GEO-Meß-Systeme GmbH

MESY GmbH · Meesmannstraße 49 · D-44807 Bochum · FRG

BOREHOLE TESTING
HYDROFRACTURING
STRESS MEASUREMENTS
System Design · Planning
Lab + Field Measurements

CBM - Project Sigillaria License Area

OPEN - HOLE PERMEABILITY AND HYDROFRAC STRESS MEASUREMENTS IN BOREHOLE NATARP-1

Operation Report

Client:	CONOCO Mineralöl GmbH, Essen
Contract:	Ref. - No. GCBM-04 dated 28.03.1995
MeSy-Quotation:	113.06.94 dated 14.06.1994 120.07.94 dated 20.07.1994
MeSy-Reporter:	Prof. Dr. F. Rummel Dipl.-Geophys. U.Weber
Date:	07.08.1995

Amtsgericht Bochum 14 HRB 2572
Geschäftsführer: Prof. Dr. F. Rummel

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Sparkasse Bochum
(BLZ 430 500 01) 43 308 618

Project:	CBM project Sigillaria License Area
Location:	Natarp / Hoetmar, NRW, Germany
Borehole:	Natarp-1
Purpose:	open-hole permeability and hydrofrac stress measurements
Test-Period:	02.-05.08.1995
Participants:	Mr. K. Thomas (Conoco Essen) Dipl. Ing. P.Hegemann (MeSy, 01.-04.08.95) Dipl. Geophys. T. Przybilla (MeSy, 01-05.08.95) Prof. Dr. F.Rummel (MeSy, 05.08.95) Dipl. Ing. H.Vogt (MeSy, 01.-05.08.95) Dipl. Geophys. U.Weber (MeSy, 01.08.95)

TIME TABLE OF TESTING

date	time	event
Juliy 95		preparation of equipment
31.07.95	14:00	arrival of winch system MKW-5000 at Natarp-1 drill-site
01.08.95	11:00-15:00	transportation of tubbing to test-site
02.08.95	17:45	departure of MeSy engineers P. Hegemann, T.Przybilla, H.Vogt and U. Weber from Bochum
	20.00	arrival at drill-site
~~03.08.95~~	20:00-01:30	set - up of winch, double-packer tool (3 m interval-length) and surface equipment
3.8.95	01:30	tool at zero-mark (middle of test-interval), venting of the hydraulic system
	01:35	start tripping into hole
	01:35-02:20	test of tool in the casing at 20 m depth
	06:00-06:53	tool at 1888.5 m (cable load: 1.7 tons) and cleaning of test section by pumping into interval while moving tool to test-position (cable load: 2.1 tons)
	06:53-10:02	**injection-test 1 at 1878.0 [1] m**
	09:29	interruption of electric power-supply, lost of all digital data recorded so far due to failure of UPS

1 all depth marks were measured from rig floor (2.80 m above ground level) and corresponds to the middle of the test-interval

date	time	event
	09:32	restart of digital data aquisition unit
	10:02-10:52	moving tool upward to next test position at 1760.0 m
	10:52-11:35	tool at 1763.2 m and cleaning of test section by pumping into interval while moving tool to test-position (cable load: 2.2 tons)
	11:35-16:16	**injection-test 2 at 1760.3 m**
	16:16-17:36	moving tool upward to next test position at 1480.5 m
	17:36-17:55	tool at 1483.0 m and cleaning of test section by pumping into interval while moving tool to test-position (cable load: 1.8 tons)
	17:55	**injection-test 3 at 1480.5 m**, during setting packers pressure rapidly decreases
	18:52	decission to end test due to pressure decrease
	18:52-21:00	tripping tool out of hole
	21:00-21:28	test of tool in the casing at 20 m depth
	21:30	tool out of hole, tubing between upper and lower packer damaged
	21:30-23:56	repair and set up hydrofrac tool with 1 m interval length
	23:56	start tripping into hole
4.8.95	00:11-00:42	test of tool in the casing at 20 m depth
	03:32	tool at 1935.0 m (cable load: 1.4 tons)
	03:40-05:08	**hydrofrac-test 1 at 1935.0 m**
	04:05	sudden decrease of packer pressure during frac-test due to failure of safty burst-disk
	05:08-08:20	tripping tool out of hole
	08:20-08:59	change of burst-disk
	08:59	start tripping into hole
	09:06-09:33	test of tool in the casing at 20 m depth
	12:20	tool at 1882.0 m (cable load: 1.4 tons)
	12:23-14:06	**hydrofrac-test 2 at 1882.0 m**
	14:06-18:26	movement to test position at 1755.0 m (max. cable load: 3.0 tons)
	18:26-20:11	**hydrofrac-test 3 at 1755.0 m**
	19:00	departure of P. Hegemann
	20:11-21:05	movement to test position at 1707.0 m
	21:05-21:54	**hydrofrac-test 4 at 1707.0 m,** it was not possible to fracture the rock with max. differential packer pressure of 27.5 MPa

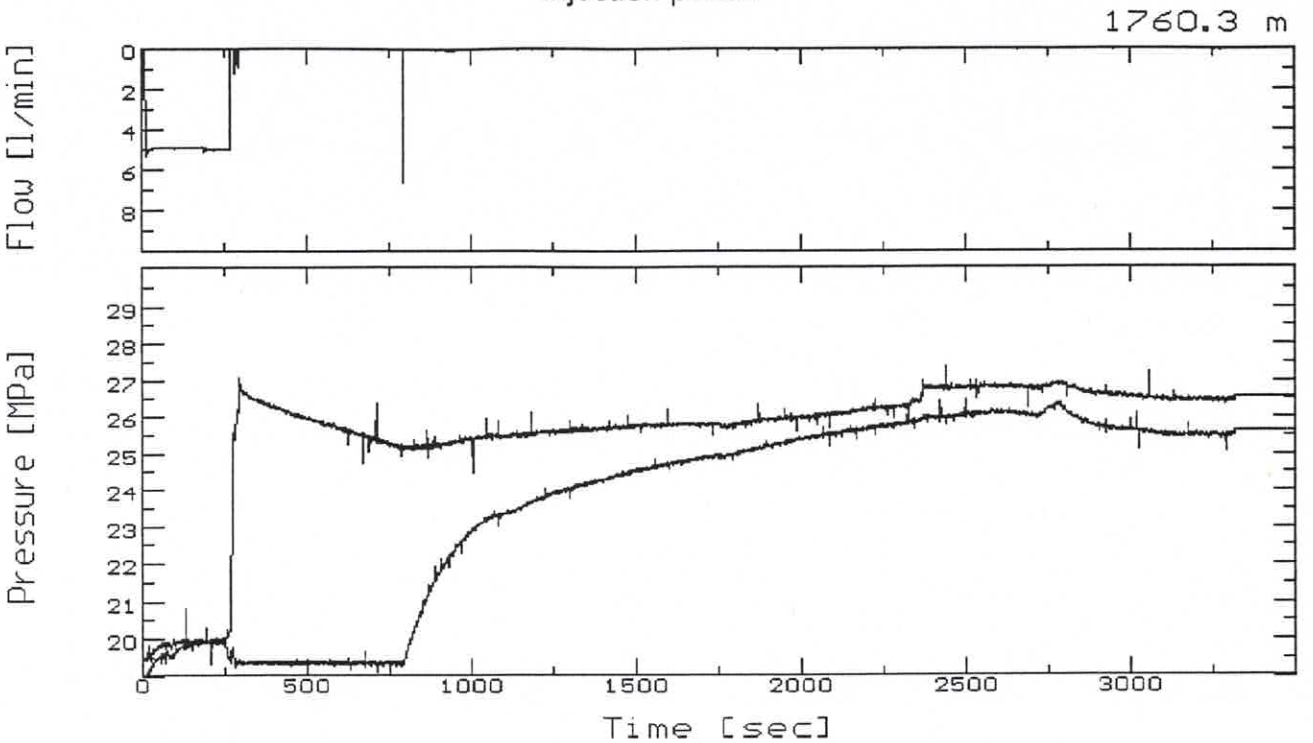
	date	time event
	21:54-22:19	movement to test position at 1681.0 m
05.08.95	22:19-01:45	**hydrofrac-test 5 at 1681.0 m**
	01:45-03:12	movement to test position at 1587.0 m
	03:12-05:18	**hydrofrac-test 6 at 1587.0 m**
	05:18-06:34	movement to test position at 1418.0 m
	06:34-08:53	**hydrofrac-test 7 at 1418.0 m**
	08:53-12:30	tripping tool out of hole
	11:30	arrival of Prof. Rummel at test-site
	13:30	equipment down from drill-rig plattform
	14:00	departure of Prof. Rummel
	16:10	departure of MeSy engineers (T.Przybilla, H.Vogt, U.Weber) from test-site with MeSy LKW and MeSy PKW, Winchsystem and 2 drums with coil-tubing remain at drill-site
	17:30	arrival at Mesy-Bochum, end of open-hole test campaign

Field Data Records

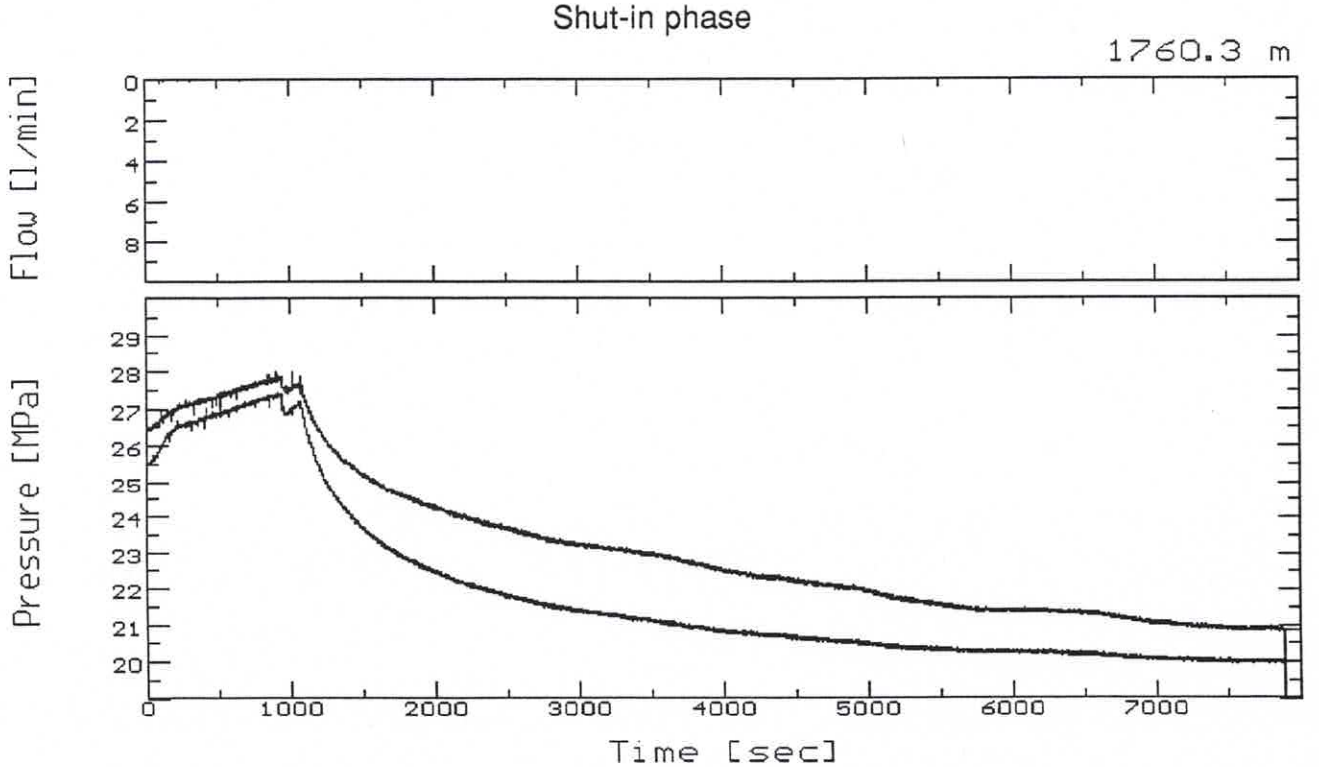
Injection tests

Overview - Plots
of Downhole Injection - and Packer Pressure
of Conducted Tests

Injection phase



Shut-in phase



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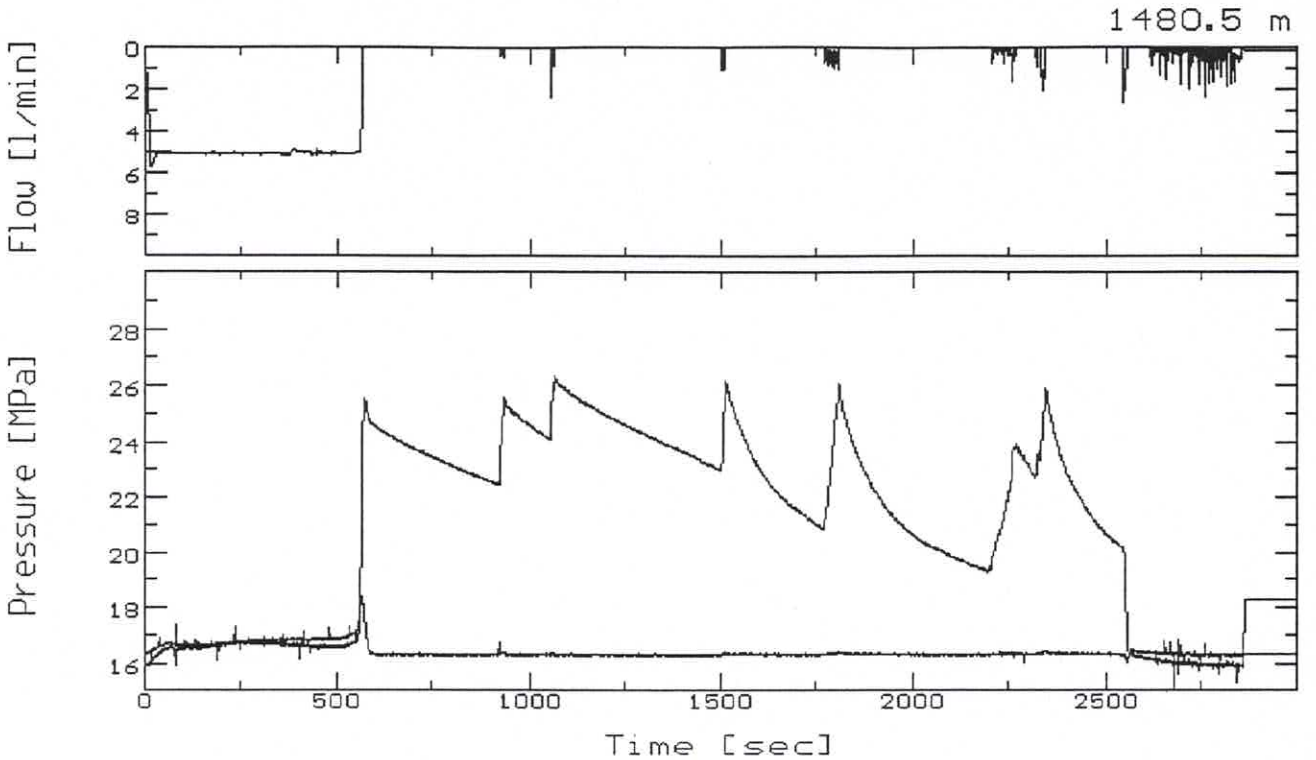

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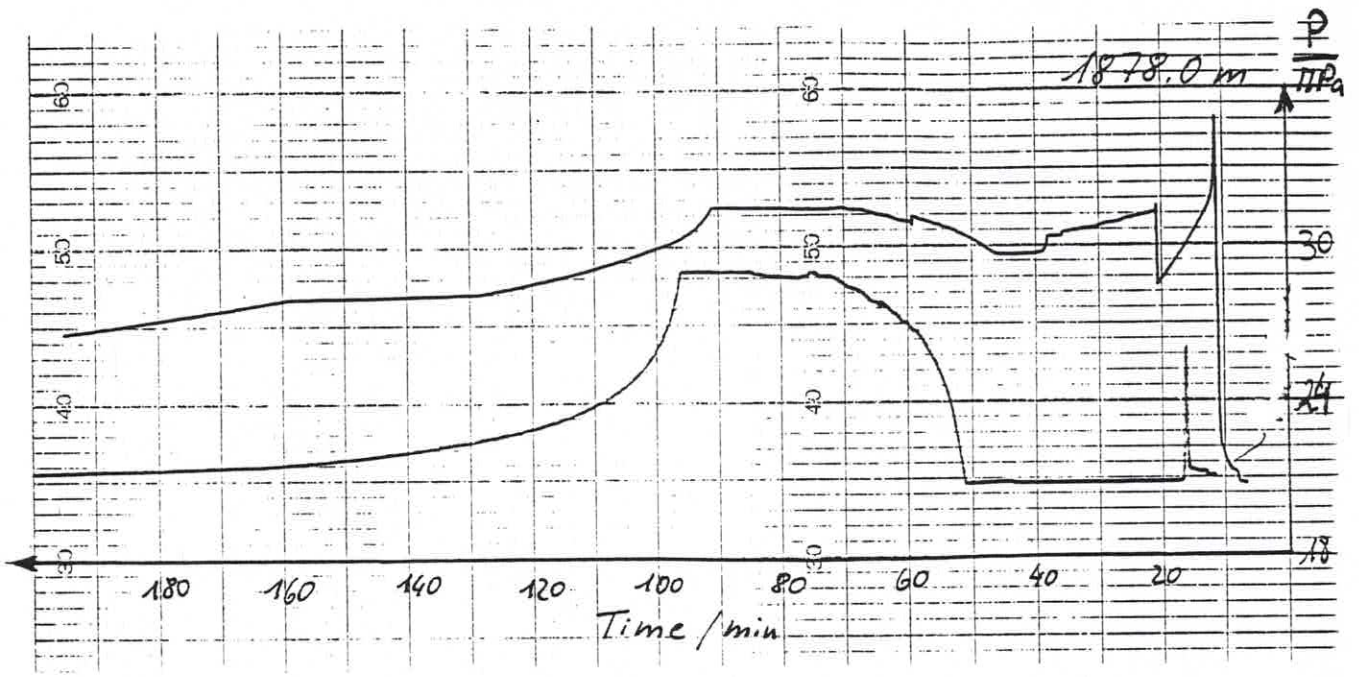
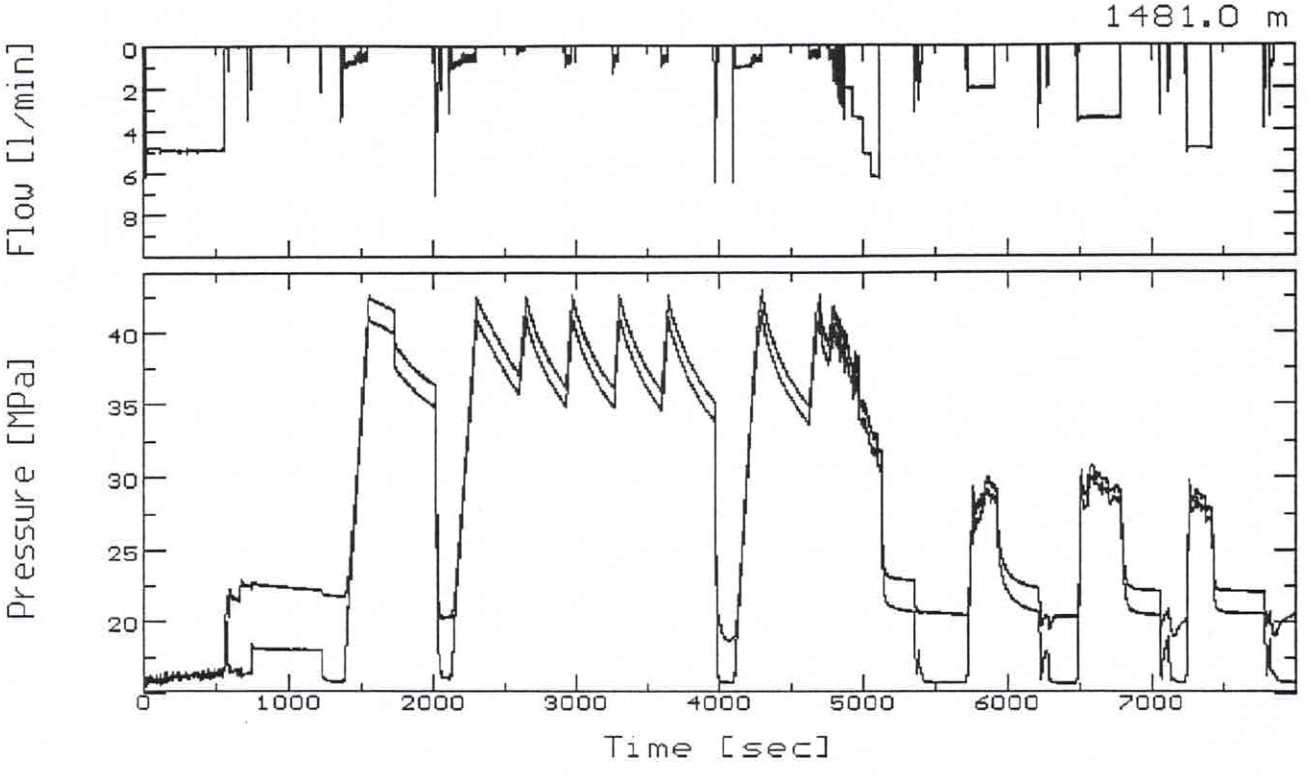
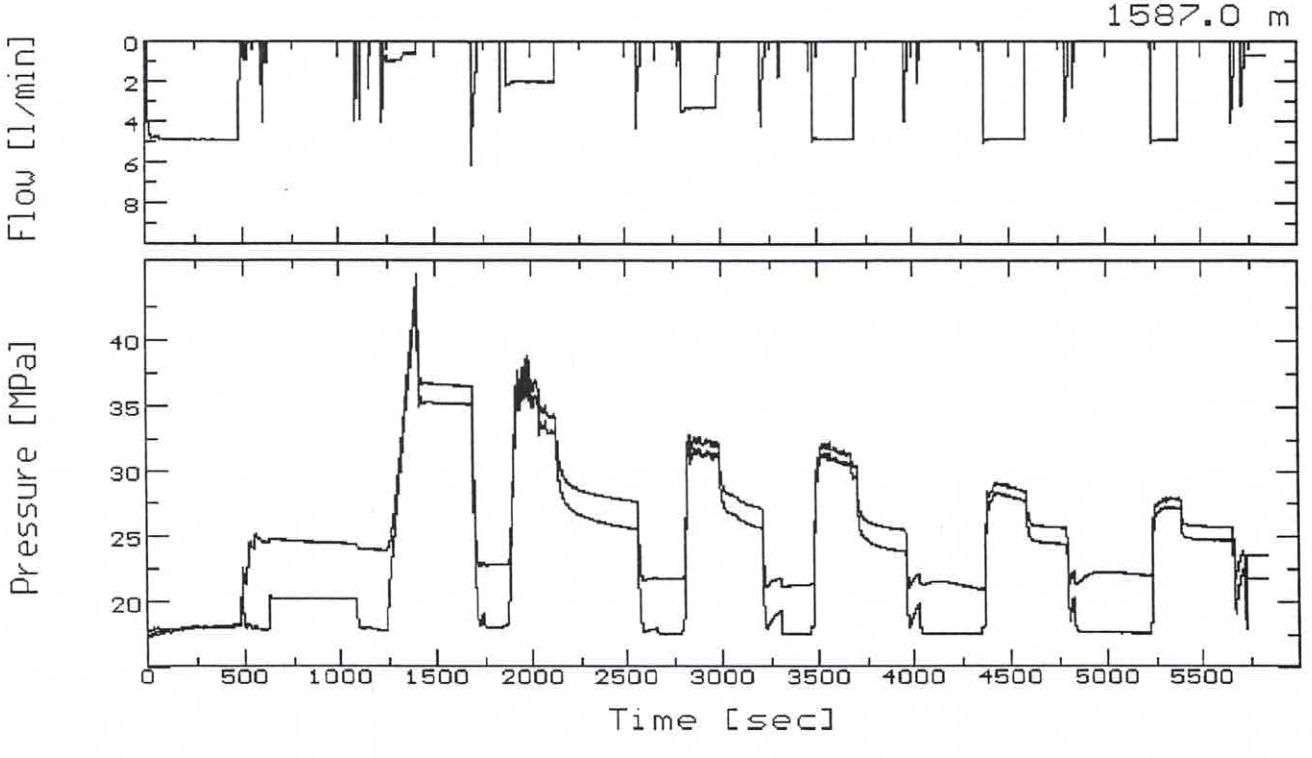


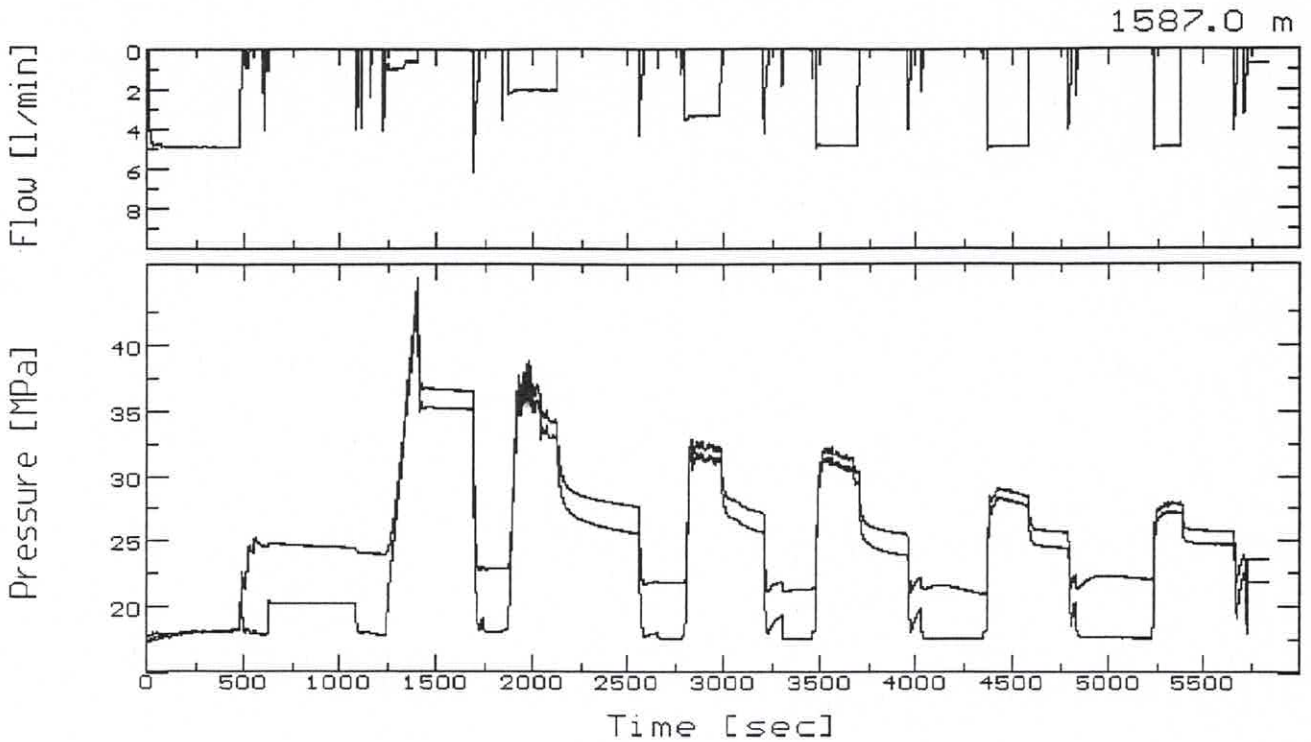
Field Data Records

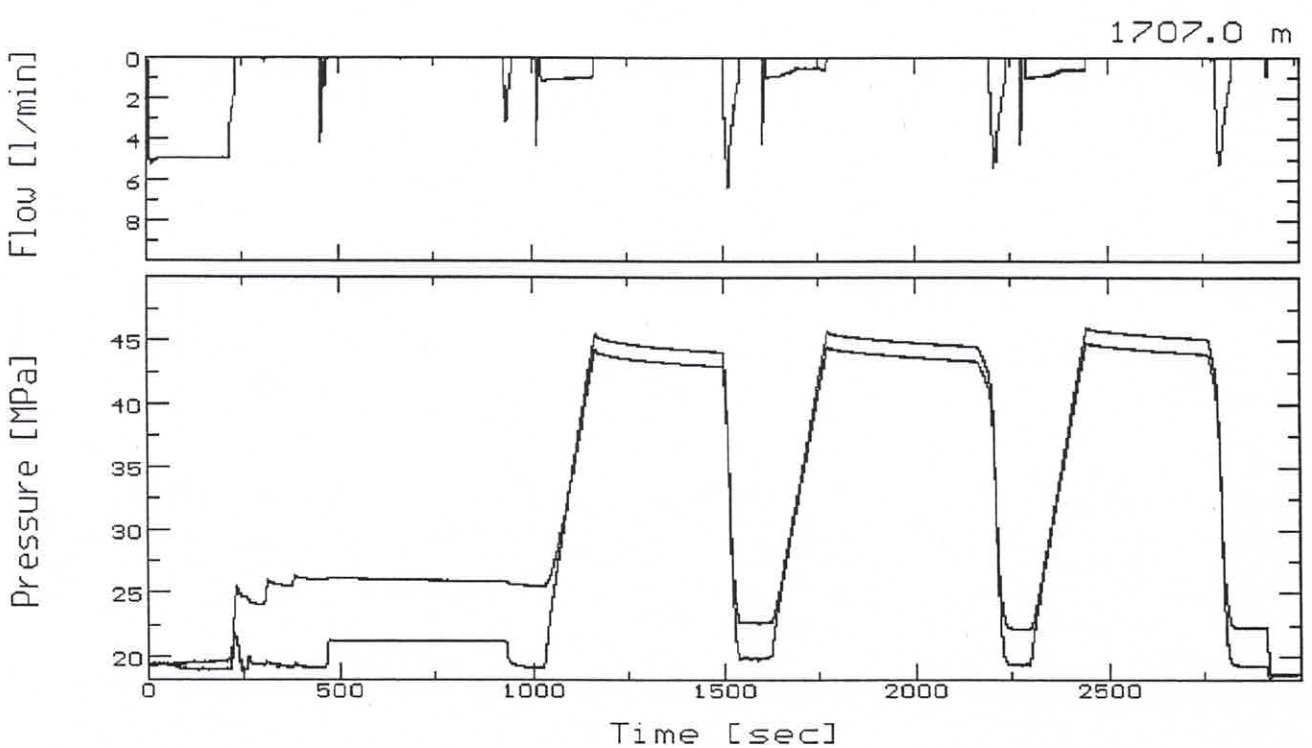
Stress tests

Overview - Plots
of Downhole Injection - and Packer Pressure
of Conducted Tests

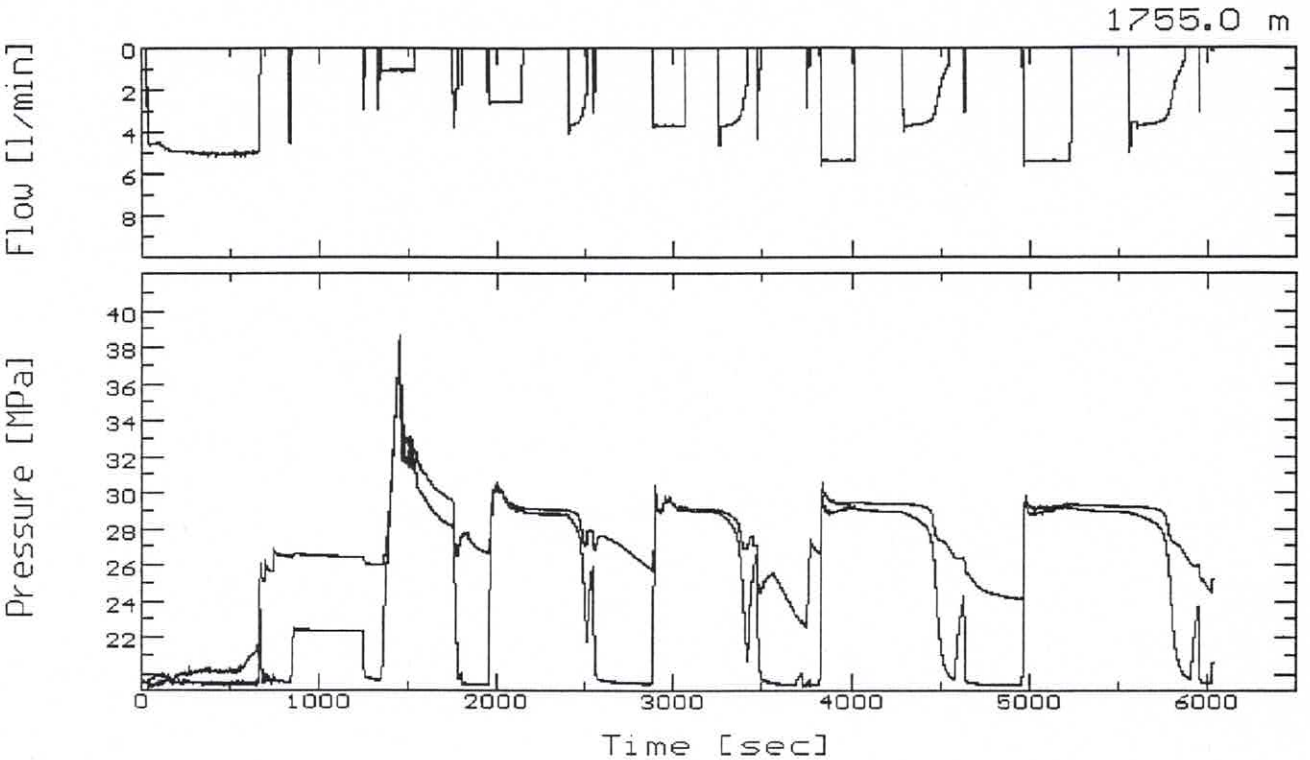

1481.0 m
Flow [l/min]
0
2
4
6
8
Pressure [MPa]
40
35
30
25
20
0
1000
2000
3000
4000
5000
6000
7000
Time [sec]

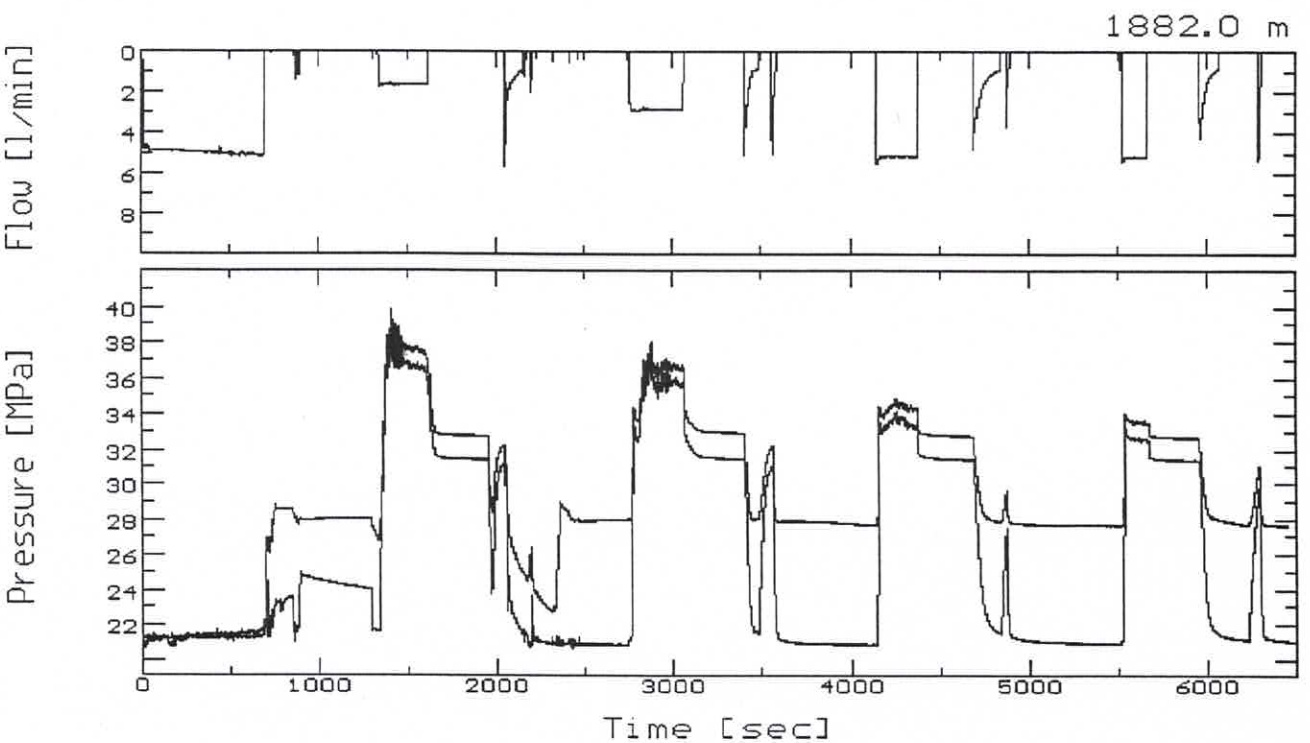

1587.0 m
Flow [l/min]
0
2
4
6
8
Pressure [MPa]
40
35
30
25
20
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
Time [sec]

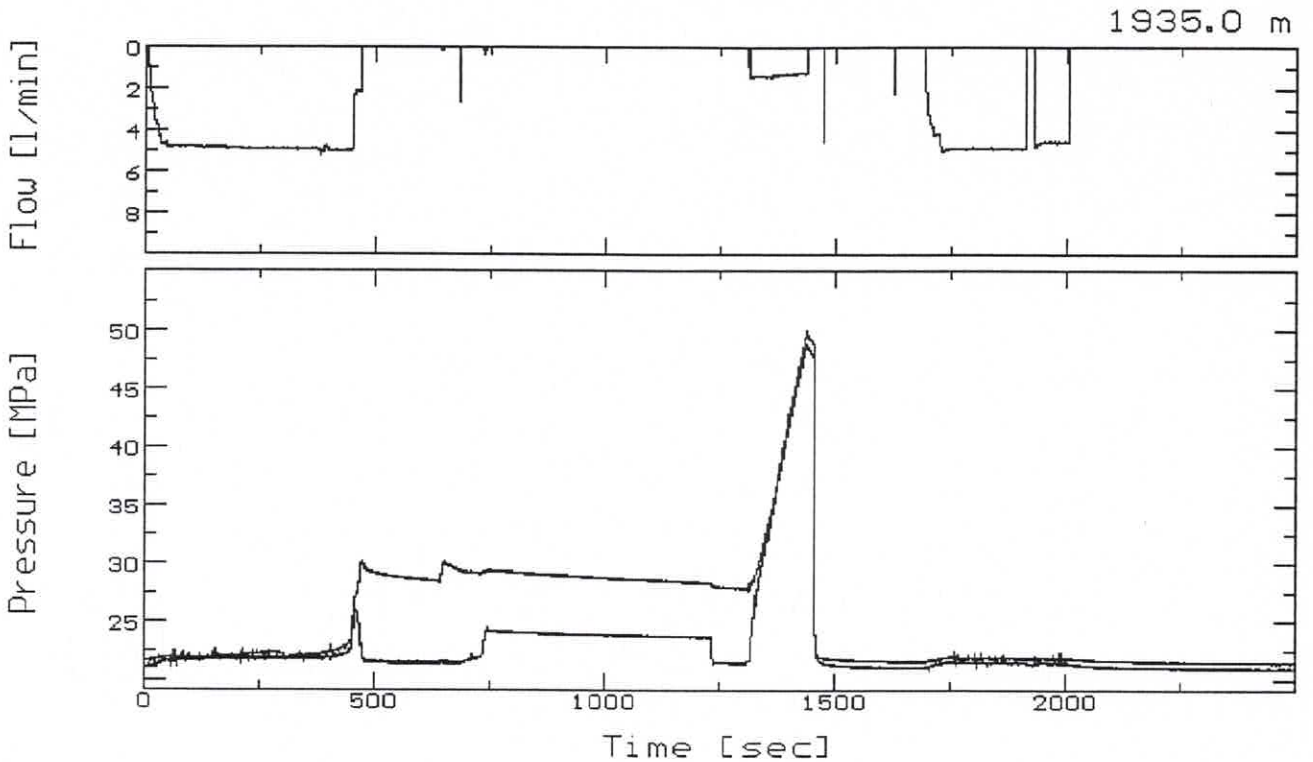




Estimation of $P_{si,min}$


1755.0 m
Flow [l/min]
0
2
4
6
8
Pressure [MPa]
40
38
36
34
32
30
28
26
24
22
0
1000
2000
3000
4000
5000
6000
Time [sec]


1882.0 m
Flow [l/min]
0
2
4
6
8
Pressure [MPa]
40
38
36
34
32
30
28
26
24
22
0
1000
2000
3000
4000
5000
6000
Time [sec]


1935.0 m
Flow [l/min]
0
2
4
6
8
Pressure [MPa]
50
45
40
35
30
25
0
500
1000
1500
2000
Time [sec]