P-04-95

Forsmark site investigation

Single-hole injection tests in borehole KFM01A

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Appendix 1

File description table

Bh id	Testsection		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)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM01A	105.45	205.45	3	1	20030515 16:38	20030515 18:30	__KFM01A_0105.45_200305151638.ht2	P, Q, Te	
KFM01A	200.45	300.45	3	1	20030512 11:47	20030512 14:01	__KFM01A_0200.45_200305121107.ht2	P, Q, Te	
KFM01A	300.45	400.45	3	1	20030512 15:44	20030512 17:24	__KFM01A_0300.45_200305121544.ht2	P, Q, Te	
KFM01A	400.45	500.45	3	1	20030513 09:25	20030513 11:06	__KFM01A_0400.45_200305130925.ht2	P, Q, Te	
KFM01A	500.45	600.45	3	1	20030513 13:22	20030513 15:16	__KFM01A_0500.45_200305131322.ht2	P, Q, Te	
KFM01A	600.45	700.45	3	1	20030514 08:16	20030514 10:06	__KFM01A_0600.45_200305140816.ht2	P, Q, Te	
KFM01A	700.45	800.45	3	1	20030514 12:41	20030514 14:33	__KFM01A_0700.45_200305141241.ht2	P, Q, Te	
KFM01A	800.45	900.45	3	1	20030514 16:26	20030514 18:00	__KFM01A_0800.45_200305141626.ht2	P, Q, Te	
KFM01A	895.45	995.45	3	1	20030514 18:45	20030514 19:57	__KFM01A_0895.45_200305141845.ht2	P, Q, Te	
KFM01A	105.45	125.45	3	1	20030519 15:44	20030519 17:13	__KFM01A_0105.45_200305191544.ht2	P, Q, Te	
KFM01A	125.45	145.45	3	1	20030520 08:42	20030520 10:01	__KFM01A_0125.45_200305200842.ht2	P, Q, Te	
KFM01A	145.45	165.45	3	1	20030520 10:36	20030520 11:57	__KFM01A_0145.45_200305201036.ht2	P, Q, Te	
KFM01A	165.45	185.45	3	1	20030520 13:02	20030520 14:24	__KFM01A_0165.45_200305201302.ht2	P, Q, Te	
KFM01A	185.45	205.45	3	1	20030520 14:50	20030520 16:11	__KFM01A_0185.45_200305201450.ht2	P, Q, Te	
KFM01A	200.45	220.45	3	1	20030521 09:03	20030521 10:15	__KFM01A_0200.45_200305210903.ht2	P, Q, Te	
KFM01A	220.45	240.45	3	1	20030521 10:32	20030521 11:54	__KFM01A_0220.45_200305211032.ht2	P, Q, Te	
KFM01A	240.45	260.45	3	1	20030521 12:51	20030521 14:02	__KFM01A_0240.45_200305211251.ht2	P, Q, Te	
KFM01A	260.45	280.45	3	1	20030521 14:20	20030521 15:43	__KFM01A_0260.45_200305211420.ht2	P, Q, Te	
KFM01A	280.45	300.45	3	1	20030521 16:18	20030521 17:42	__KFM01A_0280.45_200305211618.ht2	P, Q, Te	
KFM01A	300.45	320.45	3	1	20030521 18:00	20030521 19:19	__KFM01A_0300.45_200305211800.ht2	P, Q, Te	

Bh id	Testsection		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)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM01A	320.45	340.45	3	1	20030522 08:29	20030522 09:51	__KFM01A_0320.45_200305220829.ht2	P, Q, Te	
KFM01A	340.45	360.45	3	1	20030522 10:16	20030522 11:12	__KFM01A_0340.45_200305221016.ht2	P, Q, Te	
KFM01A	360.45	380.45	3	1	20030522 11:28	20030522 13:23	__KFM01A_0360.45_200305221128.ht2	P, Q, Te	
KFM01A	380.45	400.45	3	1	20030522 13:42	20030522 15:03	__KFM01A_0380.45_200305221342.ht2	P, Q, Te	
KFM01A	105.45	110.45	3	1	20030526 11:30	20030526 14:07	__KFM01A_0105.45_200305261130.ht2	P, Q, Te	
KFM01A	110.45	115.45	3	1	20030526 14:43	20030526 15:54	__KFM01A_0110.45_200305261443.ht2	P, Q, Te	
KFM01A	115.45	120.45	3	1	20030526 16:11	20030526 17:18	__KFM01A_0115.45_200305261611.ht2	P, Q, Te	
KFM01A	120.45	125.45	3	1	20030527 08:36	20030527 09:51	__KFM01A_0120.45_200305270836.ht2	P, Q, Te	
KFM01A	125.45	130.45	3	1	20030527 10:20	20030527 11:30	__KFM01A_0125.45_200305271020.ht2	P, Q, Te	
KFM01A	130.45	135.45	3	1	20030527 11:40	20030527 13:29	__KFM01A_0130.45_200305271140.ht2	P, Q, Te	
KFM01A	135.45	140.45	3	1	20030602 08:27	20030602 09:41	__KFM01A_0135.45_200306020827.ht2	P, Q, Te	
KFM01A	140.45	145.45	3	1	20030602 10:00	20030602 11:11	__KFM01A_0140.45_200306021000.ht2	P, Q, Te	
KFM01A	145.45	150.45	3	1	20030602 11:32	20030602 13:08	__KFM01A_0145.45_200306021132.ht2	P, Q, Te	
KFM01A	150.45	155.45	3	1	20030602 13:24	20030602 14:13	__KFM01A_0150.45_200306021324.ht2	P, Q, Te	
KFM01A	155.45	160.45	3	1	20030602 14:25	20030602 15:34	__KFM01A_0155.45_200306021425.ht2	P, Q, Te	
KFM01A	160.45	165.45	3	1	20030602 15:49	20030602 16:56	__KFM01A_0160.45_200306021549.ht2	P, Q, Te	
KFM01A	165.45	170.45	3	1	20030602 08:37	20030603 09:49	__KFM01A_0165.45_200306030837.ht2	P, Q, Te	
KFM01A	170.45	175.45	3	1	20030603 11:35	20030603 13:08	__KFM01A_0170.45_200306031135.ht2	P, Q, Te	
KFM01A	175.45	180.45	3	1	20030603 13:17	20030603 14:22	__KFM01A_0175.45_200306031317.ht2	P, Q, Te	
KFM01A	180.45	185.45	3	1	20030603 14:53	20030603 15:55	__KFM01A_0180.45_200306031453.ht2	P, Q, Te	
KFM01A	185.45	190.45	3	1	20030604 08:24	20030604 09:40	__KFM01A_0185.45_200306040824.ht2	P, Q, Te	
KFM01A	190.45	195.45	3	1	20030604 09:50	20030604 10:57	__KFM01A_0190.45_200306040950.ht2	P, Q, Te	
KFM01A	195.45	200.45	3	1	20030604 11:16	20030604 13:02	__KFM01A_0195.45_200306041116.ht2	P, Q, Te	

Bh id	Testsection		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)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM01A	200.45	205.45	3	1	20030604 13:13	20030604 14:00	__KFM01A_0200.45_200306041313.ht2	P, Q, Te	
KFM01A	205.45	210.45	3	1	20030604 14:09	20030604 14:54	__KFM01A_0205.45_200306041409.ht2	P, Q, Te	
KFM01A	210.45	215.45	3	1	20030604 15:16	20030604 16:10	__KFM01A_0210.45_200306041516.ht2	P, Q, Te	
KFM01A	215.45	220.45	3	1	20030605 08:26	20030605 09:37	__KFM01A_0215.45_200306050826.ht2	P, Q, Te	
KFM01A	220.45	225.45	3	1	20030605 09:47	20030605 11:03	__KFM01A_0220.45_200306050947.ht2	P, Q, Te	
KFM01A	225.45	230.45	3	1	20030605 11:20	20030605 13:35	__KFM01A_0225.45_200306051120.ht2	P, Q, Te	
KFM01A	230.45	235.45	3	1	20030605 13:44	20030605 14:59	__KFM01A_0230.45_200306051344.ht2	P, Q, Te	
KFM01A	235.45	240.45	3	1	20030605 15:10	20030605 16:14	__KFM01A_0235.45_200306051510.ht2	P, Q, Te	
KFM01A	260.45	265.45	3	1	20030606 08:20	20030606 09:21	__KFM01A_0260.45_200306060820.ht2	P, Q, Te	
KFM01A	265.45	270.45	3	1	20030606 09:42	20030606 10:46	__KFM01A_0265.45_200306060942.ht2	P, Q, Te	
KFM01A	270.45	275.45	3	1	20030606 10:57	20030606 12:20	__KFM01A_0270.45_200306061057.ht2	P, Q, Te	
KFM01A	275.45	280.45	3	1	20030606 12:42	20030606 13:45	__KFM01A_0275.45_200306061242.ht2	P, Q, Te	
KFM01A	280.45	285.45	3	1	20030606 13:54	20030606 14:58	__KFM01A_0280.45_200306061354.ht2	P, Q, Te	
KFM01A	285.45	290.45	3	1	20030606 15:24	20030606 16:31	__KFM01A_0285.45_200306061524.ht2	P, Q, Te	
KFM01A	290.45	295.45	3	1	20030610 08:27	20030610 09:27	__KFM01A_0290.45_200306100827.ht2	P, Q, Te	
KFM01A	295.45	300.45	3	1	20030610 09:38	20030610 10:37	__KFM01A_0295.45_200306100938.ht2	P, Q, Te	
KFM01A	300.45	305.45	3	1	20030610 10:47	20030610 11:55	__KFM01A_0300.45_200306101047.ht2	P, Q, Te	
KFM01A	305.45	310.45	3	1	20030610 12:24	20030610 13:24	__KFM01A_0305.45_200306101224.ht2	P, Q, Te	
KFM01A	310.45	315.45	3	1	20030610 13:30	20030610 14:31	__KFM01A_0310.45_200306101330.ht2	P, Q, Te	
KFM01A	315.45	320.45	3	1	20030610 14:39	20030610 15:38	__KFM01A_0315.45_200306101439.ht2	P, Q, Te	
KFM01A	320.45	325.45	3	1	20030610 15:46	20030610 16:45	__KFM01A_0320.45_200306101546.ht2	P, Q, Te	
KFM01A	325.45	330.45	3	1	20030611 08:18	20030611 09:18	__KFM01A_0325.45_200306110818.ht2	P, Q, Te	
KFM01A	330.45	335.45	3	1	20030611 09:29	20030611 10:34	__KFM01A_0330.45_200306110929.ht2	P, Q, Te	

Bh id	Testsection		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)*		YYYYMMDD hh:mm	YYYYMMDD hh:mm	__Borehole id_secup_date and time of test start		
KFM01A	335.45	340.45	3	1	20030611 10:42	20030611 11:23	__KFM01A_0335.45_200306111042.ht2	P, Q, Te	
KFM01A	360.45	365.45	3	1	20030611 11:36	20030611 13:03	__KFM01A_0360.45_200306111136.ht2	P, Q, Te	
KFM01A	365.45	370.45	3	1	20030611 13:13	20030611 14:05	__KFM01A_0365.45_200306111313.ht2	P, Q, Te	
KFM01A	370.45	375.45	3	1	20030611 14:13	20030611 15:11	__KFM01A_0370.45_200306111413.ht2	P, Q, Te	
KFM01A	375.45	380.45	3	1	20030611 15:19	20030611 16:23	__KFM01A_0375.45_200306111519.ht2	P, Q, Te	
KFM01A	380.45	385.45	3	1	20030611 16:29	20030612 08:32	__KFM01A_0380.45_200306111629.ht2	P, Q, Te	
KFM01A	385.45	390.45	3	1	20030612 08:39	20030612 09:39	__KFM01A_0385.45_200306120839.ht2	P, Q, Te	
KFM01A	390.45	395.45	3	1	20030612 09:48	20030612 10:48	__KFM01A_0390.45_200306120948.ht2	P, Q, Te	
KFM01A	395.45	400.45	3	1	20030612 10:57	20030612 12:17	__KFM01A_0395.45_200306121057.ht2	P, Q, Te	

[1)] Test type 3 corresponds to injection test

Appendix 2.1

General test data

Borehole: KFM01A

Testtype: CHir (Constant Head injection and recovery)

Field crew: J. Jönsson, J. Källgården, J. Levén, J. Olausson and T. Svensson

General comment:

Test section	Test section	Test start	Start of flow period	Stop of flow period	Test stop	Total flow time	Total recovery time
secup	seclow					tp	t_F
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
105.45	205.45	20030515 16:38	20030515 17:27:46	20030515 17:57:55	20030515 18:30	30	30
200.45	300.45	20030512 11:47	20030512 12:59:00	20030512 13:29:20	20030512 14:01	30	30
300.45	400.45	20030512 15:44	20030512 16:22:54	20030512 16:53:14	20030512 17:24	30	30
400.45	500.45	20030513 09:25	20030513 10:04:08	20030513 10:04:08	20030513 11:06	30	30
500.45	600.45	20030513 13:22	20030513 14:13:41	20030513 14:44:04	20030513 15:16	30	30
600.45	700.45	20030514 08:16	20030514 09:10:13	20030514 09:34:24	20030514 10:06	24	30
700.45	800.45	20030514 12:41	20030514 13:49:01	20030514 14:00:48	20030514 14:33	12	30
800.45	900.45	20030514 16:26	20030514 17:16:27	20030514 17:27:51	20030514 18:00	11	30
895.45	995.45	20030514 18:45	20030514 19:34:19	20030514 19:44:22	20030514 19:57	10	11
105.45	125.45	20030519 15:44	20030519 16:31:00	20030519 16:51:25	20030519 17:13	20	20
125.45	145.45	20030520 08:42	20030520 09:19:19	20030520 09:39:45	20030520 10:01	20	20
145.45	165.45	20030520 10:36	20030520 11:15:05	20030520 11:35:30	20030520 11:57	20	20
165.45	185.45	20030520 13:02	20030520 13:41:54	20030520 14:02:19	20030520 14:24	20	20
185.45	205.45	20030520 14:50	20030520 15:29:19	20030520 15:49:45	20030520 16:11	20	20
200.45	220.45	20030521 09:03	20030521 09:42:18	20030521 09:53:22	20030521 10:15	11	20
220.45	240.45	20030521 10:32	20030521 11:11:44	20030521 11:32:12	20030521 11:54	21	20
240.45	260.45	20030521 12:51	20030521 13:30:35	20030521 13:39:27	20030521 14:02	9	20
260.45	280.45	20030521 14:20	20030521 15:00:35	20030521 15:21:03	20030521 15:43	20	20
280.45	300.45	20030521 16:18	20030521 16:59:26	20030521 17:19:53	20030521 17:42	20	20
300.45	320.45	20030521 18:00	20030521 18:36:55	20030521 18:57:22	20030521 19:19	20	20
320.45	340.45	20030522 08:29	20030522 09:08:38	20030522 09:29:06	20030522 09:51	21	20
340.45	360.45	20030522 10:16	20030522 10:55:24	20030522 11:04:13	20030522 11:12	9	6
360.45	380.45	20030522 11:28	20030522 12:40:30	20030522 13:00:58	20030522 13:23	20	20
380.45	400.45	20030522 13:42	20030522 14:20:25	20030522 14:40:52	20030522 15:03	20	20
105.45	110.45	20030526 11:30	20030526 13:37:30	20030526 13:52:50	20030526 14:07	15	13
110.45	115.45	20030526 14:43	20030526 15:26:33	20030526 15:41:56	20030526 15:54	15	11
115.45	120.45	20030526 16:11	20030526 16:50:42	20030526 17:06:06	20030526 17:18	15	10
120.45	125.45	20030527 08:36	20030527 09:18:45	20030527 09:34:08	20030527 09:51	15	16
125.45	130.45	20030527 10:20	20030527 11:02:15	20030527 11:17:39	20030527 11:30	15	11
130.45	135.45	20030527 11:40	20030527 13:10:27	20030527 13:21:12	20030527 13:29	11	6
135.45	140.45	20030602 08:27	20030602 09:13:22	20030602 09:20:45	20030602 09:41	7	18
140.45	145.45	20030602 10:00	20030602 10:43:23	20030602 10:58:48	20030602 11:11	15	11
145.45	150.45	20030602 11:32	20030602 12:38:27	20030602 12:53:54	20030602 13:08	15	12
150.45	155.45	20030602 13:24	20030602 14:01:02	20030602 14:05:59	20030602 14:13	5	6

Borehole:	KFM01A
Testtype:	CHir (Constant Head injection and recovery)
Field crew:	J. Jönsson, J. Källgården, J. Levén, J. Olausson and 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** tp	**Total recovery time** t_F
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
155.45	160.45	20030602 14:25	20030602 15:06:20	20030602 15:21:44	20030602 15:34	15	11
160.45	165.45	20030602 15:49	20030602 16:28:28	20030602 16:43:54	20030602 16:56	15	10
165.45	170.45	20030602 08:37	20030603 09:21:15	20030603 09:36:17	20030603 09:49	15	11
170.45	175.45	20030603 11:35	20030603 12:39:52	20030603 12:55:17	20030603 13:08	15	11
175.45	180.45	20030603 13:17	20030603 13:54:01	20030603 14:09:26	20030603 14:22	15	11
180.45	185.45	20030603 14:53	20030603 15:27:41	20030603 15:42:43	20030603 15:55	15	11
185.45	190.45	20030604 08:24	20030604 09:12:11	20030604 09:27:40	20030604 09:40	16	11
190.45	195.45	20030604 09:50	20030604 10:29:54	20030604 10:45:33	20030604 10:57	16	10
195.45	200.45	20030604 11:16	20030604 12:34:04	20030604 12:49:06	20030604 13:02	15	11
200.45	205.45	20030604 13:13	20030604 13:47:42	20030604 13:52:48	20030604 14:00	5	5
205.45	210.45	20030604 14:09	20030604 14:46:13	20030604 14:51:01	20030604 14:54	5	2
210.45	215.45	20030604 15:16	20030604 15:52:13	20030604 16:03:05	20030604 16:10	11	5
215.45	220.45	20030605 08:26	20030605 09:22:17	20030605 09:28:47	20030605 09:37	7	6
220.45	225.45	20030605 09:47	20030605 10:33:26	20030605 10:48:54	20030605 11:03	15	12
225.45	230.45	20030605 11:20	20030605 13:07:40	20030605 13:23:07	20030605 13:35	15	10
230.45	235.45	20030605 13:44	20030605 14:30:56	20030605 14:45:59	20030605 14:59	15	11
235.45	240.45	20030605 15:10	20030605 15:45:30	20030605 16:00:35	20030605 16:14	15	11
260.45	265.45	20030606 08:20	20030606 08:59:15	20030606 09:14:18	20030606 09:21	15	5
265.45	270.45	20030606 09:42	20030606 10:18:06	20030606 10:33:33	20030606 10:46	15	11
270.45	275.45	20030606 10:57	20030606 11:32:46	20030606 11:48:12	20030606 12:20	15	30
275.45	280.45	20030606 12:42	20030606 13:17:43	20030606 13:33:09	20030606 13:45	15	10
280.45	285.45	20030606 13:54	20030606 14:33:56	20030606 14:48:58	20030606 14:58	15	7
285.45	290.45	20030606 15:24	20030606 16:01:53	20030606 16:16:55	20030606 16:31	15	12
290.45	295.45	20030610 08:27	20030610 08:59:31	20030610 09:14:59	20030610 09:27	15	10
295.45	300.45	20030610 09:38	20030610 10:10:13	20030610 10:25:43	20030610 10:37	16	10
300.45	305.45	20030610 10:47	20030610 11:20:09	20030610 11:23:16	20030610 11:55	3	30
305.45	310.45	20030610 12:24	20030610 12:56:14	20030610 13:11:41	20030610 13:24	15	11
310.45	315.45	20030610 13:30	20030610 14:02:26	20030610 14:17:29	20030610 14:31	15	12
315.45	320.45	20030610 14:39	20030610 15:11:01	20030610 15:26:28	20030610 15:38	15	11
320.45	325.45	20030610 15:46	20030610 16:19:26	20030610 16:34:52	20030610 16:45	15	10
325.45	330.45	20030611 08:18	20030611 08:51:29	20030611 09:06:56	20030611 09:18	15	10
330.45	335.45	20030611 09:29	20030611 10:06:59	20030611 10:22:27	20030611 10:34	15	10
335.45	340.45	20030611 10:42	20030611 11:13:46	20030611 11:16:49	20030611 11:23	3	6
360.45	365.45	20030611 11:36	20030611 12:36:13	20030611 12:51:39	20030611 13:03	15	10
365.45	370.45	20030611 13:13	20030611 13:44:45	20030611 13:52:50	20030611 14:05	8	10
370.45	375.45	20030611 14:13	20030611 14:44:33	20030611 14:59:35	20030611 15:11	15	10
375.45	380.45	20030611 15:19	20030611 15:56:54	20030611 16:11:56	20030611 16:23	15	10

Borehole:	KFM01A
Testtype:	CHir (Constant Head injection and recovery)
Field crew:	J. Jönsson, J. Källgården, J. Levén, J. Olausson and T. Svensson
General comment:	

Test section	**Test section**	**Test start**	**Start of flow period**	**Stop of flow period**	**Test stop**	**Total flow time**	**Total recovery time**
secup	seclow					tp	t_F
(m)	(m)	YYYYMMDD hh:mm	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm:ss	YYYYMMDD hh:mm	(min)	(min)
380.45	385.45	20030611 16:29	20030612 08:05:23	20030612 08:20:25	20030612 08:32	15	10
385.45	390.45	20030612 08:39	20030612 09:12:02	20030612 09:27:04	20030612 09:39	15	11
390.45	395.45	20030612 09:48	20030612 10:22:15	20030612 10:37:17	20030612 10:48	15	10
395.45	400.45	20030612 10:57	20030612 11:29:45	20030612 11:44:48	20030612 12:17	15	30

Appendix 2.2

Pressure and flow data

Summary of pressure and flow data for all tests in KFM01A

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p [1)]	Q_m	V_p
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
105.45	205.45	1094.99	1296.37	1150.31	9.240E-06	1.402E-05	2.560E-02
200.45	300.45	2082.01	2293.92	2143.43	1.678E-07	2.559E-07	4.660E-04
300.45	400.45	3083.99	3284.13	3169.74	3.550E-07	7.803E-07	1.421E-03
400.45	500.45	4077.09	4276.28	4134.63	5.000E-08	7.415E-08	1.354E-04
500.45	600.45	5052.52	5256.11	5188.62	1.357E-08	3.748E-08	6.836E-05
600.45	700.45	6026.81	6269.01	6259.74	-	2.610E-08	3.789E-05
700.45	800.45	6993.38	7240.68	7250.64	-	5.129E-08	3.631E-05
800.45	900.45	7935.04	8207.79	8218.32	-	6.588E-08	4.513E-05
895.45	995.45	8863.14	9070.34	9100.77	-	2.606E-08	1.574E-05
105.45	125.45	1118.21	1319.33	1174.92	4.907E-06	8.157E-06	1.000E-02
125.45	145.45	1323.20	1524.04	1343.12	4.705E-07	6.528E-07	8.023E-04
145.45	165.45	1521.27	1722.66	1564.43	4.170E-06	5.669E-06	6.950E-03
165.45	185.45	1724.87	1925.29	1765.81	1.960E-06	2.858E-06	3.504E-03
185.45	205.45	1931.25	2133.19	2012.56	1.188E-07	2.235E-07	2.747E-04
200.45	220.45	2081.73	2303.04	2271.50	-	3.712E-08	2.476E-05
220.45	240.45	2275.79	2473.45	2362.79	3.440E-08	6.656E-08	8.193E-05
240.45	260.45	2487.27	2706.37	2667.64	-	5.579E-08	2.985E-05
260.45	280.45	2669.72	2870.13	2695.86	5.00E-08	7.656E-08	9.409E-05
280.45	300.45	2873.04	3074.30	2956.45	9.270E-08	1.621E-07	1.992E-04
300.45	320.45	3065.99	3269.04	3071.52	7.400E-08	8.950E-08	1.100E-04
320.45	340.45	3269.60	3470.71	3376.93	3.080E-07	7.230E-07	8.900E-04
340.45	360.45	3484.95	3719.41	3703.36	-	4.070E-08	2.161E-05
360.45	380.45	3660.76	3861.05	3786.35	5.376E-08	2.072E-07	2.547E-04
380.45	400.45	3863.25	4136.57	3947.35	1.849E-08	4.719E-08	5.800E-05
105.45	110.45	1134.98	1333.88	1178.97	8.689E-08	2.182E-07	2.010E-04
110.45	115.45	1180.77	1412.45	1327.78	1.19E-06	2.973E-06	2.747E-03
115.45	120.45	1228.62	1431.81	1253.65	2.728E-06	3.725E-06	3.446E-03
120.45	125.45	1289.20	1502.77	1402.49	1.860E-06	3.898E-06	3.602E-03
125.45	130.45	1339.96	1539.69	1477.17	8.135E-08	2.753E-07	2.522E-04
130.45	135.45	1396.68	1773.73	1769.86	-	1.814E-07	1.172E-04
135.45	140.45	1553.25	1781.61	1850.07	-	2.748E-08	1.220E-05
140.45	145.45	1474.96	1674.69	1476.07	4.030E-07	4.460E-07	4.130E-04
145.45	150.45	1526.42	1727.53	1561.83	3.340E-06	4.149E-06	3.850E-03
150.45	155.45	1586.72	1806.38	1794.20	-	9.950E-08	2.965E-05
155.45	160.45	1627.80	1822.42	1684.10	1.517E-06	2.013E-06	1.862E-03
160.45	165.45	1679.95	1875.94	1686.32	2.377E-07	3.257E-07	3.019E-04
165.45	170.45	1733.62	1929.33	1844.54	-	5.315E-08	4.799E-05
170.45	175.45	1784.24	1977.06	1819.65	2.831E-08	6.064E-08	5.615E-05
175.45	180.45	1822.83	2017.72	1882.16	2.080E-06	5.815E-06	5.385E-03
180.45	185.45	1885.48	2101.26	2036.53	-	3.786E-08	3.419E-05
185.45	190.45	1925.18	2125.61	1954.10	8.596E-08	1.251E-07	1.163E-04

Test section		Pressure			Flow		
secup	seclow	p_i	p_p	p_F	Q_p [1)]	Q_m	V_p
(m)	(m)	(kPa)	(kPa)	(kPa)	(m^3/s)	(m^3/s)	(m^3)
190.45	195.45	1981.76	1994.35	2164.89	2.861E-08	1.676E-07	1.575E-04
195.45	200.45	2034.26	2237.51	2197.53	-	3.571E-08	3.225E-05
200.45	205.45	2096.56	2298.50	2296.01	-	7.879E-08	2.419E-05
205.45	210.45	2251.75	2548.03	2644.57	-	8.228E-08	2.378E-05
210.45	215.45	2218.55	2425.48	2423.82	-	2.708E-08	1.768E-05
215.45	220.45	2283.01	2495.74	2503.48	-	4.752E-08	1.858E-05
220.45	225.45	2283.29	2419.67	2355.22	-	8.327E-09	7.727E-06
225.45	230.45	2323.12	2515.94	2431.56	2.647E-08	6.880E-08	6.385E-05
230.45	235.45	2419.67	2652.32	2595.88	-	1.985E-08	1.794E-05
235.45	240.45	2451.48	2646.65	2635.72	-	5.064E-09	4.588E-06
260.45	265.45	2683.44	2888.57	2890.78	-	8.610E-09	7.783E-06
265.45	270.45	2723.00	2931.72	2803.37	6.834E-09	1.713E-08	1.590E-05
270.45	275.45	2770.17	2994.09	2774.58	3.567E-08	4.657E-08	4.317E-05
275.45	280.45	2889.53	3041.27	2932.26	8.976E-09	1.330E-08	1.233E-05
280.45	285.45	2909.03	3118.16	3349.42	-	-4.503E-09	-4.066E-06
285.45	290.45	2939.60	3158.56	3160.77	-	7.468E-09	6.744E-06
290.45	295.45	2962.15	3198.53	3093.27	9.823E-08	1.888E-07	1.754E-04
295.45	300.45	3016.64	3258.28	3056.75	1.910E-08	2.975E-08	2.770E-05
300.45	305.45	3150.12	3310.15	3409.19	-	3.074E-08	5.780E-06
305.45	310.45	3111.12	3358.56	3127.58	4.916E-08	6.418E-08	5.956E-05
310.45	315.45	3180.69	3370.46	3337.81	-	1.209E-08	1.093E-05
315.45	320.45	3206.83	3418.87	3211.67	2.92E-08	7.009E-08	6.504E-05
320.45	325.45	3262.71	3458.43	3392.59	1.810E-07	4.529E-07	4.198E-04
325.45	330.45	3311.12	3523.02	3482.22	5.867E-08	2.313E-07	2.146E-04
330.45	335.45	3361.74	3569.63	3437.95	9.700E-08	1.479E-07	1.374E-04
335.45	340.45	3422.60	3618.87	3626.06	-	3.474E-08	6.392E-06
360.45	365.45	3655.95	3858.86	3806.99	6.848E-08	2.128E-07	1.973E-04
365.45	370.45	3713.48	3908.23	3871.17	-	1.451E-09	7.051E-07
370.45	375.45	3765.91	3957.48	3919.85	-	6.086E-09	5.496E-06
375.45	380.45	3814.59	4006.17	3922.07	-	1.196E-08	1.080E-05
380.45	385.45	3850.14	4056.37	3922.61	-	9.977E-09	9.009E-06
385.45	390.45	3902.97	4105.19	3980.72	-	8.113E-09	7.326E-06
390.45	395.45	3960.38	4154.02	4138.95	-	4.011E-09	3.622E-06
395.45	400.45	4007.41	4203.40	4129.53	-	8.562E-09	7.740E-06

[1)] No value indicates a flow below measurement limit (less then 1.67 E-8 m^3/s).

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

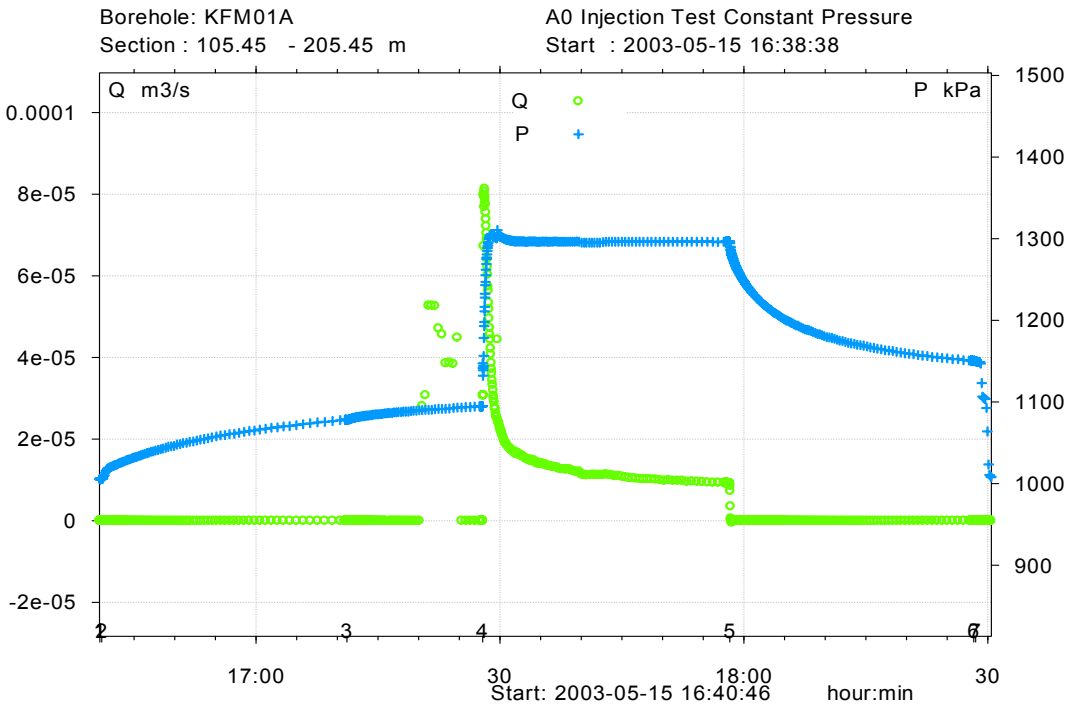


Fig A3-1. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 105.45-205.45 m in borehole KFM01A.

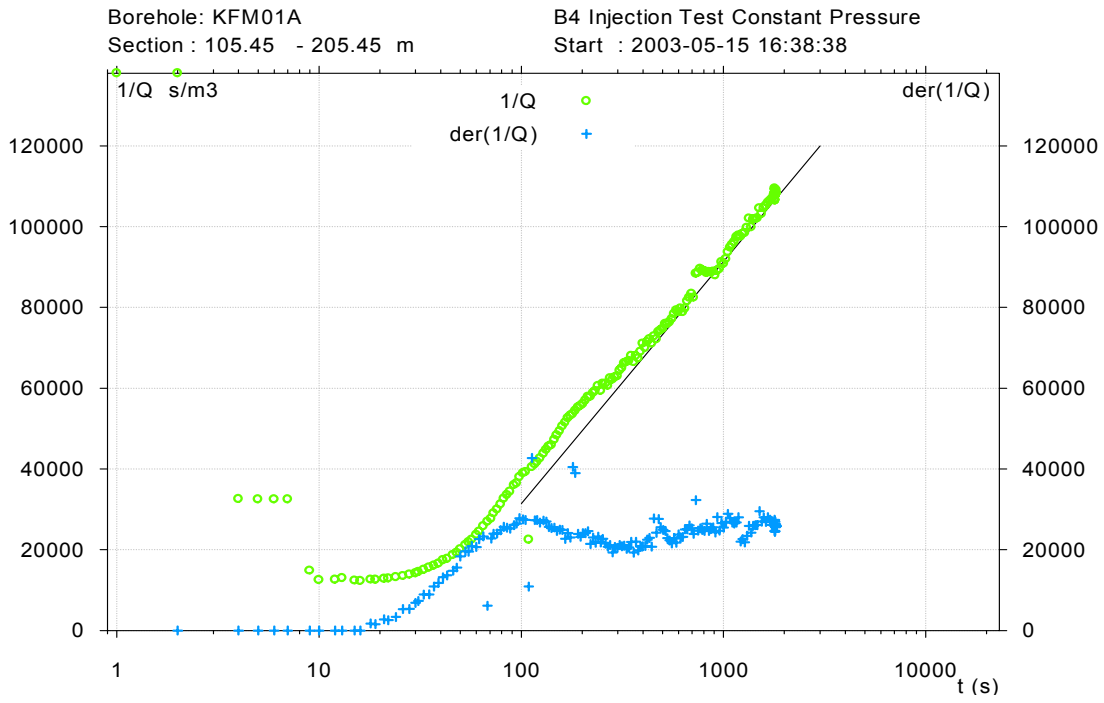


Fig A3-2. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 105.45-205.45 m in KFM01A.

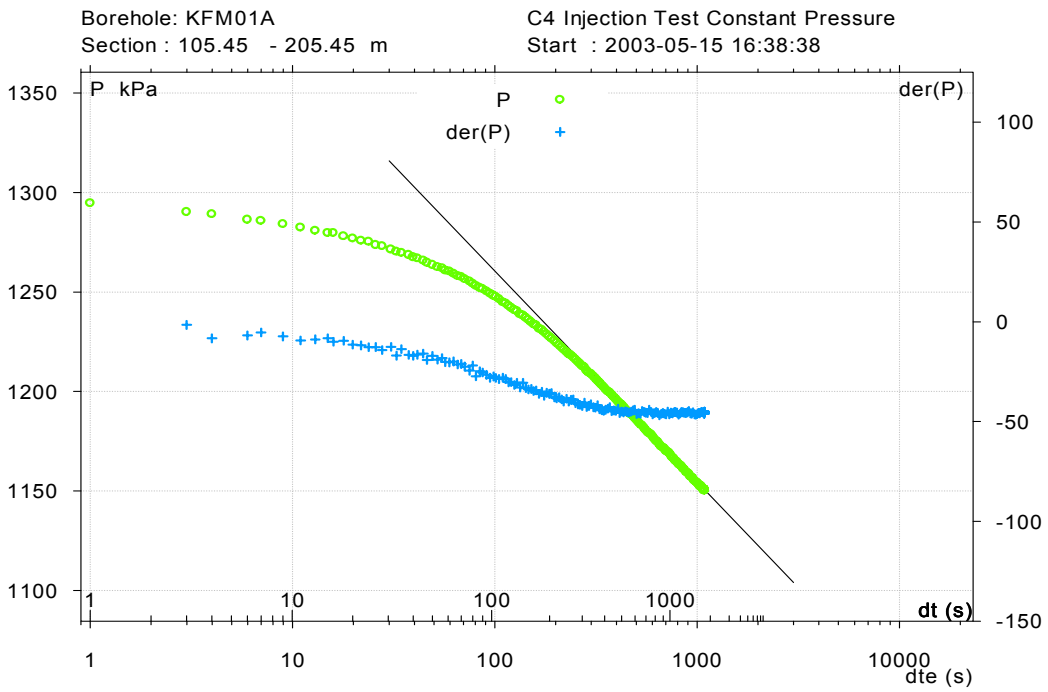


Fig A3-3. Lin-log plot of pressure recovery (p) and -derivative, d(p)/d(ln dte) versus equivalent time (dte) from the injection test in section 105.45-205.45 m in KFM01A.

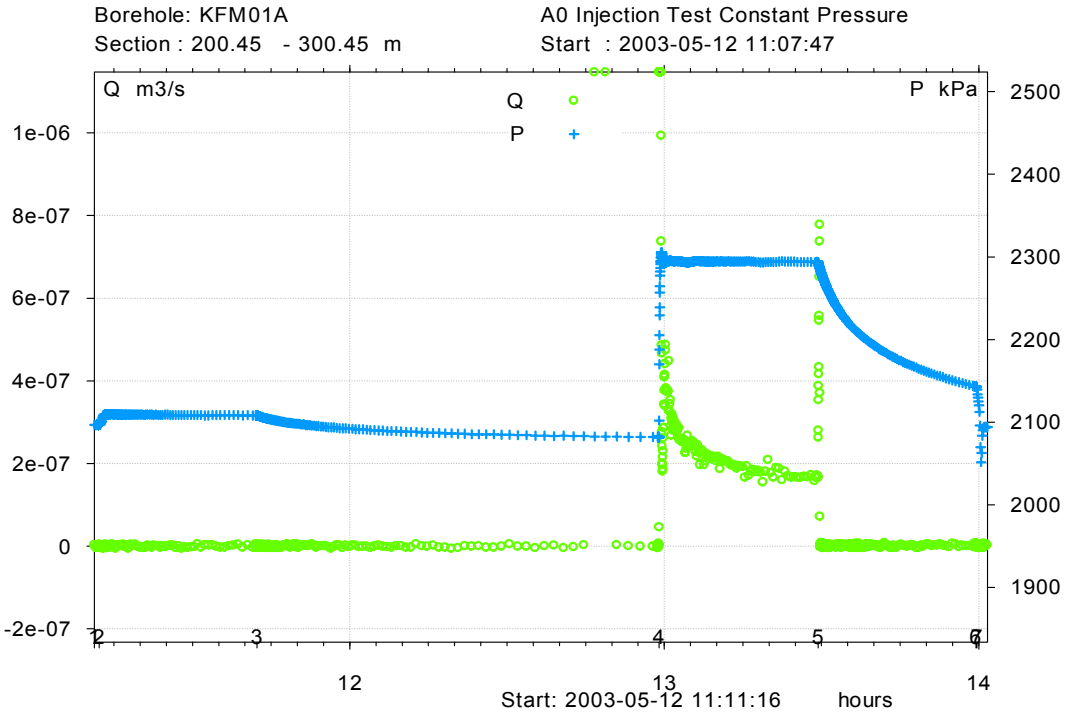


Fig A3-4. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 200.45-300.45 m in borehole KFM01A.

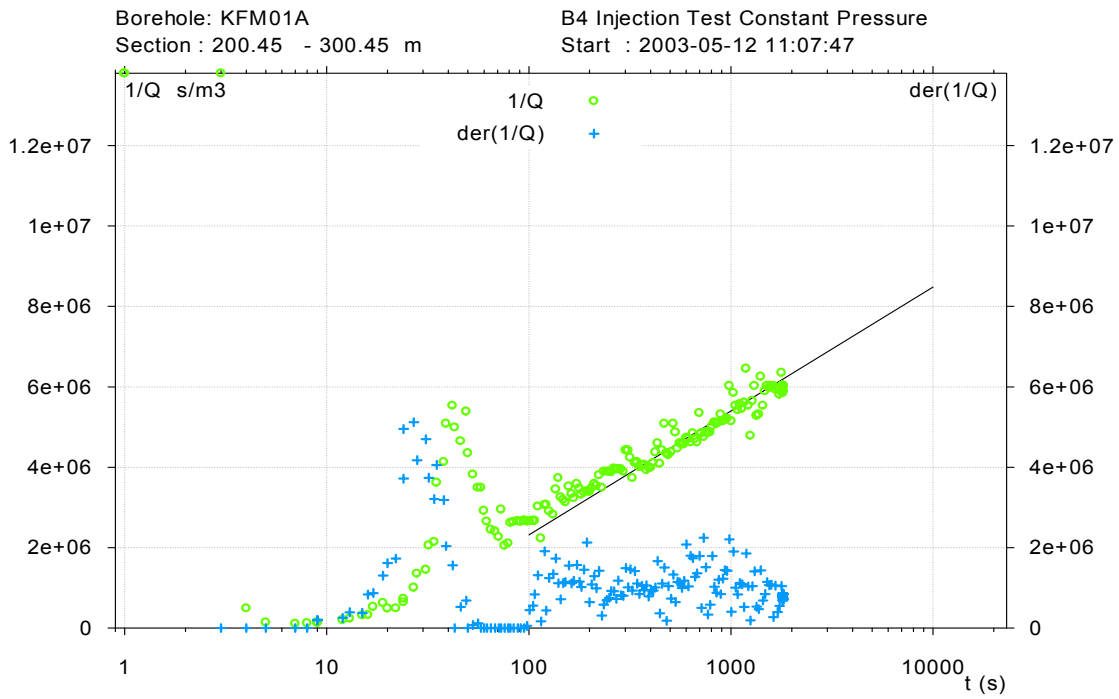


Fig A3-5. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 200.45-300.45 m in KFM01A.

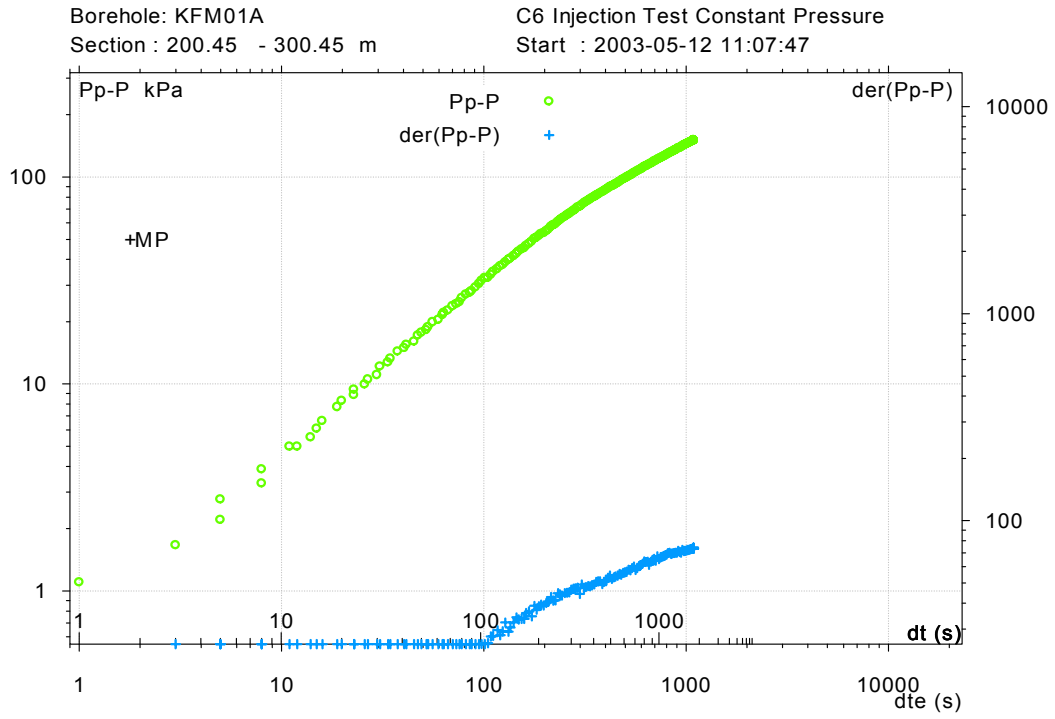


Fig A3-6. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 200.45-300.45 m in KFM01A.

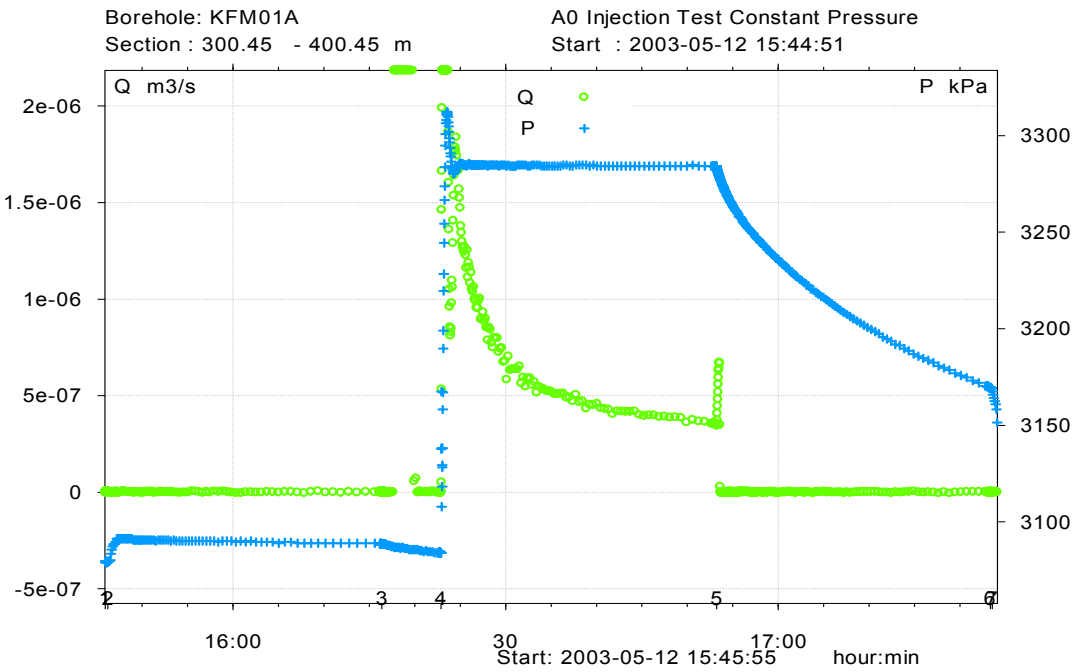


Fig A3-7. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 300.45-400.45 m in borehole KFM01A.

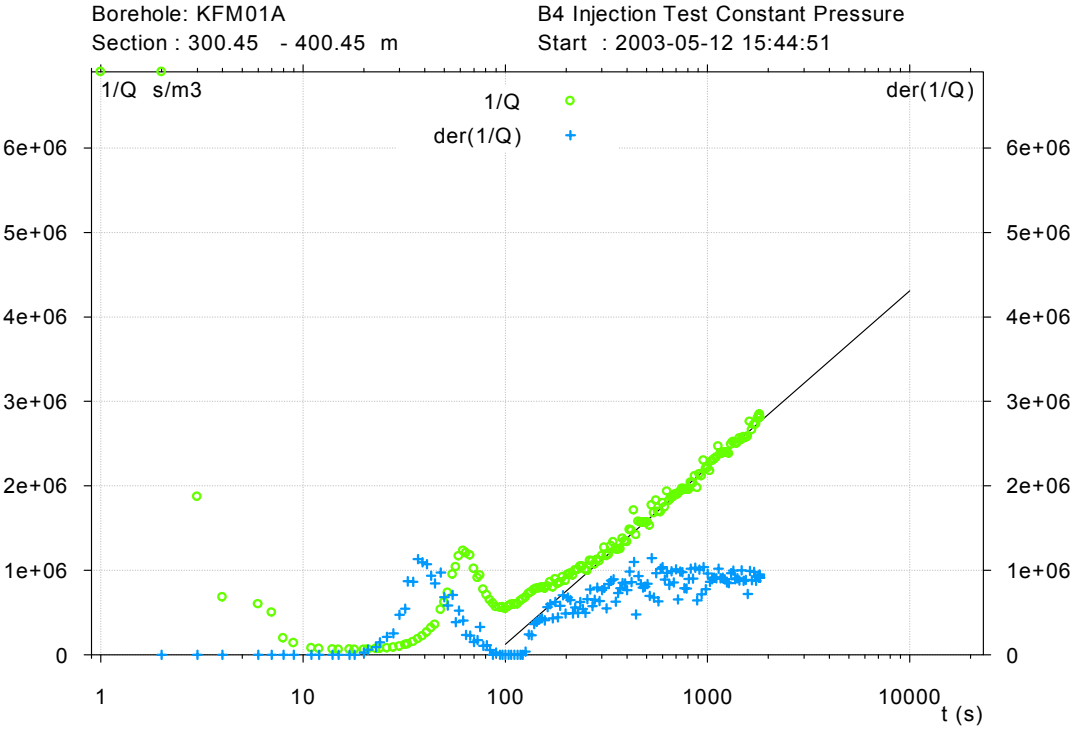


Fig A3-8. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 300.45-400.45 m in KFM01A.

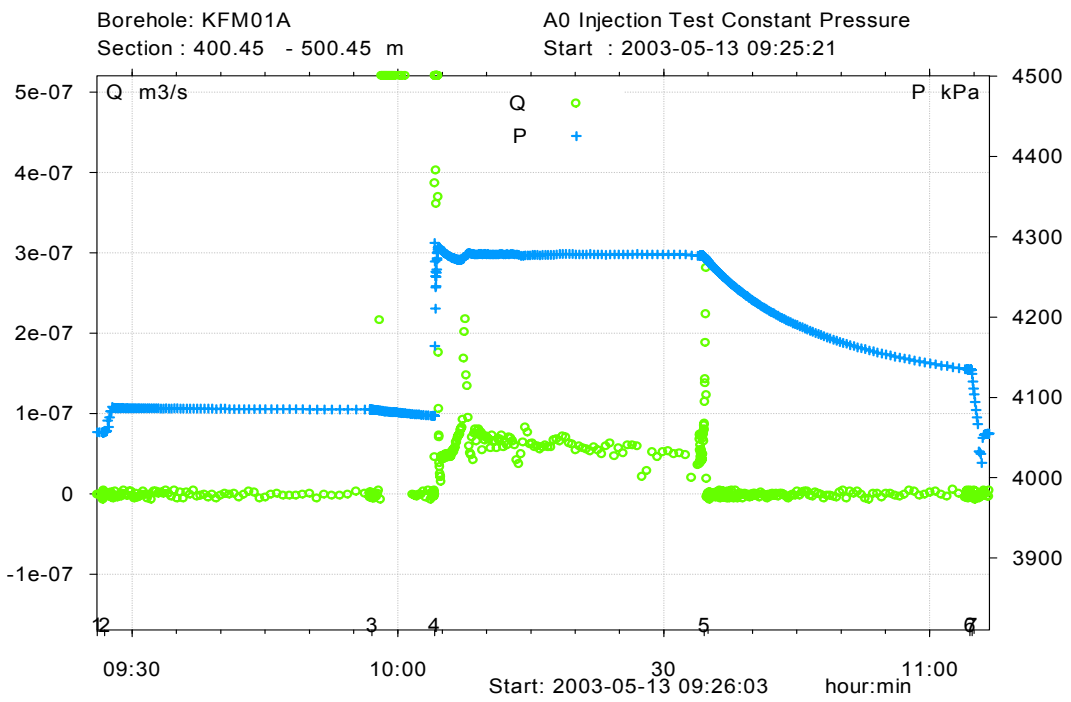


Fig A3-9. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 400.45-500.45 m in borehole KFM01A.

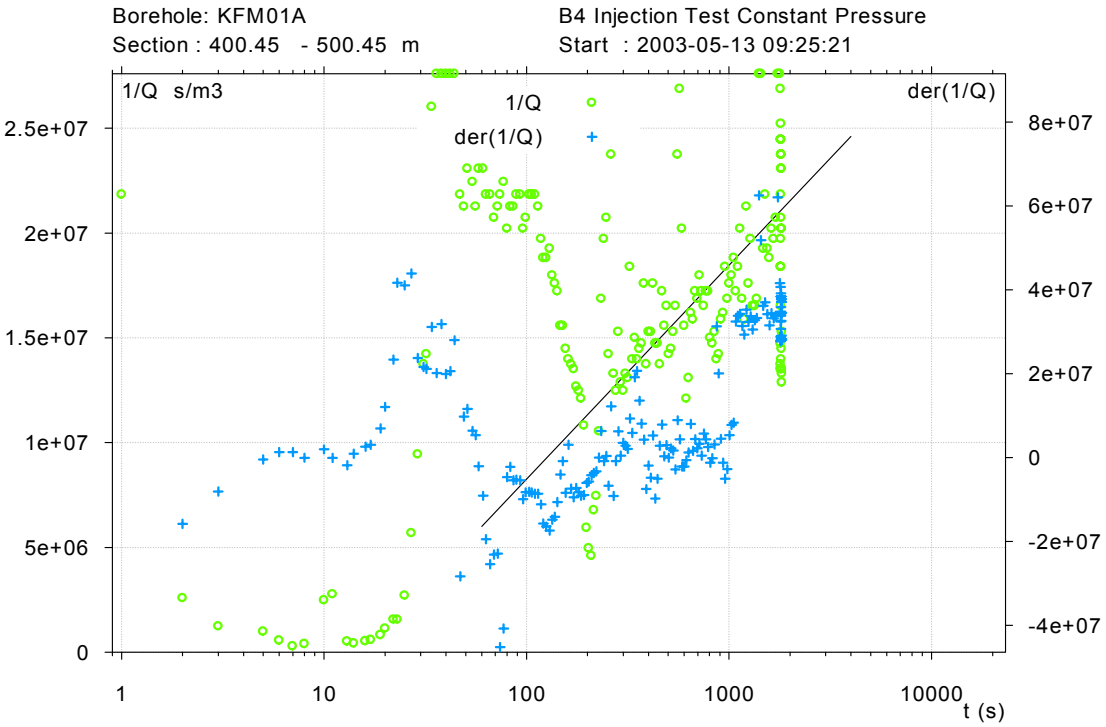


Fig A3-10. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 400.45-500.45 m in KFM01A.

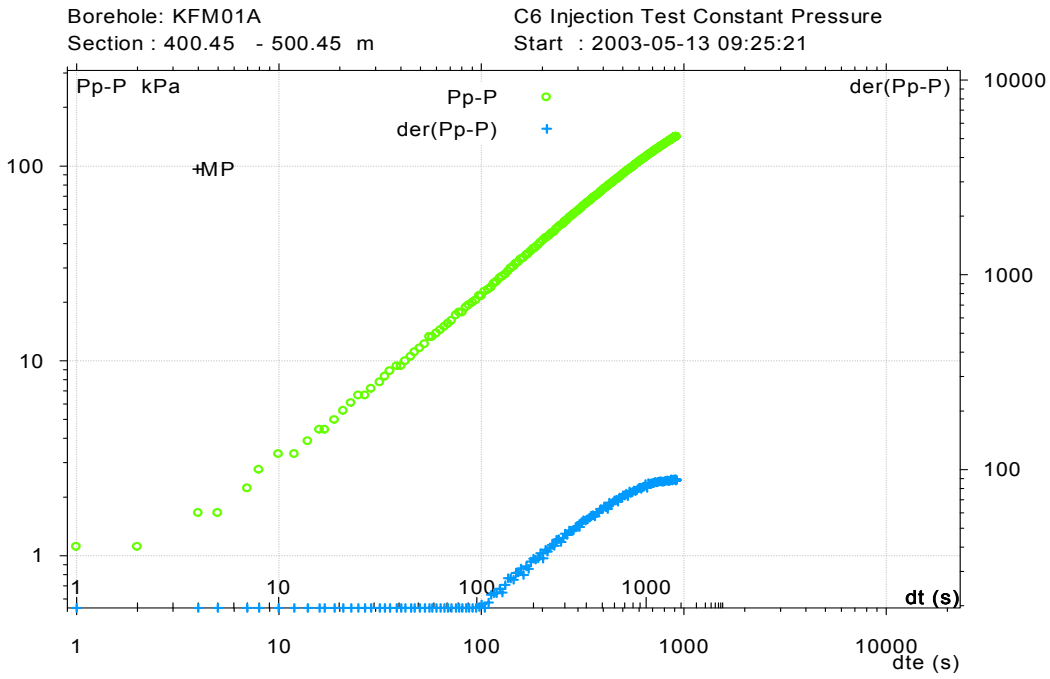


Fig A3-11. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 400.45-500.45 m in KFM01A.

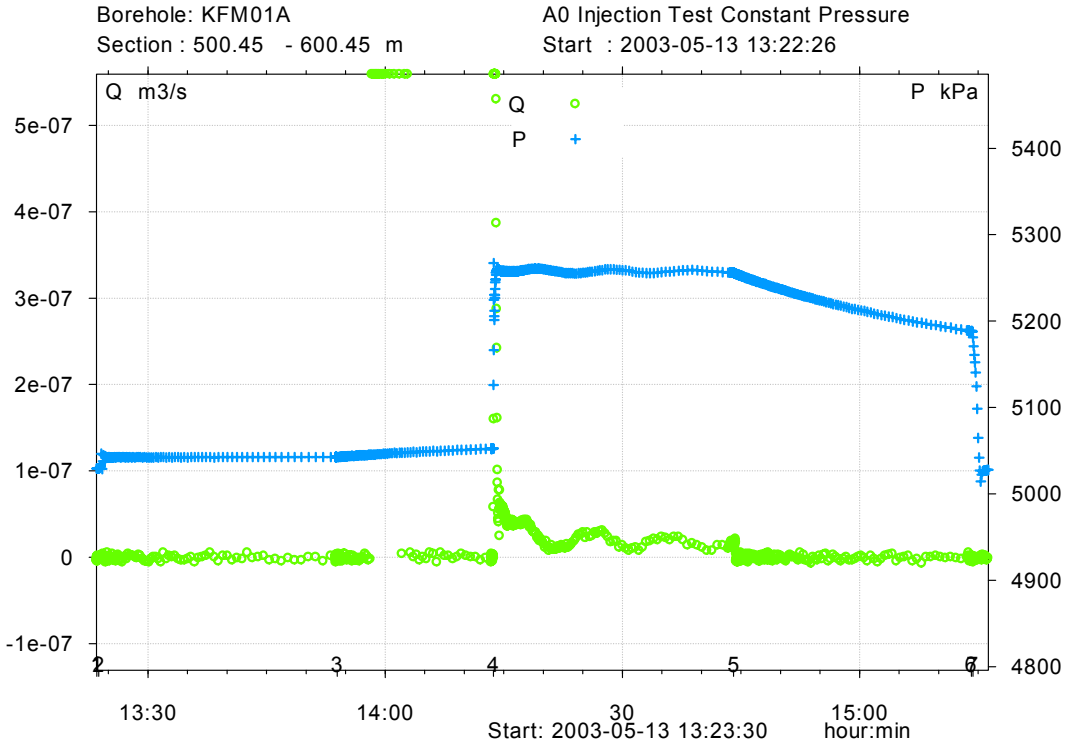


Fig A3-12. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 500.45-600.45 m in borehole KFM01A.

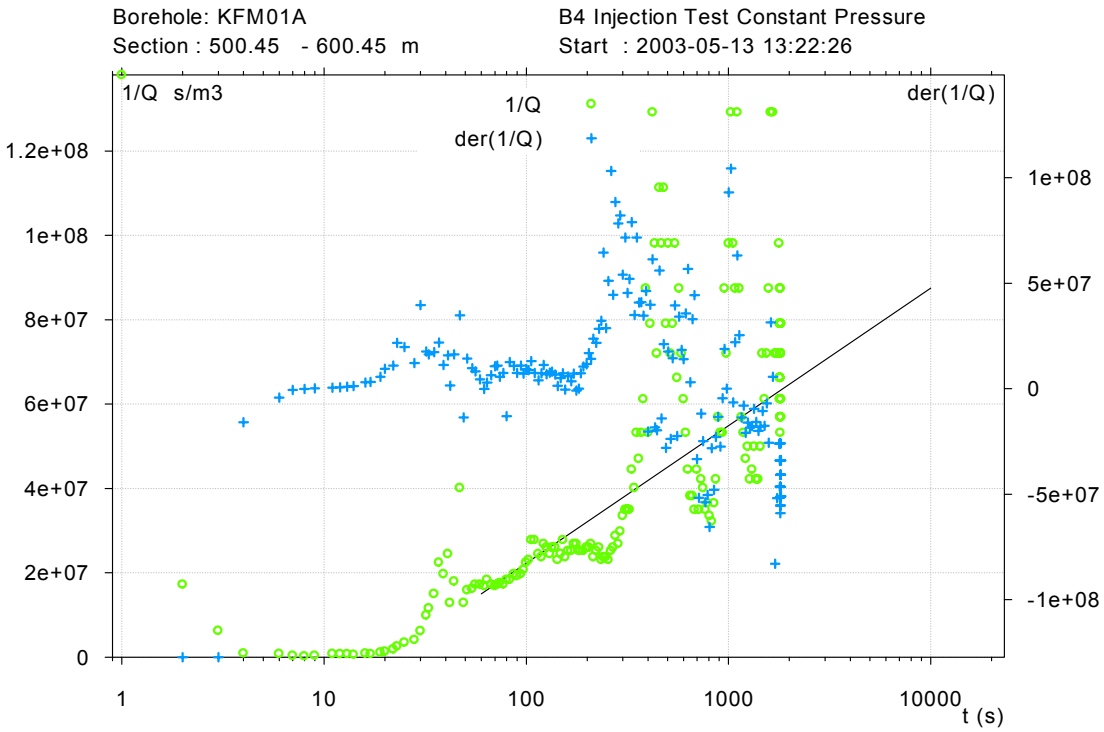


Fig A3-13. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 500.45-600.45 m in KFM01A.

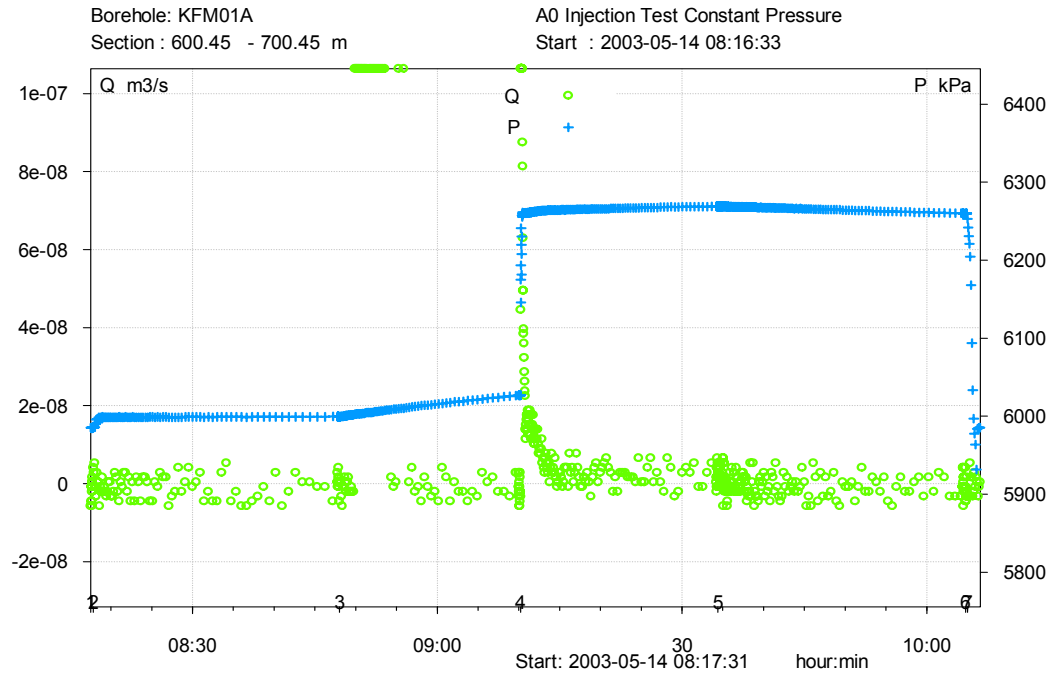


Fig A3-14. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 600.45-700.45 m in borehole KFM01A.

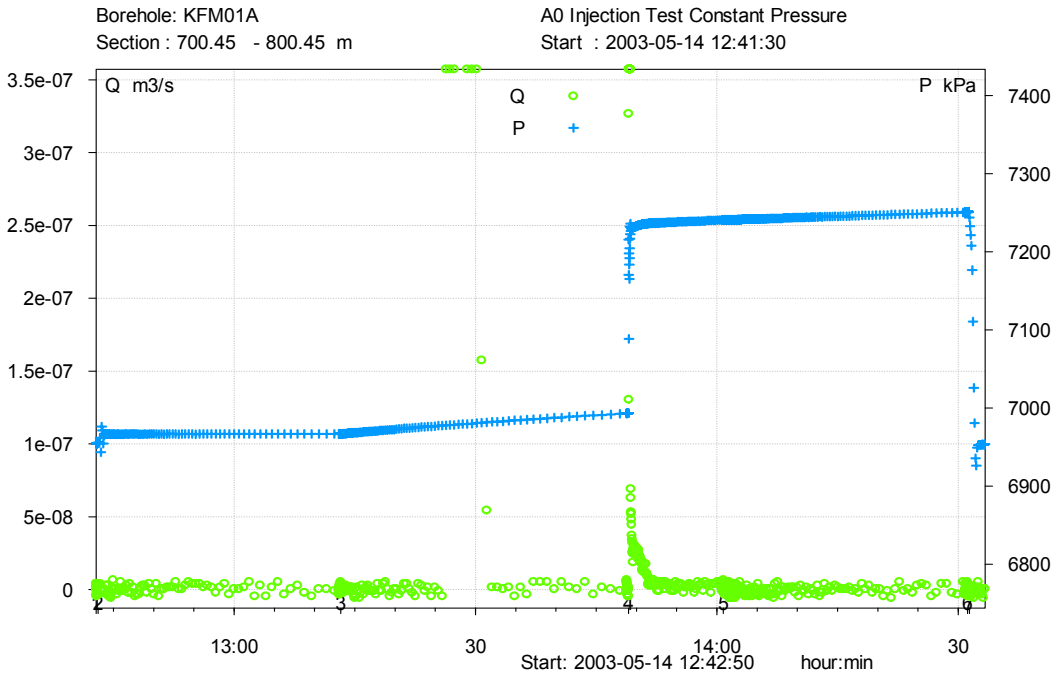


Fig A3-15. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 700.45-800.45 m in borehole KFM01A.

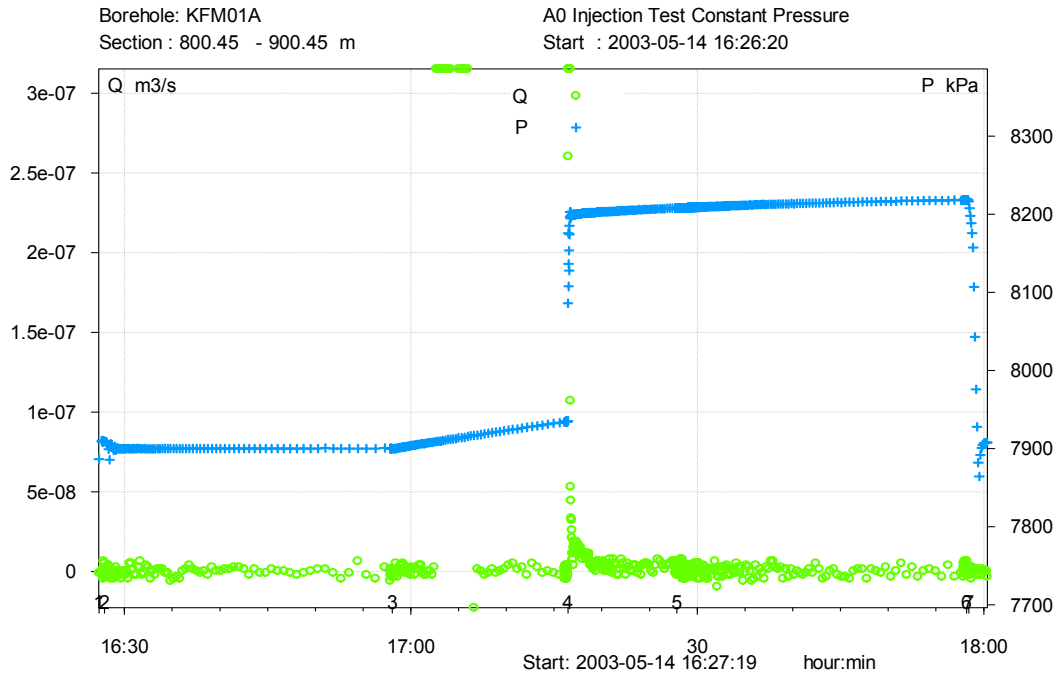


Fig A3-16. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 800.45-900.45 m in borehole KFM01A.

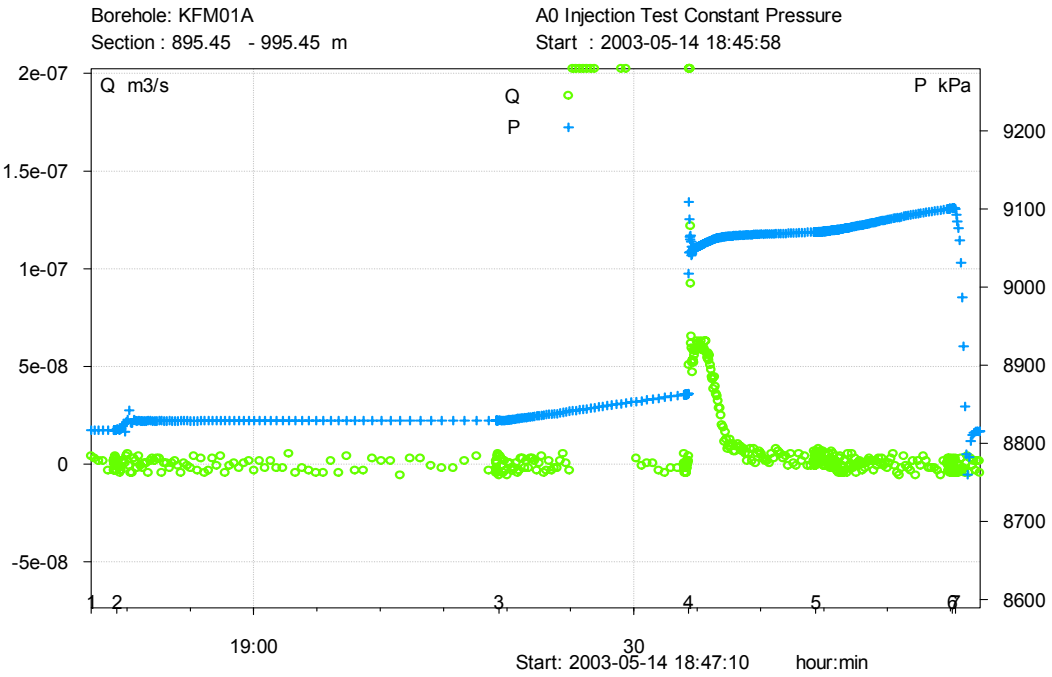


Fig A3-17. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 895.45-995.45 m in borehole KFM01A.

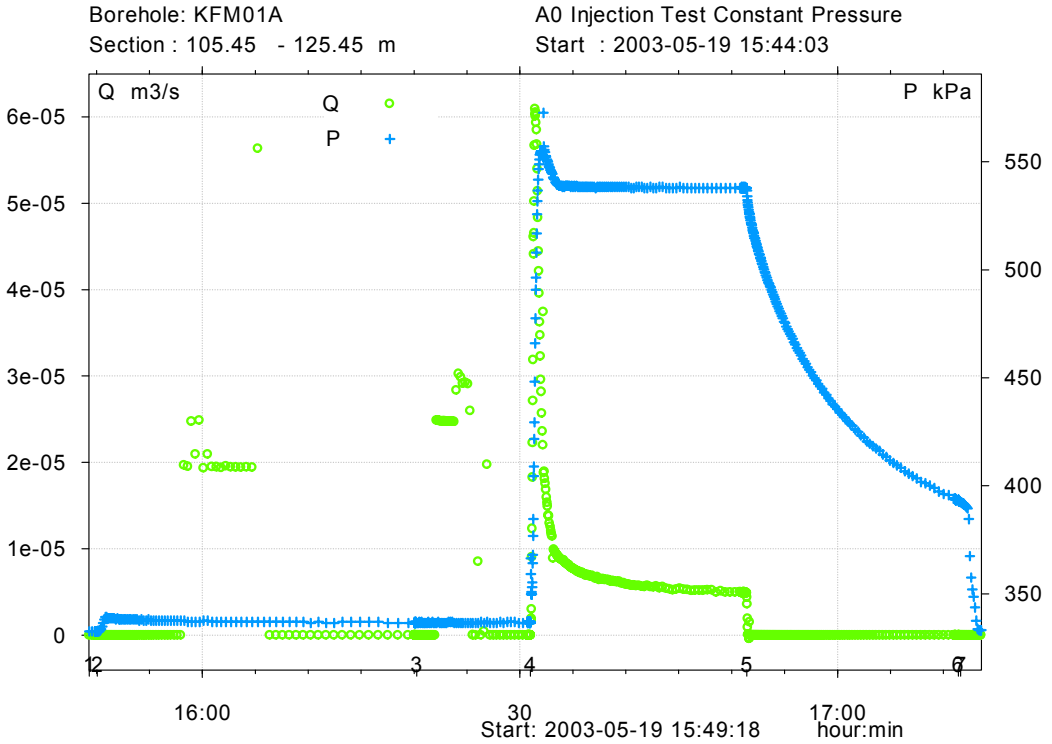


Fig A3-18. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 105.45-125.45 m in borehole KFM01A.

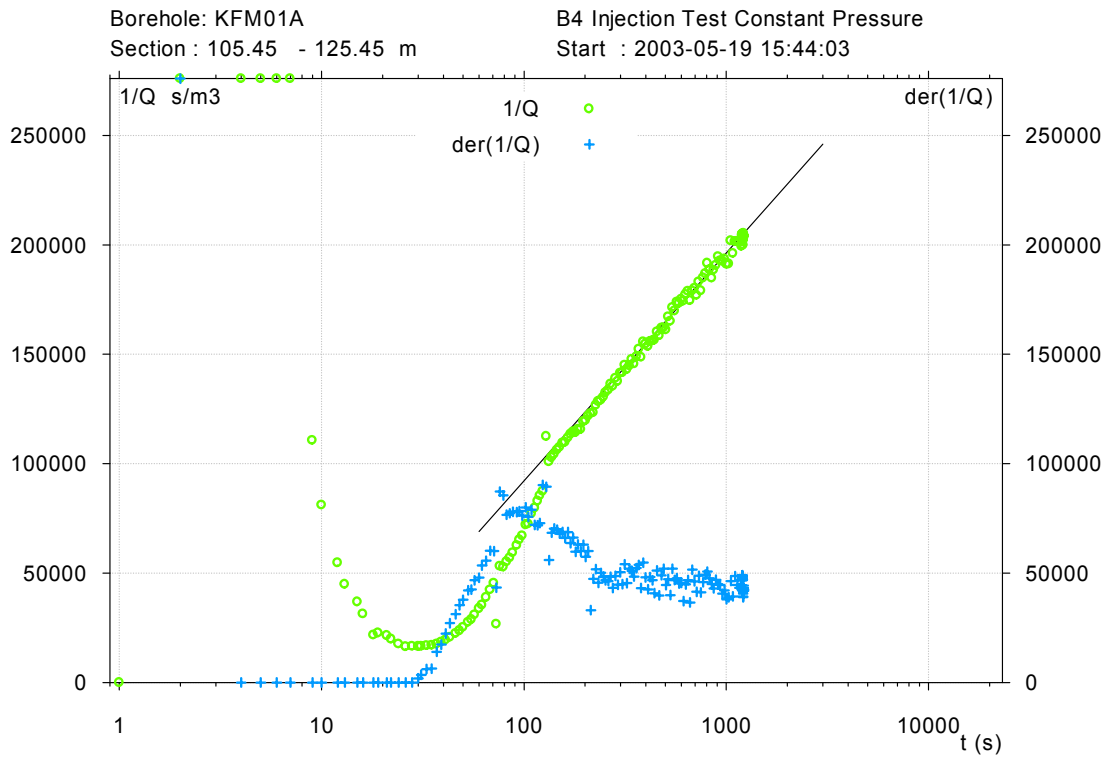


Fig A3-19. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 105.45-125.45 m in KFM01A.

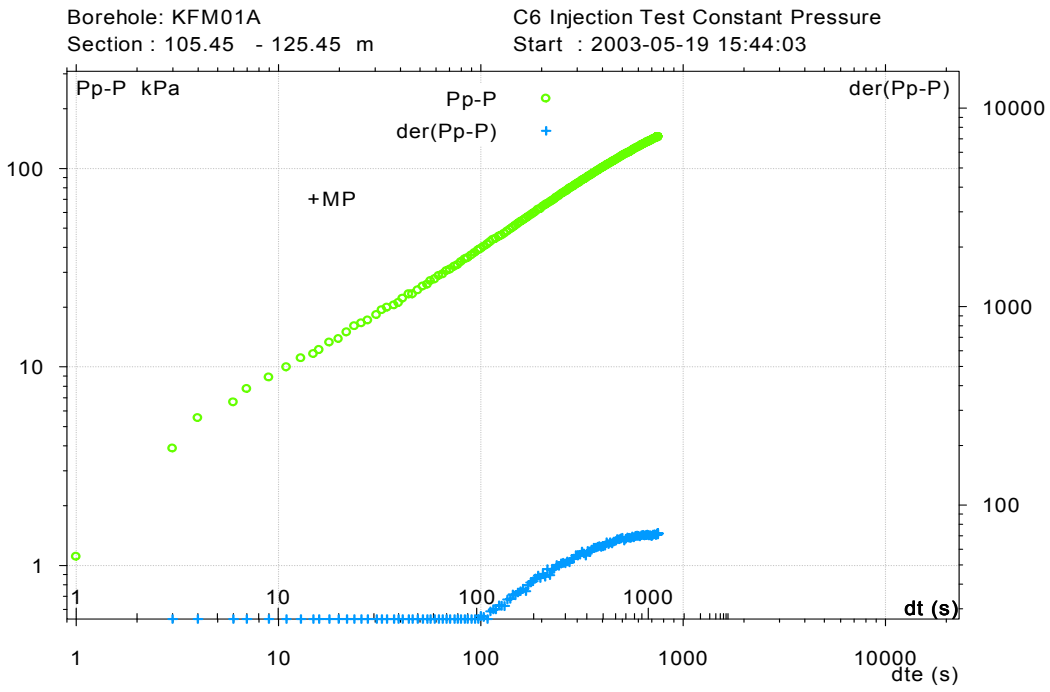


Fig A3-20. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 105.45-125.45 m in KFM01A.

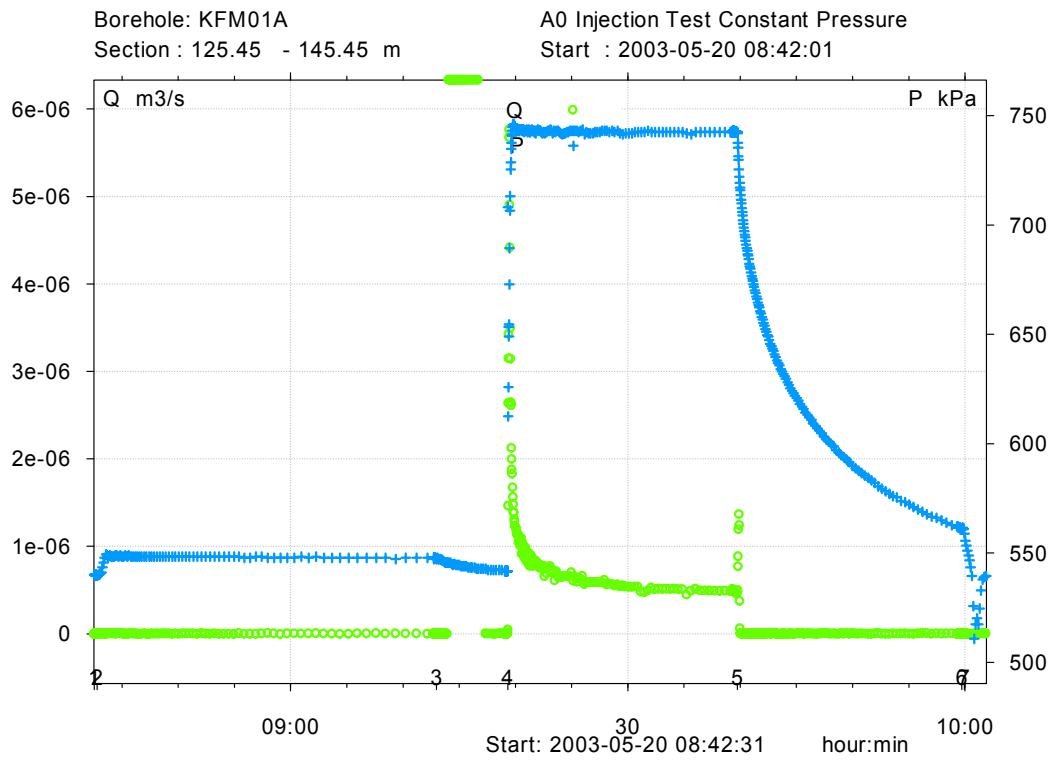


Fig A3-21. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 125.45-145.45 m in borehole KFM01A.

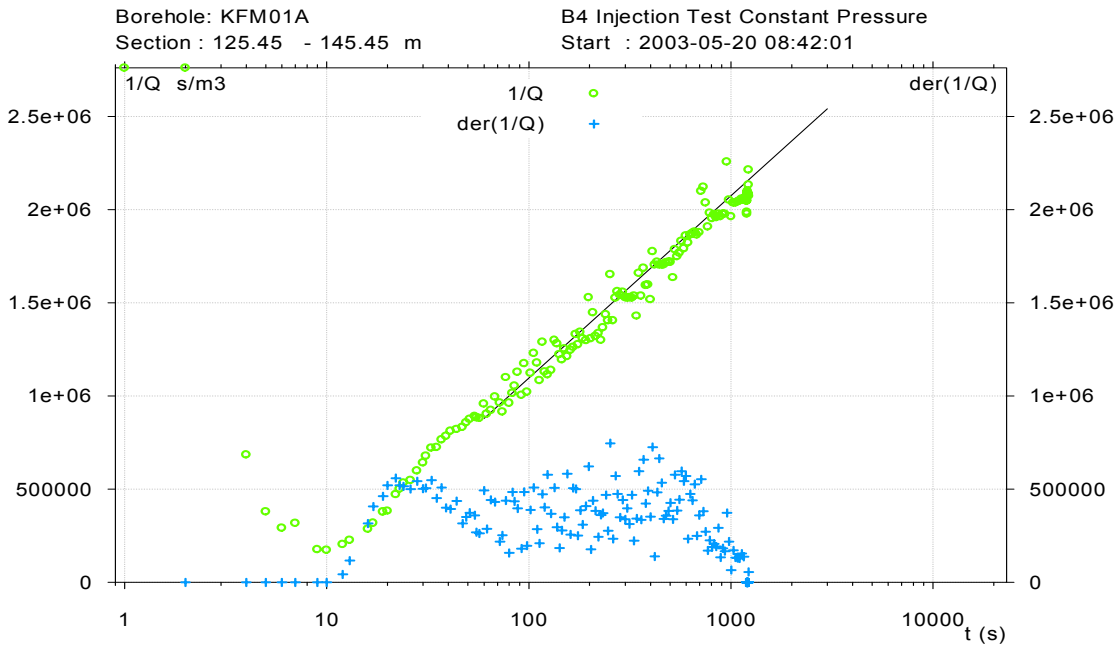


Fig A3-22. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 125.45-145.45 m in KFM01A.

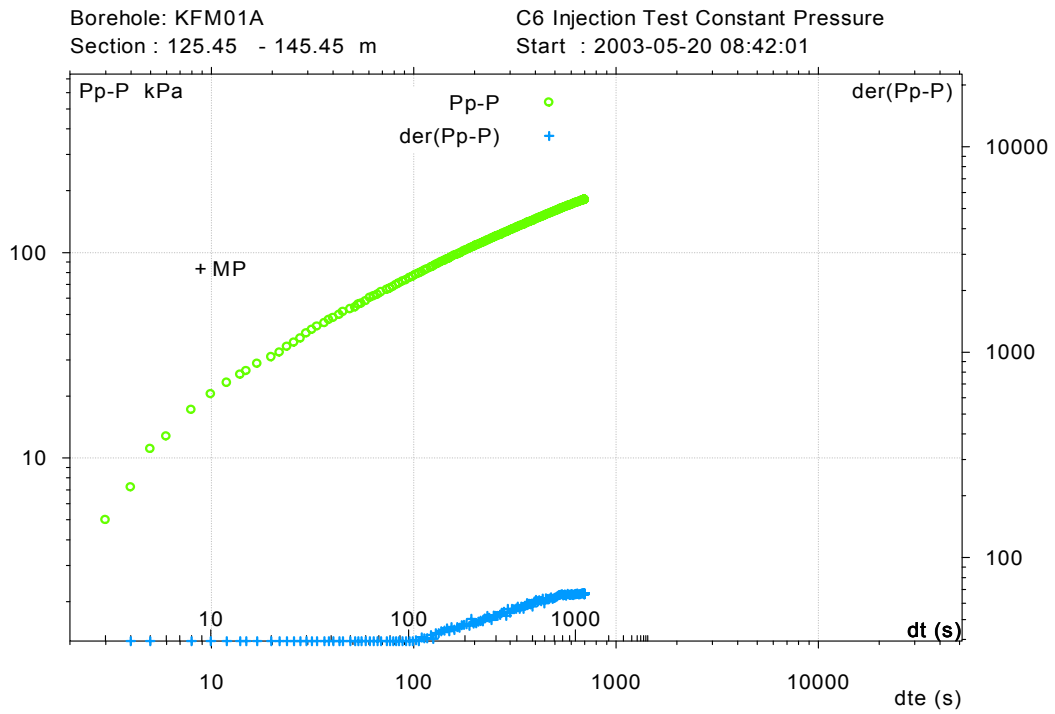


Fig A3-23. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 125.45-145.45 m in KFM01A.

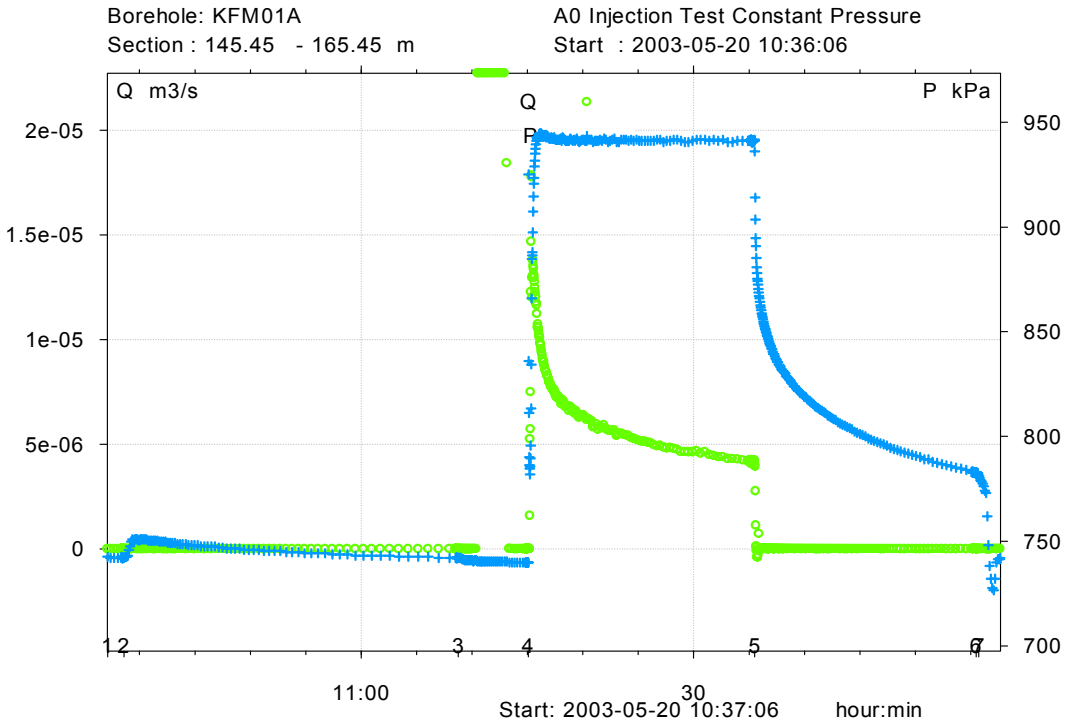


Fig A3-24. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 145.45-165.45 m in borehole KFM01A.

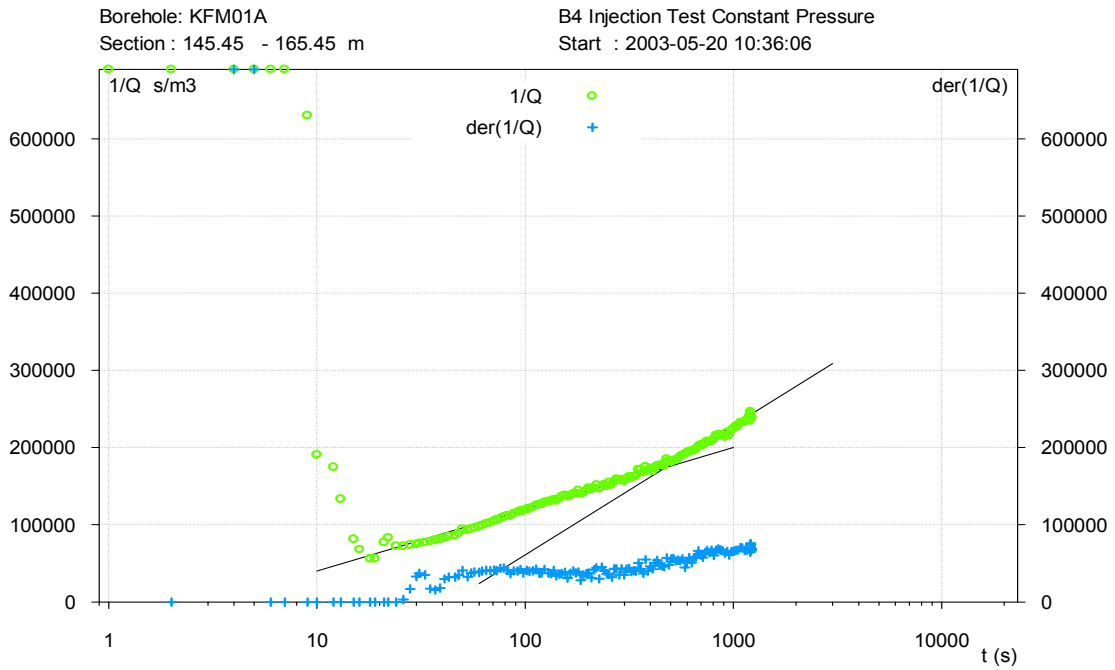


Fig A3-25. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 145.45-165.45 m in KFM01A.

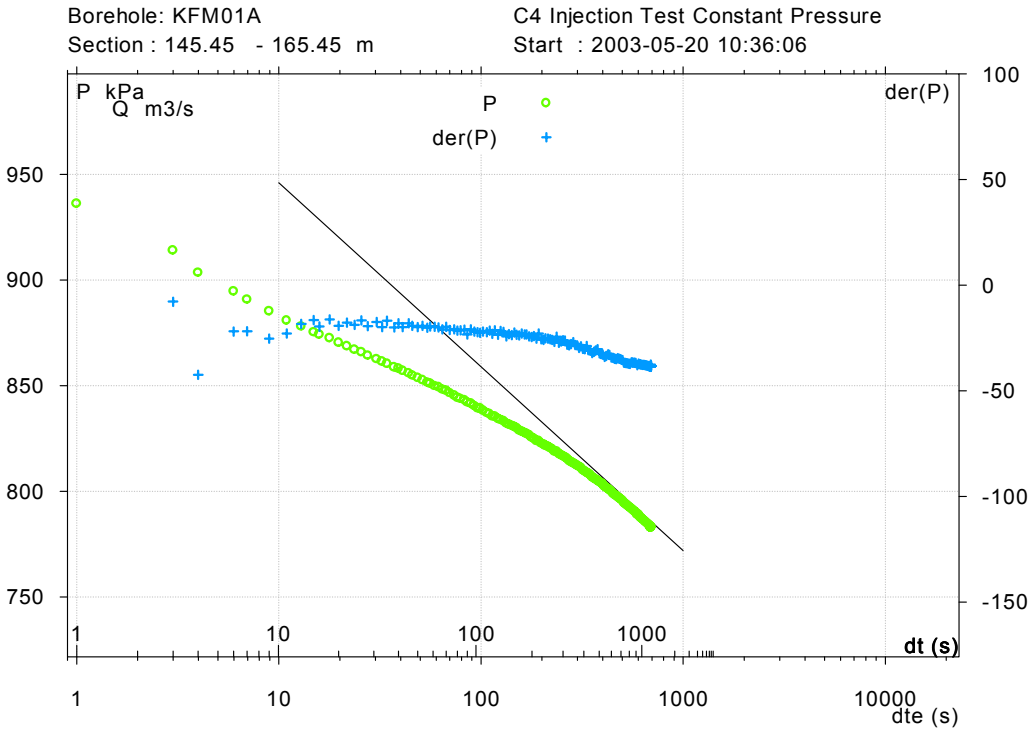


Fig A3-26. Lin-log plot of pressure recovery (p) and -derivative, d(p)/d(ln dte) versus equivalent time (dte) from the injection test in section 145.45-165.45 m in KFM01A.

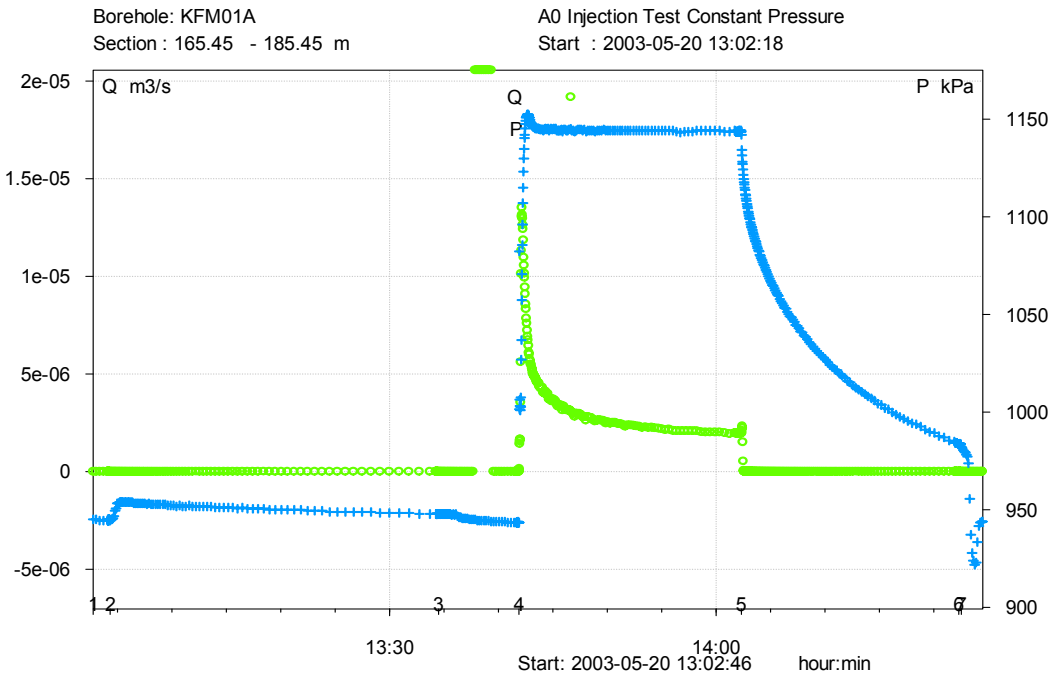


Fig A3-27. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 165.45-185.45 m in borehole KFM01A.

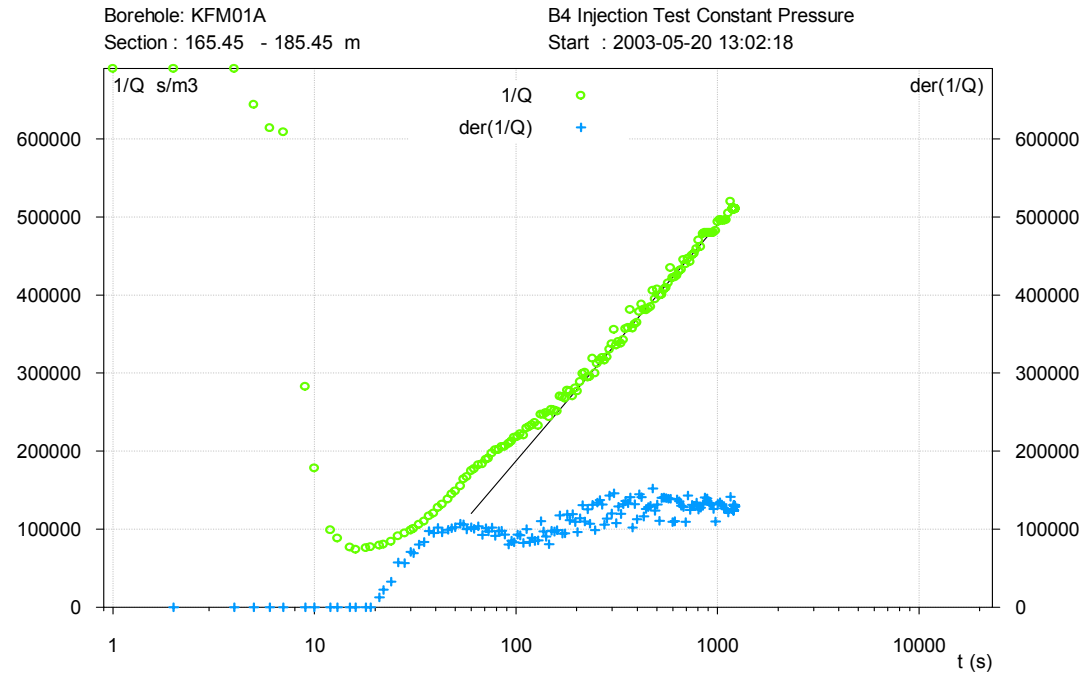


Fig A3-28. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 165.45-185.45 m in KFM01A.

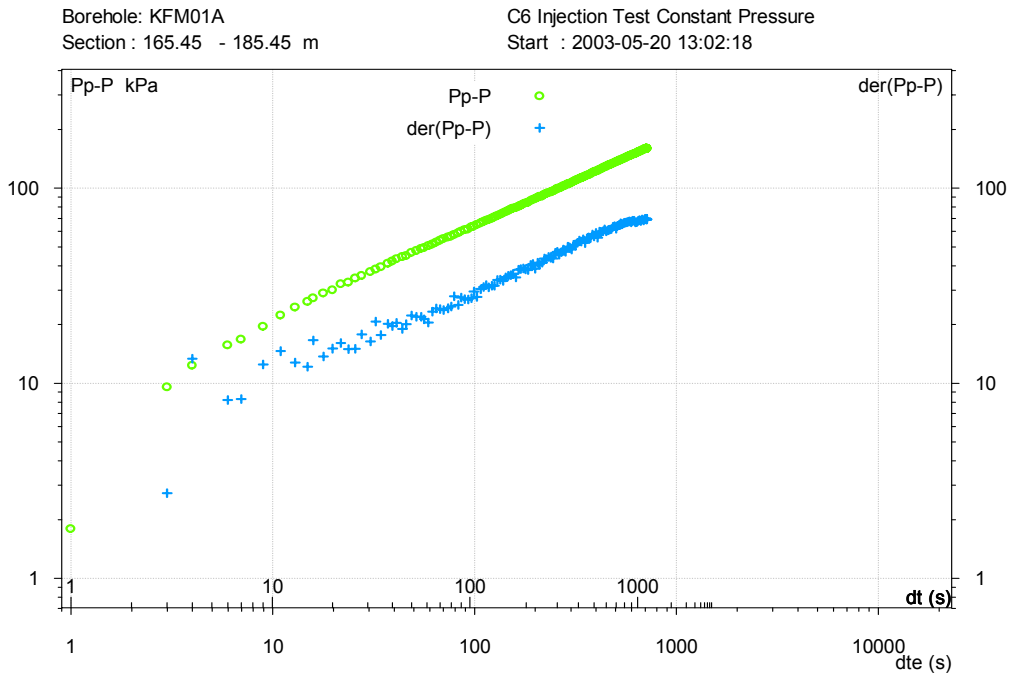


Fig A3-29. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 165.45-185.45 m in KFM01A.

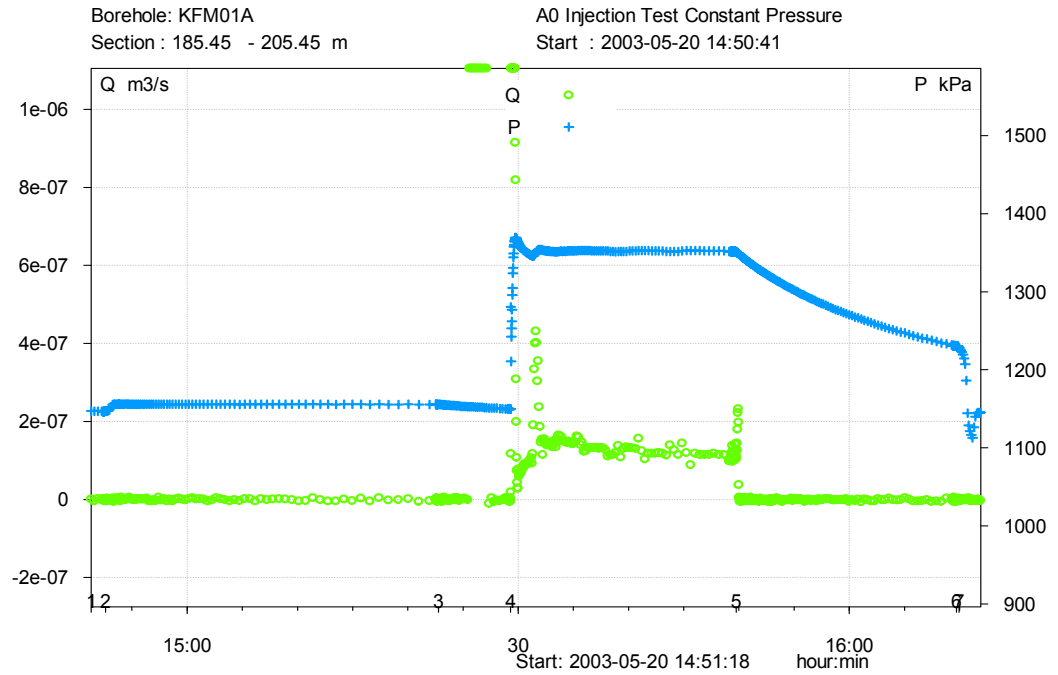


Fig A3-30. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 185.45-205.45 m in borehole KFM01A.

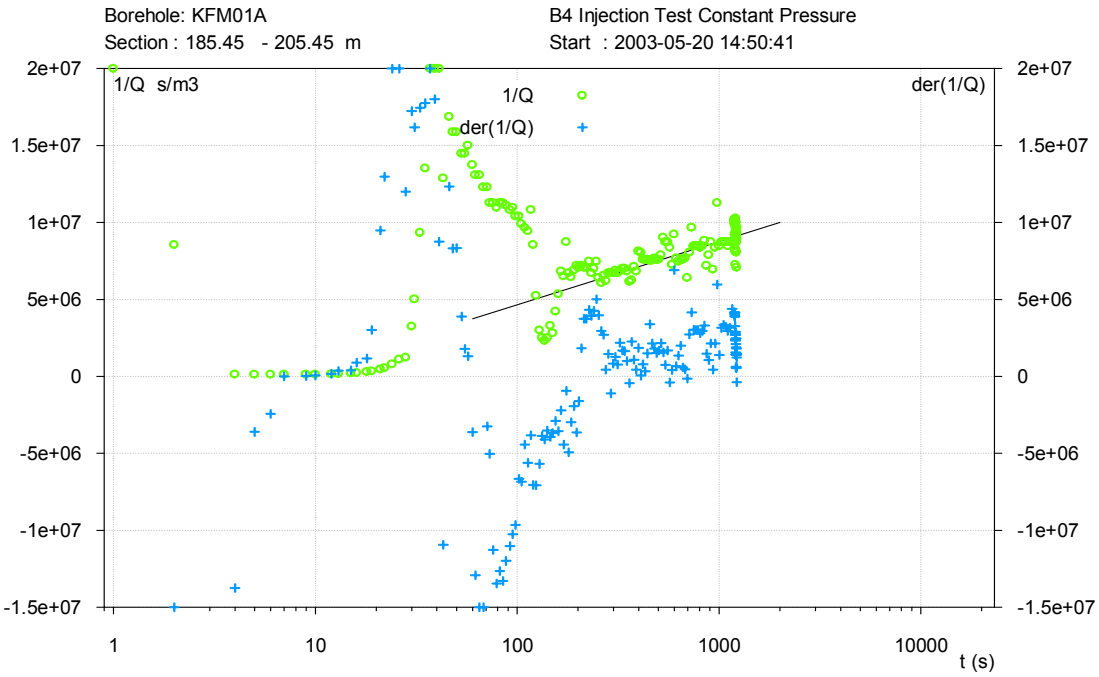


Fig A3-31. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 185.45-205.45 m in KFM01A.

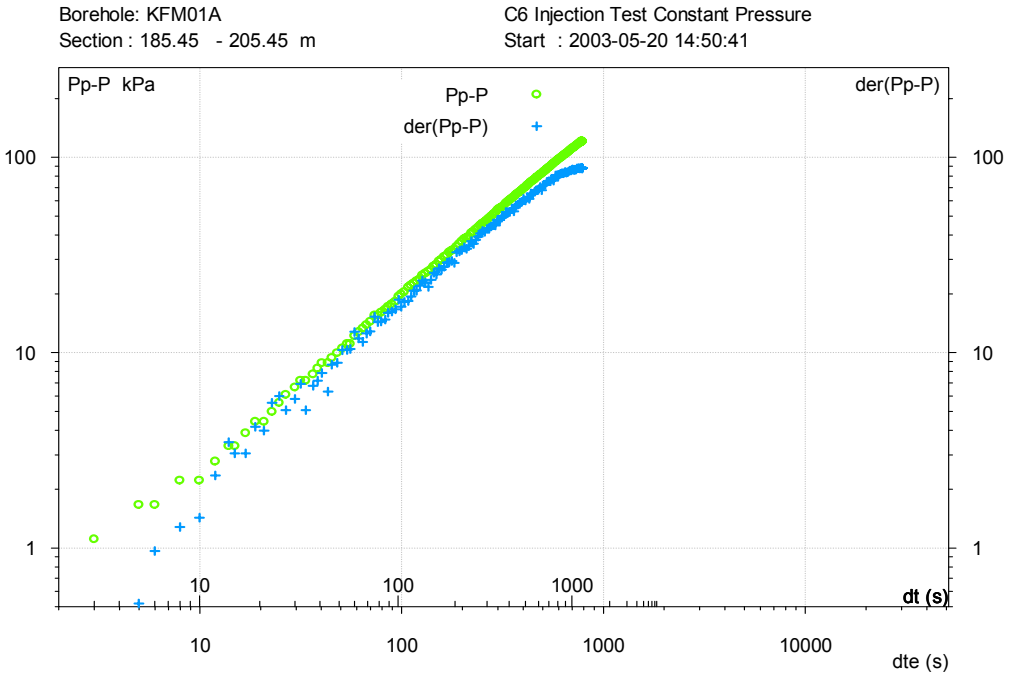


Fig A3-32. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 185.45-205.45 m in KFM01A.

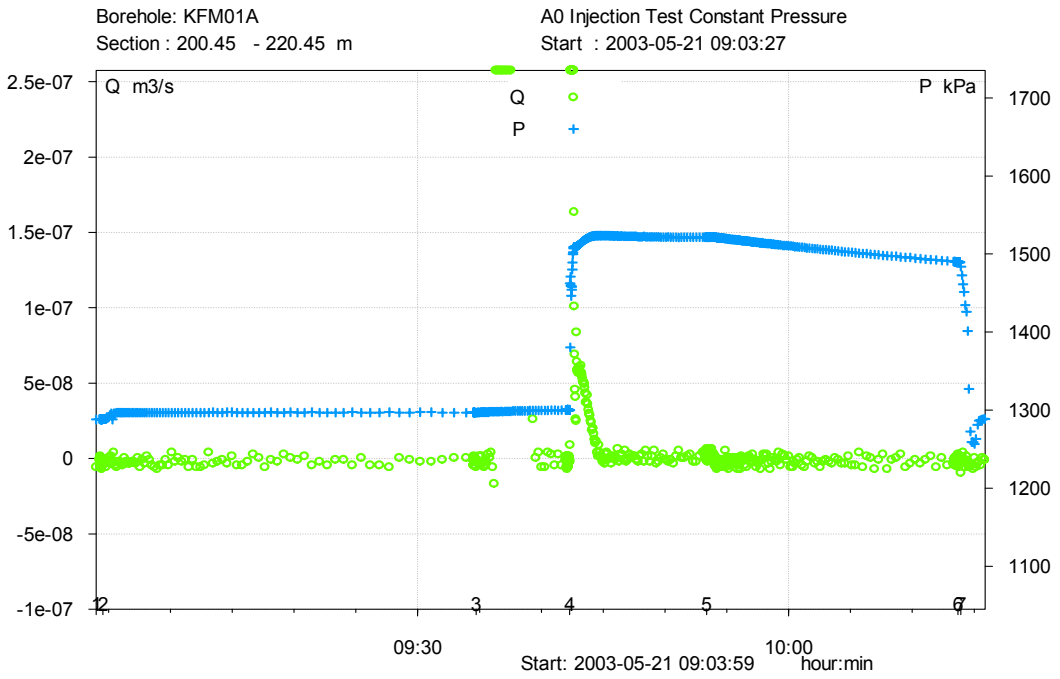


Fig A3-33. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 200.45-220.45 m in borehole KFM01A.

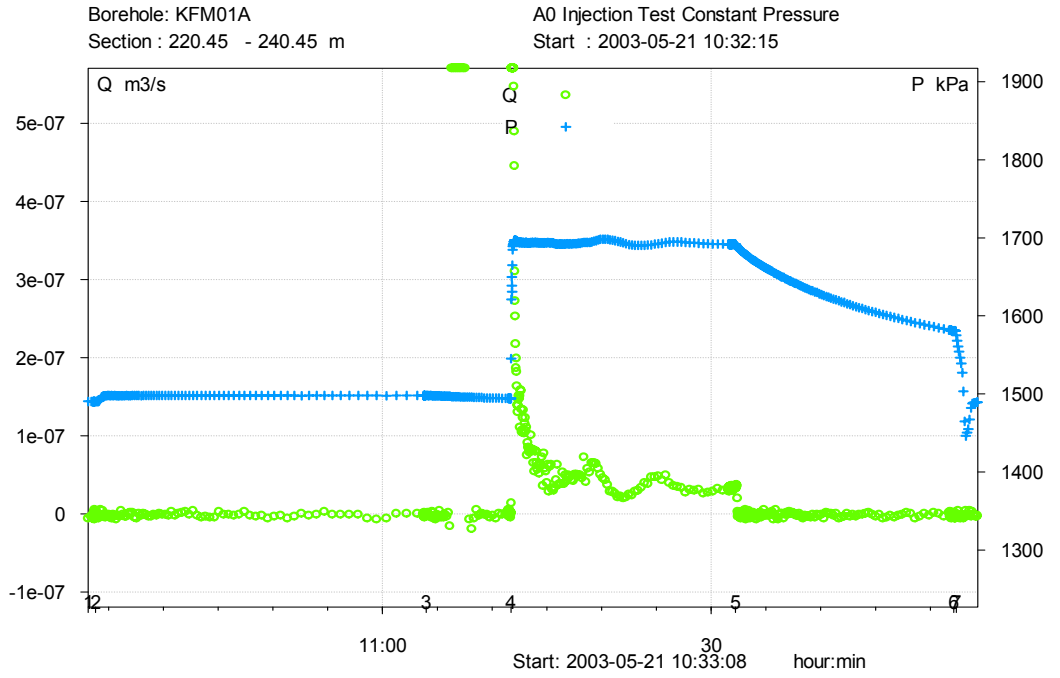


Fig A3-34. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 220.45-240.45 m in borehole KFM01A.

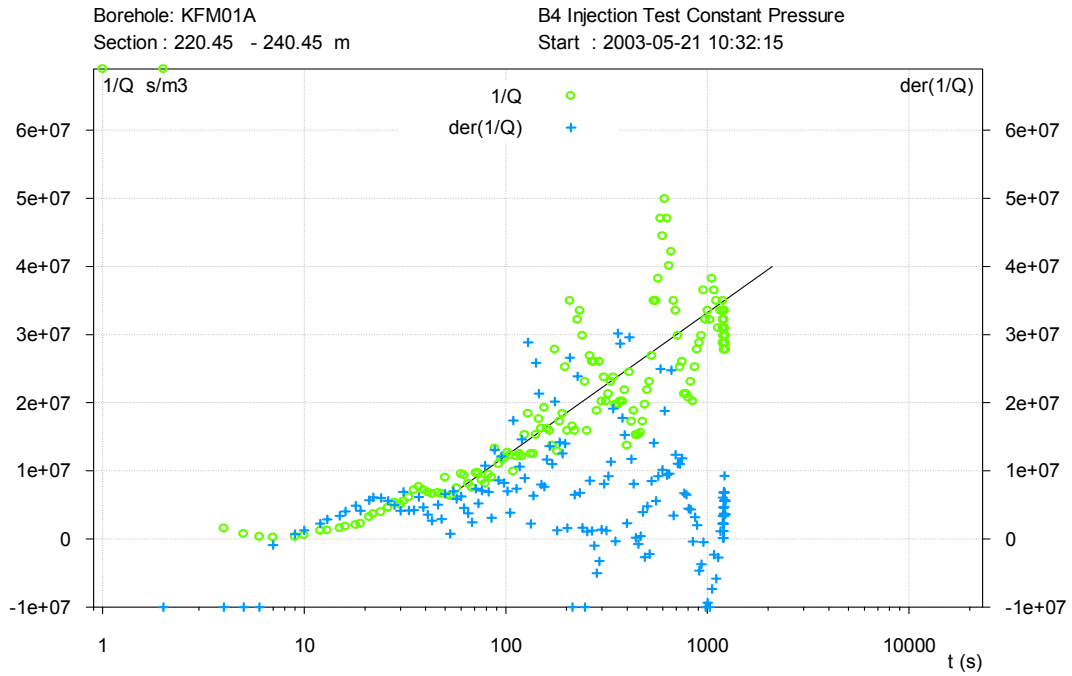


Fig A3-35. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 220.45-240.45 m in KFM01A.

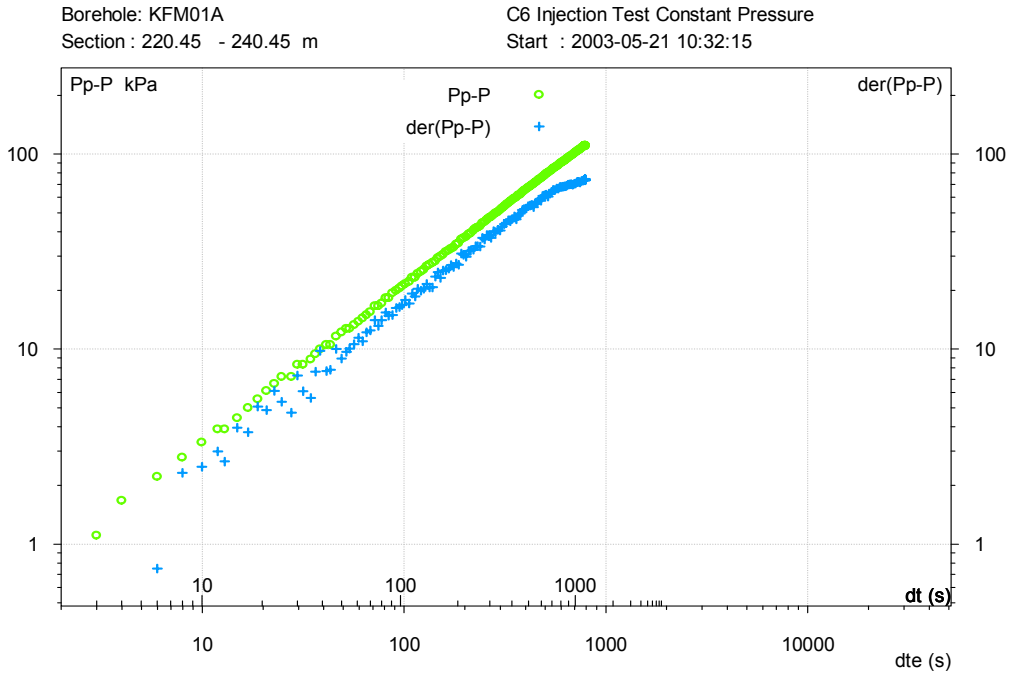


Fig A3-36. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 220.45-240.45 m in KFM01A.

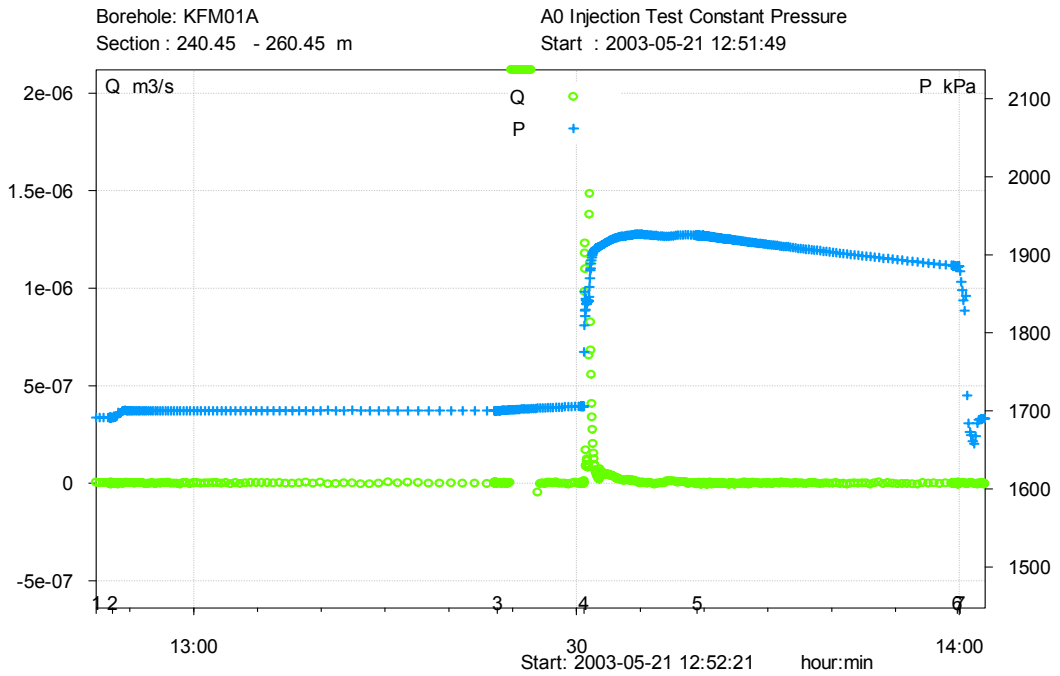


Fig A3-37. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 240.45-260.45 m in borehole KFM01A.

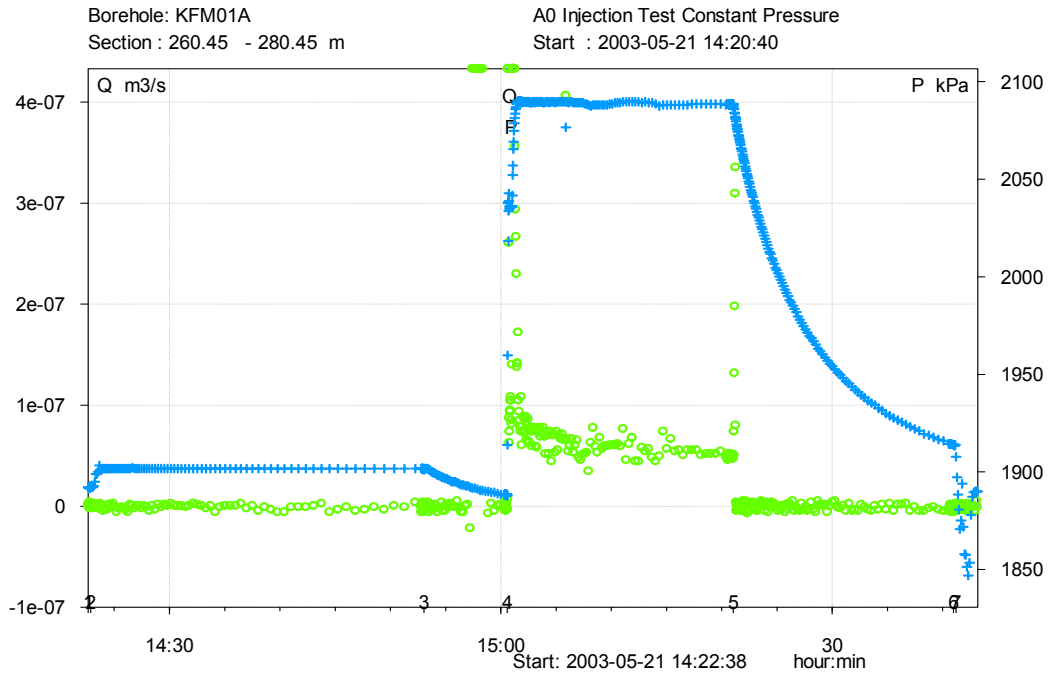


Fig A3-38. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 260.45-280.45 m in borehole KFM01A.

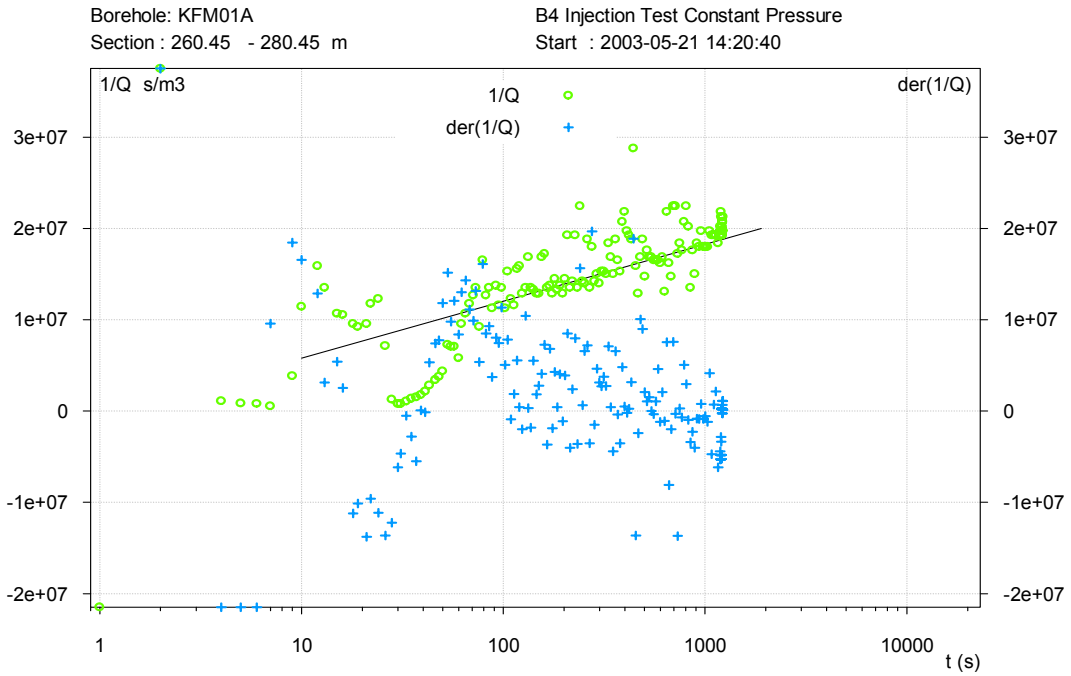


Fig A3-39. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 260.45-280.45 m in KFM01A.

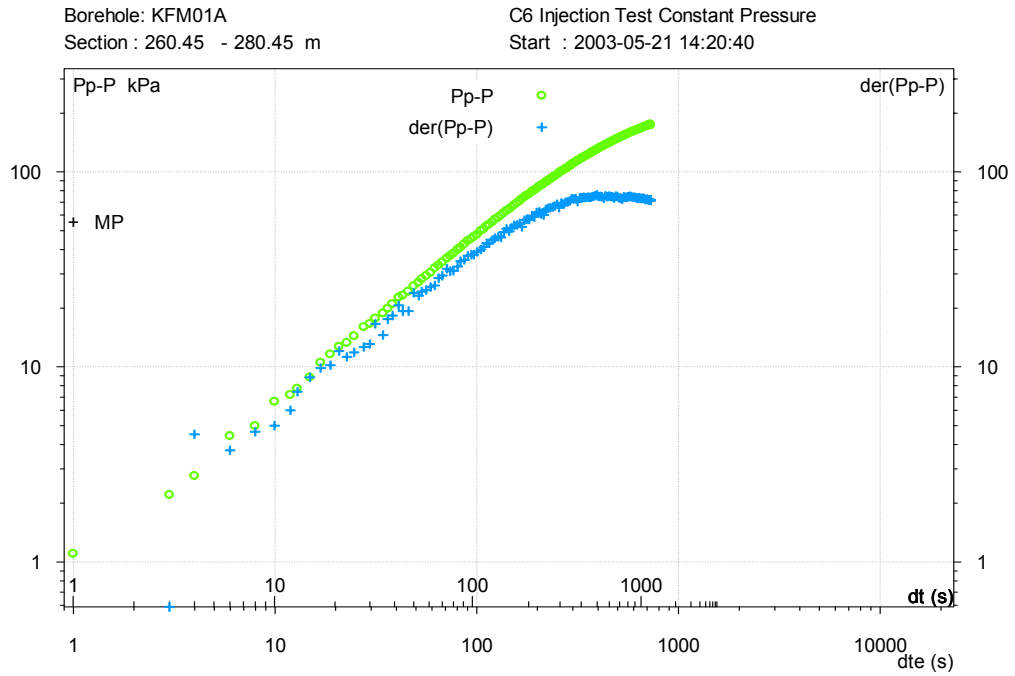


Fig A3-40. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 260.45-280.45 m in KFM01A.

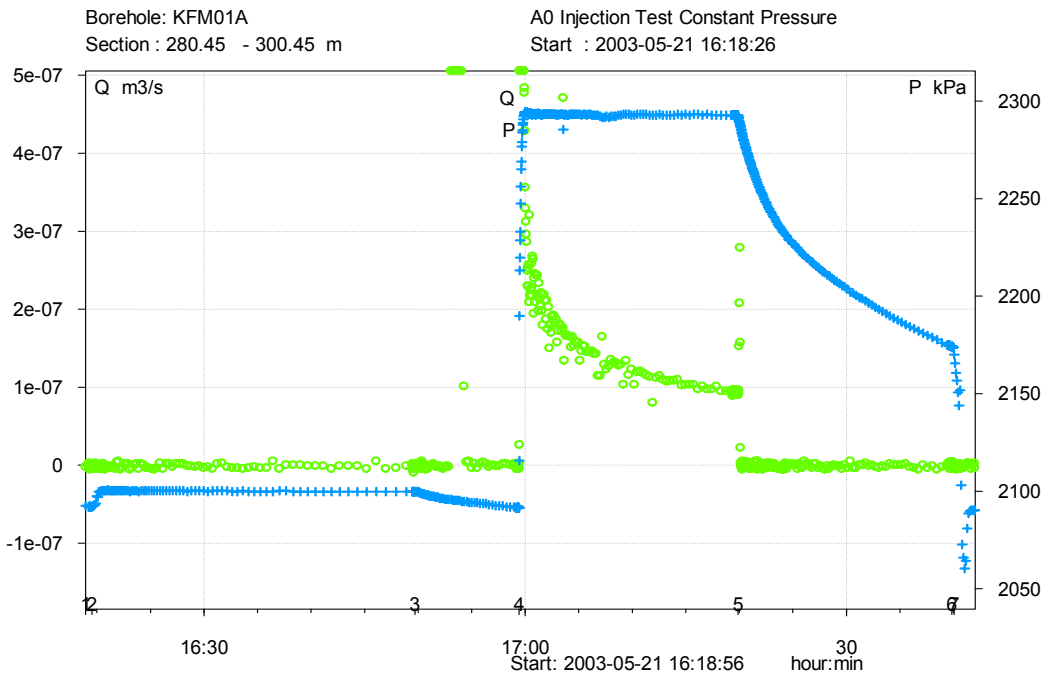


Fig A3-41. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 280.45-300.45 m in borehole KFM01A.

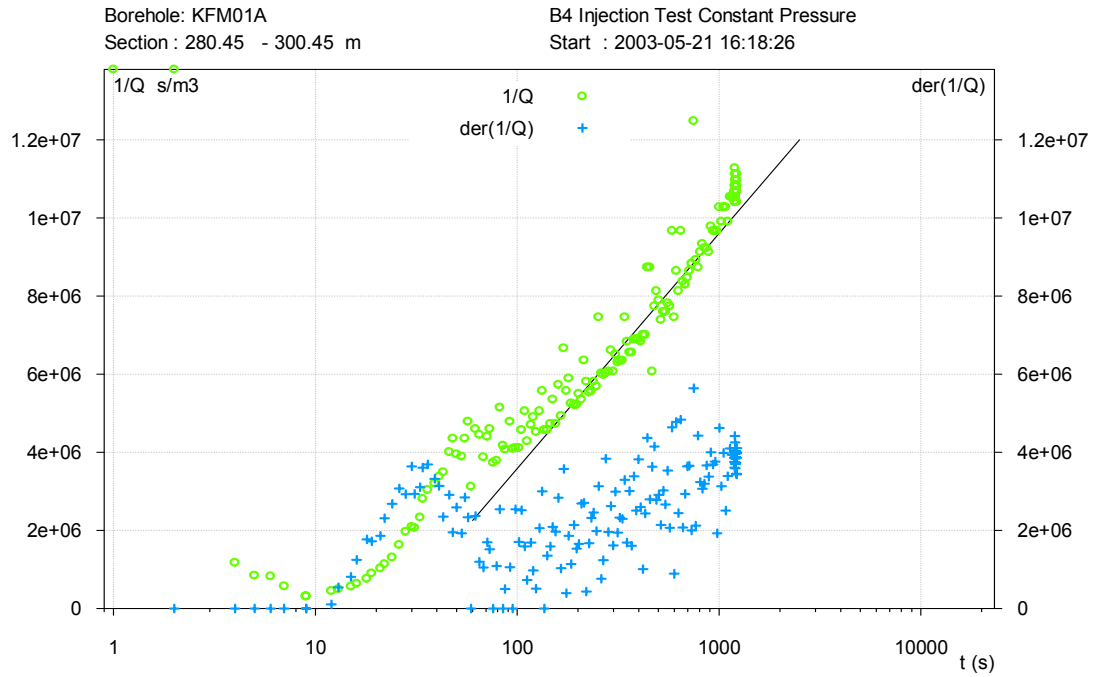


Fig A3-42. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 280.45-300.45 m in KFM01A.

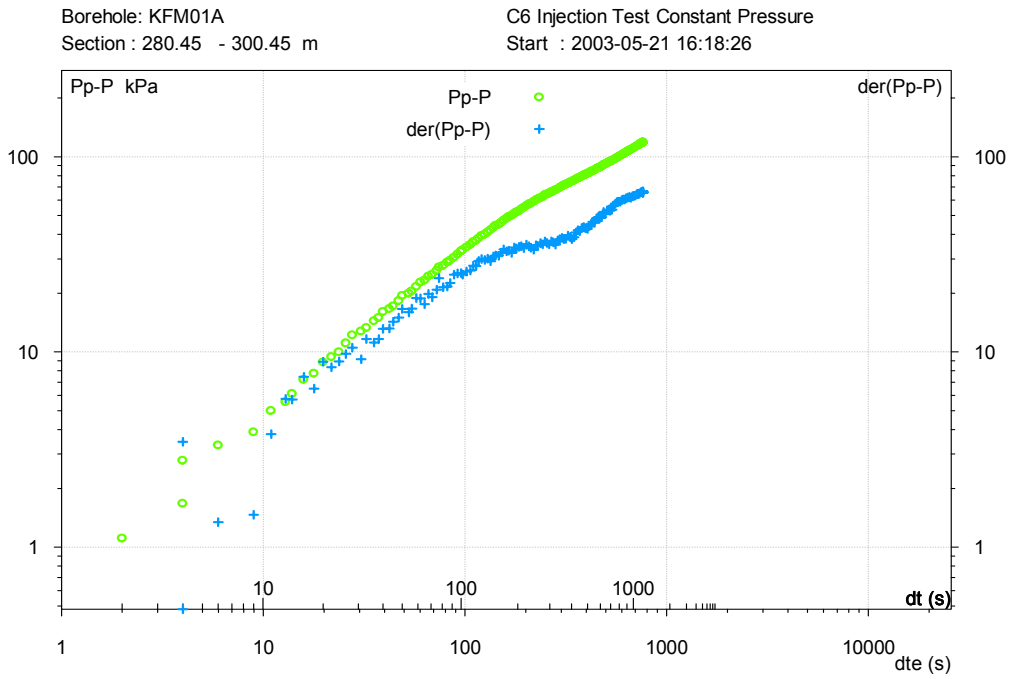


Fig A3-43. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 280.45-300.45 m in KFM01A.

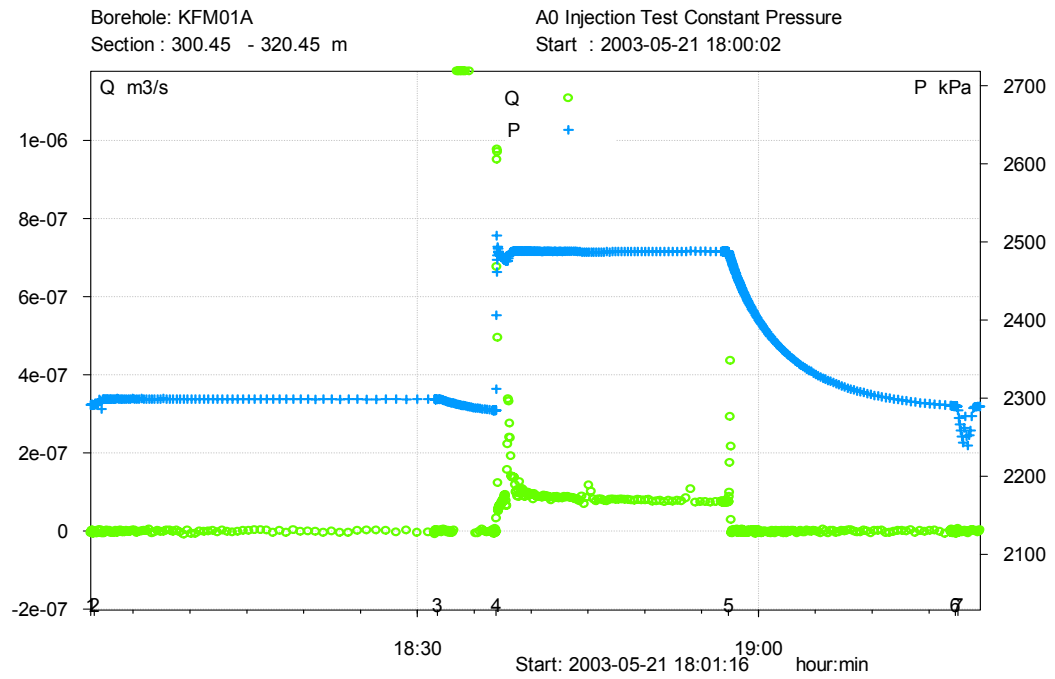


Fig A3-44. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 300.45-320.45 m in borehole KFM01A.

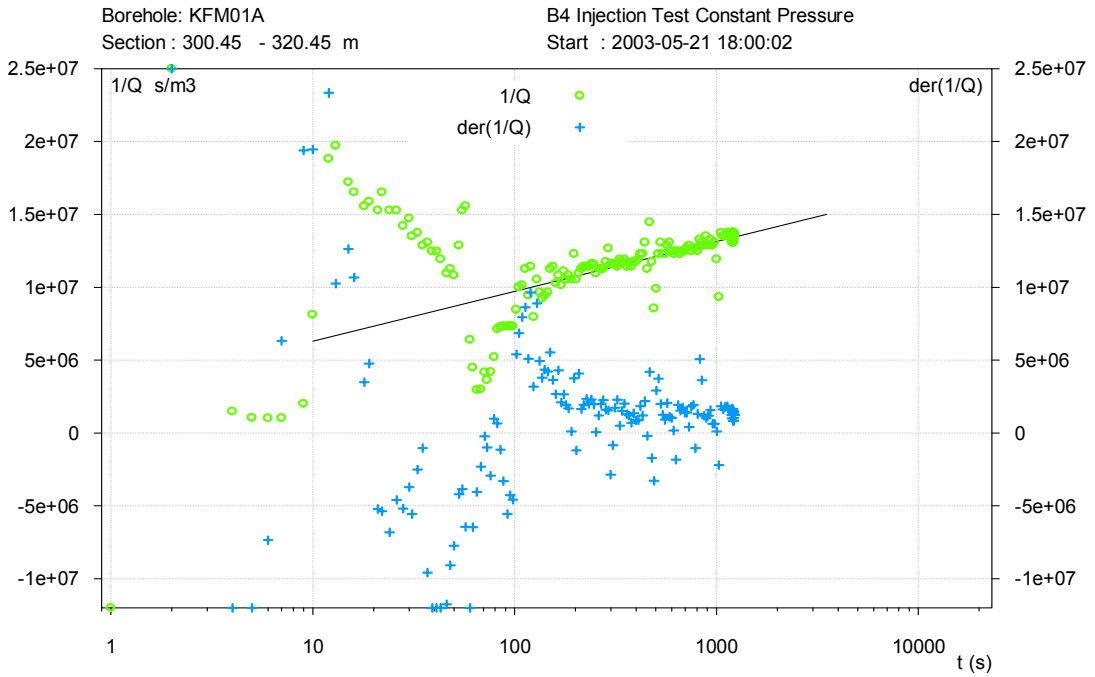


Fig A3-45. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 300.45-320.45 m in KFM01A.

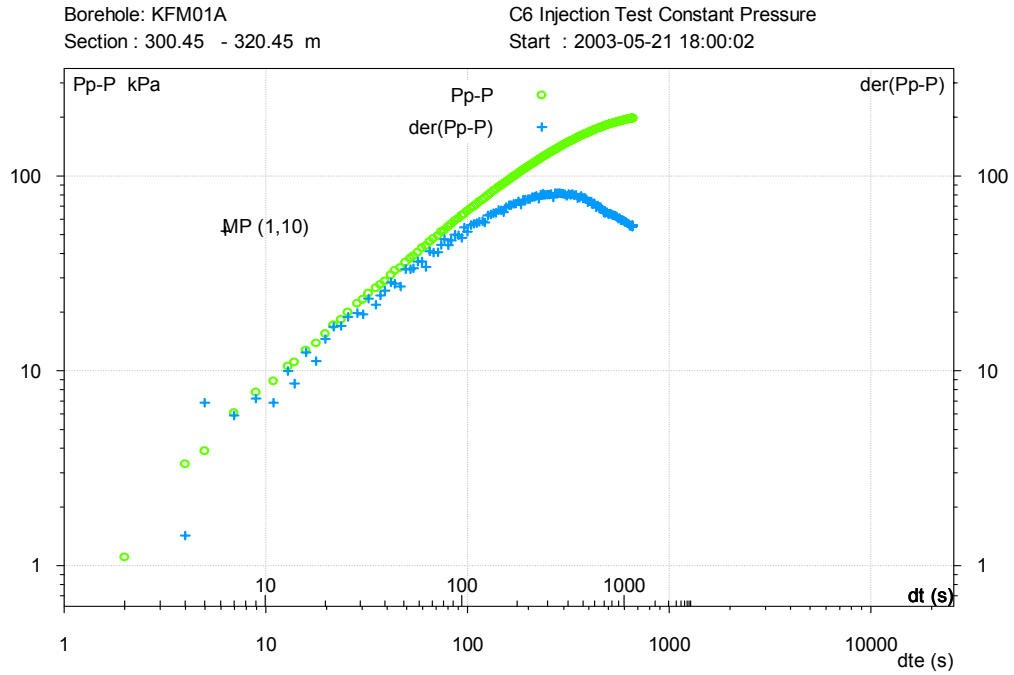


Fig A3-46. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 300.45-320.45 m in KFM01A

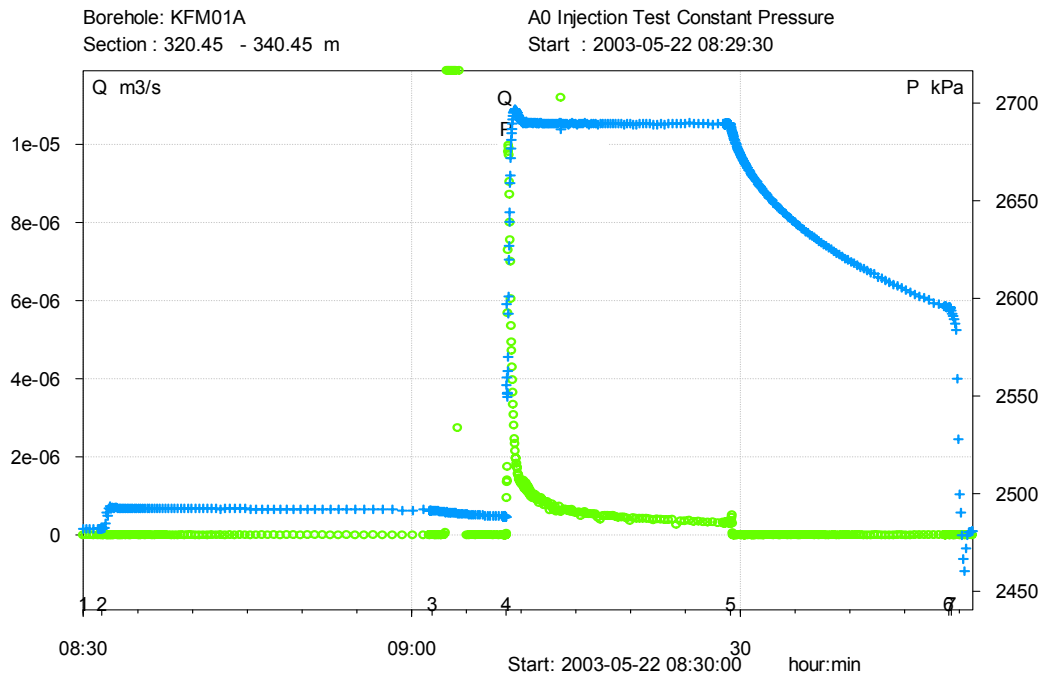


Fig A3-47. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 320.45-340.45 m in borehole KFM01A.

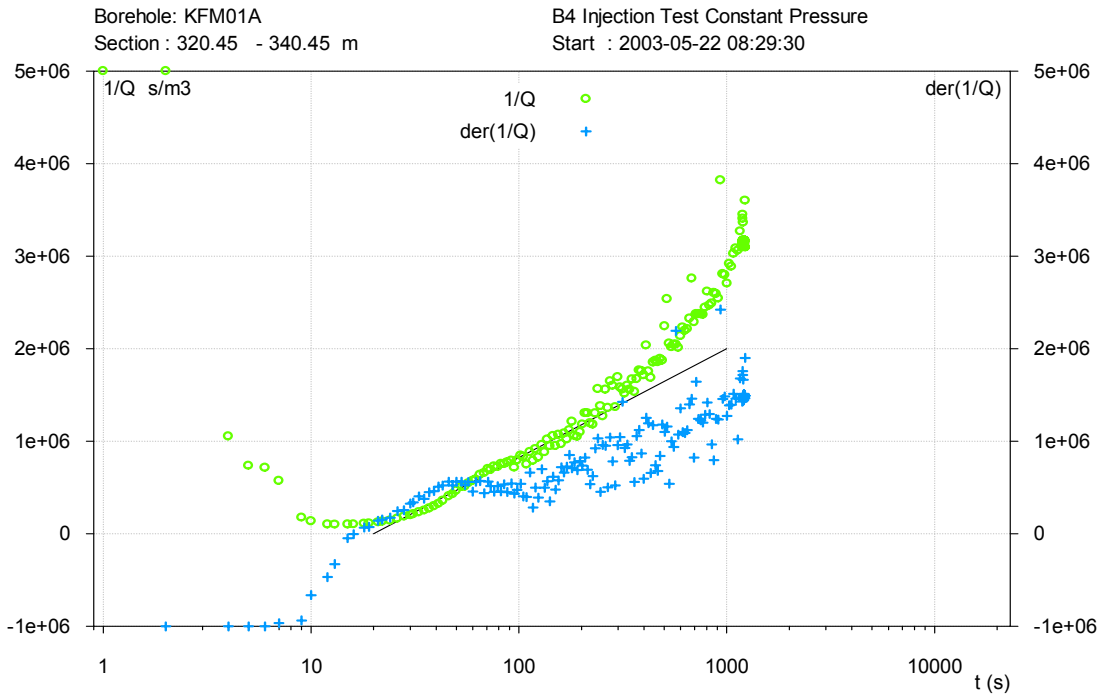


Fig A3-48. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 320.45-340.45 m in KFM01A.

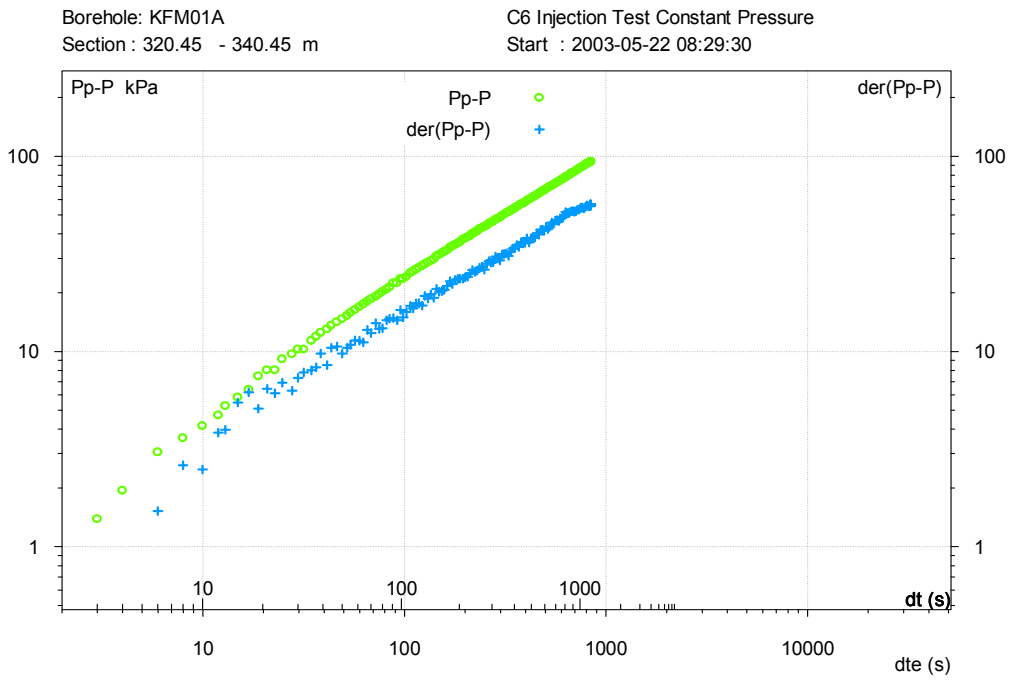


Fig A3-49. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 320.45-340.45 m in KFM01A.

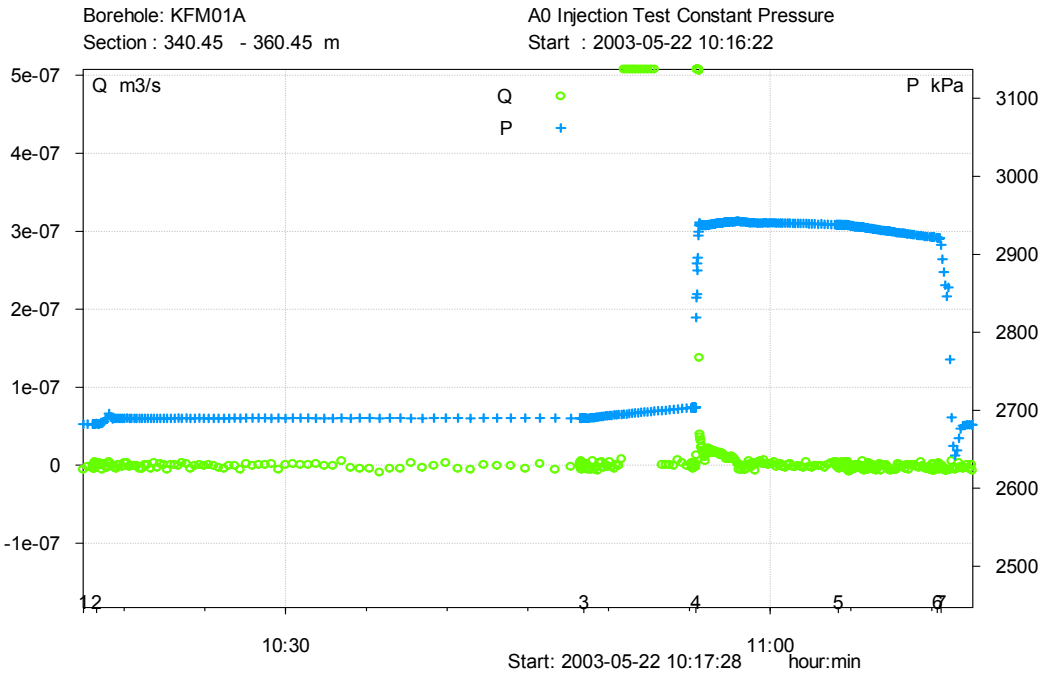


Fig A3-50. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 340.45-360.45 m in borehole KFM01A.

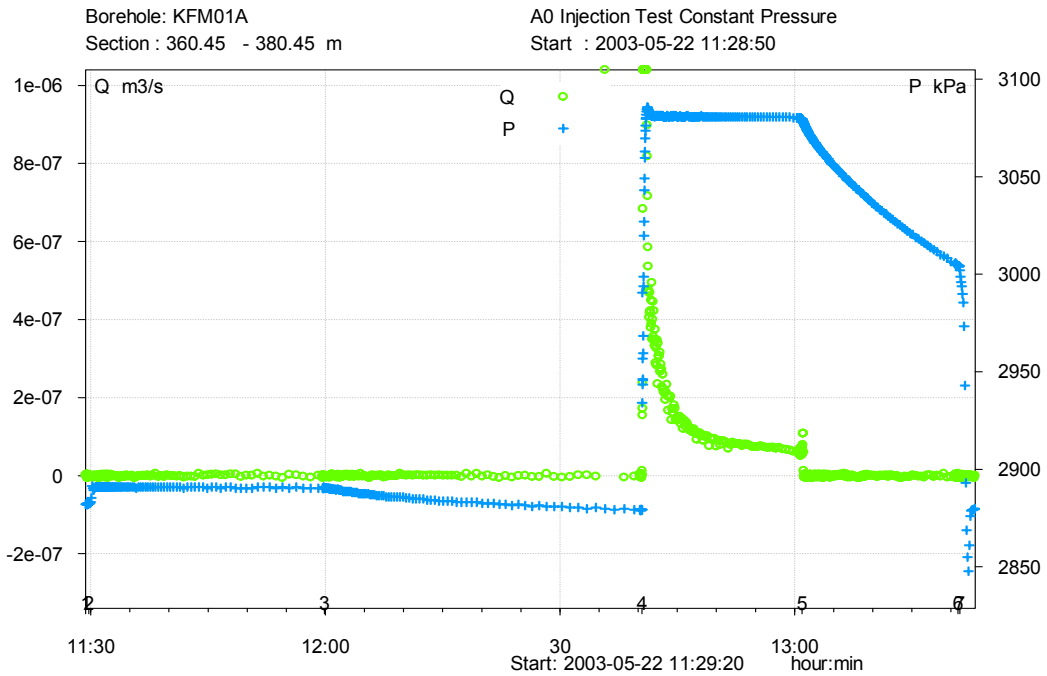


Fig A3-51. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 360.45-380.45 m in borehole KFM01A.

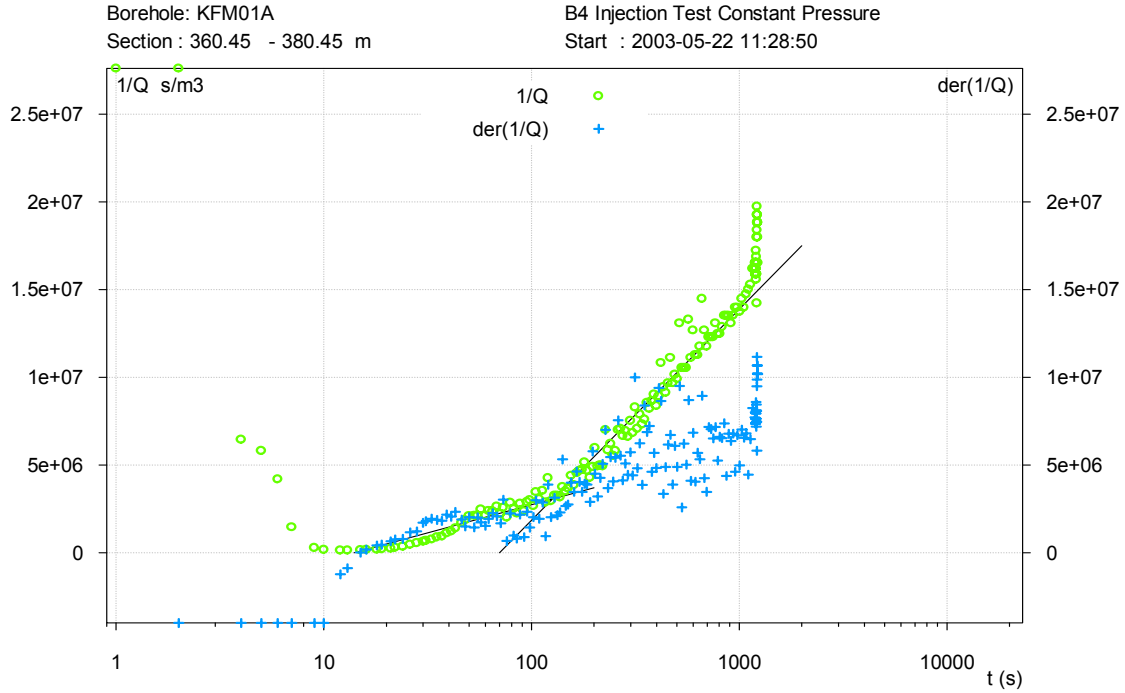


Fig A3-52. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 360.45-380.45 m in KFM01A.

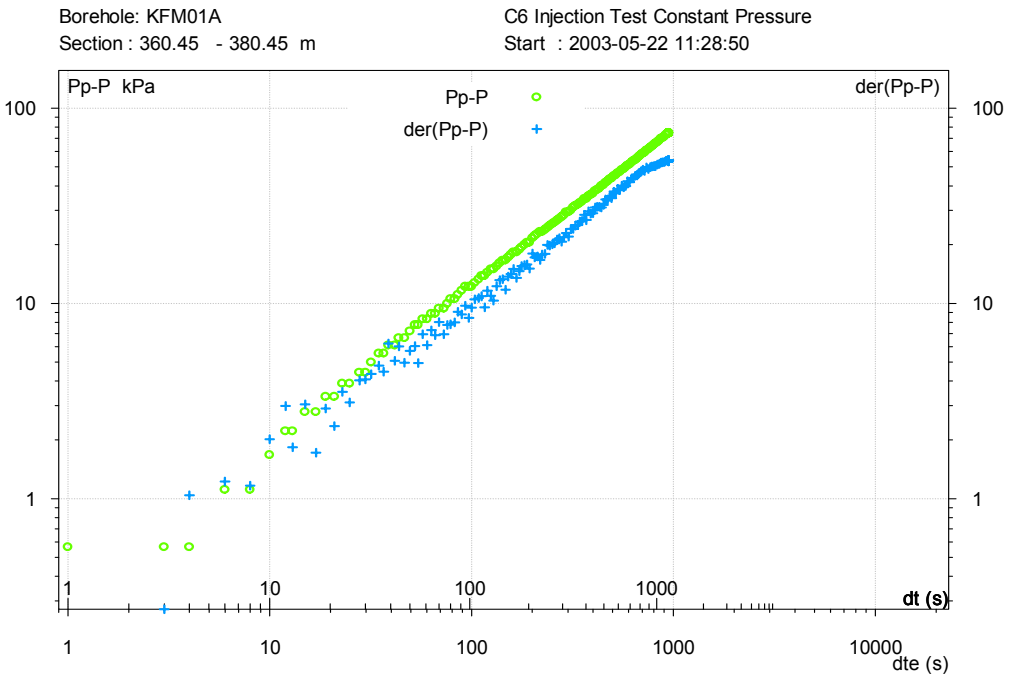


Fig A3-53. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 360.45-380.45 m in KFM01A.

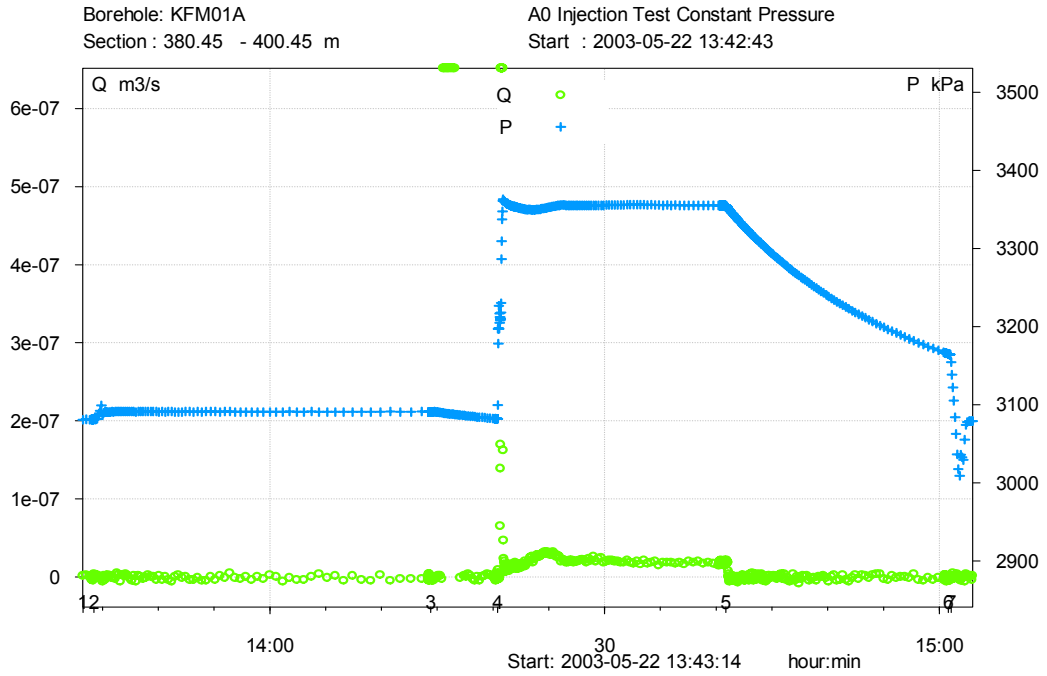


Fig A3-54. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 380.45-400.45 m in borehole KFM01A.

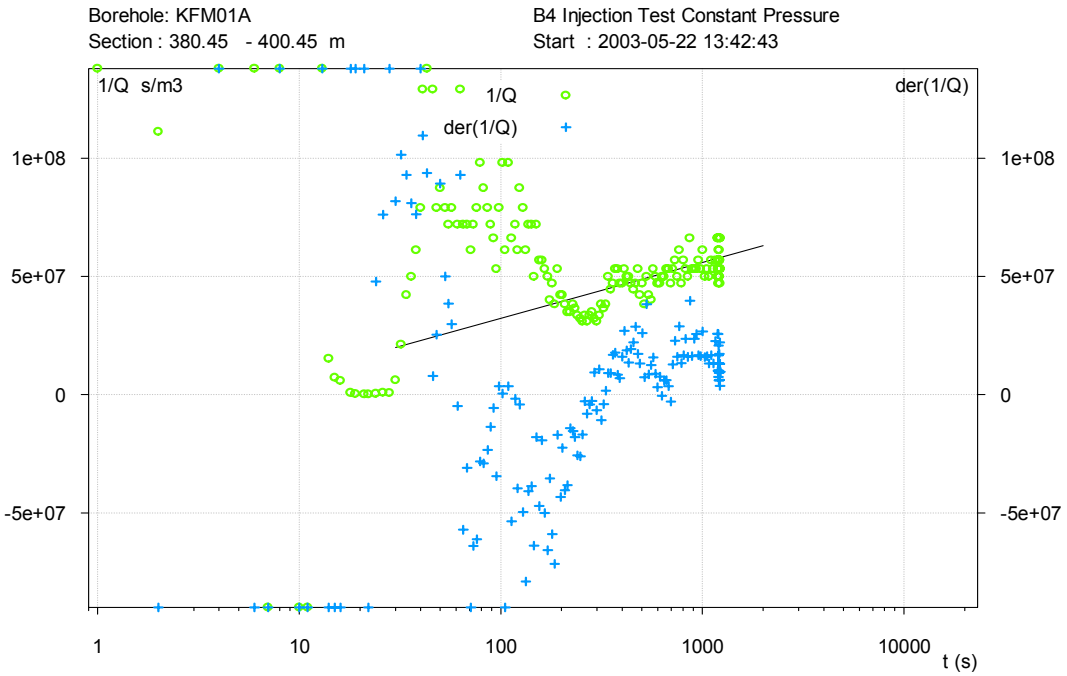


Fig A3-55. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 380.45-400.45 m in KFM01A.

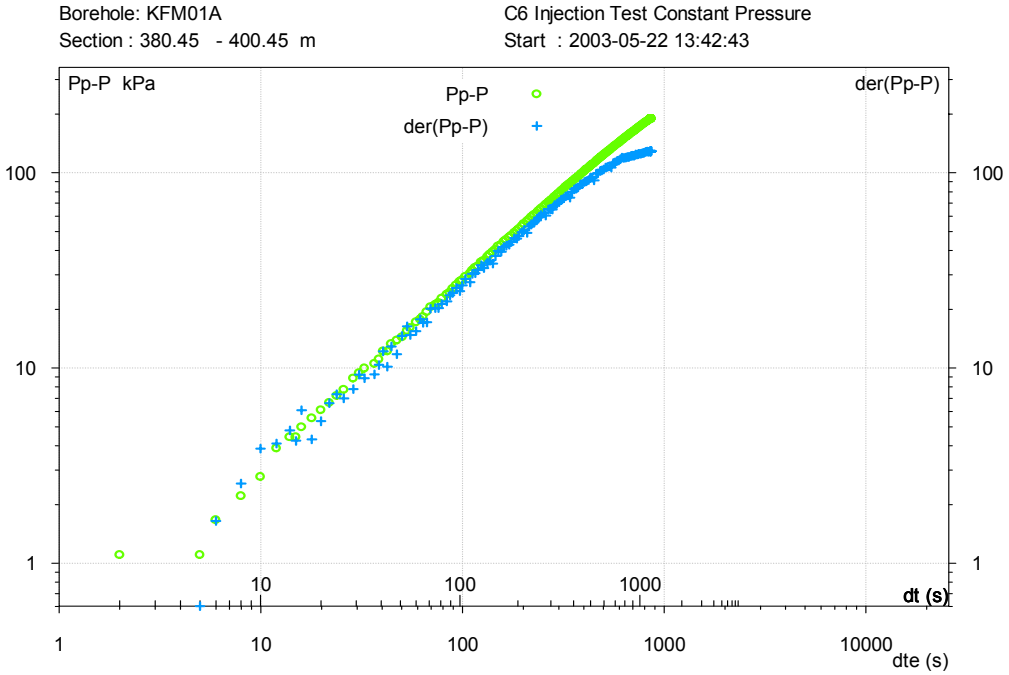


Fig A3-56. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 380.45-400.45 m in KFM01A.

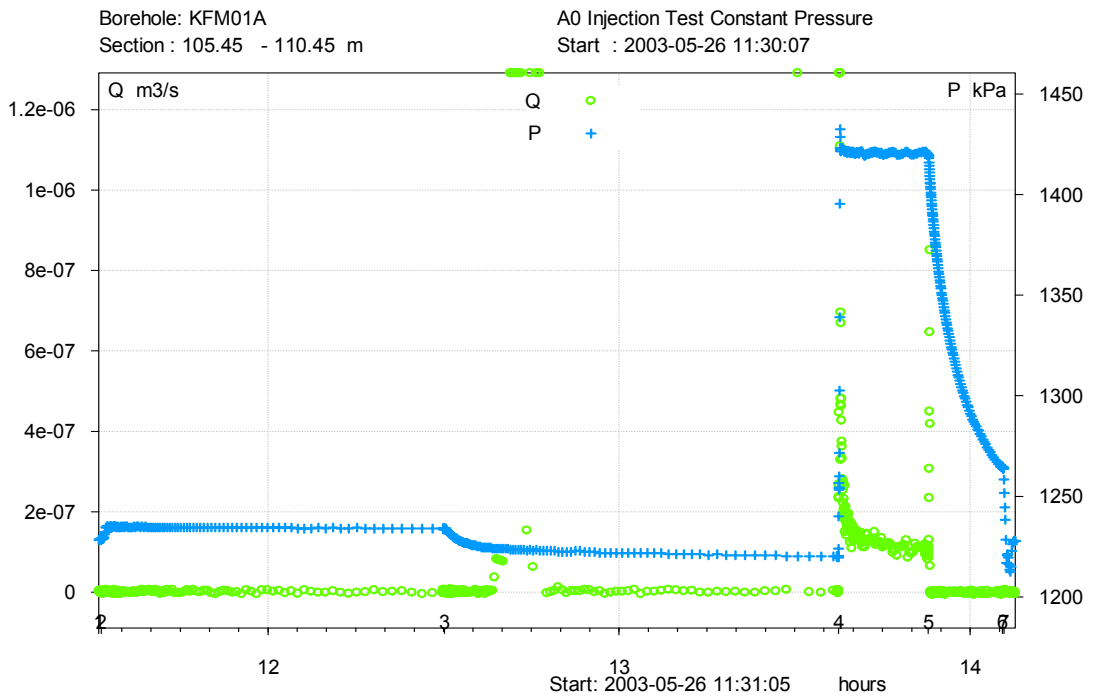


Fig A3-57. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 105.45-110.45 m in borehole KFM01A.

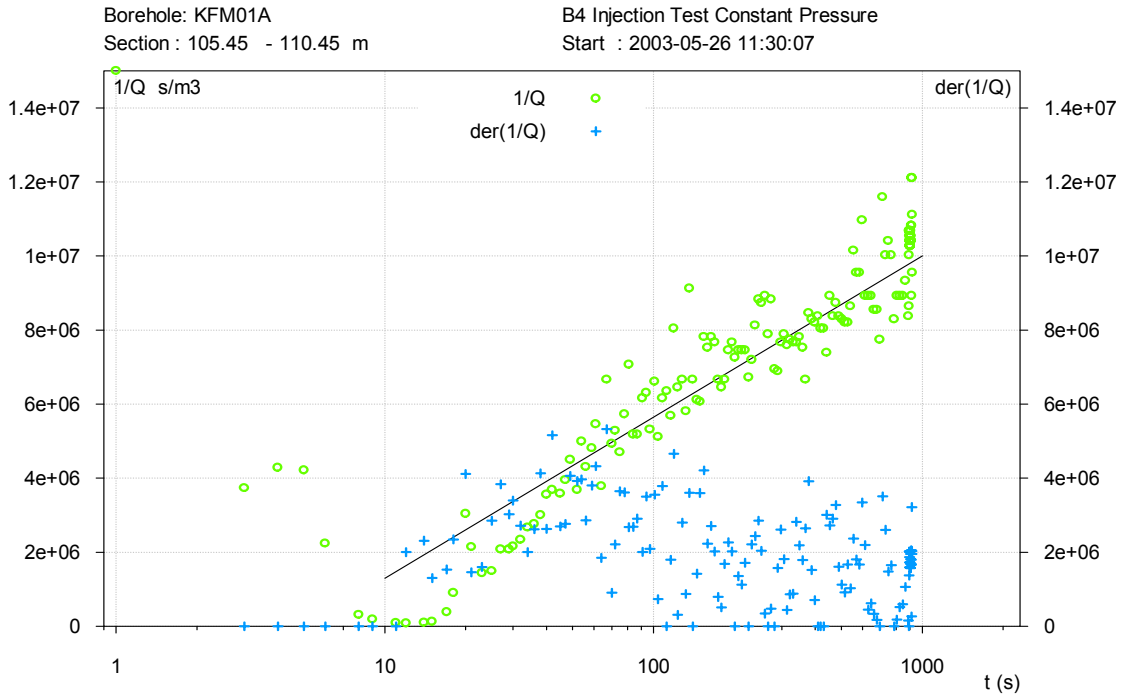


Fig A3-58. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 105.45-110.45 m in KFM01A.

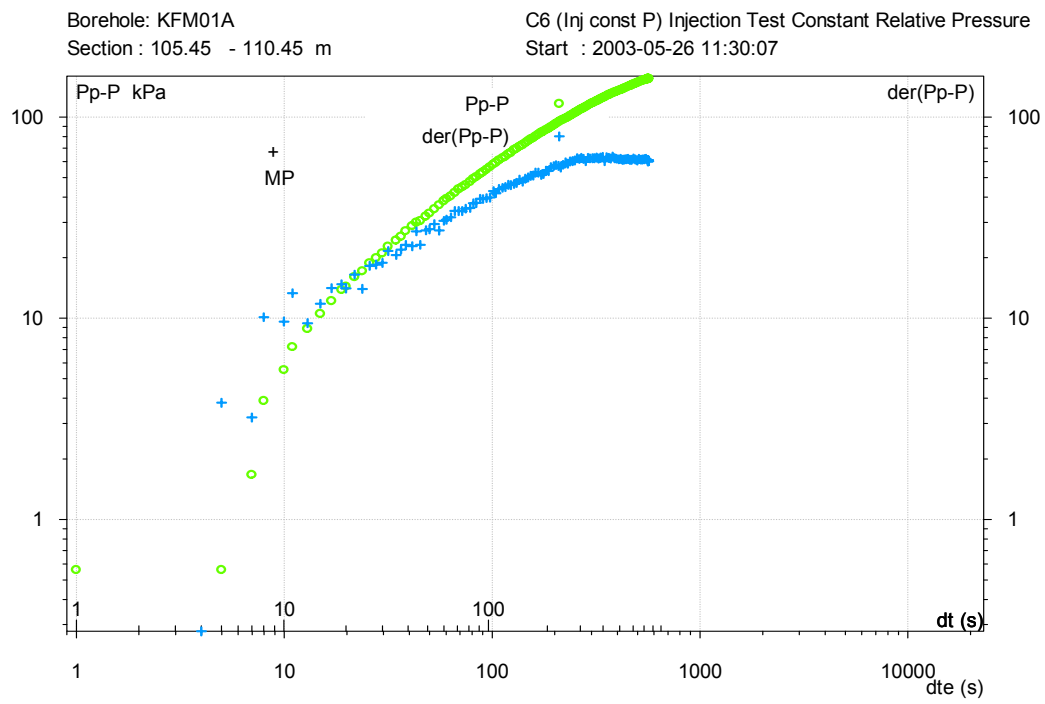


Fig A3-59. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 105.45-110.45 m in KFM01A

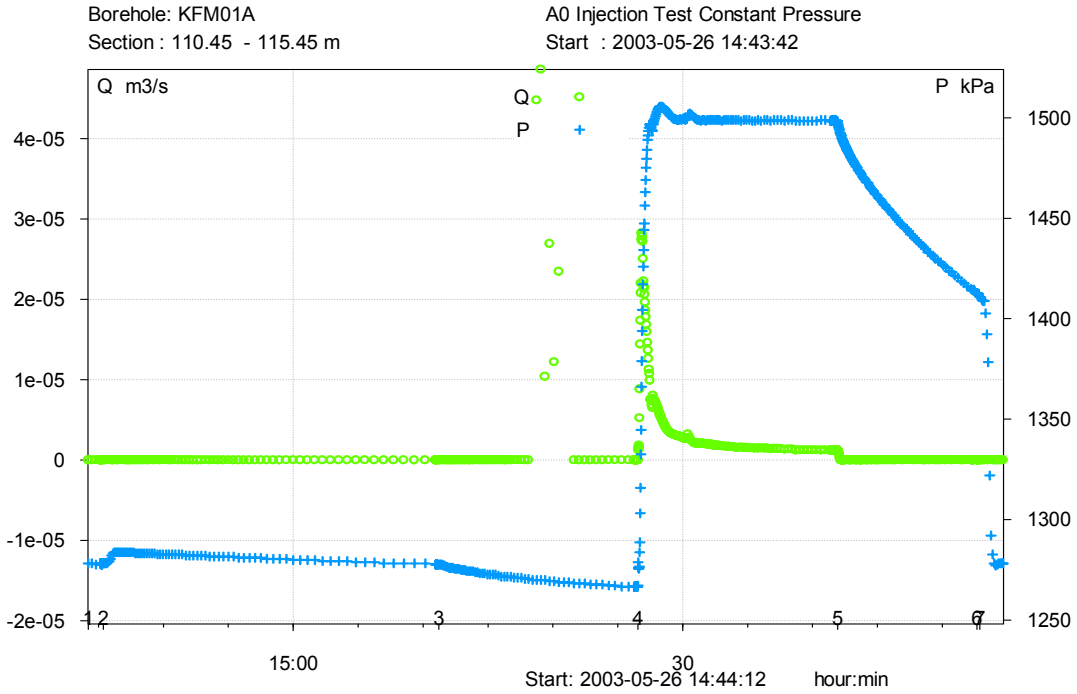


Fig A3-60. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 110.45-115.45 m in borehole KFM01A.

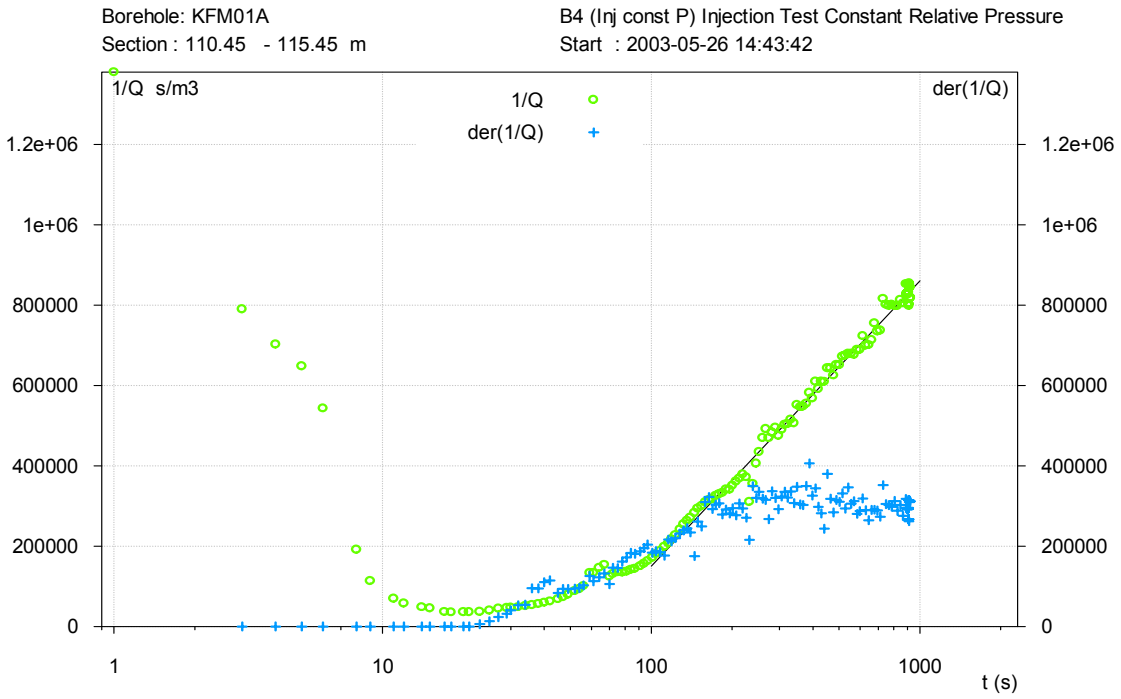


Fig A3-61. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 110.45-115.45 m in KFM01A.

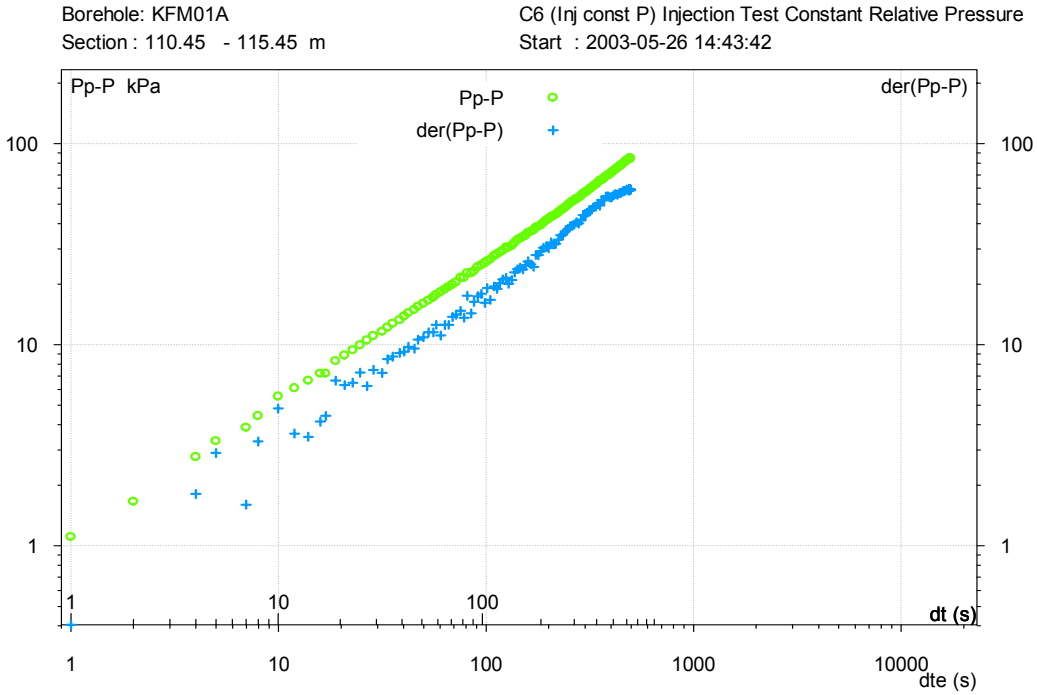


Fig A3-62. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 110.45-115.45 m in KFM01A.

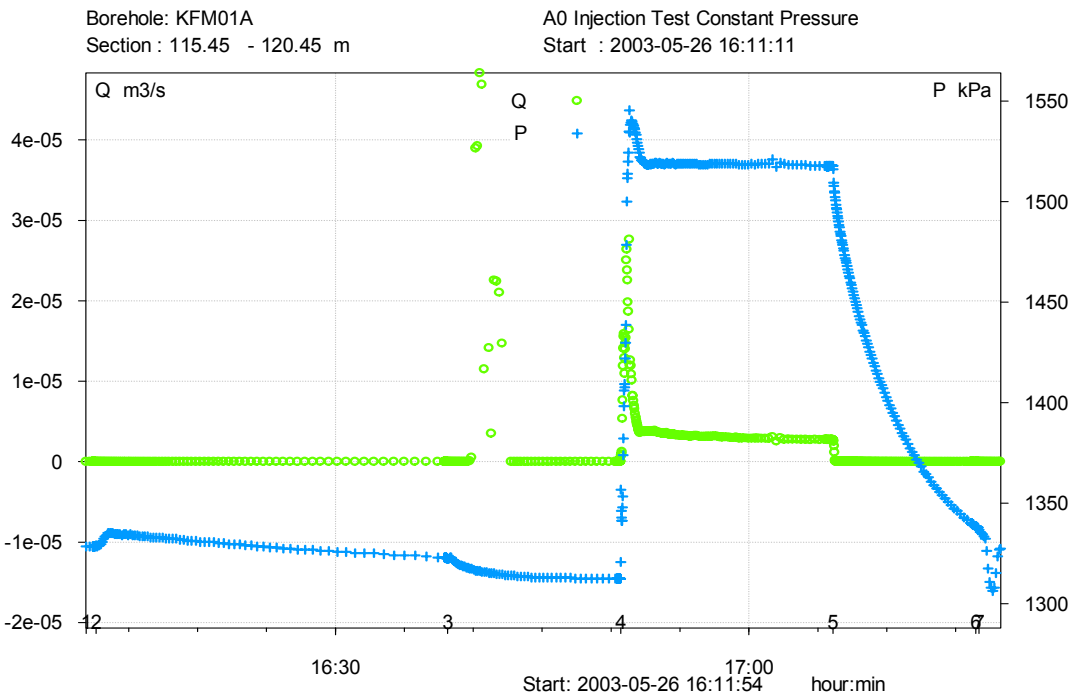


Fig A3-63. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 115.45-120.45 m in borehole KFM01A.

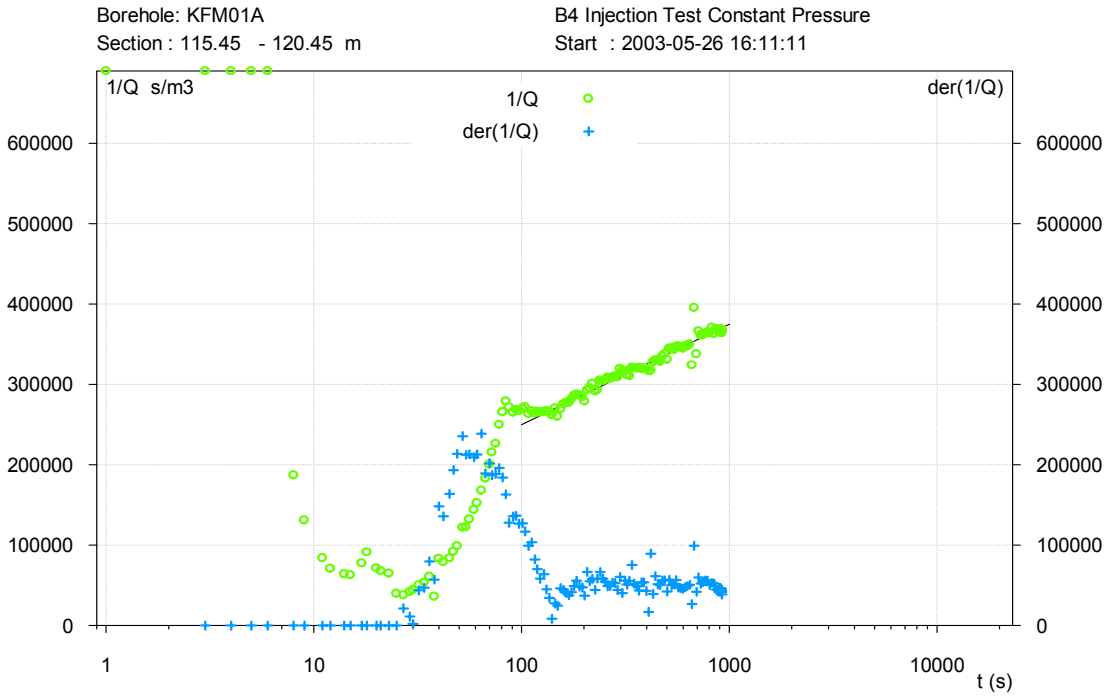


Fig A3-64. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 115.45-120.45 m in KFM01A.

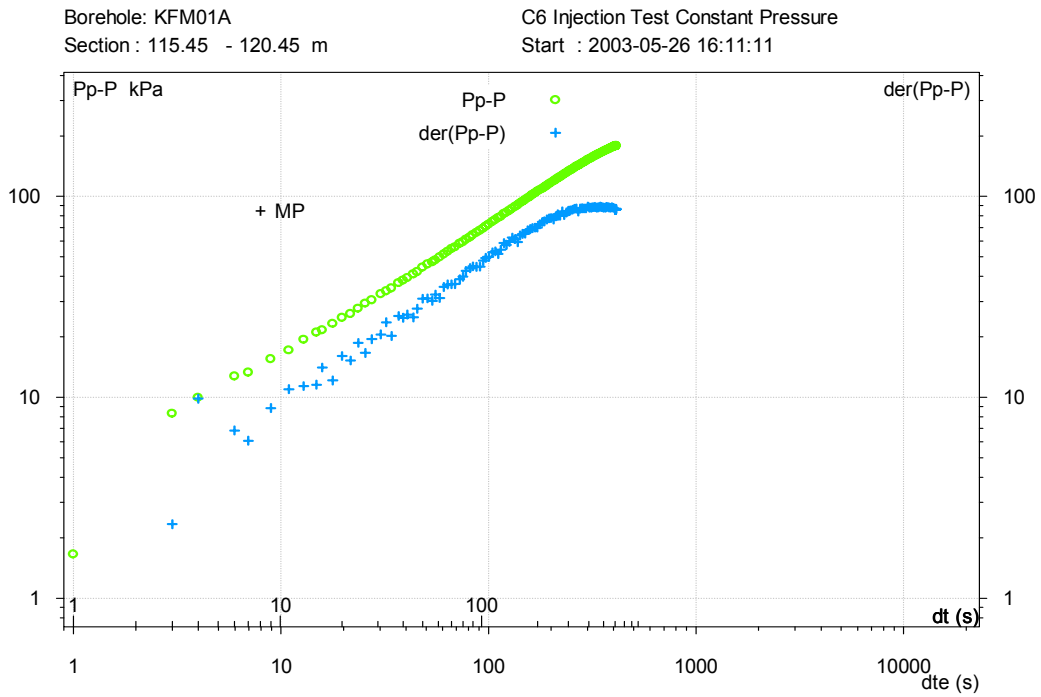


Fig A3-65. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 115.45-120.45 m in KFM01A.

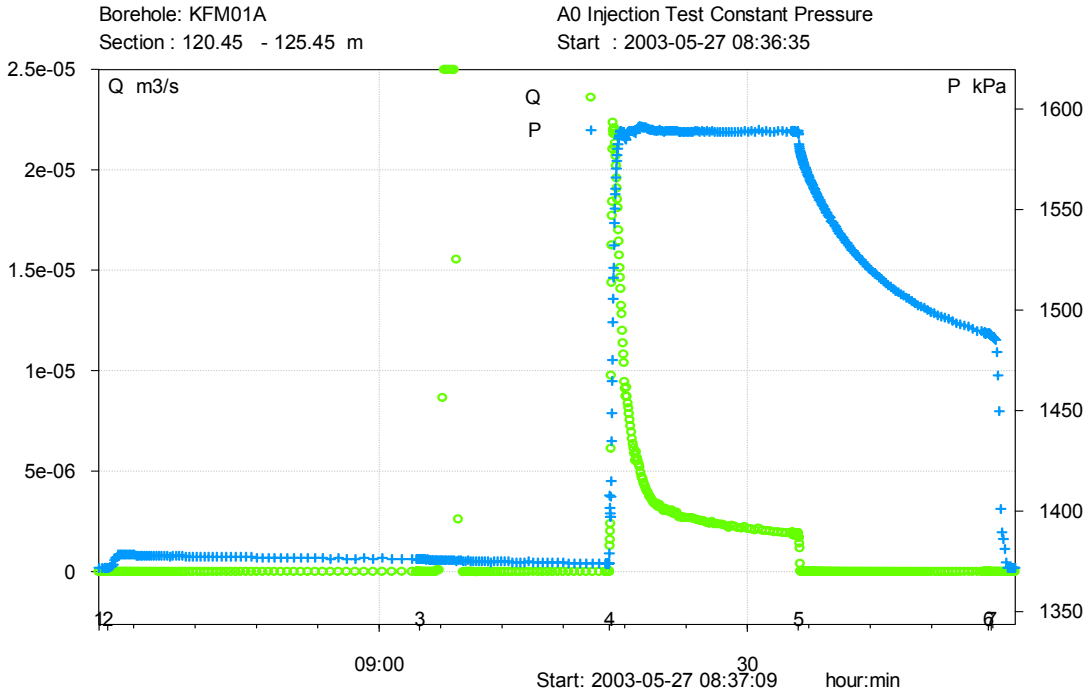


Fig A3-66. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 120.45-125.45 m in borehole KFM01A.

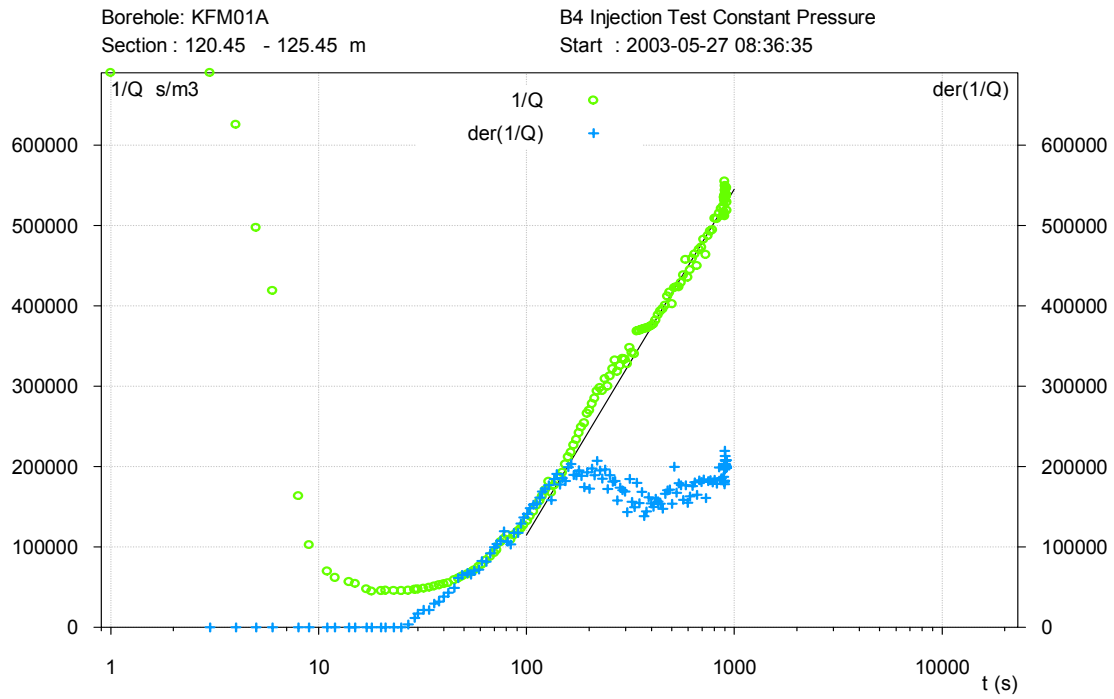


Fig A3-67. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 120.45-125.45 m in KFM01A.

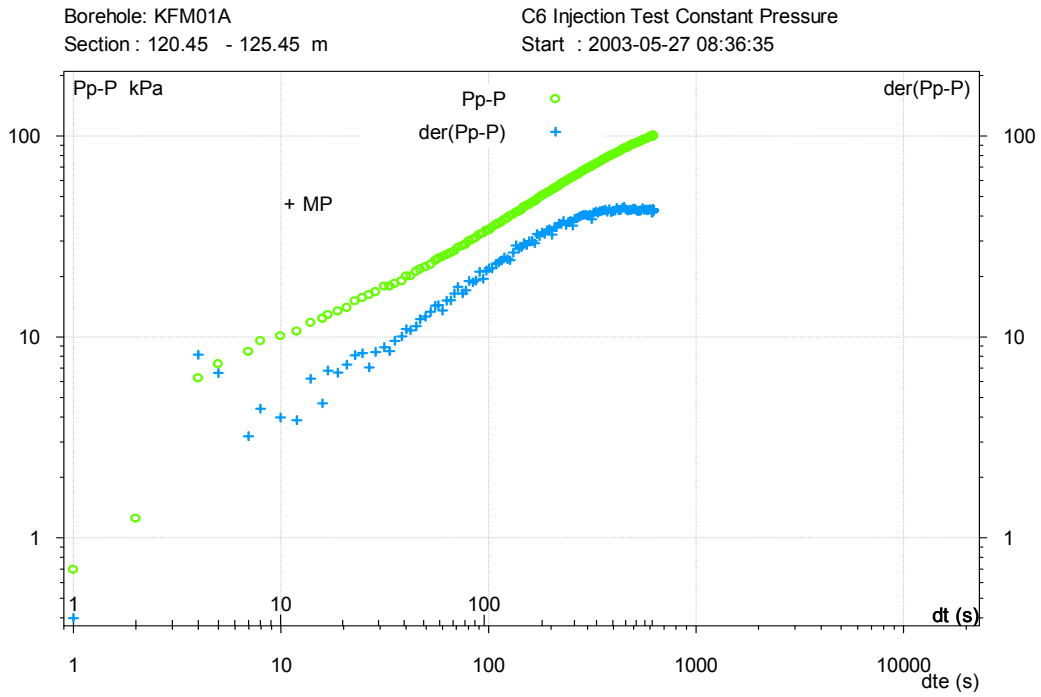


Fig A3-68. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 120.45-125.45 m in KFM01A.

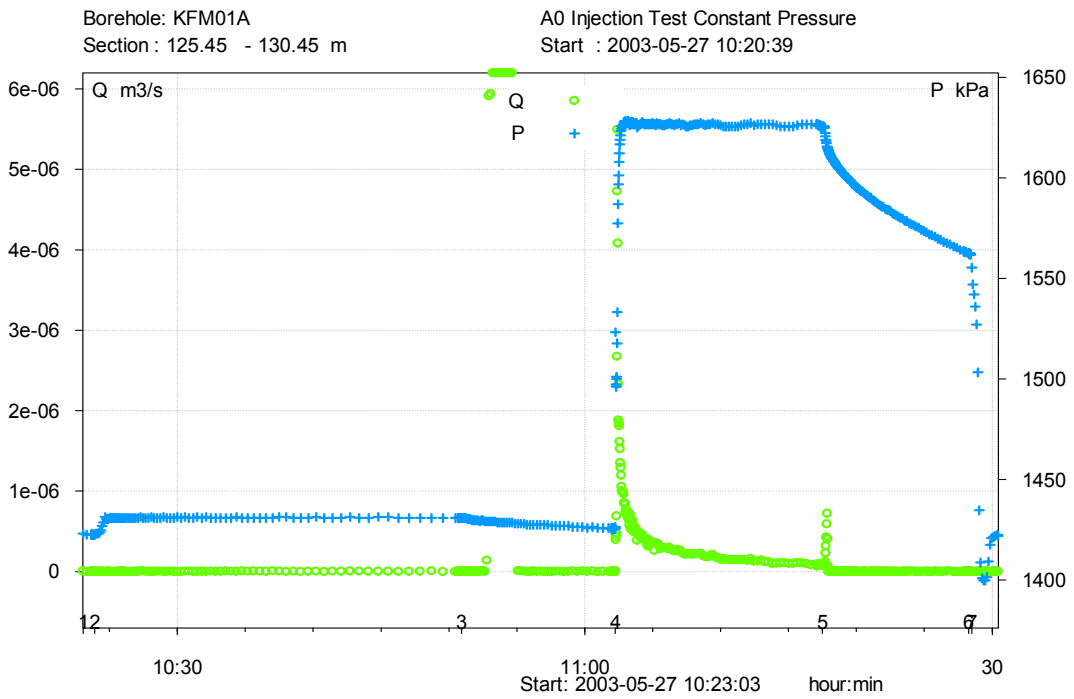


Fig A3-69. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 125.45-130.45 m in borehole KFM01A.

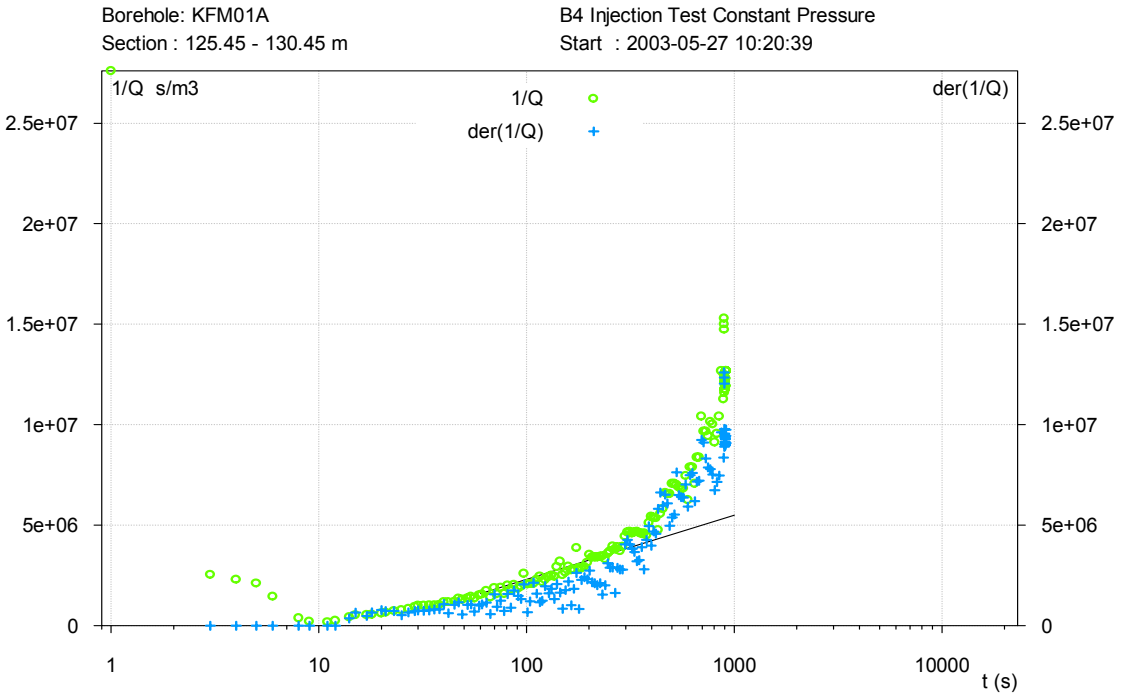


Fig A3-70. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 125.45-130.45 m in KFM01A.

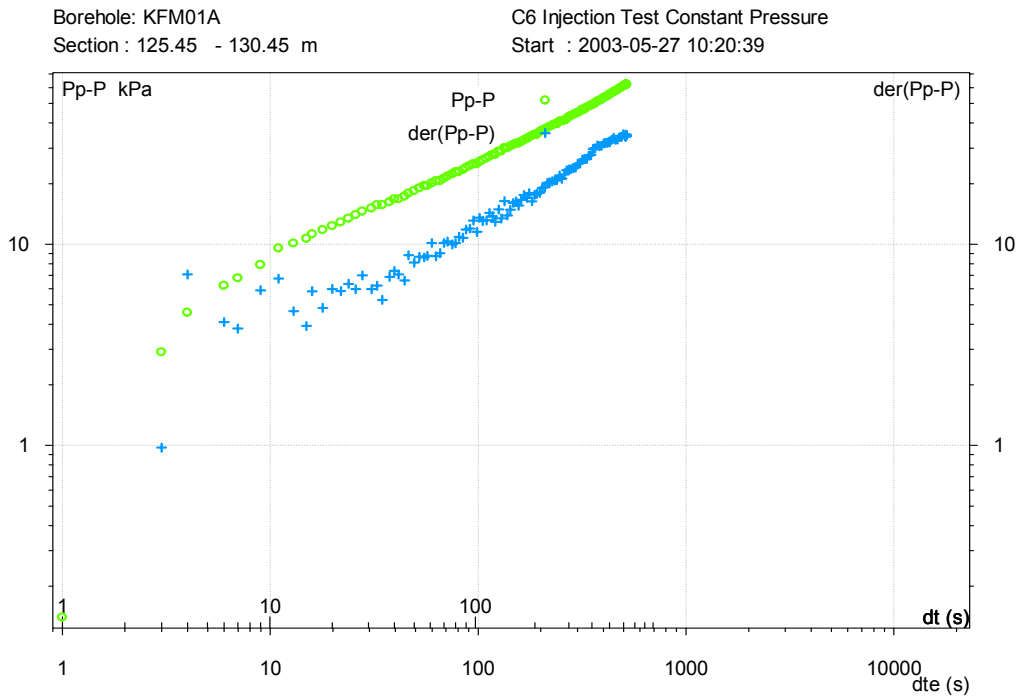


Fig A3-71. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 125.45-130.45 m in KFM01A.

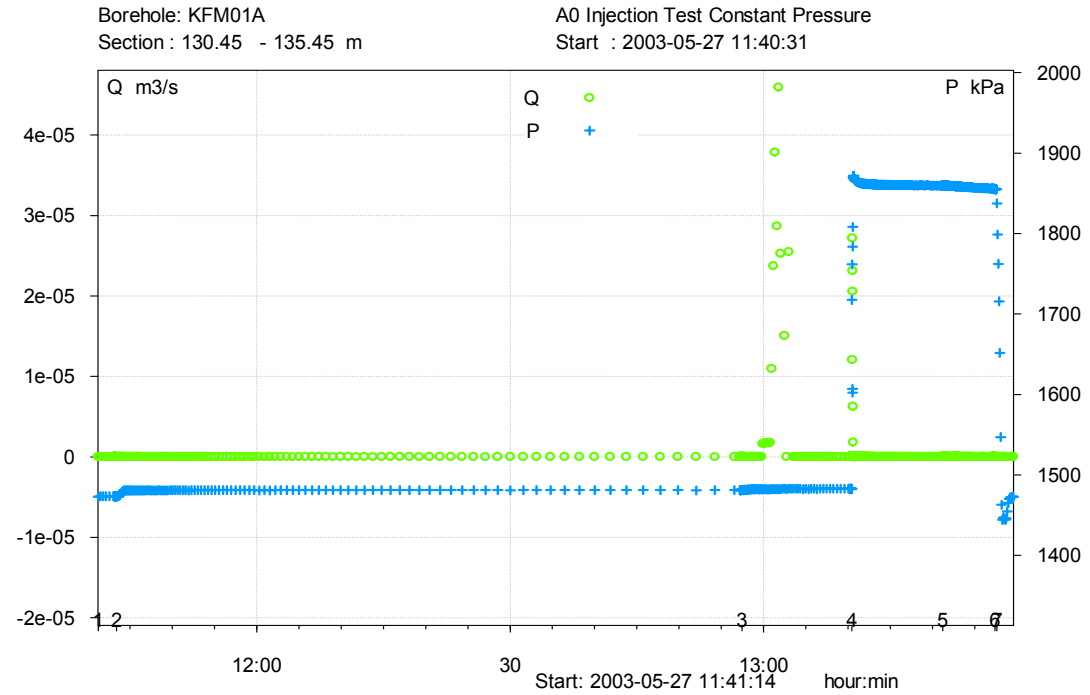


Fig A3-72. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 130.45-135.45 m in borehole KFM01A.

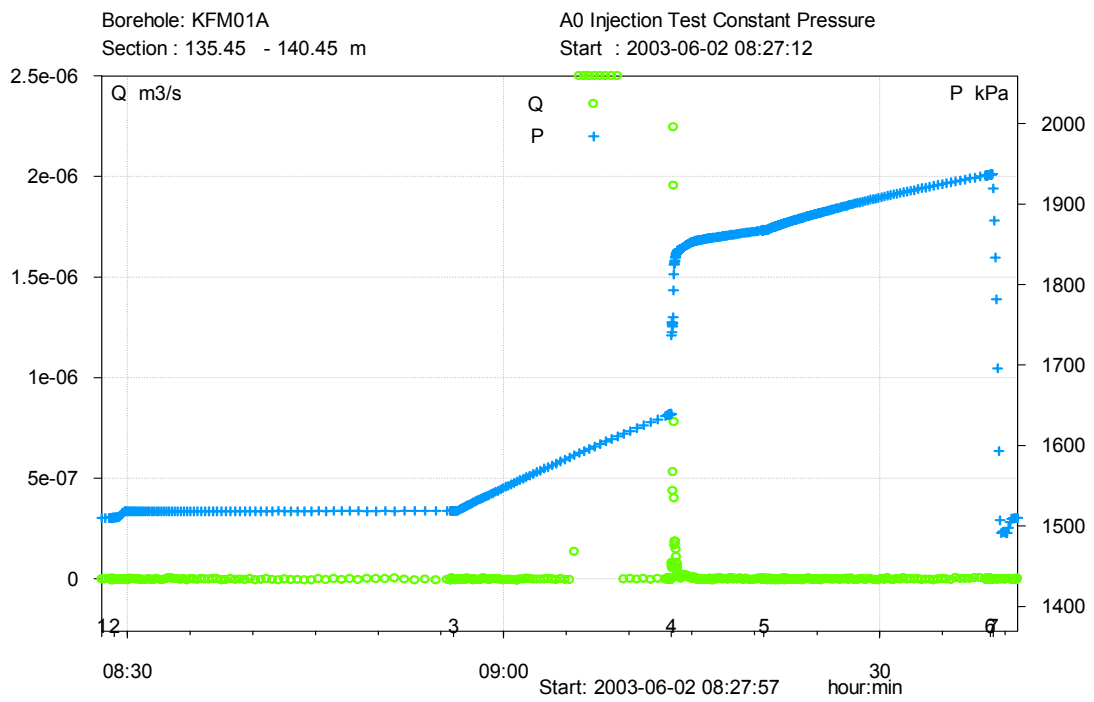


Fig A3-73. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 135.45-140.45 m in borehole KFM01A.

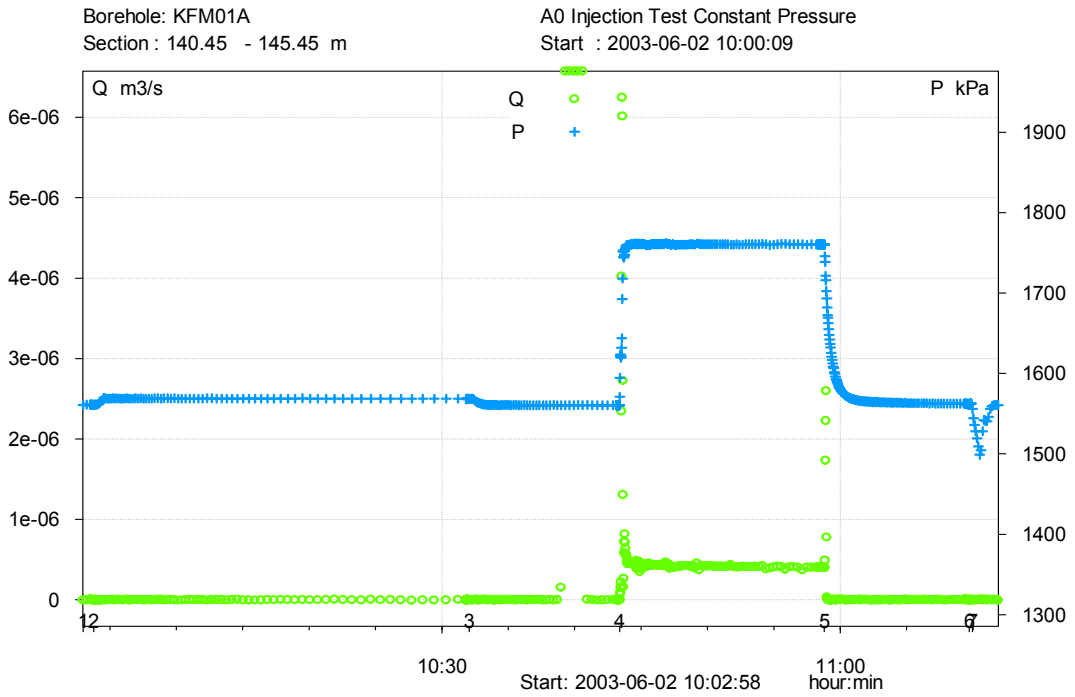


Fig A3-74. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 140.45-145.45 m in borehole KFM01A.

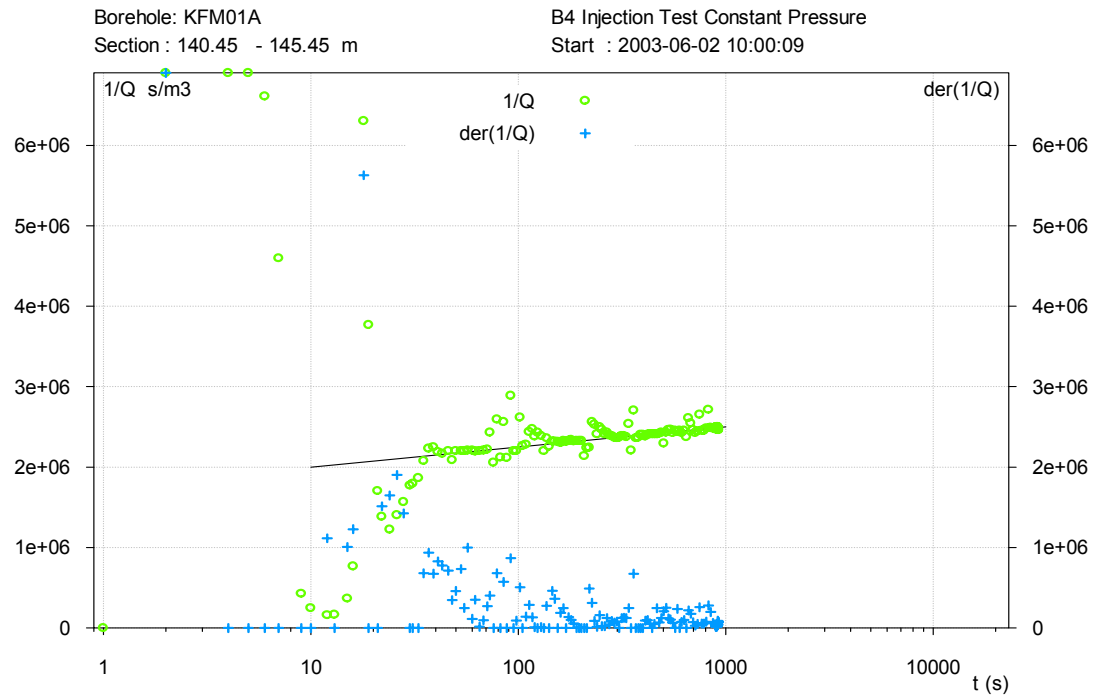


Fig A3-75. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 140.45-145.45 m in KFM01A.

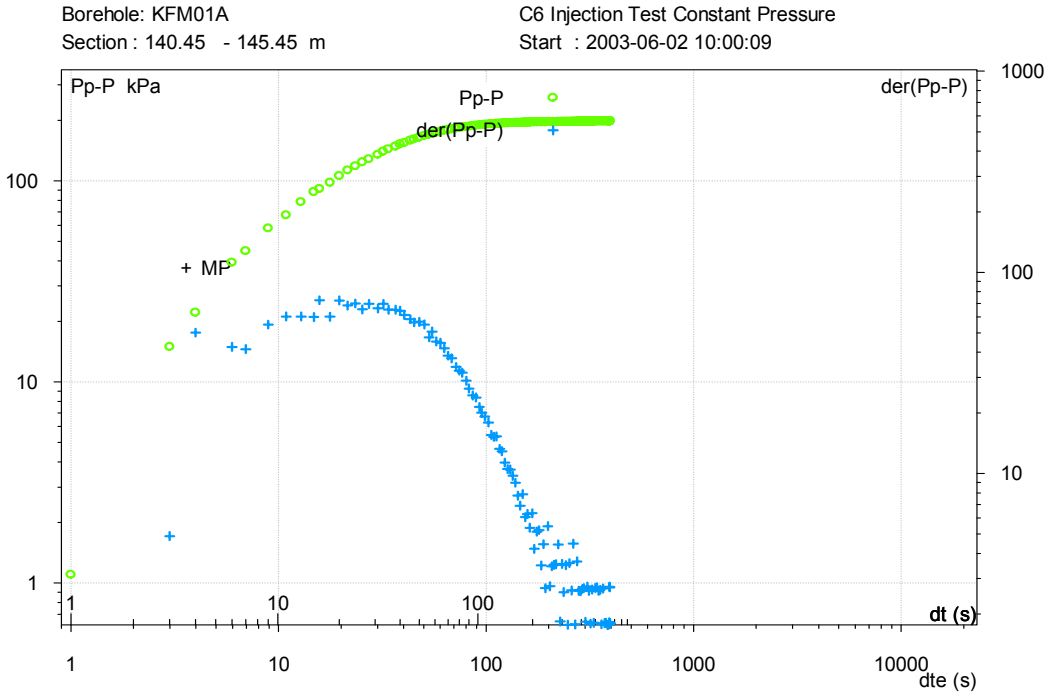


Fig A3-76. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 140.45-145.45 m in KFM01A.

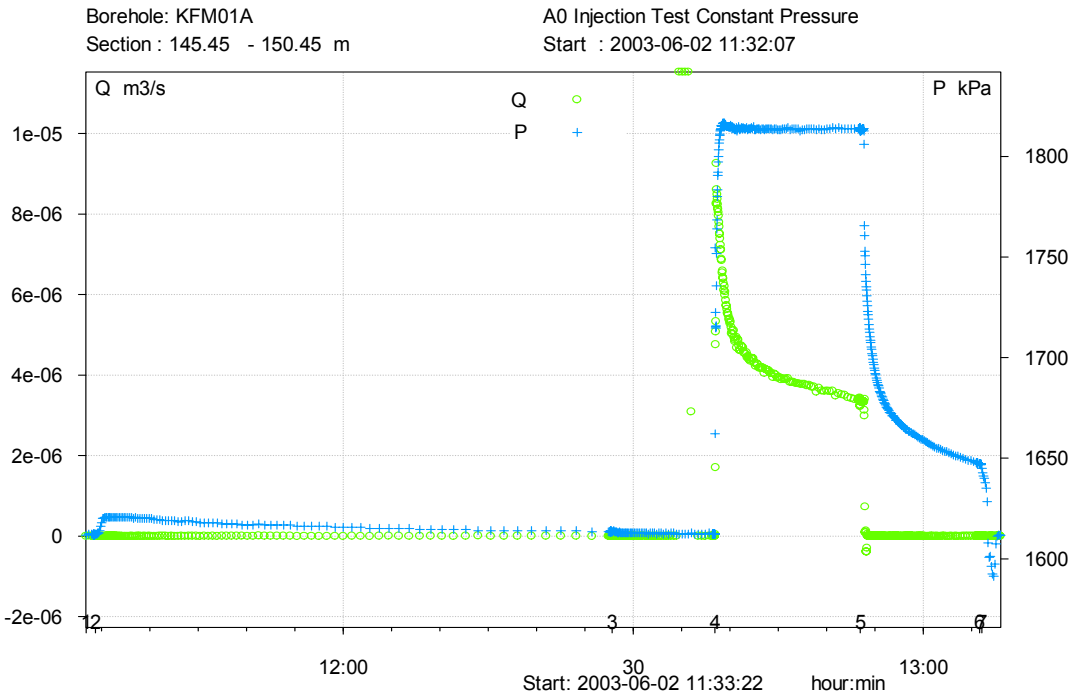


Fig A3-77. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 145.45-150.45 m in borehole KFM01A.

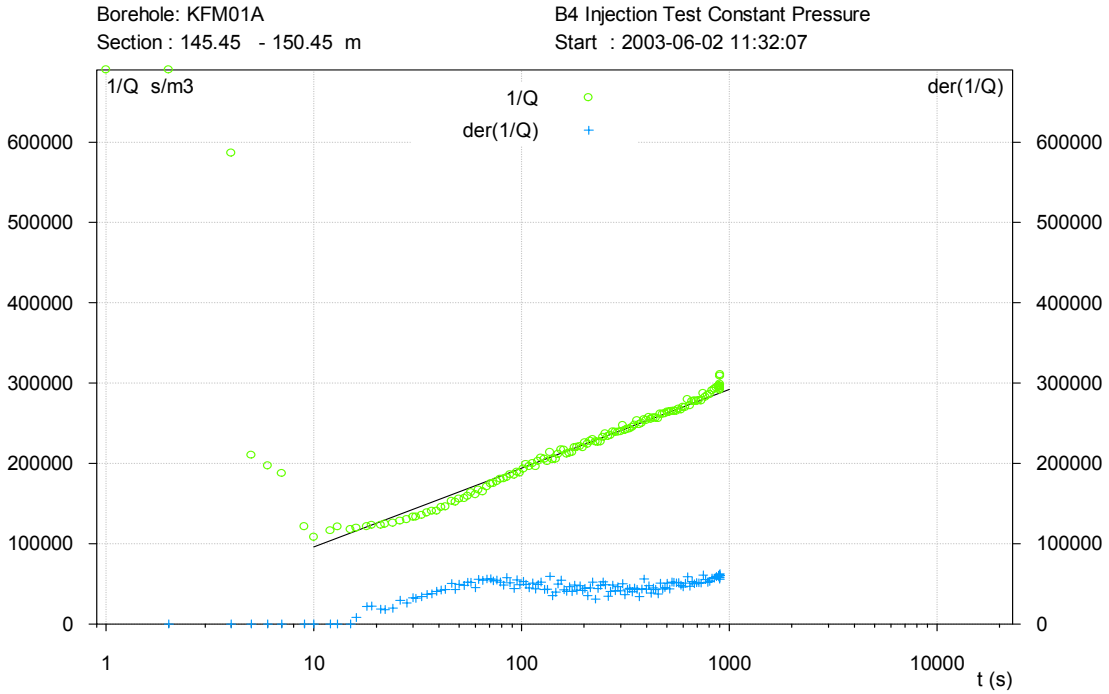


Fig A3-78. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 145.45-150.45 m in KFM01A.

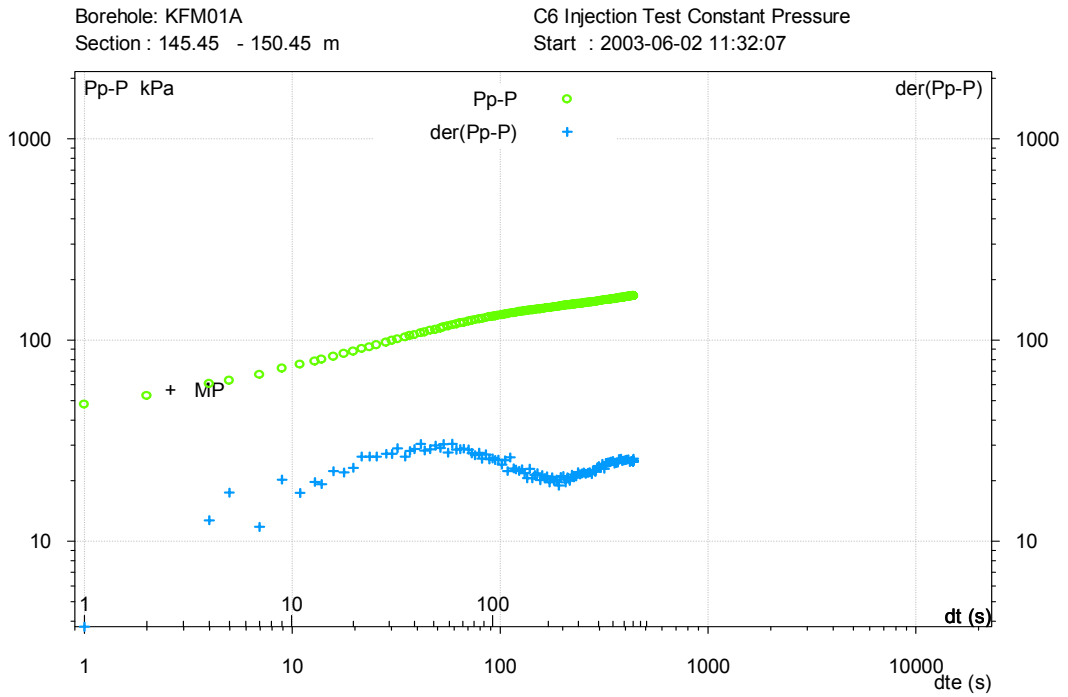


Fig A3-79. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 145.45-150.45 m in KFM01A.

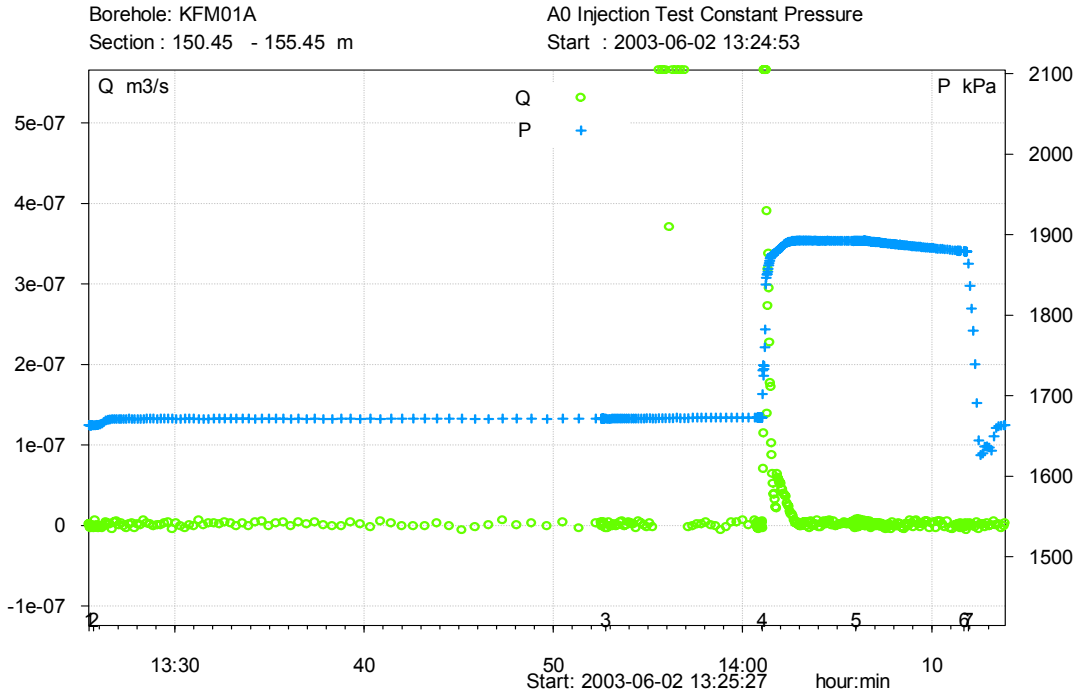


Fig A3-80. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 150.45-155.45 m in borehole KFM01A.

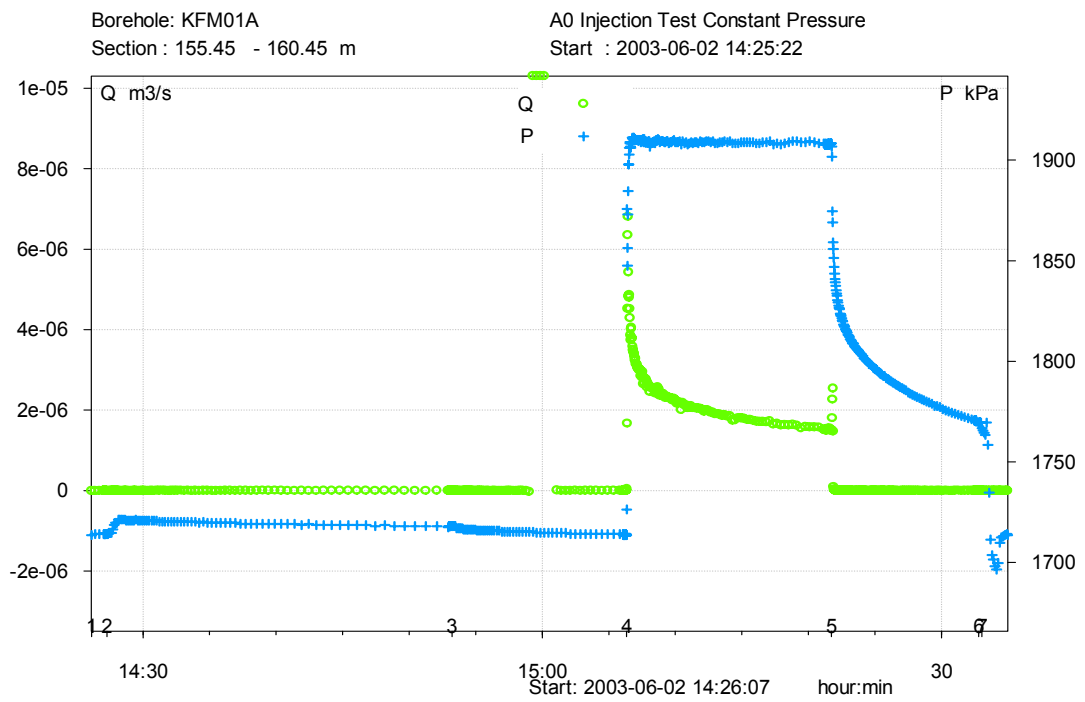


Fig A3-81. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 155.45-160.45 m in borehole KFM01A.

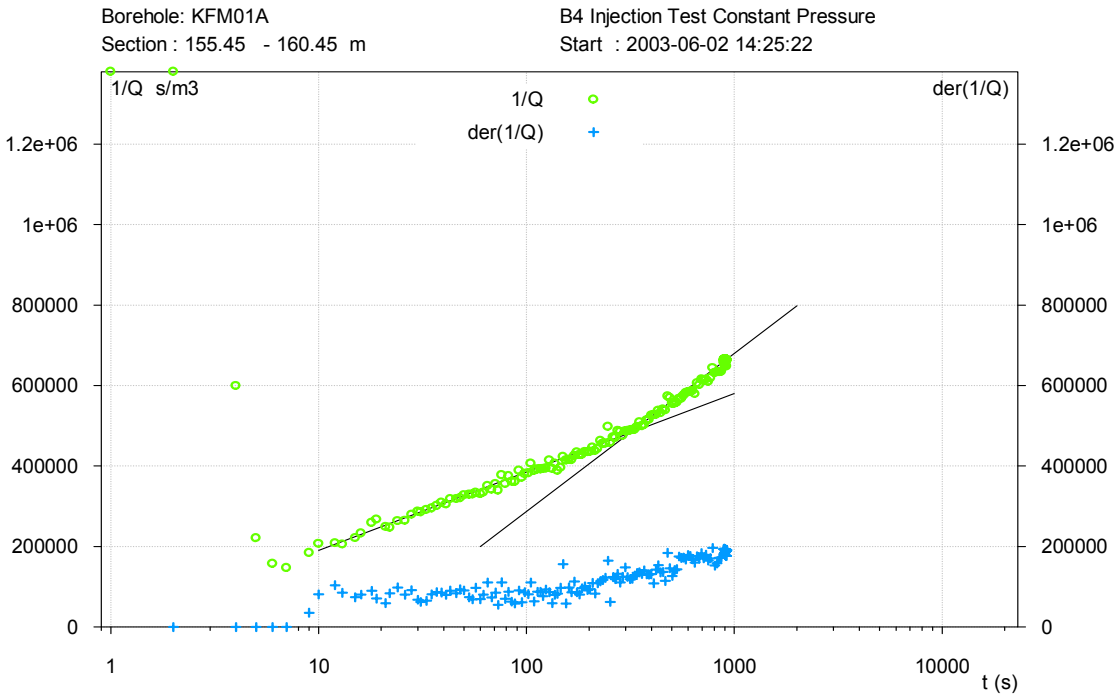


Fig A3-82. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 155.45-160.45 m in KFM01A.

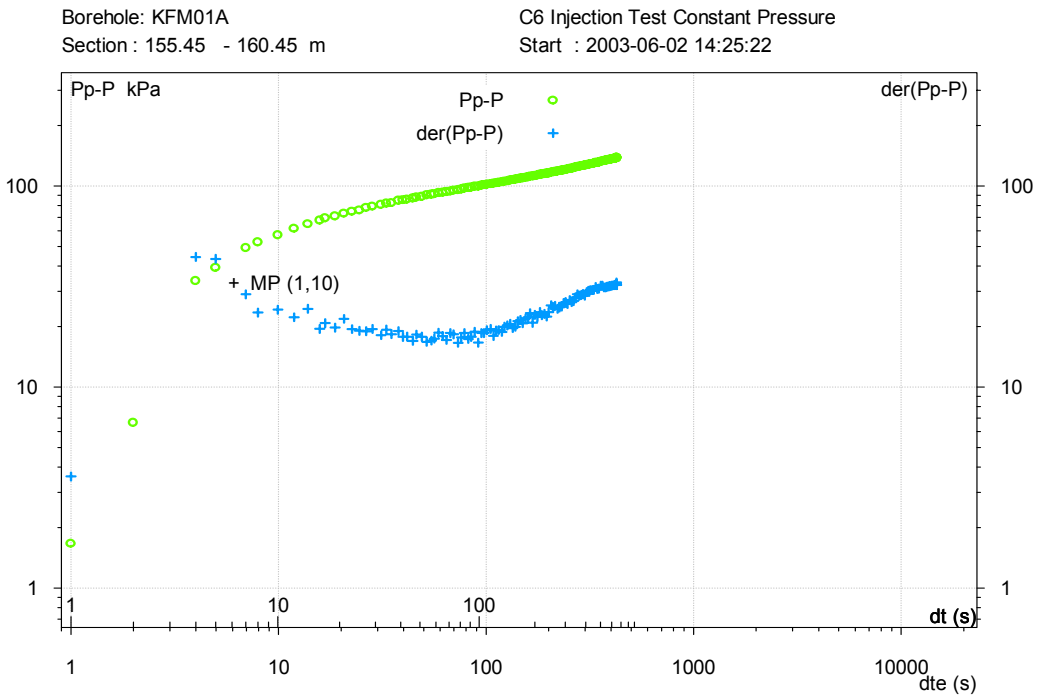


Fig A3-83. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 155.45-160.45 m in KFM01A.

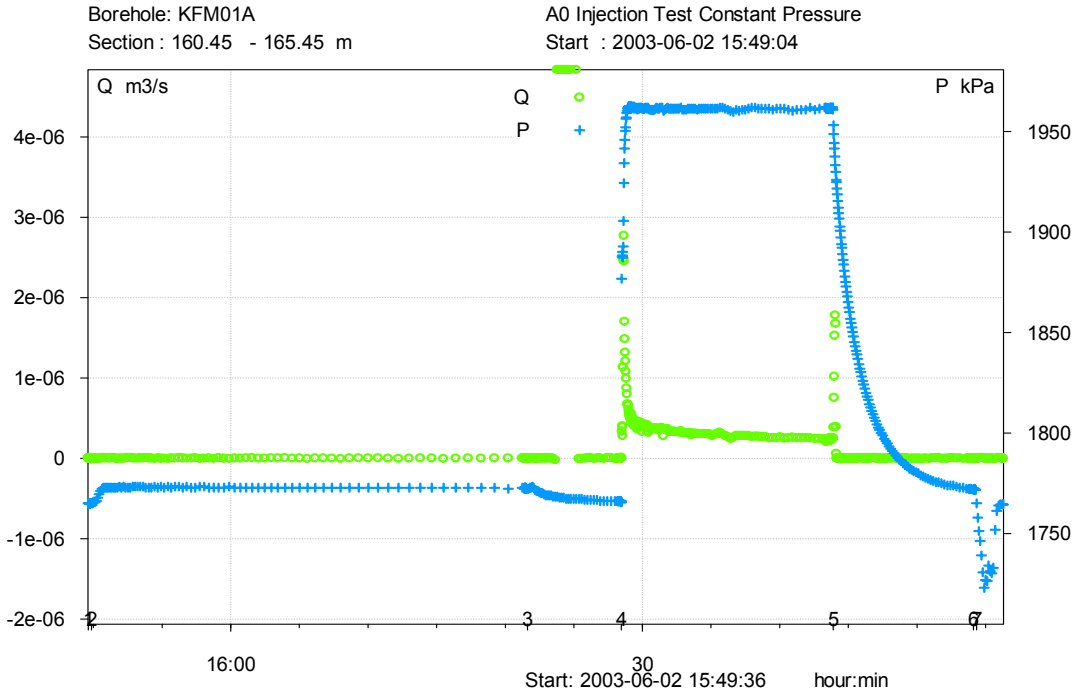


Fig A3-84. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 160.45-165.45 m in borehole KFM01A.

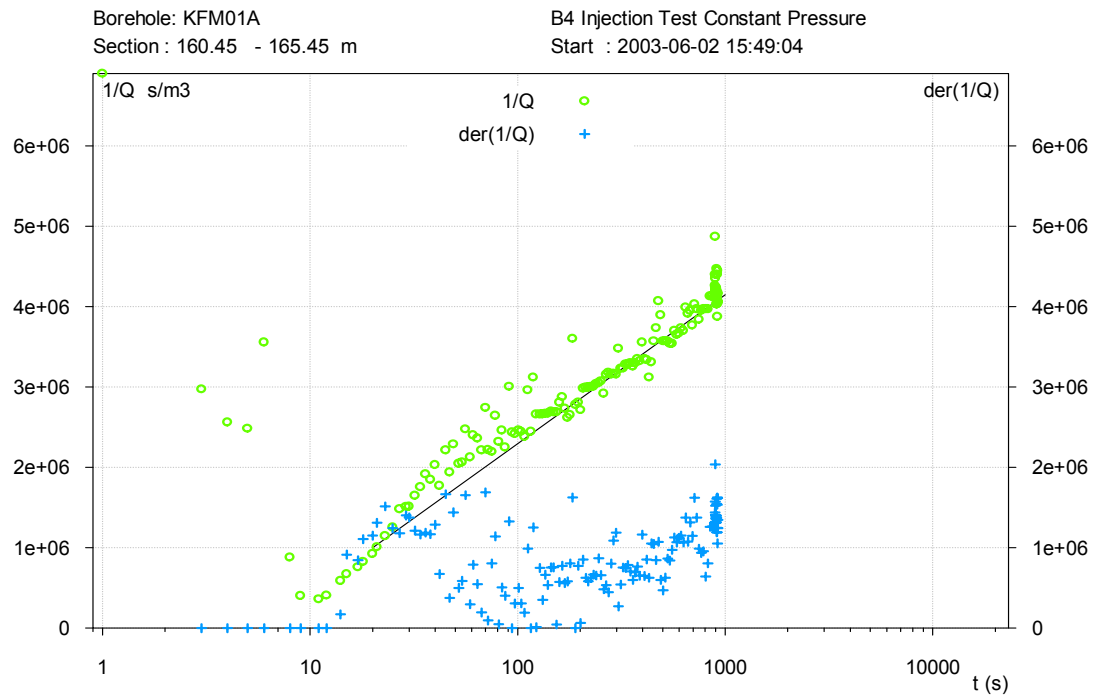


Fig A3-85. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 160.45-165.45 m in KFM01A.

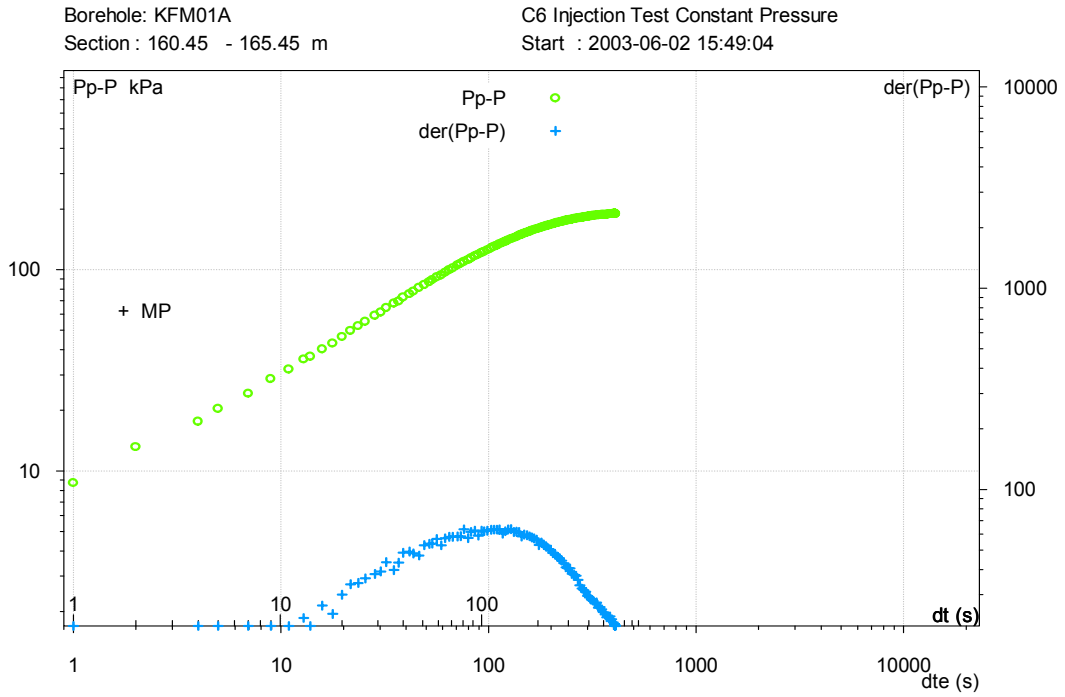


Fig A3-86. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 160.45-165.45 m in KFM01A.

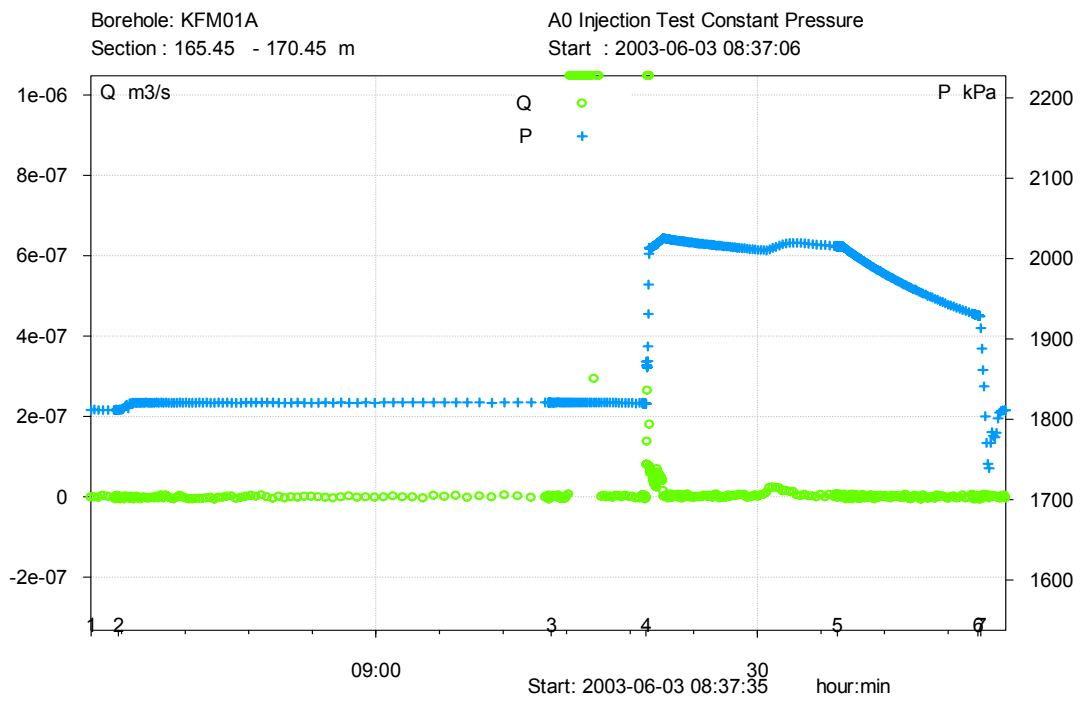


Fig A3-87. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 165.45-170.45 m in borehole KFM01A.

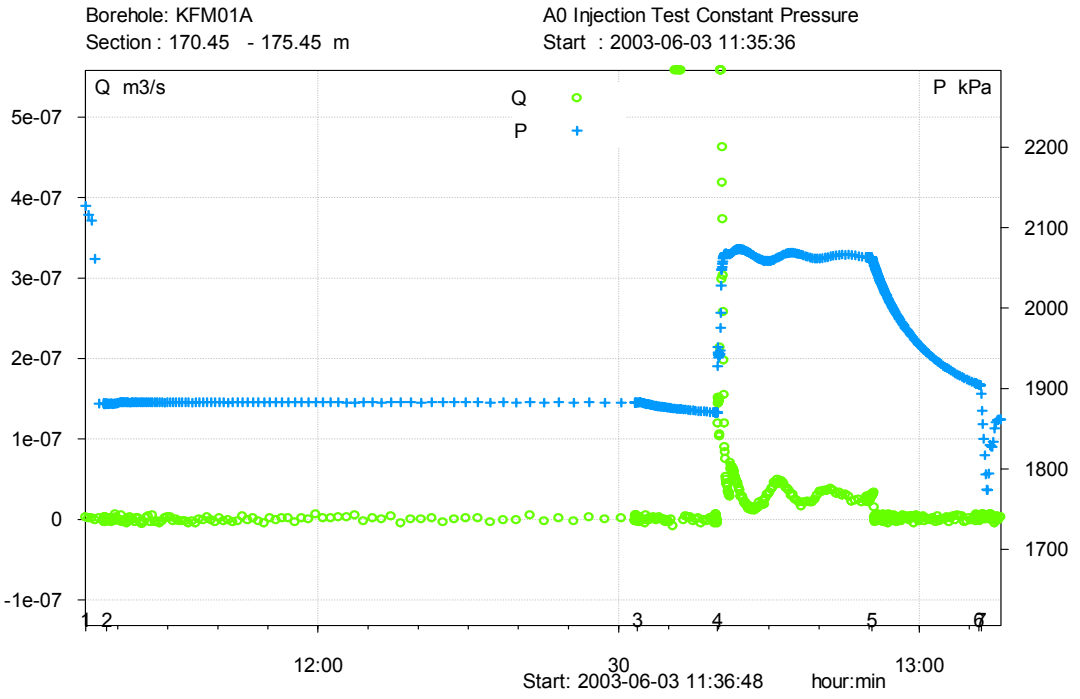


Fig A3-88. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 170.45-175.45 m in borehole KFM01A.

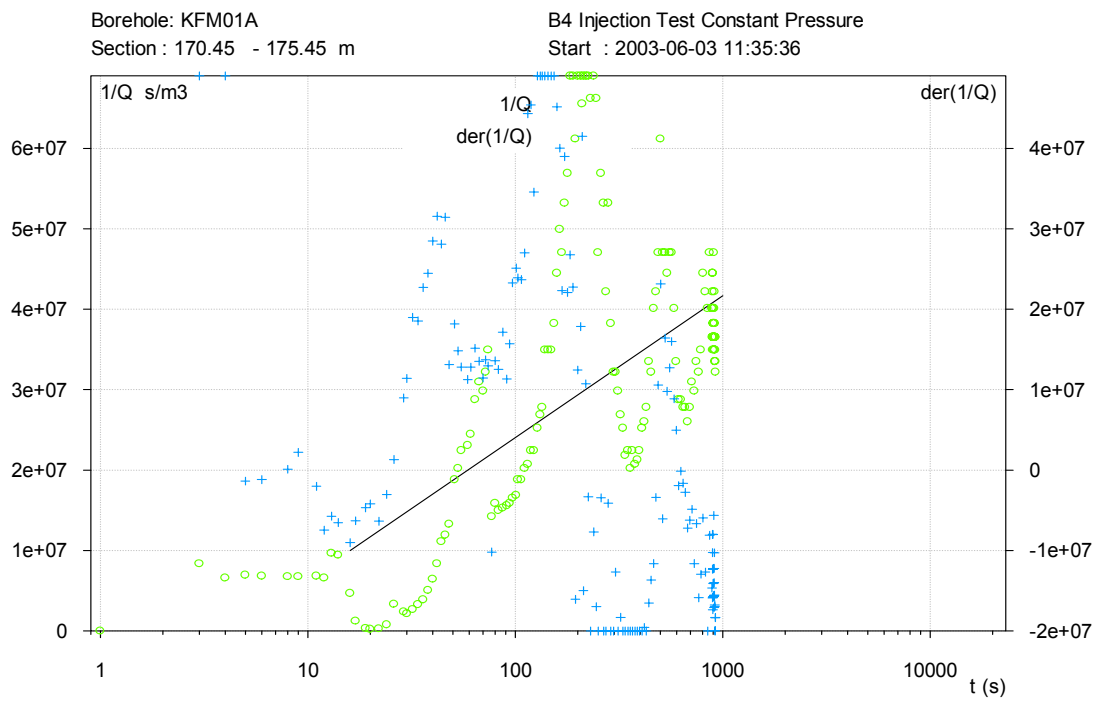


Fig A3-89. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 170.45-175.45 m in KFM01A.

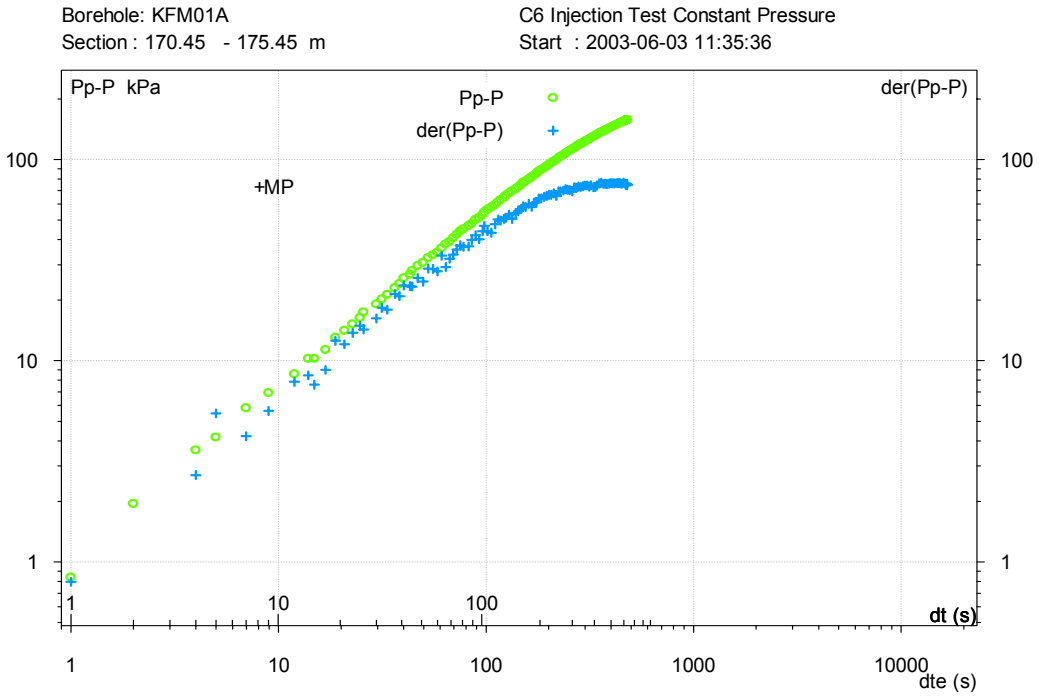


Fig A3-90. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 170.45-175.45 m in KFM01A.

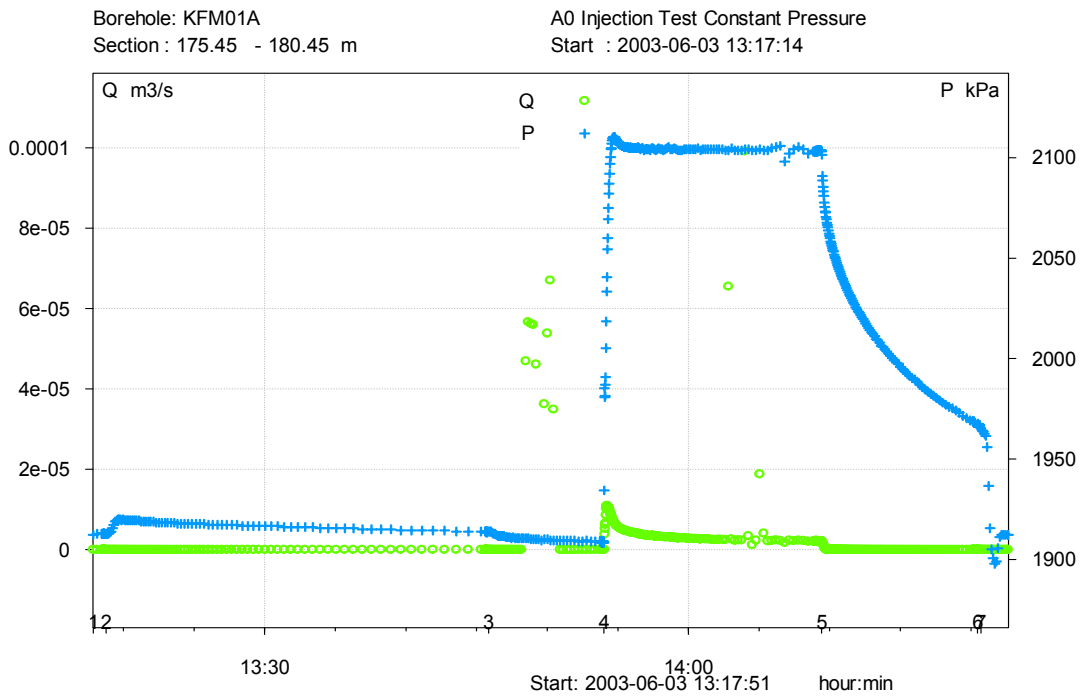


Fig A3-91. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 175.45-180.45 m in borehole KFM01A.

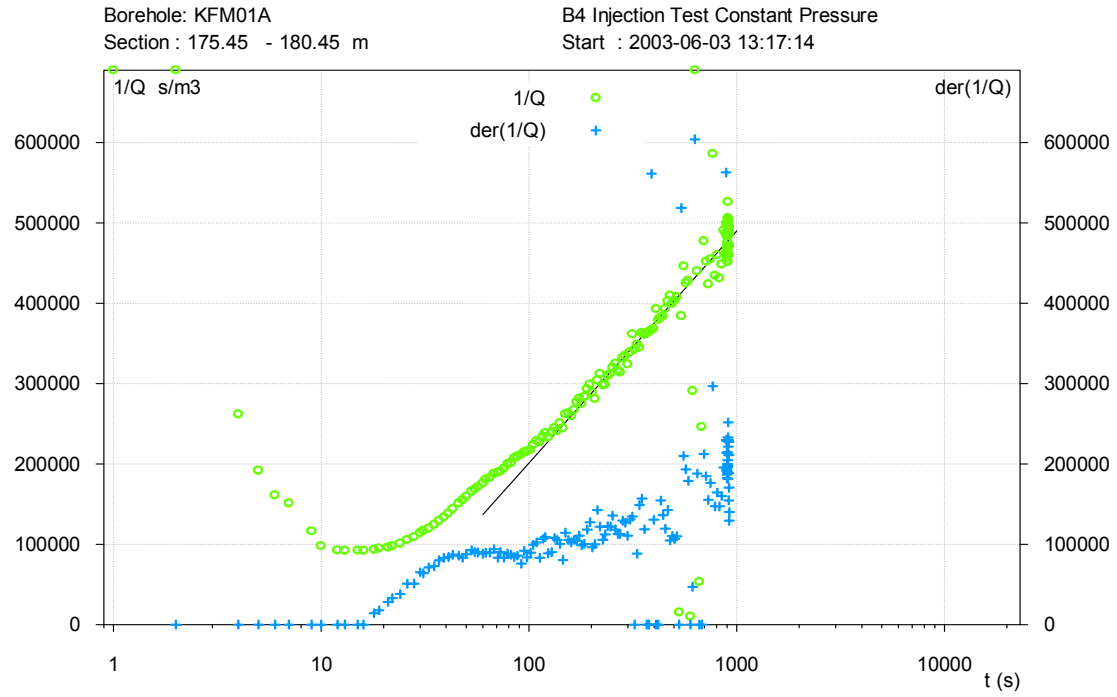


Fig A3-92. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 175.45-180.45 m in KFM01A.

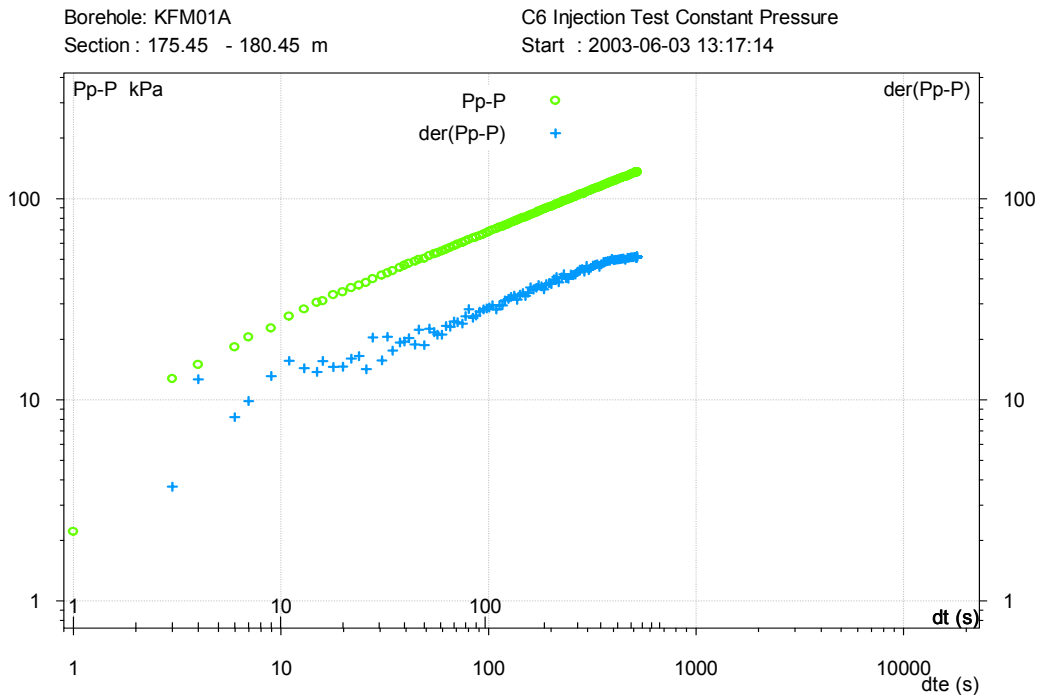


Fig A3-93. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 175.45-180.45 m in KFM01A.

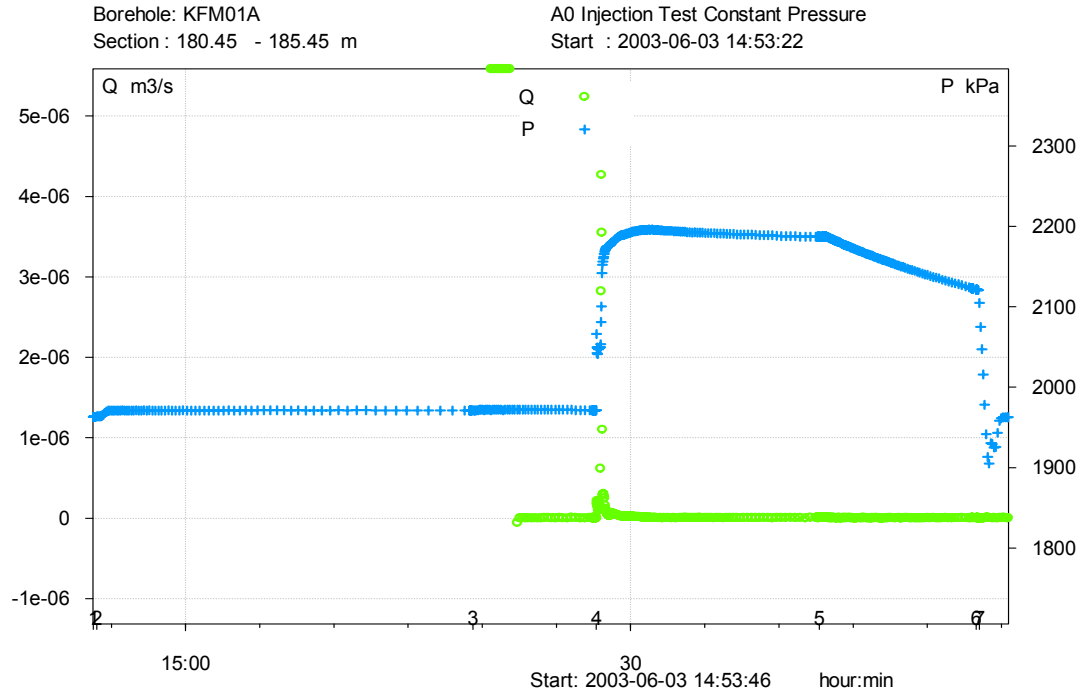


Fig A3-94. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 180.45-185.45 m in borehole KFM01A.

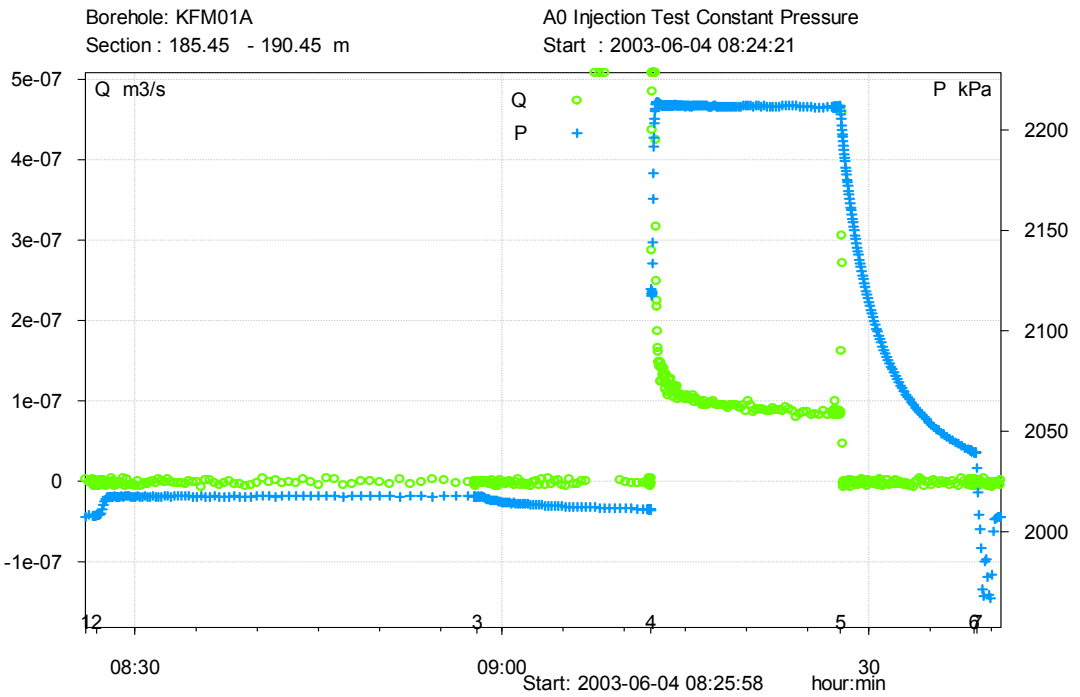


Fig A3-95. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 185.45-190.45 m in borehole KFM01A.

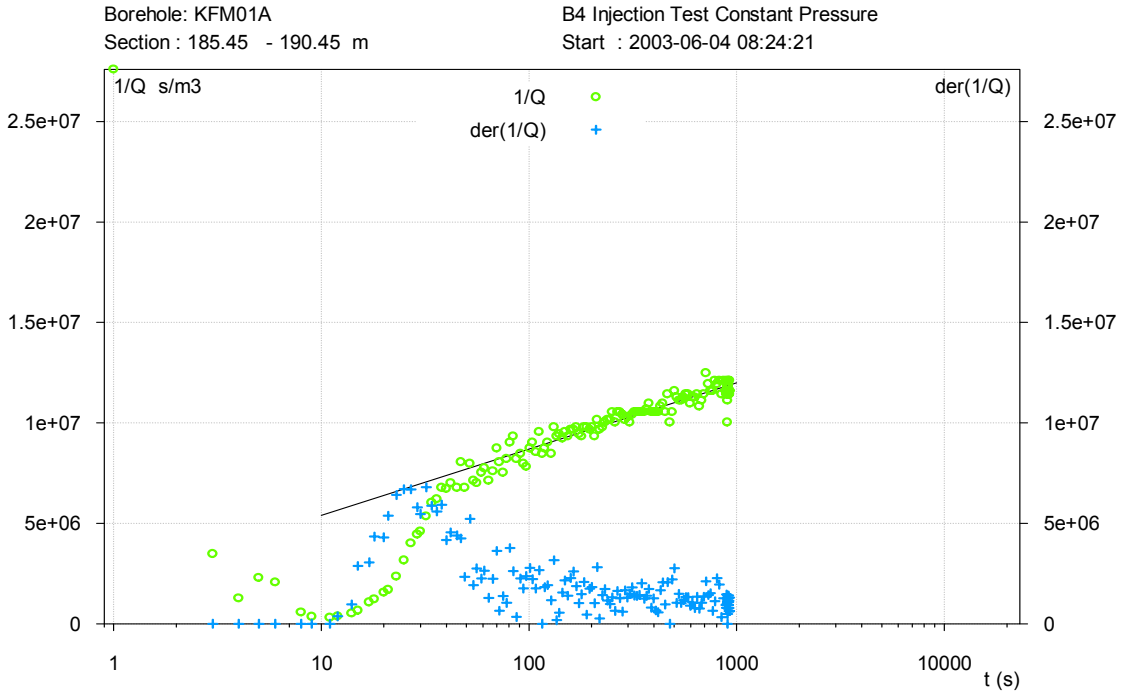


Fig A3-96. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 185.45-190.45 m in KFM01A.

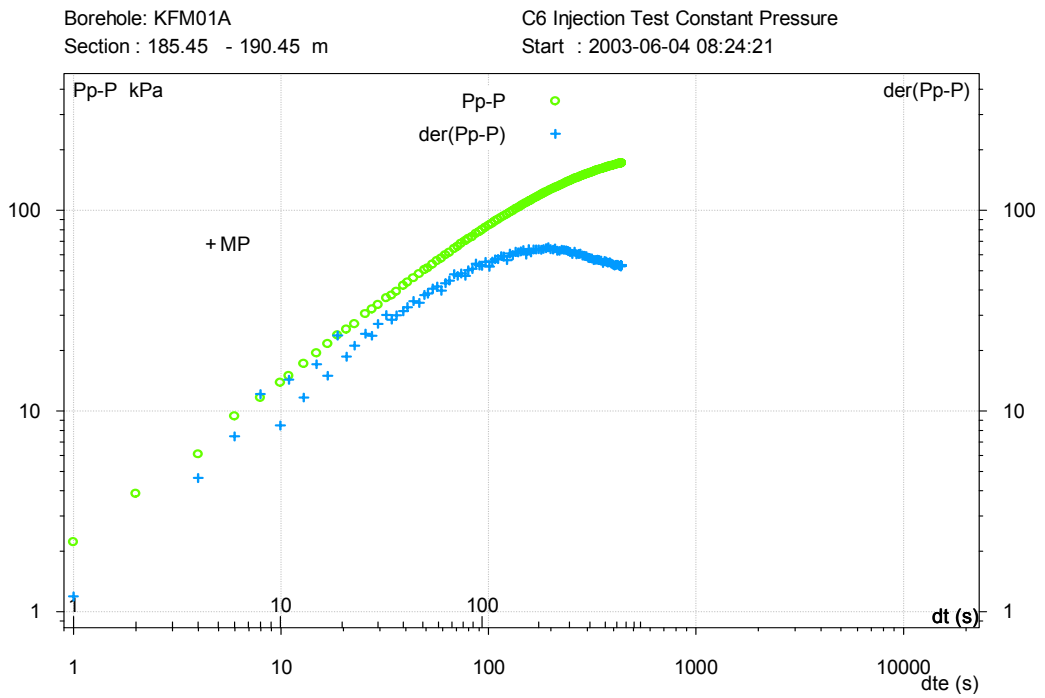


Fig A3-97. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 185.45-190.45 m in KFM01A.

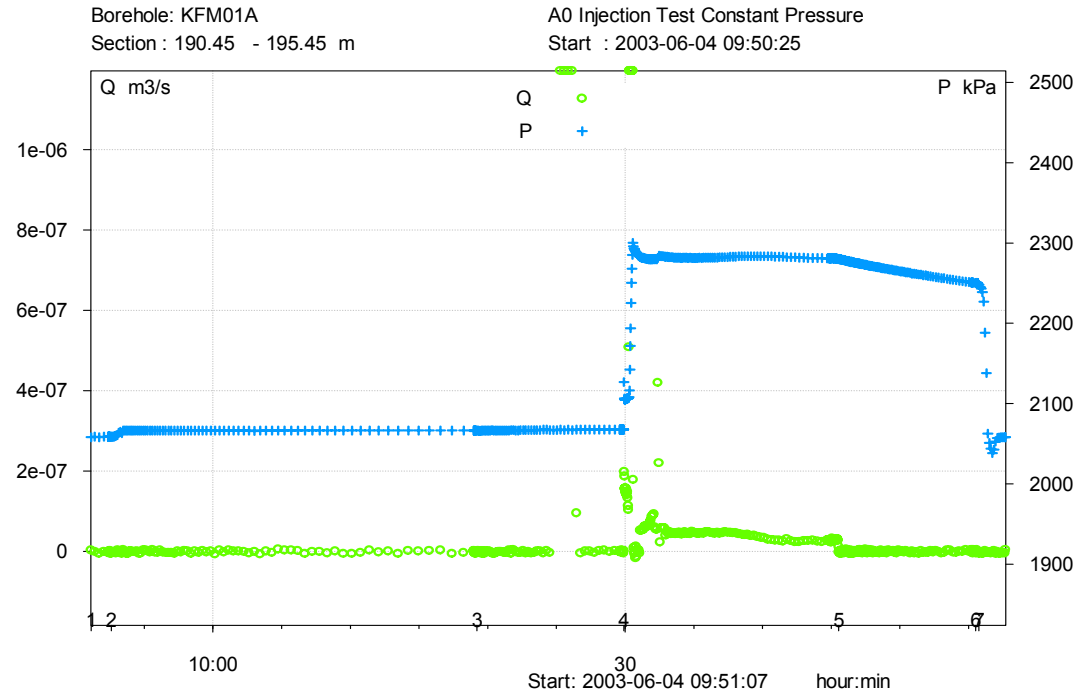


Fig A3-98. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 190.45-195.45 m in borehole KFM01A.

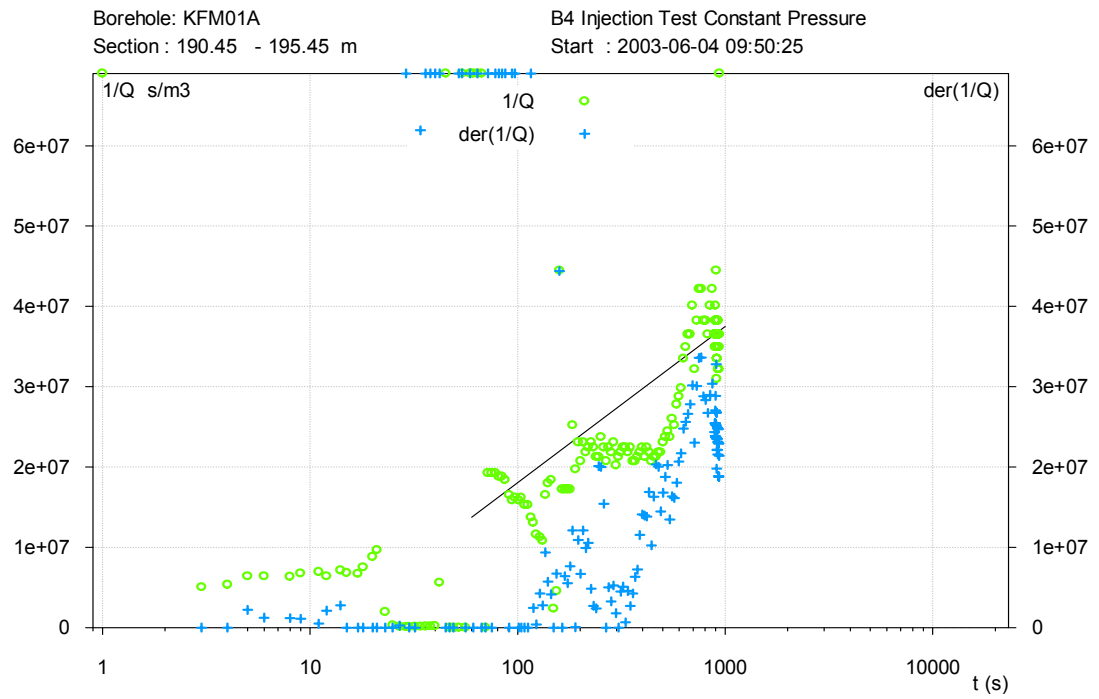


Fig A3-99. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 190.45-195.45 m in KFM01A.

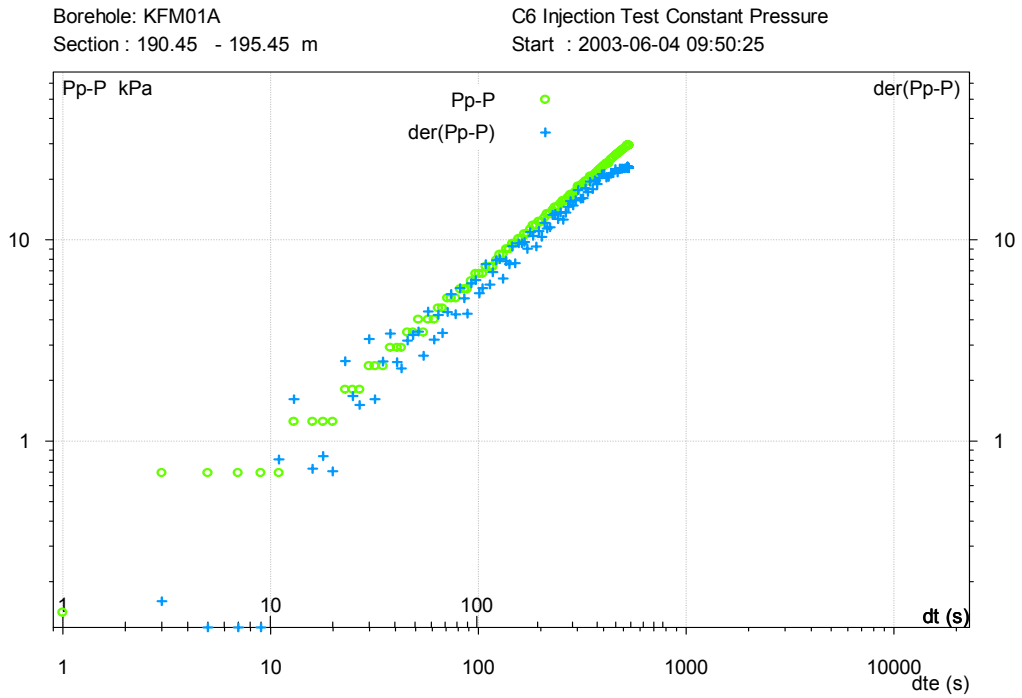


Fig A3-100. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 190.45-195.45 m in KFM01A.

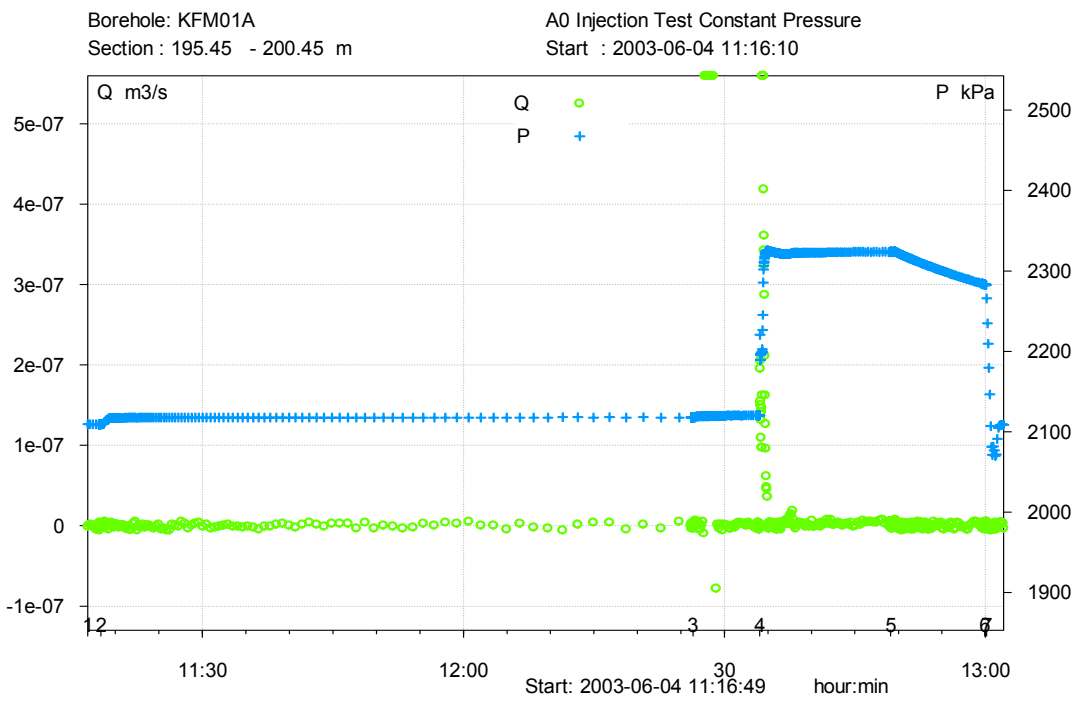


Fig A3-101. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 195.45-200.45 m in borehole KFM01A.

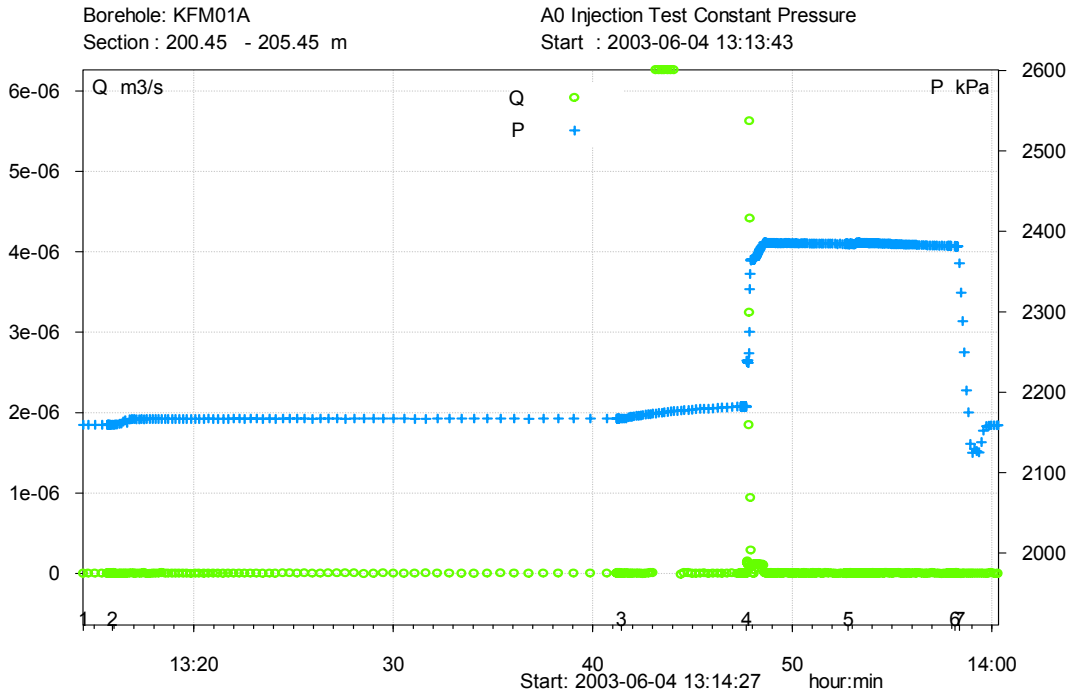


Fig A3-102. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 200.45-205.45 m in borehole KFM01A.

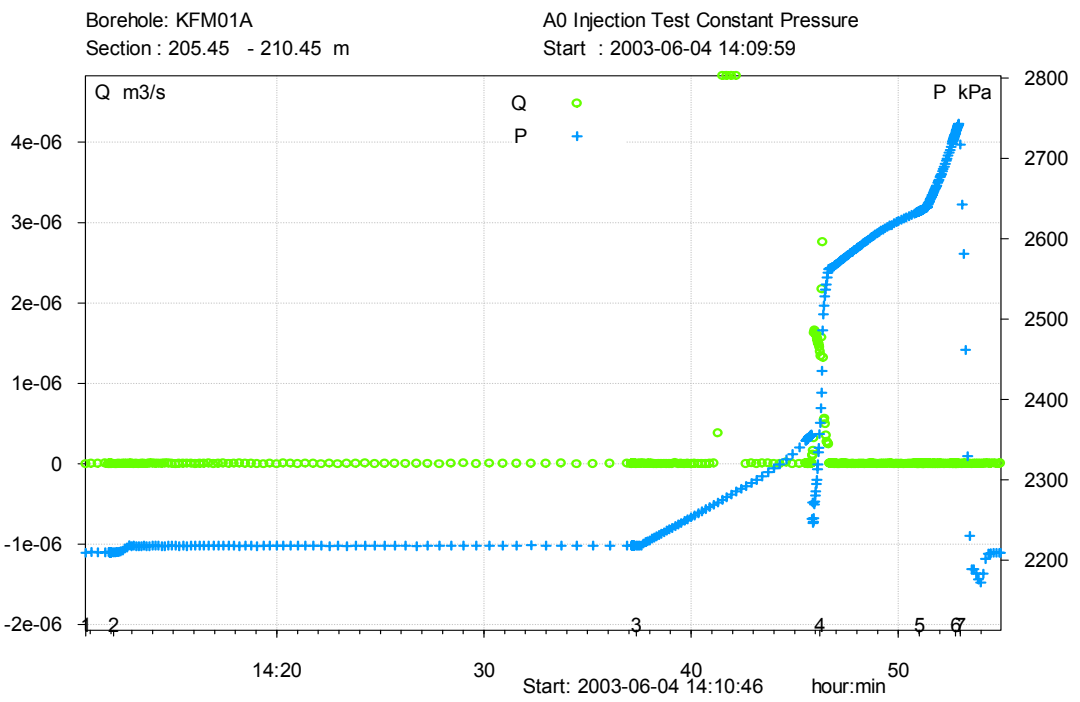


Fig A3-103. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 205.45-210.45 m in borehole KFM01A.

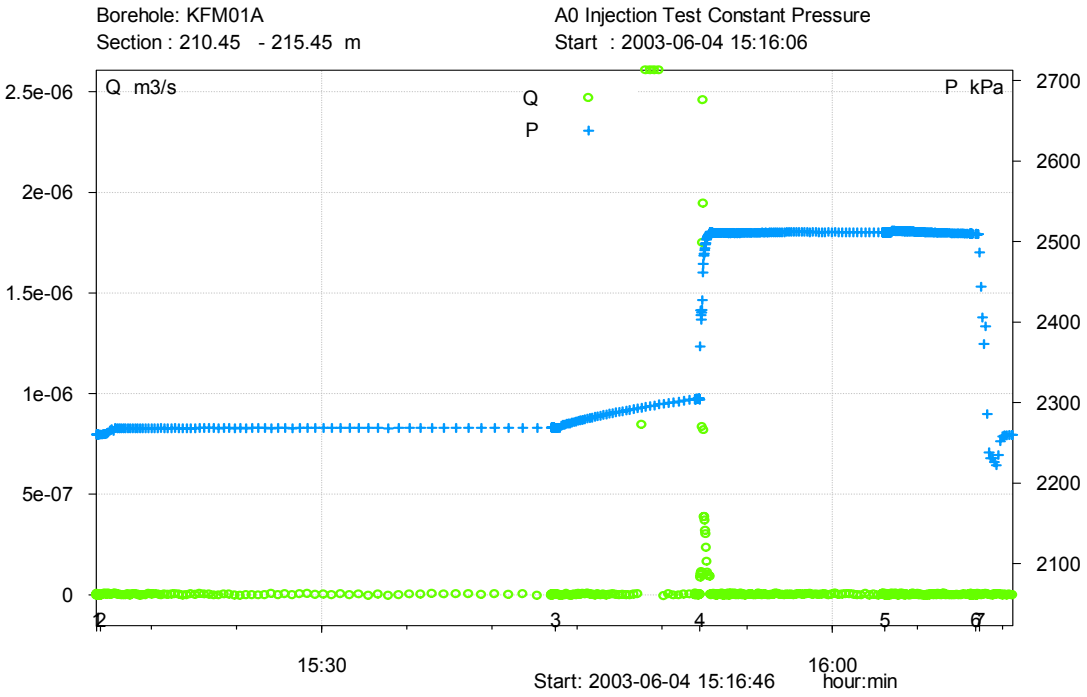


Fig A3-104. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 210.45-215.45 m in borehole KFM01A.

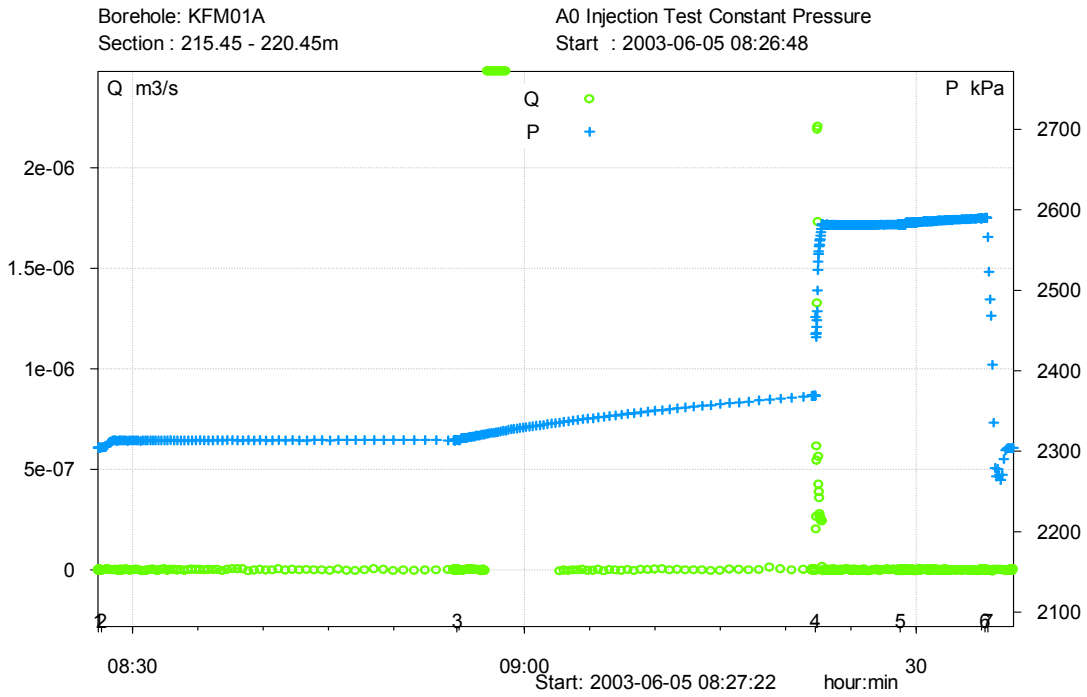


Fig A3-105. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 215.45-220.45 m in borehole KFM01A.

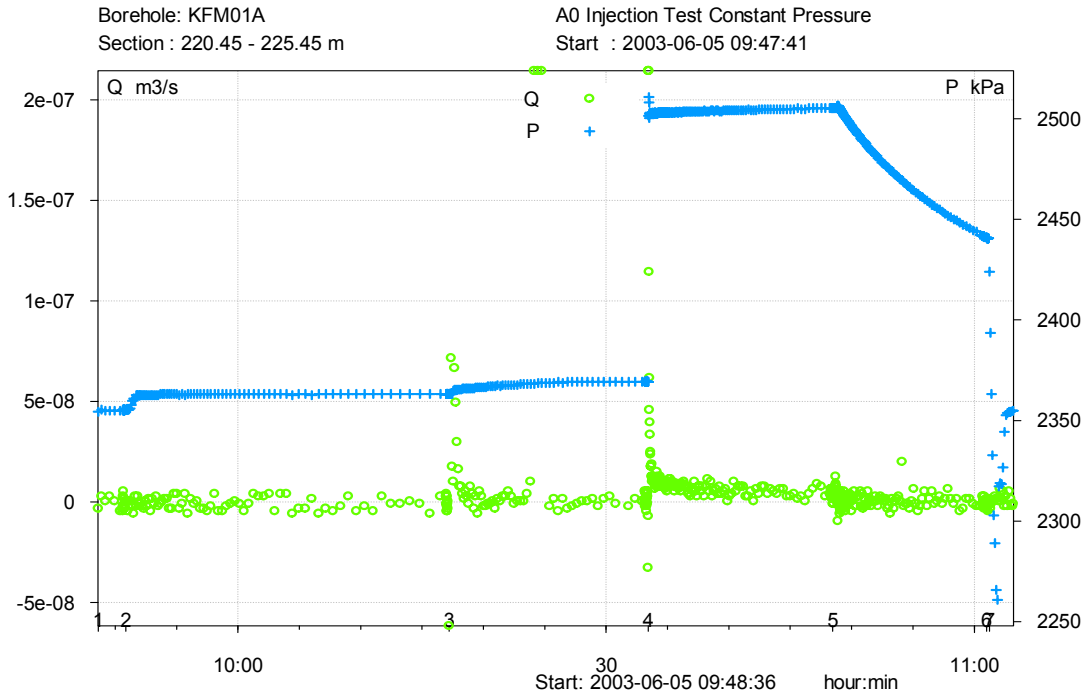


Fig A3-106. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 220.45-225.45 m in borehole KFM01A.

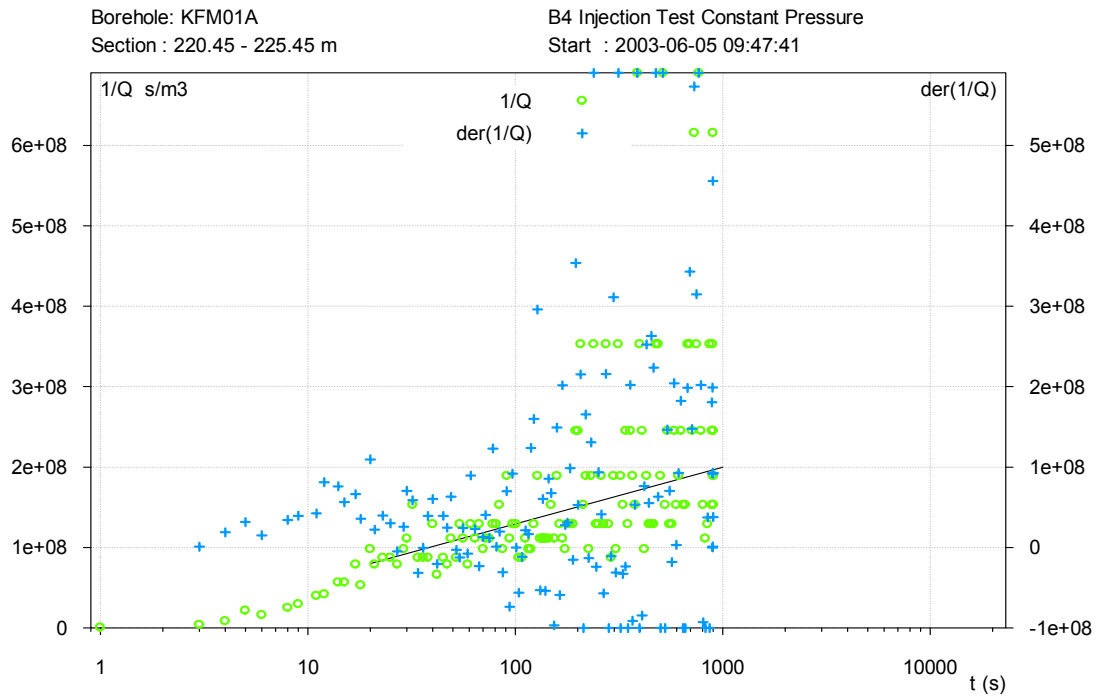


Fig A3-107. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 220.45-225.45 m in KFM01A.

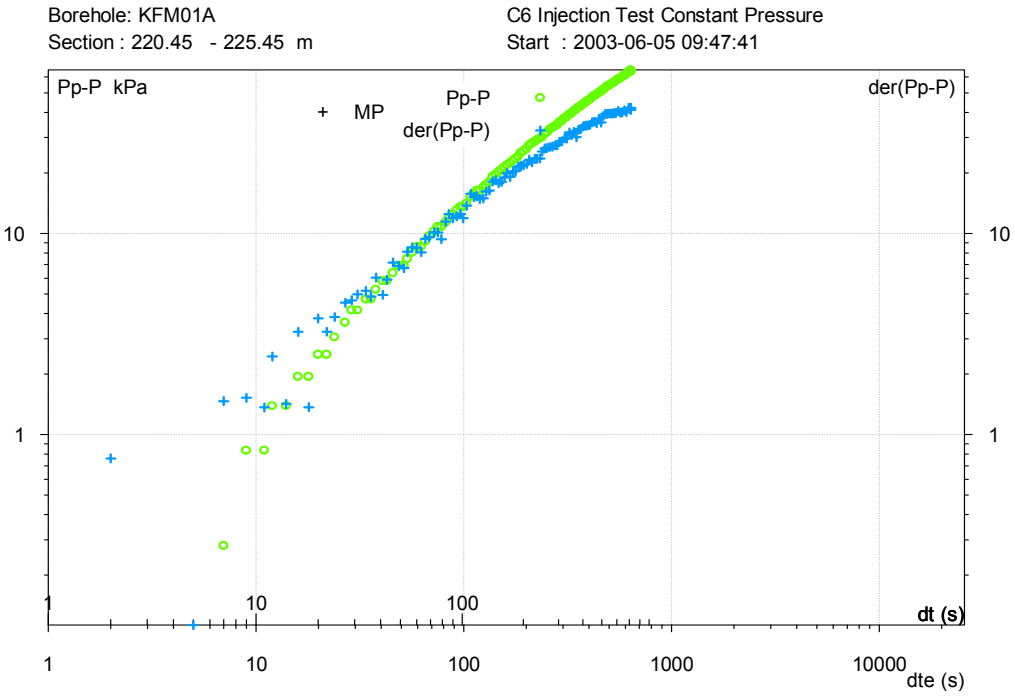


Fig A3-108. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 220.45-225.45 m in KFM01A.

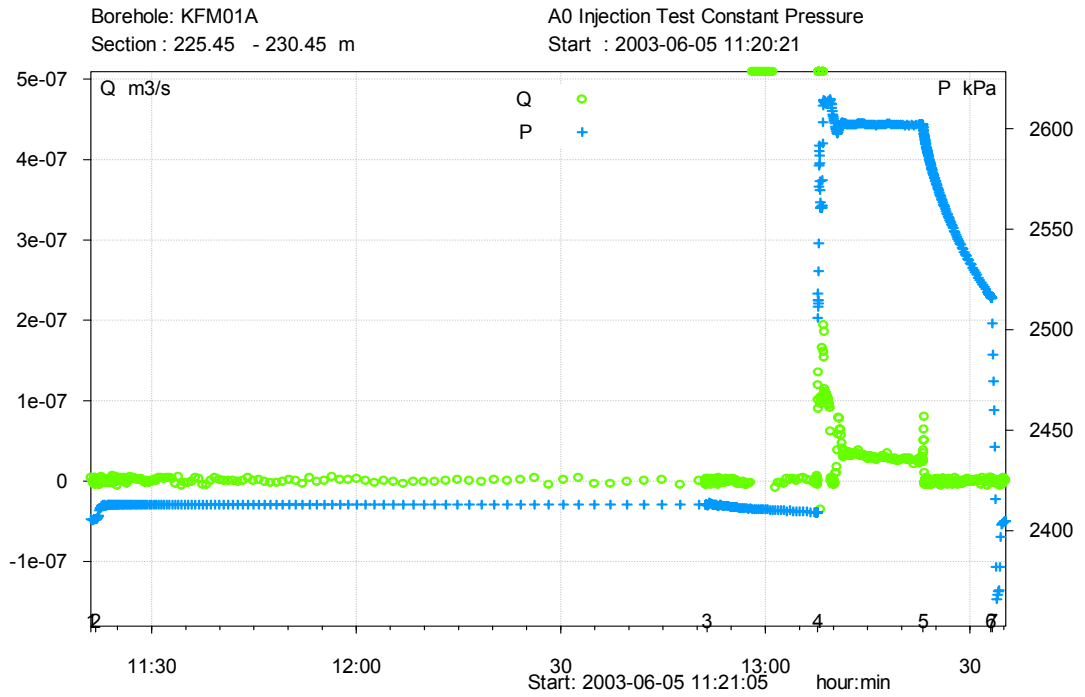


Fig A3-109. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 225.45-230.45 m in borehole KFM01A.

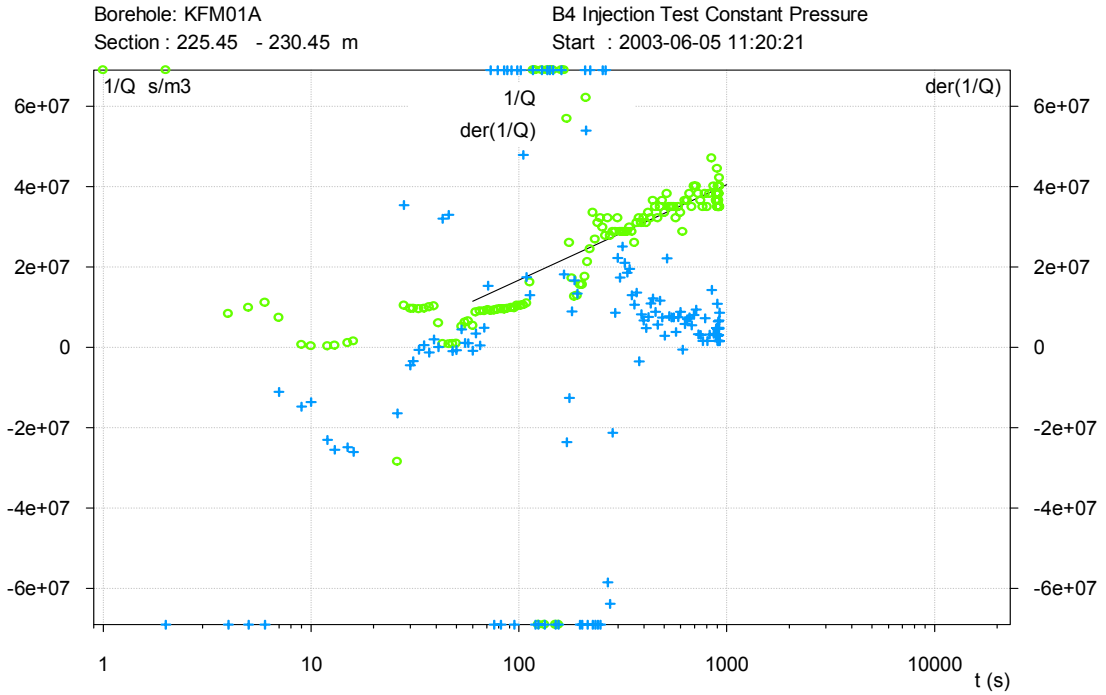


Fig A3-110. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 225.45-230.45 m in KFM01A.

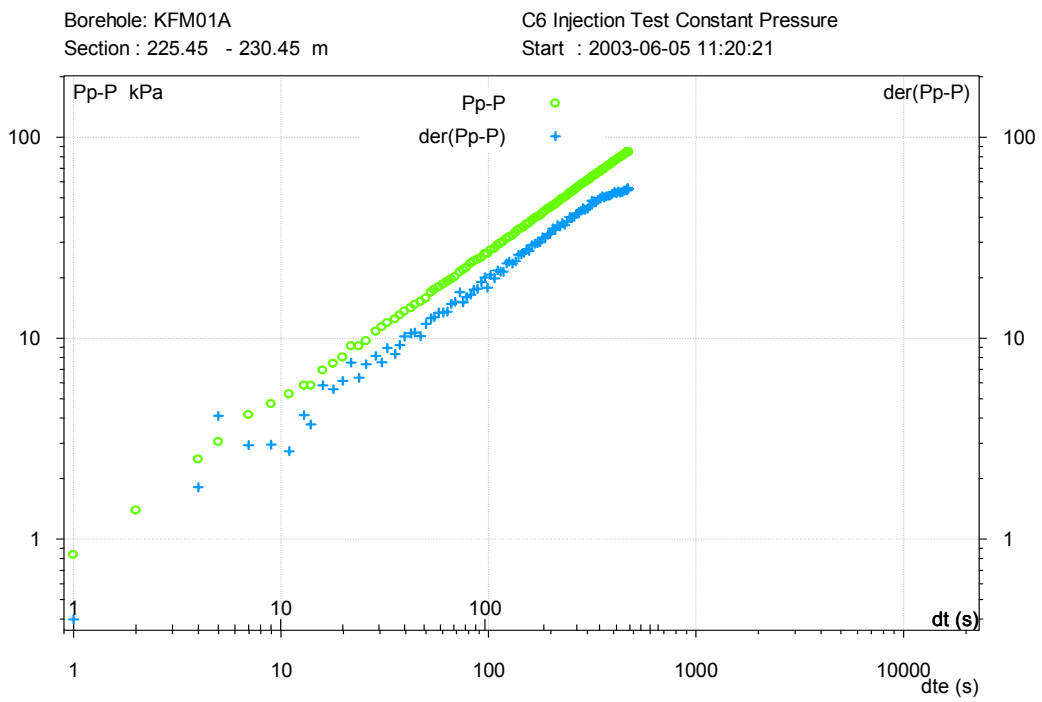


Fig A3-111. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 225.45-230.45 m in KFM01A.

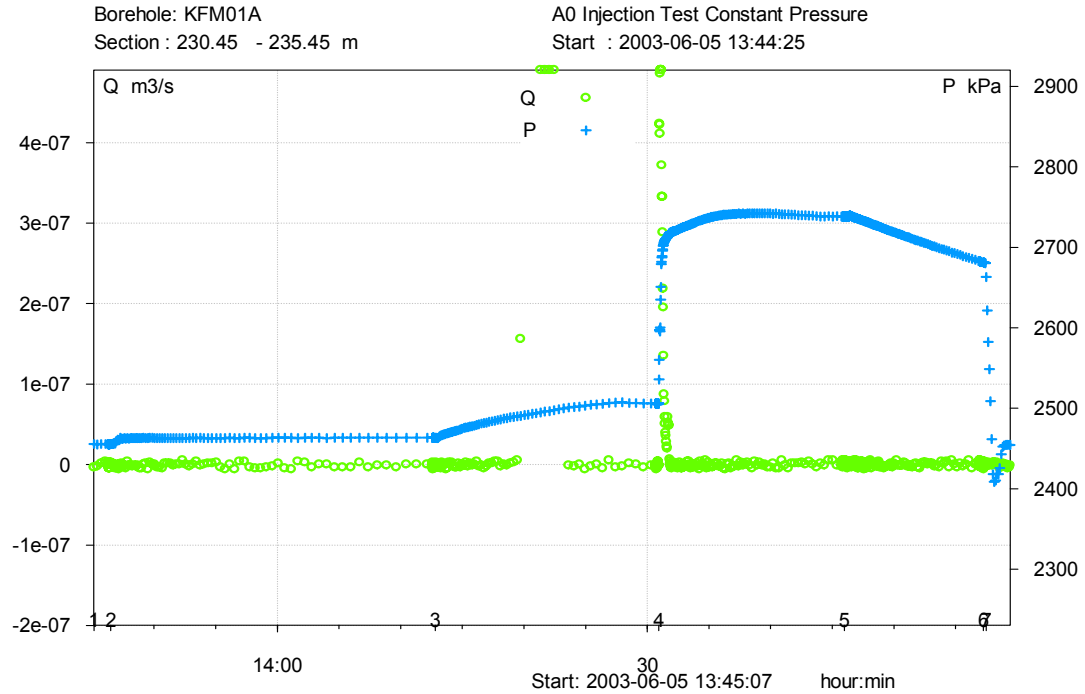


Fig A3-112. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 230.45-235.45 m in borehole KFM01A.

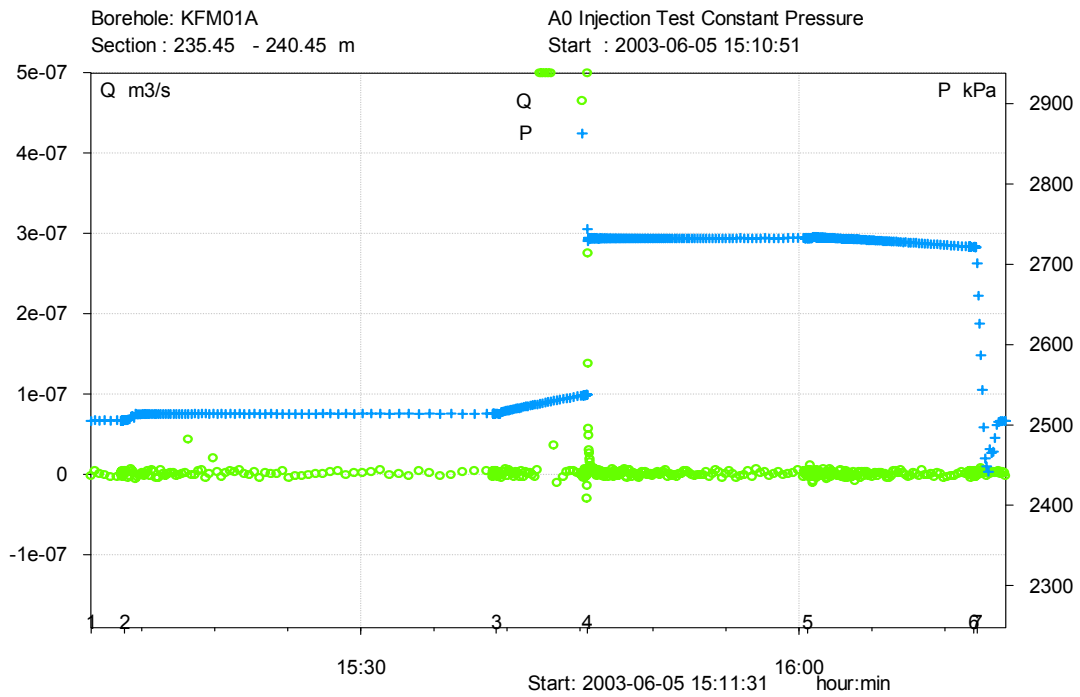


Fig A3-113. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 235.45-240.45 m in borehole KFM01A.

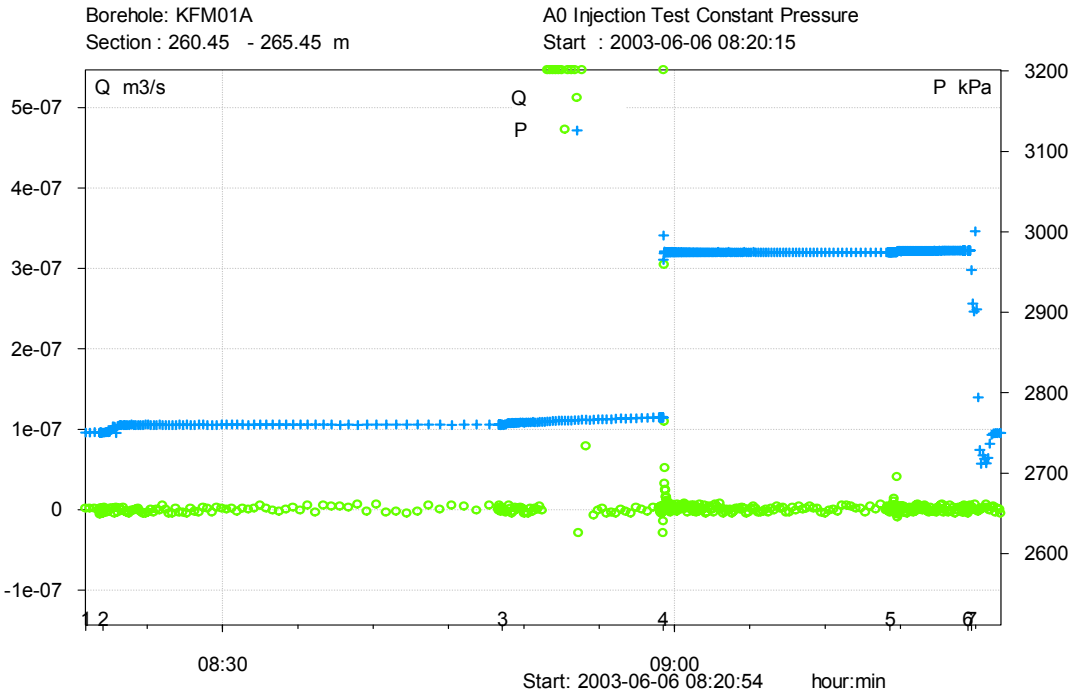


Fig A3-114. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 260.45-265.45 m in borehole KFM01A.

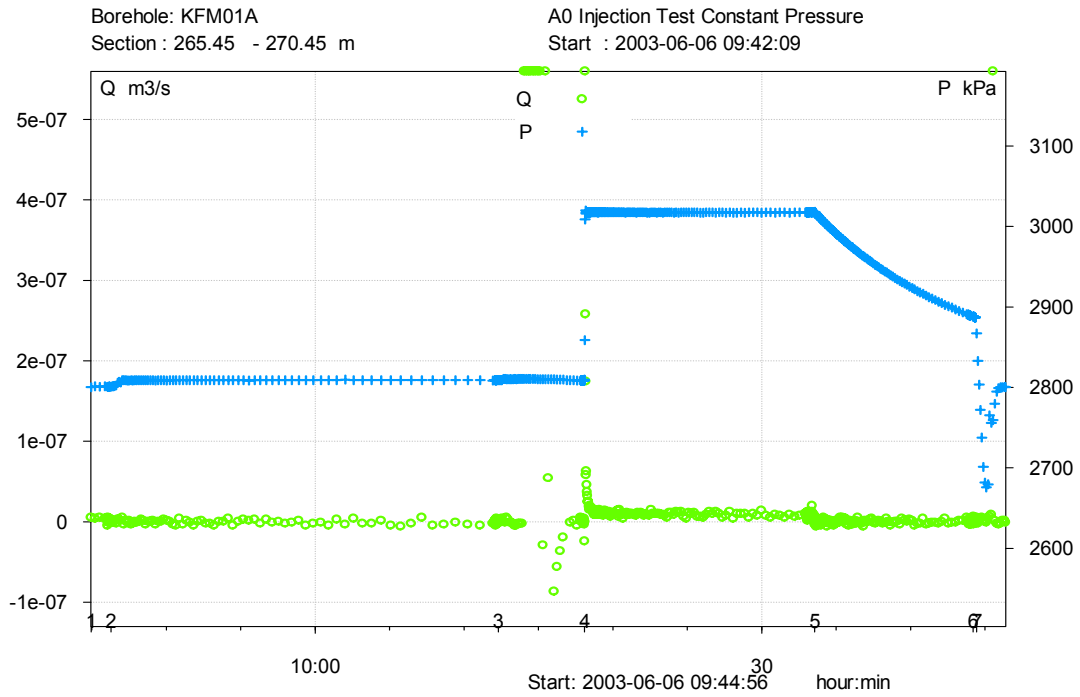


Fig A3-115. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 265.45-270.45 m in borehole KFM01A.

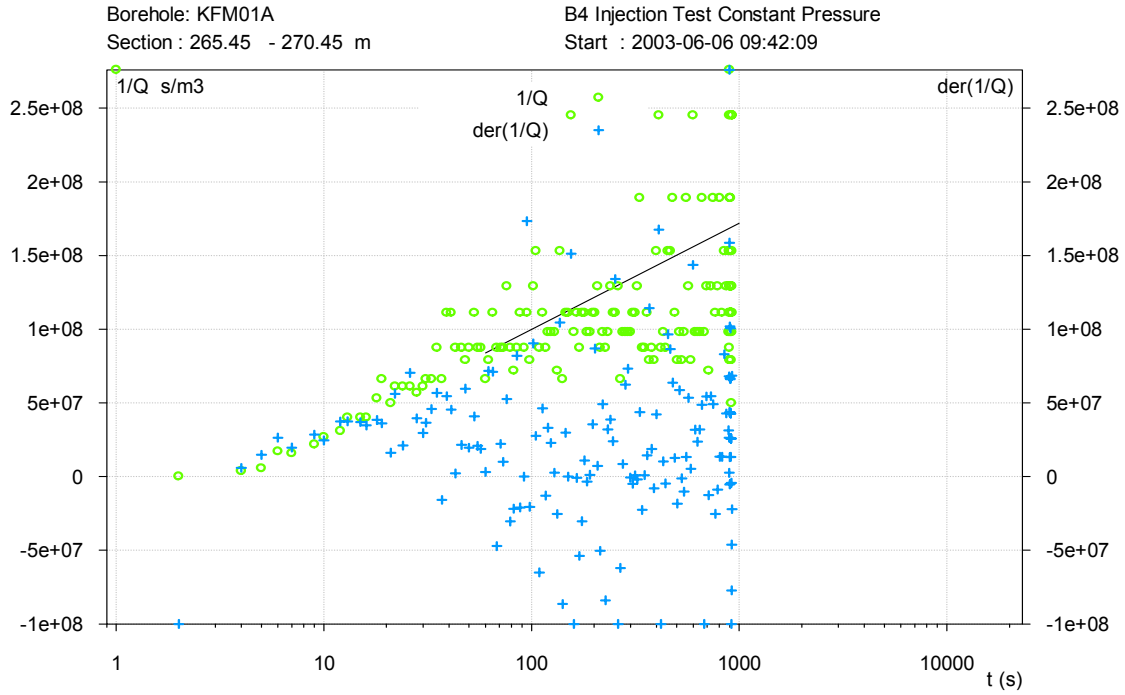


Fig A3-116. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 265.45-270.45 m in KFM01A.

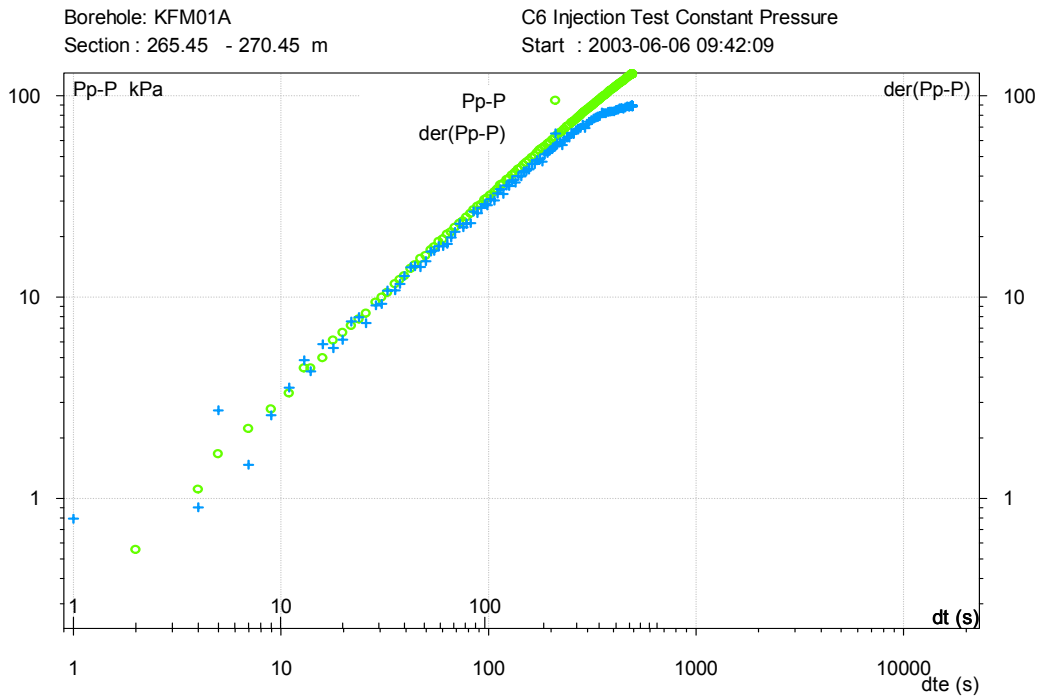


Fig A3-117. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 265.45-270.45 m in KFM01A.

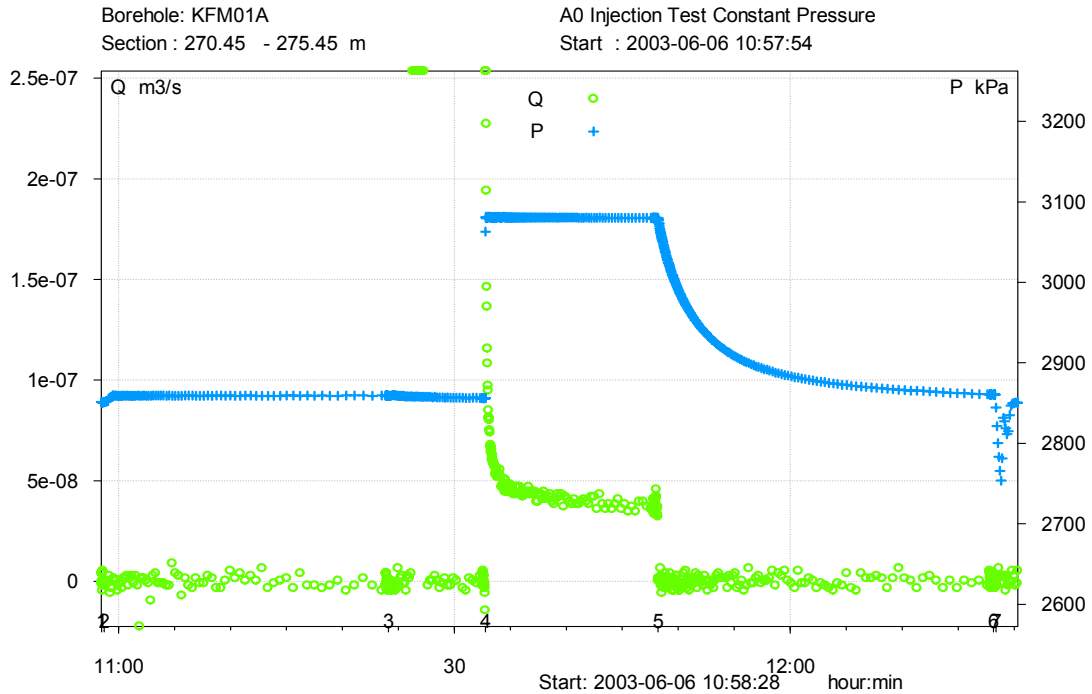


Fig A3-118. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 270.45-275.45 m in borehole KFM01A.

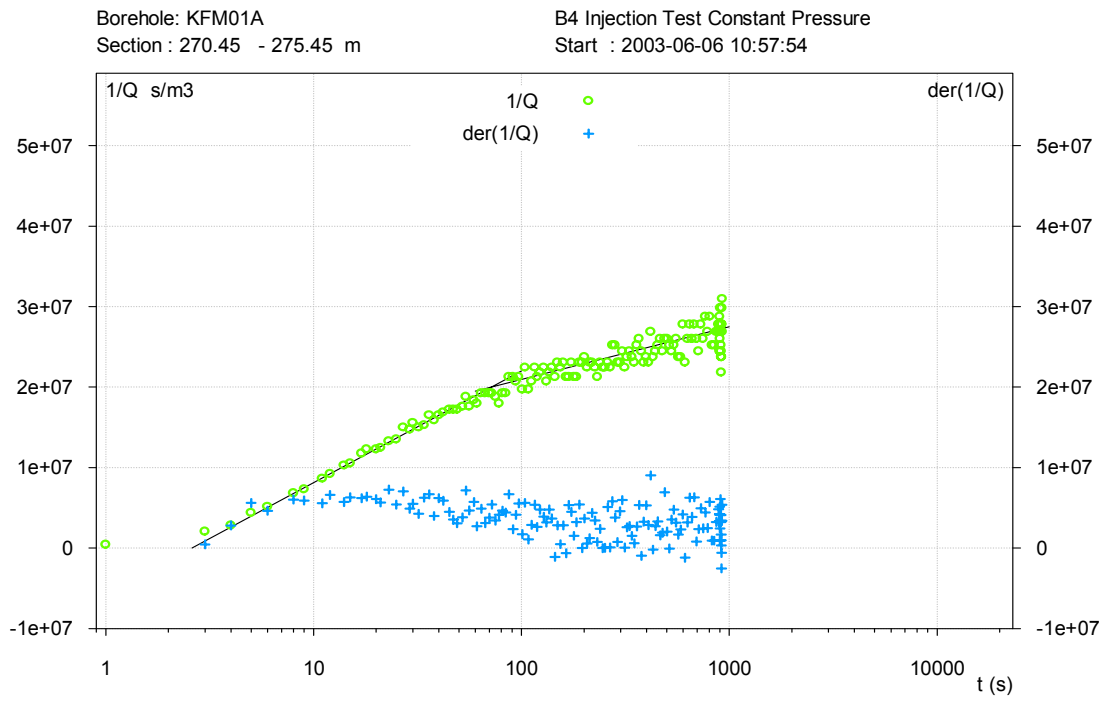


Fig A3-119. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 270.45-275.45 m in KFM01A.

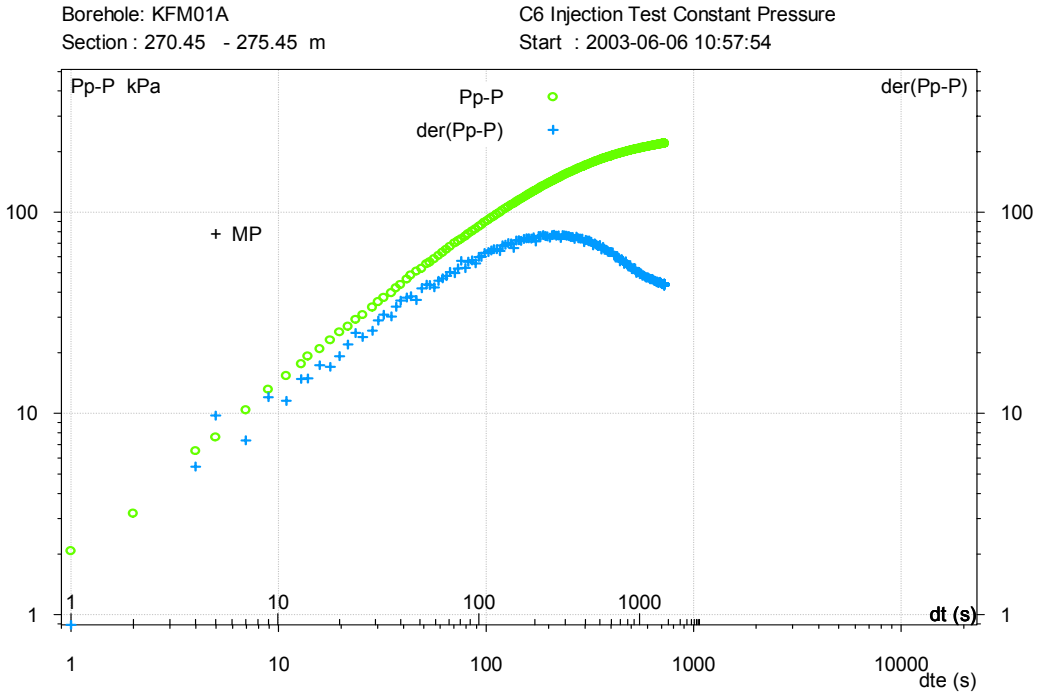


Fig A3-120. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 270.45-275.45 m in KFM01A.

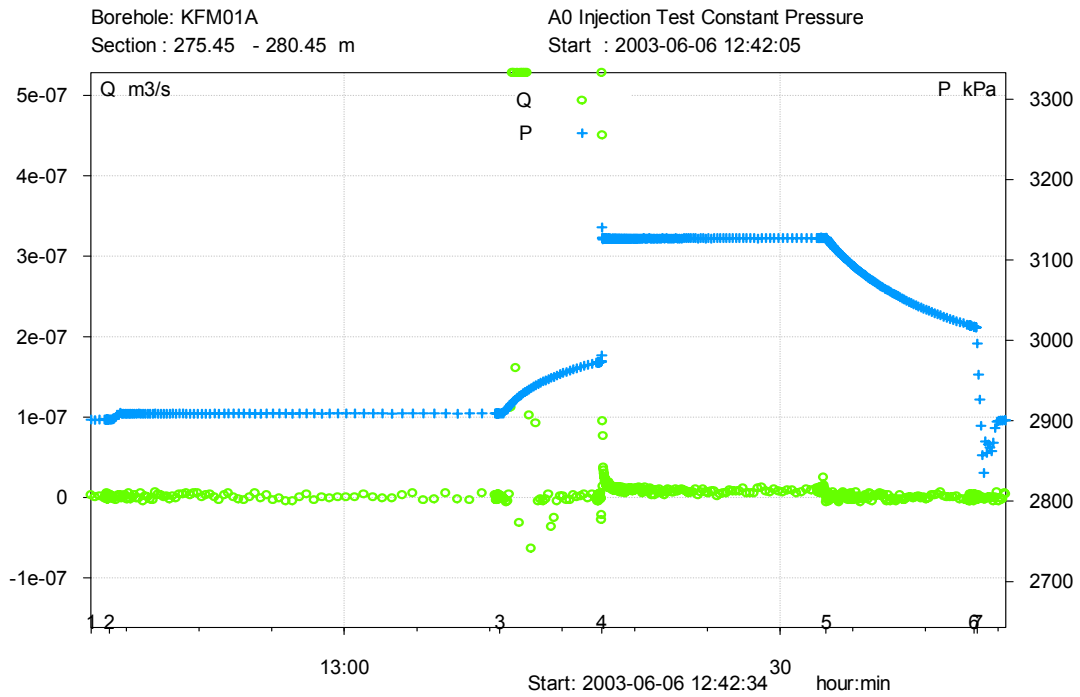


Fig A3-121. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 275.45-280.45 m in borehole KFM01A.

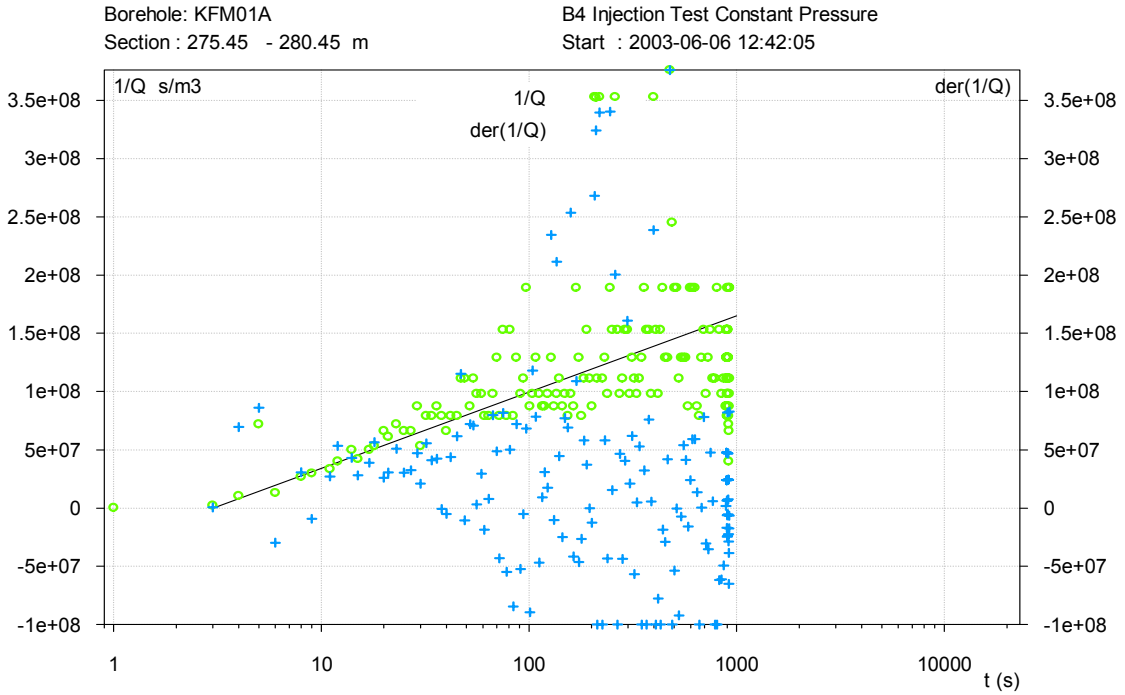


Fig A3-122. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 275.45-280.45 m in KFM01A.

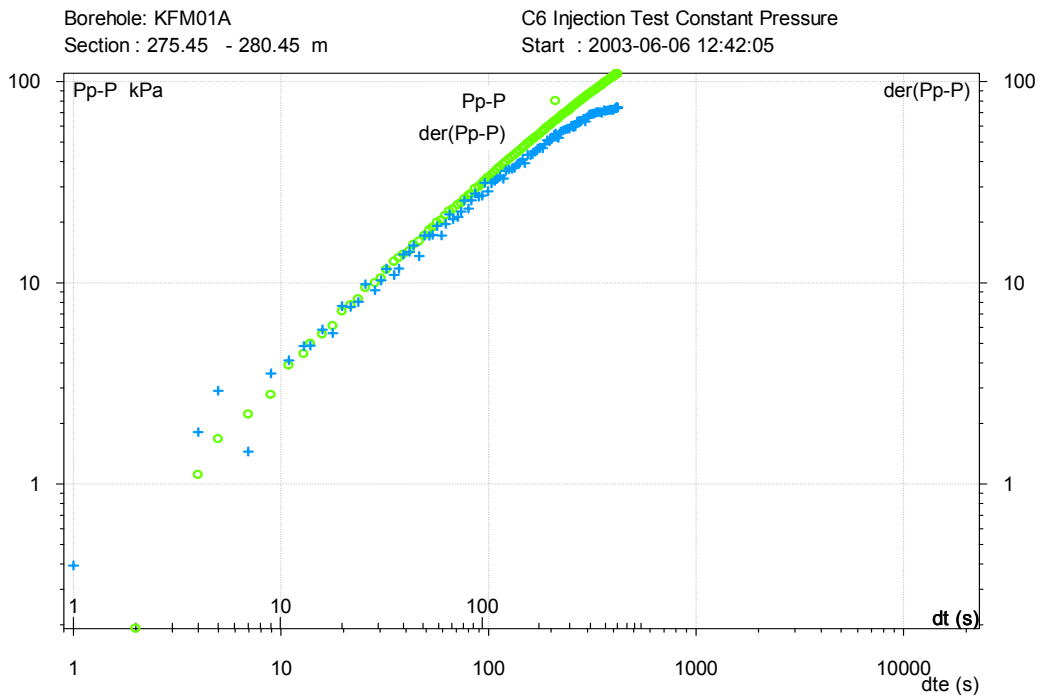


Fig A3-123. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 275.45-280.45 m in KFM01A.

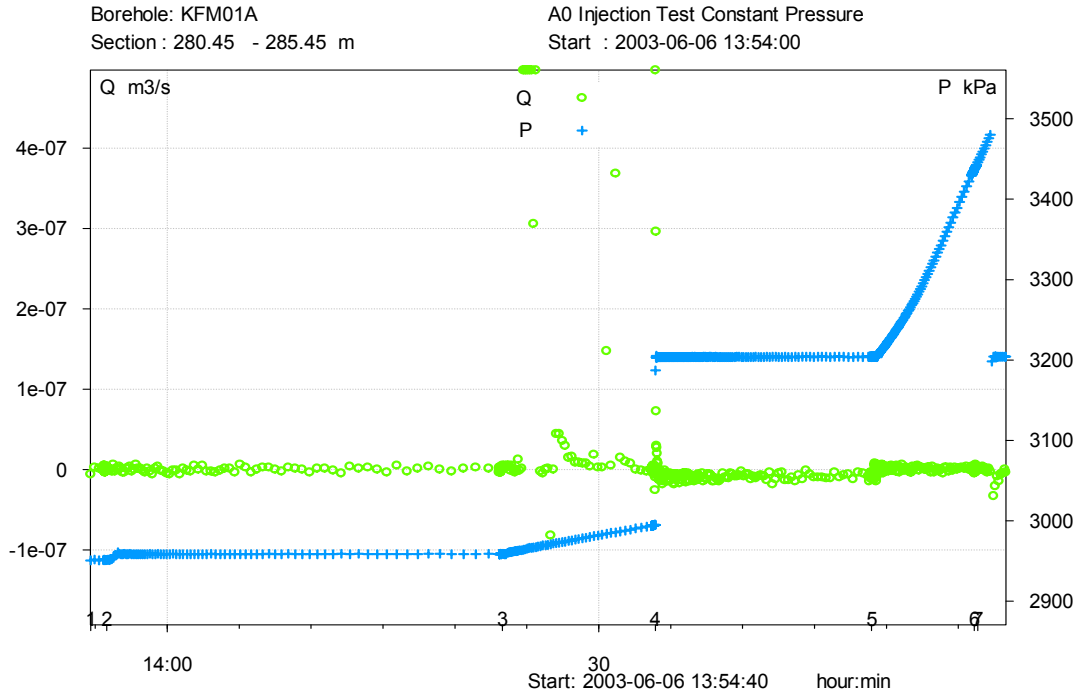


Fig A3-124. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 280.45-285.45 m in borehole KFM01A.

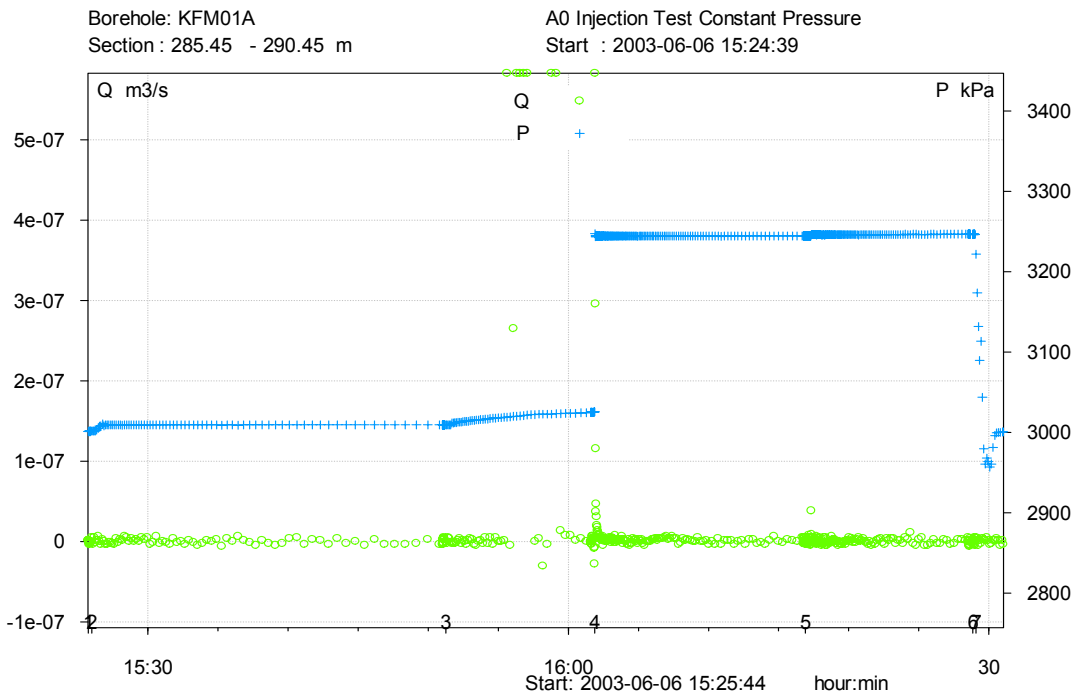


Fig A3-125. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 285.45-290.45 m in borehole KFM01A.

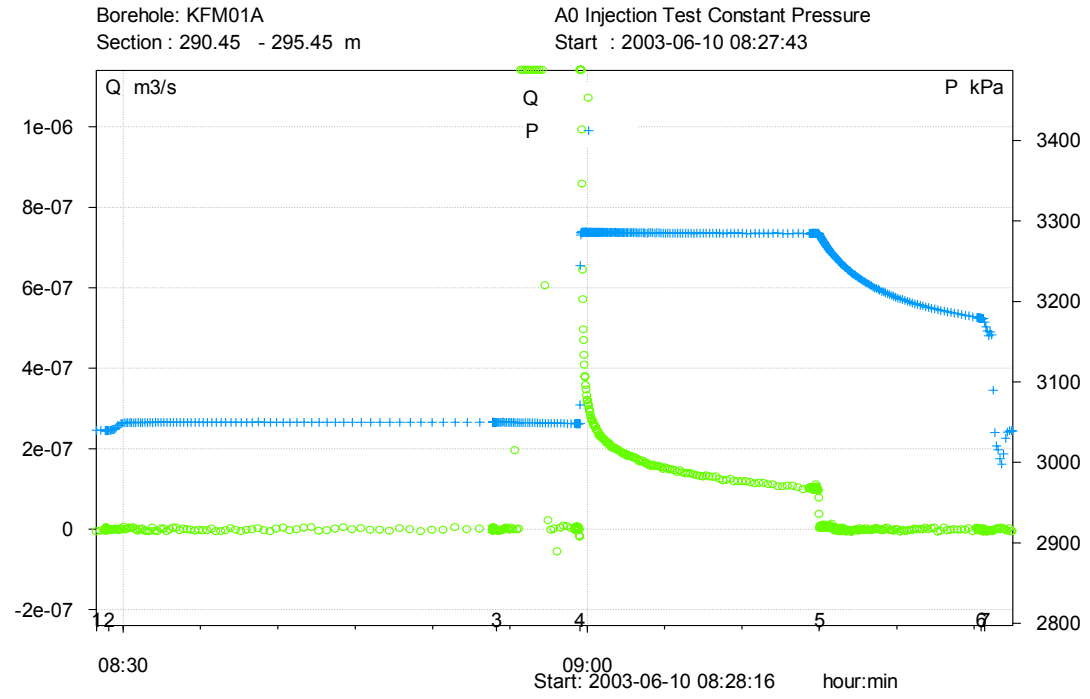


Fig A3-126. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 290.45-295.45 m in borehole KFM01A.

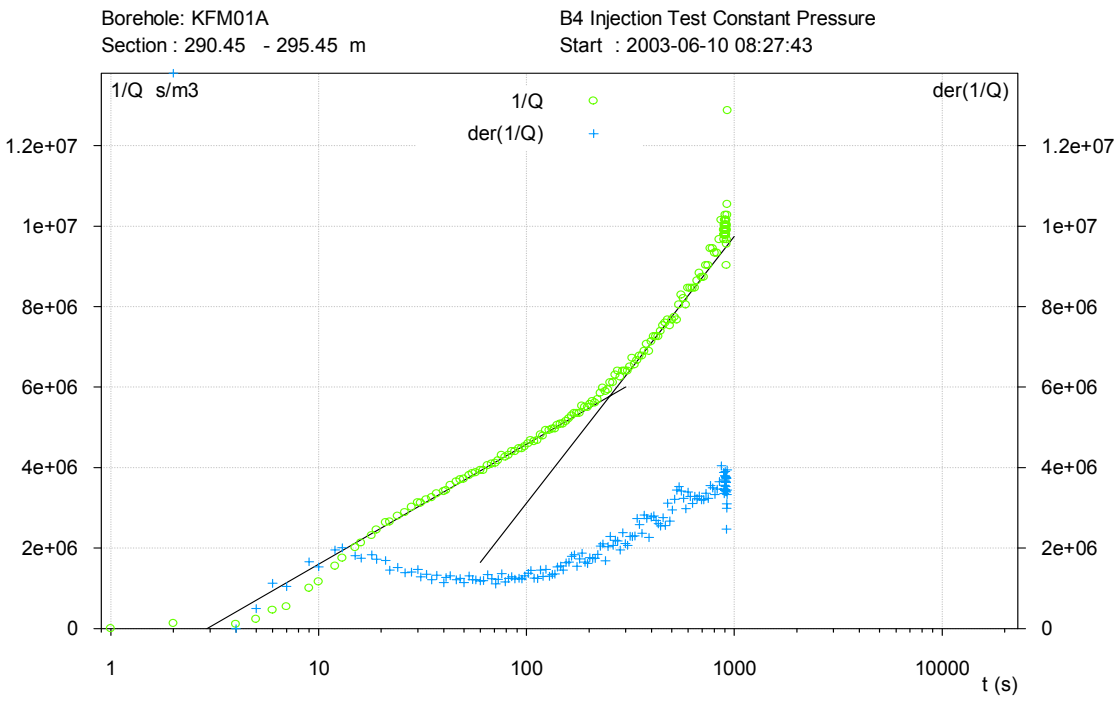


Fig A3-127. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 290.45-295.45 m in KFM01A.

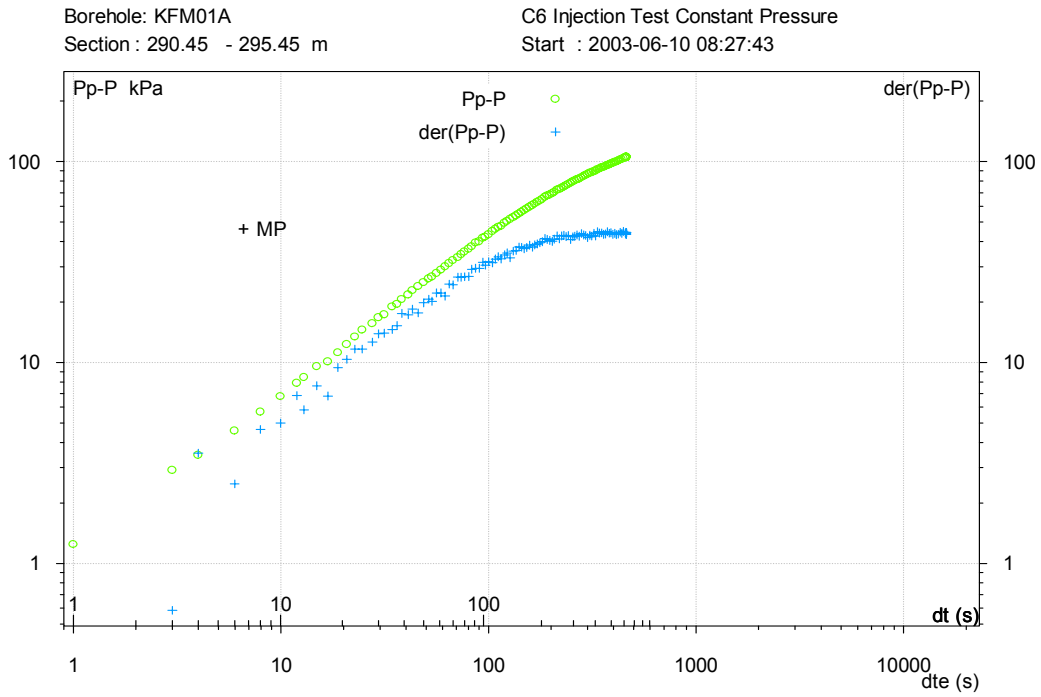


Fig A3-128. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 290.45-295.45 m in KFM01A.

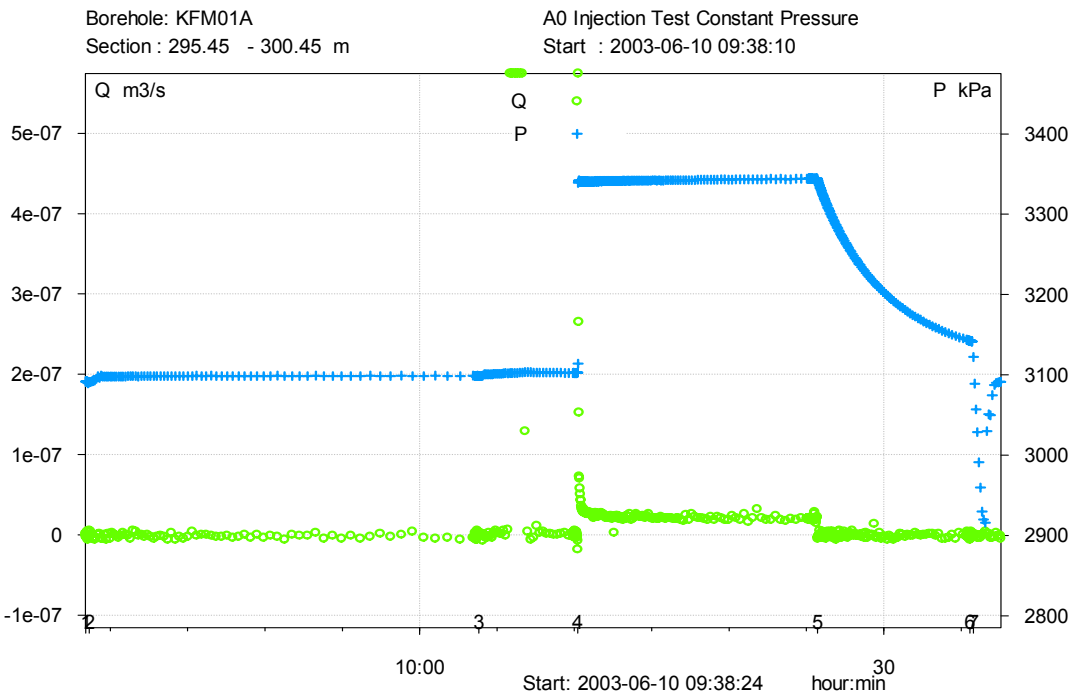


Fig A3-129. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 295.45-300.45 m in borehole KFM01A.

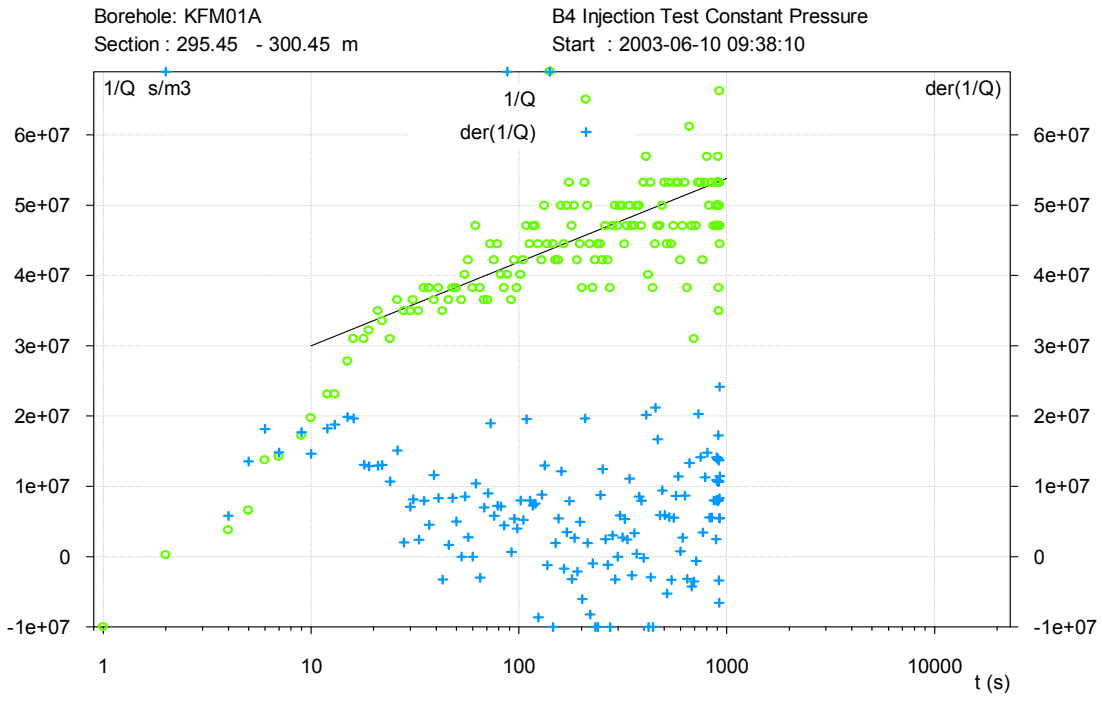


Fig A3-130. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 295.45-300.45 m in KFM01A.

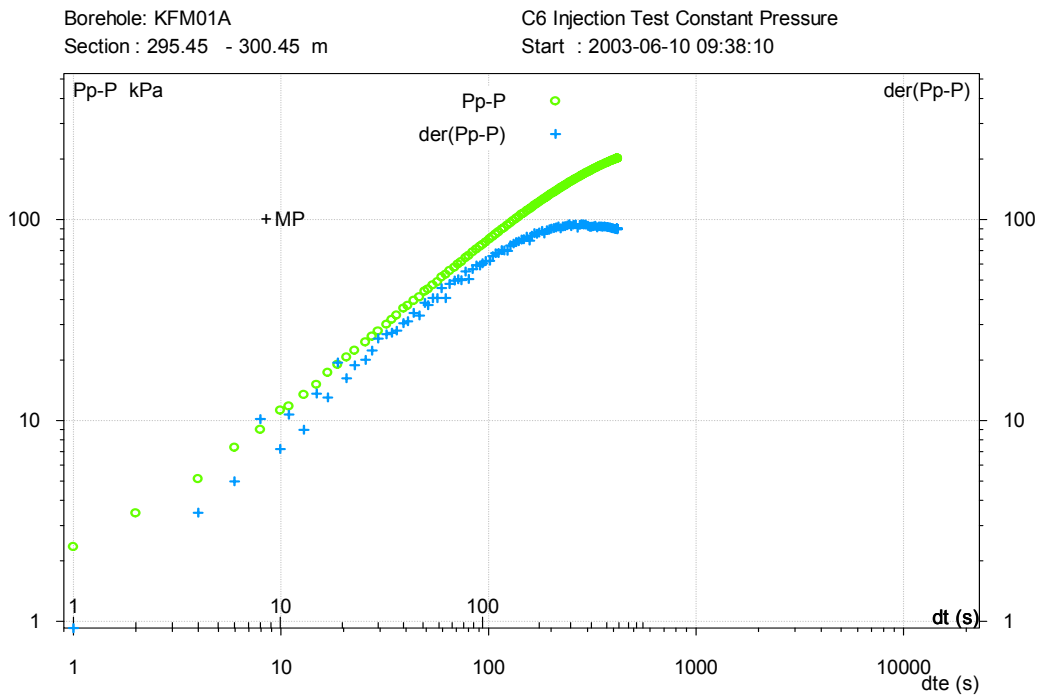


Fig A3-131. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 295.45-300.45 m in KFM01A.

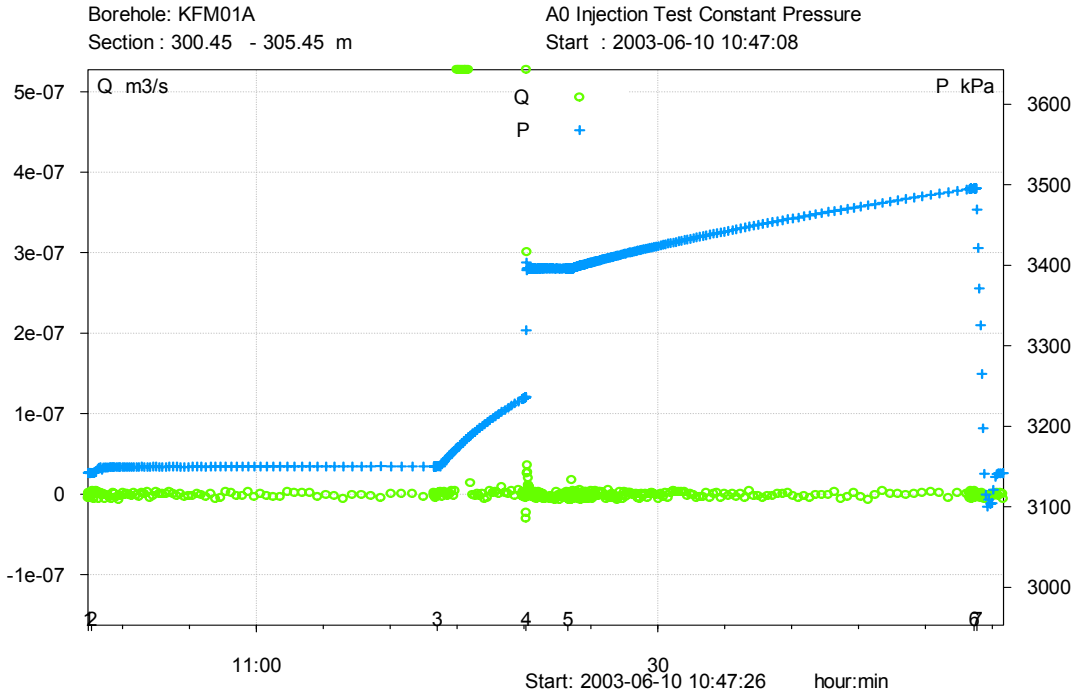


Fig A3-132. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 300.45-305.45 m in borehole KFM01A.

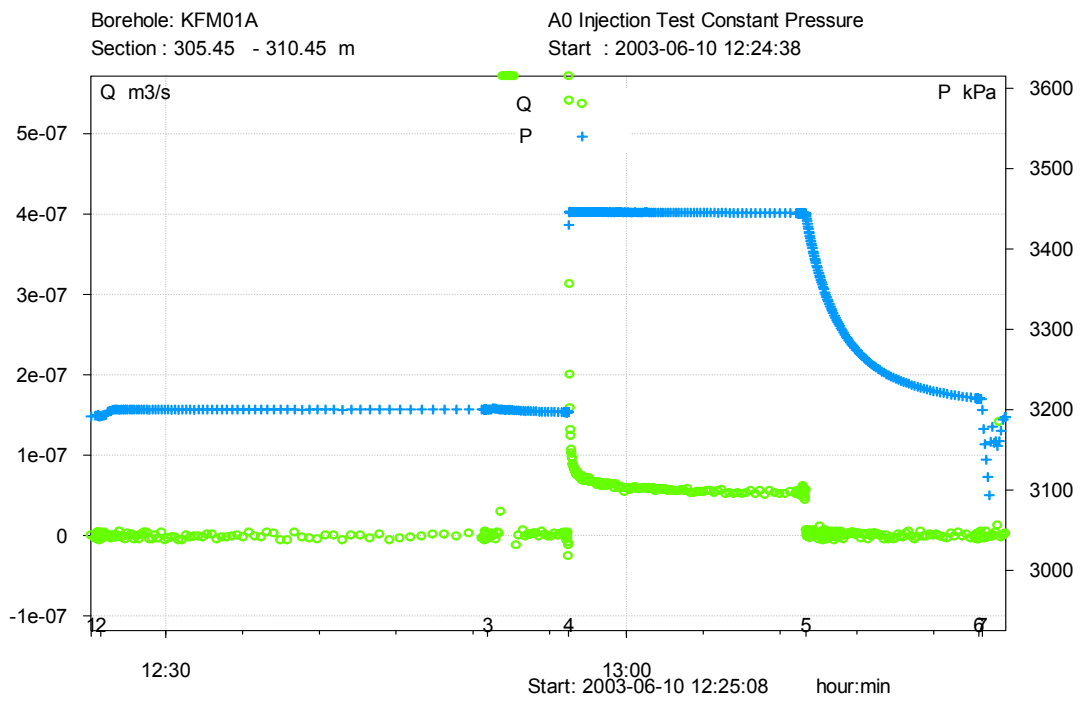


Fig A3-133. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 305.45-310.45 m in borehole KFM01A.

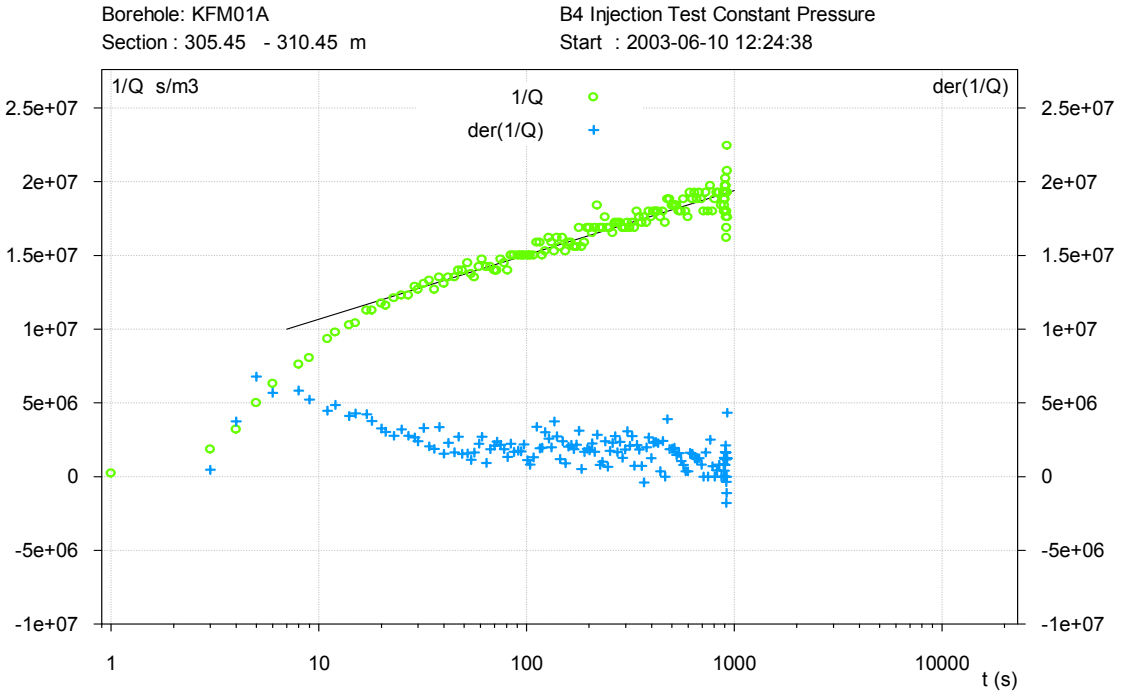


Fig A3-134. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 305.45-310.45 m in KFM01A.

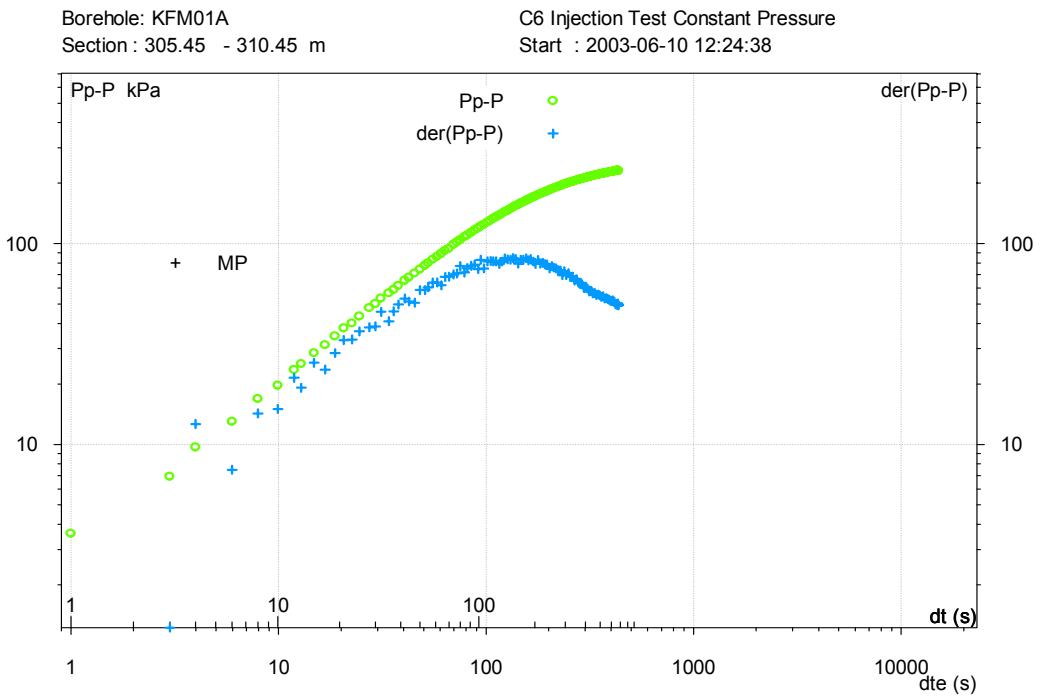


Fig A3-135. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 305.45-310.45 m in KFM01A.

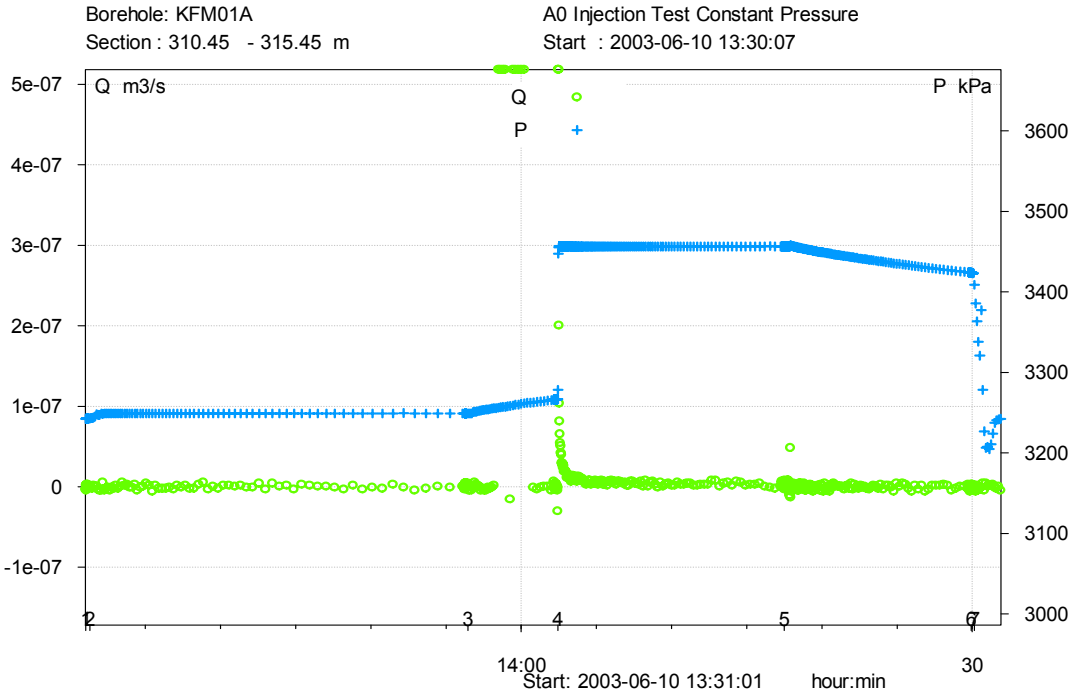


Fig A3-136. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 310.45-315.45 m in borehole KFM01A.

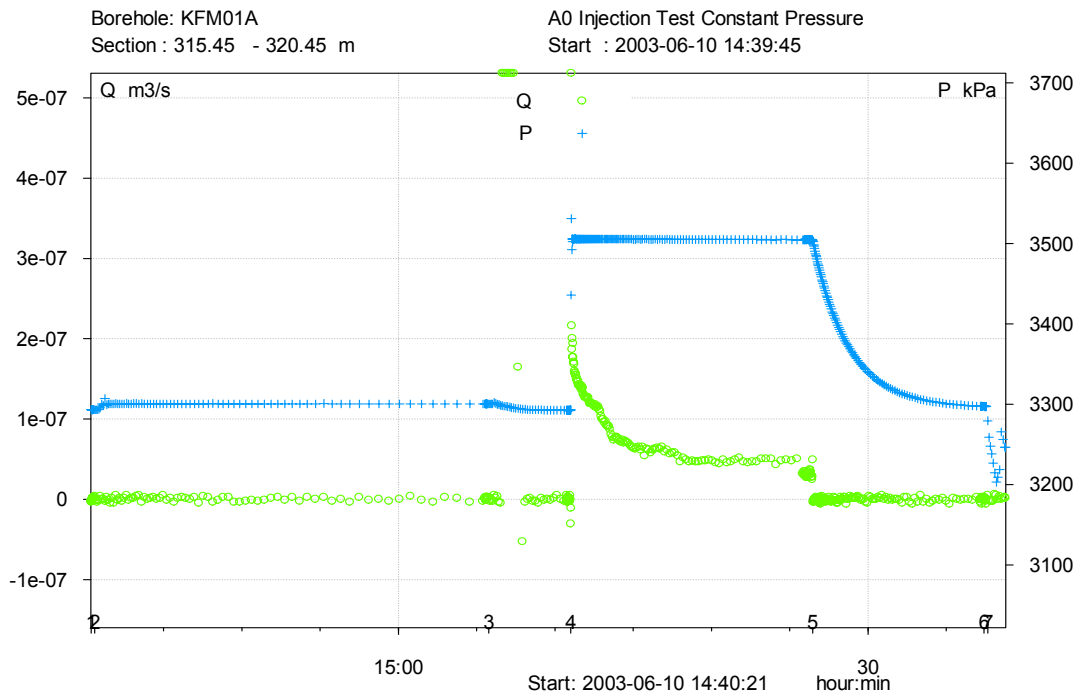


Fig A3-137. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 315.45-320.45 m in borehole KFM01A.

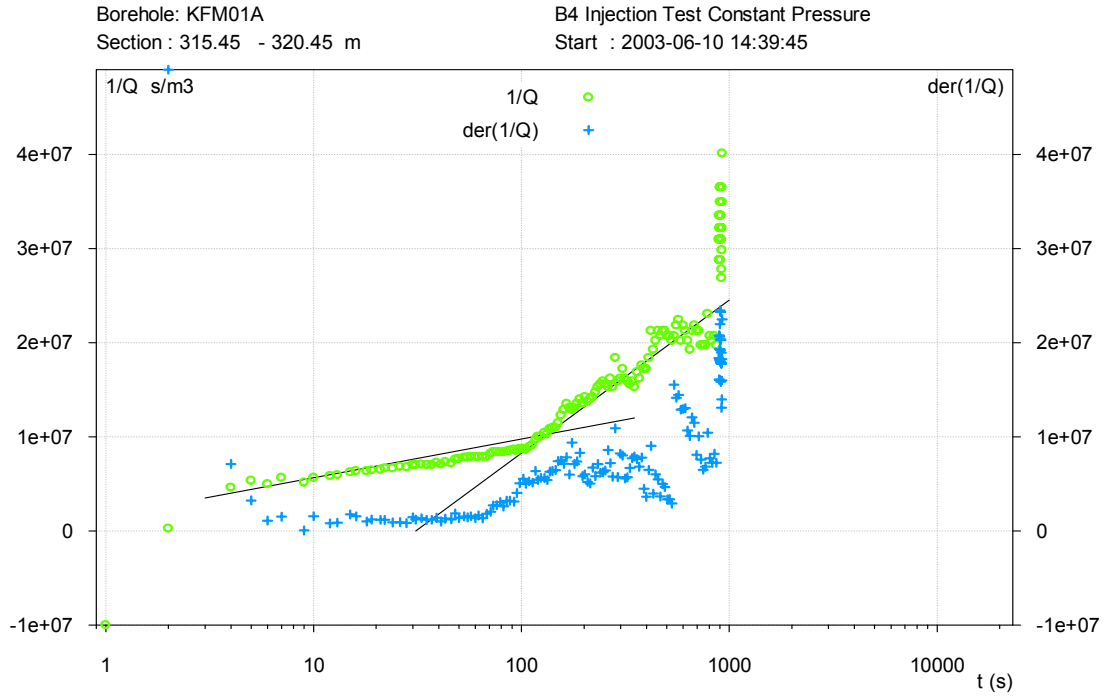


Fig A3-138. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 315.45-320.45 m in KFM01A.

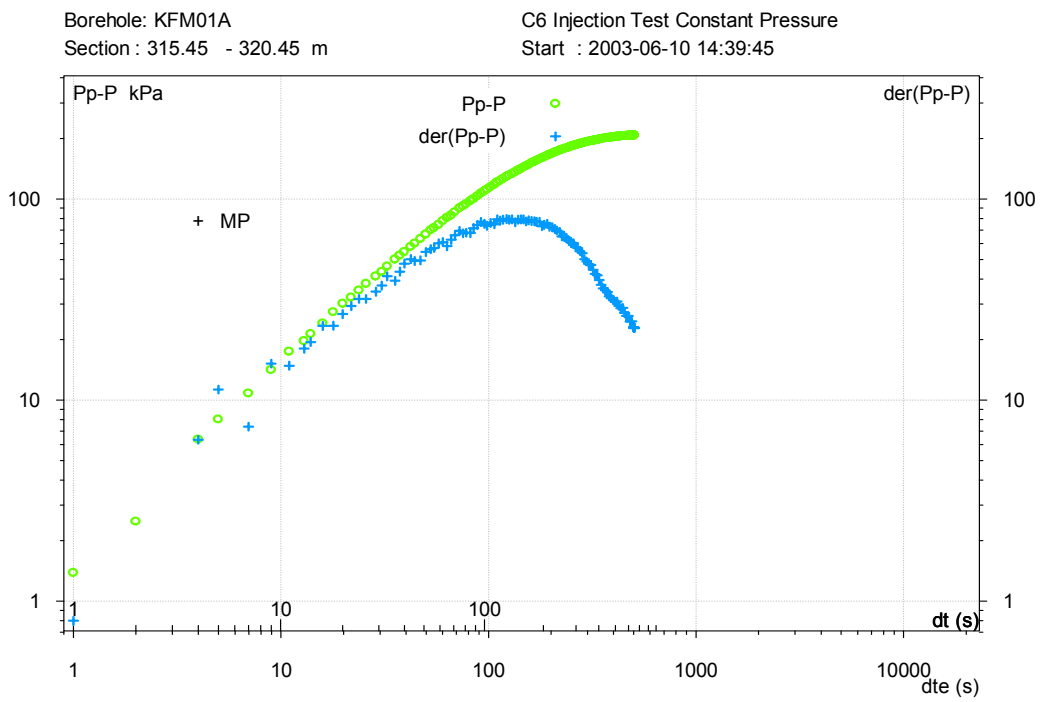


Fig A3-139. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 315.45-320.45 m in KFM01A.

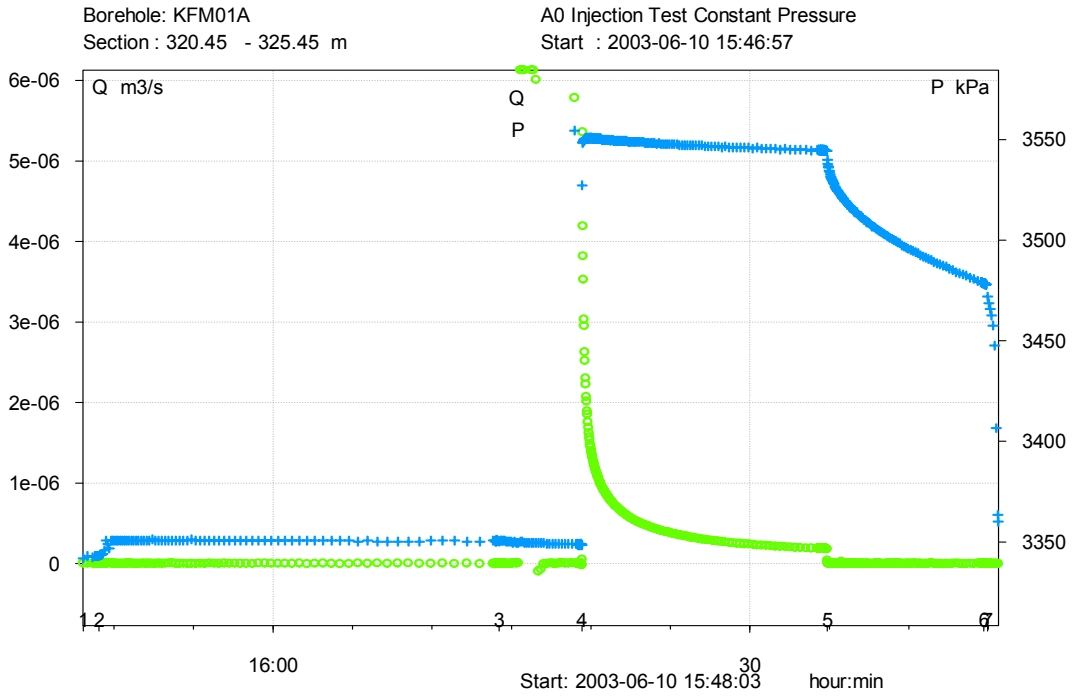


Fig A3-140. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 320.45-325.45 m in borehole KFM01A.

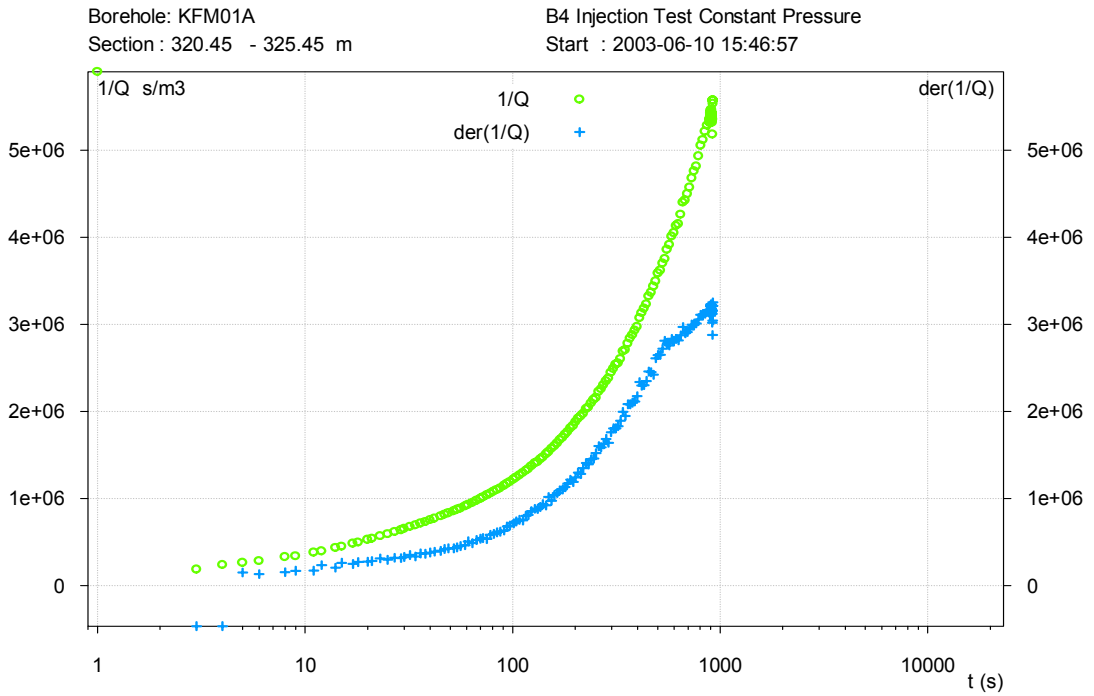


Fig A3-141. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 320.45-325.45 m in KFM01A.

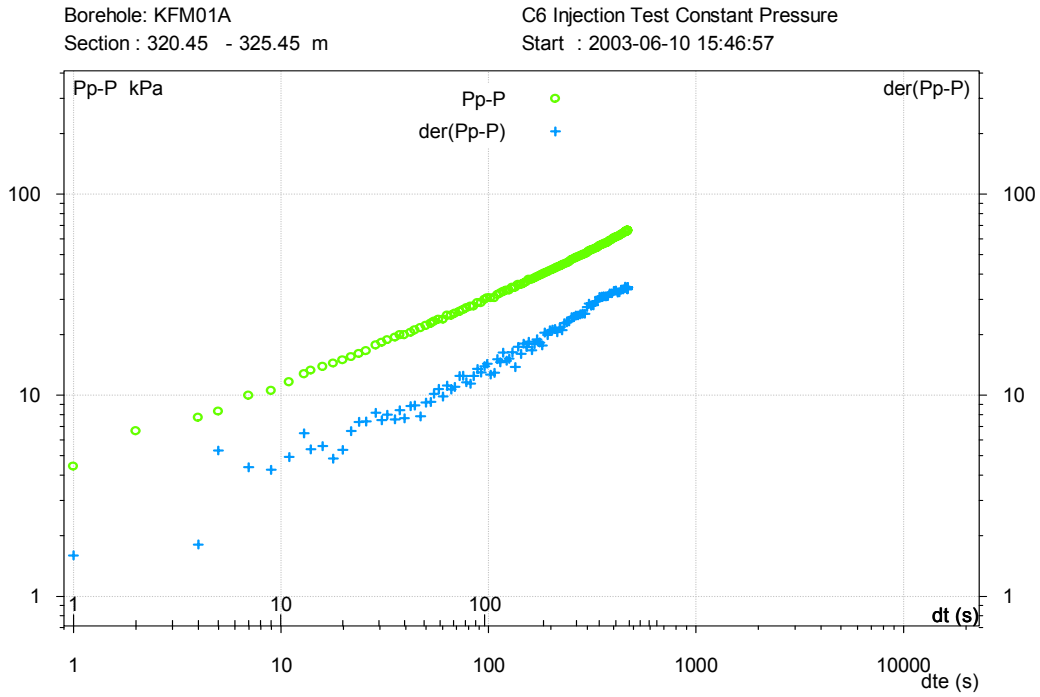


Fig A3-142. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 320.45-325.45 m in KFM01A.

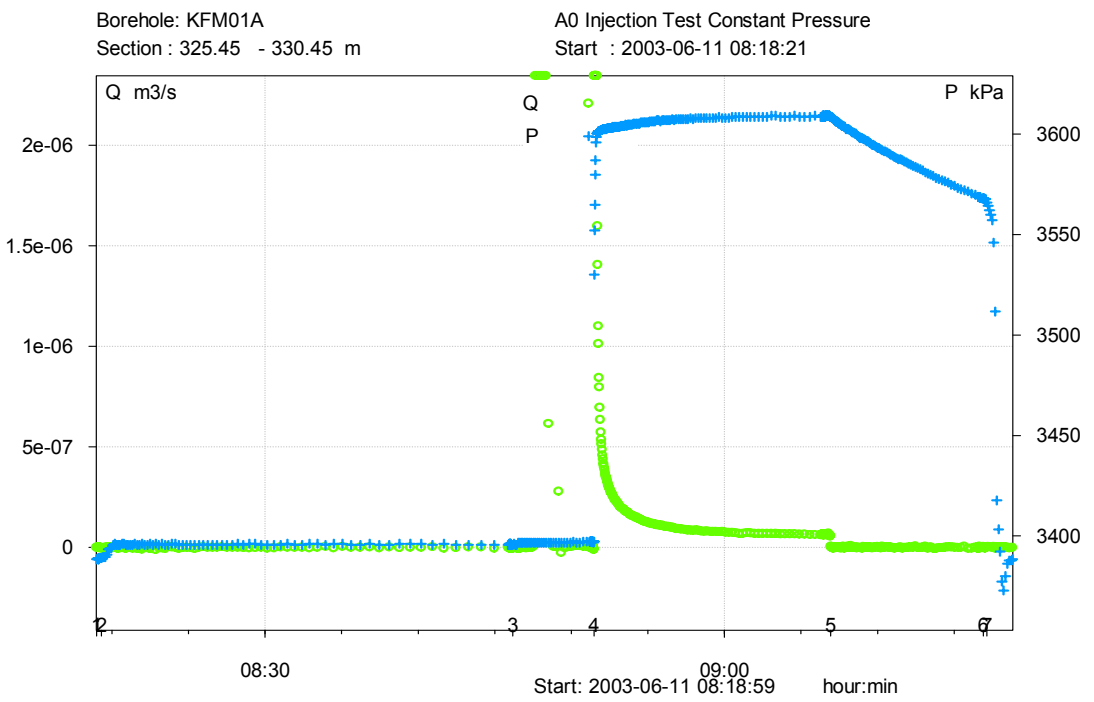


Fig A3-143. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 325.45-330.45 m in borehole KFM01A.

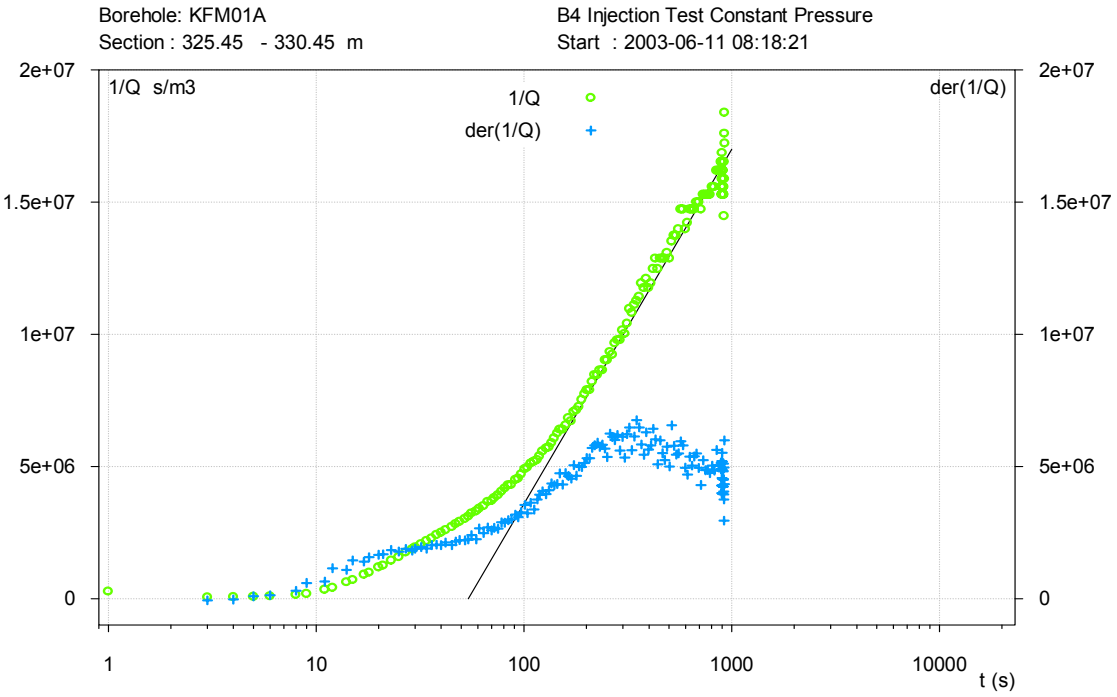


Fig A3-144. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 325.45-330.45 m in KFM01A.

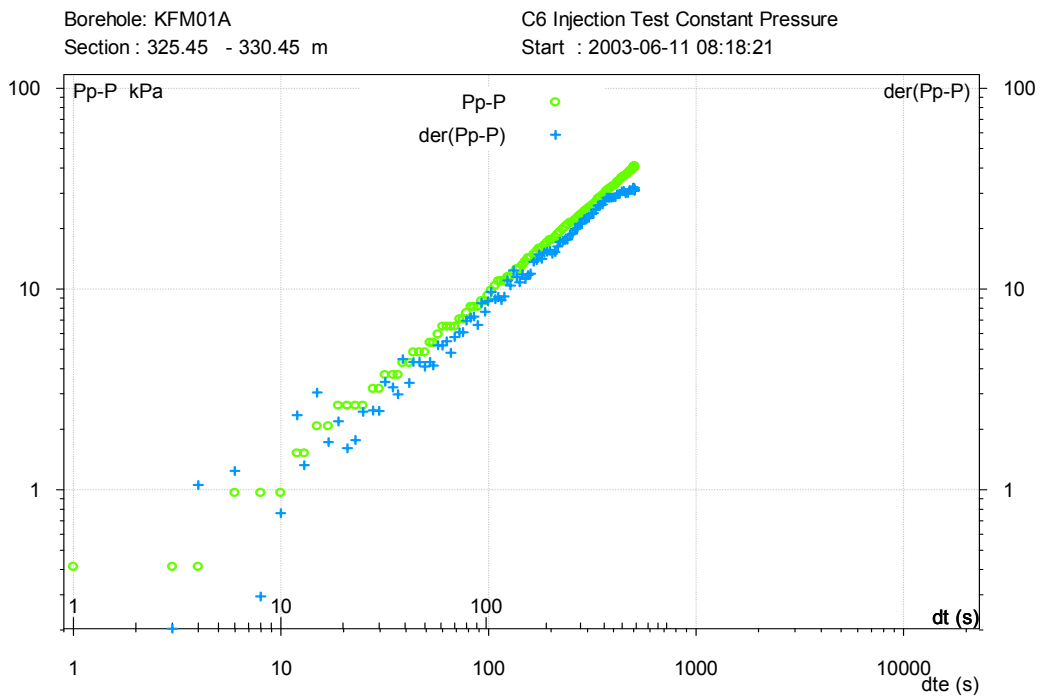


Fig A3-145. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 325.45-330.45 m in KFM01A.

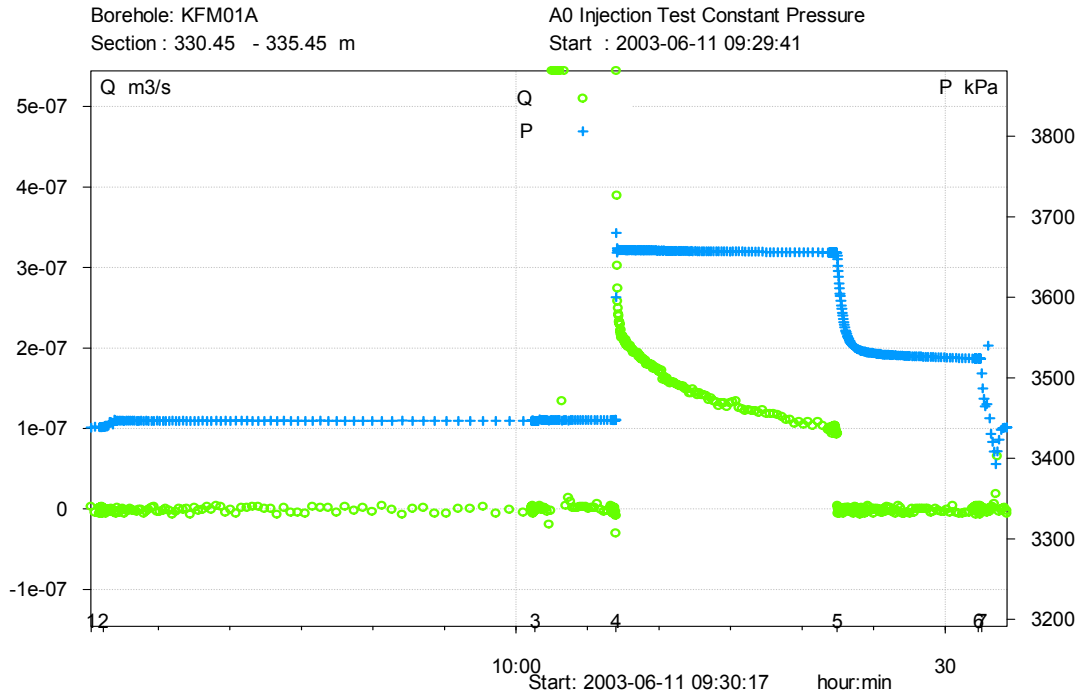


Fig A3-146. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 330.45-335.45 m in borehole KFM01A.

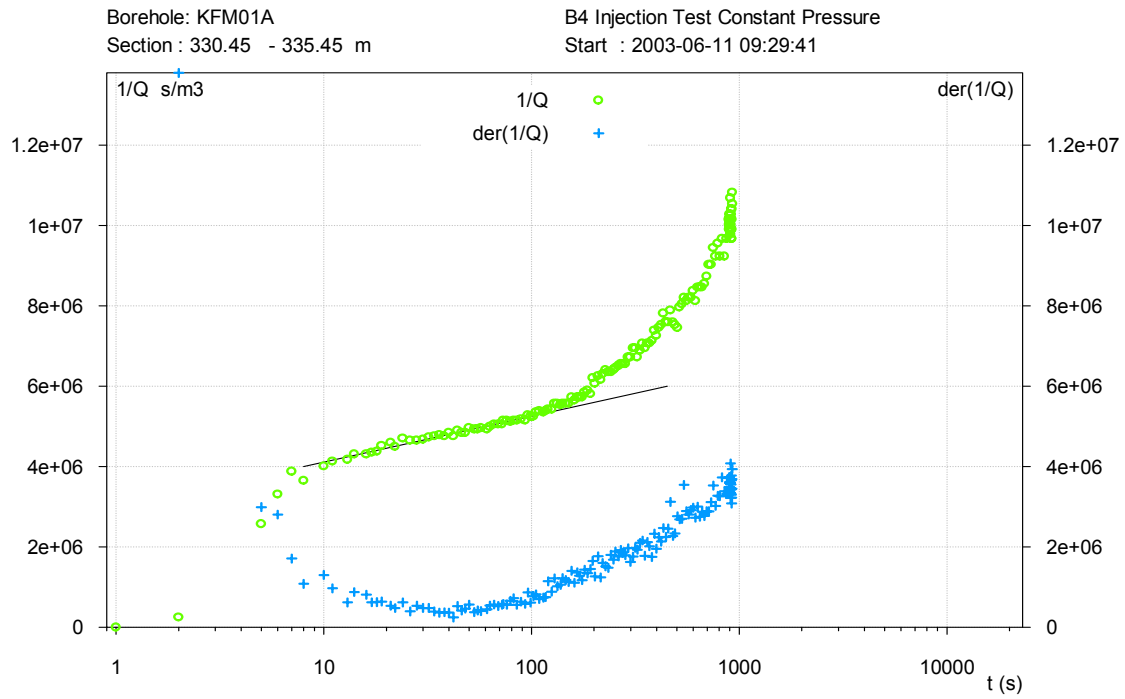


Fig A3-147. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 330.45-335.45 m in KFM01A.

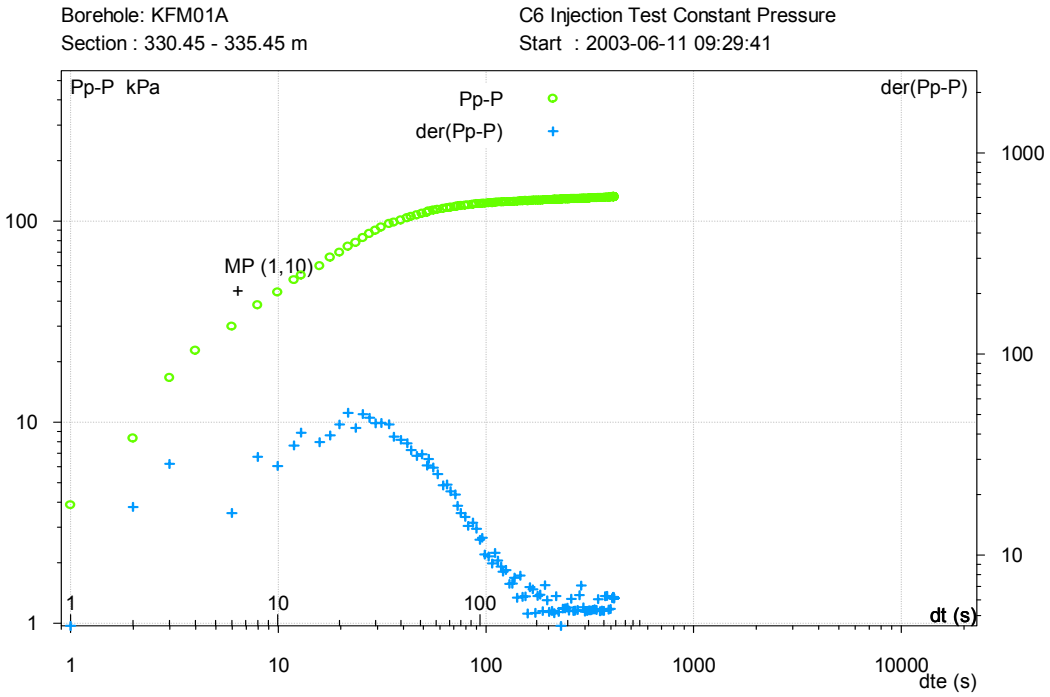


Fig A3-148. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 330.45-335.45 m in KFM01A.

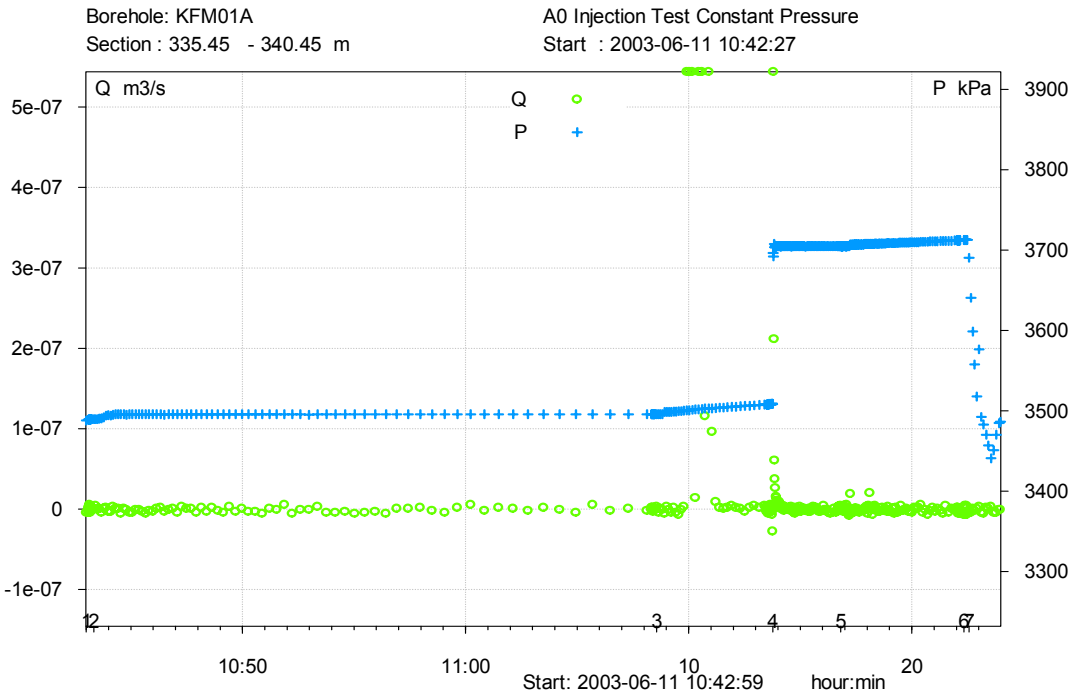


Fig A3-149. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 335.45-340.45 m in borehole KFM01A.

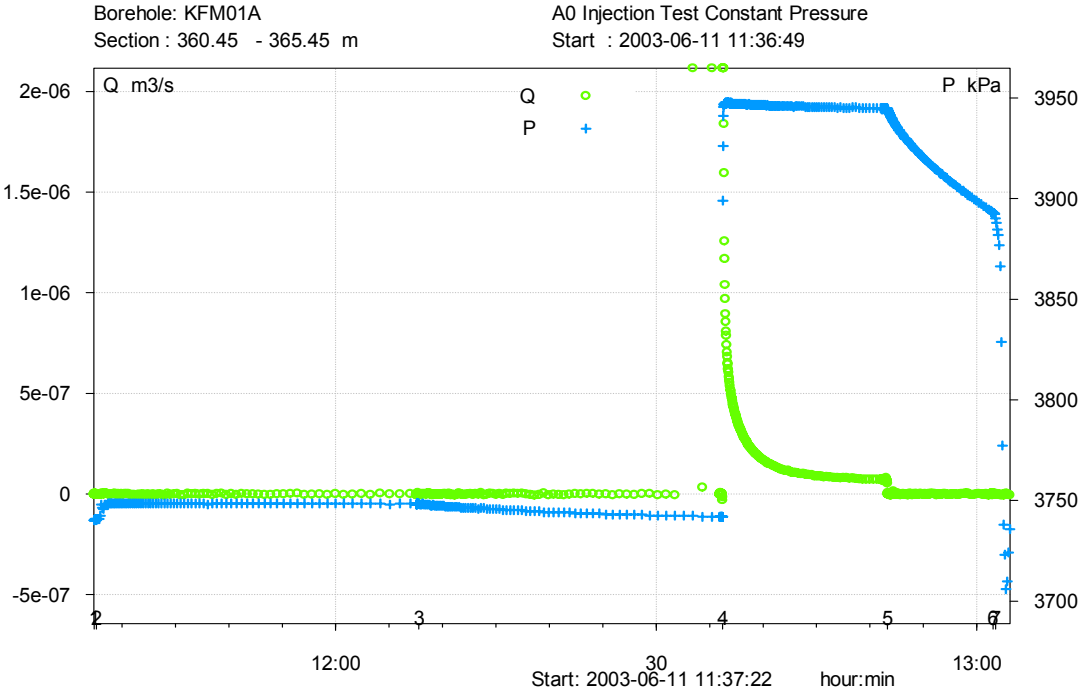


Fig A3-150. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 360.45-365.45 m in borehole KFM01A.

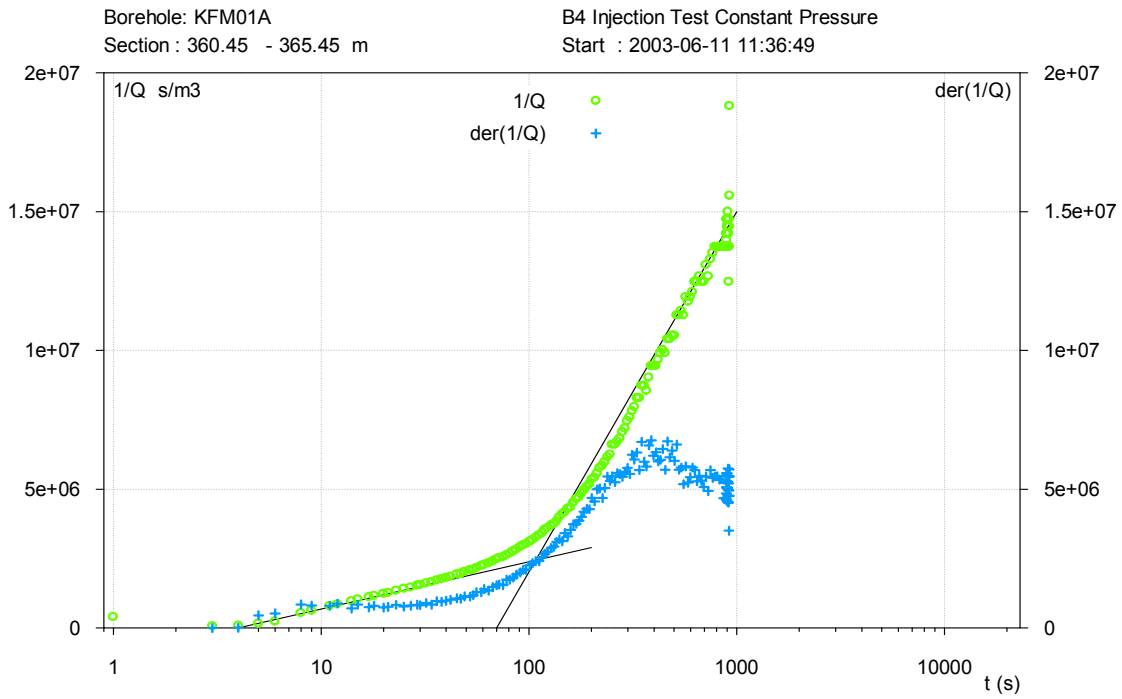


Fig A3-151. Lin-log plot of reciprocal flow rate (1/Q) and - derivative, d(1/Q)/d(ln t) versus time (t) from the injection test in section 360.45-365.45 m in KFM01A.

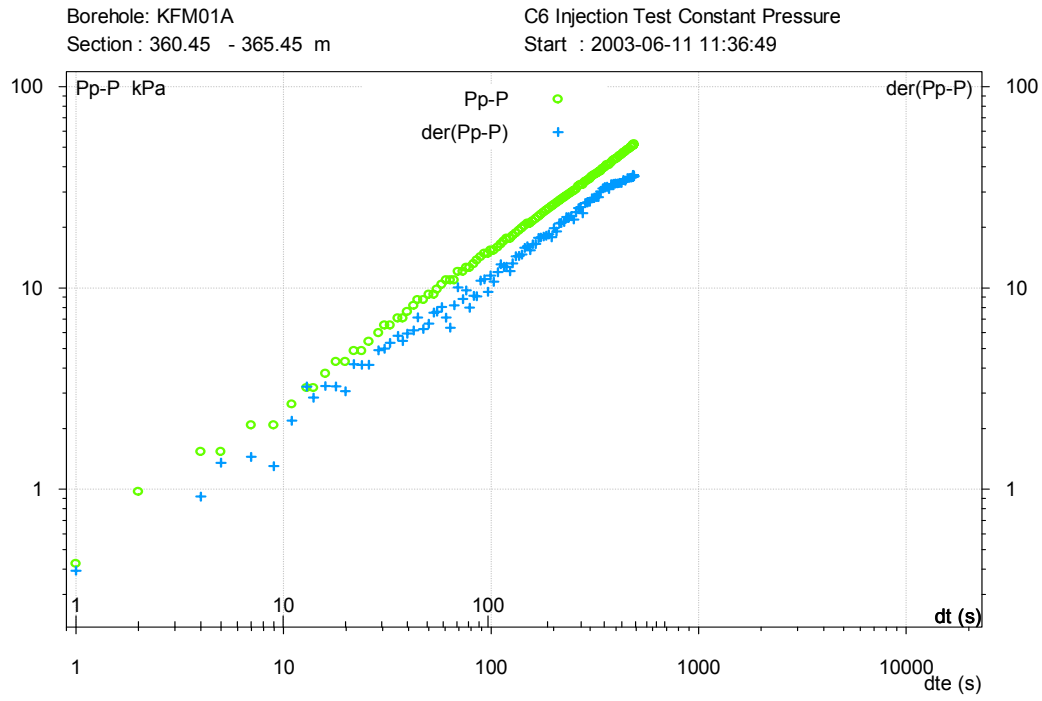


Fig A3-152. Log-log plot of pressure recovery (p_p- p) and -derivative, d(p_p-p)/d(ln dte) versus equivalent time (dte) from the injection test in section 360.45-365.45 m in KFM01A

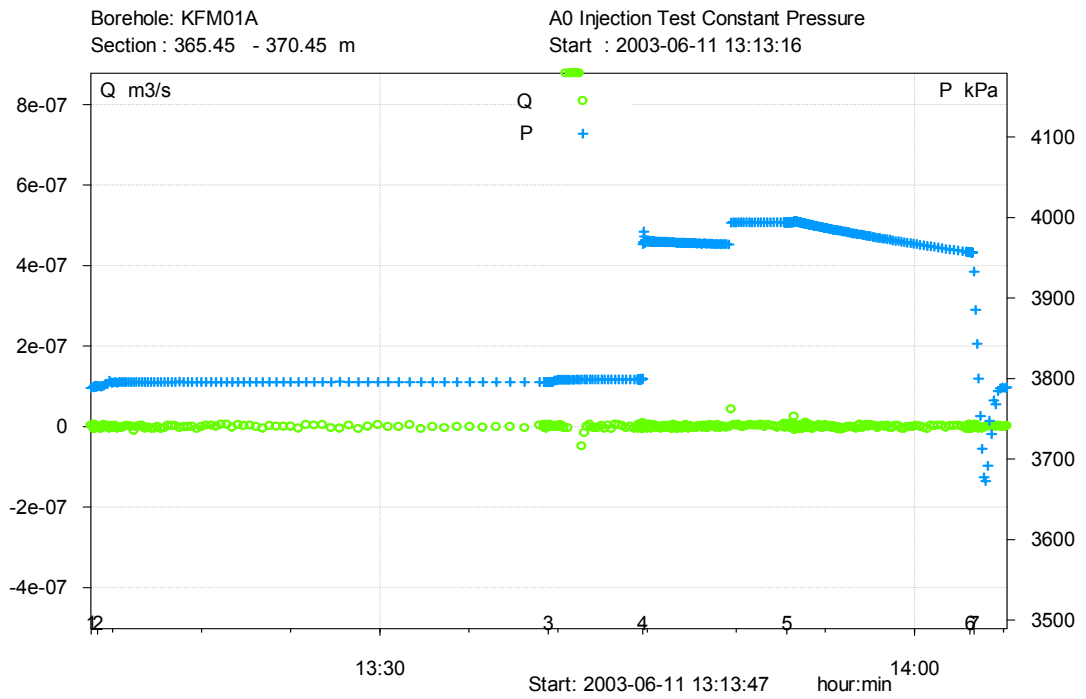


Fig A3-153. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 365.45-370.45 m in borehole KFM01A.

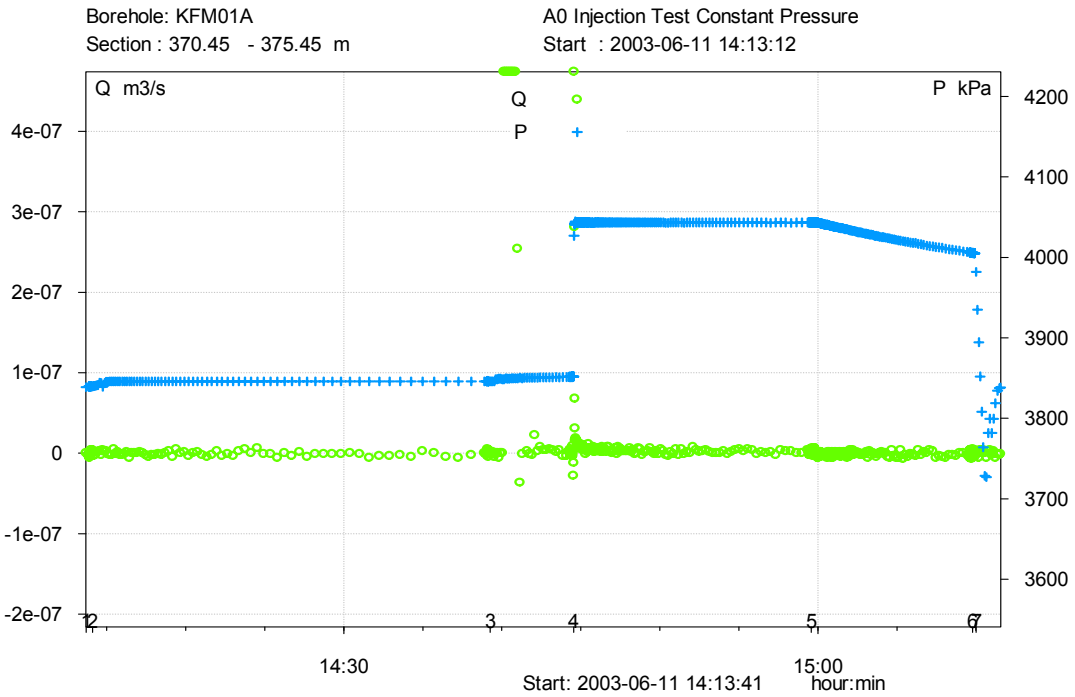


Fig A3-154. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 370.45-375.45 m in borehole KFM01A.

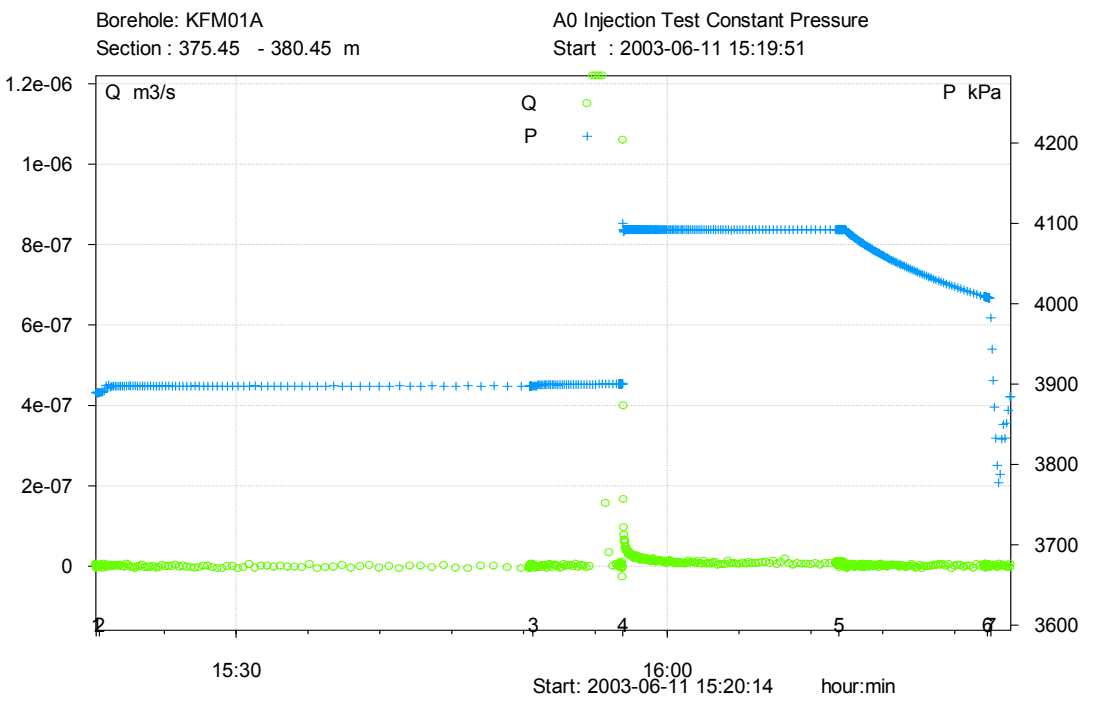


Fig A3-155. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 375.45-380.45 m in borehole KFM01A.

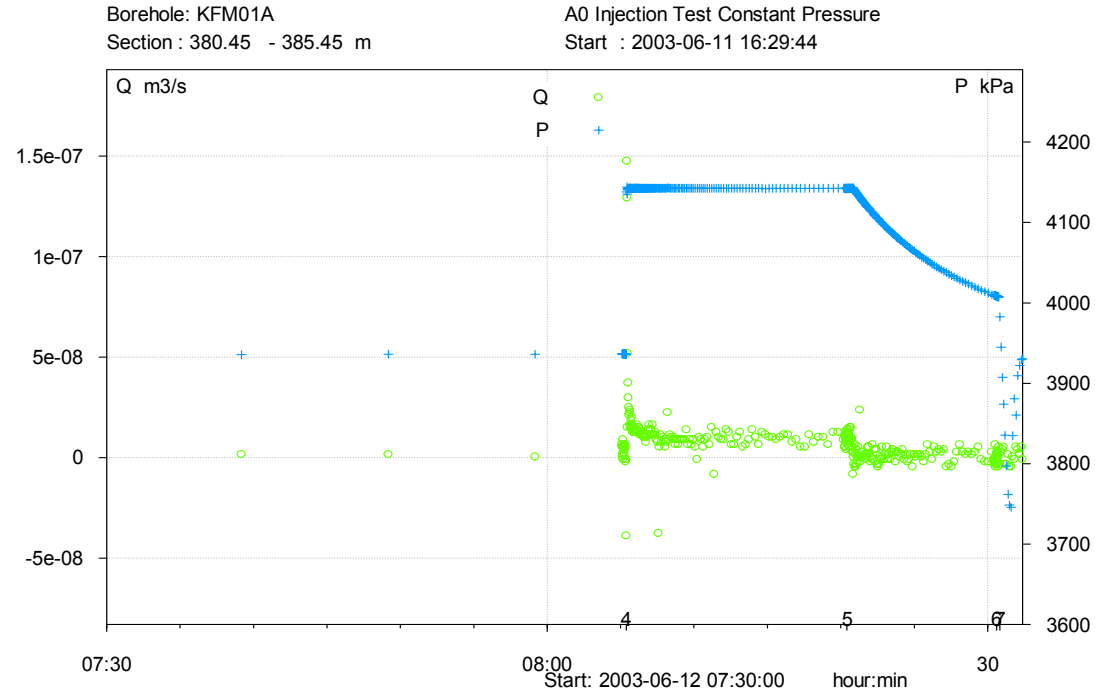


Fig A3-156. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 380.45-385.45 m in borehole KFM01A.

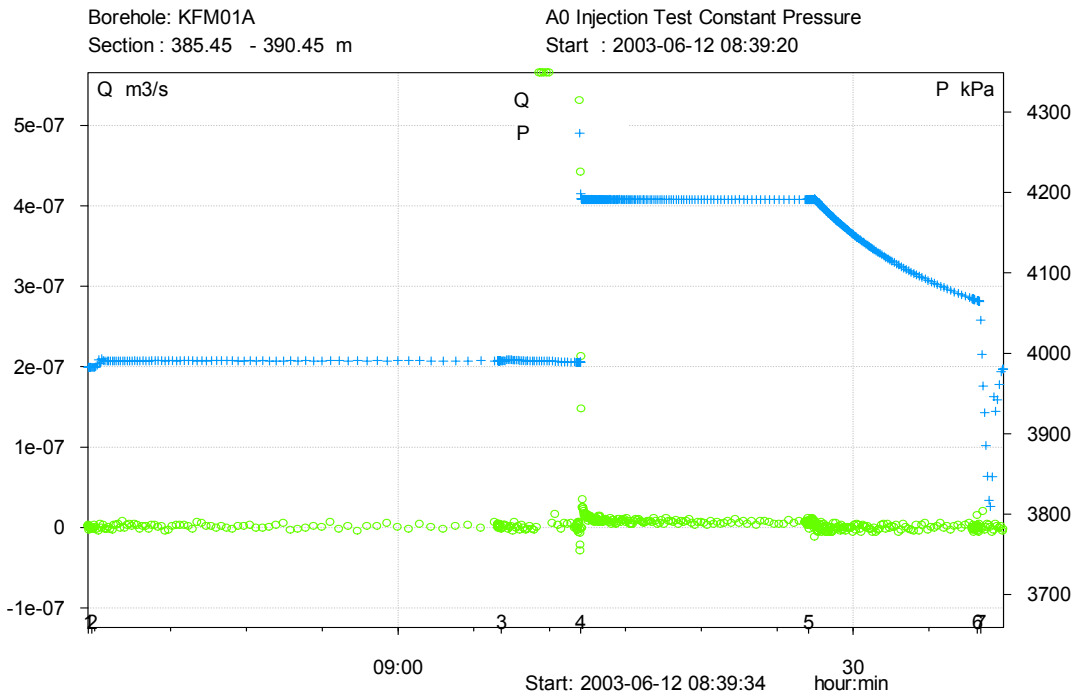


Fig A3-157. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 385.45-390.45 m in borehole KFM01A.

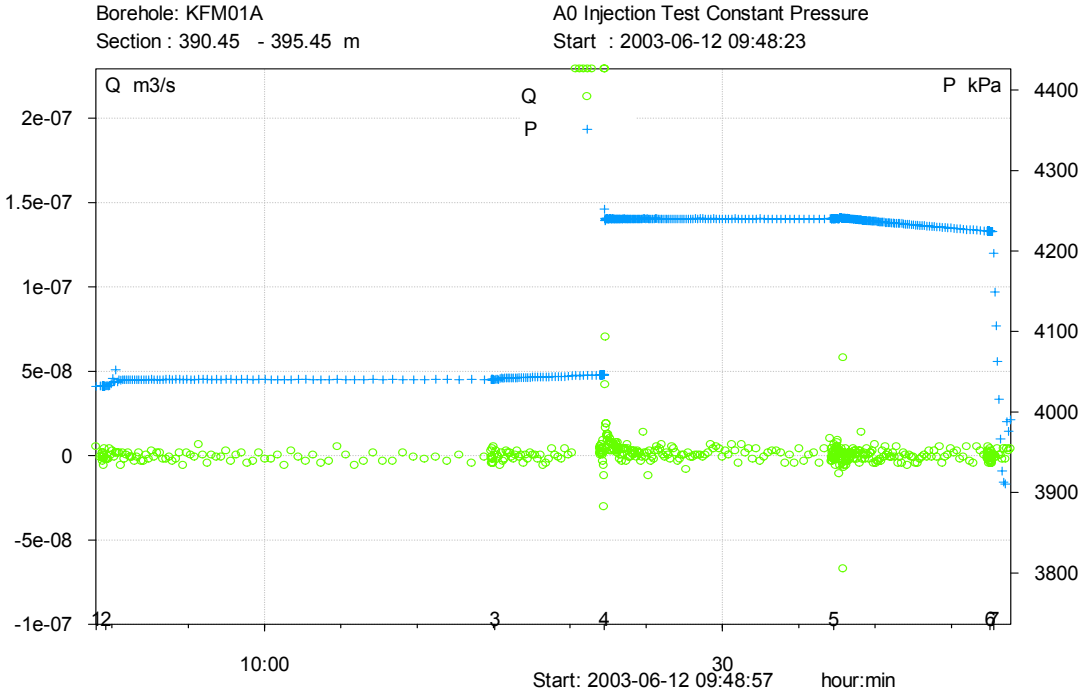


Fig A3-158. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 390.45-395.45 m in borehole KFM01A.

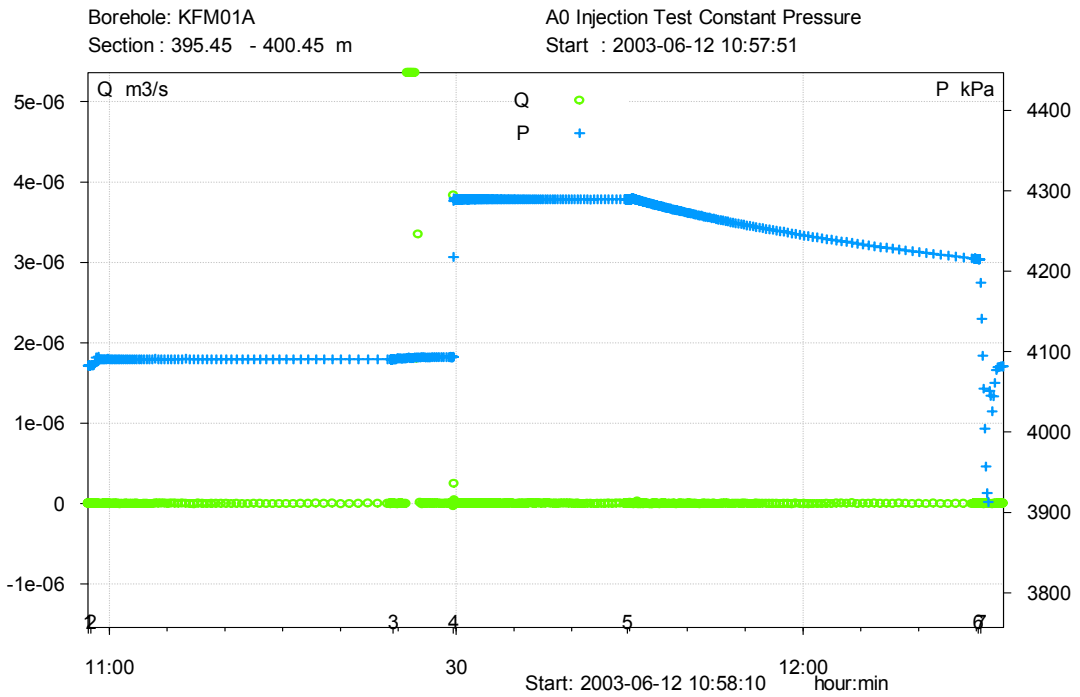
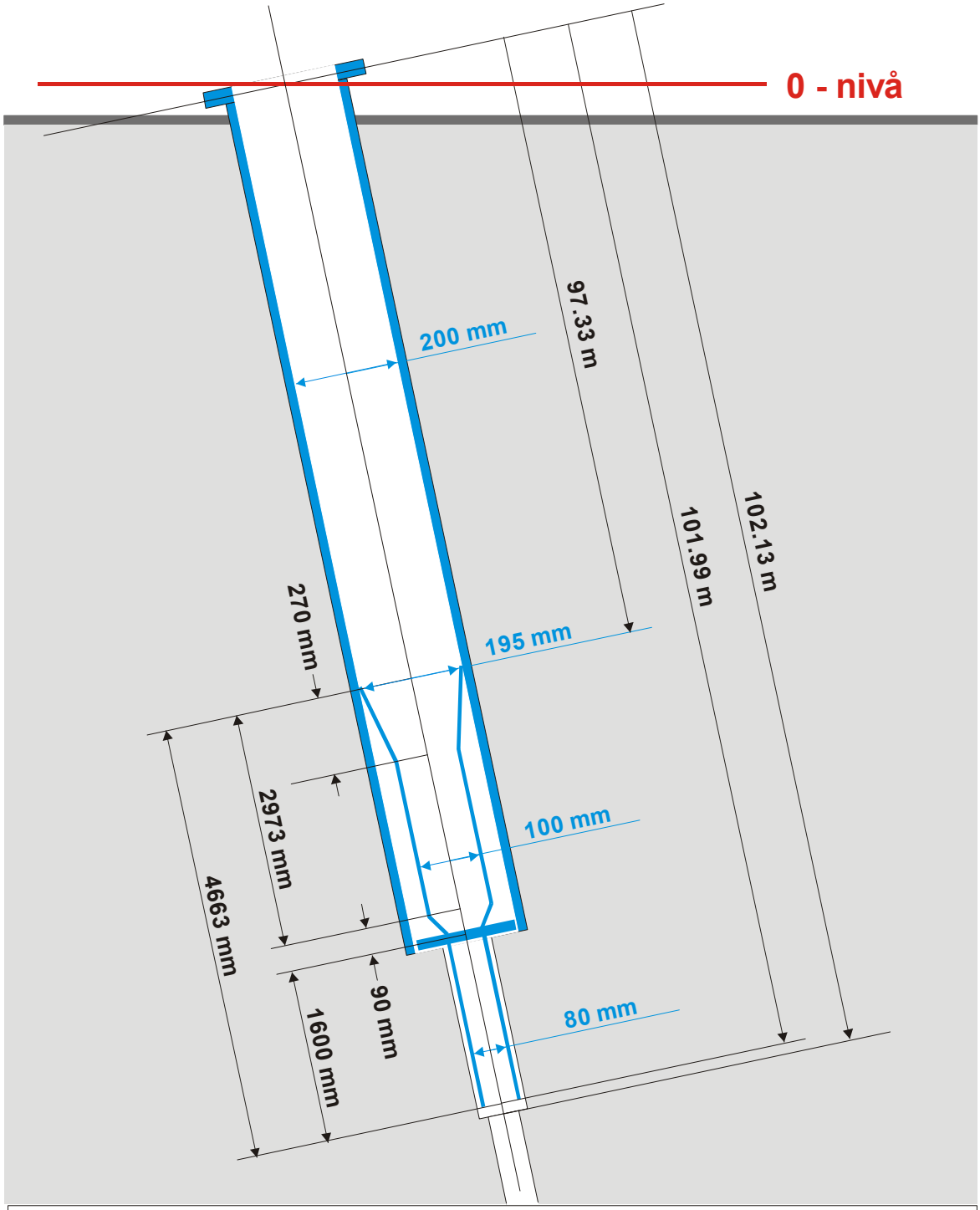


Fig A3-159. Linear plot of flow rate (Q) and pressure (p) versus time from the injection test in section 395.45-400.45 m in borehole KFM01A.

Appendix 4

Borehole technical data

KFM01A



Drilling period
Drilling start date: 2002-05-27
Drilling stop date: 2002-10-28

Drilling reference point
Northing: 6699529.813 (m), RT90 2,5 gon V 0:-15
Easting: 1631397.160 (m), RT90 2,5 gon V 0:-15
Elevation: 3.125 (m), RHB 70

Appendix 5

Sicada tables

KFM01A General information. Left 1

Borehole idcode	Borehole secup (m)	Borehole seclow (m)	Test type (1-6)	Formation type (-)	Date and time for test, start YYYYMMDD hh:mm	Date and time for test, stop YYYYMMDD hh:mm	Date and time for flow period, start YYYYMMDD hh:mm:ss	Date and time for flow period, stop YYYYMMDD hh:mm:ss	Q_p (m**3/s)	Value type (-1, 0 or 1)
KFM01A	105.45	205.45	3	1	20030515 16:38	20030515 18:30	20030515 17:27:46	20030515 17:57:55	9.240E-06	0
KFM01A	200.45	300.45	3	1	20030512 11:47	20030512 14:01	20030512 12:59:00	20030512 13:29:20	1.678E-07	0
KFM01A	300.45	400.45	3	1	20030512 15:44	20030512 17:24	20030512 16:22:54	20030512 16:53:14	3.550E-07	0
KFM01A	400.45	500.45	3	1	20030513 09:25	20030513 11:06	20030513 10:04:08	20030513 10:04:08	5.000E-08	0
KFM01A	500.45	600.45	3	1	20030513 13:22	20030513 15:16	20030513 14:13:41	20030513 14:44:04	1.357E-08	0
KFM01A	600.45	700.45	3	1	20030514 08:16	20030514 10:06	20030514 09:10:13	20030514 09:34:24		-1
KFM01A	700.45	800.45	3	1	20030514 12:41	20030514 14:33	20030514 13:49:01	20030514 14:00:48		-1
KFM01A	800.45	900.45	3	1	20030514 16:26	20030514 18:00	20030514 17:16:27	20030514 17:27:51		-1
KFM01A	895.45	995.45	3	1	20030514 18:45	20030514 19:57	20030514 19:34:19	20030514 19:44:22		-1
KFM01A	105.45	125.45	3	1	20030519 15:44	20030519 17:13	20030519 16:31:00	20030519 16:51:25	4.907E-06	0
KFM01A	125.45	145.45	3	1	20030520 08:42	20030520 10:01	20030520 09:19:19	20030520 09:39:45	4.705E-07	0
KFM01A	145.45	165.45	3	1	20030520 10:36	20030520 11:57	20030520 11:15:05	20030520 11:35:30	4.170E-06	0
KFM01A	165.45	185.45	3	1	20030520 13:02	20030520 14:24	20030520 13:41:54	20030520 14:02:19	1.960E-06	0
KFM01A	185.45	205.45	3	1	20030520 14:50	20030520 16:11	20030520 15:29:19	20030520 15:49:45	1.188E-07	0
KFM01A	200.45	220.45	3	1	20030521 09:03	20030521 10:15	20030521 09:42:18	20030521 09:53:22		-1
KFM01A	220.45	240.45	3	1	20030521 10:32	20030521 11:54	20030521 11:11:44	20030521 11:32:12	3.440E-08	0
KFM01A	240.45	260.45	3	1	20030521 12:51	20030521 14:02	20030521 13:30:35	20030521 13:39:27		-1
KFM01A	260.45	280.45	3	1	20030521 14:20	20030521 15:43	20030521 15:00:35	20030521 15:21:03	5.00E-08	0
KFM01A	280.45	300.45	3	1	20030521 16:18	20030521 17:42	20030521 16:59:26	20030521 17:19:53	9.270E-08	0
KFM01A	300.45	320.45	3	1	20030521 18:00	20030521 19:19	20030521 18:36:55	20030521 18:57:22	7.400E-08	0
KFM01A	320.45	340.45	3	1	20030522 08:29	20030522 09:51	20030522 09:08:38	20030522 09:29:06	3.080E-07	0
KFM01A	340.45	360.45	3	1	20030522 10:16	20030522 11:12	20030522 10:55:24	20030522 11:04:13		-1
KFM01A	360.45	380.45	3	1	20030522 11:28	20030522 13:23	20030522 12:40:30	20030522 13:00:58	5.376E-08	0
KFM01A	380.45	400.45	3	1	20030522 13:42	20030522 15:03	20030522 14:20:25	20030522 14:40:52	1.849E-08	0
KFM01A	105.45	110.45	3	1	20030526 11:30	20030526 14:07	20030526 13:37:30	20030526 13:52:50	8.689E-08	0
KFM01A	110.45	115.45	3	1	20030526 14:43	20030526 15:54	20030526 15:26:33	20030526 15:41:56	1.19E-06	0
KFM01A	115.45	120.45	3	1	20030526 16:11	20030526 17:18	20030526 16:50:42	20030526 17:06:06	2.728E-06	0
KFM01A	120.45	125.45	3	1	20030527 08:36	20030527 09:51	20030527 09:18:45	20030527 09:34:08	1.860E-06	0
KFM01A	125.45	130.45	3	1	20030527 10:20	20030527 11:30	20030527 11:02:15	20030527 11:17:39	8.135E-08	0
KFM01A	130.45	135.45	3	1	20030527 11:40	20030527 13:29	20030527 13:10:27	20030527 13:21:12		-1
KFM01A	135.45	140.45	3	1	20030602 08:27	20030602 09:41	20030602 09:13:22	20030602 09:20:45		-1
KFM01A	140.45	145.45	3	1	20030602 10:00	20030602 11:11	20030602 10:43:23	20030602 10:58:48	4.030E-07	0
KFM01A	145.45	150.45	3	1	20030602 11:32	20030602 13:08	20030602 12:38:27	20030602 12:53:54	3.340E-06	0
KFM01A	150.45	155.45	3	1	20030602 13:24	20030602 14:13	20030602 14:01:02	20030602 14:05:59		-1
KFM01A	155.45	160.45	3	1	20030602 14:25	20030602 15:34	20030602 15:06:20	20030602 15:21:44	1.517E-06	0
KFM01A	160.45	165.45	3	1	20030602 15:49	20030602 16:56	20030602 16:28:28	20030602 16:43:54	2.377E-07	0
KFM01A	165.45	170.45	3	1	20030602 08:37	20030603 09:49	20030603 09:21:15	20030603 09:36:17		-1
KFM01A	170.45	175.45	3	1	20030603 11:35	20030603 13:08	20030603 12:39:52	20030603 12:55:17	2.831E-08	0

KFM01A General information. Left 2

idcode	(m)	(m)	(1-6)	(-)	YYYYMMDD hh:mm	Date and time for test, stop YYYYMMDD hh:mm	Date and time for flow period, start YYYYMMDD hh:mm:ss	Date and time for flow period, stop YYYYMMDD hh:mm:ss	Q_p (m**3/s)	Value type (-1, 0 or 1)
KFM01A	175.45	180.45	3	1	20030603 13:17	20030603 14:22	20030603 13:54:01	20030603 14:09:26	2.080E-06	0
KFM01A	180.45	185.45	3	1	20030603 14:53	20030603 15:55	20030603 15:27:41	20030603 15:42:43		-1
KFM01A	185.45	190.45	3	1	20030604 08:24	20030604 09:40	20030604 09:12:11	20030604 09:27:40	8.596E-08	0
KFM01A	190.45	195.45	3	1	20030604 09:50	20030604 10:57	20030604 10:29:54	20030604 10:45:33	2.861E-08	0
KFM01A	195.45	200.45	3	1	20030604 11:16	20030604 13:02	20030604 12:34:04	20030604 12:49:06		-1
KFM01A	200.45	205.45	3	1	20030604 13:13	20030604 14:00	20030604 13:47:42	20030604 13:52:48		-1
KFM01A	205.45	210.45	3	1	20030604 14:09	20030604 14:54	20030604 14:46:13	20030604 14:51:01		-1
KFM01A	210.45	215.45	3	1	20030604 15:16	20030604 16:10	20030604 15:52:13	20030604 16:03:05		-1
KFM01A	215.45	220.45	3	1	20030605 08:26	20030605 09:37	20030605 09:22:17	20030605 09:28:47		-1
KFM01A	220.45	225.45	3	1	20030605 09:47	20030605 11:03	20030605 10:33:26	20030605 10:48:54		-1
KFM01A	225.45	230.45	3	1	20030605 11:20	20030605 13:35	20030605 13:07:40	20030605 13:23:07	2.647E-08	0
KFM01A	230.45	235.45	3	1	20030605 13:44	20030605 14:59	20030605 14:30:56	20030605 14:45:59		-1
KFM01A	235.45	240.45	3	1	20030605 15:10	20030605 16:14	20030605 15:45:30	20030605 16:00:35		-1
KFM01A	260.45	265.45	3	1	20030606 08:20	20030606 09:21	20030606 08:59:15	20030606 09:14:18		-1
KFM01A	265.45	270.45	3	1	20030606 09:42	20030606 10:46	20030606 10:18:06	20030606 10:33:33	6.834E-09	0
KFM01A	270.45	275.45	3	1	20030606 10:57	20030606 12:20	20030606 11:32:46	20030606 11:48:12	3.567E-08	0
KFM01A	275.45	280.45	3	1	20030606 12:42	20030606 13:45	20030606 13:17:43	20030606 13:33:09	8.976E-09	0
KFM01A	280.45	285.45	3	1	20030606 13:54	20030606 14:58	20030606 14:33:56	20030606 14:48:58		-1
KFM01A	285.45	290.45	3	1	20030606 15:24	20030606 16:31	20030606 16:01:53	20030606 16:16:55		-1
KFM01A	290.45	295.45	3	1	20030610 08:27	20030610 09:27	20030610 08:59:31	20030610 09:14:59	9.823E-08	0
KFM01A	295.45	300.45	3	1	20030610 09:38	20030610 10:37	20030610 10:10:13	20030610 10:25:43	1.910E-08	0
KFM01A	300.45	305.45	3	1	20030610 10:47	20030610 11:55	20030610 11:20:09	20030610 11:23:16		-1
KFM01A	305.45	310.45	3	1	20030610 12:24	20030610 13:24	20030610 12:56:14	20030610 13:11:41	4.916E-08	0
KFM01A	310.45	315.45	3	1	20030610 13:30	20030610 14:31	20030610 14:02:26	20030610 14:17:29		-1
KFM01A	315.45	320.45	3	1	20030610 14:39	20030610 15:38	20030610 15:11:01	20030610 15:26:28	2.92E-08	0
KFM01A	320.45	325.45	3	1	20030610 15:46	20030610 16:45	20030610 16:19:26	20030610 16:34:52	1.810E-07	0
KFM01A	325.45	330.45	3	1	20030611 08:18	20030611 09:18	20030611 08:51:29	20030611 09:06:56	5.867E-08	0
KFM01A	330.45	335.45	3	1	20030611 09:29	20030611 10:34	20030611 10:06:59	20030611 10:22:27	9.700E-08	0
KFM01A	335.45	340.45	3	1	20030611 10:42	20030611 11:23	20030611 11:13:46	20030611 11:16:49		-1
KFM01A	360.45	365.45	3	1	20030611 11:36	20030611 13:03	20030611 12:36:13	20030611 12:51:39	6.848E-08	0
KFM01A	365.45	370.45	3	1	20030611 13:13	20030611 14:05	20030611 13:44:45	20030611 13:52:50		-1
KFM01A	370.45	375.45	3	1	20030611 14:13	20030611 15:11	20030611 14:44:33	20030611 14:59:35		-1
KFM01A	375.45	380.45	3	1	20030611 15:19	20030611 16:23	20030611 15:56:54	20030611 16:11:56		-1
KFM01A	380.45	385.45	3	1	20030611 16:29	20030612 08:32	20030612 08:05:23	20030612 08:20:25		-1
KFM01A	385.45	390.45	3	1	20030612 08:39	20030612 09:39	20030612 09:12:02	20030612 09:27:04		-1
KFM01A	390.45	395.45	3	1	20030612 09:48	20030612 10:48	20030612 10:22:15	20030612 10:37:17		-1
KFM01A	395.45	400.45	3	1	20030612 10:57	20030612 12:17	20030612 11:29:45	20030612 11:44:48		-1

KFM01A General information. Right 1

Borehole idcode	Borehole secup (m)	Borehole seclow (m)	Q-measl-L (m**3)/s	Q-measl-U (m**3)/s	V_p (m**3)	Q_m (m**3/s)	tp (s)	t_F (s)	h_i (m a s l)	h_p (m a s l)	h_F (m a s l)	p_i (kPa)	p_p (kPa)	p_F (kPa)	Te_w (°C)	EC_w (mS/m)	TDS_w (mg/L)	TDS_{wm} (mg/ L)	Reference	Comments (-)
KFM01A	105.45	205.45	1.6E-08	5.0E-04	2.560E-02	1.402E-05	1826	1799				1094.99	1296.37	1150.31	7.95					
KFM01A	200.45	300.45	1.6E-08	5.0E-04	4.660E-04	2.559E-07	1821	1807				2082.01	2293.92	2143.43	9.07					
KFM01A	300.45	400.45	1.6E-08	5.0E-04	1.421E-03	7.803E-07	1821	1806				3083.99	3284.13	3169.74	10.14					
KFM01A	400.45	500.45	1.6E-08	5.0E-04	1.354E-04	7.415E-08	1826	1800				4077.09	4276.28	4134.63	11.26					
KFM01A	500.45	600.45	1.6E-08	5.0E-04	6.836E-05	3.748E-08	1824	1803				5052.52	5256.11	5188.62	12.47					
KFM01A	600.45	700.45	1.6E-08	5.0E-04	3.789E-05	2.610E-08	1452	1821				6026.81	6269.01	6259.74	13.76					
KFM01A	700.45	800.45	1.6E-08	5.0E-04	3.631E-05	5.129E-08	708	1821				6993.38	7240.68	7250.64	15.08					
KFM01A	800.45	900.45	1.6E-08	5.0E-04	4.513E-05	6.588E-08	685	1821				7935.04	8207.79	8218.32	16.47					
KFM01A	895.45	995.45	1.6E-08	5.0E-04	1.574E-05	2.606E-08	604	647				8863.14	9070.34	9100.77	17.80					
KFM01A	105.45	125.45	1.6E-08	5.0E-04	1.000E-02	8.157E-06	1226	1199				1118.21	1319.33	1174.92	7.09					
KFM01A	125.45	145.45	1.6E-08	5.0E-04	8.023E-04	6.528E-07	1229	1198				1323.20	1524.04	1343.12	7.35					
KFM01A	145.45	165.45	1.6E-08	5.0E-04	6.950E-03	5.669E-06	1226	1199				1521.27	1722.66	1564.43	7.58					
KFM01A	165.45	185.45	1.6E-08	5.0E-04	3.504E-03	2.858E-06	1226	1199				1724.87	1925.29	1765.81	7.79					
KFM01A	185.45	205.45	1.6E-08	5.0E-04	2.747E-04	2.235E-07	1229	1198				1931.25	2133.19	2012.56	7.98					
KFM01A	200.45	220.45	1.6E-08	5.0E-04	2.476E-05	3.712E-08	667	1220				2081.73	2303.04	2271.50	8.18					
KFM01A	220.45	240.45	1.6E-08	5.0E-04	8.193E-05	6.656E-08	1231	1196				2275.79	2473.45	2362.79	8.39					
KFM01A	240.45	260.45	1.6E-08	5.0E-04	2.985E-05	5.579E-08	535	1223				2487.27	2706.37	2667.64	8.61					
KFM01A	260.45	280.45	1.6E-08	5.0E-04	9.409E-05	7.656E-08	1229	1196				2669.72	2870.13	2695.86	8.83					
KFM01A	280.45	300.45	1.6E-08	5.0E-04	1.992E-04	1.621E-07	1229	1197				2873.04	3074.30	2956.45	9.04					
KFM01A	300.45	320.45	1.6E-08	5.0E-04	1.100E-04	8.950E-08	1229	1197				3065.99	3269.04	3071.52	9.26					
KFM01A	320.45	340.45	1.6E-08	5.0E-04	8.900E-04	7.230E-07	1231	1196				3269.60	3470.71	3376.93	9.47					
KFM01A	340.45	360.45	1.6E-08	5.0E-04	2.161E-05	4.070E-08	531	368				3484.95	3719.41	3703.36	9.69					
KFM01A	360.45	380.45	1.6E-08	5.0E-04	2.547E-04	2.072E-07	1229	1196				3660.76	3861.05	3786.35	9.92					
KFM01A	380.45	400.45	1.6E-08	5.0E-04	5.800E-05	4.719E-08	1229	1197				3863.25	4136.57	3947.35	10.13					
KFM01A	105.45	110.45	1.6E-08	5.0E-04	2.010E-04	2.182E-07	921	761				1134.98	1333.88	1178.97	6.96					
KFM01A	110.45	115.45	1.6E-08	5.0E-04	2.747E-03	2.973E-06	924	643				1180.77	1412.45	1327.78	7.02					
KFM01A	115.45	120.45	1.6E-08	5.0E-04	3.446E-03	3.725E-06	925	622				1228.62	1431.81	1253.65	7.07					
KFM01A	120.45	125.45	1.6E-08	5.0E-04	3.602E-03	3.898E-06	924	930				1289.20	1502.77	1402.49	7.13					
KFM01A	125.45	130.45	1.6E-08	5.0E-04	2.522E-04	2.753E-07	916	646				1339.96	1539.69	1477.17	7.19					
KFM01A	130.45	135.45	1.6E-08	5.0E-04	1.172E-04	1.814E-07	646	371				1396.68	1773.73	1769.86	7.24					
KFM01A	135.45	140.45	1.6E-08	5.0E-04	1.220E-05	2.748E-08	444	1084				1553.25	1781.61	1850.07	7.31					
KFM01A	140.45	145.45	1.6E-08	5.0E-04	4.130E-04	4.460E-07	926	655				1474.96	1674.69	1476.07	7.35					
KFM01A	145.45	150.45	1.6E-08	5.0E-04	3.850E-03	4.149E-06	928	716				1526.42	1727.53	1561.83	7.41					
KFM01A	150.45	155.45	1.6E-08	5.0E-04	2.965E-05	9.950E-08	298	343				1586.72	1806.38	1794.20	7.47					
KFM01A	155.45	160.45	1.6E-08	5.0E-04	1.862E-03	2.013E-06	925	664				1627.80	1822.42	1684.10	7.53					
KFM01A	160.45	165.45	1.6E-08	5.0E-04	3.019E-04	3.257E-07	927	613				1679.95	1875.94	1686.32	7.59					
KFM01A	165.45	170.45	1.6E-08	5.0E-04	4.799E-05	5.315E-08	903	664				1733.62	1929.33	1844.54	7.65					
KFM01A	170.45	175.45	1.6E-08	5.0E-04	5.615E-05	6.064E-08	926	640				1784.24	1977.06	1819.65	7.71					
KFM01A	175.45	180.45	1.6E-08	5.0E-04	5.385E-03	5.815E-06	926	662				1822.83	2017.72	1882.16	7.76					
KFM01A	180.45	185.45	1.6E-08	5.0E-04	3.419E-05	3.786E-08	903	634				1885.48	2101.26	2036.53	7.82					
KFM01A	185.45	190.45	1.6E-08	5.0E-04	1.163E-04	1.251E-07	930	656				1925.18	2125.61	1954.10	7.88					
KFM01A	190.45	195.45	1.6E-08	5.0E-04	1.575E-04	1.676E-07	940	598				1981.76	1994.35	2164.89	7.96					

KFM01A General information. Right 2

Borehole idcode	Borehole secup (m)	Borehole seclow (m)	Q-measl-L (m**3)/s	Q-measl-U (m**3)/s	V_p (m**3)	Q_m (m**3/s)	tp (s)	t_F (s)	h_i (m a s l)	h_p (m a s l)	h_F (m a s l)	p_i (kPa)	p_p (kPa)	p_F (kPa)	Te_w (^oC)	EC_w (mS/m)	TDS_w (mg/L)	TDS_{wm} (mg/ L)	Reference	Comments (-)
KFM01A	195.45	200.45	1.6E-08	5.0E-04	3.225E-05	3.571E-08	903	649				2034.26	2237.51	2197.53	7.99					
KFM01A	200.45	205.45	1.6E-08	5.0E-04	2.419E-05	7.879E-08	307	321				2096.56	2298.50	2296.01	8.05					
KFM01A	205.45	210.45	1.6E-08	5.0E-04	2.378E-05	8.228E-08	289	105				2251.75	2548.03	2644.57	8.12					
KFM01A	210.45	215.45	1.6E-08	5.0E-04	1.768E-05	2.708E-08	653	320				2218.55	2425.48	2423.82	8.18					
KFM01A	215.45	220.45	1.6E-08	5.0E-04	1.858E-05	4.752E-08	391	389				2283.01	2495.74	2503.48	8.20					
KFM01A	220.45	225.45	1.6E-08	5.0E-04	7.727E-06	8.327E-09	928	726				2283.29	2419.67	2355.22	8.29					
KFM01A	225.45	230.45	1.6E-08	5.0E-04	6.385E-05	6.880E-08	928	597				2323.12	2515.94	2431.56	8.31					
KFM01A	230.45	235.45	1.6E-08	5.0E-04	1.794E-05	1.985E-08	904	676				2419.67	2652.32	2595.88	8.40					
KFM01A	235.45	240.45	1.6E-08	5.0E-04	4.588E-06	5.064E-09	906	683				2451.48	2646.65	2635.72	8.45					
KFM01A	260.45	265.45	1.6E-08	5.0E-04	7.783E-06	8.610E-09	904	311				2683.44	2888.57	2890.78	8.68					
KFM01A	265.45	270.45	1.6E-08	5.0E-04	1.590E-05	1.713E-08	928	639				2723.00	2931.72	2803.37	8.77					
KFM01A	270.45	275.45	1.6E-08	5.0E-04	4.317E-05	4.657E-08	927	1797				2770.17	2994.09	2774.58	8.80					
KFM01A	275.45	280.45	1.6E-08	5.0E-04	1.233E-05	1.330E-08	927	611				2889.53	3041.27	2932.26	8.86					
KFM01A	280.45	285.45	1.6E-08	5.0E-04	-4.066E-06	-4.503E-09	903	429				2909.03	3118.16	3349.42	8.92					
KFM01A	285.45	290.45	1.6E-08	5.0E-04	6.744E-06	7.468E-09	903	716				2939.60	3158.56	3160.77	8.98					
KFM01A	290.45	295.45	1.6E-08	5.0E-04	1.754E-04	1.888E-07	929	628				2962.15	3198.53	3093.27	9.02					
KFM01A	295.45	300.45	1.6E-08	5.0E-04	2.770E-05	2.975E-08	931	591				3016.64	3258.28	3056.75	9.07					
KFM01A	300.45	305.45	1.6E-08	5.0E-04	5.780E-06	3.074E-08	188	1822				3150.12	3310.15	3409.19	9.14					
KFM01A	305.45	310.45	1.6E-08	5.0E-04	5.956E-05	6.418E-08	928	675				3111.12	3358.56	3127.58	9.19					
KFM01A	310.45	315.45	1.6E-08	5.0E-04	1.093E-05	1.209E-08	904	746				3180.69	3370.46	3337.81	9.26					
KFM01A	315.45	320.45	1.6E-08	5.0E-04	6.504E-05	7.009E-08	928	657				3206.83	3418.87	3211.67	9.30					
KFM01A	320.45	325.45	1.6E-08	5.0E-04	4.198E-04	4.529E-07	927	591				3262.71	3458.43	3392.59	9.35					
KFM01A	325.45	330.45	1.6E-08	5.0E-04	2.146E-04	2.313E-07	928	598				3311.12	3523.02	3482.22	9.42					
KFM01A	330.45	335.45	1.6E-08	5.0E-04	1.374E-04	1.479E-07	929	592				3361.74	3569.63	3437.95	9.44					
KFM01A	335.45	340.45	1.6E-08	5.0E-04	6.392E-06	3.474E-08	184	331				3422.60	3618.87	3626.06	9.50					
KFM01A	360.45	365.45	1.6E-08	5.0E-04	1.973E-04	2.128E-07	927	592				3655.95	3858.86	3806.99	9.76					
KFM01A	365.45	370.45	1.6E-08	5.0E-04	7.051E-07	1.451E-09	486	617				3713.48	3908.23	3871.17	9.83					
KFM01A	370.45	375.45	1.6E-08	5.0E-04	5.496E-06	6.086E-09	903	612				3765.91	3957.48	3919.85	9.89					
KFM01A	375.45	380.45	1.6E-08	5.0E-04	1.080E-05	1.196E-08	903	621				3814.59	4006.17	3922.07	9.94					
KFM01A	380.45	385.45	1.6E-08	5.0E-04	9.009E-06	9.977E-09	903	611				3850.14	4056.37	3922.61	10.00					
KFM01A	385.45	390.45	1.6E-08	5.0E-04	7.326E-06	8.113E-09	903	668				3902.97	4105.19	3980.72	10.06					
KFM01A	390.45	395.45	1.6E-08	5.0E-04	3.622E-06	4.011E-09	903	615				3960.38	4154.02	4138.95	10.10					
KFM01A	395.45	400.45	1.6E-08	5.0E-04	7.740E-06	8.562E-09	904	1821				4007.41	4203.40	4129.53	10.14					

KFM01A Observation sections

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Section Above secup (m)	Section Above seclow (m)	Section below secup (m)	Section below seclow	pai (kPa)	pap (kPa)	paF (kPa)	pbi (kPa)	pbp (kPa)	pbF (kPa)
KFM01A	105.45	205.45	20030515 16:38	100.57	104.45	206.45	1001.45	965.34	965.34	965.34	2023.57	2033.51	2039.59
KFM01A	200.45	300.45	20030512 11:47	100.57	199.45	301.45	1001.45	2056.95	2056.40	2055.99	3040.30	3039.20	3038.23
KFM01A	300.45	400.45	20030512 15:44	100.57	299.45	401.45	1001.45	3042.69	3041.71	3041.44	4058.30	4052.91	4049.04
KFM01A	400.45	500.45	20030513 09:25	100.57	399.45	501.45	1001.45	4022.89	4022.19	4021.92	5072.13	5079.18	5078.62
KFM01A	500.45	600.45	20030513 13:22	100.57	499.45	601.45	1001.45	5001.28	5000.45	5000.18	6025.36	6055.60	6072.31
KFM01A	600.45	700.45	20030514 08:16	100.57	599.45	701.45	1001.45	5965.84	5965.43	5965.15	7003.57	7007.99	7008.54
KFM01A	700.45	800.45	20030514 12:41	100.57	699.45	801.45	1001.45	6940.78	6940.09	6940.09	7969.36	7972.40	7975.16
KFM01A	800.45	900.45	20030514 16:26	100.57	799.45	901.45	1001.45	7901.73	7901.18	7900.62	8959.72	8966.08	8972.71
KFM01A	895.45	995.45	20030514 18:45	100.57	894.45	996.45	1001.45	8814.81	8814.53	8814.11	10440.86	10619.82	10726.42
KFM01A	105.45	125.45	20030519 15:44	100.57	104.45	126.45	1001.45	1081.04	1081.32	1081.04	1280.65	1282.86	1282.32
KFM01A	125.45	145.45	20030520 08:42	100.57	124.45	146.45	1001.45	1287.96	1287.96	1287.55	1488.47	1494.28	1491.65
KFM01A	145.45	165.45	20030520 10:36	100.57	144.45	166.45	1001.45	1489.62	1489.76	1489.62	1691.05	1692.70	1691.60
KFM01A	165.45	185.45	20030520 13:02	100.57	164.45	186.45	1001.45	1692.25	1692.25	1691.70	1890.45	1888.79	1887.13
KFM01A	185.45	205.45	20030520 14:50	100.57	184.45	206.45	1001.45	1893.91	1893.77	1893.22	2090.96	2088.61	2086.54
KFM01A	200.45	220.45	20030521 09:03	100.57	199.45	221.45	1001.45	2035.92	2035.92	2036.05	2241.05	2240.09	2238.98
KFM01A	220.45	240.45	20030521 10:32	100.57	219.45	241.45	1001.45	2237.57	2237.57	2237.02	2439.49	2437.84	2436.73
KFM01A	240.45	260.45	20030521 12:51	100.57	239.45	261.45	1001.45	2438.53	2438.53	2437.99	2638.89	2638.20	2636.13
KFM01A	260.45	280.45	20030521 14:20	100.57	259.45	281.45	1001.45	2639.09	2638.95	2638.40	2839.25	2836.77	2836.08
KFM01A	280.45	300.45	20030521 16:18	100.57	279.45	301.45	1001.45	2839.36	2838.81	2838.81	3038.79	3036.58	3034.92
KFM01A	300.45	320.45	20030521 18:00	100.57	299.45	321.45	1001.45	3038.67	3038.12	3037.56	3243.99	3240.67	3238.19
KFM01A	320.45	340.45	20030522 08:29	100.57	319.45	341.45	1001.45	3229.53	3229.12	3228.57	3440.91	3439.66	3437.59
KFM01A	340.45	360.45	20030522 10:16	100.57	339.45	361.45	1001.45	3421.81	3421.54	3421.54	3643.61	3641.95	3640.85
KFM01A	360.45	380.45	20030522 11:28	100.57	359.45	381.45	1001.45	3629.11	3628.56	3628.29	3848.54	3845.77	3843.56
KFM01A	380.45	400.45	20030522 13:42	100.57	379.45	401.45	1001.45	3828.70	3828.14	3827.59	4057.33	4054.01	4051.25
KFM01A	105.45	110.45	20030526 11:30	100.57	104.45	111.45	1001.45	1109.53	1109.53	1109.53	1149.45	1149.16	1148.88
KFM01A	110.45	115.45	20030526 14:43	100.57	109.45	116.45	1001.45	1159.22	1159.36	1159.36	1201.22	1201.91	1201.36
KFM01A	115.45	120.45	20030526 16:11	100.57	114.45	121.45	1001.45	1209.74	1210.02	1209.74	1253.28	1254.94	1252.17
KFM01A	120.45	125.45	20030527 08:36	100.57	119.45	126.45	1001.45	1252.37	1252.51	1252.37	1303.13	1303.54	1302.99
KFM01A	125.45	130.45	20030527 10:20	100.57	124.45	131.45	1001.45	1303.72	1303.72	1303.30	1352.42	1352.15	1352.15
KFM01A	130.45	135.45	20030527 11:40	100.57	129.45	136.45	1001.45	1353.82	1353.68	1353.68	1400.75	1400.75	1400.75
KFM01A	135.45	140.45	20030602 08:27	100.57	134.45	141.45	1001.45	1390.77	1390.77	1390.77	1445.64	1445.92	1446.05
KFM01A	140.45	145.45	20030602 10:00	100.57	139.45	146.45	1001.45	1441.44	1441.71	1441.71	1495.76	1500.46	1497.42
KFM01A	145.45	150.45	20030602 11:32	100.57	144.45	151.45	1001.45	1492.65	1492.65	1492.65	1545.61	1548.78	1547.13
KFM01A	150.45	155.45	20030602 13:24	100.57	149.45	156.45	1001.45	1543.86	1543.99	1543.58	1596.15	1596.15	1595.74
KFM01A	155.45	160.45	20030602 14:25	100.57	154.45	161.45	1001.45	1594.51	1594.51	1594.51	1645.86	1653.18	1651.52
KFM01A	160.45	165.45	20030602 15:49	100.57	159.45	166.45	1001.45	1645.45	1645.45	1645.45	1695.16	1694.46	1694.06
KFM01A	165.45	170.45	20030602 08:37	100.57	164.45	171.45	1001.45	1692.09	1691.95	1691.95	1744.18	1743.77	1743.77
KFM01A	170.45	175.45	20030603 11:35	100.57	169.45	176.45	1001.45	1742.47	1742.34	1742.34	1792.92	1792.92	1792.92
KFM01A	175.45	180.45	20030603 13:17	100.57	174.45	181.45	1001.45	1792.99	1792.99	1792.71	1847.06	1846.50	1845.95

KFM01A Observation sections Cont.

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Section Above secup (m)	Section Above seclow (m)	Section below secup (m)	Section below seclow	pai (kPa)	pap (kPa)	paF (kPa)	pbi (kPa)	pbp (kPa)	pbF (kPa)
KFM01A	180.45	185.45	20030603 14:53	100.57	179.45	186.45	1001.45	1843.50	1843.64	1843.09	1898.15	1897.18	1896.21
KFM01A	185.45	190.45	20030604 08:24	100.57	184.45	191.45	1001.45	1888.35	1888.35	1887.93	1946.48	1945.79	1945.37
KFM01A	190.45	195.45	20030604 09:50	100.57	189.45	196.45	1001.45	1939.00	1938.86	1938.86	1996.20	1995.23	1995.09
KFM01A	195.45	200.45	20030604 11:16	100.57	194.45	201.45	1001.45	1989.39	1989.25	1989.25	2044.66	2044.53	2044.25
KFM01A	200.45	205.45	20030604 13:13	100.57	199.45	206.45	1001.45	2039.77	2039.63	2039.63	2096.31	2096.03	2095.61
KFM01A	205.45	210.45	20030604 14:09	100.57	204.45	211.45	1001.45	2090.01	2090.01	2090.01	2146.43	2145.88	2145.88
KFM01A	210.45	215.45	20030604 15:16	100.57	209.45	216.45	1001.45	2140.53	2140.39	2140.39	2196.70	2195.59	2195.59
KFM01A	215.45	220.45	20030605 08:26	100.57	214.45	221.45	1001.45	2184.68	2184.68	2184.68	2242.40	2242.12	2241.99
KFM01A	220.45	225.45	20030605 09:47	100.57	219.45	226.45	1001.45	2235.47	2235.06	2235.06	2292.81	2292.25	2291.71
KFM01A	225.45	230.45	20030605 11:20	100.57	224.45	231.45	1001.45	2285.03	2284.89	2284.33	2340.45	2340.31	2340.31
KFM01A	230.45	235.45	20030605 13:44	100.57	229.45	236.45	1001.45	2335.26	2335.26	2335.26	2391.67	2391.12	2390.57
KFM01A	235.45	240.45	20030605 15:10	100.57	234.45	241.45	1001.45	2385.65	2385.65	2385.09	2443.32	2441.94	2441.38
KFM01A	260.45	265.45	20030606 08:20	100.57	259.45	266.45	1001.45	2630.49	2630.90	2630.35	2689.94	2688.98	2688.84
KFM01A	265.45	270.45	20030606 09:42	100.57	264.45	271.45	1001.45	2681.28	2681.00	2680.73	2740.35	2739.65	2738.55
KFM01A	270.45	275.45	20030606 10:57	100.57	269.45	276.45	1001.45	2731.24	2731.11	2731.11	2790.06	2788.95	2788.26
KFM01A	275.45	280.45	20030606 12:42	100.57	274.45	281.45	1001.45	2781.21	2781.07	2780.93	2839.50	2838.40	2837.97
KFM01A	280.45	285.45	20030606 13:54	100.57	279.45	286.45	1001.45	2831.45	2831.17	2830.76	2888.79	2887.97	2887.14
KFM01A	285.45	290.45	20030606 15:24	100.57	284.45	291.45	1001.45	2881.28	2881.15	2881.15	2939.33	2938.50	2937.40
KFM01A	290.45	295.45	20030610 08:27	100.57	289.45	296.45	1001.45	2919.90	2919.90	2919.90	2979.37	2978.83	2978.27
KFM01A	295.45	300.45	20030610 09:38	100.57	294.45	301.45	1001.45	2971.38	2971.38	2971.38	3030.89	3030.19	3029.65
KFM01A	300.45	305.45	20030610 10:47	100.57	299.45	306.45	1001.45	3022.04	3022.04	3022.32	3081.01	3081.01	3079.90
KFM01A	305.45	310.45	20030610 12:24	100.57	304.45	311.45	1001.45	3072.69	3072.14	3072.14	3131.83	3131.28	3130.73
KFM01A	310.45	315.45	20030610 13:30	100.57	309.45	316.45	1001.45	3122.51	3122.51	3122.51	3182.09	3180.99	3180.99
KFM01A	315.45	320.45	20030610 14:39	100.57	314.45	321.45	1001.45	3173.05	3172.63	3172.35	3235.12	3234.01	3233.46
KFM01A	320.45	325.45	20030610 15:46	100.57	319.45	326.45	1001.45	3223.01	3222.74	3222.74	3286.49	3285.24	3284.83
KFM01A	325.45	330.45	20030611 08:18	100.57	324.45	331.45	1001.45	3268.82	3268.68	3268.68	3331.78	3331.23	3330.67
KFM01A	330.45	335.45	20030611 09:29	100.57	329.45	336.45	1001.45	3318.50	3318.64	3318.50	3383.97	3382.59	3381.48
KFM01A	335.45	340.45	20030611 10:42	100.57	334.45	341.45	1001.45	3368.89	3368.89	3368.89	3434.52	3434.52	3433.97
KFM01A	360.45	365.45	20030611 11:36	100.57	359.45	366.45	1001.45	3619.96	3619.68	3619.68	3691.92	3689.71	3688.60
KFM01A	365.45	370.45	20030611 13:13	100.57	364.45	371.45	1001.45	3669.64	3669.36	3669.50	3746.60	3744.93	3742.72
KFM01A	370.45	375.45	20030611 14:13	100.57	369.45	376.45	1001.45	3719.75	3719.33	3719.33	3799.62	3797.42	3795.75
KFM01A	375.45	380.45	20030611 15:19	100.57	374.45	381.45	1001.45	3769.72	3769.16	3769.16	3849.47	3847.26	3846.02
KFM01A	380.45	385.45	20030611 16:29	100.57	379.45	386.45	1001.45	3812.34	3812.20	3811.79	3884.54	3885.79	3885.79
KFM01A	385.45	390.45	20030612 08:39	100.57	384.45	391.45	1001.45	3862.30	3862.03	3862.16	3945.99	3944.47	3943.23
KFM01A	390.45	395.45	20030612 09:48	100.57	389.45	396.45	1001.45	3912.13	3911.85	3911.99	3996.53	3995.15	3994.05
KFM01A	395.45	400.45	20030612 10:57	100.57	394.45	401.45	1001.45	3962.38	3962.38	3961.82	4043.62	4042.66	4041.55

KFM01A Basic evaluation. Left 1

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Q/s (m^2/s)	Value type (-1, 0 or 1)	T_Q (m^2/ s)	T_M (m^2/ s)	b (m)	B (1D) (m)	TB (1D) (m^3/ s)	TB-measl-L (1D) (m^3/ s)	TB-measl-U (1D) (m^3/ s)	SB (1D) (m)	SB* (1D) (m)	L_f (1D) (m)	T_T (2D) (m^2/s)	Value type (-1, 0 or
KFM01A	105.45	205.45	20030515 16:38	4.70E-07	0		6.12E-07	100.00								1.45E-07	0
KFM01A	200.45	300.45	20030512 11:47	7.84E-09	0		1.02E-08	100.00								2.73E-09	0
KFM01A	300.45	400.45	20030512 15:44	1.81E-08	0		2.35E-08	100.00								4.32E-09	0
KFM01A	400.45	500.45	20030513 09:25	2.47E-09	0		3.10E-09	100.00								8.84E-10	0
KFM01A	500.45	600.45	20030513 13:22	6.56E-10	0		8.54E-10	100.00								2.76E-10	0
KFM01A	600.45	700.45	20030514 08:16		-1		1.08E-09	100.00								1.08E-09	-1
KFM01A	700.45	800.45	20030514 12:41		-1		1.08E-09	100.00								1.08E-09	-1
KFM01A	800.45	900.45	20030514 16:26		-1		1.08E-09	100.00								1.08E-09	-1
KFM01A	895.45	995.45	20030514 18:45		-1		1.08E-09	100.00								1.08E-09	-1
KFM01A	105.45	125.45	20030519 15:44	2.58E-07	0		2.70E-07	20.00								8.58E-08	0
KFM01A	125.45	145.45	20030520 08:42	2.35E-08	0		2.46E-08	20.00								9.12E-09	0
KFM01A	145.45	165.45	20030520 10:36	2.15E-07	0		2.26E-07	20.00								1.11E-07	0
KFM01A	165.45	185.45	20030520 13:02	1.00E-07	0		1.05E-07	20.00								2.96E-08	0
KFM01A	185.45	205.45	20030520 14:50	5.84E-09	0		6.12E-09	20.00								2.22E-09	0
KFM01A	200.45	220.45	20030521 09:03		-1		8.75E-10	20.00								8.75E-10	-1
KFM01A	220.45	240.45	20030521 10:32	1.71E-09	0		1.79E-09	20.00								4.70E-10	0
KFM01A	240.45	260.45	20030521 12:51		-1		8.75E-10	20.00								8.75E-10	-1
KFM01A	260.45	280.45	20030521 14:20	2.53E-09	0		2.66E-09	20.00								1.47E-09	0
KFM01A	280.45	300.45	20030521 16:18	4.59E-09	0		4.80E-09	20.00								1.48E-09	0
KFM01A	300.45	320.45	20030521 18:00	3.61E-09	0		3.78E-09	20.00								2.68E-09	0
KFM01A	320.45	340.45	20030522 08:29	1.56E-08	0		1.64E-08	20.00								7.14E-09	0
KFM01A	340.45	360.45	20030522 10:16		-1		8.75E-10	20.00								8.75E-10	-1
KFM01A	360.45	380.45	20030522 11:28	2.72E-09	0		2.84E-09	20.00								2.76E-09	0
KFM01A	380.45	400.45	20030522 13:42	6.96E-10	0		7.28E-10	20.00								2.63E-10	0
KFM01A	105.45	110.45	20030526 11:30	4.44E-09	0		3.66E-09	5.00								2.38E-09	0
KFM01A	110.45	115.45	20030526 14:43	5.49E-08	0		4.54E-08	5.00								1.03E-08	0
KFM01A	115.45	120.45	20030526 16:11	1.39E-07	0		1.15E-07	5.00								7.07E-08	0
KFM01A	120.45	125.45	20030527 08:36	9.17E-08	0		7.55E-08	5.00								1.95E-08	0
KFM01A	125.45	130.45	20030527 11:40	4.10E-09	0		3.39E-09	5.00								2.50E-09	0
KFM01A	130.45	135.45	20030602 08:27		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	135.45	140.45	20030602 10:00		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	140.45	145.45	20030602 10:00	2.05E-08	0		1.70E-08	5.00								1.70E-08	0
KFM01A	145.45	150.45	20030602 11:32	1.67E-07	0		1.39E-07	5.00								9.10E-08	0
KFM01A	150.45	155.45	20030602 13:24		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	155.45	160.45	20030602 14:25	7.69E-08	0		6.35E-08	5.00								4.61E-08	0
KFM01A	160.45	165.45	20030602 15:49	1.21E-08	0		1.00E-08	5.00								4.85E-09	0
KFM01A	165.45	170.45	20030602 08:37		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	170.45	175.45	20030603 11:35	1.51E-09	0		1.25E-09	5.00								5.26E-10	0
KFM01A	175.45	180.45	20030603 13:17	1.08E-07	0		8.95E-08	5.00								3.18E-08	0
KFM01A	180.45	185.45	20030603 14:53		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	185.45	190.45	20030604 08:24	4.29E-09	0		3.54E-09	5.00								2.71E-09	0

KFM01A Basic Evaluation. Left 2

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Q/s (m^2/s)	Value type (-1, 0 or 1)	T_Q (m^2/ s)	T_M (m^2/ s)	b (m)	B (1D) (m)	TB (1D) (m^3/ s)	TB-measl-L (1D) (m^3/ s)	TB-measl-U (1D) (m^3/ s)	SB (1D) (m)	SB* (1D) (m)	L_f (1D) (m)	T_T (2D) (m^2/s)	Value type (-1, 0 or
KFM01A	190.45	195.45	20030604 09:50	1.44E-09	0		1.19E-09	5.00								4.22E-10	-1
KFM01A	195.45	200.45	20030604 11:16		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	200.45	205.45	20030604 13:13		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	205.45	210.45	20030604 14:09		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	210.45	215.45	20030604 15:16		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	215.45	220.45	20030605 08:26		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	220.45	225.45	20030605 09:47		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	225.45	230.45	20030605 11:20	1.39E-09	0		1.15E-09	5.00								3.96E-10	0
KFM01A	230.45	235.45	20030605 13:44		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	235.45	240.45	20030605 15:10		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	260.45	265.45	20030606 08:20		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	265.45	270.45	20030606 09:42	3.21E-10	0		2.66E-10	5.00								1.19E-10	0
KFM01A	270.45	275.45	20030606 10:57	1.56E-09	0		1.29E-09	5.00								5.53E-10	0
KFM01A	275.45	280.45	20030606 12:42	5.81E-10	0		4.80E-10	5.00								1.74E-10	0
KFM01A	280.45	285.45	20030606 13:54		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	285.45	290.45	20030606 15:24		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	290.45	295.45	20030610 08:27	4.07E-09	0		3.36E-09	5.00								2.53E-09	-1
KFM01A	295.45	300.45	20030610 09:38	7.82E-10	0		6.45E-10	5.00								2.98E-10	0
KFM01A	300.45	305.45	20030610 10:47		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	305.45	310.45	20030610 12:24	1.94E-09	0		1.61E-09	5.00								1.65E-09	0
KFM01A	310.45	315.45	20030610 13:30		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	315.45	320.45	20030610 14:39	1.35E-09	0		1.12E-09	5.00								2.82E-09	0
KFM01A	320.45	325.45	20030610 15:46	8.92E-09	0		7.40E-09	5.00								7.40E-09	0
KFM01A	325.45	330.45	20030611 08:18	2.77E-09	0		2.29E-09	5.00								6.05E-10	-1
KFM01A	330.45	335.45	20030611 09:29	4.53E-09	0		3.74E-09	5.00								7.51E-09	0
KFM01A	335.45	340.45	20030611 10:42		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	360.45	365.45	20030611 11:36	3.29E-09	0		2.72E-09	5.00								4.42E-09	0
KFM01A	365.45	370.45	20030611 13:13		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	370.45	375.45	20030611 14:13		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	375.45	380.45	20030611 15:19		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	380.45	385.45	20030611 16:29		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	385.45	390.45	20030612 08:39		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	390.45	395.45	20030612 09:48		-1		6.88E-10	5.00								6.88E-10	-1
KFM01A	395.45	400.45	20030612 10:57		-1		6.88E-10	5.00								6.88E-10	-1

KFM01A Basic evaluation. Right 1

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Q/s measl-L (m^2/ s)	Q/s measl-U (m^2/ s)	S (2D) (-)	S* (2D) (-)	K´/b´ (2D) (1/s)	K_S (3D) (m/s)	K_S-measl-L (3D) (m/s)	K_S-measl-U (3D) (m/s)	S_S (3D) (1/m)	S_S* (3D) (1/m)	L_p (m)	C (m**3/Pa)	C_D (-)	ξ (2D) (-)	ω (-)	λ (-)	dt_1 (s)	dt_2 (s)	Comments (-)
KFM01A	105.45	205.45	20030515 16:38	8.3E-10	2.5E-5		1.00E-06										-4.39			500	1800	
KFM01A	200.45	300.45	20030512 11:47	8.3E-10	2.5E-5		1.00E-06								4.20E-10		-2.16			300	1800	
KFM01A	300.45	400.45	20030512 15:44	8.3E-10	2.5E-5		1.00E-06										-3.16			550	1800	
KFM01A	400.45	500.45	20030513 09:25	8.3E-10	2.5E-5		1.00E-06								1.85E-10		-1.53			240	1800	
KFM01A	500.45	600.45	20030513 13:22	8.3E-10	2.5E-5		1.00E-06								2.15E-10		-1.08			70	1800	
KFM01A	600.45	700.45	20030514 08:16	8.3E-10	2.5E-5		1.00E-06															
KFM01A	700.45	800.45	20030514 12:41	8.3E-10	2.5E-5		1.00E-06															
KFM01A	800.45	900.45	20030514 16:26	8.3E-10	2.5E-5		1.00E-06															
KFM01A	895.45	995.45	20030514 18:45	8.3E-10	2.5E-5		1.00E-06															
KFM01A	105.45	125.45	20030519 15:44	8.3E-10	2.5E-5		1.00E-06										-3.83			250	1200	
KFM01A	125.45	145.45	20030520 08:42	8.3E-10	2.5E-5		1.00E-06										-2.34			80	700	
KFM01A	145.45	165.45	20030520 10:36	8.3E-10	2.5E-5		1.00E-06										-3.18			800	1200	
KFM01A	165.45	185.45	20030520 13:02	8.3E-10	2.5E-5		1.00E-06										-3.50			300	1200	
KFM01A	185.45	205.45	20030520 14:50	8.3E-10	2.5E-5		1.00E-06								5.17E-10		-1.59			300	1200	uncertain fitting
KFM01A	200.45	220.45	20030521 09:03	8.3E-10	2.5E-5		1.00E-06															
KFM01A	220.45	240.45	20030521 10:32	8.3E-10	2.5E-5		1.00E-06								1.28E-10		-1.44			100	1200	uncertain fitting
KFM01A	240.45	260.45	20030521 12:51	8.3E-10	2.5E-5		1.00E-06															
KFM01A	260.45	280.45	20030521 14:20	8.3E-10	2.5E-5		1.00E-06								7.95E-11		-1.59			400	1200	
KFM01A	280.45	300.45	20030521 16:18	8.3E-10	2.5E-5		1.00E-06										-2.03			100	1200	
KFM01A	300.45	320.45	20030521 18:00	8.3E-10	2.5E-5		1.00E-06								9.25E-11		0.45			200	1200	
KFM01A	320.45	340.45	20030522 08:29	8.3E-10	2.5E-5		1.00E-06										-2.74			30	150	
KFM01A	340.45	360.45	20030522 10:16	8.3E-10	2.5E-5		1.00E-06															
KFM01A	360.45	380.45	20030522 11:28	8.3E-10	2.5E-5		1.00E-06								3.16E-10		-2.06			200	1200	
KFM01A	380.45	400.45	20030522 13:42	8.3E-10	2.5E-5		1.00E-06								6.16E-11		-0.43			300	1200	
KFM01A	105.45	110.45	20030526 11:30	8.3E-10	2.5E-5		1.00E-06										-1.12			100	900	
KFM01A	110.45	115.45	20030526 14:43	8.3E-10	2.5E-5		1.00E-06										-3.50			200	900	
KFM01A	115.45	120.45	20030526 16:11	8.3E-10	2.5E-5		1.00E-06										-2.37			150	900	
KFM01A	120.45	125.45	20030527 08:36	8.3E-10	2.5E-5		1.00E-06										-3.70			200	900	
KFM01A	125.45	130.45	20030527 11:40	8.3E-10	2.5E-5		1.00E-06										-2.31			10	200	
KFM01A	130.45	135.45	20030602 08:27	8.3E-10	2.5E-5		1.00E-06															
KFM01A	135.45	140.45	20030602 10:00	8.3E-10	2.5E-5		1.00E-06															
KFM01A	140.45	145.45	20030602 10:00	8.3E-10	2.5E-5		1.00E-06													100	900	
KFM01A	145.45	150.45	20030602 11:32	8.3E-10	2.5E-5		1.00E-06										-2.52			80	900	
KFM01A	150.45	155.45	20030602 13:24	8.3E-10	2.5E-5		1.00E-06								1.84E-11							
KFM01A	155.45	160.45	20030602 14:25	8.3E-10	2.5E-5		1.00E-06										-2.22			500	900	
KFM01A	160.45	165.45	20030602 15:49	8.3E-10	2.5E-5		1.00E-06										-1.93			600	900	
KFM01A	165.45	170.45	20030602 08:37	8.3E-10	2.5E-5		1.00E-06								3.33E-11							
KFM01A	170.45	175.45	20030603 11:35	8.3E-10	2.5E-5		1.00E-06								4.04E-11		-0.65			100	900	uncertain fitting, 1)

KFM01A Basic Evaluation. Right 2

Borehole	Borehole secup (m)	Borehole seclow (m)	Date and time for test, start YYYYMMDD hh:mm	Q/s measI-L (m^2/ s)	Q/s measI-U (m^2/ s)	S (2D) (-)	S* (2D) (-)	K´/b´ (2D) (1/s)	K_S (3D) (m/s)	K_S-measI-L (3D) (m/s)	K_S-measI-U (3D) (m/s)	S_S (3D) (1/m)	S_S* (3D) (1/m)	L_p (m)	C (m**3/Pa)	C_D (-)	ξ (2D) (-)	ω (-)	λ (-)	dt_1 (s)	dt_2 (s)	Comments (-)
KFM01A	175.45	180.45	20030603 13:17	8.3E-10	2.5E-5		1.00E-06										-3.65			60	900	
KFM01A	180.45	185.45	20030603 14:53	8.3E-10	2.5E-5		1.00E-06								3.65E-11							
KFM01A	185.45	190.45	20030604 08:24	8.3E-10	2.5E-5		1.00E-06								6.61E-11		-0.03			100	900	
KFM01A	190.45	195.45	20030604 09:50	8.3E-10	2.5E-5		1.00E-06										-1.84			100	900	
KFM01A	195.45	200.45	20030604 11:16	8.3E-10	2.5E-5		1.00E-06															
KFM01A	200.45	205.45	20030604 13:13	8.3E-10	2.5E-5		1.00E-06															
KFM01A	205.45	210.45	20030604 14:09	8.3E-10	2.5E-5		1.00E-06															
KFM01A	210.45	215.45	20030604 15:16	8.3E-10	2.5E-5		1.00E-06															
KFM01A	215.45	220.45	20030605 08:26	8.3E-10	2.5E-5		1.00E-06															
KFM01A	220.45	225.45	20030605 09:47	8.3E-10	2.5E-5		1.00E-06								3.13E-11		-0.03					
KFM01A	225.45	230.45	20030605 11:20	8.3E-10	2.5E-5		1.00E-06								6.62E-11		-1.24			300	900	
KFM01A	230.45	235.45	20030605 13:44	8.3E-10	2.5E-5		1.00E-06															
KFM01A	235.45	240.45	20030605 15:10	8.3E-10	2.5E-5		1.00E-06															
KFM01A	260.45	265.45	20030606 08:20	8.3E-10	2.5E-5		1.00E-06															
KFM01A	265.45	270.45	20030606 09:42	8.3E-10	2.5E-5		1.00E-06								2.14E-11		0.14			100	900	
KFM01A	270.45	275.45	20030606 10:57	8.3E-10	2.5E-5		1.00E-06								2.38E-11		-0.42			30	900	
KFM01A	275.45	280.45	20030606 12:42	8.3E-10	2.5E-5		1.00E-06								2.56E-11		0.04			10	900	
KFM01A	280.45	285.45	20030606 13:54	8.3E-10	2.5E-5		1.00E-06															
KFM01A	285.45	290.45	20030606 15:24	8.3E-10	2.5E-5		1.00E-06															
KFM01A	290.45	295.45	20030610 08:27	8.3E-10	2.5E-5		1.00E-06								1.64E-10		-1.20			300	900	
KFM01A	295.45	300.45	20030610 09:38	8.3E-10	2.5E-5		1.00E-06								1.91E-11		1.61			10	900	
KFM01A	300.45	305.45	20030610 10:47	8.3E-10	2.5E-5		1.00E-06															
KFM01A	305.45	310.45	20030610 12:24	8.3E-10	2.5E-5		1.00E-06								2.46E-11		1.14			50	900	
KFM01A	310.45	315.45	20030610 13:30	8.3E-10	2.5E-5		1.00E-06															
KFM01A	315.45	320.45	20030610 14:39	8.3E-10	2.5E-5		1.00E-06								1.95E-11		0.28			100	900	
KFM01A	320.45	325.45	20030610 15:46	8.3E-10	2.5E-5		1.00E-06													3	50	
KFM01A	325.45	330.45	20030611 08:18	8.3E-10	2.5E-5		1.00E-06										-1.98			300	900	
KFM01A	330.45	335.45	20030611 09:29	8.3E-10	2.5E-5		1.00E-06								1.94E-11		1.73			200	900	
KFM01A	335.45	340.45	20030611 10:42	8.3E-10	2.5E-5		1.00E-06															
KFM01A	360.45	365.45	20030611 11:36	8.3E-10	2.5E-5		1.00E-06										-1.80			500	900	
KFM01A	365.45	370.45	20030611 13:13	8.3E-10	2.5E-5		1.00E-06															
KFM01A	370.45	375.45	20030611 14:13	8.3E-10	2.5E-5		1.00E-06															
KFM01A	375.45	380.45	20030611 15:19	8.3E-10	2.5E-5		1.00E-06															
KFM01A	380.45	385.45	20030611 16:29	8.3E-10	2.5E-5		1.00E-06															
KFM01A	385.45	390.45	20030612 08:39	8.3E-10	2.5E-5		1.00E-06															
KFM01A	390.45	395.45	20030612 09:48	8.3E-10	2.5E-5		1.00E-06															
KFM01A	395.45	400.45	20030612 10:57	8.3E-10	2.5E-5		1.00E-06															

1) The test may have been disturbed by a previous injection in the same section.

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Forsmark site investigation

Single-hole injection tests in borehole KFM01A

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Keywords: Forsmark, Hydrogeology, Hydraulic tests, Injection tests, Single-hole tests, Hydraulic parameters, Transmissivity, Hydraulic conductivity, AP PF 400-03-22, Field note no Forsmark 145.

Abstract

Borehole KFM01A, which was the first cored borehole in the site investigations in the Forsmark area, is of SKB hydrochemistry type. It is designed as a so called telescopic borehole in order to make it possible to install certain borehole equipment in the upper c 100 m with larger diameter than the rest of the borehole. The borehole is sub-vertical, c 1000 m deep and cased to c 100 m depth. The borehole diameter is c 76 mm in the interval 100–1000 m.

This report presents injection tests performed with the pipe string system PSS3 in borehole KFM01A and the results obtained.

The main aim of the injection tests in KFM01A was to characterize the rock aquifer adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m) regarding hydrogeological properties. Hydraulic parameters like transmissivity, conductivity, dominating flow regime and possible outer hydraulic boundaries were determined using analysis methods for stationary as well as transient conditions.

In addition, a comparison with the results of the previously performed difference flow logging and hydro-geochemical characterisation in KFM01A was made.

The injection tests showed consistent results on the different measurement scales regarding transmissivity. During most of the tests (above the measurement limit), a certain period with pseudo-radial flow could be identified from the flow period making a standard transient evaluation possible. However, the recovery period was for most tests strongly affected by wellbore storage effects due to the low-conductive conditions, making a unique transient evaluation on this period more difficult.

The injection tests also gave consistent results with the previous difference flow logging, although some differences occurred for calculated transmissivities in the same 5 m sections. However, these differences are in most cases regarded to be within the uncertainty intervals of the two methods.

The injection tests provide a platform 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 KFM01A, som var det första kärnborrhålet i platsundersökningarna i Forsmarksområdet, är av SKB kemityp. 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 subvertikalt, ca 1000 m djupt och försett med foderrör till ca 100 m djup. Borrhålsdiametern är ca 76 mm i intervallet 100–1000 m.

Föreliggande rapport beskriver genomförda injektionstester med rörgångssystemet PSS3 i borrhål KFM01A samt resultaten från desamma.

Huvudsyftet med injektionstesterna var att karaktärisera berggrundsakvifären runt borrhålet i olika mätskalor (100 m, 20 m och 5 m) med avseende på hydrogeologiska egenskaper. Hydrauliska parametrar såsom transmissivitet, konduktivitet, dominerande flödesregim och eventuella yttre hydrauliska randvillkor bestämdes med hjälp av analysmetoder för såväl stationära som transienta förhållanden.

En jämförelse med resultaten av den tidigare utförda differensflödesloggningen och den hydrokemiska karaktäriseringen i KFM01A gjordes också.

Injektionstesterna gav samstämmiga resultat för de olika mätskalorna beträffande beräknad transmissivitet. Under de flesta tester (över mätgränsen) kunde en viss period med pseudo-radiellt flöde identifieras från flödesperioden, vilket möjliggjorde en standardmässig transient utvärdering. Återhämtningsperioden för de flesta tester var däremot starkt påverkad av brunnsmagasinseffekter på grund av de lågkonduktiva förhållandena, vilket medförde att en unik transient utvärdering av denna period blev svårare.

Injektionstesterna gav i stort samstämmiga resultat med differensflödesloggningen. Vissa skillnader kunde dock konstateras för beräknade transmissiviteter i samma 5 m sektioner, men skillnaderna ligger i de flesta fall inom de båda metodernas osäkerhetsintervall.

Resultaten från injektionstesterna utgör en databas för statistisk analys av den hydrauliska konduktivitetens fördelning längs borrhålet i olika mätskalor. 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 KFM01A at Forsmark, Sweden, were carried out during May – June, 2003. The commission was conducted by Geosigma AB. Borehole KFM01A was the first deep cored borehole within the frame of the on-going site investigation in the Forsmark area and is of SKB hydrochemical type. It is designed as a so called telescopic borehole to make it possible to install certain borehole equipment in the upper c 100 m, where the diameter is larger than in the lower part of the borehole. KFM01A is sub-vertical, c 1000 m deep and cased to c 100 m depth. The borehole diameter is c 76 mm in the interval 100–1000 m. The location of the borehole is shown in Figure 1-1.

In KFM01A, difference flow logging was previously performed in November, 2002. According to the results of the latter investigation, the main part of the borehole is very low-conductive. The total flow rate from the borehole was slightly less than 0.2 L/min at a drawdown of c 11 m during the difference flow logging.

Measurements were carried out according to the Activity Plan AP PF 400-03-22 Version 1.0 (SKB internal controlling documents). Data and results were delivered to the SKB site characterization database SICADA under field note no Forsmark 145.

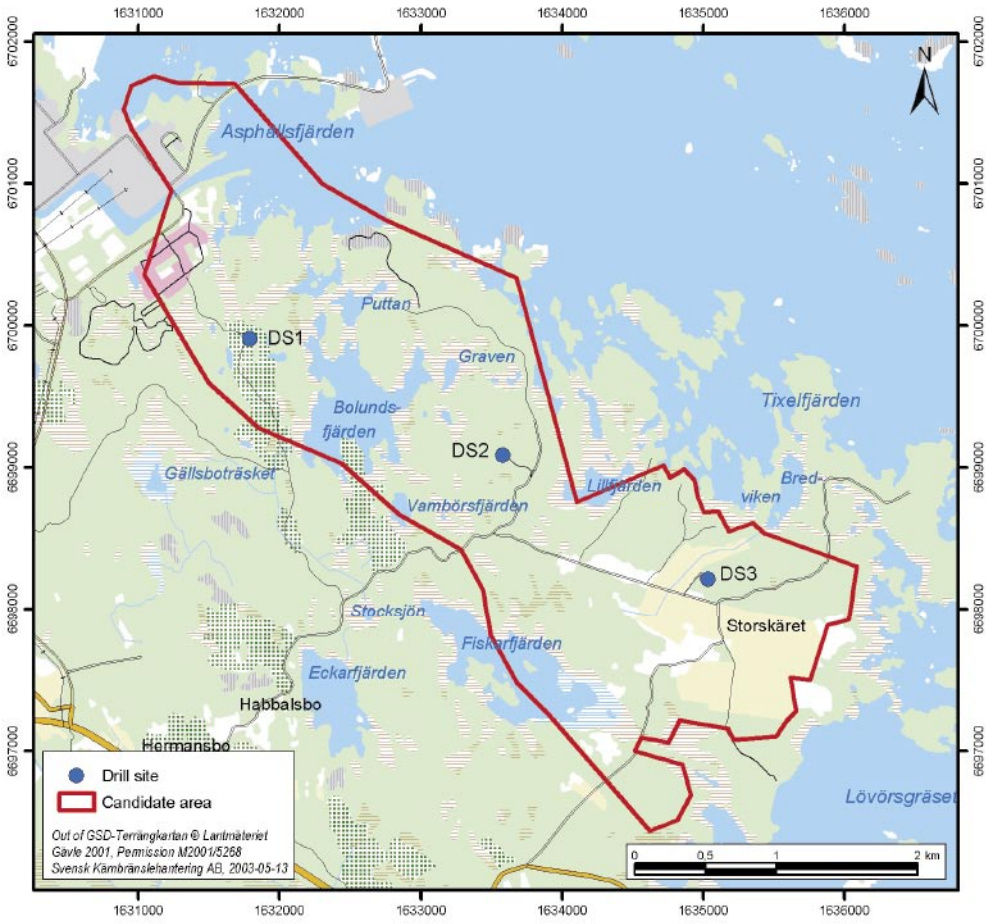

Figure 1-1. *The investigation area at Forsmark including the candidate area selected for more detailed investigations. The drilling sites for the earliest drilled deep cored boreholes are marked with blue dots. Borehole KFM01A is situated at drilling site 1.*

2 Objectives

The main aim of the injection tests in borehole KFM01A was to characterize the rock aquifer adjacent to the borehole on different measurement scales (100 m, 20 m and 5 m) regarding hydrogeological properties. 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 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, which were determined by applying 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 KFM01A was also included in the activity, to be used as a check of the plausibility of the test results obtained. The comparison also aimed at a deepened overall analysis of the hydraulic conditions of borehole KFM01A.

3 Scope

3.1 Boreholes

Technical data of the borehole tested are shown in Table 3-1 and in Appendix 4. Secup and Seclow denote the upper and lower limits, respectively (borehole length) of drilling intervals. The reference point in the borehole is always the centre of top of casing (ToC), given as “Elevation” in the table below. The Swedish National coordinate system (RT90) is used in the x-y-direction together with RHB70 in the z-direction. “Northing” and “Easting” refer to the top of the borehole. The borehole diameter in Table 3-1 refers to the final diameter of the drill bit after drilling to full depth.

Table 3-1. Technical data of borehole KFM01A (from SICADA).

Borehole length (m):	1001.450				
Drilling Period(s):	From Date	To Date	Secup(m)	Seclow(m)	Drilling Type
	2002-05-07	2002-06-10	0.000	100.570	Percussion drilling
	2002-06-25	2002-10-28	100.570	1001.490	Core drilling
Starting point coordinate:	Length(m)	Northing(m)	Easting(m)	Elevation	Coord System
	0.000	6699529.813	1631397.160	3.125	RT90–RHB70
Angles:	Length(m)	Bearing	Inclination (– = down)		
	0.000	318.352	–84.734		
Borehole diameter:	Secup(m)	Seclow(m)	Hole Diam(m)		
	0.000	12.000	0.440		
	12.000	29.400	0.358		
	29.400	100.480	0.251		
	100.480	100.520	0.164		
	100.520	102.130	0.086		
	102.130	1001.450	0.076		
Core diameter:	Secup(m)	Seclow(m)	Core Diam(m)		
	100.520	101.080	0.072		
	101.080	1001.450	0.051		
Casing diameter:	Secup(m)	Seclow(m)	Case In(m)	Case Out(m)	
	0.000	29.400	0.265	0.273	
	0.000	100.400	0.200	0.208	
	97.330	97.330	0.195	0.199	
	101.990	101.990	0.080	0.084	

3.2 Tests performed

The injection tests performed according to Activity Plan AP PF 400-03-22 Version 1.0 (SKB internal controlling document) in borehole KFM01A are listed in Table 3-2. Test number (Test no) shows the number of tests that have been performed in the actual section. The injection tests were carried out with the Pipe String System, PSS3. The tests are described, together with the equipment, in the technical description of the PSS measurement system (SKB MD 345.100–01, Version 1.0, SKB internal document) and in the corresponding methodology descriptions for hydraulic injection tests (SKB MD 323.001 Metodbeskrivning för Hydrauliska injektionstester, Version 1.0, SKB internal document).

The upper and lower limits for the test sections were in most cases the same as the upper and lower section limits used during the previous sequential difference flow logging in KFM01A /2/. A few exceptions were made to avoid the risk of packer failure when expanding packers at borehole intervals with cavities. As a result, some sections overlap.

Table 3-2. Single-hole injection tests performed in borehole KFM01A.

Borehole	Test section		Section length (m)	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
KFM01A	105.45	205.45	100	3	1	20030515 16:38	20030515 18:30
KFM01A	200.45	300.45	100	3	1	20030512 11:47	20030512 14:01
KFM01A	300.45	400.45	100	3	1	20030512 15:44	20030512 17:24
KFM01A	400.45	500.45	100	3	1	20030513 09:25	20030513 11:06
KFM01A	500.45	600.45	100	3	1	20030513 13:22	20030513 15:16
KFM01A	600.45	700.45	100	3	1	20030514 08:16	20030514 10:06
KFM01A	700.45	800.45	100	3	1	20030514 12:41	20030514 14:33
KFM01A	800.45	900.45	100	3	1	20030514 16:26	20030514 18:00
KFM01A	895.45	995.45	100	3	1	20030514 18:45	20030514 19:57
KFM01A	105.45	125.45	20	3	1	20030519 15:44	20030519 17:13
KFM01A	125.45	145.45	20	3	1	20030520 08:42	20030520 10:01
KFM01A	145.45	165.45	20	3	1	20030520 10:36	20030520 11:57
KFM01A	165.45	185.45	20	3	1	20030520 13:02	20030520 14:24
KFM01A	185.45	205.45	20	3	1	20030520 14:50	20030520 16:11
KFM01A	200.45	220.45	20	3	1	20030521 09:03	20030521 10:15
KFM01A	220.45	240.45	20	3	1	20030521 10:32	20030521 11:54
KFM01A	240.45	260.45	20	3	1	20030521 12:51	20030521 14:02
KFM01A	260.45	280.45	20	3	1	20030521 14:20	20030521 15:43
KFM01A	280.45	300.45	20	3	1	20030521 16:18	20030521 17:42
KFM01A	300.45	320.45	20	3	1	20030521 18:00	20030521 19:19
KFM01A	320.45	340.45	20	3	1	20030522 08:29	20030522 09:51
KFM01A	340.45	360.45	20	3	1	20030522 10:16	20030522 11:12
KFM01A	360.45	380.45	20	3	1	20030522 11:28	20030522 13:23
KFM01A	380.45	400.45	20	3	1	20030522 13:42	20030522 15:03
KFM01A	105.45	110.45	5	3	1	20030526 11:30	20030526 14:07
KFM01A	110.45	115.45	5	3	1	20030526 14:43	20030526 15:54
KFM01A	115.45	120.45	5	3	1	20030526 16:11	20030526 17:18
KFM01A	120.45	125.45	5	3	1	20030527 08:36	20030527 09:51
KFM01A	125.45	130.45	5	3	1	20030527 10:20	20030527 11:30
KFM01A	130.45	135.45	5	3	1	20030527 11:40	20030527 13:29
KFM01A	135.45	140.45	5	3	1	20030602 08:27	20030602 09:41
KFM01A	140.45	145.45	5	3	1	20030602 10:00	20030602 11:11
KFM01A	145.45	150.45	5	3	1	20030602 11:32	20030602 13:08
KFM01A	150.45	155.45	5	3	1	20030602 13:24	20030602 14:13
KFM01A	155.45	160.45	5	3	1	20030602 14:25	20030602 15:34
KFM01A	160.45	165.45	5	3	1	20030602 15:49	20030602 16:56
KFM01A	165.45	170.45	5	3	1	20030602 08:37	20030603 09:49

Borehole	Test section		Section length (m)	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
KFM01A	170.45	175.45	5	3	1	20030603 11:35	20030603 13:08
KFM01A	175.45	180.45	5	3	1	20030603 13:17	20030603 14:22
KFM01A	180.45	185.45	5	3	1	20030603 14:53	20030603 15:55
KFM01A	185.45	190.45	5	3	1	20030604 08:24	20030604 09:40
KFM01A	190.45	195.45	5	3	1	20030604 09:50	20030604 10:57
KFM01A	195.45	200.45	5	3	1	20030604 11:16	20030604 13:02
KFM01A	200.45	205.45	5	3	1	20030604 13:13	20030604 14:00
KFM01A	205.45	210.45	5	3	1	20030604 14:09	20030604 14:54
KFM01A	210.45	215.45	5	3	1	20030604 15:16	20030604 16:10
KFM01A	215.45	220.45	5	3	1	20030605 08:26	20030605 09:37
KFM01A	220.45	225.45	5	3	1	20030605 09:47	20030605 11:03
KFM01A	225.45	230.45	5	3	1	20030605 11:20	20030605 13:35
KFM01A	230.45	235.45	5	3	1	20030605 13:44	20030605 14:59
KFM01A	235.45	240.45	5	3	1	20030605 15:10	20030605 16:14
KFM01A	260.45	265.45	5	3	1	20030606 08:20	20030606 09:21
KFM01A	265.45	270.45	5	3	1	20030606 09:42	20030606 10:46
KFM01A	270.45	275.45	5	3	1	20030606 10:57	20030606 12:20
KFM01A	275.45	280.45	5	3	1	20030606 12:42	20030606 13:45
KFM01A	280.45	285.45	5	3	1	20030606 13:54	20030606 14:58
KFM01A	285.45	290.45	5	3	1	20030606 15:24	20030606 16:31
KFM01A	290.45	295.45	5	3	1	20030610 08:27	20030610 09:27
KFM01A	295.45	300.45	5	3	1	20030610 09:38	20030610 10:37
KFM01A	300.45	305.45	5	3	1	20030610 10:47	20030610 11:55
KFM01A	305.45	310.45	5	3	1	20030610 12:24	20030610 13:24
KFM01A	310.45	315.45	5	3	1	20030610 13:30	20030610 14:31
KFM01A	315.45	320.45	5	3	1	20030610 14:39	20030610 15:38
KFM01A	320.45	325.45	5	3	1	20030610 15:46	20030610 16:45
KFM01A	325.45	330.45	5	3	1	20030611 08:18	20030611 09:18
KFM01A	330.45	335.45	5	3	1	20030611 09:29	20030611 10:34
KFM01A	335.45	340.45	5	3	1	20030611 10:42	20030611 11:23
KFM01A	360.45	365.45	5	3	1	20030611 11:36	20030611 13:03
KFM01A	365.45	370.45	5	3	1	20030611 13:13	20030611 14:05
KFM01A	370.45	375.45	5	3	1	20030611 14:13	20030611 15:11
KFM01A	375.45	380.45	5	3	1	20030611 15:19	20030611 16:23
KFM01A	380.45	385.45	5	3	1	20030611 16:29	20030612 08:32
KFM01A	385.45	390.45	5	3	1	20030612 08:39	20030612 09:39
KFM01A	390.45	395.45	5	3	1	20030612 09:48	20030612 10:48
KFM01A	395.45	400.45	5	3	1	20030612 10:57	20030612 12:17

[1)] 3: Injection test

3.3 Control of equipment

The PSS3 equipment was fully maintained according to SKB MB 345.122 (SKB internal document) and SKB MB 345.122 (SKB internal document) in January 2003. A complementary calibration of new pressure sensors was performed in March 2003.

Functioning checks of the equipment were performed during the establishment of PSS at the test site. To check the function of the pressure sensors, the pressure in air was recorded and found to be as expected. Submerged in water while lowering, the sensors coincided well to the total head of water ($p/\rho g$). The temperature sensor showed expected values in both air and water.

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

4 Description of equipment

4.1 Overview

4.1.1 Measurement container

All equipment needed to perform the injection tests is located in a steel container (Figure 4-1). The container is divided into a data-room and workshop compartment. The container is placed on pallets to get a correct working level in relation to the borehole casing.

The hoisting rig is of a hydraulically 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 a limit value for the load may be adjusted. The maximum load is 22 kN.

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

The injection system consists of a tank, a pump and a flow meter unit at the surface. 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.

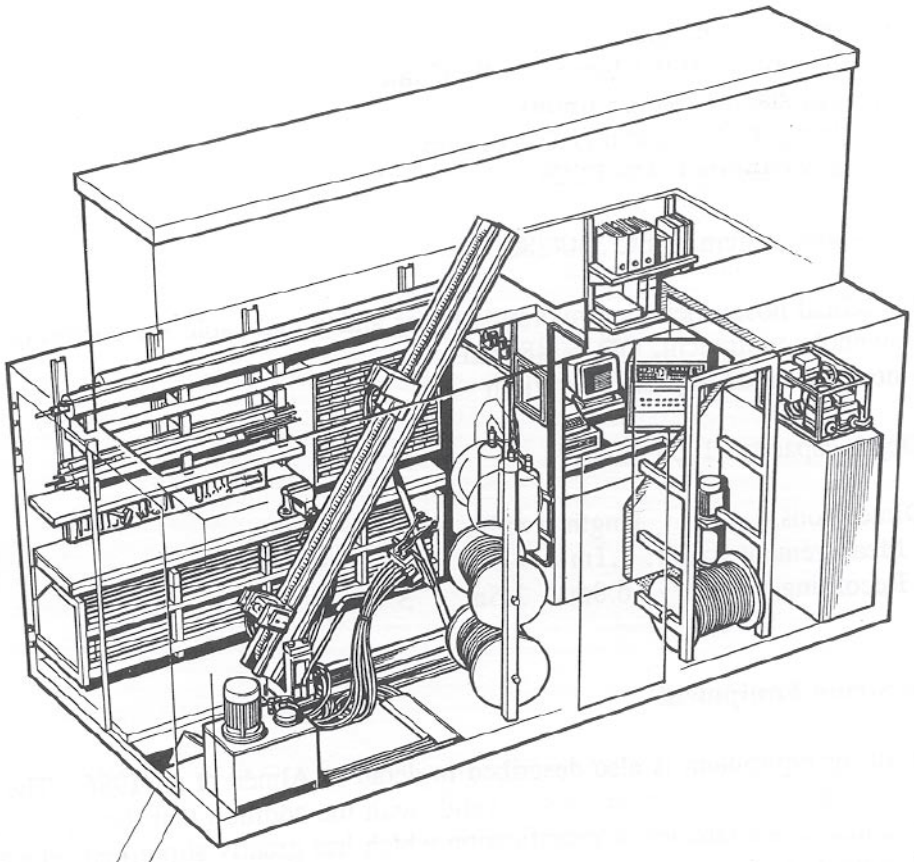

Figure 4-1. *Outline of the PSS3 container with equipment.*

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 (Pa), within (P) and below the test section (Pb), which is isolated by two packers. The groundwater temperature in the test section is 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 end of the borehole equipment, a level indicator (caliper type) gives a signal when the reference depth marks along the borehole are passed.

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

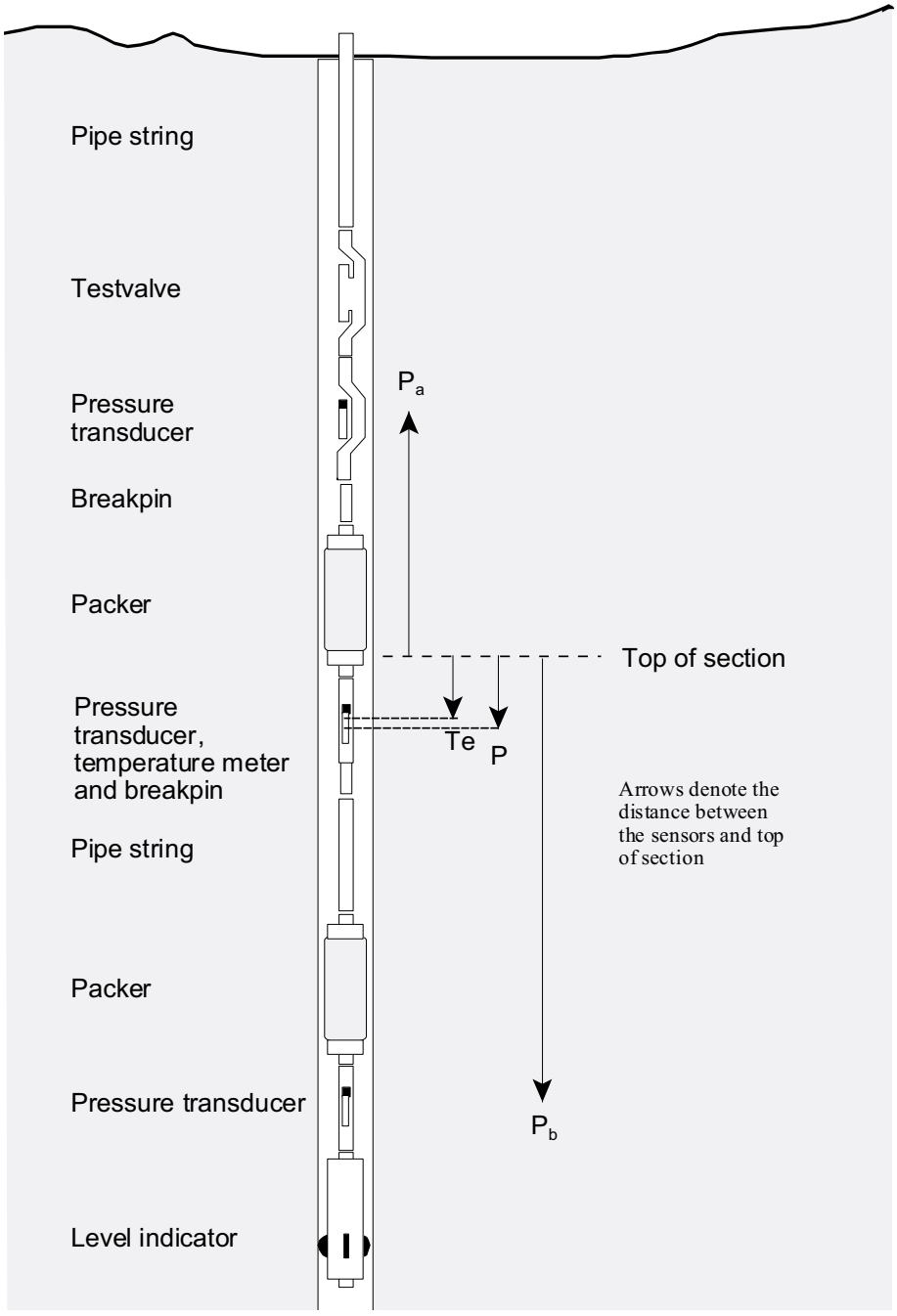

Figure 4-2. *Schematic drawing of the down-hole equipment in the PSS3 system.*

4.2 Measurement sensors

Technical specifications of the measurement sensors included in the PSS system together with corresponding data of the system are shown in Table 4-1.

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

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

Technical specification					
Parameter		**Unit**	**Sensor**	**PSS**	**Comment**
Absolute pressure	Output signal	mA	4–20		
	Meas. range	MPa	0–13.5		
	Resolution	kPa	<1.0		
	Accuracy[1)]	% F.S	0.1		
Differential pressure, 200 kPa	Accuracy	kPa		<±5	Estimated value
Temperature	Output signal	mA	4–20		
	Meas. range	°C	0–32		
	Resolution	°C	<0.01		
	Accuracy	°C	±0.1		
Flow Qbig	Output signal	mA	4–20		
	Meas. range	m^3/s	$1.67 \cdot 10^{-5}$–$1.67 \cdot 10^{-3}$		
	Resolution	m^3/s	$6.7 \cdot 10^{-8}$		
	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	$1.67 \cdot 10^{-8}$–$1.67 \cdot 10^{-5}$		
	Resolution	m^3/s	$6.7 \cdot 10^{-10}$		
	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.

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 (L) [1)]	4	18	92
Total volume of test section (L) [2)]	23	91	453
Position for sensor Pa, pressure above test section, (m above secup) [3)]	1.85	1.85	1.85
Position for sensor P, pressure in testsection, (m above secup) [3)]	–4.4	–19.4	–99.4
Position for sensor Tsec, Temperature in test section, (m above secup) [3)]	–3.75	–18.75	–98.75
Position for sensor Pb, pressure below test section, (m above secup) [3)]	–7.05	–22.05	–102.05

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

[2)] Total volume of test section ($V=\pi * d^2/4 *$section length).

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

4.3 Data acquisition system

The data acquisition system in PSS contains an ordinary office PC connected to an I/O-unit (Datascan 7320). With the software Orchestrator, pump- and injection tests are monitored and borehole sensor data collected. Along with the borehole parameters, packer and atmospheric pressure together with cabin and water temperature are logged. Test evaluation can be performed at site after a conducted test. An external display enables supervising test parameters.

The data acquisition system can 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 over the regulating valve, together with pressure in test section as input signals.

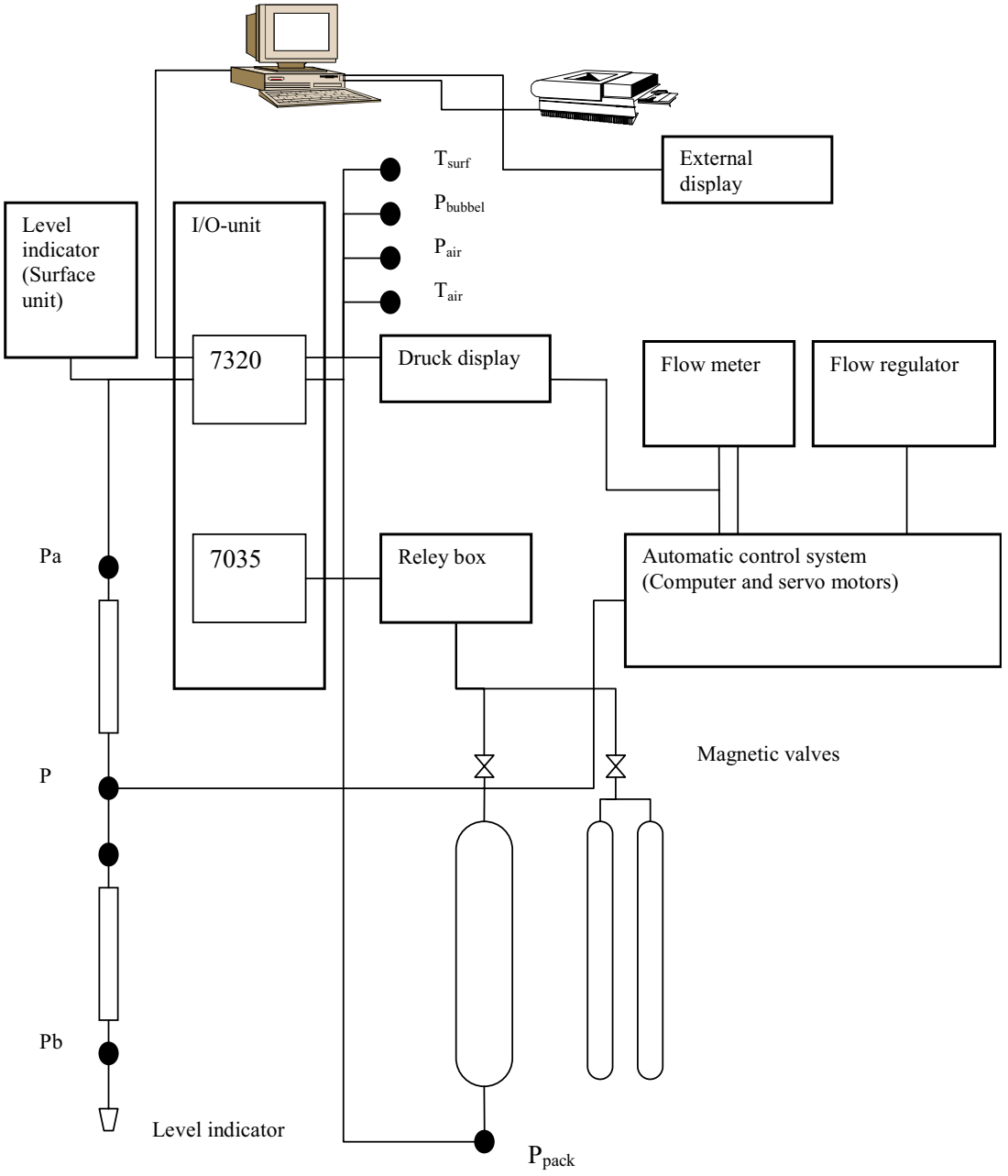

Figure 4-3. *Schematic drawing of the data acquisition system and the automatic control system in PSS.*

5 Execution

5.1 Preparations

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 every measurement campaign. Results from calibration, e.g. calibration constants, of all sensors are kept in a document folder in PSS. If a sensor is replaced at the test site, calibration constants are changed. If a new, not calibrated sensor has to be used, calibration can be performed afterwards and data recalculated.

5.1.2 Functional inspections

Functioning checks of equipment were performed during the establishment of PSS at 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.

5.2 Test performance

5.2.1 Test principle

The injection tests in KFM01A were carried out with a constant head of 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.

5.2.2 Test procedure

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 time for each phase is presented in Table 5-1. Regarding the packer inflation times and actual injection-recovery times, slightly different alternatives were used for the tests in 100 m sections compared to the tests in 20 m and 5 m sections. Due to longer test sections, together with the fact that several of the injection tests in 100 m sections are anticipated to be very low-conductive, a slightly longer packer inflation time and pressure stabilisation time were used to minimise effects of e.g. packer compliance in the 100 m sections. Furthermore, slightly longer test times were used for these tests, cf Table 5-1. Since the results of the tests in 100 m sections will have a strong effect on the continued test program, it is particularly important to ensure reliable results of these tests, including sections close to the lower measurement limit. Regarding the tests in 20 m and 5 m sections, standard packer inflation times and test times were used.

Table 5-1. Packer inflation times, pressure stabilisation times and test times used for the injection tests in KFM01A (proposed times in AP within brackets).

Test section length (m)	Packer inflation time (min)	Time for pressure stabilisation (min)	Injection phase (min)	Recovery phase(min)	Total time/test (min)[1)]
100	30	15	30	30	105
20	25	5	20	20	70
5	25	5	15 (20)	10 (20)	55 (70)

[1)] Travelling time in borehole excluded.

5.3 Data handling

With the PSS system, primary data are handled with the software Orchestrator (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 in percentage of sensor measurement range and not in engineering units. This is the raw data file delivered to the SICADA data base.

The *.ht2-files are automatically named with borehole id, top of test section and data and time of test start (as for example __KFM01A_0105.45_200305261130.ht2). The name differs slightly from the convention stated in Instructions for analysis of injection and single-borehole pump test (SKB MD 320.004, Version 1.0, SKB internal document).

With the software IPPLOT (Version 2.0), the *.ht2-files are converted to parameter files, suitable for analysis with the code SKB-plot.

A backup of data files was created each day by CD-storage and by sending the files to the Geosigma office in Uppsala by e-mail. A file description table is presented in Appendix 1.

5.4 Analyses and interpretation

As discussed in Section 5.2.1, the injection tests in KFM01A were performed as transient constant head tests followed by a pressure recovery period. The routine data processing of the measured data was carried out according to the Instruction for analysis of injection- and single-hole pumping tests. From the flow period, the flow rate and reciprocal flow rate versus time were plotted in log-log and lin-log diagrams, respectively, together with the corresponding derivatives. From the recovery period, the pressure and pressure change were plotted versus Agarwal equivalent time in lin-log and log-log diagrams, respectively, together with the corresponding derivatives.

Firstly, a qualitative evaluation of actual flow regimes, e.g. wellbore storage (WBS), pseudo-radial flow (PRF), pseudo-spherical flow (PSF) and pseudo-steady-state flow (PSS) was performed. In addition, evidences of outer boundary conditions during the tests were identified. The qualitative evaluation was made from the log-log diagrams of the responses

during the flow- and recovery period. In particular, time intervals with pseudo-radial flow, reflected by a constant (horizontal) derivative in the test diagrams, were identified. Apparent no-flow (NFB) and constant head boundaries (CHB) or corresponding boundary conditions of fractures are reflected by an increase/decrease of the derivative, respectively. In addition, a preliminary steady-state analysis of transmissivity (Moye's formula) was made on the flow period for all tests.

From the results of the qualitative evaluation, appropriate interpretation methods for the quantitative evaluation of the tests were selected. If possible, transient analysis was made on both the flow- and recovery period of the tests. Due to the very low hydraulic conductivity of borehole KFM01A, most of the responses during the recovery period were strongly influenced by wellbore storage effects. Thus, pseudo-radial flow was seldom reached during this period. On the other hand, during the flow period a certain time interval with pseudo-radial flow could, in most tests, be identified. Consequently, standard methods for single-hole tests, influenced by wellbore storage and skin effects, in an equivalent porous medium were used by the routine evaluation of the tests.

Estimations of the borehole storage coefficient C, based on actual borehole geometrical data and assumed fluid properties (net values) are shown in Table 5-2. The total volume of equipment contained in the test section (e.g. pipes and thin hoses) has been subtracted from the total volume of the test section by the calculation of the water volume V_w in the test section in Table 5-2.

For an isolated test section, the wellbore storage coefficient C may be theoretically calculated as /1/:

$$C = V_w \cdot c_w = \pi r_w^2 \cdot L_w \cdot c_w \qquad (5\text{-}1)$$

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})

Estimation of the actual borehole storage coefficient C in the test sections was also made from the recovery period, based on the early borehole response with 1:1 slope in the log-log diagrams, see Section 6.2. These values on C may be compared with the corresponding net values on C in Table 5-2.

Table 5-2. 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 (m^3/Pa)
KFM01A	0.038	100	0.453	0.092	0.361	$1.7 \cdot 10^{-10}$
KFM01A	0.038	20	0.091	0.018	0.073	$3.4 \cdot 10^{-11}$
KFM01A	0.038	5	0.023	0.004	0.019	$8.7 \cdot 10^{-12}$

The estimated values on C from the tests may differ from the net values based on geometry due to deviations of the actual geometrical borehole properties from the anticipated, e.g. borehole diameter. Furthermore, the effective compressibility for an isolated test section may sometimes be higher than the water compressibility, due to e.g. packer compliance, resulting in an increased C-value.

5.5 Nonconformities

The test program in KFM01A was performed according to the Activity Plan with a few exceptions (decided by the activity- and the investigation leader):

In order to shorten the total field test time, the injection and recovery phase times were modified for test with 5 m section length. The injection phase was set to 15 minutes and the recovery phase time to 10 minutes. This is a divergence from the methodology description for injection tests (SKB MD 323.001, SKB internal document) which proposes 15–30 minutes recovery time.

The injection time was also shortened if the hydraulic of the test section fell below the injection flow measurement limit.

6 Results

6.1 Nomenclature and symbols

The nomenclature and symbols used for the results of the injection tests in KFM01A are according to the Instruction for analysis of injection- and single-hole-pumping tests (SKB MD 320.004, SKB internal document). Additional symbols used are explained in the text.

6.2 Routine evaluation of the single-hole injection tests

6.2.1 General test data together with pressure and flow data

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

6.2.2 Lower measurement limit

The estimated lower measurement limit of flow rate for the injection tests in KFM01A is 1 mL/min ($1.7 \cdot 10^{-8}$ m^3/s). This flow rate corresponds to different steady-state transmissivity T_M depending on the section lengths used in the factor C in Moye's formula according to the Instruction for analysis of injection- and single-hole pumping tests, see Table 6-1. A standard injection pressure of 200 kPa (c 20 m water column) was used during the tests.

Table 6-1. Estimated lower measurement limits for steady-state transmissivity for injection tests in different measurement scales.

Borehole	r_w (m)	L_w (m)	Q–measl–L (m^3/s)	Injection pressure (kPa)	Factor C in Moye's formula	T_M–measl–L (m^2/s)
KFM01A	0.038	100	$1.7 \cdot 10^{-8}$	200	1.30	$1.1 \cdot 10^{-9}$
KFM01A	0.038	20	$1.7 \cdot 10^{-8}$	200	1.05	$8.8 \cdot 10^{-10}$
KFM01A	0.038	5	$1.7 \cdot 10^{-8}$	200	0.825	$6.9 \cdot 10^{-10}$

6.2.3 Length corrections

The down-hole equipment is provided with a level indicator located ca 3 m below the lower packer in the test section, see Figure 4-3. The level indicator transmits a signal every time a reference mark in the borehole is passed. In KFM01A reference marks were milled in the borehole wall at every 50 m, but not all of them could be detected by the subsequent caliper logging by SKB. The reference marks at 450 m, 800 m, 850 m and 900 m could not be detected, and the mark at 700 m gave only a faint signal.

During the injection tests in 100 m sections with PSS length reference marks were detected at the following lengths: 110 m, 150 m, 200 m, 250 m, 300 m, 350 m, 400 m, 500 m, 550 m, 600 m and 650 m. At each mark, the length scale for the injection tests was adjusted according to the reference mark.

The total difference between the reported and measured lengths at the reference marks during the injection tests was, at most, 0.07 m. The difference between two consecutive measurements over 100 m was less than 0.03 m in all cases, except between 600 m and 650 m where it was 0.06 m.

Since the length scale was adjusted in the field every time a reference mark was passed, and since the difference between consecutive marks was small, is was not found worthwhile to make any further adjustments, e.g. by linear interpolation between the reference marks, for the injection tests in KFM01A.

6.2.4 General results

A summary of the routine evaluation of the injection tests in different scales in KFM01A is presented test by test in Table 6-2. Selected test diagrams from the injection tests are presented in Appendix 3. In general, one linear diagram showing the entire test sequence together with one lin-log or log-log diagram from the flow- and recovery phase, respectively from which the quantitative analysis was performed, are presented. From tests with the flow rate below the measurement limit, only the linear diagram is presented.

The dominating transient flow regime(s) during the flow- and recovery period, respectively, deduced from the qualitative evaluation, is listed in the table. As discussed in the previous section, most recovery tests were dominated by wellbore storage effects, and no pseudo-radial flow period was reached. On the other hand, a certain time interval of pseudo-radial flow could in most cases be identified from the flow period.

By the quantitative evaluation, the steady-state transmissivity T_M was calculated by Moye's formula. Transient evaluation was conducted, whenever possible, both on the flow- and recovery periods (T_f and T_s, respectively). The evaluation of the flow period was mainly made from the lin-log diagram (1/Q versus time) by the Jacob and Lohman method /1/, whereas an approximate evaluation of the recovery period was in most cases made in the log-log diagram by type curve matching. However, for the most low-conductive sections, no unique transient evaluation could be made on the recovery period (only wellbore storage response).

The most reliable value, judged from the transient evaluation of the tests, was selected as the representative transmissivity (T_T). The associated value on the skin factor is listed in Table 6-2. In most cases, the transient transmissivity calculated from the lin-log analysis of the flow period is considered as the most reliable for the injection tests in KFM01A, since a rather well-defined time interval with pseudo-radial flow in most cases could be identified from the flow period. The start and stop times used by the transient evaluation of the representative parameter values are also listed in Table 6-2. In the very few cases when transient evaluation was not possible, T_M was chosen as the representative transmissivity.

In some cases, two transmissivity values could be calculated from the lin-log diagrams, one at early- and another at later times. It is assumed that the first transmissivity value represents the near-region of the borehole (e.g. fracture), whereas the later value may represent a larger volume of rock. In such cases, the first transmissivity value was selected as the representative one. This value is considered as most suitable for statistical analyses.

In Table 6-2, all transmissivities below the measurement limit have been assigned the corresponding lower measurement value, see Table 6-1, both for transmissivity evaluated by steady-state- and transient methods, respectively. For a few sections, lower transmissivities than the rigorous measurement limits were calculated from the transient evaluation, in particular for 5 m sections, see Table 6-2. These values are, however, considered as very uncertain.

The results of the routine evaluation of the injection tests in borehole KFM01A are compiled in appropriate tables in Appendix 5 to be stored in the SICADA database.

By the routine evaluation no corrections of the measured data, e.g. for changes of the barometric pressure or tidal fluctuations, has been made. For short-time single-hole tests such corrections are generally not needed, unless very small pressure changes are applied in the boreholes. No subtractions of the barometric pressure from the measured absolute pressure have been made since the length of test periods are short relative to the time scale for barometric pressure changes. Drilling records were checked to identify possible interference on test data from drilling in nearby boreholes. These records showed that no drilling activities were in progress during the injection testing.

In Figure 6-1, a comparison of calculated transmissivities in 5 m sections from steady-state- (T_M) and the representative transmissivity from the transient evaluation (T_T) are shown. The agreement between the two populations is considered good, although the steady-state transmissivities are in general slightly higher. The estimated lower measurement limit of transmissivity in 5 m sections for the injection tests is also shown in the figure. Values below this limit are considered as very uncertain.

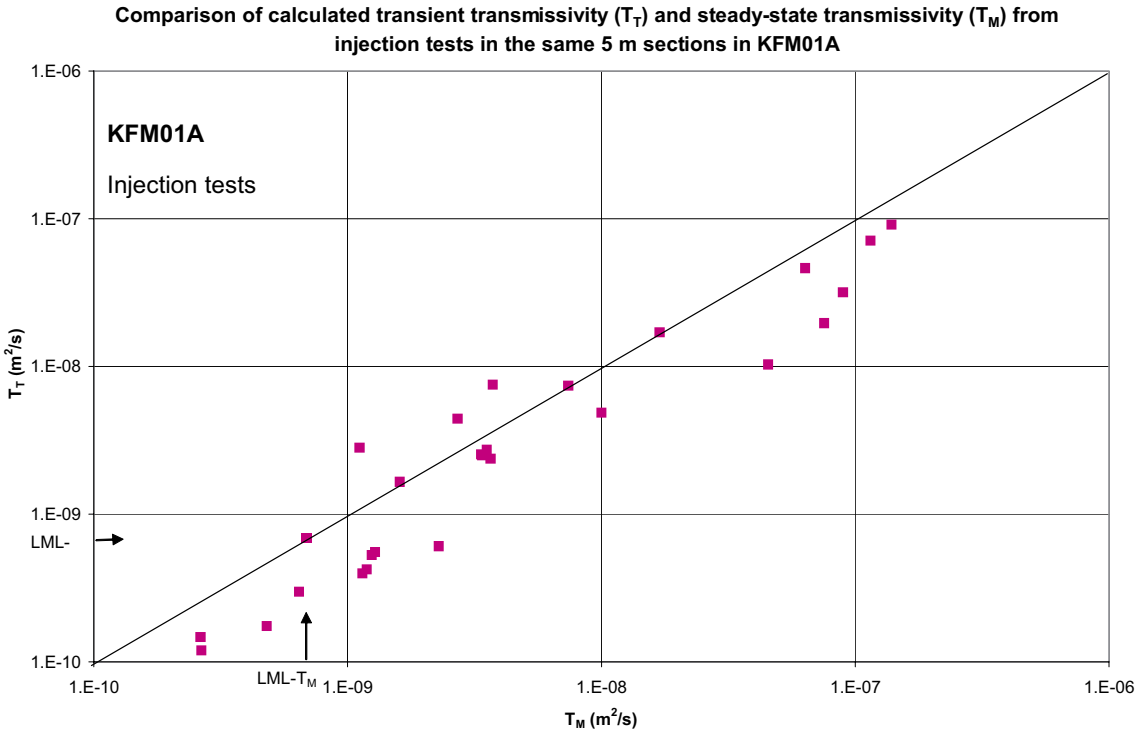

Figure 6-1. *Calculated transmissivities from injection tests in 5 m sections by steady-state- (TM) and transient (TT) evaluation.*

Table 6-2. Summary of the results of the routine evaluation of the single-hole injection tests in borehole KFM01A.

Borehole	Secup	Seclow	L_w	Dom. flow regime		T_M	T_f	T_s	T_T	ξ	t_1	t_2	C	Comments	Analyzibility	
idcode	(m)	(m)	(m)	injection	recovery	(m^2/ s)	(m^2/ s)	(m^2/ s)	(m^2/s)		(s)	(s)	(m^3/Pa)		inj.	rec.
KFM01A	105.45	205.45	100	PRF	PRF	6.12E-07	1.45E-07	1.56E-07	1.45E-07	-4.39	500	1800		Increasing background pressure	1	1
KFM01A	200.45	300.45	100	PRF	WBS	1.02E-08	2.73E-09	3.69E-09	2.73E-09	-2.16	300	1800	4.20E-10	No PRF during recovery	2	3
KFM01A	300.45	400.45	100	PRF	WBS	2.35E-08	4.32E-09		4.32E-09	-3.16	550	1800		□ominating WBS during recovery	2	4
KFM01A	400.45	500.45	100	(PRF)	WBS	3.10E-09	8.84E-10	7.80E-10	8.84E-10	-1.53	240	1800	1.85E-10	No PRF during recovery	3	3
KFM01A	500.45	600.45	100	PRF	WBS	8.54E-10	2.76E-10		2.76E-10	-1.08	70	1800	2.15E-10	Only WBS during recovery	3	4
KFM01A	600.45	700.45	100			□ 1.08E-09			1.08E-09					below measurement limit		
KFM01A	700.45	800.45	100			□ 1.08E-09			1.08E-09					below measurement limit		
KFM01A	800.45	900.45	100			□ 1.08E-09			1.08E-09					below measurement limit		
KFM01A	895.45	995.45	100			□ 1.08E-09			1.08E-09					below measurement limit		
KFM01A	105.45	125.45	20	PRF	WBS	2.70E-07	8.58E-08	1.12E-07	8.58E-08	-3.83	250	1200		No PRF during recovery	1	3
KFM01A	125.45	145.45	20	PRF	WBS	2.46E-08	9.12E-09	8.95E-09	9.12E-09	-2.34	80	700		No PRF during recovery	2	3
KFM01A	145.45	165.45	20	PRF	PRF	2.26E-07	1.11E-07	8.33E-08	1.11E-07	-3.18	30	500		□wo □-regions□t□e □irst is selected	2	2
KFM01A	165.45	185.45	20	PRF	WBS	1.05E-07	2.96E-08		2.96E-08	-3.50	300	1200		No PRF during recovery	1	3
KFM01A	185.45	205.45	20	PRF	WBS	6.12E-09	2.22E-09		2.22E-09	-1.59	300	1200	5.17E-10	Only WBS during recovery	3	4
KFM01A	200.45	220.45	20			< 8.75E-10			8.75E-10					below measurement limit		
KFM01A	220.45	240.45	20	PRF	WBS	1.79E-09	4.70E-10		4.70E-10	-1.44	100	1200	1.28E-10	Only WBS during recovery	3	4
KFM01A	240.45	260.45	20			< 8.75E-10			8.75E-10					below measurement limit		
KFM01A	260.45	280.45	20	PRF	WBS	2.66E-09	1.47E-09	9.30E-10	1.47E-09	-1.59	400	1200	7.95E-11	No PRF during recovery	3	3
KFM01A	280.45	300.45	20	PRF	WBS	4.80E-09	1.48E-09		1.48E-09	-2.03	100	1200		No PRF during recovery	3	3
KFM01A	300.45	320.45	20	PRF	WBS	3.78E-09	2.68E-09	2.22E-09	2.68E-09	0.45	200	1200	9.25E-11	No PRF during recovery	2	3
KFM01A	320.45	340.45	20	PRF→NFB	WBS	1.64E-08	7.14E-09		7.14E-09	-2.74	30	150		fracture of limited extent?	2	4
KFM01A	340.45	360.45	20			< 8.75E-10			8.75E-10					below measurement limit		
KFM01A	360.45	380.45	20	PRF→NFB	WBS	2.84E-09	2.76E-09		2.76E-09	-2.06	50	150	3.16E-10	Two T-regions, the first is selected	2	4
KFM01A	380.45	400.45	20	PRF	WBS	7.28E-10	2.63E-10		2.63E-10	-0.43	300	1200	6.16E-11	No PRF during recovery	3	3
KFM01A	105.45	110.45	5	PRF	WBS	3.66E-09	2.38E-09	2.02E-09	2.38E-09	-1.12	100	900		No PRF during recovery	3	3
KFM01A	110.45	115.45	5	PRF	WBS	4.54E-08	1.03E-08		1.03E-08	-3.50	200	900		Only WBS during recovery	2	4
KFM01A	115.45	120.45	5	PRF	WBS	1.15E-07	7.07E-08	5.07E-08	7.07E-08	-2.37	150	900		No PRF during recovery	2	3
KFM01A	120.45	125.45	5	PRF	WBS	7.55E-08	1.95E-08		1.95E-08	-3.70	200	900		No PRF during recovery	2	3
KFM01A	125.45	130.45	5	PRF→NFB	WBS	3.39E-09	2.50E-09		2.50E-09	-2.31	80	200		fracture of limited extent?	3	4
KFM01A	130.45	135.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	135.45	140.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	140.45	145.45	5	PSF	PSS	1.70E-08			1.70E-08					rock leakage?	2?	2
KFM01A	145.45	150.45	5	PRF→NFB	PRF	1.39E-07	9.10E-08	1.02E-07	9.10E-08	-2.52	80	700			1	1
KFM01A	150.45	155.45	5			< 6.88E-10			6.88E-10				1.84E-11	below measurement limit		
KFM01A	155.45	160.45	5	PRF→NFB	PRF→NFB	6.35E-08	4.61E-08	6.81E-08	4.61E-08	-2.22	10	200		Two T-regions, the first is selected	1	2
KFM01A	160.45	165.45	5	PRF	WBS	1.00E-08	4.85E-09	5.98E-09	4.85E-09	-1.93	600	900		No PRF during recovery	3	3
KFM01A	165.45	170.45	5			< 6.88E-10			6.88E-10				3.33E-11	below measurement limit		
KFM01A	170.45	175.45	5	PRF?	WBS	1.25E-09	5.26E-10	6.05E-10	5.26E-10	-0.65	100	900	4.04E-11	Uncertain test data	3	3
KFM01A	175.45	180.45	5	PRF	WBS	8.95E-08	3.18E-08		3.18E-08	-3.65	150	900		No PRF during recovery	2	3
KFM01A	180.45	185.45	5			< 6.88E-10			6.88E-10				3.65E-11	below measurement limit		
KFM01A	185.45	190.45	5	PRF	WBS	3.54E-09	2.71E-09	2.68E-09	2.71E-09	-0.03	60	900	6.61E-11	No PRF during recovery	2	3
KFM01A	190.45	195.45	5	PRF?	WBS	1.19E-09	4.22E-10		4.22E-10	-1.84	100	900		No PRF during recovery	3	3
KFM01A	195.45	200.45	5			< 6.88E-10			6.88E-10					below measurement limit		

Table 6-2 cont.

Borehole	Secup	Seclow	L_w	Dom. flow regime		T_M	T_f	T_s	T_T	ξ	t_1	t_2	C	Comments	Analyzibility	
idcode	(m)	(m)	(m)	injection	recovery	(m^2/ s)	(m^2/ s)	(m^2/ s)	(m^2/s)		(s)	(s)	(m^3/Pa)		inj.	rec.
KFM01A	200.45	205.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	205.45	210.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	210.45	215.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	215.45	220.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	220.45	225.45	5	PRF?	WBS	2.64E-10	1.47E-10	1.71E-10	1.47E-10	-0.03			3.13E-11	No PRF during recovery	3	3
KFM01A	225.45	230.45	5	PRF	WBS	1.15E-09	3.96E-10		3.96E-10	-1.24	300	900	6.62E-11	Only WBS during recovery	3	4
KFM01A	230.45	235.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	235.45	240.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	260.45	265.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	265.45	270.45	5	PRF?	WBS	2.66E-10	1.19E-10		1.19E-10	0.14	100	900	2.14E-11	Only WBS during recovery	3	4
KFM01A	270.45	275.45	5	PRF	WBS	1.29E-09	5.53E-10	6.28E-10	5.53E-10	-0.42	10	60	2.38E-11	□wo □-regions□t□e □irst is selected	2	2
KFM01A	275.45	280.45	5	PRF?	WBS	4.80E-10	1.74E-10		1.74E-10	0.04	10	900	2.56E-11	Only WBS during recovery	3	4
KFM01A	280.45	285.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	285.45	290.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	290.45	295.45	5	PRF	WBS	3.36E-09	2.53E-09	3.33E-09	2.53E-09	-1.20	20	150	1.64E-10	□wo □-regions□t□e □irst is selected	2	3
KFM01A	295.45	300.45	5	PRF	WBS	6.45E-10	5.99E-10	2.98E-10	2.98E-10	1.61	10	900	1.91E-11	No PRF during recovery	3	3
KFM01A	300.45	305.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	305.45	310.45	5	PRF	WBS	1.61E-09	1.65E-09	9.58E-10	1.65E-09	1.14	50	900	2.46E-11	No PRF during recovery	2	3
KFM01A	310.45	315.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	315.45	320.45	5	PRF	WBS-□PRF	1.12E-09	2.82E-09	5.85E-10	2.82E-09	0.28	10	100	1.95E-11	Two T-regions, the first is selected	2	3
KFM01A	320.45	325.45	5	NFB	NFB	7.40E-09			7.40E-09					fracture of limited e□tent?	4	4
KFM01A	325.45	330.45	5	PRF	WBS	2.29E-09	6.05E-10		6.05E-10	-1.98	200	600		Only WBS during recovery	2	4
KFM01A	330.45	335.45	5	PRF→NFB	WBS->PSF	3.74E-09	7.51E-09	6.30E-09	7.51E-09	1.73	10	100	1.94E-11	No PRF during recovery	2	3
KFM01A	335.45	340.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	360.45	365.45	5	PRF→NFB	WBS	2.72E-09	4.42E-09		4.42E-09	-1.80	5	50		Two T-regions, the first is selected	2	4
KFM01A	365.45	370.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	370.45	375.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	375.45	380.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	380.45	385.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	385.45	390.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	390.45	395.45	5			< 6.88E-10			6.88E-10					below measurement limit		
KFM01A	395.45	400.45	5			< 6.88E-10			6.88E-10					below measurement limit		

PRF=pseudo-radial flow
PSF=pseudo-spherical flow
PSS=pseudo-steady-state flow
WBS=wellbore storage
NFB=no-flow boundary

The wellbore storage coefficient C for each test was calculated from the 1:1 straight line 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 slope1:1 in the beginning of the recovery period. In the most conductive sections, this period only occurred during very short times. These values may be compared with the net values on C in Table 5-2 based on geometry.

Table 6-2 shows that there is, in general, a good consistency between the calculated C-values from the tests and those listed in Table 5-2. For the 100 m tests very consistent C-values were obtained, whereas for the 20 m and 5 m tests the lowest C-values calculated from the tests were slightly higher than the net values. This fact indicates a rigid and stiff test system. As discussed in Section 5.4, other factors may explain the higher values, e.g. compressibility of packers etc.

Finally, an attempt to assess the degree of analysability of the flow-and recovery period of the injection tests regarding standard transient evaluation of hydraulic parameters was made by assigning scores 1–4, see Table 6-2. The following tentative definitions of the scores were used:

1 = very good analysability (smooth test data, unique transient evaluation possible)

2 = rather good analyzability (rather unique transient evaluation possible despite some scatter in the test data)

3 = bad analyzability (unique transient evaluation difficult)

4 = transient evaluation not possible (may either depend on instrumental problems or conceptual hydro-geological problems)

It should be observed that bad analysability of the test data may either be caused by instrumental malfunctions and/or conceptual problems of the rock tested, e.g. very low-conductive sections strongly influenced by wellbore storage effects. As indicated in Table 6-2, the analyzability of data from the flow period of the injection tests is generally judged to be higher in comparison to data from the recovery phase. As discussed above, this mainly depends on wellbore storage effects affecting the latter period.

6.3 Comparison of transmissivities on different scales

The calculated steady-state transmissivities T_M from the injection tests in the measured sections of 100 m, 20 m and 5 m length are shown in Figure 6-2. A consistency check of the calculated transmissivities on the different scales was made by summing up calculated values from smaller scales (20 m and 5 m) and comparing by the measured ones in longer sections (100 m and 20 m).

In Table 6-3, calculated transmissivities in 100 m and 20 m test sections according to steady-state- (T_M) and transient evaluation (T_T) are listed together with summed up transmissivities measured in 20 m and 5 m sections over the corresponding 100 m and 20 m sections, respectively. In addition, the corresponding sum of transmissivities from the difference flow logging in 5 m sections (SUM T_D) is shown for each section.

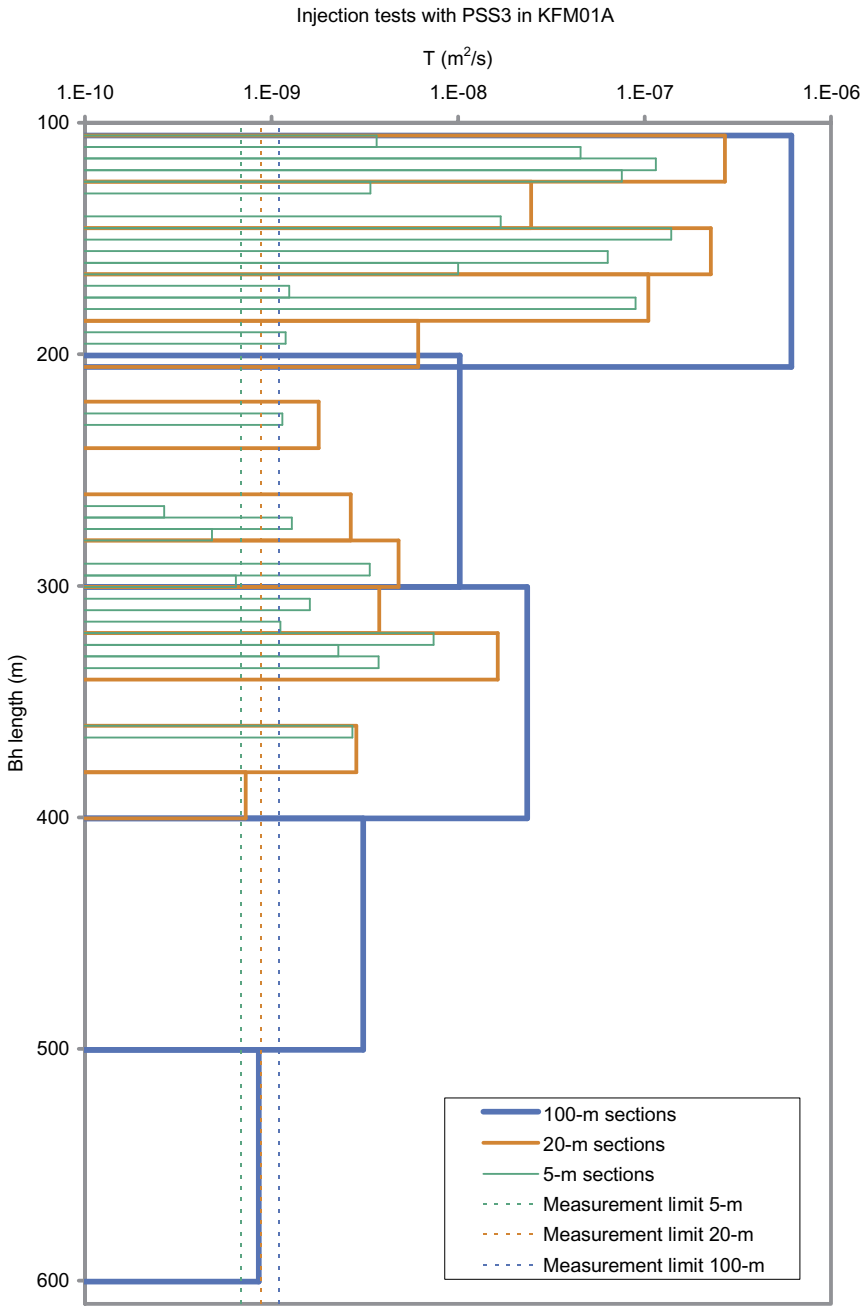

Figure 6-2. *Calculated steady-state transmissivities, $T_{M,}$ for the measured sections of 100 m, 20 m and 5 m length from the injection tests in borehole KFM01A.*

In Table 6-3, all transmissivities below the measurement limit have been assigned the estimated lower measurement value according to Table 6-1. By the summations, the measurement values are included. This fact leads to an overestimation of the summed-up transmissivities on the measurement limit. No tests were carried out in 20 m and 5 m sections below 400 m in KFM01A or in 5 m-sections in the intervals 240.45–260.45 m and 340.45–360.45 m.

Table 6-3. Calculated transmissivities in 100 m and 20 m test sections together with summed up transmissivities measured in 20 m and 5 m sections in the corresponding borehole intervals from the injection tests in KFM01A. In addition, the corresponding sum of transmissivities from the difference flow logging in 5 m sections is shown.

Bore-hole idcode	Secup (m)	Seclow (m)	L_w (m)	T_M inj. tests (m^2/ s)	T_T inj. tests (m^2/s)	SUM T_M(20m) inj. tests (m^2/s)	SUM T_T(20m) inj. tests (m^2/s)	SUM T_M(5m) inj. tests (m^2/s)	SUM T_T(5m) inj. tests (m^2/s)	SUM-T_D(5m) diff-flow log (m^2/s)
KFM01A	105.45	205.45	100	6.12E-07	1.45E-07	6.32E-07	2.38E-07	5.73E-07	3.05E-07	2.22E-07
KFM01A	200.45	300.45	100	1.02E-08	2.73E-09	1.10E-08	5.17E-09	1.36E-08	1.04E-08	4.73E-09
KFM01A	300.45	400.45	100	2.35E-08	4.32E-09	2.46E-08	1.37E-08	2.57E-08	3.13E-08	7.88E-09
KFM01A	400.45	500.45	100	3.10E-09	8.84E-10	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	2.90E-09
KFM01A	500.45	600.45	100	8.54E-10	2.76E-10	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	2.89E-09
KFM01A	600.45	700.45	100	**1.08E-09**	**1.08E-09**	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	2.88E-09
KFM01A	700.45	800.45	100	**1.08E-09**	**1.08E-09**	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	3.03E-09
KFM01A	800.45	900.45	100	**1.08E-09**	**1.08E-09**	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	3.03E-09
KFM01A	895.45	995.45	100	**1.08E-09**	**1.08E-09**	n.m. 20 m	n.m. 20 m	n.m. 5 m	n.m. 5 m	3.03E-09
KFM01A	105.45	125.45	20	2.70E-07	8.58E-08			2.40E-07	1.03E-07	1.20E-07
KFM01A	125.45	145.45	20	2.46E-08	9.12E-09			2.17E-08	2.09E-08	3.38E-09
KFM01A	145.45	165.45	20	2.26E-07	1.11E-07			2.13E-07	1.43E-07	4.64E-08
KFM01A	165.45	185.45	20	1.05E-07	2.96E-08			9.21E-08	3.37E-08	4.91E-08
KFM01A	185.45 [1)]	205.45	20	6.12E-09	2.22E-09			6.11E-09	4.51E-09	3.29E-09
KFM01A	200.45 [1)]	220.45	20	**8.75E-10**	**8.75E-10**			**2.75E-09**	**2.75E-09**	**5.88E-10**
KFM01A	220.45	240.45	20	1.79E-09	4.70E-10			2.78E-09	1.92E-09	9.24E-10
KFM01A	240.45	260.45	20	**8.75E-10**	**8.75E-10**			n.m. 5 m	n.m. 5 m	**5.86E-10**
KFM01A	260.45	280.45	20	2.66E-09	1.47E-09			2.72E-09	1.53E-09	1.81E-09
KFM01A	280.45	300.45	20	4.80E-09	1.48E-09			5.38E-09	4.20E-09	1.41E-09
KFM01A	300.45	320.45	20	3.78E-09	2.68E-09			4.10E-09	5.84E-09	3.74E-09
KFM01A	320.45	340.45	20	1.64E-08	7.14E-09			1.41E-08	1.62E-08	2.40E-09
KFM01A	340.45	360.45	20	**8.75E-10**	**8.75E-10**			n.m. 5 m	n.m. 5 m	**5.84E-10**
KFM01A	360.45	380.45	20	2.84E-09	2.76E-09			4.78E-09	6.48E-09	1.16E-09
KFM01A	380.45	400.45	20	7.28E-10	2.63E-10			**2.75E-09**	**2.75E-09**	**5.82E-10**
Sum of T in 105.45-400.45 m:				6.46E-07	1.52E-07	6.67E-07	2.57E-07	6.12E-07	3.46E-07	2.35E-07

[1)] partly overlapping sections

L.M.L.=Lower measurement limit

n.m.=not measured

values in bold denote values below L.M.L or alternatively, sum of L.M.L. according to the actual column

In Figure 6-3, calculated steady-state transmissivities for 100 m and 20 m measurement sections from the injection tests (T_M–100 m and T_M–20 m, respectively) are plotted versus the sum of transmissivities measured in 5 m sections in the corresponding intervals (SUM T_M–5 m). The lower measurement limits for the different measurements together with the cumulative measurement limit for the sum of 5 m sections are also shown in the figure.

Figure 6-3 indicates a very good agreement between measured transmissivities in longer sections and summed-up transmissivities in corresponding 5 m sections for the injection tests. The deviation towards the lower end is caused by the fact that values on the measurement limit are accumulated in the summation process which naturally leads to an overestimation of SUM T_M–5 m in this range.

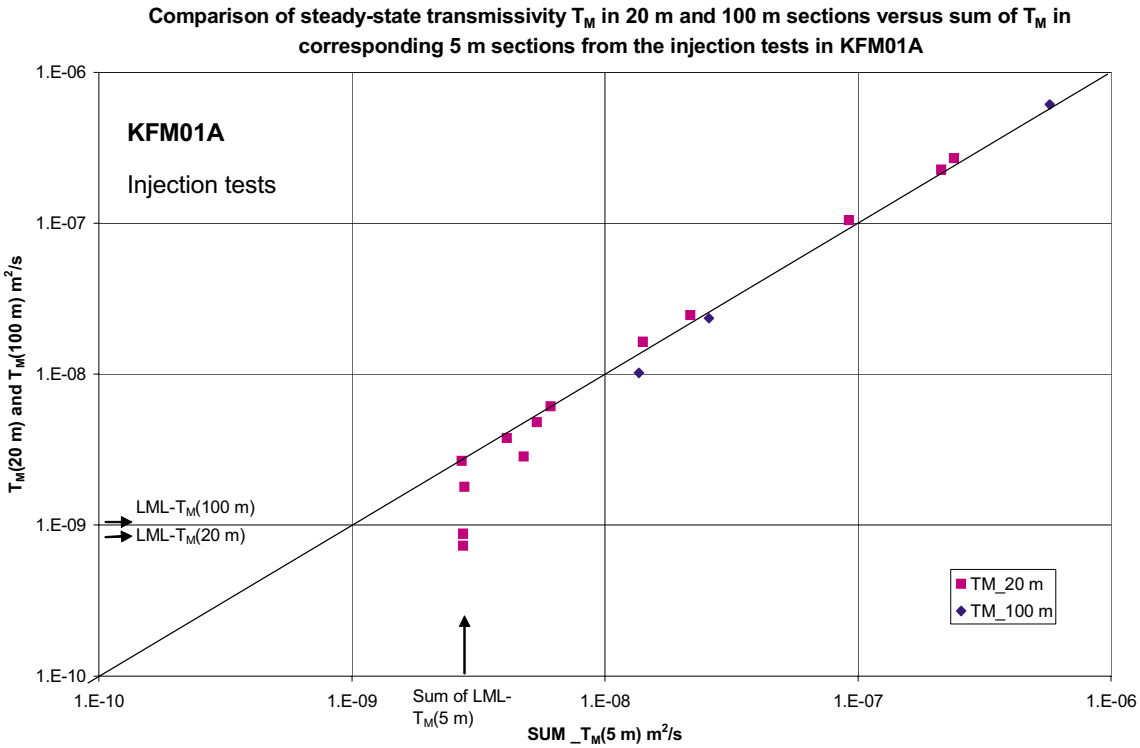

Figure 6-3. *Calculated steady-state transmissivities for 100 m and 20 m measurement sections versus the sum of calculated steady-state transmissivities for 5 m sections in the corresponding borehole intervals from the injection tests in KFM01A. (LML = Lower Measurement Limit.)*

6.4 Comparison with results from difference flow logging

In Figure 6-4, a direct comparison was made of calculated steady-state and transient transmissivities from the injection tests in 5 m sections with the calculated transmissivities in the same 5 m sections from the previously performed sequential difference flow logging in KFM01A /2/. The difference flow logging was performed at a drawdown of c 11 m in the borehole.

Figure 6-4 indicates that there is a good consistency between the calculated transmissivities from the injection tests and difference flow logging, although the transmissivities from the difference flow logging in most cases are slightly lower than those from the injection tests. It should however be remembered that the two methods are different in nature with associated assumptions and uncertainties. Potential un-certainties for difference flow logging are discussed in /3/ and for injection tests in /4/. One possible reason to the discrepancies could be a decreasing head difference along the borehole due to saline water. No head measurements were carried out along the borehole within the scope of the injection tests.

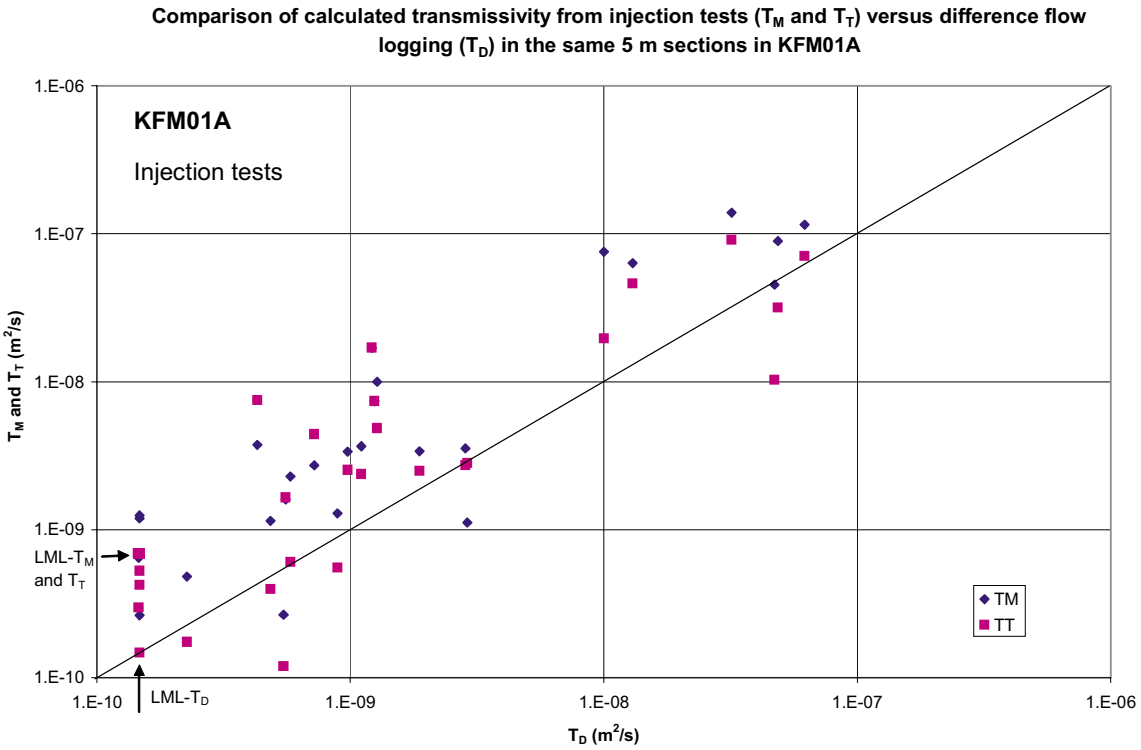

Figure 6-4. *Comparison of calculated steady-state- (T_M) and transient (T_T) transmissivities from the injection tests in 5 m sections with calculated transmissivities in the same 5 m sections from the previous difference flow logging (T_D) in KFM01A.*

In Figure 6-5, a comparison was also made of calculated steady-state transmissivities from the injection tests in 100 m and 20 m test sections with summed-up transmissivities for 5 m sections from the difference flow logging, SUM T_D(5 m), in the corresponding intervals in borehole KFM01A. The latter sums are shown in Table 6-3. Figure 6-5 should be compared with Figure 6-3 for the injection tests solely.

Figure 6-5 shows that the calculated transmissivities from the injection tests in 100 m and 20 m sections are slightly higher than the sum of transmissivities from the difference flow logging. These results are consistent with the results in Figure 6-4.

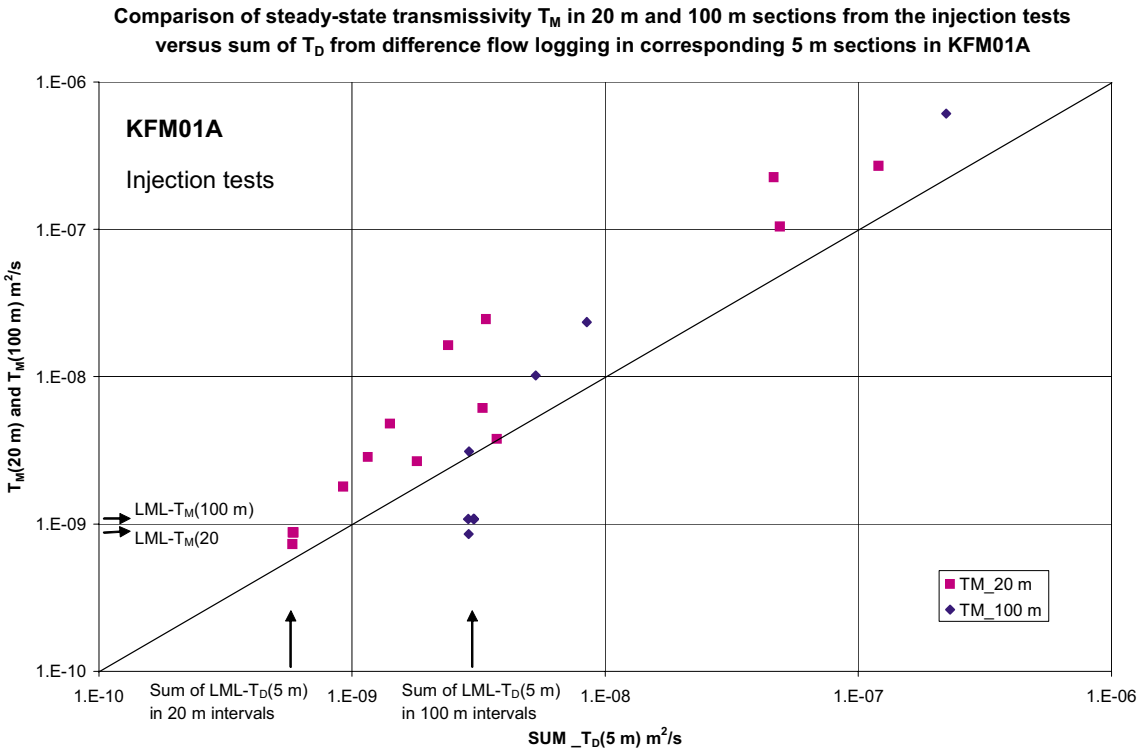

Figure 6-5. *Comparison of calculated steady-state transmissivities from injection tests in 20 m and 100 m sections with summed-up transmissivities in 5 m sections in the corresponding borehole intervals from difference flow logging in KFM01A.*

6.5 Basic statistics of hydraulic conductivity distributions

Basic statistical parameters were derived for the calculated steady-state hydraulic conductivity distributions in different scales (100 m, 20 m and 5 m) from the injection tests in borehole KFM01A. In the statistical analysis the logarithm (base 10) of the hydraulic conductivity values K_M was used. The hydraulic conductivity is derived from dividing the hydraulic transmissivity by section length. Values below the measurement limits according to Table 6-1 were included in the analyses. Selected results are shown in Table 6-4. Both the arithmetic mean and standard deviation of $Log_{10}(K_M)$ are probably strongly influenced by the lower measurement limit in this case. It should be observed that the statistics for different section lengths is based on different borehole intervals.

Table 6-4. Basic statistical parameters of steady-state hydraulic conductivity K_M in different measurement scales in borehole KFM01A. L_w=section length, m=arithmetic mean of $Log_{10}(K_M)$, s=standard deviation of $Log_{10}(K_M)$.

Borehole	Parameter	Unit	L_w=100 m	L_w=20 m	L_w=5 m
KFM01A	Measured borehole interval	m	105.45–995.45	105.45–400.45 [1)]	105.45–400.45 [2)]
	Number of tests	–	9	15	51
	N:o of tests below L.M.L.	–	5	4	29
	m ($Log_{10}(K_M)$)	Log_{10}(m/s)	–10.36	–9.48	–9.44
	s ($Log_{10}(K_M)$)	–	0.95	0.88	0.71
	$Log_{10}(K_M$–measl–L)	Log_{10}(m/s)	–11.07	–10.36	–9.86

1) Sections 185.45–205.45 m and 200.45–220.45 m are partly overlapping

2) Sections 240.45–260.45 m and 340.45–360.45 m were below L.M.L. and not measured in 5 m sections

6.6 Summary of results from hydraulic tests in KFM01A

At the bottom of Table 6-3, the sums of calculated transmissivities by different analysis methods from the injection tests and difference flow logging, respectively in the interval 105.45–400.45 m in borehole KFM01A are listed. In Table 6-5 a comparison of calculated transmissivities from different hydraulic tests in KFM01A is presented. The borehole has been divided in two parts; the conductive part 105.45–400.45 m and the remainder of the hole which had a transmissivity below the measurement limit (L.M.L) for the injection tests in 100 m sections as well as for the difference flow logging.

Table 6-5 shows that the results of the different hydraulic test methods performed in borehole KFM01A are consistent. The total transmissivity of the borehole is governed by the interval 105.45–400.45 m as indicated by the results of the pumping test during difference flow logging.

Table 6-5. Comparison of calculated transmissivities from different hydraulic tests in borehole KFM01A.

Hydraulic test method	Sum of T (m2/s)	Borehole interval and length of interval (m) 105.45–400.45	400.45–995.45	105.45–995.45
Injection tests	$\sum T_M$(100 m)	$6.46 \cdot 10^{-7}$	Below L.M.L	
	$\sum T_T$(100 m)	$1.52 \cdot 10^{-7}$	Below L.M.L	
	$\sum T_M$(20 m)	$6.67 \cdot 10^{-7}$	n.m.	
	$\sum T_T$(20 m)	$2.57 \cdot 10^{-7}$	n.m.	
	$\sum T_M$(5 m)	$6.12 \cdot 10^{-7}$	n.m.	
	$\sum T_T$(5 m)	$3.46 \cdot 10^{-7}$	n.m.	
Difference flow logging	$\sum T_D$(5 m)	$2.35 \cdot 10^{-7}$	Below L.M.L	
	$\sum T_{Df}$ (flow anomalies)	$1.98 \cdot 10^{-7}$	Below L.M.L	
Pumping test	T_M			$4.16 \cdot 10^{-7}$
	T_T			$3.06 \cdot 10^{-7}$

n.m.=no measurements were performed

7 References

1 **Almén K-E, Andersson J-E, Carlsson L, Hansson K, Larsson N-Å, 1986.** Hydraulic testing in crystalline rock. A comparative study of single-hole test methods. Technical Report 86-27. Svensk Kärnbränslehantering AB.

2 **Rouhiainen P, Pöllänen J, 2003.** Difference Flow measurements in borehole KFM01A at Forsmark. Report P-03-28. Svensk Kärnbränslehantering AB.

3 **Ludvigson J-E, Hansson K, Rouhiainen P, 2002.** Methodology study of Posiva difference flow meter in borehole KLX02 at Laxemar. SKB Report R-01-52. Svensk Kärnbränslehantering AB.

4 **Andersson P, Andersson J-E, Gustafsson E, Nordqvist, R, Voss, C, 1993.** Site characterization in fractured crystalline rock – A critical review of geohydraulic measurement methods. Site-94. SKI Technical Report 93:23. Statens Kärnkraftsinspektion.