3-19-21

TORP

Post-it® Fax Note 7671	Date 4/1/97 # of pages ▸
To Tim Carr	From Rodney Reynolds
Co./Dept. KGS	Co. TORP
~~Phone #~~ cc: Paul G + Saibal	Phone # 4-4491
Fax # 4-5317	Fax # 4-4967

Memo

To: Paul Willhite
Don Green
Shapour Vossoughi

From: Rodney Reynolds

CC: Tim Carr
Paul Gerlach
Saibal Bhattacharya

Date: April 1, 1997

Re: Wellbore flowing pressures in the Schaben Field

I am in receipt of a copy of the recent fluid level data acquired by Ritchie Exploration on the wells they operate in the Schaben Field. From my experience as a production engineer, I am familiar with how this data is acquired, the instruments used to acquire this data, the accuracy limitations associated with these instruments, and how to interpret the data. My evaluation of the data indicates that of the 23 wells on which data was received, 15 of the wells are operating in a pumped off condition. This is the general practice of the oil industry, especially when dealing with marginal production. However, occasionally situations dictate that backpressure be held against the formation in wells that have high productivity, produce excessive amounts of water, to assist in reducing lifting costs, or in some instances may assist in maintaining some percentage in oil cut. I also spoke with Danny Biggs (production superintendent) and Jack Gurley (petroleum engineer) for Pickrell Drilling Company, concerning fluid levels on their wells. They indicated that they have not recently shot fluid levels, but in general they try to pump the wells off, however they have a few large water producers they cannot pump off. They said its time to shoot fluid levels and they will supply a copy of the results to me.

I have also compared the recently acquired fluid level data to the fluid level information acquired from the historic information contained in the well files, on which TORP based the model and simulation. The recent data correlates with the data we used, with 2 exceptions. The recent data indicates the Moore B-6 is carrying approx. 200' fluid above the perforations and the well files indicated it to be pumped off and the Moore D-4 which Ritchie field personnel indicated to me had "a lot of fluid in the hole" and the recent data indicates it is pumped off.

04/01/97 16:20 TX/RX NO.5798 P.001

PTS Laboratories, Inc.

Kansas Geological Survey
File No.: 21397

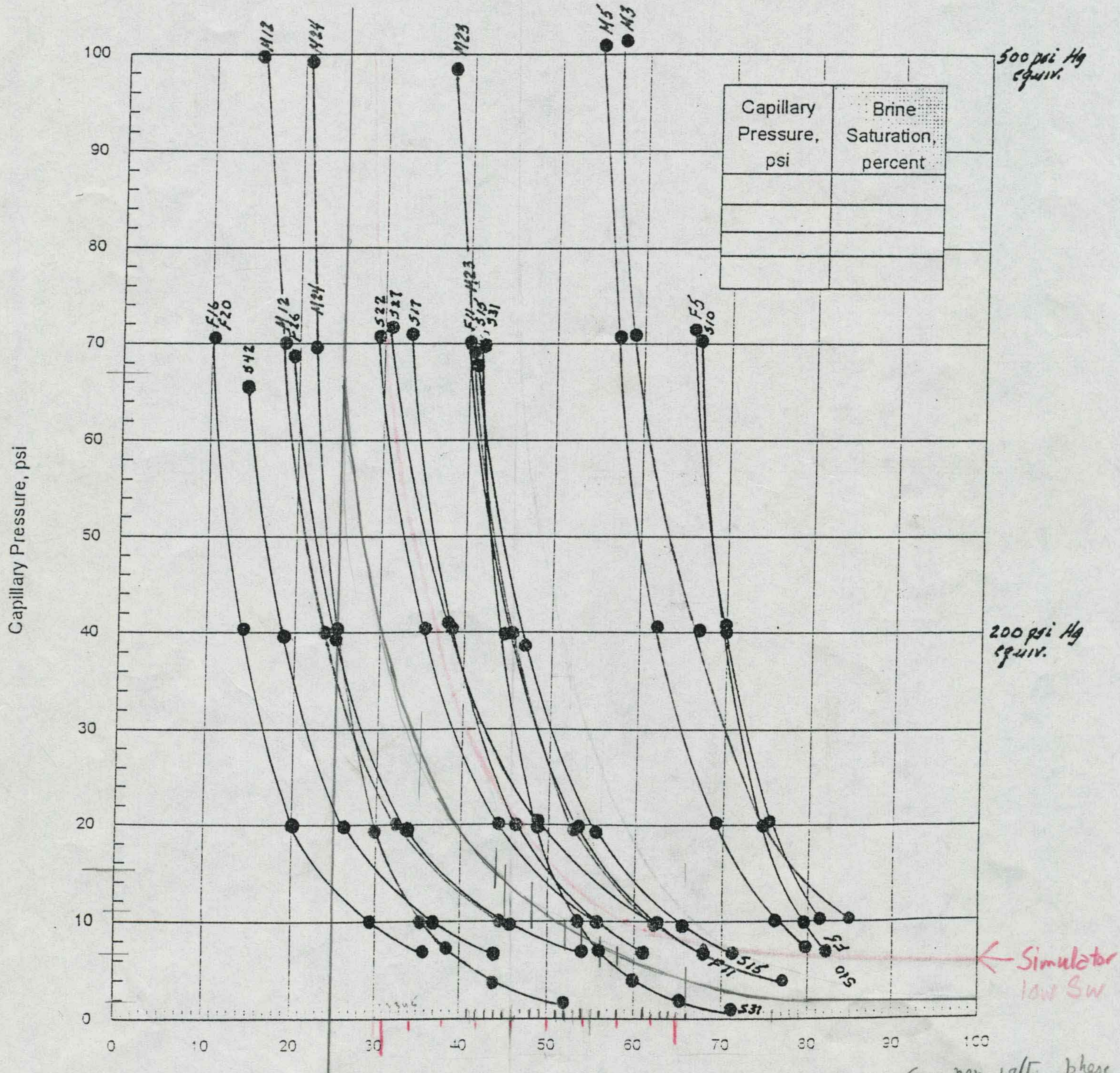
CENTRIFUGE CAPILLARY PRESSURE

Air Displacing Brine System
Ambient Conditions

$Pc(lab) = .3608\ Pc(ab)$

Well: Ritchie
Field: Schaben
Location: Ness County, Kansas

Sample ID:
Depth, ft.:
Permeability to Air, md:
Porosity, percent:



← non wetting phase increasing sat.

S 2 SCHABEN
F 1 FOOS
M 4 MOORE

15-135

30-19-21
25-19-22

Name	Interval		Vis.	Oil gr.	B= FVF	K	Phi	C	Skin	Final pr.	Temp	Water Sp gr.	Chlorides	Sulfates	Calcium	Magnesium	Kh/Vis.	Total dissolved solids
	To	From	cp			md		vol/vol/psi*10^6			F							
Moore B5	4395	4405	3		1.2		0.15	10	6.87	1375	118							
15-135-30062	4385	4395	3		1.2	30	0.15	10	5.41	1382	118							
Moore B1	4430	4440										1.029	25800	2500	2140	300 =		= 30740
15-135-29344	4313	4325		39 @ 60							119							
	4380	4396									116							
	4330	4396									116							
	4396	4410	2.5	42.6	1.2	115	0.15	12	-3.96	665	120							
	4410	4420	2.5		1.2	13.65	0.15	10	2.02	1397	119							
	4420	4430	2.5		1.2	87	0.15	12	-2.91	1413	120							
	4430	4440									118							
Moore B4	4402	4412	3		1.2	11.45	0.15	10	0.353	1273	118							
15-135	4412	4422	3		1.2	216	0.15	10	20.8	1377	120							
30042	4393	4402									118							
Moore B6	4415	4427									112							
15-135	4427	4437									112							
19004	4437	4447		39 @ 60							118							
Moore C2	Prod. Int			38														
19003	4304	4319									110							
Moore C3	DST 7																21.75	
21024	DST 6					3.45											9.19	
Moore D1	4392		28 @ 77F										25000					25000
30047	4366	4383	3		1.2	1.17	0.15	10	0.727	1405	100							
	4383	4398	3	40.5-60	1.2	28	0.17	10	2.49	1377	100							
	4398	4410	3		1.2	13.8	0.13	10	3.195	1407	100							
Moore D2	4365	4386	2.5		1.2			10	0.5	1340	116							
30023	4386	4393									118							
Moore D3	4400	4410									119							
30030	4381	4388									118							
	4388	4400	3		1.15	21.1	0.15	10	8.08	1383	119							
	4400	4410	3		1.15	100	0.15	10	11.65	1372	119							
Moore D4	4408	4418									112							
	4418	4428		36							112							
	4428	4436		38							112							
Foos A2	4409	4414		36 @ 60							115	1.035	29200	3250	2000	250		
30025	4401	4409									115							
Humburg A2												1.04	29201	5000	1222	793		
19015	4391	4401	3		1.2	17.3	0.15	10	0.695	1370	110							
	4401	4411	3		1.2	20.4	0.15	10		1275	112							
	4295	4310									110							
Borger A1	4405	4422		38 @ 60							115							
19012	4308	4323									115							
Borger A2	4398	4410	3		1.2		0.15	10	0.435	1389								
30004	4389	4398	3		1.2	9.6	0.15	10	1.7	1456	100							
	4369	4378									100							

avg.
1.035

PTS Laboratories, Inc

Kansas Geological Survey
File No.: 21397

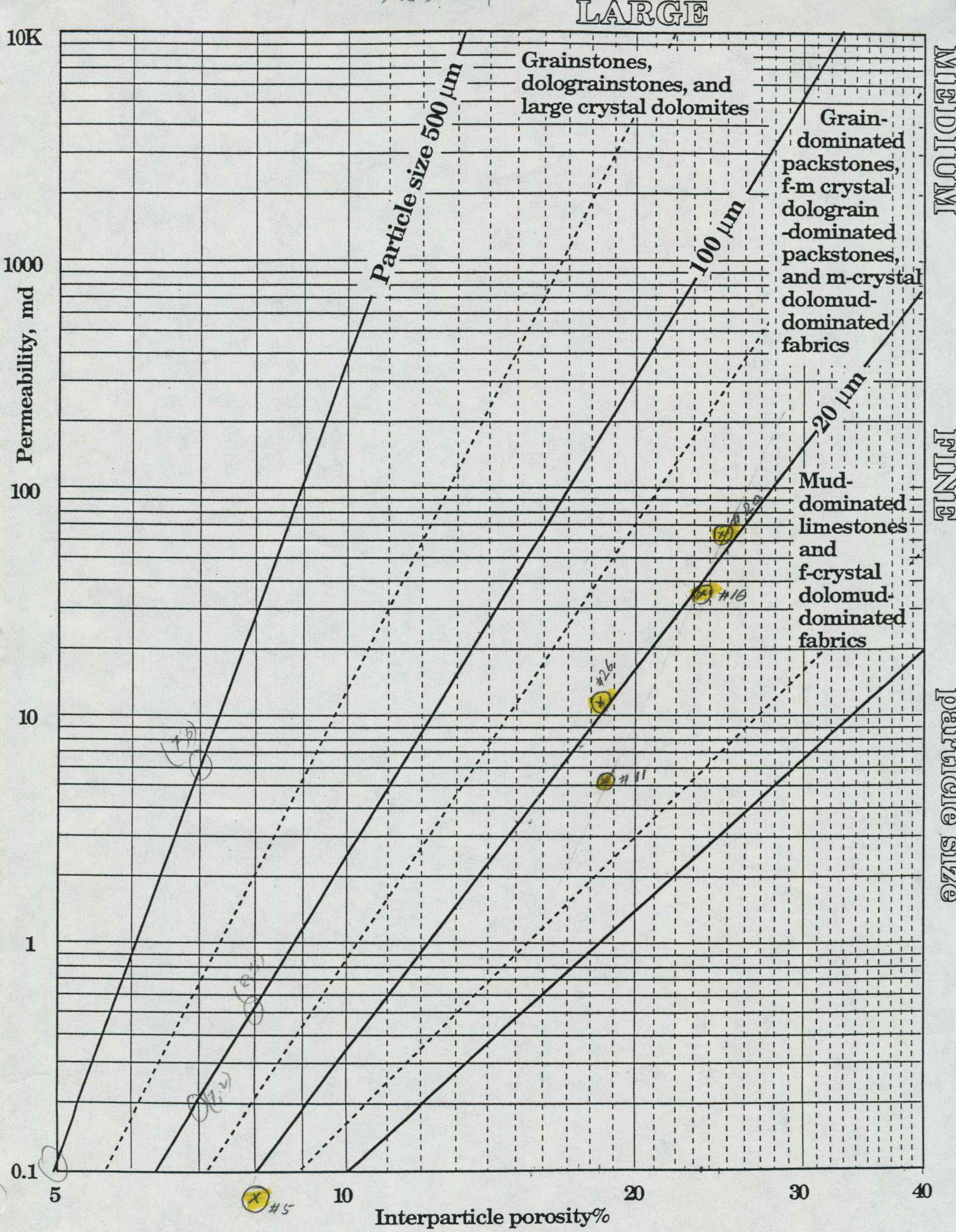
15-135-23898
31-19-21W

NMR DATA SUMMARY

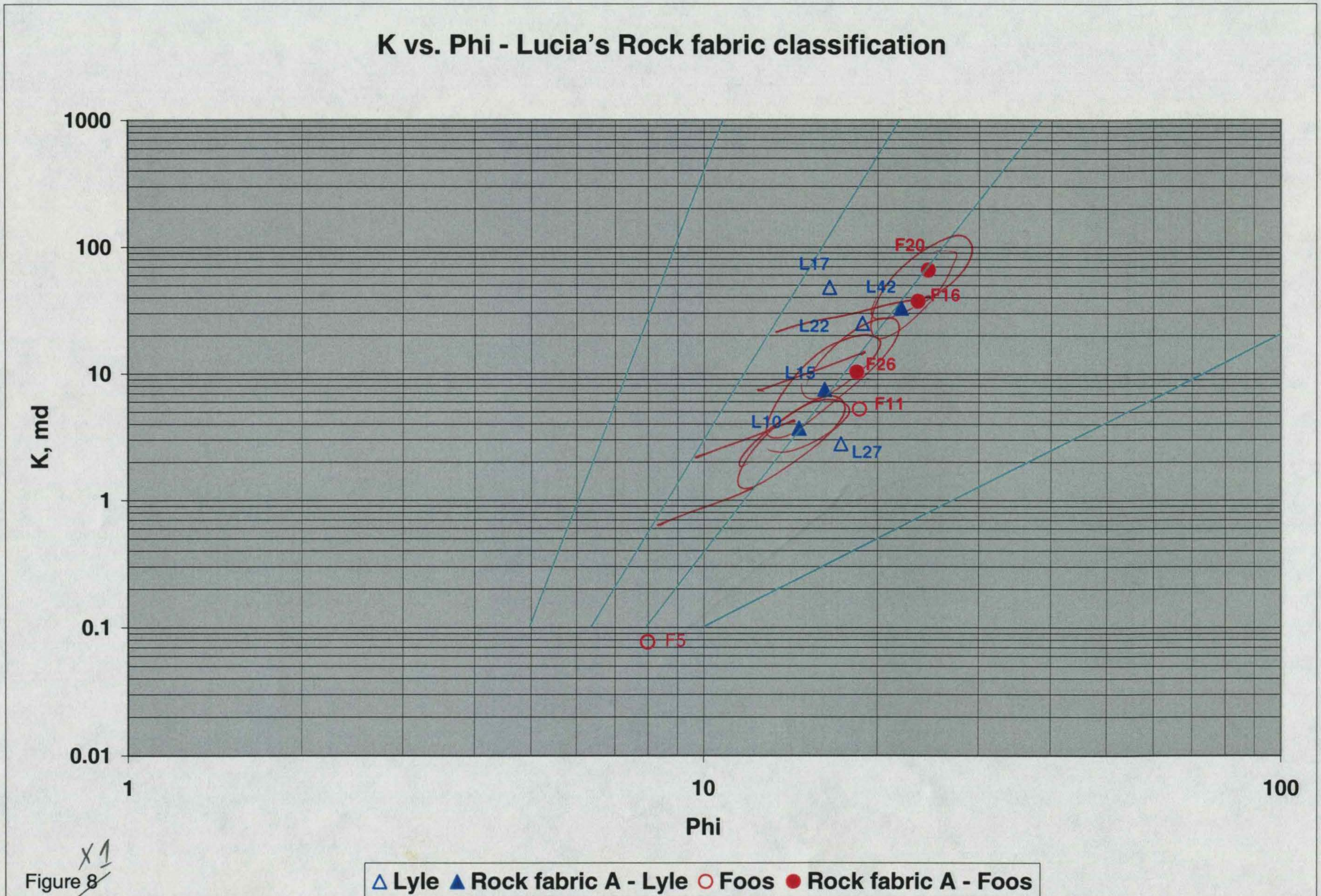
Well: Ritchie 1 Foos AP Twin

100 % Saturated Sample Data					
Sample ID	**5**	**11**	**16**	**20**	**26**
Regularized Fluid Filled Porosity, %	8.05	18.51	22.86	23.67	18.54
MRIL Fluid Filled Porosity, %	7.09	18.65	22.69	23.47	18.49
"Free" Water Saturation, % Vp	46.8	61.9	86.7	83.6	79.2
"Free" Average $T_{2,}$ ms	212.6	231.	176.2	190.4	169.63
"Bound" Water Saturation, %Vp	53.2	38.1	13.3	16.4	20.8
"Bound" Average $T_{2,}$ ms	14.64	22.44	18.46	19.15	17.2
Calculated Permeability, md	.2	32.	1119.00	794.	170.
Desaturated Sample Data (Original)(70 psi)					
Regularized Fluid Filled Porosity, %	5.51	8.99	4.89	5.83	6.80
MRIL Fluid Filled Porosity, %	5.30	9.21	4.95	5.88	6.68
"Free" Water Saturation, % Vp	41.10	71.80	63.20	66.50	69.20
"Free" Average $T_{2,}$ ms	50.01	49.24	36.88	32.06	39.80
"Bound" Water Saturation, %Vp	59.10	28.20	36.80	33.50	30.80
"Bound" Average $T_{2,}$ ms	5.99	8.55	7.13	6.91	7.58
Desaturated Sample Data (100 psi)					
Regularized Fluid Filled Porosity, %	6.66	8.79	3.55	4.92	5.32
MRIL Fluid Filled Porosity, %	6.13	8.88	3.55	4.87	5.37
"Free" Water Saturation, % Vp	40.13	64.41	44.51	47.02	53.80
"Free" Average $T_{2,}$ ms	97.46	47.85	36.50	31.18	31.89
"Bound" Water Saturation, %Vp	59.87	35.59	55.49	52.98	46.20
"Bound" Average $T_{2,}$ ms	8.23	8.12	6.49	6.67	6.90
Desaturated Sample Data (1000 psi)					
Regularized Fluid Filled Porosity, %	4.61	5.61	2.09	3.00	2.72
MRIL Fluid Filled Porosity, %	4.31	5.59	1.92	2.89	2.59
"Free" Water Saturation, %	34.10	49.00	16.67	19.38	15.40
"Free" Average $T_{2,}$ ms	55.06	40.79	70.92	44.46	59.54
"Bound" Water Saturation, %	65.90	51.00	83.33	80.62	84.60
"Bound" Average $T_{2,}$ ms	5.55	6.95	5.79	5.48	5.66

Foos AP Twin (Alan's data).

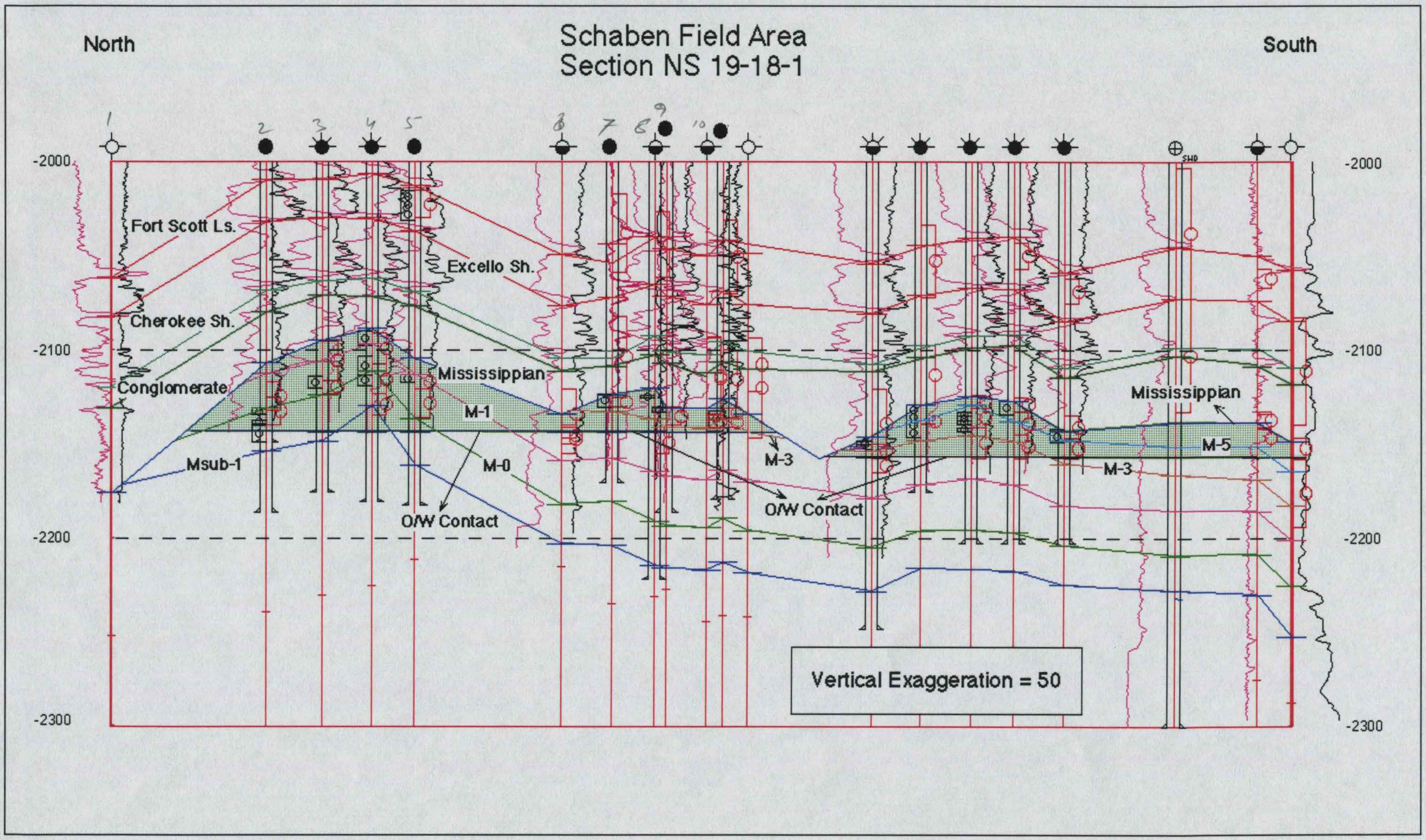


Lucia (1983, 1995) non-vuggy carbonate classification of porosity-permeability fields by particle size class. Sloping dashed lines are RMA fits for each class.

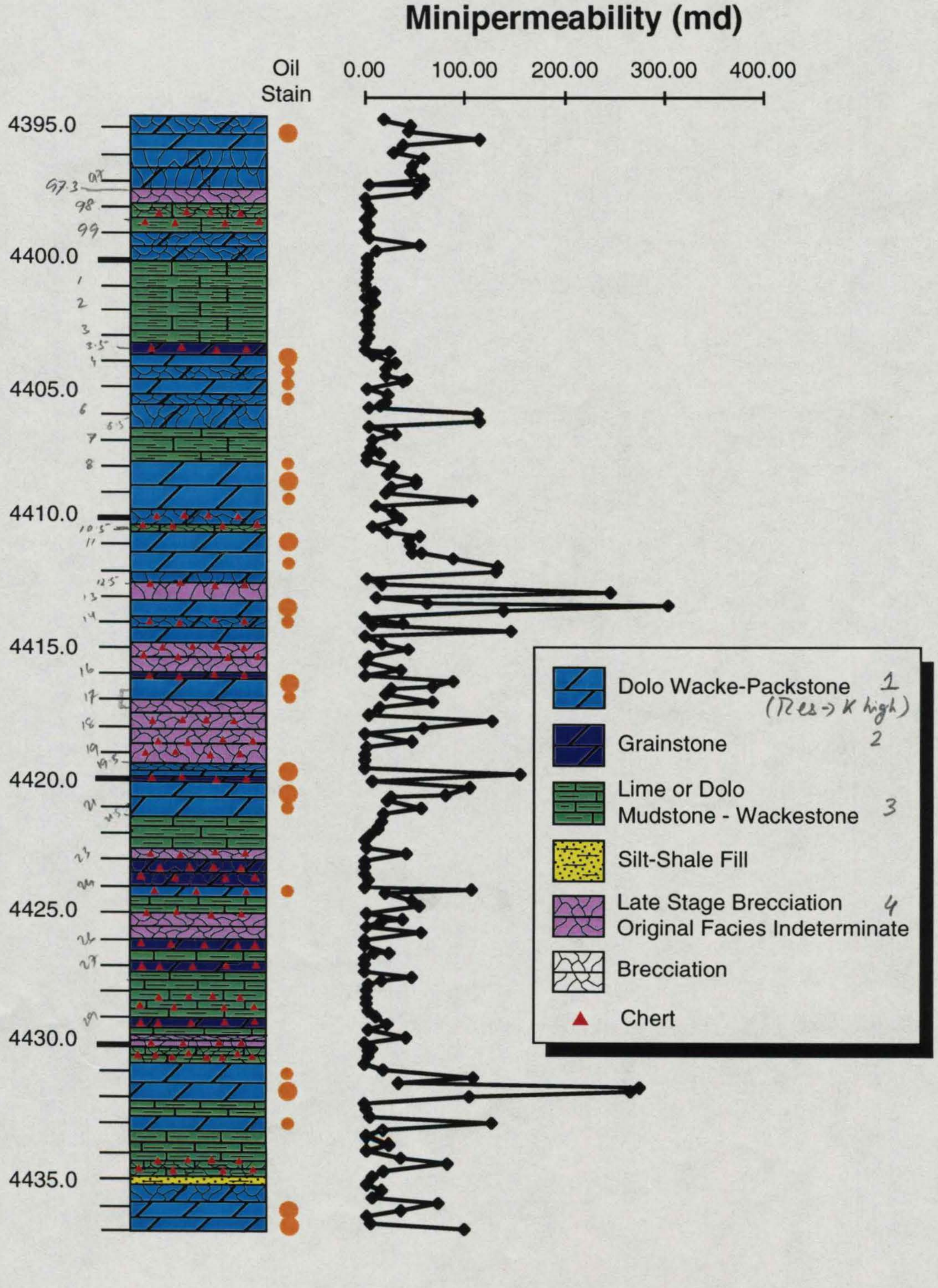

K vs. Phi - Lucia's Rock fabric classification
1000
100
10
1
0.1
0.01
K, md
1
10
100
Phi
F20
L17
L42
F16
L22
F26
L15
F11
L10
L27
F5
△ Lyle ▲ Rock fabric A - Lyle ○ Foos ● Rock fabric A - Foos

X 1
Figure ~~8~~

Through Foos AP Twin

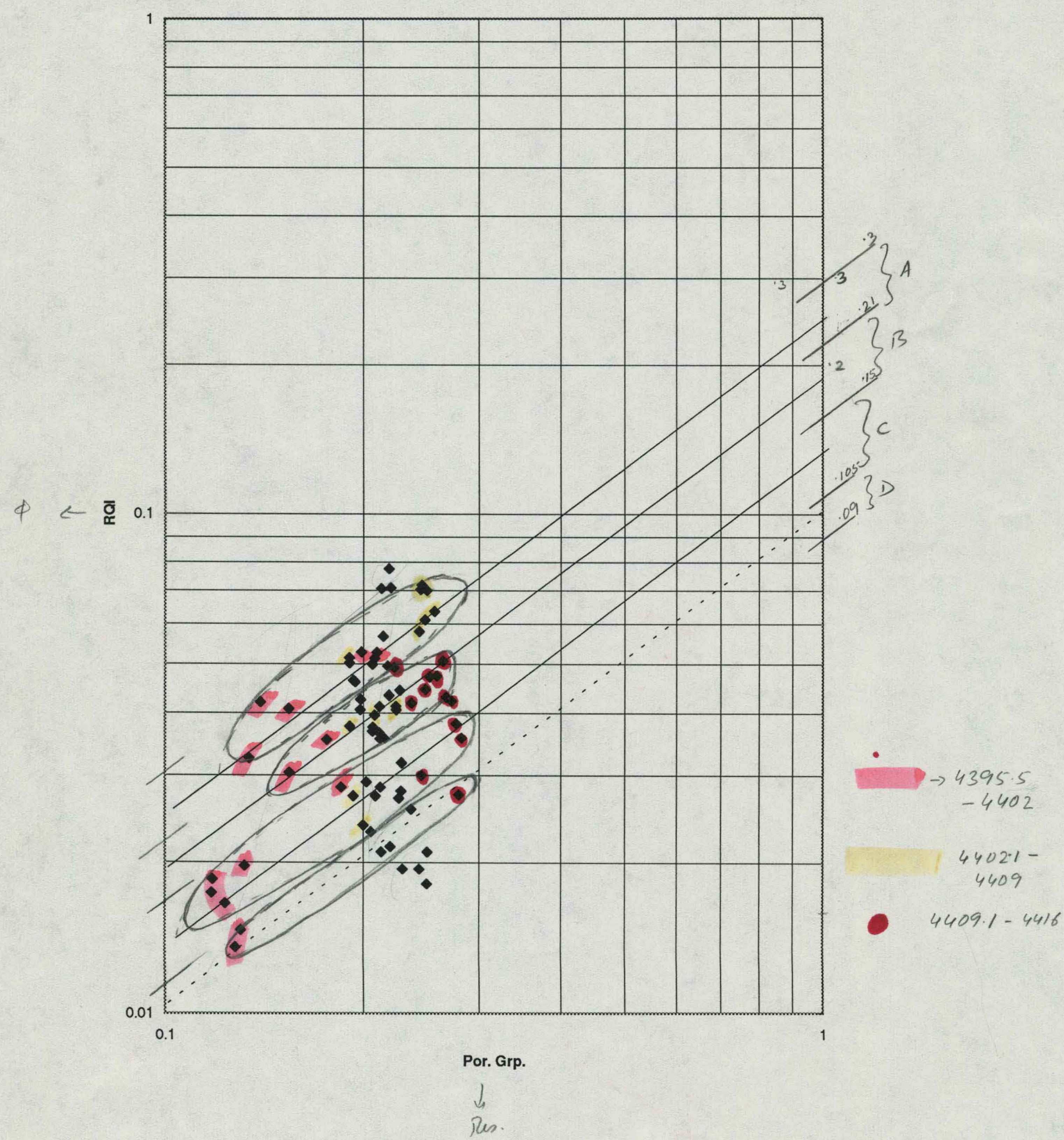


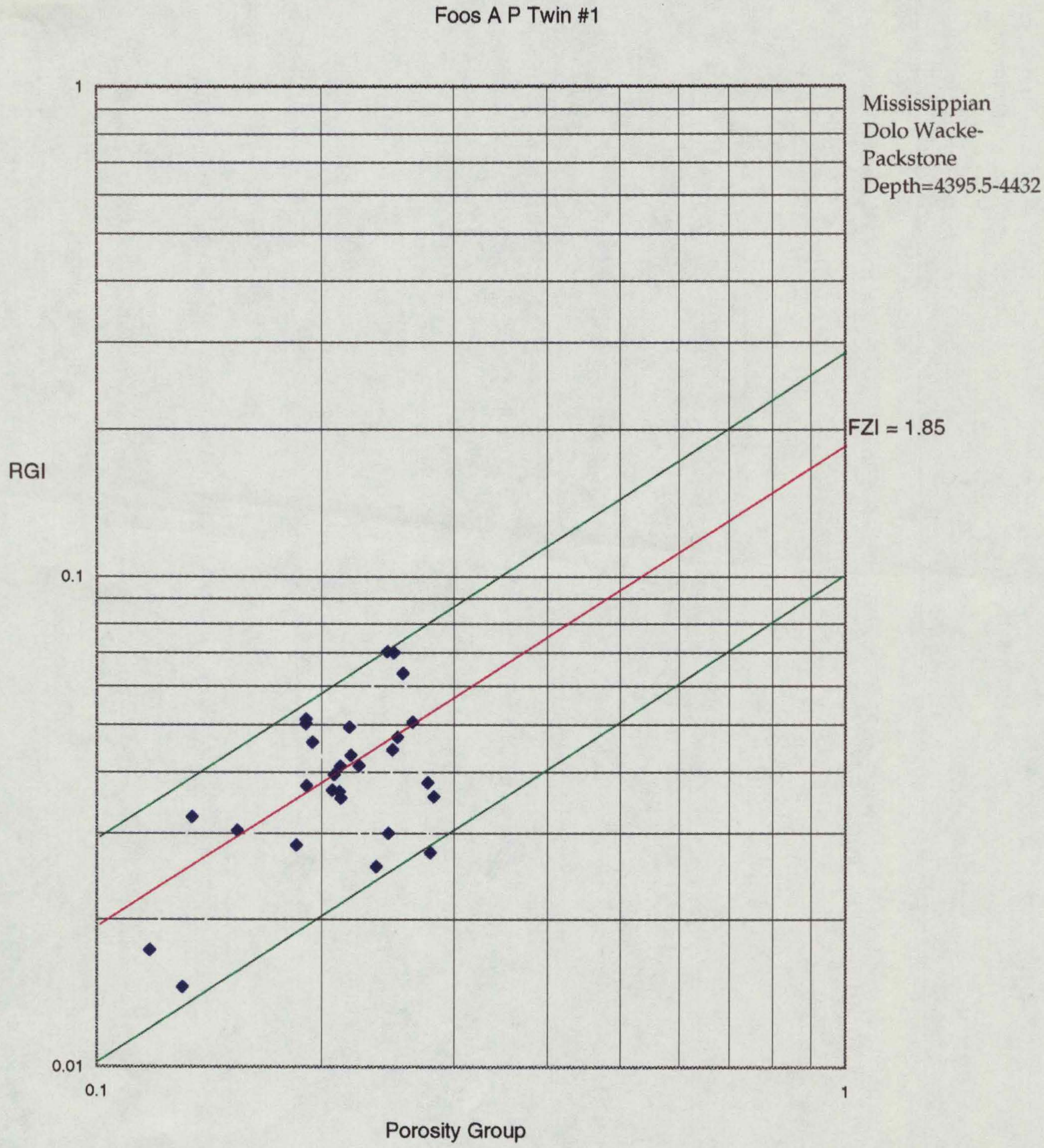
Ritchie Exploration1 Foos "A-P" Twin
NE SW SW Sec. 31-T19S-R21W
Ness County, Kansas

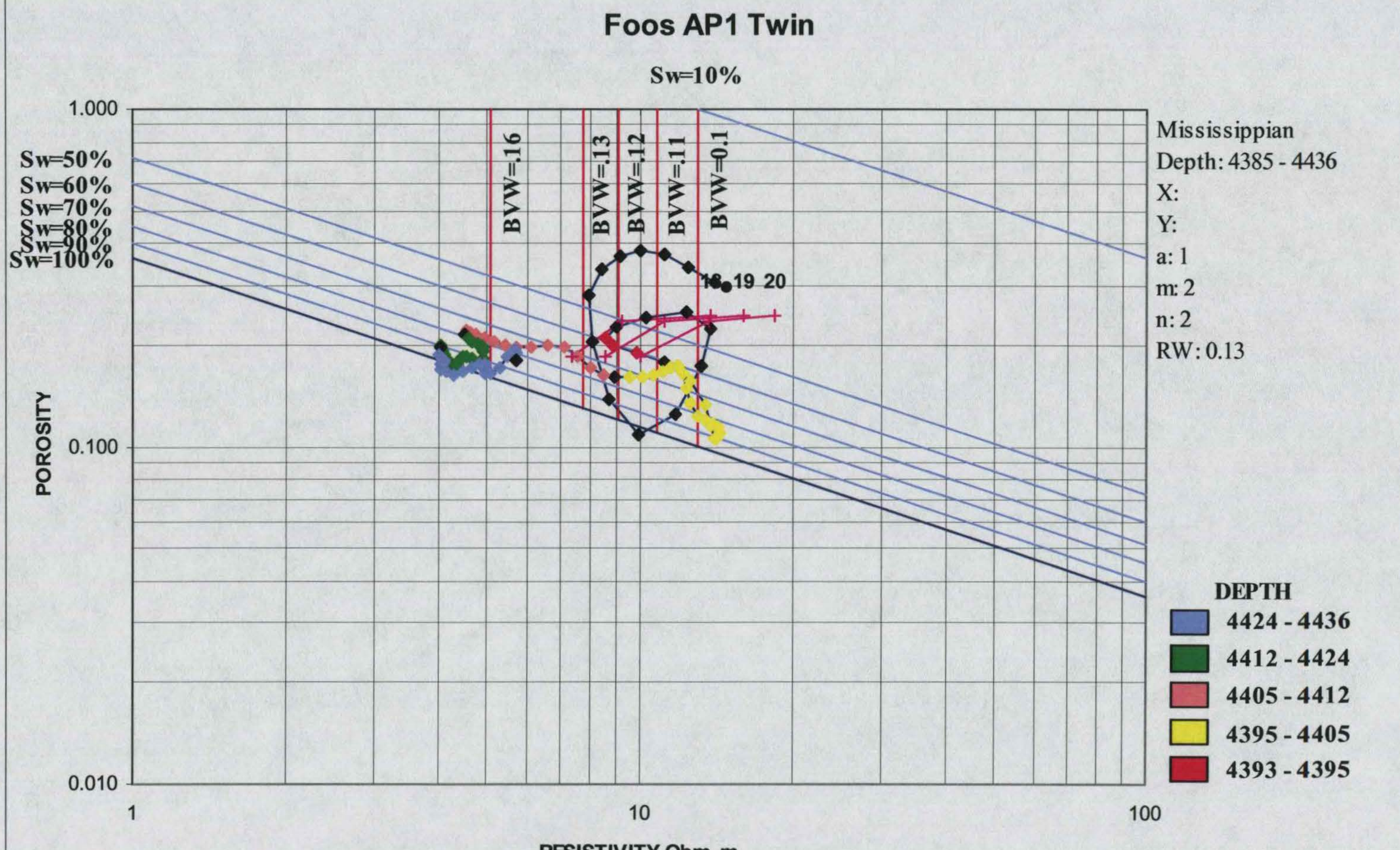


RQI vs. Por. Grp

Foos A P #1 Twin




Foos A P Twin #1
1
0.1
0.01
RGI
0.1
1
Porosity Group
Mississippian
Dolo Wacke-
Packstone
Depth=4395.5-4432
FZI = 1.85



DST 4412-24: 160' VSOCMW, 2000' VSOCW. Perf 4394-95: Acid, 9 bopd, 253 bwpd. Alan's Cap Pr data: Plugs #26, #16, #20. Perf is about 19 feet above OWC.

Figure 8

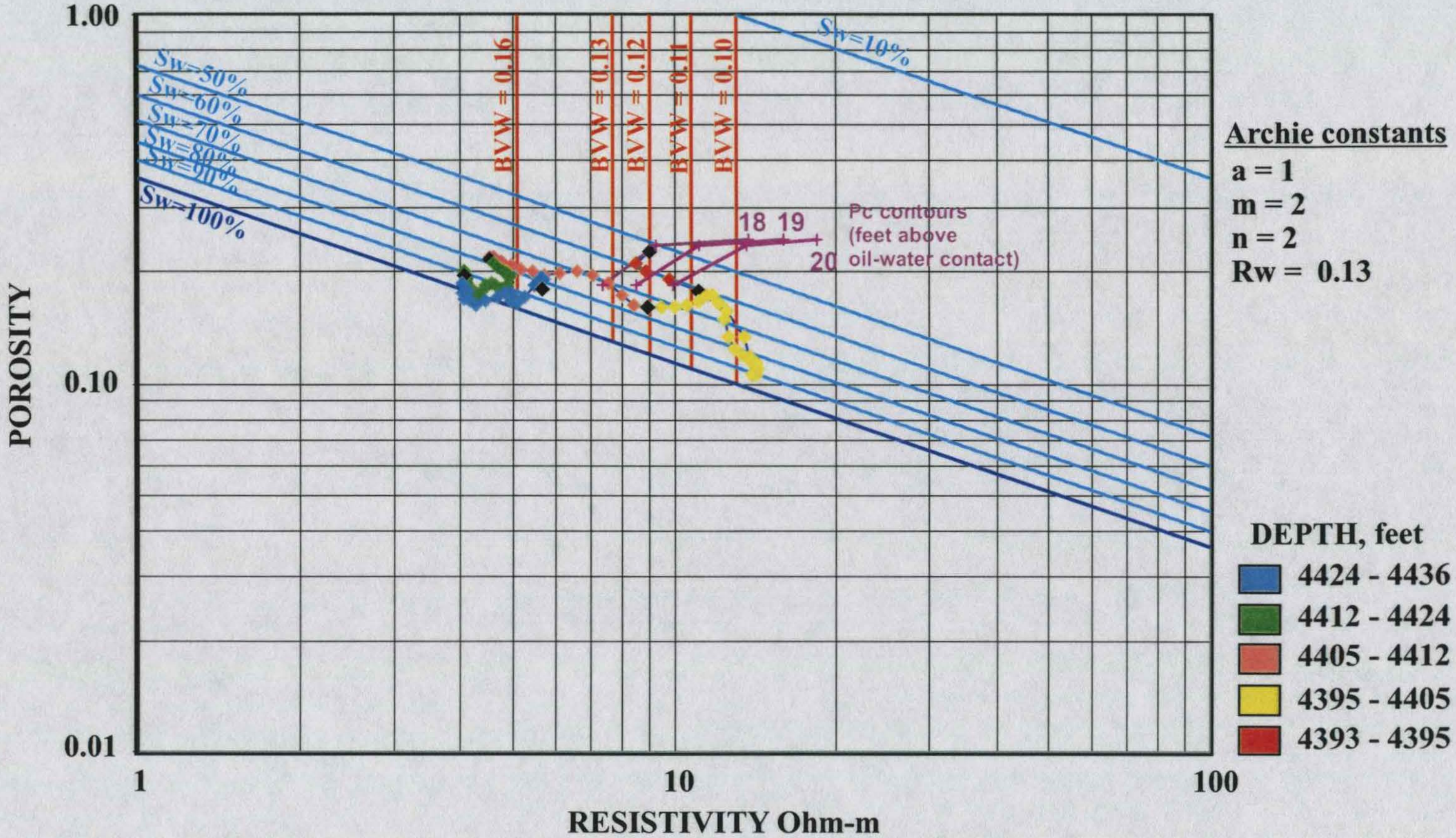
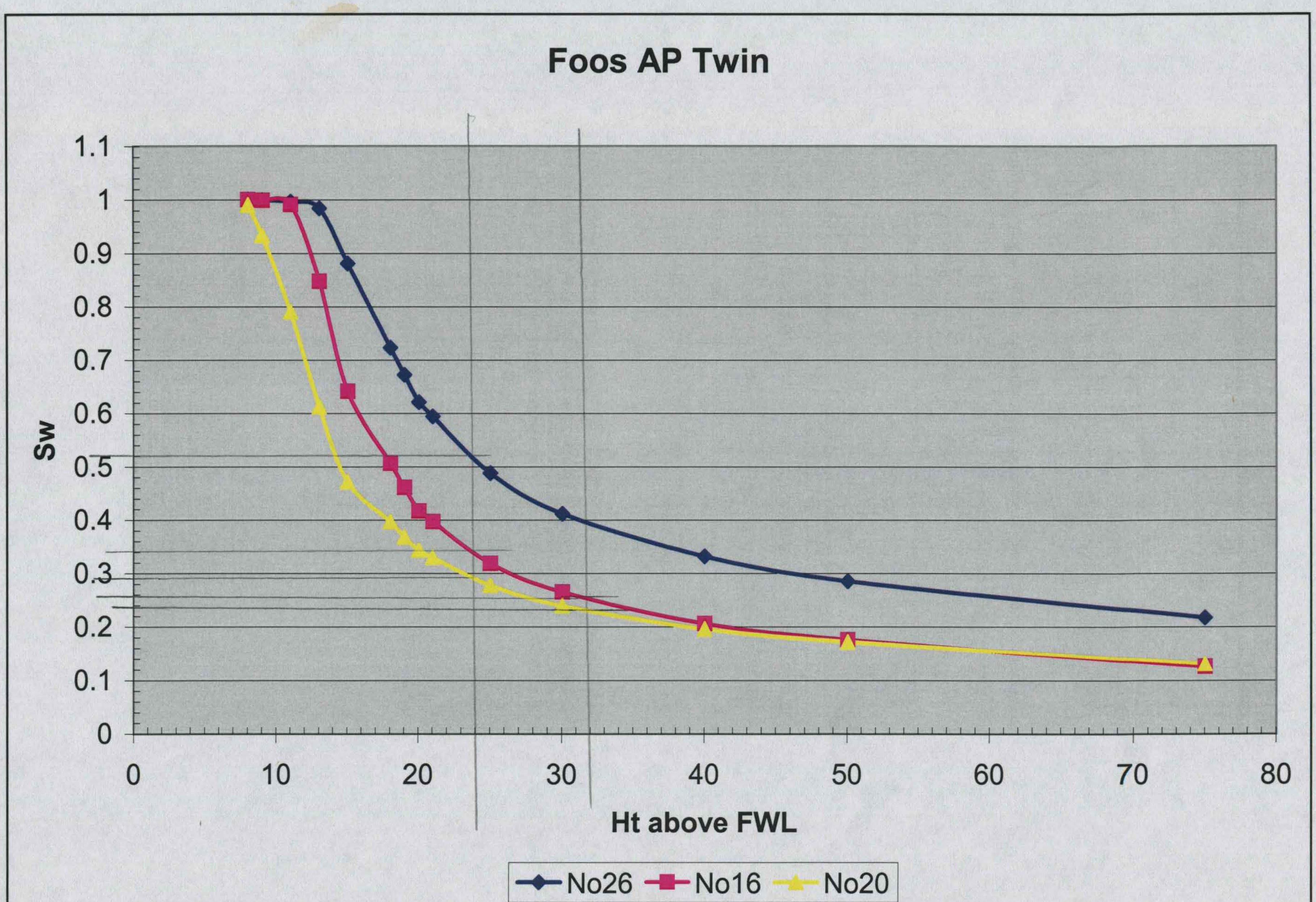
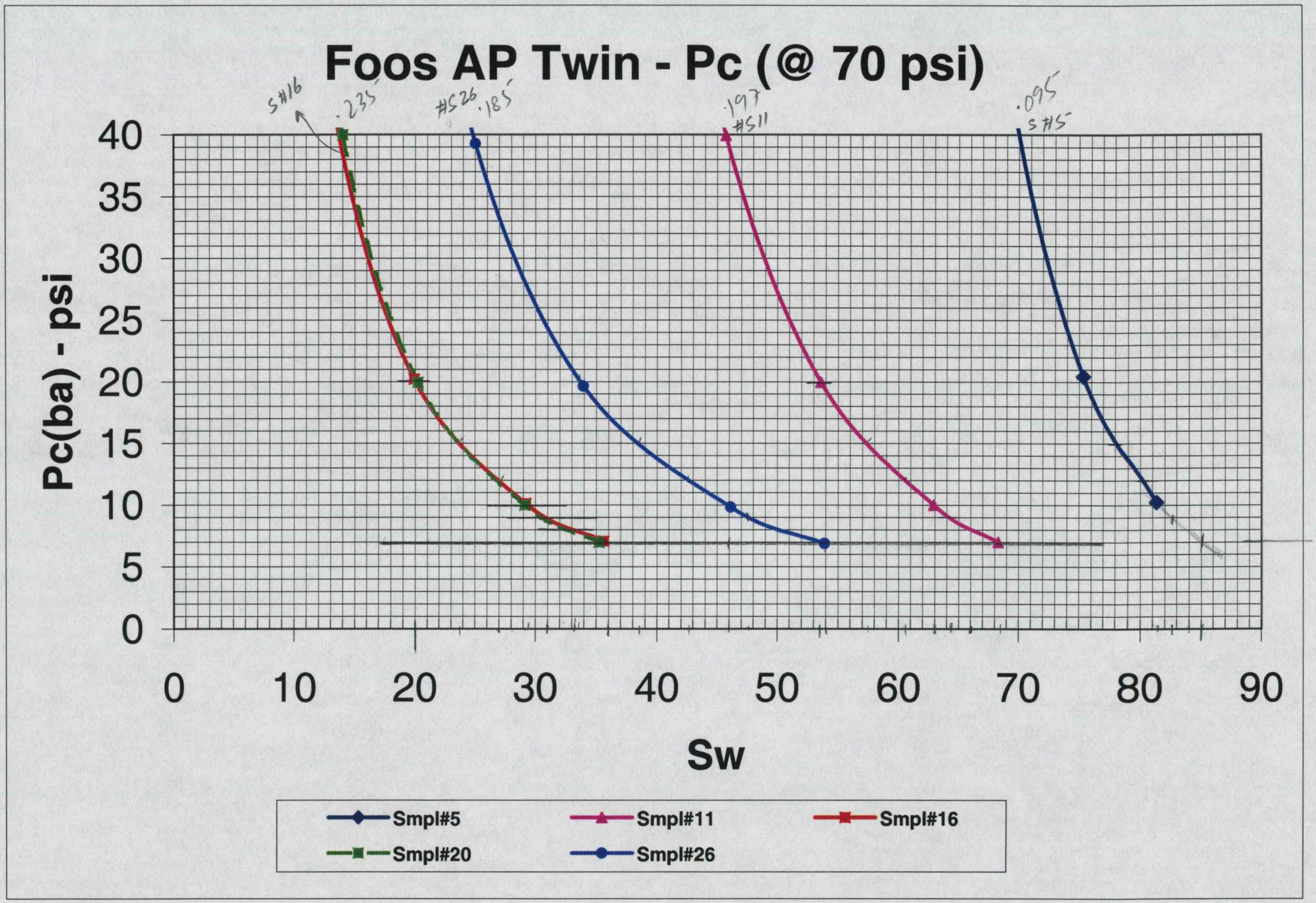
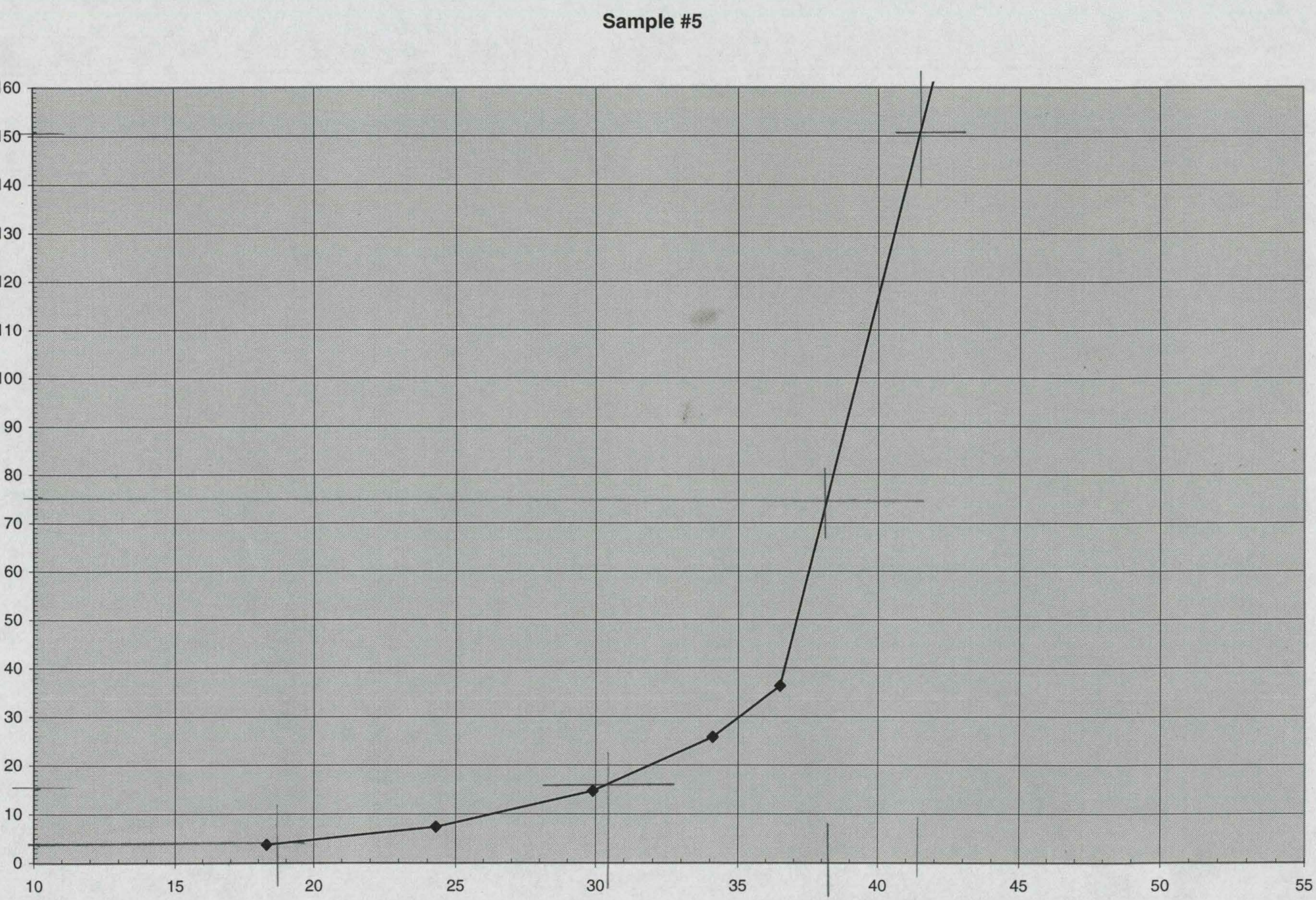


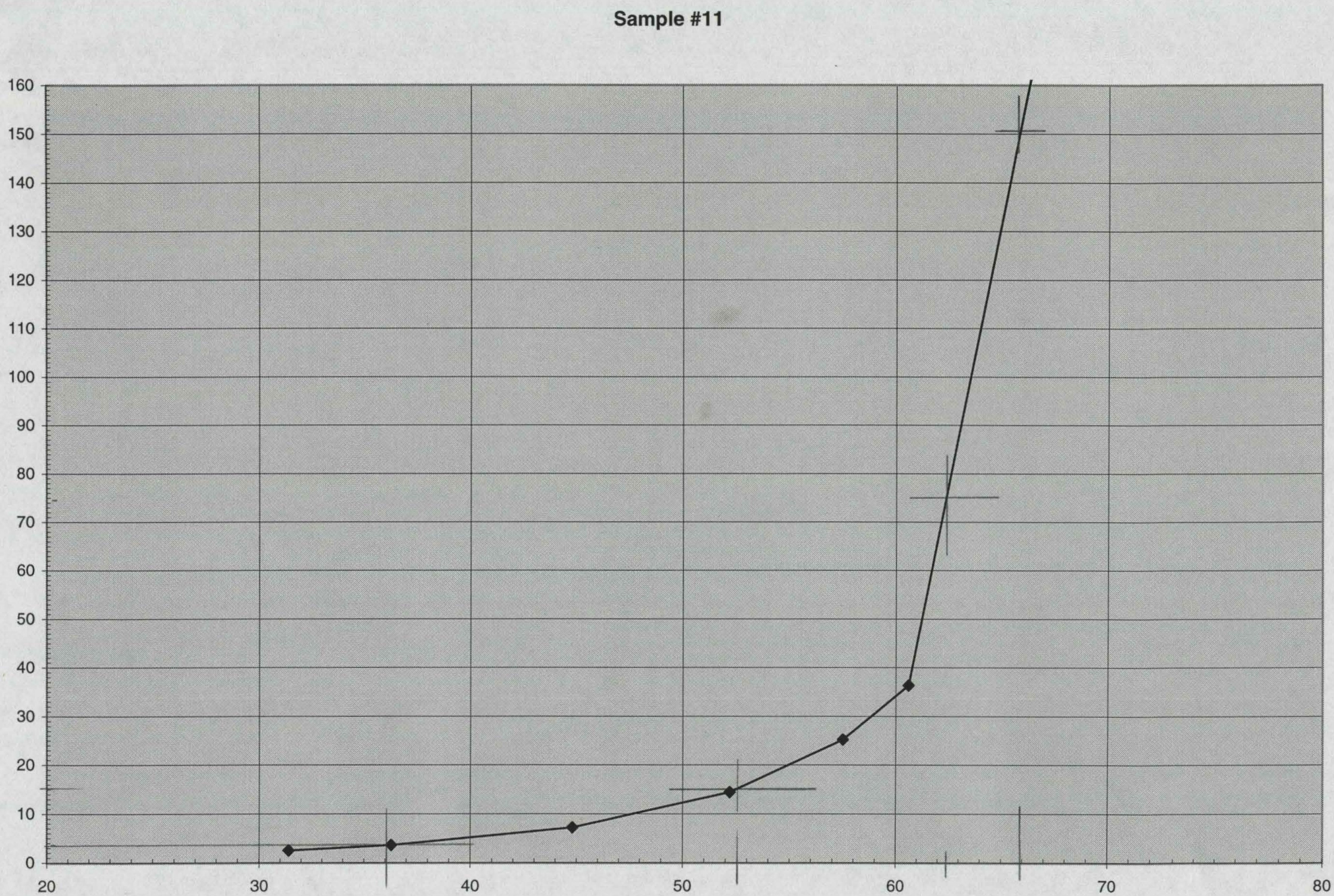
Figure --: Super-Pickett plot of Foos AP Twin well. Capillary pressure data from plugs F#26, F#16, and F#20 plotted as contours of height (feet) above oil-water contact (OWC) on the Pickett plot. Perforated interval of 4394-95 feet is 19 feet above OWC. Initial production rates 9 bopd and 253 bwpd.


Foos AP Twin
Sw
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
Ht above FWL
No26
No16
No20


Foos AP Twin - Pc (@ 70 psi)
S#16 .235
#S26 .185
.197 #S11
.095 S#5
Pc(ba) - psi
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80
90
Sw
Smpl#5
Smpl#11
Smpl#16
Smpl#20
Smpl#26

Foos AP Twin


Sample #5
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
15
20
25
30
35
40
45
50
55


Sample #11
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20
30
40
50
60
70
80

Mercury Injection Capillary Pressure Analysis
#1 FoosAP Twin 4410.6ft (#16)

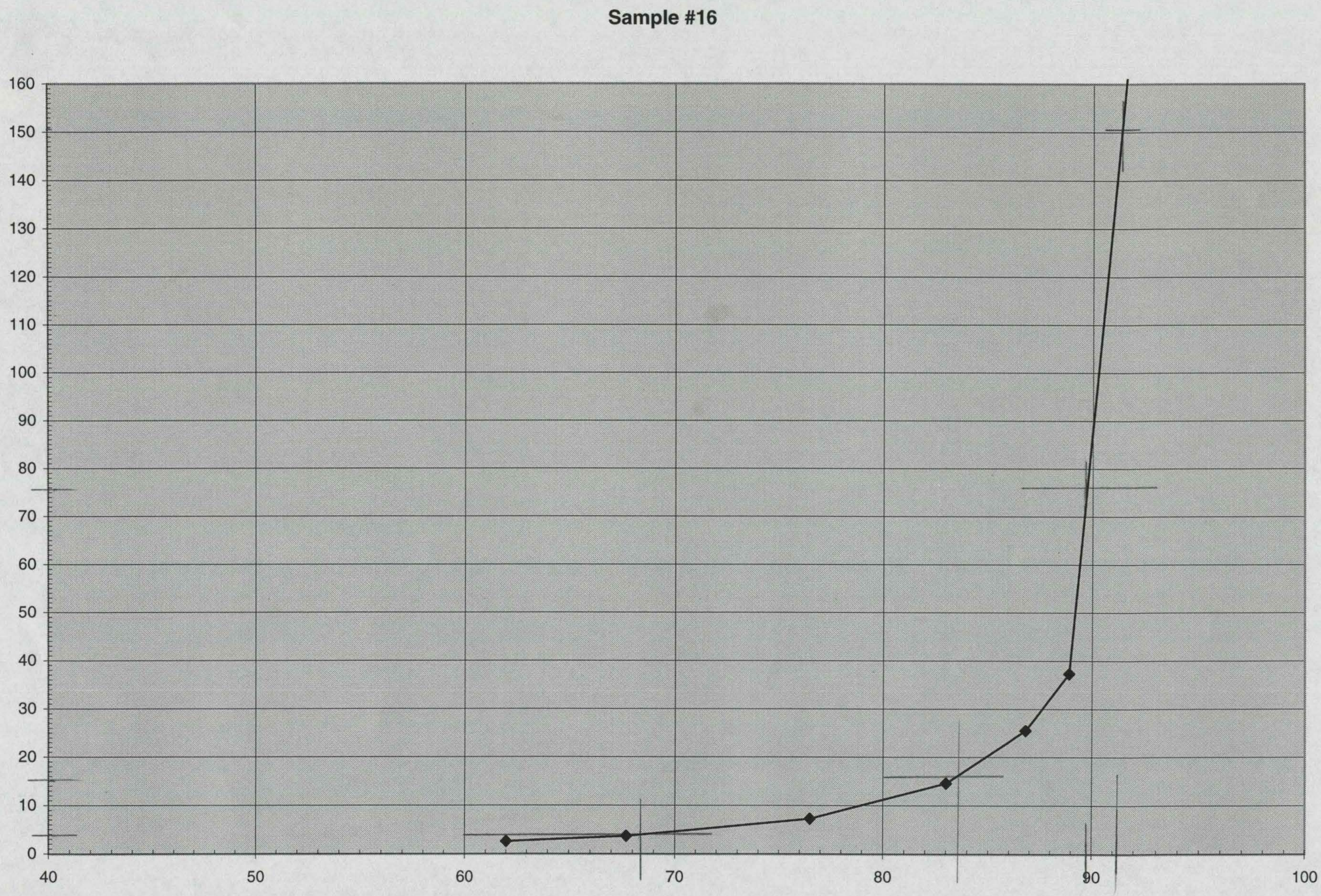
Insitu Klinkenberg Gas Permeability = 37.3md

Porosity = 23.5%

Mercury Injection Capillary Pressure (psia)	Approx. Pore Entry Diameter (um)	Cumulative Wetting Phase Saturation (% pore vol)	Pore Size Distribution Frequency	Cumulative Surface Area (m2/g)	Approx. Gas-Water Height Above Free Water Level (ft)	Approx. Oil-Water Height Above Free Water Level (ft)	Burdine-Purcell Calculated Oil Relative Permeability (%)	Log Oil/Brine Kro/Krw Ratio	Corey Calculated Oil Relative Permeability (%)	Log Oil/Brine Kro/Krw Ratio
0		100.0	0.0	0.000	0.0	0.0	0.0	-5.0	0.0	-5.0
2	107.	100.0	0.0	0.000	0.8	1.0	0.0	-5.0	0.0	-5.0
4	53.8	100.0	0.0	0.000	1.6	2.0	0.0	-5.0	0.0	-5.0
6	35.8	100.0	0.0	0.000	2.4	3.0	0.0	-5.0	0.0	-5.0
8	26.9	100.0	0.0	0.000	3.2	4.0	0.0	-5.0	0.0	-5.0
10	21.5	100.0	0.0	0.000	4.0	5.0	0.0	-5.0	0.0	-5.0
12	17.9	100.0	0.0	0.000	4.8	6.0	0.0	-5.0	0.0	-5.0
15	14.3	99.9	0.1	0.000	6.0	7.5	0.0	-5.0	0.0	-5.0
18	11.9	99.8	0.2	0.000	7.2	9.0	0.0	-5.0	0.0	-5.0
21	10.2	99.0	0.8	0.000	8.4	10.5	0.0	-5.0	0.0	-5.0
25	8.60	84.6	14.4	0.008	10.0	12.5	0.9	-1.9	0.1	-2.9
30	7.17	64.1	20.6	0.020	12	15	9.3	-0.4	1.9	-0.9
40	5.37	41.6	22.5	0.038	16	20	32.4	0.8	13.0	0.7
50	4.30	31.8	9.8	0.047	20	25	47.0	1.7	24.2	1.5
60	3.58	26.4	5.4	0.054	24	30	55.9	2.3	32.8	2.0
80	2.69	20.5	5.9	0.063	32	40	66.2	2.9	44.6	2.6
100	2.15	17.5	3.0	0.069	40	50	71.7	3.6	51.8	3.0
150	1.43	12.5	5.0	0.084	60	75	80.9	4.3	65.4	3.8
200	1.08	10.8	1.8	0.076	80	100	84.1	4.5	70.8	4.2
300	.717	8.8	1.9	0.088	120	150	87.8	5.6	77.2	4.7
400	.537	7.7	1.1	0.097	160	200	90.1	6.2	81.1	5.1
500	.430	7.1	0.6	0.103	200	250	91.2	6.7	83.2	5.3
600	.358	6.6	0.5	0.108	240	300	92.1	7.0	84.9	5.5
800	.268	5.9	0.7	0.119	320	400	93.5	7.4	87.5	5.9
1000	.215	5.5	0.5	0.129	400	500	94.4	7.8	89.2	6.2
1500	.143	4.5	1.0	0.158	600	750	96.4	8.4	93.0	6.9
2000	.107	3.9	0.6	0.183	800	1000	97.7	9.3	95.4	7.7
3000	.072	3.4	0.4	0.208	1200	1500	98.5	10.2	97.1	8.5
4000	.054	3.2	0.2	0.225	1600	2000	99.0	11.0	98.0	9.2
5000	.043	3.1	0.1	0.238	2000	2500	99.2	11.7	98.5	9.7
6000	.035	3.1	0.0	0.238	2400	3000	99.2	12.0	98.5	9.7
7000	.031	3.0	0.1	0.251	2800	3500	99.4	12.3	98.9	10.2
8000	.027	2.9	0.2	0.275	3200	4000	99.7	13.2	99.5	11.6
9000	.024	2.8	0.1	0.286	3600	4500	99.9	14.4	99.7	12.8
10000	.022	2.7	0.1	0.298	4000	5000	100.0	15.0	100.0	15.0

All Hg calculations assume air-mercury T=484 dyne/cm, contact angle=140deg.

	Gas-Water	Oil-Water	Units
Oil/Gas-Brine Pc assumes insitu o/g-brine Tcos0=	67.69	24.89	dynes/cm
Oil/gas-Brine height assumes o/g density gradient =	0.020	0.342	psi/ft
Oil/gas-Brine height assumes brine density gradient =	0.476	0.476	psi/ft
Swi assumed for relative permeability =	2.73	2.73	%


Sample #16
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
40
50
60
70
80
90
100

Mercury Injection Capillary Pressure Analysis
#1 Foos AP Twin 4416.4ft (#20)

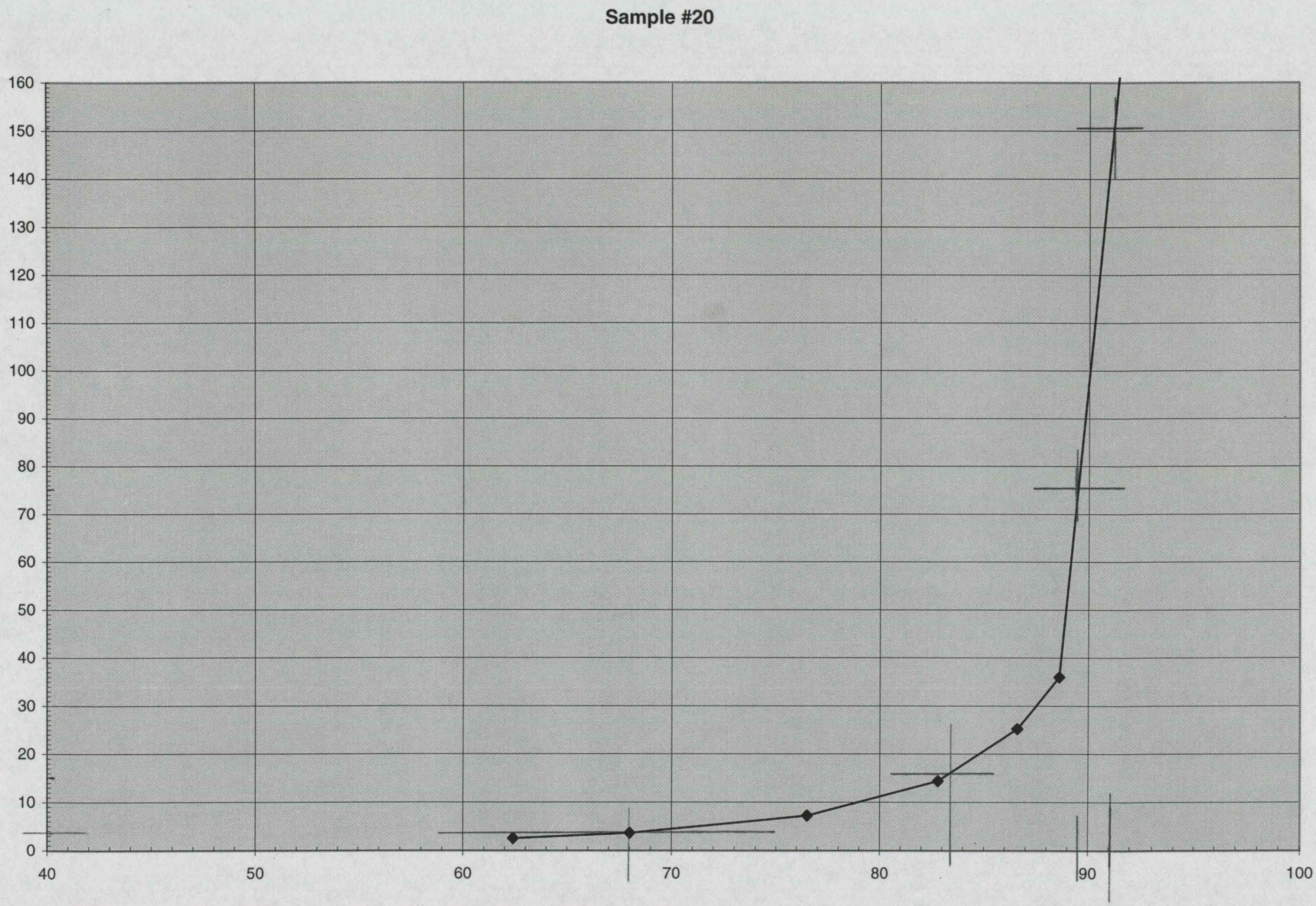
Insitu Klinkenberg Gas Permeability = 65.8md

Porosity = 24.5%

Mercury Injection Capillary Pressure (psia)	Approx. Pore Entry Diameter (um)	Cumulative Wetting Phase Saturation (% pore vol)	Pore Size Distri-bution Fre-quency	Cumula-tive Surface Area (m2/g)	Approx. Gas-Water Height Above Free Water Level (ft)	Approx. Oil-Water Height Above Free Water Level (ft)	Burdine-Purcell Calculated Oil Relative Permea-bility (%)	Log Oil/Brine Kro/Krw Ratio	Corey Calculated Oil Relative Permea-bility (%)	Log Oil/Brine Kro/Krw Ratio
0		100.0	0.0	0.000	0.0	0.0	0.0	-5.0	0.0	-5.0
2	107.	100.0	0.0	0.000	0.8	1.0	0.0	-5.0	0.0	-5.0
4	53.8	100.0	0.0	0.000	1.6	2.0	0.0	-5.0	0.0	-5.0
6	35.8	100.0	0.0	0.000	2.4	3.0	0.0	-5.0	0.0	-5.0
8	26.9	100.0	0.0	0.000	3.2	4.0	0.0	-5.0	0.0	-5.0
10	21.5	100.0	0.0	0.000	4.0	5.0	0.0	-5.0	0.0	-5.0
12	17.9	99.8	0.2	0.000	4.8	6.0	0.0	-5.0	0.0	-5.0
15	14.3	99.0	0.9	0.000	6.0	7.5	0.0	-5.0	0.0	-5.0
18	11.9	93.3	5.6	0.002	7.2	9.0	0.1	-3.0	0.0	-4.6
21	10.2	79.0	14.3	0.008	8.4	10.5	2.2	-1.3	0.2	-2.3
25	8.60	61.3	17.7	0.018	10.0	12.5	11.5	-0.2	2.4	-0.7
30	7.17	47.2	14.1	0.026	12	15	25.4	0.7	8.4	0.3
40	5.37	34.3	12.8	0.037	16	20	42.8	1.5	20.1	1.2
50	4.30	27.8	6.6	0.043	20	25	53.1	2.2	29.4	1.8
60	3.58	23.9	3.9	0.048	24	30	59.5	2.8	36.2	2.2
80	2.69	19.6	4.3	0.055	32	40	67.0	3.3	45.3	2.6
100	2.15	17.1	2.5	0.060	40	50	71.3	3.8	51.1	3.0
150	1.43	13.1	4.0	0.072	60	75	78.6	4.4	61.8	3.6
200	1.08	11.7	1.3	0.065	80	100	81.0	4.6	65.6	3.8
300	.717	10.0	1.8	0.076	120	150	84.3	5.6	71.0	4.2
400	.537	8.9	1.1	0.085	160	200	86.4	6.1	74.7	4.5
500	.430	8.3	0.5	0.091	200	250	87.4	6.5	76.4	4.6
600	.358	7.8	0.5	0.097	240	300	88.4	6.8	78.1	4.8
800	.268	7.2	0.7	0.108	320	400	89.7	7.1	80.4	5.0
1000	.215	6.4	0.7	0.123	400	500	91.1	7.4	83.0	5.3
1500	.143	5.1	1.4	0.164	600	750	93.8	8.0	87.9	5.9
2000	.107	4.2	0.9	0.201	800	1000	95.5	8.7	91.3	6.5
3000	.072	3.3	0.9	0.255	1200	1500	97.3	9.5	94.7	7.5
4000	.054	2.7	0.6	0.305	1600	2000	98.6	10.6	97.1	8.6
5000	.043	2.7	0.0	0.305	2000	2500	98.6	11.3	97.1	8.6
6000	.035	2.5	0.2	0.324	2400	3000	98.9	11.5	97.8	9.0
7000	.031	2.3	0.2	0.355	2800	3500	99.3	12.2	98.6	9.8
8000	.027	2.2	0.1	0.370	3200	4000	99.5	13.1	99.0	10.4
9000	.024	2.2	0.0	0.370	3600	4500	99.5	15.0	99.0	10.4
10000	.022	1.9	0.2	0.420	4000	5000	100.0	15.0	100.0	15.0

All Hg calculations assume air-mercury T=484 dyne/cm, contact angle=140deg.

	Gas-Water	Oil-Water	Units
Oil/Gas-Brine Pc assumes insitu o/g-brine Tcos0=	67.69	24.89	dynes/cm
Oil/gas-Brine height assumes o/g density gradient =	0.020	0.342	psi/ft
Oil/gas-Brine height assumes brine density gradient =	0.476	0.476	psi/ft
Swi assumed for relative permeability =	1.95	1.95	%


Sample #20
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150
140
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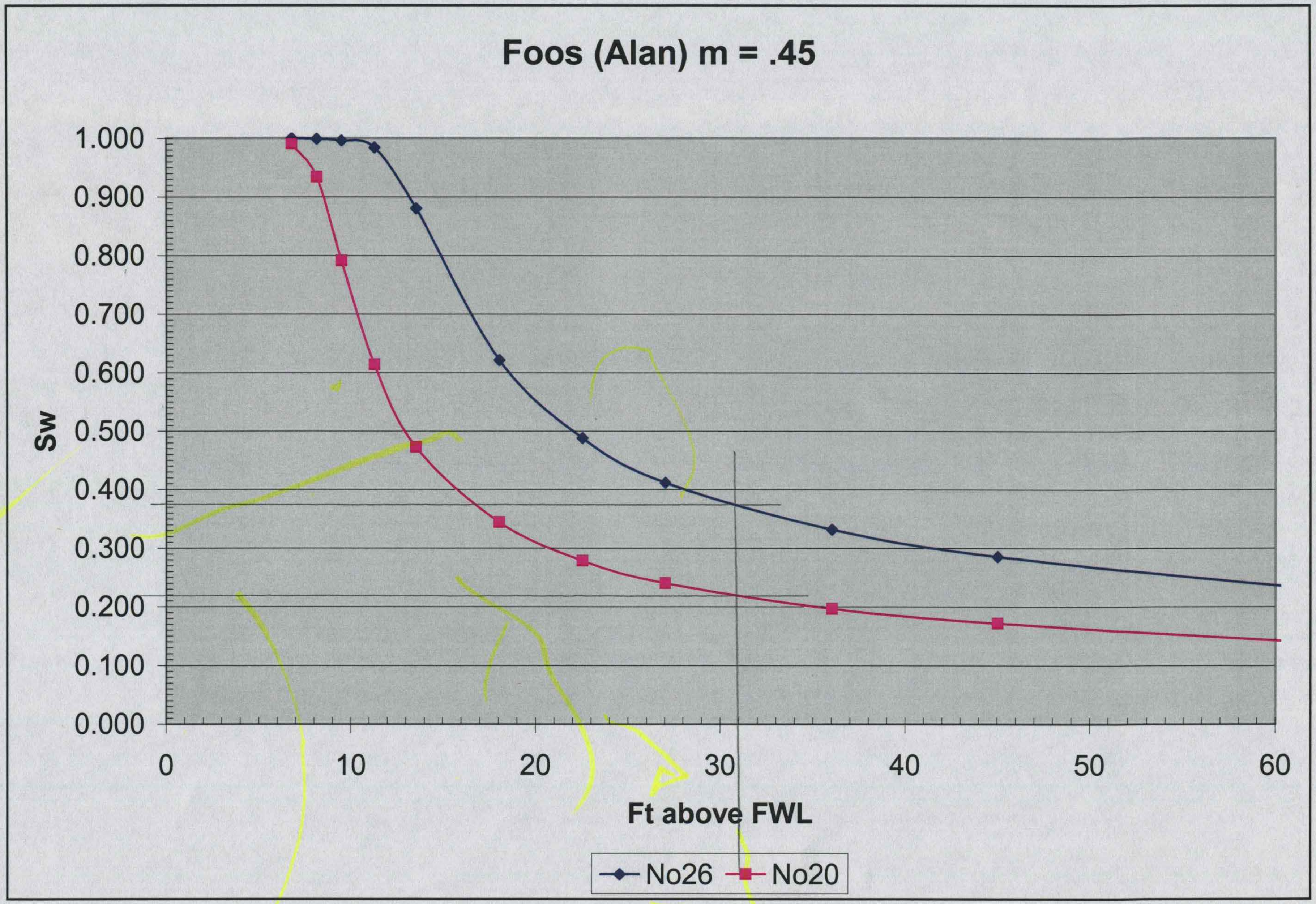
70
80
90
100



Foos (Alan) m = .45
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Sw
0
10
20
30
40
50
60
Ft above FWL
No26
No20

Mercury Injection Capillary Pressure Analysis
#1 Foos AP Twin (#26)

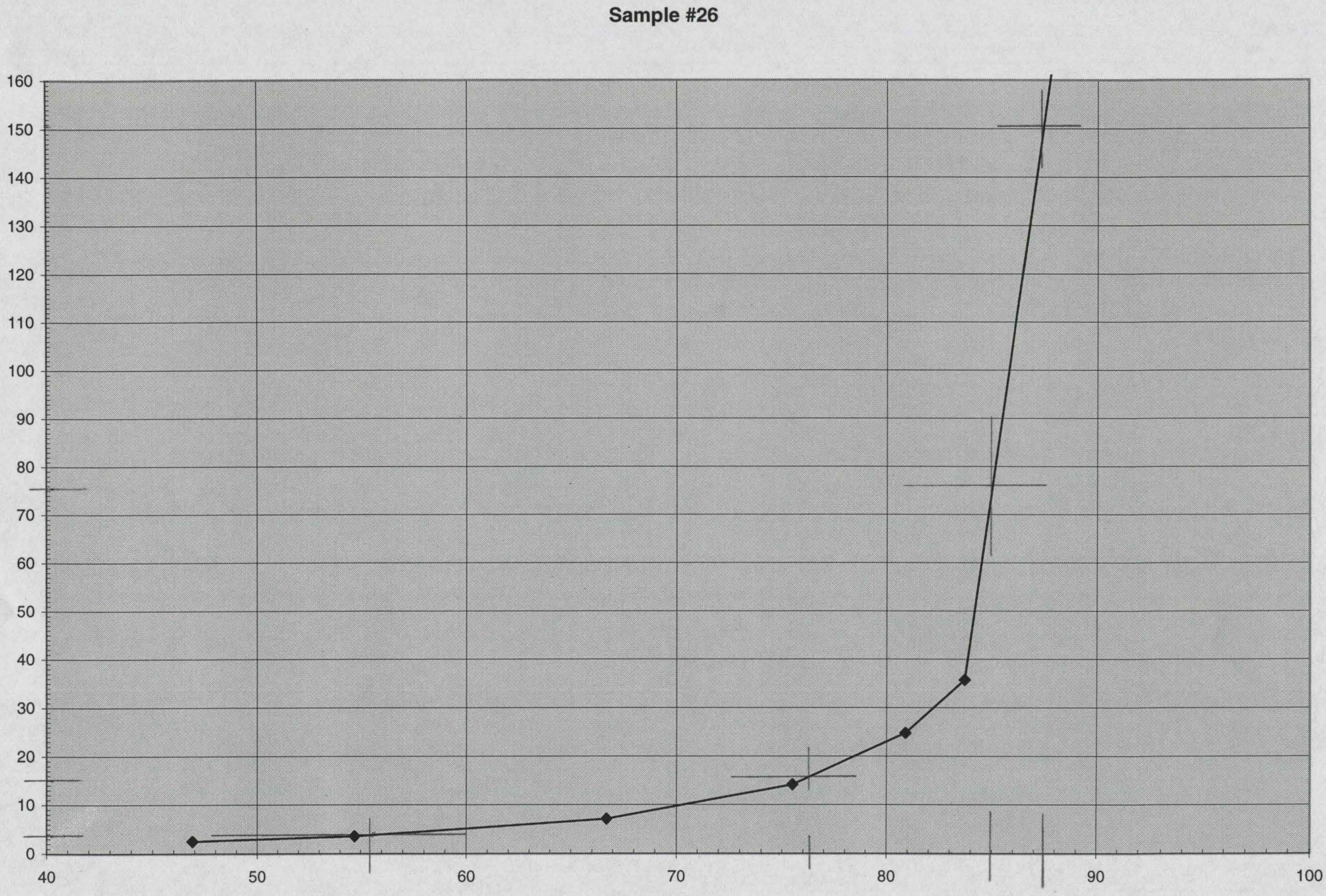
Insitu Klinkenberg Gas Permeability = 10.3md

Porosity = 18.4%

Mercury Injection Capillary Pressure (psia)	Approx. Pore Entry Diameter (um)	Cumulative Wetting Phase Saturation (% pore vol)	Pore Size Distri-bution Fre-quency	Cumula-tive Surface Area (m2/g)	Approx. Gas-Water Height Above Free Water Level (ft)	Approx. Oil-Water Height Above Free Water Level (ft)	Burdine-Purcell Calculated Oil Relative Permea-bility (%)	Log Oil/Brine Kro/Krw Ratio	Corey Calculated Oil Relative Permea-bility (%)	Log Oil/Brine Kro/Krw Ratio
0		100.0	0.0	0.000	0.0	0.0	0.0	-5.0	0.0	-5.0
2	107.	100.0	0.0	0.000	0.8	1.0	0.0	-5.0	0.0	-5.0
4	53.8	100.0	0.0	0.000	1.6	2.0	0.0	-5.0	0.0	-5.0
6	35.8	100.0	0.0	0.000	2.4	3.0	0.0	-5.0	0.0	-5.0
8	26.9	100.0	0.0	0.000	3.2	4.0	0.0	-5.0	0.0	-5.0
10	21.5	100.0	0.0	0.000	4.0	5.0	0.0	-5.0	0.0	-5.0
12	17.9	100.0	0.0	0.000	4.8	6.0	0.0	-5.0	0.0	-5.0
15	14.3	100.0	0.0	0.000	6.0	7.5	0.0	-5.0	0.0	-5.0
18	11.9	99.9	0.1	0.000	7.2	9.0	0.0	-5.0	0.0	-5.0
21	10.2	99.6	0.3	0.000	8.4	10.5	0.0	-5.0	0.0	-5.0
25	8.60	98.4	1.2	0.001	10.0	12.5	0.0	-4.7	0.0	-5.0
30	7.17	88.0	10.3	0.005	12	15	0.5	-2.2	0.0	-3.4
40	5.37	62.1	25.9	0.021	16	20	11.2	-0.3	2.2	-0.8
50	4.30	48.7	13.3	0.031	20	25	24.1	0.6	7.2	0.1
60	3.58	41.2	7.6	0.037	24	30	33.5	1.3	12.5	0.7
80	2.69	33.1	8.0	0.047	32	40	44.7	1.9	20.9	1.3
100	2.15	28.5	4.6	0.054	40	50	51.7	2.5	27.3	1.7
150	1.43	21.7	6.8	0.069	60	75	62.6	3.2	39.3	2.3
200	1.08	18.8	2.9	0.062	80	100	67.2	3.3	45.3	2.6
300	.717	16.1	2.7	0.074	120	150	71.9	4.3	51.8	3.0
400	.537	14.2	1.9	0.086	160	200	75.2	4.8	56.7	3.3
500	.430	13.0	1.2	0.094	200	250	77.3	5.2	59.8	3.5
600	.358	11.9	1.1	0.105	240	300	79.4	5.5	63.0	3.6
800	.268	10.5	1.4	0.121	320	400	81.9	5.8	67.0	3.9
1000	.215	9.3	1.2	0.138	400	500	84.0	6.2	70.6	4.2
1500	.143	7.3	2.0	0.183	600	750	87.8	6.7	77.1	4.7
2000	.107	6.0	1.3	0.222	800	1000	90.3	7.3	81.5	5.1
3000	.072	4.3	1.7	0.297	1200	1500	93.6	8.0	87.6	5.9
4000	.054	3.0	1.3	0.377	1600	2000	96.2	8.9	92.5	6.8
5000	.043	2.5	0.4	0.410	2000	2500	97.1	9.6	94.2	7.3
6000	.035	1.9	0.6	0.467	2400	3000	98.4	10.3	96.8	8.3
7000	.031	1.6	0.3	0.497	2800	3500	98.9	11.1	97.9	9.1
8000	.027	1.2	0.4	0.550	3200	4000	99.8	13.0	99.7	12.3
9000	.024	1.2	0.0	0.550	3600	4500	99.8	15.0	99.7	12.3
10000	.022	1.1	0.1	0.562	4000	5000	100.0	15.0	100.0	15.0

All Hg calculations assume air-mercury T=484 dyne/cm, contact angle=140deg.

Oil/Gas-Brine Pc assumes insitu o/g-brine Tcos0=	67.69	24.89	dynes/cm
Oil/gas-Brine height assumes o/g density gradient =	0.020	0.342	psi/ft
Oil/gas-Brine height assumes brine density gradient =	0.476	0.476	psi/ft
Swi assumed for relative permeability =	1.09	1.09	%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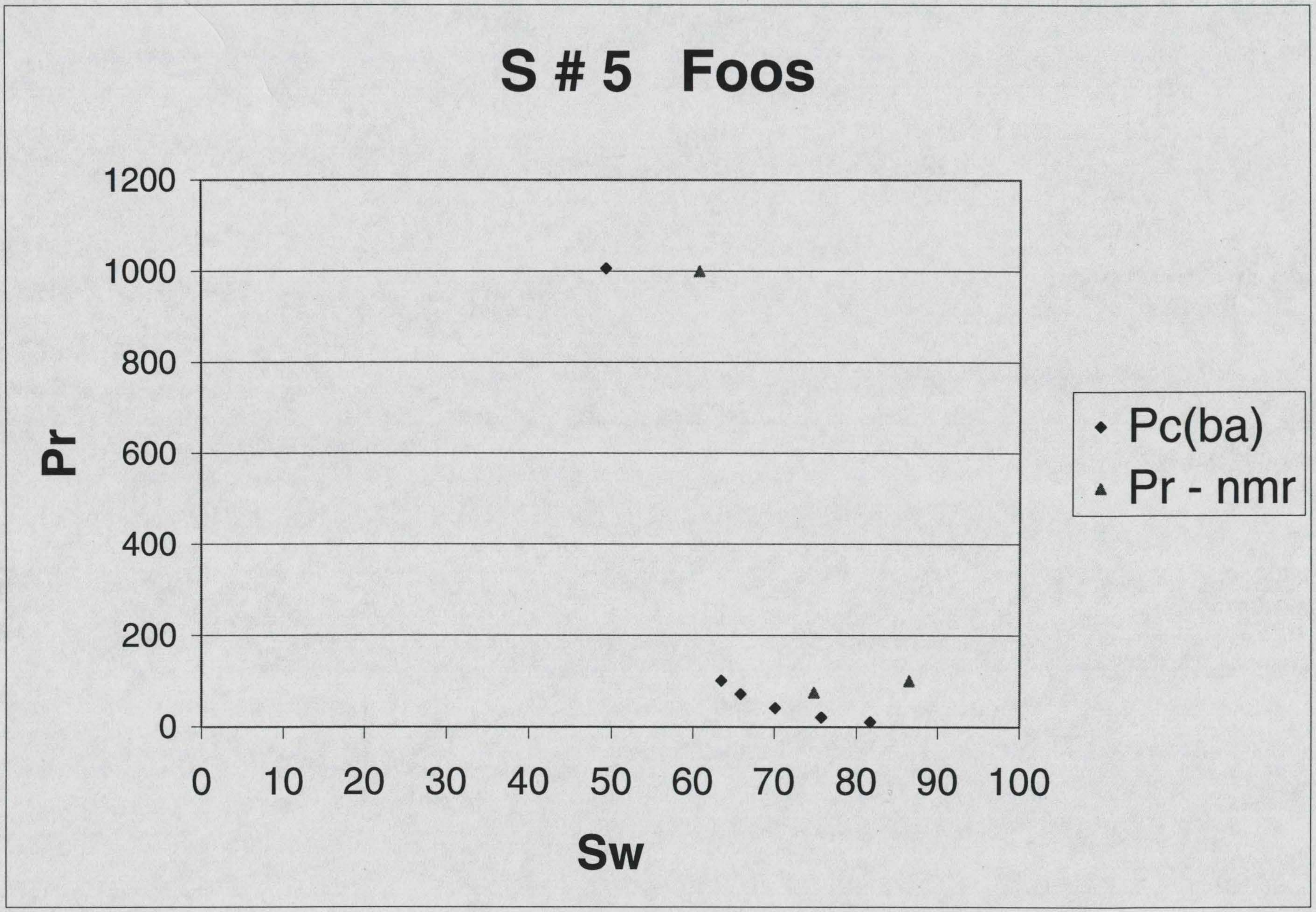
S # 5 Foos
Pr
Sw
Pc(ba)
Pr - nmr
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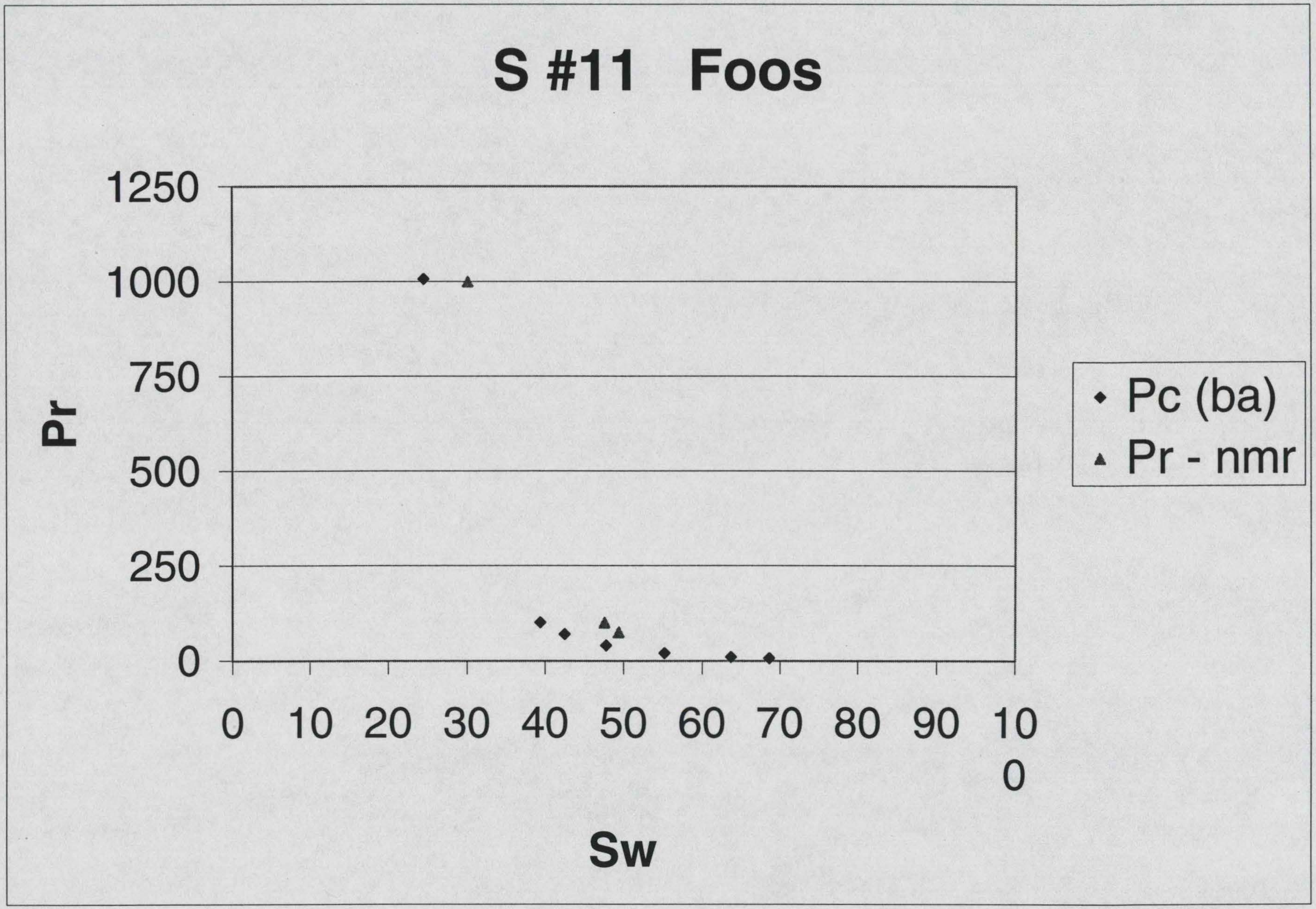
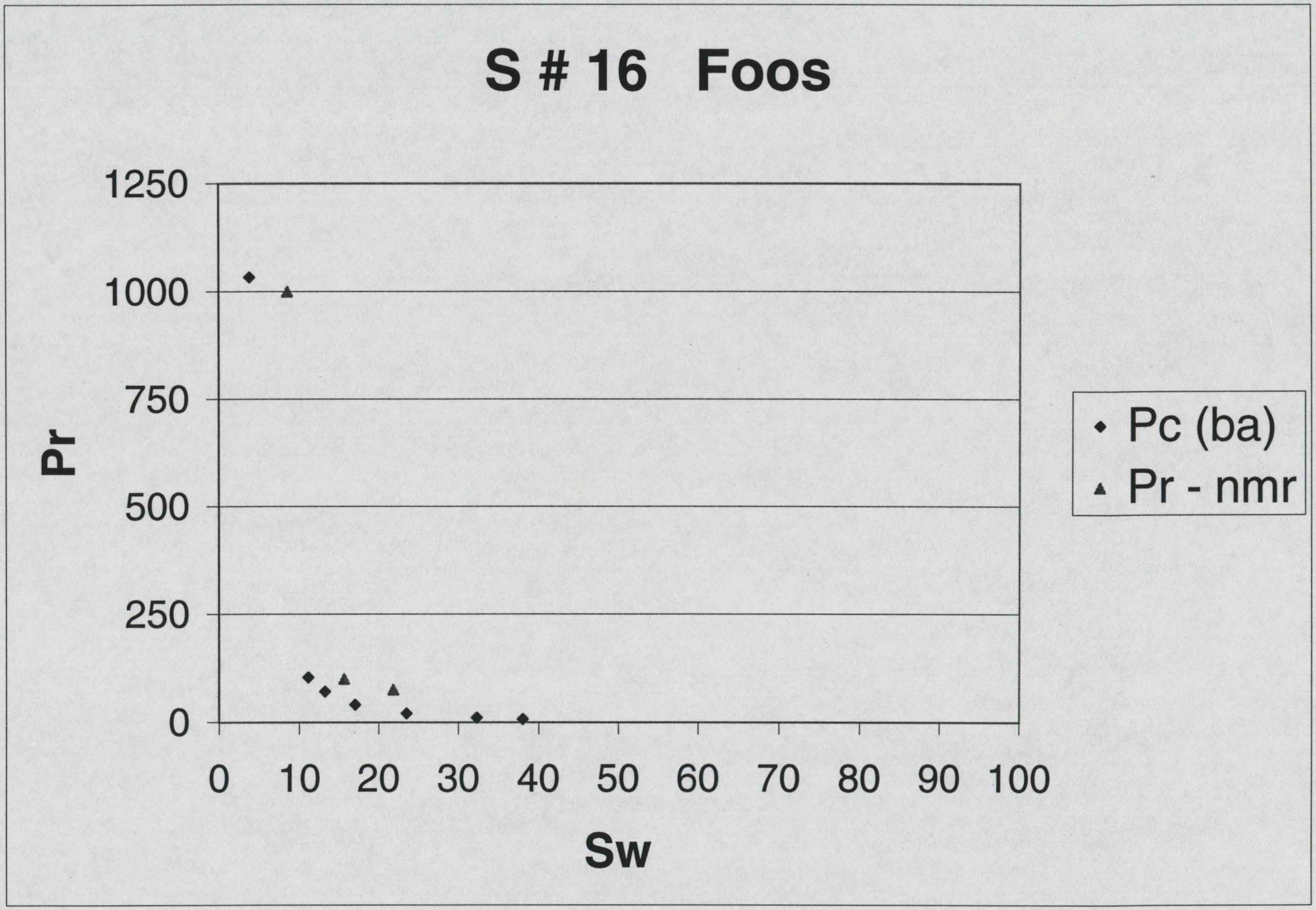
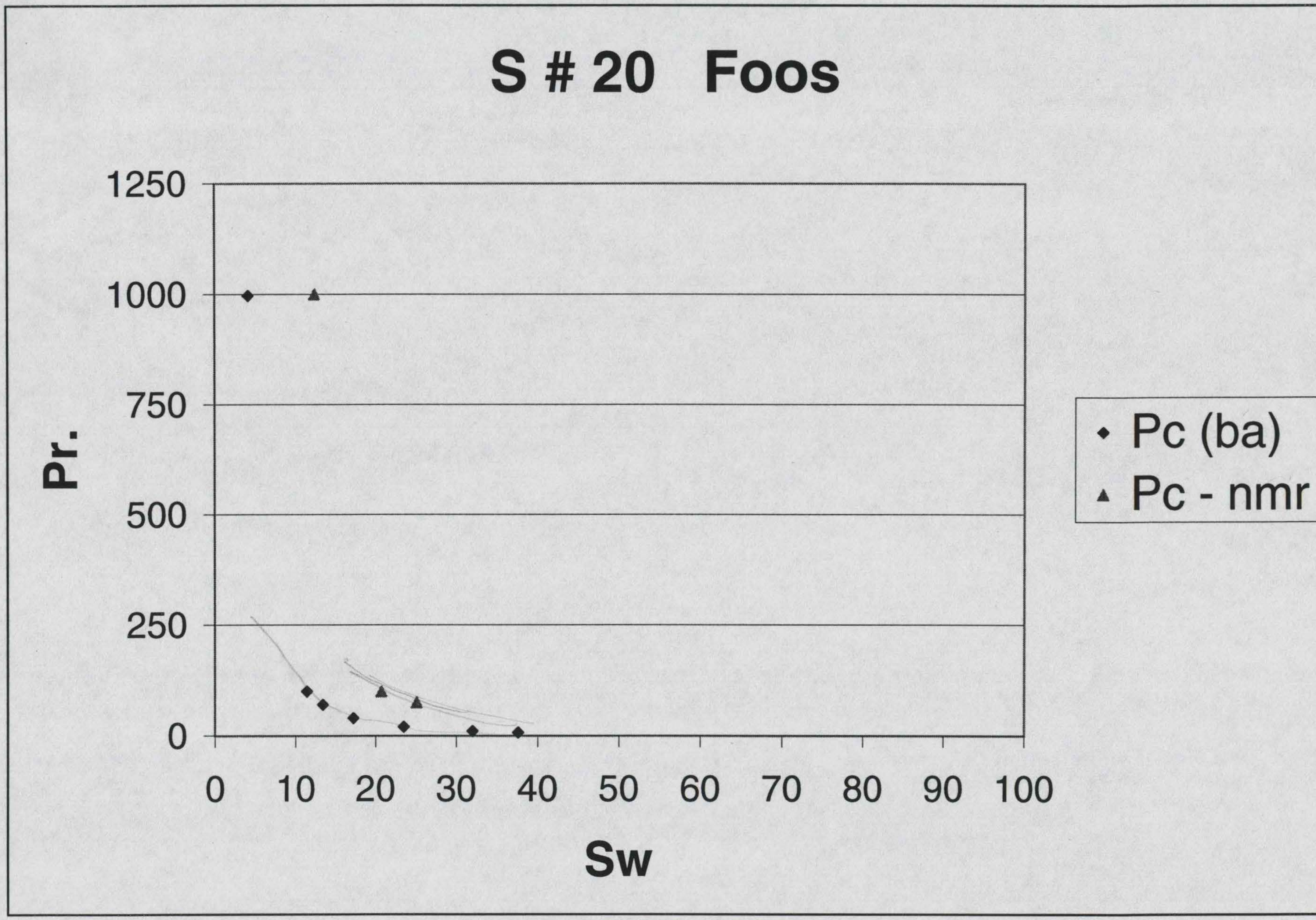
200
400
600
800
1000
1200
0
10
20
30
40
50
60
70
80
90
100


S #11 Foos
Pr
1250
1000
750
500
250
0
0
10
20
30
40
50
60
70
80
90
10
0
Sw
Pc (ba)
Pr - nmr


S # 16 Foos
1250
1000
750
500
250
0
Pr
0
10
20
30
40
50
60
70
80
90
100
Sw
Pc (ba)
Pr - nmr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1250
1000
750
500
250
0
Pr.
0
10
20
30
40
50
60
70
80
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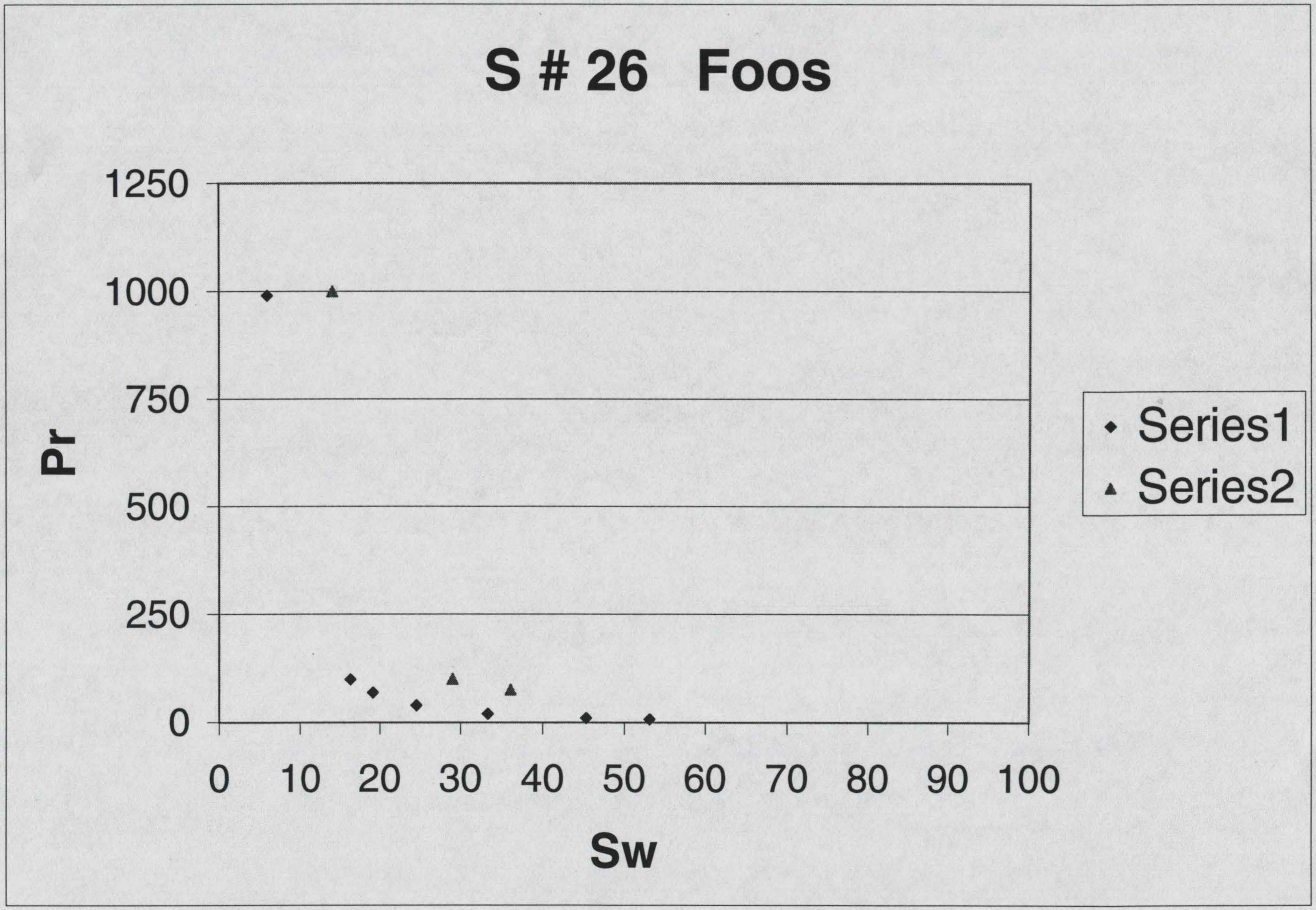
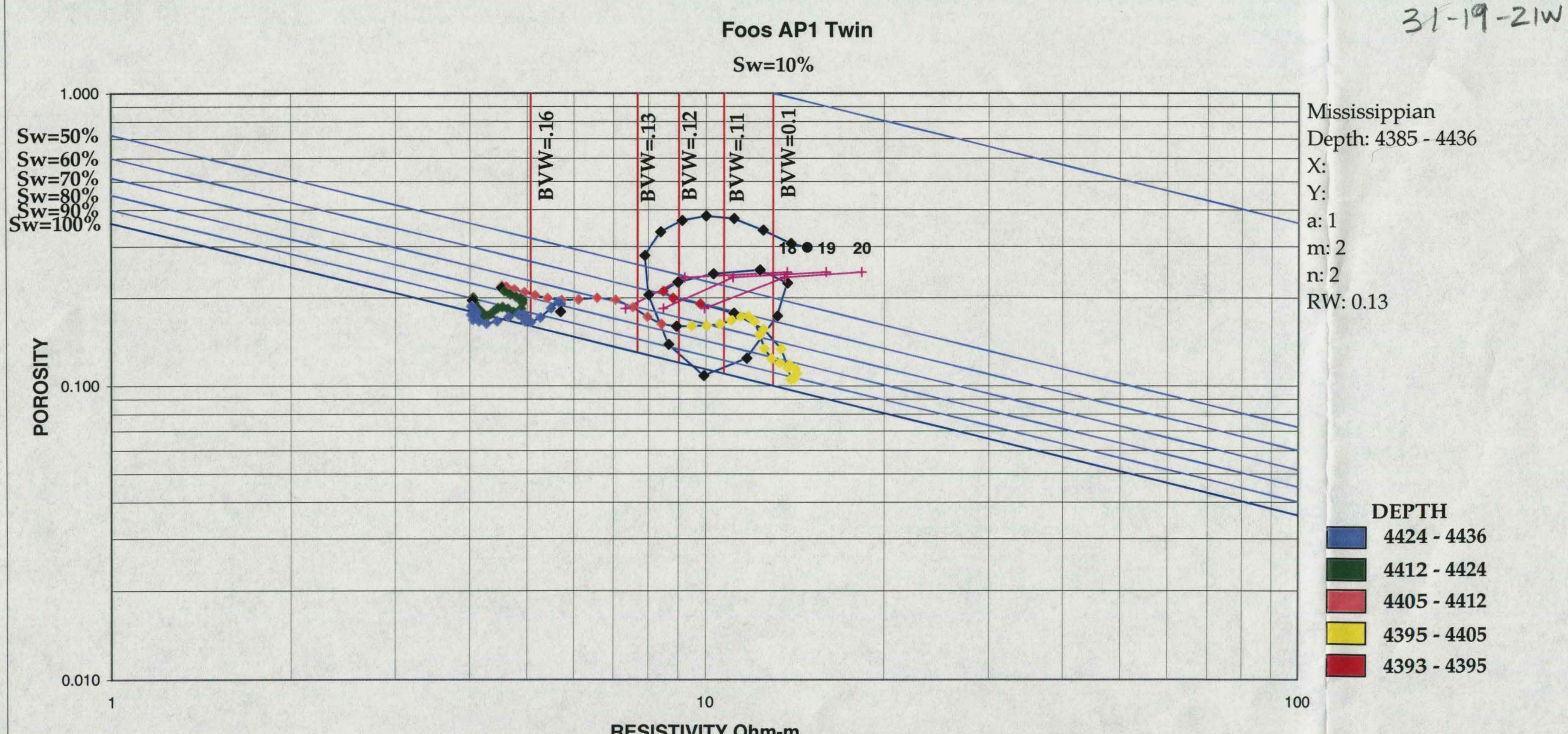
100
Sw
Pc (ba)
Pc - nmr


S # 26 Foos
Pr
1250
1000
750
500
250
0
0
10
20
30
40
50
60
70
80
90
100
Sw
Series1
Series2

15-135-23898
31-19-21W



DST 4412-24: 160' VSOCMW, 2000' VSOCW. Perf 4394-95: Acid, 9 bopd, 253 bwpd. Alan's Cap Pr data: Plugs #26, #16, #20. Perf is about 19 feet above OWC.

Figure ~~9~~ 8

Porosity and water saturation in different Mississippian zones :

n p : zone not present, n l : no log in the well, l s : log short and ends above zone, n res : no resistivity log.

Base of pay @ -2143.5

Well name and API	KB	Base Pay	Miss top	Log ends @	M5 range	avg. range	Por.	Sw	M3 range	avg. range	Por.	Sw	M1 range	avg. range	Por.	Sw	M0 range	avg. range	Por.	Sw	Msub-range	Avg.-range	Por.	Sw	Comments
MOORE "D" #2 (API # 99-0000-0010)	2270	4413.5	4365		n p	n p			4365-75				4375-90	4382-90	15.7	63.8	4390-07	4390-94	15.8	60.00	4407-4413.5				Old Miss top @ 4377
MOORE "C" #2 (API # 99-0000-0017)	2289	4432.5	4394		n p	n p			4394-02				4402-26	4402-18	17.5	60.3	4426-32.5				n p	n p			
MOORE "B" #7 (API # 15-135-20019)	2294	4437.5	4399		n p	n p			n p	n p			4399-10				4410-35	4412-35	10.6	89.20	4435-37.5				
MOORE "D" #1 (API # 15-135-00675)	2275	4418.5	4364		n p	n p			4364-72	4365-72	15	59.3	4372-86	4372-86	17.3	56.2	4386-09	4386-01	19.4	50.70	4409-4418.5				Old OWC @ 4401
MOORE "B" #2 (API # 99-0000-0011)	2273	4416.5	4387		n p	n p			n p	n p			4387-11	4398-11	17.9	61.5	4411-16.5				n p	n p			
MOORE "B" #5 (99-000-00014)	2278	4421.5	4386		n p	n p			n p	n p			4386-96	4388-96	14.8	66.9	4396-18	4396-04	16.7	60.30	4418-21.5				
3-C MOORE (1513521024)	2296	4439.5	4416		n p	n p			n p	n p			4416-37	4416-37	18.4	62.5	4437-39.5				n p	n p			
MOORE "D" #4 (API # 99-0000-0018)	2301	4444.5	4402		n p	n p			n p	n p			4402-17	4408-17	12.4	72.6	4417-38	4417-32	15.5	65.30	4438-44.5				
MOORE "D" #3 (API # 15-135-30030)	2285	4428.5	4370		n p	n p			n p	np			4370-91	4384-91	12.4	73.7	4391-11	4391-10	14.7	74.00	4411-28.5				
MOORE "B" #4 (API # 99-0000-0013)	2297	4440.5	4389		n p	n p			n p	n p			4389-02	4394-02	13.5	70.5	4402-22	4402-22	15.6	68.70	4422-40.5				
REIN "A" #6 (API # 15-135-21023)	2314	4457.5	4423		n p	n p			n p	n p			4423-32	4426-32	20.4	43.15	4432-54	4432-54	16.3	66.54	4454-57.5	4454-57.5	14.8	86.2	
CSO 1-B MOORE 9900000009	2288	4431.5	4398		n p	n p			n p	n p			4398-22	4400-22	20.8	56	4422-31.5				n p	n p			
MOORE "B" #3 (99-000-00012)	2301	4444.5	4417		n p	n p			n p	n p			4417-33				4433-44.5	4436-44.5	17.1	53.80	n p	n p			Old Miss. top @ 4436
#6 MOORE "B" (API # 15-135-00479)	2311	4454.5	4410		n p	n p			n p	n p			4410-19				4419-36	4424-36	13.9	67.10	4436-54.5				Old Miss top @ 4418
Moore C #1 (99-000-00016)	2290	4433.5	4420		n p	n p			4420-26	4420-26	11.7	74.1	4426-33.5	4426-31	13.7	71.6	4431-33.5				n p	n p			Old OWC @ 4431
REIN NO. 4-A (API # 15-135-91401)	2316	4459.5	4429		n p	n p			n p	n p			4429-33				4433-43	4433-43	13.2	65.10	4443-59.5	4443-57	17.5	60	Old OWC @ 4457, Miss top @ 4429
REIN "A" #2 (API # 15-135-30031)	2281	4424.5	4380		n p	n p			n p	n p			4380-94	4383-94	16.1	58.5	4394-09	4394-08	16.3	63.70	4409-24.5				Old Mstop & OWC @ 4380 & 4422.
Rein A 1 (99-000-00067)	2295	4438.5	4410		n p	n p			n p	n p			4410-20	n l			4420-38.5	n l			n p	n p			No log. Old Mstop & OWC @ 4428 & 4455.
GNEISH #1 (API # 15-135-30032)	2266	4409.5	4369		n p	n p			n p	n p			4369-79	4370-79	18.8	50.4	4379-01	4379-86	14.4	76.40	4401-09.5				Old OWC @ 4407
Wittman #2 (15-135-30066)	2261	4404.5	4368		n p	n p			4368-74				4374-92	4376-92	13.3	74	4392-04.5				n p	n p			Old Mstop & OWC @ 4374 & 4395
#1 JOHN WITTMAN (API # 15-135-30046)	2275	4418.5	4378		n p	n p			n p	n p			4378-95	4380-95	14.3	63.7	4395-18.5	4395-04	14.6	66.40	n p	n p			Old OWC @ 4409
#3 Wittman (15-135-23520)	2284	4427.5	4384		n p	n p			n p	n p			4384-97	l s			4397-21	l s			4421-27.5	l s			D/N too short
HAMBURG #2-A (API # 99-0000-0031)	2283	4426.5	4392		4392-97	4393-97	10.5	66.5	4397-16	4397-16	17.1	59.4	4416-26.5	4416-26.5	19.5	61.7	n p	n p			n p	n p			
Borger #1(99-000-0072)	2243	4386.5	4329		n p	n p			4329-34	n res			4334-48	n res			4348-73	n res			4373-86.5	n res			No Res. values
Borger #2 (15-135-30005)	2233	4376.5	4330		n p	n l			4330-47	n l			4347-62	n l			4362-76.5	n l			n p	n p			No log
Gneich #2 (99-0000-0064)	2302	4445.5	4415		n p	n p			n p	n p			4415-20	n l			4420-38	n l			4438-45.5	n l			No log
Schaben #1 (99-0000-0069)	2293	4436.5	4434		n p	n p			4434-36.5	n l			n p	n p			n p	n p			n p	n p			No log
Williams Estate #2 (99-0000-0037)	2281	4424.5	4423		n p	n p			4423-24.5	4424-24.5	14.1	68.4	n p	n p			n p	n p			n p	n p			
Lyle Schaben #2 (1513523925)	2279	4422.5	4384		n p	n p			4384-04	4390-04	16.3	61.5	4404-22.5	4404-22.5	15.1	82.4	n p	n p			n p	n p			
Humburg #1 A(1513500323)	2273	4416.5	4357		4357-66				4366-82	4368-82	16.9	61.4	4382-07	4382-92	18.4	51.3	4407-16.5				n p	n p			Old Mstop & OWC @ 4368 & 4407
BORGER #2-"A" (API # 15-135-30004)	2280	4423.5	4384		4384-86.5				4386.5-05	4391-00	16.1	63	4405-23.5				n p	n p			n p	n p			
BORGER NO.1 (15-135-23399)	2277	4420.5	4365		4365-77	4365-77	15.1	65	4377-96	4377-96	18.6	54.9	4396-20.5	4396-10	24.3	67	n p	n p			n p	n p			
Borger #2(15-135-23524)	2285	4428.5	4391.5		4391.5-0.5	n l			4400.5-16.5	n l			4416.5-28.5	n l			n p	n p			n p	n p			No log
Borger #3 (99-000-00070)	2276	4419.5	4365		4365-73	n l			4373-92	n l			4392-19.5	n l			n p	n p			n p	n p			No log
BORGER #4 (15-135-00505)	2290	4433.5	4392		4392-0.5	4392-98	9.1	84.8	4400.5-16.7				4416.7-33.5				n p	n p			n p	n p			
#1 BORGER (API # 99-0000-0028)	2290	4433.5																							
#2 Borger (99-000-00071)	2275	4418.5	4379.5		n p	n l			4379.5-98	n l			4398-13	n l			4413-18.5	n l			n p	n p			No log
DORA WAGNER NO.1 (99-0000-0032)	2283	4426.5	4382 - M7		4385-91	4385-91	18	50.5	4391-11.5	4391-02	19.5	52	4411.5-26.5				n p	n p			n p	n p			
		4384-85	18.1/49.8																						
DORA WAGNER NO.3 (99-000-00034)	2268	4411.5	4360.5-M7		4371-86	4371-86	12.5	78.6	4386-04	4386-96	15.1	72.3	4404-11.5				n p	n p			n p	n p			
#1 ANNA M. WILLIAMS (15-135-30039)	2263	4406.5	4360-M7		4363-73.5	4363-70	18.3	47	4373.5-96				4396-06.5				n p	n p			n p	n p			
ANNA WILLIAMS #2 (API #15-135-30160)	2269	4412.5	4370-M7		4387-09				4409-12.5				n p	n p			n p	n p			n p	n p			
		4370-80	20.7/57.7																						
ANNA M WILLIAMS #3 (15-135-30159)	2262	4405.5	4347-M7		4365.5-76	4365.5-75.5	22.8	38.8	4376-98				4398-05.5				n p	n p			n p	n p			
#1 H.L. WILLIAMS EST.(99-0000-0060)	2261	4404.5	4359		4359-68	4360-68	17.1	56.8	4368-92	4368-70	17.9	45.8	4392-04.5				n p	n p			n p	n p			
GILLIG "B" NO.1 (15-135-00465)	2286	4429.5	4378.5		4378.5-86	4378.5-86	15.5	67	4386-15.5	4386-93	14.7	66	4415.5-29.5				n p	n p			n p	n p			
#1 ROBERT B. LENT (15-135-30251)	2273	4416.5	4372		4372-82	4372-82	13.2	62.5	4382-01	4382-93	16.2	63.7	4401-16.5				n p	n p			n p	n p			
Humburg #1 (99-0000-0035)	2283	4426.5	4381		n p	n p			4381-00	4383-00	20	46	4400-24.5	4400-17	18.9	55.1	4424.5-26.5								
Borger #1 A (99-0000-0029)	2290	4433.5	4385		n p	n p			4385-04	4385-04	14.9	59.4	4404-26	4404-10	18.1	59.6	4426-33.5								
GILLIG #1 (15-135-20160)	2271	4414.5	4376-M7		4379.5-90	4379.5-90	16.9	63	4390-11	4390-93	17.7	64.7	4411-14.5												
		4376-79.5	22.2/31.2																						
DORA WAGNER NO.2 (99-0000-0033)	2270	4413.5	4369-M7		4372-78	4374-78	17.1	49.1	4378-98.5	4378-94	15.6	65.4	4398.5-13.5				n p	n p							
#1 WEGLE (1513523133)	2257	4400.5																							
RAHM NO.1 (1513521155)	2225	4368.5																							
Henry #2(15-135-21293)	2253	4396.5																							
#1B Frank Rein (15-135-22058)	2310	4453.5																							