixed storativity value of 10^{-6}, according to the instruction SKB MD 320.004. From the transmissivity value obtained, the storativity was then calculated according to Equation 5-3 and the type curve matching was repeated.

$$S = 0.0007 \cdot T^{0.5} \qquad (5\text{-}3)$$

S = storativity (–)

T = transmissivity (m^2/s)

In most cases the change of storativity did not significantly alter the calculated transmissivity by the new type curve matching. Instead, the estimated skin factor, which is strongly correlated to the storativity using the effective borehole radius concept, was altered correspondingly.

For transient analysis of the recovery period, a model presented by Dougherty-Babu (1984) /4/ was used when a certain period with pseudo-radial flow could be identified. In this model, a variety of transient solutions for flow in fractured porous media is available, accounting for e g wellbore storage and skin effects, double porosity etc. The solution for wellbore storage and skin effects is analogous to the corresponding solution presented in Earlougher (1977) /5/ based on the effective wellbore radius concept to account for non-zero (negative) skin factors. However, for tests in isolated test sections, wellbore storage is represented by a radius of a fictive standpipe (denoted fictive casing radius, r(c)) connected to the test section, c f Equation 5-6. This concept is equivalent to calculating the wellbore storage coefficient C from the compressibility in an isolated test section according to Equation 5-5.

The model by Dougherty-Babu (1984) was used to estimate the transmissivity and skin factor from the recovery period. The storativity was calculated using Equation 5-3 in the same way as described above for the transient analysis of the injection period. In addition, the wellbore storage coefficient was estimated, both from the simulated value on the fictive casing radius r(c) and from the slope of 1:1 in the log-log recovery plots.

For tests characterized by pseudo-spherical (leaky) flow or pseudo-stationary flow during the injection period a model by Hantush (1959) /6/ for constant head tests was adopted for the evaluation. In this model, the skin factor is not separated but can be calculated from the simulated effective borehole radius according to Equation 5-4. This model also allows calculation of the wellbore storage coefficient according to Equation 5-6. In addition, the leakage coefficient K'/b' can be calculated from the simulated leakage factor r/B. The corresponding model for constant flow rate tests, (Hantush 1955) /7/, was applied for evaluation of the recovery period for tests showing pseudo-spherical- or pseudo-stationary flow during this period.

$$\zeta = ln(r_w/r_{wf}) \qquad (5\text{-}4)$$

ζ = skin factor

r_w = borehole radius (m)

r_{wf} = effective borehole radius

Some tests showed fracture responses (a slope of 0.5 or less in a log-log plot). Models for single fractures were then used for the transient analysis as a complement to the standard models. The models by Ozkan-Raghavan (1991a) /8/ and (1991b) /9/ for a vertical fracture were employed. In these cases, the test section length was used to convert K and S_s to T and S, respectively, after analysis by fracture models. The quotient K_x/K_y of the hydraulic conductivity in the x and the y-direction, respectively, was assumed to be 1.0 (one). Type curve matching provided values of K_x and L_f, where L_f is the theoretical fracture length.

The different transient estimates of transmissivity from the injection and recovery period, respectively, were then compared and examined. One of these was chosen as the best representative value of the transient transmissivity of the formation adjacent to the test section. This value is denoted T_T. In cases with more than one pseudo-radial flow regime during the injection or recovery period, the first one is assumed as the most representative for the hydraulic conditions in the rock close to the tested section. In most cases, the transient estimates of transmissivity from the injection period were considered more representative than those from the recovery period. The recovery responses were quite often strongly affected by wellbore storage and frequently, no pseudo-radial flow regime was reached.

Finally, a representative value of transmissivity of the test section, T_R, was chosen from T_T and T_M. In none of the 29 injection tests (who all have a definable final flow rate) in KFM08B the steady-state transmissivity, T_M, was considered as the most representative value of transmissivity of the test section. The latter transmissivity is to be chosen whenever a transient evaluation of the test data is not possible or not being judged as reliable. If the flow rate by the end of an injection period (Q_p) is too low to be defined, and thus neither T_T nor T_M can be estimated, the representative transmissivity for the test section is considered to be less than T_M based on the estimated lower measurement limit for Q/s (i.e. $T_R < T_M$ = Q/s-measl-L·C_M).

The estimated value of the borehole storage coefficient, C, based on actual borehole geometrical data and assumed fluid properties for a 5 m section is shown in Table 5-2 together with the estimated effective C_{eff} from laboratory experiments /10/. The net water volume in the test section, V_w, has in Table 5-2 been calculated by subtracting the volume of equipment in the test section (pipes and thin hoses) from the total volume of the test section. For an isolated test section, the wellbore storage coefficient, C, may be calculated as Almén et al. (1986) /11/:

$$C = V_w \cdot c_w = L_w \cdot \pi \cdot r_w^2 \cdot c_w \qquad (5\text{-}5)$$

V_w = water volume in test section (m^3)

r_w = nominal borehole radius (m)

L_w = section length (m)

c_w = compressibility of water (Pa^{-1})

When appropriate, estimation of the actual borehole storage coefficient C in the test sections was made from the recovery period, based on the early borehole response with 1:1 slope in the log-log diagrams. The coefficient C was calculated only for tests with a well-defined line of slope 1:1 in the beginning of the recovery period. In the most conductive sections, this period occurred during very short periods at early test times. The latter values may be compared with the net value of C based on geometry and the value of C_{eff} based on laboratory experiments, (Table 5-2).

Furthermore, when using the model by Dougherty-Babu (1984), a fictive casing radius, r(c), is obtained from the parameter estimation of the recovery period. This value can then be used for calculating C as /11/:

$$C = \frac{\pi \cdot r(c)^2}{\rho \cdot g} \qquad (5\text{-}6)$$

Although this calculation was not done regularly and the results are not presented in this report, the calculations corresponded in most cases well to the value of C obtained from the line of slope 1:1 in the beginning of the recovery period.

The estimated values of C from the tests may differ from the net values in Table 5-2 based on geometry. For example, the effective compressibility for an isolated test section may sometimes be higher than the water compressibility due to e.g. packer compliance, resulting in increased C-values.

Table 5-2. Calculated net values of C, based on the actual geometrical properties of the borehole and equipment configuration in the test section (C_{net}) together with the effective wellbore storage coefficient (C_{eff}) for injection- and pressure pulse tests from laboratory experiments /10/.

r_w (m)	L_w (m)	Volume of test section (m^3)	Volume of equipment in section (m^3)	V_w (m^3)	C_{net} (m^3/Pa)	C_{eff} (m^3/Pa)
0.0381	5	0.023	0.004	0.020	$9.2 \cdot 10^{-12}$	$1.6 \cdot 10^{-11}$

The radius of influence at a certain time may be estimated from Jacob's approximation of the Theis' well function, Cooper and Jacob (1946) /12/:

$$r_i = \sqrt{\frac{2.25Tt}{S}} \qquad (5\text{-}7)$$

T = representative transmissivity from the test (m^2/s)

S = storativity estimated from Equation 5-3

r_i = radius of influence (m)

t = time after start of injection (s)

If a certain time interval of pseudo-radial flow (PRF) from t_1 to t_2 can be identified during the test, the radius of influence is estimated using time t_2 in Equation 5-7. If no interval of PRF can be identified, the actual total flow time t_p is used. The radius of influence can be used to deduce the length of the hydraulic feature(s) tested.

Furthermore, an r_i-index (–1, 0 or 1) is defined to characterize the hydraulic conditions by the end of the test. The ri-index is defined as shown below. It is assumed that a certain time interval of PRF can be identified between t_1 and t_2 during the test.

- r_i-index = 0: The transient response indicates that the size of the hydraulic feature tested is greater than the radius of influence based on the actual test time (t_2=t_p), i.e. the PRF is continuing at stop of the test. This fact is reflected by a flat derivative at this time.
- r_i-index = 1: The transient response indicates that the hydraulic feature tested is connected to a hydraulic feature with lower transmissivity or an apparent barrier boundary (NFB). This fact is reflected by an increase of the derivative. The size of the hydraulic feature tested is estimated as the radius of influence based on t_2.
- r_i-index = –1: The transient response indicates that the hydraulic feature tested is connected to a hydraulic feature with higher transmissivity or an apparent constant head boundary (CHB). This fact is reflected by a decrease of the derivative. The size of the hydraulic feature tested is estimated as the radius of influence based on t_2.

If a certain time interval of PRF cannot be identified during the test, the r_i-indices –1 and 1 are defined as above. In such cases the radius of influence is estimated using the flow time t_p in Equation 5-7.

Pressure pulse tests

By the evaluation of the pressure pulse tests both a transient and a stationary evaluation were made. A model described by Dougherty and Babu (1984) /4/ was used for transient evaluation of the pressure pulse tests performed. The normalized recovery H/H_0 was plotted versus elapsed time during the recovery period in a lin-log diagram. In this analysis, the actual head change, H, was not corrected for effects of packer generated flow.

As for the injection tests, the effective borehole radius concept, Equation (5-4), was used for calculating the skin factor as well as the concept of a fictive standpipe connected to the test section representing wellbore storage according to Equation (5-6). The value of C_{eff} (see Table 5-2) used to calculate the radius of the fictive standpipe, r(c), is derived from laboratory experiments /10/. The transmissivity and skin factor were estimated for a certain value of storativity and wellbore storage coefficient (represented by the radius of the fictive standpipe) from type curve matching. The storativity was calculated from Equation (5-3) as for the injection tests.

Whenever the transmissivity in the section was so low that the packer generated flow caused a pressure increase after the pulse, the test was interrupted and no transient evaluation was made. Since the packers are still slowly expanding, even after the time allowed for packer expansion and pressure stabilization (60 minutes), a small flow is generated throughout the tests by the packers. For such low-conductive sections this flow is not negligible, which leads to an underestimation of the transmissivities. Efforts have been made to account for the packer generated flow by different methods (e.g. by correcting H) before performing the transient evaluation, but none of them gave a satisfactory result.

The stationary method used to evaluate the pressure pulse tests should be regarded as a simple tool to estimate transmissivities below the standard measurement limit of the PSS system /10/. This method is described below and is in this report referred to as the stationary evaluation method. Firstly, some assumptions have to be made when estimating the packer generated flow:

- The test section which exhibited the highest pressure increase due to packer generated flow (packer compliance) in conjunction with pressure pulse tests performed with PSS at Forsmark so far, can be regarded as tight, i.e. the flow rate into the formation is much less than the flow rate generated by the packers.
- The average flow rate generated by the packers in the corresponding section can be calculated based on the pressure change (dp) during the first time interval (dt) of the recovery period after the application of the pressure pulse, e.g. during the first 10 minutes of the recovery period according to Equation 5-8. By this calculation, the estimated effective borehole storage coefficient (C_{eff}) for the actual test section length from laboratory tests is used. The value of C_{eff} for a 5 m test section is presented in Table 5-2.

$$C_{eff}\,\frac{dp}{dt} = Q_{packer} \qquad (5\text{-}8)$$

Q_{packer} = Packer generated flow (m^3/s)

C_{eff} = Effective borehole storage coefficient of test section (m^3/Pa)

dp/dt = Pressure change per time unit (Pa/s)

By the estimation of transmissivity some additional assumptions are made:

- The packer generated flow rate is assumed to be identical in all test sections, including the tight section which was used to estimate the packer generated flow rate. However, there are some indications from field tests that this assumption may not always be correct.
- The pressure pulse is applied at the same time after start of packer sealing for all tests. This assumption also includes the tight section which was used to estimate the packer generated flow rate.
- The average flow rate into the formation, e.g. during the first 10 minutes of the recovery period, is calculated based on the packer generated flow rate and the change of borehole storage in the test section. The change of borehole storage in the test section is calculated from the pressure change and the estimated effective borehole storage coefficient.

$$Q_{ave\ (formation)} = Q_{ave\ (packer)} + dV/dt \qquad (5\text{-}9)$$

$Q_{ave\ (formation)}$ = Average flow rate into the formation

$Q_{ave\ (packer)}$ = Average packer generated flow rate according to Equation (5-8)

$$dV/dt = \text{change of borehole storage} = C_{eff}\,\frac{dp}{dt} \qquad (5\text{-}10)$$

Finally, the transmissivity is estimated by a stationary evaluation, based on the average flow rate into the formation and the applied differential pressure. If the actual pressure changes during the test are high in relation to the applied pressure pulse, compensation can be made.

$$T_{ss,\ pulse} = Q_{ave\ (formation)} / H_0 \tag{5-11}$$

$T_{ss,\ pulse}$ = transmissivity (m^2/s)

H_0 = applied differential pressure by the pressure pulse test (m)

This method assumes that the packer generated flow is equally large for all tests. There are however indications that this flow may vary from test to test. Still, since the variation of the packer generated flow is unknown, this method gives a possibility to estimate transmissivity in very low-conductive sections (also when the pressure increases during the recovery period).

5.5 Nonconformities

The test program in KFM08B was carried out according to the Activity Plan AP PF 400-05-004 with the following exceptions:

- The tecalan hose connected to P_{bubbel}, the transducer measuring the ground water level, could not be put into position in the borehole before testing. This was due to the small diameter of the upper part of the borehole which made it impossible to get it down to the groundwater table.
- The temperature sensors in the injection water at the ground surface, T_{surf}, and in the logging cabin, T_{air}, were out of order during the injection tests in KFM08B.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results of the injection tests in KFM08B are in accordance with the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004). Additional symbols are explained in the text and in Appendix 5. Symbols used by the AQTESOLV software are explained in Appendix 3.

6.2 Routine evaluation of the single-hole injection tests

6.2.1 General test data

General test data and selected pressure and flow data from all tests are listed in Appendix 2.1 and 2.2, respectively.

During the injection tests in KFM08B pumping was recurrently going on in borehole HFM21 which is located c 500 m from KFM08B. This has probably affected the pressure above or below the test sections for some tests. Unusual pressure responses in sections below or above the test sections are noticed for these tests. It is however not likely that the test section was influenced since the pressure in the test section was however stable before the start of the injection.

Activities were also going on in KFM08A situated close to KFM08B. Lifting of equipment from this borehole affected the pressure above the test section in the two tests performed at that time (74.0–79.0 m and 49.0–54.0 m). The pressure in the test section was stable before the injection start, which indicates that these activities did not affect the tested section.

6.2.2 Length corrections

The down-hole equipment is supplied with a level indicator located c 3 m below the lower packer in the test section, see Figure 4-2. The level indicator transmits a signal each time a reference mark in the borehole is passed. Normally these reference marks are used to make length corrections, i.e. to adjust the length scale for the injection tests according to the reference marks. However in KFM08B no reference marks were milled into the borehole wall and therefore no corrections were performed.

6.2.3 General results

A summary of the results of the routine evaluation of the injection tests and pressure pulse tests is presented, test by test, in Table 6-1 and Table 6-2 respectively. Figure 6-2 shows the most representative transmissivity values from both injection- and pressure pulse tests in KFM08B. Selected test diagrams are presented in Appendix 3. In general, one linear diagram showing the entire test sequence together with lin-log and log-log diagrams from the injection and recovery periods, respectively, are presented for the injection tests. The quantitative analysis was performed from such diagrams using the AQTESOLV software. For each pressure pulse test one linear diagram showing the entire test sequence together with a lin-log diagram displaying the normalized recovery H/H_0 plotted versus elapsed time is presented. From pressure pulse tests that were interrupted during the recovery period because of increasing pressure, only the linear diagram is presented. The results of the routine evaluation of the tests in borehole KFM08B are also compiled in appropriate tables in Appendix 5 to be stored in the SICADA database.

Injection tests

For the injection tests, transient evaluation was conducted, whenever possible, both on the injection and recovery periods (T_f and T_s, respectively) according to the methods described in Section 5.4.4. The steady-state transmissivity (T_M) was calculated by Moye's formula according to Equation 5-1. The quantitative analysis was performed using the AQTESOLV software.

The dominating transient flow regimes during the injection and recovery periods, as interpreted from the qualitative test evaluation, are listed in Table 6-1 and are further commented on in Section 6.2.4. Several of the responses during the recovery period were strongly influenced by wellbore storage effects. Thus, for many tests, pseudo-radial flow was not reached during this period. On the other hand, during the injection period, a certain time interval with pseudo-radial flow could, in most tests, be identified. Consequently, standard methods for single-hole tests with wellbore storage and skin effects were generally used for the routine evaluation of the tests. The approximate start and stop times of the pseudo-radial flow regime used for the transient evaluation are also listed in Table 6-1.

For a few tests a type curve fit is yet displayed in the diagrams in Appendix 3 despite the estimated parameters from the fit are judged as non-representative and are thus not included in the result tables in SICADA. For these tests, the type curve fit is presented, for example, to illustrate that an assumption of pseudo-radial flow regime is not justified for the test. Instead, some other flow regime is likely to dominate. For example, for test responses showing only wellbore storage and tests approaching a pseudo-stationary flow, no unique transient evaluation is possible.

The transmissivity judged as the most reliable from the transient evaluation of the flow- and recovery periods of the tests was selected as T_T. The associated value of the skin factor is listed in Table 6-1. Since a fairly well-defined time interval with pseudo-radial flow in most cases could be identified from the injection period, the transmissivity calculated from this period is generally considered as the most reliable transmissivity, T_T, from the transient analysis of the injection tests in KFM08B. Furthermore, the transient evaluation of transmissivity from the injection period was for a majority of the tests also considered as the most representative estimate of transmissivity, T_R.

For those tests where transient evaluation is not possible or not considered representative, T_M is to be chosen as the representative transmissivity value, T_R. If Q_p is below the actual test-specific measurement limit, the representative transmissivity value is assumed to be less than the estimated T_M, based on Q/s-measl-L, see Section 5.4.2 and 5.4.4. However, this was not the case for any of the injection tests. They all had a Q_p above measurement limit and a transient evaluation could be made for all of them.

The results of the routine evaluation of the injection tests in borehole KFM08B are also compiled in appropriate tables in Appendix 5 to be stored in the SICADA database.

In Figure 6-1, a comparison of calculated transmissivities in 5 m sections from steady-state evaluation (T_M) and transmissivity values from the transient evaluation (T_T) is shown for the injection tests. The agreement between the two populations is in general considered as good. The lower standard measurement limit of transmissivity in 5 m sections based on a flow rate of 1 mL/min and an injection pressure of 200 kPa is indicated in the figure.

Table 6-1. Summary of the routine evaluation of the single-hole injection tests in borehole KFM08B.

Secup (m)	Seclow (m)	Test start YYYYMMDD hh:mm	b (m)	Flow regime [1] Injection	Recovery	T_M (m²/s)	T_f (m²/s)	T_s (m²/s)	T_T (m²/s)	T_R (m²/s)	ξ (–)	t_1 (s)	t_2 (s)	dte_1 (s)	dte_2 (s))	C (m³/Pa)	r_i (m)	r_i-index (–)
7.00	12.00	20050608 18:17	5.00	PSS?	WBS–>PSF	3.14E–08		2.22E–08	2.22E–08	2.22E–08	–2.08						24.06	–1
9.00	14.00	20050609 09:50	5.00	PRF	PLF–>PRF	2.02E–06	2.35E–06	5.62E–07	2.35E–06	2.35E–06	–1.66	300	1,200	400	650		76.90	0
14.00	19.00	20050609 11:30	5.00	PRF	PLF–>PRF–>PSF	3.64E–06	2.93E–06	1.16E–06	2.93E–06	2.93E–06	–3.63	200	1,200	60	100		81.22	0
19.00	24.00	20050609 13:31	5.00	PLF/NFB?	PLF	4.16E–05	8.06E–06	1.11E–05	1.11E–05	1.11E–05							113.78	1
24.00	29.00	20050609 15:00	5.00	PSF	PLF–>PSF	2.15E–05	6.97E–06	6.24E–06	6.97E–06	6.97E–06	–5.84						101.04	–1
29.00	34.00	20050609 16:28	5.00	PRF	PLF	3.06E–05	1.58E–05	9.90E–06	1.58E–05	1.58E–05	–5.61	200	1,200				123.80	0
34.00	39.00	20050610 08:19	5.00	PRF	PLF–>	1.42E–08	5.14E–09	2.75E–09	5.14E–09	5.14E–09	–4.50	500	1,200				16.63	0
39.00	44.00	20050610 09:51	5.00	PRF/PSF	WBS–>PRF	3.77E–08	4.99E–08	4.57E–08	4.99E–08	4.99E–08	0.35						29.55	–1
49.00	54.00	20050620 11:17	5.00	PRF–>NFB	WBS–>PRF–>NFB	1.27E–08	3.41E–08	2.74E–08	2.74E–08	2.74E–08	0.65	10	100	20	80		6.52	1
54.00	59.00	20050610 14:00	5.00	PLF–>PRF?	PRF–>NFB	6.43E–09	1.19E–09	1.05E–08	1.19E–09	1.19E–09				10	100		11.60	1
59.00	64.00	20050610 15:25	5.00	PRF	WBS	5.78E–08	3.38E–08		3.38E–08	3.38E–08	–3.79						26.83	0
74.00	79.00	20050620 09:43	5.00	NFB	WBS–>PRF?	8.05E–10		1.90E–09	1.90E–09	1.90E–09	–5.24					3.92E–10	13.03	0
84.00	89.00	20050613 14:48	5.00	NFB–>	PLF	2.33E–08		1.16E–08	1.16E–08	1.16E–08							20.46	1
89.00	94.00	20050613 16:17	5.00	PRF–>PSF	PSF–>NFB	3.73E–07	2.73E–07	5.18E–07	2.73E–07	2.73E–07	–2.81						45.15	–1
94.00	99.00	20050620 08:16	5.00	PRF	PRF–>PSF	2.05E–08	1.02E–08	2.82E–08	1.02E–08	1.02E–08	–3.86	300	1,200	100	300		19.73	0
99.00	104.00	20050614 07:03	5.00	NFB	WBS–>(PRF)	1.09E–08		3.39E–08	3.39E–08	3.39E–08	–5.96						26.57	1
104.00	109.00	20050617 15:20	5.00	PRF	WBS–>PRF?	2.05E–07	6.33E–08	1.10E–07	6.33E–08	6.33E–08	–5.49	100	1,200	400	1,000		31.15	0
124.00	129.00	20050615 08:22	5.00	NFB–>	PLF	8.06E–08		5.26E–08	5.26E–08	5.26E–08							29.67	1
129.00	134.00	20050617 11:32	5.00	PRF–>NFB	(PLF)	1.22E–09	2.53E–08		2.53E–08	2.53E–08	1.29	10	100				7.15	1
144.00	149.00	20050615 14:45	5.00	NFB	PLF–>PRF	4.95E–08		4.18E–08	4.18E–08	4.18E–08	–5.35						28.21	1
154.00	159.00	20050616 08:10	5.00	NFB	PLF/WBS	3.27E–08		1.01E–07	1.01E–07	1.01E–07							34.97	1
159.00	164.00	20050616 09:33	5.00	PRF	WBS–>	3.94E–09	1.41E–09	1.99E–09	1.41E–09	1.41E–09	–4.05	300	1,200			1.09E–10	12.04	0
164.00	169.00	20050616 10:58	5.00	PRF	WBS–>(PRF)	4.12E–08	2.19E–08	3.97E–08	2.19E–08	2.19E–08	–3.90	40	1,200			6.74E–10	23.89	0
166.00	171.00	20050616 12:31	5.00	PSF	WBS–>	1.70E–09	5.28E–10	5.40E–10	5.28E–10	5.28E–10	–3.74					1.50E–10	9.47	–1
171.00	176.00	20050616 13:55	5.00	PSF	WBS–>	3.50E–09	9.49E–10	1.12E–09	9.49E–10	9.49E–10	–4.17					1.88E–10	10.96	–1
176.00	181.00	20050616 15:23	5.00	PRF	PLF–>(PRF)	5.26E–09	5.11E–09	4.12E–09	5.11E–09	5.11E–09	–1.31	100	1,200	70	200		16.60	0
181.00	186.00	20050616 16:48	5.00	PRF	WBS–>	4.37E–09	5.56E–09	7.47E–09	5.56E–09	5.56E–09	0.53	100	1,200			6.61E–11	16.96	0
186.00	191.00	20050617 08:19	5.00	PRF	PRF	1.06E–08	7.13E–09	1.23E–08	7.13E–09	7.13E–09	–3.05	100	1,200	20	1,000		18.05	0
191.00	196.00	20050617 09:45	5.00	PLF–>PRF?	PLF	1.53E–06	2.77E–07	4.13E–07	2.77E–07	2.77E–07							45.28	0

[1] The acronyms in the column “Flow regime” are as follow: wellbore storage (WBS), pseudo-linear flow (PLF), pseudo-radial flow (PRF), pseudo-spherical flow (PSF), pseudo-stationary flow (PSS) and apparent no-flow boundary (NFB). The flow regime definitions are further discussed in Section 5.4.3 above.

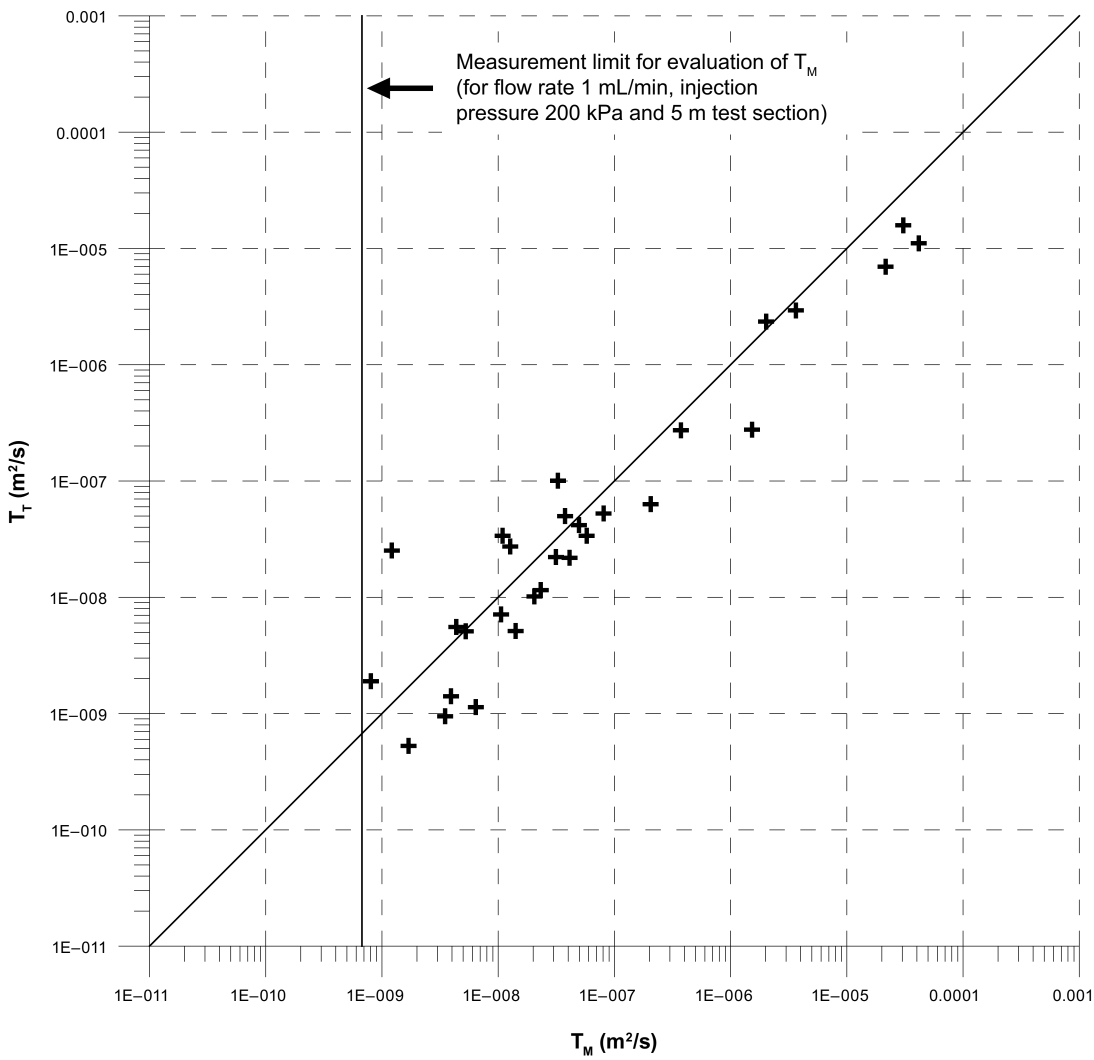

Figure 6-1. *Estimated transmissivities in 5 m sections from steady-state (T_M) and transient (T_T) evaluation for the injection tests in KFM08B.*

The wellbore storage coefficient, C, was calculated from the straight line with a unit slope in the log-log diagrams from the recovery period in KFM08B, see Table 6-1. The coefficient C was only calculated for tests with a well-defined line of unit slope in the beginning of the recovery period. In the most conductive sections, this period occurred during very short intervals at very early times and is not visible in the diagrams. In sections with a very low transmissivity, the estimates of C may be uncertain due to difficulties in defining an accurate time for the start of the recovery period. Furthermore, the resolution of the pressure sensors causes the recovery to be quite scattered in sections of low transmissivity. The values of C presented in Table 6-1 may be compared with the net values of C_{net} (based on geometry) and the value of C obtained from laboratory experiments, C_{eff} /10/, both found in Table 5-2.

The number of tests with a well-defined line of unit slope for which it was possible to calculate C was as follows: 6 of 29 injection tests resulted in a well-defined 1:1 straight line. Table 6-1 shows that the calculated values from the tests tend to be slightly higher than C_{net} presented in Table 5-2. However, when the calculated values are compared with the value C_{eff} obtained from laboratory experiments, the agreement is better although the calculated values still tend to be slightly higher.

The test in section 164.0–169.0 m resulted in a higher estimate of C than the other tests. No reasonable explanation has been found for the significantly higher wellbore storage coefficient estimated from the test in the interval of 164.0–169.0 m. When constructing a 95% confidence interval (using a t-distribution) from calculated values of C from the tests, the values of C listed in Table 5-2 are within this confidence interval.

Pressure pulse tests

Transient evaluation was performed for the pressure pulse tests, together with the stationary evaluation described in Section 5.4.4, except for the tests that were interrupted because the pressure increased after the pulse. For these tests only the stationary method was used.

In Table 6-2 the results from the transient evaluation ($T_{T,\ pulse}$) and from the stationary evaluation ($T_{ss,\ pulse}$) are presented together with the selected, most representative estimate of transmissivity, $T_{R,\ pulse}$.

For all of the pulse tests the stationary evaluation was considered as the most representative. This is, for a majority of the tests, because the packers strongly affect the section, resulting in an underestimation of the transmissivities by the transient evaluation. The transmissivity value reported for the individual pulse test is also chosen as the lower measurement limit for the specific test section. However, no values lower than $5.0 \cdot 10^{-11}$ m^2/s are regarded to be representative.

For a majority of the pressure pulse tests the transient evaluated value is much lower than the stationary evaluated one due to packer compliance. However, in the section 134.0–139.0 m the evaluated transmissivities are of the same order of magnitude. This might indicate that the effect of packer compliance is relatively small in this section, and that a transient evaluation is possible here. However, the simulated curves in the transient evaluation show poor fit to the measured data and the apparent skin factor becomes very large. Hence, the transient evaluation is not regarded as representative, and the transmissivity obtained from the stationary evaluation is chosen.

Table 6-2. Summary of the routine evaluation of the single-hole pressure pulse tests in borehole KFM08B.

Secup	Seclow	Test start	b	$T_{ss,\ pulse}$	$T_{T,\ pulse}$	ξ	$T_{meas\ limit}$	$T_{R,\ pulse}$
(m)	(m)	YYYYMMDD hh:mm	(m)	(m^2/s)	(m^2/s)	(–)	(m^2/s)	(m)
44.00	49.00	20050610 11:16	5.00	9.06E–11	4.23E–12	–3.59	9.06E–11	9.06E–11
64.00	69.00	20050610 16:46	5.00	1.64E–10	5.62E–11	–1.47	1.64E–10	1.64E–10
69.00	74.00	20050613 09:06	5.00	4.30E–11	–	–	5.00E–11	5.00E–11
79.00	84.00	20050613 12:44	5.00	6.01E–11	6.79E–13	–3.43	6.01E–11	6.01E–11
109.00	114.00	20050614 10:30	5.00	5.70E–12	–	–	5.00E–11	5.00E–11
114.00	119.00	20050614 11:42	5.00	1.26E–10	1.54E–11	–1.60	1.26E–10	1.26E–10
119.00	124.00	20050617 13:20	5.00	2.26E–10	7.04E–12	–5.31	2.26E–10	2.26E–10
134.00	139.00	20050615 10:49	5.00	1.40E–10	6.44E–10	33.05	1.40E–10	1.40E–10
139.00	144.00	20050615 12:50	5.00	9.37E–11	1.42E–11	–1.96	9.37E–11	9.37E–11
149.00	154.00	20050615 16:08	5.00	–	–	–	5.00E–11	5.00E–11

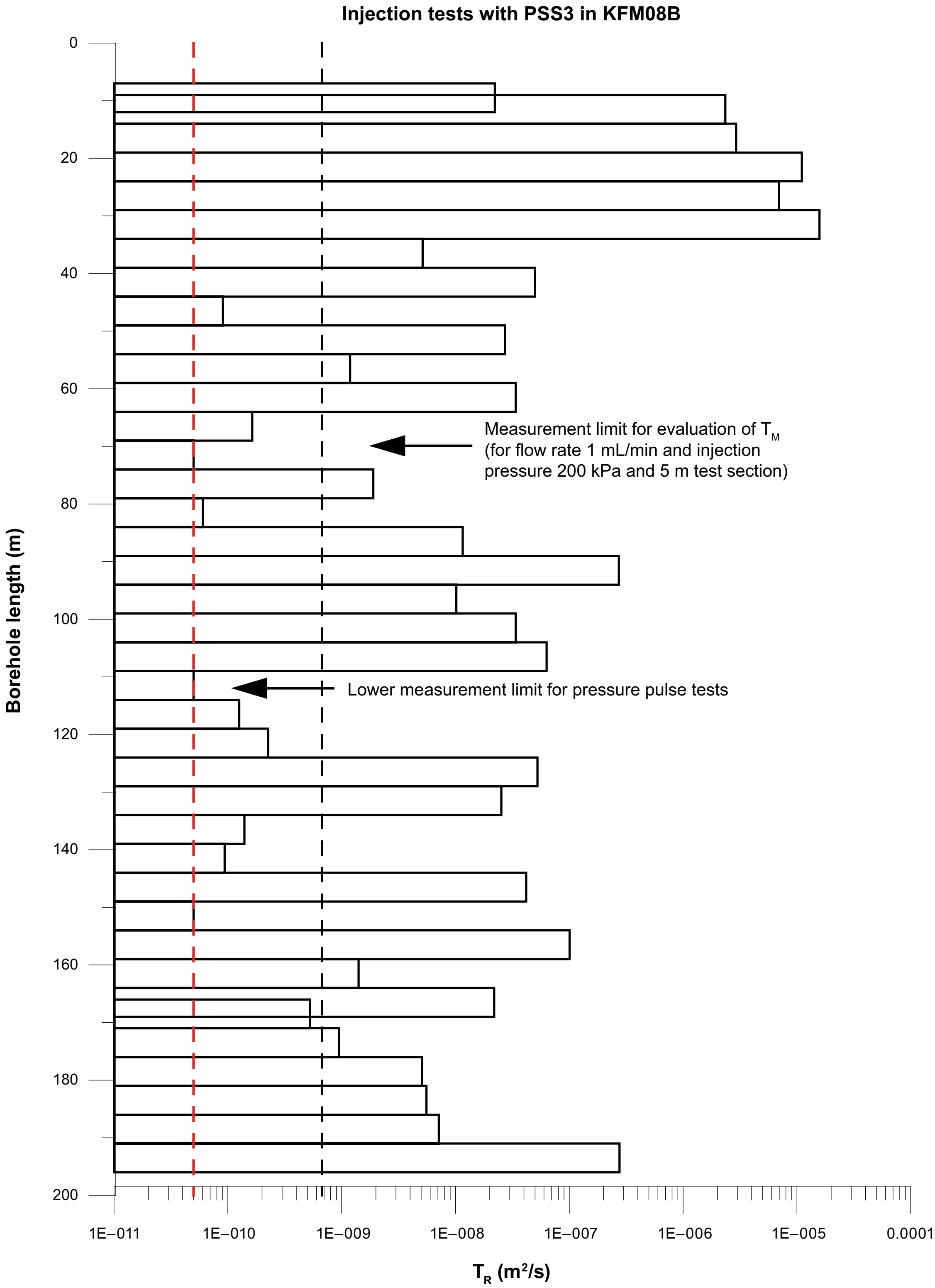

Figure 6-2. *Estimated best representative transmissivity values (T_R and $T_{R, pulse}$) from both injection tests and pressure pulse tests for sections of 5 m length in borehole KFM08B. The estimated transmissivity value for the lower standard measurement limit from stationary evaluation of injection tests (T_M-measl-L) is also shown together with the lower measurement limit for pressure pulse tests.*

Two of the sections, 119.0–124.0 m and 139.0–134.0 m, do not seem to be strongly affected by the packer generated flow (the pressure increase after the second closing of the test valve is small) and the type curves fit data well. Despite this fact, the stationary value for transmissivity is chosen as the most representative. The values from the transient evaluation are even smaller than the transmissivities in the two sections showing pressure increase after the pulse, for which the stationary evaluation was performed. This is however not likely. Hence the larger transmissivity value, from the stationary evaluation was chosen.

The method used to estimate the stationary transmissivity presupposes that section 149.0–154.0 m is non-conductive, and therefore no evaluation can be made for this section. The transmissivity is considered to be less than $5.0 \cdot 10^{-11}$ m^2/s.

In total, three sections have an estimated transmissivity lower than $5.0 \cdot 10^{-11}$ m^2/s, all of these being the ones where the pressure still increases after the pulse.

6.2.4 Comments on the tests

Short comments on each test follow below. Flow regimes and hydraulic boundaries, as discussed in Section 5.4.3, are in the text referred to as:

WBS = Wellbore storage

PRF = Pseudo-radial flow regime

PLF = Pseudo-linear flow regime

PSF = Pseudo-spherical flow regime

PSS = Pseudo-stationary flow regime

NFB = No-flow boundary

CHB = Constant-head boundary.

7.0–12.0 m

The flow rate increased slightly during the injection period although the pressure was stable. No unambiguous transient evaluation can be made of the injection period. Hence the recovery period is assumed to give most representative transmissivity for the section. The recovery period shows signs of WBS transitioning to a PSF.

9.0–14.0 m

The pressure during the injection period is not entirely stable. Therefore, the flow rate and the flow rate derivative may have been slightly affected. However, a PRF is assumed to dominate the injection from 300 s and throughout the period and a transient evaluation is possible. During the recovery period a PLF and a transition to a possible PRF is observed. The pressure in the borehole interval below the test section increased by c 2 kPa during the injection period. Since the transmissivity of the 9.0–14.0 m section is much lower than the transmissivity below 14.0 m, this relatively small pressure interference may have resulted in an overestimation of the transmissivity of this section.

14.0–19.0 m

The injection clearly displays a PRF from c 150 s throughout the period. The recovery indicates an early PLF transitioning to a short PRF and a PSF towards the end of the period. The pressure in the borehole interval below the test section increased by c 7 kPa during the injection period. Since the transmissivity of the 14.0–19.0 m section is much lower than the transmissivity below 19.0 m, this pressure interference may have resulted in an overestimation of the transmissivity of this section.

19.0–24.0 m

The section has a rather high transmissivity. Hence, the injection pressure was only c 55 kPa and the time to reach a stable pressure was rather long. In addition, the pressure decreased somewhat during the injection period. Therefore, a transient evaluation of the injection is difficult although a PLF, or possibly a NFB, is indicated from c 200 s throughout the injection period. The recovery period indicates a PLF and thus, the transient evaluation is uncertain. Nevertheless, the transient evaluation was considered to provide the most representative transmissivity value for this section. The pressure in the borehole interval below the test section increased by c 16 kPa during the injection period. Also, the pressure in the borehole interval above the test section increased by c 19 kPa during the injection period. Since the transmissivity of the 19.0–24.0 m section is in the same order of magnitude as the transmissivity below 24.0 m and above 19.0 m, and the injection pressure only was c 50 kPa, this relatively large pressure interference may have resulted in an overestimation of the transmissivity of this section.

24.0–29.0 m

The time to achieve a constant pressure during the injection period was relatively long. However, a PSF is identified during this period. The recovery period indicates a PLF transitioning to a PSF. The pressure in the borehole interval below the test section increased by c 17 kPa during the injection period. Also the pressure in the borehole interval above the test section increased by c 12 kPa during the injection period. Since the transmissivity of the 24.0–29.0 m section is of the same order of magnitude as the transmissivity below 29.0 m and above 24.0 m, and the injection pressure was only c 100 kPa, this relatively large pressure interference may have resulted in an overestimation of the transmissivity of this section.

29.0–34.0 m

The injection period indicates a PRF from c 200 s throughout the rest of the period, while the recovery period only indicates a PLF. A transient evaluation of the injection period is regarded as the most representative for this test section. The pressure in the section below the test section decreased during the packer expansion and increased again at approximately the time when the injection stopped. This may be an effect of some other activity in a borehole in the vicinity. There was a clear interference with the section above the test section during the injection.The pressure in this section increased by c 12 kPa. Since the transmissivity of the 29.0–34.0 m section is of the same order of magnitude as the transmissivity above 29.0 m, and the injection pressure was only about 80 kPa, this pressure interference may have resulted in an overestimation of the transmissivity of the test section.

34.0–39.0 m

The injection period indicates a PRF by the end. The recovery period only indicates a PLF and possibly a transition to some other flow regime. The transient evaluation of the recovery period is uncertain. By the end of the recovery period, the pressure below the test section increased significantly. However, no reasonable explanation of the phenomena, apart from possible activities in other boreholes, is available.

39.0–44.0 m

Both the pressure and the flow data are very scattered during the first c 150 seconds of the injection period due to flow regulation settings. The injection period displays a PRF/PSF after the first 200 seconds. The decrease in the derivative during the latest part of the injection period indicates a PSF. The recovery period indicates a PRF after c 100 s preceded by WBS. However, a fit with the Dougherty-Babu model to the recovery period displays a rather high positive skin factor. An evaluation with the Hantush model is also performed for the recovery period. The transient evaluation of the recovery period is considered uncertain. The pressure in the section below the test section increased during the packer expansion and was quite stable during the injection and decreased again at about the time when the injection stopped. No reasonable explanation of this phenomenon, other than possible activities in other boreholes, is available.

44.0–49.0 m (Pressure pulse test)

The pulse test was started as an injection test, but since the flow rate was less than 0.5 mL/min after 2 minutes, the injection was stopped and the test was performed as a pulse test. The pressure was not stable during the pulse because the pump was used instead of the pressure vessel. H_0 is calculated as P_p-P_i since the test was started as an injection test. The pressure in the section below the test section decreased during the first 15 minutes of the packer expansion and then stayed at a stable level during the remainder of the test. The stationary evaluation is regarded as the most representative for this section.

49.0–54.0 m

Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 4 kPa during the injection period. As a result, the reciprocal flow rate was disturbed throughout the injection period. The pressure drift caused an increasing trend in the derivative that may not be representative for the rock formation. Besides this, the development of the flow rate during the injection period is much more irregular than normally whwn using only the pressure vessel during the injection. However, both the injection and recovery period indicate a short PRF transitioning to an apparent NFB. During the recovery period, the PRF is preceded by a short period of WBS. During the packer expansion, the pressure in the section below the test section decreased while the pressure in the section above the test section increased. This could be due to activities (lifting of equipment) in the adjacent borehole KFM08A.

54.0–59.0 m

When only one minute of the injection period remained, the pressure and the flow were disturbed due to a change of valves. This fact does, however, not affect the evaluation. The injection period indicates a PLF with a possible transition to a PRF at the end. The recovery period indicates a PRF transitioning to an apparent NFB. Thus, the responses during the injection- and recovery period are not consistent. The transient evaluation from the injection period is selected as representative for the test section. The pressure in the section below the test section decreased during the packer expansion and then stayed stable at the lower level throughout the test.

59.0–64.0 m

Although the pressure was stable throughout the injection period, the flow rate data are rather scattered. However, a possible PRF can be identified after c 200 seconds of the injection period. The recovery period only indicates WBS and no unambiguous transient evaluation of the period is possible. The pressure in the section below the test section decreased during packer expansion and then stayed stable at the lower level throughout the test.

64.0–69.0 m (Pressure pulse test)

H_0 is calculated as $P_p – P_0$. The pressure in the section below the test section decreased during packer expansion and then stayed stable at the lower level throughout the test. The stationary evaluation of the transmissivity is regarded the most representative for this section, because the section is affected by the packer generated flow and the type curve fitting is poor, which makes the transient evaluation uncertain.

69.0–74.0 m (Pressure pulse test)

The section has a very low transmissivity. The pressure increased after the pulse and the test was therefore terminated after 10 minutes of recovery and no transient evaluation was made. There was a small decrease of the pressure in the section below during the packer expansion. The pressure increase was rapid after the first closing of the test valve, and slower after the second one.

74.0–79.0 m

The injection period only demonstrates an apparent NFB and no unambiguous transient evaluation can be made from this period. The recovery period indicates WBS transitioning to a possible PRF. The transient evaluation from this period is regarded as the most representative for the section. The pressure recovered only 3.0 m from the head change of 19.7 m, applied during the injection period, indicating a rather low transmissivity in the section. The pressure in the section below the test section may have been affected by activities performed in the adjacent borehole (KFM08A), where equipment was lifted during the time the injection test was performed in KFM08B.

79.0–84.0 m (Pressure pulse test)

H_0 is calculated as $P_p – P_0$. At the end of the recovery there is a little pressure increase in the section, proving that the packers are still influencing the section. The interpreted value for the transient transmissivity is therefore underestimated and instead the stationary value for the transmissivity is considered the most representative. A transient evaluation of the transmissivity is only possible for the first 1,000 seconds.

84.0–89.0 m

The injection period indicates an apparent NFB with a transition to some other flow regime at the end of the period. The entire recovery period appears to be dominated by a PLF. The only transient evaluation of the test that gives an unambiguous result is a fit with the Ozkan-Raghavan solution for a single fracture on the recovery period. This solution was selected as the most representative for the test.

89.0–94.0 m

During the injection period the dominating flow regime appears to be a PRF from c 100 seconds, transitioning to a PSF after c 800 seconds. The recovery is showing signs of a short period of a possible PSF during the first c 40 s of the recovery period, transitioning to an apparent NFB. The responses during the two periods are thus not consistent. Still, the transient evaluated transmissivities are similar.

94.0–99.0 m

The time to achieve constant pressure was quite long, more than 120 seconds, but during the rest of the injection period the pressure was stable and the period from 300 seconds and throughout the injection period was dominated by a PRF. The recovery period indicates a PRF transitioning to a PSF.

99.0–104.0 m

The time to achieve constant pressure during the injection was quite long. Therefore the data are quite scattered during the first 200 seconds. After 200 seconds there are only signs of an apparent NFB and no transient evaluation can be made from the injection period. WBS transitioning to some other flow regime, possibly a PRF, is indicated during the recovery period. Even though no distinct PRF is visible during the recovery period, an unambiguous transient evaluation of the recovery period is possible. The pressure in the section below the test section is disturbed, probably by some other external activity during the test.

104.0–109.0 m

Even though the pressure was stable during the injection period, the flow rate data are somewhat scattered, especially the derivative. Still, a PRF is likely to dominate from c 100 s and throughout the injection period. Transient evaluation of the injection period using a PRF model and a PLF model displays very similar result. The flow rate at the beginning of the injection period (the first c 100 seconds) was rather high in comparison to the flow rate during the remainder of the period. The recovery is indicating WBS effects transitioning to a possible PRF.

109.0–114.0 m (Pressure pulse test)

The section has a very low transmissivity. The pressure increased after the pulse and the test was therefore terminated after 10 minutes of recovery and no transient evaluation was made. The pressure in the section below increases during the packer expansion.

114.0–119.0 m (Pressure pulse test)

H_0 is calculated as P_p–P_0. The section seems to be effected by packer generated flow and hence the transient evaluation is uncertain. The transmissivity obtained from stationary evaluation is regarded the most representative for this section.

119.0–124.0 m (Pressure pulse test)

H_0 is calculated as P_p–P_0. The pressure increase after the second closing of the test valve is much smaller than after the first one. The pressure recovered 17 m of the head change of 21 m applied during the pulse. The section does not seem to be strongly effected by the packers and also the curve fitting is good. However, the value obtained from transient evaluation is lower than values of sections with increasing pressure after the pulse, which is not likely. The transmissivity seems to be underestimated and therefore the larger value of transmissivity from the stationary evaluation is considered the most representative for this section.

124.0–129.0 m

The time to achieve constant pressure during the injection period was pretty long. However, the only flow regime identified during the injection is a NFB and a possible transition to some other flow regime. Hence, no transient evaluation of the period is possible. The recovery only displays a PLF throughout the period. Hence, the evaluated transmissivity using a fit to the Ozkan-Raghavan solution to the recovery period is considered as the best estimate of the section.

129.0–134.0 m

Despite stable pressure during the injection period, the flow rate increased in one step after c 200 seconds. After that flow rate increment at c 200 s, the injection only indicates a NFB throughout the period. Due to a drift in the gas pressure regulator, the pressure in the test section decreased by c 2.5 kPa during the injection period. As a result, reciprocal flow rate was disturbed throughout the injection period. The pressure drift caused an increasing trend in the derivative that may not be representative for the rock formation, but this should not explain the discontinuous flow curve. However, during the first 100 seconds of the injection period a PRF is observed. The recovery period weakly indicates a PLF and no transient evaluation of the period is possible. The pressure recovered only 2.7 m from the head change of 21.9 m, applied during the injection period, indicating a rather low transmissivity in the section.

134.0–139.0 m (Pressure pulse test)

A large skin factor is required to fit the Dougherty-Babu model to the data and the fitting is poor. Hence the transient evaluation is uncertain and the stationary evaluation is regarded as the most representative for this section. Despite the large pressure increase when the test valve is closed (which might indicate a low transmissivity or a large packer generated flow) the recovery is quite large.

139.0–144.0 m (Pressure pulse test)

The pressure increased very rapidly after the first closing of the test valve during the diagnostic test. During the second closing the pressure rise was only 2–3 kPa. This might indicate that the effect of the packers is relatively small. Also the curve fitting is good when performing the transient evaluation. However, the transmissivity value obtained is lower than the stationary calculated transmissivity in the sections where the pressure increases after the pulse. This is not likely, the transmissivity is probably underestimated, and therefore the larger value from the stationary evaluation is regarded to be the most representative for the section.

144.0–149.0 m

The injection period only indicates NFB. Therefore no transient evaluation can be made from this period. During the recovery, however, signs of a period of PRF may be identified during the last part of the recovery period. The time before the PRF might indicate a PLF.

149.0–154.0 m (Pressure pulse test)

The section has a very low transmissivity. The pressure increased after the pulse and the test was therefore terminated after 10 minutes of recovery and no transient evaluation was made. Since the method for stationary evaluation presupposes that this section is non-conductive, no such evaluation can be made either. The transmissivity in this section is therefore considered to be lower than the measurement limit of $5.0 \cdot 10^{-11}$ m^2/s.

154.0–159.0 m

After achieving constant pressure only a NFB is indicated during the injection period. The recovery period only displays a PLF. Hence, the evaluated transmissivity using a fit to the Ozkan-Raghavan solution to the recovery period, which is supported by a fit with the Dougherty-Babu solution, is considered as the best estimate of the section.

159.0–164.0 m

The flow rate data are quite scattered due to problems with the automatic regulation system. Still, a PRF is assumed to dominate the injection period from 300 s and throughout the period. The recovery period displays a WBS transitioning to some other flow regime.

164.0–169.0 m

The injection period clearly demonstrates a PRF. Also the recovery period is showing signs of transitioning to a possible PRF after the initial period of WBS.

166.0–171.0 m

The flow rate data are scattered due to the low flow rate. Still, the injection period indicates a PSF. The recovery period only shows signs of WBS transitioning to some other flow regime during the last c 200 seconds.

171.0–176.0 m

The injection period is demonstrating a PSF beginning at 100 seconds and it continues during the rest of the period. The recovery period mainly indicates WBS and a transition to some other flow regime.

176.0–181.0 m

The pressure during the injection period is rather unstable causing the flow data to be scattered. Despite this fact, a PRF can be identified after c 100 s. The recovery period seems to indicate a PLF, possibly transitioning to a short PRF.

181.0–186.0 m

The injection period is dominated by a PRF from 100 s and throughout the period. The recovery is affected by WBS effects and only shows, besides WBS, a transition to some other flow regime. However, a fit with a PRF-model to the recovery period supports the evaluated transient transmissivity from the injection period.

186.0–191.0 m

Data are slightly scattered. Still, both the injection and recovery period are dominated by PRF.

191.0–196.0 m

The injection period is dominated by a PLF, possibly transitioning to a PRF by the end of the period. The entire recovery period is also dominated by a PLF. A fit with the Ozkan-Raghavan model to the injection period is considered to be the best estimate for the test section. It is supported by a fit with the same model to the recovery period. The pressure in the borehole interval below the test section increased by c 77 kPa during the injection period. Since the transmissivity of the section below the test section can not be measured, it is uncertain whether this pressure increase has resulted in an overestimation of the transmissivity or not. The pressure in the section below recovers c 44 kPa during the recovery period, which indicates that there is a significant transmissivity of the section below.

6.2.5 Flow regimes

As discussed in Section 5.4.3, several of the recovery periods were dominated by wellbore storage effects and no pseudo-radial flow period was reached. On the other hand, some time interval of pseudo-radial flow could in most cases be identified from the injection period. A summary of the frequency of identified flow regimes is presented in Table 6-3, which shows all identified flow regimes during the tests. For example, a pseudo-radial flow regime (PRF) transitioning to a pseudo-spherical flow regime (PSF) will contribute to one observation of PRF and one observation of PSF. The numbers within brackets denote the number of tests where the actual flow regime is the only one present.

Table 6-3. Interpreted flow regimes during the injection tests in KFM08B.

Borehole	Section length (m)	Number of injection tests[1)]	Number of tests with definable Q_p	Injection period					Recovery period					
				PLF	PRF	PSF	PSS	NFB	WBS	PLF	PRF	PSF	PSS	NFB
KFM08B	5	29	29	3(0)	18(12)	5(3)	1(1)	9(6)	13(5)	13(7)	13(1)	5(0)	0(0)	3(0)

[1)] Only the injection tests are included in this table.

It should be noted that the interpretation of flow regimes is only tentative and only based on visual inspection of the data curves. It should also be observed that the number of tests with a pseudo-linear flow regime during the beginning of the injection period may be underestimated due to the fact that a certain time is required for achieving a constant pressure, which fact may mask the initial flow regime.

No flow regimes have been identified for the pressure pulse tests; hence Table 6-3 is only valid for the injection tests.

Table 6-3 shows that a certain period of pseudo-radial flow could be identified from the injection period in c 60% of the tests for KFM08B. For the recovery period, the corresponding result is c 45%. The most common flow regime for the injection period was pseudo-radial flow. For the recovery period pseudo-linear and pseudo-radial flow together with wellbore storage were equally common.

For c 25% of the tests, more than one flow regime could be identified during the injection periods. The corresponding number for the recovery periods was c 45%. During the injection periods the following transitions were almost equally common: PRF –> NFB, PRF –> PSF and PLF –> PRF. The transition from wellbore storage to pseudo-radial flow was the most common during the recovery periods in KFM08B.

6.3 Basic statistics of hydraulic conductivity distributions

Some basic statistical parameters were calculated for the hydraulic conductivity distributions from the tests in borehole KFM08B. The hydraulic conductivity is obtained by dividing the transmissivity by the section length, in this case T_M/L_w. The basic statistical parameters were derived for the hydraulic conductivity considered most representative ($K_R = T_R/L_w$), including all tests, both injection- and pressure pulse tests. In the statistical analysis, the logarithm (base 10) of K_R was used. Selected results are shown in Table 6-4.

Table 6-4. Basic statistical parameters for the hydraulic conductivity considered most representative (K_R) in borehole KFM08B. L_w = section length, m = arithmetic mean, s = standard deviation.

Borehole	Parameter	Unit	Lw = 5 m
KFM08B	Measured borehole interval	m	7.0–196.0 [1)]
KFM08B	Number of tests	–	39
KFM08B	N:o of pulse tests	–	10
KFM08B	m ($Log_{10}(K_R)$)	Log_{10}(m/s)	–8.77
KFM08B	s ($Log_{10}(K_R)$)	–	1.58

[1)] Sections 7.0–12.0 and 9.0–14.0 and 164.0–169.0 and 166.0–171.0 partly overlapping.

7 References

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Appendix 1. File description table

Bh id	Test section		Test type	Test no	Test start Date, time	Test stop Date, time	Data files of raw and primary data	Parameters in file	Comments
idcode	(m)	(m)	(1-6)[1)]		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM08B	7.0	12.0	3	1	20050608 18:17	20050609 09:26	__KFM08B_0007.00_200506081817.ht2	P, Q, Te	
KFM08B	9.0	14.0	3	1	20050609 09:50	20050609 11:14	__KFM08B_0009.00_200506090950.ht2	P, Q, Te	
KFM08B	14.0	19.0	3	1	20050609 11:30	20050609 13:15	__KFM08B_0014.00_200506091130.ht2	P, Q, Te	
KFM08B	19.0	24.0	3	1	20050609 13:31	20050609 14:46	__KFM08B_0019.00_200506091331.ht2	P, Q, Te	
KFM08B	24.0	29.0	3	1	20050609 15:00	20050609 16:14	__KFM08B_0024.00_200506091500.ht2	P, Q, Te	
KFM08B	29.0	34.0	3	1	20050609 16:28	20050609 17:50	__KFM08B_0029.00_200506091628.ht2	P, Q, Te	
KFM08B	34.0	39.0	3	1	20050610 08:19	20050610 09:41	__KFM08B_0034.00_200506100819.ht2	P, Q, Te	
KFM08B	39.0	44.0	3	1	20050610 09:51	20050610 11:06	__KFM08B_0039.00_200506100951.ht2	P, Q, Te	
KFM08B	44.0	49.0	4B	1	20050610 11:16	20050610 13:05	__KFM08B_0044.00_200506101116.ht2	P, Q, Te	
KFM08B	49.0	54.0	3	1	20050613 13:14	20050613 13:50	__KFM08B_0049.00_200506101314.ht2	P, Q, Te	
KFM08B	49.0	54.0	3	2	20050620 11:17	20050620 12:31	__KFM08B_0049.00_200506201117.ht2	P, Q, Te	
KFM08B	54.0	59.0	3	1	20050610 14:00	20050610 15:15	__KFM08B_0054.00_200506101400.ht2	P, Q, Te	
KFM08B	59.0	64.0	3	1	20050610 15:25	20050610 16:38	__KFM08B_0059.00_200506101525.ht2	P, Q, Te	
KFM08B	64.0	69.0	4B	1	20050610 16:46	20050610 18:32	__KFM08B_0064.00_200506101646.ht2	P, Q, Te	
KFM08B	69.0	74.0	4B	1	20050613 09:06	20050613 10:25	__KFM08B_0069.00_200506130906.ht2	P, Q, Te	
KFM08B	74.0	79.0	3	1	20050613 10:37	20050613 11:57	__KFM08B_0074.00_200506131037.ht2	P, Q, Te	
KFM08B	74.0	79.0	3	2	20050620 09:43	20050620 10:57	__KFM08B_0074.00_200506200943.ht2	P, Q, Te	
KFM08B	79.0	84.0	4B	1	20050613 12:44	20050613 14:33	__KFM08B_0079.00_200506131244.ht2	P, Q, Te	
KFM08B	84.0	89.0	3	1	20050613 14:48	20050613 16:07	__KFM08B_0084.00_200506131448.ht2	P, Q, Te	
KFM08B	89.0	94.0	3	1	20050613 16:17	20050613 17:33	__KFM08B_0089.00_200506131617.ht2	P, Q, Te	
KFM08B	94.0	99.0	3	1	20050613 17:47	20050614 03:37	__KFM08B_0094.00_200506131747.ht2	P, Q, Te	
KFM08B	94.0	99.0	3	2	20050620 08:16	20050620 09:31	__KFM08B_0094.00_200506200816.ht2	P, Q, Te	
KFM08B	99.0	104.0	3	1	20050614 07:03	20050614 08:36	__KFM08B_0099.00_200506140703.ht2	P, Q, Te	
KFM08B	104.0	109.0	3	1	20050614 08:52	20050614 10:16	__KFM08B_0104.00_200506140852.ht2	P, Q, Te	
KFM08B	104.0	109.0	3	2	20050617 15:20	20050617 16:35	__KFM08B_0104.00_200506171520.ht2	P, Q, Te	
KFM08B	109.0	114.0	4B	1	20050614 10:30	20050614 11:31	__KFM08B_0109.00_200506141030.ht2	P, Q, Te	
KFM08B	114.0	119.0	4B	1	20050614 11:42	20050614 13:52	__KFM08B_0114.00_200506141142.ht2	P, Q, Te	
KFM08B	119.0	124.0	3	1	20050609 13:31	20050609 14:46	__KFM08B_0119.00_200506141409.ht2	P, Q, Te	
KFM08B	119.0	124.0	4B	2	20050617 13:20	20050617 15:06	__KFM08B_0119.00_200506171320.ht2	P, Q, Te	
KFM08B	124.0	129.0	3	1	20050615 08:22	20050615 09:37	__KFM08B_0124.00_200506150822.ht2	P, Q, Te	
KFM08B	129.0	134.0	3	1	20050615 09:46	20050615 09:46	__KFM08B_0129.00_200506150946.ht2	P, Q, Te	
KFM08B	129.0	134.0	3	2	20050617 11:32	20050617 13:07	__KFM08B_0129.00_200506171132.ht2	P, Q, Te	
KFM08B	134.0	139.0	4B	1	20050615 10:49	20050615 12:34	__KFM08B_0134.00_200506151049.ht2	P, Q, Te	
KFM08B	139.0	144.0	4B	1	20050615 12:50	20050615 14:36	__KFM08B_0139.00_200506151250.ht2	P, Q, Te	
KFM08B	144.0	149.0	3	1	20050615 14:45	20050615 16:00	__KFM08B_0144.00_200506151445.ht2	P, Q, Te	
KFM08B	149.0	154.0	4B	1	20050615 16:08	20050615 17:23	__KFM08B_0149.00_200506151608.ht2	P, Q, Te	
KFM08B	154.0	159.0	3	1	20050616 08:10	20050616 09:23	__KFM08B_0154.00_200506160810.ht2	P, Q, Te	
KFM08B	159.0	164.0	3	1	20050616 09:33	20050616 10:49	__KFM08B_0159.00_200506160933.ht2	P, Q, Te	
KFM08B	164.0	169.0	3	1	20050616 10:58	20050616 12:12	__KFM08B_0164.00_200506161058.ht2	P, Q, Te	
KFM08B	166.0	171.0	3	1	20050616 12:31	20050616 13:46	__KFM08B_0166.00_200506161231.ht2	P, Q, Te	

Bh id	Test section		Test type	Test no	Test start	Test stop	Data files of raw and primary data	Parameters in file	Comments
					Date, time	Date, time			
idcode	(m)	(m)	(1-6)[1)]		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM08B	171.0	176.0	3	1	20050616 13:55	20050616 15:08	__KFM08B_0171.00_200506161355.ht2	P, Q, Te	
KFM08B	176.0	181.0	3	1	20050616 15:23	20050616 16:38	__KFM08B_0176.00_200506161523.ht2	P, Q, Te	
KFM08B	181.0	186.0	3	1	20050616 16:48	20050616 18:02	__KFM08B_0181.00_200506161648.ht2	P, Q, Te	
KFM08B	186.0	191.0	3	1	20050617 08:19	20050617 09:34	__KFM08B_0186.00_200506170819.ht2	P, Q, Te	
KFM08B	191.0	196.0	3	1	20050617 09:45	20050617 11:02	__KFM08B_0191.00_200506170945.ht2	P, Q, Te	

[1)] 3: Injection test, 4B pulse test

Appendix 2.1. General test data

Borehole:	KFM08B
Testtype:	CHir (Constant Head injection and recovery)
Field crew:	C. Hjerne, K. Gokall-Norman, P Thur, T. Svensson, A. Lindquist
General comment:	

Test section secup	**Test section seclow**	**Test start**	**Start of flow period**	**Stop of flow period**	**Test stop**	**Total flow time t_p**	**Total recovery time t_F**
		YYYYMMDD	YYYYMMDD	YYYYMMDD	YYYYMMDD		
(m)	(m)	hh:mm	hh:mm:ss	hh:mm:ss	hh:mm	(min)	(min)
7.00	12.00	20050608 18:17	20050609 08:43:46	20050609 09:04:00	20050609 09:26	20	20
9.00	14.00	20050609 09:50	20050609 10:31:52	20050609 10:52:06	20050609 11:14	20	20
14.00	19.00	20050609 11:30	20050609 12:32:51	20050609 12:53:01	20050609 13:15	20	20
19.00	24.00	20050609 13:31	20050609 14:03:41	20050609 14:23:43	20050609 14:46	20	20
24.00	29.00	20050609 15:00	20050609 15:32:23	20050609 15:52:26	20050609 16:14	20	20
29.00	34.00	20050609 16:28	20050609 17:07:58	20050609 17:28:04	20050609 17:50	20	20
34.00	39.00	20050610 08:19	20050610 08:59:08	20050610 09:19:24	20050610 09:41	20	20
39.00	44.00	20050610 09:51	20050610 10:23:33	20050610 10:43:49	20050610 11:06	20	20
44.00	49.00	20050610 11:16	20050610 12:21:04	20050610 12:23:24	20050610 13:05	2	40
49.00	54.00	20050620 11:17	20050620 11:48:43	20050620 12:08:59	20050620 12:31	20	20
54.00	59.00	20050610 14:00	20050610 14:32:57	20050610 14:53:13	20050610 15:15	20	20
59.00	64.00	20050610 15:25	20050610 15:56:04	20050610 16:16:21	20050610 16:38	20	20
64.00	69.00	20050610 16:46	20050610 17:47:49	20050610 17:50:03	20050610 18:32	2	40
69.00	74.00	20050613 09:06	20050613 10:10:23	20050613 10:12:30	20050613 10:25	2	11
74.00	79.00	20050620 09:43	20050620 10:15:19	20050620 10:35:36	20050620 10:57	20	20
79.00	84.00	20050613 12:44	20050613 13:49:16	20050613 13:51:29	20050613 14:33	2	40
84.00	89.00	20050613 14:48	20050613 15:24:34	20050613 15:44:48	20050613 16:07	20	20
89.00	94.00	20050613 16:17	20050613 16:50:58	20050613 17:11:12	20050613 17:33	20	20
94.00	99.00	20050620 08:16	20050620 08:48:48	20050620 09:09:02	20050620 09:31	20	20
99.00	104.00	20050614 07:03	20050614 07:53:36	20050614 08:13:52	20050614 08:36	20	20
104.00	109.00	20050617 15:20	20050617 15:52:48	20050617 16:13:02	20050617 16:35	20	20
109.00	114.00	20050614 10:30	20050614 11:16:49	20050614 11:18:55	20050614 11:31	2	11
114.00	119.00	20050614 11:42	20050614 13:08:00	20050614 13:10:06	20050614 13:52	2	40
119.00	124.00	20050617 13:20	20050617 14:21:30	20050617 14:23:45	20050617 15:06	2	40
124.00	129.00	20050615 08:22	20050615 08:54:29	20050615 09:14:46	20050615 09:37	20	20
129.00	134.00	20050617 11:32	20050617 12:25:22	20050617 12:45:36	20050617 13:07	20	20
134.00	139.00	20050615 10:49	20050615 11:49:46	20050615 11:52:02	20050615 12:34	2	40
139.00	144.00	20050615 12:50	20050615 13:51:46	20050615 13:54:00	20050615 14:36	2	40
144.00	149.00	20050615 14:45	20050615 15:17:41	20050615 15:37:55	20050615 16:00	20	20
149.00	154.00	20050615 16:08	20050615 17:09:00	20050615 17:11:06	20050615 17:23	2	10
154.00	159.00	20050616 08:10	20050616 08:41:04	20050616 09:01:17	20050616 09:23	20	20
159.00	164.00	20050616 09:33	20050616 10:07:00	20050616 10:27:14	20050616 10:49	20	20
164.00	169.00	20050616 10:58	20050616 11:30:04	20050616 11:50:18	20050616 12:12	20	20
166.00	171.00	20050616 12:31	20050616 13:03:32	20050616 13:23:46	20050616 13:46	20	20
171.00	176.00	20050616 13:55	20050616 14:26:02	20050616 14:46:16	20050616 15:08	20	20
176.00	181.00	20050616 15:23	20050616 15:56:13	20050616 16:16:29	20050616 16:38	20	20
181.00	186.00	20050616 16:48	20050616 17:20:07	20050616 17:40:21	20050616 18:02	20	20
186.00	191.00	20050617 08:19	20050617 08:51:27	20050617 09:11:41	20050617 09:34	20	20
191.00	196.00	20050617 09:45	20050617 10:19:41	20050617 10:39:54	20050617 11:02	20	20

Appendix 2.2 Pressure and flow data

Summary of pressure and flow data for all tests in KFM08B

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p 1)	Q_m 1)	V_p 1)
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
7.00	12.00	135.67	346.10	140.49	8.16E-07	7.94E-07	9.67E-04
9.00	14.00	152.20	343.56	169.70	4.77E-05	5.08E-05	6.17E-02
14.00	19.00	195.73	386.26	198.90	8.57E-05	9.68E-05	1.17E-01
19.00	24.00	236.93	284.32	255.11	2.43E-04	3.99E-04	4.80E-01
24.00	29.00	284.86	389.02	292.03	2.77E-04	3.14E-04	3.78E-01
29.00	34.00	325.64	406.45	344.93	3.05E-04	3.69E-04	4.46E-01
34.00	39.00	360.91	573.76	421.52	3.72E-07	6.18E-07	7.52E-04
39.00	44.00	401.14	709.33	404.99	1.44E-06	1.54E-06	1.87E-03
44.00	49.00	450.18	757.27	660.68	-	-	-
49.00	54.00	484.35	678.02	519.61	3.04E-07	4.10E-07	4.99E-04
54.00	59.00	528.57	713.59	598.41	1.47E-07	2.82E-07	3.43E-04
59.00	64.00	566.74	741.82	621.56	1.25E-06	2.35E-06	2.87E-03
64.00	69.00	660.13	810.84	732.88	-	-	-
69.00	74.00	712.90	866.78	882.21	-	-	-
74.00	79.00	697.33	891.03	861.26	1.93E-08	9.34E-08	1.14E-04
79.00	84.00	792.38	967.07	956.04	-	-	-
84.00	89.00	778.74	974.23	902.60	5.62E-07	1.71E-06	2.07E-03
89.00	94.00	817.31	1017.76	856.86	9.24E-06	9.69E-06	1.18E-02
94.00	99.00	859.06	1115.57	862.93	6.50E-07	7.70E-07	9.37E-04
99.00	104.00	905.35	1114.14	1084.98	2.82E-07	1.80E-06	2.22E-03
104.00	109.00	942.13	1091.34	996.82	3.78E-06	6.62E-06	8.07E-03
109.00	114.00	1106.49	1136.79	1184.18	-	-	-
114.00	119.00	1073.56	1212.15	1125.77	-	-	-
119.00	124.00	1076.31	1285.85	1119.16	-	-	-
124.00	129.00	1110.34	1242.00	1205.12	1.31E-06	4.84E-06	5.97E-03
129.00	134.00	1151.95	1366.72	1340.13	3.23E-08	2.11E-07	2.57E-04
134.00	139.00	1289.98	1390.82	1233.23	-	-	-
139.00	144.00	1242.04	1434.78	1356.11	-	-	-
144.00	149.00	1277.31	1481.61	1406.80	1.25E-06	2.67E-06	3.25E-03
149.00	154.00	1527.76	1593.89	1644.86	-	-	-
154.00	159.00	1358.87	1493.27	1471.28	5.43E-07	3.41E-06	4.18E-03
159.00	164.00	1397.99	1595.96	1418.39	9.62E-08	1.36E-07	1.65E-04
164.00	169.00	1439.87	1636.04	1474.59	9.99E-07	1.33E-06	1.61E-03
166.00	171.00	1460.81	1685.69	1526.39	4.71E-08	8.00E-08	9.77E-05
171.00	176.00	1499.94	1710.99	1537.41	9.13E-08	1.35E-07	1.65E-04
176.00	181.00	1538.78	1792.51	1548.97	1.65E-07	2.04E-07	2.48E-04
181.00	186.00	1579.84	1790.20	1589.75	1.14E-07	1.34E-07	1.63E-04
186.00	191.00	1619.65	1825.20	1645.96	2.70E-07	3.36E-07	4.09E-04
191.00	196.00	1656.43	1882.78	1735.79	4.27E-05	7.80E-05	9.48E-02

1) No value indicates that the test is performed as a pressure pulse test and the parameters could not be calculated due to low and uncertain flow rates

p_i	Pressure in test section before start of flow period
p_p	Pressure in test section before stop of flow period
p_F	Pressure in test section at the end of recovery period
Q_p	Flow rate just before stop of flow period
Q_m	Mean (arithmetic) flow rate during flow period
V_p	Total volume injected during the flow period

Appendix 3. Test diagrams – Injection- and Pressure Pulse Tests

In the following pages diagrams are presented for all test sections. A linear diagram of pressure and flow rate is presented for each test. For most injection tests lin-log and log-log diagrams are presented, from injection and recovery period respectively. For most of the pressure pulse tests the linear diagram is presented together with a lin-log diagram.

Nomenclature for Aqtesolv:

T	=	transmissivity (m^2/s)
S	=	storativity (-)
K_z/K_r	=	ratio of hydraulic conductivities in the vertical and radial direction (set to 1)
Sw	=	skin factor
r(w)	=	borehole radius (m)
r(c)	=	effective casing radius (m)
C	=	well loss constant (set to 0)
r/B	=	leakage factor (-)

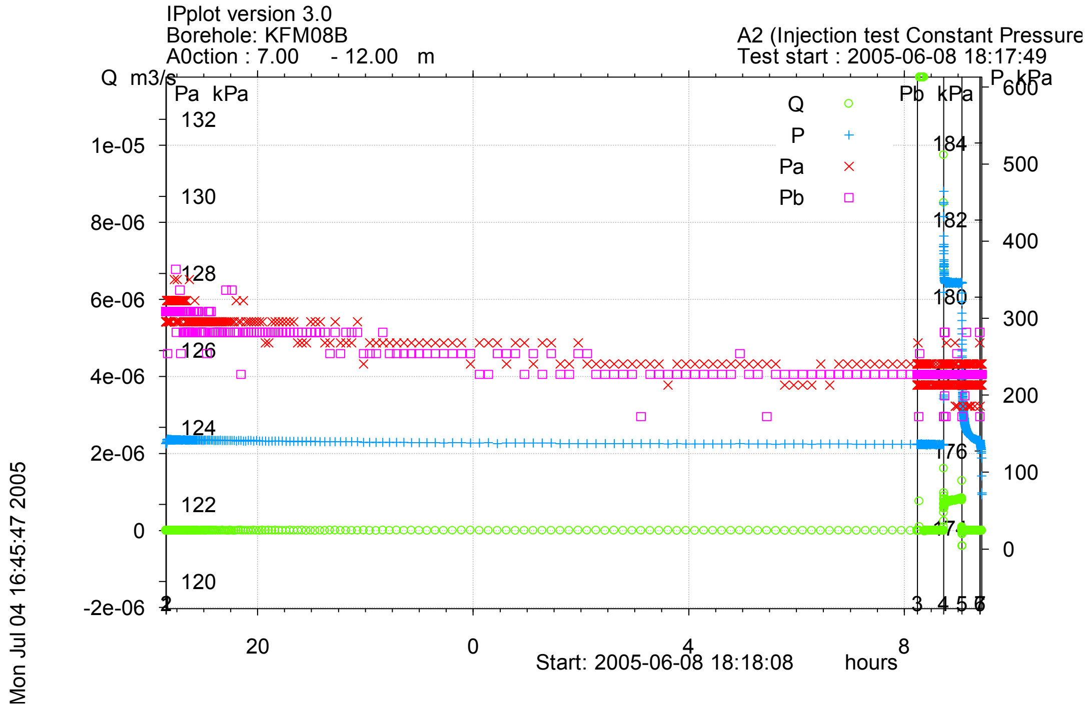


Figure A3-1. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time (showing the whole test), from the injection test in section 7.0-12.0 m in borehole KFM08B.*

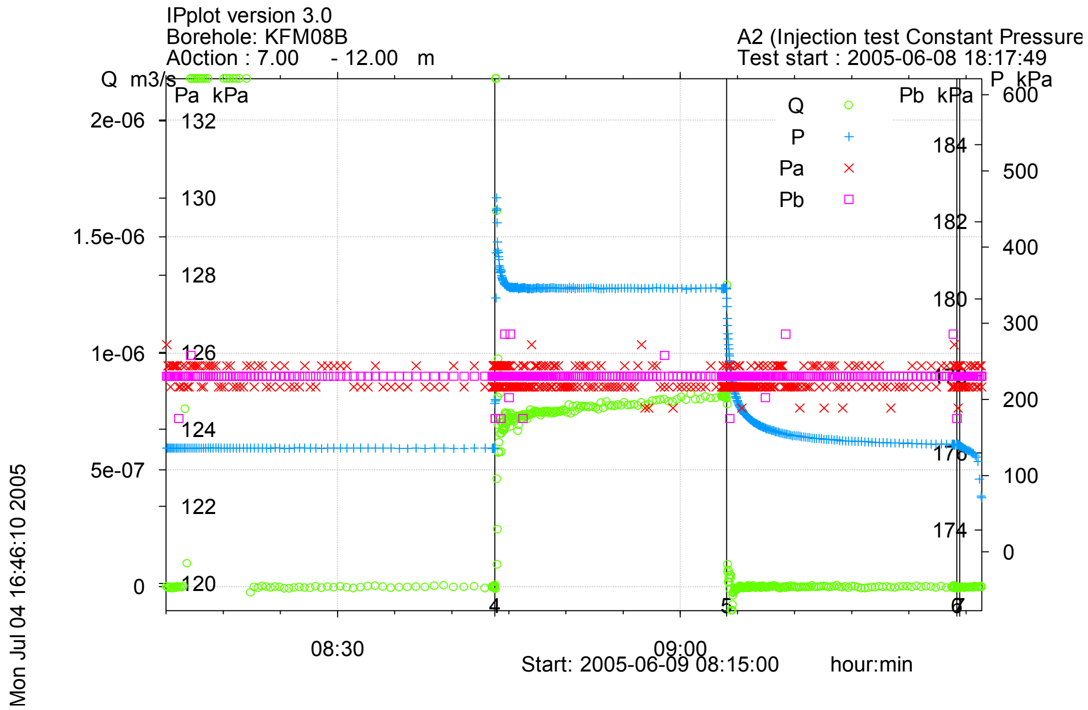


Figure A3-2. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time (showing only part of the time before the injection), from the injection test in section 7.0-12.0 m in borehole KFM08B.*

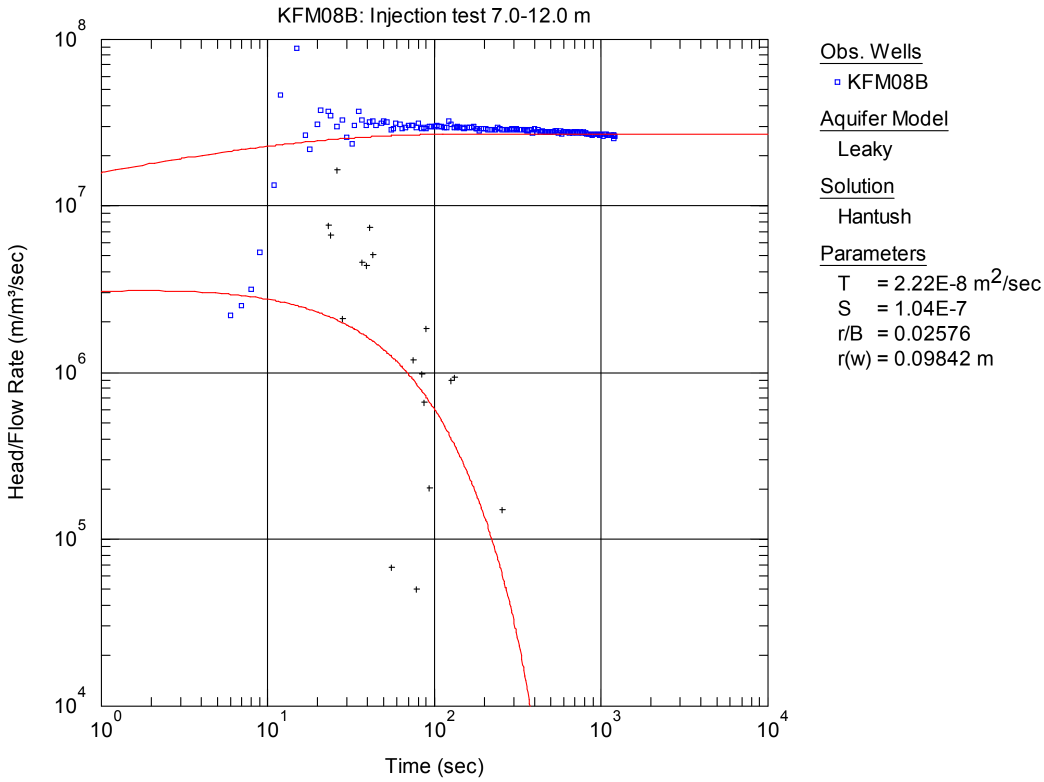


Figure A3-3. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 7.0-12.0 m in KFM08B. The presented values comes from the evaluation of the recovery period and are not representative for the injection period.*

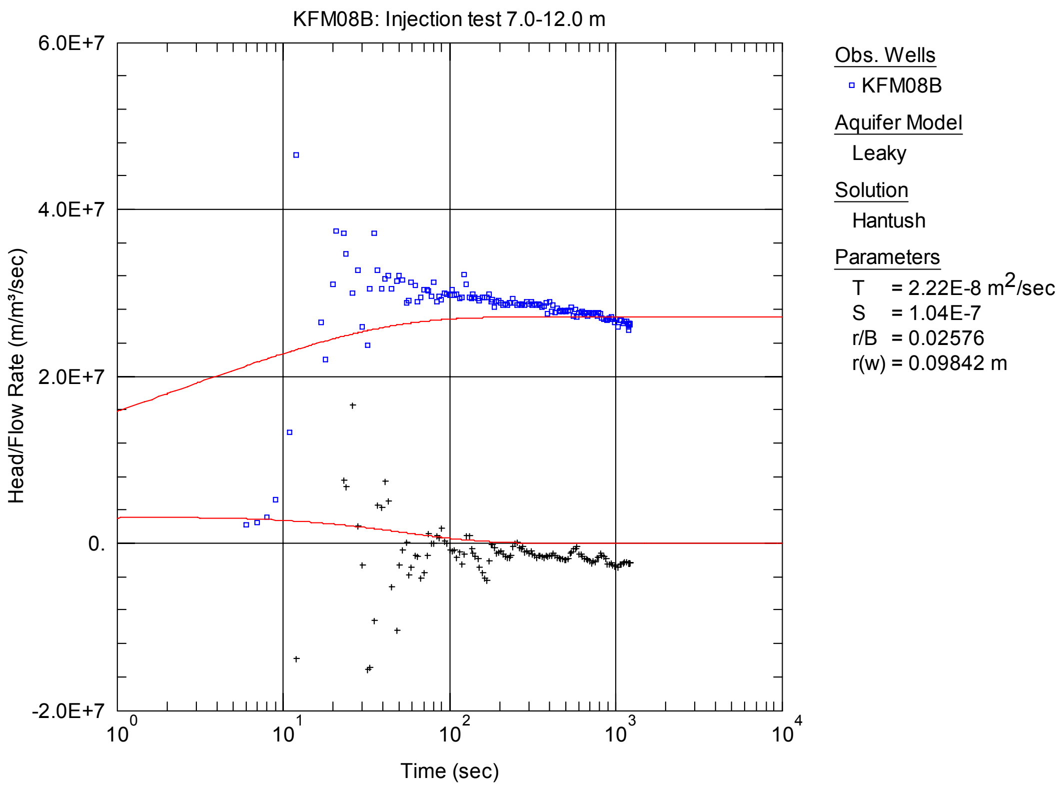


Figure A3-4. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 7.0-12.0 m in KFM08B. The presented values comes from the evaluation of the recovery period and are not representative for the injection period.*

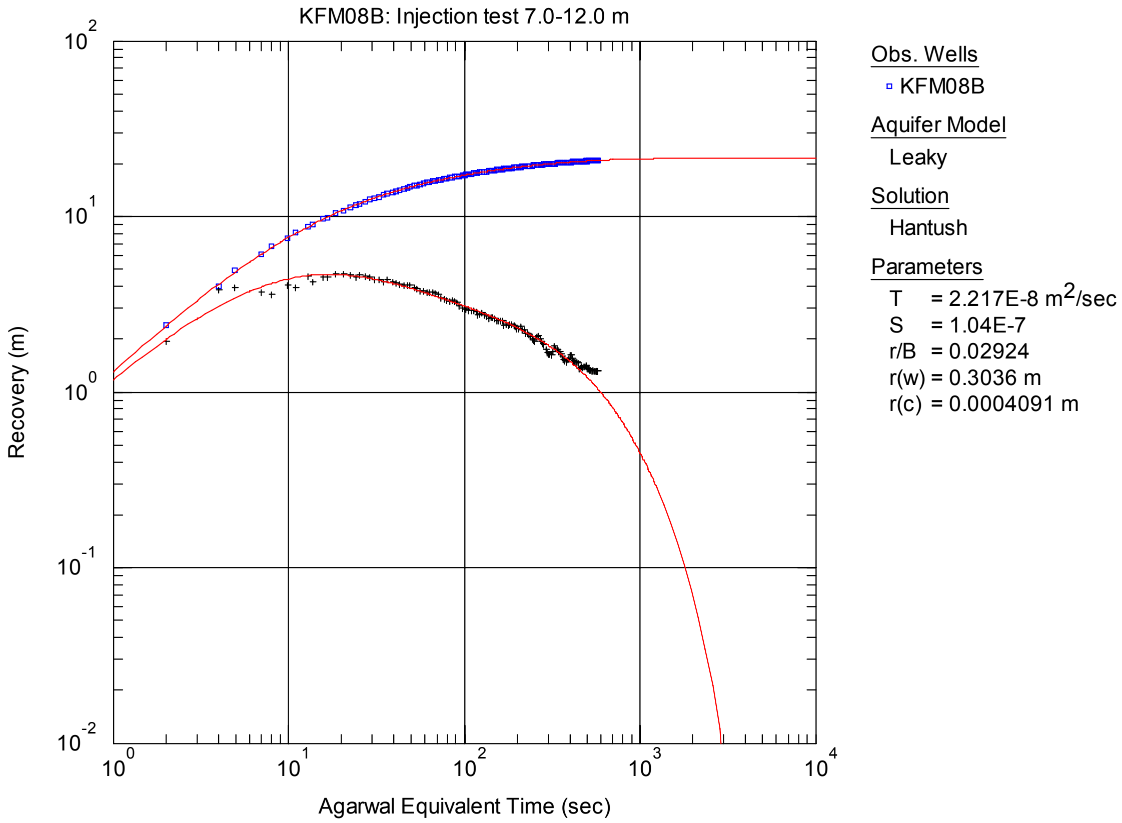


Figure A3-5. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 7.0-12.0 m in KFM08B.*

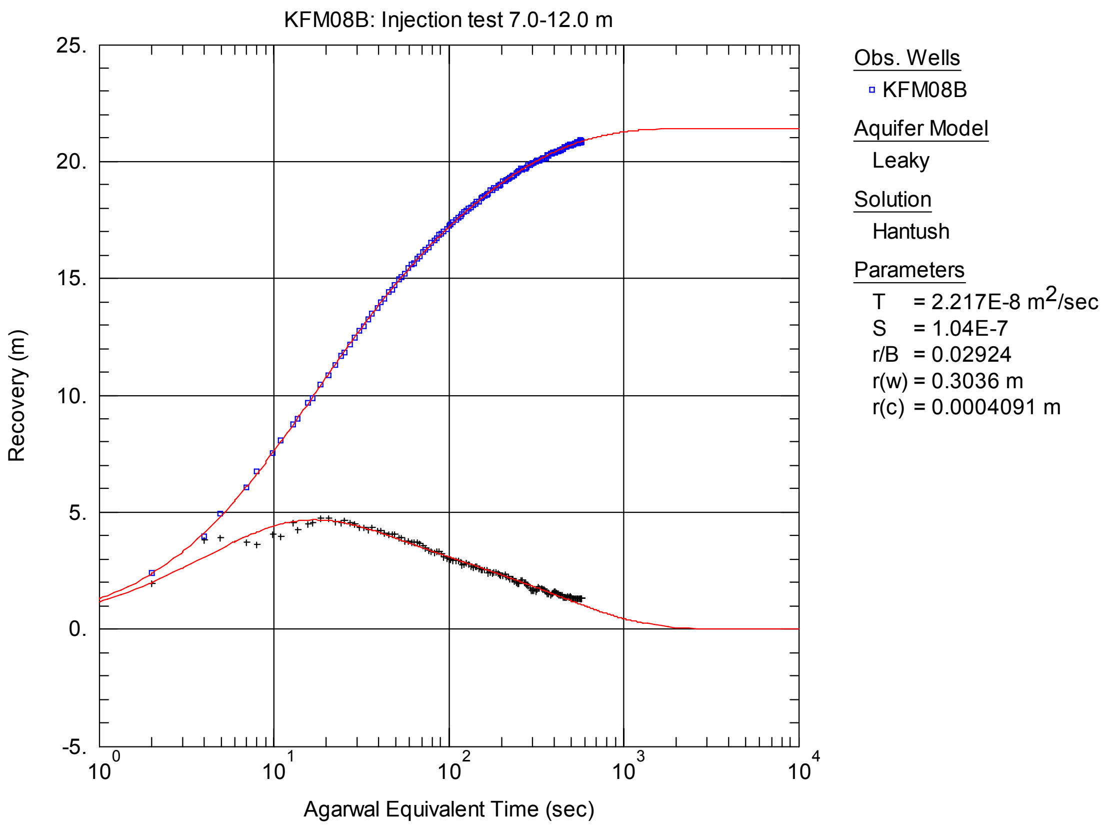


Figure A3-6. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 7.0-12.0 m in KFM08B.*

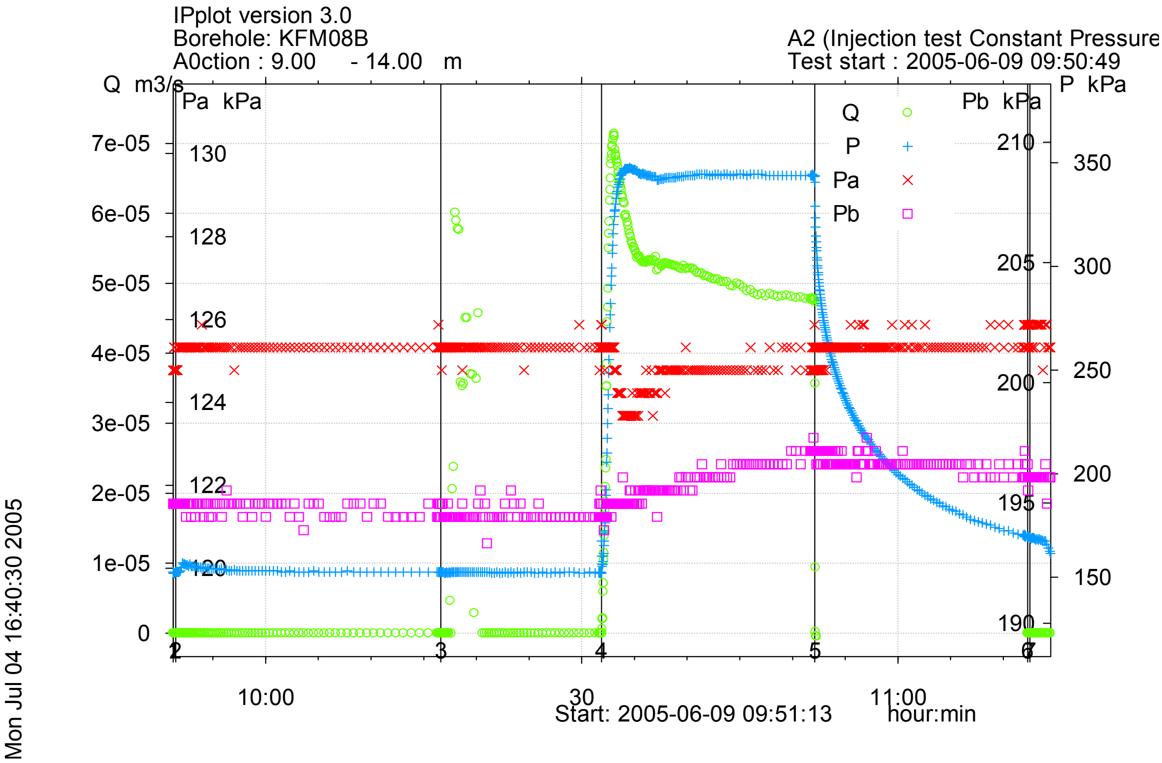


Figure A3-7. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 9.0-14.0 m in borehole KFM08B.*

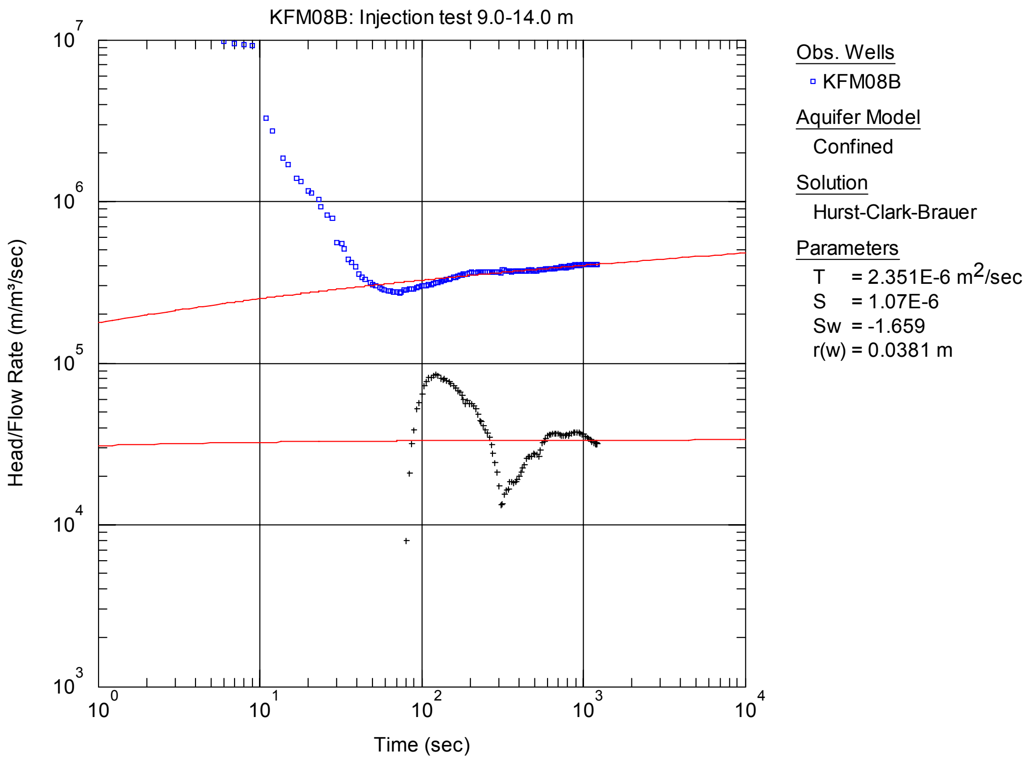


Figure A3-8. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 9.0-14.0 m in KFM08B.*

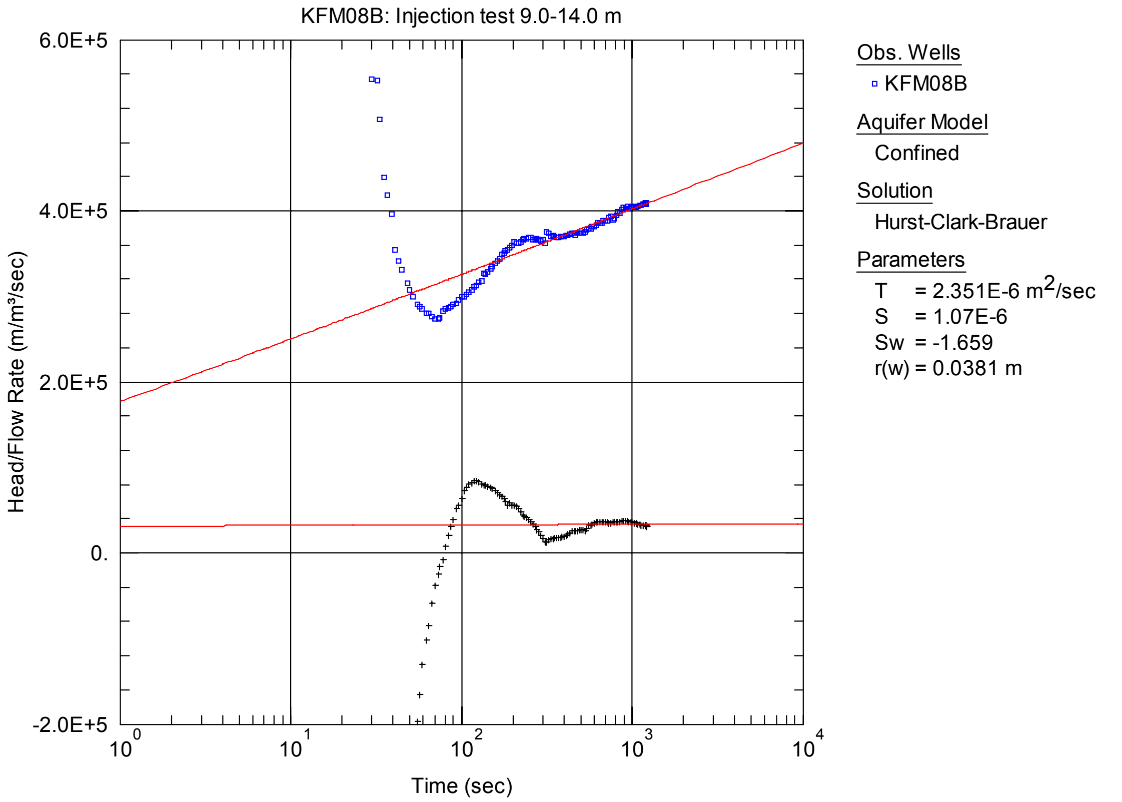


Figure A3-9. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 9.0-14.0 m in KFM08B.*

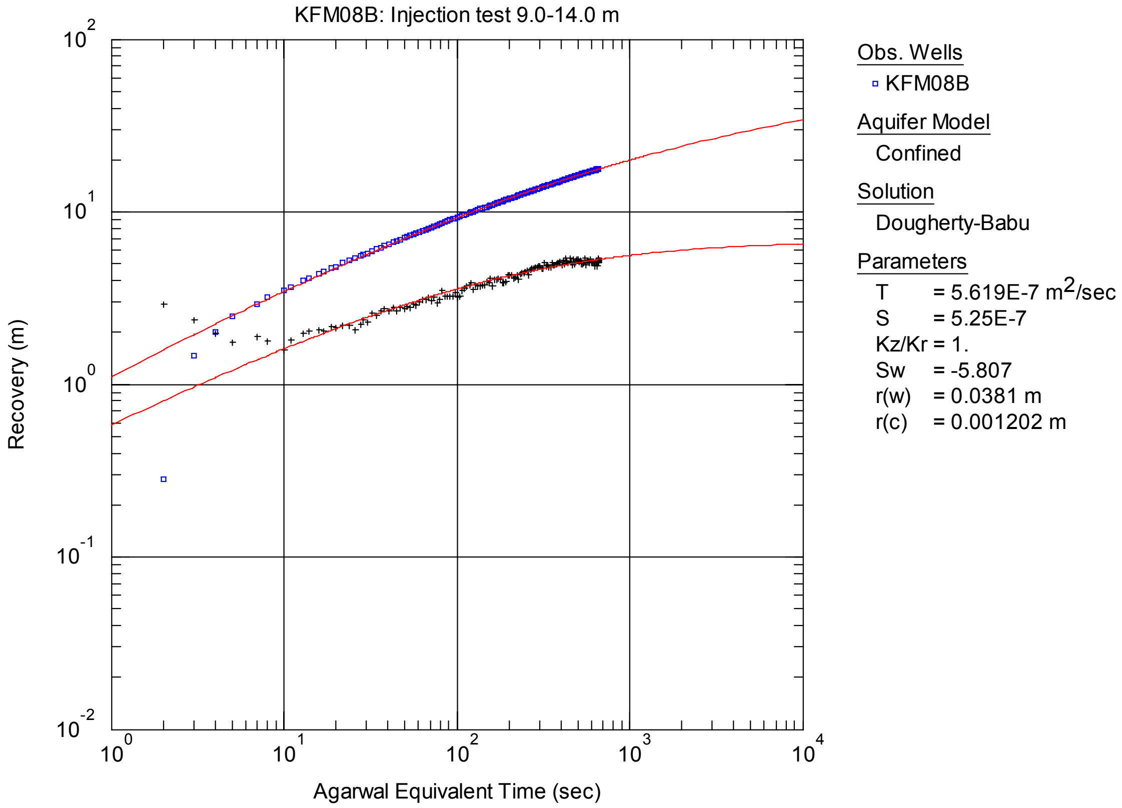


Figure A3-10. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 9.0-14.0 m in KFM08B.*

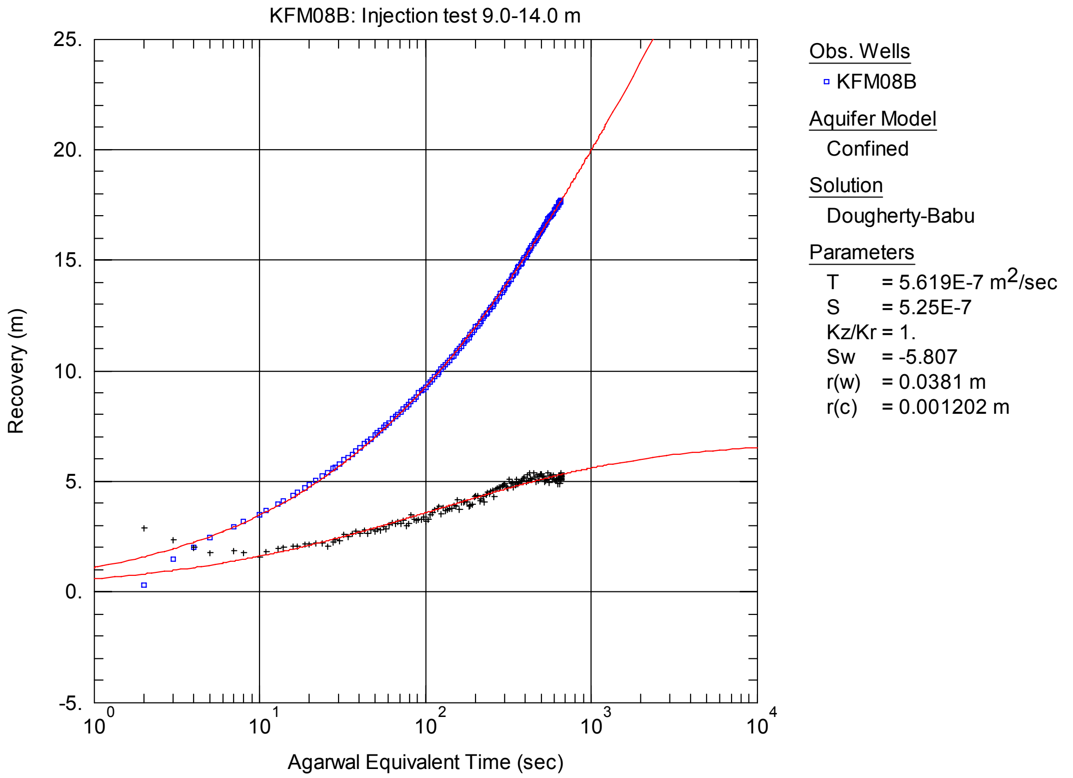


Figure A3-11. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 9.0-14.0 m in KFM08B.*

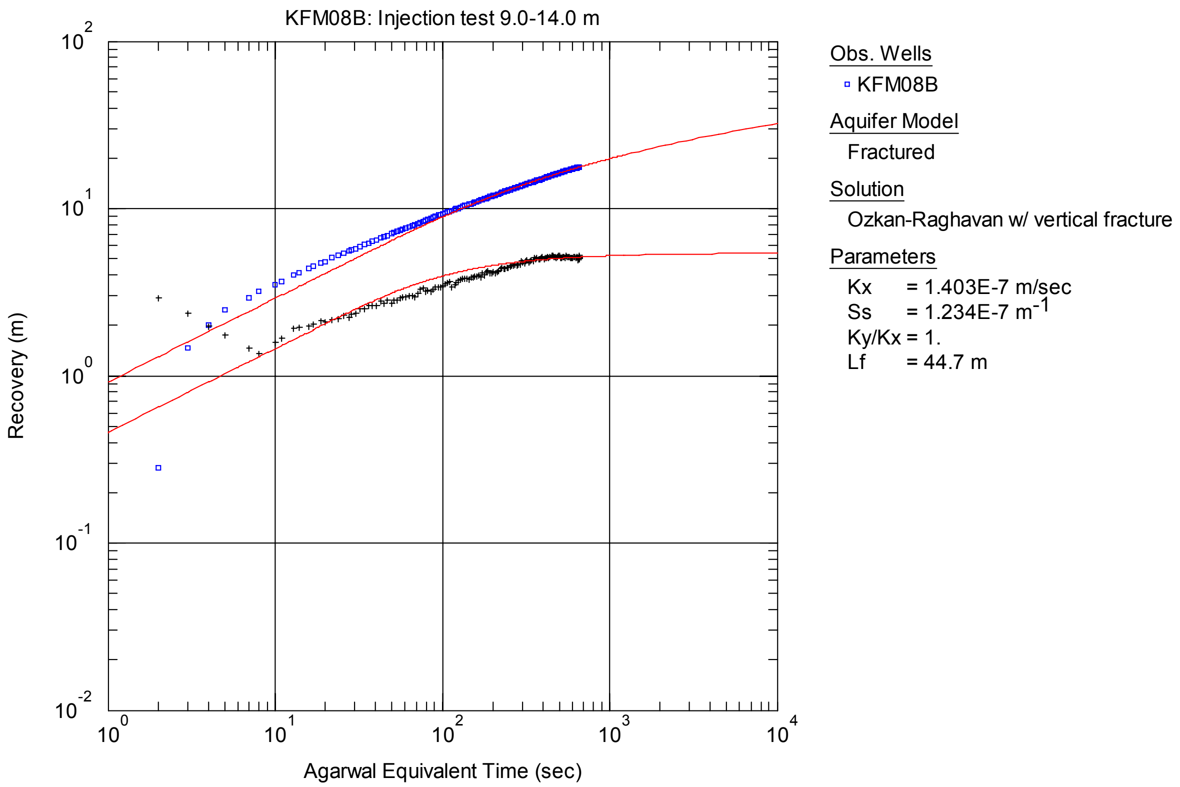


Figure A3-12. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 9.0-14.0 m in KFM08B.*

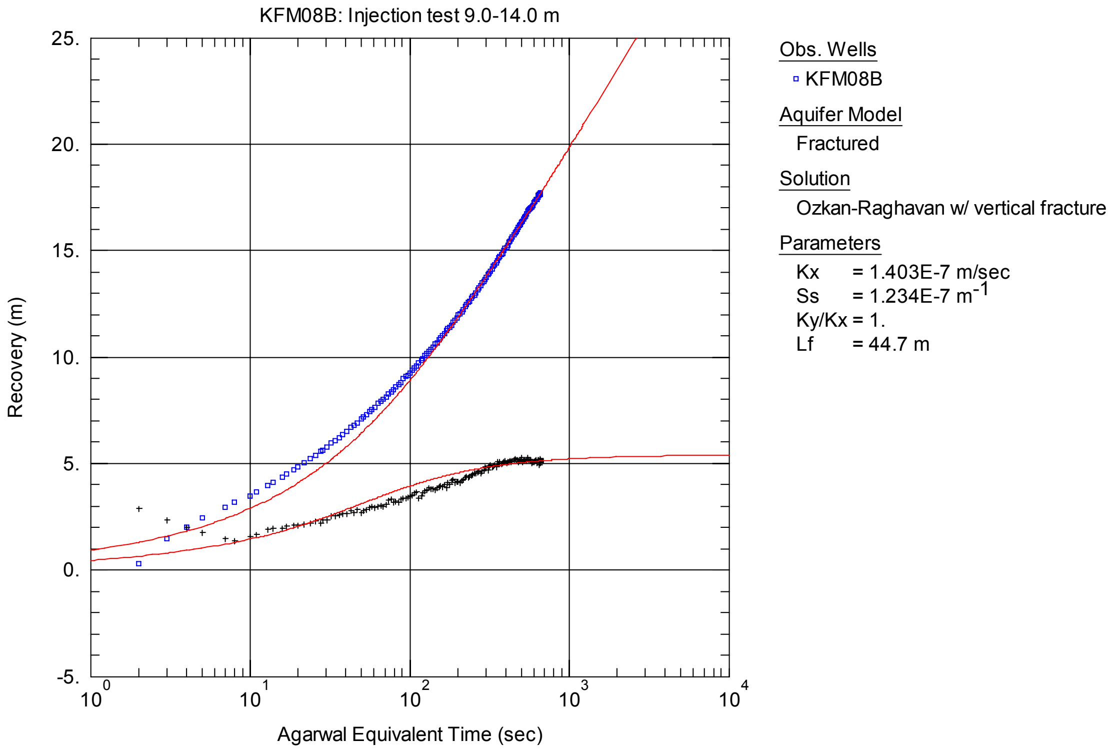


Figure A3-13. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 9.0-14.0 m in KFM08B.*

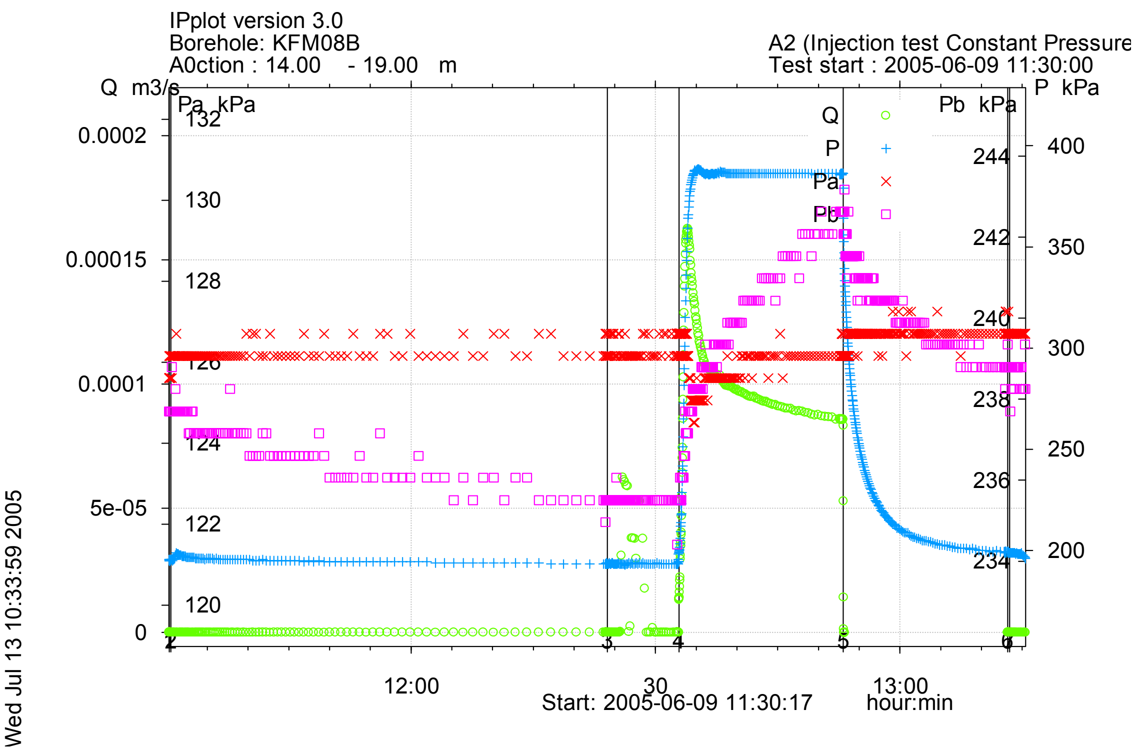


Figure A3-14. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 14.0-19.0 m in borehole KFM08B.*

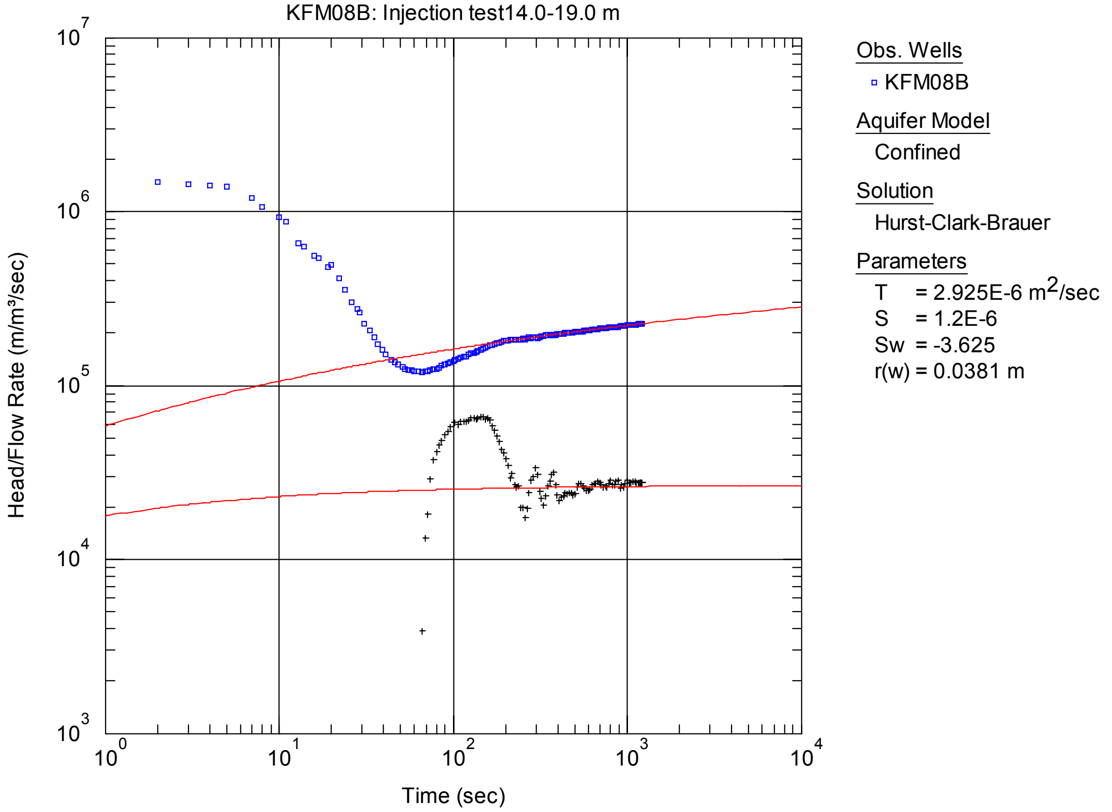


__Figure A3-15.__ Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 14.0-19.0 m in KFM08B.

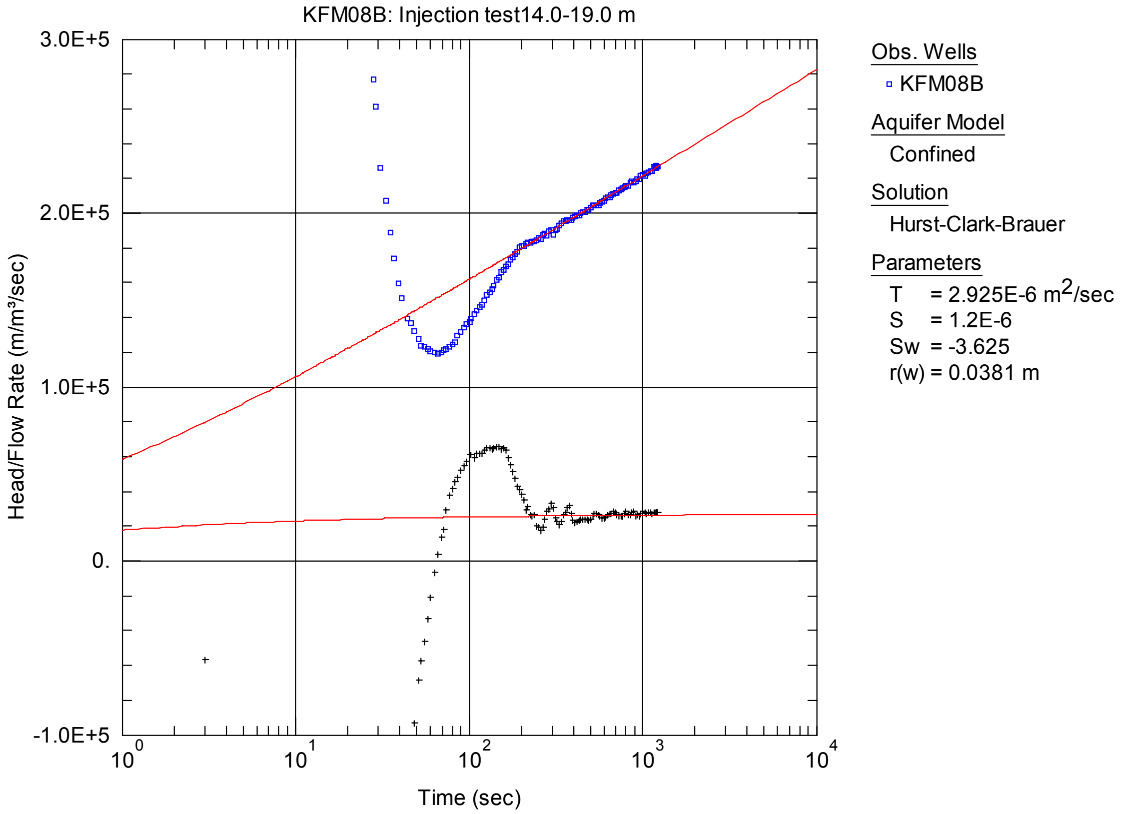


__Figure A3-16.__ Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 14.0-19.0 m in KFM08B.

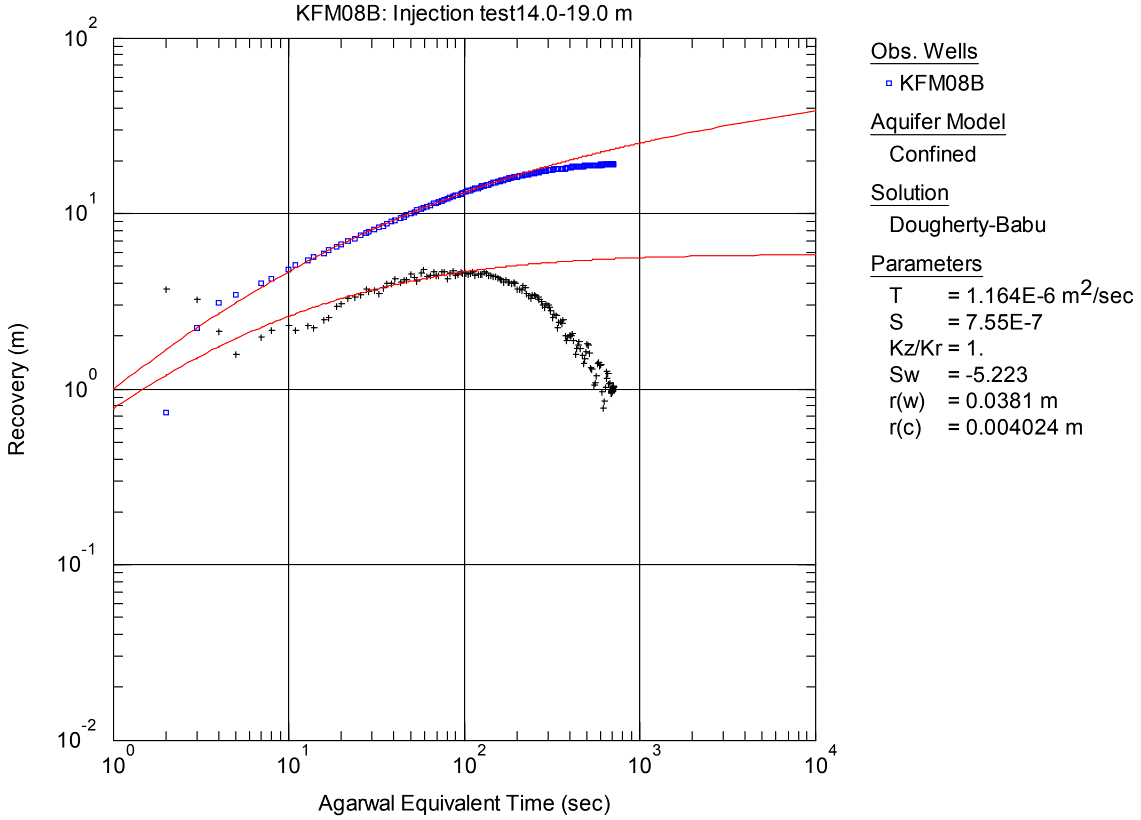


Figure A3-17. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 14.0-19.0 m in KFM08B.*

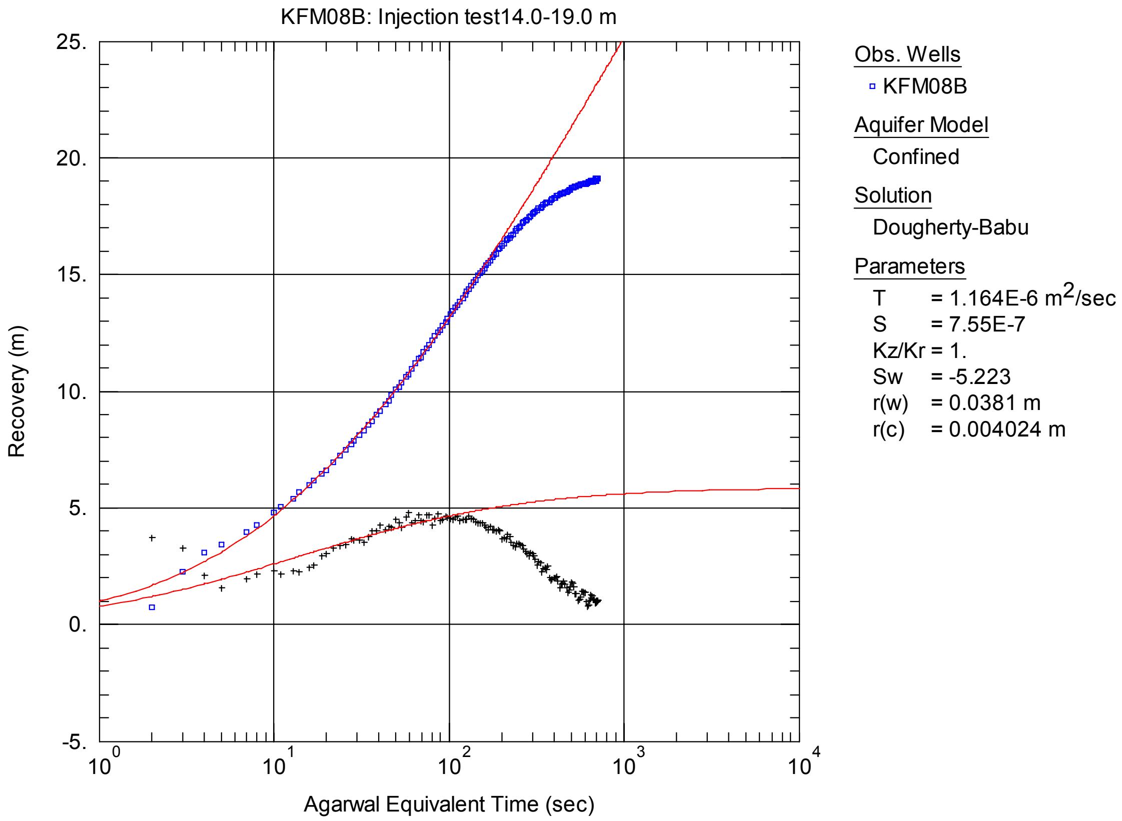


Figure A3-18. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 14.0-19.0 m in KFM08B.*

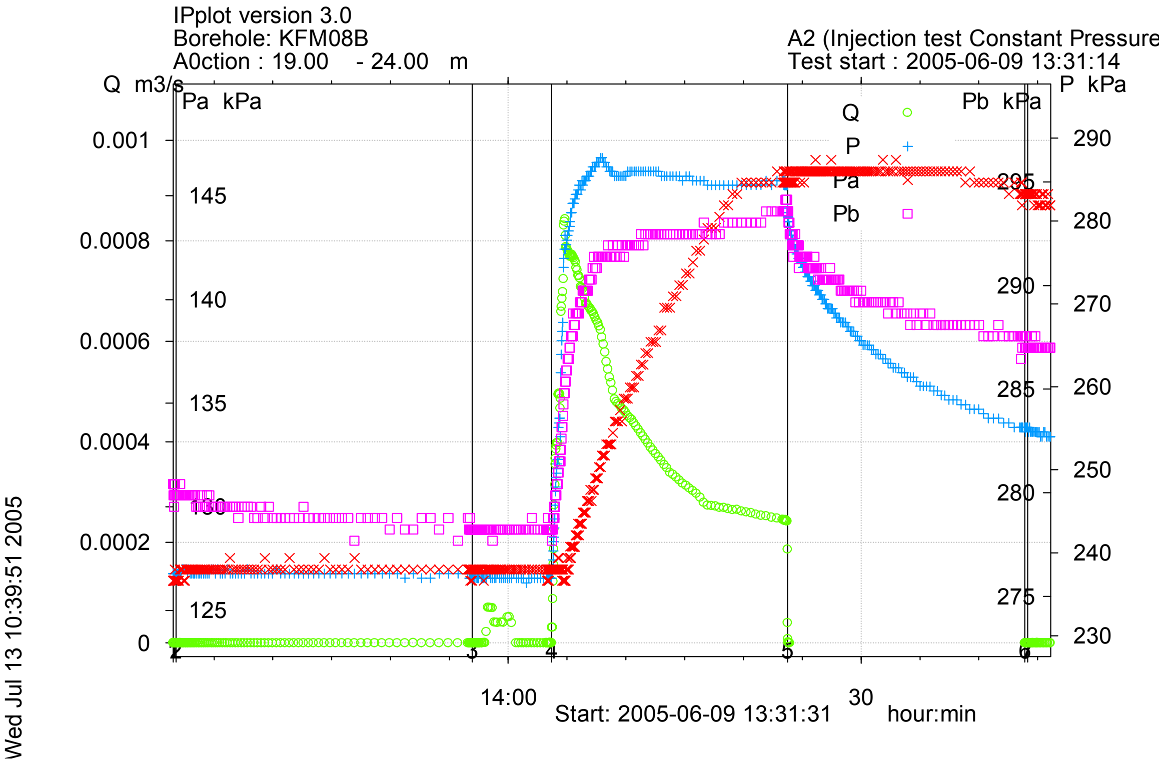


Figure A3-19. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 19.0-24.0 m in borehole KFM08B.*

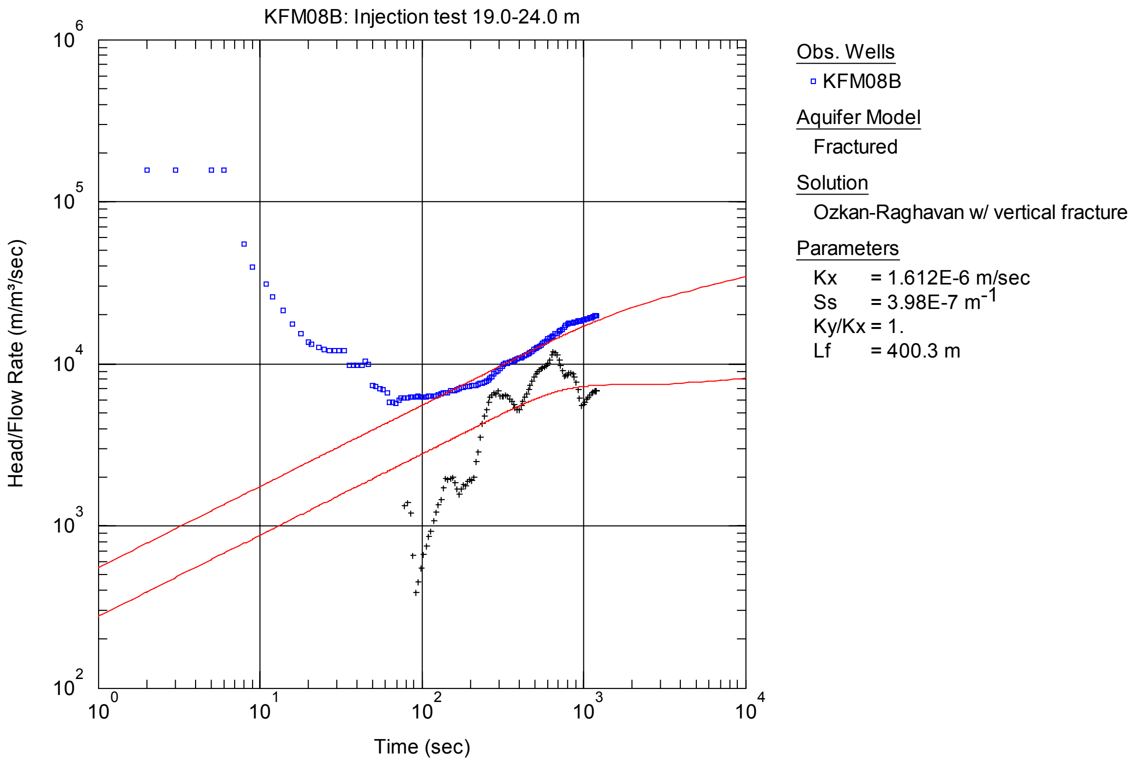


Figure A3-20. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 19.0-24.0 m in KFM08B.*

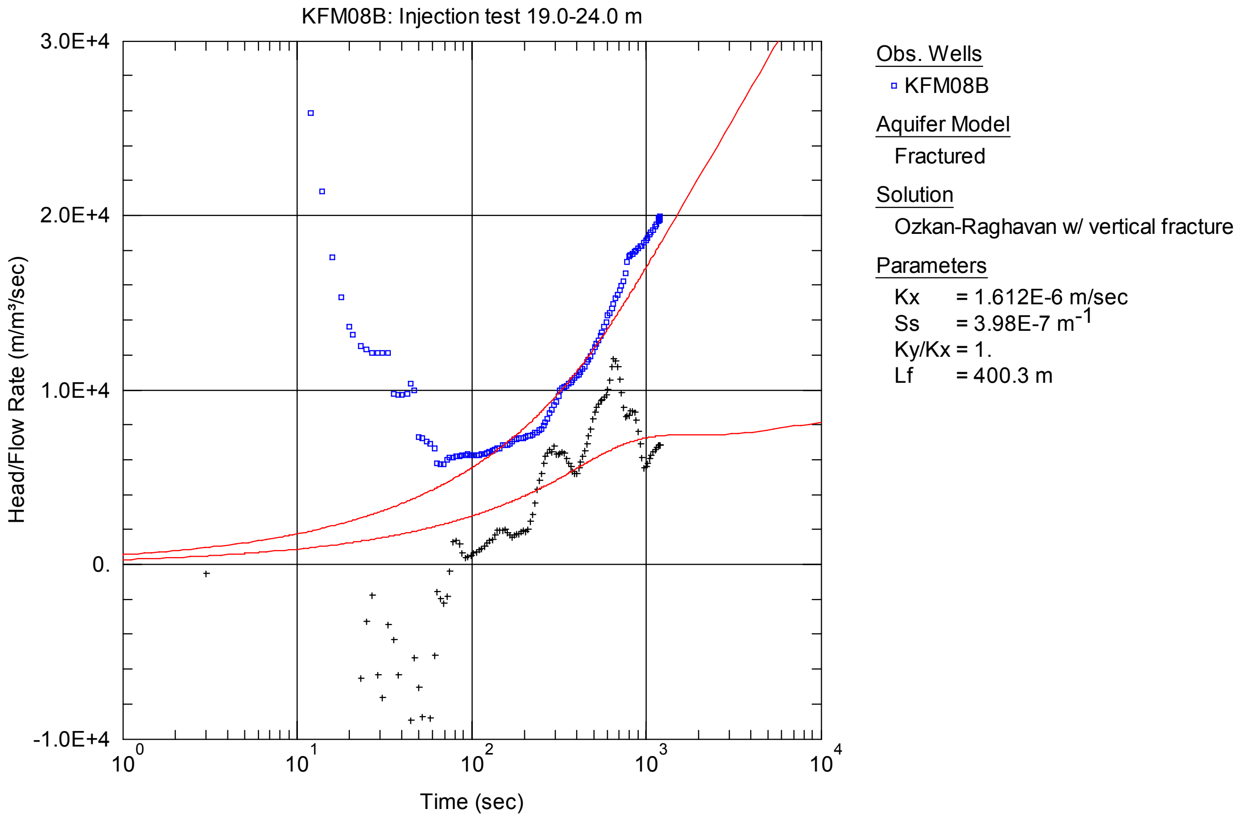


Figure A3-21. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 19.0-24.0 m in KFM08B.*

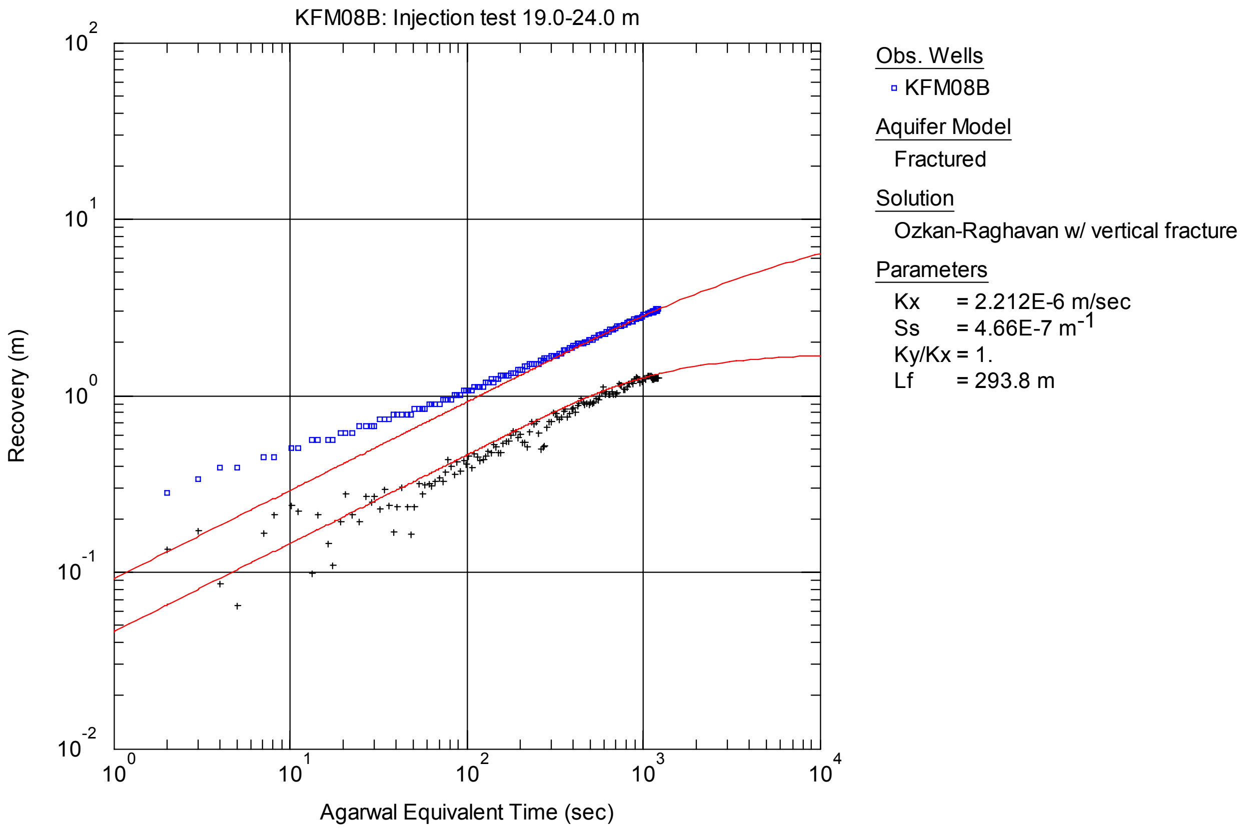


Figure A3-22. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 19.0-24.0 m in KFM08B.*

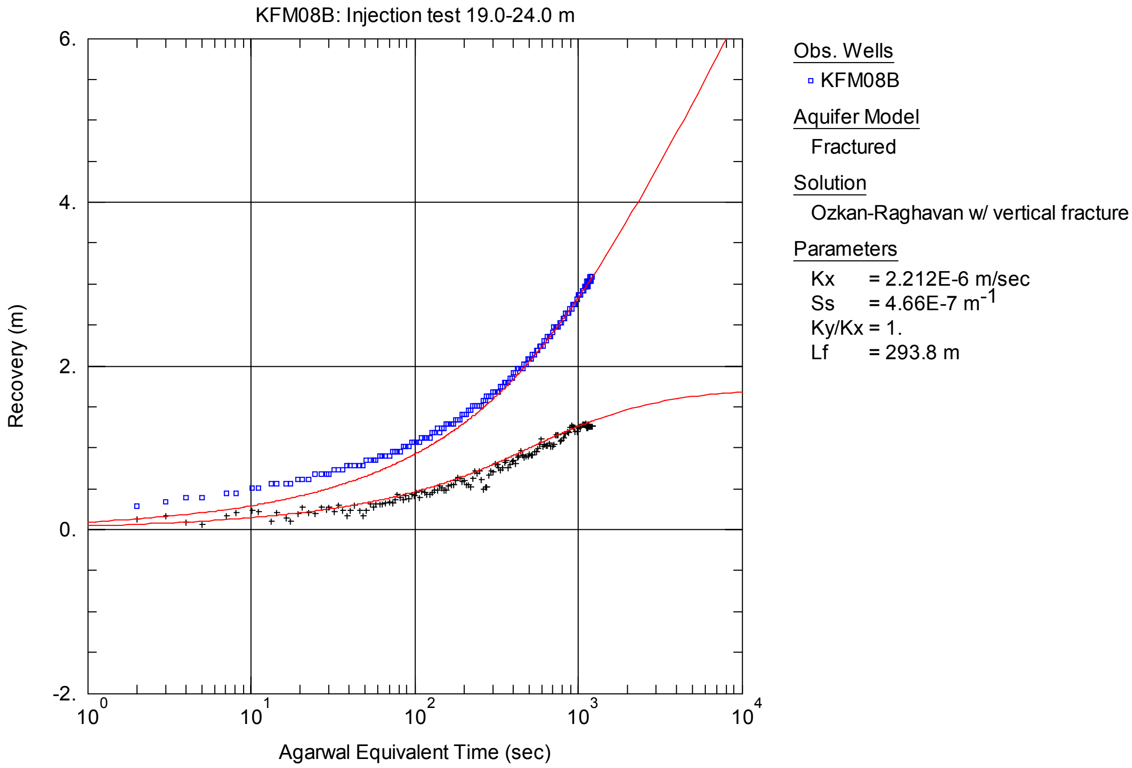


Figure A3-23. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 19.0-24.0 m in KFM08B.*

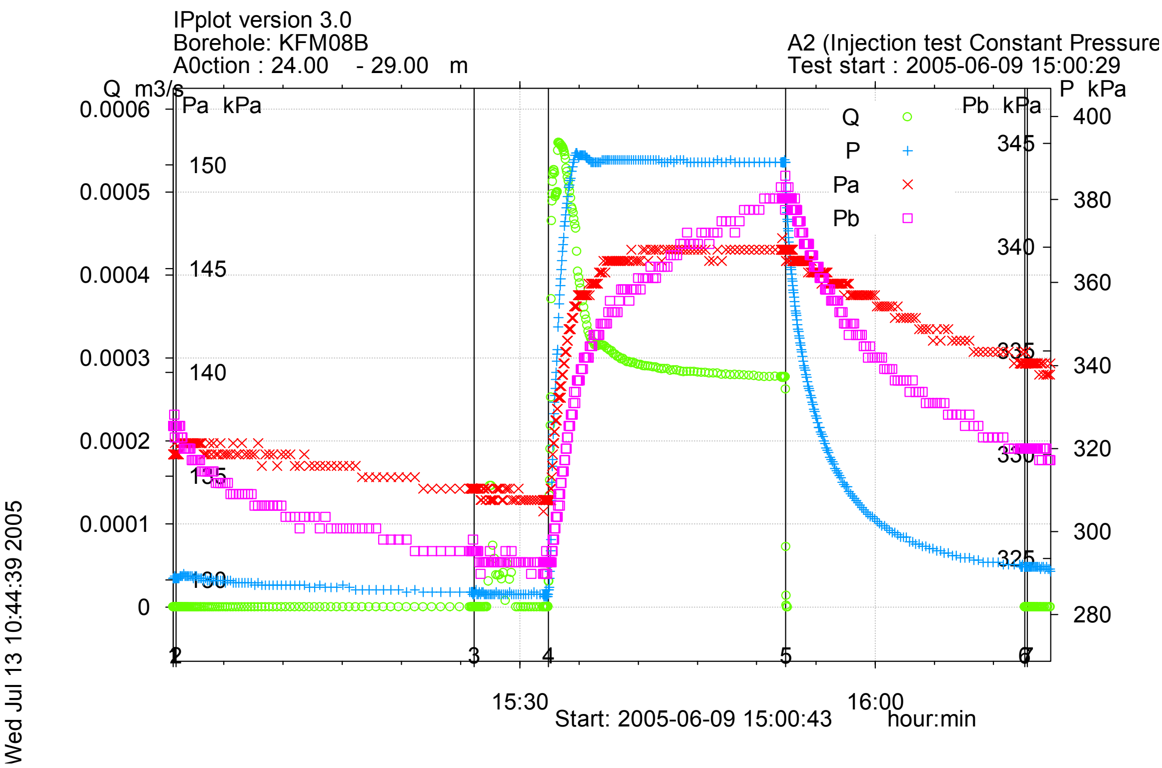


Figure A3-24. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 24.0-29.0 m in borehole KFM08B.*

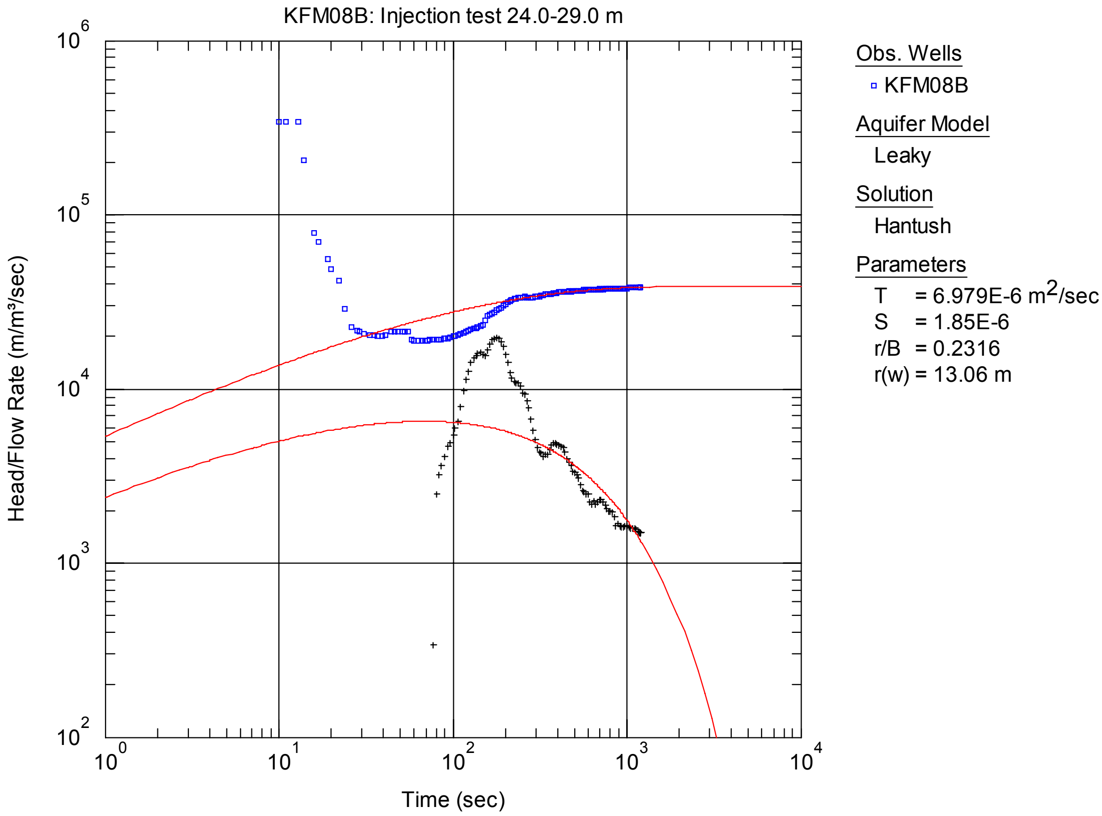


Figure A3-25. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 24.0-29.0 m in KFM08B.*

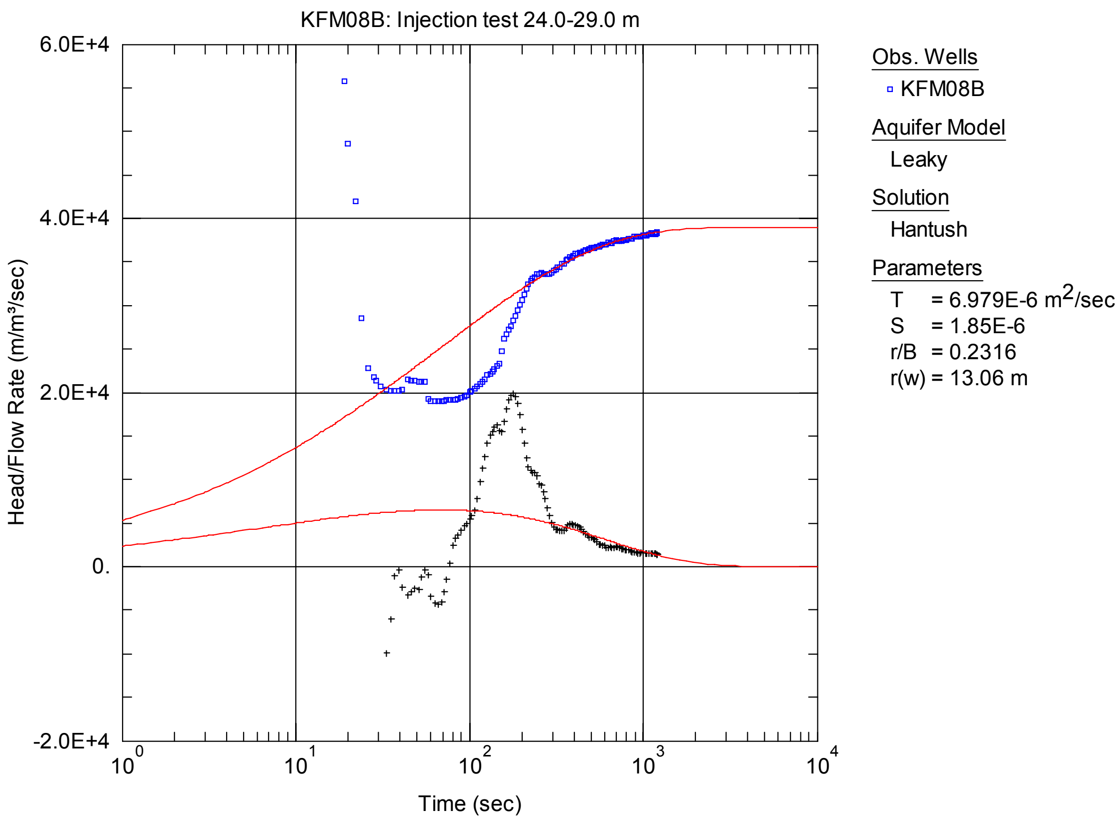


Figure A3-26. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 24.0-29.0 m in KFM08B.*

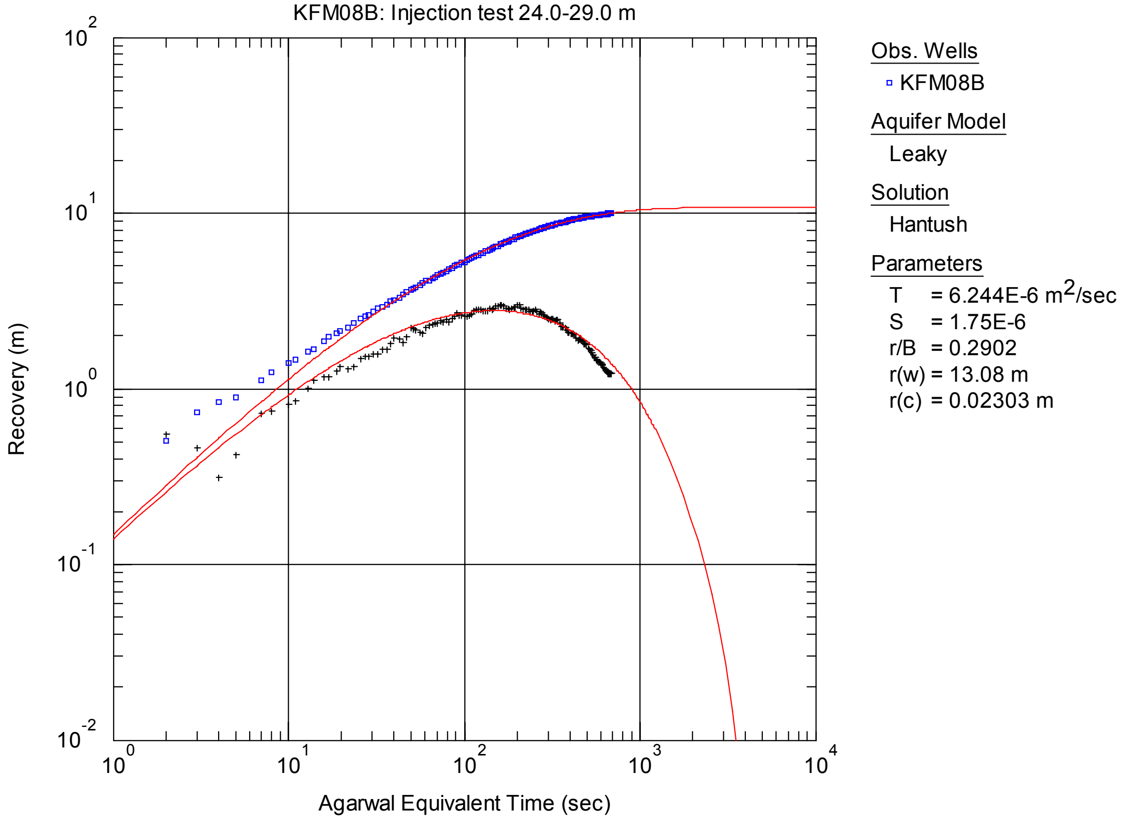


Figure A3-27. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 24.0-29.0 m in KFM08B.*

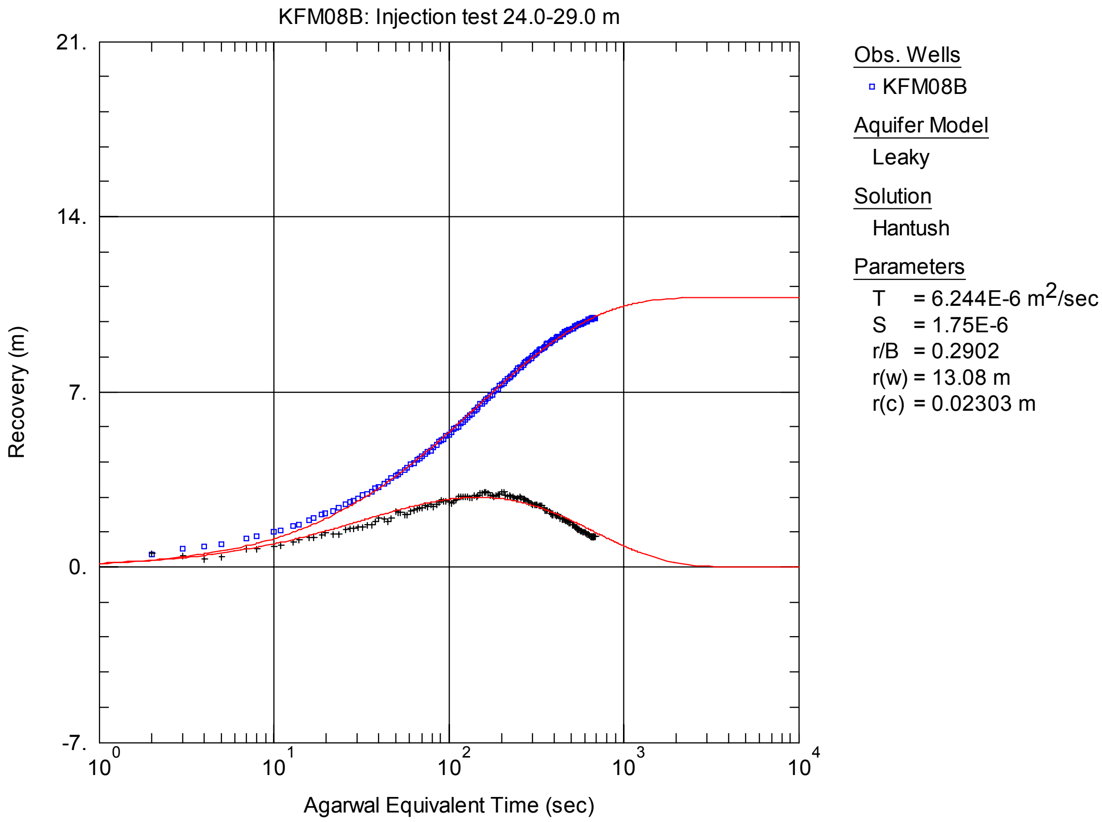


Figure A3-28. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 24.0-29.0 m in KFM08B.*

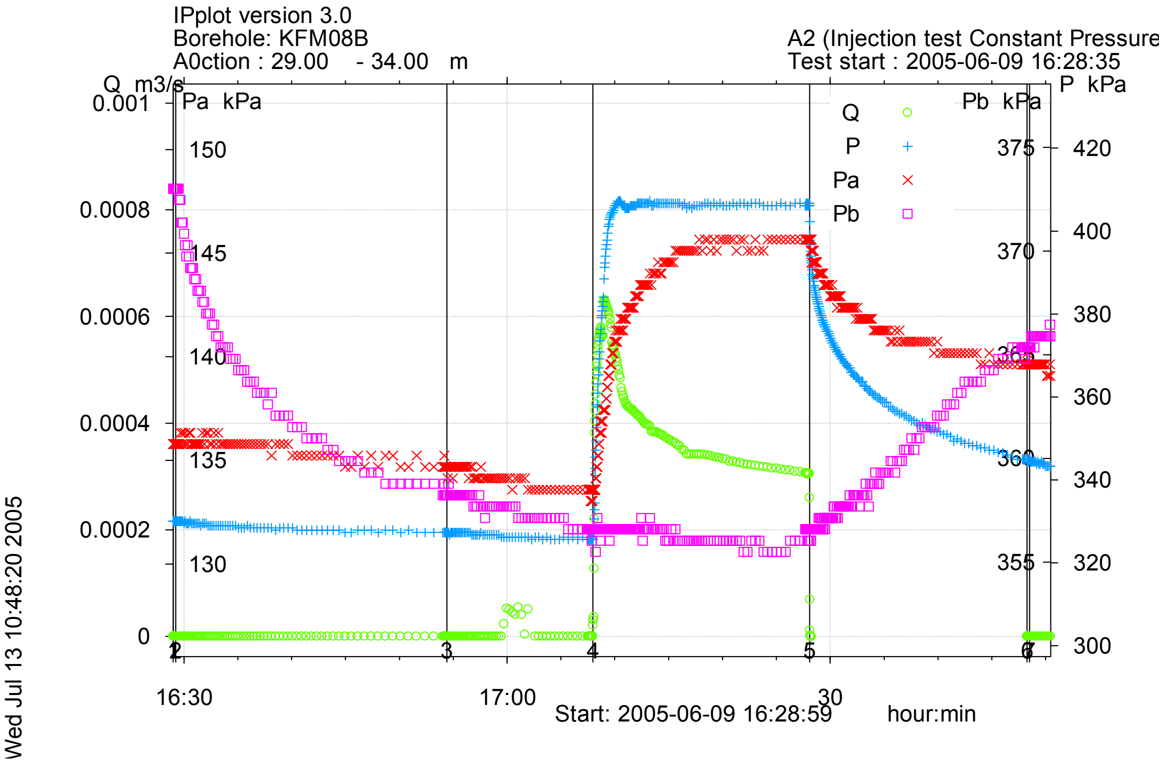


Figure A3-29. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 29.0-34.0 m in borehole KFM08B.*

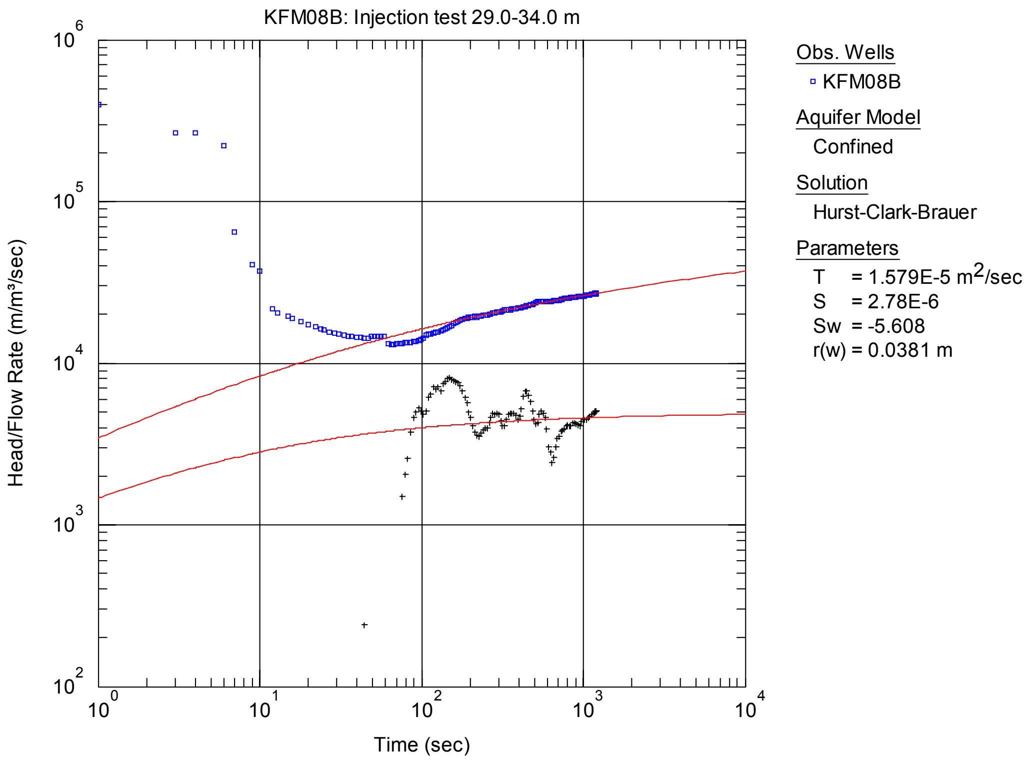


Figure A3-30. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 29.0-34.0 m in KFM08B.*

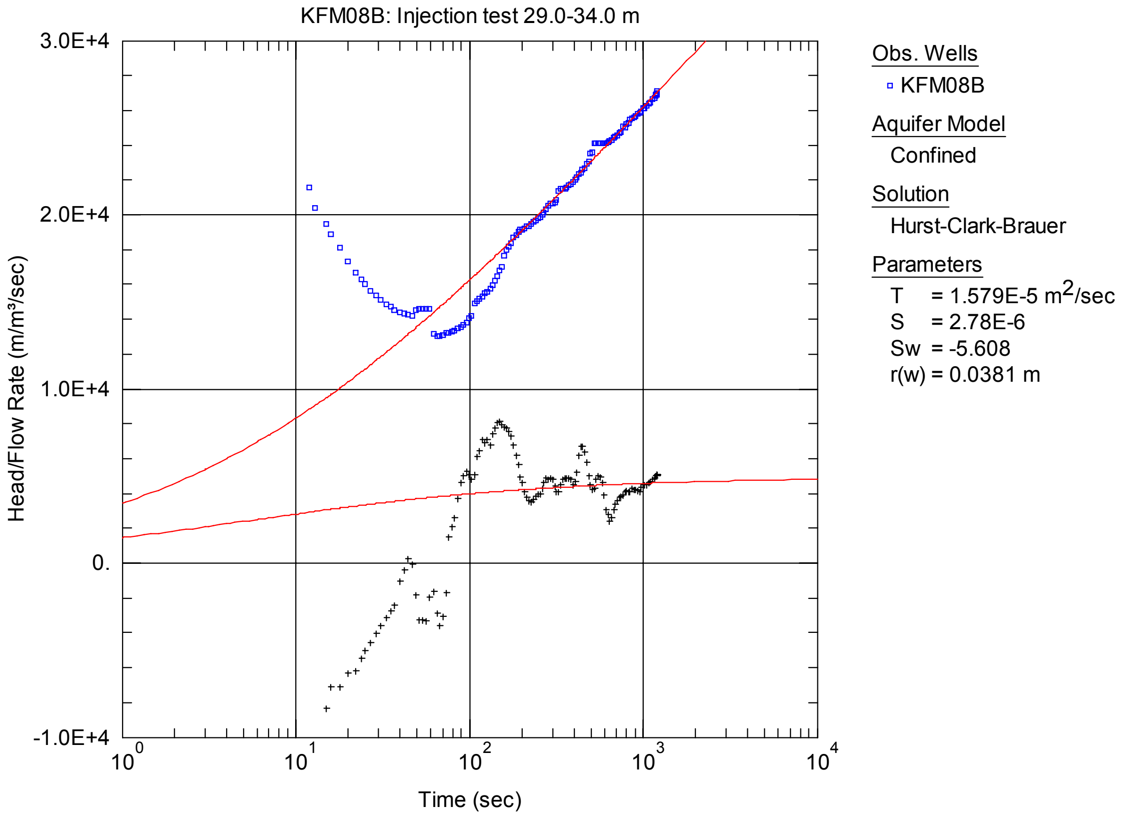


Figure A3-31. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 29.0-34.0 m in KFM08B.*

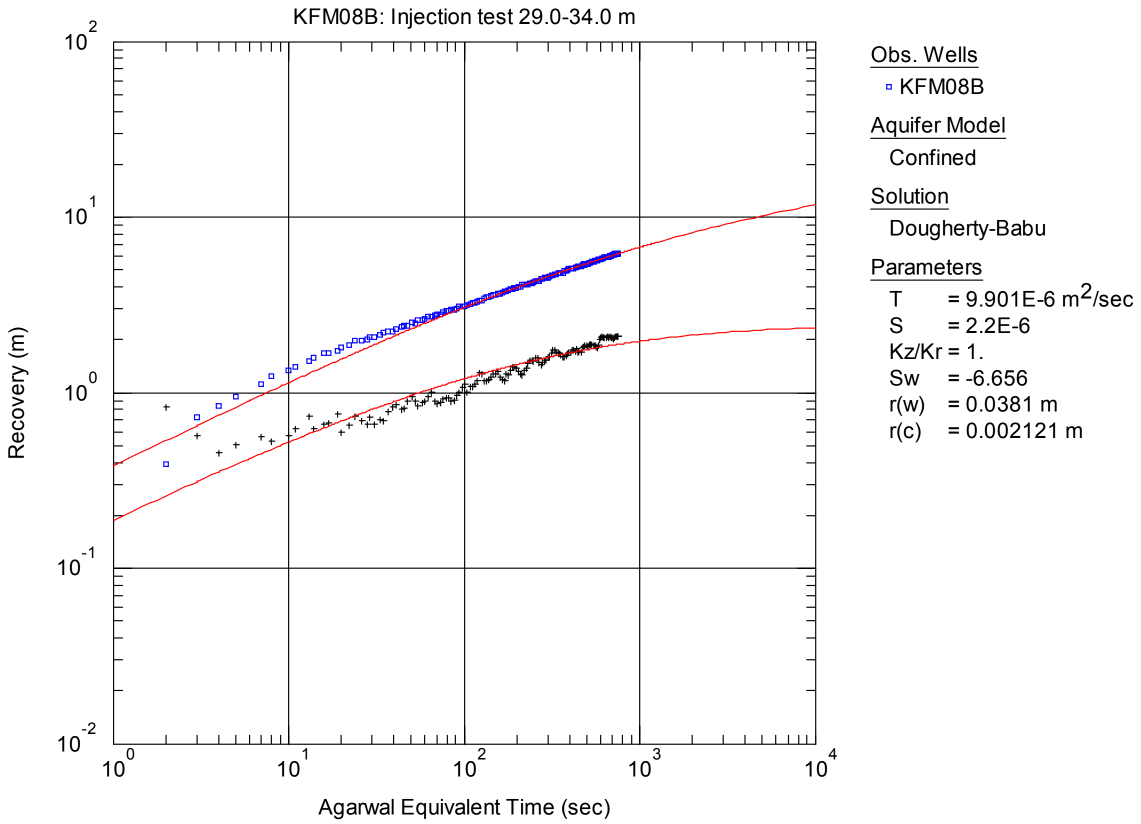


Figure A3-32. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 29.0-34.0 m in KFM08B.*

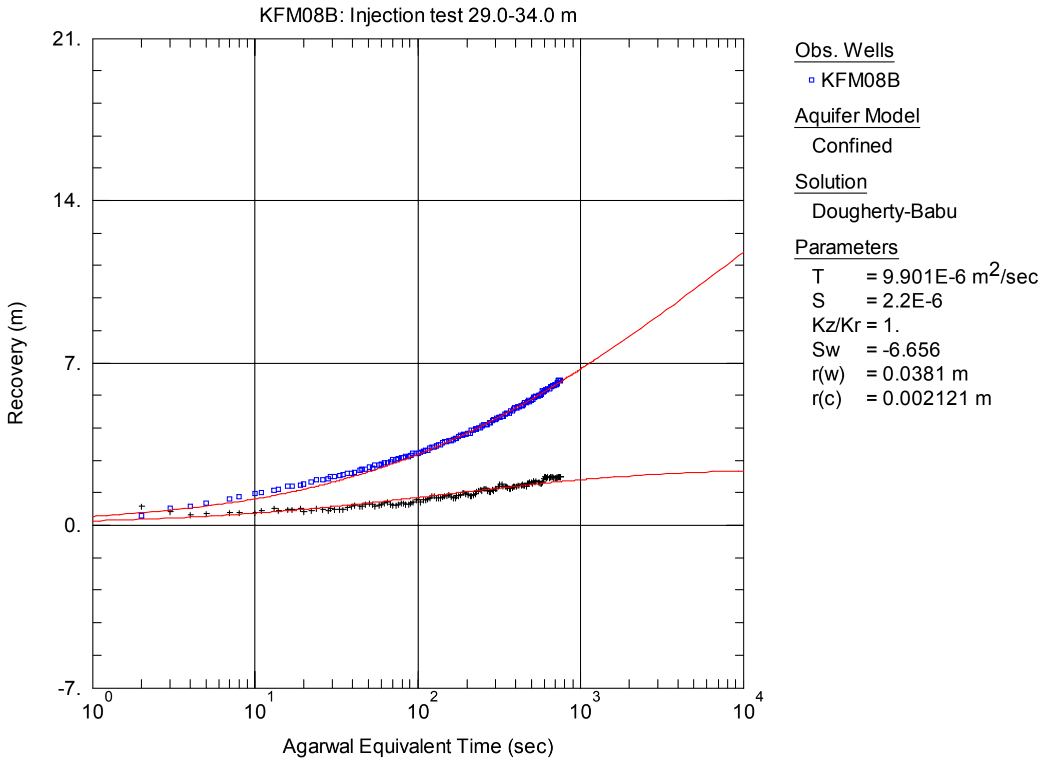


Figure A3-33. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 29.0-34.0 m in KFM08B.*

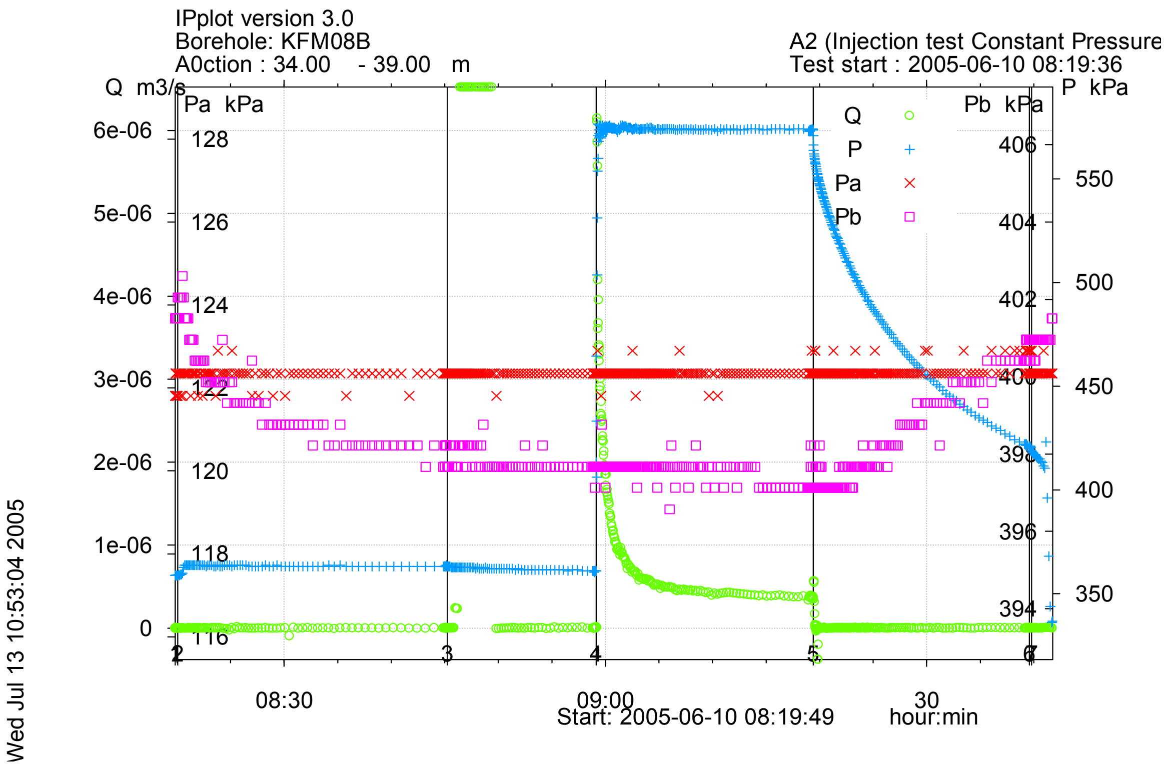


Figure A3-34. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 34.0-39.0 m in borehole KFM08B.*

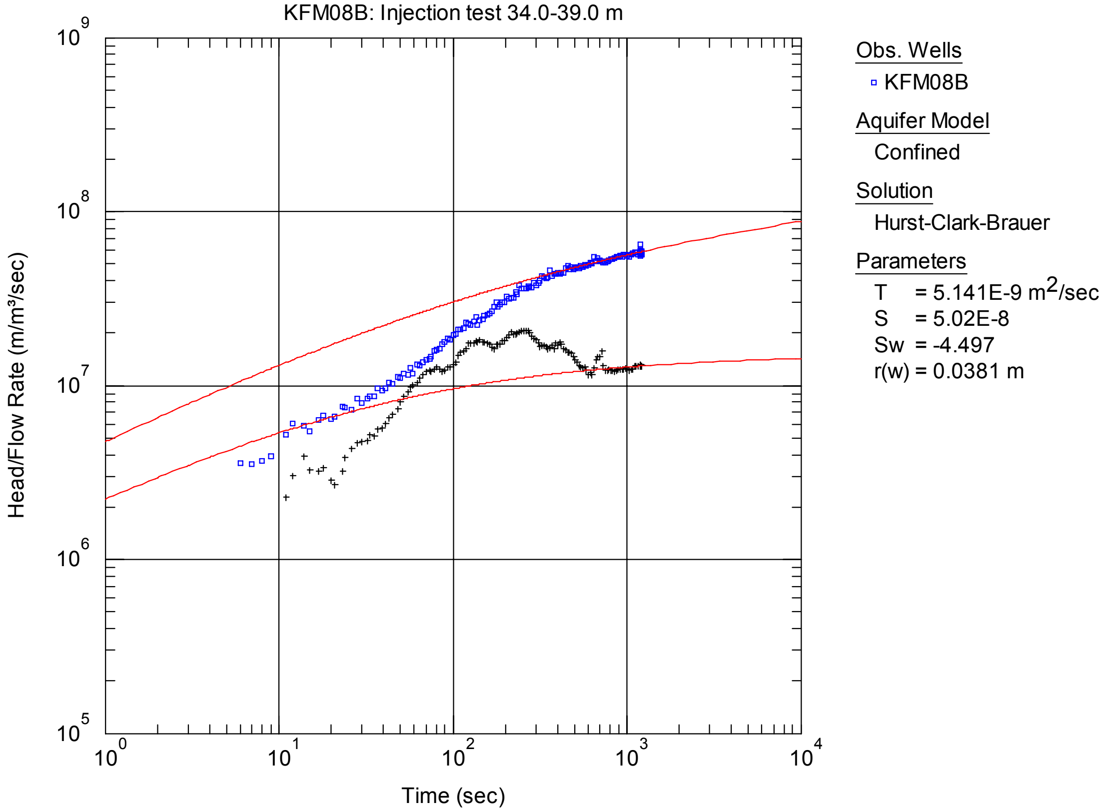


Figure A3-35. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 34.0-39.0 m in KFM08B.*

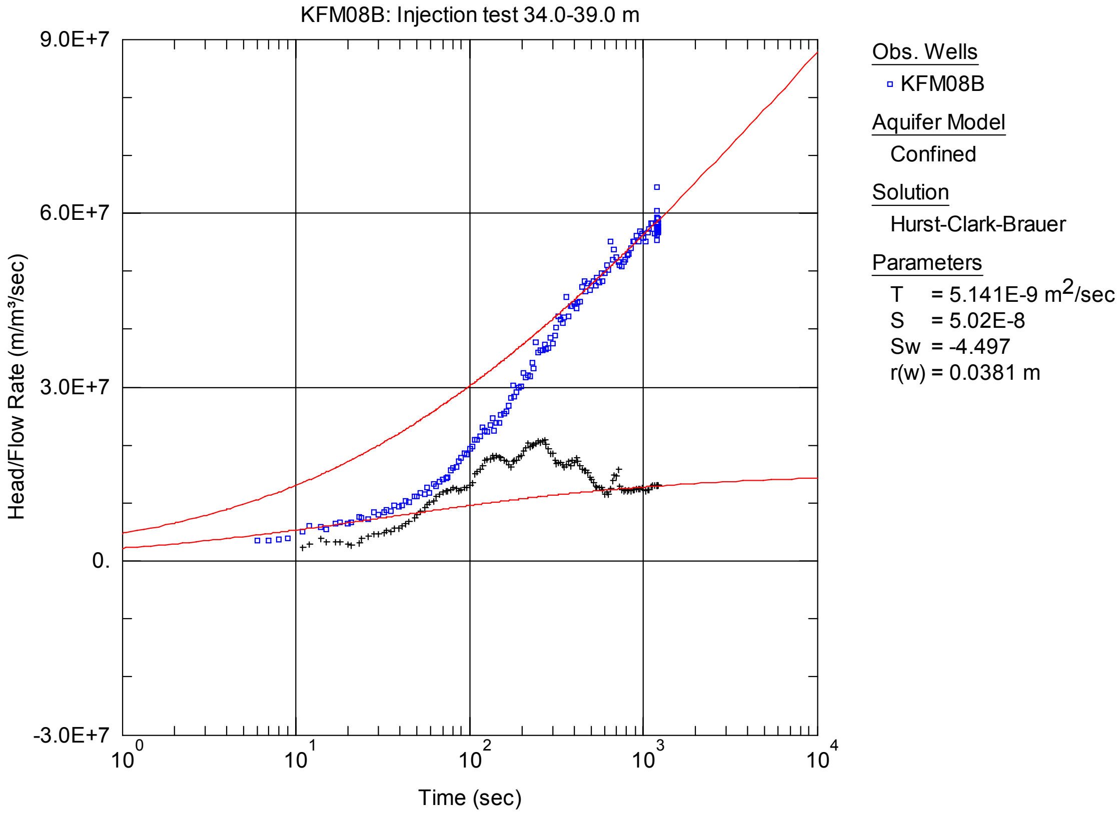


Figure A3-36. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 34.0-39.0 m in KFM08B.*

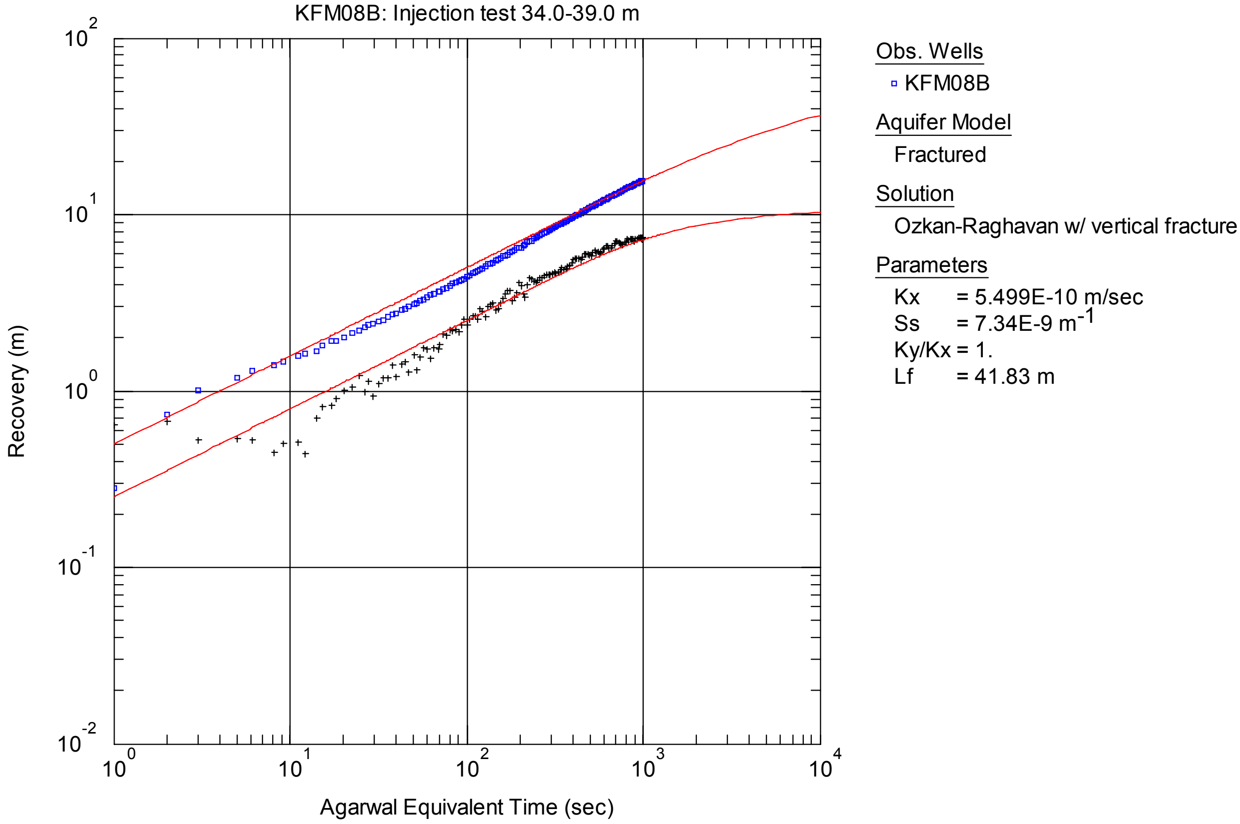


Figure A3-37. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 34.0-39.0 m in KFM08B.*

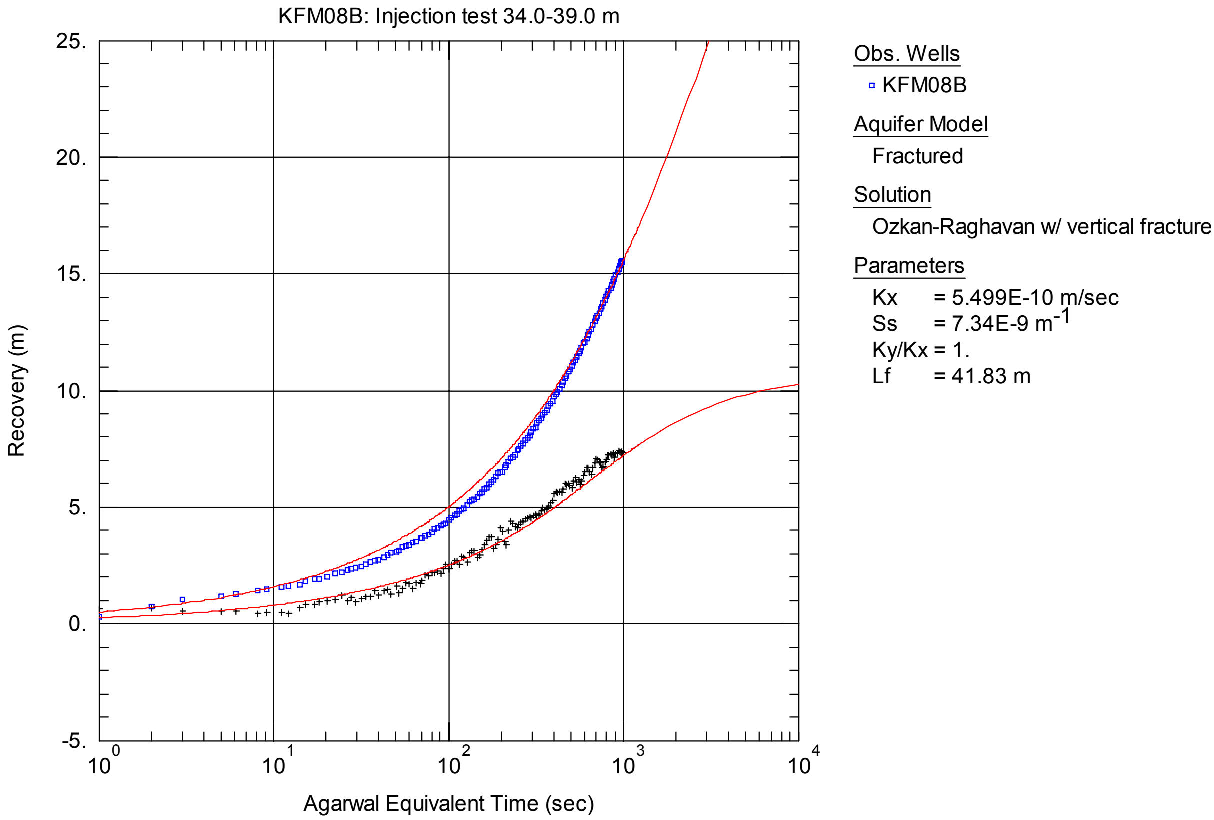


Figure A3-38. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 34.0-39.0 m in KFM08B.*

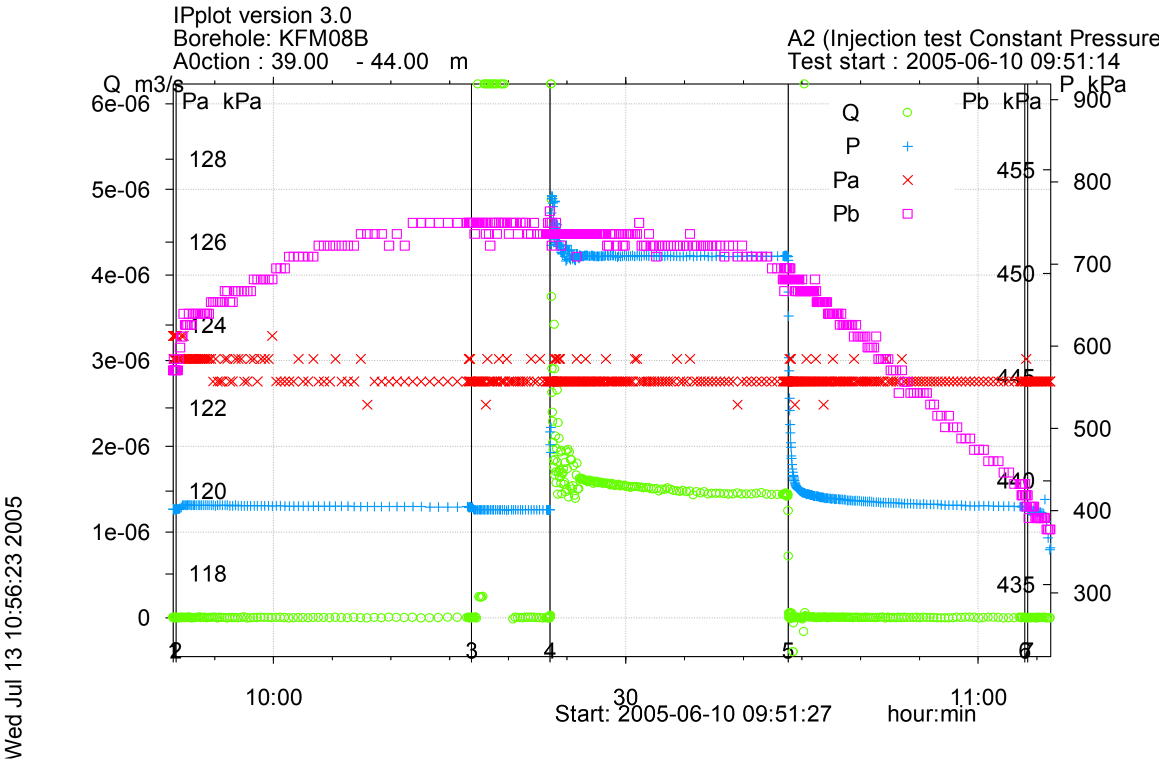


Figure A3-39. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 39.0-44.0 m in borehole KFM08B.*

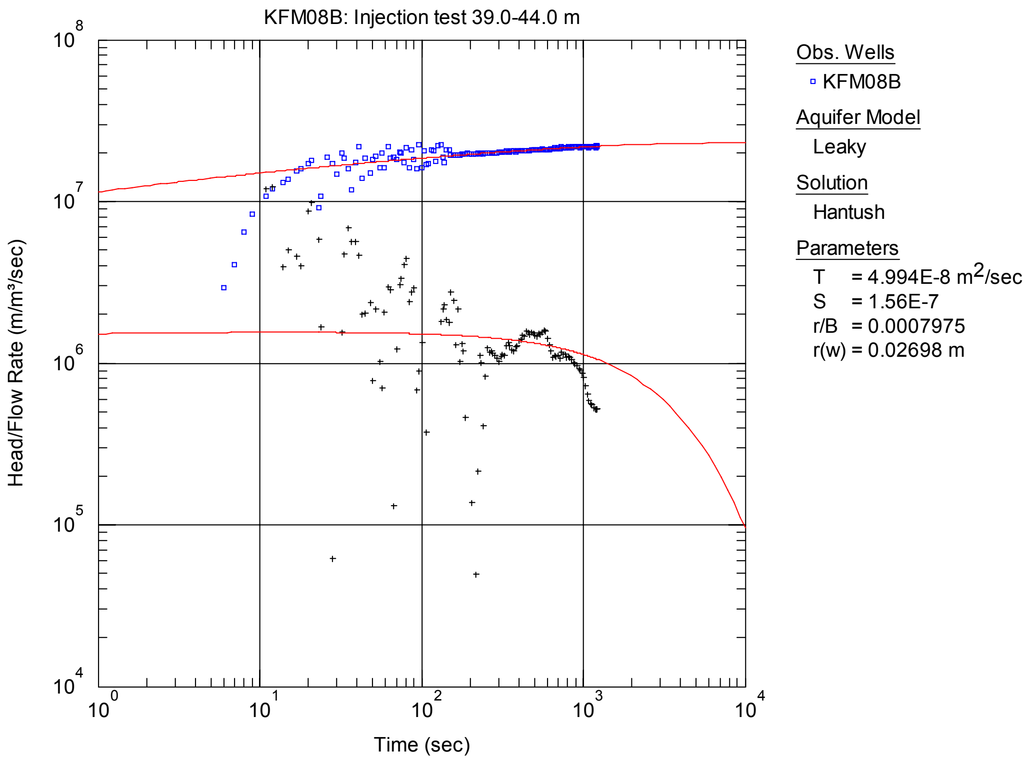


Figure A3-40. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 39.0-44.0 m in KFM08B.*

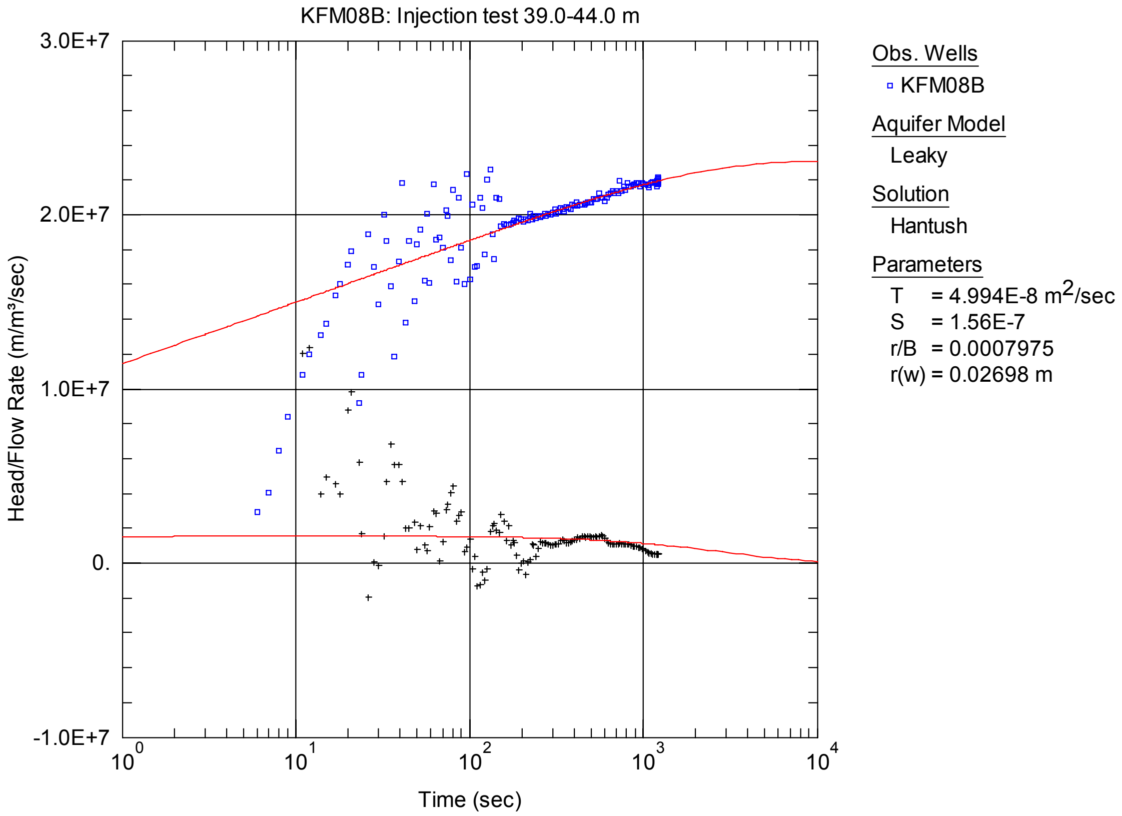


Figure A3-41. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 39.0-44.0 m in KFM08B.*

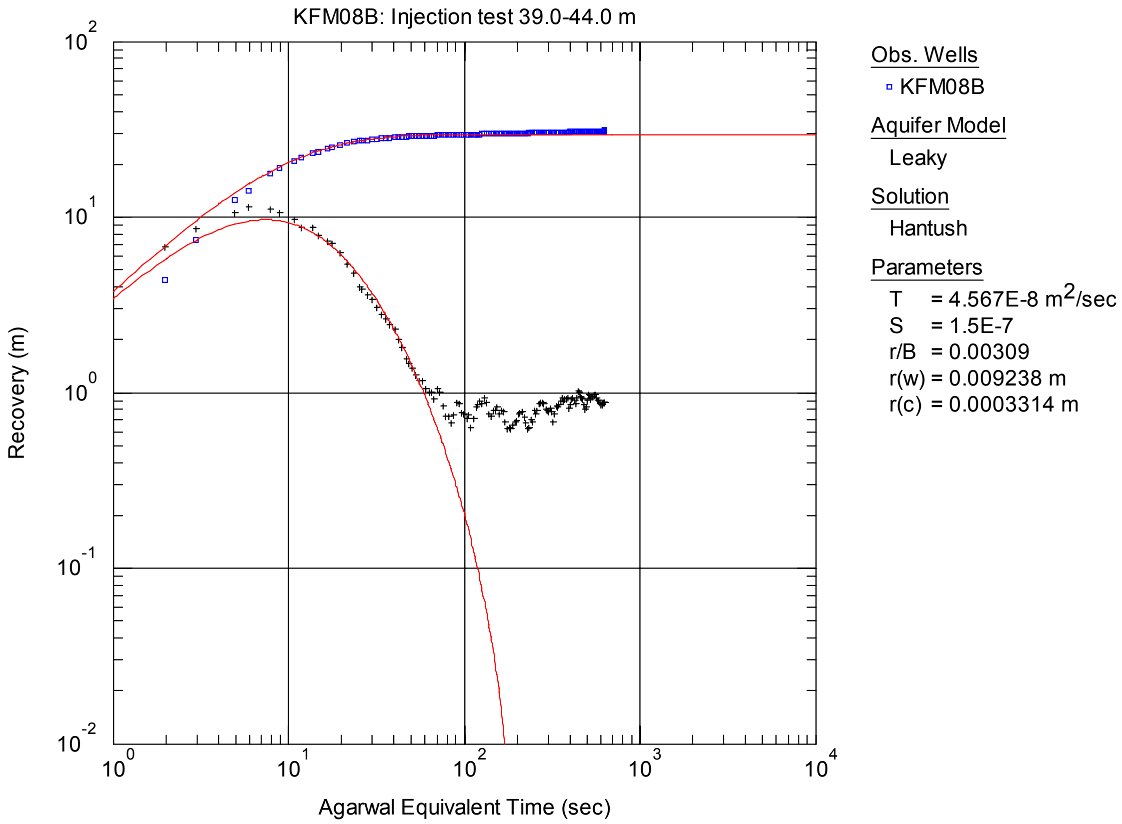


Figure A3-42. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 39.0-44.0 m in KFM08B.*

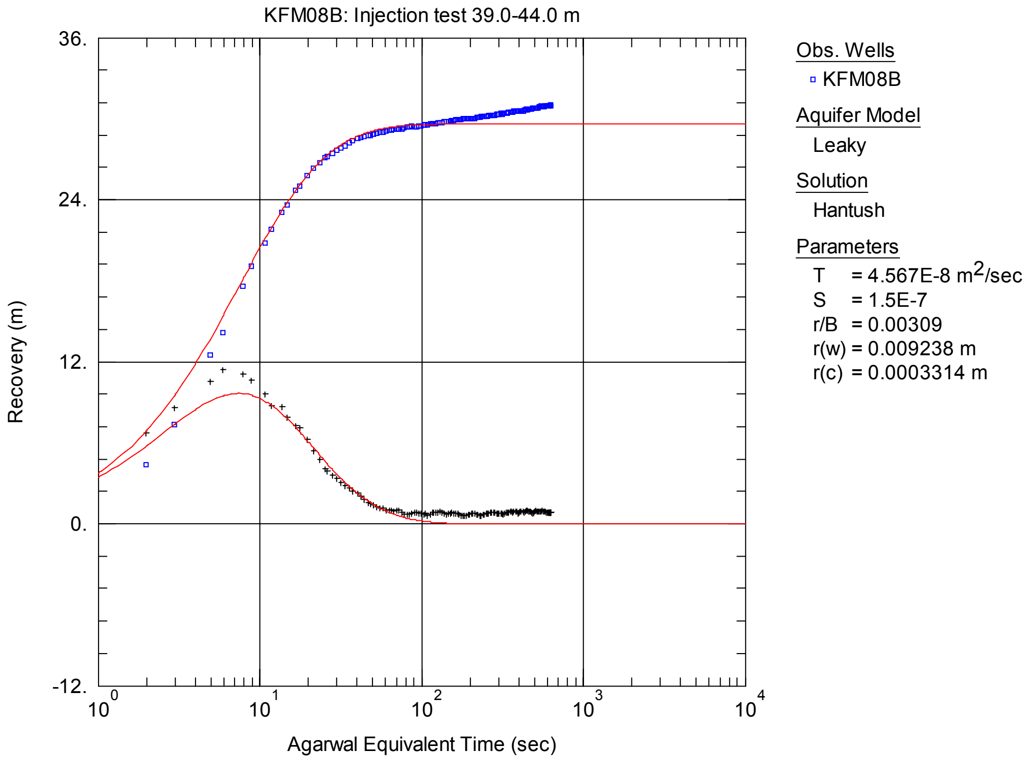


Figure A3-43. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 39.0-44.0 m in KFM08B.*

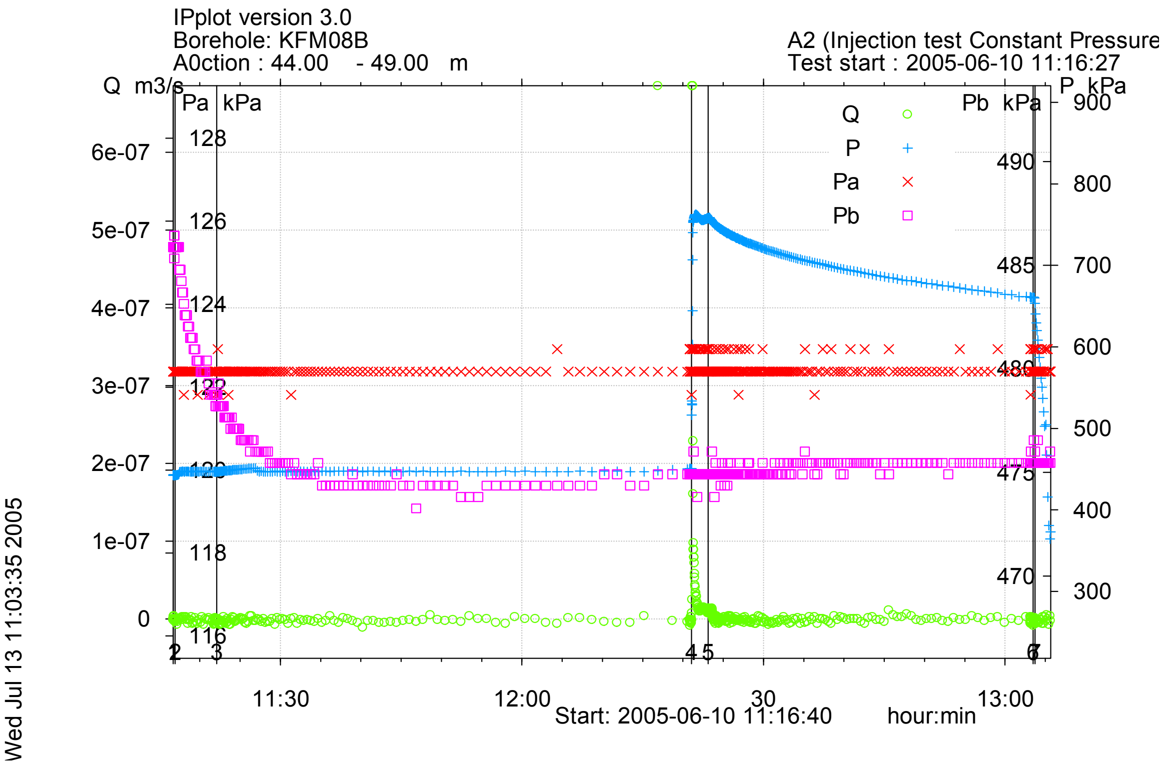


Figure A3-44. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 44.0-49.0 m in borehole KFM08B.*

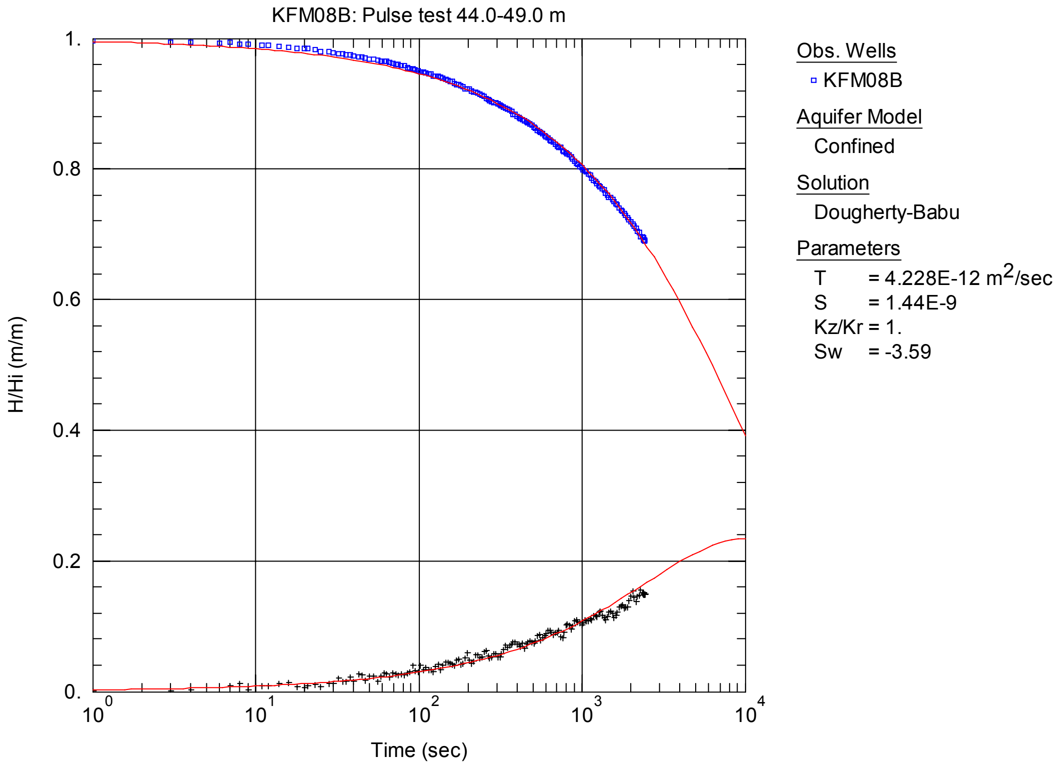


Figure A3-45. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 44.0-49.0 m in KFM08B.*

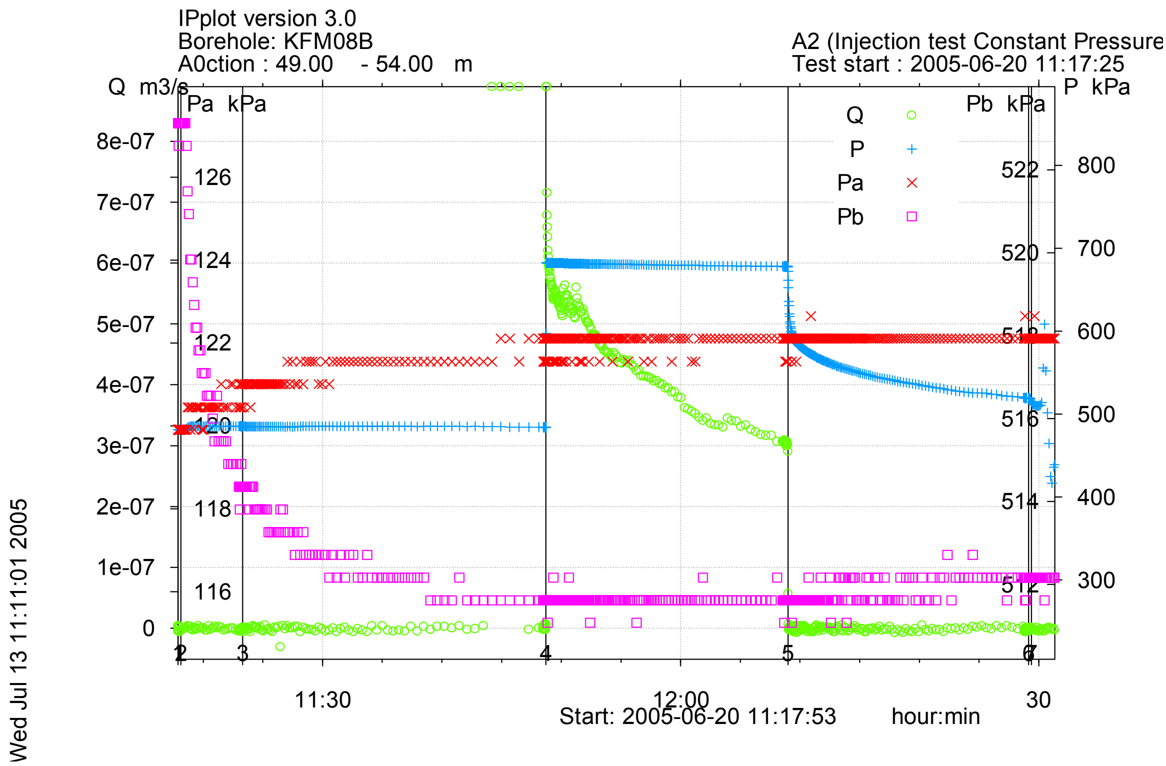


Figure A3-46. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 49.0-54.0 m in borehole KFM08B.*

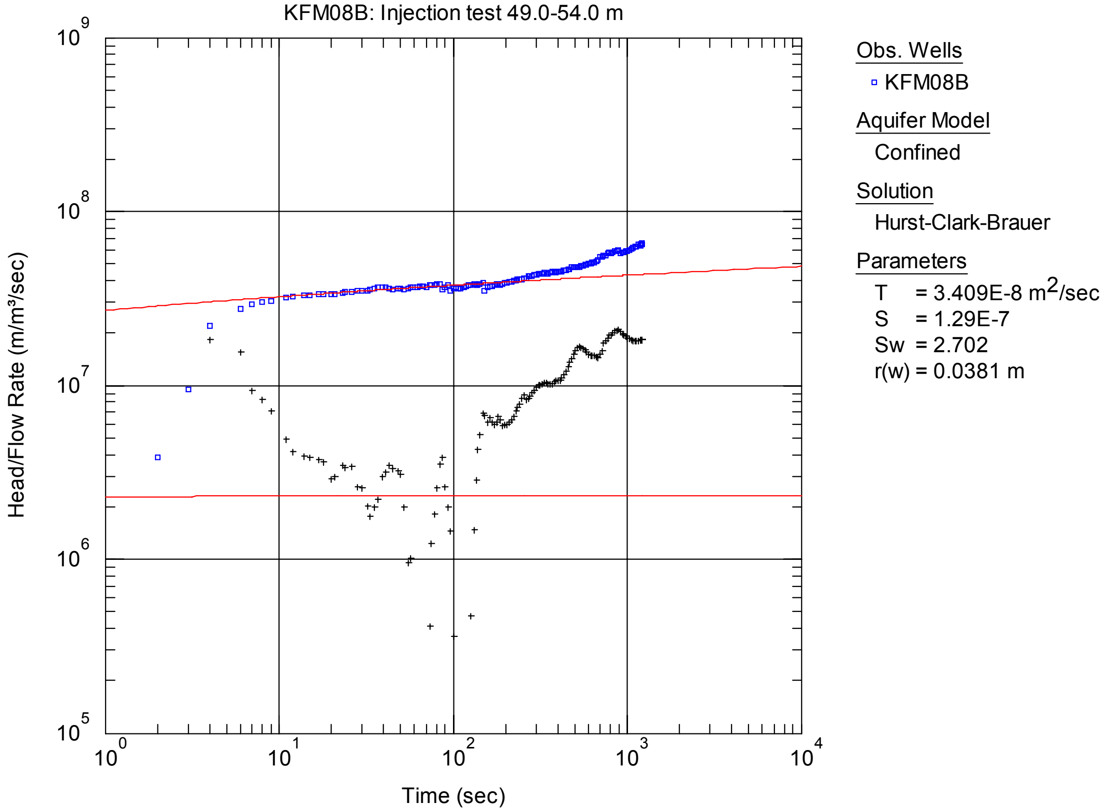


Figure A3-47. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 49.0-54.0 m in KFM08B.*

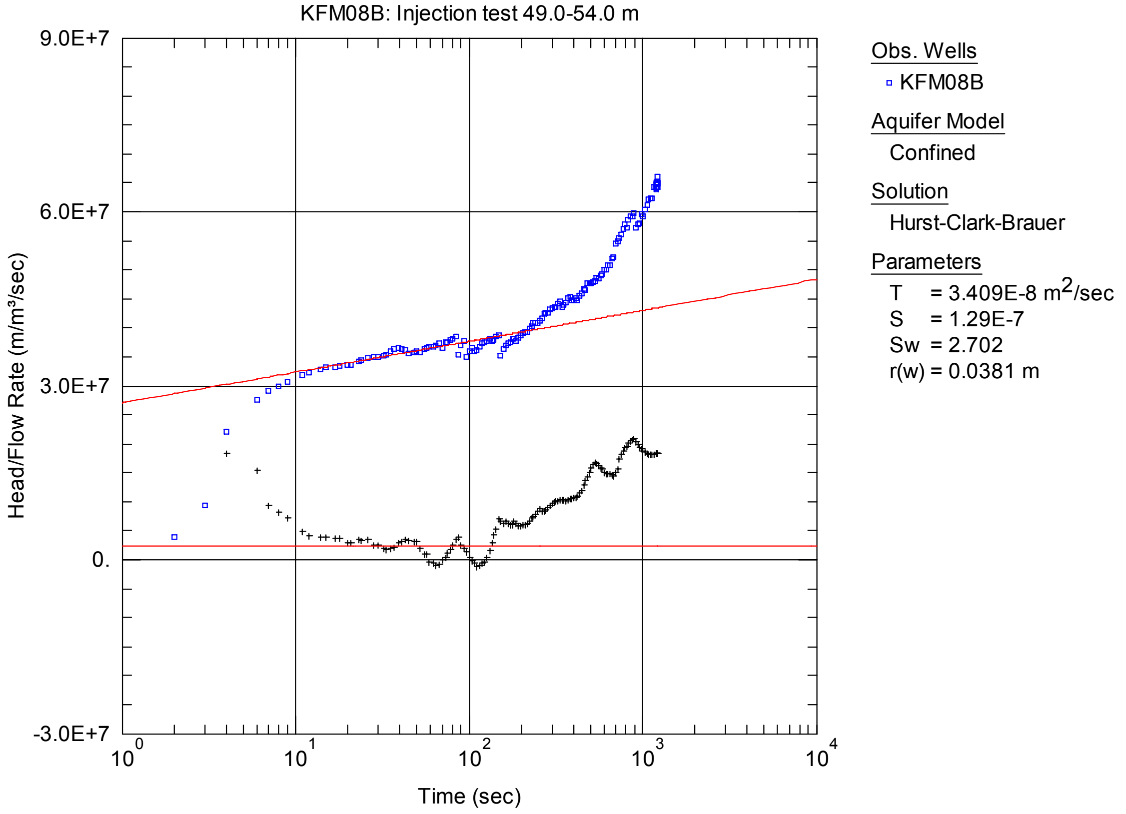


Figure A3-48. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 49.0-54.0 m in KFM08B.*

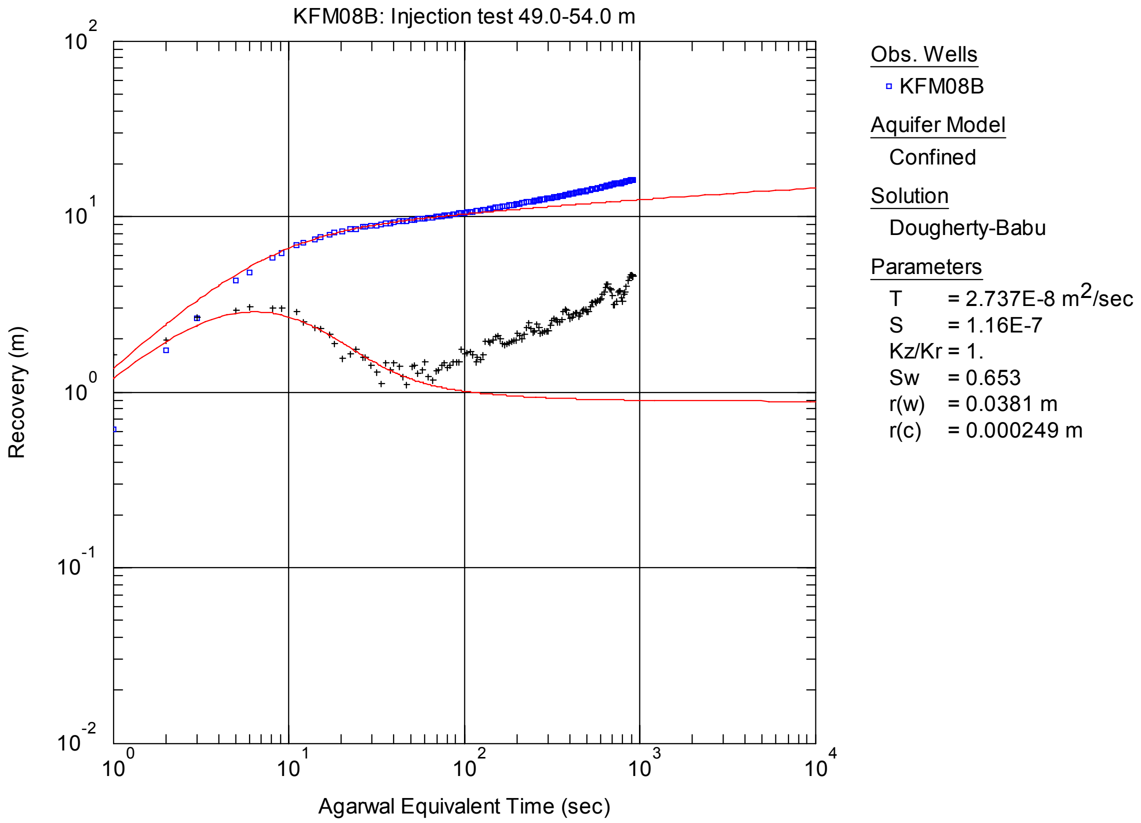


Figure A3-49. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 49.0-54.0 m in KFM08B.*

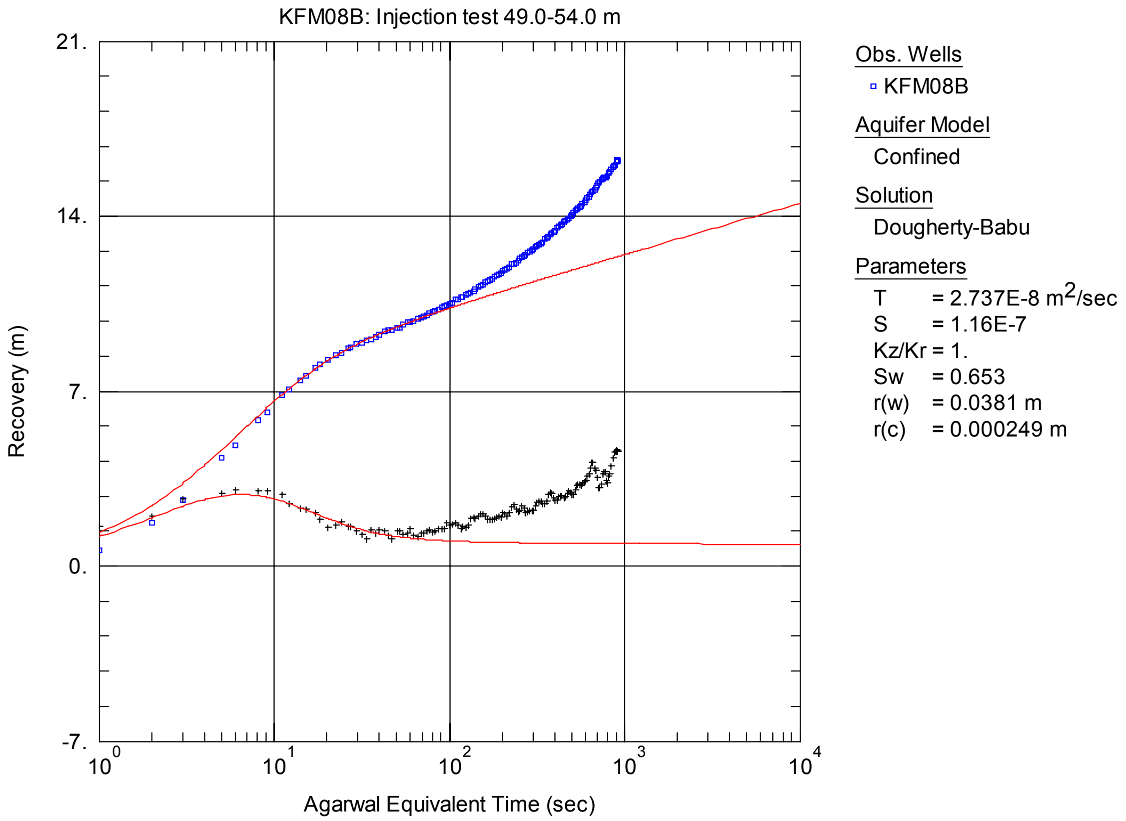


Figure A3-50. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 49.0-54.0 m in KFM08B.*

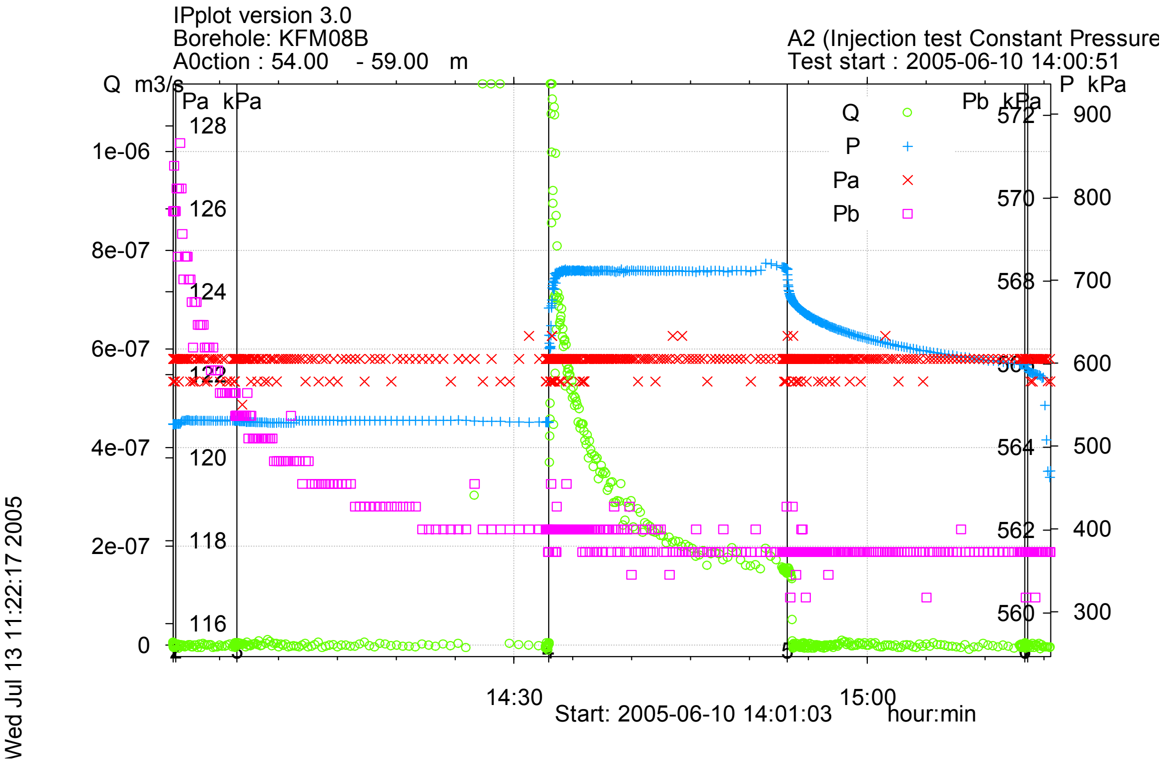


Figure A3-51. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 54.0-59.0 m in borehole KFM08B.*

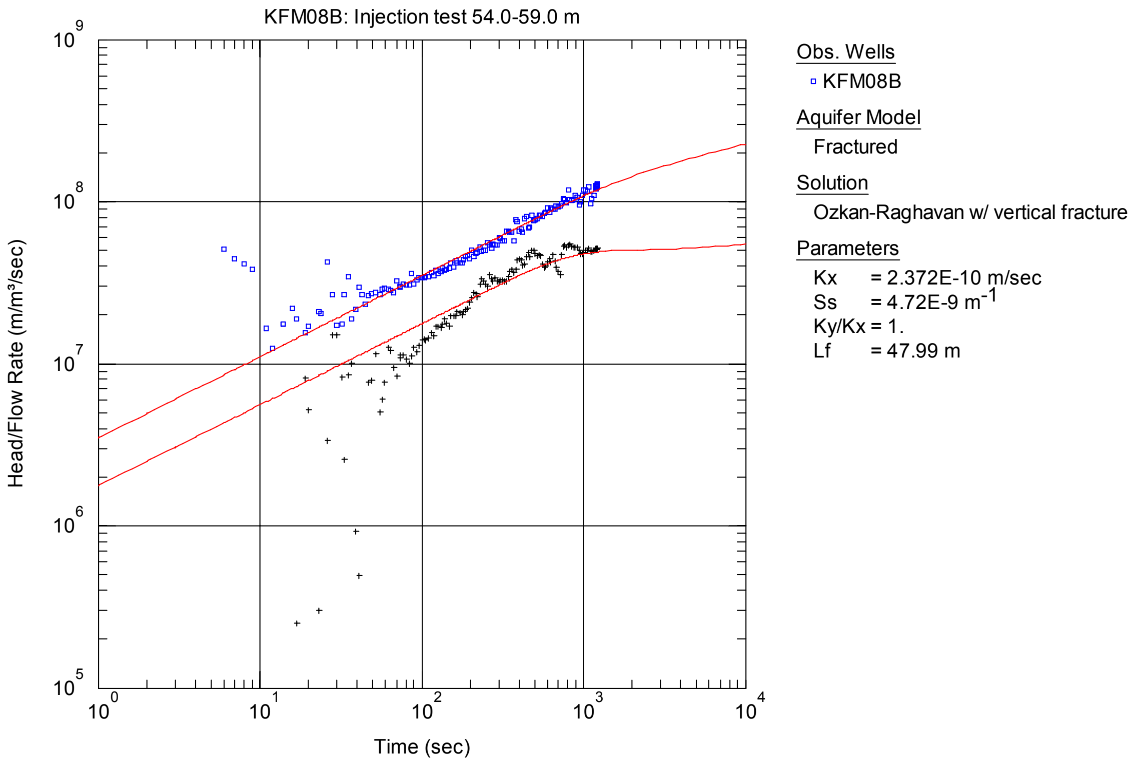


Figure A3-52. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 54.0-59.0 m in KFM08B.*

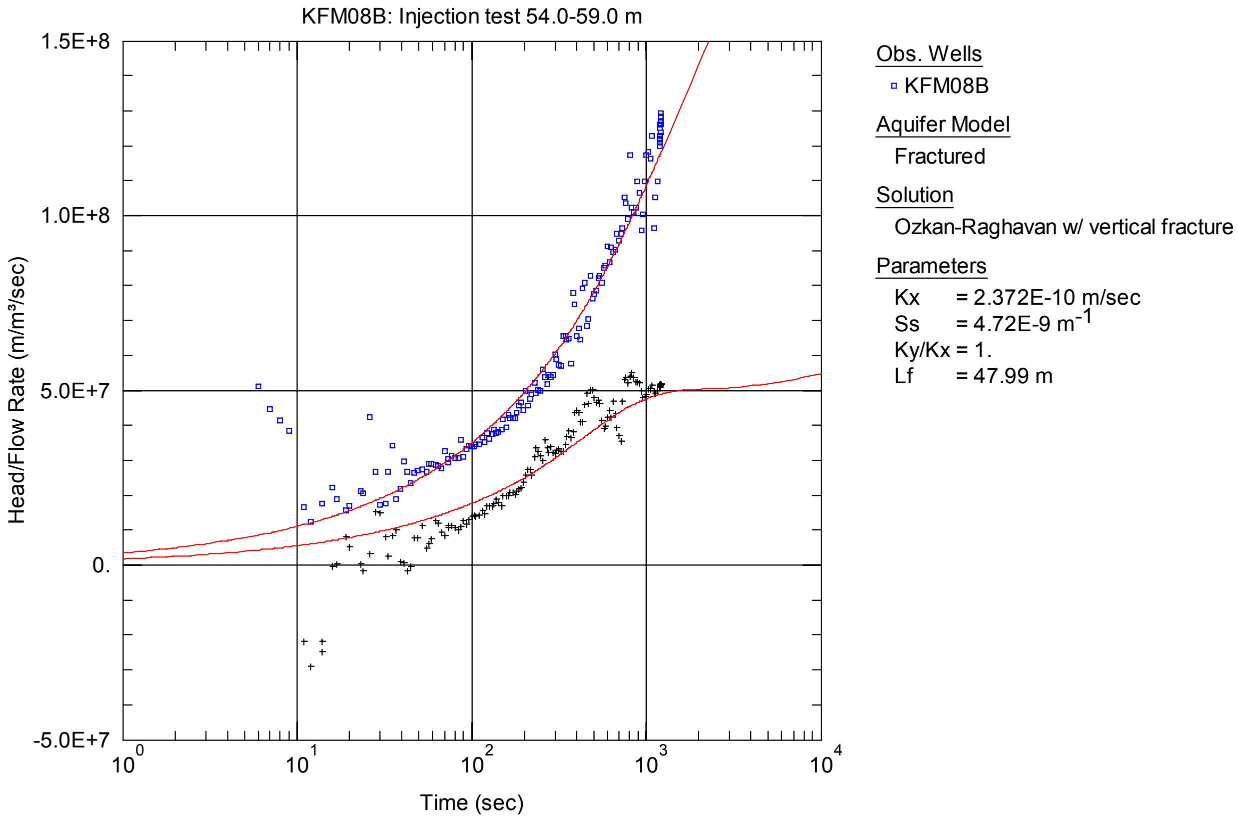


Figure A3-53. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 54.0-59.0 m in KFM08B.*

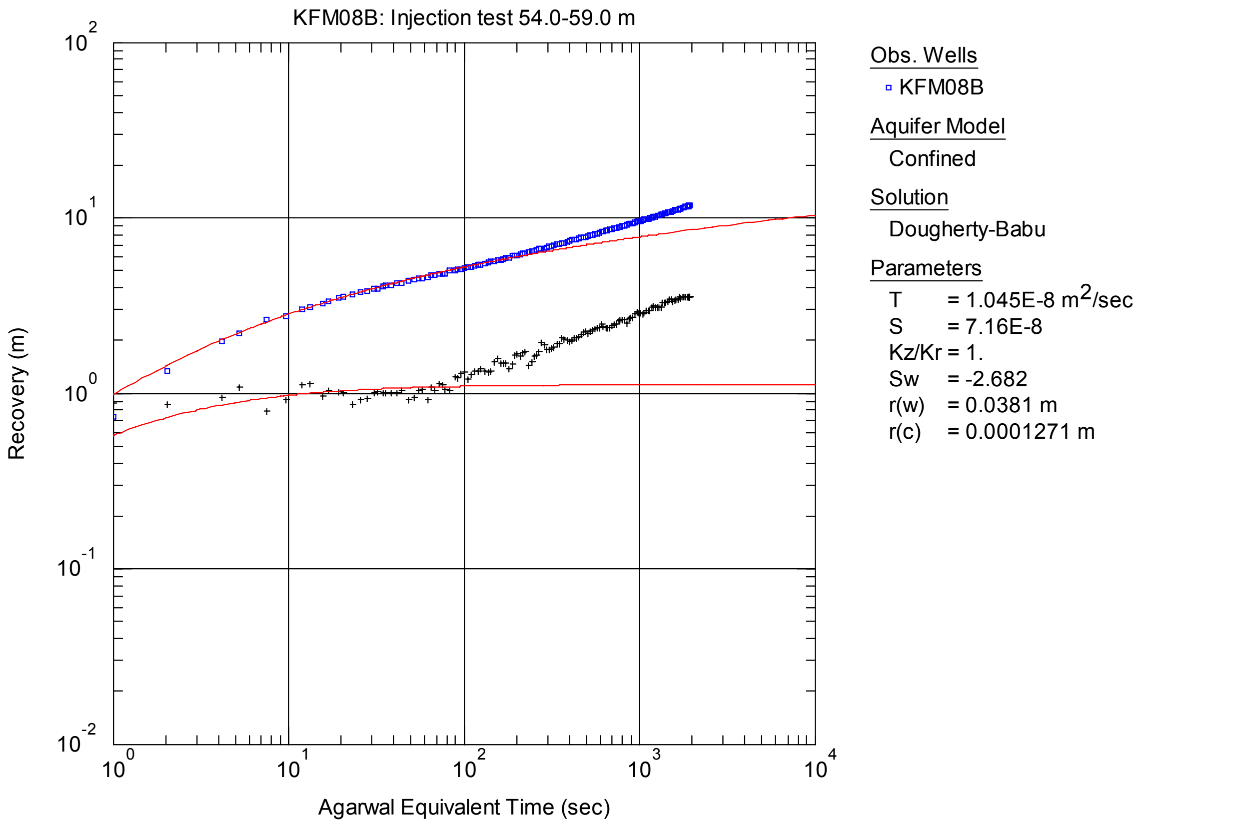


Figure A3-54. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 54.0-59.0 m in KFM08B.*

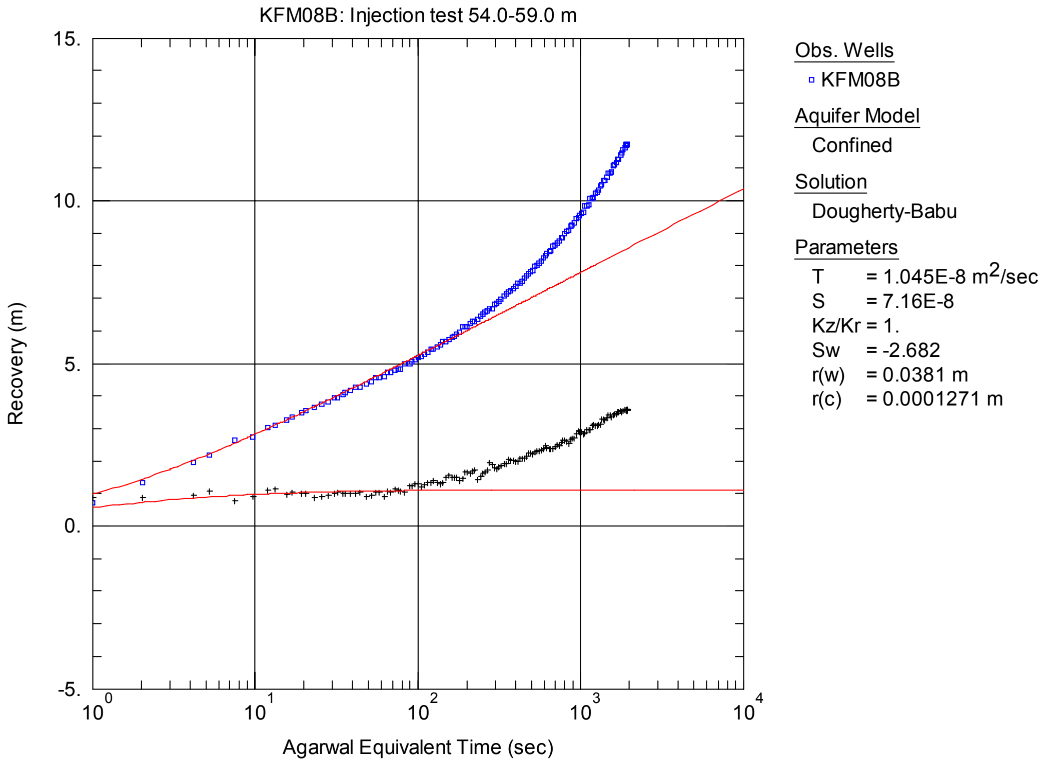


Figure A3-55. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 54.0-59.0 m in KFM08B.*

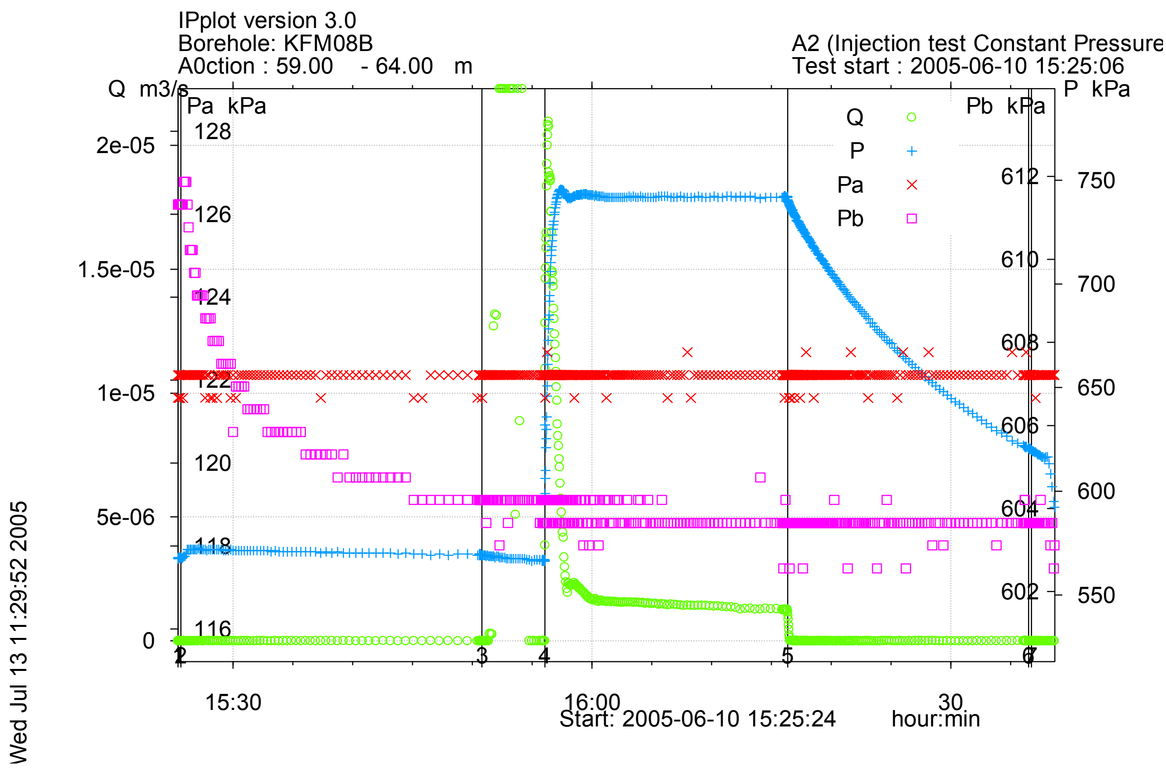


Figure A3-56. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 59.0-64.0 m in borehole KFM08B.*

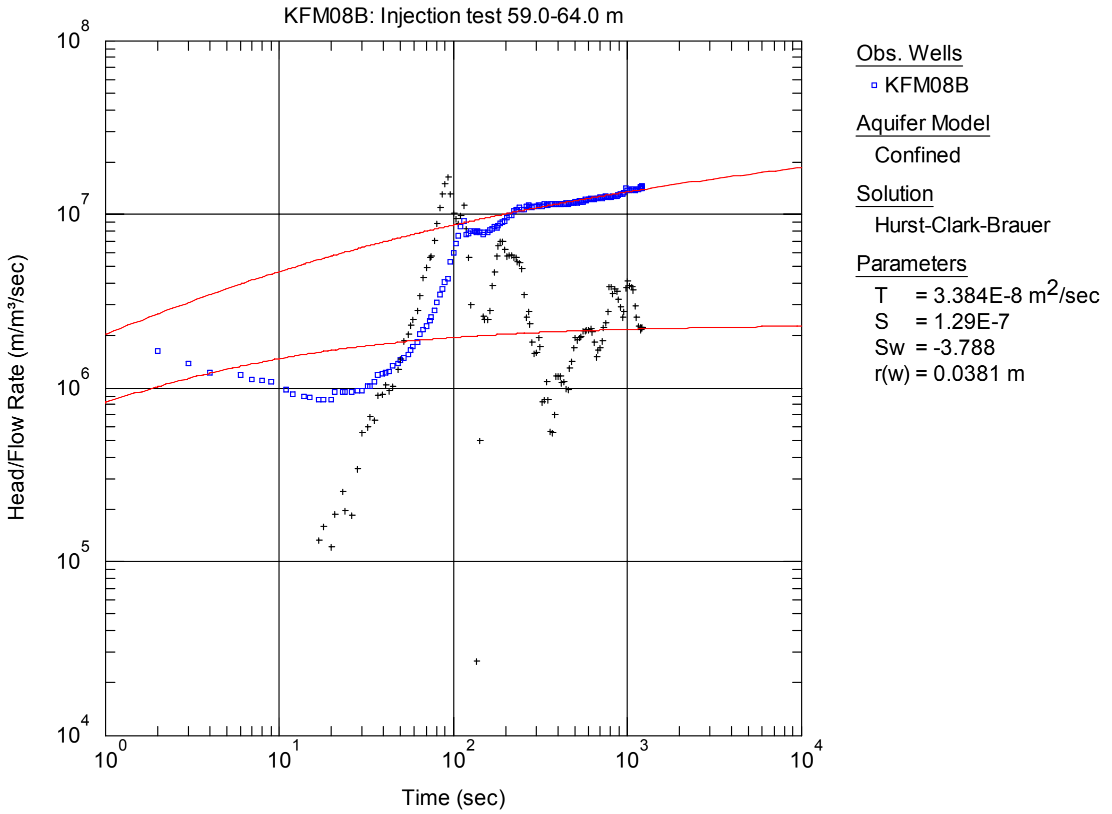


Figure A3-57. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 59.0-64.0 m in KFM08B.*

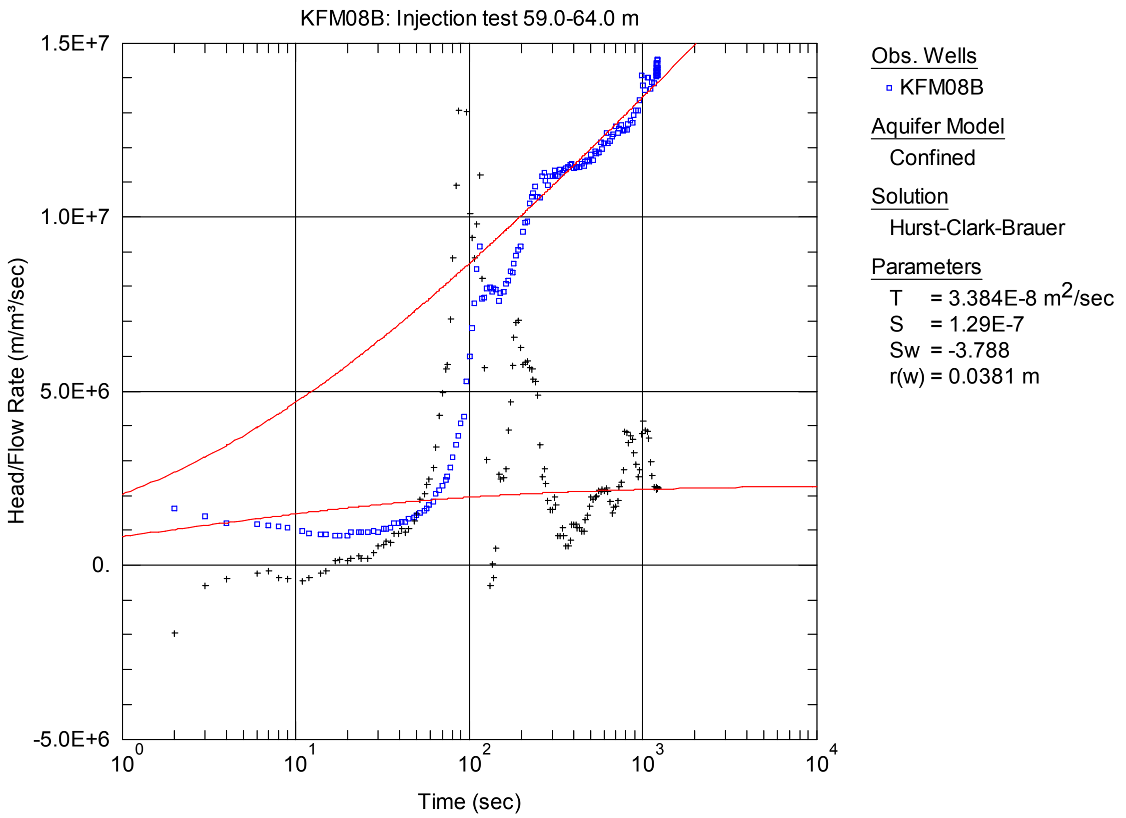


Figure A3-58. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 59.0-64.0 m in KFM08B.*

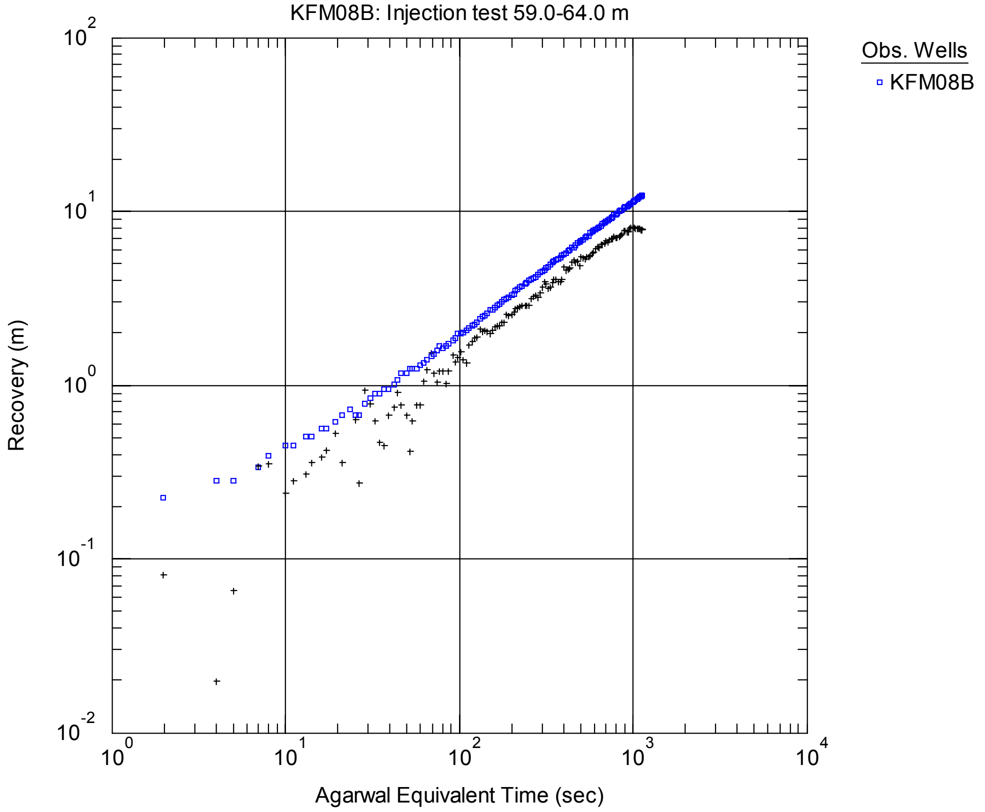


Figure A3-59. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 59.0-64.0 m in KFM08B.*

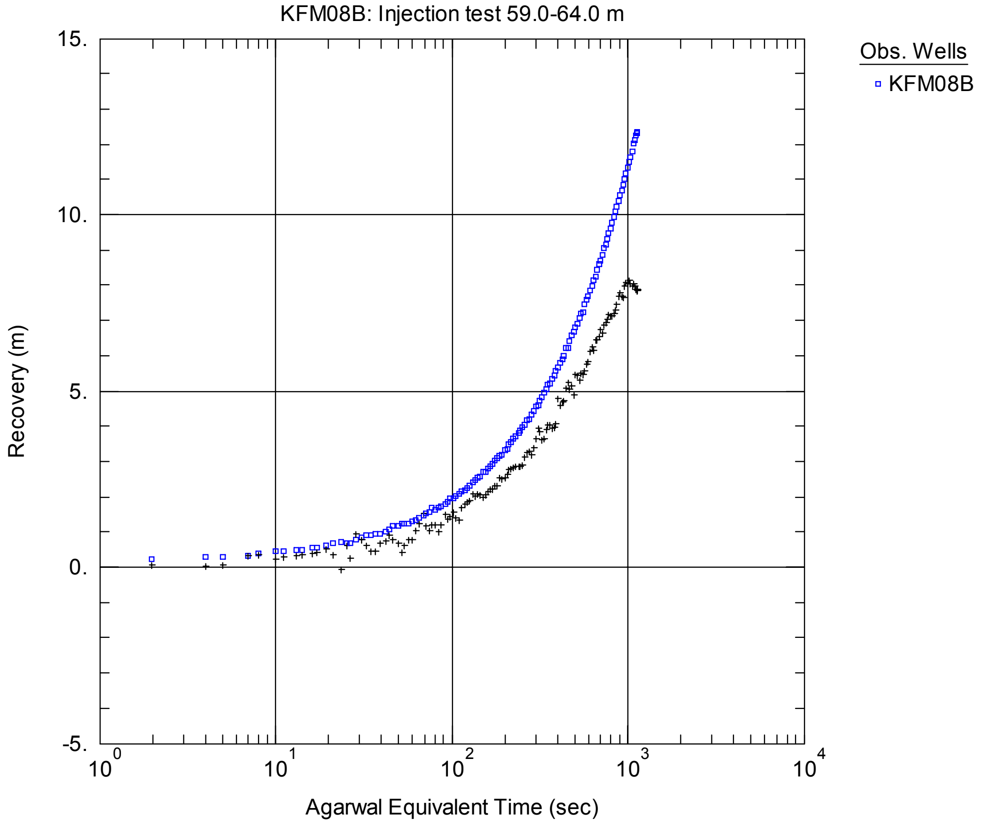


Figure A3-60. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 59.0-64.0 m in KFM08B.*

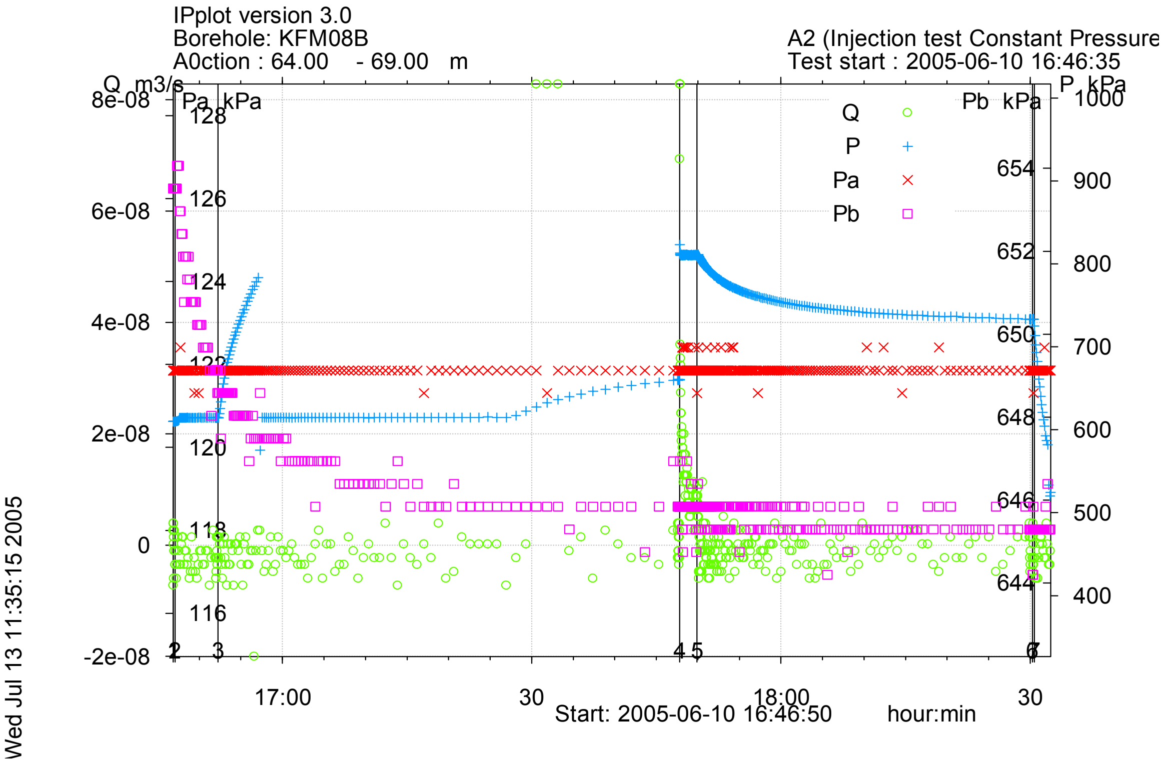


Figure A3-61. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 64.0-69.0 m in borehole KFM08B.*

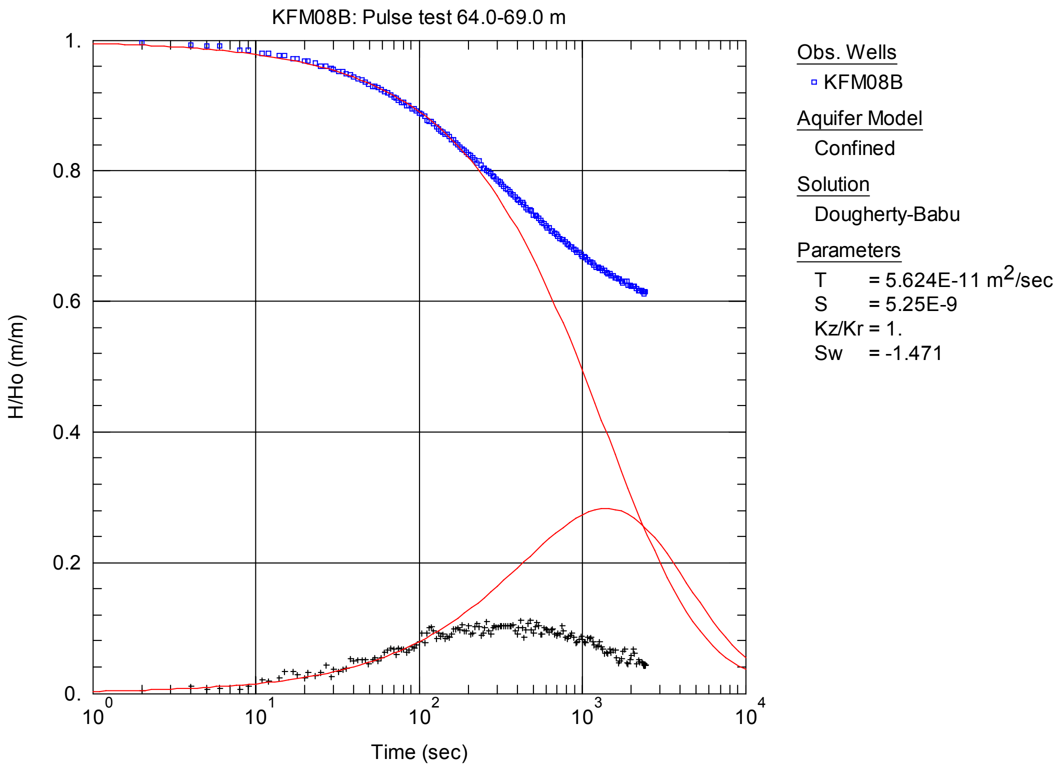


Figure A3-62. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 64.0-69.0 m in KFM08B.*

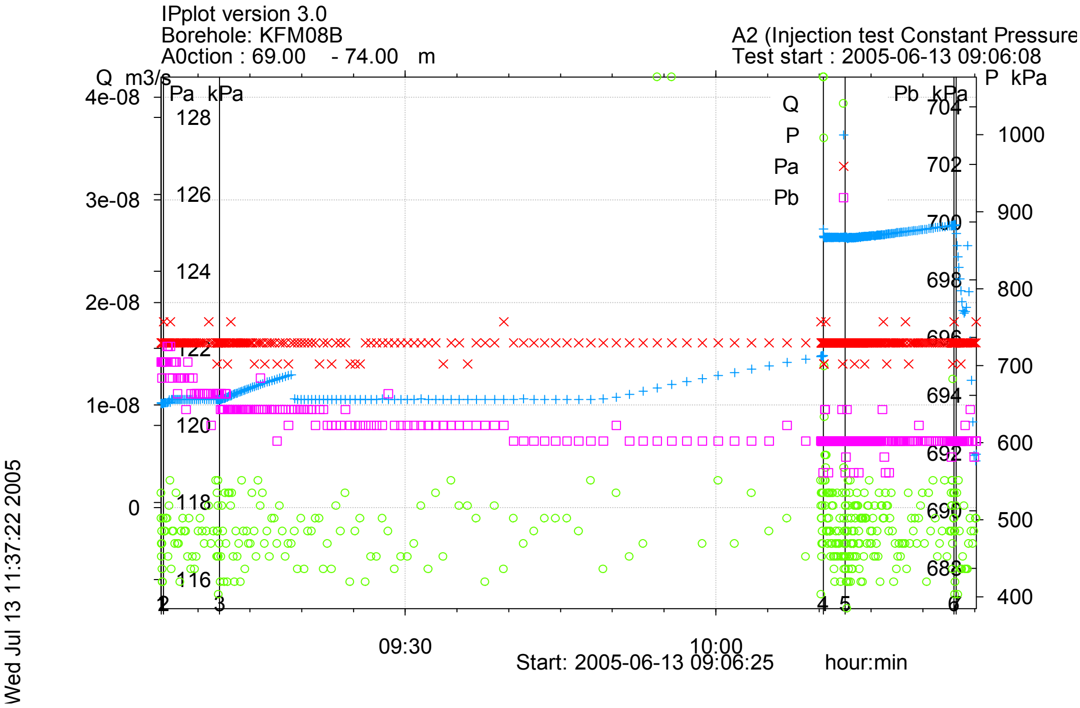


Figure A3-63. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time (showing the whole test) from the pressure pulse test in section 69.0-74.0 m in borehole KFM08B.*

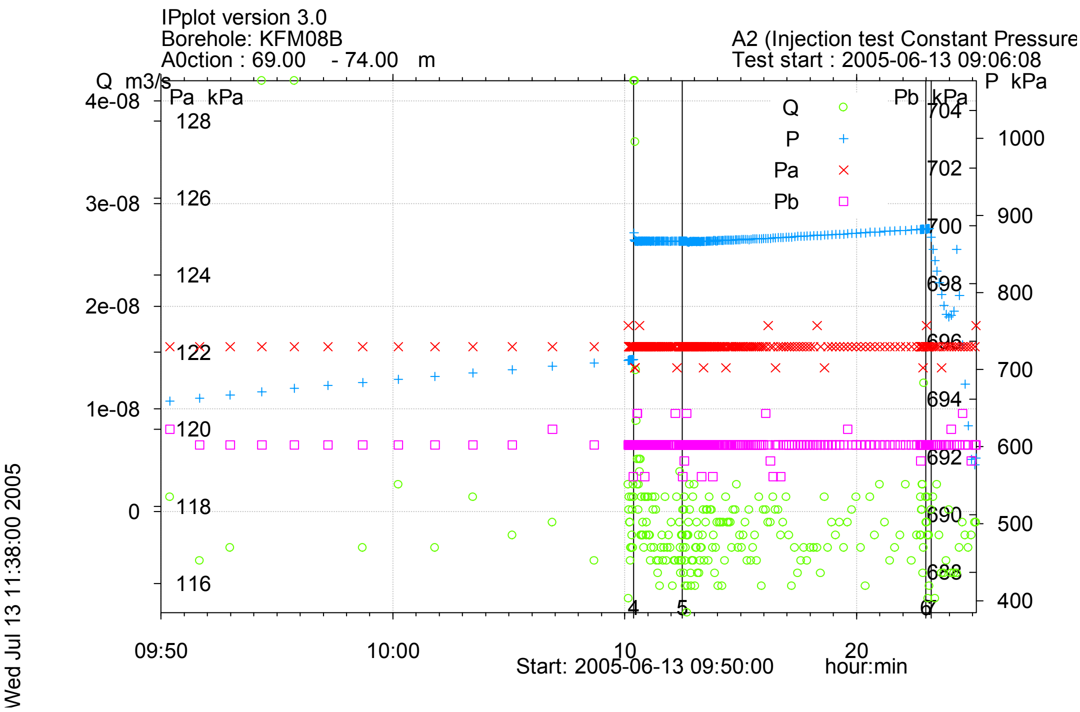


Figure A3-64. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time (showing only part of the time before the injection) from the pressure pulse test in section 69.0-74.0 m in borehole KFM08B.*

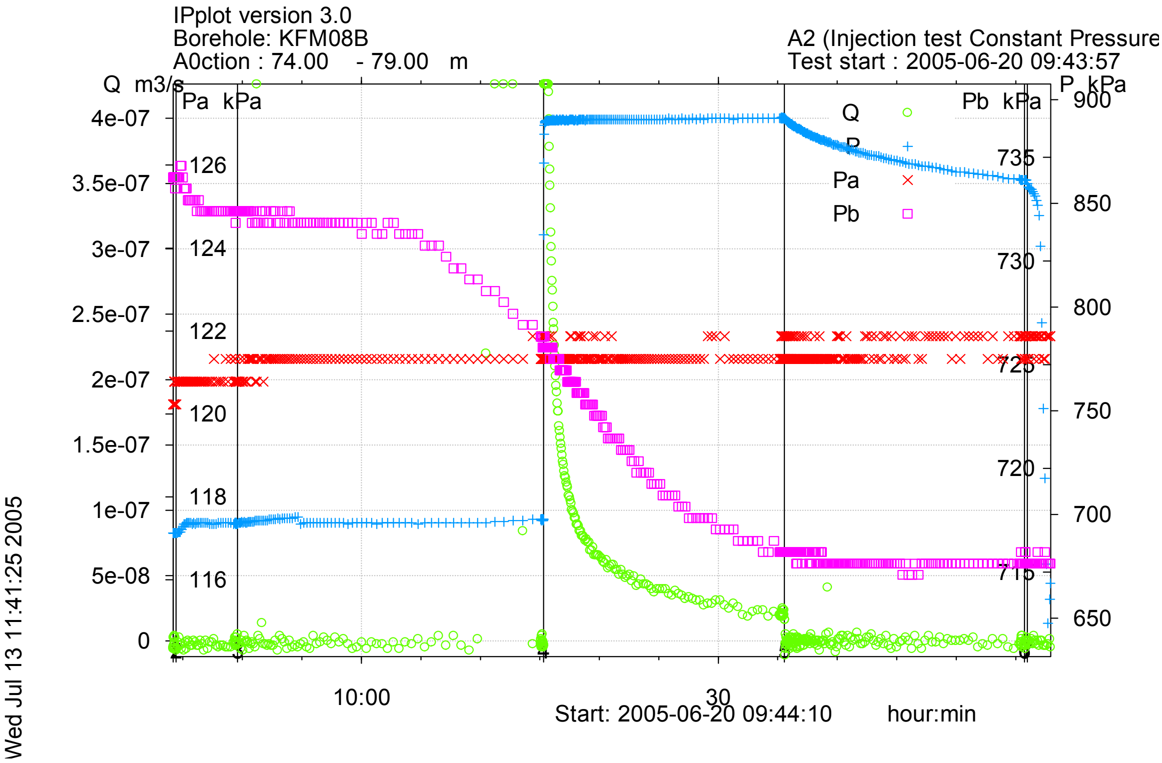


Figure A3-65. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 74.0-79.0 m in borehole KFM08B.*

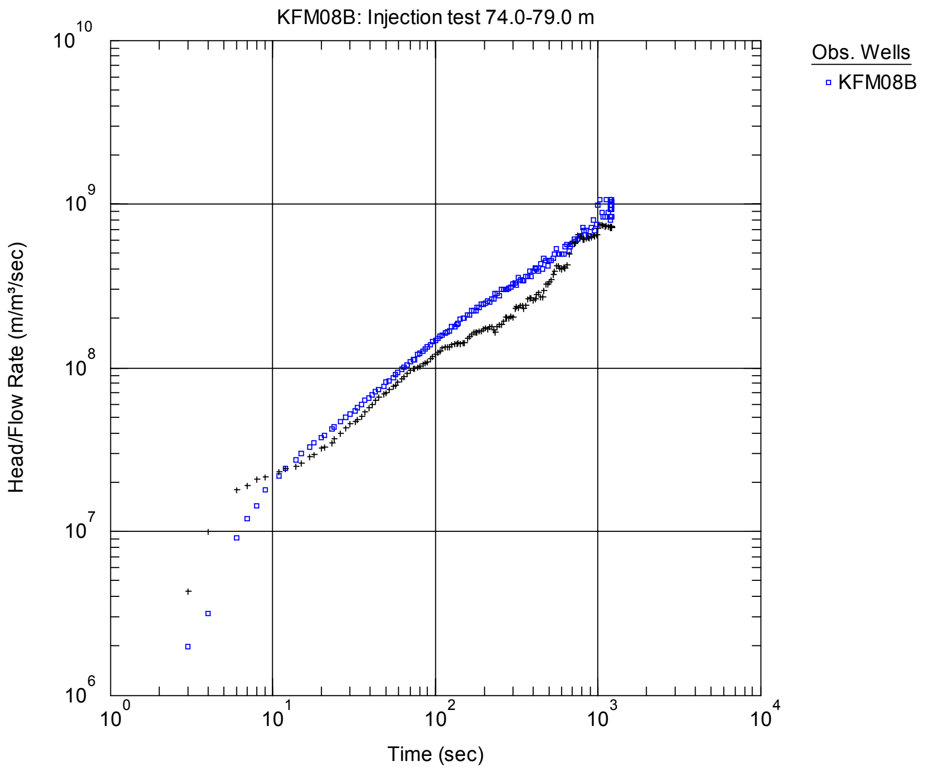


Figure A3-66. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 74.0-79.0 m in KFM08B.*

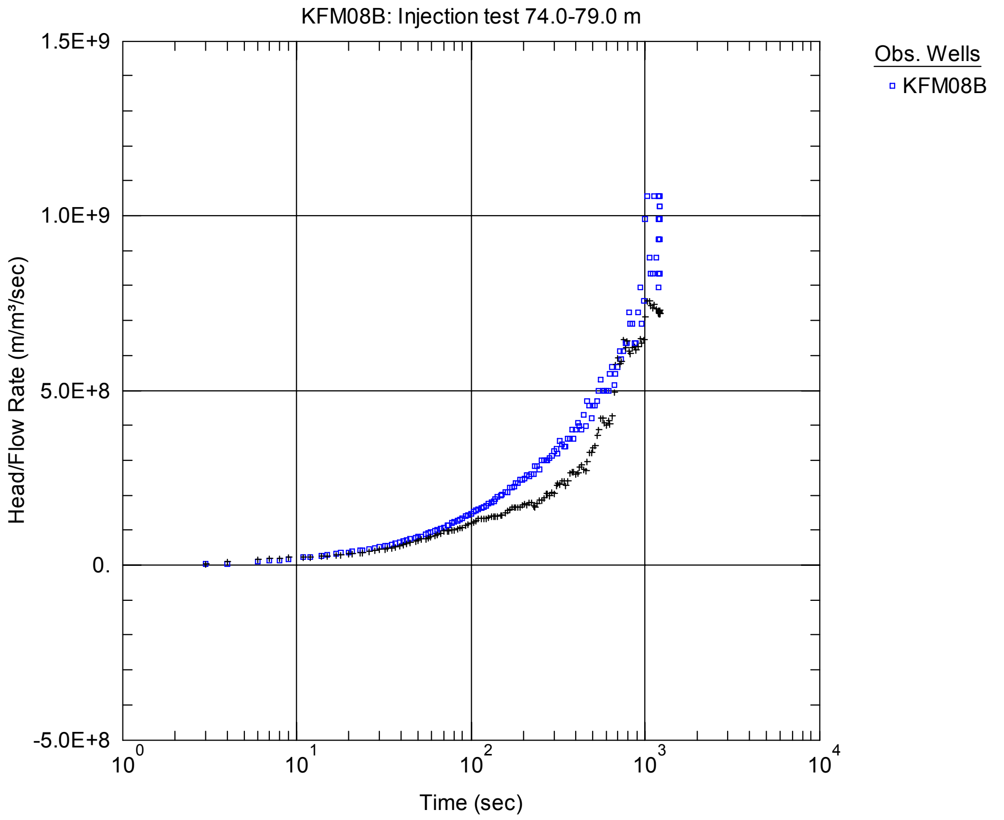


Figure A3-67. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 74.0-79.0 m in KFM08B.*

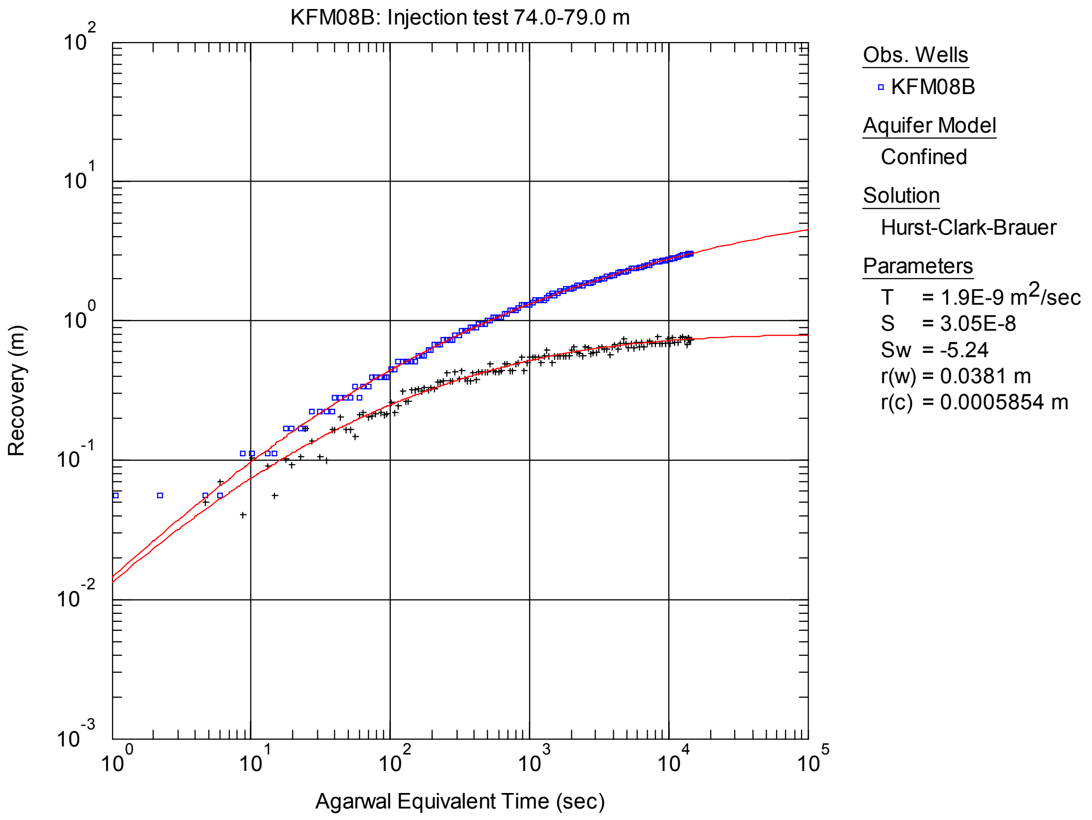


Figure A3-68. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 74.0-79.0 m in KFM08B.*

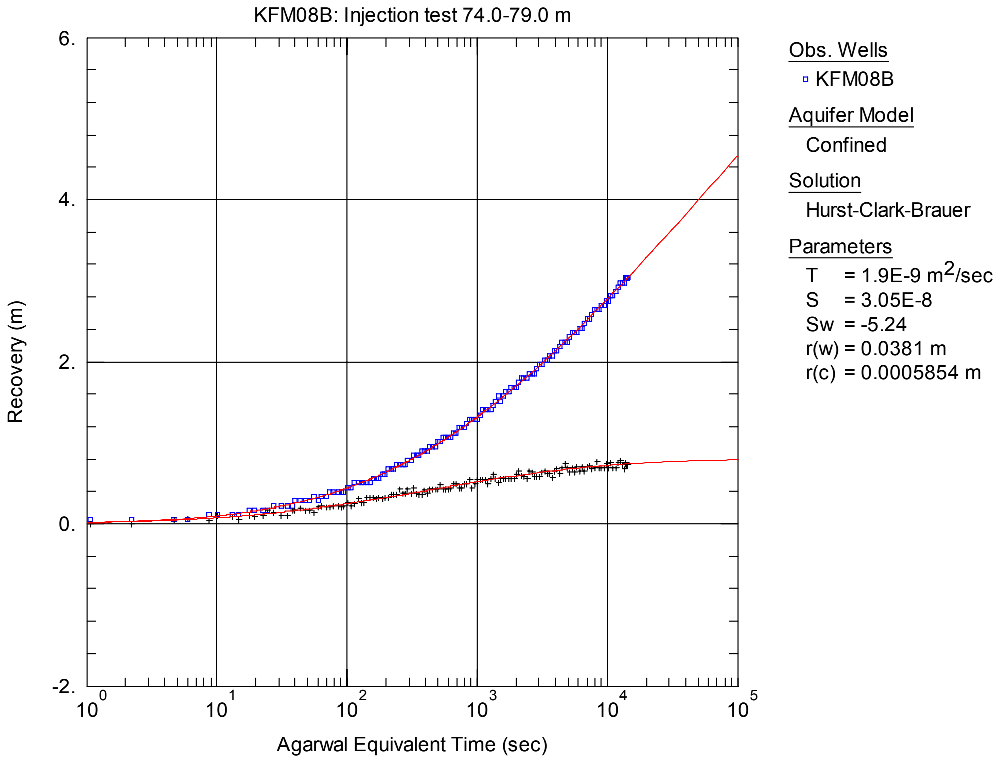


Figure A3-69. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 74.0-79.0 m in KFM08B.*

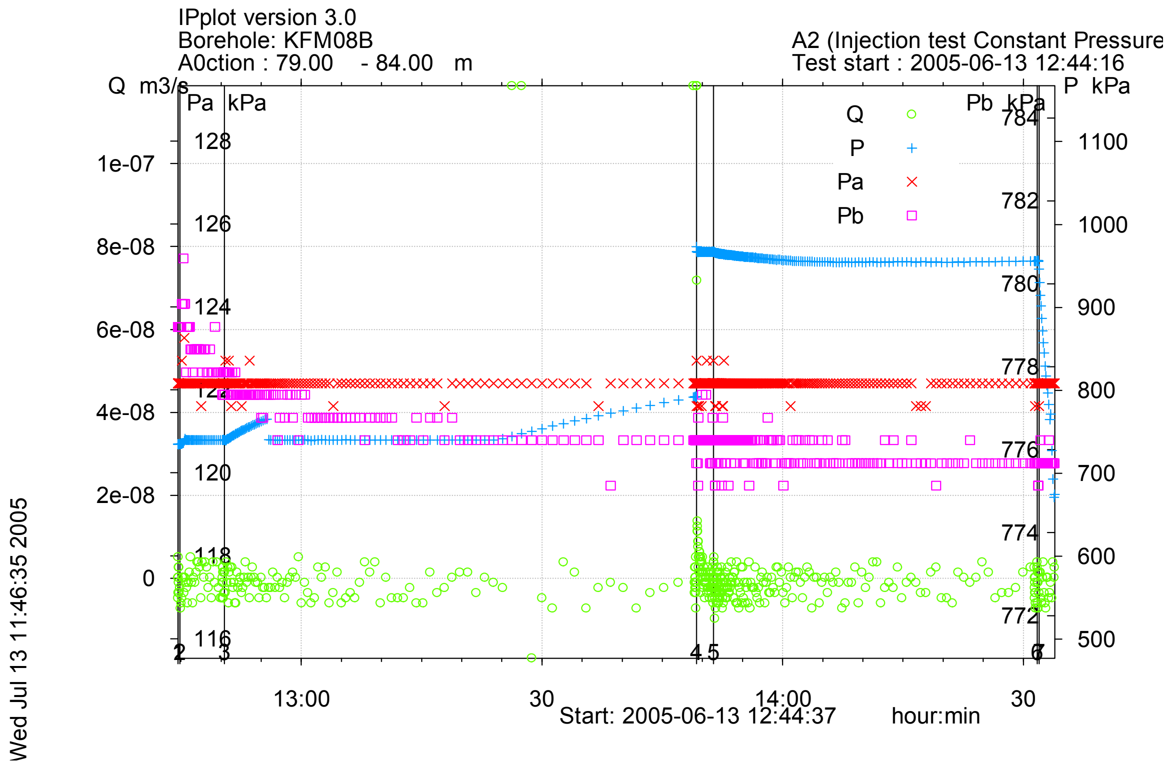


Figure A3-70. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 79.0-84.0 m in borehole KFM08B.*

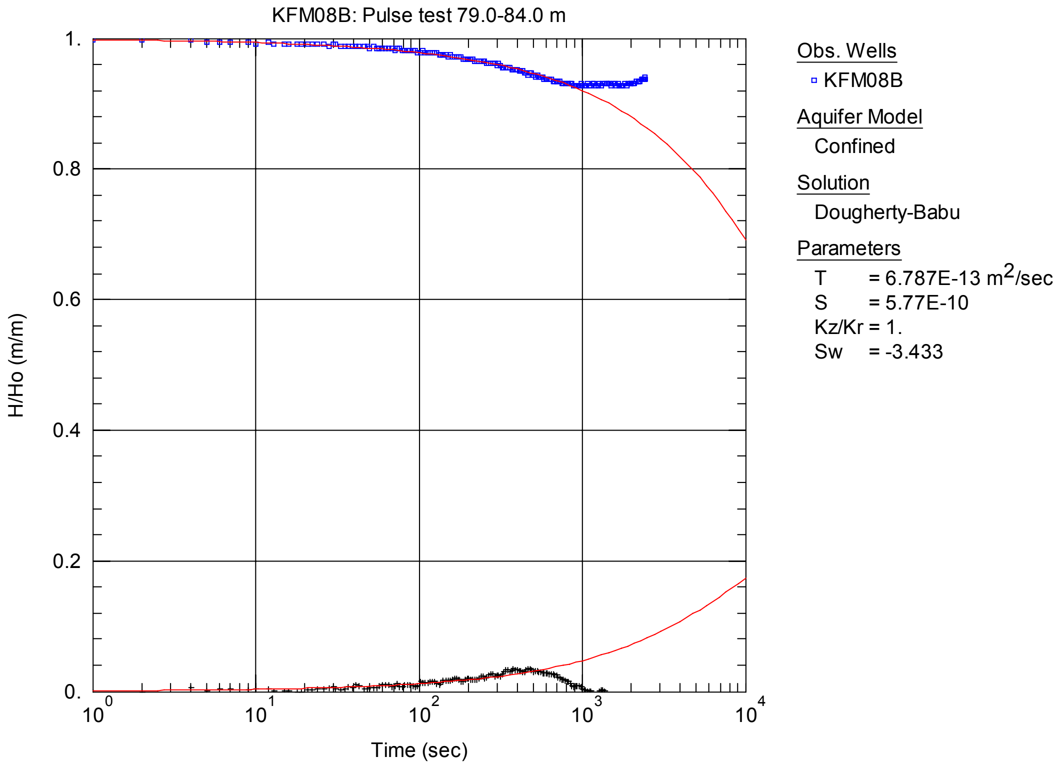


Figure A3-71. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 79.0-84.0 m in KFM08B.*

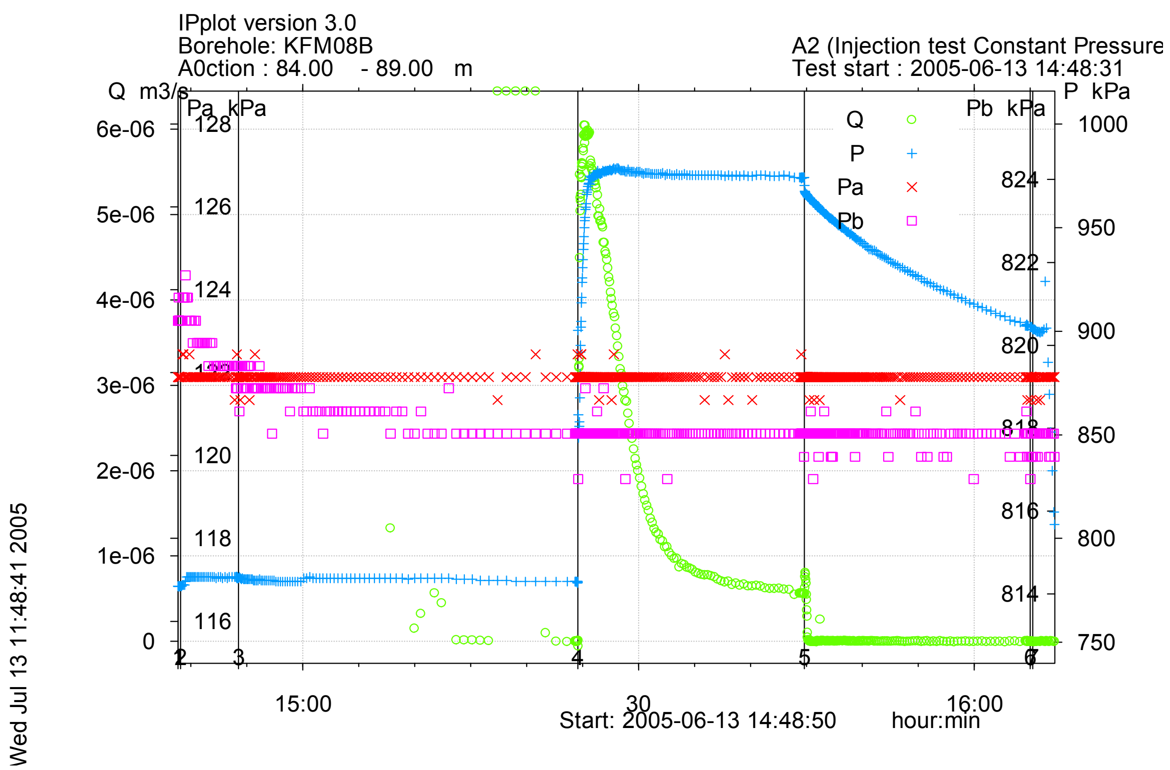


Figure A3-72. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 84.0-89.0 m in borehole KFM08B.*

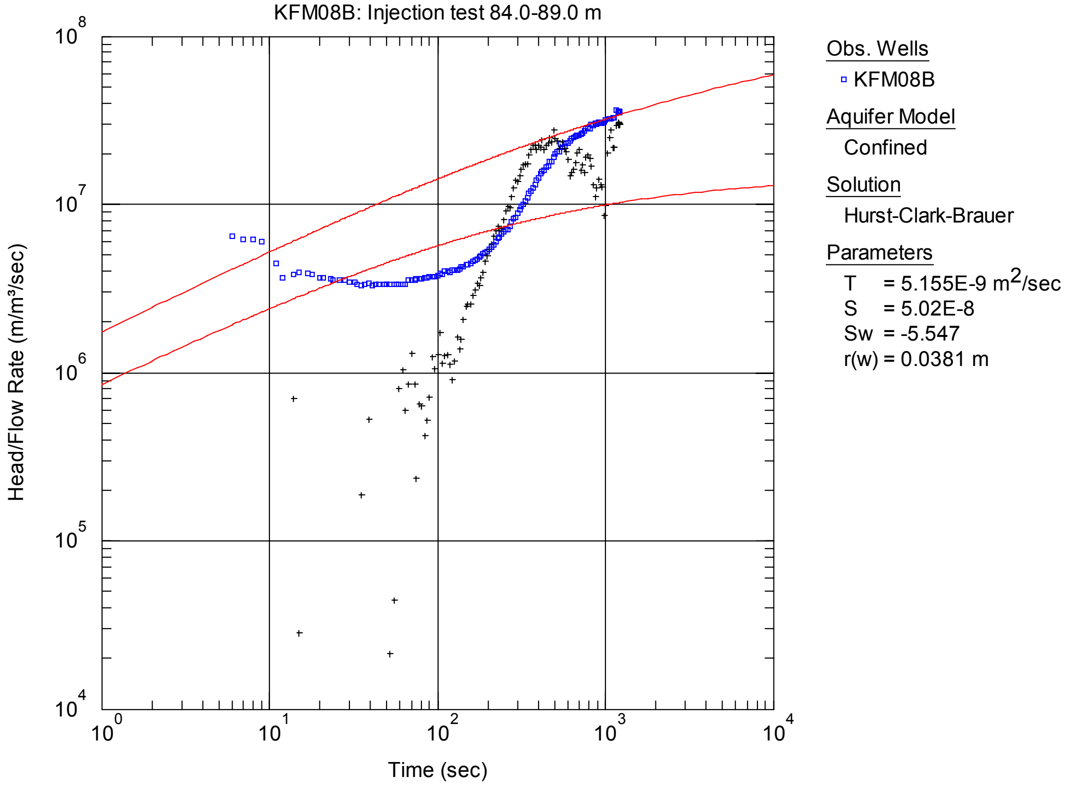


Figure A3-73. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 84.0-89.0 m in KFM08B. The values are not representative for this section, the matching is only to demonstrate the poor fitting.*

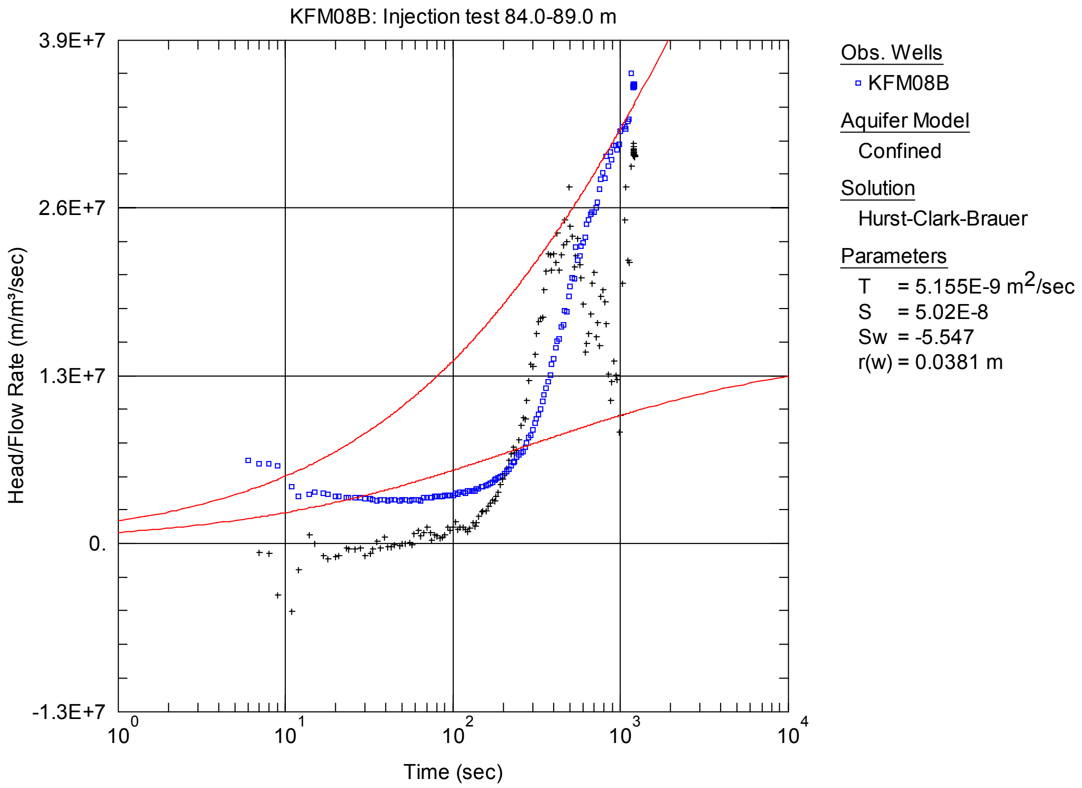


Figure A3-74. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 84.0-89.0 m in KFM08B. The values are not representative for this section, the matching is only to demonstrate the poor fitting.*

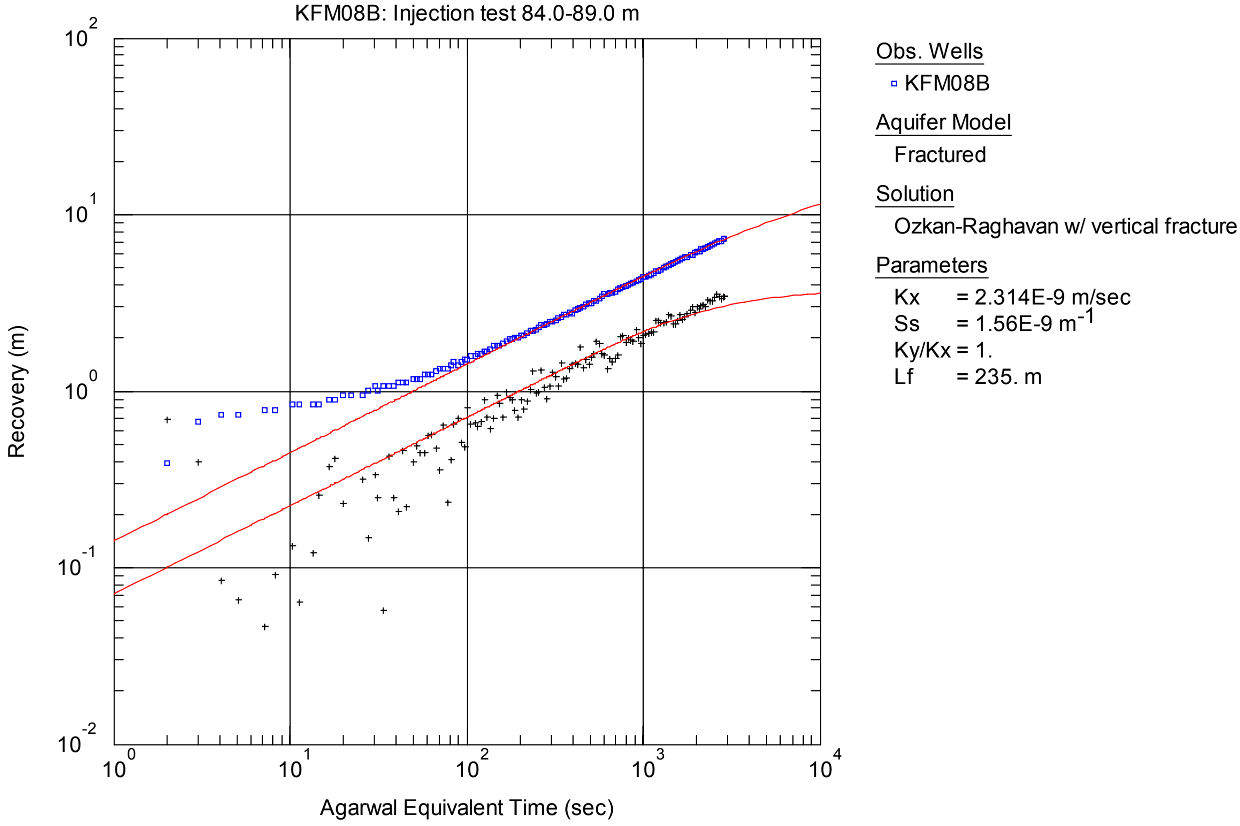


Figure A3-75. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 84.0-89.0 m in KFM08B.*

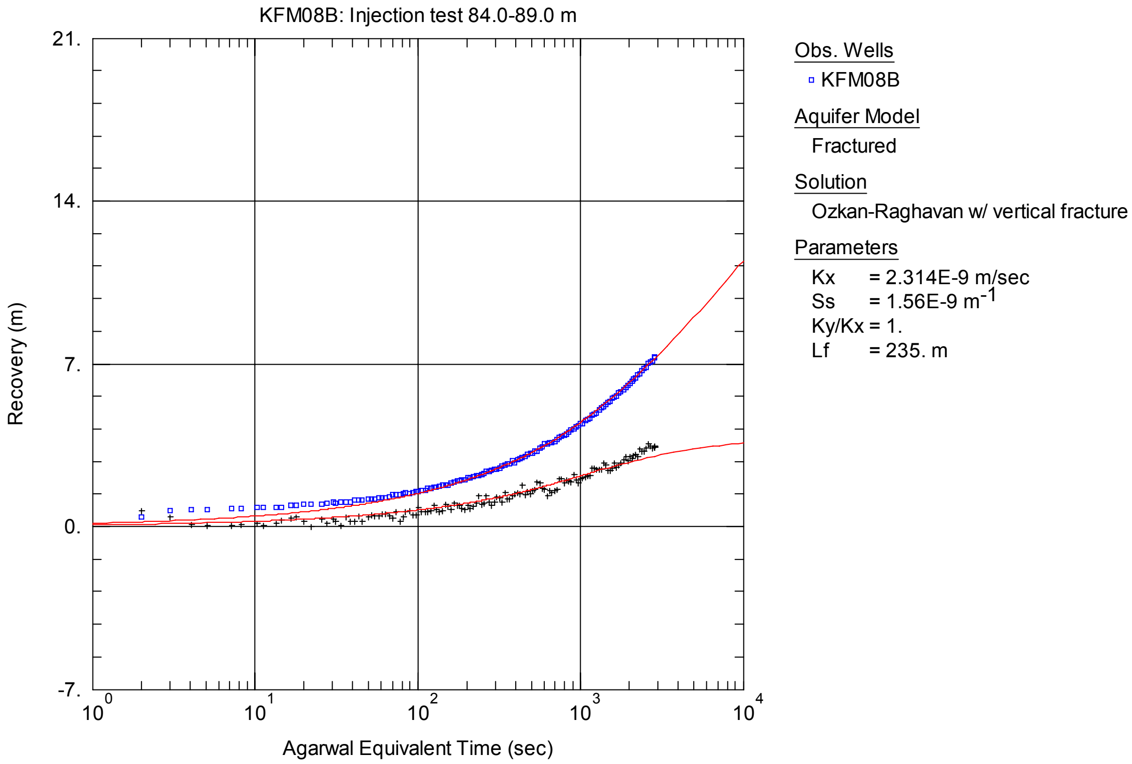


Figure A3-76. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 84.0-89.0 m in KFM08B.*

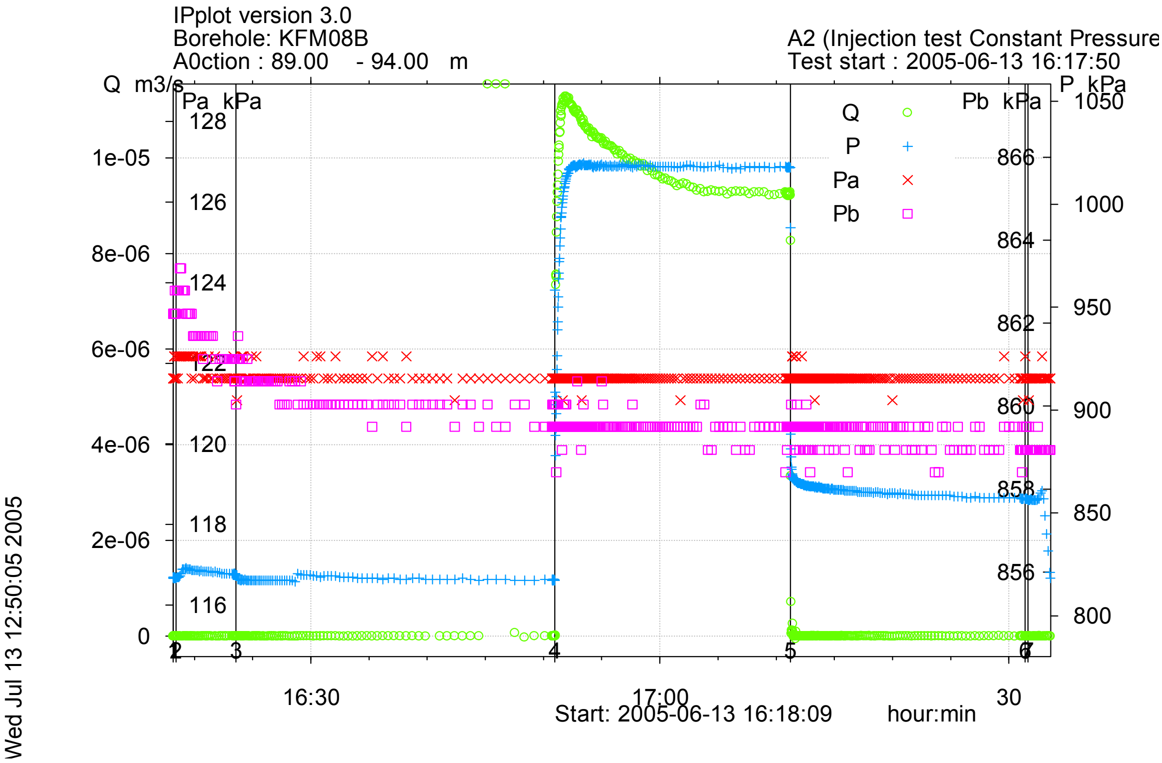


Figure A3-77. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 89.0-94.0 m in borehole KFM08B.*

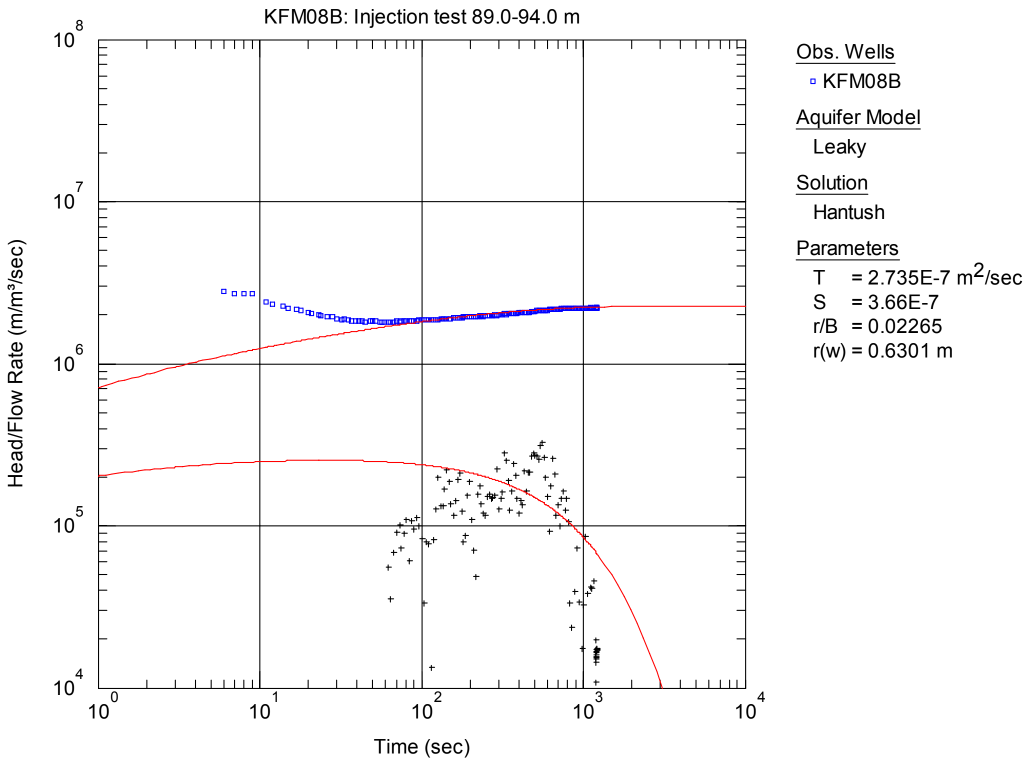


Figure A3-78. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 89.0-94.0 m in KFM08B.*

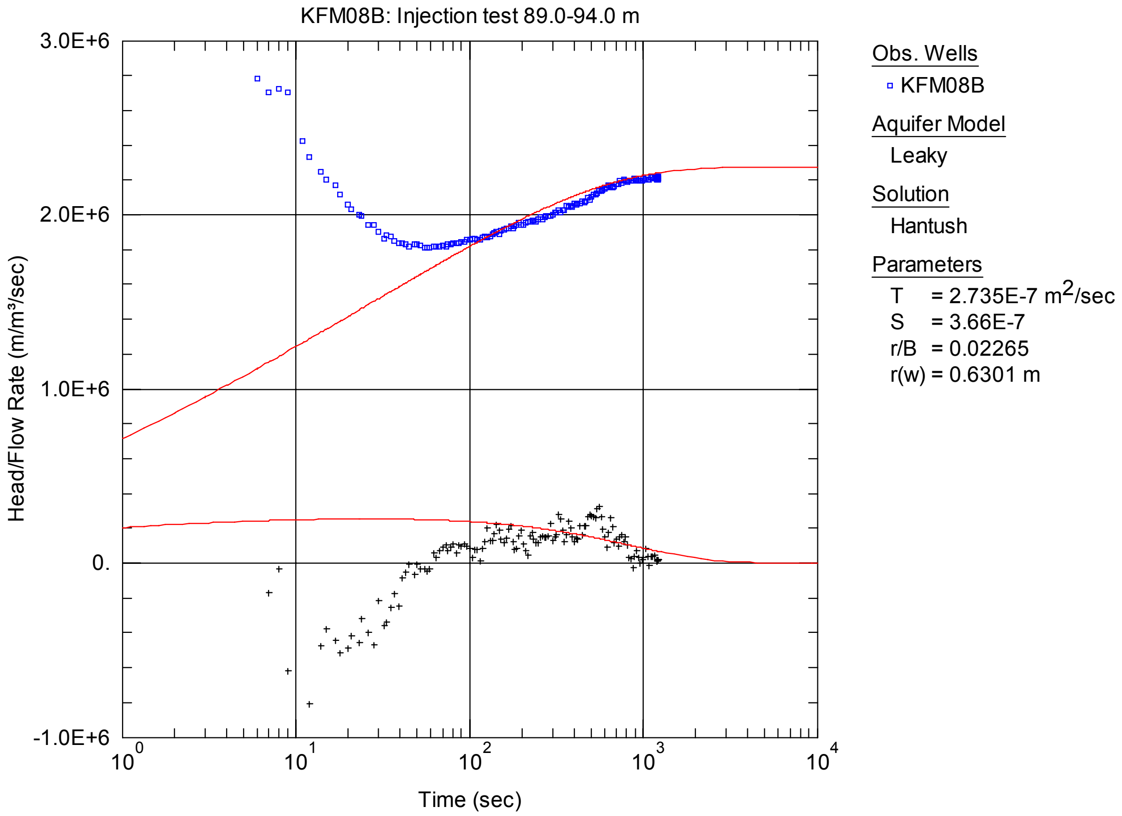


Figure A3-79. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 89.0-94.0 m in KFM08B.*

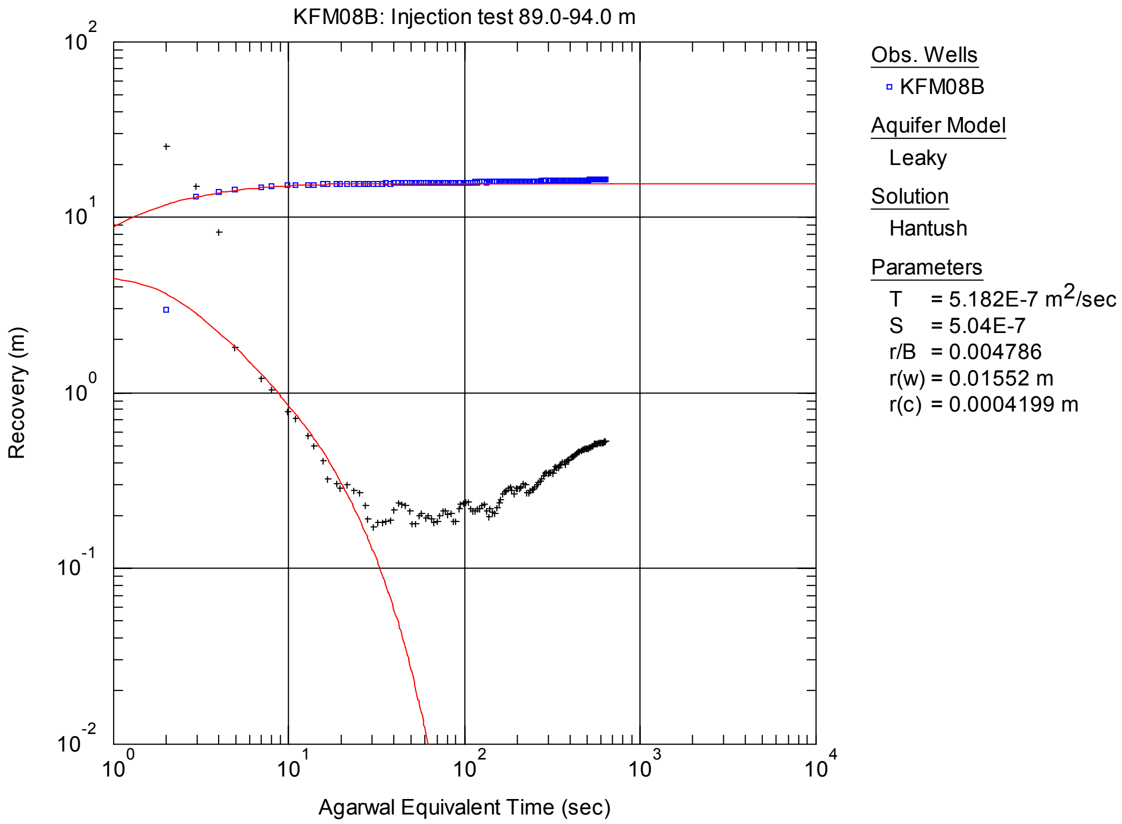


Figure A3-80. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 89.0-94.0 m in KFM08B.*

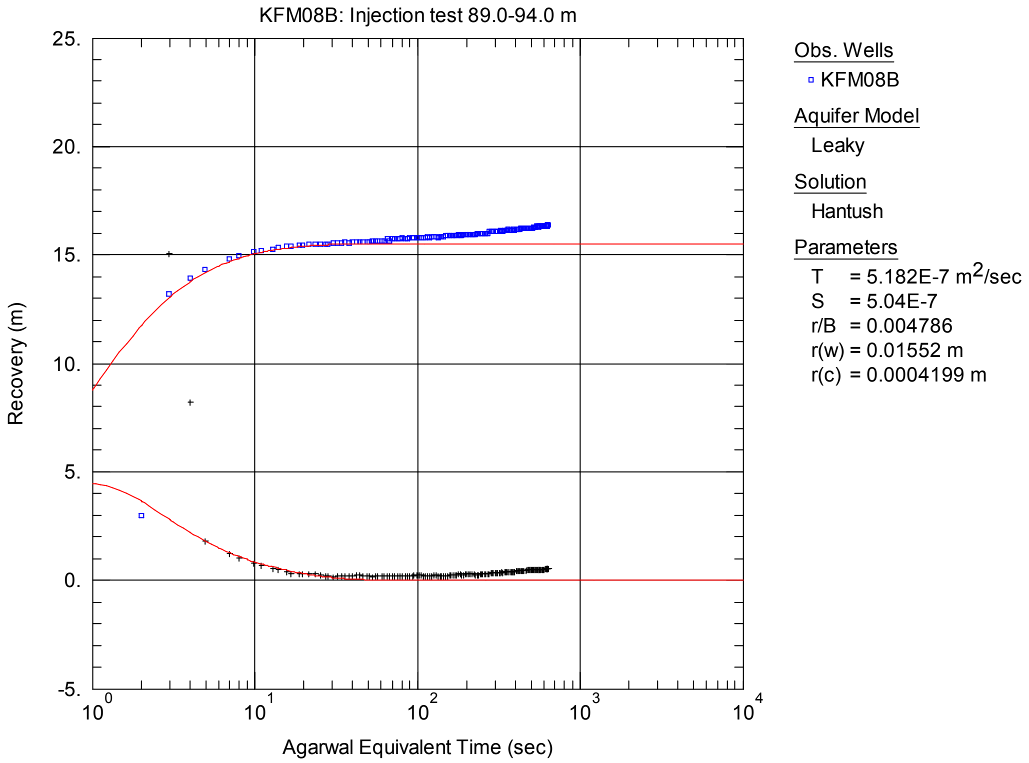


Figure A3-81. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 89.0-94.0 m in KFM08B.*

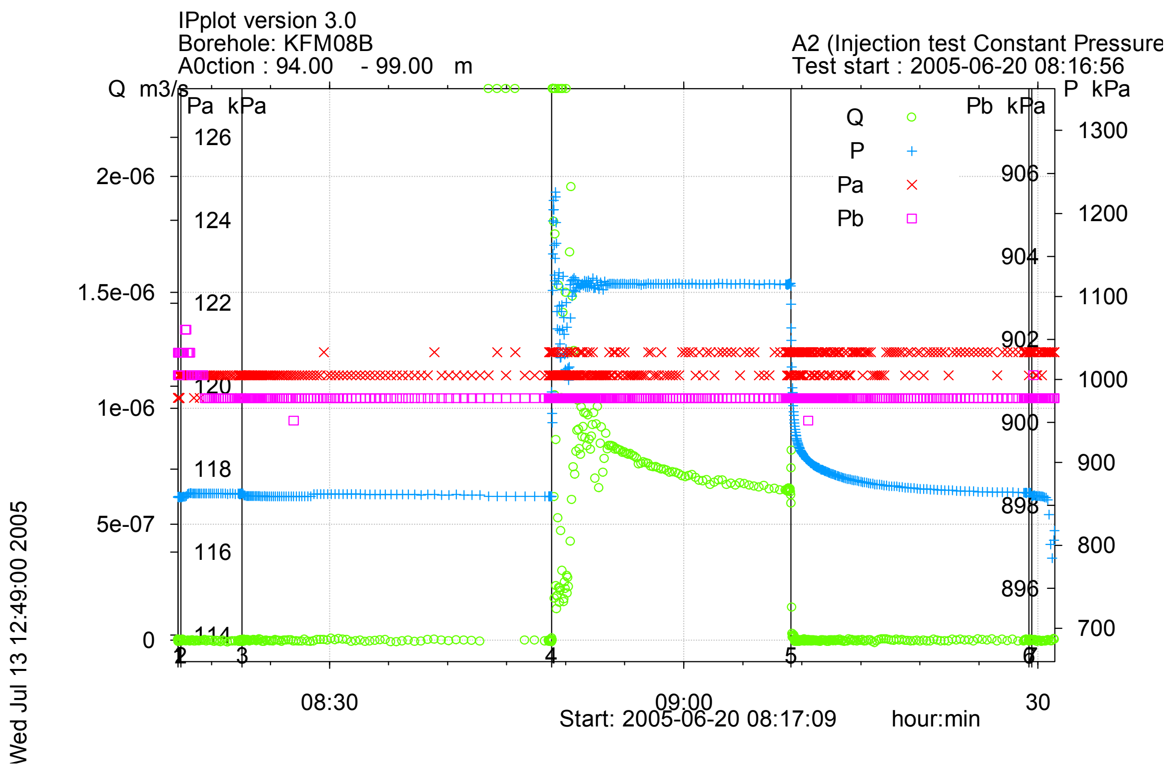


Figure A3-82. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 94.0-99.0 m in borehole KFM08B.*

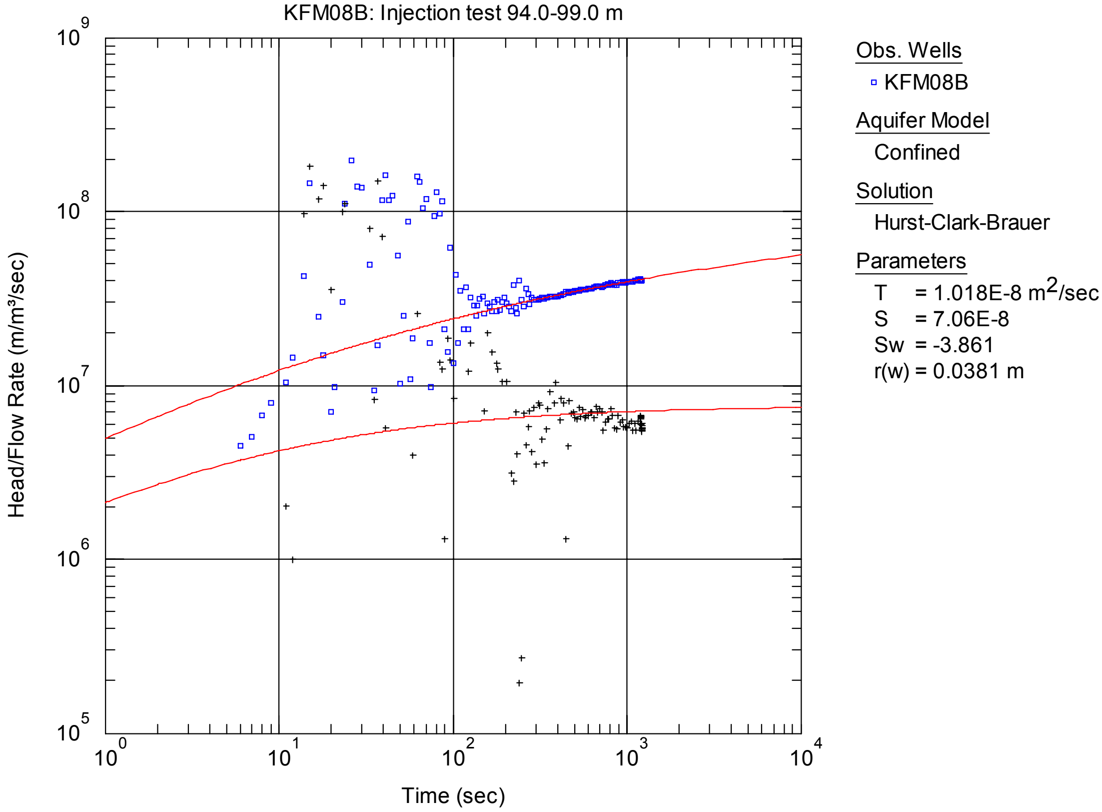


Figure A3-83. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 94.0-99.0 m in KFM08B.*

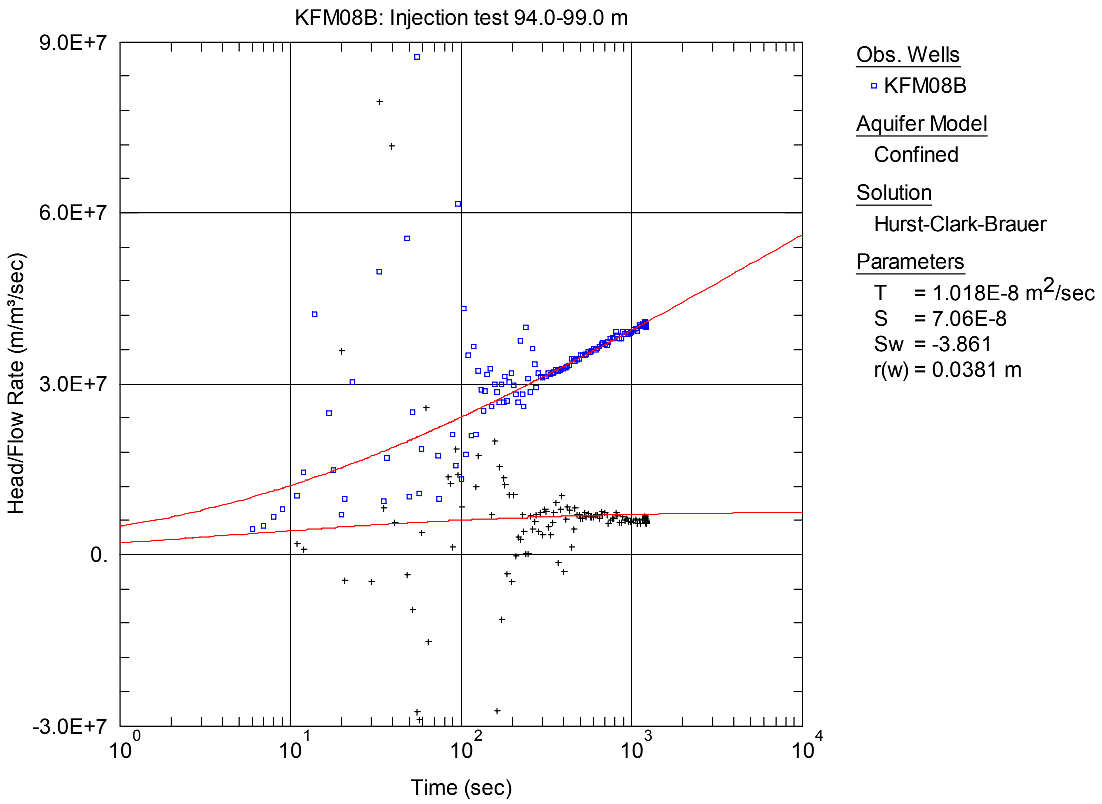


Figure A3-84. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 94.0-99.0 m in KFM08B.*

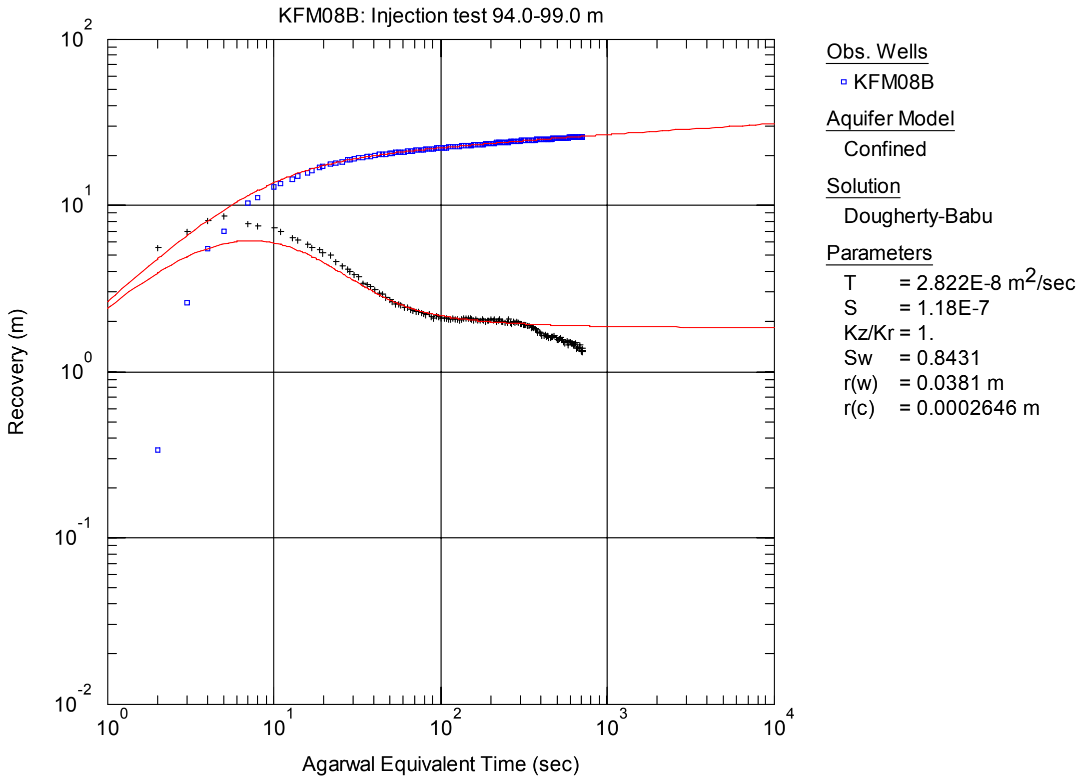


Figure A3-85. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 94.0-99.0 m in KFM08B.*

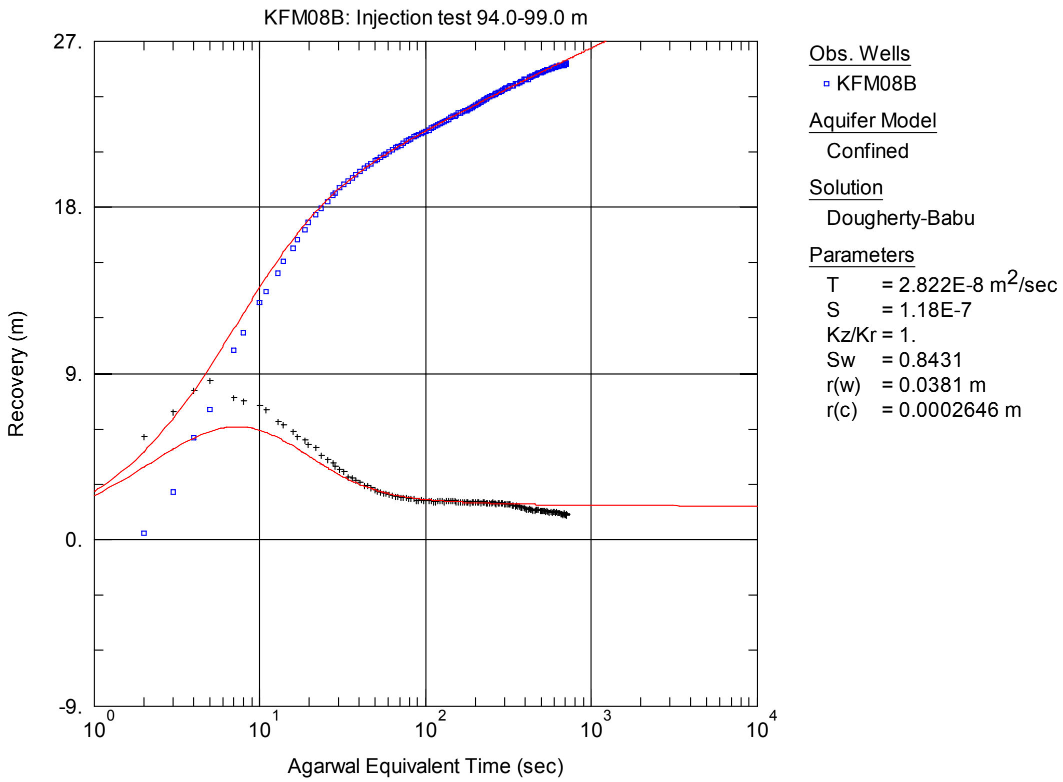


Figure A3-86. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 94.0-99.0 m in KFM08B.*

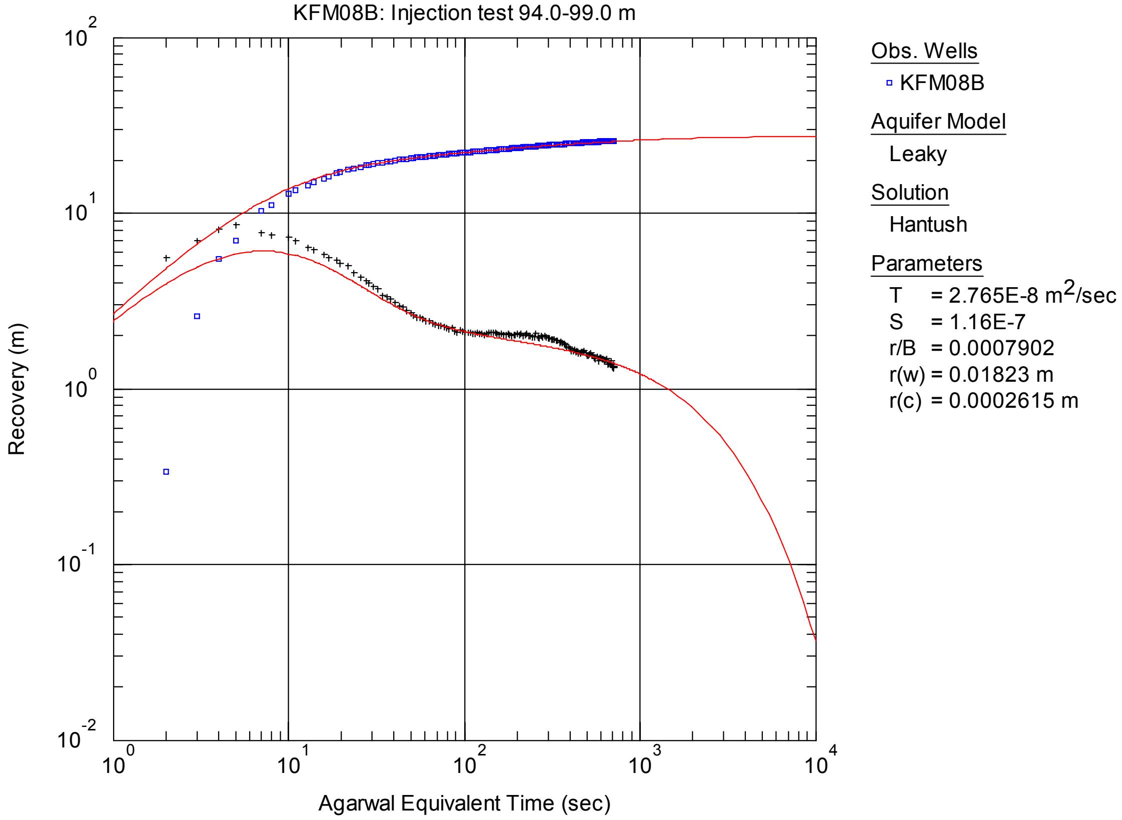


Figure A3-87. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Hantush solution, from the injection test in section 94.0-99.0 m in KFM08B.*

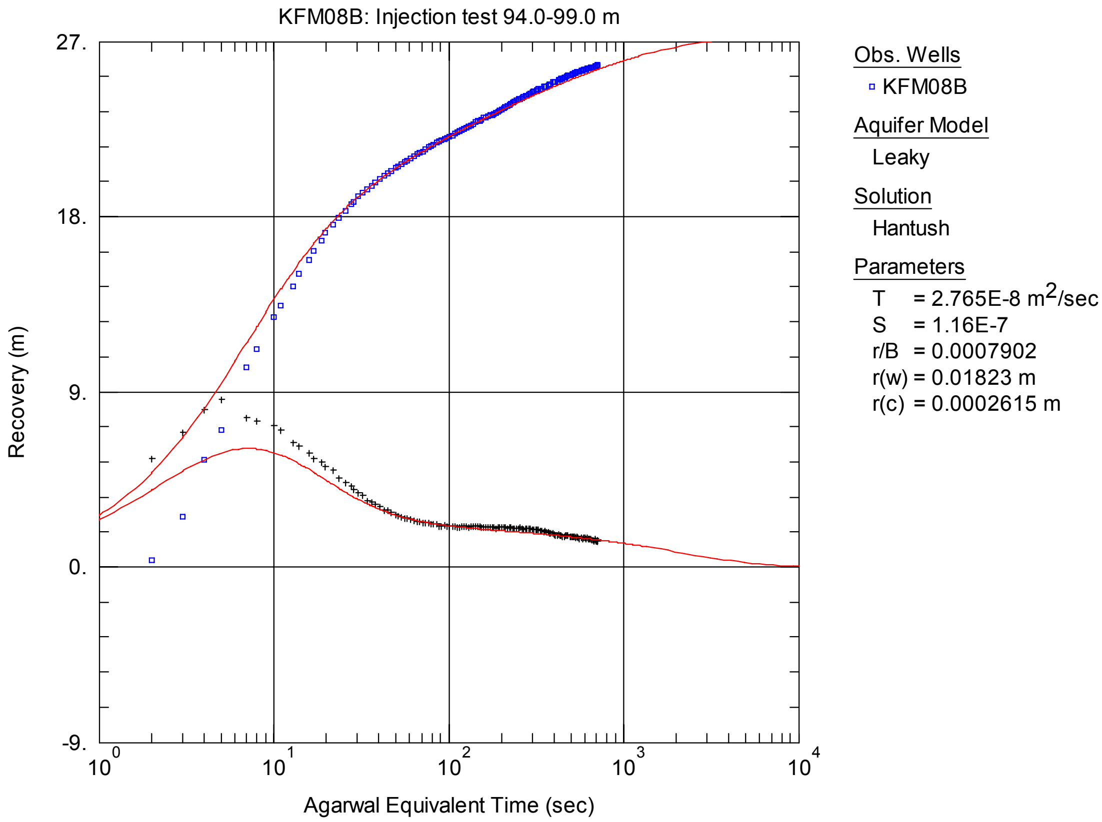


Figure A3-88. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Hantush solution, from the injection test in section 94.0-99.0 m in KFM08B.*

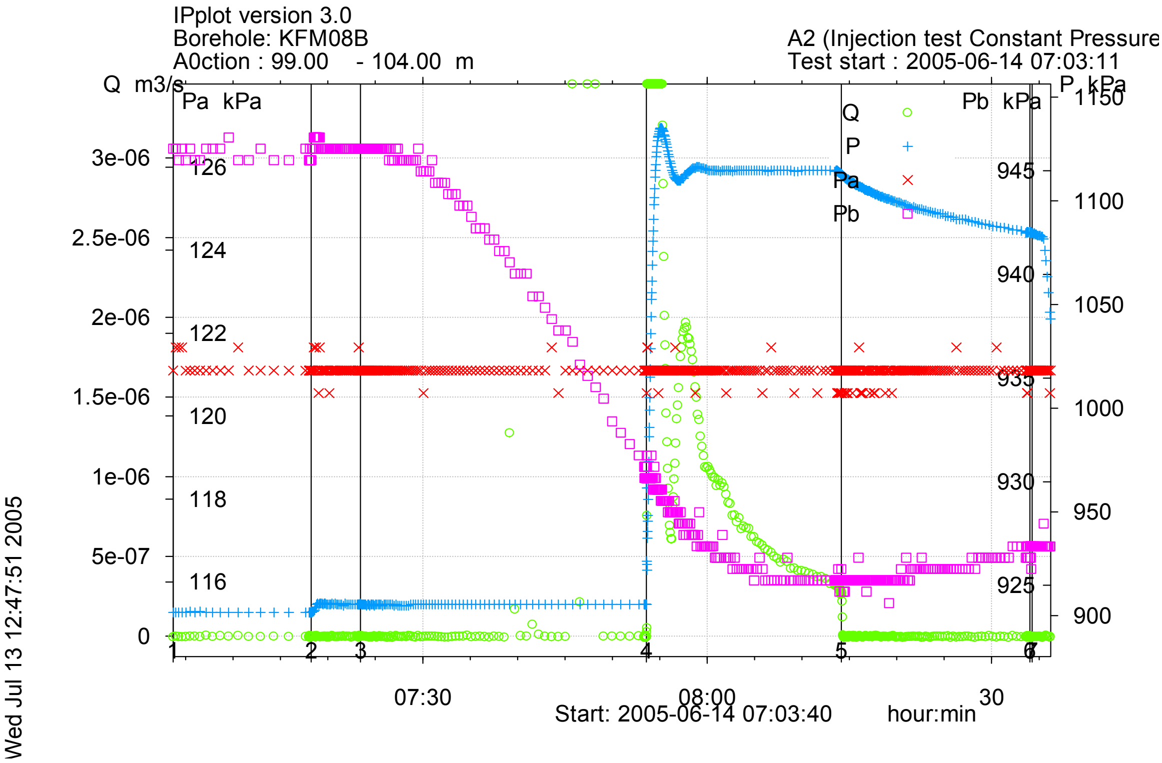


Figure A3-89. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 99.0-104.0 m in borehole KFM08B.*

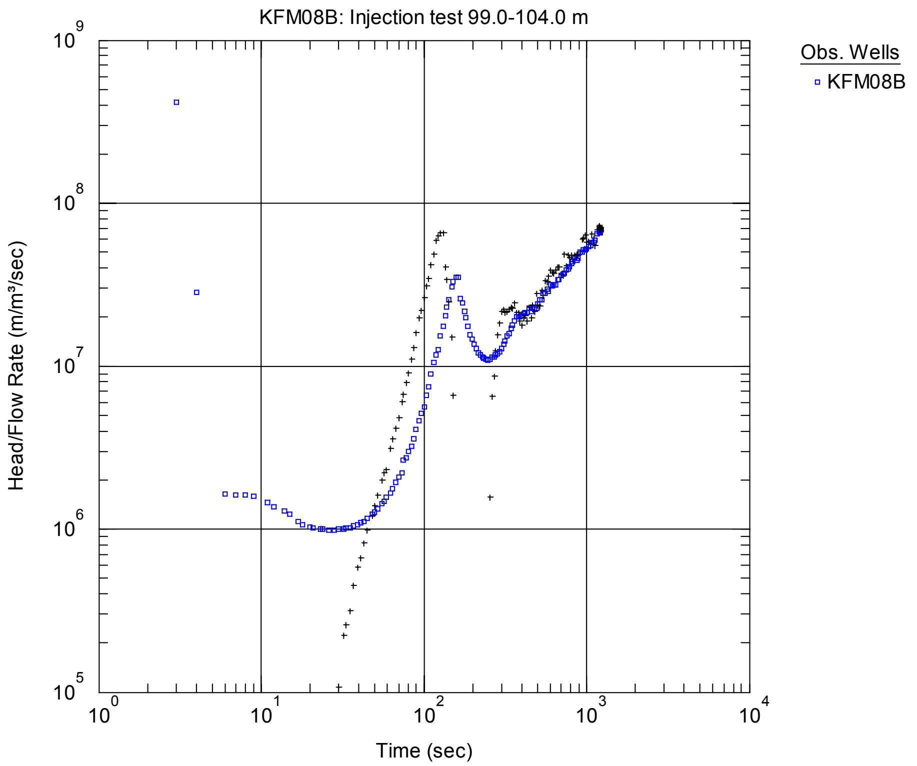


Figure A3-90. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 99.0-104.0 m in KFM08B.*

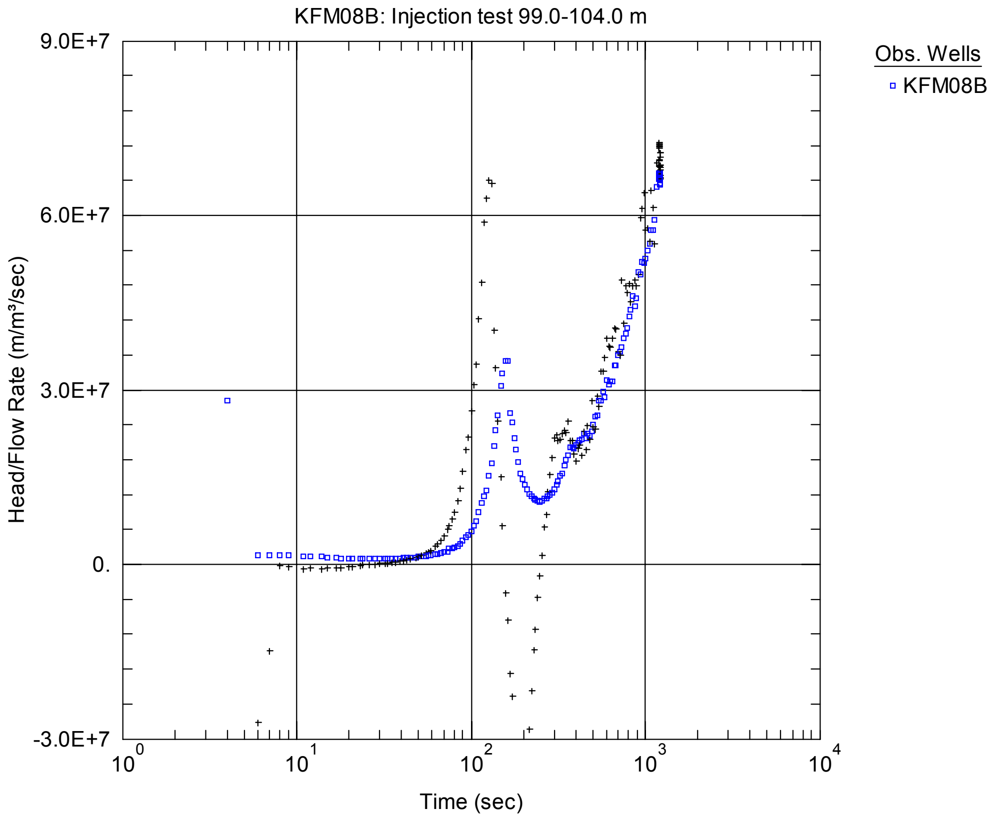


Figure A3-91. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 99.0-104.0 m in KFM08B.*

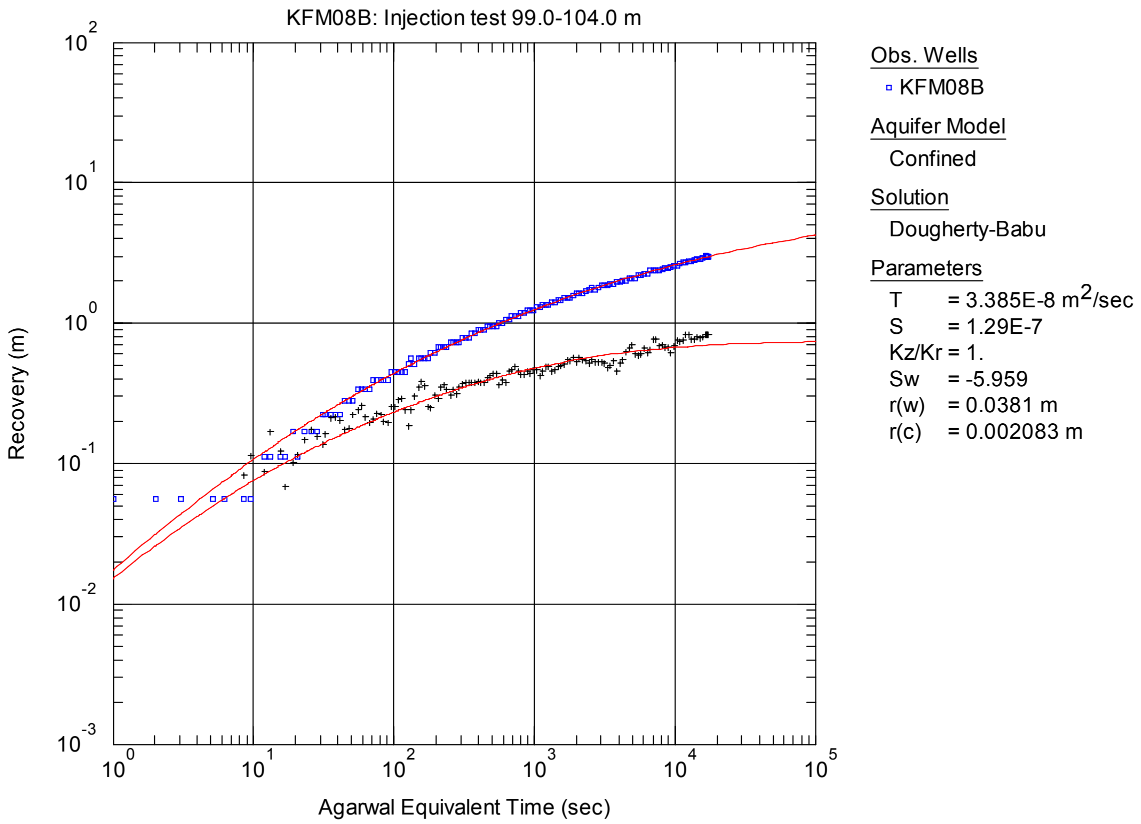


Figure A3-92. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 99.0-104.0 m in KFM08B.*

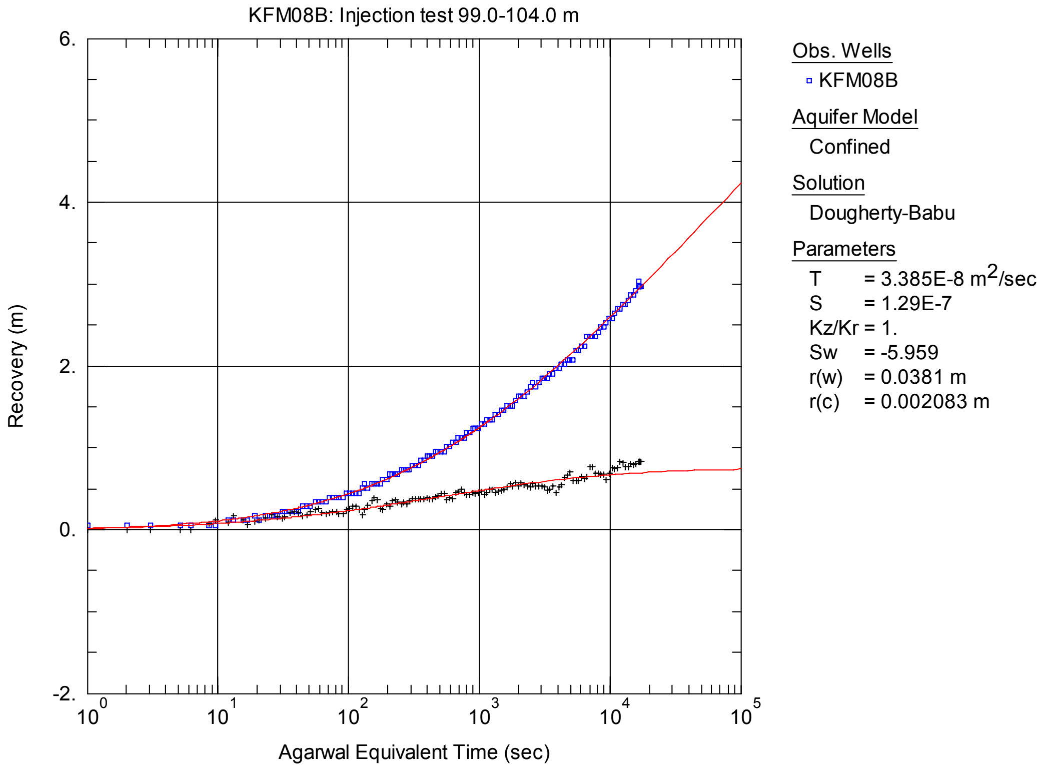


Figure A3-93. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 99.0-104.0 m in KFM08B.*

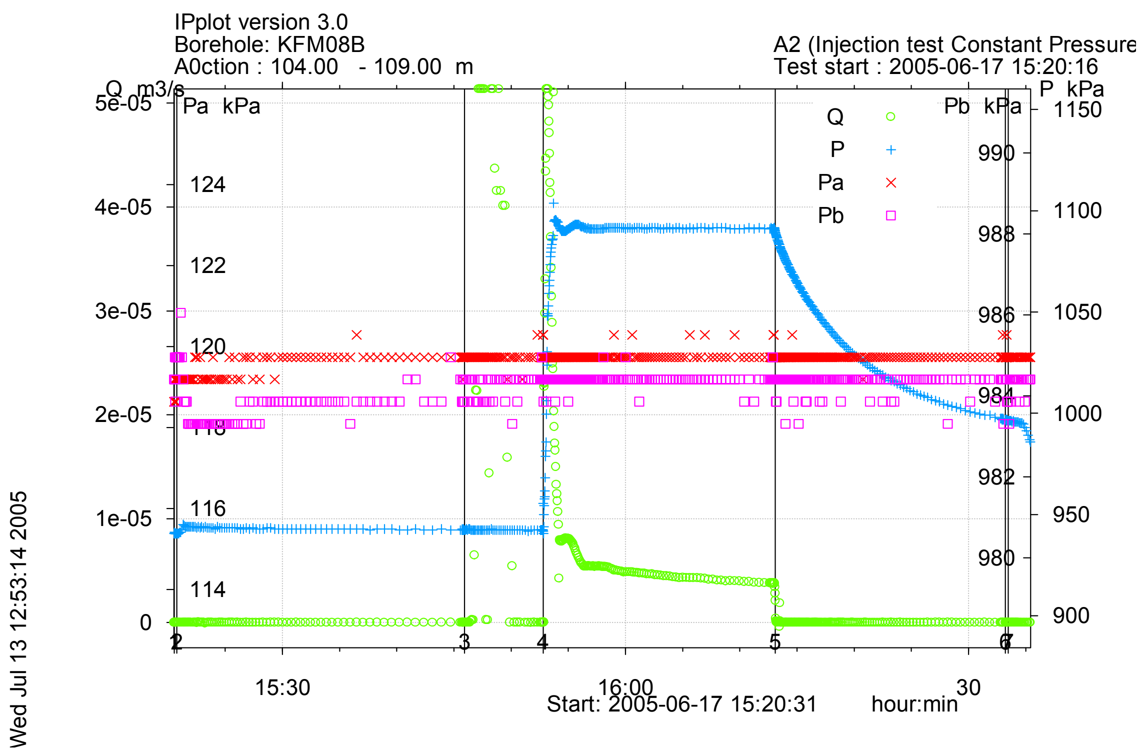


Figure A3-94. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 104.0-109.0 m in borehole KFM08B.*

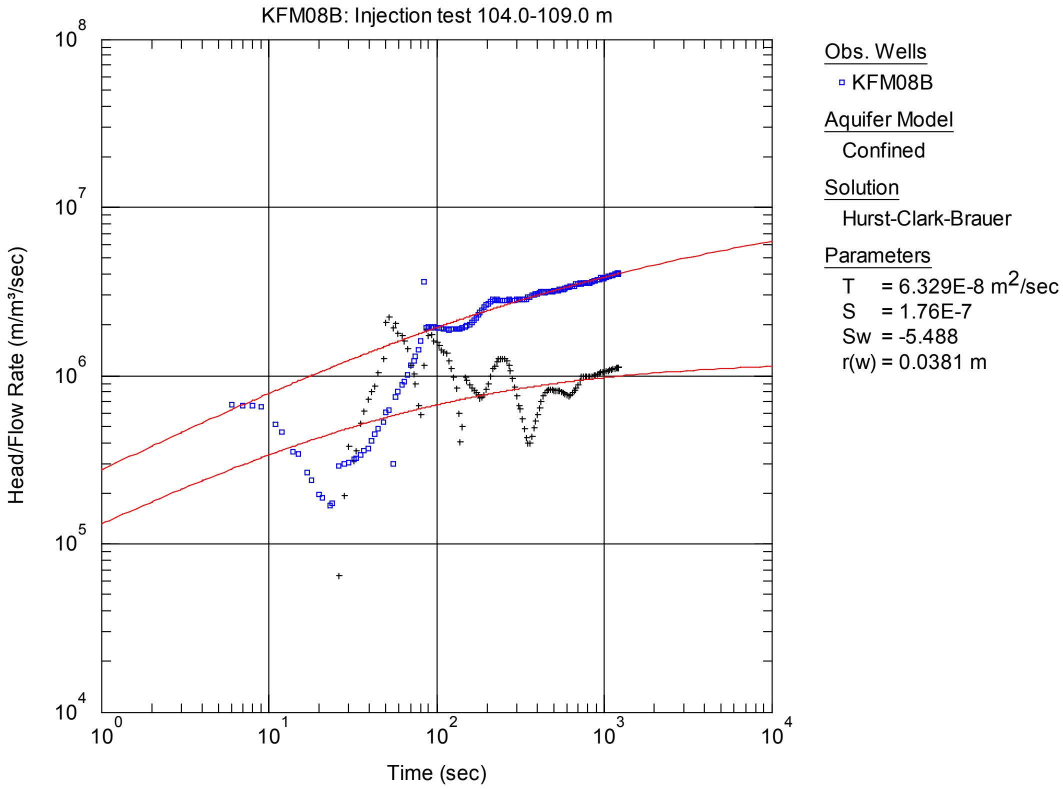


Figure A3-95. *Log-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Hurst-Clark-Brauer solution, from the injection test in section 104.0-109.0 m in KFM08B.*

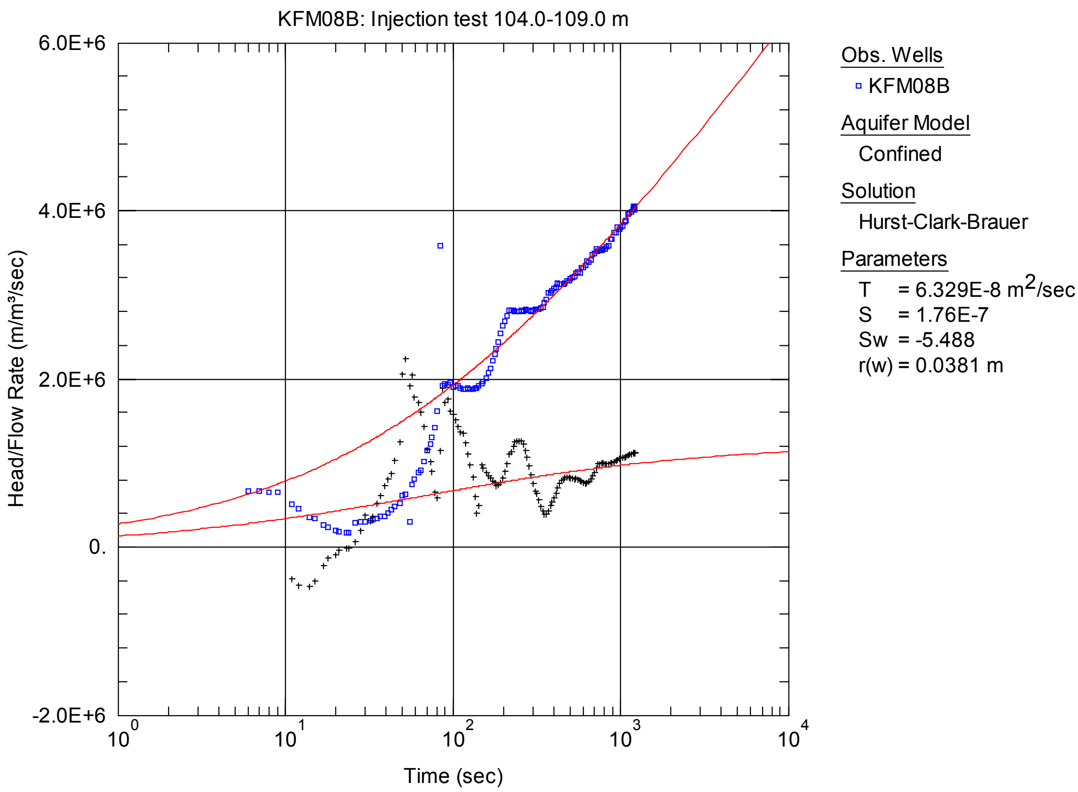


Figure A3-96. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Hurst-Clark-Brauer solution, from the injection test in section 104.0-109.0 m in KFM08B.*

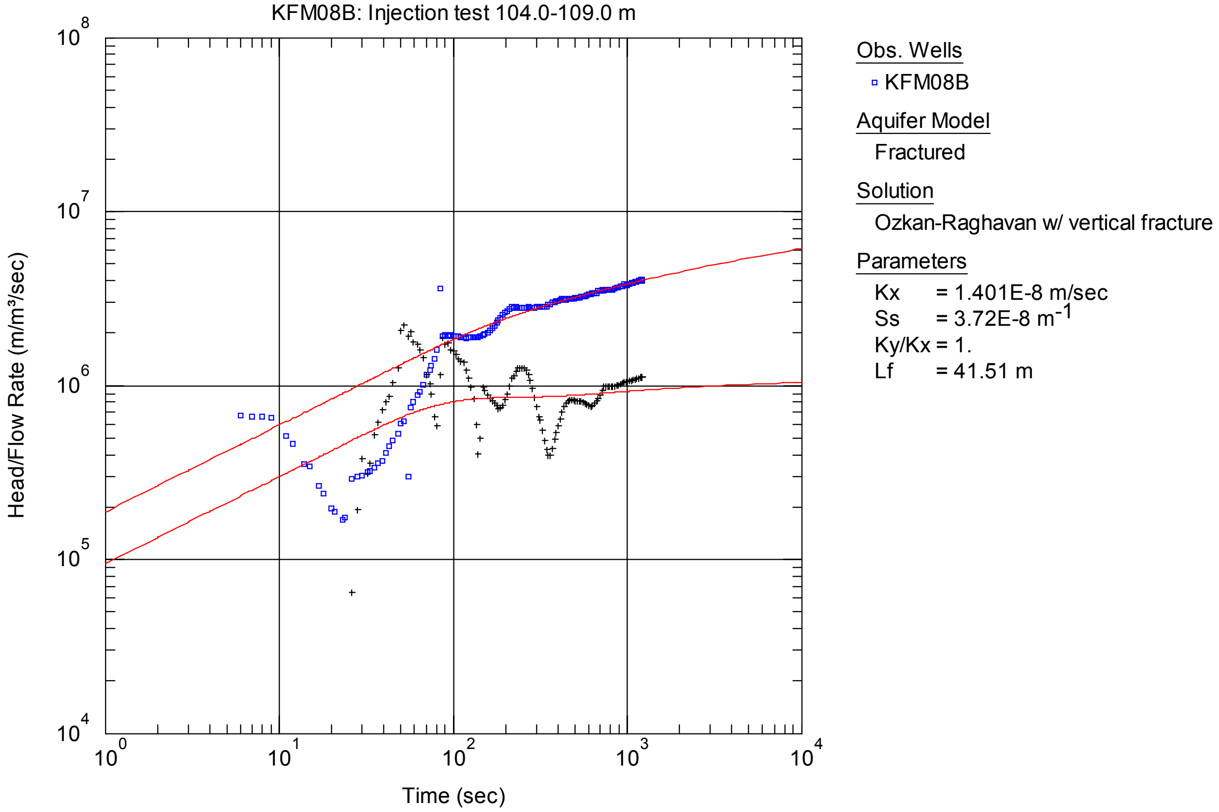


Figure A3-97. *Log-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 104.0-109.0 m in KFM08B.*

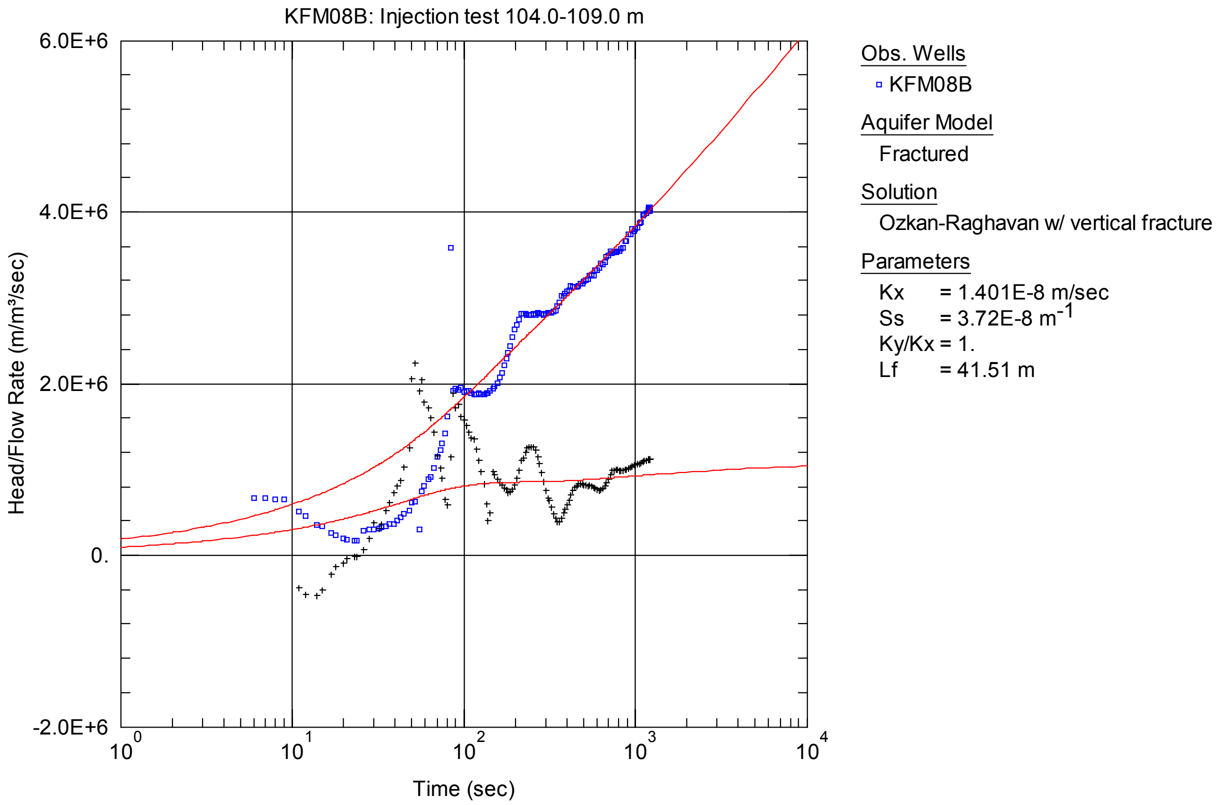


Figure A3-98. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 104.0-109.0 m in KFM08B.*

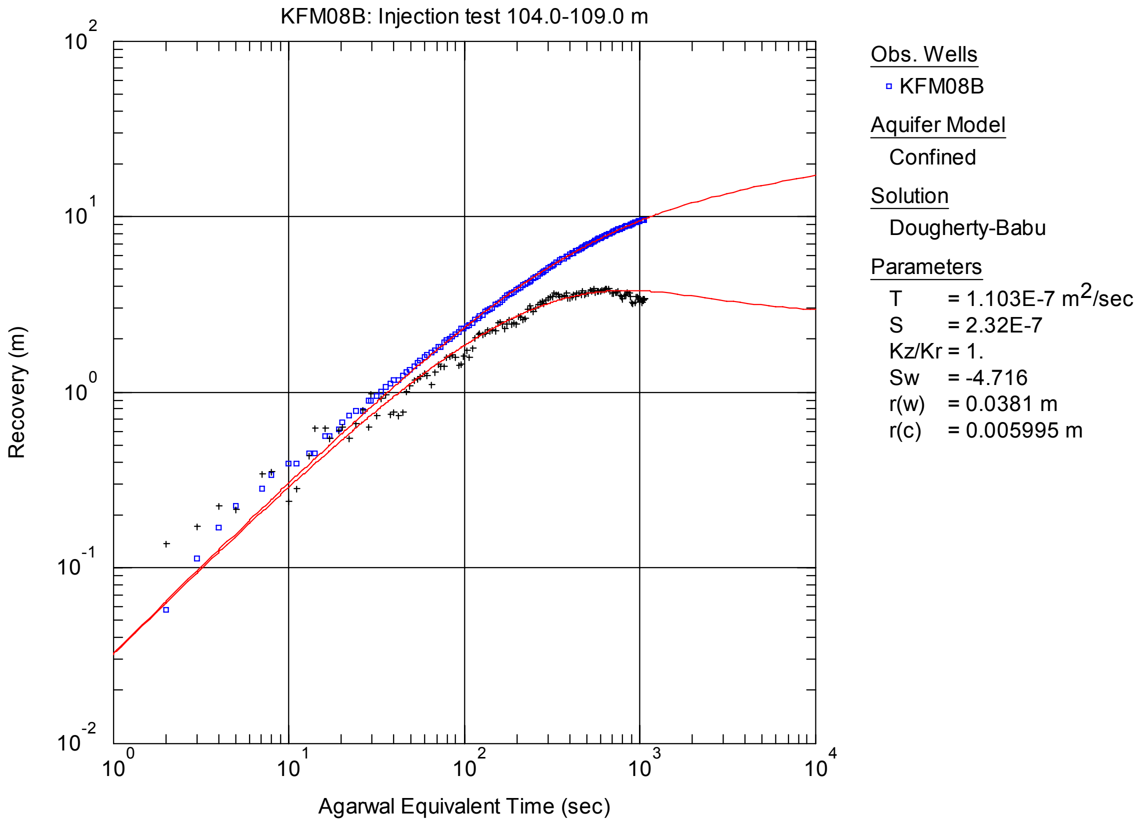


Figure A3-99. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 104.0-109.0 m in KFM08B.*

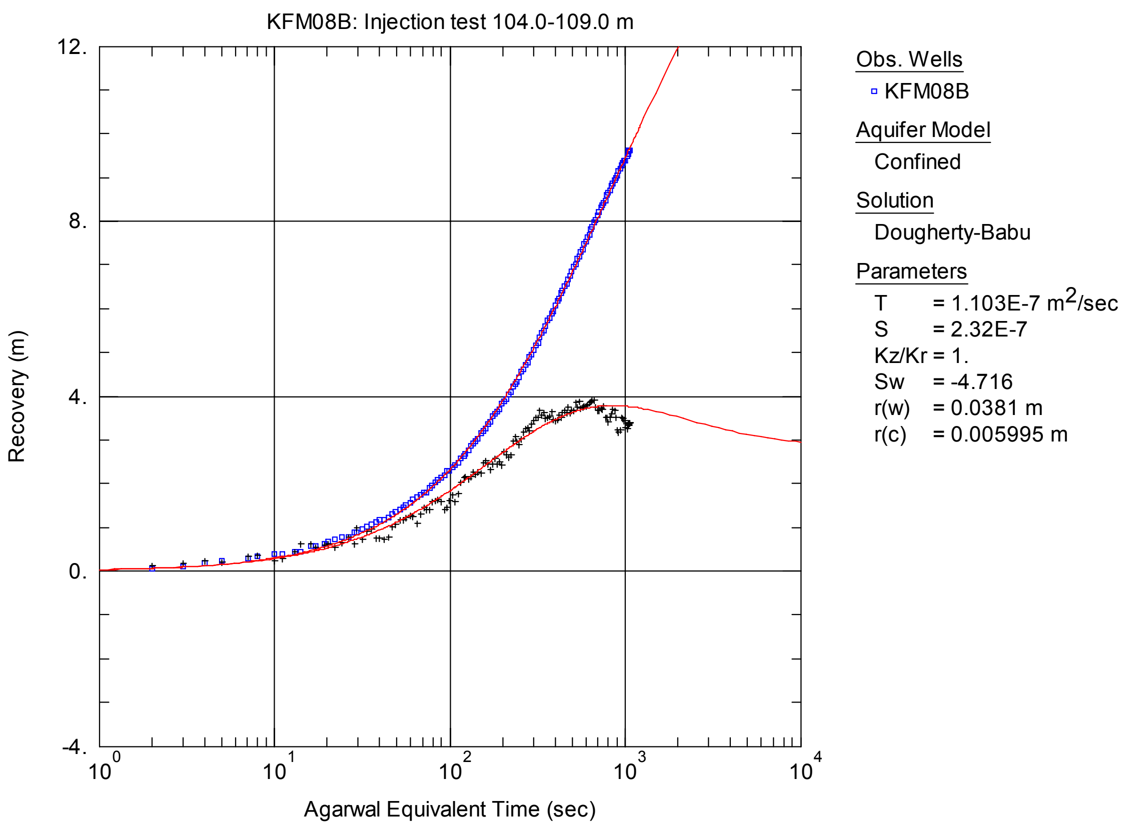


Figure A3-100. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 104.0-109.0 m in KFM08B.*

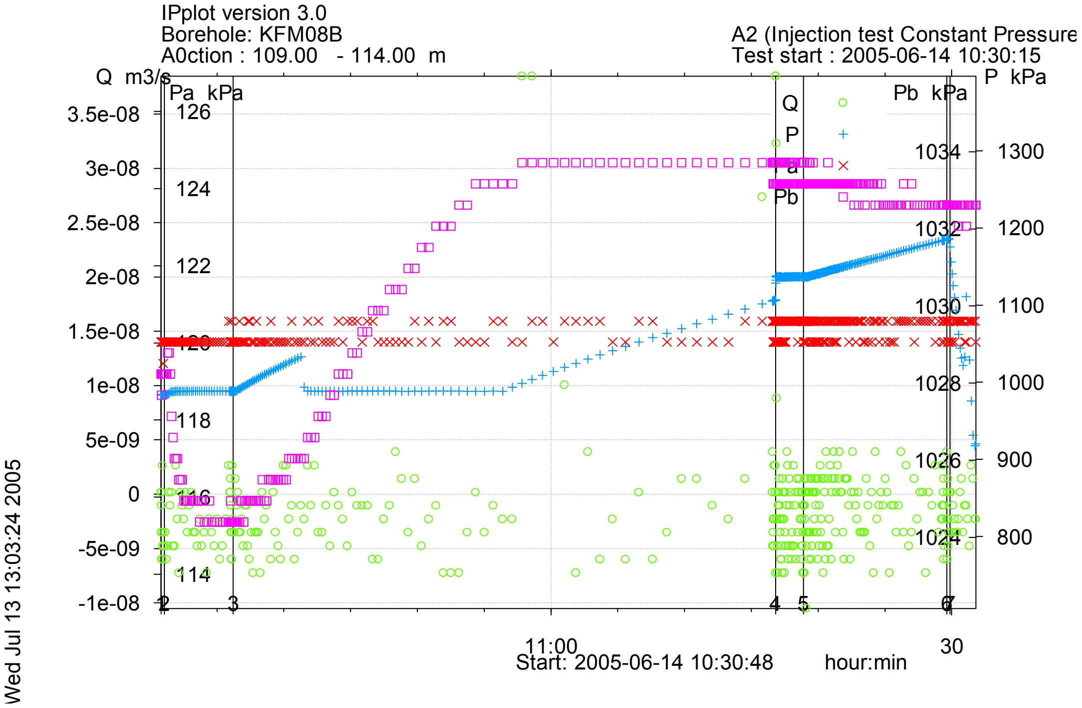


Figure A3-101. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 109.0-114.0 m in borehole KFM08B.*

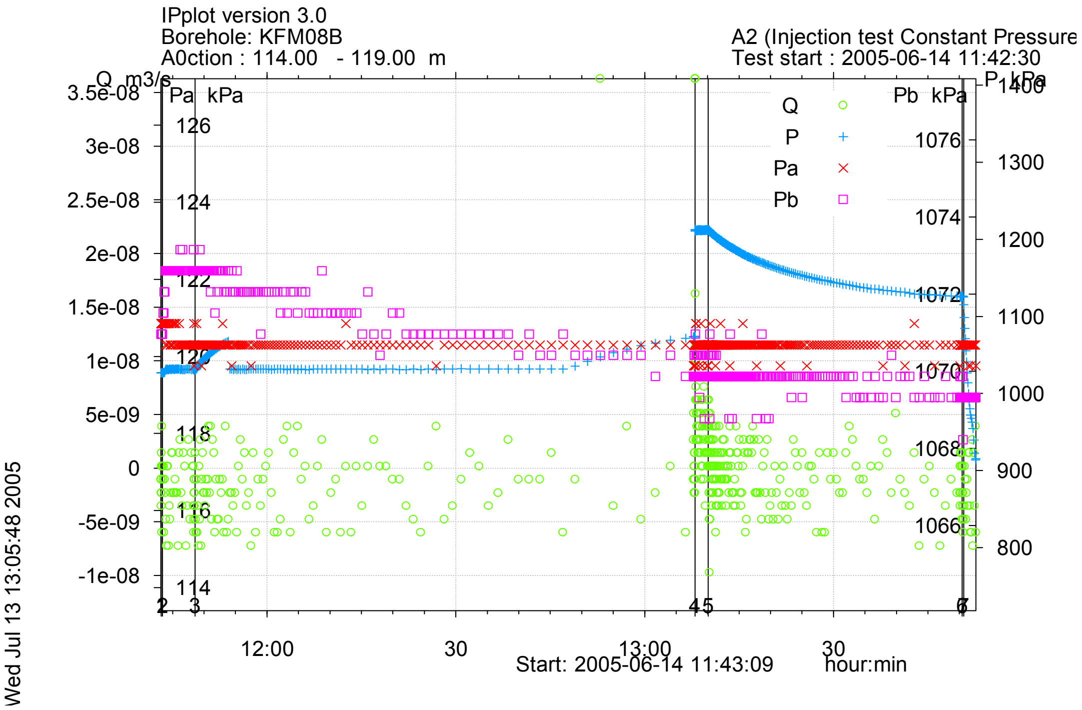


Figure A3-102. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 114.0-119.0 m in borehole KFM08B.*

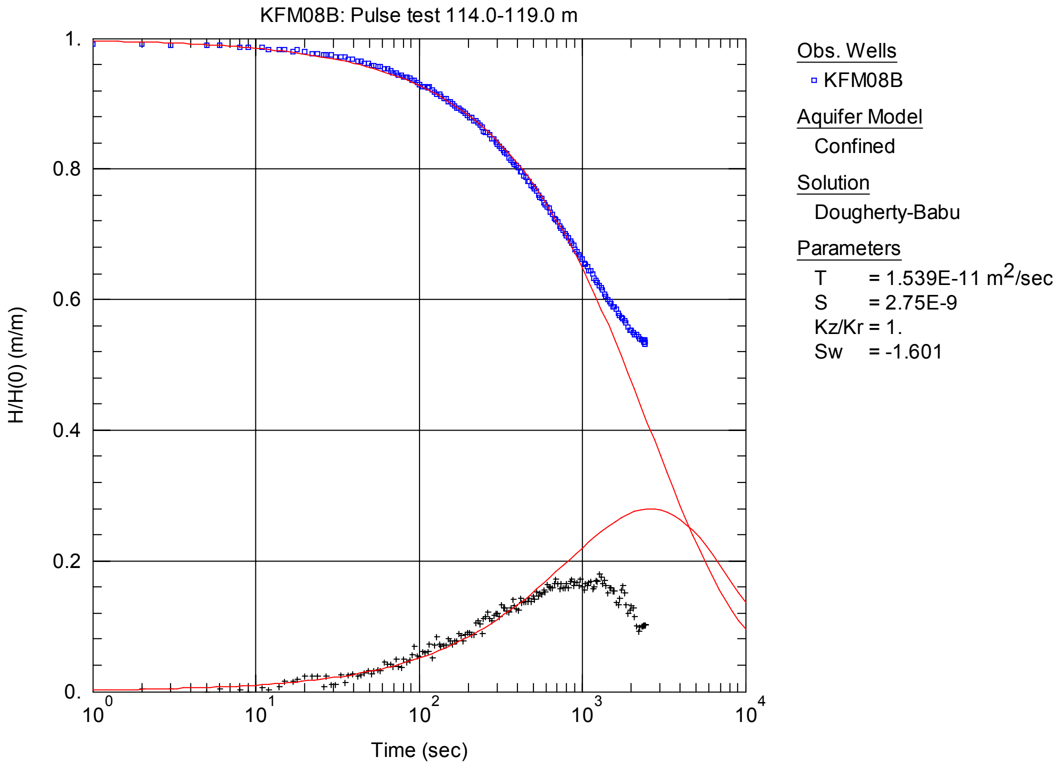


Figure A3-103. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 114.0-119.0 m in KFM08B.*

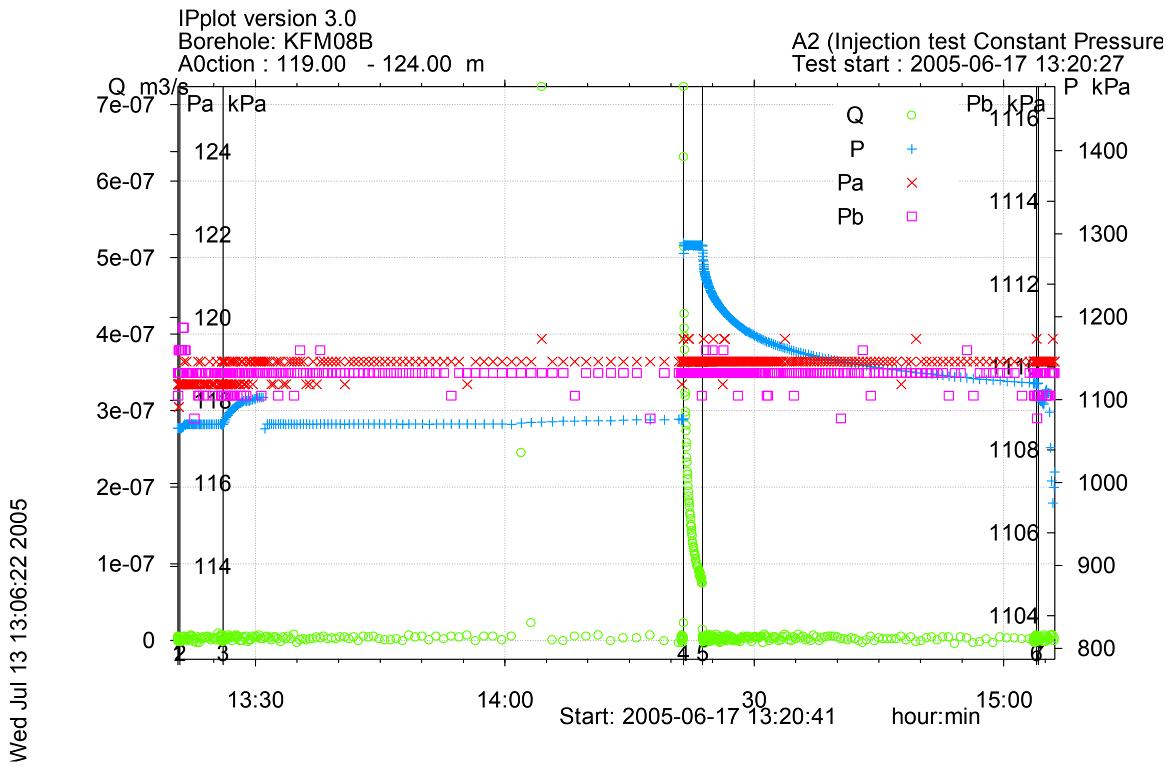


Figure A3-104. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 119.0-124.0 m in borehole KFM08B.*

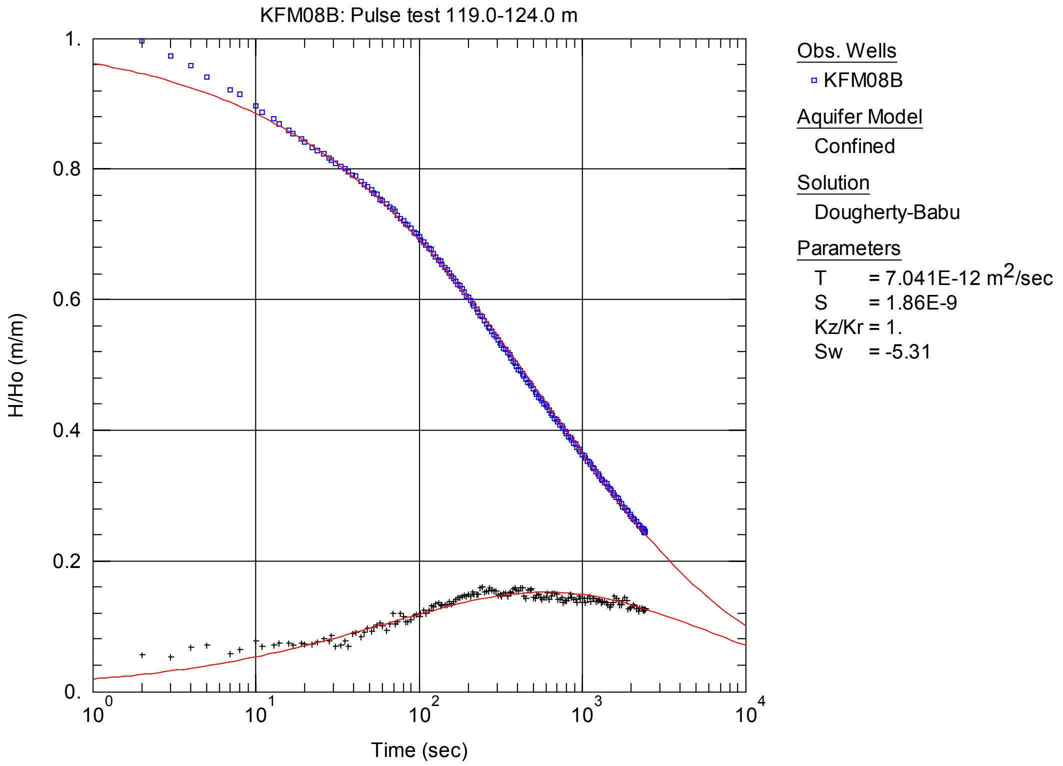


***Figure A3-105.** Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 119.0-124.0 m in KFM08B.*

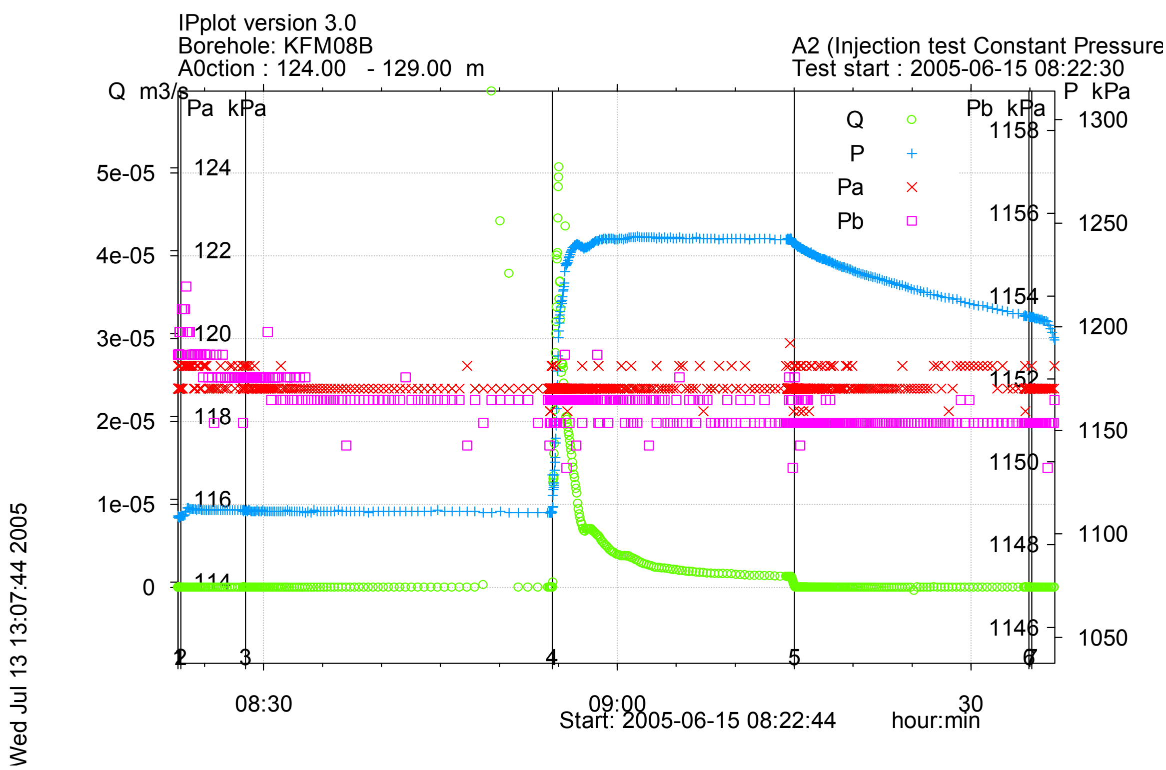


***Figure A3-106.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 124.0-129.0 m in borehole KFM08B.*

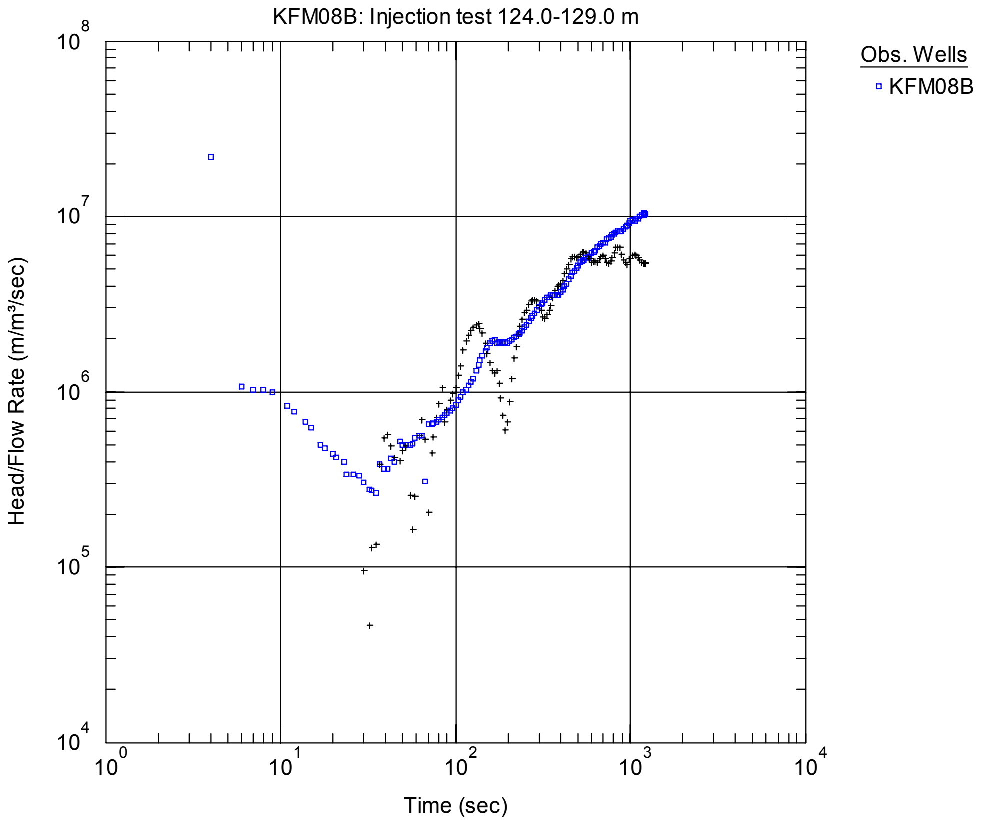


Figure A3-107. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 124.0-129.0 m in KFM08B.*

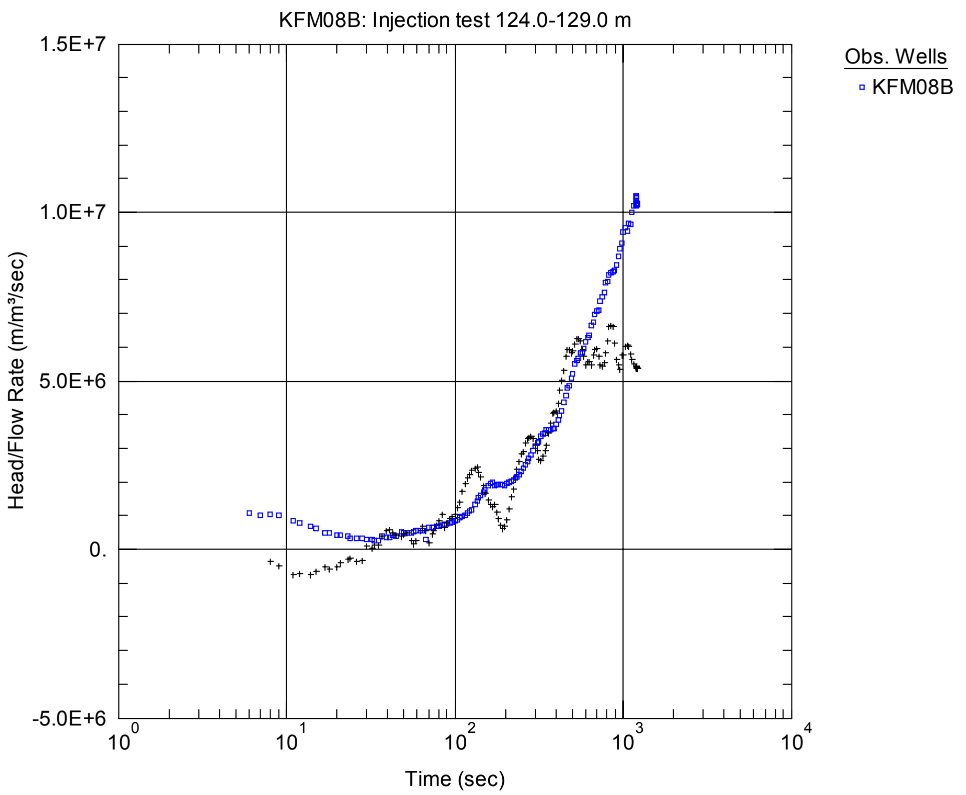


Figure A3-108. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 124.0-129.0 m in KFM08B.*

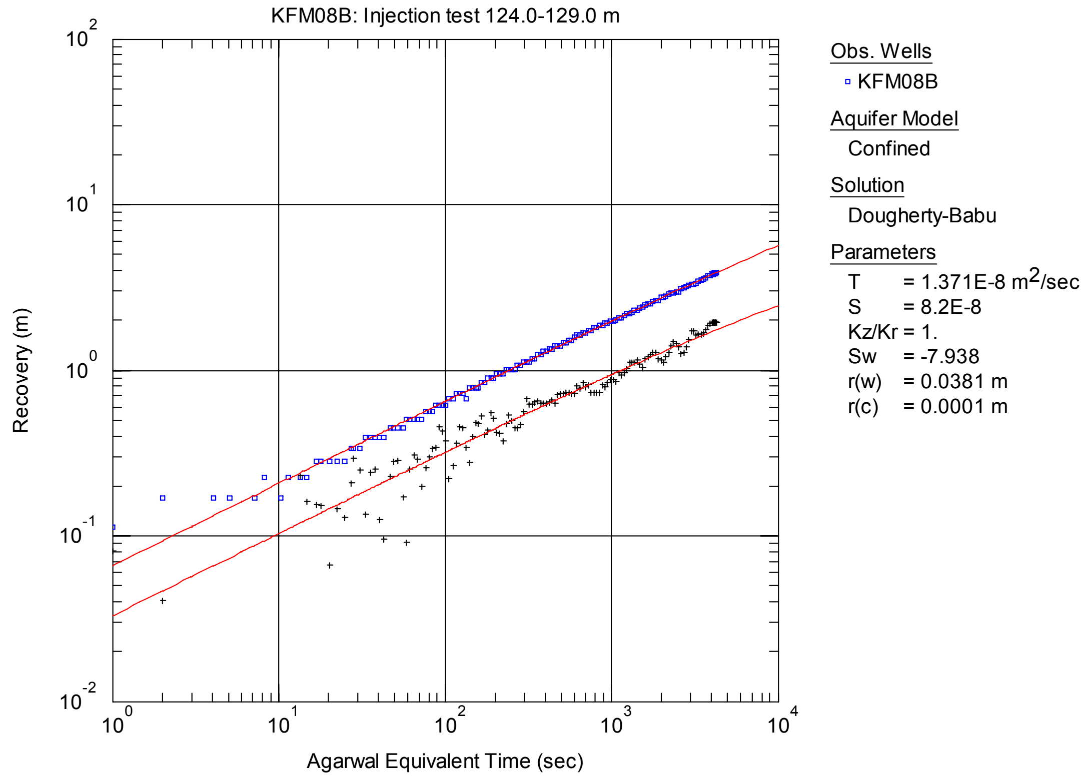


Figure A3-109. *Log-log plot of recovery (□) and derivative (+) versus equivalent time ,showing fit to the Dougherty-Babu solution, from the injection test in section 124.0-129.0 m in KFM08B.*

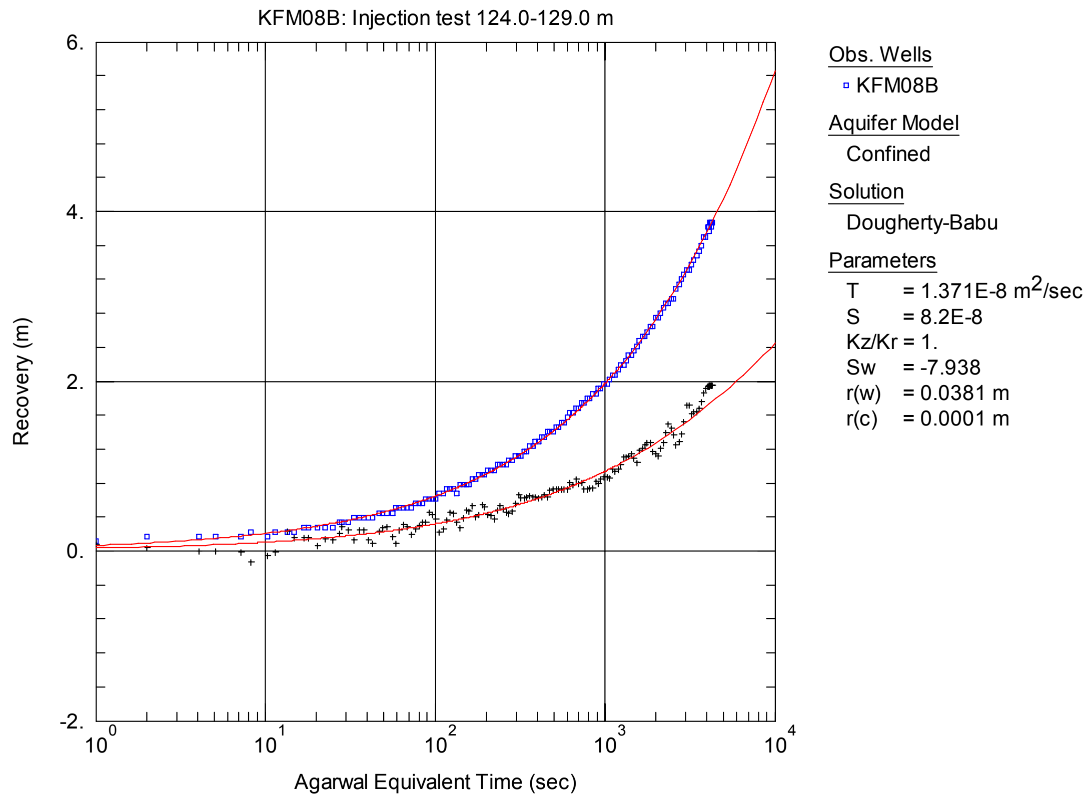


Figure A3-110. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 124.0-129.0 m in KFM08B.*

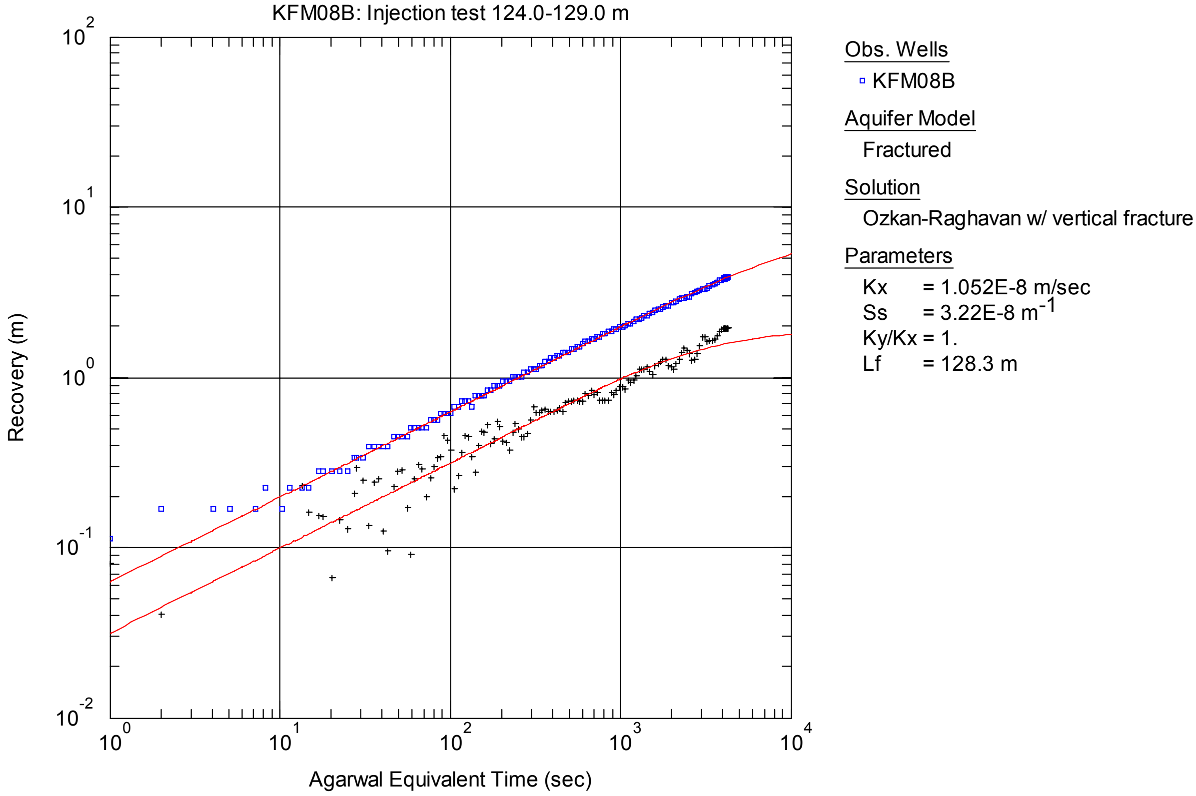


***Figure A3-111.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 124.0-129.0 m in KFM08B.*

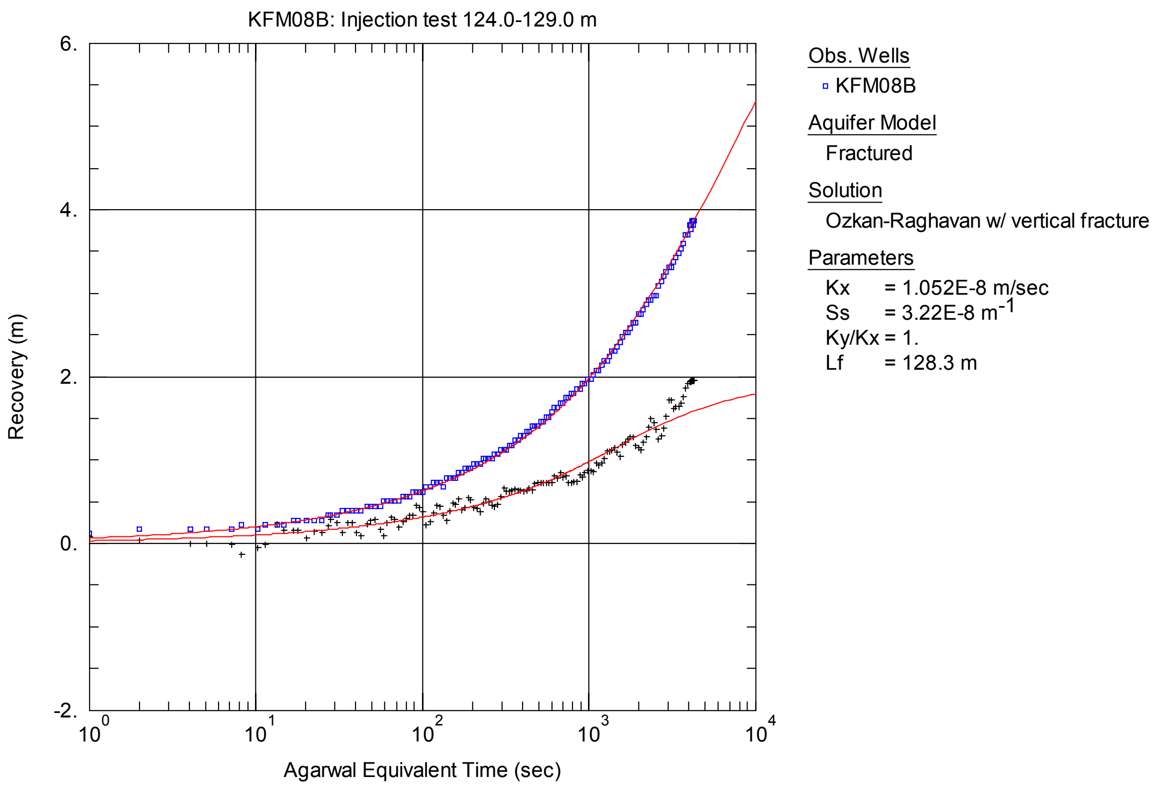


***Figure A3-112.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 124.0-129.0 m in KFM08B.*

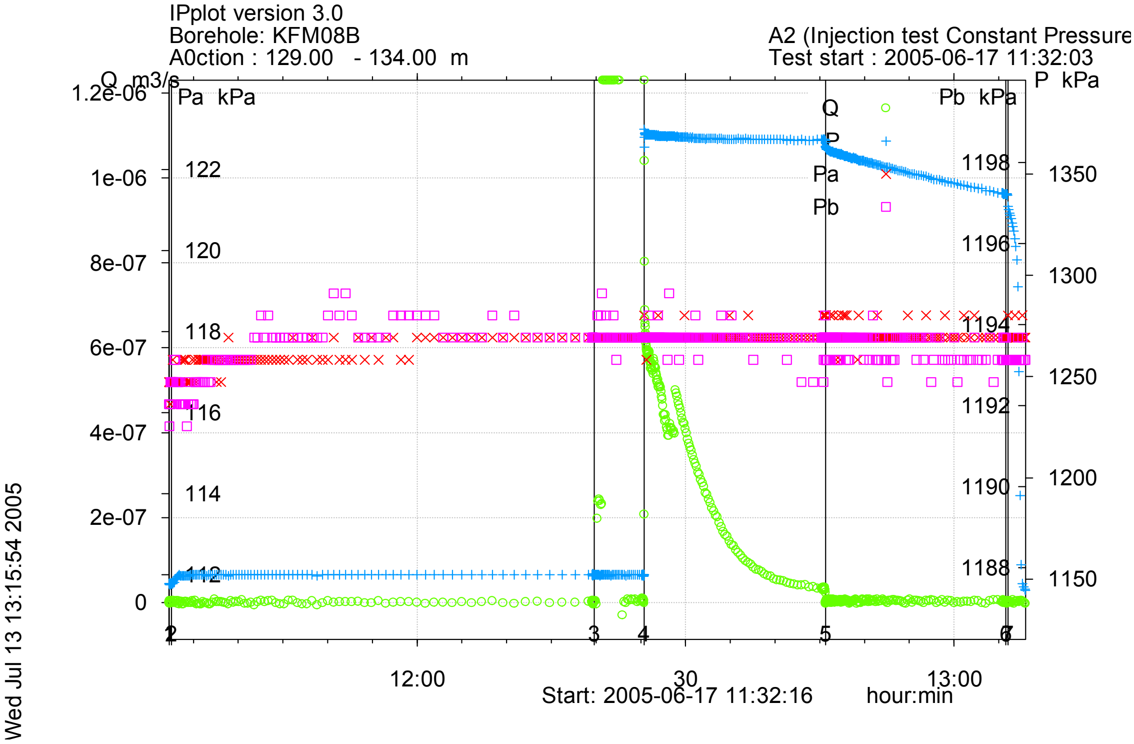


***Figure A3-113.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 129.0-134.0 m in borehole KFM08B.*

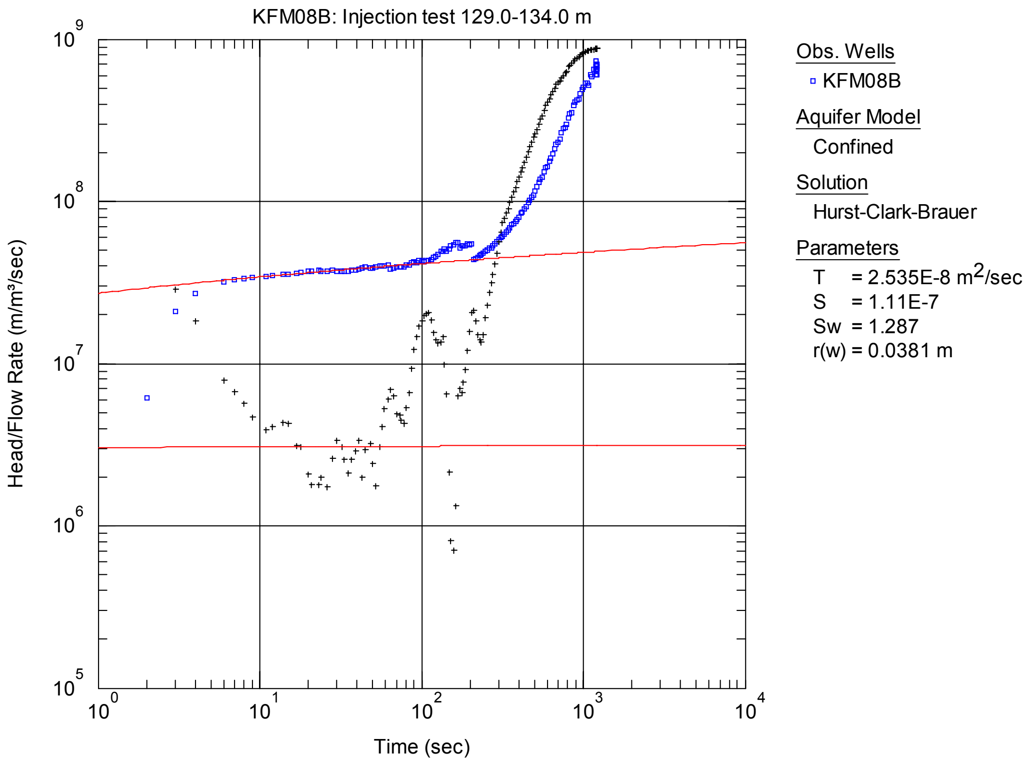


***Figure A3-114.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 129.0-134.0 m in KFM08B.*

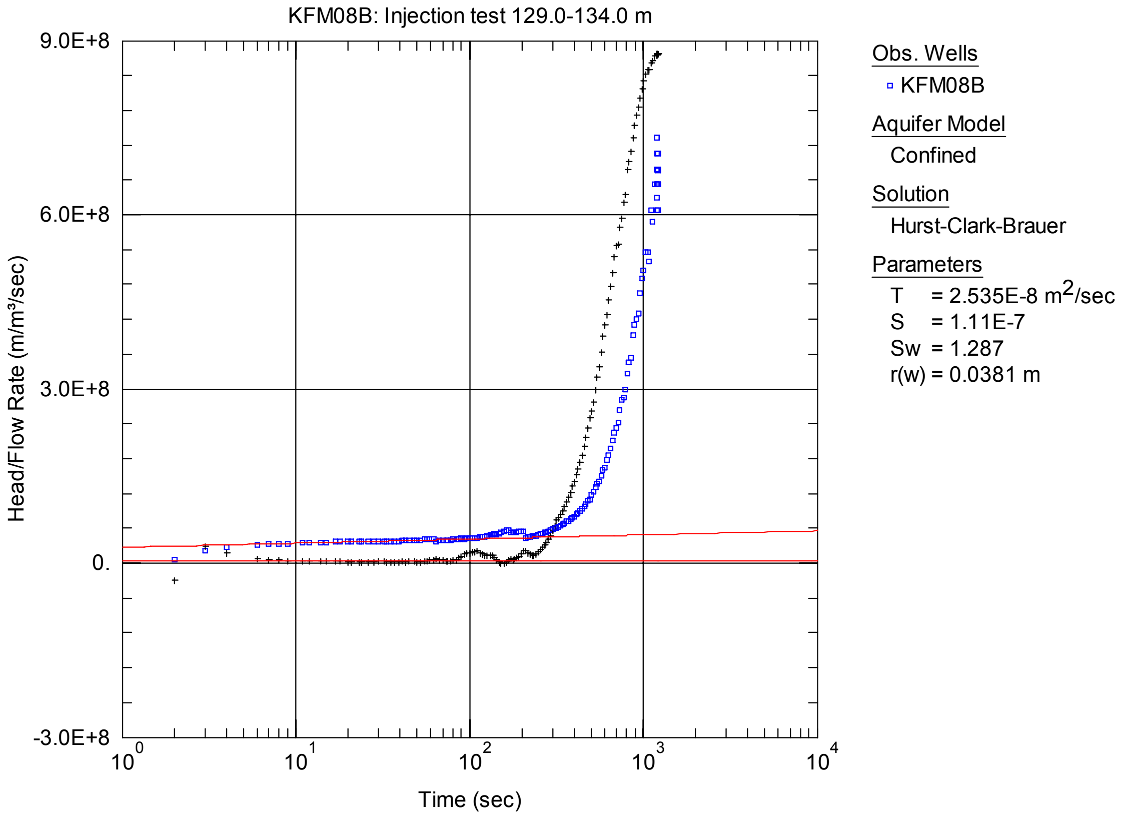


Figure A3-115. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 129.0-134.0 m in KFM08B.*

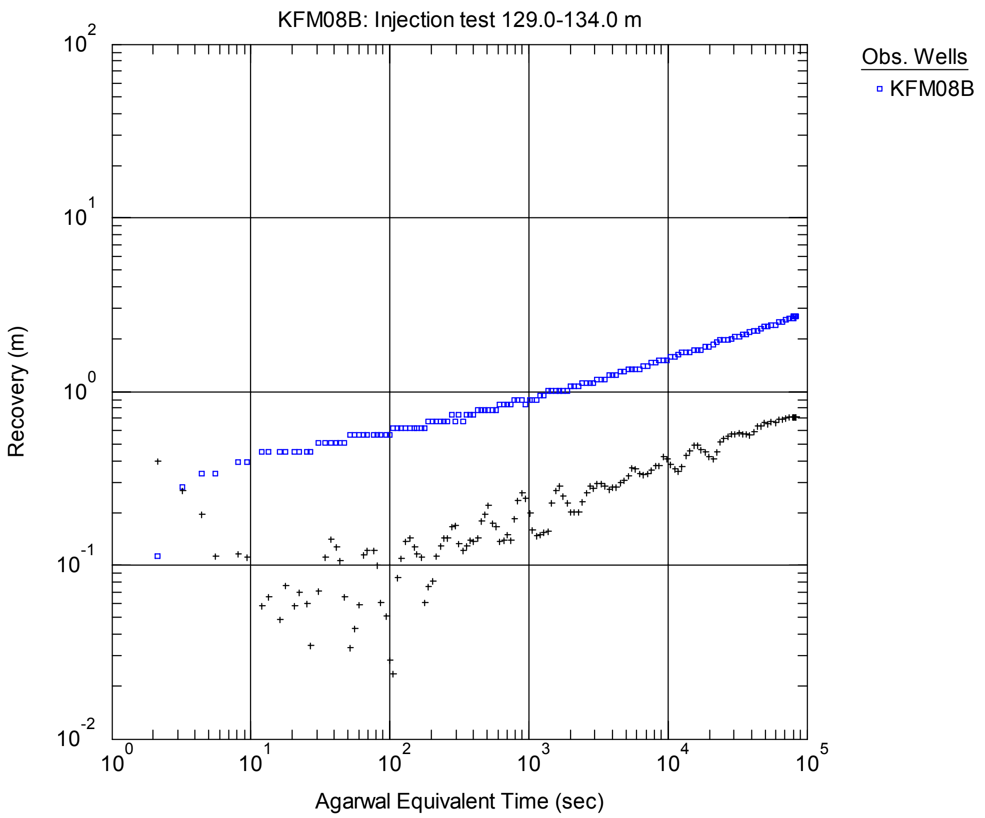


Figure A3-116. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 129.0-134.0 m in KFM08B.*

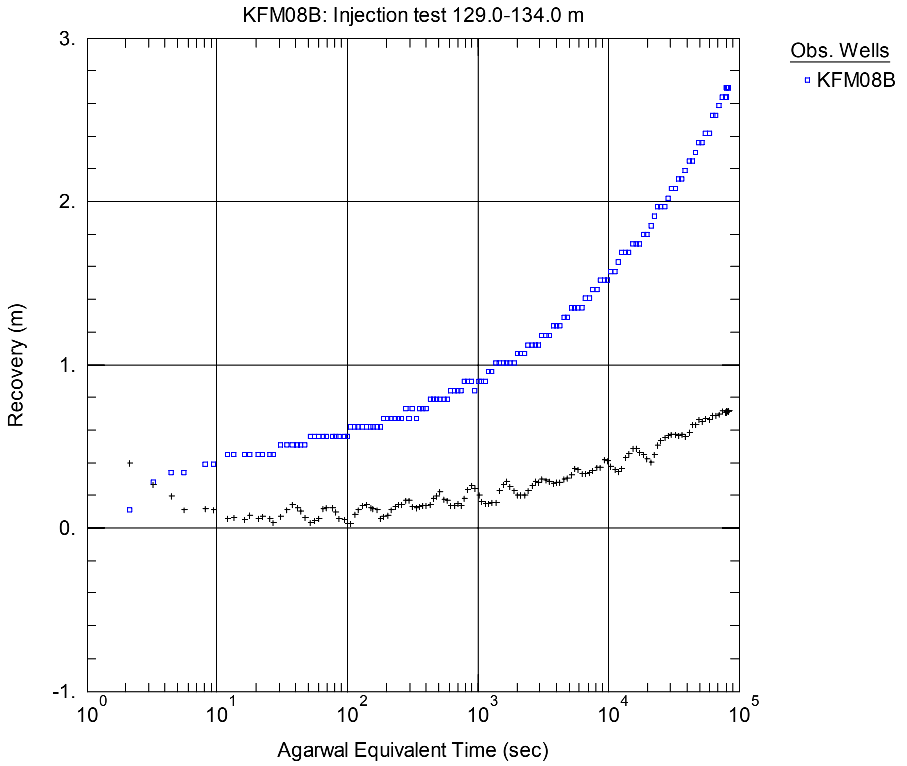


Figure A3-117. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 129.0-134.0 m in KFM08B.*

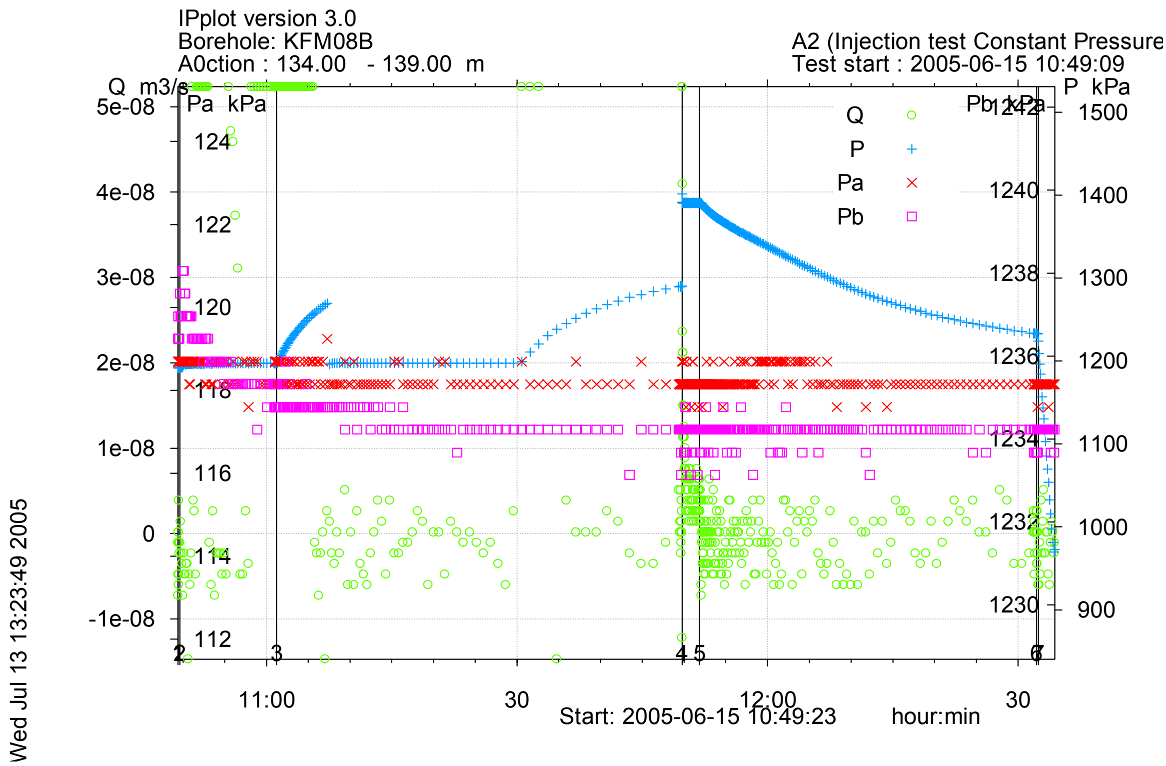


Figure A3-118. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 134.0-139.0 m in borehole KFM08B.*

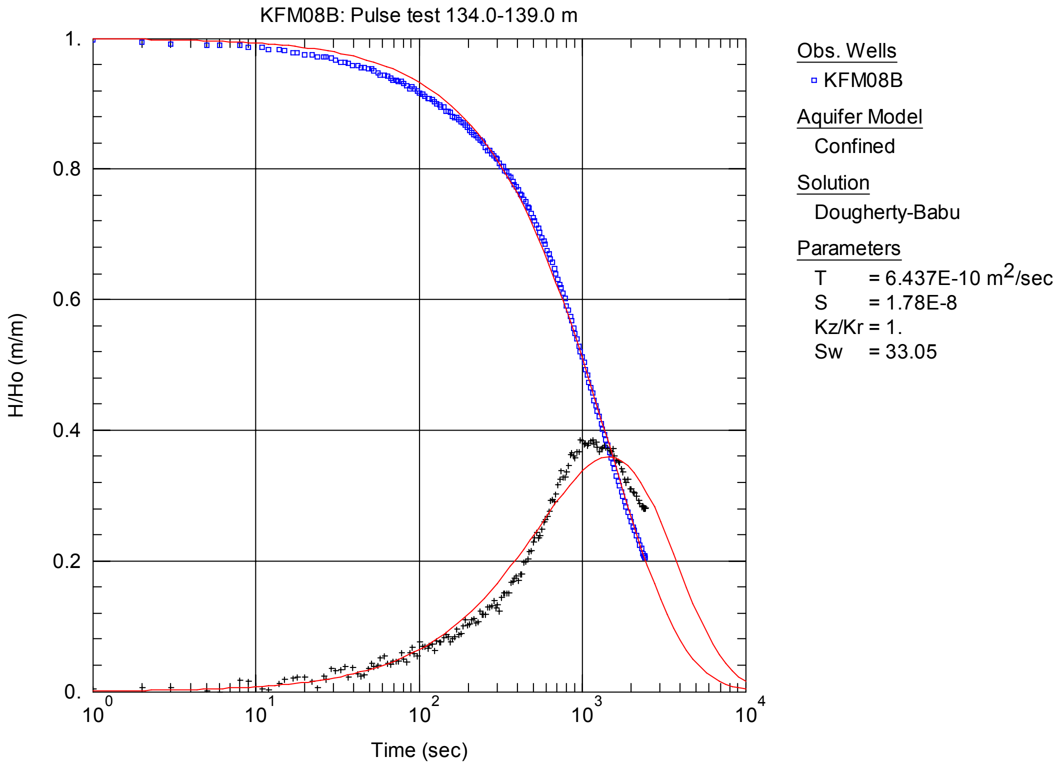


Figure A3-119. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 134.0-139.0 m in KFM08B.*

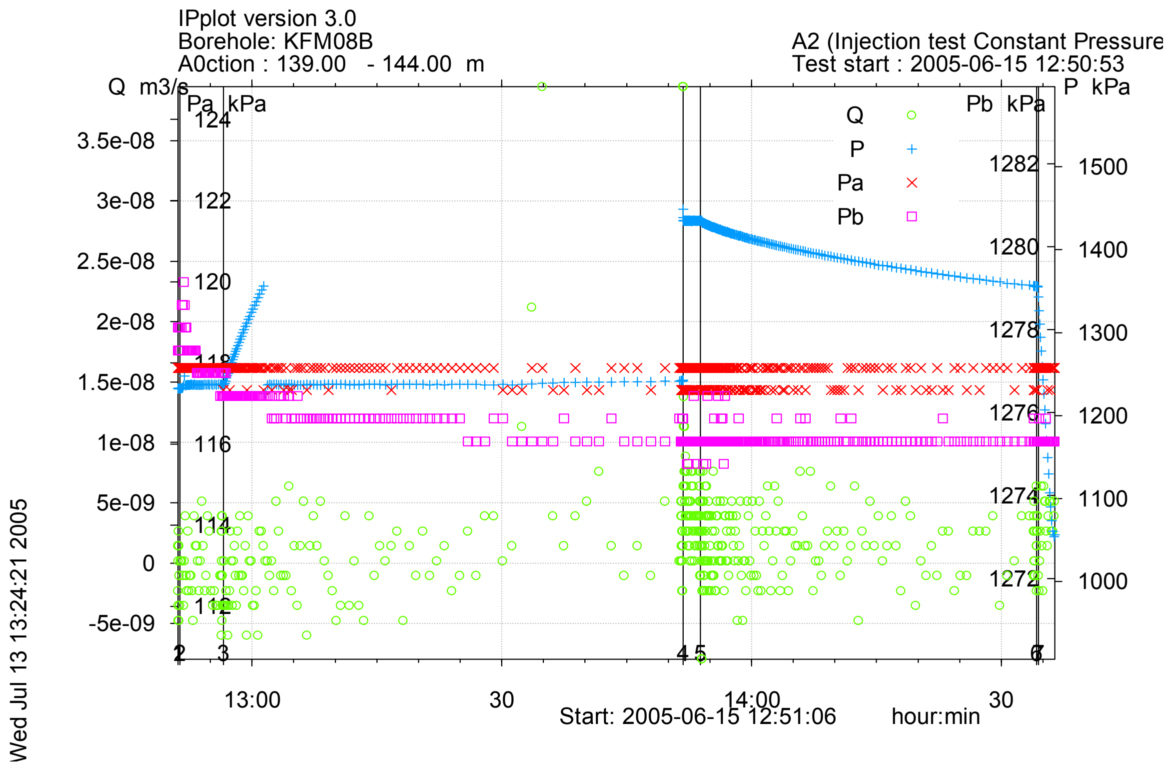


Figure A3-120. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 139.0-144.0 m in borehole KFM08B.*

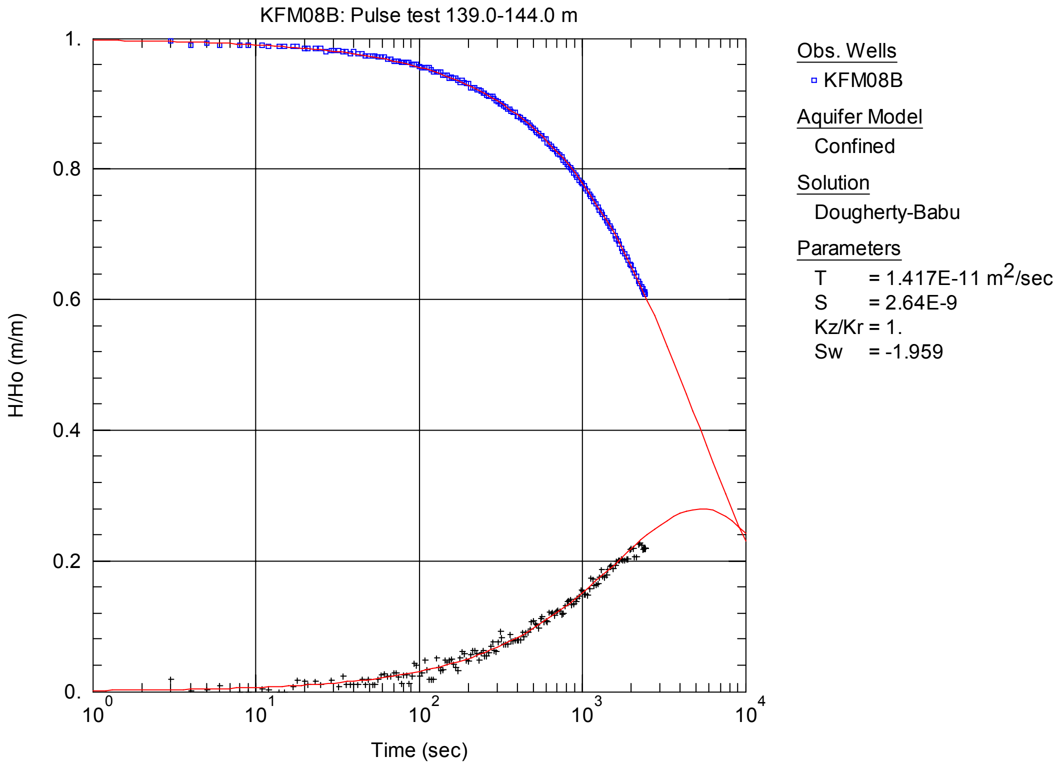


Figure A3-121. *Lin-log plot of normalized head (□) and derivative (+) versus time, from the pressure pulse test in section 139.0-144.0 m in KFM08B.*

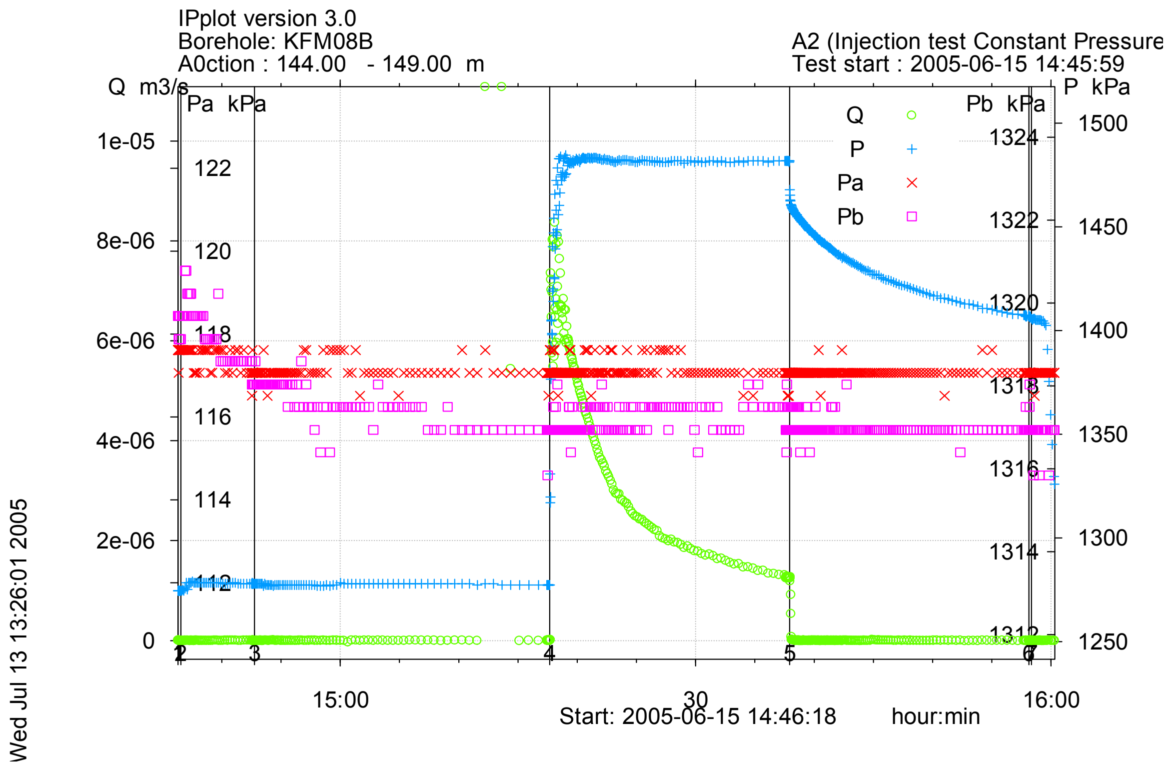


Figure A3-122. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 144.0-149.0 m in borehole KFM08B.*

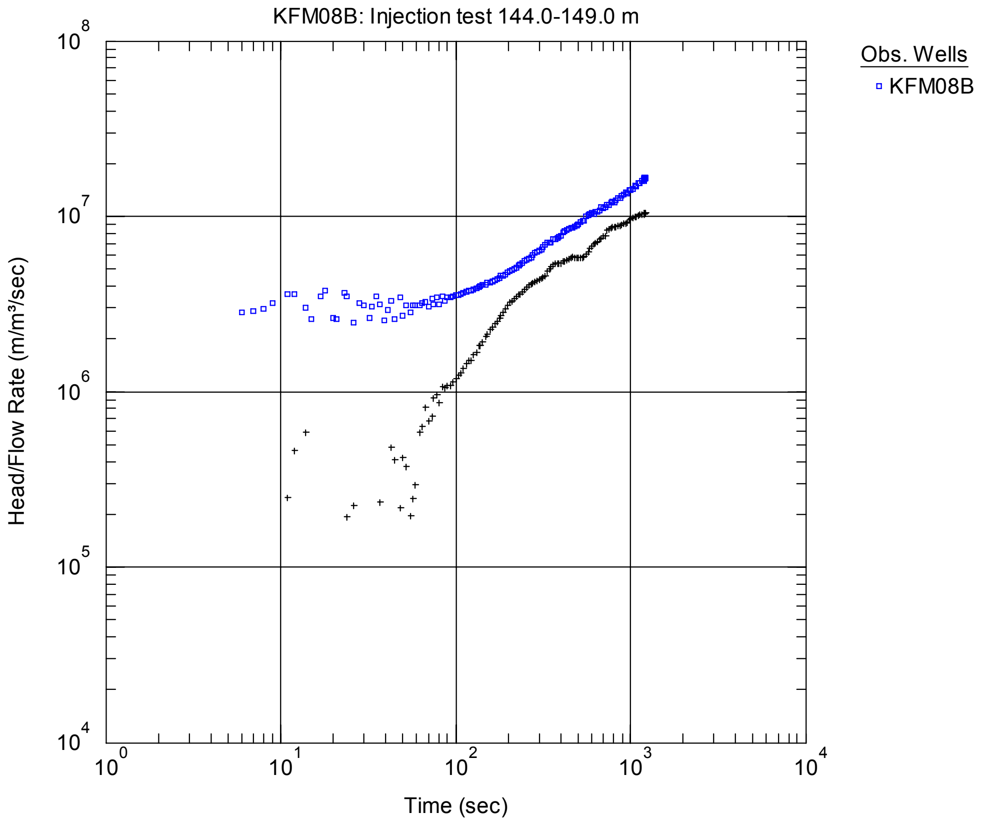


Figure A3-123. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 144.0-149.0 m in KFM08B.*

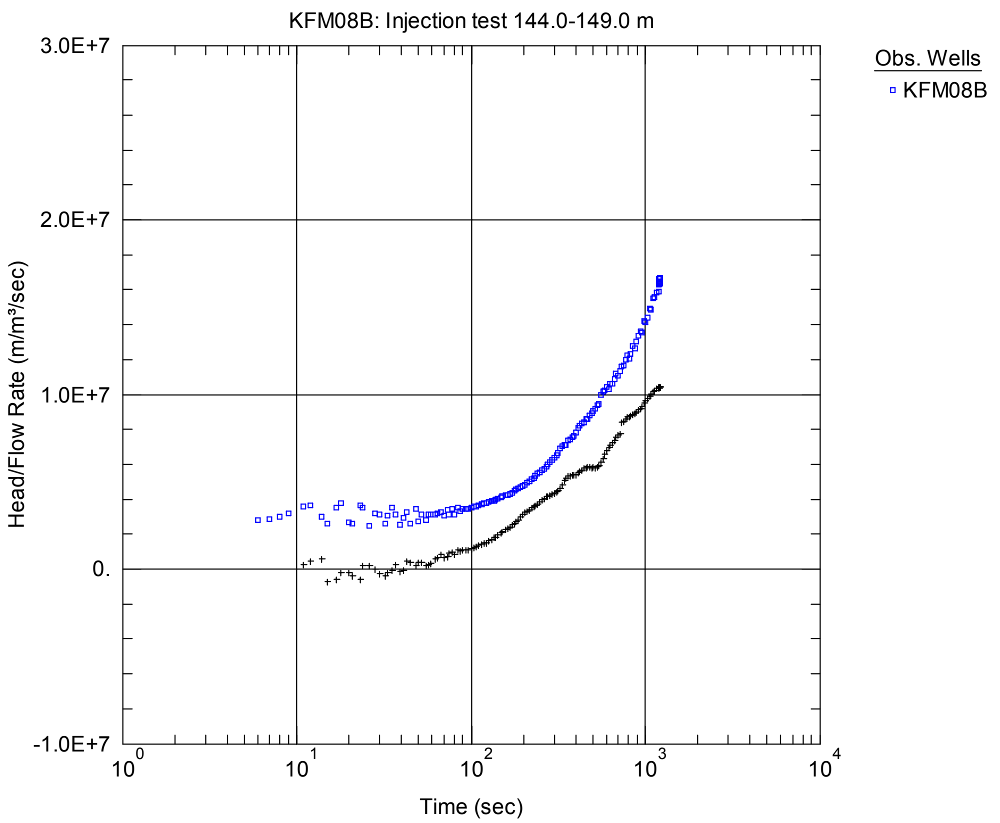


Figure A3-124. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 144.0-149.0 m in KFM08B.*

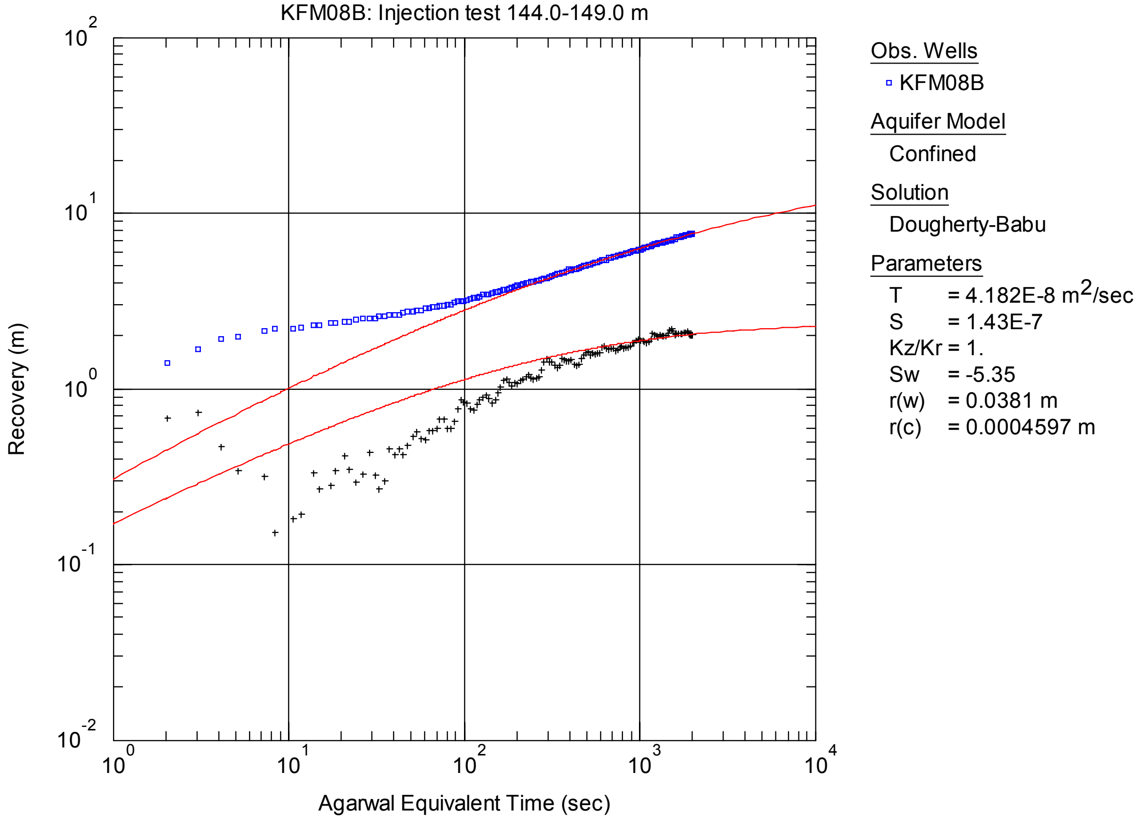


Figure A3-125. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 144.0-149.0 m in KFM08B.*

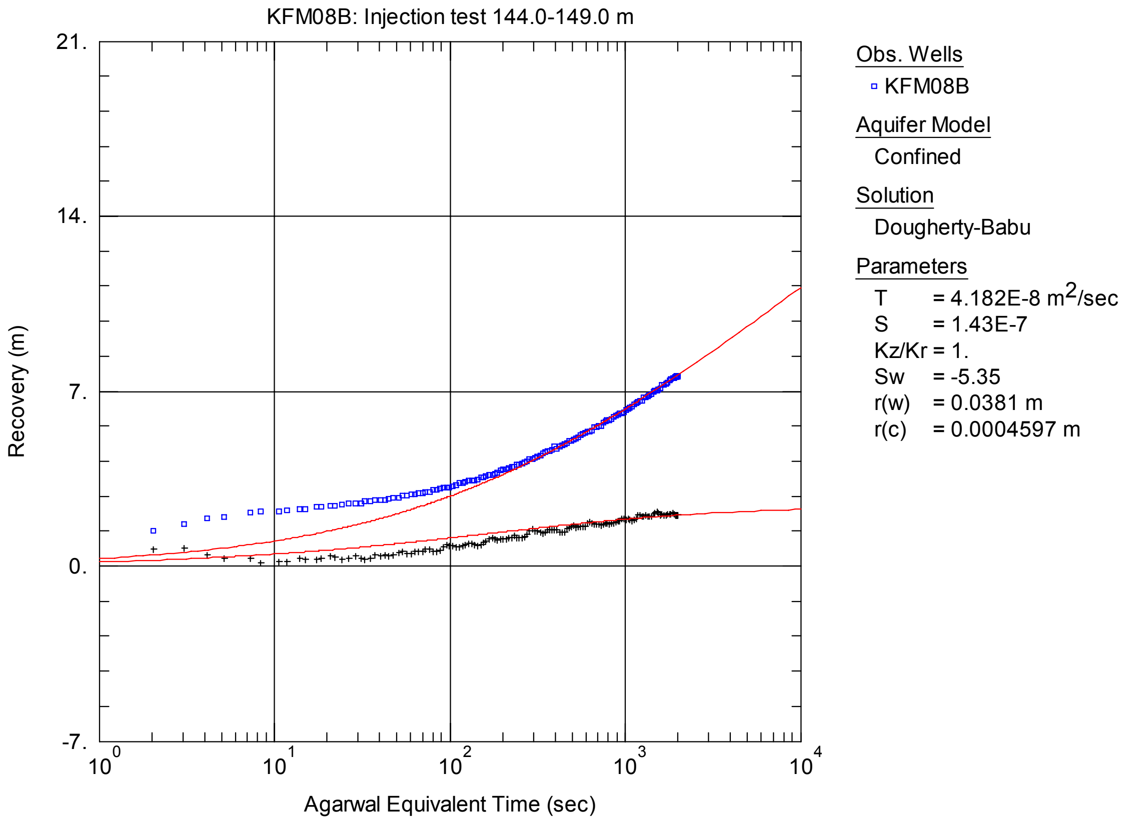


Figure A3-126. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 144.0-149.0 m in KFM08B.*

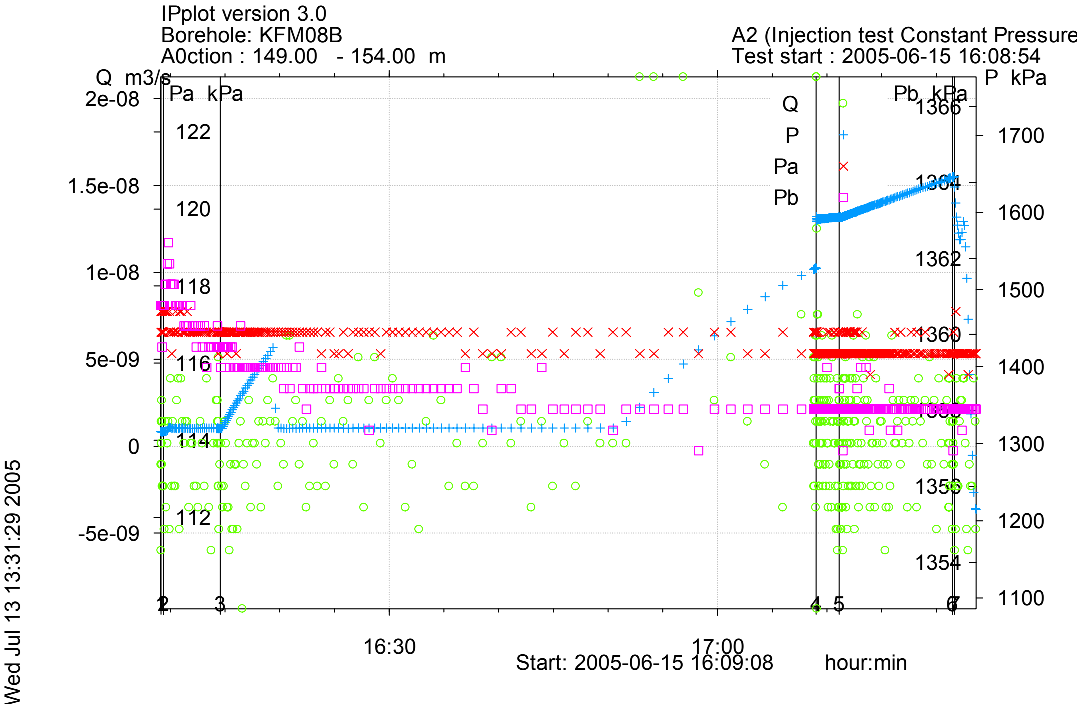


Figure A3-127. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the pressure pulse test in section 149.0-154.0 m in borehole KFM08B.*

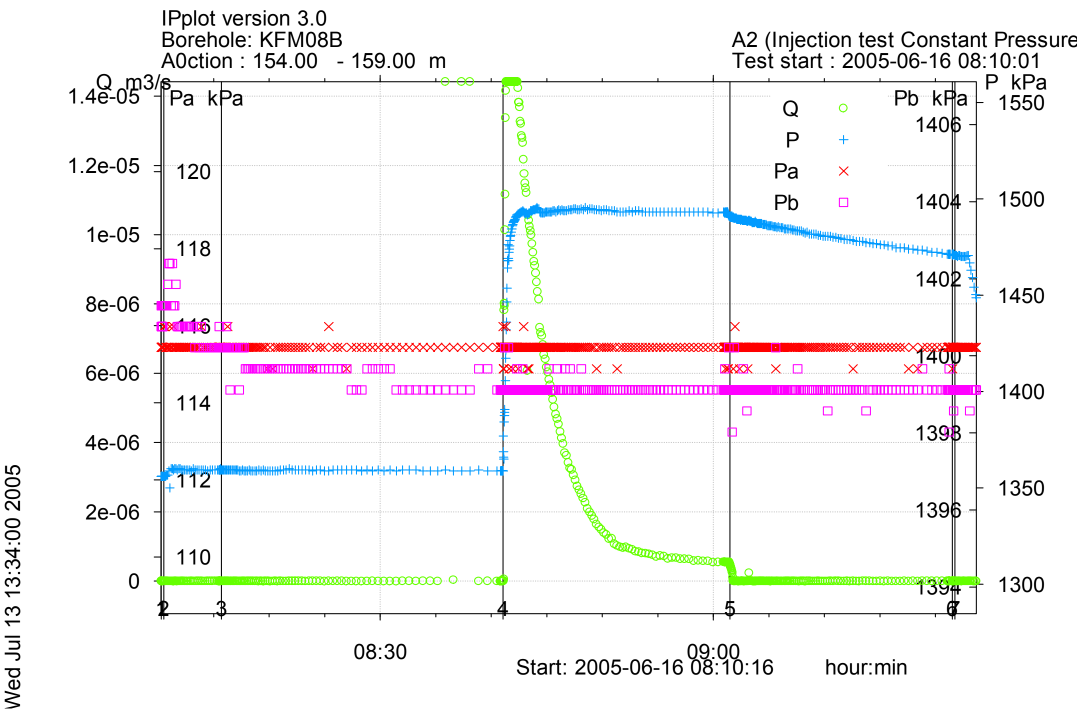


Figure A3-128. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 154.0-159.0 m in borehole KFM08B.*

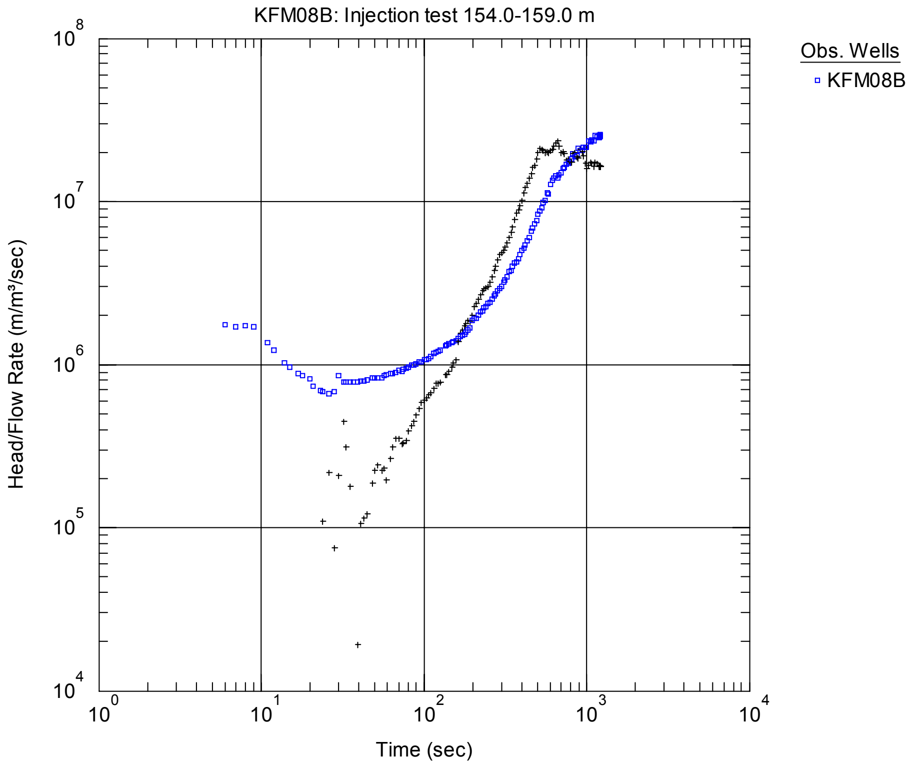


Figure A3-129. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 154.0-159.0 m in KFM08B.*

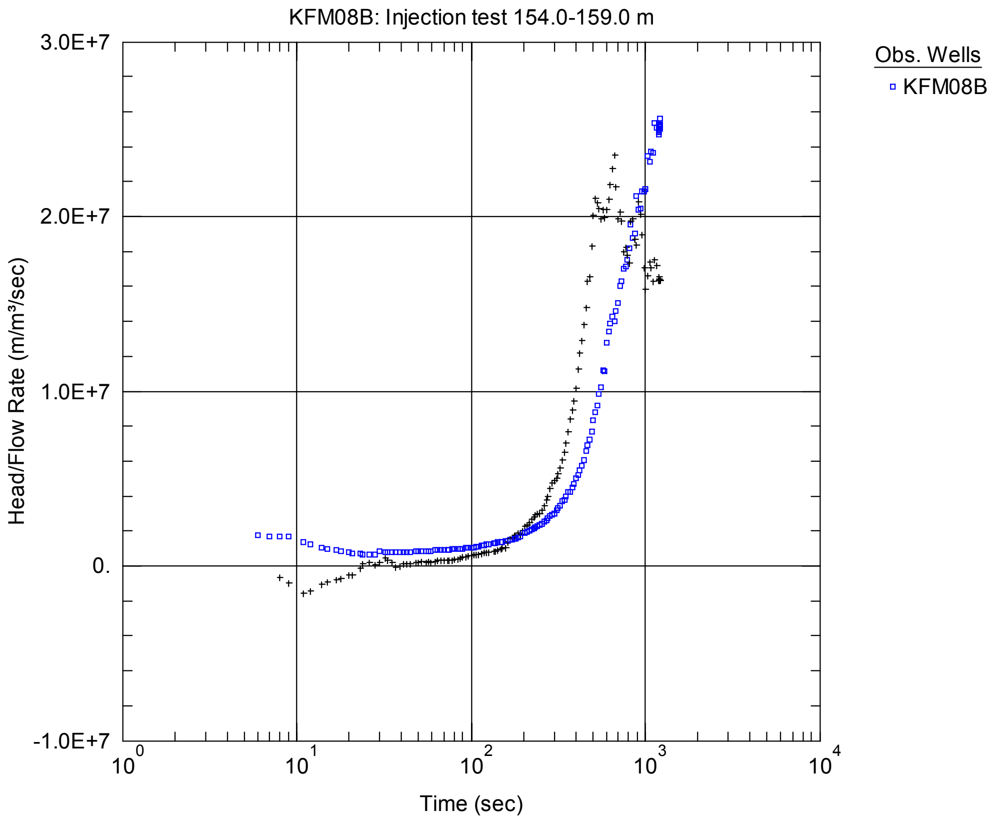


Figure A3-130. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 154.0-159.0 m in KFM08B.*

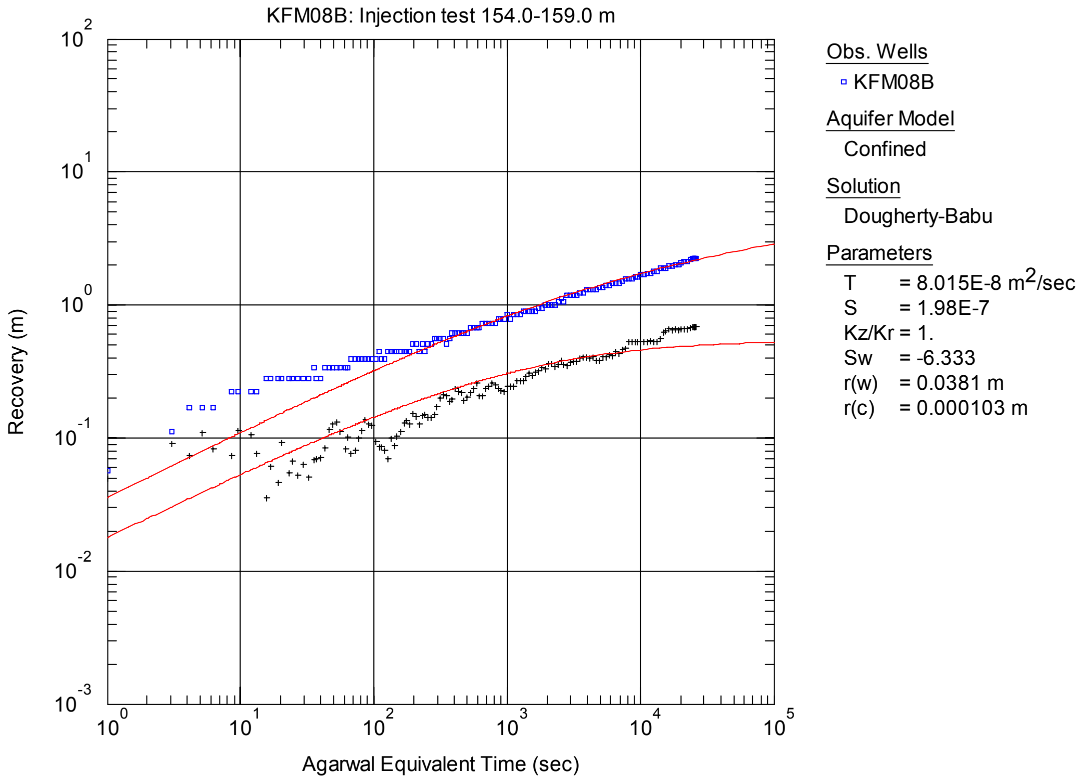


Figure A3-131. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 154.0-159.0 m in KFM08B.*

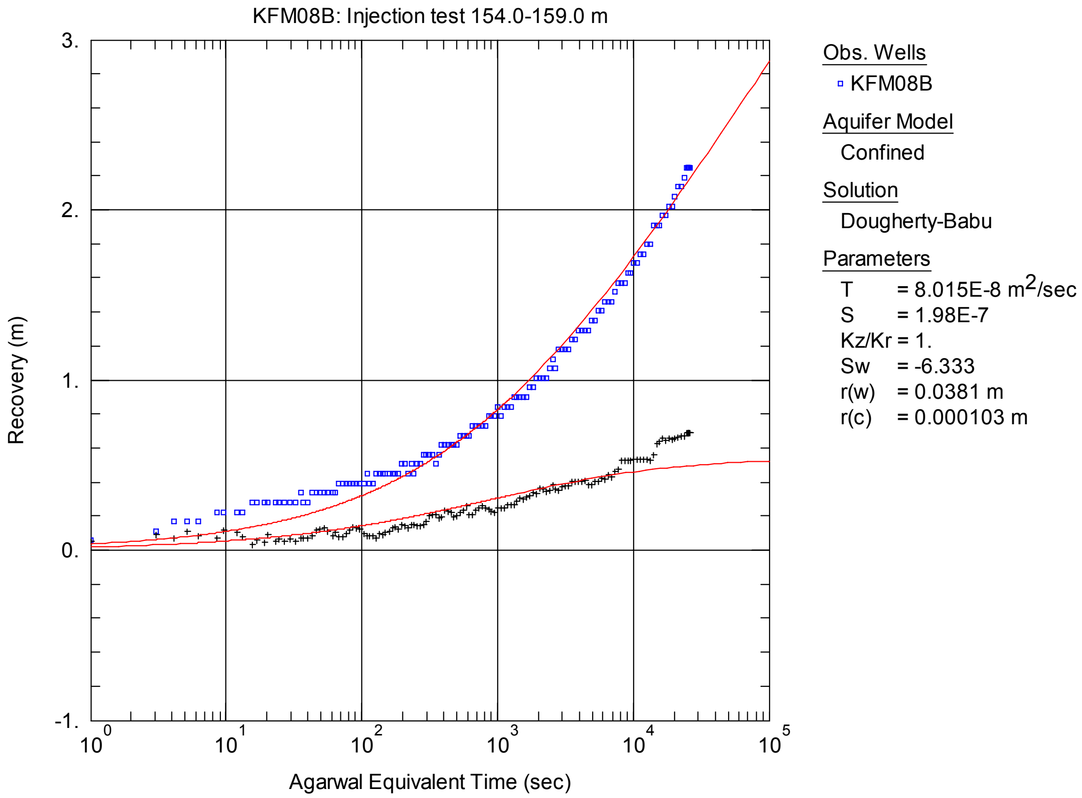


Figure A3-132. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Dougherty-Babu solution, from the injection test in section 154.0-159.0 m in KFM08B.*

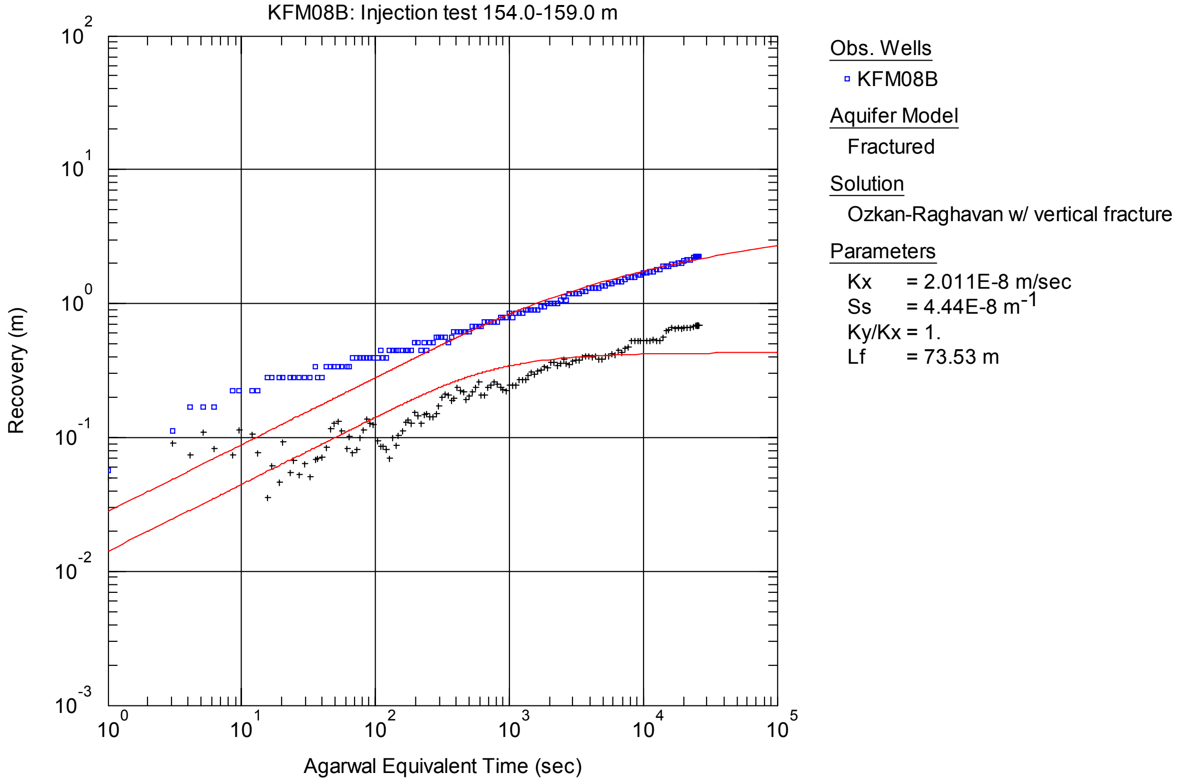


Figure A3-133. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 154.0-159.0 m in KFM08B.*

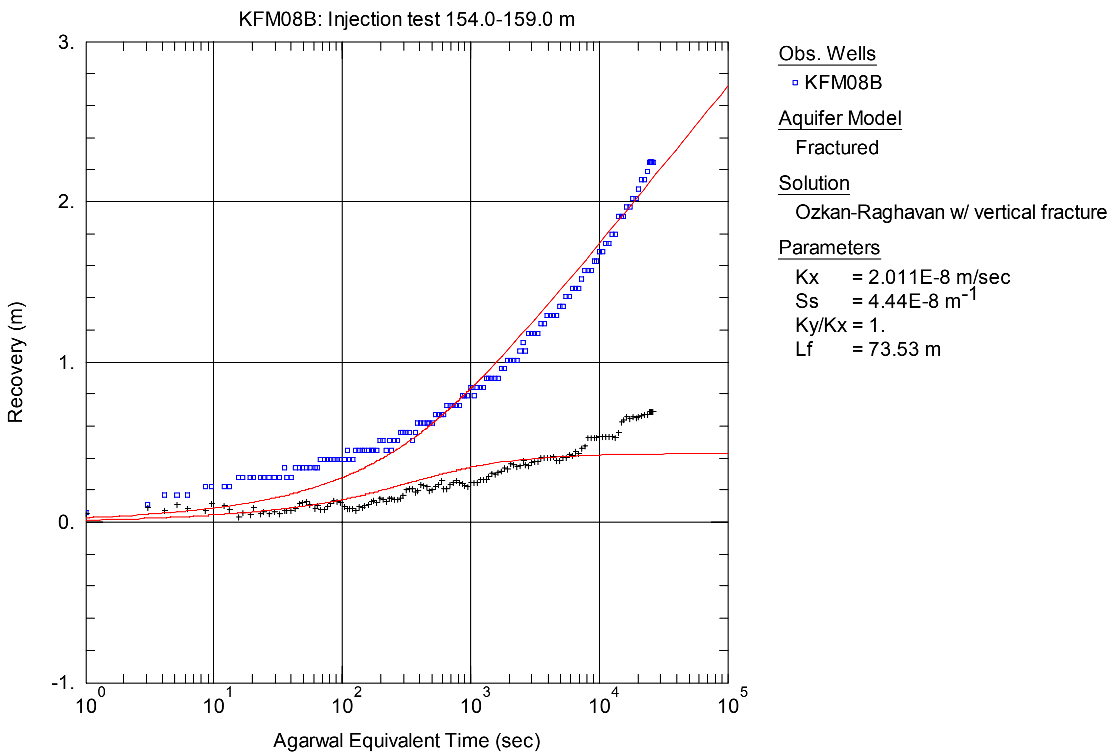


Figure A3-134. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, showing fit to the Ozkan-Raghavan solution, from the injection test in section 154.0-159.0 m in KFM08B.*

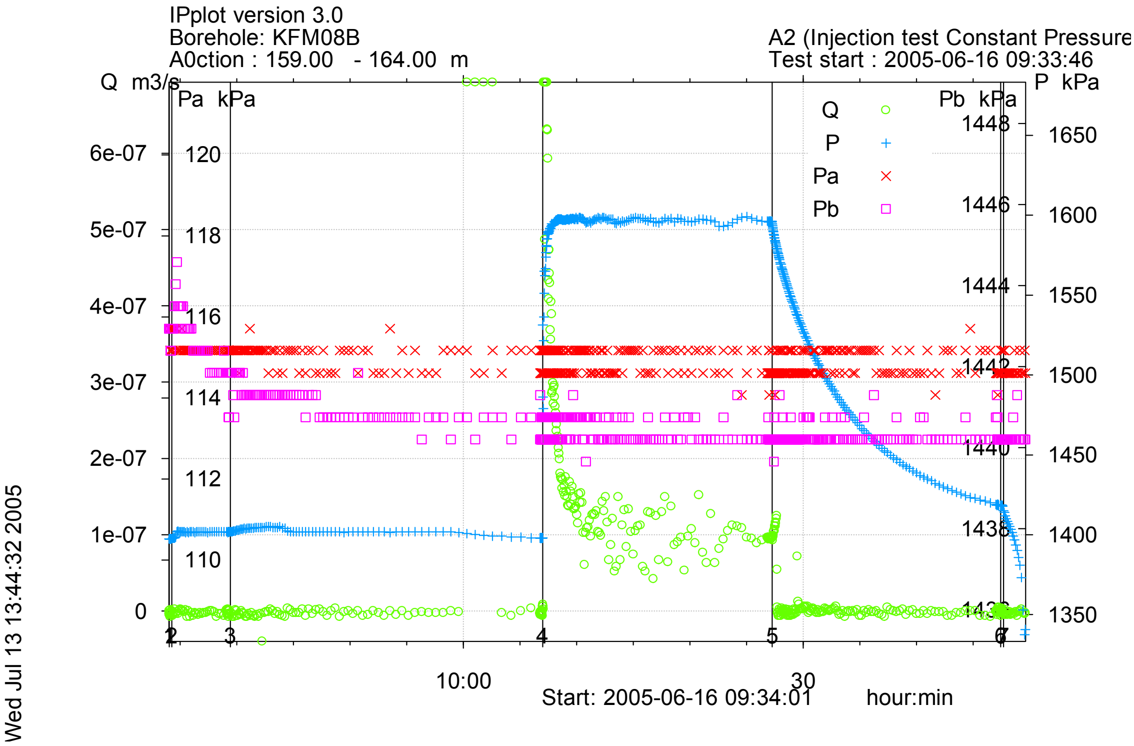


***Figure A3-135.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 159.0-164.0 m in borehole KFM08B.*

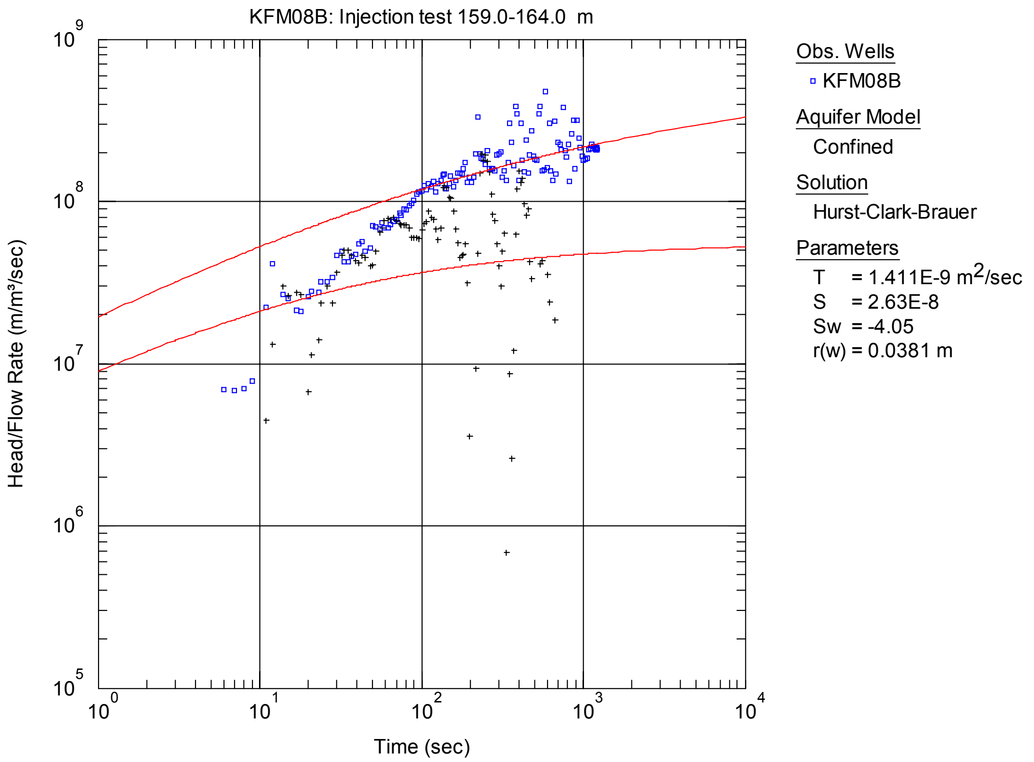


***Figure A3-136.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 159.0-164.0 m in KFM08B.*

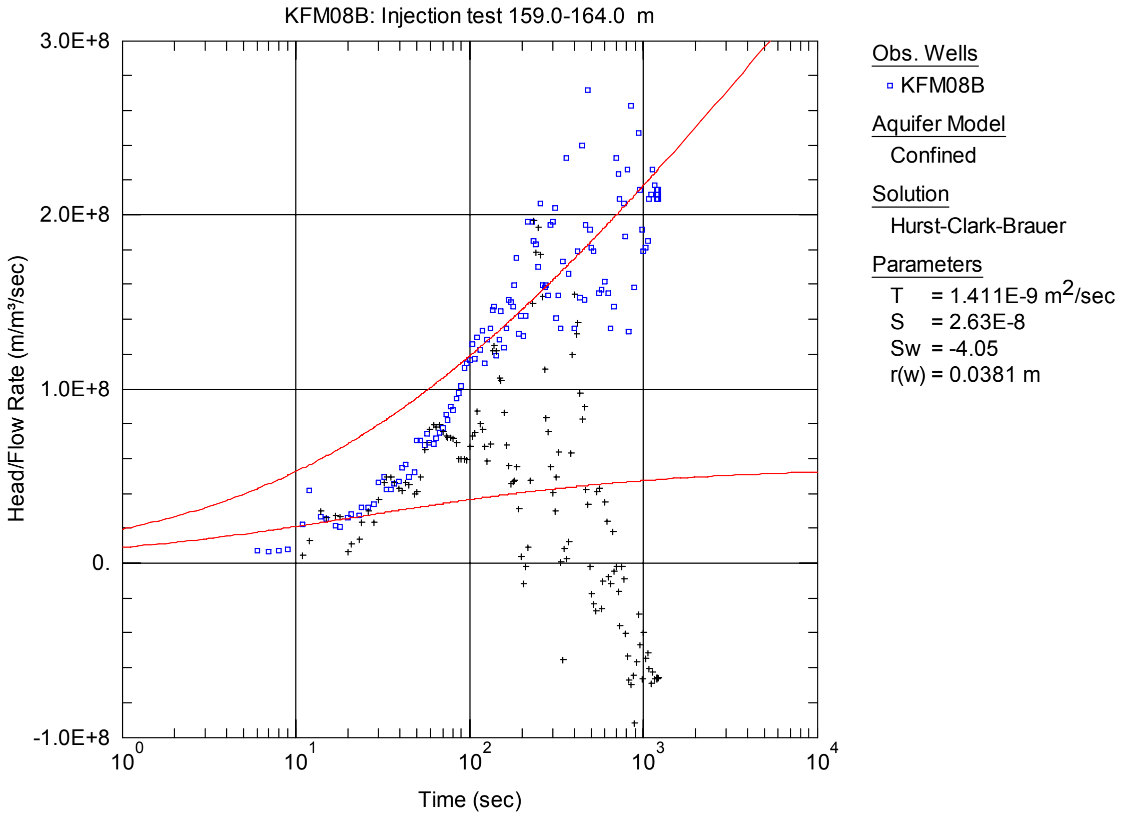


Figure A3-137. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 159.0-164.0 m in KFM08B.*

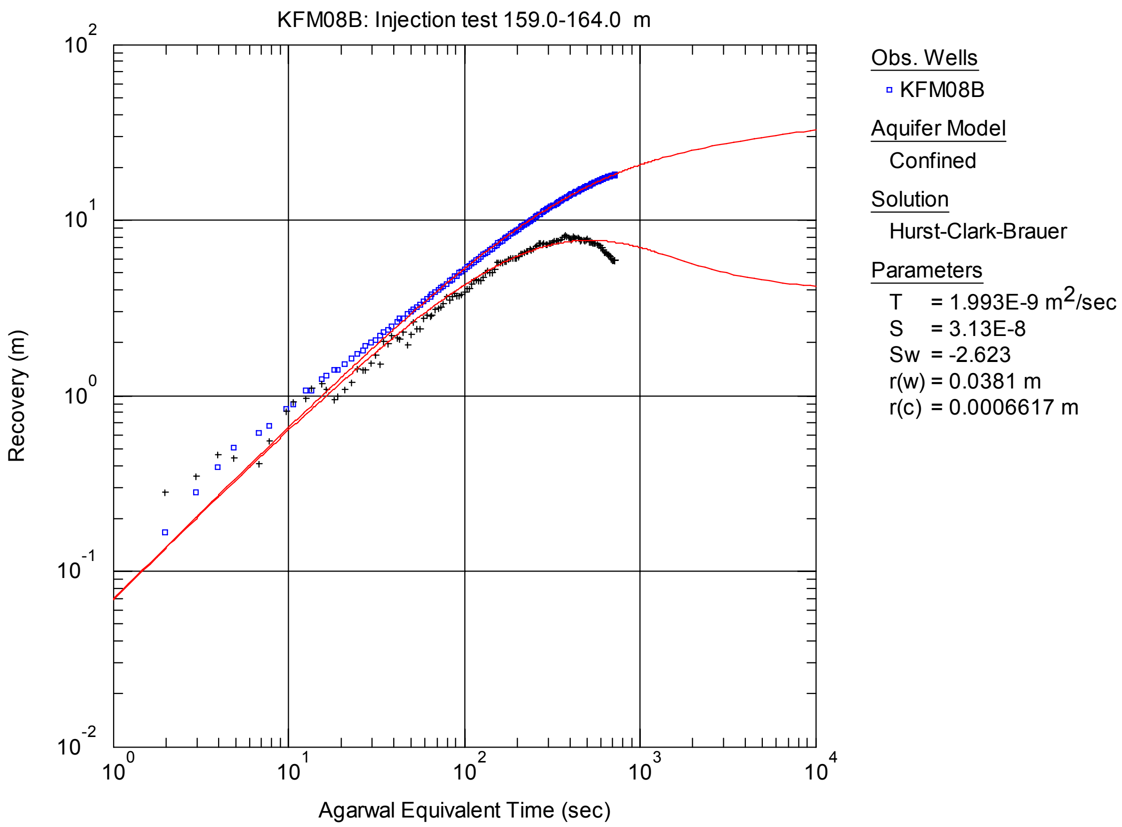


Figure A3-138. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 159.0-164.0 m in KFM08B.*

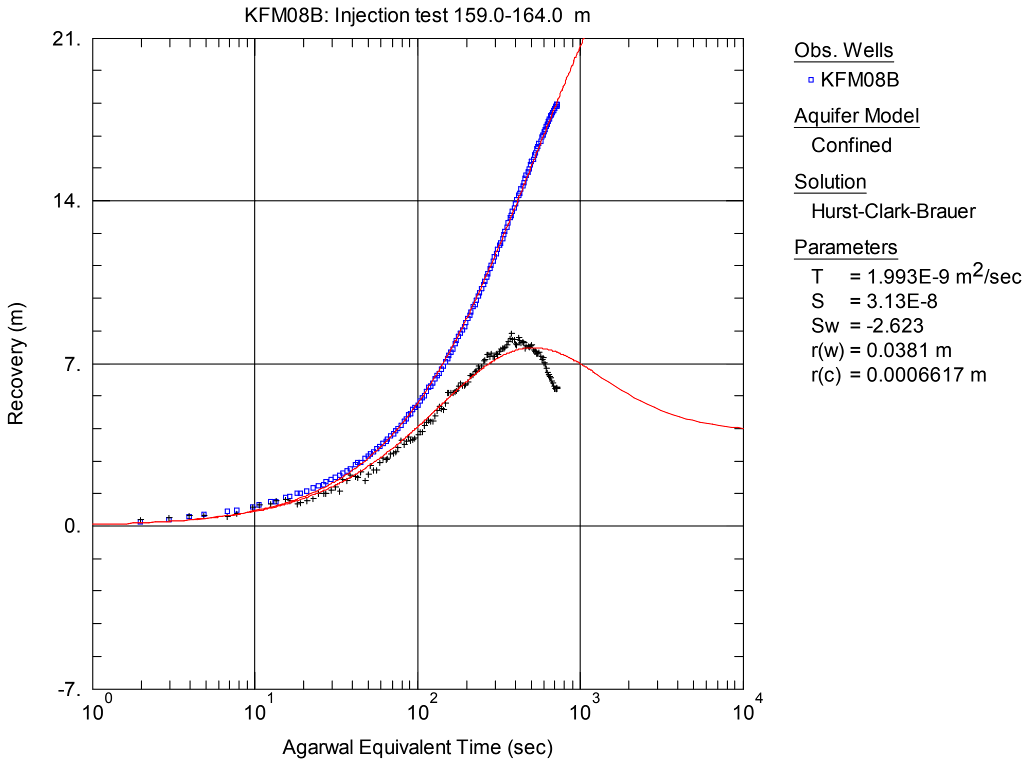


Figure A3-139. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 159.0-164.0 m in KFM08B.*

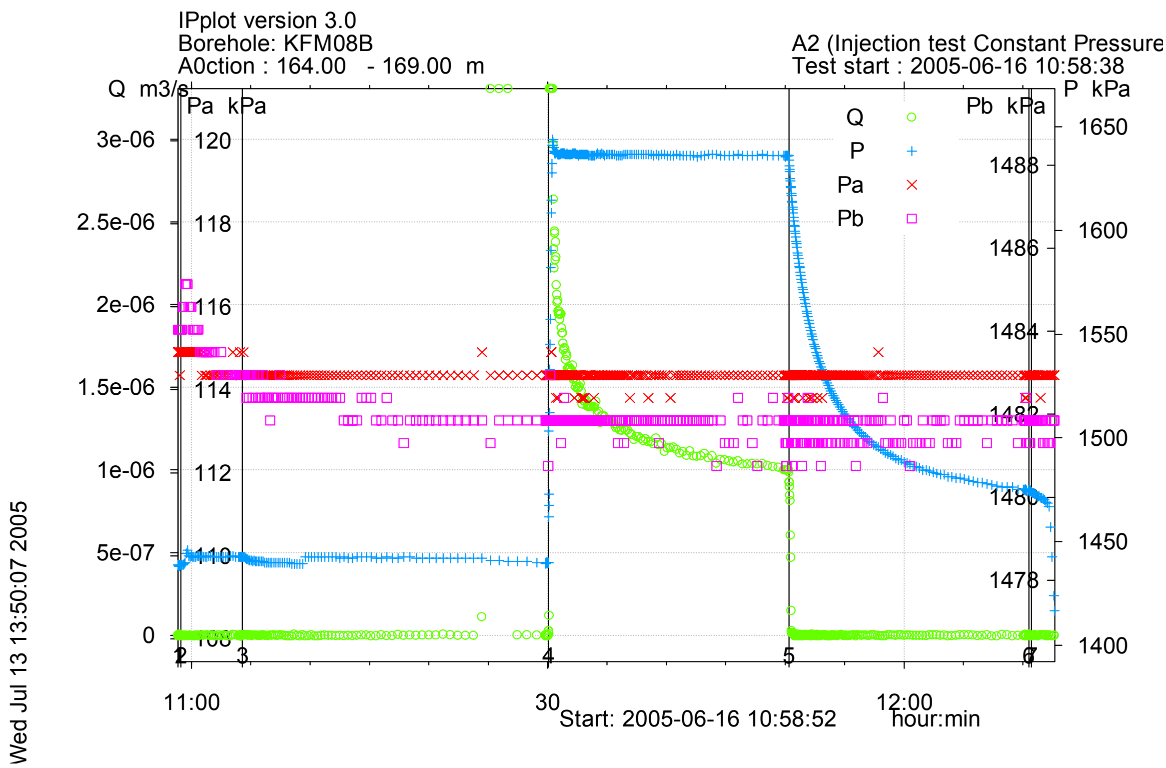


Figure A3-140. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 164.0-169.0 m in borehole KFM08B.*

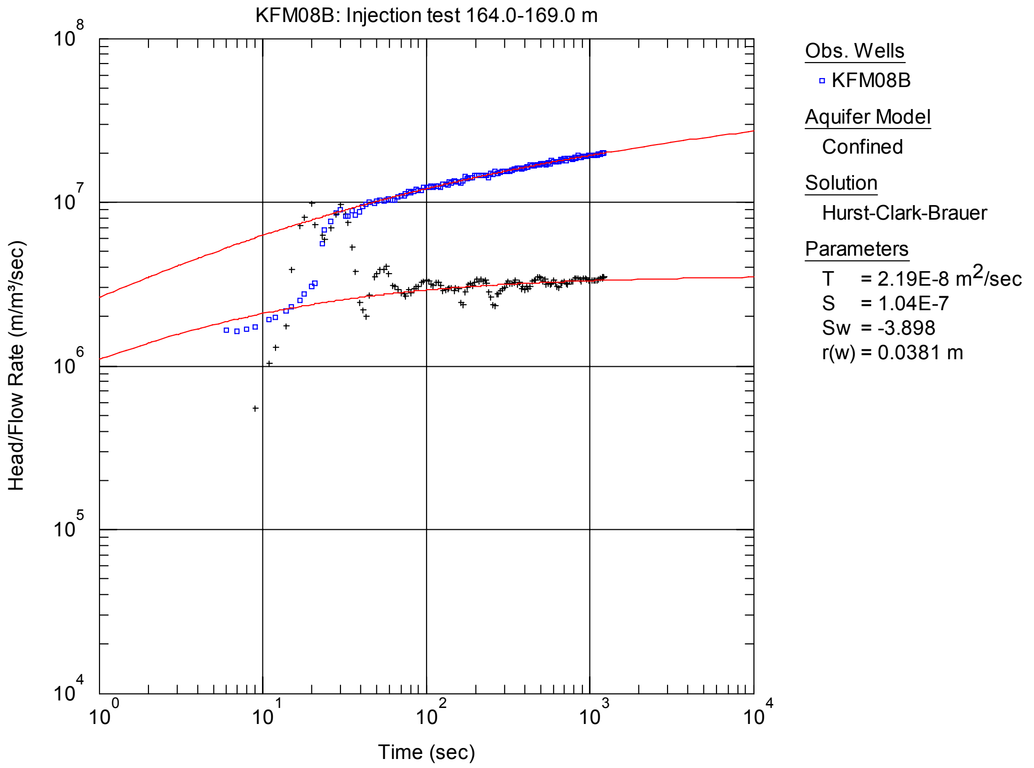


Figure A3-141. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 164.0-169.0 m in KFM08B.*

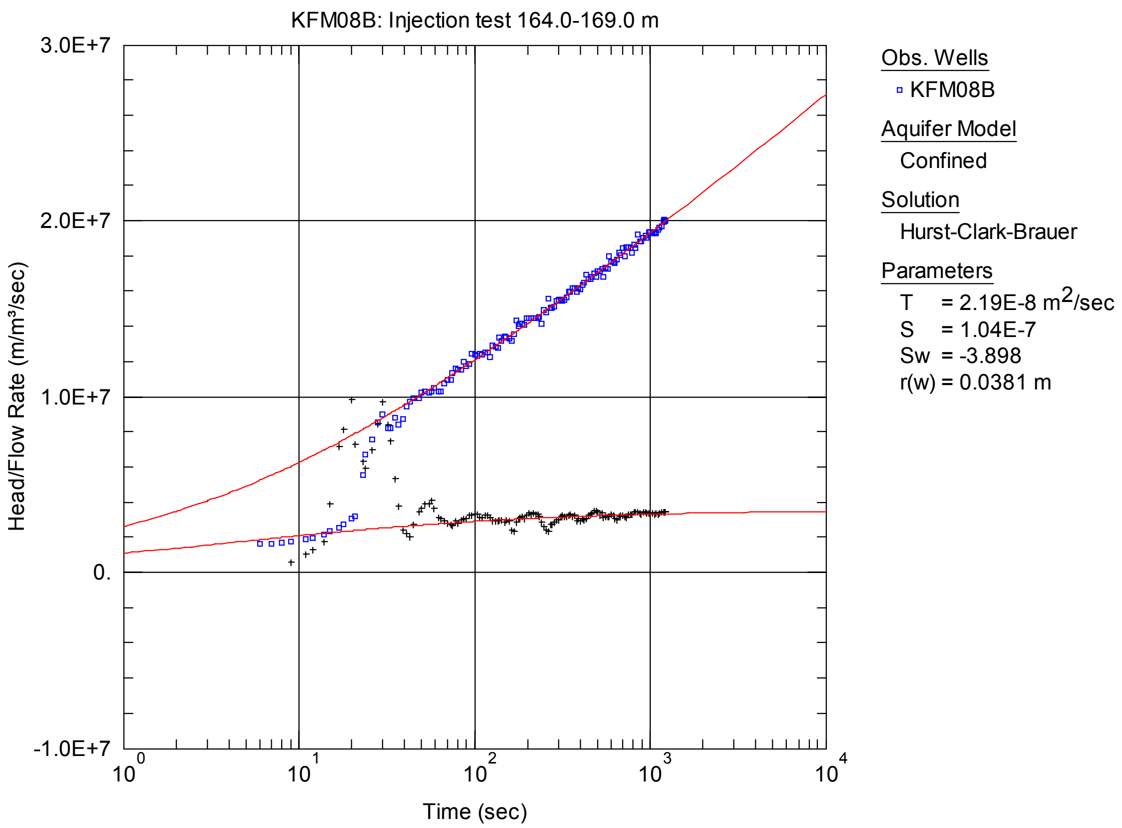


Figure A3-142. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 164.0-169.0 m in KFM08B.*

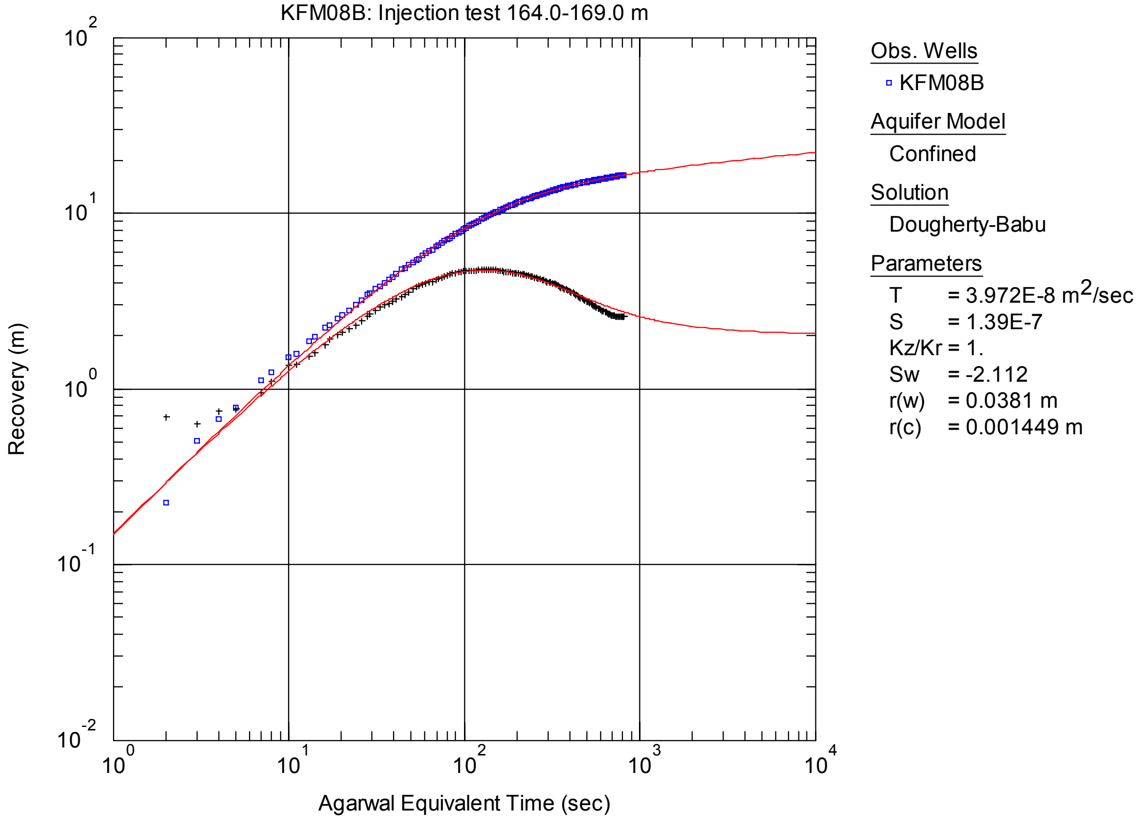


Figure A3-143. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 164.0-169.0 m in KFM08B.*

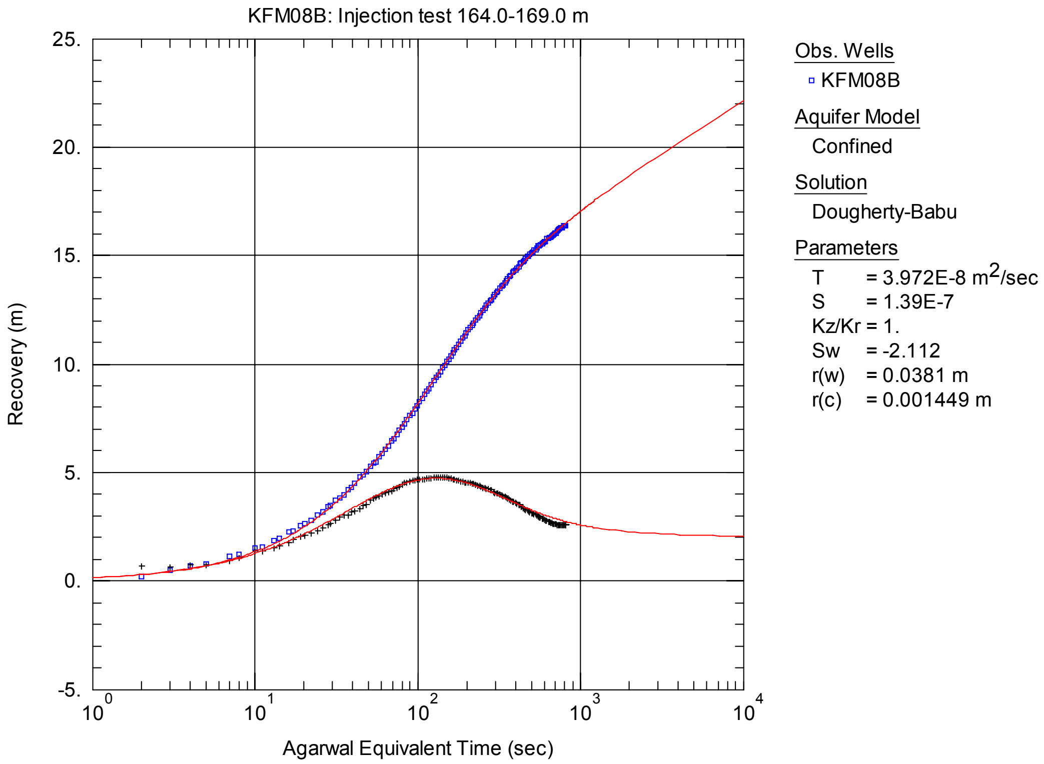


Figure A3-144. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 164.0-169.0 m in KFM08B.*

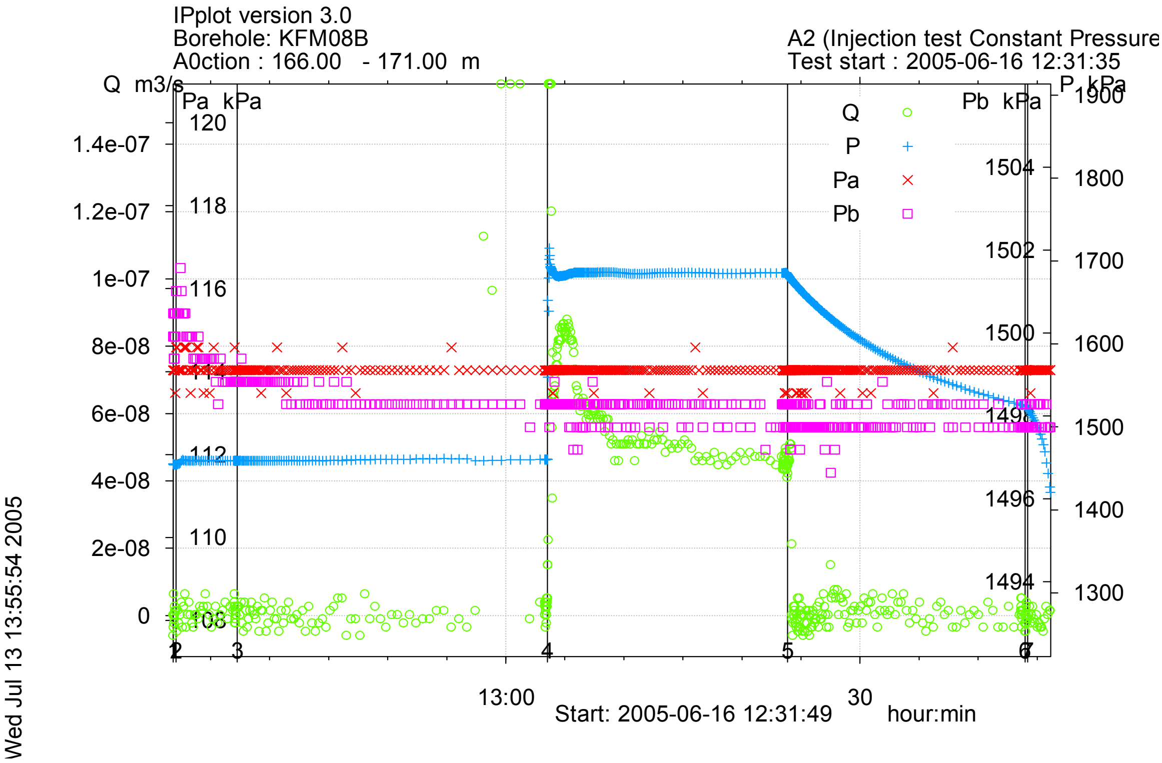


Figure A3-145. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 166.0-171.0 m in borehole KFM08B.*

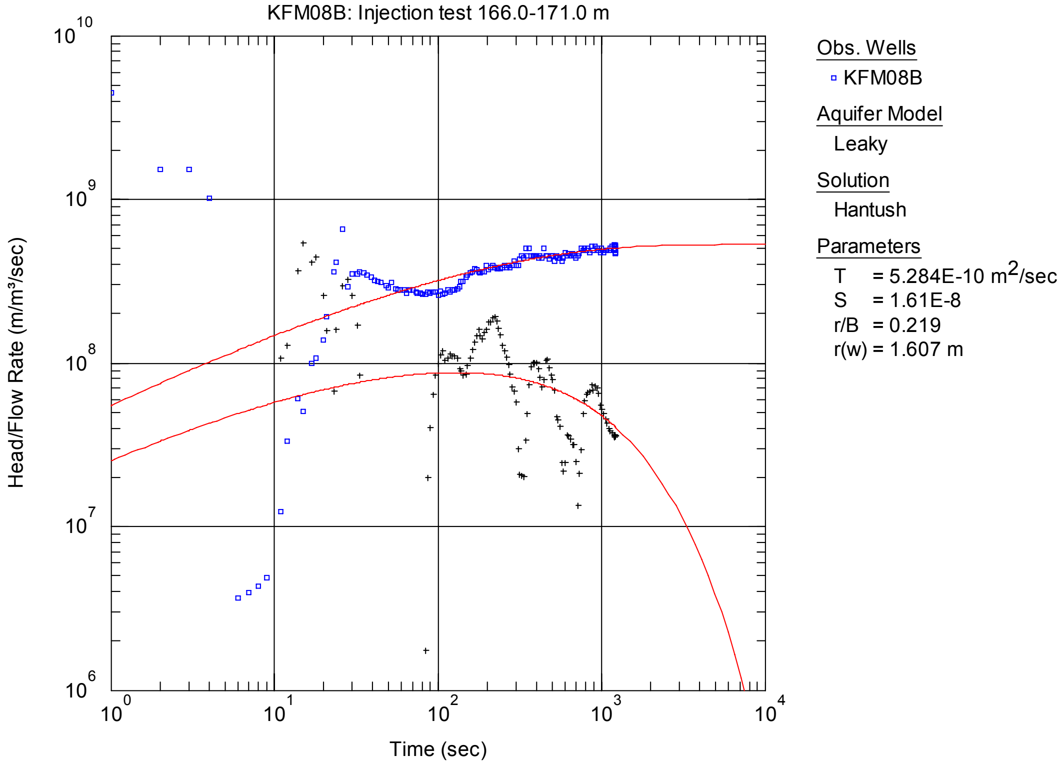


Figure A3-146. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 166.0-171.0 m in KFM08B.*

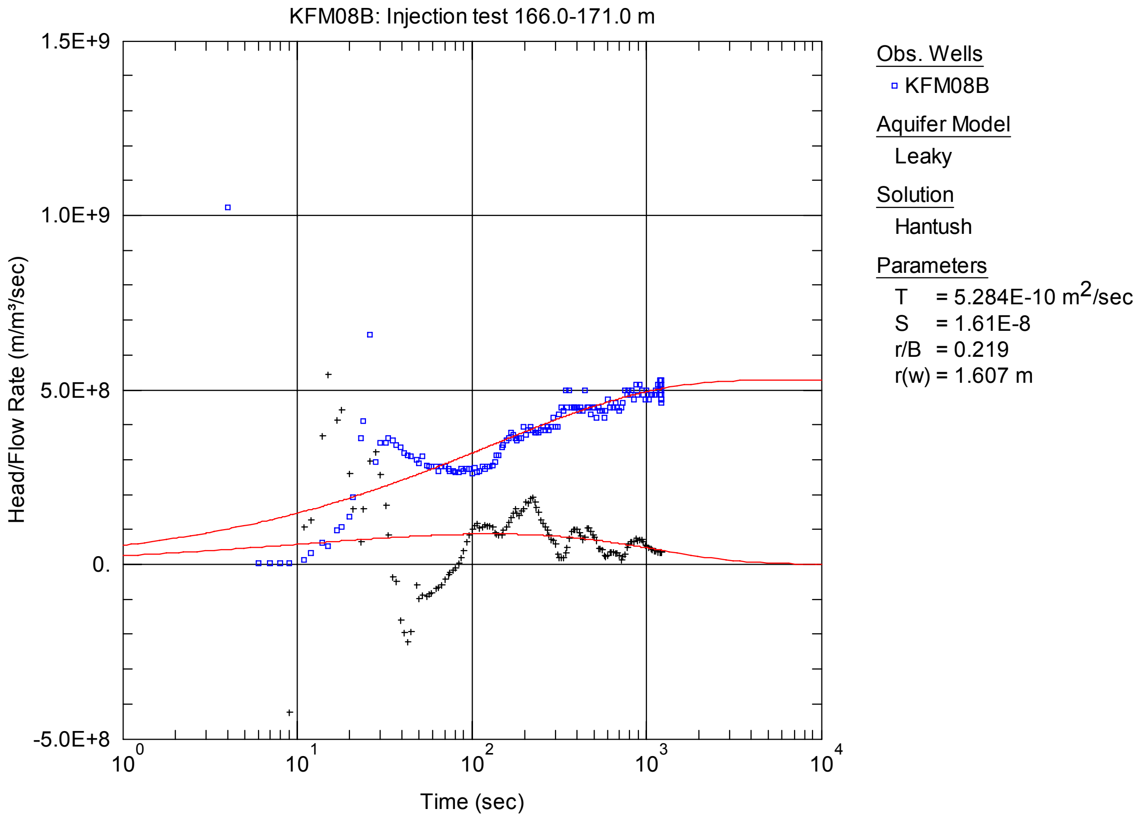


Figure A3-147. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 166.0-171.0 m in KFM08B.*

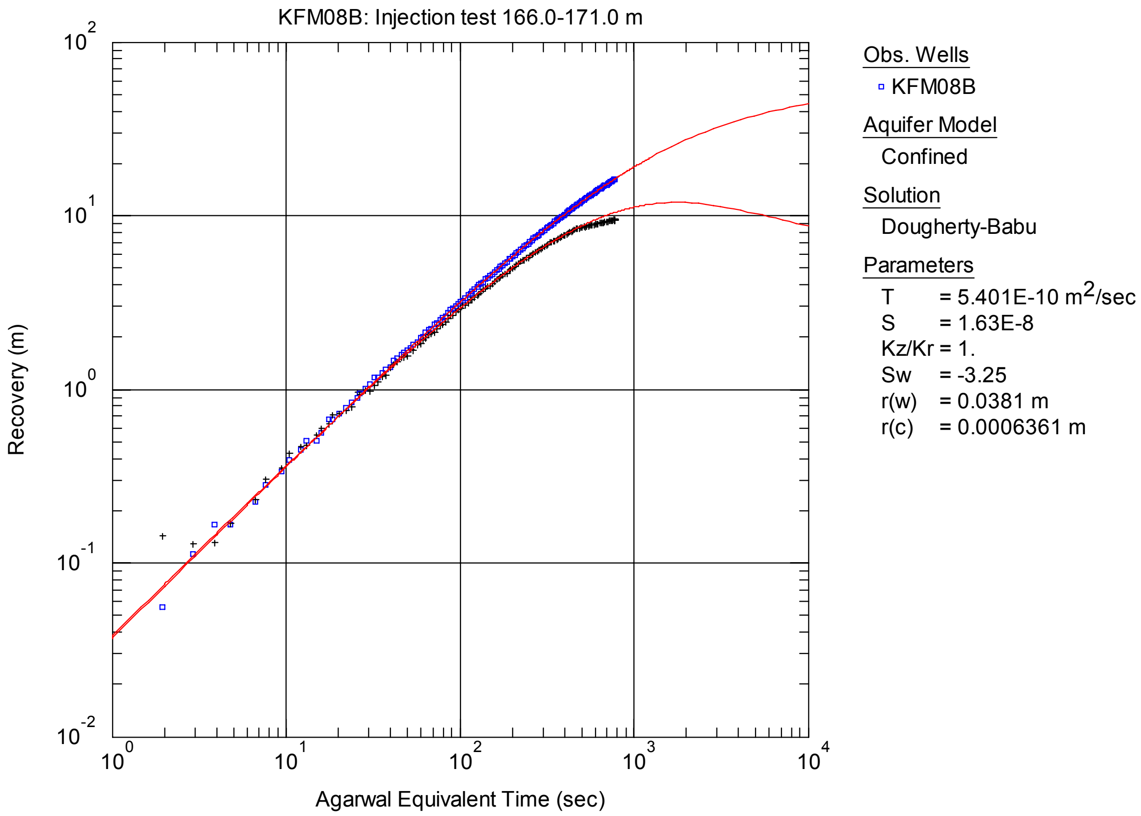


Figure A3-148. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 166.0-171.0 m in KFM08B.*

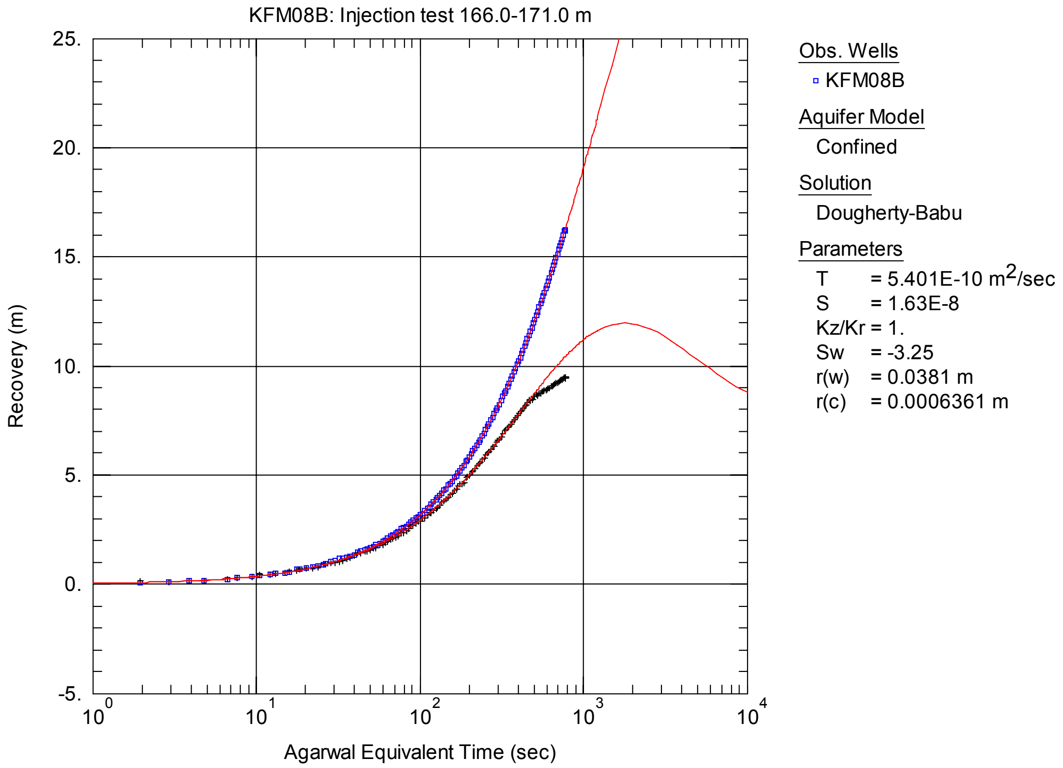


Figure A3-149. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 166.0-171.0 m in KFM08B.*

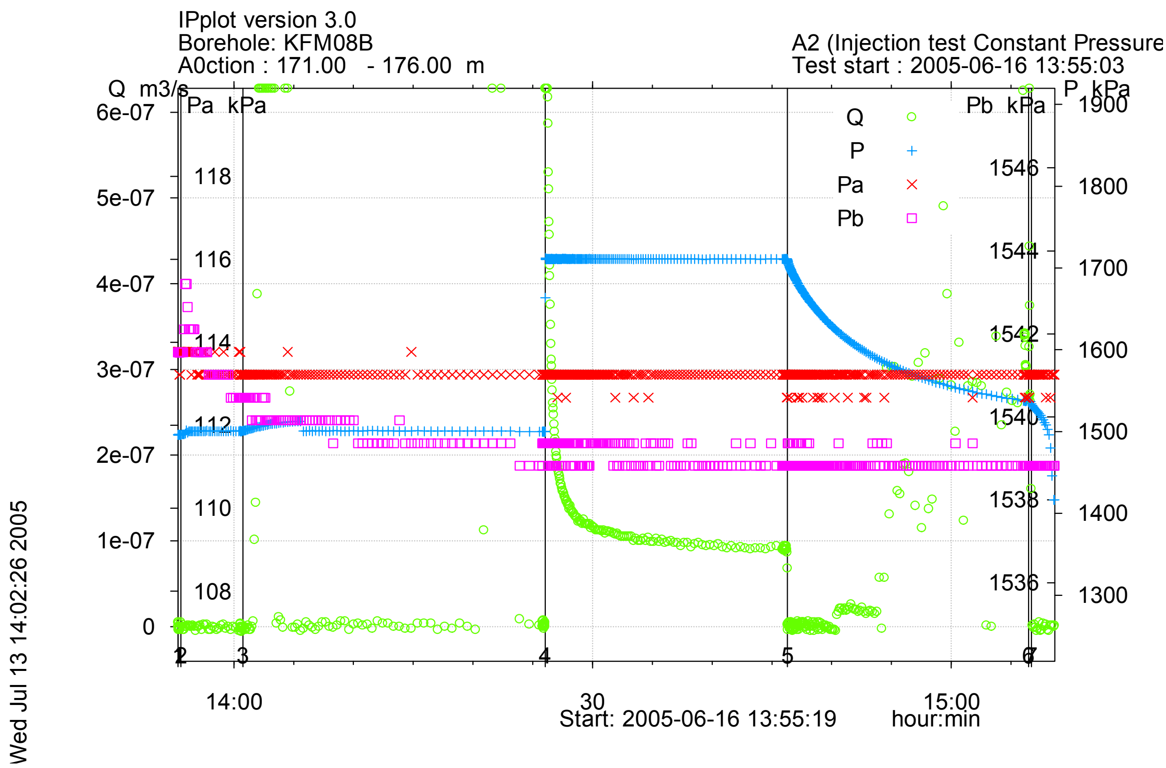


Figure A3-150. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 171.0-176.0 m in borehole KFM08B.*

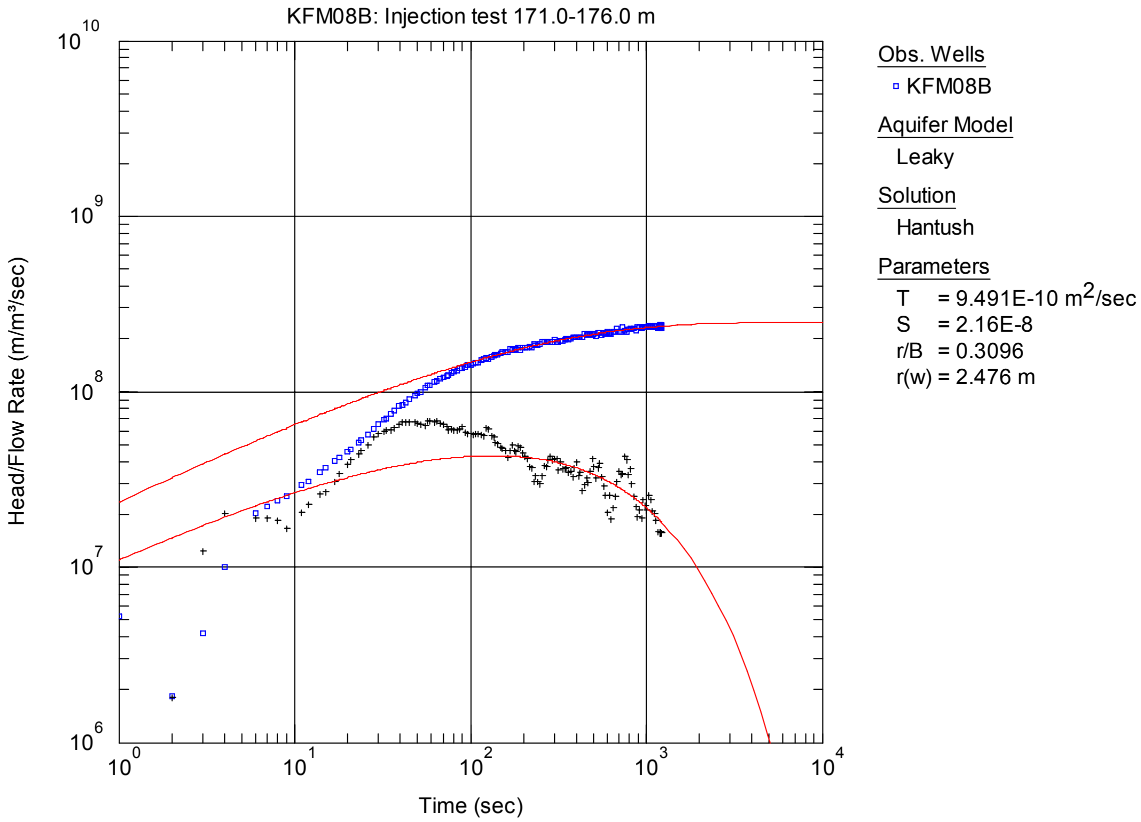


***Figure A3-151.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 171.0-176.0 m in KFM08B.*

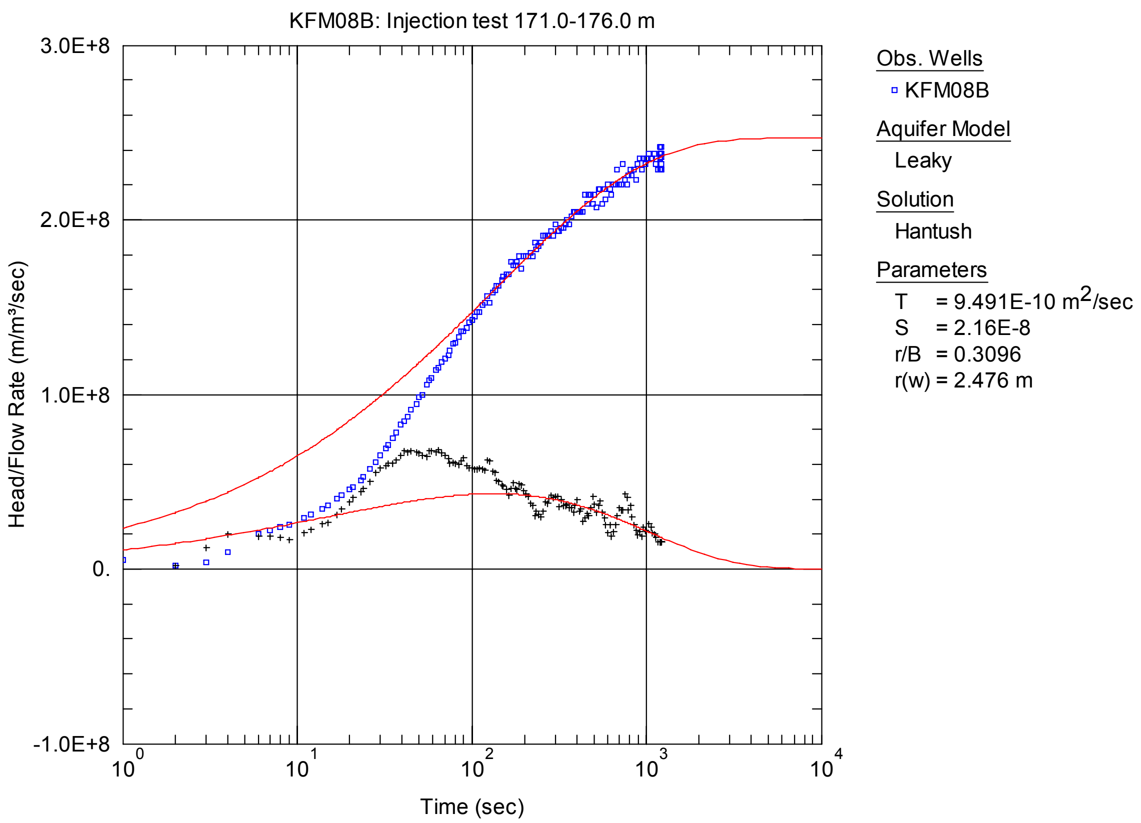


***Figure A3-152.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 171.0-176.0 m in KFM08B.*

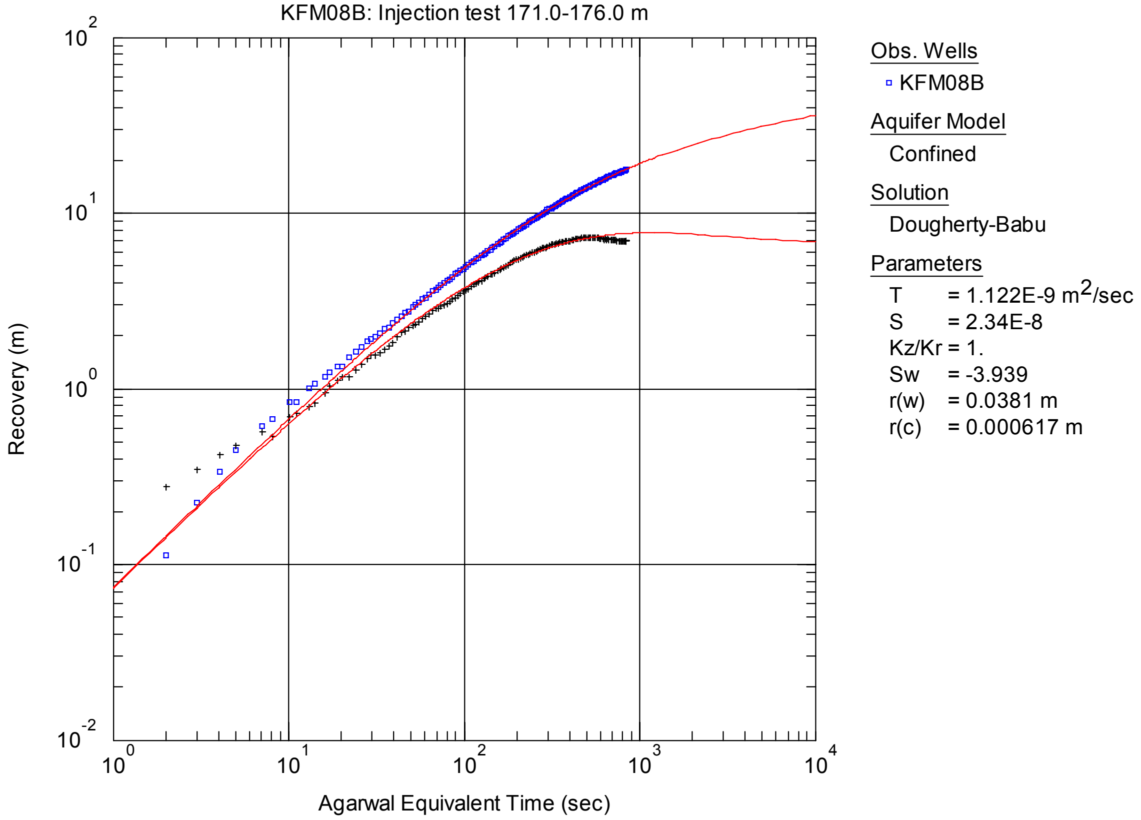


Figure A3-153. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 171.0-176.0 m in KFM08B.*

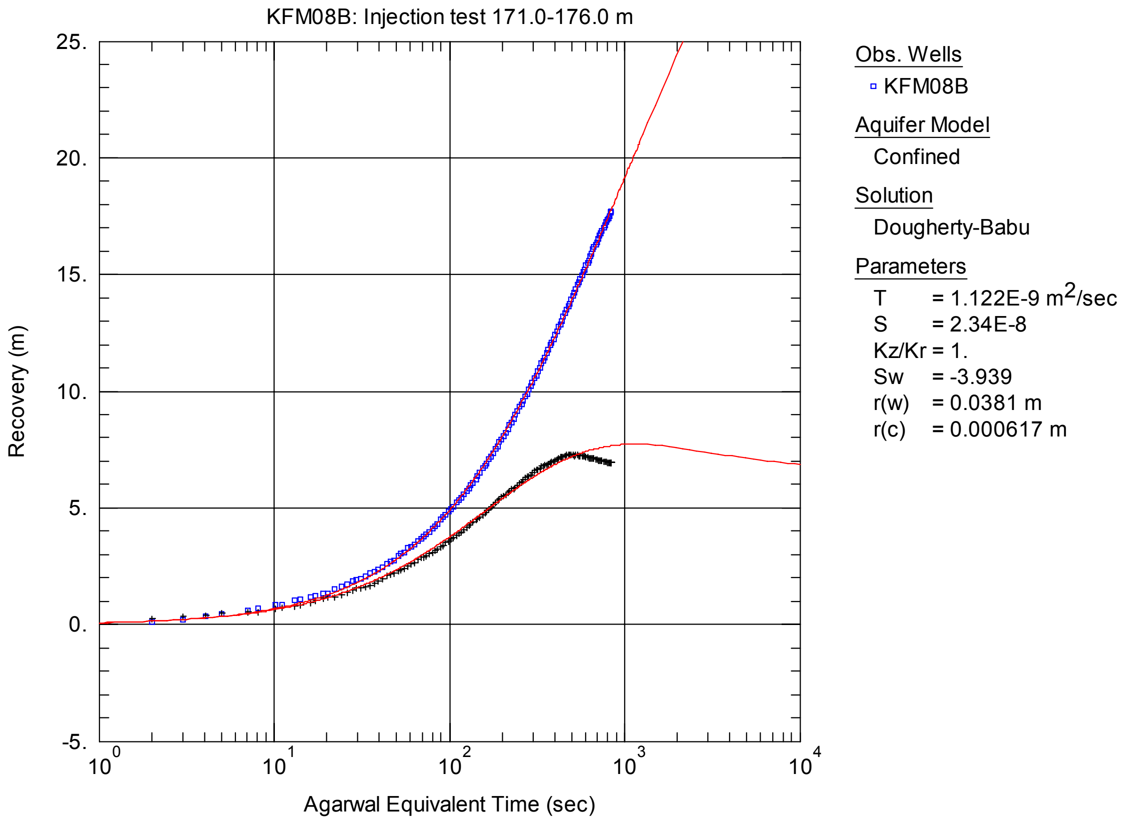


Figure A3-154. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 171.0-176.0 m in KFM08B.*

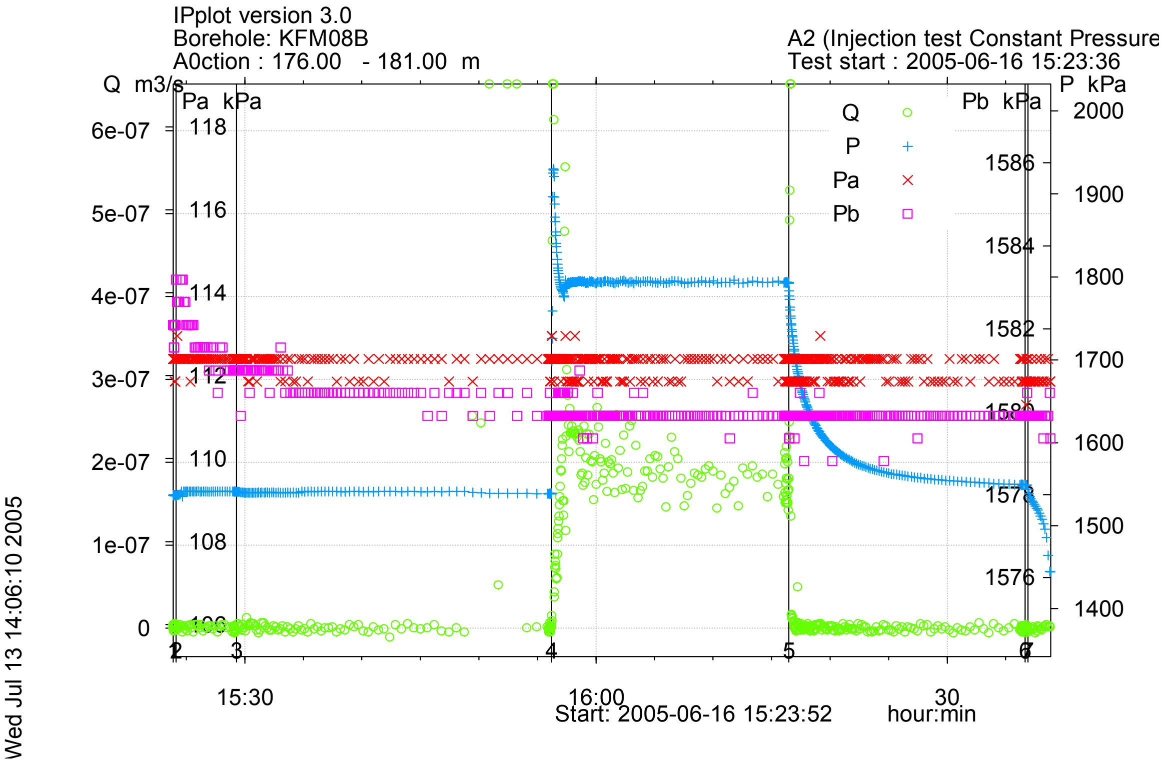


Figure A3-155. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 176.0-181.0 m in borehole KFM08B.*

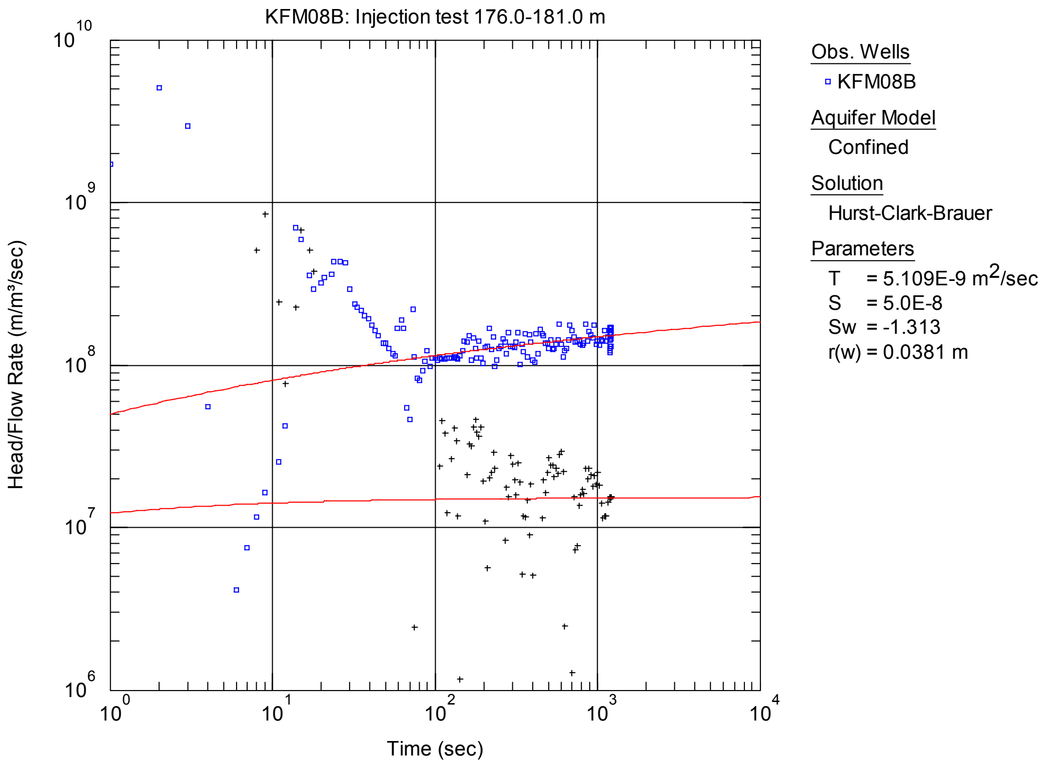


Figure A3-156. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 176.0-181.0 m in KFM08B.*

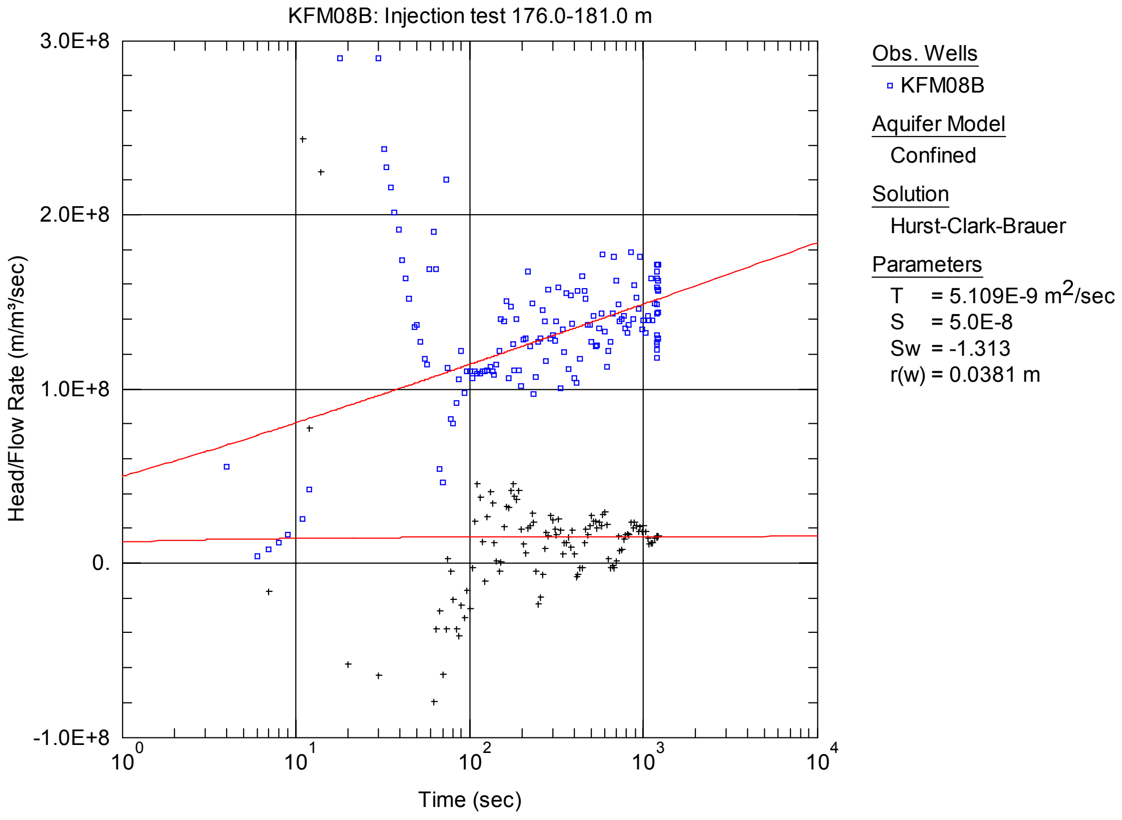


Figure A3-157. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 176.0-181.0 m in KFM08B.*

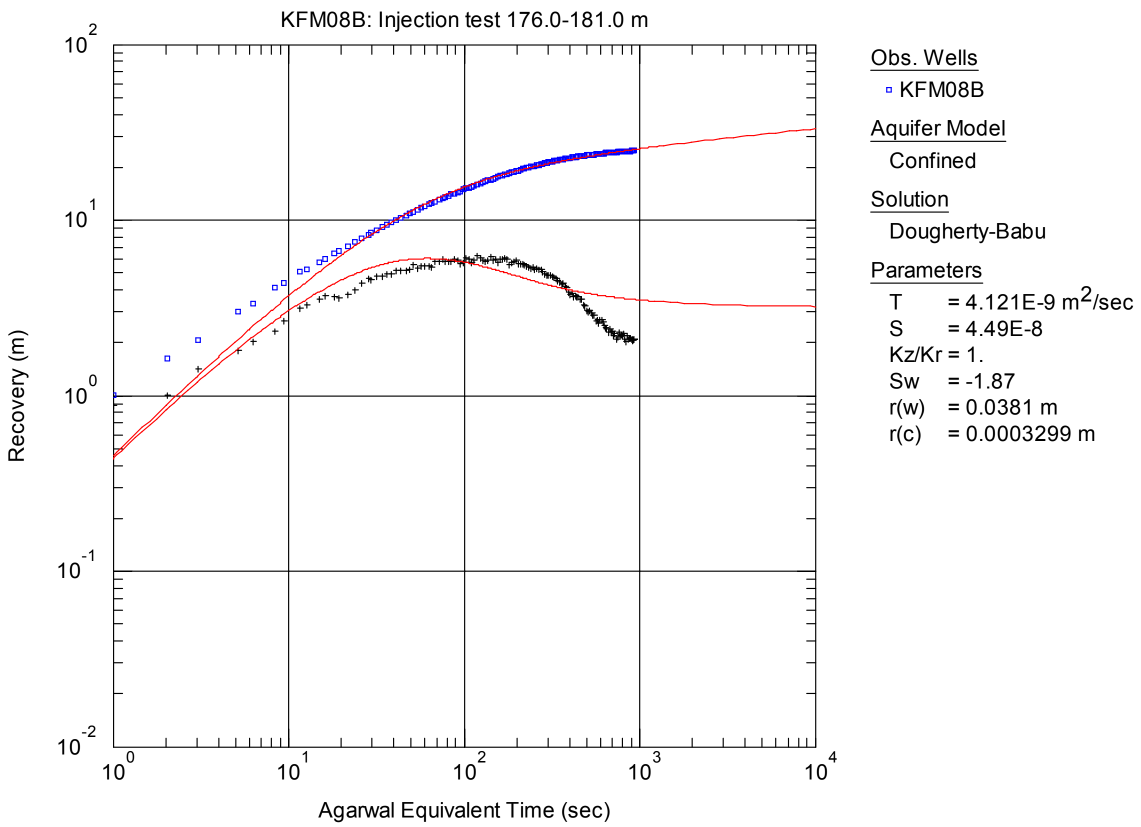


Figure A3-158. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 176.0-181.0 m in KFM08B.*

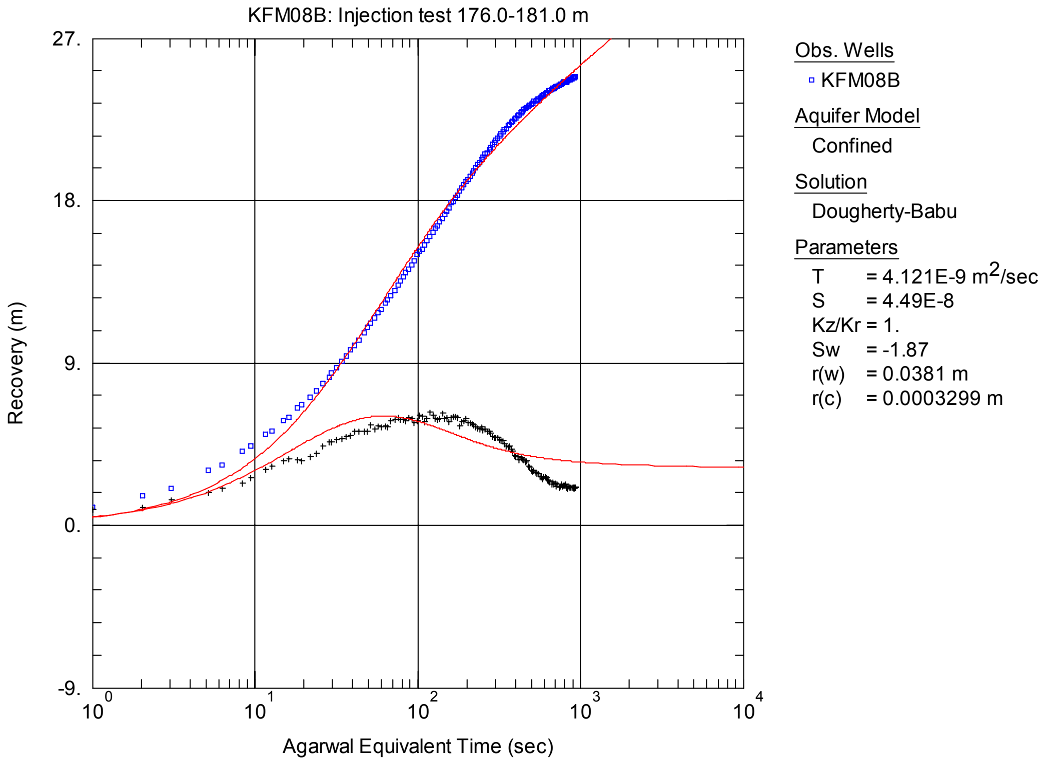


Figure A3-159. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 176.0-181.0 m in KFM08B.*

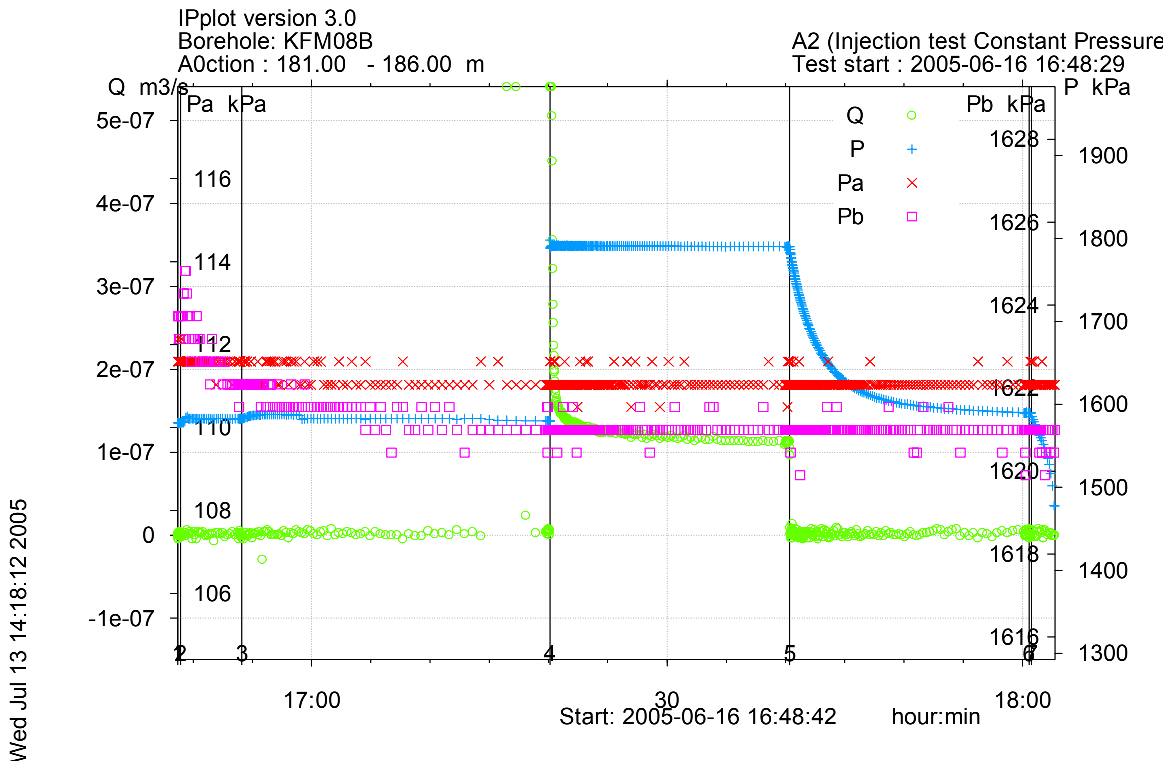


Figure A3-160. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 181.0-186.0 m in borehole KFM08B.*

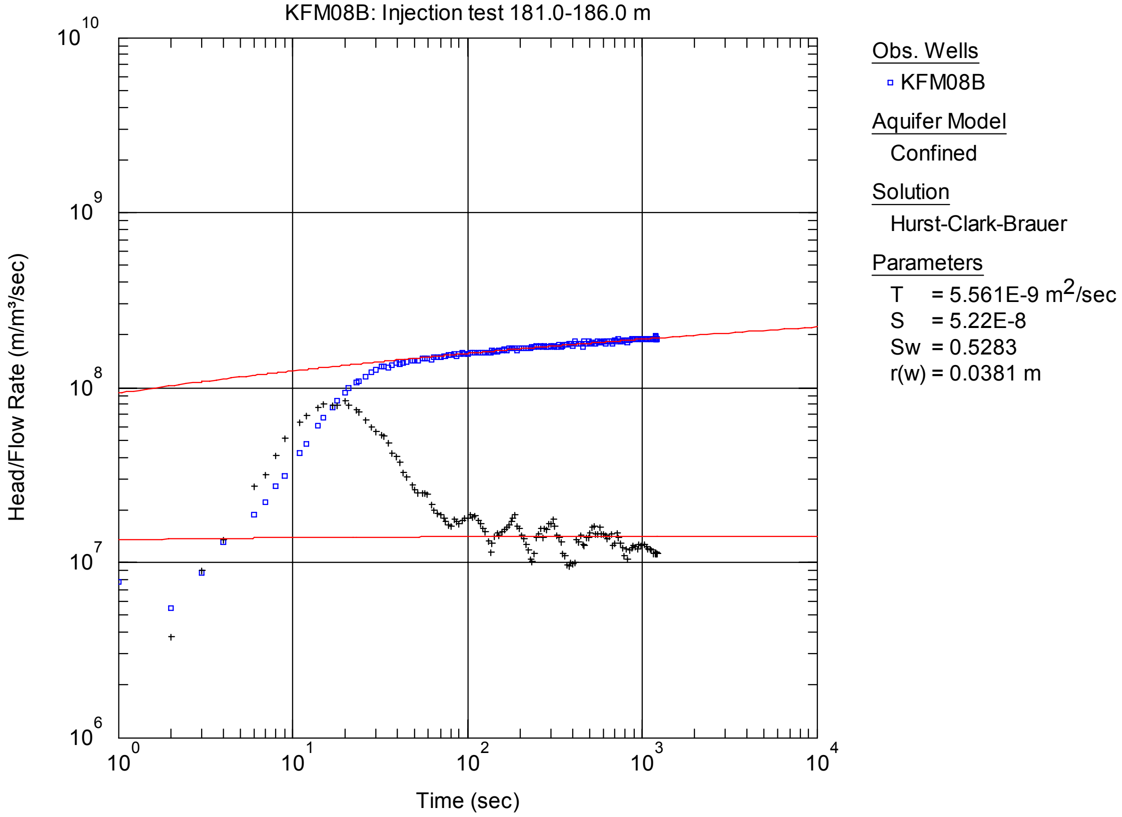


__Figure A3-161.__ Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 181.0-186.0 m in KFM08B.

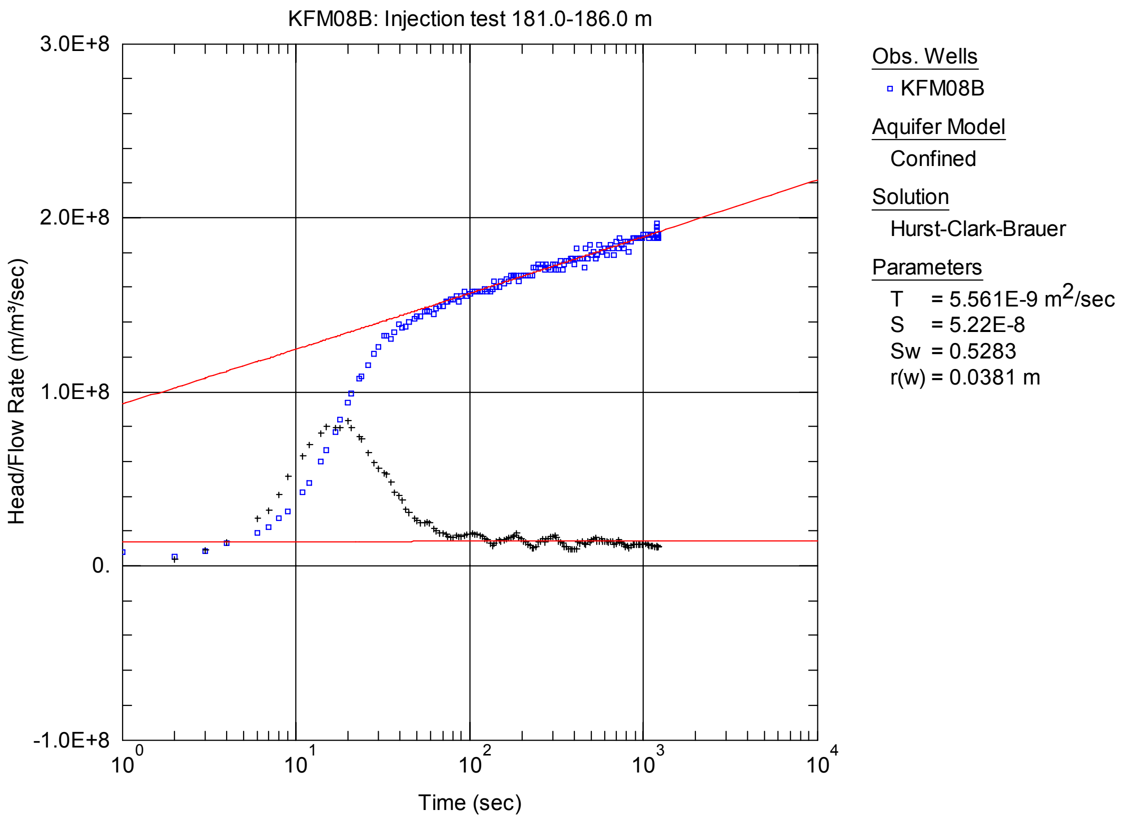


__Figure A3-162.__ Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 181.0-186.0 m in KFM08B.

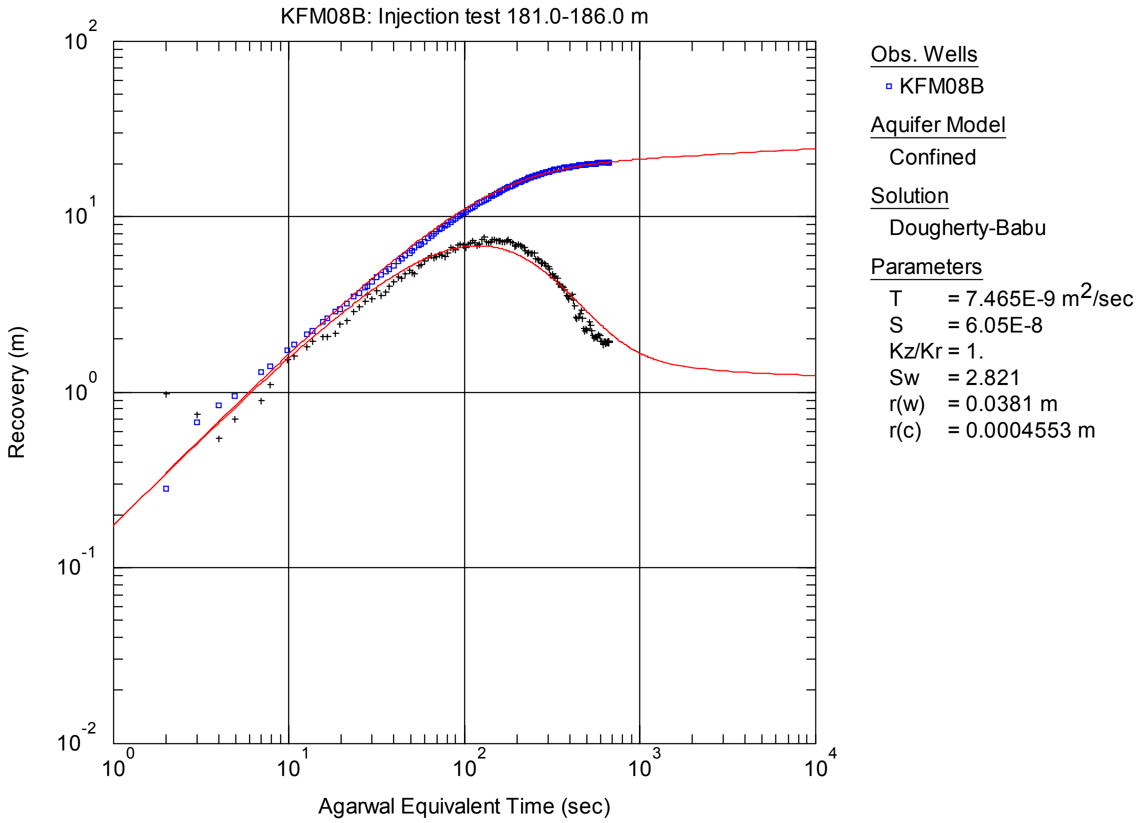


Figure A3-163. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 181.0-186.0 m in KFM08B.*

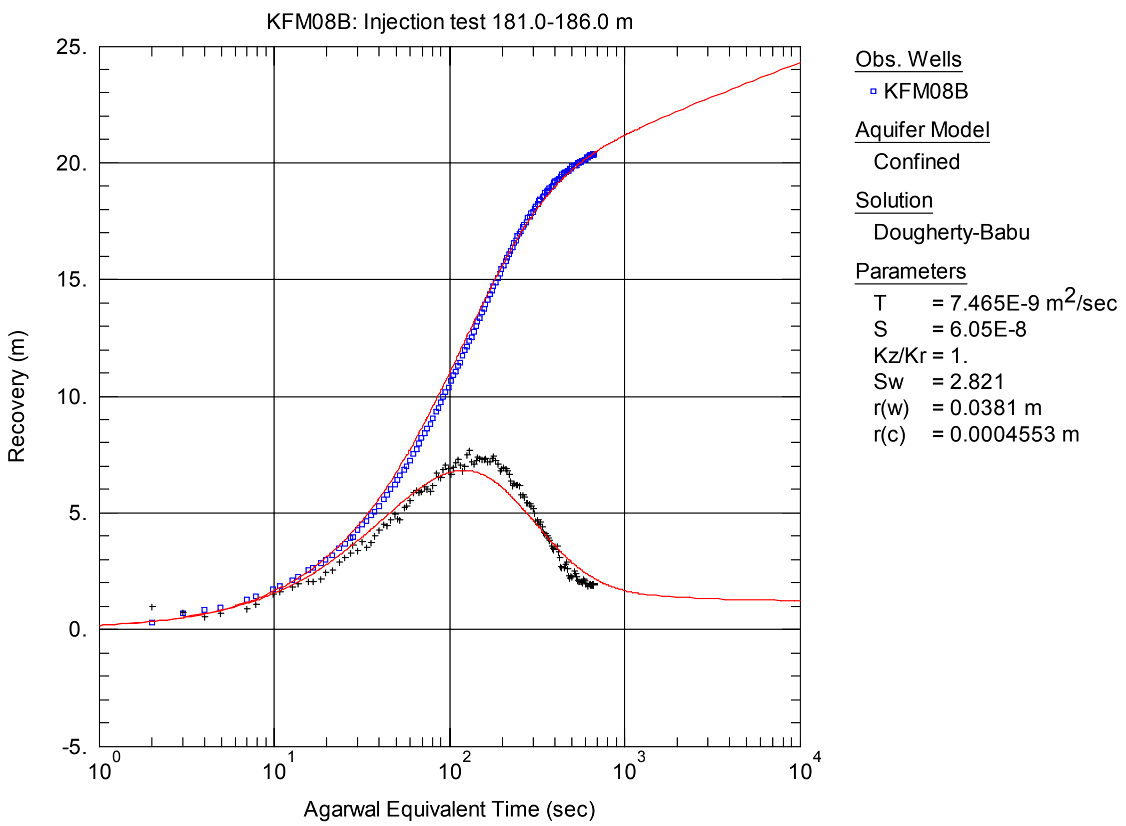


Figure A3-164. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 181.0-186.0 m in KFM08B.*

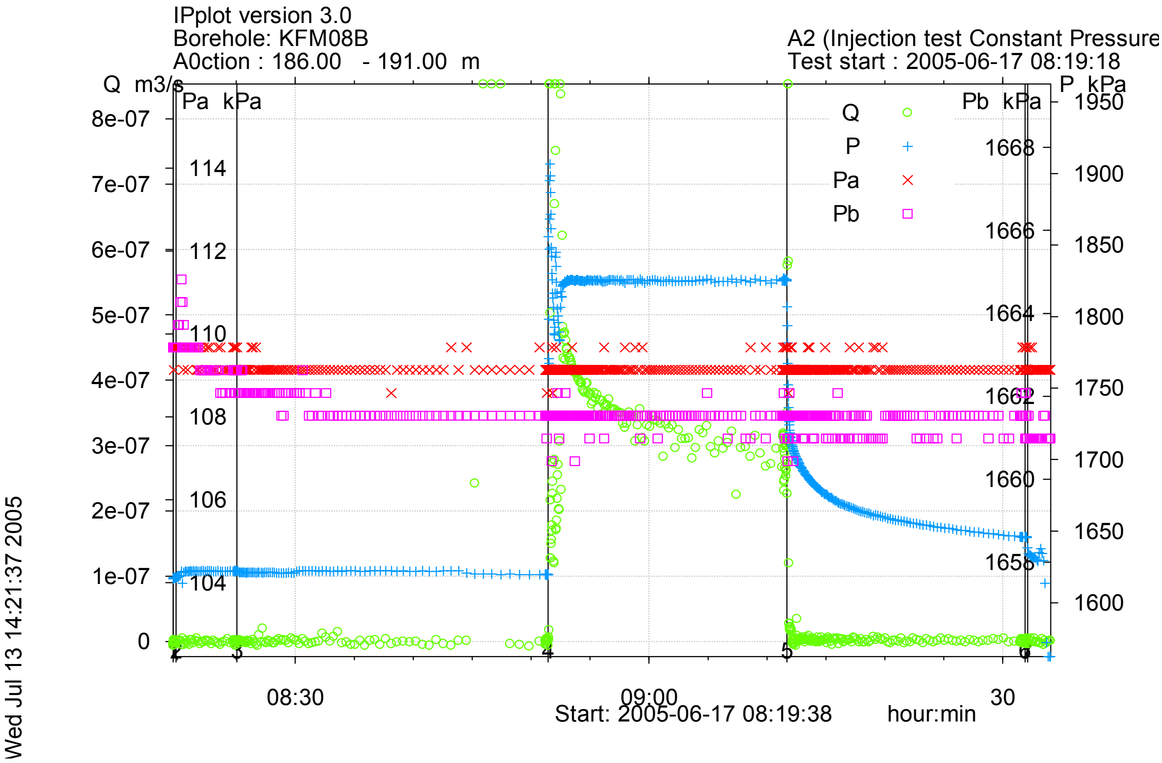


Figure A3-165. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 186.0-191.0 m in borehole KFM08B.

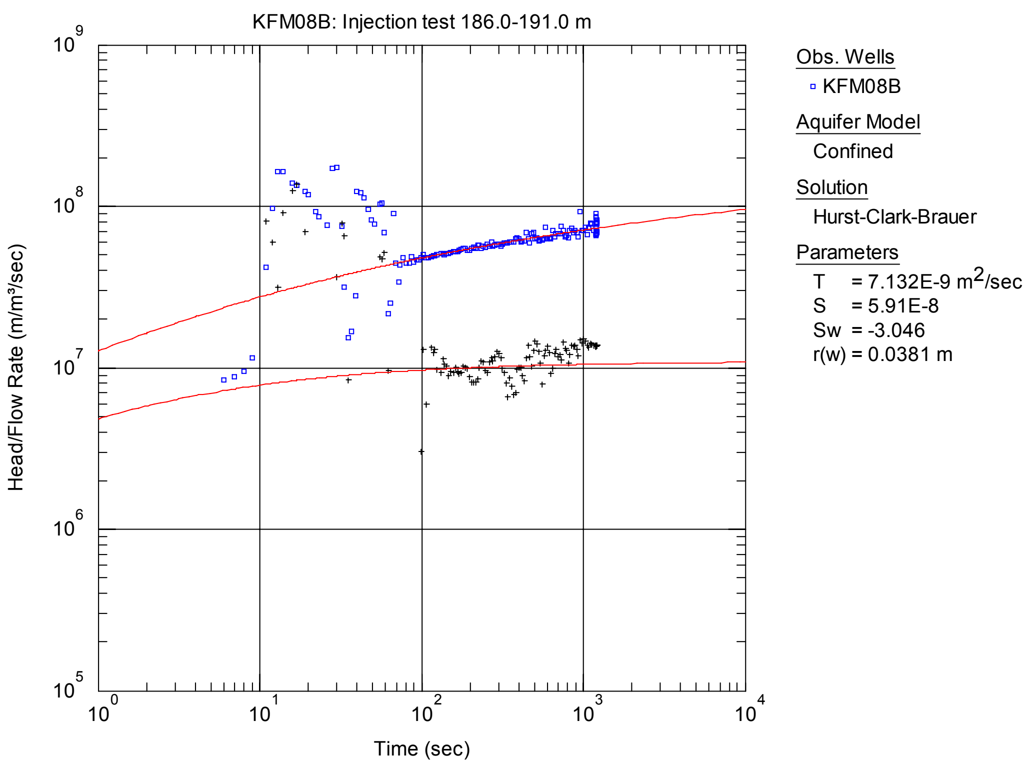


Figure A3-166. Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 186.0-191.0 m in KFM08B.

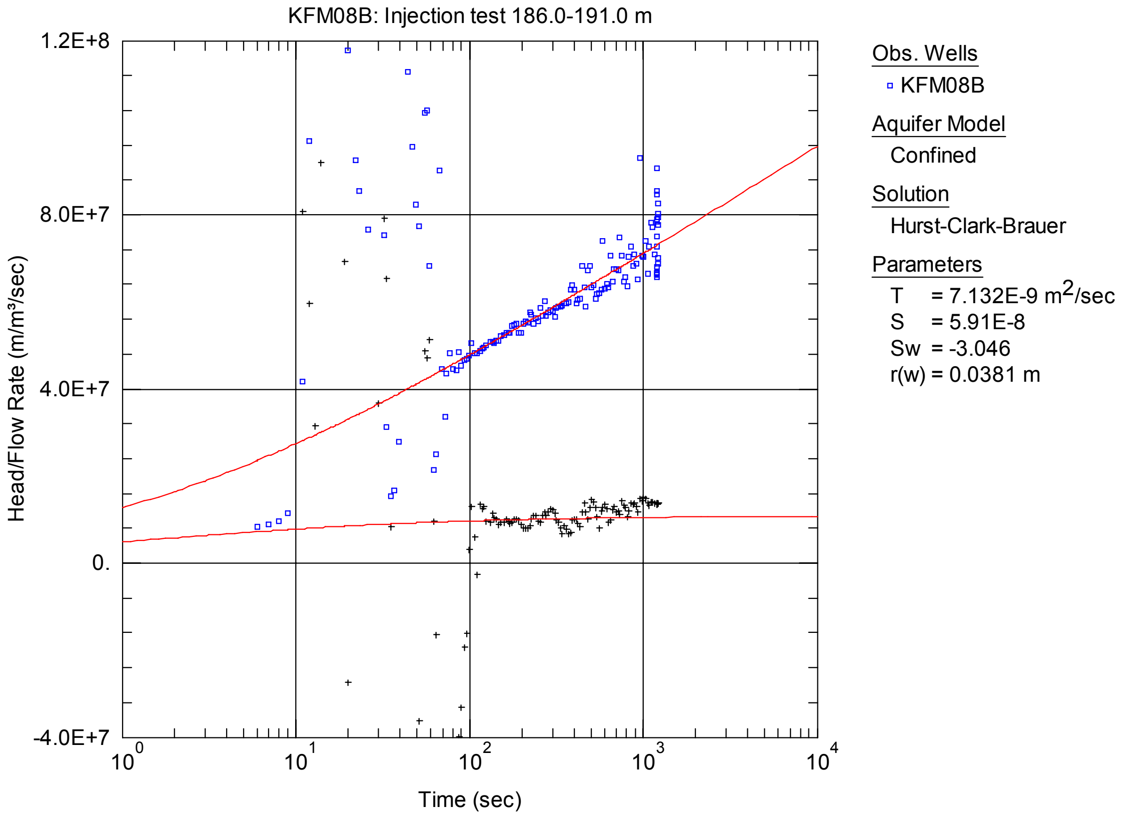


***Figure A3-167.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 186.0-191.0 m in KFM08B.*

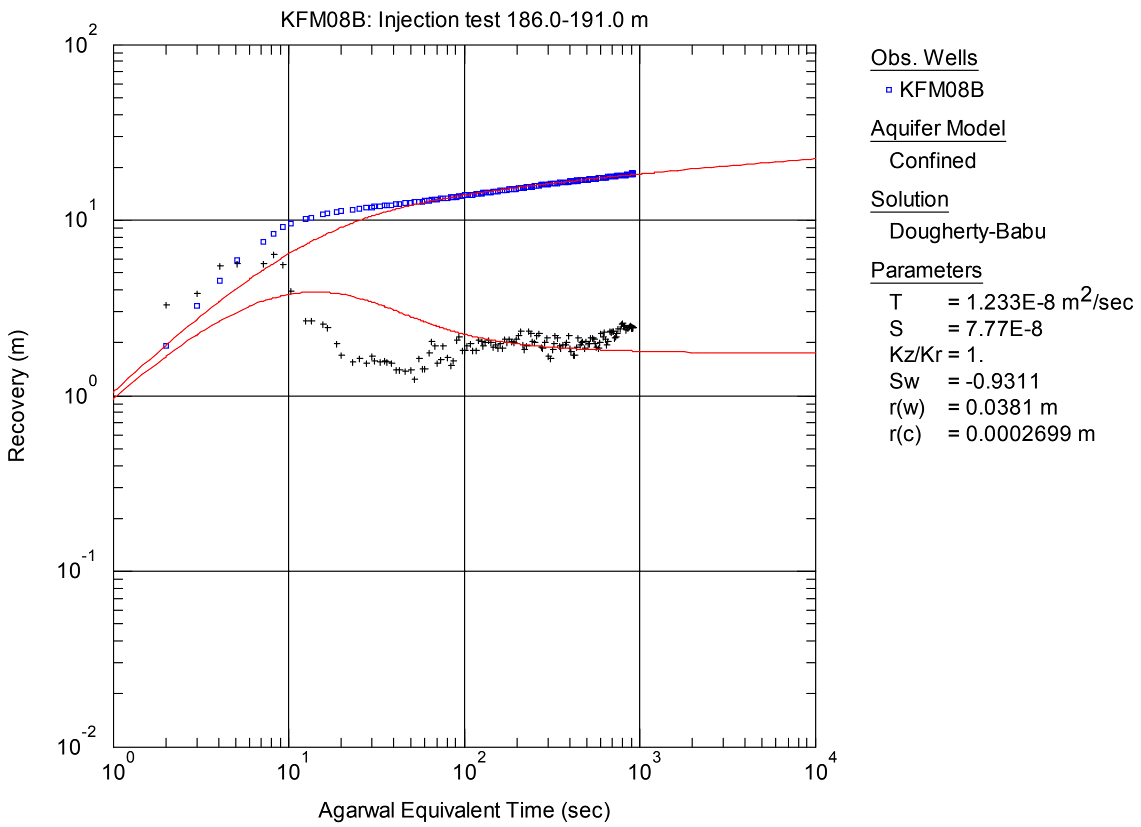


***Figure A3-168.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 186.0-191.0 m in KFM08B.*

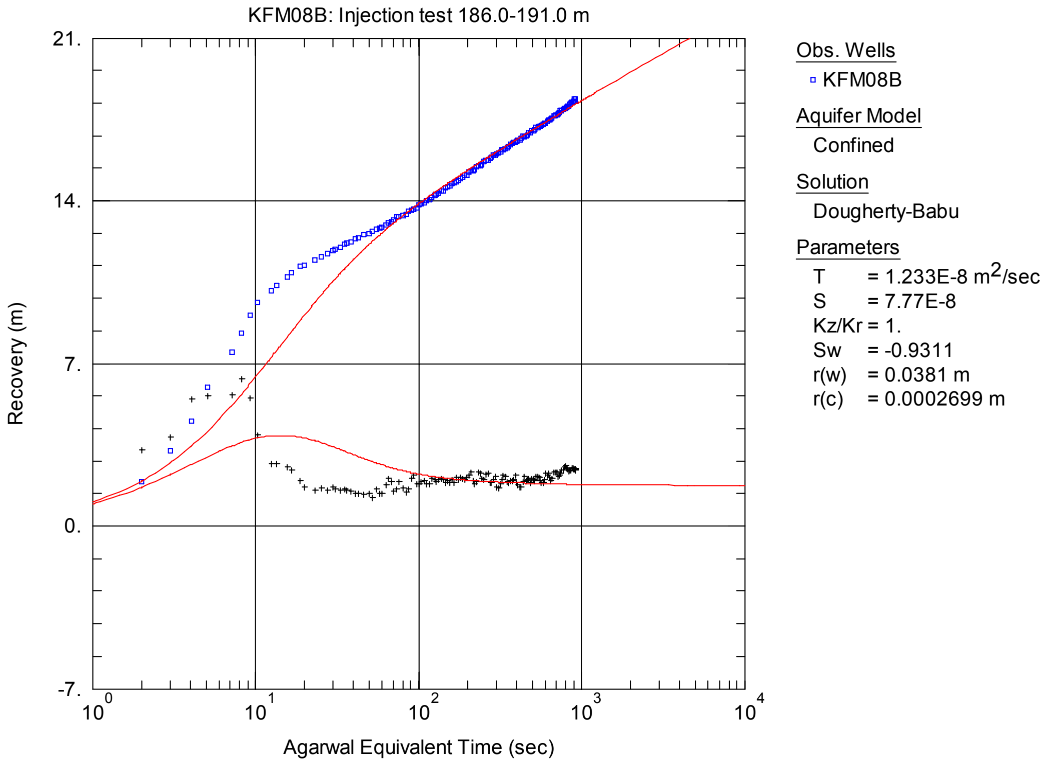


Figure A3-169. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 186.0-191.0 m in KFM08B.*

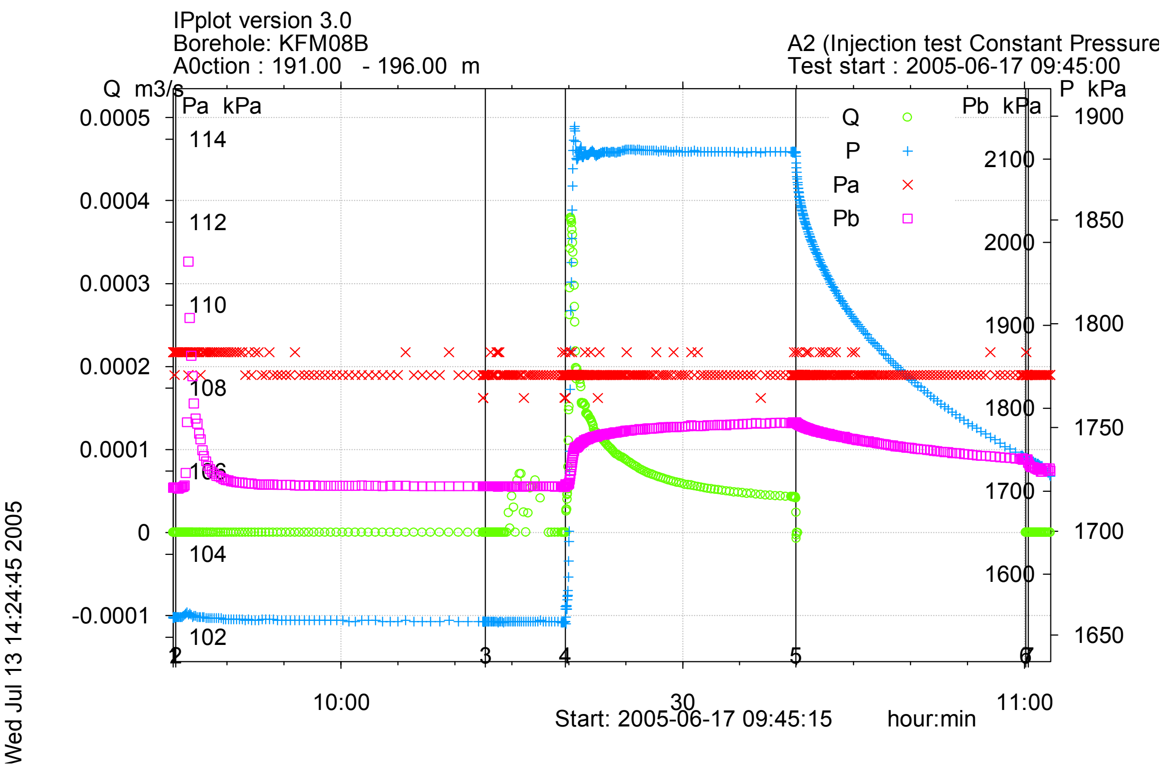


Figure A3-170. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 191.0-196.0 m in borehole KFM08B.*

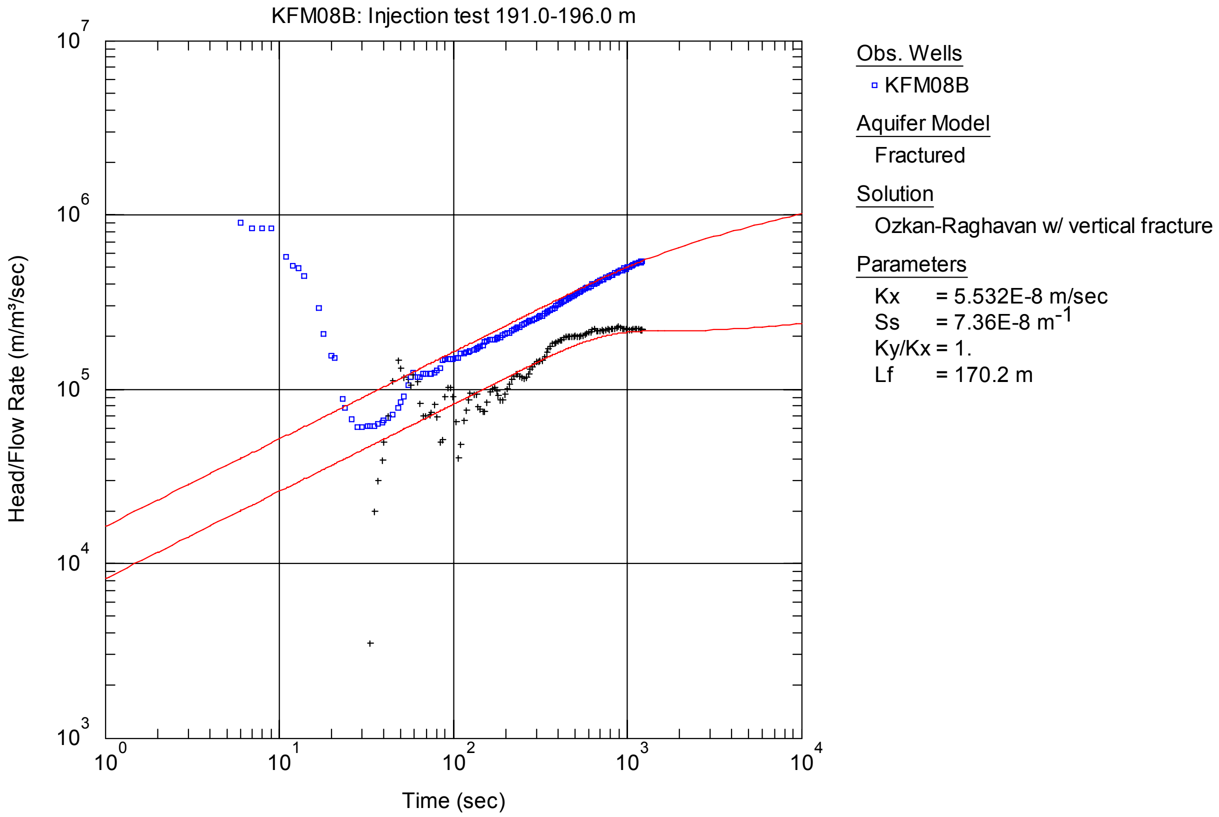


***Figure A3-171.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 191.0-196.0 m in KFM08B.*

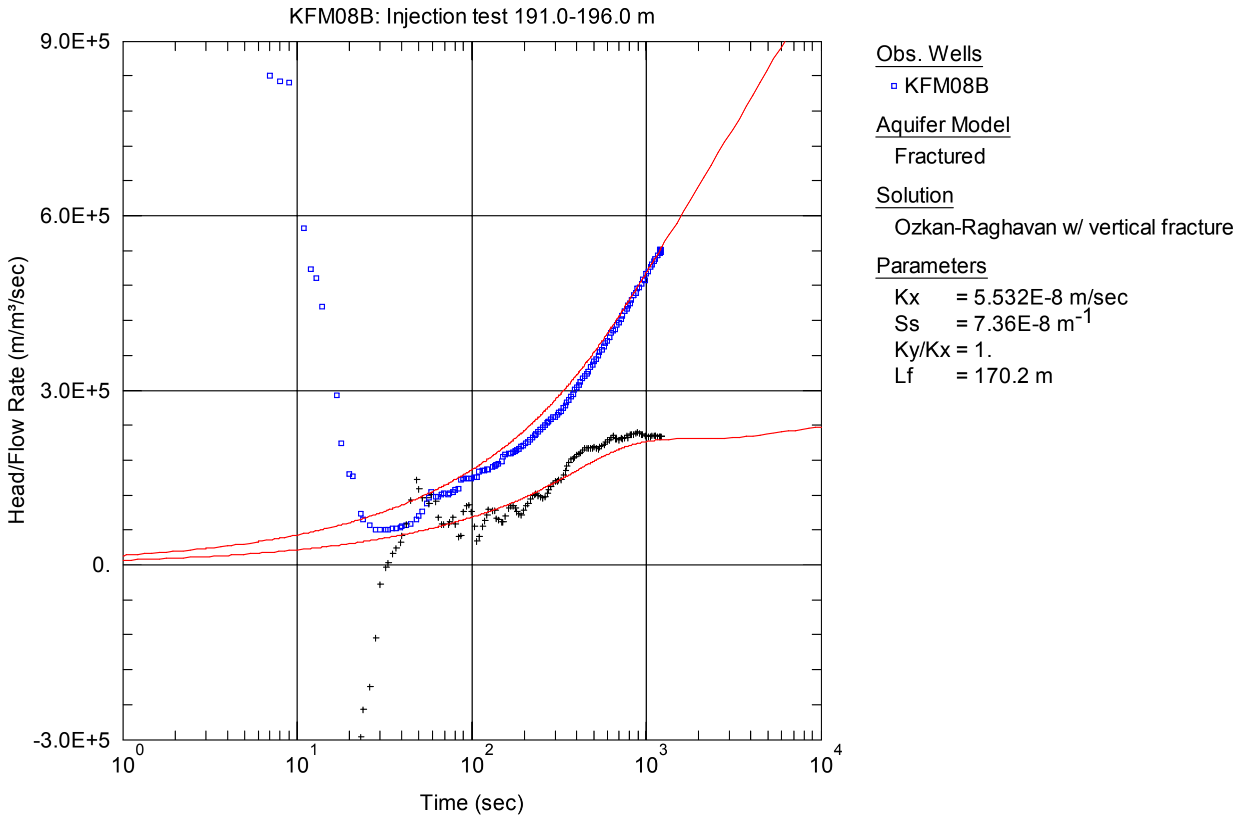


***Figure A3-172.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 191.0-196.0 m in KFM08B.*

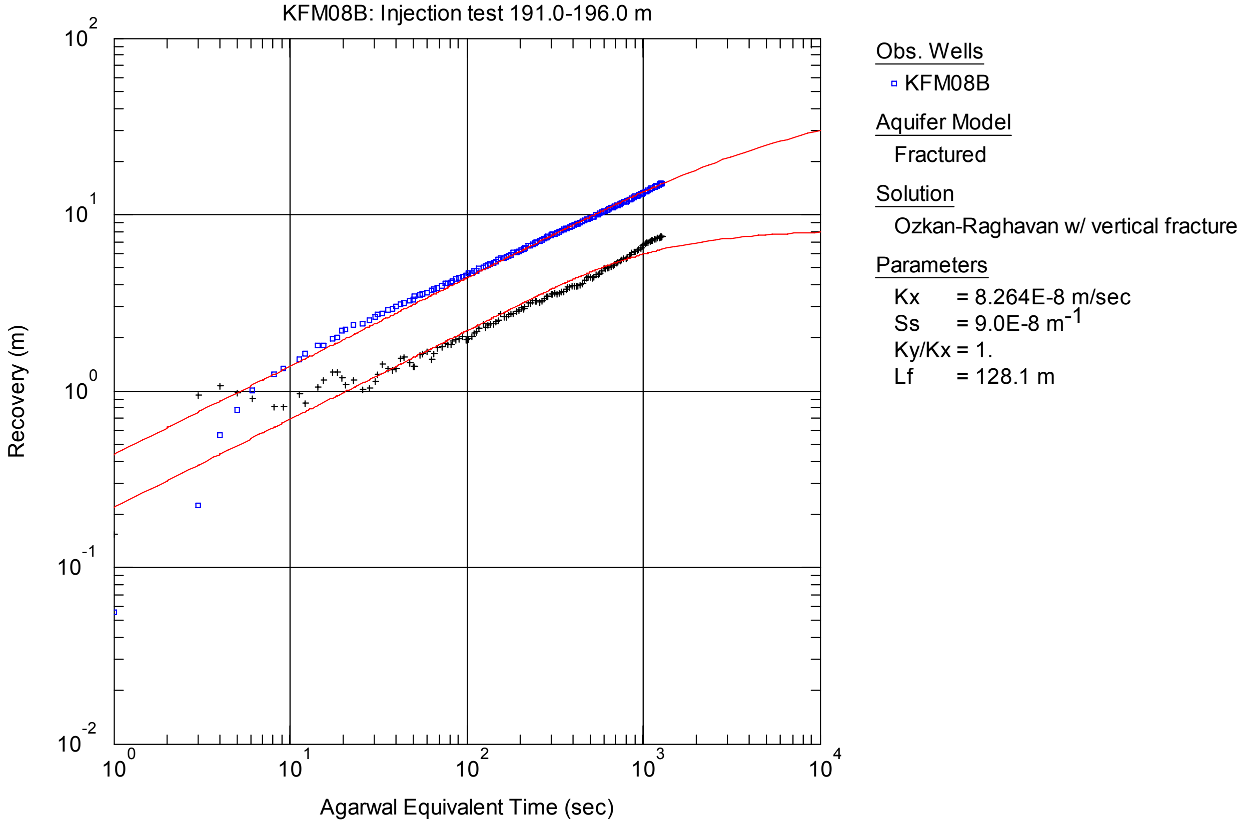


***Figure A3-173.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 191.0-196.0 m in KFM08B.*

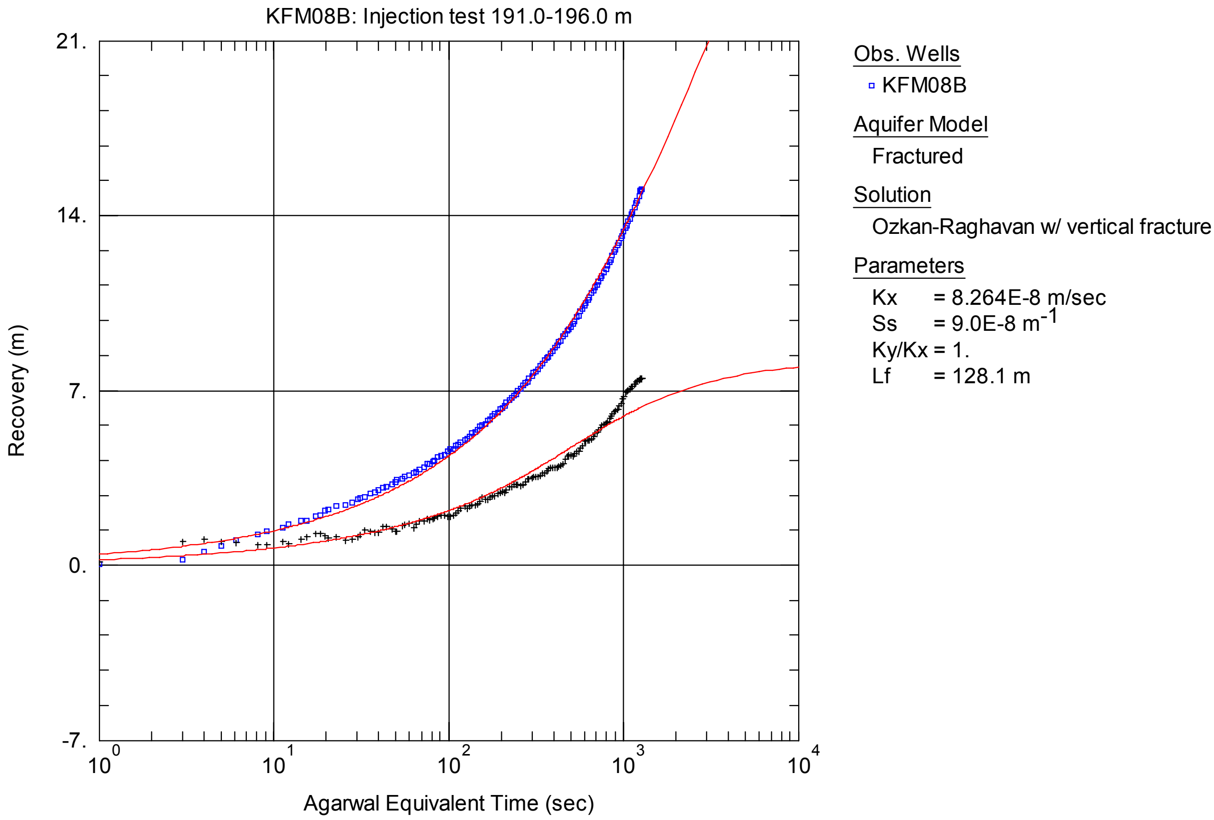
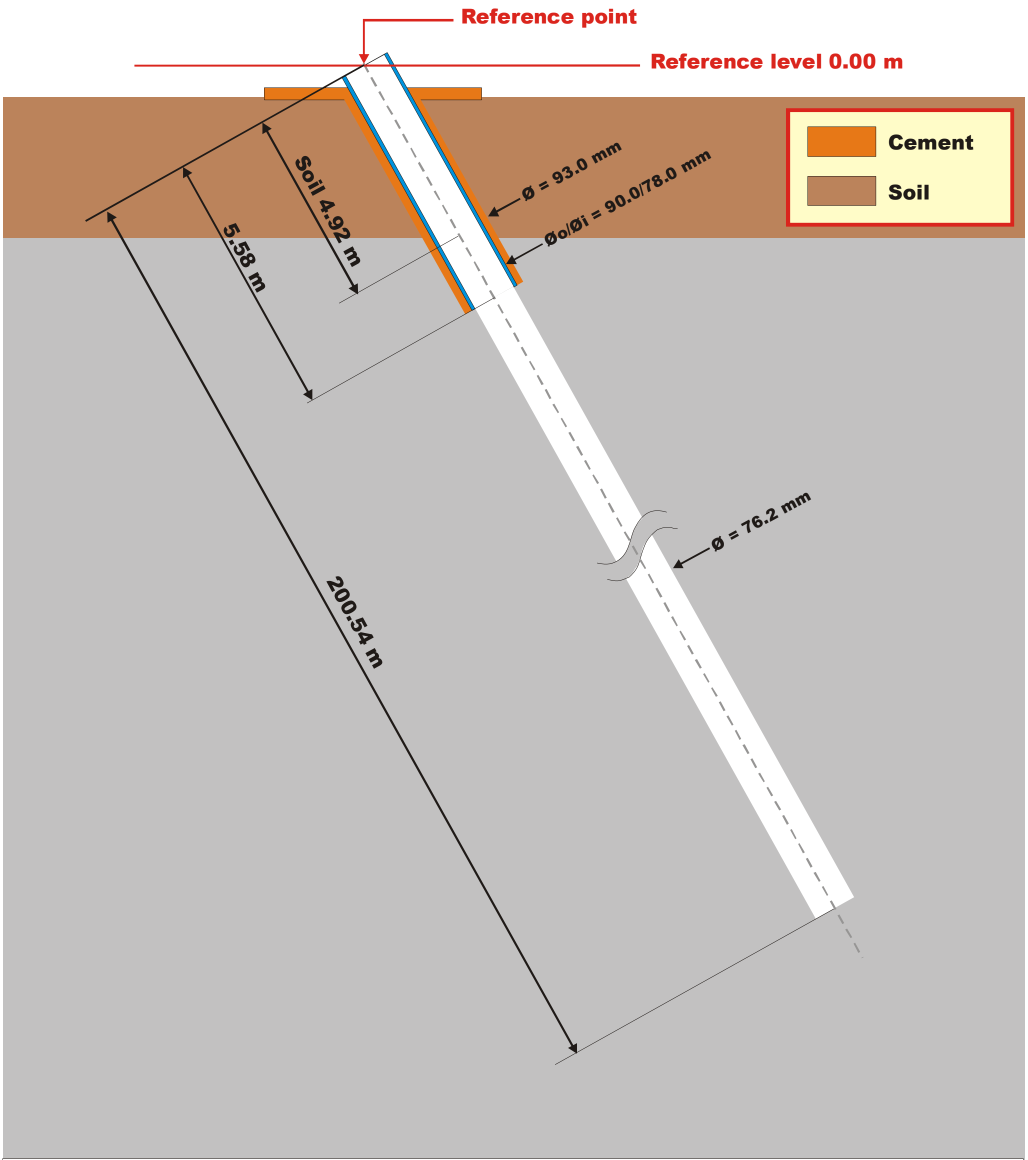


***Figure A3-174.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 191.0-196.0 m in KFM08B.*

Appendix 4. Borehole technical data

Technical data

Borehole KFM08B



Drilling reference point

Northing:	**6700492.75**	**(m), RT90 2,5 gon V 0:-15**
Easting:	**1631173.27**	**(m), RT90 2,5 gon V 0:-15**
Elevation:	**2.25**	**(m), RHB 70**

Orientation

Bearing: **270.45°**

Inclination: **-58.85°**

Drilling period

Drilling start date: **2005-01-03**

Drilling stop date: **2005-01-26**

Ver 1.0 2005-05-19

Appendix 5. Sicada tables

Nomenclature plu_s_hole_test_d

Column	Datatype	Unit	Column Description	Alt. Symbol
site	CHAR		Investigation site name	
activity_type	CHAR		Activity type code	
start_date	DATE		Date (yymmdd hh:mm:ss)	
stop_date	DATE		Date (yymmdd hh:mm:ss)	
project	CHAR		project code	
idcode	CHAR		Object or borehole identification code	
secup	FLOAT	m	Upper section limit (m)	
seclow	FLOAT	m	Lower section limit (m)	
section_no	INTEGER	number	Section number	
test_type	CHAR		Test type code (1-7), see table description	
formation_type	CHAR		1: Rock, 2: Soil (superficial deposits)	
start_flow_period	DATE	yyyymmdd	Date & time of pumping/injection start (YYYY-MM-DD hh:mm:ss)	
stop_flow_period	DATE	yyyymmdd	Date & time of pumping/injection stop (YYYY-MM-DD hh:mm:ss)	
flow_rate_end_qp	FLOAT	m**3/s	Flow rate at the end of the flowing period	
value_type_qp	CHAR		0:true value,-1<lower meas.limit1:>upper meas.limit	
mean_flow_rate_qm	FLOAT	m**3/s	Arithmetic mean flow rate during flow period	
q_measl__l	FLOAT	m**3/s	Estimated lower measurement limit of flow rate	Q-measl-L
q_measl__u	FLOAT	m**3/s	Estimated upper measurement limit of flow rate	Q-measl-U
tot_volume_vp	FLOAT	m**3	Total volume of pumped or injected water	
dur_flow_phase_tp	FLOAT	s	Duration of the flowing period of the test	
dur_rec_phase_tf	FLOAT	s	Duration of the recovery period of the test	
initial_head_hi	FLOAT	m	Hydraulic head in test section at start of the flow period	
head_at_flow_end_hp	FLOAT	m	Hydraulic head in test section at stop of the flow period.	
final_head_hf	FLOAT	m	Hydraulic head in test section at stop of recovery period.	
initial_press_pi	FLOAT	kPa	Groundwater pressure in test section at start of flow period	
press_at_flow_end_pp	FLOAT	kPa	Groundwater pressure in test section at stop of flow period.	
final_press_pf	FLOAT	kPa	Ground water pressure at the end of the recovery period.	
fluid_temp_tew	FLOAT	oC	Measured section fluid temperature, see table description	
fluid_elcond_ecw	FLOAT	mS/m	Measured section fluid el. conductivity,see table descr.	
fluid_salinity_tdsw	FLOAT	mg/l	Total salinity of section fluid based on EC,see table descr.	
fluid_salinity_tdswm	FLOAT	mg/l	Tot. section fluid salinity based on water sampling,see...	
reference	CHAR		SKB report No for reports describing data and evaluation	
comments	VARCHAR		Short comment to data	
error_flag	CHAR		If error_flag = "*" then an error occured and an error	
in_use	CHAR		If in_use = "*" then the activity has been selected as	
sign	CHAR		Signature for QA data accknowledge (QA - OK)	
lp	FLOAT	m	Hydraulic point of application	

Nomenclature plu_s_hole_test_ed1

Column	Datatype	Unit	Column Description	Alt. Symbol
site	CHAR		Investigation site name	
activity_type	CHAR		Activity type code	
start_date	DATE		Date (yymmdd hh:mm:ss)	
stop_date	DATE		Date (yymmdd hh:mm:ss)	
project	CHAR		project code	
idcode	CHAR		Object or borehole identification code	

Column	Datatype	Unit	Column Description	Alt. Symbol
secup	FLOAT	m	Upper section limit (m)	
seclow	FLOAT	m	Lower section limit (m)	
section_no	INTEGER	number	Section number	
test_type	CHAR		Test type code (1-7), see table description!	
formation_type	CHAR		Formation type code. 1: Rock, 2: Soil (superficial deposits)	
lp	FLOAT	m	Hydraulic point of application for test section, see descr.	
seclen_class	FLOAT	m	Planned ordinary test interval during test campaign.	
spec_capacity_q_s	FLOAT	m**2/s	Specific capacity (Q/s) of test section, see table descript.	Q/s
value_type_q_s	CHAR		0:true value,-1:Q/s<lower meas.limit,1:Q/s>upper meas.limit	
transmissivity_tq	FLOAT	m**2/s	Tranmissivity based on Q/s, see table description	
value_type_tq	CHAR		0:true value,-1:TQ<lower meas.limit,1:TQ>upper meas.limit.	
bc_tq	CHAR		Best choice code. 1 means TQ is best choice of T, else 0	
transmissivity_moye	FLOAT	m**2/s	Transmissivity,TM, based on Moye (1967)	T_M
bc_tm	CHAR		Best choice code. 1 means Tmoye is best choice of T, else 0	
value_type_tm	CHAR		0:true value,-1:TM<lower meas.limit,1:TM>upper meas.limit.	
hydr_cond_moye	FLOAT	m/s	K_M: Hydraulic conductivity based on Moye (1967)	K_M
formation_width_b	FLOAT	m	b:Aquifer thickness repr. for T(generally b=Lw) ,see descr.	b
width_of_channel_b	FLOAT	m	B:Inferred width of formation for evaluated TB	
tb	FLOAT	m**3/s	TB:Flow capacity in 1D formation of T & width B, see descr.	
l_measl_tb	FLOAT	m**3/s	Estimated lower meas. limit for evaluated TB,see description	
u_measl_tb	FLOAT	m**3/s	Estimated upper meas. limit of evaluated TB,see description	
sb	FLOAT	m	SB:S=storativity,B=width of formation,1D model,see descript.	
assumed_sb	FLOAT	m	SB* : Assumed SB,S=storativity,B=width of formation,see...	
leakage_factor_lf	FLOAT	m	Lf:1D model for evaluation of Leakage factor	
transmissivity_tt	FLOAT	m**2/s	TT:Transmissivity of formation, 2D radial flow model,see...	T_T
value_type_tt	CHAR		0:true value,-1:TT<lower meas.limit,1:TT>upper meas.limit,	
bc_tt	CHAR		Best choice code. 1 means TT is best choice of T, else 0	
l_measl_q_s	FLOAT	m**2/s	Estimated lower meas. limit for evaluated TT,see table descr	Q/s-measl-L
u_measl_q_s	FLOAT	m**2/s	Estimated upper meas. limit for evaluated TT,see description	Q/s-measl-U
storativity_s	FLOAT		S:Storativity of formation based on 2D rad flow,see descr.	
assumed_s	FLOAT		Assumed Storativity,2D model evaluation,see table descr.	
bc_s	FLOAT		Best choice of S (Storativity) ,see descr.	
ri	FLOAT	m	Radius of influence	
ri_index	CHAR		ri index=index of radius of influence :-1,0 or 1, see descr.	
leakage_coeff	FLOAT	1/s	K'/b':2D rad flow model evaluation of leakage coeff,see desc	
hydr_cond_ksf	FLOAT	m/s	Ksf:3D model evaluation of hydraulic conductivity,see desc.	
value_type_ksf	CHAR		0:true value,-1:Ksf<lower meas.limit,1:Ksf>upper meas.limit,	
l_measl_ksf	FLOAT	m/s	Estimated lower meas.limit for evaluated Ksf,see table desc.	
u_measl_ksf	FLOAT	m/s	Estimated upper meas.limit for evaluated Ksf,see table descr	
spec_storage_ssf	FLOAT	1/m	Ssf:Specific storage,3D model evaluation,see table descr.	
assumed_ssf	FLOAT	1/m	Ssf*:Assumed Spec.storage,3D model evaluation,see table des.	
c	FLOAT	m**3/pa	C: Wellbore storage coefficient; flow or recovery period	C
cd	FLOAT		CD: Dimensionless wellbore storage coefficient	
skin	FLOAT		Skin factor;best estimate of flow/recovery period,see descr.	ξ
dt1	FLOAT	s	Estimated start time of evaluation, see table description	
dt2	FLOAT	s	Estimated stop time of evaluation. see table description	
t1	FLOAT	s	Start time for evaluated parameter from start flow period	t_1
t2	FLOAT	s	Stop time for evaluated parameter from start of flow period	t_2
dte1	FLOAT	s	Start time for evaluated parameter from start of recovery	dte_1
dte2	FLOAT	s	Stop time for evaluated parameter from start of recovery	dte_2
p_horner	FLOAT	kPa	p*:Horner extrapolated pressure, see table description	
transmissivity_t_nlr	FLOAT	m**2/s	T_NLR Transmissivity based on None Linear Regression...	
storativity_s_nlr	FLOAT		S_NLR=storativity based on None Linear Regression,see..	

Column	Datatype	Unit	Column Description	Alt. Symbol
value_type_t_nlr	CHAR		0:true value,-1:T_NLR<lower meas.limit,1:>upper meas.limit	
bc_t_nlr	CHAR		Best choice code. 1 means T_NLR is best choice of T, else 0	
c_nlr	FLOAT	m**3/pa	Wellbore storage coefficient, based on NLR, see descr.	
cd_nlr	FLOAT		Dimensionless wellbore storage constant, see table descrip.	
skin_nlr	FLOAT		Skin factor based on Non Linear Regression,see desc.	
transmissivity_t_grf	FLOAT	m**2/s	T_GRF:Transmissivity based on Genelized Radial Flow,see...	
value_type_t_grf	CHAR		0:true value,-1:T_GRF<lower meas.limit,1:>upper meas.limit	
bc_t_grf	CHAR		Best choice code. 1 means T_GRF is best choice of T, else 0	
storativity_s_grf	FLOAT		S_GRF:Storativity based on Generalized Radial Flow, see des.	
flow_dim_grf	FLOAT		Inferred flow dimesion based on Generalized Rad. Flow model	
comment	VARCHAR	no_unit	Short comment to the evaluated parameters	
error_flag	CHAR		If error_flag = "*" then an error occured and an error	
in_use	CHAR		If in_use = "*" then the activity has been selected as	
sign	CHAR		Signature for QA data accknowledge (QA - OK)	

Nomenclature plu_s_hole_test_obs

Column	Datatype	Unit	Column Description
site	CHAR		Investigation site name
activity_type	CHAR		Activity type code
idcode	CHAR		Object or borehole identification code
start_date	DATE		Date (yymmdd hh:mm:ss)
secup	FLOAT	m	Upper section limit (m)
seclow	FLOAT	m	Lower section limit (m)
obs_secup	FLOAT	m	Upper limit of observation section
obs_seclow	FLOAT	m	Lower limit of observation section
pi_above	FLOAT	kPa	Groundwater pressure above test section,start of flow period
pp_above	FLOAT	kPa	Groundwater pressure above test section,at stop flow period
pf_above	FLOAT	kPa	Groundwater pressure above test section at stop recovery per
pi_below	FLOAT	kPa	Groundwater pressure below test section at start flow period
pp_below	FLOAT	kPa	Groundwater pressure below test section at stop flow period
pf_below	FLOAT	kPa	Groundwater pressure below test section at stop recovery per
comments	VARCHAR		Comment text row (unformatted text)

Nomenclature plu_pulse_test_ed

Column	Datatype	Unit	Column Description
site	CHAR		Investigation site name
idcode	CHAR		Object or borehole identification code
secup	FLOAT	m	
seclow	FLOAT	m	Lower section limit (m)
start_date	DATE		Date (yymmdd hh:mm:ss)
stop_date	DATE		Date (yymmdd hh:mm:ss)
activity_type	CHAR		Activity type code
test_type	CHAR		Type of test, one of 7, see table description
formation_type	CHAR		1: Rock, 2: Soil (superficial deposits)
start_flow_period	DATE		Date and time of flow phase start (YYYYMMDD hhmmss)
dur_flow_phase_tp	FLOAT	s	Time for the flowing phase of the test (tp)
dur_rec_phase_tf	FLOAT	s	Time for the recovery phase of the test (tF)
initial_head_h0	FLOAT	m	Initial formation hydraulic head, see table description
initial_displacem_dh0	FLOAT	m	Initial displacement of hydraulic head,see table description
displacem_dh0_p	FLOAT	m	Initial displacement of slugtest,see table description
displacem_dh0_f	FLOAT	m	Initial displacement of bailtest,see table description
head_at_flow_end_hp	FLOAT	m	Hydraulic head at end of flow phase,see table description
final_head_hf	FLOAT	m	Hydraulic head at the end of the recovery,see table descr.
initial_press_pi	FLOAT	kPa	Initial formation pressure
initial_press_diff_dp0	FLOAT	kPa	Initial pressure change from pi at time dt=0,pulse test
press_change_dp0_p	FLOAT	kPa	Initial pressure change;pulse test-measured
press_at_flow_end_pp	FLOAT	kPa	Final pressure at the end of the flowing period
final_press_pf	FLOAT	kPa	Final pressure at the end of the recovery period
formation_width_b	FLOAT	m	b:Interpreted formation thickness repr. for evaluated T,see
transmissivity_ts	FLOAT	m**2/s	Ts: Transmissivity based on slugtest, see table description
value_type_ts	CHAR		0:true value,-1:Ts<lower meas.limit,1:Ts>upper meas.limit
bc_ts	CHAR		Best choice code.1 means Ts is best choice of transm.,else 0
transmissivity_tp	FLOAT	m**2/s	TP: Transmissivity based on pulse test, see table descript.
value_type_tp	CHAR		0:true value,-1:Tp<lower meas.limit,1:Tp>upper meas.limit
bc_tp	CHAR		Best choice code.1 means Tp is best choice of transm.,else 0
l_meas_limit_t	FLOAT	m**2	Estimated lower measurement limit for Ts orTp,see descript.
u_meas_limit_t	FLOAT	m**2	Estimated upper measurement limit for Ts & Tp, see descript.
storativity_s	FLOAT		S= Storativity, see table description
assumed_s	FLOAT		S*=assumed storativity, see table description
skin	FLOAT		Skin factor
assumed_skin	FLOAT		Asumed skin factor
c	FLOAT	m**3/pa	Well bore storage coefficient
fluid_temp_tew	FLOAT	oC	Fluid temperature in the test section, see table description
fluid_elcond_ecw	FLOAT	mS/m	Fluid electric conductivity in test section,see table descri
fluid_salinity_tdsw	FLOAT	mg/l	Total salinity of the test section fluid (EC), see descr.
fluid_salinity_tdswm	FLOAT	mg/l	Total salinity of the test section fluid (samples),see descr
dt1	FLOAT	s	Estimated start time of evaluation, see table description
dt2	FLOAT	s	Estimated stop time of evaluation, see table description
reference	CHAR		SKB report No for reports describing data and evaluation
comments	CHAR		Short comment to evaluated parameters

KFM08B plu_s_hole_test_d. Left (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	test_type	Formation_type	start_flow_period	stop_flow_period	flow_rate_end_qp	Value_type_qp	mean_flow_rate_qm
KFM08B	20050608 18:17	20050609 09:26	7.00	12.00	3	1	20050609 08:43:46	20050609 09:04:00	8.16E-07	0	7.94E-07
KFM08B	20050609 09:50	20050609 11:14	9.00	14.00	3	1	20050609 10:31:52	20050609 10:52:06	4.77E-05	0	5.08E-05
KFM08B	20050609 11:30	20050609 13:15	14.00	19.00	3	1	20050609 12:32:51	20050609 12:53:01	8.57E-05	0	9.68E-05
KFM08B	20050609 13:31	20050609 14:46	19.00	24.00	3	1	20050609 14:03:41	20050609 14:23:43	2.43E-04	0	3.99E-04
KFM08B	20050609 15:00	20050609 16:14	24.00	29.00	3	1	20050609 15:32:23	20050609 15:52:26	2.77E-04	0	3.14E-04
KFM08B	20050609 16:28	20050609 17:50	29.00	34.00	3	1	20050609 17:07:58	20050609 17:28:04	3.05E-04	0	3.69E-04
KFM08B	20050610 08:19	20050610 09:41	34.00	39.00	3	1	20050610 08:59:08	20050610 09:19:24	3.72E-07	0	6.18E-07
KFM08B	20050610 09:51	20050610 11:06	39.00	44.00	3	1	20050610 10:23:33	20050610 10:43:49	1.44E-06	0	1.54E-06
KFM08B	20050620 11:17	20050620 12:31	49.00	54.00	3	1	20050620 11:48:43	20050620 12:08:59	3.04E-07	0	4.10E-07
KFM08B	20050610 14:00	20050610 15:15	54.00	59.00	3	1	20050610 14:32:57	20050610 14:53:13	1.47E-07	0	2.82E-07
KFM08B	20050610 15:25	20050610 16:38	59.00	64.00	3	1	20050610 15:56:04	20050610 16:16:21	1.25E-06	0	2.35E-06
KFM08B	20050620 09:43	20050620 10:57	74.00	79.00	3	1	20050620 10:15:19	20050620 10:35:36	1.93E-08	0	9.34E-08
KFM08B	20050613 14:48	20050613 16:07	84.00	89.00	3	1	20050613 15:24:34	20050613 15:44:48	5.62E-07	0	1.71E-06
KFM08B	20050613 16:17	20050613 17:33	89.00	94.00	3	1	20050613 16:50:58	20050613 17:11:12	9.24E-06	0	9.69E-06
KFM08B	20050620 08:16	20050620 09:31	94.00	99.00	3	1	20050620 08:48:48	20050620 09:09:02	6.50E-07	0	7.70E-07
KFM08B	20050614 07:03	20050614 08:36	99.00	104.00	3	1	20050614 07:53:36	20050614 08:13:52	2.82E-07	0	1.80E-06
KFM08B	20050617 15:20	20050617 16:35	104.00	109.00	3	1	20050617 15:52:48	20050617 16:13:02	3.78E-06	0	6.62E-06
KFM08B	20050615 08:22	20050615 09:37	124.00	129.00	3	1	20050615 08:54:29	20050615 09:14:46	1.31E-06	0	4.84E-06
KFM08B	20050617 11:32	20050617 13:07	129.00	134.00	3	1	20050617 12:25:22	20050617 12:45:36	3.23E-08	0	2.11E-07
KFM08B	20050615 14:45	20050615 16:00	144.00	149.00	3	1	20050615 15:17:41	20050615 15:37:55	1.25E-06	0	2.67E-06
KFM08B	20050616 08:10	20050616 09:23	154.00	159.00	3	1	20050616 08:41:04	20050616 09:01:17	5.43E-07	0	3.41E-06
KFM08B	20050616 09:33	20050616 10:49	159.00	164.00	3	1	20050616 10:07:00	20050616 10:27:14	9.62E-08	0	1.36E-07
KFM08B	20050616 10:58	20050616 12:12	164.00	169.00	3	1	20050616 11:30:04	20050616 11:50:18	9.99E-07	0	1.33E-06
KFM08B	20050616 12:31	20050616 13:46	166.00	171.00	3	1	20050616 13:03:32	20050616 13:23:46	4.71E-08	0	8.00E-08
KFM08B	20050616 13:55	20050616 15:08	171.00	176.00	3	1	20050616 14:26:02	20050616 14:46:16	9.13E-08	0	1.35E-07
KFM08B	20050616 15:23	20050616 16:38	176.00	181.00	3	1	20050616 15:56:13	20050616 16:16:29	1.65E-07	0	2.04E-07
KFM08B	20050616 16:48	20050616 18:02	181.00	186.00	3	1	20050616 17:20:07	20050616 17:40:21	1.14E-07	0	1.34E-07
KFM08B	20050617 08:19	20050617 09:34	186.00	191.00	3	1	20050617 08:51:27	20050617 09:11:41	2.70E-07	0	3.36E-07
KFM08B	20050617 09:45	20050617 11:02	191.00	196.00	3	1	20050617 10:19:41	20050617 10:39:54	4.27E-05	0	7.80E-05

KFM08B plu_s_hole_test_d. Right (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	secup	seclow	q_measl__l	q_measl__u	tot_volume_vp	dur_flow_phase_tp	dur_rec_phase_tf	initial_press_pi	press_at_flow_end_pp	final_press_pf	fluid_temp_tew
KFM08B	7.00	12.00	1.7E-08	1.0E-03	9.67E-04	1214	1209	135.67	346.10	140.49	5.88
KFM08B	9.00	14.00	1.7E-08	1.0E-03	6.17E-02	1214	1211	152.20	343.56	169.70	11.08
KFM08B	14.00	19.00	1.7E-08	1.0E-03	1.17E-01	1210	1211	195.73	386.26	198.90	11.39
KFM08B	19.00	24.00	1.7E-08	1.0E-03	4.80E-01	1202	1211	236.93	284.32	255.11	12.26
KFM08B	24.00	29.00	1.7E-08	1.0E-03	3.78E-01	1203	1211	284.86	389.02	292.03	12.49
KFM08B	29.00	34.00	1.7E-08	1.0E-03	4.46E-01	1206	1211	325.64	406.45	344.93	11.47
KFM08B	34.00	39.00	1.7E-08	1.0E-03	7.52E-04	1216	1210	360.91	573.76	421.52	7.03
KFM08B	39.00	44.00	1.7E-08	1.0E-03	1.87E-03	1216	1210	401.14	709.33	404.99	6.98
KFM08B	49.00	54.00	1.7E-08	1.0E-03	4.99E-04	1216	1210	484.35	678.02	519.61	6.98
KFM08B	54.00	59.00	1.7E-08	1.0E-03	3.43E-04	1216	1210	528.57	713.59	598.41	6.99
KFM08B	59.00	64.00	1.7E-08	1.0E-03	2.87E-03	1217	1208	566.74	741.82	621.56	7.00
KFM08B	74.00	79.00	1.7E-08	1.0E-03	1.14E-04	1217	1211	697.33	891.03	861.26	7.06
KFM08B	84.00	89.00	1.7E-08	1.0E-03	2.07E-03	1214	1211	778.74	974.23	902.60	7.12
KFM08B	89.00	94.00	1.7E-08	1.0E-03	1.18E-02	1214	1211	817.31	1017.76	856.86	7.09
KFM08B	94.00	99.00	1.7E-08	1.0E-03	9.37E-04	1214	1210	859.06	1115.57	862.93	7.16
KFM08B	99.00	104.00	1.7E-08	1.0E-03	2.22E-03	1216	1194	905.35	1114.14	1084.98	7.19
KFM08B	104.00	109.00	1.7E-08	1.0E-03	8.07E-03	1214	1208	942.13	1091.34	996.82	7.19
KFM08B	124.00	129.00	1.7E-08	1.0E-03	5.97E-03	1217	1194	1110.34	1242.00	1205.12	7.32
KFM08B	129.00	134.00	1.7E-08	1.0E-03	2.57E-04	1214	1210	1151.95	1366.72	1340.13	7.38
KFM08B	144.00	149.00	1.7E-08	1.0E-03	3.25E-03	1214	1211	1277.31	1481.61	1406.80	7.46
KFM08B	154.00	159.00	1.7E-08	1.0E-03	4.18E-03	1213	1200	1358.87	1493.27	1471.28	7.52
KFM08B	159.00	164.00	1.7E-08	1.0E-03	1.65E-04	1214	1210	1397.99	1595.96	1418.39	7.58
KFM08B	164.00	169.00	1.7E-08	1.0E-03	1.61E-03	1214	1211	1439.87	1636.04	1474.59	7.59
KFM08B	166.00	171.00	1.7E-08	1.0E-03	9.77E-05	1214	1206	1460.81	1685.69	1526.39	7.61
KFM08B	171.00	176.00	1.7E-08	1.0E-03	1.65E-04	1214	1210	1499.94	1710.99	1537.41	7.64
KFM08B	176.00	181.00	1.7E-08	1.0E-03	2.48E-04	1216	1211	1538.78	1792.51	1548.97	7.67
KFM08B	181.00	186.00	1.7E-08	1.0E-03	1.63E-04	1214	1211	1579.84	1790.20	1589.75	7.70
KFM08B	186.00	191.00	1.7E-08	1.0E-03	4.09E-04	1214	1211	1619.65	1825.20	1645.96	7.75
KFM08B	191.00	196.00	1.7E-08	1.0E-03	9.48E-02	1213	1211	1656.43	1882.78	1735.79	7.50

KFM08B plu_s_hole_test_ed1. Left (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	spec_capacity_q_s	value_type_q_s	transmissivity_moye	bc_tm	value_type_tm	hydr_cond_moye	formation_width_b
KFM08B	20050608 18:17	20050609 09:26	7.00	12.00	3	1	3.81E-08	0	3.14E-08	0	0	6.28E-09	5.00
KFM08B	20050609 09:50	20050609 11:14	9.00	14.00	3	1	2.45E-06	0	2.02E-06	0	0	4.04E-07	5.00
KFM08B	20050609 11:30	20050609 13:15	14.00	19.00	3	1	4.41E-06	0	3.64E-06	0	0	7.28E-07	5.00
KFM08B	20050609 13:31	20050609 14:46	19.00	24.00	3	1	5.04E-05	0	4.16E-05	0	0	8.31E-06	5.00
KFM08B	20050609 15:00	20050609 16:14	24.00	29.00	3	1	2.61E-05	0	2.15E-05	0	0	4.31E-06	5.00
KFM08B	20050609 16:28	20050609 17:50	29.00	34.00	3	1	3.71E-05	0	3.06E-05	0	0	6.12E-06	5.00
KFM08B	20050610 08:19	20050610 09:41	34.00	39.00	3	1	1.72E-08	0	1.42E-08	0	0	2.83E-09	5.00
KFM08B	20050610 09:51	20050610 11:06	39.00	44.00	3	1	4.57E-08	0	3.77E-08	0	0	7.55E-09	5.00
KFM08B	20050620 11:17	20050620 12:31	49.00	54.00	3	1	1.54E-08	0	1.27E-08	0	0	2.54E-09	5.00
KFM08B	20050610 14:00	20050610 15:15	54.00	59.00	3	1	7.79E-09	0	6.43E-09	0	0	1.29E-09	5.00
KFM08B	20050610 15:25	20050610 16:38	59.00	64.00	3	1	7.00E-08	0	5.78E-08	0	0	1.16E-08	5.00
KFM08B	20050620 09:43	20050620 10:57	74.00	79.00	3	1	9.76E-10	0	8.05E-10	0	0	1.61E-10	5.00
KFM08B	20050613 14:48	20050613 16:07	84.00	89.00	3	1	2.82E-08	0	2.33E-08	0	0	4.65E-09	5.00
KFM08B	20050613 16:17	20050613 17:33	89.00	94.00	3	1	4.53E-07	0	3.73E-07	0	0	7.47E-08	5.00
KFM08B	20050620 08:16	20050620 09:31	94.00	99.00	3	1	2.49E-08	0	2.05E-08	0	0	4.11E-09	5.00
KFM08B	20050614 07:03	20050614 08:36	99.00	104.00	3	1	1.33E-08	0	1.09E-08	0	0	2.19E-09	5.00
KFM08B	20050617 15:20	20050617 16:35	104.00	109.00	3	1	2.48E-07	0	2.05E-07	0	0	4.10E-08	5.00
KFM08B	20050615 08:22	20050615 09:37	124.00	129.00	3	1	9.76E-08	0	8.06E-08	0	0	1.61E-08	5.00
KFM08B	20050617 11:32	20050617 13:07	129.00	134.00	3	1	1.48E-09	0	1.22E-09	0	0	2.44E-10	5.00
KFM08B	20050615 14:45	20050615 16:00	144.00	149.00	3	1	6.00E-08	0	4.95E-08	0	0	9.91E-09	5.00
KFM08B	20050616 08:10	20050616 09:23	154.00	159.00	3	1	3.97E-08	0	3.27E-08	0	0	6.55E-09	5.00
KFM08B	20050616 09:33	20050616 10:49	159.00	164.00	3	1	4.77E-09	0	3.94E-09	0	0	7.87E-10	5.00
KFM08B	20050616 10:58	20050616 12:12	164.00	169.00	3	1	5.00E-08	0	4.12E-08	0	0	8.25E-09	5.00
KFM08B	20050616 12:31	20050616 13:46	166.00	171.00	3	1	2.06E-09	0	1.70E-09	0	0	3.39E-10	5.00
KFM08B	20050616 13:55	20050616 15:08	171.00	176.00	3	1	4.24E-09	0	3.50E-09	0	0	7.00E-10	5.00
KFM08B	20050616 15:23	20050616 16:38	176.00	181.00	3	1	6.37E-09	0	5.26E-09	0	0	1.05E-09	5.00
KFM08B	20050616 16:48	20050616 18:02	181.00	186.00	3	1	5.29E-09	0	4.37E-09	0	0	8.74E-10	5.00
KFM08B	20050617 08:19	20050617 09:34	186.00	191.00	3	1	1.29E-08	0	1.06E-08	0	0	2.12E-09	5.00
KFM08B	20050617 09:45	20050617 11:02	191.00	196.00	3	1	1.85E-06	0	1.53E-06	0	0	3.06E-07	5.00

KFM08B plu_s_hole_test_ed1. Right (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	bc_s	ri	ri_index	c	skin	t1	t2	dte1	dte2
KFM08B	7.00	12.00	2.22E-08	0	1	7.8E-10	5.0E-04	1.04E-07	1.04E-07	24.06	-1		-2.08				
KFM08B	9.00	14.00	2.35E-06	0	1	8.5E-10	5.0E-04	1.07E-06	1.07E-06	76.90	0		-1.66	300	1200		
KFM08B	14.00	19.00	2.93E-06	0	1	8.6E-10	5.0E-04	1.20E-06	1.20E-06	81.22	0		-3.63	200	1200		
KFM08B	19.00	24.00	1.11E-05	0	1	3.5E-09	5.0E-04	2.33E-06	2.33E-06	113.78	1						
KFM08B	24.00	29.00	6.97E-06	0	1	1.6E-09	5.0E-04	1.85E-06	1.85E-06	101.04	-1		-5.84				
KFM08B	29.00	34.00	1.58E-05	0	1	2.0E-09	5.0E-04	2.78E-06	2.78E-06	123.80	0		-5.61	200	1200		
KFM08B	34.00	39.00	5.14E-09	0	1	7.7E-10	5.0E-04	5.02E-08	5.02E-08	16.63	0		-4.50	500	1200		
KFM08B	39.00	44.00	4.99E-08	0	1	5.3E-10	5.0E-04	1.56E-07	1.56E-07	29.55	-1		0.35				
KFM08B	49.00	54.00	2.74E-08	0	1	8.4E-10	5.0E-04	1.16E-07	1.16E-07	6.52	1		0.65			20	80
KFM08B	54.00	59.00	1.19E-09	0	1	8.8E-10	5.0E-04	2.41E-08	2.41E-08	11.60	1						
KFM08B	59.00	64.00	3.38E-08	0	1	9.3E-10	5.0E-04	1.29E-07	1.29E-07	26.83	0		-3.79				
KFM08B	74.00	79.00	1.90E-09	0	1	8.4E-10	5.0E-04	3.05E-08	3.05E-08	13.03	0	3.92E-10	-5.24				
KFM08B	84.00	89.00	1.16E-08	0	1	8.4E-10	5.0E-04	7.53E-08	7.53E-08	20.46	1						
KFM08B	89.00	94.00	2.73E-07	0	1	8.2E-10	5.0E-04	3.66E-07	3.66E-07	45.15	-1		-2.81				
KFM08B	94.00	99.00	1.02E-08	0	1	6.4E-10	5.0E-04	7.06E-08	7.06E-08	19.73	0		-3.86	300	1200		
KFM08B	99.00	104.00	3.39E-08	0	1	7.8E-10	5.0E-04	1.29E-07	1.29E-07	26.57	1		-5.96				
KFM08B	104.00	109.00	6.33E-08	0	1	1.1E-09	5.0E-04	1.76E-07	1.76E-07	31.15	0		-5.49	100	1200		
KFM08B	124.00	129.00	5.26E-08	0	1	1.2E-09	5.0E-04	1.61E-07	1.61E-07	29.67	1						
KFM08B	129.00	134.00	2.53E-08	0	1	7.6E-10	5.0E-04	1.11E-07	1.11E-07	7.15	1		1.29	10	100		
KFM08B	144.00	149.00	4.18E-08	0	1	8.0E-10	5.0E-04	1.43E-07	1.43E-07	28.21	1		-5.35				
KFM08B	154.00	159.00	1.01E-07	0	1	1.2E-09	5.0E-04	2.22E-07	2.22E-07	34.97	1						
KFM08B	159.00	164.00	1.41E-09	0	1	8.3E-10	5.0E-04	2.63E-08	2.63E-08	12.04	0	1.09E-10	-4.05	300	1200		
KFM08B	164.00	169.00	2.19E-08	0	1	8.3E-10	5.0E-04	1.04E-07	1.04E-07	23.89	0	6.74E-10	-3.90	40	1200		
KFM08B	166.00	171.00	5.28E-10	0	1	7.3E-10	5.0E-04	1.61E-08	1.61E-08	9.47	-1	1.50E-10	-3.74				
KFM08B	171.00	176.00	9.49E-10	0	1	7.7E-10	5.0E-04	2.16E-08	2.16E-08	10.96	-1	1.88E-10	-4.17				
KFM08B	176.00	181.00	5.11E-09	0	1	6.4E-10	5.0E-04	5.00E-08	5.00E-08	16.60	0		-1.31	100	1200		
KFM08B	181.00	186.00	5.56E-09	0	1	7.8E-10	5.0E-04	5.22E-08	5.22E-08	16.96	0	6.61E-11	0.53	100	1200		
KFM08B	186.00	191.00	7.13E-09	0	1	8.0E-10	5.0E-04	5.91E-08	5.91E-08	18.05	0		-3.05	100	1200		
KFM08B	191.00	196.00	2.77E-07	0	1	7.2E-10	5.0E-04	3.68E-07	3.68E-07	45.28	0						

KFM08B plu_s_hole_test_obs (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM08B	20050608 18:17	20050609 09:26	7.00	12.00	5.58	6.00	125.37	125.23	125.65				
KFM08B	20050608 18:17	20050609 09:26	7.00	12.00	13.00	200.54				177.99	177.99	177.99	
KFM08B	20050609 09:50	20050609 11:14	9.00	14.00	5.58	8.00	125.46	125.19	125.87				
KFM08B	20050609 09:50	20050609 11:14	9.00	14.00	15.00	200.54				194.83	197.16	196.06	
KFM08B	20050609 11:30	20050609 13:15	14.00	19.00	5.58	13.00	126.29	126.43	126.70				
KFM08B	20050609 11:30	20050609 13:15	14.00	19.00	20.00	200.54				235.51	242.63	238.79	
KFM08B	20050609 13:31	20050609 14:46	19.00	24.00	5.58	18.00	126.98	145.91	145.09				
KFM08B	20050609 13:31	20050609 14:46	19.00	24.00	25.00	200.54				278.24	293.85	287.55	
KFM08B	20050609 15:00	20050609 16:14	24.00	29.00	5.58	23.00	133.85	145.91	140.44				
KFM08B	20050609 15:00	20050609 16:14	24.00	29.00	30.00	200.54				324.81	342.48	330.29	
KFM08B	20050609 16:28	20050609 17:50	29.00	34.00	5.58	28.00	133.32	145.66	139.63				
KFM08B	20050609 16:28	20050609 17:50	29.00	34.00	35.00	200.54				356.59	356.45	365.36	
KFM08B	20050610 08:19	20050610 09:41	34.00	39.00	5.58	33.00	122.35	122.35	122.90				
KFM08B	20050610 08:19	20050610 09:41	34.00	39.00	40.00	200.54				397.67	397.13	400.41	
KFM08B	20050610 09:51	20050610 11:06	39.00	44.00	5.58	38.00	122.64	122.64	122.64				
KFM08B	20050610 09:51	20050610 11:06	39.00	44.00	45.00	200.54				452.32	449.85	439.31	
KFM08B	20050620 11:17	20050620 12:31	49.00	54.00	5.58	48.00	121.69	121.97	122.11				
KFM08B	20050620 11:17	20050620 12:31	49.00	54.00	55.00	200.54				511.62	511.62	512.16	
KFM08B	20050610 14:00	20050610 15:15	54.00	59.00	5.58	53.00	122.38	122.38	122.38				
KFM08B	20050610 14:00	20050610 15:15	54.00	59.00	60.00	200.54				561.88	561.74	561.47	
KFM08B	20050610 15:25	20050610 16:38	59.00	64.00	5.58	58.00	122.12	122.12	122.12				
KFM08B	20050610 15:25	20050610 16:38	59.00	64.00	65.00	200.54				604.07	603.65	603.65	
KFM08B	20050620 09:43	20050620 10:57	74.00	79.00	5.58	73.00	121.60	121.33	121.33				
KFM08B	20050620 09:43	20050620 10:57	74.00	79.00	80.00	200.54				725.83	715.97	715.41	
KFM08B	20050613 14:48	20050613 16:07	84.00	89.00	5.58	83.00	122.03	121.89	121.89				
KFM08B	20050613 14:48	20050613 16:07	84.00	89.00	90.00	200.54				817.86	817.73	817.86	
KFM08B	20050613 16:17	20050613 17:33	89.00	94.00	5.58	88.00	121.62	121.62	121.08				
KFM08B	20050613 16:17	20050613 17:33	89.00	94.00	95.00	200.54				859.63	859.50	858.94	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM08B	20050620 08:16	20050620 09:31	94.00	99.00	5.58	93.00	120.40	120.81	120.81				
KFM08B	20050620 08:16	20050620 09:31	94.00	99.00	100.00	200.54				900.58	900.58	900.58	
KFM08B	20050614 07:03	20050614 08:36	99.00	104.00	5.58	98.00	121.10	120.96	121.10				
KFM08B	20050614 07:03	20050614 08:36	99.00	104.00	105.00	200.54				930.31	925.24	926.88	
KFM08B	20050617 15:20	20050617 16:35	104.00	109.00	5.58	103.00	120.01	119.73	119.73				
KFM08B	20050617 15:20	20050617 16:35	104.00	109.00	110.00	200.54				984.41	984.41	983.31	
KFM08B	20050615 08:22	20050615 09:37	124.00	129.00	5.58	123.00	118.94	118.53	118.67				
KFM08B	20050615 08:22	20050615 09:37	124.00	129.00	130.00	200.54				1151.49	1150.94	1150.94	
KFM08B	20050617 11:32	20050617 13:07	129.00	134.00	5.58	128.00	117.99	117.86	117.86				
KFM08B	20050617 11:32	20050617 13:07	129.00	134.00	135.00	200.54				1193.68	1193.68	1193.68	
KFM08B	20050615 14:45	20050615 16:00	144.00	149.00	5.58	143.00	117.20	116.92	117.06				
KFM08B	20050615 14:45	20050615 16:00	144.00	149.00	150.00	200.54				1316.94	1317.08	1316.94	
KFM08B	20050616 08:10	20050616 09:23	154.00	159.00	5.58	153.00	115.57	115.44	115.44				
KFM08B	20050616 08:10	20050616 09:23	154.00	159.00	160.00	200.54				1399.12	1399.39	1399.12	
KFM08B	20050616 09:33	20050616 10:49	159.00	164.00	5.58	158.00	115.03	114.61	114.61				
KFM08B	20050616 09:33	20050616 10:49	159.00	164.00	165.00	200.54				1440.62	1440.20	1440.20	
KFM08B	20050616 10:58	20050616 12:12	164.00	169.00	5.58	163.00	114.35	114.35	114.35				
KFM08B	20050616 10:58	20050616 12:12	164.00	169.00	170.00	200.54				1481.57	1481.85	1481.85	
KFM08B	20050616 12:31	20050616 13:46	166.00	171.00	5.58	165.00	114.03	114.03	114.03				
KFM08B	20050616 12:31	20050616 13:46	166.00	171.00	172.00	200.54				1498.28	1497.87	1497.73	
KFM08B	20050616 13:55	20050616 15:08	171.00	176.00	5.58	170.00	113.22	113.08	113.22				
KFM08B	20050616 13:55	20050616 15:08	171.00	176.00	177.00	200.54				1539.36	1538.82	1538.82	
KFM08B	20050616 15:23	20050616 16:38	176.00	181.00	5.58	175.00	112.54	112.27	111.86				
KFM08B	20050616 15:23	20050616 16:38	176.00	181.00	182.00	200.54				1579.90	1579.90	1579.90	
KFM08B	20050616 16:48	20050616 18:02	181.00	186.00	5.58	180.00	111.17	111.17	111.03				
KFM08B	20050616 16:48	20050616 18:02	181.00	186.00	187.00	200.54				1620.99	1620.99	1620.99	
KFM08B	20050617 08:19	20050617 09:34	186.00	191.00	5.58	185.00	109.13	109.27	109.67				
KFM08B	20050617 08:19	20050617 09:34	186.00	191.00	192.00	200.54				1661.53	1661.53	1661.53	
KFM08B	20050617 09:45	20050617 11:02	191.00	196.00	5.58	190.00	108.45	108.31	108.31				
KFM08B	20050617 09:45	20050617 11:02	191.00	196.00	197.00	200.54				1705.63	1782.74	1738.23	

KFM08B plu_pulse test_ed. Left (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	start_date	stop_date	secup	seclow	test_type	formation_type	start_flow_period	dur_flow_phase_tp	dur_rec_phase_tf	initial_press_pi	press_change_dp0_p	press_at_flow_end_pp
KFM08B	2005-06-10 11:16	2005-06-10 13:05	44.00	49.00	4B	1	2005-06-10 12:21	140.00	2421.00	450.18	307.09	757.27
KFM08B	2005-06-10 16:46	2005-06-10 18:32	64.00	69.00	4B	1	2005-06-10 17:47	134.00	2422.00	609.99	200.85	810.84
KFM08B	2005-06-13 09:06	2005-06-13 10:25	69.00	74.00	4B	1	2005-06-13 10:10	127.00	630.00	651.32	215.46	866.78
KFM08B	2005-06-13 12:44	2005-06-13 14:33	79.00	84.00	4B	1	2005-06-13 13:49	133.00	2421.00	735.08	231.99	967.07
KFM08B	2005-06-14 10:30	2005-06-14 11:31	109.00	114.00	4B	1	2005-06-14 11:16	126.00	644.00	984.15	152.64	1136.79
KFM08B	2005-06-14 11:42	2005-06-14 13:52	114.00	119.00	4B	1	2005-06-14 13:08	126.00	2422.00	1026.58	185.57	1212.15
KFM08B	2005-06-17 13:20	2005-06-17 15:06	119.00	124.00	4B	1	2005-06-17 14:21	135.00	2410.00	1065.70	220.15	1285.85
KFM08B	2005-06-15 10:49	2005-06-15 12:34	134.00	139.00	4B	1	2005-06-15 11:49	136.00	2421.00	1191.90	198.92	1390.82
KFM08B	2005-06-15 12:50	2005-06-15 14:36	139.00	144.00	4B	1	2005-06-15 13:51	134.00	2422.00	1232.67	202.11	1434.78
KFM08B	2005-06-15 16:08	2005-06-15 17:23	149.00	154.00	4B	1	2005-06-15 17:09	126.00	621.00	1315.89	278.00	1593.89

KFM08B plu_pulse test_ed. Right (This result table to SICADA includes more columns which are empty, these columns are not presented here.)

idcode	secup	seclow	final_press_pf	formation_width_b	transmissivity_tp	value_type_tp	bc_tp	l_meas_limit_t	assumed_s	skin	fluid_temp_tew
KFM08B	44.00	49.00	660.68	5.00	9.06E-11	-1	1	9.06000E-11	6.66E-09		6.97
KFM08B	64.00	69.00	732.88	5.00	1.64E-10	-1	1	1.64000E-10	8.96E-09		7.05
KFM08B	69.00	74.00	882.21	5.00	5.00E-11	-1	1	5.00000E-11	4.95E-09		7.06
KFM08B	79.00	84.00	956.04	5.00	6.01E-11	-1	1	6.01000E-11	5.43E-09		7.09
KFM08B	109.00	114.00	1184.18	5.00	5.00E-11	-1	1	5.00000E-11	4.95E-09		7.27
KFM08B	114.00	119.00	1125.77	5.00	1.26E-10	-1	1	1.26000E-10	7.86E-09		7.29
KFM08B	119.00	124.00	1119.16	5.00	2.26E-10	-1	1	2.26000E-10	1.05E-08		7.31
KFM08B	134.00	139.00	1233.23	5.00	1.40E-10	-1	1	1.40000E-10	8.28E-09		7.40
KFM08B	139.00	144.00	1356.11	5.00	9.37E-11	-1	1	9.37000E-11	6.78E-09		7.43
KFM08B	149.00	154.00	1644.86	5.00	5.00E-11	-1	1	5.00000E-11	4.95E-09		7.50