SOUTH BLANCO PICTURED CLIFFS POOL

Drainage Calculations

As additional data to support the protection of correlative rights, drainage calculations are presented. Two methods were employed, the first is a combination material balance - volumetric analysis and the second uses a Fetkovich Type Curve. All indications show the Pictured Cliffs reservoir as a low permeability gas sand with a limited drainage area. The attached tables summarize the results.

Four wells within the UNOCAL operated Rincon Unit were analyzed for drainage area. These four wells all had recent pressure buildup tests, therefore data was available for the type curve match. These wells are located in various portions of Rincon Unit, resulting in a cross sectional view of the Pictured Cliffs. For the first method, P/Z vs cumulative production (material balance) was plotted to obtain the initial gas-in-place. This volume was then inputted into the volumetric equation to determine the drainage area. As can be seen from the attached table, the drainage area after producing over 34 years ranges from 92 to 140 acres. This estimate is well within the spacing rule of 160 acres.

The results from the Fetkovich type curve and a comparison with the material balance-volumetric method are in Table 2. Attached are the type curve matches for each of these wells and the Horner Analysis of the buildup data. For the buildup analysis the porosity was assumed constant, and determined from log analysis. The pressure squared form was used as it is valid for the low pressure ranges of the Pictured Cliffs. The buildup data was also analyzed with the real gas potential and the resulting permeability matched the pressure squared form. The log porosity and buildup permeability were used to guide the type curve match. Once these values are reasonably matched the coinciding drainage area is determined. As can be seen in the accompanying table the porosity and permeability match very well. The corresponding drainage areas vary from 80 to 100 acres, all being less than the material balance - volumetric method.

To summarize, analysis shows the drainage areas are less than the 160 spacing rule. Even though this is a small sample of the entire South Blanco Pool, it is believed these wells are respresentative of the reservoir as a whole. From the low permeability and the limited drainage area, correlative rights are protected and not endangered by deproration.

REFERENCES

Al-Hussainy, R., Ramey,H.J.,Jr., and Crawford, P.B.:" The Flow of Real Gases Through Porous Media", JPT, May 1966, 624-636; *Trans.*, AIME,237.

Fetkovich,M.J.:" Decline Curve Analysis Using Type Curves"; JPT, June 1980, 1065-77.

Horner,D.R.:" Pressure Build-Up in Wells", *Proc.*, Third World Petroleum Congress., The Hague (1951), Sec. II, 503-523.

SOUTH BLANCO PICTURED CLIFFS POOL

Material Balance – Volumetric Method

Well	Gas–in–place mmcf	Gp @ Pa/Za=150 mmcf	Recovery Factor %	Drainage Area acres
Rincon Unit # 114	822	590	72	119
Rincon Unit # 119	1285	1069	83	92
Rincon Unit # 88	1140	900	79	140
Rincon Unit # 18 & 18R	895	714	80	106

Material Balance Eq:

$$P/Z = Pi/Zi\ (1 - Gp/Gi)$$

Volumetric Eq:

$$Gi = 43560\ A\ h\ \emptyset\ (1-Sw)\ Bgi$$

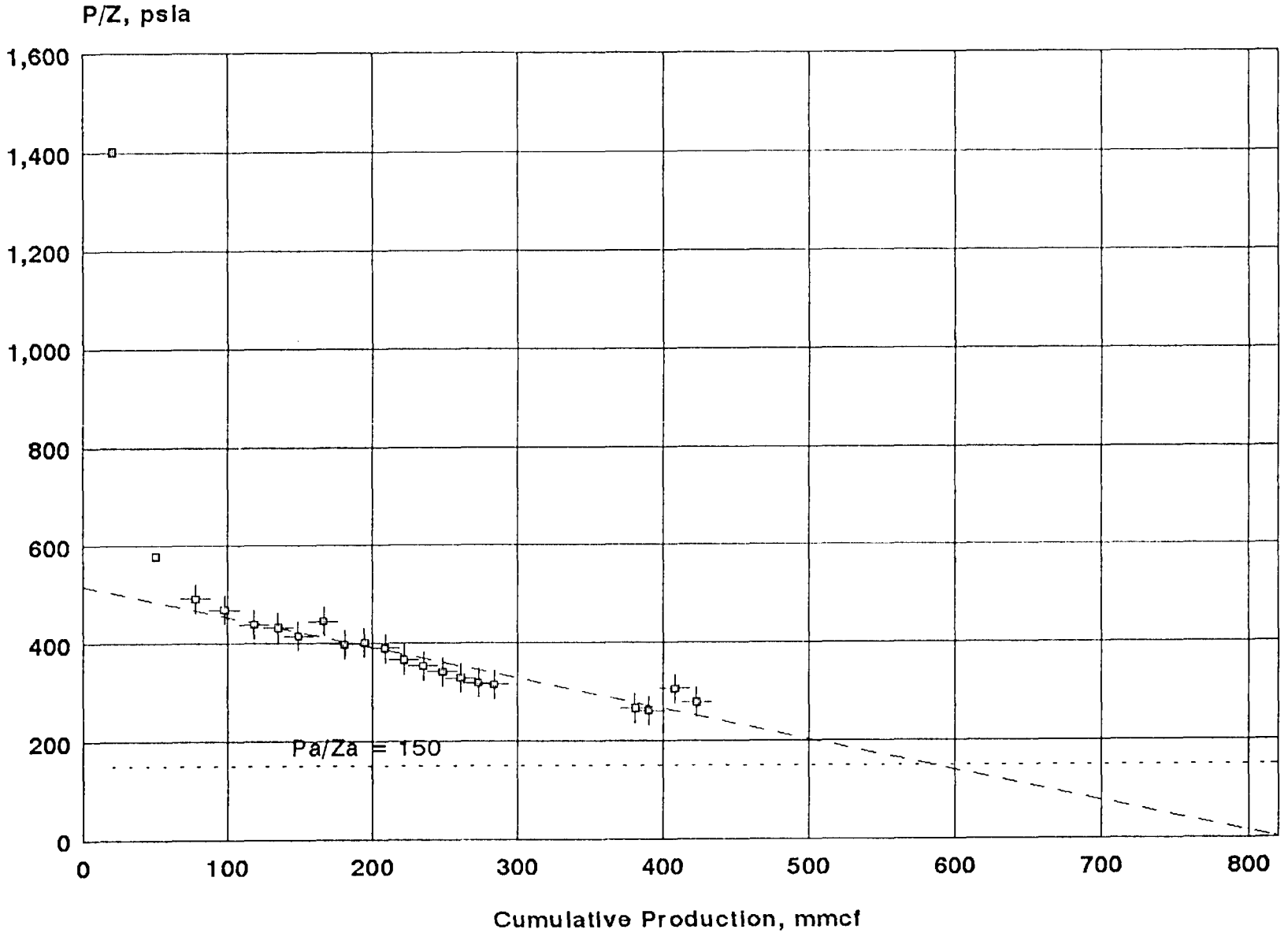
SOUTH BLANCO PICTURED CLIFFS POOL

Fetkovich Type Curve Method

Well	Buildup Analysis		Type Curve Match		Type Curve	MatBal–Vol
	porosity	permeability	porosity	permeability	drainage area	drainage area
		md		md	acres	acres
Rincon Unit # 114	0.11	0.07	0.09	0.06	60	119
Rincon Unit # 119	0.11	0.50	0.10	0.22	80	92
Rincon Unit # 88	0.11	0.23	0.07	0.19	100	140
Rincon Unit # 18 & 18R	0.11	0.22	0.10	0.25	80	106

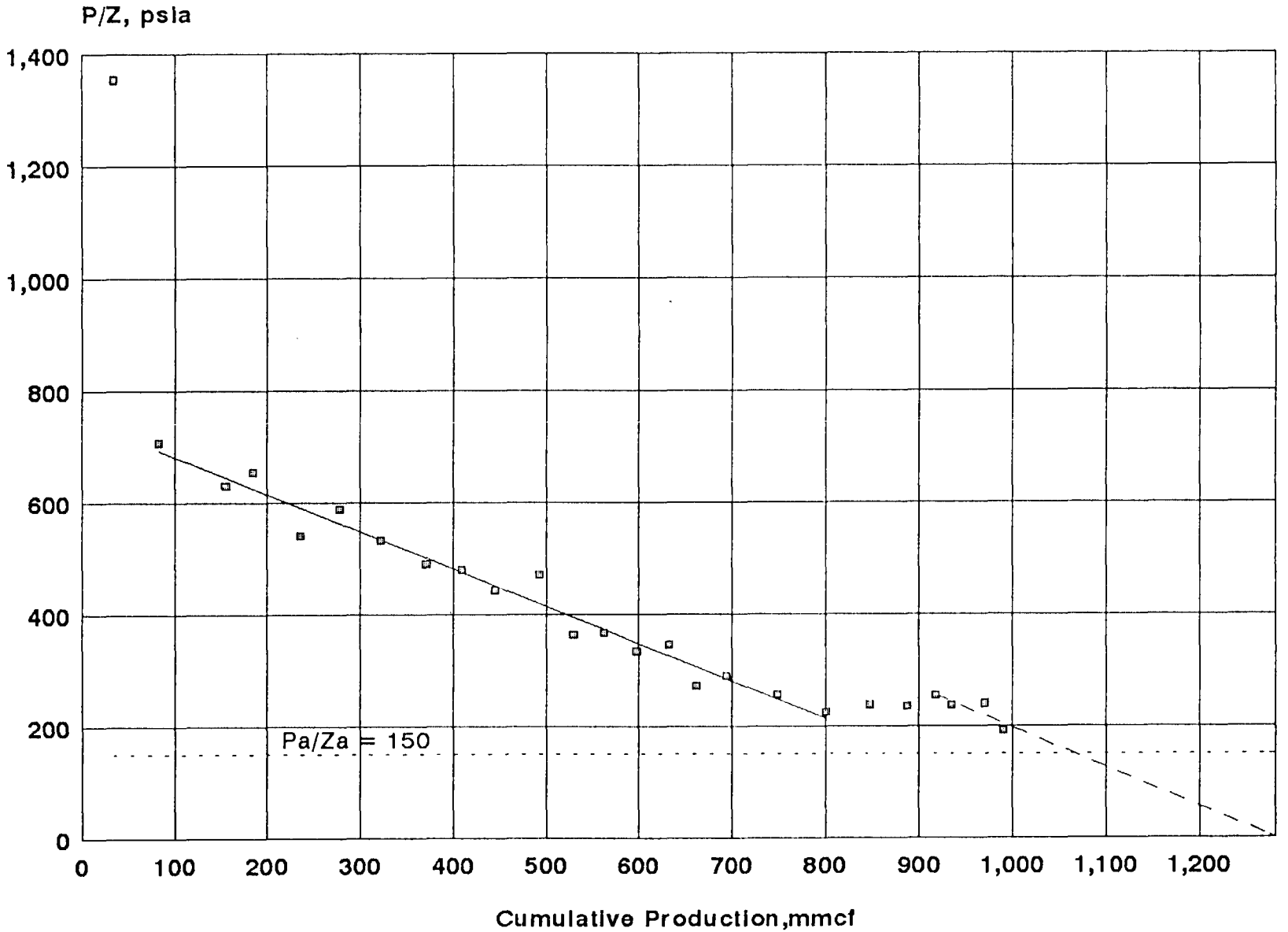
P/Z vs Cumulative Production

Rincon Unit # 114



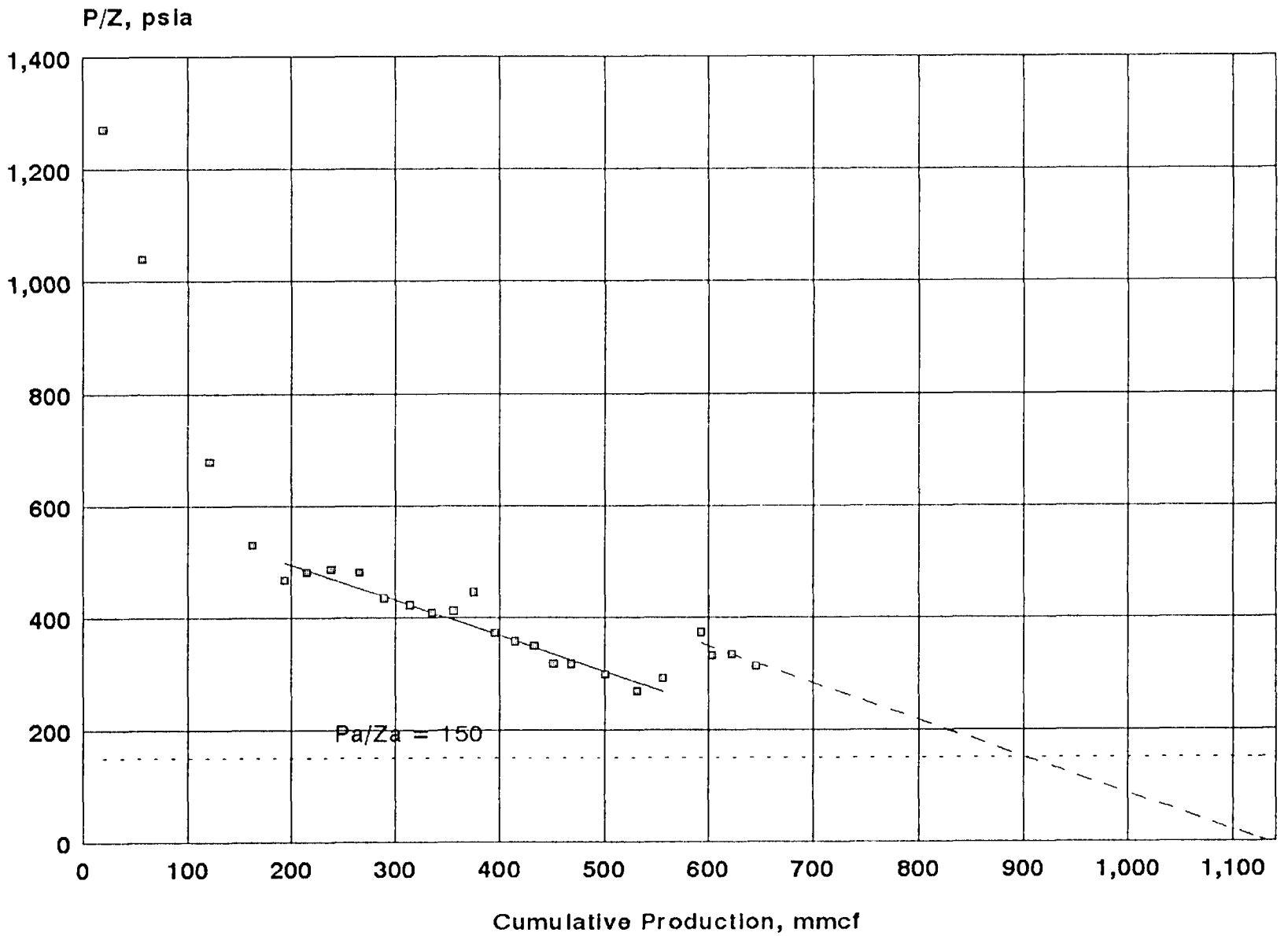
P/Z vs Cumulative Production

Rincon Unit #119



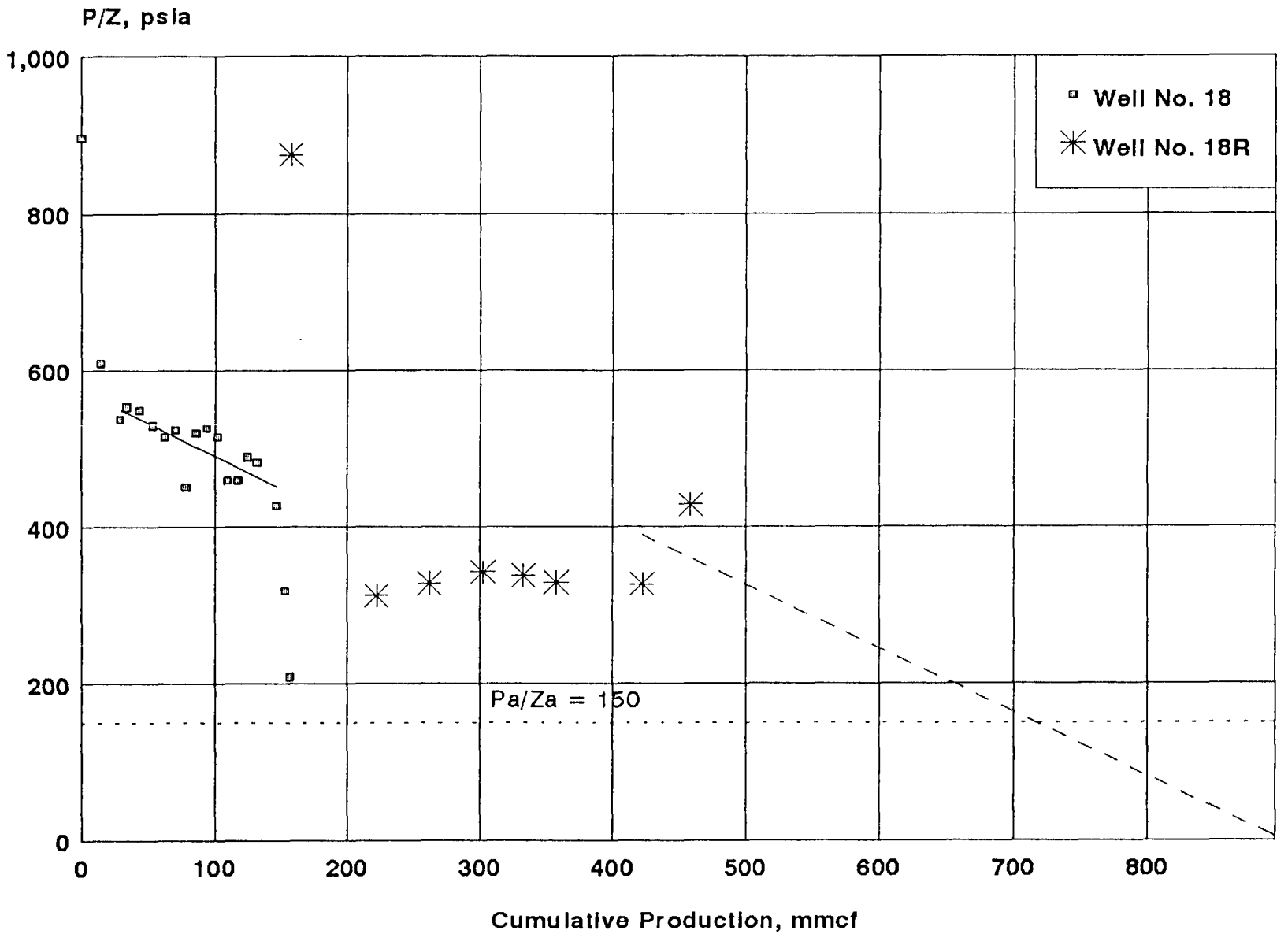
P/Z vs Cumulative Production

Rincon Unit #88



P/Z vs Cumulative Production

Rincon Unit # 18 & 18R



RINCON UNIT 114 – PC

year	cum prod mmcf	SIWHP psi	SIBHP psi	z–factor	P/Z
1958	20.5	1112	1131	0.807	1402
1959	50.9	508	527	0.911	579
1960	78.1	435	454	0.923	492
1961	98.1	416	435	0.926	470
1962	118.5	390	409	0.931	439
1963	134.9	384	403	0.932	432
1964	148.8	369	388	0.935	415
1965	166.3	395	414	0.930	445
1966	180.8	354	373	0.937	398
1967	194.5	357	376	0.937	401
1968	208.4	347	366	0.938	390
1969	221.5	326	345	0.942	366
1970	234.8	315	334	0.944	354
1971	248.0	304	323	0.946	342
1972	260.5	293	312	0.948	329
1973	272.7	284	303	0.949	319
1974	283.8	281	300	0.950	316
1975	295.2				
1976	306.3				
1977	316.7				
1978	327.0				
1979	336.2				
1980	345.7				
1981	355.1				
1982	363.6				
1983	372.4				
1984	381.0	236	255	0.957	266
1985	390.3	231	250	0.958	261
1986	392.9				
1987	396.6				
1988	408.4	272	291	0.951	306
1989	414.3				
1990	423.0	247	266	0.956	278
1991	431.0				

RINCON UNIT 119 – PC

year	cum prod mmcf	SIWHP psi	SIBHP psi	z–factor	P/Z
1958	34.2	1081	1100	0.812	1355
1959	82.9	612	631	0.893	707
1960	155.3	550	569	0.903	630
1961	185.2	570	589	0.900	654
1962	235.6	476	495	0.916	540
1963	277.7	516	535	0.909	588
1964	322.2	469	488	0.917	532
1965	370.9	433	452	0.924	489
1966	409.2	424	443	0.925	479
1967	445.1	393	412	0.930	443
1968	492.4	417	436	0.926	471
1969	529.7	324	343	0.942	364
1970	562.5	327	346	0.942	367
1971	597.4	297	316	0.947	334
1972	632.2	308	327	0.945	346
1973	661.6	242	261	0.956	273
1974	694.1	257	276	0.954	289
1975	718.7				
1976	748.8	227	246	0.959	257
1977	775.5				
1978	801.1	198	217	0.964	225
1979	824.9				
1980	846.9	210	229	0.962	238
1981	868.8				
1982	886.7	208	227	0.962	236
1983	898.9				
1984	917.0	226	245	0.959	255
1985	934.4	209	228	0.962	237
1986	939.3				
1987	948.3				
1988	969.8	212	231	0.962	240
1989	978.8				
1990	989.8	167	186	0.969	192

RINCON UNIT 88 – PC

year	cum prod mmcf	SIWHP psi	SIBHP psi	z–factor	P/Z
1957	19.3	1025	1045	0.822	1272
1958	56.0	863	883	0.849	1040
1959	121.0	589	609	0.897	679
1960	161.7	466	486	0.918	530
1961	193.6	413	433	0.927	467
1962	214.6	425	445	0.925	481
1963	238.4	429	449	0.924	486
1964	265.3	425	445	0.925	481
1965	288.8	385	405	0.932	435
1966	313.8	374	394	0.934	422
1967	334.8	363	383	0.935	409
1968	355.5	365	385	0.935	412
1969	375.1	394	414	0.930	445
1970	395.0	330	350	0.941	372
1971	414.4	317	337	0.943	357
1972	433.3	310	330	0.945	349
1973	451.4	282	302	0.949	318
1974	468.1	281	301	0.950	317
1975	484.7				
1976	501.2	264	284	0.952	298
1977	516.9				
1978	532.0	237	257	0.957	269
1979	545.3				
1980	557.0	258	278	0.953	292
1981	566.0				
1982	574.6				
1983	584.3				
1984	593.4	331	351	0.941	373
1985	603.4	295	315	0.947	333
1986	605.2				
1987	610.2				
1988	623.1	296	316	0.947	334
1989	632.9				
1990	645.9	277	297	0.950	313
1991	655.8				

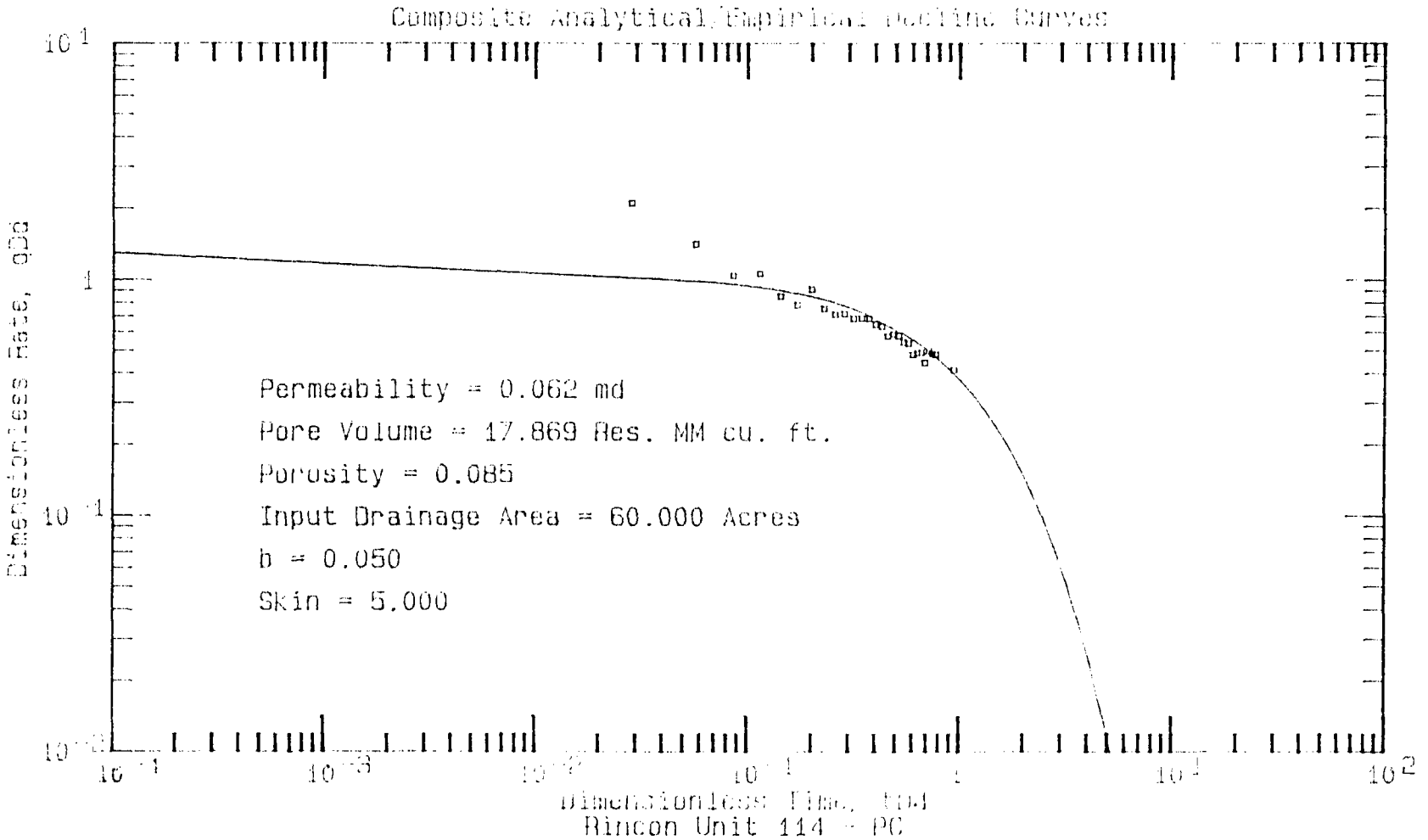
RINCON UNIT 18R & 18 – PC

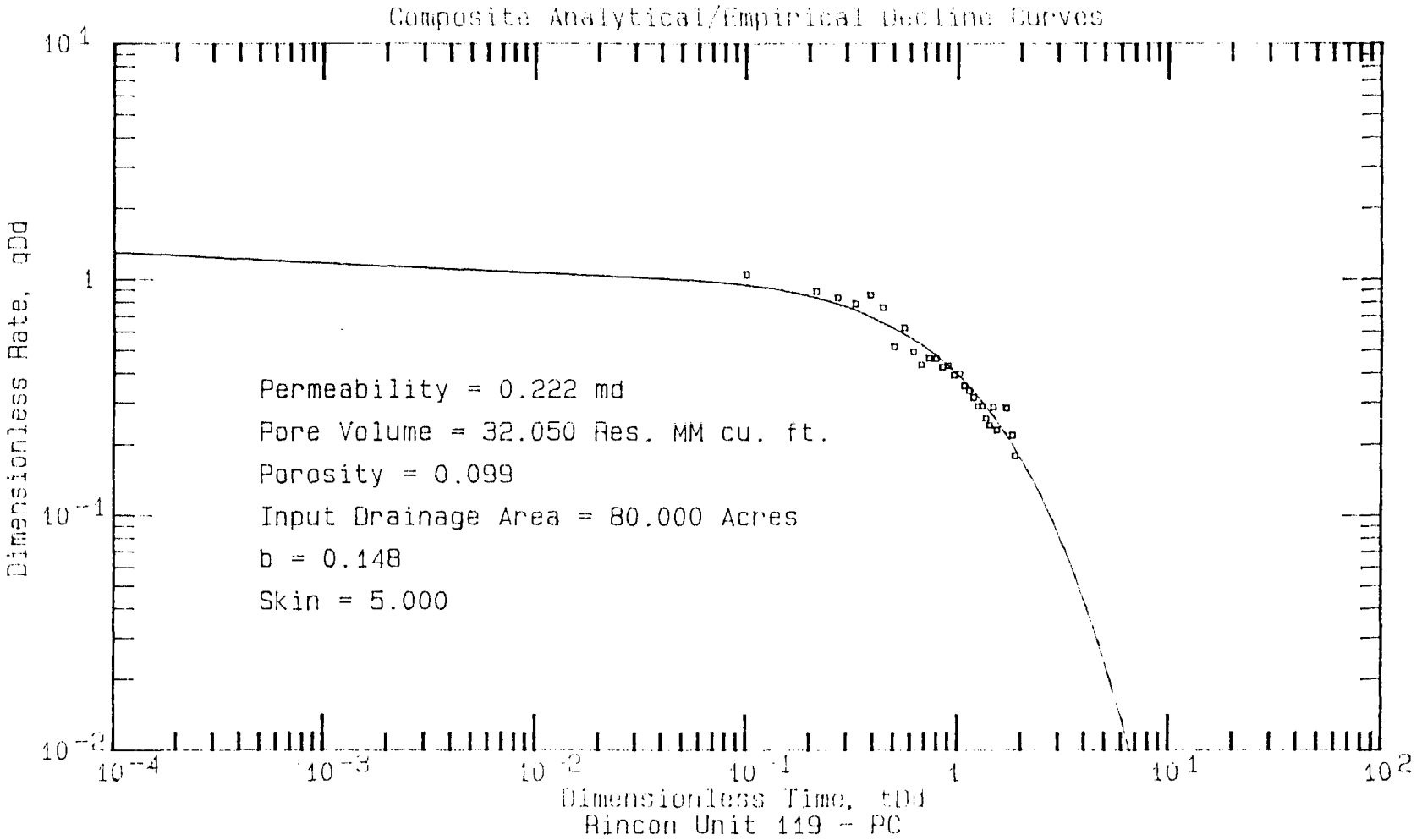
year	cum prod mmcf	SIWHP psi	SIBHP psi	z–factor	P/Z
1954	0	760	778	0.867	897
1954	14.0	534	552	0.906	609
1955	29.1	475	493	0.916	538
1956	34.0	488	506	0.914	553
1957	43.5	484	502	0.915	549
1958	53.3	468	486	0.918	530
1959	62.5	456	474	0.920	515
1960	70.5	463	481	0.919	524
1961	78.4	401	419	0.929	451
1962	86.1	460	478	0.919	520
1963	94.1	465	483	0.918	526
1964	102.3	456	474	0.920	515
1965	109.9	409	427	0.928	460
1966	117.7	409	427	0.928	460
1967	124.7	434	452	0.924	489
1968	132.1	428	446	0.925	482
1969	139.2				
1970	146.4	381	399	0.933	428
1971	152.7	284	302	0.949	318
1972	156.3	184	202	0.967	209
1973	157.3				
1981	157.3	744	762	0.870	876
1981	222.2	279	297	0.950	313
1982	262.2	293	311	0.948	328
1983	302.3	306	324	0.946	343
1984	332.9	302	320	0.946	338
1985	357.5	294	312	0.948	329
1986	377.7				
1987	391.1				
1988	422.0	292	310	0.948	327
1989	440.1				
1990	458.0	382	400	0.932	429
1991	482.2				

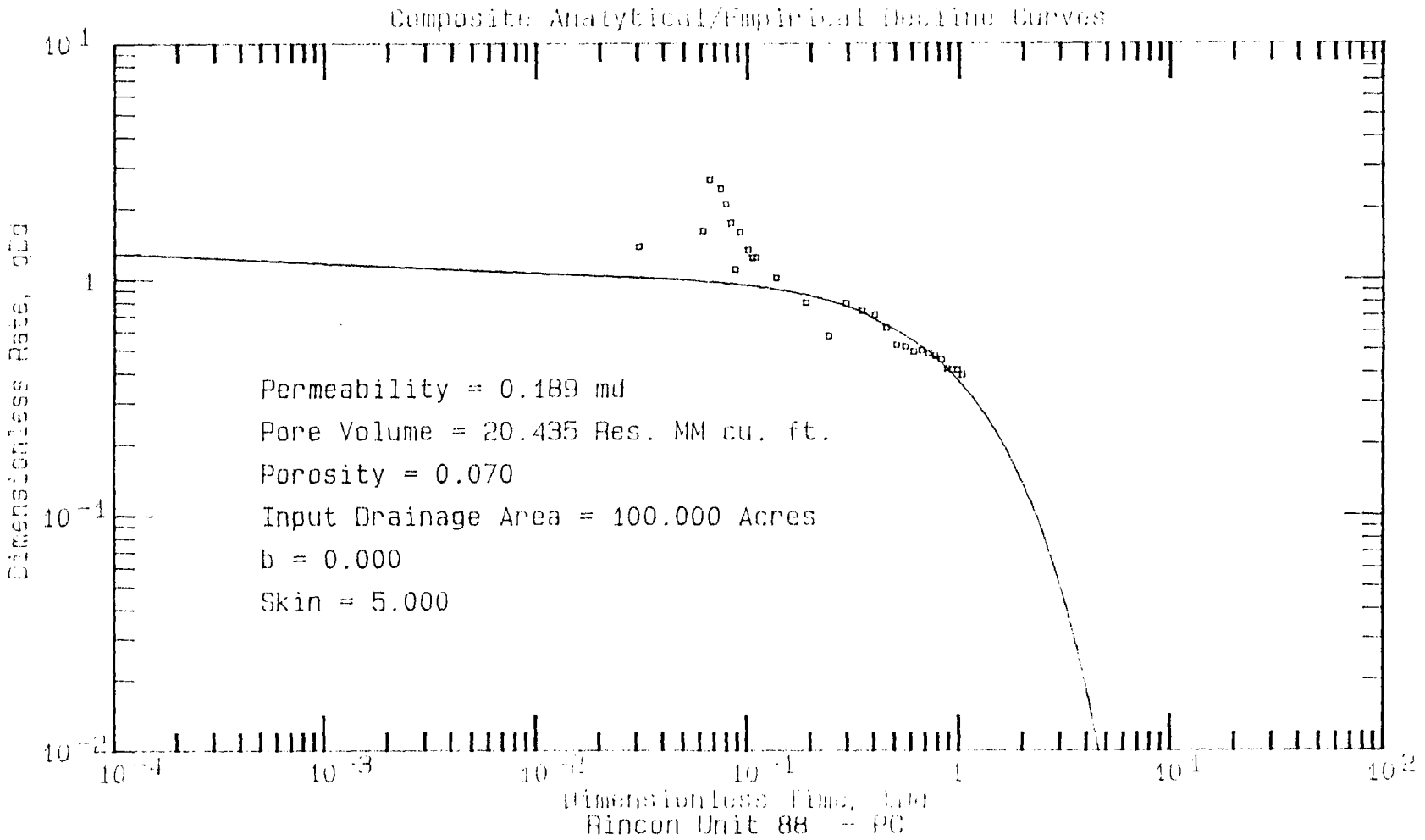
Data Sheet

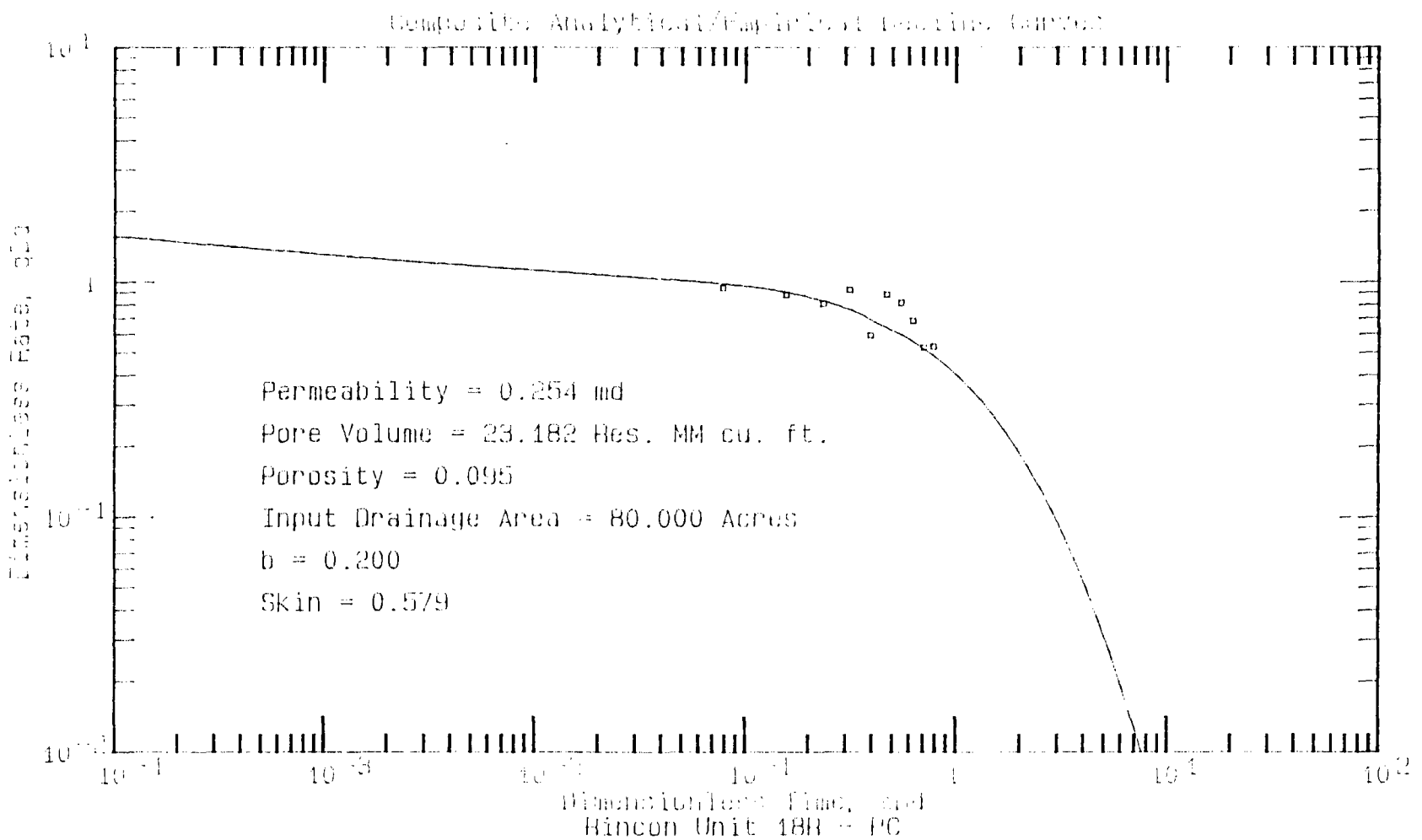
parameter	abbrev.	units	source	18 + 18R	88	114	119
wellbore radius	rw	ft	wellfile	0.229	0.229	0.229	0.229
flowing bottomhole press	Pwfs	psi	buildup	173	274	172	145
initial gas formation volume factor	Bg	scf/ft^3	calc	44.8	44.8	32.3	56.3
initial gas viscosity		cp	calc	0.0114	0.0118	0.0122	0.0119
initial compressibility	cg	psia−1	calc	0.00128	0.00096	0.00088	0.00091
initial pressure	Pi	psi	deliver. test	778	1045	1131	1100
reservoir temperature	TR	R	buildup	566	569	566	560
pay thickness	h	ft	log	70.0	67.5	80.0	92.5
porosity			log	0.11	0.11	0.11	0.11
drainage area	A	acres	assumed				
connate water saturation	Swc		study	0.44	0.44	0.44	0.44
gas specific gravity			gas analysis	0.65	0.68	0.67	0.7
critical pressure	Pc	psia	calc	669	667	668	666
critical temperature	Tc	R	calc	375	385	380	393
gas permeability	kg	md	buildup				0.5
skin	S		buildup				−4.57
gas gradient		psi/ft	buildup	0.006	0.006	0.006	0.006
stabilized flow rate	Q	mcfd	prod data	118.0	40.8	31.1	61.3

date of completion	wellfile	Jan 1981	June 1957	April 1958	June 1958
completion	wellfile	1 1/4" tbg,pkr below, chacra	1 1/2" tbg,pkr to isolate MV	1 1/4" tbg, no pkr	1 1/4" tbg, no pkr
stimulation: size	wellfile	swf 57 x 67	swf 27x40	swf 30x30	swf 35X35
rate		32 bpm	81 bpm	52 bpm	59 bpm
ISIP		700	N/A	N/A	N/A


Composite Analytical/Empirical Decline Curves
Dimensionless Rate, qDd
Permeability = 0.062 md
Pore Volume = 17.869 Res. MM cu. ft.
Porosity = 0.085
Input Drainage Area = 60.000 Acres
h = 0.050
Skin = 5.000
Dimensionless Time, tDd
Rincon Unit 114 - PC

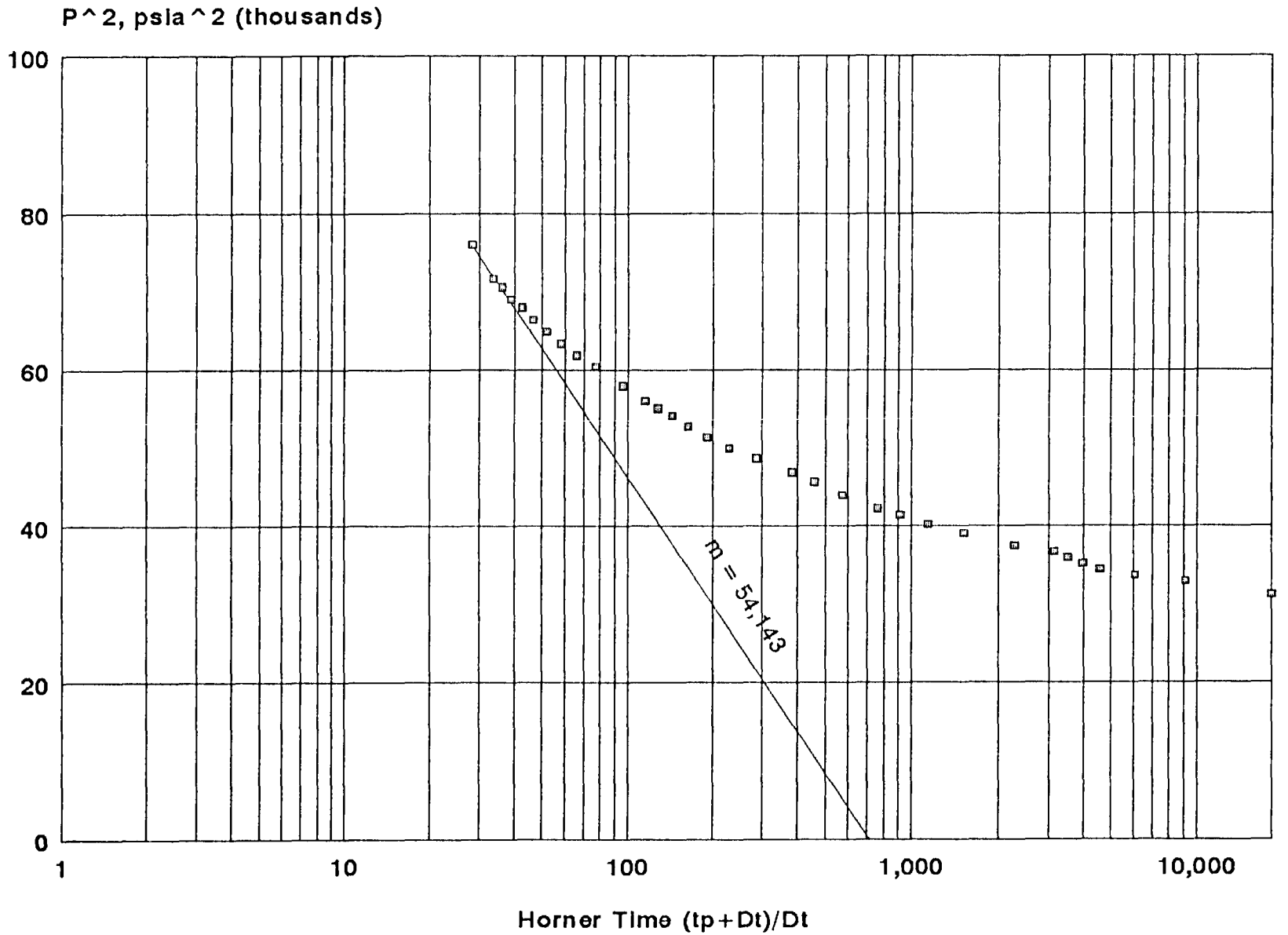

Composite Analytical/Empirical Decline Curves
Dimensionless Rate, qDd
Dimensionless Time, tDd
Permeability = 0.222 md
Pore Volume = 32.050 Res. MM cu. ft.
Porosity = 0.099
Input Drainage Area = 80.000 Acres
b = 0.148
Skin = 5.000
Rincon Unit 119 - PC


Composite Analytical/Empirical Declining Curves
Dimensionless Rate, qDa
Permeability = 0.189 md
Pore Volume = 20.435 Res. MM cu. ft.
Porosity = 0.070
Input Drainage Area = 100.000 Acres
b = 0.000
Skin = 5.000
Dimensionless Time, tDa
Rincon Unit 88 - PC


Permeability = 0.254 md
Pore Volume = 23.182 Res. MM cu. ft.
Porosity = 0.095
Input Drainage Area = 80.000 Acres
b = 0.200
Skin = 0.579
Rincon Unit 188 - PC

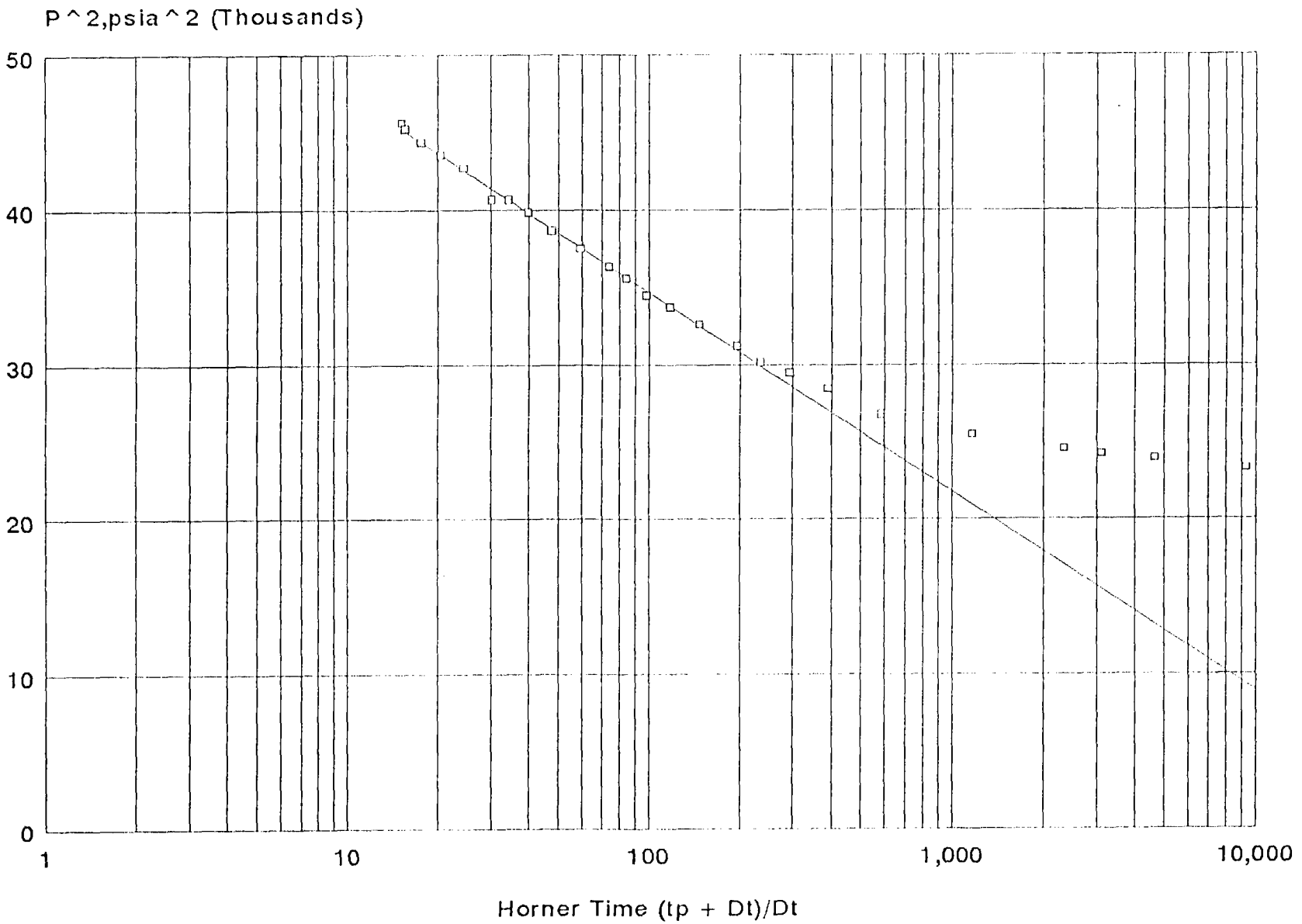
Horner Plot

Rincon Unit #114



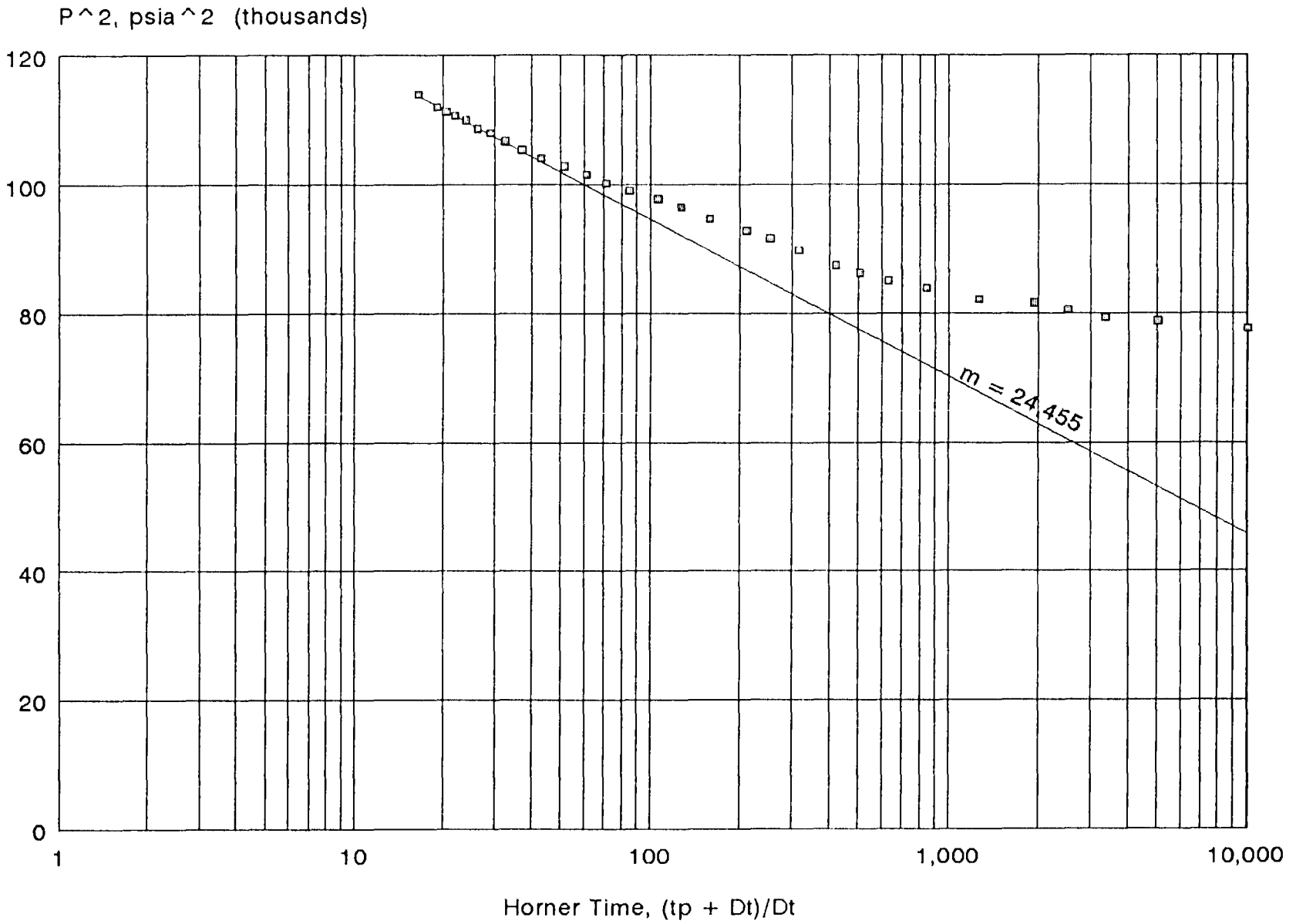
Horner Plot

Rincon Unit #119



Horner Plot

Rincon Unit #88



Horner Plot

Rincon Unit #18R