NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE

It has been reproduced from the best available copy to permit the broadest possible availability.

DOE/ET/11397-1

Final Report

VOLUME AND ACCESSIBILITY OF
ENTRAINED (SOLUTION) METHANE IN
DEEP GEOPRESSURED RESERVOIRS--
TERTIARY FORMATIONS OF THE
TEXAS GULF COAST

FINAL REPORT

by

A. R. Gregory, M. M. Dodge,
J. S. Posey, and R. A. Morton

DOE/ET/11397--1

DE82 008140

Prepared for the
U.S. Department of Energy
Division of Geothermal Energy
Under Contract No. DE-AC08-78ET11397

Bureau of Economic Geology
W. L. Fisher, Director
The University of Texas at Austin
University Station, Box X
Austin, Texas 78712

October 1980

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Printed in the United States of America.

Available from:

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price:	Printed Copy	\$21.00
	Microfiche	\$ 3.50

Final Report

VOLUME AND ACCESSIBILITY OF ENTRAINED (SOLUTION)
METHANE IN DEEP GEOPRESSURED RESERVOIRS—
TERTIARY FORMATIONS OF THE TEXAS GULF COAST

by

A. R. Gregory, M. M. Dodge,
J. S. Posey, and R. A. Morton

DOE/ET/11397--1

DE82 008140

Assisted by

I. Agbon
R. F. Carroll
W. H. Chien
K. I. Idigbe
K. K. Kendall
V. Lombeida
R. McCloskey
L. S. Schillo
J. B. Swanson
K. C. W. Yong

J. H. Anderson
C. M. Garrett
L. Huebner
E. V. Jegbefume
A. Kulkarni
M. L. Lunceford
D. M. Okoye
G. D. Shoemaker
S. P. Weiner
J. J. Yoong

R. Capo-Shoemaker
B. W. Hainey
V. A. Hunter
S. Kelkar
A. S. Lawal
R. K. Manning
M. S. Ritchie
C. Sponberg
D. G. Worrell

Prepared for the

U.S. Department of Energy
Division of Geothermal Energy

Under Contract No. DE-AC08-78ET11397

Bureau of Economic Geology
W. L. Fisher, Director
The University of Texas at Austin
University Station, Box X
Austin, Texas 78712

October 1980

TABLE OF CONTENTS

	<u>Page</u>
Addendum 1	. xiii
Abstract	1
Introduction	3
Reservoir bulk volume	5
Regional geology	5
Regional assessment	7
Formation parameters	44
Pressure	44
Heat flow and formation temperatures	52
Salinity	59
Porosity	66
Parameter plots	100
Methane solubility	101
Determination of methane in-place resource	102
Recoverable methane	163
Distribution of methane in-place resource	172
Sandstone bulk volume	173
Reservoir continuity	175
Porosity and permeability	177
Reservoir models	178
Model I	179
Model II	183
Model III	185

	<u>Page</u>
Model IV	.186
Model V	.188
Geologic evaluation of economic analyses	.190
Effects of geological bias	.190
Reservoir size	.192
Dimensions of modern sandstones	.193
Structural limitations	.196
Shale effects	.197
Size distribution	.198
Reservoir quality	.199
Reservoir drive	.200
Impact of geologic variables on economic analyses	.201
Summary (by designated tasks)	.201
Acknowledgments	.207
References	.209
Appendix A Parameter plots	.215
Appendix B Tabulation of data used to determine resource	.295
Appendix C Tabulation of operational tops of geopressure	.387
Appendix D Structural cross sections	(in separate folder)

FIGURES

- A-1. Comparison of salinity and methane solubility values using old and new methods for a well logged with lime-base oil-emulsion mud in the hole xviii
- A-2. Comparison of salinity and methane solubility values using different methods for a well logged with caustic oil-emulsion mud in the hole xix

A-3.	Comparison of salinity and methane solubility values using old and new methods for a well logged with lignosulfonate mud in the hole . . .	xx
1.	Cenozoic stratigraphic section, Texas Gulf Coast	4
2.	Schematic cross section showing depositional style of Cenozoic strata along the Texas Gulf Coast	6
3.	Major structural features of the Texas Gulf Coast	8
4.	Location of structural dip and strike cross sections	9
5.	Isopach map, lower Wilcox Group below 8,000 ft	12
6.	Net sandstone distribution, lower Wilcox Group below 8,000 ft	13
7.	Effective sandstone distribution, lower Wilcox Group below 8,000 ft	14
8.	Isopach map, middle Wilcox Group below 8,000 ft	15
9.	Net sandstone distribution, middle Wilcox Group below 8,000 ft	16
10.	Effective sandstone distribution, middle Wilcox Group below 8,000 ft	17
11.	Isopach map, upper Wilcox Group below 8,000 ft	18
12.	Net sandstone distribution, upper Wilcox Group below 8,000 ft	19
13.	Effective sandstone distribution, upper Wilcox Group below 8,000 ft	20
14.	Isopach map, lower Claiborne Group below 8,000 ft	21
15.	Net sandstone distribution, lower Claiborne Group below 8,000 ft	22
16.	Effective sandstone distribution, lower Claiborne Group below 8,000 ft	23
17.	Isopach map, upper Claiborne Group (Yegua Formation) below 8,000 ft	24
18.	Net sandstone distribution, upper Claiborne Group (Yegua Formation) below 8,000 ft	25
19.	Effective sandstone distribution, upper Claiborne Group (Yegua Formation) below 8,000 ft	26
20.	Isopach map, Vicksburg-Jackson Formations below 8,000 ft	27
21.	Net sandstone distribution, Vicksburg-Jackson Formations below 8,000 ft	28
22.	Effective sandstone distribution, Vicksburg-Jackson Formations below 8,000 ft	29

	<u>Page</u>
23. Isopach map, lower Frio Formation below 8,000 ft	30
24. Net sandstone distribution, lower Frio Formation below 8,000 ft	31
25. Effective sandstone distribution, lower Frio Formation below 8,000 ft	32
26. Isopach map, upper Frio Formation below 8,000 ft	33
27. Net sandstone distribution, upper Frio Formation below 8,000 ft	34
28. Effective sandstone distribution, upper Frio Formation below 8,000 ft	35
29. Isopach map, upper Oligocene to Pleistocene formations below 8,000 ft	36
30. Net sandstone distribution, upper Oligocene to Pleistocene formations below 8,000 ft	37
31. Effective sandstone distribution, upper Oligocene to Pleistocene formations below 8,000 ft	38
32. Location of infill wells used in construction of isopach, net sandstone, and effective sandstone maps	39
33. Location of infill wells used in construction of isopach, net sandstone, and effective sandstone maps	40
34. Location of infill wells used in construction of isopach, net sandstone, and effective sandstone maps	41
35. Location of infill wells used in construction of isopach, net sandstone, and effective sandstone maps	42
36. Subdivisions delineated for detailed mapping and calculation of in-place methane resource	43
37. Resistivity versus depth for hydro pressured and geopressed shales, Kenedy County, Texas	46
38. Shale resistivity versus depth and bottom hole shut-in pressures in perforated zones of 13 wells, Kenedy County, Texas	47
39. Correlation between ratio of normal and observed shale resistivities and pressure gradients in perforated zones of 13 wells, Kenedy County, Texas	48
40. Shale resistivity, mud weight, temperature, and bottom hole shut-in pressure versus depth, Humble No. 23 S. K. East "B," Kenedy County, Texas	50
41. Bottom hole shut-in pressure from drill stem tests for wells in Kenedy County, Texas	51

	<u>Page</u>
42. Depth to operational top of geopressure	53
43. Well log temperatures corrected to equilibrium values versus depth for wells in Lavaca County, Texas	56
44. Bottom hole shut-in pressure versus depth for 57 wells in Lavaca County, Texas	57
45. Well log temperatures corrected to equilibrium values versus depth for wells in Kenedy County, Texas	58
46. Change in montmorillonite and illite content of shales as a function of depth, GCO-DOE No. 1 Pleasant Bayou, Brazoria County, Texas	60
47. Generalized salinity trends, Texas Gulf Coast	61
48. Salinity computed from SP logs versus depth for 29 wells, Kenedy County, Texas	62
49. Salinity computed from SP log versus depth, Humble No. 22 S. K. East, Kenedy County, Texas	64
50. Salinity, pressure, temperature, and methane solubility profiles of the GCO-DOE No. 2 Pleasant Bayou, Brazoria County, Texas	65
51. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions	68
52. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions	69
53. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions	70
54. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions	71
55. Comparison of whole core and resistivity log-derived porosity data for a well in lower Texas	73
56. Comparison of whole core and resistivity log-derived porosity data for a well in middle Texas	74
57. Comparison of whole core and resistivity log-derived porosity data for a well in upper Texas	75
58. Porosity versus depth plot for Subdivision 1	76
59. Porosity versus depth plot for Subdivision 2	77

	<u>Page</u>
60. Porosity versus depth plot for Subdivision 3	78
61. Porosity versus depth plot for Subdivision 4	79
62. Porosity versus depth plot for Subdivision 5	80
63. Porosity versus depth plot for Subdivision 6	81
64. Porosity versus depth plot for Subdivision 7	82
65. Porosity versus depth plot for Subdivision 9	83
66. Porosity versus depth plot for Subdivision 12	84
67. Porosity versus depth plot for Subdivision 13	85
68. Porosity versus depth plot for Subdivision 14	86
69. Porosity versus depth plot for Subdivision 15	87
70. Porosity versus depth plot for Subdivision 16	88
71. Porosity versus depth plot for Subdivision 17	89
72. Porosity versus depth plot for Subdivision 18	90
73. Porosity versus depth plot for Subdivision 20	91
74. Porosity versus depth plot for Subdivision 21	92
75. Porosity versus depth plot for Subdivision 22	93
76. Porosity versus depth plot for Subdivision 23	94
77. Porosity versus depth plot for Subdivision 24	95
78. Comparison of porosity versus depth trends for subdivisions in the Vicksburg-Frio fault zone	96
79. Comparison of porosity versus depth trends in subdivisions updip of the Vicksburg-Frio fault zone and downdip of the Wilcox fault zone	97
80. Comparison of porosity versus depth trends for subdivisions in the Wilcox fault zone	98
81. Comparison of porosity versus depth in subdivisions updip of the Wilcox fault zone	99
82. Plots for variation in temperature, pressure, salinity, and methane solubility with depth for well No. 21 on cross section 21-21' in Subdivision 2	103

	<u>Page</u>
83. Distribution of equilibrium temperature, lower Frio Formation, Texas Gulf Coast	.105
84. Map of pressure distribution, lower Frio Formation, Texas Gulf Coast	.106
85. Map of salinity distribution, lower Frio Formation, Texas Gulf Coast	.107
86. Distribution of methane solubility, lower Frio Formation, Texas Gulf Coast	.108
87. Isopach map, lower Frio Formation, Subdivision 2	.110
88. Distribution of temperature, lower Frio Formation, Subdivision 2	.111
89. Distribution of pressure, lower Frio Formation, Subdivision 2	.112
90. Distribution of salinity, lower Frio Formation, Subdivision 2	.113
91. Distribution of net sandstone thickness, lower Frio Formation, Subdivision 2	.114
92. Distribution of methane solubility, lower Frio Formation, Subdivision 2	.115
93. Regions with characteristic values of net sandstone thickness and methane solubility, lower Frio Formation, Subdivision 2	.116
94. Distribution of effective sandstone thickness, lower Frio Formation, Subdivision 2	.117
95. Regions of unique effective sandstone thickness and methane solubility, lower Frio Formation, Subdivision 2	.118
96. Distribution of porosity, lower Frio Formation, Texas Gulf Coast	.120
97. Distribution of porosity, lower Frio Formation, Subdivision 2	.121
98. Distribution of equilibrium temperatures, lower Wilcox Group	.123
99. Distribution of pressure, lower Wilcox Group	.124
100. Distribution of salinity, lower Wilcox Group	.125
101. Distribution of methane solubility, lower Wilcox Group	.126
102. Distribution of porosity, lower Wilcox Group	.127
103. Distribution of equilibrium temperature, middle Wilcox Group	.128
104. Distribution of pressure, middle Wilcox Group	.129
105. Distribution of salinity, middle Wilcox Group	.130

	<u>Page</u>
106. Distribution of methane solubility, middle Wilcox Group	. 131
107. Distribution of porosity, middle Wilcox Group	. 132
108. Distribution of equilibrium temperature, upper Wilcox Group	. 133
109. Distribution of pressure, upper Wilcox Group	. 134
110. Distribution of salinity, upper Wilcox Group	. 135
111. Distribution of methane solubility, upper Wilcox Group	. 136
112. Distribution of porosity, upper Wilcox Group	. 137
113. Distribution of equilibrium temperature, lower Claiborne Group	. 138
114. Distribution of pressure, lower Claiborne Group	. 139
115. Distribution of salinity, lower Claiborne Group	. 140
116. Distribution of methane solubility, lower Claiborne Group	. 141
117. Distribution of porosity, lower Claiborne Group	. 142
118. Distribution of equilibrium temperature, upper Claiborne Group (Yegua Formation)	. 143
119. Distribution of pressure, upper Claiborne Group (Yegua Formation)	. 144
120. Distribution of salinity, upper Claiborne Group (Yegua Formation)	. 145
121. Distribution of methane solubility, upper Claiborne Group (Yegua Formation)	. 146
122. Distribution of porosity, upper Claiborne Group (Yegua Formation)	. 147
123. Distribution of equilibrium temperature, Vicksburg-Jackson Formations	. 148
124. Distribution of pressure, Vicksburg-Jackson Formations	. 149
125. Distribution of salinity, Vicksburg-Jackson Formations	. 150
126. Distribution of methane solubility, Vicksburg-Jackson Formations	. 151
127. Distribution of porosity, Vicksburg-Jackson Formations	. 152
128. Distribution of equilibrium temperature, upper Frio Formation	. 153
129. Distribution of pressure, upper Frio Formation	. 154

	<u>Page</u>
130. Distribution of salinity, upper Frio Formation	.155
131. Distribution of methane solubility, upper Frio Formation	.156
132. Distribution of porosity, upper Frio Formation	.157
133. Distribution of equilibrium temperature, upper Oligocene to Pleistocene formations	.158
134. Distribution of pressure, upper Oligocene to Pleistocene formations . . .	.159
135. Distribution of salinity, upper Oligocene to Pleistocene formations . . .	.160
136. Distribution of methane solubility, upper Oligocene to Pleistocene formations	.161
137. Map of porosity distribution, upper Oligocene to Pleistocene formations .	.162
138. Relationships between depositional environments and reservoir continuity, Texas Gulf Coast	.176
139. Reservoir models I and II for the Wilcox Group, Texas Gulf Coast . . .	.180
140. Reservoir models III, IV, and V for the Vicksburg and Frio Formations, Texas Gulf Coast	.181
141. Fairway and prospect areas of geothermal investigations	.182

TABLES

A-1. Comparison of values of aqueous methane solubility	.xvii
1. Gas-producing wells in Kenedy County, Texas, for which bottom hole shut-in pressure data were available from drill stem tests	45
2. Average net sandstone thickness, net sandstone bulk volume, pore volume, porosity, methane solubility, and volume of solution methane for Subdivision 2	.122
3. In-place dissolved methane, Tertiary net sandstones, onshore Texas Gulf Coast	.164
4. In-place dissolved methane, Tertiary effective sandstones, onshore Texas Gulf Coast	.165
5. Bulk volume of net sandstone, onshore Texas Gulf Coast	.166
6. Pore volume of net sandstone, onshore Texas Gulf Coast	.167

	<u>Page</u>
7. Range of methane solubility in formation waters, onshore Texas Gulf Coast	.168
8. Bulk volume of effective sandstones, onshore Texas Gulf Coast	.169
9. Pore volume of effective sandstones, onshore Texas Gulf Coast	.170
10. Range of methane solubility in formation waters, onshore Texas Gulf Coast	.171
11. Distribution of in-place methane dissolved in formation waters, onshore Texas Gulf Coast	.172
12. Summary of characteristics of depositional-structural models of Wilcox, Vicksburg, and Frio reservoirs	.191
13. Estimated maximum size of individual sand bodies in selected deltaic facies	.194
14. Metric conversion factors	.195

ADDENDUM 1

REVISED METHODS FOR CALCULATING METHANE SOLUBILITY AND SALINITY AND THEIR AFFECT ON METHANE ASSESSMENT

In this report methane solubility was calculated by an empirical equation (equation 7, p. 101) based on the experimental measurements of Blount and others (1979). Shortly after completion of this study, Blount and his co-workers discovered errors in the processing of their experimental data. The errors were corrected and new equations were formulated to determine the solubility of methane in water and in NaCl solutions for salinities of 0 to 300 grams per liter, a temperature range of 160° to 464°F, and a pressure range of 3,500 to 22,500 psi. Equations A and B below give the "best fit" to the average corrected experimental data (Price and others, 1981).

$$\begin{aligned}\log_e \text{CH}_4^* &= -1.4053 - 0.002332t + \\ &6.30 \times 10^{-6}t^2 - 0.004038S - 7.579 \times 10^{-6}p \\ &+ 0.5013 \log_e p + 3.235 \times 10^{-4}t \log_e p. \\ \text{Standard deviation of residuals} &= 0.0706 \\ \text{Multiple R} &= 0.9944\end{aligned}\tag{A}$$

$$\begin{aligned}\log_e \text{CH}_4^* &= -3.3544 - 0.002277t + \\ &6.278 \times 10^{-6}t^2 - 0.004042S + 0.9904 \log_e p \\ &- 0.0311 (\log_e p)^2 + 3.204 \times 10^{-4}t \log_e p. \\ \text{Standard deviation of residuals} &= 0.0709 \\ \text{Multiple R} &= 0.9943\end{aligned}\tag{B}$$

*CH₄ is in standard cubic feet (SCF) per petroleum barrel (42 gallons) at 25°C (77°F) and one atmosphere.

t is ° Fahrenheit.

S is salinity in grams per liter.

p is pressure in psi.

Comparison of values of methane solubility calculated by the former method (equation 7, page 101) and the revised method (equation A or B) for the range of salinities, pressures, and temperatures presented in this study show that the revised method gives significantly lower values (table A-1). Differences in solubilities calculated by the two methods are non-linear with respect to changes in salinity, pressure, and temperature. Therefore a constant correction factor cannot be applied to the in-place solution methane assessments that are made in this report.

Assessment of methane resources is further complicated by the uncertainties of log-derived salinities. Salinity in this report was determined from the SP log, using mud filtrate resistivity (R_{mf}) values recorded on the header of well logs, and following the algorithm of Bateman and Konen (1977). This method represented the state of the art when this study was done. An improved method (Dunlap and Dorfman, 1981) for determining salinity in deep hot wells logged with lignosulfonate mud and certain other types of muds was not available in time to be used in this study. Salinities derived by the improved method are commonly higher than those determined using R_{mf} values from the well log headers. The higher calculated salinities also cause reductions in estimates of methane solubility. The combined effects of using the revised equations for calculating methane solubility and the improved method for determining salinity are additive since both of these operations tend to reduce the estimated solubility of methane in formation waters.

Three wells were selected to illustrate differences in salinity and methane solubility obtained by former and revised methods (figs. A-1, A-2, and A-3). A different type of mud was used in each well. Although salinity and methane solubility profiles are plotted for both shallow and deep portions of these wells, only deep

sandstone reservoirs below -8,000 ft were considered in the assessment of solution methane.

The Halbouty and Pan American Petroleum Corporation no. 2 Doornbos well (fig. A-1) was logged with lime-base oil-emulsion mud in the hole. Salinities determined from the SP log using R_{mf} values from the well log header are about the same as those determined by the Dunlap and Dorfman method at depths above 9,200 ft. In the deep lower Hackberry (Frio) sandstone units from -11,100 to -11,500 ft, the Dunlap and Dorfman method gives much higher salinities than those obtained using the R_{mf} from the well log header. A mud weight of 17.2 lb/gal and a wellbore temperature of 180°F was recorded in the lower Hackberry sandstones at a depth of 11,348 ft. At depths above 9,200 ft differences in methane solubility calculated by old and new methods (fig. A-1) are caused only by differences in old and new equations. However, solubility differences in the lower Hackberry sandstones below -11,000 ft are caused by a combination of higher salinities determined with the Dunlap and Dorfman method and by the differences in old and new solubility equations. At depths greater than 8,000 ft methane solubility values determined by the revised methods are 20 to 40 percent lower than those calculated by methods used in this report.

The Humble no. 22 S. K. East well was logged with caustic oil-emulsion mud in the hole to a depth of over 16,000 ft. A comparison is shown (fig. A-2) for salinities determined from the SP log using (1) the R_{mf} header value and (2) R_{mf} values from the Gen 7 method (Schlumberger, 1978). The Gen 7 method gives higher salinity values above 10,800 ft and lower salinity values in the highly geopressed sandstones below 10,800 ft. Again at depths below 8,000 ft methane solubilities determined by the new method are 12 to 18 percent lower than those calculated by the old method.

Large reductions in estimates of methane solubility ranging from 31 to 46 percent were observed between the new method and the old method at depths below

8,000 ft in the Prudential no. 1-A Doornbos well (fig. A-3). The well was logged with lignosulfonate mud in the hole. The geopressed lower Hackberry sandstones are located in the depth interval from 10,860 to 11,620 ft. Mud weights across this interval increased from 13.5 to 17.5 lb/gal and borehole temperatures increased from 180° to 220°F.

In summary methane solubilities estimated by the revised methods are generally 5 to 10 scf/bbl lower than those estimated by the former methods used in this report. This represents average reductions in estimates on the order of 10 to 40 percent.

REFERENCES

- Bateman, R. M., and Konen, C. E., 1977, The log analyst and the programmable pocket calculator: *The Log Analyst*, v. 18, no. 5, p. 3-11.
- Blount, C. W., Price, L. C., Wenger, L. M., and Tarullo, M., 1979, Methane solubility in aqueous NaCl solutions at elevated temperatures and pressures: Idaho State University and U.S. Geological Survey, progress report, U.S. Department of Energy Contract No. ET-78-S-07-1716, 38 p.
- Dunlap, H. F., and Dorfman, M. H., 1981, Problems and partial solutions in using the S.P. log to predict water salinity in deep hot wells: *Proceedings, Fifth Conference on Geopressed-Geothermal Energy*, U.S. Gulf Coast, Louisiana State University, p. 189-192.
- Price, L. C., Blount, C. W., Mac Gowen, D., and Wenger, L., 1981, Methane solubility in brines with application to the geopressed resource: *Proceedings, Fifth Conference on Geopressed-Geothermal Energy*, U.S. Gulf Coast, Louisiana State University, p. 205-214.
- Schlumberger, 1978, *Log interpretation charts*, page 3.

Table A-1

Comparison of values of aqueous methane solubility (scf/bbl), calculated by old and new methods*, versus pressure (psi), salinity (g/liter), and temperature (°F).

Salinity g/liter	Pressure/psi									
	3,500		5,000		7,000		10,000		13,000	
	old	new	old	new	old	new	old	new	old	new
212°F										
0	24.88	20.2	28.87	24.5	33.22	29.25	38.54	35.0	43.00	39.8
20	23.31	18.7	26.99	22.6	30.99	27.0	35.87	32.3	39.95	36.7
50	21.15	16.5	24.40	20.0	27.92	23.9	32.20	28.6	35.77	32.5
100	17.98	13.5	20.62	16.4	23.46	19.5	26.90	23.4	29.75	26.5
150	15.28	11.0	17.42	13.4	19.72	16.0	22.48	19.1	14.75	21.7
200	12.99	9.02	14.72	10.9	16.57	13.0	18.78	15.6	20.59	17.7
250	11.04	7.38	12.44	8.94	13.92	10.7	15.69	12.8	17.13	14.5
275°F										
0	30.40	25.0	35.78	30.6	41.71	36.7	49.08	44.3	55.32	50.5
20	28.27	23.1	33.21	28.2	38.65	33.9	45.40	40.8	51.10	46.6
50	25.36	20.5	29.70	25.0	34.48	30.0	40.38	36.2	45.36	41.3
100	21.15	16.7	24.66	20.4	28.50	24.5	33.23	29.6	37.20	33.8
150	17.63	13.7	20.47	16.7	23.56	20.0	27.34	24.2	30.51	27.6
200	14.71	11.2	16.99	13.6	19.47	16.4	22.50	19.8	25.02	22.5
250	12.27	9.12	14.11	11.1	16.10	13.4	18.51	16.1	20.52	18.4
338°F										
0	38.69	32.6	46.7	40.0	54.54	48.4	65.08	58.8	74.11	67.5
20	35.71	30.0	42.55	36.9	50.21	44.7	59.83	54.3	68.07	62.3
50	31.66	26.6	37.65	32.7	44.34	39.6	52.74	48.1	59.92	55.2
100	25.90	21.8	30.71	26.7	36.05	32.3	42.74	39.3	48.44	45.1
150	21.19	17.8	25.04	21.8	29.31	26.4	34.64	32.1	39.16	36.8
200	17.34	14.5	20.42	17.8	23.83	21.6	28.07	26.2	31.66	30.1
250	14.19	11.9	16.65	14.6	19.38	17.6	22.75	21.4	25.60	24.6
401°F										
0	51.29	44.5	62.06	55.1	74.28	67.2	89.88	82.2	103.40	94.8
20	46.97	41.1	56.79	50.8	67.93	61.9	82.13	75.8	94.43	87.5
50	41.17	36.4	49.71	45.0	59.40	54.9	71.74	67.2	82.42	77.5
100	33.04	29.7	39.83	36.8	47.50	44.8	57.26	54.9	65.69	63.3
150	26.52	24.3	31.91	30.1	37.99	36.6	45.70	44.9	52.36	51.8
200	21.29	19.9	25.56	24.6	30.38	30.0	36.48	36.7	41.73	42.3
250	17.09	16.2	20.48	20.1	24.29	24.5	29.11	30.0	33.26	34.6

* old method (Blount and others, 1979); new method (Price and others, 1981).

Figure A-1. Comparison of salinity and methane solubility values using old and new methods for a well logged with lime-base oil-emulsion mud in the hole.

Figure A-2. Comparison of salinity and methane solubility values using different methods for a well logged with caustic oil-emulsion mud in the hole.

Figure A-3. Comparison of salinity and methane solubility values using old and new methods for a well logged with lignosulfonate mud in the hole.

VOLUME AND ACCESSIBILITY OF ENTRAINED (SOLUTION)
METHANE IN DEEP GEOPRESSURED RESERVOIRS--
TERTIARY FORMATIONS OF THE TEXAS GULF COAST

ABSTRACT

Declining domestic production and a recent dramatic increase in price for natural gas have stimulated interest in the methane dissolved in formation waters of sandstone reservoirs in the Texas Gulf Coast as a potential alternative source of energy.

The objective of this project was to appraise the total volume of in-place methane dissolved in formation waters of deep sandstone reservoirs of the onshore Texas Gulf Coast within the stratigraphic section extending from the base of significant hydrocarbon production (8,000 ft)* to the deepest significant sandstone occurrence. The area of investigation is about 50,000 mi². Factors that determine the total methane resource are reservoir bulk volume, porosity, and methane solubility; the latter is controlled by the temperature, pressure, and salinity of formation waters.

Regional assessment of the volume and the distribution of potential sandstone reservoirs was made from a data base of 880 electrical well logs, from which a grid of 24 dip cross sections and 4 strike cross sections was constructed. These cross sections extend from near the Wilcox outcrop to the coastline. Parameter plots corresponding to the cross sections were made to show how formation pressure, salinity, temperature, and porosity vary with depth in each well. Reservoir bulk volume was determined

*Metric conversion factors are given in table 14.

by mapping the structural and stratigraphic framework of Tertiary sandstone units. Structural and stratigraphic boundaries were used to divide the Texas Gulf Coast into 24 subdivisions. Solution methane content in each of nine formations or divisions of formations was determined for each subdivision. The distribution of solution methane in the Gulf Coast was described on the basis of five reservoir models. Each model was characterized by depositional environment, reservoir continuity, porosity, permeability, and methane solubility.

The total bulk volume of Tertiary net sandstone below 8,000 ft is estimated to be $5,700 \text{ mi}^3$, and the corresponding pore volume is 780 mi^3 . Almost half of the total bulk volume of net sandstone is made up of effective sandstones that are more than 30 ft thick.

Methane solubility values for formation waters of Tertiary sandstones range from 10 to 120 standard ft^3 per barrel (SCF/bbl). The total in-place volume of methane for Tertiary sandstones below 8,000 ft in the Texas Gulf Coast is 690×10^{12} SCF. The total in-place volume of solution methane for "effective" Tertiary sandstones (sandstone units greater than 30 ft thick) below 8,000 ft is 325×10^{12} SCF. The corresponding recoverable volumes of solution methane range from 21×10^{12} to 35×10^{12} SCF for net sandstones and from 10×10^{12} to 16×10^{12} SCF for effective sandstones, assuming a recovery factor of 3 to 5 percent of the in-place methane resource.

INTRODUCTION

Energy resources contained in geopressed sandstones along the Texas Gulf Coast are (1) thermal energy from hot brines, (2) mechanical energy from high formation fluid pressure, and (3) energy from natural gas (mostly methane) dissolved in formation water. Initial interest focused primarily on heat that could be extracted from hot brines and converted to electrical energy through turbines at the surface. In recent years, the economic climate in the United States has changed substantially because of the energy crisis, and the resulting increase in the price of natural gas has shifted economic interest from hot water to solution methane.

Estimates of the in-place and recoverable solution methane resource in geopressed sandstones in the northern Gulf of Mexico basin made by other investigators ranged from $3,000 \times 10^{12}$ SCF (125×10^{12} SCF recoverable) (Hise, 1976) to $49,000 \times 10^{12}$ SCF ($1,146 \times 10^{12}$ SCF) recoverable (Jones, 1976). These investigations covered about the same onshore and offshore areas, but different assessment techniques were used; therefore, the results are not directly comparable. The U.S. Geological Survey (USGS) first published some estimates of the accessible fluid resource base (Papadopoulos and others, 1975); generally these estimates are within the ranges quoted above. A revised USGS assessment (Wallace and others, 1978) estimated a dissolved methane resource of $1,792 \times 10^{12}$ SCF for geopressed sandstones in offshore and onshore Texas, including the inland upper Cretaceous sandstones. Recoverable methane was estimated to be 750×10^{12} SCF for their development plan 2, where the recovery was reported to be 3.3 percent of the accessible fluid resource base. These widely ranging estimates of in-place and recoverable solution methane indicated that a more detailed analysis of onshore Tertiary sediments in the Texas Gulf Coast was needed.

CENOZOIC — TEXAS GULF COAST

SYSTEM	SERIES	GROUP / FORMATION
Quaternary	Recent	Undifferentiated
	Pleistocene	Houston
Tertiary	Pliocene	Goliad
	Miocene	Fleming
		Anahuac
	Oligocene	Frio
		Vicksburg
		Jackson
	Eocene	Claiborne
		Wilcox
		Midway

Figure 1. Cenozoic stratigraphic section, Texas Gulf Coast.

The main objective of this study was to appraise the total volume of in-place methane dissolved in formation waters of deep sandstone reservoirs along the onshore Texas Gulf Coast. It was assumed in this study that all formation waters are saturated with methane, under the existing subsurface conditions of pressure, temperature, and salinity.

The top of the zone examined is the average base of oil production in the Texas Gulf Coast, about 8,000 ft below mean sea level (International Oil Scouts, 1978). The lower limit of the zone of interest is the base of the Wilcox Group, because it contains the deepest volumetrically significant sandstone units. Below the Wilcox, the stratigraphic section is almost entirely shale. The area of investigation is about 50,000 mi². Structural dip and strike cross sections over this area are attached in a separate folder (Appendix D).

Regions of significant sandstone development in the Tertiary formations (fig. 1) could contain substantial quantities of solution methane (Bebout, 1976). Factors that must be evaluated to determine the total solution methane resource are reservoir bulk volume, porosity, and methane solubility; the latter is controlled by temperature, pressure, and salinity of the formation water. Reservoir bulk volume is determined by

mapping the structural and stratigraphic framework of Tertiary sandstone units.

Porosity is determined from core analyses or derived from induction resistivity and spontaneous potential (SP) logs. Formation fluid pressure is determined from drill stem tests or derived from shale resistivity log data; salinity is calculated from SP log data, and equilibrium temperature is calculated from well log header temperatures. These parameters are plotted versus depth for most wells on dip and strike cross sections (Appendix A).

This paper describes methods used for evaluating the in-place solution methane resource. Illustrations of these methods are given for Subdivision 2, consisting of most of Kenedy, Kleberg, Nueces, and San Patricio Counties and parts of adjacent counties. A resource estimate is presented for all Tertiary sandstones below 8,000 ft along the onshore Texas Gulf Coast and for "effective" sandstones in this area, which are defined as sandstones greater than 30 ft thick.

RESERVOIR BULK VOLUME

Regional Geology

The onshore Tertiary Gulf Coast stratigraphic section is composed of many terrigenous clastic wedges of sediments that were carried in fluvial systems to the coastal margins and deposited as deltaic systems or reworked by marine processes into strandplains and barrier bars. Contemporaneous growth faulting occurred at sites of maximum deposition as these clastic wedges prograded gulfward and were deposited on the underlying low-density, water-saturated mud (prodelta and shelf muds). Continuous movement along growth faults resulted in thick, downdip accumulations of sand and mud that became isolated from updip sediments during burial (fig. 2). Abnormally high pressures developed in the isolated sections as a result of fluid entrapment, and higher-than-normal geothermal gradients developed (Bruce, 1973).

Figure 2. Schematic cross section showing depositional style of Cenozoic strata along the Texas Gulf Coast (modified from Bruce, 1973).

Deposition and faulting of these Tertiary clastic wedges were structurally controlled. The onshore Texas Gulf Coast region consists of three major structural provinces, the San Marcos Arch and the Houston and Rio Grande Embayments (fig. 3). These structural provinces effectively divide the Texas Gulf Coast into upper, middle, and lower parts (fig. 3). The San Marcos Arch, a broad, gently sloping platform that extends southeast from the Llano Uplift in Central Texas, strongly influenced the location of the lower Cretaceous Sligo and Stuart City carbonate shelf margins (fig. 3) (Fisher and Rodda, 1969; Rose, 1972). Development of growth faults in the Wilcox Group (the lowermost Tertiary clastic wedge) was in turn controlled by the location of the Sligo shelf margin (Bebout and others, 1979); Wilcox deltaic systems prograded across the continental shelf to the shelf margin, where growth faulting began. The overlying Claiborne Group and Jackson Formation did not prograde to the shelf margin and, thus, were not subject to major growth faulting. Subsequent increases in sediment supply, however, resulted in the deposition of Vicksburg and Frio sediments basinward of the growth fault trend in the Wilcox Group (figs. 2 and 3).

Vicksburg growth faulting was controlled by the location of the Wilcox shelf margin. Greater separation of the Wilcox and Vicksburg fault zones occurs in the embayments, particularly the Rio Grande Embayment, as a result of greater sediment supply and more rapid progradation during deposition of the Vicksburg Formation.

Regional Assessment

Regional assessment of the volume and distribution of potential reservoirs was made using a data base of 880 electrical well logs, from which a grid of cross sections was constructed (fig. 4). Twenty-four structural dip cross sections, using sea level as the datum, were spaced 15 to 20 mi apart along the Texas coast, extending from near the Wilcox outcrop to the coastline. Four structural strike cross sections tied to wells on dip sections were constructed to ensure consistency of correlation.

Figure 3. Major structural features of the Texas Gulf Coast.

Figure 4. Location of structural dip and strike cross sections.

Tops of formations were chosen by correlations with Wilcox, Vicksburg, and Frio stratigraphic cross sections constructed in previous geothermal investigations (Bebout and others, 1975a, 1975b, 1976a, 1979; Loucks, 1979), regional Tertiary cross sections (Bebout and others, 1976b), and cross sections provided by Exxon, U.S.A., and GeoMap Company. Upper, middle, and lower units within the Wilcox Group were delineated by Bebout and others (1979) as a modification of the work of Fisher and McGowen (1967). The Claiborne Group was divided into two units by distinguishing between the lower Claiborne, which is predominantly shale along most of the Texas Gulf Coast, and the upper Claiborne, which is the sandstone-rich Yegua Formation. Most of the Claiborne Group is not geopressed, but the Yegua contains potential geothermal reservoirs in the hydro pressured zone. Jackson and Vicksburg Formations were not differentiated in this study as the paleontological data necessary to distinguish between them was not available. The only volumetrically significant sandstones in the zone of interest (below 8,000 ft) in these formations are found in the Vicksburg Formation in South Texas. The top of the Frio Formation along the coast was redefined on the basis of detailed mapping of the Austin Bayou geothermal prospect (Bebout and others, 1978); in updip wells, the top of the Frio was determined by Catahoula and Oakville correlations made by Galloway (1977; personal communication, 1980). The Frio base was redefined according to mapping of the Vicksburg Formation in South Texas (Loucks, 1979). The Frio Formation was divided into upper and lower units by the T_4 marker, which was based on the appearance of the paleontological marker Nodosaria blanpiedi and on lithologic correlations (Bebout and others, 1975a, 1975b, 1976a).

Salt domes and growth faults shown on cross sections in this study were taken from structural maps prepared by GeoMap Company. Areas of high fault density are commonly shown schematically as a single fault with average dip and cumulative displacement.

Isopach maps (total thickness), maps of net sandstone, and effective sandstone (defined as sandstone bodies greater than 30 ft thick) were constructed for each formation below 8,000 ft (figs. 5 through 31) from cross-section and infill-well data (figs. 32, 33, 34, 35, and Appendix B).

Because resource assessment techniques required closed contours, all available well data were used, including logs that did not penetrate the entire formation. Contour lines were drawn by using exact net sandstone and total thickness values from wells that penetrated the entire formation; elsewhere, net sandstone and total thickness values were estimated for wells that did not penetrate the entire formation. Contour lines were also artificially truncated against a line marking the updip limit of the zone of interest in each formation. Owing to the constraints placed on map construction by project requirements, these maps cannot be used to interpret depositional environments. Complete sand distribution maps and discussions of depositional settings are presented by Bebout and others (1978, 1979); Fisher and McGowen (1967); Fisher and others (1969, 1970); Guevara and Garcia (1972); Loucks (1979); and Doyle (1979).

The Texas Gulf Coast was divided into 24 subdivisions (fig. 36) for detailed mapping and calculation of the in-place methane resource. Locations of Wilcox, Vicksburg, and Frio fault zones (fig. 3), as determined on each dip cross section, delineated four bands that parallel the coast. These bands encompass (1) the area updip of the Wilcox fault zone, including Subdivisions 19 through 24, (2) the Wilcox fault zone, including Subdivisions 13 through 18, (3) the area between the Wilcox fault zone and the Vicksburg and Frio fault zones, including Subdivisions 7 through 12, and (4) the area between the Vicksburg and Frio fault zones and the coast, including Subdivisions 1 through 6. Boundary lines perpendicular to the coast were drawn to separate and bisect the three structural provinces (fig. 3). For ease of calculation, the latter boundaries were drawn along nearest county lines. Each formation in each

Figure 5. Isopach map, lower Wilcox Group below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

EXPLANATION

Contour interval = 500 ft (152 m)

Figure 6. Net sandstone distribution, lower Wilcox Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 5).

Figure 7. Effective sandstone (sandstones greater than 30 ft thick) distribution, lower Wilcox Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 5).

Figure 8. Isopach map, middle Wilcox Group below 8,000 ft. Locations of wells on cross sections are shown by small dots, and infill wells are shown by larger dots.

Figure 9. Net sandstone distribution, middle Wilcox Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 8).

Figure 10. Effective sandstone (sandstones greater than 30 ft thick) distribution, middle Wilcox Group below 8,000 ft. Data used in addition to cross-section data is shown on the isopach map (fig. 8).

Figure 11. Isopach map, upper Wilcox Group below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 12. Net sandstone distribution, upper Wilcox Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 11).

Figure 13. Effective sandstone (sandstones greater than 30 ft thick) distribution, upper Wilcox Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 11).

Figure 14. Isopach map, lower Claiborne Group below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 15. Net sandstone distribution, lower Claiborne Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 14).

Figure 16. Effective sandstone (sandstones greater than 30 ft thick) distribution, lower Claiborne Group below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 14).

Figure 17. Isopach map, upper Claiborne Group (Yegua Formation) below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 18. Net sandstone distribution, upper Claiborne Group (Yegua Formation) below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 17).

Figure 19. Effective sandstone (sandstones greater than 30 ft thick) distribution, upper Claiborne Group (Yegua Formation) below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 17).

Figure 21. Net sandstone distribution, Vicksburg-Jackson Formations below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 20).

Figure 23. Isopach map, lower Frio Formation below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 24. Net sandstone distribution, lower Frio Formation below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 23).

Figure 25. Effective sandstone (sandstones greater than 30 ft thick) distribution, lower Frio Formation below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 23).

Figure 26. Isopach map, upper Frio Formation below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 27. Net sandstone distribution, upper Frio Formation below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 26).

EXPLANATION

Contour interval = 250 ft (76m)

Figure 28. Effective sandstone (sandstones greater than 30 ft thick) distribution, upper Frio Formation below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 26).

Figure 29. Isopach map, upper Oligocene to Pleistocene formations below 8,000 ft. Locations of wells on cross sections are shown by small dots and infill wells are shown by larger dots.

Figure 30. Net sandstone distribution, upper Oligocene to Pleistocene formations below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 29).

Figure 31. Effective sandstone (sandstones greater than 30 ft thick) distribution, upper Oligocene to Pleistocene formations below 8,000 ft. Data used in addition to cross-section data are shown on the isopach map (fig. 29).

Figure 32. Location of infill wells used in construction of isopach, net sandstone and effective sandstone maps.

Figure 33. Location of infill wells used in construction of isopach, net sandstone and effective sandstone maps.

Figure 35. Location of infill wells used in construction of isopach, net sandstone and effective sandstone maps.

Figure 36. Subdivisions delineated for detailed mapping and calculation of in-place methane resource.

subdivision, therefore, may be characterized by its structural as well as its depositional setting.

FORMATION PARAMETERS

Pressure

Formation fluid pressures were derived from shale resistivity data using the method of Hottman and Johnson (1965). Data from well logs and from drill stem tests (DST) for 13 selected wells in Kenedy County (table 1) were used to illustrate this method. Shale resistivity values (R_{sh}) from amplified short normal resistivity curves of induction logs were plotted as a function of depth for both hydropressured and geopressured zones (fig. 37), and normal compaction curves were drawn by a least squares regression method. R_{sh} data falling near this curve indicate normally pressured shales, whereas R_{sh} data that are lower than normal and fall to the left of this curve indicate geopressure.

Wells with bottom hole shut-in pressure (BHSIP) from DST (table 1) were plotted on a shale resistivity versus depth plot (fig. 38) by reading the R_{sh} value nearest the sandstone formations that were tested. Measured values of bottom hole shut-in pressure and pressure gradients from DST are also shown at the average depth of the perforated intervals. These wells have pressure gradients ranging from 0.47 to 0.93 psi/ft; therefore, all the perforated sandstones are geopressured by the conventional definition of geopressured reservoirs in the Gulf Coast area, i.e., reservoirs with pressure gradients that exceed 0.465 psi/ft. Shale resistivities are lower than normal and fall to the left of the normal compaction curve. Figure 39 shows how the resistivity ratio between the normal values ($R_{sh(n)}$) on the normal compaction curve and the observed values ($R_{sh(ob)}$) from resistivity logs for the 13 wells are used to establish the best relationship for converting resistivity ratio to pressure gradient.

Table 1. Gas-producing wells in Kenedy County, Texas, for which BHSIP* data were available from drill stem tests.

1. Humble No. 2 King Ranch Saltillo, 26S-19E-7
2. Hill & Wagner No. 3 McGill, 23S-17E-2
3. Humble No. 2 Kenedy, Jr. "H," 23S-18E
4. Humble No. 13 Kenedy, Jr. "E," 23S-19E-9
5. Humble No. 2 C. F. Risken, 23S-19E-8
6. Exxon No. 75 S. K. East, 25S-18E-3
7. Humble No. 24 S. K. East "B," 22S-19E
8. Humble No. 3 Santa Fe Ranch Mula Pasture, 27S-17E
9. Humble No. 14 Kenedy, Jr. "J," 23S-19E-8
10. Humble No. 13 S. K. East "B," 23S-19E-2
11. Humble No. 2 Kenedy, Jr. "J," 23S-19E-9
12. Humble No. 18 S. K. East "B," 22S-19E-7
13. Humble No. 23 S. K. East "B," 22S-19E

*Bottom hole shut-in pressure

Figure 37. Resistivity versus depth for hydro pressured and geo pressured shales, Kenedy County, Texas.

Figure 38. Shale resistivity versus depth and bottom hole shut-in pressures in perforated zones of 13 wells, Kenedy County, Texas.

Figure 39. Correlation between ratio of normal and observed shale resistivities and pressure gradients in perforated zones of 13 wells, Kenedy County, Texas.

The shale resistivities of these 13 wells are believed to be representative of shales in the 2,000- to 16,000-ft depth interval in Kenedy County. Hence, for most wells in Kenedy County, the shale resistivity ratio curve (fig. 39) can be used to obtain pressure profile data.

Geopressure profiles were determined for each of the 13 wells on individual plots of R_{sh} versus depth and for all wells shown on cross sections (fig. 4); a sample plot is shown for well number 13 (table 1 and fig. 40). The depth where values of R_{sh} decrease and cross to the left of the normal compaction curve is defined in this report as the "operational top of geopressure." The term is useful when applied to geothermal reservoirs, which depend on large driving forces to produce the water. Other methods that can be used to aid in determining operational top of geopressure are (1) shale transit time difference plots (Gregory and Backus, 1980), (2) pressure data from drill stem tests, and (3) mud weights from well log headers. The word "operational" will be deleted from the term "operational top of geopressure" in the rest of this report. Using shale resistivity data, geopressure gradients for tops of geopressure in the suite of 13 wells in Kenedy County varied from 0.60 to 0.72 psi/ft and averaged 0.68 psi/ft. Depths to top of geopressure ranged from 9,600 to 11,500 ft and averaged 10,623 ft. If R_{sh} values did not decrease and cross to the left of the normal compaction curve, the well was not considered to be geopressured for geothermal applications.

The average depth of normal fluid pressures for a given area was obtained by plotting bottom hole shut-in pressures from DST versus depth and picking the depth where the least squares regression line crosses the gradient line of 0.465 psi/ft. In Kenedy County the average maximum depth for normal fluid pressures is about 9,000 ft (fig. 41). Average depths to other pressure gradients can also be obtained from the plot when adequate data are available.

Figure 40. Shale resistivity, mud weight, temperature, and bottom hole shut-in pressure versus depth, Humble No. 23 S. K. East "B," Kenedy County, Texas.

Figure 41. Bottom hole shut-in pressure from drill stem tests for wells in Kenedy County, Texas.

The top of geopressure (fig. 42 and Appendix C) along the Texas Gulf Coast shows a series of elongate highs and lows, reflecting changes in sandstone volume and growth faulting. The top of geopressure is deeper in porous, water-bearing sandstones than in relatively impermeable shales. Growth faults are extensive in sandstone-rich sections, where they influence vertical and lateral fluid movement by controlling the permeability between sandstone units. Along the upper Texas Coast, depth to the top of geopressure first increases from 10,000 to 13,000 ft (fig. 42) because of vertical accumulation of lower Wilcox deltaic sandstones adjacent to the Wilcox fault zone. Downdip of the Wilcox fault zone, where prodelta and shelf shales are dominant, depth to the top of geopressure decreases to about 8,000 ft. It increases again to about 12,000 ft in the sandstones adjacent to the Vicksburg-Frio fault zone and decreases again to 8,000 ft downdip of the main sand depocenter. Along the lower Texas Coast the top of geopressure was not affected by upper Wilcox deltaic sedimentation. Depth to the top of geopressure decreases from 11,000 to 7,000 ft across the Wilcox fault zone, increases to 12,000 ft in the massive sands adjacent to the Vicksburg-Frio fault zone, and decreases again downdip of the main sand depocenters (fig. 42). Tops of geopressure are also given for wells along strike and dip cross sections on parameter plots (Appendix A).

Heat Flow and Formation Temperatures

Heat from deep within the Earth moves outward to the surface, where it is lost as radiant energy into the atmosphere or ocean. The flow of heat, Q , varies in different areas but is essentially constant for a specific locality within a basin (Hunt, 1979). The heat flow equation is

$$Q = k_h A \left(\frac{\Delta T}{Z} \right), \quad (1)$$

where k_h is the coefficient of thermal conductivity of the material, A is the cross sectional area of the material measured perpendicular to the flow of heat, and ΔT is

Figure 42. Depth to operational top of geopressure. Data used for construction of map are listed in Appendix C.

the temperature change across the material of thickness Z . When the flow of heat encounters an insulating material with an abnormally low value of k_h , the temperature rises at the face of the material until ΔT is large enough to restore Q to a constant equilibrium value. Hence, to achieve equal flow rates through heat insulators (low values of k_h) and heat conductors (higher values of k_h) occurring in series, a higher temperature gradient is required across the insulator.

Lewis and Rose (1970) developed the concept that geopressed zones are heat insulators with low values of k_h ; hence, abnormally high geothermal gradients are expected to exist across them. The low values of k_h in geopressed zones are caused by the higher water content of sediments in these zones. For example, the k_h value for water is 0.363 Btu/hr ft $^{\circ}\text{F}$, which is about one-third of the k_h values for the rock matrices of shale and sandstone. This means that an increase in porosity will reduce the thermal conductivity and increase the geothermal gradient of most sediments. In sand/shale sequences, shales have lower conductivity than sandstones. The value of k_h for slate is about 1.138 Btu/hr ft $^{\circ}\text{F}$; presumably dry shale has about the same value of k_h as slate. Sandstone has a k_h value of 1.330 Btu/hr ft $^{\circ}\text{F}$. Therefore, an increase in the sand/shale ratio increases the thermal conductivity and decreases the geothermal gradient. The criteria discussed above help explain the doglegs observed in geothermal gradients of many geopressed sediments in the Gulf Coast area. The presence of high porosity and low sand/shale ratios in geopressed zones causes the geothermal gradient to be higher than more normally pressured zones located above or below (Hunt, 1979).

In most areas of the Gulf Coast, the average geothermal gradient is relatively low in the hydro pressured zone (a heat conductor), increases substantially through the geopressed zone (a heat insulator), then declines in the underlying zone (a heat conductor), which presumably has more normal pressures as predicted by the model of Lewis and Rose (1970). It is often difficult to document the existence of normally

pressured formations in this deep underlying zone, which forms the third portion of the geothermal gradient dogleg. An example of incomplete documentation is given for Lavaca County (fig. 43), where the gradient is $1.44^{\circ}\text{F}/100\text{ ft}$ in the hydro pressured zone, increases to $3.5^{\circ}\text{F}/100\text{ ft}$ in the geopressed interval from 10,000 to 13,000 ft, then declines to $1.28^{\circ}\text{F}/100\text{ ft}$ below 13,000 ft. Bottom hole shut-in pressures plotted for depths below 13,000 ft in Lavaca County (fig. 44) indicate that 70 percent of the formations that were tested had low or subnormal pressure gradients. The remaining 30 percent of the formations had pressure gradients of 0.75 psi/ft or more. Three sandstones located at average depths of 11,781, 12,892, and 13,279 ft were tested in the Magnolia Petroleum No. 1 Simpson Heirs. The two shallower sandstones had normal and subnormal pressure gradients (fig. 44), whereas the third and deepest sandstone had a pressure gradient of 0.74 psi/ft. All these sandstones are relatively deep and illustrate the variability of formation pressures in a depth zone where consistently high pressures might be predicted from the general trend of data in the area. Possibly, deep zones containing some sandstone units with low pressures (fig. 44) may act as heat conductors and cause the reduced geothermal gradient observed below 13,000 ft in Lavaca County (fig. 43).

Dogleg geothermal gradients are also observed in Kenedy County (fig. 45). The first bend in the dogleg provides an estimate of the base of the hydro pressured zone. In this case, the reduced geothermal gradient in the third and deepest part of the dogleg occurs below 14,000 ft. In most areas of the Gulf Coast, the deep part of the dogleg occurs below the 300°F isotherm.

The preceding discussion indicates that the geothermal gradient is useful for locating the transition from the hydro pressured to the geopressed zone in an area with adequate well control. In Lavaca County, for example, the transition depth can be estimated from the temperature versus depth plot (fig. 43) with equal or greater

Figure 43. Well log temperatures corrected to equilibrium values versus depth for wells in Lavaca County, Texas.

Figure 44. Bottom hole shut-in pressure versus depth for 57 wells in Lavaca County, Texas.

Figure 45. Well log temperatures corrected to equilibrium values versus depth for wells in Kenedy County, Texas.

confidence than from the bottom hole shut-in pressure versus depth plot (fig. 44).

However, this relationship is not always true in other areas.

Formation temperature has an important influence on diagenetic processes in shales and sandstones. Montmorillonite converts to illite at an increased rate in the approximate critical range of subsurface temperatures from 200° to 220°F (Burst, 1969). Freed (1980) found that the increased rate of conversion of montmorillonite to illite also seems to be associated with the top of geopressure in the No. 1 Pleasant Bayou, Brazoria County, Texas (fig. 46).

Formation temperatures in this report are corrected to equilibrium values by the method of Kehle (1971):

$$T_E = T_L - 8.819 \times 10^{-12} D^3 - 2.143 \times 10^{-8} D^2 + 4.375 \times 10^{-3} D - 1.018 \quad (2)$$

where T_E = equilibrium temperature (°F)

T_L = temperature recorded on well log header (°F)

D = depth (ft)

Temperature gradient is the slope of the least squares linear fit of equilibrium temperature plotted as a function of depth. The gradients are expressed in °F/100 ft and °C/100 m. Equilibrium temperature isotherms of 200°, 250°, and 300°F are shown along dip and strike cross sections in the parameter plots (Appendix A).

Salinity

Salinity of formation waters is controlled by a complex interrelation between local and regional geology, presence of faults, salt domes, unconformities, geopressed zones, and the influence of compaction, clay diagenesis, temperature, fluid migration, rock stress, and pressure depletion history (Fertl and Timko, 1970; Burst, 1969; Fowler, 1970; Hedberg, 1967; Overton and Timko, 1969; Runnells, 1969; Von Engelhardt and Gaida, 1964; and Magara, 1968). Although much has been written about salinity, in general, the subject is poorly understood. This is unfortunate

Figure 46. Change in montmorillonite and illite content of shales as a function of depth, GCO-DOE No. 1 Pleasant Bayou, Brazoria County, Texas (after Freed, 1980).

Figure 47. Generalized salinity trends, Texas Gulf Coast. "Top of GP" in illustration refers to a pressure gradient of about 0.465 psi/ft.

because geothermal exploration methods are clearly dependent on a knowledge and understanding of salinity.

Salinities vary widely as a function of depth for different areas of the Gulf Coast. Although there are wide variations, four general salinity trends (fig. 47) are recognized in many areas, as shown by the distribution of data for Kenedy County (fig. 48). Salinity increases with depth in shallow sandstones to a zone of reasonably constant average value extending to about the base of the hydropressed zone. In the geopressed zone, there is a trend of decreasing salinity, followed by a zone in which salinity becomes erratic and essentially unpredictable. Most of these trends can be

Figure 48. Salinity computed from SP logs versus depth for 29 wells, Kenedy County, Texas.

recognized in the salinity profile of the Humble No. 22 East, Kenedy County, Texas (fig. 49). In this study, the salinity of formation water was derived from water resistivity (R_w) obtained from the spontaneous potential (SP) log, using mud filtrate resistivity (R_{mf}) values from well log headers, and following the algorithm of Bateman and Konen (1977).

Recent comparisons made between salinities determined from the SP log and those measured on samples of reservoir water show large discrepancies in deep geopressured zones where mud weights exceed 14 lb/gal. Typically, calculated salinities are too low (R_w is too high), often by a factor of 2 or more. For example, salinity of a water sample from the No. 2 Pleasant Bayou (14,644 to 14,704 ft) (fig. 50) was 132,000 ppm NaCl (Kharaka and others, 1980) compared with 36,000 ppm NaCl calculated from the SP log, using the R_{mf} value listed in the well log header. The measured and calculated salinities differ by a factor of 3.7, which is an extreme discrepancy.

Several potential sources of error exist for salinities determined from the SP log. Current work by Dunlap (1980) suggests that a major source of error lies in the use of an incorrect value of R_{mf} when high-density lignosulfonate muds are used (R_{mf} is too large). Lignosulfonate muds have been in use for over 15 years; thus, the scope of the problem is large. Also, the method of determining R_{mf} from mud resistivity using the Schlumberger chart, Gen 7 (1978), is not applicable to lignosulfonate muds, as clearly stated on the chart. The chart was based on the work of Overton (1958), which took place before lignosulfonate type muds were used. The present method of correcting R_{mf} from surface to downhole temperature, using resistivity versus temperature variations for NaCl solutions, may not be applicable to modern muds and mud filtrates, which thus introduces further errors into salinity determinations. Considerable additional research and laboratory experimental work will be required before these problems can be resolved satisfactorily. The effect, if any, that these problems may

Figure 49. Salinity computed from SP log versus depth, Humble No. 22 S. K. East, Kenedy County, Texas.

Figure 50. Salinity, pressure, temperature, and methane solubility profiles of the GCO-DOE No. 2 Pleasant Bayou, Brazoria County, Texas (modified from Gregory and Backus, 1980).

have on generalized salinity trends determined for the Gulf Coast area (fig. 47) cannot be predicted at this time. There is no doubt, however, that some of the salinities used in this assessment (Appendix A) are too low (see Addendum 1).

Porosity

Porosity values from whole core analyses are preferred in this work. When whole core data are not available, porosity can be determined from other methods, such as calculation from sonic log parameters using the time average equation (Wyllie and others, 1956). The equation is

$$\phi = \frac{\Delta t_{\log} - \Delta t_m}{\Delta t_f - \Delta t_m}, \quad (3)$$

where $\Delta t_{\log}$ = transit time from acoustic log (μ sec/ft)
 Δt_m = transit time of matrix material (μ sec/ft)
 Δt_f = transit time of fluid (μ sec/ft).

The matrix transit time Δt_m in sandstones varies from 55.5 to 51.3 microseconds/ft. Fluid transit time Δt_f varies from 203.6 to 179.3 microseconds/ft for fresh water and brine (200,000 ppm NaCl), respectively. Equation (3) is satisfactory for predicting porosities of sandstones that are well consolidated but overestimates porosities of undercompacted and poorly consolidated sandstones. An empirical correction factor C_p is used to obtain a corrected porosity ϕ_c in these undercompacted sandstones.

$$\phi_c = \frac{\Delta t_{\log} - \Delta t_m}{\Delta t_f - \Delta t_m} \cdot \frac{1}{C_p} \quad (4)$$

The value of C_p can be obtained by measuring the deviation from the relationship between true porosity and porosity computed from equation (3). The true porosity can be obtained from core analysis data or from cross plots of a suite of porosity logs

(Schlumberger document, 1974). Software for cross plotting techniques is currently under development at The University of Texas at Austin.

Many wells in the areas of interest have not been cored and do not have porosity logs. Normally, induction and SP logs are available, and porosity can be computed from formation factor F and cementation factor m using one of several available empirical expressions. Values for parameter m depend on rock type and vary from 2.2 for highly cemented quartzite to 1.3 for unconsolidated sand. The general relationship (Archie, 1942) is expressed as

$$F = \phi^{-m}, \quad (5)$$

where ϕ = porosity and $m = 1.8$ for sandstone. Formation factor is defined as a ratio of resistivities that can be obtained from induction and SP well logs. It is assumed that $R_o = R_t$, and

$$F = R_o/R_w, \quad (6)$$

where $R_o = R_t$ = resistivity of rock that is 100 percent saturated with formation water of resistivity R_w , determined from the deep induction log (ohm-meters)

R_w = resistivity of formation water, at given temperature and salinity, determined from the SP log (ohm-meters).

Other well log methods, of course, can be used for determining porosity; however, the relationship of Archie (1942) was found to be the most useful in this study because only induction and SP logs were available for the majority of wells.

The data base of whole core analyses used in this study is shown in figures 51, 52, 53, 54, and Appendix B. Whole core analyses were used for wells with whole core data below 6,000 ft. Sidewall core analyses were not used because they give values for porosity that increase anomalously with depth (Loucks and others, 1979). For subdivisions with adequate whole core data, porosity profiles were constructed by plotting the mean and standard deviation of porosity measurements in 100-ft intervals.

Figure 51. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions.

Figure 52. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions.

Figure 53. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions.

Figure 54. Wells with whole core analyses were used in preparing porosity versus depth plots for subdivisions.

For subdivisions without adequate whole core data, supplemental porosity data (Appendix A) were calculated from induction and SP logs using the empirical equation of Archie (1942). Although measured (whole core) and calculated porosities may differ considerably for individual sandstones, comparison of these data from wells from different parts of the Gulf Coast (figs. 55 through 57) shows that they may be used together to indicate regional trends.

Subdivision porosity plots are shown in figures 58 through 77. Plots for Subdivisions 8, 10, 11, and 19 are not included because of insufficient data. As porosity does not decrease to zero with depth in the subsurface (porosities of a few percent have been recorded at depths of 20,000 to 25,000 ft), regression lines were drawn so that they become asymptotic to 5 percent porosity.

Calculation of linear regression lines for porosity plots can obscure the presence of higher-than-average porosity resulting from development of secondary porosity. However, the limited data and the resource assessment techniques used required that an entire subdivision be characterized by a single porosity plot. At this scale, a calculated regression line approximates the relationship between porosity and depth.

Comparison of subdivision porosity plots shows regional trends similar to those described by Loucks and others (1979) in spite of differences in data manipulation. Trend lines were grouped according to structural criteria. Accordingly, Subdivisions 1 through 6 (fig. 78) correspond to the Vicksburg and Frio fault zones, whereas Subdivisions 7 through 12 (fig. 79) encompass the area between the Wilcox fault zone and the Vicksburg and Frio fault zones. Sediments below 8,000 ft in Subdivisions 7 through 12 are predominantly prodelta and shelf muds, which are of minor interest in this project. Subdivisions 13 through 18 (fig. 80) correspond to the Wilcox fault zone, and Subdivisions 20 through 24 (fig. 81) include Wilcox strata updip of the Wilcox fault zone.

Subdivision plots show porosity decreasing with depth, and most regression lines are reasonably parallel. The regression lines that deviate significantly from this, for

Figure 55. Comparison of whole core and resistivity log-derived porosity data for a well in lower Texas (fig. 3). Whole core data points are mean values of porosity data averaged over 50-ft intervals.

Figure 56. Comparison of whole core and resistivity log-derived porosity data for a well in middle Texas (fig. 3). Whole core data points are mean values of porosity data averaged over 50-ft intervals.

Figure 57. Comparison of whole core and resistivity log-derived porosity data for a well in upper Texas (fig. 3). Whole core data points are mean values of porosity data averaged over 50-ft intervals.

Figure 58. Porosity versus depth plot for Subdivision 1. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 59. Porosity versus depth plot for Subdivision 2. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 60. Porosity versus depth plot for Subdivision 3. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 61. Porosity versus depth plot for Subdivision 4. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 62. Porosity versus depth plot for Subdivision 5. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 7,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 63. Porosity versus depth plot for Subdivision 6. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 64. Porosity versus depth plot for Subdivision 7. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 3,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 65. Porosity versus depth plot for Subdivision 9. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 66. Porosity versus depth plot for Subdivision 12. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 6,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 67. Porosity versus depth plot for Subdivision 13. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 68. Porosity versus depth plot for Subdivision 14. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 6,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 69. Porosity versus depth plot for Subdivision 15. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 4,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 70. Porosity versus depth plot for Subdivision 16. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 71. Porosity versus depth plot for Subdivision 17. Means (dots) and standard deviations (brackets) are plotted for data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 72. Porosity versus depth plot for Subdivision 18; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 73. Porosity versus depth plot for Subdivision 20. Means (dots) and standard deviations (brackets) are plotted for whole core data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 7,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 74. Porosity versus depth plot for Subdivision 21. Means (dots) and standard deviations (brackets) are plotted for whole core data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 75. Porosity versus depth plot for Subdivision 22. Means (dots) and standard deviations (brackets) are plotted for whole core data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 5,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 76. Porosity versus depth plot for Subdivision 23. Means (dots) and standard deviations (brackets) are plotted for whole core data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data.

Figure 77. Porosity versus depth plot for Subdivision 24. Means (dots) and standard deviations (brackets) are plotted for whole core data in 100-ft intervals. A linear regression line asymptotic to a porosity of 5 percent is drawn through the data; additional porosity data derived from the Archie relationship for depths less than 4,000 ft (although not shown in plot) were used to help determine slope of regression line.

Figure 78. Comparison of porosity versus depth trends for subdivisions in the Vicksburg-Frio fault zone.

Figure 79. Comparison of porosity versus depth trends in subdivisions updip of the Vicksburg-Frio fault zone and downdip of the Wilcox fault zone. Insufficient data were available to calculate linear regression lines for Subdivisions 8, 10, and 11.

Figure 80. Comparison of porosity versus depth trends for subdivisions in the Wilcox fault zone.

Figure 81. Comparison of porosity versus depth in subdivisions updip of the Wilcox fault zone. Insufficient data were available to calculate a linear regression line for Subdivision 19.

example Subdivisions 6, 12, and 24, are based on few data. Subdivisions 1 through 6 (fig. 78) show the greatest separation of regression lines, indicating increasing reservoir quality to the northeast. At 12,000 ft, average porosity ranges from 9.5 to 18.5 percent in Subdivisions 1 to 6. At the same depth, Subdivisions 13 through 18 range from 9 to 14 percent porosity, and Subdivisions 20 through 24 range from 7.5 to 12.5 percent porosity. Loucks and others (1979) noted northward-increasing reservoir quality in the Vicksburg and Frio Formations owing to original composition and diagenetic history, which was not apparent in the Wilcox Group. Data from this study (figs. 80 and 81) show a slight northward increase in reservoir quality in the Wilcox Group, but it is much less pronounced than in the Vicksburg and Frio Formations (fig. 78).

Parameter Plots

Parameter plots consist of a series of selected formation parameters plotted as a function of depth for wells on dip and strike cross sections. The plotted parameters in this report (Appendix A) are formation temperature, formation water salinity, shale resistivity, and reservoir porosity. Temperature and salinity were selected as parameters because they directly affect the amount of methane dissolved in formation water. Shale resistivity was selected because it is empirically related to formation fluid pressure, which directly affects the solubility of methane in water. Porosity was selected because it determines the volume of fluid contained in a reservoir.

Isothermal lines were drawn for 200°F, 250°F, and 300°F where wells were deep enough to encounter these temperatures. Isopiestic lines, determined from pressures derived by methods discussed earlier in this report, are shown for pressure gradients of 0.7, 0.8, and 0.9 psi/ft when possible. The operational top of geopressure has an average value of about 0.68 psi/ft in Kenedy County, as stated earlier, and a value of about 0.7 psi/ft is assumed to be a reasonable average value for many wells in the Texas Gulf Coast area.

The parameter plots in this report follow the same dip and strike cross sections that are used to illustrate regional geologic structural features (fig. 4). It was necessary to divide the parameter plots into two or more parts for each cross section so that they were readable when reduced to page size. For example, dip section 21-21 (fig. 4) was divided into three parameter cross sections designated as 21A-21A', 21B-21B', and 21C-21C' (Appendix A).

Methane Solubility

Methane solubility in formation water is a function of pressure, temperature, and salinity. An increase in pressure or temperature causes an increase in solubility. An increase in salinity reduces solubility. Pressure and temperature are more predictable than salinity, which varies greatly throughout the Gulf Coast area. Because of this variability and the difficulty of determining salinities accurately by indirect methods, such as the well log analyses discussed earlier, salinity values generally are the most questionable of the three parameters that control methane solubility.

In this report, methane solubilities are computed by the empirical equation of Blount and others (1979). The equation is

$$\begin{aligned} \log_e(\text{CH}_4) = & 3.6003 + 1.1176 \times 10^{-3} T \log_e P \\ & + 0.10002Y - 0.01634T \\ & + 1.6574 \times 10^{-5} T^2 - 0.2828 \times 10^{-3} TY \\ & - 0.01124Y \log_e P + 2.1262 \times 10^{-5} Y T \log_e P \end{aligned} \quad (7)$$

where CH_4 = methane solubility, SCF/bbl,

T = temperature, degrees Kelvin,

P = pressure, psi,

and Y = NaCl concentration, weight percent.

Methane solubilities computed from equation (7) are considerably higher than those determined from the algorithm of Haas (1978). An example is the solubility profile for

the GCO-DOE No. 2 Pleasant Bayou, Brazoria County, Texas, comparing solubility data derived from the Haas and Blount methods (fig. 50). Formation pressures, temperatures, and average salinities are also shown for the well. The average difference between the Haas and Blount solubility profiles in this well is about 6.7 SCF/bbl. The Blount solubility values are higher than the Haas values by 20 to 60 percent, depending on the depth at which the comparison is made (fig. 50). New equations for calculating methane solubility and their effect on the methane resource assessment are discussed in Addendum 1.

DETERMINATION OF IN-PLACE METHANE RESOURCE

The lower Frio Formation in Subdivision 2 was used by Gregory and others (1980) to illustrate techniques for assessing the in-place methane resource in the Texas Gulf Coast. Subdivision 2 (fig. 36) includes most of Kenedy, Kleberg, Nueces, and San Patricio Counties and parts of adjacent counties. The Frio and Vicksburg-Jackson Formations and a small part of the upper Oligocene to Pleistocene formations occur below 8,000 ft in this area (see regional cross sections 16-16' through 21-21').

Variation in pressure, temperature, and salinity with depth, and corresponding variations in methane solubility were plotted for well no. 21 on dip section 21-21' (fig. 82). As discussed previously, salinity is highly variable with depth, and this variability is reflected in the methane solubility profile. Therefore, resource estimates that require defining a single value for each parameter in a given depth interval may differ as a function of the interval chosen. For example, salinity at the midpoint of the entire lower Frio Formation (fig. 82) is 38,000 ppm NaCl, but salinities at the midpoints of the intervals from 8,000 to 11,100 ft and 11,100 ft to 14,200 ft are 70,000 ppm NaCl and 36,000 ppm NaCl, respectively.

Two methods of estimating the methane resource were evaluated for the lower Frio Formation in Subdivision 2 to determine the effect of erratic salinity data. In the

Figure 82. Plots for variation in equilibrium temperature, pressure, salinity, and methane solubility with depth for well No. 21 on cross section 21-21' in Subdivision 2.

first method, parameters were calculated at the midpoint or the median depth of the entire lower Frio; in the second method, parameters were calculated at the midpoint of 1,000-ft intervals within the lower Frio, and methane volumes for all intervals were summed to determine a resource estimate for the lower Frio. Methane volumes determined by these two methods differed by less than 10 percent. It is questionable whether this difference is significant, considering the degree of estimation needed at all levels to evaluate the factors that determine the amount of methane in solution. The less time-consuming method of calculating parameters at median depth in an entire formation was chosen as most suitable for assessment of the entrained methane resource in the Texas Gulf Coast.

Median temperature, pressure, and salinity were determined for the lower Frio Formation for each well on each cross section in Subdivision 2. Where the base of the lower Frio was not penetrated, an estimated base was determined from the isopach map. If extrapolation below the well log was necessary, median parameters were estimated using cumulative county plots. Median methane solubilities for each interval were calculated using the empirical equations of Blount and others (1979).

Regional temperature, pressure, salinity, and methane solubility maps for the lower Frio Formation resulted from these data (figs. 83 to 86). Temperature and pressure increase gulfward and from upper to lower Texas owing to increases in median depth of the lower Frio in these directions. Temperatures range from 195° to about 365°F (fig. 83), and pressures range from about 4,000 to 13,500 psi (fig. 84) toward the coast in upper Texas. Temperatures range from about 205° to 425°F, and pressures range from about 6,000 to 18,000 psi toward the coast in lower Texas. Salinity decreases gulfward and from upper to lower Texas, ranging from 150,000 ppm NaCl to 50,000 ppm NaCl in the north to 90,000 ppm NaCl to 20,000 ppm NaCl in the south (fig. 85). A salinity high of 165,000 ppm NaCl is present in eastern Matagorda County, and a low of 15,000 ppm NaCl is present in western Kenedy and eastern

Figure 83. Distribution of equilibrium temperature, lower Frio Formation, Texas Gulf Coast.

Figure 84. Map of pressure distribution, lower Frio Formation, Texas Gulf Coast.

Figure 85. Map of salinity distribution, lower Frio Formation, Texas Gulf Coast.

Figure 86. Distribution of methane solubility, lower Frio Formation, Texas Gulf Coast.

Brooks Counties. These salinity trends are also due to increasing median depth of the lower Frio toward the Gulf and to the south, and they reflect the generalized salinity trends seen in most areas of the Gulf Coast (figs. 47 and 48). Salinity contours near the coast, however, do not reflect the variability of salinity data at depth. In many downdip wells the entire formation was not penetrated, and total depth and median depth were estimated. Salinity profiles, therefore, are incomplete, and salinity at median formation depth in these wells was estimated from a composite county curve in which erratic trends are smoothed out. Methane solubility increases toward the coast as a function of increasing temperature and pressure and decreasing salinity (fig. 86).

Isopach, temperature, pressure, salinity, net sandstone thickness, and methane solubility maps expanded in scale for Subdivision 2 were generated from equivalent regional maps (figs. 87 to 92). When these expanded maps were superimposed (fig. 93), the crossing of contour lines defined 83 regions, each region having its own characteristic set of values for net sandstone thickness and methane solubility. The area of each of these regions was measured by a planimeter, and the net sandstone bulk volume in each region was calculated. Error in use of the planimeter ranged from 0.1 to 5 percent, but most error was less than 1 percent.

Similarly, effective sandstones (sandstones greater than 30 ft thick) (fig. 94) were mapped for Subdivision 2 and superimposed on the methane solubility map (fig. 92) defining 83 regions, each having its own characteristic set of values for effective sandstone thickness and methane solubility (fig. 95). The area of each of these regions was also measured, and the effective sandstone bulk volume was calculated in the same manner as for net sandstone in Subdivision 2.

An average porosity value for calculating net sandstone or effective sandstone pore volumes was determined at median depth in the lower Frio Formation in each well from the porosity plot for Subdivision 2 (fig. 59). Porosity values from each

Figure 87. Isopach map, lower Frio Formation, Subdivision 2.

Figure 88. Distribution of temperature, lower Frio Formation, Subdivision 2.

Figure 89. Distribution of pressure, lower Frio Formation, Subdivision 2.

Figure 90. Distribution of salinity, lower Frio Formation, Subdivision 2.

Figure 91. Distribution of net sandstone thickness, lower Frio Formation, Subdivision 2.

Figure 92. Distribution of methane solubility, lower Frio Formation, Subdivision 2.

Figure 93. Regions with characteristic values of net sandstone thickness and methane solubility, lower Frio Formation, Subdivision 2.

Figure 94. Distribution of effective sandstone thickness, lower Frio Formation, Subdivision 2.

Figure 95. Regions of unique effective sandstone thickness and methane solubility, lower Frio Formation, Subdivision 2.

subdivision were used to map regional porosity (fig. 96), which was, in turn, used to generate a subdivision porosity map such as that for Subdivision 2 (fig. 97). When the subdivision porosity map was superimposed on the net sandstone thickness/methane solubility map (fig. 93), an average porosity was assigned to each of the 83 regions, and a corresponding pore volume was calculated.

To determine the methane resource, all pore spaces were assumed to be filled completely with methane-saturated water. With a known pore volume and average methane solubility, the solution methane volume was calculated for each region, and a total methane volume of 63×10^{12} SCF was calculated for net sandstones in the lower Frio Formation (table 2) in Subdivision 2. Additional expanded regional maps were prepared for evaluating the methane resource in the remaining 8 formations in each of the remaining 23 subdivisions. However, because of space constraints only the examples for the lower Frio Formation in Subdivision 2 are included in this report.

Regional temperature, pressure, salinity, methane solubility, and porosity maps were generated from data determined at median depth in each of the other Tertiary formations (figs. 98 to 137). These maps show the same general trends seen in the lower Frio Formation. Temperature and pressure increase and salinity and porosity decrease toward the Gulf owing to increasing depth. In the lower Wilcox Group, temperature gradients (fig. 98) are greater (contour lines are closely spaced) in southern Colorado County and toward lower Texas along strike from Goliad County, reflecting changes in sandstone thickness. Major sand depocenters in De Witt County and northern Colorado to Montgomery Counties (fig. 6; Bebout and others, 1979) are reflected on the temperature distribution map (fig. 98) as low-temperature gradients. Shale-rich areas are characterized by steep temperature gradients because of low permeabilities. Temperature and pressure gradients are also greater in the upper Wilcox Group (figs. 108 and 109) in lower Texas, but this is due to an increase in depth during contemporaneous growth faulting as upper Wilcox deltas prograded over

Figure 96. Distribution of porosity, lower Frio Formation, Texas Gulf Coast.

Figure 97. Distribution of porosity, lower Frio Formation, Subdivision 2.

Table 2. Average net sandstone thickness, net sandstone bulk volume, pore volume, porosity, methane solubility, and volume of solution methane tabulated individually for 10 regions and combined for regions 11-83, lower Frio Formation, Subdivision 2. Each region has its own characteristic set of values for net sandstone thickness, methane solubility, and porosity.

Region no.	Region (mi ²)	Avg. net SS thickness (mi)	Bulk vol. net SS (mi ³)	Avg. ϕ (%)	Pore vol. (mi ³)	Pore vol. net SS (x10 ¹⁰ bbl)	Avg. CH ₄ sol. SCF/bbl	Total vol. methane (x10 ¹² ft ³)
1	40.2	0.024	0.96	20.0	0.19	0.50	18.5	0.09
2	1.0	0.047	0.05	20.0	0.01	0.03	20.5	0.01
3	1.5	0.047	0.07	19.5	0.01	0.03	20.0	0.01
4	16.5	0.024	0.40	18.0	0.07	0.18	25.0	0.04
5	2.1	0.024	0.05	16.5	0.01	0.03	32.5	0.01
6	74.3	0.071	5.28	18.5	0.98	2.57	23.0	0.59
7	71.7	0.118	8.46	18.0	1.52	3.98	25.0	1.00
8	2.6	0.038	0.10	14.5	0.01	0.03	39.0	0.01
9	193.0	0.024	4.63	12.0	0.56	1.47	45.0	0.66
10	32.5	0.166	5.40	18.5	1.00	2.62	27.0	0.71
11-83	3,413.7	0.024 — 0.308	434.77	5.0 — 19.5	55.89	146.39	26 — 105	60.06

Total methane for net sandstones, Subdivision 2 (lower Frio Formation) = 63.19×10^{12} SCF

Figure 98. Distribution of equilibrium temperatures, lower Wilcox Group.

Figure 99. Distribution of pressure, lower Wilcox Group.

Figure 100. Distribution of salinity, lower Wilcox Group.

Figure 101. Distribution of methane solubility, lower Wilcox Group.

Figure 102. Distribution of porosity, lower Wilcox Group.

Figure 103. Distribution of equilibrium temperature, middle Wilcox Group.

Figure 104. Distribution of pressure, middle Wilcox Group.

Figure 105. Distribution of salinity, middle Wilcox Group.

Figure 106. Distribution of methane solubility, middle Wilcox Group.

Figure 107. Distribution of porosity, middle Wilcox Group.

Figure 108. Distribution of equilibrium temperature, upper Wilcox Group.

Figure 109. Distribution of pressure, upper Wilcox Group.

Figure 110. Distribution of salinity, upper Wilcox Group.

Figure 111. Distribution of methane solubility, upper Wilcox Group.

Figure 112. Distribution of porosity, upper Wilcox Group.

Figure 113. Distribution of equilibrium temperature, lower Claiborne Group.

Figure 114. Distribution of pressure, lower Claiborne Group.

160

Figure 115. Distribution of salinity, lower Claiborne Group.

Figure 116. Distribution of methane solubility, lower Claiborne Group.

Figure 117. Distribution of porosity, lower Claiborne Group.

Figure 118. Distribution of equilibrium temperature, upper Claiborne Group (Yegua Formation).

Figure 119. Distribution of pressure, upper Claiborne Group (Yegua Formation).

Figure 120. Distribution of salinity, upper Claiborne Group (Yegua Formation).

Figure 121. Distribution of methane solubility, upper Claiborne Group (Yegua Formation).

Figure 122. Distribution of porosity, upper Claiborne Group (Yegua Formation).

Figure 123. Distribution of equilibrium temperature, Vicksburg-Jackson Formations.

Figure 124. Distribution of pressure, Vicksburg-Jackson Formations.

Figure 125. Distribution of salinity, Vicksburg-Jackson Formations.

Figure 126. Distribution of methane solubility, Vicksburg-Jackson Formations.

Figure 127. Distribution of porosity, Vicksburg-Jackson Formations.

Figure 128. Distribution of equilibrium temperature, upper Frio Formation.

Figure 129. Distribution of pressure, upper Frio Formation.

Figure 130. Distribution of salinity, upper Frio Formation.

Figure 131. Distribution of methane solubility, upper Frio Formation.

Figure 132. Distribution of porosity, upper Frio Formation.

Figure 133. Distribution of equilibrium temperature, upper Oligocene to Pleistocene formations.

Figure 134. Distribution of pressure, upper Oligocene to Pleistocene formations.

Figure 135. Distribution of salinity, upper Oligocene to Pleistocene formations.

Figure 136. Distribution of methane solubility, upper Oligocene to Pleistocene formations.

Figure 137. Map of porosity distribution, upper Oligocene to Pleistocene formations.

unstable lower Wilcox shelf muds. In the Vicksburg-Jackson and upper Frio Formations and in the upper Oligocene to Pleistocene formations, temperature and pressure increase and salinity and porosity decrease from upper to lower Texas because of greater subsidence in the Rio Grande Embayment.

Subdivision maps were constructed from regional maps for all formations, and calculation methods outlined for the lower Frio Formation in Subdivision 2 were used to determine a methane resource of 690×10^{12} SCF for all Tertiary formations in the Texas Gulf Coast (table 3). In an analogous fashion, a resource estimate of 325×10^{12} SCF was determined for all effective sandstones (sandstones greater than 30 ft thick) (table 4). Total sandstone volume, total pore volume, and ranges in methane solubility are tabulated by formation and subdivision for net sandstones in tables 5 through 7 and for effective sandstones in tables 8 through 10. Sandstone thickness and median temperature, pressure, salinity, methane solubility, and porosity are tabulated by formation for each control well within the 24 subdivisions in Appendix B.

RECOVERABLE METHANE

The recovery of solution methane depends on the producing characteristics of individual reservoirs and is expected to range from 3 to 5 percent of the in-place resource (MacDonald and others, 1980). Total recoverable volumes of methane are estimated to range from 21×10^{12} to 35×10^{12} SCF for net sandstones and from 10×10^{12} to 16×10^{12} SCF for effective sandstones. Assuming that 3 percent of the solution methane resource (21×10^{12} SCF) could be recovered from net sandstones located in an area of $50,000 \text{ mi}^2$ in the onshore Texas Gulf Coast, the recovered gas would be equivalent to the total U.S. demand for natural gas in 1979 (Oil and Gas Journal, 1980).

**Table 3. In-place dissolved methane, totals by formation and subdivision
and total for Tertiary net sandstones below 8,000 ft, onshore Texas Gulf Coast (10^{12} SCF).**

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	4.71	33.07	25.37	35.37	—	—	—	—	—	98.52
2	0.06	47.60	63.18	25.65	—	—	—	—	—	136.49
3	—	8.80	6.72	3.88	—	—	—	—	—	19.40
4	—	2.90	19.62	5.35	—	—	—	—	—	27.87
5	4.01	6.19	25.73	1.88	—	—	—	—	—	37.81
6	1.79	3.00	21.81	0.56	—	—	—	—	—	27.16
7	—	—	—	1.17	—	—	0.69	—	—	1.86
8	—	—	—	1.24	—	—	1.64	0.02	—	2.90
9	—	—	—	—	—	—	1.79	0.31	—	2.10
10	—	—	—	—	—	—	2.14	1.19	0.70	4.03
11	—	—	—	—	1.97	—	0.35	0.78	0.40	3.50
12	—	—	0.36	—	7.78	0.25	6.22	5.48	—	20.09
13	—	—	—	—	—	—	6.50	0.25	—	6.75
14	—	—	—	—	—	—	9.91	1.63	—	11.54
15	—	—	—	—	—	—	3.01	3.49	10.40	16.90
16	—	—	—	—	—	—	4.61	3.82	28.69	37.12
17	—	—	—	—	0.13	0.01	11.53	8.79	59.07	79.53
18	—	—	—	—	0.14	—	11.36	8.25	11.47	31.22
19	—	—	—	—	—	—	—	—	0.28	0.28
20	—	—	—	—	—	—	—	0.05	0.31	0.36
21	—	—	—	—	—	—	—	0.09	6.83	6.92
22	—	—	—	—	—	—	—	0.22	13.88	14.10
23	—	—	—	—	—	—	0.78	3.62	49.05	53.45
24	—	—	—	—	—	—	3.23	6.25	39.53	49.01
Total by formation	10.57	101.56	162.79	75.59	10.02	0.26	63.76	44.24	220.83	688.91

Total methane (net sandstones) = 690×10^{12} SCF

**Table 4. In-place dissolved methane, totals by formation and subdivision
and total for Tertiary effective sandstones (more than 30 ft thick) below 8,000 ft, onshore Texas Gulf Coast (10^{12} SCF).**

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	1.25	12.73	14.90	11.49	—	—	—	—	—	40.37
2	—	24.56	32.74	5.31	—	—	—	—	—	62.61
3	—	2.07	1.52	0.40	—	—	—	—	—	3.99
4	—	0.50	10.33	2.95	—	—	—	—	—	13.78
5	1.46	1.02	12.60	—	—	—	—	—	—	15.08
6	0.92	1.33	3.78	—	—	—	—	—	—	6.03
7	—	—	—	0.55	—	—	0.57	—	—	1.12
8	—	—	—	0.06	—	—	0.29	—	—	0.35
9	—	—	—	—	—	—	0.64	0.10	—	0.74
10	—	—	—	—	—	—	1.33	0.44	0.30	2.07
11	—	—	—	—	0.65	—	—	0.25	0.33	1.23
12	—	—	0.27	—	1.32	—	2.71	4.39	—	8.69
13	—	—	—	—	—	—	2.86	—	—	2.86
14	—	—	—	—	—	—	5.11	0.78	—	5.89
15	—	—	—	—	—	—	1.75	0.96	3.42	6.13
16	—	—	—	—	—	—	2.59	1.57	17.59	21.75
17	—	—	—	—	0.05	—	6.01	3.72	29.47	39.25
18	—	—	—	—	—	—	6.93	4.94	4.20	16.07
19	—	—	—	—	—	—	—	—	—	0.00
20	—	—	—	—	—	—	—	0.03	—	0.03
21	—	—	—	—	—	—	—	0.09	3.08	3.17
22	—	—	—	—	—	—	—	0.05	9.70	9.75
23	—	—	—	—	—	—	0.43	1.76	37.44	39.63
24	—	—	—	—	—	—	1.95	2.13	20.66	24.74
Total by formation	3.63	42.21	76.14	20.82	2.02	0	33.17	21.21	126.21	325.33

Total methane (effective sandstones) = 325×10^{12} SCF

**Table 5. Bulk volume of net sandstone, totals by formation and subdivision
and total for Tertiary formations below 8,000 ft, onshore Texas Gulf Coast (mi³).**

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	52	398	226	308	—	—	—	—	—	984
2	1	414	460	165	—	—	—	—	—	1,040
3	—	54	49	23	—	—	—	—	—	126
4	—	21	162	34	—	—	—	—	—	217
5	30	35	213	10	—	—	—	—	—	288
6	12	27	71	4	—	—	—	—	—	114
7	—	—	—	9	—	—	5	—	—	14
8	—	—	—	9	—	—	12	*	—	21
9	—	—	—	—	—	—	15	2	—	17
10	—	—	—	—	—	—	22	10	6	38
11	—	—	—	—	18	—	3	5	4	30
12	—	—	3	—	61	1	39	31	—	135
13	—	—	—	—	—	—	55	3	—	58
14	—	—	—	—	—	—	65	10	—	75
15	—	—	—	—	—	—	30	32	93	155
16	—	—	—	—	—	—	47	38	239	324
17	—	—	—	—	1	*	105	75	515	696
18	—	—	—	—	1	—	84	55	83	223
19	—	—	—	—	—	—	—	—	2	2
20	—	—	—	—	—	—	—	*	2	2
21	—	—	—	—	—	—	—	1	71	72
22	—	—	—	—	—	—	—	3	150	153
23	—	—	—	—	—	—	7	38	507	552
24	—	—	—	—	—	—	27	61	299	387
Total by formation	95	949	1,184	562	81	1	516	364	1,971	<u>5,723</u>

* less than 0.5 mi³

Total bulk volume = 5,700 mi³

**Table 6. Pore volume of net sandstone, totals by formation and subdivision
and total for Tertiary sandstones below 8,000 ft, onshore Texas Gulf Coast (mi³).**

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	7	38	22	26	—	—	—	—	—	93
2	*	69	60	21	—	—	—	—	—	150
3	—	12	10	4	—	—	—	—	—	26
4	—	6	33	4	—	—	—	—	—	43
5	7	10	42	1	—	—	—	—	—	60
6	3	6	13	1	—	—	—	—	—	23
7	—	—	—	1	—	—	1	—	—	2
8	—	—	—	2	—	—	1	*	—	3
9	—	—	—	—	—	—	2	*	—	2
10	—	—	—	—	—	—	3	1	*	4
11	—	—	—	—	4	—	*	1	*	5
12	—	—	1	—	13	*	7	4	—	25
13	—	—	—	—	—	—	7	*	—	7
14	—	—	—	—	—	—	10	2	—	12
15	—	—	—	—	—	—	5	4	8	17
16	—	—	—	—	—	—	7	5	22	34
17	—	—	—	—	*	*	17	11	43	71
18	—	—	—	—	*	—	16	9	9	34
19	—	—	—	—	—	—	—	—	*	*
20	—	—	—	—	—	—	—	*	*	*
21	—	—	—	—	—	—	—	*	9	9
22	—	—	—	—	—	—	—	*	20	20
23	—	—	—	—	—	—	1	6	74	81
24	—	—	—	—	—	—	5	11	45	61
Total by formation	17	141	181	60	17	*	82	54	230	<u>782</u>

* less than 0.5 mi³

Total pore volume = 780 mi³

**Table 7. Range of methane solubility in formation waters, listed for formations and subdivisions
for Tertiary net sandstones below 8,000 ft, onshore Texas Gulf Coast (SCF/bbl).**

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox
1	18-30	20-60	26-104	35-85	—	—	—	—	—
2	18-25	15-45	17-117	25-97	—	—	—	—	—
3	—	20-35	17-65	20-67	—	—	—	—	—
4	—	16-40	15-55	20-75	—	—	—	—	—
5	17-30	17-40	15-45	25-80	—	—	—	—	—
6	17-30	17-25	17-40	16-61	—	—	—	—	—
7	—	—	—	30-45	—	—	45-55	—	—
8	—	—	—	25-35	—	—	30-55	59-61	—
9	—	—	—	—	—	24-27	25-50	40-69	—
10	—	—	—	—	17-20	21-38	25-40	28-55	80-95
11	—	—	—	—	20-26	—	26-42	35-55	80-87
12	—	—	17-19	—	18-36	22-45	30-45	40-60	—
13	—	—	—	—	—	—	35-52	20-33	—
14	—	—	—	—	—	20-28	20-55	25-67	—
15	—	—	—	—	—	—	17-35	20-50	20-84
16	—	—	—	—	—	22-24 /	17-35	15-52	33-120
17	—	—	—	—	20-24	20-31	17-45	17-55	29-90
18	—	—	—	—	18-23	—	21-39	20-45	36-70
19	—	—	—	—	—	—	—	—	34-36
20	—	—	—	—	—	—	—	25-45	30-40
21	—	—	—	—	—	—	—	23-27	21-40
22	—	—	—	—	—	—	—	15-35	15-50
23	—	—	—	—	—	—	17-25	10-32	17-44
24	—	—	—	—	—	—	21-24	17-27	14-70

Table 8. Bulk volume of effective sandstones (more than 30 ft thick), totals by formation and subdivision and total for Tertiary formations below 8,000 ft, onshore Texas Gulf Coast (mi³).

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	14	155	31	101	—	—	—	—	—	301
2	—	216	235	34	—	—	—	—	—	485
3	—	14	12	2	—	—	—	—	—	28
4	—	4	88	18	—	—	—	—	—	110
5	11	8	102	—	—	—	—	—	—	121
6	7	11	33	—	—	—	—	—	—	51
7	—	—	—	4	—	—	4	—	—	8
8	—	—	—	*	—	—	2	—	—	2
9	—	—	—	—	—	—	6	1	—	7
10	—	—	—	—	—	—	14	4	3	21
11	—	—	—	—	6	—	—	2	3	11
12	—	—	3	—	10	—	17	25	—	55
13	—	—	—	—	—	—	24	—	—	24
14	—	—	—	—	—	—	33	5	—	38
15	—	—	—	—	—	—	18	9	29	56
16	—	—	—	—	—	—	27	16	145	188
17	—	—	—	—	*	—	55	31	267	353
18	—	—	—	—	—	—	50	34	31	115
19	—	—	—	—	—	—	—	—	—	0
20	—	—	—	—	—	—	—	*	—	0
21	—	—	—	—	—	—	—	1	35	36
22	—	—	—	—	—	—	—	1	104	105
23	—	—	—	—	—	—	4	18	374	396
24	—	—	—	—	—	—	17	21	164	202
Total by formation	32	408	504	159	16	0	271	168	1,155	<u>2,713</u>

* less than 0.5 mi³

Total bulk volume = 2,700 mi³

170

Table 9. Pore volume of effective sandstones (more than 30 ft thick), totals by formation and subdivision and total for Tertiary sandstones below 8,000 ft, onshore Texas Gulf Coast (mi³).

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox	Total by subdivision
1	2	16	2	9	—	—	—	—	—	29
2	—	36	32	4	—	—	—	—	—	72
3	—	3	3	*	—	—	—	—	—	6
4	—	1	18	2	—	—	—	—	—	21
5	2	2	21	—	—	—	—	—	—	25
6	2	2	7	—	—	—	—	—	—	11
7	—	—	—	1	—	—	*	—	—	1
8	—	—	—	*	—	—	*	—	—	*
9	—	—	—	—	—	—	2	*	—	2
10	—	—	—	—	—	—	2	1	*	3
11	—	—	—	—	1	—	—	*	*	1
12	—	—	1	—	2	—	3	3	—	9
13	—	—	—	—	—	—	3	—	—	3
14	—	—	—	—	—	—	5	1	—	6
15	—	—	—	—	—	—	3	1	3	7
16	—	—	—	—	—	—	4	2	13	19
17	—	—	—	—	*	—	9	5	22	36
18	—	—	—	—	—	—	10	6	3	19
19	—	—	—	—	—	—	—	—	—	0
20	—	—	—	—	—	—	—	*	—	*
21	—	—	—	—	—	—	—	*	4	4
22	—	—	—	—	—	—	—	*	14	14
23	—	—	—	—	—	—	1	3	54	58
24	—	—	—	—	—	—	3	4	25	32
Total by formation	6	60	84	16	3	0	45	26	138	<u>378</u>

* less than 0.5 mi³

Total pore volume = 380 mi³

Table 10. Range of methane solubility in formation waters, listed for formations and subdivisions for Tertiary effective sandstones (more than 30 ft thick) below 8,000 ft, onshore Texas Gulf Coast (SCF/bbl).

Subdivision	upper Oligocene- Pleistocene	upper Frio	lower Frio	Vicksburg- Jackson	upper Claiborne (Yegua)	lower Claiborne	upper Wilcox	middle Wilcox	lower Wilcox
1	22-30	18-60	20-105	36-85	—	—	—	—	—
2	—	15-40	16-110	24-70	—	—	—	—	—
3	—	20-32	16-45	20-58	—	—	—	—	—
4	—	15-38	15-55	21-75	—	—	—	—	—
5	16-27	16-40	16-45	—	—	—	—	—	—
6	15-25	16-24	16-40	—	—	—	—	—	—
7	—	—	—	30-50	—	—	47-52	—	—
8	—	—	—	26-40	—	—	35-55	—	—
9	—	—	—	—	—	—	25-47	41-49	—
10	—	—	—	—	—	—	25-40	28-55	80-85
11	—	—	—	—	19-28	—	—	35-55	78-85
12	—	—	15-20	—	14-30	—	30-40	45-55	—
13	—	—	—	—	—	—	23-51	—	—
14	—	—	—	—	—	—	20-60	25-65	—
15	—	—	—	—	—	—	19-27	20-45	25-59
16	—	—	—	—	—	—	17-35	15-52	36-114
17	—	—	—	—	20-26	—	19-45	16-55	30-88
18	—	—	—	—	—	—	21-36	20-46	38-70
19	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	20-50	—
21	—	—	—	—	—	—	—	24-26	20-35
22	—	—	—	—	—	—	—	20-26	15-50
23	—	—	—	—	—	—	18-24	10-27	16-44
24	—	—	—	—	—	—	20-25	18-27	16-70

Table 11. Distribution of in-place methane dissolved in formation waters, Tertiary sandstones below 8,000 ft, onshore Texas Gulf Coast.

	Net Sandstone		Effective Sandstone*	
	Methane (10 ¹² SCF)	% Total methane	Methane (10 ¹² SCF)	% Total methane
Vicksburg-Frio fault zone (Subdivisions 1-6)	348	50.4	142	43.7
Updip of Vicksburg-Frio fault zone (Subdivisions 7-12)	33	4.8	13	4.0
Wilcox fault zone (Subdivisions 13-18)	183	26.5	92	28.3
Updip of Wilcox fault zone (Subdivisions 19-24)	126	18.3	78	24.0

*Sandstones more than 30 ft thick.

DISTRIBUTION OF METHANE IN-PLACE RESOURCE

More than 75 percent of the entrained methane resource occurs in the Wilcox and Vicksburg-Frio fault zones; 50 percent of the resource occurs in the Vicksburg-Frio fault zone alone, where major Tertiary sand depocenters are concentrated (table 11). Significant sand development occurs updip of the Wilcox fault zone, but vertical accumulation is less than that within the fault zones because of lack of growth faulting. Also, at shallower depths of sand accumulation, methane solubility is lower because of lower pressures and temperatures. In subdivisions downdip of the Wilcox fault zone and updip of the Vicksburg-Frio fault zone only minor, thin sands were deposited in prodelta and shelf muds because Claiborne and Jackson deltas did not prograde out to the shelf margins. The Wilcox and Vicksburg-Frio fault zones, therefore, are of primary interest in evaluating the entrained methane resource.

Quality of an entrained-methane reservoir can be defined by the following physical parameters: total sandstone volume, reservoir continuity, solubility of methane in reservoir fluids, and porosity and permeability of the reservoir. These parameters are the basis for considering detailed reservoir evaluation and testing.

Sandstone Bulk Volume

The total bulk volume of a sandstone reservoir is determined by depositional and structural environment. In a deltaic setting maximum sandstone volume occurs as distributary-mouth bars and as delta-front deposits where the coarsest grained and cleanest (low mud content) sediments are deposited. Sandstone volume decreases seaward as sediments of decreasing grain size are deposited. Sandstone volume also decreases along strike because sands were increasingly reworked by marine processes and redistributed along the coast. In the lower Wilcox Group maximum sandstone volume occurs in Subdivisions 16, 17, and 23 (figs. 6 and 36) where thick delta-front sands were deposited by high-constructive, lobate deltas. Sandstone bulk volume decreases markedly southwest of De Witt County. High-destructive deltaic deposits of the upper Wilcox Group accumulated to a lesser extent in Subdivisions 16, 17, and 18 (figs. 12 and 36). High-constructive, lobate deltas were active in the upper Wilcox in lower Texas, but net-sandstone and effective sandstone distribution maps (figs. 12 and 13) show apparent lower thicknesses probably because of lack of well control and incomplete penetration of the interval. Vicksburg sands were deposited in strongly dip-oriented, high-constructive, lobate deltas in lower Texas. The main sand depocenter occurs in Hidalgo County in Subdivision 1 (figs. 21 and 36); little sandstone development is present along strike. Major Frio sand depocenters, composed of delta-front sands of predominantly high-constructive, lobate deltas, are found in Subdivision 1 and the southern half of Subdivision 2 (fig. 36) in the lower Texas Rio Grande Embayment (figs. 24 and 27). A decrease in fluvial processes and an increase in marine processes northward along strike resulted in lower sand volume and increased strike orientation. Frio barrier-bar and strandplain systems developed along the coast in the northern half of Subdivision 2, Subdivision 3, and the lower half of Subdivision 4 (figs. 24, 27, and 36) because of marine reworking and redistribution of sediments derived from deltaic deposits in the Rio Grande and Houston Embayments and from

reduced sediment supply. Structural influences, however, led to accumulations of large volumes of sand in stacked barrier-bar systems in the Corpus Christi area. High-constructive, lobate deltas of lesser extent deposited Frio sands in the Houston Embayment (figs. 3, 24, and 27).

Growth faults occur at sites of maximum deposition in the Gulf Coast, and they tend to reinforce these trends in sand volume. In delta-front environments, extensive vertical stacking of sand bodies, which would otherwise have been carried farther seaward, can occur. Along strike, density of growth faults tends to decrease as sand volume decreases, but deposition of large amounts of sand-poor sediment can result in large displacements of the growth faults that do occur. Maximum sandstone volume in the Vicksburg and Frio Formations in the Rio Grande Embayment coincides with extensive growth faulting and vertical accumulation (Bebout and others, 1975a). A northward decrease in sand supply reduces the incidence of growth faulting and vertical stacking (Bebout and others, 1975b), although stacked barrier bars in Nueces and San Patricio Counties are volumetrically significant (Weise and others, 1980). Growth faulting is less extensive in the Houston Embayment relative to the Rio Grande Embayment because lower sediment supply and less basinal subsidence resulted in smaller delta systems.

Little variation in growth fault density along the coast is apparent on a map of Wilcox growth faults (Bebout and others, 1979) because of shifting source areas and depocenters during Wilcox time. Middle and upper Texas are dominated by lower Wilcox faulting; lower Texas is dominated by upper Wilcox faulting. A local interruption in growth faulting appears in Waller County probably because of extensive salt doming in that area.

Thinning over salt domes and other structural highs reduces total sandstone volume, but this is minor on a regional scale. In upper Texas where salt dome formation was active, sediment loading commonly led to salt withdrawal in synclinal

areas, supplying salt for nearby salt dome growth and initiating growth faulting. Rapid subsidence allowed thick sandstone and shale sections to develop. The Brazoria geothermal fairway is characterized by this type of structural setting (Bebout and others, 1978).

Reservoir Continuity

Reservoir continuity is determined by structure, sandstone geometry, and diagenetic changes. As stated above, the most significant structural features of the Gulf Coast affecting reservoir potential are growth faults. Most growth faults parallel the coast, limiting reservoir size in the dip direction. Opposing this is the tendency to enhance vertical continuity in areas of high sand influx such as in Vicksburg and Frio sandstones in lower Texas. In addition, movement along growth faults isolates these sandstone packages from updip units, allowing high pressures and temperatures to develop which increase the solubility of methane.

Sandstone geometry in the Gulf Coast reflects the interaction of fluvial and marine processes, and it largely determines the extent of vertical and lateral continuity. These relationships are summarized in figure 138 for potential reservoir sandstones. Non-reservoir distal delta and shelf sandstones are omitted. Generally, vertical continuity decreases and lateral continuity increases as fluvial processes are superseded by marine processes. In distributary-mouth bars and delta-front slope deposits in dip-oriented, high-constructive, lobate deltas common in the lower Wilcox Group in middle and upper Texas and in the Vicksburg and Frio Formations in lower Texas, sand influx is high, and vertical continuity, enhanced by growth faulting, is good. Lateral continuity typically is limited because of little redistribution along strike. Less dip-oriented delta-front deposits in the upper Wilcox in lower Texas, however, are more laterally continuous (M. B. Edwards, personal communication, 1980). High-destructive, wave-dominated deltas such as upper Wilcox deltas in middle

Figure 138. Relationships between depositional environments and reservoir continuity, Texas Gulf Coast.

and upper Texas occur in areas of lesser sand input in which marine processes are more effective, and these deltaic deposits are more laterally continuous. Distributary channels in delta plain facies of both delta systems may show significant vertical accumulation but little lateral extent. Marginal delta-front sands are thin, finer grained sand bodies deposited farther from maximum sand deposition; they may be sheetlike or laterally discontinuous. In abandoned delta lobes and distal delta facies and in areas of low sediment input, marine processes dominate fluvial processes, and deltaic deposits are reworked and redistributed along strike into barrier-bar and strandplain systems. The spatial distribution of Frio sandstones in middle Texas along the San Marcos Arch is characteristic of these processes. Barrier-bar systems may consist of single, thin, laterally extensive units, or as in the case of upper Frio deposits in Nueces and San Patricio Counties, they may be stacked in thick, vertically continuous units.

Cementation and formation of secondary porosity are diagenetic processes that change the size and configuration of potential reservoirs. Porous reservoirs commonly are areally limited by cemented zones. Secondary porosity, formed by leaching of unstable rock components, can create new reservoirs or enlarge existing ones, but lateral persistence is highly variable.

Porosity and Permeability

Regional porosity and permeability trends were described by Loucks and others (1979) as a function of rock composition and diagenetic history. Wilcox sandstones are quartzose lithic arkoses, and they vary little in composition along the Gulf Coast. Consequently, porosity and permeability trends are vague (fig. 80) to nonexistent (Loucks and others, 1979). Wilcox sandstones are low both in unstable feldspars and in rock fragments from which secondary, leached porosity is created, and they are well cemented with quartz and lesser calcium carbonate in most areas. High porosity and

permeability values are a local phenomenon, perhaps owing to local shale-water composition and shale diagenesis. Vicksburg and Frio sandstones show a regional trend with porosity and permeability increasing from lower to upper Texas (fig. 78; Loucks and others, 1979), corresponding to a compositional trend from feldspathic litharenite and lithic arkose to quartzose lithic arkose and subarkose in the same direction. The major porosity-reducing cement in these formations is calcium carbonate; this cement decreases markedly toward upper Texas as the volume of unstable components decreases and quartz increases.

On a regional scale, a relationship between porosity, permeability, and depositional environment or proximity to shale beds has not been shown (Loucks and others, 1979). On a local scale, however, high porosity and permeability are associated with clean sandstones (low mud/matrix content), and clean sandstones have the greatest potential for developing secondary porosity (Loucks and others, 1980). Sandstones with abundant matrix may have high microporosity (porosity not identifiable with standard petrographic techniques, largely occurring between clay particles), but permeability is very low.

Porosity trends with depth have been discussed in an earlier section. Porosity decreases with depths at varying rates, although locally, development of secondary porosity can re-create reservoirs. The Pleasant Bayou geothermal reservoir in Brazoria County is composed predominantly of secondary porosity (Bebout and others, 1978).

RESERVOIR MODELS

Potential geothermal reservoirs in the Texas Gulf Coast can be represented by five depositional-structural models. Models I and II describe Wilcox reservoirs (fig. 139); they are based on regional geothermal investigations of the Wilcox Group (Bebout and others, 1979). Models III through V describe Vicksburg and Frio reservoirs

(fig. 140); they are based on regional geothermal investigations (Bebout and others, 1978; Loucks, 1979; Weise and others, 1980) and on analyses of regional depositional systems by Galloway (personal communication, 1980). Each formation in each model is characterized by depositional environment (net sandstone geometry), reservoir continuity, methane solubility, and porosity and permeability. Fairway and prospect areas (fig. 141) described in detail in other geothermal investigations (Bebout and others, 1978, 1979; Loucks, 1979; Weise and others, 1980) are used as examples to illustrate internal variations within these reservoirs.

Model I

Model I (fig. 139) represents Wilcox reservoirs in lower Texas in Subdivisions 13 and 14 and in the lower half of Subdivision 15. In this area the lower Wilcox is characterized by thin, areally extensive sandstones which were deposited in a strandplain/barrier-bar system. In downdip areas (fig. 101 and table 7), methane solubility at median depth is high (up to 84 SCF/bbl) owing to high temperatures (up to 375°F) (fig. 98), high pressures (up to 10,500 psi) (fig. 99), and low salinities (20,000 to 60,000 ppm NaCl) (fig. 100). Porosity and permeability, however, are very low. Therefore, reservoir potential in the lower Wilcox in Model I is limited by inadequate sandstone volume and very low porosity and permeability.

The lower Wilcox is overlain by the transgressive-shelf and distal-deltaic sandstones of the middle Wilcox. The middle Wilcox is in turn overlain by high-constructive, lobate deltas of the upper Wilcox. The upper Wilcox is growth faulted at the lower Wilcox shelf margin, forming vertically continuous reservoirs of delta-front sandstones. Zapata, Duval, and Live Oak Fairways (fig. 141) were the major sand depocenters in this area (Bebout and others, 1979). In the Zapata Fairway, 200 to 800 ft of net sandstone and 150 to 400 ft of effective sandstones accumulated in a 2,000-ft upward-coarsening sequence. Reservoir sandstone packages range from 280

Figure 139. Reservoir models I and II for the Wilcox Group, Texas Gulf Coast.

Figure 140. Reservoir models III, IV, and V for the Vicksburg and Frio Formations, Texas Gulf Coast.

Figure 141. Fairway and prospect areas of geothermal investigations.

to 620 ft (Bebout and others, 1979). Potential reservoir sandstones are shown on cross section 23-23' (Appendix C), well No. 4. In the Live Oak Fairway, as illustrated on cross section 18-18' (Appendix C), well Nos. 11 through 13, sandstone bodies are thinner, but net sandstone packages are 300 to 700 ft thick, and effective sandstone packages are up to 600 ft thick. Reservoir sandstones in the upper Wilcox are moderately continuous along strike, but dense growth faults limit continuity in the dip direction.

Methane solubility at median depth is low to moderate (20 to 65 SCF/bbl) (fig. 111 and table 7). Pressures are moderate (up to 10,000 psi) (fig. 109), temperatures are moderate to high (225° to 350°F) (fig. 108), and salinities are low to moderate (20,000 to 60,000 ppm NaCl) (fig. 110). As in the lower Wilcox, porosity and permeability are low. In the Zapata Fairway, porosity ranges from 17 to 22 percent, and permeability ranges from 0 to 19 mD. Porosity and permeability in the Duval and Live Oak Fairways are similar (Bebout and others, 1979). Reservoir potential of the upper Wilcox in Model I, therefore, is limited by low to moderate methane solubility and low porosity and permeability.

Model II

Model II (fig. 139) represents Wilcox reservoirs in middle and upper Texas in the upper part of Subdivision 15 and Subdivisions 16 and 17. High-constructive, lobate, lower Wilcox deltas were extensively growth faulted at the carbonate shelf margin. Vertically continuous, delta-front sands accumulated to great thicknesses downdip of these growth faults, but dip orientation and rapid facies changes limit reservoir size along strike (Bebout and others, 1979). Sandstone geometry in De Witt and Colorado Fairways and the Montgomery prospect area (fig. 141) are characteristic of this model. Expansion of sandstone sections across growth faults is well illustrated in the De Witt Fairway on cross section 13-13', well Nos. 6 and 7, and in the Montgomery prospect

area on cross section 5-5', well Nos. 9 and 10. There are 400 to 1,100 ft of net sandstone and 200 to 1,000 ft of effective sandstone accumulated in the De Witt Fairway. In the Montgomery prospect area, there are 1,000 to 2,500 ft of net sandstone and 400 to 1,400 ft of effective sandstone.

Methane solubility at median depth in the lower Wilcox is high (29 to over 114 SCF/bbl) (fig. 101 and table 7) owing to high temperatures and pressures (up to 360°F and 14,000 psi) and in spite of high salinities (80,000 to 120,000 ppm NaCl). Highest methane solubility is found in the Colorado Fairway where pressures are the highest. Porosity and permeability, however, are low except for locally high values of more than 20 percent porosity and 200 mD permeability in the De Witt Fairway. Colorado and Montgomery Fairways are more typical; porosities range from 0 to 19 percent, and most permeabilities are less than 5 mD. Reservoir potential of the lower Wilcox in Model II is limited by low porosity and permeability.

Transgressive-shelf and distal-deltaic sands of the middle Wilcox overlay the lower Wilcox in upper Texas. Progradation resumed with high-destructive, wave-dominated upper Wilcox deltas (Fisher and others, 1969), but extensive growth faulting did not occur over the stable lower Wilcox base. Upper Wilcox sand reservoirs of delta-front origin were moderately continuous in all directions, but lack of growth faulting prevented extensive vertical sand accumulation. Methane solubility at median depth is low to moderate (17 to 35 SCF/bbl) (fig. 111 and table 7) because temperatures and pressures are low to moderate (190° to 275°F and 4,450 to 8,000 psi) (figs. 108 and 109). Salinities range from 20,000 to 120,000 ppm NaCl (fig. 110). Porosity and permeability are also low. Reservoir potential, therefore, in the upper Wilcox in Model II is limited by low porosity and permeability and by low pressure in updip areas.

Model III

Model III (fig. 140) represents Vicksburg and Frio reservoirs in lower Texas in Subdivision 1 and the lower part of Subdivision 2. High-constructive lobate Vicksburg deltas prograded beyond the Wilcox shelf margin where extensive growth faulting began. Massive accumulations of vertically continuous, delta-front sands occurred downdip of growth faults, but continuity along strike is limited by strong dip orientation of sandstone bodies, and continuity in a dip direction is limited by growth faults (Loucks, 1979). Facies changes along strike can be seen on structural cross section C-C', well Nos. 7 through 10. The main sand depocenter occurs in the Hidalgo Fairway (fig. 141), where net sandstone is more than 1,100 ft and effective sandstone ranges from 350 to 850 ft.

Methane solubility at median depth in the Hidalgo Fairway is high (45 to 60 SCF/bbl) (fig. 126) owing to high temperatures and pressures (285° to 350°F and 8,500 to 12,500 psi) (figs. 123 and 124) and low to moderate salinities (20,000 to 50,000 ppm NaCl) (fig. 125). Porosity in the Hidalgo Fairway averages 9 percent (fig. 127), and most permeability is less than 1 mD (Loucks, 1979). Reservoir potential in the Vicksburg in Model III is limited by very low porosity and permeability and by the lack of areally extensive sandstone bodies.

Vicksburg deltas are overlain by predominantly high-constructive, lobate, lower Frio deltas, growth faulted at the shelf margin. The Hidalgo Fairway (Bebout and others, 1978) and Candelaria and Sarita prospect areas (fig. 141) are characteristic of this model. Commonly, more than 1,000 ft of vertically continuous net and effective sandstone accumulated downdip of growth faults, as illustrated on cross section 21-21', well Nos. 21 and 22, in the Candelaria prospect area and on cross section 19-19', well Nos. 21 through 24, in the Sarita prospect area. Individual sandstones range from 10 to 200 ft thick (Bebout and others, 1978; Weise and others, 1980). Basal, lower Frio

sandstones are laterally continuous in lower Texas, extending over 50 mi² in the Candelaria prospect area (Bebout and others, 1978), but shallower, lower Frio sands are less extensive (Galloway, personal communication, 1980). Reservoir size in the dip direction is limited by growth faults.

Methane solubility at median depth is high in the lower Frio (up to 110 SCF/bbl) (fig. 86 and table 7) owing to very high temperatures and pressures (up to 430°F and 18,000 psi) (figs. 83 and 84) and low to moderate salinities (25,000 to 75,000 ppm NaCl) (fig. 85). Maximum methane solubility occurs in the Hidalgo Fairway. Porosity and permeability are low, however; average porosity is less than 20 percent (fig. 96), and average permeability is less than 1.5 mD (Bebout and others, 1978). Reservoir potential in the lower Frio in Model III is limited by very low porosity and permeability.

The overlying high-constructive, lobate deltas of the upper Frio are depositionally and structurally similar to lower Frio deltas. Large volumes of delta-front deposits with individual sandstone bodies up to 150 ft thick in the Candelaria and Sarita prospect areas are vertically continuous, but areally limited by facies changes and growth faults (Weise and others, 1980). Methane solubility in the upper Frio at median depth ranges from 15 to 45 SCF/bbl (fig. 131), but it is lower than in the Vicksburg and lower Frio owing to lower temperatures and pressures (200° to 320°F and 4,000 to 16,000 psi) (figs. 83, 84, 123, and 124). Salinity is low to moderate (25,000 to 75,000 ppm NaCl) (fig. 130). Reservoir potential in the upper Frio is largely limited by low porosity and permeability and by the lack of areally extensive sandstones.

Model IV

Model IV (fig. 140) represents Frio reservoirs in middle Texas in the upper part of Subdivision 2, Subdivision 3, and the lower part of Subdivision 4. Lower Frio sands were deposited in a strandplain/barrier-bar system in which deposition of large volumes

of sand and mud resulted in growth faults. Growth faults have large displacements, but there are fewer large faults than in sandstone-rich lower Texas. Down dip of these faults, thin, areally limited shelf deposits are the dominant facies. In the Corpus Christi Fairway (fig. 141), as shown on cross section D-D', well Nos. 20 and 21, sandstones are 1 to 10 ft thick, separated by equal or larger amounts of shale with a net sandstone accumulation of 50 to 400 ft and an effective sandstone accumulation of 0 to 200 ft.

Methane solubility at median depth in the Corpus Christi Fairway (fig. 141) is moderate (35 to 50 SCF/bbl) (fig. 86) because of moderate to high temperatures and pressures (250° to 325°F and 7,500 to 10,500 psi) (figs. 83 and 84). Salinity is low, less than 25,000 ppm NaCl (fig. 85). Porosity and permeability data from one well in Corpus Christi indicate porosities of 9 to 22 percent and permeabilities less than 5 mD (Bebout and others, 1978). Reservoir potential in the lower Frio in Model IV is limited by low sandstone volume and areal extent and by low porosity and permeability.

The overlying upper Frio strandplain/barrier-bar system differs from that in the lower Frio by vertical stacking of barrier bars down dip of growth faults. Stacked barrier bars are excellent reservoirs; they are both vertically and laterally continuous. Well Nos. 18 through 21 on cross section D-D' show reservoir development in the Corpus Christi Fairway (fig. 141) in which up to 1,000 ft of net sandstone and up to 600 ft of effective sandstone are found below 8,000 ft.

Methane solubility at median depth in the upper Frio in Model IV is low to moderate (20 to 35 SCF/bbl) (fig. 131 and table 7) owing to low temperatures and pressures (195° to 250°F and 4,500 to 8,000 psi) (figs. 128 and 129) and high salinities (50,000 to 100,000 ppm NaCl) (fig. 130). Median methane solubility, temperature, and pressure values in the Corpus Christi Fairway are in the lower ends of their ranges. Porosity and permeability in these sandstones are high; however, porosities average about 25 percent, and permeabilities average hundreds of millidarcys. Reservoir

potential in the upper Frio in Model IV is limited by low methane solubility and low pressure.

Model V

Model V (fig. 140) represents Frio reservoirs in upper Texas in the upper part of Subdivision 4, Subdivision 5, and the lower part of Subdivision 6. Frio deposition is characterized by high-constructive lobate deltas, in which delta-front sands accumulated downdip of growth faults or in salt-withdrawal basins. Upper Texas deltas are much smaller than those in lower Texas, growth faulting was less intense, and potential reservoirs are less vertically extensive (Bebout and others, 1978).

Methane solubility at median depth in the lower Frio is low to high (17 to 45 SCF/bbl) (fig. 86 and table 7). Temperatures are moderate to high (195° to 360°F) (fig. 83), pressure shows a wide range from low to high values (4,200 to 13,700 psi) (fig. 84), and salinity is moderate to high (55,000 to 150,000 ppm NaCl) (fig. 85).

The largest sand depocenters in the lower Frio are found in Subdivision 5. In the Brazoria Fairway (fig. 141) 200 to 600 ft of net sandstone and up to 500 ft of effective sandstone accumulated below 8,000 ft. These sandstones are well developed on cross section 6, well Nos. 17 through 19, and cross section 7, well No. 14. As sand accumulation was due largely to deposition in a salt-withdrawal basin, growth faulting is not a severe limitation on reservoir size. Methane solubility at median depth ranges from 20 to more than 40 SCF/bbl (fig. 86), temperatures reach 360°F (fig. 83), pressures range from 7,500 to more than 12,500 psi (fig. 84), and salinity is as high as 130,000 ppm NaCl (fig. 85).

In Matagorda Fairways and in the Old Ocean and Blessing prospect areas (fig. 141) potential lower Frio reservoirs are downdip of the main sand depocenters, and they are composed of thin, areally limited, distal-deltaic and shelf sands (Bebout and others, 1978; Weise and others, 1980). Well Nos. 18 through 21 on cross section

11-11' show sand development in the Blessing prospect area located in the Matagorda Fairway. Methane solubility may be slightly higher than in the Brazoria Fairway owing to slightly lower salinities.

Porosity and permeability are high in the lower Frio in Model V, as indicated by regional trends. In the Brazoria Fairway, porosities of 20 to 25 percent and permeabilities of hundreds of millidarcys are present (Bebout and others, 1978).

Reservoir potential is good in the lower Frio in Subdivision 5 in Model V. Although methane solubility is maximum in lower Texas in the deep Rio Grande Embayment, methane solubility is adequate in upper Texas, and reservoir continuity and porosity and permeability are favorable.

Deposition of upper Frio deltaic sands and contemporaneous growth faulting superimposed equivalent systems in the lower Frio in most of Subdivision 5. In the Brazoria Fairway, however, a localized transgression occurred, and upper Frio sands were deposited in distal-deltaic and shelf facies (W. E. Galloway, personal communication, 1980). In the upper part of Subdivision 4 and in the lower part of Subdivision 6, upper Frio deltas prograded out past major sites of lower Frio deposition. Downdip in the Matagorda Fairways and the Old Ocean and Blessing prospect areas (fig. 141), thin, sheetlike, marginal delta-front sands were deposited (Weise and others, 1980). Examples of these sandstones occur in well Nos. 18 through 21 on cross section 11-11'.

Methane solubility at median depth in the upper Frio in Model V is low to moderate (16 to 40 SCF/bbl) (fig. 131 and table 7) because temperatures and pressures are low to moderate (195° to 240° F and 4,500 to 8,000 psi) (figs. 128 and 129), and salinities are moderate to high (55,000 to 125,000 ppm NaCl) (fig. 130). Porosity and permeability, however, as deduced from regional trends, should be very good. Reservoir potential in the upper Frio in Model V is limited by low to moderate methane solubility and pressure. In the fairways and prospect areas that have been studied in detail, reservoir potential is also limited by size and geometry of sandstone bodies.

Reservoir characteristics of each formation in each model are summarized in table 12. Factors limiting reservoir potential are indicated in each case.

GEOLOGIC EVALUATION OF ECONOMIC ANALYSES

The economics of exploring for and ultimately producing energy resources depends initially on the resource base as perceived by geologists and engineers, the cost of operations, and the expectations or economic goals of the operator. Geological limitations of the resource base and potential constraints to production have a significant influence on economic analyses, thus any analysis is sensitive to the geologic data base or assumptions used in lieu of factual information.

The economics of producing methane from geopressured sandstones is no exception to the general rules that govern investment strategies and expected returns. The factors that set this activity apart from other energy programs are (1) the dilute and unconventional aspects of the resources, (2) the lack of experience in actual costs of operation, and (3) the general nature of the geologic limitations.

Effects of Geological Bias

Reservoirs selected for testing geopressured geothermal resources in the Gulf Coast are associated with productive sandstone reservoirs, and therefore they share many of the same internal properties and boundary limitations. Because of this close physical association and because field data for geopressured aquifers are sparse, analysts have used data for hydrocarbon reservoirs to predict the characteristics of geopressured aquifers. As a result, present economic analyses may yield unrealistic results because hydrocarbon reservoirs and geopressured aquifers are not identical. For example, areal extents of geopressured aquifers are largely unknown, and yet one economic analysis (Doscher and others, 1979) is based partly on the assumption that their size distribution is similar to that of oil and gas reservoirs. Therefore it is

Table 12. Summary of characteristics of depositional-structural models of Wilcox, Vicksburg, and Frio reservoirs.

	Sand geometry	Temperature	Pressure	Salinity	Methane solubility	Porosity & permeability	Factors limiting reservoir potential
Model I							
U. Wilcox	thick, laterally extensive sands	moderate to high	moderate	low to moderate	low to moderate	low	low to moderate methane solubility, low porosity and permeability
L. Wilcox	thin, areally extensive sands	high	high	low	high	very low	thin sands, very low porosity & permeability
Model II							
U. Wilcox	moderately thick sands, moderately continuous	low to moderate	low to moderate	low to high	low to moderate	low	low porosity & permeability, low pressure in updip areas
L. Wilcox	thick, laterally extensive sands	high	high	high	high	low, locally high in DeWitt fairway	low porosity & permeability
Model III							
U. Frio	thick, areally limited sands	moderate to high	moderate to high	low to moderate	high	low	areally limited sands, low porosity & permeability
L. Frio	thin, basal sands, laterally continuous	very high	very high	low to moderate	high	very low	low porosity & permeability
Vicksburg	thick, areally limited sands	high	high	low to moderate	high	very low	areally limited sands, low porosity & permeability
Model IV							
U. Frio	thick, areally extensive sands	low	low	high	low to moderate	high	low to moderate methane solubility, low pressure
L. Frio	thin, areally limited sands	moderate to high	moderate to high	low	moderate to high	low	areally limited sands, low porosity & permeability
Model V							
U. Frio	thin to moderately thick sands, areal extent variable	low to moderate	low to moderate	moderate to high	low to moderate	high	low to moderate methane solubility & pressure, low total sand volume
L. Frio							
Matagorda fairways	thin, areally limited sands	high	moderate to high	high	moderate to high	high	thin, areally limited sands
Brazoria Fairway	thick, areally extensive sands	high	moderate to high	high	moderate to high	high	—

important to recognize how existing economic analyses of methane production from geopressured aquifers are influenced by the underlying geological assumptions as well as the uncertainties of the important factors such as operating costs and future gas prices. The following discussion focuses on the geologic data base used in the analysis by Doscher and others (1979).

Reservoir Size

At least three different approaches can be used to estimate the anticipated sizes of geopressured aquifers that contain methane in solution. The first method considers the maximum thickness and areal extent of modern sandstone bodies that typically represent the depositional environments for Gulf Coast sandstones. This supposedly sets an upper limit on sandstone volume for specific sand facies before their reduction in size by faulting or diagenetic processes. The second approach relies on field data for the sizes of hydrocarbon reservoirs that are used to predict dimensions of geopressured reservoirs. The second method has the advantage of available data, but its validity remains uncertain because the data sets may not be comparable. The third and perhaps most reliable method for predicting reservoir size is based on detailed studies of productive reservoirs from the geopressured zone. Such studies are in progress, but a substantial data base has not yet been developed and published.

In the absence of statistically significant data for geopressured aquifers, Doscher and others (1979) based their estimates of reservoir size on a combination of data published for modern sand bodies (Morgan, 1970) and dimensions of offshore reservoirs previously calculated by Doscher (1977). Unfortunately, neither of these procedures is adequate for purposes of economic analyses, and both tend to underestimate actual volumes of geopressured sandstones.

Dimensions of Modern Sandstones

Reasonable estimates of individual sandstone* dimensions can be obtained from studies of modern depositional environments of the Gulf Coast. These studies also serve as guides to the interpretation of paleogeography and prediction of reservoir characteristics when properly applied. However, the value of these studies is diminished if the significance of the environments selected for comparison is not fully understood.

Sand-body data (table 13) originally compiled by Doscher and others (1979) contain factual errors as well as a bias toward thin sandstones that is disproportionate to their expected occurrence in the subsurface. For example, sedimentologists have long recognized substantial differences in sandstone geometry resulting from deposition in different water depths and wave climates. Shoal-water deltas, such as the LaFourche subdelta (table 13), produce relatively thin but widespread sheet sands, whereas the bird's foot subdelta produces bar-finger sands that are thick but limited in lateral extent. Spatial dimensions for sand bodies deposited in these markedly different deltaic settings should not be similar, contrary to data indicated in table 13. Furthermore, bar-finger sands exhibit larger volumes than sheet sands because of their greater thicknesses; however, the opposite is indicated by table 13.

Another serious shortcoming of the compiled data in table 13 is the unintentional bias toward thin sands that represent reworked delta-front and other nearshore deposits. These erosional remnants were formed during the Holocene marine transgression that followed the Wisconsin glacial period. Sabine Bank and Heald Bank (table 13) are clearly products of marine reworking as the Texas inner continental shelf was submerged by a rising sea.

Furthermore, the barrier island example presented in table 13 is atypical. Morton (1979) described the transitional setting of Galveston Island, which contains

Table 13. Estimated maximum size of individual sand bodies in selected deltaic facies (from Doscher and others, 1979).

Stratigraphic unit	Length (mi)	Width (mi)	Thickness (ft)	Volume (mi ³)	Depositional environment
LaFourche delta (1)	15 to 20	3 to 5	200 max.	3.79	Fluvially dominated portion of delta
Bar fingers	15 to 20	3 to 5	100 mode	1.89	
Niger delta (1)	22.9 max.	7.44 max.	32.80	1.06	Beach ridge/barrier island complex
Galveston barrier (2)	3 to 50	1 to 8	15 to 30	2.27*	Individual sand body
Rhone delta (1)	31	12.4	32.80	2.39	Coastal barrier sheet sand
Heald Bank (1)	25	4 to 11	26	1.35	Banks reworked from seaward
Sabine Bank (1)	26	4 to 11	15 to 30	1.62	Projecting deltaic lobes
St. Bernard delta (1)	74.52	8.69	32.80	4.02	Offshore, prodelta sheet sand

*Of this volume, only 0.33 mi³ is clean, well-sorted, fine-grained to very fine grained sand.

(1) Morgan, 1970.

(2) Bernard and others, 1970.

Table 14. Metric conversion factors.

<u>Customary Unit</u>		<u>Conversion Factor</u>		<u>Preferred Metric Unit</u>
bb1 (42 gals)	x	0.158983	=	m ³
BTU/hr · ft ² · °F/ft	x	1.730735	=	W/m ² ·K
SCF (std ft ³)	x	0.02831685	=	m ³
°F		(°F - 32)/1.8	=	°C
°C	+	273.1500	=	K
°F/100 ft	x	18.22689	=	mK/m
ft	x	0.3048	=	m
ft/sec	x	0.0003048	=	m/ms
gal	x	0.003785412	=	m ³
g/cm ³	x	1000	=	kg/m ³
md	x	0.0009869233	=	μm ²
psi	x	6.894757	=	kPa
psi/ft	x	22.62059	=	kPa/m
lbs/gal	x	119.8264	=	kg/m ³
SCF/bbl (std ft ³ /bbl)	x	0.1801175	=	std m ³ /m ³
sq mile (mi ²)	x	2.589988	=	km ²

elements of both transgressive and regressive landforms. The thin western flank of the island overlies muddy sediments deposited during the last progradation of the ancestral Brazos delta. The resulting sand wedge thickens off the delta flank and accounts for the 0.33 mi^3 of clean sand (table 13) described by Bernard and others (1970). In contrast, barrier islands that are formed in interdeltic bights and preserved in the subsurface are generally thicker and more extensive than Galveston Island. This is substantiated by the thickness and lateral extent of modern regressive barriers (Morton, 1979; Morton and McGowen, 1980) and Quaternary strandplain deposits (Winker, 1979). Although major fluctuations in sea level have occurred throughout geologic time, the downward adjustment in sandstone volume attributed to thin transgressive sandstones and incomplete barrier islands (Doscher and others, 1979, p. 1503) appears unjustified.

Structural Limitations

Until recently, geopressured geothermal prospects were delineated assuming that major faults prevent or drastically retard lateral movement of fluids. Smith (1980) presented evidence, widely known throughout industry, of non-sealing faults that displace Tertiary sandstone reservoirs in the hydropressure zone. Preliminary data for geopressured sandstones (Charles Boardman, personal communication, 1980) also suggest leakage of fluids across faults where sandstones are juxtaposed. The significance of these conditions is particularly important in South Texas, where entrained methane prospects would be increased areally if thick sandstones separated by faults are in a lateral fluid communication.

Another unresolved problem is the structural position of a test well. With methane being the primary objective, a location that is structurally high would be desirable if gas exsolves, reaches critical saturation, and migrates or forms near the top of the trap. Heretofore, off-structure locations were considered ideal because of

higher temperatures and pressures and avoidance of interference with hydrocarbon production.

The economic analysis by Doscher and others (1979) does not adequately provide for the possibility of non-sealing faults or the exsolution of gas, which might increase the gas to water ratio during the later stages of production. Consideration of either condition would result in a more optimistic economic analysis.

Shale Effects

Geopressured reservoirs are not entirely limited by the distribution of sandstone, even though geothermal fluids are produced principally from sandstone reservoirs. In addition to the interstitial sources of water within the reservoir, some influx of water from adjacent shales can occur, thereby increasing the total capacity of the reservoir. Dewatering of shales, attendant with reservoir depletion and compaction, has been documented by Wallace (1969). This short-term process related to production is different from all three stages of shale dewatering (Burst, 1969) that occur in conjunction with consolidation of sediments over periods of geologic time. Shales that are deeply buried and geopressured have most likely equilibrated with respect to compaction and dehydration processes. Therefore shale water production is the physical release of interstitial water available after diagenesis.

The volume of geothermal fluids contributed by adjacent shales depends on the surface area of the reservoir, the permeabilities at the sand-shale interface, and the pressure decline within the reservoir. Water expelled from interbedded and surrounding shales would assist in maintaining reservoir pressure after the initial pressure drops or would reduce the rate of pressure decline.

The salinity of water derived from shales in the geopressured zone is uncertain. Some workers have reasoned that it is essentially the same for all sediments (Schmidt, 1973), whereas others have argued that it is less saline than the water in nearby

sandstone reservoirs. The composition and concentration of gas associated with shale water are equally uncertain; however, they will most likely be similar to gas properties determined for nearby sandstone reservoirs. The extant economic analyses consider only the solution gas produced from the sandstone reservoir; they do not consider the shale effect or the possible time-dependent changes in reservoir permeability or brine chemistry.

Size Distribution

The sizes of geopressured geothermal reservoirs are poorly known. They are probably log-normally distributed, as suggested by Doscher and others (1979); however, the range of sizes has not been established. Because of the uncertainties involved, any attempt to quantitatively estimate the maximum or average reservoir size would be highly speculative. Despite these severe limitations, Doscher and others (1979) suggested that most geothermal reservoirs would be considerably less than 1 mi^3 . This estimate was based on their stratigraphic analysis (table 13) for individual sands and sizes for oil and gas reservoirs.

With time, the objectives and minimum requirements used to delineate geothermal prospects such as the Austin Bayou prospect in Brazoria County, Texas, have become unclear. During the initial stages of prospect delineation, 3 mi^3 of "reservoir" sandstone was considered a requirement. Subsequently this has been misinterpreted by other workers to represent a single sandstone reservoir, which Doscher and others (1979) correctly note as being less than 3 mi^3 . Apparently there is still some tendency to confuse (1) individual and isolated sandstones, such as the production reservoir for the Pleasant Bayou No. 2 well, (2) multistoried sandstones that are vertically stacked but behave as a single aquifer system, and (3) total net sandstone in the geopressured zone that meets some minimum requirements (temperature, pressure gradient) for exploration of geothermal resources. The third category represents the original

concept of reservoir volume in a prospect; however, the concept has erroneously been applied to the first category, or individual sandstones.

An equally serious misapplication of data resulted when Doscher and others (1979) suggested that dimensions for offshore oil and gas reservoirs would approximate the sizes of geopressed aquifers. Structural closures in which hydrocarbons are trapped are seldom filled to the spill point; therefore, sizes of hydrocarbon reservoirs would substantially underestimate the total size of the reservoir sandstone including the contiguous aquifer downdip of the hydrocarbon column. In fact, the adjacent aquifers are commonly about 10 to 100 times larger than the hydrocarbon reservoirs with which they are associated. Minimum size requirements for individual sandstone reservoirs must await developments in research areas considering (1) pressure and fluid contribution from shales, (2) effects of reservoir compaction on permeability, (3) reservoir limits in areas of sealing and non-sealing faults, and (4) types of reservoir drive.

Reservoir Quality

Regional diagenetic overprints tend to mask original porosity and permeability relationships inherited from the depositional environments. Regardless of their origin, Gulf Coast sandstones have experienced substantial reductions in pore space owing to several stages of cementation. Because geopressed sandstones in the Wilcox Group and Frio Formation of Texas generally have low permeabilities, especially in South Texas, Doscher and others (1979) concluded that permeabilities of geopressed reservoirs would not exceed 100 mD. Regional studies of Tertiary sandstones by Loucks and others (1979) have documented the regional variations in reservoir quality and predicted improved porosity and permeability relationships for Frio sandstones along the upper Texas Coast. Enhanced pore space development in these sediments is attributed to leached porosity, which formed late in the consolidation history of the rocks. Depth-dependent decreases in porosity and permeability are contrasted by

anomalously high departures from the regional trends in areas where secondary porosity is found in deep overpressured sandstones.

Ongoing research at the Bureau of Economic Geology tends to support the conclusions of Doscher and others (1979) regarding relatively low permeabilities. However, two important points should be stressed. First, the in situ permeabilities calculated from initial production tests of the first design well clearly established that effective permeabilities greater than 100 mD are not unlikely. In fact, the production reservoir for Pleasant Bayou No. 2 has permeabilities up to 150 mD as measured from whole cores and pressure build-up data. Perhaps more germane is the question of permeabilities in Miocene sandstones that are targets for geothermal exploration in Louisiana. Parish plots by Bebout (personal communication, 1980) show that permeabilities of 100 mD or greater might be expected even at depths of 16,000 ft. Although permeabilities in geopressed aquifers are largely untested, these recent developments indicate that the upper limit of permeabilities remains unresolved.

Reservoir Drive

Economic profits are based partly on productivity and anticipated life of the project, which translate to, among other things, reservoir size and mechanisms that move the fluids to the well bore. Recovery of solution gas from the geopressed brines depends primarily on whether the reservoir energy is derived from an active water drive, a depletion drive by gas expansion, or some other combination of forces. Preliminary data indicate that geothermal aquifers will generally have the same types of drives as gas reservoirs. What remains to be determined is the expected frequency of water drives, which are relatively efficient and allow for maximum recovery, versus depletion drives, which are relatively inefficient and offer minimum yields.

Impact of Geologic Variables on Economic Analyses

Conservative estimates for reservoir size, internal properties, the type of reservoir drive, and the discounting of possible time-dependent increases in gas to water ratio by Doscher and others (1979), resulted in an economic analysis that is less than favorable for present commercialization of the geothermal methane resource. Although the results of this analysis are not surprising, given the geological and production constraints, most active researchers believe that many questions that bear heavily on the economic issues have not been resolved. A general consensus of participants at recent geopressure geothermal meetings is that pessimistic economic analyses, such as the one presented by Doscher and others (1979), are at best premature.

SUMMARY

(by designated tasks)

Task 1.0 - Data from previous and existing contracts were evaluated to determine the best location for regional cross sections to be used in this assessment of the solution methane resource. The top of the stratigraphic section examined in this study was the base of significant oil production in the Texas Gulf Coast, about 8,000 ft below sea level. The base of the section of interest corresponds to the base of the Wilcox Group (fig. 1), which contains the deepest significant sandstone units. The area of investigation was about 50,000 mi².

Task 1.2 - Locations were determined for 24 dip cross sections and 4 strike cross sections (fig. 4) in the onshore area along the Texas Gulf Coast.

Task 1.3 - Available well logs, maps, and completion cards were acquired for wells used in this study.

Task 1.4 - A tabulation of all cross section wells and infill wells was made to give well identification and location, total depth, depth to midpoint of each formation, net sandstone and average porosity by formation, and bottom hole temperature, when available. Average values of temperature, pressure, salinity, and methane solubility were also tabulated (Appendix B).

Task 2.0 - Regional structural cross sections were constructed for 24 dip cross sections that were spaced about 20 mi apart and for 4 strike cross sections (foldouts in separate folder). Major growth faults were located on cross sections to show limits of sandstone reservoirs.

Task 2.1 - Structural and stratigraphic boundaries were used to divide the Texas Gulf Coast into 24 subdivisions (fig. 36) for regional mapping of formation thickness, net sandstone, effective sandstone, temperature, pressure, salinity, methane solubility, and porosity for each of 9 formations considered (figs. 5 to 31, 83 to 86, 96, and 98 to 137).

Task 3.0 - Detailed mapping of parameters listed in task 2.1 was done.

Task 3.1 - Equilibrium bottom hole temperatures, mud weights, and 200^o, 300^o, and 350^oF isotherms are shown for each well on regional structural cross sections (foldouts in separate folder).

Task 3.2 - "Operational top of geopressure" (defined on page 7) is given on parameter plots (Appendix A) prepared for each well along dip and strike cross sections and is shown by arrows on structural cross sections by a map (fig. 42) and is also tabulated for each well (Appendix C). Isopiestic lines for 0.7, 0.8, and 0.9 psi/ft are shown on parameter plots, when feasible.

Task 3.3 - A regional net sandstone distribution map for each of 9 formations* (or divisions of formations) was prepared using available well control and striving for a minimum of one well log per Tobin grid (figs. 6, 9, 12, 15, 18, 21, 24, 27, and 30). Appropriate portions of the regional maps were expanded in scale for each subdivision for detailed studies. An example is given for the lower Frio Formation in Subdivision 2 (fig. 91).

Task 3.4 - A regional isopach map was constructed for each of the 9 formations (figs. 5, 8, 11, 14, 17, 20, 23, 26, and 29). Appropriate portions of these maps were expanded in scale for each subdivision for further analyses. An example is given for the lower Frio Formation in Subdivision 2 (fig. 87).

Task 3.5 - Average equilibrium temperature was determined at the midpoint of the formation interval or intervals of interest in each well (Appendix B).

Task 3.6 - An average equilibrium temperature distribution map was made for each of the 9 formations (figs. 83, 98, 103, 108, 113, 118, 123, 128, and 133). Appropriate portions of these maps were expanded in scale for each subdivision for detailed work. An example is given for the lower Frio Formation in Subdivision 2 (fig. 88).

Task 3.7 - Average values of pressure were determined at the midpoint of formations of interest in each well (Appendix B). A regional average pressure (isopiestic) distribution map was made for each of the 9 formations (figs. 84, 99, 104, 109, 114, 119, 124, 129, and 134). Appropriate portions of these maps were expanded in scale for each subdivision for detailed analysis. An example is given for the lower Frio Formation in Subdivision 2 (fig. 89).

*Upper Frio, lower Frio, Vicksburg-Jackson, upper Claiborne (Yegua), lower Claiborne, upper Wilcox, middle Wilcox, lower Wilcox, and upper Oligocene-Pleistocene Formations.

Task 3.8 - Average salinity values were determined at the midpoint of formations of interest in each well (Appendix B). All salinities were determined from SP logs using values of R_{mf} from well log headings. A salinity distribution map was prepared for each of the 9 formations (figs. 85, 100, 105, 110, 115, 120, 125, 130, and 135). Appropriate portions of these maps were expanded in scale for each subdivision for detailed studies. An example is given for the lower Frio Formation in Subdivision 2 (fig. 90).

Task 3.9 - Average values of porosity were determined at the midpoint of formations of interest in each well (Appendix B). A porosity versus depth relation was established for each of the 24 subdivisions (figs. 58 to 77). Comparisons of porosity versus depth trends were made for subdivisions located in different fault zones (figs. 78 to 81). A porosity distribution map was prepared for each of the 9 formations (figs. 96, 102, 107, 112, 117, 122, 127, 132, and 137). Appropriate portions of these maps were expanded in scale for each subdivision for detailed studies. An example is given for the lower Frio Formation in Subdivision 2 (fig. 97).

Tasks 4.0 - 4.3 - These tasks concern the possible use of seismic data in defining subdivision structural settings. Seismic data were not used; therefore, these items were deleted.

Task 5.1 - Total net sandstone bulk volume (table 5) was calculated for each of 9 formations in each of the 24 subdivisions from the area, and average thickness of sandstone as determined from expanded net sandstone distribution maps. The effective sandstone bulk volume was calculated in a similar way for sandstone units greater than 30 ft thick (table 8). A regional effective sandstone distribution map was prepared for each of the 9 formations (figs. 7, 10, 13, 16, 19, 22, 25, 28, and 31). Appropriate portions of these maps were expanded in scale for each subdivision for

detailed studies. An example is given for the lower Frio Formation in Subdivision 2 (fig. 94).

Task 5.2 - The total net sandstone pore volume (table 6) was calculated for each of 9 formations in each of 24 subdivisions from appropriate net sandstone bulk volume and porosity data. The effective sandstone pore volume (table 9) was calculated in a similar way from appropriate effective sandstone bulk volume and porosity data. An example (table 2) shows some calculated values of net sandstone bulk volumes and pore volumes for the lower Frio Formation in Subdivision 2.

Task 5.3 - The empirical equation of Blount and others (1979) was used for calculating methane solubility. The ranges of methane solubility were calculated for the average values of pressure, temperature, and salinity that represent Tertiary net sandstones and effective sandstones that occur below 8,000 ft for each of 9 formations in each of 24 subdivisions, onshore Texas Gulf Coast (tables 7 and 10). Values of methane solubility in formation waters of Tertiary sandstones range from 10 to 120 SCF/bbl.

A methane solubility distribution map was constructed for each of the 9 formations (figs. 86, 101, 106, 111, 116, 121, 126, 131, and 136). Portions of these maps were expanded in scale for each subdivision for detailed studies. An example is given for the lower Frio Formation in Subdivision 2 (fig. 92).

Task 5.4 - The total volume of in-place dissolved methane was calculated by formation and by subdivision for Tertiary net sandstones and effective sandstones below 8,000 ft, onshore Texas Gulf Coast. The total volume of solution methane in the net sandstone was 690×10^{12} SCF (table 3) compared with a value of 325×10^{12} SCF (table 4) for effective sandstones. The corresponding recoverable volumes of solution methane range from 21×10^{12} to 35×10^{12} SCF for net sandstones and from 10×10^{12} to 16×10^{12} SCF for effective sandstones, assuming that 3 to 5 percent of the in-place resource can be recovered.

The distribution of the in-place volume of solution methane by fault zone (table 11) shows that net sandstones in the Vicksburg-Frio fault zone along the Texas Gulf coastline (Subdivisions 1-6) contain about half of the total dissolved methane resource.

Task 5.5 - Five conceptual depositional-structural models were developed to describe potential geothermal reservoirs in the Wilcox, Frio, and Vicksburg Formations in the Texas Gulf Coast (figs. 139 and 140). The models are characterized by depositional environment (sandstone geometry), reservoir continuity, methane solubility, porosity, and permeability. Distribution of the methane resource is related to regional trends in temperature, pressure, salinity, and porosity, and to gross structural features and depositional environments. Fairway and prospect areas described in other geothermal investigations are used as examples of reservoirs and illustrate internal variations within regional trends (fig. 141). Reservoir characteristics of formations in each model are summarized in table 12.

Task 6.0 - Tabulations of the bulk volume of net sandstones (table 5) range from 2 to 1,040 mi³ for subdivisions and from 1 to 1,971 mi³ for formations. A total bulk volume of 5,700 mi³ of net sandstone is estimated for Tertiary formations below a depth of 8,000 ft for the onshore Texas Gulf Coast. The corresponding total pore volume of these net sandstones is 780 mi³ (table 6); thus, the average porosity of these net sandstones is about 14 percent. Almost half of the net sandstone bulk volume is due to effective sandstones that are more than 30 ft thick. Tabulated values of the bulk volume of effective sandstones (table 8) range from 0 to 485 mi³ for subdivisions and from 0 to 1,155 mi³ for formations. A total of 2,700 mi³ of effective sandstone is estimated for Tertiary formations below 8,000 ft for the onshore Texas Gulf Coast. The corresponding total pore volume of these effective sandstones is 380 mi³ (table 9);

thus, the average porosity of these effective sandstones is about the same as that for the net sandstones (14 percent).

Task 7.0 - A critique is given on the unfavorable economic analysis of projected commercial methane production from geopressed geothermal reservoirs published by Doscher and others (1979). It is pointed out that conservative estimates of reservoir size, internal properties, type of reservoir drive, and failure to take into account possible time-dependent increases in production gas-water ratios led to an economic appraisal that is unduly pessimistic and premature.

Tasks 8.0 - 9.8 inclusive, describe details of report preparation and content. These tasks essentially duplicate the work covered by tasks 1 through 7 above; thus, no further comment is necessary.

ACKNOWLEDGMENTS

Sincere appreciation is expressed to the numerous individuals who were generous with their time and expertise in the course of this project. We give especial thanks to B. R. Weise and W. E. Galloway for helpful discussions of Tertiary depositional systems and to J. W. Macon and his cartographic staff for their support in preparing the figures for this manuscript. Funding for this project was provided by the U.S. Department of Energy under contract number DE-AC08-78ET11397.

We also acknowledge the many companies who provided subsurface data:

Allied Chemical	Inexco Oil
Amerada Hess	Katz Oil
Amoco Production Company	Killam and Hurd, Ltd.
Atlantic Richfield	Kirby Exploration
Bass Enterprises Production Company	Maguire Oil
Chevron, U.S.A., Inc.	Marathon Oil
Cities Service Oil Company	Maynard Oil
Cockrell Corporation	Miami Oil Producers, Inc.
Continental Oil Company	Mitchell Energy Corporation
Edwin L. Cox	Mobil Oil
Dow Chemical U.S.A.	Robert Mosbacher
Enserch Exploration	Oxy Petroleum, Inc.
Exxon Company, U.S.A.	Pennzoil
David Fasken	Phillips Petroleum
Flournoy Drilling	Quintana Petroleum
Forest Oil	Reserve Oil, Inc.
General Crude	Shell Oil
Getty Oil	Sohio Petroleum
Ginther Warren & Co.	Southern Natural Gas
Gulf Oil Exploration and Production	Southland Drilling Company, Inc.
Michel T. Halbouty	Superior Oil
Highland Resources, Inc.	Tenneco Oil
Holly Energy, Inc.	Texaco, Inc.
HNG Oil Company	Texas Eastern Transmission Corp.
Hughes and Hughes Oil & Gas	Tucker Drilling Company, Inc.
Hunt Energy Corporation	Wesley West
Hunt Oil	W. Ridley Wheeler Estate

REFERENCES

- Archie, G. E., 1942, The electrical resistivity log as an aid in determining some reservoir characteristics: American Institute of Mining Engineers Transactions, v. 146, p. 54-67.
- Bateman, R. M., and Konen, C. E., 1977, The log analyst and the programmable pocket calculator: The Log Analyst, v. 18, no. 5, p. 3-11.
- Bebout, D. G., 1976, Subsurface techniques for locating and evaluating geopressed geothermal reservoirs along the Texas Gulf Coast: Second Geopressed Geothermal Energy Conference Proceedings, The University of Texas at Austin, Center for Energy Studies, v. 2, 44 p.
- Bebout, D. G., Agagu, O. K., and Dorfman, M. H., 1975a, Geothermal resources, Frio Formation, Middle Texas Gulf Coast: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 75-8, 43 p.
- Bebout, D. G., Dorfman, M. H., and Agagu, O. K., 1975b, Geothermal resources, Frio Formation, South Texas: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 75-1, 36 p.
- Bebout, D. G., Loucks, R. G., Bosch, S. C., and Dorfman, M. H., 1976a, Geothermal resources, Frio Formation, Upper Texas Gulf Coast: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 76-3, 47 p.
- Bebout, D. G., Loucks, R. G., and Gregory, A. R., 1978, Frio sandstone reservoirs in the deep subsurface along the Texas Gulf Coast: their potential for production of geopressed geothermal energy: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 91, 92 p.
- Bebout, D. G., Luttrell, P. E., and Seo, J. H., 1976b, Regional Tertiary cross sections--Texas Gulf Coast: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 76-5, 10 p.
- Bebout, D. G., Weise, B. R., Gregory, A. R., and Edwards, M. B., 1979, Wilcox sandstone reservoirs in the deep subsurface along the Texas Gulf Coast, their potential for production of geopressed geothermal energy: The University of Texas at Austin, Bureau of Economic Geology, Report to the U.S. Department of Energy, Division of Geothermal Energy, Contract No. DE-AS05-76ET28461, 219 p.
- Bernard, H. A., Major, C. F., Jr., Parrott, B. S., and LeBanc, R. J., Sr., 1970, Recent sediments of southeast Texas, a field guide to the Brazos alluvial and deltaic plains and the Galveston barrier island complex: The University of Texas at Austin, Bureau of Economic Geology Guidebook 11, 132 p.
- Blount, C. W., Price, L. C., Wenger, L. M., and Tarullo, M., 1979, Methane solubility in aqueous NaCl solutions at elevated temperatures and pressures: Idaho State University and U.S. Geological Survey, progress report, U.S. Department of Energy Contract No. ET-78-S-07-1716, 38 p.

- Bruce, C. H., 1973, Pressured shale and related sediment deformation: mechanism for development of regional contemporaneous faults: American Association of Petroleum Geologists Bulletin, v. 57, p. 878-886.
- Burst, J. G., 1969, Diagenesis of Gulf Coast clayey sediments and its possible relation to petroleum migration: American Association of Petroleum Geologists Bulletin, v. 53, p. 73-93.
- Doscher, T. M., 1977, CO₂ flooding best bet for enhanced recovery in Gulf of Mexico: Oil and Gas Journal (May 2, 1977), p. 213.
- Doscher, T. M., Osborne, R. H., Wilson, T., Rhee, S., Cox, D., and Kuuskraa, V., 1979, The technology and economics of methane production from geopressed aquifers: Journal of Petroleum Technology, p. 1502-1514.
- Doyle, J. D., 1979, Depositional patterns of Miocene facies, Middle Texas coastal plain: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 99, p. 1-28.
- Dunlap, H. F., 1980, Study of log-derived water resistivity data in geopressed formations: The University of Texas at Austin, Center for Energy Studies, fourth progress report, June 1980 (unpublished), 10 p.
- Fertl, W. H., and Timko, D. J., 1970, Association of salinity variations and geopressures in soft and hard rock: Society of Professional Well Log Analysts, eleventh annual logging symposium, May 3-6, p. 1-23.
- Fisher, W. L., Brown, L. F., Jr., Scott, A. J., and McGowen, J. H., 1969, Delta systems in the exploration for oil and gas: The University of Texas at Austin, Bureau of Economic Geology Special Publication, 212 p.
- Fisher, W. L., and McGowen, J. H., 1967, Depositional systems in the Wilcox Group of Texas and their relationship to occurrence of oil and gas: American Association of Petroleum Geologists Bulletin, v. 53, p. 30-54.
- Fisher, W. L., Proctor, C. V., Jr., Galloway, W. E., and Nagle, J. S., 1970, Depositional systems in the Jackson Group of Texas—their relationship to oil, gas, and uranium: Gulf Coast Association of Geological Societies Transactions, v. 20, p. 234-261, reprinted as The University of Texas at Austin, Bureau of Economic Geology Geological Circular 70-4, 28 p.
- Fisher, W. L., and Rodda, P. U., 1969, Edwards Formation (Lower Cretaceous), Texas: dolomitization in a carbonate platform system: American Association of Petroleum Geologists Bulletin, v. 53, p. 33-72.
- Fowler, W. A., 1970, Pressures, hydrocarbon accumulation, and salinities, Chocolate Bayou Field, Brazoria County, Texas: Journal of Petroleum Technology, v. 22, p. 411-423.
- Freed, R. L., 1980, Shale mineralogy of the No. 1 Pleasant Bayou Geothermal Test Well, a progress report: The University of Texas at Austin, Proceedings, Fourth U.S. Gulf Coast Geopressed Geothermal Energy Conference, October 29-31, 1979, v. 1, p. 153-165.

- Galloway, W. E., 1977, Catahoula Formation of the Texas coastal plain: depositional systems, composition, structural development, ground-water flow history, and uranium distribution: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 87, 59 p.
- Gregory, A. R., and Backus, M. M., 1980, Geopressed formation parameters, geothermal well, Brazoria County, Texas: The University of Texas at Austin, Proceedings, Fourth U.S. Gulf Coast Geopressed Geothermal Energy Conference, Research and Development, v. 1, p. 235-311.
- Gregory, A. R., Dodge, M. M., and Posey, J. S., 1980, Progress report on evaluation of entrained methane in deep reservoirs, Texas Gulf Coast: The University of Texas at Austin, Proceedings, Fourth U.S. Gulf Coast Geopressed Geothermal Energy Conference, Research and Development, v. 1, p. 414-473.
- Guevara, E. H., and Garcia, R., 1972, Depositional systems and oil-gas reservoirs in the Queen City Formation (Eocene), Texas: Gulf Coast Association of Geological Societies Transactions, v. 22, p. 1-22, reprinted as The University of Texas at Austin, Bureau of Economic Geology Geological Circular 72-4, 12 p.
- Haas, J. L., Jr., 1978, An empirical equation with tables of smoothed solubilities of methane in water and aqueous sodium chloride solutions up to 25 weight percent, 360°C, and 138 MPa: U.S. Geological Survey, Reston, Virginia, Open-File Report No. 78-1004, 41 p.
- Hedberg, W. H., 1967, Pore-water chlorinities of subsurface shales: The University of Wisconsin, Ph.D. dissertation.
- Hise, B. R., 1976, Natural gas from geopressed zone, in Natural gas from unconventional geologic sources: National Research Council, Board of Mineral Resources, Commission on Natural Resources, National Academy of Sciences, p. 41-63.
- Hottmann, C. E., and Johnson, R. K., 1965, Estimation of formation pressures from log-derived shale properties: Journal of Petroleum Technology, v. 17, p. 717-723.
- Hunt, J. M., 1979, Petroleum geochemistry and geology: San Francisco, W. H. Freeman and Company, 617 p.
- International Oil Scouts Association, 1978, Texas exploration and production: Texas Oil and Gas Development, v. 6, 360 p.
- Jones, P. H., 1976, Natural gas resources of the geopressed zones in the northern Gulf of Mexico basin, in Natural gas from unconventional geologic sources: National Research Council, Board of Mineral Resources, Commission on Natural Resources, National Academy of Sciences, p. 17-33.
- Kehle, R. O., 1971, Geothermal survey of North America, 1971 annual progress report: American Association of Petroleum Geologists, Research Committee (unpublished), 31 p.
- Kharaka, Y. K., Lico, M. S., Wright, V. A., and Carothers, W. W., 1980, Geochemistry of formation waters from Pleasant Bayou No. 2 Well and adjacent areas in coastal Texas: The University of Texas at Austin, Proceedings, Fourth U.S. Gulf

Coast Geopressed Geothermal Energy Conference, Research and Development, v. 1, p. 168-193.

Knapp, R. M., and Isokrari, O. F., 1976, Aspects of numerical simulation of future performance of geopressed geothermal reservoirs: The University of Texas at Austin, Proceedings, Second Geopressed Geothermal Energy Conference, v. II, p. 103-161.

Lewis, C. R., and Rose, S. C., 1970, A theory relating high temperatures and overpressures: Journal of Petroleum Technology, v. 22, p. 11-16.

Loucks, R. G., 1979, Sandstone distribution and potential for geopressed geothermal energy production in the Vicksburg Formation along the Texas Gulf Coast: Gulf Coast Association of Geological Societies Transactions, v. 28, pt. 1, p. 239-271.

Loucks, R. G., Dodge, M. M., and Galloway, W. E., 1979, Sandstone consolidation analysis to delineate areas of high-quality reservoirs suitable for production of geopressed geothermal energy: The University of Texas at Austin, Bureau of Economic Geology, Report to the U.S. Department of Energy, Division of Geothermal Energy, Contract No. EG-77-05-5554, 98 p.

Loucks, R. G., Richmann, D. L., and Milliken, K. L., 1980, Factors controlling reservoir quality in Tertiary sandstones and their significance to geopressed geothermal production: Division of Geothermal Energy, U.S. Department of Energy Contract No. DE-AC08-79ET27111, 188 p.

MacDonald, R. C., Sepehrmoori, Kamy, Ohkuma, Hiroshi, Lewis, J. T., and Knapp, R. M., 1980, Reservoir mechanics of geopressed geothermal aquifers--Pleasant Bayou well: Fifth IASA Resources Conference on Conventional and Unconventional World Natural Gas Resources, Laxenburg, Austria, June 30 -July 4, 1980, preprints, v. 3, 25 pages.

Magara, K., 1968, Compaction and migration of fluids in Miocene mudstone, Nakaoka Plain, Japan: American Association of Petroleum Geologists Bulletin, v. 52, p. 2466-2501.

Morgan, J. P., ed., 1970, Deltaic sedimentation modern and ancient: Society of Economic Paleontologists and Mineralogists Special Publication 15, 312 p.

Morton, R. A., 1979, Temporal and spatial variations in shoreline changes and their implications, examples from the Texas Gulf Coast: Journal of Sedimentary Petrology, v. 49, p. 1101-1111.

Morton, R. A., and McGowen, J. H., 1980, Modern depositional environments of the Texas Coast: The University of Texas at Austin, Bureau of Economic Geology, Guidebook 20, 175 p.

Oil and Gas Journal, October 20, 1980, Caution urged for U.S. energy policy: v. 78, no. 42, p. 103-104.

Overton, H. L., 1958, A correlation of electrical properties of drilling fluids with solids content: American Institute of Mining, Metallurgical, and Petroleum Engineers Transactions, v. 213, p. 333-336.

- Overton, H. L., and Timko, D. J., 1969, The salinity principle, and tectonic stress indicator in marine sands: *The Log Analyst*, No. 3.
- Papadopoulos, S. S., Wallace, R. H., Wesselman, J. B., and Taylor, R. E., 1975, Assessment of onshore geopressured-geothermal resources in the northern Gulf of Mexico basin, White, D. E., and Williams, D. L., eds.: U.S. Geological Survey Circular 726, p. 125-146.
- Rose, P. R., 1972, Edwards Group, surface and subsurface, Central Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 74, 198 p.
- Runnells, D. D., 1969, Diagenesis, chemical sediments, and the mixing of natural waters: *Journal of Sedimentary Petrology*, v. 39, no. 3, p. 1188-1201.
- Schlumberger Co., 1974, Log interpretation/applications: v. 2, 116 p.
- Schlumberger Co., 1978, Log interpretation charts, (gen-7): p. 3.
- Schmidt, G. W., 1973, Interstitial water composition and geochemistry of deep Gulf Coast shales and sandstones: *American Association of Petroleum Geologists Bulletin*, v. 57, p. 321-337.
- Smith, D. A., 1980, Sealing and non-sealing faults in Louisiana Gulf Coast salt basin: *American Association of Petroleum Geologists Bulletin*, v. 64, p. 146-172.
- Von Engelhardt, W., and Gaida, K. H., 1964, Concentration changes of pore solutions during compaction of clay sediments: *Journal of Sedimentary Petrology*, v. 33, p. 919-930.
- Wallace, R. H., Jr., Kraemer, T. F., Taylor, R. E., and Wesselman, J. B., 1978, Assessment of geopressured geothermal resources in the northern Gulf of Mexico basin—1978, Muffler, L. J. P., ed.: U.S. Geological Survey Circular 790, p. 132-155.
- Wallace, W. E., 1969, Water production from abnormally pressured gas reservoirs in south Louisiana: *Journal of Petroleum Technology*, v. 21, p. 969-982.
- Weise, B. R., Edwards, M. B., Gregory, A. R., Hamlin, H. S., and Jirik, L. A., 1980, Geological studies of geopressured and hydro pressured zones in Texas: test-well site selection: The University of Texas at Austin, Bureau of Economic Geology, Report to the Gas Research Institute, Contract No. 5011-321-0125.
- Winker, C. D., 1979, Late Pleistocene fluvial-deltaic deposition, Texas coastal plain and shelf: The University of Texas at Austin, Master's thesis, 187 p.
- Wyllie, M. R. J., Gregory, A. R., and Gardner, L. W., 1956, Elastic wave velocities in heterogeneous and porous media: *Geophysics*, v. 21, no. 1, p. 41-70.

APPENDIX A

Parameter Plots

(see page 100 for explanation of plots)

1A

1A'

1B

JASPER CO.

ORANGE CO.

1B'

PHILLIPS PET. CO.
#1 MILLER-VIDOR LUMBER CO.
3N-49E-9

PRAIRIE PROD. CO.
#1 EDGAR BROWN
2N-49E-4

T. G. ANDERSON &
EDWARD L. BOWMAN
#1 LUTCHER-MOORE LUMBER CO.
1N-49E-2

JOHN W. MECOM
#2 E.W. BROWN
1N-50E-8

4A

4A'

48

48'

5A

5A'

5B

5B'

68

Pan American Petroleum Corp. Jack Frazier
Houston Unit #1N-6W-10
2S-36E-1

Carrie B. Davis
Laura Lackner #1
2S-37E-5

Sucholtz Ziebe #1
2S-37E-7

HARRIS COUNTY
BRAZORIA COUNTY

Gulf Coast Lease Holds Inc.
Yost #1
4S-39E-4

Superior Oil Company
Conklin Oil Unit #1
5S-39E-8

Phillips Petroleum Co.
Houston "M" #2
6S-39E-4

Phillips Petroleum Co.
Houston "JJ" #1
6S-39E-7

Phillips Petroleum Co.
State Lease 51000 Block 32 Well #1
7S-40E-9

68'

7A

7A'

7B

ENSERCH EXPLORATION INC.

#1 FOSTER FARMS

3S-34E-9

(10)

HUNT OIL COMPANY

#1 HARLEM STATE PRISON FARM

4S-35E-2

(11)

THE PURE OIL COMPANY

#1 N.B. KNIGHT

4S-36E-7

(12)

FORT BEND CO.
BRAZORIA CO.

UNION TEXAS PETROLEUM

#1 J.T. GARRETT

6S-37E-6

(13)

HUMBLE OIL & REFINING CO.

#1 R.W. VIEMAN

7S-38E-2

(14)

TENNECO OIL COMPANY

#1 AMERICAN FLETCHER

8S-38E-7

(15)

7B'

8A

8A'

8B

FORT BEND CO.

SCURLOCK OIL &
M.T. HALBOUTY
#1 Dennis Krause
5 S - 33 E - 2

(11)

FT. BEND OIL CO.
#1 J.M. Moore Est.
5 S - 33 E - 8 - 3

(12)

THE OIL & GAS CO.
#1 Byrne
6 S - 34 E - 3

(13)

PAN AMERICAN PROD. CO.
#1 N.W. Hopkins
6 S - 35 E - 4 - 1

(14)

BRAZORIA CO.

8B'

SAN JACINTO OIL &
GAS & D.C. BINTLIFF
#2 D.C. BINTLIFF
7 S - 36 E - 8

(15)

9b'

PAN AMERICAN PET.
A-1 B. R. L. D. Co.
8S-35E-8

19

10A

10A'

10B

11A

LAVACA CO

FIDELITY OIL & ROYALTY CO.
#1 Frank G. Olsovsky
45-24E-2

SOHIO PETRO. CO. & SKELLY OIL CO.
#1 Paul Stock
45-25E-8

K. & H. OPERATING CO.
#1 Andre Bludau et ux
55-25E-1/6

THE PURE OIL CO.
#1 E.E. Kolar
65-27E-2

H.L. HAWKINS & HAWKINS JR.
NORTH CENTRAL OIL CO.
#1 Mrs. Sada Barnes
65-27E-8

ACCO OIL & GAS CORP.
#1 Schmidt
75-28E-2

SUN OIL CO.
#1 Hawes
75-29E-9

ACCO OIL & GAS CORP.
#1 J.K. Allen
85-29E-1

IIB

WHARTON CO.
MATAGORDA CO.

IIB'

BEN D. MARKS HUNT OIL CO. SUN OIL CO. MONSANTO CHEM. MAGNOLIA PETR. AMERICAN PETROFINA
 *I KOUNTZE & STEWART *I MEHRENS C. JUNEK *I BUCKEYE *I W.W. RUGELEY D.H. BRAMAN *I
 8S-30E-4 9S-31E-4 9S-31E-7 10S-32E-3 10S-32E-7 11S-33E-2

12B

12B'

JACKSON CO

MATAGORDA CO

C.C. GILGER
#1 Deunow
IOS-28E-5TEXACO INC.
#81 L. Ranch
IOS-29E-9MONSANTO CHEM. CO.
#1 Texas Gulf Sulphur Fee
IIS-30E-3PAN AMERICAN PET. CORP.
#1 Silver Lake Ranch
IIS-30E-6

13A

GONZALES CO.

H.L. HUNT CO.
#1 W.R. MILLER
75-21E-2/3

⑤

GULF OIL CORP.
#1 MUELLER
85-21E-1

⑥

LONE STAR PRODUCING CO.
#1 FELIX HILLER
85-23E-4

⑦

HUMBLE OIL CO.
#1 A.B. BRIDGEN
85-24E-4

⑨

RODNEY DE LANGE
#3 C.K. McCAN
95-25E-2

⑩

H.M. HOWELL
#1 ARON KOLE
95-26E-9

⑪

SHALE RESISTIVITY
AND
GEOPRESSURE GRADIENTSFORMATION
WATER
SALINITYFORMATION
TEMPERATURERESERVOIR
POROSITY0 5 mi
0 8 km

13B

13B'

14 A

DEWITT CO.

GOLIAD CO.

14 A'

VICTORIA CO.

14B

14B'

16 A

ATLANTIC RICHFIELD CO. HARKINS AND CO
#1 J.R. DOUGHERTY ESTATE #1 DOYLE M. MAY
12S-18E-7th 13S-18E-8

BEE CO

LOGUE AND PATTERSON
#2 C.E. HEARD
14S-20E-3/4

REFUGIO CO.

ARGO OIL CORP	TEXACO
#A-1 A.D. ROOKE	#2 K.D. ROCHE
15S-22E-3	15S-21E-6

SAN PATRICIO CO

16 A'

MOBIL
#1 AGNES BREN
16S-22E-7

TENNECO
#1 W.G. McCAMPBELL
17S-23F-5

17A
Live Oak Co

17A

HUMBLE OIL & REFINING CO
#1 A.W. West ET-AL
13S-15E-7

CONTINENTAL OIL
#1 Alvin McKinney
13S-16E-7

H.L. BROWN
#1 G.L. Hayes
14S-16E-6

HAAS Brothers
#1 W.H. Range
14S-17E-7

SKINNER CORP
#1 Holman Cartwright
15S-17E-9

18A

PAN AMERICAN PETROLEUM CORP
L.S. McLaugherty #1
13S-12E-7

TEXAS OIL CORP
Hays-Ezzell #1
14S-14E-4

McMullen County
Live Oak County

ATLANTIC RICHFIELD
#1 El Paso Nat'l Gas 300
15S-14E-6

STANDARD OF TEXAS
#1 Mrs. Gay West Burns
15S-15E-5

18A'

19A

Quintana
 # D-3 So. Texas Syndicate
 14S-10E-8

Phillips Petroleum
 # 1 Nueces "A"
 15S-11E-4

Russel Mcquire
 # 1 Holland Ranch
 15S-12E-3

W. Ridly Wheeler
 # 1 Rives Well
 15S-12E-6

McMULLEN CO.
 DUVAL CO.

Coastal States
 # 1 Ragsdale
 16S-13E-4

19A'

190

190'

20B

HUNT OIL CO.
F.V. De Chapa #1
21S-14E-5

JIM WELLS CO.

GUY E. CHAPMAN ET AL
Unit #1 Howell et al
22S-15E-3

SUN OIL CO.
#17 P Canales
21S-16E-8

HUMBLE OIL & REF. CO.
King Ranch-Laguna Larga #10
22S-16E-7

GULF OIL CORP.
McGill Estate #2
23S-17E-1

20B'

21A

21A'

21B

21B'

21C

21C'

22A

22A'

22 B

22 B'

HUMBLE OIL
B REFINING CO
30 Mrs. A.M.K. Bass
22S-18E

HOGG CO
HIDALGO CO

SHELL B DELPHI TAYLOR
OIL CORP.
9 A.A. McAllen
27S-14E-8

MAGNOLIA PETROLEUM CO.
1 Grace Doughty
28S-15E-6

LOUISIANA LAND &
EXPLORATION CO
1 A.A. McAllen
28S-17E-9

HIDALGO CO
WILLACY CO

SHORELINE PETROLEUM CORP.
1 Lorena Walker
29S-19E-2

22C

WILLACY CO.

HUMBLE OIL & REFINING
#1 Well #1 Willamar Gas unit
29S-20E-5

22C'

PAN AMERICAN PET. CORP
#1 Maria C.N. Dearmendez
22E-30S-3

23A

GULF OIL CORP
A. RAMIREZ #1
255-7E-3

RUTTER WILBANKS & RUTTER
ADAN VOLPE #1
255-7E-6

JONNELL GAS CO.
JUAN G. BENAVIDES #3
265-8E-8

ASHLAND OIL & REFINING
RAFAELA DE MUNOZ #1
275-8E-4

AUSTRAL OIL CO.
JENNIE V. SANCHEZ
285-9E-4

23A'

23B

FORREST OIL CO.
COATES RANCH #1
28S-10E-1CONTINENTAL OIL CO.
MM GARCIA D 25
29S-11E-1COASTAL STATES GAS PROD CO
SEVERO C CASTILLO #1
29S-13E-5LOCKHART
JOHN H SHAREY #2
30S-15E-3AMERADA PETROLEUM CORP.
TBNORR CO. #1
30S-15E-1

23B

23C

UNION PRODCING CO.
WYSONG UNIT #2
30S-16E-4STANDARD OIL OF TEXAS
RIO FARMS INC #1
30S-17E-2TEXACO INC
CA JOHNSON #1
30S-18E-4GULF OIL CORP
JH McDANIEL #1
30S-19E-9CHEVRON OIL CO.
JOSE A RODRIGUEZ #1
31S-20E-5DOW CHEM CO
CONTINENTAL OIL CO. MINFEE #1
32S-12E-6

23C'

Ac

Ac'

Ba

AUSTRAL & TIDEWATER
#1 JENNIE V. SANCHEZ
28S-9E-4

STARR CO.
JIM HOGG CO.

HUMBLE OIL
#D-3 ATWOOD
26S-10E-3

ALLEN & BEMIS
#2 D.O. GALLAGHER
24S-10E-5

Ba'
BRITISH-AMERICAN OIL PROD. CO.
#1 ADAMS
22S-10E-5/6

Ba

A.M. & R. CO.
*1 J. OLIVERA
20S-12E-6

SHALE RESISTIVITY
AND
GEOPRESSURE GRADIENTS

TAYLOR REFINING
*T-2 PARS
18S-14E-9

R_{sh} OHM-M

HAAS OIL & MELBA PROD. CO.
*1 B. M. COX
17S-15E-5

TIDEWATER & SKELLY
*20 SHAEFFER RANCH
16S-16E-4/9

SKINNER CORPORATION
*1 HOLMAN CARTWRIGHT
15S-17E-9

DEPTH (1000) FEET
2
4
6
8
10
12
14
16

Bb'

FORMATION WATER SALINITY
PPM NaCl (10⁻³)

10 20 50 100 200 PPM NaCl (10⁻³)

10 20 50 100 200 PPM NaCl (10⁻³)

10 20 50 100 200 PPM NaCl (10⁻³)

10 20 50 100 200 PPM NaCl (10⁻³)

DEPTH (1000) METERS
1
2
3
4

FORMATION TEMPERATURE °F

100 200 300 °F
50 100 150 °C

100 200 300 °F
50 100 150 °C

100 200 300 °F
50 100 150 °C

100 200 300 °F
50 100 150 °C

RESERVOIR POROSITY %

10 20 30 35 %

10 20 30 35 %

10 20 30 35 %

10 20 30 35 %

0 1 2 3 4 5 MI
0 2 4 6 8 KM

Bd

VICTORIA CO.
DEWITT CO.DEWITT CO.
LAVACA CO.LAVACA CO.
COLORADO CO.

Bd'

MRS. JAMES H. DOUGHERTY

HUMBLE OIL CO.

SHELL OIL CO.

HAWKINS & NORTH CENTRAL OIL CO.

*1 WITT MURPHY

*1 ADA B. PRIDGEN

*3 WILLIAM BORCHERS

*1 MRS. SADA BARNES

9S-23E-6

8S-24E-4

7S-26E-5

6S-27E-8

Bf

Bf'

CA

CA'

Cb

Cb'

CH

CH

D8

D8'

D0'

D0

DE

DE'

Df

Df'

BRAZORIA CO

GALVESTON CO

PAN AMERICAN PETRO. CORP.

•1 T.L. Smith Heirs
7S-36E-3

UNION TEXAS PETRO. CORP.

•1 J.T. Garrett
6S-37E-6BROWN &
McKENZIE INC.•1 Clark Estate
6S-38E-1

SUPERIOR OIL CO.

•2 Conklin Oil Unit
5S-39E-8

CITIES SERVICE

•B-2 Stewart
5S-40E-4

RUSSEL MAGUIRE

•1 Ed Taylor
4S-40E-7

D6

D6'

SUPERIOR OIL CO.
St. Track 252 #1
4S-41E-5

PENZOIL PROD. CO.
St. Track 100 #2
4S-42E-3

McMORAN EXPLOR. CO.
St. Track #64-1
3S-42E-7

PAN AMERICAN PETRO. CORP.
C. A. Kieck #1
3S-43E-1

APPENDIX B

Tabulation of data used in preparing regional maps and in calculating solution methane resource. Gaps in tabulated data occur for some wells where data are not available and cannot be estimated. The following abbreviations are used in the tabulation:

- Well No. - Well Number used to identify all cross section and infill wells located on maps (figs. 32-35). The well number followed by C means whole core data used only for porosity plots.
- TD - Total depth of well (ft)
- BHT - Bottom-hole temperature of well corrected to equilibrium value ($^{\circ}\text{F}$)
- FM - Formation
- Midpoint - Depth to midpoint of formation interval (ft)
- NS - Net sandstone thickness in designated formation (ft)
- ES - Effective sandstone thickness in designated formation (sandstones more than 30 ft thick)
- Interval thickness - Thickness of formation interval, values inside parentheses refer to depths projected beyond well control (ft)
- AVG ϕ - Average porosity at midpoint of formation (percent)
- AVG T - Average equilibrium temperature at midpoint of formation ($^{\circ}\text{F}$)
- AVG P - Average fluid pressure at midpoint of formation (psi)
- AVG $S(\times 10^3)$ - Average of water salinity at midpoint of formation ($\times 10^3$ ppm NaCl), the listed number should be multiplied by 1,000
- AVG CH_4 - Average methane solubility at midpoint of formation calculated from average temperature, pressure, and salinity (ft^3/bbl)
- U. Ol-Pl - upper Oligocene-Pleistocene Formations
 - U. Fr - upper Frio Formation
 - L. Fr - lower Frio Formation
- Vk-Jk - Vicksburg-Jackson Formations
- U. Cl - upper Claiborne Group (Yegua Formation)
- L. Cl - lower Claiborne Group
- U. Wx - upper Wilcox Group
- M. Wx - middle Wilcox Group
- L. Wx - lower Wilcox Group

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
ARANSAS COUNTY														
1.	Arkansas Fuel Oil et al. 1-West Rockport Unit 1	16S-24E-9	9,788	236	U.Fr	8,018-(9,868)	8,943	360+	130+	22.4	215			
2.	Brazos Oil & Gas 1-State-Mesquite Bay Tr. 26 (section 15, no. 19)	15S-26E-8	11,744	253	U.Fr	8,027-(12,227)	10,127	91+	0+	19.5	235	6,785	51	29.5
3.	Cities Service Oil B-3 State Tract 260	17S-24E-5	13,020	316	U.Fr	8,020-(13,020)	10,520	615	150	18.6	252			
4.	Continental Oil 46-St. Charles Ranch (section 15, no.18; ties D, no.22)	15S-25E-6	12,825	301	U.Fr L.Fr Vk-Jk	8,032-9,950 9,950-12,770 12,770-(18,770)	8,991 11,360 15,770	135 113 0+	0 0 0+	22.1 16.5	226 267	5,080 9,088	92 28	22.1 40.8
5.	Getty Oil 1-State Tract 95	16S-25E-3	11,200	270	U.Fr	8,015-(11,515)	9,765	410+	125+	20.4	232			
6.	Getty Oil, Mission Corp., & Ohio Oil 1-State Tract 125	16S-24E-6	9,825	215	U.Fr	8,015-(11,015)	9,515	379+	0+	21.0	215			•
8.	Jake L. Hamon 1-Bankers Mortgage Co. (section D, no. 20)	16S-23E-7	12,010	283	U.Fr L.Fr	8,024-9,030 9,030-(12,230)	8,527 10,630	325 98+	180 45+	23.3 18.3	205 250	4,690 8,079	70 38	21.8 35.1
9.	Heep Oil 4-Zeph Roquette et al. (section D, no. 21)	16S-24E-9	10,660	231	U.Fr L.Fr	8,018-9,690 9,690-(12,660)	8,854 11,175	381 98+	91 0+	22.6 17.0	201 240	4,869 9,052	26 22	25.4 31.6
10.	Heep Oil 3-H. T. Sellers	16S-24E-9	8,620	193	U.Fr	8,020-(9,720)	8,870	296+	175+	22.6	213			
11.	Union Producing 10-Tatton (section 15, no. 17)	14S-24E-7	11,220	233	L.Fr Vk-Jk	8,033-10,360 10,360-(15,360)	9,197 12,860	74 0+	0 0+	21.6 13.0	206 297	5,472 11,317	83 25	22.2 51.6
12.	Prairie Producing 1-State Tract 12	15S-24E-7	8,710	215	U.Fr	8,020-(9,520)	8,770	174+	55+	22.8	212			
13.	Cities Service Oil 1-State Tract 242	17S-24E-5/6	10,309	270	U.Fr	8,020-(12,120)	10,070	280+	140+	19.7	250			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
14.	Cities Service Oil B-1 State Tract 260	17S-24E-5	13,000	315	U.Fr L.Fr	8,030-(12,530) (12,530)-(19,530)	10,280 16,030	710 0+	130 0+	19.2 5.4	202 371			
15.	Union Producing 4-Tatton	14S-24E-7	10,500	260	L.Fr Vk-Jk	8,030-(9,930) (9,930)-(14,930)	8,980 12,430	120 0+	70 0+	22.3 14.0	190 285			
16.	Union Producing 9-UPC Tatton	14S-25E-8	10,307	208	U.Fr L.Fr	8,025-9,175 9,175-(11,675)	8,600 10,425	190 70+	35 0+	23.2 18.8	192 240			
17C.	Conroe Drilling, King & Heyne 1-A State Tract No. 4	17S-23E-2	6,939	197										
18C.	Getty Oil 1-State Tract 77	16S-25E-3	11,415											
19C.	Humble Oil & Refining 1-State Tract 177	16S-24E-7	11,227	283										
20C.	Tenneco Oil 1-J. R. Barry Estate	17S-23E-2	9,835	286										
21C.	Tenneco Oil 2-W. G. Campbell	17S-23E-1												
22C.	Union Producing 17-Tatton	15S-25E-4												

AUSTIN COUNTY

1.	Dakamont Exploration 1-Weiss	1N-29E-8	10,803	241	M.Wx L.Wx	8,333-8,625 8,625-(12,125)	8,479 10,375	207 1,360+	200 910+					
2.	Gulf Oil 1-Otto Severin	1S-30E-7	11,904	265	M.Wx L.Wx	8,170-9,470 9,470-(15,320)	8,820 12,395	340 1,585+	110 1,350+	18.0 11.7	200 237			
3.	Holmes Drilling et al. 1-Goebel	2S-30E-1	11,012	236	U.Wx M.Wx L.Wx	8,293-8,510 8,510-9,470 9,470-(15,620)	8,402 8,990 12,545	145 165 949+	0 55 745+	18.8 17.7 11.4	212 223 375			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
4.	Humble Oil & Refining 1-Charles Kaechele "B" (section 9, no. 12; ties B, no. 23)	3S-31E-4	12,000	312	L.CI U.Wx M.Wx L.Wx	8,169-9,050 9,050-9,700 9,700-11,290 11,290-(17,490)	8,610 9,375 10,495 14,390	0 235 189 318+	0 45 84 255+	18.4 17.0 15.1 8.2	205 235 245 345	4,391 4,875 7,137 11,224	60 43 37 25	22.0 26.4 32.8 64.1
5.	Lueth & Robishaw 1-O.C. Kurtz (section 8, no. 8; ties B, no. 24)	2S-31E-6	7,565	180	Shallower than 8,000 ft									
6.	Mound Co. 1-J. K. Hillboldt	2S-31E-8	10,846	256	L.CI U.Wx M.Wx	8,220-9,115 9,115-9,820 9,820-(11,320)	8,668 9,468 10,570	0 458 257+	0 305 95+	18.3 16.9 14.9	206 232 232			
7.	Prairie Producing & Convest Energy 1-H. E. Logan Estate	1S-30E-2	10,816	272	M.Wx L.Wx	9,268-9,618 9,618-(14,918)	9,452 12,268	62 1,393+	0 935+	12.8 12.1	247 325			
8.	Skelly Oil 1-Emma Edan	1N-29E-9	10,806	255	L.Wx	8,390-(11,890)	10,140	1,585+	1,075+	15.7	236			
9.	Skelly Oil 1-Lander (section 8, no. 6)	1N-31E-9	11,102	246	U.Wx M.Wx L.Wx	8,259-8,275 8,275-9,200 9,200-(14,500)	8,267 8,738 11,850	8 237 1024+	0 0 770+	19.5 17.1 12.7	195 206 298	4,134 4,369 6,518	115 110 130	17.5 18.7 26.6
10.	Southern Natural Gas 1-Uhyrek	3S-32E-9	13,022	298	L.CI U.Wx M.Wx	8,150-10,275 10,275-11,070 11,070-(13,220)	9,213 10,673 12,145	0 415 191+	0 360 0+	17.3 14.8 12.1	202 230 282			
11.	The Texas Company 1-H. W. Hackfield (section 9, no. 8)	1N-28E-7	11,014	319	L.Wx	8,341-(11,541)	9,941	1,538+	1,231+	15.4	248	4,520	72	24.1
12.	H. L. Hawkins 1-Mewis (section 8, no. 7)	1S-31E-2	10,533	213	U.Wx M.Wx L.Wx	8,191-8,610 8,610-9,500 9,500-(15,400)	8,401 9,055 12,450	179 230 382+	55 110 200+	18.8 17.6 11.6	185 193 350	4,200 4,618 6,848	65 110 110	20.3 18.5 35.9
13.	Anderson Pritchard 1-Miles Knolles	1S-30E-3	10,524	227	M.Wx L.Wx	8,275-8,635 8,635-(13,635)	8,445 11,135	45 1,056+	0 730+	14.4 13.7	201 268			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
14.	Gulf Oil 1-Fred Waxmel	1S-30E-7	11,995	253	U.Wx M.Wx L.Wx	8,200-8,610 8,610-9,500 9,500-(15,400)	8,405 9,055 12,450	260 105 1,270+	85 30 960+	18.6 17.6 11.6	196 208 350			
BEE COUNTY														
1.	Atlantic Richfield 1-J. R. Dougherty Estate (section 16, no. 8)	12S-18E-7/8	16,035		L.Cl U.Wx M.Wx L.Wx	8,375-9,030 9,030-10,690 10,690-12,650 12,650-(16,650)	8,703 9,860 11,670 14,650	0 54 221 353+	0 45 140 175+					
2.	Harkins & Co. 1-Doyle M. May (section 16, no. 9; ties B, no. 13)	13S-18E-8	4,525	158	Shallower than 8,000 ft									
3.	Humble Oil & Refining 10-Laura T. Barrow (section C, no. 30)	15S-20E-1	5,800	165	Shallower than 8,000 ft									
4.	Logue & Patterson 2-C. E. Heard (section 16, no. 10)	14S-20E-3/4	4,810		Shallower than 8,000 ft									
5.	Pure Oil 1-O'Brien-Harkins "B" (section 15, no. 13)	13S-21E-9	16,318	383	Correlations unknown									
6.	Shell Oil 1-Juan Alvarado et al. (section 16, no. 7; ties A, no. 7)	12S-17E-3	16,937	414	L.Wx	8,377-10,177	9,290	19	0					
7.	Shell Oil 1-Alvin O'Neal (section 16, no. 6)	12S-17E-3	17,000	403	L.Wx	8,377-10,300	9,339	11	0					
9.	Shell 1-Ruhmann	11S-17E-5	14,005	362	L.Wx	8,522-10,010	9,266	9	0	12.4	225			
10.	Halbouty 1-Mae Gillette	13S-17E-6	10,440	264	L.Cl U.Wx	8,390-9,550 9,550-(11,600)	8,970 10,575	7 102+	0 40+	16.7 13.5	240 268			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
11.	White Shield 1-Martin Unit	13S-18E-4	10,525	308	L.Cl U.Wx	8,335-9,350 9,350-(11,350)	8,843 10,350	0 106+	0 35+	17.0 13.9	239 270			
12.	Cities Service Oil B-1 Magnus Beck Well	13S-17E-3	9,004	224	U.Wx	8,360-(9,400)	8,880	275+	130+	14.4	208			
13.	Skelly Oil 1-A. W. Zook	12S-18E-6	9,096	262	L.Cl U.Wx	8,280-8,400 8,400-(9,500)	8,340 8,950	0 120+	0 100+	18.0 16.7	209 210			
14.	The Texas Company 1-Ragsdale	13S-17E-2	10,520	292	U.Wx M.Wx	8,410-10,340 10,340-(11,540)	9,375 10,940	1,340 0+	890 0+	13.6 11.2	250 259			
15C.	Skelly Oil 2-W. W. Hill	12S-18E-5	8,595	257										
16C.	Tidewater Oil 1-Alfred D. Taylor	13S-18E-4	12,217	348										

BRAZORIA COUNTY

1.	Brown & McKenzie 1-Clark Estate (section D, no. 40)	6S-38E-1	11,014	261	U.Fr L.Fr	8,020-8,900 8,900-(12,290)	8,460 10,595	201 496+	75 180+	23.9 20.5	193 261	4,060 7,738	66 40	20.3 35.6
2.	Davis Oil 1-Lastracco (section D, no. 38)	6S-37E-8	10,600	242	U.Fr L.Fr	8,052-9,400 9,400-(11,800)	8,726 10,600	211 293+	35 200+	23.5 20.5	193 243			
3.	Dow Chemical 1-Bell	9S-36E-2	15,550	342	U.OI-PI U.Fr L.Fr	8,030-9,020 9,020-11,950 11,950-(16,950)	8,525 10,485 14,450	0 80 207+	0 0 40+	23.8 20.7 14.5	180 204 350			
4.	Geck Oil 1-Sara West Heirs	5S-36E-8	8,260	177	L.Fr	8,060-(8,660)	8,360	162+	150+	24.0	194			
5.	Willard Gill 1-Mitchell	4S-38E-2	9,009	192	Vk-Jk	8,075-(12,075)	10,075	0+	0+		217			
6.	Gulf Coast Leasing 1-Yost (section 6, no. 15)	4S-39E-4	10,120	207	L.Fr Vk-Jk	8,057-9,110 9,110-(14,110)	8,584 11,610	486 50+	438 0+	23.7 18.9	178 245	4,292 8,359	135 60	16.2 32.2

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ϕ	AVG T	AVG P	AVG $S(x10^3)$	AVG CH_4
7.	Gulf Oil 2-Texas St. Lease 53034	8S-39E-2	14,685	321	U.OI-PI	8,025-9,090	8,558	0	0	23.7	193			
					U.Fr	9,090-12,600	10,845	14	0	20.2	231			
					L.Fr	12,600-(23,500)	18,050	334+	220+	8.9	355			
8.	Hargrave Oil 1-Fred Klobonk	5S-37E-7	9,152	203	L.Fr	8,060-(9,260)	8,660	718+	525+	23.6	195			
9.	Humble Oil & Refining 1-R. W. Vieman (section 7, no. 14)	7S-38E-2	15,725	326	U.OI-PI	8,038-8,100	8,069	0	0	24.5	200	4,116	120	17.4
					U.Fr	8,100-10,890	9,495	112	38	22.3	225	5,032	125	19.6
					L.Fr	10,890-(15,790)	13,340	757+	410+	16.2	290	9,738	61	40.6
10.	Kirby & McFarland 1-Croce	7S-35E-1	10,795	258	L.Fr	8,060-10,170	9,115	1,565	1,235	22.9	229			
					Vk-Jk	10,170-(15,420)	12,795	0+	0+	17.1	265			
11.	Lario & Felmont 1-Bieri	7S-38E-4	12,787	258	U.OI-PI	8,040-9,020	8,530	0	0	23.8	193			
					U.Fr	9,020-12,600	10,810	27	0	20.2	230			
					L.Fr	12,600-(17,100)	14,850	22+	0+	13.9	310			
12.	J. S. Michael 1-Leedy	5S-38E-4	8,800	178	L.Fr	8,060-(9,070)	8,565	467+	325+	23.7	193			
13.	Mobil Oil 1-Retrieve State Farm Tract 1 (section 8, no. 16)	8S-36E-1	13,470	308	U.OI-PI	8,035-8,700	8,368	0	0	24.0	210	4,184	135	17.0
					U.Fr	8,700-11,700	10,200	56	0	21.2	243	5,610	110	22.6
					L.Fr	11,700-(14,500)	13,100	183+	42+	16.6	300	10,480	56	44.6
14.	Pan American A-I B.R.L.D. Co. (section 9, no. 19)	8S-35E-8	14,005	282	U.Fr	8,050-11,000	9,525	144	68	22.2	205	5,239	95	21.0
					L.Fr	11,000-13,430	12,215	171	136	18.0	233	8,795	83	29.1
					Vk-Jk	13,430-(19,830)	16,630	225+	84+	11.5				
15.	Pan American 1-M. W. Hopkins (section 8, no. 14)	6S-35E-4	6,507	164	Shallower than 8,000 ft									
16.	Pan American 1-T. L. Smith Heirs (section D, no. 37)	7S-36E-3	10,499	230	U.Fr	8,026-8,046	8,036	0	0	24.5	171	4,039	118	16.4
					L.Fr	8,046-(10,500)	9,273	1,348+	1,005+	22.6	203	4,173	120	17.6
17.	Pano Tech. Exploration 1-Jamison	7S-37E-6/7	14,030	260	U.OI-PI	8,050-9,560	8,805	20	0	23.3	167			
					U.Fr	9,560-12,990	11,275	155	0	19.5	214			
					L.Fr	12,990-(16,990)	14,990	92+	0+	13.7	311			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
18.	Phillips Petroleum 1-Houston "J J" (section 6, no. 18)	6S-39E-7	17,018	334	U.OI-PI U.Fr L.Fr	8,034-8,840 8,840-12,300 12,300-(19,300)	8,442 10,575 15,800	0 8 436+	0 0 180+	23.9 20.6 12.4	185 215 323	4,472 5,262 13,746	120 96 135	17.4 21.5 40.2
19.	Phillips Petroleum 2-M Houston (section 6, no. 17)	6S-39E-4	18,008	337	U.OI-PI U.Fr L.Fr Vk-Jk	8,045-8,110 8,110-10,600 10,600-14,650 14,650-(20,850)	8,078 9,355 12,625 17,750	0 196 380 186+	0 35 130 0+	24.5 22.5 17.4 9.5	171 190 255	4,039 4,678 9,532	118 107 95	16.8 18.6 30.9
20.	Phillips Petroleum 1-St. Lease 51000 Block 32 (section 6, no. 19)	7S-40E-9	16,458	345	U.OI-PI U.Fr L.Fr	8,030-8,980 8,980-13,900 13,900-(24,900)	8,505 11,445 19,400	0 28 43+	0 0 0+	23.8 19.2 6.8	200 250 363	5,103 8,355	12	27.0
21.	San Jacinto Oil & Gas 1-Bintliff (section 8, no. 15; ties D, no. 36)	7S-36E-8	15,500	319	U.Fr L.Fr Vk-Jk	8,042-10,560 10,560-13,400 13,400-(19,900)	9,301 11,980 16,650	144 257 22+	30 42 0+	22.6 18.4 11.1	205 240 350	5,116 8,985 15,818	115 73 26	19.4 31.1 77.6
22.	Southern Minerals 2-Wm. M. Holland (section 9, no. 18; ties D, no. 35)	8S-34E-6	11,500	245	U.Fr L.Fr	8,054-10,200 10,200-(12,650)	9,127 11,425	251 592+	85 450+	22.8 19.2	203 245	4,746 6,283	125 125	18.2 22.6
23.	Southern Minerals 1-Ramsey St. Farm	6S-36E-7	10,220	204	U.Fr L.Fr	8,060-8,330 8,330-(10,500)	8,195 9,415	106 998+	0 865+	24.3 22.4	188 216			
24.	Superior Oil 1-Conklin Oil Unit (section 6, no. 16; ties D, no. 41)	5S-39E-8	12,900	287	U.Fr L.Fr Vk-Jk	8,059-9,310 9,310-12,560 12,560-(18,660)	8,685 10,935 15,610	343 755 0+	260 465 0+	23.5 20.0 12.7	190 223 320	4,343 5,796 14,049	115 160 95	17.7 18.2 47.4
25.	Tenneco 1-American Fletcher (section 7, no. 15)	8S-38E-7	18,300	375	U.OI-PI U.Fr L.Fr	8,030-9,320 9,320-(15,420) (15,420)-	8,675 12,370	0 6+	0 0+	23.5 17.8	215 270	4,823 6,949	105 67	20.1 36.2
26.	Texas Gas Exploration 1-E. S. Smith et al.	9S-35E-3	13,800	318	U.OI-PI U.Fr L.Fr	8,045-8,765 8,765-12,305 12,305-(15,605)	8,405 10,535 13,955	0 77 295+	0 35 110+	24.0 20.6 15.3	197 226 288			
27.	Union Texas Petroleum 1-J. T. Garret (section 7, no. 13; ties D, no. 39)	6S-37E-6	11,027	228	U.Fr L.Fr	8,056-8,550 8,550-(11,730)	8,303 10,140	221 505+	30 365+	24.1 21.2	185 205	4,650 6,185	120 105	17.7 21.6

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
BROOKS COUNTY														
1.	Carrl Oil et al. 1-Richard G. Cage et al. (section C, no. 15)	24S-16E-3	12,119	287	L.Fr Vk-Jk	8,117-8,280 8,280-(13,780)	8,199 11,030	115 76+	35 0+	19.7 15.5	212 258	4,504 8,052	54 12	23.1 39.8
2.	Enserch Exploration 1-Simon Benavides (section 21, no. 19)	25S-15E-6	13,065	329	L.Fr Vk-Jk	8,150-8,780 8,780-(15,280)	8,465 12,030	129 104+	30 0+	19.3 14.0	215 334	6,602 8,662	32 7	29.3 57.7
3.	Forest Oil 1-Cage Ranch (section C, no. 14)	24S-15E-2	12,302	314	Vk-Jk	8,140-(13,240)	10,690	126+	0+	16.0	282	9,514	37	42.7
4.	General Crude 1-R. G. Garza (section C, no. 17)	23S-16E-3	11,558	288	L.Fr Vk-Jk	8,124-8,380 8,380-(13,380)	8,252 10,880	71 157+	0 52+	19.6 15.7	206 273	5,776 8,160	50 31	25.4 39.4
5.	Ginther et al. 1-John C. Miller (section C, no. 16)	23S-16E-4	13,525	312	L.Fr Vk-Jk	8,114-8,180 8,180-(13,525)	8,147 10,852	23 74	0 0	19.5 15.5	208 260	4,074 6,815	25 18	23.8 36.2
6.	Humble Oil & Refining 5-C. F. Hopper (section C, no. 12)	24S-15E-9	10,964	278	Vk-Jk	8,212-(13,712)	10,962	406+	230+	15.6	247	7,345	55	34.4
7.	Humble 1-King Ranch-Quiteria Pasture	26S-16E-2	12,989	315	L.Fr Vk-Jk	8,015-12,850 12,850-(21,350)	10,433 17,100	1,153 0+	335 0+	16.4 6.5	247			
8.	Humble Oil & Refining 2-R. J. Kleberg, Jr., Trustee (section 21, no. 20)	25S-16E-6	12,000	273	L.Fr	8,065-(12,565)	10,315	1,650+	1,150+	16.6	230		15	
9.	Humble 17-Santa Fe Ranch, Julian Pasture	26S-16E-6	14,012	322	L.Fr Vk-Jk	8,175-13,675 13,675-(18,525)	10,925 16,100	530	100	15.7 8.0	236			
10.	Humble Oil & Refining 15-Scott & Harper	25S-14E-1	10,005	227	Vk-Jk	8,245-(13,295)	10,770	95+	35+	15.9	255			
11.	Humble Oil & Refining 11-B. A. Skipper, Jr. (section C, no. 11)	25S-15E-4	12,253	307	Vk-Jk	8,232-(14,032)	11,132	210+	71+	15.4	285	9,907	90	35.7

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
12.	Magnolia 1-Luella Proctor	23S-15E-6	12,000	273	L.Fr Vk-Jk	8,160-9,050 9,050-(13,160)	8,605 11,105	539 340+	260 310+	19.1 15.4	205 257			
13.	Russell Maguire 1-Saunders (section 21, no. 16)	24S-13E-2	8,236	219	Vk-Jk	8,338-(9,538)	8,938	24+	0+		210	8,178	40	30.6
14.	Mills Bennett Estate 17-Fee	23S-14E-4	9,037	239	Vk-Jk	8,280-(10,780)	9,530	27+	0+		228			
15.	NOR-MAC Burns 1-Cage (section 21, no. 17)	24S-14E-6	7,018	175	Shallower than 8,000 ft									
16.	Shell 1-C. S. Lips	26S-15E-5	14,565	352	L.Fr Vk-Jk	8,140-9,380 9,380-(16,880)	8,760 13,130	110 428+	55 45+	18.9 12.4	208 323			
17.	Standard Oil of Texas 1-14-Braulice de Garcia	26S-14E-2	9,500	239	Vk-Jk	8,255-(13,755)	11,005	162+	50+	15.6	325			
18.	Forest Oil 1-Ed Rachal Foundation (section 21, no. 18; ties C, no. 13)	24S-15E-5	12,015	318	Vk-Jk	8,172-(12,572)	10,372	170+	0+	16.5	277	8,878	70	35.7
19.	Shell 2-Lips	26S-15E-5	13,720		L.Fr Vk-Jk	8,140-9,210 9,210-(16,410)	8,675 12,810	25 215+	0 0+	19.0 12.9	212 318			
20.	Humble Oil & Refining D-5-Mestina	25S-13E-7	8,560	212	U.Cl	8,240-(9,740)	8,990	5+	0+	18.5	218			
21.	Humble Oil & Refining 39-Robert J. Kleberg, Jr., Tr.- Quiteria Pasture	25S-16E-5/8	8,413	224	L.Fr	8,090-(11,090)	9,590	160+	130+	17.6	230			
CALHOUN COUNTY														
1.	Alcoa 1-Mary Kenyon Bryan (section 14, no. 15; ties D, no. 24)	13S-26E-5	10,415	248	U.Fr L.Fr	8,016-8,900 8,900-(12,680)	8,458 10,790	295 0+	200 0+					

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
2.	Brazos Oil & Gas 1-J. H. Tigner (section D, no. 25)	13S-27E-1	10,000	242	U.Fr L.Fr	8,025-9,450 9,450-(11,650)	8,737 10,550	151 0+	100 0+					
3.	Coastal States 1-Duncan (section 13, no. 16; ties D, no. 26)	12S-28E-4	11,515	266	U.Fr L.Fr Vk-Jk	8,027-9,200 9,200-11,250 11,250-(16,350)	8,614 10,225 13,800	52 97 42+	0 30 35+					
4.	Edwin L. Cox 1-A Fisher	12S-27E-6	9,362	211	U.Fr L.Fr	8,020-9,120 9,120-(10,920)	8,570 10,020	43 0+	0 0+	23.3 19.8	203 240			
5.	Glasscock et al. 1-State Tract 131 (section 14, no. 17)	13S-27E-9	11,006	227	U.Fr L.Fr	8,022-10,560 10,560-(12,860)	9,291 11,710	270 0+	143 0+	21.3 15.6	215 268	7,108 9,743	78 27	25.7 42.5
6.	Humble Oil & Refining 3-Elizabeth Hardie	11S-29E-8	8,805	210	U.Fr L.Fr	8,030-8,690 8,690-(11,190)	8,360 9,940	22 0+	0 0+	23.8 20.0	199 230			
7.	Humble Oil & Refining 4-Elizabeth Hardie	11S-29E-8	8,803	210	U.Fr L.Fr	8,025-8,700 8,700-(11,200)	8,363 9,950	55 0+	50 0+	23.8 20.0	199 231			
8.	Humble Oil & Refining 6-Elizabeth Hardie	11S-29E-8	8,682	212	U.Fr	8,025-(8,925)	8,475	63+	35+	23.5	201			
9.	Humble Oil & Refining 3-Lavaca Bay-State Tract 45	12S-28E-6	8,850	202	U.Fr	8,025-(9,175)	8,600	31+	0+	23.2	203			
10.	Humble Oil & Refining (Deviated Hole) 3-Lavaca Bay-State Tract 45	12S-28E-6	8,914	210	U.Fr	8,025-(9,425)	8,725	50+	0+	22.9	207			
11.	John M. Mecom 12-Minnie S. Welder	12S-26E-2	8,500	189	Vk-Jk	8,050-(10,850)	9,450	0+	0+	21.2	205			
12.	Monsanto & Ada Oil 1-State Tract 37 (section D, no. 27)	12S-28E-1	12,011	278	U.Fr L.Fr Vk-Jk	8,022-9,140 9,140-11,320 11,320-(16,520)	8,581 10,230 13,920	112 462 81+	55 190 45+	23.2 19.3 10.5	202 240 320	5,406 7,161 11,206	68 42 26	23.1 31.7 57.0
13.	Walter Van Norman 1-La Salle Ranch (section 13, no. 17)	13S-28E-5	16,020	323	U.Fr L.Fr Vk-Jk	8,034-10,850 10,850-13,500 13,500-(19,500)	9,442 12,175 16,500	0 6 13+	0 0 0+	21.0 14.5	220 270 338	6,940 10,836 14,520	74 20 37	26.2 46.1 66.8

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S \times 10^3$	AVG CH_4
14.	Powers Operating 1-Jean Thomas Bowers (section 14, no. 16)	13S-27E-4	10,020	252	U.Fr L.Fr	8,025-9,780 9,780-(11,780)	8,902 10,780	35 0+	0 0+	22.3 18.0	242	6,409	95	25.2
15.	Republic Natural Gas 1-M. F. Canion (section 13, no. 15)	11S-27E-6	10,020	216	L.Fr Vk-Jk	8,036-9,350 9,350-(12,850)	8,693 11,100	170 50+	125 50+	22.5 17.1	210 255	4,042 8,935	105 31	18.6 38.3
16.	Superior Oil 1-Maude B. Traylor Lease "B" (section D, no. 28)	11S-29E-9	14,576	321	U.Fr L.Fr Vk-Jk	8,029-9,020 9,020-11,310 11,310-(16,610)	8,524 10,165 13,960	27 64 0+	0 30 0+	23.3 19.2 10.4	210 239 317	5,370 7,116 9,842	58 38 32	24.3 32.0 51.3
17.	Tennessee Gas Transmission 1-C. H. Stiernberg (section 14, no. 18)	13S-28E-9	13,000	296	U.Fr L.Fr	8,031-11,210 11,210-(14,210)	9,620 12,710	6 0+	0 0+	20.6 13.3	222 328	7,792 11,947	66 24	28.4 61.2
18.	Tennessee Gas Transmission 1-C Maude B. Traylor	11S-28E-7	14,012	318	U.Fr L.Fr Vk-Jk	8,025-9,850 9,850-11,120 11,120-(16,120)	8,938 10,485 13,620	33 222 283+	0 60 0+	22.4 18.7 11.2	211 246 306			
19.	Sun Oil 1-Lavaca Bay State Tract 34	12S-28E-6	8,728	206	U.Fr	8,025-(9,525)	8,775	44+	0+	22.8	206			
20.	Humble Oil & Refining 12-Elizabeth K. Hardie	12S-29E-3	16,316	342	U.Fr L.Fr Vk-Jk	8,125-9,050 9,050-11,080 11,080-(16,380)	8,588 10,065 13,730	58 27 51+	0 0 0+	23.3 19.7 10.9	226 245 295			
21.	Lone Star Prod. 1-A-L. J. Foester	11S-27E-9	10,020	222	L.Fr Vk-Jk	8,055-8,600 8,600-(11,600)	8,328 10,100	376 643+	285 490+	23.9 19.6	184 210			
22.	Cities Service Oil 1-State Tract 47	14S-26E-7	9,300	217	U.Fr	8,030-(11,530)	9,780	0+	0+	20.4	227			
23.	Quintana Petroleum 1-Oscar F. Hahn	13S-27E-1	9,139	214	L.Fr Vk-Jk	8,020-8,600 8,600-(14,100)	8,310 11,350	0 0+	0 0+	23.9 10.9	198 259			
24.	Texas Eastern Transmission 1-State Tract 127	14S-27E-4	9,000	208	U.Fr	8,025-(11,325)	9,675	0+	0+	20.6	225			
25C.	Tidewater Oil 1-State Tract 139	14S-27E-8	11,000	247										

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
CAMERON COUNTY														
1.	Chevron Oil 1-Jose A. Rodriguez (section 23, no. 15)	31S-20E-5	18,500	324	U.OI-PI U.Fr	8,061-8,750 8,750-(16,250)	8,406 12,500	69 861	0 315	15.4 8.8	205 237	5,758 9,375	57 49	24.7 34.2
2.	Dow Chemical 1-Continental Oil Mineral Fee (section 23, no. 16)	32S-21E-6	13,018	303	U.OI-PI U.Fr	8,029-10,800 10,800-(20,800)	9,414 15,800	216 154+	42 0+	13.8 5.0	260	6,496	87	27.6
3.	Gulf Oil 1-J. H. McDaniel (section 23, no. 14; ties D, no. 4)	30S-19E-9	15,520	320	U.Fr L.Fr	8,056-13,850 13,850-(25,850)	10,953 19,850	810 338+	508 285+	11.3 5.0	250	6,572	24	33.8
4.	Harkins & Co. & R. Mosbacher 1-Leona Bohman	31S-19E-3	10,515	250	U.Fr	8,040-(12,840)	10,440	628+	330+	12.2	243			
5.	Humble 1-L. D. Austin	30S-18E-6	11,180	243	U.Fr	8,050-(12,450)	10,250	675+	410+	12.5	224			
6.	Humble 1-Cameron County Water Control District 6 (section 24, no. 11)	33S-20E-2	12,000	253	U.OI-PI U.Fr	8,040-9,890 9,890-(18,890)	8,965 14,390	65 58+	0 0+	14.5 5.8	200 335	6,096 12,807	24 44	27.8 60.2
7.	Humble 1-State Tract 657	30S-22E-7	10,500	238	U.OI-PI	8,015-(11,515)	9,765	1,006+	270+	13.2	222			
8.	Hydrocarbon Prod. Co., Inc. 1-J. R. Bevers et al. (section D, no. 3)	31S-18E-3	15,479	348	U.Fr L.Fr	8,075-11,820 11,820-(21,720)	9,948 16,770	205 0+	125 0+	13.0 5.0	256	6,267 15,931	45 20	31.3
9.	Pan American 1-Milton & Wentz	32S-19E-9	15,659	327	U.Fr	8,060-		499+	110+					
10.	Standard Oil of Texas 1-W. S. Moorhart (section 24, no. 10)	32S-18E-1	16,000	308	U.Fr	8,071-(16,000)	12,036	1,313	635	9.6	255	8,903	50	35.6

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
11.	Texaco I-Johnson (section 23, no. 13)	30S-18E-4	16,216	328	U.Fr L.Fr	8,061-11,320 11,320-(20,320)	9,691 15,820	594 508+	310 262+	13.4 5.0	225 385	5,815 15,662	36 72	28.3 75.5
12.	Texaco I-State Tract 226	31S-22E-7	8,859	221	U.OI-PI	8,020-(11,820)	9,920	375+	150+	13.0	226			
CHAMBERS COUNTY														
1.	Belco Petroleum I-Crawford 159 (section 2, no. 18; ties D, no. 48)	2S-46E-9	13,115	270	U.Fr L.Fr Vk-Jk	8,031-9,660 9,660-12,970 12,970-(19,970)	8,846 11,315 16,470	308 382 13+	102 220 0+	22.2 16.3 5.0	175 222	4,423 9,165	105 117	17.8 25.2
2.	Continental Oil 3-Jackson	3S-44E-8	12,610	200	U.OI-PI U.Fr L.Fr	8,020-8,590 8,590-10,705 10,705-(14,655)	8,305 9,648 12,680	0 304 0+	0 200 0+	23.5 20.3 13.0	163 192 265			
3.	M. T. Halbouty I-Earl Wilburn (section 4, no. 18)	2S-42E-3	13,687	260	L.Fr Vk-Jk U.Cl	8,058-8,590 8,590-10,800 10,800-(13,300)	8,324 9,875 12,050	23 0 0	0 0 0	23.3 21.3 18.4	202 220 243	3,870 5,530 8,435	72 50 30	20.0 26.0 35.9
4.	Humble Oil & Refining 152-Galveston Bay State "A"	4S-41E-9	11,350	235	U.Fr L.Fr	8,180-9,990 9,990-(12,940)	9,085 11,465	269 237+	85 45+	21.6 15.9	203 241			
5.	Humble Oil & Refining 1-G. C. Jackson	4S-44E-5	14,101	302	U.OI-PI U.Fr L.Fr	8,020-9,975 9,975-13,675 13,675-(19,875)	8,998 11,825 16,775	230 31 0+	100 0 0+	21.8 15.1 5.0	162 266			
6.	Humble Oil & Refining 15-M. E. Mayes	4S-43E-4	12,000	245	U.OI-PI U.Fr L.Fr	8,020-8,240 8,240-10,700 10,700-(14,700)	8,130 9,470 12,700	0 122 29+	0 40 0+	23.9 20.7 13.0	175 190 262			
7.	Humble Oil & Refining 2-State Tract 244	4S-42E-8	13,629		U.OI-PI U.Fr L.Fr	8,020-8,390 8,390-10,890 10,890-(14,690)	8,205 9,640 12,790	0 133 202+	0 40 0+	23.8 20.3 12.8	182 204 275			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
8.	McMoran Exploration 1-State Tract 64 (section 4, no. 20; ties D, no. 46)	3S-42E-7	11,890	255	U.Fr	8,022-8,730	8,376	194	40	23.3	183	5,026	135	17.2
					L.Fr	8,730-11,530	10,130	153	0	19.1	215	7,294	120	22.4
					Vk-Jk	11,530-(17,530)	14,530	0+	0+		310	13,222	16	61.1
9.	Earl T. Mackey 1-J. R. Tompkins (section 3, no. 13)	2S-43E-2	10,024	227	L.Fr	8,048-8,980	8,514	459	375	23.1	205	4,087	150	16.0
					Vk-Jk	8,980-(12,980)	10,980	24+	0+	19.8	240	8,015	95	27.4
10.	John W. Mecom 1-T. Middleton	4S-45E-1	12,600	247	U.OI-PI	8,010-9,830	8,920	0	0	22.0	201			
					U.Fr	9,830-(13,330)	11,580	0+	0+	15.7	250			
11.	Pan American 1-C. A. Kieke (section 3, no. 14; ties D, no. 47)	3S-43E-1	11,151	250	U.Fr	8,031-8,540	8,286	183	55	23.6	200	4,557	72	21.2
					L.Fr	8,540-(11,150)	9,845	78	0	19.8	225	7,679		
12.	Pennzoil Prod. 2-State Tract 100 (section D, no. 45)	4S-42E-3	11,802	252	U.Fr	8,019-8,550	8,284	154	30	23.6	203	3,852	98	18.4
					L.Fr	8,550-11,400	9,975	425	0	19.5	235	7,282	87	26.7
					Vk-Jk	11,400-(17,600)	14,500	0+	0+	8.7		12,833	40	
13.	Shell Oil 2-Barrow Ranch	3S-45E-4	14,949	289	U.OI-PI	8,010-8,800	8,405	0	0	23.3	212			
					U.Fr	8,800-10,700	9,750	115	0	20.1	240			
					L.Fr	10,700-		95+	0+					
14.	Skelly Oil 1-Gulf "J" (section 4, no. 19)	3S-42E-2	12,000	259	L.Fr	8,021-10,040	9,031	236	175	21.8	208	6,502	135	20.0
					Vk-Jk	10,040-(15,540)	12,790	0+	0+	12.8	270	10,488	35	42.9
15.	Sunray Dx Oil 1-Hall	2S-44E-2	9,800	207	U.Fr	8,040-8,350	8,195	182	110	23.8	182			
					L.Fr	8,350-(10,400)	9,375	152+	78+	20.9	200			
16.	Superior Oil 1-State Tract 252 (section D, no. 44)	4S-41E-5	10,200	201	U.Fr	8,016-8,930	8,473	259	125	23.1	180	4,236	128	16.5
					L.Fr	8,930-(11,660)	10,295	259+	105+	18.7	203	5,143	92	20.9
17.	Humble Oil & Refining 2-Moody Foundation	4S-43E-6	12,451		U.OI-PI	8,025-8,440	8,233	0	0	23.7	198			
					U.Fr	8,440-11,440	9,940	229	95	19.6	220			
					L.Fr	11,440-(16,440)	13,940	0+	0+	10.0	298			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
18.	Getty Oil I-State Tract 48	3S-42E-5	11,140	253	U.Fr L.Fr Vk-Jk	8,020-8,135 8,135-10,150 10,150-(15,850)	8,078 9,143 13,000	24 238 0+	0 145 0+	24.1 21.5 12.3	195 212 277			
19.	Humble Oil & Refining I-W. Winnie Oil I	2S-45E-1	9,500	219	U.Fr L.Fr	8,040-8,690 8,690-(11,090)	8,365 9,890	28 78+	0 35+	23.4 19.7	190 215			
20.	The Texas Company I-A. A. Davis	2S-41E-1	12,500	245	L.Fr Vk-Jk U.Cl	8,160-8,760 8,760-10,830 10,830-(14,230)	8,460 9,795 12,530	50 0 5+	30 0 0+	23.1 19.9 13.4	180 195 245			
21.	Union Producing State Tract 34-A - 1 well	2S-43E-8	8,764	200	L.Fr	8,020-(10,320)	9,170	190+	120+		212			
22C.	Gulf Energy & Mineral I-A. S. Hankamer	2S-44E-3												
23C.	Humble Oil & Refining Galveston Bay State C-72	3S-42E-7	8,930	192										
COLORADO COUNTY														
1.	Carthay Land Co. I-Leroy Stein (section 10, no. 7; ties A, no. 13)	3S-27E-6	12,738	313	M.Wx L.Wx	8,337-8,420 8,420-12,000	8,379 10,210	12 1,193	0 679	15.2 12.4	204 254	4,203 7,300	130 94	17.2 27.7
2.	Cities Service Oil I-A-Prause	3S-28E-6	11,500		M.Wx L.Wx	8,199-9,270 9,270-(13,770)	8,734 11,520	620 1,415+	315 1,005+	15.9 11.0	213 285			
3.	Cities Service B-2-F. Stephens (section 9, no. 11)	3S-29E-7	12,415	274	L.Cl U.Wx M.Wx L.Wx	8,226-8,253 8,253-8,940 8,940-10,160 10,160-(16,360)	8,240 8,597 9,550 13,260	0 405 298 1,458+	0 190 105 1,293+	16.8 16.1 14.4 7.9	214 220 235 348	3,830 3,998 4,775 7,691	24 67 55 84	24.5 21.2 25.2 42.1
4.	Five Resources I-Pokorny	3S-26E-7	10,075	222	L.Wx	8,375-(10,375)	9,375	1000+	665+	13.7	213			
5.	R. Mosbacher & Harkins I-Anne Foster	4S-30E-8	10,027	233	L.Cl U.Wx	8,183-9,735 9,735-(10,335)	8,959 10,035	0 88+	0 30+	15.5 13.6	216 240			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^{-3}$)	AVG CH ₄
6.	National Exploration 1-C. G. Glasscock (section 10, no. 8)	4S-28E-3	11,228		M.Wx L.Wx	8,306-9,170 9,170-(13,170)	8,738 11,170	134 1,074+	45 873+	15.9 11.6	215 320	4,370 5,585	165 50	15.9 36.9
7.	W. W. Paul 1-L. Miller	2S-29E-8	10,212	226	M.Wx L.Wx	8,382-9,350 9,350-(14,450)	8,866 11,900	138 603+	0 395+	15.6 10.3	210 300			
8.	Prairie Prod. & Scoggins 1-Bennie Helmcamp	4S-27E-4	10,017	252	M.Wx L.Wx	8,312-8,550 8,550-(12,050)	8,431 10,300	8 1,183+	0 860+	15.1 12.2	208 237			
9.	Prairie Prod., Hurt & Clements 1-Louis Koehn	1S-28E-7	10,517	264	M.Wx L.Wx	8,415-8,455 8,455-(11,955)	8,435 10,205	22 1,325+	0 985+	15.1 12.4	230 260			
10.	Shell Oil 2-Hayes-Stephens	4S-30E-1	9,520	251	L.Cl U.Wx	8,176-9,150 9,150-(9,650)	8,663 9,400	0 146+	0 60+	16.0 14.7	210 222			
11.	Shell Oil 1-Kyle Estate (section 10, no. 9; ties B, no. 22)	4S-29E-8	11,944		L.Cl U.Wx M.Wx L.Wx	8,200-8,710 8,710-9,430 9,430-11,000 11,000-(18,200)	8,455 9,070 10,215 14,600	0 300 156 346+	0 168 38 158+	16.2 15.3 13.3 5.5	210 220 270 420	4,228 4,535 5,312 13,724	50 45 15	24.0 30.5 110.8
12.	Shell Oil 27-Plow Realty	5S-28E-3	12,965	307	U.Wx M.Wx L.Wx	8,230-8,680 8,680-9,860 9,860-11,645	8,455 9,270 10,752	129 152 677	55 65 250	16.4 14.9 12.3	198 215 235			
13.	Shell Oil 54-Sheridan G.U.	5S-28E-3	14,703		U.Wx M.Wx	8,219-10,180 10,180-(15,680)	9,200 12,930	470 615+	195 330+	15.0 8.5	217 337			
14.	Shell Oil 1-Guy Stovall (section 10, no. 10)	5S-29E-8	16,500	394	L.Cl U.Wx M.Wx L.Wx	8,164-9,790 9,790-10,670 10,670-12,790 12,790-(19,790)	8,977 10,230 11,730 16,290	0 341 327 131+	0 215 277 0+	15.5 13.3 10.6 5.0	240 260 320 420	4,175 5,627 8,798 16,127	47 46 28 14	28.6 30.2 50.1 121.5
15.	Sinclair-Prairie 1-Gordon (section 9, no. 9; ties A, no. 14)	2S-28E-1	11,420		M.Wx L.Wx	8,310-8,500 8,500-(12,300)	8,405 10,400	61 1,181+	0 607+	15.1 12.1	195 243	4,203 5,200	23 55	23.8 26.7
16.	The Texas Company 1-R. B. Coddau (section 9, no. 10)	3S-29E-2	11,506	274	U.Wx M.Wx L.Wx	8,292-8,400 8,400-9,570 9,570-(14,870)	8,346 8,985 12,220	20 219 1,243+	0 0 731+	16.6 15.4 9.8	195 205 307	4,339 4,762 6,477	130 115 95	17.0 18.9 31.5

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
DE WITT COUNTY														
1.	Avalanche Journal Publishing 1-Rittner	7S-23E-5	10,650	269	M.Wx L.Wx	8,365-8,460 8,460-(11,060)	8,412 9,760	0 853+	0 670+	14.0 11.5	190 208			
2.	Gulf Oil 1-Mueller (section 13, no. 6; ties A, no. 10)	8S-21E-1	14,407	310	L.Wx	8,238-10,730	9,484	627	530	12.0	230	5,833	55	26.9
3.	Humble Oil & Refining 1-Ada B. Pridgen (section 13, no. 9; ties B, no. 18)	8S-24E-4	15,500	382	U.Wx M.Wx L.Wx	8,225-8,750 8,750-9,570 9,570-(15,570)	8,488 9,160 12,570	192 122 228+	190 0 105+	15.0 14.0 8.7	215 220 310	4,668 5,085 10,327	75 47 26	22.0 25.4 52.2
4.	Magnolia Petroleum 1-F. G. Hahn	8S-20E-6	10,350	223	L.Wx	8,380-(10,580)	9,480	577+	475+	12.0	225			
5.	Monsanto & Pennzoil 1-Dentler (section 14, no. 6)	9S-21E-9	12,851	333	U.Wx M.Wx L.Wx	8,344-9,090 9,090-10,550 10,550-(14,450)	8,717 9,820 12,500	257 85 380+	215 35 175+	14.7 13.0 8.8	247 270 330	4,707 6,285 10,000	20 22 27	29.4 35.9 56.0
6.	Monsanto 1-Kulavik	9S-21E-5	13,000	343	U.Wx M.Wx L.Wx	8,270-8,390 8,390-10,165 10,165-(14,065)	8,330 9,278 12,115	33 154 478+	0 45 245+	15.3 13.8 9.4	208 220 295			
7.	Monsanto & Ada Oil 1-Roberts	9S-20E-5	11,457		M.Wx L.Wx	8,390-8,520 8,520-11,350	8,455 9,935	0 348	0 180	15.1 12.8	211 235			
8.	Mosbacher & Harkins 1-Orsak	6S-23E-9	9,023	230	L.Wx	8,365-(9,865)	9,115	504+	400+	14.0	216			
9.	Occidental Petroleum 1-Matilde Osterloh et al. (section 14, no. 5; ties A, no. 9)	9S-19E-6	14,912	319	L.Wx	8,423-10,820	9,622	410	337	11.8	245	5,292	21	30.6
10.	Rowe 2-Parker	7S-23E-7	10,025	252	M.Wx L.Wx	8,270-8,970 8,970-(12,770)	8,620 10,870	91 548+	45 465+	14.8 11.3	230 260			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
DUVAL COUNTY														
1.	Amerada 1-Viggo Gruy	20S-11E-3	11,504	333	L.CI U.Wx	8,815-10,355 10,355-(14,955)	9,585 12,655	0 42+	0 0+	16.5 12.2	246 325			
2.	ARGO Oil 1-Juan R. Lopez (section 19, no. 15; ties B, no. 7)	17S-14E-6	5,886	155	Shallower than 8,000 ft									
3.	Austral Oil 1-Alice Baker	16S-14E-9	10,883	323	L.CI U.Wx M.Wx	8,550-9,000 9,000-10,730 10,730-(12,630)	8,775 9,865 11,680	0 39 0+	0 0 0+	17.6 16.1 13.6	249 293 305			
4.	Cherryville Corp. 1-J. W. Gorman	17S-12E-1	10,418	300	U.Wx M.Wx	8,570-10,300 10,300-(11,700)	9,435 11,000	201 18+	85 0+	16.7 14.5	241 285			
5.	Cherryville Corp. 1-L. T. Reyes	18S-13E-3	10,640	305	L.CI U.Wx	8,650-9,990 9,990-(14,090)	9,320 12,040	0 28+	0 0+	16.9 13.1	260 316			
6.	Coastal States 1-Ragsdale (section 19, no. 14; ties A, no. 4)	16S-13E-4	11,018	308	L.CI U.Wx M.Wx L.Wx	8,040-8,300 8,300-9,850 9,850-10,750 10,750-(13,850)	8,170 9,075 10,300 12,300	12 352 61 6+	0 122 38 0+	18.5 17.2 15.5 12.7	230 225 293	4,065 4,628 6,798 9,840	96 60 50 35	20.2 23.7 36.4
7.	Gulf Oil 1-Gulf-Peters	19S-11E-9	14,700	364	L.CI U.Wx	8,800-10,000 10,000-	9,400	0 224+	0 115+	16.8	277			
8.	Hiawatha Oil & Gas B-1 George Parr (section 20, no. 20)	20S-13E-7	14,110	355	Correlations unknown									
9.	J. M. Huber Colorado O. & G. & Shell Oil 1-Lee Hubbard	18S-12E-2	10,050	289	L.CI U.Wx	8,680-9,050 9,050-(11,950)	8,835 10,500	0 134+	0 60+	17.6 15.2	247 271			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
10.	Humble Oil & Refining 1-E. C. Lundell-State (section 20, no. 15)	18S-11E-2	8,155	239	Shallower than 8,000 ft									
11.	Hunt Oil 1-F. V. De Chapa (section 20, no. 21)	21S-14E-5	7,330	187	Shallower than 8,000 ft									
12.	Magnolia Petroleum 9-D.C.R.C. Sec. 79 (section 20, no. 14)	17S-11E-9	9,500	384	U.Wx M.Wx	8,543-8,920 8,920-(9,720)	8,732 9,320	196 32+	155 32+	16.8 17.8	215 240	4,800 4,940	27 25	26.2 28.9
13.	Shell Oil 1-L. H. Penwell (section 20, no. 16)	18S-12E-5	14,007	384	L.CI U.Wx M.Wx	8,639-9,030 9,030-(14,030) (14,030)-	8,835 11,530	0 316 0+	0 235 0+	18.5 13.8	220 325	5,301 9,916	27 33	27.6 53.0
14.	Shell Oil 1-A L. C. Weatherby (section 20, no. 17)	18S-12E-6	16,000	438	L.CI U.Wx M.Wx	8,600-9,260 9,260-(15,260) (15,260)-	8,930 12,260	0 705 208+	0 562 208+	17.4 13.1	235 322	4,912 10,421	25 28	28.2 54.8
15.	Standard Oil & Gas Farmers Life Ins. Co. MAD-1	17S-13E-5	10,600	374	L.CI U.Wx M.Wx L.Wx	8,630-9,800 9,800-11,520 11,520-12,700 12,700-(17,200)	9,215 10,660 12,110 14,950	0 139 0 7+	0 85 0 0+	17.0 15.0 13.0 9.0	238 276 318 410			
16.	Taylor Refining T-2 Parr (section 20, no. 18; ties B, no. 6)	18S-14E-9	6,000	170	Shallower than 8,000 ft									
17.	The Texas Company 1-A H. M. Graves (section 20, no. 19)	19S-13E-6	7,012	186	Shallower than 8,000 ft									
18.	Atlantic Richfield 1-ARCO et al., Humble Fee	17S-12E-1	10,600	297	U.Wx M.Wx	8,540-9,910 9,910-(11,310)	9,225 10,610	228 32+	48 0+	17.0 15.1	231 298			
19.	P. R. Rutherford 1-Walter Pursch	16S-12E-6	12,059	327	U.Wx M.Wx L.Wx	8,670-9,920 9,920-11,130 11,130-(14,130)	9,295 10,525 12,630	180 501 45+	116 410 0+	16.9 15.2 12.2	240 273 335			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
21.	Coastal States & Greenbriar 1-Ramirez	22S-12E-6	12,998	347	L.CI	8,440-(12,998)	10,719	0	0		299			
22.	Shell Oil 1-Stegall "A"	18S-12E-6	15,707	423	L.CI U.Wx	8,580-9,400 9,400-	8,990	0 751+	0 393+	17.3	241			
23.	Taylor Refining L-5 Parr	18S-14E-4	9,651	264	L.CI	8,410-(15,910)	12,160	9+	0+	12.9	320			
24.	Eason-Harper 1-160 Peters Estate	19S-11E-9	11,300	340	L.CI U.Wx	8,775-9,745 9,745-(13,745)	9,260 11,745	0 100+	0 41+	17.0 13.5	273 307			
25.	Earle Rowe 1-J. B. Peal Estate	19S-10E-5	10,014	282	U.Wx M.Wx	8,700-9,580 9,580-(10,780)	9,140 10,180	483 131+	233 105+	17.1 15.7	275 293			
26.	Morgan 3-B Richardson	20S-10E-6	13,025	350	L.CI U.Wx	8,740-10,500 10,500-(15,200)	9,620 12,850	0 0+	0 0+	16.5 11.9	283 345			
27.	Shell Oil 2-L. C. Weatherby	18S-12E-6	10,010	268	L.CI U.Wx	8,545-9,410 9,410-(14,410)	8,978 11,910	0 95+	0 90+	17.4 13.3	250 312			
29C.	Pan American Prod. et al. 11-D Hazelwood	17S-12E-1	8,590	235										
30C.	Shell Oil 1-Travis McGee	18S-12E-5/6												
31.	A. M. & R. Co. 1-J. Olivera (section B, no. 5)	20S-12E-6	6,314			Shallower than 8,000 ft								
FAYETTE COUNTY														
1.	Amoco Prod. 1-Wegenhoft (section 10, no. 6)	2S-26E-6	13,702	282	L.Wx	8,246-9,790	9,018	494	395	14.2	210	4,509	135	17.2
2.	Fort Bend Oil 1-A Bryant James	1S-27E-4	8,520	227	L.Wx	8,410-(10,010)	9,210	97+	83+	13.9				

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG $\bar{\rho}$	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH_4
FORT BEND COUNTY														
2.	Enserch Exploration 1-Foster Farms (section 7, no. 10)	3S-34E-9	15,856	358	U.CI	8,121-8,800	8,461	13	0	18.7	206	4,654	43	23.9
					L.CI	8,800-11,860	10,330	0	0	15.4	237	6,301	37	30.8
					U.Wx	11,860-12,870	12,365	0	0	11.8	272	9,274	25	42.5
					M.Wx	12,870-14,770	13,820	123	70	9.2	317	10,365	23	54.6
					L.Wx	14,770-(24,270)	19,520	0+	0+	5.0	420	17,372		
4.	Fort Bend 1-J. M. Moore Estate (section 8, no. 12; ties C, no. 46)	5S-33E-8	9,533	201	Vk-Jk	8,095-(9,200)	8,648	0	0		198	5,277	67	22.7
5.	Gulf Coast Leaseholds 1-Frank Chaloupka (section C, no. 48)	5S-34E-1	6,046	181	Shallower than 8,000 ft									
6.	Hunt Oil 1-Harlem State Prison Farm (section 7, no. 11; ties C, no. 50)	4S-35E-2	9,500	221	U.CI	8,094-9,490	8,792	72	0					
8.	M.P.S. Production 1-Sugarland Ind. (section C, no. 51)	3S-36E-9	8,017	180	Shallower than 8,000 ft									
9.	The Oil & Gas Co. 1-Byrne (section 8, no. 13)	6S-34E-3	7,215	178	Shallower than 8,000 ft									
10.	Pure Oil 1-N. B. Knight (section 7, no. 12)	4S-36E-7	8,512	195	Vk-Jk	8,075-(11,075)	9,575	0+	0+		225	6,068	55	26.9
11.	Scurlock Oil & M. T. Halbouty 1-Dennis Krause (section 8, no. 11)	5S-33E-2	8,312	209	U.CI	8,114-(9,614)	8,864	15+	0+		216	4,432		
12.	Scurlock Oil 1-McMillian Farms	2S-34E-9	11,546	273	L.CI	8,170-10,190	9,180	0	0	17.4	225			
					U.Wx	10,190-10,940	10,565	13	0	14.9	248			
					M.Wx	10,940-(12,890)	11,915	48+	37+	12.6	270			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^{-3}$)	AVG CH ₄
13.	Scurlock Oil I-Virginia J. Meek (section 7, no. 9)	3S-34E-2	13,518	335	U.CI	8,147-8,270	8,209	0	0	19.1	198	4,575	45	23.1
					L.CI	8,270-10,800	9,535	0	0	16.8	221	6,198	35	28.8
					U.Wx	10,800-11,090	10,945	60	60	14.3	265	7,841	29	37.8
					M.Wx	11,090-12,970	12,030	153	48	12.4	272	8,541	26	40.8
					L.Wx	12,970-(21,970)	17,470	67+	0+	5.0	390	14,850		
14.	SoRelle & SoRelle I-Wesendorff (section C, no. 49)	4S-35E-4	6,791	169	Shallower than 8,000 ft									
15.	Sun Oil I-Simmons (section 8, no. 10)	4S-33E-2	9,000	200	U.CI	8,134-(9,134)	8,634	117+	35+	18.4	224	4,748	65	23.5
16.	Windward & Ownby I-F. W. Sims (section C, no. 47)	5S-34E-3	6,046	148	Shallower than 8,000 ft									
17.	Magnolia-Seaboard I-Elizabeth McKennon	3S-34E-9	12,801	309	U.CI	8,120-8,520	8,320	25	0	18.9	202			
					L.CI	8,520-11,550	10,035	0	0	15.9	235			
					U.Wx	11,550-12,350	11,950	670	670	12.5	271			
					M.Wx	12,350-(14,250)	13,300	160+	87+	10.1	307			

GALVESTON COUNTY

1.	Cities Service Oil B-2 Stewart (section D, no. 42)	5S-40E-4	14,898	316	U.Fr	8,034-9,420	8,727	236	142	23.5	194	4,887	110	18.9
					L.Fr	9,420-13,300	11,360	812	385	19.3	230	7,838	83	27.5
					Vk-Jk	13,300-(19,900)	16,600	10+	0+	5.0				
2.	Gulf Oil I-Coline Oil Corp.	6S-42E-1	15,560	221	U.OI-PI	8,020-12,450	10,235			21.1	200			
					U.Fr	12,450-15,400	13,925	68	0	15.3	285			
					L.Fr	15,400-(23,400)	19,400	0+	0+	6.7	373			
3.	Houston Oil & Minerals I-State Tract 342	5S-42E-7	12,940	287	U.OI-PI	8,030-11,210	9,620	563	365	22.1	204			
					U.Fr	11,210-(14,010)	12,610	10+	0+	17.4	280			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
5.	Humble Oil & Refining 1-State Tract 81	6S-41E-5	16,701	315	U.OI-PI U.Fr L.Fr	8,020-9,050 9,050-13,560 13,560-(20,560)	8,535 11,305 17,060	71 16+	0 0+	23.8 19.3 10.4	213 275 342			
6.	Russ Maguire 1-Ed Taylor (section 5, no. 17; ties D, no. 43)	4S-40E-7	11,105	222	U.Fr L.Fr	8,320-8,690 8,690-(11,490)	8,505 10,090	114 548+	85 138+	23.8 21.3	183 205	5,103 6,760	95 98	19.7 22.9
7.	Nor-Am Exploration 1-Konzack Sidetrack	6S-40E-4	13,701	302	U.OI-PI U.Fr L.Fr	8,040-8,600 8,600-11,500 11,500-(17,800)	8,320 10,050 14,650	160 241+	34 58+	24.1 21.4 14.2	210 237 317			
8.	Superior Oil 14-Superior Oil Co. Fee	5S-41E-5	8,999	214	U.Fr	8,020-(10,520)	9,270	16+	0+	22.6	204			
9.	Humble Oil & Refining 1-State Tract 113-A	5S-42E-9	14,101		U.OI-PI U.Fr L.Fr	8,030-9,200 9,200-12,090 12,090-(18,390)	8,615 10,645 15,240	24 0+	0 0+	23.6 20.5 13.3	235 269 317			
10.	Texaco 9-Orchard O.V., O.A. 1	6S-39E-1	12,369	265	U.Fr L.Fr	8,030-10,500 10,500-(14,400)	9,265 12,450	225 195+	90 0+	22.6 17.6	197 270			
11.	The Texas Company 1-W. E. Eggers Gas Unit	6S-39E-1	14,605	300	U.Fr L.Fr	8,035-10,510 10,510-(14,510)	9,273 12,510	230 1,005	88 375	22.6 17.5	186 265			
12C.	Texas Eastern Trans. 1-Sadie L. Henck	6S-40E-6	15,900	246										
GOLIAD COUNTY														
1.	A. B. Albek 4-Sol Parks (section 14, no. 10)	11S-22E-6	4,558	147	Shallower than 8,000 ft									
2.	Amerada Petroleum 3-Mrs. Ada McFadden (section 15, no. 11; ties B, no. 14)	11S-19E-7	11,025	251	U.Wx M.Wx	8,291-9,200 9,200-(12,300)	8,746 10,750	126 801+	75 512+	14.6 11.5	225 250	5,997 6,988	20 15	30.3 35.9

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
3.	D. H. Braman, Jr. 3-Dennis O'Connor (section C, no. 34)	13S-22E-2	5,852	175	Shallower	than 8,000 ft								
4.	Chevron Oil 1-R. G. Jacobs (section 14, no. 8; ties B, no. 16)	10S-22E-9	24,760	500	L. Cl U. Wx M. Wx L. Wx	8,239-9,070 9,070-10,490 10,490-12,940 12,940-(19,940)	8,655 9,780 11,715 16,440	0 323 0	0 168 0	14.8 13.0 10.0 5.0	207 218 237 337	5,366 6,415 8,435 11,837	22 21 24 20	27.2 30.4 35.9 64.7
5.	General Crude & Mayfair 1-Pettus	11S-20E-4	11,192	272	U. Wx M. Wx	8,185-8,660 8,660-(11,160)	8,423 9,910	30 474	0 160	15.1 12.8	223 260			
6.	Robert J. Hewitt 1-Mrs. Freida Hall	11S-21E-1	10,175	292	L. Cl U. Wx	8,190-9,010 9,010-(10,310)	8,600 9,660	0 29+	0 0+	14.8 13.2	225 251			
7.	Humble Oil & Refining Co. 2-Hugo McMillan	10S-21E-3	11,627	307	U. Wx M. Wx L. Wx	8,310-8,780 8,780-10,220 10,220-(14,620)	8,545 9,500 12,420	227 54 10+	170 0 0+	14.9 13.4 8.9	226 247 313			
8.	Kirkwood & Co. 1-Willie Hoff	10S-22E-2	9,415	227	L. Cl U. Wx	8,160-8,770 8,770-(9,570)	8,465 9,170	10 98+	0 46+	15.0 14.0	215 230			
9.	Lone Star Producing 1-Emma Haynes Estate (section 14, no. 7)	10S-21E-3	14,307	356	U. Wx M. Wx L. Wx	8,282-9,100 9,100-10,540 10,540-(14,740)	8,691 9,820 12,640	1,192 45 240+	86 0 150+	14.7 13.0 8.6	230 250 325	4,432 5,990 9,733	125	18.7
10.	Lone Star Producing 1-Albert Jank Unit	10S-20E-1/6	14,000	365	U. Wx M. Wx L. Wx	8,360-8,910 8,910-10,350 10,350-(14,350)	8,635 9,630 12,350	85 101 259+	0 0 90+	14.8 13.2 9.0	220 242 325			
11.	Magnolia 2-R. F. Irby	12S-20E-4	10,800	303	L. Cl U. Wx	8,260-10,070 10,070-(11,770)	9,165 10,920	0 56+	0 30+	16.3 12.8	232 267			
12.	Plymouth Oil 1-Thompson (section 15, no. 12)	11S-21E-9/3	11,513	287	L. Cl U. Wx M. Wx	8,243-10,250 10,250-11,380 11,380-	9,242 10,815	0 31 0+	0 0 0+	16.2 13.0	225 250	5,820 7,895	80 53	24.3 32.9

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-point	NS	ES	AVG $\bar{\rho}$	AVG T	AVG P	AVG $S (x10^{-2})$	AVG CH_4
13.	Shell Oil 1-O. J. Friedrichs (section 14, no. 9)	11S-22E-4	16,014	398	L.Cl U.Wx M.Wx	8,180-11,140 11,140-12,500 12,500-(15,700)	9,660 11,820 14,100	0 33 0	0 0 0	15.3 11.0 6.4	245 315 360	5,119 8,038 11,632	84 38 30	24.1 45.1 68.8
14.	Tennessee Gas Trans. 1-H. A. Bomba	9S-22E-9	8,515	231	U.Wx	8,235-(9,435)	8,835	189+	115+	14.5	225			
15.	Atlantic Refining 1-Giebel	10S-22E-8	10,210	262	L.Cl U.Wx	8,225-8,890 8,890-(10,290)	8,558 9,590	0 80+	0 0+	17.5 15.5	235 255			
16.	Continental & Atlantic Refining 39-Pettus	10S-20E-7	13,619	329	U.Wx M.Wx L.Wx	8,350-8,900 8,900-10,330 10,330-(15,330)	8,625 9,615 12,830	71 58 83+	0 0 50+	14.8 13.3 8.3	212 236 309			
17.	Texaco Oil 1-M. D. Wilson	12S-19E-1	10,120	254	L.Cl U.Wx M.Wx	8,320-8,700 8,700-9,900 9,900-(13,100)	8,510 9,300 11,500	0 63 56+	0 30 45+	17.6 16.0 11.6	221 237 282			
18.	Jake L. Hamon 1-Mary Lutenbacher	12S-20E-4	10,227	290	L.Cl U.Wx	8,225-9,000 9,000-(10,900)	8,613 9,950	0 35+	0 0+	17.4 14.7	220 255			
19C.	Humble Oil & Refining 1-Mary A. Meyer	10S-21E-2	13,000	329										
20C.	Mosbacher & Mendell 1-Bettie Albrecht	10S-21E-9	8,355	198										
21C.	Shell Oil A-1 Bego	11S-22E-1	14,072	370										
22C.	Tennessee Gas Trans Co. 1-Alois Gisler	9S-22E-9	8,500	218										
23.	Normandy Oil & Gas 1-Otto Neese (section B, no. 15)	11S-20E-6	10,050	270	L.Cl U.Wx M.Wx	8,255-8,300 8,300-9,555 9,555-(12,055)	8,278 8,928 10,805	0 90 30+	0 50 0+	15.3 14.3 11.4	234 249	4,139 4,464	14 20	27.0 28.9

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
GONZALES COUNTY														
1.	Gulf Coast Leaseholds 1-E. Roznovsky (section 12, no. 6)	5S-22E-6	7,928	204	Shallower than 8,000 ft									
2.	H. L. Hunt 1-W. R. Miller (section 13, no. 5)	7S-21E-2/3	13,354	298	L.Wx	8,240-8,450	8,345	0	0	14.1	213	4,173	78	20.7
3.	Superior & Glassell 1-J. E. Gardien, Jr.	7S-20E-6	12,525	304	L.Wx	8,330-8,620	8,475	0	0	13.5	202			
4.	Mobil, Superior, & Total Resources 1-Dixon-Mason-Textel Unit	5S-23E-3	20,762	406	L.Wx	8,505-8,850	8,678	0	0	13.0	202			
GRIMES COUNTY														
1.	Gulf Oil 2-Wm. Gardner (section 6, no. 6)	3N-33E-8	11,616	251	M.Wx L.Wx	8,340-8,870 8,870-(12,870)	8,605 10,870	105 2,128+	0 1,695+	17.3 14.1	205 247	4,303 5,435	95 76	19.5 25.6
2.	Placid Oil, et al. 1-R. O. Davis, Jr. (section 6, no. 5; ties A, no. 17)	4N-32E-7	10,526	266	L.Wx	8,315-(11,280)	9,798	1,010+	705+	15.6	255	4,899	110	22.2
3.	Placid Oil 1-Thomas	5N-34E-9	10,233	222	L.Wx	8,340-		1,120+	675+					
4.	R. Olsen Oil 1-E. L. Hawkins	3N-32E-4	10,520	237	L.Wx	8,185-(11,185)	9,685	1,133+	585+	15.8	224			
HARDIN COUNTY														
1.	ARCO & Sinclair 1-A Hardin Co. School Land	4N-45E-2	12,700	288	L.Cl U.Wx M.Wx	8,140-9,450 9,450-10,430 10,430-(12,830)	8,795 9,940 11,630	0 300 402+	0 120 115+	20.4 18.1 14.8	205 225 264			
2.	Clegg & Hunt 1-Keith Co.	2N-47E-5	12,533		Vk-Jk U.Cl L.Cl	8,045-9,115 9,115-10,695 10,695-(14,995)	8,580 9,905 12,845	0 222 15+	0 70 0+	23.0 21.2 17.4	187 222 283			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
3.	Cyprus Oil I-Dishman (section C, no. 60)	3N-46E-9	10,314	232	Vk-Jk U.CI L.CI	8,071-8,550 8,550-10,090 10,090-(13,790)	8,311 9,320 11,940	0 172 0+	0 65 0+	23.3 22.0 18.6	203 220 275	3,864 4,334 7,642	64 60 32	205 22.8 38.4
4.	Dominion Corp. I-Wm. Seale et al.	3N-45E-6	9,312	216	U.CI L.CI	8,085-9,140 9,140-(12,140)	8,612 10,640	240 0+	47 0+	22.9 20.3	202 230			
5.	International Nuclear (INEXCO) I-Harris (section 2, no. 13)	4N-44E-5	10,958	263	L.CI U.Wx M.Wx	8,135-9,740 9,740-10,510 10,510-(13,310)	8,938 10,125 11,910	0 584 352+	0 250 235+	20.1 17.8 14.2	230 255 285	4,469 5,063 8,337	47 27 15	24.8 30.3 44.4
6.	Meredith & Co. I-Sun-Dishman-Lucas	2N-45E-5	14,431	302	Vk-Jk U.CI L.CI	8,045-9,125 9,125-11,160 11,160-(15,360)	8,585 10,142 13,260	0 181 30+	0 43 0+	23.0 20.9 16.8	197 223 288			
7.	Mobil Oil I-ARCO Fee Block "D" (section C, no. 61)	3N-47E-3	19,127	410	U.CI L.CI U.Wx	8,094-8,880 8,880-11,500 11,500-(14,500)	8,487 10,190 13,000	179 8 415+	80 0 31+	23.1 20.9 17.2	202 229 274	3,946 5,859 9,490	180 92 55	14.2 23.6 38.5
8.	Sinclair & Atlantic Refining 4-H. McGill (section C, no. 62)	4N-47E-7	12,998	311	U.CI L.CI U.Wx	8,055-8,440 8,440-10,830 10,830-(13,330)	8,248 9,635 12,080	41 0 353+	0 0 165+	23.4 21.6 18.4	192 211 278	4,042 4,721 6,044	44 42 12	21.7 24.4 37.6
9.	Sun Oil I-Williams (section 2, no. 14; ties C, no. 59)	2N-44E-5	10,012	202	U.CI L.CI	8,081-9,530 9,530-(13,530)	8,806 11,530	135 32+	0 0+	22.7 19.1	188 213	4,403 8,071	32 35	23.1 31.2
10.	The Texas Company I-F. M. Carpenter	2N-46E-4	13,501	297	Vk-Jk U.CI L.CI	8,050-9,340 9,340-11,580 11,580-(16,080)	8,695 10,460 13,830	0 106 38+	0 0 38+	22.8 20.5 16.1	192 230 306			
11.	Pan American B-I Sternewiders	4N-46E-2	12,946		L.CI U.Wx M.Wx	8,110-9,640 9,640-10,600 10,600-(13,000)	8,875 10,120 11,800	0 178 18+	0 0 0+	20.2 17.8 14.5	202 245 277			
12.	Austral Oil I-A-S 6731	4N-43E-2	11,510	245	L.CI U.Wx M.Wx	8,160-8,660 8,660-9,450 9,450-11,500	8,410 9,055 10,475	0 341 430	0 110 57	21.1 19.9 17.1	192 205 227			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
13.	Cities Service Oil 1-Kirby Lumber	3N-45E-7	9,865		U.CI L.CI	8,080-9,330 9,330-(12,930)	8,705 11,130	310 85+	45 0+	22.8 19.6	190 240			
HARRIS COUNTY														
1.	E. B. Cox & J. L. Hamon 1-Lydia Harquart	2S-35E-7	8,505		U.CI	8,125-(8,870)	8,498	0+	0+	18.6	202			
2.	Carrie B. Davis 1-Susholtz (section 6, no. 14; ties C, no. 52)	2S-37E-7	8,620	191	U.CI	8,078-(9,390)	8,734	30+	0+		200	4,635	95	19.8
3.	Eddy Refining 1-Hunt (section 5, no. 15; ties C, no. 53)	2S-39E-4	9,935	210	U.CI	8,650-(11,170)	9,910	38+	0+		210	6,838	65	26.1
4.	Eddy Refining 3-Goodrich	2S-38E-6	9,291	198	Vk-Jk U.CI	8,060-8,175 8,175-(9,625)	8,118 8,900	0 46+	0 30+		156 185			
5.	Jack Frazier 1-Laura Lockner (section 6, no. 13)	2S-37E-5	9,030		U.CI	8,087-(9,080)	8,584	31+	0+		231			
6.	Ginther Warren 1-Taub-Dwyer-McCall Unit (section 5, no. 13)	1S-37E-2	18,010	375	L.CI U.Wx M.Wx L.Wx	8,124-9,770 9,770-10,640 10,640-11,990 11,990-(19,990)	8,947 10,205 11,315 15,990	0 206 0 1,066+	0 135 0 205+	17.8 15.6 13.6 5.3	201 220 236 362	4,652 5,612 6,223 14,390	46 34 30	23.3 27.6 30.8
7.	B. M. Hester 1-U.S. Plywood-Champion Paper	1N-39E-1	8,665	210	U.CI L.CI	8,095-(8,195) (8,195)-(11,195)	8,145 9,695	80 250+	80 32+		198			
8.	Houston Oil Co. 1-Swilley (section C, no. 54)	1S-39E-8	9,618		U.CI	8,055-(9,455)	8,755	92+	0+		192	4,378	26	23.8
9.	Houston Natural Gas 1-Tanneberger (section 5, no. 12; ties B, no. 27)	1N-37E-8	14,010	258	L.CI U.Wx M.Wx L.Wx	8,152-9,560 9,560-10,330 10,330-12,240 12,240-(20,240)	8,856 9,945 11,285 16,240	0 261 57 341+	0 195 0 45+	18.0 16.0 13.8 5.0	207 225 245 362	4,516 4,973 7,787 12,992	87 85 31	20.4 22.0 34.8

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S_{(x10^3)}$	AVG CH_4
10.	Meredith & Co. et al. 1-Ross et al. (section 5, no. 14)	1S-37E-1	14,262	320	L.CI	8,105-10,530	9,312	0	0		203	5,590	72	23.1
					U.Wx	10,530-11,580	11,055	157	78		245	7,628	70	29.9
					M.Wx	11,580-13,420	12,500	71	0		290	9,125	55	40.3
					L.Wx	13,420-(21,420)	17,420	18+	0+		375	16,026	55	78.2
11.	Midwest Oil 1-Rohn Haas (section 5, no. 16)	3S-40E-3	8,540	204	Vk-Jk	8,146-(12,146)	10,146	15+	0+		208	6,088	95	22.4
12.	Pan American 1-Dorothy D. Brown (section 6, no. 11)	1S-36E-8	15,507	409	L.CI	8,135-9,940	9,038	0	0	17.6	238	4,519	24	27.6
					U.Wx	9,940-10,710	10,325	116	70	15.4	262	5,163	25	31.6
					M.Wx	10,710-12,380	11,545	61	0	13.2	285	5,773	27	35.8
					L.Wx	12,380-(21,080)	16,730	90+	55+	5.0	372	14,555	18	86.4
13.	Pan American 1-Houston Unit N-6W-10 (section 6, no. 12)	2S-36E-1	17,003	347	U.CI	8,119-8,330	8,225	0	0		198	4,112	74	20.1
					L.CI	8,330-10,650	9,490	9	0		215	6,453	68	25.6
					U.Wx	10,650-11,410	11,030	0	0		238	7,831	58	30.8
					M.Wx	11,410-13,200	12,305	139	65		270	9,229	29	41.4
					L.Wx	13,200-(22,200)	17,700	515+	290+		365	16,815	25	86.9
14.	Petroleum Corp. of Texas 2-Meyer Est.	2S-40E-2	10,305	216	Vk-Jk	8,020-		154+	58+					
15.	Sinclair 1-Henry Krezdorn	1N-33E-1	12,000	263	L.CI	8,110-9,060	8,585	0	0	18.4	224			
					U.Wx	9,060-9,650	9,355	298	88	17.1	232			
					M.Wx	9,650-10,960	10,305	424	130	15.4	237			
					L.Wx	10,960-(16,760)	13,860	659+	578+	9.1	327			
16.	Standard Oil 1-G. J. Mellinger et al. (section 6, no. 10)	1S-35E-8	14,935	345	L.CI	8,157-9,900	9,029	0	0	17.7	216	6,320	36	28.5
					U.Wx	9,900-10,710	10,305	82	0	15.4	240		34	
					M.Wx	10,710-12,260	11,485	48	0	13.3	299		30	
					L.Wx	12,260-(20,560)	16,410	128+	65+	5.0	365	15,917	30	82.7
17.	The Texas Company 1-Mrs. Emma K. Busch Est.	2S-41E-9	13,170	238	L.Fr	8,040-8,680	8,360	125	75		173			
					Vk-Jk	8,680-		0	0					
18.	Texaco Oil 1-M. D. Hallson	1N-36E-6	16,674	373	L.CI	8,170-9,310	8,740	0	0	18.2	215			
					U.Wx	9,310-10,100	9,705	223	40	16.5	229			
					M.Wx	10,100-11,830	10,965	162	65	14.2	248			
					L.Wx	11,830-(19,330)	15,580	1,197+	302+	6.1	362			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
19.	Texaco Oil I-M. M. Mergele (section 6, no. 8; ties B, no. 26)	1N-35E-8	17,464	387	L.Cl U.Wx M.Wx L.Wx	8,084-9,190 9,190-9,900 9,900-11,250 11,250-(18,550)	8,637 9,545 10,575 14,900	0 713 66 3,860+	0 82 0 2,620+	18.4 16.8 14.9 7.3	221 237 254 302	4,020 4,773 5,288 12,069	80 55 45	22.9 25.3 28.9
20.	Texaco Oil I-J. J. Sweeney Est. (section 6, no. 9)	1S-35E-5	16,490	374	L.Cl U.Wx M.Wx L.Wx	8,163-10,060 10,060-10,810 10,810-12,450 12,450-(20,450)	9,112 10,435 11,630 16,450	0 154 117 1,573+	0 38 0 872+	17.5 15.2 13.0 5.0	222 243 267 347	5,012 5,218 5,815 15,097	60 52 50	24.3 27.0 30.9
21.	Woodward & Co. I-Annie Pechanec (section C, no. 55)	1S-40E-4	9,106	200	U.Cl	8,072-(9,572)	8,822	149+	38+		199	4,411	50	21.7
23.	Brewster & Bartle I-Mrs. Z. S. Kratky	1S-40E-6	9,312	203	U.Cl	8,075-(9,825)	8,950	51+	0+		199			
24.	Trice Production I-Houston Dump	3S-37E-7	11,435		Vk-Jk U.Cl	8,065-10,630 10,630-(12,500)	9,348 11,565	13 24+	0 0+		207 255			
25.	J. P. Petkas I-Lucien Bukowski	3S-38E-9	8,848	195	L.Fr Vk-Jk	8,060-8,290 8,290-(11,290)	8,175 9,790	0 0	0 0		198 218			
26.	Noble Ginther I-Ginther Fee et al.	1S-38E-6	9,343		U.Cl	8,075-(9,175)	8,625	221	130		205			
27.	Tenneco Oil I-Shell Oil Co.	3S-39E-1	8,700	216	Vk-Jk	8,040-(11,240)	9,640	0+	0+		213			
HIDALGO COUNTY														
1.	Amerada Petroleum I-T. N. O. R. R. Co. (section 23, no. 10)	30S-15E-1	11,010	240	L.Fr	8,098-(11,598)	9,848	1,228+	1,110+	13.1	227	6,204	24	30.5
2.	Amoco Prod. 21-South Weslaco Gas Unit (section 24, no. 8)	31S-16E-7	9,000	239	U.Fr	8,085-(10,085)	9,085	246+	143+	14.3	240			
3.	Bettis & Shepherd I-J. F. Baingo Unit (section 24, no. 9; ties D, no. 1)	31S-17E-8	10,792	275	U.Fr	8,083-(10,933)	9,508	766+	447+	13.7	223	5,610	36	27.7

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S(x10^3)$	AVG CH_4
4.	Bettis & Shepherd 1-Schwartz	32S-17E-1	9,562	219	U.Fr	8,080-(11,880)	9,980	568+	374+	12.9	256			
5.	Coastal States & Greenbriar 1-Castillo (section 23, no. 8; ties C, no. 5)	29S-13E-5	14,147	360	Vk-Jk	8,312-(14,412)	11,362	1,546+	563+	10.7	300	8,749	53	41.5
6.	Coastal States 1-Murchison (section C, no. 2)	30S-13E-8	10,261	278	Vk-Jk	8,230-(15,230)	11,730	329+	75+	10.1	290	9,032	20	46.1
7.	Continental Oil 1-M. Talbot (section 24, no. 4)	31S-14E-2	11,018	263	L.Fr Vk-Jk	8,170-9,370 9,370-(18,370)	8,770 13,870	0 45+	0 0+	14.8 6.6	212 340	5,920 12,968	88 21	22.9 68.4
8.	Neil E. Hanson 1-Sara Dobbins (section 22, no. 25)	28S-17E-4	12,820	311	U.Fr L.Fr	8,090-9,110 9,110-(14,910)	8,600 12,010	669+	215+	15.1 9.6	205 248	3,999 11,165	32 48	23.2 38.5
9.	Hargrave Oil 1-Rio Farms	29S-16E-1	10,095	232	L.Fr	8,060-(13,460)	10,760	671+	362+	11.6	246			
11.	Houston Oil & American Republics 1-Hidalgo Co.-Willacy (section C, no. 1)	31S-13E-3	10,533	218	Vk-Jk	8,140-(14,740)	11,440	795+	355+	10.6	283	8,580	17	44.2
12.	Humble Oil & Refining 416 McGill Bros. (section C, no. 10)	26S-14E-7/8	14,138	354	Vk-Jk	8,204-(15,004)	11,604	763+	332+	10.3	301	9,515	60	42.1
13.	Humble Oil & Refining 7-Santa Fe Ranch-Mula Pasture	27S-16E-2	13,000	314	L.Fr	8,195-(12,495)	10,345	649+	160+	13.0	236			
14.	Humble Oil & Refining 1-Texan Development Co. (section 24, no. 3; ties C, no. 3)	30S-13E-7	10,005	237	Vk-Jk	8,240-(15,740)	11,990	174+	33+	9.7	275	9,292	32	41.9
15.	Lockhart 2-John H. Shary Estate (section 23, no. 9)	30S-15E-3	10,476	266	L.Fr Vk-Jk	8,145-8,530 8,530-(18,530)	8,338 13,530	170 20+	126 0+	15.6 7.2	200 345	6,003 12,989	35 47	26.7 62.7
16.	Louisiana Land & Expl. Co. 1-A. A. McAllen et al. (section 22, no. 24)	28S-17E-9	13,938	317	U.Fr L.Fr	8,068-9,060 9,060-(14,860)	8,564 11,960	30 898+	30 415+	15.2 9.7	205 270	3,982 10,585	76 48	20.1 40.9
17.	McCulloch Oil/I.D.S. 1-G. W. Harding	29S-17E-9	11,815	305	L.Fr	8,075-(14,875)	11,475	847+	640+	10.5	282			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
18.	Magnolia Petroleum 1-Grace Doughty (section 22, no. 22)	28S-15E-6	15,003	336	L.Fr Vk-Jk	8,100-10,680 10,680-(20,410)	9,390 15,545	724 412+	420 0+	13.8 5.0	236 349	5,164 14,923	55 25	26.1 75.3
19.	Magnolia 1-Romulo Garza (section 22, no. 23)	28S-16E-5	9,010	216	L.Fr	8,090-(12,390)	10,240	309+	120+	12.5	238	7,885	33	33.9
20.	Phillips Petroleum 1-Flores (section 24, no. 2)	30S-12E-8	9,400	238	Vk-Jk	8,217-(13,717)	10,967	0+	0+					
21.	Republic Natural Gas 1-Hammon Ranch	29S-15E-9	11,000	273	L.Fr Vk-Jk	8,170-9,700 9,700-(19,600)	8,935 14,650	297 8+	97 0+	14.6 5.4	235 340			
22.	Shell Oil 1-A. W. Beaurline (section 22, no. 21)	28S-15E-3	16,250	380	L.Fr Vk-Jk	8,113-8,880 8,880-(17,300)	8,497 13,090	265 902+	148 420+	15.3 7.5	220 305	6,032 12,252	45 48	27.4 51.5
23.	Shell Oil 1-Coates-Newmont Oil Co. (section C, no. 7)	28S-14E-4	14,792	332	Vk-Jk	8,283-(15,783)	12,033	1,214+	752+	9.6	292	10,710	30	48.3
24.	Shell Oil 1-W. H. Drawe (section D, no. 2)	31S-17E-7	14,988	322	U.Fr L.Fr	8,080-11,530 11,530-(21,030)	9,805 16,280	462 83+	275 0+	13.2 5.0	221	5,294 15,303	14 20	29.0 •
25.	Shell Oil 1-Goldston Estate	27S-15E-8	16,000	374	L.Fr Vk-Jk	8,120-9,630 9,630-(18,630)	8,875 14,130	84 741+	0 200+	14.7 6.2	225 341			
26.	Shell Oil 1-A. A. McAllen et al. (section C, no. 8)	28S-14E-2	15,318	354	Vk-Jk	8,196-(15,996)	12,096	1,579+	892+	9.5	300	10,345	17	51.8
27.	Shell Oil & Delhi-Taylor 9-A. A. McAllen (section 22, no. 20; ties C, no. 9)	27S-14E-8	13,202	320	Vk-Jk	8,179-(15,679)	11,929	271+	90+	9.8	285	10,796	48	43.8
28.	Shell Oil 12-A. A. McAllen	28S-14E-2	13,438	339	Vk-Jk	8,180-(16,180)	12,180	1,030+	470+	9.4	277			
29.	Shell Oil & Delhi-Taylor 4-Woods-Christian	28S-14E-2	11,500	303	Vk-Jk	8,210-(16,210)	12,210	669+	58+	9.3	296			
30.	Shell Oil & Delhi-Taylor 6-Woods-Christian	27S-14E-8	13,032	296	Vk-Jk	8,190-(15,690)	11,940	852+	420+	9.7	292			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
31.	Shell Oil 7-Woods-Christian	28S-14E-2	11,520	301	Vk-Jk	8,210-(16,210)	12,210	481+	218+	9.3	296			
32.	Shell Oil 8-Woods-Christian	28S-14E-2	10,200		Vk-Jk	8,210-(15,710)	11,960	348+	85+	9.7	294			
33.	Sinclair Oil & Gas 2-Houston Unit (section 24, no. 7)	32S-15E-1	16,000	360	L.Fr	8,095-(13,195)	10,645	384+	100+	11.8	270	9,527	37	40.8
34.	Sinclair-Prairie 1-Stella Greining (section C, no. 4)	30S-13E-2	9,015	217	Vk-Jk	8,244-(15,224)	11,734	0+	0+	10.1	290	8,793	20	45.5
35.	Standard Oil & Gas 1-V. M. Henderson	32S-16E-4/5	9,135	192	L.Fr	8,110-(14,210)	11,160	41+	41+	11.0	253			
36.	Standard Oil of Texas 1-Rio Farms, Inc. (section 23, no. 12)	30S-17E-2	17,000	356	U.Fr L.Fr	8,070-9,810 9,810-(17,310)	8,940 13,560	318 126+	105 45+	14.6 7.1	205 310	6,035 12,190	52 34	25.6 54.6
37.	Tenneco Oil 1-Hamman Ranch Unit II-"A"	29S-14E-6	11,531	278	L.Fr Vk-Jk	8,195-9,470 9,470-(18,670)	8,833 14,070	135 363+	30 184+	14.8 6.0	227 315			
38.	Tenneco Oil 36-McAllen Fieldwide Unit (section 24, no. 5)	31S-15E-5	14,868	343	L.Fr Vk-Jk	8,133-11,990 11,990-(22,590)	10,062 17,290	1,105 524+	790 214+	12.8 5.0	250 378	5,434 17,031	56 25	27.7 93.8
39.	Tenneco Oil 21-Pharr Fieldwide Unit (section 24, no. 6)	31S-15E-8	13,823	333	L.Fr Vk-Jk	8,135-12,420 12,420-(23,220)	10,278 17,820	1,077 280+	725 0+	12.4 5.0	257 383	8,017 17,642	46 28	34.8 96.8
40.	The Texas Company 1-El Texano Land Co.	32S-14E-1	12,020	269	L.Fr Vk-Jk	8,100-10,050 10,050-(20,050)	9,075 15,050	681 0+	420 0+	14.4 5.0	215 345			
41.	Union Producing 2-Wysong Unit (section 23, no. 11)	30S-16E-4/5	12,516	301	L.Fr	8,091-(13,091)	10,591	65+	32+	11.9	260	7,202	42	34.1
42.	P. H. Welder 1-W. J. Davis (section C, no. 6)	29S-13E-1	5,495	157	Shallower than 8,000 ft									
43.	Union Producing 1-Barnes	31S-16E-2	11,620	278	L.Fr	8,090-(13,990)	11,040	1,046+	620+	11.2	270			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S_3 ($\times 10^3$)	AVG CH_4
59C.	Shell Oil 15-McAllen	28S-14E-1												
60C.	Shell Oil 18-A. A. McAllen	28S-14E-2												
61C.	Standard Oil of Texas 1-German Unit	31S-15E-1	13,665	343										
62C.	Tenneco Oil 43-Fieldwide Unit	31S-15E-4	13,600	332										
63C.	Union Producing 1-Grade Galloway	31S-16E-2	8,542	203										
64C.	Union Producing 1-Swallow	31S-16E-2	11,286	269										
JACKSON COUNTY														
1.	C. C. Gilger 1-Deunow (section 12, no. 10)	10S-28E-5	9,300	197	L. Fr Vk-Jk	8,039-8,440 8,440-(10,840)	8,240 9,640	581 0+	270 0+	22.9 21.0	200 221	3,832 4,483	120 35	17.0 25.2
2.	Gravis & Mitchell 1-McCulloch (section C, no. 41)	8S-28E-1	6,019	156	Shallower than 8,000 ft									
3.	H. H. Howell et al. 1-Ben N. Good (section 12, no. 9; ties C, no. 40)	8S-27E-8	5,477	149	Shallower than 8,000 ft									
4.	Monsanto Chemical 1-Texas Gulf Sulfur (section 12, no. 12; ties D, no. 29)	11S-30E-3	13,498	307	U. Fr L. Fr Vk-Jk	8,036-8,850 8,850-11,900 11,900-(16,900)	8,443 10,375 14,400	105 408 8+	50 400 0+	22.6 19.9 14.3	202 233	4,112 4,824	60 24	21.3 28.0
5.	H. M. Naylor Oil 1-R. T. Stepan	10S-27E-7	9,603	205	Vk-Jk	8,050-(10,450)	9,250	157+	85+	21.5	215			
6.	Salt Dome 1-Way Ranch	9S-29E-9	8,519		L. Fr	8,020-(10,420)	9,220	217+	171+	21.6	215			
7.	Texaco B-1 L. Ranch (section 12, no. 11)	10S-29E-9	10,500	218	L. Fr Vk-Jk	8,044-10,400 10,400-(13,940)	9,222 12,170	234 0+	105 0+	21.6 17.4	215 273	4,288	37	24.5

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG $S (x10^{-2})$	AVG CH_4
8.	D. M. Wallace 1-A. Miller (section C, no. 39)	9S-27E-4	6,070	180	Shallower than 8,000 ft									
9.	Sun Oil 1-Wright Unit	9S-30E-8	8,805	194	L.Fr	8,050-(9,950)	9,000	292+	75+	21.9	212			
10.	Windfohr 1-E. R. Eversberg	9S-30E-5	8,651		L.Fr	8,065-(9,765)	8,915	404+	158+	22.0	210			
11.	Sun Oil 1-Arnold Unit	9S-30E-9	8,759	191	L.Fr	8,050-(9,850)	8,950	295+	122+	21.9	211			
12.	Sun Oil 1-Mauritz Unit 12	9S-30E-9	8,803	190	L.Fr	8,050-(9,850)	8,950	393+	223+	21.9	211			
13.	Sun Oil 1-McDaniel	8S-25E-6	10,000	257	L.Cl U.Wx	8,110-8,970 8,970-10,000	8,540 9,485	0 429	0 260		204 252			
14.	Sun Oil 5-McDaniel	8S-25E-6	9,703	216	L.Cl U.Wx	8,130-8,930 8,930-(10,230)	8,530 9,580	0 318+	0 243+		204 220			
15.	Occidental Petroleum 3-Geo. McHaney	10S-29E-6	9,850	214	L.Fr	8,041-(10,141)	9,091	638+	286+	14.1	201			
16C.	Skelly Oil Co. 1-Ida Little	10S-30E-4	8,010											

JASPER COUNTY

1.	Apache et al. 1-Martin Foley Gas Unit (section C, no. 64)	4N-49E-6	11,509	277	U.Cl L.Cl U.Wx	8,081-8,670 8,670-11,100 11,100-(13,600)	8,376 9,885 12,350	22 0 111+	0 0 35+	23.3 21.3 18.0	197 220 285	4,355 6,227 8,033	21 41 61	24.4 28.2 36.5
2.	Atlantic Richfield 1-ARCO section 61 (section 1, no. 10; ties C, no. 63)	4N-48E-7	10,051	242	U.Cl L.Cl	8,068-8,810 8,810-(11,610)	8,439 10,210	26 0+	0 0+	23.2 20.8	198 228	4,980 6,330	80 50	21.2 28.1
4.	Gulf Oil 1-Temple Lumber Co. (section 1, no. 9)	4N-48E-4/5	11,046	272	U.Cl L.Cl U.Wx	8,052-8,350 8,350-10,800 10,800-(12,800)	8,201 9,575 11,800	17 0 0+	0 0 0+	23.5 21.7 18.7	188 205 230	3,936 5,075 8,732	85 60 39	18.7 23.8 33.7

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
5.	International Nuclear 1-Arc-Allen	5N-48E-6	10,016	222	L.CI U.Wx M.Wx	8,115-9,000 9,000-9,865 9,865-(11,765)	8,558 9,433 10,815	0 259 40+	0 30 0+	20.8 19.1 16.4	202 213 245			
6.	Kelly Brock 1-Miller-Vidor	3N-48E-8	9,658	227	Vk-Jk	8,050-(9,850)	8,950	16+	0+	22.5	207			
7.	Kerr McGee 1-Sinclair-Atlantic	6N-49E-7	10,120	226	L.CI U.Wx M.Wx	8,030-8,860 8,860-9,610 9,610-(11,310)	8,445 9,235 10,460	0 435 215+	0 190 85+	21.1 19.5 17.1	206 216 232			
8.	Phillips Petr. 1-Miller-Vidor (section 1, no. 12)	3N-49E-9	7,805	166	Shallower than 8,000 ft									
9.	Prudential Drilling 1-A Arc Flores	5N-49E-8	10,835	245	L.CI U.Wx M.Wx	8,110-9,900 9,900-10,560 10,560-(13,060)	9,005 10,230 11,810	0 147 29+	0 48 0+	20.0 17.6 14.4	208 240 285			
10.	White Shield 1-Southwest Timber (section 1, no. 11)	3N-49E-3	9,365	213	U.CI	8,061-(9,570)	8,816	149+	62+	22.7	205	4,660	120	18.5
11.	Atlantic Richfield 1-D. M. Henderson et al.	8N-47E-3	11,110	248	L.Wx	8,140-8,400	8,270	0	0	19.5	218			
12.	Austral Oil 1-S-A 6732	5N-48E-5	10,026	223	L.CI U.Wx M.Wx	8,065-8,630 8,630-9,300 9,300-(11,150)	8,348 8,965 10,225	0 382 144+	0 210 32+	21.3 20.0 17.6	200 208 226			
13.	Gulf Oil Earl C. Hankamer et al. "H" #1	4N-48E-4	12,000	278	U.CI L.CI U.Wx M.Wx	8,052-8,350 8,350-10,150 10,150-10,730 10,730-(13,830)	8,201 9,250 10,440 12,280	50 0 530 870+	0 0 528 517+	23.5 22.1 20.5 18.1	188 195 218			
JEFFERSON COUNTY														
1.	Amoco Prod. 1-McFaddin Ranch "A"	2S-47E-7	12,685	277	U.OI-PI U.Fr L.Fr	8,028-9,300 9,300-11,985 11,985-(15,780)	8,664 10,643 13,883	144 11 12+	98 0 0+	22.6 17.9 10.2	182 210 298			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
2.	Amoco Prod. 1-McFaddin Ranch "B"	2S-48E-8	15,000	300	U.OI-PI U.Fr L.Fr	8,010-9,580 9,580-12,255 12,255-(16,355)	8,795 10,918 14,305	203 16 6+	150 0 0+	22.3 17.2 9.1	202 235 288			
3.	Belco Petroleum 2-Crawford 161 (section 2, no. 19)	2S-46E-8	14,520	289	U.OI-PI U.Fr L.Fr Vk-Jk	8,018-8,640 8,640-10,980 10,980-14,430 14,430-(21,530)	8,329 9,810 12,705 17,980	0 339 187 77+	0 100 105 0+	23.4 19.9 13.0 5.0	175 192 262	4,248 5,297 10,545	150 170 55	15.3 16.0 38.6
4.	Humble Oil & Refining 1-State Tract 38	2S-49E-5	13,900	274	U.OI-PI U.Fr L.Fr	8,025-9,330 9,330-12,300 12,300-(16,250)	8,678 10,815 14,275	92 0 0+	40 0 0+	22.6 17.5 9.2	195 216 305			
5.	Kirby Petro. 1-S. Wedgeworth et al. (section D, no. 50)	1S-48E-1	10,718	223	U.Fr L.Fr	8,025-9,380 9,380-(12,010)	8,703 10,695	196 182+	110 145+	22.6 17.8	193 220	4,482 8,235	76 68	20.4 28.7
6.	Glenn H. McCarthy 1-Bauer (section 2, no. 17)	1S-45E-6	10,020		L.Fr	8,057-(10,430)	9,244	175+	175+	21.3	200	4,807	130	17.9
7.	Meredith Co. American Cyanamid	1S-49E-5	11,691	252	U.Fr L.Fr	8,040-10,000 10,000-(13,200)	9,020 11,600	83 43+	0 0+	21.8 15.6	192 251			
8.	Petroleum Inc. #1 Gilbert Estate	1S-46E-4	10,553	226	U.Fr L.Fr	8,037-9,145 9,145-(11,245)	8,591 10,195	20 225+	0 140+	22.8 19.0	198 220			
9.	Prudential Oil 1-Floyd C. Smith (section D, no. 49)	1S-47E-7	12,271	263	U.Fr L.Fr Vk-Jk	8,026-9,390 9,390-11,910 11,910-(19,110)	8,708 10,650 15,510	52 196 0+	0 120 0+	22.5 17.9 6.0	180 225	6,009 8,146	55 24	23.6 34.0
10.	Sun Oil 1-T. J. White "B"	3S-46E-9	12,008	243	U.OI-PI U.Fr L.Fr	8,020-9,220 9,220-11,485 11,485-(16,485)	8,620 10,353 13,985	95 8 12+	58 0 0+	22.8 18.6 9.9	190 211 297			
11.	Texaco 1-Leger	1N-46E-5	14,530	303	Vk-Jk	8,070-(13,270)	10,670	216	0	17.8	223			
12.	Gulf Oil 1-Rake	1S-47E-6	10,013	219	U.Fr L.Fr	8,025-8,795 8,795-(11,495)	8,410 10,145	10 0+	0 0+	23.2 19.1	186 211			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
13.	McDonald Oil I-Hebert	3S-46E-8/9	10,506		U.OI-PI U.Fr	8,015-8,430 8,430-(11,430)	8,223 9,930	10 6+	0 0+	23.7 19.6	195 214			
14C.	Gulf Oil Bell et al. Gas Unit #1	1S-46E-7	11,703	208										
JIM HOGG COUNTY														
1.	Allen & Bemis 2-D. O. Gallagher (section 22, no. 15; ties B, no. 3)	24S-10E-5	3,850	151	Shallower than 8,000 ft									
2.	Atlantic Refining 3-Marrs McLean "C" (section 22, no. 14)	22S-9E-7	15,608	423	L.CI U.Wx	8,840-9,730 9,730-(15,730)	9,285 12,730	0 97+	0 52+	16.4 10.5	233 335	5,838 10,337	74 51	25.4 52.6
3.	ARCO 2-Marrs McLean Trust	23S-9E-1	16,026	262	L.CI U.Wx	8,835-9,615 9,615-(15,715)	9,225 12,665	0 194	0 60	16.5 10.6	250 351			
4.	British-American Oil 1-Adams (section 21, no. 14; ties B, no. 4)	22S-10E-5/6	7,100	186	Shallower than 8,000 ft									
5.	Gulf Oil 1-Fulbright Estate et al.	22S-9E-8	9,985	132	L.CI U.Wx	8,830-9,310 9,310-(14,110)	9,070 11,710	0 72+	0 0+	13.8 9.4	257 322			
6.	Humble Oil & Refining 30-A. M. Bass (section 22, no. 18)	26S-13E-5	8,505	217	Vk-Jk	8,270-(12,670)	10,470	8+	0+	12.0				
7.	Humble Oil & Refining 3-Mestina (section 21, no. 15)	23S-12E-4/9	6,085		Shallower than 8,000 ft									
8.	Sun Oil 45-A. C. Oil (section 22, no. 17)	25S-12E-9	6,505	189	Shallower than 8,000 ft									
9.	Sun Oil 38-Weil Bros. (section 22, no. 16)	25S-11E-2	6,211	282	Shallower than 8,000 ft									
10.	Humble Oil & Refining 6-A. M. Bass	26S-13E-5	8,702	238	L.CI	8,270-(12,270)	10,270	0+	0+	12.4	270			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
KARNES COUNTY														
1.	General Crude 1-Tipps (section 15, no. 9)	10S-18E-1/6	14,075	303	L.Wx	8,277-10,260	9,269	103	103					
2.	Harrison 1-Howard Hysaw (section 15, no. 8; ties A, no. 8)	10S-18E-3	8,795	228	L.Wx	8,234-(9,824)	9,029	79+	79+					
3.	Shell Oil 1-C. A. Atkinson (section 15, no. 10)	10S-19E-9	11,424	159	M.Wx L.Wx	8,304-10,500 10,500-(13,000)	9,402 11,750	266 236+	218 180+					
4.	Standard Oil of Texas 1-Ida Pace	9S-18E-7	13,392	337	L.Wx	8,246-10,300	9,273	236	122	12.4	224			
5.	Texas Eastern 1-Otis S. Wuest "A" (section 15, no. 7)	9S-17E-7	8,344	212	L.Wx	8,344-(9,344)	8,844	0+	0+	13.2	230	4,422	72	22.6
6.	Sohio 1-Nicholas Estate	11S-18E-2	9,280	301	L.Wx	8,416-(10,366)	9,391	40+	0+	12.2	242			
7.	General Crude 1-J. M. Grunewald	10S-17E-7	16,100	336	L.Wx	8,476-10,328	9,402	33	33	12.1	226			
8.	Texas Eastern Trans. 1-Ernest Waskow	9S-19E-8	9,505	227	L.Wx	8,415-(9,915)	9,165	255+	136+	12.6	226			
KENEDY COUNTY														
1.	Arkansas Fuel (Cities Service) 2-McGill	23S-18E-8	11,237	261	L.Fr	8,060-(12,210)	10,135	1,325+	868+	16.8	228			
2.	Austral Oil 1-Garcia Ranch	28S-18E-3	14,603	299	U.Fr L.Fr	8,050-11,000 11,000-(18,950)	9,525 14,975	1,035 615+	593 120+	17.7 9.7	220 320			
3.	Gulf Oil 2-McGill Estate (section 20, no. 25)	23S-17E-1	15,354	327	L.Fr Vk-Jk	8,057-10,940 10,940-(16,870)	9,499 13,905	335 135+	35 45+	17.8 11.3	215 305	6,364 11,820	45 22	27.6 55.3

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
4.	Gulf Oil 1-State Tract 427 (section 21, no. 26)	27S-21E-7	14,532	291	U.OI-PI U.Fr	8,025-8,330 8,330-(23,818)	8,178 16,074	0 1,780+	0 748+	19.7 8.1	174	3,801	14 29	18.5
5.	Humble Oil & Refining 22-Charles M. Armstrong (section 21, no. 22)	26S-18E-2	14,226	324	U.Fr L.Fr	8,238-9,780 9,780-(18,180)	9,009 13,980	535 1,709+	188 1,175+	18.1 11.1	205 350	4,500 10,904	58 52	22.4 57.7
6.	Humble Oil & Refining 22-Mrs. S. K. East (section 21, no. 21)	25S-18E-3	17,000	355	L.Fr Vk-Jk	8,052-(14,352) (14,352)-(24,852)	11,202 19,602	1,681 25+	475 0+	15.3	260	8,289	37	36.9
7.	Humble Oil & Refining 15-Mrs. S. K. East B (section 19, no. 24)	23S-19E-1	16,030	236	U.Fr L.Fr	8,030-9,900 9,900-(16,400)	8,965 13,150	735 820+	70 410+	18.6 12.4	200 320	4,500 11,572	130 18	17.4 59.6
8.	Humble Oil & Refining C-1 S. K. East	25S-20E-1	13,388	273	U.Fr L.Fr	8,015-11,080 11,080-(22,080)	9,548 16,580	1,685 625+	1,194 254+	17.7 7.3	210 336			
9.	Humble Oil & Refining D-1 Mrs. S. K. East (section 20, no. 29)	24S-20E-9	12,000	256	U.Fr L.Fr	8,028-11,128 11,128-(18,930)	9,578 15,029	1,060 210+	425 162+	17.5 9.6	220 310	4,787 13,523	83 35	21.9 57.1
10.	Humble Oil & Refining 1-Mrs. S. K. East "G" (section D, no. 9)	26S-19E-1	16,340	329	U.Fr L.Fr	8,000-12,120 12,120-(22,110)	10,060 17,115	1,853 1,140+	1,150 515+	16.9 6.5	226 350	5,278 16,255	57 45	25.3 68.9
11.	Humble Oil & Refining 2-John G. Kenedy, Jr. "J" (section 20, no. 27)	23S-19E-9	16,025	331	U.Fr L.Fr	8,047-9,000 9,000-(16,500)	8,524 12,750	327 2,352+	121 1,325+	19.2 13.0	200 276	4,688 10,327	90 57	20.2 40.0
12.	Humble Oil & Refining 4-John G. Kenedy, Jr. "J" (section 20, no. 28)	24S-19E-2	20,317	361	U.Fr L.Fr	8,022-10,020 10,020-(18,020)	9,021 14,020	620 1,079	315 526	18.5 11.1	205 300	4,512 11,721	26 37	24.9 50.7
13.	Humble Oil & Refining C-2 John G. Kenedy	24S-18E-1	11,549	227	U.Fr L.Fr	8,080-8,840 8,840-(15,840)	8,460 12,340	285 1,188+	80 774+	19.3	195			
14.	Humble Oil & Refining G-1 John G. Kenedy, Jr. (section 19, no. 25)	23S-20E-4	10,930	243	U.Fr L.Fr	8,027-10,750 10,750-(19,250)	9,388 15,000	1,255 105+	658 82+	18.0 9.5	219 320	5,914 13,800	62 45	25.6 57.8
15.	Humble Oil & Refining 2-King Ranch-Loma Prieta	27S-18E-4	14,005	302	U.Fr L.Fr	8,040-10,430 10,430-(18,630)	9,235 14,530	455 120+	235 62+	18.2 10.3	219 312			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
16.	Humble Oil & Refining 2-King Ranch Saltillo (section 21, no. 23; ties D, no. 8)	26S-19E-7	13,000	288	U.Fr L.Fr	8,037-12,300 12,300-(23,600)	10,169 17,950	1,190 120+	680 60+	16.8 5.0	238 380	4,728 17,232	96 170	21.9 49.8
17.	Humble Oil & Refining 1-King Ranch-Tio Moya (section 21, no. 25)	27S-20E-7	12,001	252	U.Fr	8,015-(22,915)	15,465	2,038+	1,285+	8.5	310	12,450	25	19.0
18.	Humble Oil & Refining 2-King Ranch-Tio Moya (section 21, no. 24)	27S-20E-5	15,975	316	U.Fr L.Fr	8,018-12,820 12,820-(25,920)	10,419 19,370	2,291 493+	845 182	16.4 5.0	241 430	4,844 18,354	74 50	24.1 116.9
19.	Humble Oil & Refining 1-Laguna Madre State Tract 249 (section 19, no. 27; ties D, no. 11)	24S-21E-2	11,694	240	U.Fr	8,021-(12,521)	10,271	1,845+	1,076+	16.6	225	5,136	80	23.1
20.	Humble Oil & Refining 1-Laguna Madre State Tract 384	26S-21E-8	12,000	274	U.OI-PI U.Fr	8,020-8,260 8,260-(14,060)	8,140 11,160	0 1,800+	0 846+		197 262			
21.	Humble Oil & Refining 1-H. F. McGill Jr. (section 20, no. 26)	23S-18E-2	11,602	273	L.Fr	8,050-(12,550)	10,300	1,150+	532+	16.6	245	6,283	50	29.6
22.	Humble Oil & Refining 10-Patricio Pasture (Rbt. J. Kleberg, Jr. Tr.)	24S-17E-9	11,200		L.Fr	8,030-(12,530)	10,280	1,065+	438+	16.6	248			
23.	Humble Oil & Refining 1-Daniel J. Sullivan	24S-17E-4	12,000	263	L.Fr Vk-Jk	8,020-10,450 10,450-(17,650)	9,235 14,050	530 63+	115 45+	18.2 11.0	232 238			
24.	Mobil Oil 1-State Tract 309 (section 20, no. 30; ties D, no. 10)	25S-21E-4	17,000	345	U.Fr L.Fr	8,026-12,550 12,550-(23,050)	10,288 17,800	1,925 780+	997 250+	16.6 5.0	222 340	10,084 16,732	90 25	28.9 76.2
25.	Mobil Oil 1-Texas Gulf 59202 State Tract 961L (section 20, no. 31)	25S-22E-5	18,500	351	U.OI-PI U.Fr	8,070-9,450 9,450-(15,400)	8,760 12,425	23 1,385	0 420	18.9 13.4	201 270	5,694 8,834	52 52	24.7 37.2
26.	Pan American 1-John G. Kenedy, Jr. (section 19, no. 26; ties D, no. 12)	23S-21E-4	15,610	304	U.Fr L.Fr	8,026-11,650 11,650-(21,150)	9,838 16,400	1,501 320+	955 146+	17.3 7.6	222 320	6,200 15,250	97 30	23.2 64.7
27.	Sun Oil 1-Baffin Bay State Tract 24	22S-20E-7	10,004	214	U.Fr	8,020-(11,020)	9,520	1,155+	760+	17.8	212			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
KLEBERG COUNTY														
1.	Aransas Fuel Oil 1-Beckman	22S-19E-4	12,518	262	L.Fr	8,030-(12,730)	10,380	898+	235+	16.5	250			
2.	Aransas Fuel Oil 2-V. A. Hubert	22S-19E-4	8,973	203	L.Fr	8,030-(12,730)	10,380	195+	115+	16.5	250			
3.	Aransas Fuel Oil C-1 V. A. Hubert	22S-19E-4	8,557	201	L.Fr	8,035-(12,735)	10,385	430+	195+	16.5	250			
4.	Arkansas Fuel Oil & Mokeen Oil 1-R. B. Womack	22S-18E-7	10,520	229	L.Fr	8,035-(12,735)	10,385	1,155+	790+	16.5	227			
5.	Champlin Oil 93-G. P. Wardner (section C, no. 22)	20S-17E-2	7,701	196	Shallower than 8,000 ft									
6.	Cherryville Corp. 1-South Mustang Island State Tract 978-S	22S-22E-2	13,355	307	U.Fr L.Fr	8,085-12,450 12,450-(21,950)	10,268 17,200	753 0+	120 0+	16.6 6.4	213			
7.	Golden Trend Oil & Gas 1-Marshall-Michele	20S-18E-8	8,250	201	L.Fr	8,060-(11,060)	9,560	59+	0+	17.7	227			
8.	Humble Oil & Refining 184 King Ranch-Alazan	21S-20E-8	17,716	362	U.Fr L.Fr Vk-Jk	8,045-9,860 9,860-14,850 14,850-(22,850)	8,953 12,355 18,850	865 929 456+	540 580 235+	18.6 13.6 5.0	197 250			
9.	Humble Oil & Refining King Ranch-Borregos AME-4	21S-17E-5	12,820	311	L.Fr Vk-Jk	8,080-9,600 9,600-(14,100)	8,840 11,850	212 10+	135 0+	18.8 14.3	230 295			
10.	Humble Oil & Refining ME-3 King Ranch-Borregos (section 19, no. 20)	21S-17E-2	11,468	302	L.Fr Vk-Jk	8,184-10,070 10,070-(15,070)	9,127 12,570	38 327+	0 39+	18.3 13.2	247 299	7,393 10,307	35 35	33.8 47.9
11.	Humble Oil & Refining MC-4 King Ranch- West Borregos (section 19, no. 18)	20S-16E-6	7,000	192	Shallower than 8,000 ft									
12.	Humble Oil & Refining 262 King Ranch-Borregos (section 19, no. 19; ties C, no. 21)	20S-17E-9	9,000	202	Vk-Jk	8,110-(12,110)	10,110	95+	0+	16.7	243	7,886	30	34.9

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
13.	Humble Oil & Refining G-1 King Ranch, East Caureles	20S-21E-6	12,002		U.Fr L.Fr	8,035-9,925 9,925-(15,825)	8,980 12,875	122 0+	60 0+	18.6 12.8	205 296			
14.	Humble Oil & Refining 10-King Ranch-Laguna Larga (section 20, no. 24)	22S-16E-7	12,788	303	L.Fr Vk-Jk	8,107-9,950 9,950-(15,050)	9,028 12,500	241 86+	95 0+	17.9 13.3	220 298	7,560 10,625	60 14	28.5 52.7
15.	Humble Oil & Refining 1-Laguna Madre State Tract 197 (section D, no. 14)	21S-22E-9	15,994	315	U.Fr L.Fr	8,006-12,360 12,360-(20,860)	10,183 16,610	1,050 0+	410 0+	16.8 7.3	227 340	5,804 15,780	60 27	26.2 73.4
16.	Humble Oil & Refining C-177 King Ranch Seelingson (section C, no. 19)	21S-16E-8	7,825	163	Shallower than 8,000 ft									
17.	Humble Oil & Refining E-45 King Seelingson (section C, no. 20)	21S-16E-6	11,039	245	Vk-Jk	8,111-(11,610)	9,860	262+	47+	17.2	221	7,393	80	26.4
18.	Lone Star Producing 1-Bessie H. Muil (section 19, no. 21)	21S-18E-7	15,930	354	L.Fr Vk-Jk	8,051-12,190 12,190-(17,890)	10,120 15,040	500 200+	200 128+	16.9 9.6	218 337	8,602 12,670	30 25	33.2 65.5
19.	Pure Oil A-1 Laguna Madre State Tract 168 (section D, no. 15)	20S-22E-8	10,970		U.Fr	8,012-(11,880)	9,946	497+	230+	17.1	240	7,360	65	29.5
20.	Shell Oil 1-State Tract 206 (section D, no. 13)	22S-21E-6	10,501	230	U.Fr	8,026-(11,980)	10,003	1,213+	700+	17.0	220	6,854	80	25.5
21.	Sun Oil 1-Baffin State 376	22S-19E-8	9,155	213	U.Fr	8,020-(9,520)	8,770	390+	200+	18.9	205			
22.	Sun Oil 43-A. T. Canales	22S-16E-5	11,200	252	L.Fr Vk-Jk	8,145-8,950 8,950-(13,450)	8,548 11,200	15 210+	0 0+	19.2 15.2	209 223			
23.	Sun Oil & Morgan Minerals 1-Estella E. Fimble (section 19, no. 22)	22S-19E-2	12,056	277	L.Fr	8,034-(14,533)	11,284	370+	201+	15.1	260	7,673	50	34.0
24.	Sun Oil & Morgan Minerals 2-Fimble Gas Unit	22S-19E-3	11,504	215	L.Fr	8,035-(12,535)	10,285	590+	235+	16.6	232			

[illegible]

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
2.	Royal Oil & Gas B-1 Robert Coquat (section 20, no. 11)	16S-8E-2	6,300	171	Shallower than 8,000 ft									
LAVACA COUNTY														
1.	Alcoa I-Janak	6S-25E-1/2	10,528	262	M.Wx	8,190-		1,457+	1,325+					
2.	Anadarko Prod. I-A. P. C.-Lacy-Pohl	5S-26E-7	11,016	238	U.Wx M.Wx L.Wx	8,180-8,240 8,240-9,500 9,500-(13,500)	8,210 8,870 11,500	0 180 766+	0 70 410+	16.8 15.6 11.0	193 203 294			
3.	H. J. Chavanne I-Carter (section 12, no. 7; ties A, no. 11)	6S-24E-8	10,252	236	M.Wx L.Wx	8,266-10,126 10,126-(28,126)	9,196 19,126	8 10+	0 0+	12.0 5.0	210	4,600	25	25.5
4.	Falcon Seaboard Drilling I-Renger	6S-26E-8	12,007		U.Wx M.Wx	8,200-9,250 9,250-	8,725	150 433+	130 190+	15.9	226			
5.	Fidelity I-Frank G. Olsovsky (section 11, no. 5)	4S-24E-2	8,804	210	L.Wx	8,380-(8,880)	8,630	14+	0+	14.8	207	4,315	21	25.0
6.	Hawkins & Hawkins I-Mrs. Sada Barnes (section 11, no. 11; ties B, no. 21)	6S-27E-8	10,160	264	L.Cl U.Wx M.Wx	8,164-8,600 8,600-9,470 9,470-(11,410)	8,382 9,035 10,440	0 472 122+	0 290 50+	16.5 15.4 12.9	200 235 260	4,331 4,970 5,742	55 50 42	22.1 26.0 30.9
7.	K. & H. Operating I-Andres Bludau (section 11, no. 7)	5S-25E-1/6	9,542	245	L.Wx	8,280-(11,060)	9,670	598+	580+	13.2	231	4,835	48	25.6
8.	North Central Oil A-1 Cranz Estate	7S-27E-3	9,673	230	L.Cl U.Wx M.Wx	8,170-8,580 8,580-9,575 9,575-(13,575)	8,375 9,078 11,575	0 506 47+	0 320 0+		204 213 281			
9.	Pure Oil I-E. E. Kolar (section 11, no. 8)	6S-27E-2	16,533	375	L.Cl U.Wx M.Wx L.Wx	8,220-8,470 8,470-9,310 9,310-10,490 10,490-(16,790)	8,345 8,890 9,900 13,640	0 549 29 132+	0 500 0 40+	16.6 15.6 13.8 7.2	215 225 242 320	4,173 4,623 5,445 10,411	36 35 27 24	24.0 25.8 30.0 55.2

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG $\bar{\rho}$	AVG T	AVG P	AVG _s S (x10 ²)	AVG CH ₄
10.	Shell Oil 3-William Borchers (section 12, no. 8; ties B, no. 19)	7S-26E-5	16,002	394	L.CI U.Wx M.Wx L.Wx	8,164-8,440 8,440-9,950 9,950-13,220 13,220-(21,220)	8,302 9,195 11,585 17,220	0 572 188 86+	0 440 50 40+	16.7 15.1 10.9 5.0	206 225 295 397	4,251 4,781 9,512 17,048	24 27 26 15	24.5 26.9 47.1 109.1
11.	Shell Oil 7-E. T. Neuhaus (section 11, no. 9)	6S-27E-2	14,502	347	L.CI U.Wx M.Wx L.Wx	8,194-8,300 8,300-9,100 9,100-10,870 10,870-(17,370)	8,247 8,700 9,985 14,120	0 444 107 1,019+	0 240 65 505+	16.8 16.0 13.7 6.4	215 205 232 347	4,124 4,350 5,093 12,284	31 25 23 26	24.2 24.6 28.6 67.4
12.	Shell Oil 1-Sibley	7S-25E-5	15,517	381	U.Wx M.Wx L.Wx	8,170-9,090 9,090-12,525 12,525-(18,325)	8,630 10,808 15,425	231 145 283+	140 0 0+	16.1 12.2 5.0	225 270 362			
13.	Shell Oil 1-Traylor (section 11, no. 10)	6S-27E-5	11,722	347	L.CI U.Wx M.Wx L.Wx	8,176-8,450 8,450-9,230 9,230-11,230 11,230-(18,230)	8,313 8,840 10,230 14,730	0 252 98 0+	0 140 45 0+	16.7 15.7 13.3 5.3	200 207 222 350	4,157 4,420 5,320 12,521	27 24 47 20	23.6 25.0 26.0 70.9
14.	Sohio 1-Ponish	4S-26E-4	14,501	359	L.Wx	8,275-10,100	9,188	595	440	13.9	216			
15.	Sohio & Skelly 1-Paul Stock (section 11, no. 6; ties A, no. 12)	4S-25E-8	14,037	320	L.Wx	8,084-10,000	9,042	441	322	14.2	217	4,521	8.2	21.3
16.	Sun Oil 1-Borchers	8S-25E-5	9,277		L.CI U.Wx	8,160-8,605 8,605-(9,705)	8,383 9,155	0 316+	0 150+		205 214			
17.	Superior Oil 1-Kouvicka	5S-24E-6	10,001	251	L.Wx	8,300-10,000	9,150	549	280	14.0	215			
18.	Union 1-A. Borchers	7S-26E-9	11,200	301	L.CI U.Wx M.Wx	8,150-8,230 8,230-9,560 9,560-(13,260)	8,190 8,895 11,410	0 462 0+	0 295 0+		258 270 325			
19.	Belco Petroleum 1-J. M. Taylor	5S-26E-7	10,259	262	U.Wx M.Wx L.Wx	8,190-8,300 8,300-9,470 9,470-(13,470)	8,245 8,885 11,470	35 196 505+	0 40 290+	16.8 15.6 11.1	223 235 276			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
20.	W. B. Osborn I-Fougereousse	5S-27E-4	11,265	261	U.Wx M.Wx L.Wx	8,245-8,690 8,690-9,900 9,900-(13,900)	8,468 9,295 11,900	258 158 389+	145 75 65+	16.4 14.9 10.3	212 226 301			
23.	Humble Oil & Refining I-C. T. Matthews	7S-24E-7	13,917	329	U.Wx M.Wx L.Wx	8,200-9,040 9,040-11,270 11,270-(16,270)	8,620 10,155 13,770	233 61 74+	175 0 0+	16.1 13.4 7.0	207 235 342			
24.	Magnolia Petroleum I-Sam Allen	6S-28E-4	9,305	215	L.CI U.Wx	8,170-8,970 8,970-(9,670)	8,570 9,320	0 140+	0 105+	16.2 14.9	206 217			
25.	Magnolia Petroleum Commerce Trust Co. #1	6S-27E-6	9,278	128	L.CI U.Wx	8,165-8,808 8,808-(9,458)	8,487 9,133	0 215+	0 125+	16.3 15.2	205 214			
26.	Magnolia Petroleum I-E. Suttle	6S-28E-3	9,214	182	L.CI U.Wx	8,165-8,840 8,840-9,540	8,503 9,190	0 110+	0 60+	16.3 15.1	205 220			
27C.	Magnolia Petroleum I-Simpson Heirs	6S-27E-9	15,000	361										
28.	Christie Mitchell & Mitchell 3-Granz (section B, no. 20)	7S-26E-1	10,017	256	L.CI U.Wx M.Wx	8,156-8,230 8,230-9,490 9,490-(12,990)	8,193 8,860 11,240	0 515 78+	0 405 55+	16.8 15.7 11.5	212 225 270	4,100 4,607 7,643	45 40 27	22.9 25.3 38.4
LIBERTY COUNTY														
1.	Amerada I-R. C. Brown (section 4, no. 17; ties C, no. 57)	1N-41E-7	10,255	210	Vk-Jk U.CI	8,087-8,550 8,550-(10,340)	8,319 9,445	0 142+	0 0+	23.3 21.8	187 200	4,492 5,195	130 52	17.0 23.8
2.	Anderson & Bowman I-Kovalcik (section C, no. 56)	1N-40E-7	9,320	201	Vk-Jk U.CI	8,088-8,110 8,110-(9,610)	8,099 8,860	0 101+	0 0+	23.6 22.6	184 197	4,050 4,341	97 86	18.0 19.7
3.	Cherryville Corp. I-Thelma Jackson	3N-41E-3	15,020	352	L.CI U.Wx M.Wx L.Wx	8,170-9,160 9,160-9,900 9,900-11,550 11,550-(17,850)	8,665 9,530 10,725 14,700	0 466 581 862+	0 295 260 440+	20.6 18.9 16.6 8.8	230 245 263 345			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
4.	General Crude 1-Brauer (section 3, no. 12; ties C, no. 58)	1N-42E-1	10,207	229	Vk-Jk	8,168-8,260	8,214	9	0	23.5	198	4,107	61	21.0
					U.CI	8,260-9,970	9,115	333	110	22.3	210	4,831	70	22.4
					L.CI	9,970-(14,970)	12,471	0+	0+	17.9	265	9,477	47	31.2
5.	General Crude D-1 Mooris Bluff	1S-41E-6	12,489	270	Vk-Jk	8,070-8,950	8,510	0	0	23.1	202			
					U.CI	8,950-10,600	9,775	270	35	21.4	225			
					L.CI	10,600-		0+	0+					
6.	Humble Oil & Refining 1-B B. E. Quinn (section 4, no. 14)	2N-40E-2	16,979	353	L.CI	8,144-9,370	8,757	0	0	20.4	217	4,816	60	23.6
					U.Wx	9,370-10,200	9,785	328	247	18.4	230	5,480	44	27.2
					M.Wx	10,200-12,430	11,315	319	33	15.4	248	6,336	32	32.1
					L.Wx	12,430-(19,630)	16,030	229+	70+	6.1	362	13,626		
7.	Lamar Hunt 1-Carr Dev. Co.	1N-43E-3	9,990	218	Vk-Jk	8,080-8,300	8,190	0	0	13.8	192			
					U.CI	8,300-9,740	9,020	276	0	22.3	205			
					L.CI	9,740-(14,740)	12,240	0+	0+	18.2	262			
8.	John W. Mecom 1-Lacy Armour	1S-42E-6	11,571		Vk-Jk	8,070-9,965	9,018	0	0	22.4	205			
					U.CI	9,965-(12,165)	11,065	212+	80+	19.7	240			
9.	John W. Mecom D-6 Merchant	2N-43E-7	13,748	310	Vk-Jk	8,090-8,500	8,295	0	0	23.4	197			
					U.CI	8,500-10,300	9,400	136	32	21.9	212			
					L.CI	10,300-13,550	11,925	10	0	18.6	240			
					U.Wx	13,550-		0+	0+					
10.	George Mitchell & Assoc. 1-H. R. Cherry (section 4, no. 12; ties B, no. 28)	3N-40E-3	14,108	332	L.CI	8,153-8,650	8,402	0	0	21.2	210	4,200	65	21.5
					U.Wx	8,650-9,450	9,050	265	234	19.9	220	4,706	55	23.9
					M.Wx	9,450-10,980	10,215	138	133	17.6	235	5,414	42	27.7
					L.Wx	10,980-(16,980)	13,980	424+	167+	10.2	321	9,646	28	52.6
11.	Peninsula Explor. 1-Creel (section 4, no. 16)	1N-41E-1	8,412	198	U.CI	8,098-(9,598)	8,848	22+	0+	22.6	195	4,114	70	20.3
12.	Shell Oil 1-Kirby Lumber Co. (section 4, no. 15)	2N-41E-5	17,255	334	U.CI	8,140-8,600	8,370	116	60	23.3	207	3,892	100	18.5
					L.CI	8,600-11,340	9,970	0	0	21.2	245	4,686	43	26.8
					U.Wx	11,340-12,600	11,970	357	228	18.5	285	6,105	35	35.6
					M.Wx	12,600-(16,600)	14,600	687+	340+	15.1	330	10,074	30	55.5

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
13.	Sun Oil 1-Stone (section 2, no. 15)	1N-45E-3	11,484	249	Vk-Jk U.CI L.CI	8,062-8,950 8,950-10,980 10,980-(16,180)	8,506 9,965 13,580	0 162 0+	0 81 0+	23.1 21.2 16.4	200 220 295	4,423 4,543 10,728	75 57 60	20.7 23.4 43.4
14.	Superior Oil 1-T. J. Hightower (section 4, no. 13)	3N-40E-9	15,687	354	L.CI U.Wx M.Wx L.Wx	8,120-9,450 9,450-10,350 10,350-11,400 11,400-(17,400)	8,785 9,900 10,875 14,400	0 412 399 864+	0 245 290 355+	20.4 18.2 16.3 9.4	225 242 262 325	4,380 5,150 5,980 11,088	59 45 36 28	23.3 27.5 32.4 57.3
15.	Anthony J. Tambarello 1-Williamson	2N-43E-2	9,199	205	U.CI L.CI	8,080-8,950 8,950-(11,950)	8,515 10,450	148 0+	50 0+	23.1 20.5	200 230			
16.	Texaco 1-Curtis Hankamer (section 2, no. 16)	1N-44E-7	12,631	233	Vk-Jk U.CI L.CI	8,065-9,410 9,410-11,530 11,530-(17,530)	8,738 10,470 14,530	0 33 0+	0 0 0+	22.8 20.5 15.2	190 220 290	4,544 5,549 11,333	130 90 75	17.1 22.7 41.1
17.	Texas Gas 1-Nona Mills (section 3, no. 11)	3N-42E-6	8,156	119	U.CI	8,058-(8,300)	8,179	53+	0+	23.5	198	4,090	78	22.4
18.	Pan American 1-Mabel Ott Howard	3N-40E-1	15,500	355	L.CI U.Wx M.Wx L.Wx	8,170-9,160 9,160-10,020 10,020-11,620 11,620-(17,720)	8,665 9,590 10,820 14,670	0 400 417 1,008+	0 220 140 420+	20.6 18.8 16.4 8.8	210 225 245 326			
19.	Floyd Rarsten 1-English	4N-42E-6	10,015		L.CI U.Wx M.Wx	8,080-8,830 8,830-9,570 9,570-(11,770)	8,455 9,200 10,670	0 397 271+	0 245 190+	21.1 19.6 16.7	200 211 236			
20.	Shell Oil 2-Bill Daniels	1S-43E-2	11,279	240	Vk-Jk U.CI	8,070-9,890 9,890-(11,790)	8,980 10,840	0 80+	0 65+	22.5 20.0	227 252			
21.	The Texas Company 1-Blanding	2N-42E-4	9,013	202	U.CI	8,050-(9,100)	8,575	262+	35+	23.0	202			
22.	Wesley West 1-C. K. Boyt	1S-44E-7	8,736	189	L.Fr	8,055-(9,855)	8,955	119+	45+	22.0	208			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
MATAGORDA COUNTY														
1.	American Petrofina 1-D. H. Braman (section 11, no. 21)	11S-33E-2	17,291	353	U.Fr L.Fr Vk-Jk	8,029-12,660 12,660-16,300 16,300-(24,000)	10,344 14,480 20,150	39 158 311+	0 152 245+	20.0 14.1 6.1	237 304 400	8,686 12,043	44 36	33.8 52.4
2.	BBM Drilling 1-Wiekow	8S-33E-7	11,625	224	U.Fr L.Fr	8,080-9,500 9,500-(13,400)	8,790 11,450	252 789+	90 380+	22.2 18.4	191 239			
3.	Bradco Oil & Gas 1-Elizabeth Burkhart et al. (section 10, no. 17)	8S-32E-7	10,957	234	L.Fr Vk-Jk	8,076-10,530 10,530-(14,930)	9,303 12,730	1,263 0+	772 0+	21.4 16.6	208 282	4,326 10,757	113 38	18.5 45.0
4.	George R. Brown 1-Jennie Grant (section D, no. 31)	10S-31E-2	11,255	232	U.Fr L.Fr	8,048-8,800 8,800-(11,300)	8,424 10,050	126 63+	52 0+	22.7 20.4	196 220	6,065 7,035	75 32	23.2 30.5
5.	E. Cockrell, Jr. 1-L. P. Neuszer (section D, no. 30)	10S-30E-8	13,524	275	U.Fr L.Fr Vk-Jk	8,040-8,930 8,930-11,410 11,410-(16,410)	8,485 10,170 13,910	95 37 0+	0 0 0+	22.6 20.2 14.9	192 218 310	3,946 6,712 10,850	45 16	21.4 31.5
6.	Continental Oil 1-W.W. Foundren, Jr. (section D, no. 33)	9S-32E-7	13,516	282	U.Fr L.Fr Vk-Jk	8,055-9,470 9,470-12,160 12,160-(16,460)	8,762 10,815 14,310	136 441 336+	30 128 298+	22.2 19.3 14.3	201 234 315	6,046 7,949 12,879	45 48 34	25.9 31.8 57.3
7.	Falcon Seaboard A-1 Baer Ranch	10S-34E-9	17,303	369	U.OI-Pl U.Fr L.Fr	8,015-8,280 8,280-13,735 13,735-(17,735)	8,148 11,008 15,735	0 44 549+	0 30 270+	23.1 19.0 12.4	197 241 344			
8.	Frazier & Ferguson 1-J. B. Pierce Estate	7S-33E-7	9,074	204	L.Fr	8,070-(10,570)	9,320	408+	320+	21.4	200			
9.	Holly Energy, Inc. 1-Hurlbutt (section 10, no. 16)	8S-31E-7	8,544	192	L.Fr	8,071-(9,020)	8,546	64+	0+	22.5	192	3,974	87	18.8

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
10.	Hunt Oil 1-Mehrens (section 11, no. 17)	9S-31E-4	10,501	218	L.Fr Vk-Jk	8,105-10,170 10,170-(13,670)	9,138 11,920	900 0+	600 0+	21.7 17.7	192	4,249	127	17.0
11.	Magnolia Petro. 1-W. W. Rugeley (section 11, no. 20)	10S-32E-7	15,565	326	U.Fr L.Fr Vk-Jk	8,036-11,150 11,150-14,250 14,250-(20,350)	9,593 12,700 17,300	0 0 0+	0 0 0+	21.0 16.6 10.1	225 277 351	8,250 11,938	60 24	30.0 48.8
12.	Manco Corp. 1-Kountze (section 11, no. 16)	9S-30E-1	9,002	224	L.Fr	8,080-(9,100)	8,590	562+	328+	22.4	218	3,994	110	18.6
13.	Mid-Century Oil & Gas 1-Florence A. Howard "A" (section 9, no. 17)	7S-34E-4	11,603	228	U.Fr L.Fr Vk-Jk	8,074-8,650 8,650-11,230 11,230-(16,230)	8,362 9,940 13,730	316 1,585 8+	233 1,046 0+	22.8 20.5 15.2	175 209 335	4,348 4,722 10,778	165 52 45	14.7 23.5 55.1
14.	Mobil Oil 15-Ethel Cornelius (section 10, no. 19)	9S-34E-9	16,500	356	U.Fr L.Fr Vk-Jk	8,046-11,050 11,050-14,000 14,000-(20,500)	9,548 12,525 17,250	147 121 305+	0 0 45+	21.1 16.4 8.0	228 280	6,588 10,450	117 150	22.6 28.3
15.	Monsanto Chemical 1-Buckeye (section 11, no. 19; ties D, no. 32)	10S-32E-3	16,923	353	U.Fr L.Fr Vk-Jk	8,054-9,340 9,340-11,790 11,790-(17,090)	8,697 10,565 14,440	101 347 0+	0 100 0+	22.3 19.7 13.5	205 245 309	4,046 7,928 14,791	83 50 36	19.8 32.7 59.0
16.	Pan American 1-T. J. Petruchka	10S-33E-4	14,994	335	U.Fr L.Fr Vk-Jk	8,020-11,000 11,000-14,340 14,340-(20,540)	9,510 12,670 17,440	44 109 0+	0 0 0+	21.2 16.7 10.0	210 283 367			
17.	Pan American 2-Sherill Gas Unit (section 10, no. 18; ties D, no. 34)	9S-33E-2	13,100	299	U.Fr L.Fr Vk-Jk	8,065-9,280 9,280-11,820 11,820-(17,120)	8,672 10,550 14,470	212 727 24+	40 330 0+	22.3 19.7 14.2	205 238 319	4,032 4,906 13,602	137 165 29	16.6 17.4 61.2
18.	Pan American 1-Silver Lake Ranch (section 12, no. 13)	11S-30E-6	16,000	346	U.Fr L.Fr Vk-Jk	8,021-8,890 8,890-11,820 11,820-(17,620)	8,456 10,355 14,720	0 0 167+	0 0 100+	22.6 20.0 13.9	203 220 325	5,835 8,390 13,000	86 70 47	22.4 28.7 57.5

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S \times 10^{-3}$	AVG CH_4
MCMULLEN COUNTY														
1.	Edwin L. Cox I-J. W. Atkinson	16S-12E-1	9,506	241	M.Wx	8,519-(9,519)	9,019	122+	72+	17.3	232			
2.	Russell Maguire I-Holland Ranch (section 19, no. 12)	15S-12E-3	7,596	217	Shallower than 8000 ft									
3.	Phillips Petroleum I-A Nueces Lease (section 19, no. 11)	15S-11E-4	24,220	405	L.Wx	8,283-8,310	8,296	0	0	14.2	220	4,148	10	26.4
4.	Standard of Texas I-J. T. Callihan (section 17, no. 7)	13S-14E-3	12,632	303	L.Wx	8,244-8,720	8,482	0	0	14.3	218	4,241	36	24.3
5.	Texam Oil I-Hays-Ezzell (section 18, no. 10; ties A, no. 5)	14S-14E-4	15,000	363	L.Wx	8,256-9,750	9,003	0	0	13.9	223	6,392	30	29.9
6.	W. Ridley Wheeler I-Rives Well (section 19, no. 13)	15S-12E-6	8,507	227	L.Wx	8,351-(9,951)	9,151	123+	105+	17.0				
MONTGOMERY COUNTY														
1.	Abercrombie I-Glenna Aylor	3N-39E-3	9,015	214	L.Cl U.Wx	8,180-8,670 8,670-(9,470)	8,425 9,070	0 93+	0 30+	18.7 17.6	196 214			
2.	Amerada I-H. A. Godejohn	3N-39E-6	13,440		L.Cl U.Wx M.Wx L.Wx	8,150-9,260 9,260-10,070 10,070-11,210 11,210-(17,610)	8,705 9,665 10,640 14,410	0 572 91 324+	0 355 35 270+	18.2 16.5 14.8 8.1	208 229 248 321			
3.	Caroline Hunt Sands I-San Jacinto Trust Co.	3N-38E-1	10,055	212	L.Cl U.Wx M.Wx	8,220-8,550 8,550-9,360 9,360-(10,860)	8,385 8,955 10,110	0 443 193+	0 295 0+	18.8 17.8 15.8	190 198 213			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S (x10^3)$	AVG CH_4
4.	Capitol Oil 1-Alliance Trust	4N-35E-7	11,022	251	M.Wx L.Wx	8,250-8,420 8,420-(12,520)	8,335 10,470	59 1,277+	35 460+	18.9 14.6	201 245			
5.	Humble 1-Grand Lake Gas Unit 1	3N-37E-9	11,800	267	L.Cl U.Wx M.Wx L.Wx	8,200-8,290 8,290-9,040 9,040-10,260 10,260-(15,860)	8,245 8,665 9,650 13,060	0 332 429 586+	0 65 125 355+	19.0 18.3 16.6 10.5	201 207 222 287			
6.	Mobil (Socony) 1-Bender Estate Farm	1N-38E-3	14,937	325	L.Cl U.Wx M.Wx L.Wx	8,130-9,970 9,970-10,790 10,790-12,350 12,350-(19,950)	9,050 10,380 11,570 16,150	3 454 416 35+	0 255 155 30+	17.8 15.3 13.2 5.2	213 232 257 356			
7.	Moran 1-J. C. Browder (section 4, no. 10)	4N-38E-4	12,909	263	M.Wx L.Wx	8,278-9,550 9,550-(14,050)	8,914 11,800	472 1,325+	187 873+	16.8 12.7	212 247	4,460 5,900	76 74	21.4 26.6
8.	Moran 1-M & M Minerals (section 5, no. 11)	2N-36E-5	16,525	358	L.Cl U.Wx M.Wx L.Wx	8,206-8,840 8,840-9,570 9,570-10,770 10,770-(16,870)	8,523 9,205 10,170 13,820	0 325 405 2,185+	0 160 145 1,148+	18.5 17.4 15.6 9.2	206 217 232 301	4,432 4,880 5,695 9,079	49 53 35 25	23.0 24.2 28.8 47.4
9.	Oil Reserves Corp. 1-Foster Estate	4N-37E-6	12,220	273	U.Wx M.Wx L.Wx	8,360-8,400 8,400-9,510 9,510-(14,010)	8,380 8,955 11,760	8 318 1,206+	0 115 740+	17.6 16.8 12.8	207 217 265			
10.	Phillips Petroleum 1-A Coke (section 5, no. 8)	5N-35E-7	16,762	360	L.Wx	8,248-11,750	9,999	1,856	1,449	15.3	236	5,000	135	19.4
11.	Samedan Oil 1-Coleman	2N-39E-1	11,252	262	L.Cl U.Wx M.Wx	8,040-9,470 9,470-10,390 10,390-(12,290)	8,755 9,930 11,340	0 306 190+	0 190 85+	18.1 16.1 13.6	220 240 253			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
12.	Sinclair Oil 1-McCrabb	1N-34E-1	10,999	252	L.CI U.Wx M.Wx	8,260-9,010 9,010-9,670 9,670-10,975	8,635 9,340 10,322	0 147 336	0 50 0	18.4 17.1 15.4	211 233 245			
13.	Sinclair Oil 1-Martin Estate	3N-35E-4	12,510	301	U.Wx M.Wx L.Wx	8,170-8,260 8,260-9,300 9,300-(13,800)	8,215 8,780 11,550	79 232 1,173+	52 49 790+	17.8 17.0 13.1	203 212 259			
14.	Socony-Mobil 1-Sealy-Smith Foundation	3N-36E-4	13,501	302	U.Wx M.Wx L.Wx	8,245-8,400 8,400-9,540 9,540-13,040	8,322 8,970 11,290	58 414 1,526	0 170 995	17.7 16.8 13.5	225 235 272			
15.	Standard of Texas 1-Dorothy Anderson et al.	2N-38E-5	15,004	352	L.CI U.Wx M.Wx L.Wx	8,140-9,800 9,800-10,635 10,635-12,600 12,600-(19,600)	8,970 10,218 11,618 16,100	10 539 161 23+	0 330 50 0+	17.8 15.6 13.1 5.1	220 250 285 355			
16.	Standard of Texas 1-M. A. Dean et al.	2N-35E-3	11,505	275	L.CI U.Wx M.Wx L.Wx	8,300-8,360 8,360-8,990 8,990-10,300 10,300-(15,350)	8,330 8,675 9,645 12,825	8 297 439 754+	0 170 200 500+	18.9 18.3 16.6 10.9	201 207 228 290			
17.	Standard of Texas 1-Ruel F. Sanders et al. #2	3N-34E-8	11,500	273	M.Wx L.Wx	8,300-9,480 9,480-(14,180)	8,890 11,830	499 1,272+	165 985+	17.9 12.7	215 271			
18.	Superior Oil 3-S. Tex. Dev. Co. (section 5, no. 10)	2N-36E-3	15,071		L.CI U.Wx M.Wx L.Wx	8,198-8,520 8,520-9,220 9,220-10,400 10,400-(15,900)	8,359 8,870 9,810 13,150	0 318 433 2,397+	0 231 130 1,360+	18.8 19.2 16.3 10.4	217 213 229 287	4,347 4,612 5,396 10,310	52 58 37 24	23.2 23.1 27.7 47.6
19.	Superior & Speed 1-Sykes (section 5, no. 9; ties A, no. 18)	4N-36E-6	13,061	293	M.Wx L.Wx	8,279-8,900 8,900-12,910	8,589 10,905	280 1,564	68 1,218	17.3 14.0	195 232	4,295 5,450	170 120	14.9 21.0
20.	Strake 1-Peel	4N-35E-9	8,566	238	M.Wx	8,175-(10,175)	9,175	116+	60+	16.5	220			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
21.	Humble Oil & Refining I-Baldwin	1N-37E-3	14,380	299	L.CI	8,150-9,350	8,750	0	0	18.2	200			
					U.Wx	9,350-10,025	9,688	423	242	16.5	210			
					M.Wx	10,025-11,200	10,612	304	150	14.9	240			
					L.Wx	11,200-(18,200)	14,700	774+	300+	7.6	320			
22.	Sinclair Oil I-Grogan-Cochran Lumber Co.	2N-37E-4	12,000	273	L.CI	8,175-9,175	8,675	0	0	18.3	198			
					U.Wx	9,175-9,950	9,562	488	420	16.7	211			
					M.Wx	9,950-11,040	10,495	368	210	15.1	233			
					L.Wx	11,040-(17,340)	14,190	236+	135+	8.5	316			
23.	Cities Service Oil Dan H. Mackley #1	4N-36E-9	11,502	247	M.Wx	8,193-8,700	8,446	205	70	17.0	203			
					L.Wx	8,700-(12,900)	10,800	1,705+	1,050+	14.0	245			
24.	D. D. Feldman Oil & Gas et al. Teas Nursery Co. #1	3N-36E-1	11,636	283	U.Wx	8,280-8,535	8,408	220	220	17.6	204			
					M.Wx	8,535-9,680	9,108	495	240	16.6	235			
					L.Wx	9,680-(14,380)	12,030	1,265	720+	12.4	275			
25.	Panuco Oil Leases Inc. & Michel T. Halbouty L. Brown et al. #1	2N-34E-6	9,586	231	U.Wx	8,310-8,730	8,520	330	290	18.6	205			
					M.Wx	8,730-(9,980)	9,355	705+	700+	17.1	224			
26.	Superior Oil Lake Creek Unit # 30	2N-36E-1	14,726	337	L.CI	8,200-8,560	8,380	15	0	18.8	220			
					U.Wx	8,560-9,245	8,902	510	335	17.9	228			
					M.Wx	9,245-10,420	9,832	520	245	16.2	278			
					L.Wx	10,420-(16,220)	13,320	2,210+	1,480+	10.1	300			
27.	Texaco I-B.D. Griffin	3N-38E-4	15,010	322	L.CI	8,310-8,845	8,578	0	0	18.5	205			
					U.Wx	8,845-9,710	9,278	545	470	17.2	221			
					M.Wx	9,710-10,980	10,345	765	575	15.3	243			
					L.Wx	10,980-(16,680)	13,830	2,990+	2,490+	9.2	310			
28.	Union Producing Foster Lumber Co. E-1	3N-39E-5	14,495	325	L.CI	8,070-9,060	8,565	0	0	18.5	224			
					U.Wx	9,060-9,860	9,460	360	220	16.9	238			
					M.Wx	9,860-11,160	10,510	330	220	15.0	255			
					L.Wx	11,160-(17,460)	14,310	720+	500+	8.3	331			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG $S(x10^3)$	AVG CH_4
NEWTON COUNTY														
1.	ARCO C-3 Kirby Lumber Co.	5N-51E-3	9,509	205	L.Cl U.Wx	8,059-9,150 9,150-(9,800)	8,604 9,475	0 90+	0 0+	20.8 19.0	202 218			
2.	ARCO & Sinclair 1-T&NO RR Fee Sec. 5	6N-51E-2	11,700	263	L.Cl U.Wx M.Wx L.Wx	8,115-8,275 8,275-8,900 8,900-10,690 10,690-(14,390)	8,195 8,588 9,795 12,540	0 305 400 280+	0 105 160 160+	18.8 17.8 15.0 10.2	199 201 225 287			
3.	Draper Goodall & Co., Inc. 1-D. A. Fomby	7N-51E-8	11,025	236	U.Wx M.Wx L.Wx	8,149-8,500 8,500-10,210 10,210-(13,610)	8,324 9,355 11,910	214 561 368+	70 230 245+	18.4 16.0 11.5	200 213 235			
4.	Humble Oil & Refining 13-E.C. Hankamer (section C, no. 65)	4N-50E-2	13,155	278	U.Cl L.Cl U.Wx	8,059-8,840 8,840-11,110 11,110-(13,210)	8,449 9,975 12,160	129 0 114+	0 0 80+	23.2 21.2 18.3	189 212 260	4,310 6,483 9,369	18 16 13	24.0 30.4 42.7
5.	Macpet & Prairie Prod. 1-C. R. Harrison	5N-50E-6/7	11,520	251	L.Cl U.Wx M.Wx	8,074-9,650 9,650-10,290 10,290-(12,990)	8,862 9,970 11,640	0 229 261+	0 60 40+	20.2 18.1 14.8	209 226 250			
6.	Pan American A-1 E. W. Brown, Jr.	8N-50E-5	14,111	336	L.Wx	8,300-9,360	8,830	301	80	18.2	240			
7.	Pure Oil 1-W. West	6N-50E-9	11,526	248	L.Cl U.Wx M.Wx L.Wx	8,020-8,680 8,680-9,420 9,420-11,260 11,260-(15,360)	8,350 9,050 10,340 13,310	0 563 561 11+	0 410 340 0+	21.3 19.9 17.3 11.5	201 208 219 305			
8.	Oil Reserves Corp. 6-Kirby Winfrey	7N-51E-6	11,174	253	U.Wx M.Wx L.Wx	8,190-8,295 8,295-10,000 10,000-(13,100)	8,242 9,147 11,550	43 505 463+	0 195 200+	18.6 17.6 12.3	200 212 265			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^{-3}$)	AVG CH ₄
9.	Humble Oil & Refining 1-W. W. Moore, Jr.	6N-52E-4/5	13,196	278	L.CI U.Wx M.Wx L.Wx	8,090-8,530 8,530-9,270 9,270-11,160 11,160-(15,110)	8,310 8,900 10,215 13,135	0 288 404 269+	0 0 175 70+	21.3 20.2 17.6 11.8	205 213 233 278			
NUECES COUNTY														
1.	ARCO & Tidewater 3-State Tract 45-47 Unit Tract 470	18S-23E-9	11,473	320	U.Fr L. Fr	8,020-11,810 11,810-(18,310)	9,915 15,060	969 0+	345 0+	17.1 9.6	225 328			
2.	Arkansas Fuel Oil 2-State Tract 75	18S-21E-1	10,022	316	L.Fr	8,060-(12,260)	10,160	640+	510+	16.8	235			
3.	Atlantic Refining 1-State Tract 36 (section 17, no. 19; ties D, no. 18)	18S-22E-8	14,503	331	U. Fr L. Fr	8,025-9,960 9,960-(15,460)	8,992 12,710	735 342+	425 95+	18.8 13.0	215 289	4,496 10,931	65 24	22.4 49.3
4.	Atlantic Refining 1-Jane S. Womack (section 18, no. 20)	19S-19E-6	10,000	268	L.Fr Vk-Jk	8,020-9,660 9,660-(15,560)	8,840 12,610	115 0+	60 0+	18.8 18.0	250	6,630	50	30.8
5.	Champlin Oil 99-G. P. Wardner	19S-17E-8	9,613	221	Vk-Jk	8,130-(10,530)	9,330	25+	0+	18.0	218			
6.	Champlin Oil 2-Bush Wofford "C" (section C, no. 23)	19S-17E-6	9,500	229	Vk-Jk	8,125-(10,625)	9,375	496+	333+	18.0	228	7,031	22	32.5
7.	Cherryville Corp. 1-Burton Dunn et al. (section 18, no. 23; ties D, no. 7)	20S-23E-3	15,045	344	U.Fr L. Fr	8,020-11,670 11,670-(14,470)	9,845 13,070	371 71	70 0	17.3 12.5	220 295	7,482 11,214	40 27	30.4 50.6
8.	Cities Service Oil 1-Boggan "A"	20S-19E-3	13,102	305	L.Fr Vk-Jk	8,070-10,620 10,620-(15,320)	9,345 12,970	187 20+	100 0+	18.0 12.6	227 303			
9.	Cities Service Oil 1-State Tract 773-L (section 18, no. 24)	19S-23E-7	14,500		U.Fr L. Fr	8,068-14,010 14,010-(22,510)	11,039 18,260	765 0+	170 0+	15.1 5.0	260	9,052	37	38.3

[illegible]

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
32.	Morgan & Geiser 73-1 Chapman Ranch	20S-20E-1	13,020	298	U.Fr L. Fr Vk-Jk	8,050-9,000 9,000-12,470 12,470-(18,470)	8,525 10,735 15,470	605 760 0+	595 370 0+	19.2 16.0 8.9	199 235			
33.	Atlantic Richfield 4-State Tract 470 Unit 45-47	19S-23E-3	11,473	228	U.Fr	8,020-(11,820)	9,920	965+	295+	17.2	220			
34.	Glasscock 2-Countiss	17S-19E-9	10,004	214	L.Fr Vk-Jk	8,035-8,850 8,850-(10,850)	8,442 9,850	450 0+	240 0+	19.4	187			
35.	Shell Oil 1-State Tract 346	18S-23E-6	16,608	357	U. Oil-Pl U. Fr L. Fr Vk-Jk	8,030-8,190 8,190-10,640 10,640-13,330 13,330-(21,230)	8,110 9,415 11,985 17,280	21 375 60 805+	0 60 0 515+	19.8 17.9 14.1 6.3	190 215 277 363			
36.	Arkansas Fuel Oil 1-State Tract 751	18S-22E-3	10,009	228	L.Fr	8,030-	,	935+	738+					
37.	Arkansas Fuel Oil 2-State Tract 751	18S-21E-1	10,022	216	L.Fr	8,060-(10,260)	9,160	670+	505+	18.3	203			
38.	Cities Service Petroleum 4-State Tract 9	18S-22E-1	8,501	209	U.Fr	8,020-(9,370)	8,695	255+	220+	19.0	211			
39.	Cities Service Oil & Sunray DX Oil 1-State Tract 51	19S-22E-1/2	13,500	310	U.Fr L. Fr	8,030-9,890 9,890-(16,890)	8,960 13,390	680 835+	410 195+	18.6 12.0	220 310			
40.	Cities Service Oil 2-State Tract 61	18S-22E-9	9,015	211	U.Fr	8,020-(9,320)	8,670	330+	238+	19.0	210			
41.	Magnolia Petr. 22-J. C. Baldwin	19S-20E-2	10,003	252	L.Fr	8,060-(10,460)	9,260	295+	275+	18.1	237			
42.	A. O. Morgan, D. H. Geiser, & Coastal States Gas Prod. Co., et al. 1-Chapman "C"	20S-21E-3	15,020	329	U.Fr L. Fr Vk-Jk	8,135-9,320 9,320-14,250 14,250-(20,550)	8,727 11,785 17,400	600 325 0+	460 188 0+	18.9 14.4 6.1	225 260 365			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
43.	Shell Oil 6-State Tract 349	18S-23E-6	9,002	212	U. Fr	8,020-(11,020)	9,520	65+	0+	17.8	222			
44.	Texaco 30-Chapman	19S-20E-7	12,798	295	L.Fr	8,040-(11,540)	9,790	1,420	955	17.4	230			
45C.	Jake L. Hamon 3-State Tract 8	18S-22E-1	14,629	330										
ORANGE COUNTY														
1.	Edwin Allday 1-George Henderson	2N-51E-9	11,330	253	U.Fr L. Fr Vk-Jk	8,020-8,740 8,740-11,100 11,100-(17,400)	8,380 9,920 14,250	168 102 0+	80 48 0+	23.3 19.6 9.3	195 220			
2.	Anderson & Bowman 1-Lutcher & Moore Lbr. Co. (section 1, no. 14)	1N-49E-2	10,817	211	L.Fr	8,030-(11,060)	9,545	644+	510+	20.5	194	4,963	45	23.6
3.	Gulf Oil 1-Miller Vidor Land Co. Unit 2	2N-48E-6	13,601	256	L.Fr Vk-Jk	8,040-8,370 8,370-(13,470)	8,205 10,920	0 5	0 0	23.8 17.2	195 225			
4.	J. W. Mecom 2-E. W. Brown (section 1, no. 15; ties D, no. 51)	1N-50E-7	9,057	248	U.Fr L. Fr Vk-Jk	8,022-9,920 9,920-12,390 12,390-(18,190)	8,971 11,155 15,290	147 37 0+	50 0 0+	21.9 16.7 6.8	203 225 263	4,486 7,809 12,691	55 41	22.4 31.4
5.	Midwest Oil 2-Starrs	2N-50E-9	10,082	212	L.Fr	8,030-(10,080)	9,055	231	175	21.7	198			
6.	Prairie Producing 1-Edgar Brown (section 1, no. 13)	2N-49E-4	8,515	193	L.Fr	8,045-(8,450)	8,248	89	50	23.6	190	4,124	115	17.4
7.	Phillips Petroleum 1-Boise "A"	1N-48E-1	10,060		L.Fr	8,030-(10,080)	9,055	277+	80+	21.7	205			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG $\bar{\rho}$	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
POLK COUNTY														
1.	American Liberty et al. 1-Cameron Heirs (section 3, no. 7)	8N-41E-1	12,702	263	Shallower than 8,000 ft.									
2.	Continental A-1-W.T. Carter & Bros.	5N-43E-8	10,622	219	U.Wx M.Wx	8,160-8,910 8,910-(10,510)	8,535 9,710	443 203	308 35	20.9 18.6	195 212			
3.	Continental B-1-Carter & Bros. (section 3, no. 10; ties B, no. 29)	5N-42E-5	12,290	301	M.Wx L.Wx	8,025-9,230 9,230-(14,230)	8,628 11,730	343 853+	75 430+		220 261			
5.	Justiss-Mears C-1 W. T. Carter & Bros.	6N-43E-2	11,204	264	M.Wx L.Wx	8,290-8,340 8,340-(11,440)	8,315 9,890	0 532+	0 80+	19.4 15.9	200 227			
6.	Oil Reserves Corp. 1-W. T. Carter & Bros.	5N-43E-8	11,031	254	U.Wx M.Wx L.Wx	8,200-8,950 8,950-10,450 10,450-(15,050)	8,575 9,700 12,750	432 396 36+	265 35 0+	20.8 18.6 12.6	195 213 275			
7.	Oil Reserves Corp. 3-Kirby-Stephenson	4N-43E-1	10,200	215	L.CI U.Wx M.Wx	8,160-8,200 8,200-8,750 8,750-(10,550)	8,180 8,475 9,650	0 557 275+	0 83 0+	21.5 21.0 18.7	190 197 210			
8.	Pan American A-1 Southland Paper Mill	7N-43E-3	13,577	346	L.Wx	8,400-(10,000)	9,200	742	450	17.4	212			
9.	Shell 1-Alexander (section 3, no. 8; ties A, no. 20)	7N-41E-6	15,197	357	L.Wx	8,270-9,980	9,125	621	480	17.6	222	4,562	57	23.6
10.	Shell Oil 1-Southland Paper Mill	7N-42E-6	14,500		L.Wx	8,350-(10,150)	9,250	782	310	17.3	225			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ϕ	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
11.	Tribal & Patrick 1-Camden (section 3, no. 9)	6N-42E-5	17,016	362	M.Wx L.Wx	8,299-8,960 8,960-12,770	8,630 10,865	287 935	139 670	18.7 13.8	210 246	4,142 5,432	110 150	18.5 19.5
12.	Ashland Oil 1-Wirt Davis	7N-41E-1	13,283	265	L.Wx	8,300-(9,800)	9,050	362	240	17.8	208			
13.	Wainoco 1-Carter Bros.	8N-43E-4	12,267	308	L.Wx	8,360-(9,160)	8,760	261	145	18.4	215			
14.	Woodley Petr. 1-J. H. Edmonds	5N-41E-2	8,535	211	L.Wx	8,140-(12,140)	10,140	173+	0+	15.4	230			
REFUGIO COUNTY														
1.	ARCO A-1 A. D. Rooke, et al. (section 16, no. 11; ties C, no. 31)	15S-22E-3	8,014	198	Shallower than 8,000 ft									
2.	Continental 1-F. O. Neumann (section 14, no. 14)	13S-25E-1	10,015	234	L.Fr Vk-Jk	8,050-9,550 9,550-(13,250)	8,800 11,400	0 0+	0 0+	22.6 16.2	227 298	4,796 9,120	100 27	21.1 46.6
3.	Harkins 1-A Rae Wood Welder (section C, no. 32)	14S-21E-1	6,016	170	Shallower than 8,000 ft.									
4.	Magnolia 1-J. W. Calloway (section D, no. 23)	14S-26E-3	10,015	216	U.Fr L. Fr	8,023-9,060 9,060-(11,170)	8,542 10,115	178 81+	55 0+	23.3 19.5	198 217	5,128 7,691	39 28	24.6 31.8
5.	Mana Oil 1-Mary S. Huff (section 15, no. 14; ties C, no. 33)	13S-22E-7	7,150	186	Shallower than 8,000 ft.									
6.	Sunray Mid-Continent 1-W. F. Hartman	15S-23E-8	9,009	208	L.Fr	8,035-(10,035)	9,035	226+	30+	22.2	208			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
7.	Texaco 2-K. D. Roche (section 16, no. 12)	15S-21E-6	8,809	210	Vk-Jk	8,063-(10,563)	9,313	0+	0+	21.3	222	5,588	77	23.9
8.	Union Producing A-1 O'Brien (section 15, no. 16)	14S-23E-4	8,725	191	L.Fr	8,057-(10,757)	9,407	134+	83+	21.1	205	7,000		
9.	Union C-1 Tatton Ranch	14S-25E-2	10,509	251	L.Fr Vk-Jk	8,130-10,300 10,300-(15,300)	9,215 12,800	189 0+	58 0+	21.8 13.2	233			
10.	Sam E. Wilson, Jr. F-22 Hynes (section 15, no. 15)	14S-23E-3	8,100	188	Shallower than 8,000 ft.									
11.	P. H. Welder 1-John L. Zarskey	13S-25E-7	9,223	209	L.Fr	8,140-(9,840)	8,990	34+	0+	22.3	210			
12.	Cox, et al. 1-Dammann	15S-22E-7	9,210	217	L.Fr Vk-Jk	8,040-9,110 9,110-(13,110)	8,575 11,110	234 9+	98 0+	23.3 17.2	208			
13.	Quintana A-114 O'Connor	14S-23E-1	8,990	220	L.Fr Vk-Jk	8,070-8,530 8,530-(11,430)	8,300 9,980	112 0+	30 0+	24.0 19.9	193 236			
14.	Morgan Minerals 1-To Wirt	13S-25E-1	9,017	207	L.Fr	8,050-(9,250)	8,650	196+	41+	23.1	201			
SAN JACINTO COUNTY														
1.	J. C. Barns 1-2 Johnson et al. (section 4, no. 9)	5N-38E-8	12,016	248	M.Wx L.Wx	8,400-9,050 9,050-(13,350)	8,725 11,200	187 1184+	35 663+	18.5 13.1	208 242	4,670 5,600	73 42	21.8 28.8

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S (x10^3)$	AVG CH_4
2.	Continental 1-Frost	4N-41E-1	13,070	258	L.CI U.Wx M.Wx L.Wx	8,080-8,260 8,260-9,020 9,020-10,540 10,540-(15,640)	8,170 8,640 9,780 13,090	23 462 384 979+	0 280 130 605+	21.6 20.7 18.4 11.9	193 198 207 279			
3.	Humble Oil & Refining 1-Ben Ogeltree	7N-39E-9	15,495	346	L.Wx	8,260-10,260	9,260	704	380	17.3	225			
4.	King & DeLange 1-Langham G.U.	5N-40E-6	10,520	272	M.Wx L.Wx	8,190-9,510 9,510-(14,010)	8,850 11,760	532 447+	97 215+	18.2 11.9	200 264			
5.	Reserve Oil & Gas 1-Polk	5N-39E-9	11,019	253	U.Wx M.Wx L.Wx	8,320-8,355 8,355-9,860 9,860-(14,260)	8,338 9,108 12,060	0 515 413+	0 138 140+	19.3 17.6 11.2	210 222 273			
6.	Shell Oil 11-Central Coal & Coke (section 4, no. 11)	4N-39E-8	14,006		L.CI U.Wx M.Wx L.Wx	8,179-8,330 8,330-9,140 9,140-10,420 10,420-(15,920)	8,225 8,735 9,780 13,170	0 415 273 971+	0 242 0 513+	21.4 20.5 18.4 11.8	205 215 231 290	4,127 4,455 5,086 8,692	67 60 47 27	21.0 22.7 26.2 44.1
8.	Stanolind 1-Caret, Land Dev. Co.	6N-39E-4	11,020	246	L.Wx	8,300-(11,400)	9,850	1142+	740+	16.0	218			
9.	Stanolind 1-Falvey	4N-41E-1	9,758		L.CI U.Wx M.Wx	8,120-8,170 8,170-9,000 9,000-(10,500)	8,145 8,585 9,750	0 495 234+	0 145 0+	21.7 20.8 18.5	198 207 210			
10.	Fuller & Assoc. 1-Foster Lbr. Co.	4N-40E-5	9,778	227	L.CI U.Wx M.Wx	8,190-8,370 8,370-9,150 9,150-(10,650)	8,280 8,760 9,900	0 365 207+	0 80 45+	21.4 20.4 18.2	194 199 218			
11.	Cities Service Oil 1-Melvin Unit	5N-38E-8	11,693	249	M.Wx L.Wx	8,430-9,410 9,410-(13,710)	8,920 11,560	344 1,252+	135 655+	18.1 12.3	207 246			
12.	H. L. Hunt 1-Foster Estate	6N-39E-8	11,020	229	L.Wx	8,280-(11,780)	10,030	987+	335+	15.6	218			
13.	Pan American 2-Emily Langham "B"	5N-41E-4	10,194	225	M.Wx L.Wx	8,110-8,990 8,990-(13,290)	8,550 11,140	823 1,092+	0 103+	18.9 13.2	196 249			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
14.	Amerada Petr. 1-Central Coal & Coke	4N-39E-7	10,000	222	L.Cl U.Wx M.Wx	8,110-8,350 8,350-9,170 9,170-(10,670)	8,230 8,760 9,920	240 820 830+	0 470 265+	21.5 20.4 18.2	197 204 220			
15.	Cities Service Oil 1-B Browder	5N-38E-5	11,452	231	M.Wx L.Wx	8,270-8,830 8,830-(12,630)	8,550 10,730	560 2,620+	112 1,120+	18.9 14.1	227 263			
SAN PATRICIO COUNTY														
1.	Getty Oil et al. 1-Wikerson (section 17, no. 17)	17S-21E-3	10,509	242	L.Fr	8,070-(10,570)	9,320	210+	60+	18.1	225	7,269	55	29.0
2.	Tom Graham 1-R Morgan (section 17, no. 15; ties C, no. 28)	16S-19E-6	6,533		Shallower than 8,000 ft.									
3.	Jake L. Hamon 3-J. H. Harvey	17S-22E-1	12,472	291	U.Fr L.Fr Vk-Jk	8,050-8,530 8,530-11,335 11,335-(16,635)	8,290 9,930 13,985	230 43 0+	188 0 0+	19.6 17.1 11.1	205 233 308			
4.	McCulloch-I.D.S. 1-Boehm, et al. (section 16, no. 13)	16S-22E-5	11,000	253	L.Fr Vk-Jk	8,046-9,570 9,570-(13,820)	8,808 11,695	145 0+	55 0+	18.8 14.5	227 268	4,096 9,473	97 1	20.0 46.4
5.	Midland Prod. 1-Hunt (section C, no. 29)	16S-20E-3	6,318	185	Shallower than 8,000 ft.									
6.	Mobil 1-Agnes Bren (section 16, no. 14)	16S-22E-7	11,020	244	L.Fr Vk-Jk	8,031-10,950 10,950-(16,150)	9,490 13,550	258 0+	180 0+	17.8 11.8	225 306	6,738	70	26.7
8.	Southern Minerals 1-Mary H. Griffith	17S-20E-8	10,008	231	L.Fr	8,070-(10,220)	9,145	1,218+	825+	18.3	219			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
9.	Tenneco 1-W.G. McCampbell (section 16, no. 15; ties D, no. 19)	17S-23E-5	14,037	322	U.Fr L.Fr	8,022-9,550 9,550-(14,200)	8,786 11,875	330 275+	310 195+	18.8 14.3	212 263	5,447 7,362	101 11	21.2 39.1
10.	Transcontinental Prod. 2-Ewing (section 17, no. 16)	16S-20E-7	9,943	207	L.Fr	8,078-(10,088)	9,083	480+	110+	18.4	200	5,431	64	23.3
11.	Union of California 1-Stanley Fry (section 17, no. 14)	15S-18E-7/8	14,500	377	correlations unknown									
12.	Skelly Oil 1-F. J. Smith (section c, no. 27)	17S-19E-5	7,753	202	Shallower than 8,000 ft.									
13.	Superior Oil 26-Welder	16S-21E-5	8,998	243	L.Fr Vk-Jk	8,050-8,425 8,425-(11,325)	8,238 9,875	295 88+	135 0+	19.6 17.2	204 226			
14.	Amerada Petr. 1-Stalcup	16S-19E-1	19,399	410	Vk-Jk	8,130-		0+	0+					
15.	Conroe Drilling & Feldman O & G 1-W. E. Hunt	17S-22E-9	10,608	223	L.Fr	8,040-(11,240)	9,640	1,030+	540+	17.6	220			
16.	Conroe Drilling et al. 2-Bankers Mortgage	17S-23E-2	9,008	200	U.Fr	8,030-(9,430)	8,730	205+	36+	18.9	213			
17.	Conroe Drilling et al. 1-A. J. Wheeler	17S-23E-9	8,727	204	U.Fr	8,030-(9,530)	8,780	380+	218+	18.8	214			
18.	Seaboard Oil of Delaware 1-Elliott	17S-20E-2	8,814	211	L.Fr	8,095-(10,095)	9,095	220+	105+	18.4	215			
19C.	Conroe Drilling et al. 1-B. L. Chandler	17S-23E-2	9,012	205										
STARR COUNTY														
1.	Austral & Tidewater 1-J. V. Sanchez (section 23, no. 5; ties B, no. 1)	28S-9E-4	13,116	363	U.Wx	8,371-(14,371)	11,371	0+	0+	12.8	293	10,643	63	42.4

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
2.	Continental Oil 25-M. M. Garcia "D" (section 23, no. 7)	29S-11E-1	8,600	235	Vk-Jk	8,354-(12,854)	10,604	0+	0+	11.9	270	7,529	16	39.8
3.	Forest Oil 4-Coates Ranch (section 23, no. 6)	28S-10E-1	9,899	283	L.CI	8,447-(10,047)	9,247	0+	0+	16.4	272	7,721	91	30.5
4.	Humble Oil & Refining 1-Humble Martinez Fee	28S-8E-2	13,495		U.Wx	8,510-(13,070)	10,790	360	168	11.2	293			
5.	Humble Oil & Refining 1-D. Olivarez (section 22, no. 19)	27S-13E-1	8,239	131	Shallower than 8,000 ft.									
6.	Shell Oil 1-Heard Heirs	28S-13E-4	11,240	293	Vk-Jk	8,365-(13,865)	11,115	932+	542+	11.1	275			
7.	Shell Oil 1-H. W. Lehman	29S-10E-9	17,004	438	U.Wx	8,210-		34+	0+		270			
8.	Texas O & G 2-Diaz (section 24, no. 1)	30S-12E-5	6,500		Shallower than 8,000 ft.									
9.	Arkansas Fuel Oil 1-La Brisa	29S-12E-4	9,057	254	Vk-Jk	8,390-(13,190)	10,790	0+	0+	11.6	290			
10.	Neuhaus 1-Unit I	28S-12E-7	9,557	199	Vk-Jk	8,380-(13,580)	10,980	0+	0+	13.3	297			
11.	Champlin Oil & Refining 4-B Arcadio Guerra	27S-13E-7	10,846	293	Vk-Jk	8,270-(14,070)	11,170	1,140+	708+	11.0	300			
12.	Continental Oil A-122 T. B. Slick	29S-12E-3	9,008	234	Vk-Jk	8,455-(13,155)	10,805	0+	0+	11.6	291			
13.	The Texas Company 5-Martinez-State	28S-12E-1/6	9,515	241	Vk-Jk	8,430-(13,040)	10,735	Data	No Good	11.7	268			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S_{(x10^{-3})}$	AVG CH_4
TYLER COUNTY														
1.	Am. Republics Houston I-Sutton	6N-46E-6	11,000	234	M.Wx L.Wx	8,160-9,410 9,410-(12,810)	8,785 11,110	409 489+	84 0+	18.4 13.3	195 235			
2.	Basin Petroleum I-Kirby-Wurts	5N-46E-4	10,015	240	L.Cl U.Wx M.Wx	8,095-8,570 8,570-9,440 9,440-(11,140)	8,332 9,005 10,290	0 338 108+	0 97 37+	21.3 20.0 17.4	212 224 245			
3.	Davidson, et al. I-Herbert Neyland, et al. (section 1, no. 6; ties A, no. 23)	8N-46E-5	12,020	273	L.Wx	8,364-9,090	8,727	175	118	18.5	195	9,189	61	21.0
4.	Grubb-Hawkins I-Kirby Lbr. (section 1, no. 7; ties B, no. 31)	6N-47E-6	7,512	205	Shallower than 8,000 ft									
5.	Gulf Oil I-Carter-Camden (section 2, no. 11)	6N-44E-5	16,000	356	M.Wx L.Wx	8,291-9,010 9,010-(12,510)	8,651 10,760	315 1,163	148 645	18.6 14.0	191 217	4,326 5,380	78 55	19.9 25.1
6.	Justiss-Mears I-Rice	5N-47E-2	12,519	275	U.Wx M.Wx L.Wx	8,140-8,810 8,810-10,600 10,600-(14,700)	8,475 9,705 12,650	459 288 239+	326 70 63+	21.0 18.6 12.8	182 195 226			
7.	Justiss-Mears B-I W. T. Carter & Bros. (section 2, no. 10; ties A, no. 21)	7N-44E-4	10,259	237	L.Wx	8,442-(10,442)	9,442	662+	305+	16.9	223	4,437	210	13.9
8.	Justiss-Mears D-I W. T. Carter & Bros. (section 2, no. 9)	8N-44E-8	9,311	229	L.Wx	8,317-(9,530)	8,924	325+	172+	18.1	221	4,462	45	24.3
9.	Humble Oil & Refining I-E. Texas Oil Co.	6N-46E-7	9,491	219	M.Wx	8,180-(9,480)	8,830	300	98	18.2	206			
10.	Humble Oil & Refining F-I E. Texas Oil Co.	5N-45E-6	10,604	231	L.Cl U.Wx M.Wx	8,130-8,390 8,390-9,130 9,130-(10,830)	8,260 8,760 9,980	0 212 114+	0 30 0+	21.4 20.4 18.1	202 201 208			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
11.	Nebo Oil 1-Ethyl Sawyer	6N-45E-5	9,512	211	M.Wx L.Wx	8,210-9,160 9,160-(12,660)	8,685 10,910	157 148+	75 37+	18.6 13.7	205 242			
12.	Pan American 1-Long Bell (section A, no. 22)	7N-46E-3	14,505	336	L.Wx	8,269-10,000	9,133	577	4,567	95	24.2			
13.	Shell 1-Kirby Lbr. Co. 104A, Well 1	5N-45E-9	11,699	271	L.CI U.Wx M.Wx L.Wx	8,150-8,390 8,390-9,190 9,190-11,210 11,210-(16,010)	8,270 8,790 10,200 13,610	0 443 316 0+	0 220 40 0+	21.4 20.4 17.6	192 200 220 315			
14.	Shell 1-Kirby Lbr. Corp. Tract 165-A	5N-45E-9	10,502	224	L.CI U.Wx M.Wx	8,160-8,390 8,390-9,170 9,170-(10,870)	8,275 8,780 10,020	0 344 220+	0 40 77+	21.4 20.4 18.0	197 206 222			
15.	Shell 1-Kirby Lbr. A352 (section 2, no. 12; ties B, no. 30)	5N-44E-6	12,800	311	L.CI U.Wx M.Wx L.Wx	8,156-8,300 8,300-9,040 9,040-11,000 11,000-(16,000)	8,228 8,670 10,020 13,500	32 587 337 26+	30 265 200 0+	21.5 20.6 18.0 11.1	195 201 222 327	4,114 4,335 5,010 9,600	47 41 36 20	21.8 23.6 26.3 55.7
16.	Superior & Cullen 1-L.S. Kirby Estate (section 2, no. 8)	8N-43E-1	11,606	225	L.Wx	8,226-8,330	8,278	0	0	19.5	216	4,139	95	19.7
17.	Tesoro Petroleum 1-E. Bryant	8N-45E-9	13,020	309	L.Wx	8,270-9,670	8,970	397	300	18.0	210			
18.	Wolf Exploration 1-Atlantic Sinclair Fee (section 1, no. 8)	6N-47E-7	10,010	242	U.Wx M.Wx	8,155-8,690 8,690-(10,190)	8,422 9,440	245 241+	140 0+	21.1 18.9	212 232	4,211 4,873	50 60	22.8 24.7
19.	Justiss-Mears A-1 W. T. Carter & Bros.	7N-44E-3	9,778	236	L.Wx	8,440-(9,940)	9,190	374+	125+	17.5	212			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
11.	H. H. Howell, et al. 1-Aron Kolle (section 13, no. 11)	9S-26E-9	5,879	162	Shallower than 8,000 ft									
12.	H. L. "Ike" Poole 1-L. V. Small et al. (section C, no. 37)	10S-25E-7	5,833	166	Shallower than 8,000 ft.									
13.	Ross 1-McCormick	9S-24E-5	9,191	231	L.Cl U.Wx	8,140-8,970 8,970-(9,970)	8,555 9,470	0 41+	0 0+	17.5 15.7	204 222			
14.	Sun 1-Urban	10S-24E-4	17,474	398	L.Cl U.Wx M.Wx L.Wx	8,135-12,080 12,080-13,240 13,240-14,380 14,380-(15,880)	10,108 12,660 13,810 15,130	0 15 53 10	0 0 0 0	14.4 9.3 7.0 5.0	258 328 348 366			
15.	Arnold O. Morgan A-4 R. H. Welder	9S-24E-2	8,912	215	L.Cl U.Wx	8,213-8,540 8,540-(9,340)	8,358 8,940	0 175+	0 135+	17.9 16.8	201 211			
16C.	A. O. Morgan 1-Murphy	9S-23E-6	9,018	220										
17.	Mrs. J. H. Dougherty 1-Witt Murphy (section B, no. 17)	9S-23E-6	9,220	259	U.Wx	8,400-(9,560)	8,980	15+	0+		255			
WALKER COUNTY														
1.	Marr & Moran 3-Gibbs Bros. (section 4, no. 7; ties A, no. 19)	6N-37E-5	15,402	337	L.Wx	8,385-10,940	9,663	1,090	528	15.8	227	4,830	12	28.6
2.	Moran Corp. 2-Central Coal & Coke	5N-36E-5	12,020	246	L.Wx	8,310-(11,510)	9,910	1,460+	520+	15.4	240			
3.	Moran 1-Gibbs (section 5, no. 7)	6N-36E-3	12,492	287	L.Wx	8,333-8,390	8,361	0	0	17.6	197	3,888	52	21.1
4.	Placid Oil 2-Gibbs Bros. (section 4, no. 8)	6N-38E-9	18,167	367	L.Wx	8,389-11,480	9,935	1,291	749	15.4	213	4,967	30	26.1

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
5.	Tidewater 1-A. D. Newman Unit (section 4, no. 6)	7N-38E-3	13,800	292	L.Wx	8,196-8,720	8,458	60	48	17.5	226	4,570	69	22.9
WALLER COUNTY														
1.	Exxon W-45 K.G.F. U.2	2S-33E-1	11,200	293	L.CI U.Wx M.Wx	8,190-10,300 10,300-11,100 11,100-(12,600)	9,245 10,700 11,850	0 254 52+	0 45 40+	17.3 14.7 12.7	235 278 290			
2.	Exxon 1-A.D. Parker (section 7, no. 8)	2S-33E-7	8,175	216	L.CI	8,159-(8,201)	8,180	0+	0+	19.2	212	4,090	54	22.2
3.	Michel T. Halbouty 1-J.W. Harris, et al. (section 7, no. 6; ties B, no. 25)	1S-33E-8	13,525	327	L.CI U.Wx M.Wx L.Wx	8,211-10,480 10,480-11,120 11,120-12,790 12,790-(20,290)	9,346 10,800 11,955 16,540	0 225 215 430+	0 65 30 305+	17.1 14.5 12.5 5.0	221 245 280 377	4,860 7,020 8,389 14,059	36 30 26	26.0 33.4 41.8
4.	Hana Oil & Associated Oil 1-J. H. Smith	2N-33E-4	11,016	273	M.Wx L.Wx	8,350-9,520 9,520-(14,020)	8,935 11,770	440 913+	245 575+	16.8 12.8	233 288			
5.	Humble Oil & Refng. Co. 1-W. Katy Gas Field Unit 31 (section 7, no. 7)	2S-33E-6	19,000		L.CI U.Wx M.Wx L.Wx	8,186-9,960 9,960-10,730 10,730-12,420 12,420-(20,920)		22+ 162 111 1,893+	0+ 122 0 520+					
6.	Humble 1-T. E. Sparks	1S-33E-6	11,183	295	L.CI U.Wx M.Wx	8,195-10,550 10,550-11,180 11,180-(11,980)	9,372 10,865 11,580	0 198 0	0 70 0	17.1 14.4 13.1	245 285 287			
7.	Miami Oil Prod. 1-Rowan (section 7, no. 5)	1N-31E-1	11,600	264	M.Wx L.Wx	8,235-9,150 9,150-(14,050)	8,693 11,600	281 1,682+	100 1,175+	17.2 13.0	217 265	4,340 5,530	38 48	24.33 30.2

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
8.	Mound Lbr. I-J. H. England. (section 8, no. 9)	3S-33E-3	16,020	319	U.CI L.CI U.Wx M.Wx L.Wx	8,136-8,300 8,300-11,050 11,050-11,740 11,740-(13,450) (13,450)-(21,950)	8,218 9,675 11,395 12,595 17,700	41 0 260 146 732	35 0 85 30 680+		255 292 393			
9.	Shell I-G.A. Chapman (section 7, no. 4; ties A, no. 16)	2N-32E-4	20,800	429	M.Wx L.Wx	8,254-8,650 8,650-(12,740)	8,452 10,695	129 1,907	0 1,290	17.5 14.3	212 255	4,226 5,347	82 80	20.5 25.6
10.	Texas Co. I-Walter D. Caldwell	2N-31E-7	11,012	268	M.Wx L.Wx	8,171-8,950 8,950-(13,250)	8,560 11,100	130 659+	60 365+	17.3 13.7	220 335			
11.	Texas Co. I-Rice Institute (section 6, no. 7)	2N-34E-4	12,047		U.Wx M.Wx L.Wx	8,249-8,550 8,550-9,800 9,800-(14,800)	8,400 9,175 12,300	187 439 1,390+	100 200 1,075+	18.8 17.4 11.9	208 223 295	4,200 4,586 6,150	68 72 84	21.2 22.5 30.7
12.	Humble 17-B Rufus Hardy "B"	1S-32E-3	11,000	245	U.Wx M.Wx L.Wx	8,160-8,210 8,210-8,880 8,880-(15,080)	8,185 8,545 11,980	17 103 1,409+	0 0 833+	19.2 18.0 12.4	217 224 293			
13.	Pel-Tex Co., Inc. I-J. W. Harris	1S-33E-8	11,055	251	L.CI U.Wx	8,220-10,540 10,540-(11,040)	9,380 10,790	0 227	0 142	17.0 14.5	230 265			
WASHINGTON COUNTY														
1.	Gulf Coast Leaseholds, Inc. I-G. W. Tate (section 7, no. 3)	3N-31E-2	9,800	230	L.Wx	8,308-(9,970)	9,139	713+	585+	16.5	220	4,570	76	22.0
2.	Magnolia Petr. I-Giddings Est. (section 8, no. 5; ties A, no. 15)	1N-30E-1	10,500	231	M.Wx L.Wx	8,285-8,650 8,650-(12,650)	8,468 10,650	98 908+	0 520+	17.5 14.4	196 250	4,234 5,320	66 54	20.8 27.7
3.	Pan American I-Woodrow Free	2N-29E-6	18,228		L.Wx	8,310-11,400	9,855	1,098	808	15.5	223			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG Ø	AVG T	AVG P	AVG S (x10 ³)	AVG CH ₄
4.	Speed I-Makowsky (section 9, no. 7)	2N-28E-9	5,505			Shallower than 8,000 ft.								
5.	Tex Harvey Oil Co. I-Fred W. Dallas	2N-29E-1	9,424	221	L.Wx	8,350-(10,950)	9,650	679+	355+	15.8	230			
6.	Union Sulphur I-Joe Kubecza (section 8, no. 4)	2N-30E-6	10,963	263	L.Wx	8,291-		1,605+	1,040+					
7.	Bradco I-Liddell	1N-31E-2	12,856	313	M.Wx L.Wx	8,270-8,750 8,750-(13,150)	8,510 10,950	157 1,829+	65 1,320+	17.4 14.0	224 265			
8.	H.A. Potter et al. I-H.F. Shroeder (section 8, no. 3)	3N-29E-6	14,251	371	L.Wx	8,346-9,540	8,943	216	100	16.8	239	4,520	84	22.5

WEBB COUNTY

1.	Atlantic Refining I-A Billings (section 21, no. 12)	19S-10E-9	10,500	263	U.Wx M.Wx	8,610-9,490 9,490-(10,490)	9,050 9,990	460 125	232 0	13.9 12.5	240 255	5,159 5,794	75 82	24.6 26.3
2.	Atlantic Refining I-Puig Gas Unit (section 22, no. 13)	22S-9E-3	11,500	301	U.Wx	8,903-(12,903)	10,903	208+	35+	11.1	288	7,960	23	42.6
3.	Brown, Del Mar & Dennis I-Laurel Heirs	21S-9E-5	10,016	314	U.Wx	8,860-(11,860)	10,360	154+	70+	11.9	272			
4.	General Crude 2-A Adami (section 20, no. 13; ties A, no. 3)	16S-10E-9	7,700	208		Shallower than 8,000 ft.								
5.	Good Hope Refining & Medallion Oil I-Bruni Mineral Trust (section 22, no. 10)	21S-7E-6	10,700	274	M.Wx L.Wx	8,515-(9,515) (9,515)-	9,015	0+	0+	13.9	215	4,508	65	22.4
6.	Jake L. Hamon et al. I-Amado Perez et al. (section 21, no. 13)	20S-10E-5/8	12,500	363	U.Wx	8,792-(12,592)	10,692	190+	30+	11.4	290	8,539	47	40.4

1. Acco Oil & Gas 1-J. K. Allen (section 11, no. 14)	8S-29E-1	6,543	167	Shallower than 8,000 ft.
--	----------	-------	-----	--------------------------

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG $S(x10^3)$	AVG CH_4
2.	Acco Oil & Gas 1-Schmidt (section 11, no. 12)	7S-28E-2	4,960	145	Shallower than 8,000 ft.									
3.	Getty Oil 1-Esther Beard (section 9, no. 14)	5S-32E-3	15,038	375	U.CI	8,136-8,570	8,353	0	0		201	3,341	90	17.8
					L.CI	8,570-10,610	9,590	0	0		223	5,179	54	25.2
					U.Wx	10,610-11,490	11,050	44	44		263	7,956	34	37.1
					M.Wx	11,490-14,150	12,820	375	31		310	10,897	34	51.8
					L.Wx	14,150-(24,150)	19,150	619+	220+		377	17,235	20	95.8
4.	Getty Oil 1-W. C. Leveridge (section 9, no. 13)	4S-31E-7	16,594	376	U.CI	8,135-8,480	8,307	0	0		196	3,489	54	20.1
					L.CI	8,480-10,300	9,390	0	0		217	4,977	65	23.5
					U.Wx	10,300-11,250	10,775	23	0		251	7,543	38	34.2
					M.Wx	11,250-13,550	12,400	158	0		292	10,292	30	47.4
					L.Wx	13,550-(21,350)	17,450	614+	163+		385	13,088	30	83.0
5.	Claud B. Hamill & Sunray DX Oil Co. 1-J. P. Henderson	6S-28E-6	10,512	257	L.CI	8,150-9,840	8,995	0	0		225			
					U.Wx	9,840-(10,740)	10,290	422+	195+		253			
6.	Humble Oil & Refining 1-Armit Thomas et al.	4S-31E-4	10,004	230	L.CI	8,170-9,520	8,845	0	0		212			
					U.Wx	9,520-(10,220)	9,870	117+	0+		230			
7.	Hunt Oil 1-H. O. Halamicek (section 10, no. 14; ties C, no. 44)	7S-31E-4	6,403	154	Shallower than 8,000 ft									
8.	McDonnald Oil 1-Dortek (section 10, no. 13)	6S-30E-7	6,299	166	Shallower than 8,000 ft									
9.	Magnolia Petr. 1-C. R. Reynolds (section 10, no. 11)	5S-30E-8	14,947	350	L.CI	8,143-10,140	9,142	0	0		210	4,480	71	21.7
					U.Wx	10,140-11,250	10,695	0	0		240	7,433	39	32.6
					M.Wx	11,250-13,850	12,550	0	0		292	10,479	32	47.4
					L.Wx	13,850-(23,850)	18,850	21+	0+		403			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
10.	Russell Maguire 2-Ilse Miller (section 10, no. 12)	6S-30E-1/2	11,220	308	U.CI L.CI U.Wx	8,151-8,350 8,350-10,740 10,740-(12,240)	8,251 9,545 11,490	0 0 250+	0 0 250+		245 272	3,300 5,059	92 60	19.5 28.5
11.	Ben D. Marks 1-Kountze & Stewart (section 11, no. 15)	8S-30E-4	7,250	180	Shallower than 8,000 ft									
12.	F. S. Pratt 1-Fleer (section 10, no. 15)	7S-31E-8	7,370	172	Shallower than 8,000 ft.									
13.	Lloyd M. Smith 1-Rufus Johnson (section C, no. 43)	7S-30E-2	6,005	184	Shallower than 8,000 ft									
14.	Standard of Texas 1-Meriwether	5S-31E-7	17,002	390	U.CI L.CI U.Wx M.Wx L.Wx	8,115-8,970 8,970-11,910 11,910-13,020 13,020-15,820 15,820-(25,000)	8,542 10,440 12,465 14,420 20,410	0 0 77 218 0+	0 0 45 45 0+		208 257 317 340			
15.	Sun Oil 1-Hawes (section 11, no. 13; ties C, no. 42)	7S-29E-9	6,134	162	Shallower than 8,000 ft									
16.	Sunray DX Oil 1-Maude Wallace	6S-29E-4	11,900	298	L.CI U.Wx M.Wx	8,150-9,970 9,970-10,920 10,920-(13,820)	9,060 10,445 12,370	0 78 142+	0 50 0+		216 241 295			
17.	Texas Gulf Sulphur 1-Bassett (section 9, no. 16)	6S-33E-7	9,943	196	L.Fr Vk-Jk	8,100-9,420 9,420-(12,020)	8,760 10,720	669 530+	455 0+	22.2 19.4	183 253	4,993 5,896	83 38	20.3 30.9
18.	The Texas Company 1-J.F.D. Moore (section 9, no. 15; ties C, no. 45)	6S-33E-2	11,467	255	Correlations unknown									

WILLACY COUNTY

1.	Humble Oil & Refining 1-Sauz Ranch-Jardin	28S-20E-3	12,289	293	U.Fr	8,190-(13,090)	10,640	1,607+	583+	11.8	223			
----	--	-----------	--------	-----	------	----------------	--------	--------	------	------	-----	--	--	--

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG ₃ S (x10 ³)	AVG CH ₄
2.	Humble Oil & Refining 2-Sauz Ranch Nopal (section 22, no. 29)	29S-21E-9	11,986	231	U.OI-PI U.Fr	8,120-9,340 9,340-(16,340)		47 812+	0 370+					
3.	Humble Oil & Refining T-3 Sauz Ranch-Tenerias	28S-21E-3	8,999	203	U.Fr	8,030-(14,130)	11,080	423	140	11.1	247			
4.	Humble Oil & Refining 1-Willamar Field G. U. (section 22, no. 28)	29S-20E-5	15,975	336	U.OI-PI U.Fr L.Fr	8,040-8,460 8,460-14,150 14,150-(28,150)	8,250 11,305 21,150	113 1,708 661+	0 350 112+	15.7 10.8 5.0	205 260	3,836 8,144	92 50	18.8 34.9
5.	Pan American 1-M.C.N. De Armendiaz (section 22, no. 30)	30S-21E-3	16,000	334	U.OI-PI U.Fr	8,027-9,270 9,270-(15,970)	8,648 12,620	79 2,267	30 728	15.1 8.6	200 268	4,021 11,232	51 78	21.6 37.1
6.	Pan American 1-H. C. Coleman	29S-18E-2	14,507	311	U.Fr L.Fr	8,050-11,200 11,200-(20,000)	9,625 15,600	985 1,275+	290 543+	13.5 5.0	217 335			
7.	Pan American 1-St. Tr. 569	29S-22E-8	10,798	227	U.Fr	8,020-(17,020)	12,520	726+	258+	8.8	276			
8.	Phillips Petr. 1-W. S. Livingston	30S-20E-6	12,002	245	U.OI-PI U.Fr	8,020-8,340 8,340-(15,340)	8,180 11,840	0 273	0 46	15.8 9.9	189 242			
9.	Shoreline Petro. 1-Lorena Walker (section 22, no. 26; ties D, no. 5)	29S-19E-2	11,015	236	U.Fr	8,040-(12,410)	10,225	1,292+	855+	12.5	225	4,755	86	21.9
10.	Sun Oil 1-Scott (section 22, no. 27)	29S-19E-1	10,001	192	U.OI-PI U.Fr	8,033-8,150 8,150-(13,150)	8,092 10,650	8 613+	0 140+	15.9 11.8				
11.	Superior Oil 3-Chess Todd	29S-18E-3	9,499	215	U.Fr	8,045-(11,045)	9,545	469+	133+	13.6	216			
12.	Texaco A-10 Yturria Land & Livestock (section D, no. 6)	28S-19E-4	16,115	332	U.Fr L.Fr	8,040-11,920 11,920-(21,920)	9,980 16,920	1,748 1,236+	900 885+	12.9 5.0	232	4,990 15,228	70 28	24.1
13.	Superior Oil 2-Clark-Cowden "B"	28S-18E-3	9,509	193	U.Fr	8,044-(10,644)	9,344	640+	473+	13.9	210			
14.	Superior Oil 5-Chess Todd	29S-18E-3	8,503	199	U.Fr	8,045-(11,545)	9,795	255+	180+	13.2	224			

Well No.	Operator and Lease	Location	TD	BHT	FM	Interval Thickness	Mid-Point	NS	ES	AVG ρ	AVG T	AVG P	AVG S ($\times 10^3$)	AVG CH ₄
12.	Jonnell I-Ramos	27S-8E-9	10,438	290	U. Wx	8,380-(11,880)	10,130	69+	0+	12.2	265			
13.	Humble I-Haynes Sr. Estate	25S-8E-5	13,529	357	U. Wx M. Wx	8,440-(10,540) (10,540)-(15,540)	9,490 13,040	88 170+	51 170+	13.2	244 345			
14C.	Delhi Oil Corp. 2-Ramirez	27S-8E-4	9,790	251										

APPENDIX C

Tabulation of depth to operational top of geopressure for section wells.

Well No.	Depth (ft) to oper. top of geopressure	Well No.	Depth (ft) to oper. top of geopressure	Well No.	Depth (ft) to oper. top of geopressure
ARANSAS COUNTY		CALHOUN COUNTY		DUVAL COUNTY	
2. Section 15, no. 19	7,000	1. Section 14, no. 15;		9. Section 14, no. 5;	
4. Section 15, no. 18;		ties D, no. 24	9,300	ties A, no. 9	9,800
ties D, no. 22	8,900	2. Section D, no. 25	8,800	15. Section 13, no. 7	9,600
9. Section D, no. 21	9,000	3. Section 13, no. 16;		DUVAL COUNTY	
11. Section 15, no. 17	8,600	ties D, no. 26	8,400	6. Section 19, no. 14;	
AUSTIN COUNTY		12. Section D, no. 27	8,800	ties A, no. 4	9,800
4. Section 9, no. 12;		13. Section 13, no. 17	10,100	8. Section 20, no. 20	7,000
ties B, no. 23	11,200	15. Section 13, no. 15	9,600	12. Section 20, no. 14	9,200
BEE COUNTY		16. Section D, no. 28	8,900	13. Section 20, no. 16	8,600
1. Section 16, no. 8	9,900	CAMERON COUNTY		14. Section 20, no. 17	9,400
5. Section 15, no. 13	6,000	1. Section 23, no. 15	11,000	17. Section 20, no. 19	7,000
6. Section 16, no. 7;		2. Section 23, no. 16	9,400	FORT BEND COUNTY	
ties A, no. 7	9,000	3. Section 23, no. 14;		2. Section 7, no. 10	9,800
BRAZORIA COUNTY		ties D, no. 4	11,600	6. Section 7, no. 11;	
1. Section D, no. 40	10,250	6. Section 24, no. 11	11,400	ties C, no. 50	8,900
6. Section 6, no. 15	9,100	8. Section D, no. 3	10,400	13. Section 7, no. 9	8,400
9. Section 7, no. 14	12,200	10. Section 24, no. 10	10,500	GALVESTON COUNTY	
13. Section 8, no. 16	11,800	11. Section 23, no. 13	11,500	1. Section D, no. 42	10,700
14. Section 9, no. 19	9,200	CHAMBERS COUNTY		GOLIAD COUNTY	
18. Section 6, no. 18	10,900	1. Section 2, no. 18;		4. Section 14, no. 8;	
19. Section 6, no. 17	12,000	ties D, no. 48	10,100	ties B, no. 16	11,400
20. Section 6, no. 19	7,500	3. Section 4, no. 18	10,000	9. Section 14, no. 7	10,300
21. Section 8, no. 15;		8. Section 4, no. 20;		12. Section 15, no. 12	10,100
ties D, no. 36	11,400	ties D, no. 46	9,500	13. Section 14, no. 9	10,200
24. Section 6, no. 16;		9. Section 3, no. 13	9,400	GONZALES COUNTY	
ties D, no. 41	11,000	11. Section 3, no. 14;		2. Section 13, no. 5	9,000
25. Section 7, no. 15	9,300	ties D, no. 47	9,500	HARDIN COUNTY	
27. Section 7, no. 13;		12. Section D, no. 45	9,500	3. Section C, no. 60	9,800
ties D, no. 39	9,800	14. Section 4, no. 19	9,000	7. Section C, no. 61	9,700
BROOKS COUNTY		COLORADO COUNTY		HARRIS COUNTY	
1. Section C, no. 15	8,500	1. Section 10, no. 7;		2. Section 6, no. 14;	
2. Section 21, no. 19	8,000	ties A, no. 13	9,600	ties C, no. 52	7,600
3. Section C, no. 14	8,600	DE WITT COUNTY		5. Section 6, no. 13	8,700
4. Section C, no. 17	8,600	2. Section 13, no. 6;		6. Section 5, no. 13	13,200
5. Section C, no. 16	8,700	ties A, no. 10	9,400		
6. Section C, no. 12	8,300	3. Section 13, no. 9;			
11. Section C, no. 11	7,600	ties B, no. 18	9,500		
18. Section 21, no. 18;		5. Section 14, no. 6	11,400		
ties C, no. 13	8,300				

Well No.	Depth (ft) to oper. top of geopressure	Well No.	Depth (ft) to oper. top of geopressure	Well No.	Depth (ft) to oper. top of geopressure
9. Section 5, no. 12; ties B, no. 27	12,100	JEFFERSON COUNTY		14. Section 20, no. 24	8,000
10. Section 5, no. 14	11,000	3. Section 2, no. 19	10,700	17. Section C, no. 20	7,900
12. Section 6, no. 11	12,600	6. Section 2, no. 17	9,100	18. Section 19, no. 21	9,300
13. Section 6, no. 12	8,900	9. Section D, no. 49	8,500	23. Section 19, no. 22	10,000
16. Section 6, no. 10	12,500	JIM HOGG COUNTY		25. Section 19, no. 23	9,800
19. Section 6, no. 8; ties B, no. 26	11,200	2. Section 22, no. 14	10,600	LAVACA COUNTY	
20. Section 6, no. 9	12,000	6. Section 22, no. 18	8,100	9. Section 11, no. 8	12,200
HIDALGO COUNTY		JIM WELLS COUNTY		10. Section 12, no. 8; ties B, no. 19	10,600
3. Section 24, no. 9; ties D, no. 1	9,800	5. Section 20, no. 23; ties C, no. 18	8,600	15. Section 11, no. 6; ties A, no. 12	10,400
5. Section 23, no. 8; ties C, no. 5	10,200	KARNES COUNTY		LIBERTY COUNTY	
7. Section 24, no. 4	10,400	1. Section 15, no. 9	8,700	2. Section C, no. 56	9,300
8. Section 22, no. 25	10,400	3. Section 15, no. 10	8,500	4. Section 3, no. 12; ties C, no. 58	9,200
12. Section C, no. 10	9,100	KENEDY COUNTY		6. Section 4, no. 14	12,600
14. Section 24, no. 3; ties C, no. 3	10,000	3. Section 20, no. 25	9,000	10. Section 4, no. 12; ties B, no. 28	12,800
16. Section 22, no. 24	10,200	4. Section 21, no. 26	11,000	12. Section 4, no. 15	12,800
18. Section 22, no. 22	10,800	5. Section 21, no. 22	11,100	13. Section 2, no. 15	11,100
20. Section 24, no. 2	8,900	6. Section 21, no. 21	11,000	14. Section 4, no. 13	11,600
22. Section 22, no. 21	8,600	7. Section 19, no. 24	11,600	16. Section 2, no. 16	10,800
23. Section C, no. 7	9,200	9. Section 20, no. 29	11,900	LIVE OAK COUNTY	
24. Section D, no. 2	12,000	11. Section 20, no. 27	10,300	1. Section 18, no. 11	10,100
26. Section C, no. 8	8,300	16. Section 21, no. 23; ties D, no. 8	11,300	2. Section 17, no. 11	9,700
27. Section 22, no. 20; ties C, no. 9	8,200	18. Section 21, no. 24	12,100	3. Section 18, no. 12	10,200
33. Section 24, no. 7	9,300	19. Section 19, no. 27; ties D, no. 11	10,500	5. Section 17, no. 10	9,500
36. Section 23, no. 12	10,600	20. Section 20, no. 26	10,500	12. Section 18, no. 13	9,800
38. Section 24, no. 5	10,400	24. Section 20, no. 30; ties D, no. 10	10,300	MATAGORDA COUNTY	
39. Section 24, no. 6	10,400	25. Section 20, no. 31	12,600	1. Section 11, no. 21	6,400
41. Section 23, no. 11	10,550	26. Section 19, no. 26; ties D, no. 12	11,000	5. Section D, no. 30	11,500
JACKSON COUNTY		KLEBERG COUNTY		6. Section D, no. 33	11,000
4. Section 12, no. 12; ties D, no. 29	10,200	5. Section C, no. 22	7,100	11. Section 11, no. 20	6,000
7. Section 12, no. 11	10,300	10. Section 19, no. 20	7,000	13. Section 9, no. 17	11,000
JASPER COUNTY		12. Section 19, no. 19; ties C, no. 21	7,000	14. Section 10, no. 19	7,100
1. Section C, no. 64	9,600			15. Section 11, no. 19; ties D, no. 32	11,000
2. Section 1, no. 10; ties C, no. 63	9,500			17. Section 10, no. 18; ties D, no. 34	11,900
4. Section 1, no. 9	8,800			18. Section 12, no. 13	9,600
				19. Section 11, no. 18	10,500

Well No.		Depth (ft) to oper. top of geopressure	Well No.		Depth (ft) to oper. top of geopressure	Well No.		Depth (ft) to oper. top of geopressure
MCMULLEN COUNTY			9.	Section 3, no. 8; ties A, no. 20	12,500	WASHINGTON COUNTY		
3.	Section 19, no. 11	10,200	11.	Section 3, no. 9	11,400	2.	Section 8, no. 5; ties A, no. 15	10,200
5.	Section 18, no. 10; ties A, no. 5	8,600	REFUGIO COUNTY			6.	Section 8, no. 4	10,100
MONTGOMERY COUNTY			1.	Section 16, no. 11; ties C, no. 31	7,800	8.	Section 8, no. 3	9,600
7.	Section 4, no. 10	12,500	4.	Section D, no. 23	8,400	WEBB COUNTY		
8.	Section 5, no. 11	13,200	7.	Section 16, no. 12	8,100	6.	Section 21, no. 13	8,800
10.	Section 5, no. 8	12,400	SAN PATRICIO COUNTY			7.	Section 21, no. 10	9,600
18.	Section 5, no. 10	12,800	1.	Section 17, no. 17	8,900	WHARTON COUNTY		
19.	Section 5, no. 9; ties A, no. 18	12,000	4.	Section 16, no. 13	9,000	3.	Section 9, no. 14	9,200
NEWTON COUNTY			6.	Section 16, no. 14	9,700	9.	Section 10, no. 11	11,800
4.	Section C, no. 65	9,600	9.	Section 16, no. 15; ties D, no. 19	10,700	10.	Section 10, no. 12	8,100
NUECES COUNTY			10.	Section 17, no. 16	9,000	17.	Section 9, no. 16	9,200
3.	Section 17, no. 19; ties D, no. 18	9,300	11.	Section 17, no. 14	7,600	18.	Section 9, no. 15; ties C, no. 45	8,200
4.	Section 18, no. 20	8,300	STARR COUNTY			WILLACY COUNTY		
6.	Section C, no. 23	8,800	1.	Section 23, no. 5; ties B, no. 1	9,300	2.	Section 22, no. 29	10,900
7.	Section 18, no. 23; ties D, no. 7	8,800	2.	Section 23, no. 7	8,200	4.	Section 22, no. 28	10,400
9.	Section 18, no. 24	8,500	3.	Section 23, no. 6	8,700	5.	Section 22, no. 30	10,900
13.	Section 17, no. 18	10,000	5.	Section 22, no. 19	8,100	ZAPATA COUNTY		
14.	Section 18, no. 19; ties C, no. 25	8,500	TYLER COUNTY			1.	Section 23, no. 4	10,250
23.	Section 18, no. 25	7,100	5.	Section 2, no. 11	12,100	2.	Section 23, no. 1	8,200
24.	Section 18, no. 21	9,200	12.	Section A, no. 22	12,200	6.	Section 23, no. 3	9,500
25.	Section C, no. 24	8,200	15.	Section 2, no. 12; ties B, no. 30	11,400			
27.	Section 18, no. 22	10,200	VICTORIA COUNTY					
ORANGE COUNTY			9.	Section 13, no. 13	8,200			
2.	Section 1, no. 14	10,300	WALLER COUNTY					
4.	Section 1, no. 15; ties D, no. 51	10,200	3.	Section 7, no. 6; ties B, no. 25	12,000			
POLK COUNTY			8.	Section 8, no. 9	11,700			
3.	Section 3, no. 10; ties B, no. 29	11,400						

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET-11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

14

14'

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

20

20'

21

21'

2

Prepared for the U. S. Department of Energy
Division of Geothermal Energy
under contract number DE-AC08-78ET11397

Bureau of Economic Geology
The University of Texas at Austin
Austin, Texas 78712
W. L. Fisher, Director

23

ZAPATA CO

STARR CO

HIDALGO CO

CAMERON CO

23'

24

STARR CO

HIDALGO CO

CAMERON CO

24'