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Forsmark site investigation

Single-hole injection tests in borehole KFM05A

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March 2005

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Abstract

Borehole KFM05A is the fifth deep core-drilled borehole within the site investigations in the Forsmark area. It is designed as a so called telescopic borehole, with an enlarged diameter in the upper approximately 100 m, which makes it possible to install certain borehole equipment. The borehole is inclined c 60° from the horizontal plane, about 1,000 m long and cased to about 110 m borehole length. The borehole diameter is about 77 mm in the interval 110–1,000 m.

This report presents performance and results from the injection tests in borehole KFM05A, using the pipe string system PSS3.

The main aim of the injection tests in KFM05A was to characterize the hydraulic conditions of the rock adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m). Hydraulic parameters such as transmissivity and hydraulic conductivity were determined using analysis methods for stationary as well as transient conditions together with the dominating flow regime and possible outer hydraulic boundaries. In addition, a comparison with the results of previously performed difference flow logging was made.

The injection tests gave consistent results on the different measurement scales regarding transmissivity. During most of the tests, some period with pseudo-radial flow could be identified from the injection period, making a relatively straight-forward transient evaluation possible. However, the recovery periods were often strongly affected by wellbore storage, making a transient evaluation of this period more difficult.

The injection test results were generally consistent with the results from the previous difference flow logging in KFM05A, despite some discrepancies in calculated transmissivities in 5 m sections.

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

Sammanfattning

Borrhål KFM05A är det femte kärnborrhålet i platsundersökningarna i Forsmarksområdet. Det är utfört som ett så kallat teleskopborrhål för att göra det möjligt att installera viss borrhålsutrustning i de övre, ca 100 m med större diameter än resten av borrhålet. Borrhålet är ansatt med en lutning av ca 60° från horisontalplanet, är drygt 1 000 m långt och försett med foderrör till ca 110 m. Borrhålsdiametern är ca 77 mm i intervallet 110–1 000 m.

Föreliggande rapport beskriver genomförda injektionstester med rörgångssystemet PSS3 i borrhål KFM05A samt resultaten från desamma.

Huvudsyftet med injektionstesterna var att karaktärisera de hydrauliska förhållandena av berget i anslutning till borrhålet i olika mätskalor (100 m, 20 m och 5 m). Hydrauliska parametrar såsom transmissivitet och hydraulisk konduktivitet bestämdes med hjälp av analysmetoder för såväl stationära som transienta förhållanden tillsammans med dominerande flödesregim och eventuella yttre hydrauliska randvillkor.

En jämförelse med resultaten av den tidigare utförda differensflödesloggningen i KFM05A gjordes också.

Injektionstesterna gav samstämmiga resultat för de olika mätskalorna beträffande transmissivitet. Under de flesta tester kunde en viss period med pseudo-radiellt flöde identifieras från flödesperioden, vilket möjliggjorde en standardmässig transient utvärdering. Återhämtningsperioden var däremot ofta starkt påverkad av brunnsmagasinseffekter, vilket gjorde en unik transient utvärdering av denna period svårare.

Injektionstesterna gav även över lag samstämmiga resultat med den tidigare utförda differensflödesloggningen i KFM05A, även om vissa avvikelser fanns för beräknade transmissiviteter i samma 5 m sektioner.

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

Contents

1 Introduction

The injection tests in borehole KFM05A at Forsmark, Sweden, were carried out during December of 2004 and January of 2005 by GEOSIGMA AB. The borehole KFM05A was the fifth deep cored borehole within the on-going site investigation in the Forsmark area. The borehole is a so called telescopic borehole. This makes it possible to install certain borehole equipment in the upper c 100 m where the diameter is larger than in the rest of the borehole. The borehole is inclined c 60° from the horizontal plane, about 1,000 m long and cased to about 110 m borehole length. The borehole diameter is c 77 mm in the interval 110.10–1,002.71 m. The location of the borehole is shown in Figure 1-1.

In KFM05A, difference flow logging was previously performed during May and June in 2004. According to the results of this investigation, 27 conductive fractures were detected and the most conductive ones were found at 108.9, 110.1 and 111.6 m borehole length. Below 264.4 m, no flowing fractures were identified, except for two small fractures at 702.7 m and 720 m Pöllänen et al. (2004) /1/.

This document reports the results obtained from the injection tests in borehole KFM05A. 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.

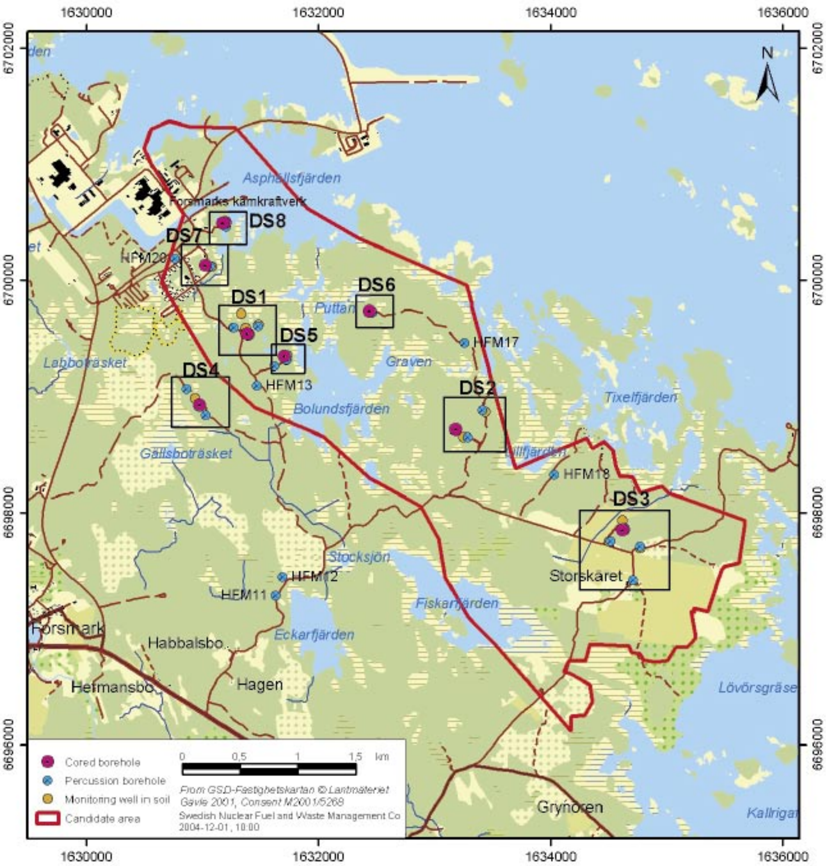

Figure 1-1. *The investigation area at Forsmark including the candidate area selected for more detailed investigations. Borehole KFM05A is situated at drill site DS5.*

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

Activity Plan	Number	Version
Hydraulic injection tests in borehole KFM05A with PSS3	AP PF 400-04-111	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
Allmänna ordnings-, skydd- och miljöregler för platsundersökningar Forsmark	SDPF-003-s	5.0

2 Objectives

The main aim of the injection tests in borehole KFM05A was to characterize the hydraulic properties of the rock adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m). The primary parameter to be determined was hydraulic transmissivity from which hydraulic conductivity can be derived. The results of the injection tests provide a database which can be used for statistical analyses of the hydraulic conductivity distribution along the borehole on different measurement scales. Basic statistical analyses are presented in this report.

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.

A comparison with the results of the previously performed difference flow logging in KFM05A was also included in the activity, as a check of the plausibility of the test results. Further, the combined analysis of the injection tests and the difference flow logging provides a more comprehensive understanding of the hydraulic conditions of borehole KFM05A.

3 Scope

3.1 Borehole data

Technical data of the tested borehole are shown in Table 3-1 and in Appendix 4. The reference point of the boreholes 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 the borehole KFM05A (printout from SKB database, SICADA).

Borehole length (m):	**1,002.710**				
Drilling Period(s):	**From Date**	**To Date**	**Secup (m)**	**Seclow (m)**	**Drilling Type**
	2003-11-23	2003-12-16	0.000	100.350	Percussion d.
	2003-11-25	2004-05-05	100.350	1,002.710	Core drilling
Starting point coordinate:	**Length (m)**	**Northing (m)**	**Easting (m)**	**Elevation**	**Coord System**
	0.000	6699344.850	1631710.804	5.528	RT90-RHB70
Angles:	**Length (m)**	**Bearing**	**Inclination (– = down)**		
	0.000	80.897	–59.804		
Borehole diameter:	**Secup (m)**	**Seclow (m)**	**Hole Diam (m)**		
	0.000	12.250	0.340		
	12.250	100.300	0.244		
	100.300	100.350	0.164		
	100.350	110.100	0.086		
	110.100	1,002.710	0.077		
Core diameter:	**Secup (m)**	**Seclow (m)**	**Core Diam (m)**		
	100.350	101.900	0.072		
	101.900	1,002.710	0.051		
Casing diameter:	**Secup (m)**	**Seclow (m)**	**Case In (m)**	**Case Out (m)**	
	0.000	100.020	0.200	0.208	
	0.000	12.250	0.310	0.324	
	0.190	12.250	0.309	0.324	
	100.020	100.070	0.170	0.208	
	100.020	100.070	0.170	0.208	

3.2 Tests performed

The injection tests in borehole KFM05A, performed according to Activity Plan AP PF 400-04-111, see Table 1-1 are listed in Table 3-2. The injection 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, see Table 1-1).

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.

In test section 284–289 m, five tests were evaluated. The last four tests were conducted using different injection pressures (50, 100, 200 and 300 kPa) and are presented last in Table 3-2. These tests were performed in order to investigate the relationship between injection pressure and flow rate, indications of possible turbulence and observed differences between the results from the injection period and the recovery period. The results from the routine evaluation of these tests are presented in Table 6-2 and at the bottom in Appendix 3 and not in other figures and tables in this report. The detailed results from the above mentioned investigation may be covered in a separate report later on.

The upper and lower packer positions for the injection test sections were as close as possible to the section limits used during the previous difference flow logging in 5 m sections in KFM05A /1/. However, in the difference flow logging in KFM05A, the measurement sections in the borehole turned out to be slightly longer than 5 m after the length calibration of the measurements. In addition, some of the injection test sections were shifted intentionally from the section limits used during the difference flow logging in order to avoid cavities in the borehole. Therefore, the section limits used for the injection tests and difference flow logging respectively differed with a maximum of 2.43 m along the borehole. However, in the upper part of the borehole, c 116–177 m, where the difference flow logging registered most of the flow into the borehole, the maximum difference was only 0.08 m.

Table 3-2. Single-hole injection tests performed in borehole KFM05A.

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
KFM05A	116.5	216.5	100	3	1	20041213 11:35	20041213 15:05
KFM05A	216.5	316.5	100	3	3	20041222 06:37	20041222 08:29
KFM05A	316.5	416.5	100	3	1	20041214 11:06	20041214 12:57
KFM05A	416.5	516.5	100	3	1	20041214 14:43	20041214 16:37
KFM05A	516.5	616.5	100	3	1	20041215 09:03	20041215 10:57
KFM05A	606.5	706.5	100	3	1	20041215 13:18	20041215 15:08
KFM05A	686.5	786.5	100	3	1	20041220 14:31	20041220 16:27
KFM05A	706.5	806.5	100	3	2	20041216 08:39	20041216 10:47
KFM05A	806.5	906.5	100	3	1	20041216 14:44	20041216 15:57
KFM05A	886.5	986.5	100	3	1	20041220 08:16	20041220 10:14
KFM05A	116.5	136.5	20	3	1	20050104 06:57	20050104 08:35
KFM05A	136.5	156.5	20	3	1	20050104 09:02	20050104 10:27

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
KFM05A	156.5	176.5	20	3	1	20050104 10:51	20050104 13:05
KFM05A	176.5	196.5	20	3	1	20050104 13:38	20050104 14:44
KFM05A	196.5	216.5	20	3	1	20050105 08:18	20050105 09:46
KFM05A	214	234	20	3	1	20050105 10:08	20050105 11:25
KFM05A	234	254	20	3	1	20050105 11:55	20050105 13:20
KFM05A	254	274	20	3	3	20050111 12:38	20050111 13:54
KFM05A	274	294	20	3	2	20050110 10:11	20050110 11:29
KFM05A	294	314	20	3	1	20050110 11:53	20050110 13:43
KFM05A	296.5	316.5	20	3	1	20050110 13:56	20050110 14:38
KFM05A	416.5	436.5	20	3	1	20050110 15:57	20050110 17:18
KFM05A	436.5	456.5	20	3	1	20050110 17:47	20050110 19:04
KFM05A	456.5	476.5	20	3	1	20050111 06:29	20050111 07:13
KFM05A	476.5	496.5	20	3	1	20050111 07:35	20050111 08:20
KFM05A	496.5	516.5	20	3	1	20050111 08:41	20050111 09:28
KFM05A	116.5	121.5	5	3	2	20050120 11:09	20050120 13:14
KFM05A	121.5	126.5	5	3	1	20050113 14:11	20050113 15:33
KFM05A	126.5	131.5	5	3	1	20050113 15:46	20050113 17:12
KFM05A	131.5	136.5	5	3	3	20050120 09:41	20050120 10:56
KFM05A	136.5	141.5	5	3	1	20050114 08:45	20050114 09:35
KFM05A	141.5	146.5	5	3	2	20050120 08:12	20050120 09:27
KFM05A	146.5	151.5	5	3	1	20050114 11:15	20050114 13:04
KFM05A	151.5	156.5	5	3	1	20050114 13:13	20050114 14:29
KFM05A	156.5	161.5	5	3	1	20050114 14:38	20050114 15:52
KFM05A	161.5	166.5	5	3	1	20050117 09:47	20050117 11:12
KFM05A	166.5	171.5	5	3	2	20050120 06:34	20050120 07:51
KFM05A	171.5	176.5	5	3	1	20050117 13:06	20050117 14:24
KFM05A	214	219	5	3	1	20050117 14:58	20050117 15:43
KFM05A	219	224	5	3	1	20050117 15:58	20050117 17:14
KFM05A	224	229	5	3	1	20050117 17:31	20050117 18:45
KFM05A	229	234	5	3	1	20050117 18:58	20050117 19:40
KFM05A	254	259	5	3	1	20050118 06:50	20050118 08:06
KFM05A	259	264	5	3	1	20050118 08:20	20050118 09:14
KFM05A	264	269	5	3	1	20050118 09:29	20050118 10:50
KFM05A	269	274	5	3	1	20050118 11:04	20050118 12:30
KFM05A	274	279	5	3	1	20050118 12:40	20050118 13:23
KFM05A	279	284	5	3	1	20050118 13:39	20050118 14:20
KFM05A	284	289	5	3	1	20050118 14:29	20050118 15:43
KFM05A	289	294	5	3	1	20050119 09:44	20050119 10:41
KFM05A	294	299	5	3	1	20050119 11:07	20050119 12:21
KFM05A	416.5	421.5	5	3	1	20050119 13:58	20050119 15:16
KFM05A	421.5	426.5	5	3	1	20050119 15:29	20050119 16:12
KFM05A	426.5	431.5	5	3	1	20050119 16:24	20050119 17:38
KFM05A	431.5	436.5	5	3	1	20050119 17:57	20050119 18:38
KFM05A	284	289	5	3	3	20050124 12:49	20050124 14:06
KFM05A	284	289	5	3	4	20050124 14:11	20050124 15:26
KFM05A	284	289	5	3	5	20050124 15:31	20050124 16:45
KFM05A	284	289	5	3	6	20050124 16:48	20050124 18:04

[1] 3: Injection test3

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 December 2004.

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. The temperature sensor, however, stopped working properly during the 20 m tests and was replaced before the start of the 5 m tests.

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.

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.

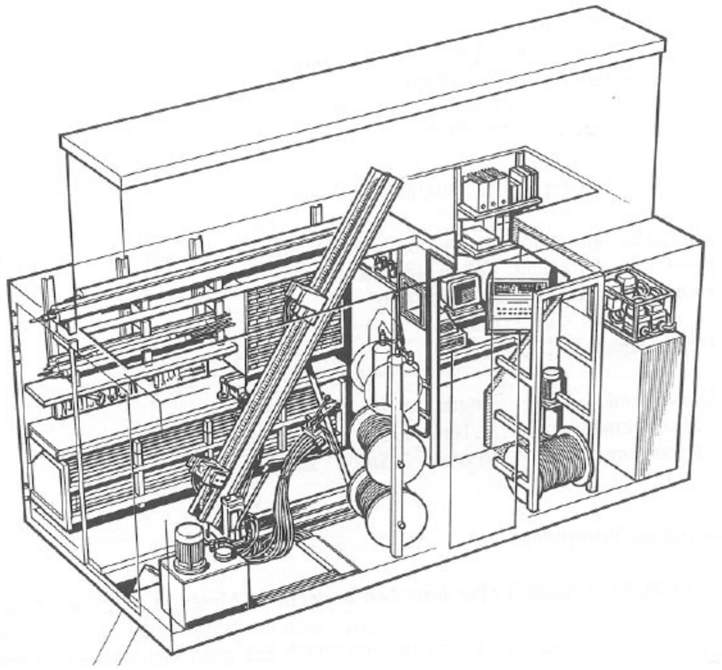

Figure 4-1. *Outline of the PSS3 container with equipment.*

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).

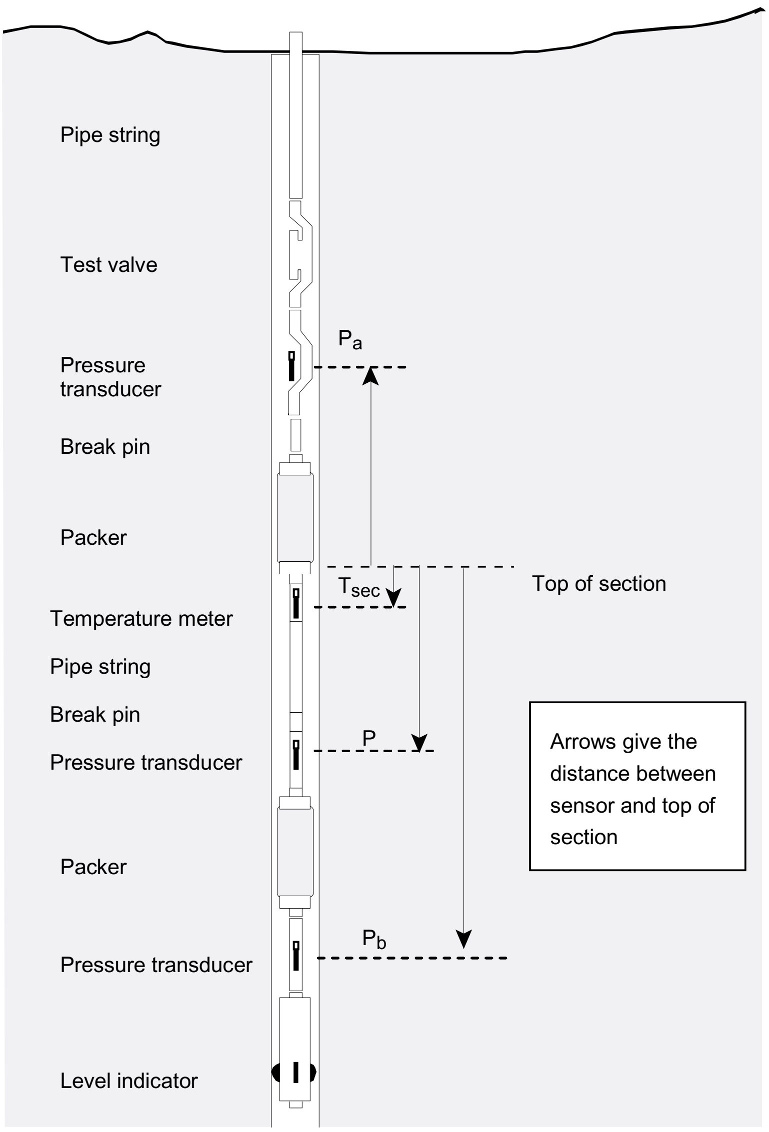

Figure 4-2. *Schematic drawing of the down-hole equipment in the PSS3 system.*

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.

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	1.67×10^{-5}–1.67×10^{-3}		
	Resolution	m^3/s	6.7×10^{-8}		
	Accuracy[2)]	% O.R	0.15–3	0.2–1	The specific accuracy is depending on actual flow
Flow Qsmall	Output signal	mA	4–20		
	Meas range	m^3/s	1.67×10^{-8}–1.67×10^{-5}		
	Resolution	m^3/s	6.7×10^{-10}		
	Accuracy[2)]	% O.R	0.4–10	0.4–20	The specific accuracy is depending on actual flow

[1)] 0.1% of Full Scale. Includes hysteresis, linearity and repeatability.
[2)] Maximum error in % of actual reading (% o.r.). The higher numbers correspond to the lower flow.

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

Parameter	Length of test section (m) 5	20	100
Equipment displacement volume in test section [1)]	3.6	13	61
Total volume of test section [2)]	23	93	466
Position for sensor P_a, pressure above test section, (m above secup) [3)]	1.87	1.87	1.85
Position for sensor P, pressure in test section, (m above secup) [3)]	–4.14	–19.12	–99.11
Position for sensor T_{sec}, Temperature in test section, (m above secup) [3)]	–1.01	–0.98	–0.96
Position for sensor P_b, pressure below test section, (m above secup) [3)]	–7.00	–22.00	–101.98

[1)] Displacement volume in test section due to pipe string, signal cable, sensors and packer ends (in litre).
[2)] Total volume of test section ($V=section\ length*\pi*d^2/4$).
[3)] Position of sensor relative top of test section. A negative value indicates a position below top of test section, (secup).

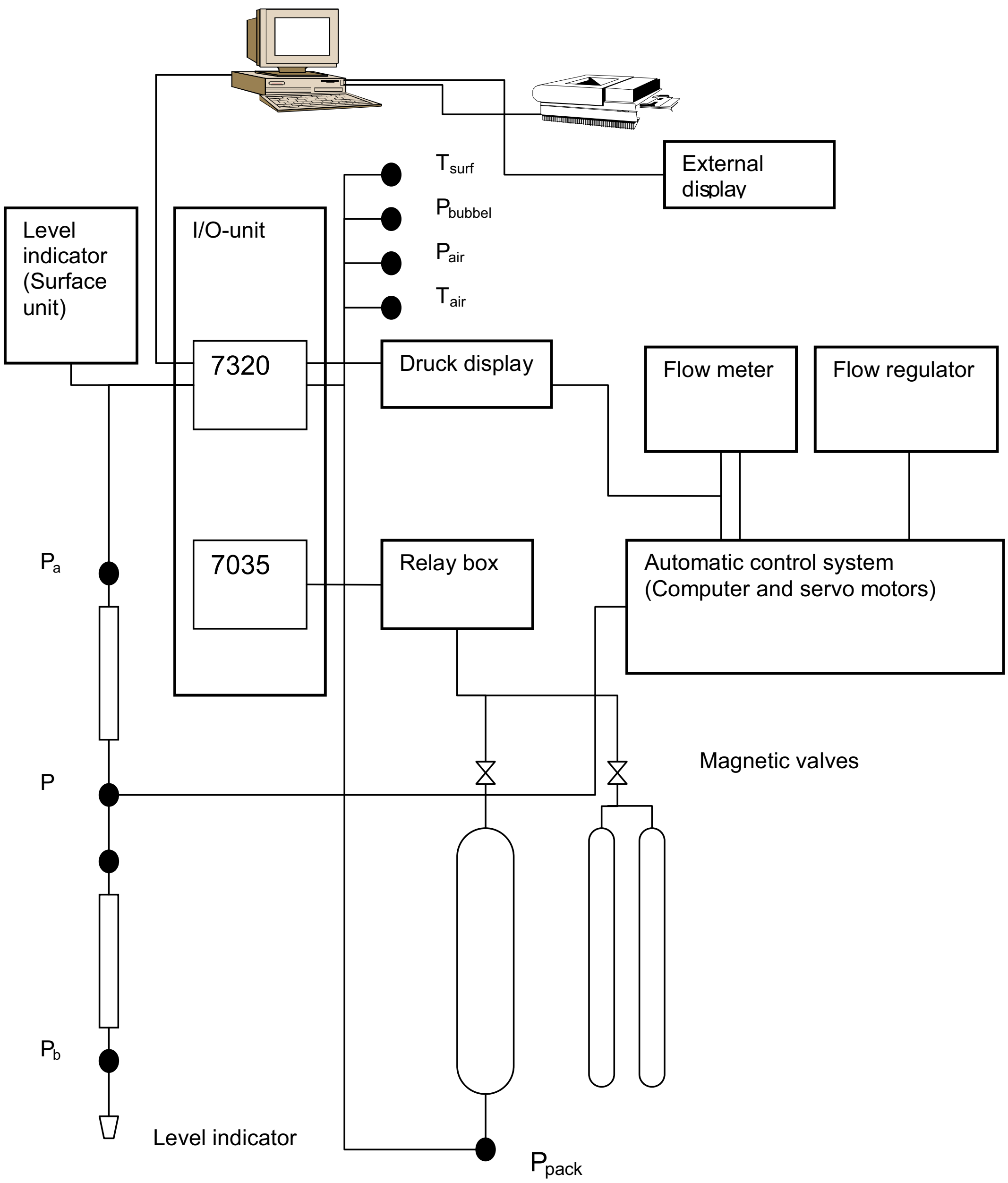

Figure 4-3. *Schematic drawing of the data acquisition system and the automatic control system in PSS.*

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.

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 at every change of test section length, as well as 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

The injection tests in KFM05A were carried out while maintaining a constant head of generally 200 kPa (20 m) 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.

For injection tests with 20 m and 5 m section length, the injection phase was interrupted if the injection flow was clearly below the measurement limit. Thereafter, the recovery was measured for at least 5 minutes to verify the low conductivity of the section.

5.2.2 Test procedure

Generally, the tests were performed according to the Activity Plan AP PF 400-04-111. Exceptions to this are presented in Section 5.5.

A test cycle 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.

The estimated times for the various phases are presented in Table 5-1. Regarding the packer inflation times and actual injection and recovery times, slightly different procedures were used for the tests in 100 m sections compared to the tests in 20 m and 5 m sections in accordance with the Activity Plan. Furthermore, slightly longer test times were used for the tests in 100 m sections, cf Table 5-1.

Table 5-1. Packer inflation times, pressure stabilisation times and test times used for the injection tests in KFM05A.

Test section length (m)	Packer inflation time (min)	Time for pressure stabilisation (min)	Injection period (min)	Recovery period (min)	Total time/test (min)[1)]
100	30	15	30	30	105
20	25	5	20	20	70
5	25	5	20	20	70

[1)] Exclusive of trip times in the borehole

5.2.3 Test strategy

Firstly, injection tests in 100 m sections were performed in the interval 116.5–986.5 m. The limits of the test sections were, as far as possible, the same as were used by the difference flow logging, to facilitate comparison of the results.

Secondly, injection tests in 20 m sections were carried out in the intervals 116.5–316.5 m and 416.5–516.5 m. All 100 m sections, within these intervals, were measured in five successive injection tests using a 20 m section length.

Finally, injection tests with 5 m section length were conducted in all 20 m sections with a definable flow rate in the intervals 116.5–316.5 m and 416.5–516.5 m. Four tests using a 5 m section length were performed within the 20 m intervals. The total number of injection tests was, thus, dependent on the results of the previous tests.

Since the results of the tests in 100 m sections would have a strong effect on the continued test program, it was particularly important to ensure reliable results of these tests, including sections close to the lower measurement limit.

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 __KFM05A_0116.50_200412131135.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 2.0), the *.ht2-files are converted to parameter files suitable for plotting using 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 KFM05A 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).

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 (1.7×10^{-8} m^3/s). However, if the flow rate for a test was close to, or below, the standard lower measurement limit, a test-specific estimate of the lower measurement limit of flow rate was made. The test-specific lower limit was 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 identified, but it might be of both technical and hydraulic character. For approximately 50 per cent of the injection tests in KFM05A, the actual lower measurement limit of the flow rate was estimated ranging from 4×10^{-9} m^3/s to 1.2×10^{-8} m^3/s.

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, see Table 5-2. 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 KFM05A, the actual injection pressure was considerably different. For one of the tests, the injection pressure exceeded 300 kPa 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 the PSS. The estimated test-specific lower measurement limit for the specific flow rate in KFM05A ranged from 2.0×10^{-10} m^2/s to 6.0×10^{-10} m^2/s.

Whenever the final flow rate (Q_p) was not defined (i.e. not clearly above the measurement noise before and after the injection period), the estimated lower measurement limit for the specific flow rate was based on the estimated lower measurement limit for the flow rate for the specific test and a standard injection pressure of 200 kPa. This is done in order to avoid excessively high estimates of the specific flow rate for these low conductivity sections, which would have been the result if the actual injection pressure had been used (since the actual pressure often was significantly less than 200 kPa, see above).

The lower measurement limits for the flow rate correspond to different values of steady-state transmissivity, T_M, depending on the section lengths used in the factor C_M in Moye's formula, as described in the Instruction for analysis of injection and single-hole pumping tests (SKB MD 320.004), see Table 5-2.

The practical upper measurement limit of hydraulic transmissivity for the PSS system is estimated at a flow rate of c 30 L/min (5×10^{-4} m^3/s) and an injection pressure of c 1 m. Thus, the upper measurement limit for the specific flow rate is 5×10^{-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).

Table 5-2. Estimated lower measurement limit for specific flow rate and steady-state transmissivity for different injection pressures, measurement scales and estimated lower measurement limits for flow rate for the injection tests in borehole KFM05A.

r_w (m)	L_w (m)	Q-measl-L (m^3/s)	Injection pressure (kPa)	Q/s-measl-L (m^2/s)	Factor C_M in Moye's formula	T_M-measl-L (m^2/s)
0.0385	100	1.7E–08	100	1.6E–09	1.30	2.1E–09
0.0385	100	1.7E–08	200	8.2E–10	1.30	1.1E–09
0.0385	100	1.7E–08	300	5.5E–10	1.30	7.1E–10
0.0385	100	1.2E–08	100	1.1E–09	1.30	1.5E–09
0.0385	100	1.2E–08	200	5.7E–10	1.30	7.4E–10
0.0385	100	1.2E–08	300	3.8E–10	1.30	5.0E–10
0.0385	100	5.0E–09	100	4.9E–10	1.30	6.4E–10
0.0385	100	5.0E–09	200	2.5E–10	1.30	3.2E–10
0.0385	100	5.0E–09	300	1.6E–10	1.30	2.1E–10
0.0385	20	1.7E–08	100	1.6E–09	1.04	1.7E–09
0.0385	20	1.7E–08	200	8.2E–10	1.04	8.5E–10
0.0385	20	1.7E–08	300	5.5E–10	1.04	5.7E–10
0.0385	20	1.2E–08	100	1.1E–09	1.04	1.2E–09
0.0385	20	1.2E–08	200	5.7E–10	1.04	6.0E–10
0.0385	20	1.2E–08	300	3.8E–10	1.04	4.0E–10
0.0385	20	5.0E–09	100	4.9E–10	1.04	5.1E–10
0.0385	20	5.0E–09	200	2.5E–10	1.04	2.6E–10
0.0385	20	5.0E–09	300	1.6E–10	1.04	1.7E–10
0.0385	5	1.7E–08	100	1.6E–09	0.82	1.3E–09
0.0385	5	1.7E–08	200	8.2E–10	0.82	6.7E–10
0.0385	5	1.7E–08	300	5.5E–10	0.82	4.5E–10
0.0385	5	1.2E–08	100	1.1E–09	0.82	9.4E–10
0.0385	5	1.2E–08	200	5.7E–10	0.82	4.7E–10
0.0385	5	1.2E–08	300	3.8E–10	0.82	3.1E–10
0.0385	5	5.0E–09	100	4.9E–10	0.82	4.0E–10
0.0385	5	5.0E–09	200	2.5E–10	0.82	2.0E–10
0.0385	5	5.0E–09	300	1.6E–10	0.82	1.3E–10

5.4.3 Qualitative analysis

Initially, a qualitative evaluation of the 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. 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.

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.

Due to the limited resolution of the flow meter and pressure sensor, the derivative may some times erroneously indicate a false horizontal line by the end of 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. In addition, a preliminary steady-state analysis of transmissivity according to Moye's formula (denoted T_M) was made for the injection period for all 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)

5.4.4 Quantitative analysis

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. Several of the responses during the recovery period were strongly influenced by wellbore storage effects. Thus, for most 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 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 /2/ 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) /3/. The storativity was set to a fixed value of 10^{-6}, according to the instruction SKB MD 320.004.

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, cf Equation 5-5. This concept is equivalent to calculating the wellbore storage coefficient C from the compressibility in an isolated test section according to Equation 5-4.

The model by Dougherty-Babu (1984) was used to estimate the transmissivity and skin factor from the recovery period for an assumed value on the storativity. 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 showing pseudo-spherical (leaky) flow or pseudo-stationary flow during the injection period a model by Hantush (1959) /6/ for constant head tests was used 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. 5-3. 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.

$$\zeta=\ln(r_w/r_{wf}) \qquad (5\text{-}3)$$

ζ = skin factor
r_w = borehole radius (m)
r_{wf} = effective borehole radius

For tests characteized by pseudo-spherical- or pseudo-stationary flow during the recovery period the model by Hantush (1955) /7/ was adopted. This model also allows calculation of the skin factor from Equation 5-3 together with the wellbore storage coefficient according to Equation (5-5).

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. Both models by Ozkan-Raghavan (1991a) /8/ and (1991b) /9/ for a vertical fracture and the model by Gringarten-Ramey (1974) /10/ for a horizontal 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 often strongly affected by wellbore storage and generally no pseudo-radial flow regime was reached. In addition, pseudo-stationary flow sometimes occurred during the recovery period.

Finally, a representative value of the transmissivity of the test section, T_R, was chosen from T_T and T_M. In general, the transient evaluation was considered as the best estimate. In only four out of 55 tests the steady state transmissivity was chosen as the most representative value of transmissivity of the test section. In all four of those tests only apparent NFB was detected during the injection period and only WBS during the recovery period making a unique transient evaluation impossible. Whenever the flow rate by the end of the injection period (Q_p) was too low to be defined, and thus neither T_T nor T_M could be estimated, the representative transmissivity for the test section was 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).

Estimated values of the borehole storage coefficient, C, based on actual borehole geometrical data and assumed fluid properties are shown in Table 5-3. The net water volume in the test section, V_w, has in Table 5-3 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/:

$$C = V_w \times c_w = L_w \times \pi \times r_w^2 \times c_w \qquad (5\text{-}4)$$

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})

Table 5-3. Calculated net values of the wellbore storage coefficient C for injection tests with different section length, based on the actual geometrical properties of the borehole and equipment configuration in the test section.

Borehole	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)
KFM05A	0.03865	100	0.469	0.061	0.408	1.9×10^{-10}
KFM05A	0.03865	20	0.094	0.013	0.081	3.7×10^{-11}
KFM05A	0.03865	5	0.023	0.004	0.020	9.2×10^{-12}

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 a 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 values of C based on geometry (Table 5-3).

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/:

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

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 5-3 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.

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.

5.5 Nonconformities

The test program in KFM05A was carried out according to the Activity Plan AP PF 400-04-111 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 inclination of the borehole which made the hose to wedge between borehole equipment and the casing. Instead, manual measurement of the groundwater level was performed to an increased extent.
- The temperature sensor, T_{sec}, measuring the temperature in the test section, gave unstable temperature values during testing with 20 m section length. This resulted in uncertain temperature values or lack of temperature values for some tests. The temperature sensor was exchanged before the testing with 5 m test section commenced.
- The temperature sensor in the injection water at the ground surface was out of order during the injection tests in KFM05A.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results of the injection tests in KFM05A 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.

Records of other activities in the investigation area during the test period were checked in order to identify possible interference with test data. These records showed that rinse pumping was performed in KFM07A, see Figure 1-1, from 2004-12-21 until 2005-01-05. No evidence that these activities have interfered with the injection tests in KFM05A has been found. Due to the distance of about 1,000 m between KFM07A and KFM05A the injection tests in KFM05A are assumed to be unaffected by the activities in KFM07A.

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. In KFM05A, reference marks were milled into the borehole wall at every 50 m (with a few exceptions).

During the injection tests in KFM05A with the PSS, length reference marks were detected as presented in Table 6-1. As seen from Table 6-1, five of the length marks in the lower half of the borehole were not detected. At each mark, the length scale for the injection tests was adjusted according to the reported length to the reference mark.

The largest difference between the reported and measured lengths at the reference marks during the injection tests was 0.23 m, at the 800 m reference mark. The difference between two consecutive measurements over a 100 m borehole interval was 0.1 m or less in all cases. A comparison of the measurements performed with different section lengths results in a maximum difference of 0.03 m.

Since the length scale was adjusted in the field every time a reference mark was passed, and because the difference between consecutive marks was small, it was not found worthwhile to make any further adjustments after the measurements, e.g. by linear interpolation between reference marks.

Table 6-1. Detected reference marks during the injection tests in KFM05A.

Borehole length (m)	Detected during the injection tests in 100 m sections	Detected during the injection tests in 20 m sections	Detected during the injection tests in 5 m sections
120	yes	yes	yes
152	yes	yes	yes
199	yes	yes	yes
252	yes	yes	yes
300	yes	yes	yes
352	yes	yes	yes
402	yes	yes	yes
450	yes	yes	–
501	no	–	–
550	no	–	–
606	yes	–	–
650	yes	–	–
700	no	–	–
750	no	–	–
800	yes	–	–
850	yes	–	–
900	no	–	–

6.2.3 General results

A summary of the results of the routine evaluation of the injection tests in different scales in KFM05A is presented, test by test, in Table 6-2. 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. The quantitative analysis was performed from such diagrams using the AQTESOLV software. From tests with a flow rate below the estimated lower measurement limit for the specific test, only the linear diagram is presented.

The dominating transient flow regimes during the injection and recovery periods, as interpreted from the qualitative test evaluation, are listed in Table 6-2 and further commented on in Section 6.2.4.

For some tests, particularly from the recovery period, a type curve fit is displayed in the diagrams in Appendix 3, despite that the parameters from the fit are judged as not representative and are thus not included in the result tables for SICADA. For these tests, the type curve fit is presented only to illustrate that an assumption of pseudo-radial flow regime is not justified. Instead, some other flow regime is likely to dominate, as commented on in the diagrams and in Section 6.2.4. For tests showing only wellbore storage and tests approaching a pseudo-stationary flow, no unique transient evaluation is possible. In such cases, no type curve matching was done.

In the quantitative evaluation, the steady-state transmissivity (T_M) was calculated by Moye's formula. Transient evaluation was conducted, whenever possible, both on the injection and recovery periods (T_f and T_s, respectively). However, for many low conductivity sections, no unique transient evaluation could be made from the recovery period (only wellbore storage response). Transient evaluation was performed for all tests for which a significant flow rate, Q_p, could be identified, see Section 5.4.2.

The value judged as the most reliable from the transient evaluation of the tests was selected as T_T. The associated value for the skin factor is listed in Table 6-2. 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 in most cases considered as the most reliable transient analysis for the injection tests in KFM05A. In addition, the transient evaluation of transmissivity from the injection period was for most of the tests also considered as the most representative estimate of transmissivity, T_R. The approximate start and stop times used for the transient evaluation are also listed in Table 6-2. For those tests where transient evaluation was not possible or not considered representative, T_M was chosen as the representative transmissivity value, T_R. If Q_p was below the actual estimated measurement limit, the representative transmissivity value was assumed to be less than the estimated T_M, based on Q/s-measl-L, see Section 5.4.2 and 5.4.3.

The results of the routine evaluation of the injection tests in borehole KFM05A 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. The agreement between the two populations is in general considered as good. The lower measurement limit of transmissivity in 5 m sections for a flow rate of 1 mL/min and an injection pressure of 200 kPa is indicated in the figure.

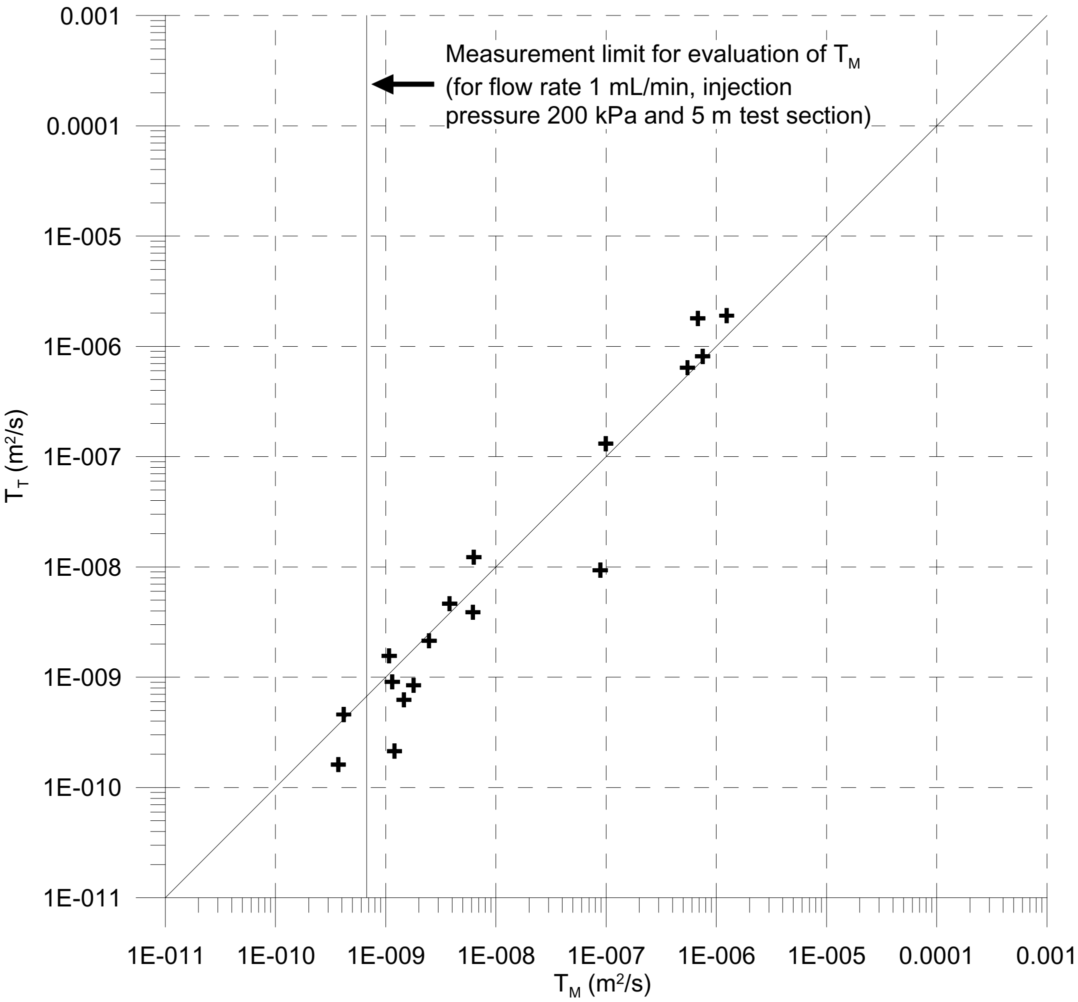

Figure 6-1. *Estimated transmissivities in 5 m sections from steady-state (T_M) and transient (T_T) evaluation in KFM05A.*

The wellbore storage coefficient, C, was calculated from the straight line with a unit slope in the log-log diagrams from the recovery period, see Table 6-2. 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 6-2 may be compared with the net values of C in Table 5-3 (based on geometry).

The number of tests with a well-defined line of unit slope for which it was possible to calculate C was as follows: 6 out of 10 tests with the 100 m test section resulted in a well-defined 1:1 straight line. The corresponding figures for 20 m tests were 6 out of 16, and for 5 m tests 13 out of 29. Table 6-2 shows that there is, in general, a good agreement between the calculated C values from the tests and those listed in Table 5-3, although the calculated values from the tests tend to be slightly higher.

The test in section 264–269 m resulted in a significantly higher estimate of C than tests in the other 5 m intervals. The 100 m test that straddles the interval 264–269 m also indicate higher C-values than the other 100 m test intervals. No reasonable explanation has been found for the significantly higher wellbore storage coefficient estimated from the test in the interval of 264–269 m. When constructing 95% confidence intervals (using a t-distribution) from calculated values of C from the tests, the values of C listed in Table 5-3 are within these confidence intervals. When constructing 95% confidence intervals (using a t-distribution) from calculated values of C from the tests, but omitting the tests covering the interval of 264–269 m, the values of C listed in Table 5-3 are within these confidence intervals for the 100 m and 20 m sections but slightly lower than the confidence interval for the 5 m sections.

Table 6-2. Summary of the routine evaluation of the single-hole injection tests in borehole KFM05A.

Secup (m)	Seclow (m)	Test start YYYYMMDD hh:mm	b (m)	Flow regime [1] injection	recovery	T_M (m^2/s)	T_f (m^2/s)	T_s (m^2/s)	T_T (m^2/s)	T_R [2] (m^2/s)	ξ (–)	t_1 (s)	t_2 (s)	dte_1 (s)	dte_2 (s)	C (m^3/Pa)
116.50	216.50	2004-12-13 11:35	100	PLF->PRF	PLF->PRF	4.09E–06	1.19E–06	1.85E–06	1.19E–06	1.19E–06	–5.36	700	1,816	100	300	
216.50	316.50	2004-12-22 06:37	100	NFB->PLF/PRF	WBS	1.26E–07	1.70E–08	(1.7E–08)	1.70E–08	1.70E–08	–5.00	500	1,800			7.43E–08
316.50	416.50	2004-12-14 11:06	100	NFB	WBS	2.91E–10				2.91E–10						1.78E–10
416.50	516.50	2004-12-14 14:43	100	PRF->NFB	WBS->	2.00E–09	7.55E–10	7.50E–10	7.55E–10	7.55E–10	–1.32	20	400			2.31E–10
516.50	616.50	2004-12-15 09:03	100	–	–	< 5.00E–10				< 5.00E–10						
606.50	706.50	2004-12-15 13:18	100	PRF	WBS	2.15E–09	7.31E–10		7.31E–10	7.31E–10	–1.16	200	1,819			2.48E–10
686.50	786.50	2004-12-20 14:31	100	NFB-> PRF?	WBS	3.00E–09	3.52E–10		3.52E–10	3.52E–10	–3.31	300	1,823			5.40E–10
706.50	806.50	2004-12-16 08:39	100	NFB-> PRF?	WBS	1.68E–09	1.30E–10		1.30E–10	1.30E–10	–3.28	500	2,008			6.37E–10
806.50	906.50	2004-12-16 14:44	100	–	–	< 4.29E–10				< 4.29E–10						
886.50	986.50	2004-12-20 08:16	100	–	–	< 5.85E–10				< 5.85E–10						
116.50	136.50	2005-01-04 06:57	20	PSF->NFB	PSF	1.77E–06	8.83E–07	1.58E–06	8.83E–07	8.83E–07	3.88	60	200	10	200	
136.50	156.50	2005-01-04 09:02	20	PRF->PSF	WBS->	6.95E–09	4.98E–09	4.67E–09	4.98E–09	4.98E–09	0.15	300	1,200			2.78E–10
156.50	176.50	2005-01-04 10:51	20	PRF->NFB	PLF->PRF->NFB	1.80E–06	7.28E–07	9.97E–07	9.97E–07	9.97E–07	–4.16	300	1,200	70	300	
176.50	196.50	2005-01-04 13:38	20	–	–	< 4.07E–10				< 4.07E–10						
196.50	216.50	2005-01-05 08:18	20	(PRF)	WBS	5.91E–10	1.52E–10		1.52E–10	1.52E–10	–1.48	100	1,800			5.07E–11
214.00	234.00	2005-01-05 10:08	20	NFB->	WBS	1.18E–09				1.18E–09						
234.00	254.00	2005-01-05 11:55	20	–	–	< 4.70E–10				< 4.70E–10						
254.00	274.00	2005-01-11 12:38	20	NFB->PLF/PRF	WBS	1.43E–07	1.37E–08	(1.37E–08)	1.37E–08	1.37E–08	–5.38					
274.00	294.00	2005-01-10 10:11	20	PRF->NFB	WBS->	2.12E–09	2.54E–09		2.54E–09	2.54E–09	1.63	20	300			5.36E–11
294.00	314.00	2005-01-10 11:53	20	PSF->NFB	WBS->PSF	3.70E–09	2.83E–09	9.79E–10	2.83E–09	2.83E–09	1.15	20	200			6.04E–11
296.50	316.50	2005-01-10 13:56	20	–	–	< 4.07E–10				< 4.07E–10						
416.50	436.50	2005-01-10 15:57	20	PRF->NFB	WBS->	1.66E–09	5.86E–10	1.15E–09	5.86E–10	5.86E–10	–1.53	10	600			6.37E–11
436.50	456.50	2005-01-10 17:47	20	(PRF)->NFB	WBS->	3.88E–10	3.53E–10	5.56E–10	3.53E–10	3.53E–10	–0.48	10	100			6.37E–11

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 2) (m²/s)	ξ (–)	t_1 (s)	t_2 (s)	dte_1 (s)	dte_2 (m³/Pa)	C
456.50	476.50	2005-01-11 06:29	20	–	–	< 6.26E–10				< 6.26E–10						
476.50	496.50	2005-01-11 07:35	20	–	–	< 5.22E–10				< 5.22E–10						
496.50	516.50	2005-01-11 08:41	20	–	–	< 4.70E–10				< 4.70E–10						
116.50	121.50	2005-01-20 11:09	5	PRF1->PRF2	PSF	1.24E–06	1.90E–06	1.34E–06	1.90E–06	1.90E–06	–0.01	50	400			
121.50	126.50	2005-01-13 14:11	5	PRF	PRF->PSF/PSS	5.45E–07	6.40E–07	3.76E–07	6.40E–07	6.40E–07	–0.98	300	1,200	10	100	
126.50	131.50	2005-01-13 15:46	5	PRF->PSF	PRF->PSF	6.18E–09	3.89E–09	3.55E–09	3.89E–09	3.89E–09	–1.33	200	600		600	
131.50	136.50	2005-01-20 09:41	5	PRF1->PRF2	WBS->PRF->NFB	1.08E–09	1.56E–09	1.52E–09	1.56E–09	1.56E–09	–0.55	10	50	40	100	2.17E–11
136.50	141.50	2005-01-14 08:45	5	–	–	< 3.70E–10				< 3.70E–10						
141.50	146.50	2005-01-20 08:12	5	NFB->PSF	WBS	1.20E–09	2.14E–10		2.14E–10	2.14E–10	2.15	300	1,200			5.83E–11
146.50	151.50	2005-01-14 11:15	5	PSF	WBS->	3.81E–09	2.71E–09	4.66E–09	4.66E–09	4.66E–09	2.63	600	1,200		600	6.55E–11
151.50	156.50	2005-01-14 13:13	5	(PRF)->NFB	WBS->	4.16E–10	1.49E–10	4.60E–10	4.60E–10	4.60E–10	–0.87	10	200		600	3.21E–11
156.50	161.50	2005-01-14 14:38	5	NFB->PSF	WBS	1.79E–09	8.47E–10		8.47E–10	8.47E–10	1.57	700	1,}200			1.83E–10
161.50	166.50	2005-01-17 09:47	5	PRF->NFB	PLF->PRF->NFB	7.50E–07	2.72E–07	8.11E–07	8.11E–07	8.11E–07	–4.55	100	400	50	300	
166.50	171.50	2005-01-20 06:34	5	PRF->NFB	PLF->PRF->NFB	9.93E–08	1.31E–07	2.18E–07	1.31E–07	1.31E–07	–0.11	200	600	300	500	
171.50	176.50	2005-01-17 13:06	5	PRF1->PRF2->NFB	PSS->NFB	6.77E–07	1.79E–06		1.79E–06	1.79E–06	4.28	30	100			
214.00	219.00	2005-01-17 14:58	5	–	–	< 2.06E–10				< 2.06E–10						
219.00	224.00	2005-01-17 15:58	5	NFB	WBS	4.27E–10				4.27E–10						3.46E–11
224.00	229.00	2005-01-17 17:31	5	NFB	WBS	5.48E–10				5.48E–10						3.51E–10
229.00	234.00	2005-01-17 18:58	5	–	–	< 2.06E–10				< 2.06E–10						
254.00	259.00	2005-01-18 06:50	5	PRF->PSF->NFB	WBS->PRF	6.31E–09	4.47E–09	1.23E–08	1.23E–08	1.23E–08	2.05	10	50	300	900	3.90E–11
259.00	264.00	2005-01-18 08:20	5	–	–	< 1.65E–10				< 1.65E–10						
264.00	269.00	2005-01-18 09:29	5	NFB->PLF/PRF	WBS	8.84E–08	9.34E–09		9.34E–09	9.34E–09	–5.60	500	1200			4.89E–08

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 [2] (m²/s)	ξ (–)	t_1 (s)	t_2 (s)	dte_1 (s)	dte_2 (s)	C (m³/Pa)
269.00	274.00	2005-01-18 11:04	5	–	–	< 2.88E–10				< 2.88E–10						
274.00	279.00	2005-01-18 12:40	5	–	–	< 2.06E–10				< 2.06E–10						
279.00	284.00	2005-01-18 13:39	5	–	–	< 2.47E–10				< 2.47E–10						
284.00	289.00	2005-01-18 14:29	5	PRF	WBS->PSS	1.46E–09	6.25E–10	(6.25E–10)	6.25E–10	6.25E–10	–1.65	200	1200			8.54E–12
289.00	294.00	2005-01-19 09:44	5	–	–	< 3.70E–10				< 3.70E–10						
294.00	299.00	2005-01-19 11:07	5	PRF	WBS->PSF	2.48E–09	2.14E–09	(2.14E–09)	2.14E–09	2.14E–09	0.27	400	1200			1.52E–11
416.50	421.50	2005-01-19 13:58	5	PRF->NFB	WBS-->NFB	1.15E–09	9.09E–10	1.99E–09	9.09E–10	9.09E–10	–1.36	20	100	5	50	5.58E–11
421.50	426.50	2005-01-19 15:29	5	–	–	< 2.06E–10				< 2.06E–10						
426.50	431.50	2005-01-19 16:24	5	PRF	WBS->	3.71E–10	1.62E–10	1.06E–10	1.62E–10	1.62E–10	–0.36	80	1000			1.34E–11
431.50	436.50	2005-01-19 17:57	5	–	–	< 2.88E–10				< 2.88E–10						
284.00	289.00	2005-01-24 12:49	5	PRF/PSF	WBS–>PSS	2.79E–09	1.48E–09		1.48E–09	1.48E–09		10	200			1.46E–11
284.00	289.00	2005-01-24 14:11	5	PRF/PSF	WBS->PSS	2.89E–09	1.79E–09		1.79E–09	1.79E–09		10	200			1.55E–11
284.00	289.00	2005-01-24 15:31	5	PRF/PSF	WBS->PSS	2.29E–09	1.61E–09		1.61E–09	1.61E–09		10	200			1.49E–11
284.00	289.00	2005-01-24 16:48	5	PRF/PSF->NFB	WBS->PSS	3.57E–09	2.33E–09		2.33E–09	2.33E–09		10	200			1.52E–11

[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 6.2.5 below

[2] For the tests were Q_p was not detected, T_R was assumed equal to the estimated Q/s-measl-L.

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

116.5–216.5 m

The injection period indicates a PLF transitioning to a PRF after c 700 s. The recovery indicates a PLF transitioning to a PRF with a weak effect of a possible NFB by the end of the period. Fits to single fracture models give consistent transmissivity values for both the injection- and recovery period.

216.5–316.5 m

The time to achieve constant head in the test section was long during the injection period. Therefore, the flow rate data before 200 s are considered as unreliable. The flow rate is rapidly declining up to c 400 s indicating an apparent NFB. After this time, a transition to a PLF/PRF is weakly indicated. However, no good type curve fit is possible to this part of the data curve. During the recovery period only WBS is indicated and therefore no unique evaluation is possible. However, with assumed T and skin from the injection period an r(c) value is possible to derive. Noticeable is that the derived r(c) value results in a very large wellbore storage coefficient compared with other sections and theoretical value wellbore storage coefficient. The pressure only recovered c 3 m from the head change of 24 m applied during the injection period, pointing to that the section has a low transmissivity. The recovery period thus strongly contradicts the injection period, for which the estimated T_M indicates that the section is fairly transmissive.

316.5–416.5 m

The section has a low transmissivity. The flow rate data are very scattered and no distinct flow regime is indicated during the injection period. During the recovery period only WBS is observed. Hence, no transient evaluation is possible for either the injection or the recovery period. T_M is considered to be the most representative transmissivity value for the section.

416.5–516.5 m

Due to drift in a gas pressure regulator the injection pressure increased c 2 kPa during the injection period. Still, a clear PRF occurred during the injection period. Towards the end of the injection period a transition to a NFB is indicated. During the recovery period WBS is observed and a transition to some other flow regime.

516.5–616.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. As a result, T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section.

606.5–706.5 m

A PRF is identified after c 200 s and throughout the injection period. The entire recovery period is dominated by WBS and no transient evaluation was possible for the period. The pressure did not recover more 14 m from the head change of 22 m during the injection period.

686.5–786.5 m

A possible PRF is noticed after c 300 s during the injection period, preceded by an apparent NFB. However, no good type curve fit can be made and this evaluation is uncertain. The entire recovery period is dominated by WBS and no unique transient evaluation was possible for the period. The pressure only recovered c 7 m from the head change of 18 m applied during the injection period indicating a section of low transmissivity.

706.5–806.5 m

A possible PRF appears after c 500 s during the injection period, preceded by an apparent NFB. However, no good type curve fit can be made and this evaluation is uncertain. The entire recovery period is dominated by WBS and no unique transient evaluation was possible for the period. The pressure only recovered c 5 m from the head change of 18 m applied during the injection period which is a sign of the section being of low transmissivity.

806.5–906.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

886.5–986.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. Due to high pressure below the test section during packer inflation, the pressure in the packers was set to 9 bars instead of the usual pressure exceeding 20 bars. The pressure in the borehole interval below the test section increased by c 30 kPa during the injection period. However, this could be an effect of insufficient packer inflation.

116.5–136.5 m

The injection period is dominated by a NFB by the end of the period. A weak PSF is indicated between 20 s and 50 s. The recovery period is dominated by a PSF.

136.5–156.5 m

The flow rate data are scattered. Although the derivative is very scattered a short PRF may possibly be indicated in the beginning of the injection period. A PSF is indicated between 300 s and 1,200 s. The recovery period demonstrates WBS transitioning to some other flow regime.

156.5–176.5 m

The stabilization time for the injection pressure in the section was relatively long. Despite this fact, a very short PRF is indicated during the beginning of the injection period, transitioning to a NFB. The beginning of the recovery period display a PLF transitioning to a short PRF between 70 and 300 s and to a NFB by the end of the period. Since the injection period was affected by the relatively long stabilization time, T_s is considered to be the most representative transmissivity value for this section. Fit with a single fracture model corresponds well to the calculated transmissivity values for the recovery period (Gringarten-Ramey).

176.5–196.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in compliance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section.

196.5–216.5 m

The flow rate data are scattered and no well defined flow regime is indicated during the injection period. However, a PRF is assumed to dominate during the injection period. During the recovery period, only WBS effects are observed and no transient evaluation is possible. The pressure recovered 9.8 m from the head change of 14 m during the injection period, indicating that the section has a relatively low transmissivity.

214–234 m

The injection period is dominated by a NFB. At the end of the injection period, a transition to some other flow regime is indicated but no transient evaluation of the period is possible. The recovery period is dominated by WBS effects and no transient evaluation of the period is possible. The pressure only recovered 2.8 m from the head change of 20 m applied during the injection period, showing that the section has a low transmissivity. Since no unique transient evaluation can be made, T_M is considered to be the most representative transmissivity value for this section.

234–254 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section.

254–274 m

The injection pressure was unusually unstable but an apparent NFB is indicated in the beginning of the injection period, followed by a transition to a PLF/PRF by the end of the period. During the recovery period only WBS is indicated and therefore no unique evaluation is possible. However, with assumed T and skin from the injection period an r(c) is possible to derive. Noticeable is that the derived r(c) results in a very large wellbore storage coefficient compared with other sections and the theoretical value of the wellbore storage coefficient. The pressure only recovered 4 m from the head change of 31 m applied during the injection period, indicating that the section has a low transmissivity. The behaviour is thus highly inconsistent during the injection- and recovery period, respectively.

274–294 m

Although the derivative is very scattered, the injection period indicates a short PRF transiting to an apparent NFB after c 300 s. The recovery period is dominated by WBS and a transition period. No unique evaluation can be made from the recovery period.

294–314 m

The injection period indicates a PSF between 20 and 200 s transitioning to a NFB by the end of the period. The recovery period indicates WBS transitioning to a possible PSF.

296.5–316.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, as stated in AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

416.5–436.5 m

The injection period indicates a PRF between 10 and 600 s transitioning to a NFB by the end of the period. The recovery period indicates WBS transitioning to some other flow regime.

436.5–456.5 m

The flow rate data are scattered and no well defined flow regime is indicated during the injection period, although a short initial PRF is indicated followed by a NFB. The recovery period was dominated by WBS effects with a transition to some other flow regime at the end of the period. Approximate transient evaluation of the injection and recovery period was possible and supported the transmissivity calculated by T_M. However, T_s should not be considered as the most representative transmissivity value, due to the strong influence by WBS. The pressure recovered only 4.9 m from the head change of 20.2 m applied during the injection period, also pointion to that the section has a low transmissivity.

456.5–476.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

476.5–496.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in compliance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

496.5–516.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, showing that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

116.5–121.5 m

The injection period indicates an early PRF from 50 s to 400 s transitioning to a later PRF from 600 s and throughout the period. The recovery period is dominated by a PSF.

121.5–126.5 m

During the injection period a PRF is indicated from 300 s throughout the period. The recovery period indicates a PRF between 10 and 100 s transitioning to a PSF or possibly PSS. As indicated in the overview plot, the sensors P and P_b are disturbed during the test. No reasonable hydraulic explanation is found for this disturbance. It is more likely that the effect is equipment related. However, the evaluation is considered to be unaffected by this disturbance.

126.5–131.5 m

During the injection period a PRF is indicated between 200 and 600 s followed by a PSF. The recovery period indicates initial WBS transitioning to a PRF and a PSF at the end of the period. As indicated in the overview plot, the sensors P and P_b are disturbed during the test. No reasonable hydraulic explanation is found for this disturbance. It is more likely that the effect is equipment related. However, the evaluation is considered to be unaffected by this disturbance.

131.5–136.5 m

The injection period demonstrates an early PRF followed by a transition period to a late PRF or possibly a NFB. The recovery period indicates WBS followed by a possible PRF transitioning to a NFB by the end of the period.

136.5–141.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in according to AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section.

141.5–146.5 m

The flow rate data are scattered. However, an apparent NFB transitioning to a PSF is weakly indicated from 300 s and throughout the injection period. WBS dominates the recovery period and no other flow regime is observed.

146.5–151.5 m

The injection period indicates a PSF and the recovery period a WBS transitioning to some other flow regime.

151.5–156.5 m

The injection period weakly indicates a PRF followed by an apparent NFB. The recovery period is showing WBS transitioning to some other flow regime.

156.5–161.5 m

The beginning of the injection period indicates an apparent NFB transitioning to a PSF from 700 s to the end of the period. WBS dominates the recovery period.

161.5–166.5 m

During the injection period a PRF is identified between c 100 and 400 s transitioning to a NFB by the end of the period. The beginning of the recovery period is dominated by a PLF transitioning to a PRF between c 50 and 300 s and an apparent NFB by the end of the period.

166.5–171.5 m

The injection period is dominated by a transition to a PRF between c 200 and 600 s followed by a NFB. The recovery period indicates an early PLF followed by a transition to a short PRF. At the end of the recovery period a NFB is observed. Fit with a single fracture model (Gringarten-Ramey) to the early PLF results in a slightly lower estimate of the transmissivity value than fit with the Dougherty-Babu model to the late PRF regime for the recovery period.

171.5–176.5 m

The injection period indicates an early PRF from c 20 s. to 100 s transitioning to a later PRF from c 100 s to 400 s. Finally, a NFB is identified at the end of the period. The recovery is almost instantaneous. A PSS is transitioning to an apparent NFB lasting to the end of the period. No unique transient evaluation can be made on the recovery period.

214–219 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

219–224 m

The injection period is dominated by a NFB, whereas WBS dominates the recovery period. No unique transient evaluation is possible. The pressure only recovered 3 m from the head change of 20 m applied during the injection period, proving that the section has a very low transmissivity. T_M is considered to be the most representative transmissivity value for this section.

224–229 m

The injection period is dominated by a NFB. WBS dominates the recovery period. No transient evaluation of the period is possible. The pressure only recovered c 2 m from the head change of 20 m applied during the injection period, indicating that the section has a low transmissivity. T_M is considered to be the most representative transmissivity value for this section.

229–234 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase demonstrating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

254–259 m

The injection period indicates a short PRF from c 10 to 50 s transitioning to a PSF and an apparent NFB by the end of the period. The injection pressure decreased c 2–3 kPa during the injection period. The recovery period indicates initial WBS transitioning to a PRF between c 300 and 900 s. There is an inconsistent behaviour between the injection- and recovery period.

259–264 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, following AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a slight pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

264–269 m

The injection period is dominated by a NFB, possibly followed by a transition to a PLF/PRF by the end of the period. The pressure is unstable throughout the injection period. A change of valve after c 250 s and a switch of flow meters after c 300 s may contribute to the disturbances seen during the flow period. During the recovery period only WBS is indicated and therefore no unique evaluation is possible. However, with assumed T and skin from the injection period an r(c) value is possible to derive. Noticeable is that the derived r(c) value results in a very large wellbore storage coefficient compared with other sections and theoretical value of the wellbore storage coefficient. The pressure recovered only 3 m from the head change of 22 m applied during the injection period, showing that the section has a low transmissivity. Thus, the response during the injection period is very inconsistent with the response during the recovery period.

269–274 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

274–279 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

279–284 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, as stated in AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

284–289 m

A PRF is weakly indicated during the last part of the injection period. During the recovery period WBS with a transition to a PSS is indicated. The recovery period is not consistent with the injection period.

289–294 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

294–299 m

Although the derivative is scattered a PRF is indicated by the end of the injection period. The beginning of the recovery period indicates WBS transitioning to a possible PSF.

416.5–421.5 m

The injection period indicates a PRF transitioning to a NFB after c 100 s. The recovery period displays WBS for the first c 80 s and after a transition period it goes into an apparent NFB by the end of the period.

421.5–426.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase, indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

426.5–431.5 m

The test section has a very low transmissivity. The flow during the injection period is very close to the measurement limit. Although the flow rate data are very scattered throughout the injection period a PRF is assumed to dominate the period. The recovery period displays WBS for the first c 80 s followed by a transition period.

431.5–436.5 m

The test section has a very low transmissivity. Since the flow rate was not detectable, neither steady-state nor transient evaluation of transmissivity was possible. Hence, in accordance with AP PF 400-04-111, the injection time was shortened. As a result T_M, based on Q/s-measl-L, was considered to be the most representative transmissivity value for this section. The period of measured recovery only showed a pressure increase indicating that the section is of such low transmissivity that the packer expansion affects the pressure throughout the period.

284–289 m (50 kPa injection pressure)

Although the derivative data are scattered an apparent PRF, or possibly, a PSF is indicated during c 10–200 s of the injection period. After this time there is a significant increase in the derivative indicating a NFB. Initially during the recovery period WBS effects are indicated transitioning to a PSS after c 100 s.

284–289 m (100 kPa injection pressure)

Although the derivative data are scattered, an apparent PRF, or possibly, a PSF is indicated during c 10–200 s of the injection period. After this time, there is a slight increase in the derivative. Initially during the recovery period, WBS effects are indicated transitioning to a PSS after c 100 s.

284–289 m (200 kPa injection pressure)

Although the derivative data are scattered an apparent PRF, or possibly, a PSF is indicated during c 10–200 s of the injection period. After this time, there is a slight decrease in the derivative indicating a PSF. Initially during the recovery period, WBS effects are indicated transitioning to a PSS after c 100 s.

284–289 m (300 kPa injection pressure)

A very short period with a PRF, or possibly, a PSF is indicated during the first phase of the injection period. After c 30 s there is a slight increase in the derivative. At c 200 s, the flow rate data show a sudden decrease, but the pressure is unchanged. It is not clear if this decrease in flow rate is a borehole effect (e.g. turbulence) or an error in the flow rate recording. By the end of the injection period the derivative decreases indicating a PSF. Initial WBS effects are indicated during the recovery period transitioning to a PSS after c 100 s.

6.2.6 Flow regimes

As discussed in Section 5.4.4, several 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 on different scales is presented in Table 6-3, which shows all identified flow regimes. For example, if a certain flow period indicates a pseudo-radial flow regime transitioning to a pseudo-spherical flow regime, this flow period contributes to one observation of pseudo-radial and one observation of pseudo-spherical flow. The numbers within parenthesis denote the number of tests where the actual flow regime is the only one present.

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

Table 6-3. Interpreted flow regimes during the injection tests in KFM05A.

Section length (m)	Number of tests	Number of tests with definable Q_p	Injection period PLF	PRF	PSF	PSS	NFB	Recovery period WBS	PLF	PRF	PSF	PSS	NFB
5	29	19	1(0)	14(4)	5(1)	0(0)	11(2)	13(8)	2(0)	6(0)	4(1)	3(0)	5(0)
20	16	10	1(0)	7(0)	3(0)	0(0)	8(0)	8(7)	1(0)	1(0)	2(1)	0(0)	1(0)
100	10	7	2(0)	6(1)	0(0)	0(0)	5(1)	6(6)	1(0)	1(0)	0(0)	0(0)	0(0)

Table 6-3 shows that a period of pseudo-radial flow could be identified from the injection period in c 75% of the tests with a definable final flow rate. For the recovery period, the corresponding result is only c 22%. In 75% of the tests, more than one flow regime could be identified. The most common transitions were from pseudo-radial flow regime to an apparent no-flow boundary (NFB) during the injection period and from WBS to a pseudo-radial flow regime during the recovery period.

Apparent no-flow boundaries were identified more often in KFM05A than was the case with previous injection tests in KFM02A, KFM03A and KFM04A. This is true both for the injection period and the recovery period. This might be a reflection of the generally low transmissivity in KFM05A. Another observation is that no pseudo-stationary flow regime could be identified during the injection period for any test, while three of the tests indicated such flow regime during the recovery period.

6.3 Transmissivity values on different scales

The transmissivity values considered the most representative, T_R, from the injection tests in the tested sections of 100 m, 20 m and 5 m length, respectively, are shown in Figure 6-2. This figure demonstrates a good agreement between results obtained from tests on different scales. A consistency check of the transmissivity values on the different scales was made by summation of calculated values from smaller scales (20 m and 5 m) and comparing with the estimated values in longer sections (100 m and 20 m).

In Table 6-4, estimated transmissivity values in 100 m and 20 m test sections according to steady-state (T_M) and most representative evaluation (T_R) are listed together with summed transmissivities in 20 m and 5 m sections over the corresponding 100 m and 20 m sections. In addition, the corresponding sum of transmissivities from the difference flow logging in 5 m sections (SUM T_D) is displayed for each section.

In Table 6-4, when the transmissivity values are below the measurement limit (Q_p could not be defined), the most representative transmissivity value, T_R, was considered to be less than T_M, based on Q/s-measl-L, for the test section. The measurement limit values are included in the summed values in Table 6-4. This leads to overestimated values of the summed transmissivities. This is particularly true for the summed transmissivities from the difference flow logging in 5 m sections, due to the increased (cumulative) lower measurement limit for these tests, see /1/.

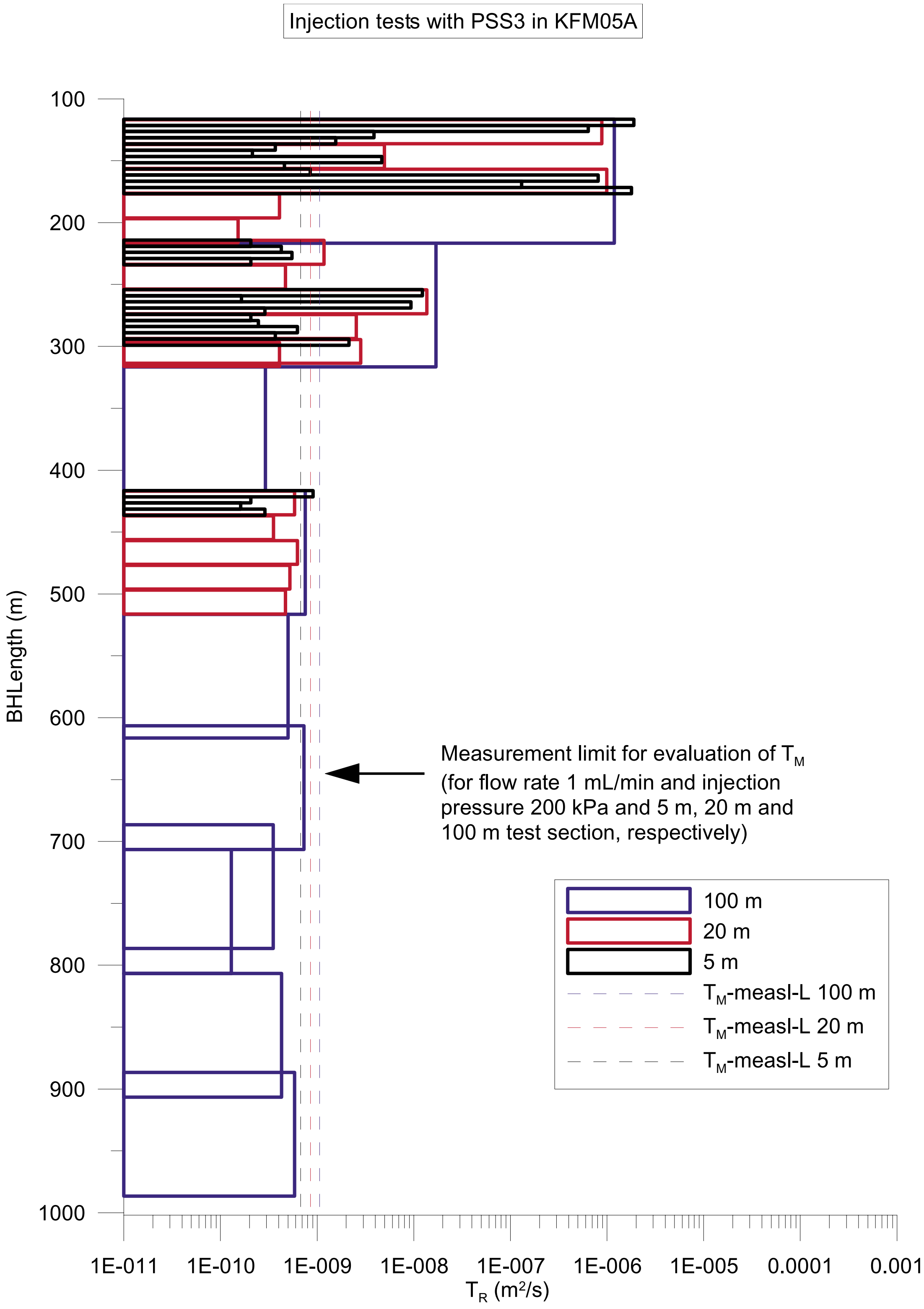

Figure 6-2. *Estimated best representative transmissivity values (T_R) for sections of 100 m, 20 m and 5 m length in borehole KFM05A. Estimated transmissivity values for the lower measurement limit from stationary evaluation (T_M-measl-L) (flow rate 1.7×10^{-8} m³/s and injection pressure 200 kPa) for different test section lengths are also shown.*

Table 6-4. Estimated transmissivity values in 100 m and 20 m test sections together with summed up transmissivity values in 20 m and 5 m sections in the corresponding borehole intervals from the injection tests in KFM05A. In addition, the corresponding sum of transmissivity values from the difference flow logging in 5 m sections is shown.

Borehole Idcode	Secup inj.test (m)	Seclow inj.test (m)	L_w (m)	T_M inj. tests (m^2/ s)	T_R inj. tests (m^2/s)	SUM T_M (20 m) inj. tests (m^2/s)	SUM T_R (20 m) inj. tests (m^2/s)	SUM T_M (5 m) inj. tests (m^2/s)	SUM T_R (5 m) inj. tests (m^2/s)	Secup diff-flow log (m)	Seclow diff-flow log (m)	SUM-T_D (5 m) diff-flow log (m^2/s)
KFM05A	116.5	216.5	100	4.09E–06	1.19E–06	3.58E–06	1.89E–06	3.33E–06	5.28E–06	116.42	216.57	1.88E–06
KFM05A	216.5	316.5	100	1.26E–07	1.70E–08	1.50E–07	2.11E–08	1.01E–07	2.71E–08	216.58	316.64	4.38E–08
KFM05A	316.5	416.5	100	2.91E–10	2.91E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	316.65	416.73	2.54E–08
KFM05A	416.5	516.5	100	2.00E–09	7.55E–10	3.66E–09	2.56E–09	2.01E–09	1.56E–09	416.74	516.89	5.14E–08
KFM05A	516.5 [1)]	616.5	100	< 5.00E–10	< 5.00E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	516.90	617.04	2.65E–08
KFM05A	606.5 [1)]	706.5	100	2.15E–09	7.31E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	607.03	707.24	2.65E–08
KFM05A	686.5 [1)]	786.5	100	3.00E–09	3.52E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	687.21	787.38	3.43E–08
KFM05A	706.5 [1)]	806.5	100	1.68E–09	1.30E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	707.25	807.41	3.44E–08
KFM05A	806.5	906.5	100	< 4.29E–10	< 4.29E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	807.42	907.71	2.70E–08
KFM05A	886.5	986.5	100	< 5.85E–10	< 5.85E–10	n m 20 m	n m 20 m	n m 5 m	n m 5 m	887.67	987.88	7.77E–08
KFM05A	116.5	136.5	20	1.77E–06	8.83E–07			1.79E–06	2.54E–06	116.42	136.49	1.55E–06
KFM05A	136.5	156.5	20	6.95E–09	4.98E–09			5.80E–09	5.70E–09	136.49	156.50	6.02E–09
KFM05A	156.5	176.5	20	1.80E–06	9.97E–07			1.53E–06	2.73E–06	156.5	176.52	3.17E–07
KFM05A	176.5	196.5	20	< 4.07E–10	< 4.07E–10			n m 5 m	n m 5 m	176.53	196.55	5.19E–09
KFM05A	196.5 [1)]	216.5	20	5.91E–10	1.52E–10			n m 5 m	n m 5 m	196.56	216.57	5.20E–09
KFM05A	214 [1)]	234	20	1.18E–09	1.18E–09			1.39E–09	1.39E–09	216.58	236.59	5.24E–09
KFM05A	234	254	20	< 4.70E–10	< 4.70E–10			n m 5 m	n m 5 m	236.59	256.61	5.17E–09
KFM05A	254	274	20	1.43E–07	1.37E–08			9.52E–08	2.21E–08	256.61	276.62	2.31E–08
KFM05A	274	294	20	2.12E–09	2.54E–09			2.29E–09	1.45E–09	276.62	296.63	5.16E–09
KFM05A	294 [1)]	314	20	3.70E–09	2.83E–09			2.48E–09	2.14E–09	296.63	316.64	5.11E–09
KFM05A	296.5 [1)]	316.5	20	< 4.07E–10	< 4.07E–10			n m 5 m	n m 5 m	296.63	316.64	5.11E–09
KFM05A	416.5	436.5	20	1.66E–09	5.86E–10			2.01E–09	1.56E–09	416.74	436.75	5.11E–09
KFM05A	436.5	456.5	20	3.88E–10	3.53E–10			n m 5 m	n m 5 m	436.76	456.78	5.20E–09
KFM05A	456.5	476.5	20	< 6.26E–10	< 6.26E–10			n m 5 m	n m 5 m	456.79	476.82	5.20E–09
KFM05A	476.5	496.5	20	< 5.22E–10	< 5.22E–10			n m 5 m	n m 5 m	476.82	496.85	5.22E–09
KFM05A	496.5	516.5	20	< 4.70E–10	< 4.70E–10			n m 5 m	n m 5 m	496.86	516.89	5.27E–09

[1)] Partly overlapping sections

n m = not measuredIn Figure 6-3, transmissivity values considered as the most representative for 100 m and 20 m sections (T_R–100 m and T_R–20 m, respectively) are plotted versus the sum of the transmissivity values considered most representative in 5 m sections in the corresponding intervals (SUM T_R–5 m). The lower measurement limit of T_M for the different section lengths (Q_p= 1mL/min and an assumed pressure difference of 200 kPa) together with the cumulative measurement limit for the sum of 5 m sections are also shown in the figure.

Figure 6-3 indicates a good agreement between measured transmissivity values in longer sections and summed transmissivity values in corresponding 5 m sections for the injection tests. Deviations towards the lower measurement limit is caused by the fact that values at the measurement limit (Q/s-measl-L) are accumulated in the summation process which most likely results in overestimated values of SUM T_R–5 m.

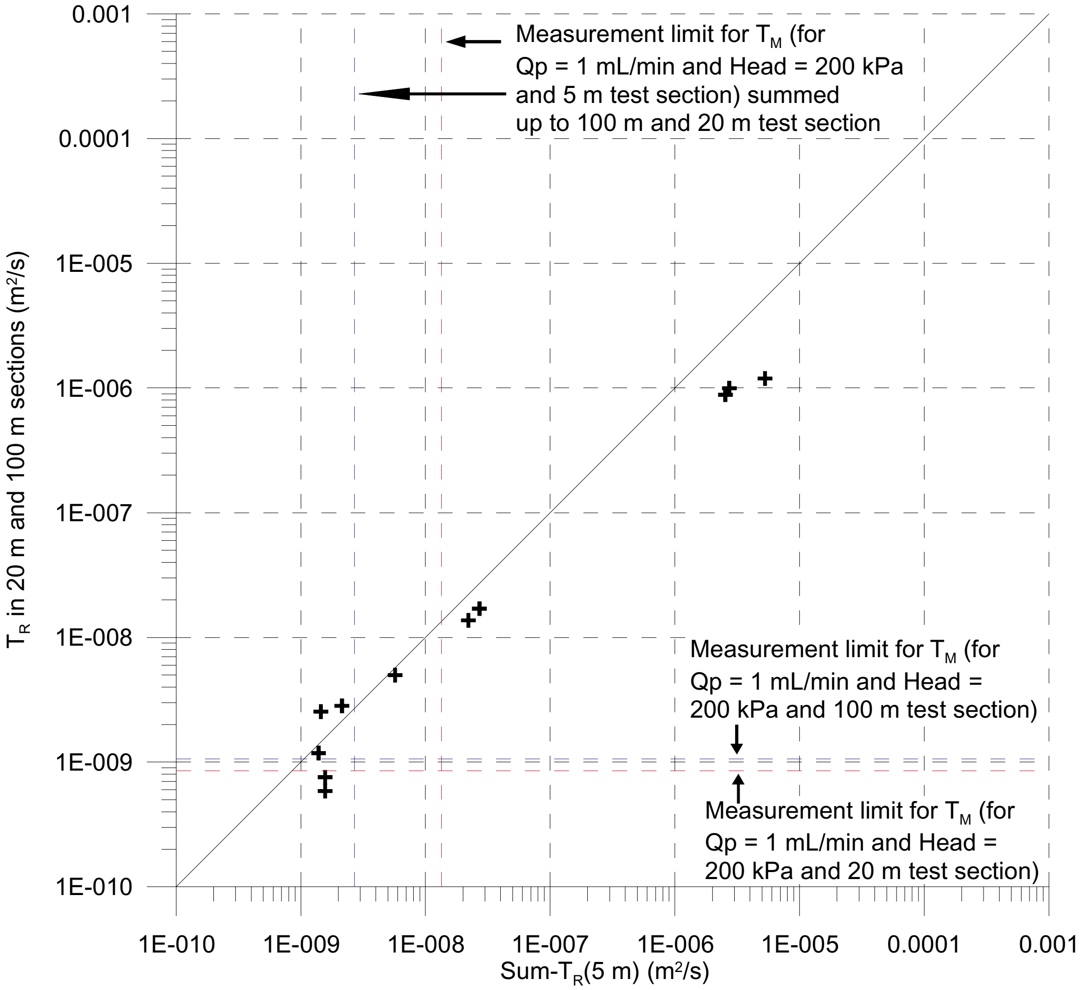

Figure 6-3. *Transmissivity values considered most representative (T_R) for 100 m and 20 m sections versus the sum of most representative transmissivity values (T_R) in 5 m sections in the corresponding borehole intervals from the injection tests in KFM05A.*

6.4 Comparison with results from the difference flow logging

In Figure 6-4, a direct comparison is made of calculated steady-state (T_M) and most representative transmissivity values (T_R) from the injection tests in 5 m sections with the calculated transmissivity values in the corresponding 5 m sections from the sequential difference flow logging (T_D) in KFM05A /1/. In Figure 6-5, T_R and T_D are plotted versus the borehole length for the injections tests in 5 m sections. The presented measurement limit for the difference flow logging is the practical lower measurement limit (varying along the borehole) /1/. In the summation of the transmissivities from the 5 m sections, the estimated values for the lower (practical) measurement limits are included.

Figure 6-4 indicates good agreement between the estimated transmissivity values from the injection tests and the difference flow logging. It should, however, be noted that the two methods differ regarding assumptions and associated uncertainties. Potential uncertainties for difference flow logging results are discussed in Ludvigson et al. (2002) /12/ and for injection tests in Andersson et al. (1993) /13/.

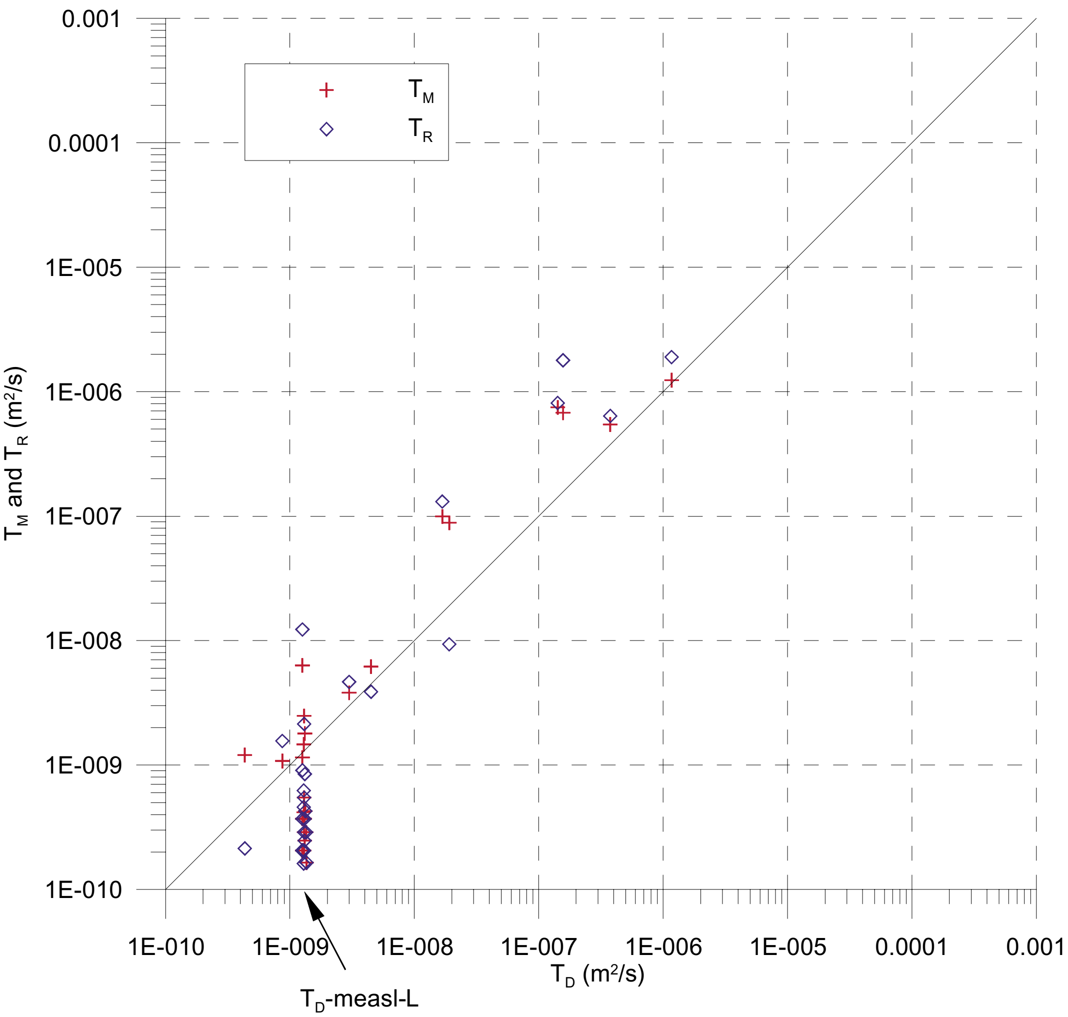

Figure 6-4. *Comparison of estimated steady-state (T_M) and most representative (T_R) transmissivity values from the injection tests in 5 m sections with estimated transmissivity values in the corresponding 5 m sections from the previous difference flow logging (T_D) in KFM05A.*

For the difference flow logging, the lower limit for transmissivity was in most sections of KFM05A estimated at approximately 1.3×10^{-9} m²/s. This limit is significantly higher than the corresponding limits for the injection tests in KFM05A. This is clearly seen in Figure 6-4 as a difference between T_D, T_M and T_R, respectively, for low transmissivity values. Figure 6-4 and 6-5 further indicate that both T_M and T_R tend to be higher than T_D when T_M and T_R are higher than T_D-measl-L. This is particularly true for the sections 161.5–166.5 m, 166.5–171.5 m and 171.5–176.5 m, which is clearly seen in Figure 6-5.

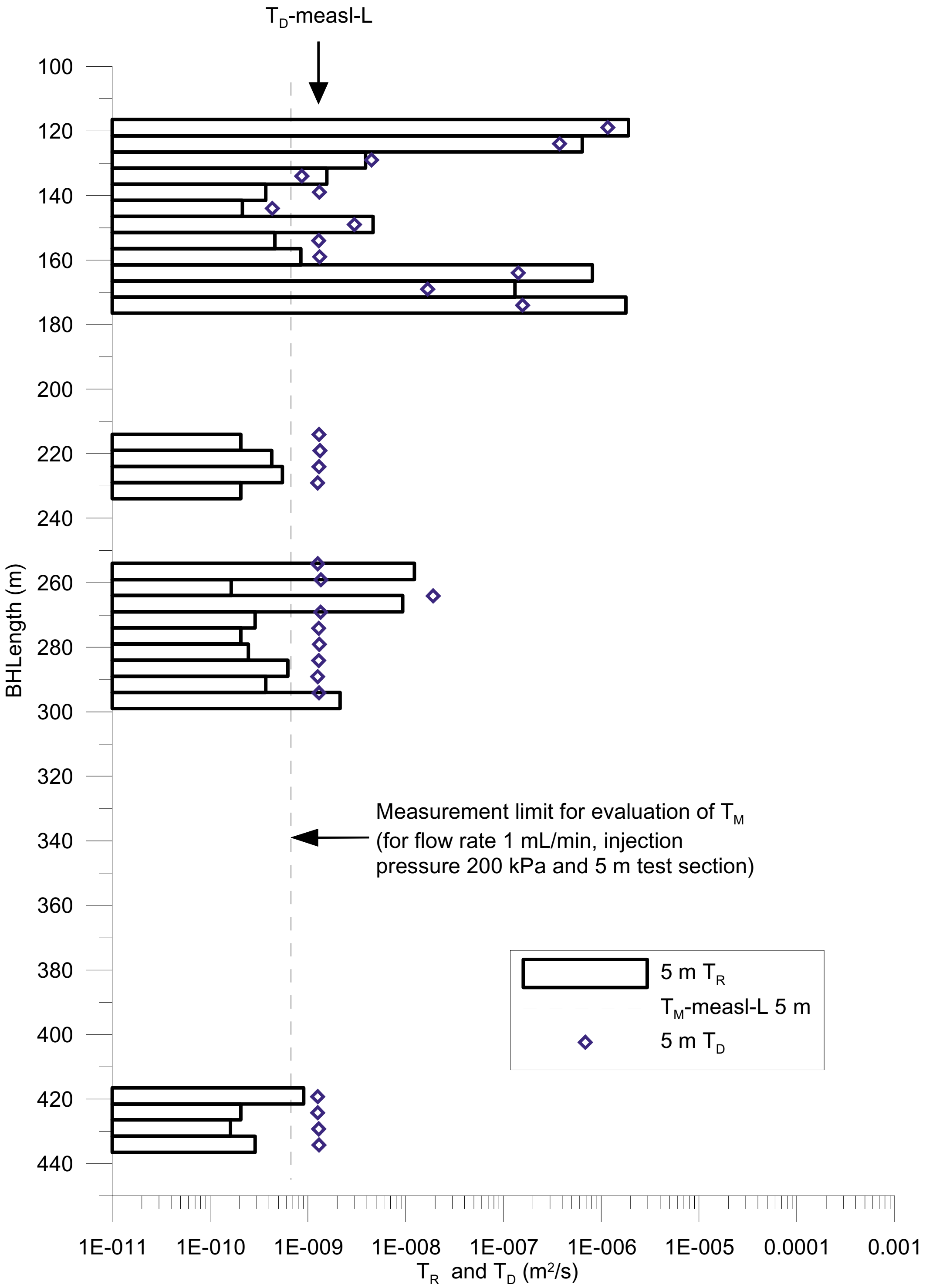

Figure 6-5. *Comparison of most representative transmissivity values (T_R), from the injection tests in 5 m sections with estimated transmissivity values in the corresponding 5 m sections from the previous difference flow logging (T_D) in KFM05A.*

In Figure 6-6, a comparison is made of the estimated steady-state transmissivity values from the injection tests in 100 m and 20 m test sections with summed transmissivity values for 5 m sections from the difference flow logging (SUM T_D(5 m)) in the corresponding borehole intervals. The latter sums are shown in Table 6-4. Figure 6-6 shows that the estimated transmissivity values from the injection tests in 100 m and 20 m sections are distributed over a much wider range than the sum of transmissivity values from the difference flow logging. This is partly a result of the lower measurement limit values being included in the sum for the difference flow logging. In Figure 6-7, T_R and SUM T_D(5 m) are plotted versus the borehole length for the injection test intervals in 20 m and 100 m sections.

The results in Figure 6-6 are consistent with the results in Figure 6-4 even though the number of tests exceeding the lower measurement limit for the difference flow logging in Figure 6-6 is relatively low. The tendency in Figures 6-4, 6-5 and 6-6 towards higher values of T_M and T_R than T_D is not as clear in Figure 6-7. Still, the 20 m section in the interval 156.5–176.5 m shows significantly higher T_R than T_D as is the case of the 5 m sections in the interval 161.5–176.5 m.

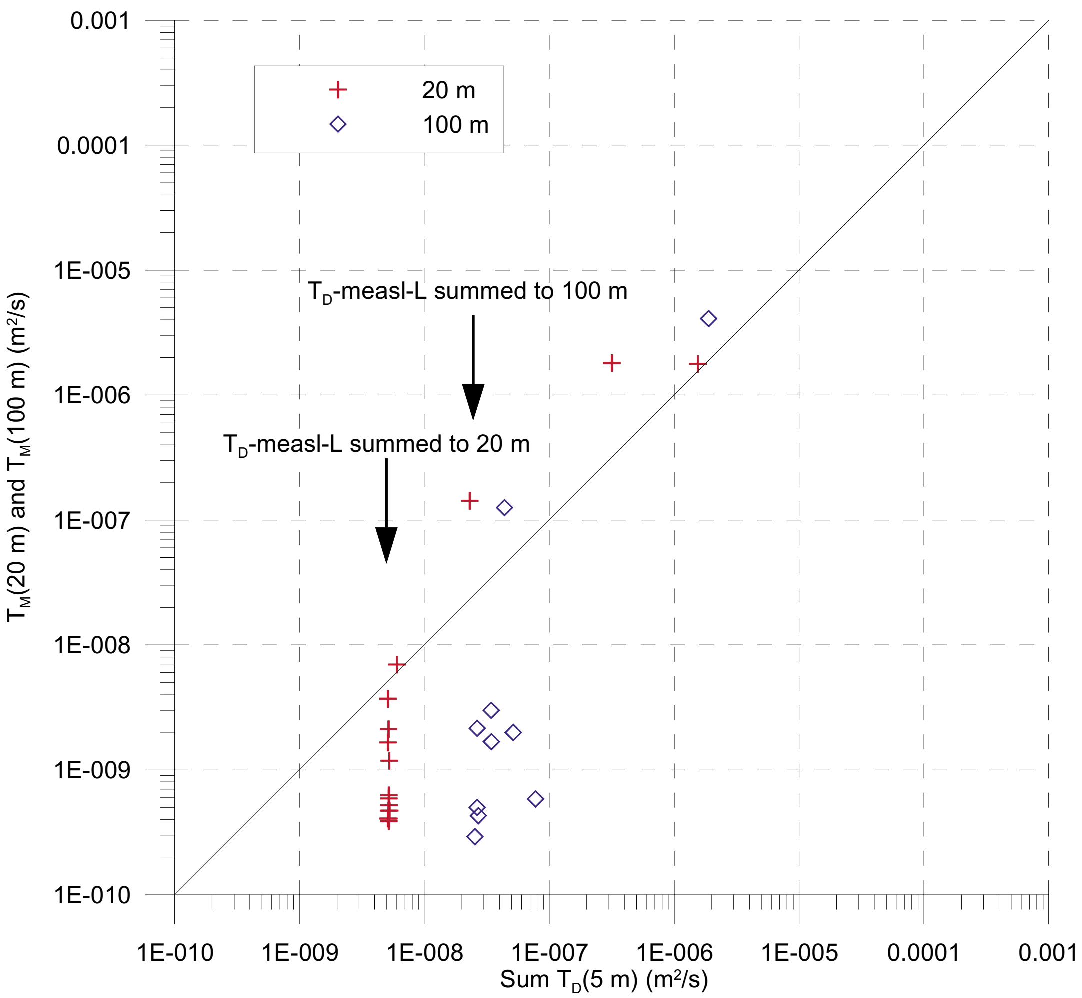

Figure 6-6. *Comparison of estimated steady-state transmissivity values from injection tests in 20 m and 100 m sections with summed transmissivity values in 5 m sections in the corresponding borehole intervals from difference flow logging in KFM05A.*

For the difference flow logging, the flow period in the borehole was much longer than for the injection tests. Therefore, the difference flow logging measures interconnected, conductive fracture networks reaching further away from the borehole than the injection tests. This may be an explanation of the significantly higher T_R than T_D in some of the 5 m and 20 m sections, assuming that the fractures in these sections are of limited extent and not connected to a larger fracture network. Thus, the transmissivity of such fractures is assumed to decrease with increasing flow times. During short injection tests, such effects may not be seen.

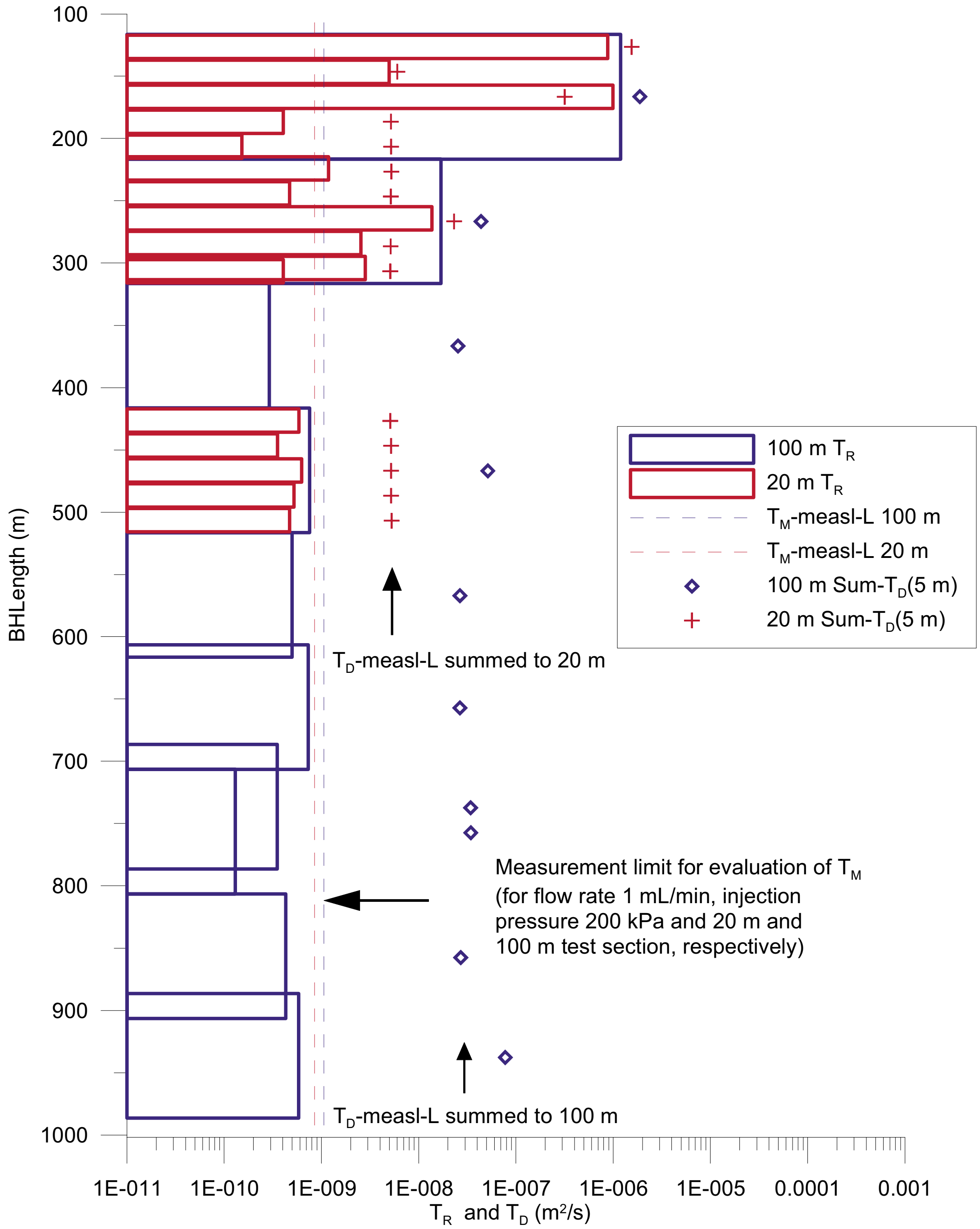

***Figure 6-7.** Comparison of most representative (T_R) transmissivity values from injection tests in 20 m and 100 m sections with summed transmissivity values in 5 m sections in the corresponding borehole intervals from difference flow logging in KFM05A.*

6.5 Basic statistics of hydraulic conductivity distributions

Some basic statistical parameters were calculated for the steady-state hydraulic conductivity (K_M) distributions in different scales (100 m, 20 m and 5 m) from the injection tests in borehole KFM05A. The hydraulic conductivity is obtained by dividing the transmissivity by the section length, in this case T_M/L_w. Results from tests where Q_p was below the estimated measurement limit were not included in the statistical analyses of K_M. Therefore, the same basic statistical parameters were derived for the hydraulic conductivity considered most representative ($K_R = T_R/L_w$), including all tests. In the statistical analysis, the logarithm (base 10) of K_M and K_R was used. Selected results are shown in Table 6-5. It should be noted that the statistics for the different section lengths is based on different borehole intervals.

Table 6-5. Basic statistical parameters for steady-state hydraulic conductivity (K_M) and hydraulic conductivity considered most representative (K_R) in borehole KFM05A. L_w=section length, m=arithmetic mean, s=standard deviation.

Borehole KFM05A	Parameter Measured borehole interval	Unit m	L_w=100 m 116.50–986.50 [2)]	L_w=20 m 116.50–516.50 [3)]	L_w=5 m 116.50–436.50 [4)]
	No of tests	–	10	16	29
	No of tests below E.L.M.L.[1)]	–	3	6	10
	m ($Log_{10}(K_M)$)	Log_{10}(m/s)	–10.07	–9.30	–8.79
	s ($Log_{10}(K_M)$)	–	1.42	1.38	1.25
	m ($Log_{10}(K_R)$)	Log_{10}(m/s)	–10.87	–9.97	–9.38
	s ($Log_{10}(K_R)$)	–	1.17	1.14	1.30

1) Number of tests where Qp could not be defined (E.L.M.L. = estimated lower measurement limit).
2) Sections 516.50–616.50 m and 606.50–706.50 m partly overlapping. Sections 606.50–706.50 m and 686.50–786.50 m partly overlapping. Sections 686.50–786.50 m and 706.5–806.5 m partly overlapping. Sections 806.5–906.5 m and 886.5–906.5 m partly overlapping.
3) Sections 196.50–216.50 and 214.00–234.00 partly overlapping. Sections 294.00–314.00 m and 296.50–316.50 m partly overlapping. The interval 316.50–416.50 m was not measured.
4) The intervals 176.50–214.00 m, 234.00–254.00 m and 299.00–416.50 m were not measured with 5 m section.

6.6 Comparison of results from different hydraulic tests in KFM05A

In Table 6-6, a comparison of estimated transmissivity values from different hydraulic tests in KFM05A is presented. It should be observed that the summed transmissivity values for the injection tests only include the tests actually performed for each section length. However, the most conductive sections are measured.

Table 6-6 also shows that the results of the different test methods used in borehole KFM05A give consistent results. The total transmissivity of the borehole (116.5–986.5 m) is dominated by the interval 116.5–176.5 m. It should be noted that the dominating flow anomaly, contributing to almost all of the measured transmissivity from the difference flow logging, lies at c 108 m below top of casing and is not measured by any injection test.

Table 6-6. Comparison of calculated transmissivity values from different hydraulic tests in borehole KFM05A.

Hydraulic test method	Sum of T (m^2/s)	Borehole interval and length of interval (m) 116.50–986.50	106.39–992.89
Injection tests	$\sum T_M$(100 m)	4.23E–06	
	$\sum T_R$(100 m)	1.21E–06	
	$\sum T_M$(20 m) [1)]	3.74E–06	
	$\sum T_R$(20 m) [1)]	1.91E–06	
	$\sum T_M$(5 m) [2)]	3.43E–06	
	$\sum T_R$(5 m) [2)]	5.31E–06	
Difference flow logging	$\sum T_D$(5 m)	1.90E–06 [3)]	4.13E–04
	$\sum T_{Df}$ (flow anomalies)	1.83E–06	1.25E–03
Pumping test in conjunction with difference flow logging	T_M		4.5E–04

[1)] Actual measured intervals were 116.5–316.5 m and 416.5–516.5 m.
[2)] Actual measured intervals were 116.5–176.5 m, 214.0–234.0 m, 254.0–299.0 m and 416.5–436.5 m.
[3)] Actual measured interval was 116.42–987.88 m.

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Appendices

Appendix 1	File description table
Appendix 2.1	General test data
Appendix 2.2	Pressure and flow data
Appendix 3	Test diagrams – Injection tests
Appendix 4	Borehole technical data
Appendix 5	Sicada tables

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		
KFM05A	116.5	216.5	3	1	20041213 11:35	20041213 15:05	__KFM05A_0116.50_200412131135.ht2	P,Q,Te	
KFM05A	216.5	316.5	3	1	20041214 08:34	20041214 09:35	__KFM05A_0216.50_200412140834.ht2	P,Q,Te	
KFM05A	316.5	416.5	3	1	20041214 11:06	20041214 12:57	__KFM05A_0316.50_200412141106.ht2	P,Q,Te	
KFM05A	416.5	516.5	3	1	20041214 14:43	20041214 16:37	__KFM05A_0416.50_200412141443.ht2	P,Q,Te	
KFM05A	516.5	616.5	3	1	20041215 09:03	20041215 10:57	__KFM05A_0516.50_200412150903.ht2	P,Q,Te	
KFM05A	606.5	706.5	3	1	20041215 13:18	20041215 15:08	__KFM05A_0606.50_200412151318.ht2	P,Q,Te	
KFM05A	706.5	806.5	3	1	20041215 16:36	20041215 17:36	__KFM05A_0706.50_200412151636.ht2	P,Q,Te	
KFM05A	706.5	806.5	3	2	20041216 08:39	20041216 10:47	__KFM05A_0706.50_200412160839.ht2	P,Q,Te	
KFM05A	806.5	906.5	3	1	20041216 14:44	20041216 15:57	__KFM05A_0806.50_200412161444.ht2	P,Q,Te	
KFM05A	886.5	986.5	3	1	20041220 08:16	20041220 10:14	__KFM05A_0886.50_200412200816.ht2	P,Q,Te	
KFM05A	686.5	786.5	3	1	20041220 14:31	20041220 16:27	__KFM05A_0686.50_200412201431.ht2	P,Q,Te	
KFM05A	216.5	316.5	3	2	20041221 17:31	20041221 20:05	__KFM05A_0216.50_200412211731.ht2	P,Q,Te	
KFM05A	216.5	316.5	3	3	20041222 06:37	20041222 08:29	__KFM05A_0216.50_200412220637.ht2	P,Q,Te	
KFM05A	116.5	136.5	3	1	20050104 06:57	20050104 08:35	__KFM05A_0116.50_200501040657.ht2	P,Q,Te	
KFM05A	136.5	156.5	3	1	20050104 09:02	20050104 10:27	__KFM05A_0136.50_200501040902.ht2	P,Q,Te	
KFM05A	156.5	176.5	3	1	20050104 10:51	20050104 13:05	__KFM05A_0156.50_200501041051.ht2	P,Q,Te	
KFM05A	176.5	196.5	3	1	20050104 13:38	20050104 14:44	__KFM05A_0176.50_200501041338.ht2	P,Q,Te	
KFM05A	196.5	216.5	3	1	20050105 08:18	20050105 09:46	__KFM05A_0196.50_200501050818.ht2	P,Q,Te	
KFM05A	214	234	3	1	20050105 10:08	20050105 11:25	__KFM05A_0214.00_200501051008.ht2	P,Q,Te	
KFM05A	234	254	3	1	20050105 11:55	20050105 13:20	__KFM05A_0234.00_200501051155.ht2	P,Q,Te	
KFM05A	254	274	3	1	20050105 13:46	20050105 15:17	__KFM05A_0254.00_200501051346.ht2	P,Q,Te	
KFM05A	274	294	3	1	20050110 09:28	20050110 10:05	__KFM05A_0274.00_200501100928.ht2	P,Q,Te	
KFM05A	274	294	3	2	20050110 10:11	20050110 11:29	__KFM05A_0274.00_200501101011.ht2	P,Q,Te	
KFM05A	294	314	3	1	20050110 11:53	20050110 13:43	__KFM05A_0294.00_200501101153.ht2	P,Q,Te	
KFM05A	296.5	316.5	3	1	20050110 13:56	20050110 14:38	__KFM05A_0296.50_200501101356.ht2	P,Q,Te	
KFM05A	416.5	436.5	3	1	20050110 15:57	20050110 17:18	__KFM05A_0416.50_200501101557.ht2	P,Q,Te	
KFM05A	436.5	456.5	3	1	20050110 17:47	20050110 19:04	__KFM05A_0436.50_200501101747.ht2	P,Q,Te	
KFM05A	456.5	476.5	3	1	20050111 06:29	20050111 07:13	__KFM05A_0456.50_200501110629.ht2	P,Q,Te	
KFM05A	476.5	496.5	3	1	20050111 07:35	20050111 08:20	__KFM05A_0476.50_200501110735.ht2	P,Q,Te	
KFM05A	496.5	516.5	3	1	20050111 08:41	20050111 09:28	__KFM05A_0496.50_200501110841.ht2	P,Q,Te	
KFM05A	254	274	3	2	20050111 11:19	20050111 12:31	__KFM05A_0254.00_200501111119.ht2	P,Q,Te	
KFM05A	254	274	3	3	20050111 12:38	20050111 13:54	__KFM05A_0254.00_200501111238.ht2	P,Q,Te	

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		
KFM05A	116.5	121.5	3	1	20050113 11:37	20050113 13:56	__KFM05A_0116.50_200501131137.ht2	P,Q,Te	
KFM05A	121.5	126.5	3	1	20050113 14:11	20050113 15:33	__KFM05A_0121.50_200501131411.ht2	P,Q,Te	
KFM05A	126.5	131.5	3	1	20050113 15:46	20050113 17:12	__KFM05A_0126.50_200501131546.ht2	P,Q,Te	
KFM05A	131.5	136.5	3	1	20050113 17:28	20050113 18:44	__KFM05A_0131.50_200501131728.ht2	P,Q,Te	
KFM05A	131.5	136.5	3	2	20050114 07:58	20050114 08:32	__KFM05A_0131.50_200501140758.ht2	P,Q,Te	
KFM05A	136.5	141.5	3	1	20050114 08:45	20050114 09:35	__KFM05A_0136.50_200501140845.ht2	P,Q,Te	
KFM05A	141.5	146.5	3	1	20050114 09:54	20050114 11:04	__KFM05A_0141.50_200501140954.ht2	P,Q,Te	
KFM05A	146.5	151.5	3	1	20050114 11:15	20050114 13:04	__KFM05A_0146.50_200501141115.ht2	P,Q,Te	
KFM05A	151.5	156.5	3	1	20050114 13:13	20050114 14:29	__KFM05A_0151.50_200501141313.ht2	P,Q,Te	
KFM05A	156.5	161.5	3	1	20050114 14:38	20050114 15:52	__KFM05A_0156.50_200501141438.ht2	P,Q,Te	
KFM05A	161.5	166.5	3	1	20050117 09:47	20050117 11:12	__KFM05A_0161.50_200501170947.ht2	P,Q,Te	
KFM05A	166.5	171.5	3	1	20050117 11:23	20050117 12:53	__KFM05A_0166.50_200501171123.ht2	P,Q,Te	
KFM05A	171.5	176.5	3	1	20050117 13:06	20050117 14:24	__KFM05A_0171.50_200501171306.ht2	P,Q,Te	
KFM05A	214	219	3	1	20050117 14:58	20050117 15:43	__KFM05A_0214.00_200501171458.ht2	P,Q,Te	
KFM05A	219	224	3	1	20050117 15:58	20050117 17:14	__KFM05A_0219.00_200501171558.ht2	P,Q,Te	
KFM05A	224	229	3	1	20050117 17:31	20050117 18:45	__KFM05A_0224.00_200501171731.ht2	P,Q,Te	
KFM05A	229	234	3	1	20050117 18:58	20050117 19:40	__KFM05A_0229.00_200501171858.ht2	P,Q,Te	
KFM05A	254	259	3	1	20050118 06:50	20050118 08:06	__KFM05A_0254.00_200501180650.ht2	P,Q,Te	
KFM05A	259	264	3	1	20050118 08:20	20050118 09:14	__KFM05A_0259.00_200501180820.ht2	P,Q,Te	
KFM05A	264	269	3	1	20050118 09:29	20050118 10:50	__KFM05A_0264.00_200501180929.ht2	P,Q,Te	
KFM05A	269	274	3	1	20050118 11:04	20050118 12:30	__KFM05A_0269.00_200501181104.ht2	P,Q,Te	
KFM05A	274	279	3	1	20050118 12:40	20050118 13:23	__KFM05A_0274.00_200501181240.ht2	P,Q,Te	
KFM05A	279	284	3	1	20050118 13:39	20050118 14:20	__KFM05A_0279.00_200501181339.ht2	P,Q,Te	
KFM05A	284	289	3	1	20050118 14:29	20050118 15:43	__KFM05A_0284.00_200501181429.ht2	P,Q,Te	
KFM05A	289	294	3	1	20050119 09:44	20050119 10:41	__KFM05A_0289.00_200501190944.ht2	P,Q,Te	
KFM05A	294	299	3	1	20050119 11:07	20050119 12:21	__KFM05A_0294.00_200501191107.ht2	P,Q,Te	
KFM05A	416.5	421.5	3	1	20050119 13:58	20050119 15:16	__KFM05A_0416.50_200501191358.ht2	P,Q,Te	
KFM05A	421.5	426.5	3	1	20050119 15:29	20050119 16:12	__KFM05A_0421.50_200501191529.ht2	P,Q,Te	
KFM05A	426.5	431.5	3	1	20050119 16:24	20050119 17:38	__KFM05A_0426.50_200501191624.ht2	P,Q,Te	
KFM05A	431.5	436.5	3	1	20050119 17:57	20050119 18:38	__KFM05A_0431.50_200501191757.ht2	P,Q,Te	
KFM05A	166.5	171.5	3	2	20050120 06:34	20050120 07:51	__KFM05A_0166.50_200501200634.ht2	P,Q,Te	
KFM05A	141.5	146.5	3	2	20050120 08:12	20050120 09:27	__KFM05A_0141.50_200501200812.ht2	P,Q,Te	
KFM05A	131.5	136.5	3	3	20050120 09:41	20050120 10:56	__KFM05A_0131.50_200501200941.ht2	P,Q,Te	
KFM05A	116.5	121.5	3	2	20050120 11:09	20050120 13:14	__KFM05A_0116.50_200501201109.ht2	P,Q,Te	
KFM05A	284	289	3	2	20050124 11:10	20050124 12:34	__KFM05A_0284.00_200501241110.ht2	P,Q,Te	~ 50 kPa inj. P
KFM05A	284	289	3	3	20050124 12:49	20050124 14:06	__KFM05A_0284.00_200501241249.ht2	P,Q,Te	~ 100 kPa inj. P
KFM05A	284	289	3	4	20050124 14:11	20050124 15:26	__KFM05A_0284.00_200501241411.ht2	P,Q,Te	~ 200 kPa inj. P

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		
KFM05A	284	289	3	5	20050124 15:31	20050124 16:45	__KFM05A_0284.00_200501241531.ht2	P,Q,Te	~ 300 kPa inj. P
KFM05A	284	289	3	6	20050124 16:48	20050124 18:03	__KFM05A_0284.00_200501241648.ht2	P,Q,Te	~ 50 kPa inj. P

[1)] 3: Injection test

Appendix 2.1

General test data

Borehole:	KFM05A
Testtype:	CHir (Constant Head injection and recovery)
Field crew:	C. Hjerne, J. Jönsson, K. Gokall-Norman, P Thur, T. Svensson
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**
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
116.50	216.50	20041213 11:35	20041213 14:03:06	20041213 14:33:22	20041213 15:05	30	30
216.50	316.60	20041222 06:37	20041222 07:26:59	20041222 07:57:20	20041222 08:29	30	30
316.50	416.50	20041214 11:06	20041214 11:54:57	20041214 12:25:22	20041214 12:57	30	30
416.50	516.50	20041214 14:43	20041214 15:34:28	20041214 16:04:51	20041214 16:37	30	30
516.50	616.50	20041215 09:03	20041215 09:55:22	20041215 10:25:28	20041215 10:57	30	30
606.50	706.50	20041215 13:18	20041215 14:05:40	20041215 14:35:59	20041215 15:08	30	30
686.50	786.50	20041220 14:31	20041220 15:24:42	20041220 15:55:05	20041220 16:27	30	30
706.50	806.50	20041216 08:39	20041216 09:41:36	20041216 10:15:04	20041216 10:47	33	30
806.50	906.50	20041216 14:44	20041216 15:31:33	20041216 15:49:40	20041216 15:57	18	6
886.50	986.50	20041220 08:16	20041220 09:11:02	20041220 09:41:58	20041220 10:14	31	30
116.50	136.50	20050104 06:57	20050104 07:52:52	20050104 08:13:08	20050104 08:35	20	20
136.50	156.50	20050104 09:02	20050104 09:45:06	20050104 10:05:24	20050104 10:27	20	20
156.50	176.50	20050104 10:51	20050104 12:23:02	20050104 12:43:17	20050104 13:05	20	20
176.50	196.50	20050104 13:38	20050104 14:19:17	20050104 14:37:17	20050104 14:44	18	7
196.50	216.50	20050105 08:18	20050105 09:03:36	20050105 09:23:56	20050105 09:46	20	20
214.00	234.00	20050105 10:08	20050105 10:43:20	20050105 11:03:38	20050105 11:25	20	20
234.00	254.00	20050105 11:55	20050105 12:51:48	20050105 13:11:53	20050105 13:20	20	6
254.00	274.00	20050111 12:38	20050111 13:11:58	20050111 13:32:18	20050111 13:54	20	20
274.00	294.00	20050110 10:11	20050110 10:47:22	20050110 11:07:40	20050110 11:29	20	20
294.00	314.00	20050110 11:53	20050110 13:01:06	20050110 13:21:24	20050110 13:43	20	20
296.50	316.50	20050110 13:56	20050110 14:30:28	20050110 14:32:41	20050110 14:38	2	6
416.50	436.50	20050110 15:57	20050110 16:36:18	20050110 16:56:39	20050110 17:18	20	20
436.50	456.50	20050110 17:47	20050110 18:21:47	20050110 18:42:17	20050110 19:04	21	20
456.50	476.50	20050111 06:29	20050111 07:01:34	20050111 07:08:11	20050111 07:13	7	5
476.50	496.50	20050111 07:35	20050111 08:08:42	20050111 08:13:04	20050111 08:20	4	5
496.50	516.50	20050111 08:41	20050111 09:16:25	20050111 09:19:26	20050111 09:28	3	7
116.50	121.50	20050120 11:09	20050120 12:32:06	20050120 12:52:29	20050120 13:14	20	20
121.50	126.50	20050113 14:11	20050113 14:51:11	20050113 15:11:28	20050113 15:33	20	20
126.50	131.50	20050113 15:46	20050113 16:29:50	20050113 16:50:09	20050113 17:12	20	20
131.50	136.50	20050120 09:41	20050120 10:13:53	20050120 10:34:17	20050120 10:56	20	20
136.50	141.50	20050114 08:45	20050114 09:24:30	20050114 09:27:45	20050114 09:35	3	5
141.50	146.50	20050120 08:12	20050120 08:45:10	20050120 09:05:34	20050120 09:27	20	20
146.50	151.50	20050114 11:15	20050114 12:21:39	20050114 12:41:57	20050114 13:04	20	20
151.50	156.50	20050114 13:13	20050114 13:46:26	20050114 14:06:48	20050114 14:29	20	20
156.50	161.50	20050114 14:38	20050114 15:10:20	20050114 15:30:39	20050114 15:52	20	20
161.50	166.50	20050117 09:47	20050117 10:29:27	20050117 10:49:46	20050117 11:12	20	20
166.50	171.50	20050120 06:34	20040120 07:09:00	20040120 07:29:21	20050120 07:51	20	20
171.50	176.50	20050117 13:06	20050117 13:42:14	20050117 14:02:31	20050117 14:24	20	20
214.00	219.00	20050117 14:58	20050117 15:33:26	20050117 15:36:31	20050117 15:43	3	5
219.00	224.00	20050117 15:58	20050117 16:31:43	20050117 16:52:01	20050117 17:14	20	20
224.00	229.00	20050117 17:31	20050117 18:02:58	20050117 18:23:21	20050117 18:45	20	20
229.00	234.00	20050117 18:58	20050117 19:28:41	20050117 19:33:05	20050117 19:40	4	5
254.00	259.00	20050118 06:50	20050118 07:23:30	20050118 07:43:50	20050118 08:06	20	20
259.00	264.00	20050118 08:20	20050118 09:00:29	20050118 09:04:13	20050118 09:14	4	8
264.00	269.00	20050118 09:29	20050118 10:08:00	20050118 10:28:21	20050118 10:50	20	20
269.00	274.00	20050118 11:04	20050118 12:19:10	20050118 12:22:15	20050118 12:30	3	6
274.00	279.00	20050118 12:40	20050118 13:12:08	20050118 13:15:35	20050118 13:23	3	5
279.00	284.00	20050118 13:39	20050118 14:11:07	20050118 14:13:08	20050118 14:20	2	5
284.00	289.00	20050118 14:29	20050118 15:00:45	20050118 15:21:07	20050118 15:43	20	20
289.00	294.00	20050119 09:44	20050119 10:22:12	20050119 10:33:48	20050119 10:41	12	6
294.00	299.00	20050119 11:07	20050119 11:39:14	20050119 11:59:36	20050119 12:21	20	20
416.50	421.50	20050119 13:58	20050119 14:33:52	20050119 14:54:16	20050119 15:16	20	20
421.50	426.50	20050119 15:29	20050119 16:01:39	20050119 16:05:00	20050119 16:12	3	6
426.50	431.50	20050119 16:24	20050119 16:56:12	20050119 17:16:36	20050119 17:38	20	20
431.50	436.50	20050119 17:57	20050119 18:28:46	20050119 18:31:28	20050119 18:38	3	6

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
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
284.00	289.00	20050124 12:49	20050124 13:23:33	20050124 13:43:48	20050124 14:06	20	20
284.00	289.00	20050124 14:11	20050124 14:43:43	20050124 15:03:58	20050124 15:26	20	20
284.00	289.00	20050124 15:31	20050124 16:02:54	20050124 16:23:09	20050124 16:45	20	20
284.00	289.00	20050124 16:48	20050124 17:21:27	20050124 17:41:43	20050124 18:04	20	20

Appendix 2.2

Pressure and flow data

Summary of pressure and flow data for all tests in KFM05

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p 1)	Q_m 2)	V_p 2)
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
116.50	216.50	1054.58	1261.44	1076.58	6.64E-05	8.66E-05	1.57E-01
216.50	316.60	1896.14	2142.64	2110.17	2.43E-06	1.36E-05	2.47E-02
316.50	416.50	2727.90	2946.94	2912.17	5.00E-09	3.75E-08	6.85E-05
416.50	516.50	3546.40	3763.96	3660.82	3.40E-08	7.61E-08	1.39E-04
516.50	616.50	4364.08	4585.35	4570.63			
606.50	706.50	5084.95	5301.68	5169.67	3.65E-08	7.91E-08	1.44E-04
686.50	786.50	5730.05	5910.06	5839.65	4.24E-08	1.18E-07	2.16E-04
706.50	806.50	5892.31	6130.09	6081.68	3.13E-08	1.22E-07	2.45E-04
806.50	906.50	6702.16	6903.49	6905.69			
886.50	986.50	7371.04	7450.66	7446.4			
116.50	136.50	1048.28	1248.65	1049.38	3.47E-05	4.44E-05	5.39E-02
136.50	156.50	1223.48	1424.67	1250.17	1.37E-07	2.04E-07	2.49E-04
156.50	176.50	1389.47	1590.11	1444.89	3.53E-05	5.06E-05	6.15E-02
176.50	196.50	1571.54	1766.95	1747.97			
196.50	216.50	1799.14	1937.75	1851.39	8.00E-09	1.44E-08	1.76E-05
214.00	234.00	1884.39	2083.02	2056.57	2.29E-08	1.23E-07	1.50E-04
234.00	254.00	2053.81	2251.56	2250.2			
254.00	274.00	2225.99	2529.63	2490.57	4.23E-06	2.37E-05	2.89E-02
274.00	294.00	2388.81	2592.33	2391.01	4.21E-08	6.82E-08	8.30E-05
294.00	314.00	2562.08	2759.01	2607.18	7.11E-08	9.02E-08	1.10E-04
296.50	316.50	2587.38	2780.46	2794.77			
416.50	436.50	3570.50	3771.28	3640.77	3.25E-08	5.70E-08	6.97E-05
436.50	456.50	3740.32	3938.12	3890.51	7.50E-09	1.62E-08	1.99E-05
456.50	476.50	3908.10	4110.40	4116.04			
476.50	496.50	4075.88	4267.85	4280.5			
496.50	516.50	4239.65	4427.38	4442.77			
116.50	121.50	1049.98	1250.34	1050.94	3.08E-05	3.35E-05	4.10E-02
121.50	126.50	1090.55	1291.87	1093.31	1.36E-05	1.49E-05	1.82E-02
126.50	131.50	1138.95	1338.62	1163.71	1.53E-07	1.94E-07	2.37E-04
131.50	136.50	1195.51	1386.90	1246.22	2.56E-08	3.92E-08	4.79E-05
136.50	141.50	1246.77	1434.34	1431.59			
141.50	146.50	1278.95	1471.06	1359.53	2.86E-08	5.68E-08	6.95E-05
146.50	151.50	1317.17	1521.60	1317.73	9.64E-08	1.14E-07	1.39E-04
151.50	156.50	1360.77	1564.80	1489.35	1.05E-08	2.09E-08	2.56E-05
156.50	161.50	1402.98	1605.41	1486.05	4.49E-08	9.60E-08	1.17E-04
161.50	166.50	1437.78	1645.05	1537.2	1.93E-05	3.26E-05	3.97E-02
166.50	171.50	1478.07	1680.50	1498.15	2.49E-06	3.03E-06	3.70E-03
171.50	176.50	1523.04	1723.68	1541.6	1.68E-05	1.93E-05	2.35E-02
214.00	219.00	2077.00	2084.25	2162.08			
219.00	224.00	1936.15	2129.07	2099.37	1.02E-08	4.20E-08	5.11E-05
224.00	229.00	1974.24	2169.78	2147.23	1.33E-08	8.54E-08	1.04E-04
229.00	234.00	2063.90	2209.39	2259.45			
254.00	259.00	2227.41	2423.37	2289.7	1.53E-07	2.03E-07	2.47E-04
259.00	264.00	2301.25	2523.48	2527.33			
264.00	269.00	2306.75	2525.96	2500.38	2.40E-06	1.63E-05	1.99E-02
269.00	274.00	2403.97	2546.17	2559.23			
274.00	279.00	2546.86	2589.08	2668.7			
279.00	284.00	2535.58	2631.71	2701.15			
284.00	289.00	2488.82	2673.65	2489.38	3.35E-08	4.66E-08	5.69E-05
289.00	294.00	2533.80	2720.13	2720.4			
294.00	299.00	2564.60	2758.91	2601.04	5.96E-08	6.92E-08	8.46E-05
416.50	421.50	3579.75	3772.14	3682.47	2.74E-08	5.09E-08	6.23E-05
421.50	426.50	3706.68	3813.40	3868.95			
426.50	431.50	3662.40	3857.40	3701.73	8.97E-09	1.08E-08	1.33E-05
431.50	436.50	3715.35	3901.00	3915.17			
284.00	289.00	2476.58	2614.65	2482.22	4.76E-08	5.16E-08	6.28E-05
284.00	289.00	2477.13	2688.99	2485.52	7.58E-08	8.05E-08	9.78E-05
284.00	289.00	2485.52	2794.12	2495.43	8.75E-08	1.00E-07	1.22E-04
284.00	289.00	2494.32	2561.71	2498.18	2.98E-08	3.76E-08	4.57E-05

[1)] No value indicates a flow below measurement limit (measurement limit is unique for each test but nominally 1.67 E-8 m^3/s).
[2)] No value indicates that the parameter could not be calculated due to low and uncertain flow rates during a major part of flow period

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 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 tests lin-log and log-log diagrams are presented, from the injection and recovery period respectively.

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 (-)

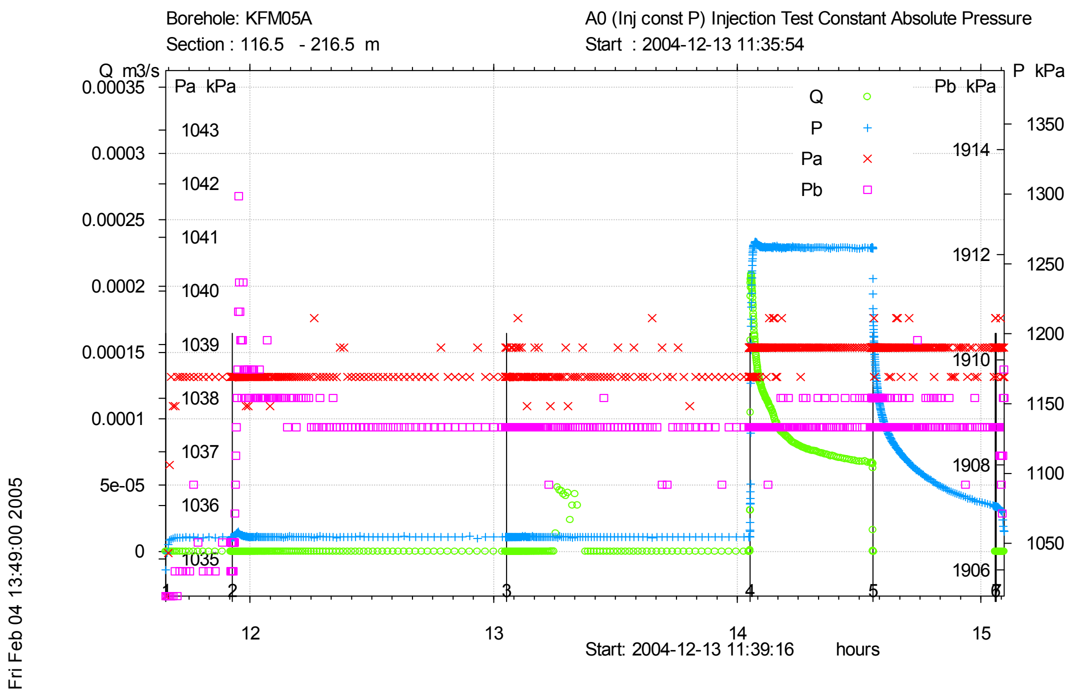


Figure A3-1. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 116.5-216.5 m in borehole KFM05A.*

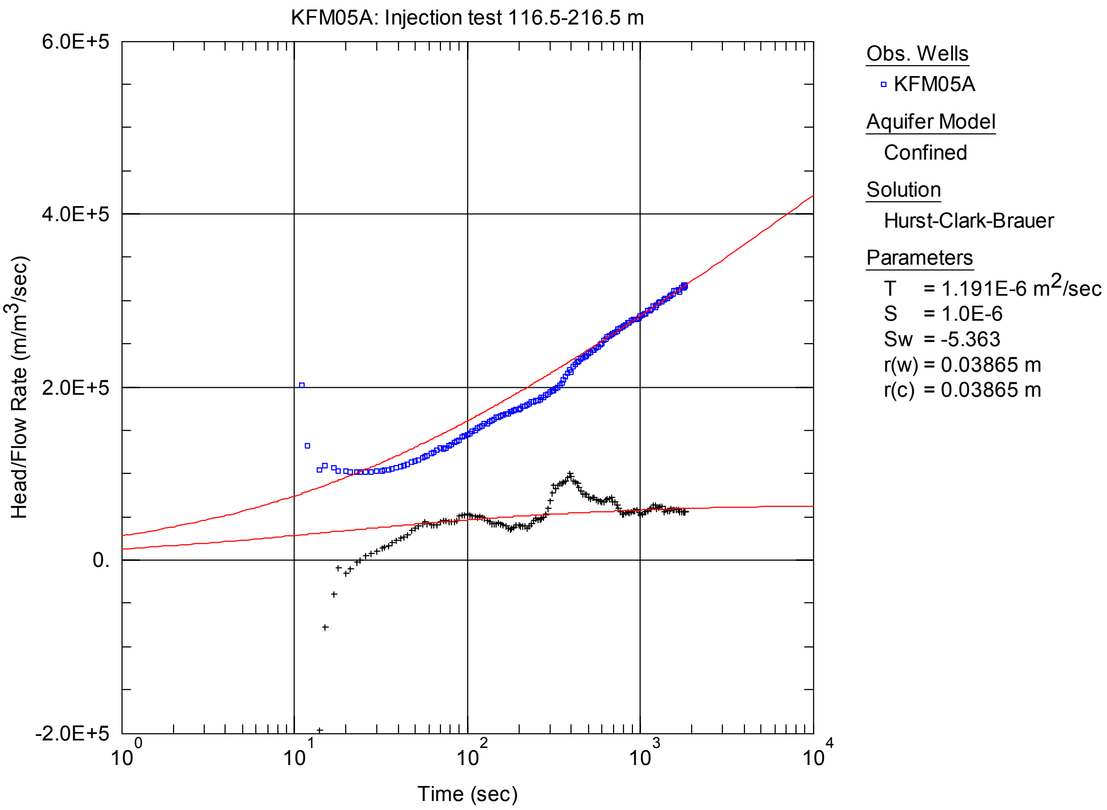


Figure A3-2. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-216.5 m in KFM05A.*

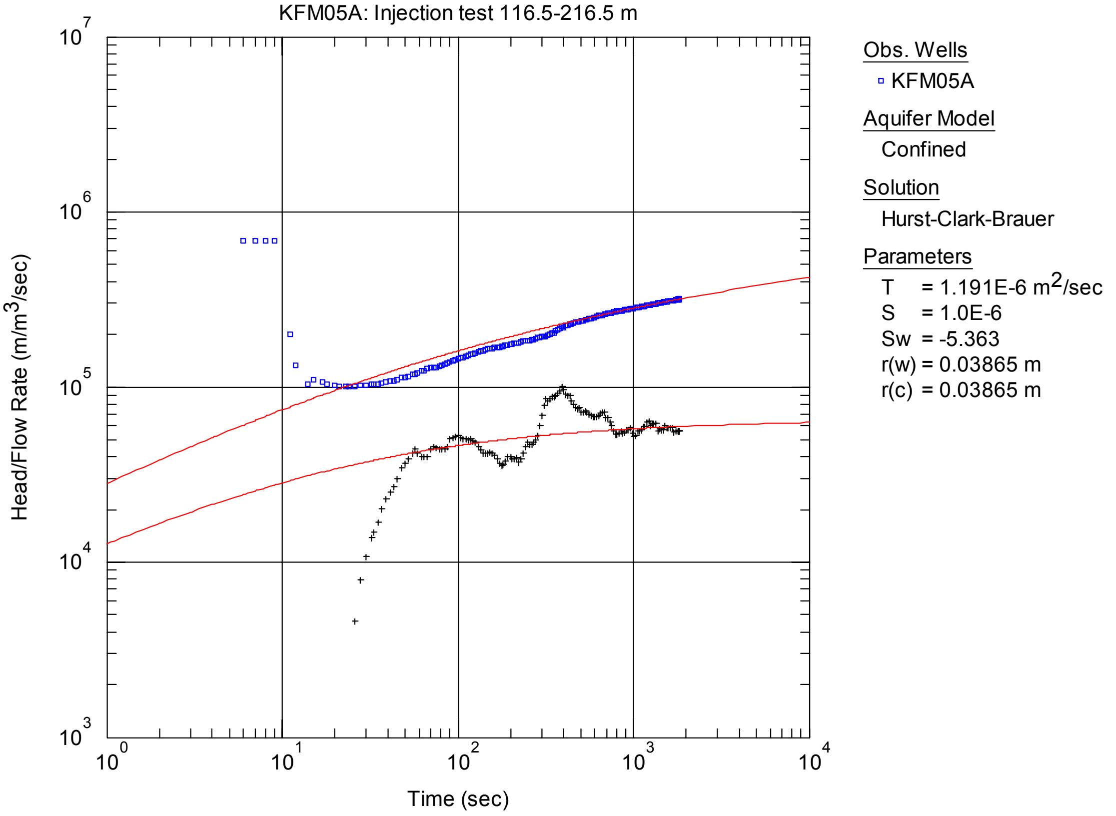


Figure A3-3. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-216.5 m in KFM05A.*

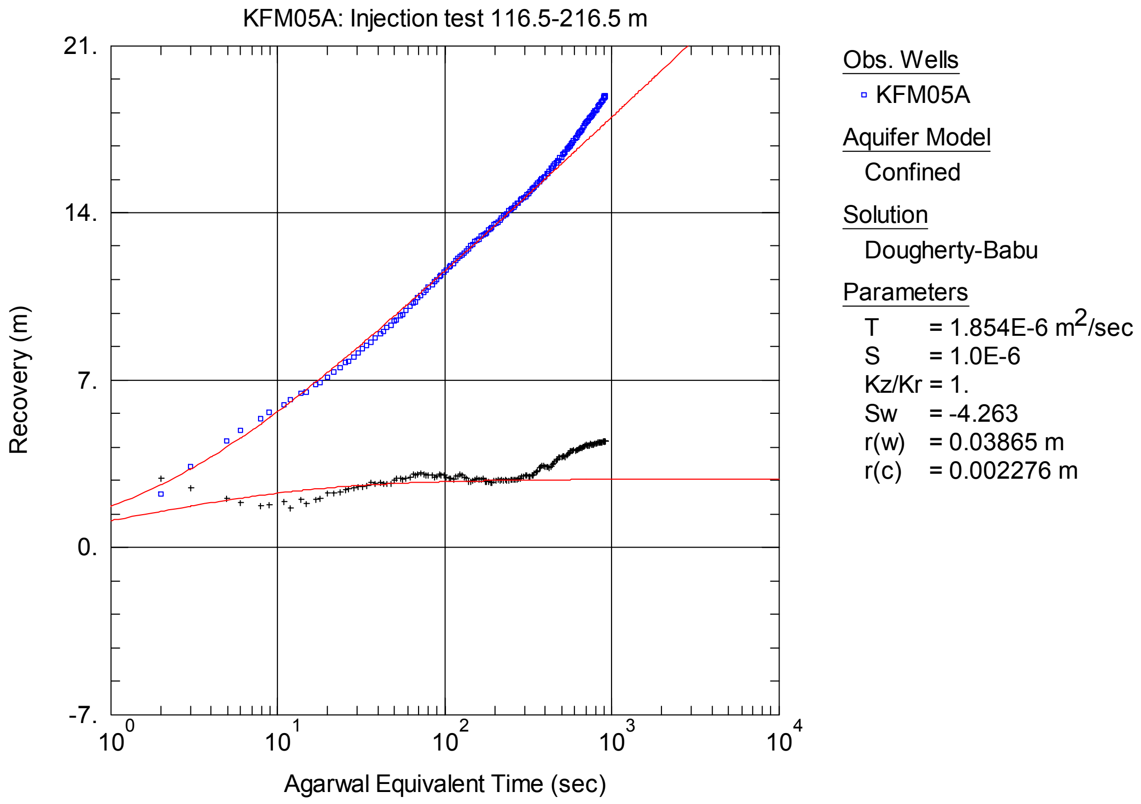


Figure A3-4. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-216.5 m in KFM05A.*

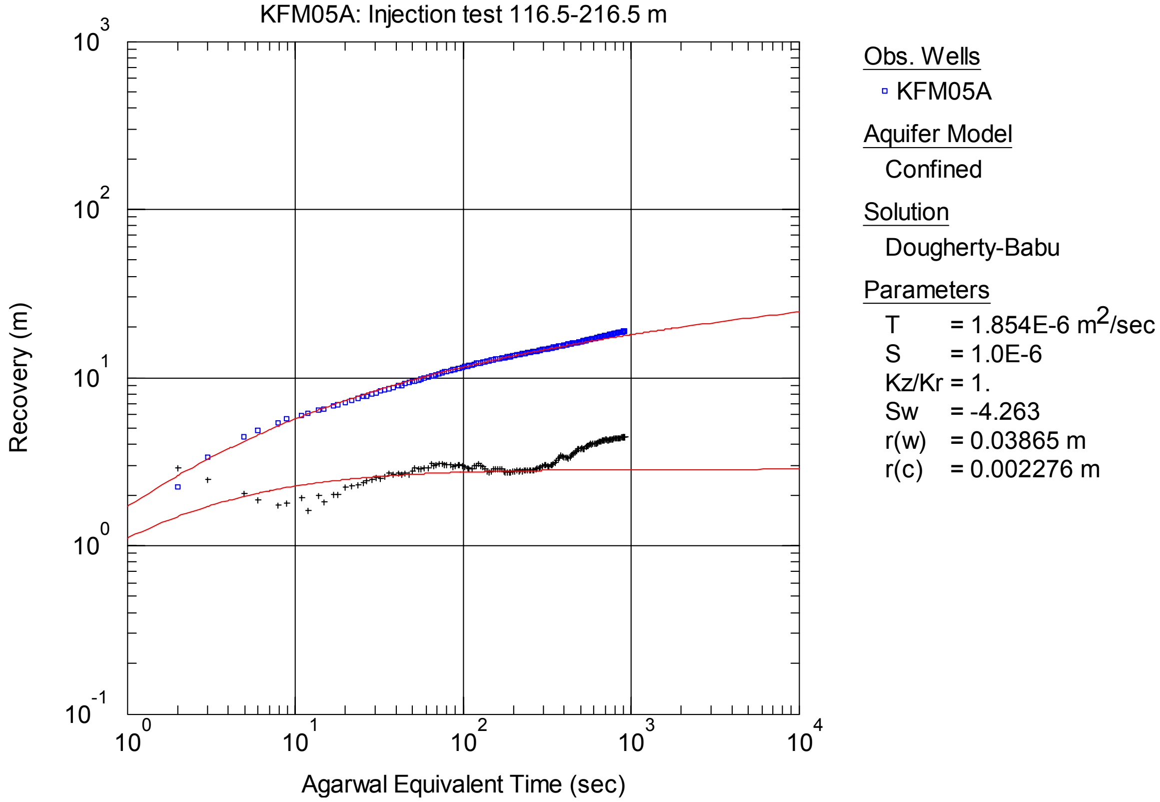


Figure A3-5. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-216.5 m in KFM05A*

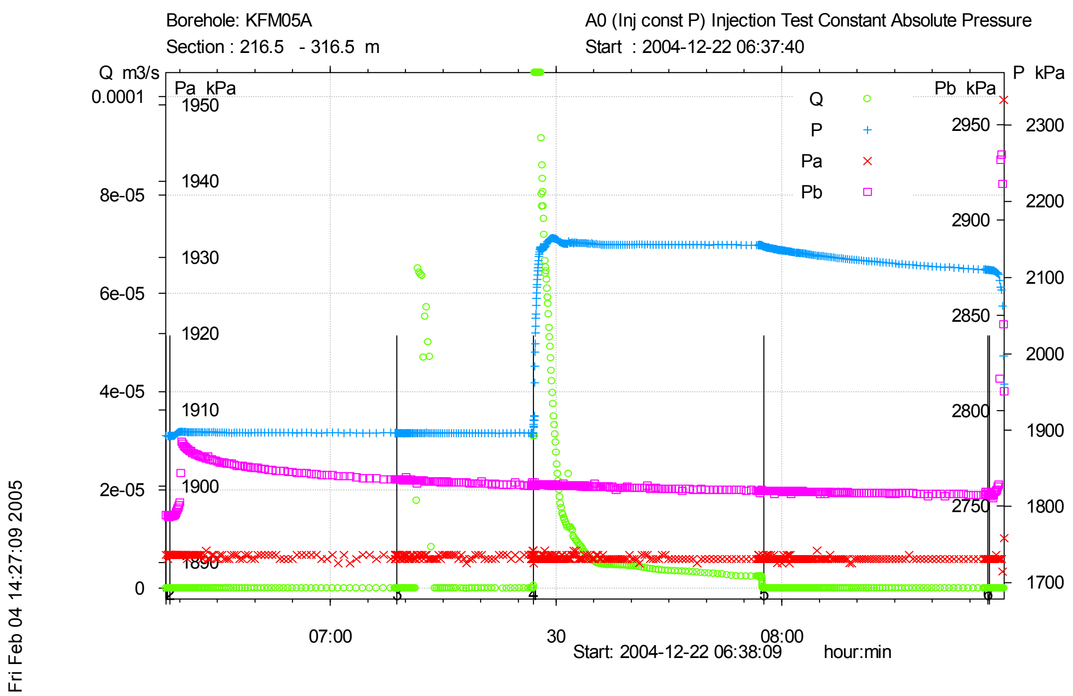


Figure A3-6. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 216.5-316.5 m in borehole KFM05A.*

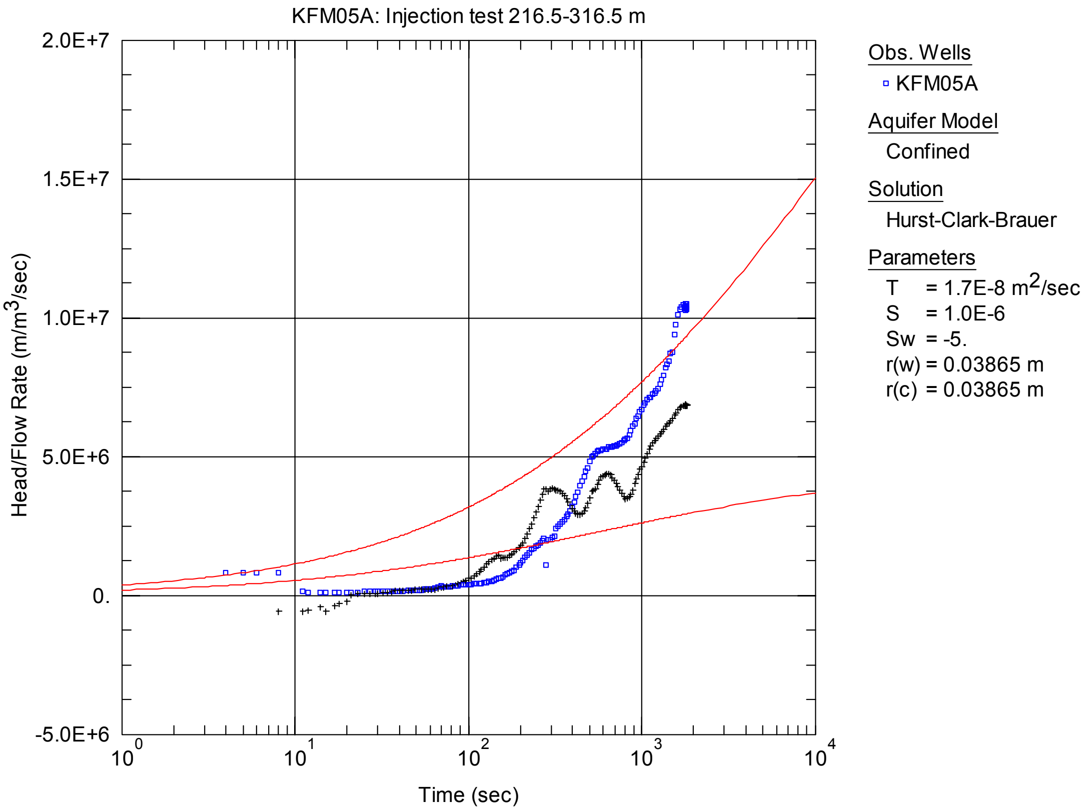


Figure A3-7. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 216.5-316.5 m in KFM05A.*

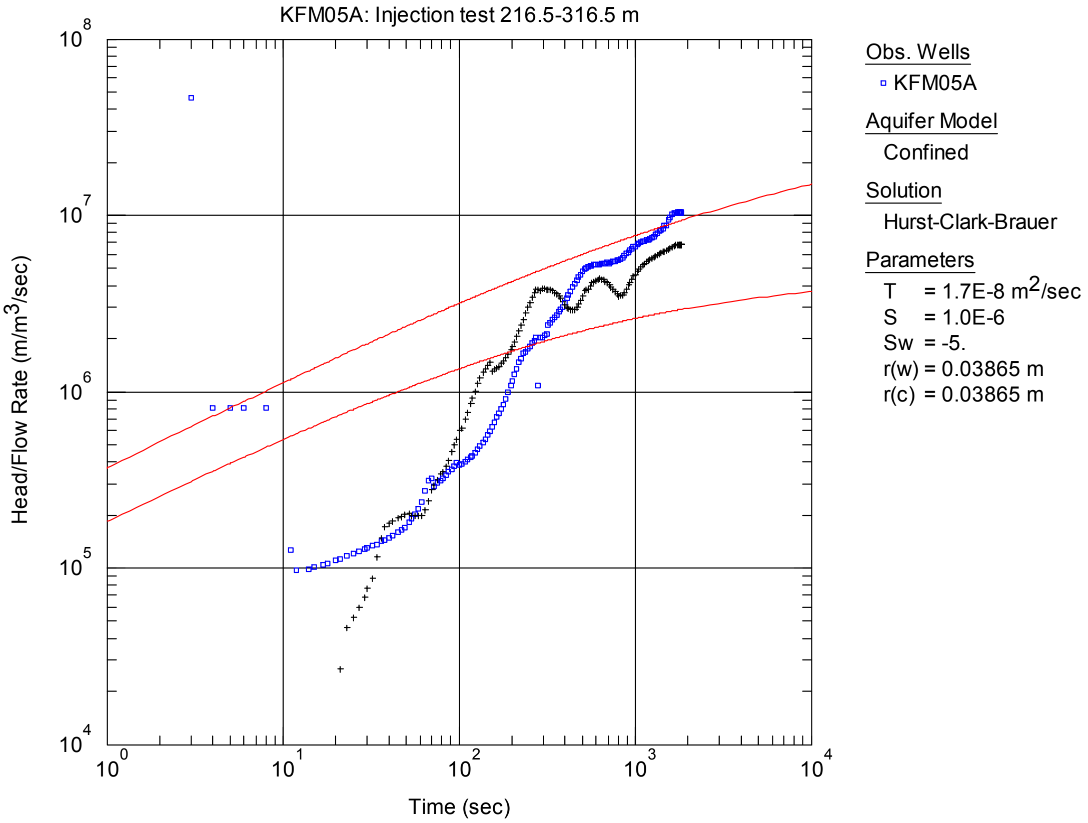


Figure A3-8. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 216.5-316.5 m in KFM05A.*

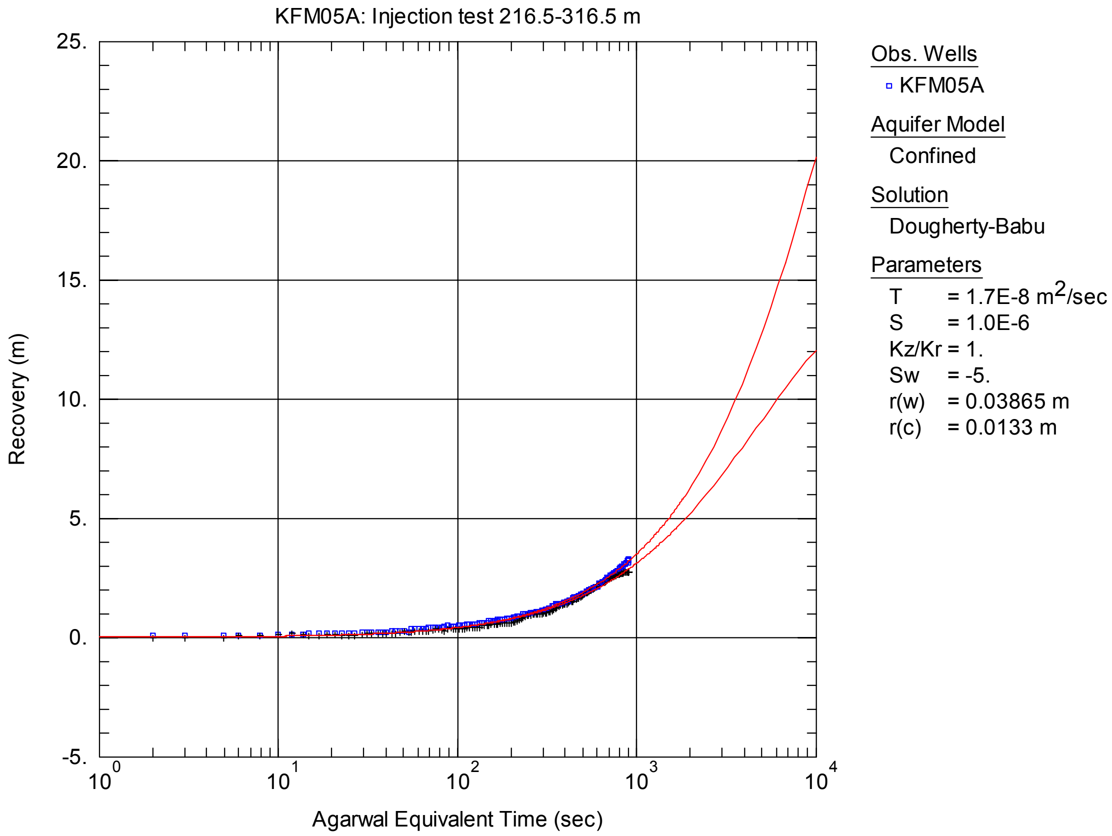


Figure A3-9. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 216.5-316.5 m in KFM05A.*

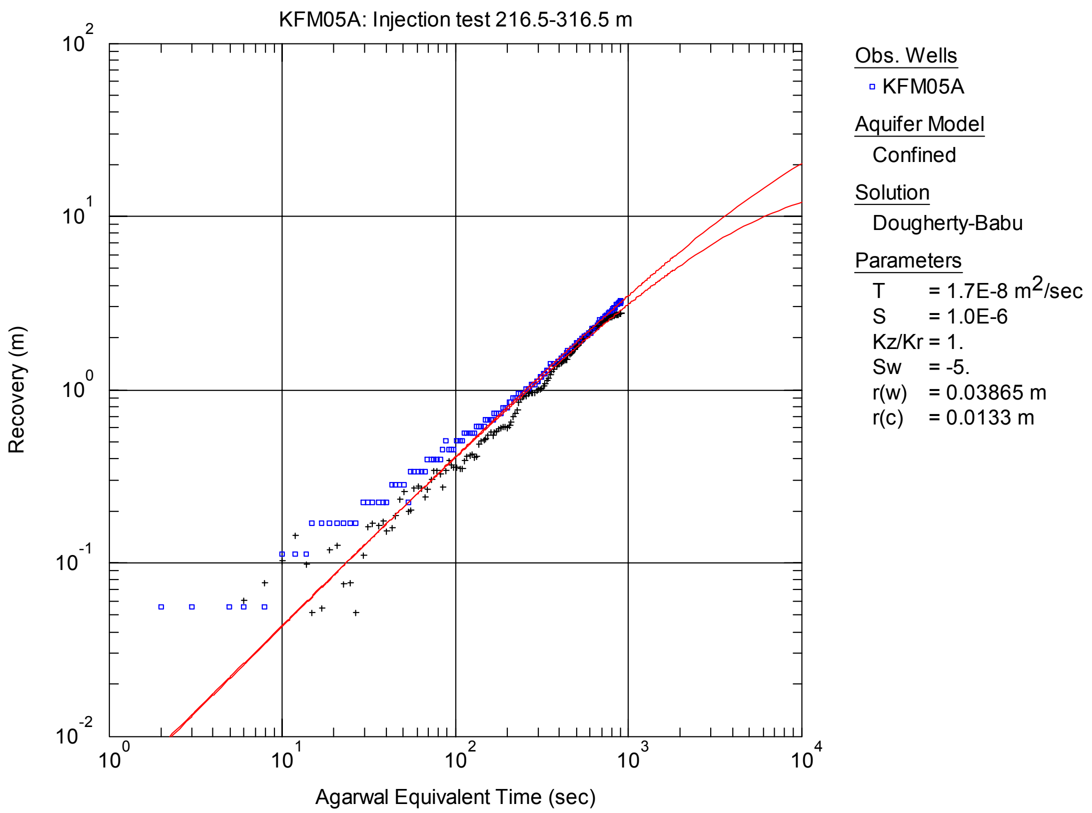


Figure A3-10. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 216.5-316.5 m in KFM05A.*

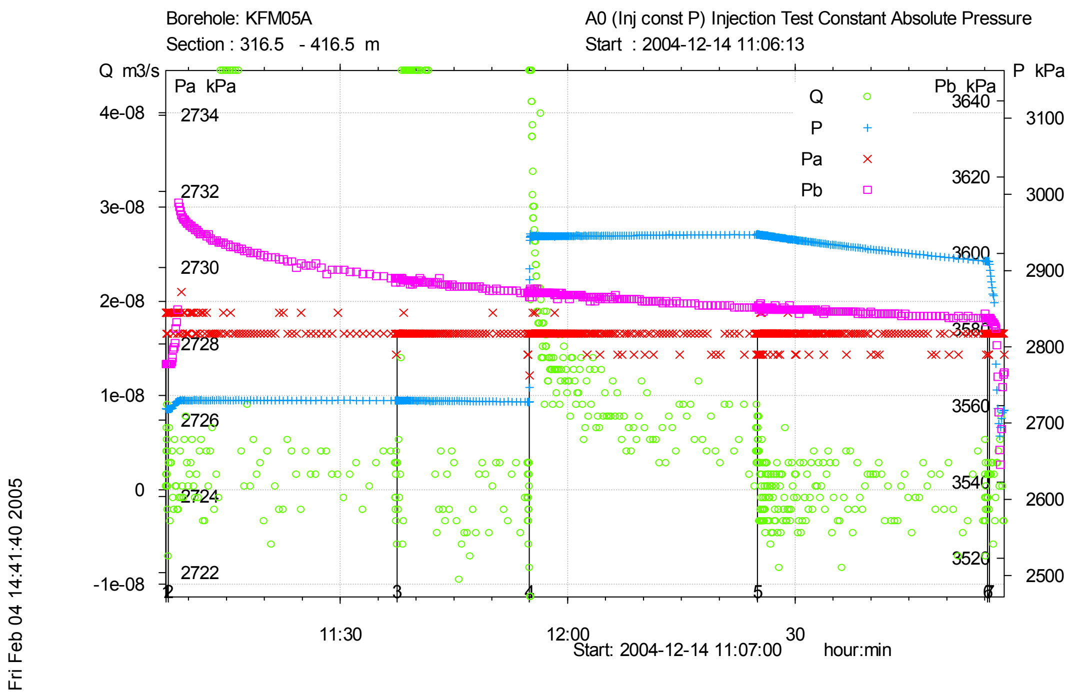


Figure A3-61. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 316.5-416.5 m in borehole KFM05A.*

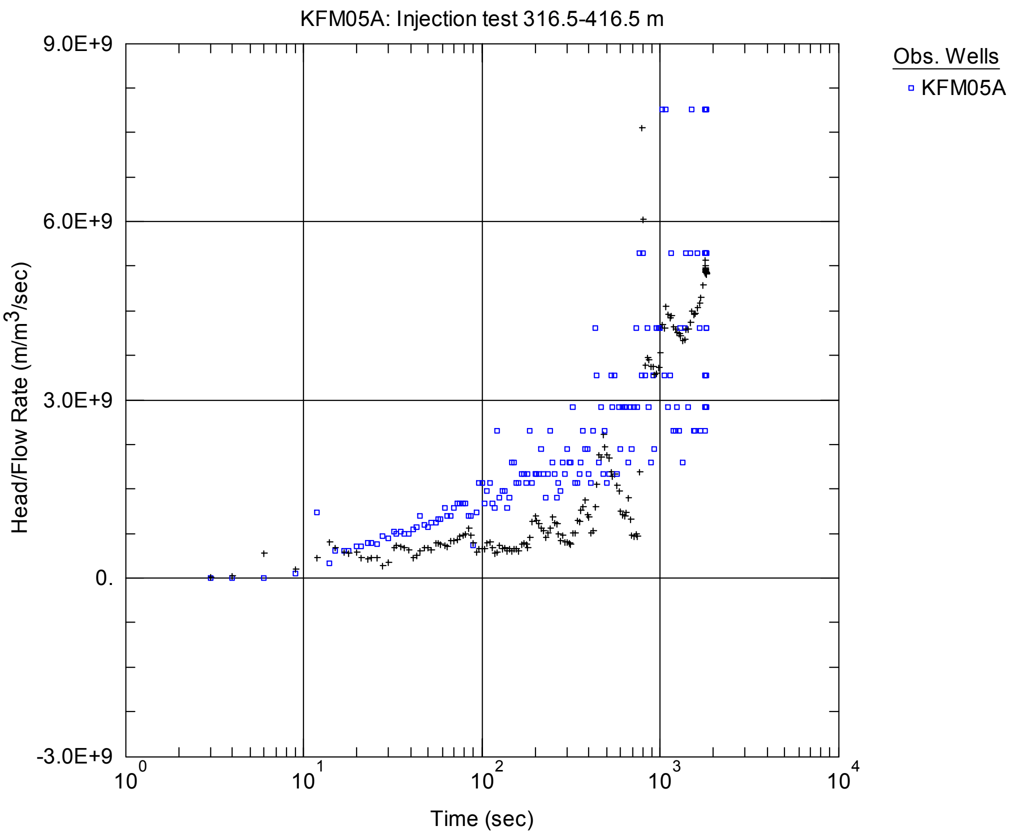


Figure A3-17. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 316.5-416.5 m in KFM05A.*

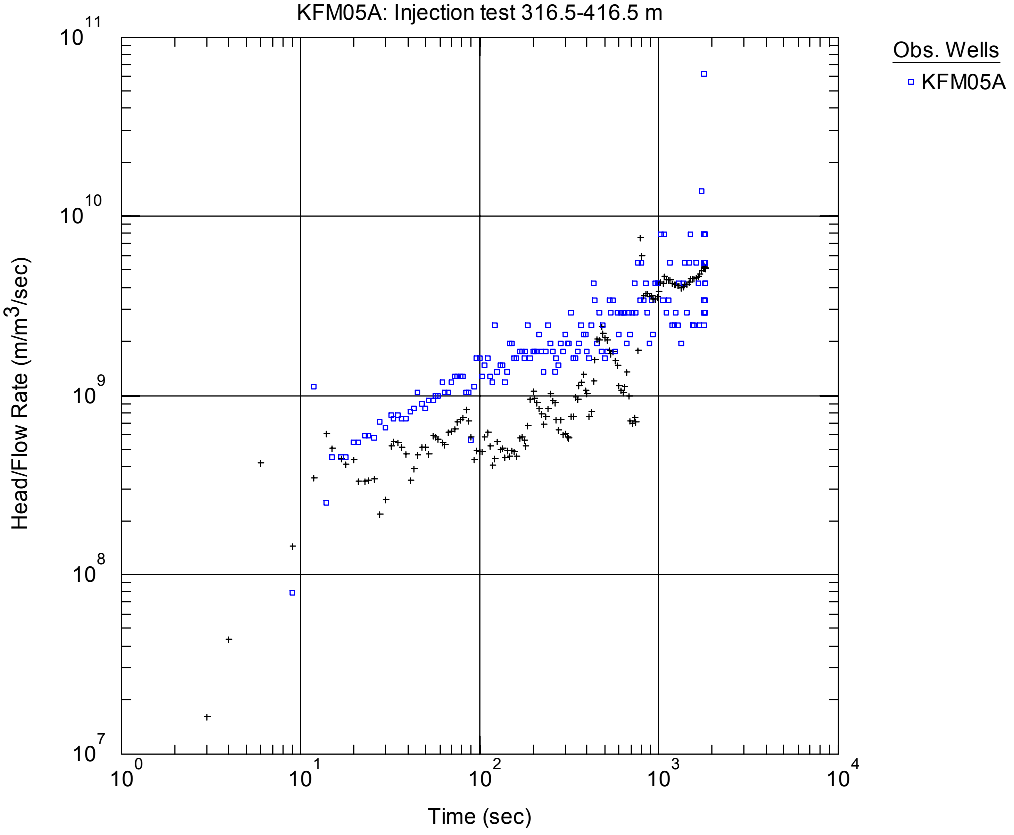


***Figure A3-18.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 316.5-416.5 m in KFM05A.*

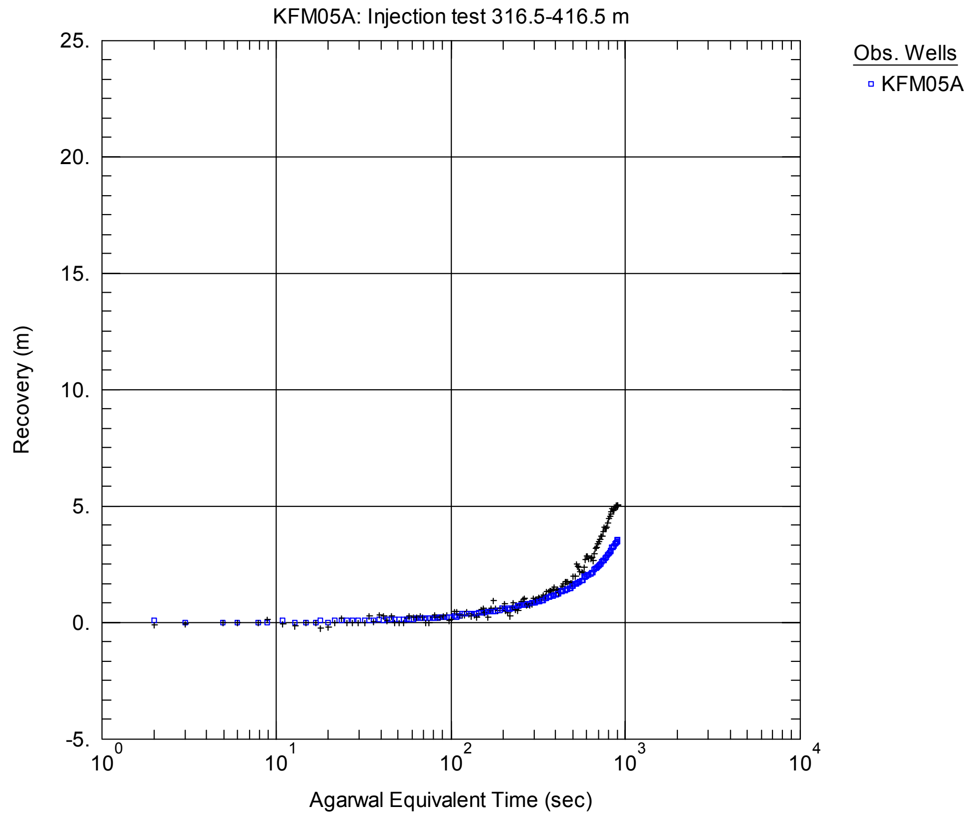


***Figure A3-19.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 316.5-416.5 m in KFM05A.*

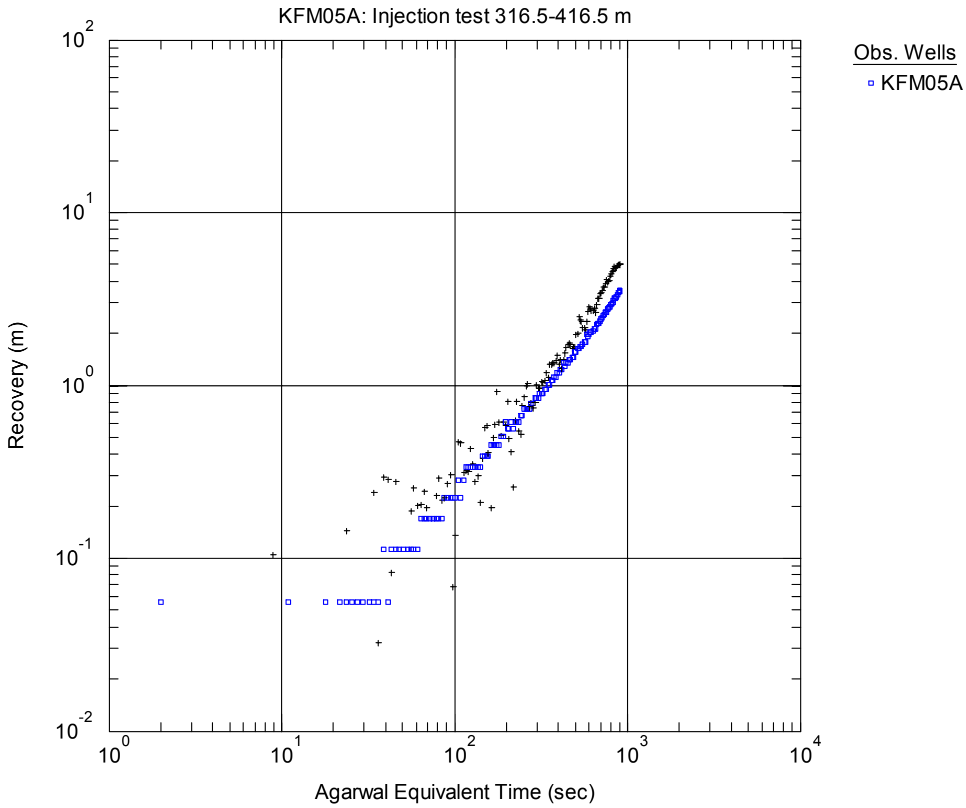


***Figure A3-110.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 316.5-416.5 m in KFM05A.*

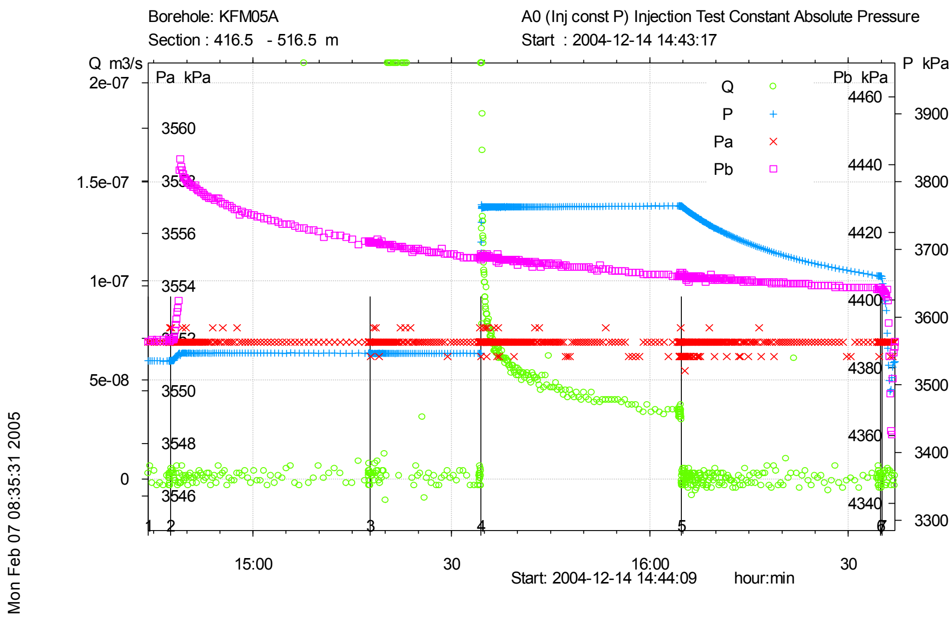


***Figure A3-116.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 416.5-516.5 m in borehole KFM05A.*

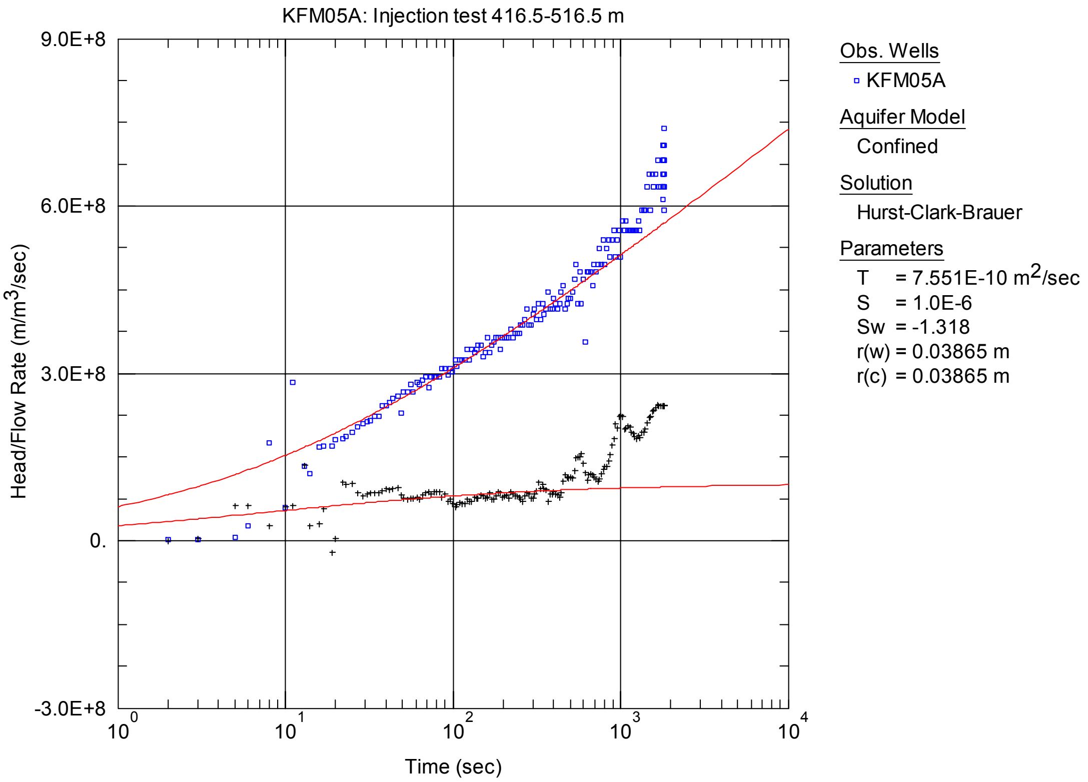


Figure A3-17. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-516.5 m in KFM05A.*

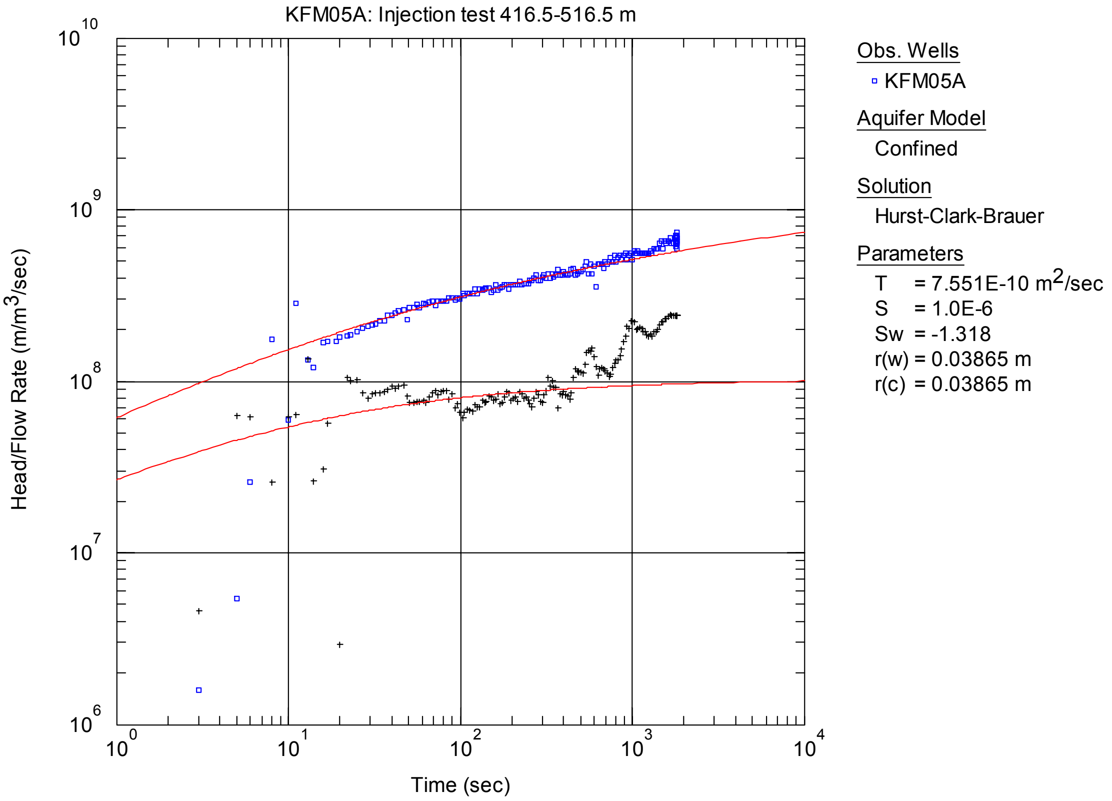


Figure A3-18. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-516.5 m in KFM05A.*

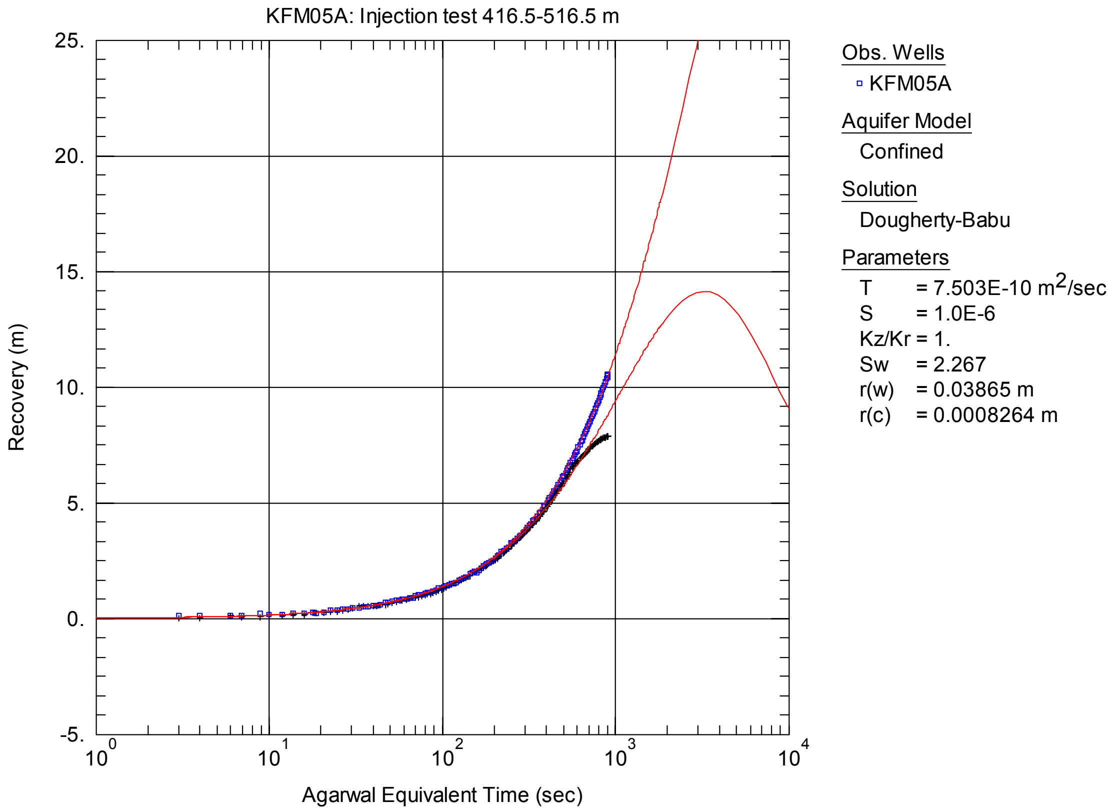


Figure A3-19. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-516.5 m in KFM05A.*

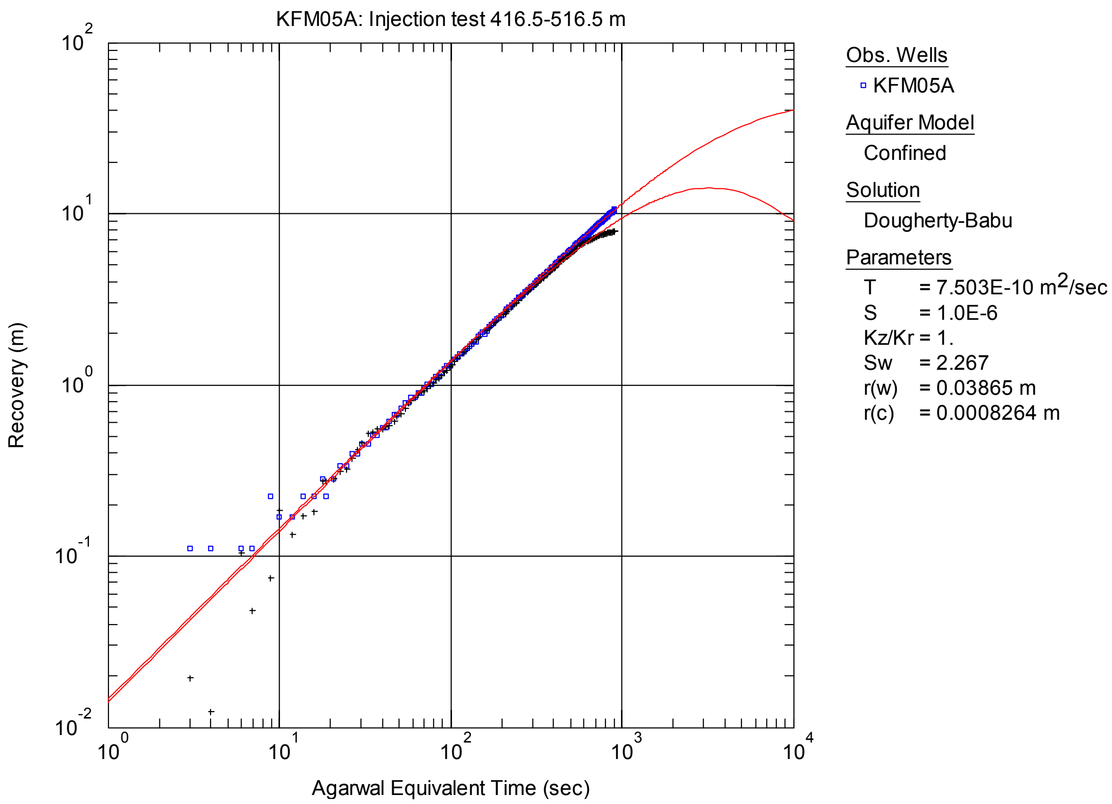


Figure A3-20. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-516.5 m in KFM05A.*

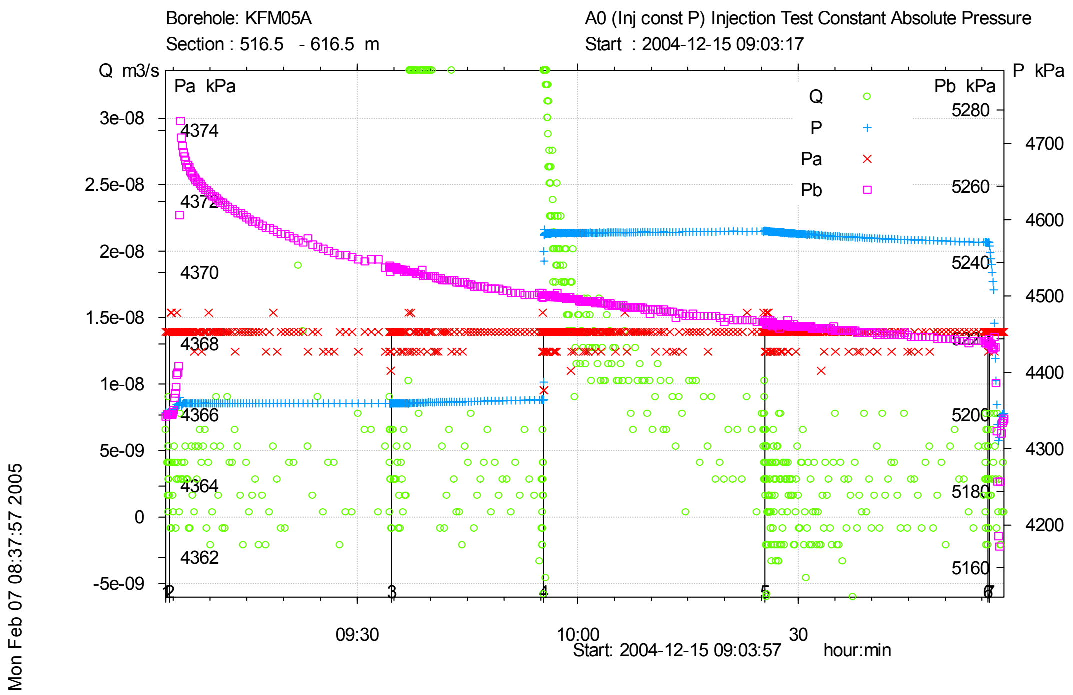


__Figure A3-212.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 516.5-616.5 m in borehole KFM05A.

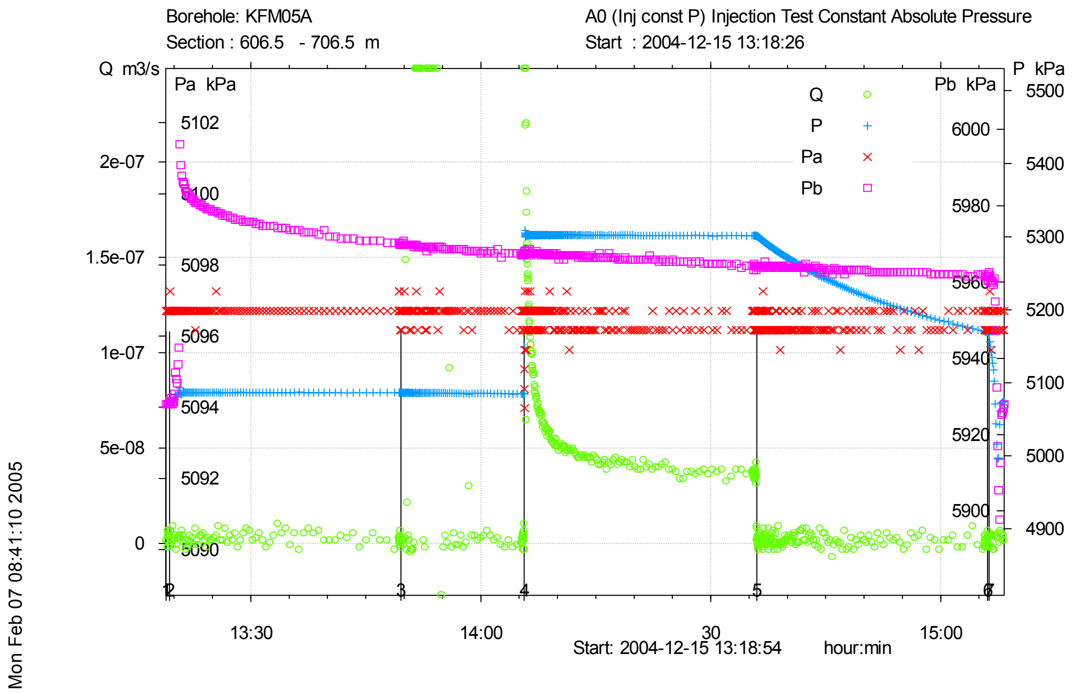


__Figure A3-22.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 606.5-706.5 m in borehole KFM05A.

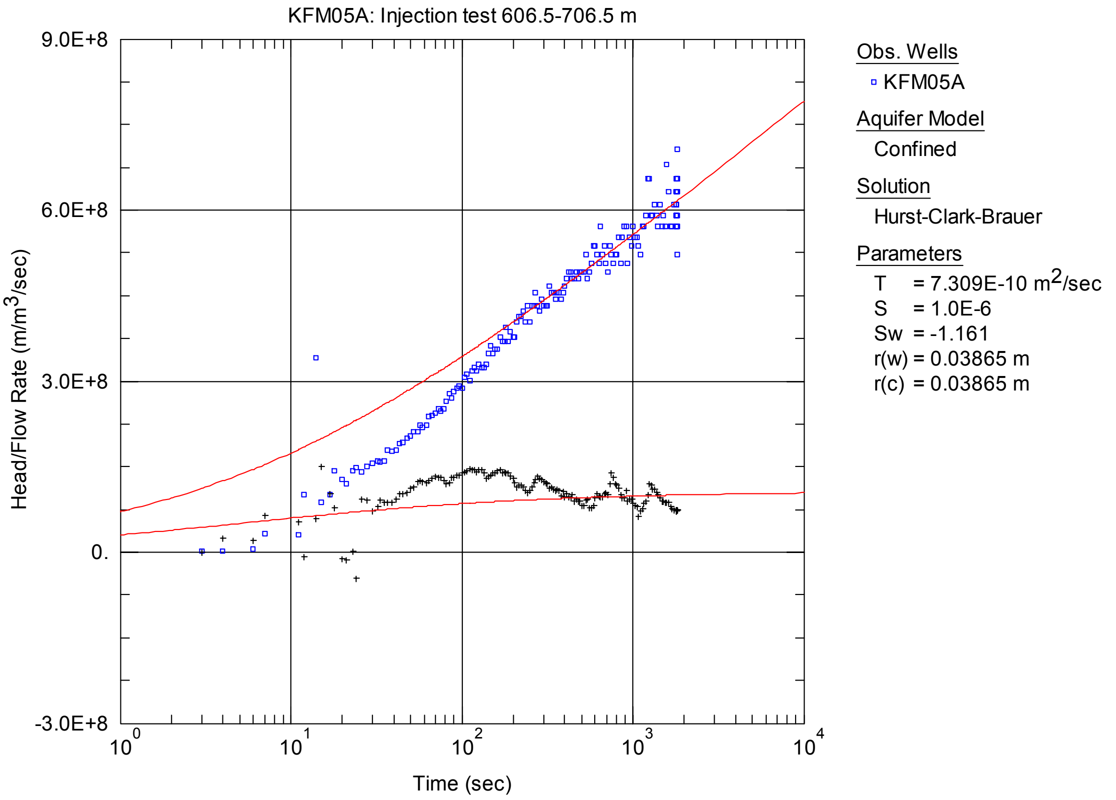


Figure A3-23. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 606.5-706.5 m in KFM05A.*

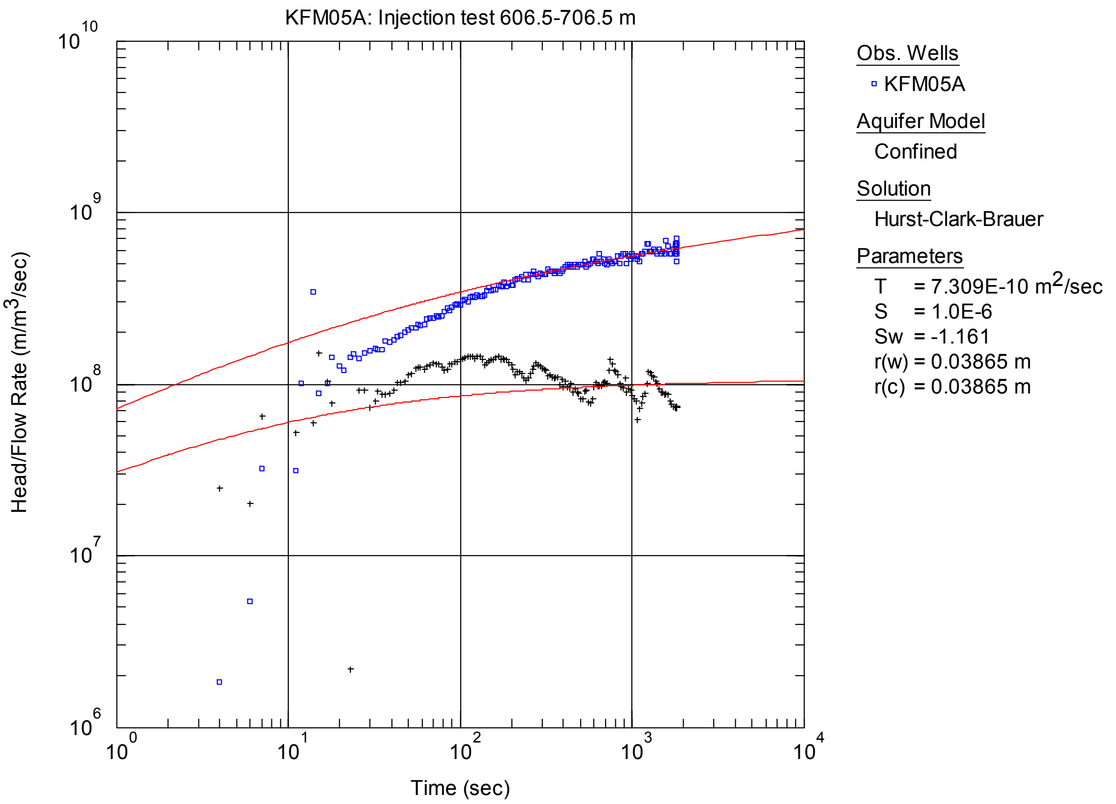


Figure A3-24. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 606.5-706.5 m in KFM05A.*

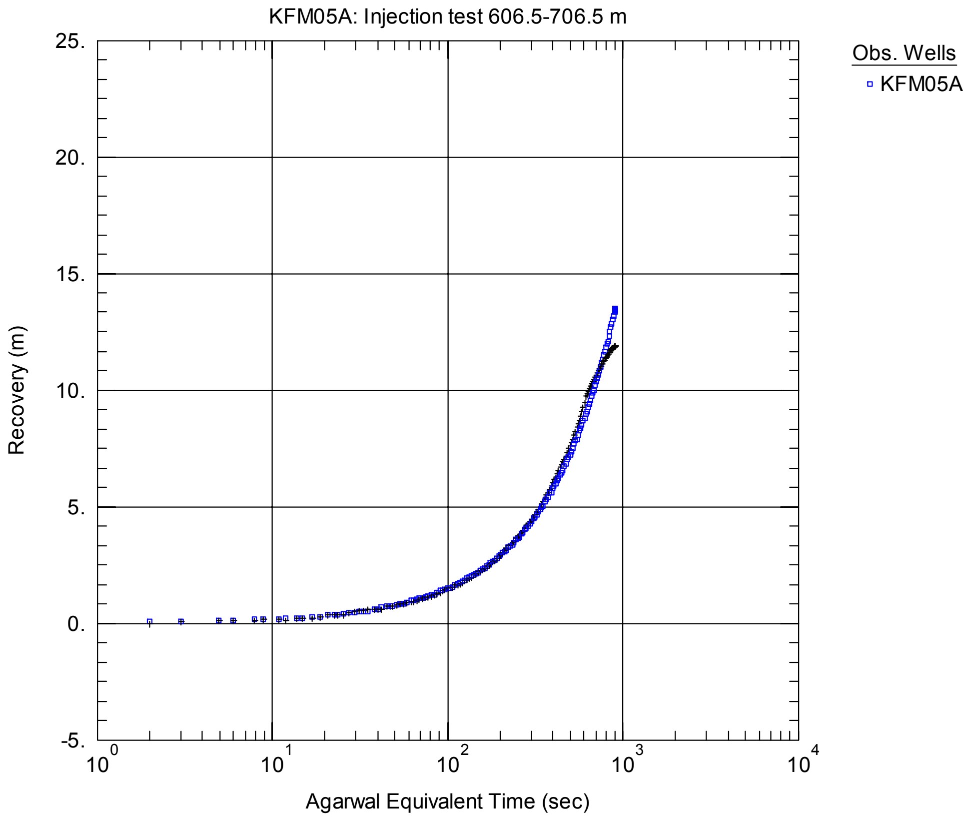


Figure A3-25. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 606.5-706.5 m in KFM05A.*

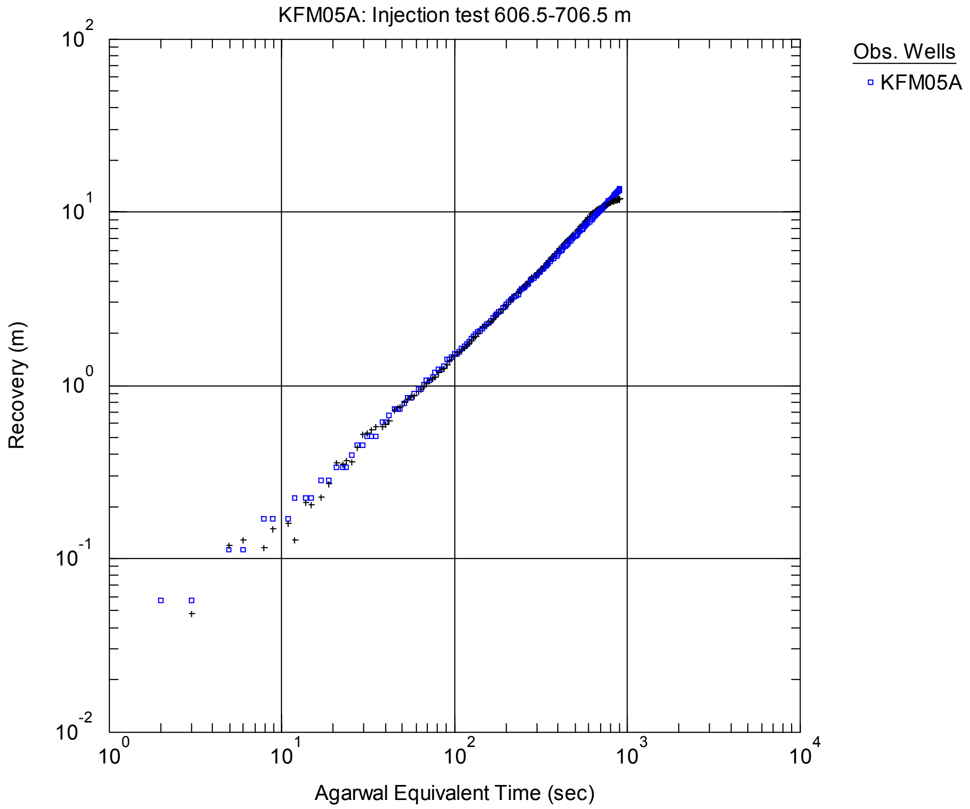


Figure A3-26. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 606.5-706.5 m in KFM05A.*

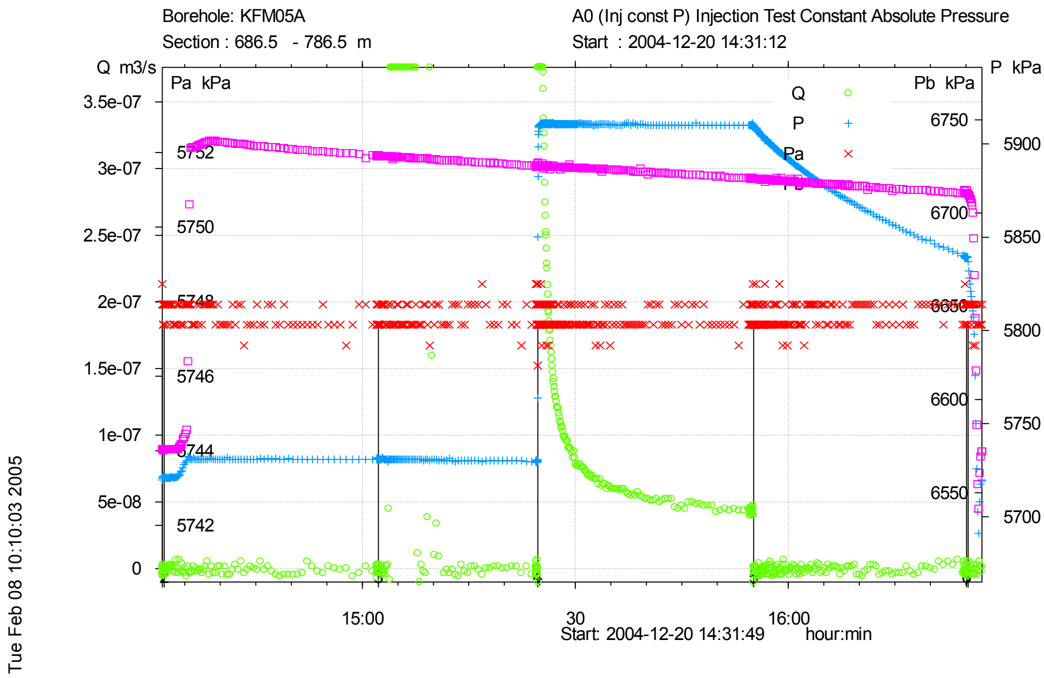


Figure A3-27. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 686.5-786.5 m in borehole KFM05A.

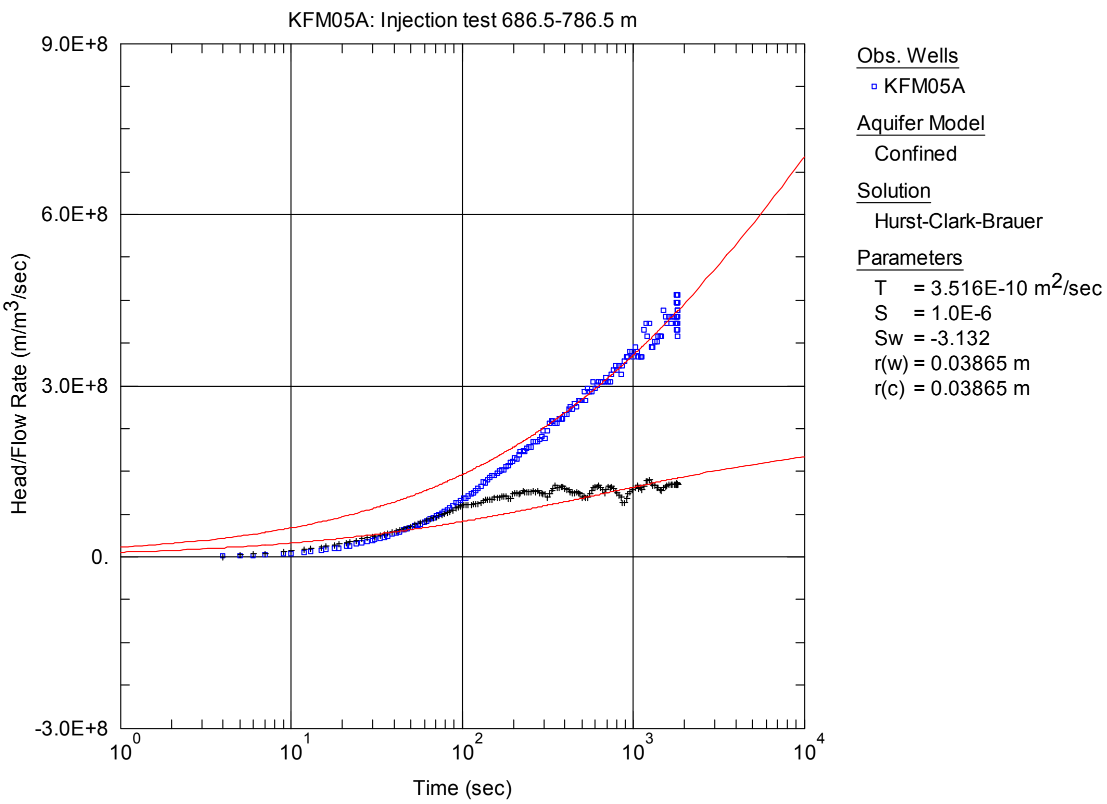


***Figure A3-138.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 686.5-786.5 m in KFM05A.*

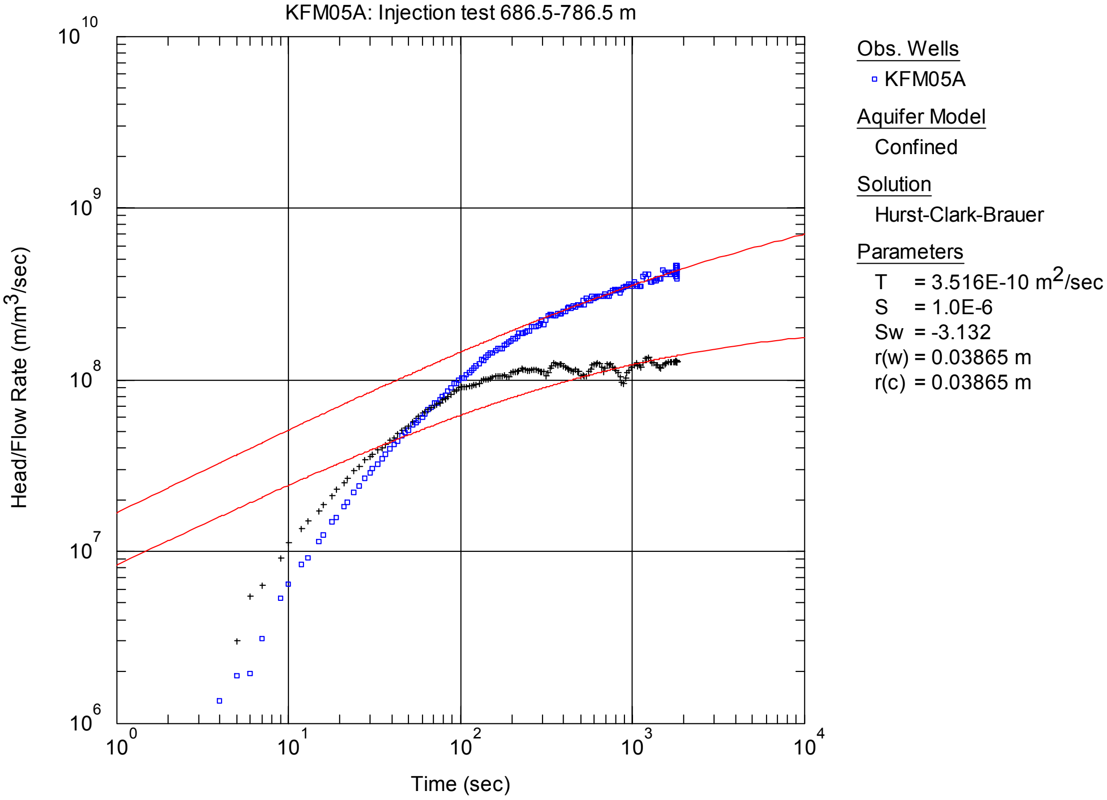


Figure A3-29. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 686.5-786.5 m in KFM05A.*

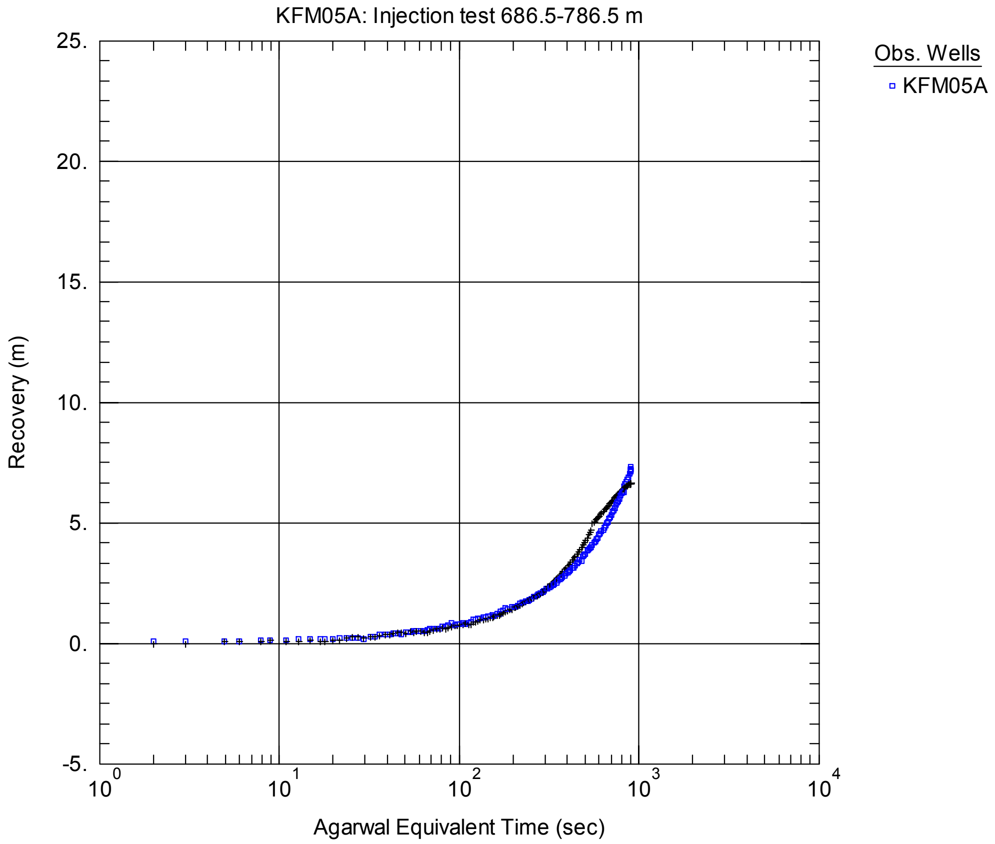


Figure A3-30. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 686.5-786.5 m in KFM05A.*

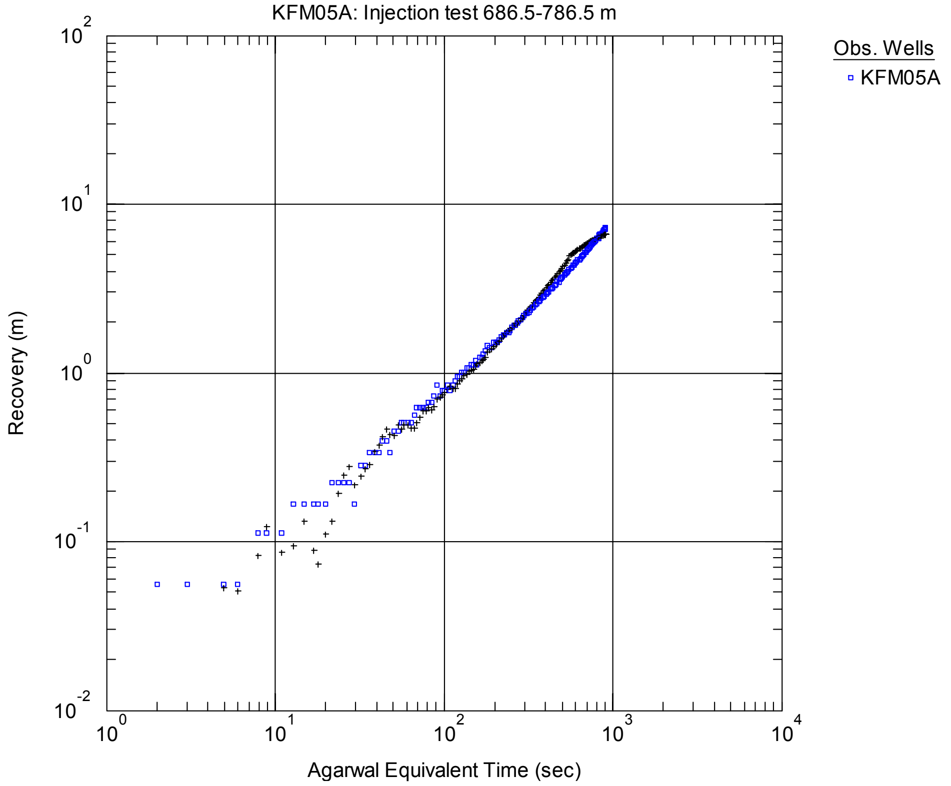


Figure A3-31. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 686.5-786.5 m in KFM05A.*

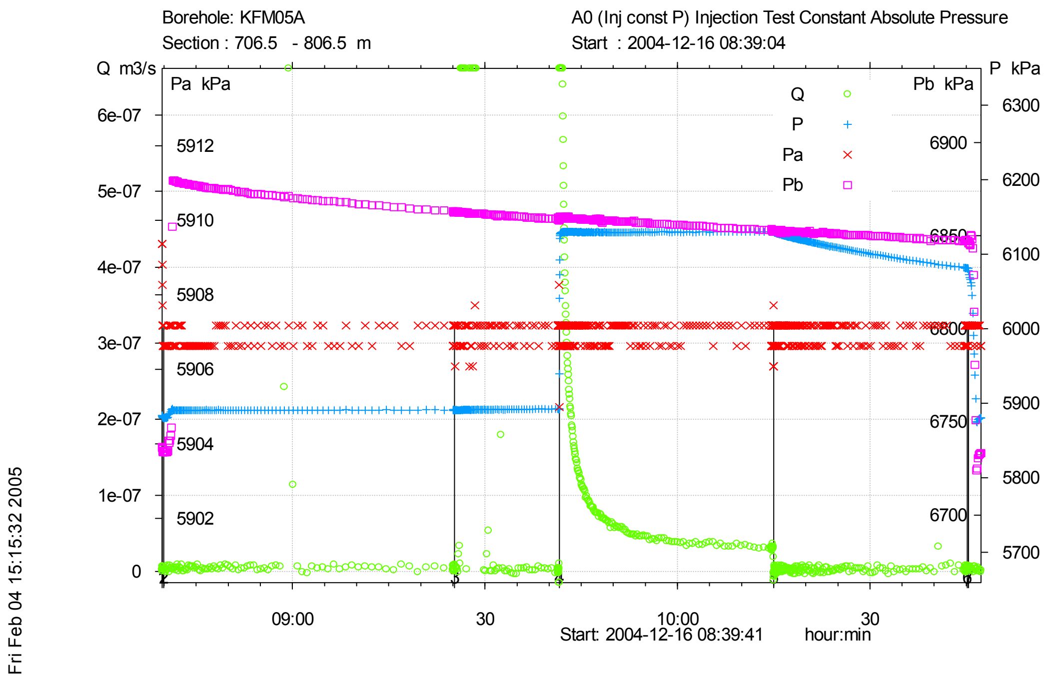


Figure A3-32. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 706.5-806.5 m in borehole KFM05A.*

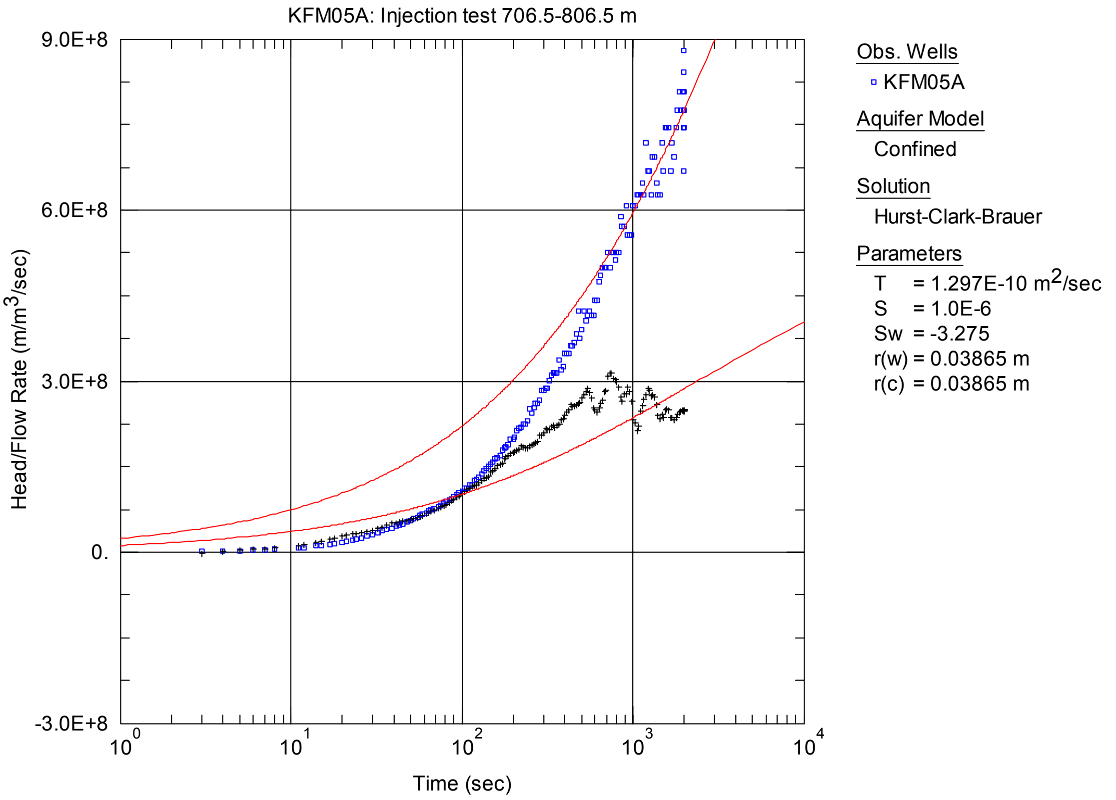


Figure A3-33. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 706.5-806.5 m in KFM05A.*

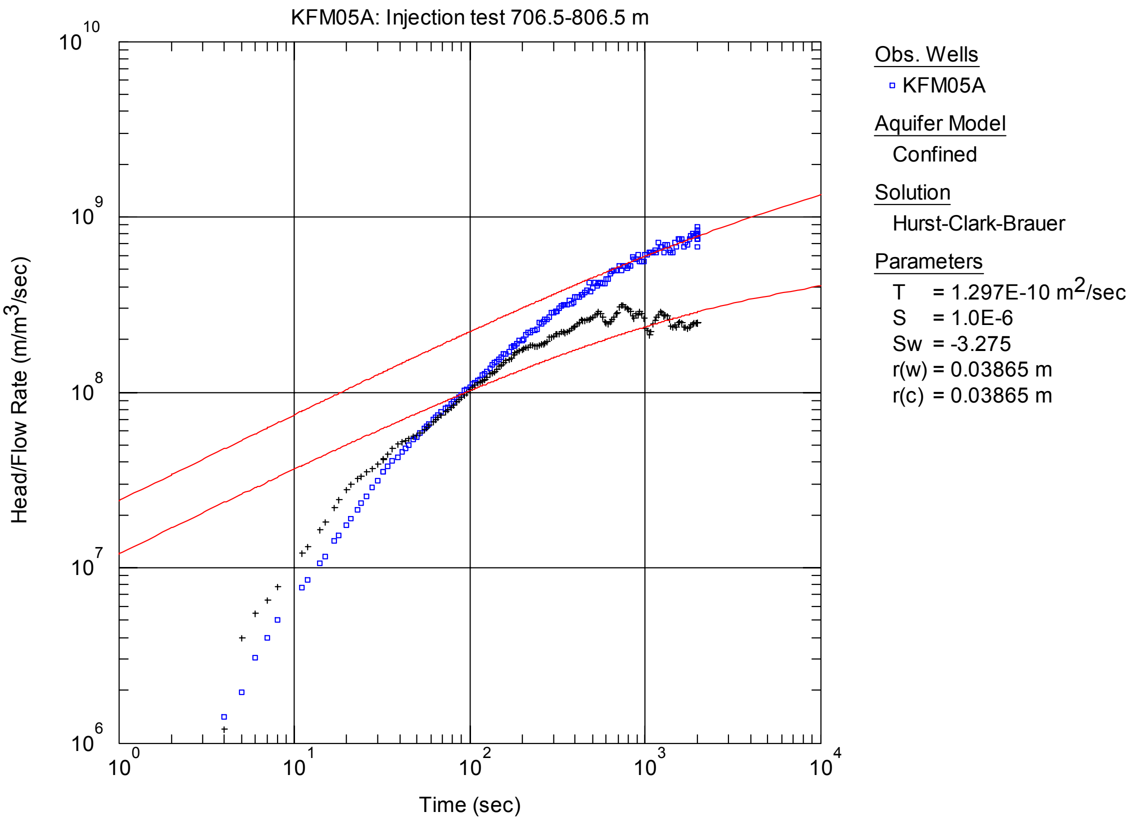


Figure A3-34. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 706.5-806.5 m in KFM05A.*

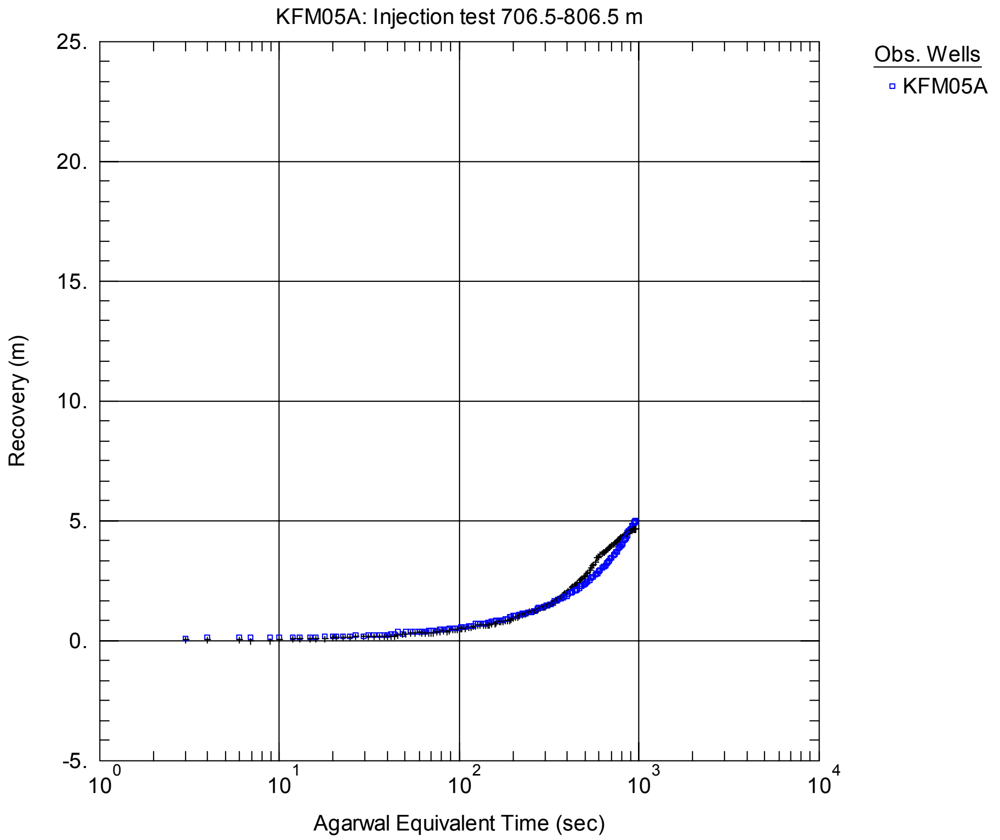


Figure A3-35. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 706.5-806.5 m in KFM05A.*

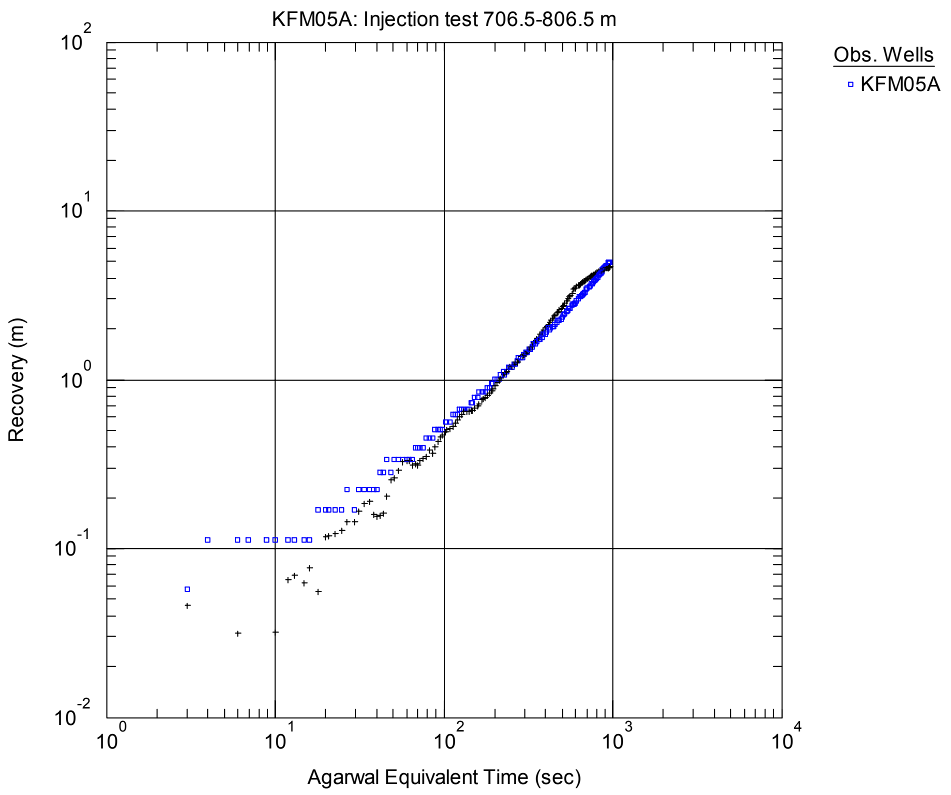


Figure A3-36. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 706.5-806.5 m in KFM05A.*

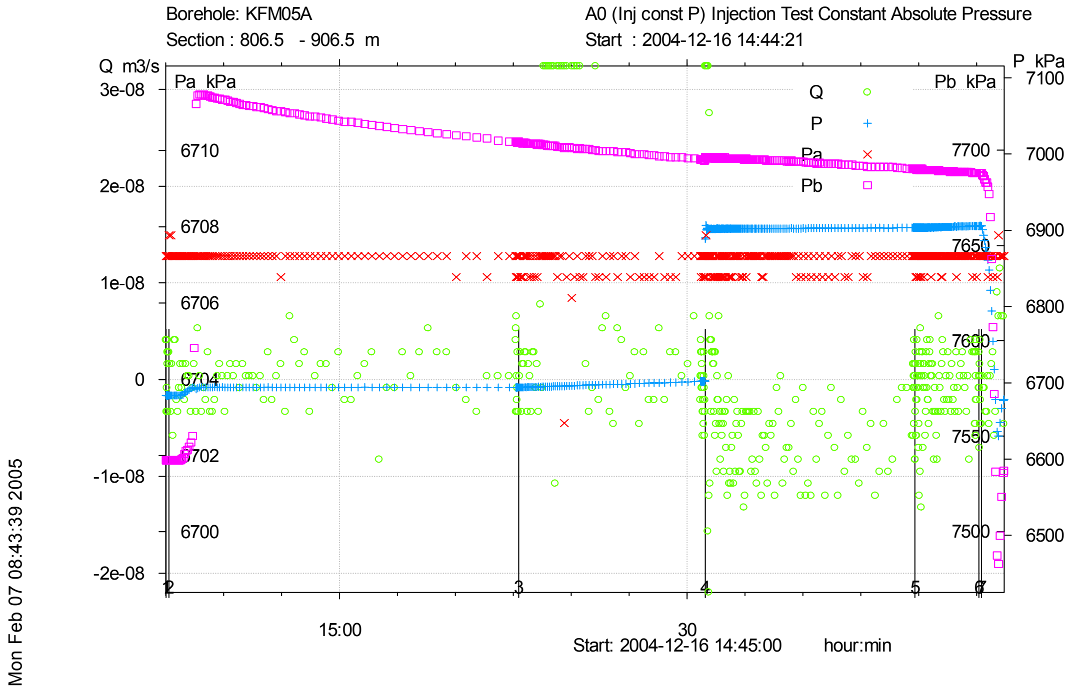


Figure A3-37. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 806.5-906.5 m in borehole KFM05A.*

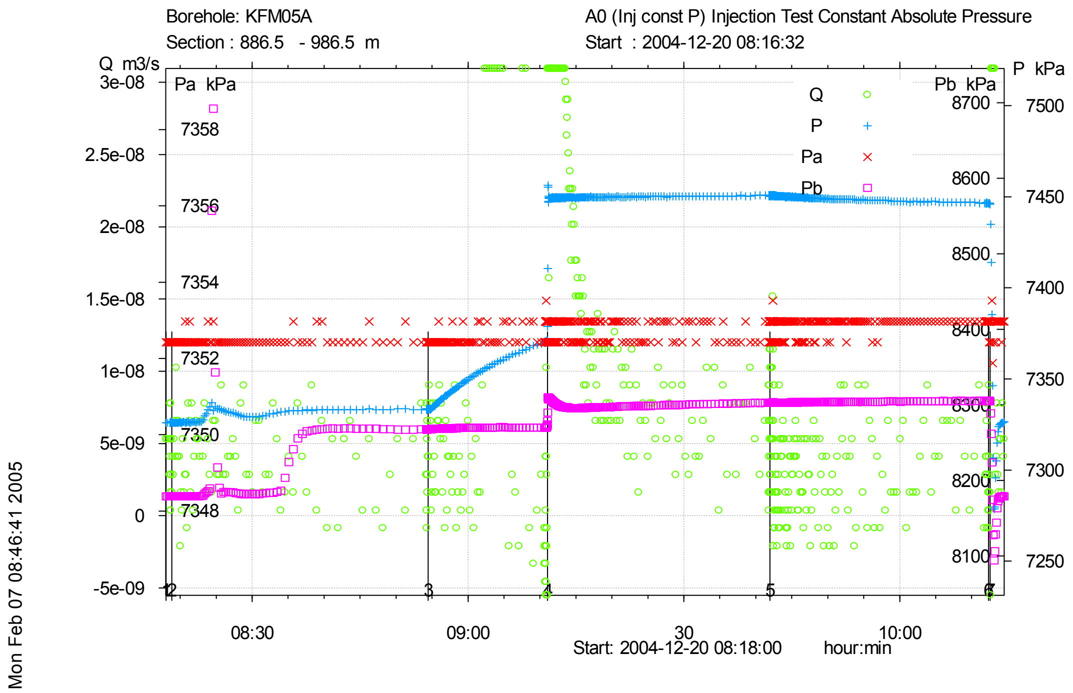


Figure A3-38. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 886.5-986.5 m in borehole KFM05A.*

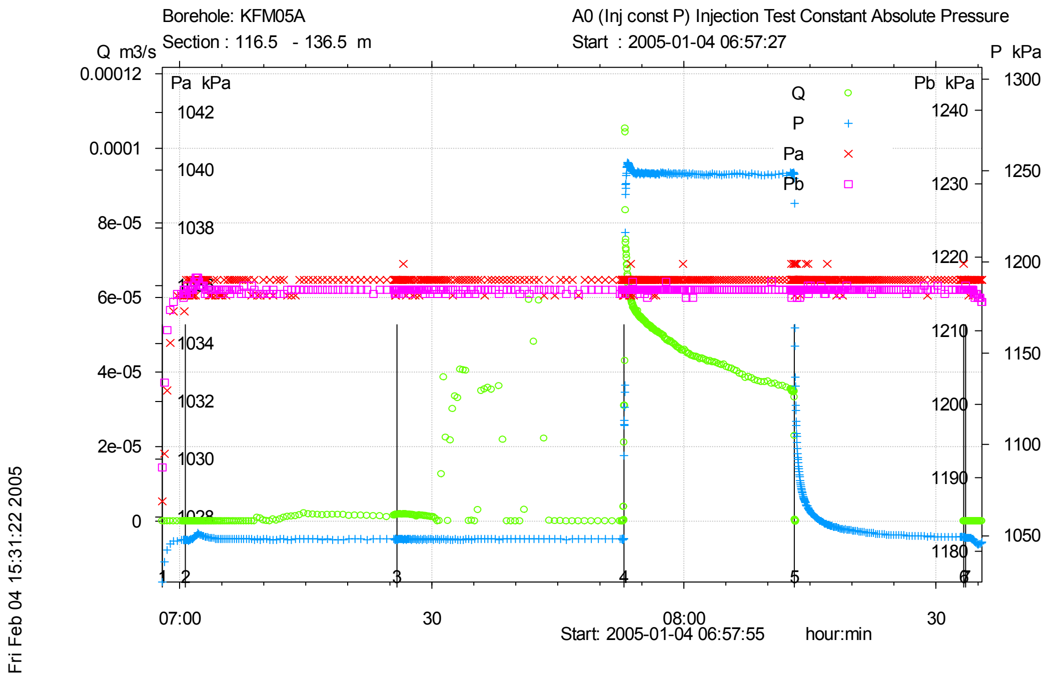


Figure A3-39. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 116.5-136.5 m in borehole KFM05A.*

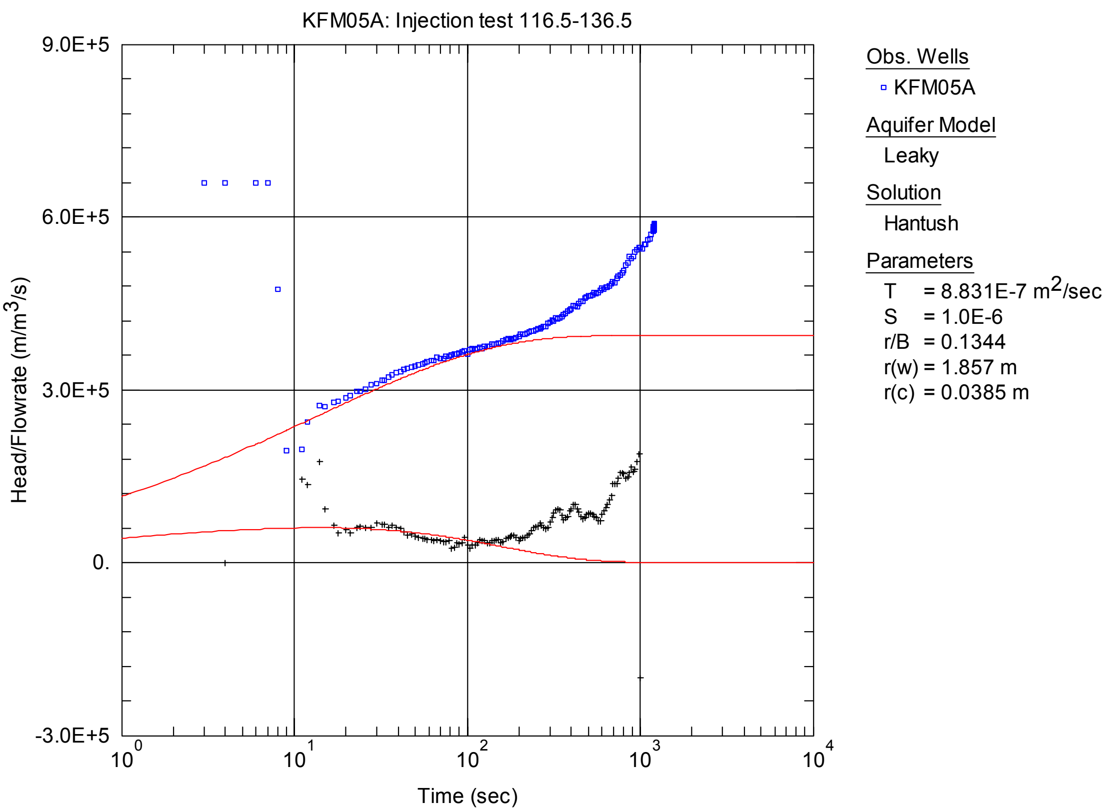


Figure A3-40. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-136.5 m in KFM05A.*

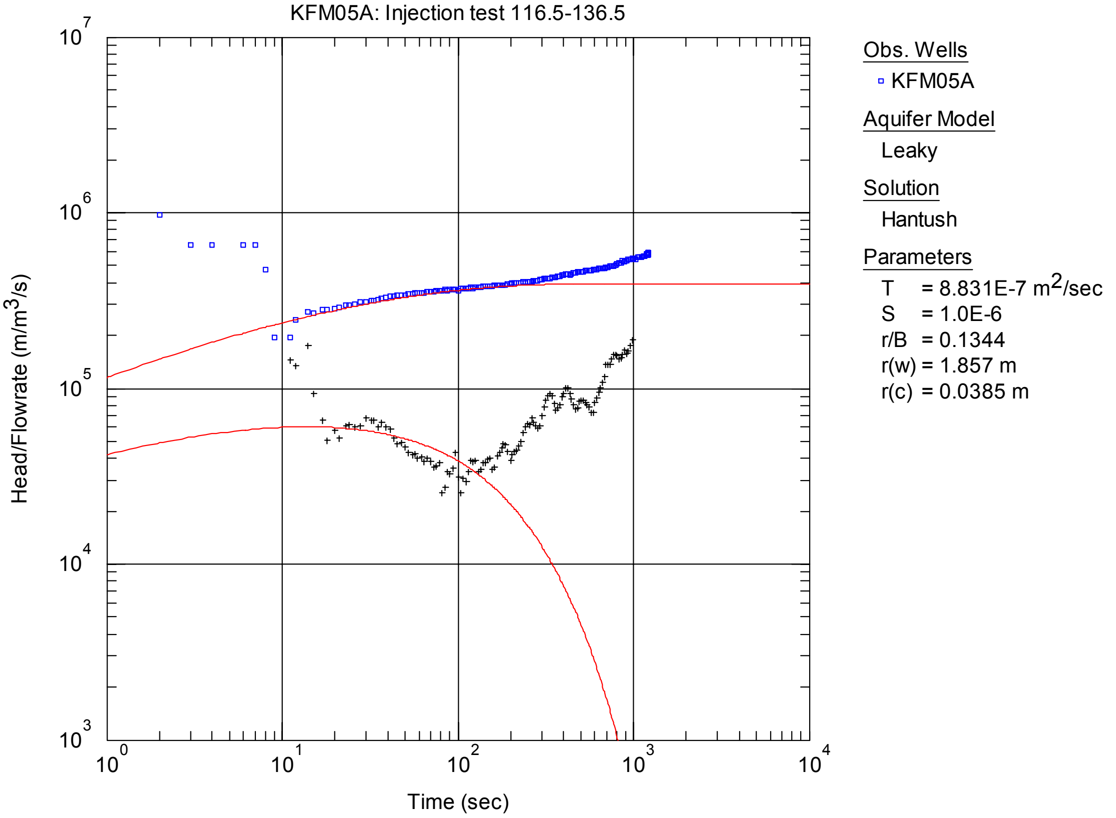


Figure A3-41. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-136.5 m in KFM05A.*

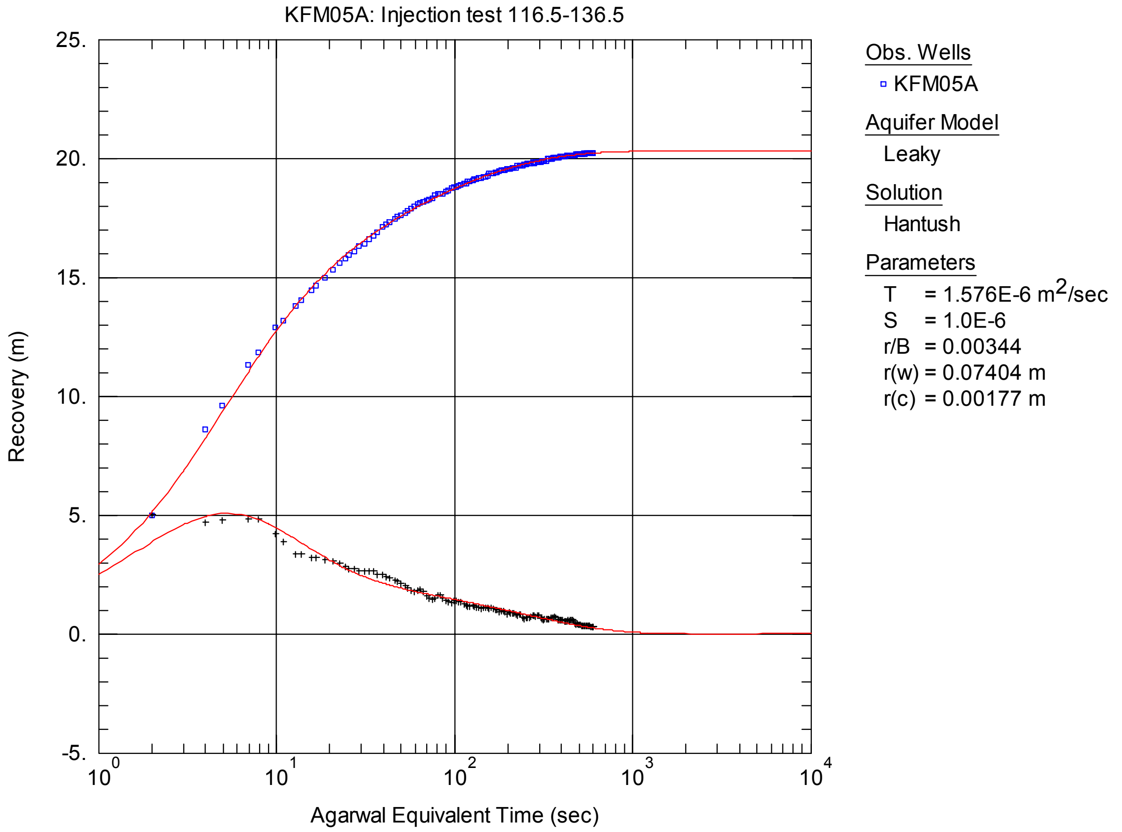


Figure A3-42. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-136.5 m in KFM05A.*

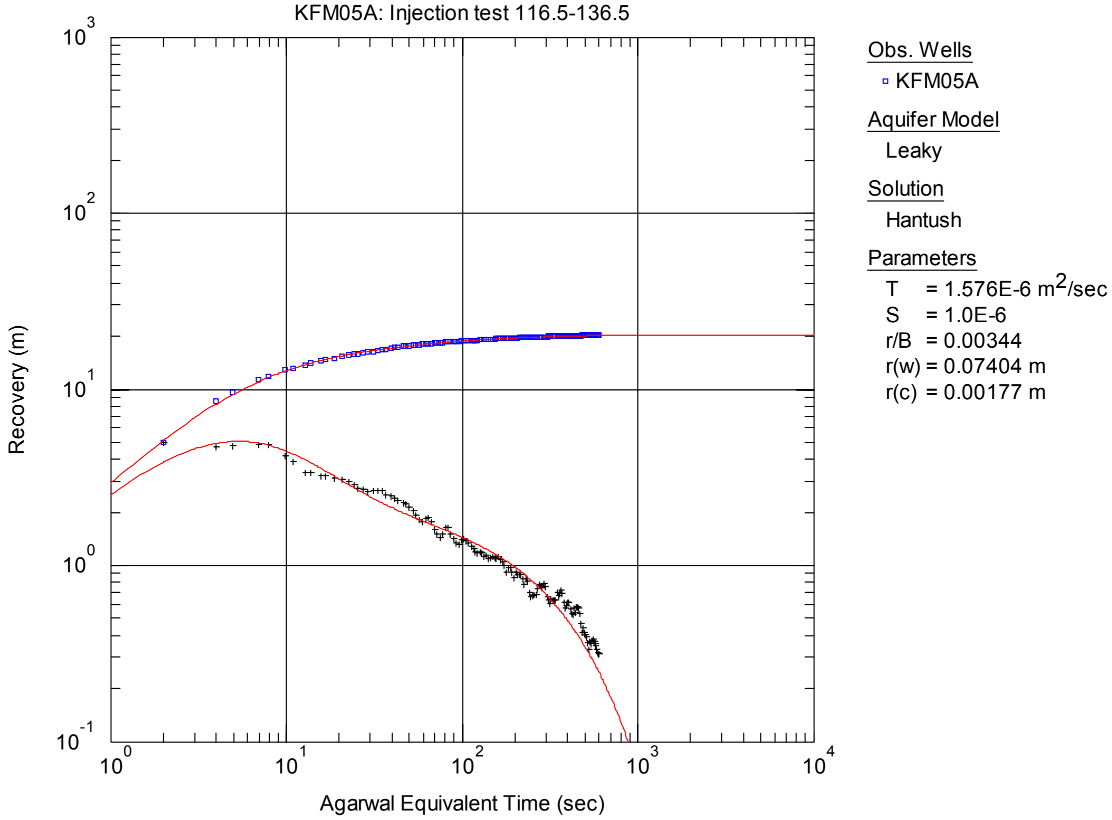


Figure A3-43. Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-136.5 m in KFM05A.

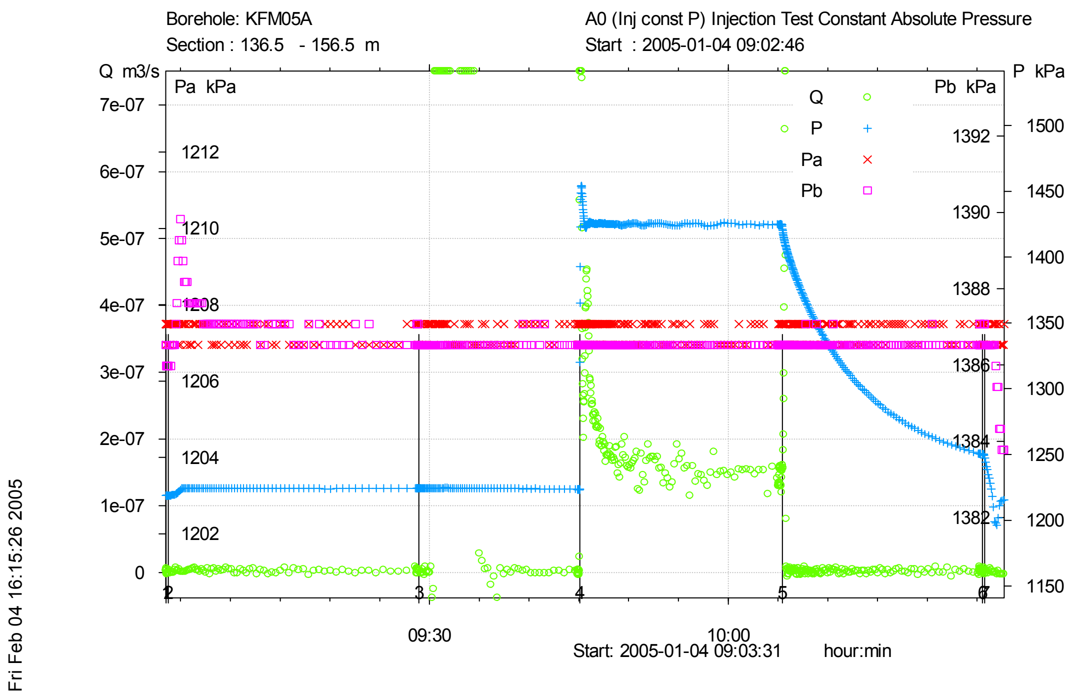


Figure A3-44. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 136.5-156.5 m in borehole KFM05A.

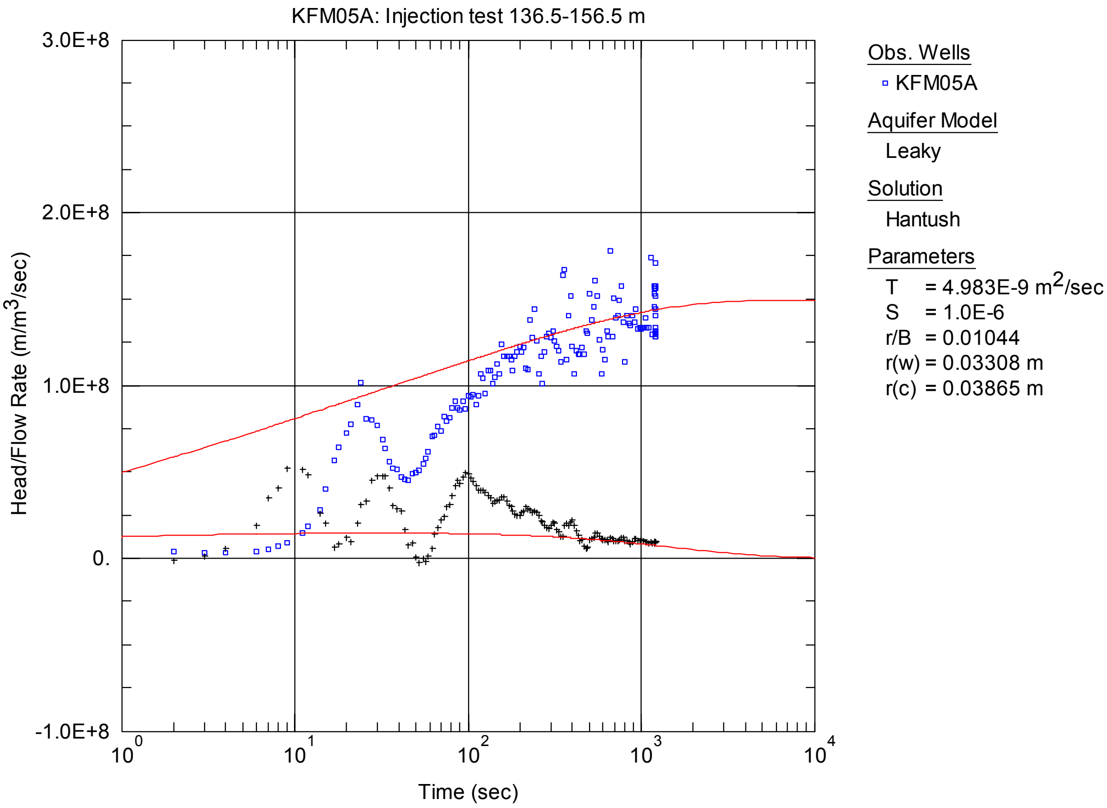


Figure A3-45. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 136.5-156.5 m in KFM05A.*

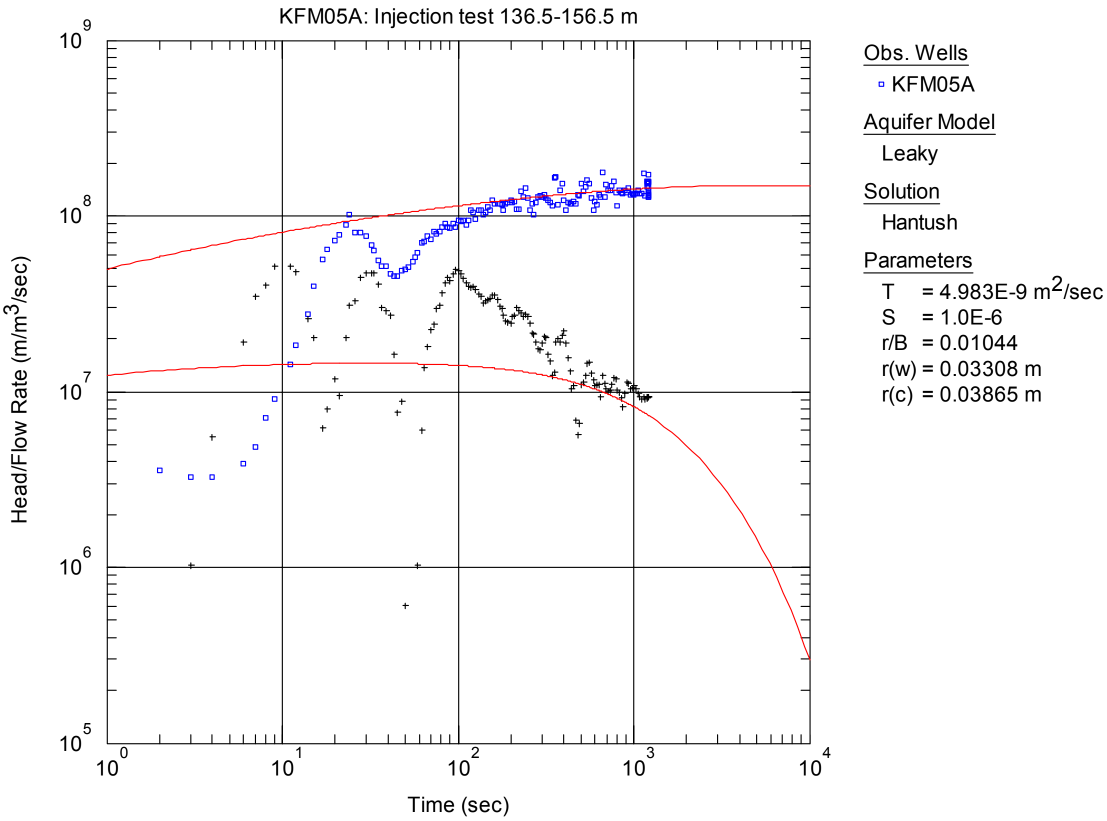


Figure A3-46. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 136.5-156.5 m in KFM05A.*

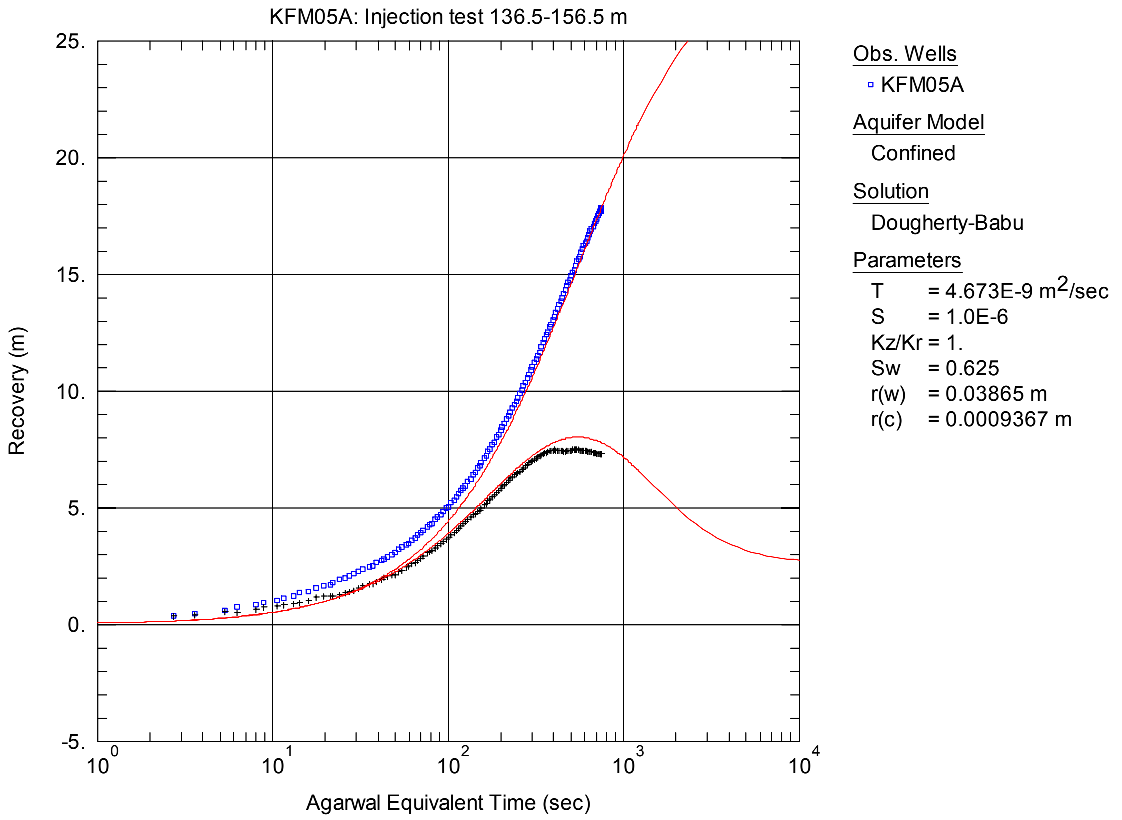


Figure A3-47. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 136.5-156.5 m in KFM05A.*

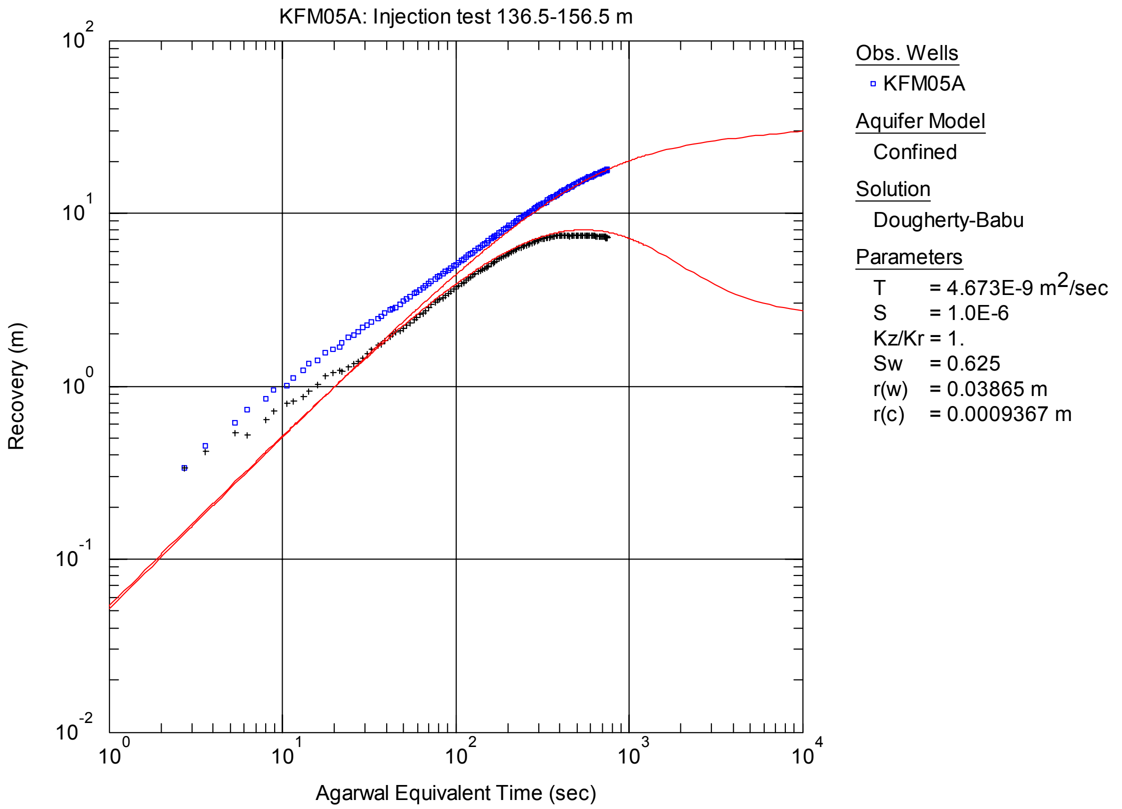


Figure A3-48. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 136.5-156.5 m in KFM05A.*

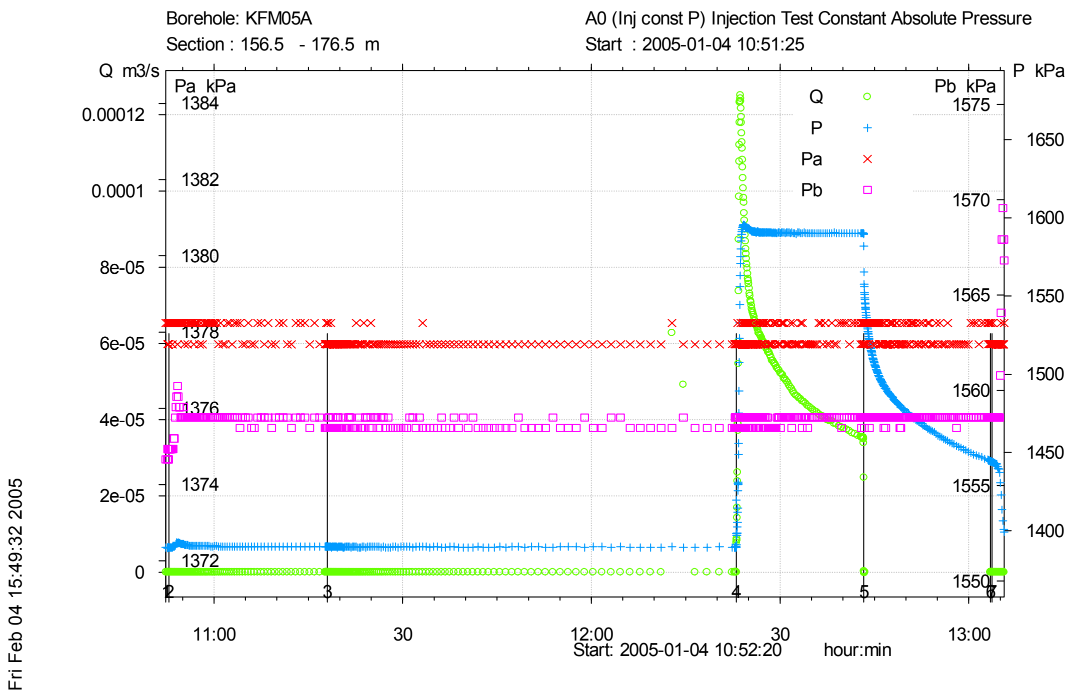


__Figure A3-49.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 156.5-176.5 m in borehole KFM05A.

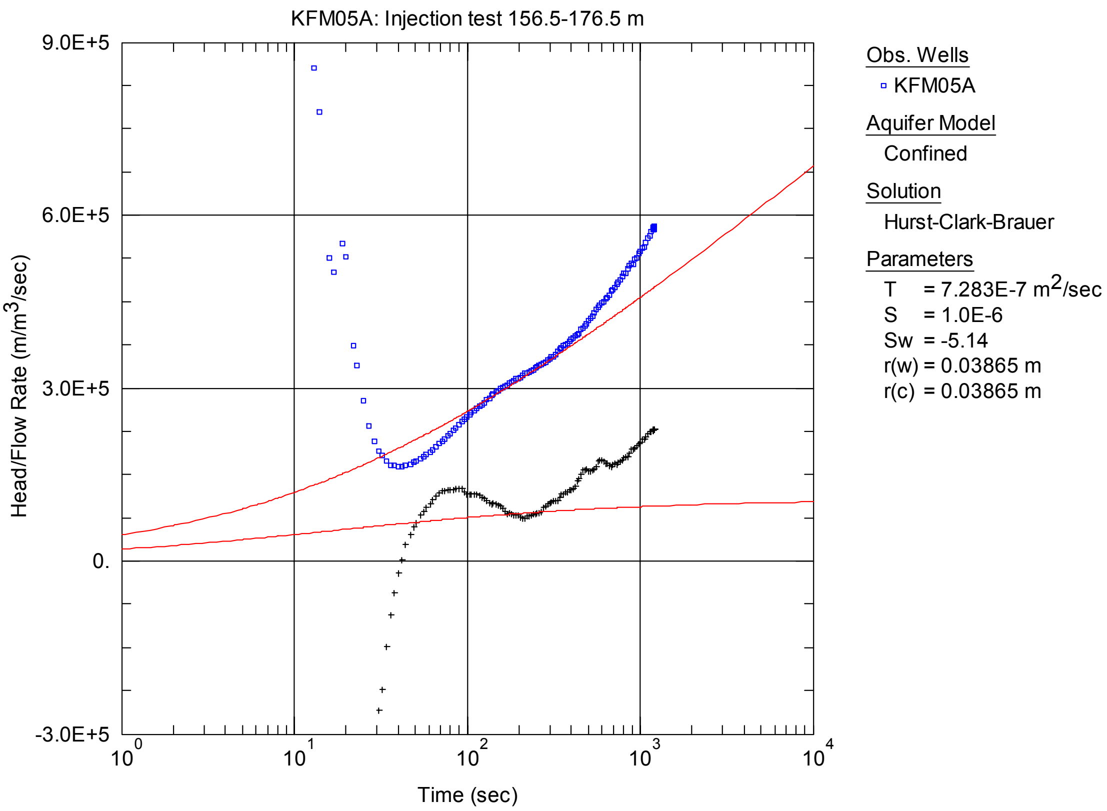


__Figure A3-50.__ Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 156.5-176.5 m in KFM05A.

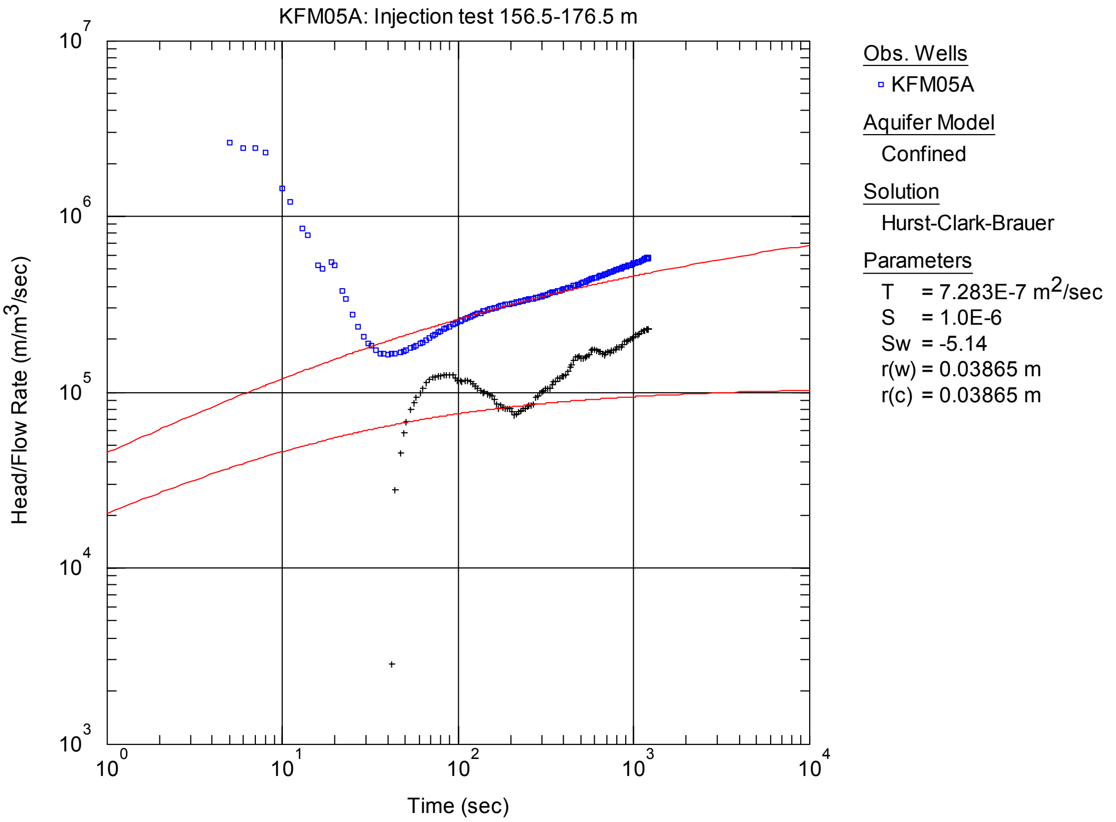


Figure A3-51. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 156.5-176.5 m in KFM05A.*

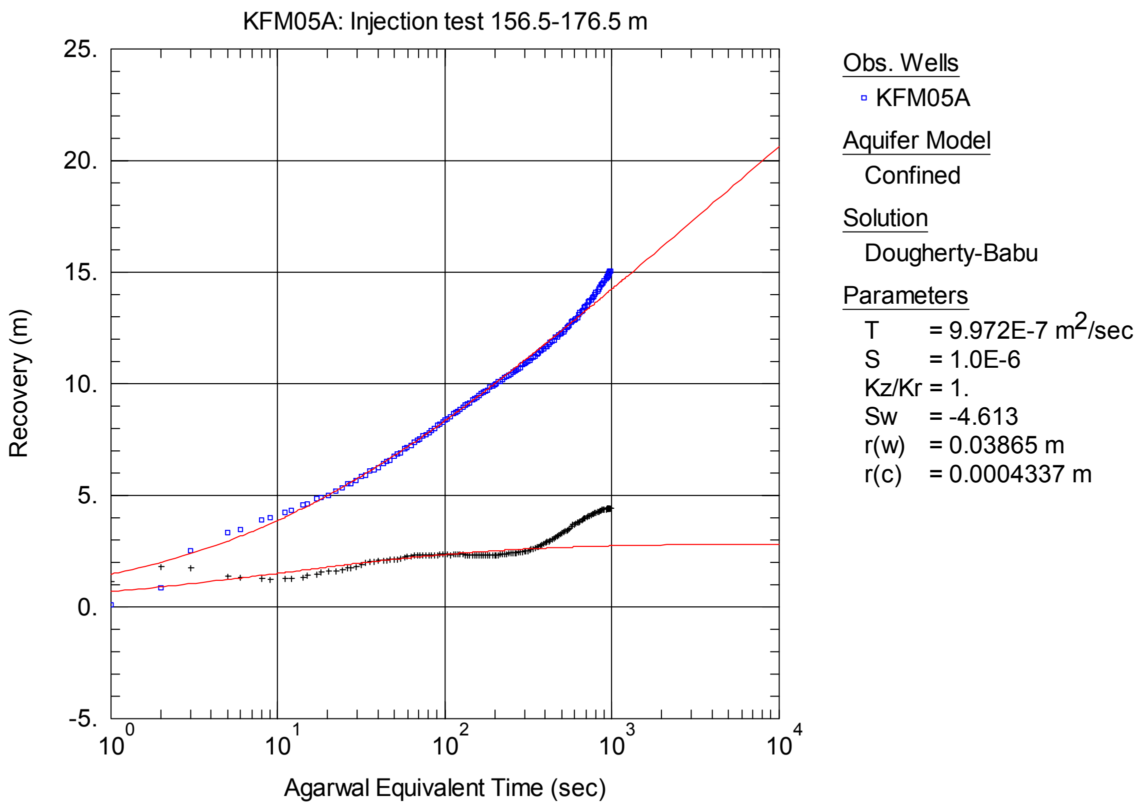


Figure A3-52. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 156.5-176.5 m in KFM05A.*

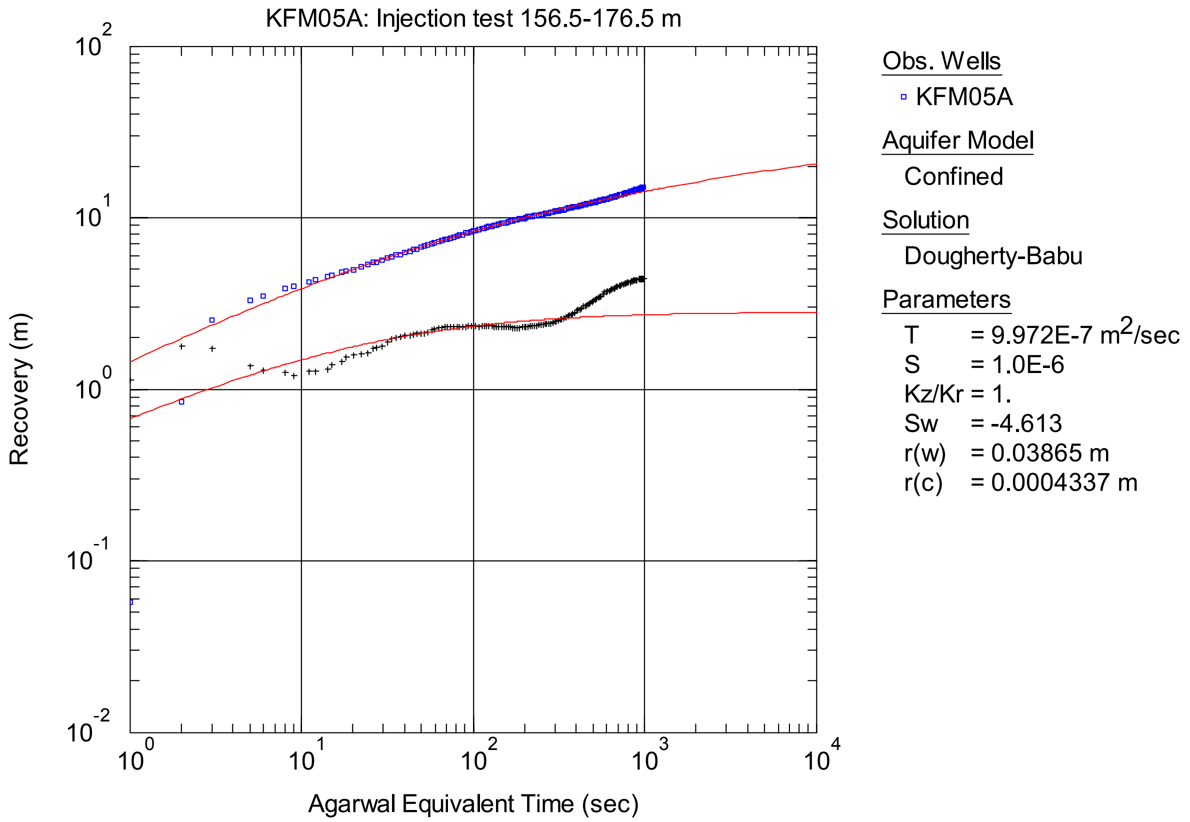


Figure A3-53. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 156.5-176.5 m in KFM05A.*

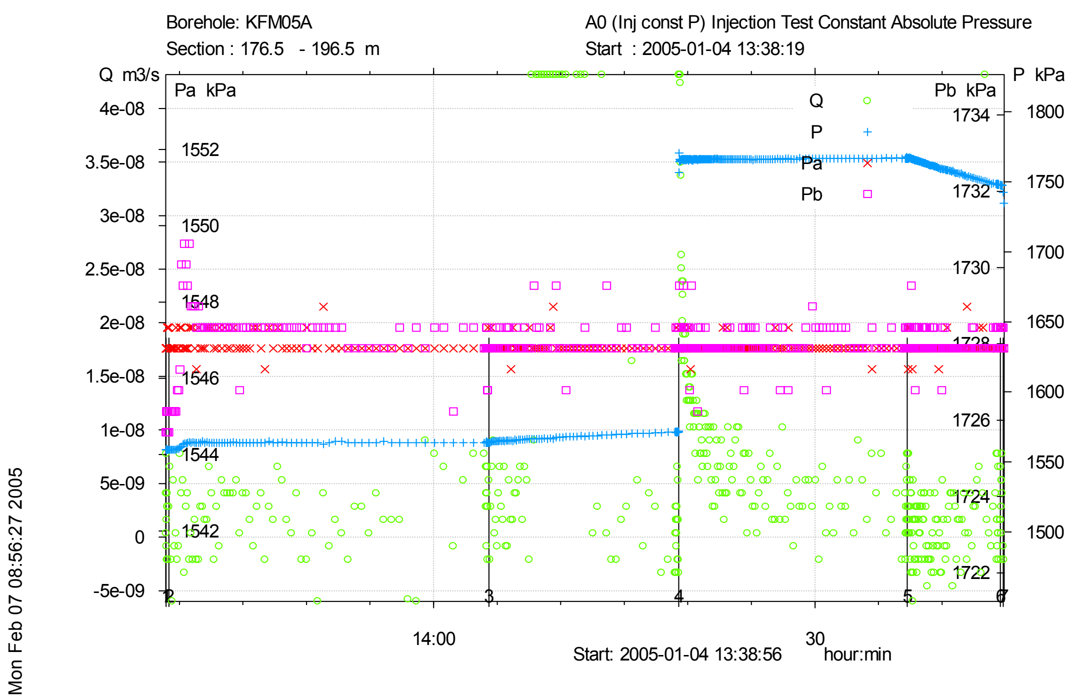


Figure A3-54. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 176.5-196.5 m in borehole KFM05A.*

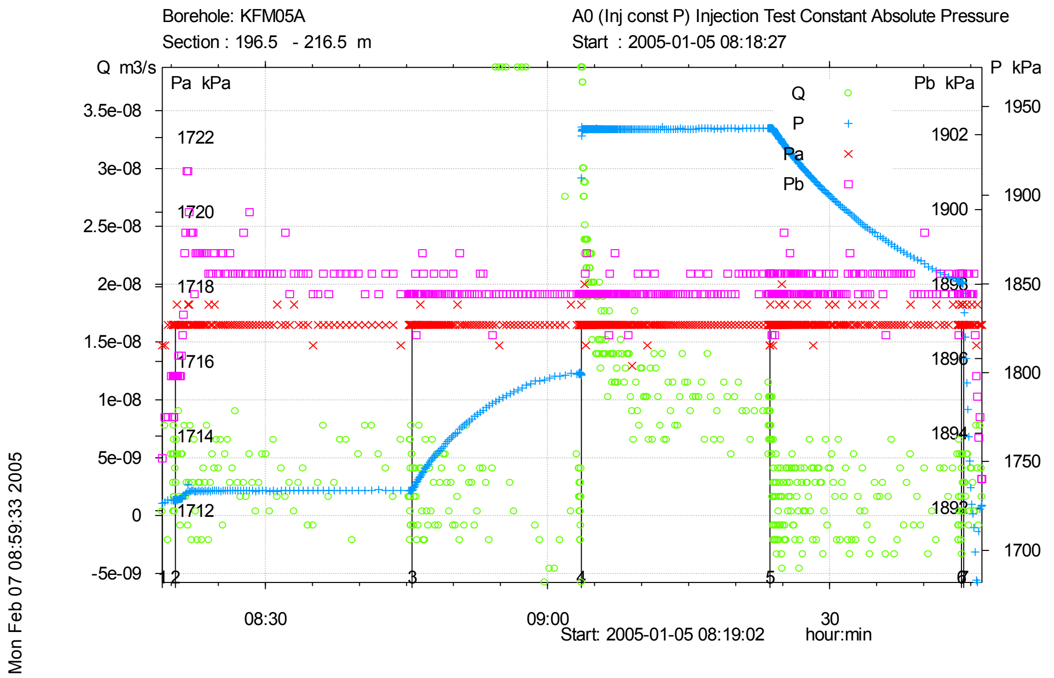


Figure A3-55. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 196.5-216.5 m in borehole KFM05A.*

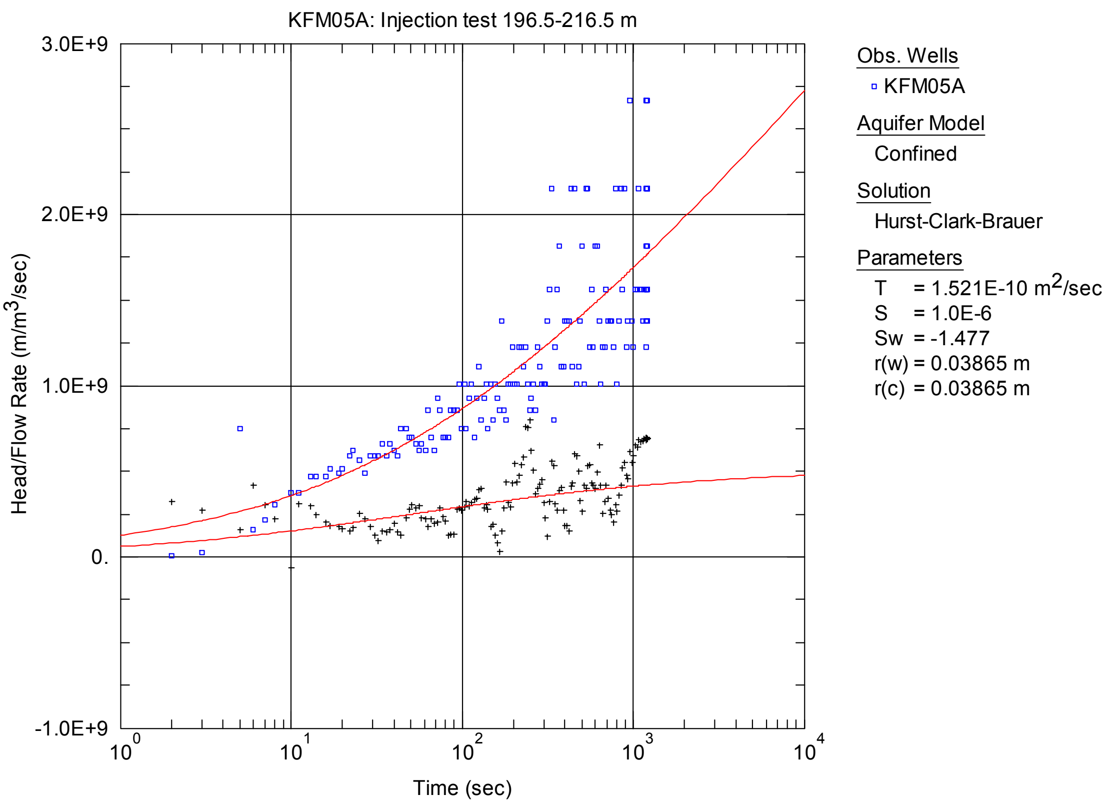


Figure A3-56. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 196.5-216.5 m in KFM05A.*

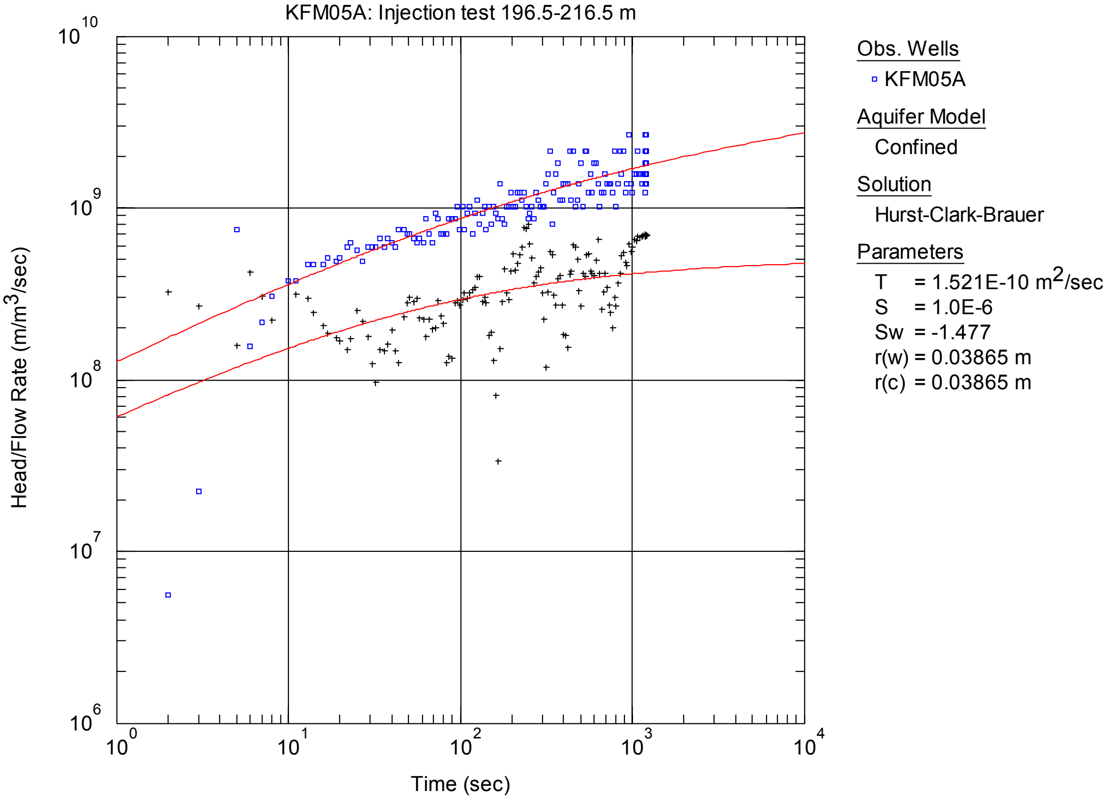


Figure A3-57. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 196.5-216.5 m in KFM05A.*

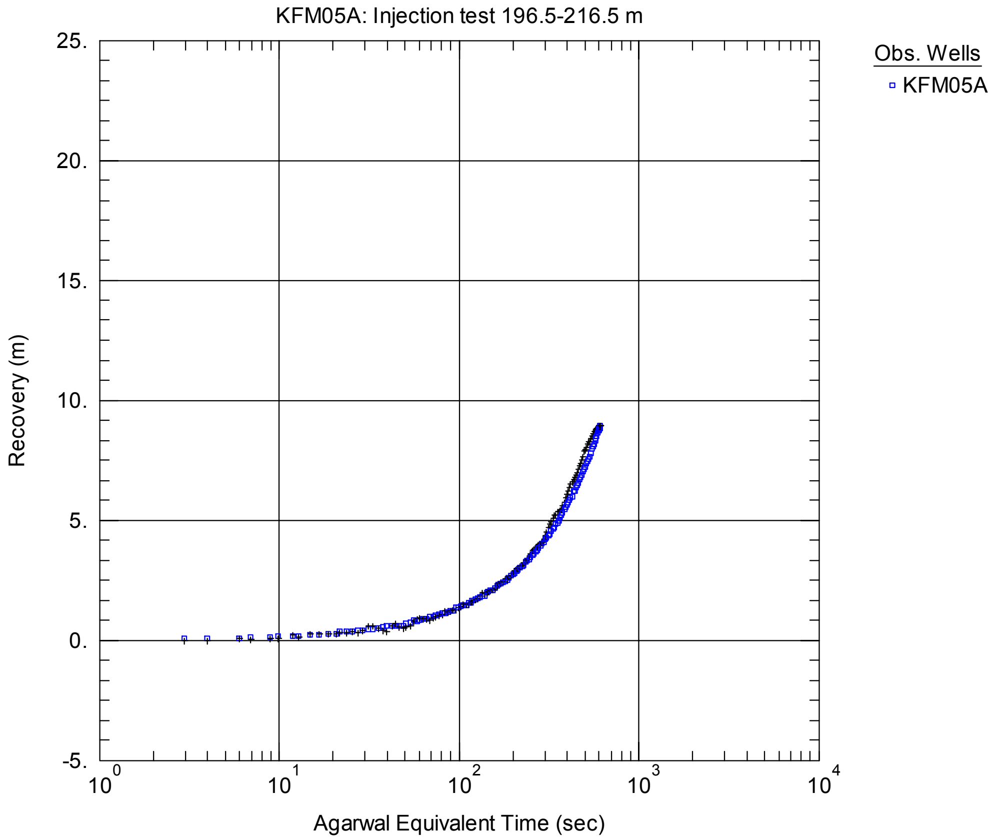


Figure A3-58. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 196.5-216.5 m in KFM05A.*

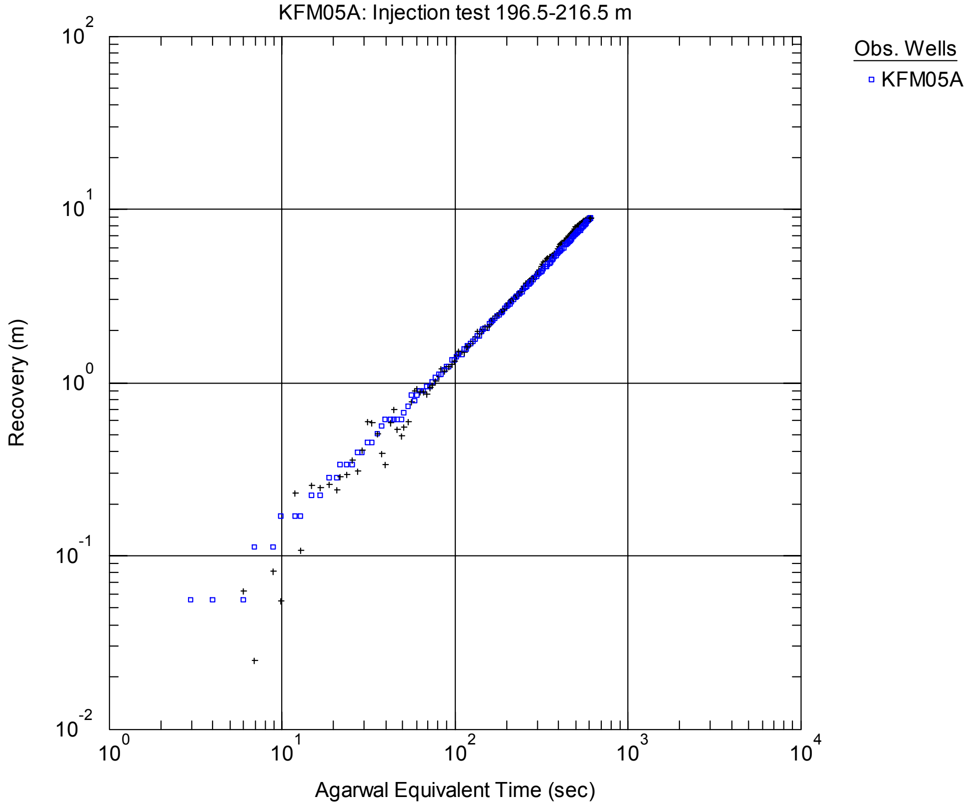


Figure A3-59. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 196.5-216.5 m in KFM05A.*

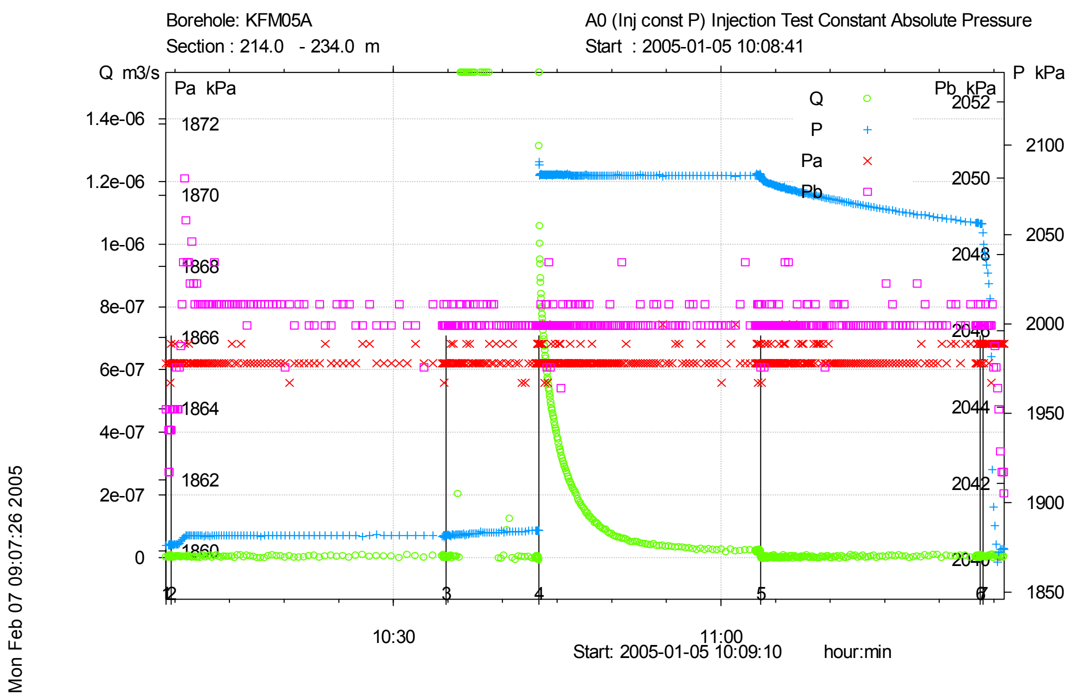


Figure A3-60. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 214.0-234.0 m in borehole KFM05A.*

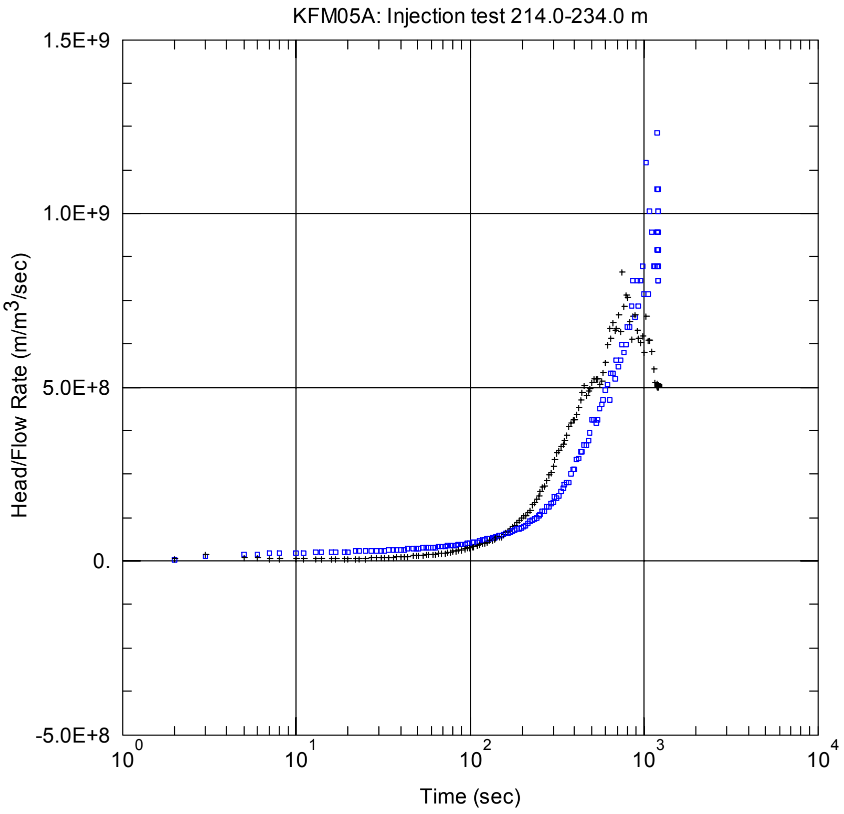


Figure A3-61. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 214.0-234.0 m in KFM05A.*

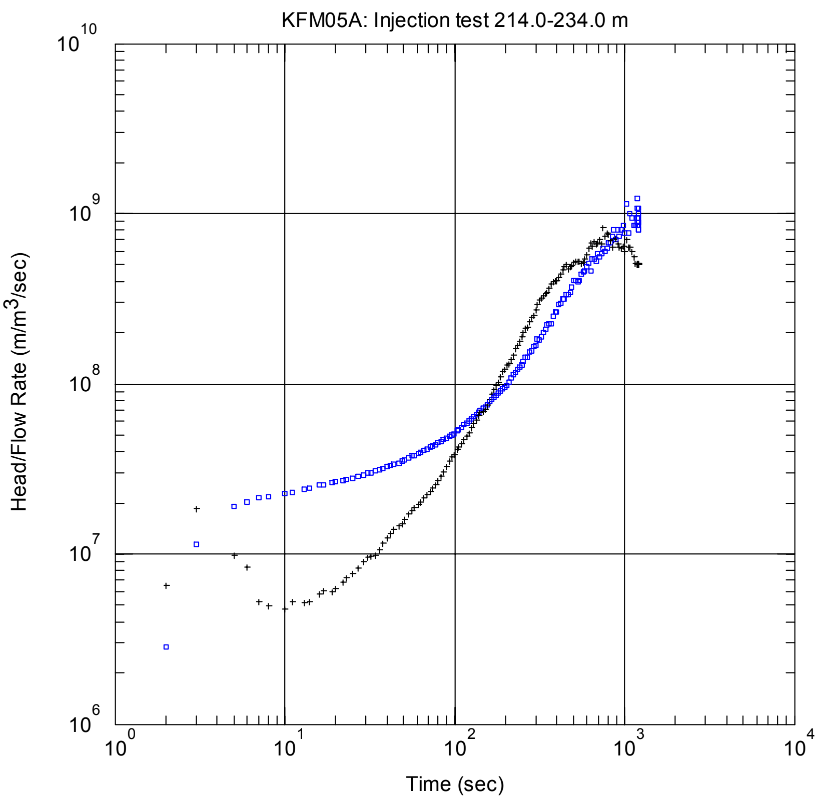


Figure A3-62. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 214.0-234.0 m in KFM05A.*

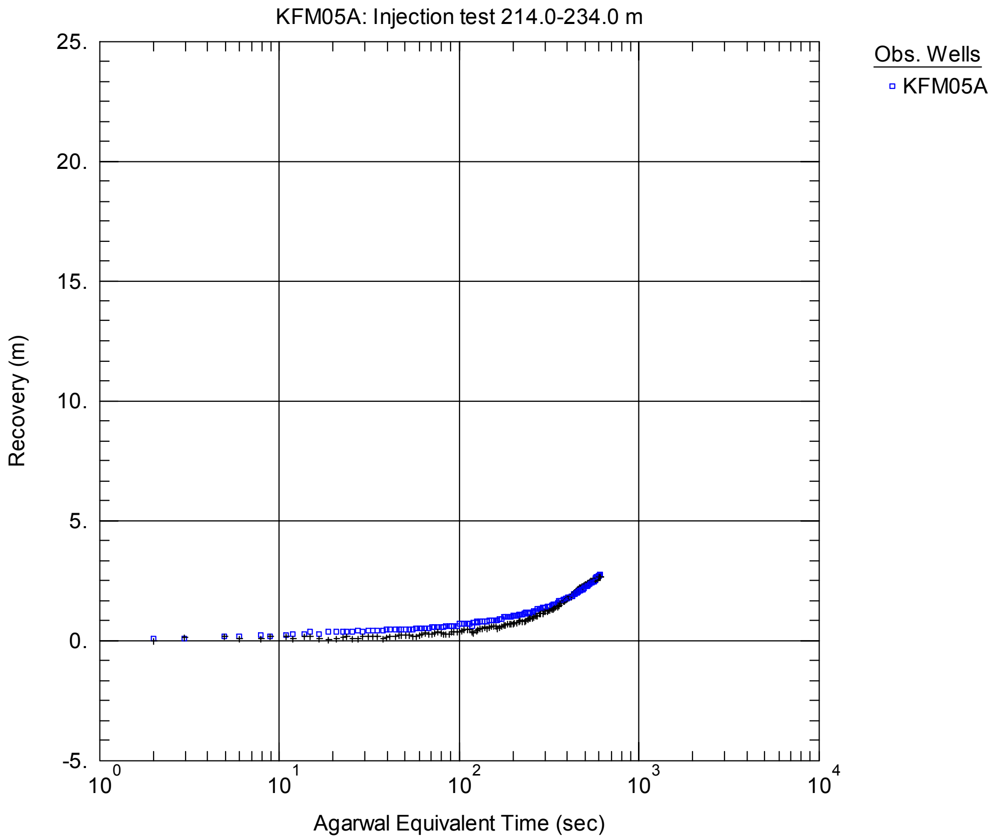


Figure A3-63. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 214.0-234.0 m in KFM05A.*

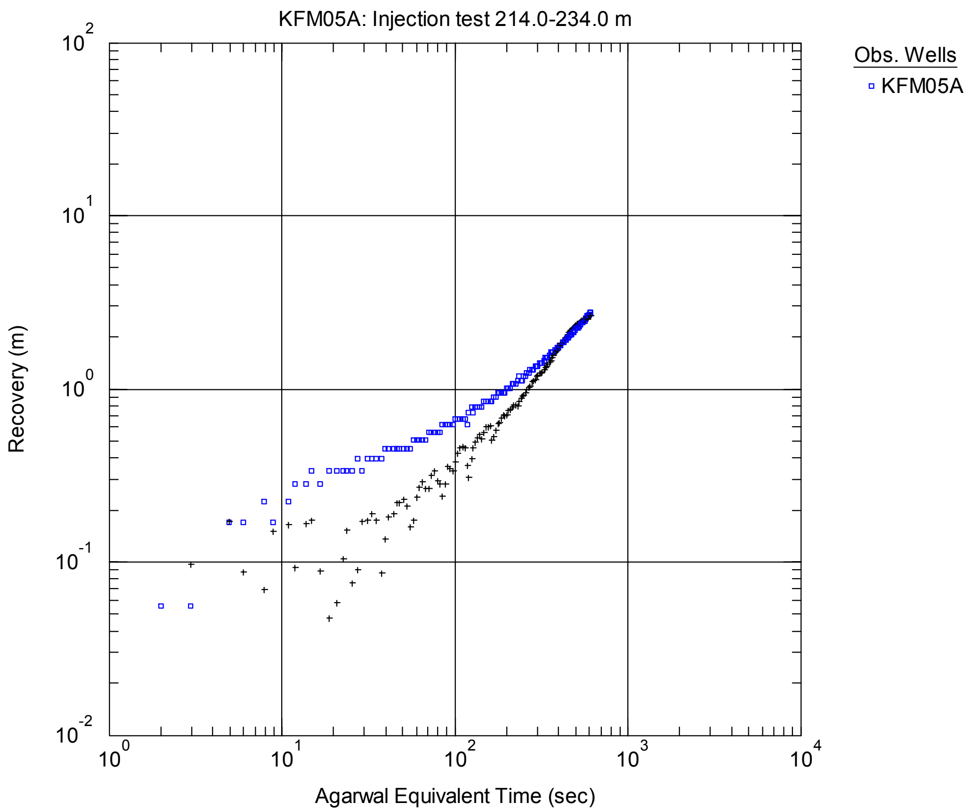


Figure A3-64. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 214.0-234.0 m in KFM05A.*

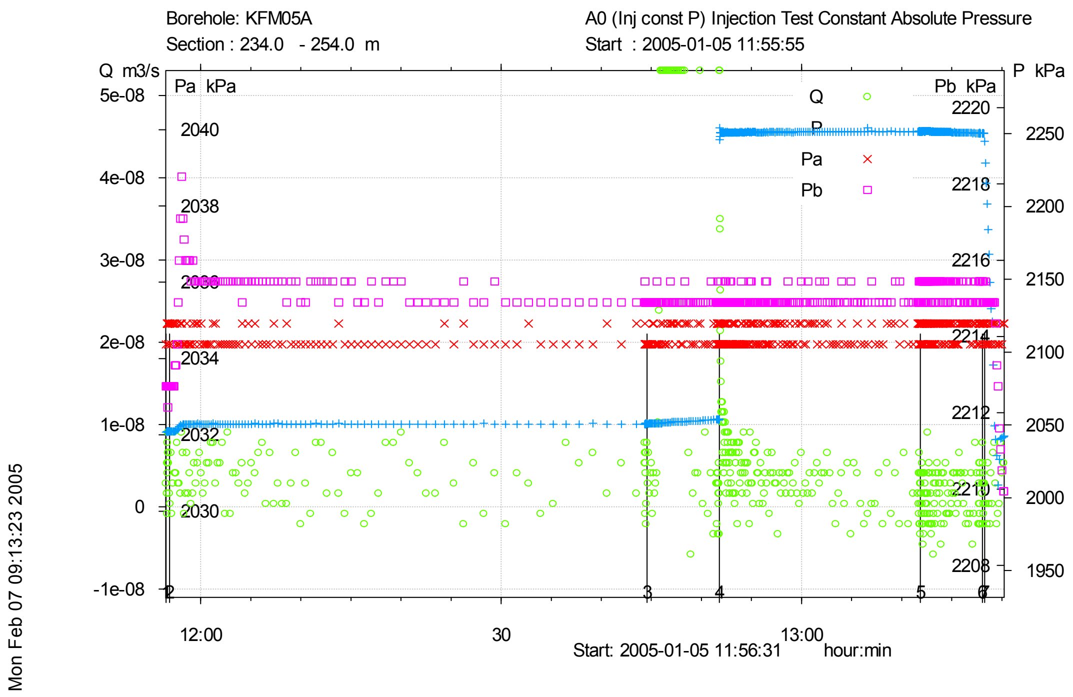


Figure A3-65. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 234.0-254.0 m in borehole KFM05A.*

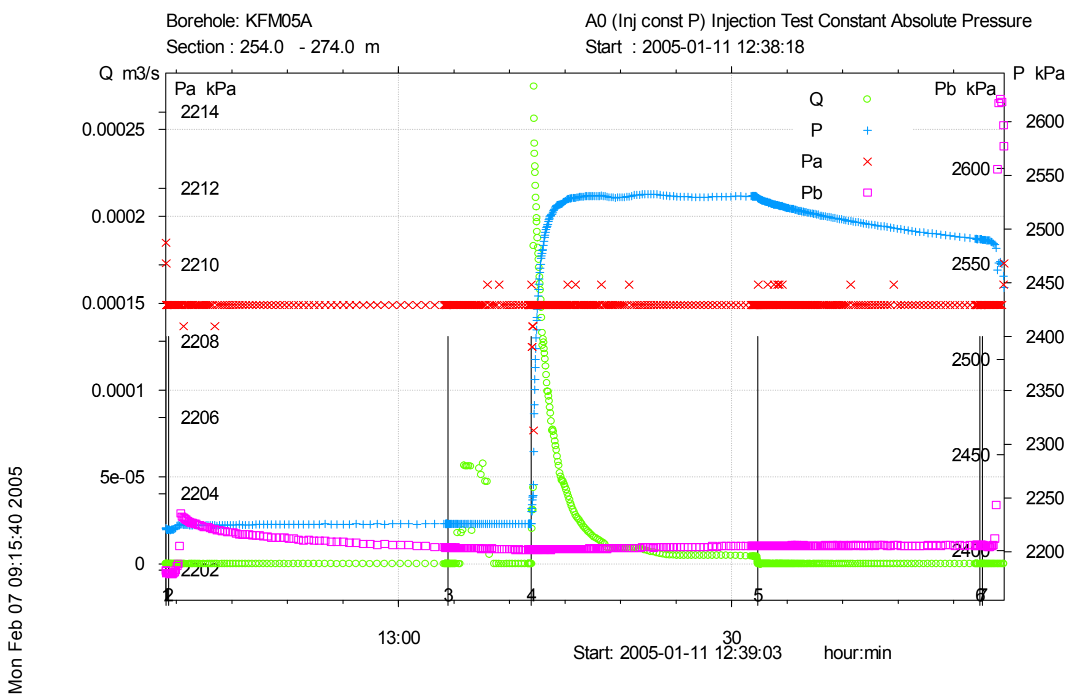


Figure A3-66. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 254.0-274.0 m in borehole KFM05A.*

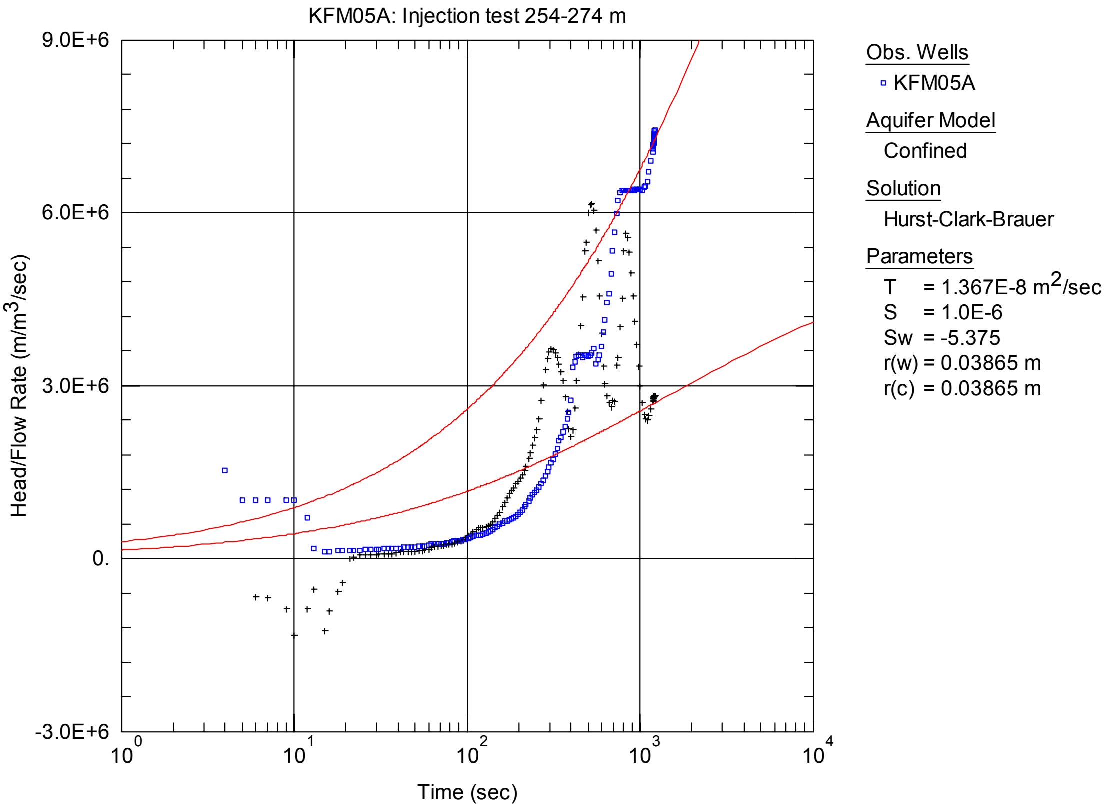


Figure A3-67. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-274.0 m in KFM05A.*

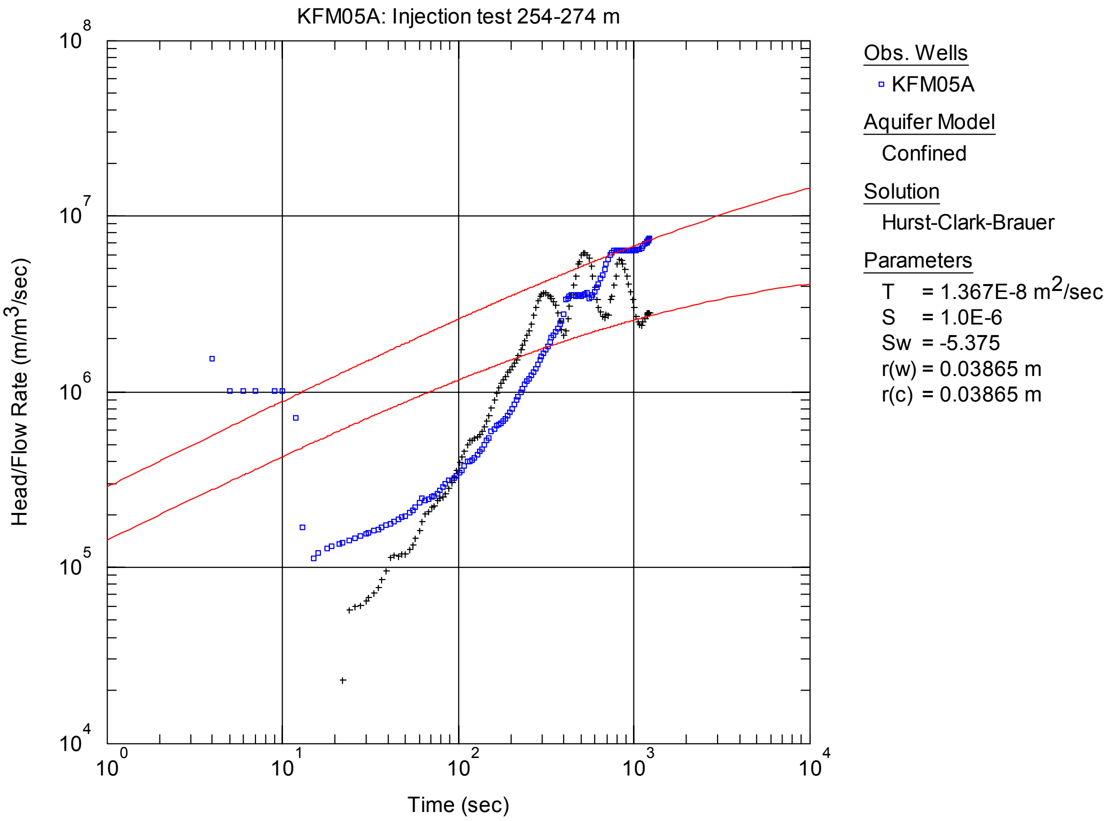


Figure A3-68. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-274.0 m in KFM05A.*

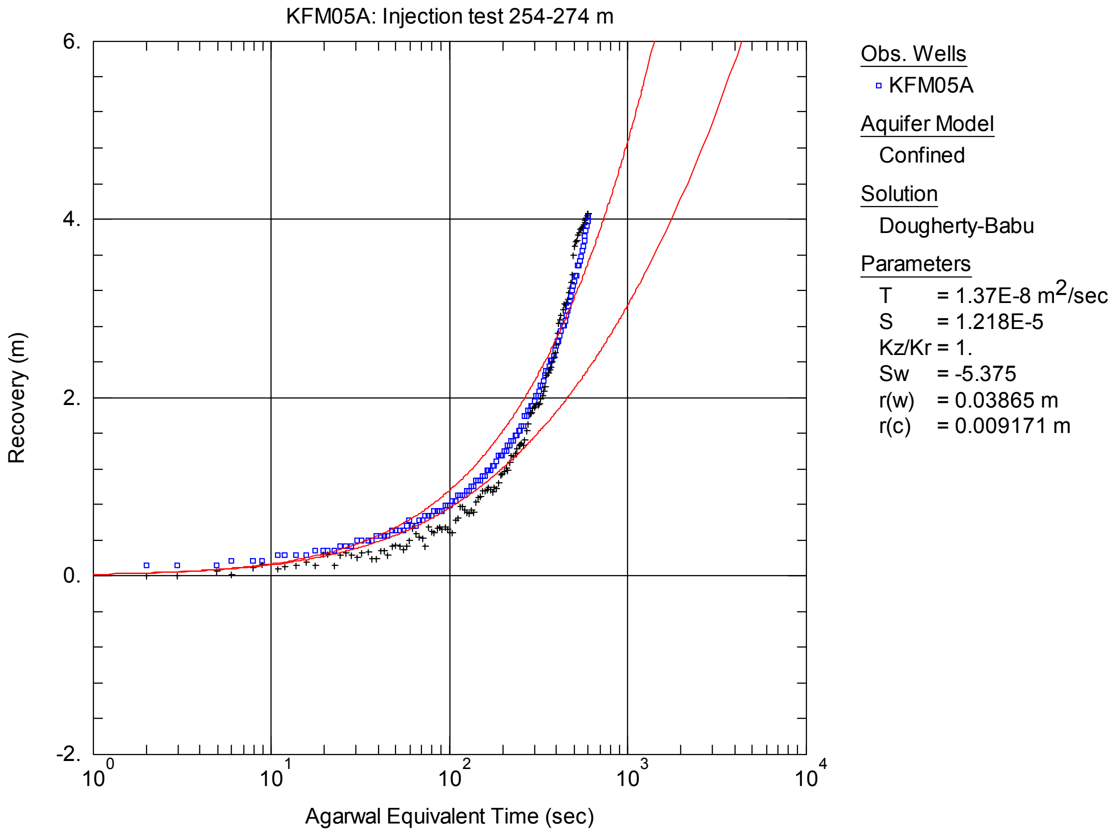


Figure A3-69. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 254.0-274.0 m in KFM05A.*

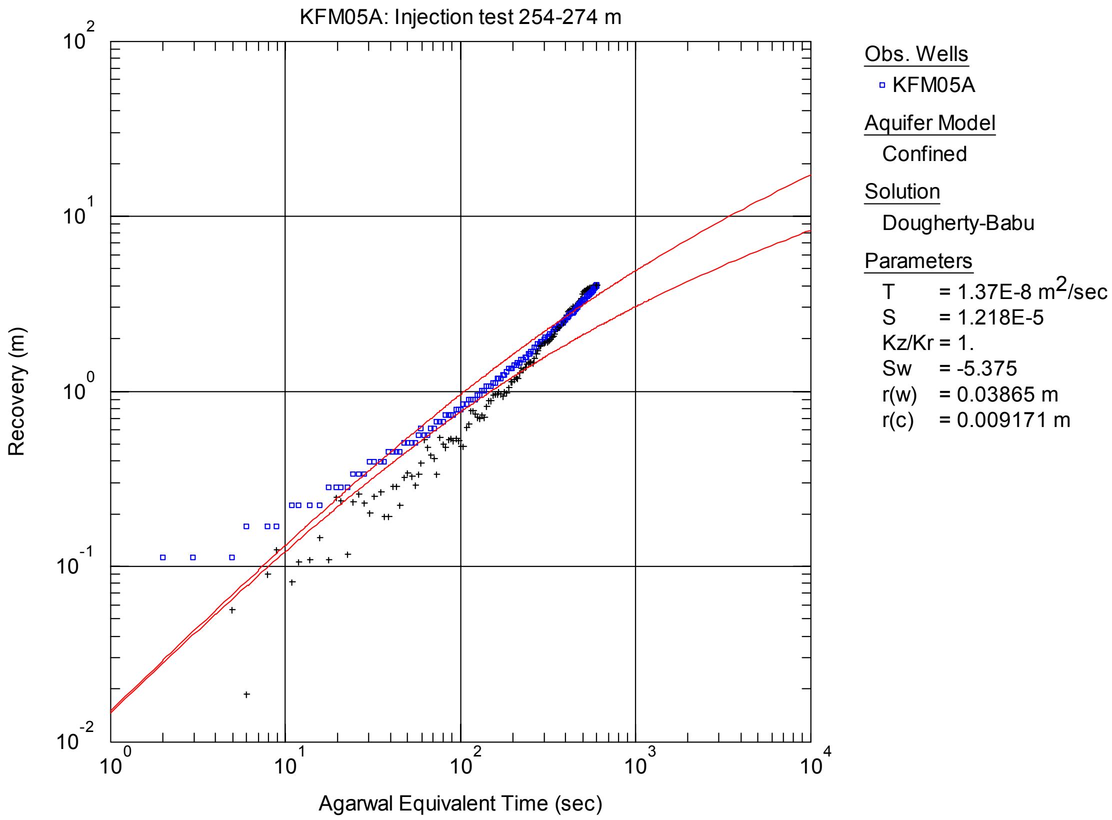


Figure A3-70. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 254.0-274.0 m in KFM05A.*

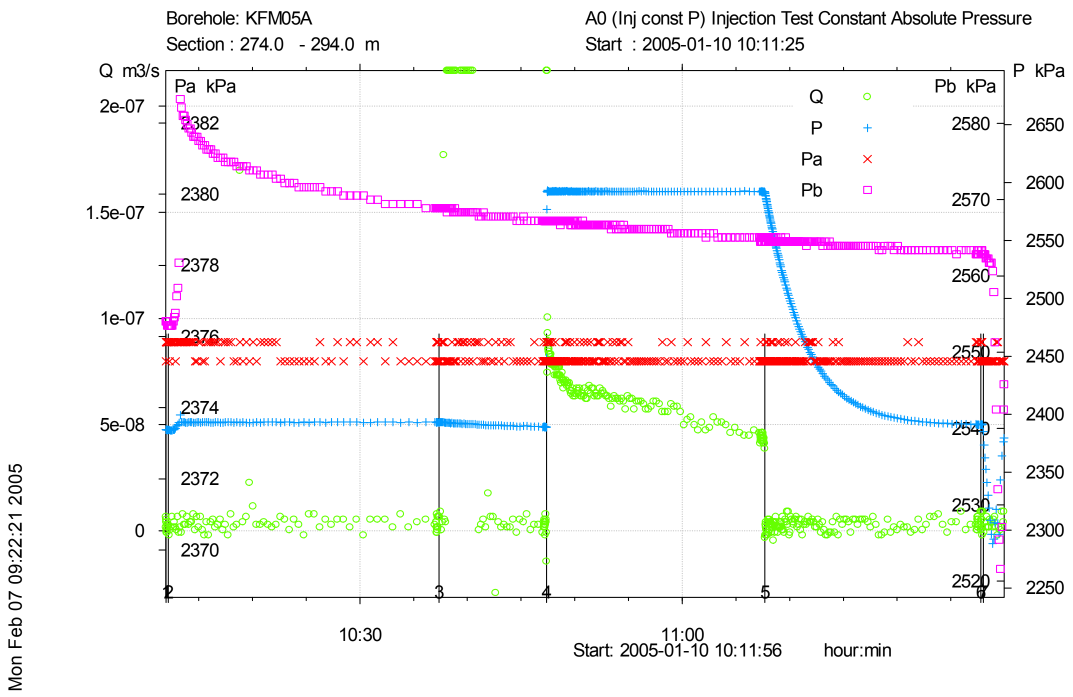


Figure A3-71. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 274.0-294.0 m in borehole KFM05A.*

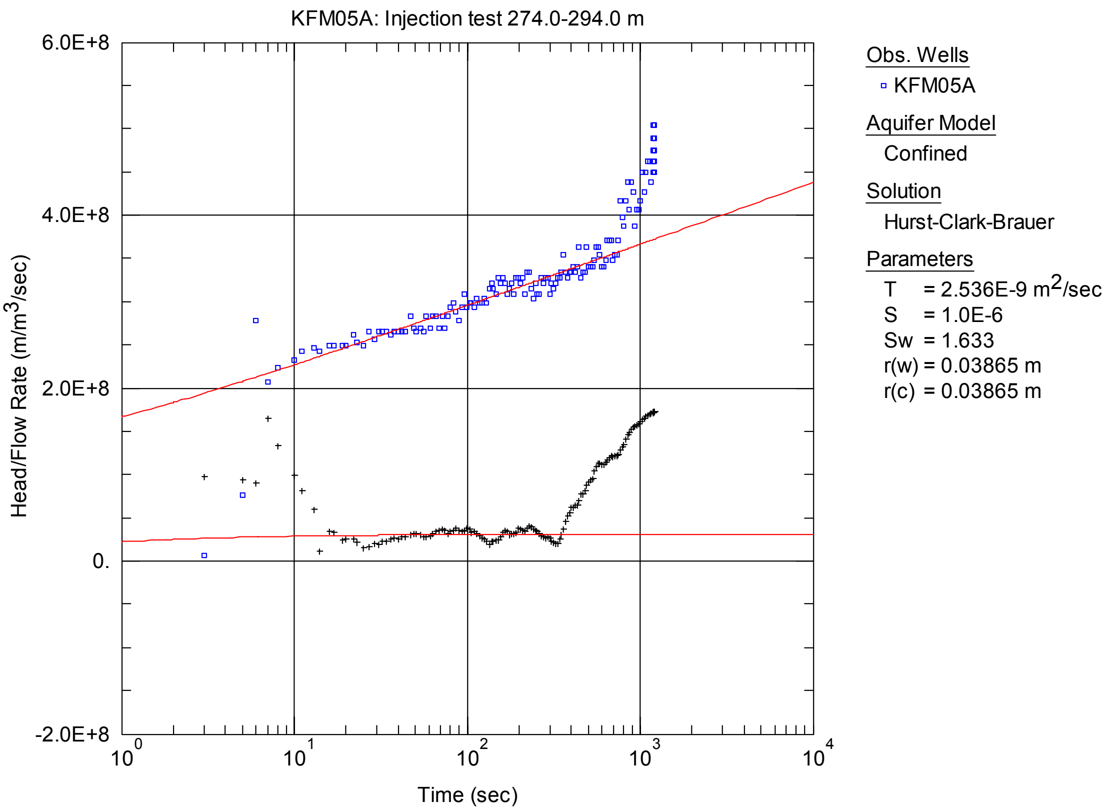


Figure A3-72. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 274.0-294.0 m in KFM05A.*

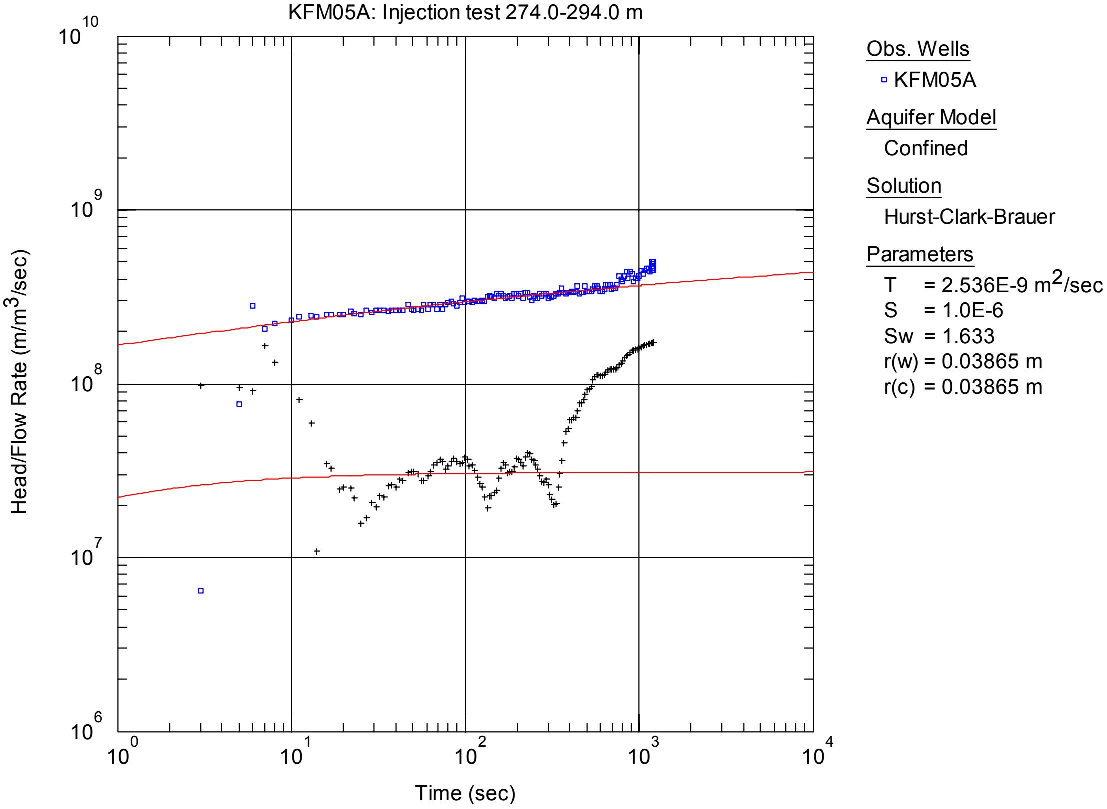


Figure A3-73. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 274.0-294.0 m in KFM05A.*

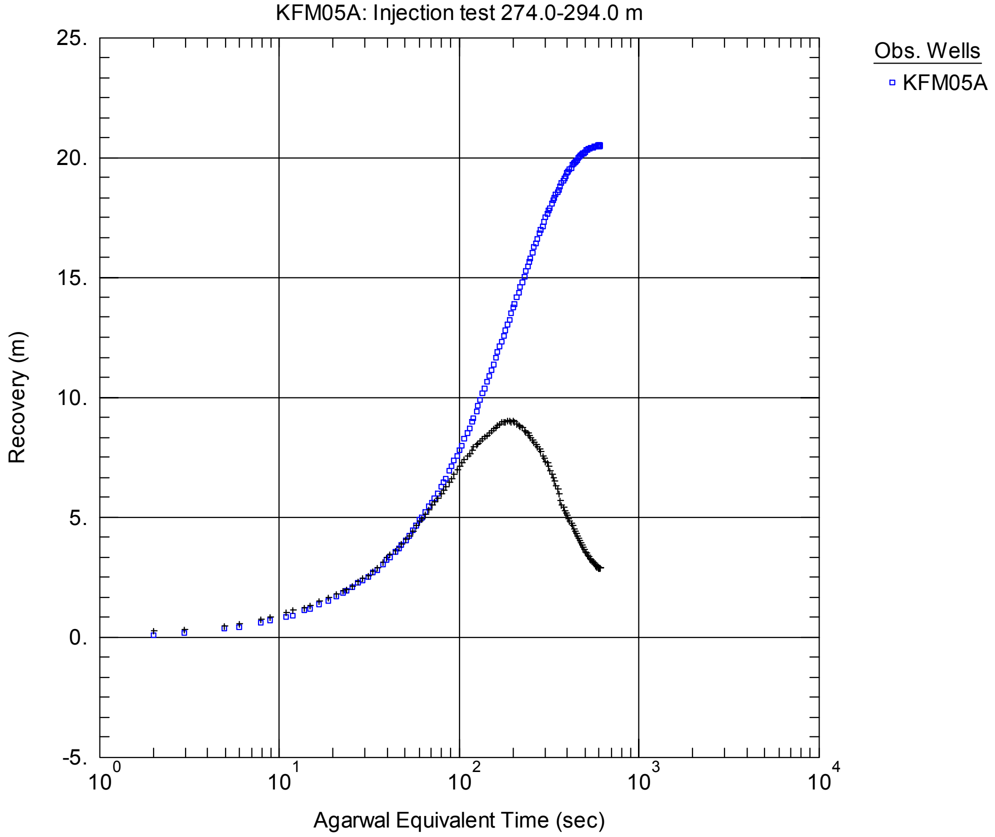


Figure A3-74. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 274.0-294.0 m in KFM05A.*

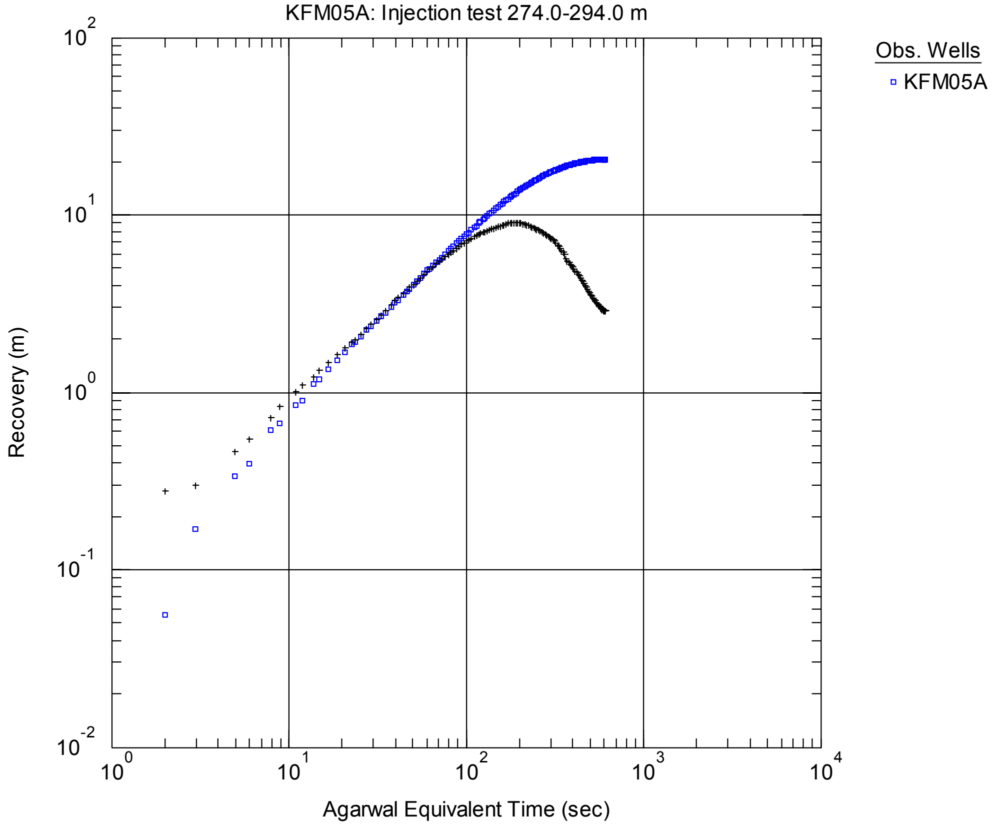


Figure A3-75. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 274.0-294.0 m in KFM05A.*

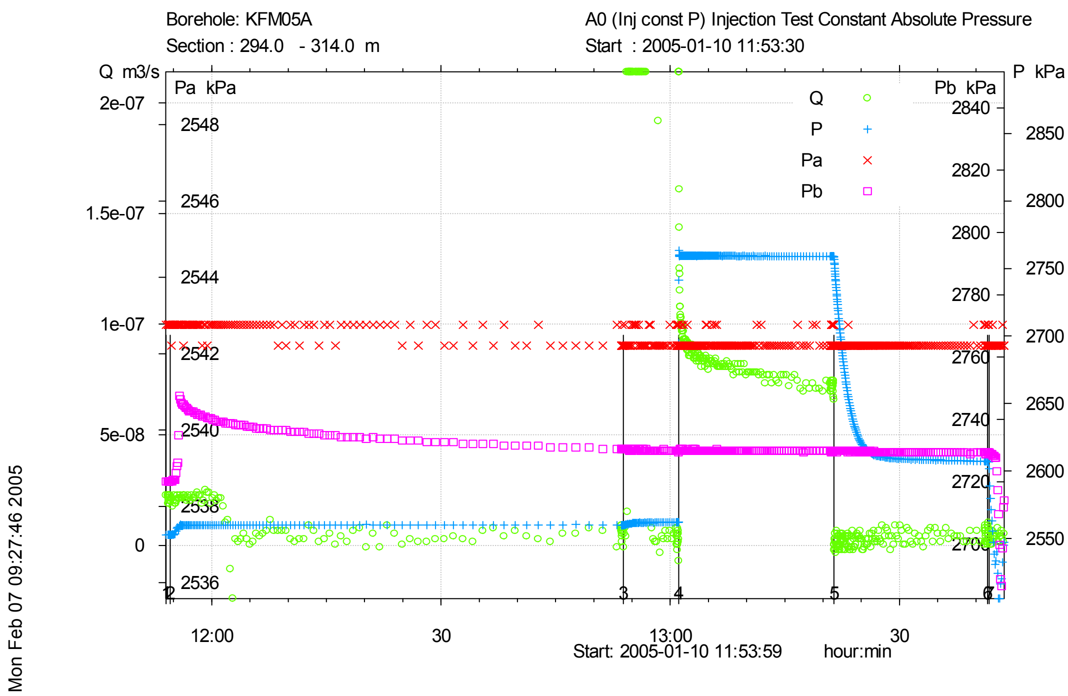


Figure A3-76. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 294.0-314.0 m in borehole KFM05A.*

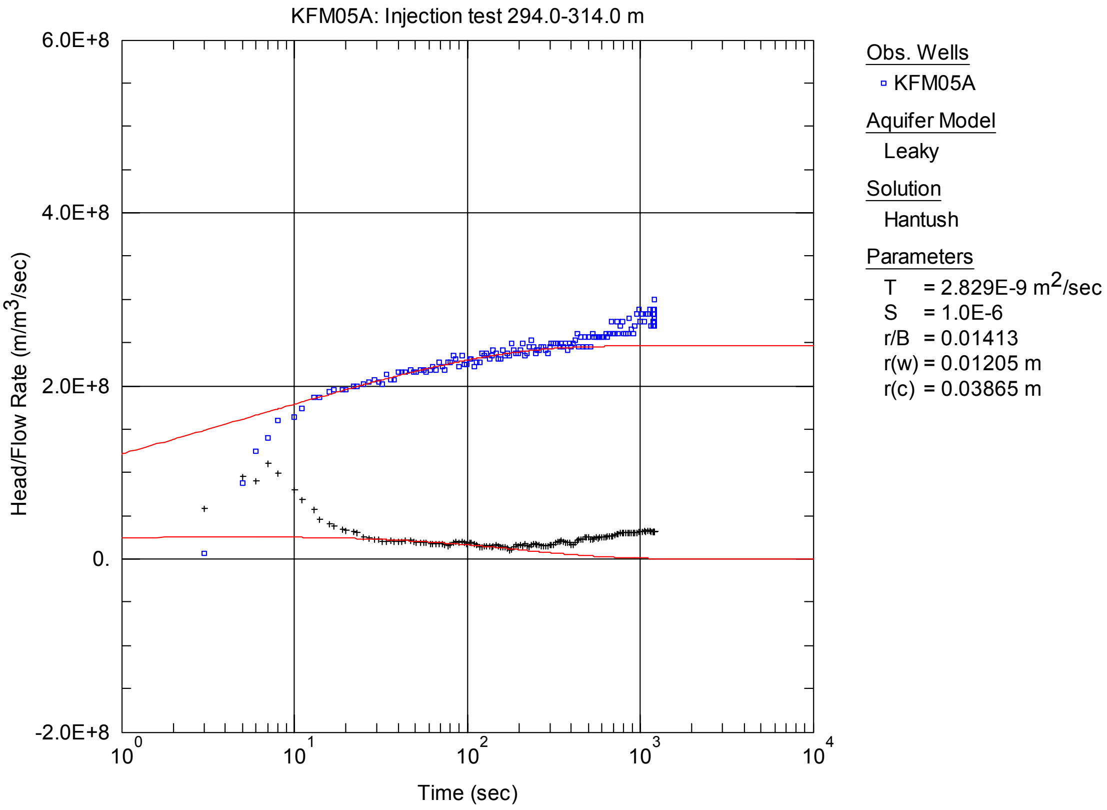


Figure A3-77. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 294.0-314.0 m in KFM05A.*

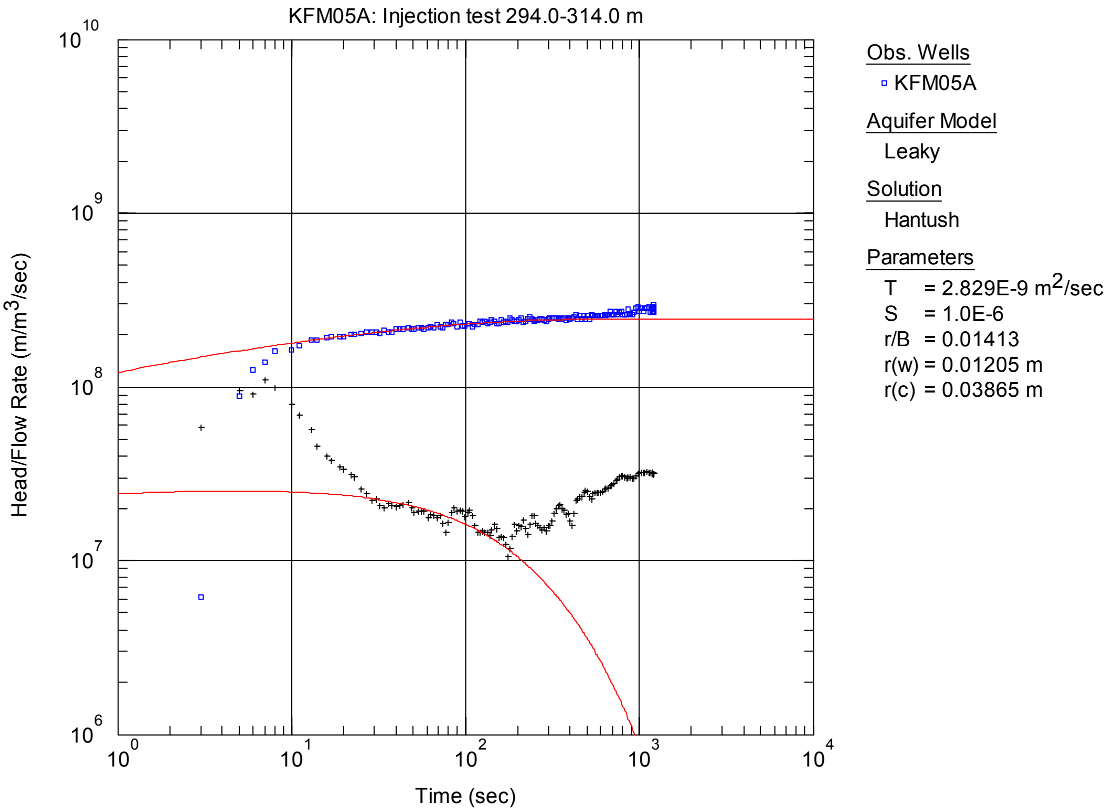


Figure A3-78. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 294.0-314.0 m in KFM05A.*

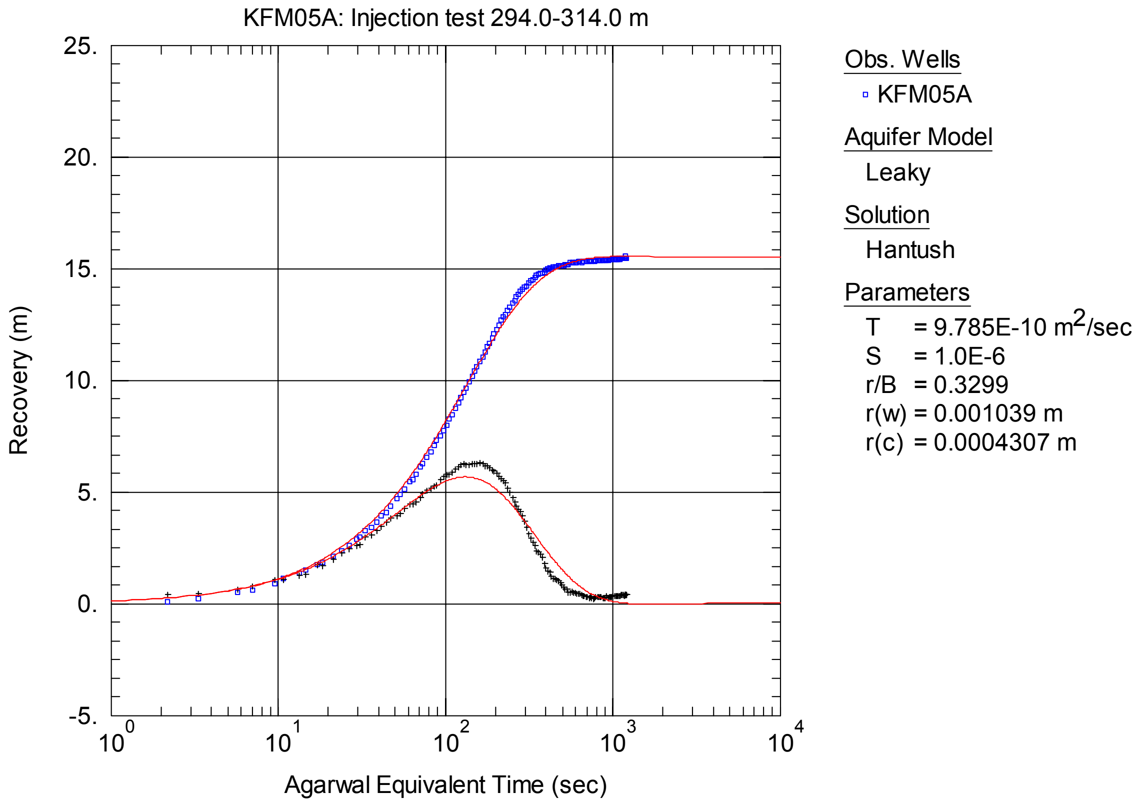


Figure A3-79. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 294.0-314.0 m in KFM05A.*

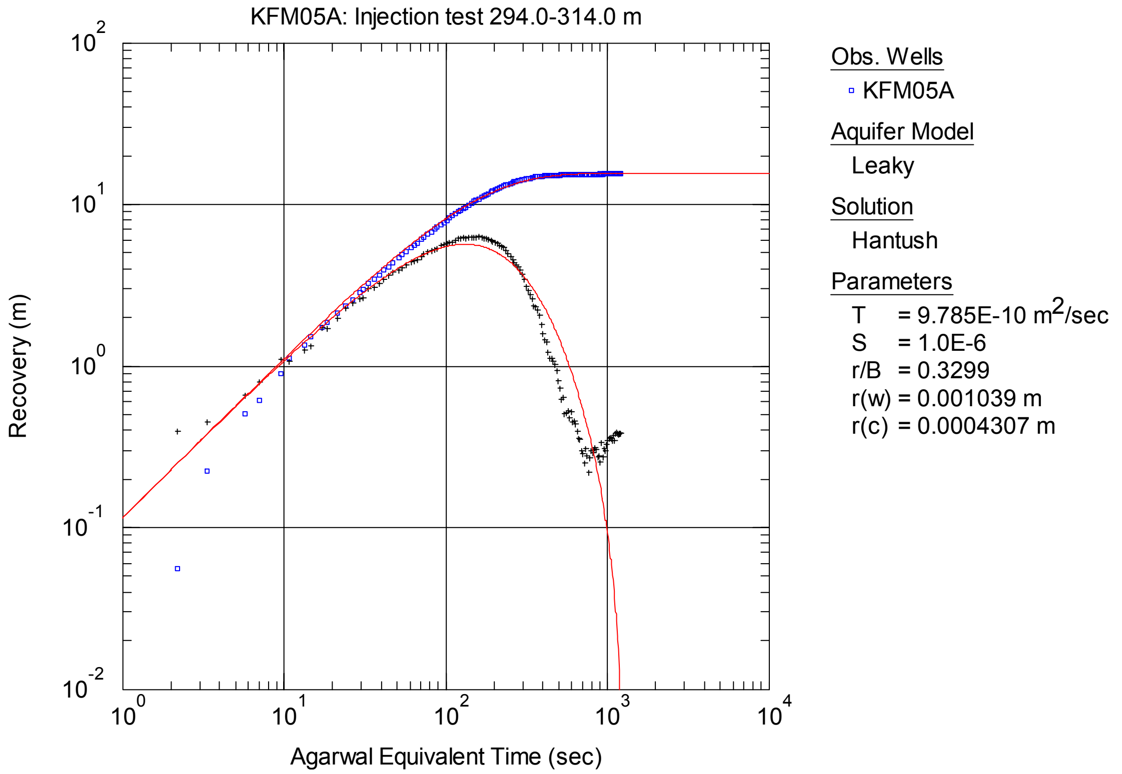


Figure A3-80. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 294.0-314.0 m in KFM05A.*

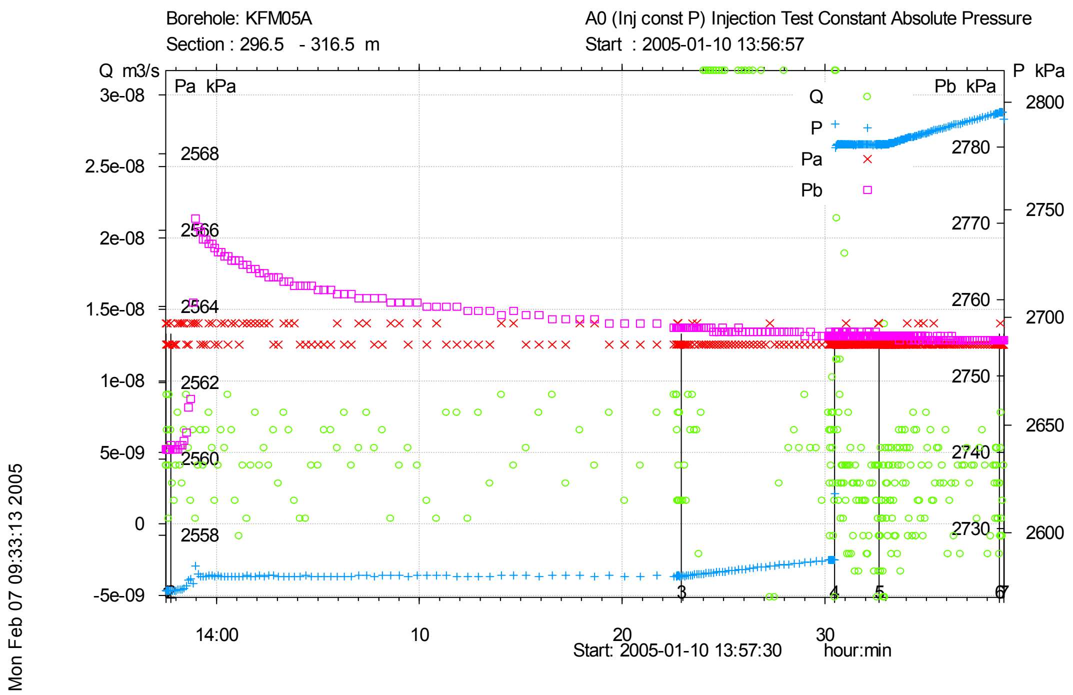


Figure A3-81. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 296.5-316.5 m in borehole KFM05A.*

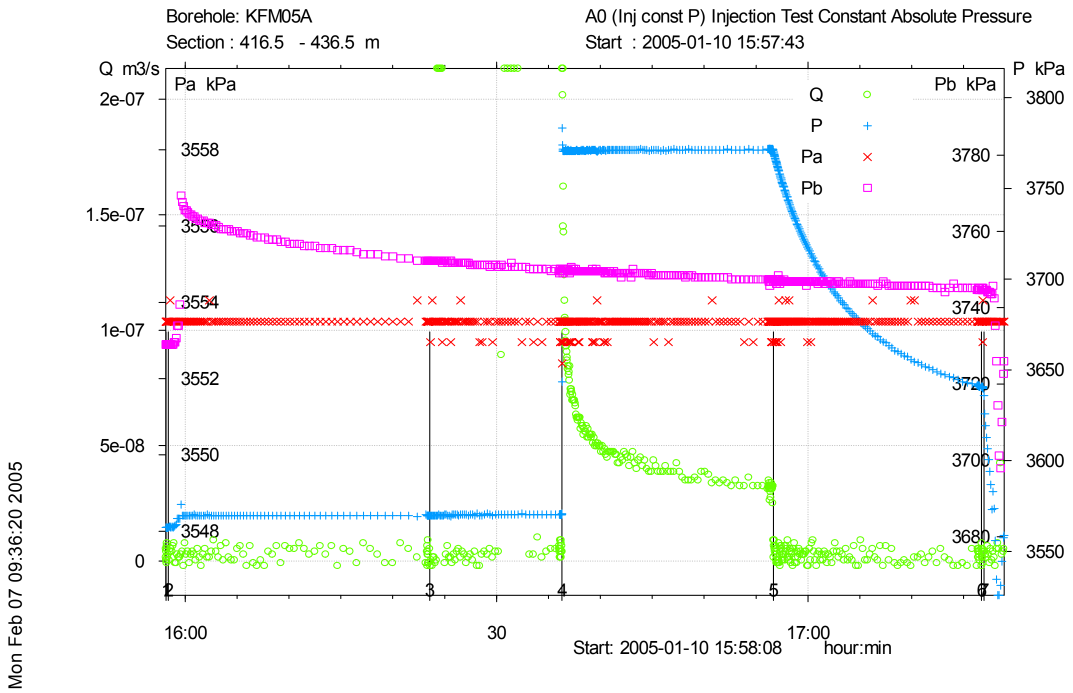


Figure A3-82. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 416.5-436.5 m in borehole KFM05A.*

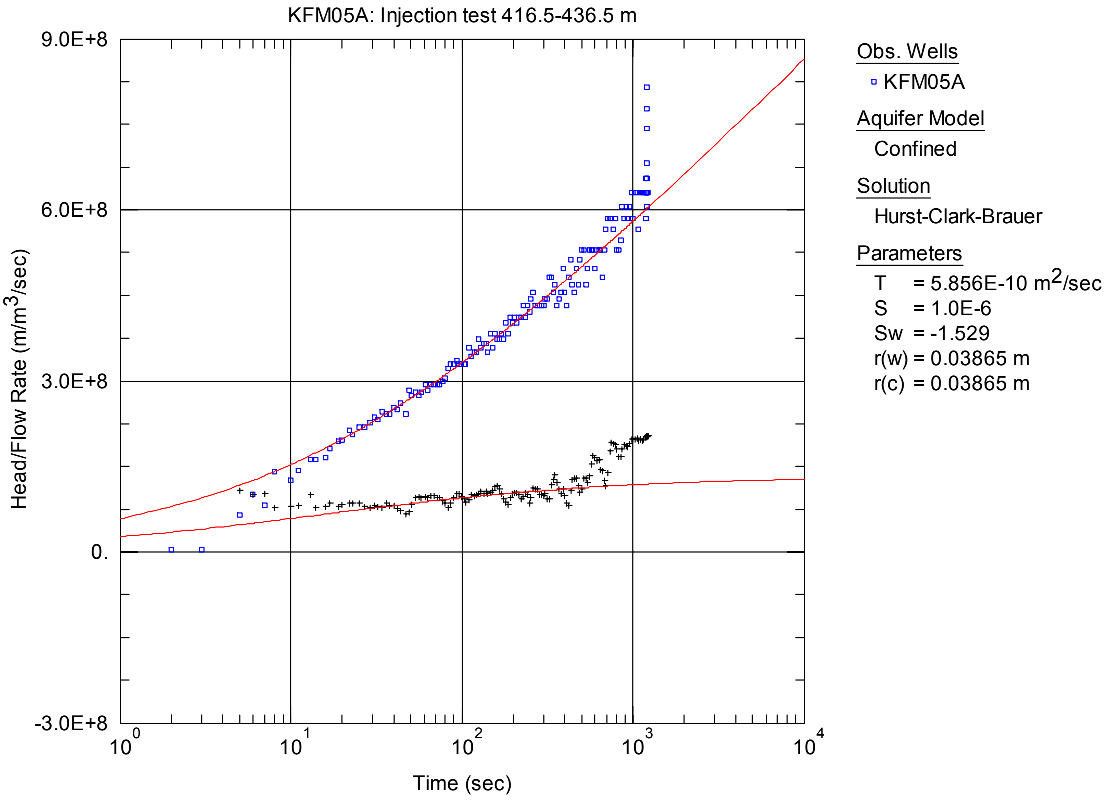


Figure A3-83. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-436.5 m in KFM05A.*

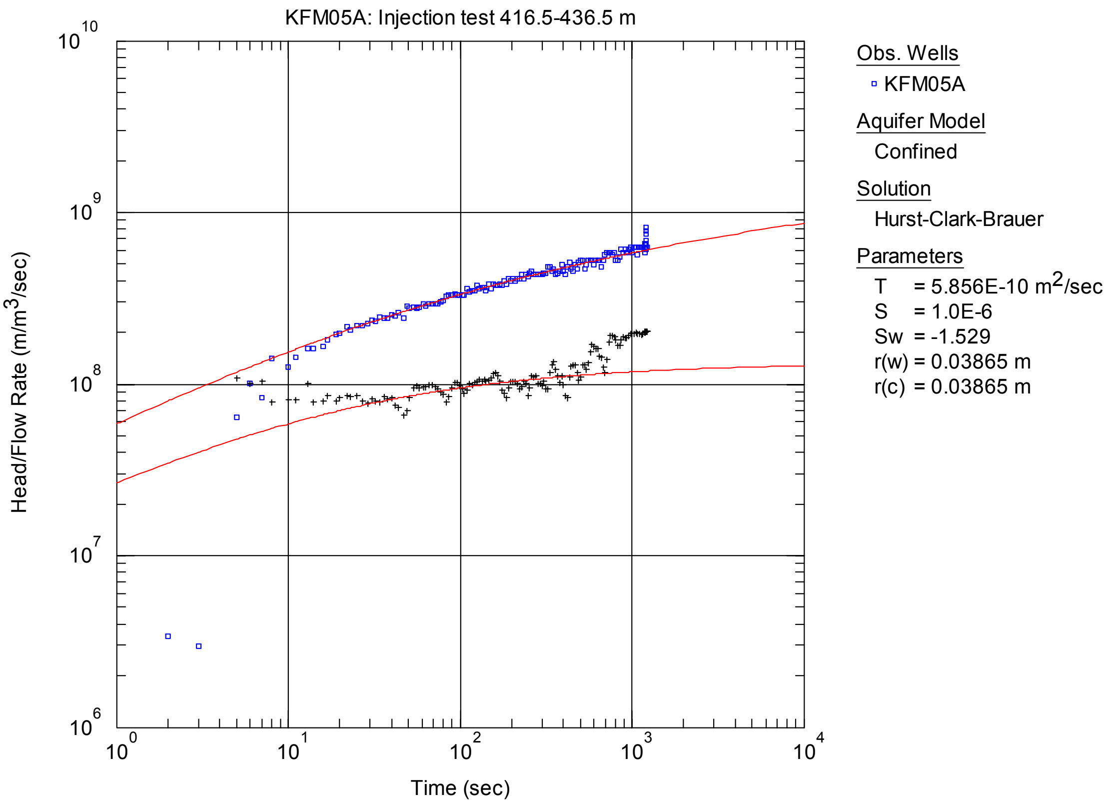


Figure A3-84. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-436.5 m in KFM05A.*

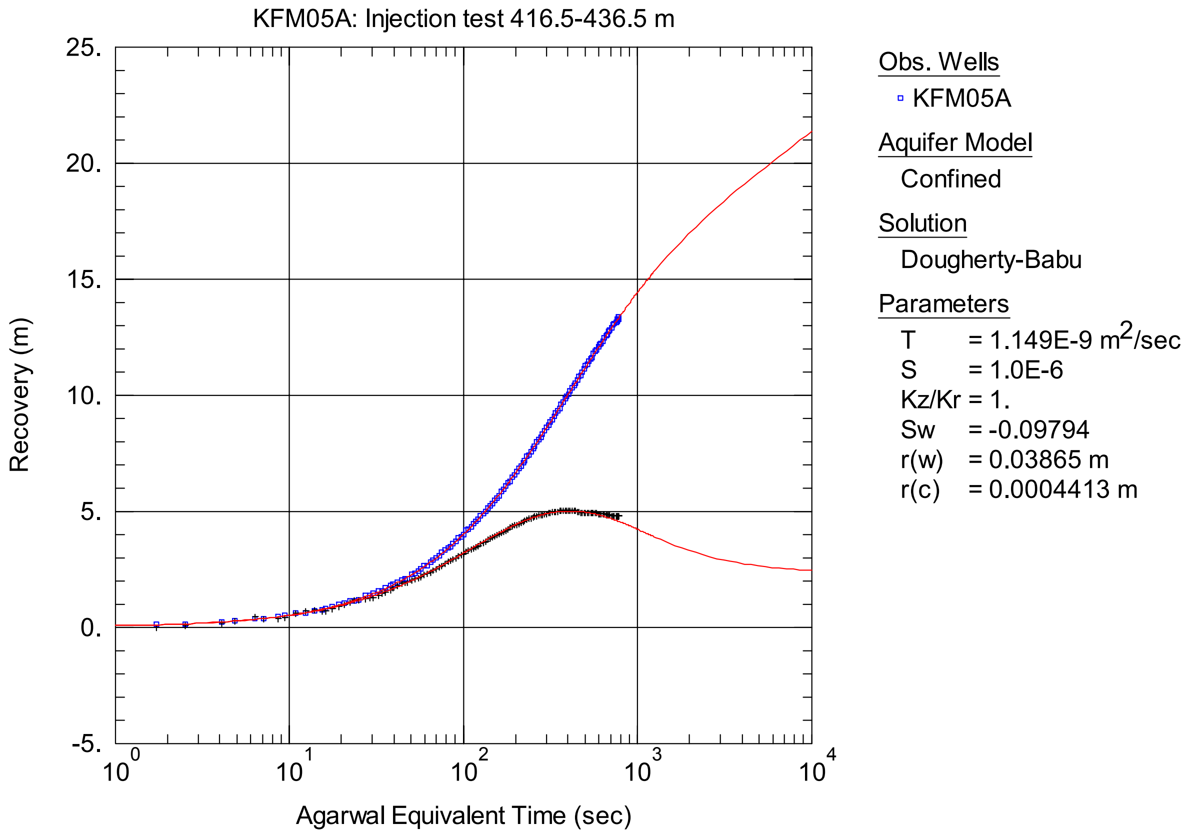


Figure A3-85. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-436.5 m in KFM05A.*

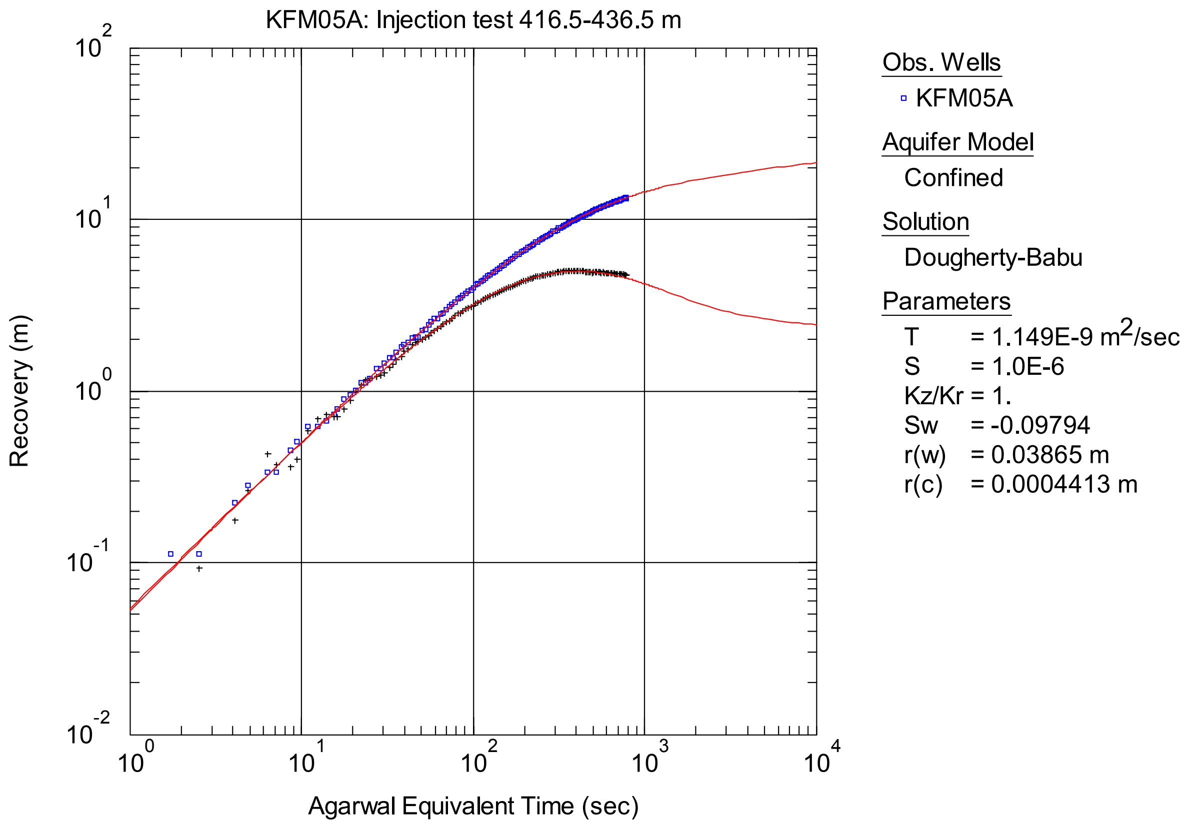


Figure A3-86. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-436.5 m in KFM05A.*

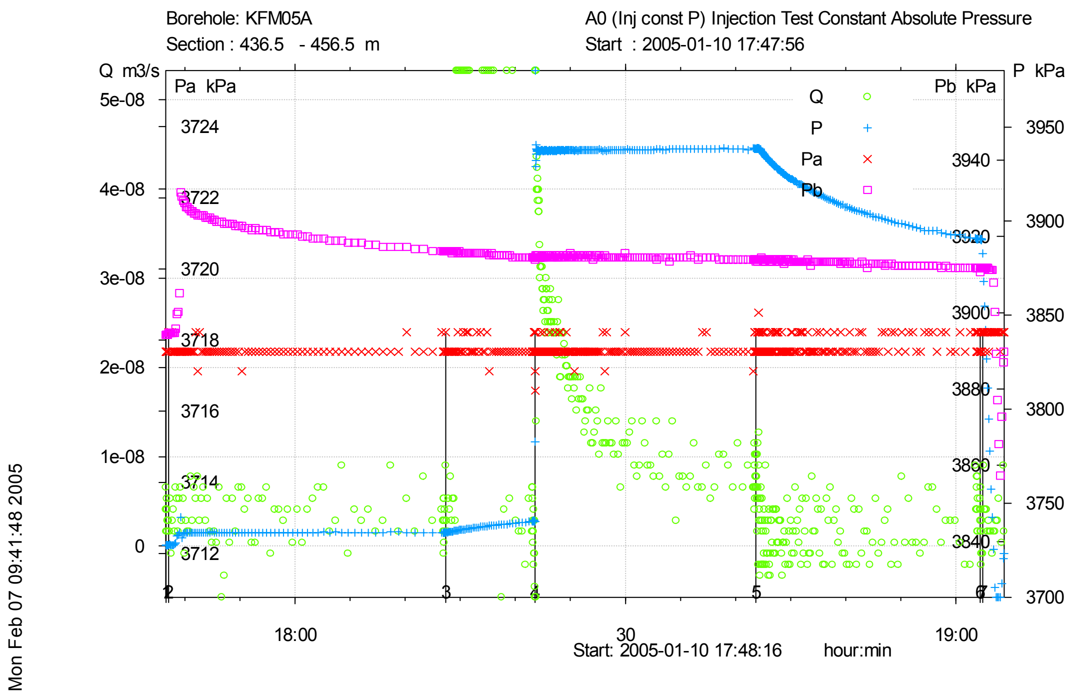


Figure A3-87. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 436.5-456.5 m in borehole KFM05A.*

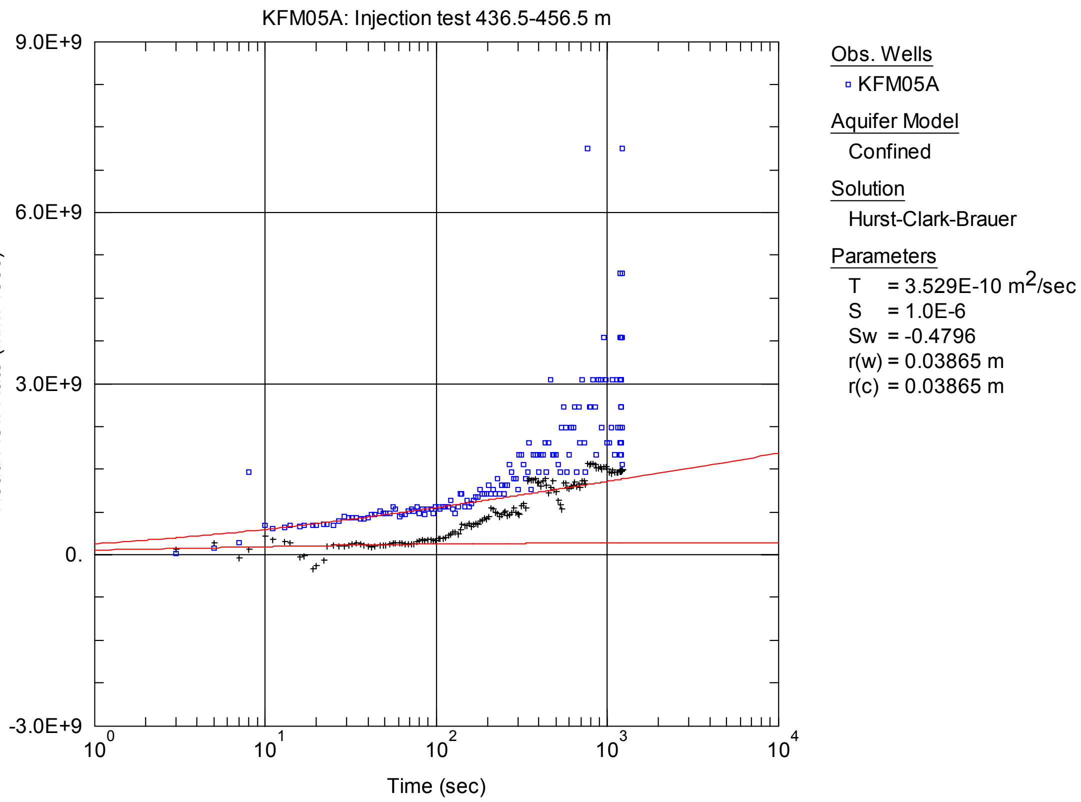


Figure A3-88. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 436.5-456.5 m in KFM05A.*

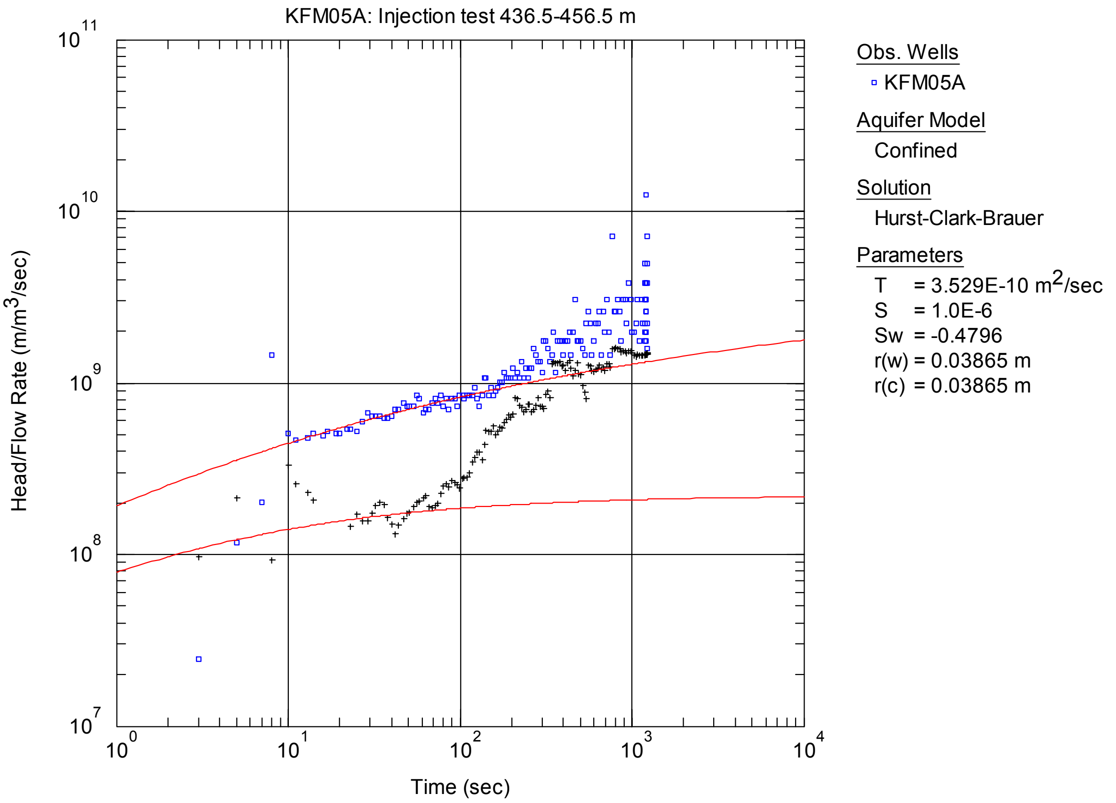


Figure A3-89. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 436.5-456.5 m in KFM05A.*

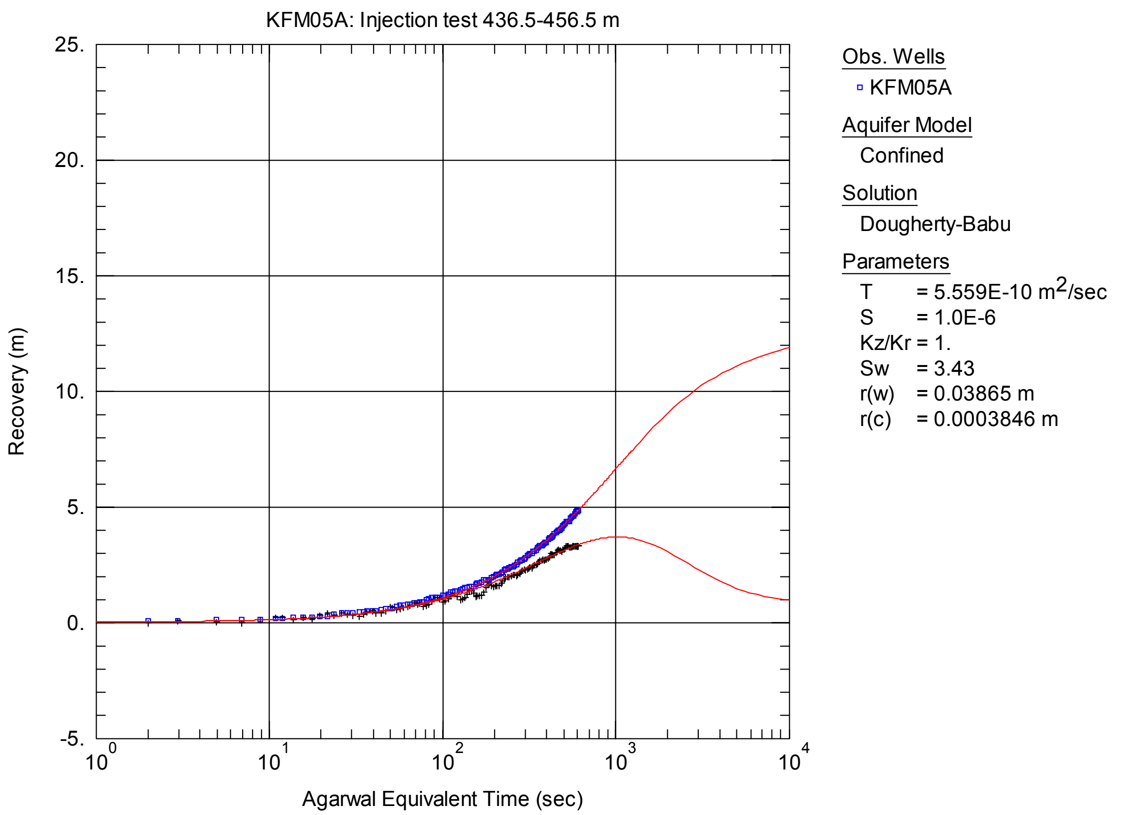


Figure A3-90. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 436.5-456.5 m in KFM05A.*

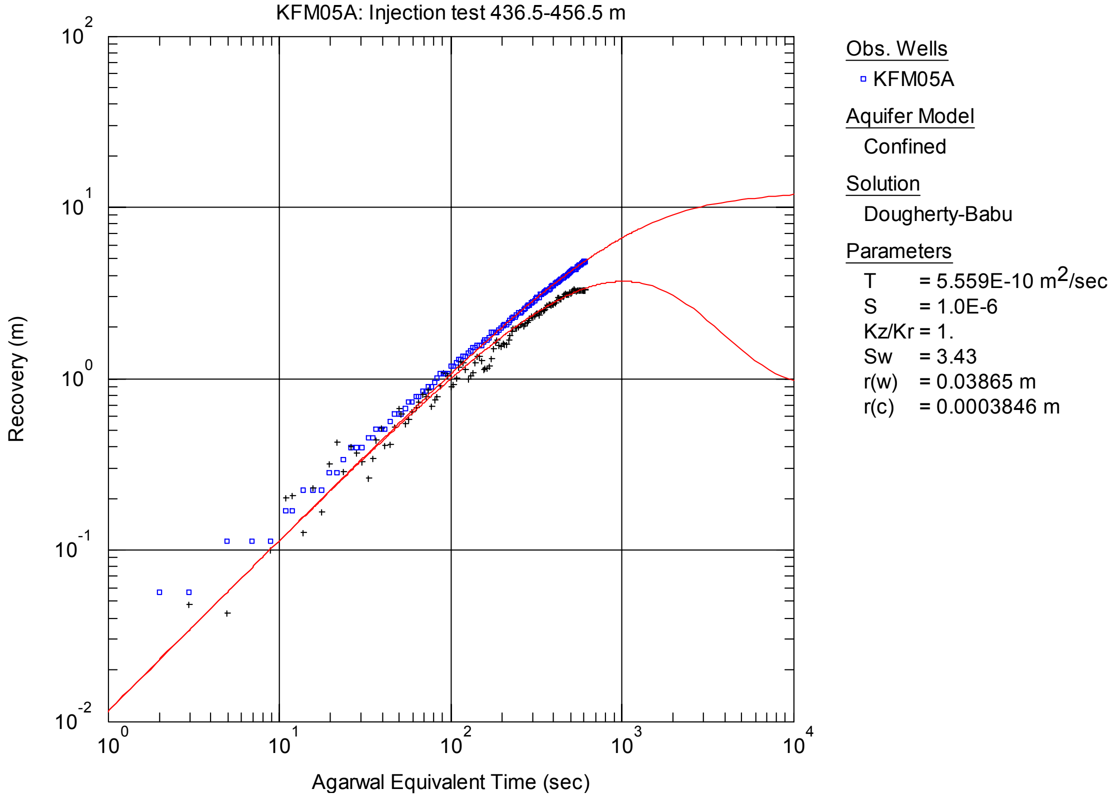


Figure A3-91. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 436.5-456.5 m in KFM05A.*

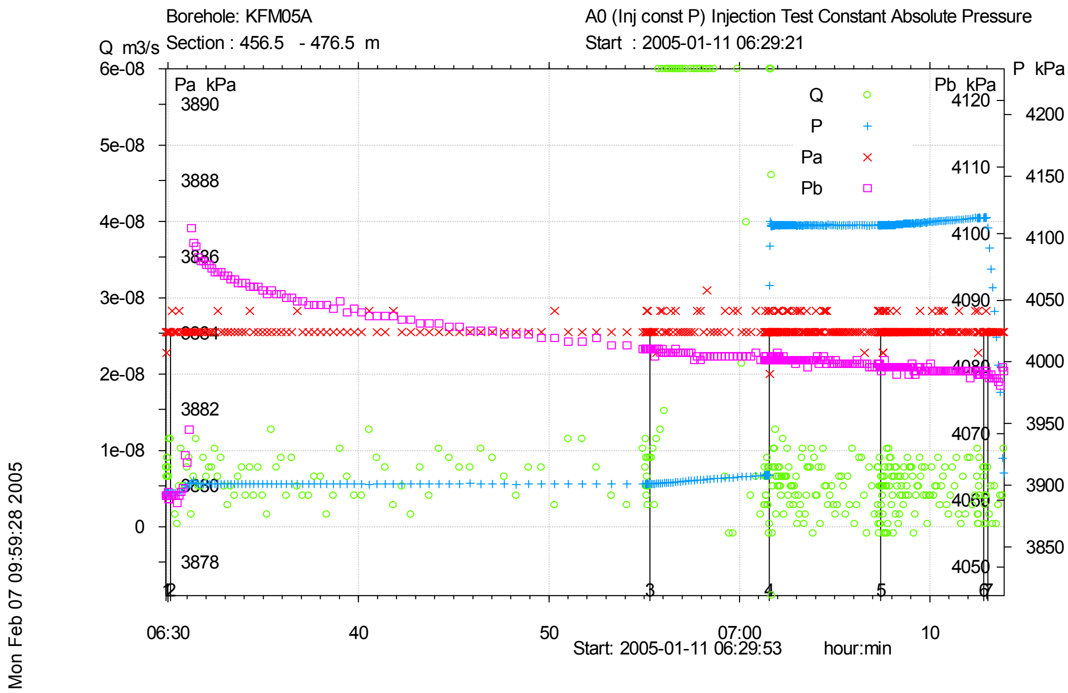


Figure A3-92. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 456.5-476.5 m in borehole KFM05A.*

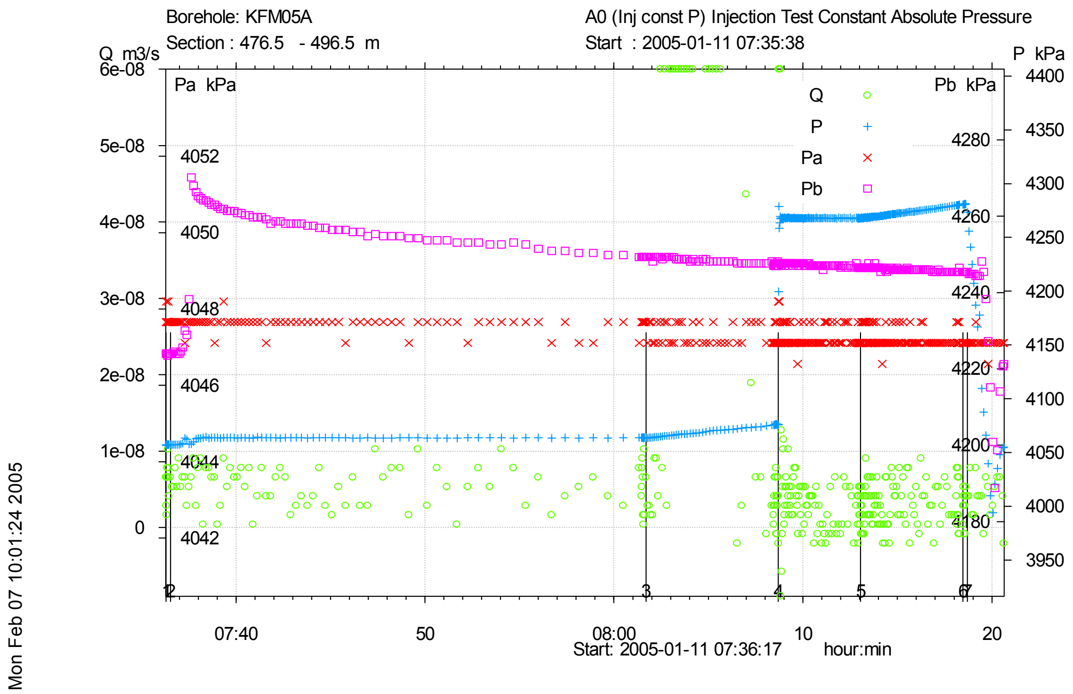


Figure A3-93. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 476.5-496.5 m in borehole KFM05A.*

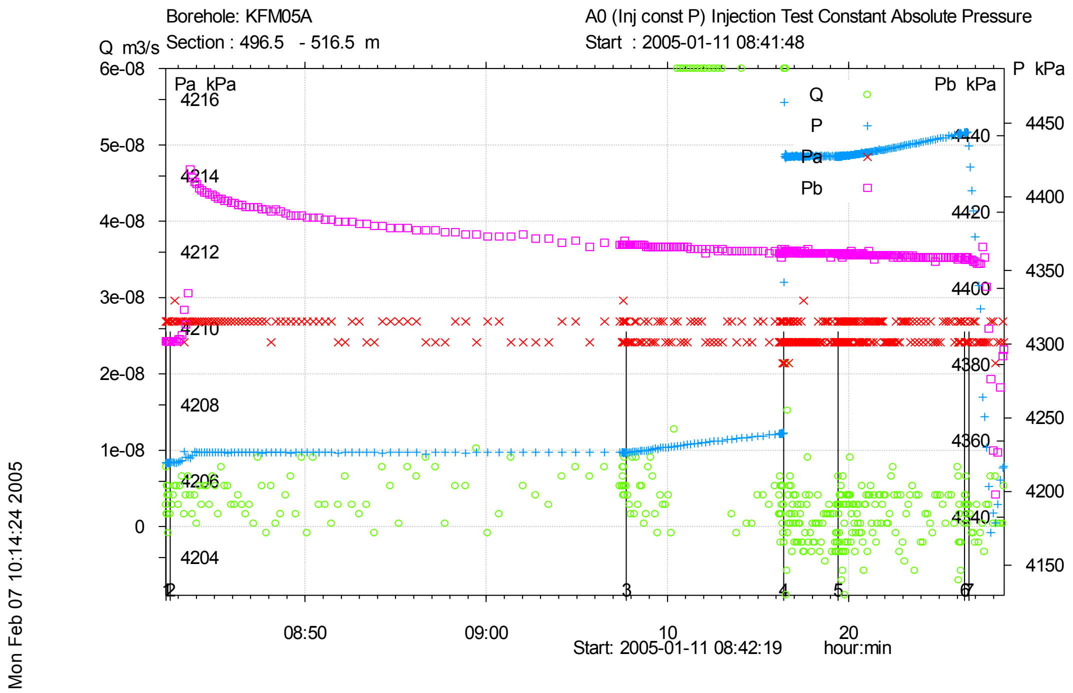


Figure A3-94. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 496.5-516.5 m in borehole KFM05A.*

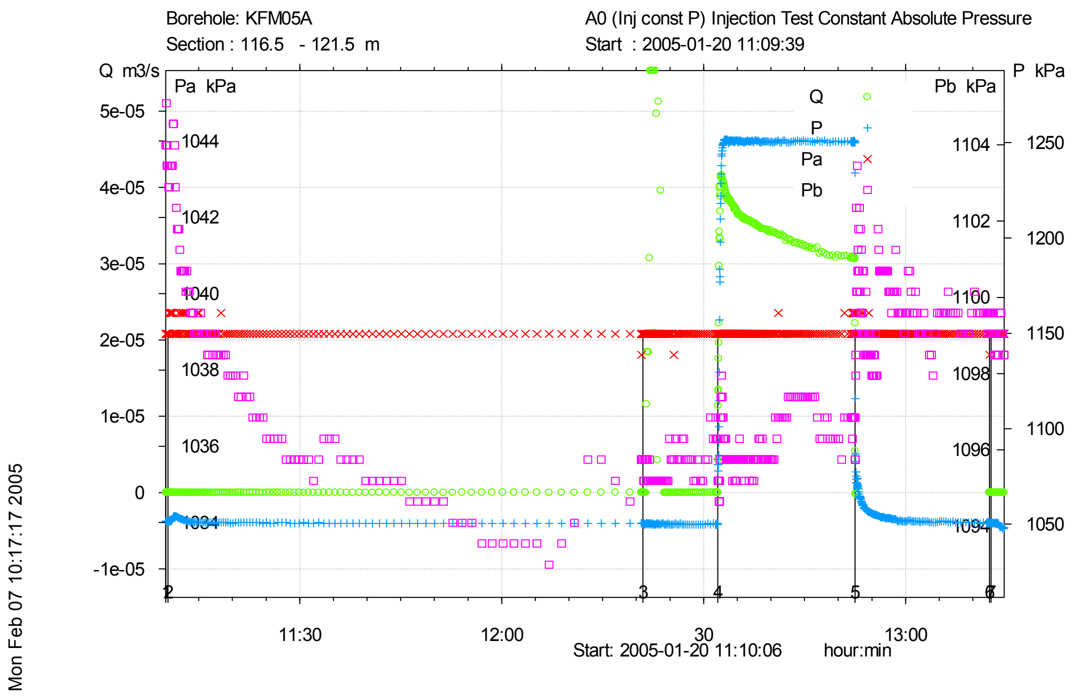


__Figure A3-95.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 116.5-121.5 m in borehole KFM05A.

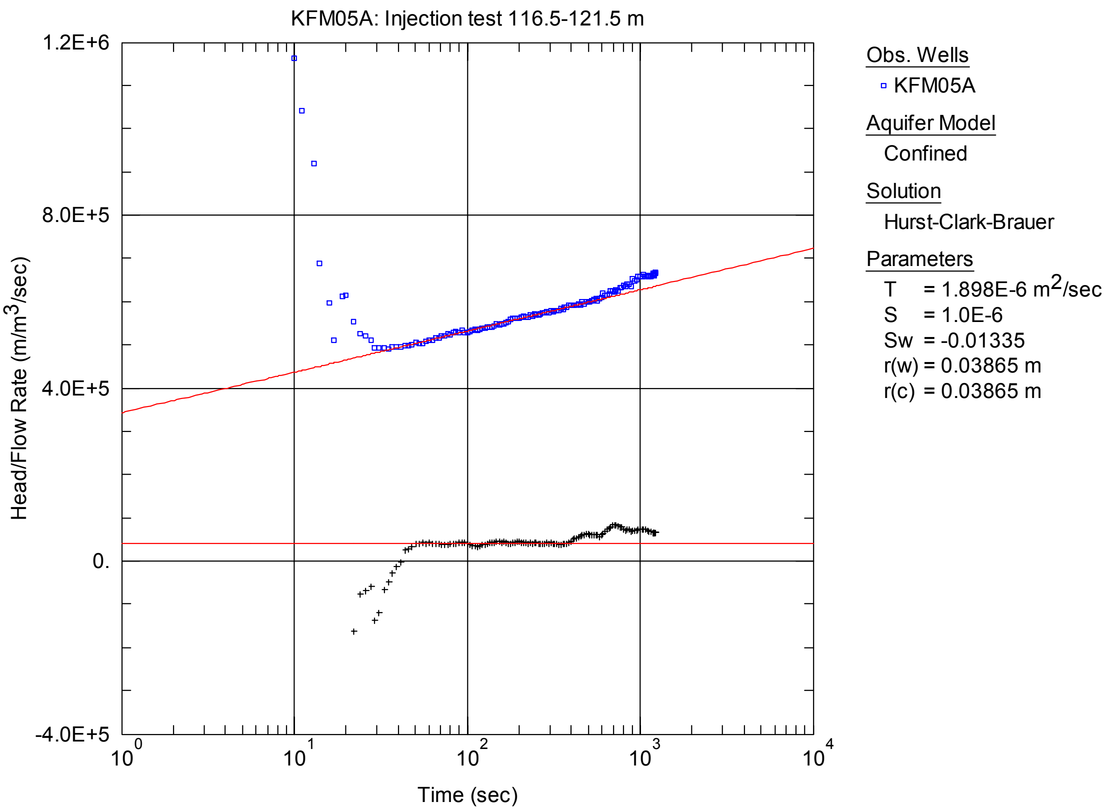


__Figure A3-96.__ Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-121.5 m in KFM05A.

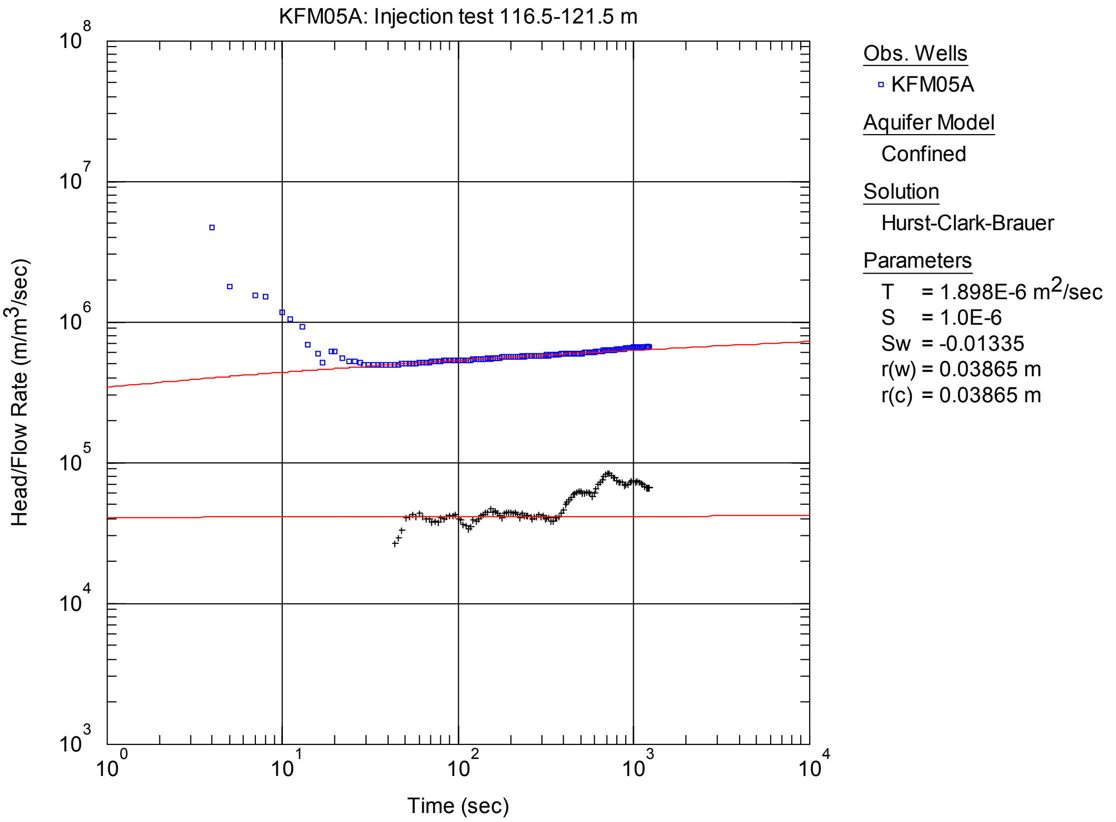


Figure A3-97. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 116.5-121.5 m in KFM05A.*

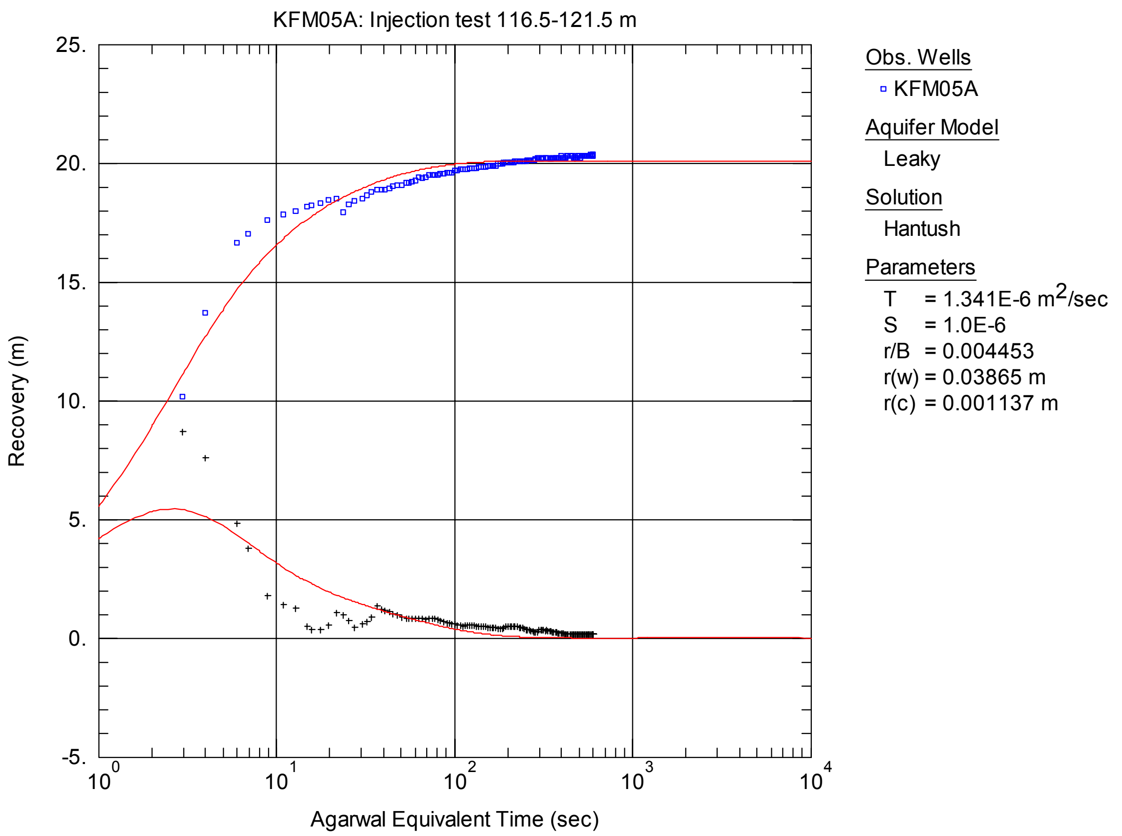


Figure A3-98. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-121.5 m in KFM05A.*

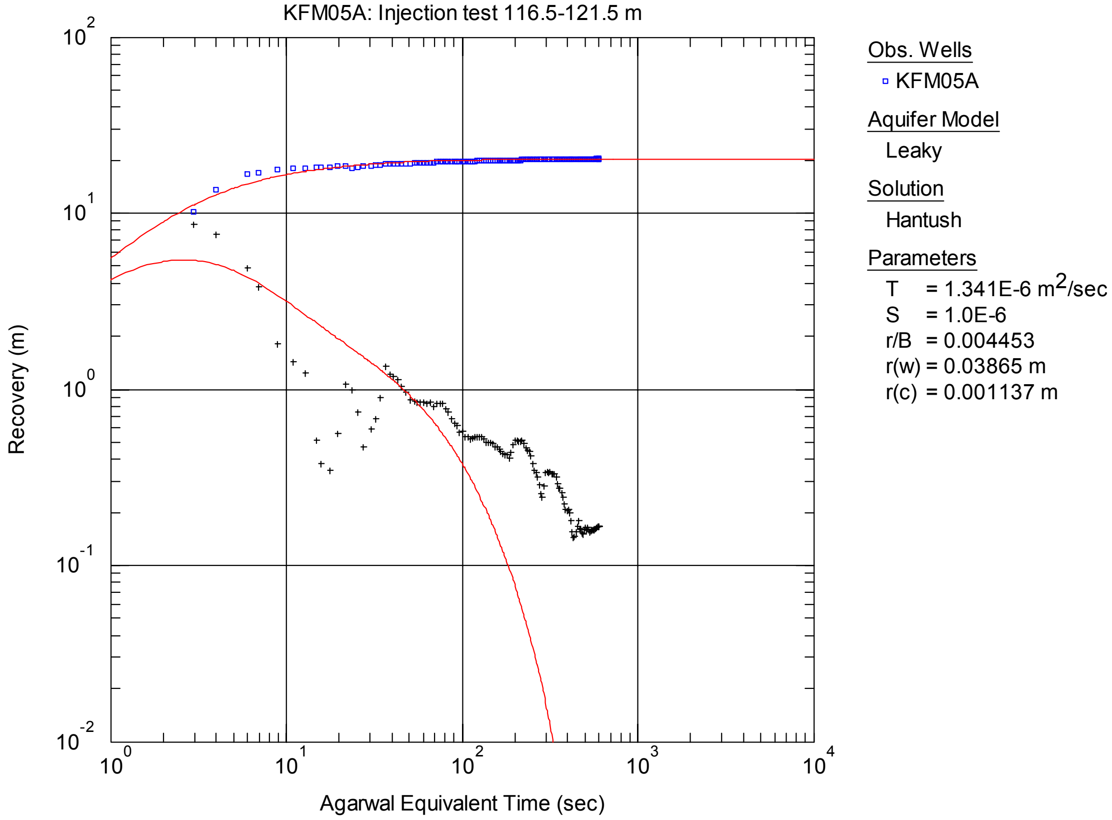


Figure A3-99. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 116.5-121.5 m in KFM05A.*

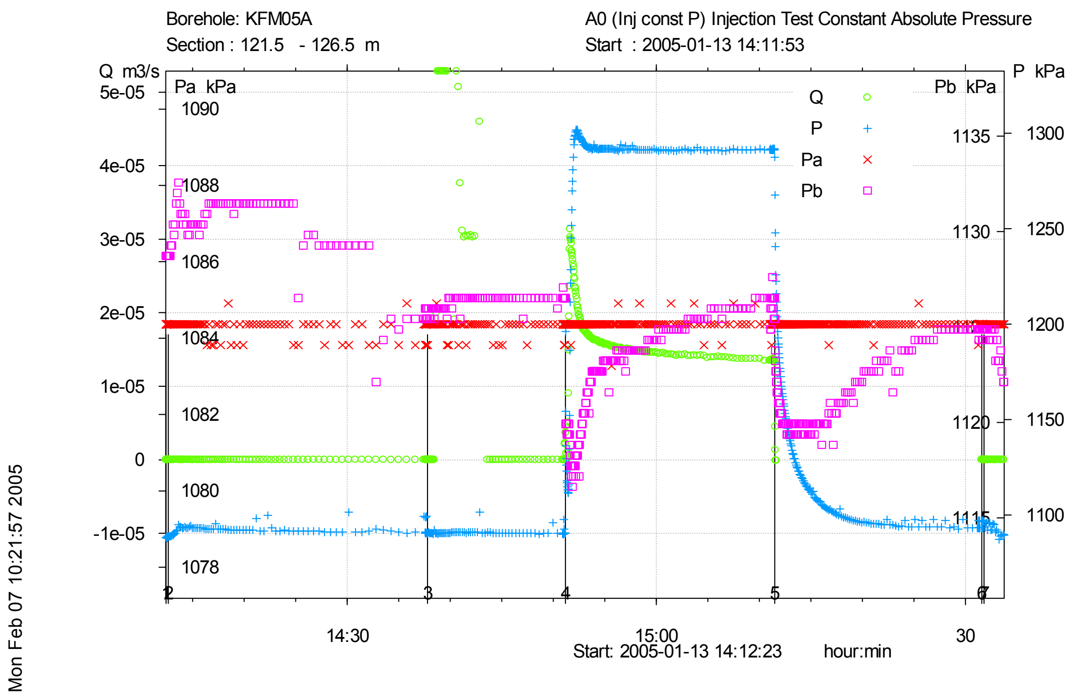


Figure A3-100. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 121.5-126.5 m in borehole KFM05A.*

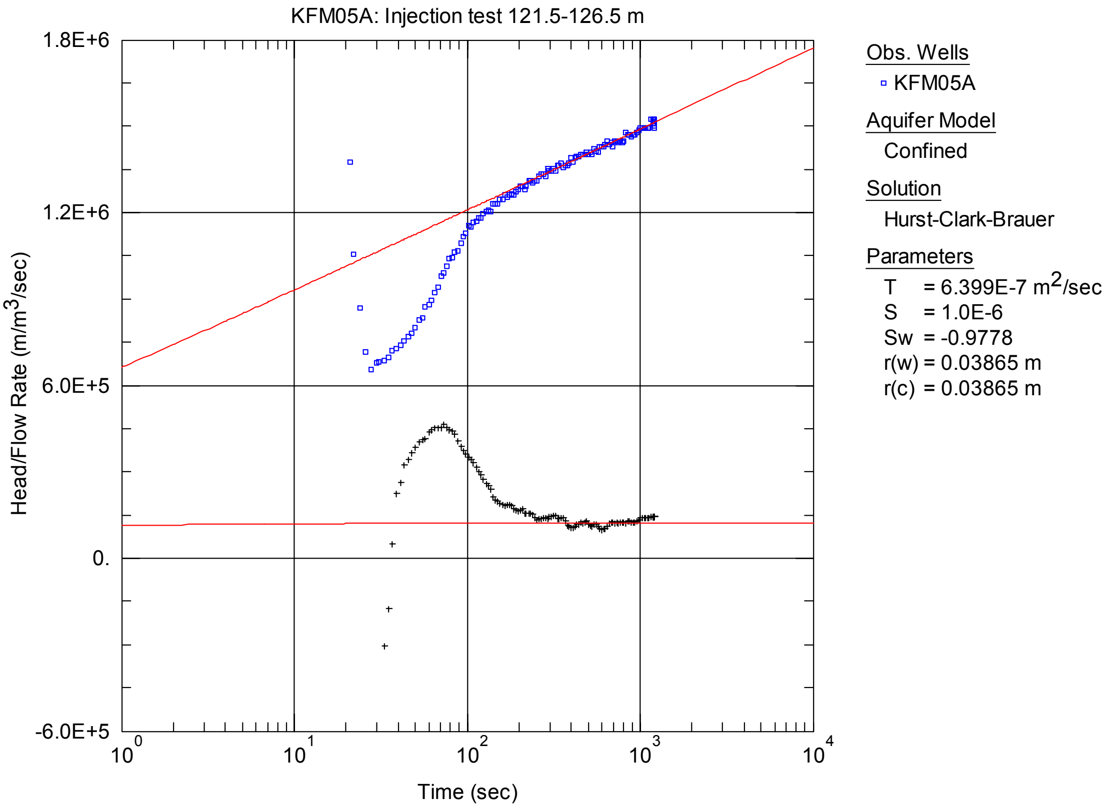


Figure A3-101. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 121.5-126.5 m in KFM05A.*

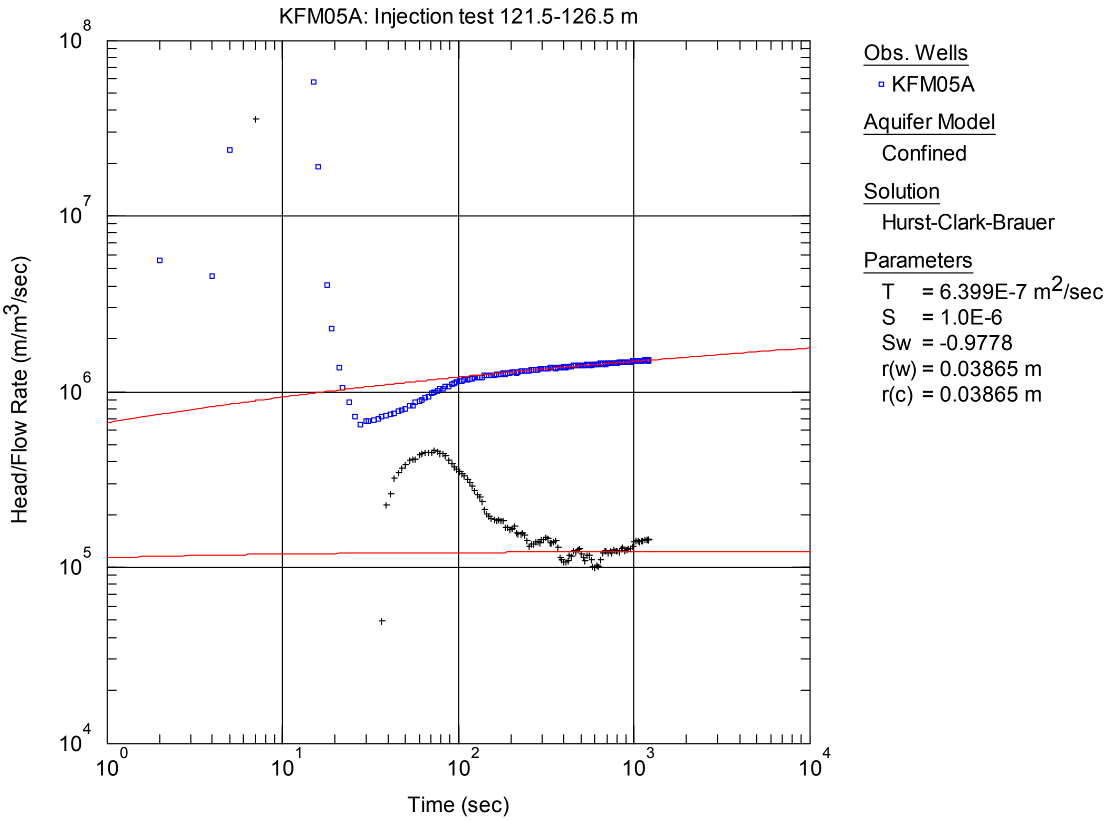


Figure A3-102. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 121.5-126.5 m in KFM05A.*

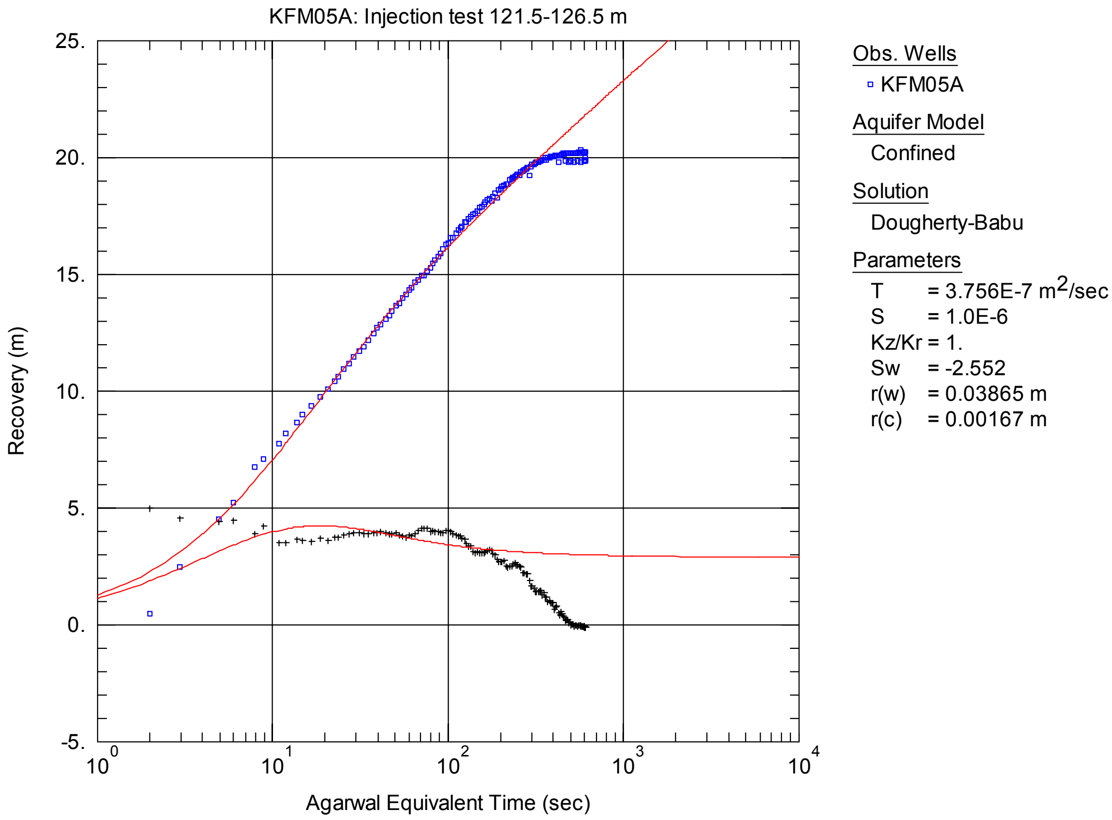


Figure A3-103. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 121.5-126.5 m in KFM05A.*

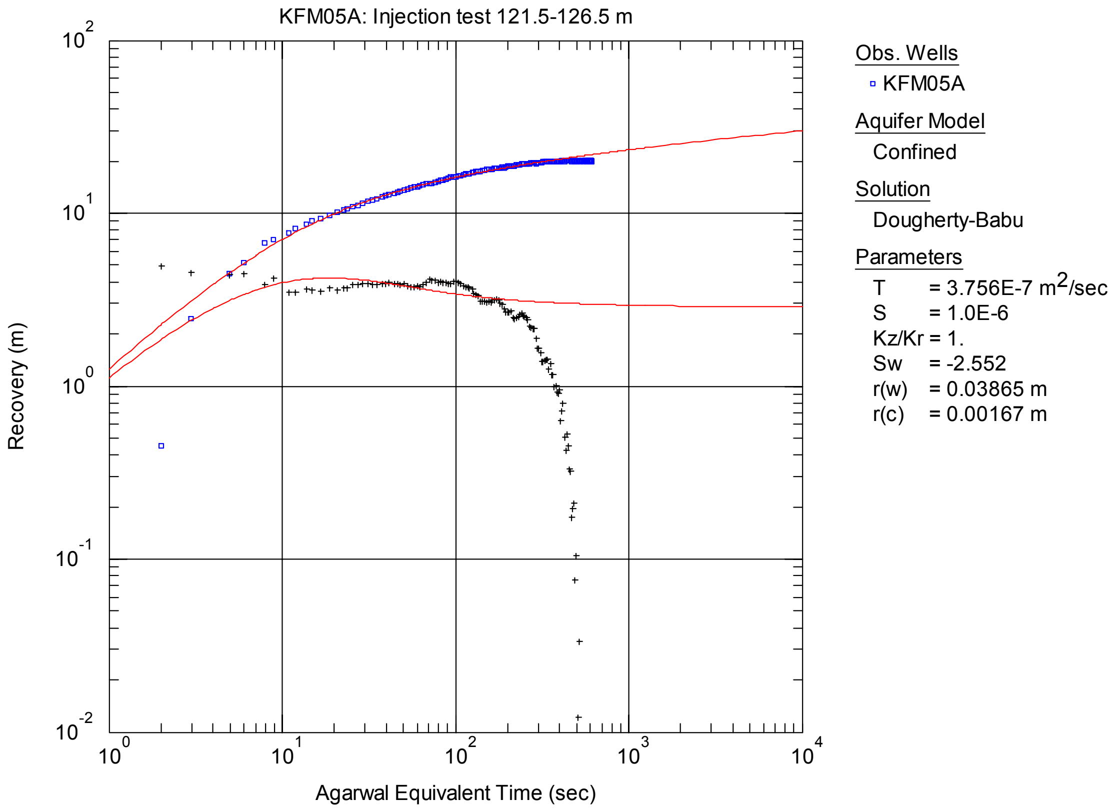


Figure A3-104. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 121.5-126.5 m in KFM05A.*

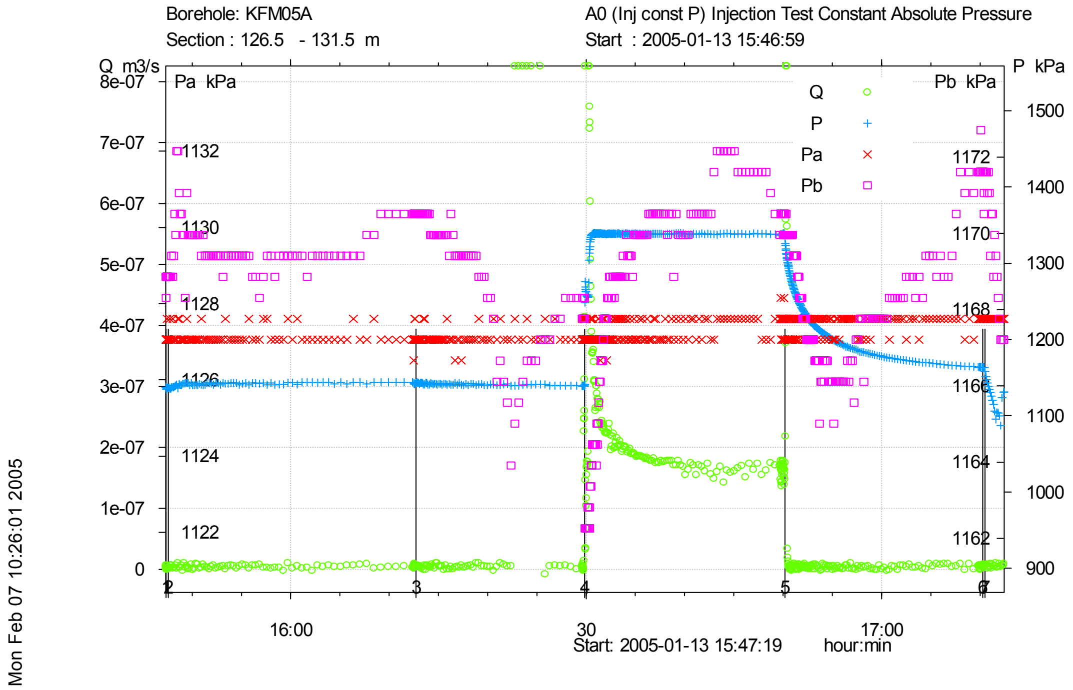


Figure A3-105. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 126.5-131.5 m in borehole KFM05A.*

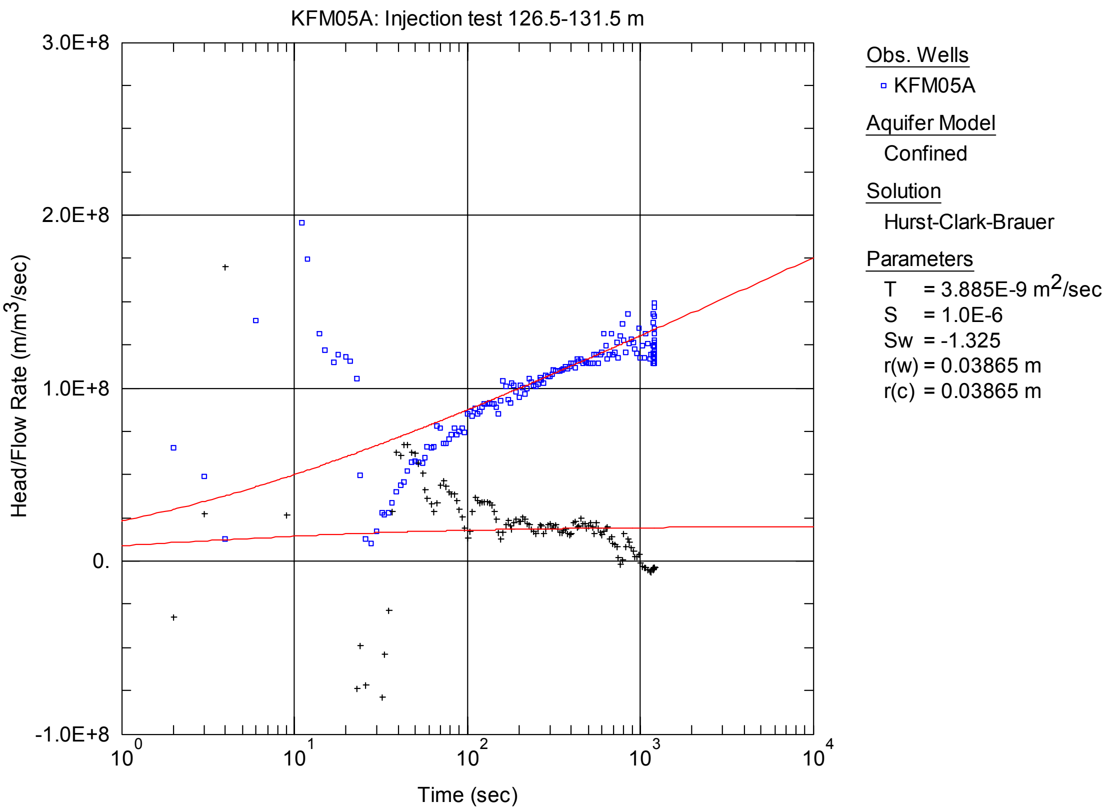


Figure A3-106. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 126.5-131.5 m in KFM05A.*

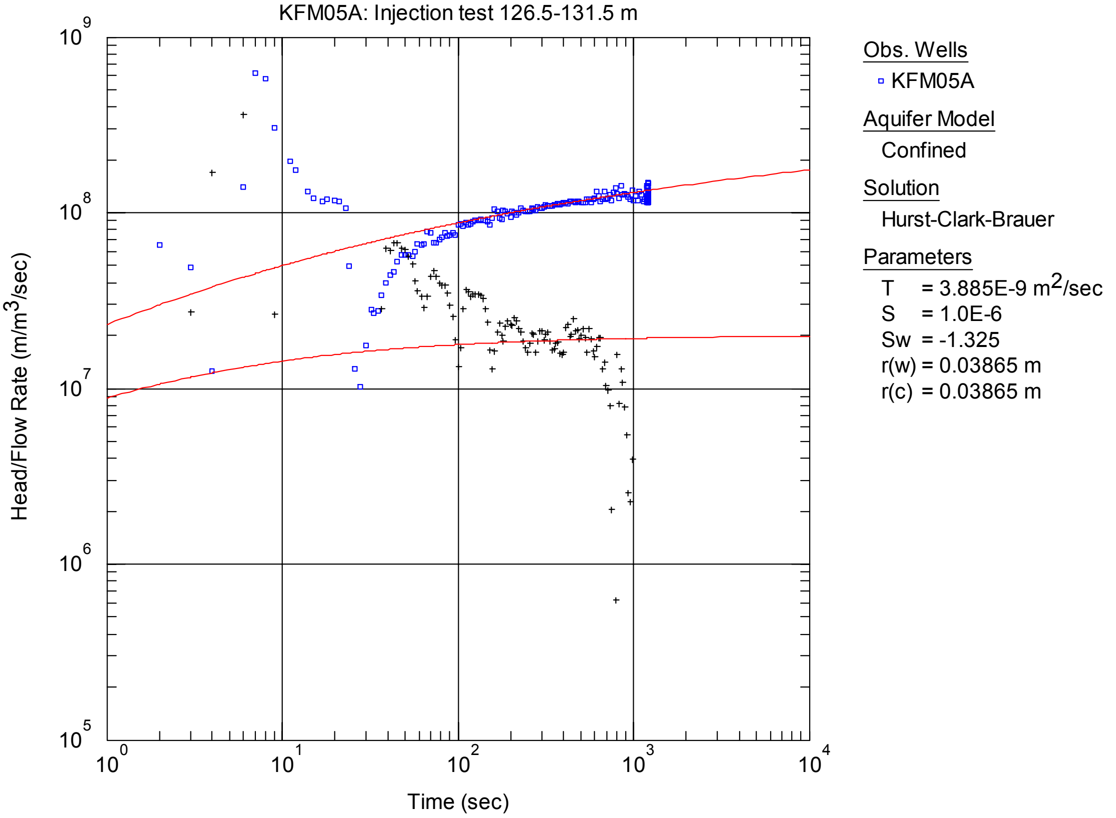


***Figure A3-107.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 126.5-131.5 m in KFM05A.*

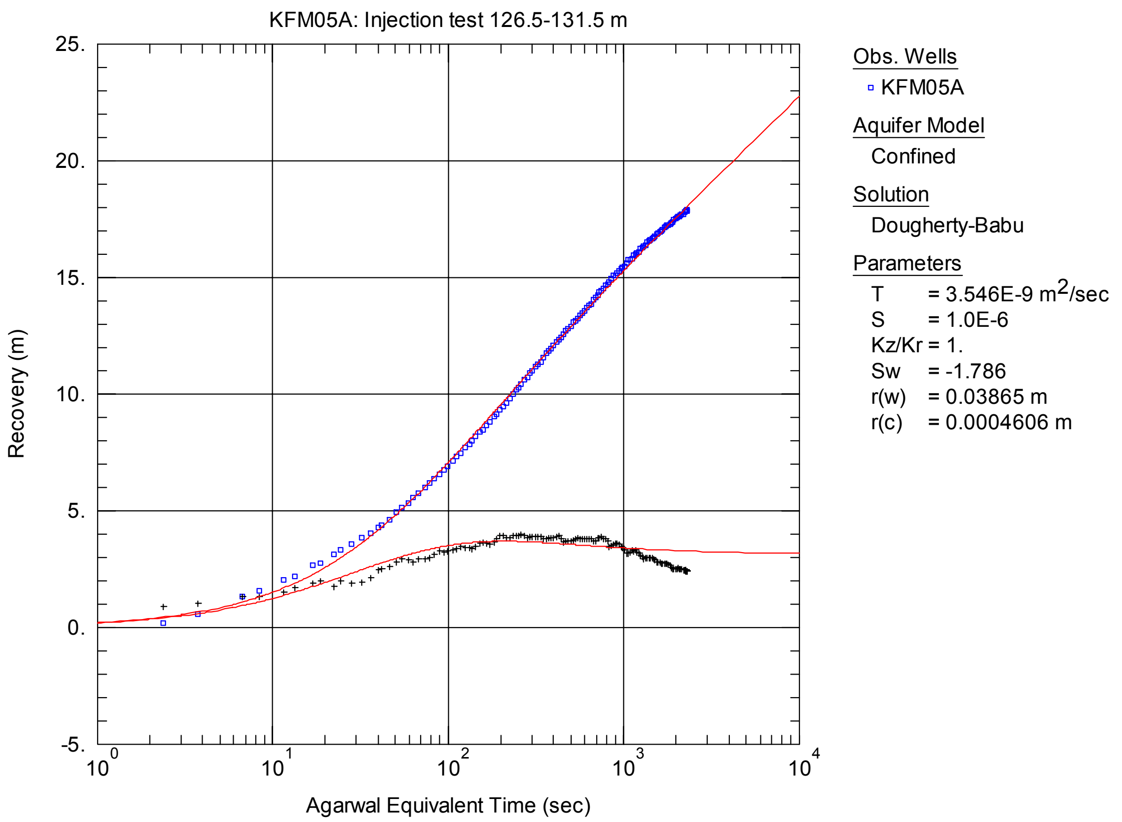


***Figure A3-108.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 126.5-131.5 m in KFM05A.*

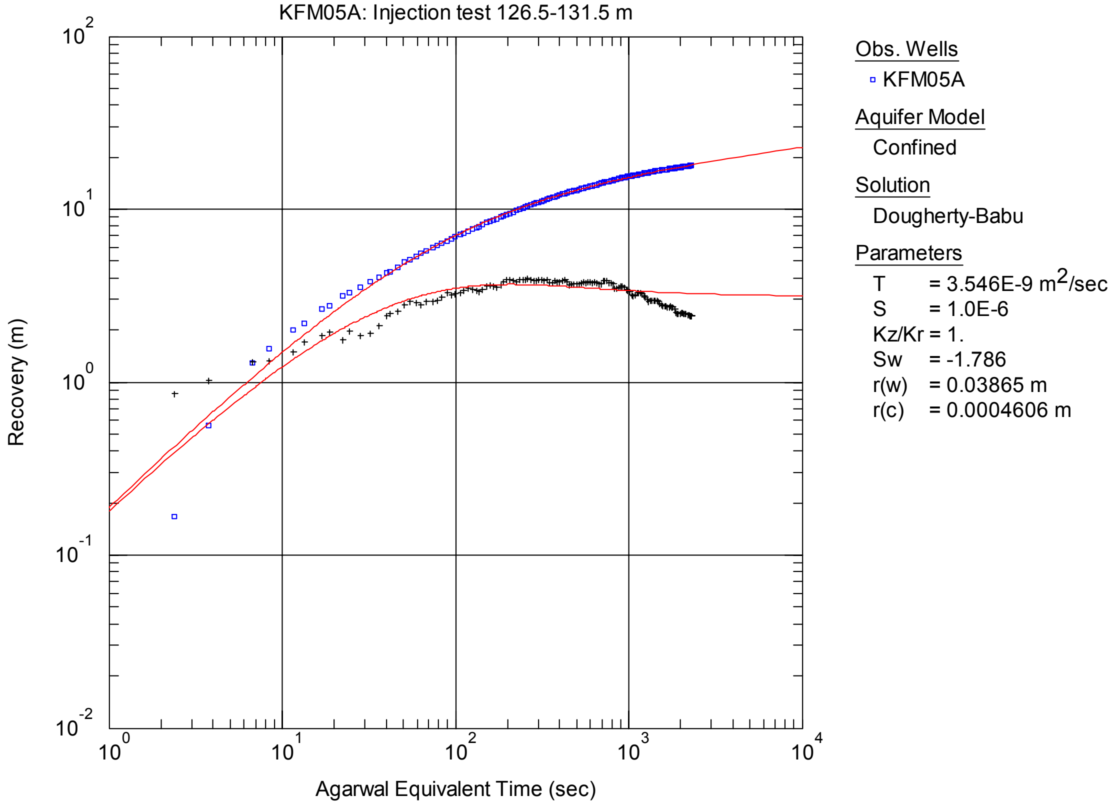


Figure A3-109. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 126.5-131.5 m in KFM05A.*

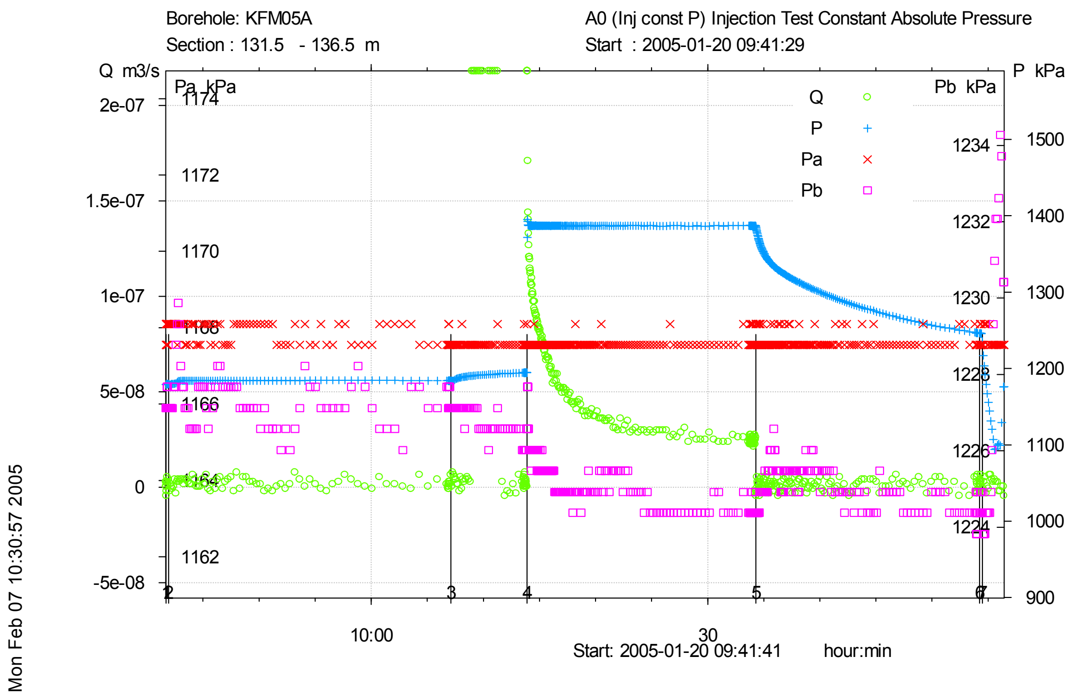


Figure A3-110. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 131.5-136.5 m in borehole KFM05A.*

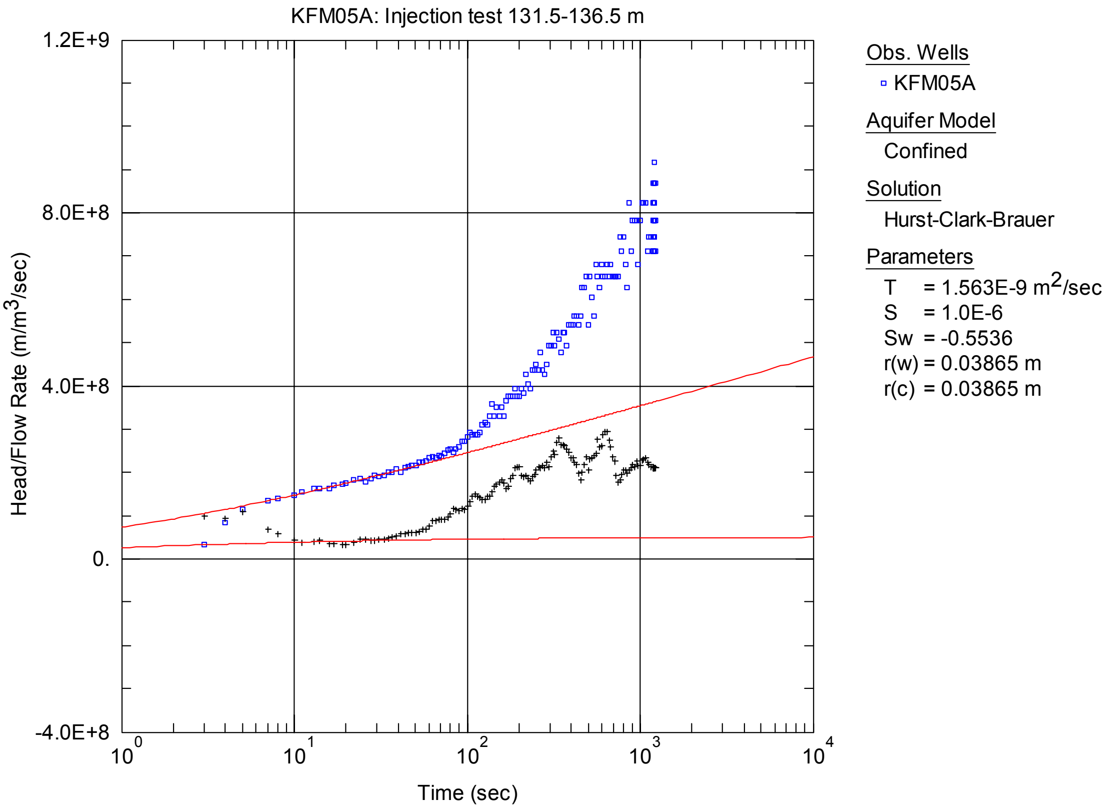


Figure A3-111. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 131.5-136.5 m in KFM05A.*

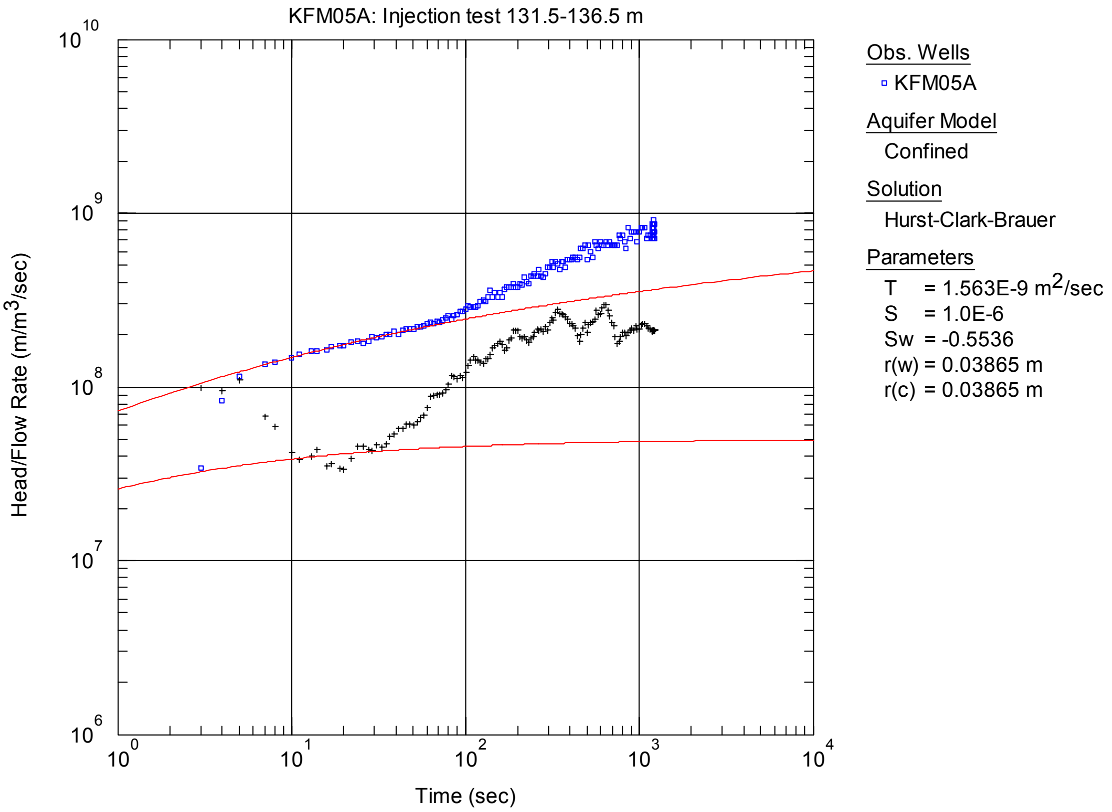


Figure A3-112. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 131.5-136.5 m in KFM05A.*

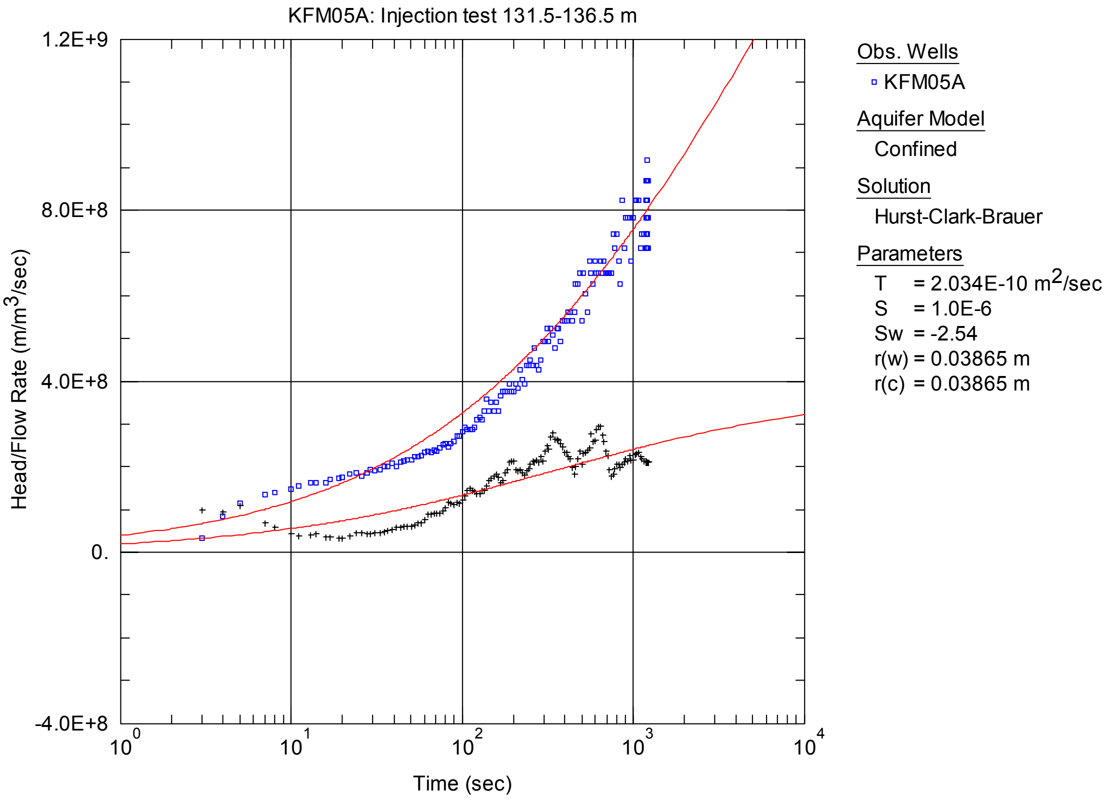


Figure A3-113. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to an assumed second PRF not chosen as representative, from the injection test in section 131.5-136.5 m in KFM05A.*

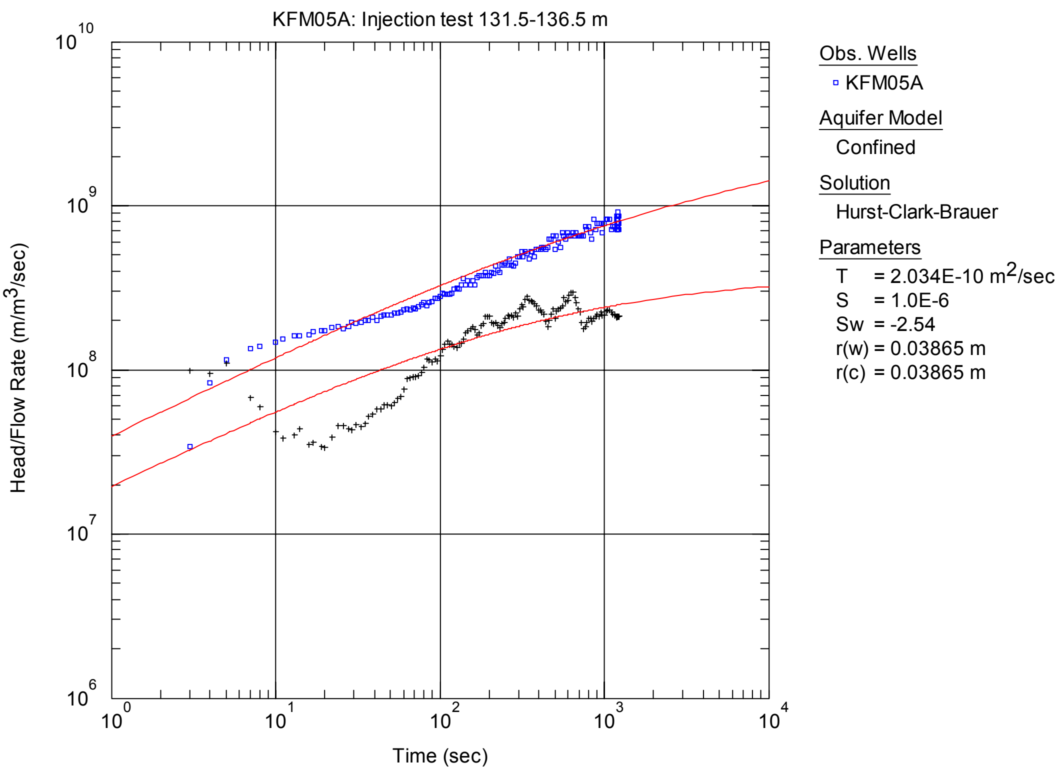


Figure A3-114. *Log-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to an assumed second PRF not chosen as representative, from the injection test in section 131.5-136.5 m in KFM05A.*

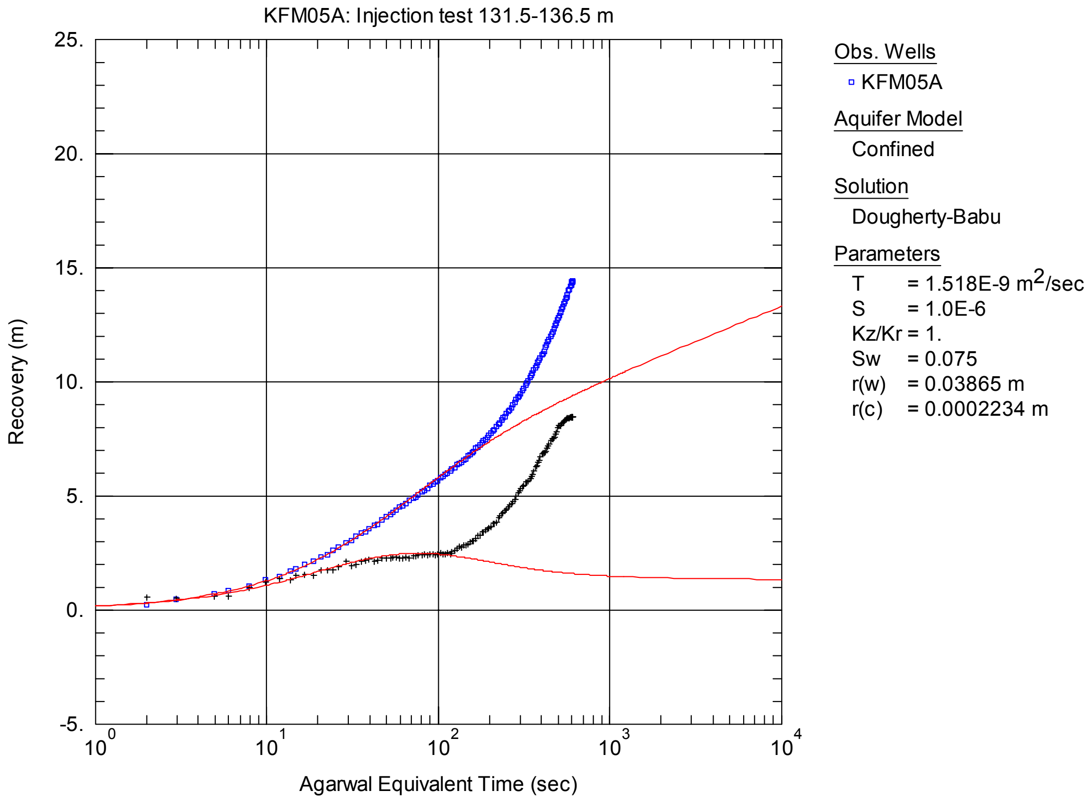


Figure A3-115. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 131.5-136.5 m in KFM05A.*

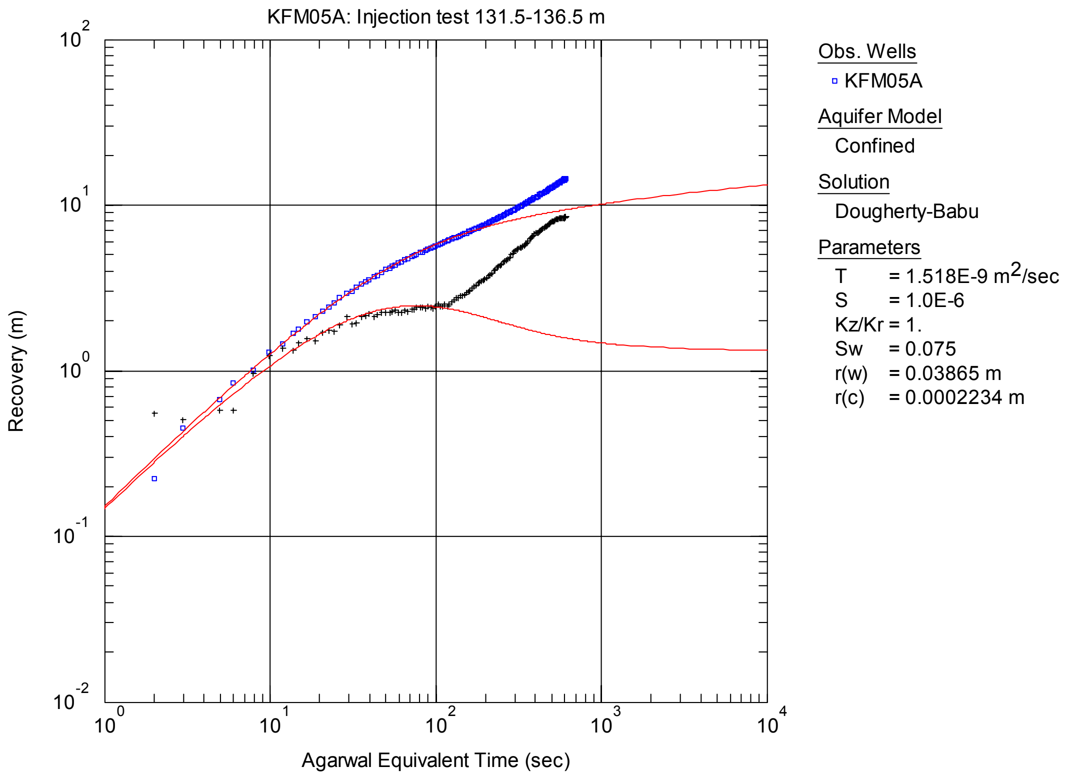


Figure A3-116. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 131.5-136.5 m in KFM05.*

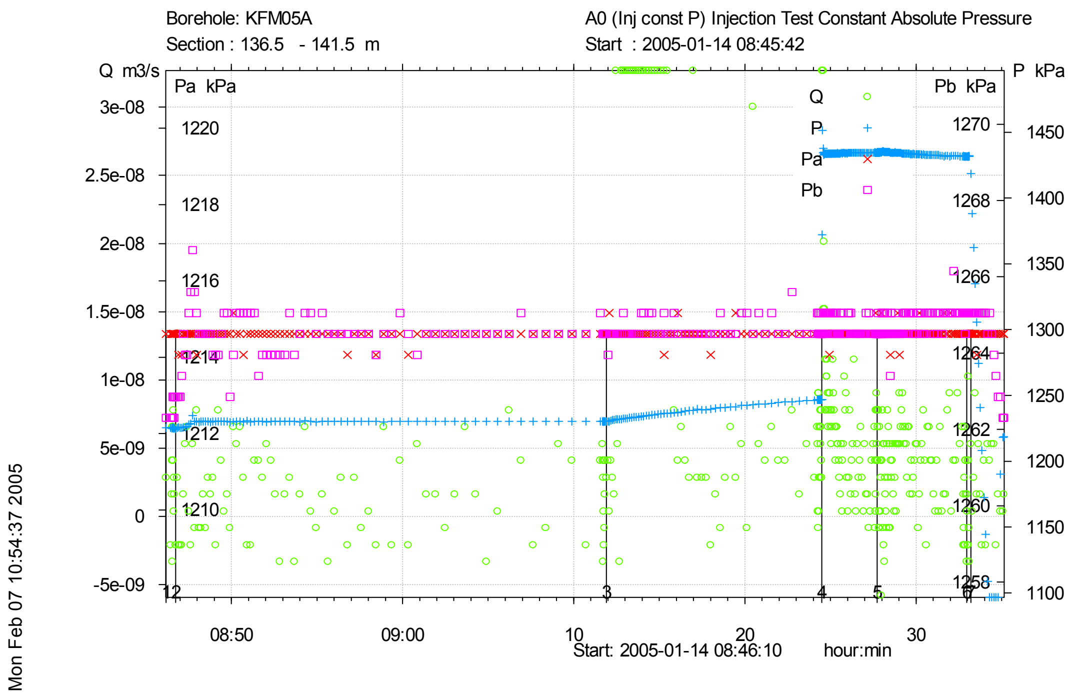


***Figure A3-117.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 136.5-141.5 m in borehole KFM05A.*

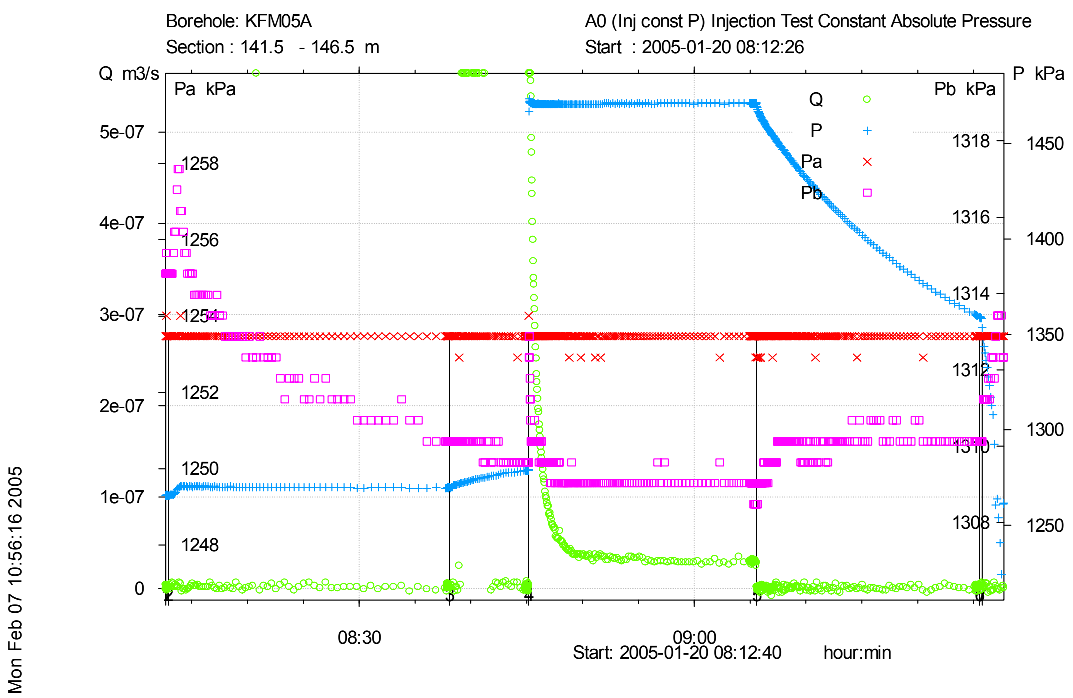


***Figure A3-118.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 141.5-146.5 m in borehole KFM05A.*

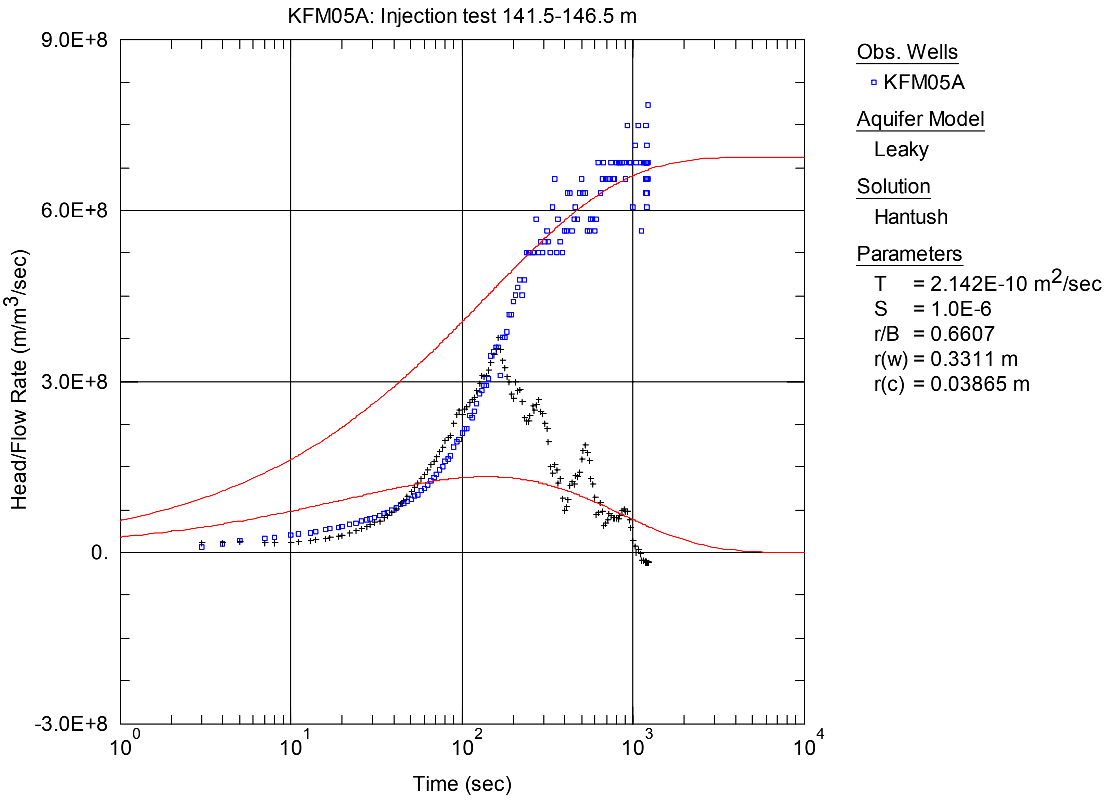


Figure A3-119. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 141.5-146.5 m in KFM05A.*

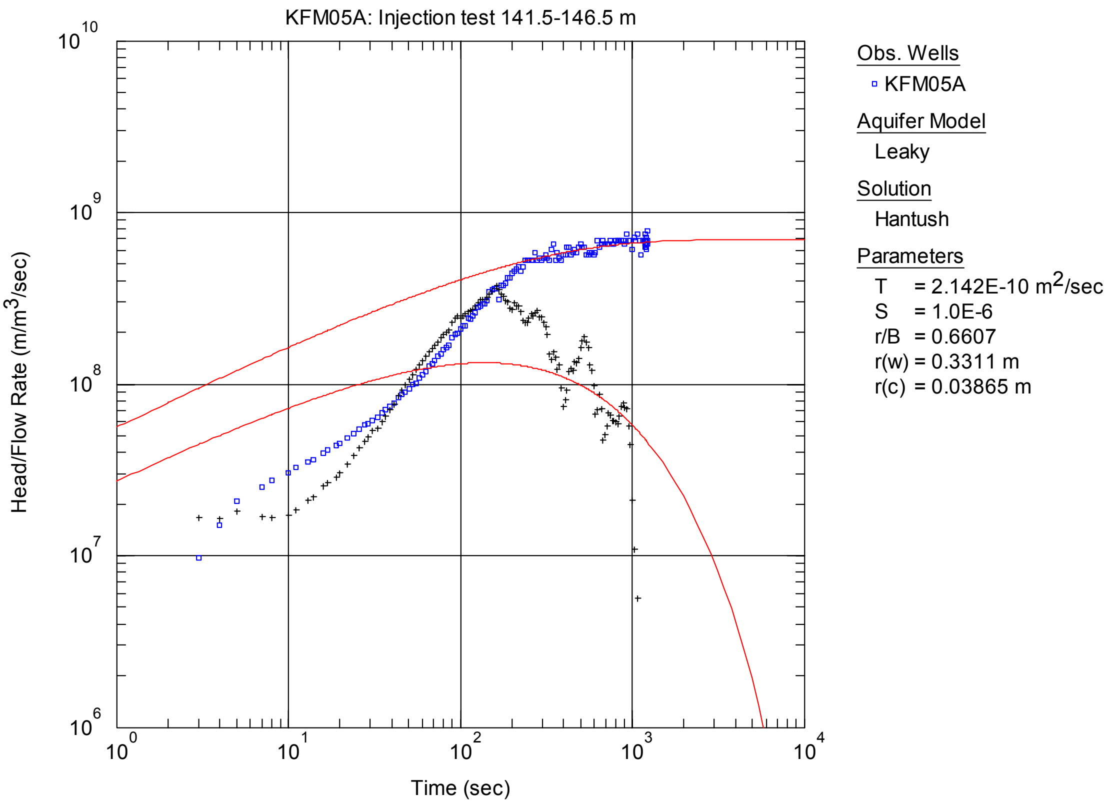


Figure A3-120. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 141.5-146.5 m in KFM05A.*

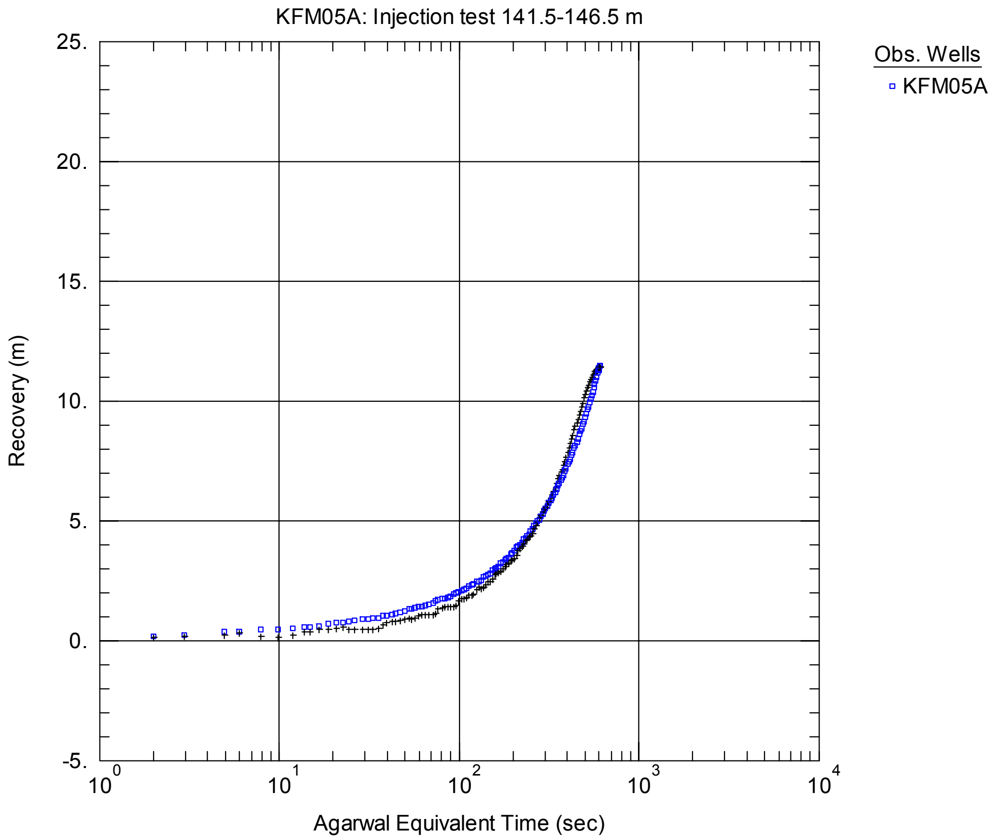


Figure A3-121. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 141.5-146.5 m in KFM05A.*

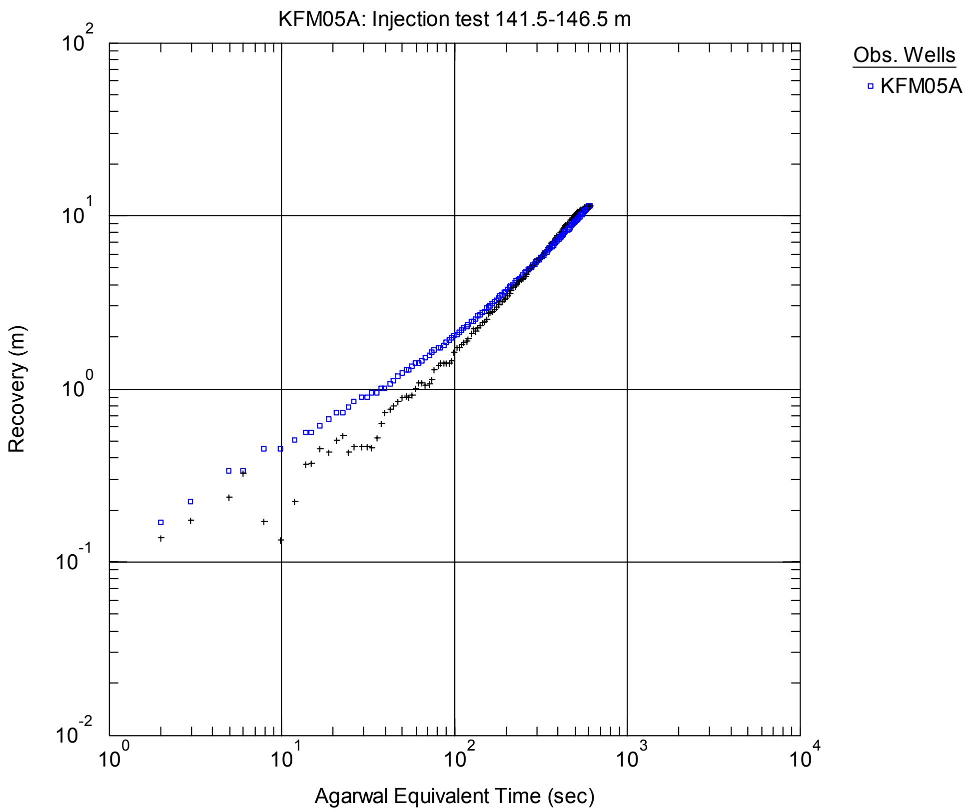


Figure A3-122. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 141.5-146.5 m in KFM05A.*

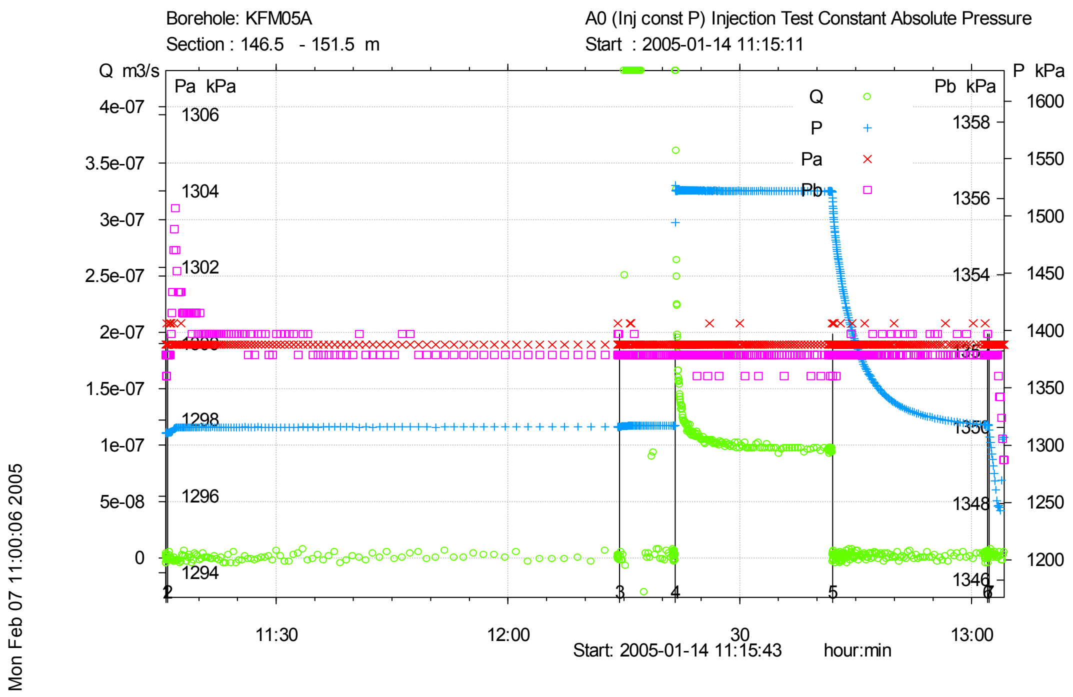


Figure A3-123. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 146.5-151.5 m in borehole KFM05A.*

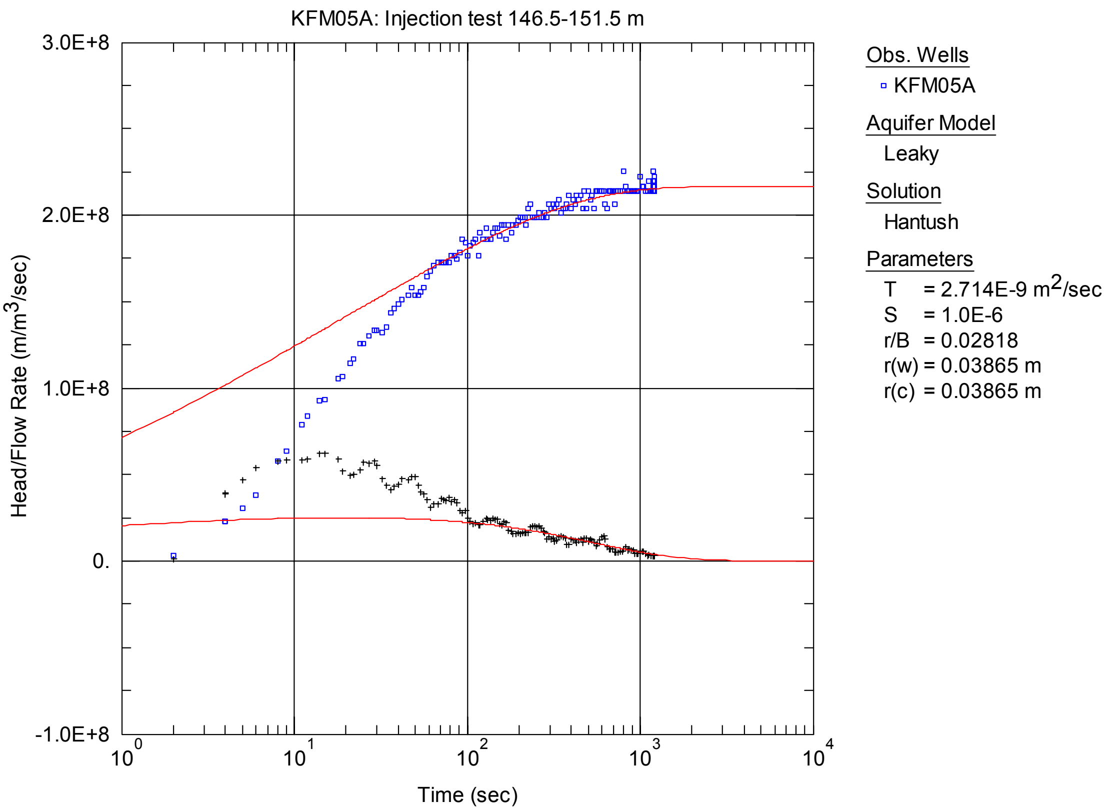


Figure A3-124. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 146.5-151.5 m in KFM05A.*

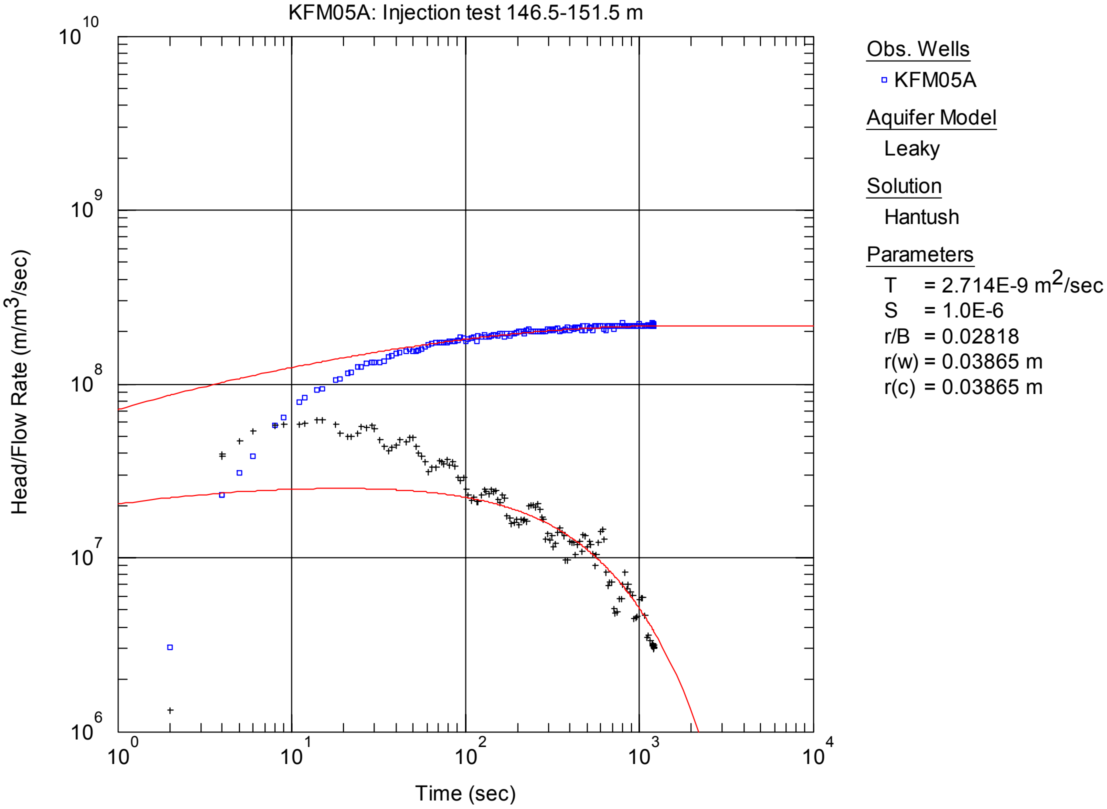


Figure A3-125. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 146.5-151.5 m in KFM05A.*

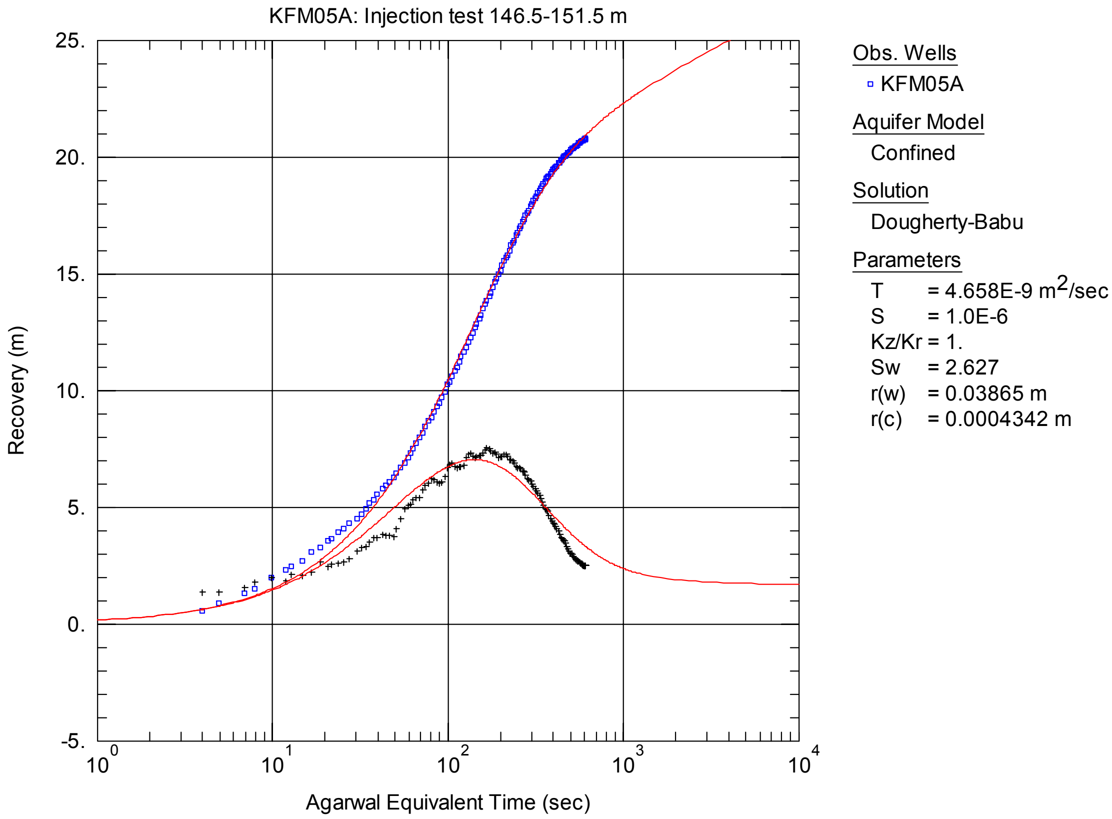


Figure A3-126. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 146.5-151.5 m in KFM05A.*

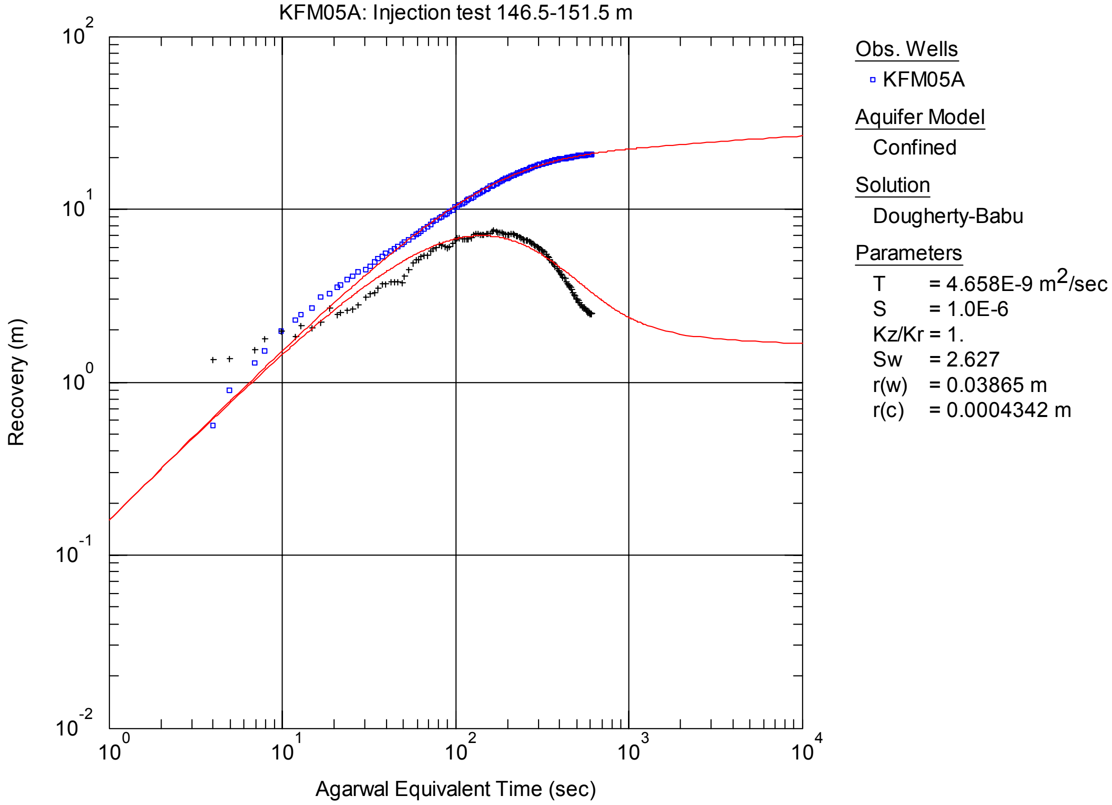


Figure A3-127. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 146.5-151.5 m in KFM05A.*

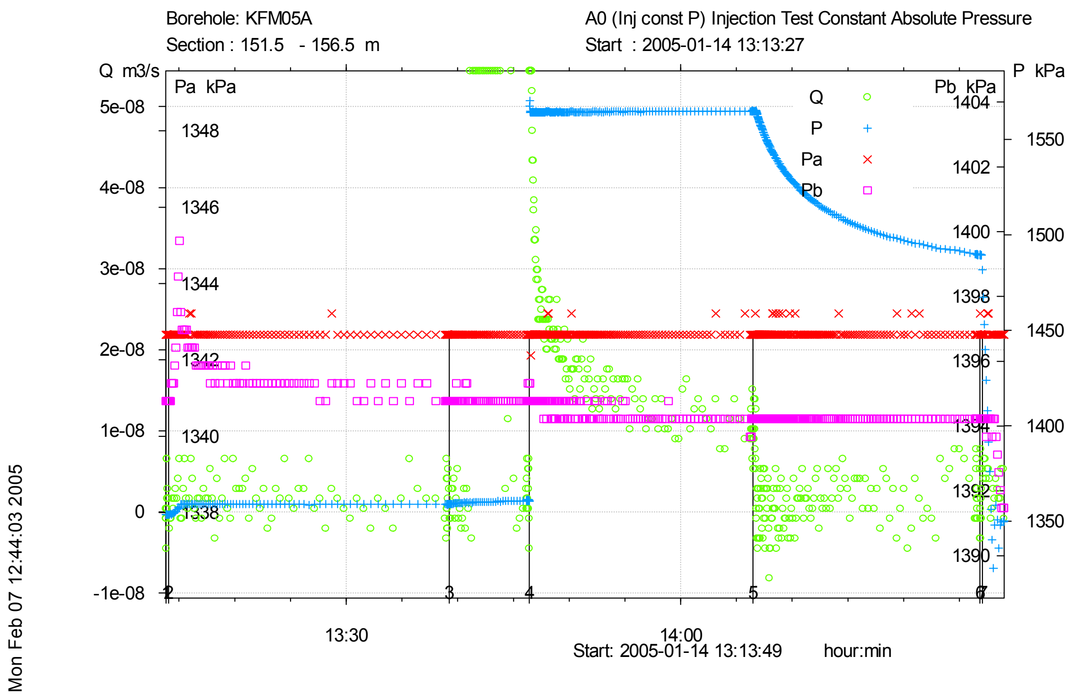


Figure A3-128. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 151.5-156.5 m in borehole KFM05A.*

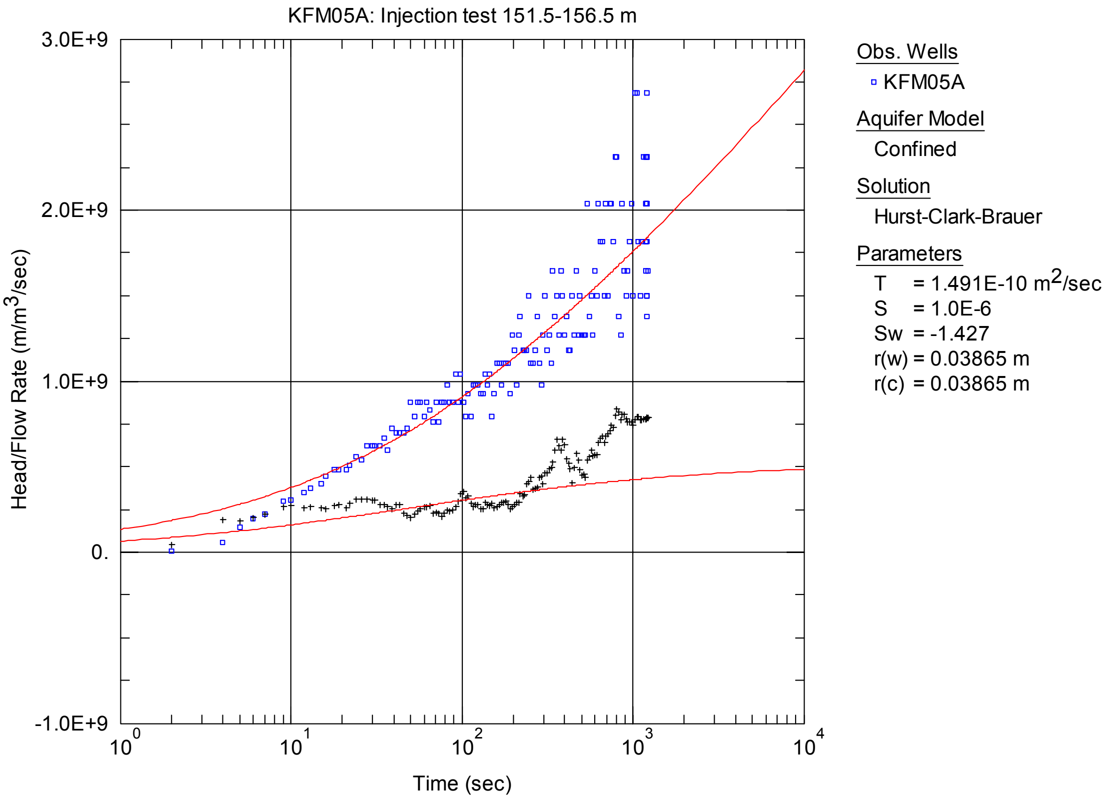


Figure A3-129. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 151.5-156.5 m in KFM05A.*

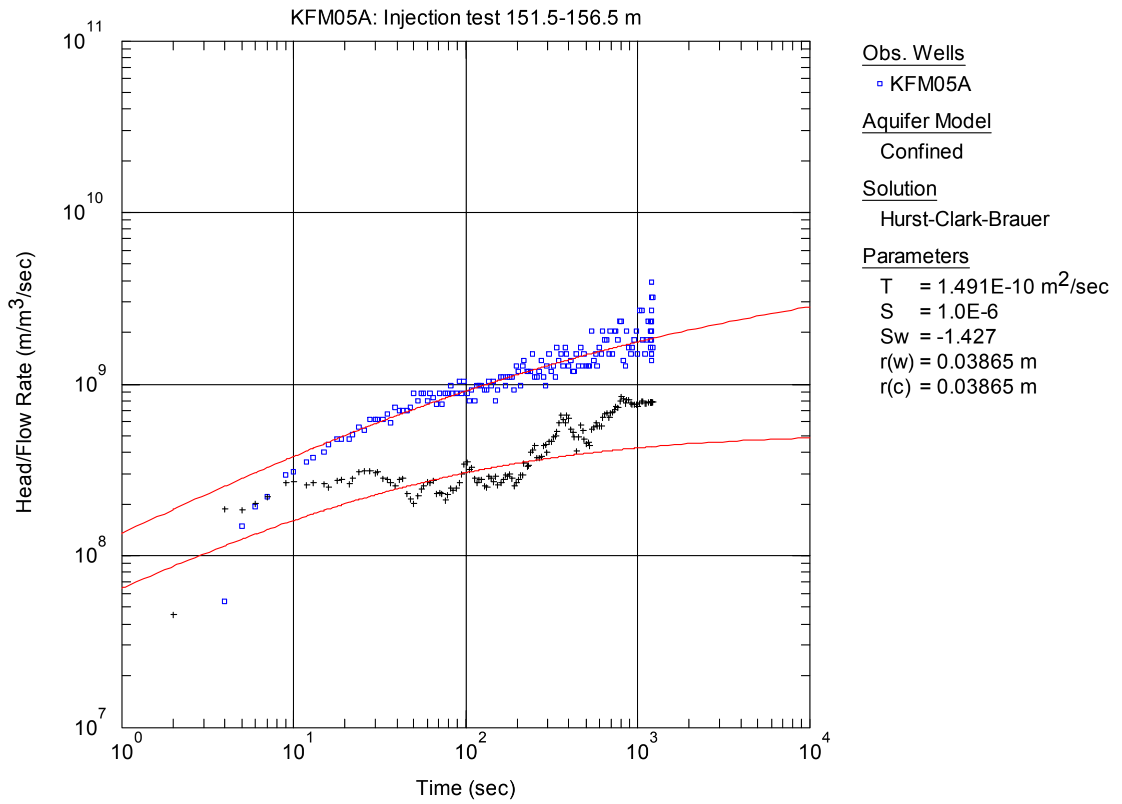


Figure A3-130. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 151.5-156.5 m in KFM05A.*

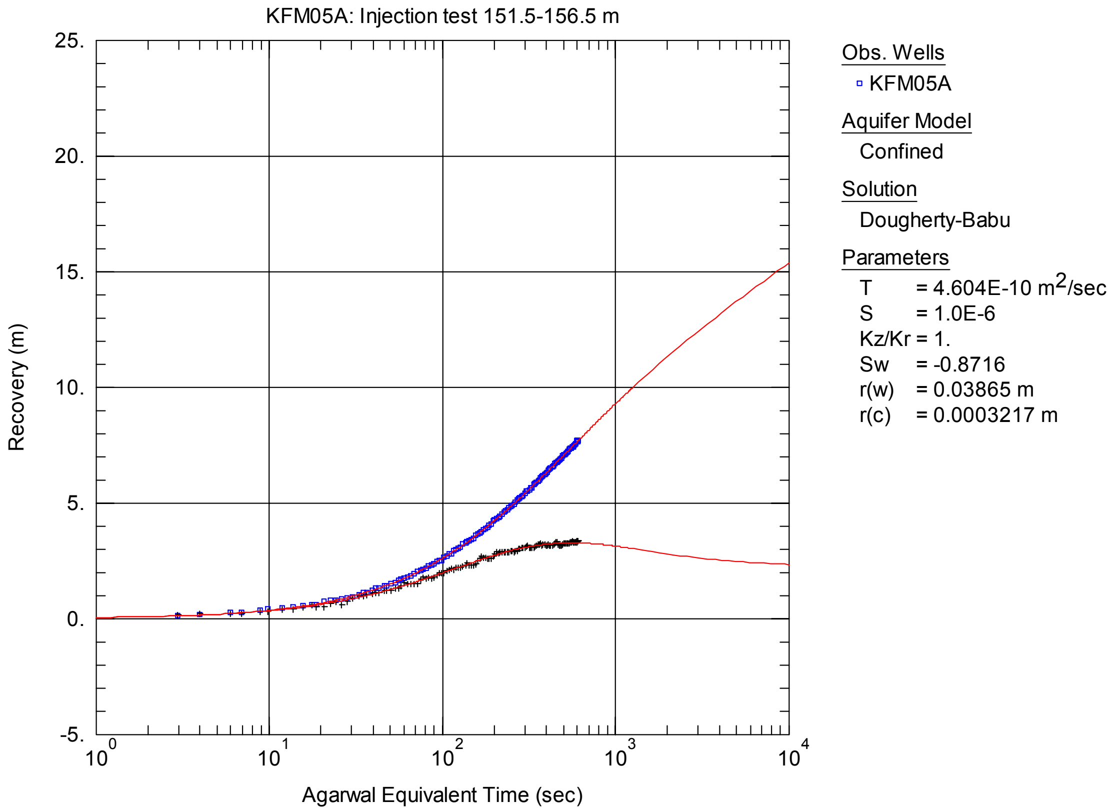


Figure A3-131. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 151.5-156.5 m in KFM05A.*

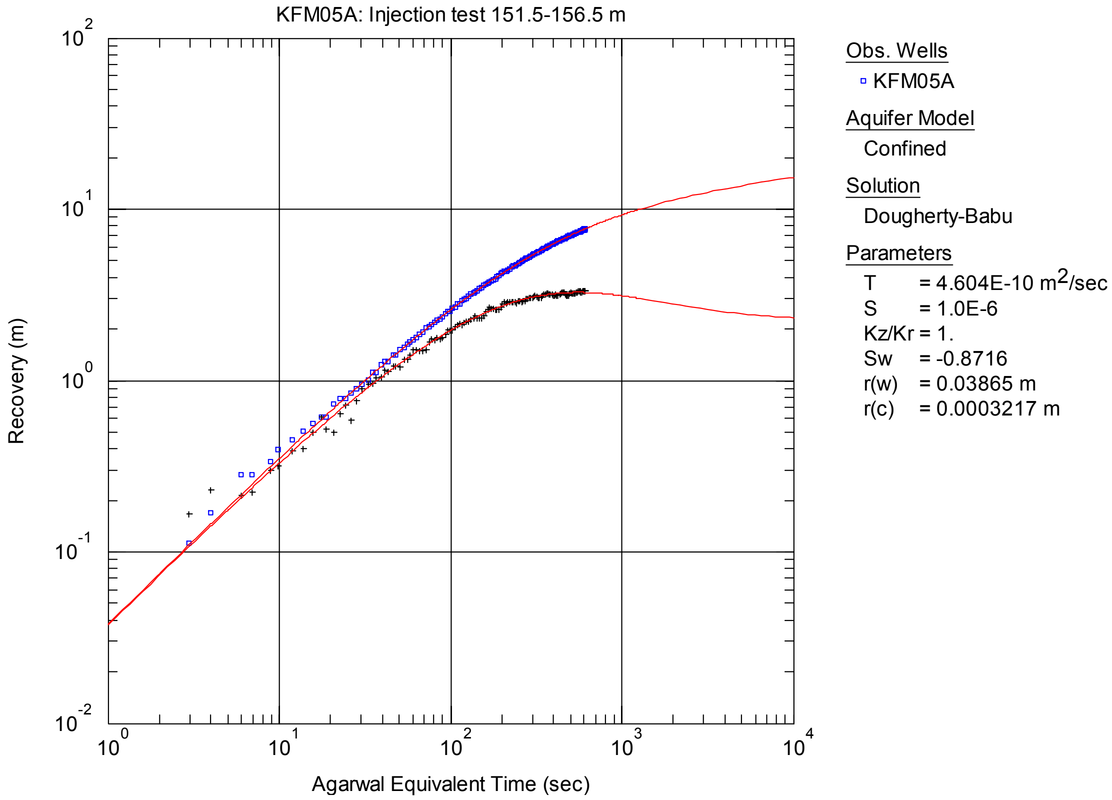


Figure A3-132. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 151.5-156.5 m in KFM05A.*

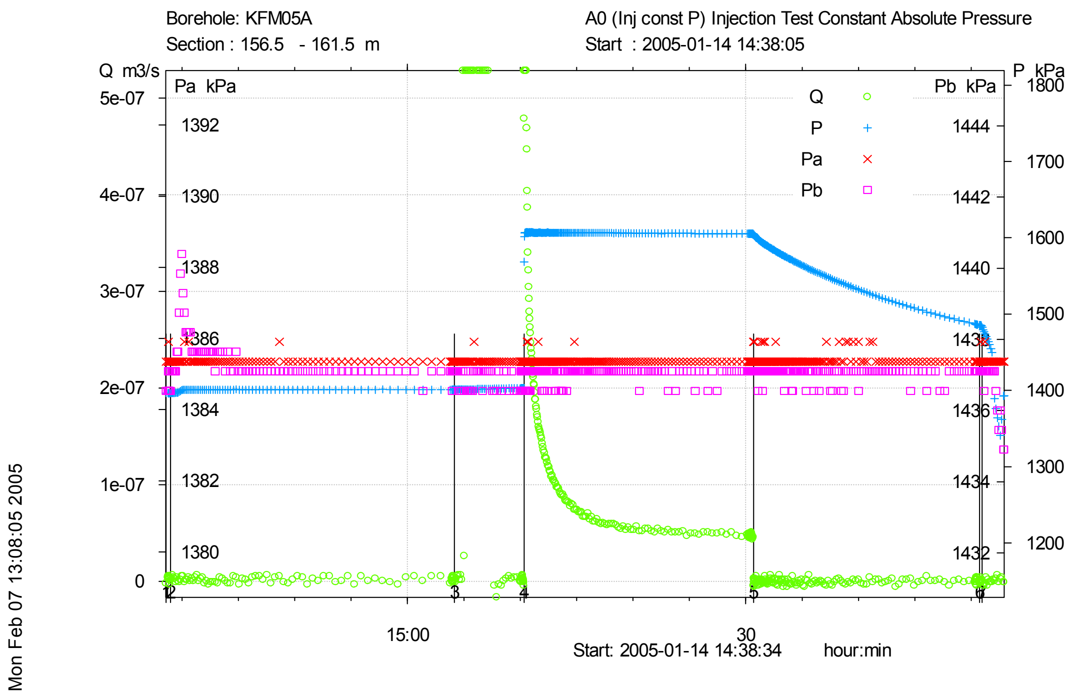


Figure A3-133. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 156.5-161.5 m in borehole KFM05A.

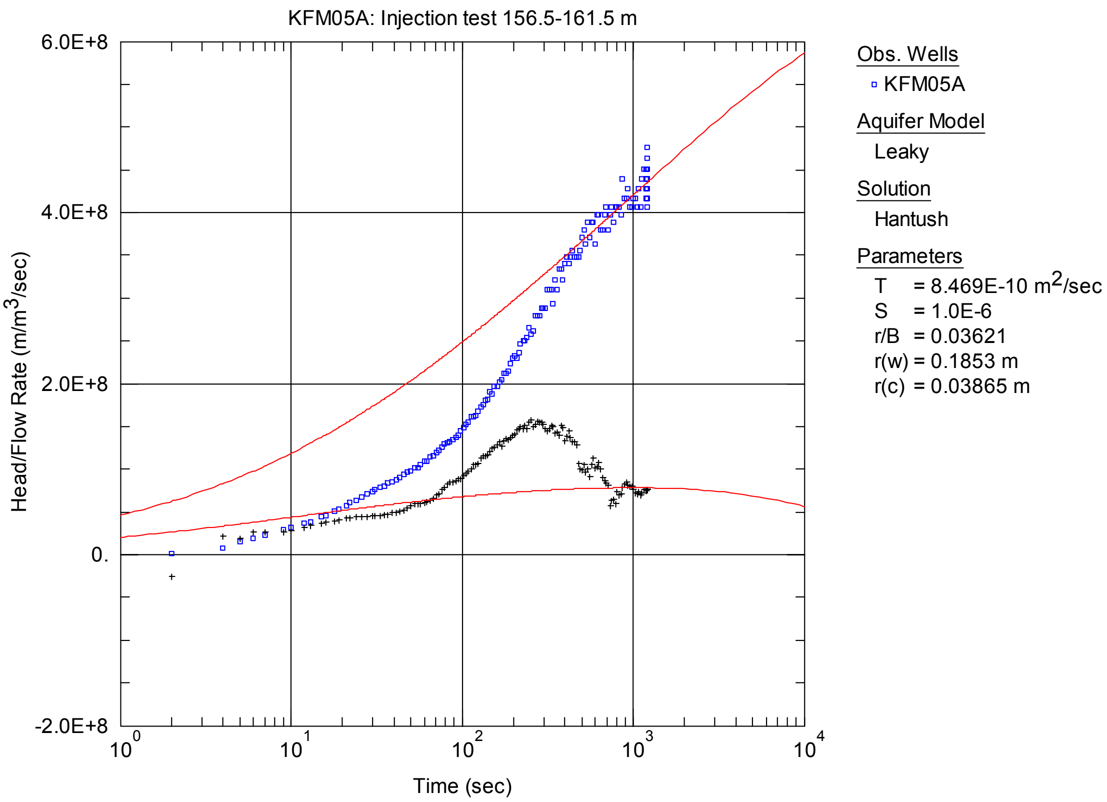


Figure A3-134. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 156.5-161.5 m in KFM05A.

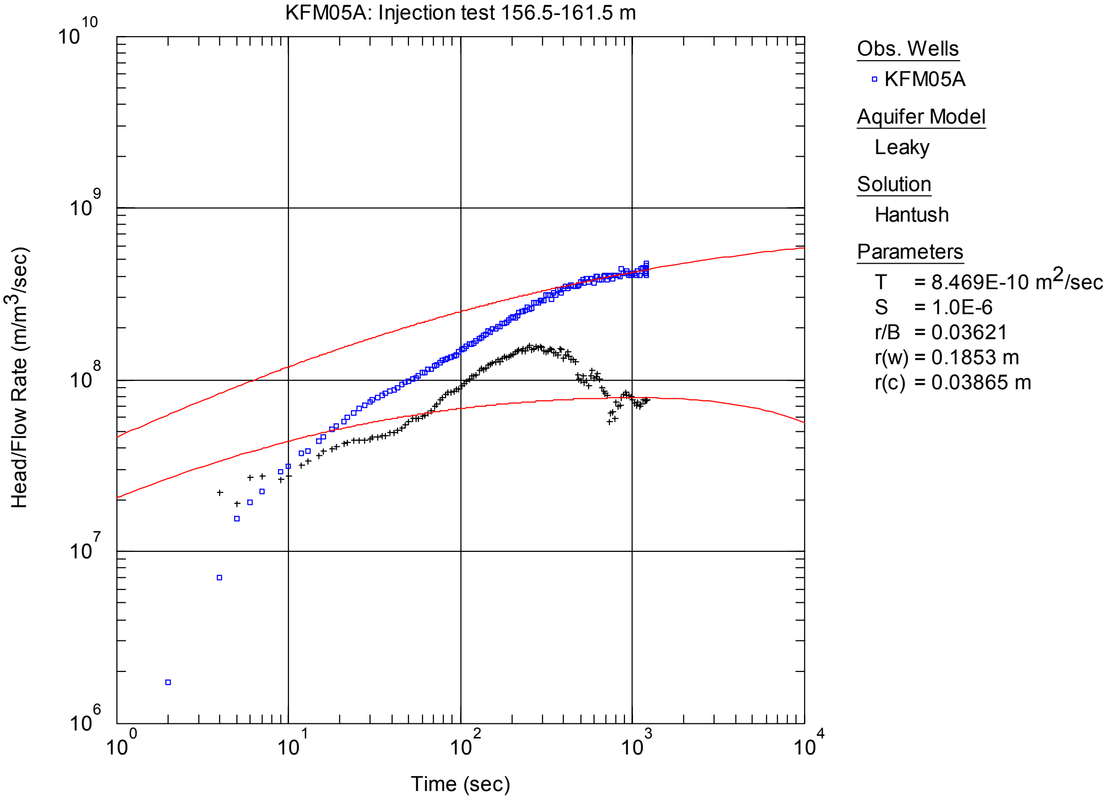


Figure A3-135. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 156.5-161.5 m in KFM05A.*

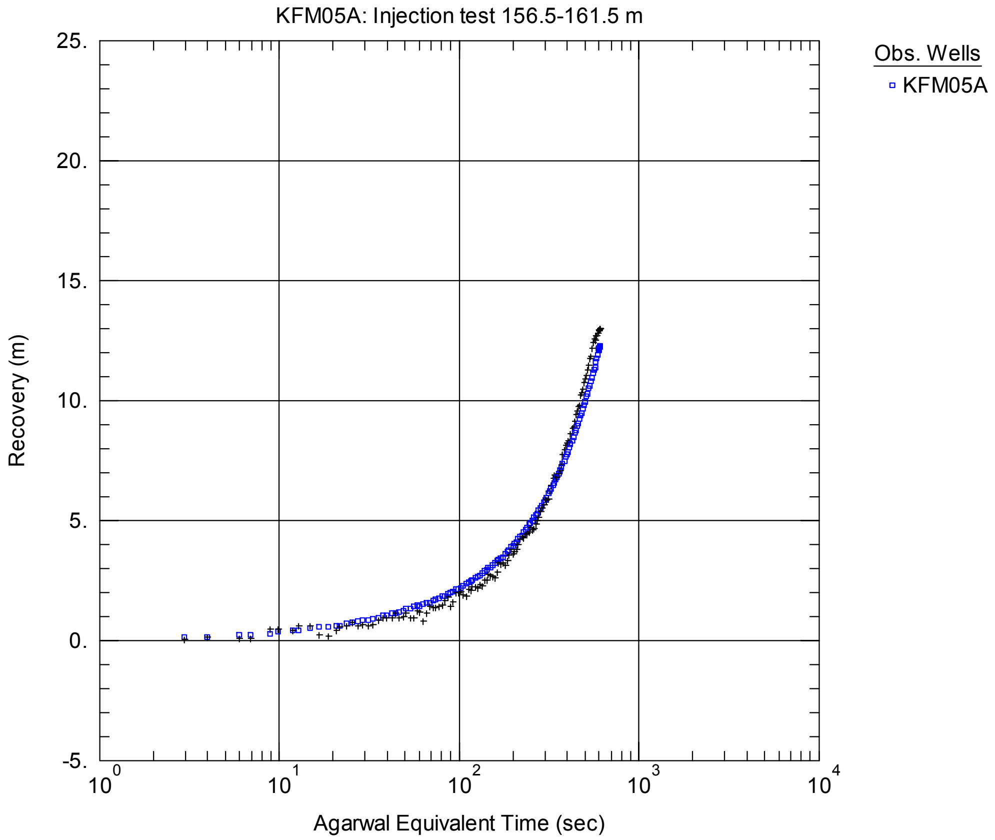


Figure A3-136. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 156.5-161.5 m in KFM05A.*

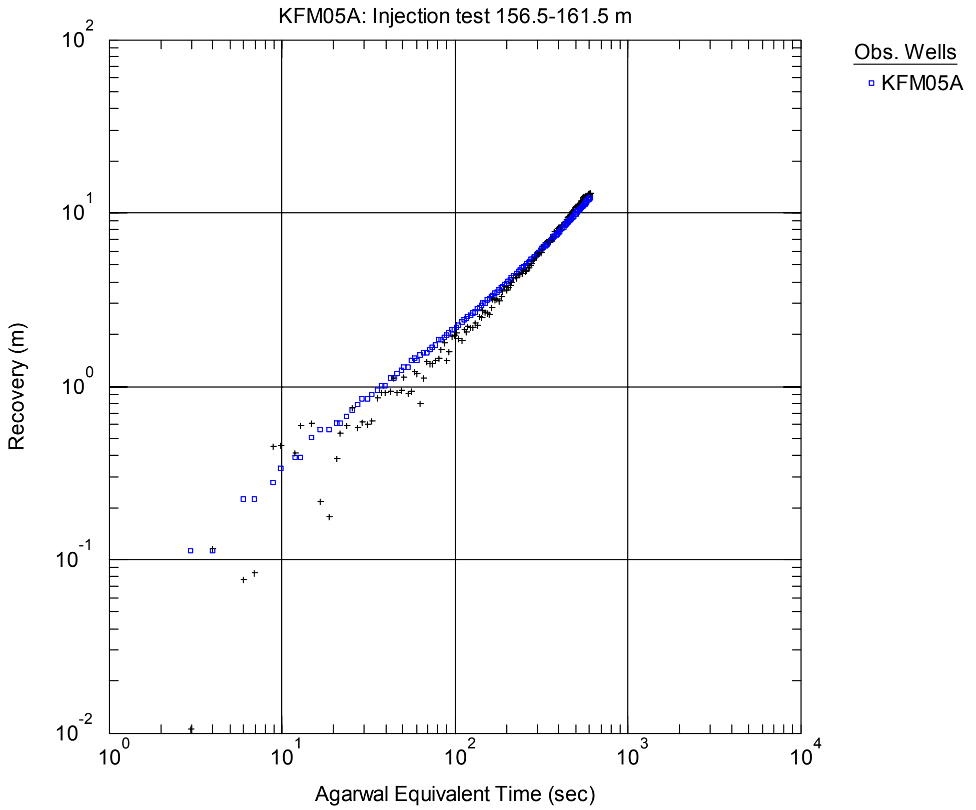


Figure A3-137. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 156.5-161.5 m in KFM05A.*

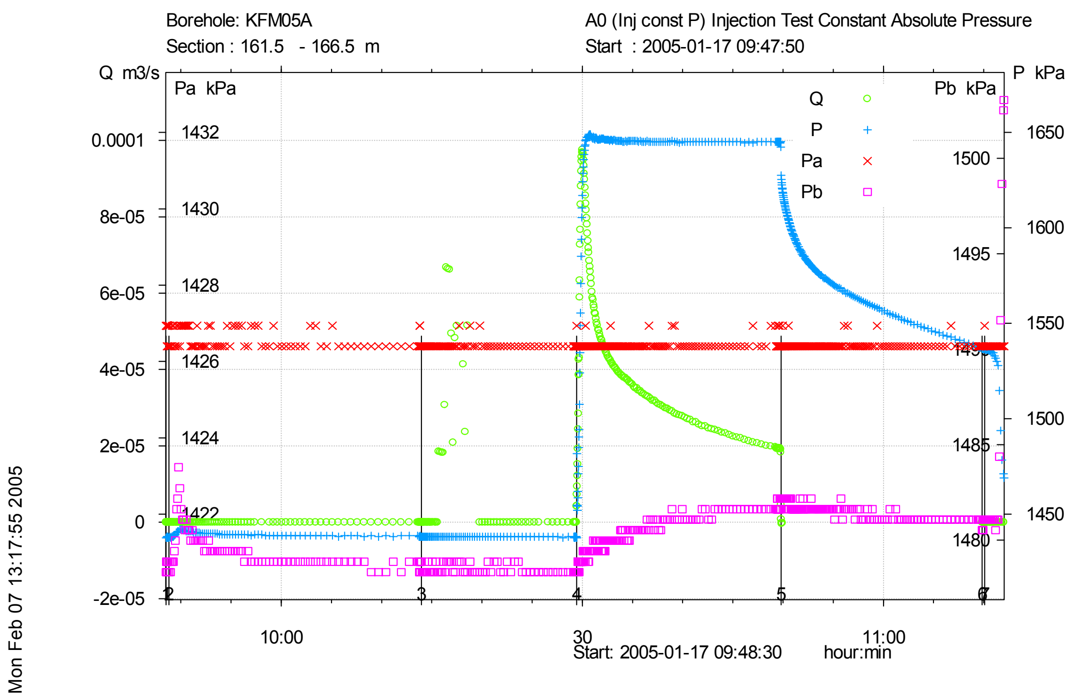


Figure A3-138. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 161.5-166.5 m in borehole KFM05A.*

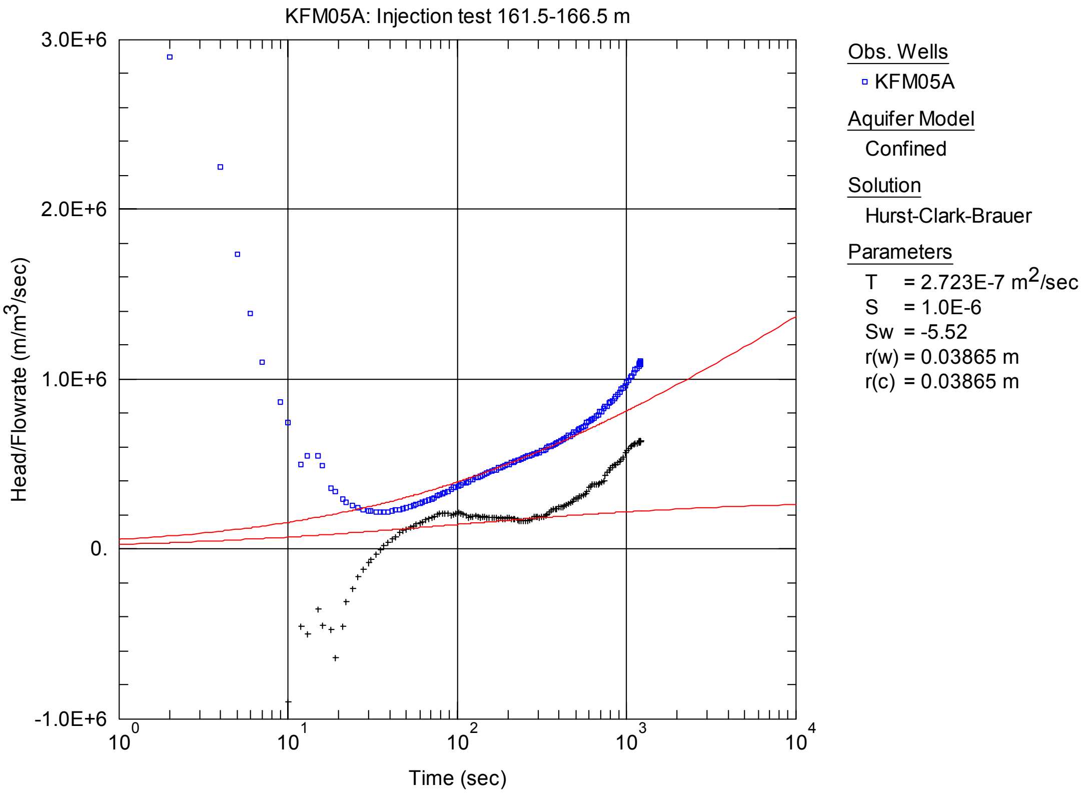


Figure A3-139. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 161.5-166.5 m in KFM05A.*

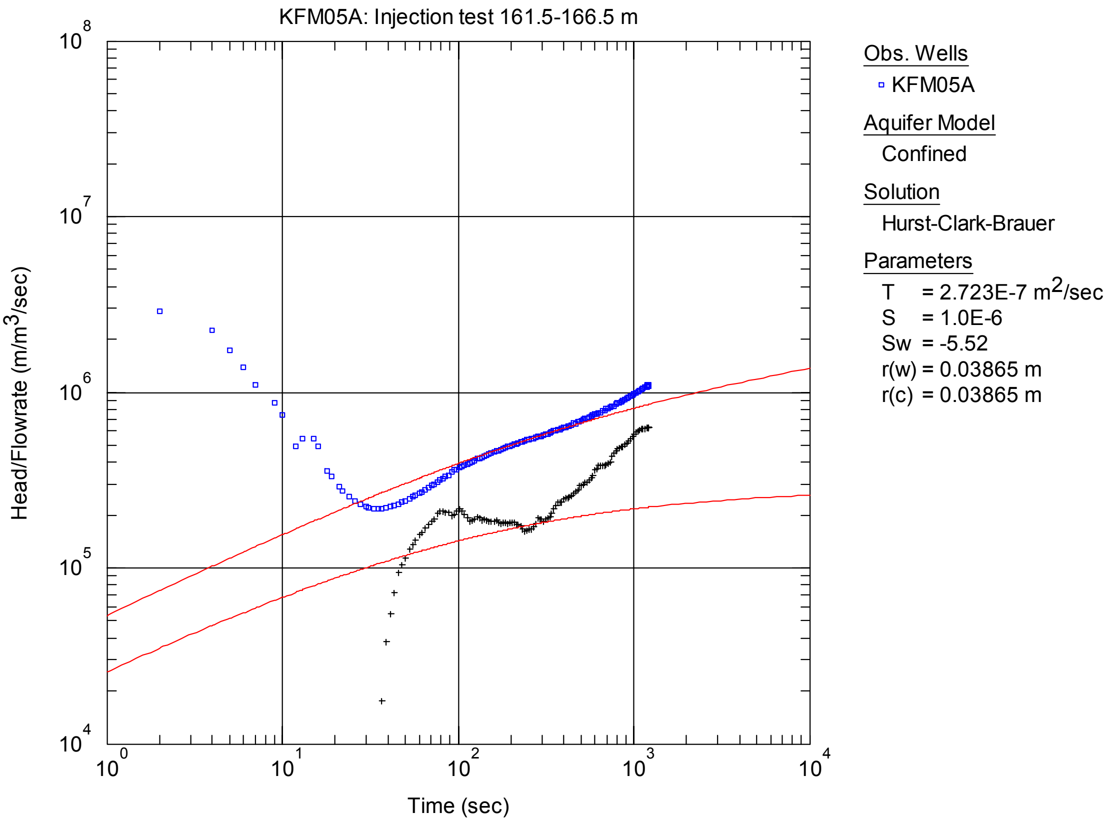


Figure A3-140. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 161.5-166.5 m in KFM05A.*

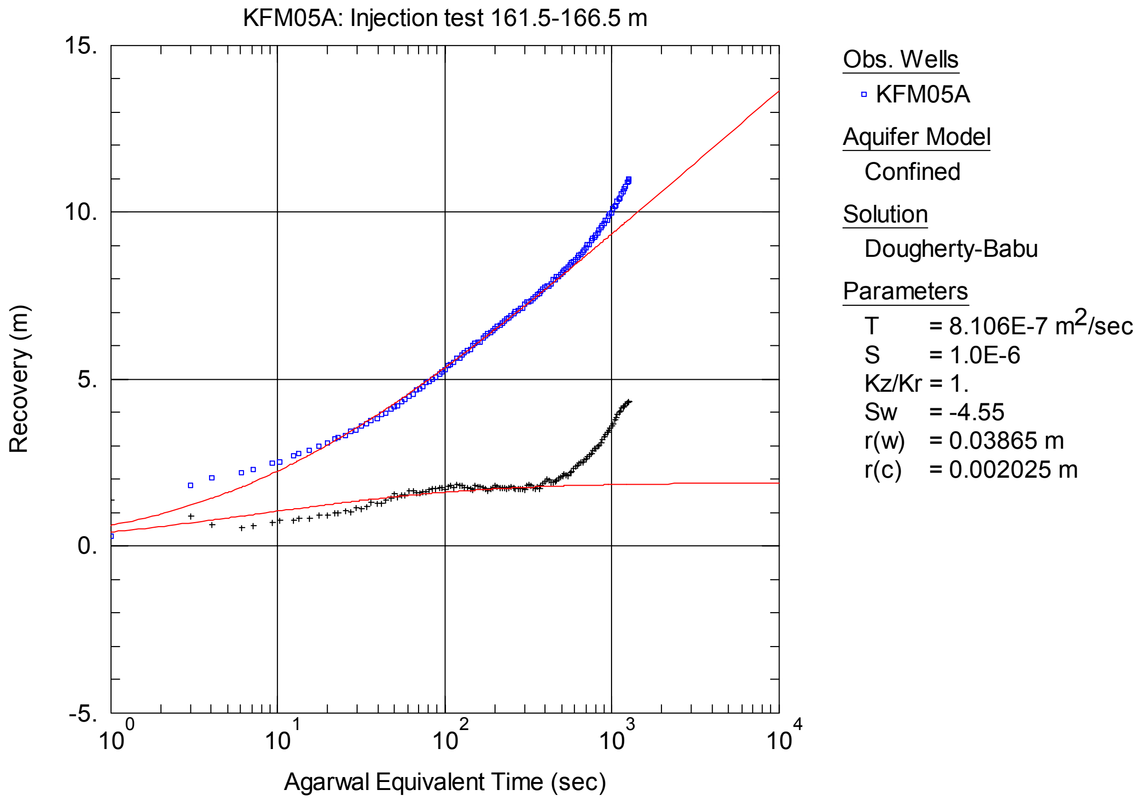


Figure A3-141. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 161.5-166.5 m in KFM05A.*

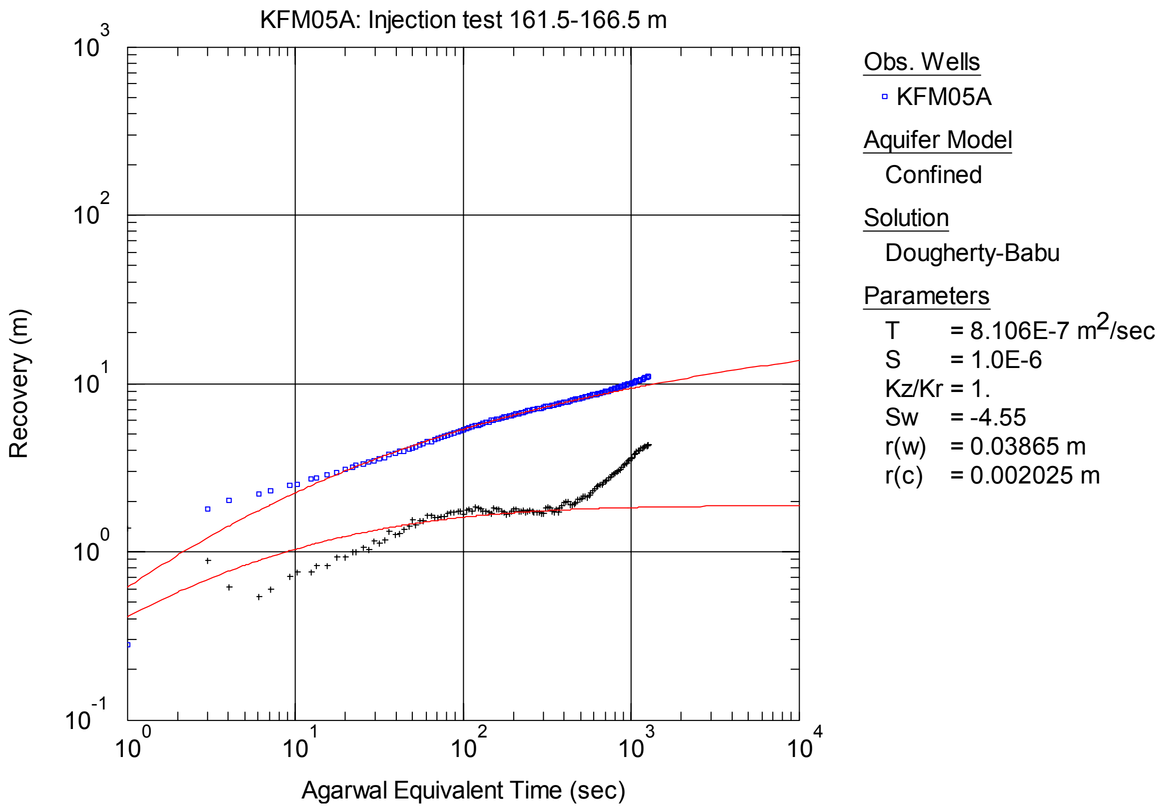


Figure A3-142. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 161.5-166.5 m in KFM05A.*

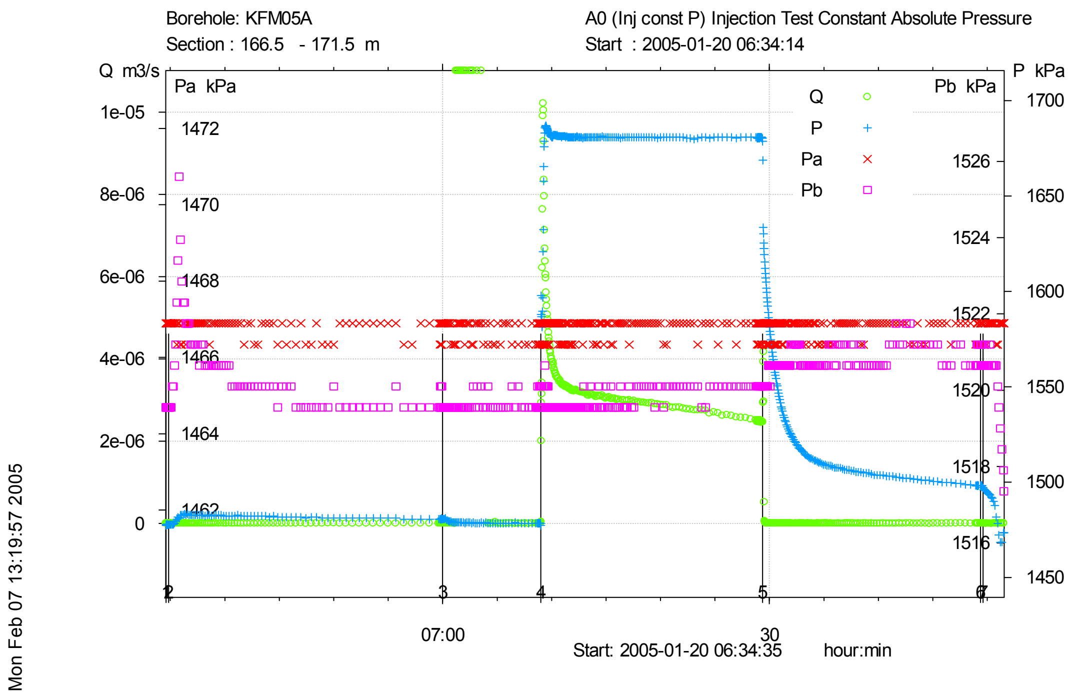


Figure A3-143. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 166.5-171.5 m in borehole KFM05A.

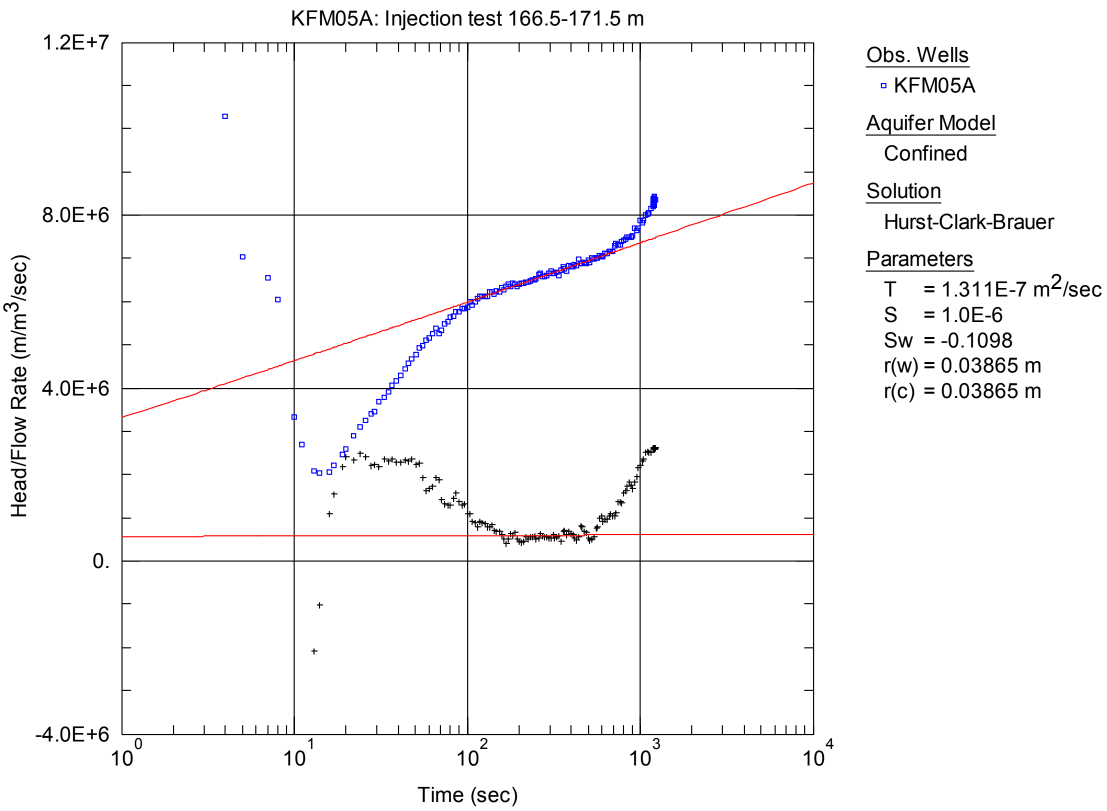


Figure A3-144. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 166.5-171.5 m in KFM05A.

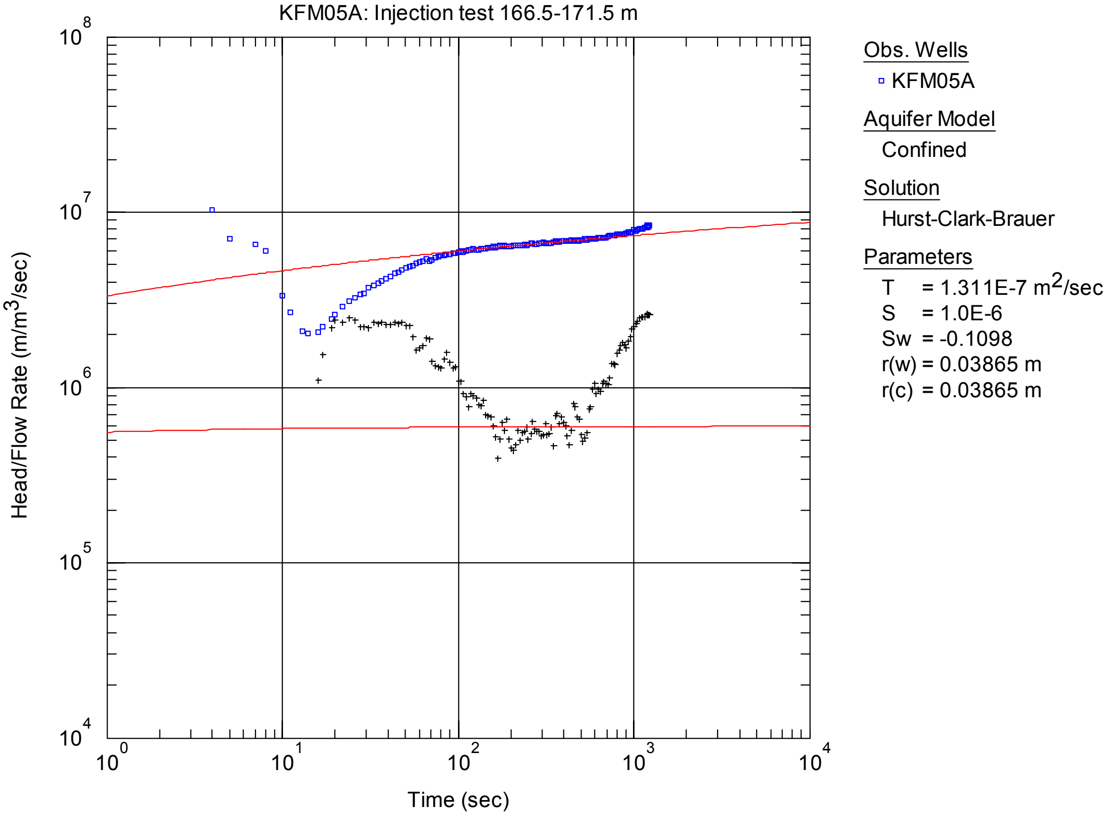


***Figure A3-145.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 166.5-171.5 m in KFM05A.*

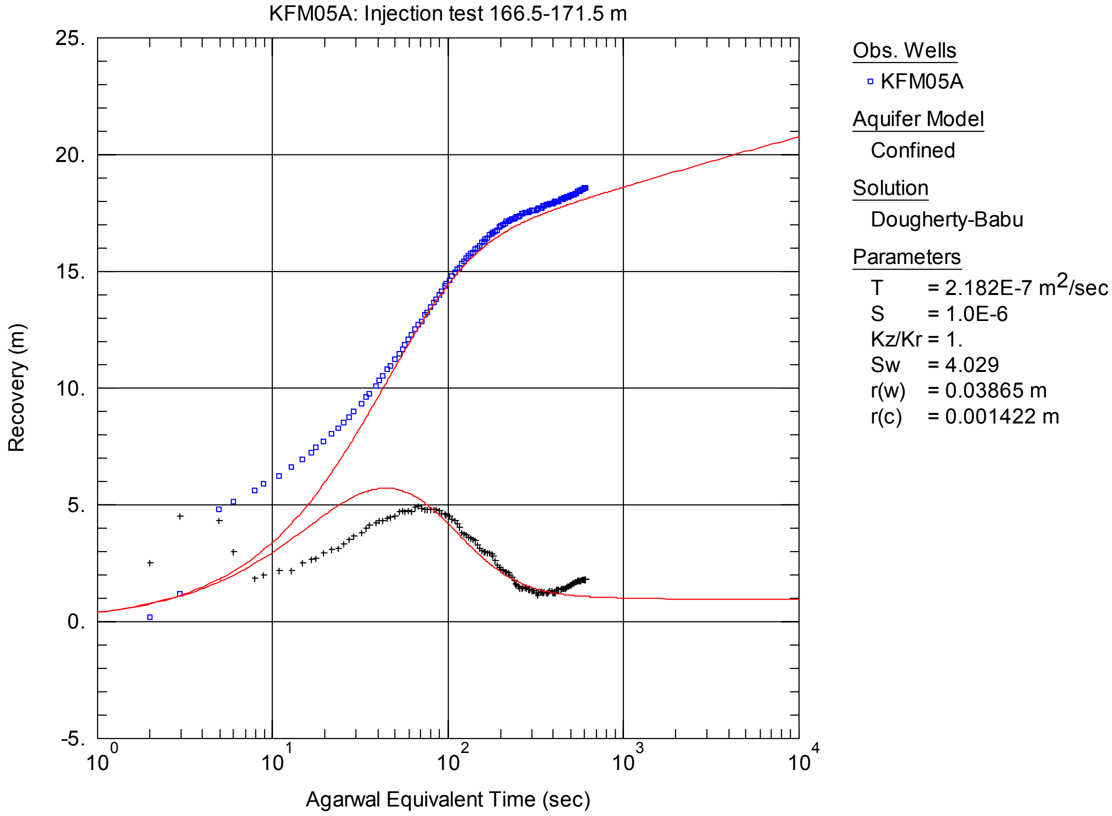


***Figure A3-146.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 166.5-171.5 m in KFM05A.*

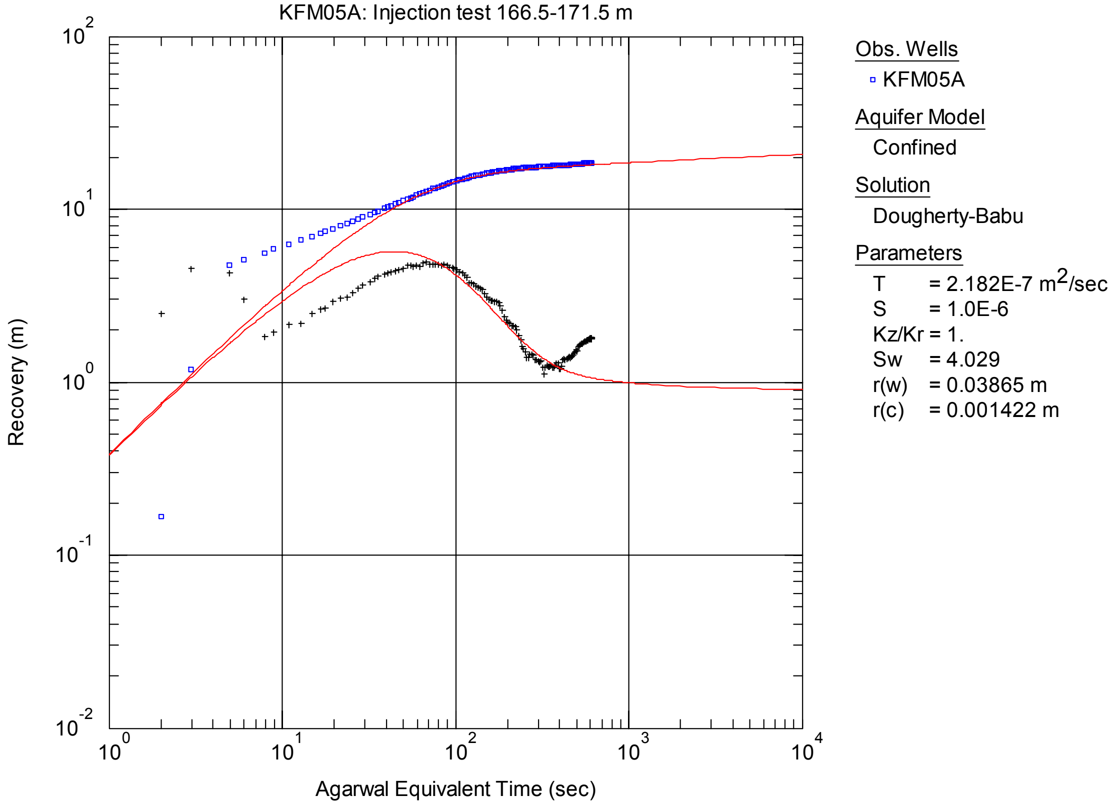


Figure A3-147. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 166.5-171.5 m in KFM05A.*

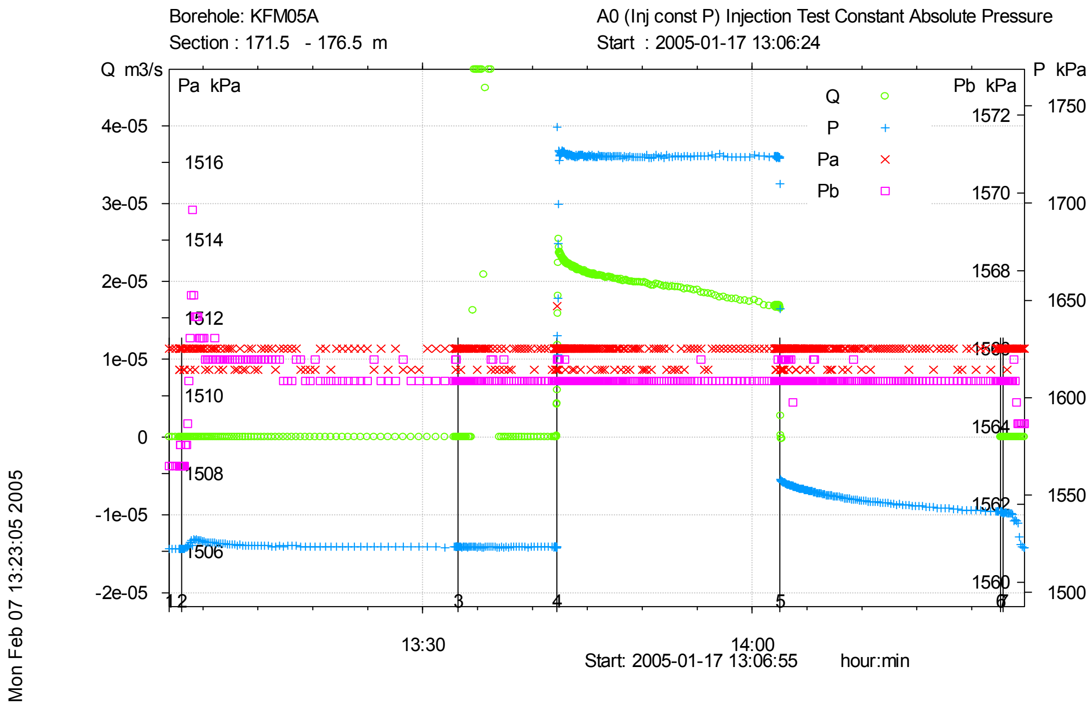


Figure A3-148. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 171.5-176.5 m in borehole KFM05A.*

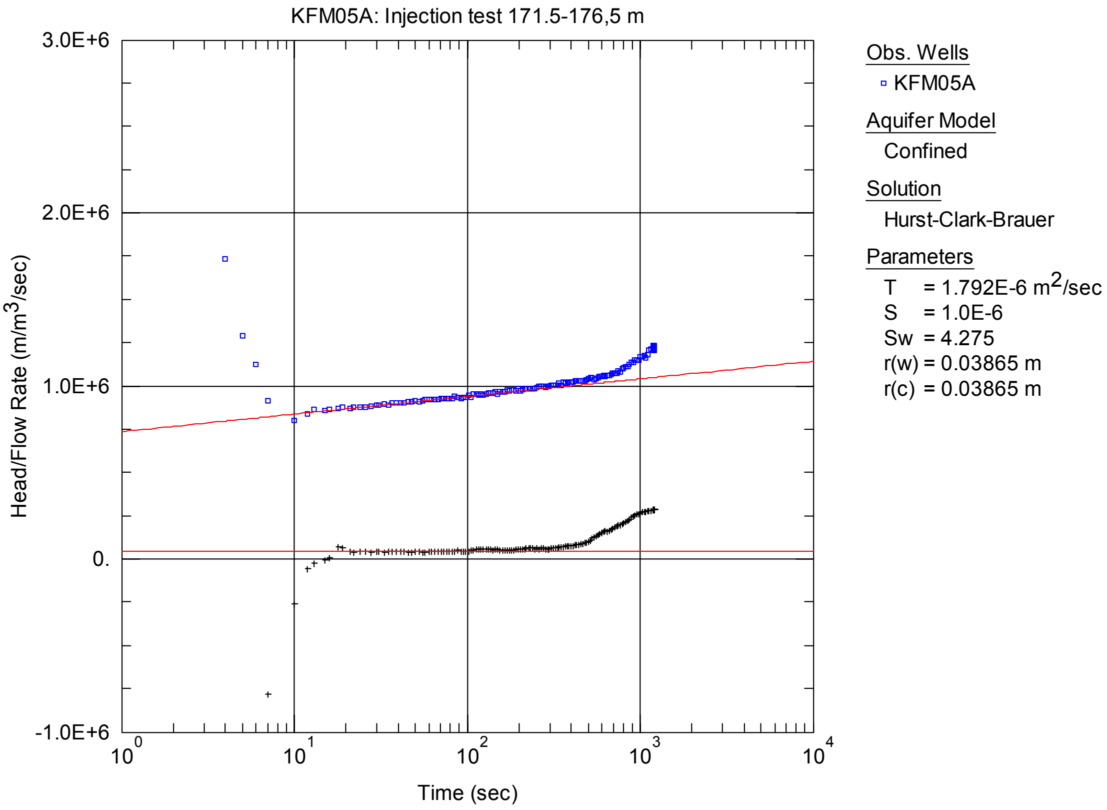


Figure A3-149. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 171.5-176.5 m in KFM05A.*

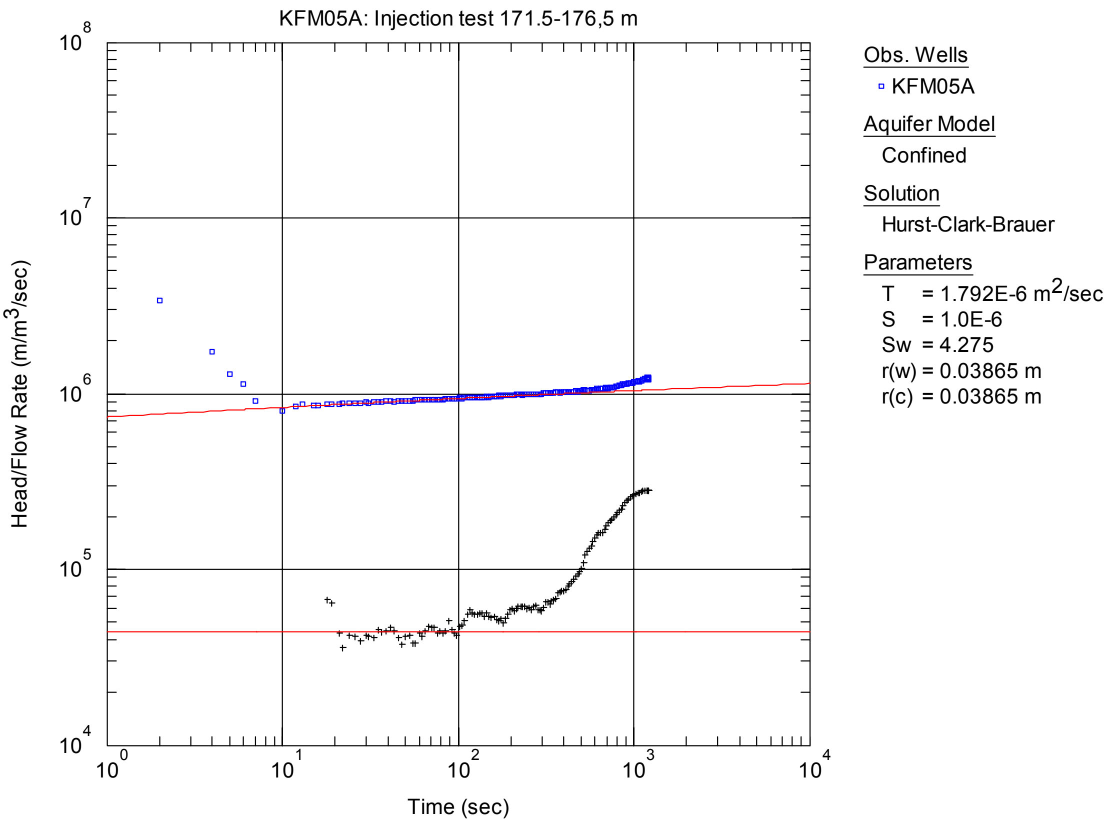


Figure A3-150. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 171.5-176.5 m in KFM05A.*

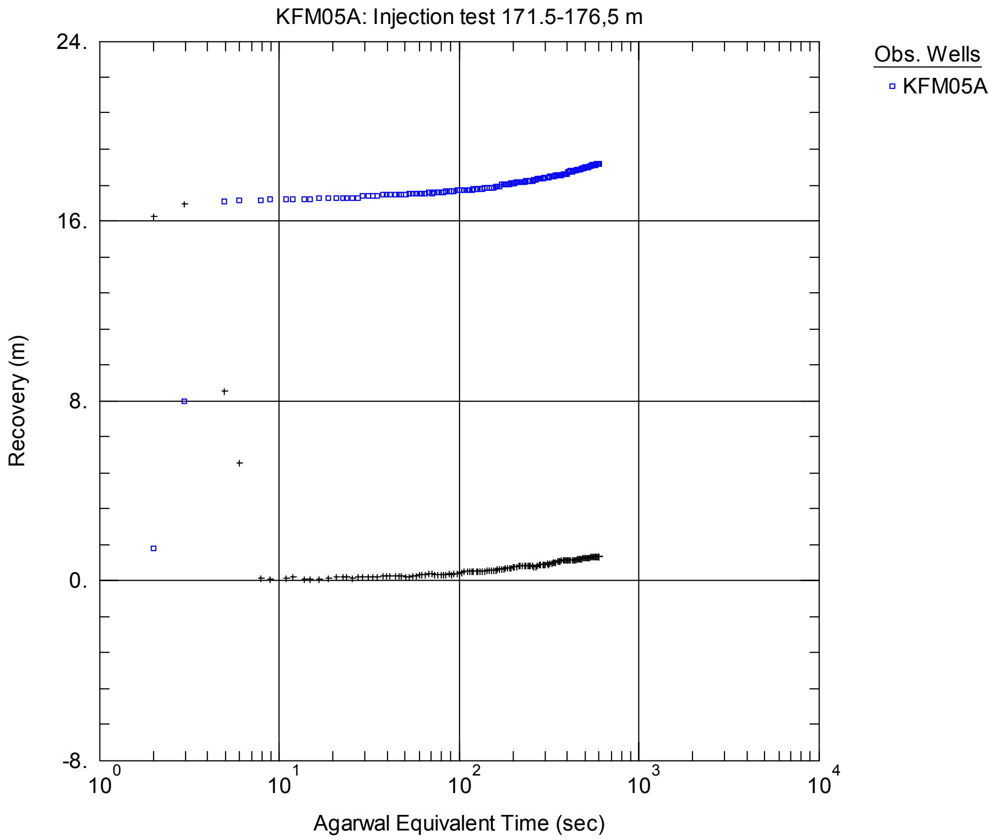


Figure A3-151. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 171.5-176.5 m in KFM05A.*

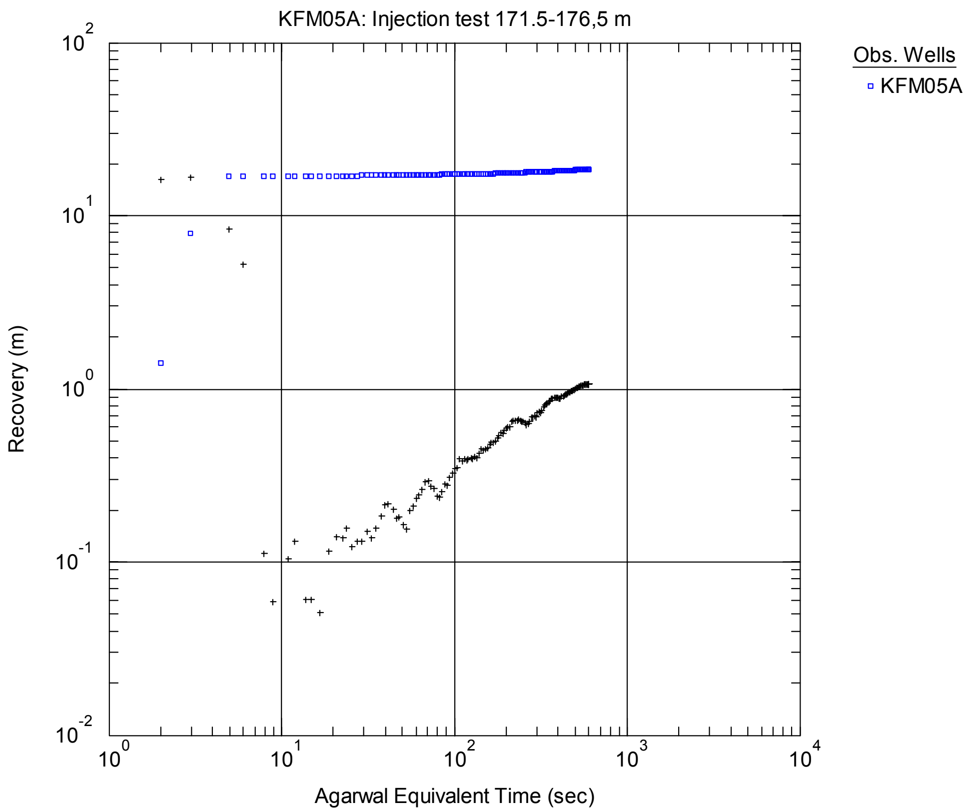


Figure A3-152. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 171.5-176.5 m in KFM05A.*

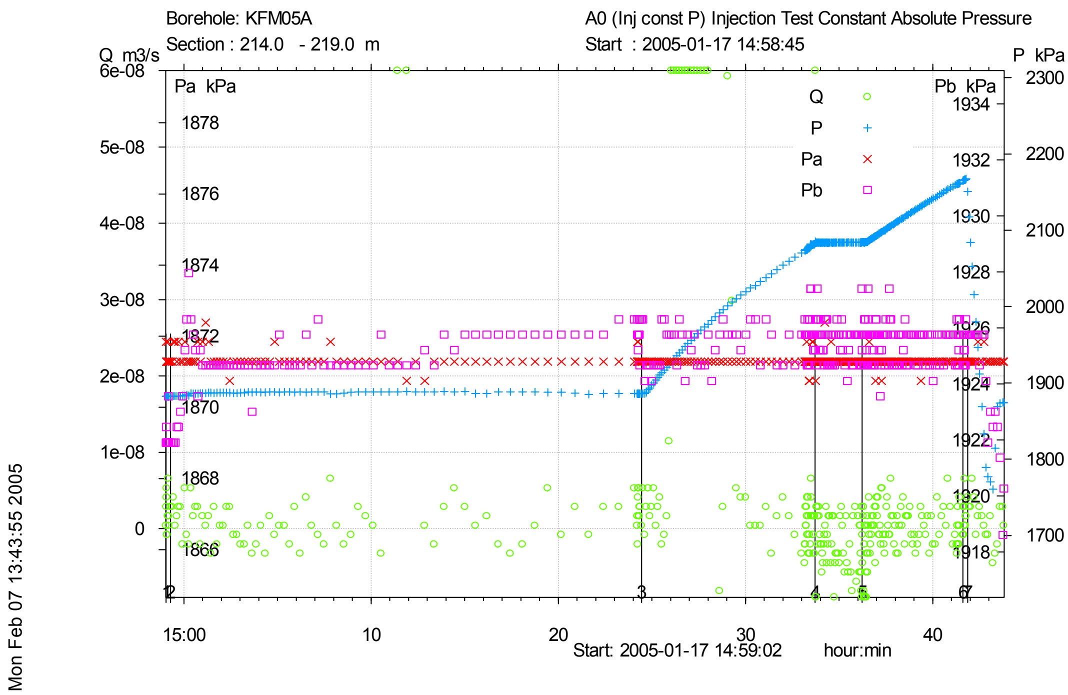


Figure A3-153. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 214.0-219.0 m in borehole KFM05A.*

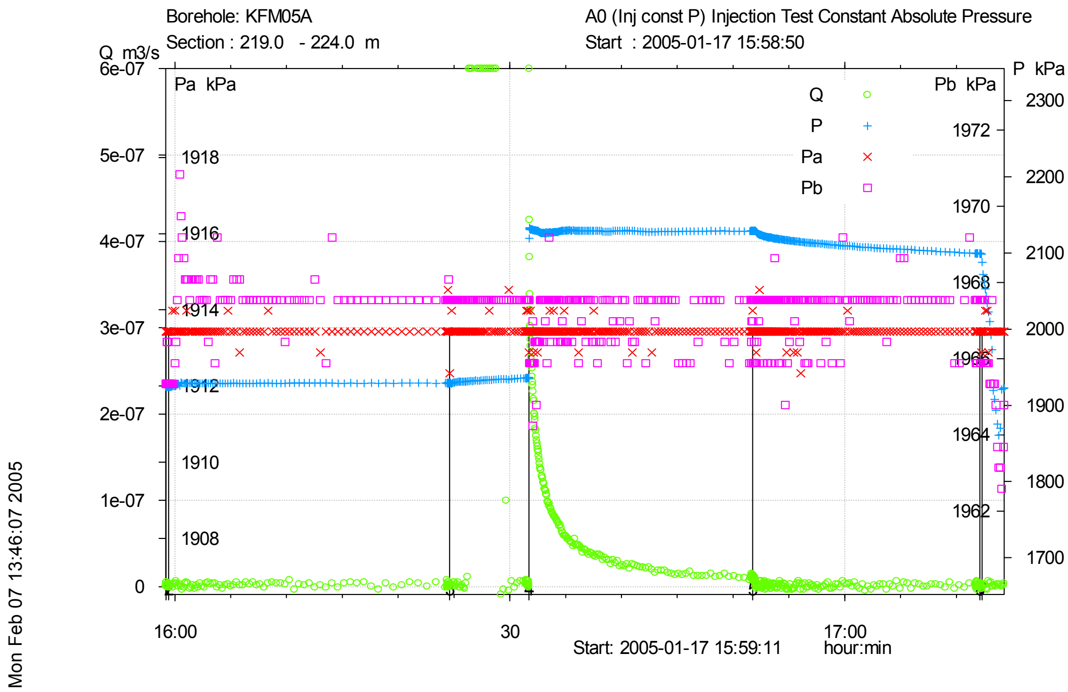


Figure A3-154. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 219.0-224.0 m in borehole KFM05A.*

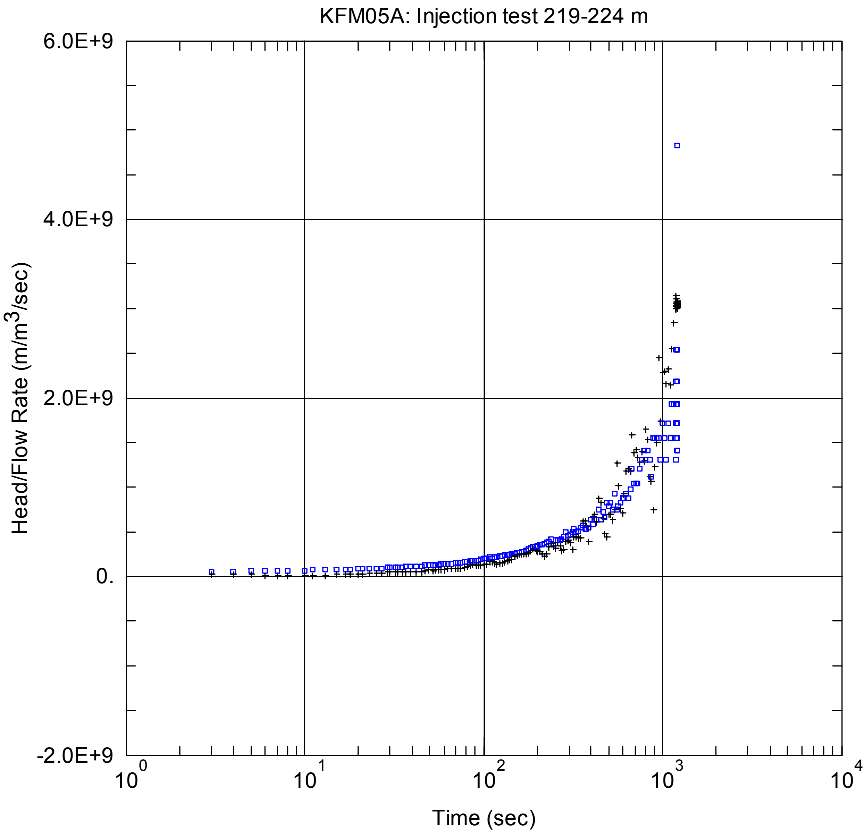


Figure A3-155. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 219.0-224.0 m in KFM05A.*

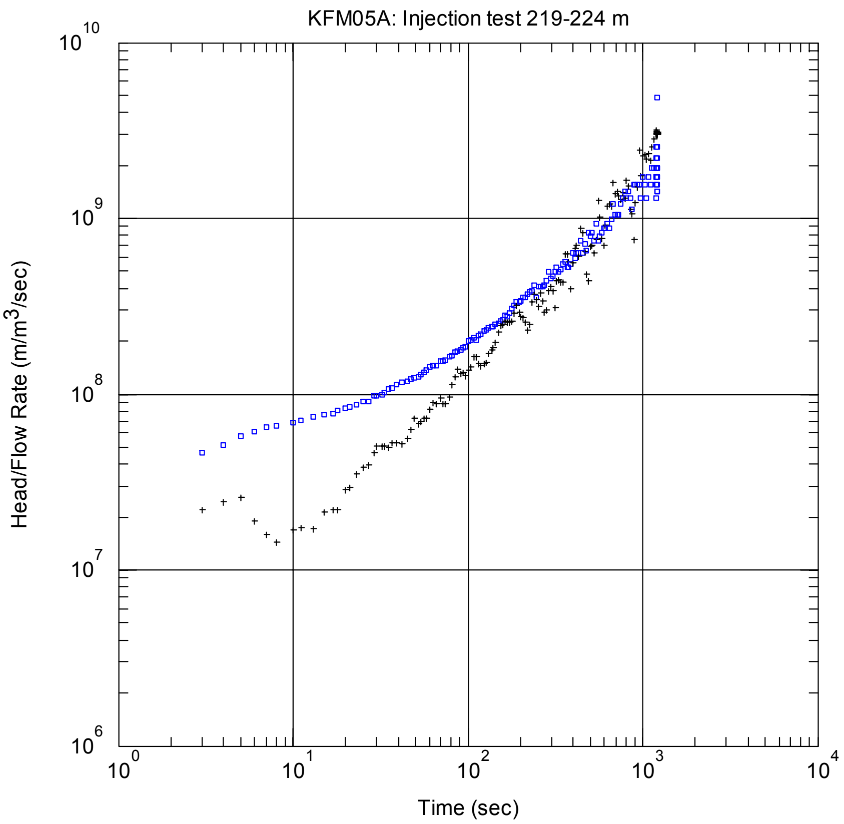


Figure A3-156. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 219.0-224.0 m in KFM05A.*

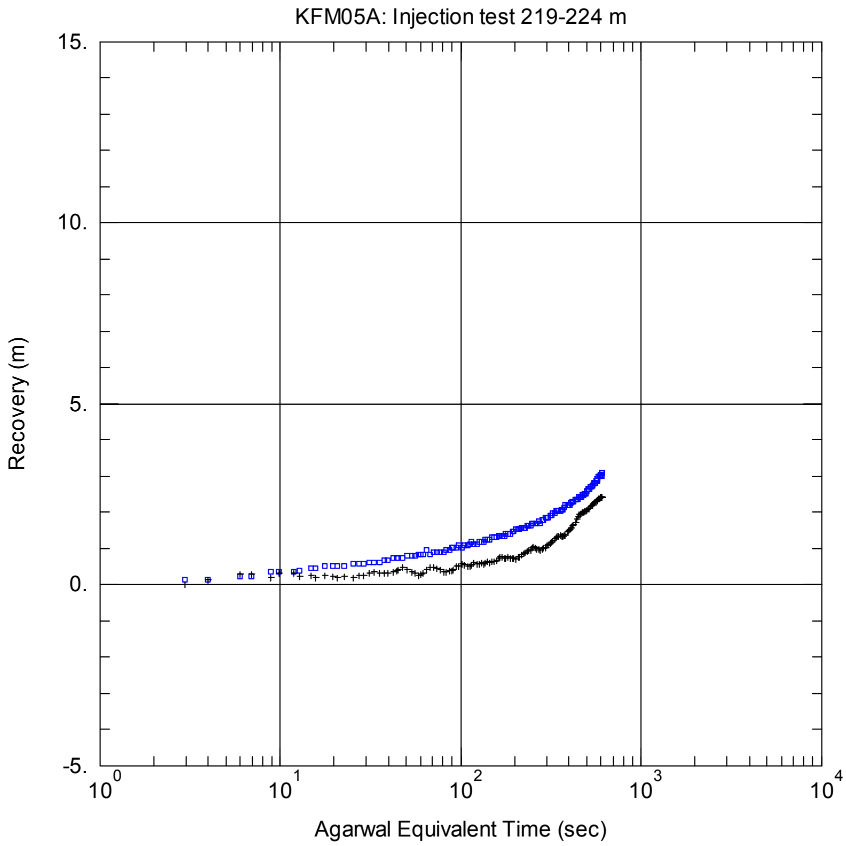


Figure A3-157. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 219.0-224.0 m in KFM05A.*

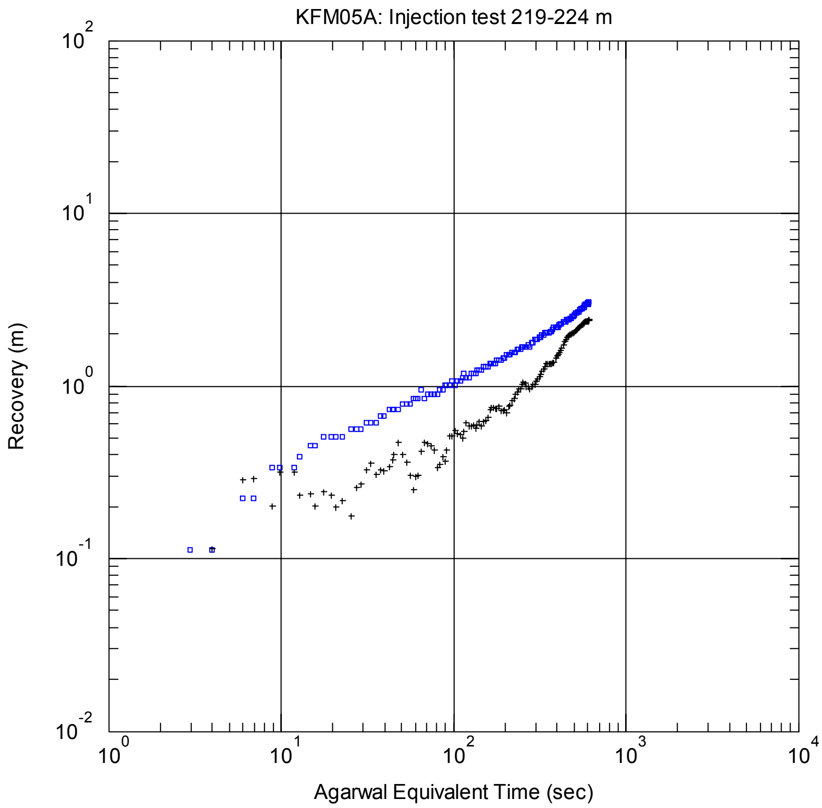


Figure A3-158. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 219.0-224.0 m in KFM05A.*

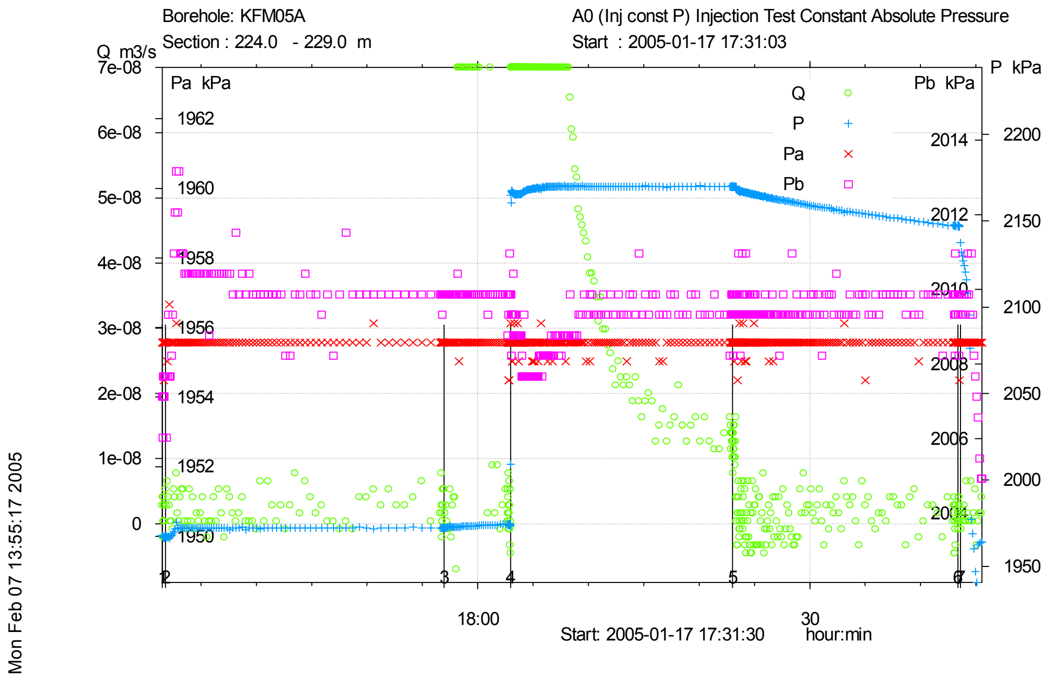


Figure A3-159. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 224.0-229.0 m in borehole KFM05A.*

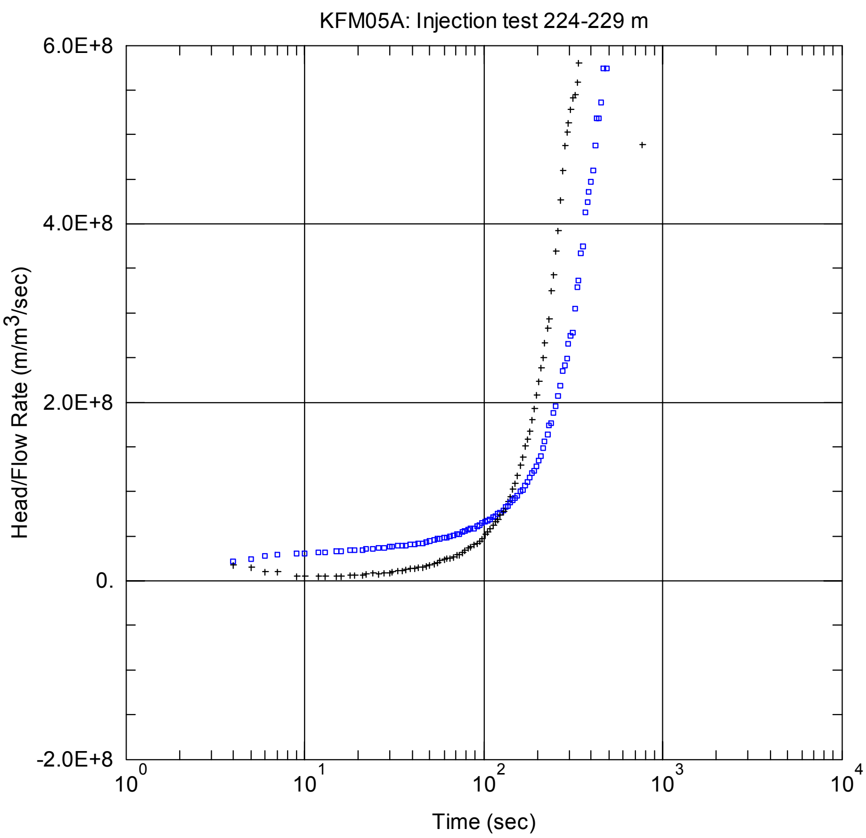


Figure A3-160. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 224.0-229.0 m in KFM05A.*

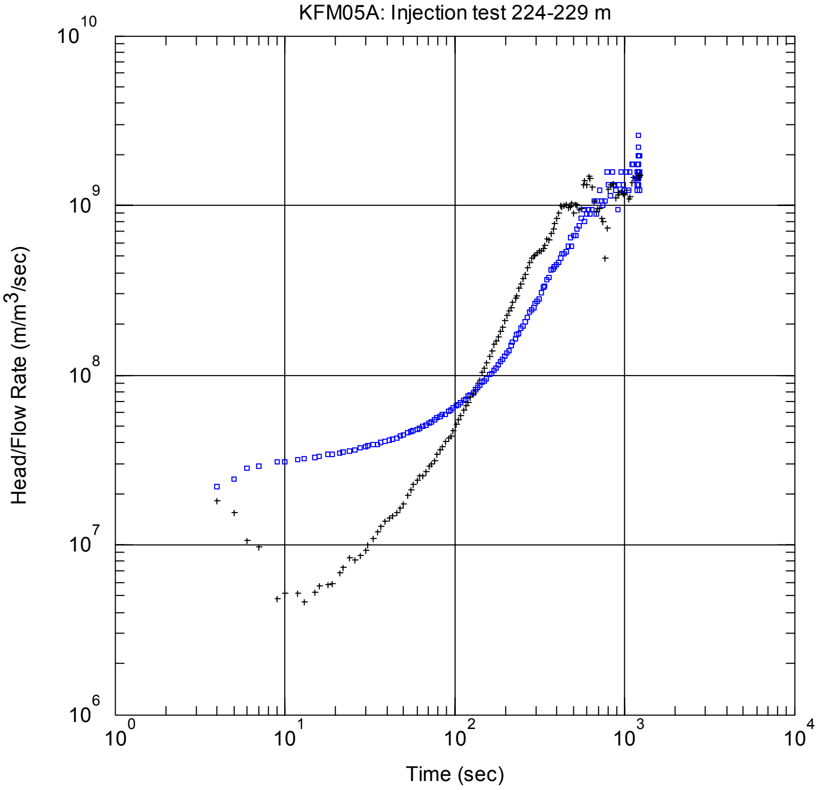


Figure A3-161. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 224.0-229.0 m in KFM05A.*

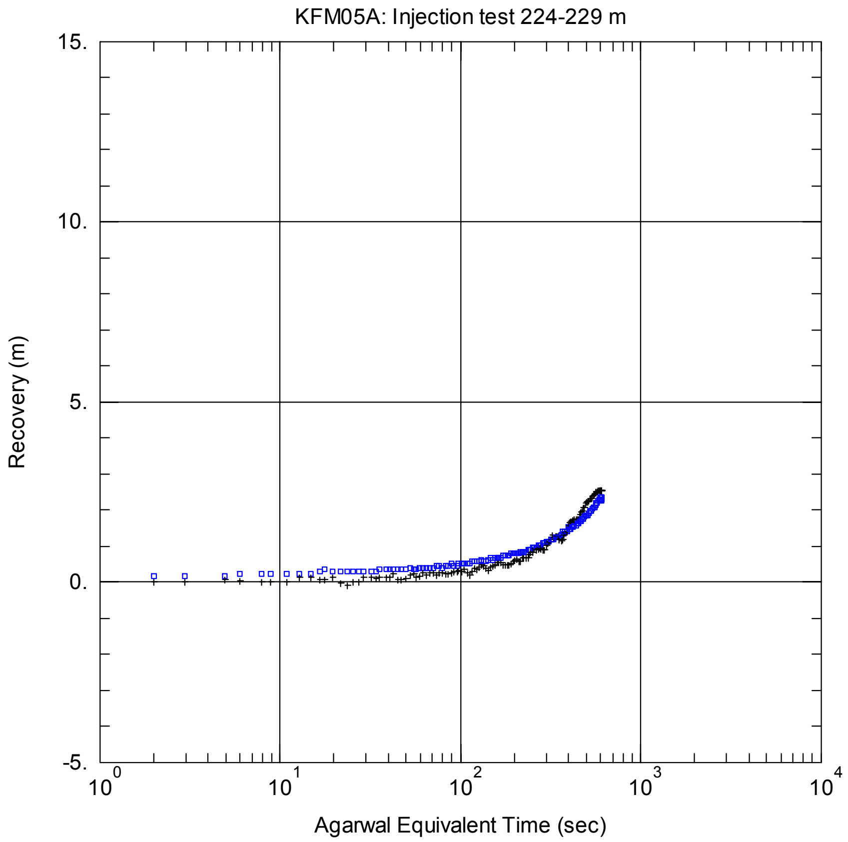


Figure A3-162. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 224.0-229.0 m in KFM05A.*

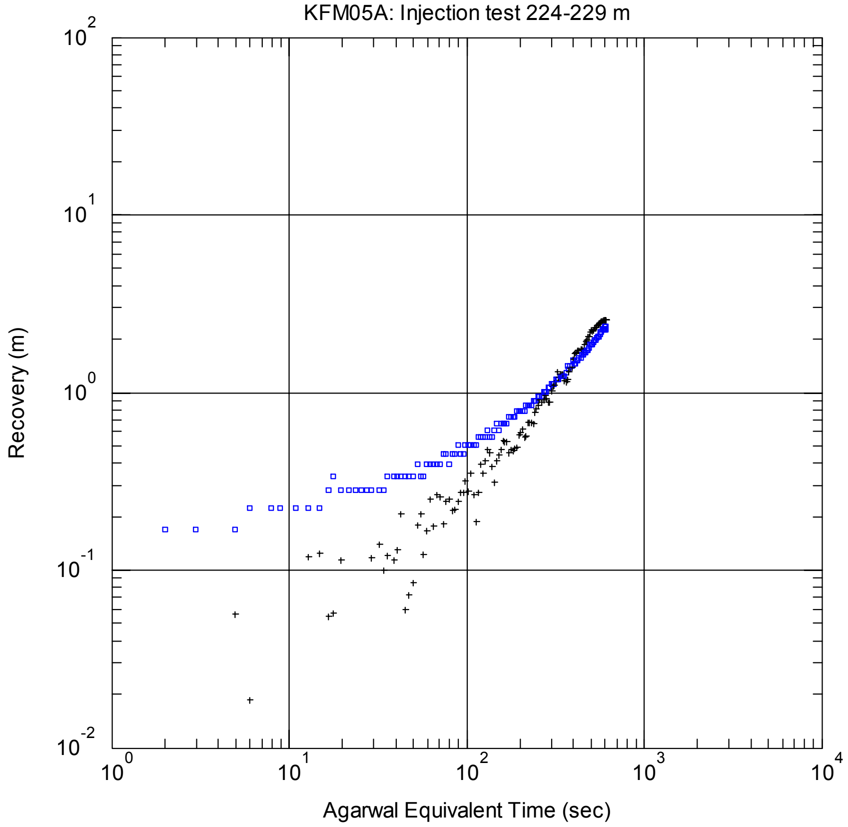


Figure A3-163. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 224.0-229.0 m in KFM05A.*

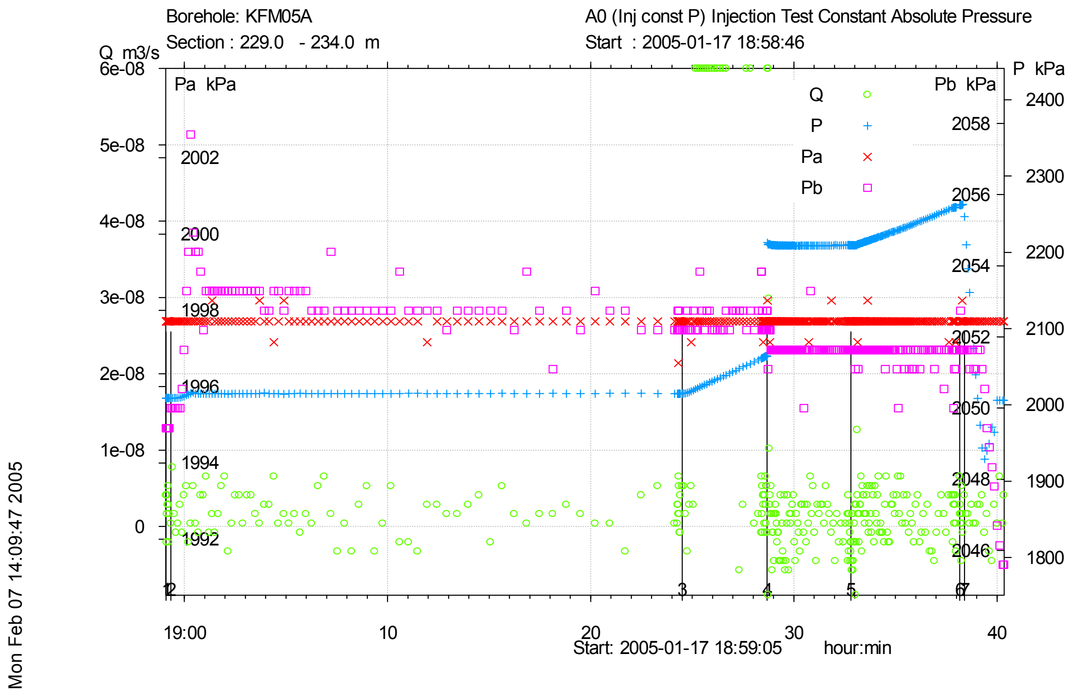


Figure A3-164. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 229.0-234.0 m in borehole KFM05A.*

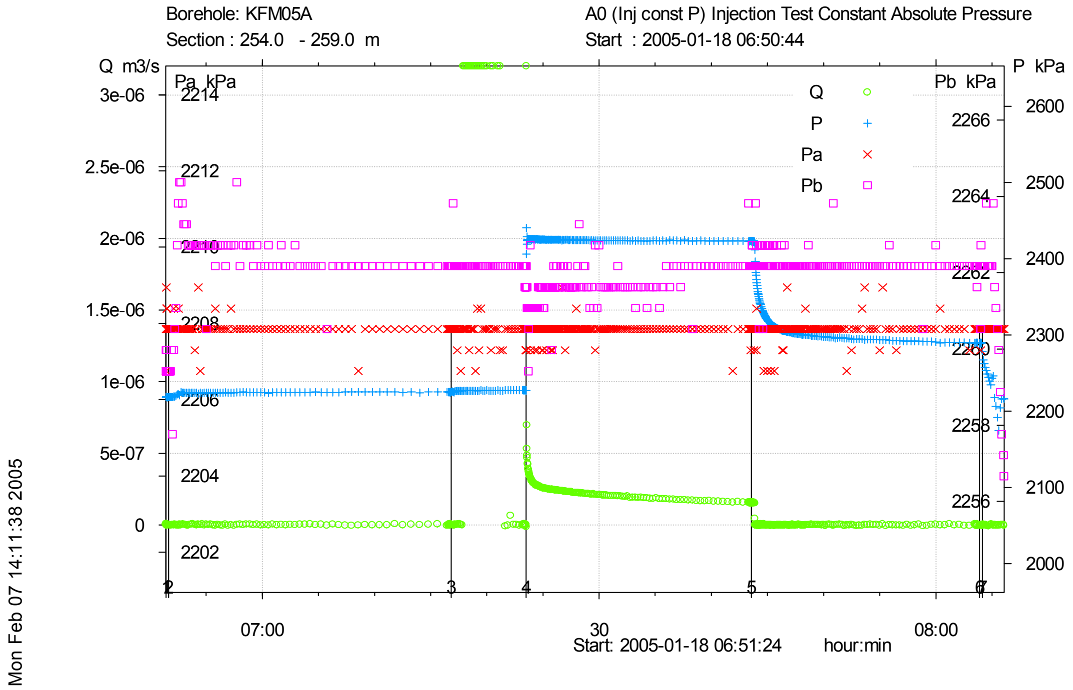


Figure A3-165. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 254.0-259.0 m in borehole KFM05A.*

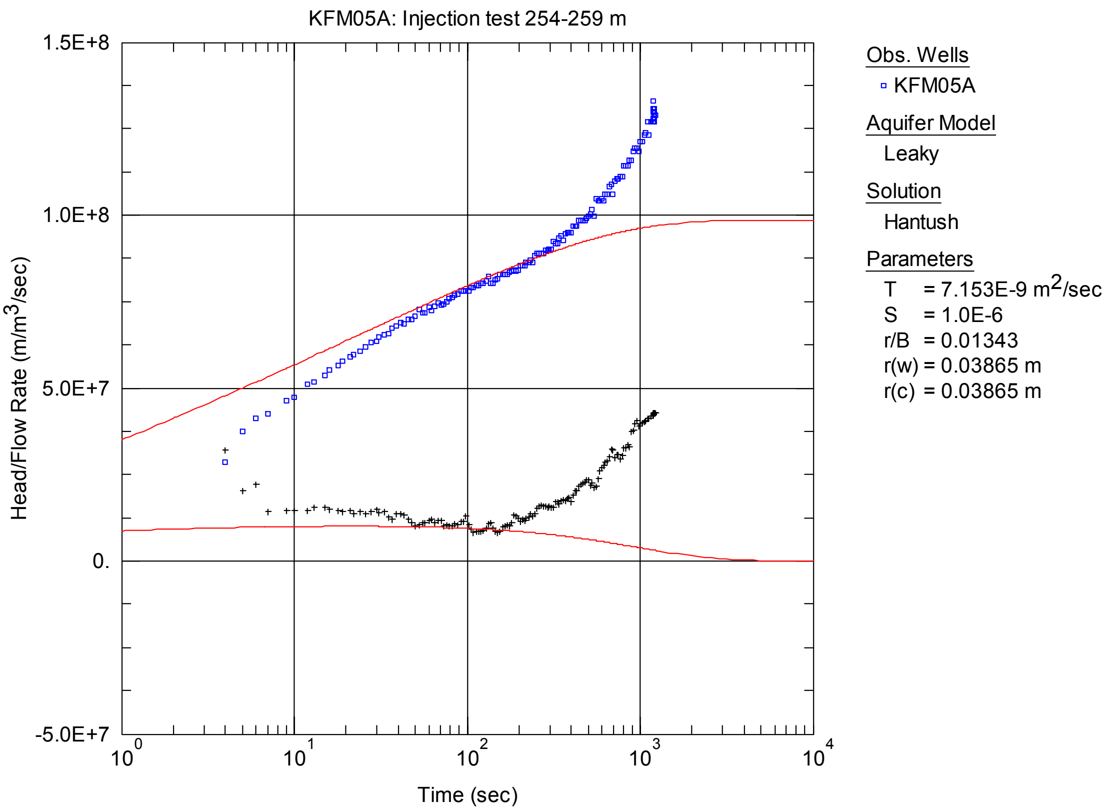


Figure A3-166. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-259.0 m in KFM05A.*

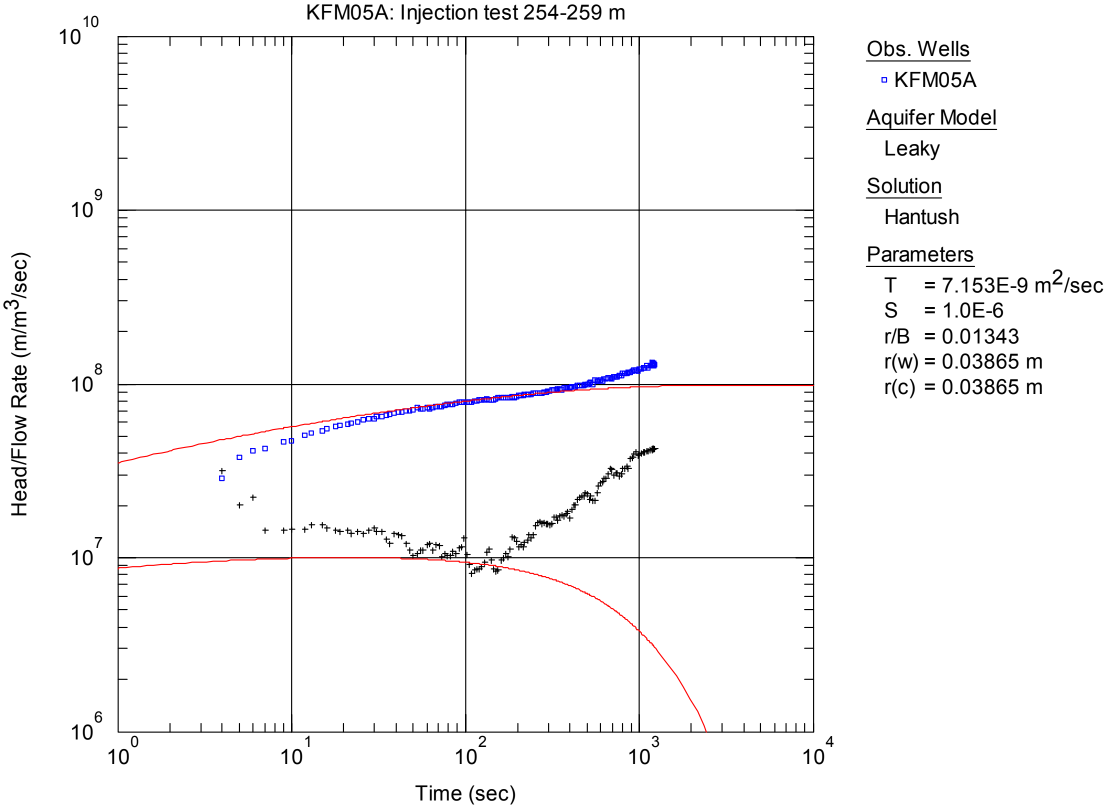


Figure A3-167. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-259.0 m in KFM05A.*

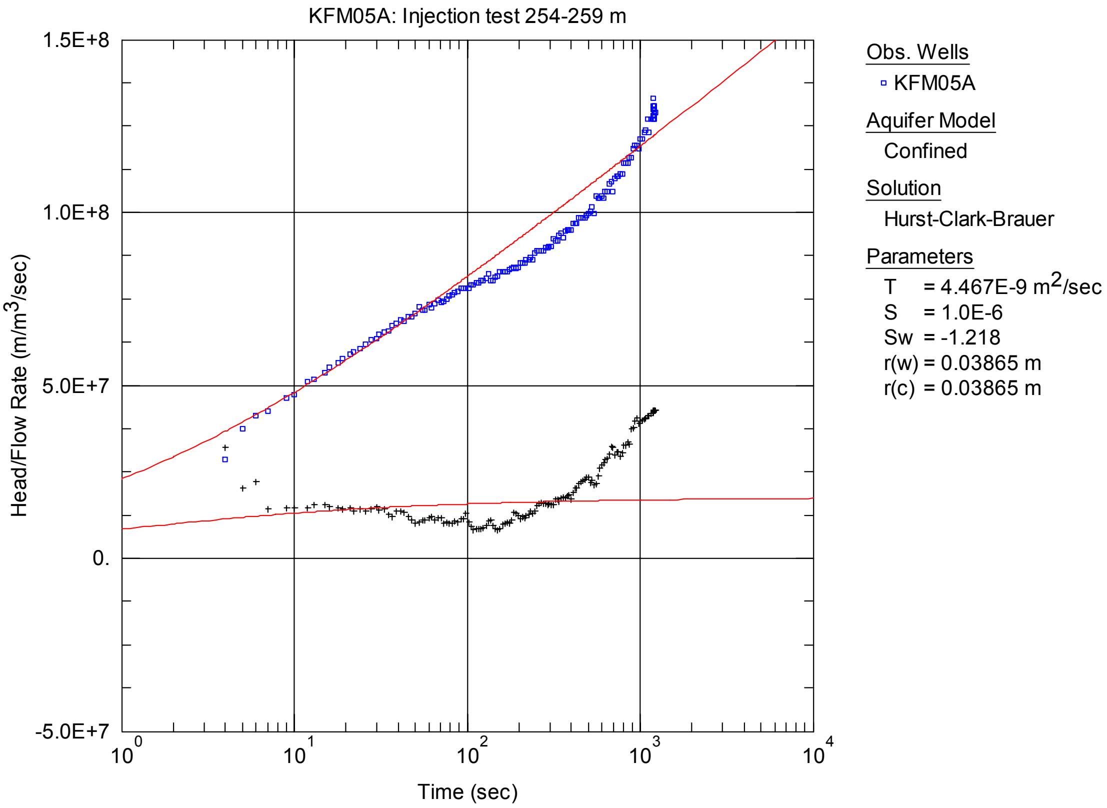


Figure A3-168. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-259.0 m in KFM05A.*

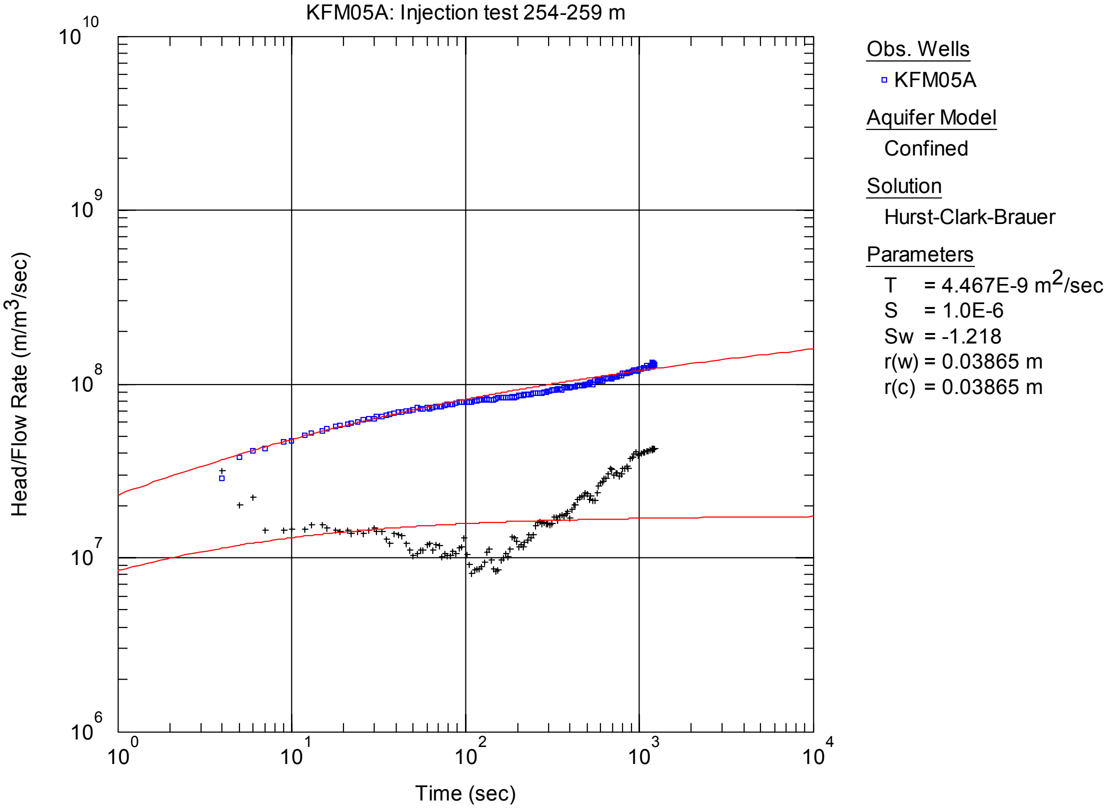


Figure A3-169. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 254.0-259.0 m in KFM05A.*

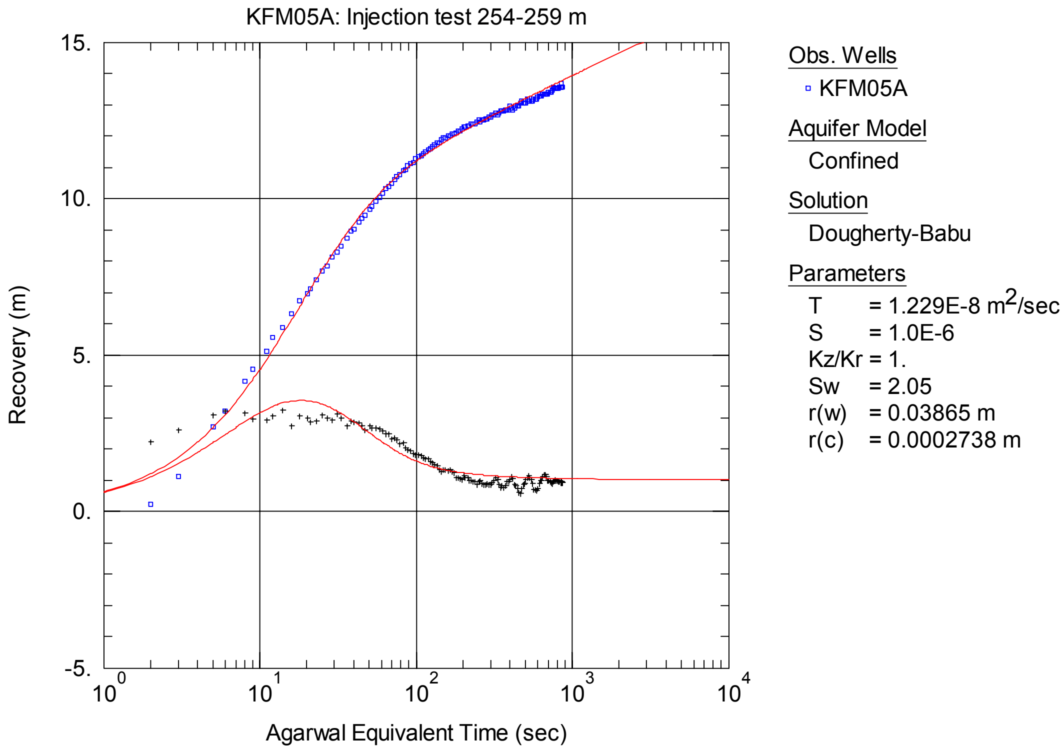


Figure A3-170. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 254.0-259.0 m in KFM05A.*

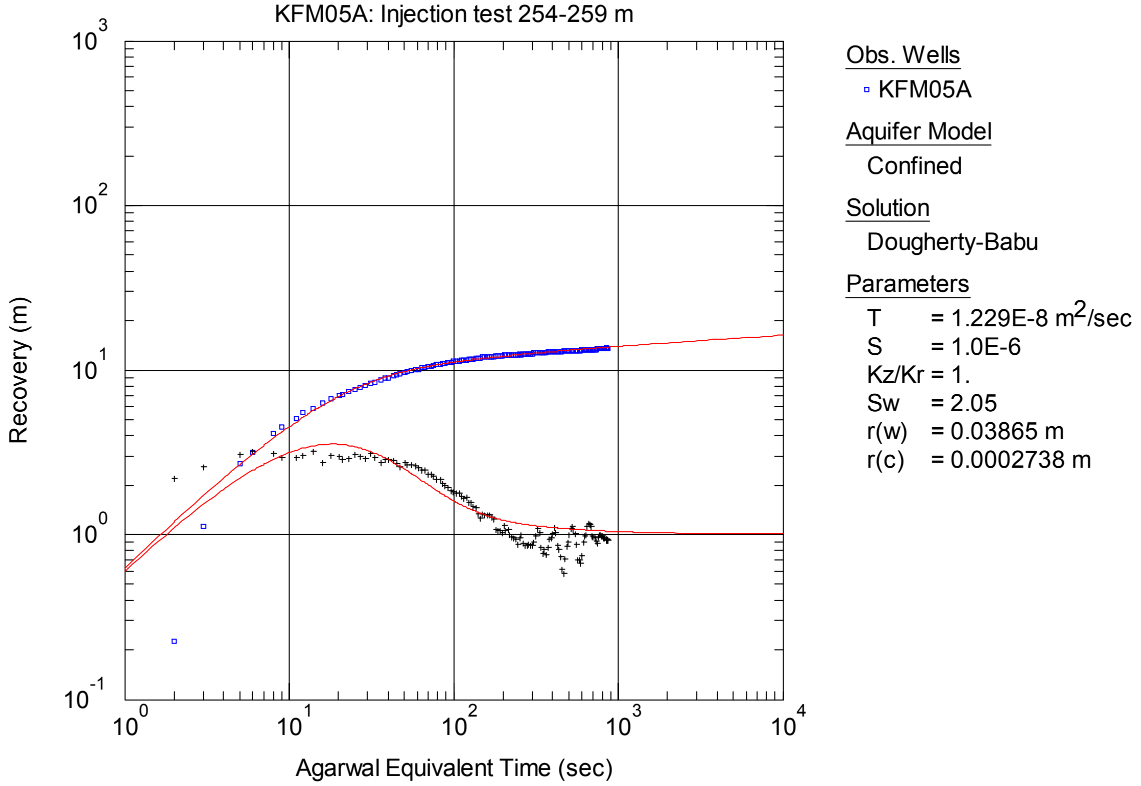


Figure A3-171. Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 254.0-259.0 m in KFM05A.

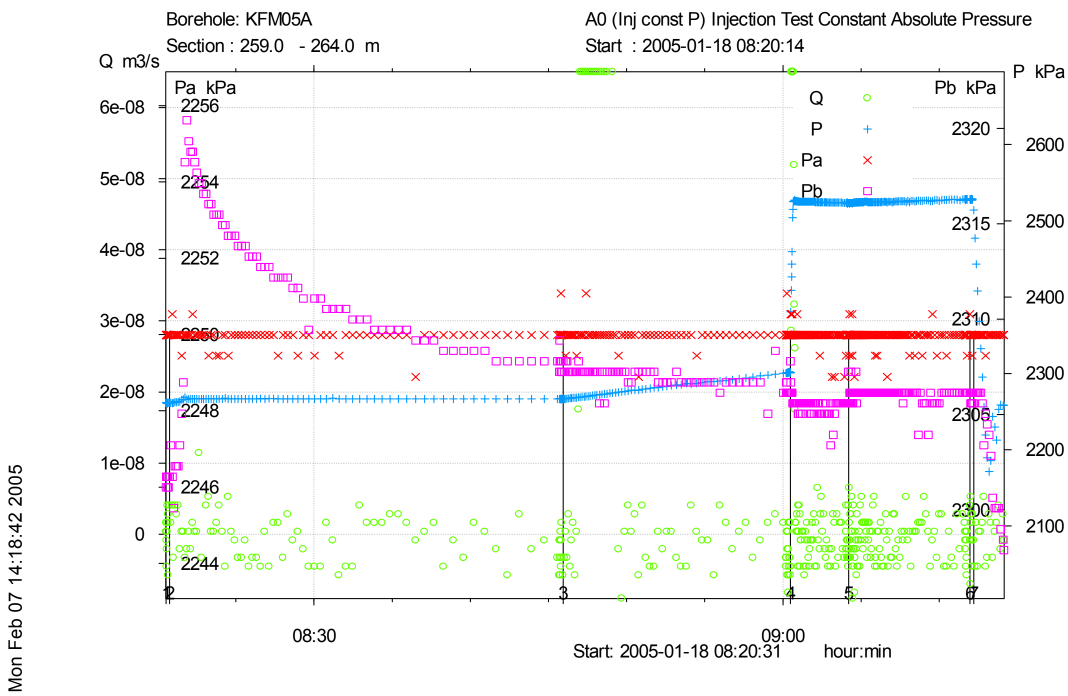


Figure A3-172. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 259.0-264.0 m in borehole KFM05A.

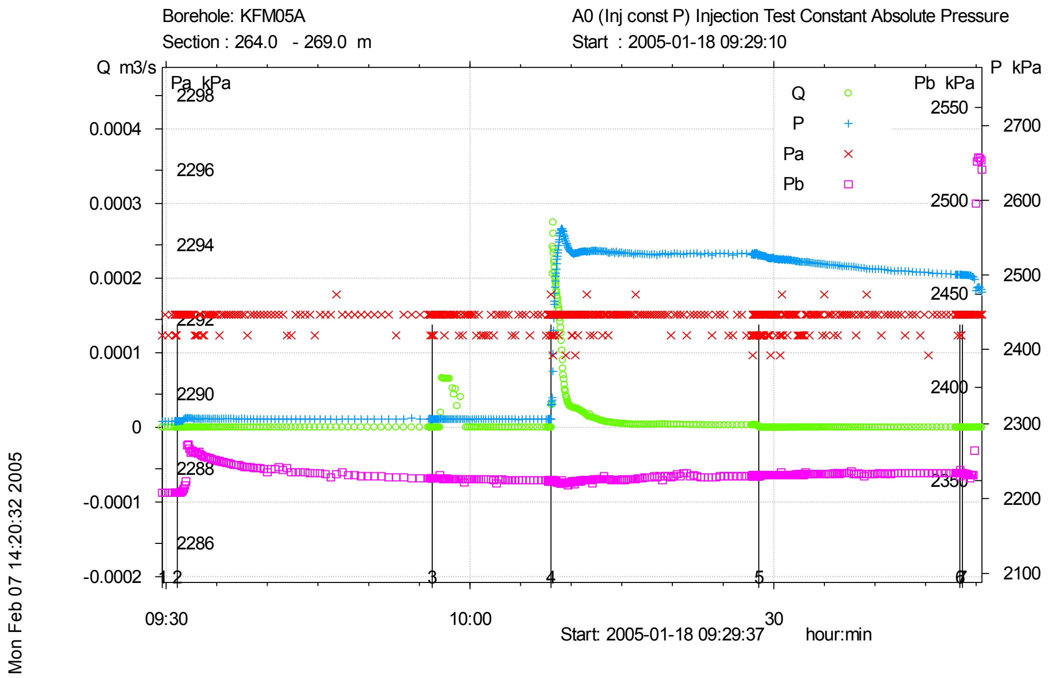


Figure A3-173. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 264.0-269.0 m in borehole KFM05A.*

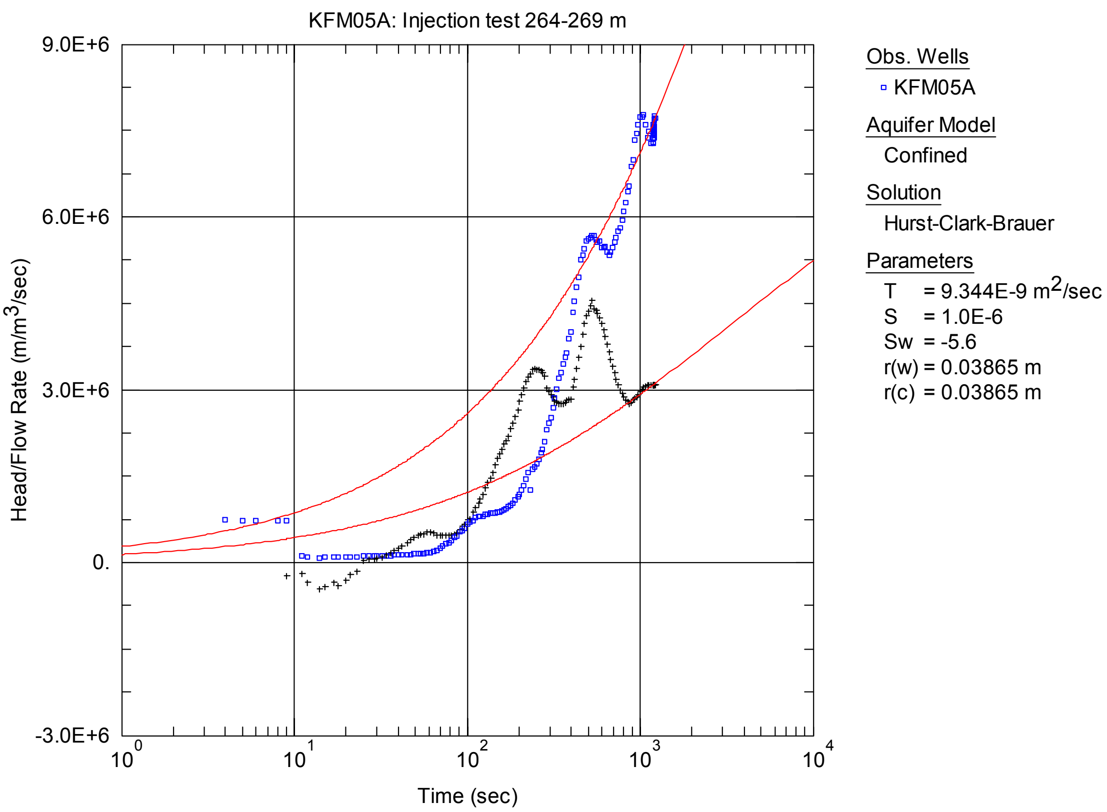


Figure A3-174. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 264.0-269.0 m in KFM05A.*

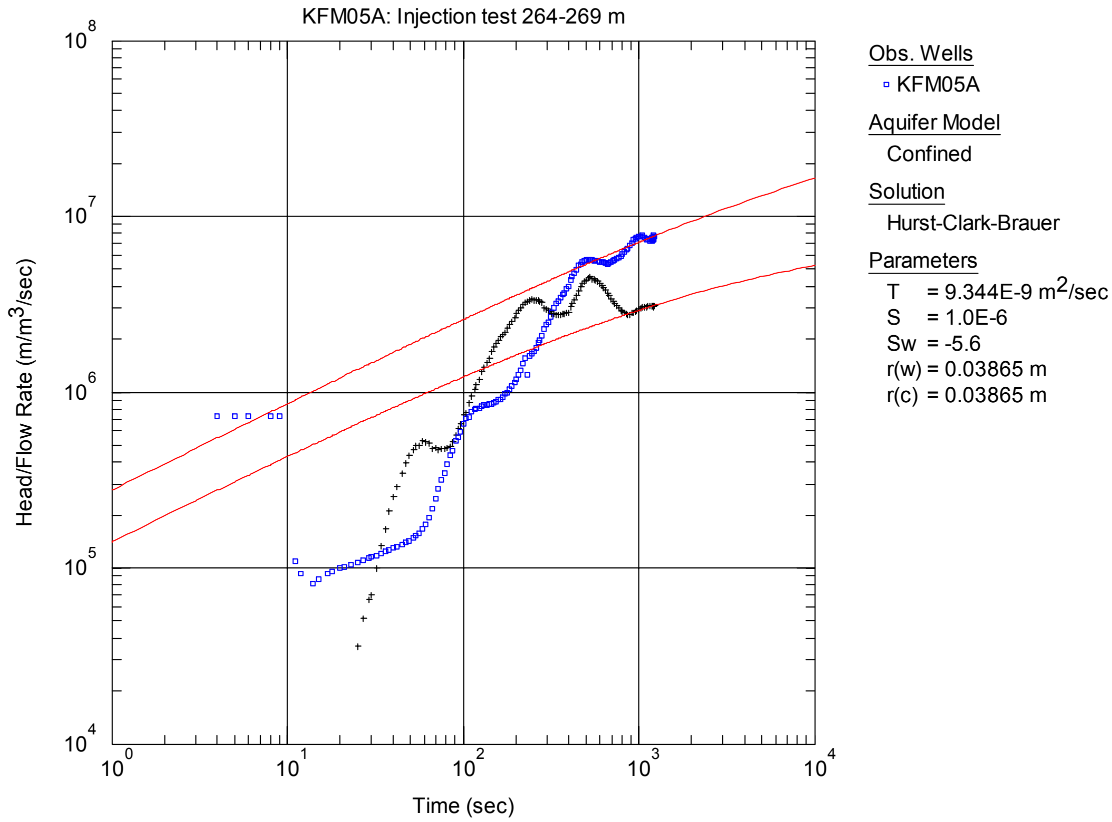


Figure A3-175. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 264.0-269.0 m in KFM05A.*

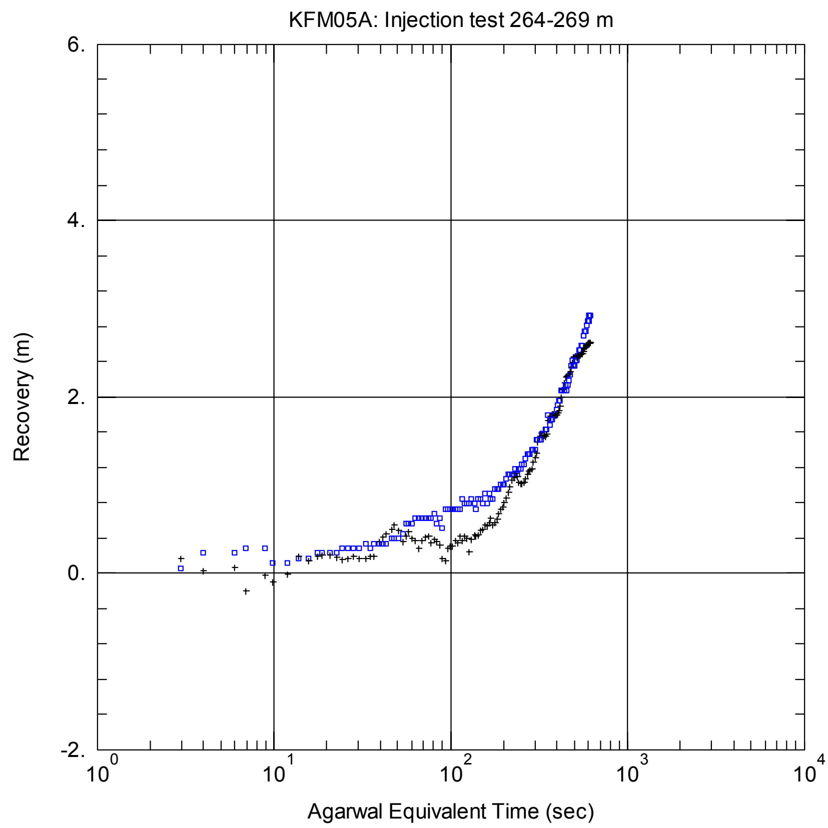


Figure A3-176. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 264.0-269.0 m in KFM05A.*

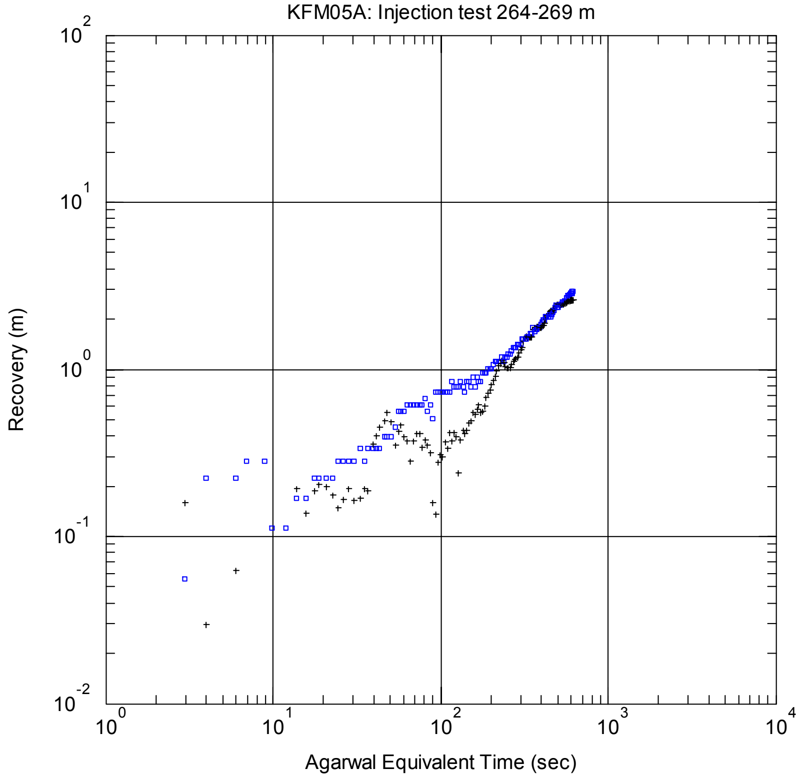


Figure A3-177. Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 264.0-269.0 m in KFM05A.

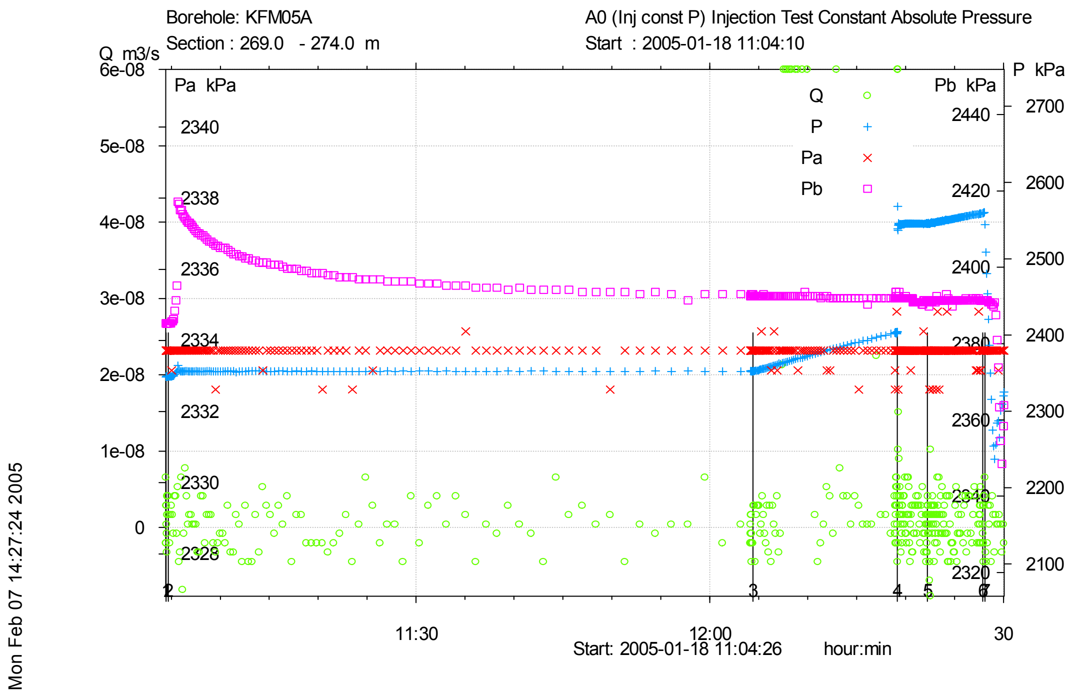


Figure A3-178. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 269.0-274.0 m in borehole KFM05A.

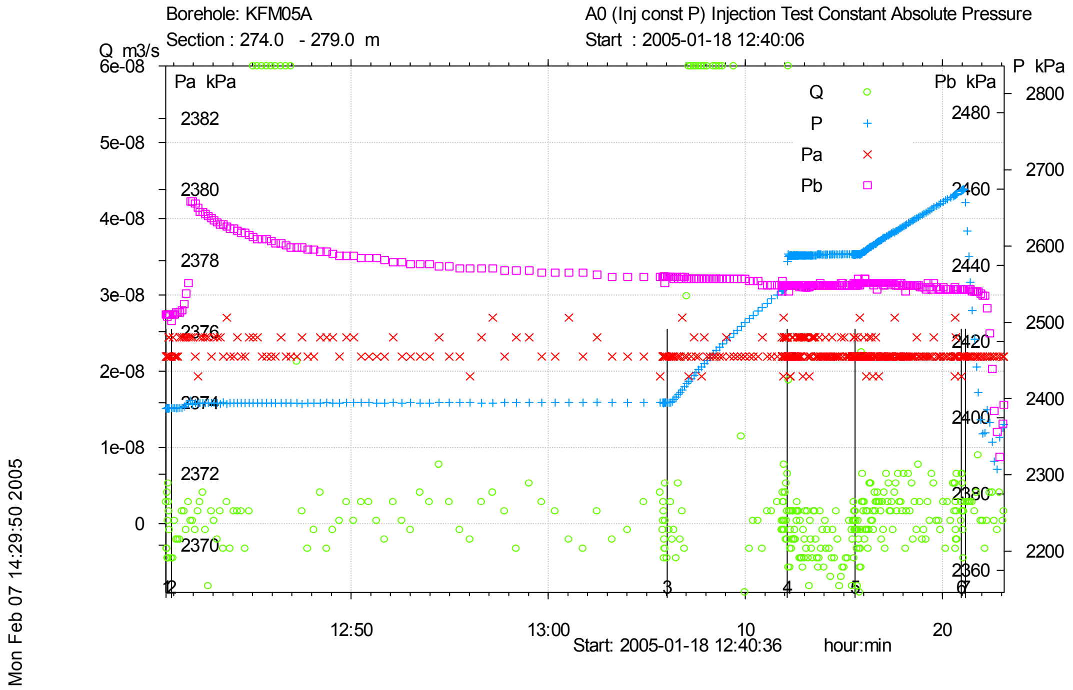


Figure A3-179. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 274.0-279.0 m in borehole KFM05A.*

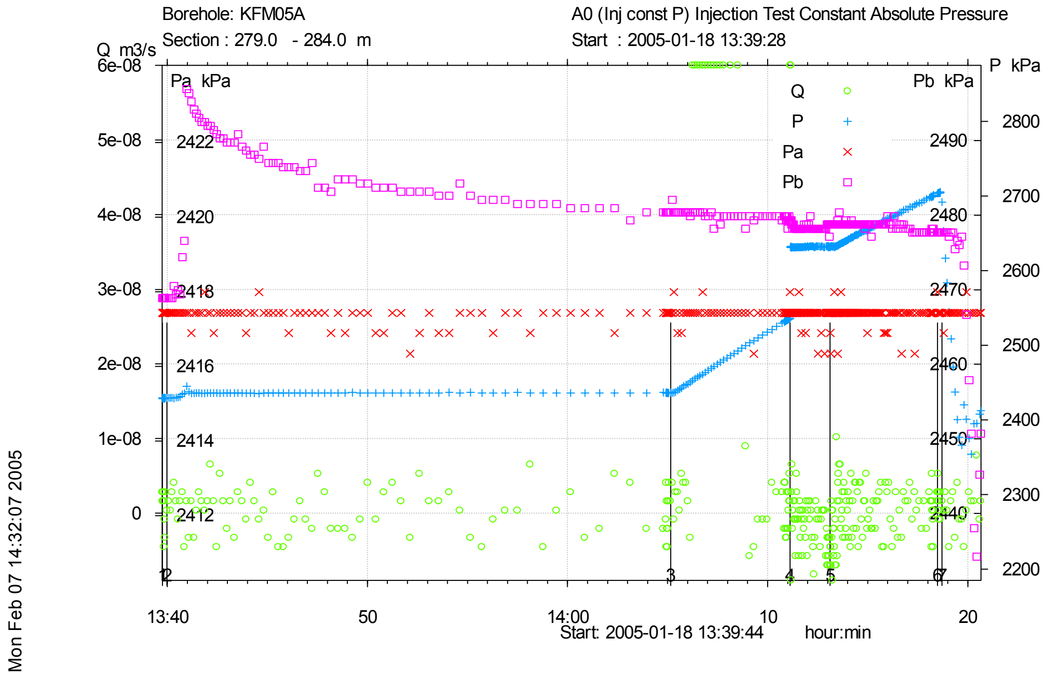


Figure A3-180. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 279.0-284.0 m in borehole KFM05A.*

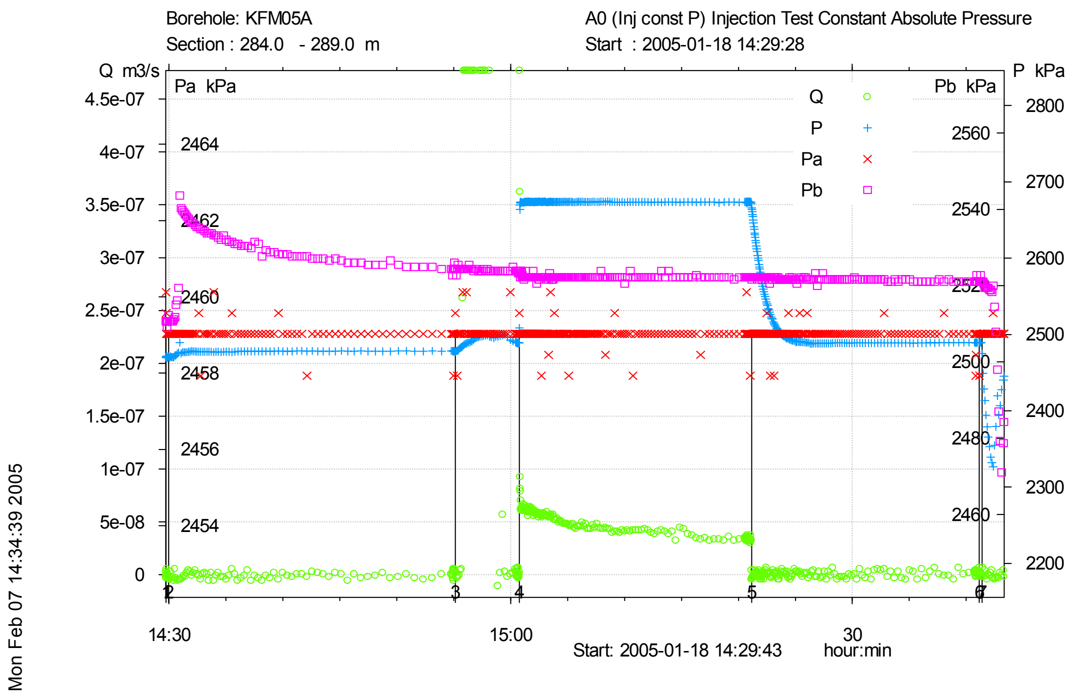


Figure A3-181. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time the injection test in section 284.0-289.0 m in borehole KFM05A.

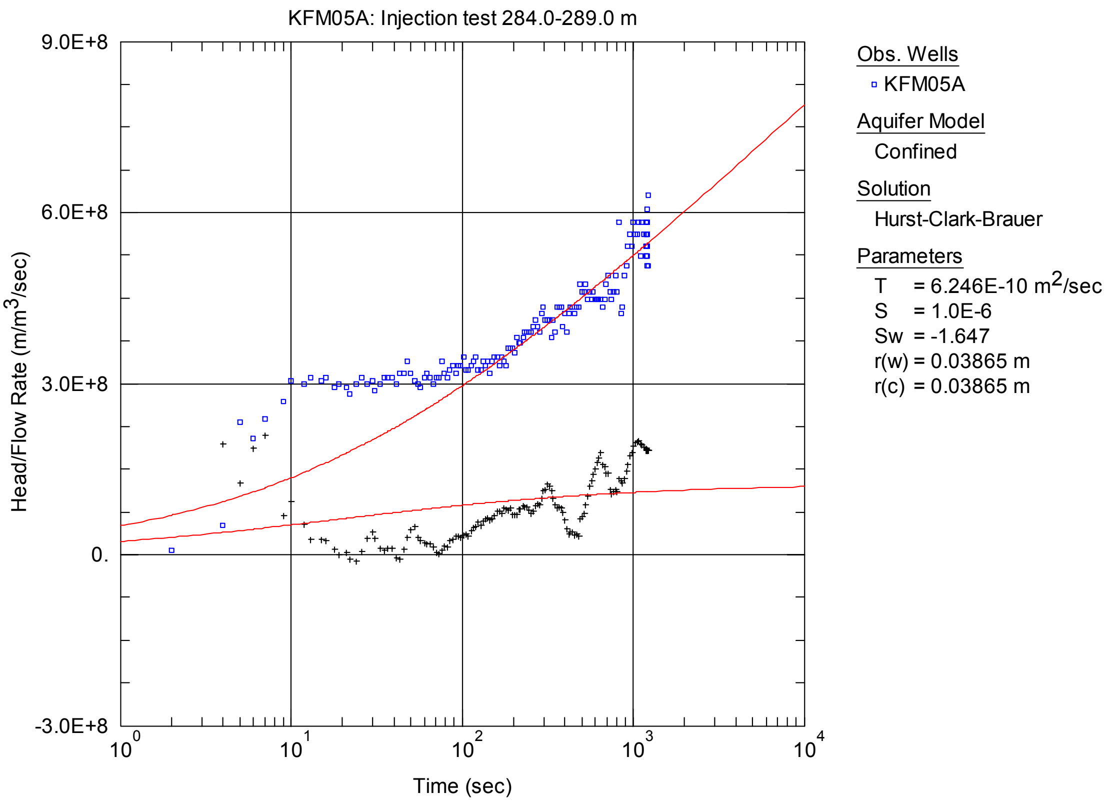


Figure A3-182. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A.

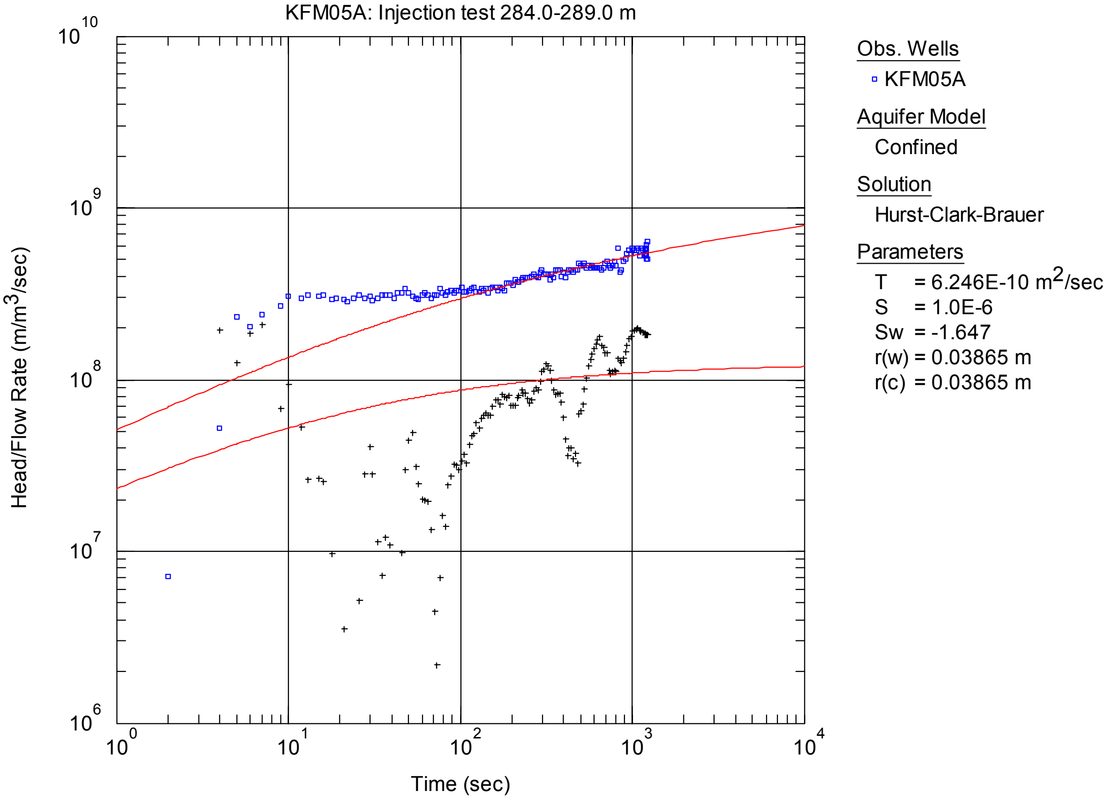


Figure A3-183. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A.*

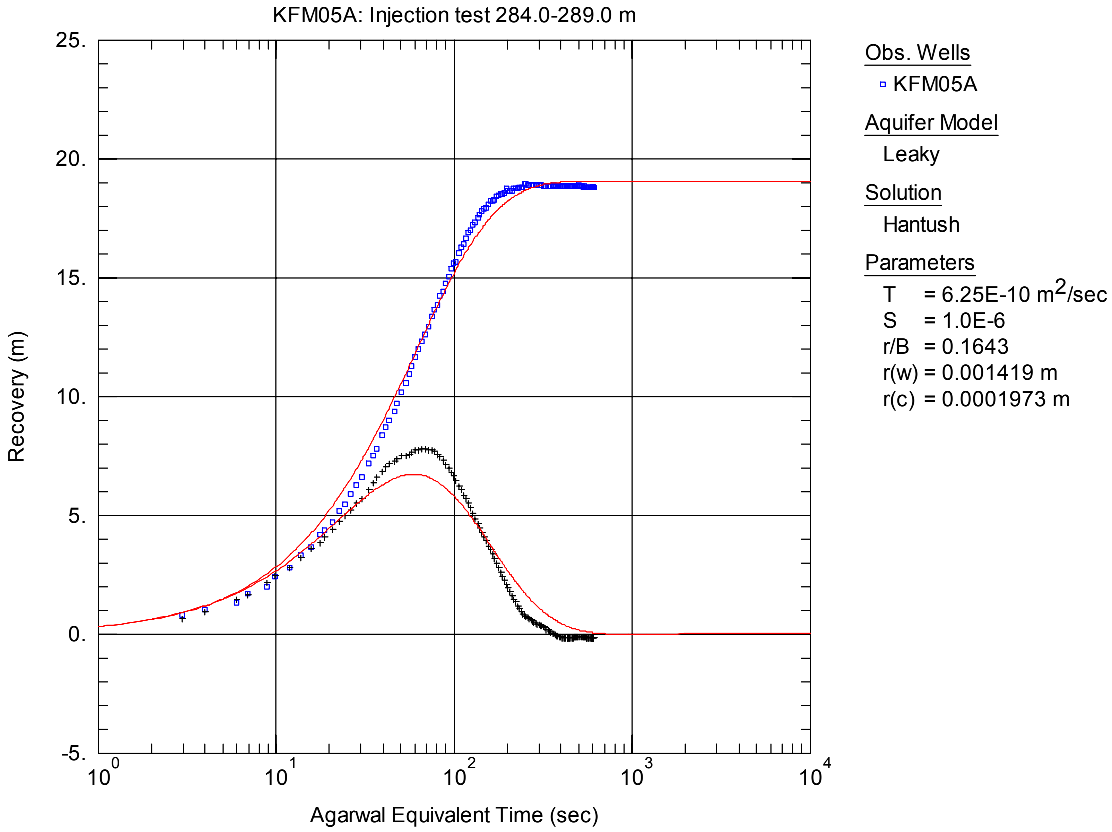


Figure A3-184. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A.*

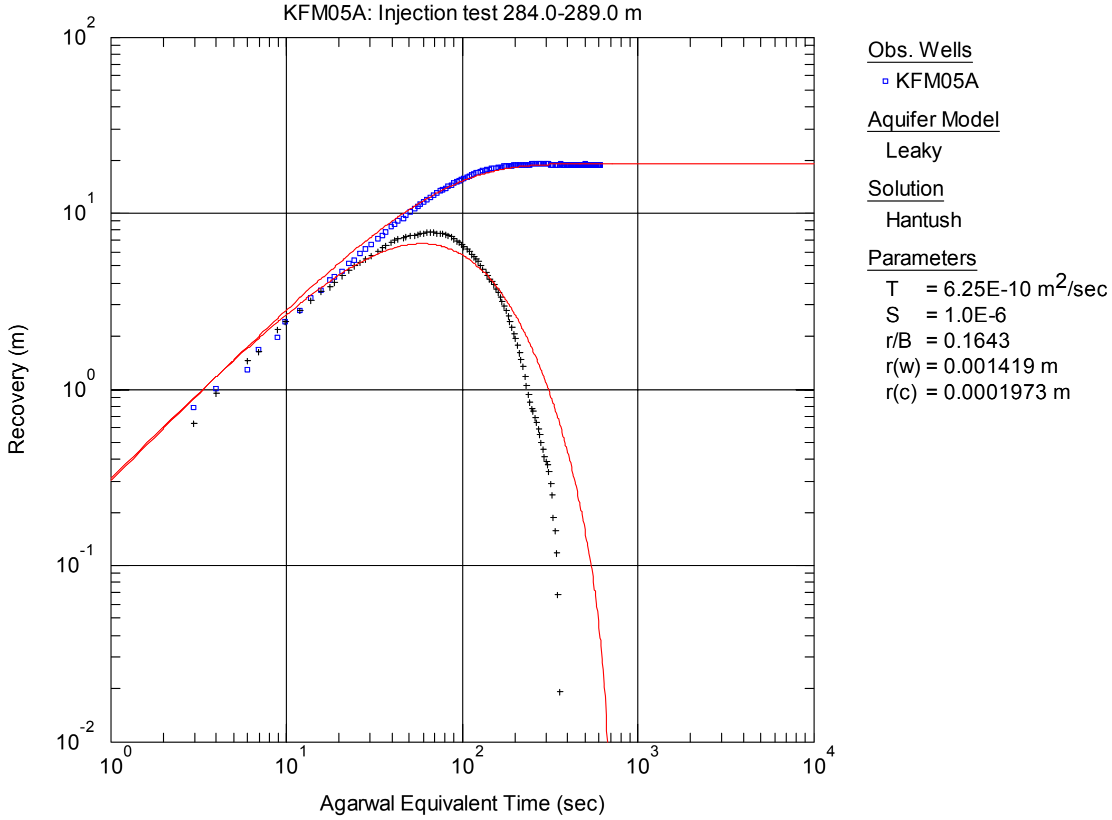


***Figure A3-185.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A.*

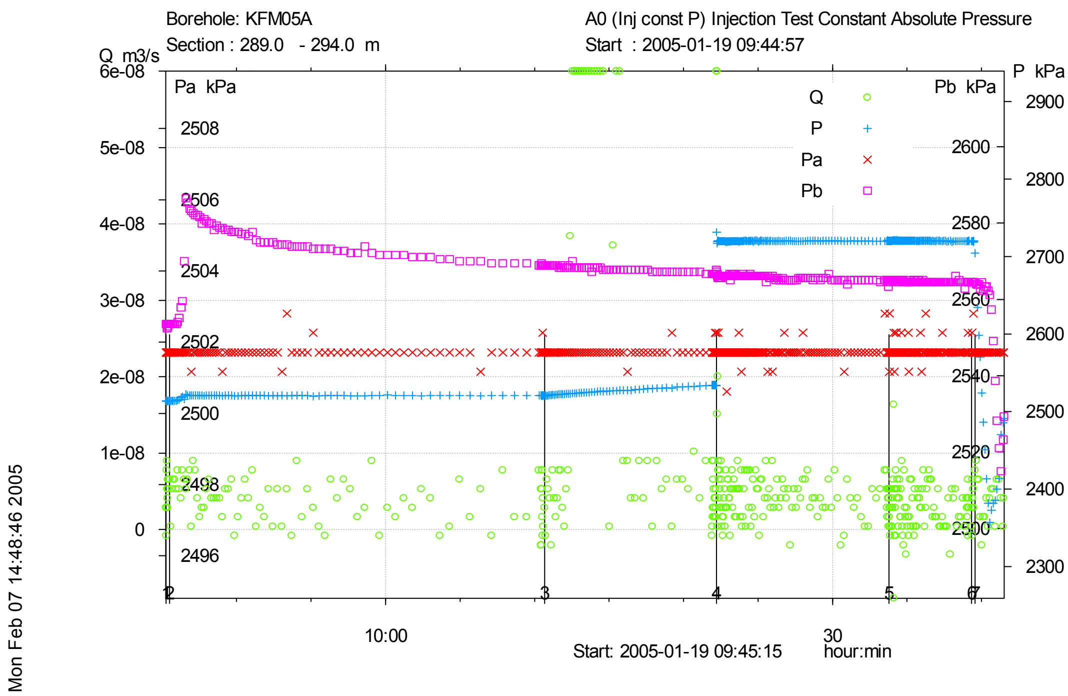


***Figure A3-186.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 289-294 m in borehole KFM05A.*

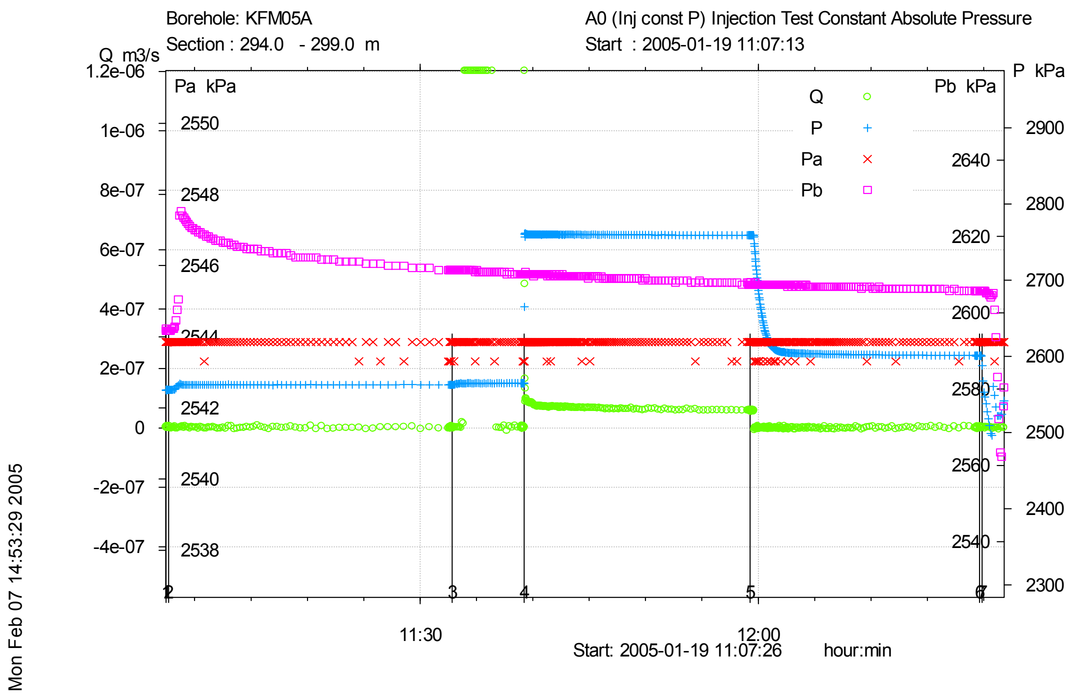


__Figure A3-187.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 294.0-299.0 m in borehole KFM05A.

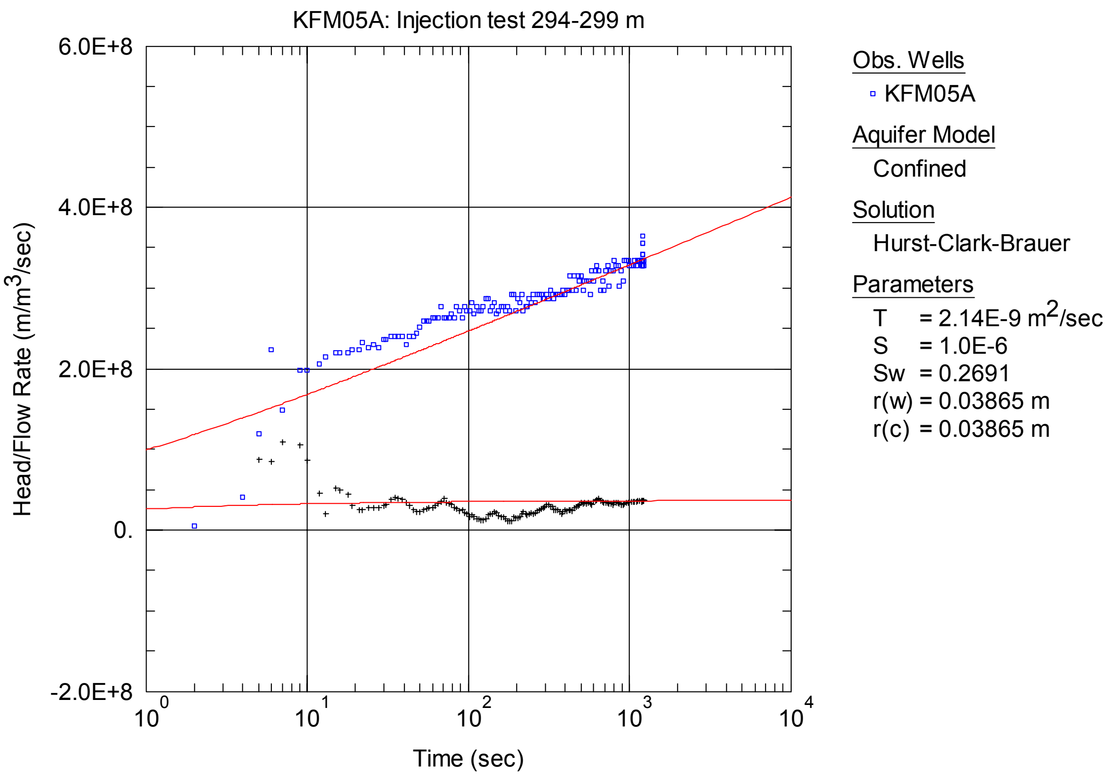


__Figure A3-188.__ Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 294.0-299.0 m in KFM05A.

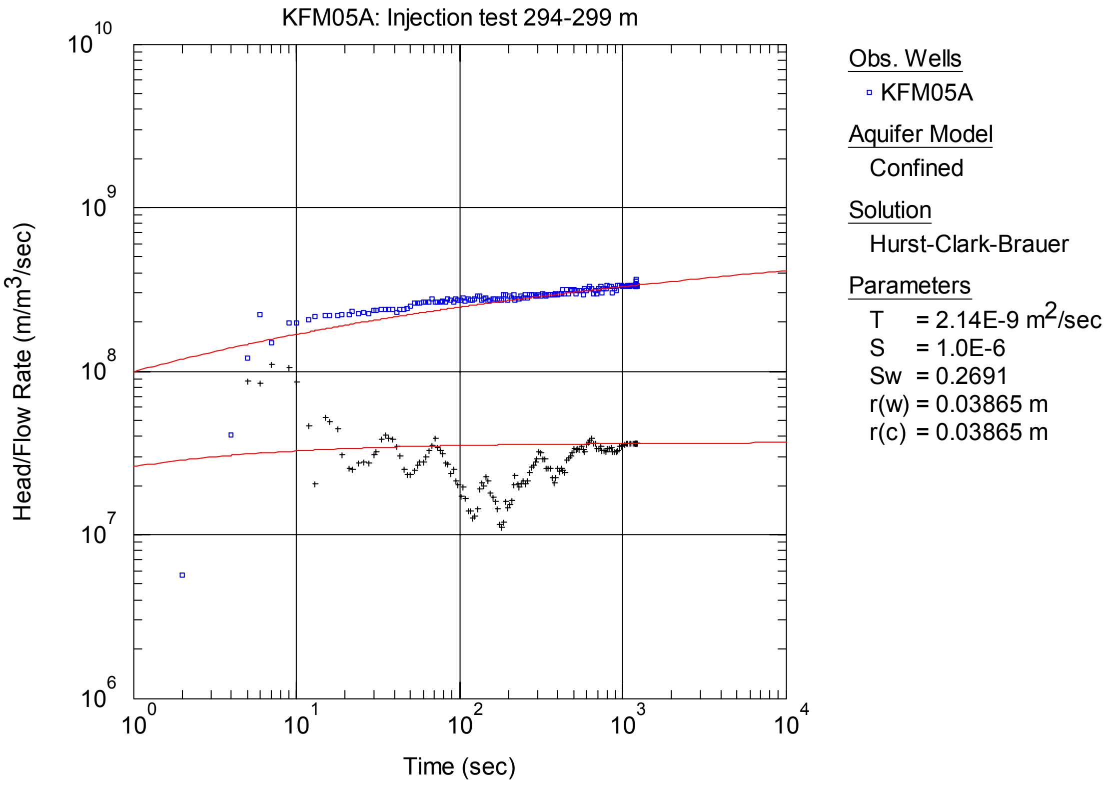


***Figure A3-189.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 294.0-299.0 m in KFM05A.*

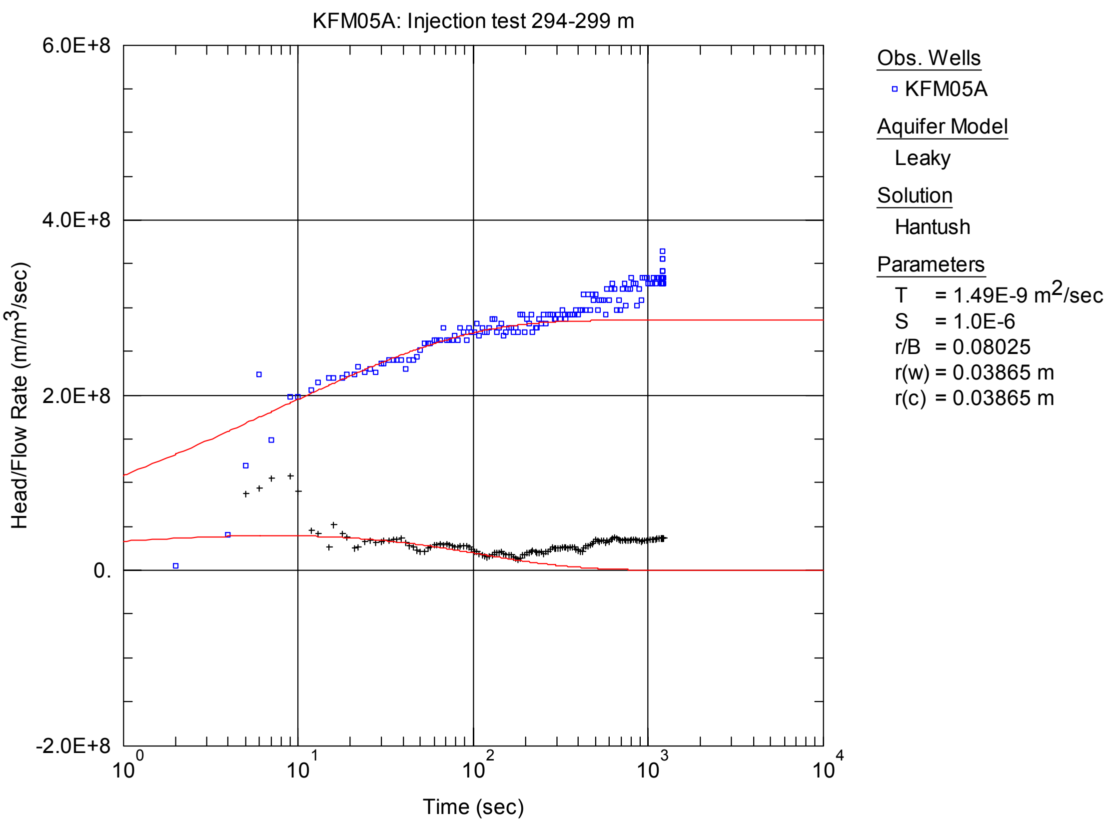


***Figure A3-190.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Hantush solution, from the injection test in section 294.0-299.0 m in KFM05A.*

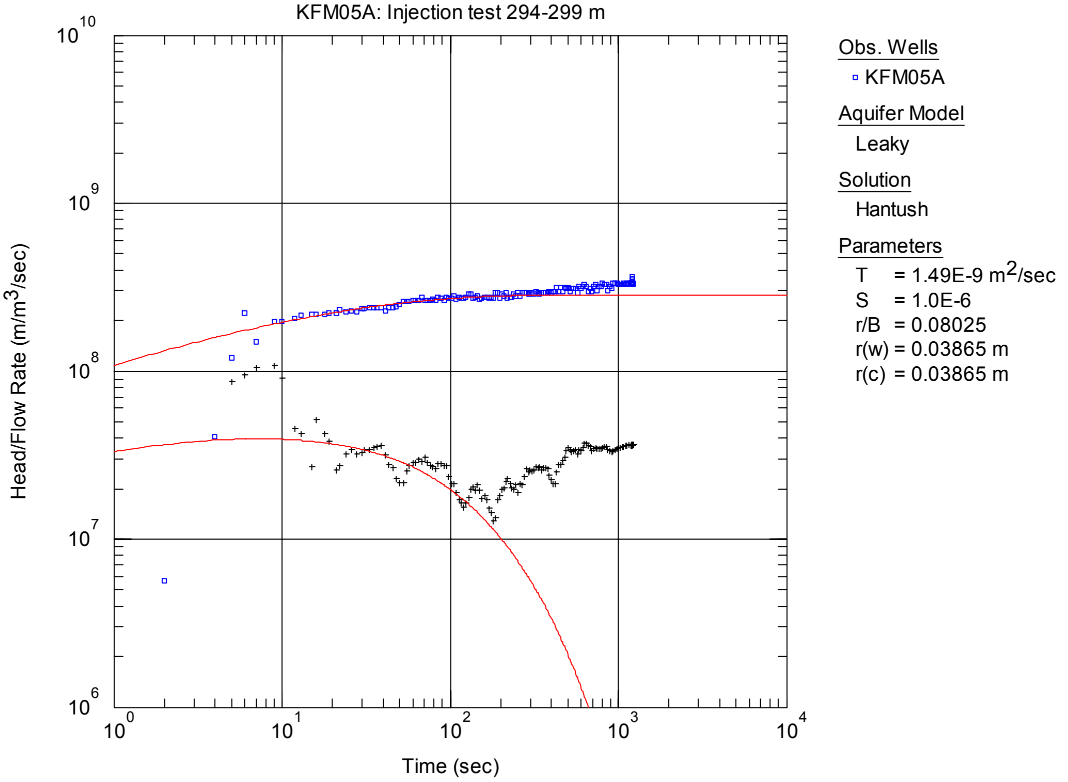


***Figure A3-191.** Log-log plot of head/flow rate (□) and derivative (+) versus time, showing fit to the Hantush solution, from the injection test in section 294.0-299.0 m in KFM05A.*

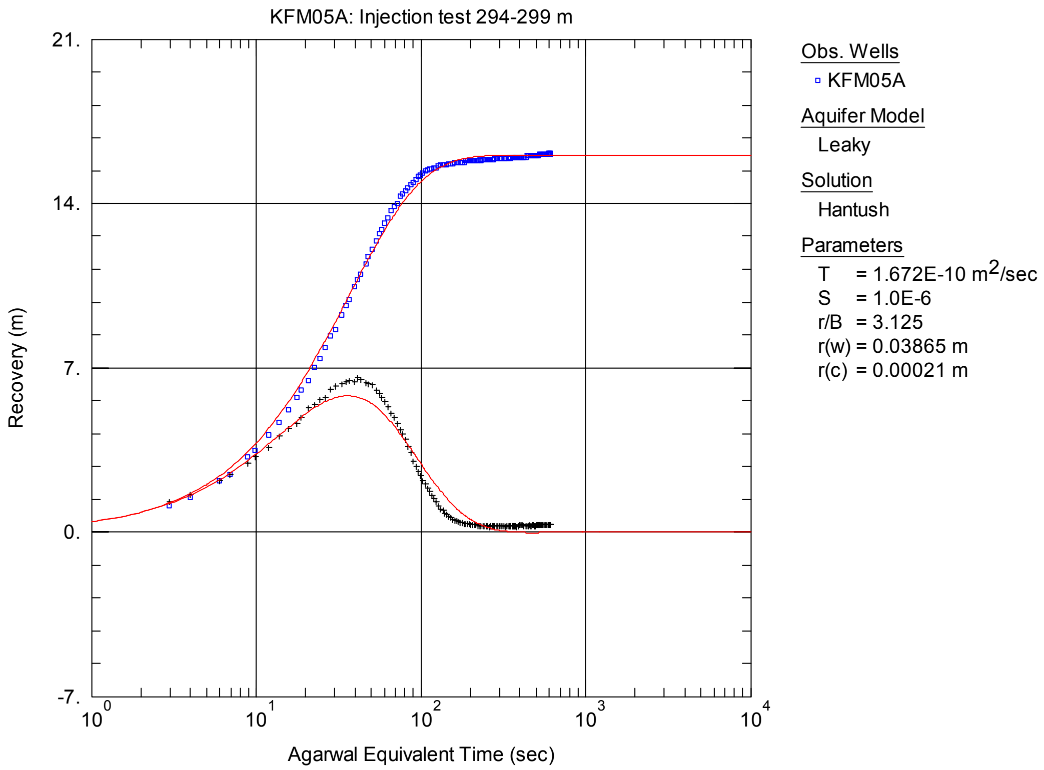


***Figure A3-192.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 294.0-299.0 m in KFM05A.*

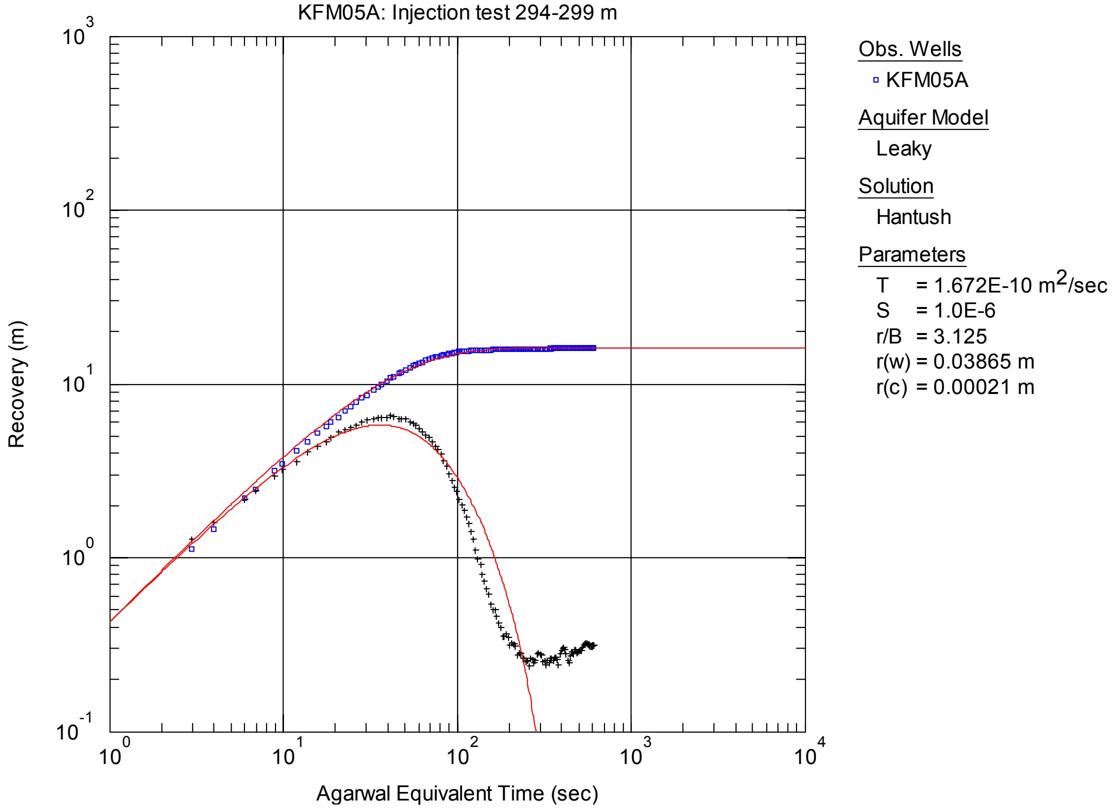


***Figure A3-193.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 294.0-299.0 m in KFM05A.*

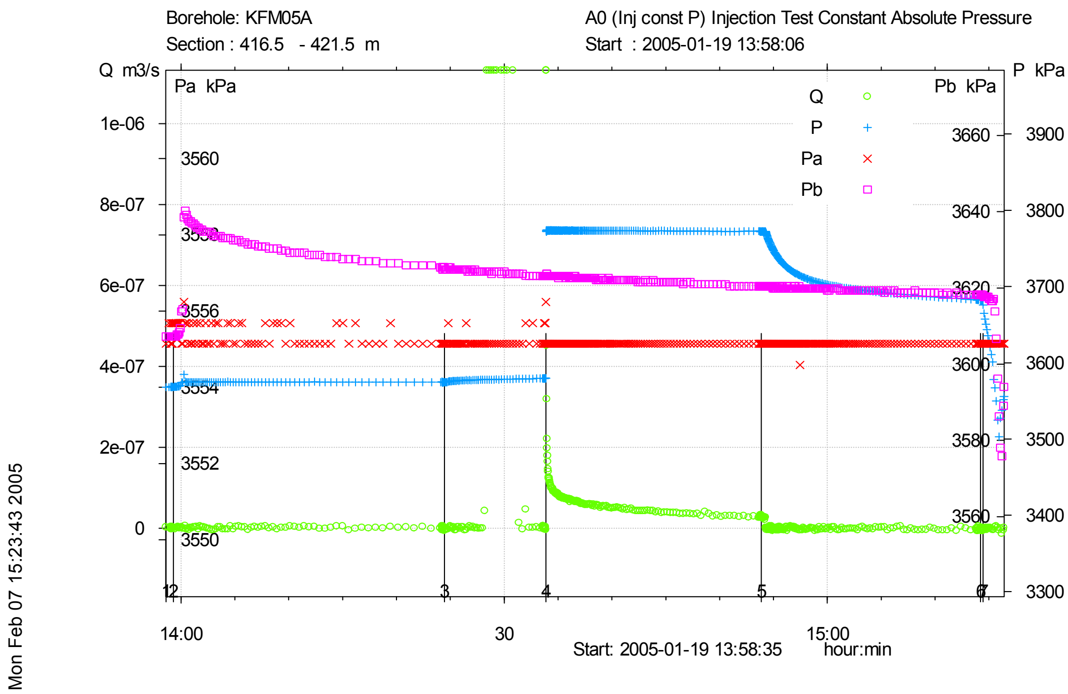


***Figure A3-194.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 416.5-421.5 m in borehole KFM05A.*

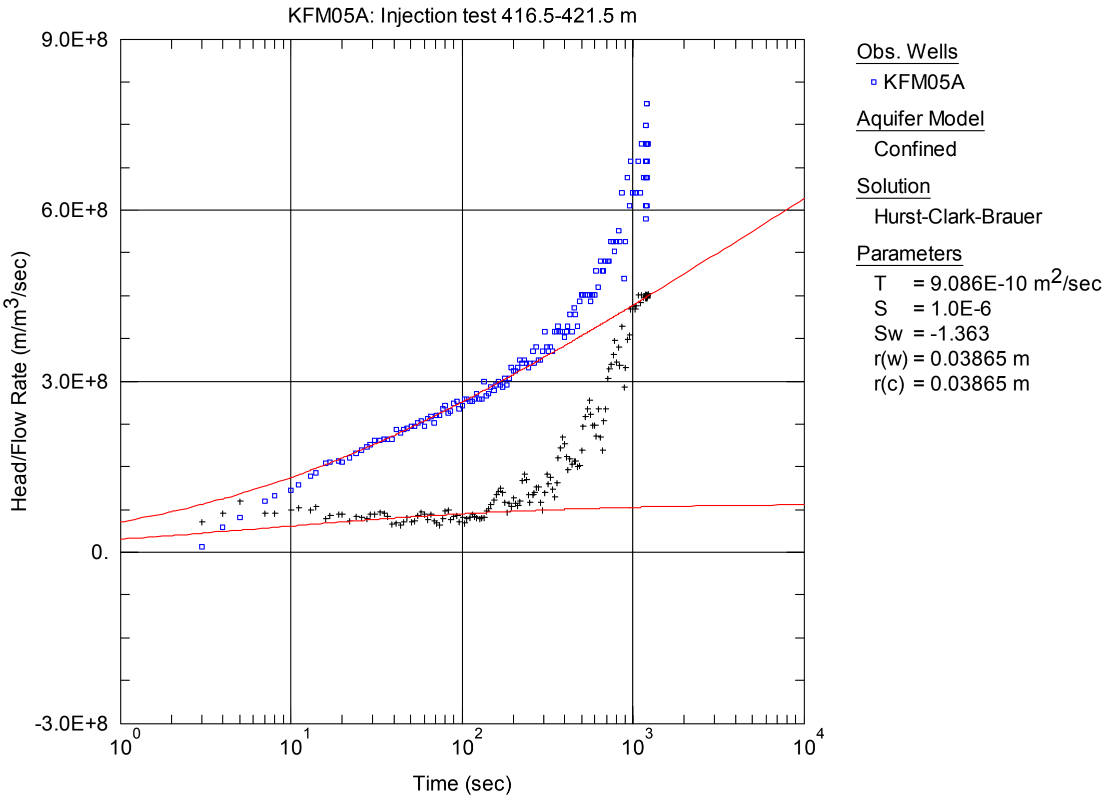


***Figure A3-195.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-421.5 m in KFM05A.*

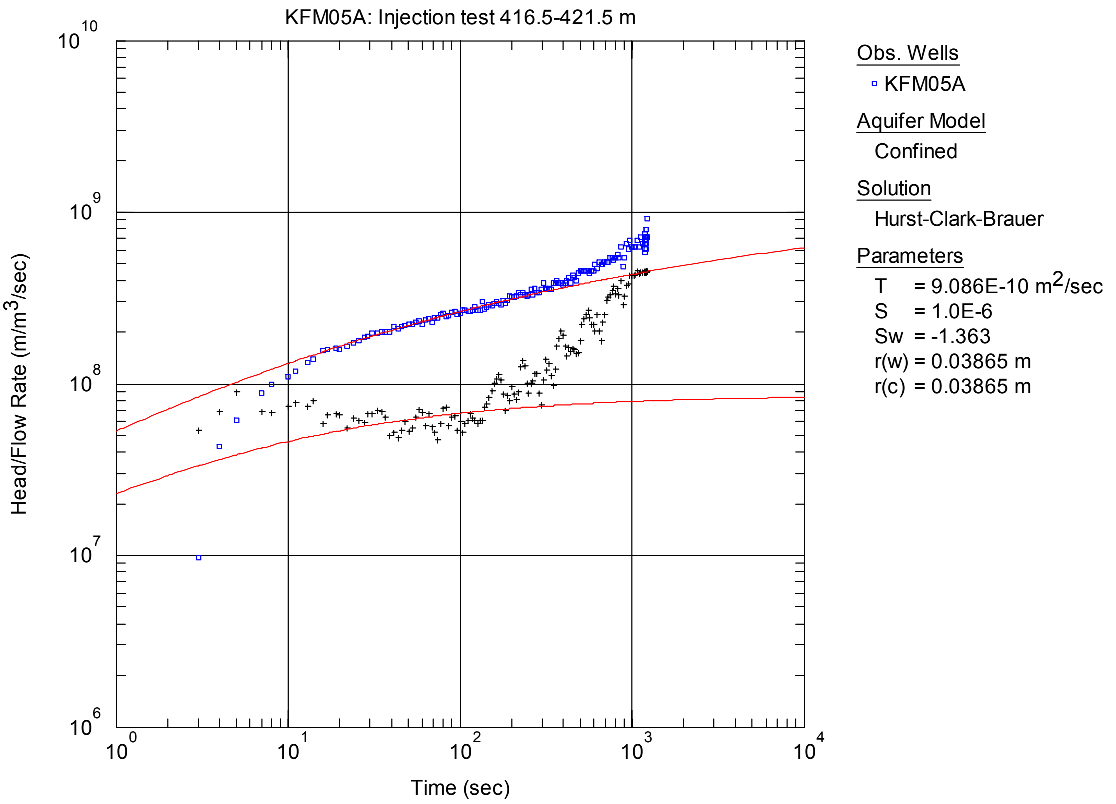


***Figure A3-196.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 416.5-421.5 m in KFM05A.*

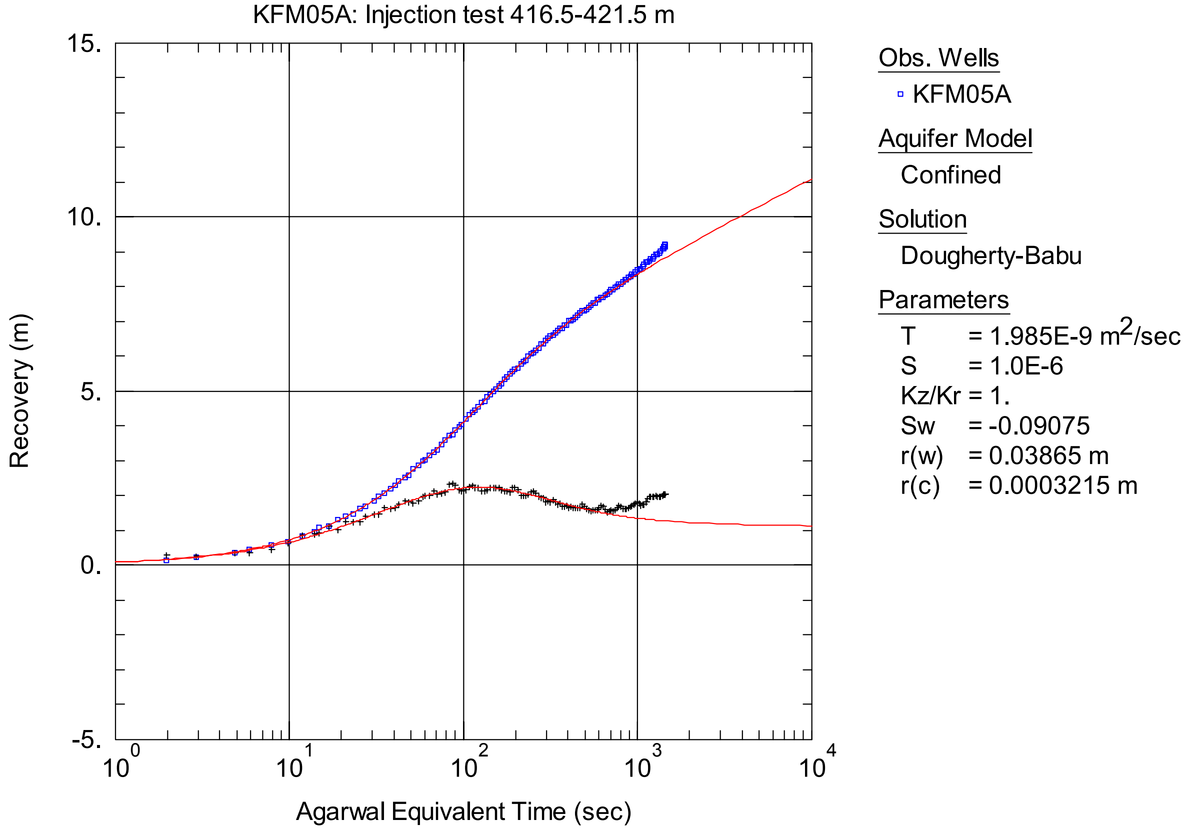


***Figure A3-197.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-421.5 m in KFM05A.*

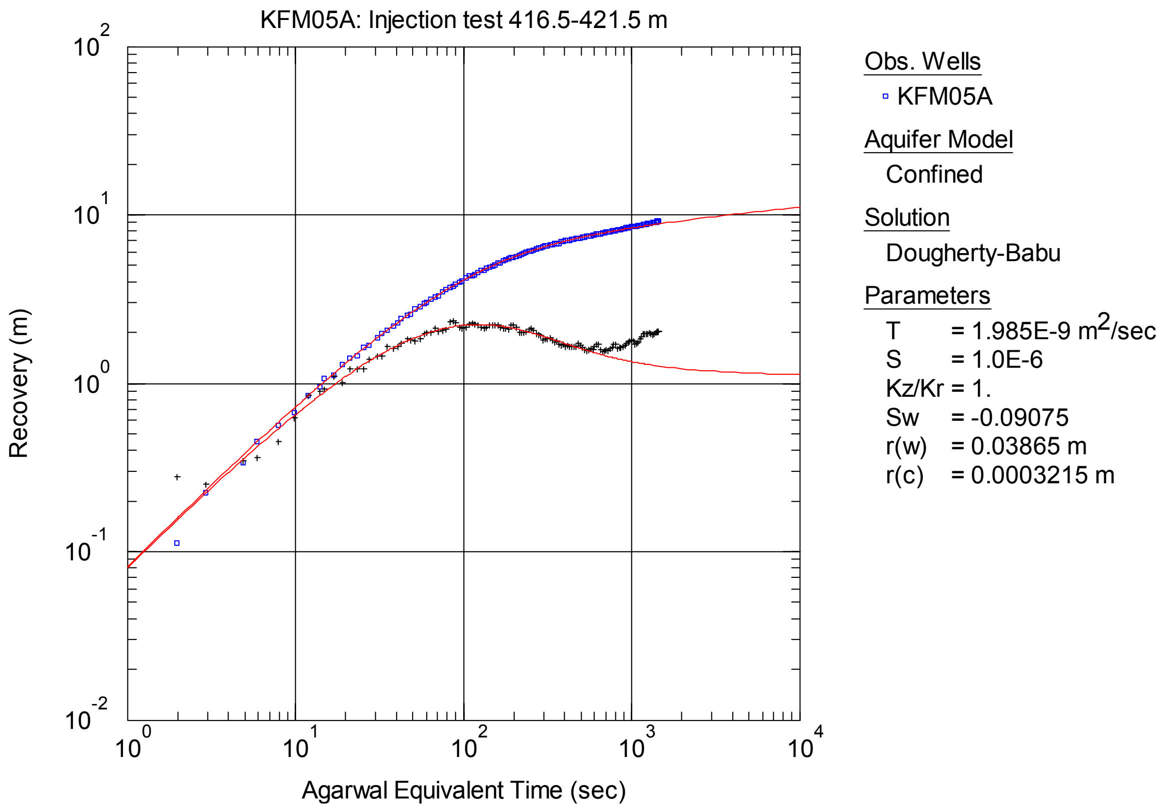


***Figure A3-198.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 416.5-421.5 m in KFM05A.*

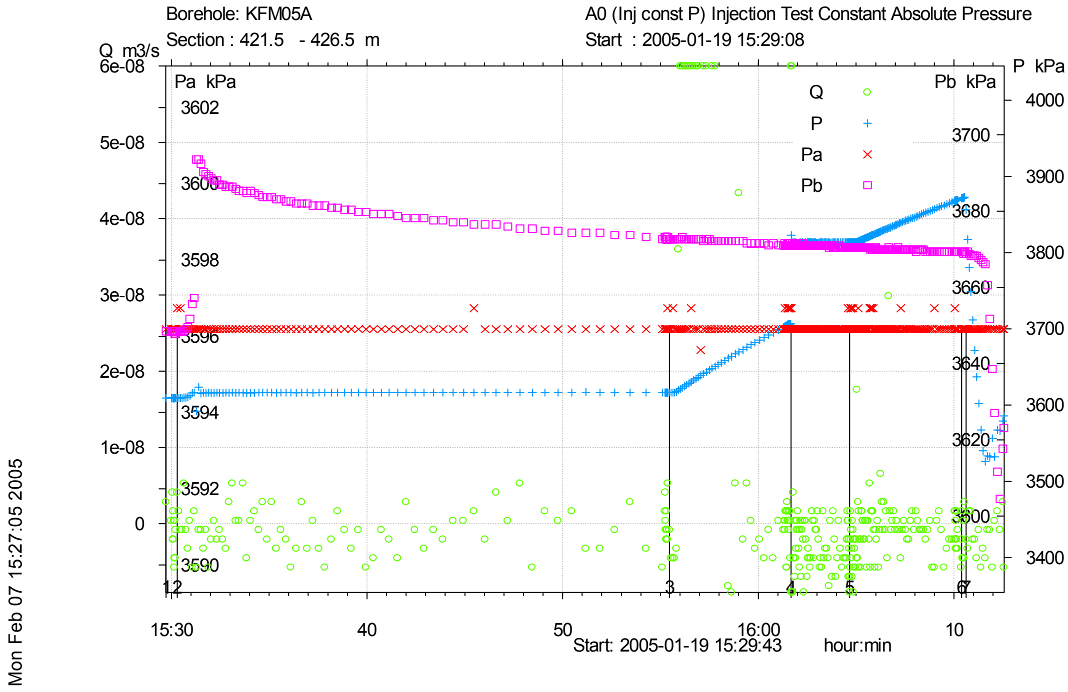


__Figure A3-199.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 421.5-426.5 m in borehole KFM05A.

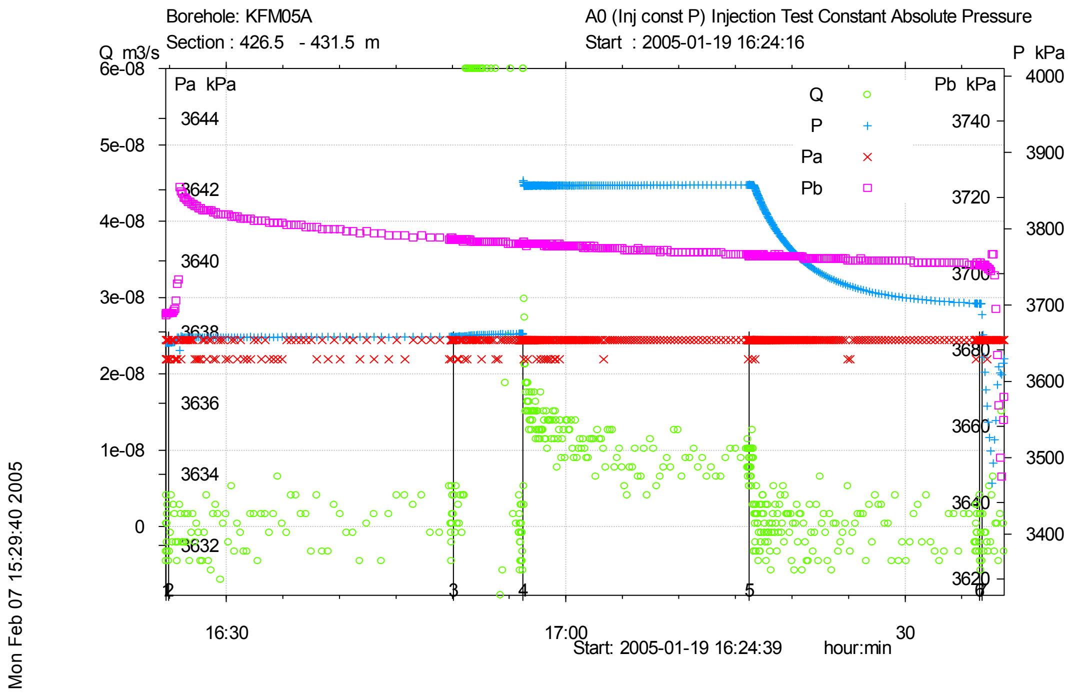


__Figure A3-200.__ Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 426.5-431.5 m in borehole KFM05A.

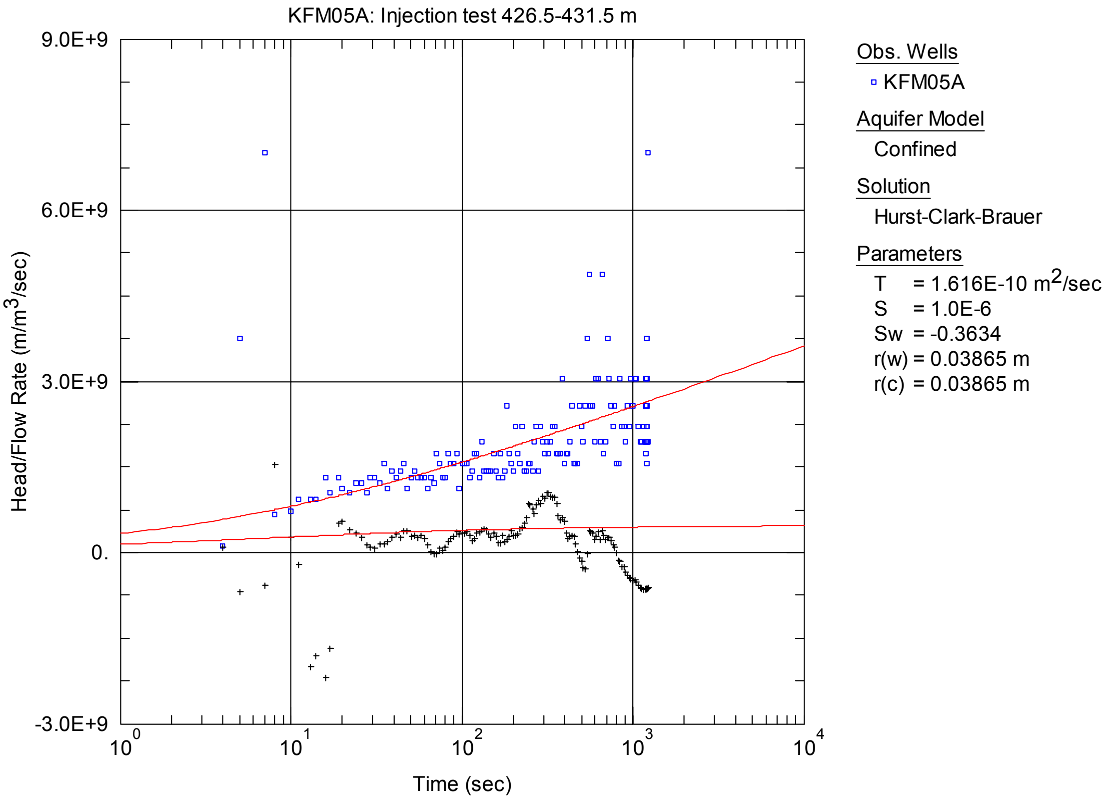


Figure A3-201. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 426.5-431.5 m in KFM05A.*

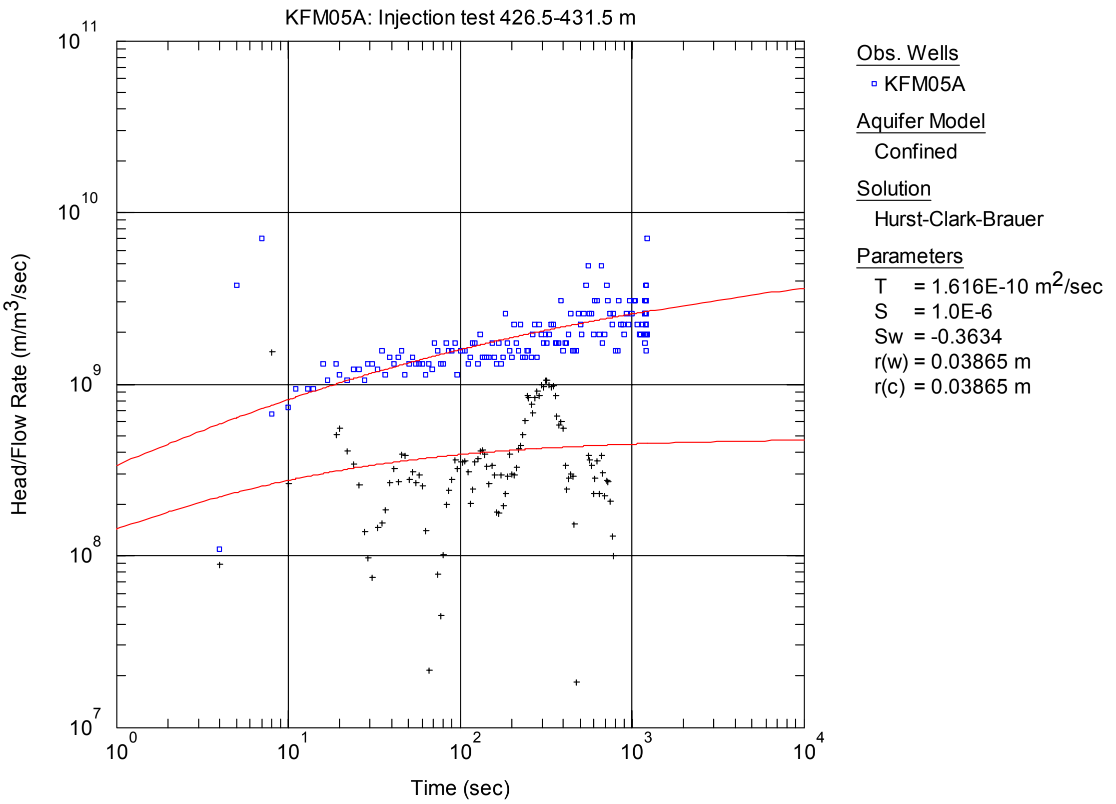


Figure A3-202. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 426.5-431.5 m in KFM05A.*

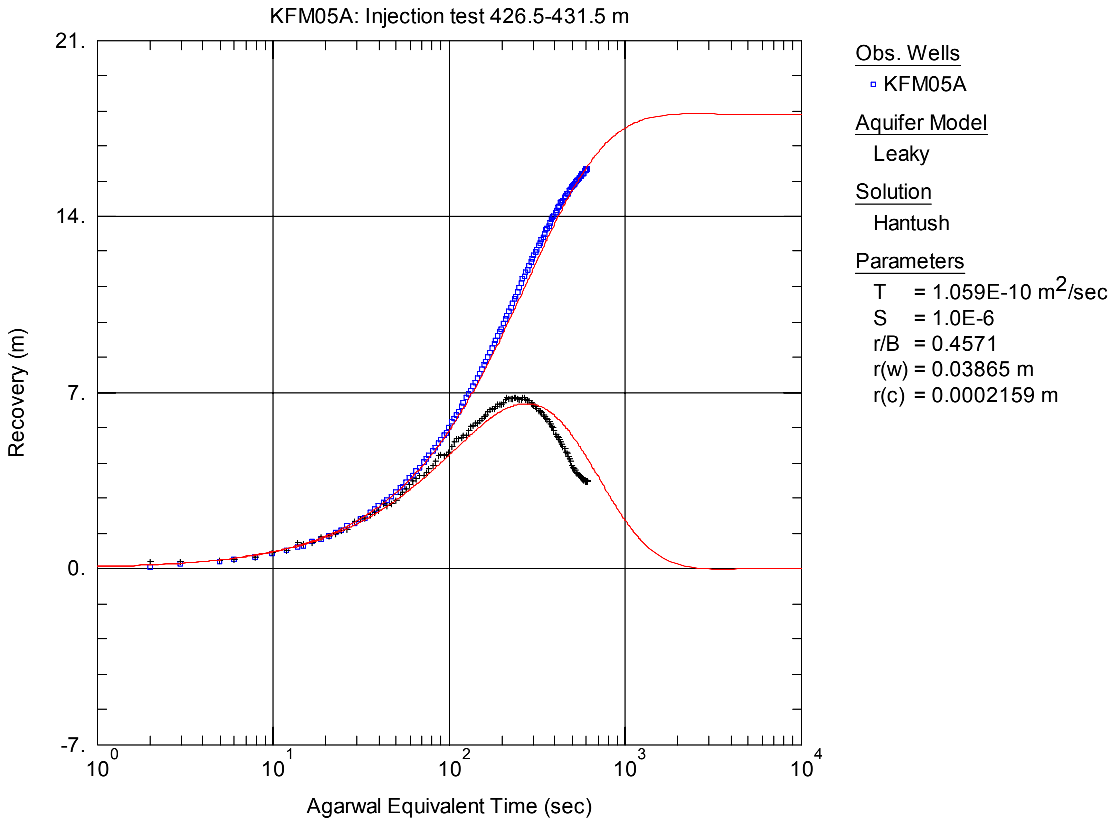


Figure A3-203. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 426.5-431.5 m in KFM05A.*

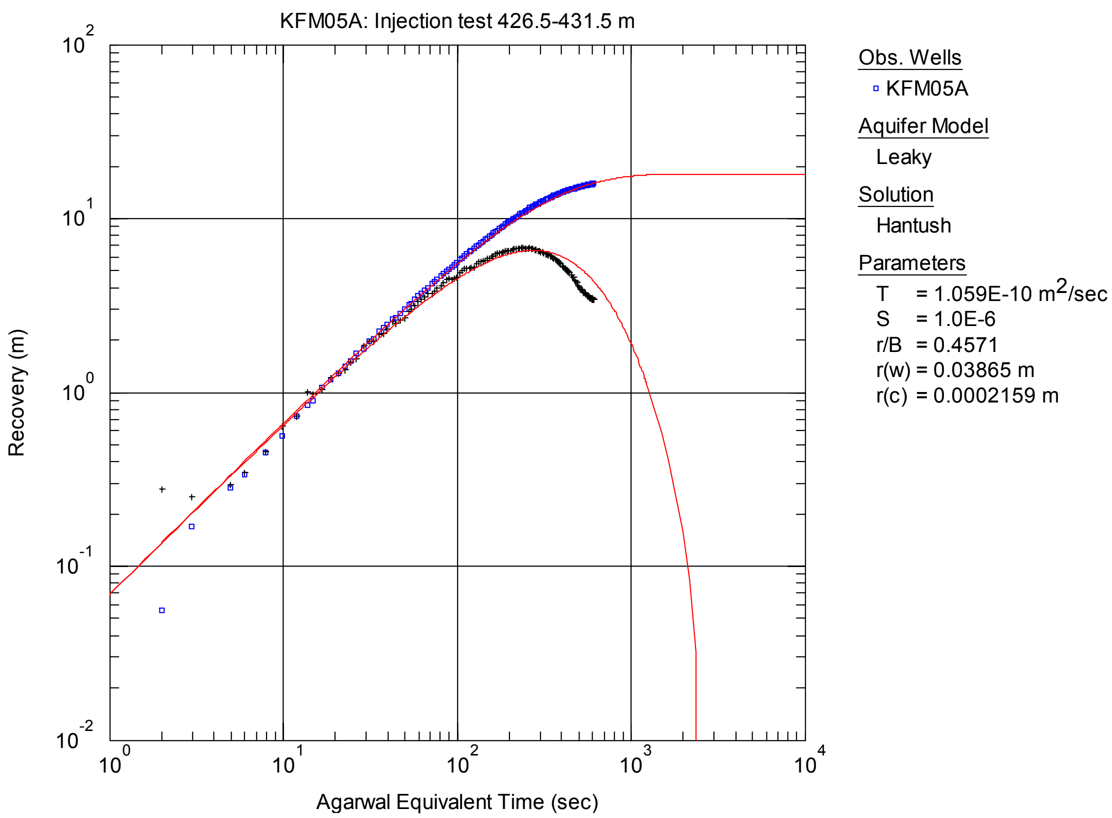


Figure A3-204. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 426.5-431.5 m in KFM05A.*

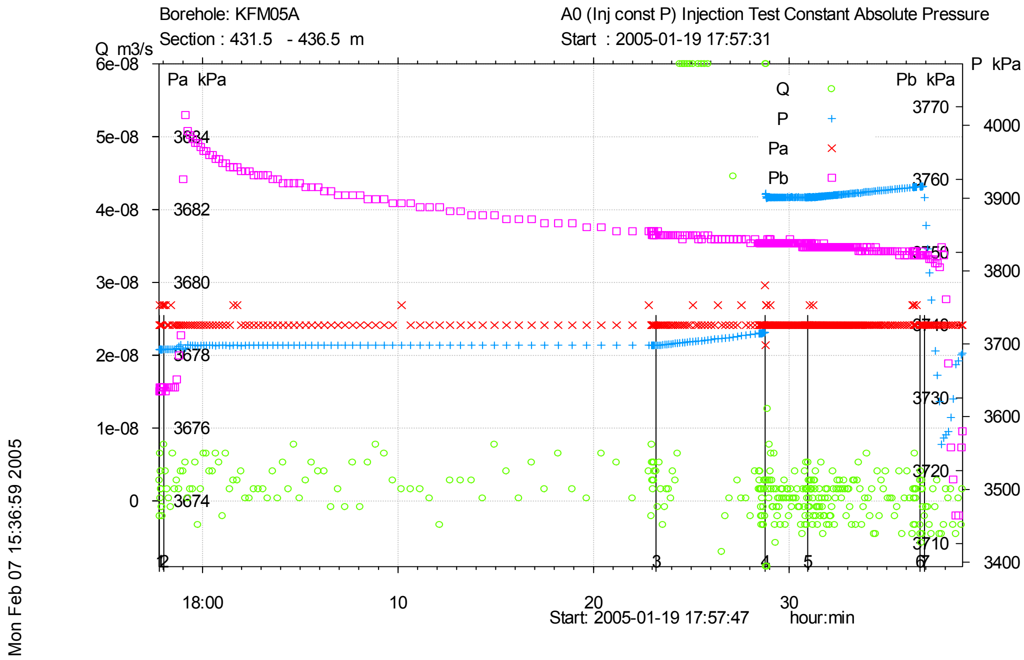


Figure A3-205. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 431.5-436.5 m in borehole KFM05A.*

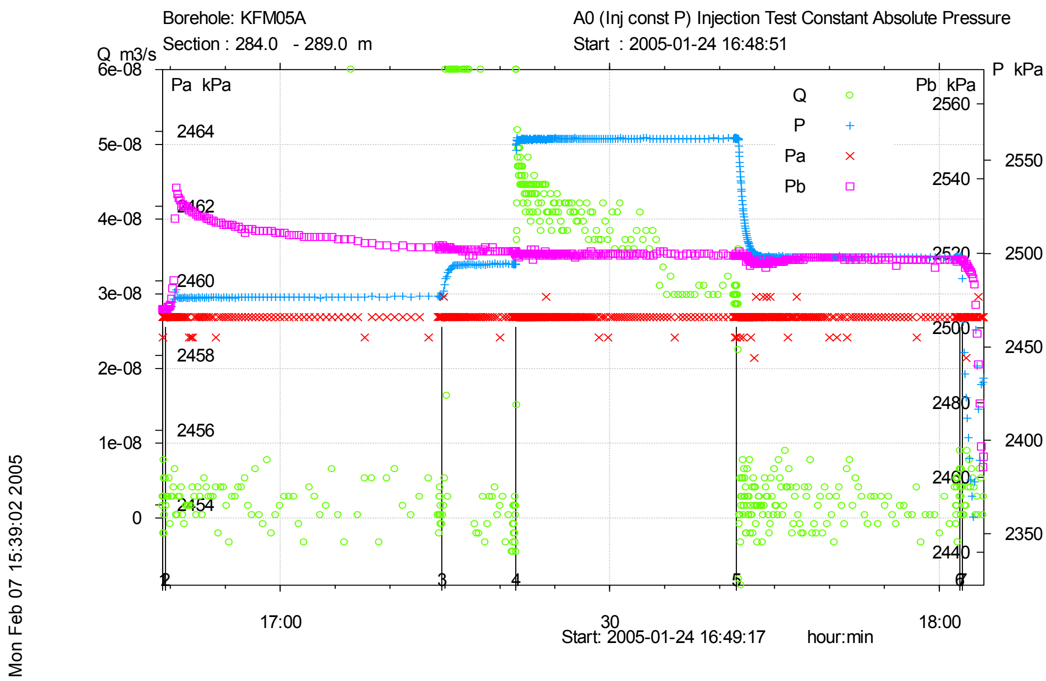


Figure A3-206. *Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 284.0-289.0 m in borehole KFM05A. 50 kPa injection pressure.*

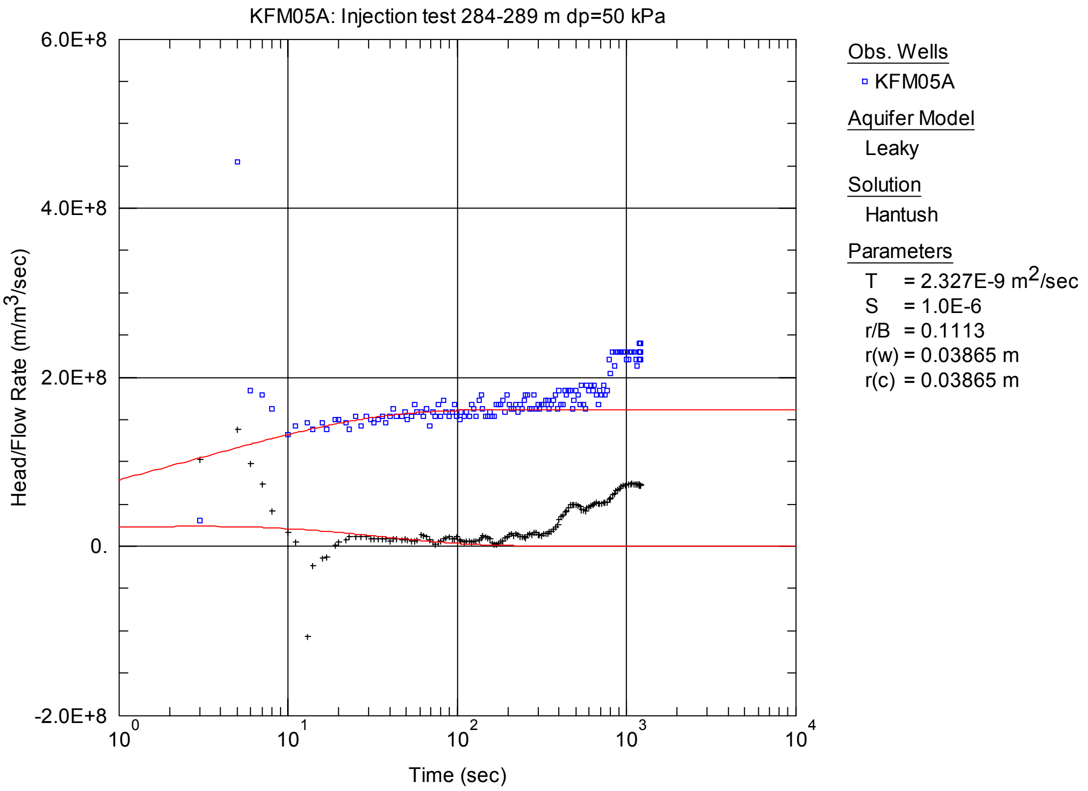


***Figure A3-207.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 50 kPa injection pressure.*

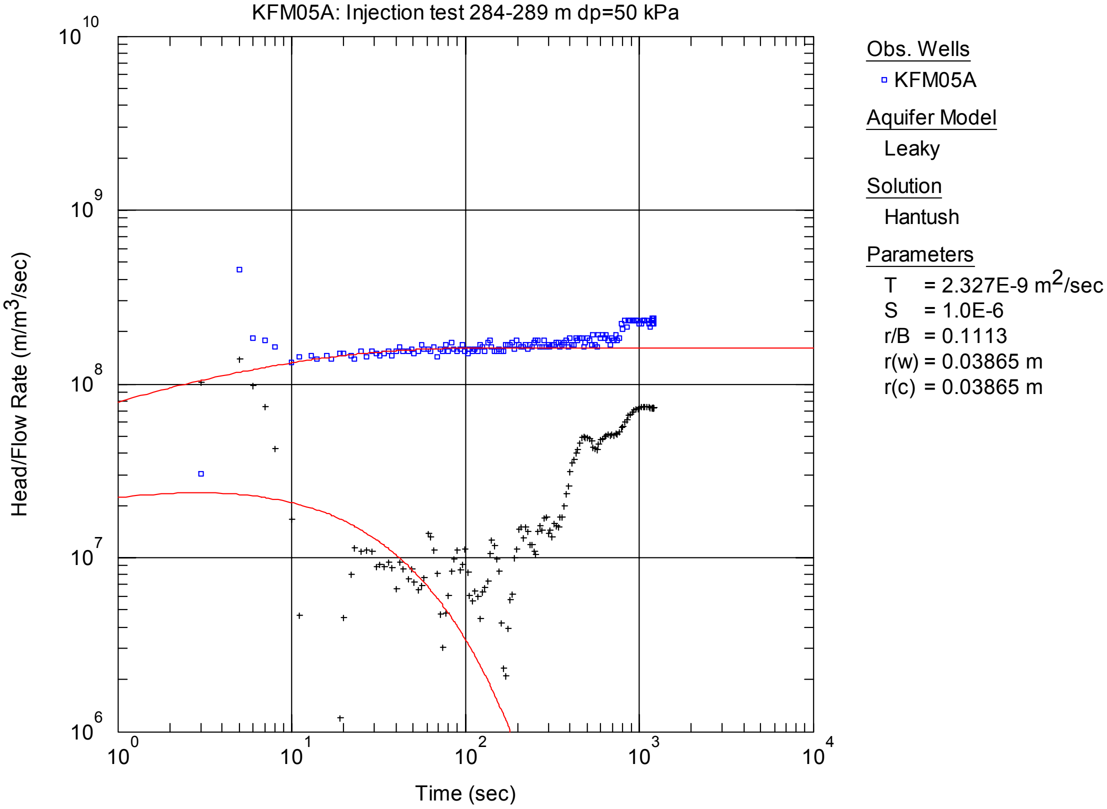


***Figure A3-208.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 50 kPa injection pressure.*

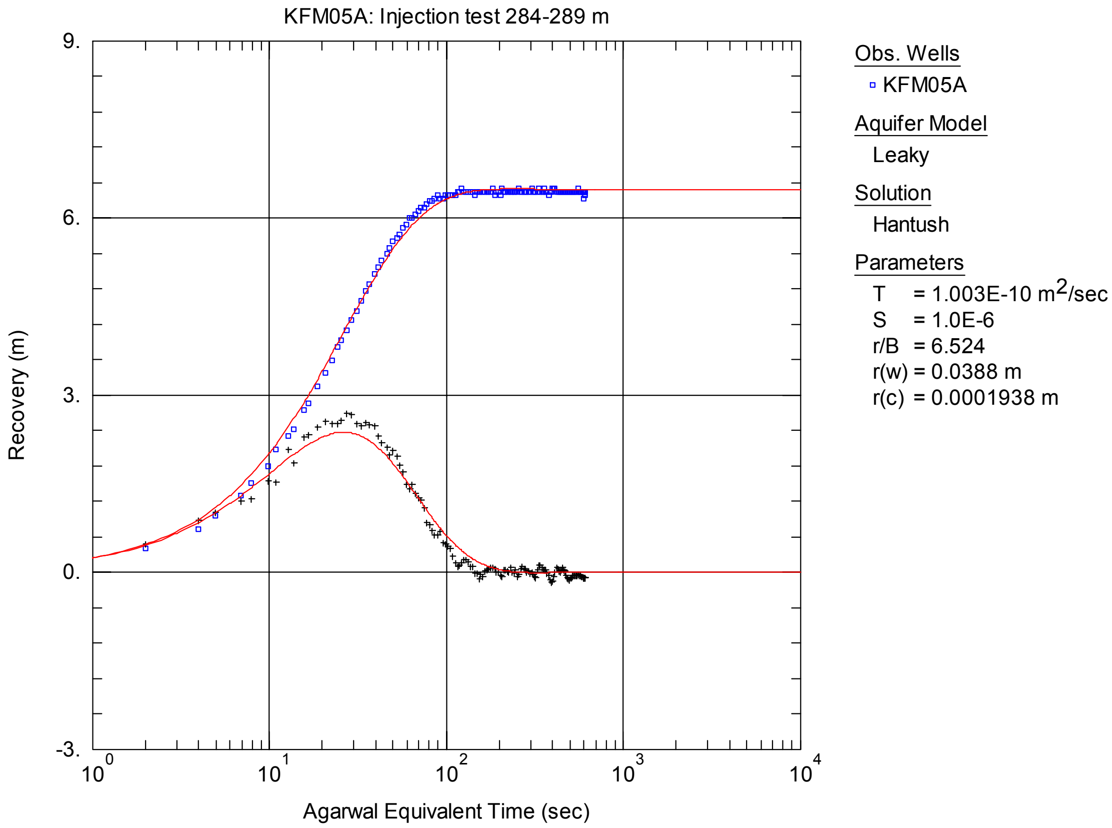


Figure A3-209. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 50 kPa injection pressure.*

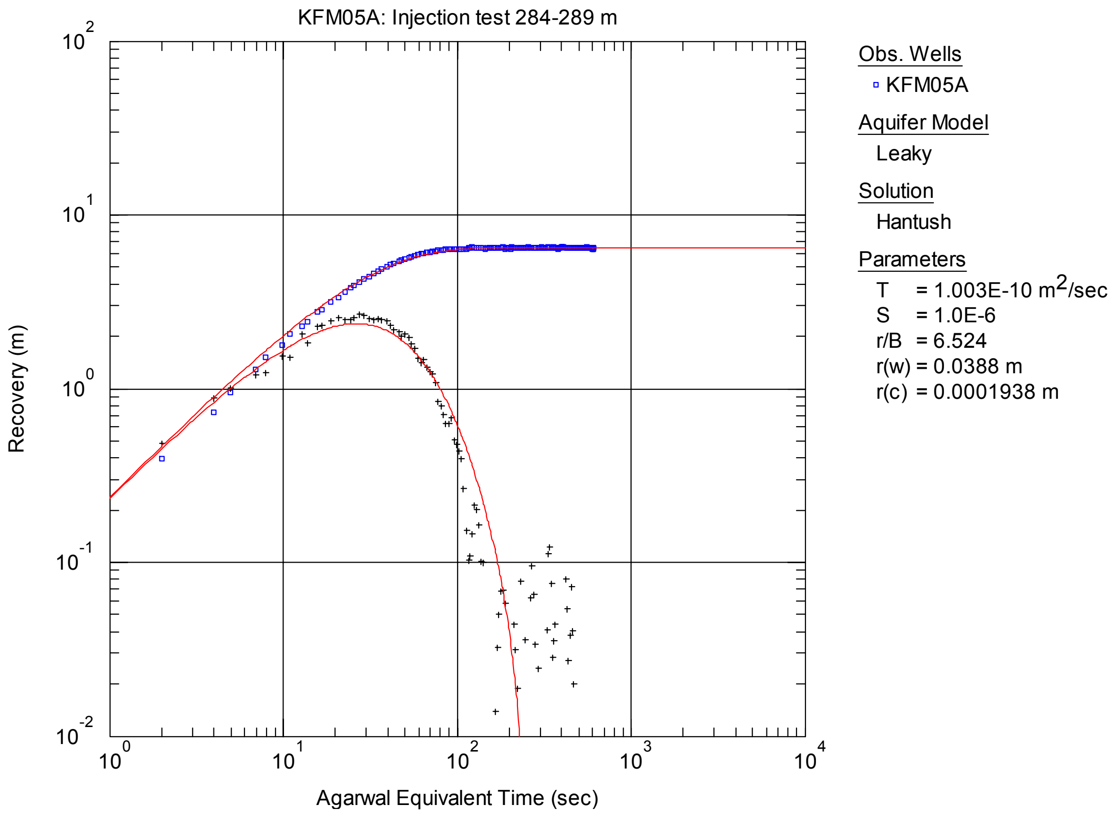


Figure A3-210. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A50 kPa injection pressure.*

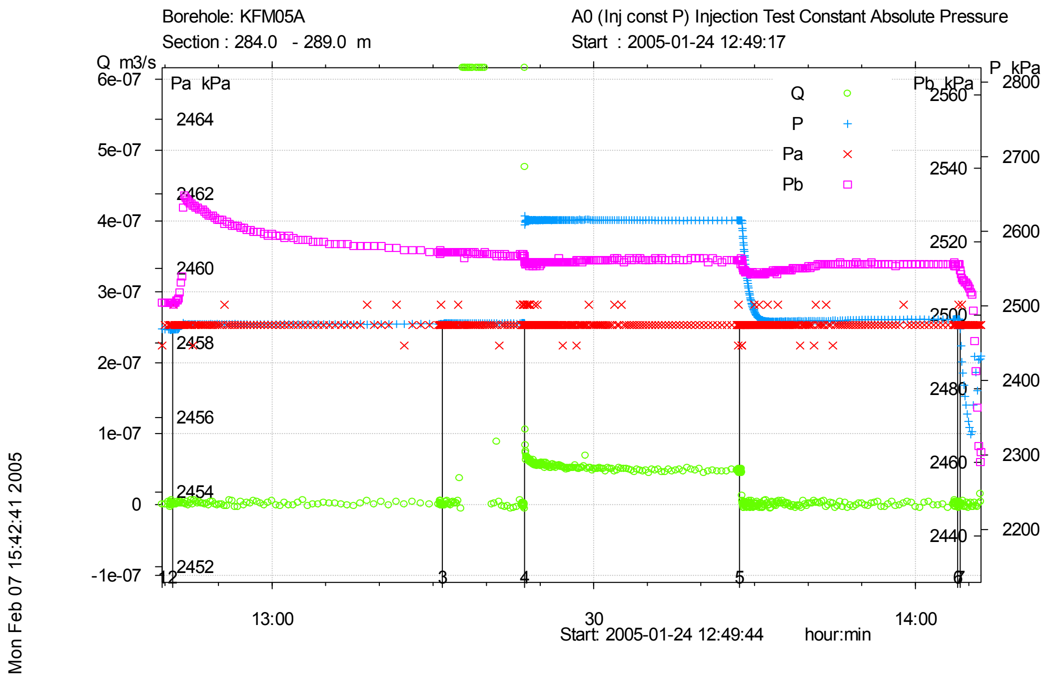


***Figure A3-211.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 284.0-289.0 m in borehole KFM05A. 100 kPa injection pressure.*

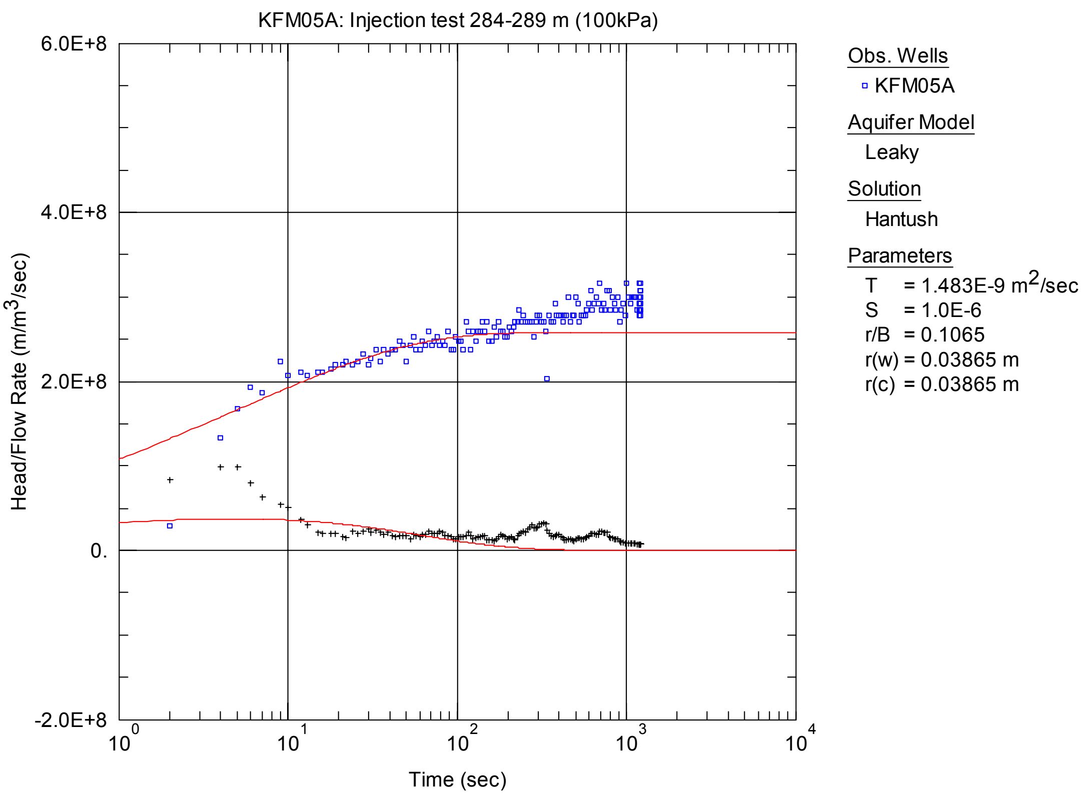


***Figure A3-212.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

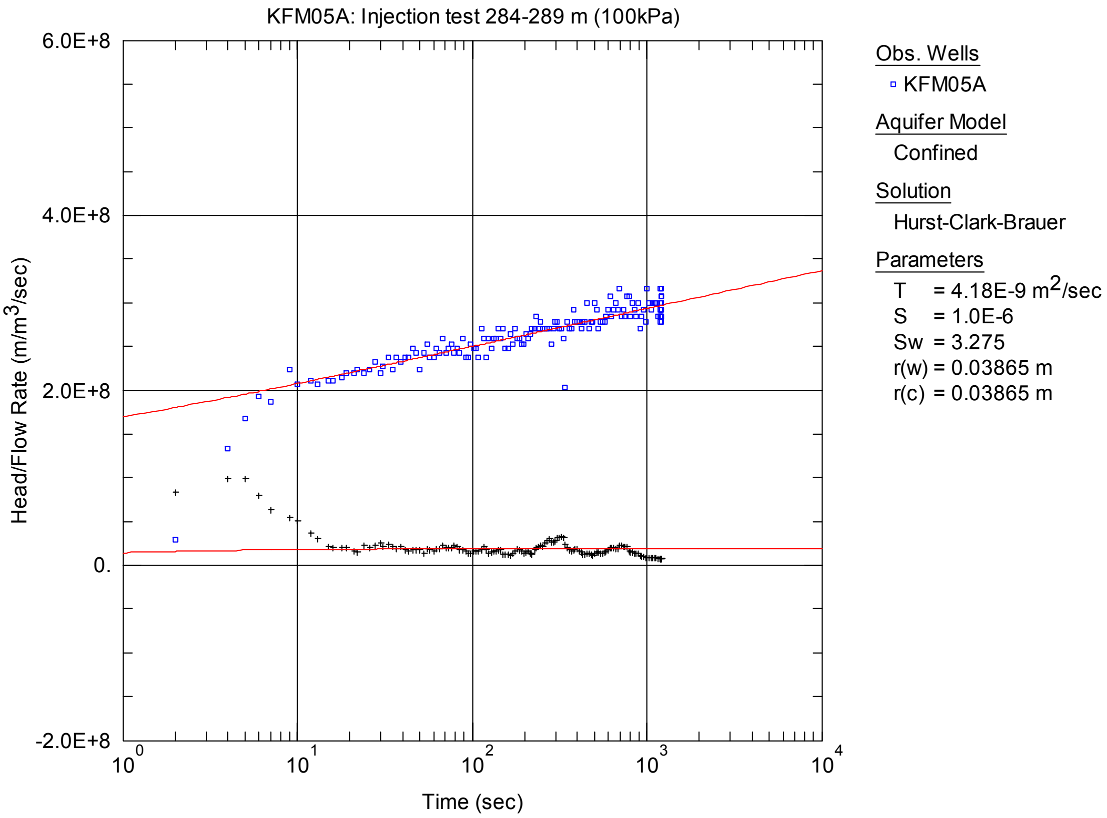


Figure A3-213. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

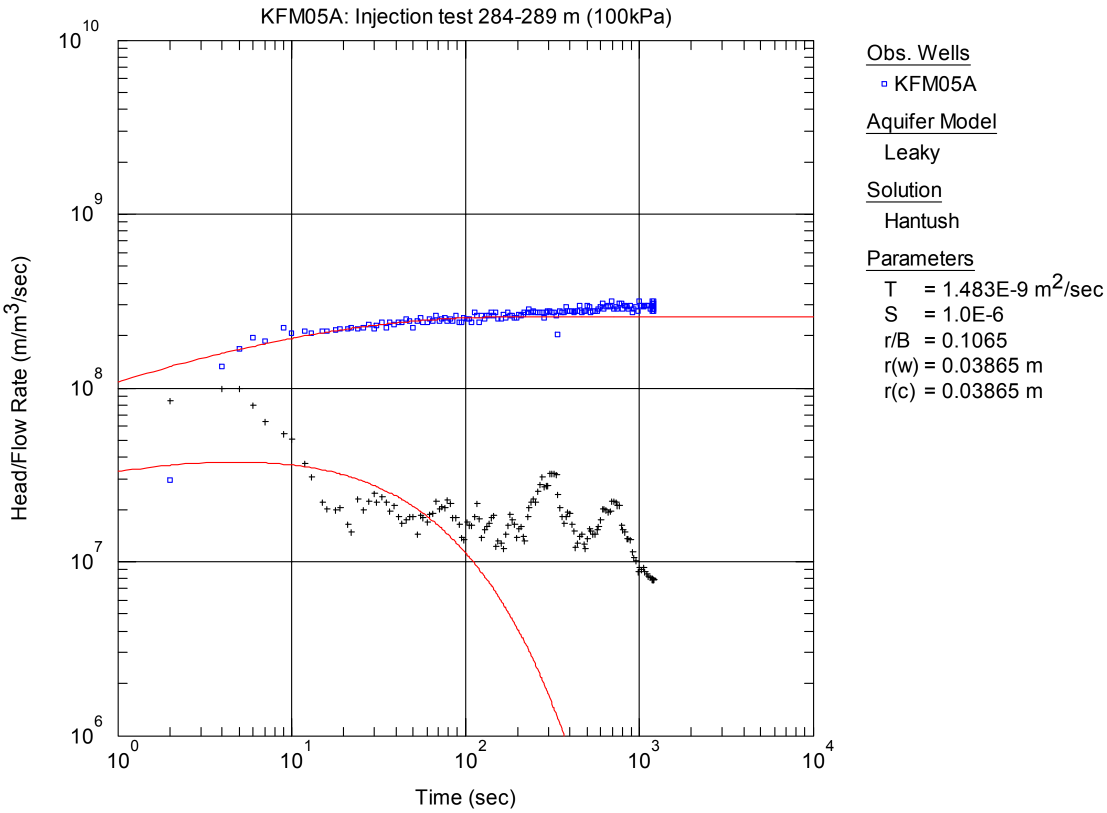


Figure A3-214. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

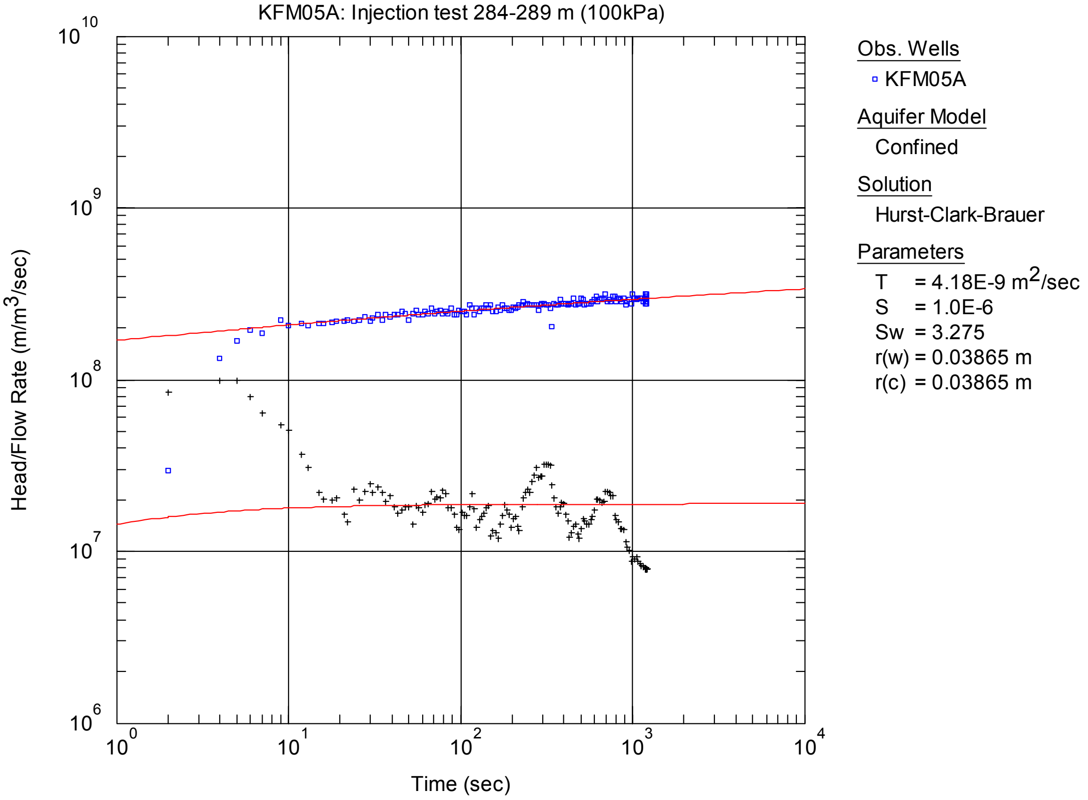


Figure A3-215. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

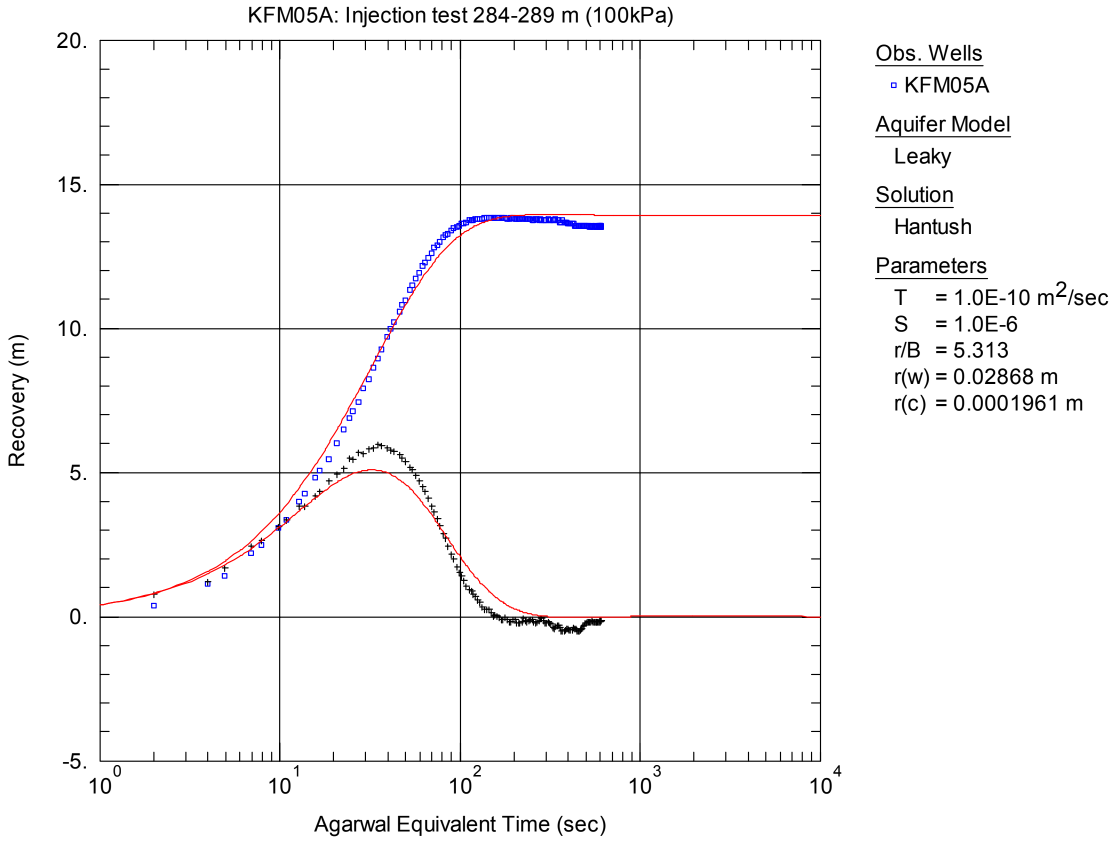


Figure A3-216. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

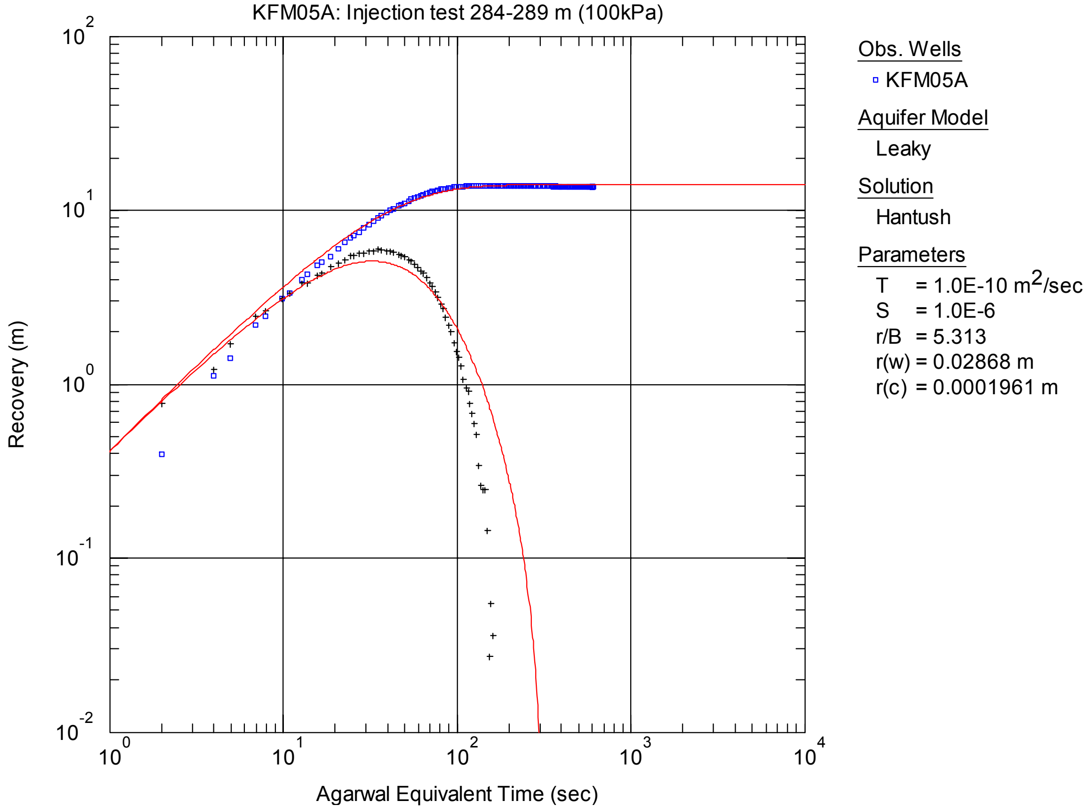


***Figure A3-217.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 100 kPa injection pressure.*

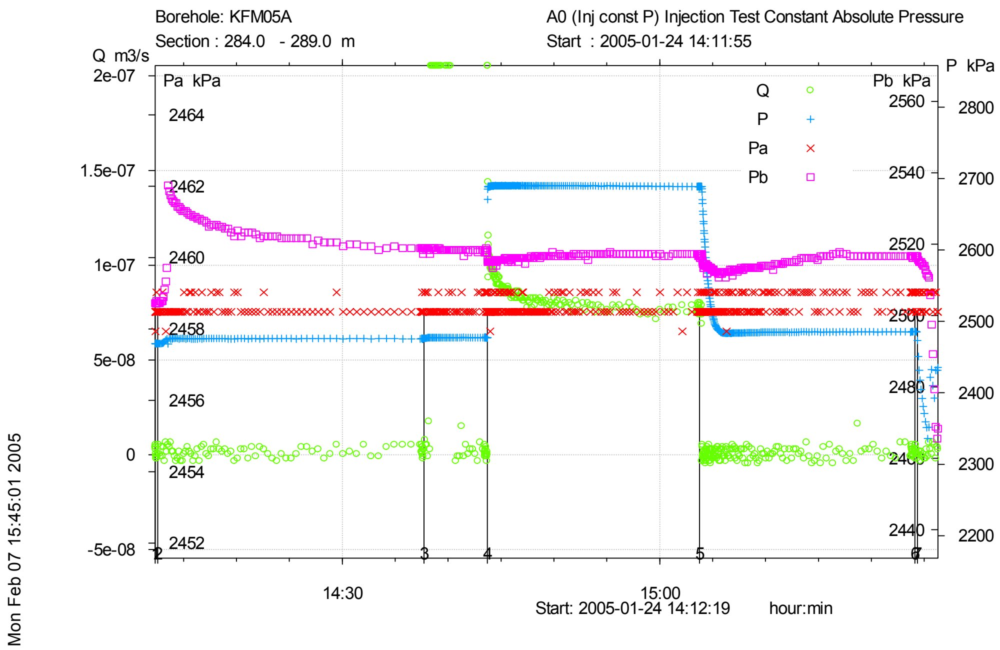


***Figure A3-218.** Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 284.0-289.0 m in borehole KFM05A. 200 kPa injection pressure.*

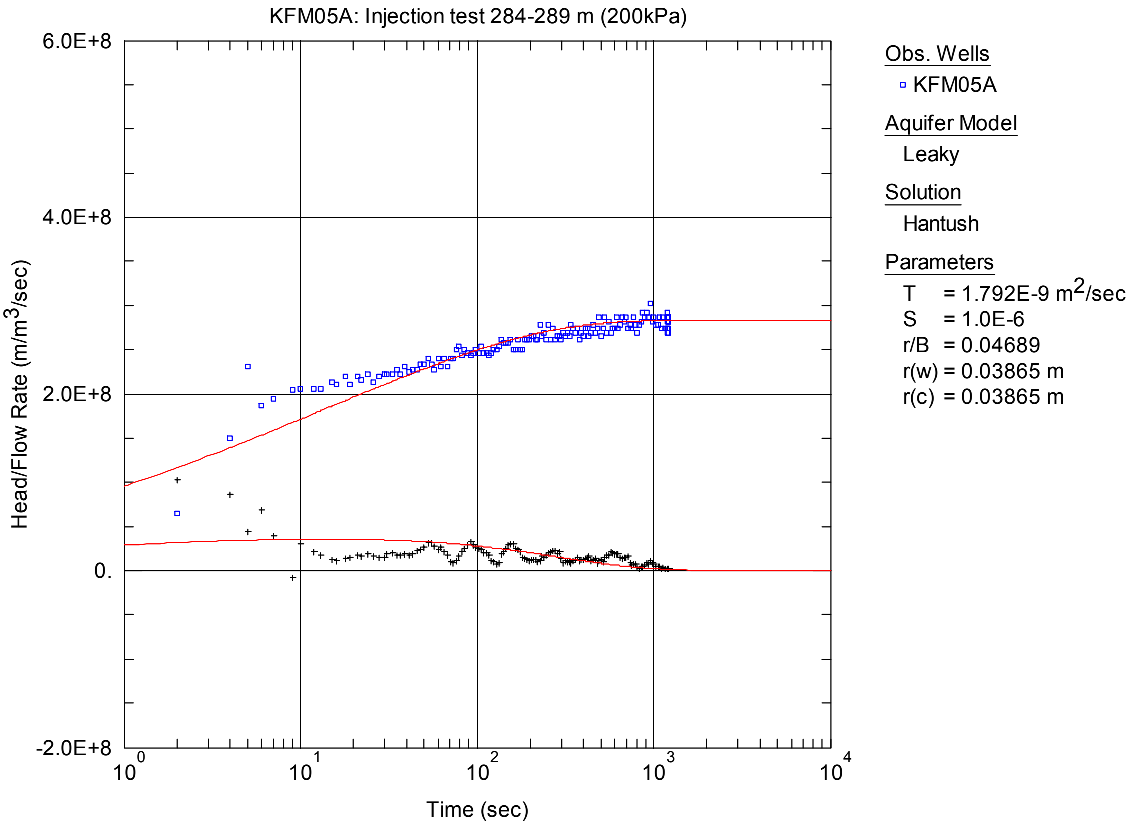


Figure A3-219. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

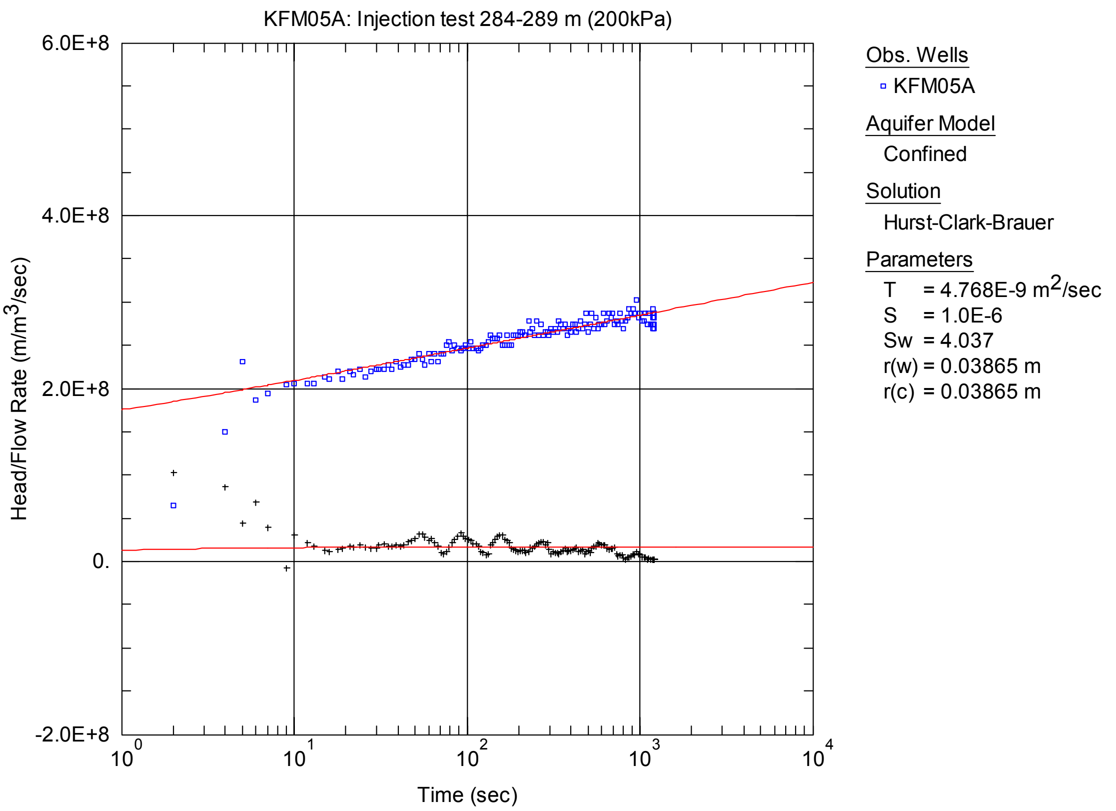


Figure A3-220. *Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

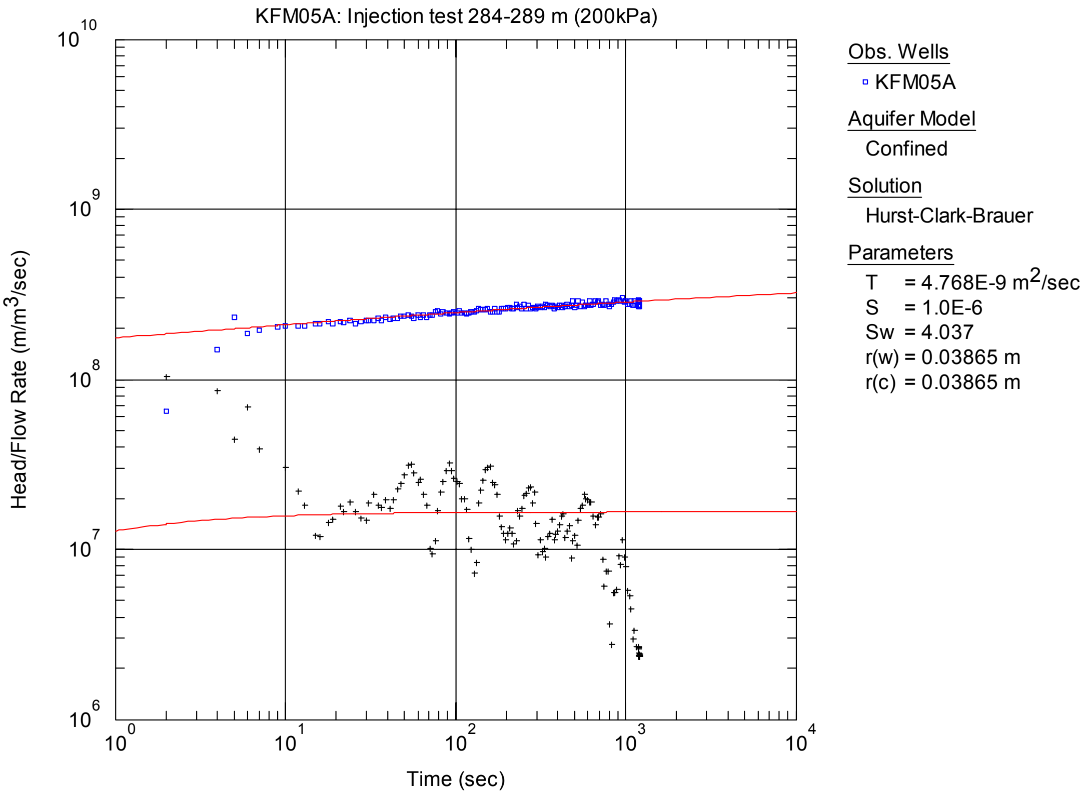


Figure A3-221. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

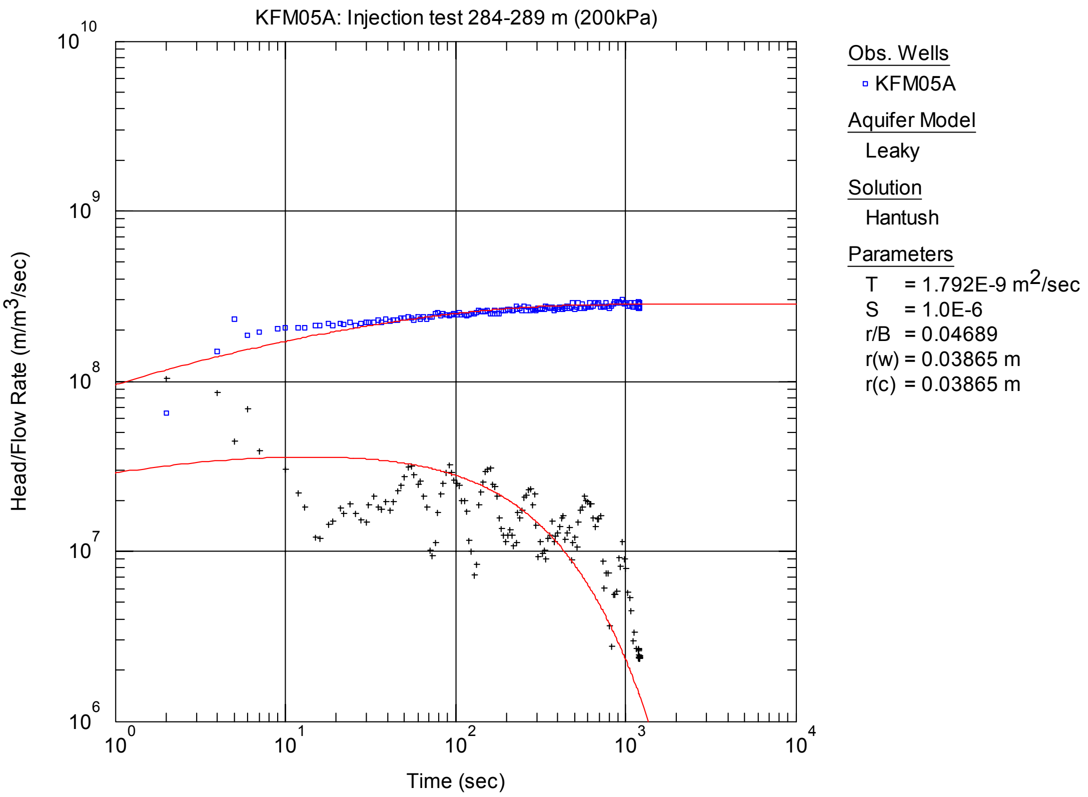


Figure A3-222. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

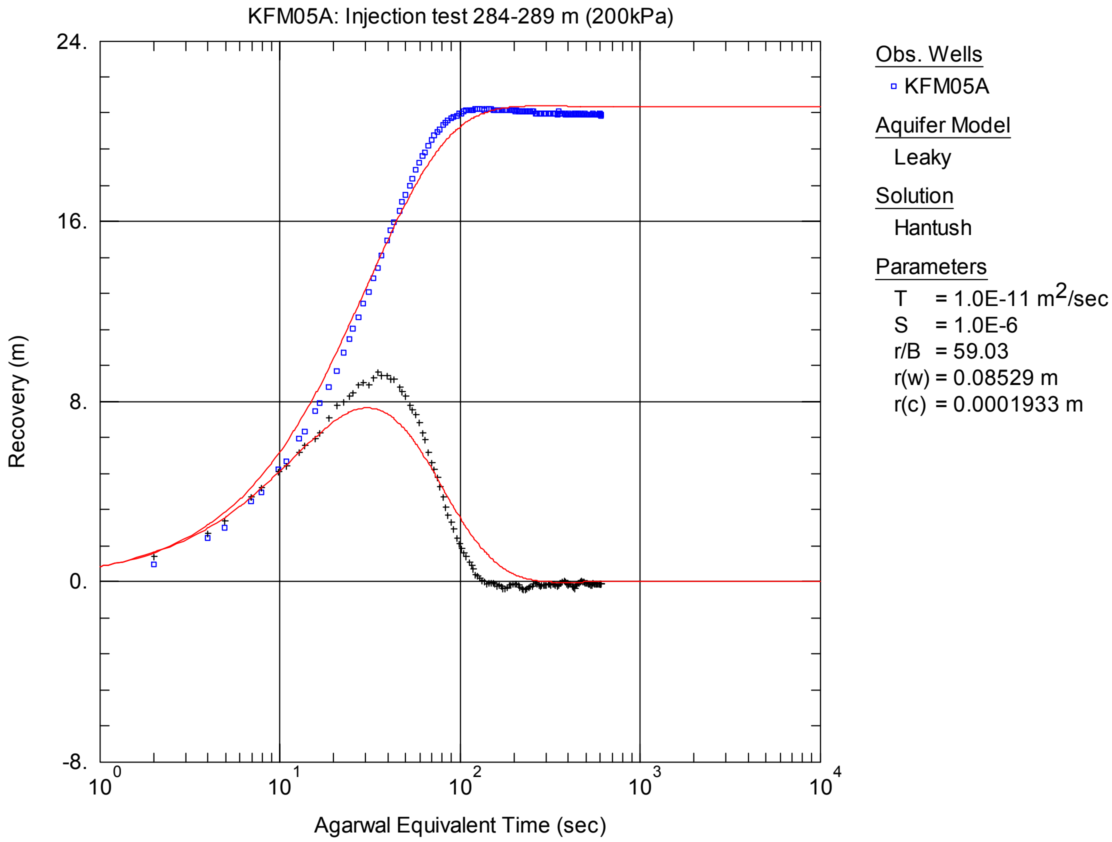


***Figure A3-223.** Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

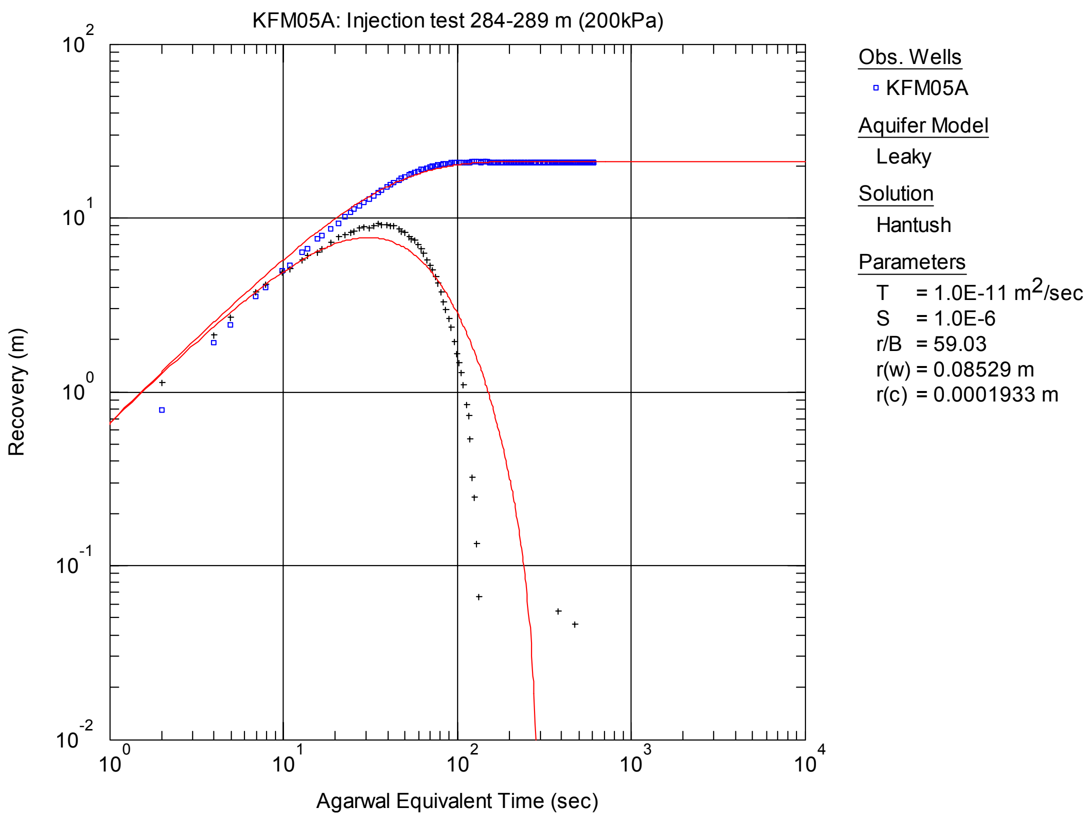


***Figure A3-224.** Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 200 kPa injection pressure.*

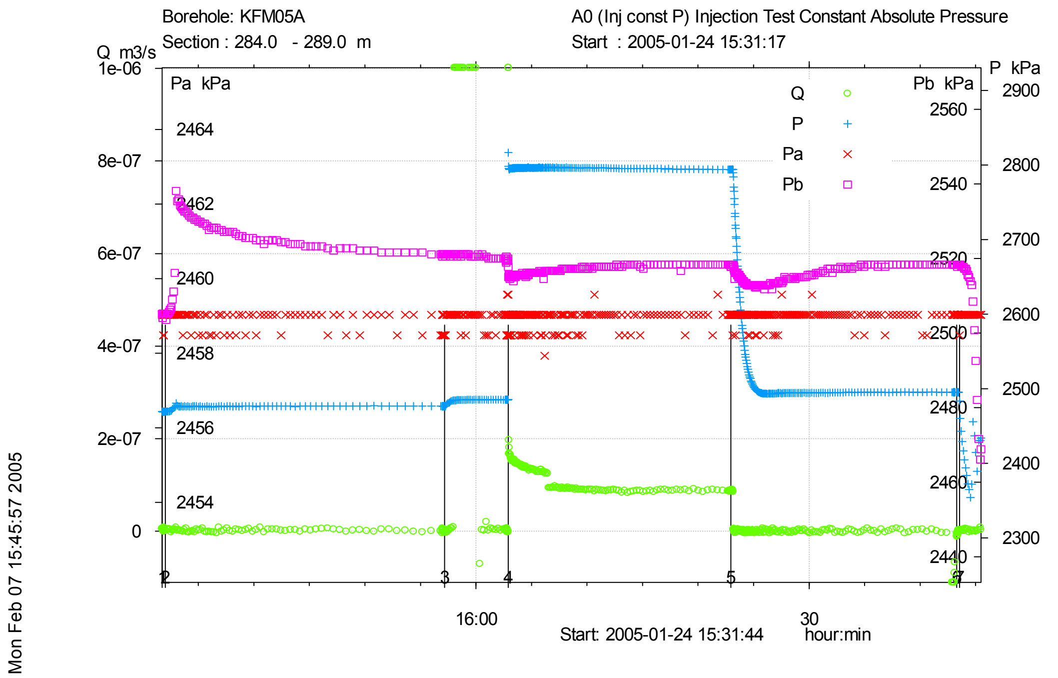


Figure A3-225. Linear plot of flow rate (Q), pressure (P), pressure above section (Pa) and pressure below section (Pb) versus time from the injection test in section 284.0-289.0 m in borehole KFM05A. 300 kPa injection pressure.

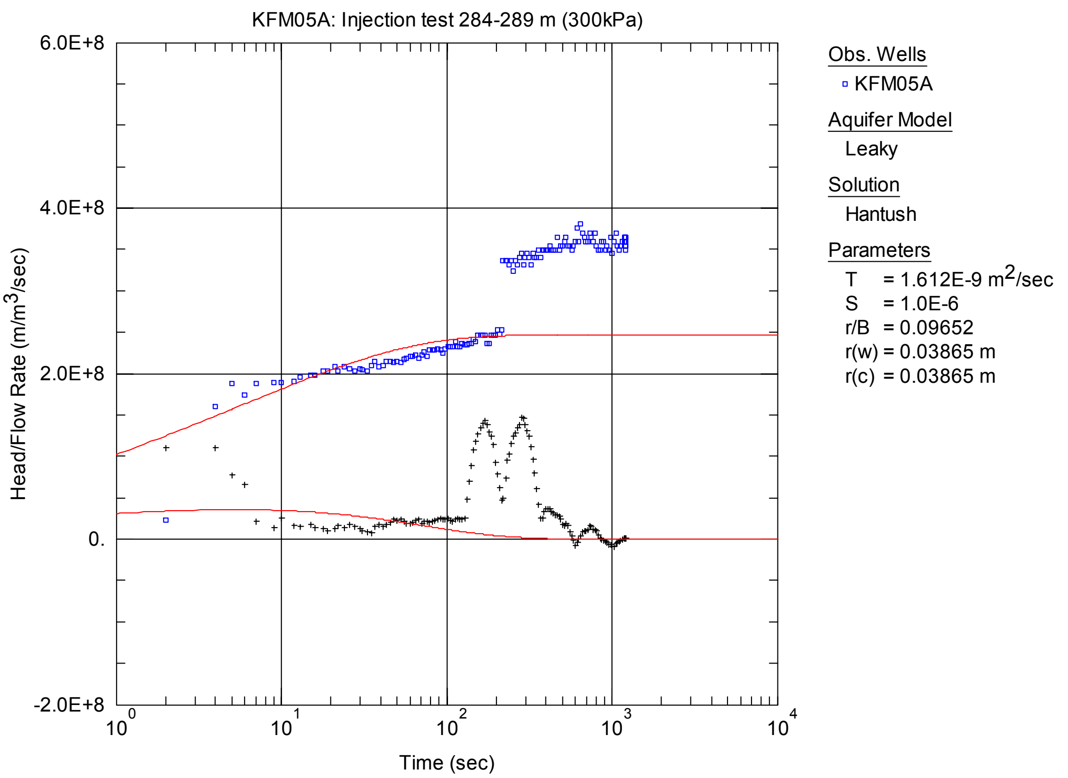


Figure A3-226. Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 300 kPa injection pressure.

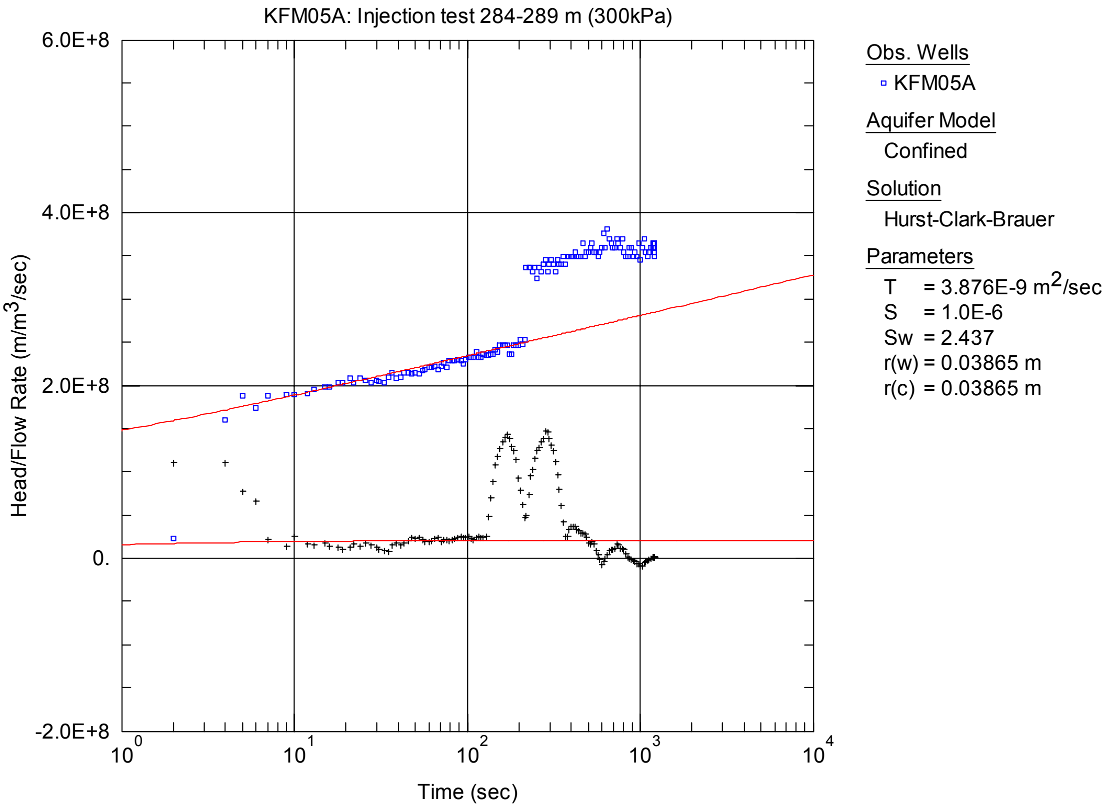


***Figure A3-227.** Lin-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 300 kPa injection pressure.*

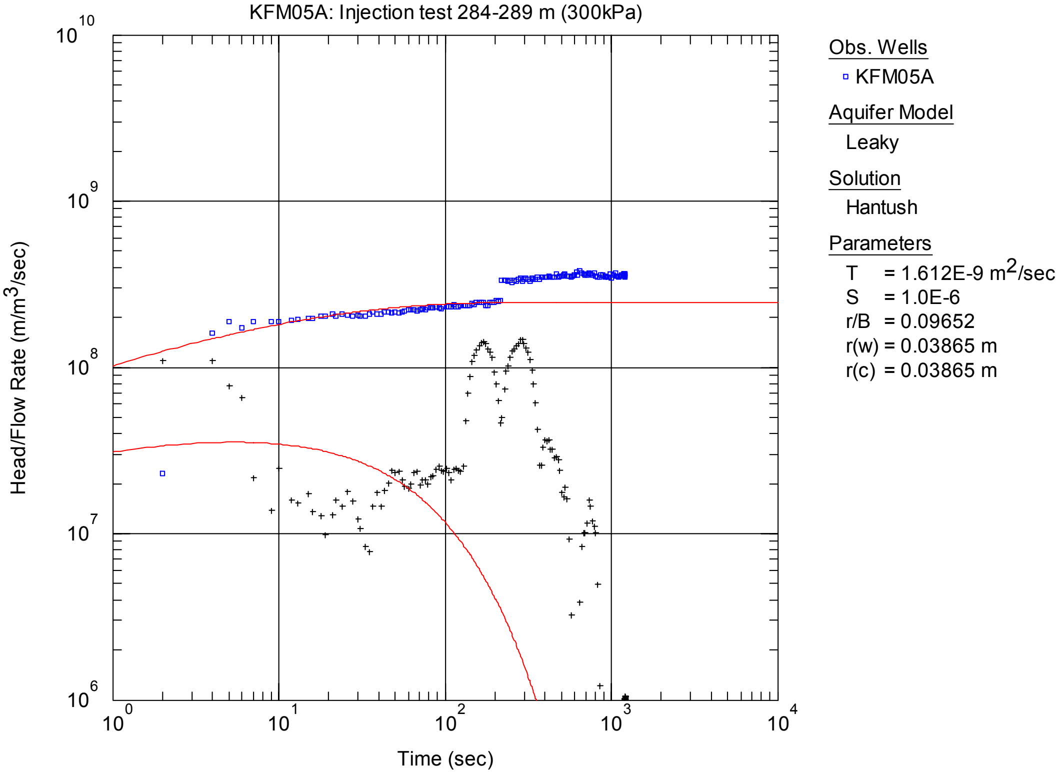


***Figure A3-228.** Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 300 kPa injection pressure.*

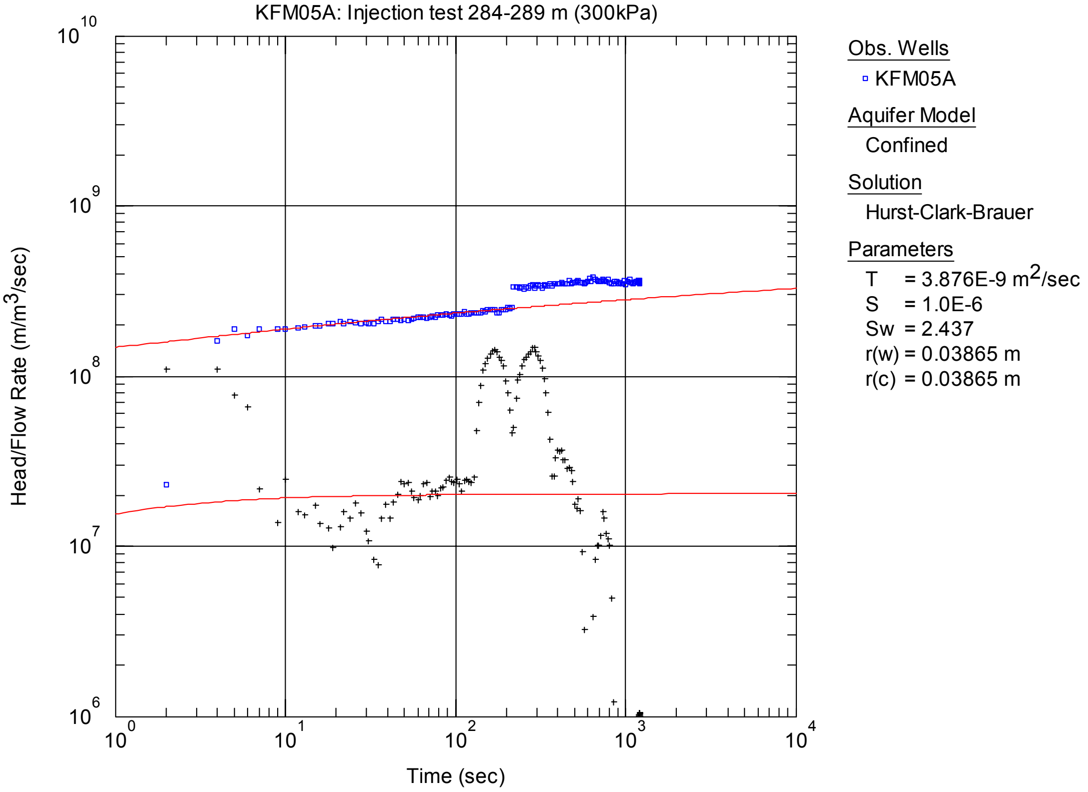


Figure A3-229. *Log-log plot of head/flow rate (□) and derivative (+) versus time, from the injection test in section 284.0-289.0 m in KFM05A. 300 kPa injection pressure.*

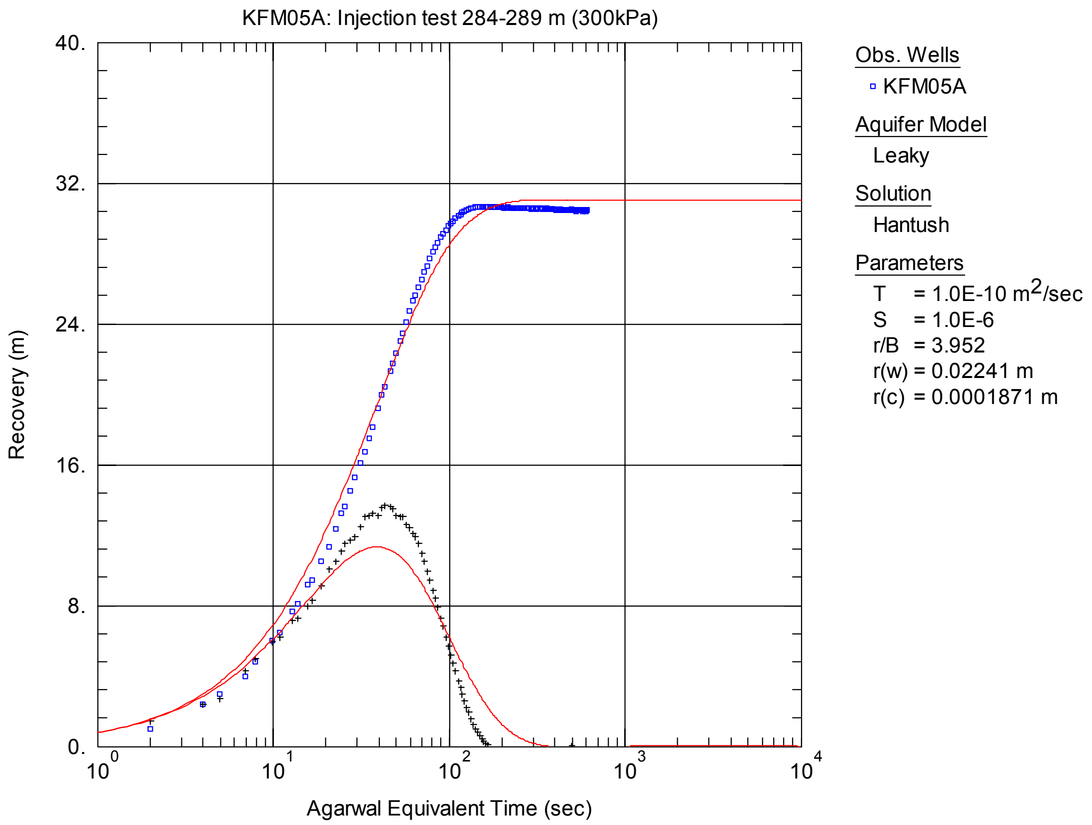


Figure A3-230. *Lin-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A. 300 kPa injection pressure.*

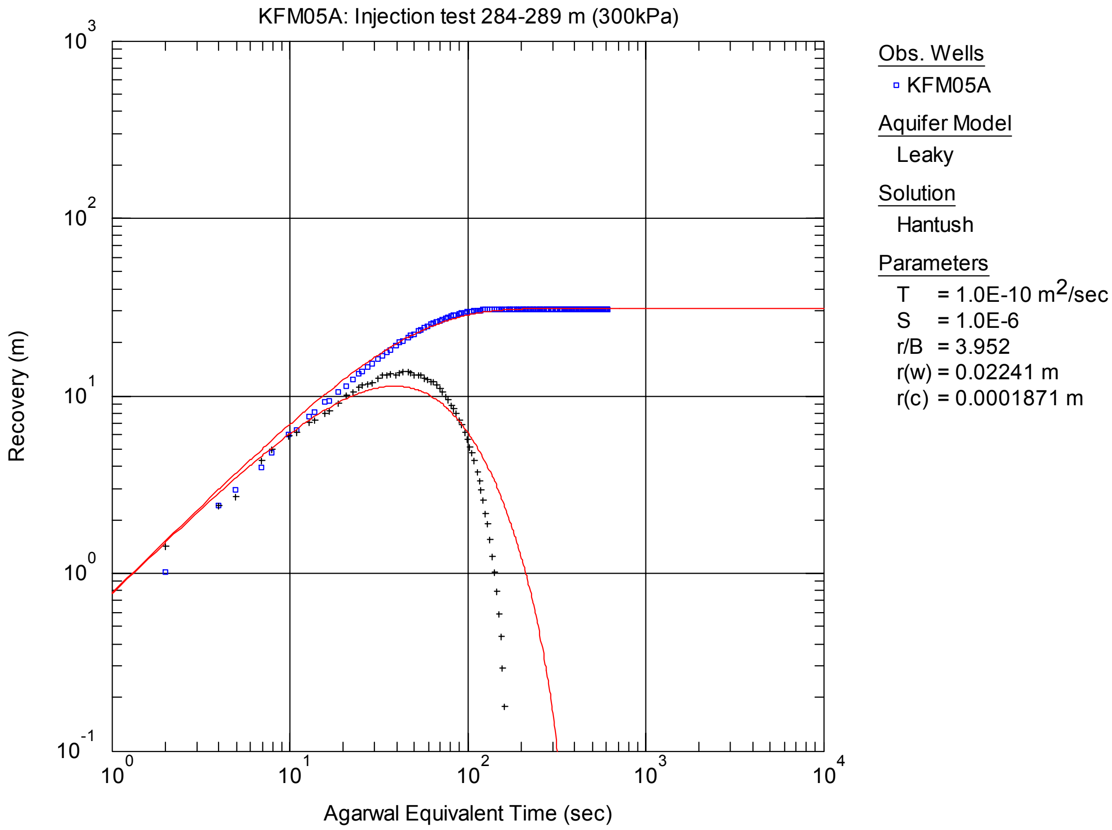
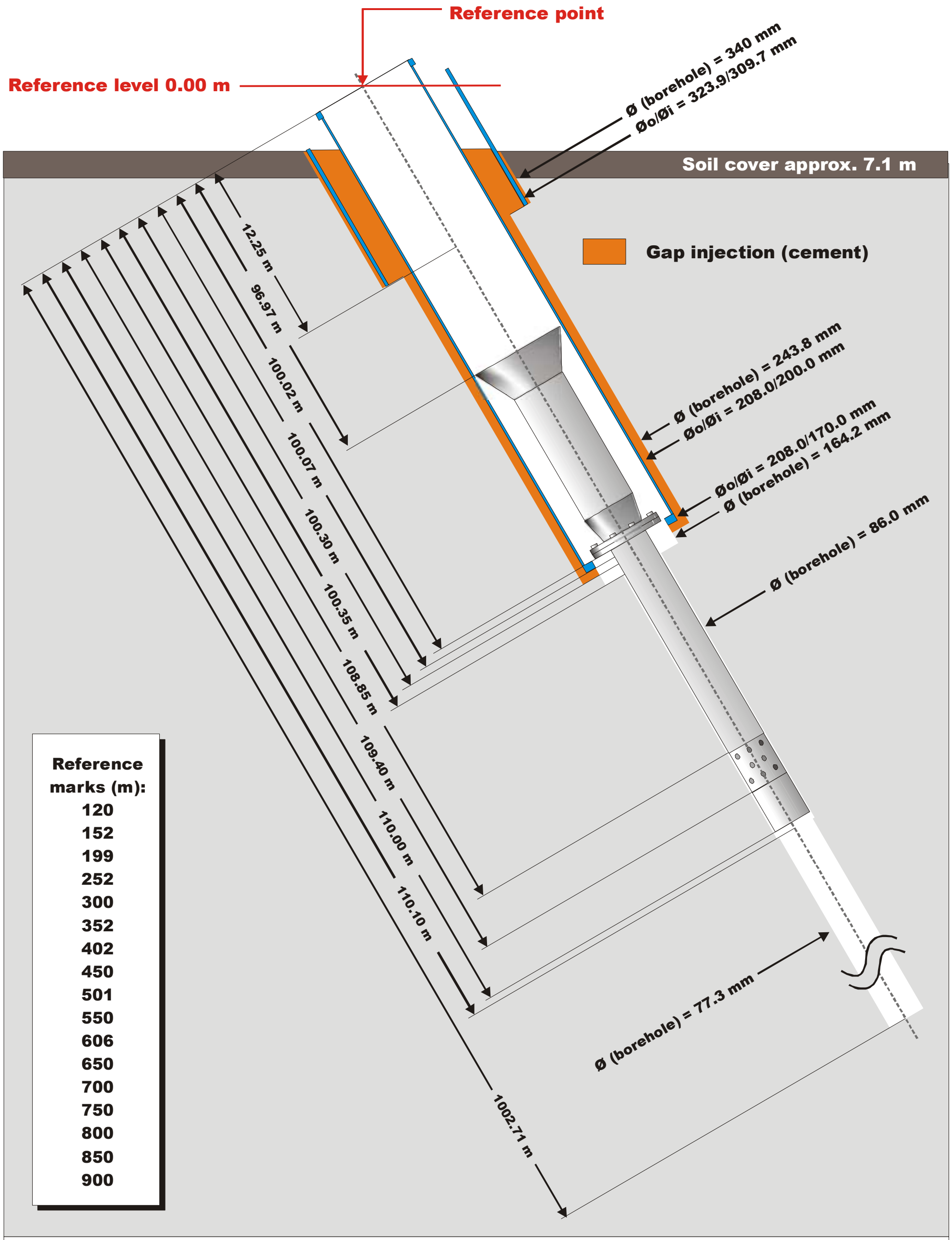


Figure A3-231. *Log-log plot of recovery (□) and derivative (+) versus equivalent time, from the injection test in section 284.0-289.0 m in KFM05A 300 kPa injection pressure.*

Borehole technical data



Drilling reference point

Northing:	6699344.85 (m), RT90 2,5 gon V 0:-15
Easting:	1631710.80 (m), RT90 2,5 gon V 0:-15
Elevation:	5.53 (m), RHB 70

Orientation

Bearing (degrees):	80.90°
Inclination (degrees):	-59.80°

Borehole

Length:	1002.71 m

Percussion drilling period

Drilling start date:	2003-11-23
Drilling stop date:	2003-12-16

Core drilling period

Drilling start date:	2004-01-27
Drilling stop date:	2004-04-20

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(positive) or injected(negative) 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	

Column	Datatype	Unit	Column Description	Alt. Symbol
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	
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	

Column	Datatype	Unit	Column Description	Alt. Symbol
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.	
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	dt_1
dt2	FLOAT	s	Estimated stop time of evaluation. see table description	dt_2
t1	FLOAT	s	Start time for evaluated parameter from start flow period	
t2	FLOAT	s	Stop time for evaluated parameter from start of flow period	
dte1	FLOAT	s	Start time for evaluated parameter from start of recovery	
dte2	FLOAT	s	Stop time for evaluated parameter from start of recovery	
p_horner	FLOAT	kPa	p*:Horner extrapolated pressure, see table description	

Column	Datatype	Unit	Column Description	Alt. Symbol
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..	
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)

KFM05A 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
KFM05A	20041213 11:35	20041213 15:05	116.50	216.50	3	1	20041213 14:03:06	20041213 14:33:22	6.64E-05	0	8.66E-05
KFM05A	20041222 06:37	20041222 08:29	216.50	316.50	3	1	20041222 07:26:59	20041222 07:57:20	2.43E-06	0	1.36E-05
KFM05A	20041214 11:06	20041214 12:57	316.50	416.50	3	1	20041214 11:54:57	20041214 12:25:22	5.00E-09	0	3.75E-08
KFM05A	20041214 14:43	20041214 16:37	416.50	516.50	3	1	20041214 15:34:28	20041214 16:04:51	3.40E-08	0	7.61E-08
KFM05A	20041215 09:03	20041215 10:57	516.50	616.50	3	1	20041215 09:55:22	20041215 10:25:28		-1	
KFM05A	20041215 13:18	20041215 15:08	606.50	706.50	3	1	20041215 14:05:40	20041215 14:35:59	3.65E-08	0	7.91E-08
KFM05A	20041220 14:31	20041220 16:27	686.50	786.50	3	1	20041220 15:24:42	20041220 15:55:05	4.24E-08	0	1.18E-07
KFM05A	20041216 08:39	20041216 10:47	706.50	806.50	3	1	20041216 09:41:36	20041216 10:15:04	3.13E-08	0	1.22E-07
KFM05A	20041216 14:44	20041216 15:57	806.50	906.50	3	1	20041216 15:31:33	20041216 15:49:40		-1	
KFM05A	20041220 08:16	20041220 10:14	886.50	986.50	3	1	20041220 09:11:02	20041220 09:41:58		-1	
KFM05A	20050104 06:57	20050104 08:35	116.50	136.50	3	1	20050104 07:52:52	20050104 08:13:08	3.47E-05	0	4.44E-05
KFM05A	20050104 09:02	20050104 10:27	136.50	156.50	3	1	20050104 09:45:06	20050104 10:05:24	1.37E-07	0	2.04E-07
KFM05A	20050104 10:51	20050104 13:05	156.50	176.50	3	1	20050104 12:23:02	20050104 12:43:17	3.53E-05	0	5.06E-05
KFM05A	20050104 13:38	20050104 14:44	176.50	196.50	3	1	20050104 14:19:17	20050104 14:37:17		-1	
KFM05A	20050105 08:18	20050105 09:46	196.50	216.50	3	1	20050105 09:03:36	20050105 09:23:56	8.00E-09	0	1.44E-08
KFM05A	20050105 10:08	20050105 11:25	214.00	234.00	3	1	20050105 10:43:20	20050105 11:03:38	2.29E-08	0	1.23E-07
KFM05A	20050105 11:55	20050105 13:20	234.00	254.00	3	1	20050105 12:51:48	20050105 13:11:53		-1	
KFM05A	20050111 12:38	20050111 13:54	254.00	274.00	3	1	20050111 13:11:58	20050111 13:32:18	4.23E-06	0	2.37E-05
KFM05A	20050110 10:11	20050110 11:29	274.00	294.00	3	1	20050110 10:47:22	20050110 11:07:40	4.21E-08	0	6.82E-08
KFM05A	20050110 11:53	20050110 13:43	294.00	314.00	3	1	20050110 13:01:06	20050110 13:21:24	7.11E-08	0	9.02E-08
KFM05A	20050110 13:56	20050110 14:38	296.50	316.50	3	1	20050110 14:30:28	20050110 14:32:41		-1	
KFM05A	20050110 15:57	20050110 17:18	416.50	436.50	3	1	20050110 16:36:18	20050110 16:56:39	3.25E-08	0	5.70E-08
KFM05A	20050110 17:47	20050110 19:04	436.50	456.50	3	1	20050110 18:21:47	20050110 18:42:17	7.50E-09	0	1.62E-08
KFM05A	20050111 06:29	20050111 07:13	456.50	476.50	3	1	20050111 07:01:34	20050111 07:08:11		-1	
KFM05A	20050111 07:35	20050111 08:20	476.50	496.50	3	1	20050111 08:08:42	20050111 08:13:04		-1	

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
KFM05A	20050111 08:41	20050111 09:28	496.50	516.50	3	1	20050111 09:16:25	20050111 09:19:26		-1	
KFM05A	20050120 11:09	20050120 13:14	116.50	121.50	3	1	20050120 12:32:06	20050120 12:52:29	3.08E-05	0	3.35E-05
KFM05A	20050113 14:11	20050113 15:33	121.50	126.50	3	1	20050113 14:51:11	20050113 15:11:28	1.36E-05	0	1.49E-05
KFM05A	20050113 15:46	20050113 17:12	126.50	131.50	3	1	20050113 16:29:50	20050113 16:50:09	1.53E-07	0	1.94E-07
KFM05A	20050120 09:41	20050120 10:56	131.50	136.50	3	1	20050120 10:13:53	20050120 10:34:17	2.56E-08	0	3.92E-08
KFM05A	20050114 08:45	20050114 09:35	136.50	141.50	3	1	20050114 09:24:30	20050114 09:27:45		-1	
KFM05A	20050120 08:12	20050120 09:27	141.50	146.50	3	1	20050120 08:45:10	20050120 09:05:34	2.86E-08	0	5.68E-08
KFM05A	20050114 11:15	20050114 13:04	146.50	151.50	3	1	20050114 12:21:39	20050114 12:41:57	9.64E-08	0	1.14E-07
KFM05A	20050114 13:13	20050114 14:29	151.50	156.50	3	1	20050114 13:46:26	20050114 14:06:48	1.05E-08	0	2.09E-08
KFM05A	20050114 14:38	20050114 15:52	156.50	161.50	3	1	20050114 15:10:20	20050114 15:30:39	4.49E-08	0	9.60E-08
KFM05A	20050117 09:47	20050117 11:12	161.50	166.50	3	1	20050117 10:29:27	20050117 10:49:46	1.93E-05	0	3.26E-05
KFM05A	20050120 06:34	20050120 07:51	166.50	171.50	3	1	20040120 07:09:00	20040120 07:29:21	2.49E-06	0	3.03E-06
KFM05A	20050117 13:06	20050117 14:24	171.50	176.50	3	1	20050117 13:42:14	20050117 14:02:31	1.68E-05	0	1.93E-05
KFM05A	20050117 14:58	20050117 15:43	214.00	219.00	3	1	20050117 15:33:26	20050117 15:36:31		-1	
KFM05A	20050117 15:58	20050117 17:14	219.00	224.00	3	1	20050117 16:31:43	20050117 16:52:01	1.02E-08	0	4.20E-08
KFM05A	20050117 17:31	20050117 18:45	224.00	229.00	3	1	20050117 18:02:58	20050117 18:23:21	1.33E-08	0	8.54E-08
KFM05A	20050117 18:58	20050117 19:40	229.00	234.00	3	1	20050117 19:28:41	20050117 19:33:05		-1	
KFM05A	20050118 06:50	20050118 08:06	254.00	259.00	3	1	20050118 07:23:30	20050118 07:43:50	1.53E-07	0	2.03E-07
KFM05A	20050118 08:20	20050118 09:14	259.00	264.00	3	1	20050118 09:00:29	20050118 09:04:13		-1	
KFM05A	20050118 09:29	20050118 10:50	264.00	269.00	3	1	20050118 10:08:00	20050118 10:28:21	2.40E-06	0	1.63E-05
KFM05A	20050118 11:04	20050118 12:30	269.00	274.00	3	1	20050118 12:19:10	20050118 12:22:15		-1	
KFM05A	20050118 12:40	20050118 13:23	274.00	279.00	3	1	20050118 13:12:08	20050118 13:15:35		-1	
KFM05A	20050118 13:39	20050118 14:20	279.00	284.00	3	1	20050118 14:11:07	20050118 14:13:08		-1	
KFM05A	20050118 14:29	20050118 15:43	284.00	289.00	3	1	20050118 15:00:45	20050118 15:21:07	3.35E-08	0	4.66E-08
KFM05A	20050119 09:44	20050119 10:41	289.00	294.00	3	1	20050119 10:22:12	20050119 10:33:48		-1	
KFM05A	20050119 11:07	20050119 12:21	294.00	299.00	3	1	20050119 11:39:14	20050119 11:59:36	5.96E-08	0	6.92E-08
KFM05A	20050119 13:58	20050119 15:16	416.50	421.50	3	1	20050119 14:33:52	20050119 14:54:16	2.74E-08	0	5.09E-08
KFM05A	20050119 15:29	20050119 16:12	421.50	426.50	3	1	20050119 16:01:39	20050119 16:05:00		-1	
KFM05A	20050119 16:24	20050119 17:38	426.50	431.50	3	1	20050119 16:56:12	20050119 17:16:36	8.97E-09	0	1.08E-08
KFM05A	20050119 17:57	20050119 18:38	431.50	436.50	3	1	20050119 18:28:46	20050119 18:31:28		-1	

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
KFM05A	20050124 12:49	20050124 14:06	284.00	289.00	3	1	20050124 13:23:33	20050124 13:43:48	4.76E-08	0	5.16E-08
KFM05A	20050124 14:11	20050124 15:26	284.00	289.00	3	1	20050124 14:43:43	20050124 15:03:58	7.58E-08	0	8.05E-08
KFM05A	20050124 15:31	20050124 16:45	284.00	289.00	3	1	20050124 16:02:54	20050124 16:23:09	8.75E-08	0	1.00E-07
KFM05A	20050124 16:48	20050124 18:04	284.00	289.00	3	1	20050124 17:21:27	20050124 17:41:43	2.98E-08	0	3.76E-08

KFM05A 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	reference	comments
KFM05A	116.50	216.50	1.7E-08	1.0E-03	1.57E-01	1816	1809	1054.58	1261.44	1076.58	7.49		
KFM05A	216.50	316.50	1.7E-08	1.0E-03	2.47E-02	1821	1785	1896.14	2142.64	2110.17	8.44		
KFM05A	316.50	416.50	4.0E-09	1.0E-03	6.85E-05	1825	1821	2727.90	2946.94	2912.17	9.18		
KFM05A	416.50	516.50	1.7E-08	1.0E-03	1.39E-04	1823	1806	3546.40	3763.96	3660.82	9.94		
KFM05A	516.50	616.50	7.7E-09	1.0E-03		1806	1821	4364.08	4585.35	4570.63	10.76		
KFM05A	606.50	706.50	1.7E-08	1.0E-03	1.44E-04	1819	1807	5084.95	5301.68	5169.67	11.58		
KFM05A	686.50	786.50	1.7E-08	1.0E-03	2.16E-04	1823	1800	5730.05	5910.06	5839.65	12.35		
KFM05A	706.50	806.50	1.7E-08	1.0E-03	2.45E-04	2008	1810	5892.31	6130.09	6081.68	12.53		
KFM05A	806.50	906.50	6.6E-09	1.0E-03		1087	331	6702.16	6903.49	6905.69	13.55		
KFM05A	886.50	986.50	9.0E-09	1.0E-03		1856	1822	7371.04	7450.66	7446.40	14.38		
KFM05A	116.50	136.50	1.7E-08	1.0E-03	5.39E-02	1216	1210	1048.28	1248.65	1049.38	7.29		Te uncertain due to noise in the sensor
KFM05A	136.50	156.50	1.7E-08	1.0E-03	2.49E-04	1218	1206	1223.48	1424.67	1250.17	7.85		
KFM05A	156.50	176.50	1.7E-08	1.0E-03	6.15E-02	1215	1209	1389.47	1590.11	1444.89	7.65		
KFM05A	176.50	196.50	7.8E-09	1.0E-03		1080	439	1571.54	1766.95	1747.97	8.18		
KFM05A	196.50	216.50	6.6E-09	1.0E-03	1.76E-05	1220	1221	1799.14	1937.75	1851.39	8.33		
KFM05A	214.00	234.00	9.0E-09	1.0E-03	1.50E-04	1218	1206	1884.39	2083.02	2056.57	8.46		
KFM05A	234.00	254.00	9.0E-09	1.0E-03		1205	371	2053.81	2251.56	2250.20	8.59		
KFM05A	254.00	274.00	1.7E-08	1.0E-03	2.89E-02	1220	1199	2225.99	2529.63	2490.57	-		Te not available due to faulty sensor
KFM05A	274.00	294.00	1.7E-08	1.0E-03	8.30E-05	1218	1205	2388.81	2592.33	2391.01	8.55		Te uncertain due to noise in the sensor
KFM05A	294.00	314.00	1.7E-08	1.0E-03	1.10E-04	1218	1205	2562.08	2759.01	2607.18	8.50		Te uncertain due to noise in the sensor
KFM05A	296.50	316.50	7.8E-09	1.0E-03		133	356	2587.38	2780.46	2794.77	8.28		Te uncertain due to noise in the sensor
KFM05A	416.50	436.50	1.7E-08	1.0E-03	6.97E-05	1221	1203	3570.50	3771.28	3640.77	9.53		Te uncertain due to noise in the sensor
KFM05A	436.50	456.50	6.6E-09	1.0E-03	1.99E-05	1230	1221	3740.32	3938.12	3890.51	9.70		Te uncertain due to noise in the sensor
KFM05A	456.50	476.50	1.2E-08	1.0E-03		397	324	3908.10	4110.40	4116.04	10.06		Te uncertain due to noise in the sensor
KFM05A	476.50	496.50	1.0E-08	1.0E-03		262	325	4075.88	4267.85	4280.50	10.24		Te uncertain due to noise in the sensor

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	reference	comments
KFM05A	496.50	516.50	9.0E-09	1.0E-03		181	419	4239.65	4427.38	4442.77	10.36		Te uncertain due to noise in the sensor
KFM05A	116.50	121.50	1.7E-08	1.0E-03	4.10E-02	1223	1199	1049.98	1250.34	1050.94	7.29		
KFM05A	121.50	126.50	1.7E-08	1.0E-03	1.82E-02	1217	1206	1090.55	1291.87	1093.31	7.39		
KFM05A	126.50	131.50	1.7E-08	1.0E-03	2.37E-04	1219	1205	1138.95	1338.62	1163.71	7.61		
KFM05A	131.50	136.50	1.7E-08	1.0E-03	4.79E-05	1224	1197	1195.51	1386.90	1246.22	7.76		
KFM05A	136.50	141.50	9.0E-09	1.0E-03		195	314	1246.77	1434.34	1431.59	7.66		
KFM05A	141.50	146.50	1.7E-08	1.0E-03	6.95E-05	1224	1197	1278.95	1471.06	1359.53	7.85		
KFM05A	146.50	151.50	1.7E-08	1.0E-03	1.39E-04	1218	1203	1317.17	1521.60	1317.73	7.81		
KFM05A	151.50	156.50	6.5E-09	1.0E-03	2.56E-05	1222	1222	1360.77	1564.80	1489.35	7.86		
KFM05A	156.50	161.50	1.7E-08	1.0E-03	1.17E-04	1219	1203	1402.98	1605.41	1486.05	7.89		
KFM05A	161.50	166.50	1.7E-08	1.0E-03	3.97E-02	1219	1203	1437.78	1645.05	1537.20	7.69		
KFM05A	166.50	171.50	1.7E-08	1.0E-03	3.70E-03	1221	1200	1478.07	1680.50	1498.15	8.03		
KFM05A	171.50	176.50	1.7E-08	1.0E-03	2.35E-02	1217	1206	1523.04	1723.68	1541.60	7.88		
KFM05A	214.00	219.00	5.0E-09	1.0E-03		185	323	2077.00	2084.25	2162.08	8.25		
KFM05A	219.00	224.00	7.0E-09	1.0E-03	5.11E-05	1218	1221	1936.15	2129.07	2099.37	8.28		
KFM05A	224.00	229.00	8.0E-09	1.0E-03	1.04E-04	1223	1221	1974.24	2169.78	2147.23	8.34		
KFM05A	229.00	234.00	5.0E-09	1.0E-03		264	322	2063.90	2209.39	2259.45	8.38		
KFM05A	254.00	259.00	1.7E-08	1.0E-03	2.47E-04	1220	1221	2227.41	2423.37	2289.70	8.58		
KFM05A	259.00	264.00	4.0E-09	1.0E-03		224	466	2301.25	2523.48	2527.33	8.62		
KFM05A	264.00	269.00	1.7E-08	1.0E-03	1.99E-02	1221	1191	2306.75	2525.96	2500.38	8.65		
KFM05A	269.00	274.00	7.0E-09	1.0E-03		185	339	2403.97	2546.17	2559.23	8.69		
KFM05A	274.00	279.00	5.0E-09	1.0E-03		207	323	2546.86	2589.08	2668.70	8.71		
KFM05A	279.00	284.00	6.0E-09	1.0E-03		121	322	2535.58	2631.71	2701.15	8.75		
KFM05A	284.00	289.00	1.7E-08	1.0E-03	5.69E-05	1222	1200	2488.82	2673.65	2489.38	8.78		
KFM05A	289.00	294.00	9.0E-09	1.0E-03		696	333	2533.80	2720.13	2720.40	8.82		
KFM05A	294.00	299.00	1.7E-08	1.0E-03	8.46E-05	1222	1221	2564.60	2758.91	2601.04	8.86		
KFM05A	416.50	421.50	1.7E-08	1.0E-03	6.23E-05	1224	1221	3579.75	3772.14	3682.47	9.80		
KFM05A	421.50	426.50	5.0E-09	1.0E-03		201	343	3706.68	3813.40	3868.95	9.83		
KFM05A	426.50	431.50	5.0E-09	1.0E-03	1.33E-05	1224	1221	3662.40	3857.40	3701.73	9.87		
KFM05A	431.50	436.50	7.0E-09	1.0E-03		162	345	3715.35	3901.00	3915.17	9.92		

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	reference	comments
KFM05A	284.00	289.00	1.7E-08	1.0E-03	6.28E-05	1215	1221	2476.58	2614.65	2482.22	8.77		
KFM05A	284.00	289.00	1.7E-08	1.0E-03	9.78E-05	1215	1221	2477.13	2688.99	2485.52	8.78		
KFM05A	284.00	289.00	1.7E-08	1.0E-03	1.22E-04	1215	1221	2485.52	2794.12	2495.43	8.79		
KFM05A	284.00	289.00	1.7E-08	1.0E-03	4.57E-05	1216	1221	2494.32	2561.71	2498.18	8.79		

KFM05A 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
KFM05A	20041213 11:35	20041213 15:05	116.50	216.50	3	1	3.15E-06	0	4.09E-06	0	0	4.09E-08	100.00
KFM05A	20041222 06:37	20041222 08:29	216.50	316.50	3	1	9.67E-08	0	1.26E-07	0	0	1.26E-09	100.00
KFM05A	20041214 11:06	20041214 12:57	316.50	416.50	3	1	2.24E-10	0	2.91E-10	1	0	2.91E-12	100.00
KFM05A	20041214 14:43	20041214 16:37	416.50	516.50	3	1	1.54E-09	0	2.00E-09	0	0	2.00E-11	100.00
KFM05A	20041215 09:03	20041215 10:57	516.50	616.50	3	1	3.85E-10	-1	5.00E-10	0	-1	5.00E-12	100.00
KFM05A	20041215 13:18	20041215 15:08	606.50	706.50	3	1	1.65E-09	0	2.15E-09	0	0	2.15E-11	100.00
KFM05A	20041220 14:31	20041220 16:27	686.50	786.50	3	1	2.31E-09	0	3.00E-09	0	0	3.00E-11	100.00
KFM05A	20041216 08:39	20041216 10:47	706.50	806.50	3	1	1.29E-09	0	1.68E-09	0	0	1.68E-11	100.00
KFM05A	20041216 14:44	20041216 15:57	806.50	906.50	3	1	3.30E-10	-1	4.29E-10	0	-1	4.29E-12	100.00
KFM05A	20041220 08:16	20041220 10:14	886.50	986.50	3	1	4.50E-10	-1	5.85E-10	0	-1	5.85E-12	100.00
KFM05A	20050104 06:57	20050104 08:35	116.50	136.50	3	1	1.70E-06	0	1.77E-06	0	0	8.87E-08	20.00
KFM05A	20050104 09:02	20050104 10:27	136.50	156.50	3	1	6.66E-09	0	6.95E-09	0	0	3.48E-10	20.00
KFM05A	20050104 10:51	20050104 13:05	156.50	176.50	3	1	1.73E-06	0	1.80E-06	0	0	9.01E-08	20.00
KFM05A	20050104 13:38	20050104 14:44	176.50	196.50	3	1	3.90E-10	-1	4.07E-10	0	-1	2.03E-11	20.00
KFM05A	20050105 08:18	20050105 09:46	196.50	216.50	3	1	5.66E-10	0	5.91E-10	0	0	2.95E-11	20.00
KFM05A	20050105 10:08	20050105 11:25	214.00	234.00	3	1	1.13E-09	0	1.18E-09	1	0	5.91E-11	20.00
KFM05A	20050105 11:55	20050105 13:20	234.00	254.00	3	1	4.50E-10	-1	4.70E-10	0	-1	2.35E-11	20.00
KFM05A	20050111 12:38	20050111 13:54	254.00	274.00	3	1	1.37E-07	0	1.43E-07	0	0	7.13E-09	20.00
KFM05A	20050110 10:11	20050110 11:29	274.00	294.00	3	1	2.03E-09	0	2.12E-09	0	0	1.06E-10	20.00
KFM05A	20050110 11:53	20050110 13:43	294.00	314.00	3	1	3.54E-09	0	3.70E-09	0	0	1.85E-10	20.00
KFM05A	20050110 13:56	20050110 14:38	296.50	316.50	3	1	3.90E-10	-1	4.07E-10	0	-1	2.03E-11	20.00
KFM05A	20050110 15:57	20050110 17:18	416.50	436.50	3	1	1.59E-09	0	1.66E-09	0	0	8.29E-11	20.00
KFM05A	20050110 17:47	20050110 19:04	436.50	456.50	3	1	3.72E-10	0	3.88E-10	0	0	1.94E-11	20.00
KFM05A	20050111 06:29	20050111 07:13	456.50	476.50	3	1	6.00E-10	-1	6.26E-10	0	-1	3.13E-11	20.00
KFM05A	20050111 07:35	20050111 08:20	476.50	496.50	3	1	5.00E-10	-1	5.22E-10	0	-1	2.61E-11	20.00
KFM05A	20050111 08:41	20050111 09:28	496.50	516.50	3	1	4.50E-10	-1	4.70E-10	0	-1	2.35E-11	20.00

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
KFM05A	20050120 11:09	20050120 13:14	116.50	121.50	3	1	1.51E-06	0	1.24E-06	0	0	2.48E-07	5.00
KFM05A	20050113 14:11	20050113 15:33	121.50	126.50	3	1	6.63E-07	0	5.45E-07	0	0	1.09E-07	5.00
KFM05A	20050113 15:46	20050113 17:12	126.50	131.50	3	1	7.51E-09	0	6.18E-09	0	0	1.24E-09	5.00
KFM05A	20050120 09:41	20050120 10:56	131.50	136.50	3	1	1.31E-09	0	1.08E-09	0	0	2.16E-10	5.00
KFM05A	20050114 08:45	20050114 09:35	136.50	141.50	3	1	4.50E-10	-1	3.70E-10	0	-1	7.40E-11	5.00
KFM05A	20050120 08:12	20050120 09:27	141.50	146.50	3	1	1.46E-09	0	1.20E-09	0	0	2.40E-10	5.00
KFM05A	20050114 11:15	20050114 13:04	146.50	151.50	3	1	4.63E-09	0	3.81E-09	0	0	7.61E-10	5.00
KFM05A	20050114 13:13	20050114 14:29	151.50	156.50	3	1	5.06E-10	0	4.16E-10	0	0	8.32E-11	5.00
KFM05A	20050114 14:38	20050114 15:52	156.50	161.50	3	1	2.18E-09	0	1.79E-09	0	0	3.58E-10	5.00
KFM05A	20050117 09:47	20050117 11:12	161.50	166.50	3	1	9.11E-07	0	7.50E-07	0	0	1.50E-07	5.00
KFM05A	20050120 06:34	20050120 07:51	166.50	171.50	3	1	1.21E-07	0	9.93E-08	0	0	1.99E-08	5.00
KFM05A	20050117 13:06	20050117 14:24	171.50	176.50	3	1	8.23E-07	0	6.77E-07	0	0	1.35E-07	5.00
KFM05A	20050117 14:58	20050117 15:43	214.00	219.00	3	1	2.50E-10	-1	2.06E-10	0	-1	4.11E-11	5.00
KFM05A	20050117 15:58	20050117 17:14	219.00	224.00	3	1	5.19E-10	0	4.27E-10	1	0	8.54E-11	5.00
KFM05A	20050117 17:31	20050117 18:45	224.00	229.00	3	1	6.66E-10	0	5.48E-10	1	0	1.10E-10	5.00
KFM05A	20050117 18:58	20050117 19:40	229.00	234.00	3	1	2.50E-10	-1	2.06E-10	0	-1	4.11E-11	5.00
KFM05A	20050118 06:50	20050118 08:06	254.00	259.00	3	1	7.67E-09	0	6.31E-09	0	0	1.26E-09	5.00
KFM05A	20050118 08:20	20050118 09:14	259.00	264.00	3	1	2.00E-10	-1	1.65E-10	0	-1	3.29E-11	5.00
KFM05A	20050118 09:29	20050118 10:50	264.00	269.00	3	1	1.07E-07	0	8.84E-08	0	0	1.77E-08	5.00
KFM05A	20050118 11:04	20050118 12:30	269.00	274.00	3	1	3.50E-10	-1	2.88E-10	0	-1	5.76E-11	5.00
KFM05A	20050118 12:40	20050118 13:23	274.00	279.00	3	1	2.50E-10	-1	2.06E-10	0	-1	4.11E-11	5.00
KFM05A	20050118 13:39	20050118 14:20	279.00	284.00	3	1	3.00E-10	-1	2.47E-10	0	-1	4.94E-11	5.00
KFM05A	20050118 14:29	20050118 15:43	284.00	289.00	3	1	1.78E-09	0	1.46E-09	0	0	2.93E-10	5.00
KFM05A	20050119 09:44	20050119 10:41	289.00	294.00	3	1	4.50E-10	-1	3.70E-10	0	-1	7.40E-11	5.00
KFM05A	20050119 11:07	20050119 12:21	294.00	299.00	3	1	3.01E-09	0	2.48E-09	0	0	4.95E-10	5.00
KFM05A	20050119 13:58	20050119 15:16	416.50	421.50	3	1	1.40E-09	0	1.15E-09	0	0	2.30E-10	5.00
KFM05A	20050119 15:29	20050119 16:12	421.50	426.50	3	1	2.50E-10	-1	2.06E-10	0	-1	4.11E-11	5.00
KFM05A	20050119 16:24	20050119 17:38	426.50	431.50	3	1	4.51E-10	0	3.71E-10	0	0	7.43E-11	5.00
KFM05A	20050119 17:57	20050119 18:38	431.50	436.50	3	1	3.50E-10	-1	2.88E-10	0	-1	5.76E-11	5.00
KFM05A	20050124 12:49	20050124 14:06	284.00	289.00	3	1	3.39E-09	0	2.79E-09	0	0	5.57E-10	5.00
KFM05A	20050124 14:11	20050124 15:26	284.00	289.00	3	1	3.51E-09	0	2.89E-09	0	0	5.78E-10	5.00

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
KFM05A	20050124 15:31	20050124 16:45	284.00	289.00	3	1	2.78E-09	0	2.29E-09	0	0	4.58E-10	5.00
KFM05A	20050124 16:48	20050124 18:04	284.00	289.00	3	1	4.34E-09	0	3.57E-09	0	0	7.14E-10	5.00

KFM05A 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	c	cd	skin	t1	t2	dte1	dte2	comment
KFM05A	116.50	216.50	1.19E-06	0	1	7.9E-10	5.0E-04	1.00E-06			-5.36	700	1816			
KFM05A	216.50	316.50	1.70E-08	0	1	6.6E-10	5.0E-04	1.00E-06	7.43E-08		-5.00	500	1800			
KFM05A	316.50	416.50		0	0	1.8E-10	5.0E-04	1.00E-06	1.78E-10							
KFM05A	416.50	516.50	7.55E-10	0	1	7.5E-10	5.0E-04	1.00E-06	2.31E-10		-1.32	20	400			
KFM05A	516.50	616.50		-1	0	3.9E-10	5.0E-04	1.00E-06								
KFM05A	606.50	706.50	7.31E-10	0	1	7.5E-10	5.0E-04	1.00E-06	2.48E-10		-1.16	200	1819			
KFM05A	686.50	786.50	3.52E-10	0	1	9.1E-10	5.0E-04	1.00E-06	5.40E-10		-3.31	300	1823			
KFM05A	706.50	806.50	1.30E-10	0	1	6.9E-10	5.0E-04	1.00E-06	6.37E-10		-3.28	500	2008			
KFM05A	806.50	906.50		-1	0	3.3E-10	5.0E-04	1.00E-06								
KFM05A	886.50	986.50		-1	0	4.5E-10	5.0E-04	1.00E-06								The pressure in the packers was set to 9 bar instead of the usual pressure exceeding 20 bar
				-1	0	8.3E-10	5.0E-04	1.00E-06								
KFM05A	116.50	136.50	8.83E-07	0	1	8.2E-10	5.0E-04	1.00E-06			3.88	60	200			
KFM05A	136.50	156.50	4.98E-09	0	1	8.1E-10	5.0E-04	1.00E-06	2.78E-10		0.15	300	1200			
KFM05A	156.50	176.50	9.97E-07	0	1	8.2E-10	5.0E-04	1.00E-06			-4.16			70	300	
KFM05A	176.50	196.50		-1	0	3.9E-10	5.0E-04	1.00E-06								
KFM05A	196.50	216.50	1.52E-10	0	1	4.7E-10	5.0E-04	1.00E-06	5.07E-11		-1.48	100	1800			
KFM05A	214.00	234.00		0	0	4.4E-10	5.0E-04	1.00E-06								
KFM05A	234.00	254.00		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM05A	254.00	274.00	1.37E-08	0	1	5.4E-10	5.0E-04	1.00E-06			-5.38					
KFM05A	274.00	294.00	2.54E-09	0	1	8.0E-10	5.0E-04	1.00E-06	5.36E-11		1.63	20	300			
KFM05A	294.00	314.00	2.83E-09	0	1	8.3E-10	5.0E-04	1.00E-06	6.04E-11		1.15	20	200			
KFM05A	296.50	316.50		-1	0	3.9E-10	5.0E-04	1.00E-06								
KFM05A	416.50	436.50	5.86E-10	0	1	8.1E-10	5.0E-04	1.00E-06	6.37E-11		-1.53	10	600			
KFM05A	436.50	456.50	3.53E-10	0	1	3.3E-10	5.0E-04	1.00E-06	6.37E-11		-0.48	10	100			
KFM05A	456.50	476.50		-1	0	6.0E-10	5.0E-04	1.00E-06								
KFM05A	476.50	496.50		-1	0	5.0E-10	5.0E-04	1.00E-06								
KFM05A	496.50	516.50		-1	0	4.5E-10	5.0E-04	1.00E-06								

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	c	cd	skin	t1	t2	dte1	dte2	comment
				-1	0	8.3E-10	5.0E-04	1.00E-06								
KFM05A	116.50	121.50	1.90E-06	0	1	8.2E-10	5.0E-04	1.00E-06			-0.01	50	400			
KFM05A	121.50	126.50	6.40E-07	0	1	8.1E-10	5.0E-04	1.00E-06			-0.98	300	1200			
KFM05A	126.50	131.50	3.89E-09	0	1	8.2E-10	5.0E-04	1.00E-06			-1.33	200	600			
KFM05A	131.50	136.50	1.56E-09	0	1	8.5E-10	5.0E-04	1.00E-06	2.17E-11		-0.55	10	50			
KFM05A	136.50	141.50		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM05A	141.50	146.50	2.14E-10	0	1	8.5E-10	5.0E-04	1.00E-06	5.83E-11		2.15	300	1200			
KFM05A	146.50	151.50	4.66E-09	0	1	8.0E-10	5.0E-04	1.00E-06	6.55E-11		2.63				600	
KFM05A	151.50	156.50	4.60E-10	0	1	3.1E-10	5.0E-04	1.00E-06	3.21E-11		-0.87				600	
KFM05A	156.50	161.50	8.47E-10	0	1	8.1E-10	5.0E-04	1.00E-06	1.83E-10		1.57	700	1200			
KFM05A	161.50	166.50	8.11E-07	0	1	7.9E-10	5.0E-04	1.00E-06			-4.55			50	300	
KFM05A	166.50	171.50	1.31E-07	0	1	8.1E-10	5.0E-04	1.00E-06			-0.11	200	600			
KFM05A	171.50	176.50	1.79E-06	0	1	8.2E-10	5.0E-04	1.00E-06			4.28	30	100			
KFM05A	214.00	219.00		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM05A	219.00	224.00		0	0	3.6E-10	5.0E-04	1.00E-06	3.46E-11							
KFM05A	224.00	229.00		0	0	4.0E-10	5.0E-04	1.00E-06	3.51E-10							
KFM05A	229.00	234.00		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM05A	254.00	259.00	1.23E-08	0	1	8.3E-10	5.0E-04	1.00E-06	3.90E-11		2.05			300	900	
KFM05A	259.00	264.00		-1	0	2.0E-10	5.0E-04	1.00E-06								
KFM05A	264.00	269.00	9.34E-09	0	1	7.5E-10	5.0E-04	1.00E-06	4.89E-08		-5.60	500	1200			
KFM05A	269.00	274.00		-1	0	3.5E-10	5.0E-04	1.00E-06								
KFM05A	274.00	279.00		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM05A	279.00	284.00		-1	0	3.0E-10	5.0E-04	1.00E-06								
KFM05A	284.00	289.00	6.25E-10	0	1	8.8E-10	5.0E-04	1.00E-06	8.54E-12		-1.65	200	1200			
KFM05A	289.00	294.00		-1	0	4.5E-10	5.0E-04	1.00E-06								
KFM05A	294.00	299.00	2.14E-09	0	1	8.4E-10	5.0E-04	1.00E-06	1.52E-11		0.27	400	1200			
KFM05A	416.50	421.50	9.09E-10	0	1	8.5E-10	5.0E-04	1.00E-06	5.58E-11		-1.36	20	100			
KFM05A	421.50	426.50		-1	0	2.5E-10	5.0E-04	1.00E-06								
KFM05A	426.50	431.50	1.62E-10	0	1	2.5E-10	5.0E-04	1.00E-06	1.34E-11		-0.36	80	1000			
KFM05A	431.50	436.50		-1	0	3.5E-10	5.0E-04	1.00E-06								
				-1	0	8.3E-10	5.0E-04	1.00E-06								
KFM05A	284.00	289.00	1.48E-09	0	1	1.2E-09	5.0E-04	1.00E-06	1.46E-11		0.00	10	200			

idcode	secup	seclow	transmissivity_tt	value_type_tt	bc_tt	l_measl_q_s	u_measl_q_s	assumed_s	c	cd	skin	t1	t2	dte1	dte2	comment
KFM05A	284.00	289.00	1.79E-09	0	1	7.7E-10	5.0E-04	1.00E-06	1.55E-11		0.00	10	200			
KFM05A	284.00	289.00	1.61E-09	0	1	5.3E-10	5.0E-04	1.00E-06	1.49E-11		0.00	10	200			
KFM05A	284.00	289.00	2.33E-09	0	1	2.4E-09	5.0E-04	1.00E-06	1.52E-11		0.00	10	200			

KFM05A 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
KFM05A	20041213 11:35	20041213 15:05	116.50	216.50	100.35	115.50	1038.81	1038.95	1038.95				
KFM05A	20041213 11:35	20041213 15:05	116.50	216.50	217.50	1002.71				1908.72	1909.13	1908.72	
KFM05A	20041222 06:37	20041222 08:29	216.50	316.50	100.35	215.50	1890.86	1890.45	1890.45				
KFM05A	20041222 06:37	20041222 08:29	216.50	316.50	317.50	1002.71				2760.72	2757.97	2755.77	
KFM05A	20041214 11:06	20041214 12:57	316.50	416.50	100.35	315.50	2728.27	2728.27	2727.72				
KFM05A	20041214 11:06	20041214 12:57	316.50	416.50	417.50	1002.71				3589.64	3585.79	3581.94	
KFM05A	20041214 14:43	20041214 16:37	416.50	516.50	100.35	415.50	3551.86	3551.86	3551.86				
KFM05A	20041214 14:43	20041214 16:37	416.50	516.50	517.50	1002.71				4412.64	4407.01	4403.71	
KFM05A	20041215 09:03	20041215 10:57	516.50	616.50	100.35	515.50	4368.20	4368.34	4368.34				
KFM05A	20041215 09:03	20041215 10:57	516.50	616.50	617.50	1002.71				5230.98	5224.38	5219.43	
KFM05A	20041215 13:18	20041215 15:08	606.50	706.50	100.35	605.50	5096.57	5096.17	5096.17				
KFM05A	20041215 13:18	20041215 15:08	606.50	706.50	707.50	1002.71				5967.27	5963.97	5961.50	
KFM05A	20041220 14:31	20041220 16:27	686.50	786.50	100.35	685.50	5747.79	5747.79	5747.92				
KFM05A	20041220 14:31	20041220 16:27	686.50	786.50	787.50	1002.71				6725.41	6718.54	6710.70	
KFM05A	20041216 08:39	20041216 10:47	706.50	806.50	100.35	705.50	5907.45	5906.90	5907.17				
KFM05A	20041216 08:39	20041216 10:47	706.50	806.50	807.50	1002.71				6858.57	6852.67	6847.58	
KFM05A	20041216 14:44	20041216 15:57	806.50	906.50	100.35	805.50	6707.23	6707.23	6706.68				
KFM05A	20041216 14:44	20041216 15:57	806.50	906.50	907.50	1002.71				7695.05	7690.24	7688.04	
KFM05A	20041220 08:16	20041220 10:14	886.50	986.50	100.35	885.50	7352.97	7352.69	7352.97				
KFM05A	20041220 08:16	20041220 10:14	886.50	986.50	987.50	1002.71				8272.76	8303.13	8305.33	
KFM05A	20050104 06:57	20050104 08:35	116.50	136.50	100.35	115.50	1035.94	1036.48	1036.21				
KFM05A	20050104 06:57	20050104 08:35	116.50	136.50	137.50	1002.71				1215.58	1215.58	1215.58	
KFM05A	20050104 09:02	20050104 10:27	136.50	156.50	100.35	135.50	1207.08	1207.08	1206.95				
KFM05A	20050104 09:02	20050104 10:27	136.50	156.50	157.50	1002.71				1386.52	1386.52	1386.52	
KFM05A	20050104 10:51	20050104 13:05	156.50	176.50	100.35	155.50	1377.68	1378.10	1378.23				
KFM05A	20050104 10:51	20050104 13:05	156.50	176.50	177.50	1002.71				1558.58	1558.58	1558.58	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM05A	20050104 13:38	20050104 14:44	176.50	196.50	100.35	175.50	1546.78	1546.92	1546.78				
KFM05A	20050104 13:38	20050104 14:44	176.50	196.50	197.50	1002.71				1728.16	1727.89	1727.89	
KFM05A	20050105 08:18	20050105 09:46	196.50	216.50	100.35	195.50	1717.11	1716.70	1716.98				
KFM05A	20050105 08:18	20050105 09:46	196.50	216.50	217.50	1002.71				1897.73	1898.14	1898.28	
KFM05A	20050105 10:08	20050105 11:25	214.00	234.00	100.35	213.00	1865.55	1865.28	1865.28				
KFM05A	20050105 10:08	20050105 11:25	214.00	234.00	235.00	1002.71				2046.14	2046.14	2046.70	
KFM05A	20050105 11:55	20050105 13:20	234.00	254.00	100.35	233.00	2034.51	2034.78	2034.92				
KFM05A	20050105 11:55	20050105 13:20	234.00	254.00	255.00	1002.71				2214.89	2215.17	2214.89	
KFM05A	20050111 12:38	20050111 13:54	254.00	274.00	100.35	253.00	2208.94	2208.94	2208.94				
KFM05A	20050111 12:38	20050111 13:54	254.00	274.00	275.00	1002.71				2400.27	2402.33	2402.88	
KFM05A	20050110 10:11	20050110 11:29	274.00	294.00	100.35	273.00	2375.30	2375.30	2375.30				
KFM05A	20050110 10:11	20050110 11:29	274.00	294.00	295.00	1002.71				2567.24	2564.90	2563.40	
KFM05A	20050110 11:53	20050110 13:43	294.00	314.00	100.35	293.00	2542.35	2542.49	2542.21				
KFM05A	20050110 11:53	20050110 13:43	294.00	314.00	315.00	1002.71				2729.80	2729.93	2728.83	
KFM05A	20050110 13:56	20050110 14:38	296.50	316.50	100.35	295.50	2563.00	2563.28	2563.00				
KFM05A	20050110 13:56	20050110 14:38	296.50	316.50	317.50	1002.71				2755.22	2755.22	2754.67	
KFM05A	20050110 15:57	20050110 17:18	416.50	436.50	100.35	415.50	3553.49	3553.36	3553.49				
KFM05A	20050110 15:57	20050110 17:18	416.50	436.50	437.50	1002.71				3749.60	3747.26	3745.20	
KFM05A	20050110 17:47	20050110 19:04	436.50	456.50	100.35	435.50	3717.95	3717.67	3717.67				
KFM05A	20050110 17:47	20050110 19:04	436.50	456.50	457.50	1002.71				3914.36	3913.81	3911.75	
KFM05A	20050111 06:29	20050111 07:13	456.50	476.50	100.35	455.50	3884.30	3884.16	3884.03				
KFM05A	20050111 06:29	20050111 07:13	456.50	476.50	477.50	1002.71				4081.05	4080.22	4078.85	
KFM05A	20050111 07:35	20050111 08:20	476.50	496.50	100.35	475.50	4047.38	4047.11	4047.11				
KFM05A	20050111 07:35	20050111 08:20	476.50	496.50	497.50	1002.71				4247.47	4246.51	4246.51	
KFM05A	20050111 08:41	20050111 09:28	496.50	516.50	100.35	495.50	4209.64	4209.78	4210.19				
KFM05A	20050111 08:41	20050111 09:28	496.50	516.50	517.50	1002.71				4409.21	4409.21	4408.11	
KFM05A	20050120 11:09	20050120 13:14	116.50	121.50	100.35	115.50	1038.95	1039.22	1038.95				
KFM05A	20050120 11:09	20050120 13:14	116.50	121.50	122.50	1002.71				1096.29	1096.85	1099.59	
KFM05A	20050113 14:11	20050113 15:33	121.50	126.50	100.35	120.50	1084.36	1084.36	1084.36				
KFM05A	20050113 14:11	20050113 15:33	121.50	126.50	127.50	1002.71				1126.53	1126.12	1124.88	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM05A	20050113 15:46	20050113 17:12	126.50	131.50	100.35	125.50	1127.47	1127.60	1127.60				
KFM05A	20050113 15:46	20050113 17:12	126.50	131.50	132.50	1002.71				1167.90	1170.51	1172.71	
KFM05A	20050120 09:41	20050120 10:56	131.50	136.50	100.35	130.50	1167.69	1167.55	1167.55				
KFM05A	20050120 09:41	20050120 10:56	131.50	136.50	137.50	1002.71				1226.44	1224.51	1224.38	
KFM05A	20050114 08:45	20050114 09:35	136.50	141.50	100.35	135.50	1214.61	1214.61	1215.16				
KFM05A	20050114 08:45	20050114 09:35	136.50	141.50	142.50	1002.71				1264.50	1264.50	1265.05	
KFM05A	20050120 08:12	20050120 09:27	141.50	146.50	100.35	140.50	1253.60	1253.33	1253.47				
KFM05A	20050120 08:12	20050120 09:27	141.50	146.50	147.50	1002.71				1309.57	1308.89	1310.12	
KFM05A	20050114 11:15	20050114 13:04	146.50	151.50	100.35	145.50	1299.98	1300.11	1299.98				
KFM05A	20050114 11:15	20050114 13:04	146.50	151.50	152.50	1002.71				1351.90	1351.90	1351.90	
KFM05A	20050114 13:13	20050114 14:29	151.50	156.50	100.35	150.50	1342.66	1342.66	1342.66				
KFM05A	20050114 13:13	20050114 14:29	151.50	156.50	157.50	1002.71				1394.77	1394.22	1394.22	
KFM05A	20050114 14:38	20050114 15:52	156.50	161.50	100.35	155.50	1385.35	1385.35	1385.35				
KFM05A	20050114 14:38	20050114 15:52	156.50	161.50	162.50	1002.71				1436.96	1437.10	1437.10	
KFM05A	20050117 09:47	20050117 11:12	161.50	166.50	100.35	160.50	1426.53	1426.40	1426.40				
KFM05A	20050117 09:47	20050117 11:12	161.50	166.50	167.50	1002.71				1478.33	1481.90	1481.08	
KFM05A	20050120 06:34	20050120 07:51	166.50	171.50	100.35	165.50	1466.75	1466.61	1466.34				
KFM05A	20050120 06:34	20050120 07:51	166.50	171.50	172.50	1002.71				1519.82	1520.10	1521.20	
KFM05A	20050117 13:06	20050117 14:24	171.50	176.50	100.35	170.50	1511.21	1511.21	1511.21				
KFM05A	20050117 13:06	20050117 14:24	171.50	176.50	177.50	1002.71				1565.17	1565.17	1565.17	
KFM05A	20050117 14:58	20050117 15:43	214.00	219.00	100.35	213.00	1871.29	1871.29	1871.29				
KFM05A	20050117 14:58	20050117 15:43	214.00	219.00	220.00	1002.71				1925.49	1925.63	1925.77	
KFM05A	20050117 15:58	20050117 17:14	219.00	224.00	100.35	218.00	1913.29	1913.43	1913.43				
KFM05A	20050117 15:58	20050117 17:14	219.00	224.00	225.00	1002.71				1967.54	1967.54	1967.54	
KFM05A	20050117 17:31	20050117 18:45	224.00	229.00	100.35	223.00	1955.71	1955.57	1955.57				
KFM05A	20050117 17:31	20050117 18:45	224.00	229.00	230.00	1002.71				2009.86	2009.46	2009.32	
KFM05A	20050117 18:58	20050117 19:40	229.00	234.00	100.35	228.00	1997.71	1997.71	1997.71				
KFM05A	20050117 18:58	20050117 19:40	229.00	234.00	235.00	1002.71				2052.33	2051.64	2051.64	
KFM05A	20050118 06:50	20050118 08:06	254.00	259.00	100.35	253.00	2207.57	2207.71	2207.85				
KFM05A	20050118 06:50	20050118 08:06	254.00	259.00	260.00	1002.71				2262.03	2262.17	2262.17	
KFM05A	20050118 08:20	20050118 09:14	259.00	264.00	100.35	258.00	2249.98	2249.98	2249.44				
KFM05A	20050118 08:20	20050118 09:14	259.00	264.00	265.00	1002.71				2306.56	2306.01	2306.14	

idcode	start_date	stop_date	secup	seclow	obs_secup	obs_seclow	pi_above	pp_above	pf_above	pi_below	pp_below	pf_below	comments
KFM05A	20050118 09:29	20050118 10:50	264.00	269.00	100.35	263.00	2292.26	2292.13	2292.13				
KFM05A	20050118 09:29	20050118 10:50	264.00	269.00	270.00	1002.71				2349.70	2352.31	2353.96	
KFM05A	20050118 11:04	20050118 12:30	269.00	274.00	100.35	268.00	2333.72	2333.72	2333.72				
KFM05A	20050118 11:04	20050118 12:30	269.00	274.00	275.00	1002.71				2391.89	2391.06	2391.34	
KFM05A	20050118 12:40	20050118 13:23	274.00	279.00	100.35	273.00	2375.71	2375.44	2375.30				
KFM05A	20050118 12:40	20050118 13:23	274.00	279.00	280.00	1002.71				2434.76	2434.76	2433.66	
KFM05A	20050118 13:39	20050118 14:20	279.00	284.00	100.35	278.00	2417.57	2417.43	2417.43				
KFM05A	20050118 13:39	20050118 14:20	279.00	284.00	285.00	1002.71				2479.42	2478.32	2477.64	
KFM05A	20050118 14:29	20050118 15:43	284.00	289.00	100.35	283.00	2459.03	2458.75	2459.03				
KFM05A	20050118 14:29	20050118 15:43	284.00	289.00	290.00	1002.71				2523.54	2522.16	2521.06	
KFM05A	20050119 09:44	20050119 10:41	289.00	294.00	100.35	288.00	2501.85	2501.71	2501.71				
KFM05A	20050119 09:44	20050119 10:41	289.00	294.00	295.00	1002.71				2566.96	2564.49	2564.49	
KFM05A	20050119 11:07	20050119 12:21	294.00	299.00	100.35	293.00	2543.85	2543.85	2543.85				
KFM05A	20050119 11:07	20050119 12:21	294.00	299.00	300.00	1002.71				2610.11	2607.37	2605.71	
KFM05A	20050119 13:58	20050119 15:16	416.50	421.50	100.35	415.50	3555.55	3555.14	3555.14				
KFM05A	20050119 13:58	20050119 15:16	416.50	421.50	422.50	1002.71				3623.16	3620.42	3618.22	
KFM05A	20050119 15:29	20050119 16:12	421.50	426.50	100.35	420.50	3596.46	3596.18	3596.18				
KFM05A	20050119 15:29	20050119 16:12	421.50	426.50	427.50	1002.71				3671.27	3670.44	3669.34	
KFM05A	20050119 16:24	20050119 17:38	426.50	431.50	100.35	425.50	3637.77	3637.77	3637.77				
KFM05A	20050119 16:24	20050119 17:38	426.50	431.50	432.50	1002.71				3707.82	3704.93	3702.33	
KFM05A	20050119 17:57	20050119 18:38	431.50	436.50	100.35	430.50	3679.10	3678.82	3679.37				
KFM05A	20050119 17:57	20050119 18:38	431.50	436.50	437.50	1002.71				3751.24	3750.97	3749.60	
KFM05A	20050124 12:49	20050124 14:06	284.00	289.00	100.35	283.00	2458.62	2458.48	2458.48				
KFM05A	20050124 12:49	20050124 14:06	284.00	289.00	290.00	1002.71				2515.98	2515.02	2513.36	
KFM05A	20050124 14:11	20050124 15:26	284.00	289.00	100.35	283.00	2458.89	2458.48	2459.03				
KFM05A	20050124 14:11	20050124 15:26	284.00	289.00	290.00	1002.71				2517.90	2516.80	2516.66	
KFM05A	20050124 15:31	20050124 16:45	284.00	289.00	100.35	283.00	2459.16	2459.03	2459.03				
KFM05A	20050124 15:31	20050124 16:45	284.00	289.00	290.00	1002.71				2519.14	2518.32	2518.32	
KFM05A	20050124 16:48	20050124 18:04	284.00	289.00	100.35	283.00	2459.03	2459.03	2459.03				
KFM05A	20050124 16:48	20050124 18:04	284.00	289.00	290.00	1002.71				2520.38	2519.55	2518.32	