NEW MEXICO PETROLEUM RECOVERY RESEARCH CENTER

Exhibits in Case Nos. 7980, 8946, 8950, and 9111
Before the Oil Conservation Commission of the
New Mexico Department of Energy and Minerals.

June 13, 1988

A Review of the Gavilan-West Puerto Chiquito Mancos Reservoir
Performance During the Period of
July, 1987 - February, 1988.

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A REVIEW OF THE GAVILAN - WEST PUERTO CHIQUITO MANCOS RESERVOIR PERFORMANCE DURING THE PERIOD OF JULY, 1987 - FEBRUARY, 1988.

Background

The New Mexico Oil Conservation Division (OCD) requested that operators of the two subject pools, Gavilan and West Puerto Chiquito, conduct pressure buildup tests[1] on key wells. The purpose of the tests was to create data of sufficient quality to determine static pressures and reservoir characteristics. The Commission also ordered a variation in well-producing rates via the allowables ruling to test rate sensitivity.[2] The variation in producing rates suggests that the reservoir may be rate-sensitive, as shown by the fact that lower gas-oil ratios (GOR) were observed during periods of high production rates.

Included in the pressure study were wells Wildfire #1, High Adventure #1, Loddy #1, and Boyt & Lola #1, operated by Sun E&P; Bearcat #1 by Mesa Grande Resources; Howard Federal #43-15 by Reading and Bates; Hill Federal #2Y (later switched to Hill Federal #1) by Meridian; Johnson Federal 12#5 by Mallon; Lindrith B-37 by Mobil; and Canada Ojita Unit (C.O.U.) wells E-6, B-32, A-20, and K-13, operated by Benson-Montin-Greer. In addition to the data from these thirteen wells being studied by the Commission, operators generously provided information from other wells which is incorporated in this review.

The two subject pools both produce from the Mancos Shale at a depth of about 6,200 to 7,800 feet. Production is from the "A", "B", and "C" zones in what is described as a tight naturally-fractured reservoir consisting of shaley siltstone and low-porosity, fine-grained sand. Production from the Gavilan Pool is by primary means only, while the West Puerto Chiquito Pool has produced primary and secondary oil via a gas injection program during the past twenty years.

The 25-well Boulder Mancos pool is located in T28N R1W. This pool has been produced by primary means only since 1961 and is close to depletion as seen in Figure 1. Pressure buildup tests were conducted on this pool by Standard of Texas during 1963, and the resulting transmissability, kh/μ, was reported to be 97 D-ft/cp for three wells.[3] The pool encompasses about 4000 acres and will produce 1,830,000 cumulative barrels of oil, assuming 3 BOPD is the economic limit. In comparison, C.O.U. well E-10 alone has produced over 2,200,000 barrels of oil--evidence that gas injection is a successful secondary recovery process.

Static Pressures

Static pressures were measured on 6/30/87, 11/19/87, and 2/23/88 in the wells listed above with all other pool wells shutin. Pressures which were obtained with a downhole bomb are illustrated in Figures 2-4.

The method of arriving at the +370-ft pressure used in the figures is outlined in Matthews and Russell's monograph entitled "Pressure Buildup and Flow Tests in Wells."[4] Briefly, bomb pressure was corrected to the top of the "B" zone based on the tubing gradient. The pressure was then adjusted to a +370-ft datum based on the reservoir gradient. The reservoir gradient was determined from the volume-weighted, average fluid density from the Loddy #1 PVT data. The volume parameters used were the gas- and oil-producing rates prior to the test, corrected to reservoir conditions. The work sheets are included in Appendix 1.

Examination of the pressure data illustrates the presence of a pressure gradient from east to west across the pools--the exception being the undeveloped north and east sides of Gavilan. Pressure gradients of this nature are not uncommon in secondary recovery projects. For example, the isobaric lines shown in Figure 5 are taken from a CO_2 flood located in the Texas Panhandle.[5] The well density is 80 acres in this tight, heterogeneous carbonate reservoir, the capacity is about 1 D-ft, and the production response shown in Figure 6 clearly demonstrates that this Texas reservoir is contiguous, even with a 300-psi pressure drop across the 80 acres (~ 200 psi/1000 ft).

Other examples of the pressure gradients seen in secondary recovery projects include the 21 psi/1000 ft gradient measured at the 13 D-ft capacity Schuler Field edge-gas-injection project[6] (Figure 7) and the 75 psi/1000 ft gradient observed at the Judy Creek Waterflood[7] which is in the 5-10 D-ft capacity range (Figure 8). These examples are similar to the 25 psi/1000 ft pressure gradients in C.O.U. as seen in Figure 9.

Figure 9 also illustrates the directional dependency of the pressure gradients resulting from gas injection in West Puerto Chiquito. Notice that the pressure drop per 1000 ft is about a factor of 10 larger in the east-west direction than in the north-south direction.

Pressure Buildup Tests

Transmissibility, kh/μ, was calculated from the transient buildup data whenever the data permitted. Since the GOR's were above those of solution gas, the analytical method used to find reservoir parameters included converting gas and oil flow rates to one reservoir flow rate. Formation volume factors and fluid viscosities were arrived at by volume averaging the Loddy #1 PVT data in a manner similar to that used to find reservoir fluid density.

The technique used to analyze most of the transient data consisted of using Agarwal[8] time, T x dt/T + dt, as the time parameter to eliminate short, producing-time effects, and plotting the pressure difference vs. time on logarithmic paper along with the first derivative[9] of the pressure difference curve in order to find the proper semi-log straight line. Most of the buildups had storage and skin effects, which were identified by a unit slope on the logarithmic plots. The middle-time (MTR) straight line began at about 50 times the end of the unit slope line. The first derivative plot confirms the unit-slope-line rule. In an effort to maintain consistency with the Gavilan analyses, the pseudo-steady state (MTR) straight line was used in all analyses. The single exception was the November data from the B-37 well which fit a dual-porosity model very nicely and was so analyzed. Work sheets are included in Appendix 2.

Table I summarizes the analyses of the pressure buildup data. The transmissibilities are mapped in Figure 10.

As mentioned earlier, the 11/19/87 buildup data from the B-37 well was of sufficient quality, and free of boundary effects, that the dual-porosity analytic model described by Raghaven[10] in 1983 could be applied, producing the following results:

Fracture capacity, $k_f h_f$	=	1,477 md-ft
Matrix capacity, $k_m h_m$	=	9.16 md-ft
Transfer coefficient, λ'	=	1.27×10^{-7}
Fracture storativity, $\phi_f C_f h_f$	=	1.106×10^{-5}
Dimensionless matrix storativity, ω'	=	27 (about 4% of total porosity is in the fracture system)

During a recent review of the B-37 well data with Mobil, it was suggested that the proper reservoir thickness was the top 50 feet of the "B" zone, which is the producing interval. This zone was cored in the B-38 well, and found to have an arithmetic average porosity of 0.019 and permeability of 0.39 md.

Using a thickness of 50 ft and a matrix porosity of 1.9%, instead of the 233 ft and 0.1% used in the above calculations, produces the following results:

Fracture capacity, $k_f h_f$	=	1,477 md-ft
Matrix capacity, $k_m h_m$	=	30 md-ft
Transfer coefficient, λ'	=	5.12×10^{-7}
Fracture storativity, $\phi_f C_f h_f$	=	4.46×10^{-5}
Dimensionless matrix storativity, ω'	=	27

The matrix capacity agrees well with the 20 md-ft from the core analysis. These results support Mobil's observation that the reservoir is a dual-porosity system.

Interference Tests

Benson-Montin-Greer recorded bottomhole pressures at various observation wells while stimulating seven Canada Ojitos Unit wells. The pressure pulse generated by the hydraulic fracture treatment was recorded as a deviation from the pressure trend as seen on the curves included in Appendix 3. During conversations with M.M. Kamal, R. Raghavan, and W.E. Brigham, it became evident that the superposition method should be used to evaluate the frac pulse results rather than the analytical methods applied in the preliminary study. The superposition method is described in many of the textbooks used as references.[11,15,16,18] Briefly, the method involved obtaining the pressure difference, Δp, resulting from the frac jobs and the prior pressure trend. The observed pressure difference was then matched to the theoretical pressure difference resulting from the application of superposition. The permeability, k, and the porosity, ϕ, values were varied in the superposition calculations until the theoretical Δp matched the observed Δp as illustrated in the appendix.

The problem of reconciling the pressure buildup kh/μ with the interference test kh/μ is qualitatively answered with the information shown in Figure 11, reproduced from Ref. 11, p 133. The figure indicates that kh resulting from an interference test in a naturally fractured reservoir will always be greater than that resulting from a buildup unless t_D is larger than $1x10^6$. Since the dimensionless time results, t_D, calculated from the buildup results tabulated in Table I are all less than $1\ x10^1$ for one-mile well spacing, it is evident that the pulse test results in Table II reflect the transmissibility and storage capacity of the fracture system rather than the total system properties obtained from a single well test.

Accepting that the pressure buildup tests provide a reliable estimate of total kh/μ, the contribution to production resulting from the pressure drop existing on November 19, 1987, between B-32 and C-34 wells can be estimated utilizing

$$q = \frac{1.127\ kA\Delta p}{\mu L}$$

Substituting the B-32 buildup results, a one-mile distance between wells B-32 and B-29, and a 460-psi pressure drop between wells B-32 and C-34 result in a 5500 RB/D rate. The combined rate of wells B-32 and B-29 was 9700 RB/D at the time of the buildup. It is apparent that about 50% of the production from the two wells was being replaced by drainage from the gas injection area.

Frac pulse response was identified by examining the pressure vs. time curves illustrated in Appendix 3. Due to the wide well spacing, the fracture transmissibility must be much greater than the transmissibility calculated from the buildup tests. It appears that fracture transmissibility must be on the order of 5-10 times greater than buildup transmissibility if a readily defined frac response is to be seen at the observation well. The absence of a frac pulse response at an observation well does not necessarily mean the wells are not connected, but it could indicate that the fracture transmissibility is approaching the buildup transmissibility.

Frac response at eight wells was identified and analyzed. The calculated values of transmissibilities and storativity feet are presented in Table II. The transmissibilities also are illustrated in Figure 12.

Rate Sensitivity

During the 6/30/87 to 2/23/88 test period, a GOR vs. BOPD trend developed which indicated increased recovery efficiency at high production rates. A total of 87 wells were monitored. The GOR's were based on monthly averages except where producing time was less than three months; then daily rates were utilized. The data were sorted according to the producing rate so that correlations between rate and GOR could be studied; therefore, once the data was sorted it was not necessarily in chronological order.

Logarithmic plots of rate vs. GOR were made for the 87 wells. A total of 46 wells had a goodness of fit to a logarithmic straight line of 85% or better. The remaining 41 wells exhibited too much variation in their rate vs. GOR plots to be statistically meaningful. Three of the data plots of the statistically significant wells are in chronological order. These plots suggest performance typical of the solution-gas producing mechanism, not of rate sensitivity. Only one well had a positive slope, indicating poor recovery efficiency at high rates; the remaining wells indicate increased recovery efficiency at high rates. The wells with their correlation coefficients are tabulated in Table III. All wells are included in Appendix 4.

Explanations for the more efficient rate sensitivity vary. Three possibilities are:

1. Counter-current gas flow with the formation of a secondary gas cap displacing oil downward.

2. Formation of a large pressure difference between the fractures and the matrix enhancing the transfer of oil to the fracture system.

3. Formation of an unusually large number of gas bubbles in oils subject to rapid pressure decline which in turn reduces the oil saturation.

The concept of the formation of gas bubbles with resulting reduced oil saturation was proposed 25 years ago by Amoco in a paper titled "The Role of Bubble Formation in Oil Recovery by Solution Gas Drives in Limestones,"[12] which followed a paper by Kennedy and Olsen[13] on the same subject. Since then, little has been done to advance the concept.

Increasing the pressure difference between the fractures and the matrix was suggested by Elkins[14] as a means of improving recovery efficiency in the Spraberry Trend. If this was applied in the field, the results were not well documented in the literature. The concept does have merit in the Mancos where the surface area available for flow from the very tight matrix is extensive due to the fracture system. Flow from the matrix could continue for a number of years following the depletion of fracture storativity.

Normally, rate-sensitivity is associated with a displacement process and is readily described with the fractional flow equation:[15,16,17]

$$f_g = \frac{1 - \dfrac{4.9 \times 10^{-4}\, k\, k_{ro}\, A\, (\Delta\rho) \sin\Theta}{q_t\, \mu_o}}{1 + \dfrac{kro}{krg}\dfrac{\mu g}{\mu o}}$$

Dake, Eq. 10.21

With the formation of a secondary gas cap, oil is displaced downward and the sin(-90°) becomes minus, which allows the fraction of gas flowing, f_g, to decrease as the total rate, q_t, increases.

The equation shown above was applied to well B-37 utilizing the parameters derived from the November pressure buildup test, 320 acres drainage, relative permeability ratios from Slider's textbook[18] (curve #16 on page 456 which is for large fractures connected together), and Loddy #1 PVT data. Figures 13-16 depict the theoretical match to the actual data obtained, utilizing only the fractional flow equation. The trend of the theoretical curve is similar to the production trend in the B-37, E-6, and Johnson-Federal 12#5 wells; however, the Bearcat #1 does not follow suit.

The match of the theoretical to the actual shown in Figure 17 for the B-37 well was obtained by reducing the permeability-area product in the fractional flow equation from 8.75 x 10^7 md-ft^2 to 8.75 x 10^5 md-ft^2, suggesting that the secondary gas cap is not continuous throughout the 320-acre drainage area.

The permeability calculated from the well B-37 buildup test was used to match the producing f_g trend in the critical rate, q_{crt}, equation[15] shown below.

$$q_{crt} = \frac{4.9 \times 10^{-4} \, k k_{rg} \, A \, \Delta\gamma \sin\Theta}{\mu_g \, (M-1)}$$

This equation results in a 50 STB/D critical flow rate.

Counter to the production data supporting the improvement in the recovery efficiency, is recovery efficiency as a function of pressure drop. During the period of high-production rates, the recovery efficiency averaged 98 barrels/psi for the nine wells illustrated in Figure 18. However, during the low-production-rate period, illustrated in Figure 19, the recovery efficiency increased to 543 barrels/psi. Results are tabulated in Table IV.

This dichotomy can be explained by pressure support external to the individual well-drainage areas. Also notice that the Bearcat #1 and Howard-Federal #43-15 demonstrate little variation in recovery efficiency as a function of pressure drop since they do not have external pressure support. However, wells E-6, A-20, and B-32 show improvement during the period of low production rates when gas injection was able to support withdrawals. Notice that pressure increased 4 psi at the Hill Federal #1 during the period of restricted rates. The well produced 537 BO and 29,123 Mcf of gas during this time. Well E-10's static pressure increased 12 psi while the well produced 2,558 BO and 29,100 mcf of gas during the restricted rate period.

Conclusions

The Gavilan-West Puerto Chiquito Mancos Pools appear to be a common reservoir. It is probable that reservoir transmissibility is sufficient to allow fluid migration across pool boundaries.

Approximately 50% of the wells studied exhibited the more efficient rate-sensitive characteristics, with the GOR declining during the period of high oil production rates. The rate-sensitive producing mechanism is not clearly understood.

The anisotropic nature of the reservoir should be defined in order to investigate a secondary recovery process in Gavilan. Production rates in a secondary mode would be dependent on balancing injection and production rates.

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TABLES

Table I

Transient Test Results[11]

Well	Test Date	$\frac{kh}{\mu}$ md-ft/cp	$k_o h$ md-ft	$k_g h$ md-ft
E-6	11/19/87	18,320	1,290	232
B-32	11/19/87	21,700	4,925	196
Fisher Federal #2-1	2/23/88	5,710	154	76
Johnson Federal 12#5	11/19/88	3,110	88	44
Hill Federal 2Y	6/30/87	1,240	126	15
Hill Federal #1	11/19/87	7,020	12.3	98
Bearcat #1	6/30/87	2,500	133	32
Lindrith B-37	11/19/87	19,020	1,242	235
Howard Federal 43-15	11/19/87	3,690	14.2	50.5
High Adventure #1	11/19/87	11,150	992	134
Loddy #1	11/19/87	2,085	113	27

Table II

Frac Pulse Test Results

Well		Frac	Transmissibility	Storativity Feet
Signal	Observation	Date	kh/μ, $\frac{D\text{-}ft}{cp}$	$\frac{\phi\mu h}{psi} \times 10^{-5}$
Tap-4	E-6	2-13-86	180	9.8
N-31	E-6	4-1-86	54	4.9
F-7	E-6	11-25-87	310	6.5
F-7	J-61	1-25-87	400	0.5
F-30	B-32	9-4-86	62	5.5
F-30	Hill Fed 2Y	9-4-86	44	0.9
A-20	B-32	2-4-87	82	0.052
A-20	B-29	2-4-87	122	3.2

TABLE III

Gavilan Dome
Rate Sensitivity Correlation Coefficients

Operator	Well Name	c.c.	Slope	
AMOCO	SCC	1.00	NEG	
M.G.	PRO#2	1.00	NEG	
B.M.G.	L-11	1.00	NEG	
B.M.G.	J-6	1.00	NEG	
MALLON	JF 12#5	1.00	NEG	
MERIDIAN	HF 3	1.00	NEG	
MERIDIAN	HF #1	0.99	NEG	
SUN	JA A2	0.99	NEG	
SUN	NS 2	0.98	NEG	
M.G.	BC#1	0.98	NEG	
M.G.	RL#3	0.98	NEG	
MOBIL	B 37	0.98	NEG	
SUN	FS A2	0.97	NEG	
MALLON	RF 2#16	0.97	NEG	
MERIDIAN	HF 2Y	0.97	NEG	
MALLON	HF 1#11	0.97	NEG	
MERRION	KRY 1	0.96	NEG	
M.G.	HC #1	0.96	NEG	
MERIDIAN	HAF 2	0.96	NEG	
SUN	DRDO 1	0.96	NEG	
B.M.G.	E-10	0.96	NEG	-- CHRONOLOGICAL
SUN	HR 1	0.95	NEG	
SUN	NS 1	0.95	NEG	
MOBIL	B 73	0.95	NEG	
SUN	ET 1	0.93	NEG	
SUN	LOD 1	0.93	NEG	
M.G.	GH#1	0.92	NEG	-- CHRONOLOGICAL
M.G.	MAR#1	0.92	NEG	
B.M.G.	N-31	0.92	NEG	
MERIDIAN	HAF 3	0.92	NEG	
M.G.	INV#1	0.91	NEG	
SUN	FT E1	0.91	NEG	
MALLON	FF 2#1	0.90	NEG	
M.G.	GAV #3	0.90	NEG	
B.M.G.	A-20	0.90	POS	
MALLON	PF 13#6	0.89	NEG	
B.M.G.	E-6	0.89	NEG	
SUN	BL 2	0.89	NEG	
SUN	FT 1	0.88	NEG	
MOBIL	B 34	0.88	NEG	
SUN	ML 2	0.87	NEG	
B.M.G.	F-19	0.87	NEG	
SUN	NS 3	0.86	NEG	
MOBIL	B 38	0.86	NEG	-- CHRONOLOGICAL
MOBIL	B 74	0.86	NEG	
MALLON	DF 3#15	0.85	NEG	

Of the sample
with c.c. > .85

Negative Slopes	
amount	percentage
45	97.83%

Positive Slopes	
amount	percentage
1	2.17%

85% Correlation Coefficient Cut Off Point

TABLE III

Gavilan Dome
Rate Sensitivity Correlation Coefficients

Operator	Well Name	c.c.	Slope
B.M.G.	C-34	0.84	POS
SUN	LL 1	0.80	NEG
SUN	GG 1	0.80	NEG
R&B	IN 34-16	0.79	NEG
B.M.G.	O-9	0.76	NEG
B.M.G.	B-29	0.76	POS
R&B	HF 43-15	0.76	NEG
DUGAN	LIND 1	0.75	NEG
M.G.	RL#2	0.73	NEG
SUN	HA 2	0.71	NEG
B.M.G.	L-3	0.68	NEG
B.M.G.	F-30	0.66	NEG
SUN	JA B3	0.66	NEG
SUN	NH 1	0.65	NEG
SUN	WW 1	0.62	NEG
B.M.G.	F-18	0.58	NEG
M.G.	BRO#1	0.54	NEG
SUN	HA 1	0.52	NEG
B.M.G.	D-17	0.52	NEG
MOBIL	B 72	0.49	NEG
SUN	FS B3	0.48	NEG
SUN	FS 1	0.46	NEG
SUN	BB 1	0.44	NEG
B.M.G.	L-27	0.43	NEG
B.M.G.	O-33	0.43	NEG
B.M.G.	B-32	0.36	POS
AMOCO	SGC 1	0.35	NEG
M.G.	GAV #1	0.32	POS
AMOCO	BCU 1	0.31	NEG
MALLON	HF 1#8	0.31	NEG
SUN	JA 1	0.29	NEG
B.M.G.	K-8	0.20	NEG
B.M.G.	F-7	0.18	POS
B.M.G.	N-22	0.17	POS
B.M.G.	A-16	0.16	NEG
MERRION	OCG 1	0.15	POS
B.M.G.	G-5	0.13	POS
SUN	ML 1	0.08	POS
HIXON	DIV 3	0.06	NEG
B.M.G.	G-32	0.05	NEG
HIXON	TAP 4	0.01	POS

TABLE IV

Gavilan Dome, Recovery Efficiency
Barrel per PSI Pressure Drop

6/30-11/19

Operator	Well Name	dP psi	Cum Oil bbl	Cum/dP bbl/psi
B.M.G.	E-6	-208	41118	-198
B.M.G.	A-20	-217	2443	-11
B.M.G.	B-32	-237	83828	-354
M.G.	Bearcat #1	-271	2929	-11
Mobil	Lind B 37	-270	26385	-98
R & B	HF 43-15	-261	1020	-4
Sun	High Adventure #1	-291	24002	-82
Sun	Loddy #1	-230	7296	-32
			Average	98 bbl/psi

11/19-2/23

Operator	Well Name	dP psi	Cum Oil bbl	Cum/dP bbl/psi
B.M.G.	E-6	-16	4424	-277
B.M.G.	A-20	-19	2400	-126
B.M.G.	E-10	12	2317	193*
B.M.G.	B-32	-13	42177	-3244
Merridian	Hill Federal #1	4	453	113*
M.G.	Bearcat #1	-33	531	-16
Mobil	Lind B 37	-36	13011	-361
R & B	HF 43-15	-37	393	-11
Sun	High Adventure #1	-54	14052	-260
Sun	Loddy #1	-53	3318	-63
			Average	543 bbl/psi

* Not Included in Average
Since Pressure Increased

FIGURES

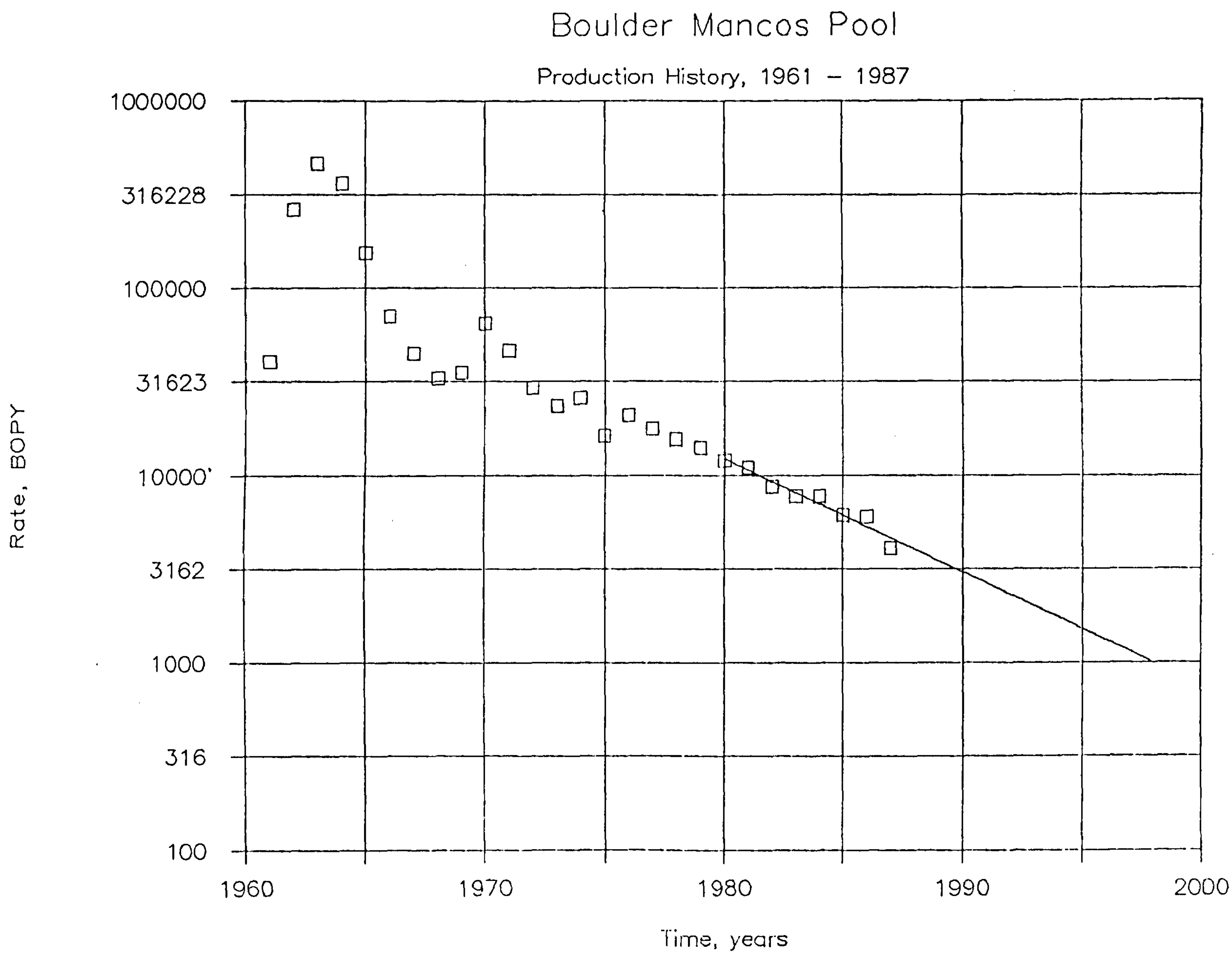
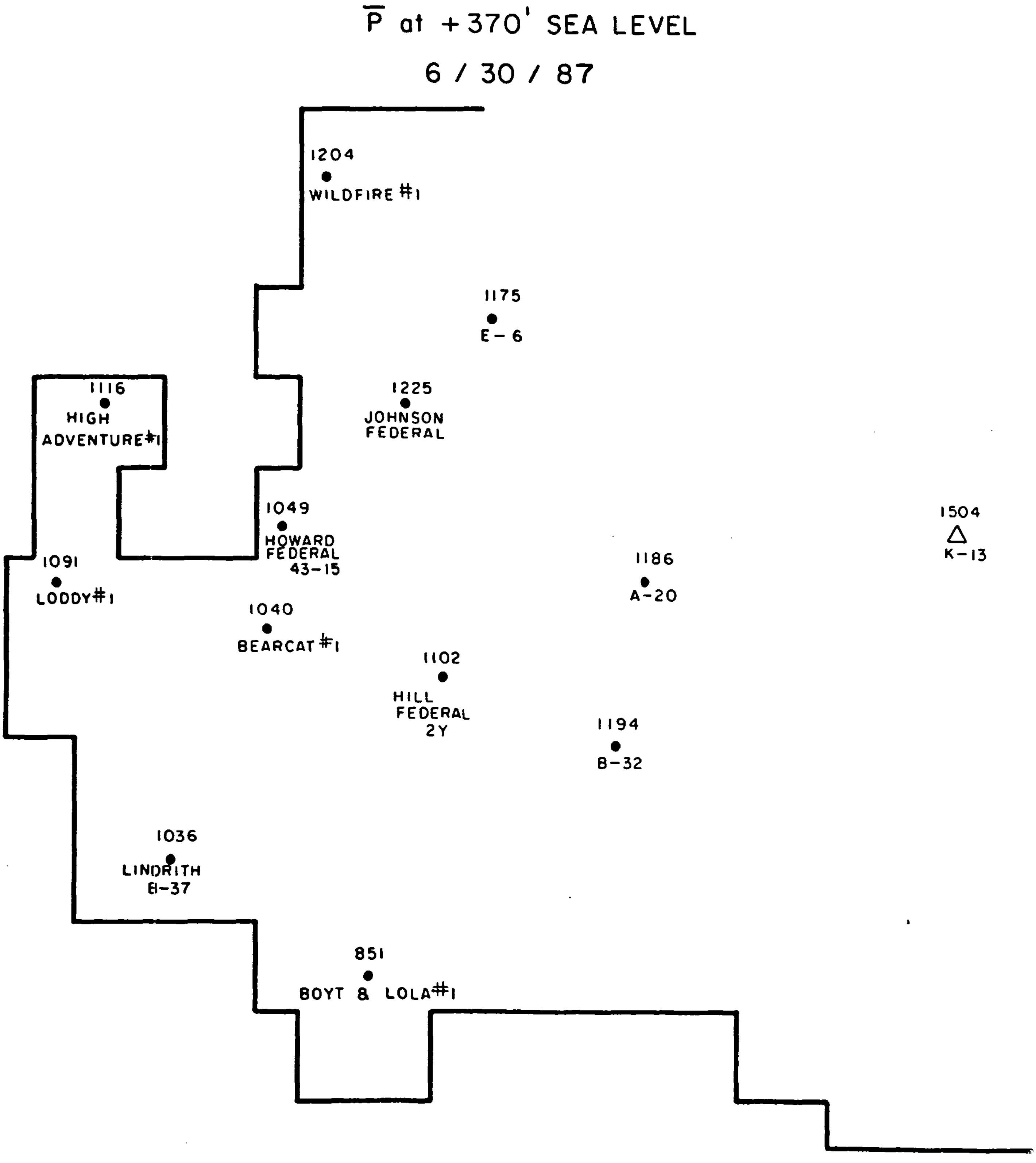

Boulder Mancos Pool
Production History, 1961 – 1987
Rate, BOPY
1000000
316228
100000
31623
10000
3162
1000
316
100
1960
1970
1980
1990
2000
Time, years

Figure 1


P̄ at +370' SEA LEVEL
6 / 30 / 87
1204
WILDFIRE #1
1175
E-6
1116
HIGH
ADVENTURE #1
1225
JOHNSON
FEDERAL
1049
HOWARD
FEDERAL
43-15
1504
K-13
1091
LODDY #1
1186
A-20
1040
BEARCAT #1
1102
HILL
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2Y
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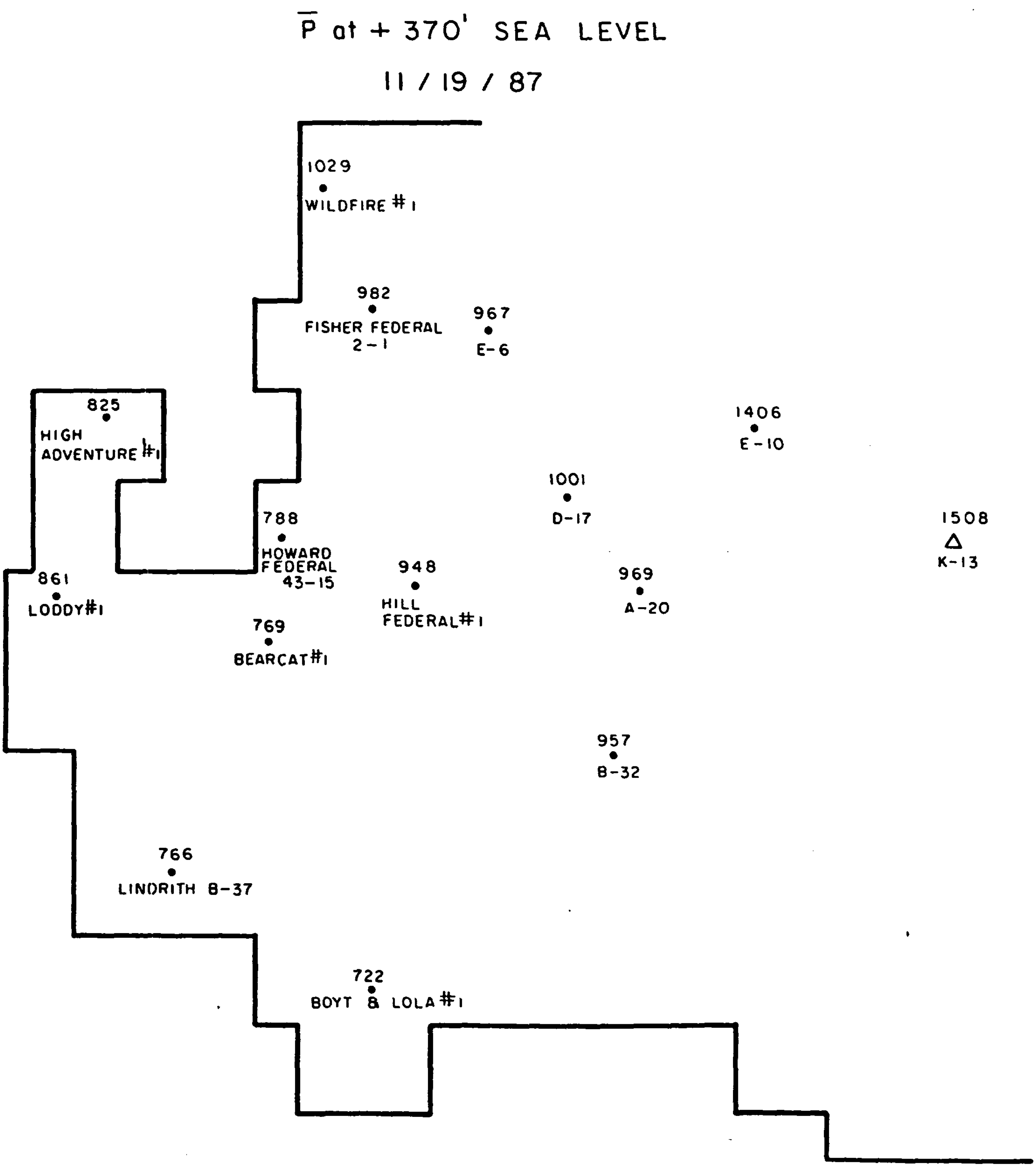
B-32
1036
LINDRITH
B-37
851
BOYT & LOLA #1

Figure 2



$\overline{P}$ at + 370' SEA LEVEL
11 / 19 / 87
1029
WILDFIRE #1
982
FISHER FEDERAL
2-1
967
E-6
825
HIGH
ADVENTURE #1
1406
E-10
1001
D-17
1508
K-13
788
HOWARD
FEDERAL
43-15
861
LODDY #1
948
HILL
FEDERAL #1
969
A-20
769
BEARCAT #1
957
B-32
766
LINDRITH B-37
722
BOYT & LOLA #1

Figure 3

$\overline{P}$ at +370' SEA LEVEL 2/23/88

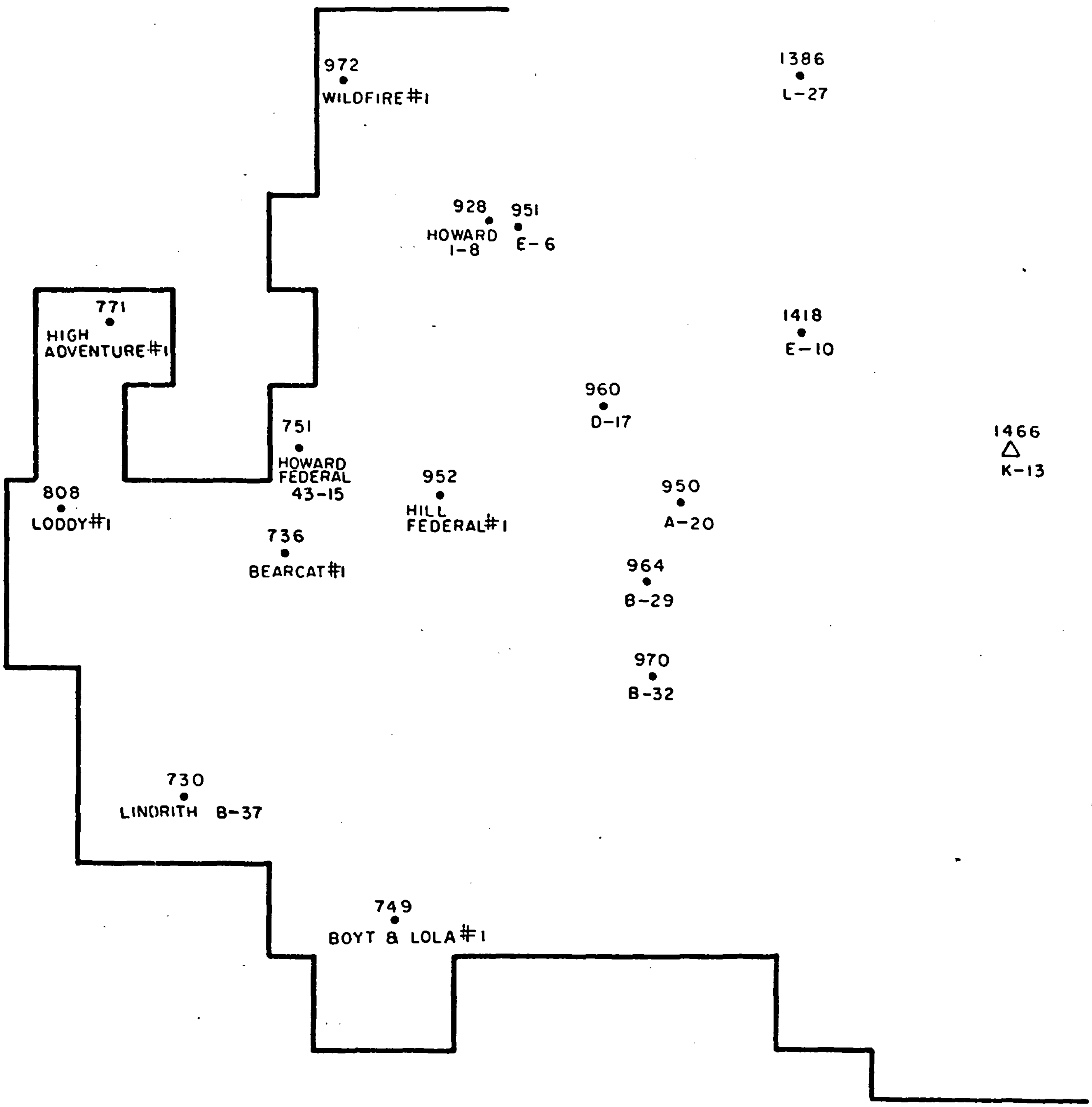


Figure 4

CO_2 FLOOD ISOBARS

SPE / DOE 17327

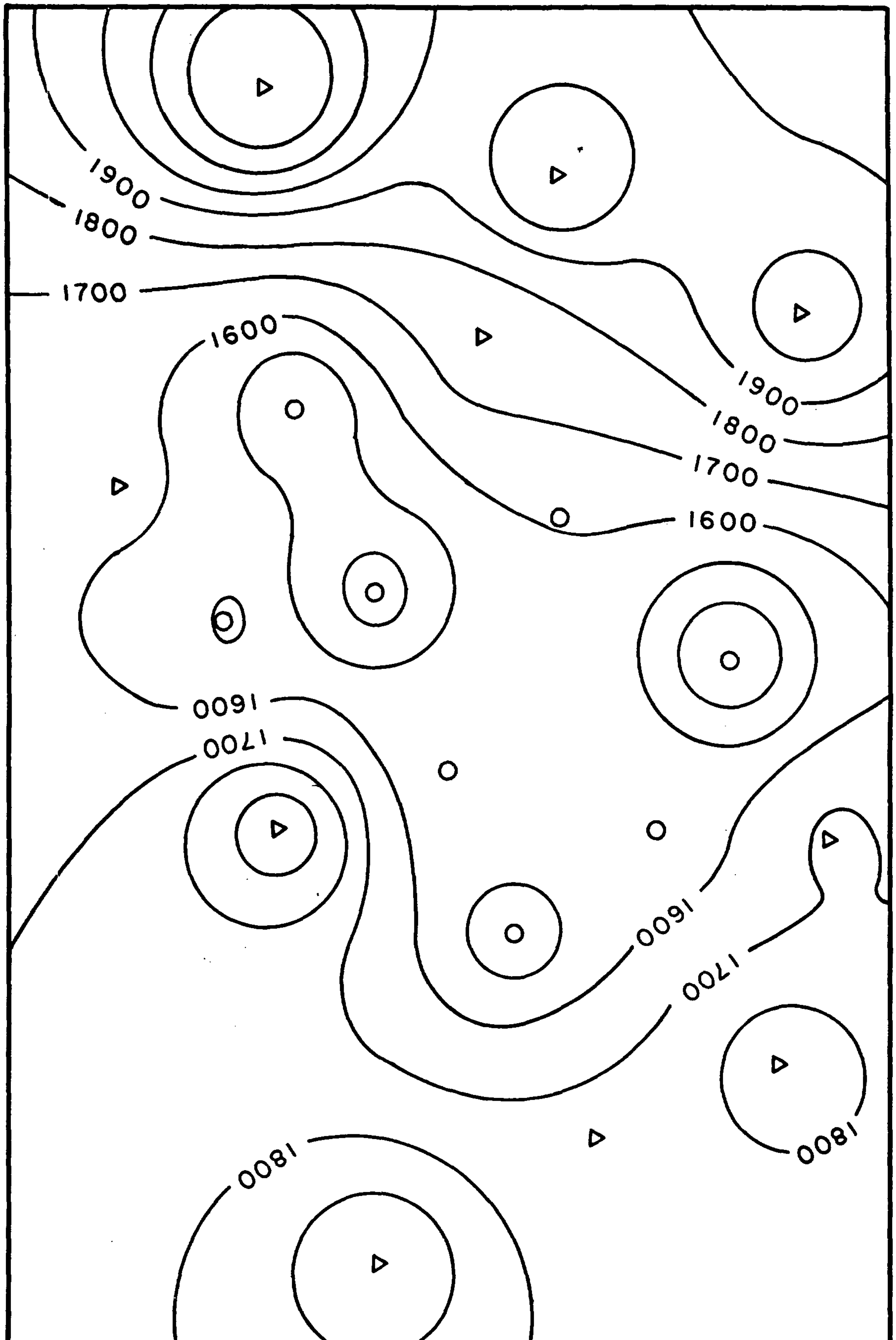
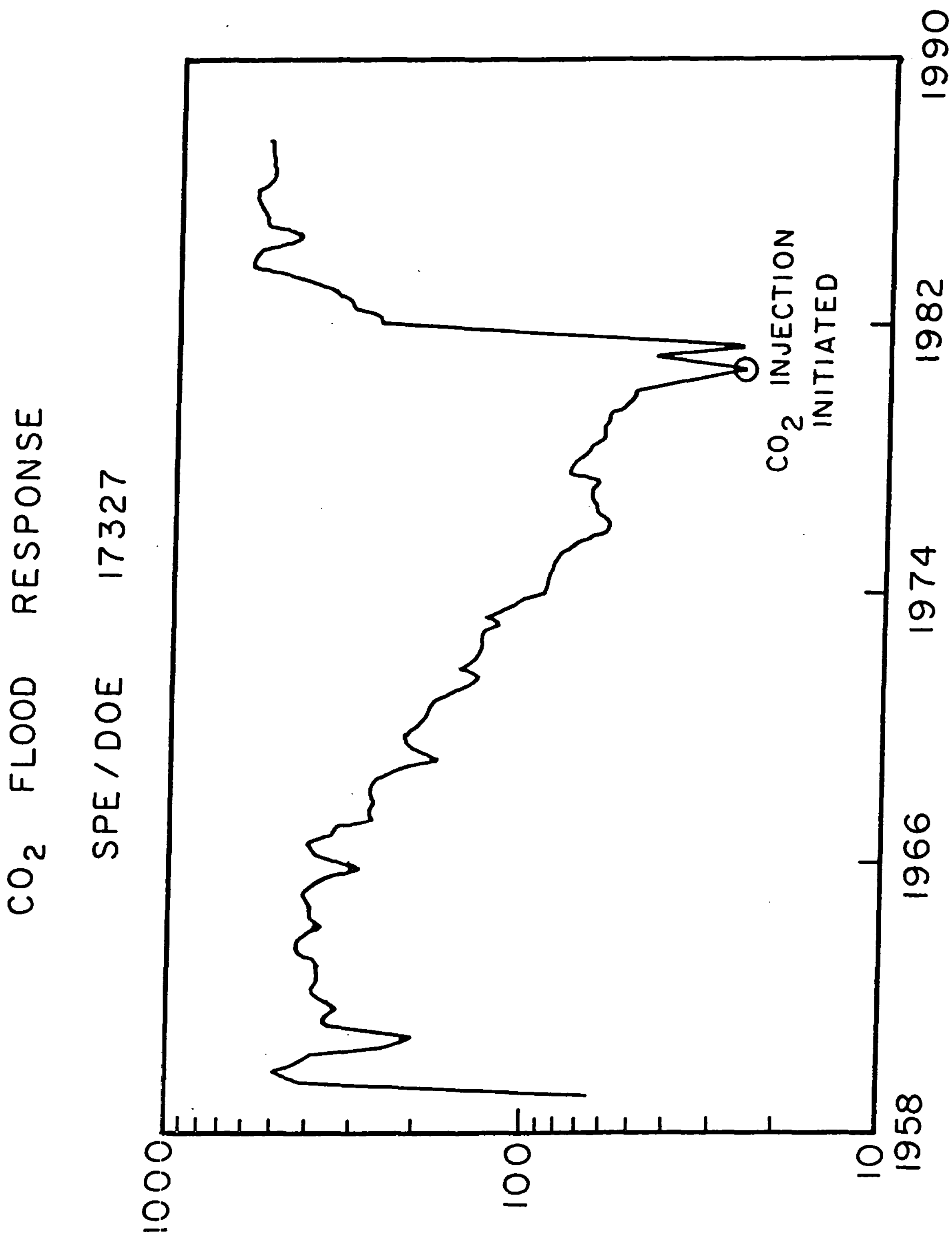


Figure 5



CO_2 FLOOD RESPONSE
SPE/DOE 17327
CO_2 INJECTION INITIATED
OIL PRODUCTION (bbl/d)
1000
100
10
1958
1966
1974
1982
1990

Figure 6

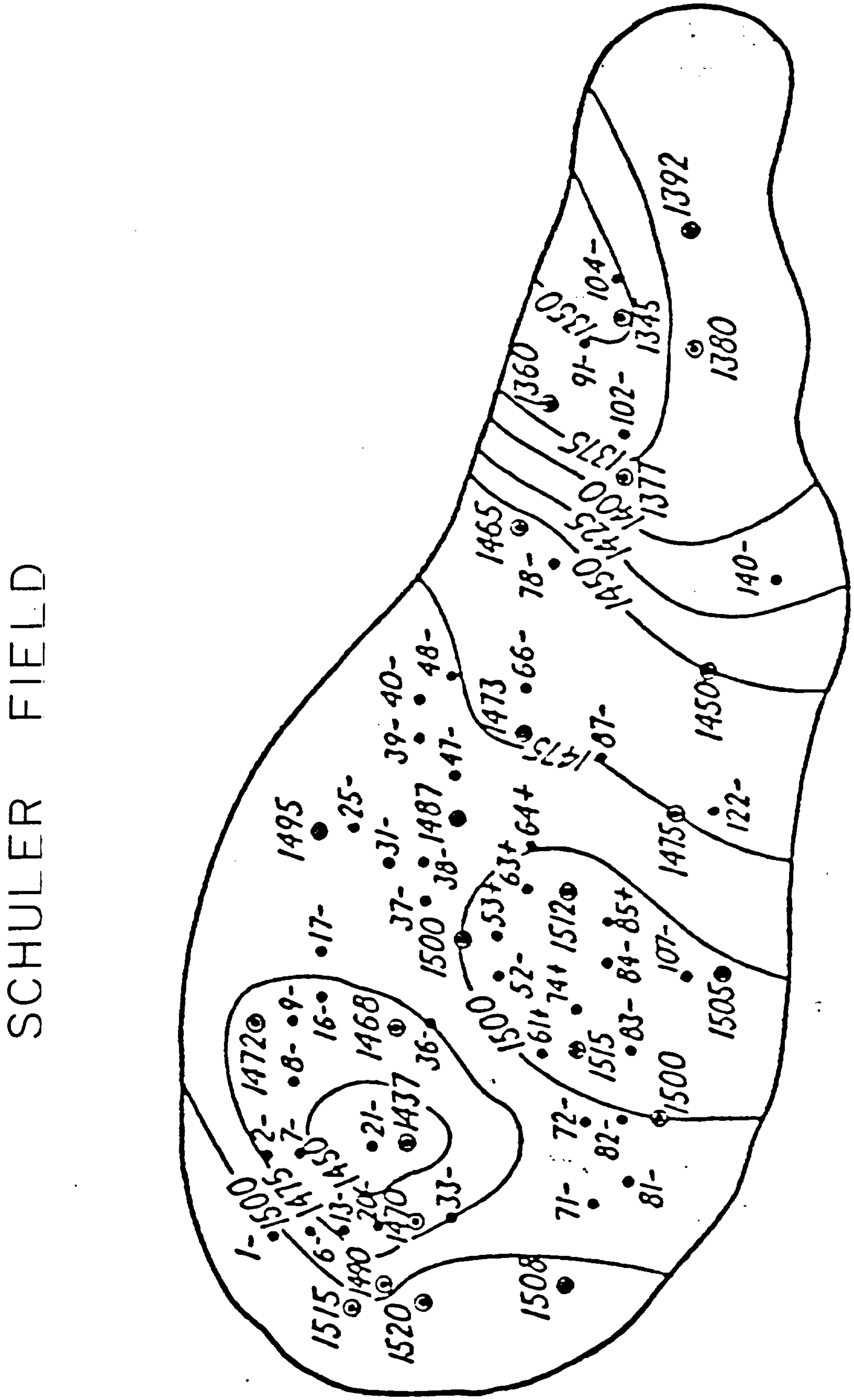


Figure 7

JUDY CREEK

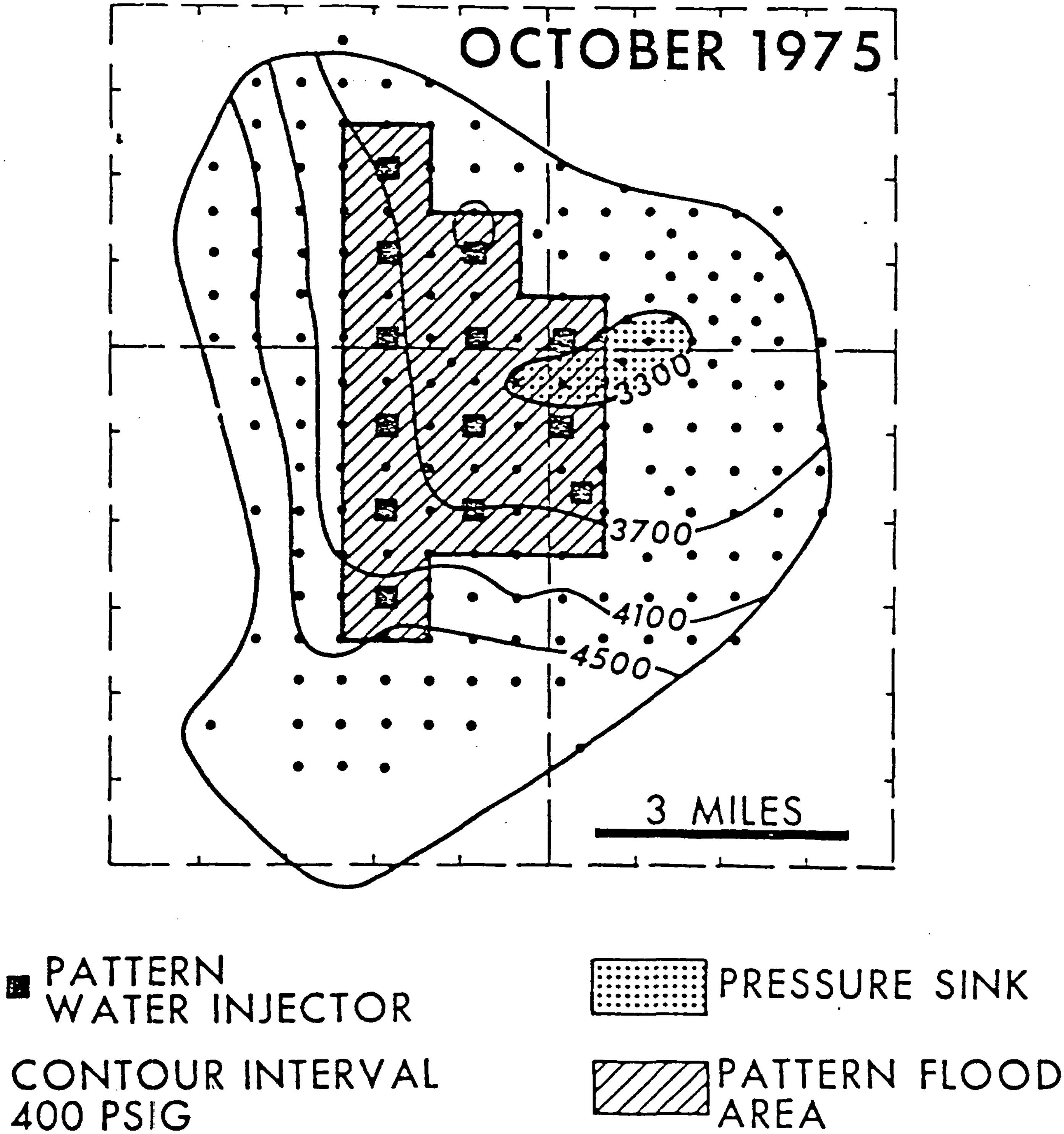
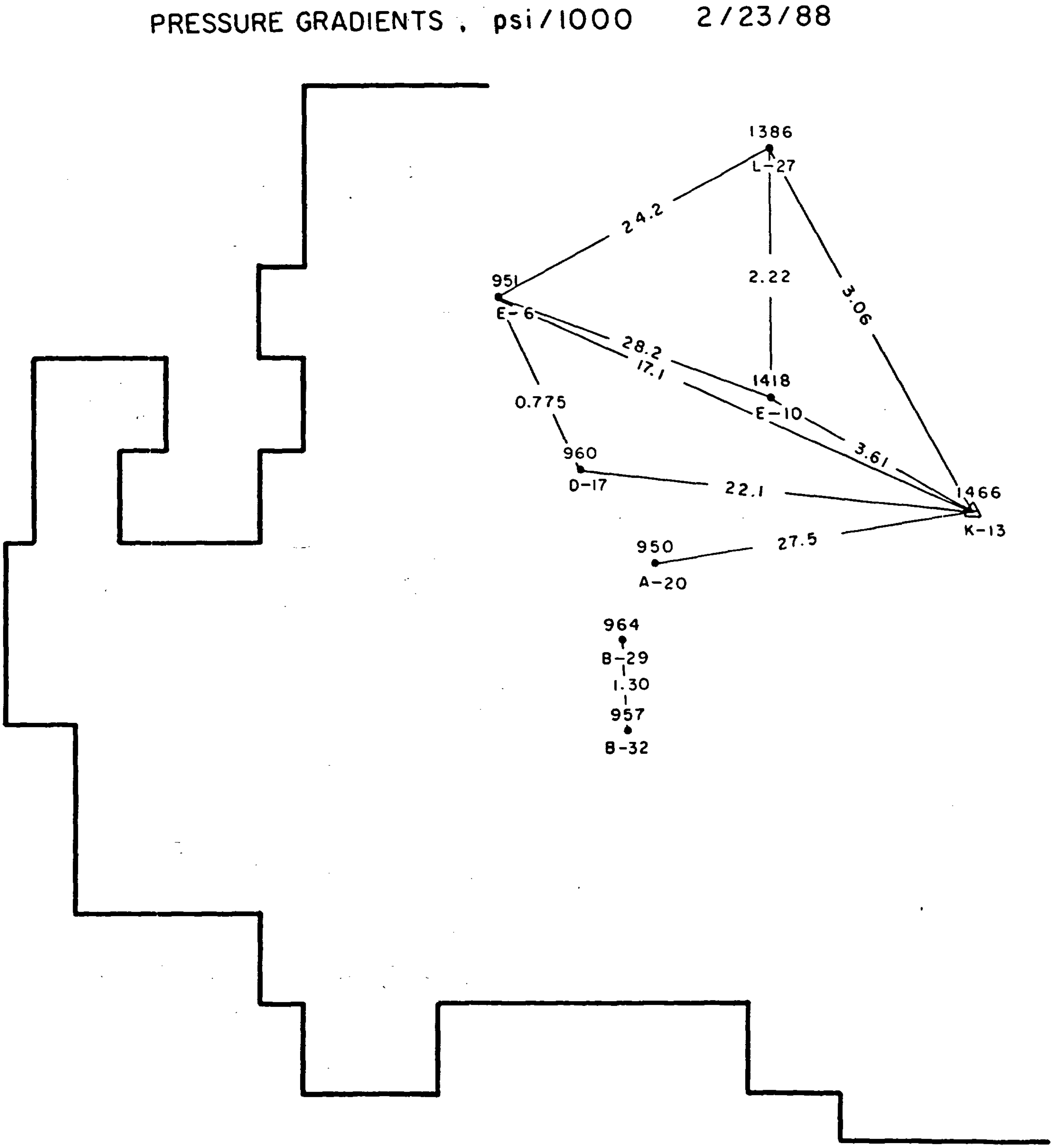


Figure 8



PRESSURE GRADIENTS , psi/1000 2/23/88
1386
L-27
24.2
2.22
3.06
951
E-6
28.2
17.1
0.775
1418
E-10
3.61
960
D-17
22.1
1466
K-13
950
27.5
A-20
964
B-29
1.30
957
B-32

Figure 9

TRANSMISSIBILITY $\frac{Kh}{\mu}$, $\frac{D \cdot ft}{cp}$ FROM BUILDUPS

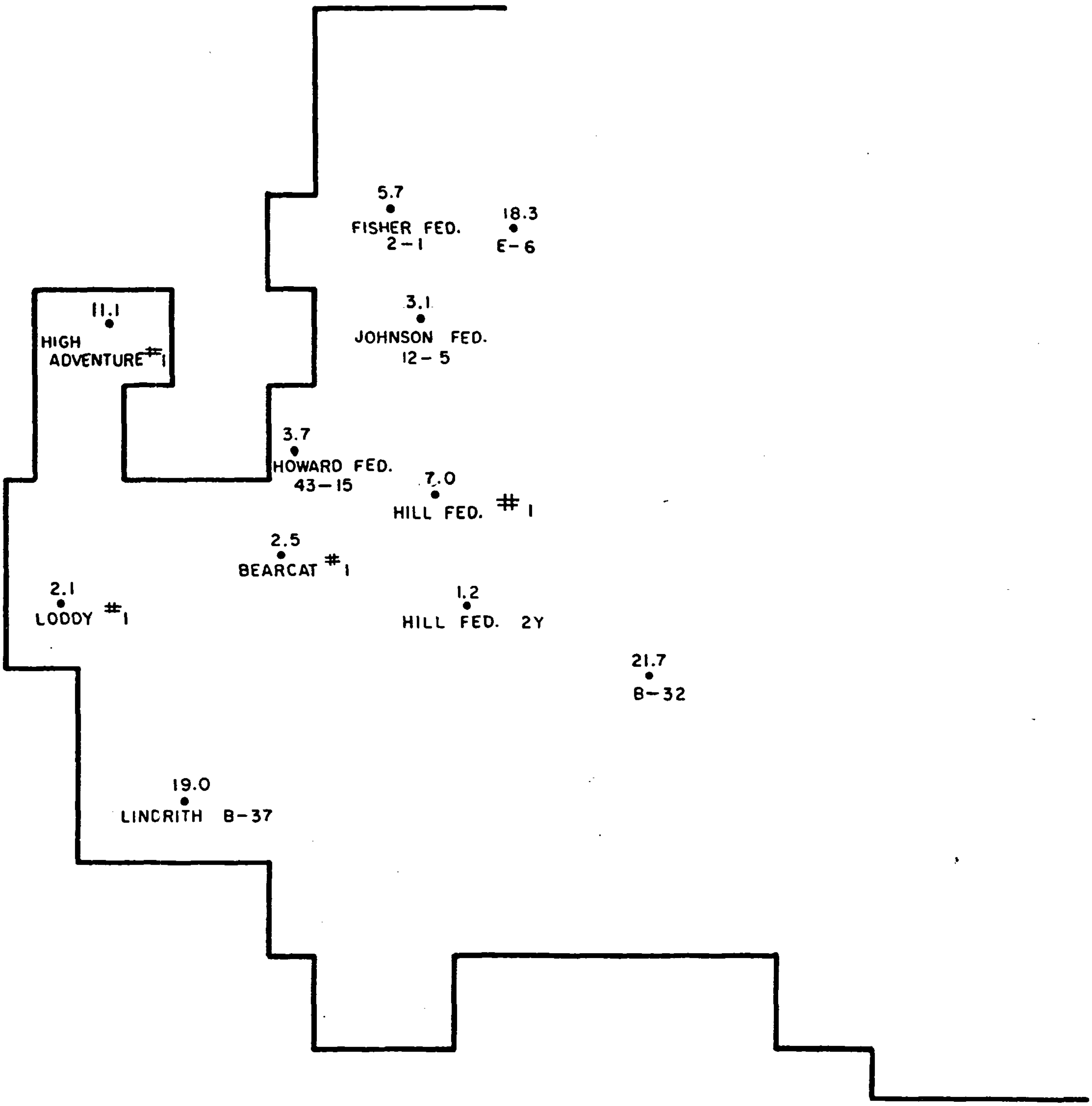
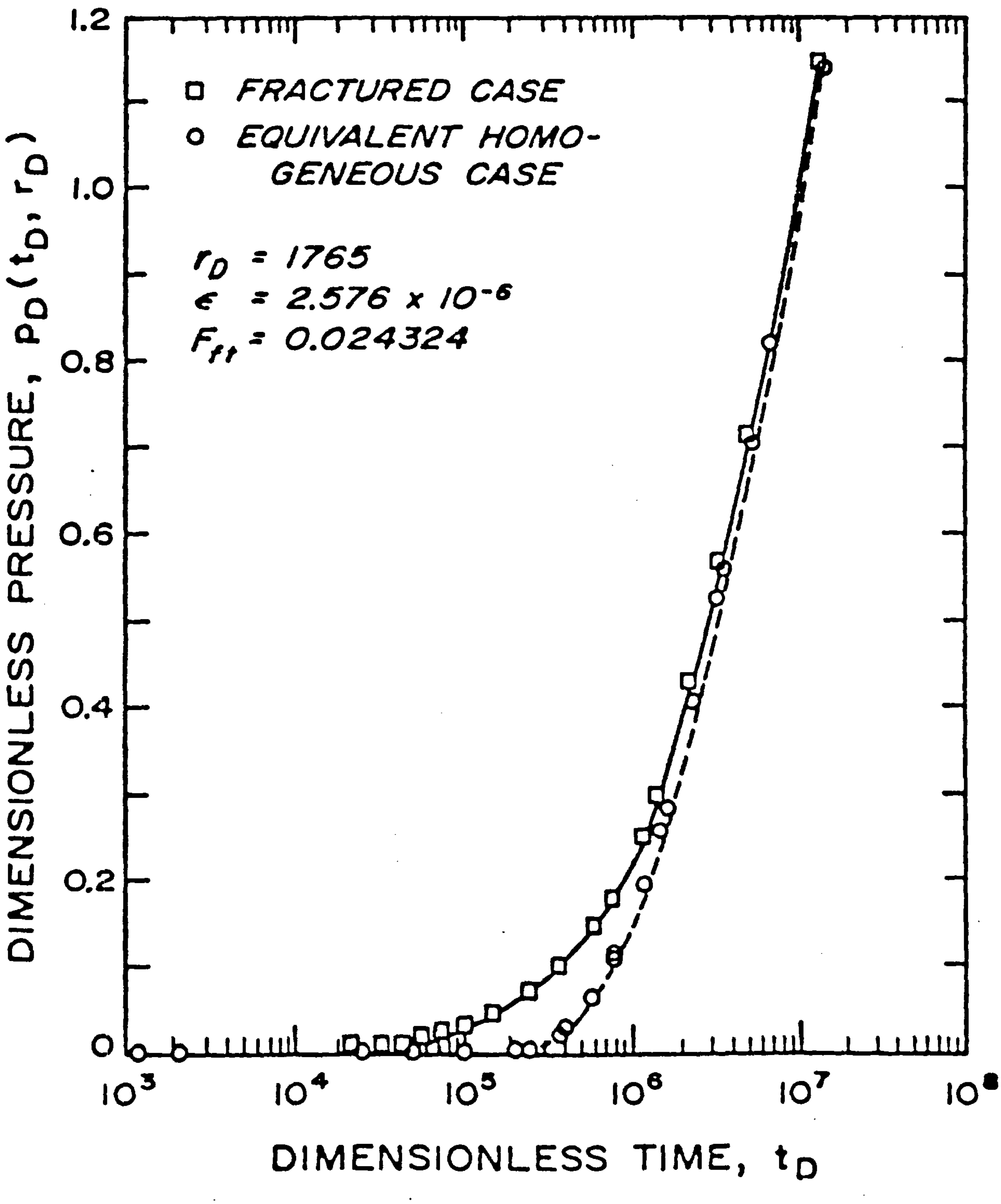
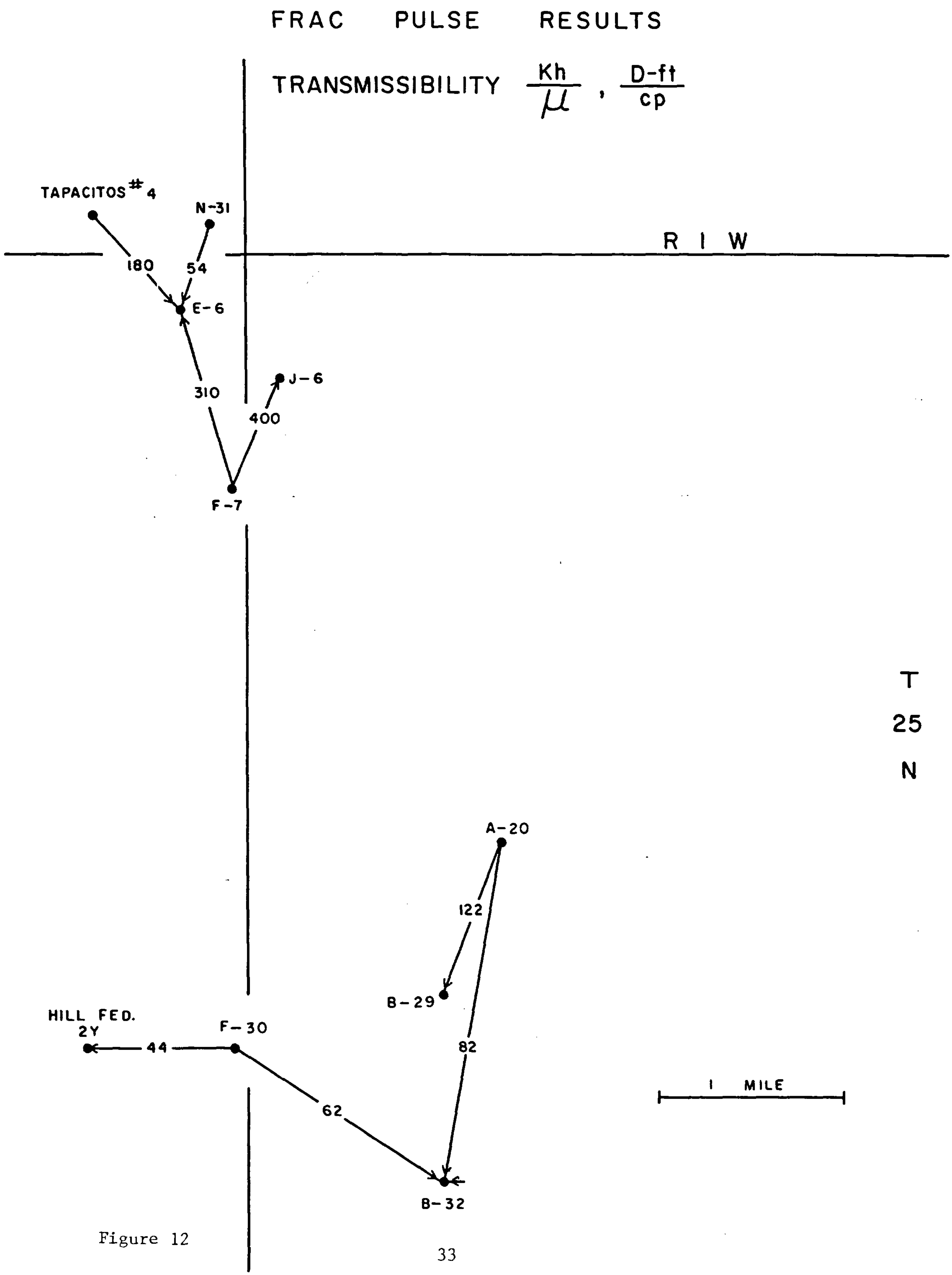


Figure 10



FRACTURED CASE
EQUIVALENT HOMO-GENEOUS CASE
r_D = 1765
ϵ = 2.576 x 10^{-6}
F_{ft} = 0.024324
DIMENSIONLESS PRESSURE, $p_D(t_D, r_D)$
1.2
1.0
0.8
0.6
0.4
0.2
0
10^3
10^4
10^5
10^6
10^7
10^8
DIMENSIONLESS TIME, t_D

Figure 11



FRAC PULSE RESULTS
TRANSMISSIBILITY $\frac{Kh}{\mu}$, $\frac{D\text{-}ft}{cp}$
TAPACITOS # 4
N-31
R I W
180
54
E-6
J-6
310
400
F-7
T 25 N
A-20
122
B-29
HILL FED. 2Y
F-30
44
82
1 MILE
62
B-32

Figure 12

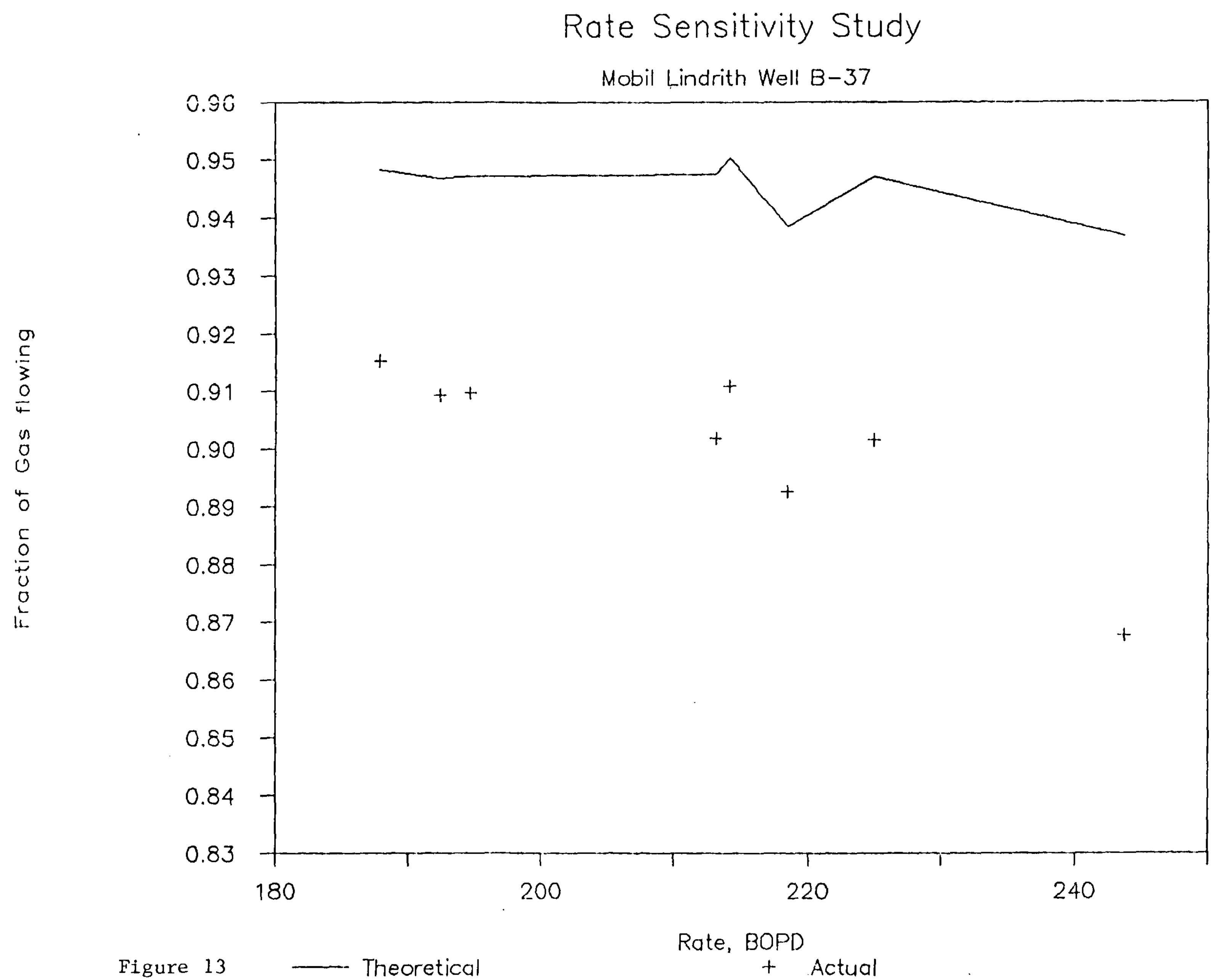
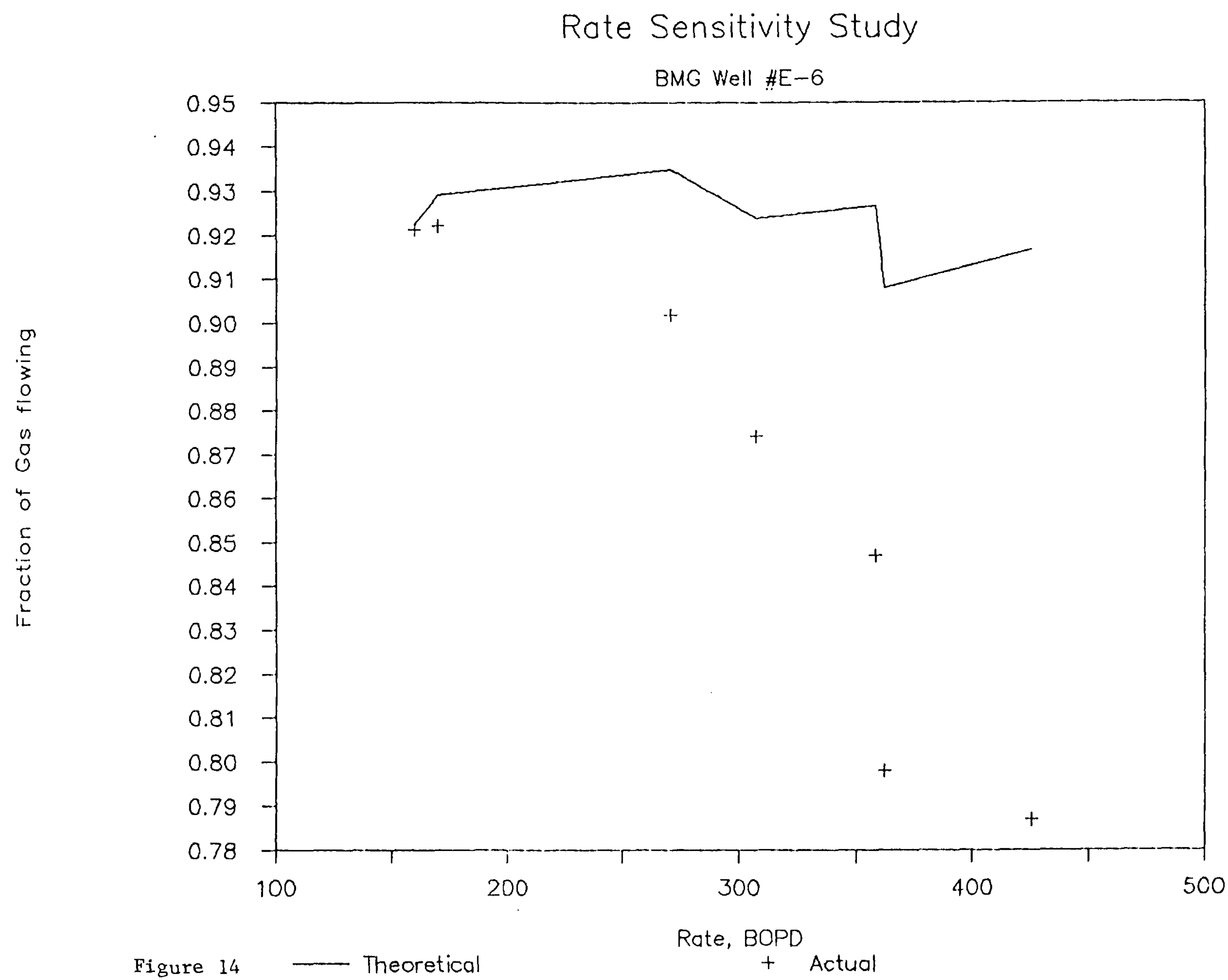
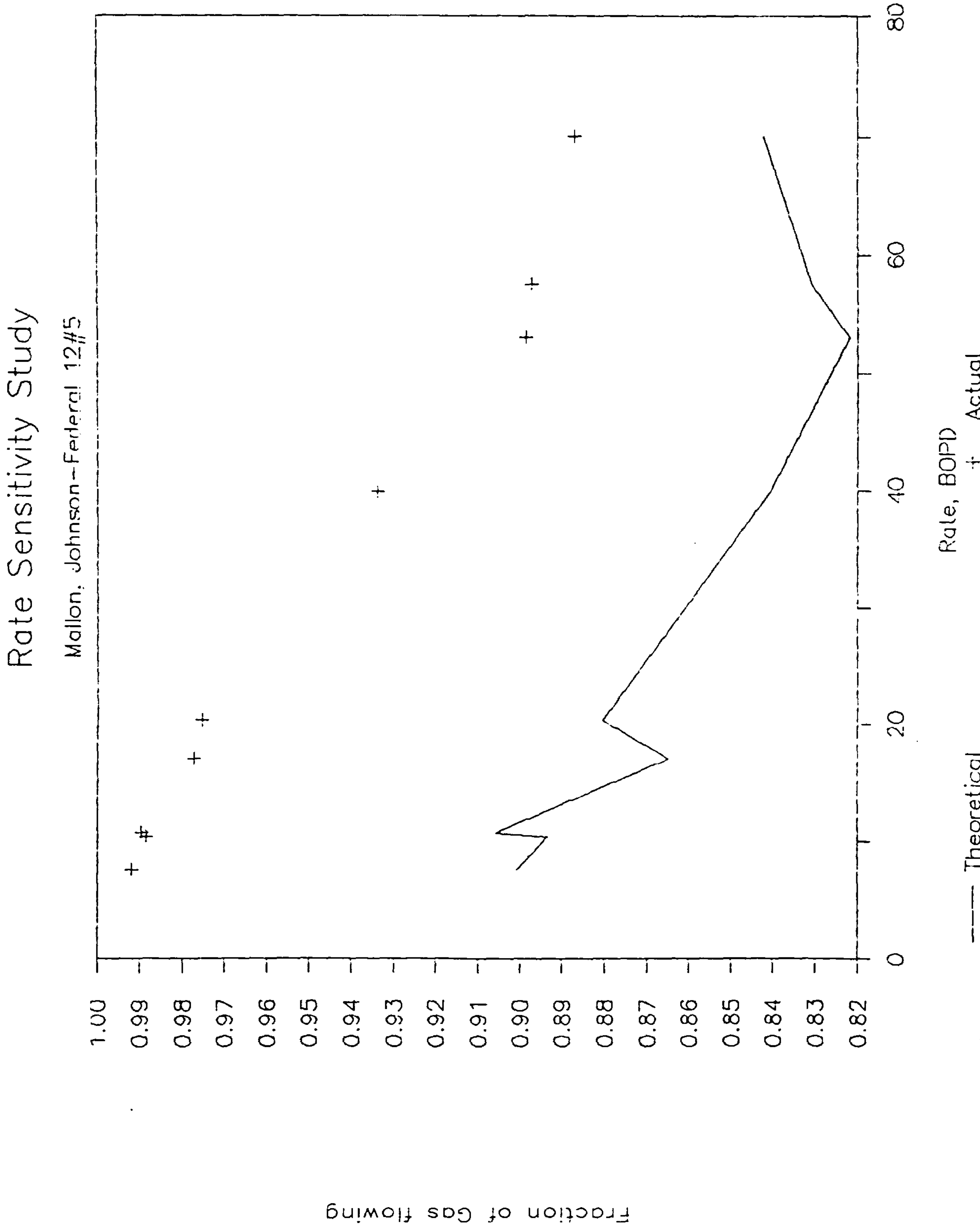

Rate Sensitivity Study
Mobil Lindrith Well B-37
Fraction of Gas flowing
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
180
200
220
240
Rate, BOPD
Theoretical
Actual

Figure 13



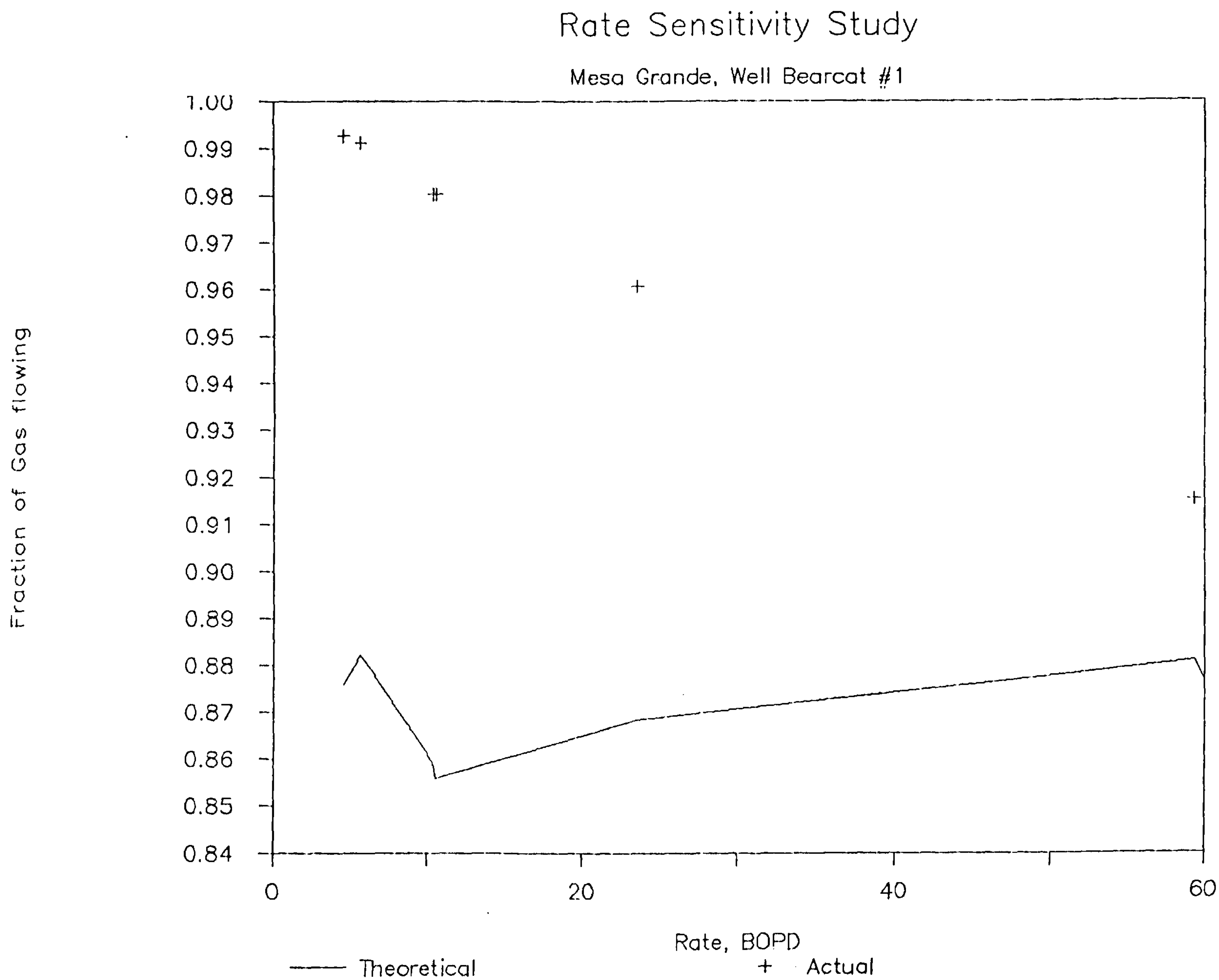
Rate Sensitivity Study
BMG Well #E-6
Fraction of Gas flowing
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0.81
0.80
0.79
0.78
100
200
300
400
500
Rate, BOPD
Theoretical
Actual

Figure 14



Rate Sensitivity Study
Mallon, Johnson-Federal 12#5
Fraction of Gas flowing
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0
20
40
60
80
Rate, BOPD
Theoretical
Actual

Figure 15



Rate Sensitivity Study
Mesa Grande, Well Bearcat #1
Fraction of Gas flowing
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0
20
40
60
Rate, BOPD
Theoretical
+ Actual

Figure 16

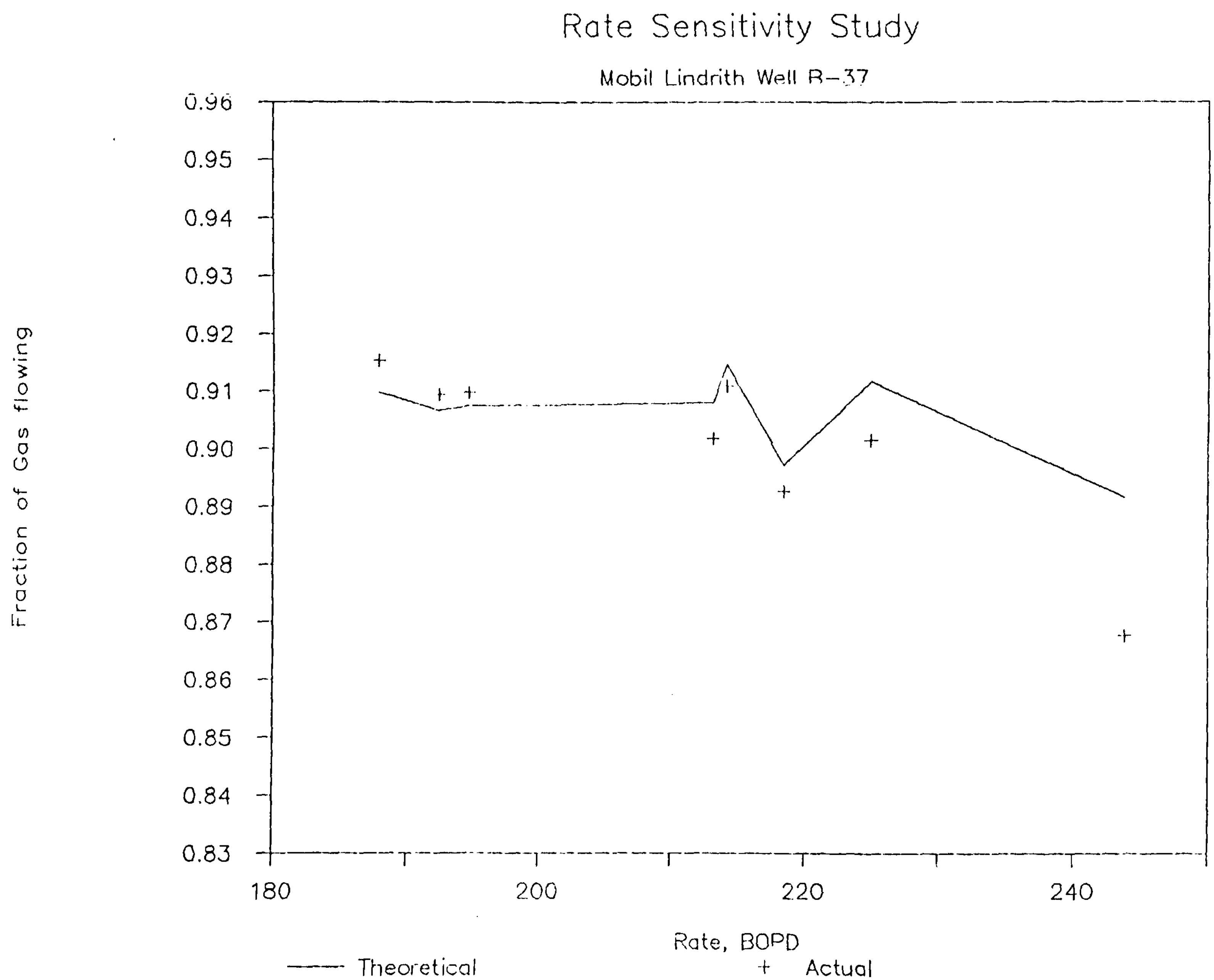

Rate Sensitivity Study
Mobil Lindrith Well B-37
Fraction of Gas flowing
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
180
200
220
240
Rate, BOPD
Theoretical
Actual

Figure 17

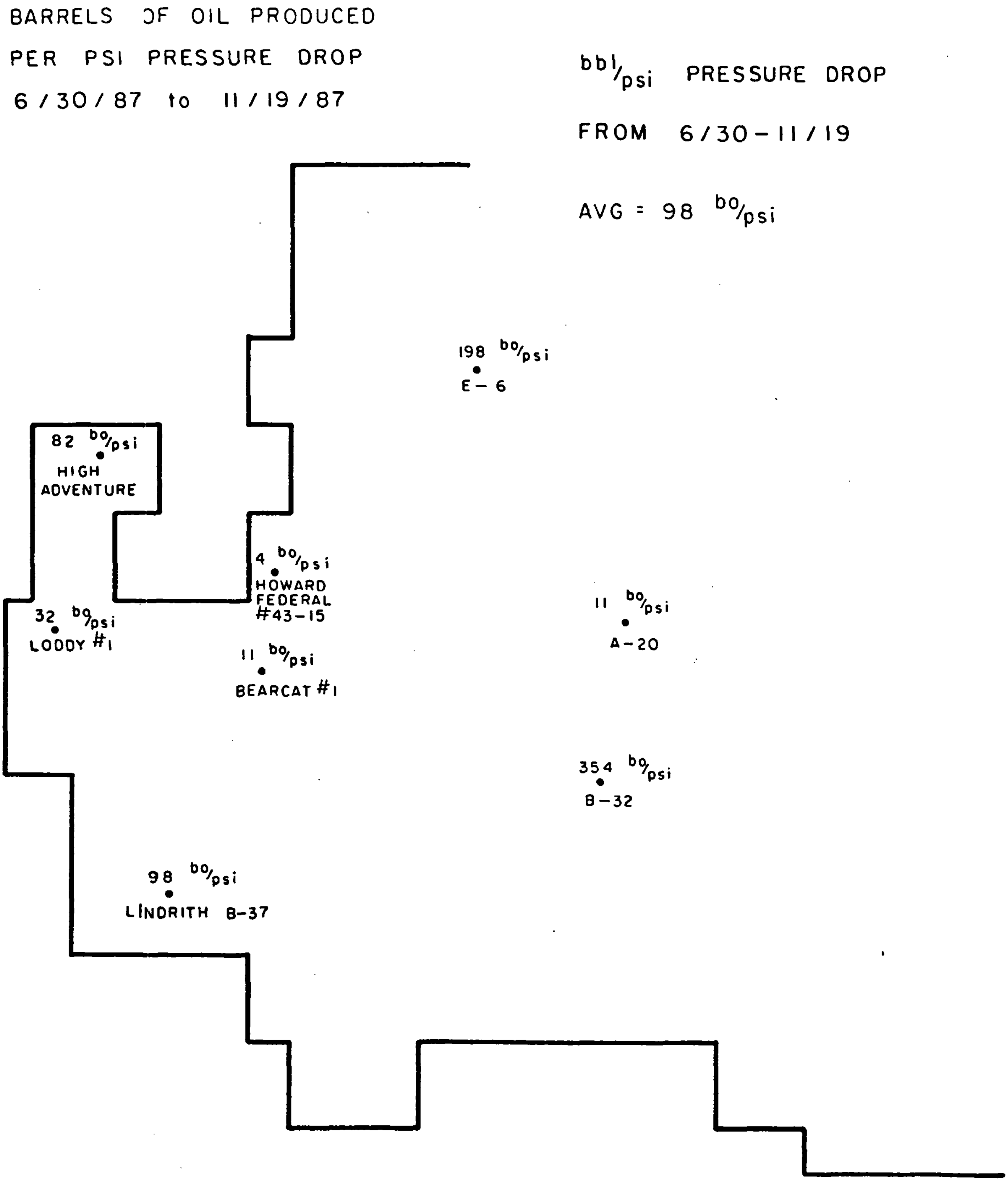

BARRELS OF OIL PRODUCED
PER PSI PRESSURE DROP
6 / 30 / 87 to 11 / 19 / 87
bbl/psi PRESSURE DROP
FROM 6/30 - 11/19
AVG = 98 bo/psi
198 bo/psi
E - 6
82 bo/psi
HIGH ADVENTURE
4 bo/psi
HOWARD FEDERAL #43-15
32 bo/psi
LODDY #1
11 bo/psi
BEARCAT #1
11 bo/psi
A-20
354 bo/psi
B-32
98 bo/psi
LINDRITH B-37

Figure 18

BARRELS OF OIL PRODUCED
PER PSI PRESSURE DROP
11/19/87 to 2/23/88

bbl/psi PRESSURE DROP
FROM 11/19 – 2/23

AVE = 543 bo/psi

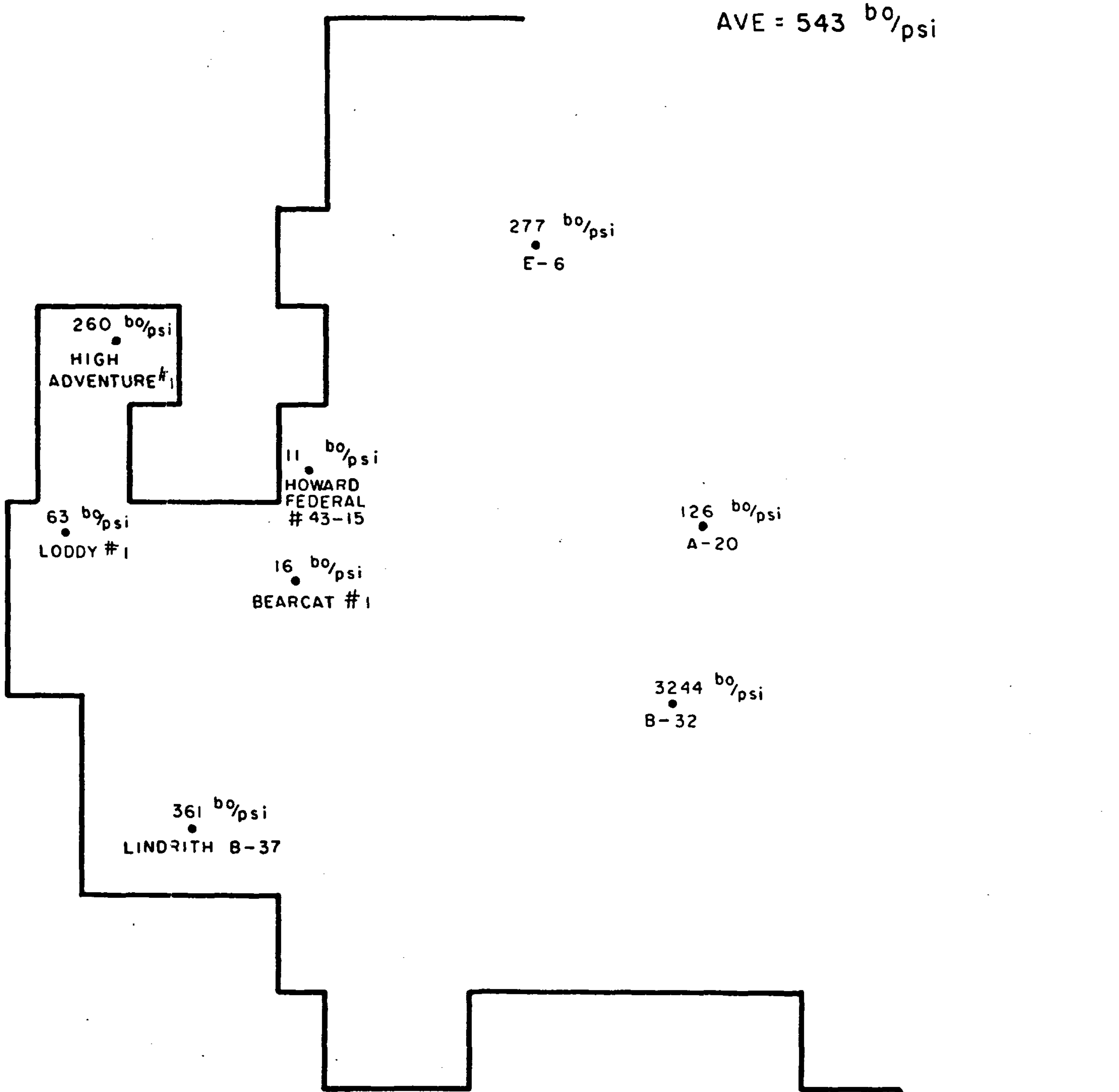


Figure 19

APPENDIX 1

Static Pressure Worksheets

	KB		Subsea
Operator	BMG		
Well	E-6		
Elevation	7505		
Top of B Zone	7148		+357
Test Date		6/30/87	
Bomb Depth	7277		+228
Bomb Pressure, psig		1214.2	
Fluid Level	7137		+368
Wellbore Gradient			
Oil, psi/ft	(0.3)(228-357)		-38.7
Gas, psi/ft			
Pressure at Top of B Zone		1175.5	
Top of B Zone to +370 ft	13		
Production			
BO/D		321	
Mcf/D		1471	
Volume Weighted Reservoir Density, psi/ft		0.06350	
dP to +370 ft		.83	
Pressure at +370 ft datum		1174.7	

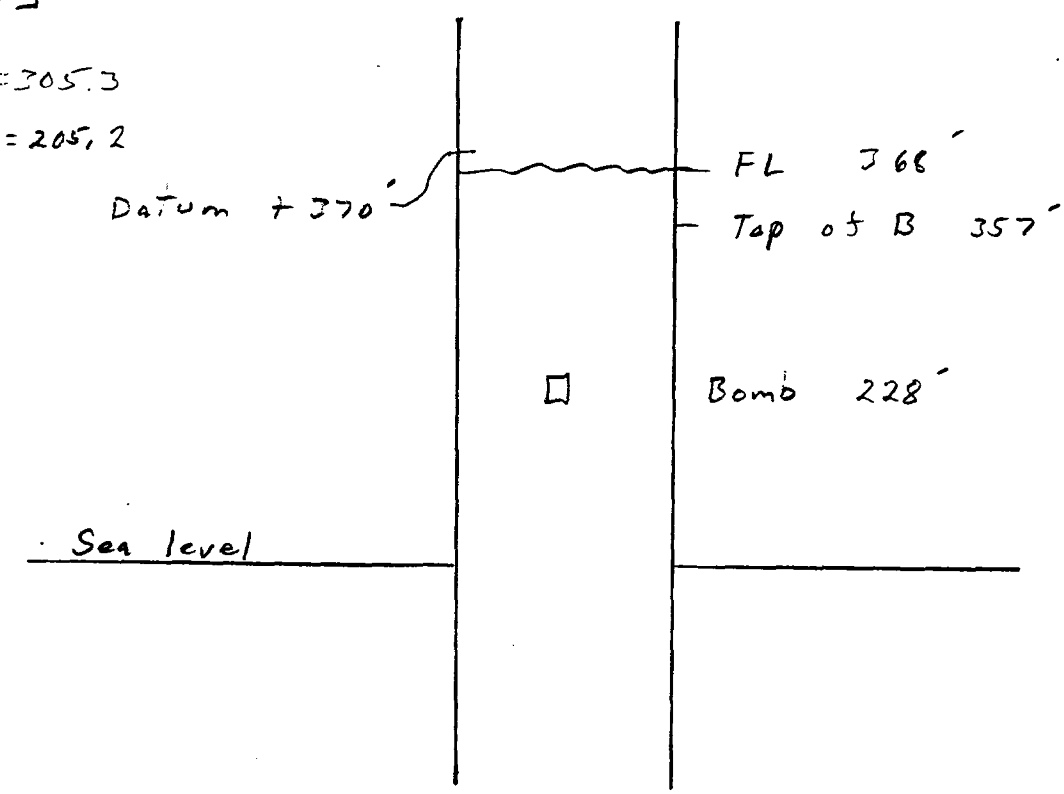
(321)(1.342) = 430.8

$\left[1471 - \frac{(321)(501)}{1000}\right] 2.328 = 3050.1$

(7088)(430.8) = 305.3

(.067265)(3050.1) = 205.2

(.433)(.1466)



	KB		Subsea
Operator	BMG		
Well	E-6		
	KB		Subsea
Elevation	7505		
Top of B Zone	7148		+357
Test Date		11/19/87	
Bomb Depth	7337		+168
Bomb Pressure, psig		1014.9	
Fluid Level	7132		+323
Wellbore Gradient			
Oil, psi/ft	0.3(168-323)		-46.5
Gas, psi/ft	0.03(323-357)		-1.0
Pressure at Top of B Zone		967.4	
Top of B Zone to +370 ft	13		
Production			
BO/D		291	
Mcf/D		1250	
Volume Weighted Reservoir Density, psi/ft		0.05437	
dP to +370 ft		0.7	
Pressure at +370 ft datum		966.7	

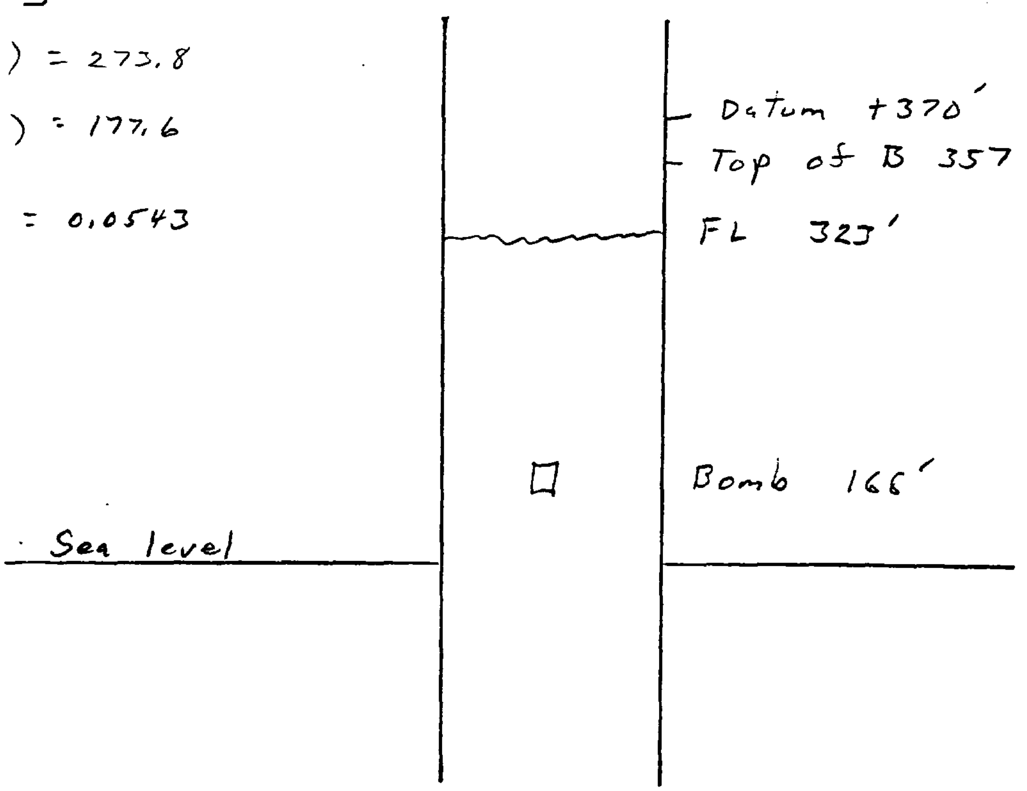
(291) (1.317) = 383.2

[1250 291(443)/1000] 2.865 = 3211.9

(.7143) (383.2) = 273.8

(.055291)(3211.9) = 177.6

(.433)(.1256) = 0.0543



	KB		Subsea
Operator	BMG		
Well	E-6		
Elevation	7505		
Top of B Zone	7148		+357
Test Date		2/23/88	
Bomb Depth	7277		+228
Bomb Pressure, psig		955.2	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(228-357)		-3.9
Pressure at Top of B Zone		951.3	
Top of B Zone to +370 ft	13		
Production			
BO/D		160	
Mcf/D		840	
Volume Weighted Reservoir Density, psi/ft		0.04788	
dP to +370 ft		0.6	
Pressure at +370 ft datum		950.7	

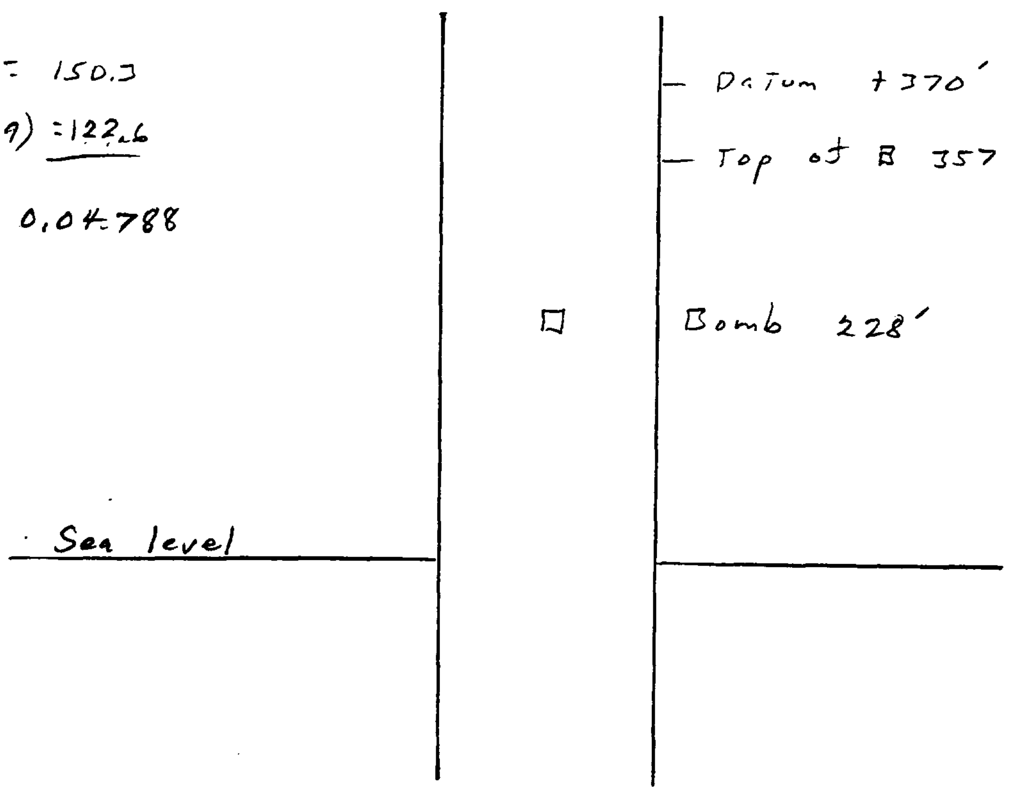
$(160)\ (1.314) = 210.24$

$\left[840 - \frac{(160)(437)}{1000}\right] 2.932 = 2257.9$

$(.7148)(210.2) = 150.3$

$(.054314)(2257.9) = 122.6$

$(.433)(.1106) = 0.04788$



	KB		Subsea
Operator	BMG		
Well	E-10		
Elevation	7341		
Top of B Zone	6820		+ 521
Test Date		11/19/87	
Bomb Depth	7012		+ 329
Bomb Pressure, psig		1403	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(329-521)		-5.8
Pressure at Top of B Zone		1397.2	
Top of B Zone to +370 ft	151'		
Production			
BO/D		234	
Mcf/D		1760	
Volume Weighted Reservoir Density, psi/ft		0.0580	
dP to +370 ft		8.8	
Pressure at +370 ft datum		1406.0	

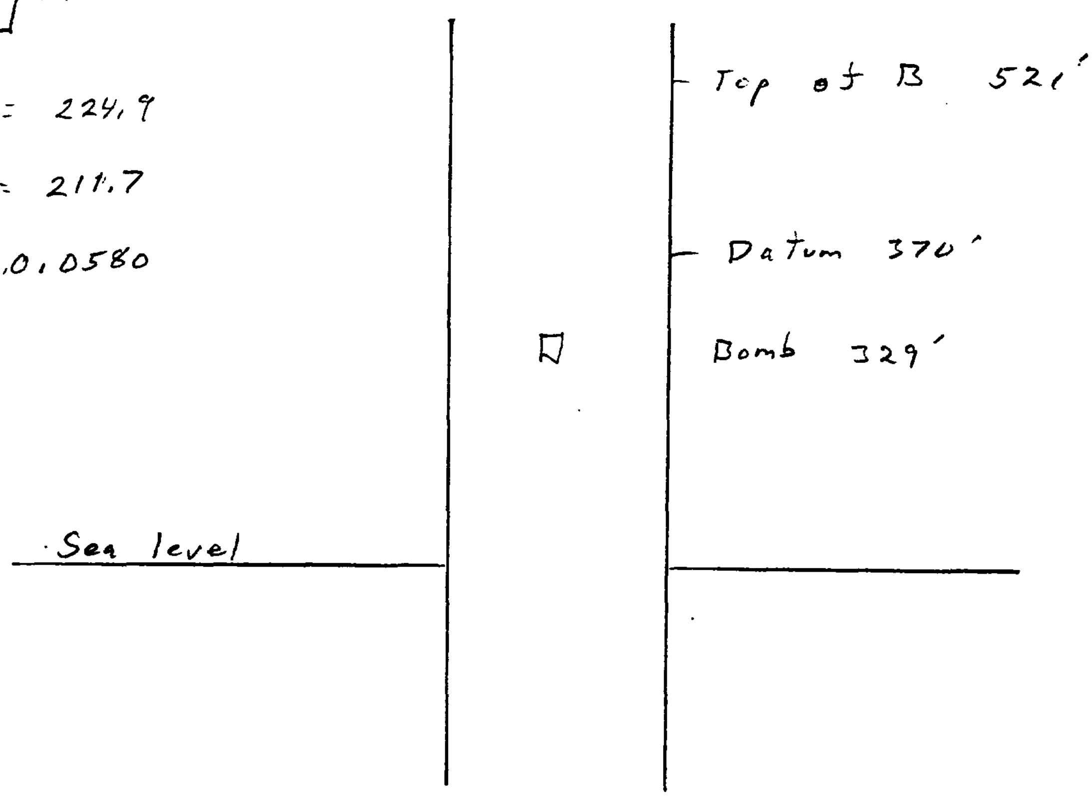
(234)(1.370) = 320.6

$\left[1760 - \frac{234(565)}{1000}\right] 2.081 = 3387.4$

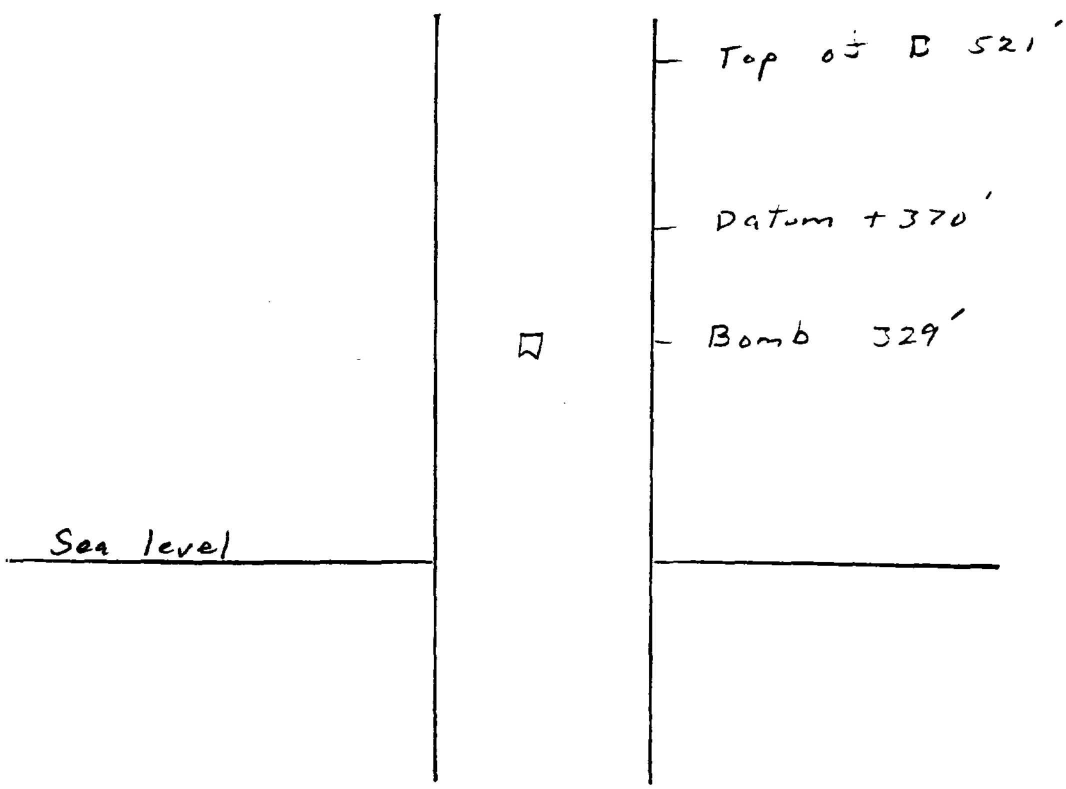
(.7015)(320.6) = 224.9

(.080205)(557.4) = 211.7

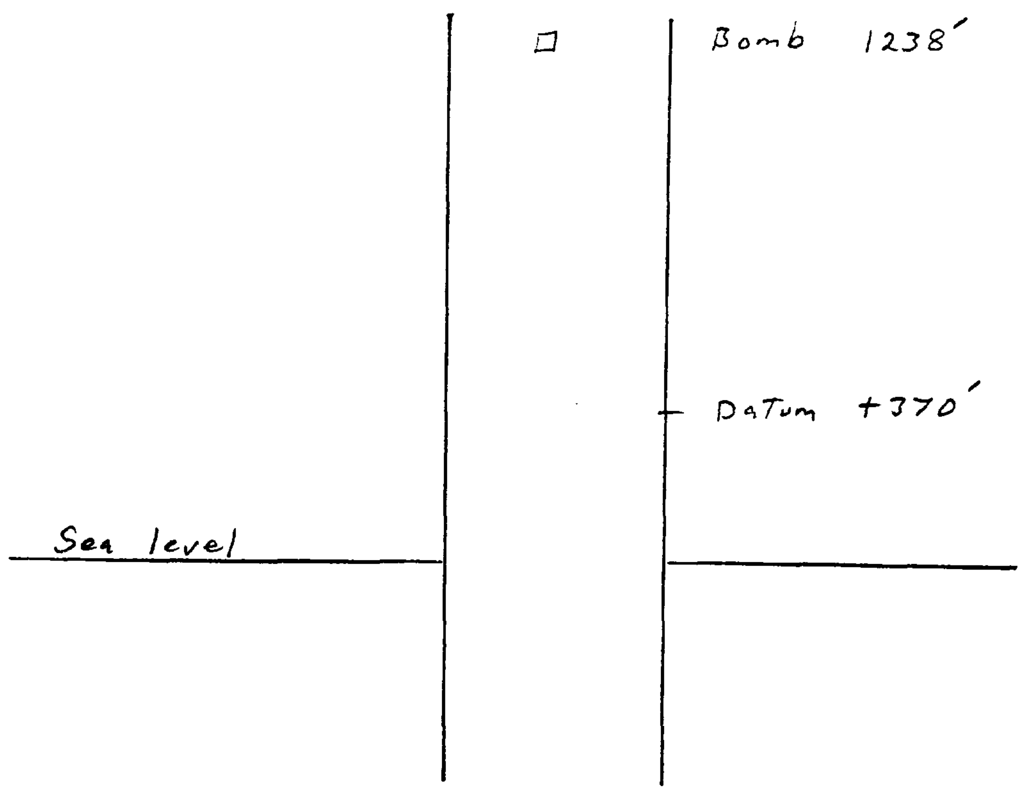
(.433)(.1339) = .0.0580



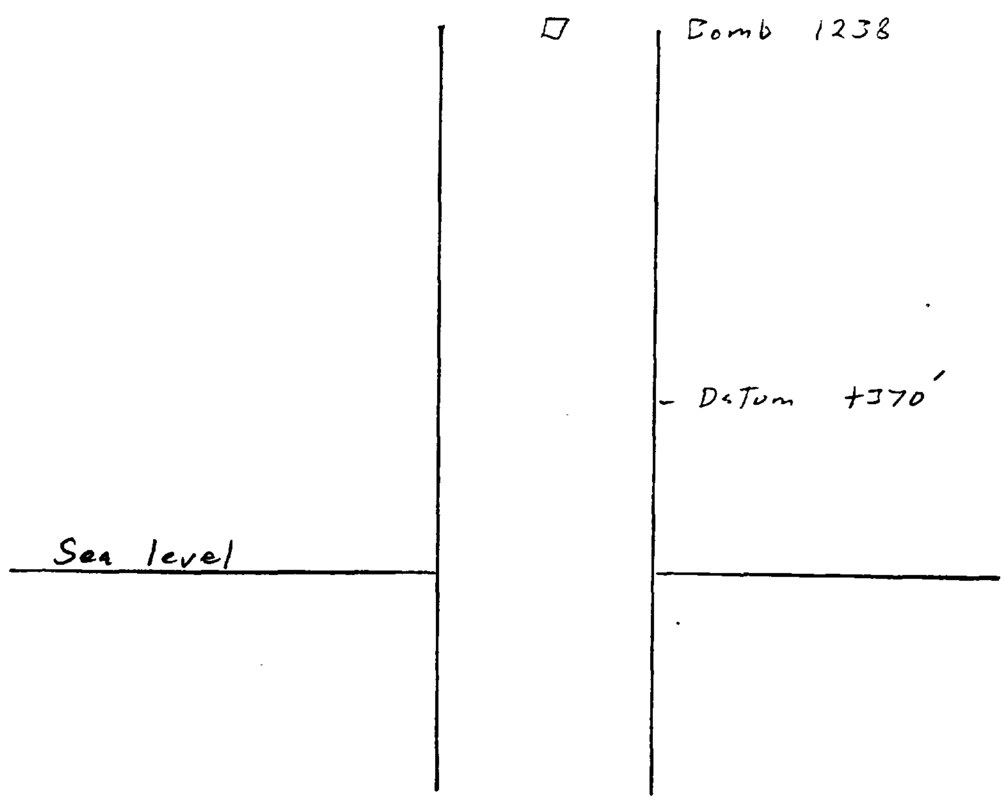
	KB	Subsea
Operator	BMG	
Well	E-10	
Elevation	7341	
Top of B Zone	6820	+521
Test Date	2/23/88	
Bomb Depth	7012	+329
Bomb Pressure, psig	1415	
Fluid Level		
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(329-521)	-5.8
Pressure at Top of B Zone	1409.2	
Top of B Zone to +370 ft	151	
Production		
BO/D	23	
Mcf/D	1600	
Volume Weighted Reservoir Density, psi/ft	.058	
dP to +370 ft	8.8	
Pressure at +370 ft datum	1418.0	



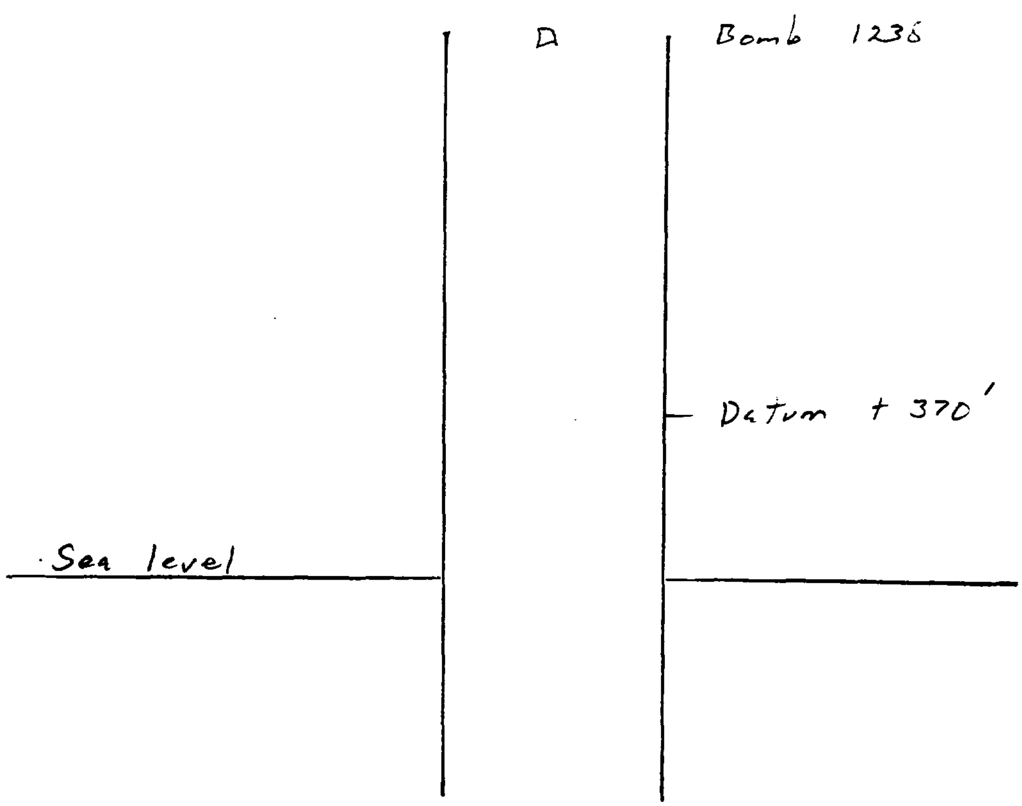
Operator	BMG		
Well	K-13		
	KB		Subsea
Elevation	7100		
Top of B Zone			
Test Date		6/30/87	
Bomb Depth	5862		+1238
Bomb Pressure, psig		1477.8	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(0.03)(1238-370)		26.04
Pressure at Top of B Zone			
Top of B Zone to +370 ft			
Production			
BO/D			
Mcf/D			
Volume Weighted Reservoir Density, psi/ft			
dP to +370 ft			
Pressure at +370 ft datum		1503.8	



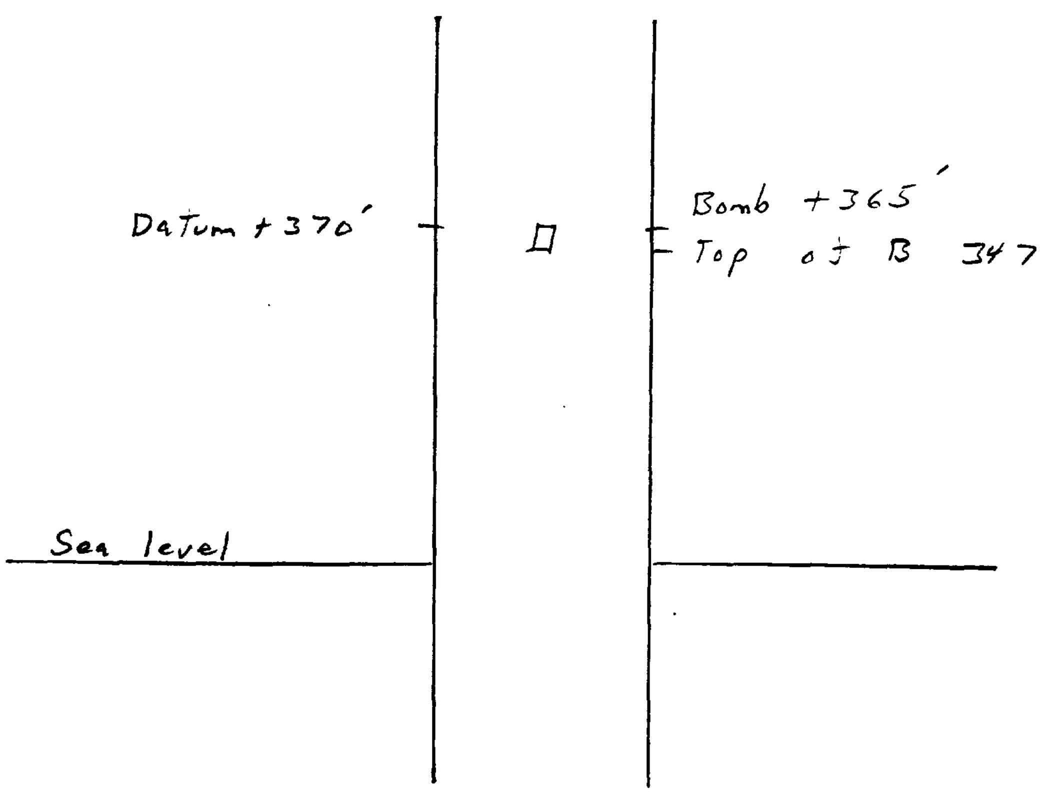
	KB		Subsea
Operator	BMG		
Well	K-13		
Elevation	7100		
Top of B Zone			
Test Date		11/19/87	
Bomb Depth	5862		+ 1238
Bomb Pressure, psig		1482	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(1238-370)		26.04
Pressure at Top of B Zone			
Top of B Zone to +370 ft			
Production			
BO/D			
Mcf/D			
Volume Weighted Reservoir Density, psi/ft			
dP to +370 ft			
Pressure at +370 ft datum		1508	



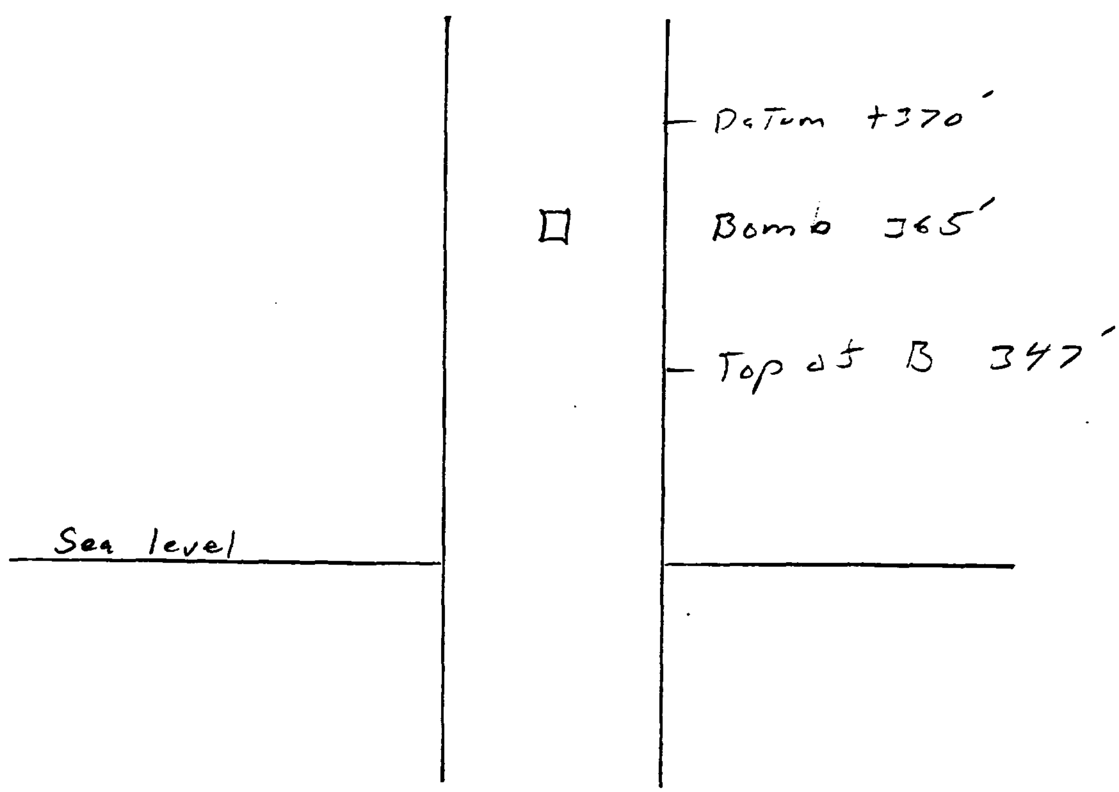
	KB	Subsea
Operator	BMG	
Well	K-13	
Elevation	7100	
Top of B Zone		
Test Date	2/23/88	
Bomb Depth	5862	+1238
Bomb Pressure, psig	1440	
Fluid Level		
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(1238-370)	26
Pressure at Top of B Zone		
Top of B Zone to +370 ft		
Production		
BO/D		
Mcf/D		
Volume Weighted Reservoir Density, psi/ft		
dP to +370 ft		
Pressure at +370 ft datum	1466	



	KB		Subsea
Operator	BMG		
Well	D-17		
Elevation	7477		
Top of B Zone	7130		+347
Test Date		11/19/87	
Bomb Depth	7112		+365
Bomb Pressure, psig		1001	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(365-347)		.5
Pressure at Top of B Zone		1001.5	
Top of B Zone to +370 ft	23		
Production			
BO/D			
Mcf/D			
Volume Weighted Reservoir Density, psi/ft		.035	
dP to +370 ft		0.8	
Pressure at +370 ft datum		1000.7	



	KB	Subsea
Operator	BMG	
Well	D-17	
Elevation	7477	
Top of B Zone	7130	+347
Test Date	2/23/88	
Bomb Depth	7112	+365
Bomb Pressure, psig	960	
Fluid Level		
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(365-347)	0.5
Pressure at Top of B Zone	960.5	
Top of B Zone to +370 ft	23	
Production		
BO/D		
Mcf/D		
Volume Weighted Reservoir Density, psi/ft	.035	
dP to +370 ft	0.8	
Pressure at +370 ft datum	959.7	



	KB	Subsea
Operator	BMG	
Well	A-20	
Elevation	7444	
Top of B Zone	7038	+406
Test Date	11/19/87	
Bomb Depth	7166	+278
Bomb Pressure, psig	971.1	
Fluid Level		
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(0.03)(278-406)	-3.8
Pressure at Top of B Zone	967.3	
Top of B Zone to +370 ft	36	
Production		
BO/D	37	
Mcf/D	220	
Volume Weighted Reservoir Density, psi/ft	0.0458	
dP to +370 ft	1.6	
Pressure at +370 ft datum	968.9	

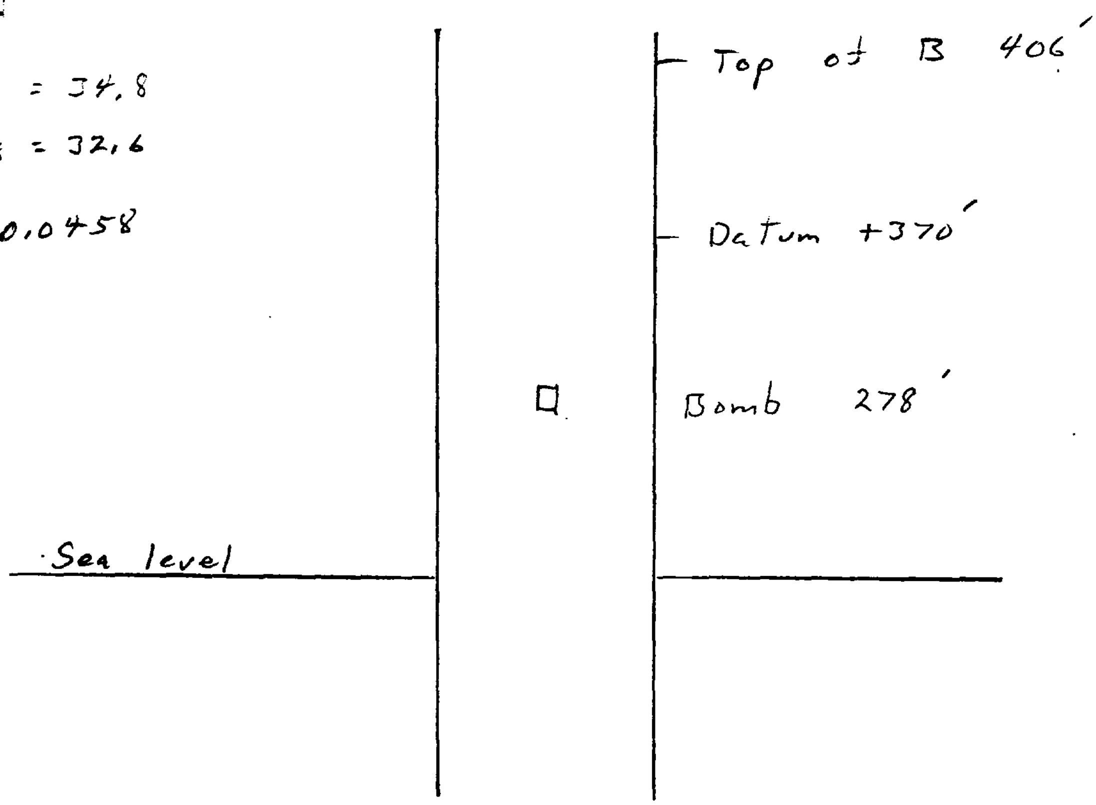
$(37)(1.316) = 48.7$

$\left[220 - \frac{(37)(441)}{1000}\right] 2.891 = 588.8$

$(.7144)\ 48.7 = 34.8$

$(.055291)\ 588.8 = 32.6$

$433).1057 = 0.0458$



	KB		Subsea
Operator	BMG		
Well	A-20		
Elevation	7444		
Top of B Zone	7038		+406
Test Date		6/30/87	
Bomb Depth	7166		+278
Bomb Pressure, psig		1224.6	
Fluid Level	6992		+454
Wellbore Gradient			
Oil, psi/ft	(0.3)(278-406)		-38.4
Gas, psi/ft			
Pressure at Top of B Zone		1186.2	
Top of B Zone to +370 ft	36		
Production			
BO/D		37	
Mcf/D		220	
Volume Weighted Reservoir Density, psi/ft		0.05628	
dP to +370 ft		2.0	
Pressure at +370 ft datum		1186.0	

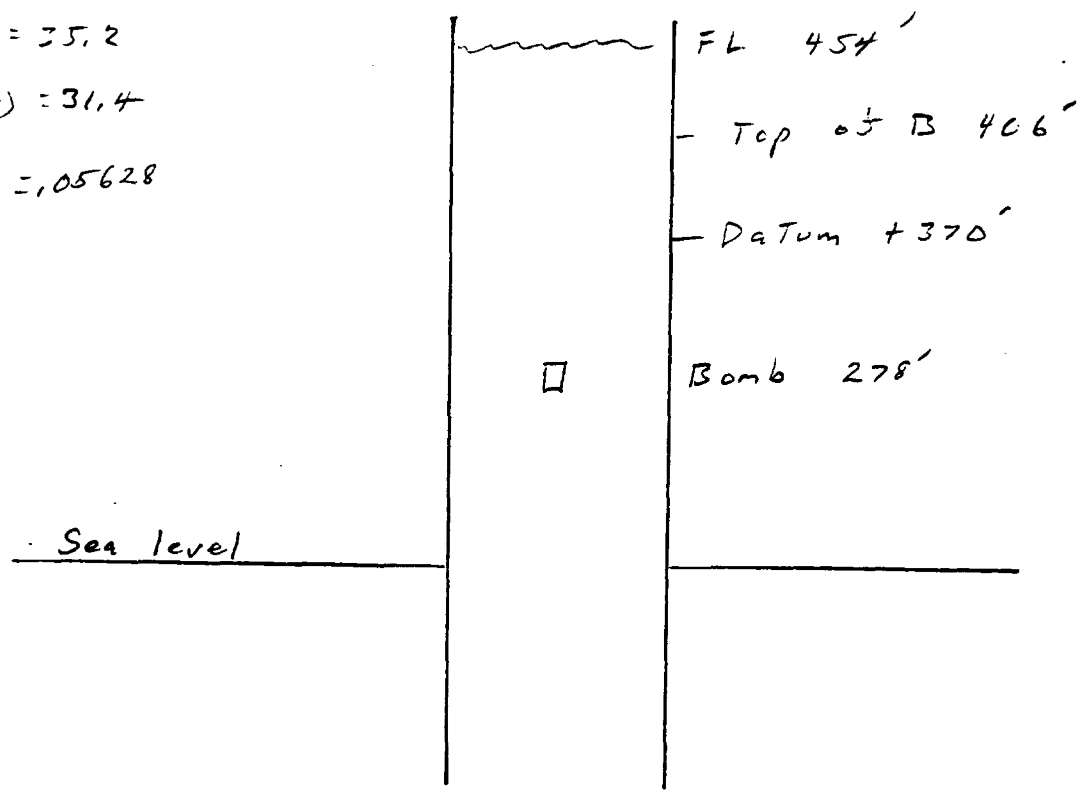
(37) (1.344) = 49.7

[220 - (37)(505)/1000] 2.3 = 463

(.7074)(49.4) = 35.2

(0.067899)(463) = 31.4

(.433)(.1300) =.05628



	KB	Subsea
Operator	BMG	
Well	A-20	
Elevation	7444	
Top of B Zone	7038	+406
Test Date	2/25/88	
Bomb Depth	7166	+278
Bomb Pressure, psig	952.4	
Fluid Level	None	
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(278-406)	-3.8
Pressure at Top of B Zone	948.6	
Top of B Zone to +370 ft	36	
Production		
BO/D	45	
Mcf/D	360	
Volume Weighted Reservoir Density, psi/ft	.0395	
dP to +370 ft	1.4	
Pressure at +370 ft datum	950.0	

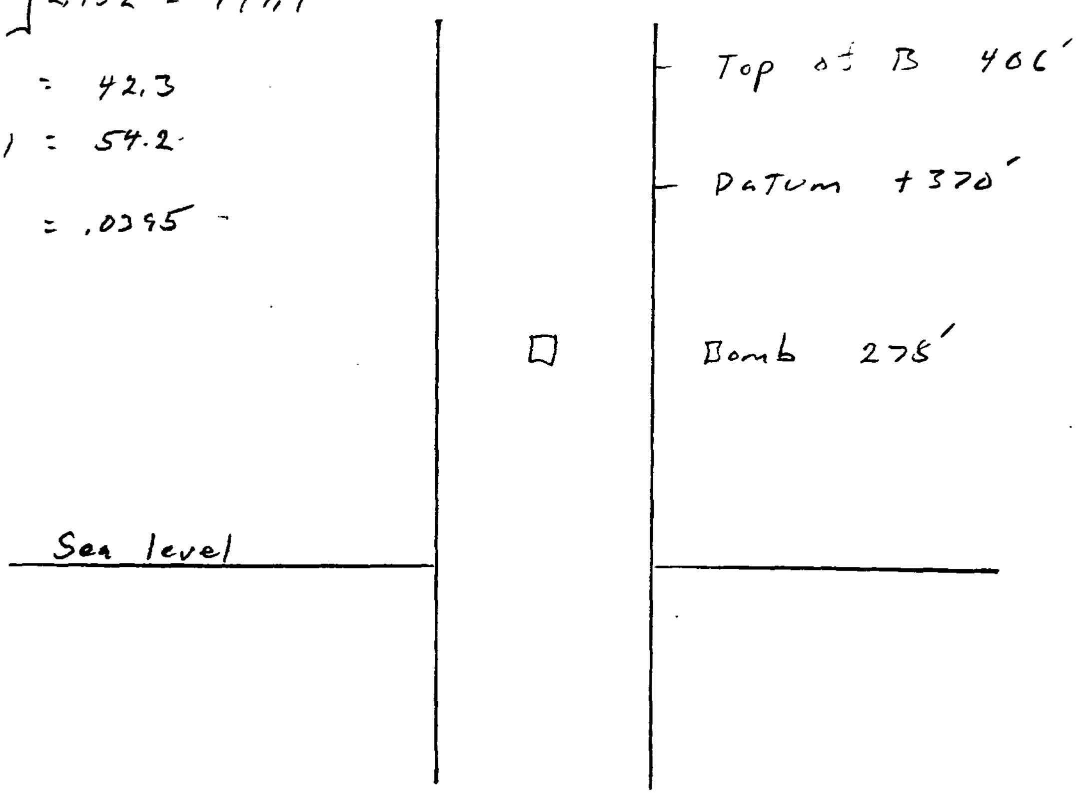
$(45)(1.314) = 59.1$

$\left[360 - \frac{(45)(437)}{1000}\right] 2.932 = 997.9$

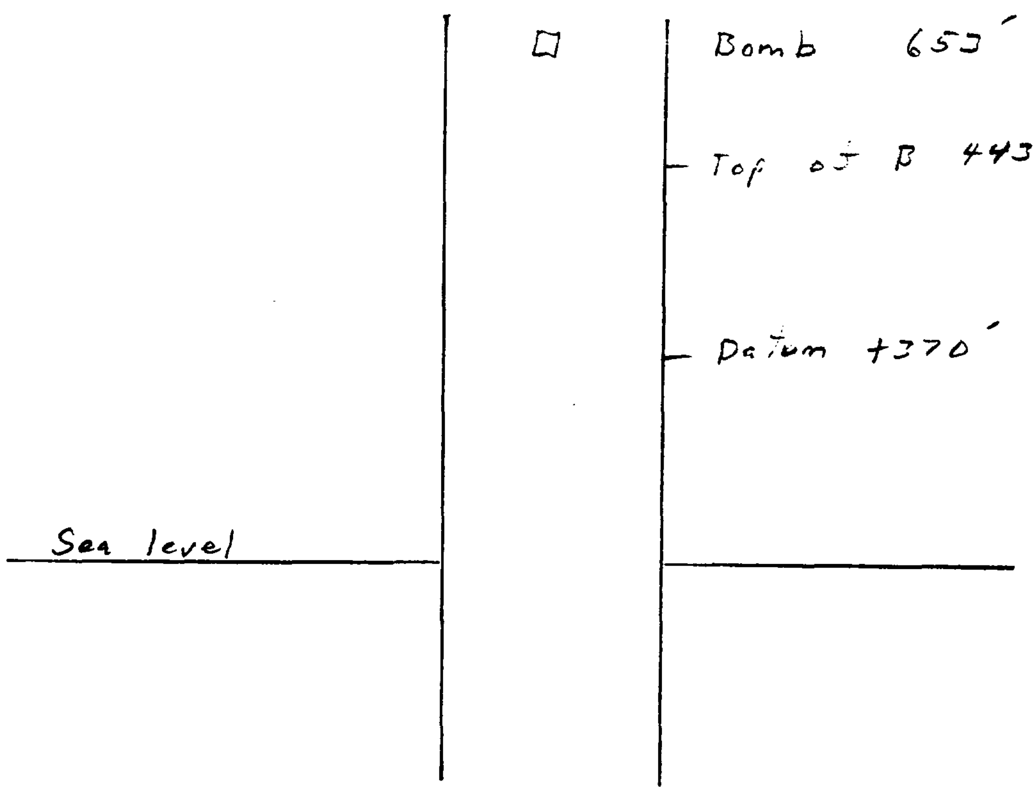
$(.7148)(59.1) = 42.3$

$(.054314)(997.9) = 54.2$

$(.433)(.09130) = .0395$



	KB		Subsea
Operator	BMG		
Well	L-27		
Elevation	7475		
Top of B Zone	7032		+443
Test Date		2/26/88	
Bomb Depth	6822		+653
Bomb Pressure, psig		1372	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(653-443)		6.3
Pressure at Top of B Zone		1383.3	
Top of B Zone to +370 ft	73		
Production			
BO/D			
Mcf/D			
Volume Weighted Reservoir Density, psi/ft		.035	
dP to +370 ft		2.6	
Pressure at +370 ft datum		1385.9	



	KB		Subsea
Operator	B M G		
Well	B-29		
Elevation	7508		
Top of B Zone	7085		+423
Test Date		2/23/88	
Bomb Depth	7212		+296
Bomb Pressure, psig		962	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(03)(296-423)		-3.8
Pressure at Top of B Zone		958.2	
Top of B Zone to +370 ft	53		
Production			
BO/D		1136	
Mcf/D		1590	
Volume Weighted Reservoir Density, psi/ft		0.1117	
dP to +370 ft		5.9	
Pressure at +370 ft datum		964.1	

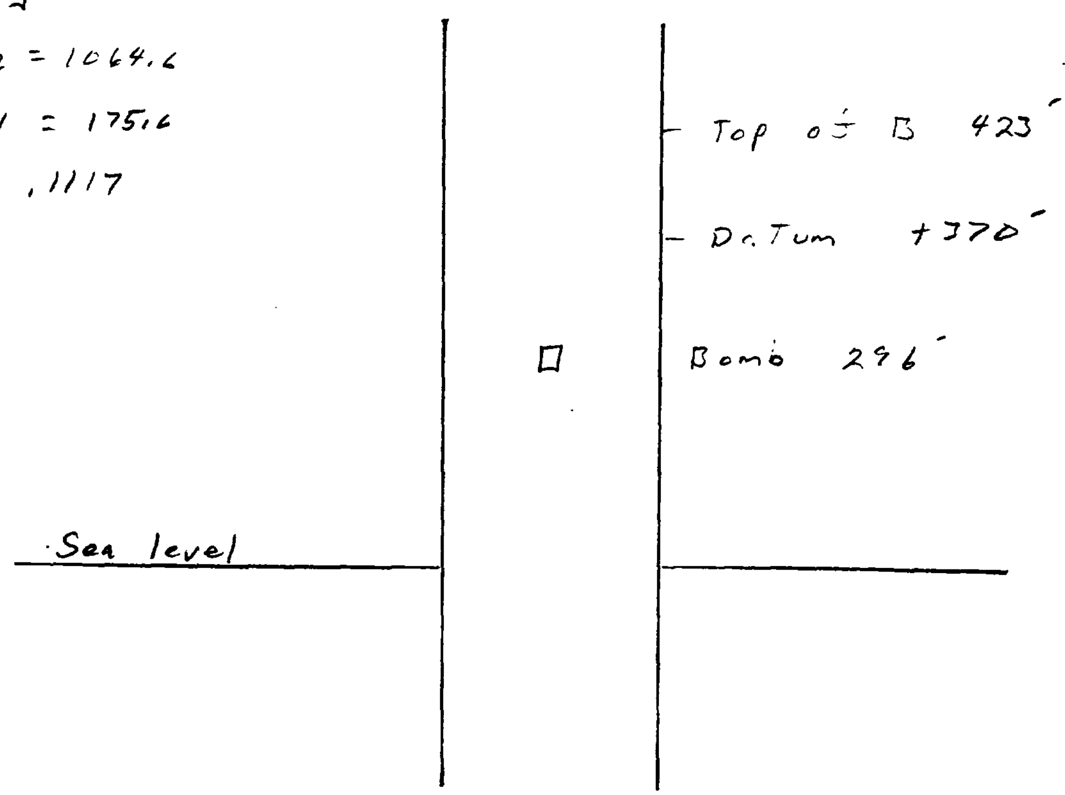
(1136) 1.316 = 1488.2

$\left[1590 - \frac{(1136)(430)}{1000}\right] 3.015 = 3321.1$

(.7154) 1488.2 = 1064.6

(.052877) 3321.1 = 175.6

(.433)(.2579) = .1117



	KB		Subsea
Operator	BMG		
Well	B-32		
Elevation	7611		
Top of B Zone	7190		+ 421
Test Date		6/30/87	
Bomb Depth	7316		+ 295
Bomb Pressure, psig		1203.4	
Fluid Level	7262		+ 349
Wellbore Gradient			
Oil, psi/ft	(.3)(295-349)		- 16.2
Gas, psi/ft	(.03)(349-421)		- 2.2
Pressure at Top of B Zone		1185	
Top of B Zone to +370 ft	51		
Production			
BO/D		520	
Mcf/D		470	
Volume Weighted Reservoir Density, psi/ft		0.1832	
dP to +370 ft		+ 9.3	
Pressure at +370 ft datum		1194.3	

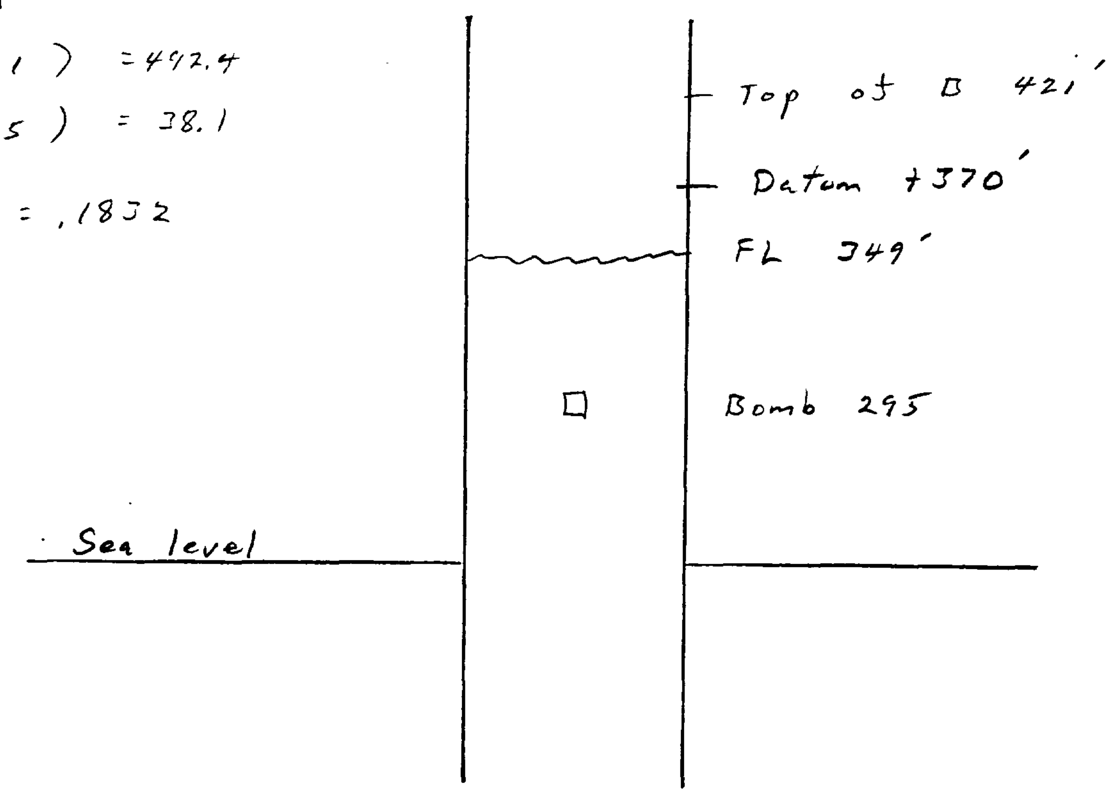
$(520)\ (1.331) = 692.1$

$\left[470 - \frac{(520)(476)}{1000}\right] 2.524 = 561.5$

$(.7115)(692.1) = 492.4$

$(.067841)(561.5) = 38.1$

$(.433)(0.4232) = .1832$



	KB	Subsea
Operator	BMG	
Well	B-32	
Elevation	7611	
Top of B Zone	7190	+421
Test Date	11/19/87	
Bomb Depth	7302	+309
Bomb Pressure, psig	970.5	
Fluid Level	None	
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(309-421)	-3.4
Pressure at Top of B Zone	967.1	
Top of B Zone to +370 ft	51	
Production		
BO/D	766	
Mcf/D	920	
Volume Weighted Reservoir Density, psi/ft	.05684	
dP to +370 ft	2.9	
Pressure at +370 ft datum	970.0	

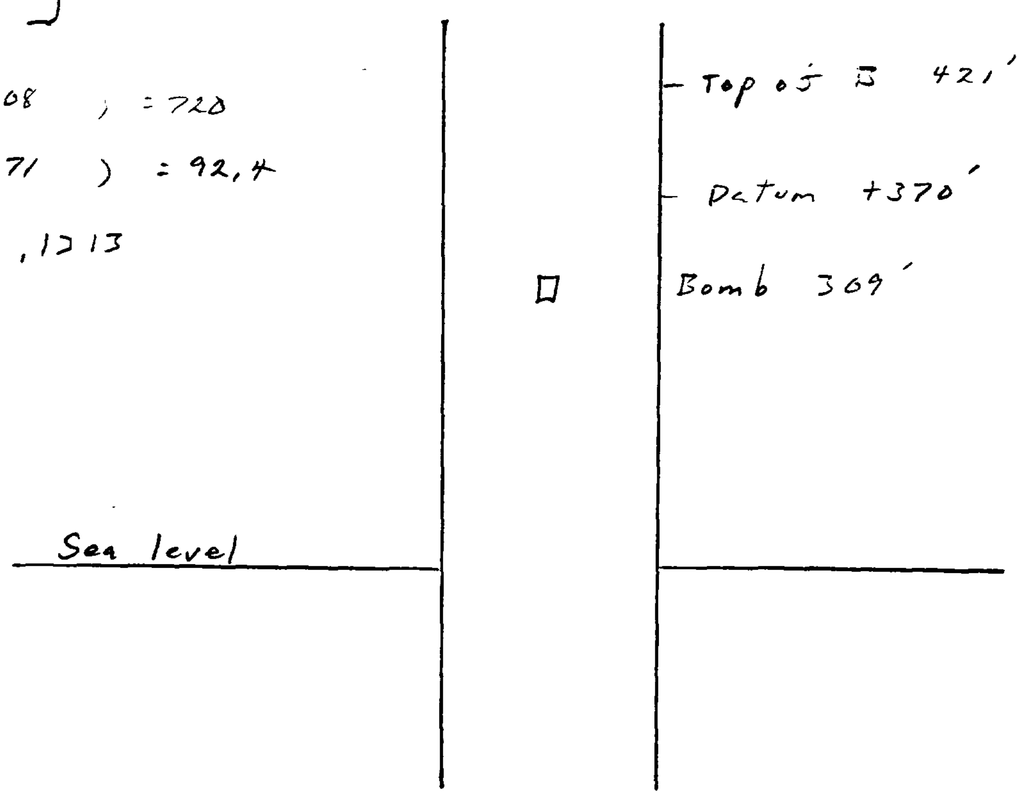
766) (1.316) = 1008.1

$\left[920 - \frac{(766)(442)}{1000}\right] 2.875 = 1671.6$

(0.71423) (1008) = 720

(0.055291)(1671) = 92.4

(.433)(.3032) = .1313



	KB		Subsea
Operator	BMG		
Well	B-32		
Elevation	7611		
Top of B Zone	7190		+ 421
Test Date		2/23/88	
Bomb Depth	7302		+309
Bomb Pressure, psig		953.8	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	.03(309-421)		-3.4
Pressure at Top of B Zone		950.4	
Top of B Zone to +370 ft	51		
Production			
BO/D		754	
Mcf/D		770	
Volume Weighted Reservoir Density, psi/ft		0.1238	
dP to +370 ft		+ 6.3	
Pressure at +370 ft datum		956.7	

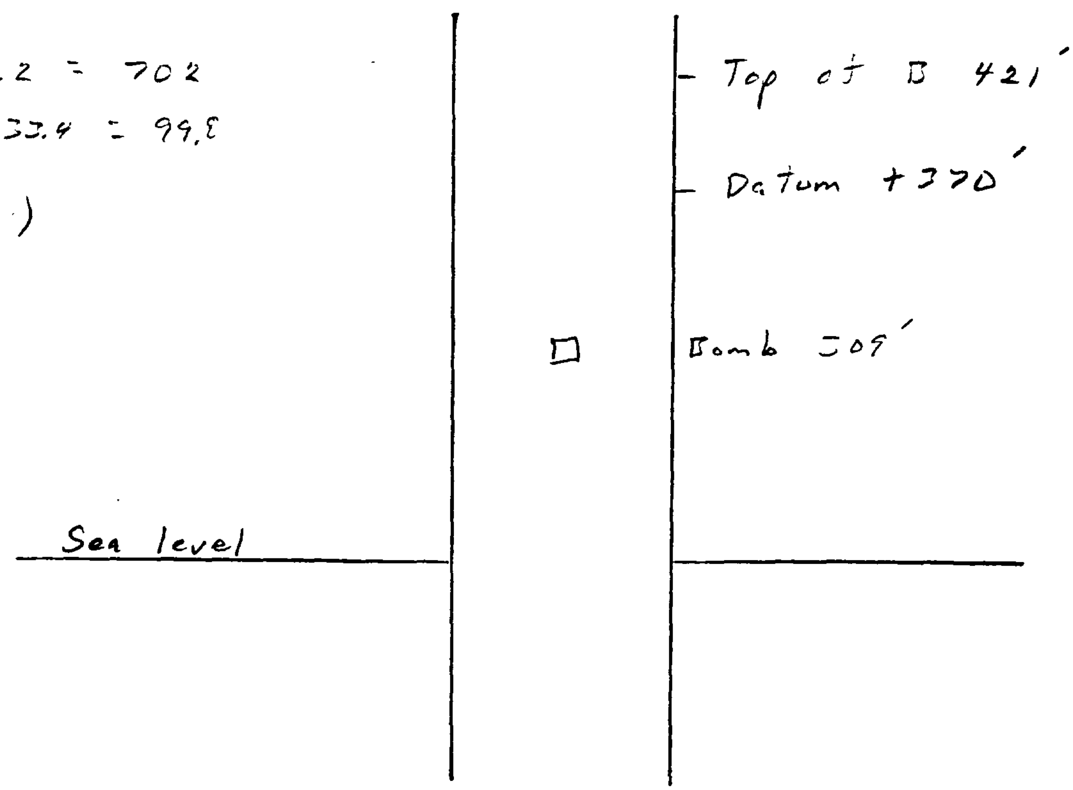
(754) 1.288 = 971.2

$\left[770 - \frac{754(280)}{1000}\right] 3.792 = 1833.4$

(.7229) 971.2 = 702

(.054314) 1833.4 = 99.8

(.433)(0.2858)



	KB		Subsea
Operator	Mallon		
Well	Johnson Federal 12-5		
Elevation	7430		
Top of B Zone	7029		+401
Test Date		6/30/87	
Bomb Depth	7611		−181
Bomb Pressure, psig		1427	
Fluid Level	5205		+2225
Wellbore Gradient			
Oil, psi/ft	(0.355)(−181−401)		−206.6
Gas, psi/ft			
Pressure at Top of B Zone		1220.4	
Top of B Zone to +370 ft	94		
Production			
BO/D		30	
Mcf/D		382	
Volume Weighted Reservoir Density, psi/ft		0.04324	
dP to +370 ft		4.1	
Pressure at +370 ft datum		1224.5	

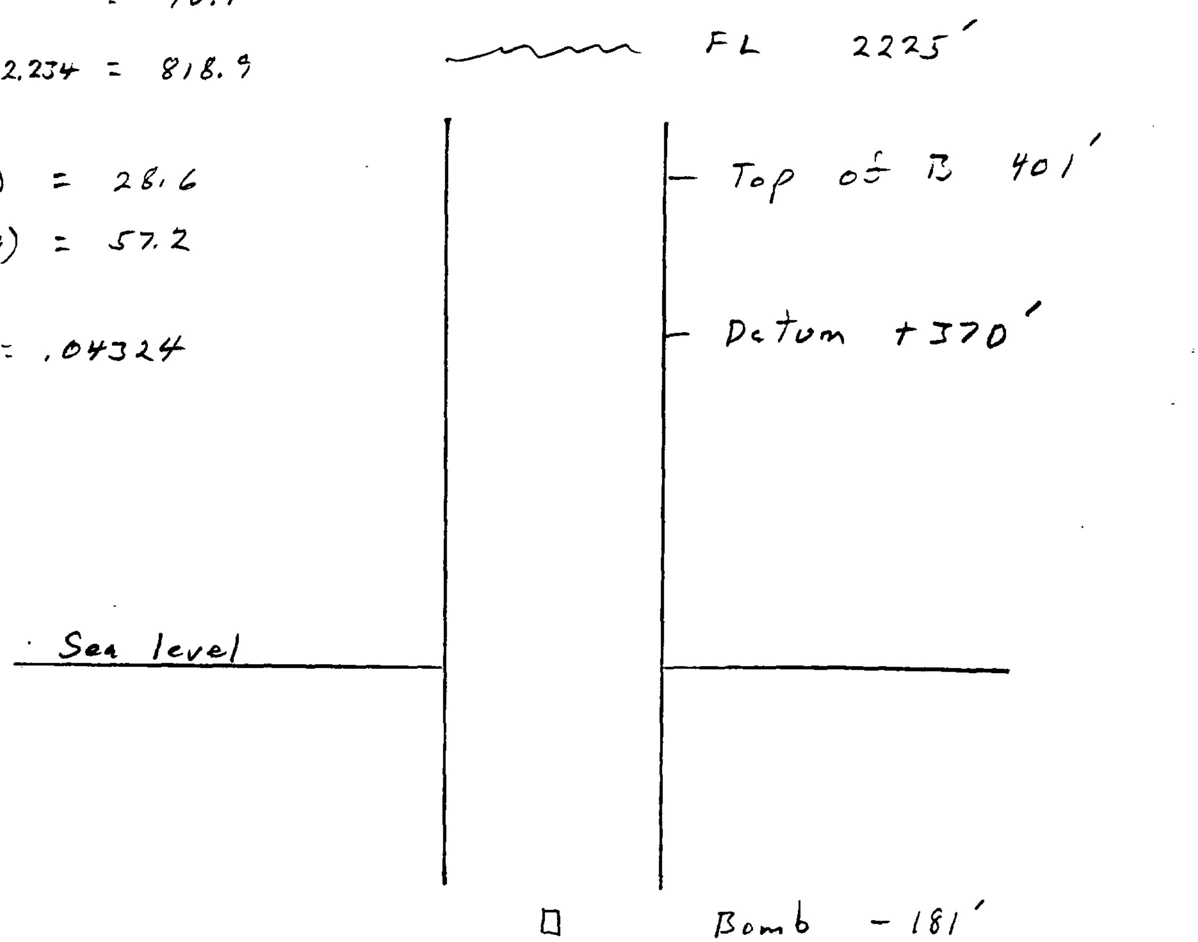
$(30)(1.348) = 40.4$

$\left[382 - \frac{(30)(515)}{1060}\right] 2.234 = 818.9$

$(.7072)(40.4) = 28.6$

$(.069860)(818.9) = 57.2$

$(.433)(.09986) = .04324$



	KB		Subsea
Operator	Mallon		
Well	Fisher Federal 2-1		
Elevation	7654		
Top of B Zone	7307		+347
Test Date		11/19/87	
Bomb Depth	7875		-221
Bomb Pressure, psig		1177	
Fluid Level	7297		+357
Wellbore Gradient			
Oil, psi/ft	(0.34)(-221-347)		-193.1
Gas, psi/ft			
Pressure at Top of B Zone		983.8	
Top of B Zone to +370 ft	23		
Production			
BO/D		228	
Mcf/D		575	
Volume Weighted Reservoir Density, psi/ft		0.08429	
dP to +370 ft		1.9	
Pressure at +370 ft datum		981.9	

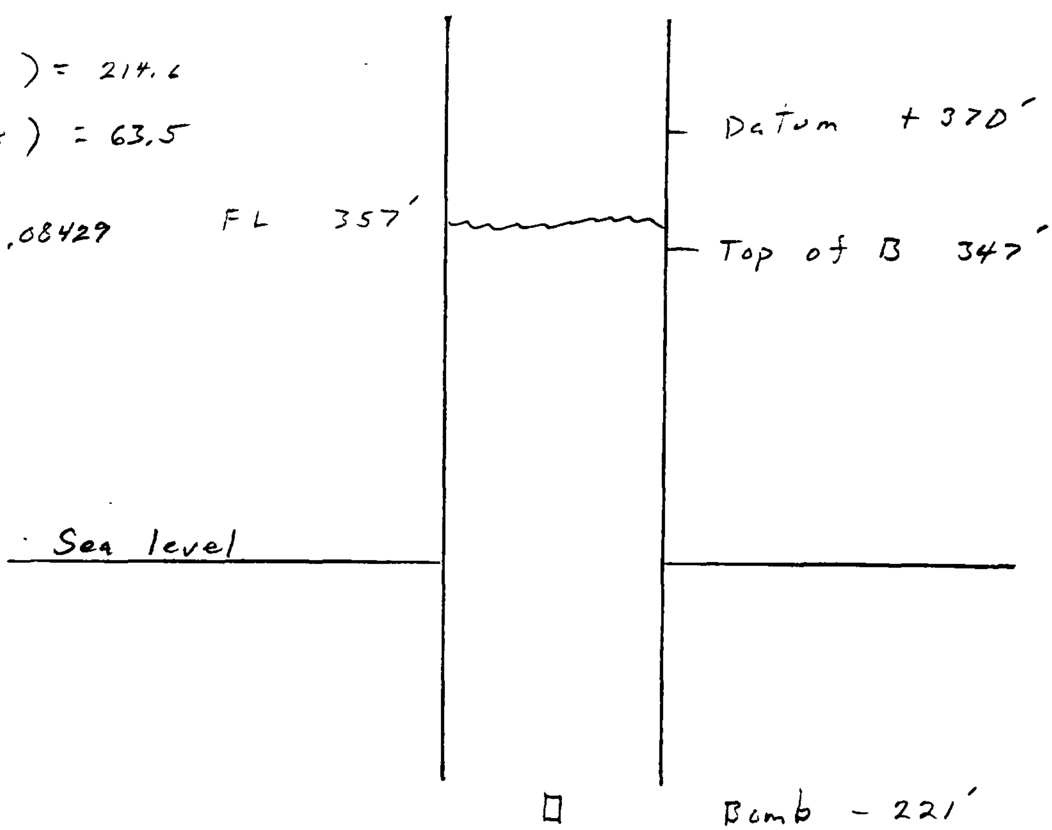
(228) (1.3185) = 300.6

$\left[575 - \frac{(228)(448)}{1000}\right] 2.808 = 1127.8$

(.7140) (300.6) = 214.6

(.05627)(1127.8) = 63.5

(.433)(.19467) = .08429



	KB		Subsea
Operator	Mallon		
Well	Howard 1-8		
Elevation	7522		
Top of B Zone	7150		+372
Test Date		2/23/88	
Bomb Depth	7300		+222
Bomb Pressure, psig		980	
Fluid Level	4523		+2999
Wellbore Gradient			
Oil, psi/ft	.345 (222-372)		-51.8
Gas, psi/ft			
Pressure at Top of B Zone		928	
Top of B Zone to +370 ft	2		
Production			
BO/D		120	
Mcf/D		1021	
Volume Weighted Reservoir Density, psi/ft		.03754	
dP to +370 ft		0.1	
Pressure at +370 ft datum		928.1	

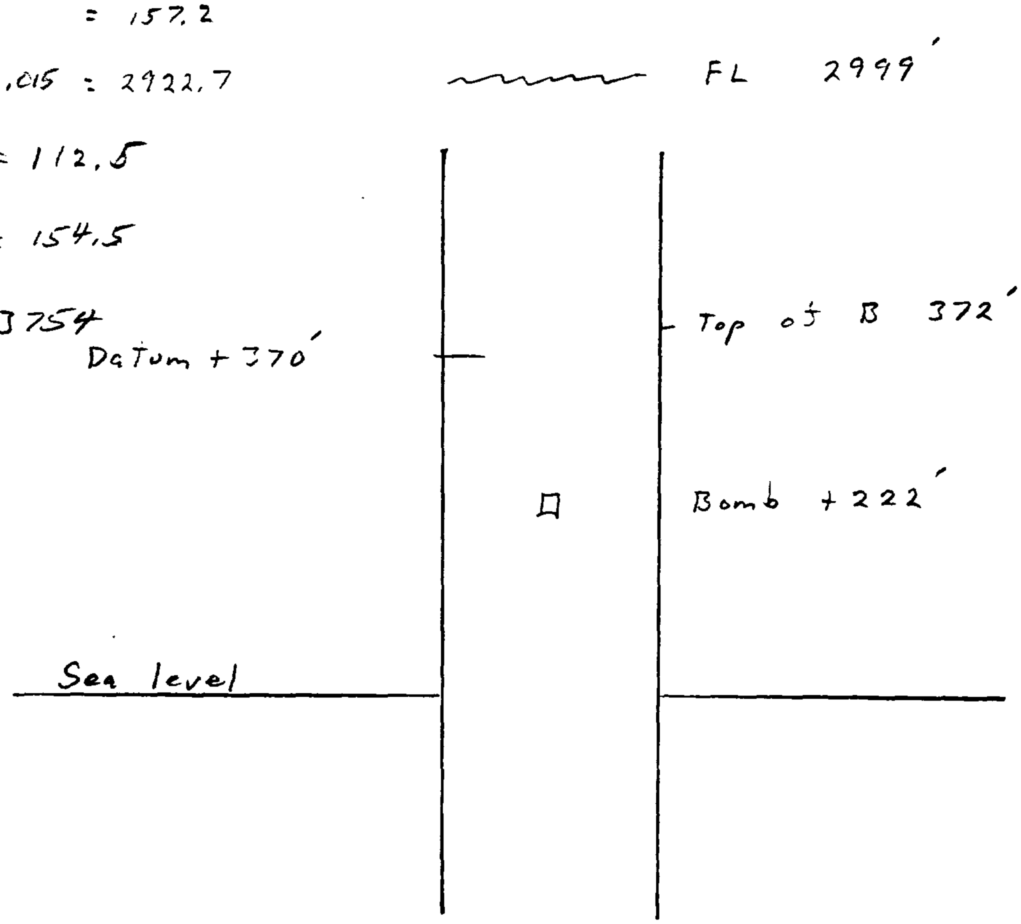
(120) (1.310) = 157.2

$\left[1021 - \frac{(120)(430)}{1000}\right] 3.015 = 2922.7$

(.7154)(157.2) = 112.5

(.052877)(2922.7) = 154.5

(.433)(.08671) = .03754



	KB		Subsea
Operator	Mesa Grande		
Well	Bearcat #1		
Elevation	7249		
Top of B Zone	6777		+472
Test Date		6/30/87	
Bomb Depth	6800		+449
Bomb Pressure, psig		1036	
Fluid Level			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(449-472)		-.66
Pressure at Top of B Zone		1035.4	
Top of B Zone to +370 ft	102'		
Production			
BO/D		52	
Mcf/D		347	
Volume Weighted Reservoir Density, psi/ft		0.04657	
dP to +370 ft		4.8	
Pressure at +370 ft datum		1040.2	

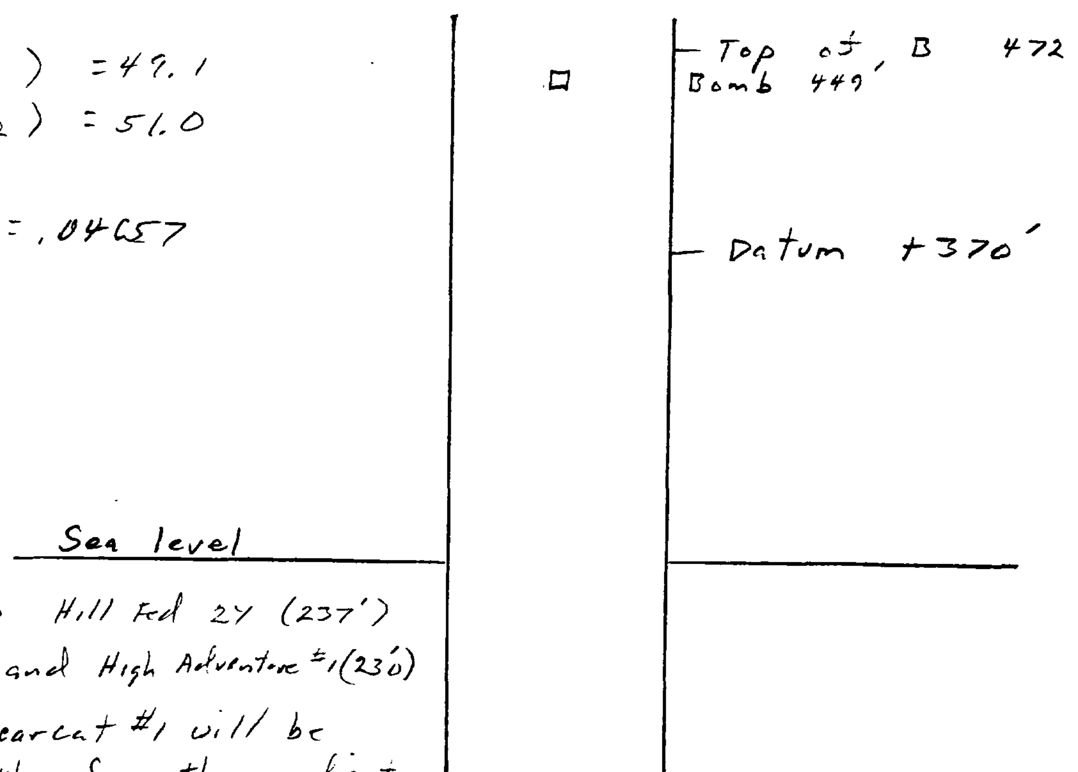
$(52)(1.325) = 68.9$

$\left[347 - \frac{(52)(463)}{1000}\right] 2.67 = 862.2$

$(.7129)(68.9) = 49.1$

$(.05920)(862.2) = 51.0$

$(.433)(.1076) = .04657$



By analogy to Hill Fed 24 (237') Loddy #1 (205') and High Adventure #1 (230') the FL of Bearcat #1 will be +200' to +250' therefore the gradient is gas only

	KB		Subsea
Operator	Mesa Grande		
Well	Bearcat #1		
Elevation	7249		
Top of B Zone	6777		+ 472
Test Date		11/19/87	
Bomb Depth	6770		+ 479
Bomb Pressure, psig		765	
Fluid Level	below +370'		
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(479-472)		.15
Pressure at Top of B Zone		765.15	
Top of B Zone to +370 ft	102		
Production			
BO/D		10.6	
Mcf/D		192	
Volume Weighted Reservoir Density, psi/ft		.035	
dP to +370 ft		3.6	
Pressure at +370 ft datum		768.7	

$(10.6)(1.289) = 13.7$

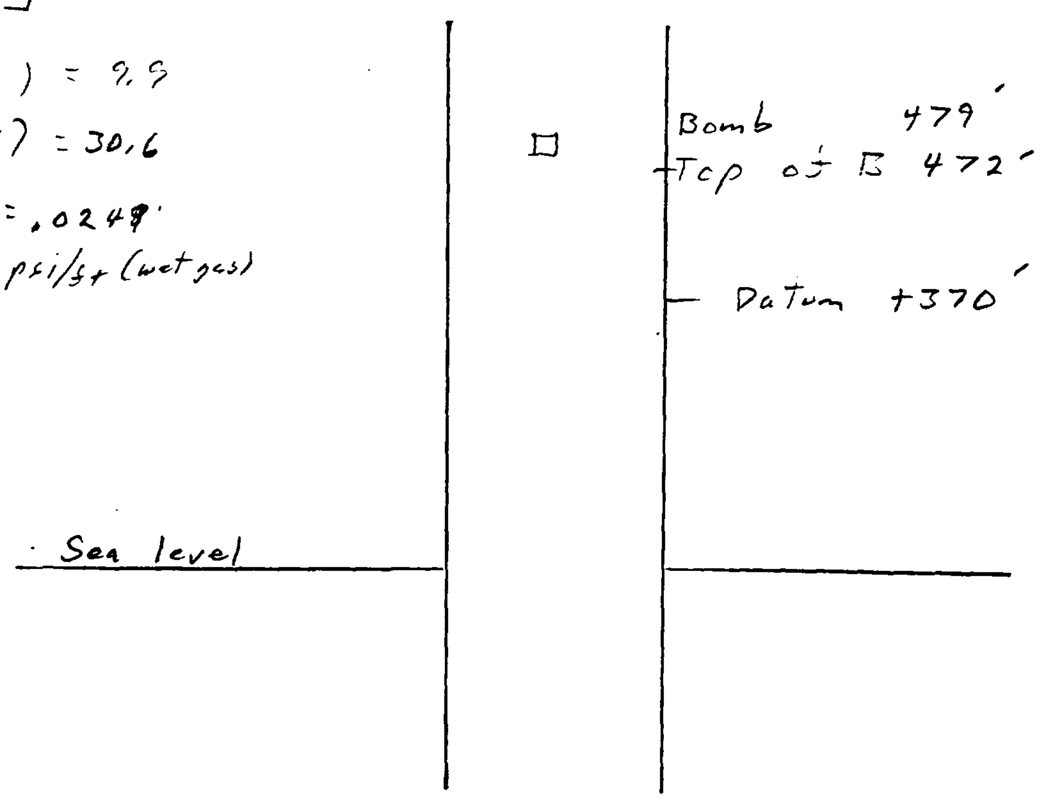
$\left[192 - \frac{(10.6)(385)}{1000}\right] 3.7 = 695.3$

$(.722)(13.7) = 9.9$

$(.04414)(695.3) = 30.6$

$(.433)(.05725) = .0248$

use 0.035 psi/ft (wet gas)



	KB	Subsea
Operator	Mesa Grande	
Well	Bearcat #1	
Elevation	7249	
Top of B Zone	6777	+472
Test Date	2/23/88	
Bomb Depth	6770	+479
Bomb Pressure, psig	732	
Fluid Level	below +370'	
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	(.03)(479-472)	.15
Pressure at Top of B Zone	732.15	
Top of B Zone to +370 ft	102	
Production		
BO/D	5.7	
Mcf/D	213	
Volume Weighted Reservoir Density, psi/ft	0.035	
dP to +370 ft	3.6	
Pressure at +370 ft datum	735.7	

$(5.7)(1.285) = 7.3$

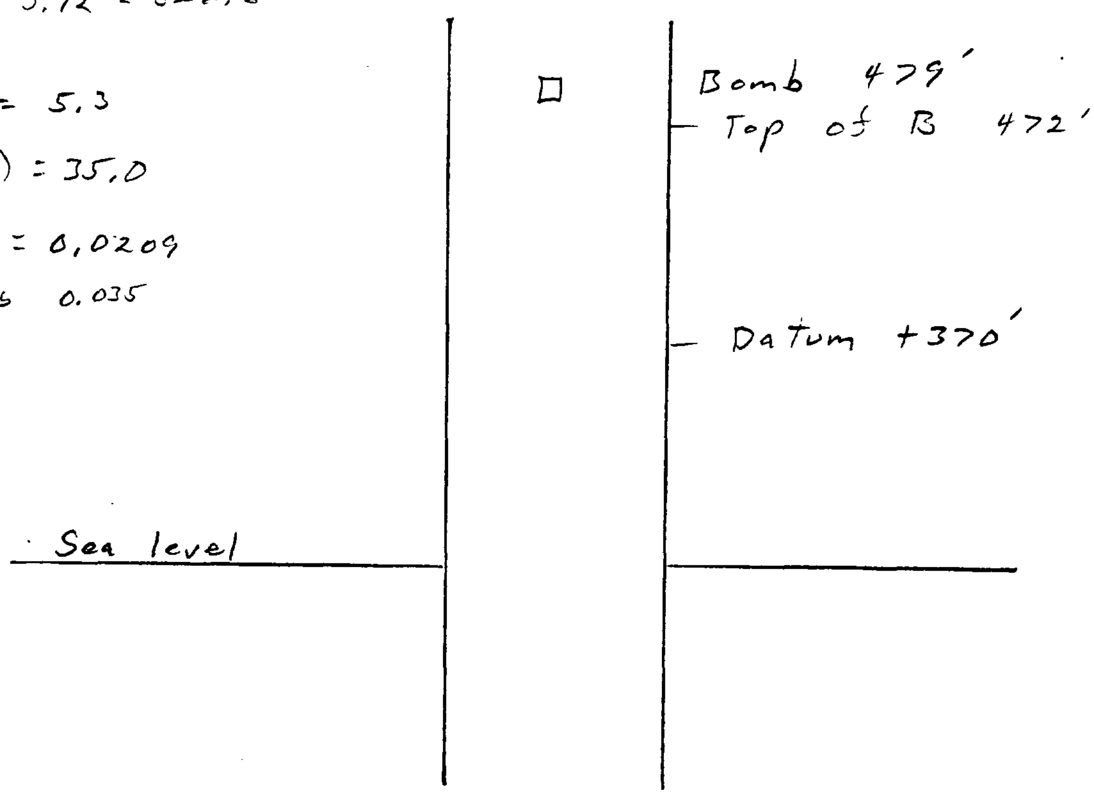
$\left[213 - \frac{5.7(373)}{1000}\right] 3.92 = 826.6$

$(.7239)(7.3) = 5.3$

$(.04239)(826.6) = 35.0$

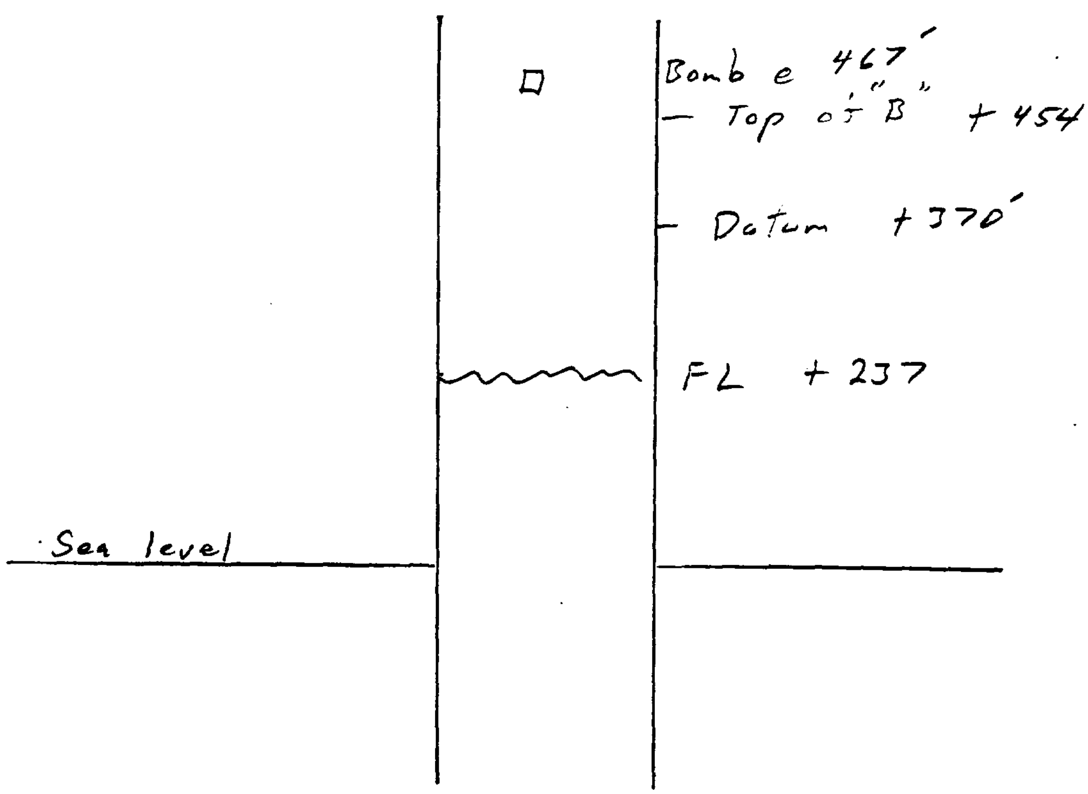
$(.433)(.04837) = 0.0209$

use wet gas 0.035



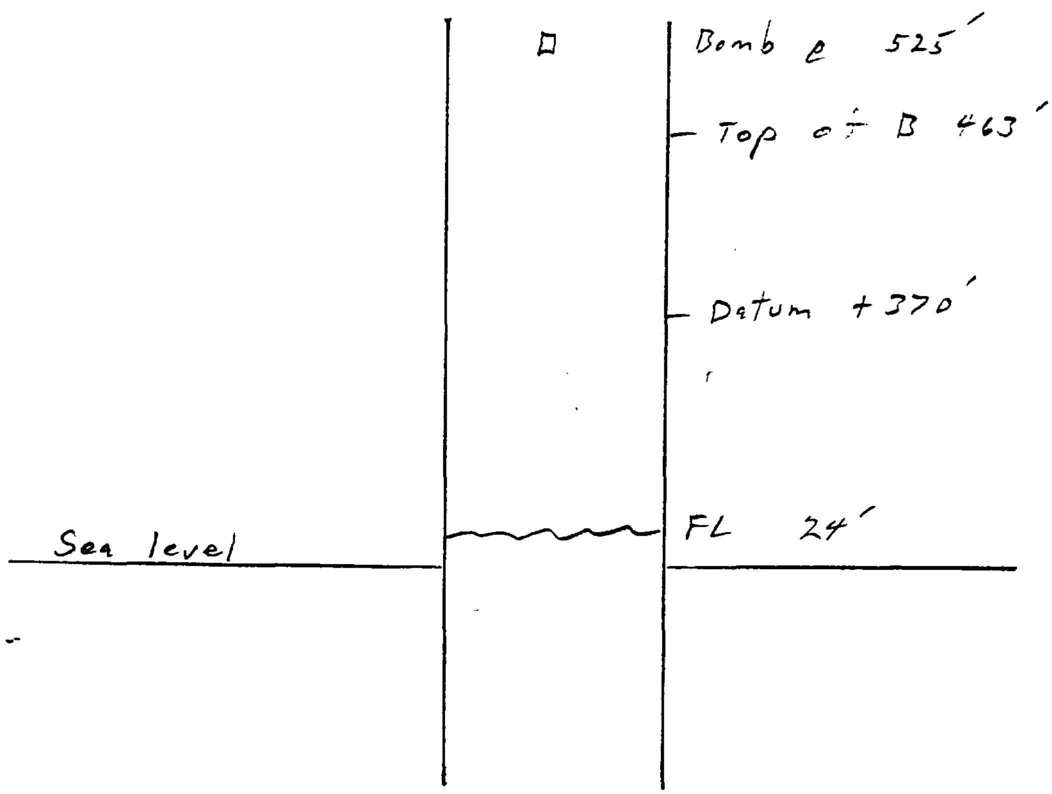
5/28/86

	KB		Subsea
Operator	Merridian		
Well	Hill Federal 2 Y		
Elevation	7467		
Top of B Zone	7013		+454
Test Date		6/30/87	
Bomb Depth	7000		+467
Bomb Pressure, psig		1109	
Fluid Level	7230		+237
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(13)		0.4
Pressure at Top of B Zone		1109.4	
Top of B Zone to +370 ft	84		
Production			
BO/D		100	
Mcf/D		240	
Volume Weighted Reservoir Density, psi/ft		0.08803	
dP to +370 ft		7.4	
Pressure at +370 ft datum		1116.8	



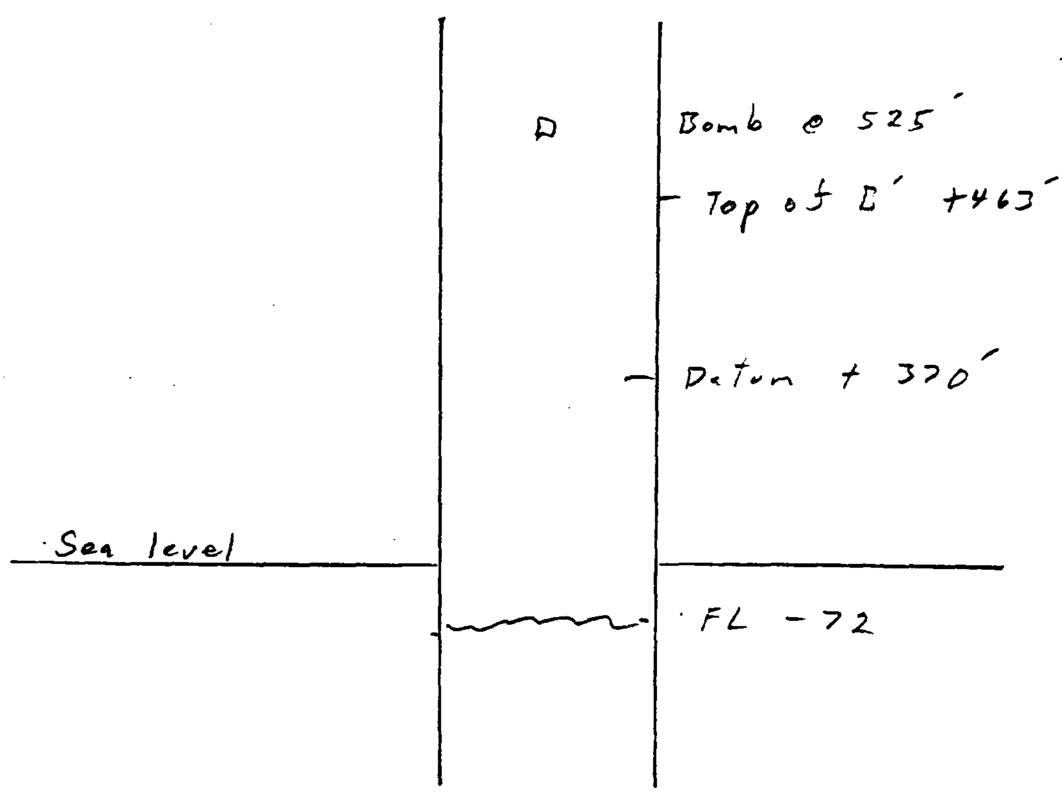
5/28/88

	KB		Subsea
Operator	Meridian		
Well	Hill Federal #1		
Elevation	7480		
Top of B Zone	7017		+463
Test Date		11/19/87	
Bomb Depth	6955		+525
Bomb Pressure, psig		936	
Fluid Level	7456		+24
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.03)(525-463)		+1.86
Pressure at Top of B Zone		937.9	
Top of B Zone to +370 ft	93'		
Production			
BO/D		27	
Mcf/D		880	
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		3.3	
Pressure at +370 ft datum		941.2	



5/28/86

Operator	Meridian		
Well	Hill Federal #1		
	KB		Subsea
Elevation	7480		
Top of B Zone	7017		+463
Test Date		2/23/86	
Bomb Depth	6955		+525
Bomb Pressure, psig		940	
Fluid Level	7552		-72
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft	(.62)(525-463)		1.86
Pressure at Top of B Zone		941.9	
Top of B Zone to +370 ft	93'		
Production			
BO/D		11	
Mcf/D		962	
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		3.3	
Pressure at +370 ft datum		945.2	



5/3/88

	KB		Subsea
Operator	Mobil		
Well	Lindrith B-37		
Elevation	7134		
Top of B Zone	6683		+451
Test Date		6/30/87	
Bomb Depth	6814		+334
Bomb Pressure, psig		1059	
Fluid Level			+419
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft		0.3 (419-334)	
Gas, psi/ft		0.03 (451-419)	
Pressure at Top of B Zone		1059-26 = (1032)	
Top of B Zone to +370 ft		81	
Production			
BO/D		54	
Mcf/D		435	
Volume Weighted Reservoir Density, psi/ft		0.04270	
dP to +370 ft		3.5	
Pressure at +370 ft datum		1035.5	

(54)(1.323) = 71.4

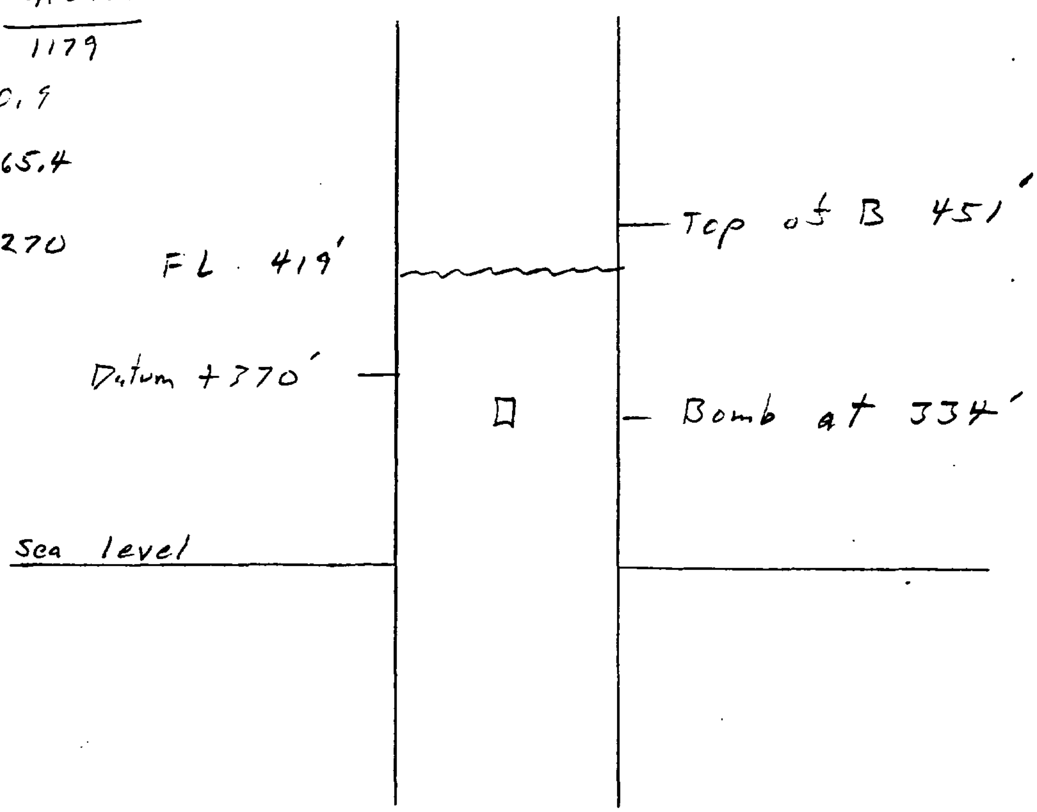
$\left[435 - \frac{(54)(459)}{1000}\right] 2.7 = 1107.6$

1179

(71.4)(.7131) = 50.9

(1107.6)(.05903) = 65.4

.433(.0986) = .04270



	KB		Subsea
Operator	Mobil		
Well	Lindrith B-37		
Elevation	7134		
Top of B Zone	6683		+451
Test Date		11/19/87	
Bomb Depth	6814		+334
Bomb Pressure, psig		797	
Fluid Level			+522
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft		0.3 (451-334)	
Gas, psi/ft		0.03	
Pressure at Top of B Zone		762	
Top of B Zone to +370 ft		81	
Production			
BO/D		214	
Mcf/D		889	
Volume Weighted Reservoir Density, psi/ft		0.04422	
dP to +370 ft		3.6	
Pressure at +370 ft datum		765.6	

$(214)(1.291) = 276.3$

$\left[889 - \frac{(214)(357)}{1000}\right] 3.656 = 2947.4$

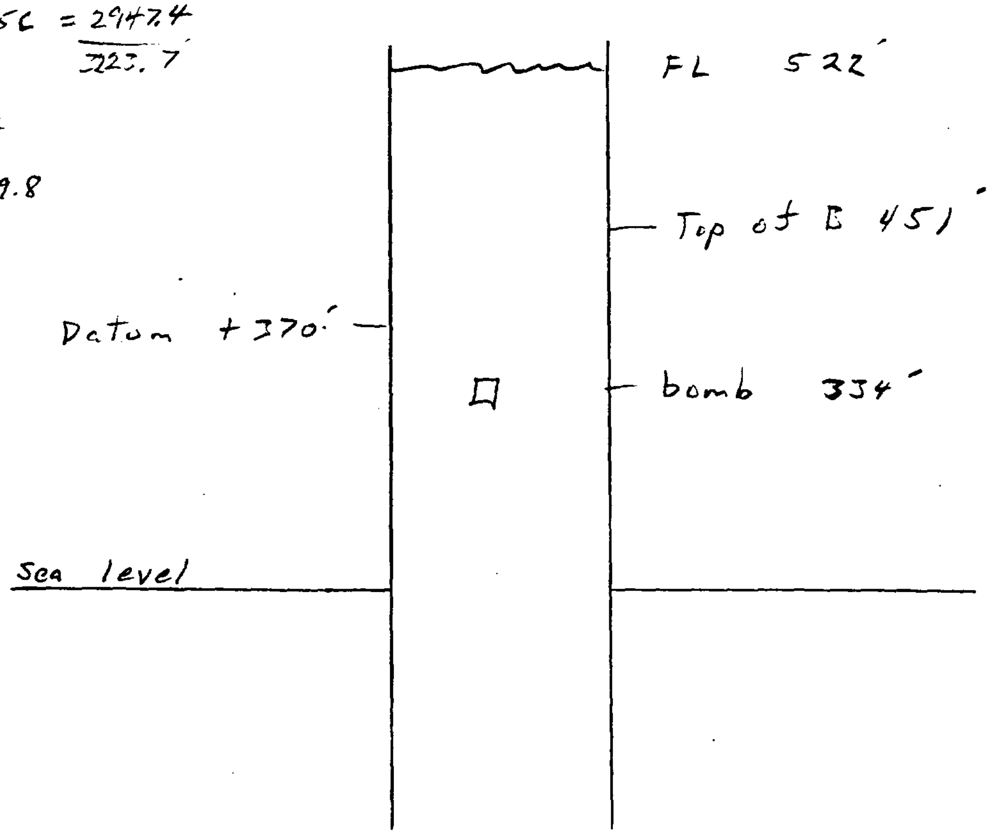
$\underline{} 3223.7$

$(276.3)(.7218) = 199.4$

$(2947.4)(.04404) = 129.8$

$\rho_{Avg} = (.10212)(.433)$

$= .04422$



	KB		Subsea
Operator	Mobil		
Well	Lundrith B-37		
Elevation	7134		
Top of B Zone	6683		+451
Test Date		2/23/88	
Bomb Depth	6894		+240
Bomb Pressure, psig		774	
Fluid Level	6744		+390
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft		.3 (390-240) = 45	
Gas, psi/ft		.03 (451-390) = 1.8	
Pressure at Top of B Zone		774-47 = (727)	
Top of B Zone to +370 ft		81	
Production			
BO/D		188	
Mcf/D		816	
Volume Weighted Reservoir Density, psi/ft		0.04070	
dP to +370 ft		3.3	
Pressure at +370 ft datum		730.3	

(188)(1.284) = 241.4

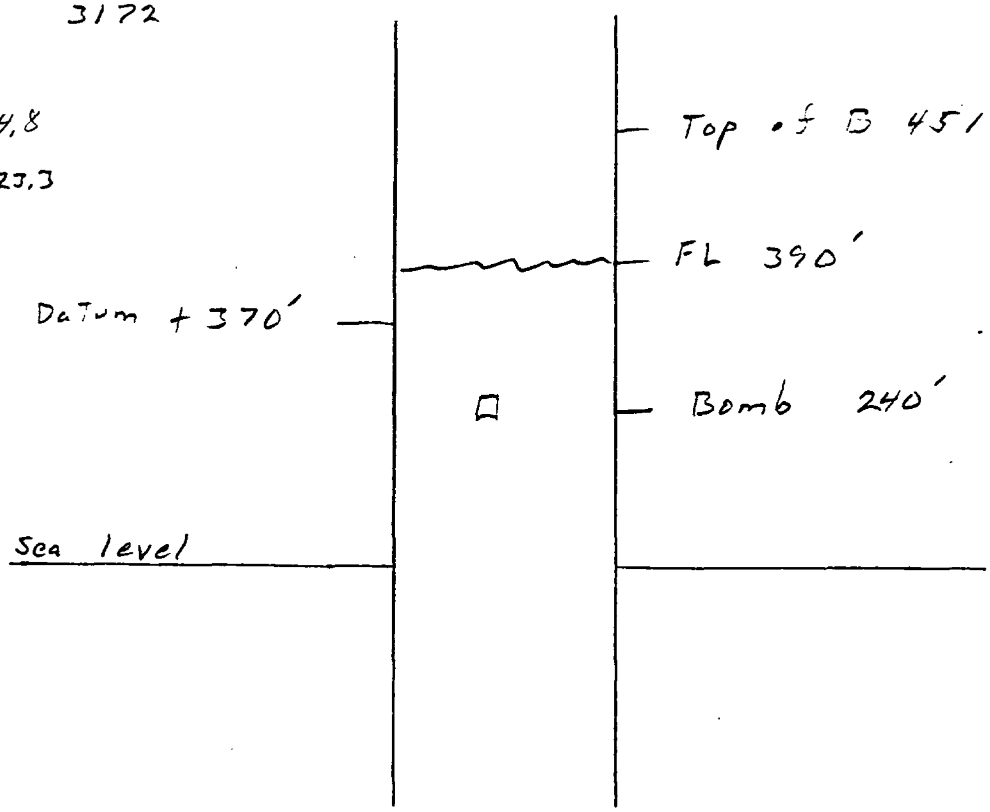
$\left[816 - \frac{(188)(372)}{1000}\right] 3.928$ = 2930.5

3172

(.7241)(241.4) = 174.8

(.04209)(2930.5) = 123.3

ρ_{AV} = .09399 (433)



	KB		Subsea
Operator	Reading & Bates		
Well	Howard Federal 43-15		
Elevation	7269		
Top of B Zone	6799		+ 470
Test Date		6/30/87	
Bomb Depth	6802		+ 467
Bomb Pressure, psig		1045	
Fluid Level	None		
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft		.03	
Pressure at Top of B Zone		1045 - (.03)(2) = 1045	
Top of B Zone to +370 ft		100'	
Production			
BO/D		4.3	
Mcf/D		239	
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		3.5	
Pressure at +370 ft datum		1048.5	

(4.3)(1.327) = 5.7

[239 - (4.3)(466)/1000] 2.62 = 623.8

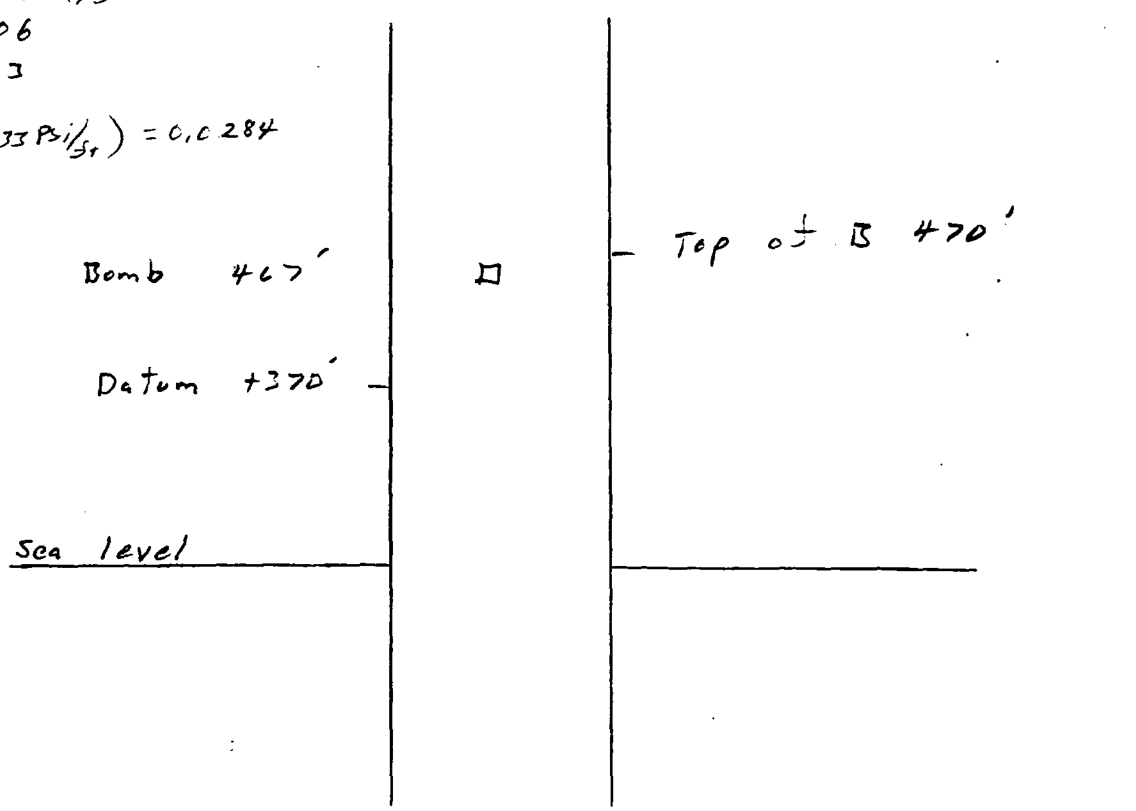
629.5

(.7125)(5.7) = 4.06

(.05978)(623.8) = 37.3

$\rho_A = (.0657\ gm/cc)(0.433\ psi/ft) = 0.0284$

use 0.035 (wet gas)



	KB		Subsea
Operator	Reading + Bates		
Well	Howard Federal #3-15		
Elevation	7269		
Top of B Zone	6799		+470
Test Date		11/19/87	
Bomb Depth	6512		+757
Bomb Pressure, psig		776	
Fluid Level			
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft			
Gas, psi/ft		0.03 (757-470) =	
Pressure at Top of B Zone		776 + 8.6 = 784.6	
Top of B Zone to +370 ft		100	
Production			
BO/D		9.2	
Mcf/D		637	
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		3.5	
Pressure at +370 ft datum		788.1	

(9.2) (1.292) = 11.8

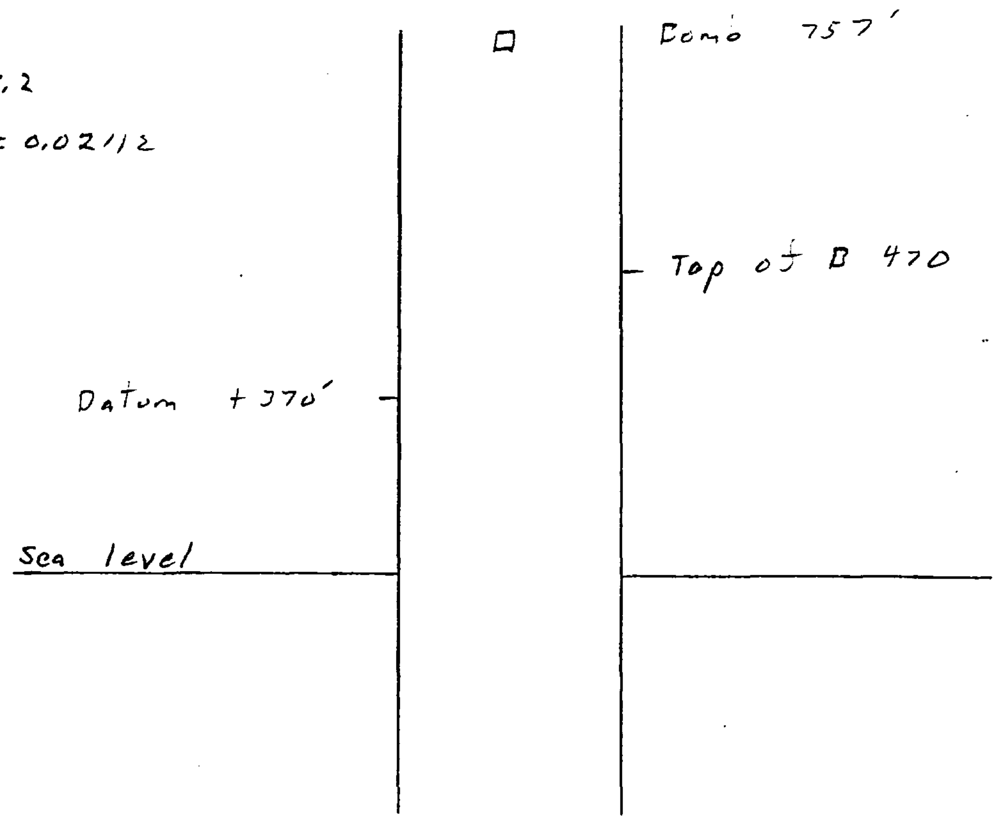
$\left[637 - \frac{(9.2)(390)}{1000}\right] 3.6 = 2280$

(.7218)(11.8) = 8.57

(.04526)(2280) = 103.2

(.437)(0.04877) = 0.02112

use 0.035



	KB	Subsea
Operator	Reading + Bates	
Well	Howard Federal 43-15	
Elevation	7269	
Top of B Zone	6799	+470
Test Date	2/23/88	
Bomb Depth	6512	+757
Bomb Pressure, psig	739	
Fluid Level	None	
~~Distance to Top of B Zone~~		
Wellbore Gradient		
Oil, psi/ft		
Gas, psi/ft	.03 (470 - 757)	
Pressure at Top of B Zone	739 + 8.6 = 747.6	
Top of B Zone to +370 ft	100	
Production		
BO/D	3.6	
Mcf/D	240	
Volume Weighted Reservoir Density, psi/ft	0.035	
dP to +370 ft	3.5	
Pressure at +370 ft datum	751.1	

(3.6) (1.288) = 4.63

$\left[240 - \frac{(3.6)(380)}{1000}\right] 3792 = 904.9$

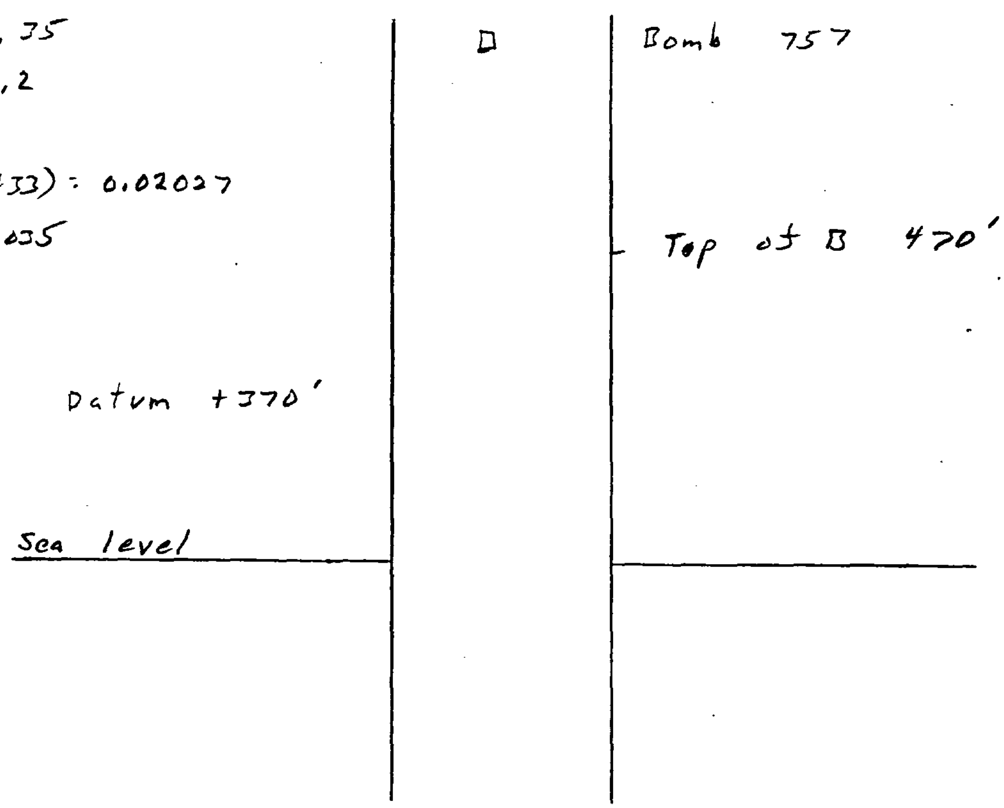
909.5

(.7229)(4.63) = 3.35

(.04334)(904.9) = 39.2

ρ_A = (.04681)(.433) = 0.02027

use wet gas 0.035



	KB		Subsea
Operator	Sun		
Well	Boyt & Lola #1		
Elevation	7351		
Top of B Zone	6848		+ 503
Test Date		6/30/87	
Bomb Depth	7000		+ 351
Bomb Pressure, psig		853	
Fluid Level			+ 363
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft		0.3	
Gas, psi/ft		0.03	
Pressure at Top of B Zone		845	
Top of B Zone to +370 ft (133')			
Production			
BO/D		1.8	
Mcf/D		9.7	
Volume Weighted Reservoir Density, psi/ft		.04210	
dP to +370 ft		5.6	
Pressure at +370 ft datum		850.6	

(0.3)(363-351) = 3.6 } 7.8
(.03)(503-363) = 4.2

853
− 8
845

(1.8)(1.301) = 2.3

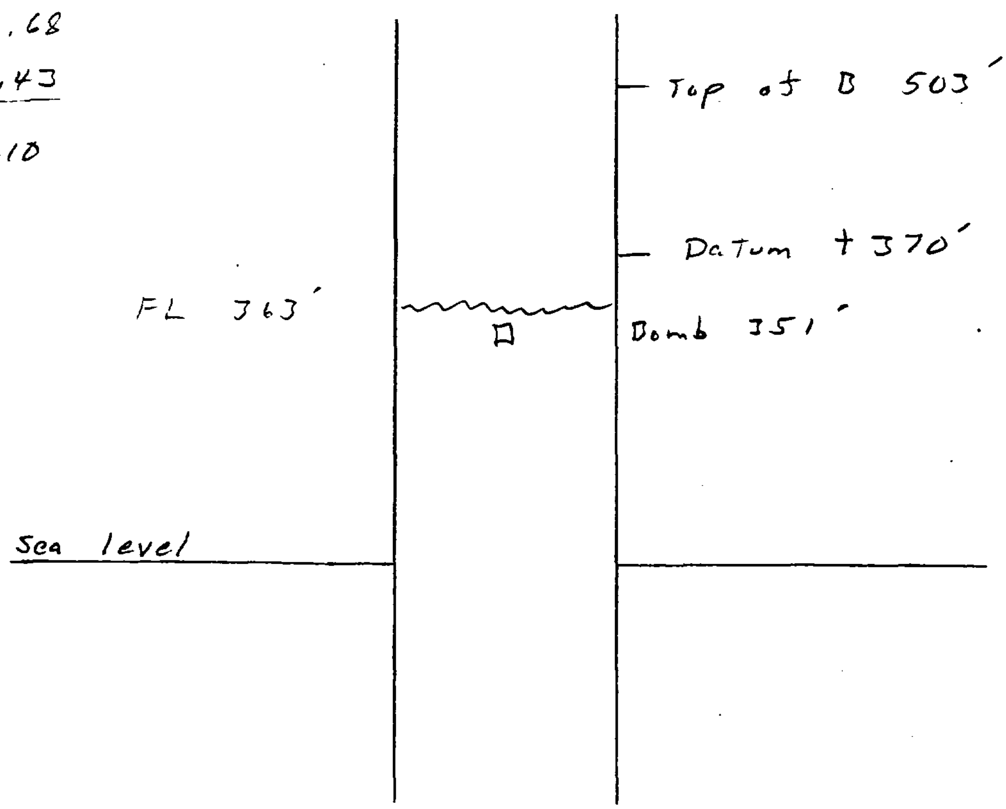
[9.7 − (1.8) 409 / 1000] 3.309 = 29.6

32.03

(.7183) (2.3) = 1.68

(.04848)(29.6) = 1.43

(.433)(.0973) = .04210



Operator	Sun		
Well	Boyt + Lola #1		
	KB		Subsea
Elevation	7351		
Top of B Zone	6848		+503
Test Date		11/19/87	
Bomb Depth	7000		+351
Bomb Pressure, psig		762	
Fluid Level			+571
Distance to Top of B Zone			
Wellbore Gradient			
Oil, psi/ft		.3(503-351) = 45.6	
Gas, psi/ft			
Pressure at Top of B Zone	762 - 46	716.4	
Top of B Zone to +370 ft	133'		
Production			
BO/D		1.8	
Mcf/D		9.7	
Volume Weighted Reservoir Density, psi/ft		0.04241	
dP to +370 ft		5.6	
Pressure at +370 ft datum		722.0	

(1.8) (1.315) = 2.4

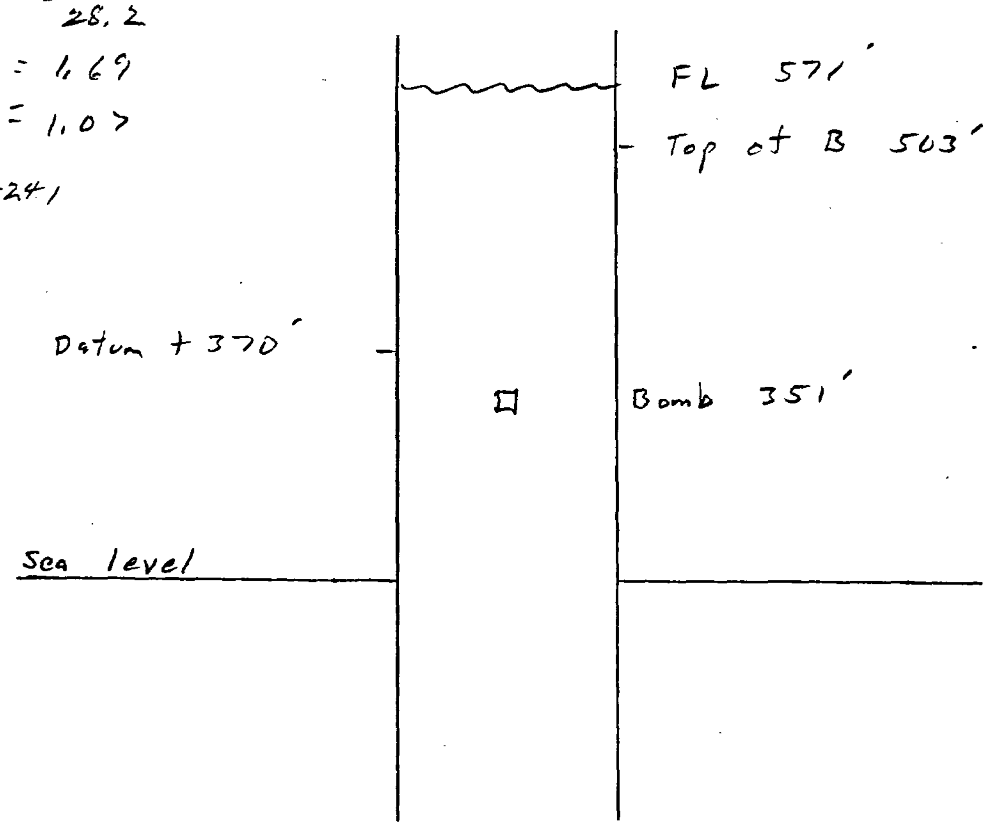
$\left[9.7 - \frac{(1.8)(440)}{1000}\right] 29 = 25.8$

28.2

(.7146) (2.4) = 1.69

(.04155)(25.8) = 1.07

(.433)(.09794) = .04241



	KB		Subsea
Operator	Sun		
Well	Boyt + Lola #1		
Elevation	7351		
Top of B Zone	6848		+503
Test Date		2/23/88	
Bomb Depth	7000		+351
Bomb Pressure, psig		790	
Fluid Level			+561
~~Distance to Top of B Zone~~			
Wellbore Gradient			
Oil, psi/ft		(0.3)(503-351) = 45.6	
Gas, psi/ft			
Pressure at Top of B Zone	790 - 45.6	= 744.4	
Top of B Zone to +370 ft	133'		
Production			
BO/D		1.8	
Mcf/D		9.7	
Volume Weighted Reservoir Density, psi/ft		.03727	
dP to +370 ft		5.0	
Pressure at +370 ft datum		749.4	

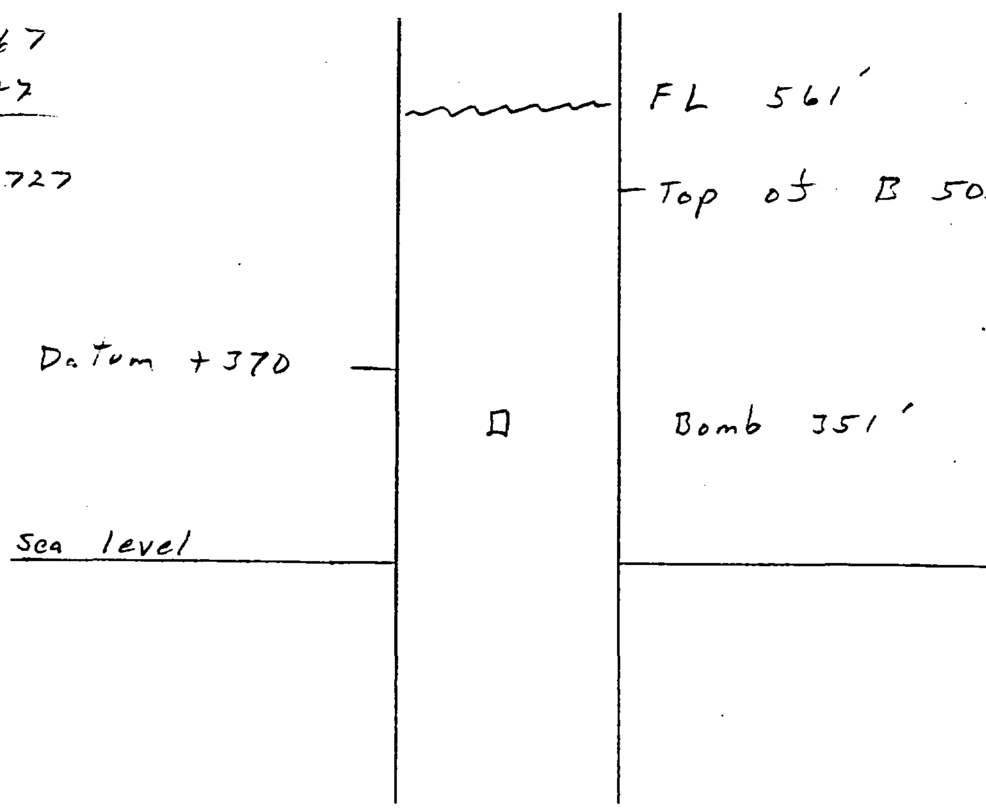
$(1.8)(1.288) = 2.3$

$\left[9.7 - \frac{(1.8)(380)}{1000}\right] 3.792 = 34.2$

$(.7229)(2.3) = 1.67$

$(.04302)(34.2) = 1.47$

$(.433)(.08606) = .03727$



	KB		Subsea
Operator	Sun		
Well	High Adventure #1		
Elevation	7332		
Top of B Zone	7150		+ 182
Test Date		6/30/87	
Bomb Depth	7310		+ 22
Bomb Pressure, psig		1164	
Fluid Level	7102		+ 230
Wellbore Gradient			
Oil, psi/ft	0.3 (182-22)		48
Gas, psi/ft			
Pressure at Top of B Zone	1164-48	= 1116	
Top of B Zone to +370 ft	188'		
Production			
BO/D		225	GOR
Mcf/D		604	2684
Volume Weighted Reservoir Density, psi/ft		.07474	
dP to +370 ft		14.1	
Pressure at +370 ft datum		1101.9	

(225) (1.334) = 300.2

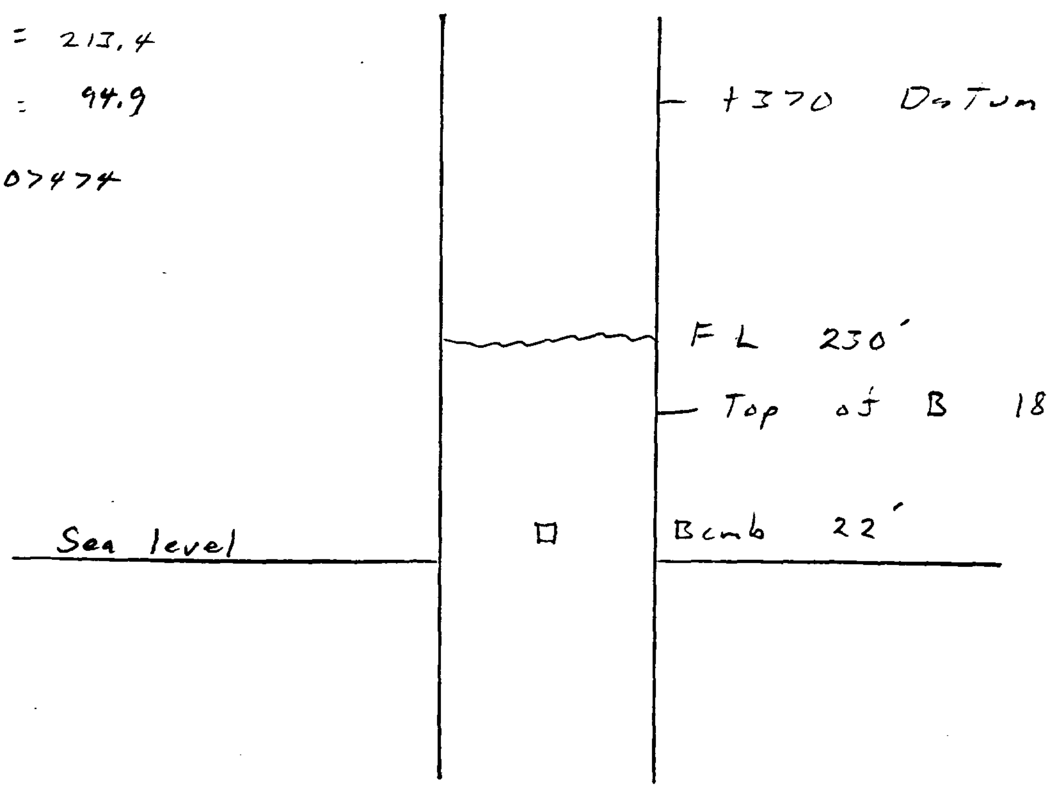
[604 − (225)(482) / 1000] 2.46 = 1485.8

1786

(.7110) (300.2) = 213.4

(.063860) (1485.8) = 94.9

(.433) (.1720) = 0.07474



	KB		Subsea
Operator	Sun		
Well	High Adventure #1		
Elevation	7332		
Top of B Zone	7150		+182
Test Date		11/19/87	
Bomb Depth	7400		-68
Bomb Pressure, psig		911	
Fluid Level			+210'
Wellbore Gradient			
Oil, psi/ft	(.3)(-68-182)		-75
Gas, psi/ft			
Pressure at Top of B Zone		836	
Top of B Zone to +370 ft	188		
Production			
BO/D		228	
Mcf/D		689	
Volume Weighted Reservoir Density, psi/ft		0.05798	
dP to +370 ft		10.9	
Pressure at +370 ft datum		825.1	

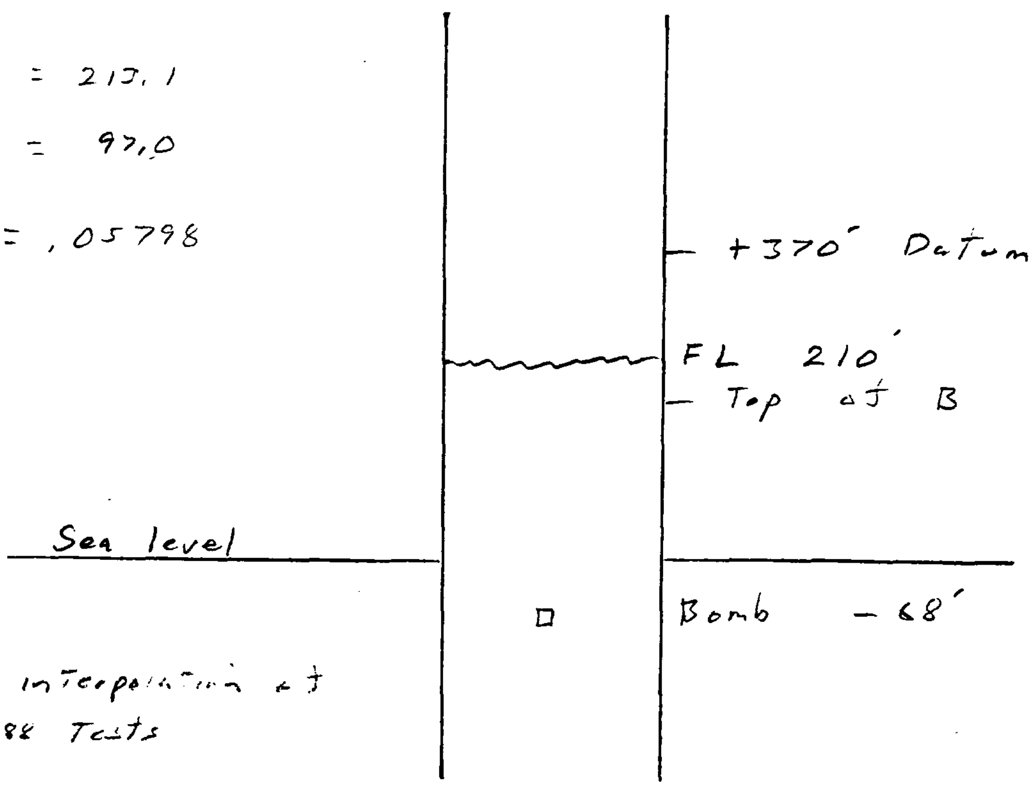
(228)(1.30) = 296.4

[689 − 228(405)/1000] 3.385 = 2019.6

(.719)(296.4) = 213.1

(.04805)(2019.6) = 97.0

(.433)(.1339) = .05798



Fluid level by interpolation at 6/30/87 + 11/19/88 Tests

$$\frac{1116-785}{911-785} = \frac{230-197}{FL_{11/88}-197}$$

FL = 210'

	KB		Subsea
Operator	Sun		
Well	High Adventure #1		
Elevation	7332		
Top of B Zone	7150		+182
Test Date		2/23/88	
Bomb Depth	7400		-68
Bomb Pressure, psig		860	
Fluid Level	7135		+197
Wellbore Gradient			
Oil, psi/ft	(.3)(-68-182)		-75
Gas, psi/ft			
Pressure at Top of B Zone		785	
Top of B Zone to +370 ft	188'		
Production			
BO/D		269	GOR
Mcf/D		584	2171
Volume Weighted Reservoir Density, psi/ft		0.07269	
dP to +370 ft		13.7	
Pressure at +370 ft datum		771.3	

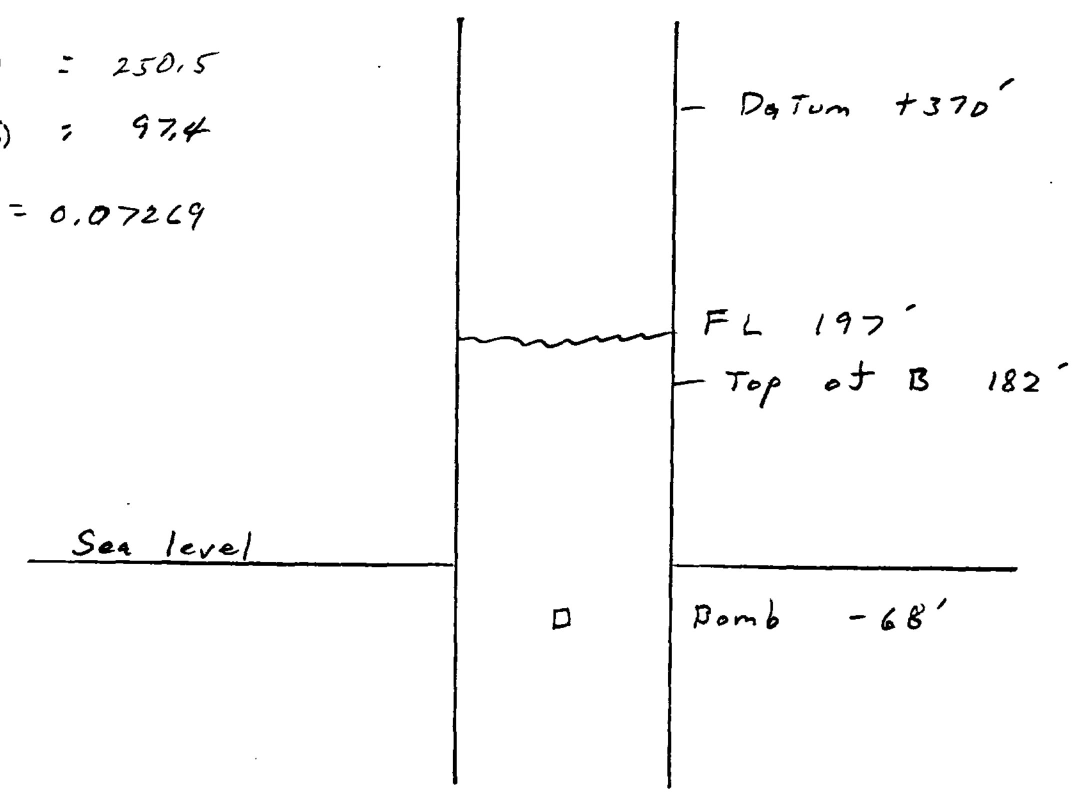
(269)(1.292) = 347.5

$\left[584 - \frac{269(390)}{1000}\right] 3.6 = 1724.7$

(.7210)(347.5) = 250.5

(.05647)(1724.7) = 97.4

(.433)(.11789) = 0.07269



	KB	Subsea
Operator	Sun	
Well	Loddy #1	
Elevation	7167	
Top of B Zone	6927	+ 240
Test Date	6/30/87	
Bomb Depth	7100	+ 67
Bomb Pressure, psig	1140	
Fluid Level	6962	+ 205
Wellbore Gradient		
Oil, psi/ft	(.3)(205-67)	41.4
Gas, psi/ft	(.03)(240-205)	1.1
Pressure at Top of B Zone	1097.5	
Top of B Zone to +370 ft	130'	
Production		
BO/D	61	
Mcf/D	433	
Volume Weighted Reservoir Density, psi/ft	.04819	
dP to +370 ft	6.3	
Pressure at +370 ft datum	1091.2	

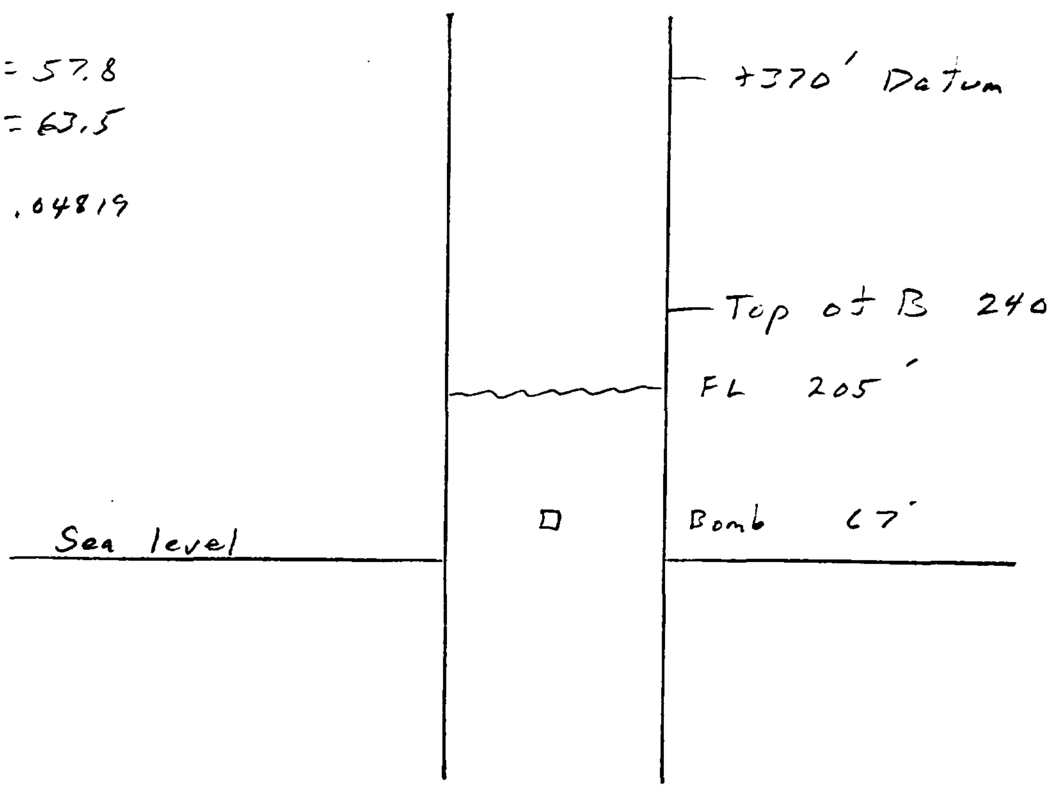
(61) (1.33) = 81.3

$\left[433 - \frac{(61)(480)}{1000}\right] 2.497 = 1008.1$

(.7113) (81.3) = 57.8

(.062944) (1008.1) = 63.5

(.433) (.1113) = .04819



	KB		Subsea
Operator	Sun		
Well	Loddy #1		
Elevation	7167		
Top of B Zone	6927		+240
Test Date		11/19/87	
Bomb Depth	7100		+67
Bomb Pressure, psig		902	
Fluid Level			+182
Wellbore Gradient			
Oil, psi/ft	(.3)(182-67)		34.5
Gas, psi/ft	(.03)(240-182)		1.7
Pressure at Top of B Zone		866.8	
Top of B Zone to +370 ft	130		
Production			
BO/D		58	
Mcf/D		338	
Volume Weighted Reservoir Density, psi/ft		0.4187	
dP to +370 ft		5.4	
Pressure at +370 ft datum		861.4	

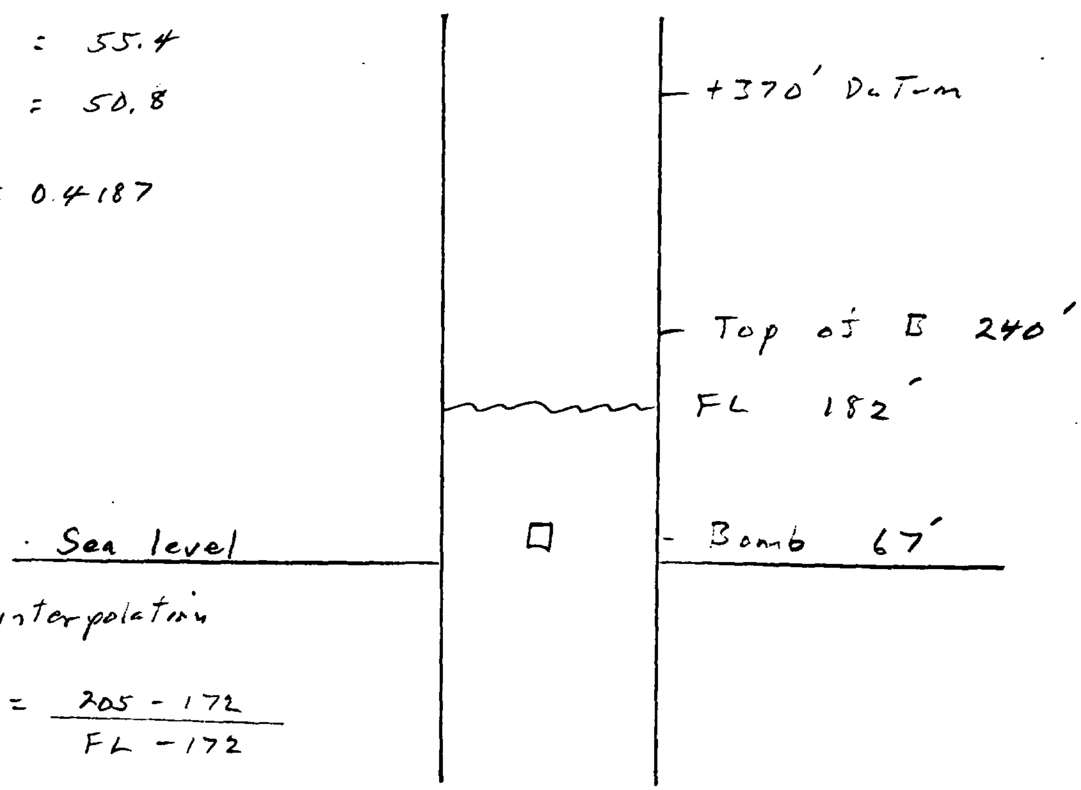
(58)(1.303) = 77.1

$$\left[338 - \frac{(58)(412)}{1000}\right] 3.25 = 1020.8$$

(.7178)(77.1) = 55.4

(.049729)(1020.8) = 50.8

(.433)(.09670) = 0.4187



Fluid level by interpolation

$$\frac{1097.5 - 812.5}{902 - 812.5} = \frac{205 - 172}{FL - 172}$$

FL = 182

	KB		Subsea
Operator	Sun		
Well	Loddy #1		
Elevation	7167		
Top of B Zone	6927		+240
Test Date		2/23/88	
Bomb Depth	7100		+67
Bomb Pressure, psig		846	
Fluid Level			+ 172
Wellbore Gradient			
Oil, psi/ft	(.3)(172-67)		31.5
Gas, psi/ft	(.03)(240-172)		2.04
Pressure at Top of B Zone		812.5	
Top of B Zone to +370 ft	130		
Production			
BO/D		52	
Mcf/D		369	
Volume Weighted Reservoir Density, psi/ft		.03569	
dP to +370 ft		4.6	
Pressure at +370 ft datum		867.8	

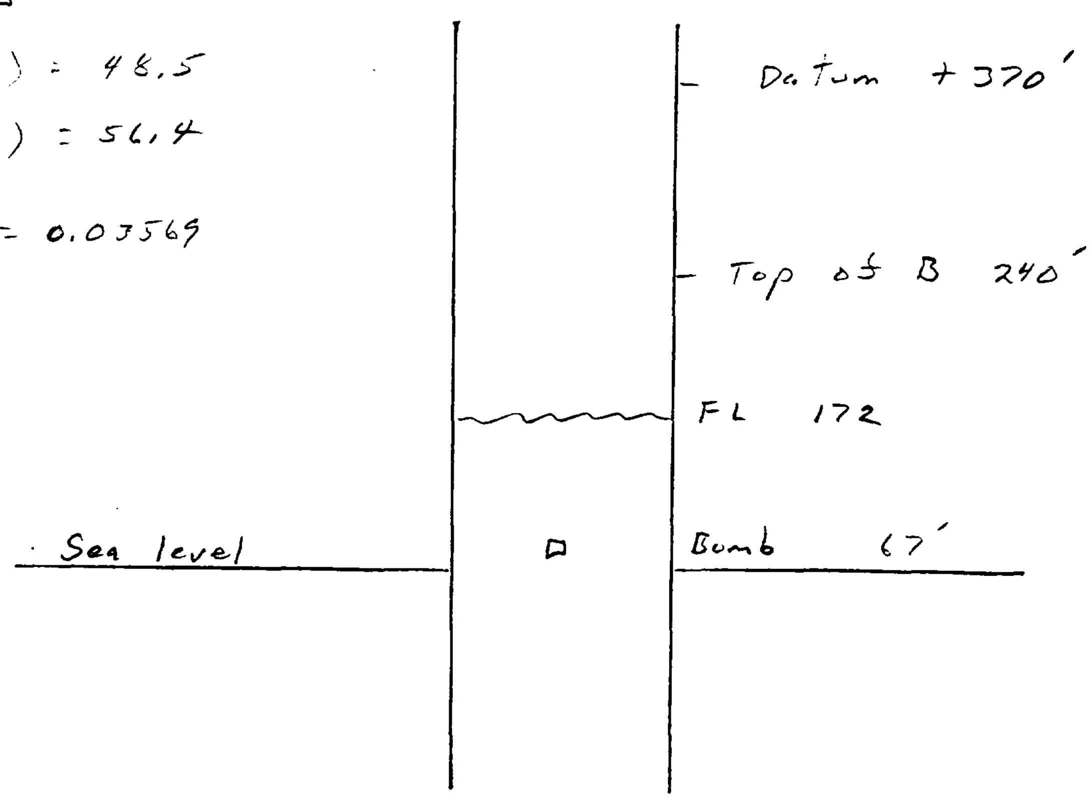
(52)(1.295) = 67.3

[369 - (52)(399)/1000] 3.46 = 1205.0

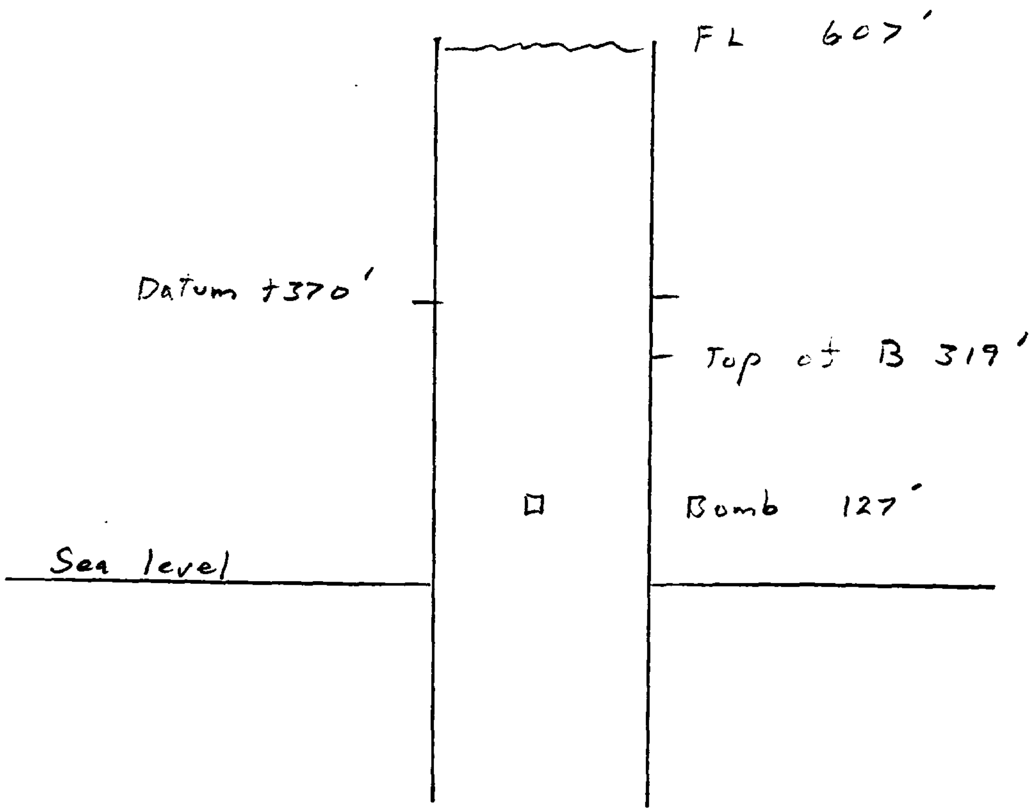
(.7200)(67.3) = 48.5

(.04679)(1205) = 56.4

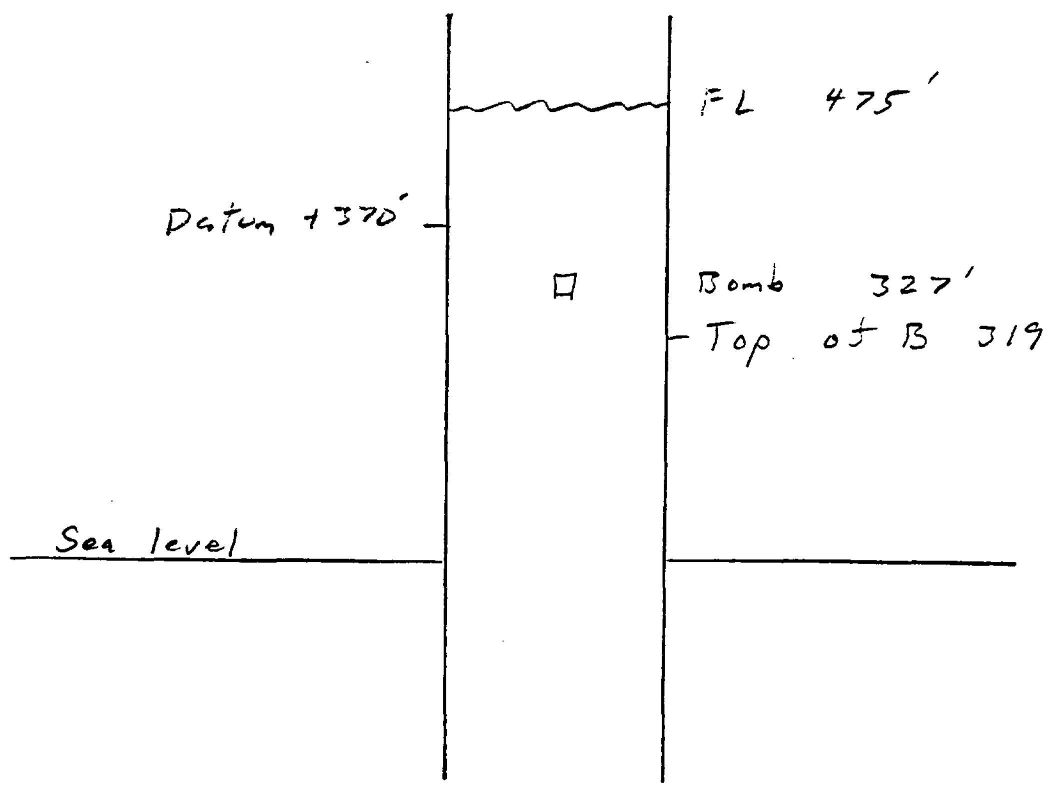
(.433)(0.08243) = 0.03569



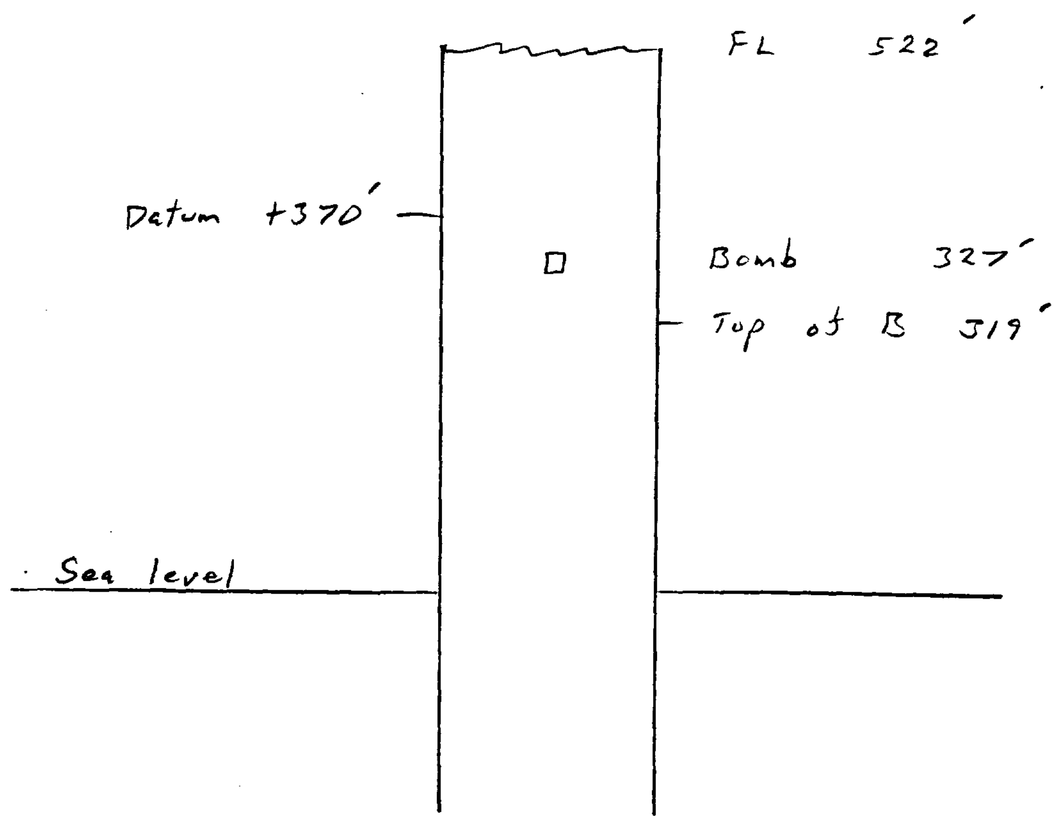
	KB		Subsea
Operator	Sun		
Well	Wildfire #1		
Elevation	7727		
Top of B Zone	7408		+ 319
Test Date		6/30/87	
Bomb Depth	7600		+ 127
Bomb Pressure, psig		1263	
Fluid Level	7120		+ 607
Wellbore Gradient			
Oil, psi/ft	(.3)(319-127)		57.6
Gas, psi/ft			
Pressure at Top of B Zone		1205.4	
Top of B Zone to +370 ft	51		
Production			
BO/D		Not Produced	
Mcf/D			
Volume Weighted Reservoir Density, psi/ft		.035	
dP to +370 ft		1.8	
Pressure at +370 ft datum		1203.6	



	KB		Subsea
Operator	Sun		
Well	Wildfire #1		
Elevation	7727		
Top of B Zone	7408		+319
Test Date		11/19/87	
Bomb Depth	7400		+327
Bomb Pressure, psig		1028	
Fluid Level	7252		+475
Wellbore Gradient			
Oil, psi/ft	(.3)(327-319)		2.4
Gas, psi/ft			
Pressure at Top of B Zone		1030.4	
Top of B Zone to +370 ft	51		
Production			
BO/D		Not Produced	
Mcf/D			
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		1.8	
Pressure at +370 ft datum		1028.6	



	KB		Subsea
Operator	Son		
Well	Wildfire #1		
Elevation	7727		
Top of B Zone	7408		+319
Test Date		2/23/86	
Bomb Depth	7400		+327
Bomb Pressure, psig		972	
Fluid Level	7205		+522
Wellbore Gradient			
Oil, psi/ft	.3(327-319)		2.4
Gas, psi/ft			
Pressure at Top of B Zone		974	
Top of B Zone to +370 ft	51		
Production			
BO/D		NoT Produced	
Mcf/D			
Volume Weighted Reservoir Density, psi/ft		0.035	
dP to +370 ft		1.8	
Pressure at +370 ft datum		972.2	

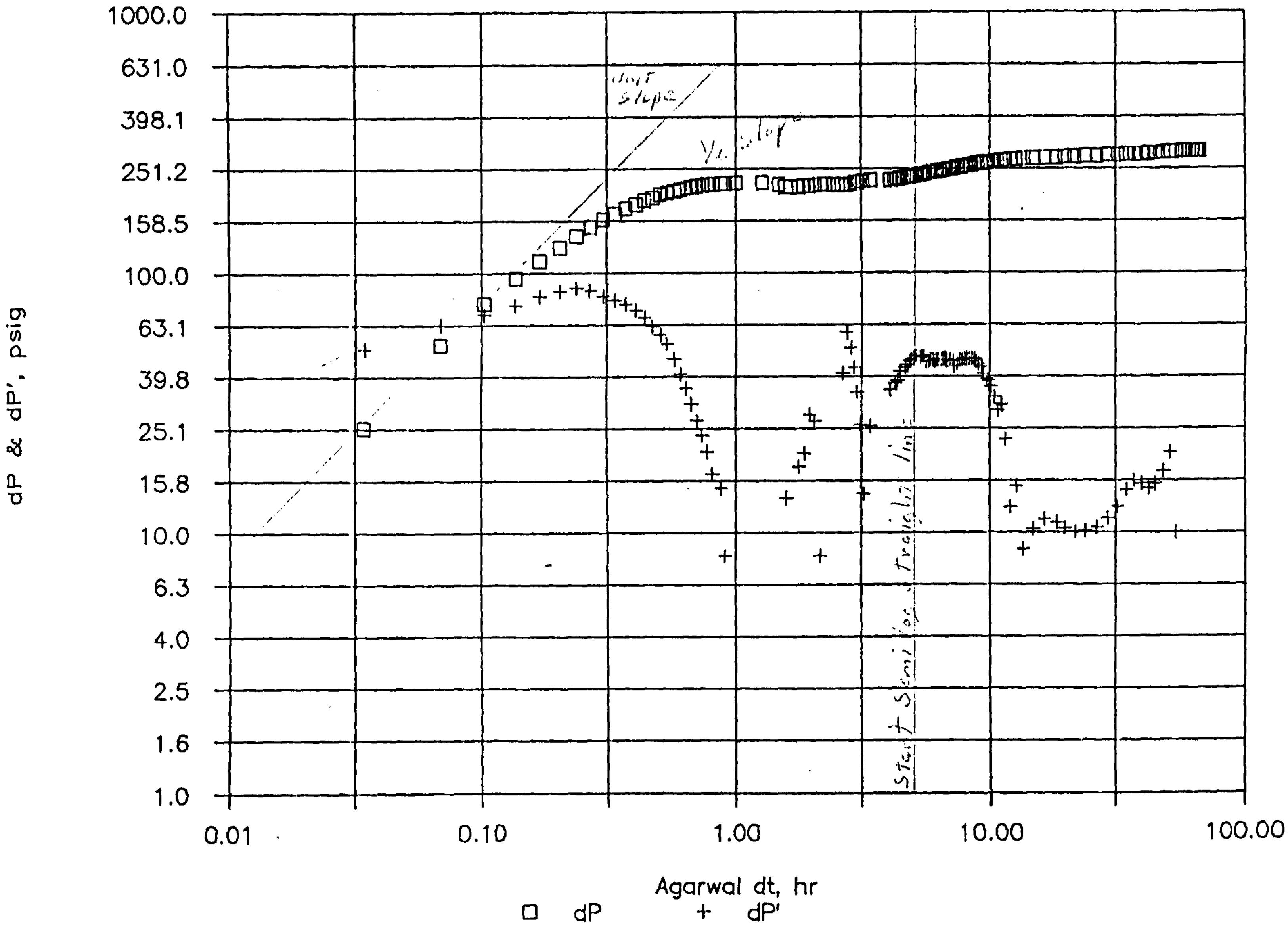


APPENDIX 2

Pressure Buildup Worksheets

Gavilan Dome

BMG #E-6, 11/19/87 Buildup



Gavilan Dome, 11/19/87 Buildup

BMG, E-6, q = 281 B/D GOR = 4300

Initial work,

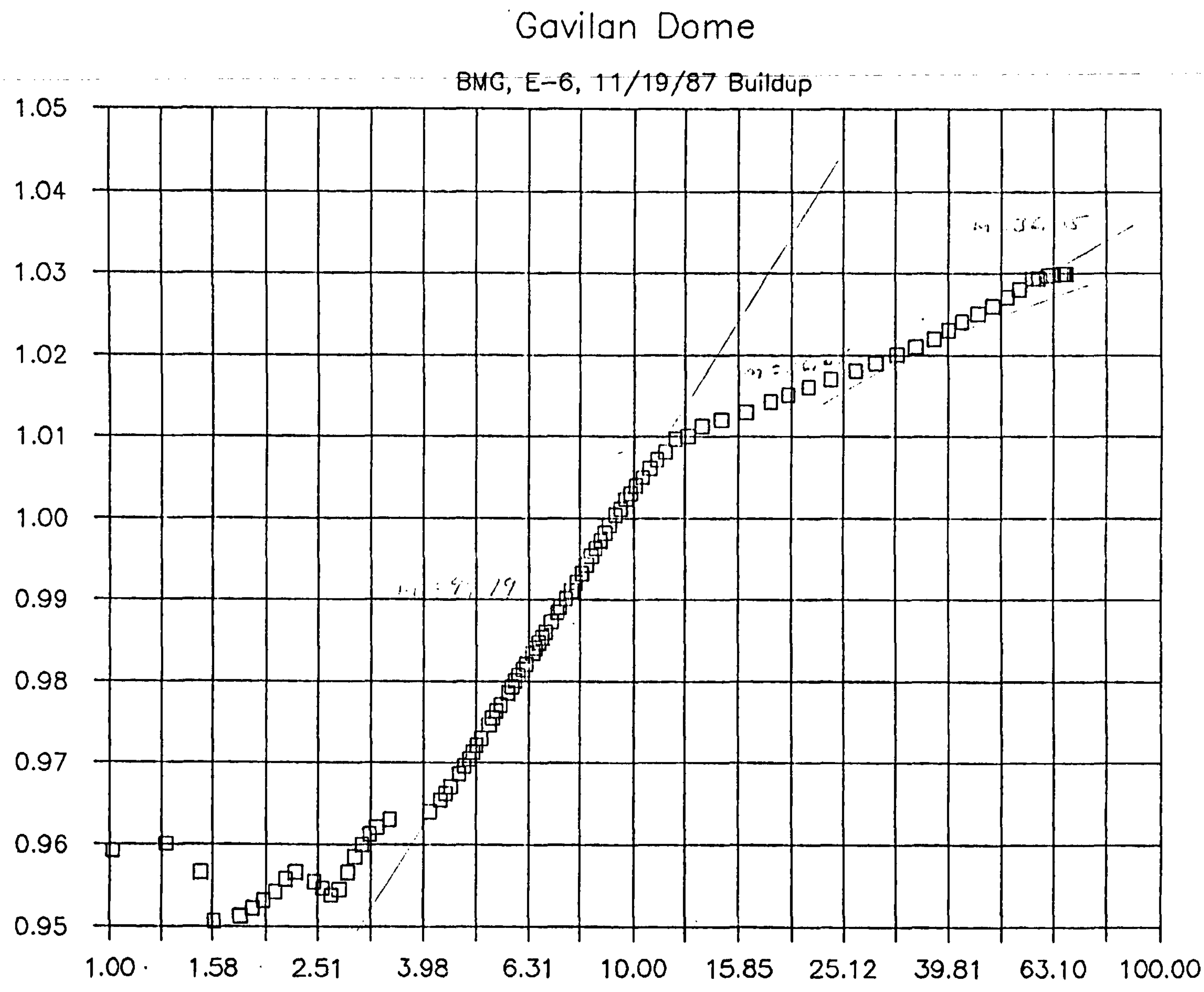
From Standings Correlations

GOR = 4000

B = 11.0

q = 281

m = 36.05



$\frac{Kh}{\mu} = \frac{162.6\, q\, B}{m}$

$\frac{Kh}{\mu} = 13{,}942 \; \frac{md\text{-}ft}{cp}$

Using q_{t} concept

$q_{Rt} = q_o B_o + \left(q_g - \frac{q_o R_s}{1000}\right) B_g + q_w B_w$

$\frac{Kh}{\mu} = 14{,}156$

From Laddy PVT

$B_g = 2.798$ RB/mcf

$B_o = 1.242$

$B_g = 5.04 \times 10^{-3} \frac{TZ}{P}$

R. - ...

q_{Rt} = B ...

11/19/87 Buildups

4/14/88 ①

Initial Work

E-6 q_o = 281 B/D GOR = 4296 q_g = 1207 Mcf/D

Boundry Dominated Flow. Therefore use Flow Regime 1 (doesn't work 4/28)

for analyses m = 99.19 Max pressure = 1030 psig

Transform gas flow rate to RB

$$\left(q_g - \frac{q_o R_s}{1000}\right) B_g$$

where q_g, Mscf/D

R_s; scf/bbl

B_g, RB/Mscf

$$\left[1207 - \frac{(281)(466)}{1000}\right] 2.632 = 2832 \text{ RB/D}$$

Total flowrate = (281)(1.327) + 2832

= 3205 RB/Day

Flow Regime #1

$$\lambda h_t = \frac{(162.6)\, q_{Rt}}{m} = 5254 \frac{md \cdot ft}{cp} \quad (m = 99.19 \text{ psi/cycle})$$

if m = 36.05

last slope

$$\lambda h_t = 14,456 \frac{md \cdot ft}{cp} = \left(14,456 \frac{md \cdot ft}{cp}\right)(.0831\ cp) = 1200 md \cdot ft$$

Average viscosity (1.327)(281 BO/D)(.605) = 255.6 $\frac{RB \cdot cp}{D}$

+ (2832 RB G/D)(.0143) = 40.5 $\frac{RB \cdot cp}{D}$

3204 RB/D 266.1 $\frac{RB \cdot cp}{D}$

$$\frac{266.1 \frac{RB \cdot cp}{D}}{3204 \text{ RB}} = 0.0831\ cp$$

Average Rate, STB/D

(1,076)(2.632) = 2832 STB/D

+ 281 (1.327) = 373 STB/D

3205 STB/D

Average FVF $\frac{3205}{}$ = ...

doesn't work with m = 99.19 psi/cy

$$Kh_{absolut} = \left(5254 \frac{md \cdot ft}{cp}\right)(.0831\ cp) = ~~1200~~\ 437\ md \cdot ft$$

$$K_o h = \frac{(162.6)(281)(1.327)(.605)}{36.05} = 1018\ md \cdot ft$$

$$K_g h = \frac{(162.6)(2832)(\ \ \ \ )(0.0143)}{36.05} = 783\ md \cdot ft$$

BMG E-6 11/19/87 Buildup Last effort 4/15/66 (3)

10 hr → 55 hr Agarwal Time (Averaged slope)

cc = 99.5%, Intercept = 977.9 psig slope = <u>28.44</u>

$$\frac{Kh}{\mu}_{absolute} = \frac{162.6\, q_{R} t}{m} = \frac{(162.6)(3205)}{28.44} = 18324 \frac{md \cdot ft}{cp}$$

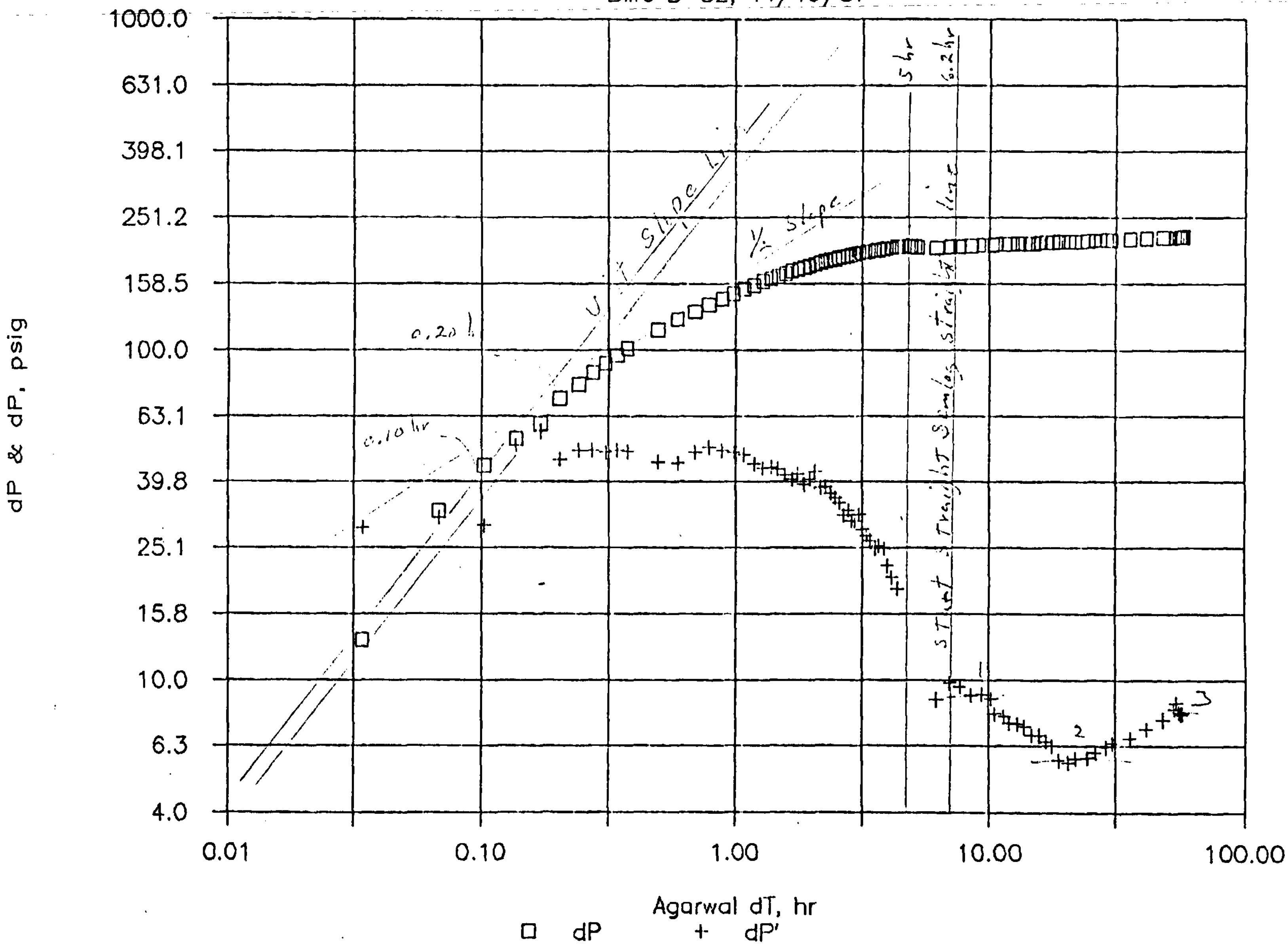
$$Kh_{absolute} = \left(18324 \frac{md \cdot ft}{cp}\right)(0.0831\ cp) = 1523\ md \cdot ft$$

$$K_o h = \frac{(162.6)(281)(1.327)(.605)}{28.44} = 1290\ md \cdot ft$$

$$K_g h = \frac{(162.6)(2832)(0.0143)}{28.44} = 232\ md \cdot ft$$

Gavilan Dome, Buildup

BMG B-32, 11/19/87

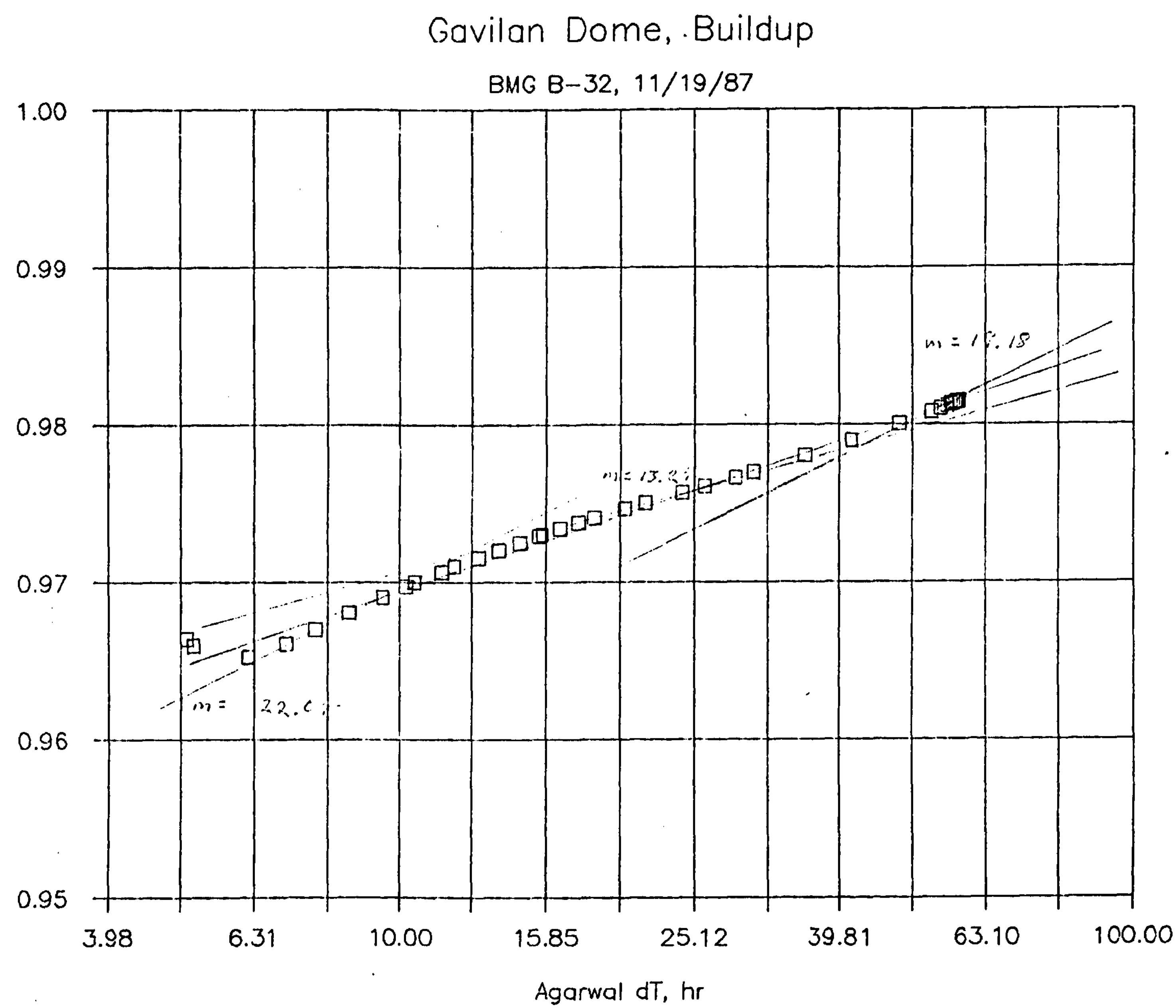


From Loddy #1
PVT data @ 1000 psig
GOR = 1200
B = 1.242
q = 719 BOPD
m = 19.18

$\frac{kh}{\mu} = \frac{162.6\ q\ B}{m}$

$\frac{kh}{\mu}$ = 7570 md·ft/cp

Gavilan Dome, Buildup



BMG B-32 4/26/82

11/19/81 Buildup

q_o = 719 BOPD GOR = 1,242

q_g = 893 Mcf/D Max pressure 955 psi

B_o = 1.314 B_g = 2.932 μ_o = 0.635 μ_g = 0.01403 R_s = 437

ρ_o = .7148 ρ_g = .000891

q_o, RB = (719)(1.314) = 944.5 RB/D

(579 bbl/D equivalent)

q_g, RB = $\left[893 - \frac{(719)(437)}{1000}\right]$ 2.932 = 1697 RB/D

q_t = q_o + q_g = 2642 RB/D

Volume average viscosity + density

(944.8)(0.635) = 599.9
(1697)(0.01403) = 23.8
623.8

$\mu_{Average}$ = 0.2361 cp

(944.8)(0.7148) = 675.3
(1697)(.000891) = 1.5
676.9

$\rho_{Average}$ = 0.2562 gm/cc

$\frac{0.2562}{1} = \frac{X}{0.433 \text{ psi/ft}}$

Reservoir gradient, X = 0.110 Psi/ft

$\frac{K_t h}{\mu} = \frac{(162.6)(2642 \text{ RB/D})}{19.8}$ = 21,696 $\frac{\text{md}\cdot\text{ft}}{\text{cp}}$, Kh = 5123 md·ft
K = 34.2 md

h ≈ 150

$K_o h = \frac{(162.6)(944.8)(.635)}{19.8}$ = 4927 md·ft

$K_g h = \frac{(162.6)(1697)(0.01403)}{19.8}$ = 196 md·ft

Mallon 7/29/88

Fisher Federal 2-1

11/19/87 Buildup $m = 69.0$ $q_o = 39.8$ $q_g = 347.47$

$\bar{P}$ 978 $B_o = 1.317$ $B_g = 2.55$ $\mu_o = 0.628$ $\mu_g = 0.01409$ $R_s = 444$

$q_o, RB = (39.8)(1.317) = 52.4166$

$q_g, RB = \left[347.47 - \frac{(39.8)(444)}{1000}\right] 2.55 = 939.9$

$q_t, RB = 992.3\ RB/D$

$(52.4)(.628) =$

$(939.9)(.01409) =$

46.15

$\mu_{Average} = 0.0465\ cp$

$\lambda_t h = \frac{(162.6)(992.3)}{m} = 2338\ \frac{md \cdot ft}{cp}$

$Kh = 109\ md$

2/23/88 Buildup $m = 87$ $q_o = 98$ $q_g = 1013$

$\bar{P} \sim 925$ $B_o = 1.310$ $B_g = 3.015$ $\mu_o = 0.643$ $\mu_g\ 0.01396$ $R_s = 430$

$q_o = (1.310)(98) = 128.4\ RB/D$

$q_g = \left[1013 - \frac{(98)(430)}{1000}\right] 3.015 = 2927.1$ "

3055

$q_t = 3055\ RB/D$

$\lambda_t h = \frac{(162.6)(3055)}{87}$

$(128.4)(.643) = 82.56$

$(2927.1)(0.01396) = 40.86$

123.42

$\lambda_t h = 5710\ \frac{md \cdot ft}{cp}$

$\mu_{Average} : 0.0404$

$\bar{K}h = 231\ md \cdot ft$

$K_o h = \frac{(128.4)(.643)(162.6)}{87} = 154$

$K_g h = \frac{(2927.1)(.01396)(162.6)}{87} = 76.4$

Meridian
Hill Federal 2-7

6/30 ?? Buildup

m = 108.4 q_o = 107.2 q_g = 327.0 $\bar{P}$ = 1111

B_o = 1.334 B_g = 2.477 μ_o = .588 μ_g = 0.01442 R_s = 482

$$q_o = (107.2)(1.334) = 143.0$$

$$q_g = \left[\left(327 - \frac{(107.2)(482)}{1000}\right)\right]2.477 = 682$$

825 RB/D

(143)(.588) = 84
(682)(0.01442) = 9.8
93.92

$$\lambda_t h = \frac{(162.6)(825)}{108.4} = 1237.5 \frac{md}{cp}$$

$\mu_{Average}$ = 0.1138

$\bar{k} h$ = 141 md

$$k_o h = \frac{(162.6)(143)(.588)}{108.4} = 126$$

$$k_g h = \frac{(162.6)(682)(.01442)}{108.4} = 15$$

Meridian
Hill Federal #1

11/19/97 Buildup

$m = 168.9$ $q_{bo} = 24$ $q_g = (820)(3)$ $\bar{P} = 943$

$B_o = 1.312$ $B_g = 2.965$ $\mu_g = 0.01401$ $\mu_o = .637$ $R_s = 435$

$q_{bo} = (24)(1.312) = 31.5$

$q_{bg} = \left[(820)(3) - \frac{(24)(435)}{1000}\right] 2.965 = 7262.9$

$q_{bt} =$ 7294 RB/D

$(31.5)(0.637) = 20.06$

$(7262.9)(.01401) = 101.75$

121.81

Average μ = 0.01670

$$\lambda_t h = \frac{(162.6)(7294)}{168.9} = 7022 \frac{md \cdot ft}{cp}$$

$\bar{k} h = 117.3$ md·ft

$$k_o h = \frac{(162.6)(20.06)(.637)}{168.9} = 12.3$$

$$k_g h = \frac{(162.6)\,7262.9\,(.01401)}{168.9} = 98.0$$

Bear Cat #1

6/30/87 Buildup

4/24

q_o = 47.11 BO/D

q_g = 268.95 Mcf/D

h = 95' (perforated)

Max BHP 1052 psig

P_{1hr} = 950.2 psig

m = 46.36 psig/cycle

B_o = 1.327

B_g = 2.632

μ_o = .605

μ_g = .0142

R_s = 466

q_o, RB = (47.11)(1.327) = 62.5 RB/D

q_g, RB = $\left[268.95 - \frac{(47.11)(466)}{1000}\right]$ 2.632 = 650.1 RB/D

$q_t = q_o + q_g$ = 712.6 RB/D

Volume average viscosity

(62.5)(0.605) = 37.8

(650.1)(0.01428) = 9.28

47.1

$\frac{47.1}{712.6}$ = 0.06610 cp

$\lambda_t h = \frac{162.6\ q_t}{m} = \frac{(162.6)(712.6)}{46.36}$ = 2499 $\frac{md \cdot ft}{cp}$

$k_o h = \frac{162.6\ q_o B_o \mu_o}{m} = \frac{(162.6)(62.5)(.605)}{46.36}$ = 132.6 md·ft

$k_g h = \frac{162.6\ q_g (RB) \mu_g}{m} = \frac{(162.6)(650.1)(0.01428)}{46.36}$ = 32.6 md·ft

$Kh_{Absolute}$ = $\left(2499\ \frac{md \cdot ft}{cp}\right)$(0.0661 cp) = 165.2 md·ft

$K_{Absolute}$ = 1.8 md

end of storage at .035 hr

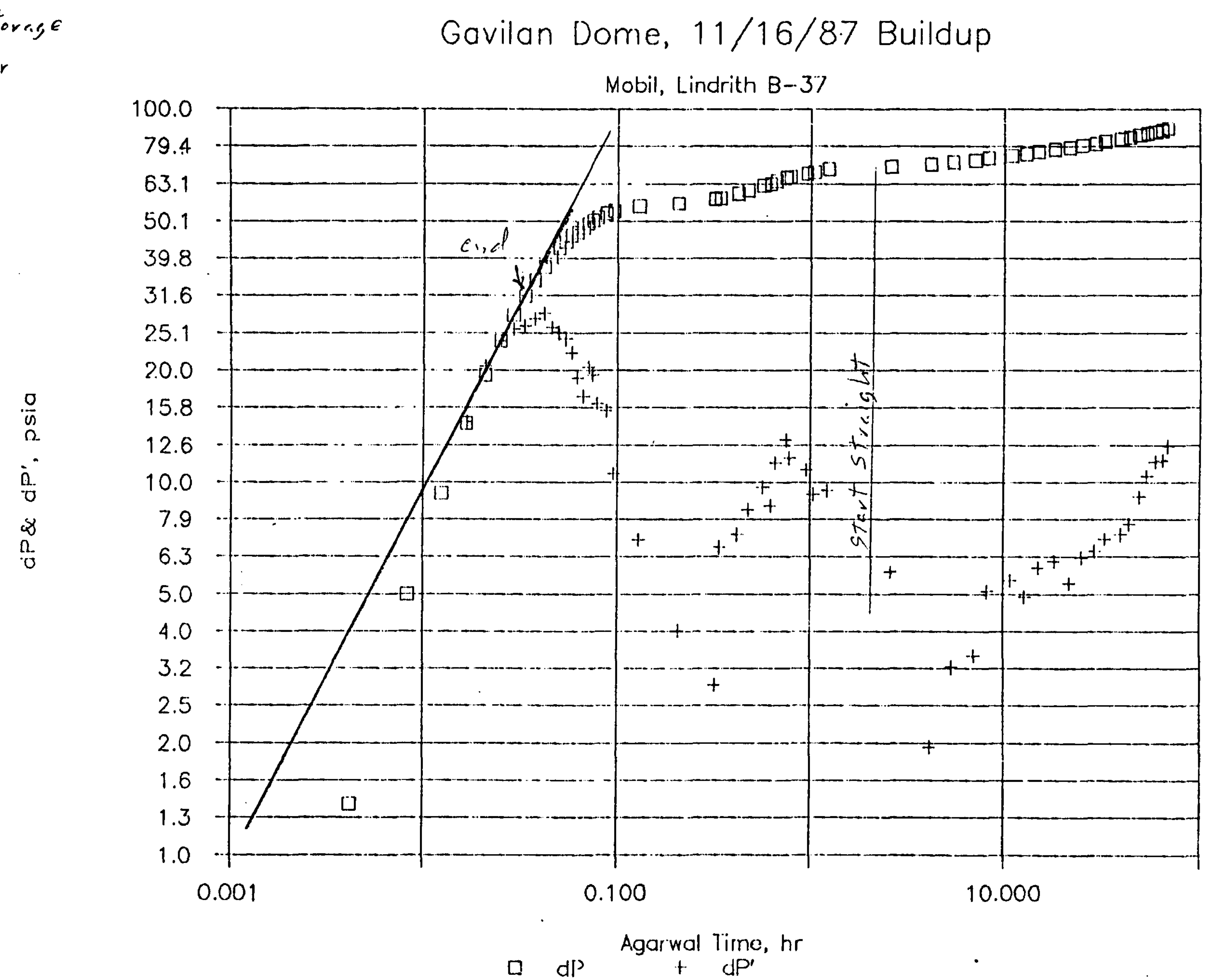


Fig 1

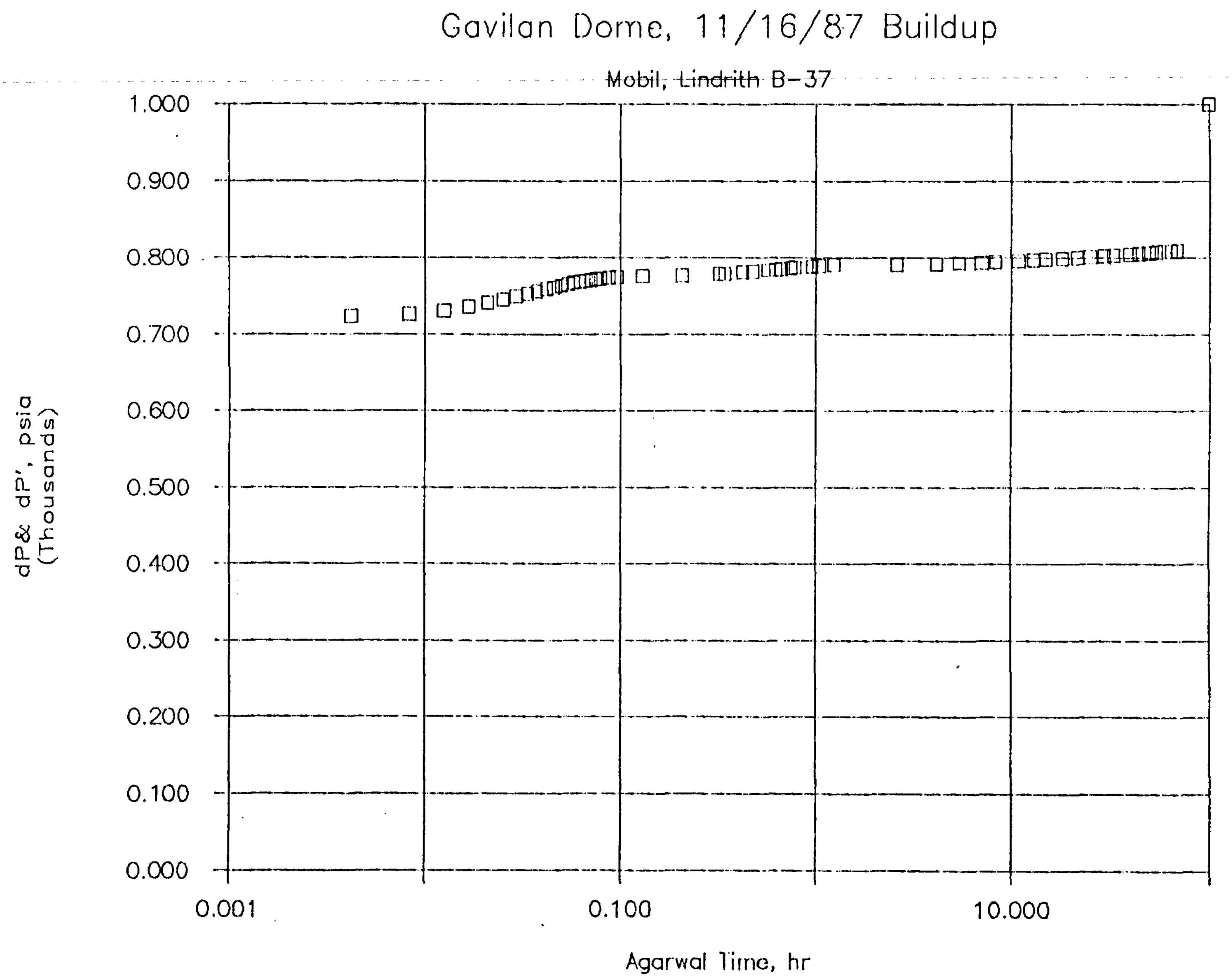

Gavilan Dome, 11/16/87 Buildup
Mobil, Lindrith B-37
dP& dP', psia
(Thousands)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.001
0.100
10.000
Agarwal Time, hr

Fig 2

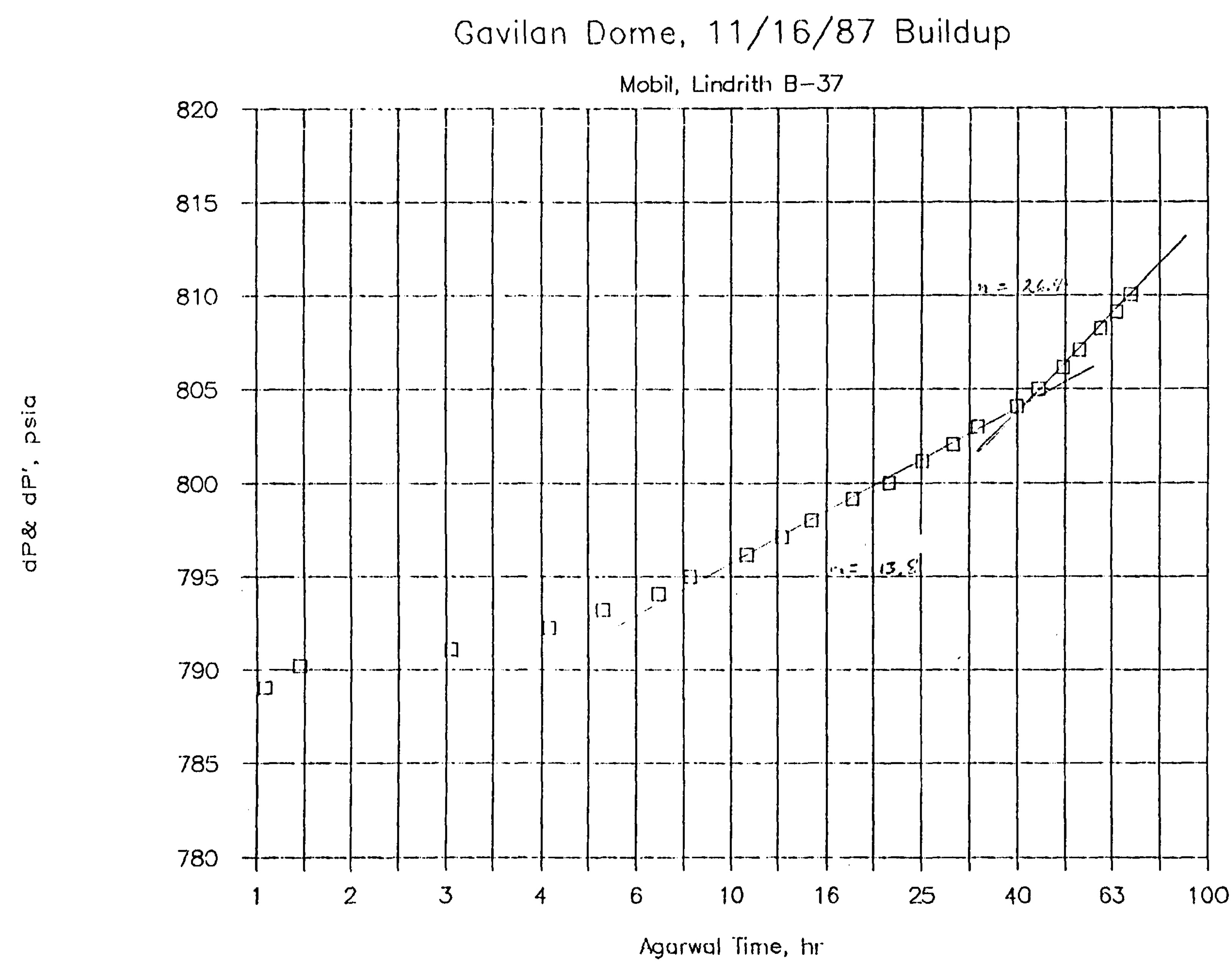

Gavilan Dome, 11/16/87 Buildup
Mobil, Lindrith B-37
820
815
810
805
800
795
790
785
780
dP& dP', psia
1
2
3
4
6
10
16
25
40
63
100
Agarwal Time, hr

Fig 3

Mobil Lindrith "B" Unit
Well #37
11/16/87 Buildup

Max Pressure 810 psig   Loddy PVT Data

Rates 221.2 BOPD, 889.1 Mcf/D   GOR = 3907 scf/bbl

m = 26.4 psig/cycle   h = 233 ft

Flow Rates, Reservoir bbl

gas $\left[889.1 - \frac{221.2(400)}{1000}\right] 3.5 = 2802$ RB/D

oil $(221.2)(1.295) = 286$ RB/D

$q_t = 3088$ RB/D

$\lambda h_t = \frac{(162.6)(3088)}{26.4} = 19{,}022 \ \frac{md \cdot ft}{cp}$

Average viscosity

$(2802)(.0136) = 38.11$
$(286)(.705) = 201.63$
239.7

$\frac{239.7 \text{ RB} \cdot cp}{3088 \text{ RB}} = 0.0776 \ cp$

$\left(\frac{Kh}{\mu}\right)_{absolute} = 19{,}022 \ \frac{md \cdot ft}{cp}$ or $1477 \ md \cdot ft$ (6.3 md)

$K_o h = \frac{(162.6)(286)(.705)}{26.4} = 1242 \ md \cdot ft$ (5.3 md

$K_g h = \frac{(162.6)(2802)(0.0136)}{26.4} = 235 \ md \cdot ft$ (1.0 m

Skin estimate

$$S = 1.151\left[\frac{761.4 - 721.2}{26.4} - \log\frac{6.3}{(.001)(1.265\times10^{-3})(.0776)(.229^2)} + 3.23\right]$$

(C1) (C2)

$S = -5$

Then from type curve for wells with storage + skin at $S = -5$

$$P_D = \frac{(1477)(87)}{(141.2)(3088)(0.776)} = 3.80 \qquad \frac{\Delta P\, k h}{141.2\, q B \mu} = 1$$

at $\Delta P = 87$ psig $\Delta t = 59{,}523$

From Type curve at $P_D = 3.8$ & $S = -5$ $t_D = 1.9\times10^{7}$

$$\phi = \frac{(2.637\times10^{-4})(6.3)(59{,}523)}{(1.9\times10^{7})(0.0776)(1.265\times10^{-3})(.229^2)} \qquad t_D = \frac{2.637\times10^{-4}\, k t}{\phi \mu c_t r_w^2}$$

$\phi = 10.11\times10^{-2}$

$\phi h = 0.236$

$$k_m = \frac{(532.3)(1.011\times10^{-3})(1.265\times10^{-3})(233^2)(0.0776)}{41.6}$$

$k_m = 0.069$ md

$$\lambda' = 12\left(\frac{.069}{6.3}\right)\left(\frac{0.229^2}{233^2}\right) = 1.27\times10^{-7}$$

$$\phi_f c_f h_f = 8.33\times10^{-4}\left[\frac{(1477)(1.011\times10^{-3})(1.265\times10^{-3})(233)(1.27\times10^{-7})(12.833)}{(0.0776)(.229^2)}\right]^{1/2}$$

$\phi_f c_f h_f = 1.106\times10^{-5}$ $\phi_f = \frac{1.106\times10^{-5}}{(\ldots\times10^{-3})(\ldots)} = 3.75\times10^{-5}$

$$\omega' = \frac{\phi_m}{\phi_f} = \frac{1.011 \times 10^{-3}}{3.75 \times 10^{-5}} = 27$$

or ~ 3.7% of total porosity is in fractures

Mesa B-37 11/16/87 Buildup

Dual Porosity Effect with 50' h (6685-6735) ①

"B" Zone only producing zone

Mike Stallworth 6/2/88

$\phi = 0.019$, $K = 0.39$ md } Mat

$\phi h = 0.95$

slope = 26.4 psi/cy

① $$\lambda h_t = \frac{(162.6)(3088)}{26.4} = 19{,}022 \frac{md \cdot ft}{cp}$$

weighted average viscosity 0.0776 cp

$Kh_t = 1477$ md·ft

$h = 50'$

$K = 29.5$ md

$$K_o h = \frac{(162.6)(286)(.705)}{26.4} = 1242 \text{ md·ft}$$

$$K_g h = \frac{(162.6)(2802)(.0136)}{26.4} = 235 \text{ md·ft}$$

② Skin estimate with ϕ from Lindrith B-38 Top 50' of "B"

$$S = 1.151\left[\frac{761.4 - 721.2}{26.4} - \log\frac{29.5}{(.019)(1.265\times10^{-3})(.0776)(.229^2)} + 3.23\right]$$

$S = -4.2$

③ Composit ϕh from Ramey type curve with storage + skin

at 59.5 hr $\Delta P = 87$ psig

at $P_D = 3.8$ on Ramey Curve

$t_D = 9\times10^6$

$$P_D = \frac{(19022)(27)}{(1412)(3088)} = 3.8$$

$$\phi = \frac{(2.637\times10^{-4})(29.5)(59.5)}{(9.0\times10^6)(.0776)(1.265\times10^{-3})(.229^2)}$$

$\phi = 0.00999$ or 0.01 fair agreement with B-38 core

④ $K_m = \dfrac{(532.3)(.019)(1.265\times10^{-3})(50^2)(0.0776)}{41.6}$

$K_m = 0.05966 = 0.06$ md (B-38 core is 0.04 md)

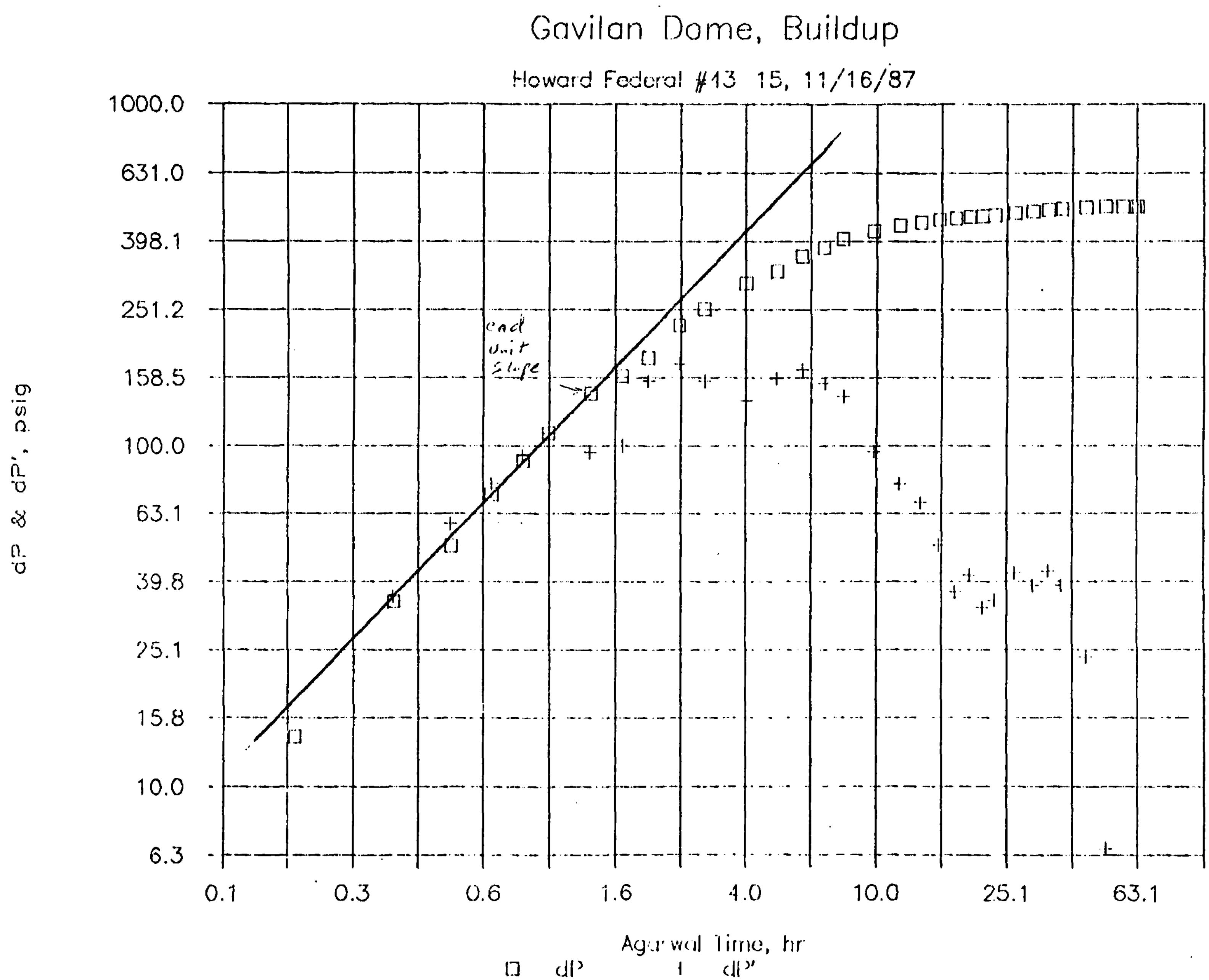
⑤ $\lambda' = 12\left(\dfrac{.06}{29.5}\right)\left(\dfrac{.229^2}{50^2}\right) = 5.12\times10^{-7}$

⑥ $\phi_f c_f h_f = 8.33\times10^{-4}\left[\dfrac{(1477)(.019)(1.265\times10^{-3})(50)(5.12\times10^{-7})(12{,}833)}{(0.0776)(.229^2)}\right]^{1/2}$

$\phi_f c_f h_f = 4.46\times10^{-5}$

$\phi_f = \dfrac{4.46\times10^{-5}}{(1.265\times10^{-3})(50)} = 7.05\times10^{-4}$

⑦ $\omega' = \dfrac{\phi_m}{\phi_f} = \dfrac{0.019}{7.05\times10^{-4}} = 26.9$

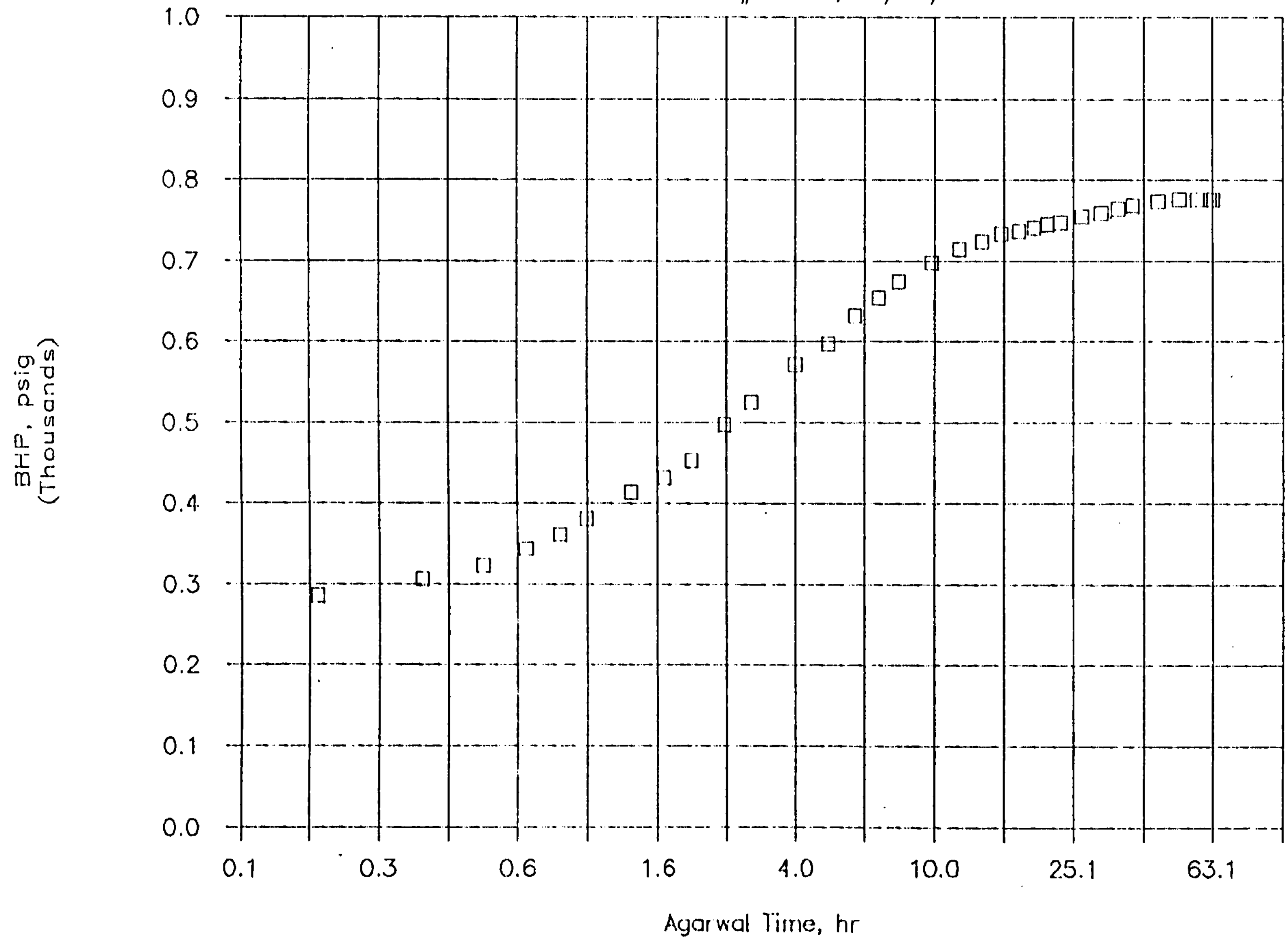


Gavilan Dome, Buildup
Howard Federal #13 15, 11/16/87
1000.0
631.0
398.1
251.2
158.5
100.0
63.1
39.8
25.1
15.8
10.0
6.3
dP & dP', psig
0.1
0.3
0.6
1.6
4.0
10.0
25.1
63.1
Agarwal Time, hr
dP
dP'
end unit slope

Fig 1

Gavilan Dome, Buildup

Howard Federal #43-15, 11/16/87



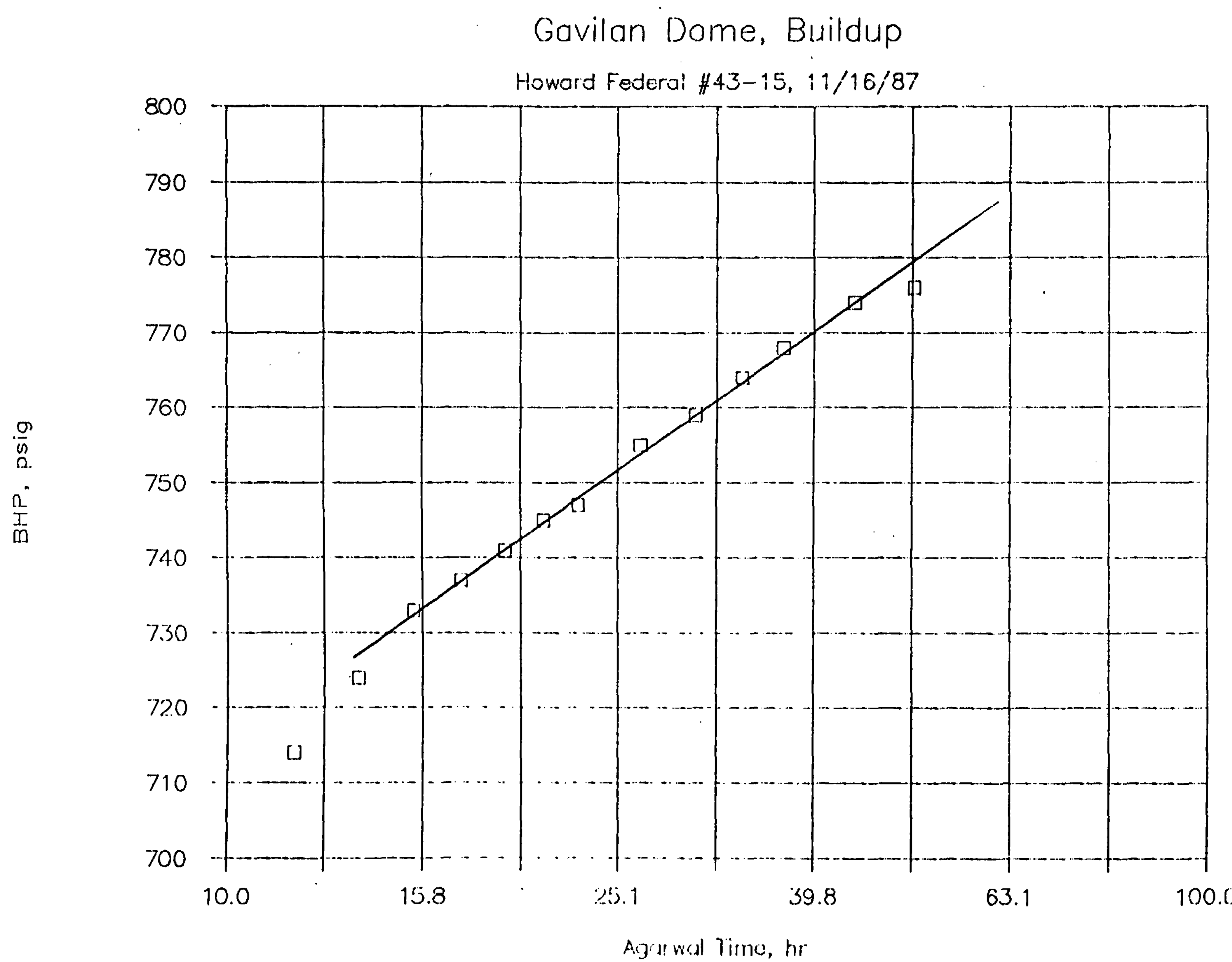

Gavilan Dome, Buildup
Howard Federal #43-15, 11/16/87
BHP, psig
800
790
780
770
760
750
740
730
720
710
700
10.0
15.8
25.1
39.8
63.1
100.0
Agarwal Time, hr

Fig 3

Reading ...

Howard Federal #43-15

11/19 Buildup

$q_o = 9.19$ BOPD $\quad q_g = 636.63$ Mcf/D $\quad \bar{P} = 852 \quad m = 92.77$

$B_o = 1.301 \quad B_g = 3.309 \quad R_s = 409 \quad \mu_o = .680 \quad \mu_g = 0.01375$

$q_o = (9.19)(1.301) = 11.9$

$q_g = \left[636.63 - \frac{(9.19)(409)}{1000}\right] 3.309 = 2094.2$

$q_t = 2106$ RB/D

$(11.9)(.680) = 8.13$

$(2094.2)(0.01375) = 28.79$

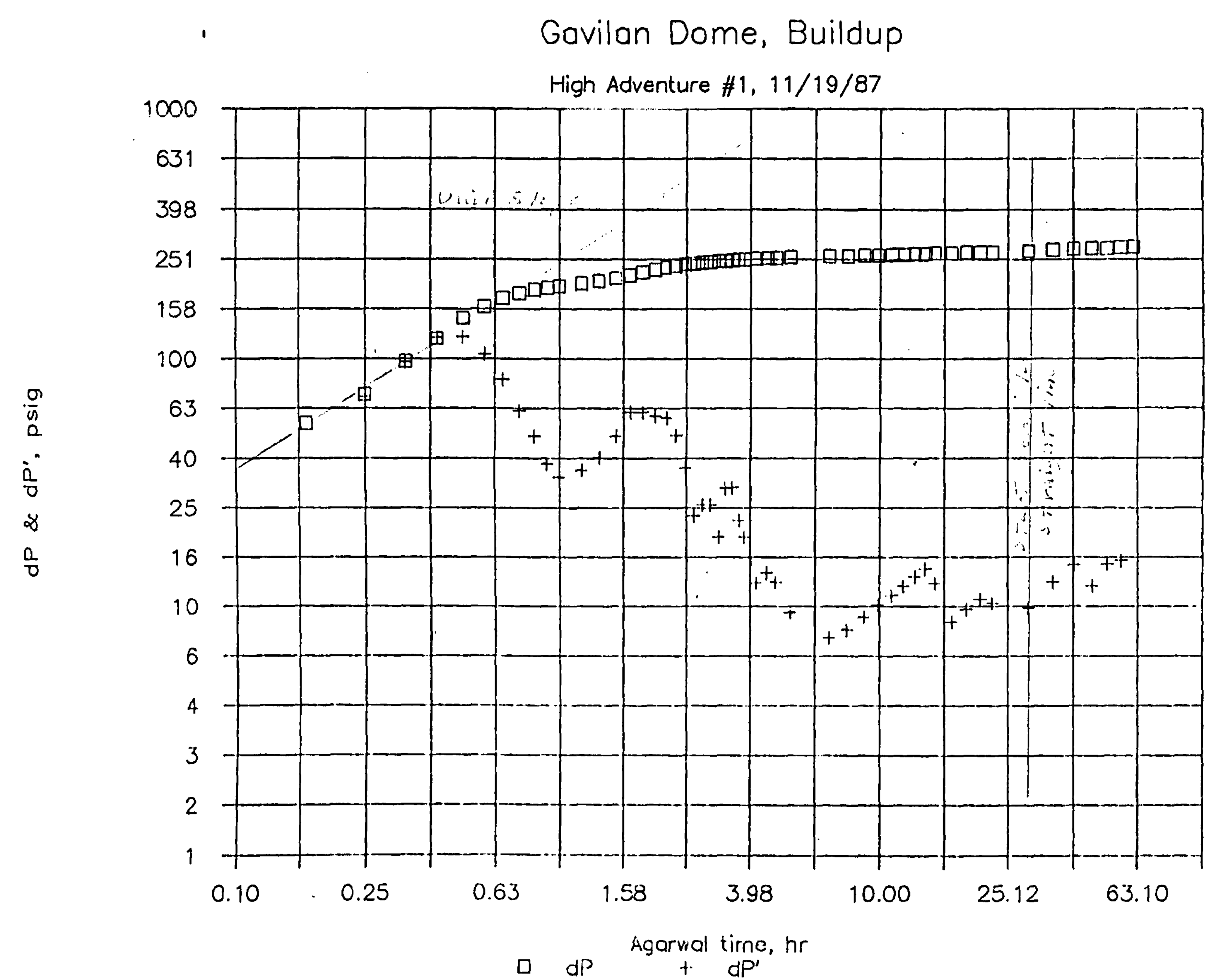
$\mu_{average} = 0.01755$ cp

$$\lambda_t h = \frac{(162.6)(2106)}{92.77} = 3691 \ \frac{md \cdot ft}{cp}$$

$\bar{K} h = 64.7$ md·ft

$$k_o h = \frac{(162.6)(11.9)(.68)}{92.77} = 14.2$$

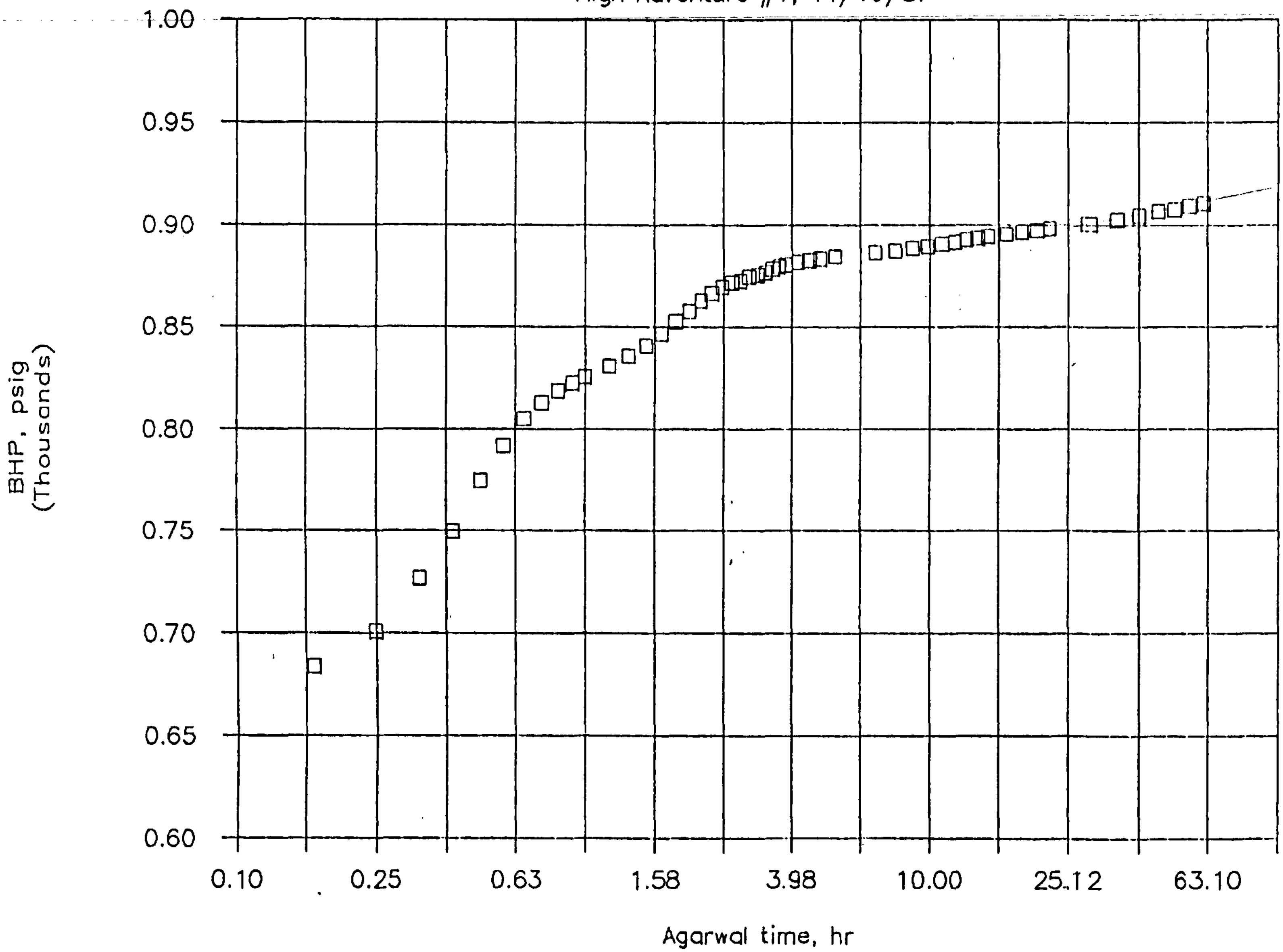
$$k_g h = \frac{(162.6)\, 2094.2 (.01375)}{92.77} = 50.5$$



Gavilan Dome, Buildup
High Adventure #1, 11/19/87
dP & dP', psig
1000
631
398
251
158
100
63
40
25
16
10
6
4
3
2
1
0.10
0.25
0.63
1.58
3.98
10.00
25.12
63.10
Agarwal time, hr
□ dP
+ dP'

Gavilan Dome, Buildup

High Adventure #1, 11/19/87



[illegible] k_g = [illegible]

Gavilan Dome Buildup Analysis

Sun High Adventure #1, Start Test 11:23 AM, 11/16/87

Flow Time, T = 840 hours   q = 233 B/D

@ 910 Psig $q_o = 233$ $T = 840 h$

$B_o = 1.308$ $B_g = 3.065$ $R_s = 426$ $\mu_o = .647$ $\mu_g = .01392$

dt hr	BHP psig	dP psig	T*dt/T+dt Agarwal	Agarwal' WMS Tech
0.00				
0.17	683.8	54.9	0.167	
0.25	700.8	71.9	0.250	70.4
0.33	726.8	97.9	0.333	97.3
0.42	749.7	120.8	0.416	121.4
0.50	774.7	145.8	0.500	122.4
0.58	791.6	162.7	0.583	104.8
0.67	805.0	176.1	0.666	82.9
0.75	813.0	184.1	0.749	62.0
0.83	818.9	190.0	0.832	49.0
0.92	822.9	194.0	0.916	38.0
1.00	825.9	197.0	0.999	33.5
1.17	830.9	202.0	1.168	35.7
1.33	835.9	207.0	1.328	40.3
1.50	840.9	212.0	1.497	49.1
1.67	846.9	218.0	1.667	61.0
1.83	852.8	223.9	1.826	60.8
2.00	857.8	228.9	1.995	58.9
2.17	862.8	233.9	2.164	[illegible]
2.33	866.8	237.9	2.327	49.2
2.50	869.8	240.9	2.493	36.7

hr	psig	psig	Agarwal	WMS Tech
36.00	902.7	273.8	34.521	12.6
42.00	904.7	275.8	40.000	14.7
48.00	906.7	277.8	45.405	12.1
54.00	907.7	278.8	50.738	14.9
60.00	909.7	280.8	56.000	15.5
66.00	910.7	281.8	61.192	

Reservoir bbl

$(233)(1.308) = 304.8$ RB

$\left[723 - \frac{(233)(426)}{1000}\right] 3.065 = 1911.8$ RB

$q_t = 2217$ RB/D

$(304.8)(0.647) =$

$(1911.8)(.01392) =$

$\mu_{Average} = 0.1010$ cp

6 points

CL : 99.7%

P_{1hr} : 852.9 psig

slope : 32.34 psi/cycle

$$\lambda_t h = \frac{(162.6)(2217)}{32.34} = 11{,}146 \ \frac{md \cdot ft}{cp}$$

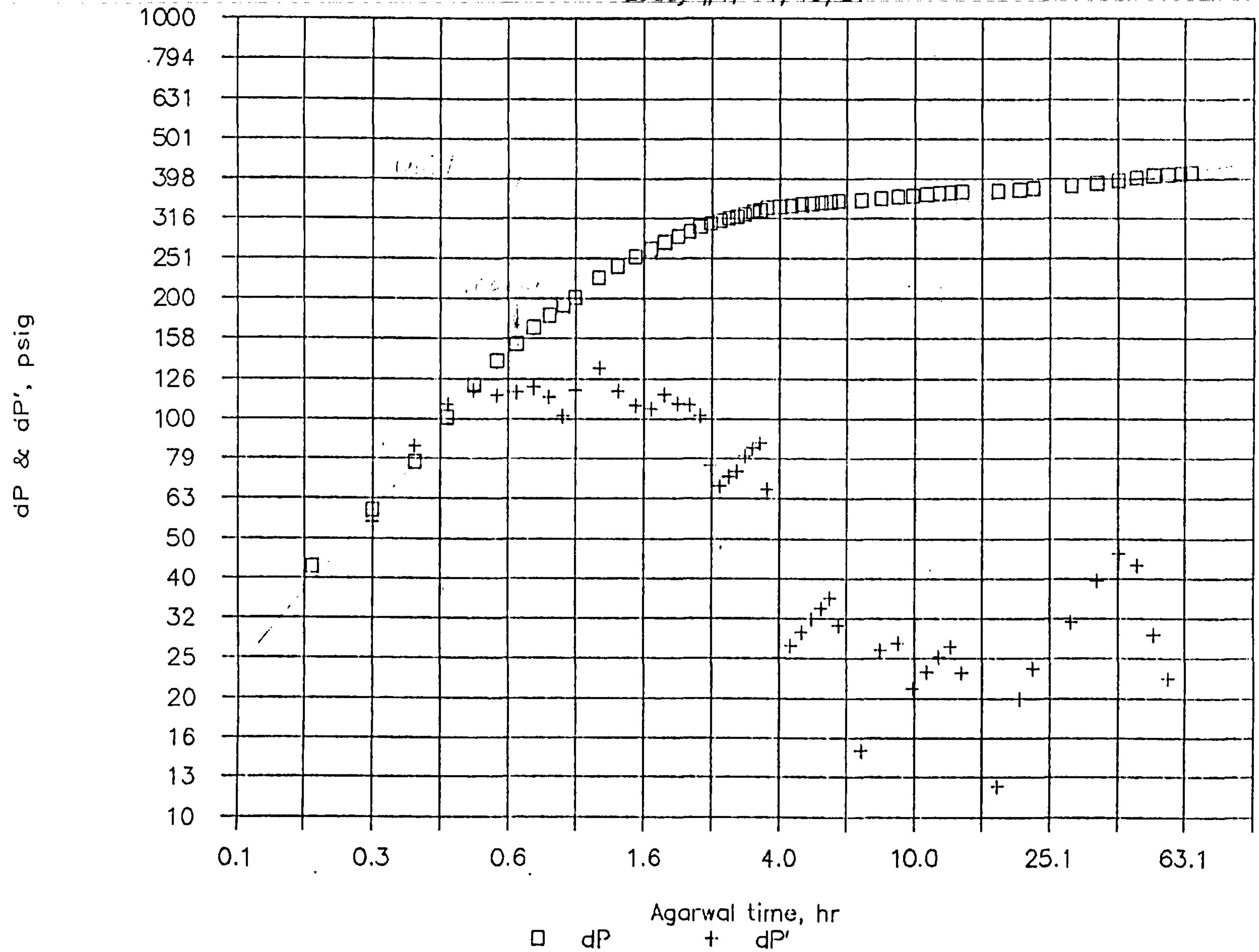
$$\bar{k} h = 1126 \ md \cdot ft$$

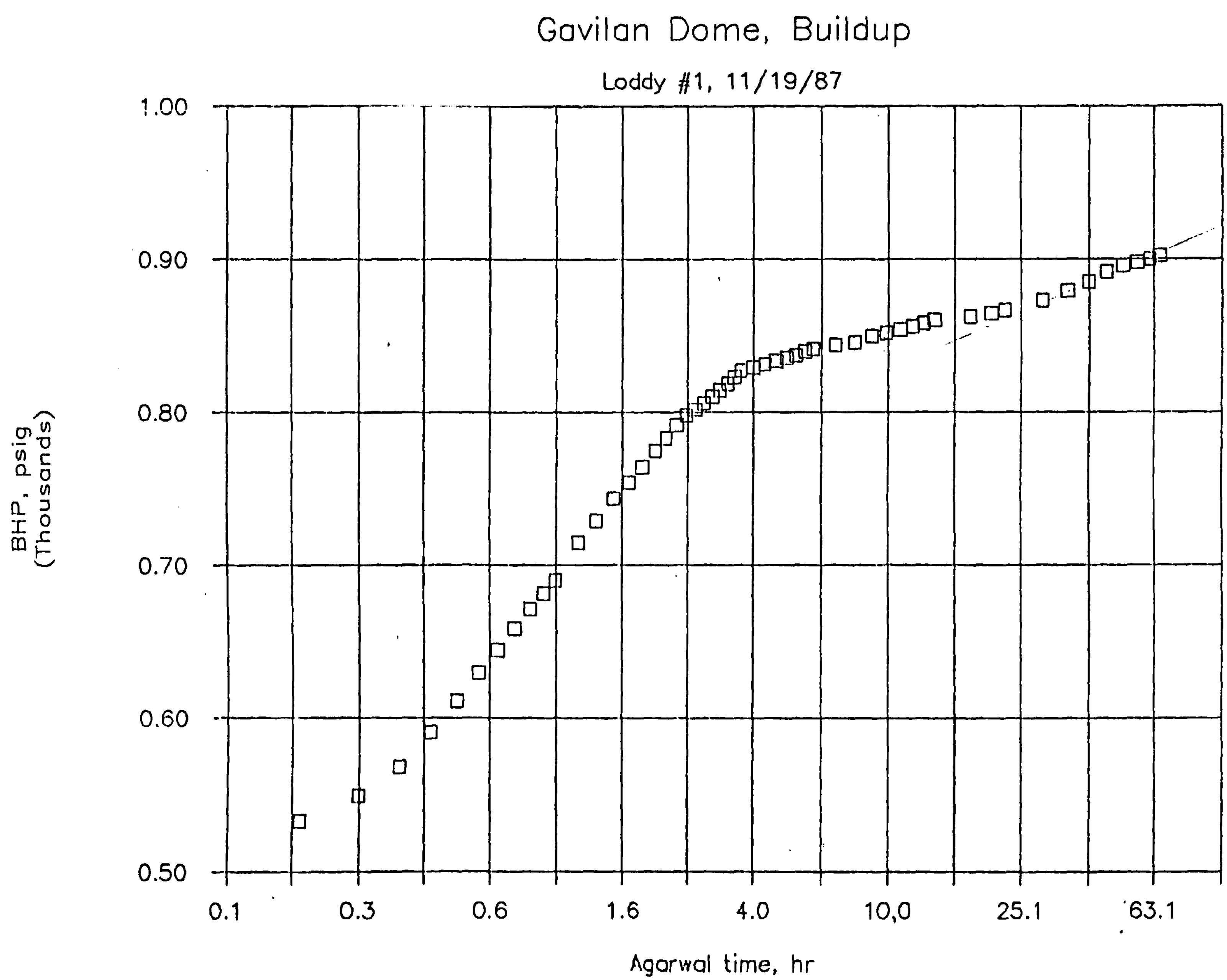
$$k_o h = \frac{(162.6)(304.8)(.647)}{32.34} = [illegible]$$

$$k_g h = \frac{(162.6)(1911.8)(.01392)}{32.34} = [illegible]$$

Gavilan Dome, Buildup

Loddy #1, 11/19/87





Gavilan Dome, Buildup
Loddy #1, 11/19/87
BHP, psig
(Thousands)
1.00
0.90
0.80
0.70
0.60
0.50
0.1
0.3
0.6
1.6
4.0
10,0
25.1
63.1
Agarwal time, hr

Gavilan Dome Buildup Analysis

Sun Loddy#1, Start Test 10:06 AM, 11/~~16~~ 19/87

Flow Time,T = ~~816~~ 840 hours q = ~~69~~ 67 B/D

q_g = 338.54 Mcf/D

q = 67 BO/D

T = 840 hr

B_o = 1.307 B_g = 3.098 R_s = 423 μ_o = 0.650 μ_g = 0.01390

dt hr	BHP psig	dP psig	T*dt/T+dt Agarwal	Agarwal' WMS Tech
0.00	490.0			
0.17	532.6	42.6	0.167	
0.25	549.2	59.2	0.250	55.1
0.33	567.9	77.9	0.333	85.7
0.42	590.7	100.7	0.416	108.3
0.50	611.4	121.4	0.500	117.7
0.58	630.1	140.0	0.583	114.4
0.67	644.6	154.6	0.666	116.5
0.75	659.1	169.1	0.749	120.6
0.83	671.5	181.5	0.832	113.3
0.92	681.9	191.9	0.916	101.8
1.00	690.2	200.2	0.999	117.9
1.17	715.0	225.0	1.168	133.7
1.33	729.5	239.5	1.328	117.2
1.50	744.0	254.0	1.497	108.1
1.67	754.4	264.4	1.667	105.8
1.83	764.8	274.8	1.826	115.3
2.00	775.1	285.1	1.995	109.1
2.17	783.4	293.4	2.164	108.7
2.33	791.7	301.7	2.326	102.2
2.50	797.9	307.9	2.492	76.4
hr	psig	psig	Agarwal	WMS Tech
36.00	879.2	389.2	34.479	39.4
42.00	885.4	395.4	39.944	46.2
48.00	891.7	401.7	45.333	43.1
54.00	895.8	405.8	50.648	28.9
60.00	897.9	407.9	55.890	22.4
66.00	900.0	410.0	61.061	27.7
71.00	902.1	412.1	65.317	

Cartesian plot
cc = 100%
Intercept
P_{bhr} = 490 psig

(67)(1.307) = 87.57 B/D

$\left[338.54 - \frac{(67)(423)}{1000}\right]3.098$

= 961.0 RB/D

q_t = 1049 RB/D

(87.57)(.650)

(961)(.01390)

$\mu_{Average}$ = 0.0670 cp

7 points

cc 98.9%

P_{1hr} = 754.7 psig

slope = 81.82 psi/cycle

$$\lambda_t h = \frac{(162.6)(1049)}{81.82} = 2085 \frac{md \cdot ft}{cp}$$

$$Kh = 140 \; md \cdot ft$$

$$K_o h = \frac{(162.6)(87.57)(.650)}{81.82} = 113.1$$

$$K_g h = \frac{(162.6)(961)(.01390)}{81.82} = 26.5$$

APPENDIX 3

Interference Test Analyses

Displacement Calculations

6/5/01

①

From Craft & Hawkins
P276

11/19/87 B-32
Buildup

$w = 1$ mile

$$q = \frac{1.127\, K A \Delta P}{\mu L}$$

$$\frac{KA}{\mu} = \frac{Kh}{\mu} \times w$$

$$q = \frac{1.127 \frac{Kh}{\mu} w \Delta P}{L} = \frac{1.127 (21.696)(5280)(1400-960)}{10{,}411}$$

$q = 5{,}456$ RB/D

	Oil Rate RB/D	BOPD	Mcf/D
B-32	2642.0	719	893
B-29	7041.5	1040	2390
	9684 RB/D		

B-29

$RB_o = (1040)(1.314) = 1367$

$RB_g = \left[2390 - \frac{(1040)(437)}{1000}\right] 2.932 = 5675$

7041.5 RB/D

B.M.G.
Interference Test TAP 4 - E-6
2/13/86 TAP 4 Frac Q = 100,800 bfpd r = 3448 ft
GOR = 348 scf/bbl, BHP = 1691 psig

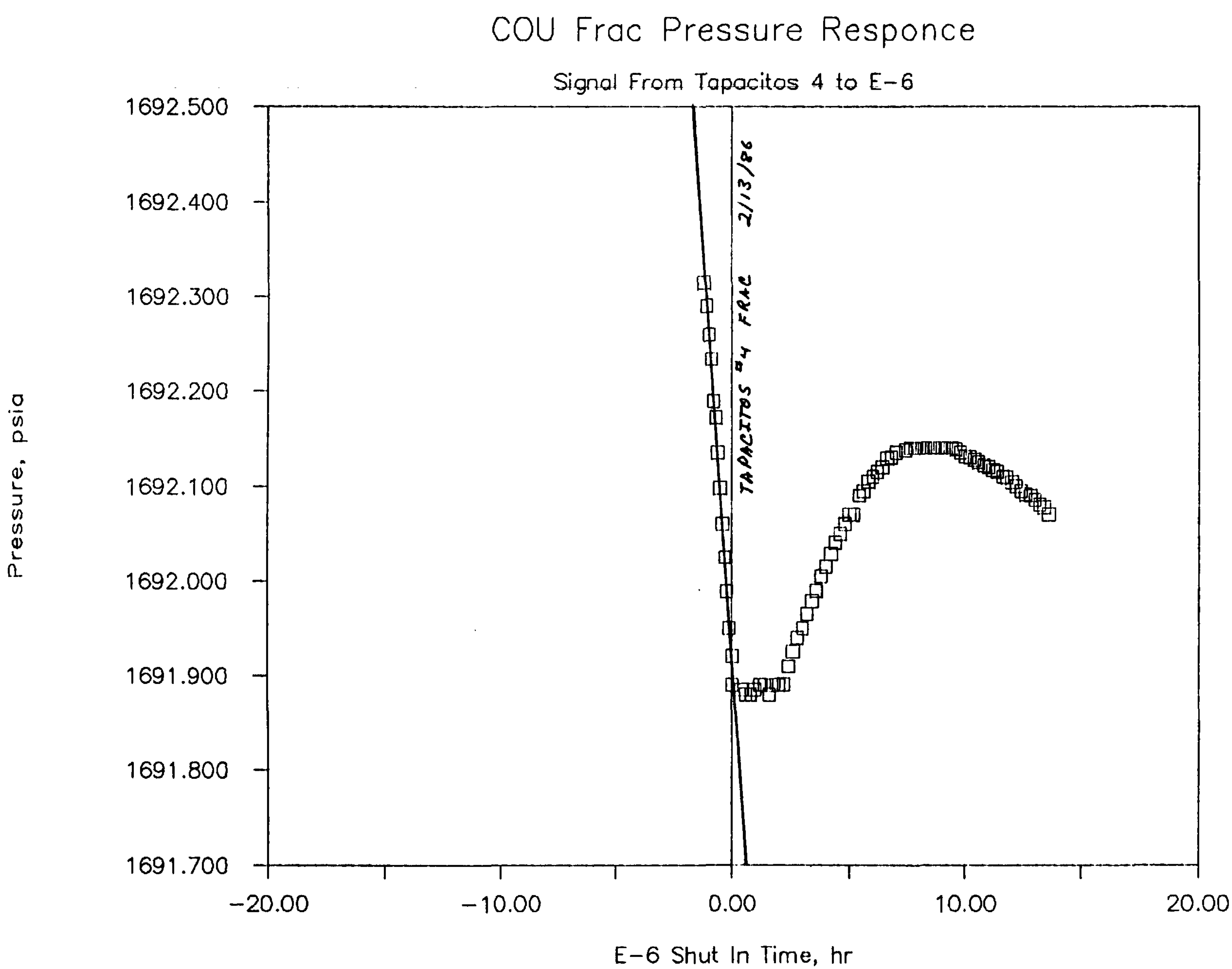
Pressures and times taken from graph, BMG exhibit #3.

time (hr)	pressure
0.02	1691.890
0.40	1691.885
0.60	1691.880
0.80	1691.880
1.00	1691.885
1.20	1691.890
1.40	1691.890
1.60	1691.880
1.80	1691.890
2.00	1691.890
2.20	1691.891
2.40	1691.910
2.60	1691.925
2.80	1691.940
3.00	1691.950
3.20	1691.965
3.40	1691.979
3.60	1691.990
3.80	1692.005
4.00	1692.015
4.20	1692.029
4.40	1692.040
4.60	1692.050
4.80	1692.060
5.00	1692.070
5.20	1692.070
5.40	1692.090
5.60	1692.095
5.80	1692.105
6.00	1692.110
6.20	1692.115
6.40	1692.120
6.60	1692.129
6.80	1692.130
7.00	1692.135
7.40	1692.138
7.60	1692.140
7.80	1692.140
8.00	1692.140
8.20	1692.140
8.40	1692.140
8.60	1692.140
8.80	1692.140
9.00	1692.140
9.20	1692.140
9.40	1692.140
9.60	1692.139

B.M.G.
Interference Test TAP 4 - E-6
2/13/86 TAP 4 Frac Q = 100,800 bfpd r = 3448 ft
GOR = 348 scf/bbl, BHP = 1691 psig

Pressures and times taken from graph, BMG exhibit #3.

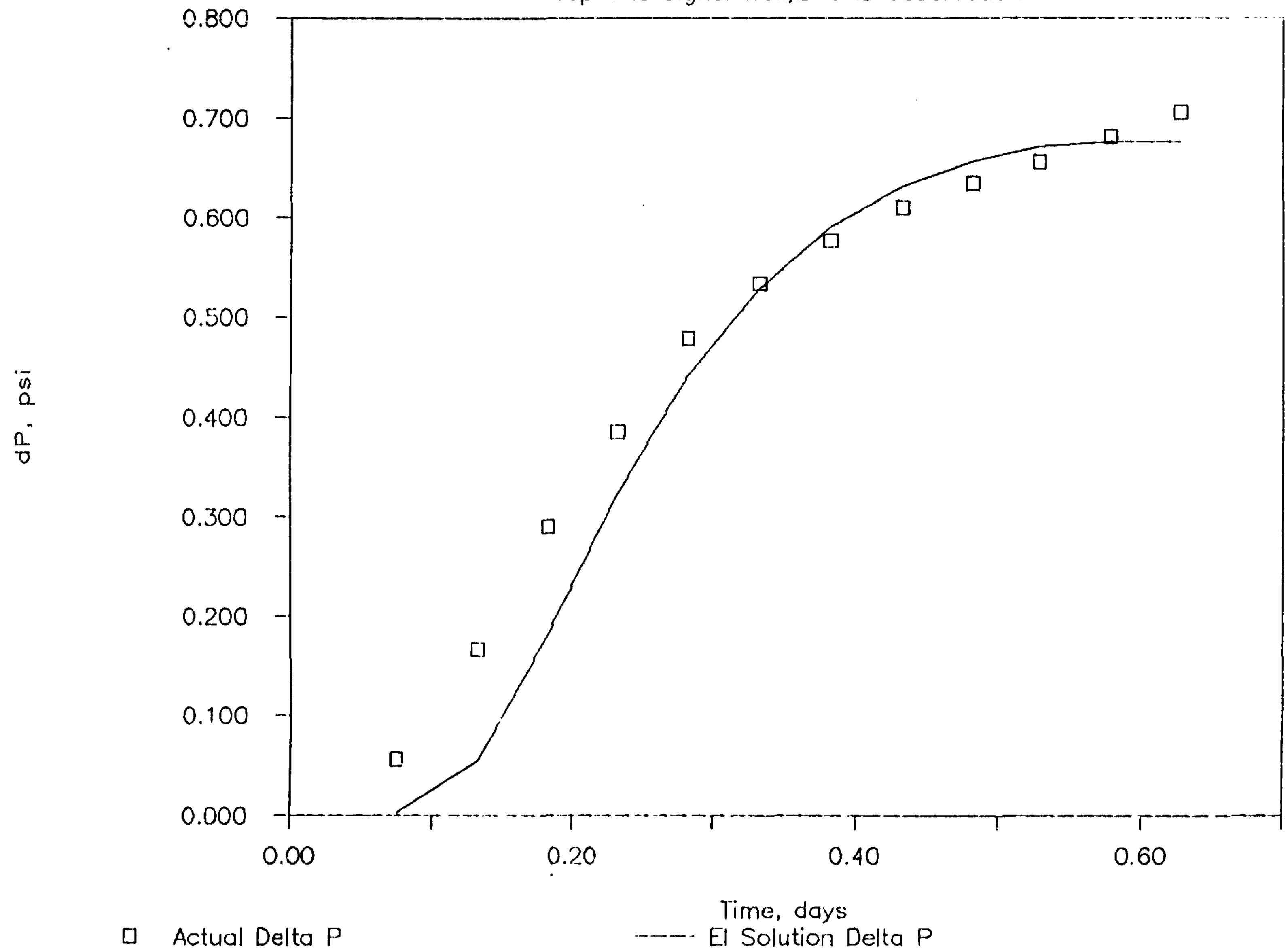
time (hr)	pressure
9.80	1692.135
10.00	1692.131
10.20	1692.130
10.40	1692.128
10.60	1692.125
10.80	1692.122
11.00	1692.120
11.20	1692.117
11.40	1692.115
11.60	1692.110
11.80	1692.109
12.00	1692.104
12.20	1692.100
12.40	1692.095
12.60	1692.091
12.80	1692.090
13.00	1692.085
13.20	1692.080
13.40	1692.078
13.60	1692.070
0.00	1691.920
-0.10	1691.950
-0.20	1691.989
-0.30	1692.025
-0.40	1692.060
-0.50	1692.098
-0.60	1692.135
-0.70	1692.173
-0.80	1692.190
-0.90	1692.234
-1.00	1692.260
-1.10	1692.290
-1.20	1692.315



COU Frac Pressure Responce
Signal From Tapacitos 4 to E-6
TAPACITOS #4 FRAC 2/13/86
Pressure, psia
1692.500
1692.400
1692.300
1692.200
1692.100
1692.000
1691.900
1691.800
1691.700
-20.00
-10.00
0.00
10.00
20.00
E-6 Shut In Time, hr

COU Frac Interference Test Analysis

Tap 4 is Signal Well,E-6 is Observation

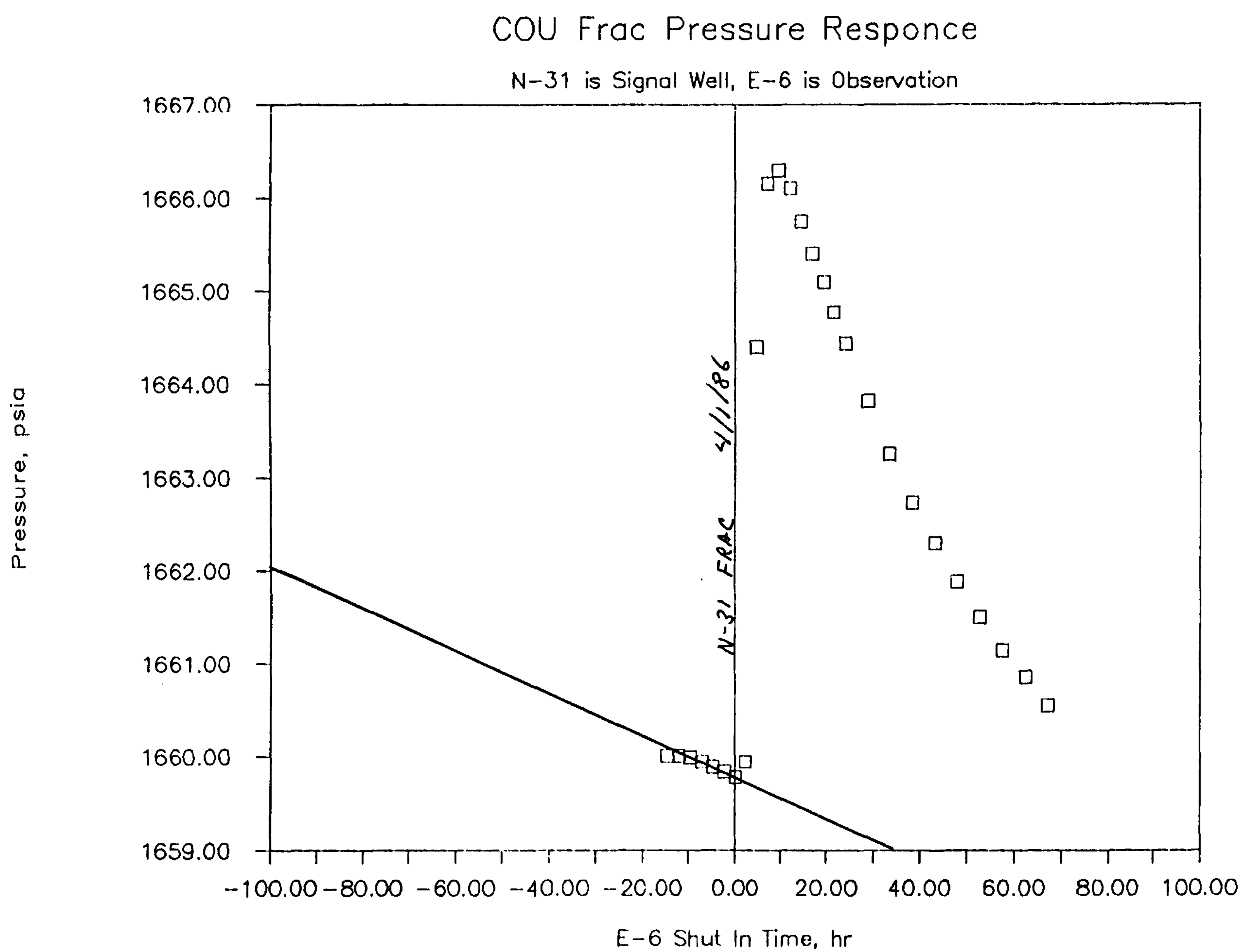


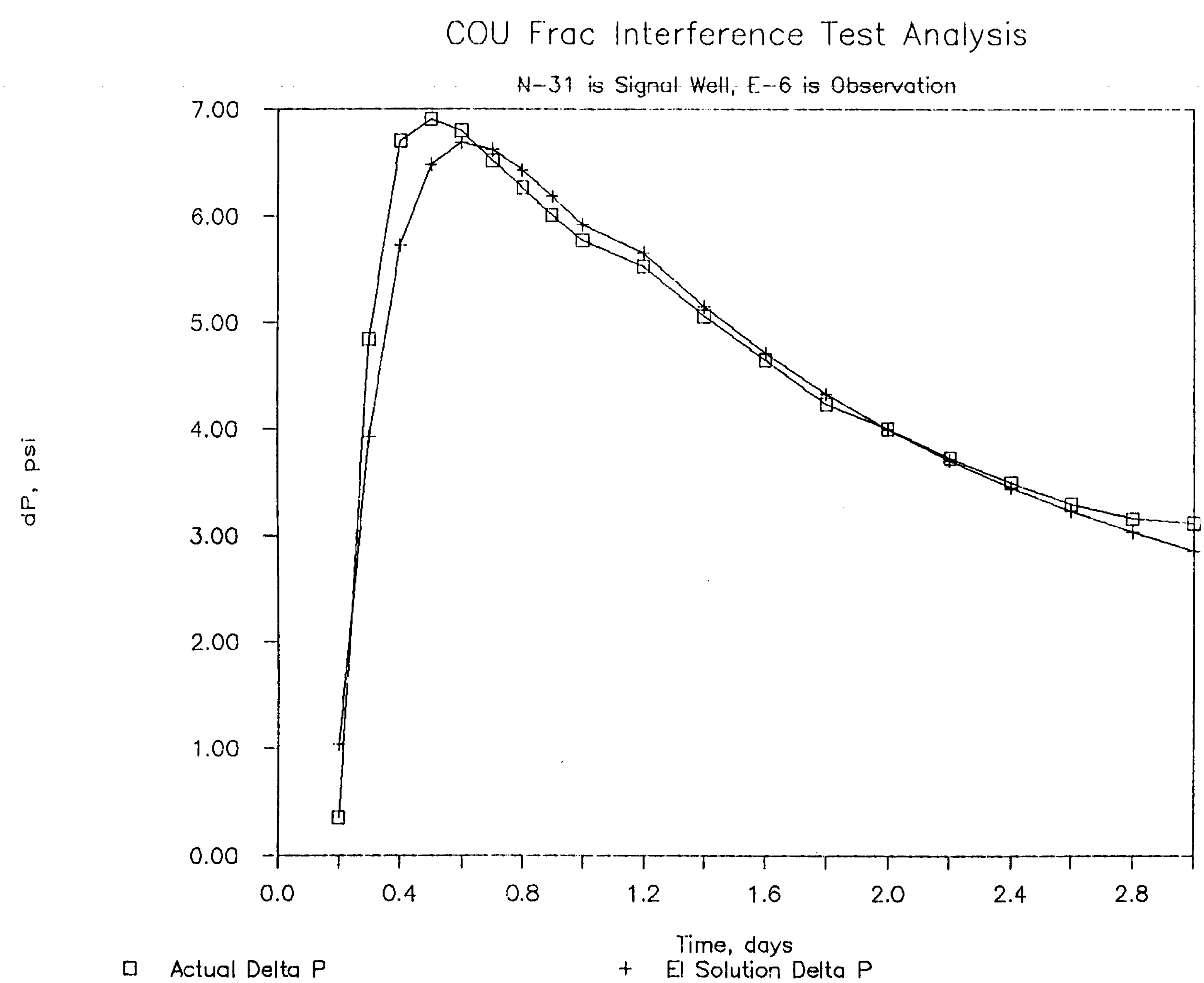
COU Frac Interference Analysis
N-31 Signal Well E-6 Response Well
April 1, 1986 Test Date

Injection Rate 111 BPM = 159,840 BPD
Injection Period 0.0468 Day = 1.12 Hr

From Pressure Response Curve BMG Exhibit #3

Time Hr	Actual Pressure Psi
2.4	1659.95
4.8	1664.40
7.2	1666.15
9.6	1666.30
12.0	1666.10
14.4	1665.75
16.8	1665.40
19.2	1665.10
21.6	1664.77
24.0	1664.44
28.8	1663.82
33.6	1663.25
38.4	1662.73
43.2	1662.30
48.0	1661.88
52.8	1661.50
57.6	1661.15
62.4	1660.86
67.2	1660.55
0.0	1659.78
-2.4	1659.84
-4.8	1659.89
-7.2	1659.95
-9.6	1660.00
-12.0	1660.01
-14.4	1660.01

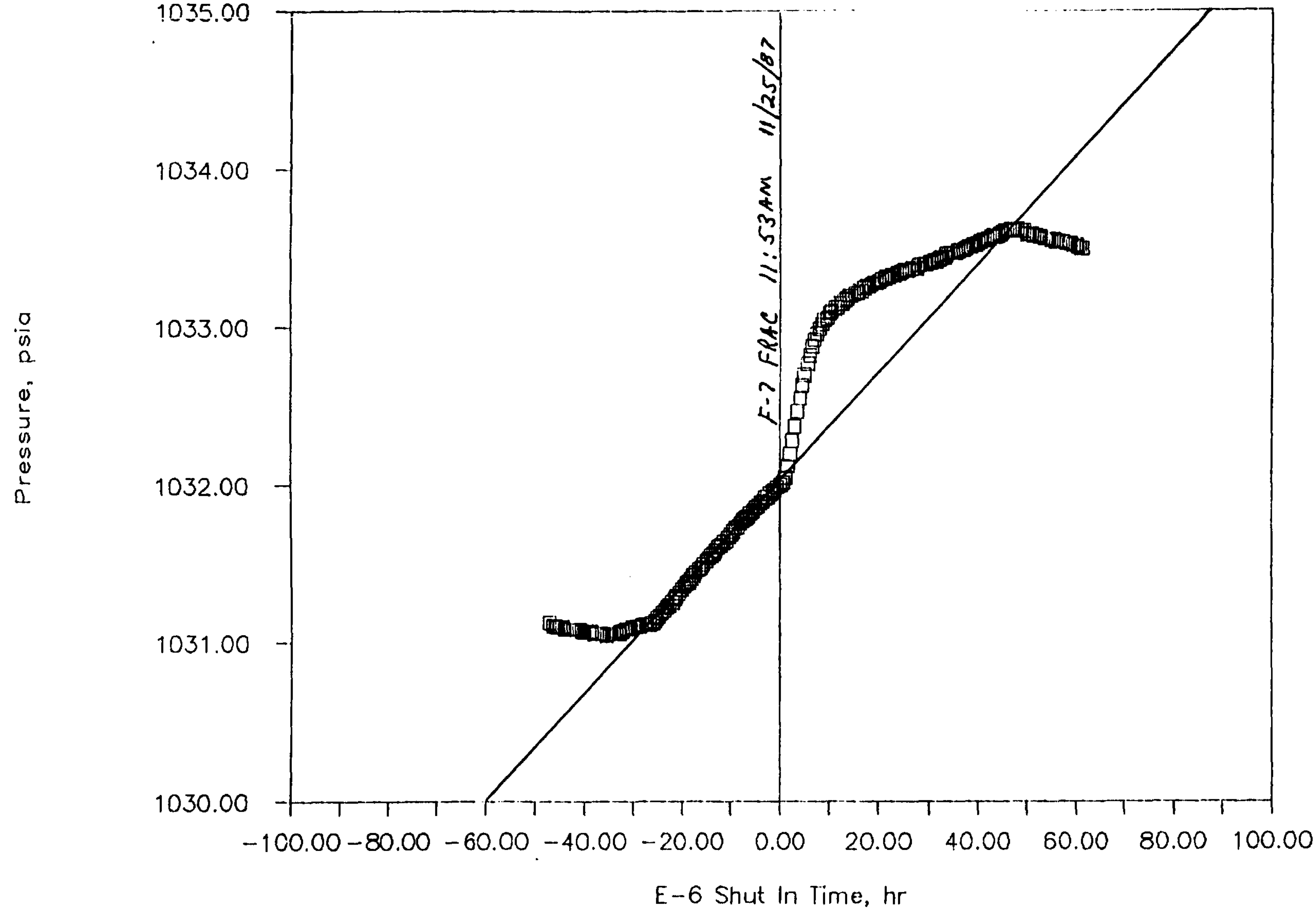

COU Frac Pressure Responce
N-31 is Signal Well, E-6 is Observation
1667.00
1666.00
1665.00
1664.00
1663.00
1662.00
1661.00
1660.00
1659.00
Pressure, psia
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
E-6 Shut In Time, hr
N-31 FRAC
4/1/86

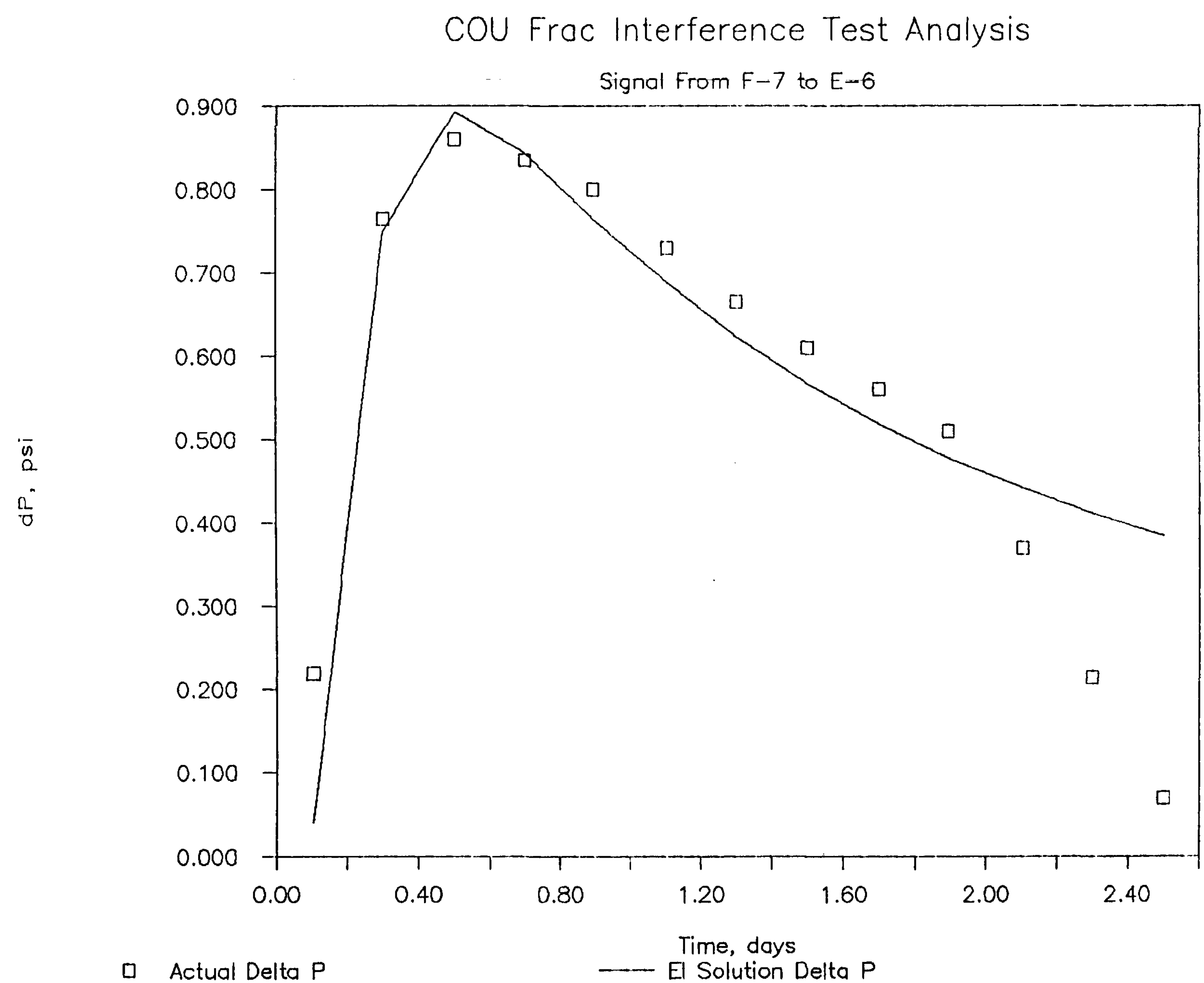


COU Frac Interference Test Analysis
N-31 is Signal Well, E-6 is Observation
dP, psi
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
Time, days
Actual Delta P
El Solution Delta P

COU Frac Pressure Responce

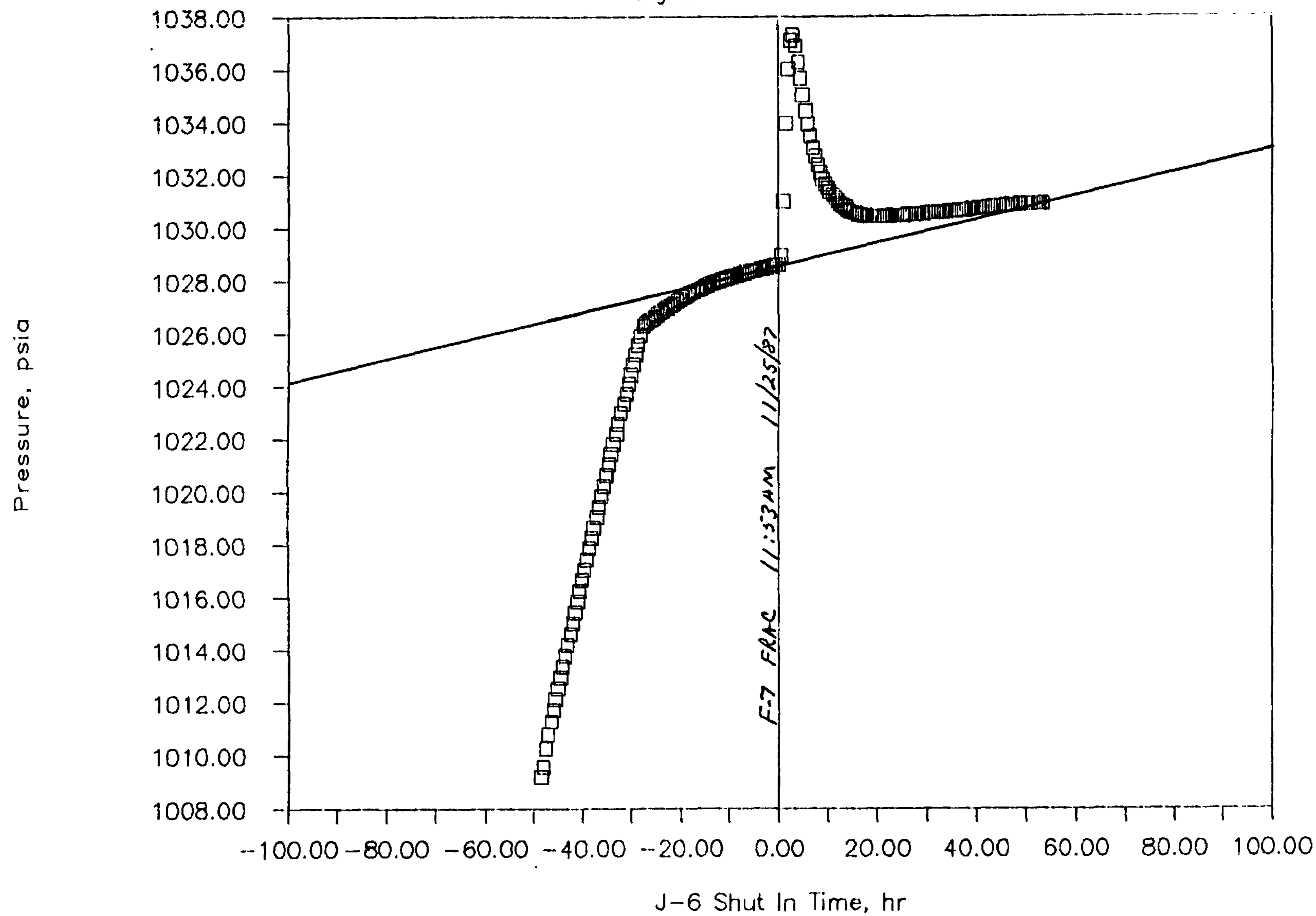
Signal From F-7 to E-6

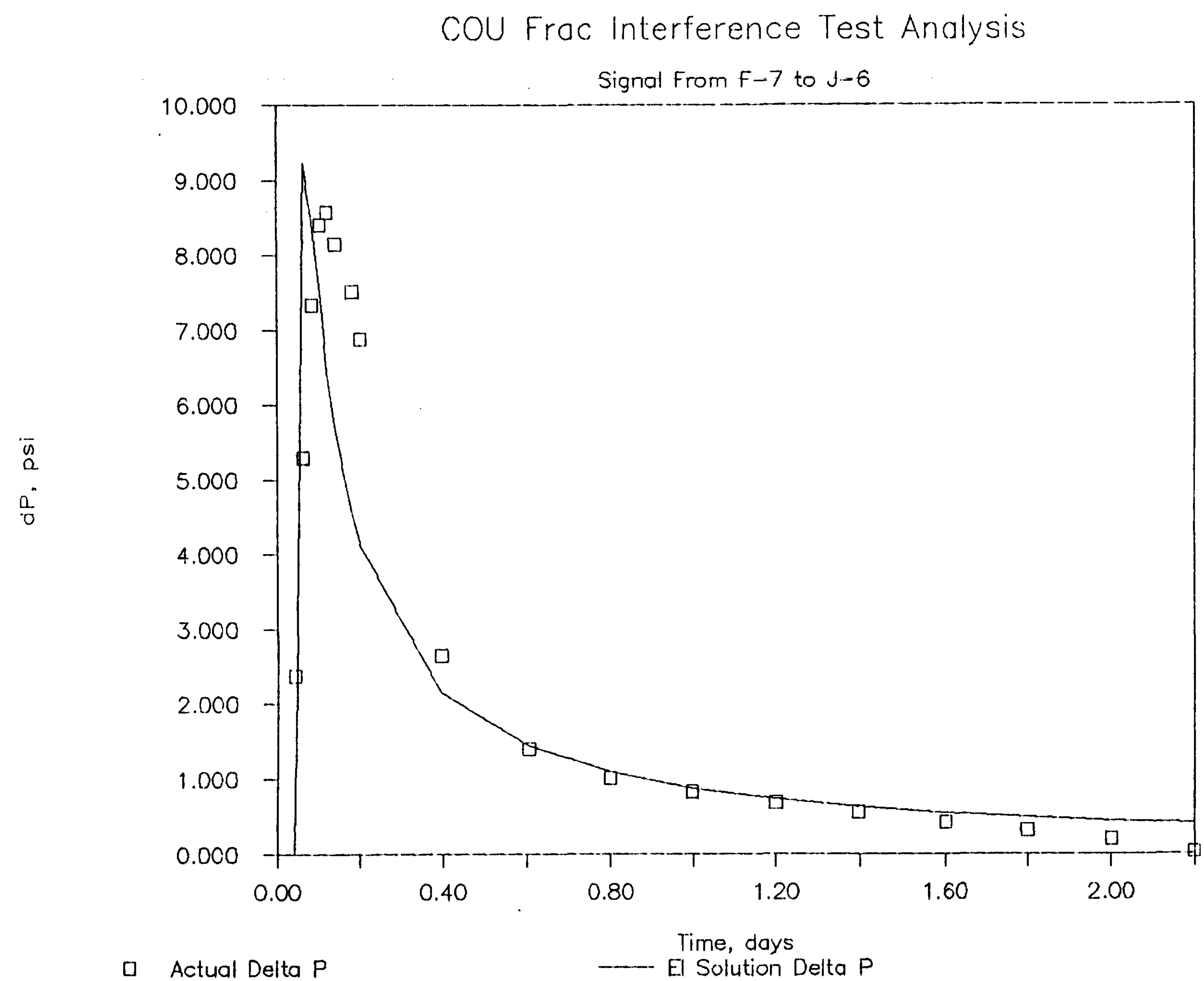



COU Frac Interference Test Analysis
Signal From F-7 to E-6
dP, psi
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.00
0.40
0.80
1.20
1.60
2.00
2.40
Time, days
Actual Delta P
El Solution Delta P

COU Frac Pressure Responce

Signal From F-7 to J-6




COU Frac Interference Test Analysis
Signal From F-7 to J-6
dP, psi
10.000
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0.00
0.40
0.80
1.20
1.60
2.00
Time, days
Actual Delta P
El Solution Delta P

Pressure Responce Of A-20 Frac Observed At B-32

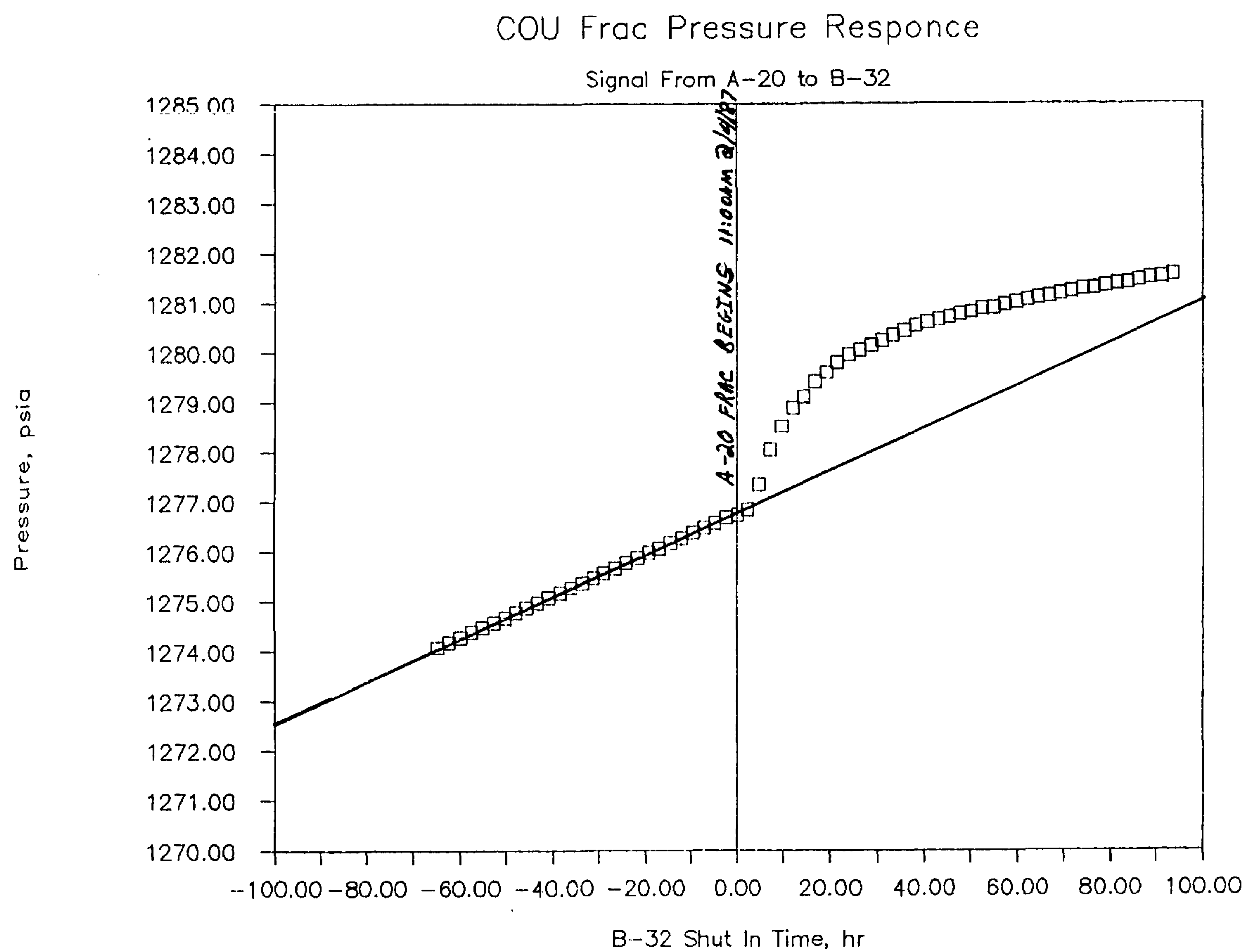
Pressures and times taken from BMG exhibit March 30, 1987.

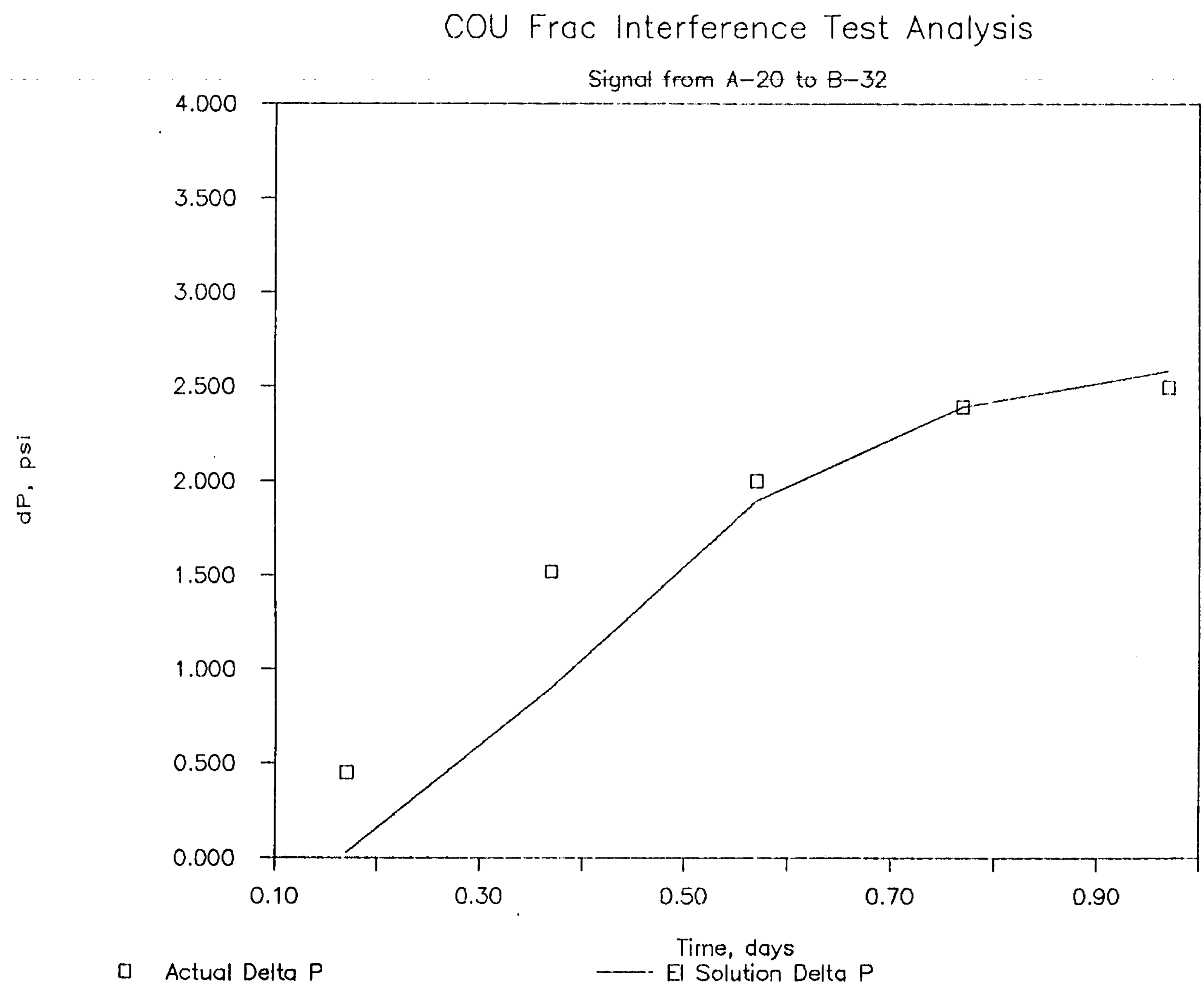
time hr	pressure psia
-64.80	1274.08
-62.40	1274.18
-60.00	1274.28
-57.60	1274.38
-55.20	1274.48
-52.80	1274.58
-50.40	1274.68
-48.00	1274.78
-45.60	1274.88
-43.20	1274.98
-40.80	1275.08
-38.40	1275.18
-36.00	1275.28
-33.60	1275.38
-31.20	1275.48
-28.80	1275.58
-26.40	1275.68
-24.00	1275.78
-21.60	1275.88
-19.20	1275.98
-16.80	1276.08
-14.40	1276.18
-12.00	1276.28
-9.60	1276.38
-7.20	1276.48
-4.80	1276.58
-2.40	1276.68
0.00	1276.73
2.40	1276.85
4.80	1277.35
7.20	1278.05
9.60	1278.52
12.00	1278.9
14.40	1279.11
16.80	1279.41
19.20	1279.6
21.60	1279.79
24.00	1279.95
26.40	1280.05
28.80	1280.15
31.20	1280.25
33.60	1280.35
36.00	1280.45
38.40	1280.54
40.80	1280.6
43.20	1280.67
45.60	1280.72
48.00	1280.78
50.40	1280.82

Pressure Responce Of A-20 Frac Observed At B-32

Pressures and times taken from BMG exhibit March 30, 1987.

time hr	pressure psia
52.80	1280.89
55.20	1280.91
57.60	1280.97
60.00	1281.01
62.40	1281.07
64.80	1281.11
67.20	1281.14
69.60	1281.2
72.00	1281.24
74.40	1281.28
76.80	1281.3
79.20	1281.35
81.60	1281.39
84.00	1281.42
86.40	1281.47
88.80	1281.5
91.20	1281.52
93.60	1281.58


COU Frac Pressure Responce
Signal From A-20 to B-32
A-20 FRAC BEGINS 11:00AM 2/9/87
1285.00
1284.00
1283.00
1282.00
1281.00
1280.00
1279.00
1278.00
1277.00
1276.00
1275.00
1274.00
1273.00
1272.00
1271.00
1270.00
Pressure, psia
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
B-32 Shut In Time, hr


COU Frac Interference Test Analysis
Signal from A-20 to B-32
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
dP, psi
0.10
0.30
0.50
0.70
0.90
Time, days
Actual Delta P
El Solution Delta P

Frac Interference Test Anal
Signal from A-20 to B-29

time hrs	Pressure psi	dt hr
4.5	1219.35	-44.5
5	1221.7	-44
5.5	1223.4	-43.5
6	1224.44	-43
6.5	1224.92	-42.5
7	1225.01	-42
7.5	1225	-41.5
8	1224.99	-41
8.5	1224.99	-40.5
9	1224.99	-40
9.5	1224.99	-39.5
10	1224.99	-39
10.5	1224.99	-38.5
11	1225.01	-38
11.5	1225.03	-37.5
12	1225.03	-37
12.5	1225.03	-36.5
13	1225.04	-36
13.5	1225.06	-35.5
14	1225.07	-35
14.5	1225.08	-34.5
15	1225.1	-34
15.5	1225.11	-33.5
16	1225.13	-33
16.5	1225.14	-32.5
17	1225.15	-32
17.5	1225.16	-31.5
18	1225.17	-31
18.5	1225.2	-30.5
19	1225.22	-30
19.5	1225.23	-29.5
20	1225.27	-29
20.5	1225.28	-28.5
21	1225.29	-28
21.5	1225.32	-27.5
22	1225.34	-27
22.5	1225.37	-26.5
23	1225.38	-26
23.5	1225.42	-25.5
24	1225.44	-25
24.5	1225.46	-24.5
25	1225.46	-24
25.5	1225.51	-23.5
26	1225.51	-23
26.5	1225.5	-22.5
27	1225.53	-22
27.5	1225.54	-21.5
28	1225.57	-21
28.5	1225.6	-20.5

Frac Interference Test Anal
Signal from A-20 to B-29

time hrs	Pressure psi	dt hr
29	1225.61	-20
29.5	1225.63	-19.5
30	1225.64	-19
30.5	1225.67	-18.5
31	1225.68	-18
31.5	1225.69	-17.5
32	1225.71	-17
32.5	1225.73	-16.5
33	1225.76	-16
33.5	1225.77	-15.5
34	1225.8	-15
34.5	1225.8	-14.5
35	1225.82	-14
35.5	1225.85	-13.5
36	1225.85	-13
36.5	1225.88	-12.5
37	1225.9	-12
37.5	1225.91	-11.5
38	1225.92	-11
38.5	1225.96	-10.5
39	1225.98	-10
39.5	1225.99	-9.5
40	1226.01	-9
40.5	1226.02	-8.5
41	1226.03	-8
41.5	1226.04	-7.5
42	1226.07	-7
42.5	1226.09	-6.5
43	1226.1	-6
43.5	1226.12	-5.5
44	1226.14	-5
44.5	1226.14	-4.5
45	1226.17	-4
45.5	1226.18	-3.5
46	1226.21	-3
46.5	1226.23	-2.5
47	1226.26	-2
47.5	1226.27	-1.5
48	1226.29	-1
48.5	1226.3	-0.5
49	1226.31	0
49.5	1226.36	0.5
50	1226.53	1
50.5	1226.74	1.5
51	1227.06	2
51.5	1227.43	2.5
52	1227.88	3
52.5	1228.28	3.5
53	1228.65	4

Frac Interference Test Anal
Signal from A-20 to B-29

time hrs	Pressure psi	dt hr
53.5	1228.89	4.5
54	1228.99	5
54.5	1229.1	5.5
55	1229.21	6
55.5	1229.3	6.5
56	1229.44	7
56.5	1229.55	7.5
57	1229.65	8
57.5	1229.73	8.5
58	1229.8	9
58.5	1229.88	9.5
59	1229.93	10
59.5	1229.97	10.5
60	1230.01	11
60.5	1230.04	11.5
61	1230.07	12
61.5	1230.08	12.5
62	1230.1	13
62.5	1230.09	13.5
63	1230.06	14
63.5	1230.07	14.5
64	1230.06	15
64.5	1230.06	15.5
65	1230.06	16
65.5	1230.06	16.5
66	1230.06	17
66.5	1230.08	17.5
67	1230.09	18
67.5	1230.09	18.5
68	1230.09	19
68.5	1230.11	19.5
69	1230.1	20
69.5	1230.11	20.5
70	1230.12	21
70.5	1230.14	21.5
71	1230.14	22
71.5	1230.14	22.5
72	1230.14	23
72.5	1230.14	23.5
73	1230.14	24
73.5	1230.14	24.5
74	1230.14	25
74.5	1230.13	25.5
75	1230.12	26
75.5	1230.12	26.5
76	1230.13	27
76.5	1230.12	27.5
77	1230.12	28
77.5	1230.12	28.5

Frac Interference Test Anal
Signal from A-20 to B-29

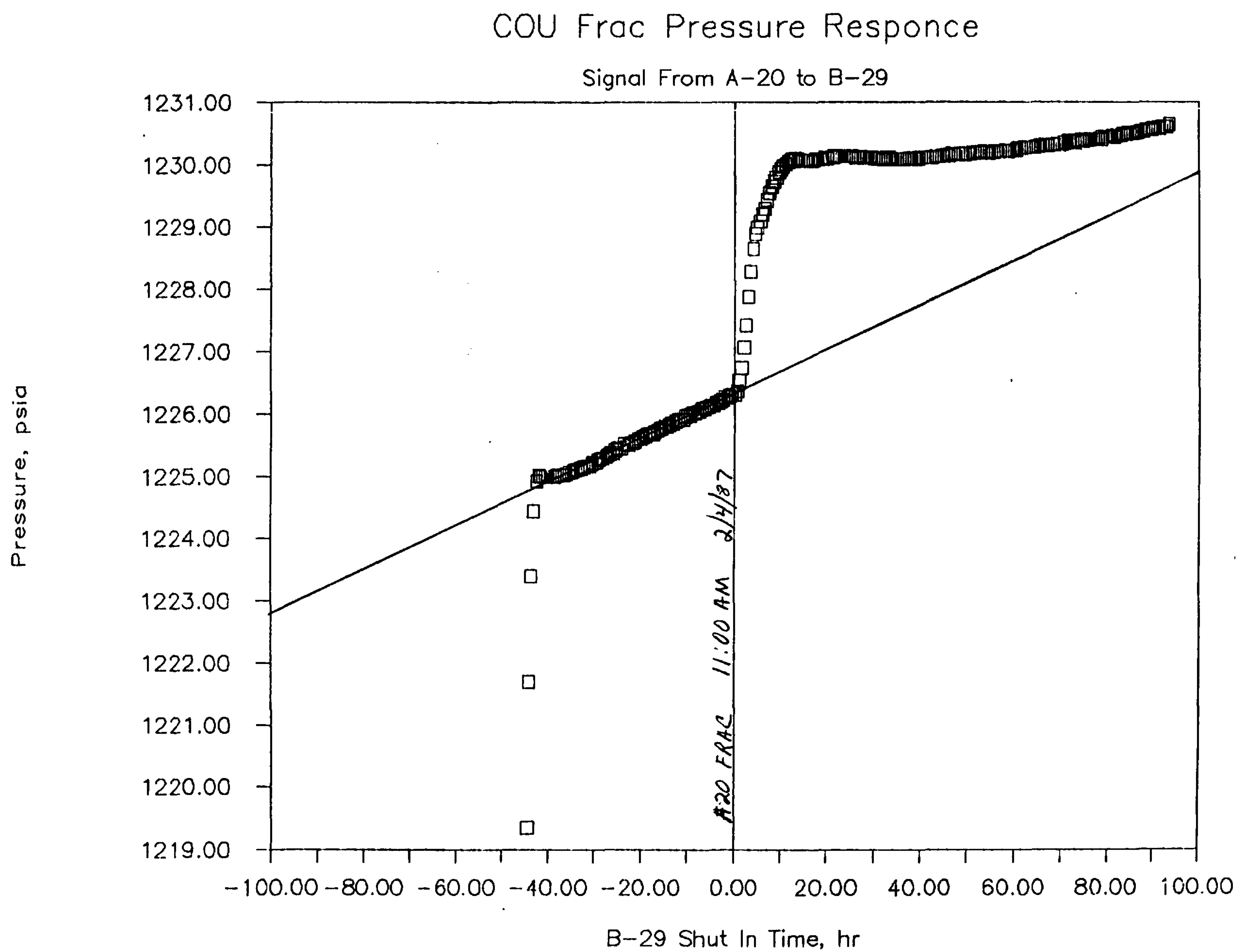
time hrs	Pressure psi	dt hr
78	1230.11	29
78.5	1230.11	29.5
79	1230.1	30
79.5	1230.11	30.5
80	1230.1	31
80.5	1230.11	31.5
81	1230.09	32
81.5	1230.09	32.5
82	1230.11	33
82.5	1230.1	33.5
83	1230.08	34
83.5	1230.09	34.5
84	1230.08	35
84.5	1230.08	35.5
85	1230.08	36
85.5	1230.09	36.5
86	1230.09	37
86.5	1230.1	37.5
87	1230.09	38
87.5	1230.1	38.5
88	1230.09	39
88.5	1230.1	39.5
89	1230.11	40
89.5	1230.11	40.5
90	1230.12	41
90.5	1230.11	41.5
91	1230.11	42
91.5	1230.12	42.5
92	1230.13	43
92.5	1230.13	43.5
93	1230.13	44
93.5	1230.14	44.5
94	1230.14	45
94.5	1230.15	45.5
95	1230.15	46
95.5	1230.17	46.5
96	1230.16	47
96.5	1230.17	47.5
97	1230.17	48
97.5	1230.18	48.5
98	1230.16	49
98.5	1230.16	49.5
99	1230.18	50
99.5	1230.18	50.5
100	1230.19	51
100.5	1230.19	51.5
101	1230.2	52
101.5	1230.2	52.5
102	1230.19	53

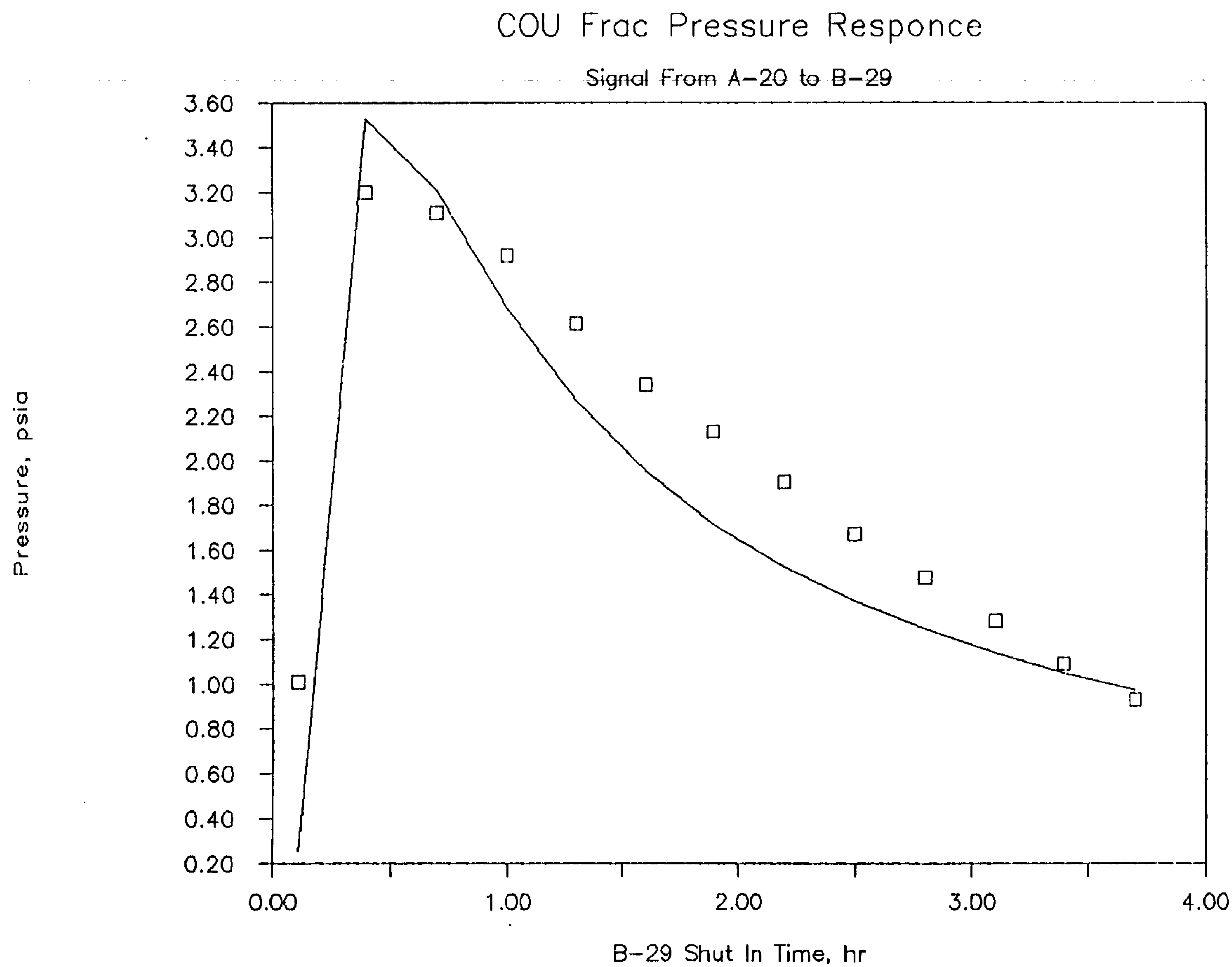
Frac Interference Test Anal
Signal from A-20 to B-29

time hrs	Pressure psi	dt hr
102.5	1230.21	53.5
103	1230.2	54
103.5	1230.19	54.5
104	1230.21	55
104.5	1230.2	55.5
105	1230.21	56
105.5	1230.22	56.5
106	1230.22	57
106.5	1230.22	57.5
107	1230.23	58
107.5	1230.22	58.5
108	1230.23	59
108.5	1230.23	59.5
109	1230.23	60
109.5	1230.25	60.5
110	1230.26	61
110.5	1230.26	61.5
111	1230.28	62
111.5	1230.27	62.5
112	1230.27	63
112.5	1230.28	63.5
113	1230.28	64
113.5	1230.29	64.5
114	1230.29	65
114.5	1230.3	65.5
115	1230.3	66
115.5	1230.31	66.5
116	1230.3	67
116.5	1230.31	67.5
117	1230.32	68
117.5	1230.32	68.5
118	1230.33	69
118.5	1230.32	69.5
119	1230.33	70
119.5	1230.35	70.5
120	1230.35	71
120.5	1230.37	71.5
121	1230.36	72
121.5	1230.36	72.5
122	1230.35	73
122.5	1230.38	73.5
123	1230.39	74
123.5	1230.38	74.5
124	1230.4	75
124.5	1230.39	75.5
125	1230.4	76
125.5	1230.41	76.5
126	1230.41	77
126.5	1230.41	77.5

Frac Interference Test Anal
Signal from A-20 to B-29

time hrs	Pressure psi	dt hr
127	1230.41	78
127.5	1230.41	78.5
128	1230.44	79
128.5	1230.44	79.5
129	1230.44	80
129.5	1230.45	80.5
130	1230.46	81
130.5	1230.45	81.5
131	1230.47	82
131.5	1230.47	82.5
132	1230.47	83
132.5	1230.49	83.5
133	1230.49	84
133.5	1230.5	84.5
134	1230.5	85
134.5	1230.51	85.5
135	1230.51	86
135.5	1230.52	86.5
136	1230.53	87
136.5	1230.54	87.5
137	1230.55	88
137.5	1230.56	88.5
138	1230.56	89
138.5	1230.57	89.5
139	1230.58	90
139.5	1230.58	90.5
140	1230.59	91
140.5	1230.58	91.5
141	1230.61	92
141.5	1230.6	92.5
142	1230.61	93
142.5	1230.64	93.5

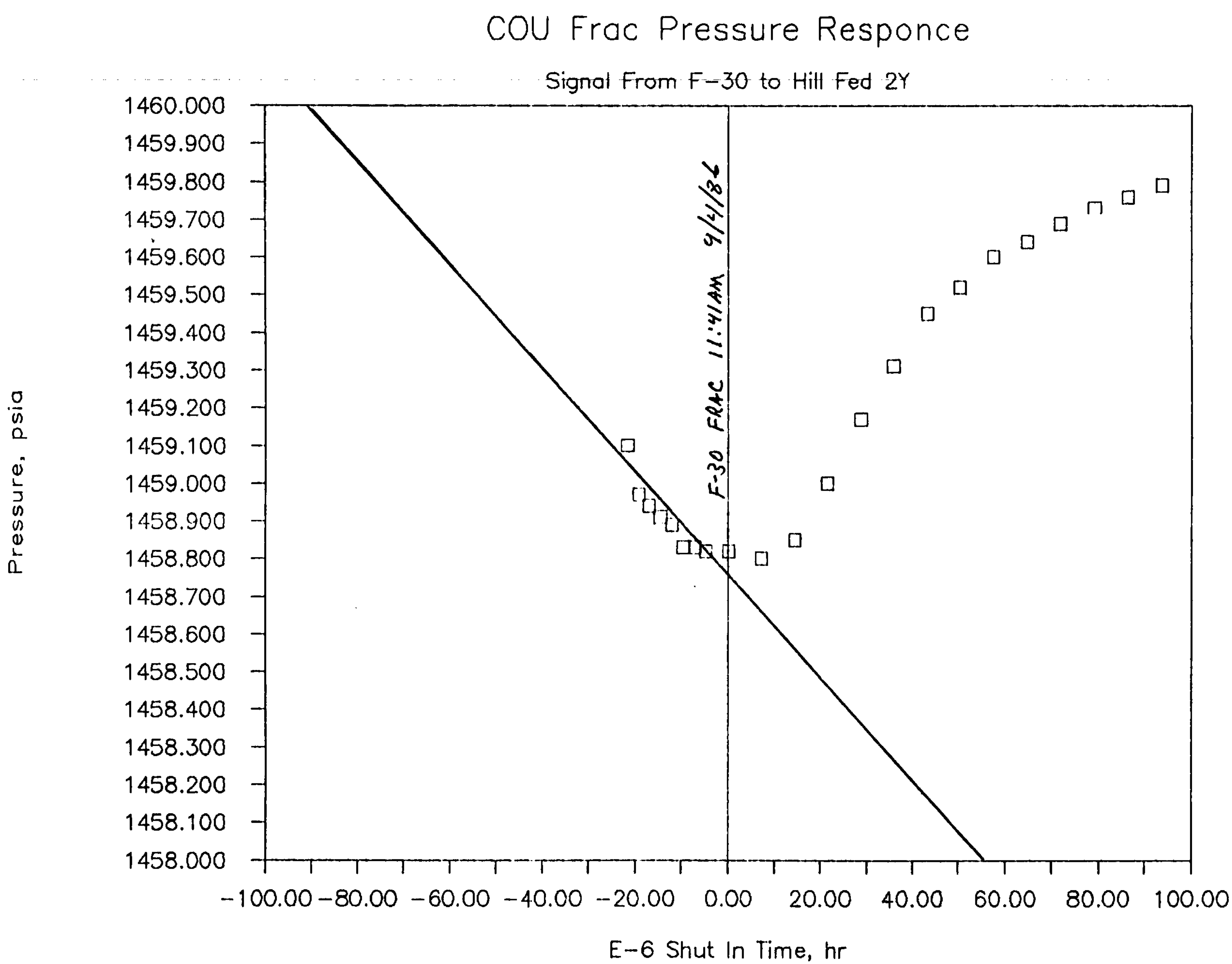

COU Frac Pressure Responce
Signal From A-20 to B-29
Pressure, psia
1231.00
1230.00
1229.00
1228.00
1227.00
1226.00
1225.00
1224.00
1223.00
1222.00
1221.00
1220.00
1219.00
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
B-29 Shut In Time, hr
#20 FRAC 11:00 AM 2/4/87


COU Frac Pressure Responce
Signal From A-20 to B-29
Pressure, psia
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
2.00
3.00
4.00
B-29 Shut In Time, hr

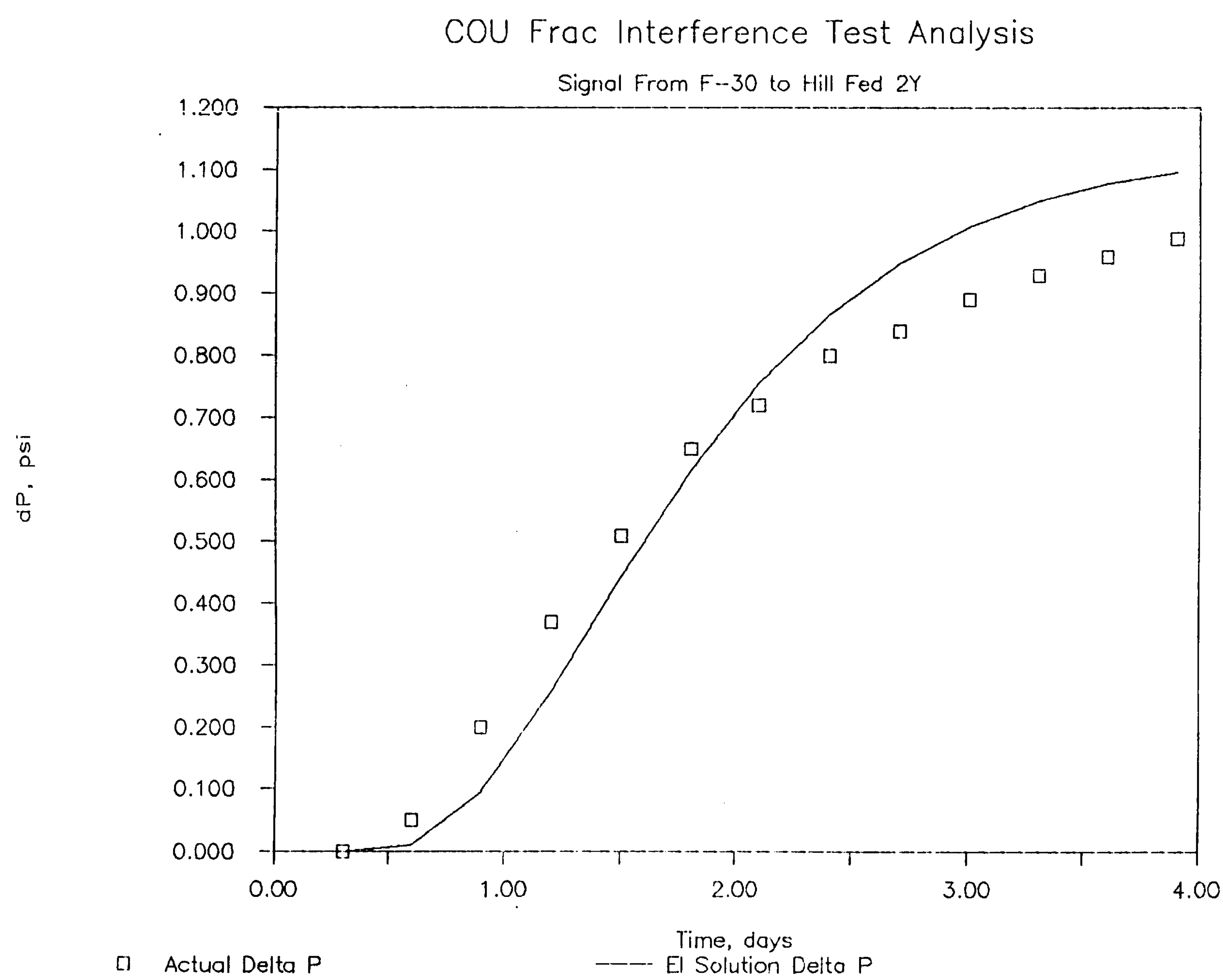
Frac Interference Test Analysis
Signal - F-30 to Hill Fed 2Y

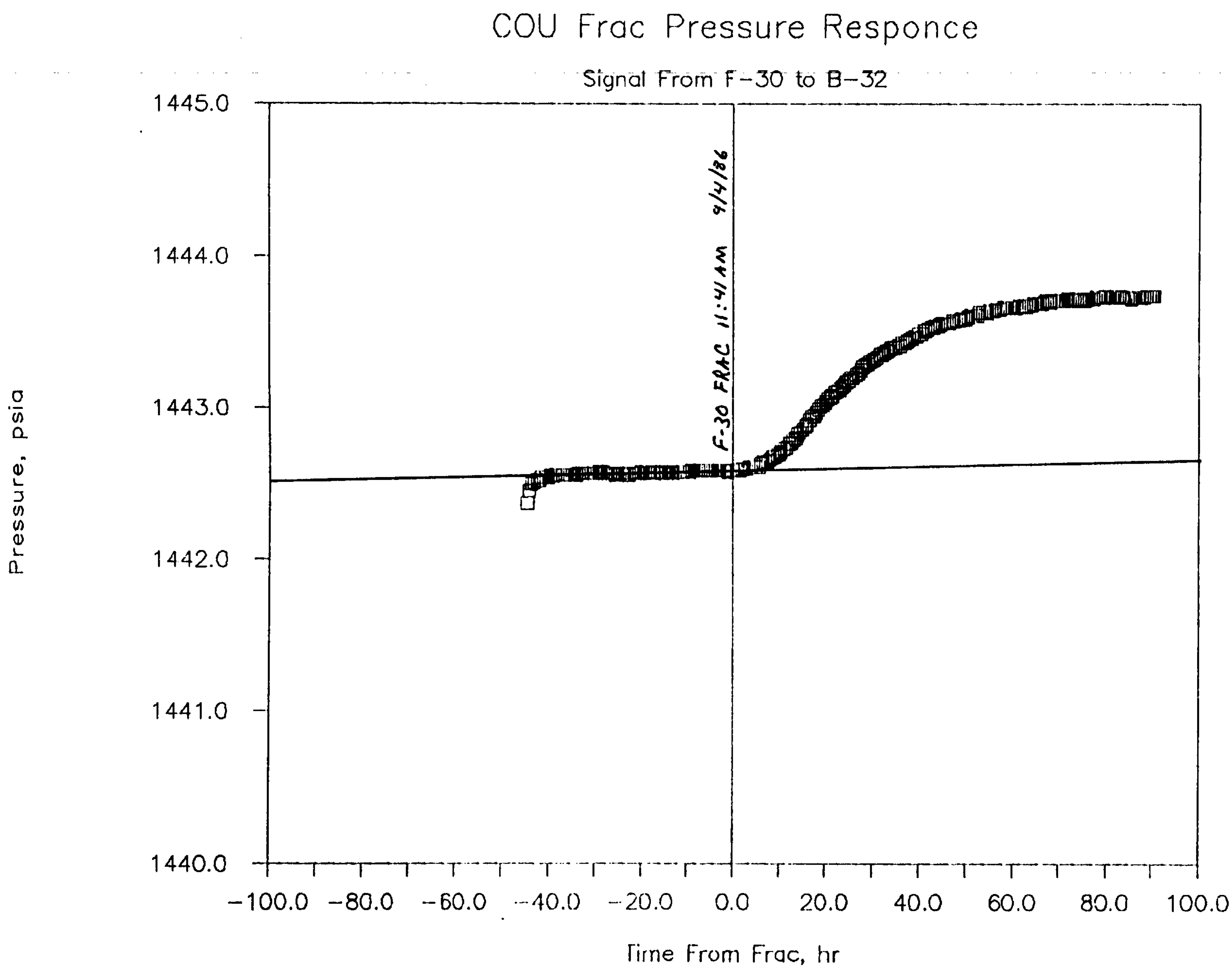
Pressures and times taken from BMG exhibit March 30, 1987

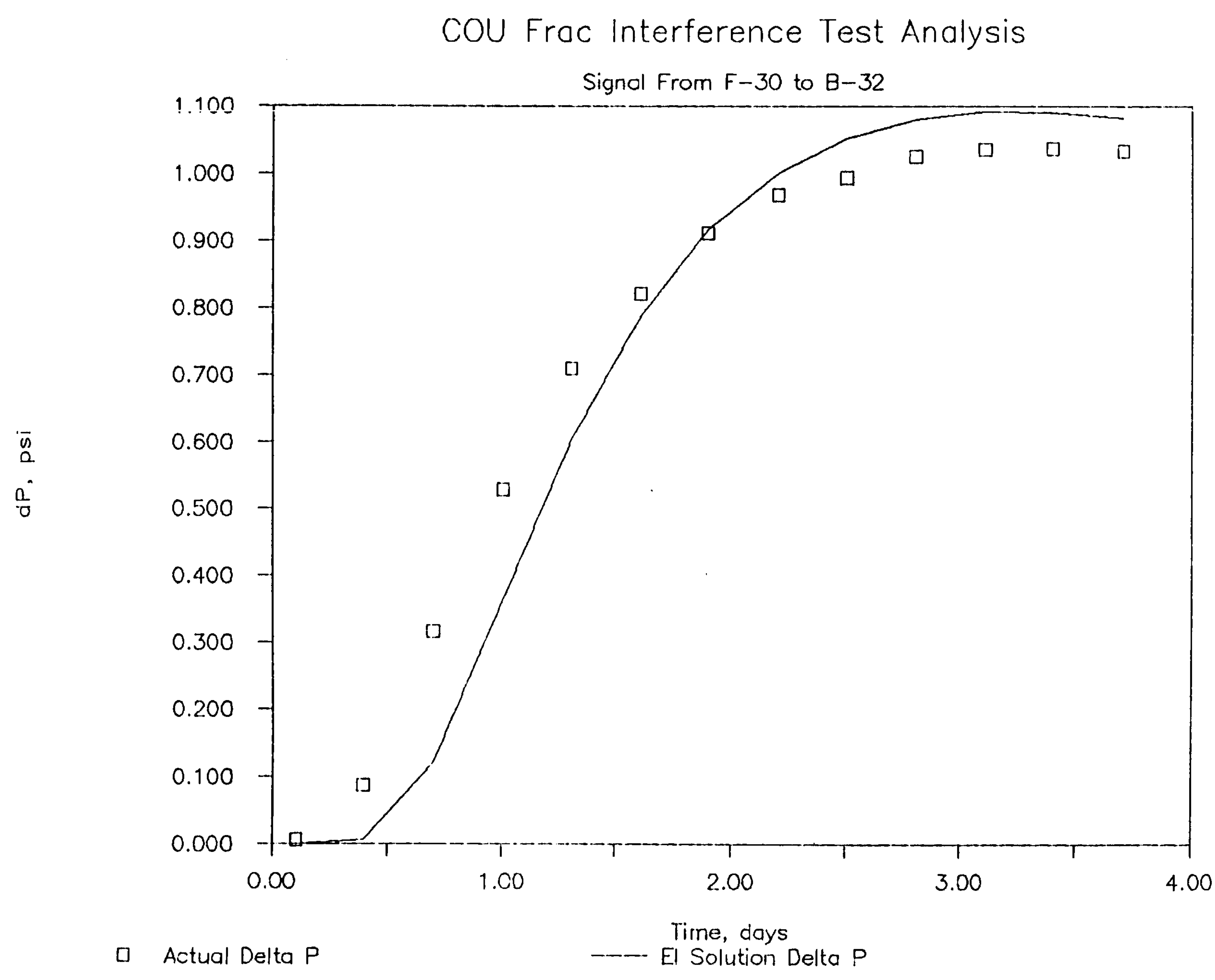
time hr	Pressure psi
7.20	1458.800
14.40	1458.850
21.60	1459.000
28.80	1459.170
36.00	1459.310
43.20	1459.450
50.40	1459.520
57.60	1459.600
64.80	1459.640
72.00	1459.690
79.20	1459.730
86.40	1459.760
93.60	1459.790
0.00	1458.820
-4.80	1458.820
-7.20	1458.830
-9.60	1458.830
-12.00	1458.890
-14.40	1458.910
-16.80	1458.940
-19.20	1458.970
-21.60	1459.100

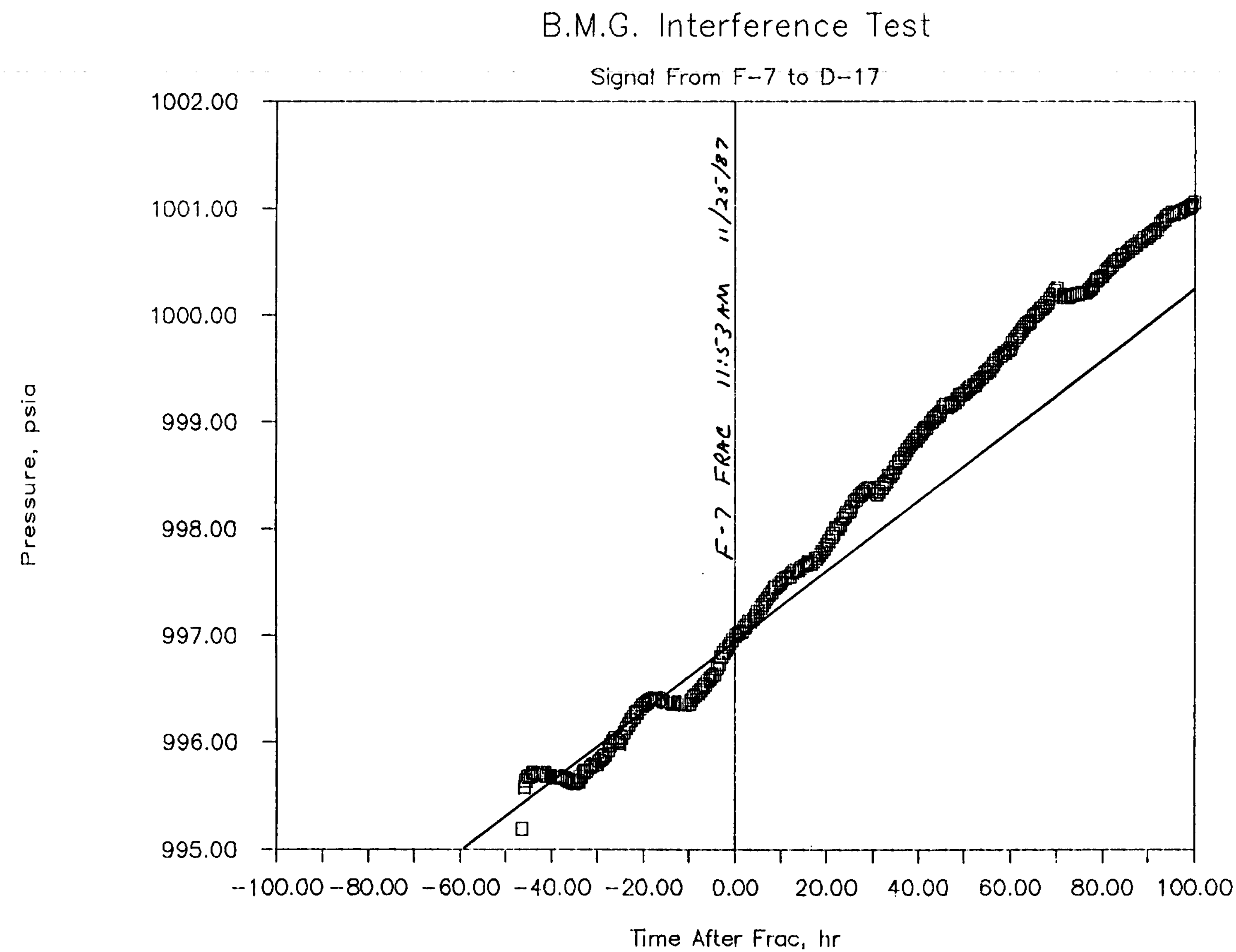


COU Frac Pressure Responce
Signal From F-30 to Hill Fed 2Y
Pressure, psia
1460.000
1459.900
1459.800
1459.700
1459.600
1459.500
1459.400
1459.300
1459.200
1459.100
1459.000
1458.900
1458.800
1458.700
1458.600
1458.500
1458.400
1458.300
1458.200
1458.100
1458.000
-100.00 -80.00 -60.00 -40.00 -20.00 0.00 20.00 40.00 60.00 80.00 100.00
E-6 Shut In Time, hr
F-30 FRAC 11:41AM 9/4/86

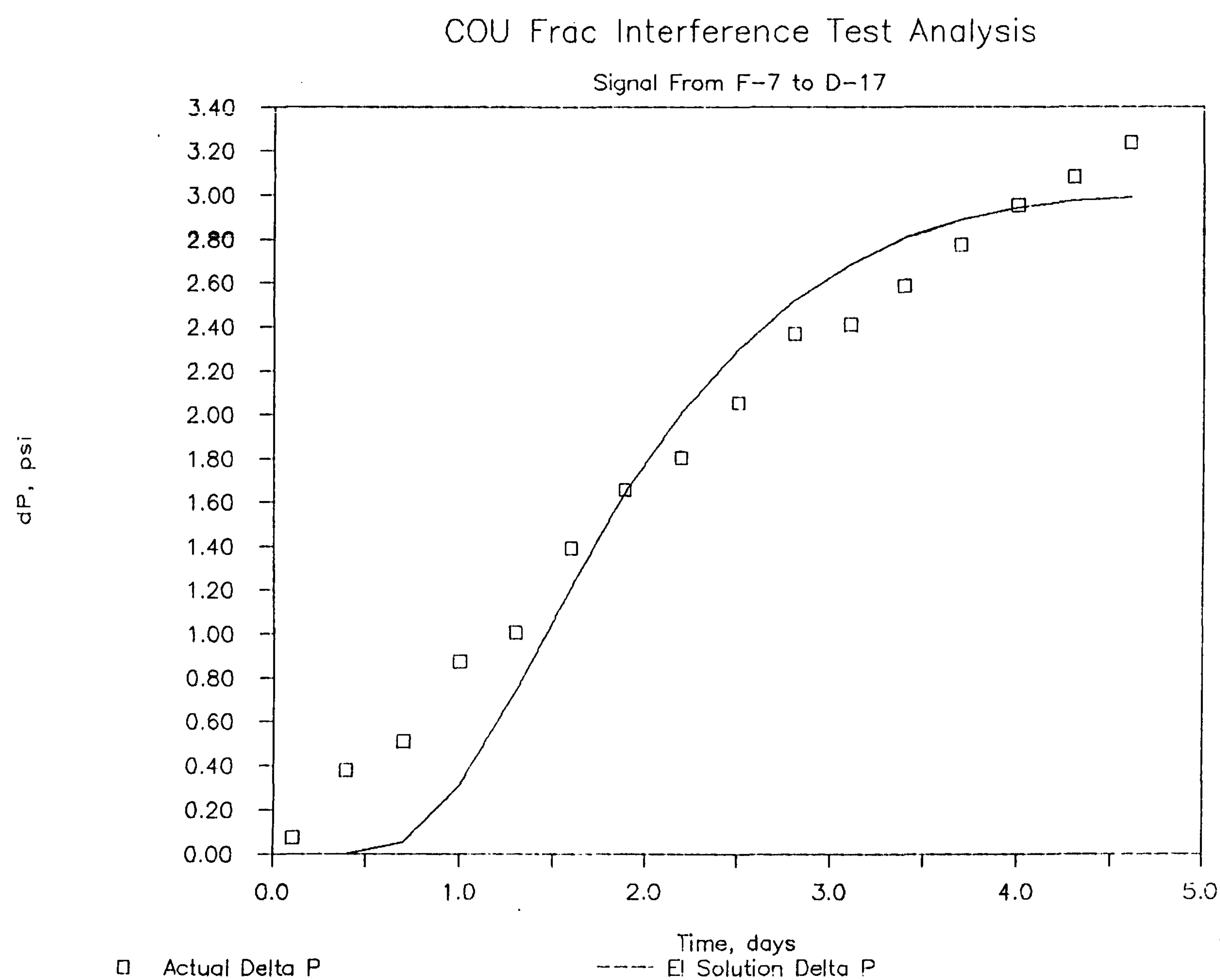

COU Frac Interference Test Analysis
Signal From F--30 to Hill Fed 2Y
dP, psi
1.200
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.00
1.00
2.00
3.00
4.00
Time, days
Actual Delta P
El Solution Delta P

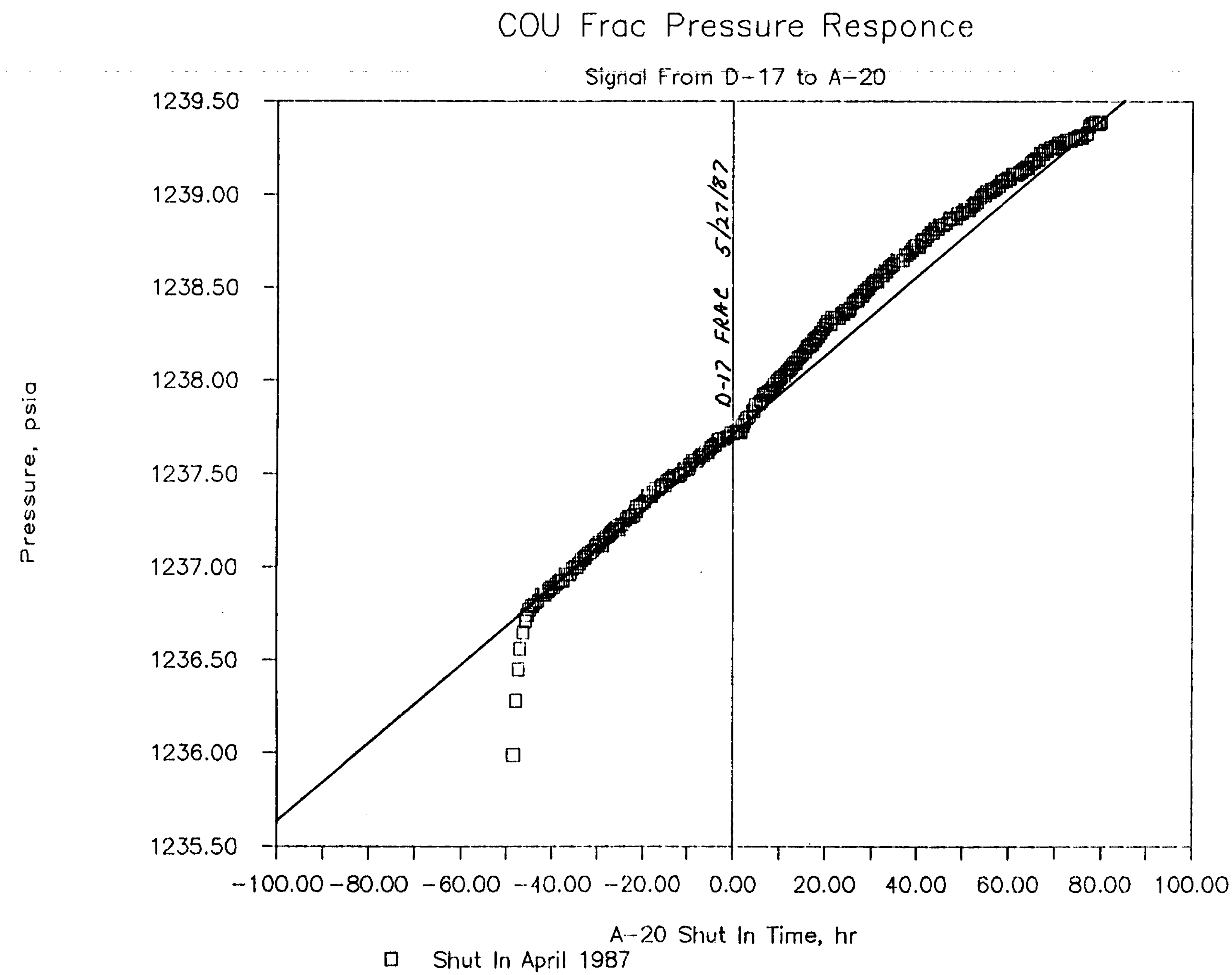

COU Frac Pressure Responce
Signal From F-30 to B-32
F-30 FRAC 11:41AM 9/4/86
Pressure, psia
1445.0
1444.0
1443.0
1442.0
1441.0
1440.0
Time From Frac, hr
-100.0
-80.0
-60.0
-40.0
-20.0
0.0
20.0
40.0
60.0
80.0
100.0


COU Frac Interference Test Analysis
Signal From F-30 to B-32
dP, psi
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.00
1.00
2.00
3.00
4.00
Time, days
Actual Delta P
El Solution Delta P

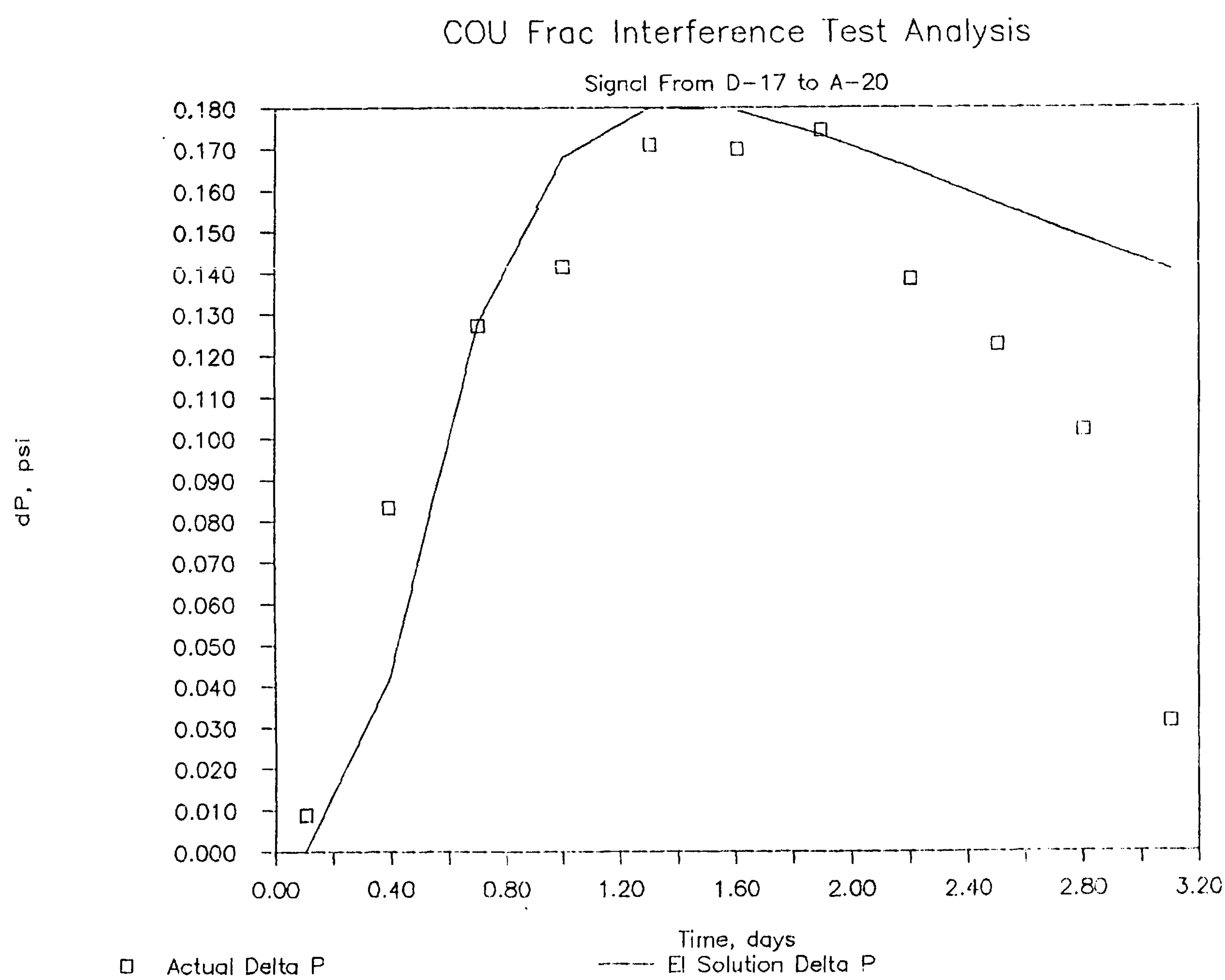


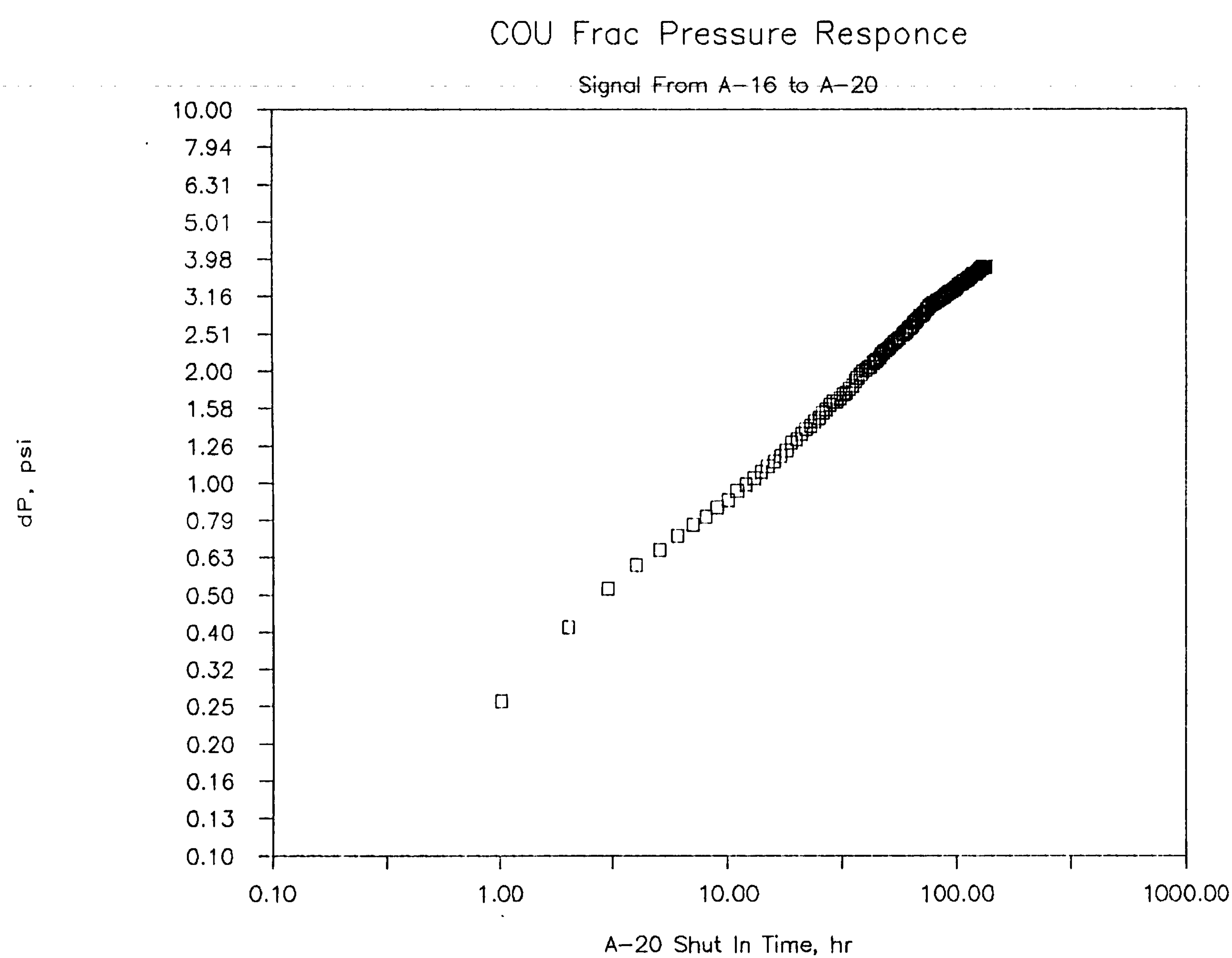
B.M.G. Interference Test
Signal From F-7 to D-17
1002.00
1001.00
1000.00
999.00
998.00
997.00
996.00
995.00
Pressure, psia
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
Time After Frac, hr
F-7 FRAC 11:53 AM 11/25/87


COU Frac Interference Test Analysis
Signal From F-7 to D-17
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
dP, psi
0.0
1.0
2.0
3.0
4.0
5.0
Time, days
Actual Delta P
El Solution Delta P

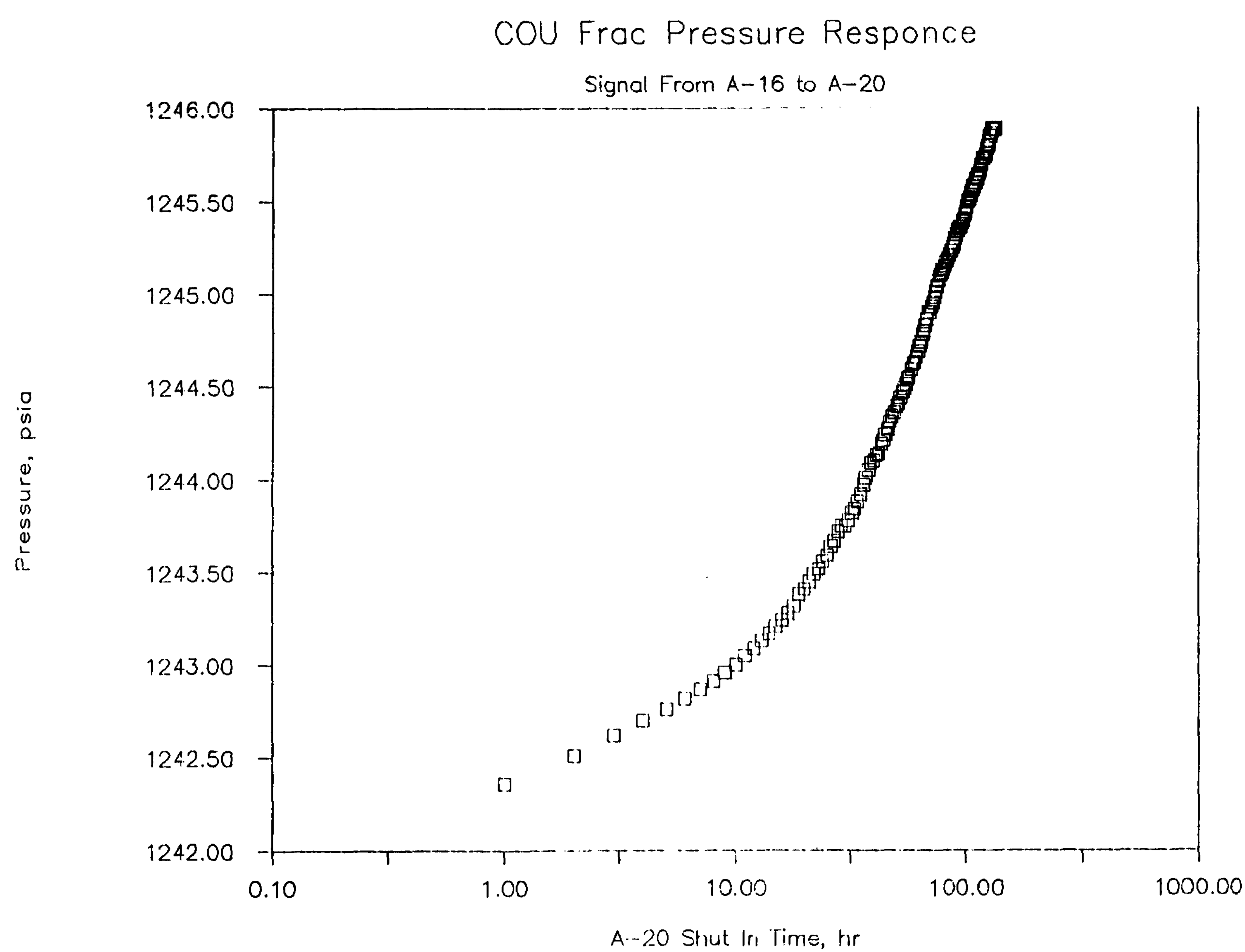


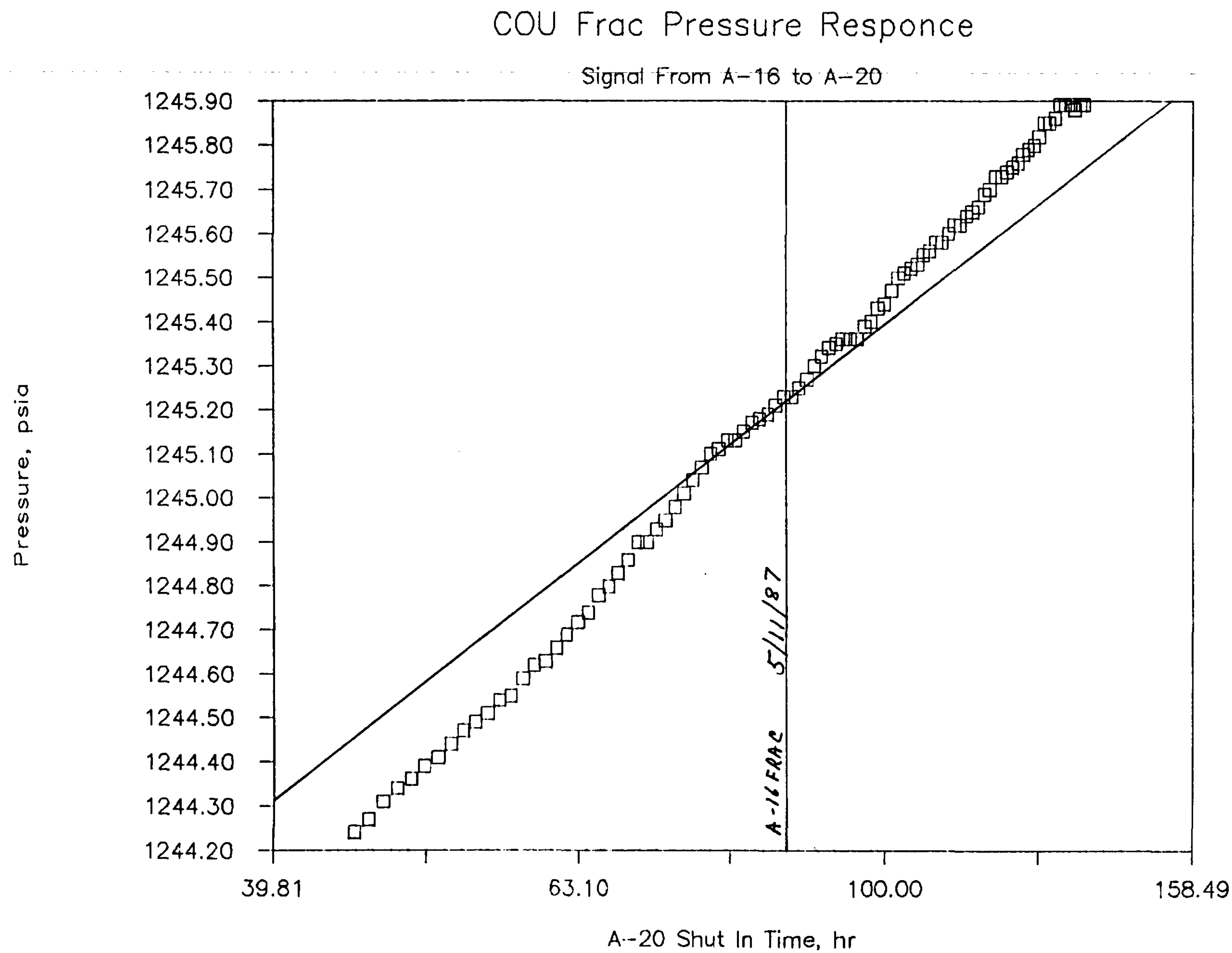
COU Frac Pressure Responce
Signal From D-17 to A-20
D-17 FRAC 5/27/87
Pressure, psia
1239.50
1239.00
1238.50
1238.00
1237.50
1237.00
1236.50
1236.00
1235.50
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
A-20 Shut In Time, hr
Shut In April 1987

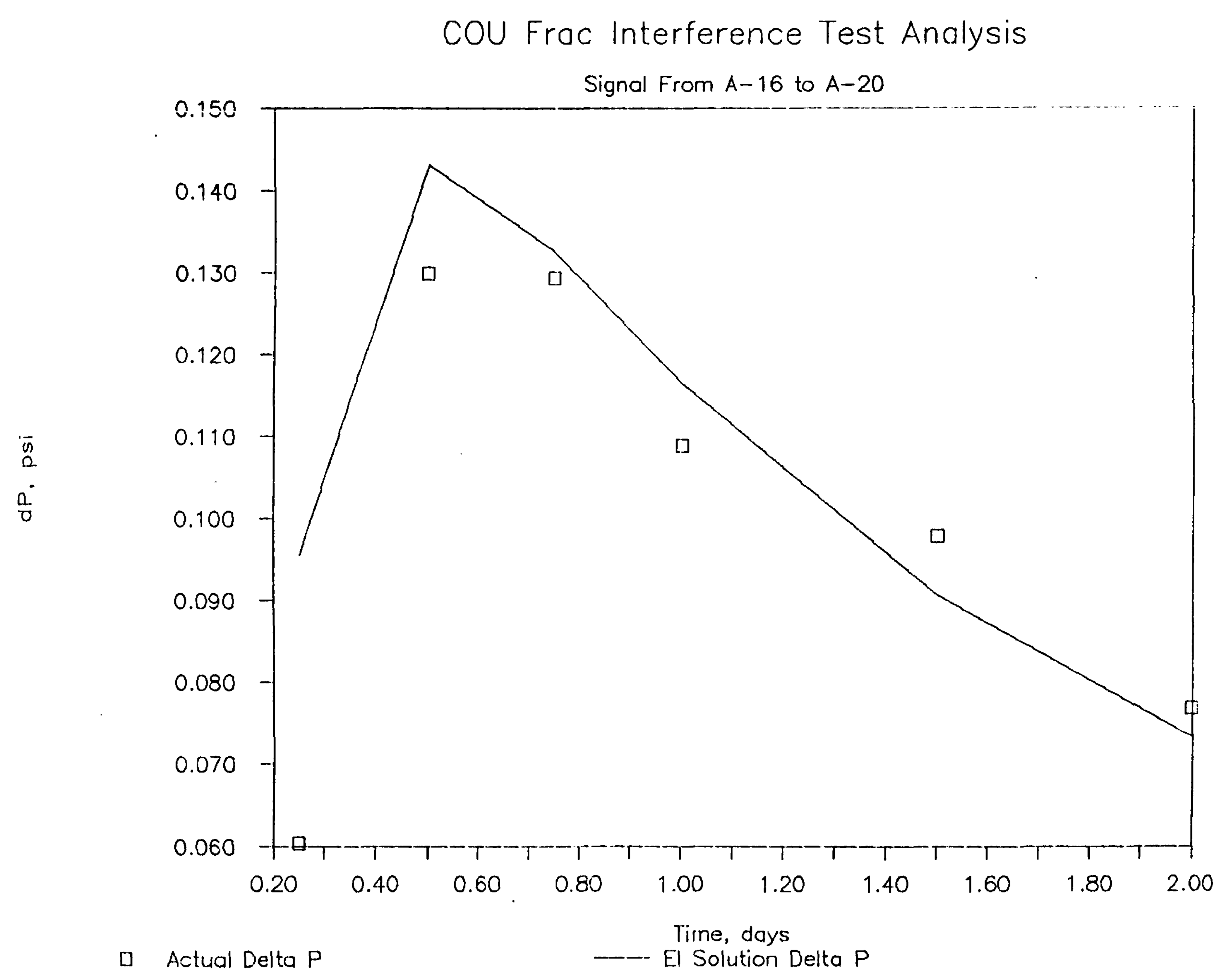

COU Frac Interference Test Analysis
Signal From D-17 to A-20
dP, psi
0.180
0.170
0.160
0.150
0.140
0.130
0.120
0.110
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
Time, days
Actual Delta P
El Solution Delta P



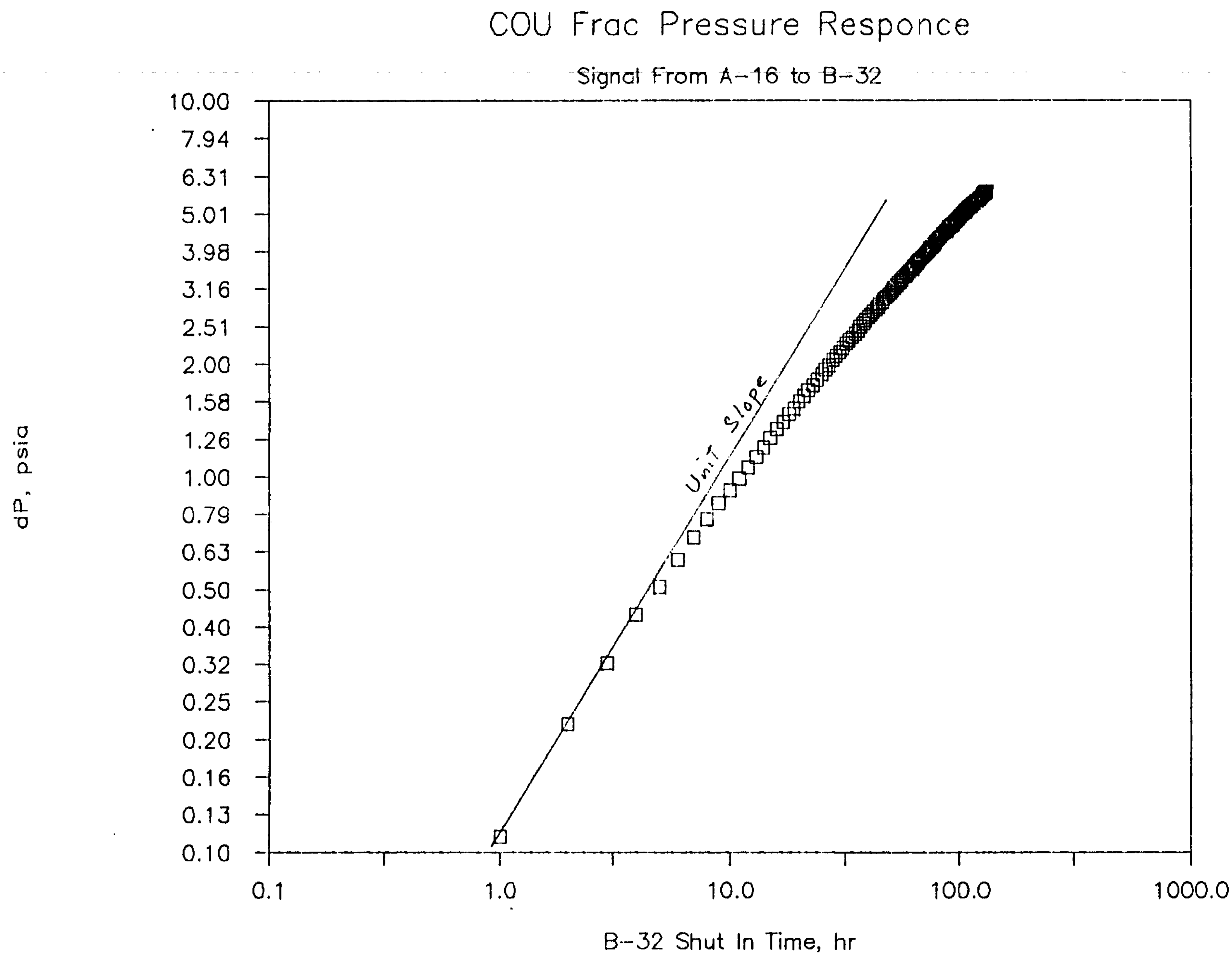
COU Frac Pressure Responce
Signal From A-16 to A-20
dP, psi
10.00
7.94
6.31
5.01
3.98
3.16
2.51
2.00
1.58
1.26
1.00
0.79
0.63
0.50
0.40
0.32
0.25
0.20
0.16
0.13
0.10
0.10
1.00
10.00
100.00
1000.00
A-20 Shut In Time, hr

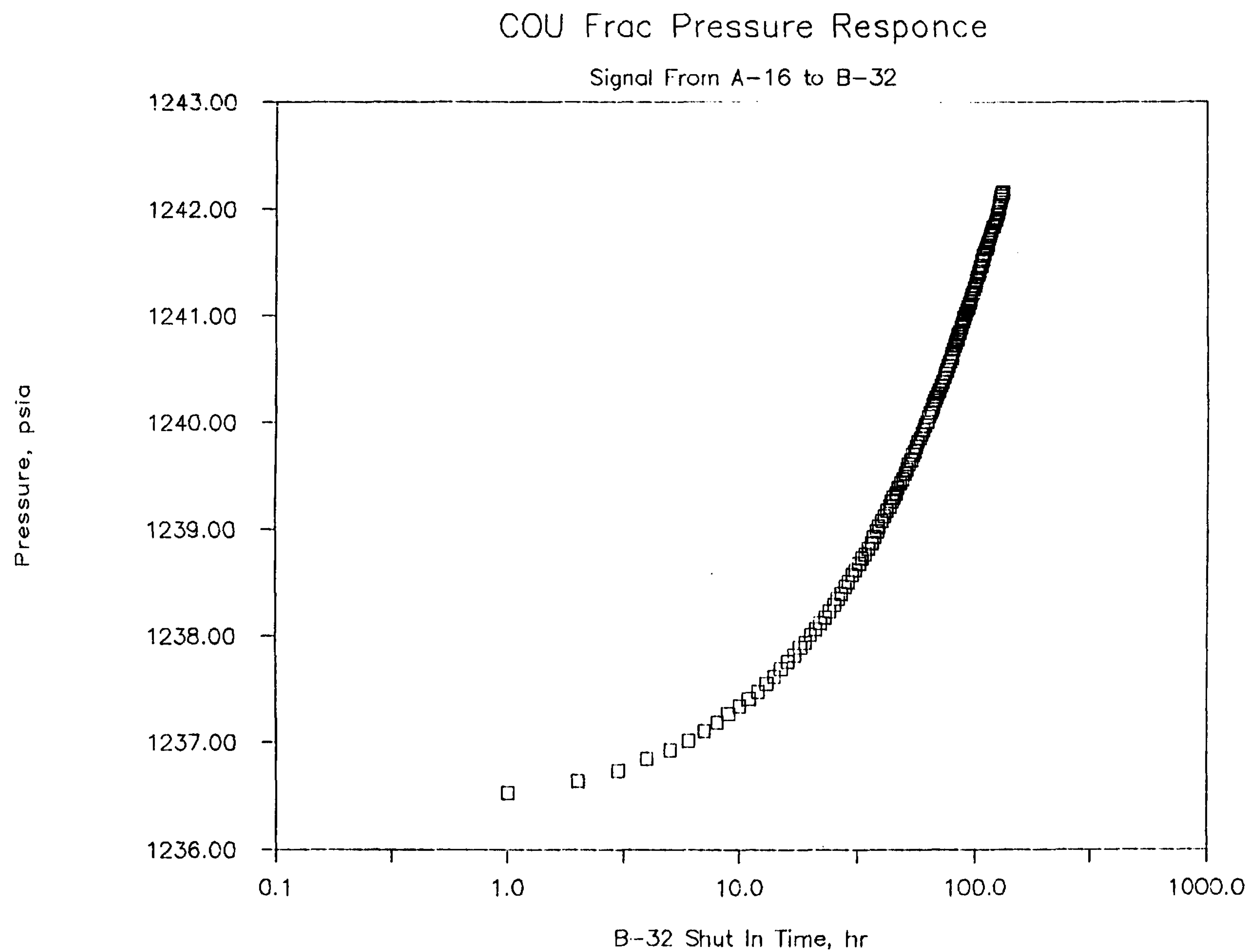

COU Frac Pressure Responce
Signal From A-16 to A-20
1246.00
1245.50
1245.00
1244.50
1244.00
1243.50
1243.00
1242.50
1242.00
Pressure, psia
0.10
1.00
10.00
100.00
1000.00
A-20 Shut In Time, hr

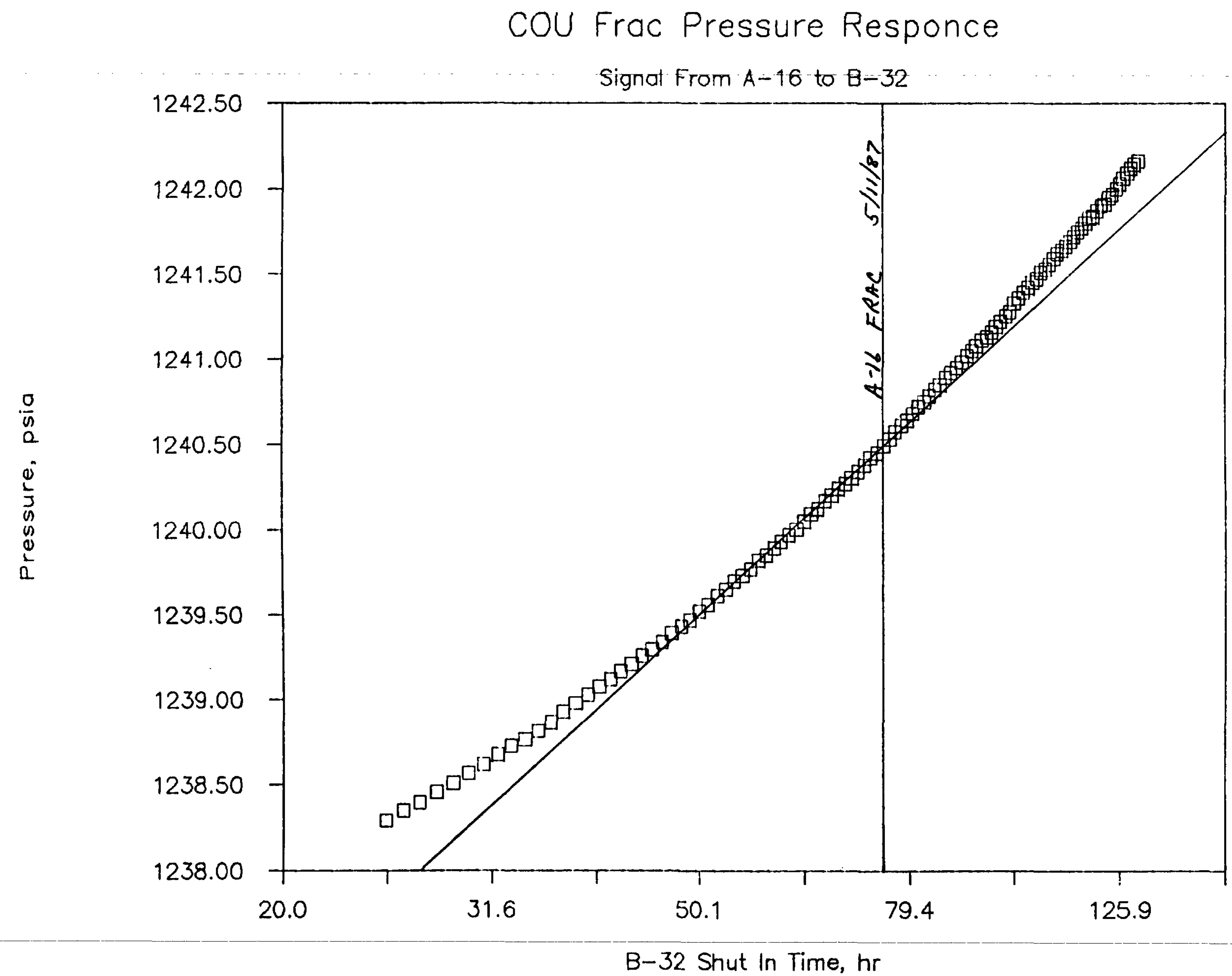

COU Frac Pressure Responce
Signal From A-16 to A-20
Pressure, psia
1245.90
1245.80
1245.70
1245.60
1245.50
1245.40
1245.30
1245.20
1245.10
1245.00
1244.90
1244.80
1244.70
1244.60
1244.50
1244.40
1244.30
1244.20
39.81
63.10
100.00
158.49
A-20 Shut In Time, hr
A-16 FRAC
5/11/87

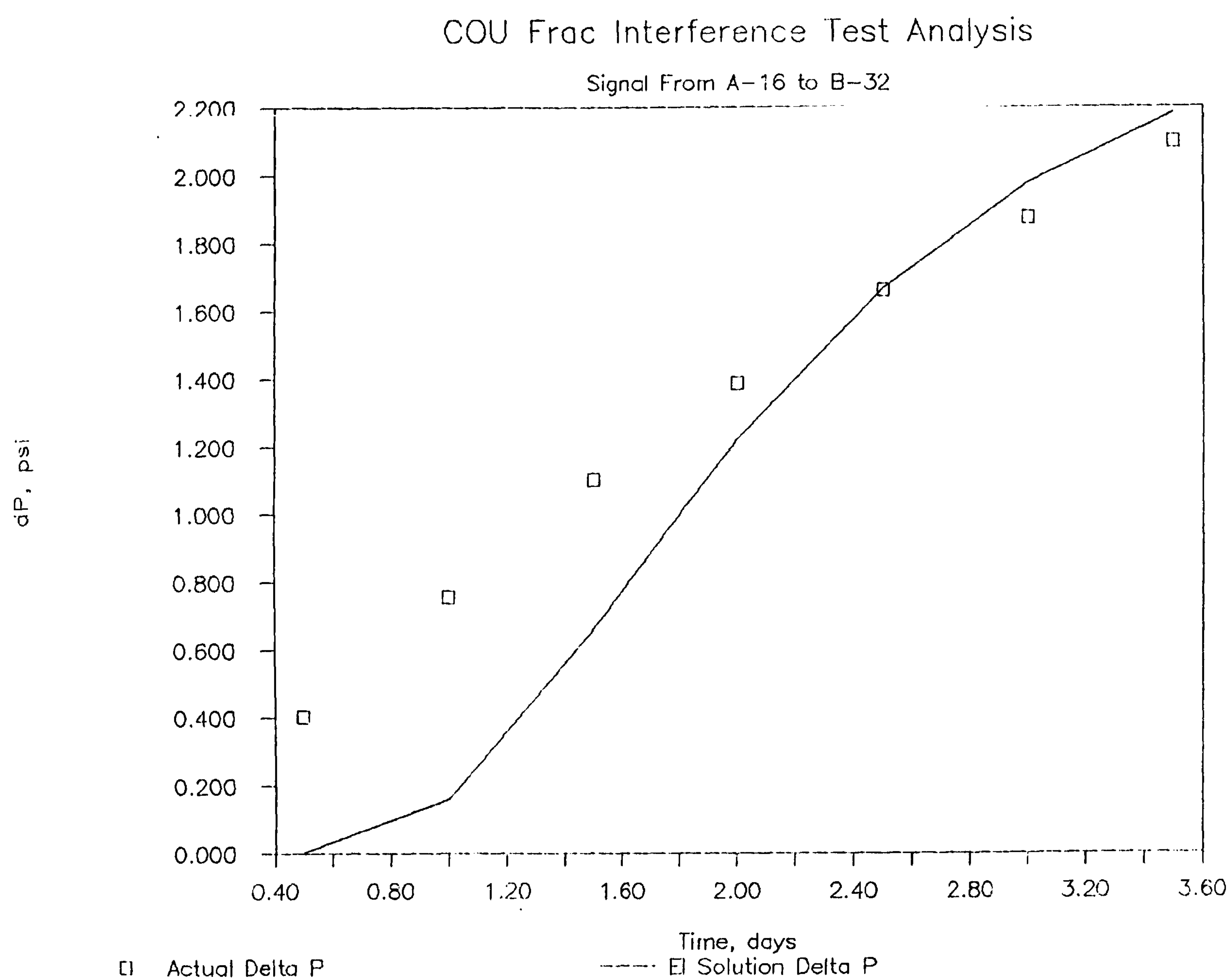


COU Frac Interference Test Analysis
Signal From A-16 to A-20
dP, psi
0.150
0.140
0.130
0.120
0.110
0.100
0.090
0.080
0.070
0.060
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
Time, days
Actual Delta P
El Solution Delta P

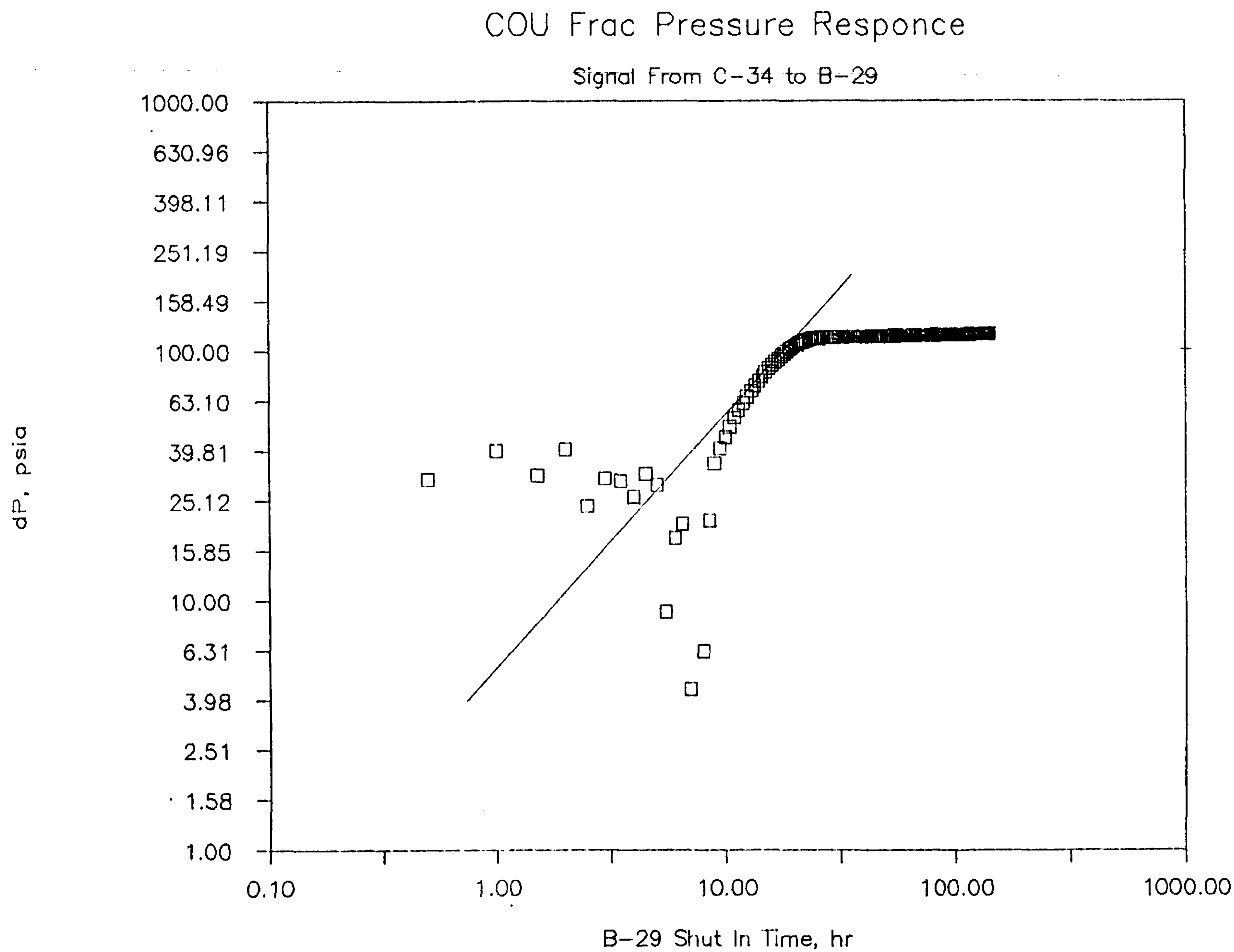

COU Frac Pressure Responce
Signal From A-16 to B-32
dP, psia
10.00
7.94
6.31
5.01
3.98
3.16
2.51
2.00
1.58
1.26
1.00
0.79
0.63
0.50
0.40
0.32
0.25
0.20
0.16
0.13
0.10
0.1
1.0
10.0
100.0
1000.0
B-32 Shut In Time, hr
Unit Slope

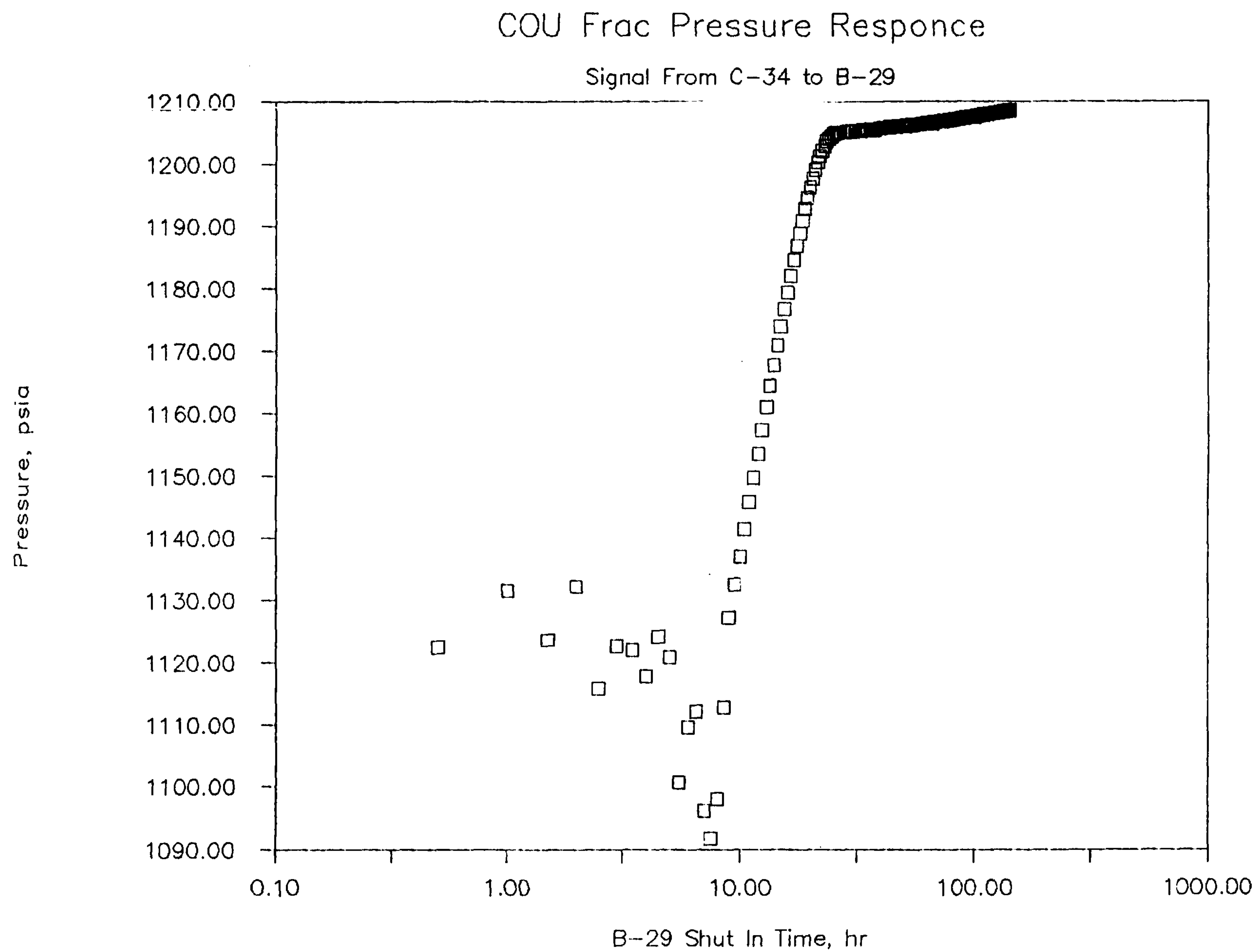

COU Frac Pressure Responce
Signal From A-16 to B-32
1243.00
1242.00
1241.00
1240.00
1239.00
1238.00
1237.00
1236.00
Pressure, psia
0.1
1.0
10.0
100.0
1000.0
B-32 Shut In Time, hr

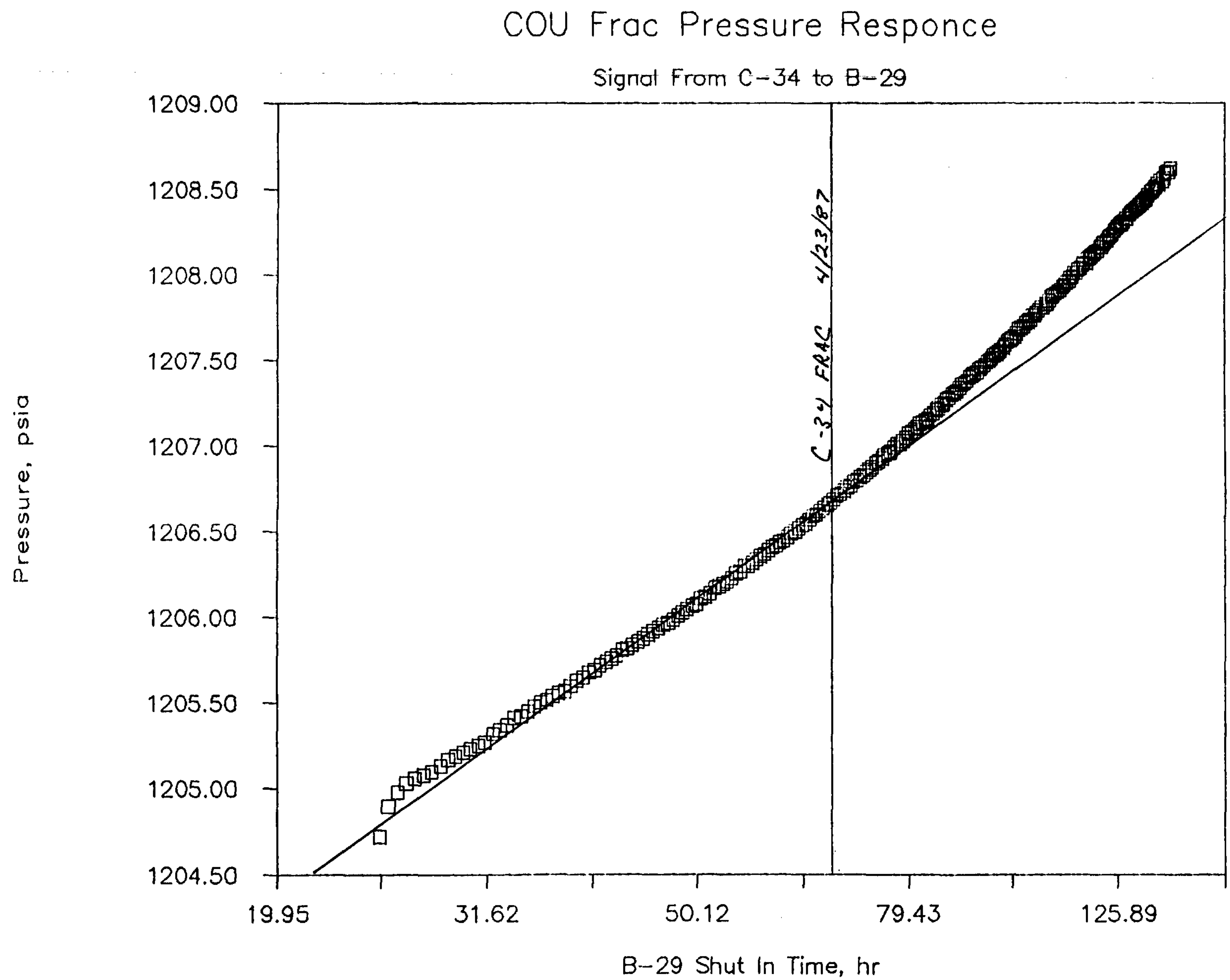

COU Frac Pressure Responce
Signal From A-16 to B-32
A-16 FRAC 5/11/87
Pressure, psia
1242.50
1242.00
1241.50
1241.00
1240.50
1240.00
1239.50
1239.00
1238.50
1238.00
20.0
31.6
50.1
79.4
125.9
B-32 Shut In Time, hr



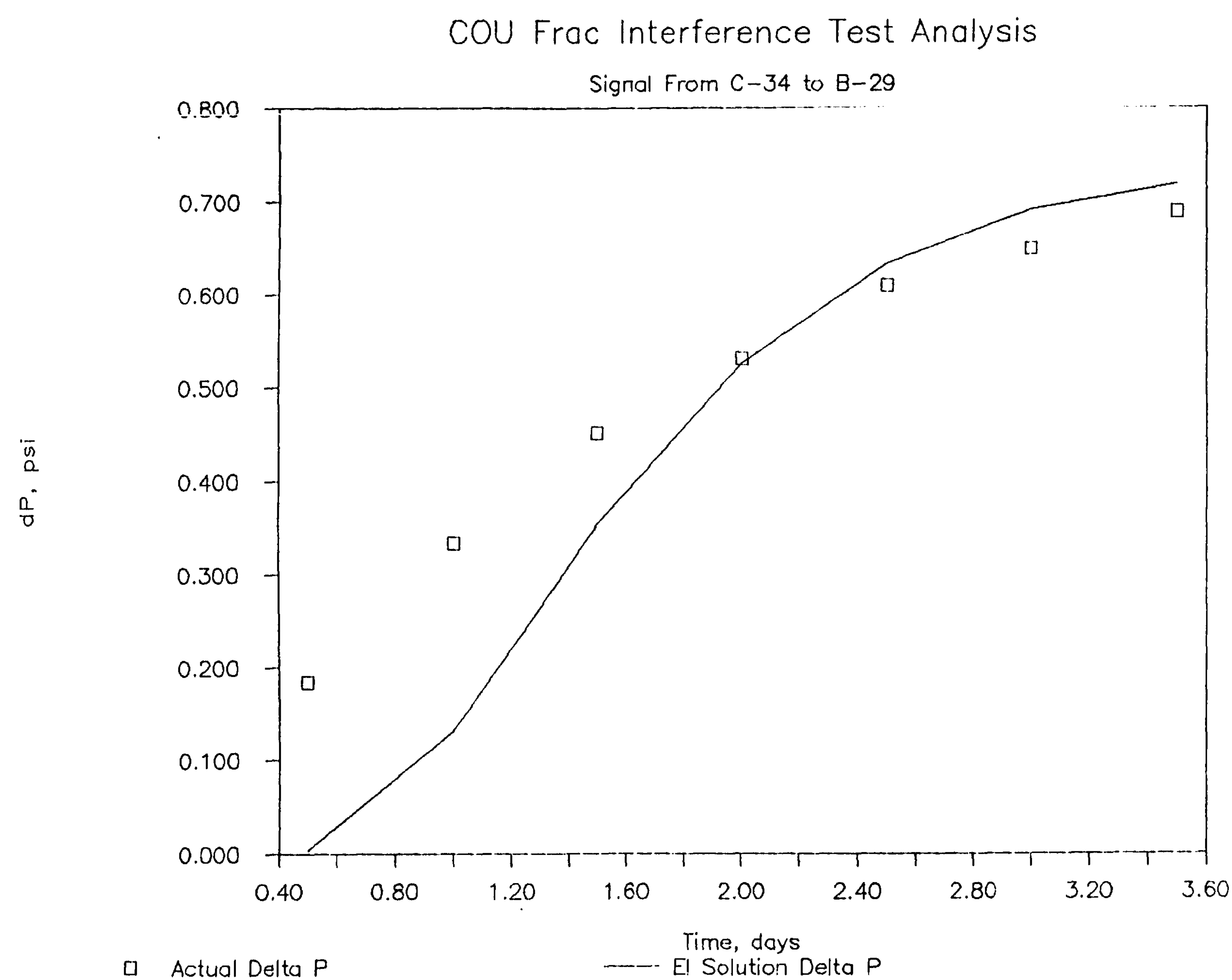
COU Frac Interference Test Analysis
Signal From A-16 to B-32
dP, psi
2.200
2.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
Time, days
Actual Delta P
El Solution Delta P


COU Frac Pressure Responce
Signal From C-34 to B-29
1000.00
630.96
398.11
251.19
158.49
100.00
63.10
39.81
25.12
15.85
10.00
6.31
3.98
2.51
1.58
1.00
dP, psia
0.10
1.00
10.00
100.00
1000.00
B-29 Shut In Time, hr

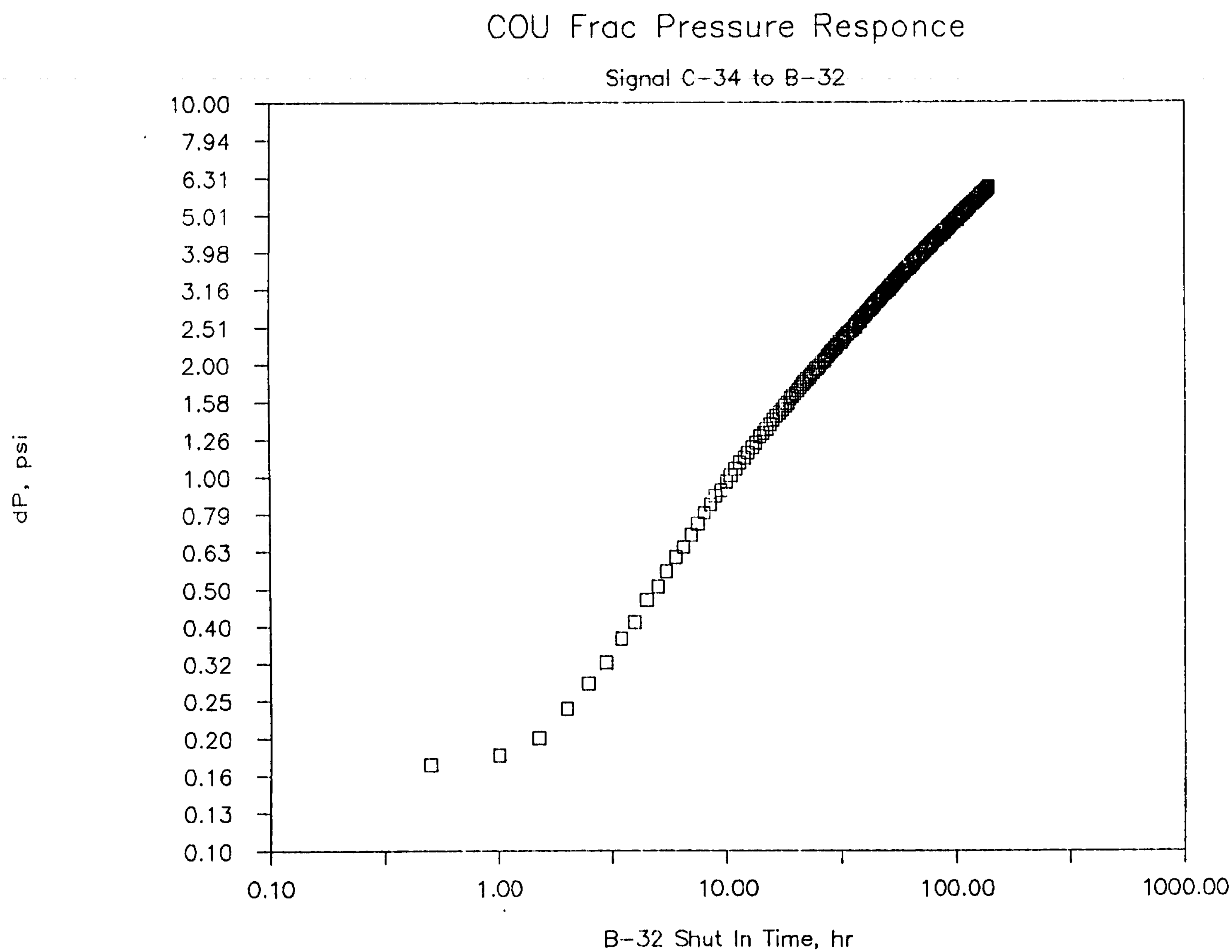

COU Frac Pressure Responce
Signal From C-34 to B-29
Pressure, psia
1210.00
1200.00
1190.00
1180.00
1170.00
1160.00
1150.00
1140.00
1130.00
1120.00
1110.00
1100.00
1090.00
0.10
1.00
10.00
100.00
1000.00
B-29 Shut In Time, hr

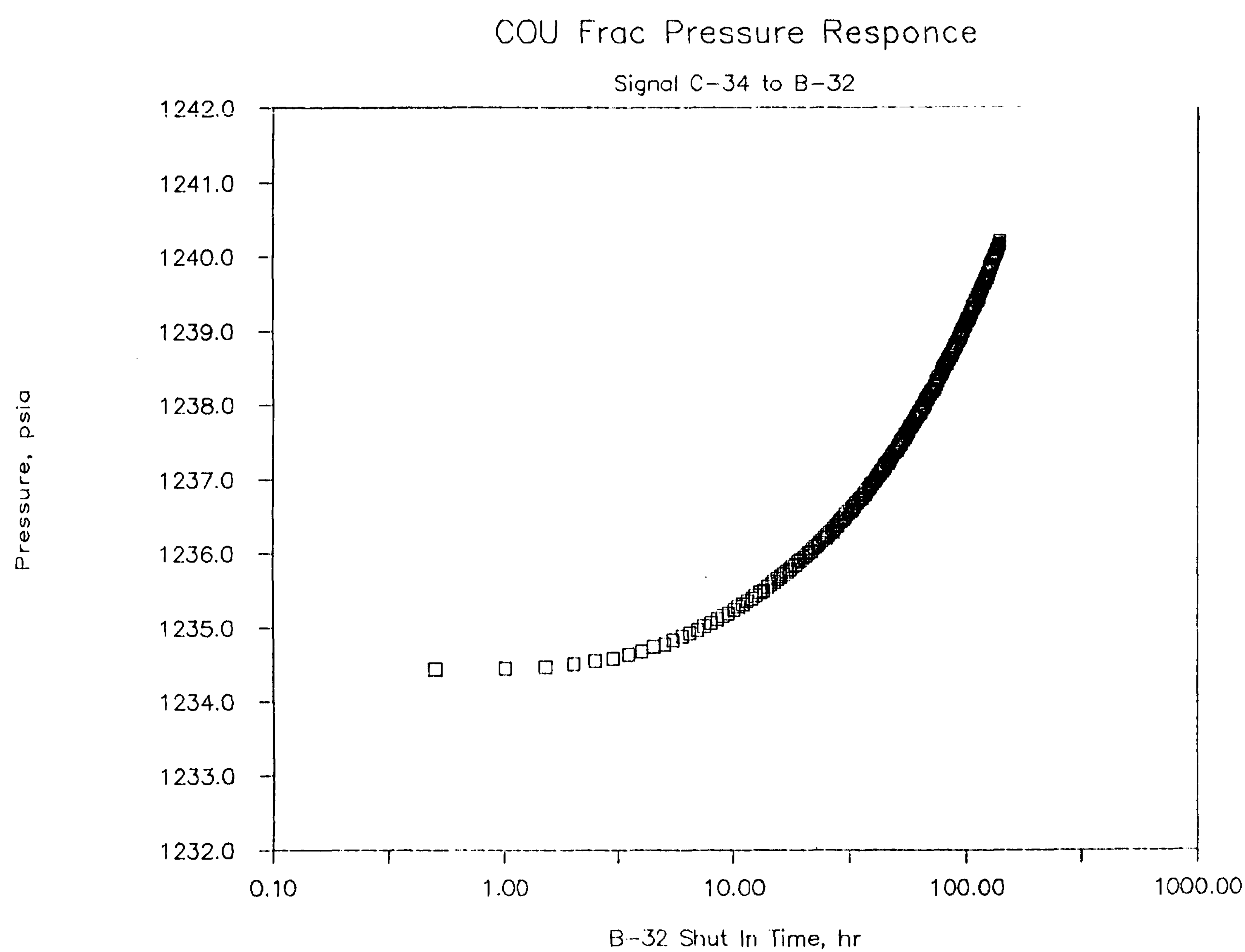


COU Frac Pressure Responce
Signal From C-34 to B-29
Pressure, psia
1209.00
1208.50
1208.00
1207.50
1207.00
1206.50
1206.00
1205.50
1205.00
1204.50
19.95
31.62
50.12
79.43
125.89
B-29 Shut In Time, hr
C-34 FRAC 4/23/87

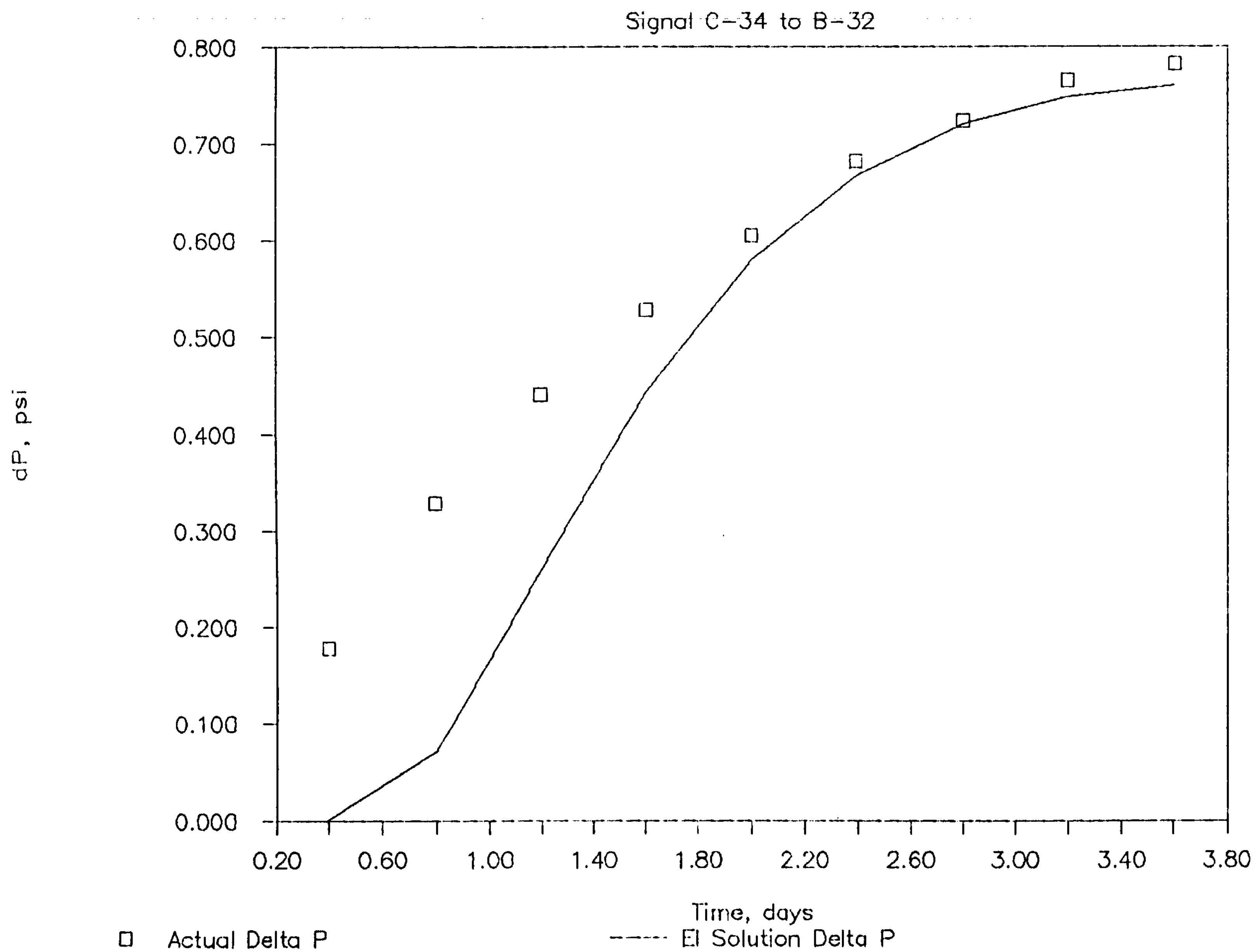


COU Frac Interference Test Analysis
Signal From C-34 to B-29
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
dP, psi
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
Time, days
Actual Delta P
El Solution Delta P


COU Frac Pressure Responce
Signal C-34 to B-32
dP, psi
10.00
7.94
6.31
5.01
3.98
3.16
2.51
2.00
1.58
1.26
1.00
0.79
0.63
0.50
0.40
0.32
0.25
0.20
0.16
0.13
0.10
0.10
1.00
10.00
100.00
1000.00
B-32 Shut In Time, hr


COU Frac Pressure Responce
Signal C–34 to B–32
Pressure, psia
1242.0
1241.0
1240.0
1239.0
1238.0
1237.0
1236.0
1235.0
1234.0
1233.0
1232.0
0.10
1.00
10.00
100.00
1000.00
B–32 Shut In Time, hr

COU Frac Interference Test Analysis



APPENDIX 4

Rate Sensitivity

$$q_{crit} = \frac{(4.9\times10^{-4})(k k'_{rg})(A)(\Delta\gamma)(\sin\theta)}{(\mu_g)(M-1)} = RB/D$$

Page 376 Dake

$kk'_{rg} = \frac{235}{235 ft} = 1.0 md$

$B_o = 1.293$

$A = 139400$

$\Delta\gamma = (0.7206 - 0.0136)$

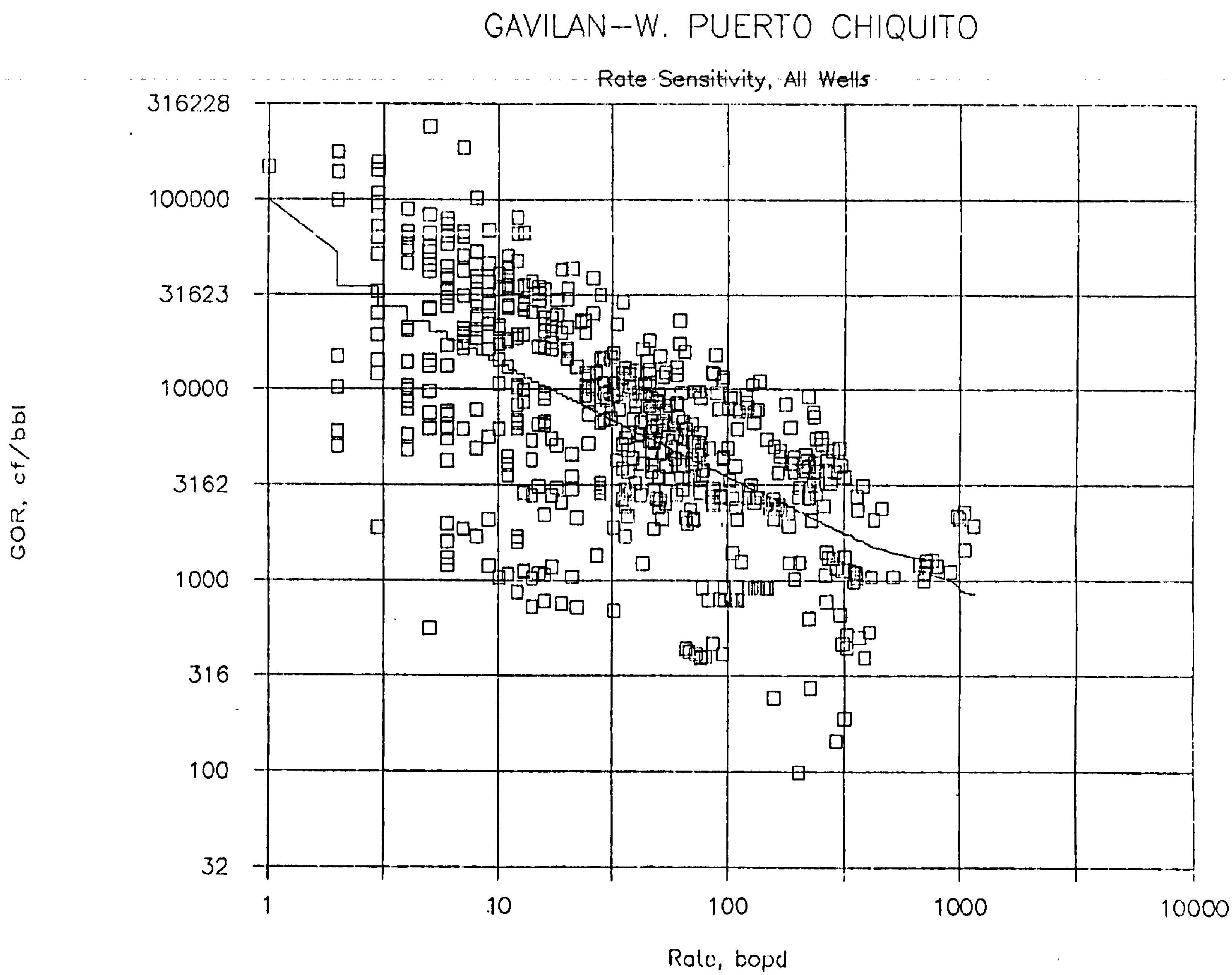
$\mu_g = 0.01359$

$\mu_o = 0.710$

$M = \frac{k_{rg}}{k_{ro}} \frac{\mu_o}{\mu_g}$ @ 800 psi $\frac{(0.85)(0.710)}{0.01359} = 44.4$

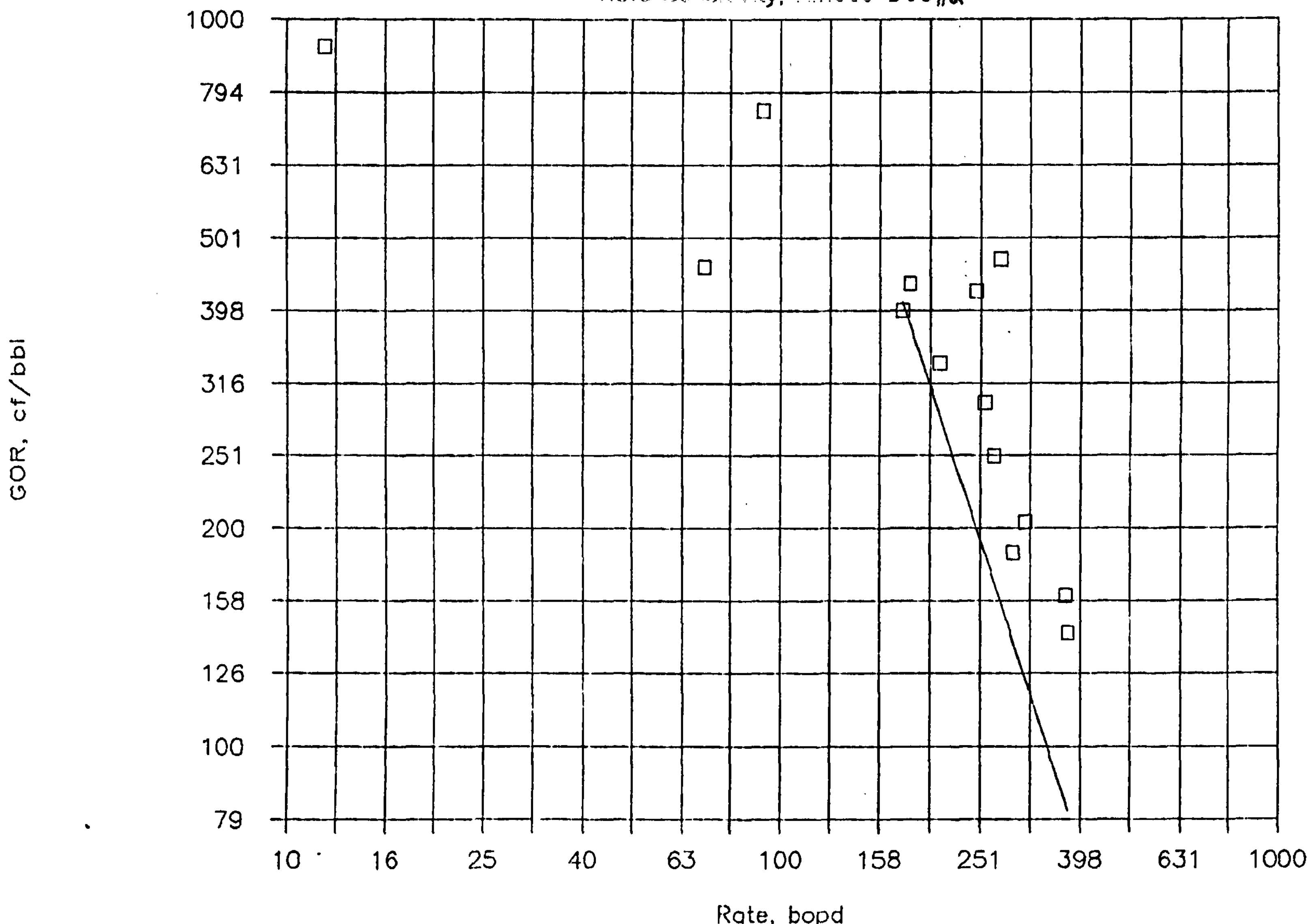
$$q_{crit} = \frac{(4.9\times10^{-4})(1 md)(139400)(0.7206-0.0136)(-1)}{(0.01359)(44.4-1)(1.293)}$$

$q_{crit} = 63.13$ RB/D or 50 STB/D


GAVILAN—W. PUERTO CHIQUITO
Rate Sensitivity, All Wells
316228
100000
31623
10000
3162
1000
316
100
32
GOR, cf/bbl
1
10
100
1000
10000
Rate, bopd

Gavilan Dome, 2/15–2/29/88

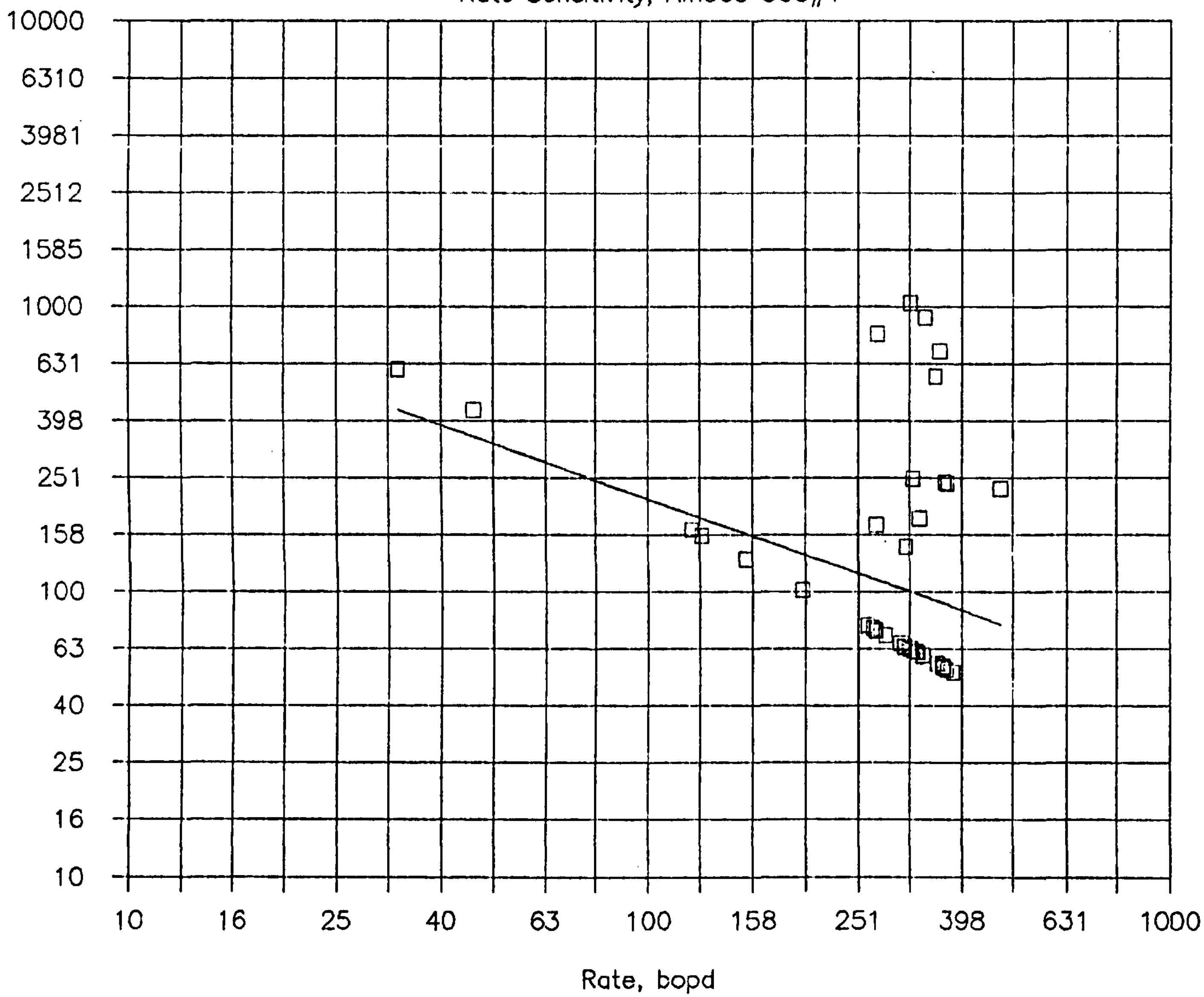
Rate Sensitivity, Amoco BCU#2



C.C. = 0.31

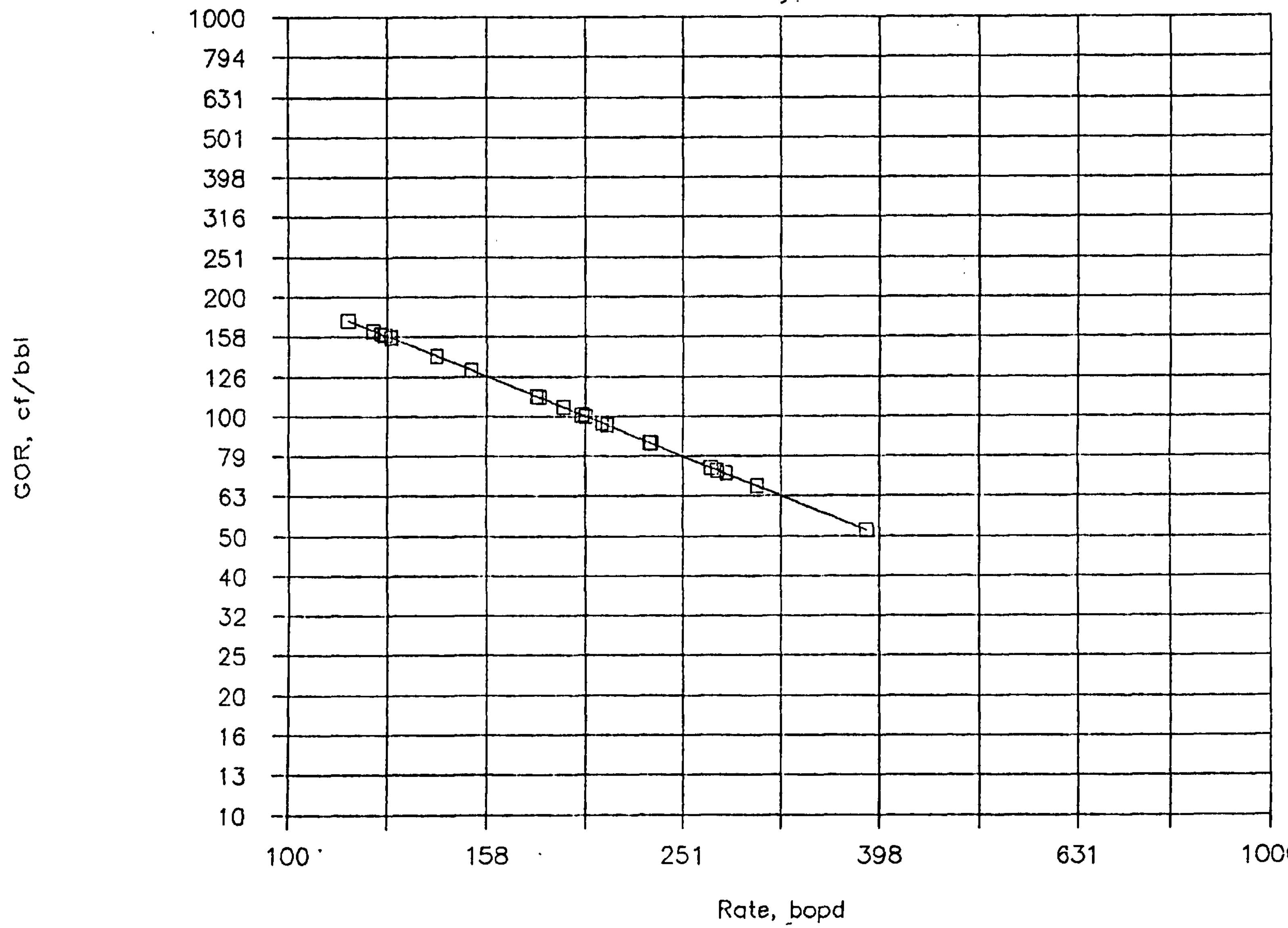
Gavilan Dome, 1/6–2/29/88

Rate Sensitivity, Amoco SGC#1

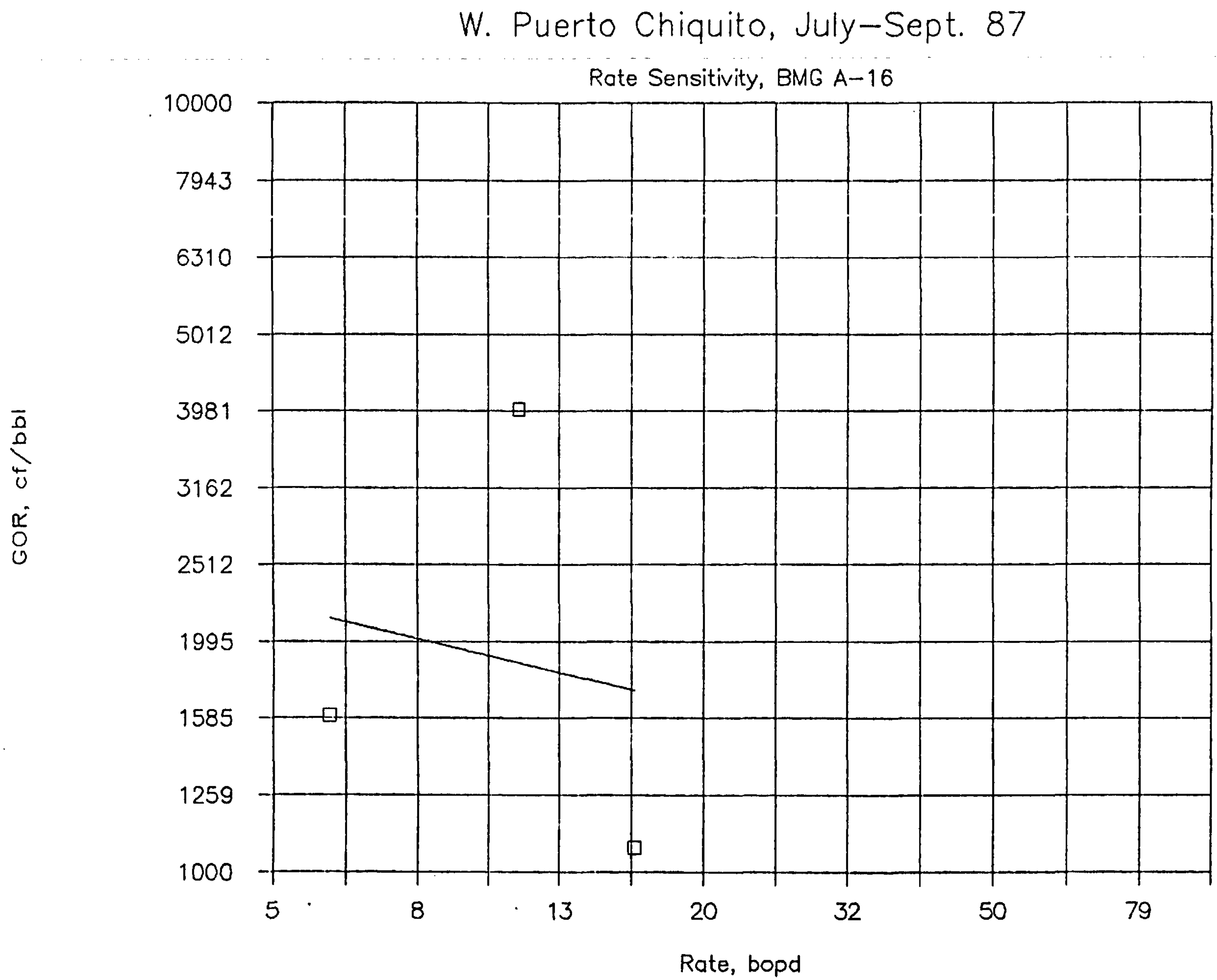


Gavilan Dome, 2/1–2/29/88

Rate Sensitivity, Amoco SCC

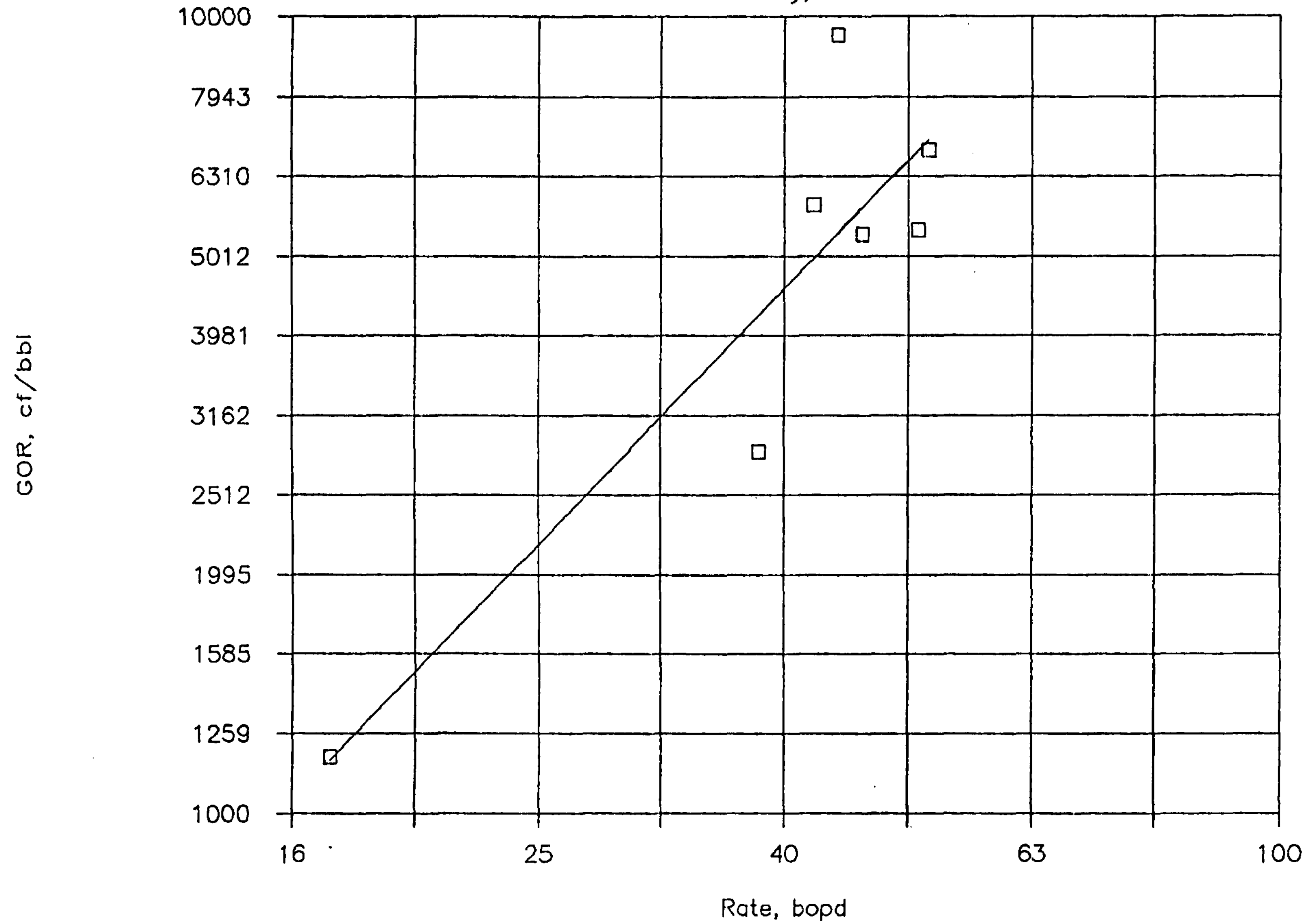


C.C. = 1.00

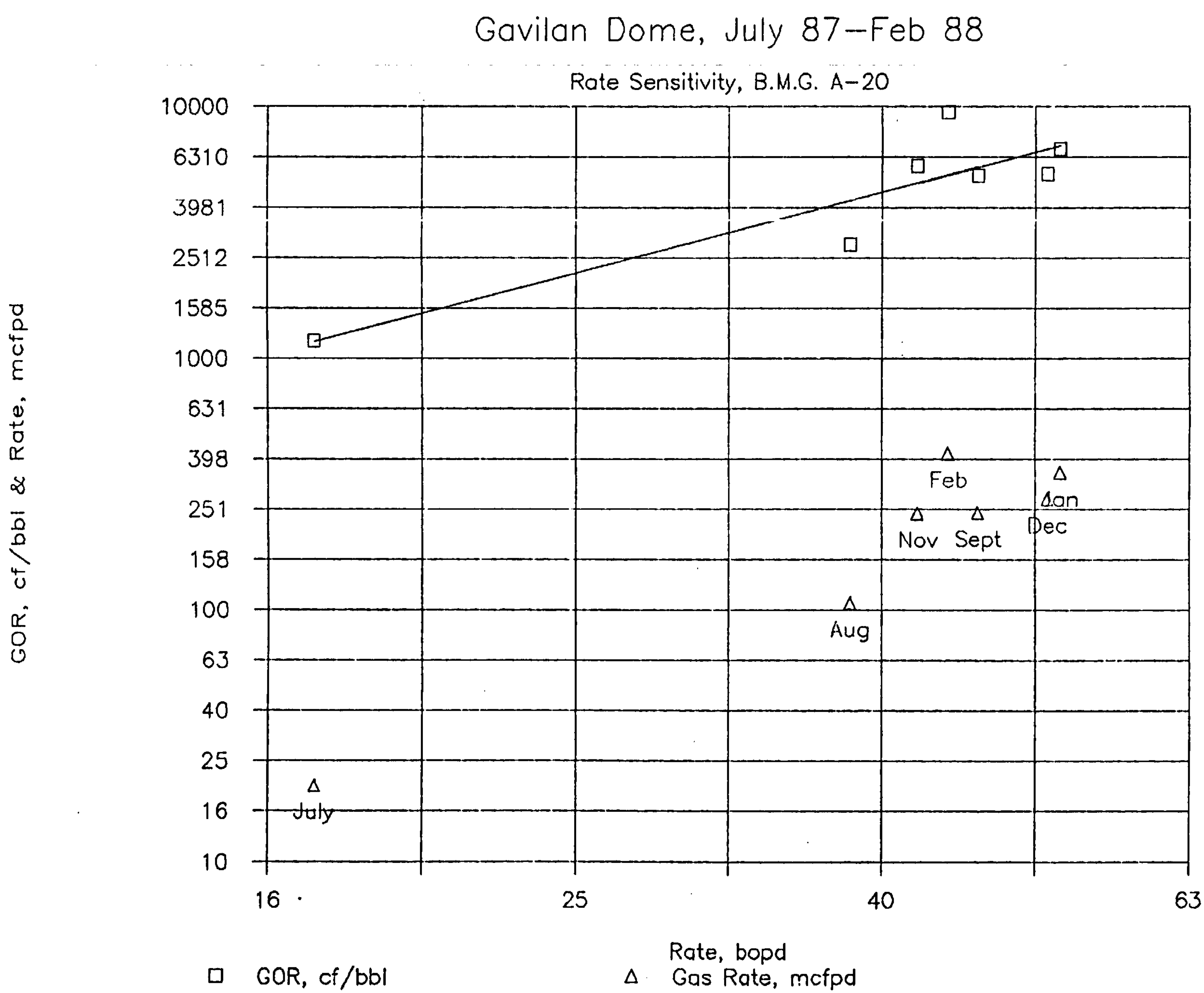

W. Puerto Chiquito, July—Sept. 87
Rate Sensitivity, BMG A—16
GOR, cf/bbl
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
5
8
13
20
32
50
79
Rate, bopd

W. Puerto Chiquito, July 87—Feb 88

Rate Sensitivity, BMG A-20



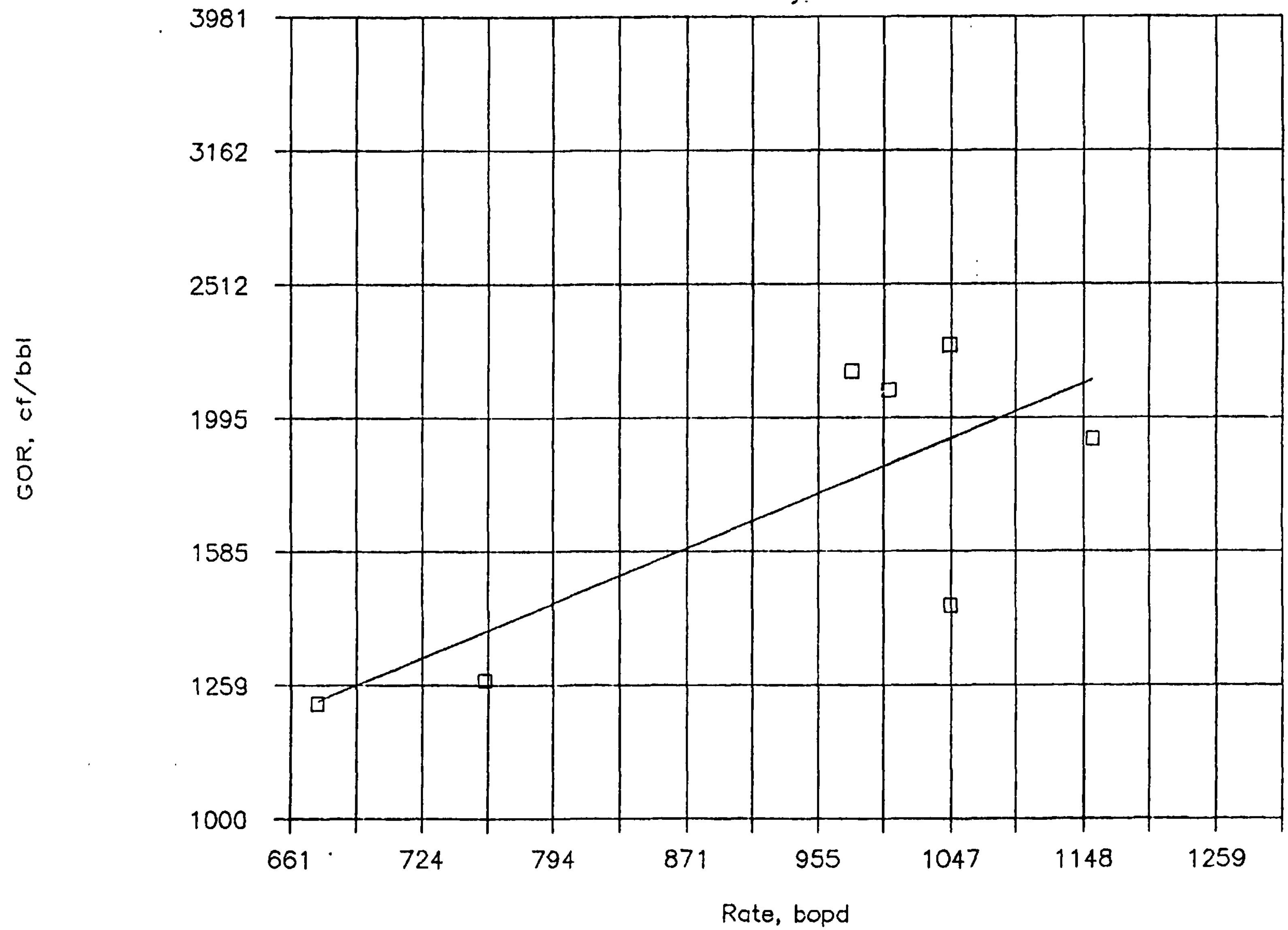
C. C. =0.90



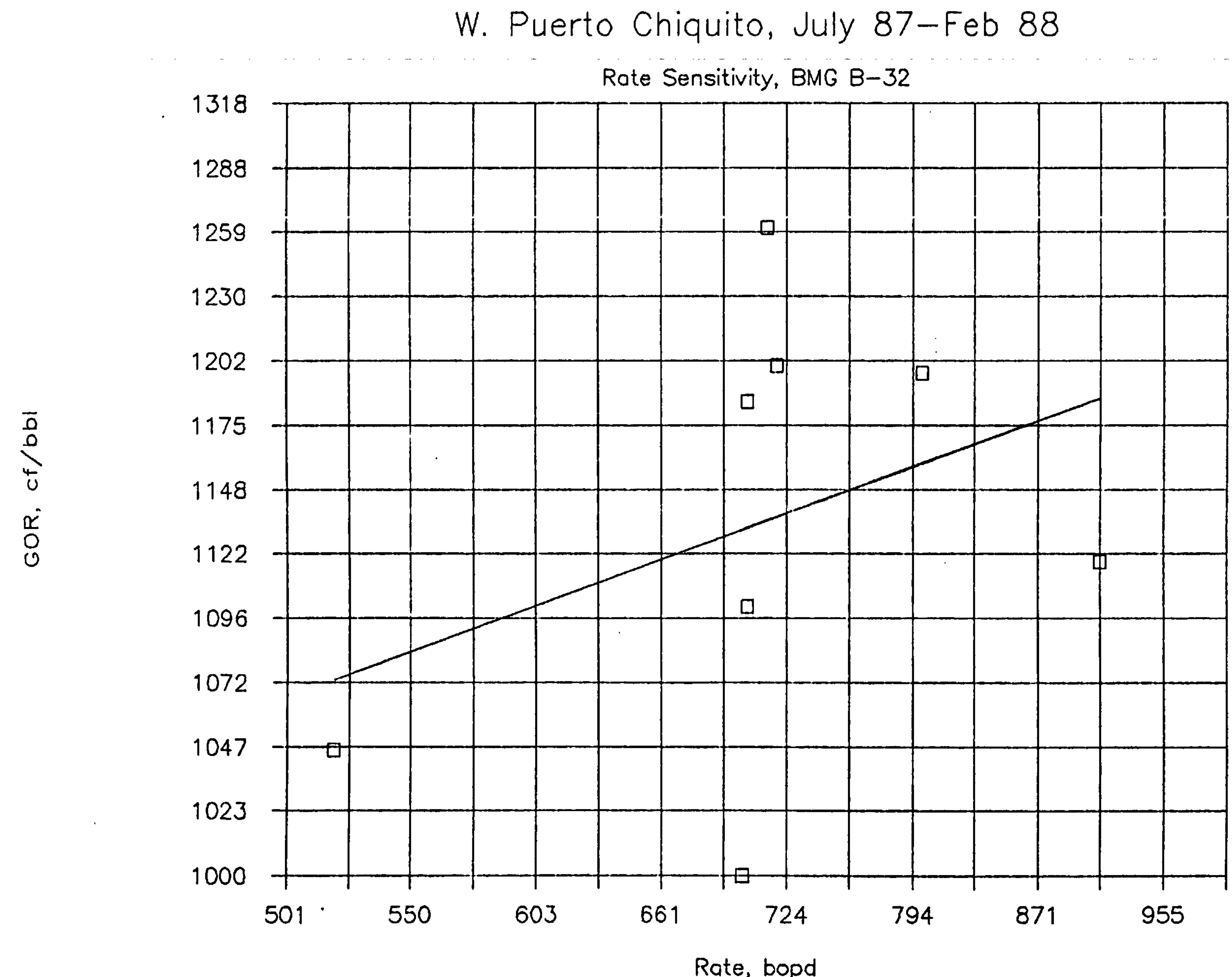
Gavilan Dome, July 87—Feb 88
Rate Sensitivity, B.M.G. A-20
GOR, cf/bbl & Rate, mcfpd
10000
6310
3981
2512
1585
1000
631
398
251
158
100
63
40
25
16
10
16
25
40
63
Rate, bopd
Feb
Jan
Dec
Nov
Sept
Aug
July
GOR, cf/bbl
Gas Rate, mcfpd

W. Puerto Chiquito, July 87—Feb 88

Rate Sensitivity, BMG B-29



C. C. = 0. 76

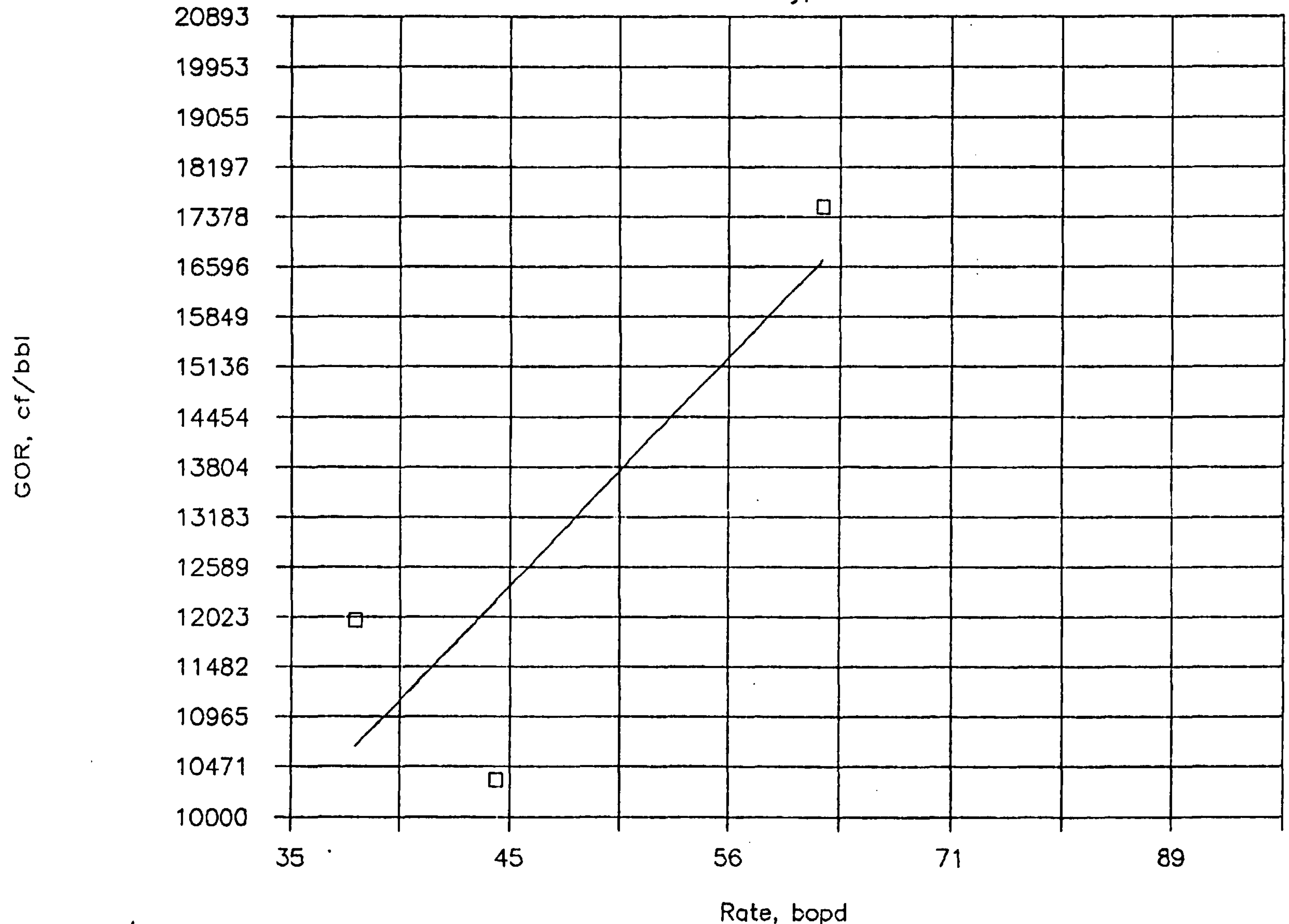


W. Puerto Chiquito, July 87–Feb 88
Rate Sensitivity, BMG B–32
GOR, cf/bbl
1318
1288
1259
1230
1202
1175
1148
1122
1096
1072
1047
1023
1000
501
550
603
661
724
794
871
955
Rate, bopd

C.C. = 0.36

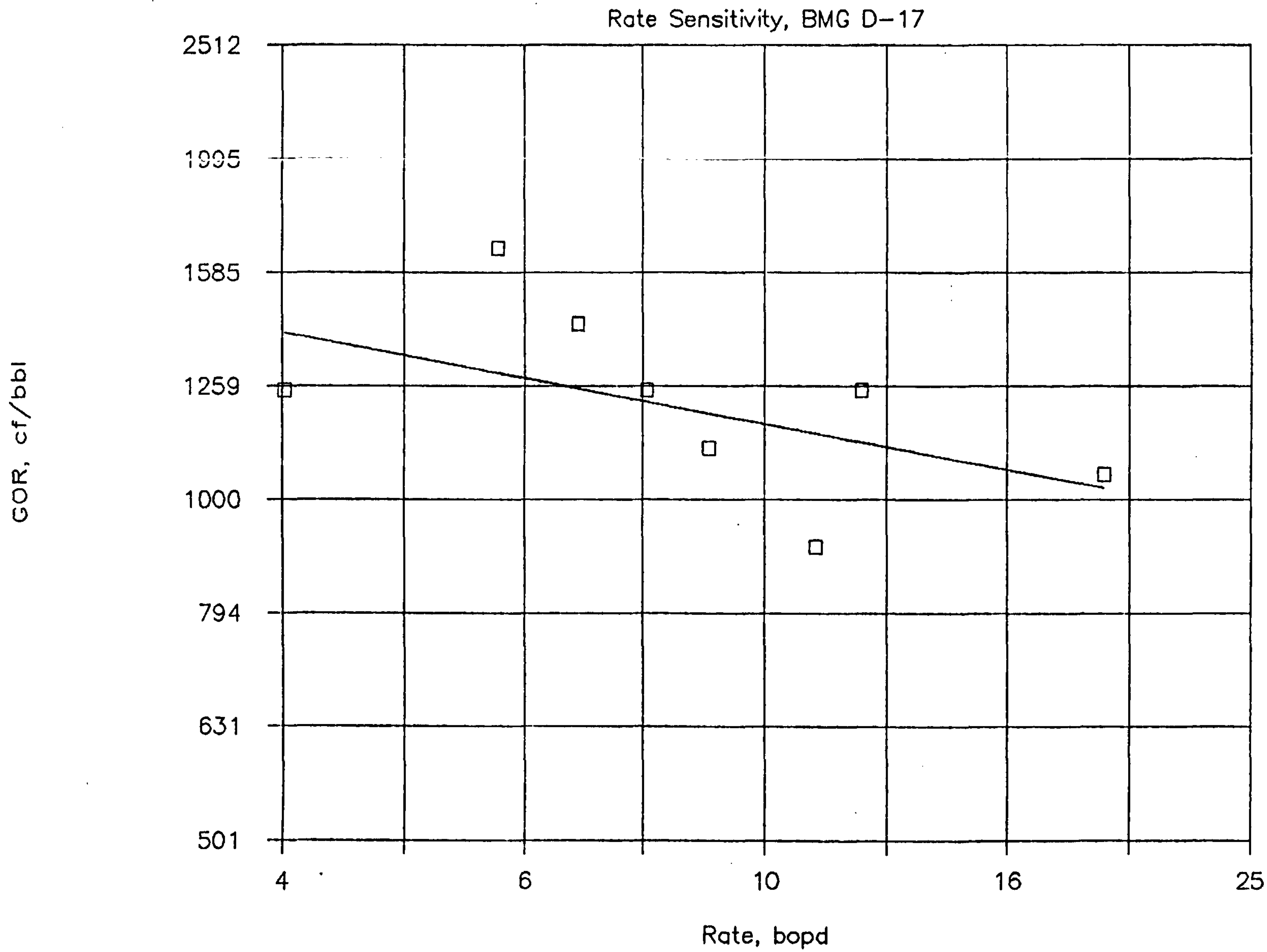
W. Puerto Chiquito, Dec 87—Feb 88

Rate Sensitivity, BMG C—34

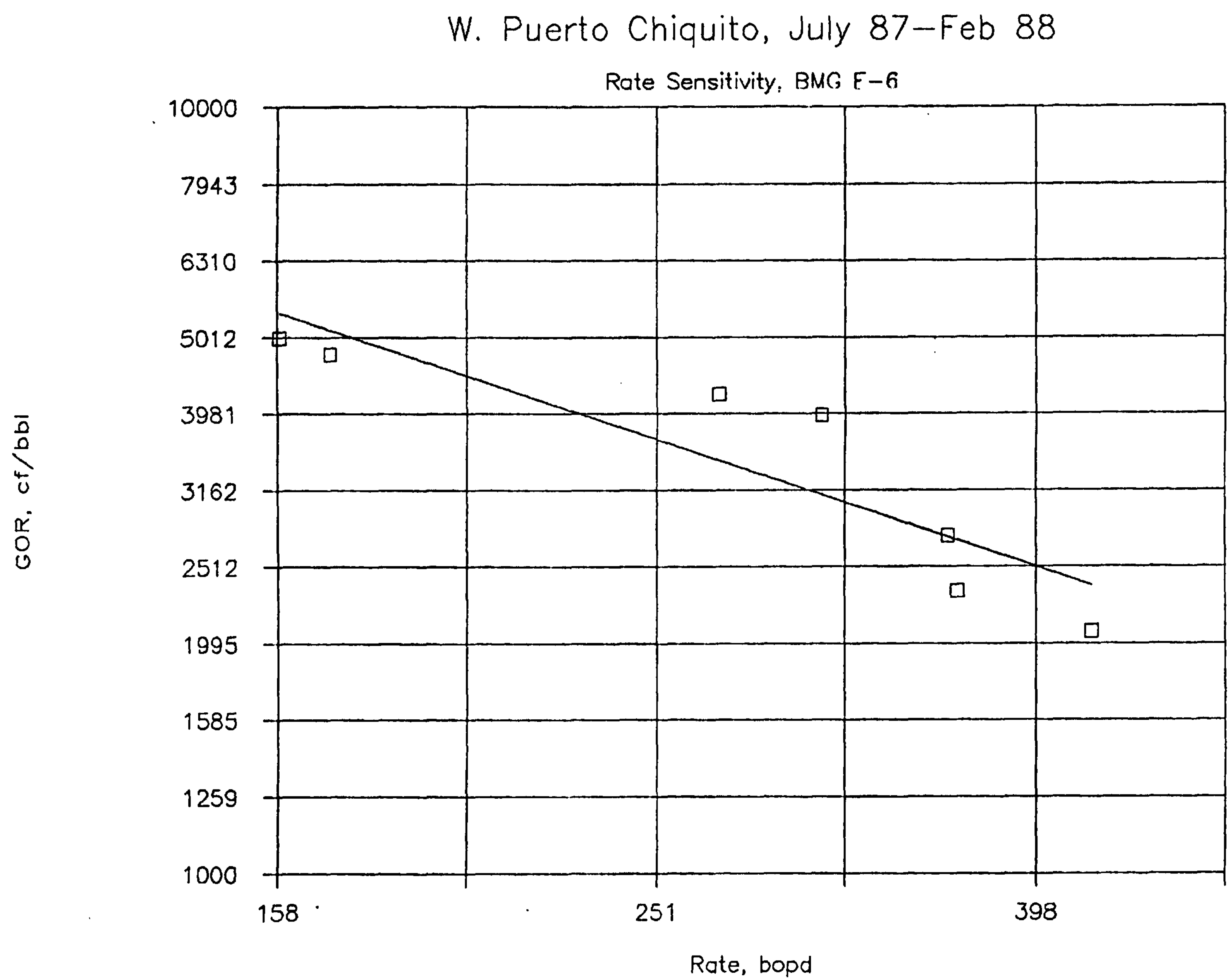


C.C. = 0.84

W. Puerto Chiquito, July 87



C.C. = 0.52

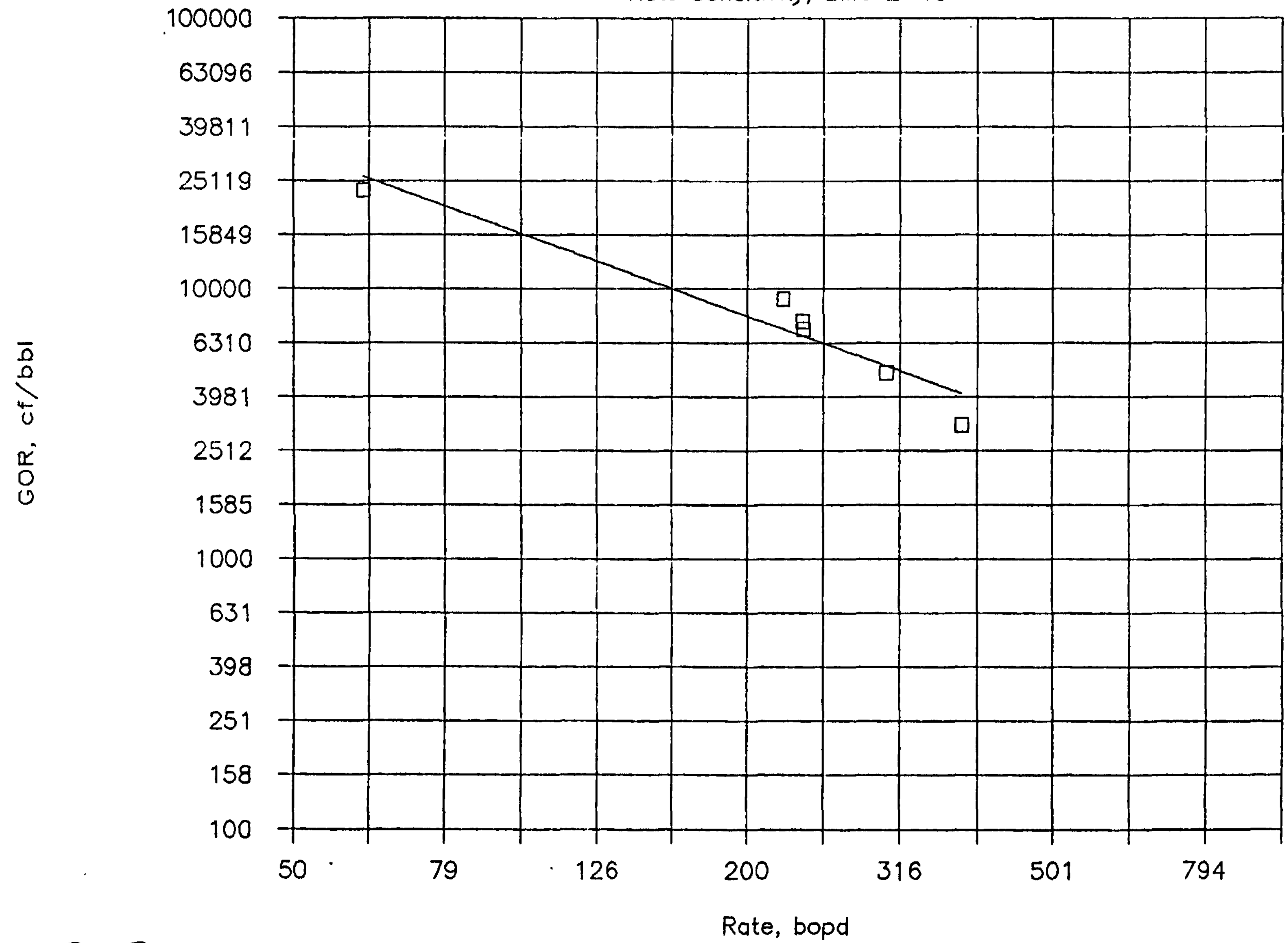


W. Puerto Chiquito, July 87–Feb 88
Rate Sensitivity, BMG F-6
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
GOR, cf/bbl
158
251
398
Rate, bopd

C. C. = 0.89

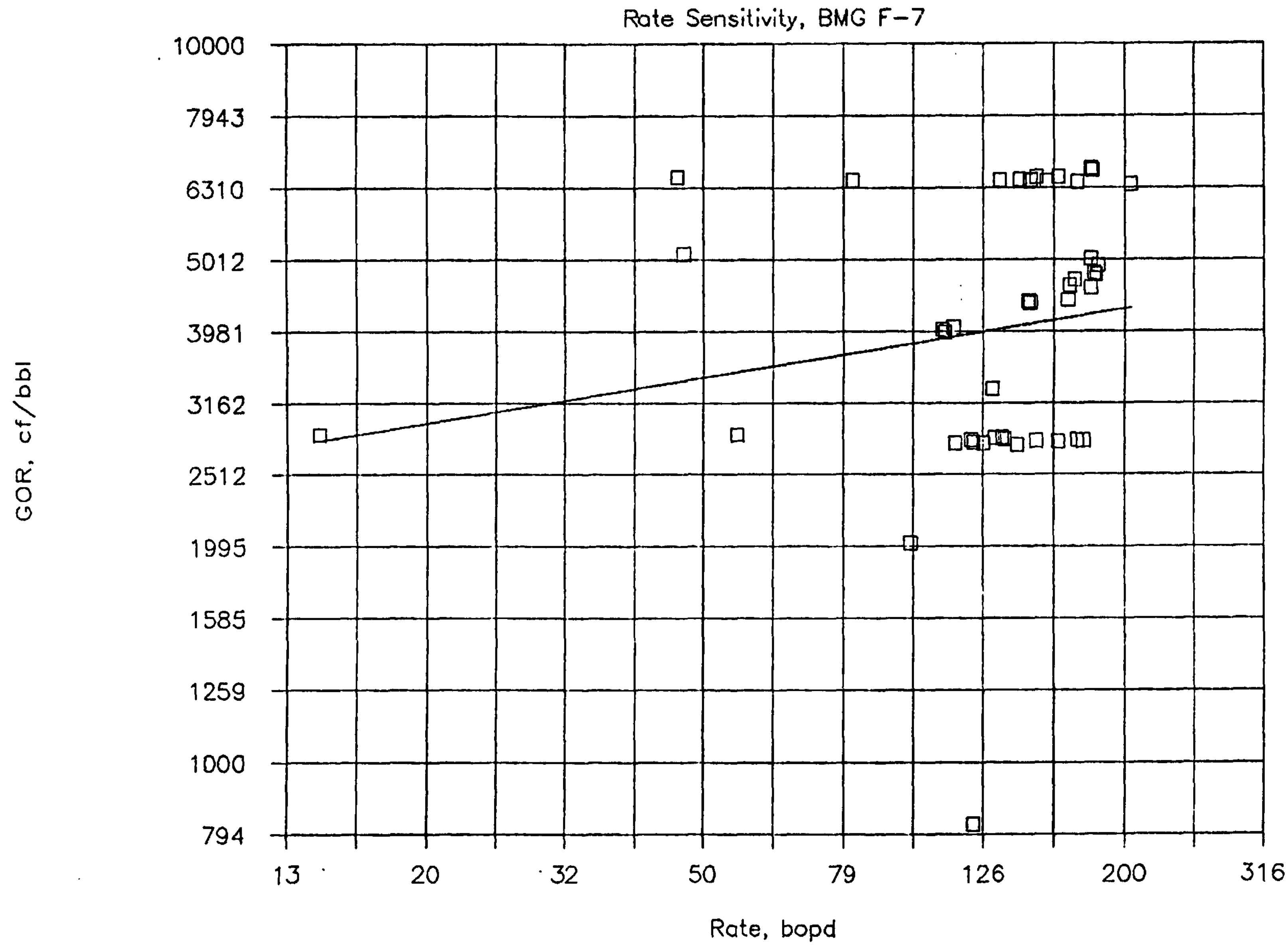
W. Puerto Chiquito, July 87—Feb 88

Rate Sensitivity, BMG E-10



C.C. = 0.96

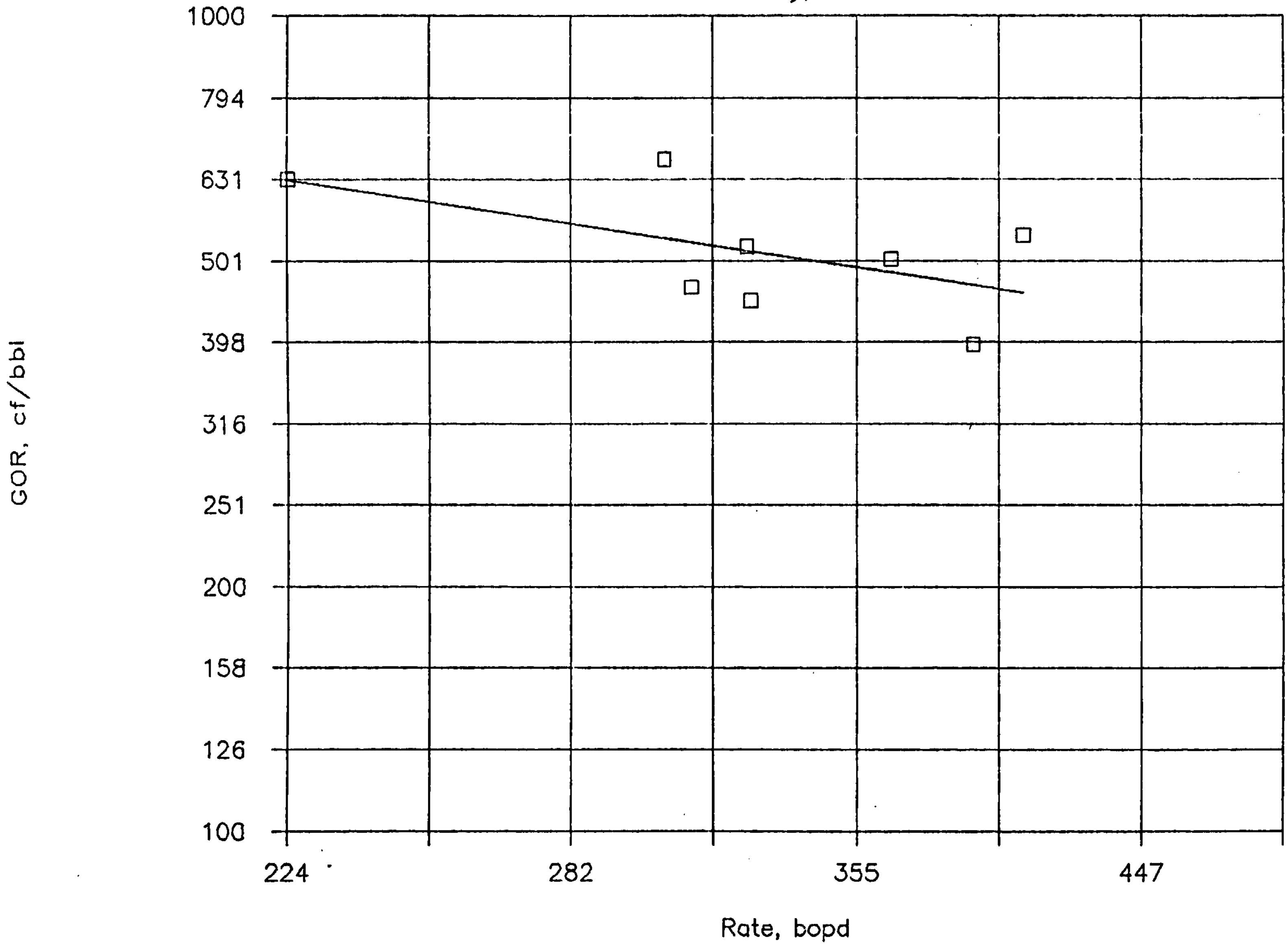
W. Puerto Chiquito, Dec 87—Jan 88



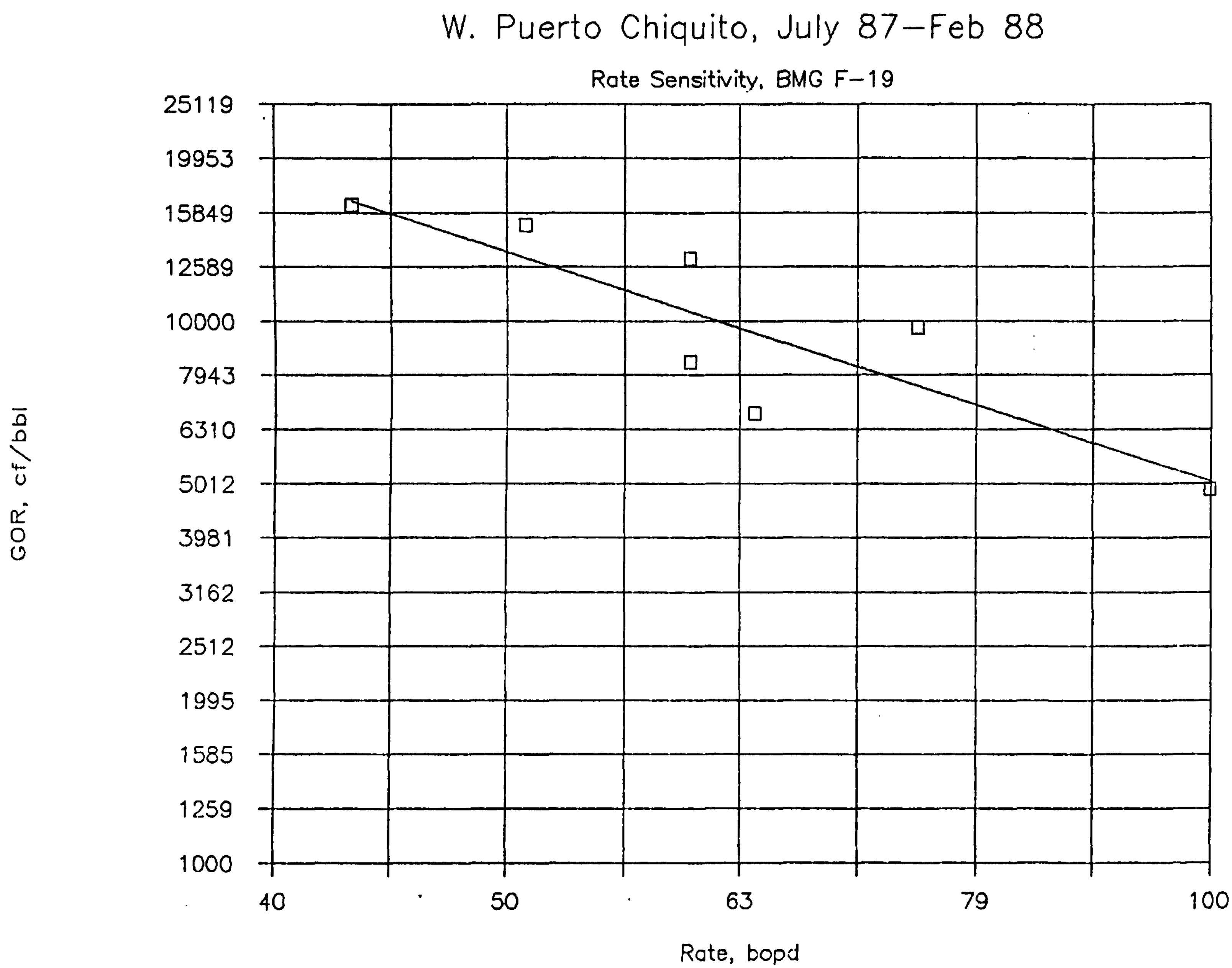
C.C. = 0.18

W. Puerto Chiquito, July 87–Feb 88

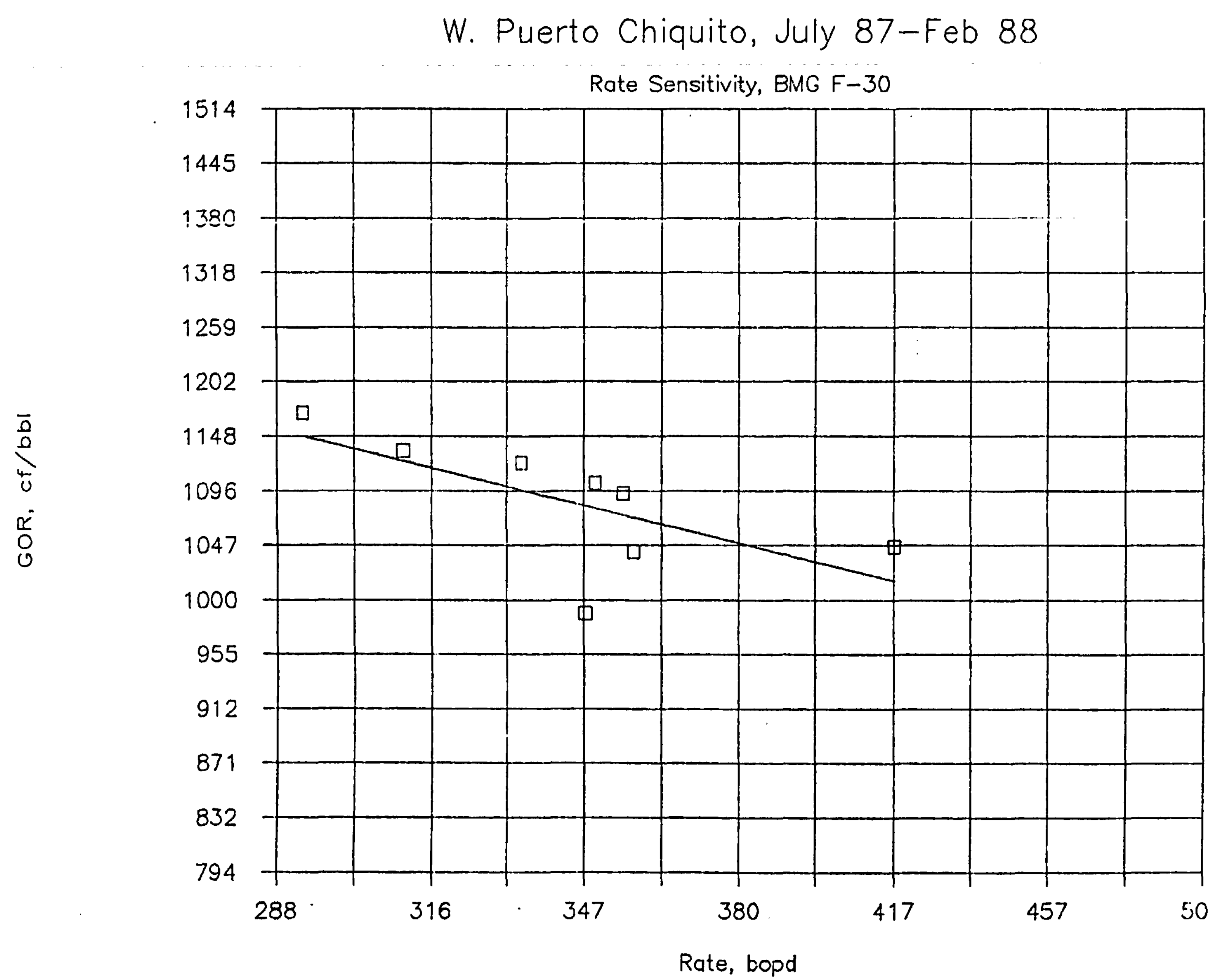
Rate Sensitivity, BMG F-18



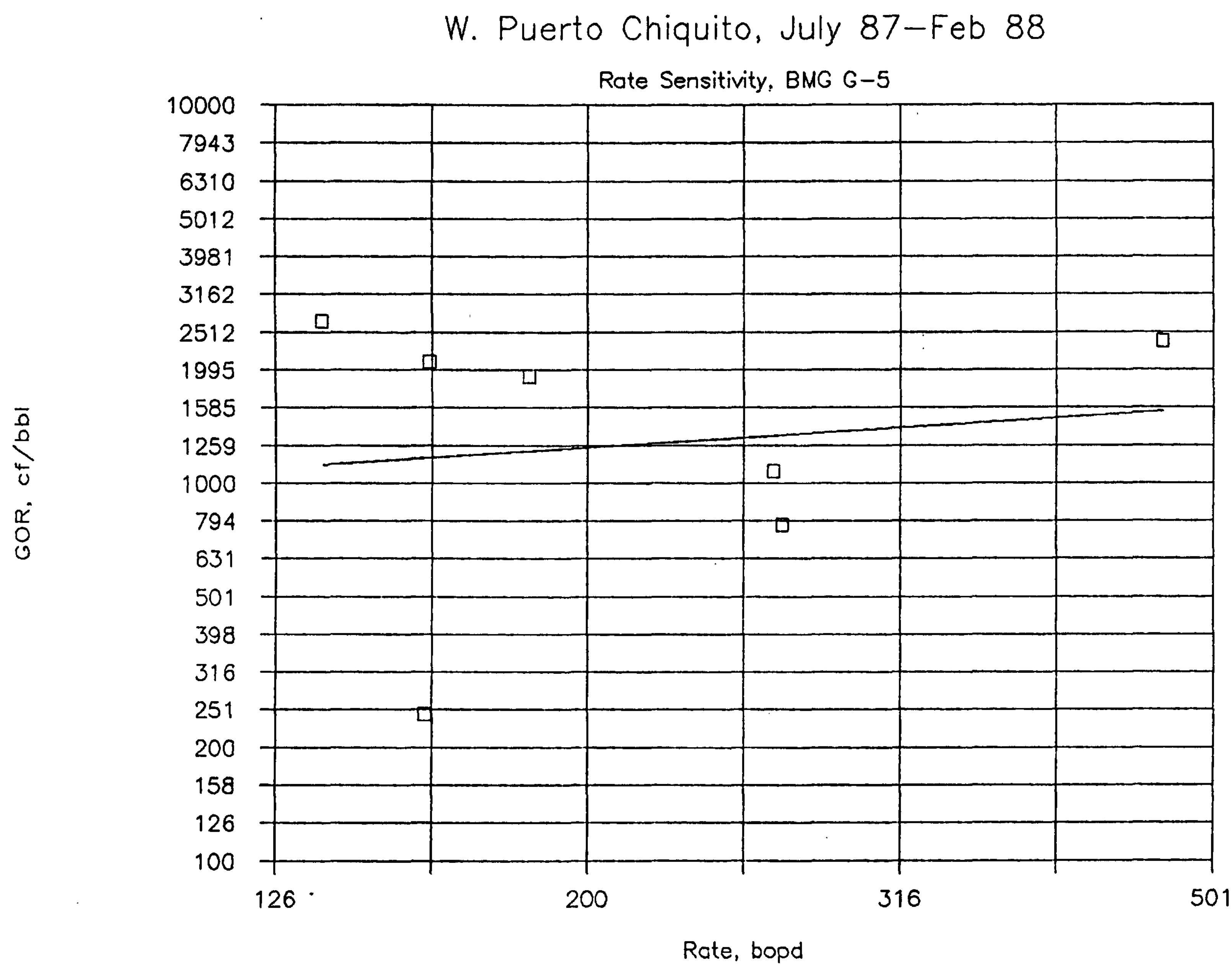
C.C. = 0.58


W. Puerto Chiquito, July 87—Feb 88
Rate Sensitivity, BMG F-19
GOR, cf/bbl
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
40
50
63
79
100
Rate, bopd

C. C. = 0.87


W. Puerto Chiquito, July 87–Feb 88
Rate Sensitivity, BMG F–30
1514
1445
1380
1318
1259
1202
1148
1096
1047
1000
955
912
871
832
794
GOR, cf/bbl
288
316
347
380
417
457
501
Rate, bopd

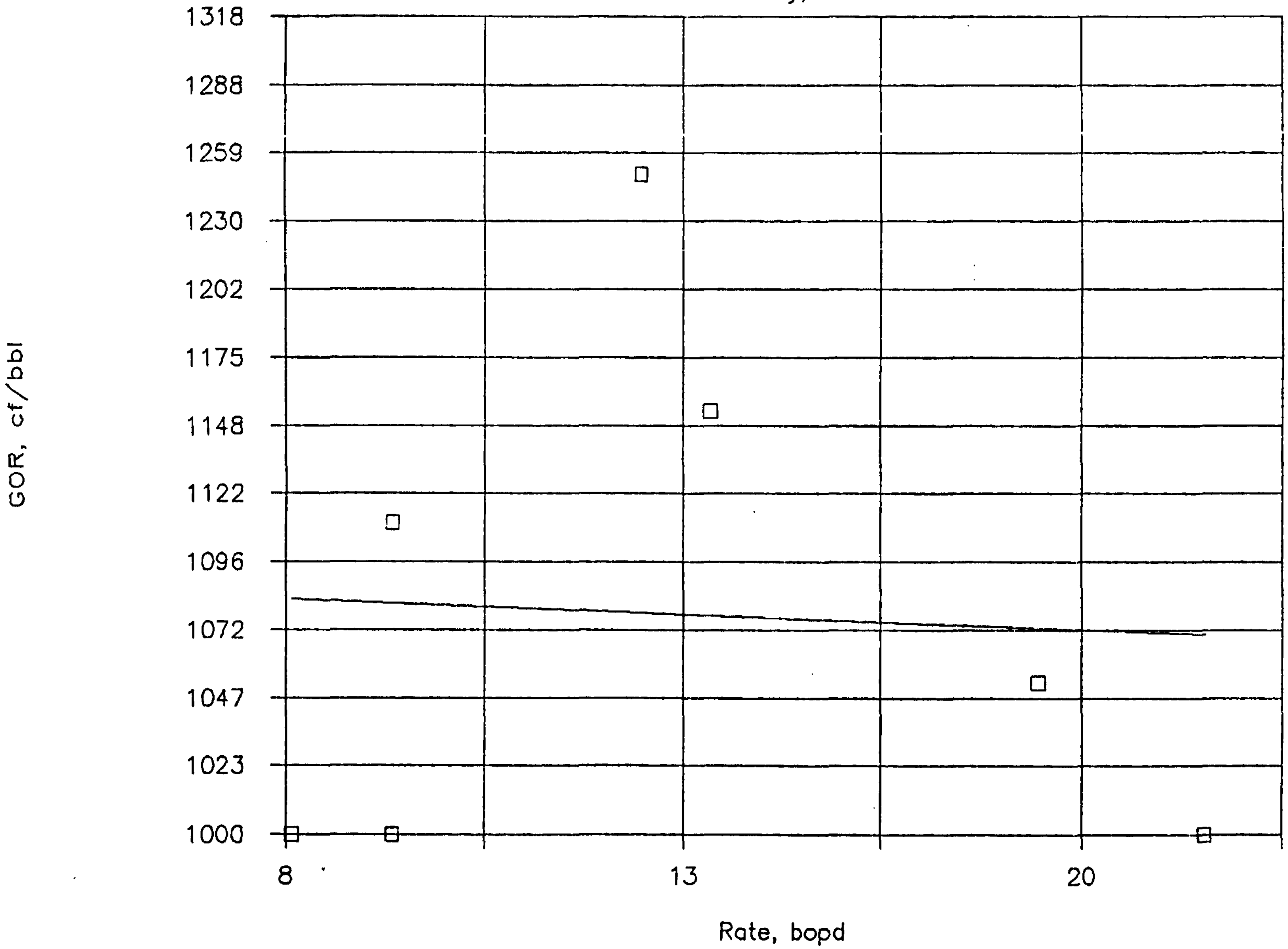
C.C. = 0.66


W. Puerto Chiquito, July 87—Feb 88
Rate Sensitivity, BMG G-5
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
794
631
501
398
316
251
200
158
126
100
GOR, cf/bbl
126
200
316
501
Rate, bopd

C.C. = 0.13

W. Puerto Chiquito, July 87–Sept 87

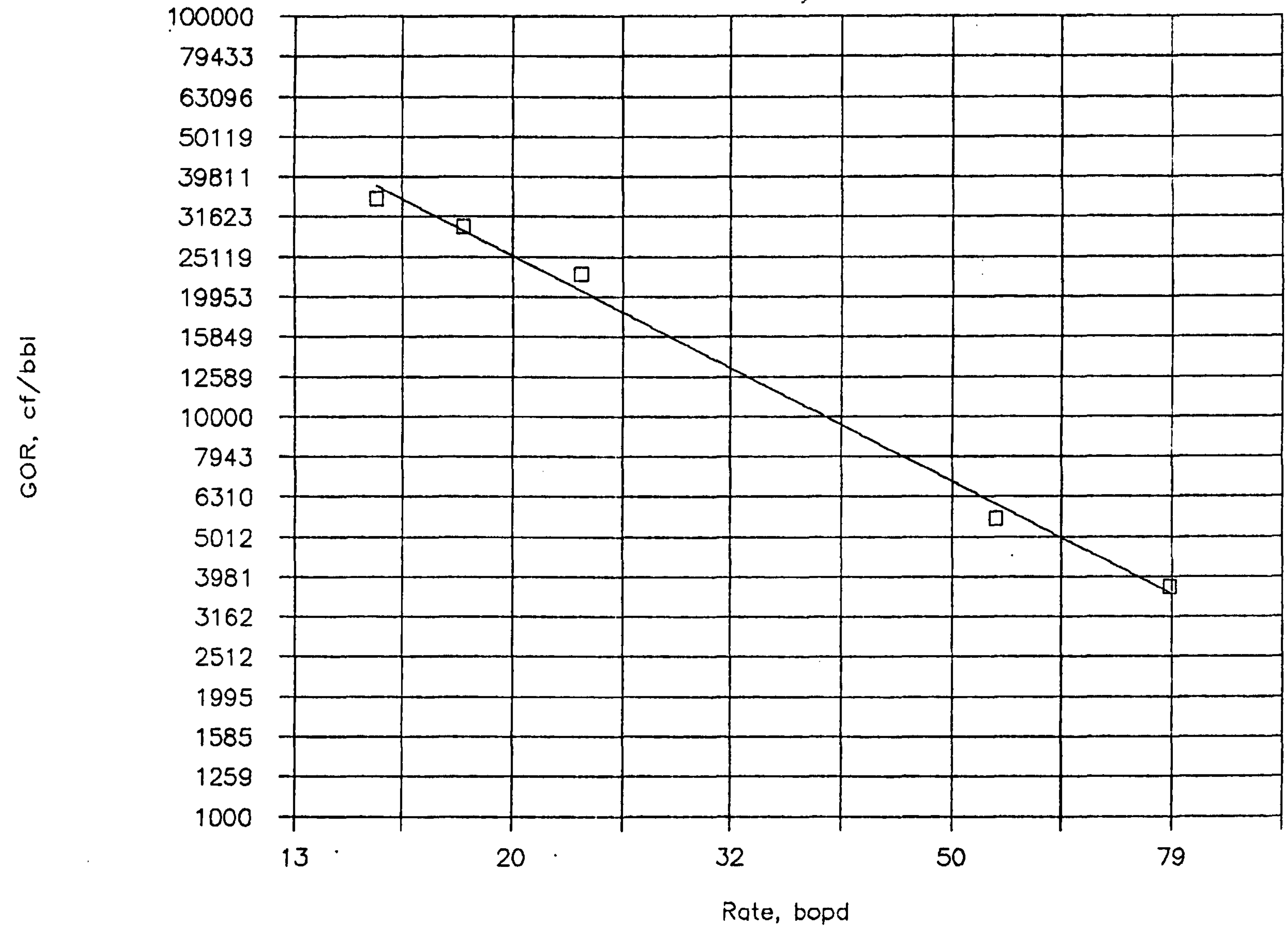
Rate Sensitivity, BMG G-32



C.C = 0.05

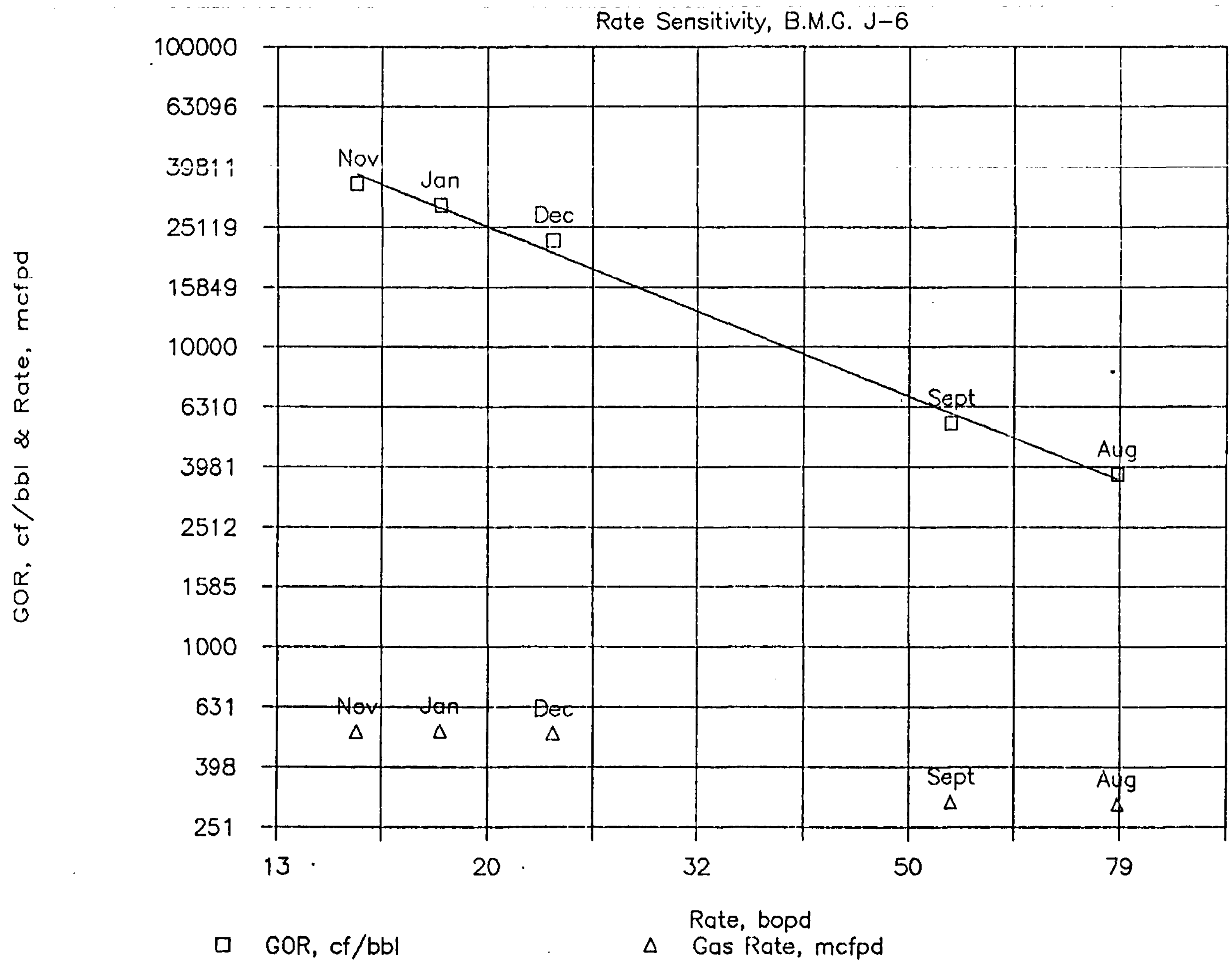
W. Puerto Chiquito, Aug 87—Jan 88

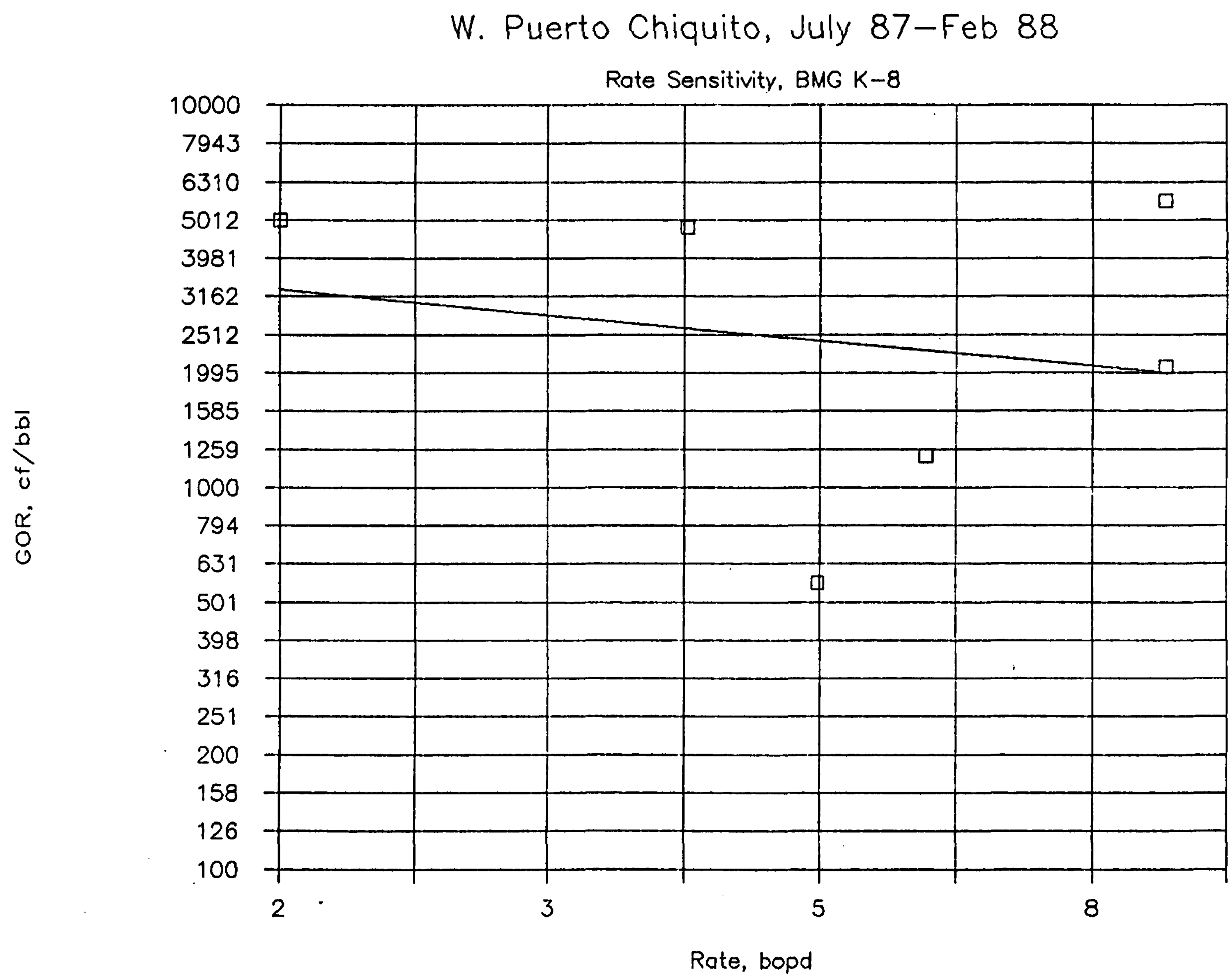
Rate Sensitivity, BMG J—6



C.C. = 1.00

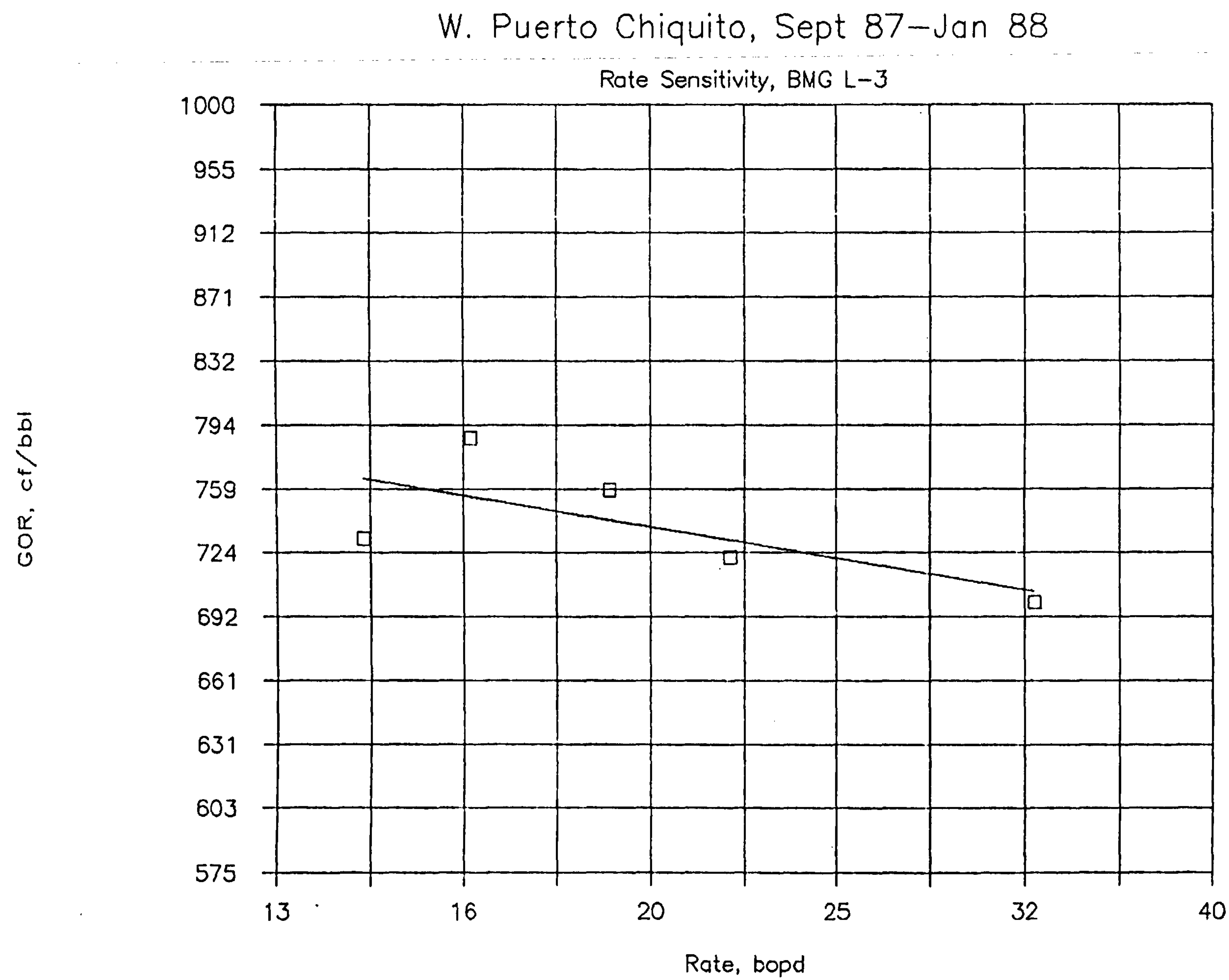
Gavilan Dome, Aug 87–Jan 88



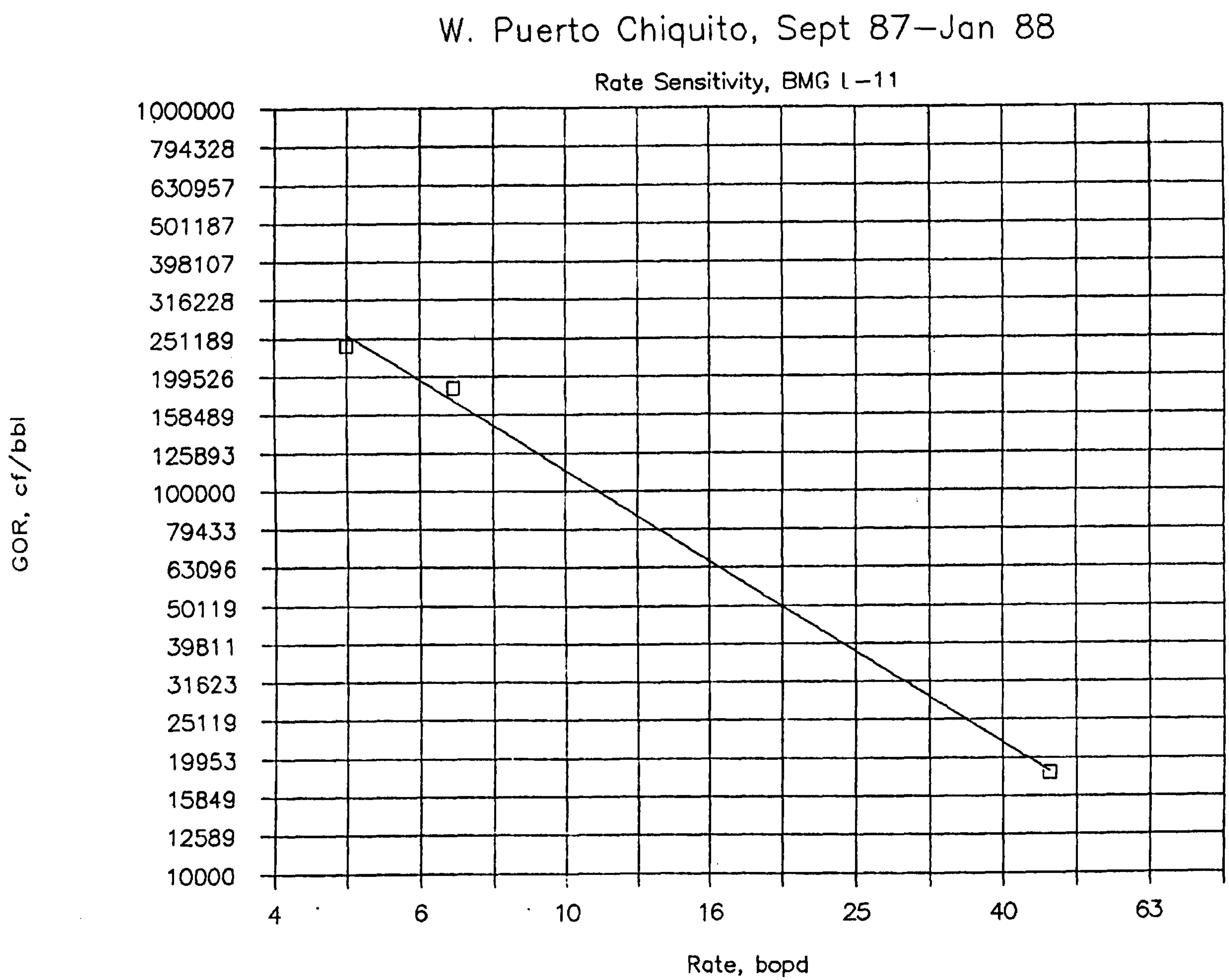


W. Puerto Chiquito, July 87–Feb 88
Rate Sensitivity, BMG K–8
GOR, cf/bbl
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
794
631
501
398
316
251
200
158
126
100
2
3
5
8
Rate, bopd

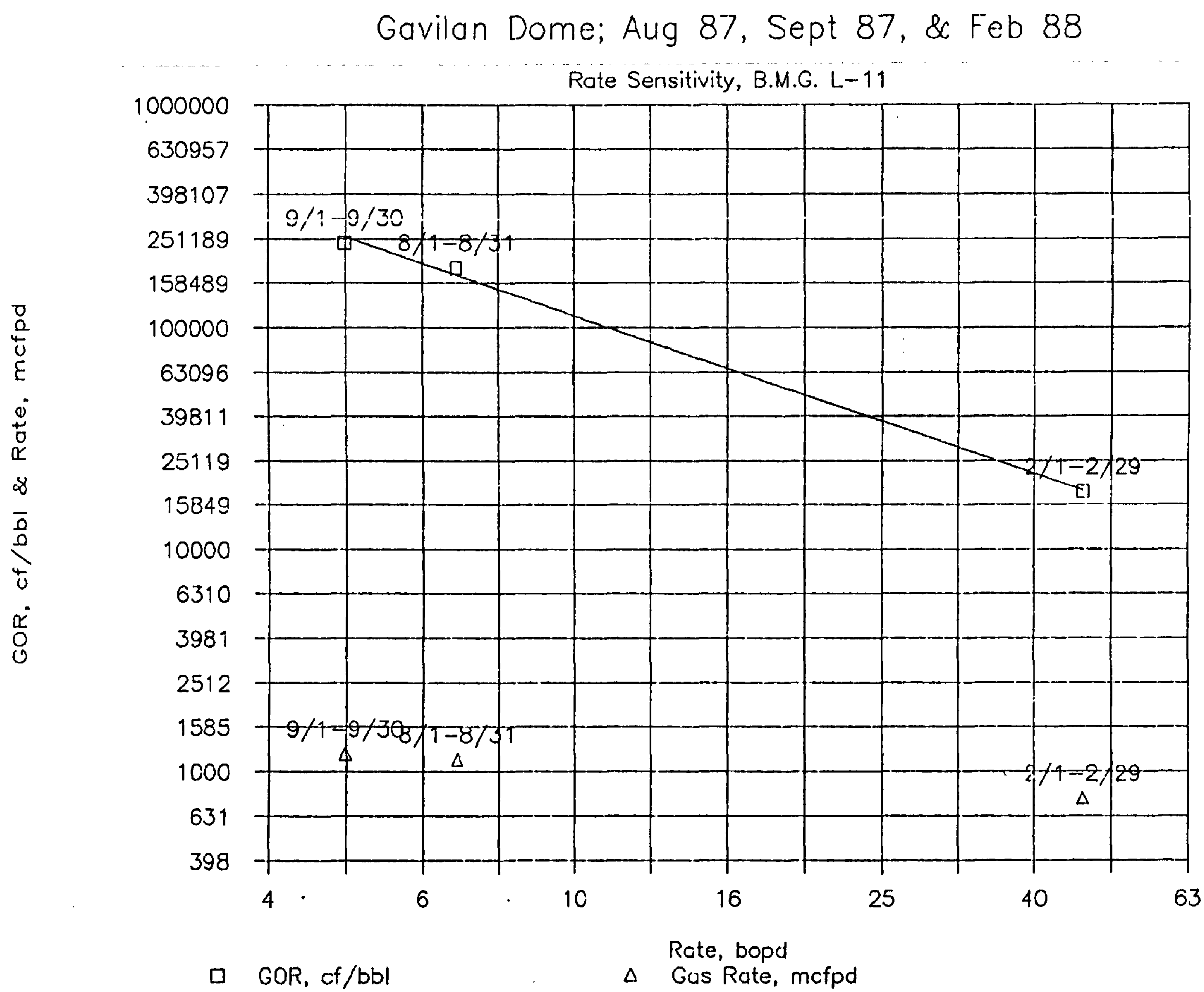
C.C. = 0.20

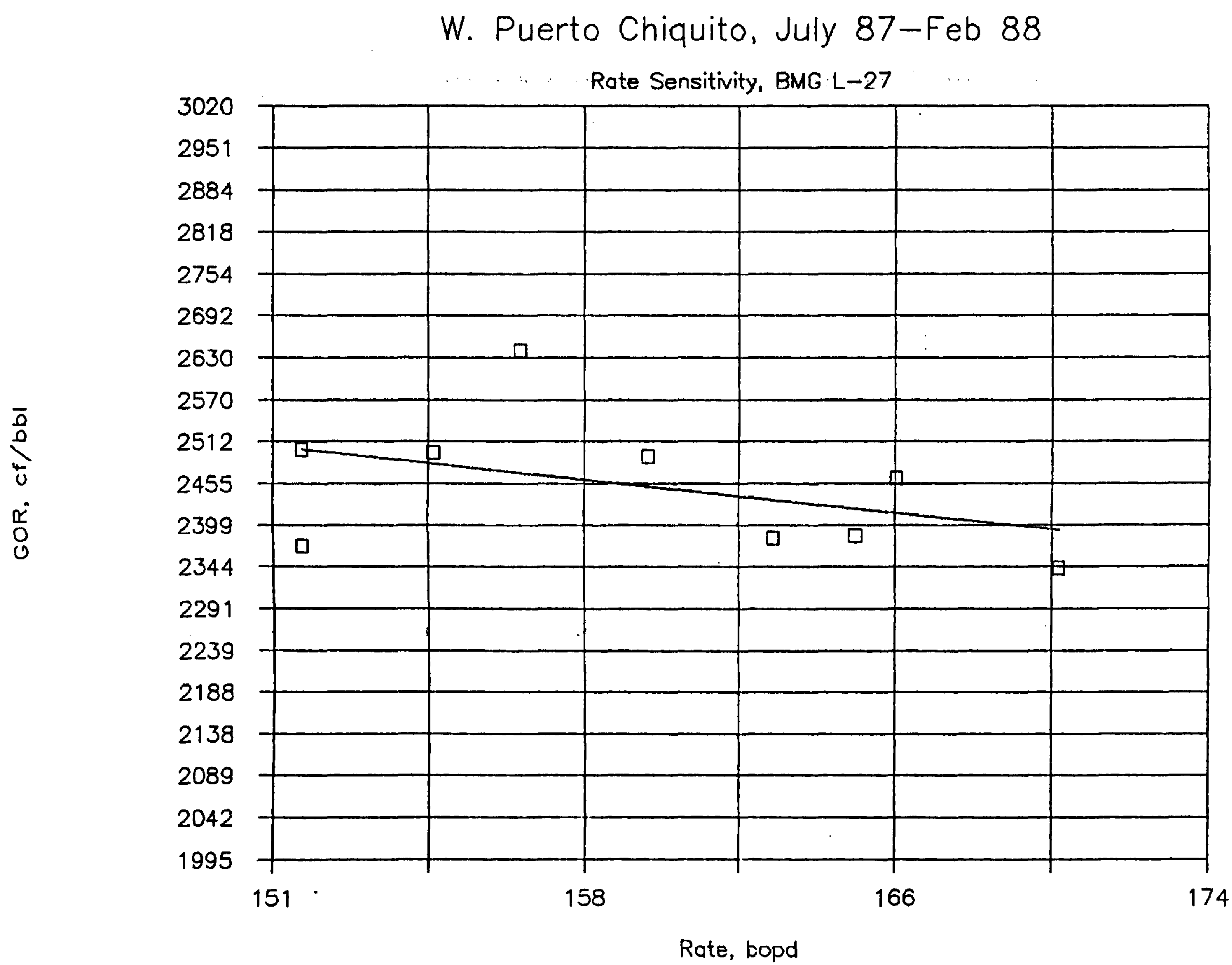

W. Puerto Chiquito, Sept 87–Jan 88
Rate Sensitivity, BMG L-3
1000
955
912
871
832
794
759
724
692
661
631
603
575
GOR, cf/bbl
13
16
20
25
32
40
Rate, bopd

C.C = 0.68


W. Puerto Chiquito, Sept 87—Jan 88
Rate Sensitivity, BMG L-11
1000000
794328
630957
501187
398107
316228
251189
199526
158489
125893
100000
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
GOR, cf/bbl
4
6
10
16
25
40
63
Rate, bopd

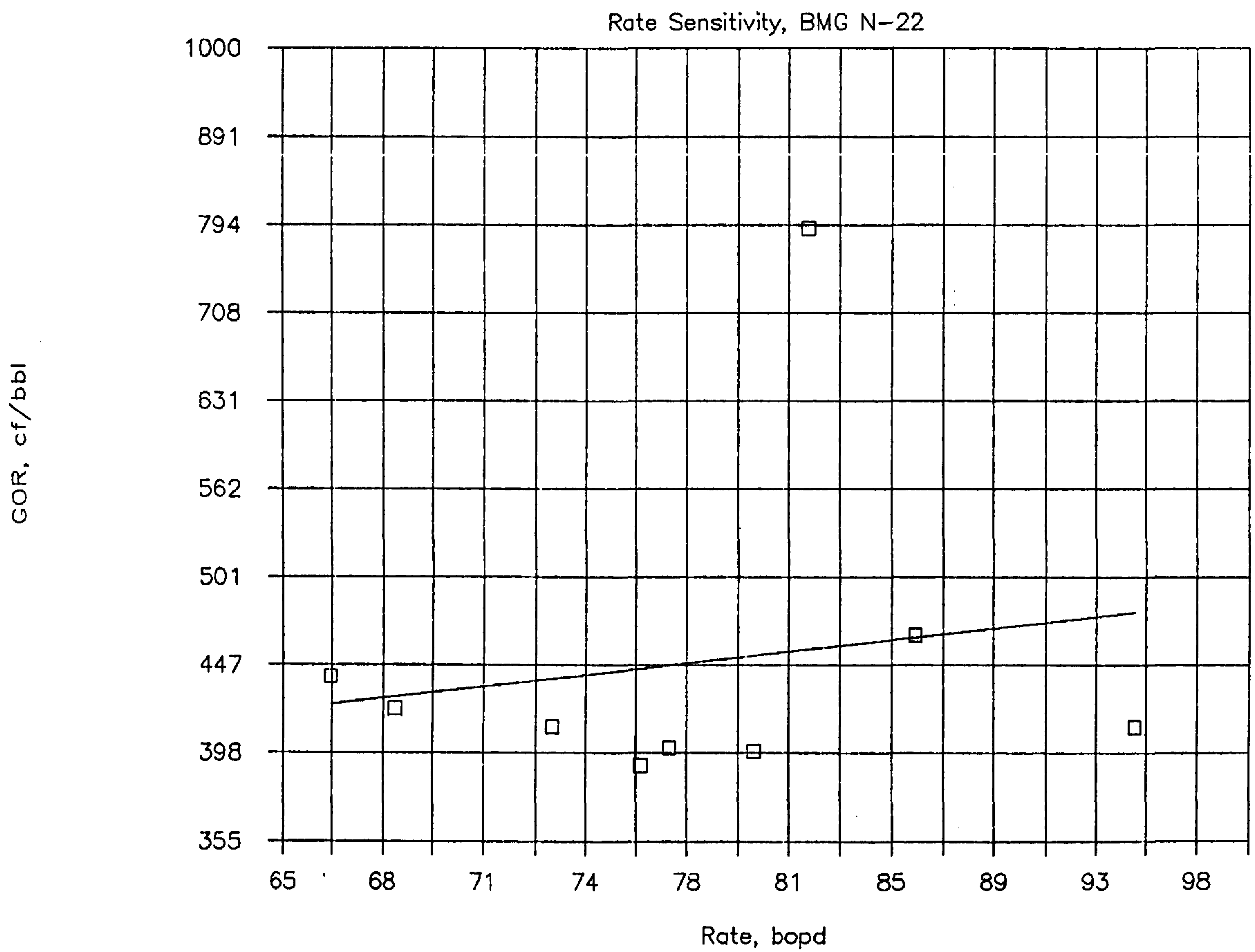
C.C. = 1.00


Gavilan Dome; Aug 87, Sept 87, & Feb 88
Rate Sensitivity, B.M.G. L-11
GOR, cf/bbl & Rate, mcfpd
1000000
630957
398107
251189
158489
100000
63096
39811
25119
15849
10000
6310
3981
2512
1585
1000
631
398
9/1-9/30
8/1-8/31
2/1-2/29
9/1-9/30
8/1-8/31
2/1-2/29
4
6
10
16
25
40
63
Rate, bopd
GOR, cf/bbl
Gas Rate, mcfpd

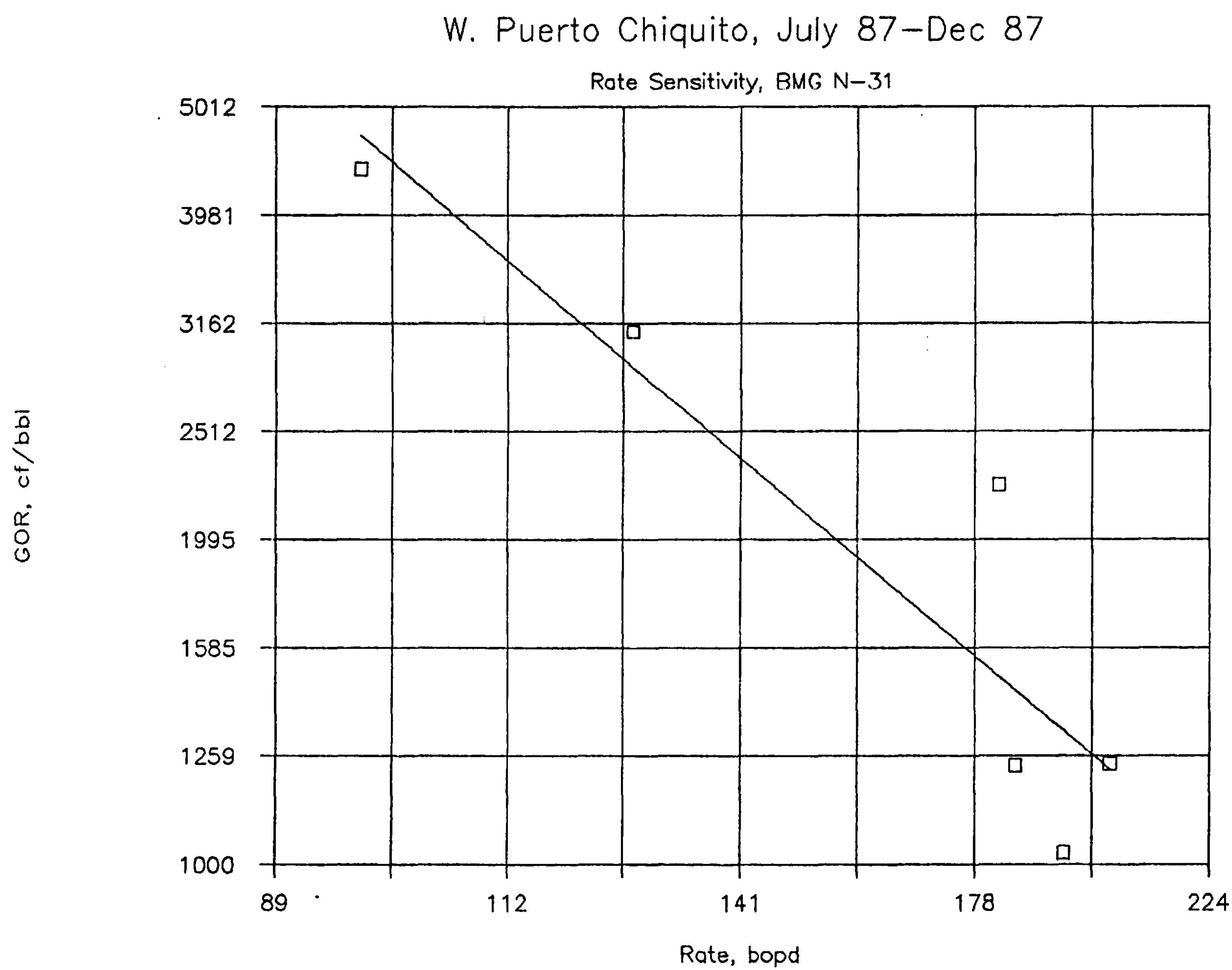

W. Puerto Chiquito, July 87—Feb 88
Rate Sensitivity, BMG L—27
3020
2951
2884
2818
2754
2692
2630
2570
2512
2455
2399
2344
2291
2239
2188
2138
2089
2042
1995
GOR, cf/bbl
151
158
166
174
Rate, bopd

C.C. = 0.43

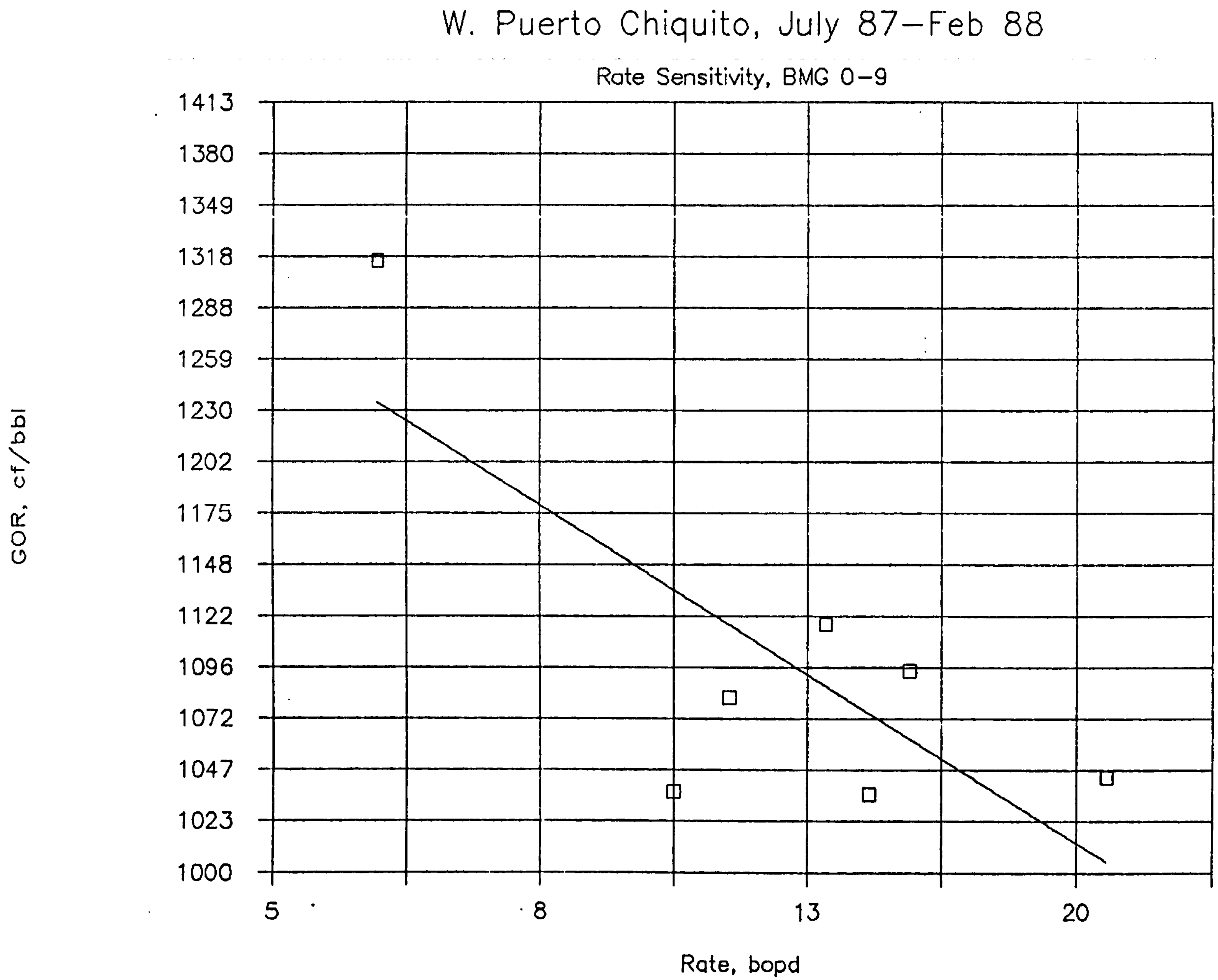
W. Puerto Chiquito, July 87—Feb 88



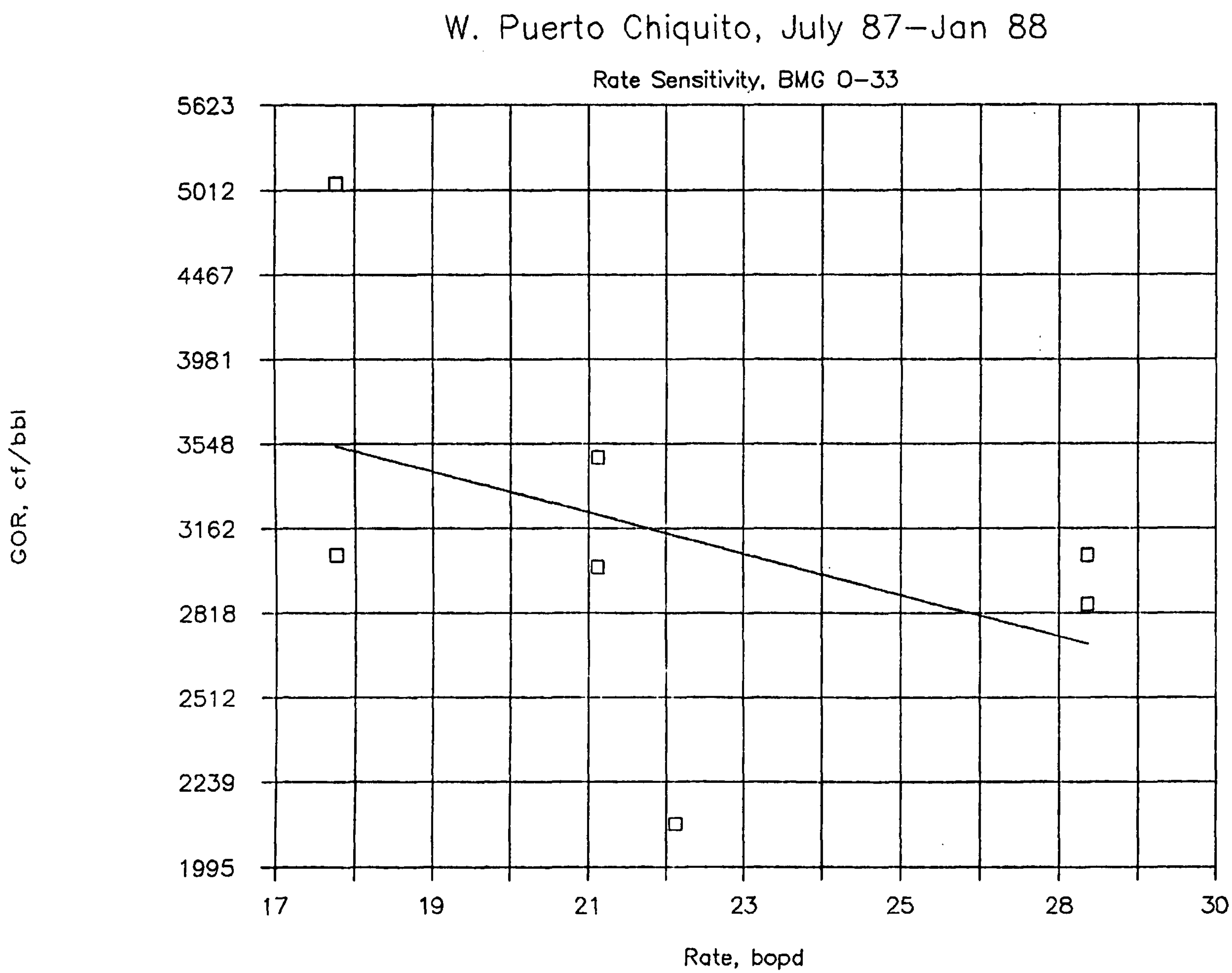
CC = 0.17


W. Puerto Chiquito, July 87–Dec 87
Rate Sensitivity, BMG N–31
5012
3981
3162
2512
1995
1585
1259
1000
GOR, cf/bbl
89
112
141
178
224
Rate, bopd

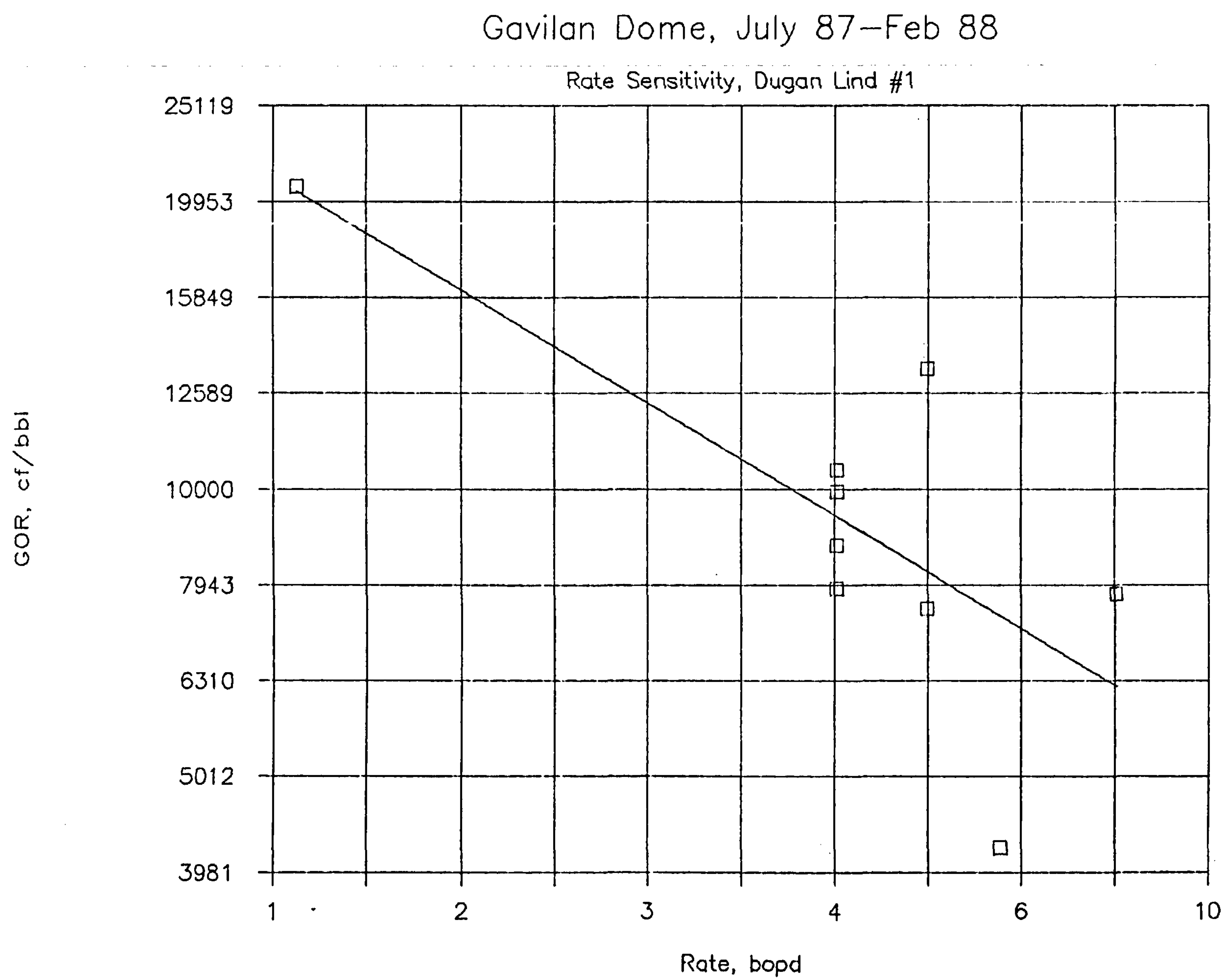
C.C. = 0.92


W. Puerto Chiquito, July 87—Feb 88
Rate Sensitivity, BMG 0-9
1413
1380
1349
1318
1288
1259
1230
1202
1175
1148
1122
1096
1072
1047
1023
1000
GOR, cf/bbl
5
8
13
20
Rate, bopd

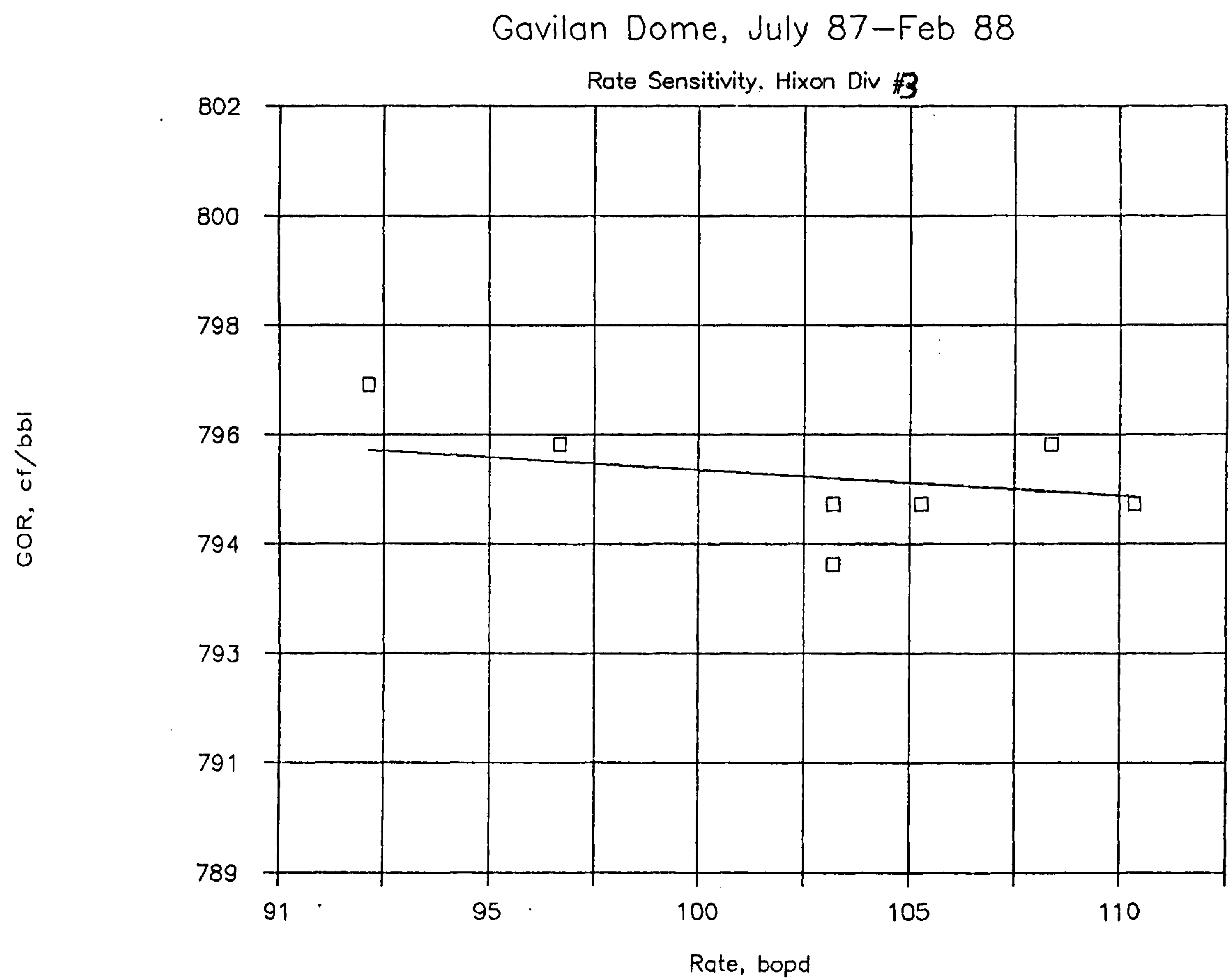
C.C. = 0.76


W. Puerto Chiquito, July 87—Jan 88
Rate Sensitivity, BMG 0-33
GOR, cf/bbl
5623
5012
4467
3981
3548
3162
2818
2512
2239
1995
17
19
21
23
25
28
30
Rate, bopd

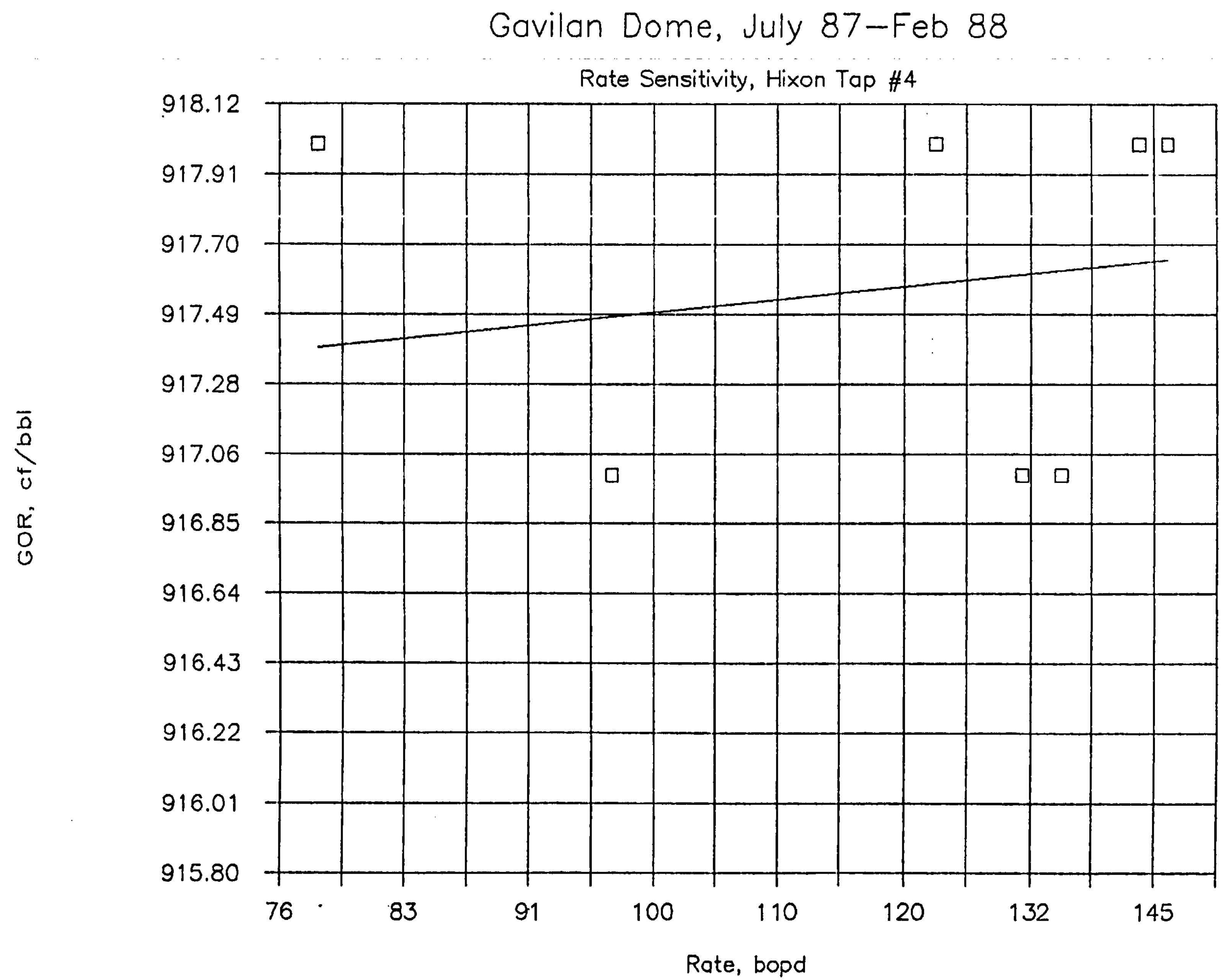
C.C. = 0.43


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Dugan Lind #1
25119
19953
15849
12589
10000
7943
6310
5012
3981
GOR, cf/bbl
1
2
3
4
6
10
Rate, bopd

C. C. = 0.75


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Hixon Div #3
GOR, cf/bbl
802
800
798
796
794
793
791
789
91
95
100
105
110
Rate, bopd

C.C. = 0.06

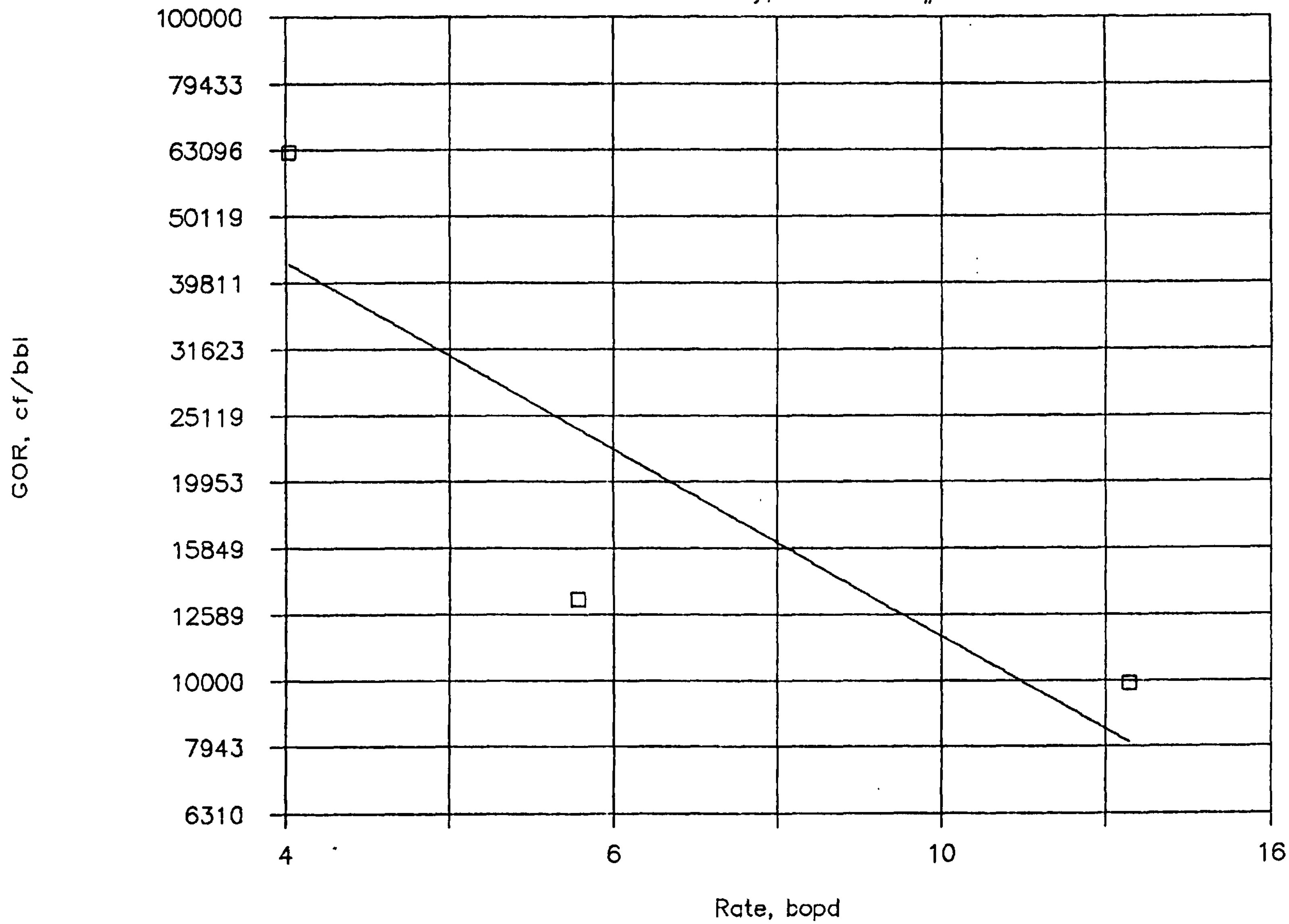


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Hixon Tap #4
918.12
917.91
917.70
917.49
917.28
917.06
916.85
916.64
916.43
916.22
916.01
915.80
GOR, cf/bbl
76
83
91
100
110
120
132
145
Rate, bopd

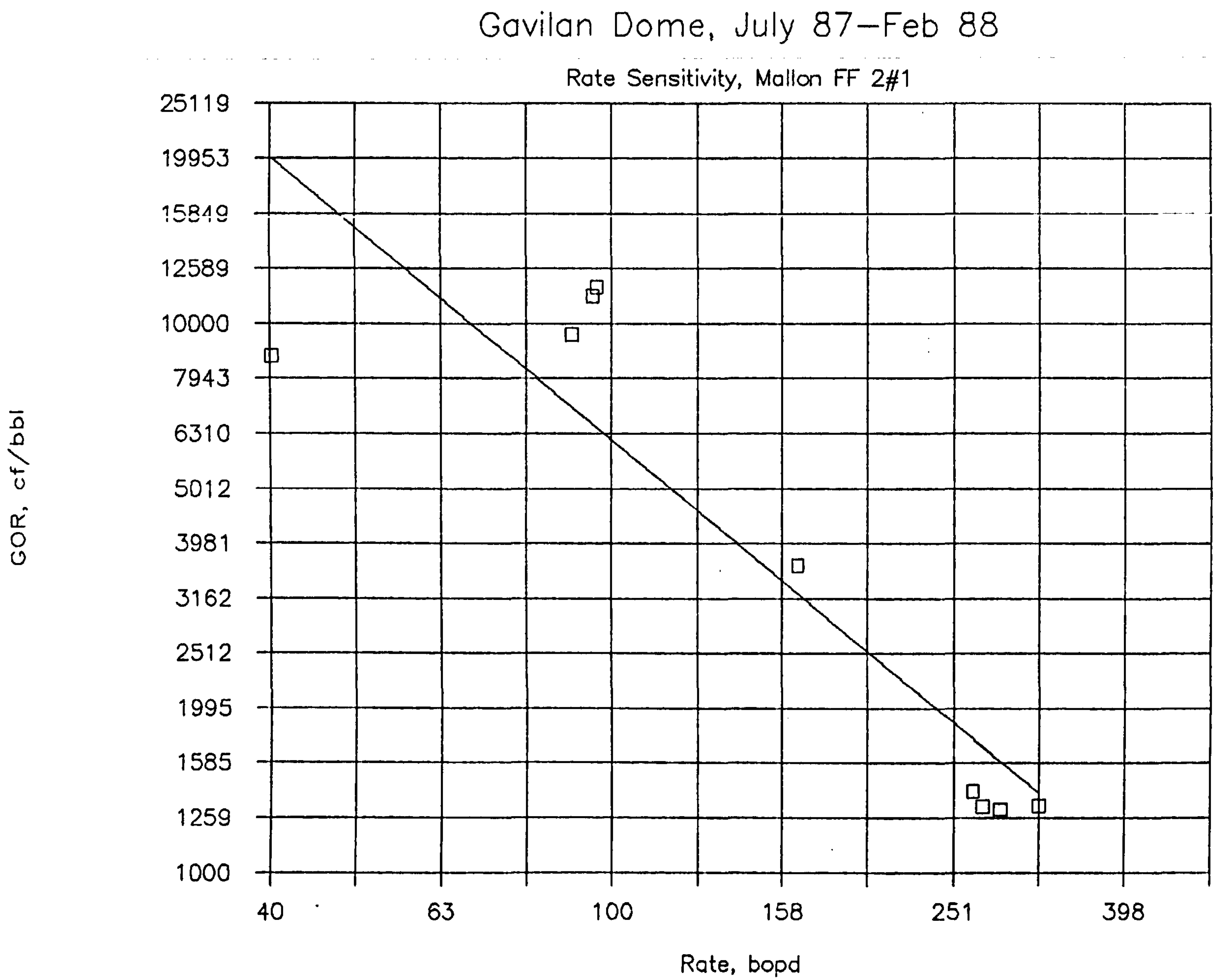
C.C. = 0.01

Gavilan Dome, Dec 87—Feb 88

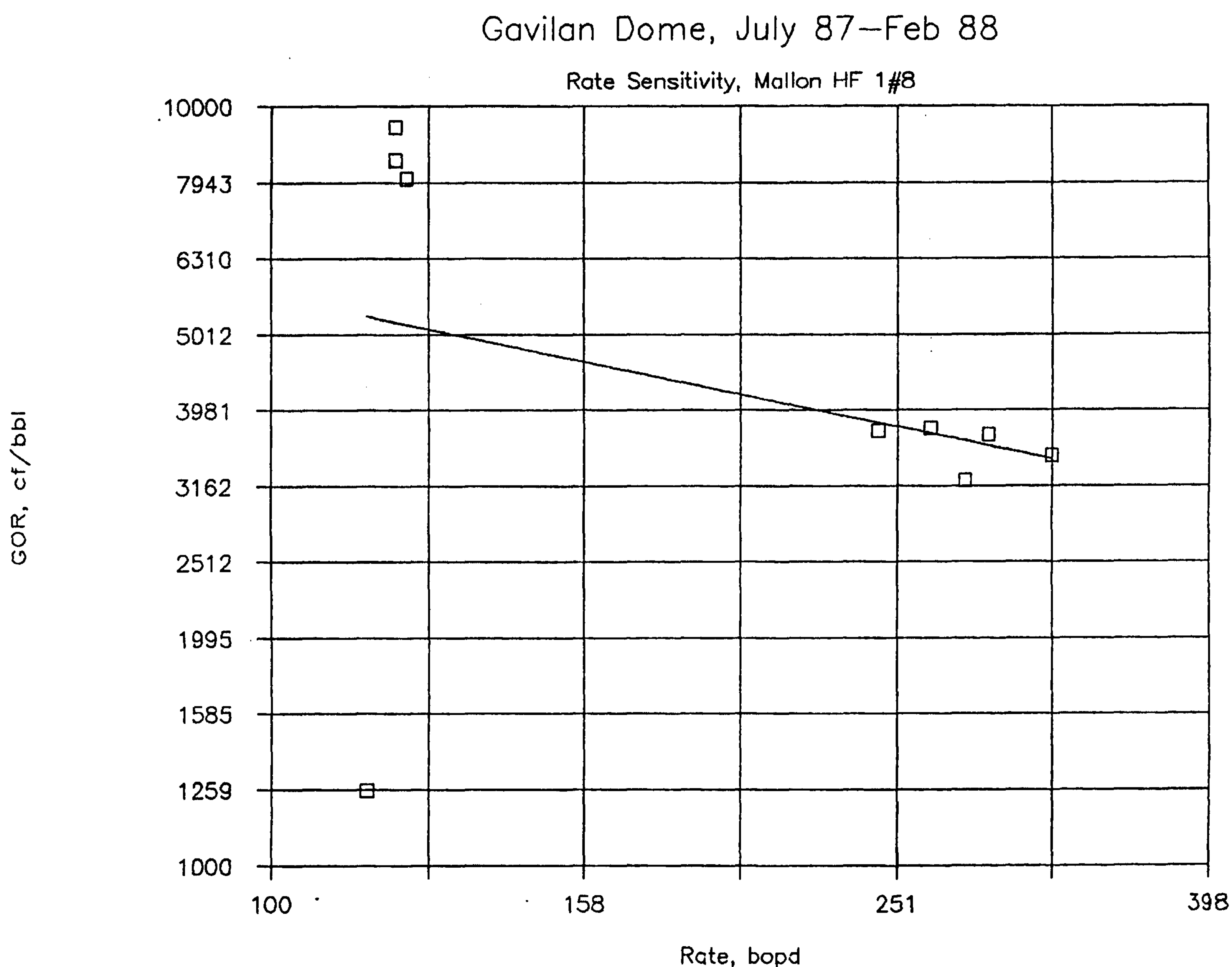
Rate Sensitivity, Mallon DF 3#15



C.C.=0.85


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mallon FF 2#1
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
GOR, cf/bbl
40
63
100
158
251
398
Rate, bopd

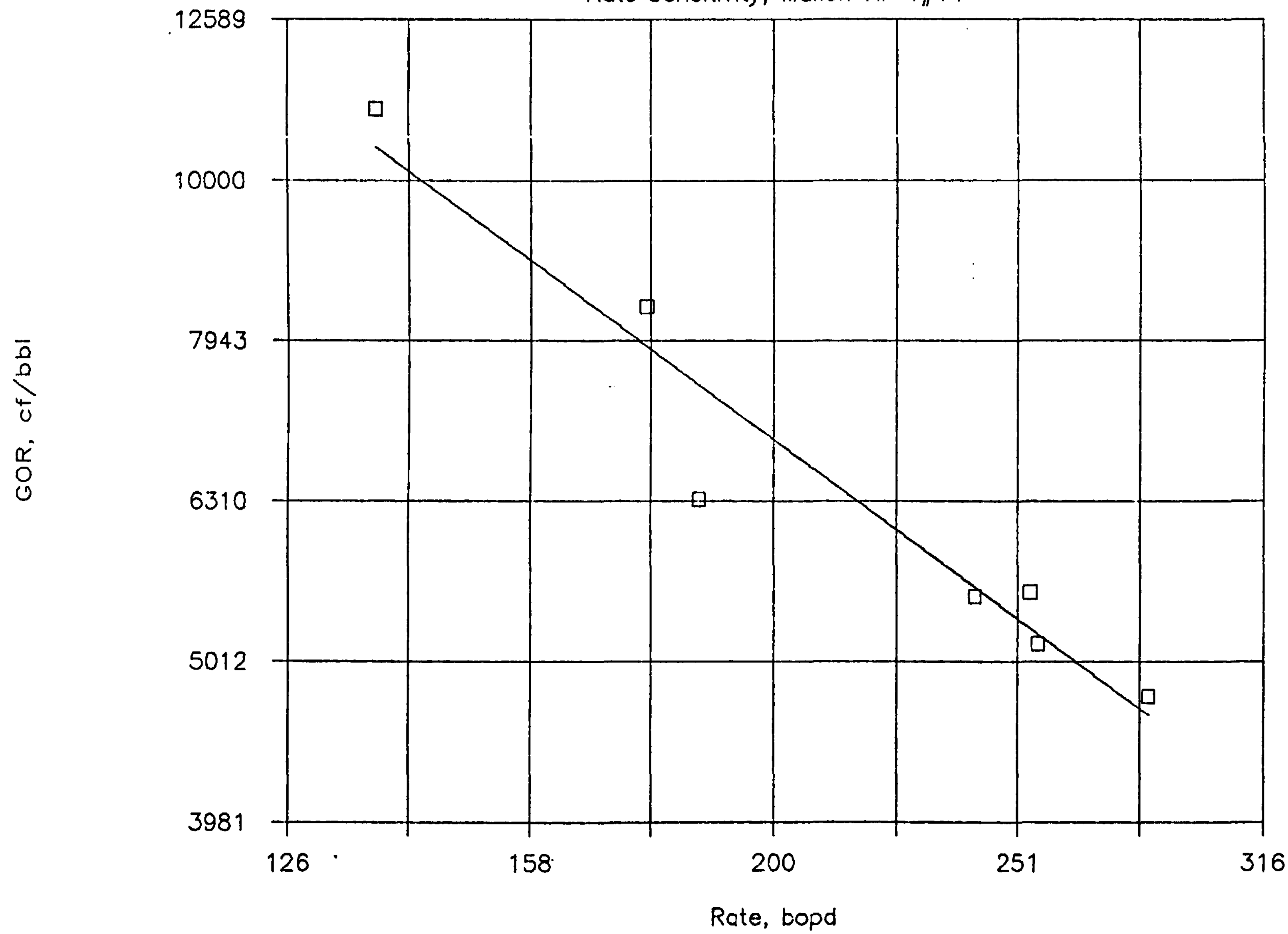
C.C. = 0.90


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mallon HF 1#8
GOR, cf/bbl
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
100
158
251
398
Rate, bopd

C. C. = 0.31

Gavilan Dome, July 87–Feb 88

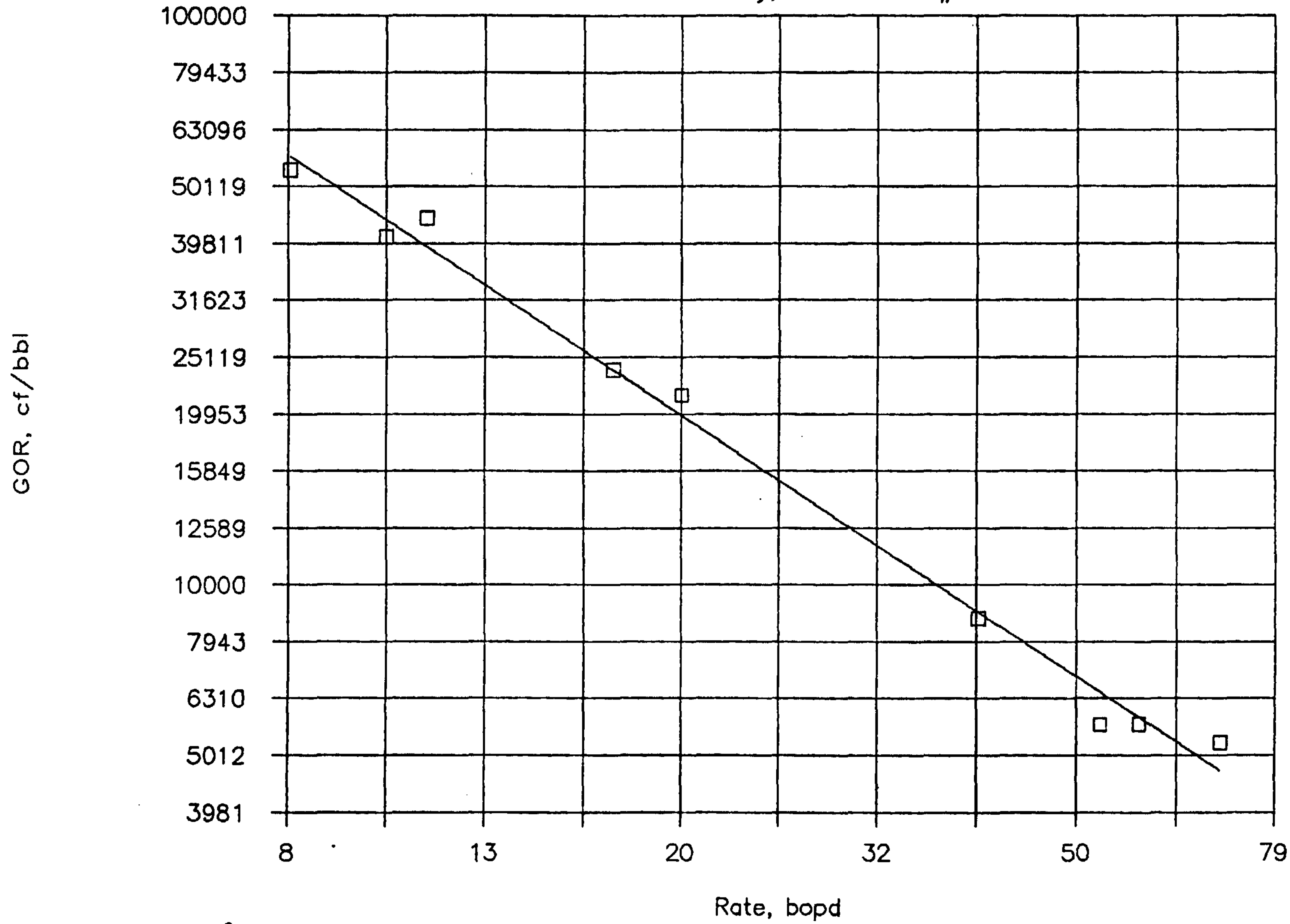
Rate Sensitivity, Mallon HF 1#11



C.C. = 0.97

Gavilan Dome, July 87—Feb 88

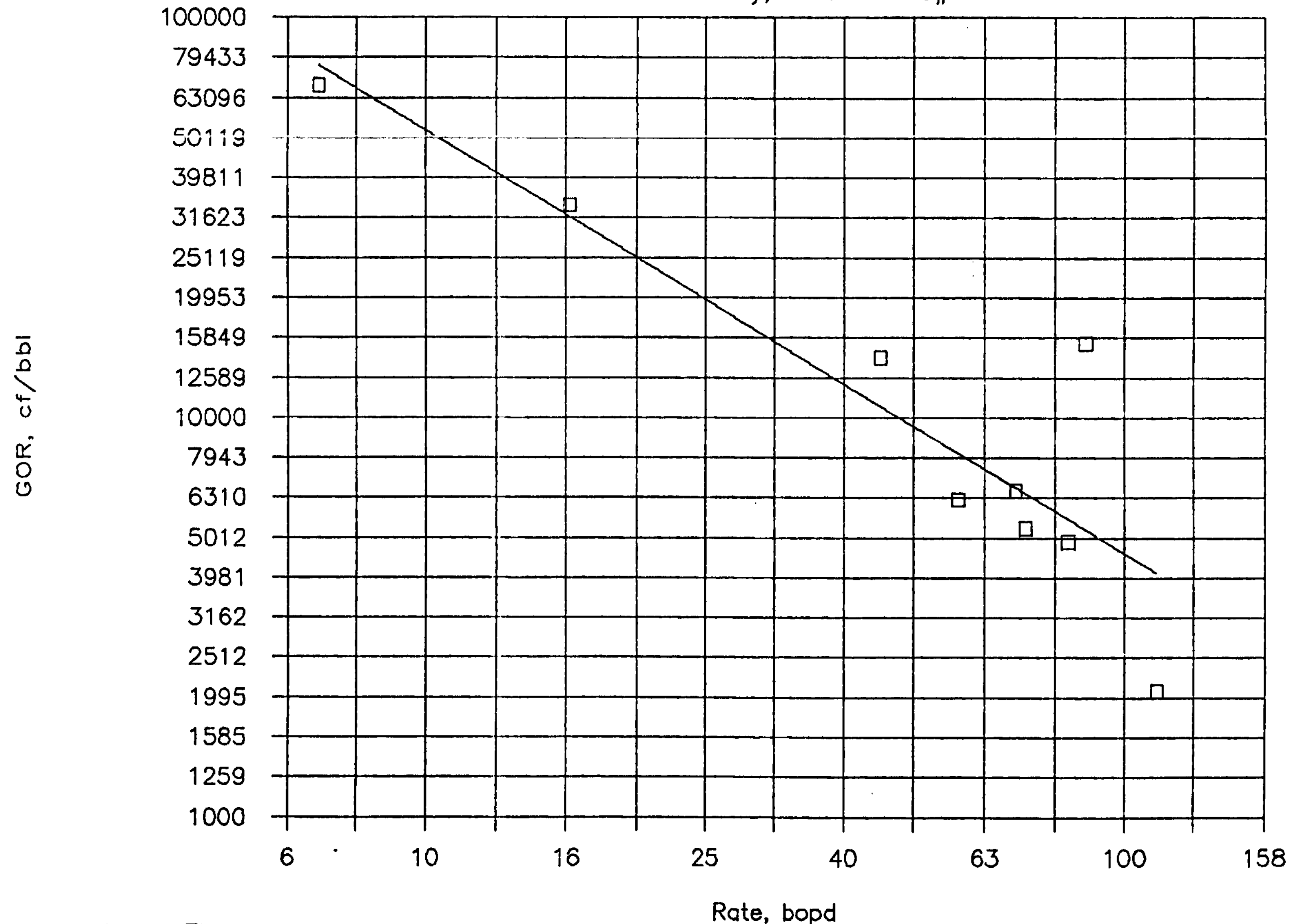
Rate Sensitivity, Mallon JF 12#5



C.C. = 1.00

Gavilan Dome, July 87—Feb 88

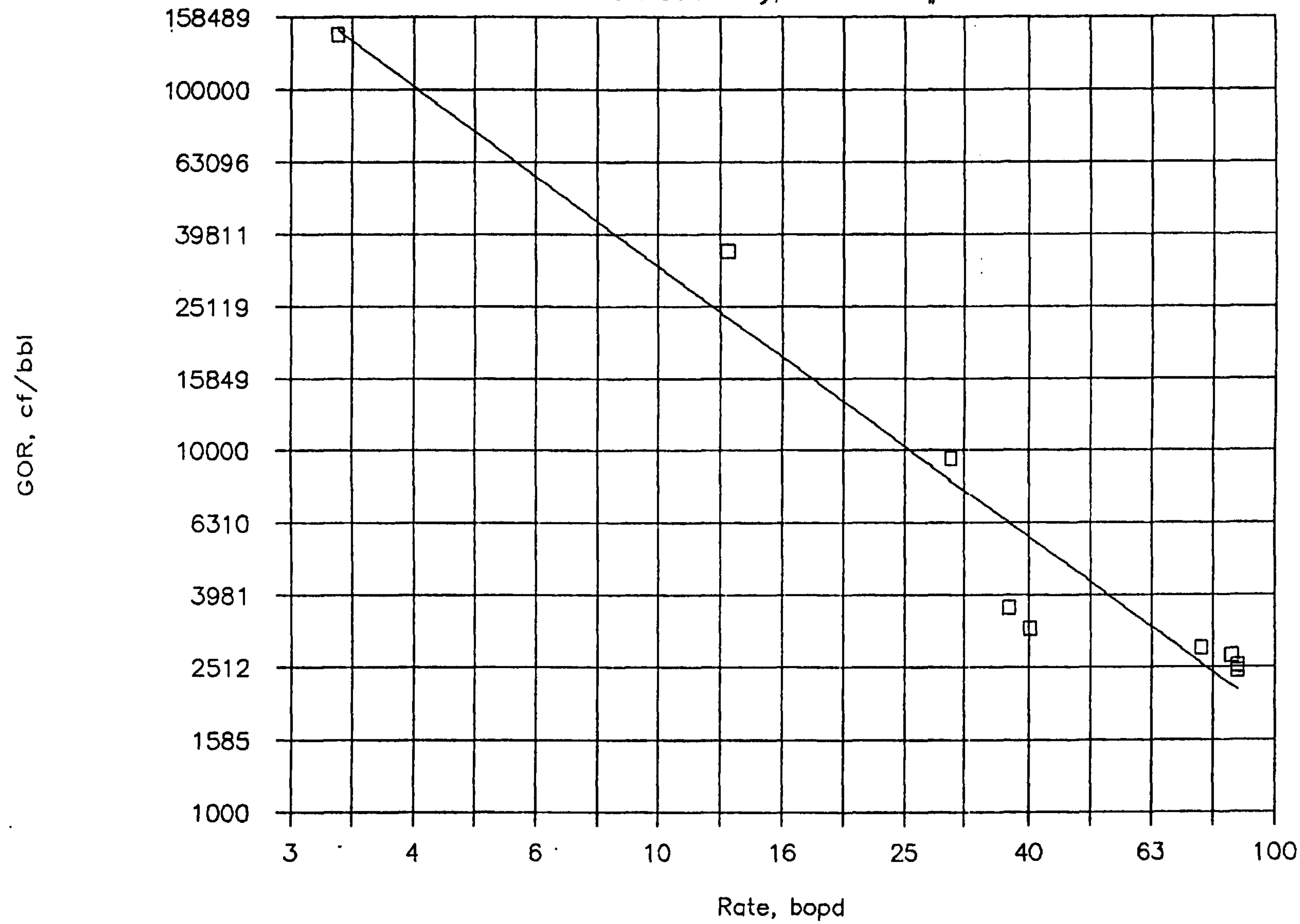
Rate Sensitivity, Mallon PF 13#6



C. C. = 0.89

Gavilan Dome, July 87–Feb 88

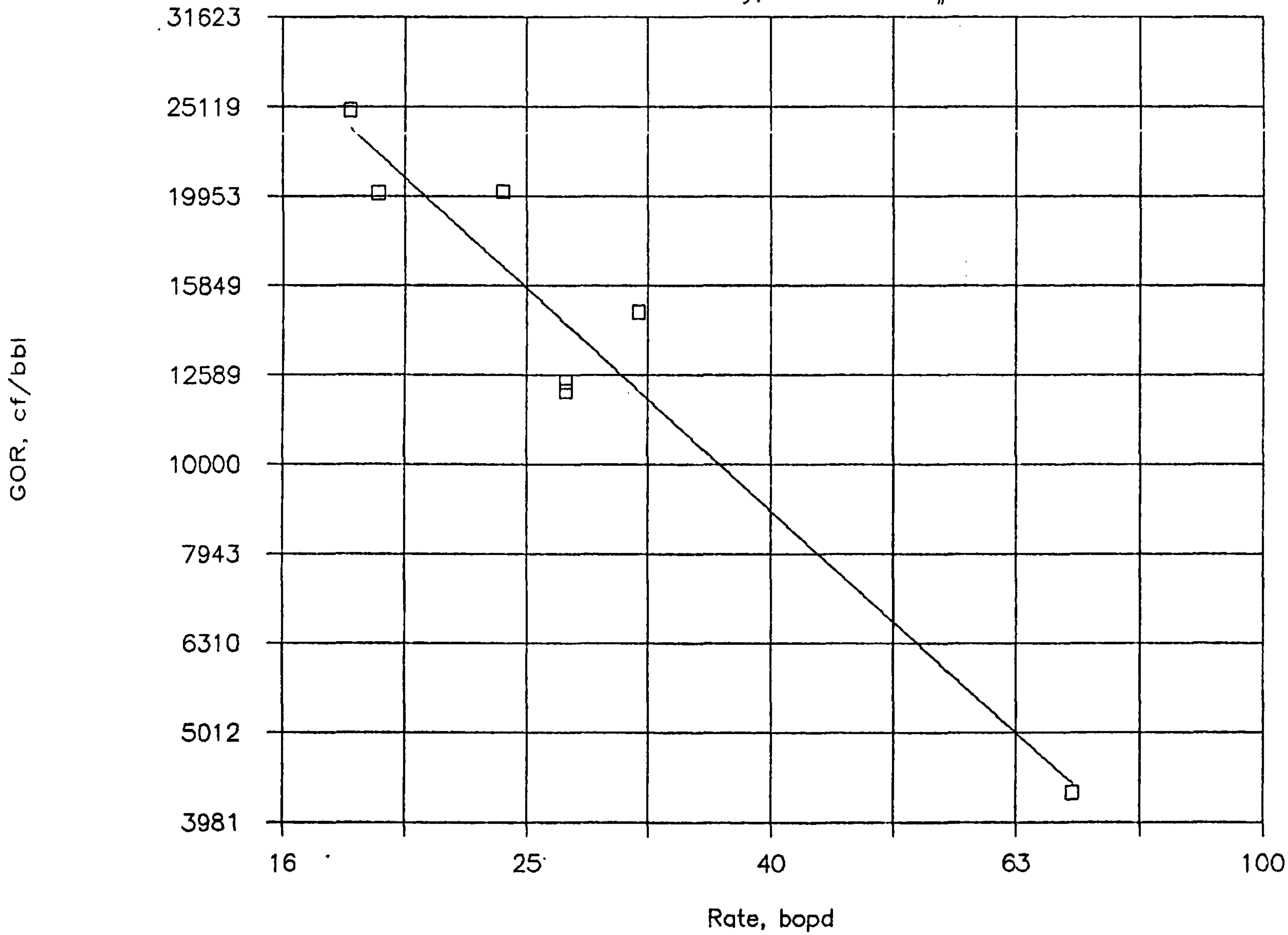
Rate Sensitivity, Mallon Rf 2#16



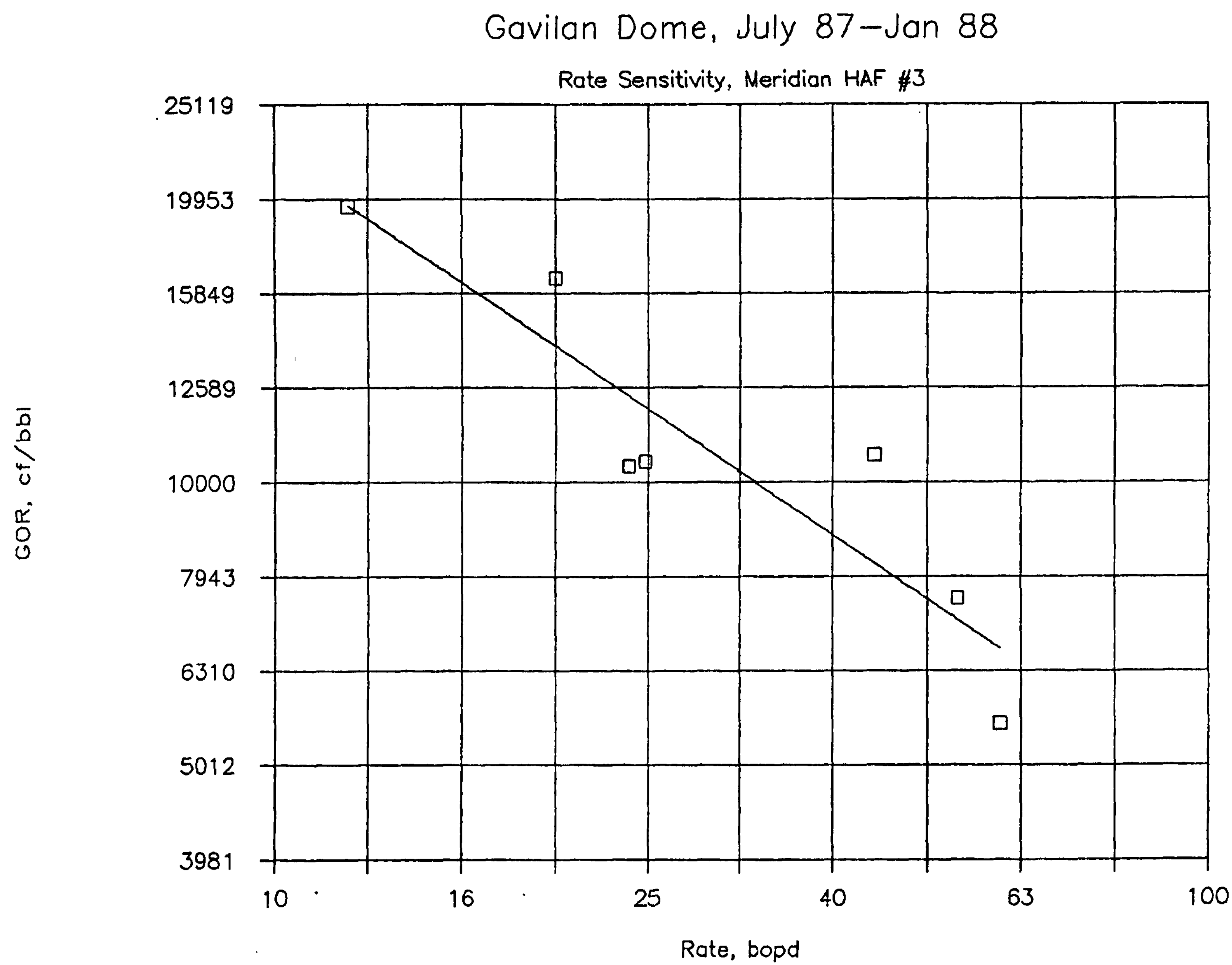
C.C. = 0.97

Gavilan Dome, July 87—Jan 88

Rate Sensitivity, Meridian HAF #2

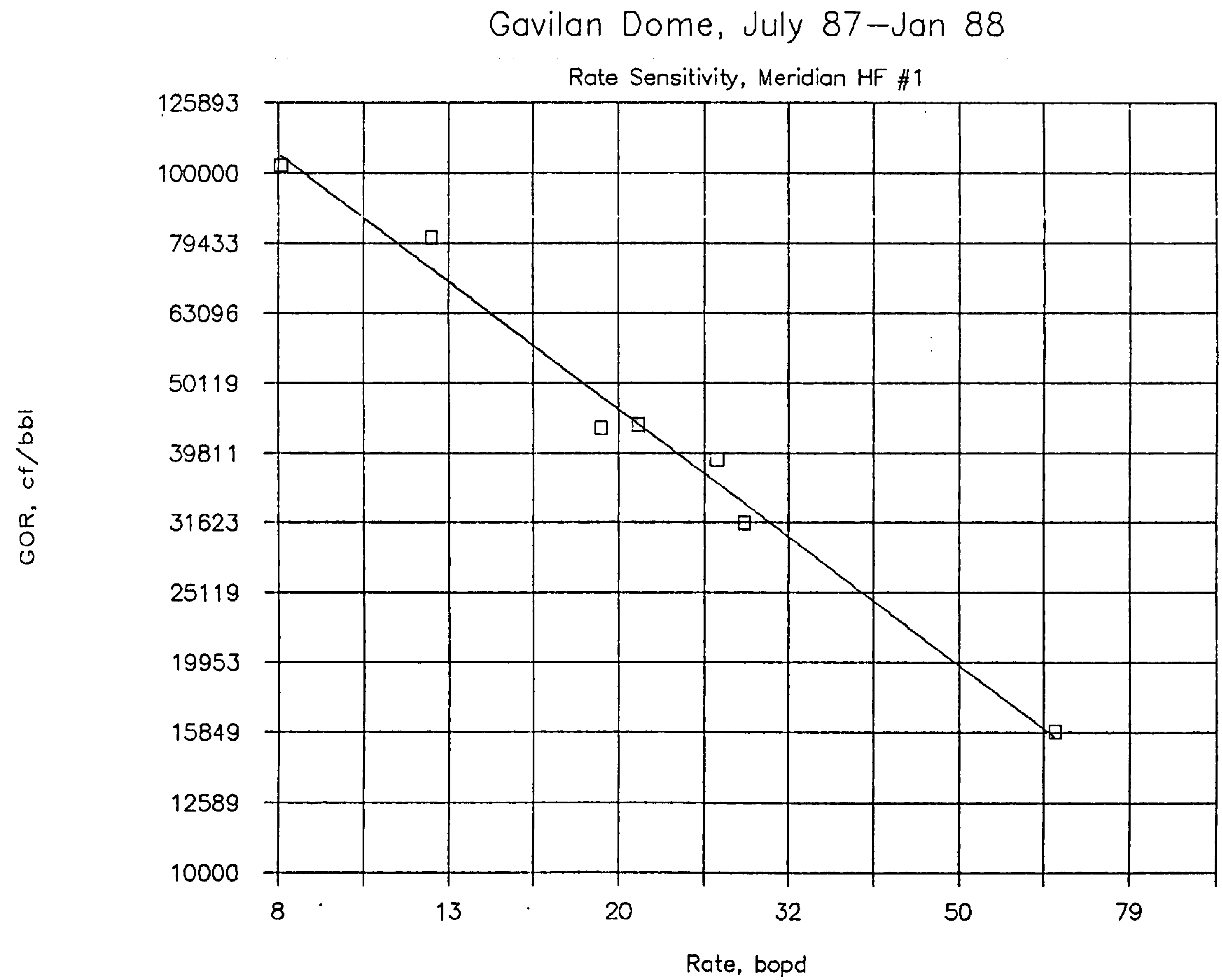


C. C. = 0.96



Gavilan Dome, July 87—Jan 88
Rate Sensitivity, Meridian HAF #3
25119
19953
15849
12589
10000
7943
6310
5012
3981
GOR, cf/bbl
10
16
25
40
63
100
Rate, bopd

C.C. = 0.92

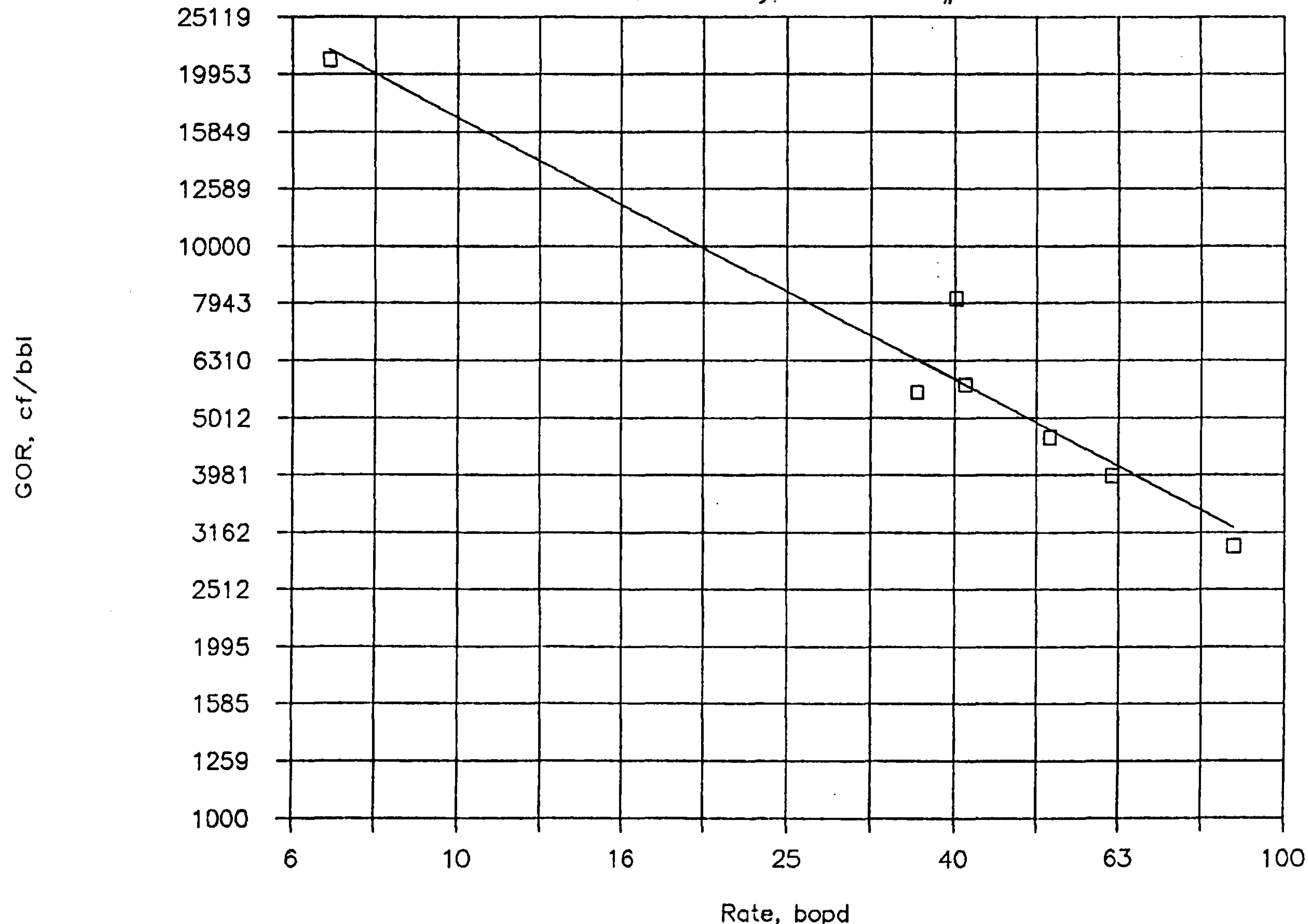


Gavilan Dome, July 87—Jan 88
Rate Sensitivity, Meridian HF #1
125893
100000
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
GOR, cf/bbl
8
13
20
32
50
79
Rate, bopd

C.C. = 0.99

Gavilan Dome, June 87—Jan 88

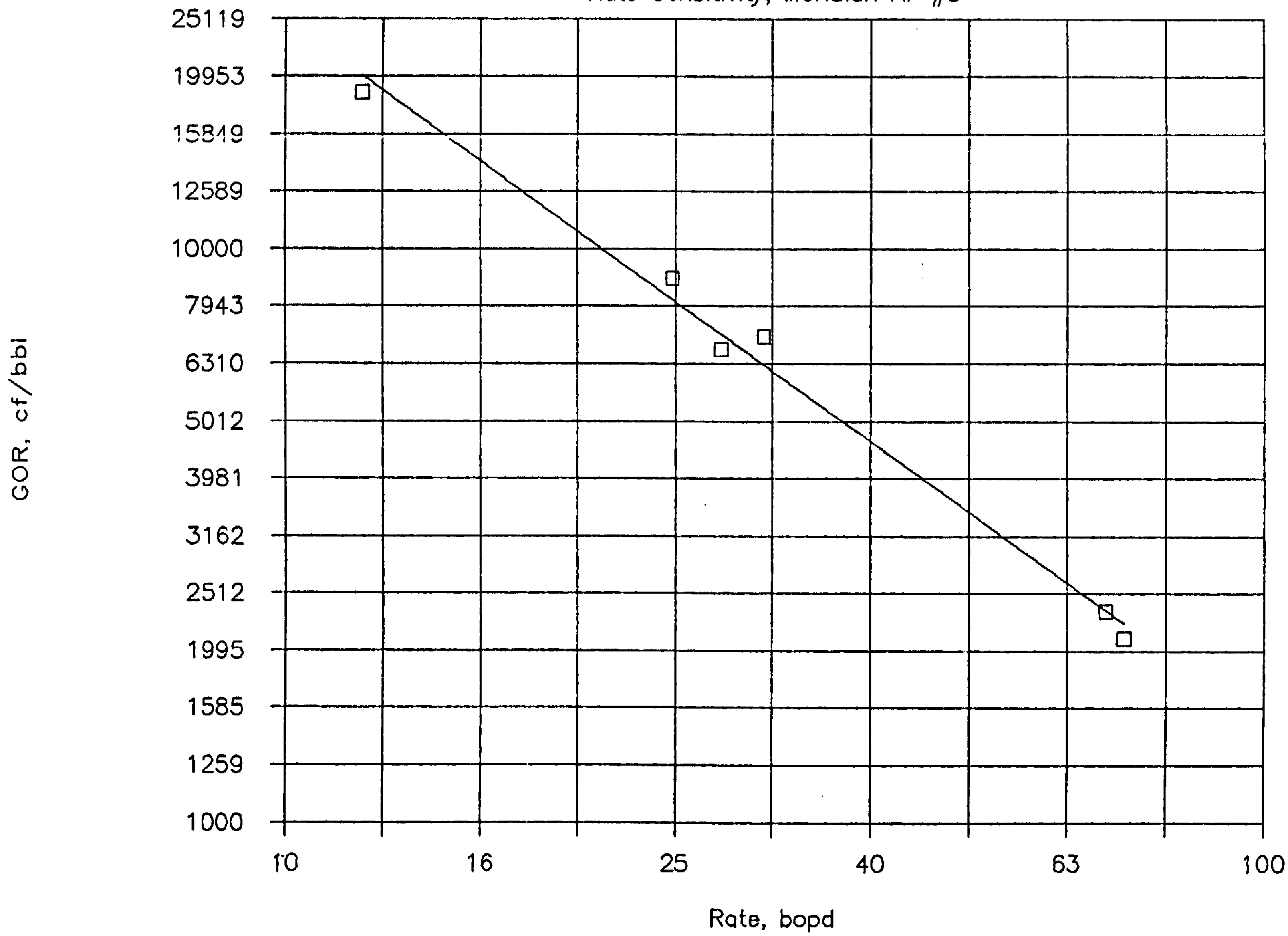
Rate Sensitivity, Meridian HF #2Y



C.C. = 0.97

Gavilan Dome, July 87—Jan 88

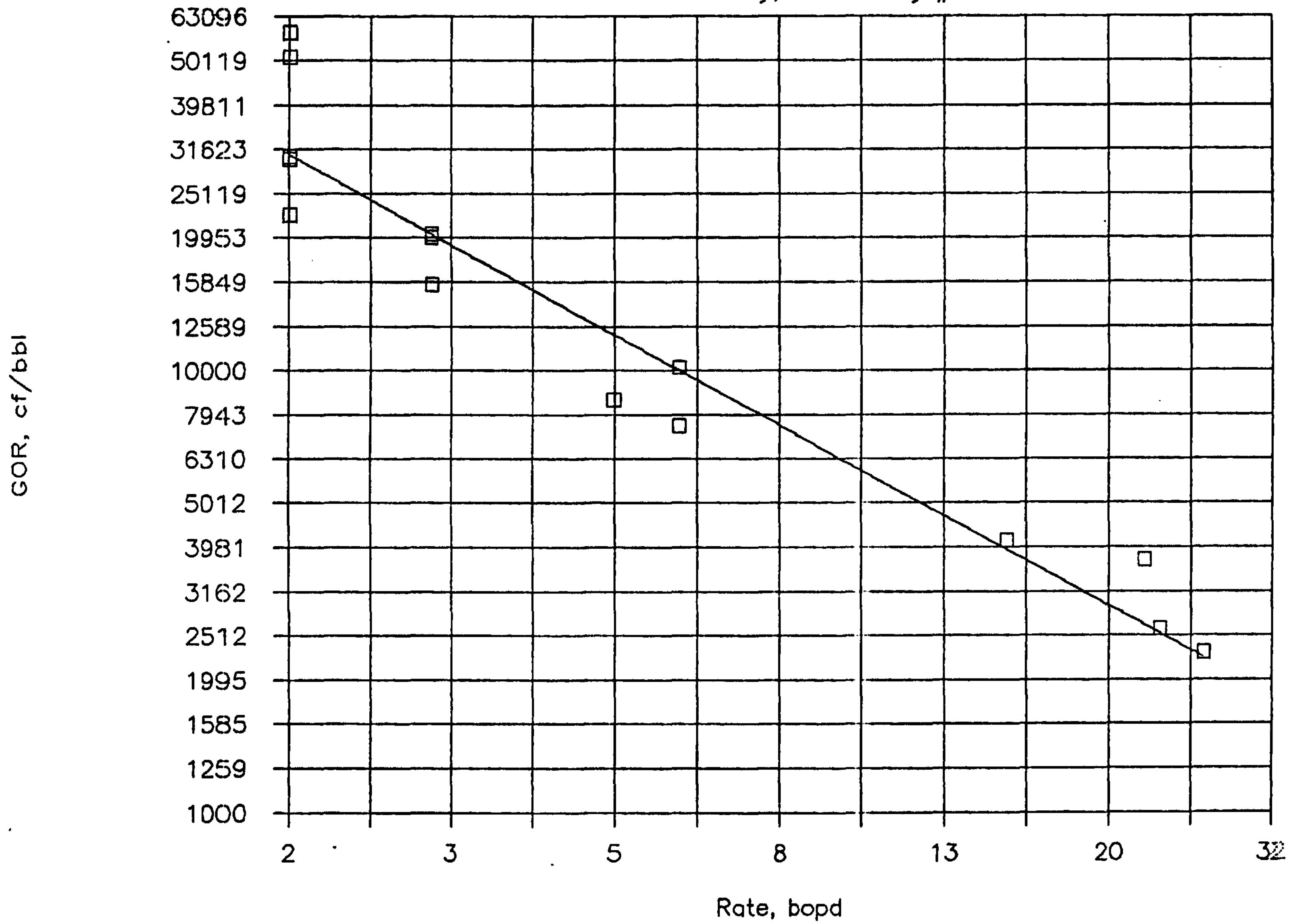
Rate Sensitivity, Meridian HF #3



C C = 1.00

Gavilan Dome, 1/1–2/15/88

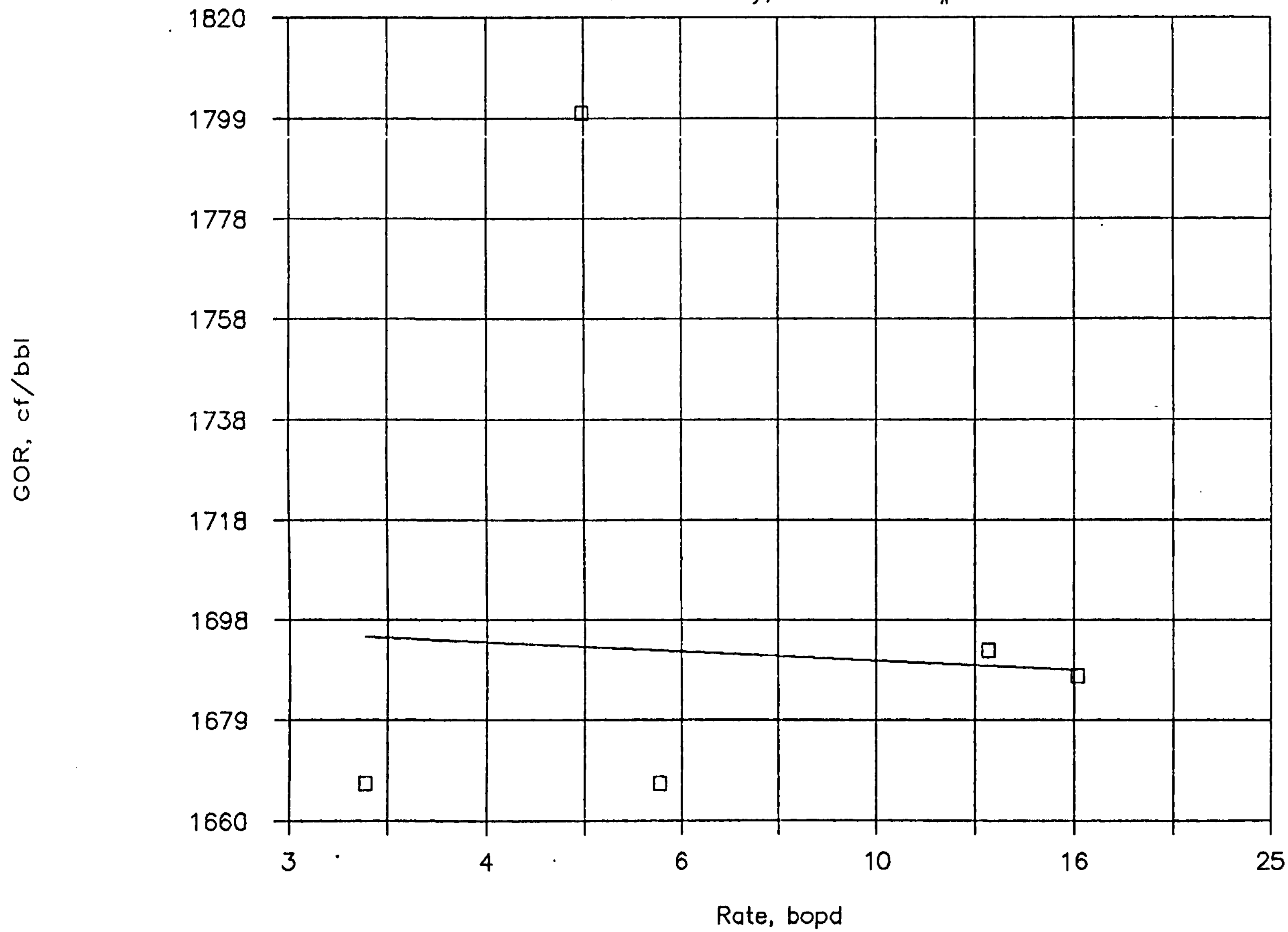
Rate Sensitivity, Merrion Kry #1



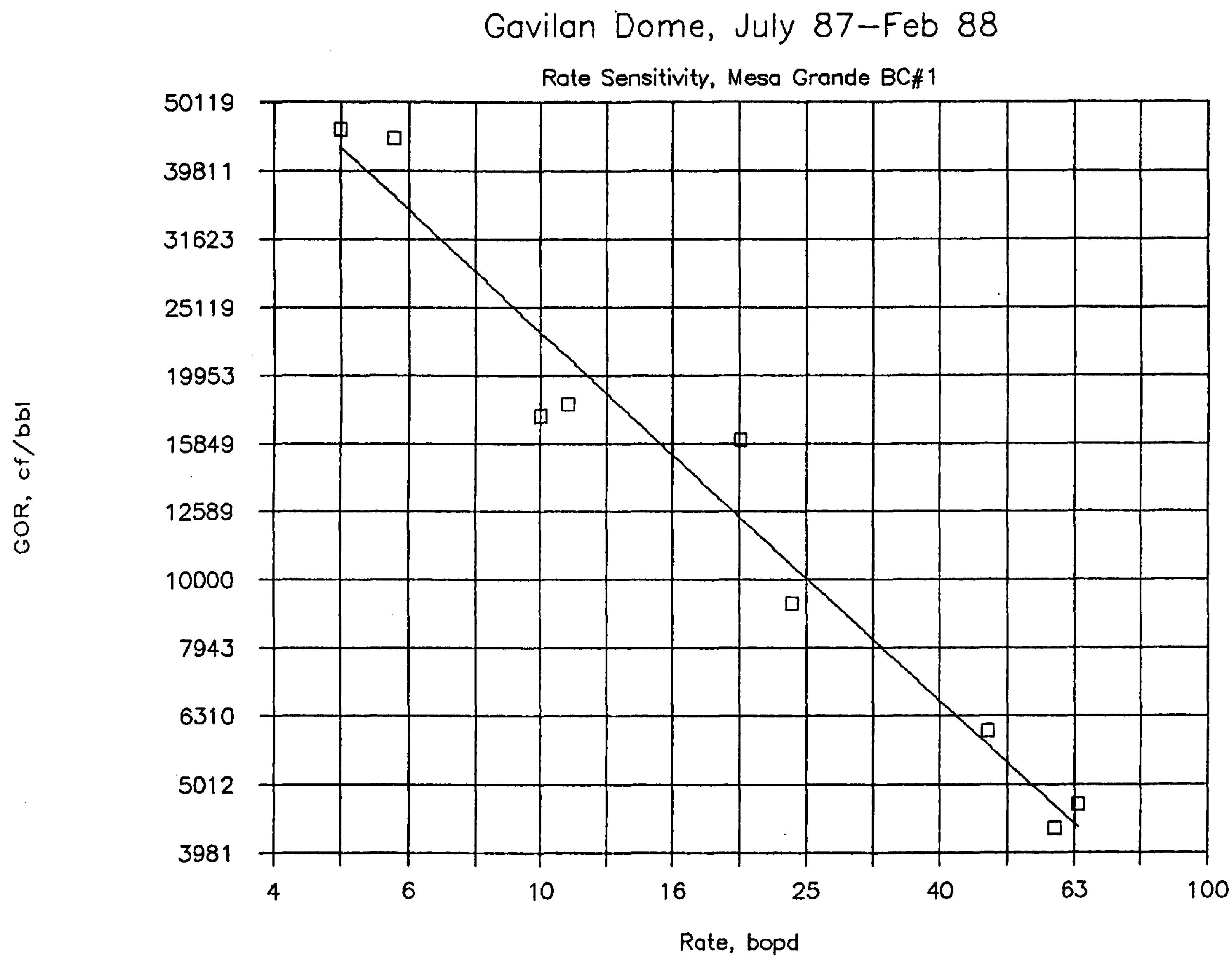
C.C. = 0.96

Gavilan Dome, July 87

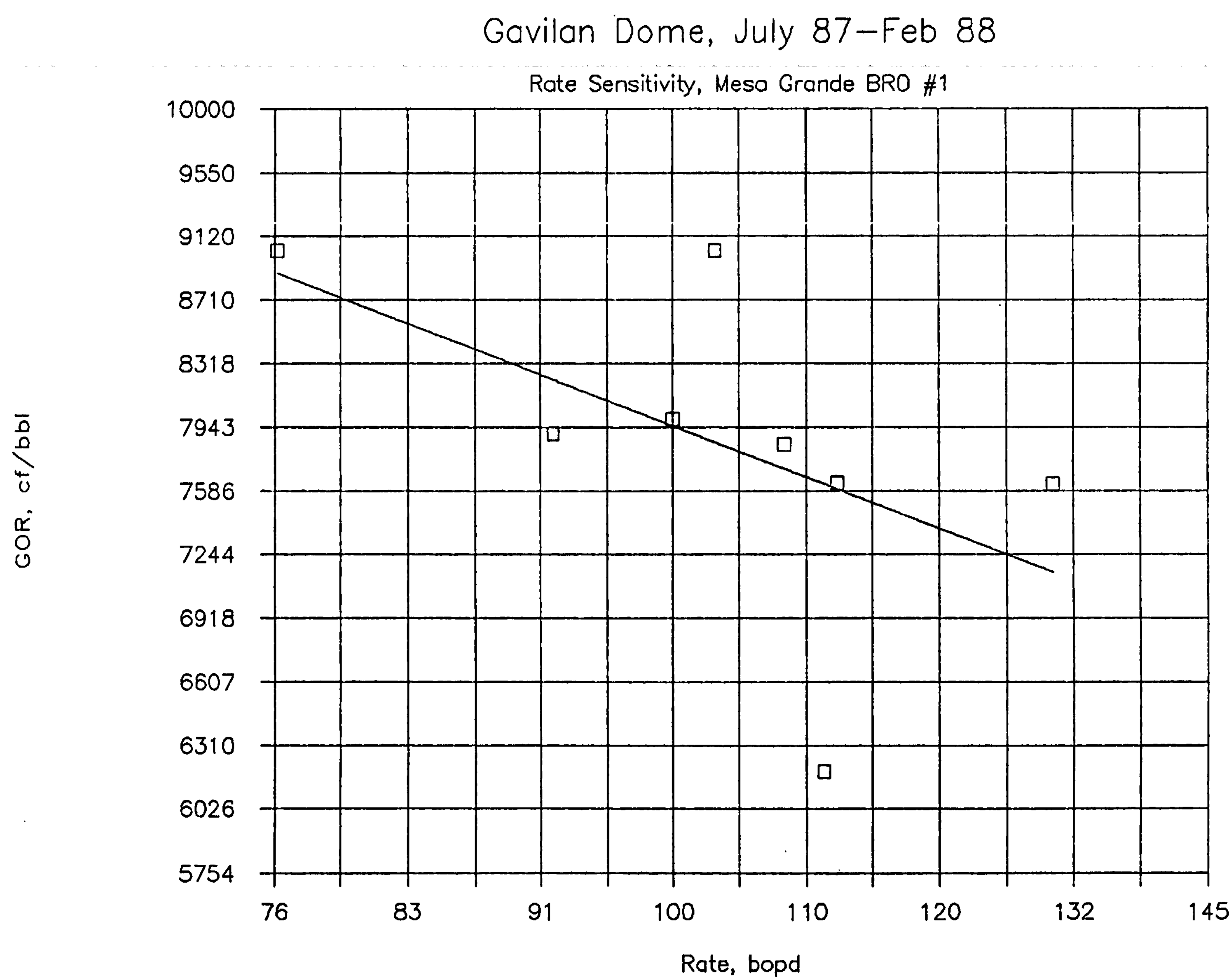
Rate Sensitivity, Merrion OCG #1



C. C. = 0.15

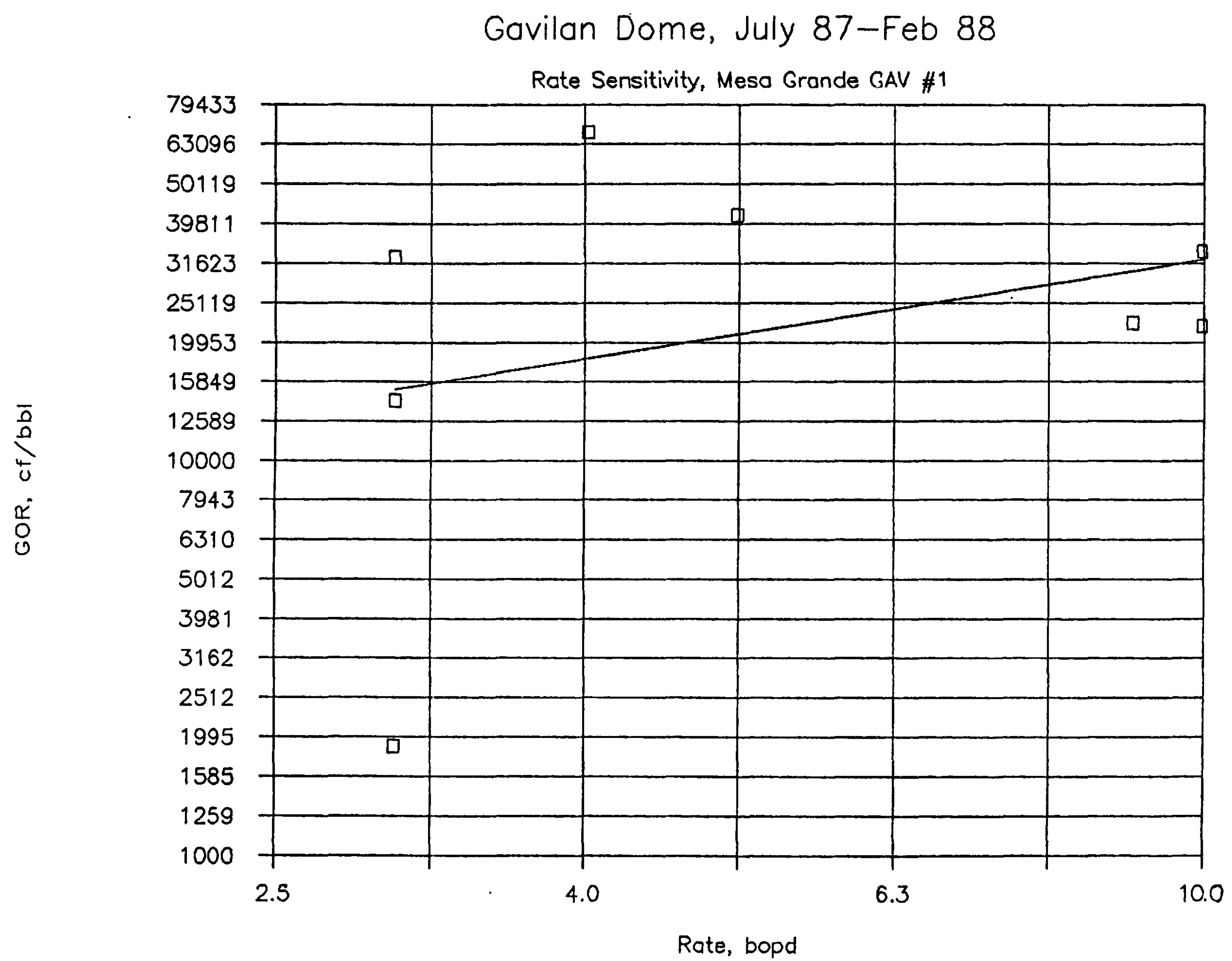

Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mesa Grande BC#1
GOR, cf/bbl
50119
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
4
6
10
16
25
40
63
100
Rate, bopd

C.C. = 0.98

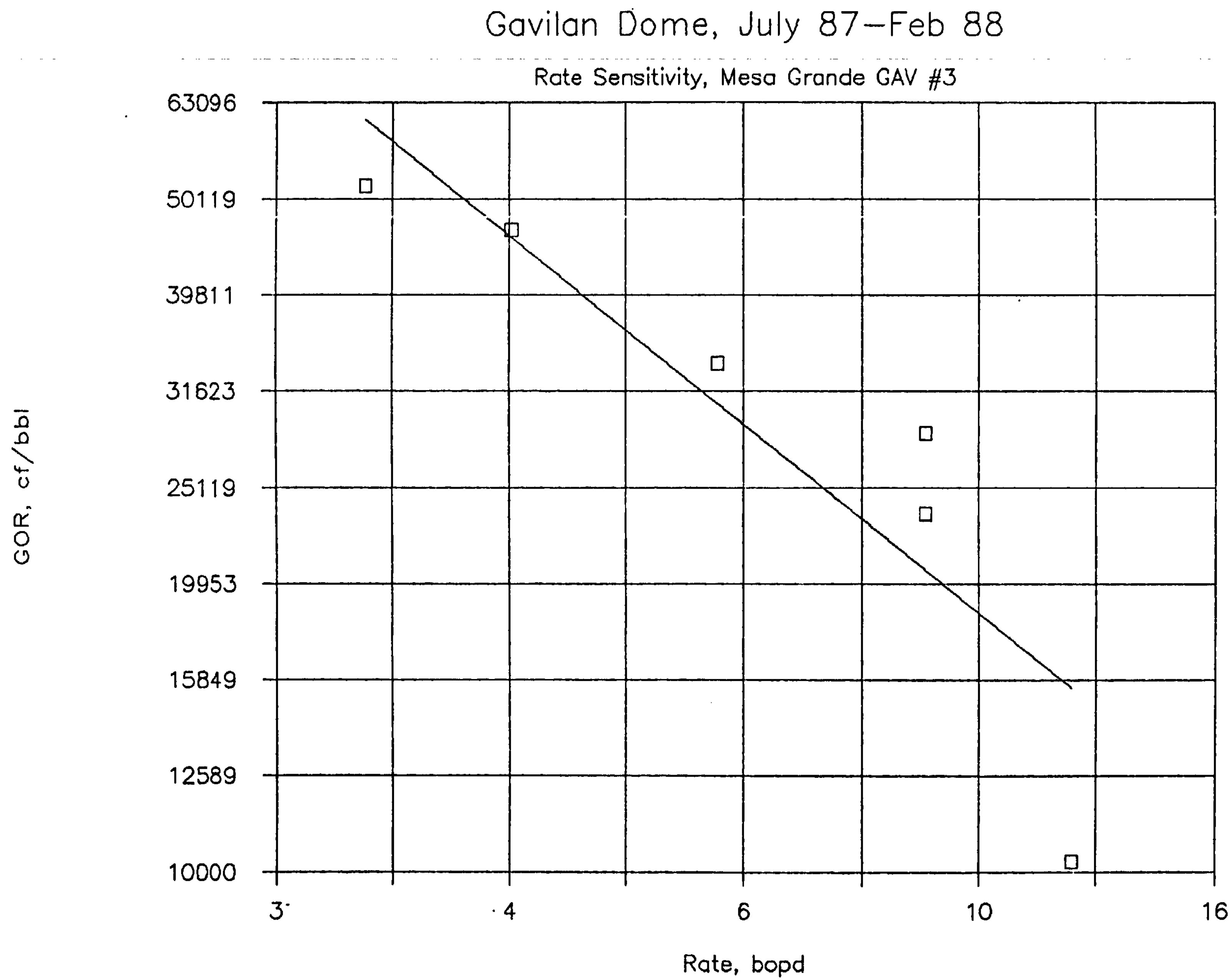


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mesa Grande BRO #1
GOR, cf/bbl
10000
9550
9120
8710
8318
7943
7586
7244
6918
6607
6310
6026
5754
76
83
91
100
110
120
132
145
Rate, bopd

C.C. = 0.54


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Mesa Grande GAV #1
GOR, cf/bbl
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
2.5
4.0
6.3
10.0
Rate, bopd

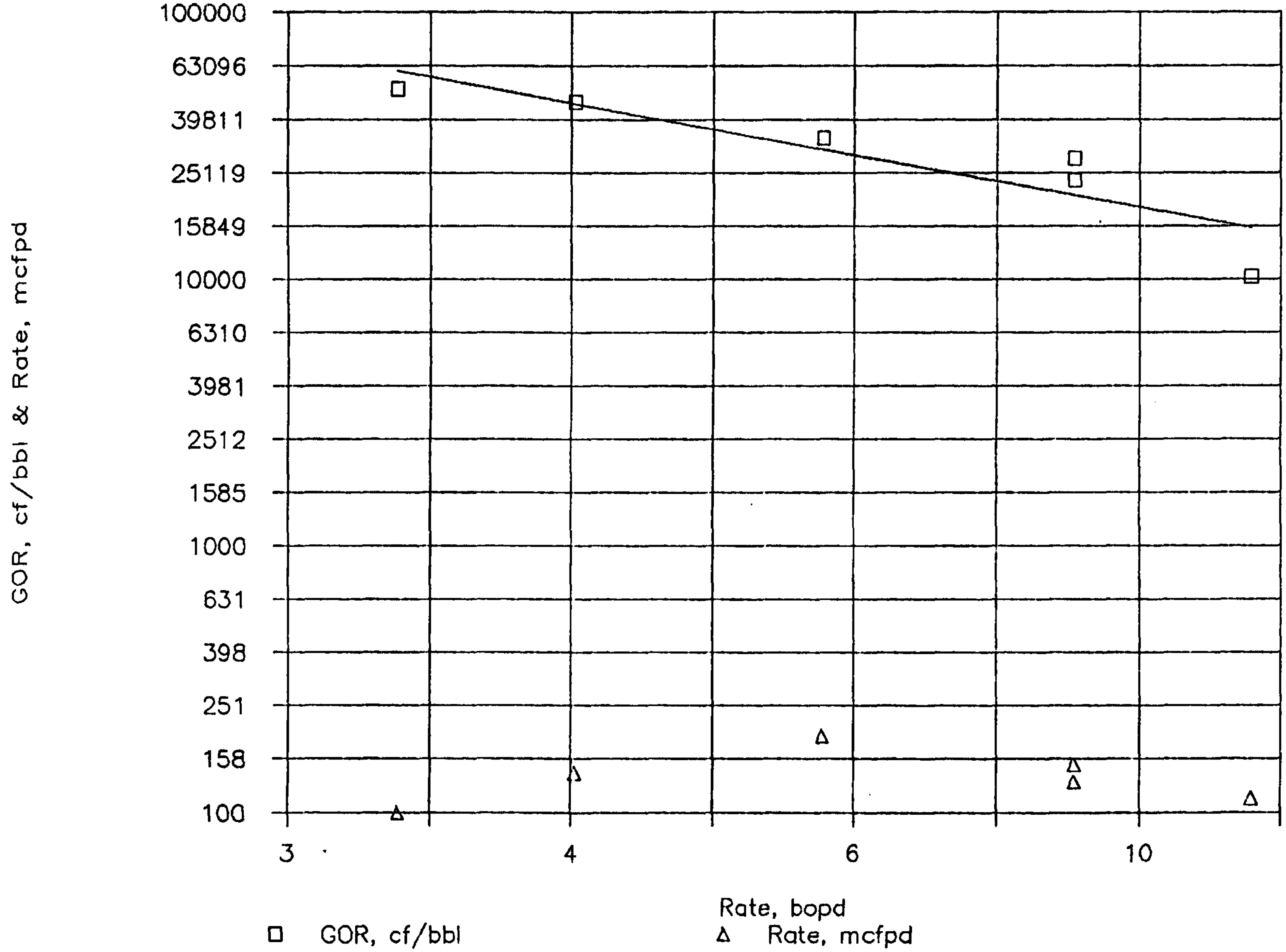
C.C. = 0.32

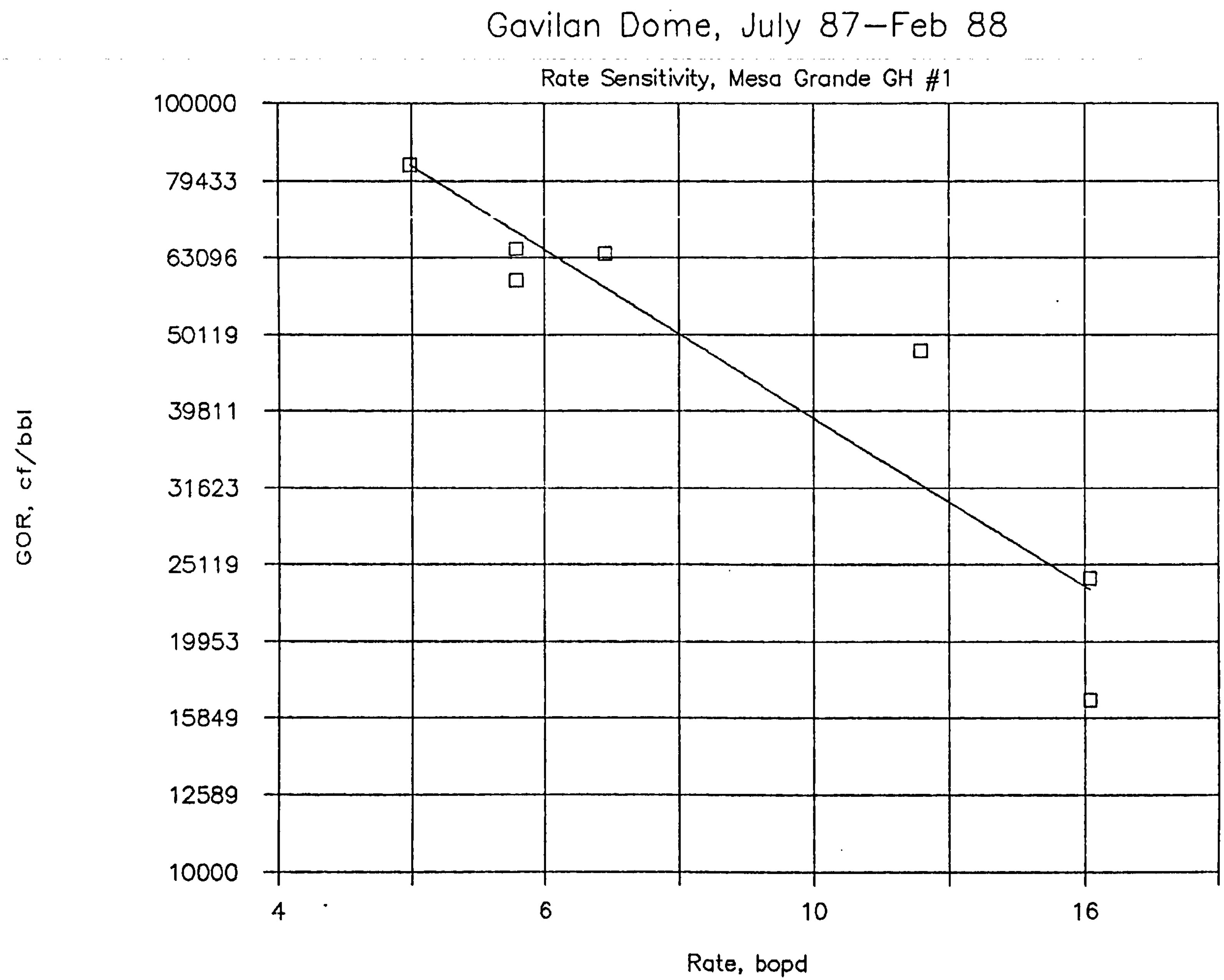

Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mesa Grande GAV #3
GOR, cf/bbl
63096
50119
39811
31623
25119
19953
15849
12589
10000
3
4
6
10
16
Rate, bopd

C. I. = 0.90

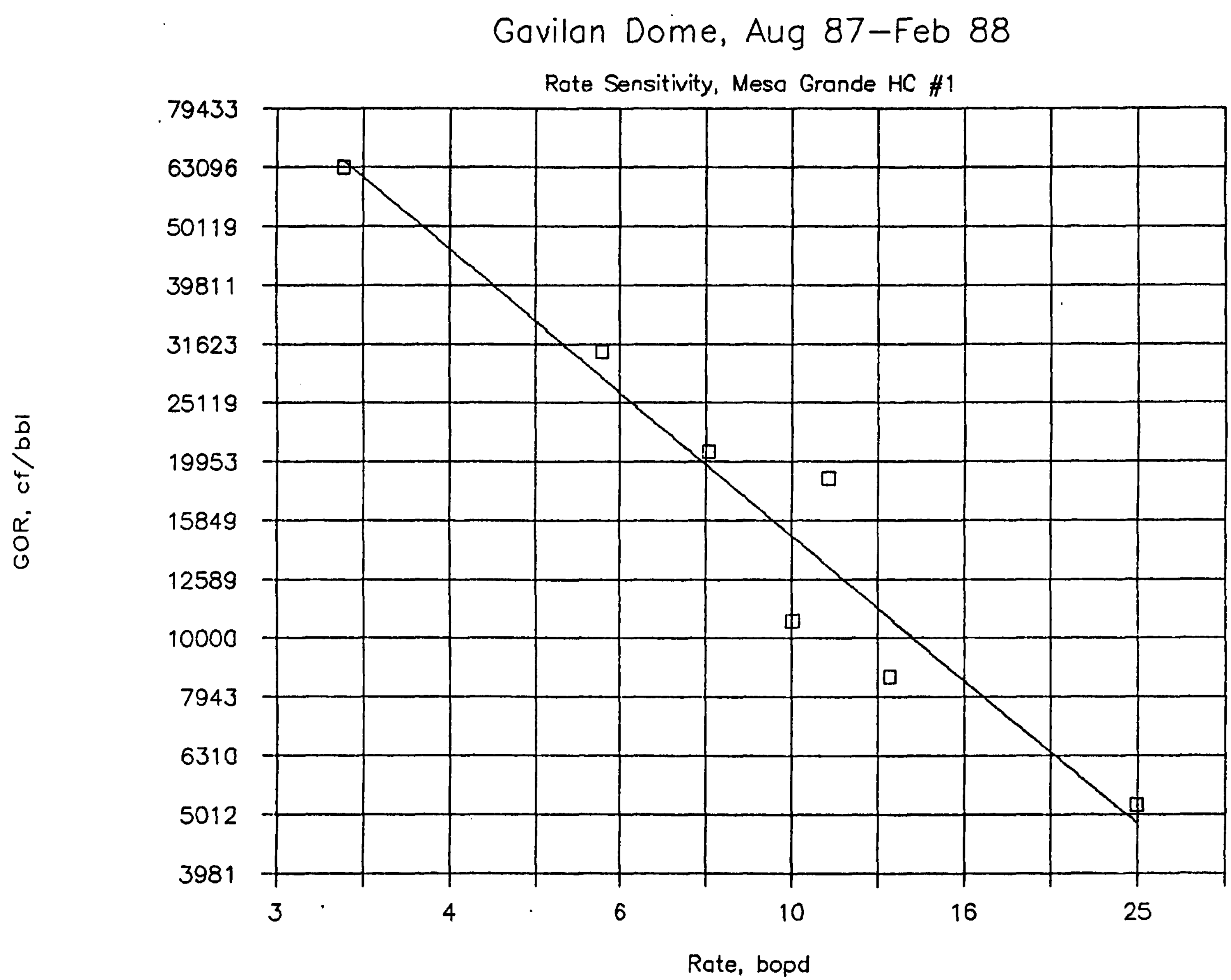
Gavilan Dome, July 87–Feb 88

Rate Sensitivity, M.G. Gav #3



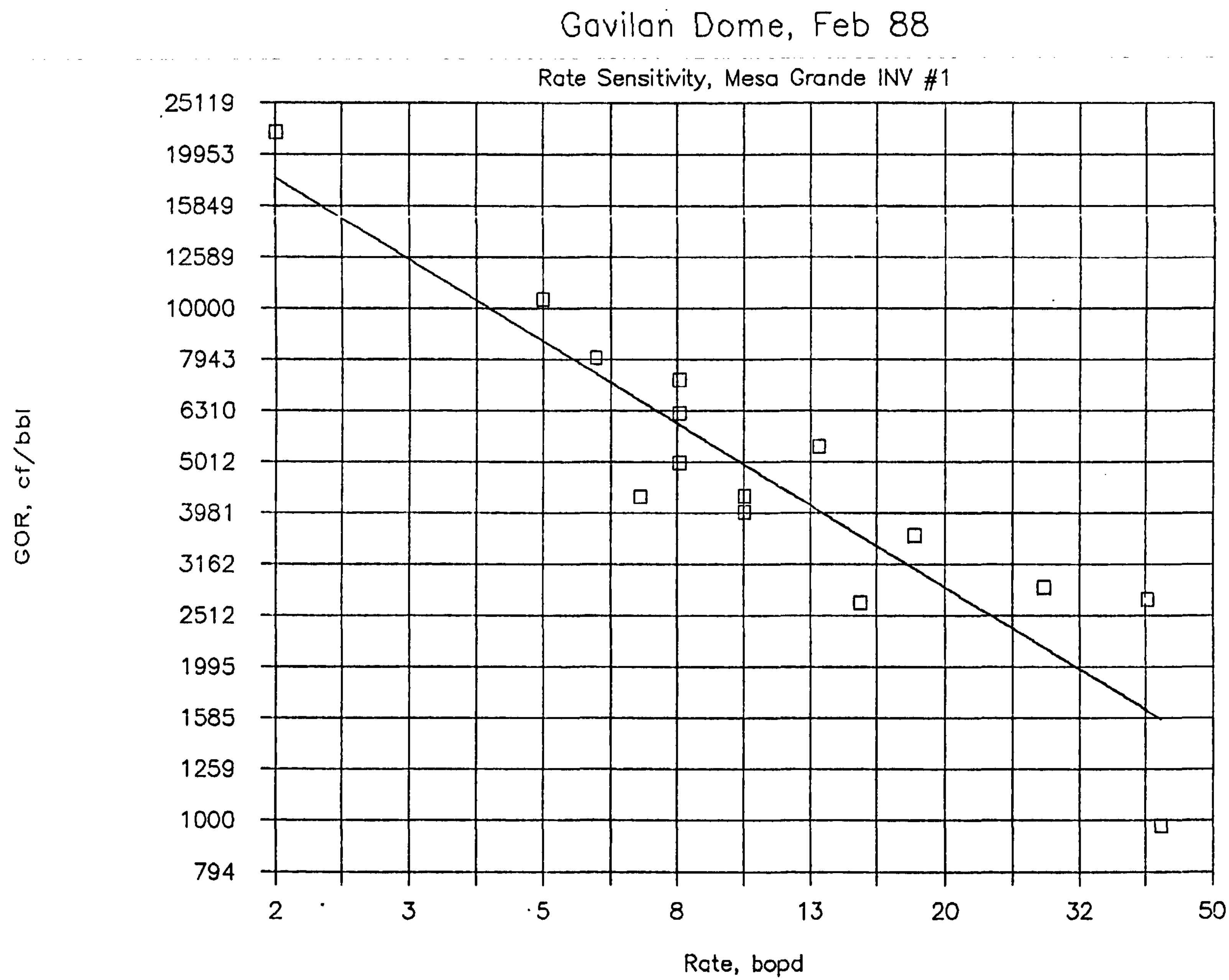

Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Mesa Grande GH #1
100000
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
GOR, cf/bbl
4
6
10
16
Rate, bopd

C.C. = 0.92

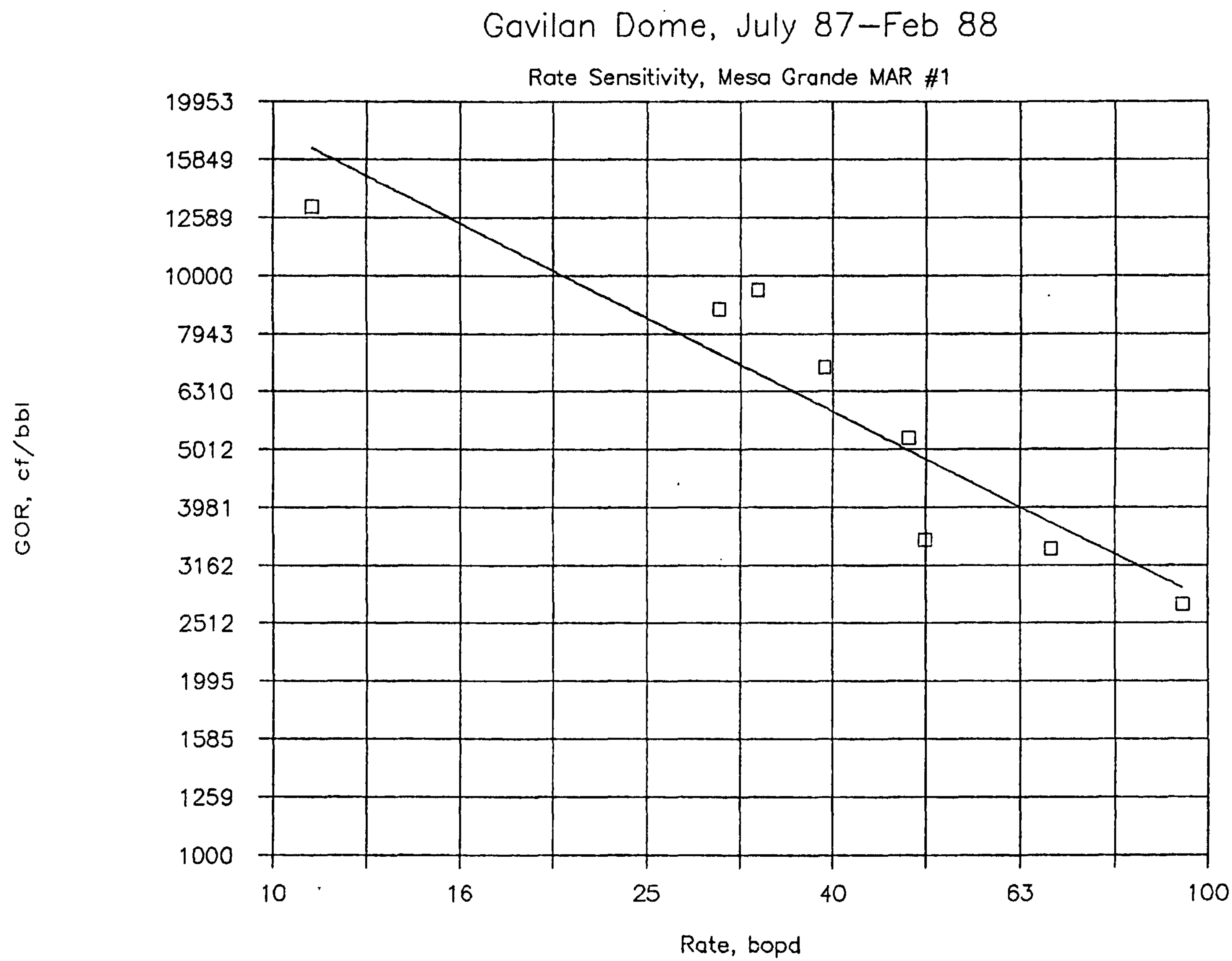


Gavilan Dome, Aug 87—Feb 88
Rate Sensitivity, Mesa Grande HC #1
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
GOR, cf/bbl
3
4
6
10
16
25
Rate, bopd

C.C. ≈ 0.96


Gavilan Dome, Feb 88
Rate Sensitivity, Mesa Grande INV #1
GOR, cf/bbl
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
794
2
3
5
8
13
20
32
50
Rate, bopd

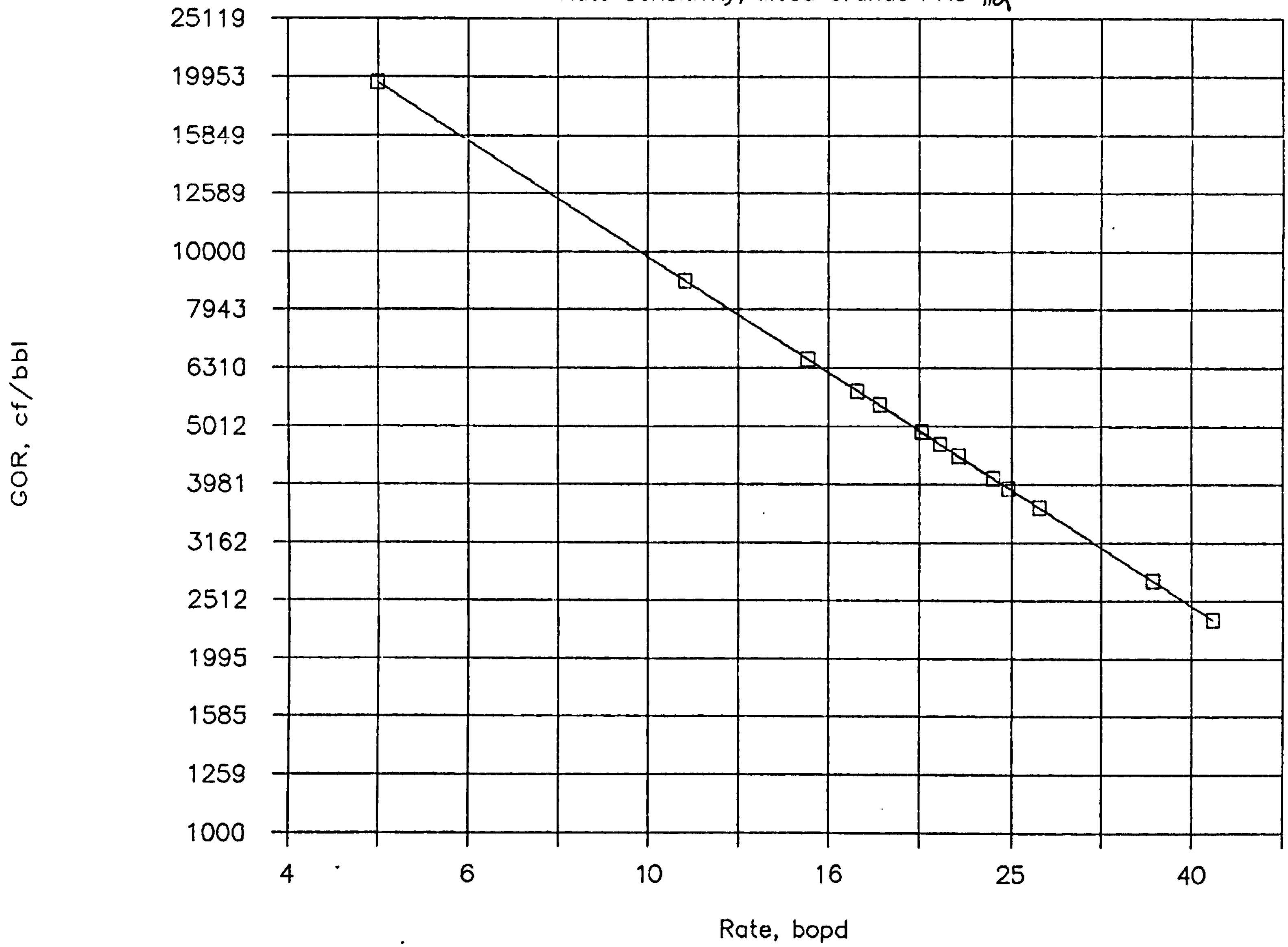
C.C. = 0.91

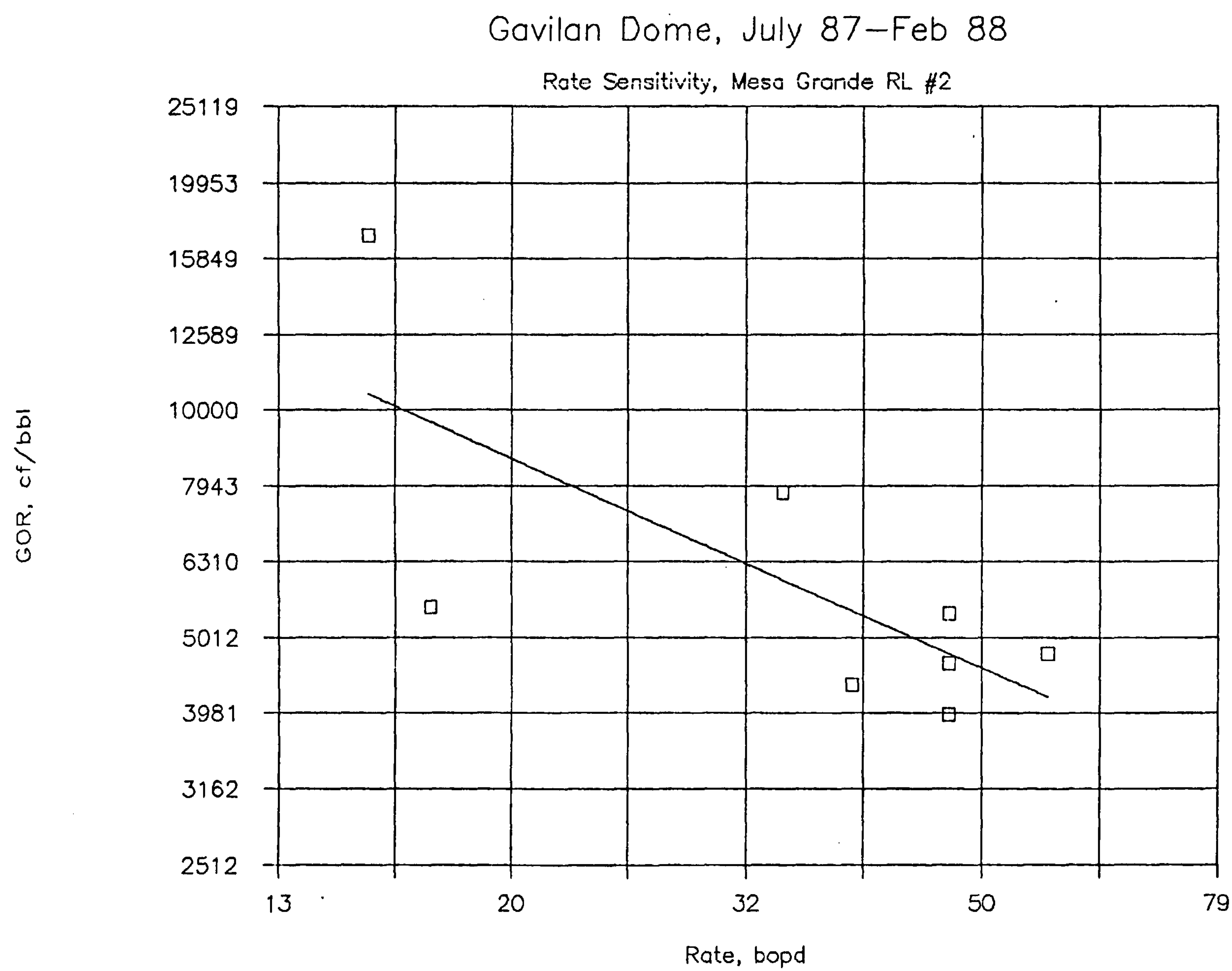

Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Mesa Grande MAR #1
GOR, cf/bbl
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
10
16
25
40
63
100
Rate, bopd

C. C. = 0.92

Gavilan Dome, Feb 88

Rate Sensitivity, Mesa Grande PRO #2



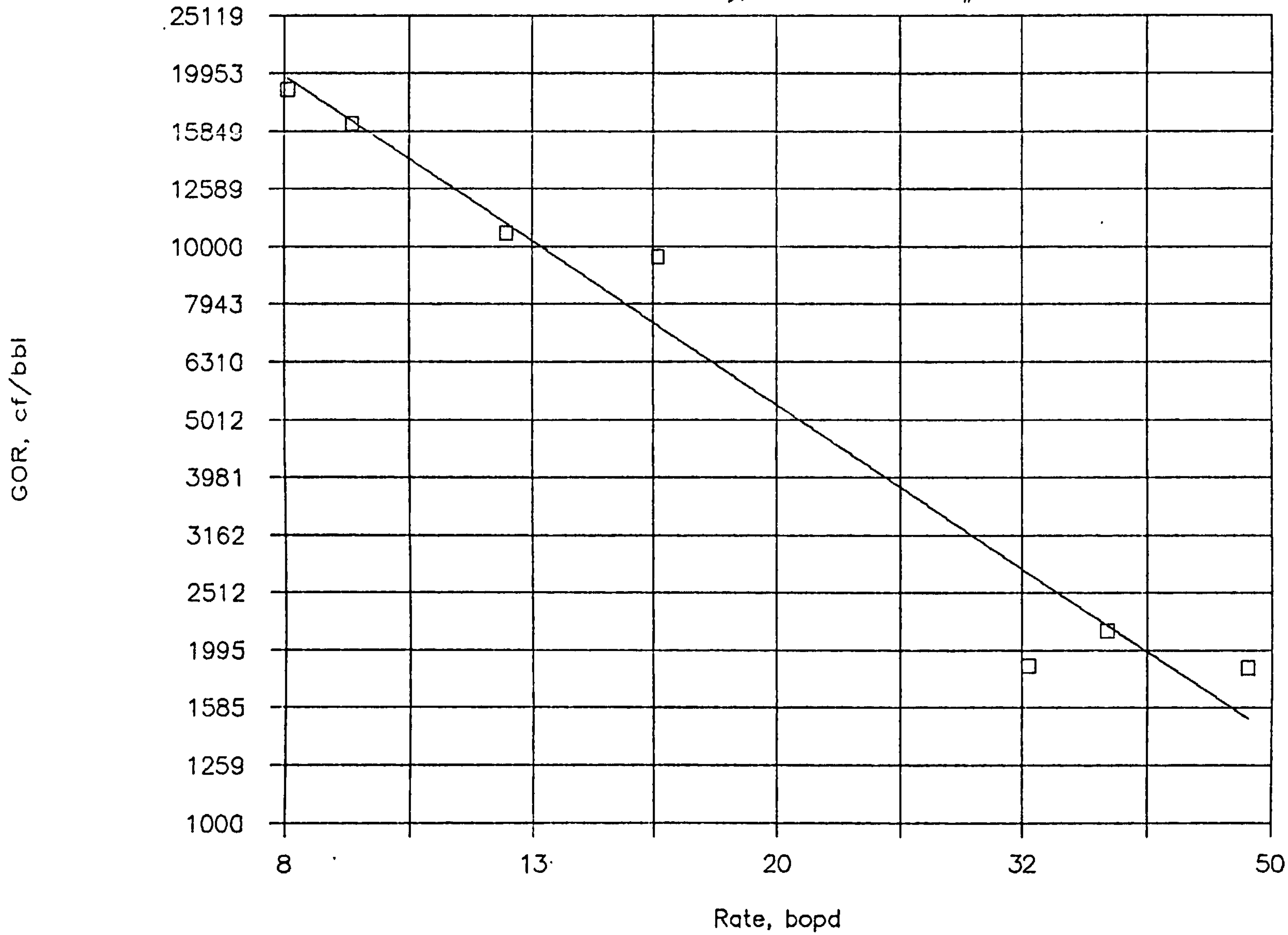


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Mesa Grande RL #2
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
GOR, cf/bbl
13
20
32
50
79
Rate, bopd

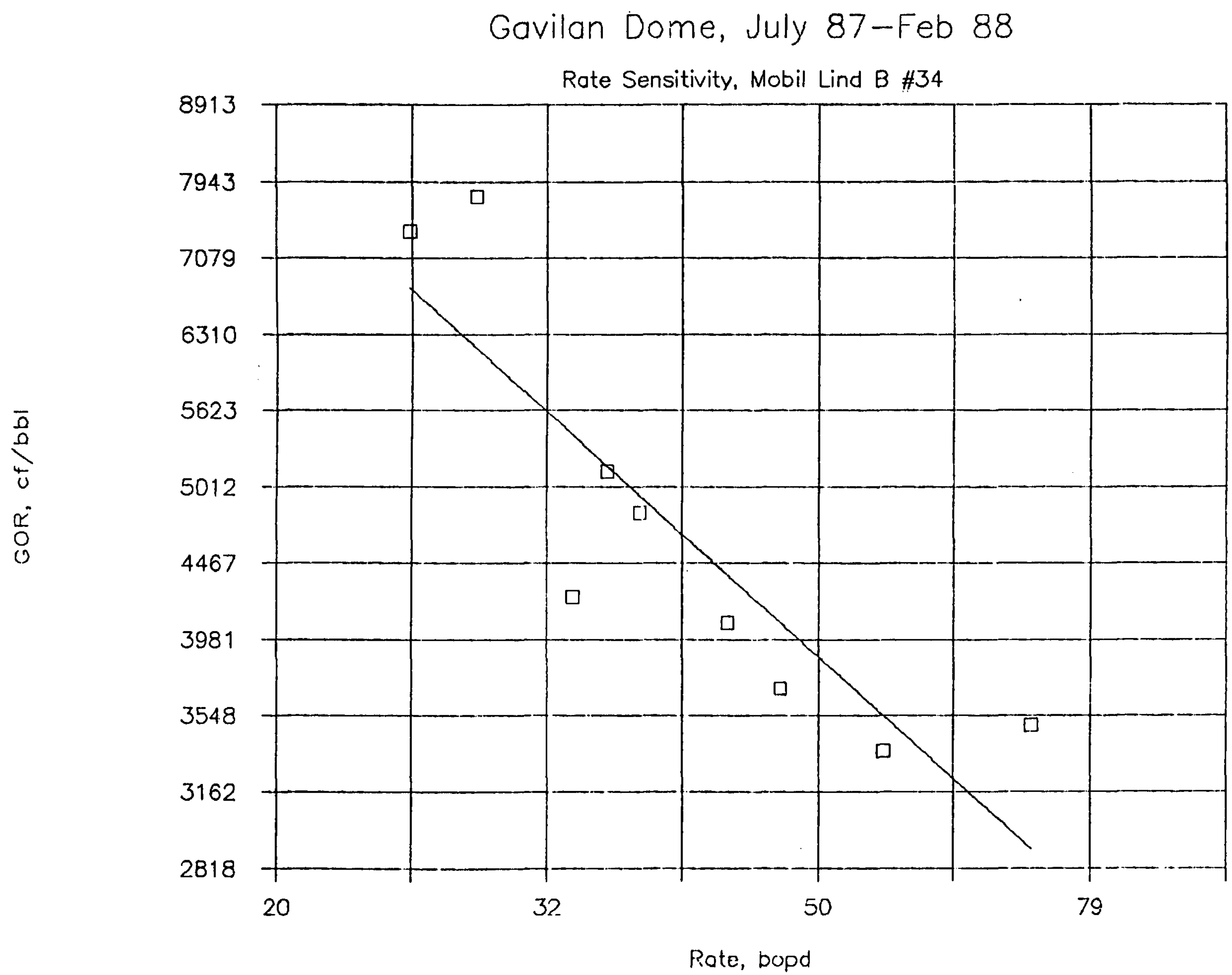
C.C. = 0.73

Gavilan Dome, July 87–Feb 88

Rate Sensitivity, Mesa Grande RL #3



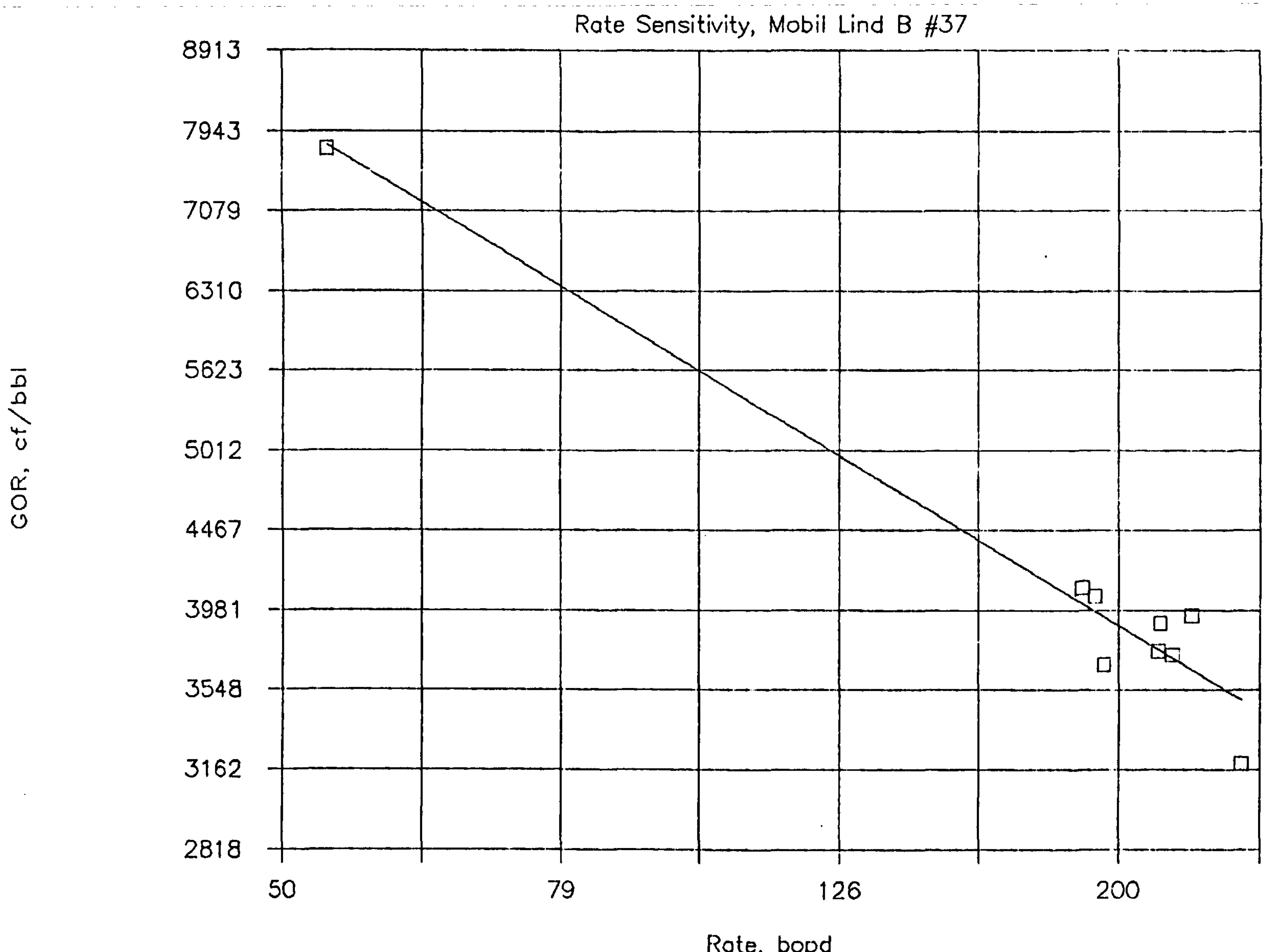
C.C. = 0.98



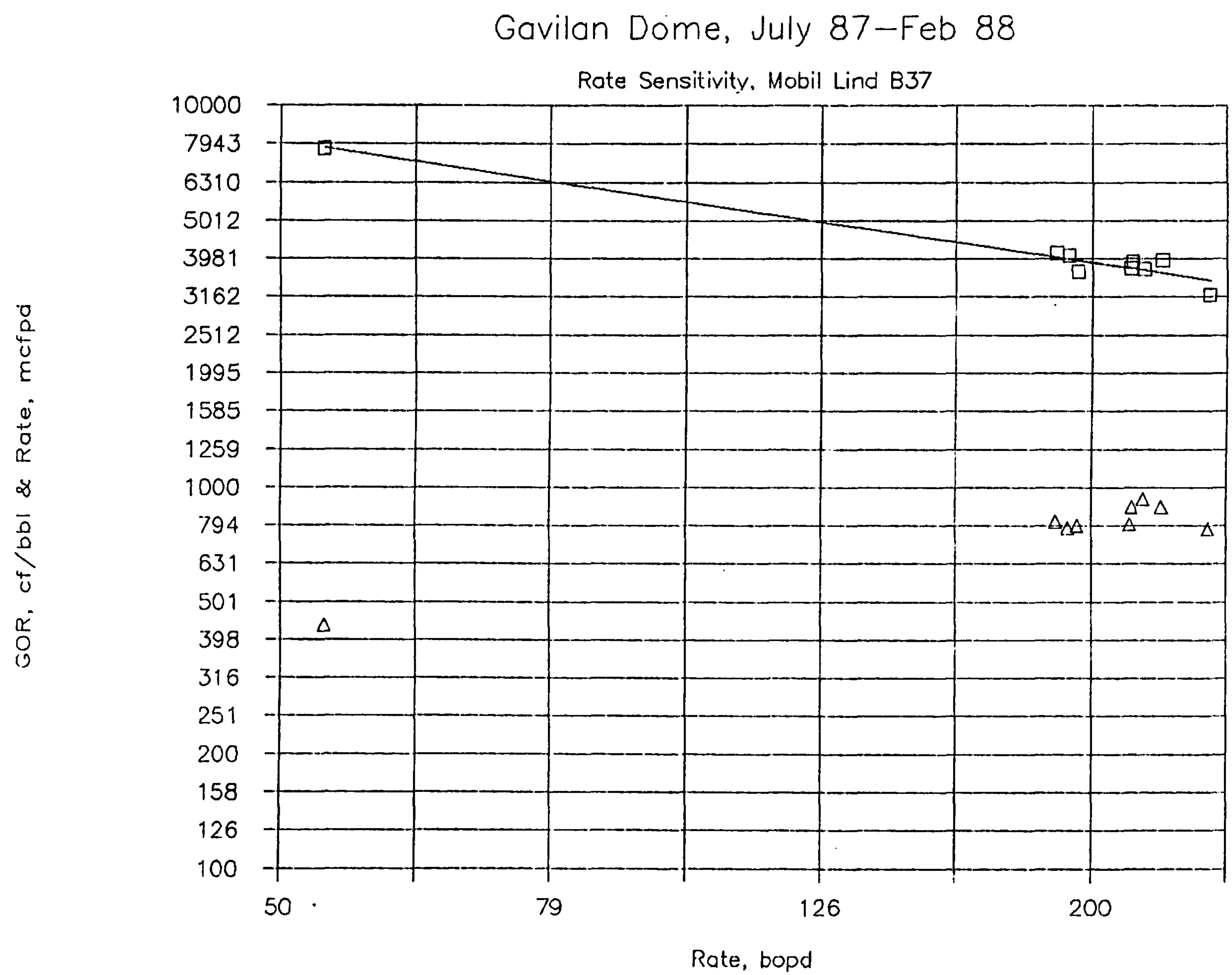
Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Mobil Lind B #34
GOR, cf/bbl
8913
7943
7079
6310
5623
5012
4467
3981
3548
3162
2818
20
32
50
79
Rate, bopd

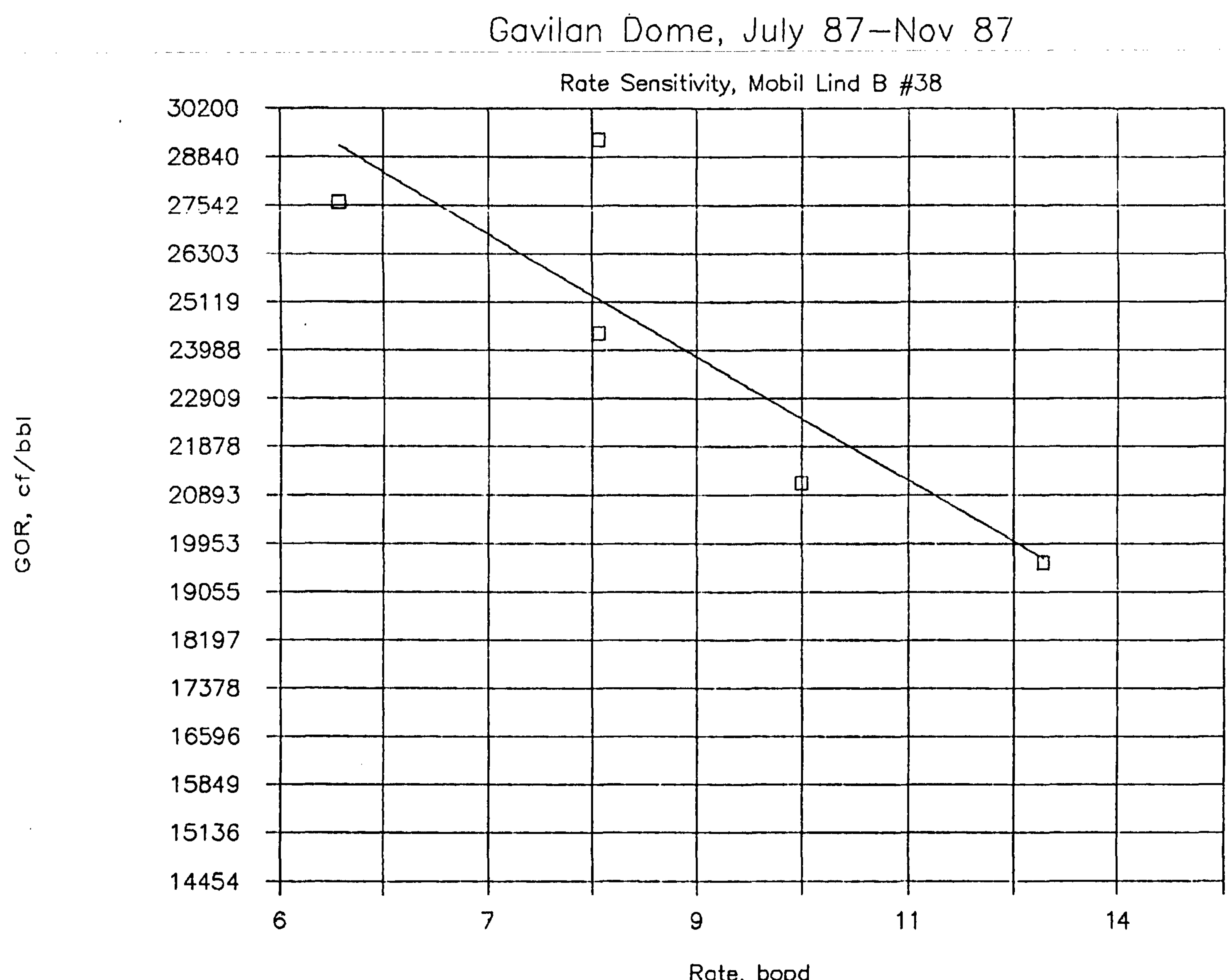
C.C. = 0.88

Gavilan Dome, July 87—Feb 88



C.C. = 0.98


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Mobil Lind B37
GOR, cf/bbl & Rate, mcfpd
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
794
631
501
398
316
251
200
158
126
100
50
79
126
200
Rate, bopd

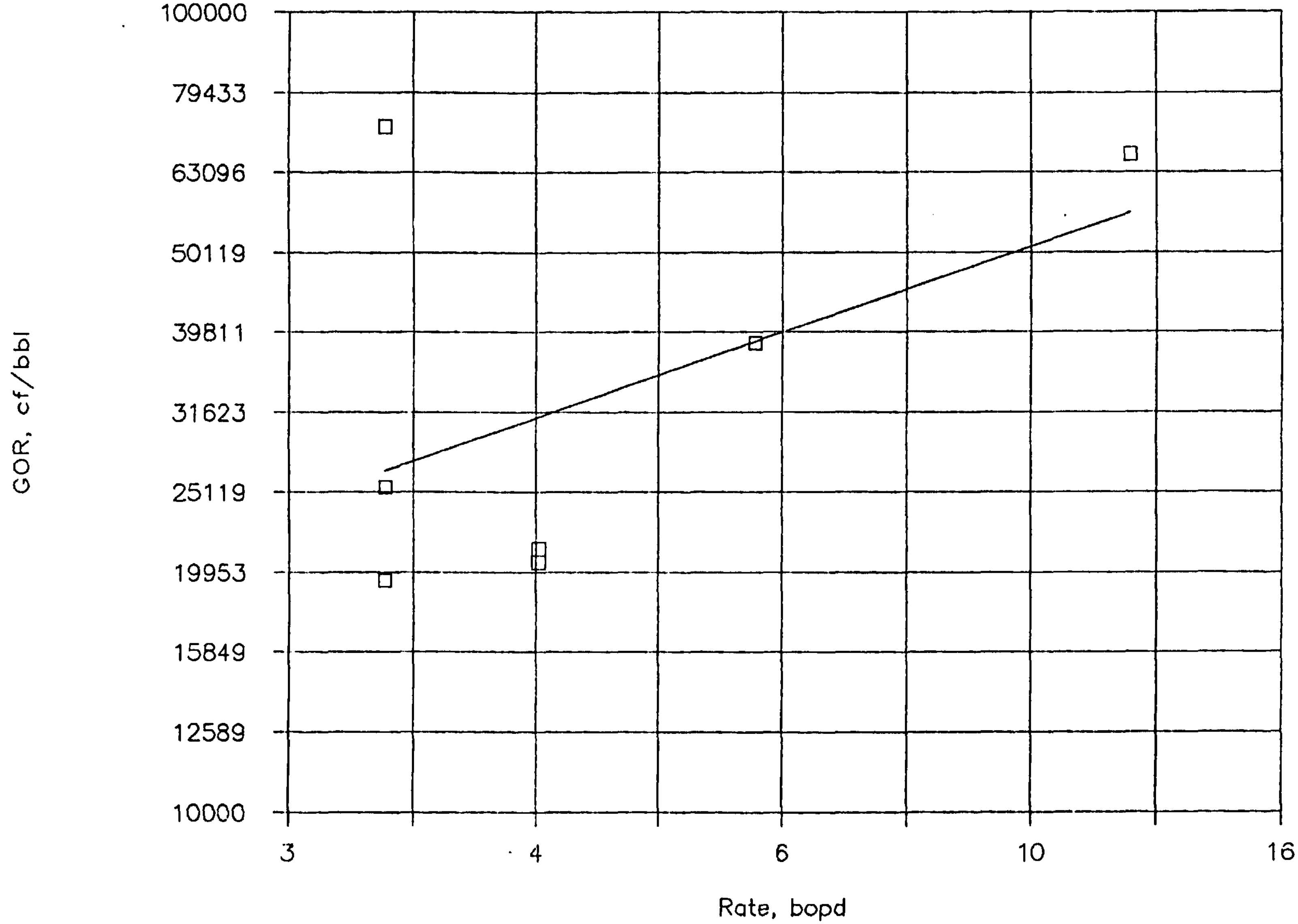


Gavilan Dome, July 87–Nov 87
Rate Sensitivity, Mobil Lind B #38
GOR, cf/bbl
30200
28840
27542
26303
25119
23988
22909
21878
20893
19953
19055
18197
17378
16596
15849
15136
14454
6
7
9
11
14
Rate, bopd

C.C. = 0.86

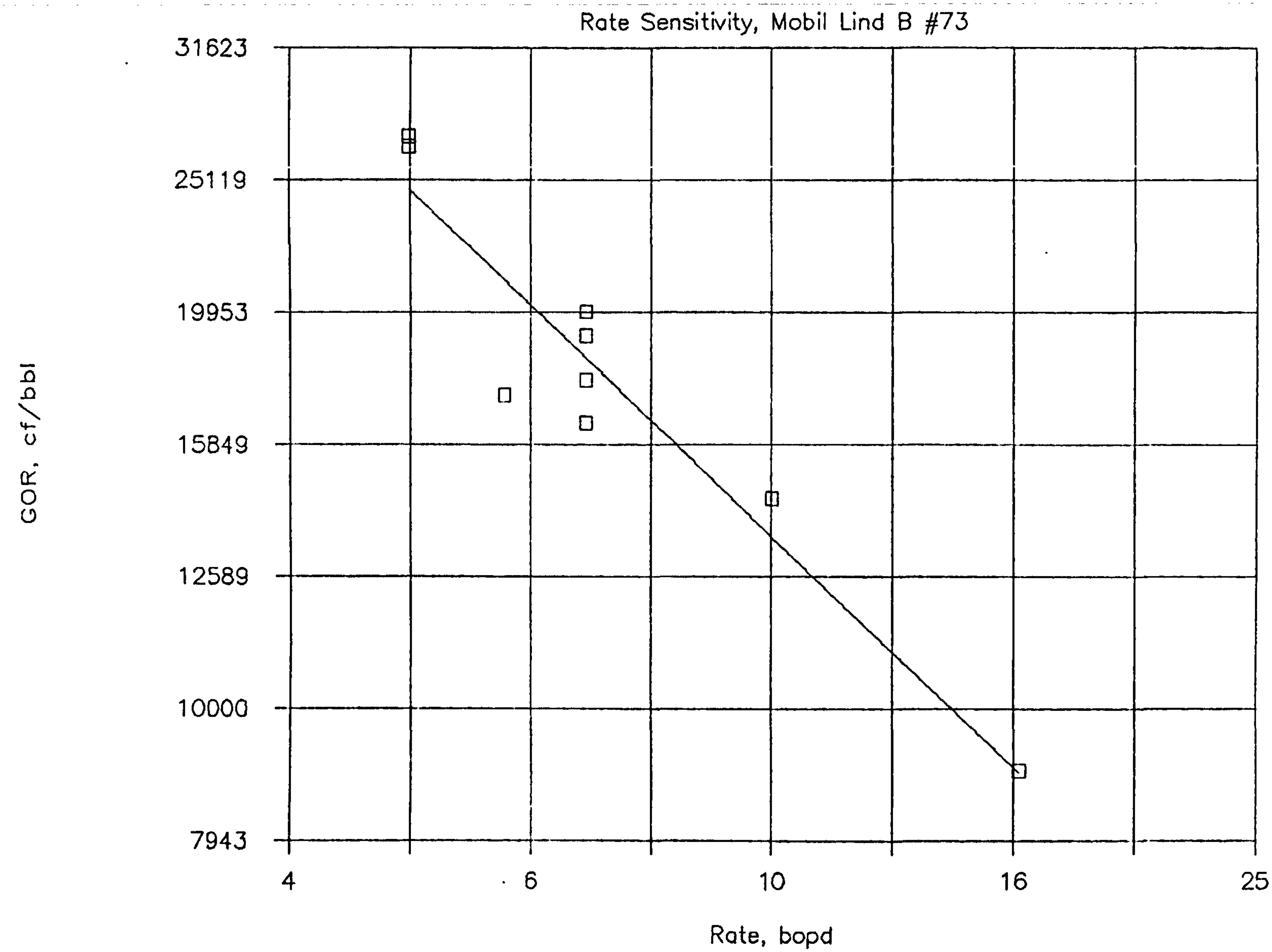
Gavilan Dome, July 87–Feb 88

Rate Sensitivity, Mobil Lind B #72



C.C.=0.49

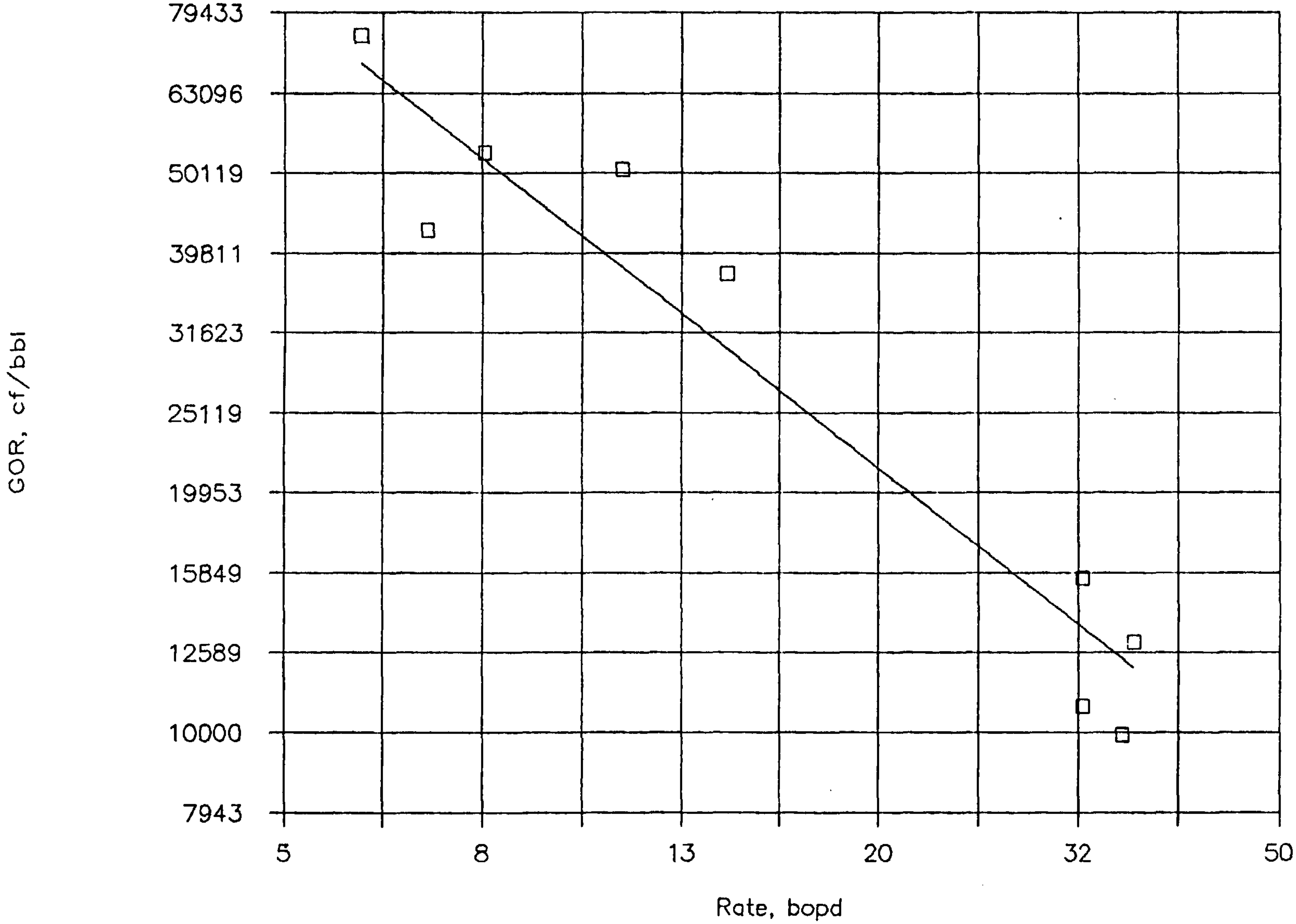
Gavilan Dome, July 87--Feb 88



C.C. = 0.95

Gavilan Dome, July 87–Feb 88

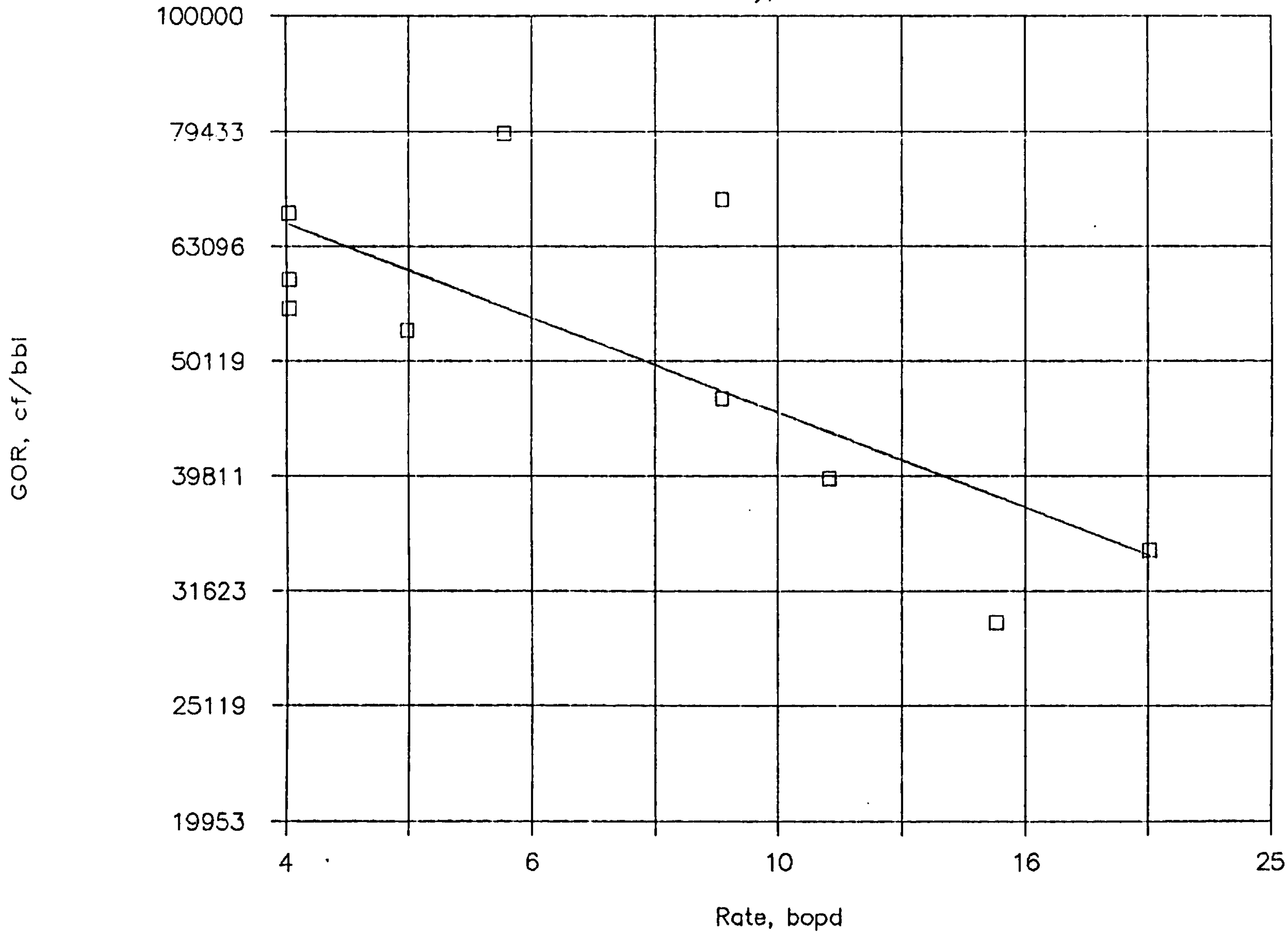
Rate Sensitivity, Mobil Lind B #74



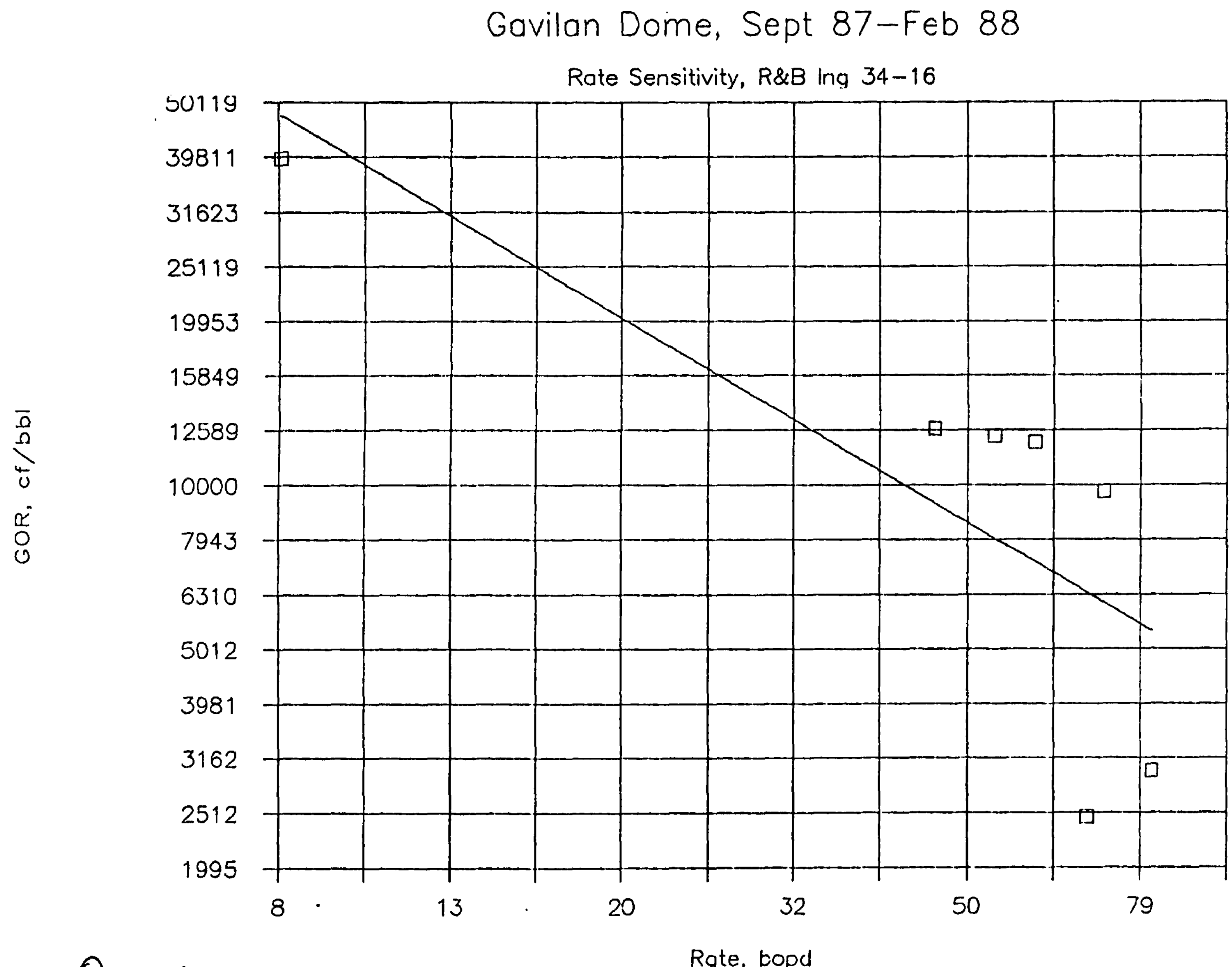
C.C. = 0.86

Gavilan Dome, June 87–Feb 88

Rate Sensitivity, R&B HF 43-15

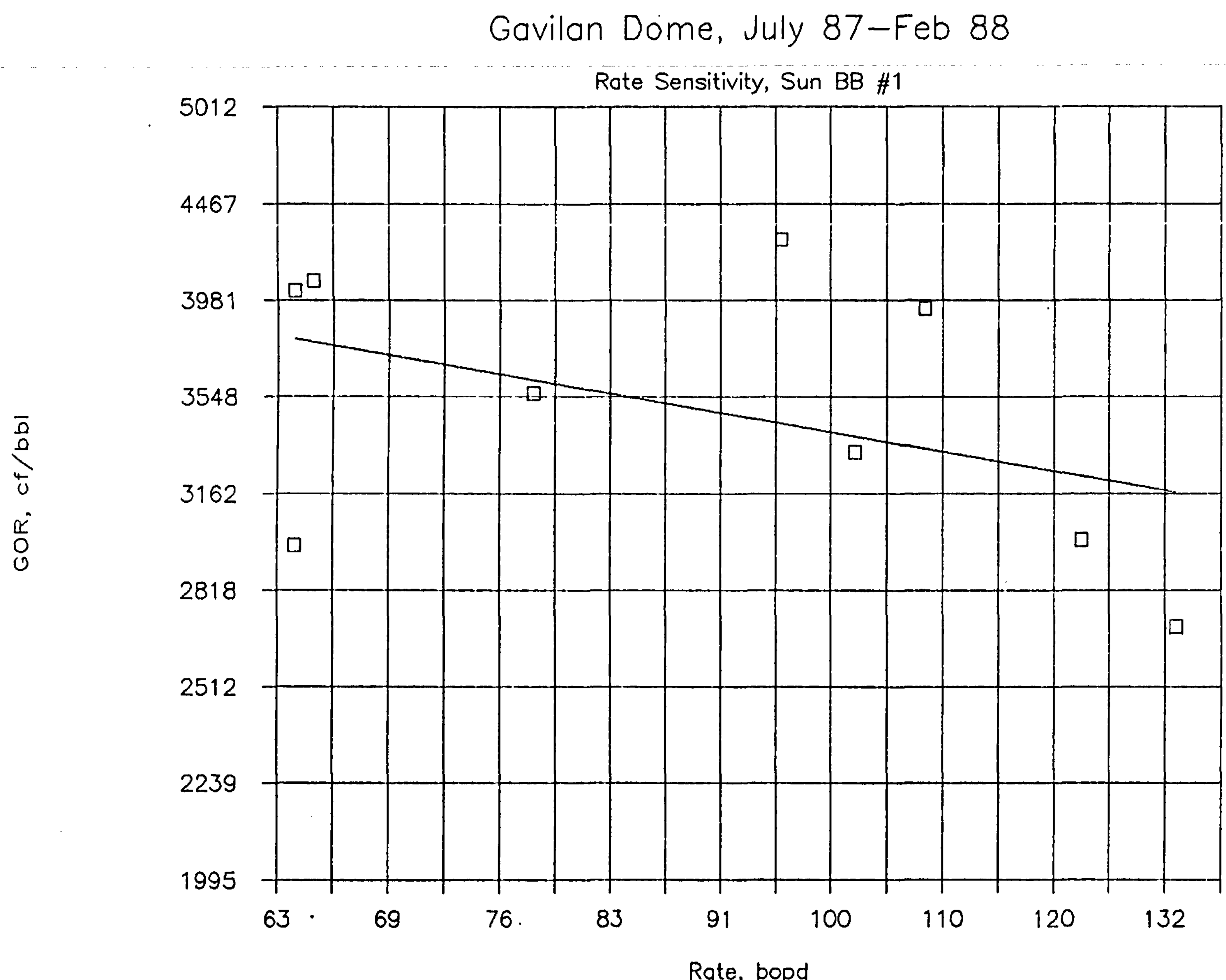


C.C. = 0.76



Gavilan Dome, Sept 87–Feb 88
Rate Sensitivity, R&B Ing 34–16
50119
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
GOR, cf/bbl
8
13
20
32
50
79
Rate, bopd

C.C. = 0.79

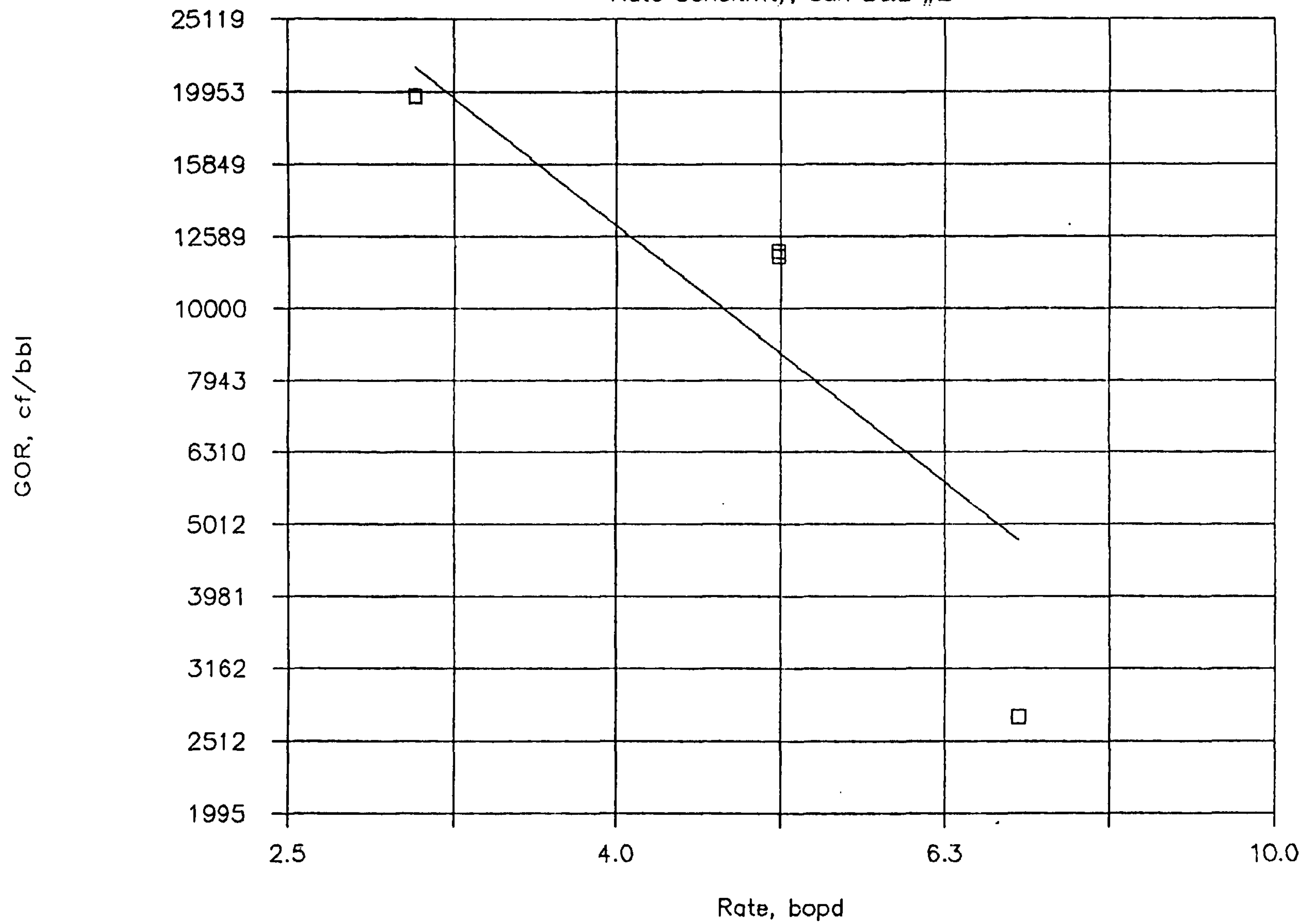


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Sun BB #1
GOR, cf/bbl
5012
4467
3981
3548
3162
2818
2512
2239
1995
63
69
76
83
91
100
110
120
132
Rate, bopd

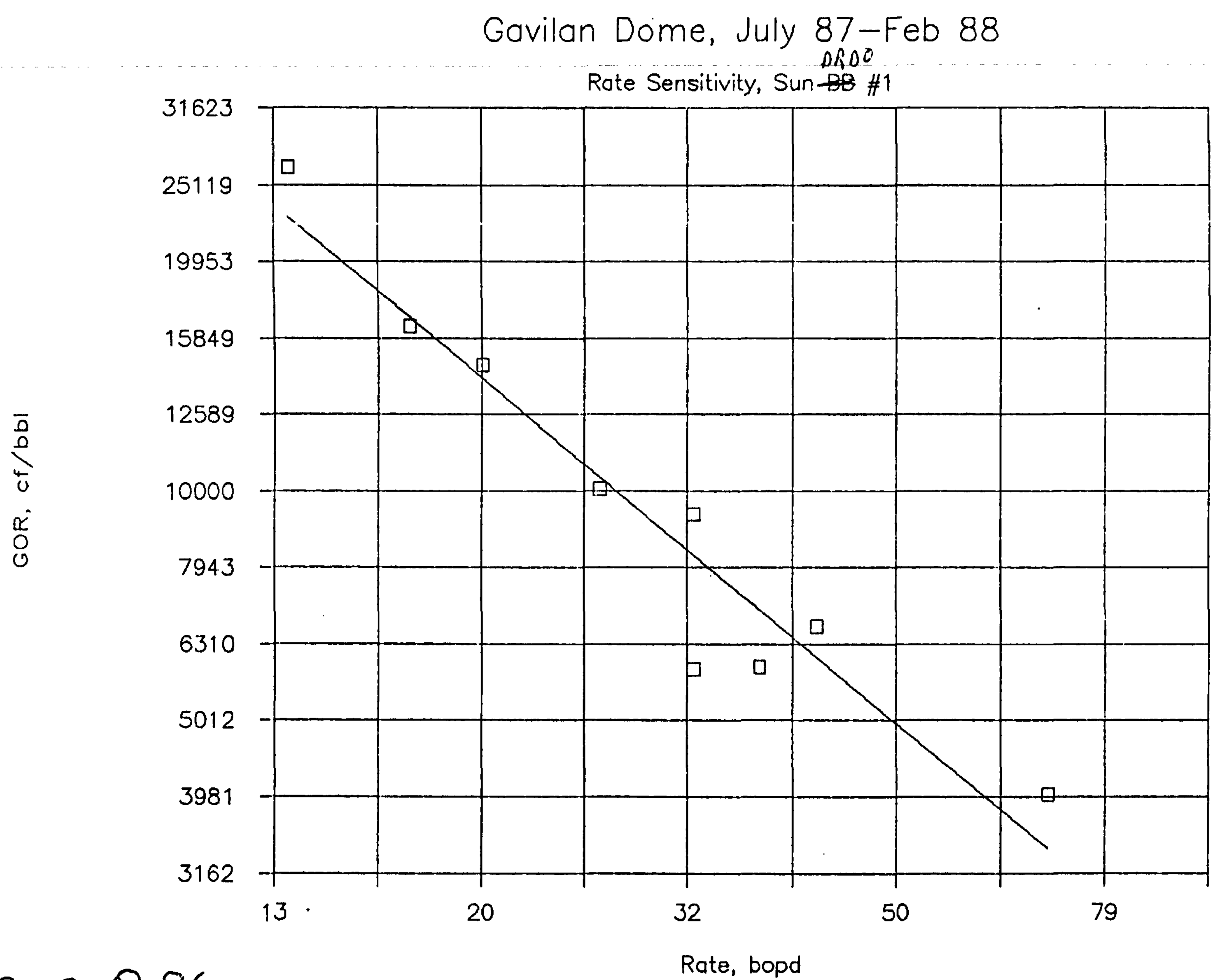
C.C. = 0.44

Gavilan Dome, July 87

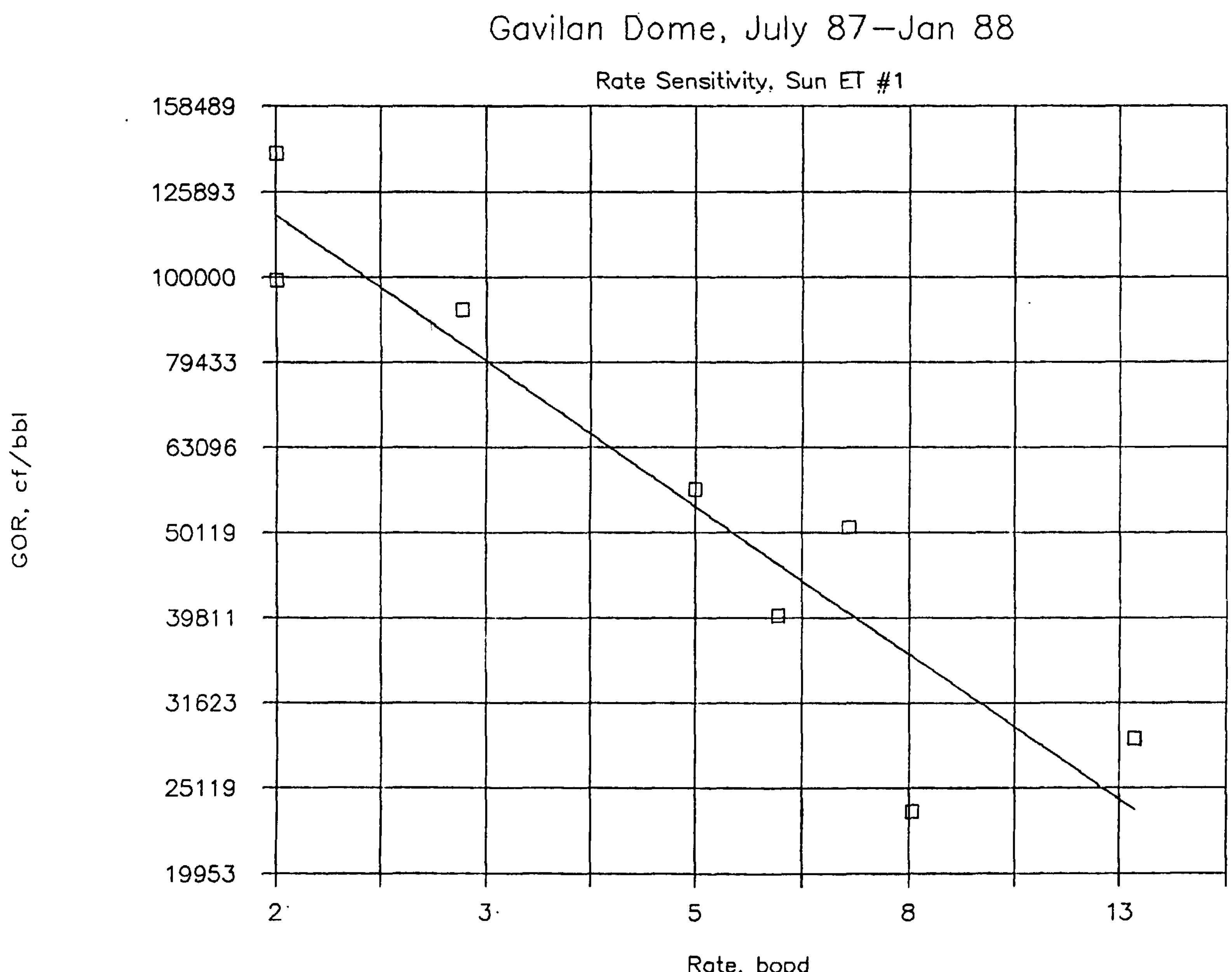
Rate Sensitivity, Sun B&L #2



C. C. = 0.89


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Sun ~~BB~~ DROO #1
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
GOR, cf/bbl
13
20
32
50
79
Rate, bopd

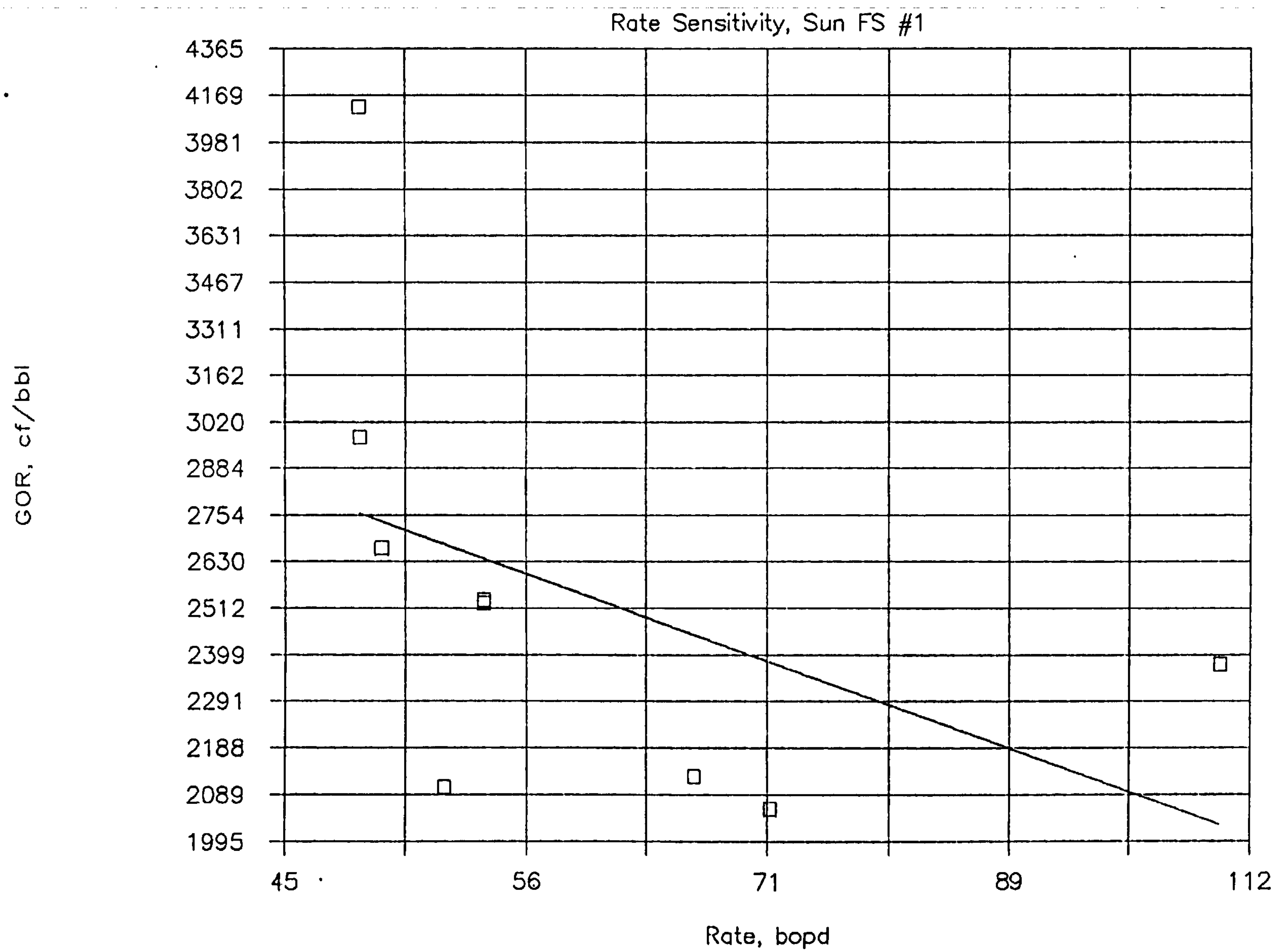
C.C. = 0.96



Gavilan Dome, July 87—Jan 88
Rate Sensitivity, Sun ET #1
158489
125893
100000
79433
63096
50119
39811
31623
25119
19953
GOR, cf/bbl
2
3
5
8
13
Rate, bopd

C.C. = 0.93

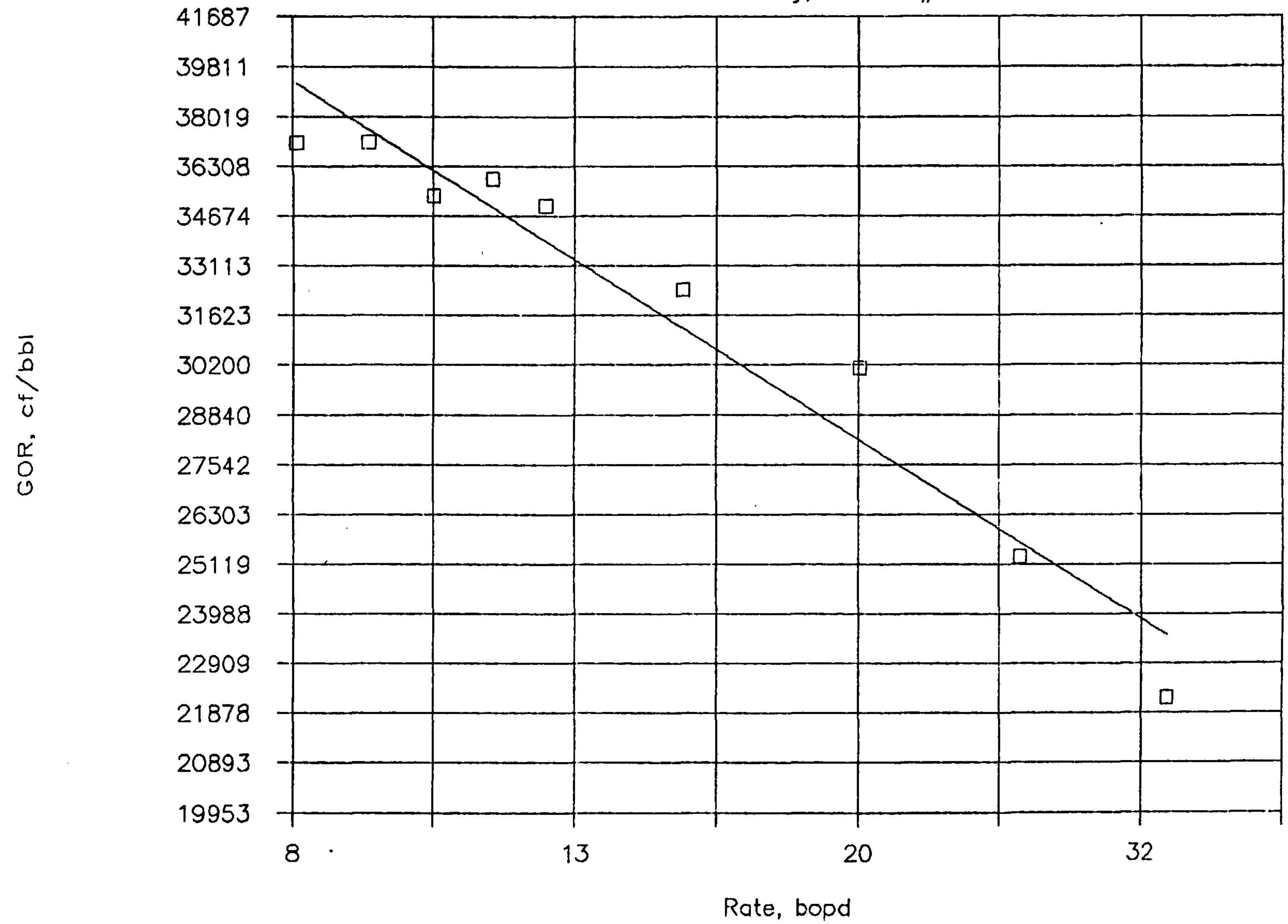
Gavilan Dome, July 87—Feb 88



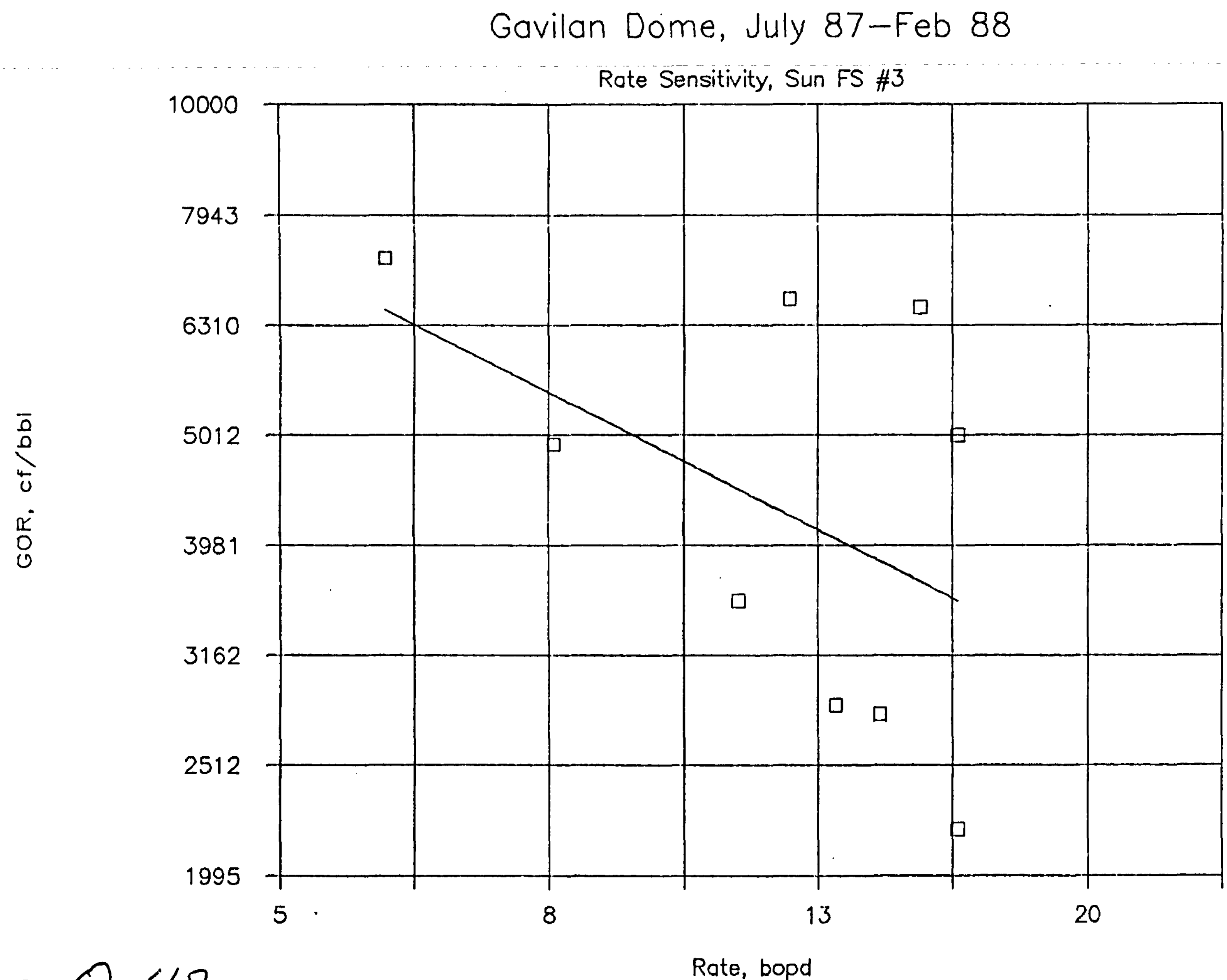
C.C. = 0.46

Gavilan Dome, July 87–Feb 88

Rate Sensitivity, Sun FS #2



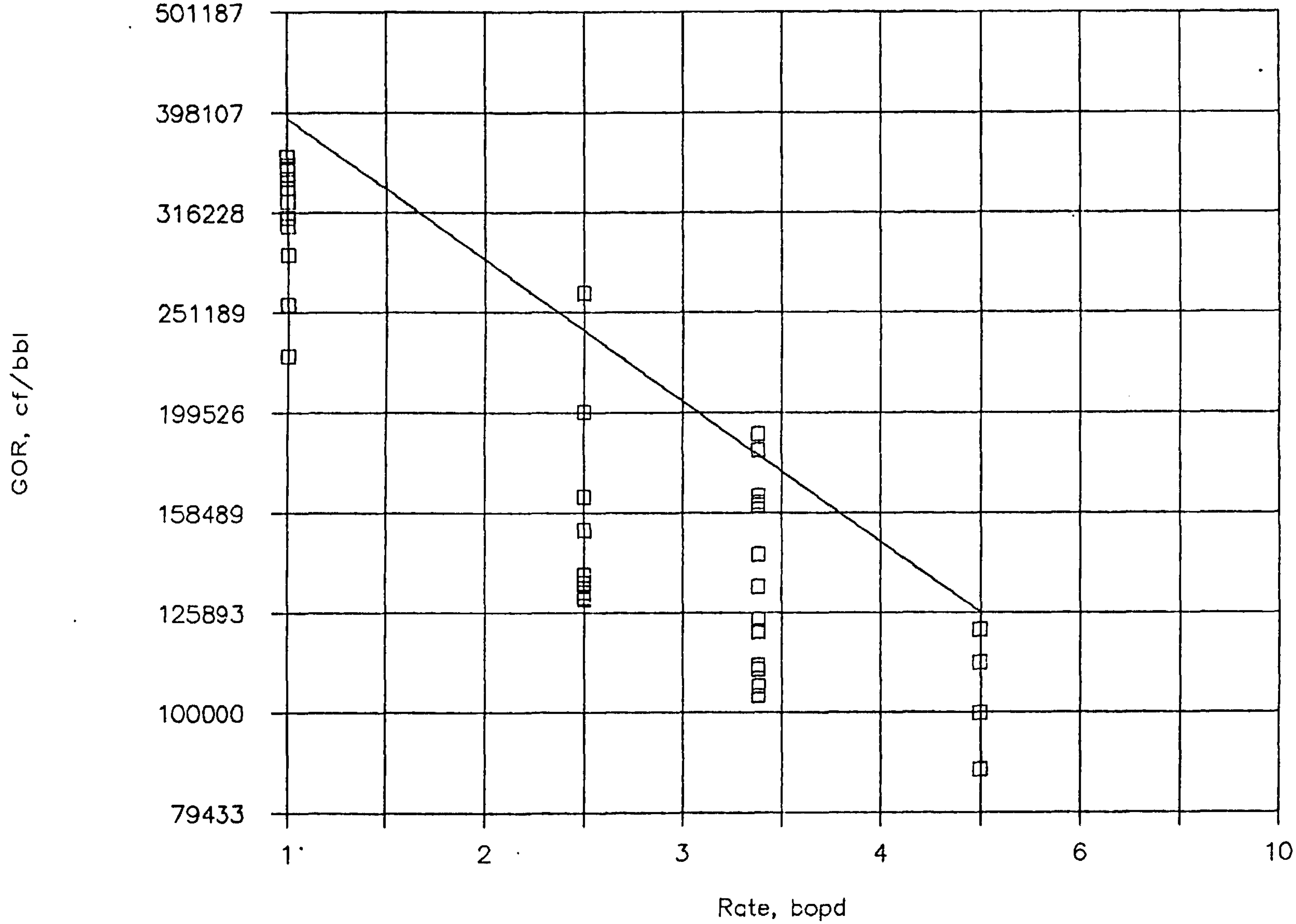
C.C. = 0.97


Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Sun FS #3
GOR, cf/bbl
10000
7943
6310
5012
3981
3162
2512
1995
5
8
13
20
Rate, bopd

C. C. = 0.48

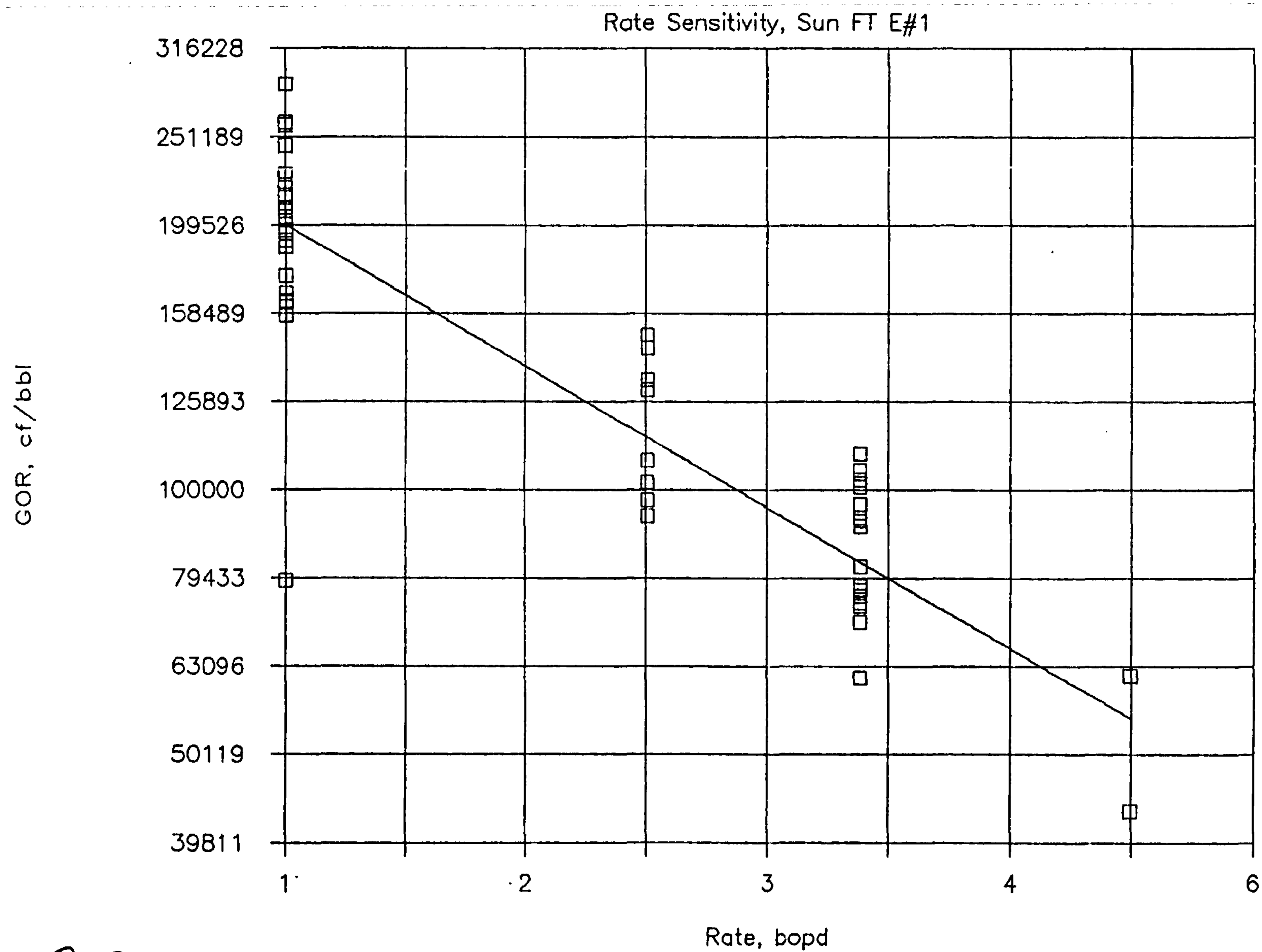
Gavilan Dome, July 87–Aug 87

Rate Sensitivity, Sun FT #1

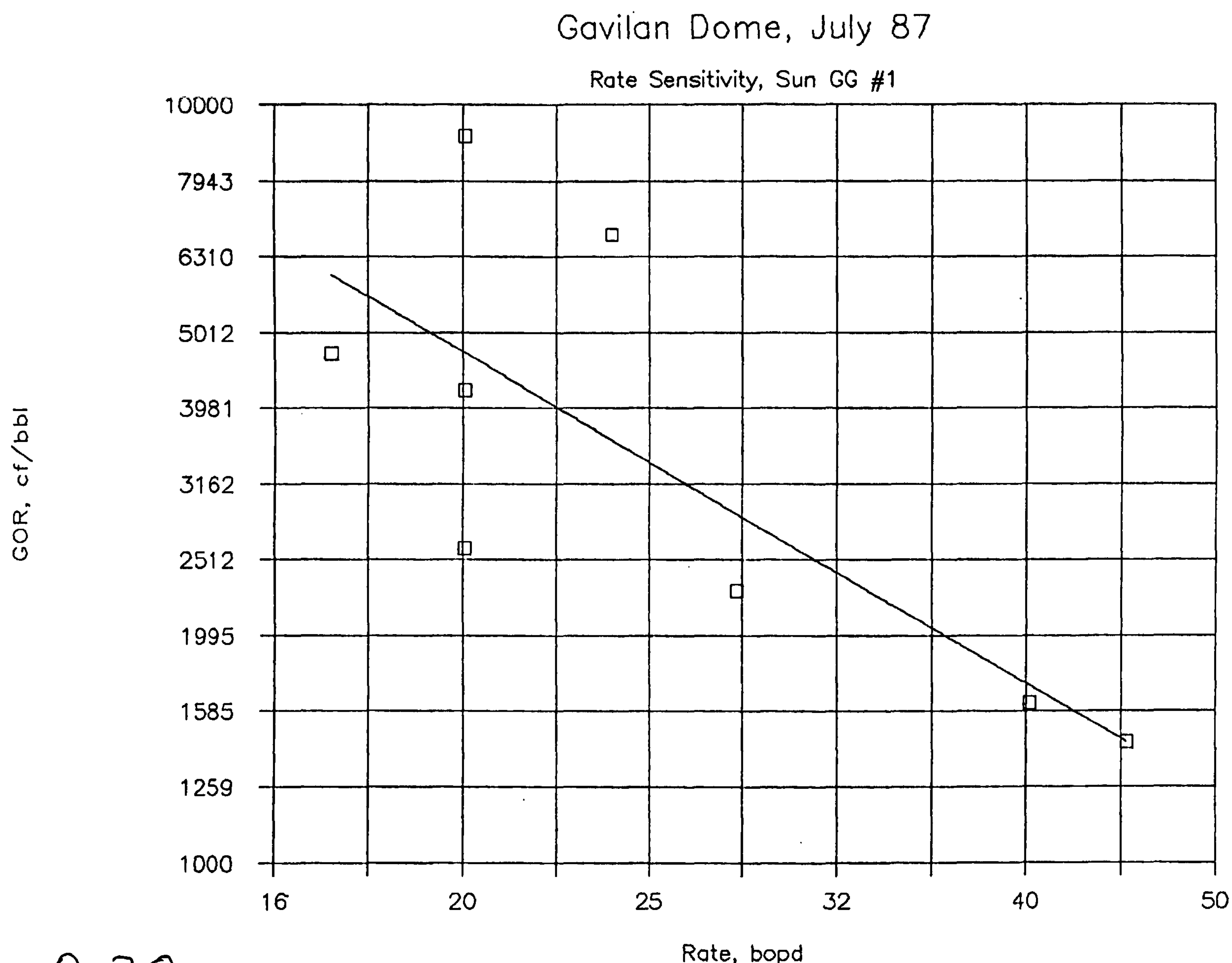


C. C. = 0.88

Gavilan Dome, July 87–Aug 87

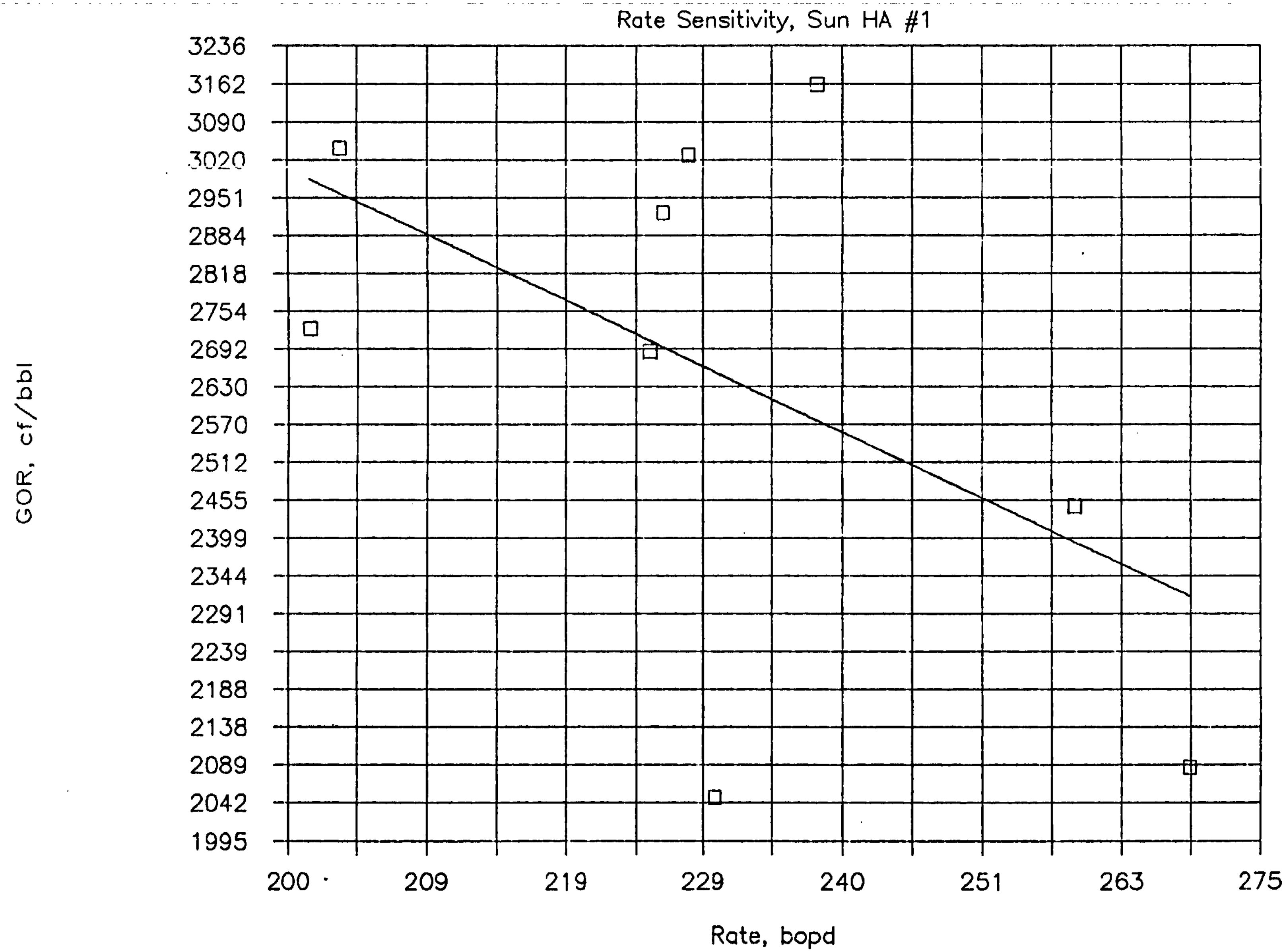


C.C. = 0.91


Gavilan Dome, July 87
Rate Sensitivity, Sun GG #1
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
GOR, cf/bbl
16
20
25
32
40
50
Rate, bopd

C.C. = 0.80

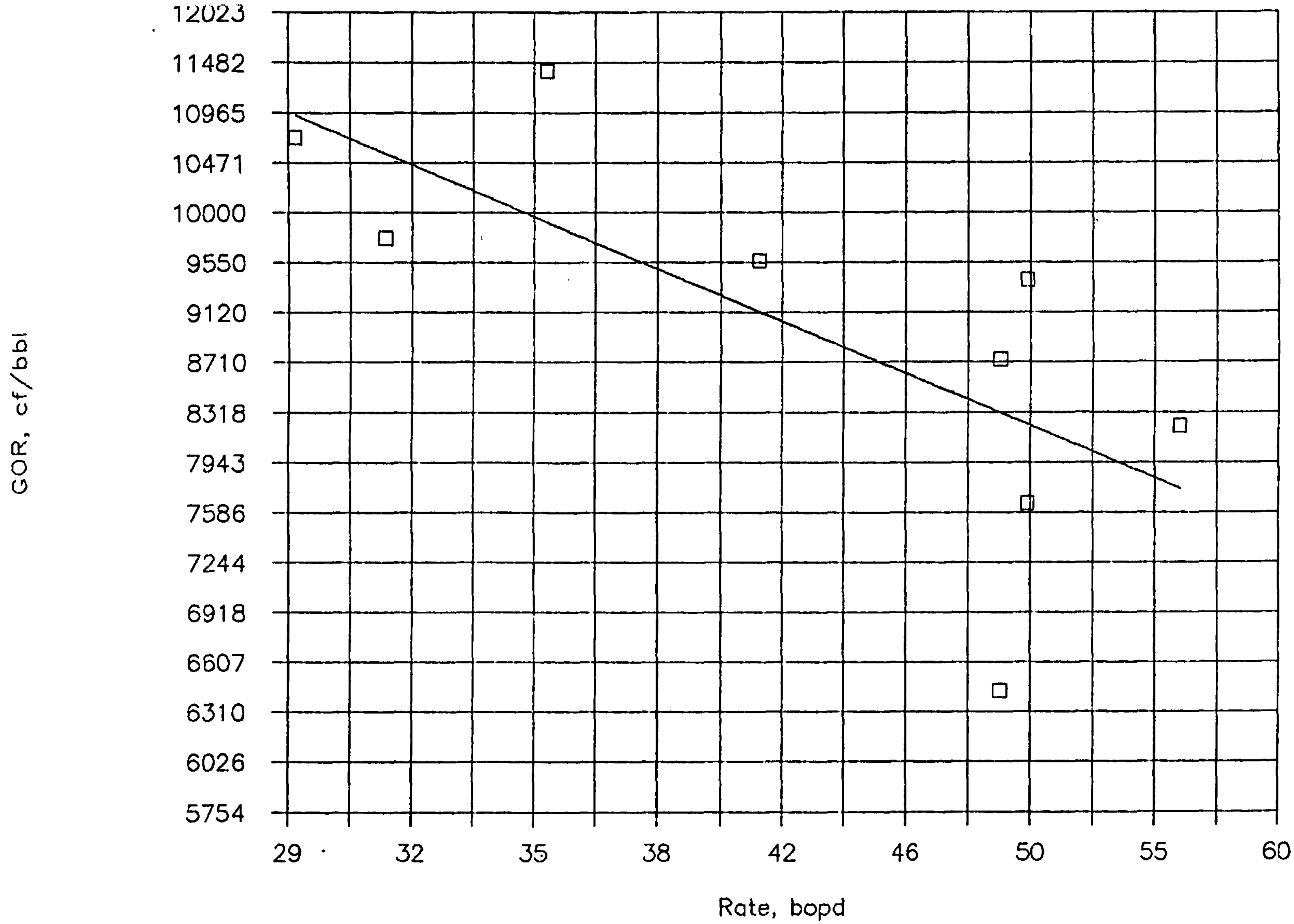
Gavilan Dome, July 87—Feb 88



C. C. = 0.52

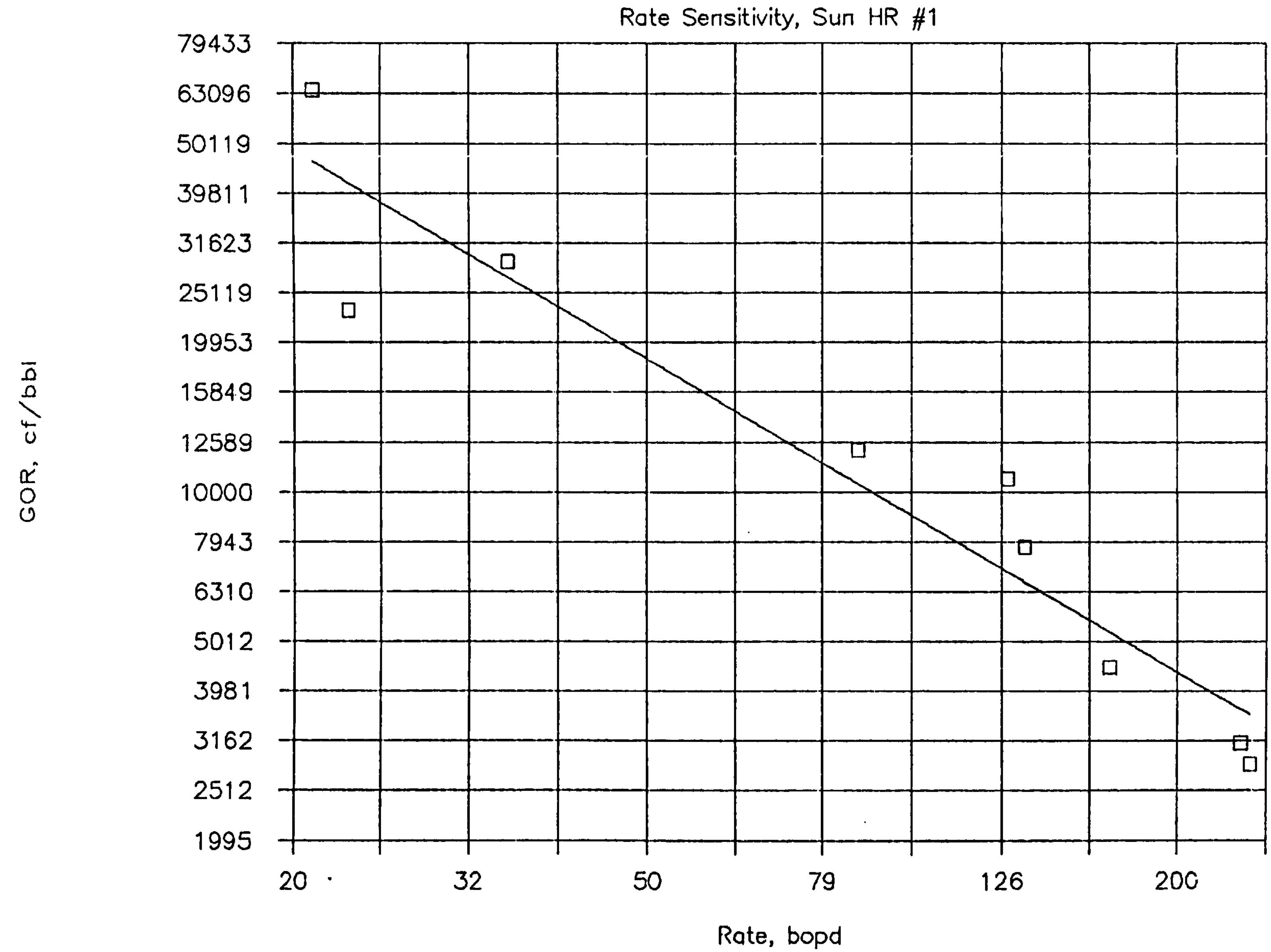
Gavilan Dome, July 87–Feb 88

Rate Sensitivity, Sun HA #2



C.C. = 0.71

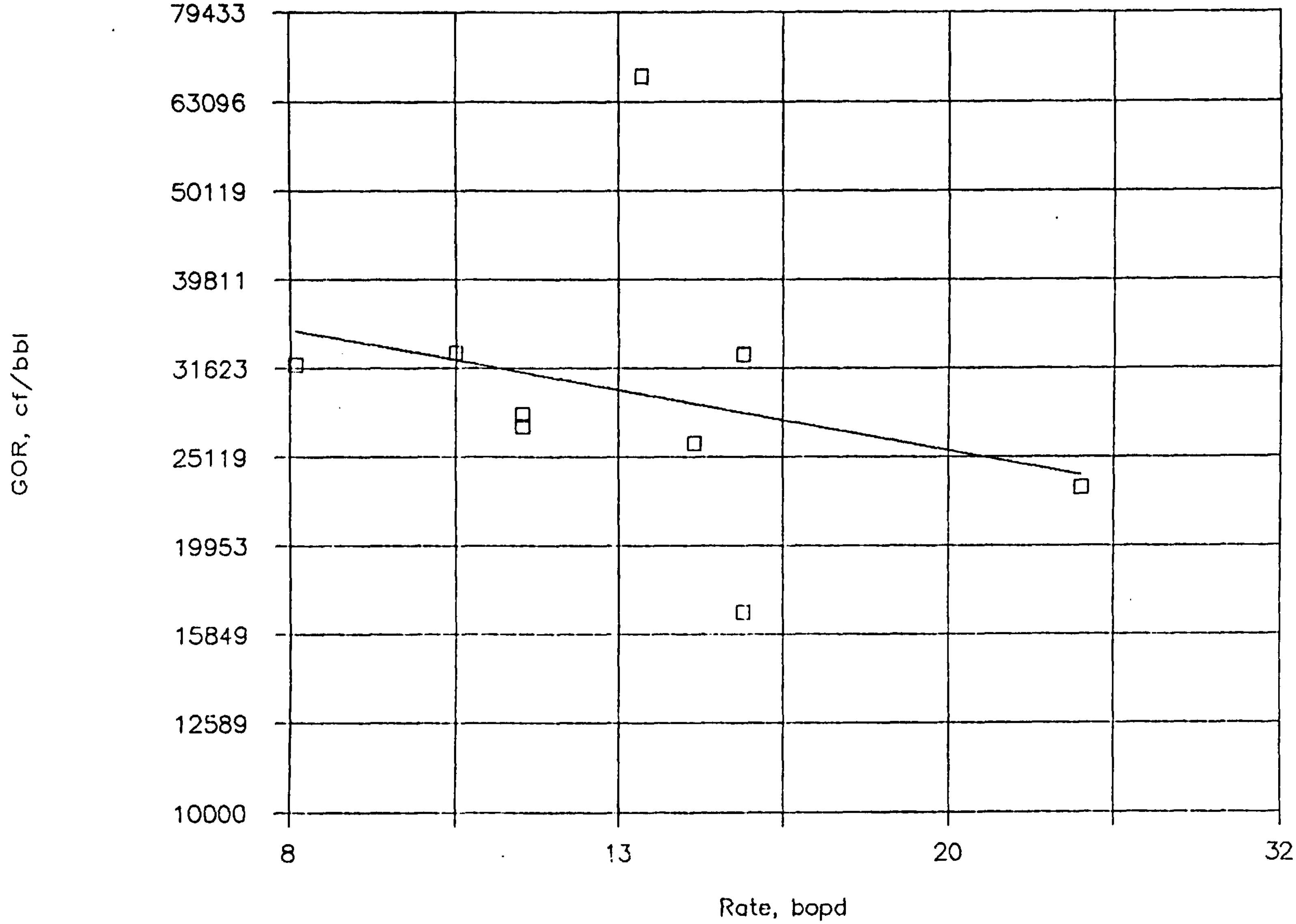
Gavilan Dome, July 87—Feb 88



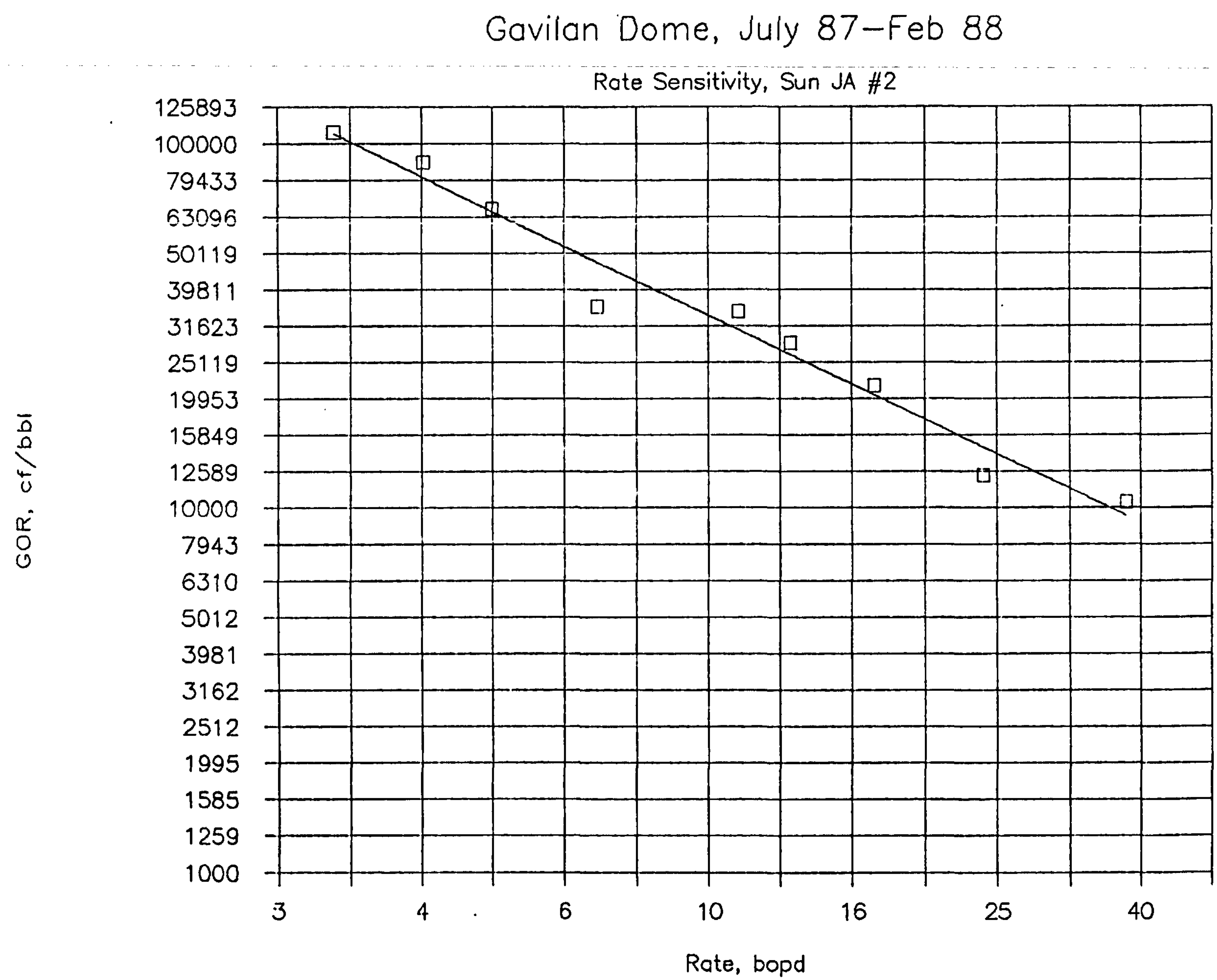
C. C. = 0.95

Gavilan Dome, July 87—Feb 88

Rate Sensitivity, Sun JA #1



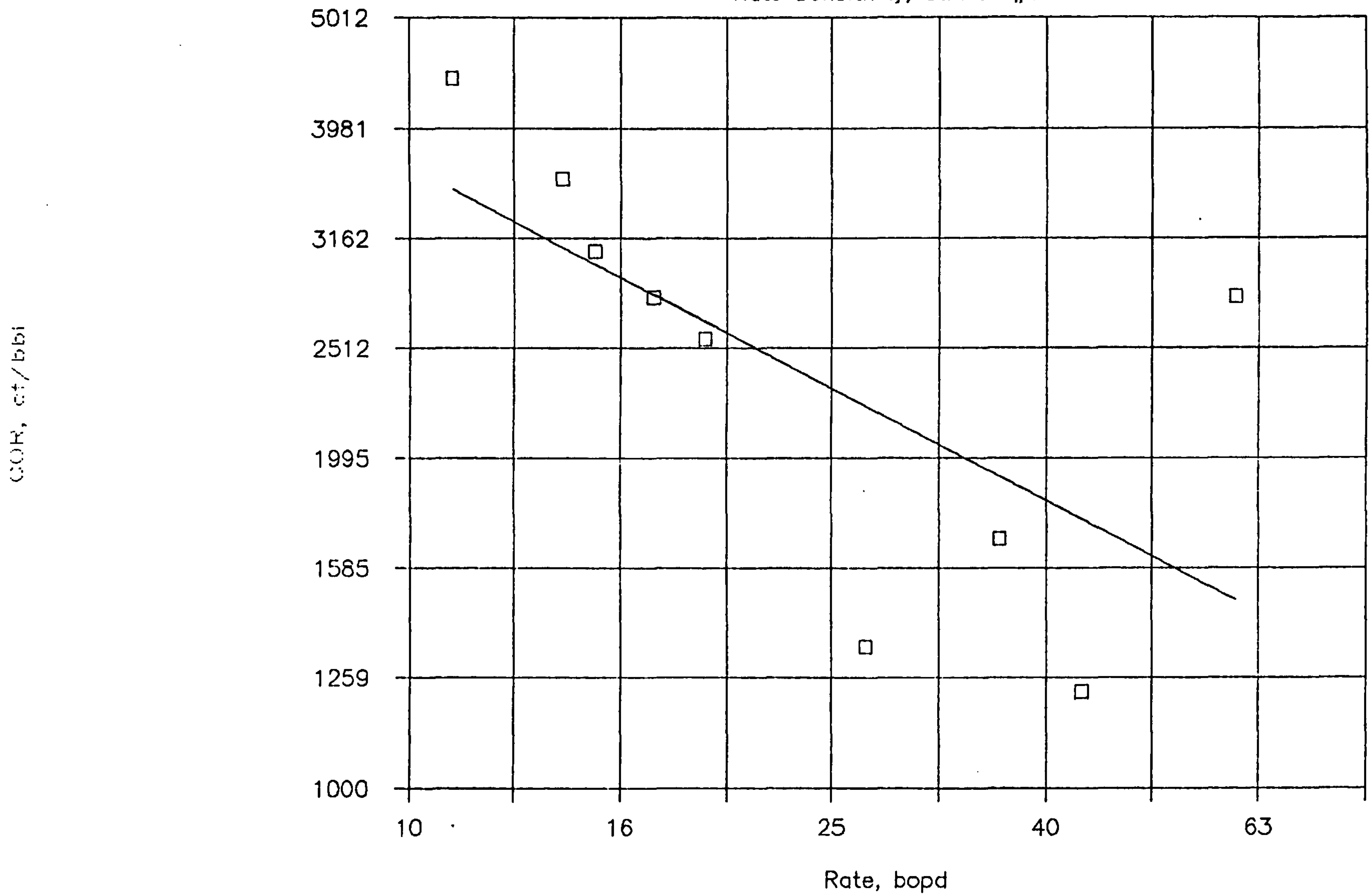
C.C. = 0.29


Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Sun JA #2
GOR, cf/bbl
125893
100000
79433
63096
50119
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
3
4
6
10
16
25
40
Rate, bopd

CC = 0.99

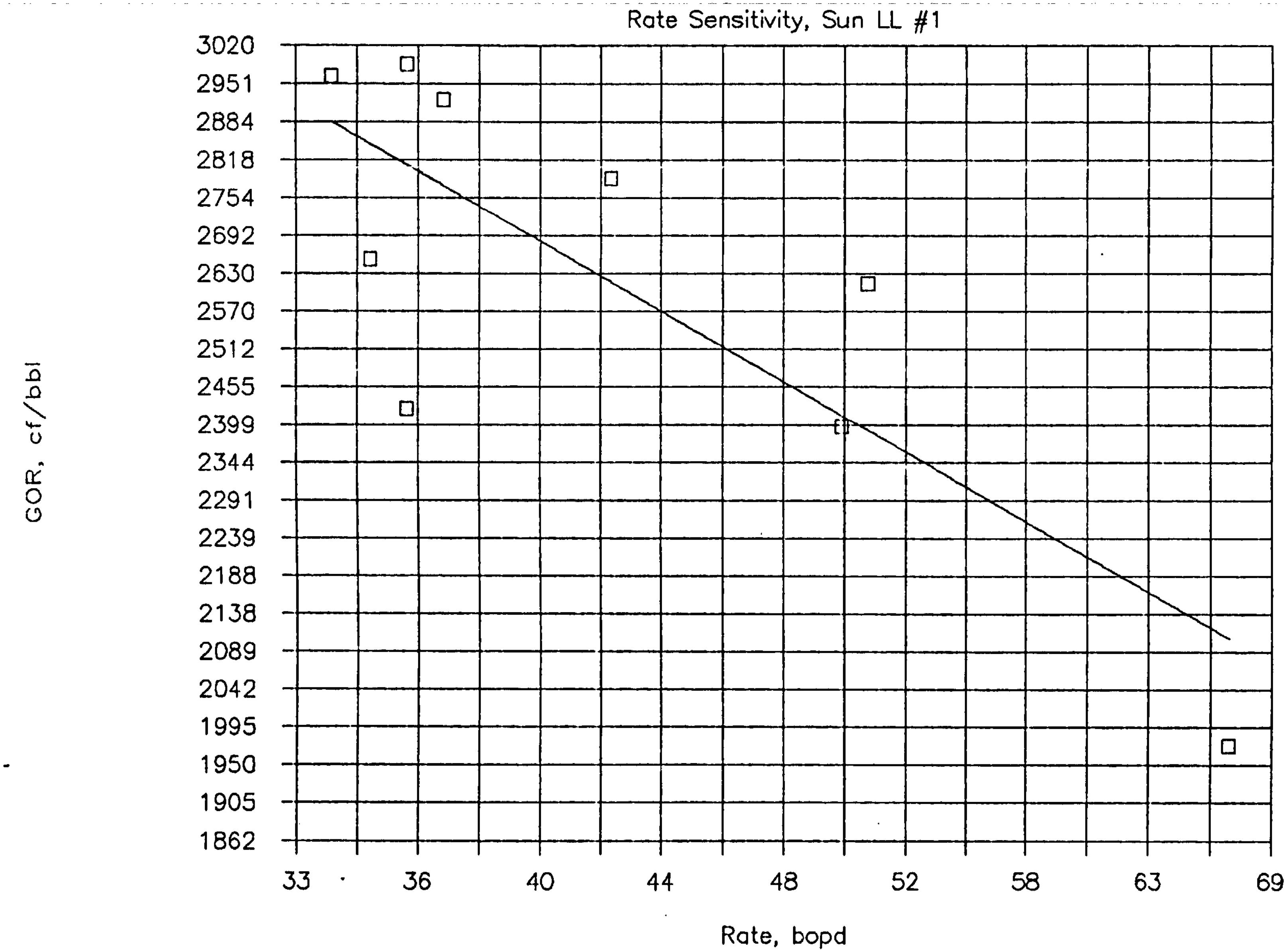
Gavilan Dome, July 87—Feb 88

Rate Sensitivity, Sun JA #3



C.C. = 0.66

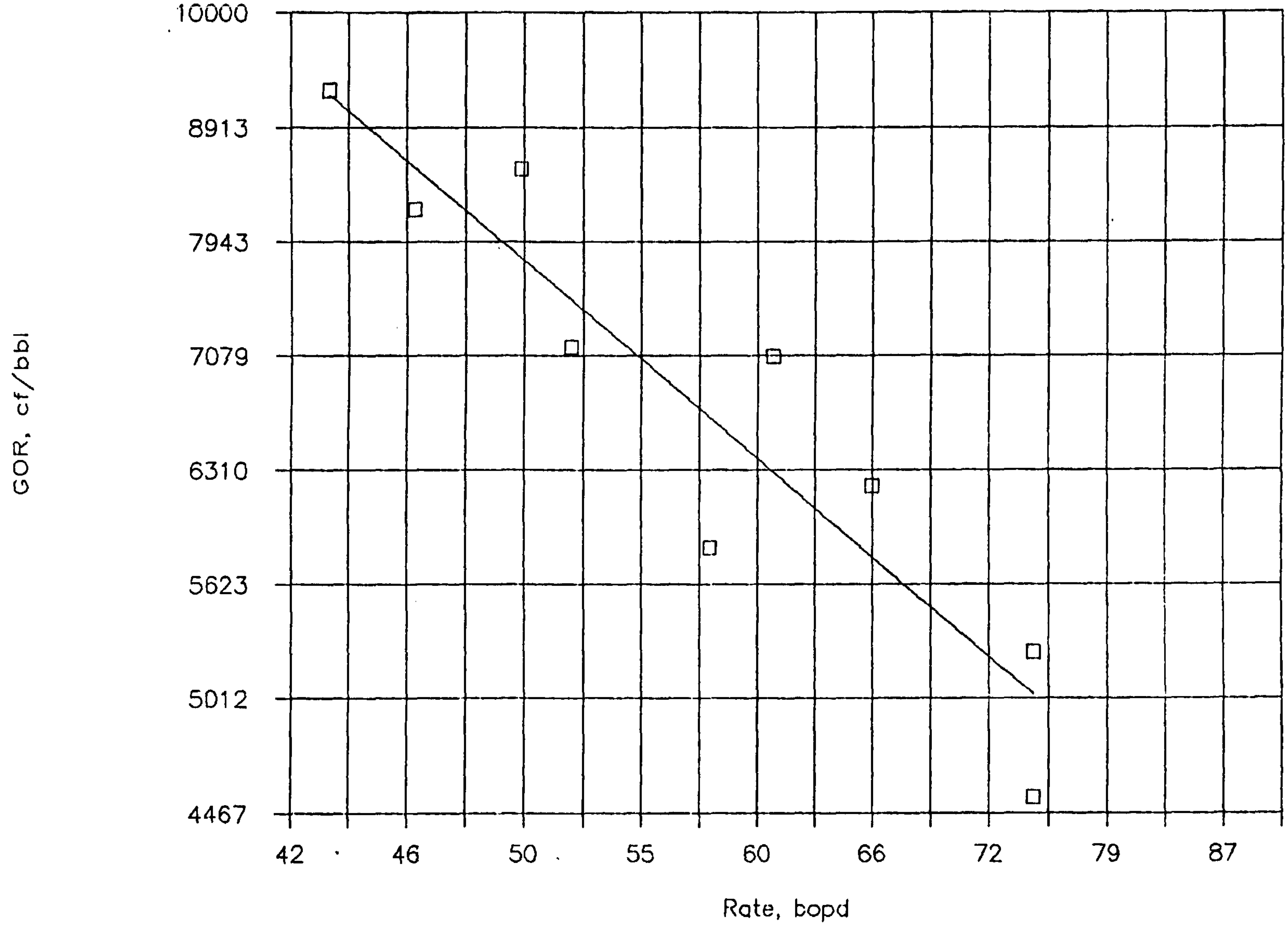
Gavilan Dome, July 87—Feb 88



C. C. = 0.80

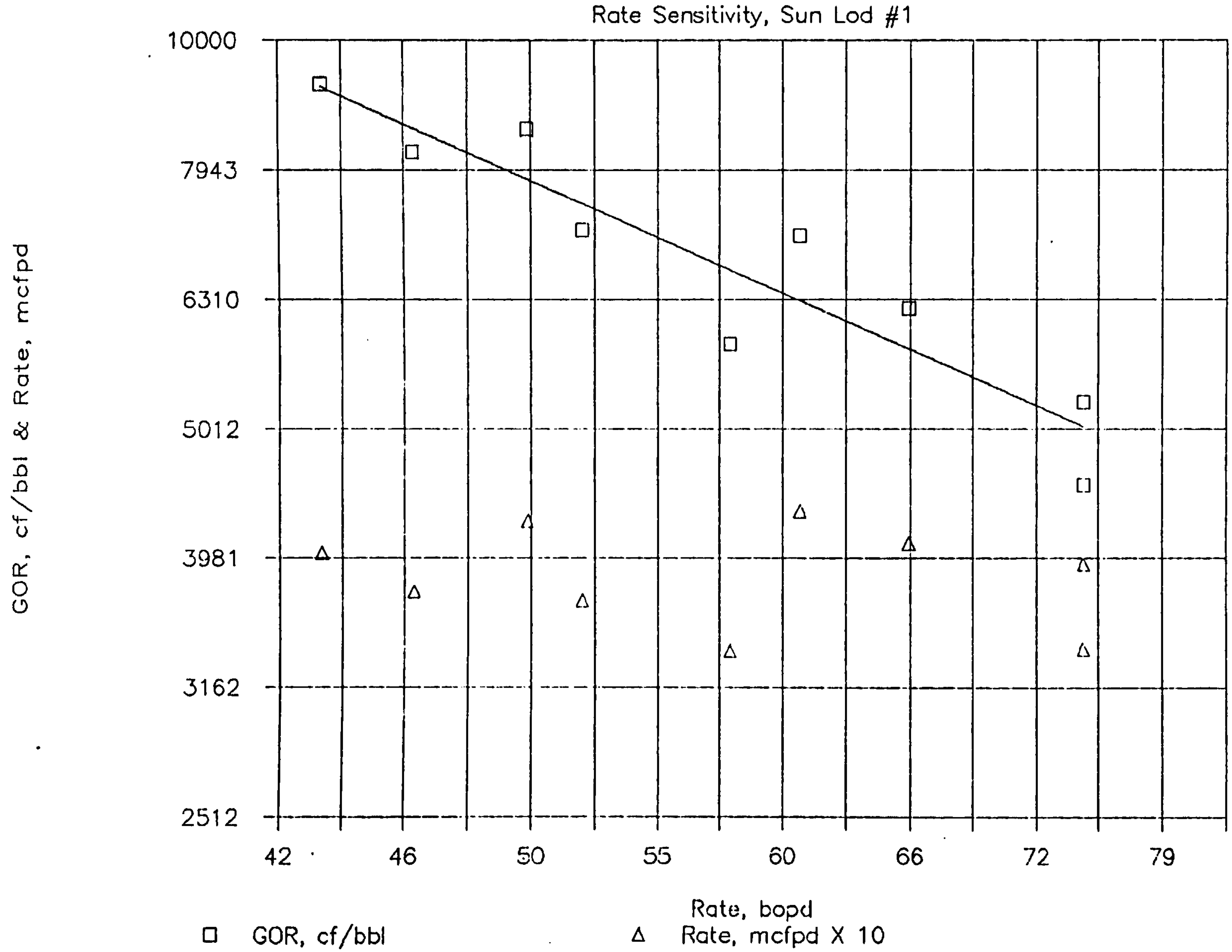
Gavilan Dome, July 87–Feb 88

Rate Sensitivity, Sun LOD #1



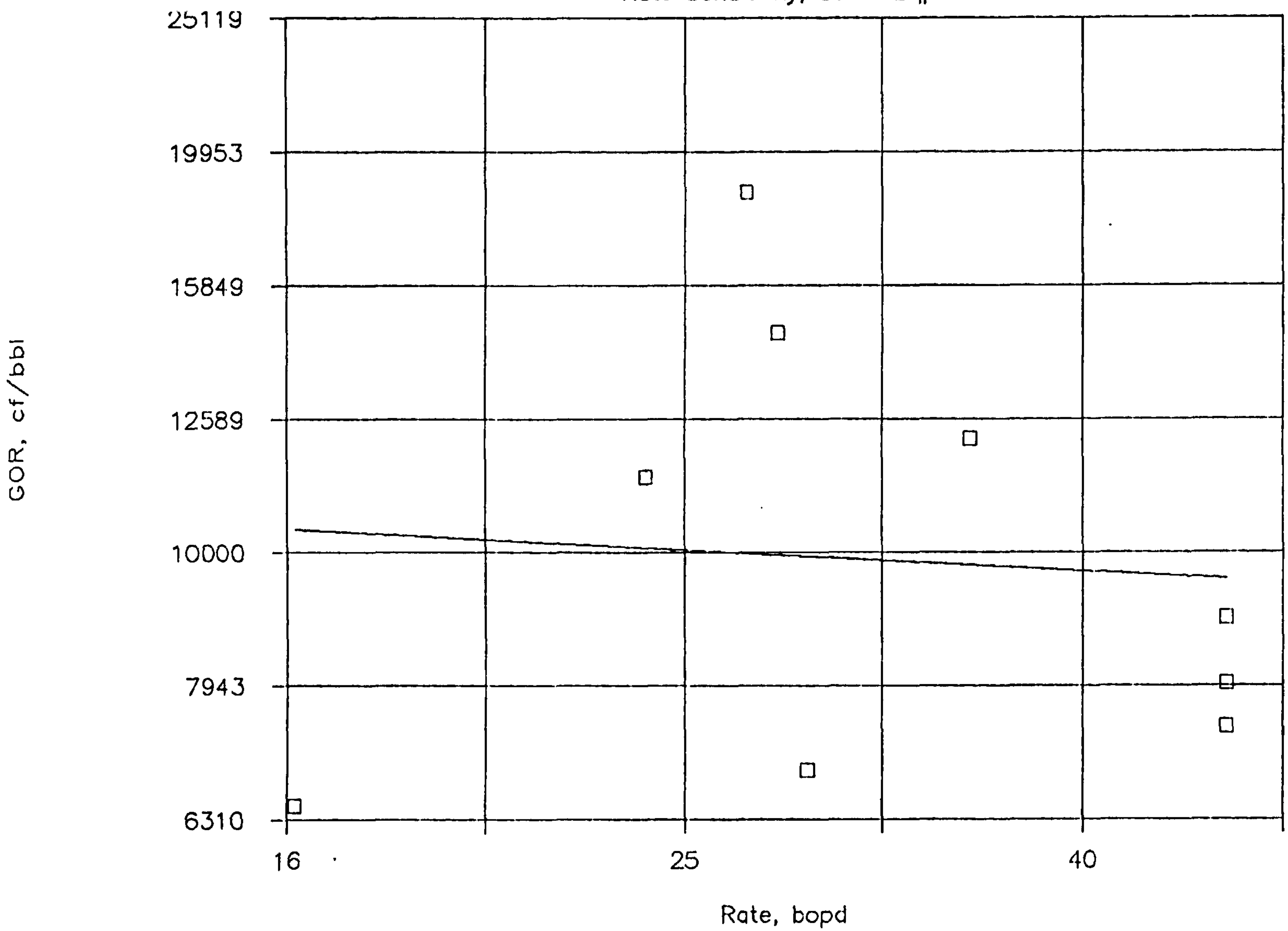
C.C. = 0.93

Gavilan Dome, July 87—Feb 88



Gavilan Dome, July 87—Feb 88

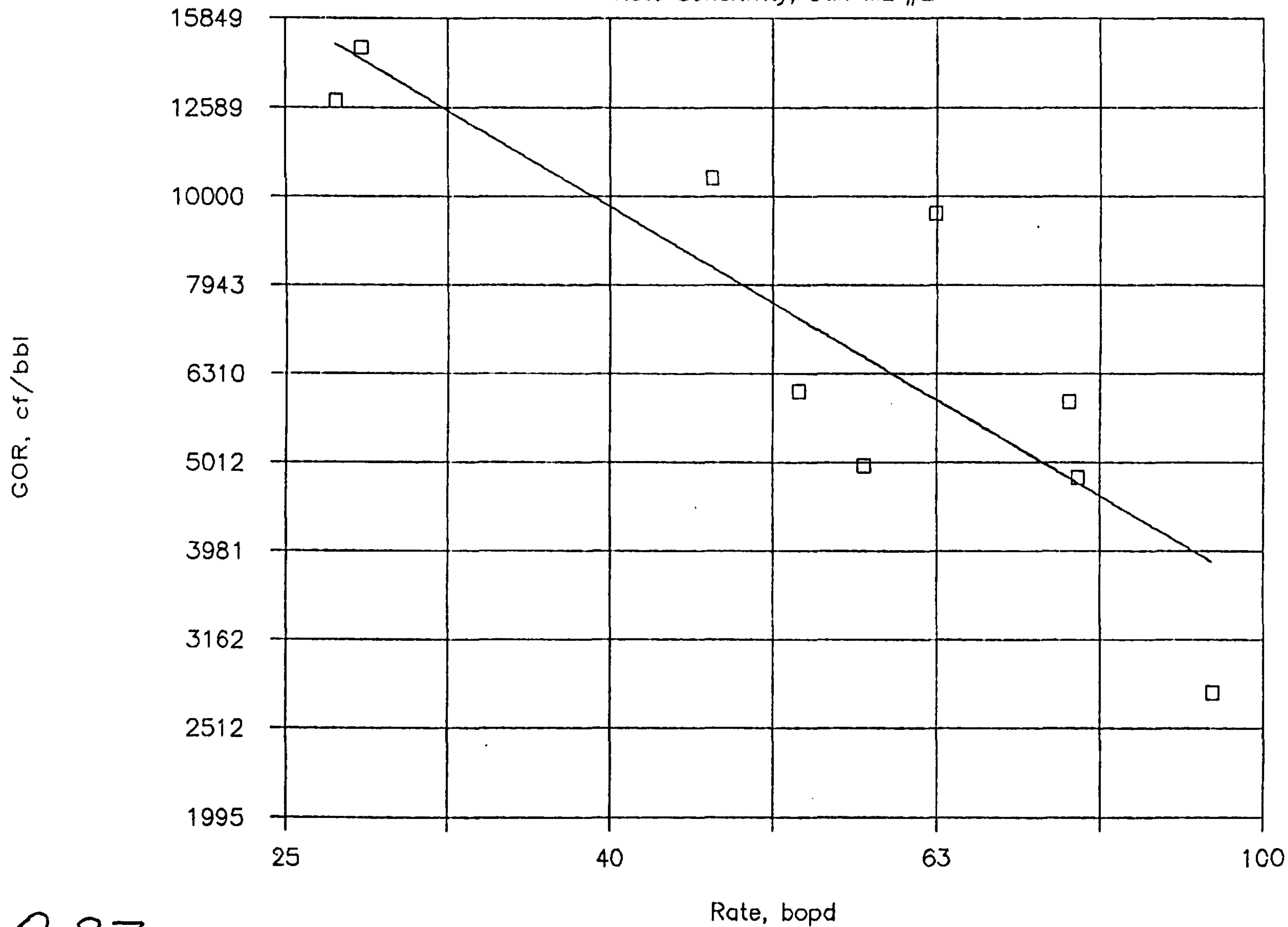
Rate Sensitivity, Sun ML #1



C.C. = 0.08

Gavilan Dome, July 87--Feb 88

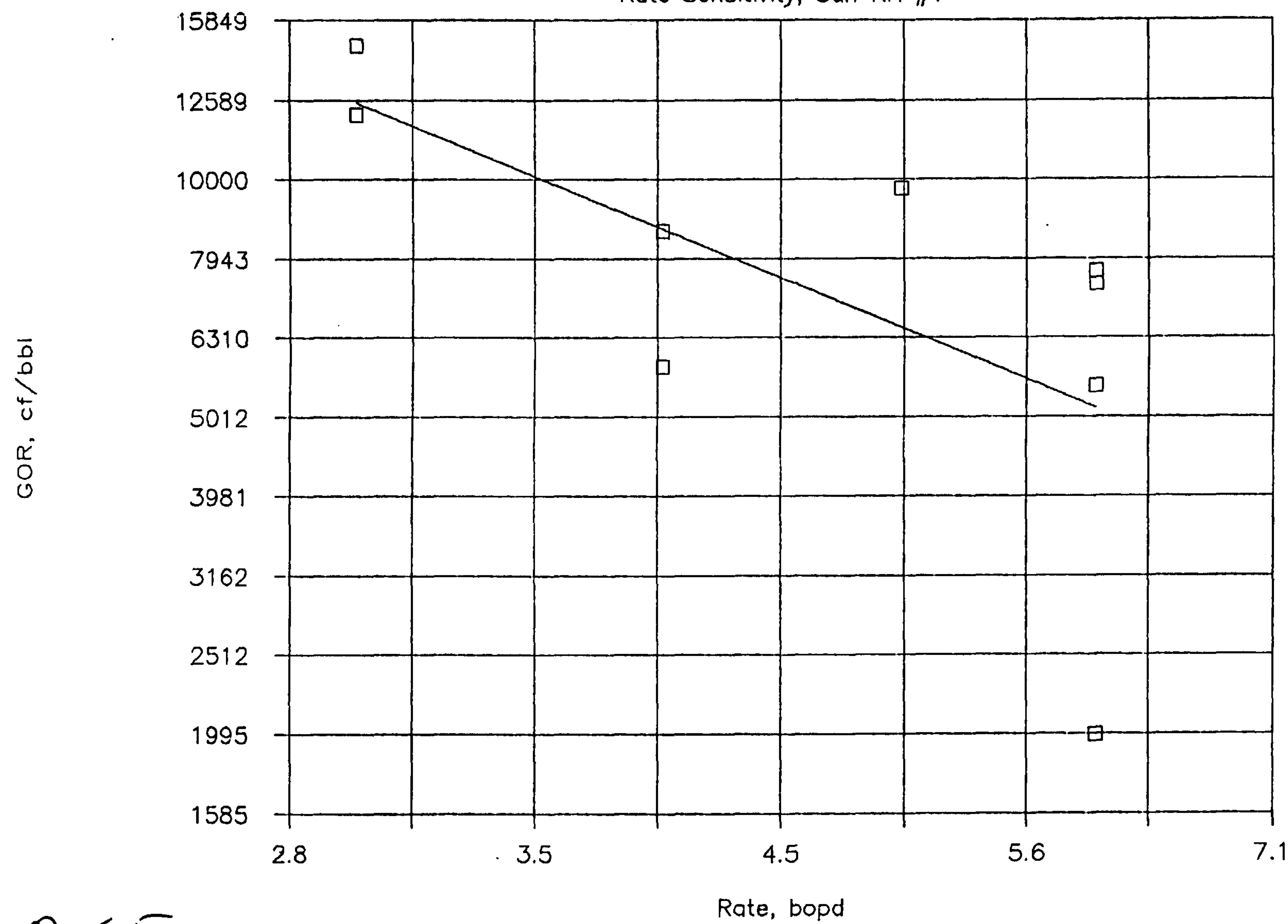
Rate Sensitivity, Sun ML #2



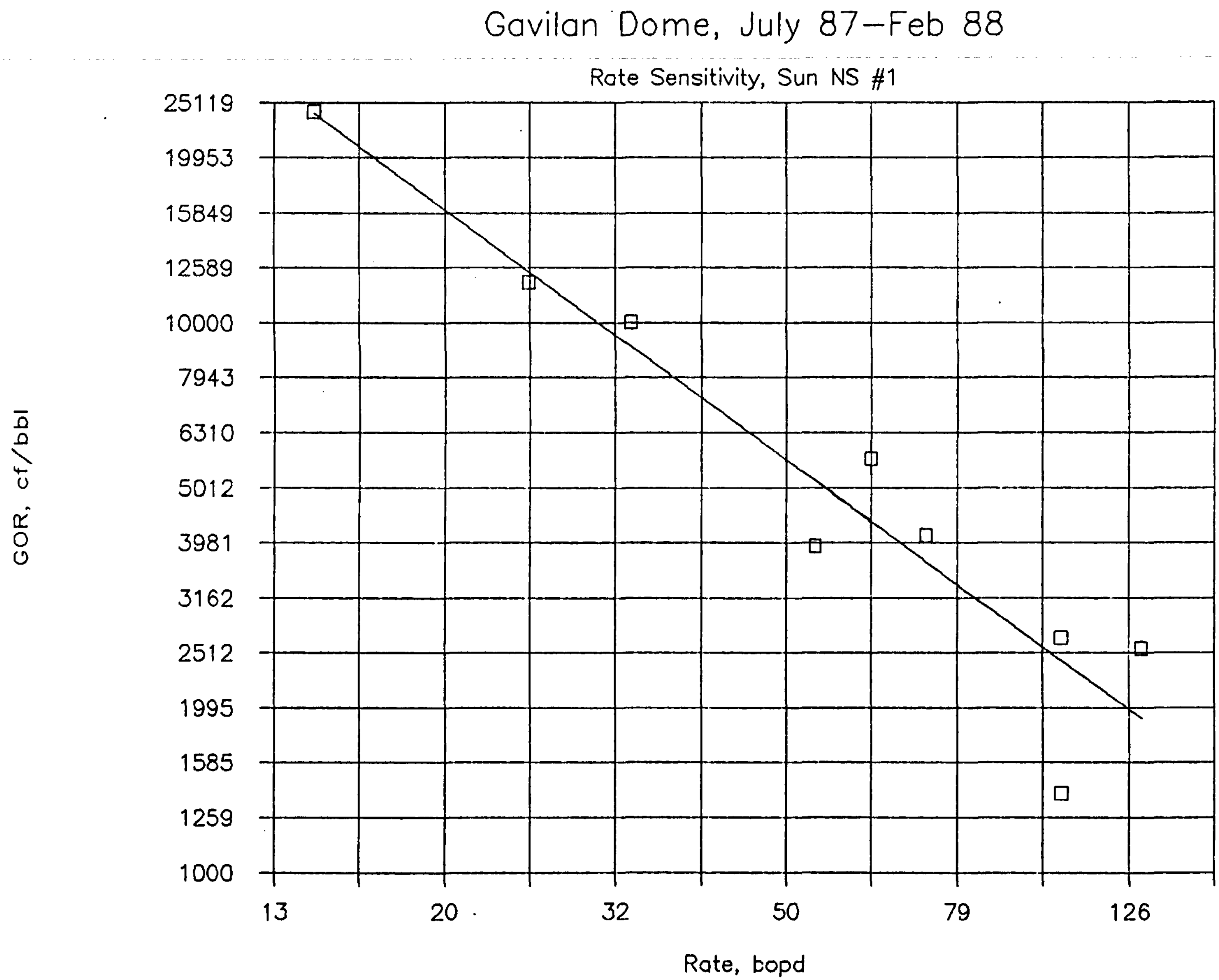
C. C. = 0.87

Gavilan Dome, July 87—Feb 88

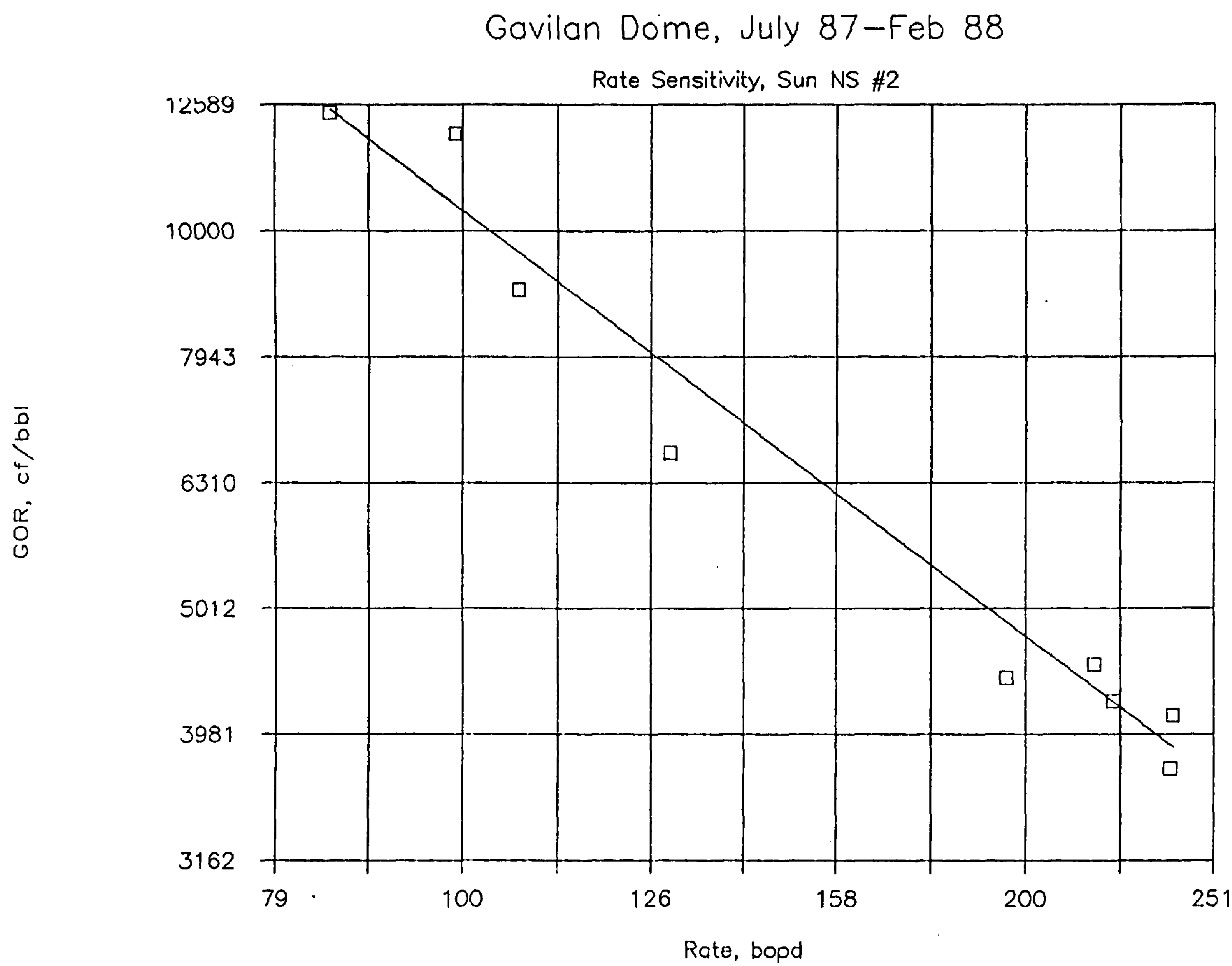
Rate Sensitivity, Sun NH #1



C. C. = 0.65

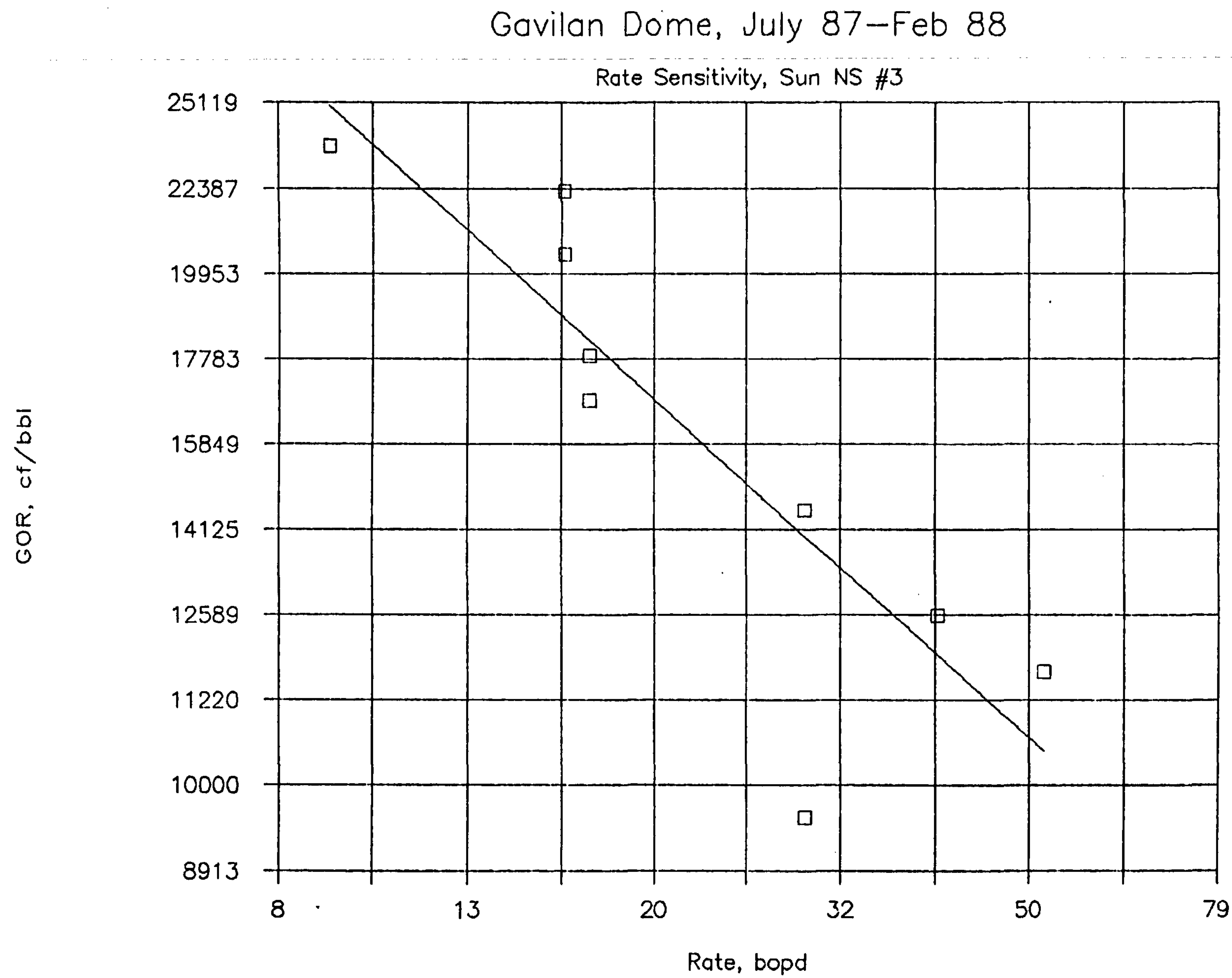

Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Sun NS #1
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
1000
GOR, cf/bbl
13
20
32
50
79
126
Rate, bopd

C.C. = 0.95



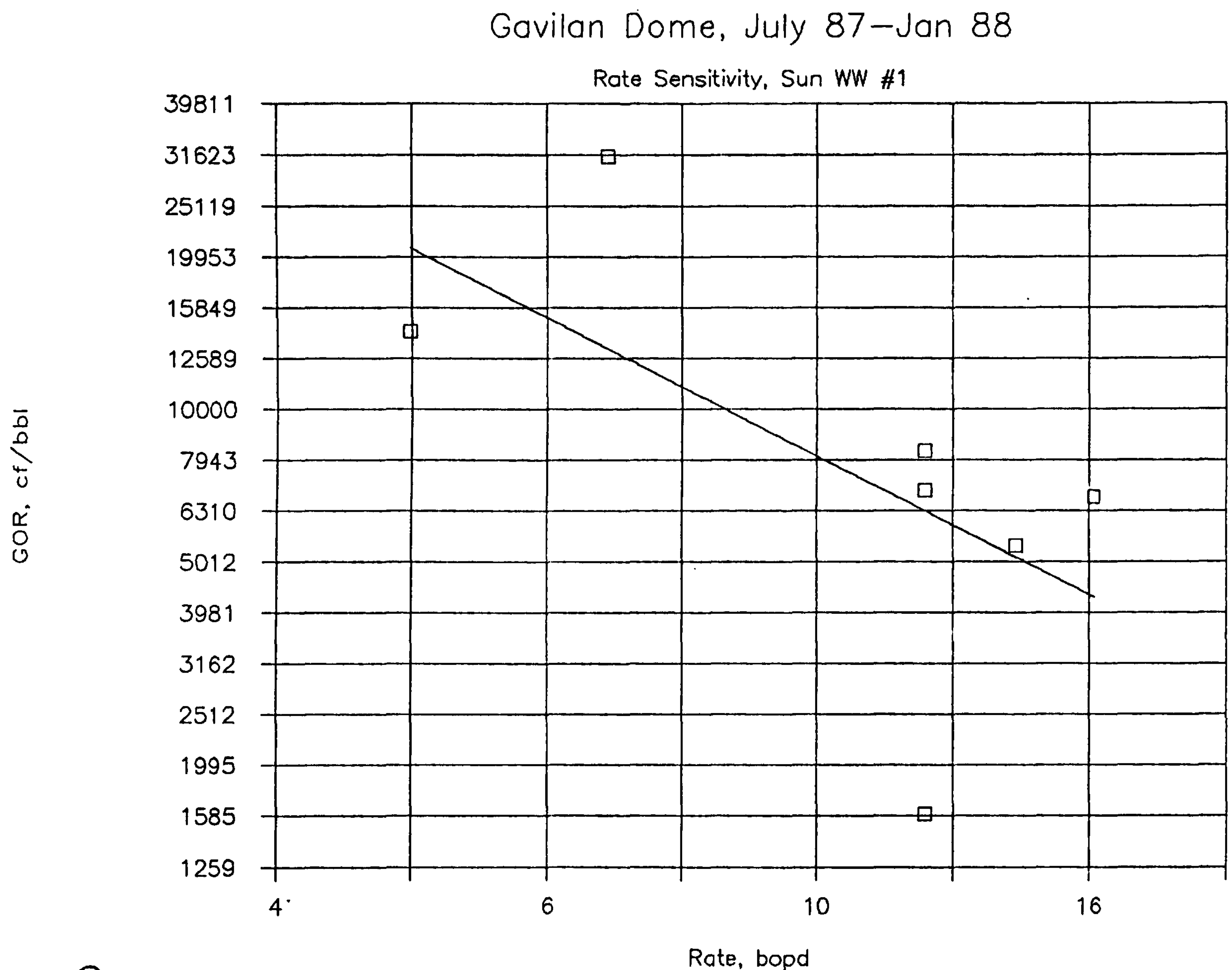
Gavilan Dome, July 87–Feb 88
Rate Sensitivity, Sun NS #2
GOR, cf/bbl
12589
10000
7943
6310
5012
3981
3162
79
100
126
158
200
251
Rate, bopd

C.C. = 0.98



Gavilan Dome, July 87—Feb 88
Rate Sensitivity, Sun NS #3
GOR, cf/bbl
25119
22387
19953
17783
15849
14125
12589
11220
10000
8913
8
13
20
32
50
79
Rate, bopd

C. C. = 0.86



Gavilan Dome, July 87–Jan 88
Rate Sensitivity, Sun WW #1
39811
31623
25119
19953
15849
12589
10000
7943
6310
5012
3981
3162
2512
1995
1585
1259
GOR, cf/bbl
4
6
10
16
Rate, bopd

C.C. = 0.62

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
AMOCO	BCU#1	1/1-1/31	190	314	8173	1554	60
AMOCO	BCU#1	2/1-2/29	145	292	7297	1058	42
				606			
AMOCO	BCU#2	2/1-2/29	274	228	3421	938	67
AMOCO	HTF#1	2/1-2/29	1687	12	83	140	20
AMOCO	OCFB#1	2/1-2/29	13250	22	44	583	292
AMOCO	SGC#1	1/1-1/31	8971	30	273	2449	245
AMOCO	SGC#1	2/1-2/29	3856	35	810	3123	142
				65			
AMOCO	SCC#1	2/1-2/29	99	201	4432	440	20
BMG	A-16	7/1-7/31	1075	16	214	230	18
BMG	A-16	8/1-8/31	1600	6	25	40	10
BMG	A-16	9/1-9/30	4009	11	212	850	45
				33			
BMG	A-20	7/1-7/31	1176	17	187	220	20
BMG	A-20	8/1-8/31	2843	38	568	1615	107
BMG	A-20	9/1-9/30	5331	46	1103	5880	245
BMG	A-20	11/1-11/14	5812	42	585	3400	243
BMG	A-20	12/1-12/31	5405	51	666	3600	277
BMG	A-20	1/1-1/31	6802	52	1601	10890	351
BMG	A-20	2/1-2/29	9474	44	133	1260	420
				290			
BMG	B-29	7/1-7/31	1219	673	18176	22160	821
BMG	B-29	8/1-8/31	1269	757	21187	26887	960
BMG	B-29	9/1-9/30	1922	1156	32372	62230	2223
BMG	B-29	10/1-10/31	2092	1003	15041	31460	2097
BMG	B-29	11/1-11/16	2262	1046	16738	37860	2366
BMG	B-29	11/30-12/31	2161	977	17578	37990	2111
BMG	B-29	2/1-2/29	1444	1047	8379	12100	1513
				6659			
BMG	B-32	7/1-7/31	1046	519	12984	13575	543
BMG	B-32	8/1-8/31	1261	714	19993	25210	900
BMG	B-32	9/1-9/30	1119	911	27344	30600	1020
BMG	B-32	10/1-10/31	1197	800	11998	14360	957
BMG	B-32	11/1-11/16	1200	719	11509	13810	863
BMG	B-32	11/30-12/31	1185	704	11964	14180	834
BMG	B-32	1/1-1/31	1000	701	13319	1300	700

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
BMG	B-32	2/1-2/29	1101	704	16894	18605	775
				5772			
BMG	C-34	12/1-12/31	10345	44	348	3600	450
BMG	C-34	1/1-1/31	11990	38	191	2290	458
BMG	C-34	2/1-2/29	17551	62	494	8670	1084
				144			
BMG	D-17	7/1-7/31	1195	9	135	160	1067
BMG	E-6	7/1-7/31	3966	307	7687	30490	1220
BMG	E-6	8/1-8/31	2339	362	11228	26260	847
BMG	E-6	9/1-9/30	2068	426	12765	26404	880
BMG	E-6	10/1-10/31	2757	358	5375	14820	988
BMG	E-6	11/1-11/16	4223	271	4063	17160	1144
BMG	E-6	12/1-12/31	4998	159	2391	11950	797
BMG	E-6	1/1-1/31	4752	169	2033	9660	805
				2052			
BMG	E-10	7/1-7/31	3124	380	11012	34400	1186
BMG	E-10	8/1-8/31	4896	303	9384	45940	1482
BMG	E-10	9/1-9/30	7124	236	6127	43760	1750
BMG	E-10	11/1-11/16	7589	235	3754	28490	1781
BMG	E-10	1/1-1/31	9199	222	1761	16200	1800
BMG	E-10	2/1-2/29	23201	62	556	12900	1433
				1438			
BMG	F-7	12/1-12/31	2689	124	2224	5980	332
BMG	F-7	1/1-1/31	5457	147	3832	20910	804
				271			
BMG	F-18	7/1-7/31	631	224	3362	2120	141
BMG	F-18	8/1-8/31	448	326	10096	4520	146
BMG	F-18	9/1-9/30	538	406	9751	5250	219
BMG	F-18	10/1-10/31	395	390	5846	2310	154
BMG	F-18	11/1-11/16	504	365	5469	2755	184
BMG	F-18	12/1-12/31	522	325	9753	5095	170
BMG	F-18	1/1-1/31	465	311	9643	4480	145
BMG	F-18	2/1-2/29	667	304	6982	4655	202
				2651			
BMG	F-19	7/1-7/31	6754	64	1869	12624	435
BMG	F-19	8/1-8/31	9719	75	2314	22490	725
BMG	F-19	9/1-9/30	13050	60	1436	18740	781
BMG	F-19	11/1-11/14	15035	51	712	10705	765
BMG	F-19	12/1-12/31	16392	43	693	11360	757
BMG	F-19	1/1-1/31	4899	100	398	1950	488
BMG	F-19	2/1-2/29	8417	60	120	1010	505
				453			

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
BMG	F-30	7/1-7/31	1042	357	10009	10430	373
BMG	F-30	8/1-8/31	989	347	9703	9600	343
BMG	F-30	9/1-9/30	1046	417	12506	13080	436
BMG	F-30	10/1-10/31	1094	355	5331	5830	389
BMG	F-30	11/1-11/16	1123	334	5337	5992	375
BMG	F-30	11/30-12/31	1134	311	9963	11295	353
BMG	F-30	1/1-1/31	1171	293	8491	9940	343
BMG	F-30	2/1-2/29	1104	349	8366	9240	385
				2763			
BMG	G-5	9/1-9/30	774	266	1330	1030	206
BMG	G-5	10/1-10/31	1073	263	3952	4240	283
BMG	G-5	11/1-11/16	1912	183	2924	5590	349
BMG	G-5	11/21-11/30	2093	158	473	990	330
BMG	G-5	12/1-12/31	2688	135	2697	7250	363
BMG	G-5	1/1-1/31	244	157	4860	11880	383
BMG	G-5	2/1-2/29	2374	465	3252	7720	351
				1627			
BMG	G-32	7/1-7/31	1132	13	53	60	15
BMG	G-32	9/1-9/30	870	12	46	40	10
				25			
BMG	J-6	8/1-8/31	3764	79	1905	7170	299
BMG	J-6	9/1-9/30	5556	55	1530	8500	304
BMG	J-6	11/1-11/10	35101	15	149	5230	523
BMG	J-6	12/1-12/31	22735	23	340	7730	515
BMG	J-6	1/1-1/31	29858	18	211	6300	525
				190			
BMG	J-8	9/1-9/30	1852	7	27	50	13
BMG	K-8	7/1-7/31	562	5	146	82	3
BMG	K-8	8/1-8/31	1207	6	29	35	7
BMG	K-8	9/1-9/30	2065	9	46	95	19
BMG	K-8	12/1-12/31	5618	9	89	500	50
BMG	K-8	1/1-1/31	4789	4	95	455	20
BMG	K-8	2/1-2/29	5000	2	41	205	10
				35			
BMG	L-3	9/1-9/30	722	22	486	351	16
BMG	L-3	10/1-10/31	732	14	205	150	10
BMG	L-3	11/1-11/16	758	19	211	160	16
BMG	L-3	12/1-12/31	699	32	256	179	22
BMG	L-3	1/1-1/31	787	16	305	240	13
				103			
BMG	L-11	8/1-8/31	186207	7	116	21600	1137

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
BMG	L-11	9/1-9/30	240000	5	15	3600	1200
BMG	L-11	2/1-2/29	18206	46	418	7610	761
				58			
BMG	L-27	7/1-7/31	2462	166	3980	9800	408
BMG	L-27	8/1-8/31	2641	157	4863	12845	414
BMG	L-27	9/1-9/30	2386	165	4949	11810	394
BMG	L-27	10/1-10/31	2382	163	2439	5810	387
BMG	L-27	11/1-11/16	2497	155	2479	6190	387
BMG	L-27	11/21-11/30	2491	160	1443	3595	399
BMG	L-27	12/1-12/31	2343	170	3064	7180	399
BMG	L-27	1/1-1/31	2372	152	4697	11140	359
BMG	L-27	2/1-2/29	2501	152	3351	8380	381
				1440			
BMG	N-22	7/1-7/31	791	82	2365	1870	64
BMG	N-22	8/1-8/31	465	86	1634	760	40
BMG	N-22	9/1-9/30	401	77	2317	930	31
BMG	N-22	10/1-10/31	412	73	1093	450	30
BMG	N-22	11/1-11/16	392	76	1213	475	30
BMG	N-22	11/21-11/30	412	95	947	390	39
BMG	N-22	12/1-12/31	422	68	2108	890	33
BMG	N-22	1/1-1/31	440	66	1911	840	29
BMG	N-22	2/1-2/29	399	80	1753	700	32
				703			
BMG	N-31	7/1-7/31	2240	182	5291	11850	409
BMG	N-31	8/1-8/31	1238	203	6303	7800	252
BMG	N-31	9/1-9/30	1025	194	5833	5980	199
BMG	N-31	10/1-10/31	1234	185	2771	3420	228
BMG	N-31	11/1-11/16	3106	127	2035	6320	395
BMG	N-31	12/1-12/31	4393	97	1457	6400	427
				988			
BMG	O-9	7/1-7/31	1082	11	319	345	12
BMG	O-9	8/1-8/31	1316	6	19	25	8
BMG	O-9	9/1-9/30	1044	21	297	310	22
BMG	O-9	11/21-11/30	1095	15	137	150	17
BMG	O-9	12/1-12/31	1118	13	331	370	16
BMG	O-9	1/1-1/31	1037	10	270	280	10
BMG	O-9	2/1-2/29	1036	14	304	315	15
				90			
BMG	O-33	7/1-7/31	3484	21	574	2000	74
BMG	O-33	8/1-8/31	5056	18	89	450	90
BMG	O-33	9/1-9/30	3052	28	729	2225	85
BMG	O-33	10/1-10/31	3003	21	313	940	63
BMG	O-33	11/1-11/14	2115	22	260	550	46
BMG	O-33	12/1-12/31	2853	28	333	950	95
BMG	O-33	1/1-1/31	3051	18	372	1135	54

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
				156			
DUGAN	LIND #1	7/1-7/31	7766	8	128	994	34
DUGAN	LIND #1	8/1-8/31	7504	5	121	908	36
DUGAN	LIND #1	9/1-9/30	7884	4	95	749	31
DUGAN	LIND #1	10/1-10/31	8733	4	116	1013	33
DUGAN	LIND #1	11/1-11/16	10465	4	22	225	28
DUGAN	LIND #1	11/21-11/30	9935	4	15	152	30
DUGAN	LIND #1	12/1-12/31	13367	5	60	802	29
DUGAN	LIND #1	1/1-1/31	4227	6	22	93	23
				40			
HIXON	DIV #3	7/1-7/31	794	103	2480	1969	82
HIXON	DIV #3	8/1-8/31	795	105	3147	2501	83
HIXON	DIV #3	10/1-10/31	795	110	1759	1399	87
HIXON	DIV #3	11/1-11/15	796	108	1619	1289	86
HIXON	DIV #3	12/1-12/31	795	103	3083	2452	82
HIXON	DIV #3	1/1-1/31	796	97	3019	2404	78
HIXON	DIV #3	2/2-2/29	797	93	2322	1851	74
				719			
HIXON	TAP #2	7/1-7/31	6239	12	355	2215	73
HIXON	TAP #2	8/1-8/31	6209	10	325	2018	65
HIXON	TAP #2	10/1-10/31	6202	6	99	614	38
HIXON	TAP #2	11/1-11/15	6208	7	77	478	43
HIXON	TAP #2	12/1-12/31	6220	5	127	790	32
HIXON	TAP #2	1/1-1/31	6196	5	56	347	32
HIXON	TAP #2	2/1-2/29	6220	6	41	255	36
				51			
HIXON	TAP #4	7/1-7/31	918	143	4133	3795	131
HIXON	TAP #4	8/1-8/31	918	146	4235	3889	134
HIXON	TAP #4	10/1-10/31	917	135	2154	1976	124
HIXON	TAP #4	11/1-11/15	917	131	1970	1807	120
HIXON	TAP #4	12/1-12/31	918	123	3824	3510	113
HIXON	TAP #4	1/1-1/31	917	97	2140	1962	89
HIXON	TAP #4	2/1-2/29	918	78	1944	1784	71
				853			
MALLON	DF 3#15	12/1-12/31	62591	4	44	2754	230
MALLON	DF 3#15	1/1-1/31	9908	13	141	1397	64
MALLON	DF 3#15	2/1-2/29	13295	6	95	1263	66
				23			
MALLON	FF 2#1	7/1-7/31	1326	316	9789	12979	419
MALLON	FF 2#1	8/1-8/31	1407	265	8211	11556	373
MALLON	FF 2#1	9/1-9/30	1306	285	6844	8936	372
MALLON	FF 2#1	10/1-10/31	1321	272	8426	11134	359
MALLON	FF 2#1	11/1-11/15	8730	40	597	5212	347
MALLON	FF 2#1	11/20-11/30	3636	165	1814	6596	600

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
MALLON	FF 2#1	12/1-12/31	9591	90	1077	10329	861
MALLON	FF 2#1	1/1-1/31	11649	96	479	5580	1116
MALLON	FF 2#1	2/1-2/29	11232	95	1048	11771	1070
				1624			
MALLON	HF 1#8	7/1-7/31	3212	278	8609	27649	892
MALLON	HF 1#8	8/1-8/31	3691	288	8919	32922	1062
MALLON	HF 1#8	9/1-9/30	3472	316	9471	32886	1096
MALLON	HF 1#8	10/1-10/31	3771	264	8186	30871	996
MALLON	HF 1#8	11/1-11/15	3736	244	3657	13664	911
MALLON	HF 1#8	11/21-11/30	8022	122	856	6867	981
MALLON	HF 1#8	12/1-12/31	1255	115	805	1010	144
MALLON	HF 1#8	1/1-1/31	9388	120	720	6759	1127
MALLON	HF 1#8	2/1-2/29	8498	120	841	7147	1021
				1867			
MALLON	HF 1#11	7/1-7/31	6328	186	5578	35298	1217
MALLON	HF 1#11	8/1-8/31	5147	256	5368	27628	1316
MALLON	HF 1#11	9/1-9/30	4770	284	6241	29769	1294
MALLON	HF 1#11	10/1-10/31	5503	241	7472	41119	1326
MALLON	HF 1#11	11/1-11/30	5545	254	3803	21087	1406
MALLON	HF 1#11	12/1-12/31	8339	177	1415	11800	1311
MALLON	HF 1#11	2/1-2/29	11085	137	684	7582	1516
				1535			
MALLON	JF 12#5	7/1-7/31	23870	17	322	7686	452
MALLON	JF 12#5	8/1-8/31	5281	70	1260	6654	370
MALLON	JF 12#5	9/1-9/30	5689	58	1725	9813	327
MALLON	JF 12#5	10/1-10/31	5682	53	1644	9341	301
MALLON	JF 12#5	11/1-11/15	8730	40	597	5212	347
MALLON	JF 12#5	11/20-11/30	21547	20	223	4805	437
MALLON	JF 12#5	12/1-12/31	40893	10	270	11041	425
MALLON	JF 12#5	1/1-1/31	44067	11	75	3305	472
MALLON	JF 12#5	2/1-2/29	53509	8	114	6100	407
				287			
MALLON	PF 13#6	7/1-7/31	5311	72	2235	11869	383
MALLON	PF 13#6	8/1-8/31	4897	83	2558	12526	404
MALLON	PF 13#6	9/1-9/30	2071	111	3331	6899	230
MALLON	PF 13#6	10/1-10/31	15351	88	2725	41831	1349
MALLON	PF 13#6	11/1-11/15	6241	58	872	5442	363
MALLON	PF 13#6	11/20-11/30	6573	70	769	5055	460
MALLON	PF 13#6	12/1-12/31	14096	45	178	2509	627
MALLON	PF 13#6	1/1-1/31	34024	16	252	8574	536
MALLON	PF 13#6	2/1-2/29	67677	7	96	6497	406
				550			
MALLON	RF 2#16	7/1-7/31	2849	76	2366	6741	217
MALLON	RF 2#16	8/1-8/31	2468	87	2708	6683	216
MALLON	RF 2#16	9/1-9/30	2541	87	2604	6617	221

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
MALLON	RF 2#16	10/1-10/31	2718	85	2550	6931	224
MALLON	RF 2#16	11/1-11/15	3686	37	370	1364	136
MALLON	RF 2#16	11/20-11/30	3227	40	441	1423	129
MALLON	RF 2#16	12/1-12/31	9538	30	751	7163	276
MALLON	RF 2#16	1/1-1/31	35631	13	295	10511	350
MALLON	RF 2#16	2/1-2/29	141905	3	21	2980	373
				458			
MERIDIAN	HAF #2	7/1-7/31	20207	24	386	7800	488
MERIDIAN	HAF #2	8/1-8/31	14827	31	689	10216	464
MERIDIAN	HAF #2	9/1-9/30	4296	70	1049	4506	300
MERIDIAN	HAF #2	11/1-11/16	12074	27	27	326	326
MERIDIAN	HAF #2	11/21-11/30	12384	27	190	2353	336
MERIDIAN	HAF #2	12/1-12/31	20154	19	325	6550	364
MERIDIAN	HAF #2	1/1-1/31	24918	18	306	7625	477
				216			
MERIDIAN	HAF #3	7/1-7/31	10685	44	696	7437	465
MERIDIAN	HAF #3	8/1-8/31	7537	54	1089	8208	410
MERIDIAN	HAF #3	9/1-9/30	5551	60	907	5035	336
MERIDIAN	HAF #3	11/1-11/16	10520	25	25	263	263
MERIDIAN	HAF #3	11/21-11/30	10401	24	167	1737	248
MERIDIAN	HAF #3	12/1-12/31	19618	12	280	5493	211
MERIDIAN	HAF #3	1/1-1/31	16465	20	159	2618	154
				239			
MERIDIAN	HF #1	7/1-7/31	15915	65	1037	16504	1032
MERIDIAN	HF #1	8/1-8/31	38913	26	515	20040	1002
MERIDIAN	HF #1	9/1-9/30	43723	21	314	13729	915
MERIDIAN	HF #1	11/1-11/16	102500	8	8	820	820
MERIDIAN	HF #1	11/21-11/30	31623	28	167	5281	880
MERIDIAN	HF #1	12/1-12/31	43236	19	191	8258	751
MERIDIAN	HF #1	1/1-1/31	81011	12	95	7696	962
				179			
MERIDIAN	HF #2Y	6/1-6/30	2997	87	1819	5452	260
MERIDIAN	HF #2Y	8/1-8/31	3978	62	934	3715	219
MERIDIAN	HF #2Y	9/1-9/30	4626	52	773	3576	238
MERIDIAN	HF #2Y	11/1-11/16	21143	7	7	148	148
MERIDIAN	HF #2Y	11/21-11/30	8100	40	140	1296	216
MERIDIAN	HF #2Y	12/1-12/31	5733	41	857	4913	234
MERIDIAN	HF #2Y	1/1-1/31	5554	36	1082	6009	207
				325			
MERIDIAN	HF #3	7/1-7/31	2342	69	1105	2588	162
MERIDIAN	HF #3	8/1-8/31	2101	72	1516	3185	152
MERIDIAN	HF #3	11/1-11/16	6679	28	28	187	187
MERIDIAN	HF #3	11/21-11/30	7027	31	183	1286	214
MERIDIAN	HF #3	12/1-12/31	8861	25	624	5529	213
MERIDIAN	HF #3	1/1-1/31	18724	12	199	3726	143

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
				237			
MERRION	KRY #1	1/1-1/31	19631	13	65	1276	51
MERRION	OCG #1	7/1-7/31	1691	8	55	93	13

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
MESA GR.	BC #1	6/1-6/30	6010	47	895	5379	269
MESA GR.	BC #1	7/1-7/31	4681	64	966	4522	301
MESA GR.	BC #1	8/1-8/31	4323	59	1543	6670	267
MESA GR.	BC #1	10/1-10/31	16050	20	20	321	321
MESA GR.	BC #1	11/1-11/17	9263	24	400	3705	218
MESA GR.	BC #1	11/21-11/30	18094	11	85	1538	192
MESA GR.	BC #1	12/1-12/31	17406	10	251	4369	182
MESA GR.	BC #1	1/1-1/31	45768	5	99	4531	206
MESA GR.	BC #1	2/1-2/29	44417	6	96	4264	213
MESA GR.	BRO #1	7/1-7/31	9027	76	1135	10246	683
MESA GR.	BRO #1	8/1-8/31	9027	103	2783	25123	930
MESA GR.	BRO #1	10/1-10/31	7627	130	3912	29837	962
MESA GR.	BRO #1	11/1-11/16	7848	108	1725	13538	846
MESA GR.	BRO #1	11/21-11/30	7990	100	800	6392	799
MESA GR.	BRO #1	12/1-12/31	7631	112	2234	17047	852
MESA GR.	BRO #1	1/1-1/31	6194	111	1886	11681	687
MESA GR.	BRO #1	2/1-2/29	7907	92	1661	13133	773
MESA GR.	GAV #1	7/1-7/31	21926	10	149	3267	218
MESA GR.	GAV #1	8/1-8/31	22408	9	238	5333	190
MESA GR.	GAV #1	10/1-10/31	32875	3	104	3419	110
MESA GR.	GAV #1	11/1-11/17	14220	3	41	583	34
MESA GR.	GAV #1	11/21-11/30	42027	5	37	1555	194
MESA GR.	GAV #1	12/1-12/31	1889	3	36	68	6
MESA GR.	GAV #1	1/1-1/31	33977	10	130	4417	316
MESA GR.	GAV #1	2/1-2/29	67716	4	81	5485	219
MESA GR.	GAV #3	7/1-7/31	28595	9	79	2259	151
MESA GR.	GAV #3	8/1-8/31	10247	12	299	3064	113
MESA GR.	GAV #3	10/1-10/31	33843	6	178	6024	194
MESA GR.	GAV #3	12/1-12/31	23618	9	55	1299	130
MESA GR.	GAV #3	1/1-1/31	51710	3	31	1603	100
MESA GR.	GAV #3	2/1-2/29	46578	4	45	2096	140
MESA GR.	GH #1	7/1-7/31	16749	16	239	4003	267
MESA GR.	GH #1	8/1-8/31	24102	16	372	8966	345
MESA GR.	GH #1	10/1-10/31	47667	12	12	572	572
MESA GR.	GH #1	11/1-11/17	64780	6	109	7061	392
MESA GR.	GH #1	11/21-11/30	58909	6	44	2592	324
MESA GR.	GH #1	12/1-12/31	63796	7	152	9697	359
MESA GR.	GH #1	1/1-1/31	83186	5	118	9816	393
MESA GR.	HC #1	8/1-8/31	8604	13	371	3192	110
MESA GR.	HC #1	10/1-10/31	5200	25	25	130	130

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
MESA GR.	HC #1	11/1-11/16	10727	10	161	1727	108
MESA GR.	HC #1	11/22-11/30	63267	3	15	949	136
MESA GR.	HC #1	12/1-12/31	18663	11	89	1661	151
MESA GR.	HC #1	1/1-1/31	20767	8	129	2679	128
MESA GR.	HC #1	2/1-2/29	30725	6	109	3349	146
MESA GR.	INV #1	2/1-2/29	4259	14	228	971	54
MESA GR.	MAR #1	7/1-7/31	2709	94	1416	3836	256
MESA GR.	MAR #1	8/1-8/31	3376	68	1489	5027	229
MESA GR.	MAR #1	10/1-10/31	5237	48	1394	7301	243
MESA GR.	MAR #1	11/1-11/17	6948	39	620	4308	253
MESA GR.	MAR #1	11/21-11/30	8774	30	212	1860	233
MESA GR.	MAR #1	12/1-12/31	13194	11	263	3470	129
MESA GR.	MAR #1	1/1-1/31	3494	50	451	1576	197
MESA GR.	MAR #1	2/1-2/29	9449	33	750	7087	308
MESA GR.	PRO #1	2/1-2/29	4594	21	512	2352	98
MESA GR.	RL #2	7/1-7/31	4771	57	855	4079	272
MESA GR.	RL #2	8/1-8/31	5389	47	1260	6790	251
MESA GR.	RL #2	10/1-10/31	3967	47	1456	5776	186
MESA GR.	RL #2	11/1-11/17	4336	39	664	2879	169
MESA GR.	RL #2	11/21-11/31	5500	17	120	660	83
MESA GR.	RL #2	12/1-12/31	4629	47	1088	5036	187
MESA GR.	RL #2	1/1-1/31	7791	34	506	3942	141
MESA GR.	RL #2	2/1-2/29	17015	15	336	5717	249
MESA GR.	RL #3	7/1-7/31	2156	37	556	1199	80
MESA GR.	RL #3	8/1-8/31	1860	48	1250	2325	83
MESA GR.	RL #3	10/1-10/31	1875	32	933	1749	56
MESA GR.	RL #3	11/1-11/17	9625	16	32	308	62
MESA GR.	RL #3	12/1-12/31	10554	12	177	1868	75
MESA GR.	RL #3	1/1-1/31	16365	9	192	3142	101
MESA GR.	RL #3	2/1-2/29	18720	8	175	3276	131
MOBIL	LIN B#34	7/1-7/31	3501	72	2229	7804	252
MOBIL	LIN B#34	8/1-8/31	3365	56	1733	5832	216
MOBIL	LIN B#34	9/1-9/30	3697	47	1396	5161	172
MOBIL	LIN B#34	10/1-10/31	4817	37	955	4600	170
MOBIL	LIN B#34	11/1-11/16	4246	33	532	2259	141
MOBIL	LIN B#34	11/20-11/30	4083	43	384	1568	174
MOBIL	LIN B#34	12/1-12/31	5126	35	987	5059	181
MOBIL	LIN B#34	1/1-1/31	7368	25	560	4126	179
MOBIL	LIN B#34	2/1-2/29	7766	28	691	5366	215

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
MOBIL	LIN B#37	7/1-7/31	7750	54	1683	13044	435
MOBIL	LIN B#37	8/1-8/31	3733	218	6772	25283	936
MOBIL	LIN B#37	9/1-9/30	3192	244	7314	23349	778
MOBIL	LIN B#37	10/1-10/31	3953	225	6975	27573	889
MOBIL	LIN B#37	11/1-11/17	3907	214	3641	14225	889
MOBIL	LIN B#37	11/20-11/30	3682	195	1947	7168	796
MOBIL	LIN B#37	12/1-12/31	3757	213	3837	14417	801
MOBIL	LIN B#37	1/1-1/31	4063	192	3657	14858	782
MOBIL	LIN B#37	2/1-2/29	4112	188	3570	14679	816
MOBIL	LIN B#38	7/1-7/31	19598	13	415	8133	262
MOBIL	LIN B#38	8/1-8/31	21127	10	300	6338	235
MOBIL	LIN B#38	9/1-9/30	29320	8	219	6421	199
MOBIL	LIN B#38	10/1-10/31	24403	8	238	5808	187
MOBIL	LIN B#38	11/1-11/16	27625	6	96	2652	166
MOBIL	LIN B#72	7/1-7/31	20565	4	108	2221	74
MOBIL	LIN B#72	8/1-8/31	21349	4	86	1836	68
MOBIL	LIN B#72	9/1-9/30	25473	3	74	1885	63
MOBIL	LIN B#72	11/20-11/30	38523	6	44	1695	188
MOBIL	LIN B#72	12/1-12/31	66383	12	81	5377	199
MOBIL	LIN B#72	1/1-1/31	71987	3	79	5676	183
MOBIL	LIN B#72	2/1-2/29	19500	3	58	1131	45
MOBIL	LIN B#73	7/1-7/31	19977	7	173	3456	115
MOBIL	LIN B#73	8/1-8/31	17279	6	165	2851	106
MOBIL	LIN B#73	9/1-9/30	16449	7	187	3076	103
MOBIL	LIN B#73	10/1-10/31	17724	7	192	3403	110
MOBIL	LIN B#73	11/1-11/16	26657	5	67	1786	112
MOBIL	LIN B#73	11/20-11/30	19154	7	52	996	111
MOBIL	LIN B#73	12/1-12/31	8970	16	302	2709	113
MOBIL	LIN B#73	1/1-1/31	14429	10	219	3160	117
MOBIL	LIN B#73	2/1-2/29	27143	5	98	2660	111
MOBIL	LIN B#74	7/1-7/31	53190	8	210	11170	30
MOBIL	LIN B#74	8/1-8/31	15613	32	727	11351	437
MOBIL	LIN B#74	9/1-9/30	12994	36	980	12734	424
MOBIL	LIN B#74	10/1-10/31	9931	35	1008	10010	323
MOBIL	LIN B#74	11/1-11/16	10793	32	482	5202	325
MOBIL	LIN B#74	11/20-11/30	37495	14	109	4087	454
MOBIL	LIN B#74	12/1-12/31	50631	11	141	7139	376
MOBIL	LIN B#74	1/1-1/31	74360	6	100	7436	372
MOBIL	LIN B#74	2/1-2/29	42538	7	119	5062	281

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
R&B	HF 43-15	6/1-6/30	55728	4	103	5740	239
R&B	HF 43-15	7/1-7/31	29693	15	378	11224	416
R&B	HF 43-15	8/1-8/31	39632	11	353	13990	466
R&B	HF 43-15	9/1-9/30	46545	9	44	2048	410
R&B	HF 43-15	10/1-10/31	34337	20	98	3365	673
R&B	HF 43-15	11/1-11/16	69293	9	147	10186	637
R&B	HF 43-15	11/21-11/30	79180	6	61	4830	483
R&B	HF 43-15	12/1-12/31	53333	5	117	6240	240
R&B	IN 34-16	9/1-9/30	39613	8	31	1228	205
R&B	IN 34-16	10/1-10/31	12698	46	1160	14730	526
R&B	IN 34-16	11/1-11/16	12312	54	858	10564	660
R&B	IN 34-16	11/20-11/30	11991	60	663	7950	723
R&B	IN 34-16	12/1-12/31	9708	72	1231	11950	703
SUN	BB#1	7/1-7/31	2701	133	3585	9684	372
SUN	BB#1	8/1-8/31	2995	123	3309	9909	367
SUN	BB#1	9/1-9/30	3322	102	1635	5431	362
SUN	BB#1	10/1-10/31	3944	108	2054	8100	426
SUN	BB#1	11/1-11/16	4282	96	1533	6564	410
SUN	BB#1	11/22-11/30	2973	64	451	1341	192
SUN	BB#1	12/1-12/31	3563	78	2026	7219	267
SUN	BB#1	1/1-1/31	4030	64	1538	6198	258
SUN	B&L#1	7/1-7/31	10250	2	48	492	21
SUN	B&L#1	8/1-8/31	6020	2	50	301	10
SUN	B&L#1	9/1-9/30	14909	2	11	164	15
SUN	B&L#2	7/1-7/31	13971	4	34	475	53
SUN	DRDO#1	7/1-7/31	4010	70	2106	8445	282
SUN	DRDO#1	8/1-8/31	6664	42	1038	6917	266
SUN	DRDO#1	9/1-9/30	9324	32	550	5128	302
SUN	DRDO#1	10/1-10/31	14614	20	383	5597	295
SUN	DRDO#1	11/1-11/16	16424	17	264	4336	271
SUN	DRDO#1	11/21-11/30	26475	13	101	2674	334
SUN	DRDO#1	12/1-12/31	10084	26	713	7190	257
SUN	DRDO#1	1/1-1/31	5901	37	1135	6698	216
SUN	E.T.	7/1-7/31	28740	13	404	11611	387
SUN	E.T.	8/1-8/31	50890	7	172	8753	324
SUN	E.T.	9/1-9/30	56356	5	87	4903	288
SUN	E.T.	10/1-10/31	91667	3	48	440	232
SUN	E.T.	11/1-11/16	99280	2	25	2482	155

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
SUN	E.T.	11/21-11/30	40089	6	45	1804	226
SUN	E.T.	12/1-12/31	23621	8	214	5055	181
SUN	E.T.	1/1-1/31	139615	2	13	1815	113
SUN	FS#1	7/1-7/31	2533	54	1404	3556	142
SUN	FS#1	8/1-8/31	2060	71	1918	3952	146
SUN	FS#1	9/1-9/30	2128	66	1120	2383	140
SUN	FS#1	10/1-10/31	2525	54	1027	2593	136
SUN	FS#1	11/1-11/16	2667	49	787	2099	131
SUN	FS#1	11/21-11/30	2378	109	368	875	109
SUN	FS#1	12/1-12/31	2105	52	1405	2957	106
SUN	FS#1	1/1-1/31	2976	48	1446	4303	143
SUN	FSA#2	7/1-7/31	22195	33	990	21973	732
SUN	FSA#2	8/1-8/31	25292	26	678	17148	660
SUN	FSA#2	9/1-9/30	30122	20	345	10392	611
SUN	FSA#2	10/1-10/31	32395	15	294	9524	501
SUN	FSA#2	11/1-11/16	35884	11	138	4952	354
SUN	FSA#2	11/21-11/30	37120	8	50	1856	309
SUN	FSA#2	12/1-12/31	35008	12	244	8542	427
SUN	FSA#2	1/1-1/31	37137	9	95	3528	358
SUN	FSB#3	7/1-7/31	6550	15	447	2928	98
SUN	FSB#3	8/1-8/31	2800	14	370	1036	38
SUN	FSB#3	9/1-9/30	2197	16	254	558	35
SUN	FSB#3	10/1-10/31	2851	13	255	727	38
SUN	FSB#3	11/1-11/16	3548	11	177	628	39
SUN	FSB#3	11/21-11/30	6663	12	83	553	69
SUN	FSB#3	12/1-12/31	4919	8	222	1092	39
SUN	FSB#3	1/1-1/31	7263	6	137	995	38
SUN	FTS#1	7/1-7/31	156636	3	22	3446	431
SUN	FTS#1	8/1-8/31	177222	2	45	7975	332
SUN	FTS#1-E	7/1-7/31	96712	3	73	7060	243
SUN	FTS#1-E	8/1-8/31	147825	1	40	5913	211
SUN	GG#1	7/1-7/31	3224	28	254	819	91
SUN	HA#1	7/1-7/31	2688	225	6290	16905	604
SUN	HA#1	8/1-8/31	2924	226	6098	17831	660
SUN	HA#1	9/1-9/30	3042	203	3451	10499	618
SUN	HA#1	10/1-10/31	3160	238	4522	14288	752

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
SUN	HA#1	11/1-11/16	3029	228	3641	11029	689
SUN	HA#1	11/21-11/30	2446	259	1812	4433	633
SUN	HA#1	12/1-12/31	2725	201	3422	9324	548
SUN	HA#1	1/1-1/31	2049	230	3450	7068	471
SUN	HA#2	7/1-7/31	6435	49	1455	9363	312
SUN	HA#2	8/1-8/31	9774	31	810	7917	293
SUN	HA#2	9/1-9/30	10726	29	485	5202	306
SUN	HA#2	10/1-10/31	8211	56	1057	8679	457
SUN	HA#2	11/1-11/16	8733	49	776	6777	424
SUN	HA#2	11/21-11/30	9566	41	327	3128	391
SUN	HA#2	12/1-12/31	9398	50	906	8515	473
SUN	HA#2	1/1-1/31	11391	35	741	8441	384
SUN	HR#1	7/1-7/31	2837	241	7231	20516	684
SUN	HR#1	8/1-8/31	3130	235	6347	19865	736
SUN	HR#1	9/1-9/30	10617	128	1914	20321	1195
SUN	HR#1	10/1-10/31	7768	134	2538	19714	1038
SUN	HR#1	11/1-11/16	4455	167	2671	11899	744
SUN	HR#1	11/21-11/30	12157	87	611	7428	929
SUN	HR#1	12/1-12/31	29058	35	242	7032	1005
SUN	HR#1	1/1-1/31	23162	23	68	1575	525
SUN	JA#1	7/1-7/31	26019	14	420	10928	364
SUN	JA#1	8/1-8/31	28062	11	305	8559	317
SUN	JA#1	9/1-9/30	27180	11	178	4838	285
SUN	JA#1	10/1-10/31	16785	15	293	4918	259
SUN	JA#1	11/1-11/16	67333	13	39	2626	219
SUN	JA#1	11/21-11/30	23240	24	96	2231	279
SUN	JA#1	12/1-12/31	32738	15	160	5238	249
SUN	JA#1	1/1-1/31	31906	8	212	6764	251
SUN	JAA#2	7/1-7/31	10379	38	1125	11676	389
SUN	JAA#2	8/1-8/31	12279	24	655	8043	298
SUN	JAA#2	9/1-9/30	28395	13	215	6105	359
SUN	JAA#2	10/1-10/31	34693	11	212	7355	409
SUN	JAA#2	11/1-11/16	66521	5	73	4856	208
SUN	JAA#2	11/1-11/21	21660	17	103	2231	279
SUN	JAA#2	12/1-12/31	88865	4	74	6576	329
SUN	JAA#2	1/1-1/31	107549	3	51	5485	274
SUN	JAB#3	7/1-7/31	1224	43	1283	1570	52
SUN	JAB#3	8/1-8/31	1688	36	961	1622	60
SUN	JAB#3	9/1-9/30	1344	27	453	609	36
SUN	JAB#3	10/1-10/31	2560	19	368	942	50

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
SUN	JAB#3	11/1-11/16	2795	17	268	749	47
SUN	JAB#3	11/21-11/30	3075	15	120	369	46
SUN	JAB#3	12/1-12/31	2801	60	423	1185	44
SUN	JAB#3	1/1-1/31	4416	11	334	1475	49
SUN	LL#1	7/1-7/31	1973	67	1939	3826	125
SUN	LL#1	8/1-8/31	2615	51	1374	3593	133
SUN	LL#1	9/1-9/30	2397	50	844	2023	119
SUN	LL#1	10/1-10/31	2787	42	752	2096	116
SUN	LL#1	11/1-11/16	2986	36	574	1714	107
SUN	LL#1	11/21-11/30	2922	37	294	859	107
SUN	LL#1	12/1-12/31	2653	35	992	2632	94
SUN	LL#1	1/1-1/31	2422	36	1071	2594	84
SUN	LOD #1	7/1-7/31	7072	61	1898	13422	433
SUN	LOD #1	8/1-8/31	6212	66	1776	11033	409
SUN	LOD #1	9/1-9/30	5255	75	1276	6705	394
SUN	LOD #1	10/1-10/31	4538	75	1420	6444	339
SUN	LOD #1	11/1-11/16	5837	58	926	5405	338
SUN	LOD #1	11/21-11/30	8548	50	398	3402	425
SUN	LOD #1	12/1-12/31	8206	46	1051	8625	375
SUN	LOD #1	1/1-1/31	9252	43	1043	9650	402
SUN	ML#1	7/1-7/31	11402	24	711	8107	270
SUN	ML#1	8/1-8/31	6861	29	793	5441	202
SUN	ML#1	9/1-9/30	6460	16	63	407	136
SUN	ML#1	10/1-10/31	7402	47	894	6617	389
SUN	ML#1	11/1-11/16	7984	47	745	5948	372
SUN	ML#1	11/21-11/30	8942	47	378	3380	423
SUN	ML#1	12/1-12/31	12175	35	629	7658	450
SUN	ML#1	1/1-1/31	14617	28	847	12381	442
SUN	MLA#2	7/1-7/31	9571	63	1877	17965	599
SUN	MLA#2	8/1-8/31	2756	93	2512	6924	256
SUN	MLA#2	9/1-9/30	4973	57	910	4525	266
SUN	MLA#2	10/1-10/31	6030	52	989	5964	314
SUN	MLA#2	11/1-11/16	4815	77	1239	5966	373
SUN	MLA#2	11/21-11/30	5869	76	611	3586	448
SUN	MLA#2	12/1-12/31	10493	46	836	8772	487
SUN	MLA#2	1/1-1/31	14692	28	770	11313	435
SUN	NS#1	7/1-7/31	4105	73	2181	8952	309
SUN	NS#1	8/1-8/31	2679	105	2831	7584	281
SUN	NS#1	9/1-9/30	1395	105	210	293	147
SUN	NS#1	10/1-10/31	2556	130	518	1324	331

GAVILAN DOME DATA BASE
RATE vs. GOR SENSITIVITY

OPERATOR	WELL	DATE	AVERAGE GOR	AVERAGE BOPD	CUM OIL	CUM GAS	AVERAGE MCFPD
SUN	NS#1	11/1-11/16	3932	54	862	3389	242
SUN	NS#1	11/21-11/30	5661	63	502	2842	355
SUN	NS#1	12/1-12/31	10044	33	749	7523	289
SUN	NS#1	1/1-1/31	11837	25	711	8416	301
SUN	NSA#2	7/1-7/31	4229	222	6646	28108	937
SUN	NSA#2	8/1-8/31	3739	238	6421	24005	889
SUN	NSA#2	9/1-9/30	4125	239	4066	16774	988
SUN	NSA#2	10/1-10/31	4526	217	4127	18678	983
SUN	NSA#2	11/1-11/16	4414	195	3113	13742	859
SUN	NSA#2	11/21-11/30	6669	129	900	6002	857
SUN	NSA#2	12/1-12/31	8984	107	859	7717	965
SUN	NSA#2	1/1-1/31	12412	85	677	8403	1050
SUN	NSB#3	7/1-7/31	11665	52	1360	15865	610
SUN	NSB#3	8/1-8/31	12580	40	1087	13675	506
SUN	NSB#3	9/1-9/30	14502	29	458	6642	391
SUN	NSB#3	10/1-10/31	9581	29	520	4982	293
SUN	NSB#3	11/1-11/16	17857	17	237	4232	282
SUN	NSB#3	11/21-11/30	20477	16	109	2232	319
SUN	NSB#3	12/1-12/31	22308	16	276	6157	342
SUN	NSB#3	1/1-1/31	23718	9	163	3866	276
SUN	NH#1	7/1-7/31	5802	4	121	702	24
SUN	NH#1	8/1-8/31	1989	6	176	350	11
SUN	NH#1	9/1-9/30	5484	6	95	521	31
SUN	NH#1	10/1-10/31	8600	4	85	731	38
SUN	NH#1	11/1-11/16	12059	3	51	615	38
SUN	NH#1	11/21-11/30	9750	5	32	312	39
SUN	NH#1	12/1-12/31	7653	6	121	926	39
SUN	NH#1	1/1-1/31	7371	6	159	1172	39
SUN	WW#1	7/1-7/31	6731	16	468	3150	105
SUN	WW#1	8/1-8/31	6923	12	311	2153	80
SUN	WW#1	9/1-9/30	5406	14	219	1184	70
SUN	WW#1	10/1-10/31	8290	12	207	1716	90
SUN	WW#1	11/1-11/16	1599	12	187	299	37
SUN	WW#1	11/21-11/30	14256	5	39	556	70
SUN	WW#1	12/1-12/31	31385	7	13	408	17