statoil
Gullfaks
LD/EL
10.11.82
PTEK820029

34/10-15:: WELL TESTING

1. TESTS REQUIRED

34/10-15 is prognosed to penetrate the Lower Brent (Rannoch), the Cook and the top of the Statfjord. The following test sequence is proposed:

Statfjord: No tests

Cook: Unit-2
* DST-1, across entire sand interval.
* Formation breakdown test across same interval.

Unit-3
* DST-2, across entire sand interval.

Rannoch:
* DST-3, possibly across a thin, isolated sand unit if the Digital Sonic log indicates the likelihood of sand production from parts of the section. (This may instead be accomplished by DST-2, above).
* DST-4, across the entire Rannoch sand.

— JERIK / TERJE samarbeide

That is, a maximum of 4 DST's and one formation breakdown test.

2. TESTING RATIONALE

a) Cook — The aim is to test the well as though it were being completed for development. This means perforating over larger intervals than previously.

The tests are designed to:

I) develop a completion policy for the Cook
II) establish a safe, maximum injection pressure
III) test for depletion

Three, former tests on this formation in wells 34/10-7 and 9 (refer Appendix 1) provided incomplete or inconclusive data on the above.

I) Completion Policy

Sand unit 3 in the Cook has extremely high permeabilities compared to unit 2, refer figures 1 and 2 attached. This raises the same sort of problems in deciding on a safe completion policy as are currently being anticipated on the Etive/Rannoch reservoir.

DST-1 should establish whether the productivity of unit 2 is sufficiently high to permit injection/production from this sand prior to perforating unit 3 in development wells. The full section of sand should be perforated.

DST-2 should be conducted across the highly productive unit 3. Again, the full sand section should be perforated to permit a realistic evaluation of the PI.

II) Injectivity

The productivity data from these tests, coupled with the formation fracture pressure, should enable a reasonable estimate of injectivity to be made. It is quite possible in performing the fracture test that

some degree of communication be established between units 2 and 3, which could lead to an overestimate of the PI of the latter in DST-2. This is a risk worth taking, since it is of prime importance to establish the breakdown pressure of unit 2, in case injection into this sand is elected as the initial, safe development policy.

III) Depletion

There is some evidence that pressure depletion was observed during DST-1 in well 34/10-7 (ref. fig. 3). Precisely how much is not known because of an uncertainty in the extrapolation of the initial pressure buildup. Since the observation of depletion would have a significant impact on development planning, it is imperative to determine the initial pressure correctly in DST's 1 and 2. This can be achieved by restricting the initial flow period to 5 minutes followed by at least a one hour buildup. This gives a Horner dimension less time ratio of $\log(5+60)/60 = .035$ thus minimising the extrapolation of the first buildup.

b) Rannoch

A Digital Sonic log will be run in this well, which is designed to locate intervals which are likely to produce sand. If analysis of the log indicates problem sands, particularly in the Rannoch 2, one of these may be tested at high rate (DST-3) to assess the reliability of the logging tool in field development.

The main test on the Rannoch is DST-4 across the entire sand interval. Since serious attention is now

being given to restricting initial completions on the Etive/Rannoch reservoir to the Rannoch sand, it is very important to determine the PI of this total interval for planning the details of development drilling.

The four tests conducted on the Rannoch to date have been over small intervals, 2-6 meters, and it is impossible, using these test data, to assess the productivity of the interval as a whole.

APPENDIX 1

Tests conducted to date on the Cook sand are as follows (refer figures 1 and 2):

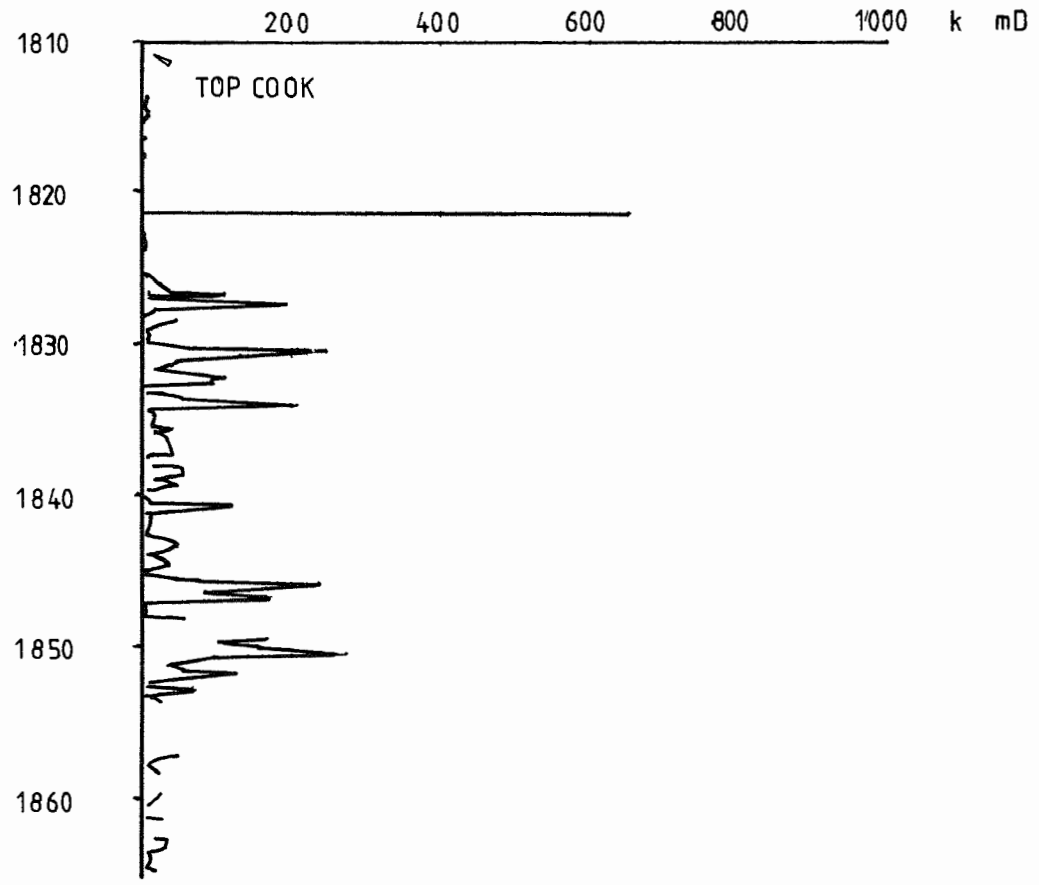
34/10-7, DST-1, tested 7 metres of the lower part of unit 2. The production rate was 471 Sm^3/D but it is not clear just how much of the formation was contributing to this rate (7 or 20 metres), hence it is difficult to use the data to determine a representative PI.

It is possible that some reservoir depletion (maximum 25psi) was observed in this test.

34/10-9, DST-1, tested 6 metres of unit 2, producing 42 Sm^3/D. This is probably representative of the formation which has much poorer permeability than 34/10 - 7 (k = 17 mD).

34/10-9, DST-2, tested 6 metres of unit 3. The well produced 756 Sm^3/D. The high skin factor is attributed to the effects of partial penetration in this high permeability sand (k = 2221 mD). It is, therefore, not certain whether the productivity is representative of the full unit 3 section or merely the perforated interval.

34/10 -7 COOK FORMATION

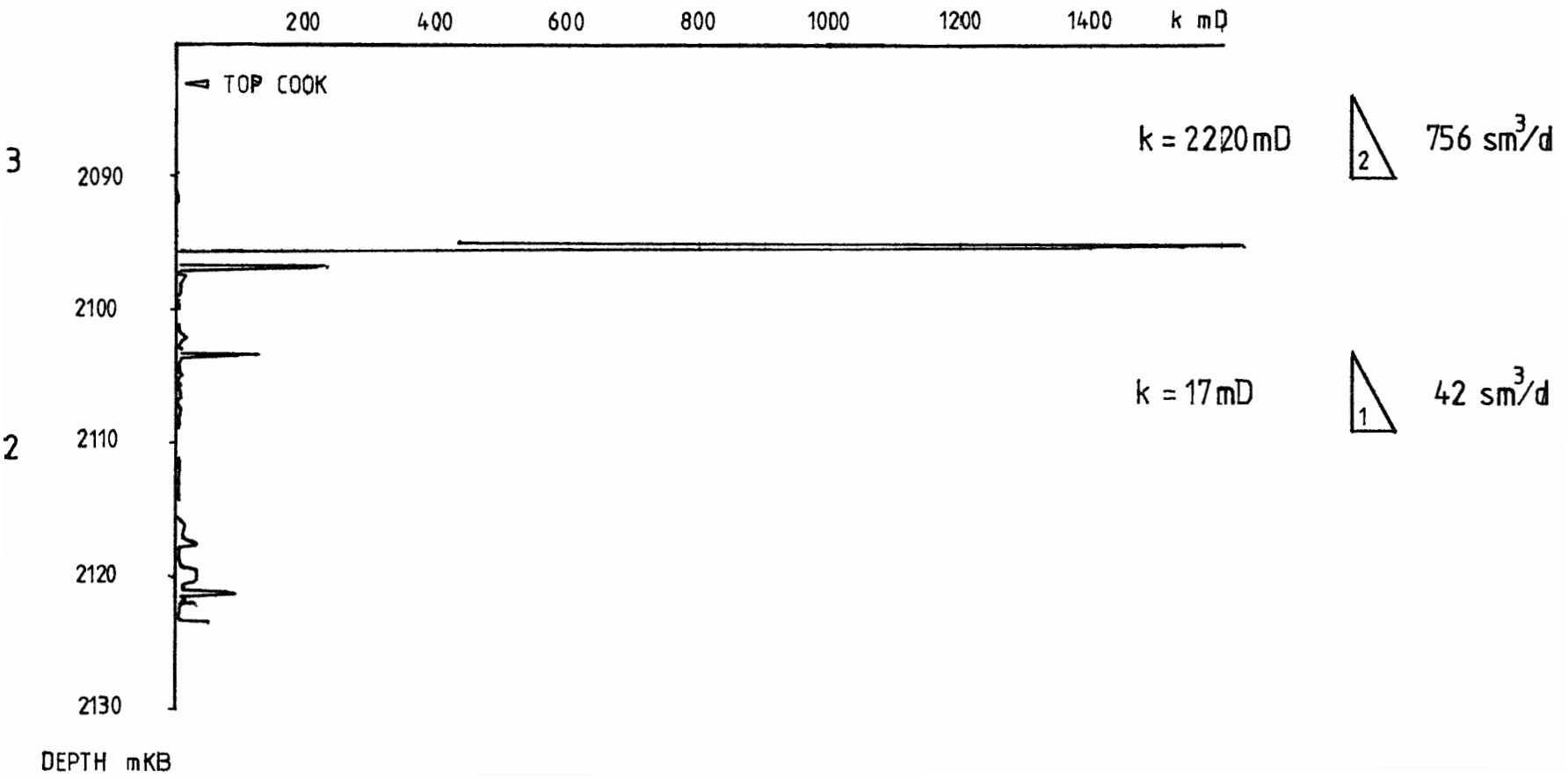


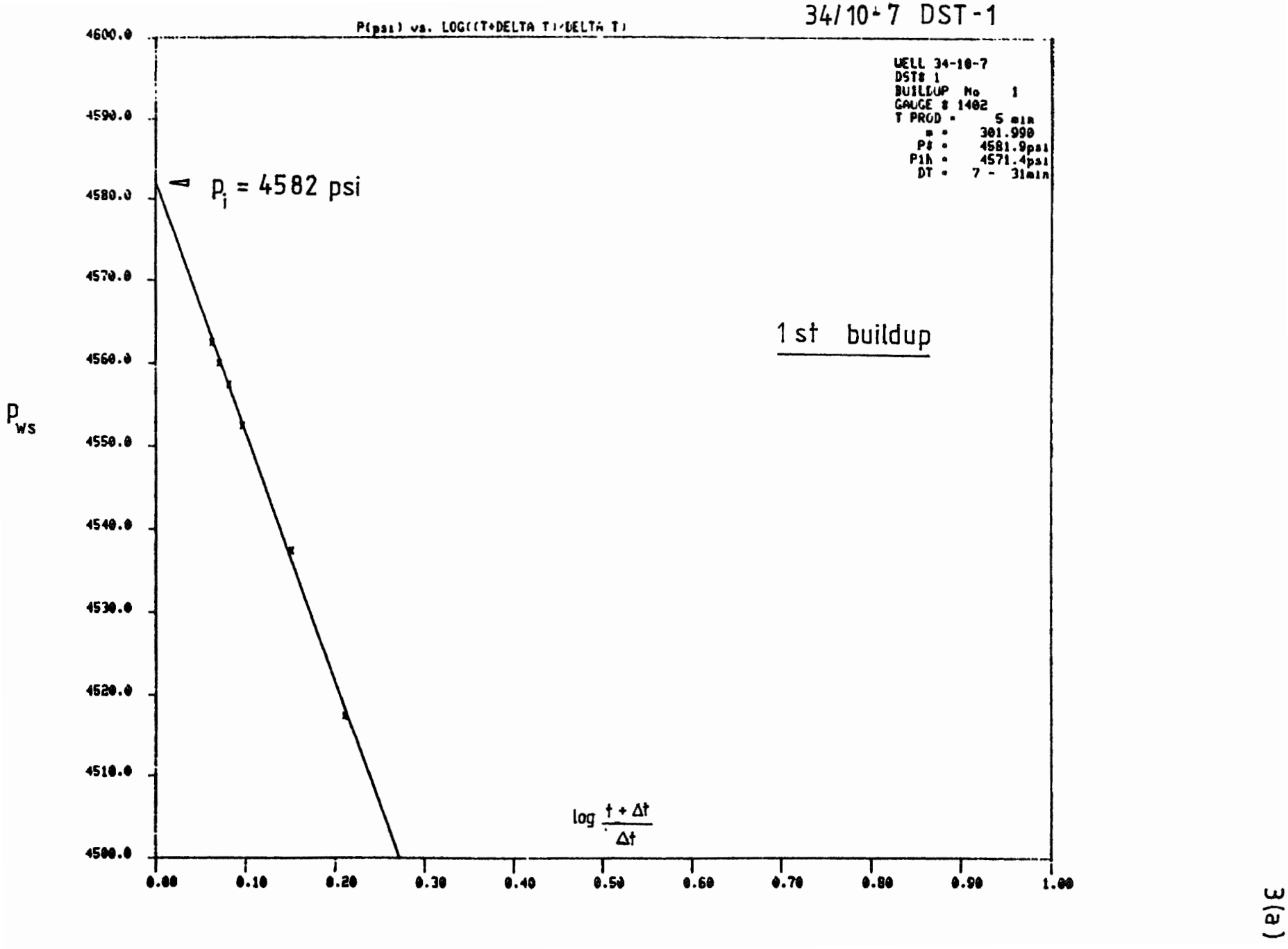
3

2

471 sm/d

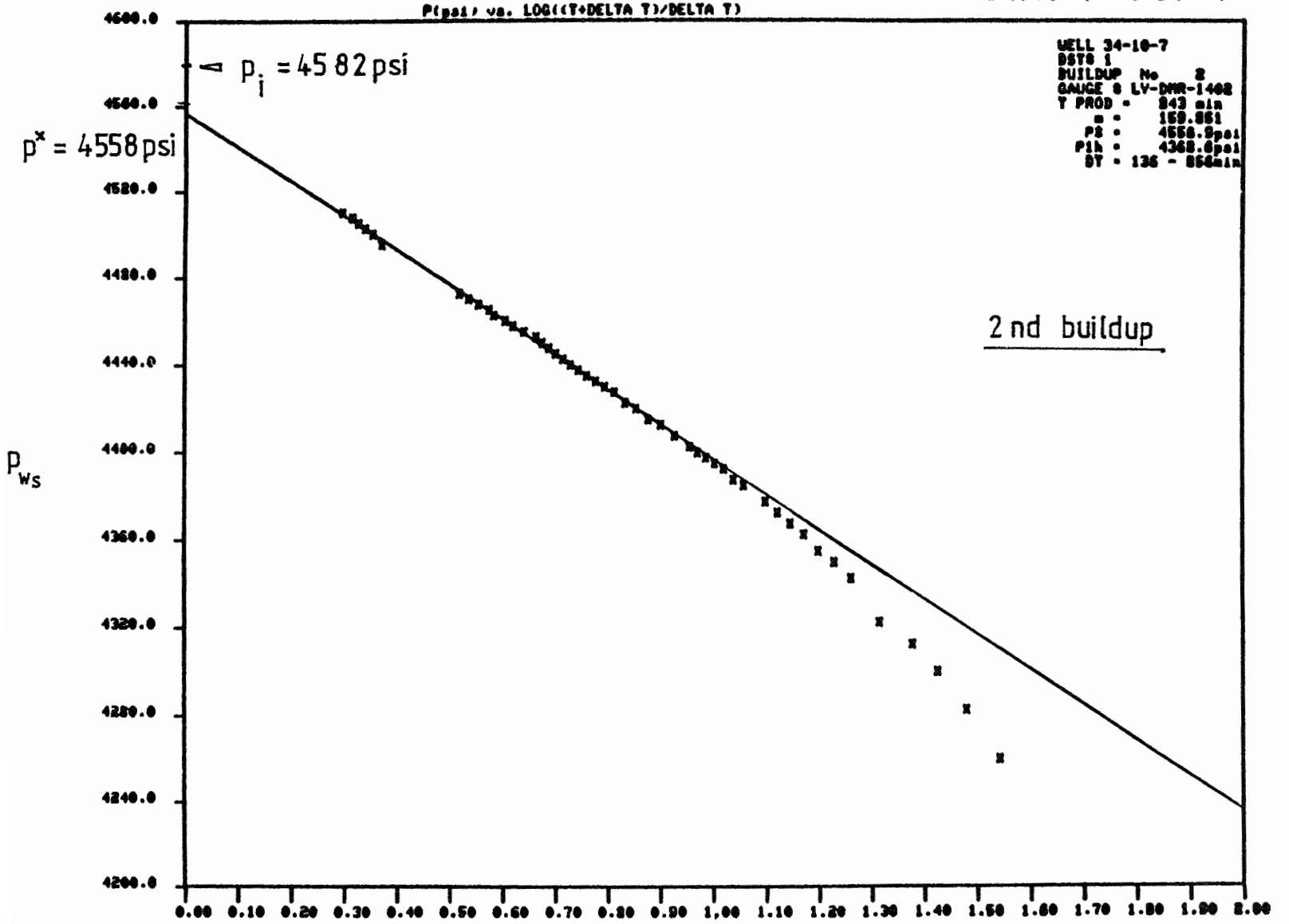
34/10-9 COOK FORMATION




34/10-7 DST-1
P(psi) vs. LOG((T+DELTA T)/DELTA T)
WELL 34-10-7
DST# 1
BUILDUP No 1
GAUGE # 1402
T PROD = 5 min
m = 301.990
P* = 4581.9psi
P1h = 4571.4psi
DT = 7 - 31min
p_i = 4582 psi
1 st buildup
p_{ws}
$\log \frac{t + \Delta t}{\Delta t}$
4600.0
4590.0
4580.0
4570.0
4560.0
4550.0
4540.0
4530.0
4520.0
4510.0
4500.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00

3(a)

34/10 -7 DST -1



3 (b)