PRESSURE DRAWDOWN ANALYSIS FOR THE: TRAVALE 22 WELL

A. Barelli, W.E. Brigham, H. Cinco, M. Economides, F.G. Miller,
H.J. Ramey, Jr., and A. Schultz
Department of Petroleum Engineering
Stanford University
Stanford, California 94305

Introduction

This work presents preliminary results on the analysis of draw-
down data for Travale 22. Both wellhead pressure and flow rate
data were recorded in this well for over a period of almost two years.

In the past, Barelli et al. (1975) and Atkinson et al. (1977) pre-
sented the analysis of five pressure buildup tests. Figure 1 shows
the Horner plot for these cases. They found that to have a good match
in all cases, it was necessary to assume that the Travale 22 well is
intersected by a partially penetrating vertical fracture in a parallele-
piped whose bottom side is maintained at constant pressure (boiling
front), as shown in Fig. 2.

Atkinson et al. also presented an analysis for a pressure inter-
face test run in the Travale-Radicondoli area. In this case, the
Travale 22 well *was* flowing and the pressure recorded at wells R1, R3,
R5, R6, R9, and Chl (see Fig. 3). Analysis of these data showed that
pressure interference in this reservoir can be matched by considering
pure linear flow (Figs. 4 and 5). This indicated the possible presence of
a vertical fracture intersecting the Travale 22 well. It was deter-
mined that fracture is oriented along the N73°W direction. In addi-
tion, the pressure interference data showed that no boundary exists
within 2 kilometers from the fracture plane. It was mentioned that
linear flow should take place in both horizontal and vertical direc-
tions.

Analysis of Drawdown Data

As mentioned previously, both wellhead pressure and flow rate
were measured when this well was continuously flowing during almost
two years. First the bottomhole pressure was calculated and plotted
on a semilog paper (Fig. 6). Data on this graph show a curve of in-
creasing slope similar to a fractured well case. The pressure seems
to stabilize *at 400* days, indicating a possible constant pressure
boundary.

A log-log graph of the pressure data is shown in Fig. 7. It
can be seen that the first data points follow a one-half slope
straight line, suggesting 3inear flow.

Since previous buildup analysis and interference analysis sug-
gested that the well is intersected by a fracture and the reservoir
has a constant pressure boundary, two models are used to analyze the
pressure drawdown data:

1) a well intersected by a fully penetrating vertical frac-
   ture in a finite system (Gringarten, Ramey, and Raghavan),
   and,

2) a well intersected by a partially penetrating vertical
   fracture in a parallelepiped whose bottom side is a con-
   stant pressure boundary.

Figure **8** presents the application of the type-curve matching
technique by using the first model. Agreement between most of the
pressure data and the dimensionless pressure curve is good; however,
at very long time (about 400 days), the system seems to reach steady-
state flow, indicating the existence of a constant pressure boundary.

Figure **9** presents the match of data with the second flow model
(parallelepiped model). The data appears to match the curve for
dimensionless formation thickness ≈ 2.5.

Results from this analysis and from previous work are summarized
in Table I. It can be seen that although both the results from
buildup and drawdown analysis suggest the same type of geometry for
the system, they do not agree regarding the dimensions of the reser-
voir.

Further effort is needed in the analysis of additional draw-
down data not presented in this work. At this point, the results
from the buildup data are more reliable because the analysis was
based on several tests.

Conclusions

A preliminary analysis of the drawdown data for the Travale 22
well seems to indicate the following:

1) the well is intersected by a highly conductive fracture, as
   found from the buildup and interference data, and

2) a constant pressure boundary seems to exist, causing the
   system to reach pseudosteady flow at about 400 days.

References

Atkinson, P., Barelli, A., Brigham, W.E., Celati, R., Manetti, **G.**,
    Miller, F., Nery, G., and Ramey, H.J., Jr.: "Well-Testing in
    Travale-Radicondoli Field," Proc., Lardarello Workshop on Geo-
    thermal Resource Assessment and Reservoir Engineering, Pisa,
    Italy, Sept. 12-16, 1977.

Barelli, A., Celati, R., Manetti, G., and Neri, G.: "Horner's Method
    Applied to Buildup Tests on Travale 22 Well," Summaries **of** the
    Second Workshop on Geothermal Reservoir Engineering, Stanford
    University, Stanford, California, Dec. 15-17, 1975.

Nomenclature

c_t = compressibility $(Kg/cm2)-1$

h = reservoir thickness (m)

k = permeability (m)

p = pressure (Kg/cm^2)

q = flow rate (tons/hour)

t = time (days)

x_f = half fracture length (m)

ϕ = porosity

μ = viscosity (cp)

TABLE I: RESULTS FROM PRESSURE TESTS

	$kx_f h_f$ (Darcy m2)	$\phi h_f x_f (m^2)$
Interference	5×10^4	1.5×10^4
Buildup	$2.5 \times 10^5 k$	2.5×10^4 (ϕ=.1)
Drawdown (Parallelepiped)	1.4×10^3 (ϕ=.1)	1.2×10^4 (ϕ=.1)
Drawdown (Vertical Fracture)	$6.552 \, x_f$	$3.66 \times 106/x_f$
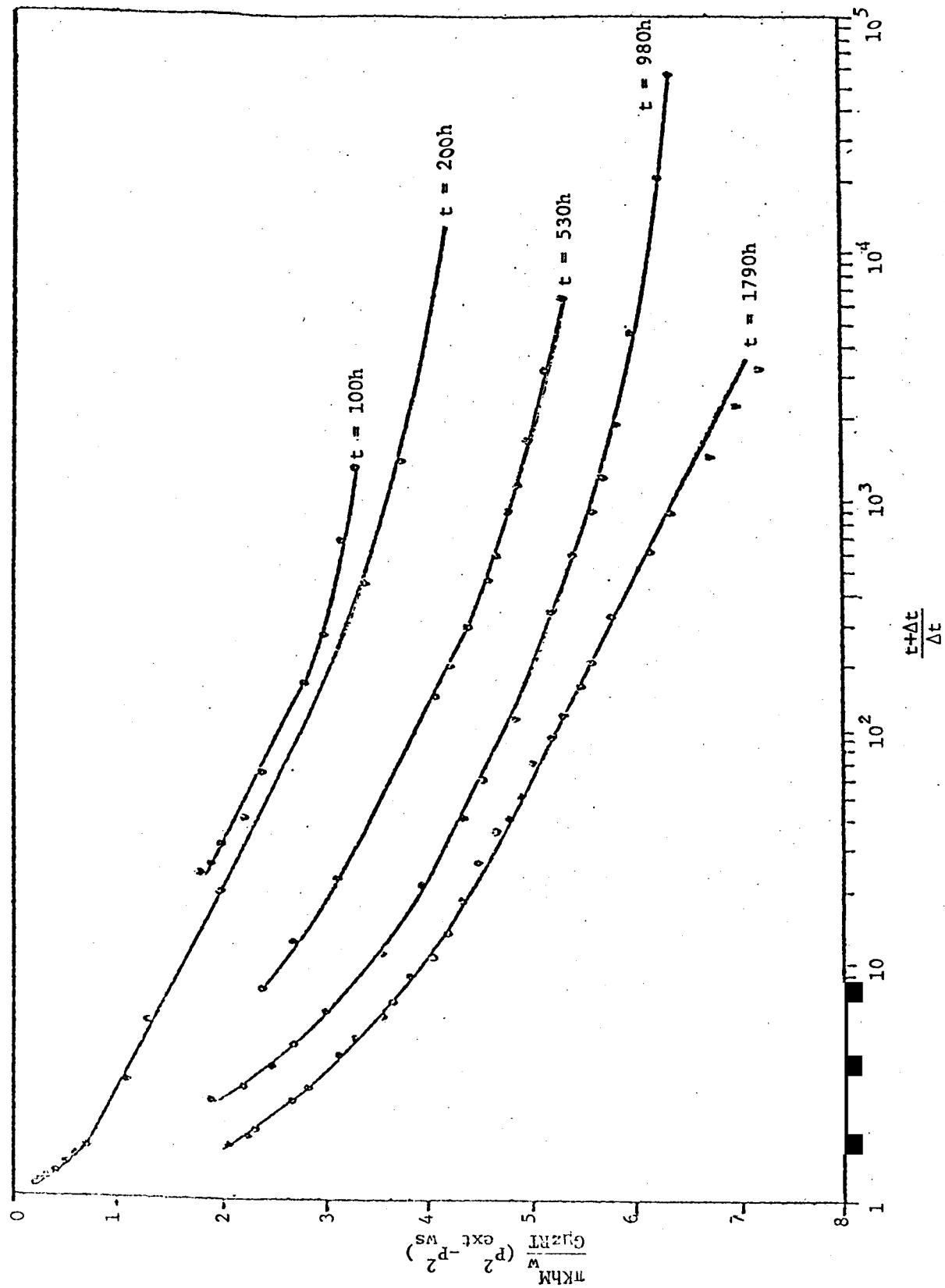
FIG. 1: RECONSTRUCTED HORNER BUILDUP GRAPH FOR T-22 WELL, 1972-1973 (Barelli et al., 1975)
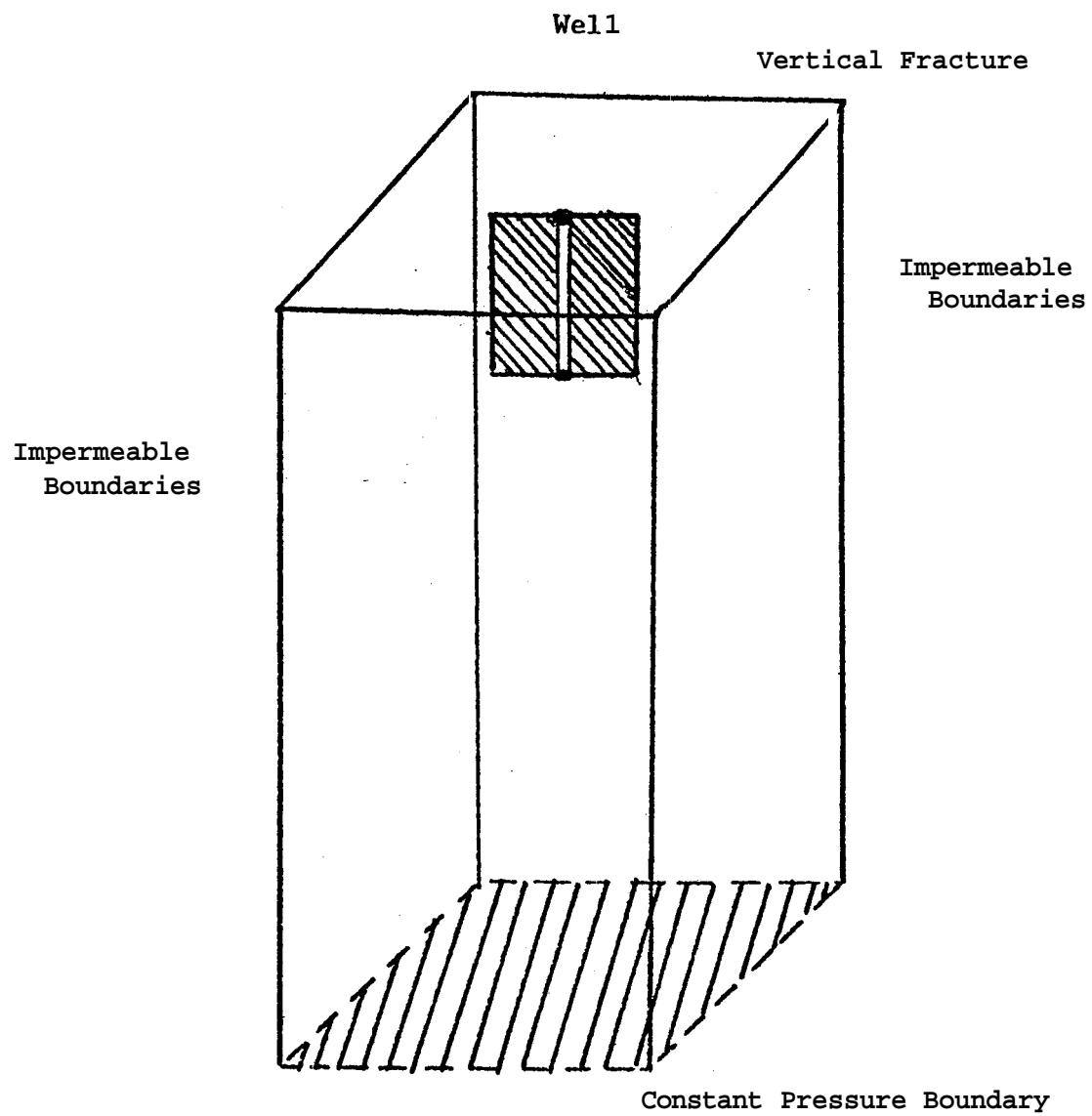
FIG. 2 : PARALLELEPIPED MODEL FOR A WELL INTERSECTED BY A PARTIALLY
PENETRATING VERTICAL FRACTURE
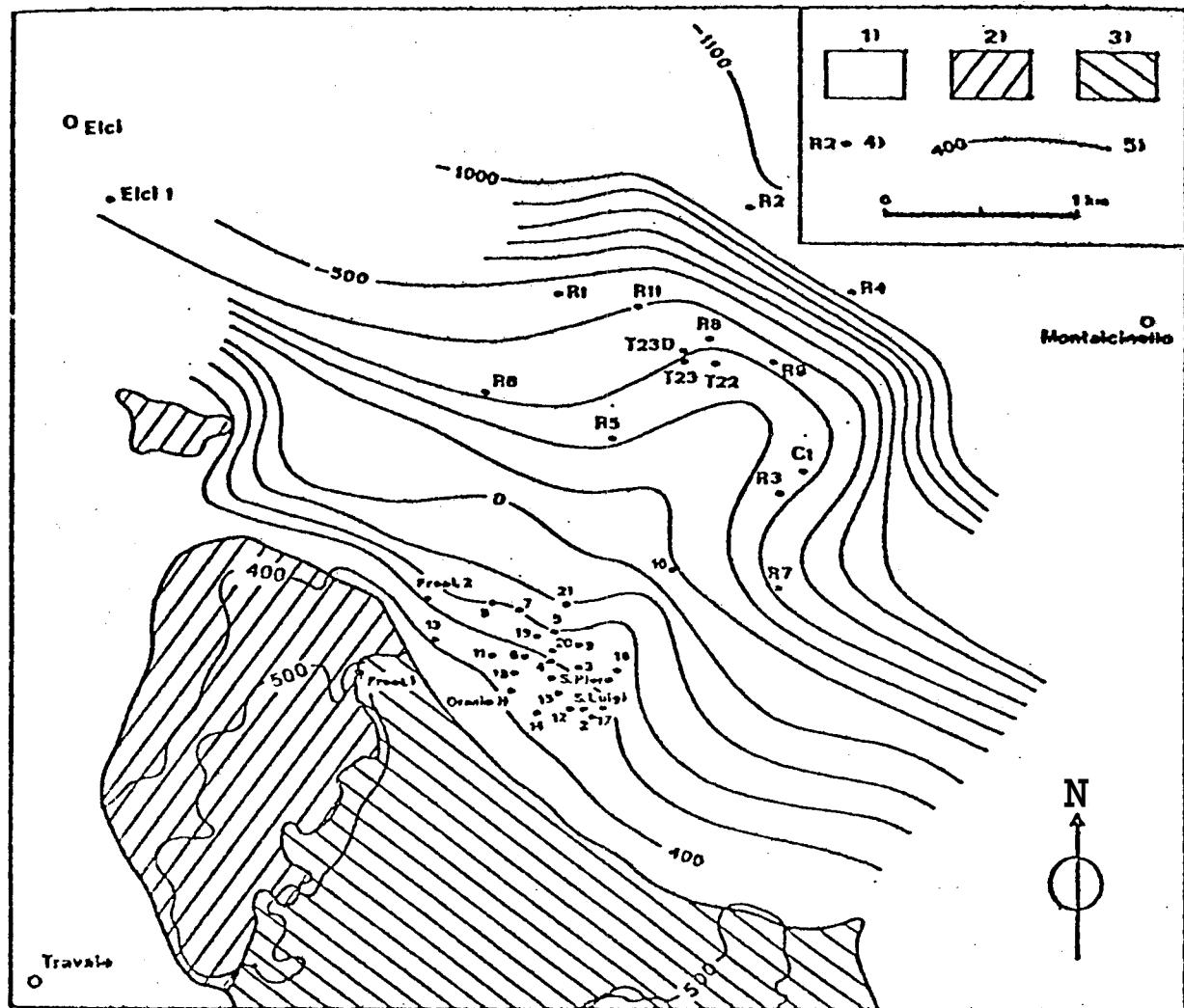
FIG. 3: TRAVALE GEOTHERMAL FIELD.   STRUCTURAL MAP OF THE RESERVOIR TOP.

      1: COVER COMPLEX: 2: RADIOLARITES AND LIMESTONES (PREDOMINATING);

   3: CAVERNOUS LIMESTONES; 4: WELLS; 5: ISOBATHS (ELEVATION m a.s.l.)
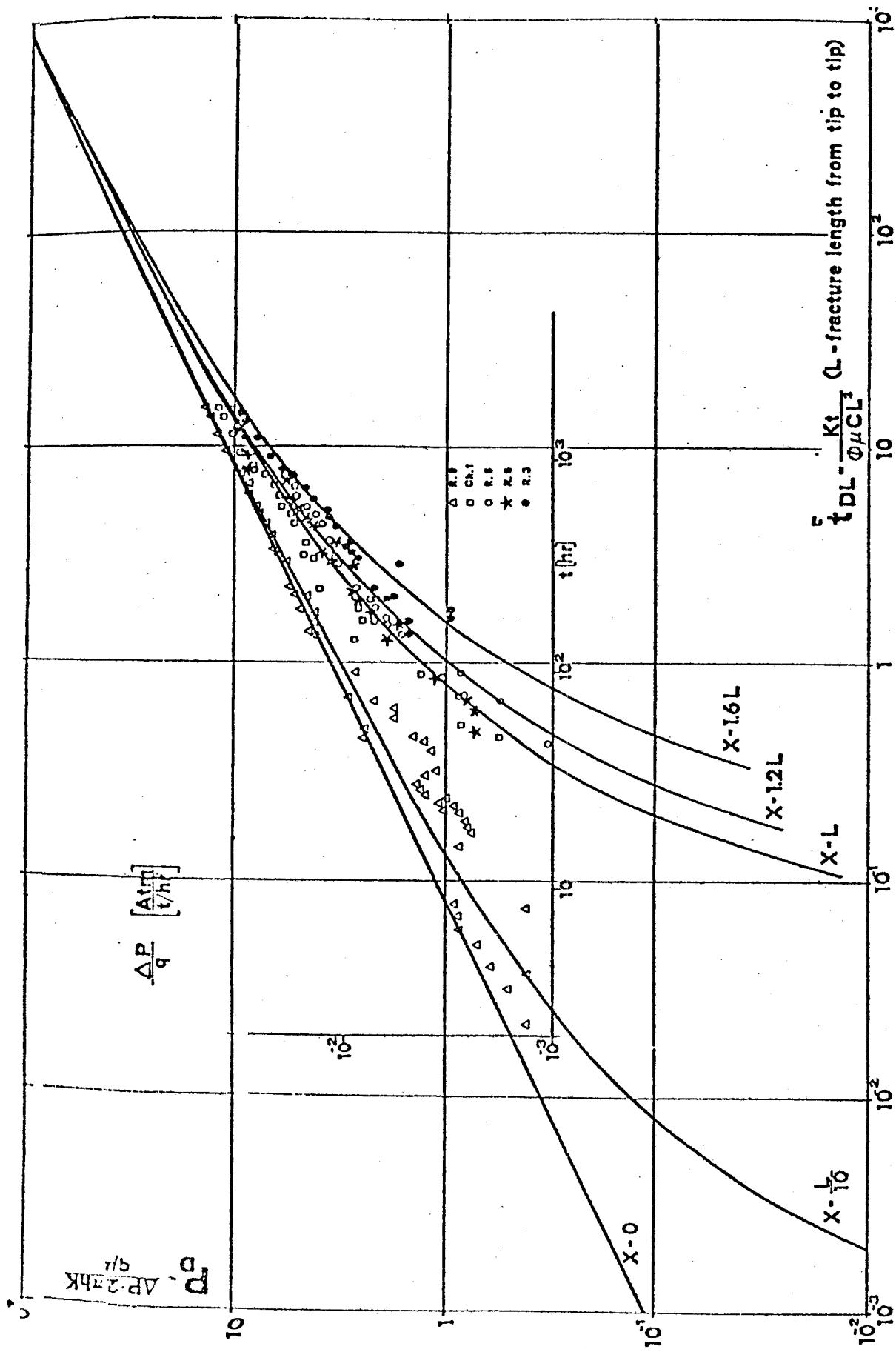
FIG. 4: INTERFERENCE DATA MATCHED WITH TYPE CURVES (Atkinson et al.)
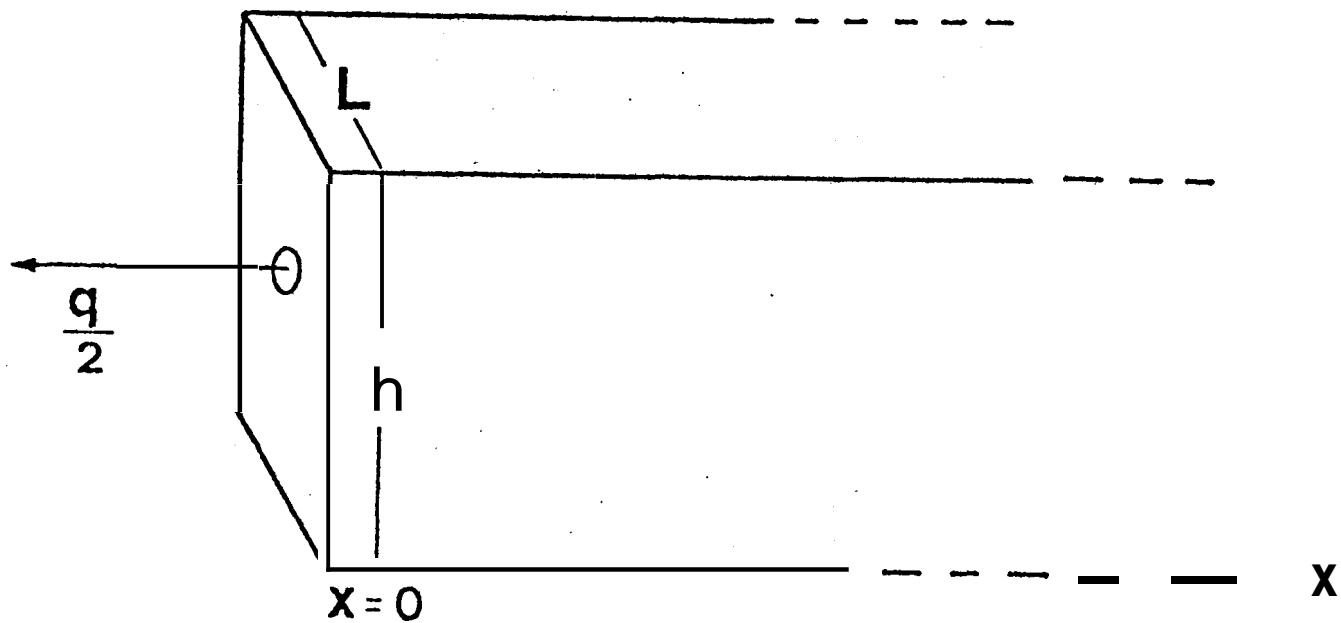
FIG. 5: LINEAR FLOW GEOMETRY (Atkinson et al.)

At (days)
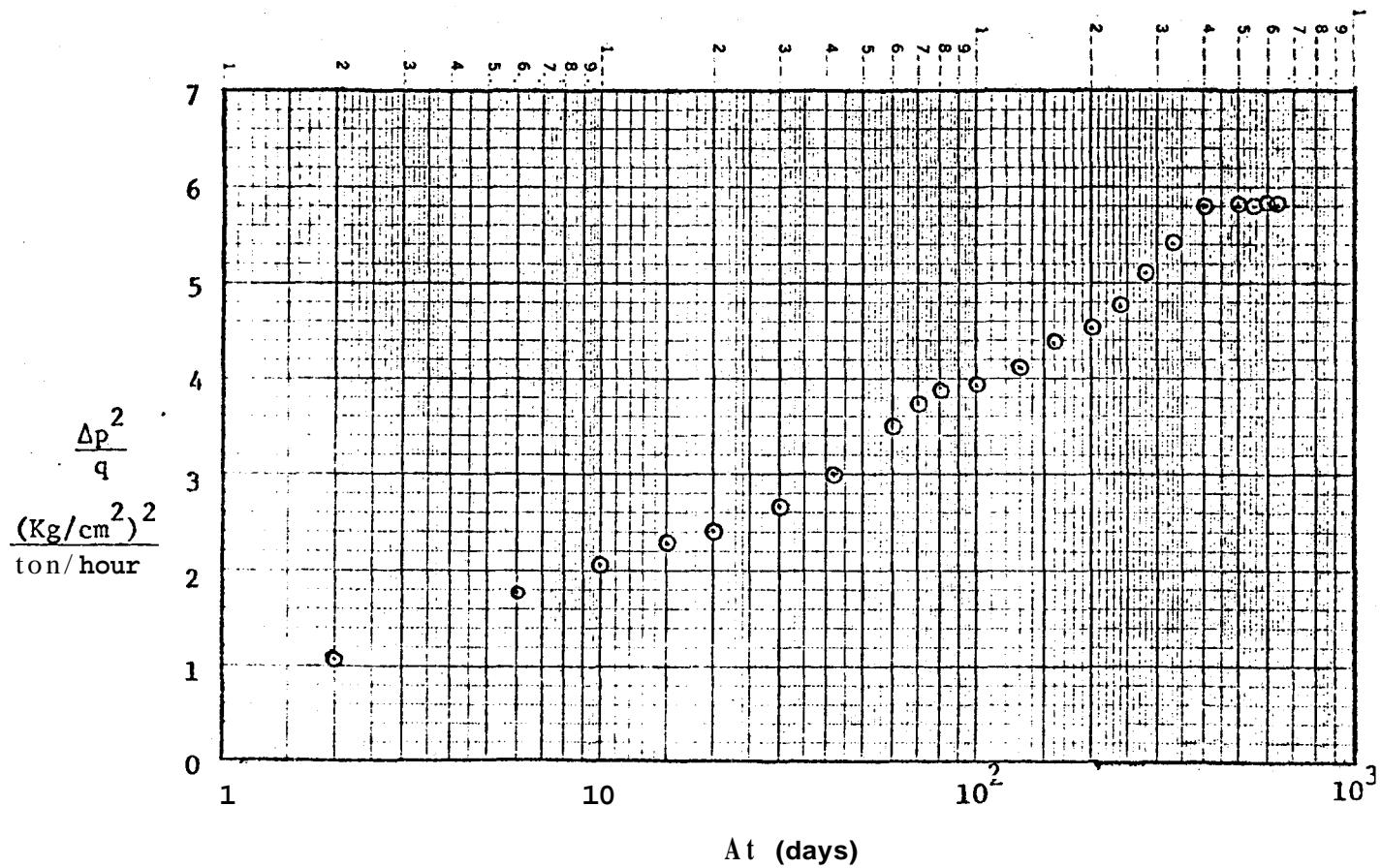
FIG. 6: SEMILOGARITHMIC PLOT FOR THE TRAVALE 22 WELL DRAWDOWN DATA
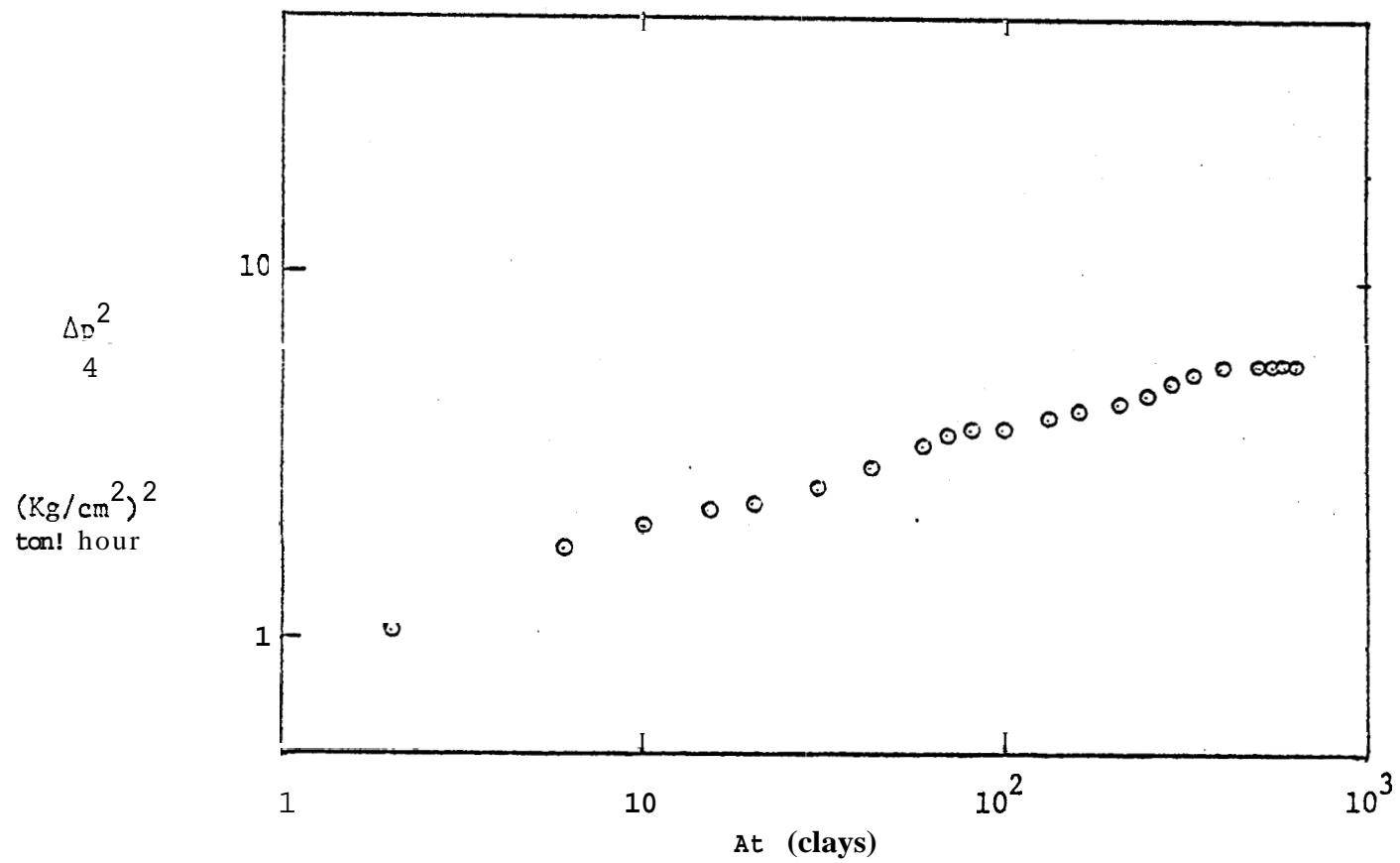
FIG. 7: LOG–LOG GRAPH OF DRAWDOWN DATA
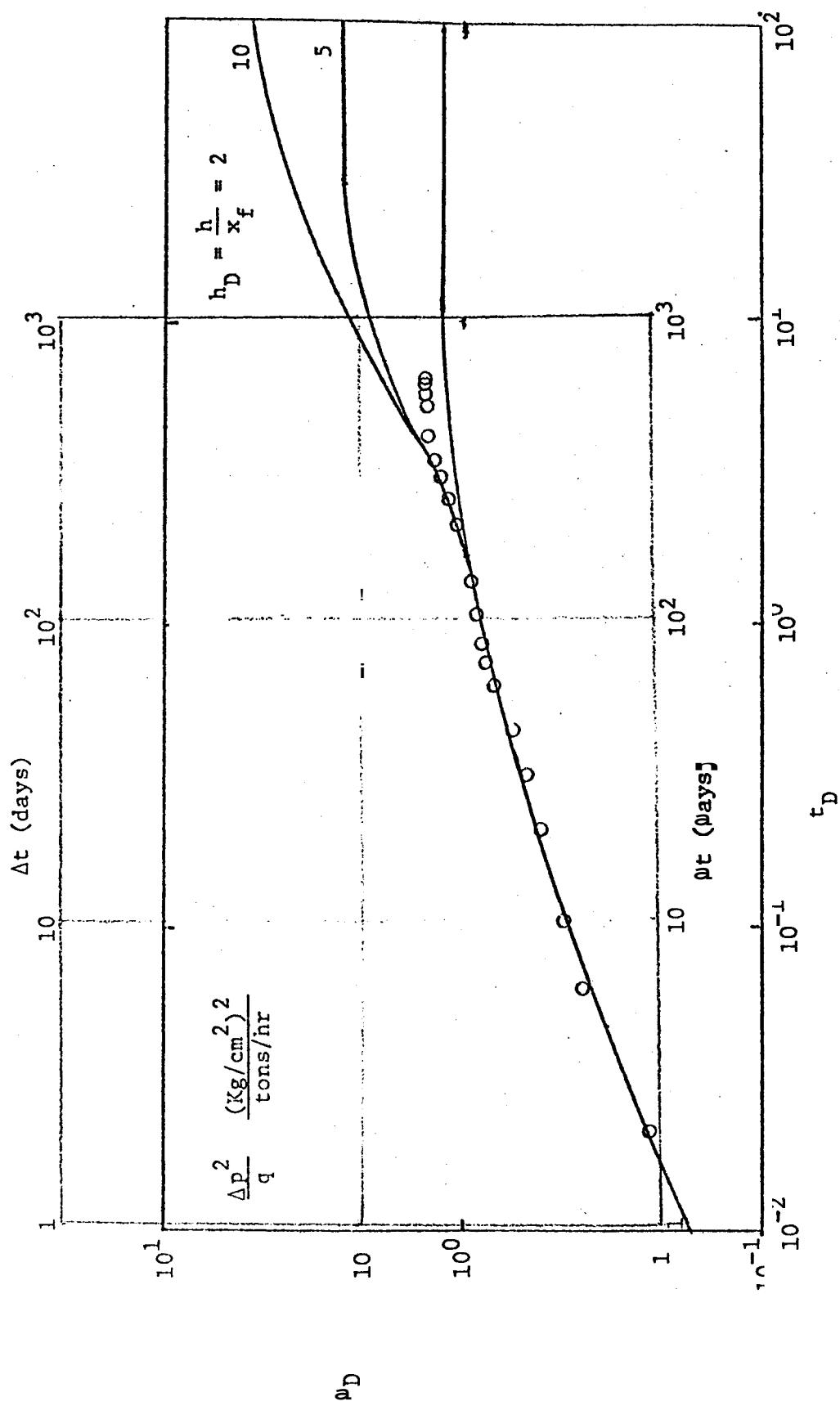
FIG. 8: TYPE-CURVE MATCHING WITH PARALLELEPIPED MODEL
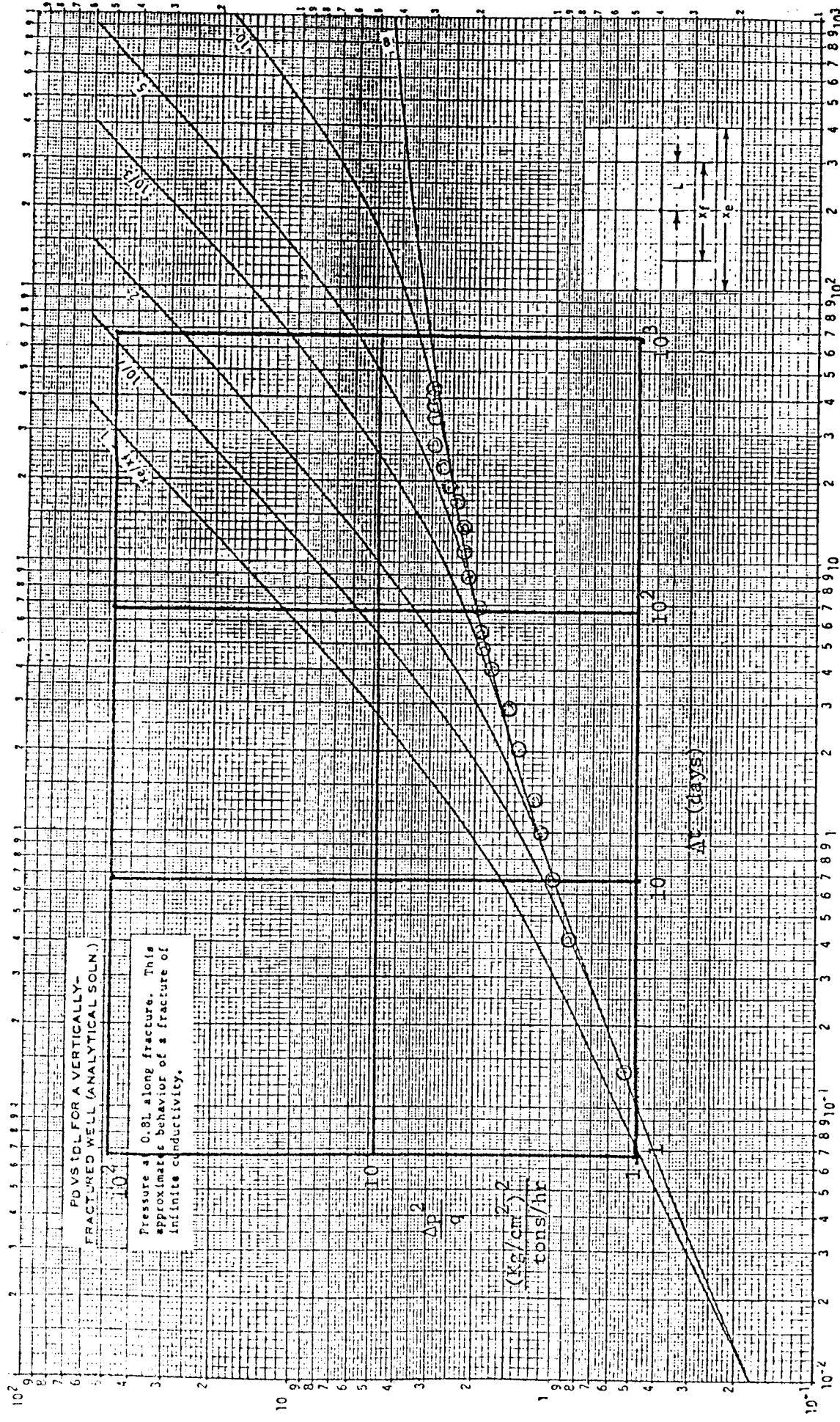
FIG. 9: TYPE-CURVE MATCH FOR THE DRAWDOWN DATA BY USING THE INFINITE CONDUCTIVITY VERTICAL FRACTURE SOLUTION

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