GEOLOGICAL CHARACTERIZATION OF TEXAS OIL RESERVOIRS

Final Report

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by

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DISCLAIMER

EXECUTIVE SUMMARY

Approximately 153 billion barrels of in-place oil have been discovered in Texas reservoirs. Assuming recovery efficiency continues to increase modestly, an estimated 61 billion barrels of this oil will be produced, largely by conventional primary and secondary recovery technologies. The remaining 90 plus billion barrels of oil represent a target of immense proportions. For comparison, most recent estimates by the U.S. Geological Survey are that only 6 to 22 billion barrels of additional recoverable oil are likely to be found by continued exploration in the State.

Certainly not all of this unproduced oil can be recovered. Recovery efficiency of oil is limited by several factors. First, a portion of the oil contained within a reservoir, called the residual oil saturation, is not flushed from the rock because it is trapped in dead-end or isolated pores or has "wet" the mineral grains. This oil can only be moved from the reservoir by altering its physical characteristics or by artificially improving the ability of moving fluids to sweep it from the reservoir. Such oil is thus a potential target for the advanced, or so-called tertiary recovery processes. However, residual oil saturation can be measured and commonly ranges between 15 and 35 percent.

Simple arithmetic shows that about one fourth of the unrecovered 90 to 100 million barrels must remain in portions of the reservoirs that have not been drained in the course of conventional field development. Such oil is trapped in isolated compartments or lenses that were not tapped by wells drilled on conventional, regular spacings. Thus it constitutes a potential target for selective infield exploration and drilling. The objectives of this study were (1) to examine the geology and development history of the entire population of Texas oil reservoirs, (2) to improve our estimate of the amount of oil that remains as a target for strategic infield "exploration" and development, and (3) to identify families of oil fields that offer the greatest potential for significantly improving statewide recovery efficiency by application of such infill programs.

The number of oil fields in Texas is enormous. To reduce the potential data base to manageable proportions, only reservoirs (the basic hydrocarbon producing unit) that had a cumulative oil production of more than 10 million barrels were studied. These major reservoirs, which number slightly over 500, account for 71 percent of all Texas oil production. Basic engineering and geologic data for each reservoir were tabulated from information in the hearing files of the Texas Railroad Commission and other public sources. With these data, fields and reservoirs were grouped into families, or "plays" which are characterized by common reservoir geology, and consequently, by common engineering and production attributes. Nearly all of the major Texas oil reservoirs can be grouped into 47 geological plays. These plays become the basis for further analysis of strategic infield potential. Furthermore, examination of the comparative oil recovery efficiency of the plays shows that several factors influence the proportion of oil in place in the reservoir that is actually produced. The drive mechanism (the natural energy of the reservoir that expels the oil), permeability (the ease with which fluids can move through the rock), and the properties of the oil are important. In addition, the nature of the reservoir rock--its composition (sandstone, limestone, dolomite), its origin, and later modifications imposed by burial and time--influences the ease with which it yields its oil. The recovery efficiency of relatively few major Texas plays is constrained primarily by permeability or by properties of the oil. Rather, limitations are related to the geologic complexity of the reservoirs. Because the vast majority of Texas oil is produced from reservoirs originating in ten major genetic settings, called depositional systems, a limited suite of geologic/engineering reservoir models would be necessary to aid future infield drilling. Development of such generic reservoir models in the public sector is necessary if results are to be widely used and long-term recovery efficiency is to be favorably influenced statewide.

For each play, the total oil in place, the estimated ultimate recovery, and the average residual oil remaining in produced portions of the reservoirs were calculated.

Recovery efficiency is simply the ultimate recovery divided by the oil in place. The target oil for strategic infill development is approximated, in turn, by the recovery efficiency less the residual oil percentage (discounted for original water saturation) times the total oil in place in the play. In some geologic settings, such as the Woodbine Sandstone of East Texas (which is the reservoir in the East Texas Field), recovery efficiency is high, and nearly all remaining oil occurs as residual oil that can only be recovered by a tertiary process. In other settings, such as the San Andres Formation (the major oil-producing horizon in West Texas and on many State and University leases), recovery efficiency is particularly low, and even after residual oil is taken into account, as much as 40 to 50 percent of the oil in place remains as a target for infill development. Compilation of results for all of the plays shows that a measured potential target of nearly 20 billion barrels exists in the reservoirs studied. This is a minimum value, reflecting only the large reservoirs incorporated in this study. It also excludes the Austin Chalk/Buda play (south-central Texas) and large portions of the Spraberry Sandstone (West Texas), in which low permeability limits recovery. These plays offer some potential for additional recovery through improved conventional infield development, as well as being major targets for advanced recovery technologies. This figure represents about 20 percent of the total oil in place in these same large reservoirs.

The potential target is not uniformly distributed across the state. Largest volumes of unrecovered oil lie in the geologically old reservoirs of West and North Texas. Sizable targets also occur in both East Texas and along the Coastal Plain, however. In all, 28 plays are estimated to contain more than 100 million barrels of infield target oil. Based on the size of the infill target and their geologic similarity to other important plays, the Frio barrier/strandplain (Coastal Plain) play and the San Andres/Grayburg play of the southern Central Basin Platform (West Texas) have been selected for detailed geologic and engineering analysis.

In summary, the future of the Texas petroleum industry will likely rely increasingly on our ability to improve recovery of the great volumes of oil already known to exist in fields reaching advanced stages of depletion. The potential target for strategic infield drilling and development is large, and could well play a major role in improving ultimate recovery. Examples of such infield exploration and development programs, involving selective drilling, exist in the public record. They document the economic viability and positive results of such combined geologic/engineering analysis, but they represent a distinct minority of reservoirs, however. We conclude that a well-executed research and development program, backed up with widespread public dissemination of results, has the potential to measurably increase the ultimate recovery of Texas' great oil resource.

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INTRODUCTION

Of the approximately 153 billion barrels of oil discovered in Texas to date, eventual recovery, based on conventional techniques and practices, will amount to some 51 billion barrels, or about 33 percent of the estimated original oil in place. If ultimate conventional recovery reaches 40 percent of original oil in place, considered by some as possible, about 61 billion barrels will be produced by conventional techniques and practices.

Thus, between 92 and 102 billion barrels of oil discovered to date are conventionally unrecoverable. While this volume of oil constitutes a major potential target for nonconventional recovery, just how much might be recovered is debated by oil professionals. Estimates range from as little as 5 percent to as much as 40 percent. Several factors contribute to this uncertainty. But, basically, they involve questions as to the spatial distribution and geologic occurrence of unrecoverable oil within known reservoirs.

The basic historical assumption has been that reservoirs and the distribution of fluids in them are essentially uniform and homogeneous. Accordingly, conventional field development has been based on a specified number of uniformly spaced wells (acre-spacing). Considerable evidence indicates that many reservoirs show significant geologic variations and compartmentalization and that uniform spacing may not efficiently tap and drain a significant volume of the reservoir. Such untapped oil is the potential target of strategic infill drilling. By contrast, residual oil remaining in portions of reservoirs that have been tapped and drained in the course of conventional primary and secondary production is the potential target of enhanced or tertiary recovery technologies.

Taking into account general features of Texas reservoirs as a subset of large United States oil fields, potential targets for infill drilling and tertiary recovery techniques were estimated for the State of Texas by W. L. Fisher in the report of the Texas 2000 Commission "Texas, Past and Future" (Office of the Governor, State of Texas, Austin, June 1981) (table 1).

Table 1. Preliminary estimates of volumes of crude oil (in billions of barrels) that might be obtained by nonconventional recovery techniques. Giant fields are those with ultimate recoveries of 500 million barrels or more.

	Original Oil In Place	Conventional Ultimate Recovery	Nonconventional Potential: Infill Potential	Nonconventional Potential: Tertiary Potential
Gulf Basin:				
Giant fields	16.6	11.4	2.7	2.5
Non-giant fields	31.7	11.9	11.9	7.9
Subtotal	48.3	23.3	14.6	10.4
West Texas Basin:				
Giant fields	41.7	13.0	13.5	15.2
Non-giant fields	63.3	14.7	23.3	25.3
Subtotal	105.0	27.7	36.8	40.5
TOTAL	153.3	51.0	51.4	50.9

Ability to recover just 13 percent of an infill target of this magnitude would yield recovery equal to current proven reserves. Ability to increase recovery from smaller fields to a level now achieved in giant Texas fields would yield 15 billion barrels. For comparison, the most recent projections by the U.S. Geological Survey assign only 6.3 to 22 billion barrels of potential undiscovered oil to the same general area (Dolton and others, 1981).

Despite vastly increased oil drilling efforts in the State, the volume of new oil being discovered is not increasing proportionately. The long-term future of Texas oil production hinges critically on the degree of success in developing second-crop oil. This is readily apparent in figure 1, which shows that current production relies heavily on oil reservoirs discovered before 1960. These fields, which are in advanced stages of primary and secondary depletion, are the obvious targets for enhanced recovery efforts.

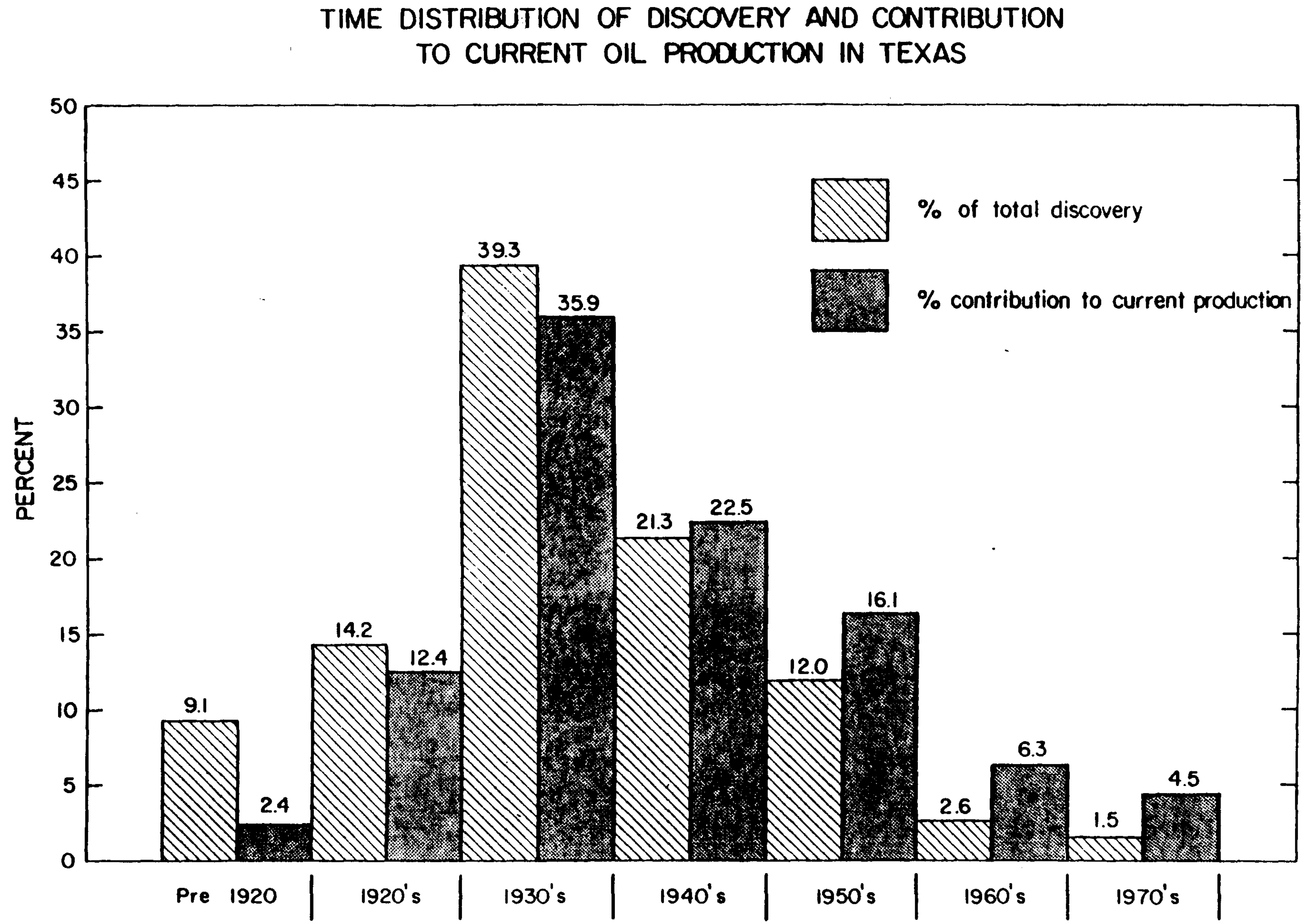

Figure 1. Time distribution of discovery and contribution to current oil production in Texas.

The infill target is defined as that oil left in reservoirs that was not affected by drainage or sweeping between existing conventional wells. This oil is distinguished from that left as residual oil in place within those portions of reservoirs drained in primary production and flooded or swept during secondary water flooding. Residual oil is recoverable only by in situ modification of its chemical or physical properties or by alteration of the displacing mechanism and is thus the target of tertiary recovery. Commonly, all oil not recovered through conventional primary and secondary techniques is considered a potential target for tertiary techniques. However, the volume of oil not now recovered exists in two distinct categories: that which is untapped but recoverable through strategic infill drilling using primary or secondary techniques, and that which is left in swept portions of reservoirs and recoverable only to tertiary methods. Different approaches to recovery of the unrecovered oil in Texas are thus required.

Clearly not all of the estimated infill-potential target of 90 to 100 billion barrels can be realized. Geologic and engineering knowledge of all reservoirs will never reach perfection, and economics would preclude recovery of all the oil even if our state of knowledge were perfect. For example, if we were able to characterize a reservoir down to isolated compartments with volumes of only a few hundred barrels, drilling and recovery costs obviously would not be justified. However, the average volume of oil developed per oil well completed in Texas over the past five years could, under typical conditions of pay thickness and saturation, underlie an area of less than three acres. The average volume discovered per exploratory well completion in Texas could be contained in an area as small as 10 acres. Such small compartments would be easily missed by conventional 20- to 40-acre spacing.

Although the estimated Texas infill potential here outlined is substantial, it must be stressed that opinions as to potential differ widely among competent oil professionals; that level of uncertainty should be reduced. Further, the serious decline in conventional production plus declines in new field wildcat finding rates and average size of oil well completions add a measure of urgency to determining the potential of additional oil recovery, both from infill drilling and from tertiary recovery. Recognition of this need and of its importance to the State of Texas is the primary motivating force for this research program.

Objectives

This report documents the results of the first year of a two-year examination of the geologic and engineering attributes of the major oil-producing reservoirs of Texas. The goals of year one of this program include:

(1) Collect, collate, and synthesize geologic, engineering, and production data on major Texas oil reservoirs. Reservoirs that have produced more than 10 million barrels of oil were included in the initial data base.

(2) Develop geologically related families of reservoirs, called "plays." A hydrocarbon play is a group of geologically related fields having basically the same source-reservoir-trap controls. Primary groupings are by similar reservoir genetic facies. Further subdivision is usually by trap type (White, 1980).

(3) Using data from files of the Texas Railroad Commission and other public sources, characterize each defined oil play in terms of: (a) recoverable reserves, (b) volume of in-place oil, (c) petrophysical properties of the reservoir, (d) trapping mechanism, (e) fluid properties, (f) drive mechanism, (g) reservoir management practices and conventional well spacing, and (h) calculated oil recovery efficiency.

(4) Select those plays which, because of their large volume of in-place oil, low recovery efficiencies, and favorable reservoir and fluid properties, are primary candidates for more detailed geologic and engineering analysis. Such candidate plays are the targets for significant improvement of ultimate production.

(5) Evaluate comparative recovery efficiency as a function of well spacing.

(6) Accomplish a preliminary examination of the utility of generic reservoir facies models in prediction of reservoir compartmentalization and heterogeneity, and thus as predictors of reservoir performance.

PROJECT PLAN

The number of individual oil-producing reservoirs in the State is immense. In order to reduce the data collection effort to manageable dimensions, several screening criteria were applied. First, the focus of the study was directed toward the primary element of hydrocarbon production--the individual reservoir. Secondly, the Annual Report of the Oil and Gas Division of the Railroad Commission of Texas (TRRC) was used to select only those pools or reservoirs that have produced cumulatively, through 1981, 10 million barrels or more of oil. Where production is comingled or statistics are not kept for individual reservoirs within the field, data in the field files were used to partition production among the principal reservoirs. In all, more than 500 individual reservoirs satisfied these criteria.

Hearing files maintained by the Central Records Section of the Oil and Gas Division of the TRRC provided the principal source of geologic and engineering data for the selected reservoirs. Unitization, injection, MER, field rules, and discovery files proved particularly useful. Additional sources of data included oil and gas field files maintained by the U.S. Department of Energy, Energy Information Agency, Dallas, and summary reports on secondary recovery projects published biannually by the Railroad Commission of Texas. Additional publications containing statistics for giant oil fields, fields targeted for potential tertiary recovery projects, and abandoned oil fields provided ancillary sources for data. A literature survey of geological and petroleum engineering journals, and reports of the U.S. Bureau of Mines yielded several papers describing specific reservoir studies.

Together, these sources provided a broad range of data for the selected large reservoirs. However, the quality and internal consistency of the data is obviously quite variable, and the degree to which the data are representative of the reservoir in the entire field area is commonly uncertain. Generally, basic geologic and engineering data appear to be adequate. However, great uncertainty is often attached to estimates of oil in place. In-place oil volumes are important, as recovery efficiency can only be calculated if the initial oil-in-place is known.

Values for oil in place were derived from a number of sources, including unitization and injection files, published figures for the giant fields, and direct correspondence with field operators. Most data represent volumetric calculations and are considered to be good to plus or minus ten percent. Where no other value was available, limited data were occasionally used to estimate the oil in place. In order to get a total in-place figure for each play, crude estimates were made for fields with no other data by using the ultimate recovery and assuming the field had an average production efficiency typical of the play. Finally, values were rounded off to the nearest million barrels for the play summary. Realistically, rounding to the nearest hundred million barrels would result in little significant error for the larger plays. Given the immensity of Texas oil resources, values of less than 100 million barrels are submerged in the totals of the larger plays.

An additional figure, equally important in estimating recovery efficiency, is the estimated ultimate recovery for the reservoir. Many older fields are nearing depletion, so that ultimate recovery can be readily extrapolated. Other fields pose much more difficulty. Ultimate recovery for fields can be a difficult figure to determine, primarily because it is often a moving target. The increased price of oil, and consequent surge in further development of known fields in the last decade have resulted in significant increases in estimated ultimate recovery of oil in many reservoirs. In general, values used here are conservative, and have been derived from numerous sources. Projected ultimate recovery data, calculated for selected surveillance reservoirs using production data through 1977 by the U.S. Department of Energy, Energy Information Agency, provided the basic values used in many estimates. Data provided by companies in response to direct inquiry or estimates included with hearing files further expanded and updated recovery projections. In addition, published projections for select fields were incorporated where it was judged they reflected a more accurate extrapolation. As a last resort, the latest cumulative production figures provided a minimal estimate of production efficiency. That continual increase in ultimate recoveries results in a concomitant decrease in the target for infill exploration simply reflects the fact that many operators, particularly among the larger, integrated oil companies, recognize the potential of the target and are actively pursuing both engineering and geological improvements in recovery efficiency.

Finally, the residual oil in place also constitutes something of an elusive figure. Although abundant data exist in the hearing files, primarily because residual oil saturation is specifically requested on recent injection application forms, the meanings of the number given are obviously diverse. The specific variable of interest is the residual oil left within portions of the reservoirs that have been depleted by primary and if appropriate, secondary production. This value is most accurately determined by subsurface logging programs or by specific coring and laboratory analytical procedures (Interstate Oil Compact Commission, 1978). Values derived through such analytical methods are typically lower than values given in injection files. Many times the latter represent a calculation based on the assumption that all remaining oil is uniformly distributed throughout the reservoir, or, in other words, that the entire reservoir has been uniformly swept. We have used such values, but have tempered our estimates of the strategic infill target by utilization or preferential weighting of the more reliable measured values provided in the literature or by operators.

In all, the nearly 500 reservoirs tabulated in this study have produced more than 32 billion barrels of oil. They represent approximately 70 percent of the total production of the State and two-thirds of the calculated original oil in place, and thus provide a good sampling for characterizing Texas oil reservoirs.

RESULTS OF PHASE I RESEARCH PROGRAM

Recognition and Characterization of Plays

As suggested by White (1980), interpretation of the reservoir facies assemblage provided the primary basis for selection and areal delineation of oil-producing plays. Close association of groups of reservoirs with a regional structural feature or an unconformity was locally used to delineate some plays. More commonly, similarity of structural style or geographic proximity provided a secondary basis for subdividing large assemblages of stratigraphically similar reservoirs.

Recognized plays are, with a few exceptions, named after the geologic unit or reservoir commonly listed in Texas Railroad Commission publications or, where many local names are used, after their general age or stratigraphic position. A genetic modifier may be appended to further characterize a key attribute of the group of reservoirs. In all, 47 plays have been delineated in this survey. A few reservoirs are sufficiently geographically or geologically isolated such that they cannot reasonably be included within any larger play; they have been grouped into a "miscellaneous" play or placed below summary tables for geologically similar plays. Many of these reservoirs are representative of families of smaller reservoirs that have not individually produced the 10 million barrels of oil required for inclusion in this study.

Geographic distribution of defined oil plays is shown on the regional map (fig. 2). It is readily apparent that Texas oil production is concentrated in two belts, one extending along the Coastal Plain and into East Texas, and the second stretching between north-central and west-central Texas. Because many plays traverse Railroad Commission

1. Eocene Deltaic Sandstones
2. Yegua Deep-Seated Domes
3. Yegua Dome Flanks
4. Caprock
5. Frio Deep-Seated Domes
6. Frio (Buna) Barrier/Strandplain
7. Frio Barrier/Strandplain
8. Wilcox Fluvial/Deltaic Sandstone
9. Jackson/Yegua Bar/Strandplain
10. Frio/Vicksburg (Vicksburg Flexure)
11. San Miguel/Olmos Deltaic Sandstone
12. Edwards Restricted Platform
13. Austin Chalk/Buda Stratigraphic Traps
14. Rodessa Stratigraphic/Structural Traps
15. Paluxy Fault Line
16. Cretaceous Clastics/Salt-Related Structures
17. Glen Rose Carbonate/Salt-Related Structures
18. East Texas Woodbine
19. Woodbine Fluvial-Deltaic Sandstone
20. Woodbine Fault Line
21. Strawn Sandstone
22. Bend Conglomerate
23. Strawn Reef
24. Upper Pennsylvanian Shelf Sandstone
25. Pennsylvanian Reef/Bank
26. Upper Pennsylvanian Basinal Sandstone
27. Eastern Shelf Permian Carbonate
28. Horseshoe Atoll
29. Spraberry/Dean Sandstone
30. Central Basin Platform Unconformity
31. Ellenburger Fractured Dolomite
32. Siluro-Devonian Ramp Carbonate
33. Siluro-Devonian Ramp Carbonate (S.C.B.P.)
34. Siluro-Devonian Ramp Carbonate (N.C.B.P.)
35. Yates Area
36. San Andres/Grayburg (Ozona Arch)
37. San Andres/Grayburg (S.C.B.P.)
38. San Andres/Grayburg (N.C.B.P.)
39. Permian Sandstone and Carbonate
40. Clear Fork Platform Carbonate
41. Queen Platform/Strandplain
42. Wolfcamp Platform Carbonate
43. Pennsylvanian Platform Carbonate
44. Northern Shelf Permian Carbonate
45. Delaware Sandstone
46. Panhandle Granite Wash/Dolomite
47. Panhandle Morrow

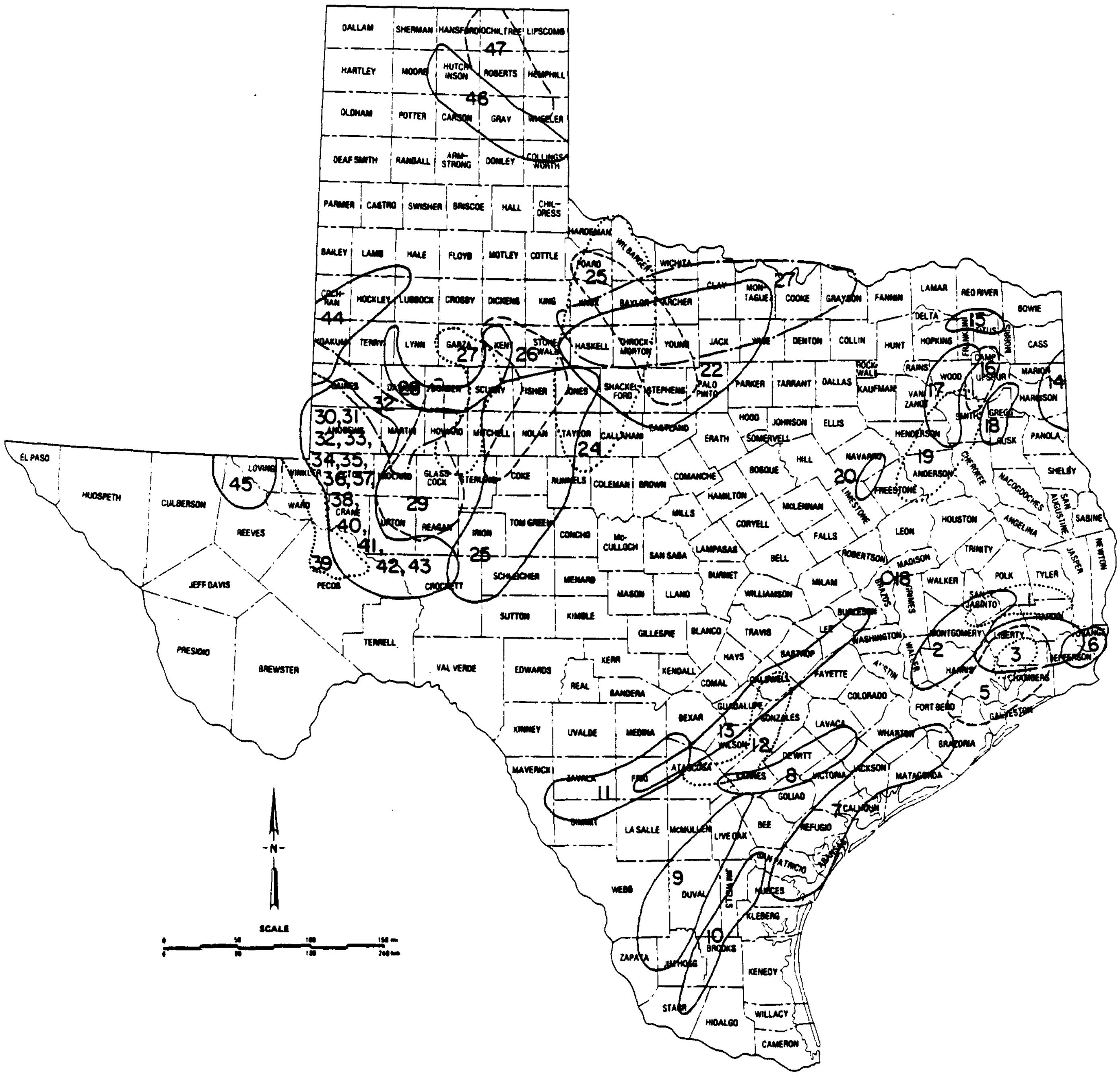

Figure 2. Areal extent of the larger identified Texas oil plays.

district boundaries, they are grouped in following discussions by these two broader geographic subdivisions. The geologic age relationships of the stratigraphic units containing large oil reservoirs is shown schematically in figure 3.

Each of the larger, multi-reservoir plays are briefly reviewed below. Tables listing included fields and reservoirs, as well as their geologic, petrophysical, and engineering parameters are included in Appendix I.

1. Eocene Deltaic Sandstones

Fluvial and deltaic sandstones of the Paleocene to lower Eocene Wilcox Group and the upper Eocene Yegua Formation form several reservoirs in southeast Texas. Production is from elongate or domal anticlines formed updip and downdip from normal faults of the Wilcox fault trend. Water drive with or without gas cap expansion is the rule.

No oil-in-place data are available. The estimated ultimate recovery for the three Wilcox reservoirs is 47 million barrels, plus 35 million barrels for the two Yegua reservoirs. Residual oil saturations lie in the range of 10 to 15 percent with moderate confidence. If better data become available, this play may be divided into two constituent subplays.

2. Yegua Deep-Seated Domes

Deltaic and related fluvial sandstones of the upper Eocene Yegua Formation are important reservoirs in a broad trend lying north of Houston in the Houston Salt Basin. Production is from large faulted domes, which may be either deep-seated salt domes, pillows, or turtle structures. Intense faulting divides these reservoirs into compartments, which commonly have separate production histories despite originally uniform pressures and fluid contacts. Stratigraphic irregularities are locally important; one purely stratigraphic trap is included. The reservoirs in this play contain over 1.5 billion barrels of oil in place. All reservoirs have strong water and gas cap expansion drives. There is some potential for strategic infill drilling due to both stratigraphic and structural complexities.

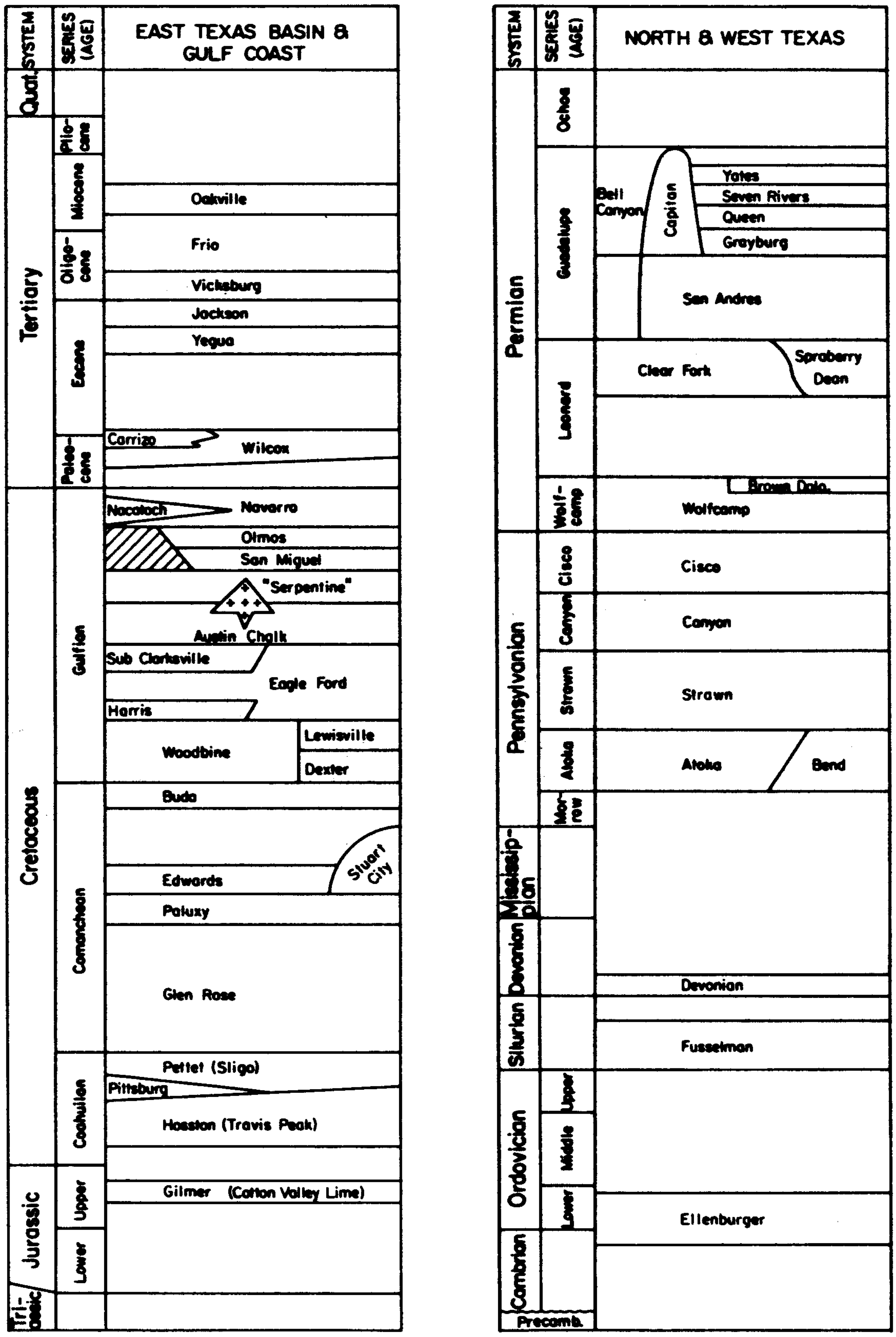

Figure 3. Geologic age relationships of stratigraphic units containing reservoirs of one or more plays described in this report.

3. Yegua Salt-Dome Flanks

Distal deltaic sandstones of the Yegua Formation (upper Eocene) form productive reservoirs on the lower flanks of several piercement salt domes in a belt northeast of Houston. The Yegua sands dip steeply away from the domes, are variably faulted, and are bounded updip by faults and/or stratigraphic pinchout. Although only two reservoirs with production over 10 million barrels have been identified, a large number of smaller reservoirs are productive in the area. The reservoirs typically have very thick oil columns, up to 1,800 ft, providing efficient gravity drainage in addition to solution gas and water drives. The two reservoirs listed have 54 million barrels of oil in place.

4. Caprock

The first large oil fields discovered on the Gulf Coast produced from porous, sulfur-bearing, calcite caprock over piercement salt domes (Deussen, 1936; Halbouty, 1979). The origin of this caprock has been controversial, but it appears to have formed by bacterial alteration of the anhydrite caprock left as a residue after salt dissolution at the top of salt stocks. Irregular, pinpoint to cavernous porosity commonly exceeds 40 percent. Only four salt domes in Texas contained large reservoirs of oil in caprock: Spindletop, Sour Lake, Batson, and Humble. All of these fields were discovered before 1910; production was uncontrolled, leading to rapid depletion of a probable original solution gas (gas cap?) drive, and irregular water influx.

No oil in-place or residual oil figures are available. Cumulative production prior to 1937 from caprock in these four reservoirs was 189 million barrels; more recent production may raise this figure above 220 million barrels. No targets for infill drilling or enhanced recovery can be defined without additional data.

5. Frio Deep-Seated Domes

Deltaic and related sandstones of the Frio Formation (upper Oligocene) are prolific oil and gas producers in the Houston Salt Basin. These sands were deposited within the

Houston Delta System (Galloway and others, 1982). Large oil fields occur as highly faulted domal structures, which in many cases overlie deep-seated salt stocks. Intense faulting and fracturing divide most of the 16 structures included in this play into multiple compartments, yielding 25 fields of large production and additional fields with smaller production. Often reservoirs with equivalent initial pressures and fluid contacts develop irregular pressures and fluid contacts during production. Stratigraphic complexities are locally significant, and allow oil bypassing in some fields. The reservoirs in this play contain about 4.5 billion barrels of original oil in place. Strong water and gas cap drives are the rule in this play, so that secondary waterfloods are uncommon. There is some potential for strategic infill drilling due both to stratigraphic and structural complexities, and infill drilling programs have been conducted in a few fields.

6. Frio (Buna) Barrier/Strandplain

Strandplain and/or barrier bar sandstones of the Frio Formation (upper Oligocene) form multipay oil and gas fields in southeastern Texas, near Beaumont. These sands lie within the Buna strandplain system of Galloway and others (1982). Only three reservoirs with large production have been identified; however, several fields with poor data and smaller reservoirs in the fields listed account for substantial additional production. The traps are anticlines and domal anticlines associated with Oligocene growth faults.

The three reservoirs listed contain over 110 million barrels of oil in place, and exhibit water and gas cap expansion drives.

7. Frio Barrier/Strandplain

One of the most prolific plays in Texas and the largest in terms of number of reservoirs (46) is the Frio barrier/strandplain play. The play, located over the San Marcos Platform on the central Gulf Coast of Texas, is situated in an area of mature exploration averaging more than 1.8 wells per sq mi. Stacked, strike-parallel, coastal barrier and strandplain sandstones comprise the reservoir lithology. These sandstones are interbedded with thick successions of alternating back-barrier sandstones and shale (Galloway and others, 1982). Simple and faulted anticlines are the dominant traps, although stratigraphic traps and partially productive structures also occur in the play. Water drive is the common source of reservoir energy. On the eastern and western margins of the play, gas cap or solution gas drives can accompany or supersede the water drive. Well spacings range from 10 to 40 acres. Original oil in place is estimated to be in excess of 4 billion barrels.

8. Wilcox Fluvial/Deltaic Sandstone

The Wilcox play in south-central Texas is limited to five reservoirs; production is derived largely from upper Wilcox and Carrizo sandstones. Fault-bounded anticlines comprise the trapping mechanism. The upper Wilcox sandstones are dominantly fluvial with associated transgressive marine facies. Production in lower Wilcox sands is from delta front and marine-reworked deposits. Reservoir energy is provided by encroaching bottom waters and minor local gas cap expansion. Average reservoir depth is 6,500 ft.

Only local secondary recovery attempts via gas injection (to prevent oil migration into shrinking gas caps) and a minor water injection pressure maintenance project have been undertaken. Further recovery efficiency data are required to evaluate the potential of this small play for enhanced production. Cumulative production to 1981 approaches 90 million barrels.

9. Jackson/Yegua Bar/Strandplain Sandstone

Stratigraphic traps formed by the updip porosity pinchout of Jackson and Yegua barrier bar and/or strandplain sandstones are well-known and important reservoirs in South Texas (Fisher and others, 1970). The reservoirs form north-south elongate fields, with pinchout to the west and oil-water contacts to the east; locally, faulting or gentle anticlines form part of the structure. The oil in some reservoirs is low gravity (below 20°). The 16 reservoirs listed contain approximately 1.2 billion barrels of oil in place. Solution gas drive predominates, but all fields have undergone waterflooding.

10. Frio/Vicksburg (Vicksburg Flexure)

Fluvial and delta-plain sandstones of the Frio Formation (upper Oligocene) and upper Vicksburg (lower Oligocene) are important producing horizons in South Texas. The Frio sands form part of the Gueydan fluvial system of Galloway and others (1982), near its junction with the Norias delta system. The partially productive anticlinal reservoirs of this play are composed of dip-oriented fluvial channel sands draped over immense rollover anticlines formed downdip of the Vicksburg Fault (Nanz, 1954). Each anticline field typically contains 20 to 30 reservoir horizons, often consisting of several non-interconnecting channel sand bodies, so that distinct reservoirs greater than 10 million barrels are less common than the large field productions would indicate. The 15 reservoirs listed in this play are the larger and better documented representatives of many other reservoirs; aggregate production is over 917 million barrels (Galloway and others, 1982).

The listed reservoirs contain 850 million barrels of oil in place. Gas cap drive predominates, with secondary contributions of water and solution gas drive. Unitization has been frequently adopted for pressure maintenance and efficient development of the irregular sand bodies. There is potential for additional infill drilling due to the small scale of stratigraphic variation.

11. San Miguel/Olmos Deltaic Sandstone

Upper Cretaceous sandstones of the San Miguel and Olmos Formations in the Maverick Basin, South Texas, were deposited in wave-dominated delta systems (Weise, 1980). Five large reservoirs, all driven by solution gas, occur in these strike-parallel sand sequences. Trapping mechanisms are diverse and include both structural (simple sealing faults) and stratigraphic traps (updip porosity pinchouts, mud-enveloped sand bodies, and regional truncation combined with lateral pinchout). Numerous smaller reservoirs not included in this play are formed by structural traps over volcanic plugs.

Reservoir sandstones are tight (average permeability of 4 to 6 md) and require fracture treatments to stimulate production. The two San Miguel reservoirs have undergone infill drilling programs. Unusually high water saturations (48 to 65 percent) are characteristic of this play. Original oil in place was in excess of 800 million barrels, however, cumulative production to date is only 136 million barrels.

12. Edwards Restricted Platform-Strandline Carbonates

Three shallow and two deep oil reservoirs (average depths of 2,400 ft and 9,100 ft, respectively) located in three major fault zones over the San Marcos arch are included in this play. The oil is trapped on the upthrown side of up-to-the-coast faults of middle Tertiary age in the Luling Fault Zone and along the antithetic faults of grabens that were actively subsiding during the latter part of the Early Cretaceous in the Karnes and Atascosa Troughs (Rose, 1972). Structures range from simple fault-bounded homoclines, (for example, Jourdanton Field) to segmented reservoirs with multiple small fault traps (Person field). Down-faulted, less-permeable carbonates and clays of Late Cretaceous age comprise the seal against which porous Edwards Group reservoirs are juxtaposed. In the shallow reservoirs water influx provides the drive, whereas expanding gas caps, assisted by water, supply reservoir energy in deeper producing intervals.

Oil production from the Edwards Formation in South Texas is closely associated with shallow water deposits that originated in restricted platform and strandline (tidal flat) environments. Superimposed on the depositional fabric is a diagenetic overprint in the form of extensive dolomitization. Edwards dolomite has an affinity for rocks formed as shallow water deposits (restricted shallow shelf and tidal flat deposits; Rose, 1972; Fisher and Rodda, 1967).

The major share of Edwards production is derived from the upper part of the Edwards Group (Person Formation). Reservoirs are commonly complex with productive units interbedded or intertongued with non-porous limestone beds or lenses which may contain chert nodules. In the Person field (the areally largest Edwards accumulation encompassing some 12,600 acres) six zones are productive (Cook, 1979). The main productive zones are (1) collapse breccias formed by dissolution of tidal flat evaporites at shallow depths, (2) leached dolomites (originally restricted, shallow-marine limestones) with moldic porosity resulting from diagenetic destruction of mollusk fragments (leached Member) and, (3) an interbedded restricted shallow marine-tidal flat sequence (cyclic Member) (Rose, 1972). Average effective pay for the play is 30 ft.

Cumulative production from the play exceeds 150 million barrels. Residual oil saturation at abandonment based on limited available data appears to be high (40 to 50 percent). This figure is independent of depth of the reservoir.

13. Austin Chalk/Buda Stratigraphic Traps

Amorphous limestone chalk deposited in open-shelf environments hosts major oil production in a swath through the south, central and east Texas Coastal Plain. Five fields that range in depth from 1,850 to 7,500 ft are included. Solution gas provides reservoir energy, assisted by gravity drainage in the Pearsall reservoir. Production is from naturally occurring and induced fractures; many fracture sets do not communicate with others, creating a myriad of ill-defined reservoirs, especially in the large Giddings field area.

Austin and Buda completions exhibit high capacities after stimulation by fracturing, but production histories show rapid declines. Estimated ultimate primary recoveries are abnormally low largely as a response to the low permeability of the chalk matrix. Secondary recovery projects have thus far been largely unsuccessful (Hester and others, 1965). This play is still under active development, hence figures for oil in place are unobtainable.

14. Rodessa Stratigraphic/Structural Traps

Shallow open-shelf limestones and nearshore sandstones of the Rodessa Member of the Cretaceous Lower Glen Rose Formation in the East Texas Basin are weakly productive. The play is located on the flanks of the Sabine Uplift. Although reservoirs are unitized for pressure maintenance and waterfloods, recovery efficiencies are low. Cumulative production from the play is 120 million barrels; the major share of this production is from the Rodessa Field. Trapping mechanisms in this play are combined stratigraphic-structural. Porosity pinchouts over simple anticlines or pinchouts accompanied by sealing faults account for the traps. The drive mechanism is solution gas. The Rodessa play is a potential target for further infield exploration; however, additional oil in-place data are required before a final decision can be reached.

15. Paluxy Fault Line

Three reservoirs of Paluxy age that originated in a meanderbelt system comprise this play which is located along the Mexia-Talco Fault Zone and produces high viscosity (average viscosity greater than 20 cp) crudes. The oil is trapped on the upthrown block of a sealing antithetic fault. Lenticularity of the sandstones imparts a partial stratigraphic control. The reservoirs are water driven and only one has undergone pressure maintenance and been unitized for waterflooding.

Original oil in place was approximately 860 million barrels largely contained in the Talco (Paluxy) reservoir. High-viscosity crudes, lenticularity of the sands, and permeability variations have led to water channeling.

16. Cretaceous Clastics/Salt-Related Structures

Eagle Ford, Paluxy, and Pettet (Glen Rose) sandstones of Cretaceous age in the East Texas Basin are grouped in this play of nine reservoirs. The sandstones are of fluvial, deltaic, and marginal marine origin. Traps were formed by warping of reservoir rocks over salt and turtle-structure anticlines in the East Texas salt province. Reservoirs are commonly faulted and segmented; average reservoir size is 2,500 acres. Solution gas is the dominant drive mechanism, although water drives are present in three reservoirs and partially active in three additional reservoirs.

Pressure maintenance and waterflooding have been undertaken in most reservoirs. Original oil in-place exceeded 550 million barrels. Porosity, permeability, and hydrocarbon gravity do not impose constraints on recovery.

17. Glen Rose Carbonate/Salt-Related Structures

Oolitic, fossiliferous limestone deposited on a restricted platform and reefal debris from an open platform patch-reef complex comprise the reservoir rocks of this Glen Rose play in the salt province of the East Texas Basin. Three reservoirs are included, the largest of which is the Fairway (James Lime) which contained 400 million barrels of oil. The trapping mechanism is combined stratigraphic-structural caused by warping of the carbonates over salt and turtle-structure anticlines accompanied by porosity pinchout.

All reservoirs were unitized for pressure maintenance and waterflooding early in their development, resulting in relatively high productivities. Solution gas drives dominate. This small play is not considered a high priority research target, as most of the non-residual oil remaining in the play is contained in the Fairway reservoir.

18. East Texas Woodbine

Elevation and regional truncation of the Upper Cretaceous Woodbine Formation over the western flank of the Sabine Uplift has resulted in one of Texas' most prolific plays. Three fields are included in the play, but the vast bulk of the production is derived from the East Texas field. The New Diana field to the north is separated from the East Texas field by five dry holes. The Kurten field is located southwest of the Sabine uplift.

East Texas and New Diana fields are stratigraphic traps, with deltaic Dexter sandstones of the Woodbine Formation being unconformably overlain by the Austin Chalk and, locally, by the Eagle Ford Shale. The original productive area of these fields was in excess of 131,000 acres (204 sq mi). Recovery is accomplished by a strong water drive. Well density in the East Texas Field averages 4.5 acres per well; a maximum of 26,000 wells were productive in 1939. The Kurten field has a producing area of almost 100 sq mi with reserves estimated at 100 million barrels of oil (Turner and Conger, 1981). Shelfal sand bars offshore of the Harris Delta System (Oliver, 1971) were leached by fresh waters along an erosional unconformity overlain by the Austin Chalk. Permeability decreases away from the unconformity, and a permeability barrier forms the updip limit of the field, resulting in a subtle, combined stratigraphic-diagenetic trap (Turner and Conger, 1981). The Kurten (Woodbine) is a recent discovery (1976).

The East Texas field is a classic example of excellent areal and vertical sweep efficiency. Ultimate recovery is expected to be in excess of 5.5 billion barrels of oil, with a recovery efficiency of approximately 85 percent. This excellent productivity is a function of the strong water drive, nature of development of the play, and the role played by the Railroad Commission in regulating production during early development in the 1930's.

19. Woodbine Fluvial-Deltaic Sandstone

Sandstones of the Cretaceous Woodbine Formation are highly productive in the salt province of the East Texas Basin. Traps are large, simple and faulted crestal-anticlines and domes floored by salt. Production is derived from both the lower (Dexter) and upper (Lewisville) intervals of the Woodbine. The Dexter contains a large proportion of the 2.4 billion barrels of oil in place and, as a water-driven reservoir, has a recovery efficiency of approximately 80 percent. The overlying Lewisville sandstones have solution gas drives and lower recovery efficiencies (50 percent). All of the reservoirs in this play have undergone pressure maintenance via water or gas injection.

The breakdown of the Woodbine into lower Dexter and upper Lewisville divisions in Railroad Commission Files differs from the genetic usage of these same names by Oliver (1971), who recognized a Dexter fluvial system which fed the Freestone delta system and was partially overlain by, and partially marginal to, the Lewisville shelf-strandplain system. The Dexter (in TRRC usage) is thus composed of both wave-dominated deltaic (the Freestone delta system of Oliver) and fluvial elements; the Lewisville of lenticular, meandering fluvial and strandplain-shelf deposits (combining the Dexter and Lewisville of Oliver). The lower, fluvial-deltaic sandstones are laterally persistent, contain more oil and are more productive than the upper lenticular sands. Cumulative production from this play is approximately 1.4 billion barrels. While this is an attractive target for further development, the high average recovery efficiency is a limiting factor.

20. Woodbine Fault Line

Woodbine reservoirs along the Mexia-Talco Fault Zone were rapidly developed soon after discovery in the 1920's at close spacing (average density 4.1 acres/well) and wide open flow. Three reservoirs are included in the play for which ultimate recovery is estimated at over 260 million barrels. The reservoirs occur on the upthrown block of a regional, extensional sealing fault and are water driven. The play is essentially depleted. There have been no attempts at secondary recovery. In view of production methods, and well density, this play is not considered a priority candidate for infield exploration.

21. Strawn Sandstone

Fluvial and deltaic sandstones of Strawn (Pennsylvanian) age are highly productive in an area covering much of the Sherman-Marietta Basin, and northeastern and eastern shelves of the Midland Basin. Production occurs primarily in large structural traps, but the comparatively small scale of the individual reservoir units results in considerable localization of production within the larger area of the structure. Combination and a few purely stratigraphic traps also occur.

Reservoirs in the play have produced a total of 336 million barrels of oil. More than 800 million barrels of in-place oil are indicated. In addition to the 14 reservoirs that have individually produced more than 10 million barrels of oil, numerous smaller fields and several of the large, diffuse County Regular fields produce from analogous Strawn reservoirs in the same geologic provinces. A well-by-well tabulation summarized by American Institute of Mining, Metallurgical and Petroleum Engineers and North Texas Geological Society (1957) showed that Strawn reservoirs accounted for 25 percent of cumulative District 9 production. Though a somewhat dated calculation, the proportional importance of Strawn reservoirs has likely remained comparable, placing accumulated Strawn sandstone production at approximately 750 million barrels. As much as a third of the 10 billion barrels of original oil in place in sandstone reservoirs of District 9 may reside in Strawn sands. Dominance of solution gas drives has required extensive unitization and waterflood for efficient reservoir development. Some of the pioneer waterflood programs were initated in reservoirs of this play. The play offers a substantial target for enhanced production by strategic infield drilling because the scale of reservoir facies, rather than low permeabilities or fluid properties, is likely to be the dominant factor limiting recovery.

22. Bend Conglomerate

The six reservoirs of the Bend Conglomerate play consist of coarse-grained alluvial fan delta deposits containing abundant conglomerate and conglomeratic sandstone. Bend production is widespread over the Bend Arch and in the Fort Worth Basin, with numerous smaller fields occurring among the large reservoirs included in this survey. Scale of individual reservoir units is typically small; production may be trapped stratigraphically or structurally. Solution gas is the most important drive mechanism; consequently, most reservoirs are unitized and undergoing waterflood. In-place volume of oil totals less than 500 million barrels for tabulated pools, but a plethora of smaller fields and a significant proportion of Bend production under County Regular classification would substantially increase this figure.

23. Strawn Reef

The Strawn Caddo Limestone contains several areally extensive reservoirs, most of which were discovered and depleted during early phases of exploration in North-Central Texas. Following many years of stripper production, several large units have been established; together with the deeper Rasberry Caddo 6100 reservoir, these form a distinct play that is estimated to have contained over 700 million barrels of oil in place. Lack of early production records precludes meaningful calculation of cumulative production.

24. Upper Pennsylvanian Shelf Sandstone

Pennsylvanian fluvial and deltaic sandstone bodies deposited on the eastern and northeastern shelves of the Midland Basin constitute the reservoirs in a multiplicity of small- to medium-sized fields. Much of the oil production in many of the North-Central Texas County Regular fields is from such reservoirs. However, small size of such sandstone units results in few large individual reservoirs. Entrapment may be structural, but combination and stratigraphic traps are common. Solution gas drives dominate. Some of the larger reservoirs are unitized.

Documented oil in place in the large reservoirs of this play is a modest 250 million barrels. However, recovery factors, even in unitized fields undergoing systematic waterflood, are low. Most of the reservoirs are shallow and are in the stripper stage of production.

25. Pennsylvanian Reef/Bank

This play includes limestones of several different stratigraphic units. However, all reservoirs were deposited as parts of massive Pennsylvanian carbonate reefs or mounds that were later burried by shale or mudstone, preserving the original topography of the carbonate buildup. The mounds and reefs were scattered across the floor of shallow basins or along shelf margins. Preservation of primary or diagenetic porosity within the massive limestones, which are surrounded on most or all sides by impermeable mudstones, produces the trap in all fields of this play. Solution gas drives are commonly augmented by natural water drive where reefs and mounds are rooted in laterally extensive porous limestone foundations.

In total, the Pennsylvanian reef/bank play contains over 950 million barrels of in-place oil. Most reservoirs are unitized for pressure maintenance or waterflood.

26. Upper Pennsylvanian Basinal Sandstone

Sandstones deposited in a series of submarine fans deposited within the offlapping slope system of the eastern shelf of the Midland Basin constitute several moderate-sized reservoirs scattered through three Railroad Commission districts. Reservoirs are isolated within basinal and slope mudstones, and hydrocarbons are trapped stratigraphically. Reservoir energy is exclusively solution gas. Though mapped extent of reservoirs commonly covers many square miles, the sandstone units are shown by detailed correlation to be extremely complex internally. The five large reservoirs of this play contain more than 500 million barrels of oil in place.

27. Eastern Shelf Permian Carbonate

Similarity of depositional environment and geographic alignment provide the basis for grouping these 11 reservoirs. Several of the fields have multiple reservoir units. Howard-Glasscock, for example, produces from Guadalupian Seven Rivers and San Andres, as well as Leonardian Clear Fork Formations. Restricted-platform dolomite interbedded with limited terrigenous sands and limestone provide the reservoir of the play. As with any carbonate unit, diagenesis strongly influenced reservoir development. Dolomitization, recrystallization, and dissolution all contribute to reservoir quality.

The reservoirs listed contain over 3 billion barrels of oil originally in place; 724 million barrels have been produced. Nearly half of the play reserves are in the giant Howard-Glasscock Field.

28. Horseshoe Atoll

This well-known play involving Pennsylvanian Strawn, Canyon, and Cisco, and Permian Wolfcamp reef development was initiated with the discovery of Kelly-Snyder by Standard of Texas in 1948. Within five years a concentrated application of subsurface geology and detailed seismic analysis resulted in the discovery and rapid definition of the major fields in the Horseshoe Atoll Reef trend. Early appreciation of the need for pressure maintenance and unitized secondary and tertiary recovery efforts account for better-than-average recovery efficiencies from these reservoirs in which porosity averages 10 percent and permeabilities nearly 100 md. Spacing patterns for the most part were 40-acre; however, fields with 80-acre spacing have estimated recovery efficiencies in excess of 50 percent.

The 15 reservoirs included have produced over 2 billion barrels, which represents 84 percent of the recoverable oil. It is estimated that 2.4 billion barrels of oil should be recovered from these reservoirs, which would represent 51 percent of the 4.7 billion barrels of oil originally in place. Nearly 2.3 billion barrels will remain in the reservoirs after production of the estimated ultimately recoverable oil.

29. Spraberry/Dean Basinal Sandstone

Extensive, fine-grained, low-permeability sandstones and siltstones deposited on the floor of the Midland Basin in Early Permian time constitute the reservoirs for one of the giant oil plays of West Texas. Stratigraphic isolation of these submarine fan deposits within organic-rich basin mudstone has produced numerous, areally extensive, stratigraphically trapped oil reservoirs. The drive mechanism is exclusively solution gas, and most of the reservoir area has been unitized for systematic waterflooding. Natural fracturing is important in reservoir development. In-place reserves of the Spraberry/Dean play total over 10.6 billion barrels. However, the low permeabilities and discontinuous nature of the fan reservoirs results in extremely low recovery. A few fields are notable exceptions.

30. Central Basin Platform Unconformity

This group of reservoirs originated in differing environments of deposition but are grouped because all produce from regional-unconformity-related stratigraphic traps. Uplift and truncation of the reservoir lithologies took place during the late-middle Paleozoic. The reservoirs are all located on the Central Basin Platform and all but one, Arenosa (Strawn detritus), are Devonion age and older. Most, but not all, are carbonates with varying amounts of sandstone and chert. Porosity ranges from 2 to 22 percent with a play average of 10 percent. Oil gravities are consistently in the 37^{o} to 43^{o} range. Both solution gas and water drives occur.

The listed reservoirs include two Ellenburger, two Simpson, two Silurian, one Pennsylvanian, and six Devonian. Original oil in place has been estimated at 1.3 billion barrels; production totals 326.1 million barrels.

31. Ellenburger Fractured Dolomite

This play consists of 31 Ellenburger dolomite reservoirs located on the Ozona and Central Basin Platforms. Barnes and others (1959) interpreted the Ellenburger of this region as ancestral open shelf platform deposits. A common characteristic is the presence of considerable fracturing. Most reservoirs experienced a fairly effective water drive. However, there are some exceptions. Because of the greater depths involved and the attendant higher costs of development, many of the fields have been developed on 80-acre spacing. Recovery efficiency for this group of reservoirs does not appear to relate directly to spacing, as some areas of 80-acre spacing will apparently recover a higher percentage of the oil originally in place than at least some of the 40-acre spacing fields.

Even though porosity averages only 3 percent, the great thickness of reservoir development provides significant accumulations of hydrocarbons. In addition to the 31 reservoirs which have produced in excess of 10 million barrels, another 90 fields are listed in Railroad Commission files. Thirty-three of these have been abandoned, with production for the abandoned fields totaling 46 million barrels. Original oil in place exceeded 3.0 billion barrels for the play. Production totals 1.2 billion barrels.

32. Siluro-Devonian Ramp Carbonate

This group of 11 dolomite and limestone reservoirs originated in an inner ramp environment. Reservoirs demonstrate a slightly better-than-average recovery efficiency that may be related to an effective water drive. Simple anticlinal traps dominate. Porosity and permeability average 8 percent and 70 md, respectively. Porosity development is mostly vugular and intercrystalline with minor fracture porosity. The play has an estimated 739 million barrels of original oil in place. Production totals 288 million barrels.

33. Siluro-Devonian Ramp Carbonate (Southern Central Basin Platform)

The three reservoirs of this play are characterized by geographic grouping along the southern Central Basin Platform and the presence of extensive chert beds. Environment of deposition is interpreted as outer ramp to basinal. Although porosity is relatively uniform, there is great variation in average permeability. The University-Waddell and Block 31 Devonian reservoirs have average permeabilities of less than 1 md. Another 30 or so similar Siluro-Devonian producing areas in the south part of the Central Basin Platform are associated with this play but are not included because cumulative production was less than our 10 million barrel cut-off figure. Production from these smaller fields totals nearly 95 million barrels or approximately one-fourth of the production of the included fields.

Of particular interest in this grouping is the Block 31 (Devonian) Field. Extremely low permeabilities dictated early study as to type of pressure maintenance and secondary recovery. Primary production was estimated to be approximately 16 percent of original oil in place. To date the field has produced in excess of 50 percent of the original oil in place and is expected to produce an additional 10 percent before abandonment. An effective miscible flood involving the use of gas injected as a stripping agent under high pressure and awareness of sweep efficiencies in the poorer portions of the reservoir are believed to be responsible for the increased recoveries reported.

The play is estimated to contain 561 million barrels of original oil in place. Production totals 237 million barrels.

34. Siluro-Devonian Ramp Carbonate (Northern Central Basin Platform)

These six reservoirs are characterized by outer ramp/basinal carbonate development and are located on the northern part of the present-day Central Basin Platform. The platform was not a topographic high during Siluro-Devonian deposition as the carbonates are interpreted as deeper water sediments. Reservoir development in these fields is characterized by considerable heterogeneity. Traps are simple or faulted anticlines.

The play had an estimated 698 million barrels of oil originally in place. The heterogeneity of the reservoir is reflected by the great variability in porosity (5 to 18 percent) and permeability (2 to 500 md). Recovery efficiencies are similarly variable. Production totals 187 million barrels.

35. Yates Area

The Toborg and Yates Fields are grouped in this play even though reservoir origins and other conditions are dissimilar. The shallow, low-gravity (22^{o}) Toborg Field, situated immediately adjacent to Yates, owes at least part of its production to charging by "leakage" from Yates. Cretaceous Trinity sands, which are fluvial in origin and are poorly cemented and discontinous, comprise the reservoir rocks in the Toborg Field.

The Permian Yates reservoir, a supergiant oil field discovered in October 1926, encompasses all the various elements of a platform-margin reef complex. Reservoir development is related to depositional and diagenetic factors associated with the genesis of the complex and varies from poor to excellent. Dolomites, limestones, and sandstones are all productive lithologies, however dolomites predominate. Solution vugs, cavities, and caverns make attempts to average reservoir conditions extremely difficult and somewhat meaningless.

Quality of the reservoir is indicated by the fact that after production of over 861 million barrels average reservoir pressure has dropped by less than 350 psi. This production is less than 40 percent of the estimated ultimate recovery of 2.0 billion barrels.

36. San Andres/Grayburg - Ozona Arch

Porous, diagenetic dolomite beds originally deposited as part of a restricted platform system are productive on several broad, low-relief anticlines and structural noses located along the Ozona Arch. Distribution of permeable strata is quite irregular and discontinuous, thus most production is typically limited to portions of a larger structural feature. Reservoirs included in this play display both solution gas and water drives and have moderate permeabilities. Low API gravity oils reflect the shallow depth of most production. Big Lake field, the original discovery on University of Texas lands, is included in the play.

Original in-place reserves of the play total approximately 900 million barrels of oil. Although waterflood programs are numerous, few large units have been developed.

37. San Andres/Grayburg (S.C.B.P.)

Characterized by limestone and dolomite deposits associated with the platform edge and located in the southern Central Basin Platform, these reservoirs have provided some of the largest accumulations of the prolific Central Basin Platform. Reservoir development, which occurs throughout a thick interval, is laterally and vertically variable. Depositional and diagenetic factors affect the development of porosity and permeability in these restricted platform units. The relative interdependence of these factors determines the character of the reservoir rock. Solution gas is the most common drive mechanism.

The 19 reservoirs listed in this play are estimated to have contained in excess of 10.2 billion barrels of oil originally in place. Production to January 1981 was 2.36 billion barrels, or about 87 percent of the ultimate recovery.

38. San Andres/Grayburg Carbonate (N.C.B.P.)

Dolomite, limestone, and minor terrigenous sandstone comprise the reservoirs in the six fields in this play, which is located on the northern portion of the Central Basin Platform. Reservoir lithologies include cyclic supratidal to marsh-lagoonal strandline deposits, oolitic, platform-margin bank deposits, and low energy, restricted shelf platform carbonates. Porosity and permeability may be developed in any of these units; however, the quality of the reservoir is quite variable. Supratidal deposits of dense dolomite, anhydrite, and silt are generally poor reservoirs. Platform facies include thin reservoir beds with well-developed barriers to vertical migration. Thick oolite bar/bank grainstones deposited under high-energy conditions normally comprise good to excellent reservoirs and slope/basin deposits contain scattered porous units due to dissolution of fossil material.

Cumulative production is 655 million barrels. About 2.4 billion barrels of oil were originally in place.

39. Permian Sandstone and Carbonate

The 13 reservoirs included in this play are located on or near the western margin of the Central Basin Platform. Reservoir facies include porous sandstone and carbonates of the Yates, Queen, Seven Rivers, Grayburg, and San Andres Formations. Depositional similarity is indicated by the more or less continuous pattern of producing wells all along the western margin of the platform. Productive closure in many instances is related to deposition, drape, and reef growth over topography developed by Early Permian to Late Pennsylvanian platform edge carbonates. Reservoir development is related to depositional and diagenetic features associated with reef and with back-reef restricted-platform carbonate deposition. Terrigenous sands of strandline origin (possibly eolian) also contribute to production. Presence of evaporites suggests the intertidal to supratidal origin of part of the deposits, and provides reservoir seals in some accumulations.

The play had nearly 3.0 billion barrels of oil in place. Production of 1.02 billion barrels is some 97 percent of the estimated ultimate recovery.

40. Clear Fork Platform Carbonate

The 13 reservoirs of the Leonard-age platform carbonate play on the Central Basin Platform have similar reservoir characteristics, and have relatively low recovery efficiencies. The presence of sandstone and some evaporites indicates shallow-water to supratidal deposition typical of restricted shelf platform and strandline settings. The reservoirs are characteristically heterogeneous. There are many additional smaller reservoirs on the platform with similar characteristics, but which have individually produced less than 10 million barrels of oil. It is believed, however, that the included fields will account for approximately 60 percent of the oil in place for Leonard-age reservoirs on the platform. Solution gas drives are universal, and traps are generally partially productive anticlines.

The reservoirs of the play have been estimated as having over 4 billion barrels of original oil in place. Approximately 840 million barrels have been produced.

41. Queen Platform/Strandplain

Sandstones and dolomites of the Queen Formation are productive in many fields on the Central Basin Platform; however, in only three fields are Queen reservoirs separated from other units with sufficient production to be included in the tabulation. The two principal sand bodies and the intervening dense dolomite were deposited in inner restricted platform and strandline environments. Data suggest lower average porosity than normal for clean sandstone, indicating pervasive diagenetic cementation or poor sorting.

Three hundred twenty-four million barrels of oil originally in place has been estimated from the available data for the reservoirs, which have produced 98 million barrels. Combination traps and solution gas drive typify the play.

42. Wolfcamp Platform Carbonate

This group of seven reservoirs located on or near the eastern edge of the Central Basin Platform owes its development to sediment drape and reef growth over Pennsylvanian-age platform edge carbonates fringing the Central Basin Platform. Reservoir development is related to depositional as well as diagenetic factors and occurs throughout a fairly thick section; however, difficulty of well-to-well correlation of individual reservoir units confirms the heterogeneity of the reservoirs. Solution gas drive augmented by waterflood programs provides reservoir energy.

The included reservoirs are the largest of a group of 35 Wolfcamp fields in Andrews County, and their production is some 80 percent of the total production reported for these reservoirs. Although a small play in terms of in-place oil (388 million barrels of oil originally in place), the play is a significant target for improved recovery efficiencies.

43. Pennsylvanian Platform Carbonate

These Pennsylvanian-age platform-edge carbonates are located on or near the eastern edge of the Central Basin Platform. Reservoir development is due to depositional and diagenetic attributes of this platform-margin environment. Porosity and permeability are developed throughout the relatively thick depositional unit, yet individual beds are quite variable from well to well. Traps are mainly partially productive anticlinal structures. Permeability is low, averaging about 10 md.

The six reservoirs included in the play represent approximately 10 percent of the total Pennsylvanian fields of a similar origin, yet their production exceeds 60 percent of the oil produced from all the Pennsylvanian fields. Over 440 million barrels of original in-place oil are indicated from data available for the six fields. Of this, 91 million barrels (90 percent of ultimate recovery) have been produced.

44. Northern Shelf Permian Carbonate

This play of 17 fields produces from carbonates of the Permian San Andres Formation, and lower and upper Clear Fork Group. These carbonates were deposited in a restricted platform environment; reservoir development is extensive, but it is laterally and vertically variable. Transgressive-regressive depositional cycles (Ramondetta, 1982) of major and minor importance are responsible for reservoir heterogeneity and reflect both regional and local changes in sea level, salinity, and bottom topography. Furthermore, diagenetic changes greatly altered the porosity and permeability of the sediments. Although not all located on the geographically defined northern shelf, the productive zones in those fields involved are restricted platform deposits of the San Andres and are therefore included in this play. Significant quantities of hydrocarbons will remain after primary and secondary recovery; however, much of this is contained in the Wasson, Slaughter, and Levelland Fields where tertiary recovery and infill drilling are being attempted. The fifteen reservoirs listed have an estimated 12.0 billion barrels of oil originally in place; projected ultimate recovery is 4.2 billion barrels.

45. Delaware Sandstone

Five major and numerous smaller reservoirs constitute the Delaware Sandstone play, which is located in the Delaware Basin. Reservoirs were deposited as submarine channel systems produced by the down-slope flow of dense, saline water from the surrounding evaporative shelves. Consequently, unlike typical submarine slope or fan systems, reservoir facies are clean, well-sorted, permeable sandstones. Entrapment is stratigraphic, and solution gas provides the primary drive mechanism. Most reservoirs are unitized and undergo waterflood to improve recovery. In-place reserves total nearly 500 million barrels.

46. Panhandle Granite Wash/Dolomite

The Panhandle field was first discovered in the Osborne area of Wheeler County in 1910 and subsequently extended into Gray, Carson, Hutchinson, and Moore Counties in the 1920's with later extensions to Collingsworth and Potter Counties. Panhandle field reservoirs include sandstones, conglomerates, dolomites, and limestones. However, principal production is from the granite wash and the "Brown" dolomite or limestone. The granite-wash arkose was derived from the Precambrian granite core of the Late Paleozoic Amarillo-Wichita Uplift. Typically, such arkosic fan-delta (Dutton, 1982) deposits interfinger with shallow marine units. Deposits in this play, both arkose and shallow marine carbonates, provide reservoir beds covering a very large area. The "Brown" dolomite, and the "Panhandle" limestone, "arkosic" lime, and granite wash, produce from traps that are primarily structural with porosity development related to depositional controls.

The API (1980) estimated original oil in place for the Panhandle Field of over 6 billion barrels. Ultimate recovery according to API will be some 1.45 billion barrels. Well spacing is difficult to determine in the multiple-zone producing area, as several different periods of development occurred, however, many 10 acre spacing units exist.

Large numbers of independent operators, as well as major oil companies, participated in the development of the play. Currently, many secondary recovery projects are underway that include both gas and water injection.

47. Panhandle Morrow

This group of fields in the Panhandle area is located north of the Amarillo-Wichita Uplift and its associated granite wash fields. The Morrow reservoir, which is the producing horizon in the R.H.F. and Farnsworth Fields, has been productive in approximately 60 other smaller fields. Most of these reservoirs are small because the sandstones that comprise the reservoir rocks were deposited in deltaic and strandline environments and do not cover extensive areas. The 51 million barrels cumulative production for the R.H.F. and Farnsworth (Morrow) Fields is approximately 40 percent of the total for all Morrow fields in the Panhandle area.

Miscellaneous Reservoirs

Four reservoirs constitute large but isolated production in the Gulf Coast:

Willamar and Willamar West Frio reservoirs, with 206 million barrels of oil in place, occur on an isolated dome in Willacy County north of Brownsville. Reservoirs are the topmost sands of the Norias Delta System of the Frio Formation (upper Oligocene). No other significant production of this type is known from South Texas. The Berclair Vicksburg reservoir is formed by a Vicksburg sand occurring updip from the Vicksburg flexure in Central Texas. Ultimate recovery is about 13 million barrels. Lytton Springs reservoir is a palagonite tuff mound in Caldwell County, south of Austin. Production is from intergranular and fracture porosity in the tuff, which forms an isolated porous lens (isolani) within Upper Cretaceous chalk, marl, and clay. Ultimate recovery is about 11 million barrels, with a recovery efficiency of only 15 percent. Smaller volcanic and volcanic-related reservoirs are scattered through Caldwell and adjoining counties along the Luling and Balcones fault trends (Ewing and Caran, 1982); cumulative production is approximately 32 million barrels.

Piercement salt domes produce some of the largest and best known oil fields in Southeast Texas. Although cumulative production has been large, individual reservoir size is small, generally under one million barrels. This is due to the intense faulting that occurs atop and on the flanks of most salt domes, combined with sand pinchouts towards the crest of the domes. Large reservoirs are infrequently found in lower flank sands of the Yegua Formation (see the Yegua salt-dome flank play) and within caprock (see the Caprock play). Supradome production is abundant in some domes; this merges imperceptibly with the deep-seated dome plays. In particular, Sugarland, South Houston and Raccoon Bend fields are found immediately above the top of salt. The dividing line for inclusion in the "deep-seated dome" plays is the existence of relatively uniform fluid contacts over large portions of the dome. Production on the piercement salt domes is from formations ranging from Wilcox and Cretaceous at Clay Creek to Miocene and Pliocene in many of the coastal domes. Reservoir properties vary widely, but porosity and permeability are generally high. The larger supradome and most flank reservoirs produce by water drive aided by gravity segregation, but most of the smaller supradome reservoirs, and some flank reservoirs, have weak solution gas drive. Gas caps are uncommon, except in lower flank reservoirs.

No meaningful estimates of oil in place can be made for these fields, as the tapping and draining of new fault blocks is continually underway. Gas-injection "attic" and water-injection "cellar" secondary recovery projects give high recovery efficiencies in individual fault blocks, often from one well. Because of continual redevelopment and workover, production of these largely stripper fields has decreased only very slowly in the past decades, giving rise to high estimates of reserves and ultimate recovery. The target for stratigraphic-infill drilling is small, as the structural complexity overrides most stratigraphic variation.

Four isolated reservoirs occur in East Texas. Shelf limestones and fluvial, deltaic, and strandplain sandstones comprise the reservoir rocks, which range in age from Upper Jurassic (Smackover Formation) through Upper Cretaceous (Wolfe City Formation). Combination stratigraphic-structural and structural traps and solution gas drives are the dominant trap and drive mechanisms. Well spacings range from 10 to 320 acres, and cumulative production for all reservoirs totals 70 million barrels. Two reservoirs are recent discoveries (Brantley Jackson and Cheneyboro).

In North-Central Texas, six isolated reservoirs, ranging in age from Ordovician through Pennsylvanian, have individually produced over 10 million barrels of oil. Reservoirs range from open-shelf limestones to shelf/deltaic transitional facies. Cumulative reserves of each field are modest.

Quinduno is the only field currently producing from the lower Albany dolomite in the Panhandle. Cumulative production of 61 million barrels approaches the estimated ultimate recovery figure of 64 million barrels.

CONCLUSIONS

Factors Determining Recovery Efficiency

The overall efficiency of primary oil recovery is largely determined by three groups of variables: (1) the drive mechanism (energy source), (2) basic rock properties (lithology), and (3) fluid properties. Where large groups of fields are being considered, the average productivity may be reasonably approximated by cross plots of drive mechanism, lithology, and oil gravity (W. Dietzman, U.S. Department of Energy, personal communication, 1982). Significant deviations from such average curves indicate important modification of the producibility of oil by other parameters, such as abnormally low permeability or poor reservoir continuity.

More detailed mathematical treatment of oil production (American Petroleum Institute, 1969) shows that, for solution gas and water drive reservoirs, recovery efficiency is controlled by reservoir porosity, permeability, water saturation, formation volume factor, oil viscosity, and the ratio of initial or bubble point pressure and pressure at abandonment. However, even these more extensive statistical treatments of reservoir performance retain much unaccounted for variability. More recently, production engineers and geologists have recognized a fourth family of variables that relate to the genetic facies make-up of the reservoir (Harris and Hewitt, 1977). As pointed out by Alpay (1972), variations in ultimate hydrocarbon recovery from a reservoir are due to three levels of heterogeneity. Microscopic heterogeneities are variations that occur at the dimensions of pores within the rocks. Macroscopic heterogeneities determine well-to-well variability. Megascopic heterogeneities reflect field-wide or regional variations in reservoir attributes.

Microscopic variables include pore-size distribution, pore geometry, and amounts of isolated or dead-end pore space. These elements primarily affect the irreducible water saturation (S_W) and the residual oil left in swept portions of the reservoir. Consequently, analysis of microscopic heterogeneity is particularly important in design of tertiary recovery programs.

Macroscopic heterogeneity is a product of primary stratification and internal permeability trends within reservoir units. Complexities include:

1. Stratification contrasts in grain size, texture, degree of cementation, etc.
2. Non-uniform stratification or bedding.
3. Lateral discontinuity of beds.
4. Insulation to cross flow due to low-permeability zones.
5. Permeability heterogeneity.
6. Vertical or lateral permeability trends.
7. Permeability anisotropy.

All of these features are inherent attributes of the reservoir that are products of its depositional history and subsequent diagenetic overprint. It is at the scale of such macroscopic variability that large volumes of reservoir are partially or wholly isolated from the effective swept area. The scale of these features is commonly measurable in terms of a few acres areally or a few feet vertically. Consequently, compartments or layers that are not drained by conventional well spacing or completion practices may, if recognized, be tapped by selected infill drilling or by modification of well completion practice.

Megascopic variations, such as lateral facies changes, porosity pinch-outs, and separation of reservoirs by widespread sealing beds are also products of original depositional setting or subsequent structural deformation and modification. Such large-scale variations are conventionally evaluated during the course of modern reservoir development and management by techniques such as porosity mapping, net pay isopach preparation, and detailed well log cross section correlation.

Utility of Genetic Depositional and Diagenetic Models

The application of genetic reservoir analysis to field development is relatively new. Certainly few reports or applications contained within the Texas Railroad Commission files indicate use of geologic data beyond the conventional applications, which are directed at megascopic variations within a field area.

A survey of the literature shows that the state-of-the-art use of genetic models in interpretation is most advanced in sandstone reservoirs. However, the potential utility of facies or combined facies/diagenetic analysis in limestone and dolomite reservoirs is indicated by studies such as that of the Zelten field (Bebout and Pendexter, 1975) and a more detailed review by Jardine (1977). In sandstones, genetic facies interpretation and models were first and foremost developed for, and directed toward, improving prediction of reservoir distribution within areas of exploration. Genetic models of sandstone bodies were defined to allow early recognition of reservoir origin so that the direction and probable extent of specific oil-bearing sandstones could be predicted. The application of facies analysis to stratigraphic-trap exploration and discovery-well offset drilling led directly to the development of models that predict external geometry of a sandstone body--its trend, lateral extent, thickness, and potential for recurrence. More than 20 years of effort have been devoted to the generation and application of such exploration-oriented models.

A much smaller body of literature illustrates the potential use of genetic stratigraphic analysis in field-development and enhanced recovery programs. In many areally extensive fields, external dimensions of the sand bodies, rather than trap size, determine the productive limits of the reservoirs. In a classic study of the Frio Sandstone in Seeligson field in South Texas, Nanz (1954) described and interpreted the complex distributary channel geometry of a major reservoir sand body. In Seeligson, reservoir dimensions are areally delimited by the sand-body geometries which, in turn, reflect deposition by upper delta-plain fluvial and distributary channels within a large, long-lived delta system. Weber (1971) illustrated the different areal and cross-sectional geometries of reservoir sand bodies deposited in distributary channel, coastal barrier, and meander-belt environments of the Tertiary Niger delta system. The variable trend and continuity of individual depositional units results in multiple oil-water contacts and areal configurations for productive horizons in the structurally-trapped fields.

Single reservoirs, as defined from apparent correlation and uniform fluid content, may in fact consist of a mosaic of individual genetic units. Pennsylvanian sandstones in the Elk City field of the southern Anadarko Basin provide a graphic example of the genetic complexity inherent in many large reservoirs. Elk City is a large asymmetrical anticline covering about 25 mi^2. Detailed stratigraphic analysis of one reservoir (Sneider and others, 1977), the L_3 zone, revealed highly variable thickness and distribution patterns that reflect an equally complex facies composition. Core, log pattern, and isolith data were combined to differentiate and map alluvial channel fill, distributary channel fill, delta margin, and barrier bar sandstone facies. Distribution of these facies influences the comparative efficiency of various well completion and recovery practices. Similarly, Hartman and Paynter (1979) describe several examples of reservoir drainage anomalies, some of which are clearly related to facies boundaries within single reservoir sand bodies. For example, wells penetrating distributary channel fills were found to have poorly drained adjacent delta margin facies. Closely-spaced in-fill wells tapped essentially virgin reservoir pressures and oil-water contacts. Significantly, porosity and permeability of the geologically young Gulf Coast reservoirs described are high, reflecting the unconsolidated condition of the sands. Similar drainage anomalies were noted during infill drilling of Devonian carbonate reservoirs in District 8. Here wells as close as 200 ft (60 m) to abandoned wells have produced water-free oil at near virgin pressures.

Within a single genetic facies, macroscopic heterogeneities are introduced by bedding and spatial variability of textural parameters. Bedding produces a stratified permeability distribution that restricts cross-flow and channels fluids within the more permeable beds (Polasek and Hutchinson, 1967; Alpay, 1972). Preliminary studies (Zeito, 1965, for example) indicated the potential for continuity of internal permeability stratification and showed that the geometry and continuity of bedding was correlative with interpreted depositional environment of the sand body. Weber (1982) has presented a quantitative summary of the relationship between environment and continuity of shale beds. The impact of horizontal layering is well recognized in reservoir simulation studies; however, more complex bedding styles associated with lateral accretion or progradation are less commonly recognized. Shannon and Dahl (1971) demonstrated compartmentalization of a distributary mouth bar reservoir by progradational bedding geometry in a Strawn delta system deposited in the Midland Basin. Recognition of the individual reservoir lenses, which reflect the deposition of frontal splays, suggested modifications to well completion practices and improved oil recovery.

Within relatively uniform sand bodies or their component beds, permeability may vary systematically either laterally or vertically, and thus influence fluid flow pattern. For example, distinctive vertical permeability trends reflect textural trends characteristic of channel fill, delta front, and barrier shore-face sequences comprising the Elk City reservoirs (Sneider and others, 1977). From this and other studies, Sneider and others (1978) suggested generalized trends of various reservoir properties for framework bar- and channel-type facies of delta systems (table 2). The trends suggested are qualitative but may be calibrated with engineering data and used to develop an accurate reservoir simulation model and improve oil recovery in deltaic reservoirs (Weber and others, 1978). Spatial organization of reservoir properties of the sand facies of other types of depositional systems are less well documented. In addition, systematic lateral variation in permeability is poorly described but is suggested by limited studies of modern sand bodies. For example, Pryor (1973) demonstrated a general down-channel decrease in average permeability in two river point bars.

Finally, grain orientation and textural lamination introduce microscopic variability, which, if systematic, produces permeability anistropy within the sand bed. Limited study of modern sand bodies (Pryor, 1973) showed maximum permeability in alluvial sands to be oriented along the channel axis. Thus, flow is easiest along the axis of the resultant genetic unit. In contrast, upper shoreface and beach sands have maximum permeability axes that are oriented parallel to wave swash, producing an axis of maximum permeability that is perpendicular to the trend of the sand body.

Taken together, studies of both modern sand bodies and their reservoir counterparts suggest that genetic interpretation allows prediction of a hierarchy of parameters,

Table 2. Generalized reservoir characteristics of delta system framework sand bodies (modified from Sneider and others, 1978). S_w = irreducible water saturation.

	Grain Size	Sorting	Porosity	Pore Size	Permeability	S_w	Continuity
Top	Finest	Best	Highest	Small	Lowest	Highest	Deteriorates Upward
Distributary Channels	↓	↑	↑	↓	↓	↑	↓
Bottom	Coarsest	Poorest	Lowest	Large	Highest	Lowest	Best
Top	Coarsest	Best	Highest	Large	Highest	Lowest	Best
Channel Mouth Bars; Delta Front Sands; Coastal Barriers	↑	↑	↑	↑	↑	↓	↑
Bottom	Finest	Poorest	Lowest	Small	Lowest	Highest	Deteriorates Downward

ranging from external dimensions and morphology to internal compartmentalization and permeability stratification, heterogeneity, and anisotropy, that affect reservoir performance. Integrating and calibrating these predictions with reservoir engineering data has been shown to produce considerable improvement in recovery efficiency.

Example: Fluvial System Models

As would be expected from the highly variable depositional styles, fluvial (river) systems constitute diverse reservoirs for oil and gas. At one extreme, sand-rich systems contain abundant reservoir rock but are source and seal-poor; conversely, mud-rich systems contain only moderate quantities of reservoir lithologies encased in abundant mudstone. However, all fluvial systems share several common attributes as reservoirs. (1) Principal reservoirs are the channel fill and bar sands. Crevasse splay sands are a secondary reservoir facies. (2) Reservoir continuity is excellent to good, at least along channel trend. (3) Internally, fluvial reservoirs are extremely heterogeneous and anisotropic.

Sand-Rich Fluvial Systems

Permeable, framework sand bodies form abundant, well-interconnected reservoirs in sand-rich systems (fig. 4A). Broad sand belts are internally complex and texturally variable, but the lack of systematic stratification or laterally continuous permeability barriers results in highly productive reservoirs that behave homogeneously to fluid flow at the scale of typical reservoir development.

Mixed-Load Fluvial Systems

Increased deposition and preservation of bounding mud facies within mixed-load fluvial systems result in greater isolation of the meanderbelt sand bodies, which are characterized by well-developed and complex anisotropy and heterogeneity, particularly in their upper portion, where hydrocarbons preferentially accumulate (fig. 4B). The systematic upward-fining textural trend is reflected by upward-decreasing permeability.

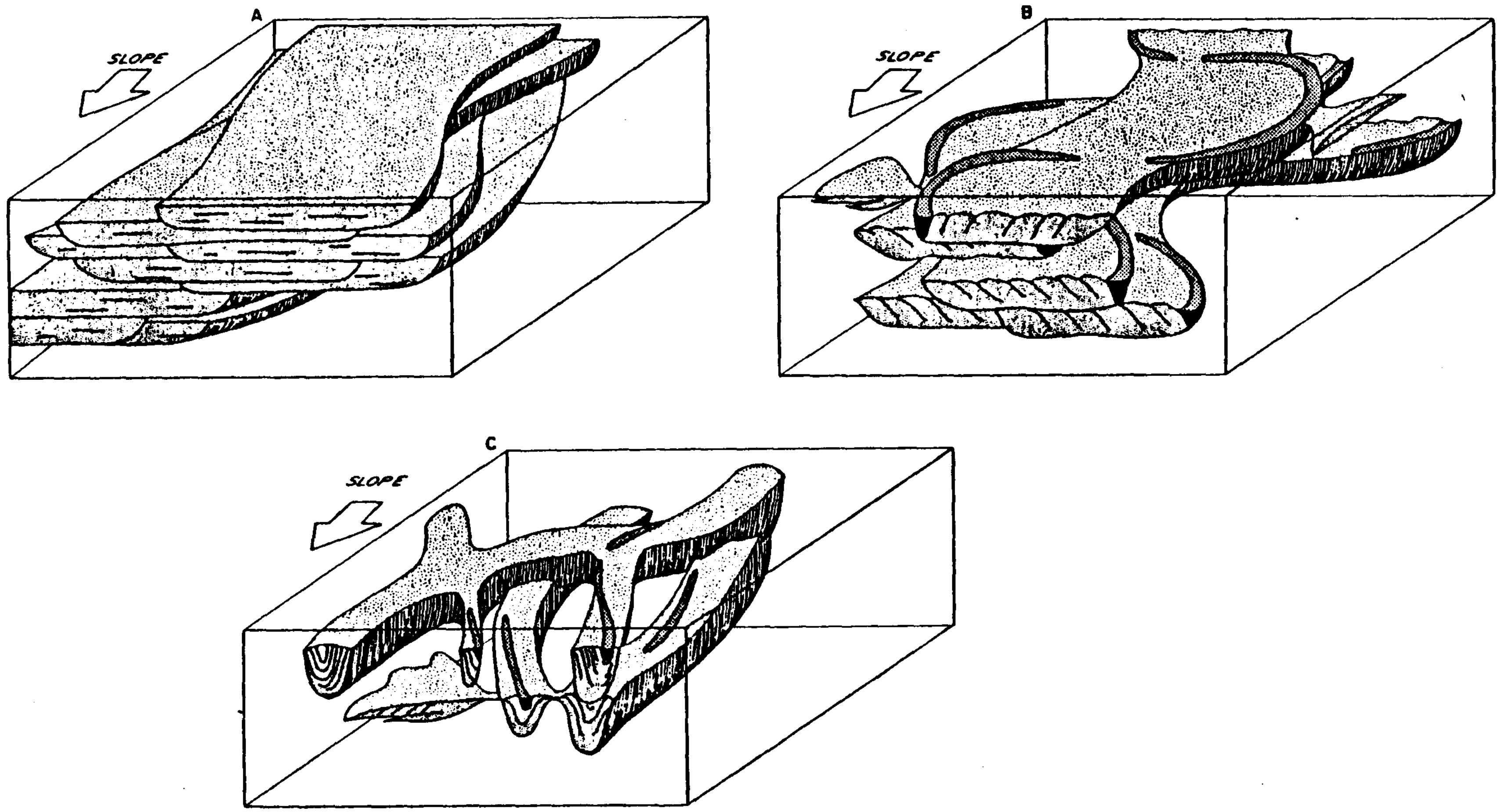

Figure 4. Block diagrams illustrating the variable reservoir geometries produced by sandstones of three kinds of fluvial (river) systems. The sand-rich river (A) deposits nested, tabular sand bodies. The mixed-load river (B) generates nested, sinuous belts of sand containing cross-cutting shale and silt interbeds and elongate, arcuate mud lenses, or plugs. Additional complexity is introduced in reservoirs deposited by mud-dominated rivers (C), which form lenticular, interweaving, highly compartmentalized sand bodies.

Lateral-accretion bedding introduces permeability stratification that cuts across the sand body. The resultant permeability units are arcuate in plan view. The reservoir may be partially compartmentalized by mud plugs. In addition, the top of the permeable reservoir lithology commonly displays buried topography, reflecting preservation of ridge-and-swale and channel plugs.

Mud-Rich Fluvial Systems

Increasing preservation of muddy facies and consequent isolation of permeable channel-fill facies make suspended-load systems ideal targets for stratigraphic trap exploration. Isolated meanderbelt or anastomosed "shoe-string" sand bodies commonly display great variation in trend and are typically small reservoirs, rarely containing more than a few tens of millions of barrels of producible petroleum (fig. 4C). They pose great difficulty in the development of large structurally-defined fields because of their limited dimensions, variable orientation, and erratic isolation.

Both lateral accretion and symmetrical bedding (fig. 4C) produce cross-cutting permeability stratification. The upward-fining textural trend is reflected in upward-decreasing reservoir quality. Channel plugs, which are typically muddy, further compartmentalize the reservoir and, as in mixed-load channels, may play a major role in defining the trap. Topography on the top of permeable, hydrocarbon-saturated sand may be quite significant and is commonly accentuated by differential compaction and draping.

Summary of Play Results

Analysis of the results of characterization of each of the major Texas oil-producing plays provides several insights into the factors that determine ultimate recovery of hydrocarbons from a reservoir.

The median recovery efficiency of the plays is 38 percent. Graphical presentation of recovery efficiency shows a tendency of data to group into three classes. Poor reservoirs give up less than 32 percent of the in-place hydrocarbons. The better reservoirs yield more than 46 percent of their oil. The large family of average reservoirs are projected to recover between 32 and 46 percent of the oil in place. However, within a single play, the range of recovery from reservoir to reservoir may vary greatly. Comparison of play averages, as well as evaluation of intraplay variability, suggests several trends and generalizations about factors determining ultimate field recovery.

1. The most obvious factor determining recovery efficiency is the reservoir drive mechanism. A strong natural water drive or a combination of drive mechanisms working in concert characterize nearly all plays that are projected to produce more than 40 percent of their oil in place. In contrast, nearly all low-recovery plays are characterized by solution gas drives. Significantly, however, well-engineered and carefully managed solution gas reservoirs may approach the recovery efficiency of water drive reservoirs. Because most large plays are composites of numerous fields, the extent of applied production technology ranges widely, and, for the play as a whole, the calculated recovery efficiency tends to reflect the well-known relative efficiency of the natural drive mechanism.

2. Lithology also influences recovery efficiency, but there is great overlap among the various lithic categories. In general, comparison of average play recovery efficiency shows that sandstone reservoirs are better than limestone reservoirs, which are, in turn, better than dolomite reservoirs. Conglomerates appear to be quite variable. Sand and sandstone reservoirs show great variation in average recovery, which is strongly influenced by the drive mechanism operating within the reservoir. Dolomite reservoirs exhibit, at best, moderate recovery efficiencies. Like sandstones, they too are least efficient in solution gas drive reservoirs.

3. Porosity shows little direct correlation with recovery efficiency. However, a weak inverse correlation between porosity and residual oil saturation is apparent.

Published reservoir-specific data (Murphey and others, 1977) suggest a decrease in residual oil as porosity increases within the same lithologic type.

4. Permeability varies widely among the reservoirs of the various plays, but shows little obvious correlation to recovery efficiency. Permeability appears to be an overriding limitation on ultimate production only in a few reservoirs where average values are very low (less than a few millidarcys).

5. Specific gravity of the oil, expressed as API gravity, is a factor in limiting recovery in a few reservoirs. Within most plays, oil gravity varies within a narrow range, and thus does not account for production variability within the play. Oil viscosity would likely be a more effective predictor of recovery efficiency, but viscosity is highly dependent on measurement techniques and conditions, which are rarely specified in hearing files.

6. The impact of well spacing on recovery is difficult to isolate. Within individual plays, spacing is commonly reasonably uniform; differences that do exist commonly reflect major changes in overall recovery strategy or technology. To further confuse possible trends that might emerge from comparison of various plays, many shallow, low-recovery reservoirs are common targets for dense well spacing. Even with unusually close well spacing, they are still poor to average reservoirs. The argument that decreased well spacing leads to improved ultimate recovery, other factors being equal, is strongly supported by numerous individual field files, which document measurably increased projections of ultimate recovery following programs of infield drilling. Many such programs date to the early 1970's and thus have substantial follow-up to document results.

7. Field development practice emerges as one of the most obvious controls on ultimate recovery efficiency. This is made readily apparent by comparison of the average production efficiency of the large, and consequently more thoroughly engineered reser-

voirs included in this survey, with the Texas average. Average projected recovery of the larger reservoirs noticeably exceeds the average of all reservoirs included in the tabulation.

8. Reservoir genesis--the geologic origin and nature of the producing zone--emerges as an important factor in determining (and predicting) recovery efficiency in well-managed fields. Firstly, numerous parameters discussed in points 1 through 7 are interrelated variables that are determined by the geologic history of the reservoir. Secondly, although the relationship between interpreted reservoir genesis and productivity is modified by extremes in permeability or fluid parameters, it otherwise follows predictable trends based on the known scale and internal complexity of depositional or diagenetic "compartments" and heterogeneity within the geologic system.

Fan and Fan Delta Systems

Fan and fan delta systems contain a multiplicity of small facies elements exhibiting great textural and compositional heterogeneity. Barring extensive diagenetic modification, the coarse grain size and consequent high initial permeability of the reservoir sandstones and conglomerates compensates somewhat for the extensive compartmentalization. Production from the Panhandle and Bend conglomerates plays suggests that a broad range of production efficiency typifies fan reservoirs.

Fluvial Systems

Fluvial reservoirs occur both as independent depositional systems and as an important element within deltaic systems. At the level of this preliminary analysis, specific interpretation is rarely possible. However, examination of individual field data, including the rare files that presented specific facies interpretations of the reservoir, indicates that conventional recovery from fluvial channel facies is typically moderate to low. Exceptions include coarse-grained, sand-rich meanderbelt and braided stream deposits such as some of the Bend conglomerate reservoirs or the Woodbine in Neches field.

Fluvio-Deltaic Systems

Fluvio-deltaic systems are a major producing class in many clastic reservoirs of North, East, and Coastal Plain Texas. Facies have a wide range of production efficiencies. However, closer examination shows a predictable correlation between reservoir productivity and type of delta system. Fluvial-dominated deltas, which occur in such plays as the Strawn sandstone and shale, Pennsylvanian shelf sandstone, and Frio/Vicksburg sandstone plays, historically have low to average production efficiencies. In contrast, wave-dominated deltas, such as much of the Woodbine, including East Texas field, have well above average production efficiencies. Large deltas, such as those of the Frio deep-seated dome play of the Upper Coastal Plain, that exhibit considerable wave modification and produce with the aid of gas cap expansion and gravity drainage, are also highly productive.

Clastic Shore-Zone (Barrier Bar/Strandplain) Systems

Clastic shore-zone (barrier bar/strandplain) systems are typified by well-sorted, laterally continuous sand bodies. They exhibit high productivities in plays, such as the Frio barrier/strandplain play, where structural entrapment results in accumulation of oil in the massive, well-developed barrier core sands. Water or combination drive mechanisms also characterize such plays. However, stratigraphic entrapment places the oil in the updip back-barrier sands, which are thin, shaly, and discontinuous. In such plays, solution gas provides most of the reservoir energy, and productivity is only low to moderate.

Clastic Slope/Basin Systems

Clastic slope/basin systems contain reservoirs deposited as facies in submarine fans and channels. Such reservoirs have inherently low recovery efficiencies, which are further limited by the dominance of stratigraphic isolation and solution gas drives. Sediments are commonly fine-grained, with low permeability and high residual oil saturations. Finally, internal compartmentalization and heterogeneity of submarine fan and channel reservoirs are inherent attributes of the depositional processes.

Open Shelf and Associated Reef/Banks

Two major plays, the Horseshoe Atoll and the Pennsylvanian reef/bank trends, produce oil from limestone knolls, pinnacles, and atolls buried by basinal shales and mudstones. Entrapment results from the burial of the carbonate porosity mound within the impermeable sealing shales. Most reservoirs of these reef/bank complexes exhibit solution gas drives, occasionally augmented by water drive where the base of the carbonate mass connects to a widespread limestone unit. The vertical relief, lateral isolation, strongly developed permeability layering, and large reserves typical of open shelf reef and bank reservoirs has resulted in extensive unitization and systematic field development. As a result, recovery efficiencies are unusually high, particularly for solution gas drive-dominated reservoirs.

Open shelf reef and bank limestone bodies of Texas are similar to the reservoir of the famous Redwater field of Canada. At Redwater, careful attention to geologic description of the reef complex and its component facies--reef, fore-reef, and back reef--resulted in better definition of flow patterns during injection (Jardine and others, 1977). Application of this information, in turn, resulted in modification of injection well location and recompletion intervals. Projected recovery is now placed at 65 percent of the oil in place.

Platform Margin Reef/Bank Systems

Accumulations of plant and animal debris along shallow water, submerged platform edges formed organic reef and bank units characterized by great lithologic and diagenetic heterogeneity. Unlike the reefs that grew upward from deeper water open shelves and were encased in shale, platform margin reefs and banks commonly grade laterally and vertically into a variety of sealing or less permeable strata. Further, facies belts tend to be thin, narrow, highly elongate, and internally complex. Reservoir quality commonly reflects great post-depositional modification of original sediment texture. At one extreme, leaching by fresh water has produced vuggy, cavernous porosity (and an excellent reservoir) as at Yates field. More commonly, permeability is highly stratified and lenticular, and recovery efficiencies are low. The Pennsylvanian and Wolfcamp platform carbonate plays are typical of this genetic group.

Restricted Platform Systems

Much of the limestone of both the upper Paleozoic and Mesozoic sections of Texas was deposited on shallow water platforms under arid climatic conditions. Consequently, post-depositional diagenesis of original sediments produced extensive beds of dolomite with its characteristically low porosities and permeabilities. Reservoirs are highly stratified and exhibit moderate to high residual oil saturations following flushing. Isolation of permeable zones within lithologically heterogeneous sequences results in dominance of solution gas drive. Together, the comparatively inefficient drive mechanisms, stratification, and combined depositional and diagenetic heterogeneity result in low to moderate recovery efficiencies for plays producing from restricted platform carbonates. Enormous reserves and unrecovered oil are contained within reservoirs belonging to this genetic class, including the San Andres/Grayburg plays of West Texas.

Open Platform and Inner Ramp Systems

Limestones and dolomites of several plays, including much of the West Texas Ellenburger and Devonian production, are tentatively interpreted to have been deposited on broad, shallow to moderately deep, gently sloping carbonate shelves commonly called ramps. Production is controlled largely by post-depositional modifications of the original carbonate strata, including dolomitization, folding and fracturing, erosional truncation and associated diagenesis, leaching, and silicification. Consequently, production efficiency is variable, generally ranging from poor to average. Younger strata, such as the Glen Rose Limestone in the East Texas Basin, contain a few major reservoirs in similar settings. These diagenetically simpler reservoirs, such as the giant Fairway field, may have better-than-average ultimate recovery. Drive mechanisms may be either solution gas or mixed types including natural water drive. Recovery efficiency varies accordingly.

The Target for Strategic Infill Exploration

As a class, the large reservoirs incorporated in this study exhibit anomalously high recovery efficiencies. However, a wide range of productivity is encompassed by the delineated plays. A few yield less than 10 percent of the oil in place; at the other extreme several plays are projected to yield in excess of 60 percent of the in-place reservoir.

Recovery efficiencies of the North and West Texas plays are decidedly lower than those of Coastal Plain and East Texas plays. Comparative recovery indices, described as low (less than 33 percent of oil in place), moderate (33 to 45 percent of oil in place), or high (more than 45 percent of oil in place), of the plays are listed in table 3. Major targets for enhanced recovery, either by strategic infill drilling or by tertiary processes, abound in Districts 8, 8A, and 9. Additional targets exist in moderately productive plays located in Districts 2 and 4.

Principal factors limiting production efficiency include low permeability, low oil gravity (high density), high residual oil saturation in the swept zone (commonly a result of abundant microporosity and high oil viscosity), and reservoir compartmentalization or heterogeneity at a scale smaller than conventional well spacing. Table 4 lists factors limiting recovery in each low- to moderate-productivity play. Plays in which rock or fluid

Table 3. Calculated volumes of oil that constitute the strategic infill target for each play.

Play	Oil in Place (mmbbl)	Ultimate Recovery (mmbbl)	Percent Unrecovered	ROS (%)	Sw (%)	Target Oil* (mmbbl)
Eocene deltaic sandstones	243	93	62	13	28	49
Yegua deep-seated domes	1,727	980	43	19	24	311
Yegua dome flanks	54	29	47	24	23	9
Caprock	---	---	No data	---	---	---
Frio deep-seated domes	4,491	2,590	42	17	26	855
Frio (Buna) barrier/strandplain	102	75	26	14	35	6
Frio barrier/strandplain	4,222	2,235	47	25	26	560
Wilcox fluvial/deltaic sandstone	182	89	51	29	29	19
Jackson/Yegua barrier/strandplain	1,132	427	62	27	33	249
Frio/Vicksburg (Vicksburg Flexure)	779	373	52	35	27	31
San Miguel/Olmos deltaic sandstone	840	178	79	30	48	177
Edwards restricted platform	1,181	358	70	29	31	327
Austin Chalk/Buda stratigraphic traps	---	---	---	37	34	---

Table 3. (cont.)

Play	Oil in Place (mmbbl)	Ultimate Recovery (mmbbl)	Percent Unrecovered	ROS (%)	Sw (%)	Target Oil* (mmbbl)
Rodessa stratigraphic/ structural traps	531	233	56	27	29	96
Paluxy fault line	860	331	62	28	14	249
Cretaceous clastics/salt-related structures	579	258	55	32	22	96
Glen Rose carbonate/salt-related structures	467	232	50	32	27	30
East Texas Woodbine	8,126	6,536	20	15	14	173
Woodbine fluvial-deltaic sandstone	2,291	1,584	31	21	12	160
Woodbine fault line	559	267	52	15	10	199
Strawn sandstone	992	357	64	28	30	238
Bend conglomerate+	241	99	59	24	30	60
Strawn reef	701	206	71	27	27	238
Upper Pennsylvanian shelf sandstone	233	72	70	28	29	72
Pennsylvanian reef/bank	924	405	56	37	23	74
Upper Pennsylvanian basinal sandstone	513	108	79	32	38	138

+Ranger removed from calculation because of inadequate data

Table 3. (cont.)

Play	Oil in Place (mmbbl)	Ultimate Recovery (mmbbl)	Percent Unrecovered	ROS (%)	Sw (%)	Target Oil* (mmbbl)
Eastern shelf Permian carbonate	3,005	878	71	31	33	932
Horseshoe Atoll	4,691	2,412	49	28	25	563
Spraberry/Dean sandstone	10,581	660	93	34	36	4,232**
Central Basin Platform unconformity	1,342	354	74	26	30	498
Ellenburger fractured dolomite	3,150	1,270	60	29	20	756
Siluro-Devonian ramp carbonate	739	322	56	32	25	96
Siluro-Devonian ramp carbonate (S.C.B.P.)	561	275	51	27	39	39
Siluro-Devonian ramp carbonate (N.C.B.P.)	698	201	71	30	24	223
Yates area	4,070	2,040	50	25	26	692
San Andres/Grayburg (Ozona Arch)	837	230	73	25	24	452
San Andres/Grayburg (S.C.B.P.)	10,286	2,712	74	25	25	4,217

**Total should be significantly reduced because of low permeability and fractured nature of most reservoirs; only 1/4, or 1,050 bbls, were included in final summation of target.

Table 3. (cont.)

Play	Oil in Place (mmbbl)	Ultimate Recovery (mmbbl)	Percent Unrecovered	ROS (%)	Sw (%)	Target Oil* (mmbbl)
San Andres/Grayburg (N.C.B.P.)	2,400	818	66	26	19	816
Permian sandstone and carbonate	2,961	1,053	64	32	37	385
Clear Fork platform carbonate	4,084	924	77	30	28	1,429
Queen platform/strandplain	324	103	68	26	37	87
Wolfcamp platform carbonate	388	125	68	32	25	97
Pennsylvanian platform carbonate	442	101	76	35	28	119
Northern Shelf Permian carbonate	12,021	4,209	65	40	23	1,562
Delaware sandstone	484	92	81	19	41	237
Panhandle granite wash/ dolomite	6,060	1,450	76	35	37	1,212
Panhandle Morrow	188	53	72	27	33	60

Target oil = Percent unrecovered - (ROS/1-Sw) properties restrict productive efficiency are primarily targets for tertiary recovery processes. Those in which reservoir depositional or diagenetic complexity plays a significant or dominant role in limiting recovery are potential targets for infill drilling.

Determination of the total amount of oil that constitutes the strategic infill target within each play is primarily dependent on the accuracy of oil-in-place, ultimate recovery, and residual oil calculations. Consequently, comments on the origin and inferred reliability of these numbers in the discussion of the project plan should be borne in mind.

Within the limitations imposed by the data, the calculated infill target for each play is given in table 3. The total potential target for strategic infill exploration and development (in reservoirs where low permeability or oil gravity do not restrict production) is 19.9 billion barrels, or nearly 20 percent of the total oil in place. Extrapolation to the total universe of Texas oil reservoirs yields nearly 30 billion barrels of target oil, a figure somewhat lower than original estimates using data from giant fields, but nonetheless imposing. The validity of the calculated percentage is indirectly substantiated by results of a comparison of oil in place calculated by volumetric and mass-balance methods in the Fullerton field, a major San Andres producer (George and Stiles, 1978). Using the same data base, the volumetric calculation was higher, suggesting that only 75 percent of the oil in place has actually been contacted by producing wells, and was thus reflected in the mass-balance calculation. In other words, 25 percent of the oil in place remained as a target for infield development (George and Stiles, 1978).

Examples of Strategic Infill Drilling

In addition to the calculation of the cumulative infill target represented by the plays, the potential for improving ultimate recovery of Texas' oil resource is further indicated by examples gleaned from the hearing files in the course of data collection. Two comments are in order. First, these examples do indeed suggest that such programs

Table 4. Factors limiting recovery efficiency in plays containing at least 100 million barrels of potential infill-target oil.

		Limiting Factor			
Play	Recovery Efficiency	Low Oil Gravity	Low Permeability	Structural Complexity	Depositional/ Diagenetic Complexity
Yegua deep-seated domes	High			x	x
Frio deep-seated domes	High			x	x
Frio barrier/strandplain	High				x
Jackson/Yegua barrier/strandplain	Low	x			x
Edwards restricted platform	Low				x
San Miguel/Olmos deltaic sandstone	Low		x		x
Austin Chalk/Buda stratigraphic traps	Low		x	x	
Rodessa stratigraphic/structural traps	Low				x
Cretaceous clastics - salt-related structures	Moderate			x	x
East Texas Woodbine	Moderate				x
Woodbine fluvial-deltaic sandstone	High			x	
Strawn sandstone	Moderate				x
Strawn reef	Low		x?		x
Upper Pennsylvanian basinal sandstone	Low				x
Eastern Shelf Permian carbonate	Low		x		x
Horseshoe Atoll	High				x
Spraberry/Dean sandstone	Low		x		x
Central Basin Platform unconformity	Low		x		x
Ellenburger fractured dolomite	Moderate		x		x
Siluro-Devonian Ramp Carbonate	Moderate		x		x
Siluro-Devonian Ramp Carbonate (N.C.B.P.)	Low		x		x
Yates area	High				x
San Andres/Grayburg (Ozona Arch)	Moderate				x
San Andres/Grayburg (S.C.B.P.)	Low		x		x
San Andres/Grayburg (N.C.B.P.)	Low to Moderate		x		x
Permian sandstone and carbonate	Moderate				x
Clear Fork platform carbonate	Low		x		x
Queen platform/strandplain	Low				x
Wolfcamp platform carbonate	Low to Moderate				x
Pennsylvanian platform carbonate	Low		x		x
Northern Shelf Permian carbonate	Low		x		x
Delaware sandstone	Low				x
Panhandle granite wash	Low				x

can improve oil recovery, and that the petroleum industry is actively seeking ways to do so. Secondly, systematic integration of geologic models with field engineering remains extremely rare, showing that much research and popularization of geologically-based infield exploration remains to be accomplished if resultant improvements in state-wide oil recovery are to be realized.

Example 1 - Neches Field (Woodbine fluvial-deltaic sandstone play)

The Neches (Woodbine) field is a simple anticlinal trap producing from a stacked series of laterally discontinuous sandstones deposited as point bars in a meandering river system. The reservoirs are closely analogous to the schematic sandstone bodies shown in figure 4B. Continuous floodplain mudstone and shale units separate sandstone bodies vertically, imparting local but strongly expressed vertical heterogeneity to the reservoir (fig. 5). Truncation of the mudstones and local superposition of sandstone units results in vertically interconnected reservoirs, which originally had a common oil-water contact.

Of great importance to management of the reservoir was the recognition of clay plugs within the point-bar sandstone units (fig. 5). These impermeable abandoned channel fills act as barriers to oil flow as the reservoir drains. The field operator recognized that areas downdip of the plugs potentially trapped oil that would not be drained at the conventional 40 acre well spacing. Detailed structural maps of the top of individual sandstone units, combined with interpretive facies information, were used to outline locations for infill wells (fig. 6). Because these wells had to be drilled off regular spacing, locations were submitted to and approved by the Railroad Commission. Specific results of the infield exploration program are not given, but an indication of the success of the operators is suggested by the estimated recovery of 63 percent of oil in place indicated for this 210 million barrel (in place) reservoir.

Example 2 - Kelly-Snyder Field (Horseshoe Atoll play)

The Kelly-Snyder limestone reservoir displays the pronounced permeability layering typical of carbonate reef deposits (fig. 7A). Lateral discontinuity of the lenses, combined

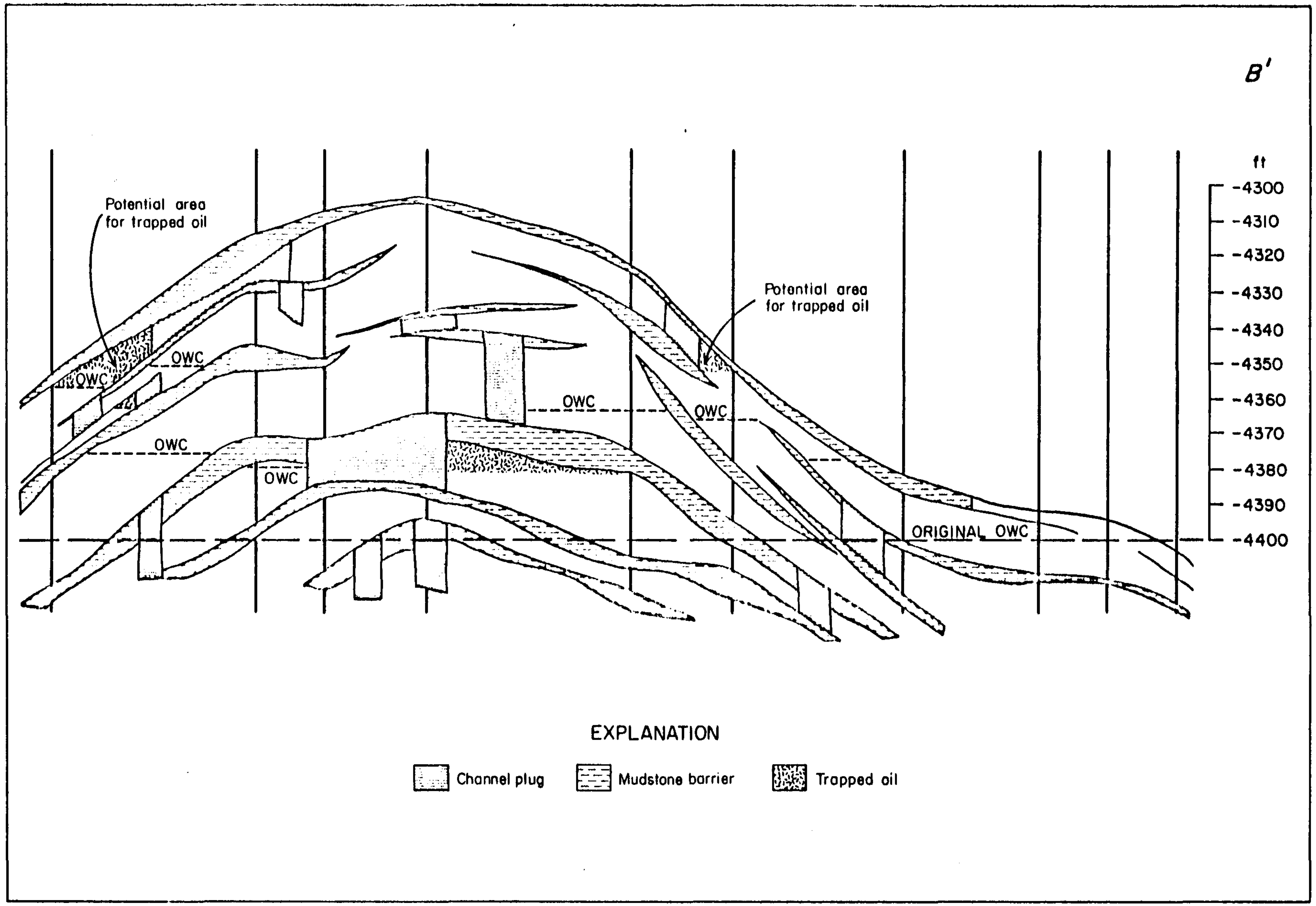

Figure 5. Cross section showing stacked river meanderbelt sandstone bodies forming the Woodbine reservoir in Neches field. Mud plugs form impermeable barriers and locally trap oil within the reservoir.

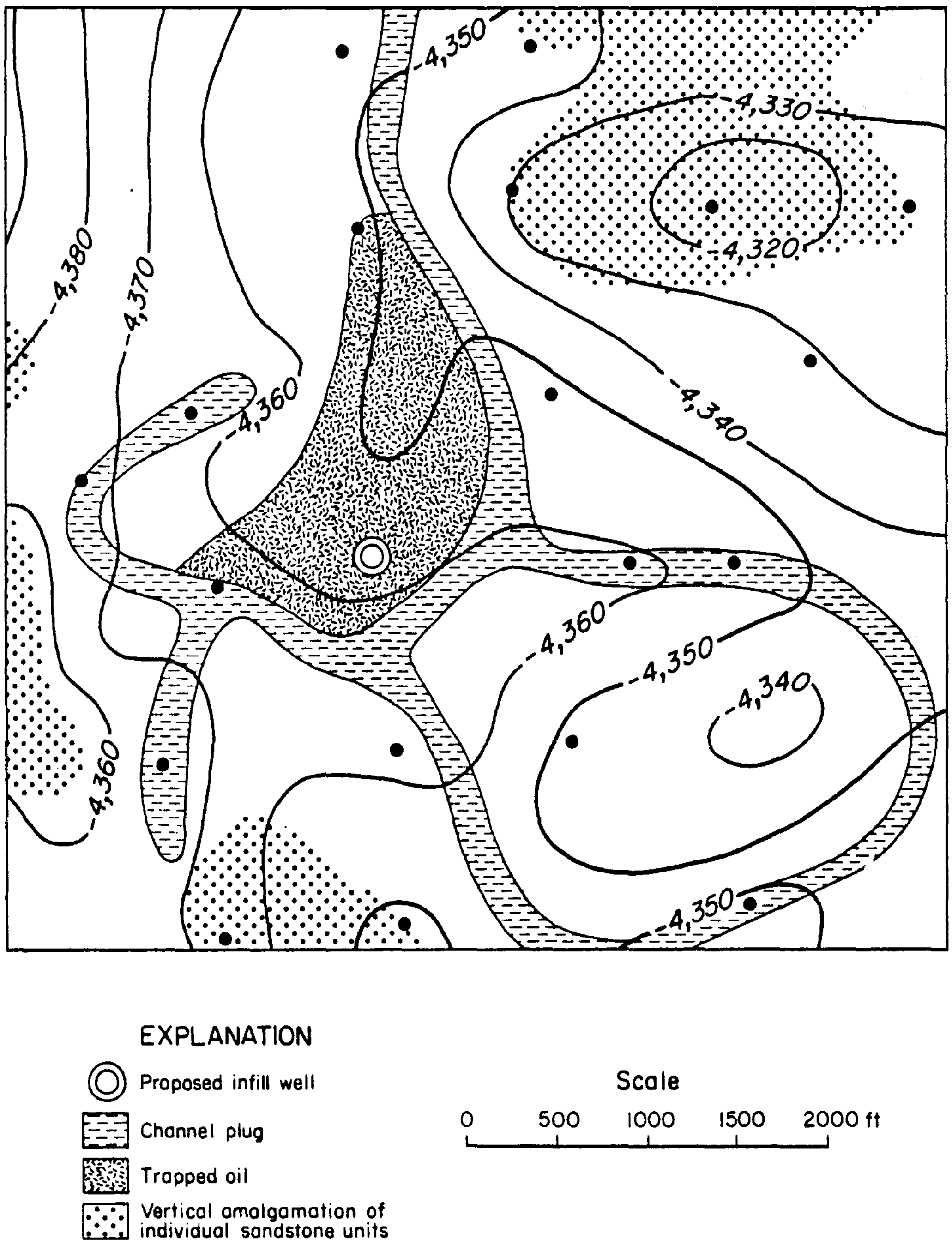

Figure 6. Map of one infill drilling target in Neches field. The contours show the structure on top of a sandstone compartment isolated from the surrounding sandstone by the channel plug.

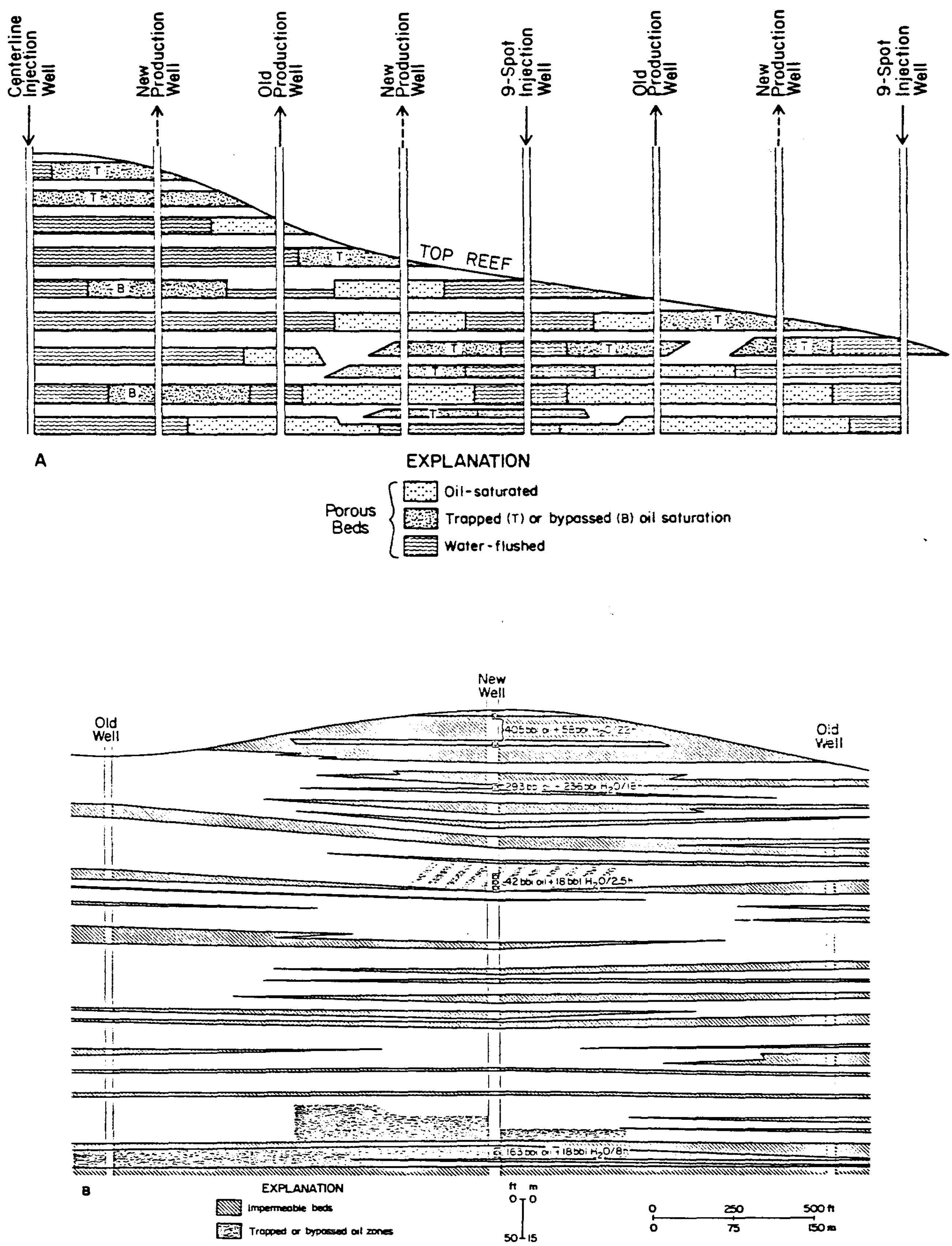

Figure 7. A. Schematic illustration of anticipated trapped oil lenses in the highly layered reef reservoir at Kelly-Snyder field. B. Test results of an infill well drilled to recover lenses of trapped oil.

with irregular topography on the top of the reservoir created isolated lenses of trapped oil. According to the field operator, such lenses were due to several factors, including (1) pinchout of permeable beds between wells, (2) isolation of lenses within local reservoir topographic closures, and (3) less than optimal sweep efficiencies produced by existing injector-well locations and completion intervals. As shown by figure 7B, the infill-well program located substantial new zones of oil production. Over a five year production history following the infill program, an additional production increment of 30 million barrels was attributed by the operator to the infill wells. This amounts to an increase of more than one percent in recovery efficiency for this giant field, which is also undergoing miscible flood.

Example 3 - Block 31 Devonian Field (Siluro-Devonian Ramp Carbonate play)

The reservoir in the Block 31 field is a heterogeneous limestone and chert produced by diagenetic modification of bedded limestones deposited in a deep water portion of an inferred carbonate ramp system. Early in its production history the operator initiated a miscible flood. In 1973, an infill well program was implemented to improve recovery of reserves left in large areas of the reservoir that had been bypassed by injection. As is typical of many miscible displacement programs using injected, high pressure gas, fingering of the injected gas was a main limitation on sweep efficiency. More recently, the operator returned to the Railroad Commission with a plan to follow up the initial infill program, which was deemed highly successful, with two additional infill projects. First, additional wells will be drilled at field edge locations where the producing interval is relatively thin. Secondly, 16 additional infill wells will be sited in selected locations designed to recover oil trapped by intrareservoir discontinuities (fig. 8) and to improve conformance by localizing injection into zones still retaining large volumes of unswept oil.

The operator estimates that primary recovery in the Block 31 field would have been about 20 percent of the oil in place. Conventional secondary recovery practices would

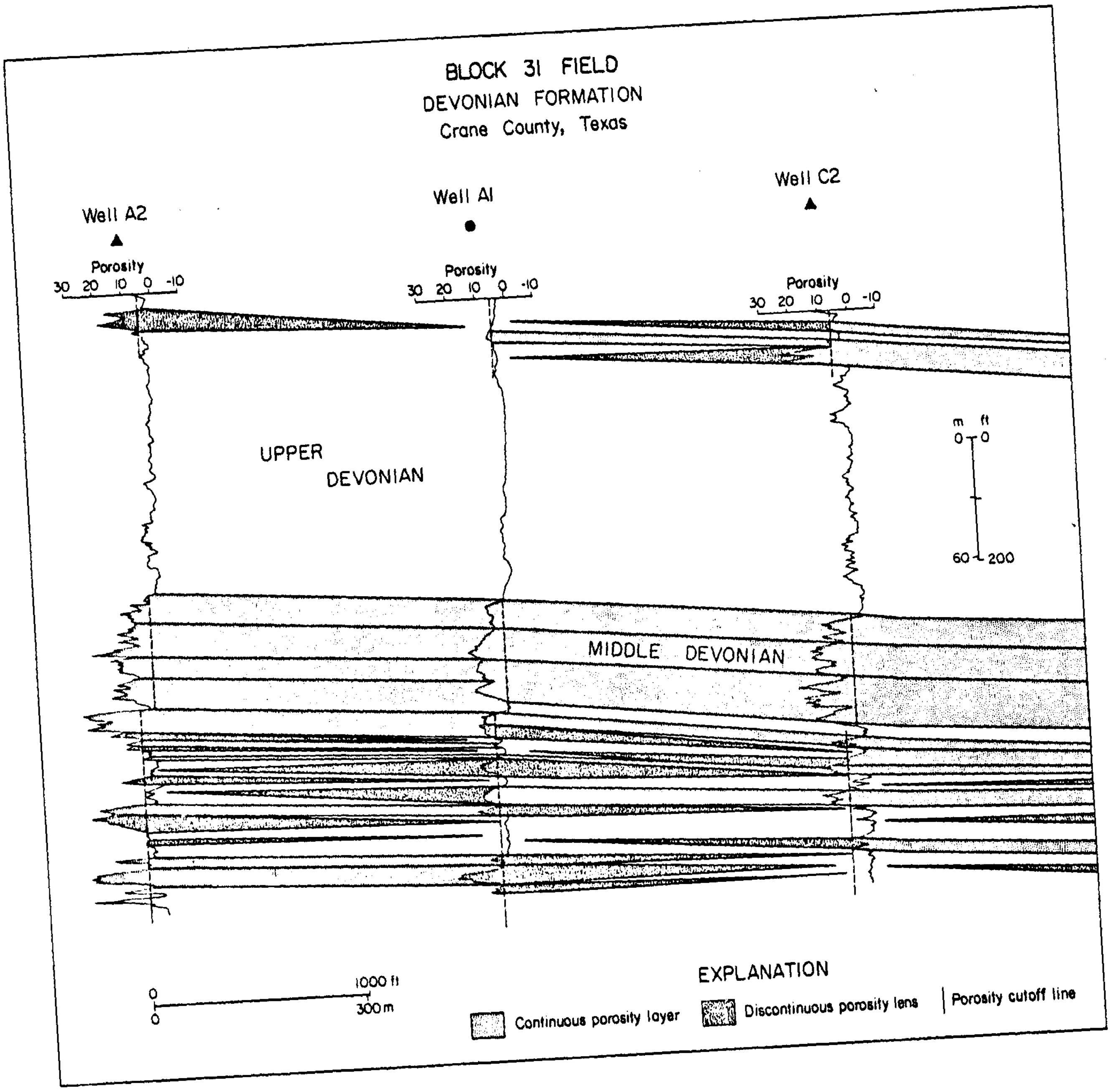

Figure 8. Cross section of a portion of the Block 31 (Devonian) reservoir showing laterally discontinuous porosity layers that could trap oil within the existing well distribution pattern.

have increased this to 30 percent. However, use of a miscible flood and infill drilling, first on the basis of an engineering and then on a geological analysis has resulted in a projected recovery approaching 60 percent of the oil in place. The edge and center infill programs are projected to recover 8 million barrels of additional oil.

Each of these examples illustrates the variety of reservoir heterogeneities and properties that combine with conventional production technologies to limit oil recovery. They also show that fields in advanced stages of depletion may be approached as exploration targets in which additional reserves of oil may be localized and produced by selective infill development.

Selection of Targets for Phase II

Twenty-nine plays each contain potential targets for infill drilling exceeding 100 million barrels. This number does not include plays, such as the Ellenburger, Spraberry/Dean, or Austin/Buda, in which production is influenced by natural fracturing, or plays, such as the San Miguel/Olmos, in which low permeability limits production efficiency. Twenty-three of the 29 plays possess target infill oil volumes approaching or exceeding 200 million barrels (Appendix I), and constitute the most important suite of candidates for further study and description. By far the majority of the candidate plays lie in West Texas Railroad Commission Districts 8 and 8A.

Four genetic, depositional/diagenetic reservoir assemblages contain the great proportion of the target oil:

1. Fluvial/deltaic systems
2. Barrier/strandplain systems
3. Restricted platform carbonate systems
4. Platform margin reef/bank systems

In phase II of this research program, one play representative of two of these major generic categories will be selected for analysis. Candidate plays have been ranked on the basis of the following criteria:

1. Large in-place volumes of unrecovered oil within the candidate play and geologically analogous plays. The size of the target depends on the original oil in place, recovery efficiency, and sweep efficiency. Because high sweep efficiency commonly accompanies high recovery, a low to moderate recovery percentage is not, per se, a necessary qualification for potential candidates.

2. A consensus interpretation that depositional or diagenetic complexities, and resultant isolation of oil within the reservoir, are the primary factors limiting recovery in reservoirs of the play.

3. Presence of multiple potential candidate fields within the play. Multiple targets offer greater opportunity to isolate variables affecting production in an otherwise geologically similar population, and to approach several different operators for the necessary cooperation required for a detailed field study.

Further, the final selection was designed to provide one example of both carbonate and clastic reservoir types, and to provide geographic diversity.

With these criteria and guidelines in mind, the San Andres/Grayburg (of the northern or southern Central Basin Platform) and the Frio barrier/strandplain (Vicksburg Flexure) are the designated targets for reservoir-specific analysis in Phase II of this project. Should unexpected problems or availability of time develop, the Clear Fork platform carbonate and Frio/Vicksburg fluvial-deltaic (Vicksburg Flexure) plays are equally good alternatives or additions.

In summary, these selected plays are representative of two of the most important oil productive units in the state, provide lithologic and geographic diversity, and are representative of important classes of restricted-productivity, generic reservoir types found throughout the state. Improved understanding of parameters influencing production efficiency and of methods for improved extraction of these hydrocarbons will have the potential for widespread application.

RECOMMENDED CONTINUING RESEARCH PROGRAM

As the culmination of the initial phase of this program, data collected are being compiled into an "Atlas of Texas Oil Reservoirs" which will be published by the Bureau of Economic Geology. This atlas will review the pertinent geologic and engineering data for each play, and present selected maps, well logs, cross sections, and interpretative diagrams to illustrate defining attributes of representative fields. This document will be of major interest for both development and exploration personnel in the Texas petroleum industry.

Phase II: Research Program

The first year of this program culminates with regional description, characterization, and ranking of infield reserve potential of Texas oil-producing plays. From this matrix, representative reservoirs from two plays having great potential for substantial improvement in oil recovery by infield exploration will be selected for a more detailed analysis. Objectives of this second phase of the research program are:

(1) Detailed site-specific geologic characterization of typical reservoirs encompassed by the selected plays. Available logs, cores, and field data will be utilized to describe both the depositional and, where pertinent, the diagenetic facies of representative reservoir(s) in order to determine the relationships among facies heterogeneity, reservoir properties, and conventional oil recovery. Depositional and diagenetic facies models, applicable to other reservoirs in the target play or in geologically similar plays will be established. Beginning with this effort, cooperation of field or unit operating companies is necessary and will be actively solicited.

(2) The descriptive, qualitative reservoir models generated will be calibrated by integrating time-dependent well production data and other engineering data collected in the course of reservoir development. The engineering and historical data will then be

interpreted in the context of the geologic model in order to substantiate the model and quantify predictions about reservoir heterogeneity. Potentially useful data include individual well production histories, pressure data, well productivity test results, and observed results of injection programs.

(3) Develop integrated geologic facies/engineering performance models for the major types of oil reservoirs identified in the study. These "infield exploration" models will describe and illustrate formats for modifying conventional well spacing, geographic distribution, or completion practices to improve recovery from generic classes of reservoirs.

(4) Utilizing the models and methodologies developed in the site-specific reservoir analyses, define examples of strategic infill drilling programs designed to improve conventional recovery in the studied reservoirs or in similar reservoirs of the play. Assuming successful completion of the project to this point, a cooperative program with industry might be initiated to identify an applicable field for a possible demonstration project.

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APPENDIX I

Summary tables for each of the plays and their component reservoirs. Miscellaneous reservoirs that do not fit within any major play are grouped as a final "Miscellaneous" play. A few reservoirs that appear to be somewhat similar to a major play are listed below the summary row for that play.

Abbreviations used for reservoir description on play tables:

Lithology

SS - Sandstone
CONG - Conglomerate
LS - Limestone
DOLO - Dolomite

Trap

SA - Simple anticline or dome
FBA - Fault-bounded anticline or dome
FA - Faulted anticline or dome
FEH - Fault-enclosed anticline or dome
SSF - Simple sealing fault
D - Diapir
I - Isolani (isolated porous lens)
UPP - Updip porosity pinchout
DPL - Diagenetic porosity loss
RT - Regional truncation
OLP - Onlap porosity pinchout
DTR - Depositional topography on reef top
FS - Fracture system
NPP - Porosity pinchout across a nose (dome, terrace)
PPS - Partially productive structure
SES - Structure modified by an erosional surface

Drive Mechanism

WD	-	Water drive
GCE	-	Gas cap expansion
GD	-	Gravity drainage
SG	-	Solution gas drive (depletion, fluid expansion, etc.)
l	-	Limited or local

Production Technology

PM_w	-	Pressure maintenance by water injection
PM_g	-	Pressure maintenance by gas injection
WF	-	Waterflood
CO_2	-	CO_2 flood
M	-	Miscible flood
LPG	-	LPG flood
P	-	Polymer flood
T	-	Thermal recovery project
Im	-	Imbibition
ARg	-	Attic recovery by gas injection
Frac	-	Fracture

PLAY NAME: (1) EOCENE DELTAIC SANDSTONES — 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	LIVINGSTON(YEGUA)	32	SS	XFA	WD+GCE	4500	45	28	120.	1 2		40	250	1890	154			20		56	20.0	20.5	37.
2	3	LIVINGSTON(WILCOX)	42	SS	XFA	WD	7400	80	21	70.		25	35		2834	183			40		42	18.2	18.8	45.
3	3	MERCY(8260 WILCOX)	42	SS	XFBA	WD	8300	37	21	256.		15	38	900	3793	226		42	40	13	30	13.2	13.3	44.
4	3	SEGNO(YEGUA)	36	SS	XFBA	GCE+SG+W	5200	10	28	713.	2 3	33	41		1735	161			10		32	11.3	11.3	35.
5	3	SEGNO,DEEP(WILCOX)	38	SS	XFBA	SG+WD	8200		20			40	38	800	3738	225			20		42	14.9	15.0	36.
6	3	SILSBEE(FIRST YEGUA)	36	SS	XSA	WD+GCE	7000	25	31	500.		34	41		2992	166			20	10	41	14.1	14.3	35.
							6694.	43.	25.	289.		29.	39.	599.	2802	184.		17.%		11.	243	91.7	93.2	38.

PLAY NAME: (2) YEGUA DEEP-SEATED DOMES — 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	CONROE(MAIN CONROE)	32	SS	XFA	WD+GCE	5200	160	32	1400.	1 3	23	38	535	2190	170	PMG,PMW	78	20	18	1320	666.0	751.0	57.
2	3	DURKEE(FAIRBANKS)	50	SS	ZNPP	WD+GCE	7100	40	34	2400.	2 4	24	35	584	3079	191	PMW,WF		20	37	22	12.5	13.1	60.
3	3	FAIRBANKS(FAIRBANKS)	38	SS	ZPPS	GCE	6800	26	28	2000.		30	36	3600	3030	185			10	20	78	41.2	41.2	53.
4	3	HARDIN(FRAZIER)	35	SS	XFA	WD	7900	100	24	500.		25	38	688	3400				10		43	21.2	22.6	53.
5	3	KATY(I-B)	43	SS	XSA	GCE+WD	6600	12	28	1050.		31	43	1330	2920	196	GCY	43	40		20	11.5	12.0	60.
6	3	RACCOON BEND(COCKFIE	34	SS	XFA	WD	4200		33	840.		18	34	300	1800	155	PMG	34	20	22	98	52.8	54.0	55.
7	3	TOMBALL(KOBS)	33	SS	XFA	WD+GCE	5500	20	31	1000.		31	40	590	2490	182			20	16	60	28.1	35.6	59.
8	3	TOMBALL(SCHULTZ SE)	33	SS	XFA	WD+GCE	5500	20	32	1200.		25	40	930	2505	182	PMG		20		86	37.2	51.0	59.
							5349.	137.	32.	1361.		24.	38.	699.	2281	171.		38.%		19.	1727	870.5	980.5	57.

PLAY NAME: (3) YEGUA DOME FLANKS — 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	ESPERSON,S.(CROCKETT	39	SS	XFA	GCE+SG+G	7300	1800	27	240.	1 3	24	39	700	3440	200	PMG,WF	49	20		31	17.1	18.5	60.
2	3	MERCHANT(EY-1B)	51	SS	XFA	GCE+SG+G	8900	918	31	230.	1 3	21	30	683	3795	205	WF,PMW		20	24	23	10.0	10.1	44.
							7890.	1475.	28.	236.		23.	36.	694.	3571	202.		50.%		24.	54	27.1	28.6	53.

PLAY NAME: (4) CAPROCK

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	BATSON(CAPROCK)	03	LS	ZNPP	GCE+GD	1100		35				30			116						44.0		
2	3	HUMBLE(CAPROCK)	05	LS	ZNPP	GCE+GD	1200		35				22									56.0		
3	3	SOUR LAKE(CAPROCK)	02	LS	ZNPP	GCE+GD	600		35				22									81.0		
4	3	SPINDLETOP(CAPROCK)	01	LS	ZNPP	GCE+GD	800		35				22		350							60.0		
							880.		35.				23.		350	116.		0%				241.0		

PLAY NAME: (5) FRIO DEEP-SEATED DOMES

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	ANAHUAC(MAIN FRIO)	35	SS	XFA	WD+GCE	7100	125	28	1085.	2 3	35	35	728	3230	178	PMG		20	16	423	227.0	237.0	56.
2	3	CEDAR POINT(FRIO 590	38	SS	XFA	WD+GCE	6000	75	32	900.	2 3	37	38	518	2691	178			20	13	26	13.2	13.4	52.
3	3	CHOCOLATE BAYOU(ALIB	52	SS	XFA	WD	9400	52	29	400.		30	42	455	4522	225			80		15	8.7	9.0	60.
4	3	CHOCOLATE BAYOU(UPPE	50	SS	XFA	GCE+WD	8800	20	28	1090.		34	42	1100	4115	212			80		33	19.6	20.0	61.
5	3	CLEAR LAKE(FRIO)	38	SS	XFA	WD+GCE	5900	60	30	977.		20	26	380	2665	164			22	13	52	22.1	23.5	45.
6	3	FIG RIDGE(SEABREEZE)	41	SS	XFA	SG+WD	8500	100	27	750.	2 3	37	35		3825	198	PMW		40	20	94	43.5	49.0	52.
7	3	GILLOCK(BIG GAS)	35	SS	XFA	WD+GCE+S	8400	505	28	1470.	2 3	15	38		4339	214			20		48	24.4	25.0	52.
8	3	GILLOCK(EAST SEG.)	49	SS	XFA	WD	9600	370	29	1330.	2 3	57	39	900	3710	224			40	12	44	20.7	31.3	71.
9	3	GILLOCK,S.(BIG GAS)	39	SS	XFA	WD+GCE	9600	574	28	900.	1 3	23	38	708	4339		WF,CO2	66	40	27	78	44.3	45.6	58.
10	3	HASTINGS,E.(UPPER FR	34	SS	XFA	WD+GCE	6100	145	29	720.	2 3	20	32	475	2755	170			10	13	212	112.0	113.0	53.
11	3	HASTINGS,W.(FRIO)	34	SS	XFA	WD+GCE+S	6100	625	31	865.	1 3	20	31	444	2755	160			10	13	960	534.0	663.0	69.
12	3	HOUSTON,S.(MIOCENE)	35	SS	XFA	WD+GCE	4000	180	28	100.	0 3		22	250	1800	136			16		34	14.9	15.2	45.
13	3	HOUSTON,S.(FRIO)	35	SS	XFA	WD+GCE	4800	295	25	710.	0 3		27	330	2039	156			16		60	26.4	27.0	45.
14	3	MANVEL(F.B. I OLIG.)	33	SS	XFA	WD+GCE	5100	129	28	500.	2 3	18	28		2315	165	PMG	33	10	19	58	29.9	30.4	52.
15	3	MANVEL(F.B. II OLIG.	34	SS	XFA	WD+GCE	5700	126	28	500.	2 3	18	28	1200	2546	165	PMG	34	10	19	67	31.2	32.0	48.
16	3	OYSTER BAYOU(SEABREE	41	SS	XFA	WD+GCE	8300	177	29	1325.	2 3	20	36	1130	3800	190	PMG,WF		40	20	228	127.0	146.0	64.
17	3	SUGARLAND(UPPER FRIO	28	SS	XSA	GCE+WD	3800	575	29	900.	2 3	28	29		1550	149	PMG		20	17	135	70.6	71.0	53.
18	3	THOMPSON(FRIO)	31	SS	XFA	WD+GCE	5400	250	30	1100.	2 3	30	25		2430	168	PMG,ID		20	19	848	325.0	352.0	42.
19	3	THOMPSON,N.(VKSBG,UP	39	SS	XFA	WD+SG	7800	150	31	3400.	2 4	35	36	615	4014	184			17		52	27.2	28.9	56.
20	3	THOMPSON,S.(4400)	39	SS	XFA	WD	4400	130	34	367.		27	25	260	1952	135			20		57	27.2	34.2	60.
21	3	THOMPSON,S.(5400)	39	SS	XFA	WD+GCE	5300	80	31	900.		29	25	324	2490	155			20		23	10.7	10.8	47.
22	3	TRINITY BAY(FRIO 12)	51	SS	XFA	WD+GCE	8100	11	30	2344.	0 3	27	36	730	3680	182	PMG	50	80	19	36	21.2	22.1	61.
23	3	TURTLE BAY(MIDDLETON	35	SS	XFA	WD	6600	40	32	1000.	2 3	24	31	540	2963	158			20		18.	11.0	12.0	67.
24	3	WEBSTER(UPPER FRIO)	37	SS	XFA	WD+GCE	5800	400	31	2350.	1 4	25	29	385	2700	163	PMG,WF,ID	73	20	19	890	528.0	579.0	65.
							6252.	351.	30.	1309.		26.	31.	543.	2847	168.		21.%		17.	4491	2319.8	2590.4	58.

PLAY NAME: (6) FRIO (BUNA) BARRIER/STRANDPLAIN

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	AMELIA(FRIO 6)	36	SS	XSA	WD+GCE	6800	20	31	1390.		25	30	456	3150	164	PMG		10	12	47	27.5	34.2	73.
2	3	LOVELLS LAKE(FRIO 1)	38	SS	XSA	WD+GCE	7700	10	29	450.	2 3	40	38		3485	167	GCY	65	20	15	13	10.3	10.6	82.
3	3	LOVELLS LAKE(FRIO 2)	39	SS	XSA	WD+GCE	7900	50	29	454.		43	38	800	3520		PMG	65	20	15	42	30.2	30.2	72.
							7425.	32.	30.	832.		35.	35.	636.	3365	165.		67.%		14.	102	68.0	75.0	74.

PLAY NAME: (7) FRIO BARRIER/STRANDPLAIN

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	2	BLOOMINGTON(4600)	47	SS	XFBA	WD	4600	40	34	1140.	2 3	40	23	173	2058	145	PMW		14.5		69	30.5	31.4	46.
2	2	BONNIE VIEW	44	SS	XSA	WD	4500	30	30	1000.		30	24	200	2044	130			20	50	50	19.1	19.5	39.
3	2	FRANCITAS, NORTH	51	SS	XSA	WD+GCE+S	8500	18	27	1800.	2 3	30	49	680	3587	198			50		25	13.1	13.2	53.
4	2	GANADO WEST(4700)	40	SS	XFA	WD	4700	80	33	1411.	2 3	38	24	330	2139	146	PMW		20	27	44	13.5	23.4	53.
5	2	GRETA(4400)	33	SS	XSA	WD	4400	65	33	687.	1 3	27	2'	250	1980	145	PMG,PMW		25		313	124.7	147.0	47.
6	2	HEYSER(5400)	36	SS	XFA	WD+MSG	5400	36	24	300.	1 3	35	34	500	2528	164	PMW,PMG,W		20	35	90	10.4	48.7	54.
7	2	LAKE PASTURE(H-440 S	59	SS	XSA	WD+SG	4500	50	32	1197.	1 3	32	24		1970	155	PMG		36	25	132	37.7	74.0	56.
8	2	LA ROSA(5400)	38	SS	XFBA	WD	5400	39	29		2 3		30	2000	2360	164			20		20	10.0	10.0	50.
9	2	LA ROSA(5900)	38	SS	XFBA	WD+GCE	5900	25	29	1682.	2 3		30	6000	2710		PMG		20	29	23	12.0	14.2	62.
10	2	LA WARD, NORTH	41	SS	XSA	GCE+MWD	5200	33	26	350.		33	26	402	2300	160			40,20		68	18.7	20.0	29.
11	2	LOLITA(MARGINULINA)	40	SS	XFA	WD+PSG	5300	25	29	164.		34	26	872	2325	158			20	28	32	16.2	17.2	54.
12	2	LOLITA(WARD ZONE)	40	SS	XFA	WD	5900	30	30	635.		31	32	590	2667	171			20	26	29	17.4	18.0	62.
13	2	M.E. OCONNOR(FQ-40)	53	SS	XSA	WD	5900		33	820.	2 4	22	40	650	2710	168			20		31	17.3	18.0	58.
14	2	MAURBRO(MARGINULINA)	41	SS	XFA	WD+GCE	5200	34	27	450.	3 3	25	25	400	2360	158	PMG,PMW	71	40		51	24.7	26.0	51.
15	2	MCFADDIN(4400)	38	SS	XSA	WD	4400	53	32	287.	1 3	25	25	300	1981	145	T		20	36	51	22.4	24.3	48.
16	2	PLACEDO(4700 SAND)	37	SS	XFBA	WD	4700	40	33	847.		40	24	500					10		77	41.4	45.0	58.
17	2	TOM O'CONNOR(4400)	52	SS	XSA	SG+WD	4400	15	32	578.	2 3	48	24	231	1973	141		80	20		30	11.0	16.0	53.
18	2	TOM O'CONNOR(4500 GR	59	SS	XSA	WD	4500	20	33	2290.	2 3	32	24	237	1895	162	PMG		40-25	33	59	15.9	33.0	56.
19	2	TOM O'CONNOR(5500)	37	SS	XFBA	SG+PWD	5500	80	31	816.	2 4	30	31	407	2511	169	PMW		25	25	261	77.7	140.0	54.
20	2	TOM O'CONNOR(5800)	34	SS	XFBA	WD+GCE+S	5800	200	32	1758.	2 3	16	36	577	2650	176	PMW,WF	76	35		422	224.0	252.0	60.
21	2	TOM O'CONNOR(5900)	35	SS	XFBA	WD	5900	150	32	2136.	2 3	14	35	577	2650	176	PMW		20-25	18	549	246.3	337.0	61.
22	2	WEST RANCH(GRETA)	38	SS	XSA	WD	5100	48	32	1000.	2 3	33	24	306	2357	160	PMG		40		223	73.9	111.0	50.
23	2	WEST RANCH(GLASSCOCK	39	SS	XSA	GCE+WD	5500	95	29	394.	1 3	45	31	550	2560	168	M,WF,LPG		36	17	127	50.3	53.0	42.
24	2	WEST RANCH(WARD)	39	SS	XSA	WD+GCE	5700	30	32	1228.	1 3	42	31	448	2650	170	PMW,PMG		20		69	36.2	37.0	54.
25	2	WEST RANCH(41-A)	40	SS	XSA	WD	5700	60	30	869.	1 3	28	32	454	2625	171	PMW		30		203	84.6	94.0	46.
26	2	WEST RANCH(98-A)	40	SS	XSA	WD	6100	70	30	497.	1 3	30	40	643	2795	178	PMW		20		82	45.3	47.0	57.
27	3	MAGNET WITHERS	36	SS	XFA	WD+GCE	5600	20	29	1700.	2 3	27	26	250	2550	171	PMG		20	33	163	78.6	91.3	56.
28	3	MARKHAM N.BCN(CARL)	38	SS	XSA	WD+GCE	7000	25	31	3333.	2 3	26	36	600	3175	182	PMG	52	40	28	20	10.7	11.5	58.
29	3	MARKHAM N.BCN(CORN)	38	SS	XSA	WD+GCE	8400	40	24	750.			36	640	3450		PMG	52	40		36	9.7	22.0	61.
31	3	OLD OCEAN(ARMSTRONG)	36	SS	XFBA	GCE	10000	83	26	251.	1 2	13	37	1022	4658	236	PMG	48	40		136	67.3	69.0	51.
32	3	OLD OCEAN(CHENAULT)	38	SS	XFBA	GCE	9600	60	27	640.	0 4	24	36	990	3193	232	PM		40		27	10.2	10.3	38.
33	3	SUGAR VALLEY N.(LAUR	46	SS	XFBA	WD+GCE	8900	37	23	600.	2 3	27	32	880	4100	220			30	48	21	6.3	6.5	31.
34	3	WITHERS, NORTH	36	SS	XFEH	WD+GCE	5300	70	25	2500.		20	26	360	2410	150	PMW,WF		20		100	49.0	50.0	50.
35	3	PICKETT RIDGE	35	SS	ZNPP	WD+GCE	4700	80	38	312.		33	25	2700	2120	138				12	27	15.8	16.2	60.
36	4	ARANSAS PASS	36	SS	XFA	SG+MWD	7100	16	28	225.		31	42	200	3500	198	PMW		10		44	20.1	20.5	47.
37	4	ARNOLD-DAVID(CHAPMAN	60	SS	ZPPS	WD	6100	69	30	917.	1 3		42	550	2786	166			40		21	10.3	10.7	51.
38	4	FLOUR BLUFF(PHILLIPS	36	SS	XFA	GCE+WD	6600	20	31	745.		40	44	719	3060	186			20		37	18.7	18.8	51.
39	4	LONDON GIN(DOUGHTY)	49	SS	ZPPS	WD	4500	47	32	1698.		27	32	105	1850	144			20	34	24	14.2	15.0	63.
40	4	MIDWAY(MAIN MIDWAY)	37	SS	XFA	WD+GCE	5300	15	34	4500.	3 4	29	27	200	2434	160	WF		20	17	60	16.6	17.0	28.
42	4	PLYMOUTH(HEEP)	36	SS	ZNFP	WD+GCE	5600	30	28	3300.	1 3	20	31	400	2442	162	PMG		20	39	113	53.4	55.4	49.
43	4	PORTILLA(7300)	50	SS	XSA	WD	7300	44	29	1412.		33	40	834	3267	204			20	10	25	11.7	12.6	50.
44	4	PORTILLA(7400)	50	SS	XSA	WD	7400	130	28	1634.		27	40	838	3330	206	PMG		20	13	75	42.3	46.7	62.
45	4	TAFT(4000)	35	SS	XFA	WD	4000	73	25	1500.	3 3	23	23	230	1804	133	PMW		15	37	45	24.8	26.0	58.
46	4	WHITE POINT E.(BRIGH	38	SS	XFA	WD	5700	82	33	575.		38	39	502	2543	162			20	33	119	64.5	66.0	55.
							5736.	87.	31.	1323.		26.	32.	553.	2606	170.		14.%		26.	4223	1818.5	2235.4	53.

PLAY NAME: (8) WILCOX FLUVIAL/DELTAIC SANDSTONE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	1	WEIGANG(CARRIZO)	46	SS	XFBA	WD	3900		28	1357.		27	24	125	1620	140			20		29	10.4	11.5	40.
2	2	COTTONWOOD CR. S.(MW	50	SS	XFBA	WD+GCE	7600	20	22	790.	1 3	44	36	700	3400	220			40		22	10.6	11.0	50.
3	2	FALLS CITY LBAR, LPA	44	SS	XFBA	WD	6100	50	30	371.	1 2	25	39	167	2625	190	PMW		20	34	38	19.1	22.5	59.
4	2	HELEN GOHLKE(WILCOX)	50	SS	XFA	WD+GCE	8100	65	20	180.		30	34	670	3600	240	PMG		40	25	61	23.7	24.4	40.
5	2	SLICK(WILCOX)	43	SS	XFBA	WD+MGCE	7300	50	22	350.		25	36	732	3350	218	PMG		40		32	19.6	20.0	63.
							6867.	51.	24.	488.		29.	35.	505.	3046	208.		0%		29.	182	83.4	89.4	49.

PLAY NAME: (9) JACKSON/YEGUA BAR/STRANDPLAIN

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	4	AVIATORS(MIRANDO)	22	SS	YUPP	SG+WD	1700	51	32	357.	1 3	37	21		700	107	WF,ID	66	10	25	37	10.1	10.3	28.
2	4	COLORADO(COCKFIELD)	36	SS	YUPP	SG	2600	300	28	800.	2 3	25	45	287	1125	145	WF		10-40	31	52	21.7	21.8	42.
3	4	CONOCO DRISCOLL(U1GW	37	SS	ZNPP	GCE	2800	54	31	458.		32	33	139	1290	153	PMG	37	20	9	69	20.0	23.7	34.
4	4	ESCOBAS(MIRANDO)	28	SS	ZNPP	SG	1200	70	30	500.	1 3	40	23		575	100	WF,T		10	30	28	12.8	12.9	46.
5	4	GOVT. WELLS,N.(G.W.)	28	SS	YUPP	SG+WD	2200	60	32	800.	2 3	30	21	800	875	114	WF,P,T		10	36	150	77.3	78.0	52.
6	4	GOVT. WELLS,S.(G.W.)	28	SS	YUPP	SG	2300	89	30	600.	2 3	35	21	880	850		PMG,WF		10	20	40	16.6	18.0	45.
7	4	HOFFMAN(DOUGHERTY)	47	SS	ZNPP	SG	2000	250	34	757.		40	23	85	795	131	WF,P		16	18	55	20.5	21.0	38.
8	4	LOMA NOVIA(LOMA NOVI	35	SS	YUPP	SG	2600	240	26	800.	1 3	25	26	40	1003	114	WF,GI		10	35	176	47.7	48.0	27.
9	4	LOPEZ(FIRST MIRANDO)	35	SS	YUPP	SG+GCE+W	2200	70	35	250.	1 3	40	22		780	111	PMG,WF,T	55	10	25	75	30.4	33.0	44.
10	4	MIRANDO CITY(MIRANDO	21	SS	YUPP	SG+GCE+W	1600	35	33	1600.	2 3	40	21	125	665		WF,T			25	46	12.1	12.1	26.
11	4	O'HERN(PETTUS)	30	SS	ZNPP	SG	2700	200	28	286.	1 3	20	28		990	136	PMG,WF,T	57	10	20	83	22.2	30.0	36.
12	2	PETTUS(PETTUS)	29	SS	ZNPP	GCE	3900	81	38	452.		25	44		1850		PMG,WF	62	20	25	46	16.2	17.0	37.
13	4	PIEDRE LUMBRE(G.W.)	35	SS	ZNPP	WD+SG	1900	65	30	300.	1 3	30	22		820	100	PMG,WF,LP		10	25	95	20.7	22.0	23.
14	4	PRADO(MIDDLE LOMA NO	56	SS	YUPP	SG+GCE	3700	65	32	850.	1 4	26	40	600	1407	109	PMG,WF	57	10	30	38	10.4	23.7	62.
15	4	SEVEN SISTERS(G.W.)	35	SS	ZNPP	SG+WD	2330	75	28	225.	1 2	55	20		1150	132	PMG,WF		10	15	142	35.0	56.0	39.
							2373.	119.	31.	604.		33.	26.	428.	980	121.		40.%		27.	1132	373.7	427.5	38.

PLAY NAME: (10) FRIO/VICKSBURG (VICKSBURG FLEXURE)

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	4	GARCIA(GARCIA MAIN)	42	SS	XFA	LWD+GCE	3800	80	32	1285.	2 3	18	47	545	1688	152	PMW		40	30	32	16.2	17.0	53.
2	4	KELSEY(M-2)	41	SS	ZPPS	GCE+SG	4700	93	25	454.	0 3	27	47	655	2253	160	PMW,PMG	63	40		26	10.8	10.9	42.
3	4	RINCON(FRIO D-5)	40	SS	XFA	SG+GCE+W	3800	149	27	206.	0 3	41	38	700	1604	159	WF	72	40	31	26	8.1	11.2	43.
4	4	RINCON(FRIO E1+E2)	40	SS	ZPPS	GCE	4000	157	28	161.	1 3	22	40	830	1645		WF	65	40	27	23	9.7	14.7	64.
5	4	RINCON(VICKSBURG SAN	50	SS	ZPPS	SG+WD+GC	5300	570	22	284.	-2 3	23	44	850	2550	140	WF		40	21	35	17.1	17.4	50.
6	4	SEELIGSON(ZONE 10)	44	SS	ZPPS	GCE+LWD	4600	24	25	766.	1 3	33	39	580	2201	153			40		26	11.0	11.5	44.
7	4	SEELIGSON(ZONE 14-B)	41	SS	ZPPS	GCE+WD	5100	35	26	353.	1 3	35	40	636	2493	164	PMG		40		71	30.0	31.0	44.
8	4	SEELIGSON(ZONE 16)	42	SS	ZPPS	GCE	5700		22	214.	1 3		40						40		27	11.0	11.5	43.
9	4	SEELIGSON(ZONE 19-B)	42	SS	ZPPS	GCE	6100	175	24	546.	1 3	27	41	763	2812	179			40		45	17.3	19.0	42.
10	4	SEELIGSON(ZONE 19-C-	41	SS	ZPPS	GCE	5900	212	24	585.	1 3	23	43		2789				40	26	192	80.0	83.0	43.
11	4	SEELIGSON(ZONE 20-C)	41	SS	ZPPS	GCE	6100	42	25	513.	1 3		40		2920				40		23	10.0	11.0	48.
12	4	STRATTON(BERTRAM WAR	38	SS	ZPPS	GCE	6500	200	21	220.	2 3	37	43	758	3000	190	GCY,PMG,P		20-40	54	38	18.6	18.6	49.
13	4	SUN(FRIO D-1)	41	SS	ZPPS	GCE	4300	109	26	549.	1 3	33	45	650	2025	160	PMG			27	30	15.0	15.3	51.
14	4	T.C.B.(21-B)=ZONE 21	44	SS	ZNPP	GCE	7100	117	25	186.	2 3	26	40	7008	3885	205	PMG,PMW		42	45	157	77.0	91.1	58.
15	4	WADE CITY(BIERSTADT)	40	SS	XFA	WD	4800						29	250	2250				20		28	10.0	10.1	36.
							5727.	159.	25.	432.		27.	41.	2694.	2817	178.		20.%		34.	779	341.8	373.3	48.

PLAY NAME: (11) SAN MIGUEL/OLMOS DELTAIC SANDSTONE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	1	BIG FOOT(OLMOS B)	49	SS	YRT	SG	3300	580	27	3.	1 2	60	43	465	1450	120	WF,PMG	70	20	32	126	27.3	32.5	26.
2	1	BIG WELLS(SAN MIGUEL	69	SS	YI	SG+LGCE	5400	200	19	6.	-1 1	45	33	482	2493	170	PMW,PMG	73	80	36	198	37.4	57.0	29.
3	1	CHARLOTTE(NAVARRO)	46	SS	XSSF	SG+MGCE	5100	260	22	20.	1 2	45	34	366	2480		WF,PMW		40	24	236	37.0	39.0	17.
4	1	SACATOSA(SAN MIGUEL	56	SS	YUPP	SG	1200	615	24	4.	-1 1	45	32	450	610	105	WF		10-40	30	221	20.4	32.2	15.
5	1	SOMERSET(OLMOS B)	11	SS	XSSF	SG	1000		28	85.	1 2	48	34	10	600	92	PMW,PMG		20	25	59	15.5	17.5	30.
							3784.	372.	23.	18.		48.	35.	390.	1790	131.		40.%		30.	840	137.6	178.2	21.

PLAY NAME: (12) EDWARDS RESTRICTED PLATFORM AND STRANDLINE CARBONATES

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	1	DARST CREEK(EDWARDS)	29	DO,LS	XSSF	WD	2600	200	21	200.	1 3	40	36		1200		PMW		5	15	331	90.0	96.0	29.
2	1	JOURDANTON(EDWARDS)	45	DO,LS	XSSF	WD,MGC	7300	400	15	23.	0 2	50	38	1231	3450	191	PMW		40	50	45	12.6	14.6	32.
3	1	LULING-BRANYON(EDWAR	22	DO,LS	XSSF	WD	2200	150	28	200.	0 2	25	36	120	1400		PMW		2	31	483	138.0	150.0	31.
4	1	SALT FLAT(EDWARDS)	28	DO,LS	XSSF	WD	2725		30		-1 2		30						2	40	266	63.7	80.0	30.
5	2	PERSON(EDWARDS)	59	DO,LS	XSSF	GCE	10850	120	12	3.	-1 1	20	40	1910	5203	283			80		56	15.4	17.0	30.
							3035.	178.	25.	179.		31.	35.	370.	1659	242.		0%		29.	1181	319.7	357.6	30.

PLAY NAME: (13) AUSTIN CHALK/BUDA STRATIGRAPHIC TRAPS

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	1	LULING BRANYON(AUSTI	22	LS	XSSF-XFS	SG	1900	300	18	0.	-1		22	36		1400		WF,IM		20	30		15.0	95.0	
2	1	PEARSALL(AUSTIN CHAL	36	LS	XFS	SG,GD	5300		6	0.	-1		30	28		3410	146	WF,IM		80			40.9	45.0	
3	1	SALT FLAT(AUSTIN CHA	28	LS	XSSF-XFS	SG	2400	500	18	0.	-1	0	40	36		1000		WF,IM,T		20	50		10.0		
4	1	DARST CREEK(BUDA)	60	LS	XSSF-XFS	SG	2200		12	0.	-1	1	49	32		778		WF		10		117	17.3	22.7	19.
5	3	GIDDINGS(AUSTIN CHAL	60	LS	XFS	SG	7500		6	0.	-1	0	56	40	1050	3800	225	IM		40-80	14		66.1		
							5379.	380.	9.	0.			44.	35.	1050.	2914	195.		0%		21.	117	149.3	162.7	139.

PLAY NAME: (14) RODESSA STRATIGRAPHIC/STRUCTURAL TRAPS

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	6	BETHANY(GL.RO.,4300)	58	LS	XSA	SG	4300		23	203.	1	3	21	43	14	1933	162	PMW,WF,P	65	40	27	42	14.9	16.0	38.
2	6	HAYNES(MITCHELL)	54	LS,SS	YUPP	SG	5900	140	17	25.	1	3	32	40		2720	148	WF	65	40	24	57	12.9	14.0	25.
3	6	KILDARE(RODESSA)	42	LS,SS	ZNPP	SG	6000	60	16	27.	-1	2	20	40		2400	158	WF	65	40	20	54	11.3	12.9	24.
4	6	RODESSA	37	LS,SS	ZNPP	SG,PGC,W	5700	80	19	61.	1	2	25	43	1050	2750	177	WF		40	25	326		176.0	54.
5	6	BETHANY NE(LINE 3850	56	LS	ZNPP	SG	3900	30	18	28.	1	3	42	43	60	1650		WF,IM	65	40	35	52	13.0	14.1	27.
							4965.	77.	19.	77.			29.	42.	35.	2159	156.		80.%		27.	531	52.1	233.0	44.

PLAY NAME: (15) PALUXY FAULT LINE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	5	SULPHUR BLUFF(PALUXY	36	SS	XSSF	WD	4500	150	25	4000.	3	4	40	21	0	1958		WF		10	28	74	31.2	33.7	46.
2	6	PEWITT RANCH(PALUXY)	49	SS	ZNPP	WD	4300	78	24	2460.	2	4	10	19	11	1894	160			10		54	20.7	23.0	43.
3	6	TALCO(PALUXY)	36	SS	ZNPP	WD	4300	200	26	2000.	-1	4	11	22	22	1920	147	PM,WF,T	67	10		732	257.4	273.9	37.
							4320.	187.	26.	2233.			14.	22.	19.	1922	148.		33.%		28.	860	309.3	330.6	38.

PLAY NAME: (16) CRETACEOUS CLASTICS/SALT-RELATED STRUCTURES 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H20 SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	6	COKE(PALUXY)	42	SS	XSA	WD	6300	131	22	1175.		28	27	80	2704	190	PMW		40	26	73	23.5	28.1	38.
2	6	HITTS LAKE(PALUXY)	53	SS	XFA	SG+WD	7200	130	22	400.	-1 2	10	26	103	3145	175	WF	77	40	51	32	10.1	13.9	43.
3	6	MANZIEL(PALUXY)	53	SS	XFA	WD	6300	165	20	830.		34	32	25	2625	190			40	26	52	20.1	23.0	44.
4	6	QUITMAN(EAGLE FORD)	42	SS	XFA	SG+WD	4200	200	25	115.	-1 3	55	25	50	1850	165	WF	70	20	33	30	10.0	10.5	35.
5	6	QUITMAN(PALUXY)	42	SS	XFA	WD	6200	150	22	599.		15	43	150	2744	198	PMW		40		173	67.1	77.8	45.
6	6	SAND FLAT(PALUXY)	44	SS	XFA	SG	7000	251	18	277.	1 3	17	29	160	3000	210	WF	66	40	27	77	26.9	36.3	47.
7	6	SHAMBURGER LAKE(PAL)	57	SS	XFA	SG	7300	585	21	200.	1 2	15	32	349	3115	206	PMW	63	31	41	49	26.6	32.7	67.
8	6	NEW HOPE(PITTSBURG.)	43	SS	XSA	SG+MWD	8000	367	13	61.	0 3	29	46	306	3523	216	PMW	46	40	38	30	19.6	20.4	68.
9	6	PITTSBURG(PITTSBURG)	40	SS	XSA	SG	8000	107	12	40.	-1 3	20	42	250	3480	224	WF	60	65	21	63	13.4	14.9	24.
							6682.	233.	20.	479.		22.	36.	170.	2899	199.		67.%		32.	579	217.3	257.6	44.

PLAY NAME: (17) GLEN ROSE CARBONATE/SALT-RELATED STRUCTURES 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H20 SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	6	NEW HOPE(BACON LIME)	43	LS	XSA	SG+MWD	7400	120	18	379.		25	44	256	3425	203	PMW	46	40	15	33	15.1	16.0	48.
2	5	PICKTON(BACON LIME)	44	LS,DO	ZNPP	SG	7900	37	20	252.	1 3	25	46	2000	3578	209	PMG,M,PMW	52	40	35	34	16.3	16.3	48.
3	56	FAIRWAY(JAMES LIME)	60	LS	ZNPP	SG	10000	130	11	18.	-1 3	27	48	1371	5226	260	PMW,M	65	160-80	33	400	163.9	200.0	50.
							9624.	121.	12.	65.		27.	48.	1337.	4949	251.		100.%		32.	467	195.3	232.3	50.

PLAY NAME: (18) EAST TEXAS WOODBINE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H20 SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	3	KURTEN(WOODBINE)	76	SS		SG	8300		15	2.	-1 1	38	38	644	3800	230	WF,CO2,M		160	32	528	8.3	100.0	19.
2	6E	EAST TEXAS(WOODBINE)	30	SS	YRT	WD	3600	324	25	1300.	1 3	14	38	353	1620	146	PMW,WF	70	4.5	15	7558	4678.5	6424.3	85.
3	6	NEW DIANA(WOODBINE)	59	SS	YRT	WD	3700	75	26	141.		34	40			124			40	14	40	10.7	12.0	30.
							3609.	323.	25.	1295.		14.	38.	354.	1624	146.		33.%		15.	8126	4697.5	6536.3	80.

PLAY NAME: (19) WOODBINE FLUVIAL-DELTAIC SANDSTONE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	6	CAYUGA(WOODBINE)	34	SS	XFA	WD	4000	20	25	500.	1 3	20	29	370	1200	160	PMG,PMW		20	45	105	61.2	63.0	60.
2	6	HAWKINS(WOODBINE)	40	SS	XFA	SG+WD+GD	4500	300	26	3394.	2 5	10	24	377	1710	168	PMW,G,WF	75	29	25	1274	733.8	843.0	66.
3	6	LONG LAKE(WOODBINE)	33	SS	XFA	SG+PWD	5200	60	25	1085.	2 3	30	40	2000	2900	144	PMG		20	14	62	34.6	37.3	60.
4	6	NECHES(WOODBINE)	53	SS	ZNPP	WD	4700	90	25	1020.	2 3	27	40	662	1836	155	PM		40	14	210	83.5	133.0	63.
5	5	VAN(WOODBINE)	29	SS	XFA	WD	2700	700	29	1000.	2 3	9	34	300	1245	140	WF,ARG	64%70	7	15	640	484.7	508.0	79.
							3883.	408.	27.	2238.		12.	29.	407.	1563	157.		40.%		21.	2291	1397.8	1584.3	69.

PLAY NAME: (20) WOODBINE FAULT LINE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	5	MEXIA(WOODBINE)	21	SS	XSSF	WD	3000	110	25	1600.		10	35						6.8	14	244	108.3	110.0	45.
2	5	POWELL(WOODBINE)	23	SS	XSSF	WD	2900	150		1600.			36			115	WF	69	3.5	14	259	130.7	132.0	51.
3	5	WORTHAM(WOODBINE)	24	SS	XSSF	WD	2900	50	22	1620.			39	10	1400				2	30	56	24.5	25.0	45.
							2941.	124.	24.	1602.		10.	36.	10.	1400	115.		33.%		15.	559	263.5	267.0	48.

PLAY NAME: (21) STRAWN SANDSTONE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	KATZ	51	SS	XSA	WD	4900	74	17	200.	0 2	28	37	241	2200	117			40		175	30.0	34.9	20.
2	7B	KATZ(5100)	51	SS	XSA	WD+SG	5100	90	16	56.	0 2	36	37	254	2217	120			40	40	75	14.3	15.0	20.
3	7B	SOJOURNER	50	SS	ZNPP	SG	5300	115	14	15.	0 1	30	41	450	2216		WF	55	40	25	20	10.1	10.2	51.
4	9	ANTELOPE(M1)	40	SS	ZNPP	SGAWD	3200	65	17	133.	0 3	32	43	180	1315	113	PMW	64	16	28	26	13.5	13.8	53.
5	9	BIG MINERAL CREEK(BA	51	SS	XFA	SG	5300	300	18	59.	0 2	32	37	400	2477	118	PMW,WF	62	20-40	24	56	19.4	24.4	44.
6	9	BRYSON, E.	15	SS	YUPP	SG	3100		17	60.	0 2	30	40		900		WF	60	20	27	32	12.7	13.0	41.
7	9	GATEWOOD	44	SS	ZNPP	SG+LWD	1600		23	148.	1 3	25	33	100	700		WF		5	40	30	10.5	11.0	37.
8	9	HULL-SILK-SIKES(4300	38	SS	ZPPA	SG	4300	125	15	61.	0 3	32	41		1650		PMG,WF	62-64	10	25	180	68.4	69.0	38.
9	9	JOY(STRAWN)	43	SS	ZPPA	SG	4400	150	15	40.	0 2	35	41	1060	1760	137	WF		20	20	34	17.2	18.0	53.
10	9	SADLER(PENN.)	51	SS	YUPP	SG	6700	400	14	28.	0 2	23	34	558	3040	140	WF	59	20	24	50	16.6	17.5	35.
11	9	SIVELLS BEND	44	SS	XFA	SG	6600		18	126.	0 3	41	42	300	3000	127	WF	69-72	40	26	102	26.6	29.1	29.
12	9	WALNUT BEND(HUDSPETH	47	SS	ZPPA	SG+LWD	3900	100	20	138.	-1 3	39	40		1885	110	PMW,WF	63	20	33	50	20.3	22.0	44.
13	9	WALNUT BEND(REGULAR)	38	SS	ZPPA	SGAWD	4900	300	19	176.	1 2	25	36	245	2360	115	PMW	63	20	30	111	44.5	52.0	47.
14	9	WALNUT BEND(WINGER)	43	SS	ZPPA	SG+PWD	5500	300	17	309.		17	32	254	2715	143	PMW	61	40	35	50	26.3	27.5	55.
							4764.	187.	17.	120.		30.	38.	348.	2097	123.		71.%		28.	991	330.4	357.4	36.

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	9	HULL-SILK-SIKES(3800	39	SS	ZPPA	SG	3800	100	17	180.	0 2	25	39		1650		PMG,WF	60-69	10		48	11.8		
2	9	KMA	31	SS	ZPPA	SG	3700		16	55.	1 3	25	40	525	1750	125	PMG,W	58-69	10	36		161.0		

PLAY NAME: (22) BEND CONGLOMERATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	BOYD(CONGL.)	51	CONGL	XFBA	SG+LWD	6000	125	14	55.	0 3	35	40	872	2600	136	PMW,WF	72	40	25	52	23.1	28.5	55.
2	7B	OLD GLORY	50	CO+SS	XSA	SG+LWD	5900	120	17	49.	0 3	35	40	1200	2550		WF	61	40	22	41	12.1	14.3	35.
3	9	HILDRETH	42	CONGL	XSA	SG+LWD	7500	100	14	257.	-1 3	30	41	770	3000	152	PMG,WF	51-65	40	24	70	27.3	28.7	41.
4	9	RUSMAG	50	CONGL	YUPP	SG+GCE	4600	175	12	19.	0 2	30	41	475	1400	130	WF	60	20	22	46	15.0	16.1	35.
5	9	WORSHAM-STEED(BEND)	42	CONGL	YI	SG+GCE	4700	210	14	50.	-1 2	29	41	511	1435	140	WF	61-65	30	32	32	10.3	11.0	34.
6	7B	RANGER	17	SS+CO	ZPPS	SG	3400		17	162.	1 2	20	37	540	1550	111	PMG,WF		40			73.0		
							4853.	135.	15.	134.		26.	39.	668.	2001	126.		83.%		25.	241	160.8	98.6	41.

PLAY NAME: (23) STRAWN REEF

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	BRECKENRIDGE POOL	19	LS	YUPP	SG	3100	80	13	15.	-1 2	27	38		1525	110	WF		10-80	28	450	145.0	147.0	33.
2	7B	CURRY POOL	18	LS	YUPP	SG	3200	90	14	12.	-1 2	22	40			100	WF	66	20	23	61	6.0	17.0	28.
3	7B	ELIASVILLE POOL	20	LS	YUPP	SG	3300	90	12	8.	-1 2	25	39		1250	115	WF	76-78	40	20	140	28.0	30.0	21.
4	9	RASBERRY POOL(6100)	55	LS	ZPPS	SG	6100	174	7	3.		35	41	350	2410		WF	70	40	30	50	10.8	12.0	24.
							3303.	87.	13.	13.		27.	38.	350.	1535	110.		75.%		27.	701	189.8	206.0	29.

PLAY NAME: (24) UPPER PENNSYLVANIAN SHELF SANDSTONE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	COOK RANCH(COOK SD)	26	SS	ZNPP	SG	1300		25	380.	-1 3	30	38		410		WF		2-10	25	33	10.8	11.2	34.
2	7B	HAMLIN E.	50	SS	YUPP	SG+LWD	3200	55	19	350.	1 3	22	39		1400	117	PMW		20	25	74	12.8	15.2	21.
3	7C	CREE-SYKES(GARDNER)	50	SS	YUPP	SG	4000		14	111.		21	41	640	1520	128	WF,PMG	55	20	25	43	17.0	17.1	40.
4	9	FARGO(3900)	40	SS	XSA	SG	3900	110	17	100.		30	41		1716		WF	66	40	40	39	12.0	13.3	34.
5	9	FARGO(4200)	40	SS	XSA	SG	4200	215	14	10.	0 2	45	40		1633		WF	66	40		55	13.0	15.2	28.
							3421.	127.	17.	180.		29.	40.	640.	1372	123.		60.%		28.	244	65.6	72.0	30.

PLAY NAME: (25) PENNSYLVANIAN REEF/BANK

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	CLAYTONVILLE(CNYN)	52	LS	YDTR	SG+LWD	5700	820	5	10.		15	42	1195	2335	146	PMW,PMG	60	60	45	135	59.7	74.3	55.
2	7B	GRIFFIN	38	LS	YDTR	WD	3300	55	20			35	43	155	1470	128	PMW		16	25	24	10.1	10.5	44.
3	7B	NENA LUCIA(STRWN RF)	55	LS	YDTR	SG+GCE	6900	230	7	5.	-1 3	24	46		2860		PMW,PMG,W	61-63	40	28	125	31.5	37.0	30.
4	7B	ROUND TOP(PALO PNTO)	47	LS	YDTR	SG+WD	4800	475	10	6.	-1 2	25	40	800	2018	140	PMW,PMG	71	20	39	120	40.6	66.0	55.
5	7C	H-J(STRAWN)	54	LS	YDTR	SG+PWD	5500	200	9	100.	0 3	28	42	600	2280				80		58	23.2	28.8	50.
6	7C	HULLDALE(PENN REEF)	50	LS	YDTR	GCE+PWD	5800	87	9	43.	-1 3	28	40	800	2265	156	WF,PMG	64	30	39	68	25.6	26.1	38.
7	7C	I.A.B.(MENIELLE PEN)	57	LS	YDTR	SG	5300	435	6	5.	-1 2	25	44	1500	2510		WF,PMW	62	80	40	48	18.5	20.3	42.
8	7C	JAMESON(REEF)	46	LS	YDTR	GCE+SG	6400	405	9	2.	-1 3	22	43	1750	2750		WF,PMW	52	20	42	113	40.8	44.2	39.
9	7C	NEVA, WEST(STRAWN)	51	LS	YDTR	GCE	6200	166	10	8.	-1 3	28	46	830	2537	158	PMW,PMG	67	40	31	36	12.5	16.0	44.
10	7C	SUSAN PEAK	48	LS	XSA	WD	4700	113	10	40.	-1 2	20	37	500	1920	139			25		34	14.3	14.5	43.
11	7C	TODD DEEP(CRINOIDAL)	40	LS	YDTR	SG+PWD	5800	450	12	14.	-1 2	19	41		2743	163	PMW	50	40	32	90	30.8	35.5	39.
12	8A	CLAIREMONT	50	LS	YDTR	WD	6700	47	10	21.	-1 2	38	39	700	3026	144	PM	60	80	28	43	14.1	16.4	38.
13	9	KNOX CITY N.(CNYN)	50	LS	YDTR	SG+LWD	4200	155	5	13.		25	40	257	1893	121	WF	57	40		30	13.9	15.0	50.
							5653.	381.	9.	19.		23.	42.	988.	2409	146.		77.%		37.	924	335.6	404.6	44.
1	8A	ROPES	50	LS	YDTR	SG,PWD	9300	215	9	66.	-1 3	24	41	368	3754	159	PMW	59	44	37	69	23.5	25.0	36.

PLAY NAME: (26) UPPER PENNSYLVANIAN BASINAL SANDSTONE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	PERMEABILITY LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7B	FLOWERS(CANYON SAND)	51	SS	YUPP	SG	4100		16	17.	-2 2	43	41	430	1732	123	WF	72	40	30	107	25.3	26.6	25.
2	7B	LAKE TRAMMELL W.(CN)	50	SS	YUPP	SG	5200	180	15	6.	0 1	38	40		2000	137	WF	61	40	25	41	10.6	12.0	29.
3	7C	JAMESON	52	SS	YUPP	SG	6300	700	12	2.	-1 2	38	49	2650	2700	144	WF	52	40-80	35	280	37.0	43.1	15.
4	8A	KELLY-SNYDER(CSC SD)	52	SS		SG	6100	120	18	42.	-1 2	35	42		2435	118	WF		40	30	60	15.0	15.5	26.
5	8A	SMS(CANYON SAND)	54	SS	YUPP	SG	6100	63	19	117.		35	38	437	2467		WF	59	40		25	11.1	11.3	45.
							5567.	411.	15.	25.		38.	44.	1550.	2311	133.		80.%		32.	513	99.0	108.5	21.

PLAY NAME: (27) EASTERN SHELF PERMIAN CARBONATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	HOWARD-GLASSCOCK PER	25	DO,SS	XSA	SG			12	25.	-1 2	30	32	450	450	86	WF	60-72	10	30	1221	335.1	388.7	32.
2	8	HOWARD-GLASSCOCK(GLO	25	LS,DO	XSA	SG+WD	3200		11	4.	-1 2	30	27	450	1000	100	WF		20	30	200	20.2	54.0	27.
3	8	SNYDER	26	DO,LS	XSA	SG	2600		10	1.	-1 1	25	30	100	1050	97	WF		10	30	90	33.2	36.0	40.
4	8	IATAN-E. HOWARD	26	DO,LS	XSA	SG+PWD	2700	500	11	10.	-1 2	30	30		950	98	WF	62	10	35	430	115.7	125.0	29.
5	8	WESTBROOK	21	DOLO	ZPPS	SG	2900	250	6	5.	-1 1	27	24	133	1100	98	PM,WF	69-73	40	30	272	70.0	87.0	32.
6	8A	SHARON RIDGE(2400)	23	DOLO	XSA	SG	2400	150	15	8.	-1 2	35	32			96	WF		20-10	30	76	16.6	19.7	26.
7	8A	SHARON RIDGE(1700)	23	DOLO	XSA	SG	1700		15	3.	-1 1	37	28	75	750	90	WF,M	67-77	10	30	195	42.3	47.0	24.
8	8A	REVILO (GLORIETA)	55	SS,DO	XSA	SG	2700		15	3.	-1 1	60	35	150	1000	98	WF	65	40	18	48	11.6	11.8	25.
9	8A	DORWARD	50	DOLO	XSA	SG	2400	100	18	3.	-1 1	50	38	300	1000	95	WF		40	35	78	14.3	16.1	21.
10	8A	GARZA	35	DOLO	ZPPS	SG	2500	300	21	8.	-1 1	48	35	232	1000	90	WF	67-73	20-10	34	337	73.3	79.9	24.
11	8A	FLUVANNA(STRAWN)	54	LS	XSA	SG+PWD	7800	300	10	93.	-1 2	27	40	752	3130	140	PMW,PMG,M	75	40	35	58	12.1	12.9	22.
							1502.	347.	12.	16.		33.	31.	340.	772	92.		64.%		31.	3005	744.4	878.1	29.

PLAY NAME: (28) HORSESHOE ATOLL

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8A	SALT CREEK	50	LS	YDTR	SG	6300	726	12	10.	-1 1	29	40	338	2940	129	PM,M,LPG	52	80		471	194.1	248.0	53.
2	8A	COGDELL	49	LS	YDTR	SG	6800	770	10	18.		35	42	664	3125	136	PM	55	40	30	524	240.0	250.1	48.
3	8A	KELLY-SNYDER	48	LS	YDTR	SG	6700	700	8	19.		22	42	1010	3122	130	WF,CO2,M	53	40	26	2161	1075.6	1229.6	57.
4	8A	DIAMOND M	48	LS	YDTR	SG+LWD	6600	440	9	72.	-1 4	28	44	850	3135	130	PM,WF	51-55	40	26	616	221.6	239.5	39.
5	8A	VON ROEDER AND N.V.R	54-59	LS	YDTR	SG	6800	155	10	13.		20	43	1200	3020	134	PM,WF	54	40	60	62	26.1	27.3	44.
6	8A	REINECKE	50	LS	YDTR	SG+LWD	6800	304	10	22.	-1 4	21	46	1100	3164	139	PM,WF	71	40	57	166	68.4	90.9	55.
7	8A	GOOD	49	LS	YDTR	WD	8000	489	8	52.	-1 3	36	44	1158	3650	140	PM		40	9	124	40.5	50.2	40.
8	8A	ADAIR(WOLFCAMP)	50	LS	YDTR	SG	8500	215	12	28.		24	43	430	3513	133	WF	56	40	35	110	47.4	53.0	48.
9	8A	HOBO	51	LS	YDTR	WD	7100	100	10	32.		30	46	1290	2990	150	PM		40		28	11.1	11.7	42.
10	8A	WELLMAN	50	DOLO	YDTR	SG+PWD	9300	800	8	100.	-1 3	23	43	400	4105	151	PM,WF	78	40	35	164	51.4	83.9	51.
11	8	VEALMOOR EAST	50	LS	YDTR	WD	7400	610	10	38.	-1 3	16	48	1290	3362	155	WF,M	74	40	16	125	50.5	67.7	54.
12	8	OCEANIC	53	LS	YDTR	WD	8100	215	12	84.		18	42	978	3410	160			40-80		59	21.0	21.9	37.
13	8	VEALMOOR	48	LS	YDTR	WD	7800	200	10	32.	0 2	31	46	1145	3500	164	PM		40		81	34.7	37.9	47.
							6850.	632.	9.	28.		25.	42.	881.	3165	133.		69.%		28.	4691	2082.4	2411.7	51.

PLAY NAME: (29) SPRABERRY/DEAN SANDSTONE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG	RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7C	BENEDUM(SPRABERRY)	47	SS	ZFPS	SG	7600	250	12	1.	-1	0	35	36	538	2315		WF	67	100		200	22.0	30.0	15.
2	7C	CALVIN(DEAN)	65	SS	YUPP	SG	7400		11	1.	-1	0	35	41	4000	2484	141			160	50	270	28.3	35.0	13.
3	7C	COPE	51	SS	YI	SG	5100		16	24.	-1	2	20	35	450	1950		WF	59	40	47	31	11.6	12.0	39.
4	7C	PEGASUS(SPRABERRY)	52	SS	XSA	SG	8300	160	8	0.			35	37	600	2675	135	WF	63	80-160	46	100	11.4	12.7	13.
5	7C	SPRABERRY TREND	49	SS	YUPP	SG	6800		10	0.	-1	0	35	39	613	2500	132	WF,PMW	62-65	80	28	9400	227.0	470.0	5.
6	8A	ACKERLY(DEAN)	54	SS	YUPP	SG	8200	500	10	0.	-1	0	40	38	985	3660	138	WF	69-76	80		250	30.3	34.6	14.
7	8A	JO MILL(SPRABERRY)	54	SS	YUPP	SG	7100		16	3.			39	39	800	2843	109	WF,PMW	63-69	80	44	330	54.7	79.0	24.
							7036.	353.	11.	1.			36.	39.	908.	2617	130.		86.%		34.	10581	385.3	673.3	6.

PLAY NAME: (30) CENTRAL BASIN PLATFORM UNCONFORMITY

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG	RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	APCO-WARNER(ELL)	39	DOLO	ZSES	WD	4600	300	3				17	40	150	2212	103			40	30	70	11.9	12.3	18.
2	8	ABELL(SIL.-MONTOYA)	48	DO,CH	ZSES	SG	5000	272	8				20	40	100	2385	103	PMW	68	40	30	47	12.6	12.8	27.
3	8	CORDONA LAKE(DEV.)	49	LS,CH	ZSES	SG	5400	235	18	15.	-1	2	40	40	657	2635	103	PMW	67	40	25	65	20.4	24.2	37.
4	8	CROSSETT(DEV.)	44	LS,CH	ZSES	SG	5400	260	22	6.	-1	2	35	44	1900	2500	106	PMG,M,CO2	64	40	19	53	13.8	17.6	33.
5	8	CROSSETT SOUTH(DEV.)	56	DO,CH	ZSES	SG	5600	500	19	3.	-1	2	40	42	1900	2500	107	PMG	70	40	19	98	17.5	18.6	19.
6	8	RUNNING W(WADDELL)	36	SS	ZSES	SG+GCE	6100	350	12	164.	-1	3	35	38	750	2747	105	WF,PMG	72	40	25	74	21.6	22.3	30.
7	8	THREE BAR(DEV.)	45	CH,LS	ZSES	SG	8400	375		54.	0	2	30	40	669	3315	120	WF,PMW,PM	51	40	25	129	35.7	41.2	32.
8	8	KEYSTONE(DEV.)	46	CH,LS	ZSES	SG+MGCE	7900	1100	9	8.	-1	2	35	37	655	3338	125	WF		40	30	89	15.2	15.3	17.
9	8	KEYSTONE(SIL.)	45	DO,LS	ZSES	SG	8400	1200	6	3.	-1	1	10	39	800	3377	120	WF	74	40	32	125	26.1	29.1	23.
10	8	EMBAR(ELL.)	42	DOLO	ZSES	WD	7700	380	5	40.	-1	3	25	45	723	3271	115			40	30	79	21.9	22.0	28.
11	8	FULLERTON(8500 DEV.)	44	DOLO	ZSES	WD	8500	350	8	50.	-1	3	25	45	374	3670	120	WF		40	25	110	44.3	46.8	43.
12	8	SAND HILLS(ORD.)	40	DOLO	ZSES	WD	5900	30	2				20	37	100	2625	103			40	25	48	12.3	13.0	27.
13	8	TXL(DEVONIAN)	44	CHERT	ZSES	SG	8000	600	11	100.	-1	3	41	40	900	3240	136	PMG,PMW	61	40	25	225	56.4	57.1	25.
14	8	ARENOSA(STRAWN DET.)	65	CHERT	ZSES	SG	8500	600	10	73.	-1	2	35	38	650	3762	125	PMW		160	35	130	16.4	22.0	17.
							7298.	494.	10.	55.			30.	41.	742.	3115	118.		57.%		26.	1342	326.1	354.3	26.

PLAY NAME: (31) ELLENBURGER FRACTURED DOLOMITE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H20 SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7C	AMACKER-TIPPETT(ELL)	53	DOLO	XFBA	WD	12100		6	23.	-1	2	15	53	850	5164	201			80	30	49	16.8	17.1	35.
2	7C	BARNHART(ELLENBURGER	41	DOLO	ZSES	SG+PWD	9000	397	4	7.	0	1	24	47	1200	3935	193	PMW		80	25	115	16.0	16.1	14.
3	7C	BIG LAKE(ELLENBURGER	28	DOLO	ZSES	WD	8300	282	4					42	1700	3860	190			160	30	72	21.0	21.2	29.
4	7C	ELKHORN(ELLENBURGER)	51	DOLO	ZSES	WD+SG	7200	455	2	34.	0	2		39	635	3140	179	PMW		40	39	27	11.5	11.7	43.
5	7C	PEGASUS(ELLENBURGER)	49	DOLO	XFA	GD	13000	829	3				30	53	1556	5668	214	PMW,PMG	54	80	32	216	87.2	87.5	41.
6	7C	TODD DEEP(ELLEN.)	45	DOLO	XFA	WD+SG	6000		7	5.	-1	2	34	42	475	2675	158	PMW		40	29	140	40.6	42.2	30.
7	7C	WILSHIRE(ELLENBURGER	51	DOLO	XSA	WD	12200	616	2	15.	-1	2		53	648	5306	202	PMW		40	30	124	40.3	40.9	33.
8	8	DORA ROBERTS(ELLEN.)	54	DOLO	XFA	SG+WD	13000		2	280.	-1	4	24	51	1249	5730	210	PMW,PMG	61	80	30	145	48.4	52.9	36.
9	8	HEADLEE(ELLENBURGER)	53	DOLO	XSA	SG+LWD	13300	393	2	40.	0	2	20	51	1259	5834	208	PMW		80	6	96	36.8	40.0	42.
10	8	ANDREWS NORTH(ELL.)	59	DOLO	XSA	WD	12400		2	50.	-1	3	10	45		4699	164			80	27	64	27.6	28.8	45.
11	8	WAR-SAN(ELLENBURGER)	54	DOLO	XFA	SG+PWD	13100		2	51.	-1	2	46	49	841	5564	210			80	40	40	13.2	13.8	35.
12	8	INEZ(ELLENBURGER)	61	DOLO	XSA	WD	12500		2	9.	-1	2	4	50	650	5213	178	WF		80	17	43	15.7	19.4	45.
13	8	MAGUTEX(ELLENBURGER)	62	LS,DO	XSA	WD	13800	160	3	16.	-1	2	15	46	490	6031	216			40	63	31	16.0	16.2	52.
14	8	MIDLAND FARMS(ELL.)	52	DOLO	XSA	WD	12600	525	2	9.	-1	2	7	48	650	5770	204	PMW	59	80	17	92	48.6	50.0	54.
15	8	BAKKE(ELLENBURGER)	56	DOLO	XFA	WD	12400		2	47.	-1	3	10	43	592	5185	168			40	8	68	23.6	24.0	35.
16	8	LOWE(ELLENBURGER)	57	DOLO	XSA	WD	13300		2	31.	-1	3	40	54	450	5764				80	35	37	11.2	11.5	31.
17	8	TXL(ELLENBURGER)	45	DOLO	XFBA	WD	9600	660	4	39.	0	2	15	44	1063	4065	138	WF		40	30	288	126.8	128.0	44.
18	8	DEEP ROCK(ELLEN.)	54	DOLO	XSA	WD	12300		2	10.	-1	2	10	44	465	5150	158			80	30	51	13.5	13.8	27.
19	8	EMMA(ELLENBURGER)	53	DOLO	XFA	WD	12300	183	3	54.	-1	3	20	49	636	5337	185			40	29	195	45.0	45.2	23.
20	8	FULLERTON SOUTH(ELL)	48	DOLO	XFA	WD	10700		2	77.	-1	3	15	44	530	4477	132			40	30	23	11.3	11.4	50.
21	8	KEYSTONE(ELLENBURGER	43	DOLO	XFA	WD+LGCE	9600	585	3	5.	-1	2	34	44	1467	4283	144	PMG	72	40	30	262	142.8	143.1	55.
22	8	HARPER(ELLENBURGER)	62	DO,LS	XFA	SG+WD	12300		2	2.	-1	3	30	46		4575	163			80	36	51	20.5	21.5	42.
23	8	DOLLARHIDE(ELLEN)	47	DOLO	XFA	WD	10000		3	5.	-1	2	33	41	498	4295	139	PMW	59	40	35	54	25.0	27.4	51.
24	8	MARTIN(ELLENBURGER)	46	DOLO	XFA	WD	8800	545	2	369.	-1	4	10	43	855		131	WF		40	28	69	36.1	36.2	52.
25	8	WHEELER(ELLENBURGER)	43	DOLO	XFA	WD	10500	342	1	54.	-1	3	15	44	1701	4630	146			80-40	30	35	17.7	17.8	51.
26	8	YAR. AND ALLEN(ELL)	47	DOLO	XFA	WD	10500		2	28.	-1	2	20	41	1171	4662	147	PMW		40	30	78	39.6	39.7	51.
27	8	PENWELL(ELLENBURGER)	46	DOLO	XFA	WD	8900		2				5	43	595					40	28	25	13.5	13.6	54.
28	8	JORDAN(ELLENBURGER)	47	DOLO	XFA	WD	8800		2	300.	-1	4	10	45	710	3864	134			40	30	65	30.2	31.0	48.
29	8	ANDECTOR	46	DOLO	XFA	WD	8500	817	1	300.	-1	4	10	44	553	3500	132			40	31	474	154.1	195.7	41.
30	8	LEA(ELLENBURGER)	53	DOLO	XFBA	WD	8200	430	2	300.	-1	4	6	43	367	3728	138			80	29	31	19.6	20.9	67.
31	8	VIREY(ELLENBURGER)	54	DOLO	XFBA	SG+WD	13100		2	32.	-1	2	24	51		5709	210	PMG,WF	66	80	38	90	28.8	31.0	34.
							10560.	601.	3.	100.			20.	46.	954.	4588	165.		19.%		29.	3150	1199.0	1269.6	40.

PLAY NAME: (32) SILURO-DEVONIAN RAMP CARBONATE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8A	BRONCO(SILURO-DEV.)	52	DOLO	XFA	WD	11800	265	6	150.	-1	3	25	44	178	4789	172			40	30	40	13.7	14.2	35.
2	8A	WEST(DEVONIAN)	57	DOLO	XSA	WD	11100	200	8	9.	-1	2	20	40	74	4455	160			40	35	65	17.9	25.9	40.
3	8A	RUSSELL NORTH(DEV.)	48	DOLO	XSA	WD	11200	500	6	141.	-1	3	20	41	193	4625	155	PMW		40	35	136	73.9	78.9	58.
4	8A	AMROW(DEVONIAN)	54	DOLO	XSA	WD	12600	159	4	34.	0	2	30	35	30	5455	178			80	20	43	13.2	14.6	34.
5	8A	TEX.-HAMON(FUSSELMAN	62	DO,CH	XSA	WD	11600	167	7	25.	-1	2	35	40	19	5066	154			80	30	28	15.4	16.5	59.
6	8	GLASCO(DEVONIAN)	53	DOLO	XSA	WD	12600	150	14	200.	-1	3	30	37	134	5492	186			40	30	52	18.5	19.9	38.
7	8	BREEDLOVE	51	DO,LS	XSA	WD	12100	145	9	50.	-1	3	30	41	32	5600	206			80	30	76	26.9	33.8	44.
8	8	HUTEX(DEVONIAN)	53	DO,LS	XSA	WD	12500	270	6	44.	-1	3	35	44	29	5480	162			80	30	89	35.1	40.8	46.
9	8	MAGUTEX(DEVONIAN)	53	DO,LS	XSA	WD	12500	150	6	83.	-1	3	20	43	50	5350	187			80	35	93	40.3	42.9	46.
10	8	LOWE(SILURIAN)	53	DOLO	XSA	SG	12800	150	5	7.	-1	2	30	49	530	5274	177	PMW,G,WF	66	80	30	47	13.5	14.3	30.
11	8	LUTHER SE(SIL.-DEV)	53	DOLO	YUPP	SG	9900	125	15	16.	-1	2	20	44	300	4246	168	PMW	67	80	35	70	19.3	20.7	30.
							11811.	262.	7.	83.			25.	42.	132.	5042	171.		18.%		32.	739	287.7	322.5	44.

PLAY NAME: (33) SILURO-DEVONIAN RAMP CARBONATE (S.C.B.P.) 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	GOLDSMITH(DEVONIAN)	47	LS,CH	XFA	SG+PWD	8000	150	15	47.	-1	3	25	40		3231	135	PMW	66	40	30	46	12.8	13.7	30.
2	8	UNIV.-WADDELL(DEV.)	49	LS,CH	XSA	SG	8600	900	11	1.	-1	1	37	40	1638	4062	140	PMW,PMG,M	67	40-20	28	175	49.7	56.6	32.
3	8	BLOCK 31(DEVONIAN)	45	LS,CH	XFBA	SG	8500	610	15	1.	-1	1	40	40	1300	4145	140	M(GAS)	52	40-20	26	340	174.1	204.6	60.
							8494.	646.	14.	3.			39.	40.	1375.	4078	140.		100.%		27.	561	236.6	274.9	49.

PLAY NAME: (34) SILURO-DEVONIAN RAMP CARBONATE (N.C.B.P.) 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE		H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	ANDREWS SOUTH(DEV.)	53	LS,DO	XSA	SG	10900		6	2.	-1	2	21	47		4390	183	WF		80	15	39	10.0	10.1	26.
2	8	BAKKE(DEVONIAN)	56	DOLO	XSA	WD	10500	150	8	903.	-1	4	16	47	732	4401	166			40	9	44	15.6	16.0	36.
3	8	SHAFTER LAKE(DEV.)	47	LS	XSA	SG+LGD	9500	710	5	6.	0	1	23	38	289	4085	135	PMW		40	35	147	22.3	23.5	16.
4	8	DOLLARHIDE(DEVONIAN)	45	DO,CH	XFA	SG	8000	1000	14	17.	-1	2	28	40	1270	3300	120	WF	59	40	36	138	72.2	76.8	56.
5	8	DOLLARHIDE(SILURIAN)	47	DO,LS	XFA	WD	8500	520	6	9.	-1	1	22	42	270	3555	120	PMW	59	40	35	180	36.2	40.5	22.
6	8	BEDFORD(DEVONIAN)	45	CH,LS	XFA	SG+LWD	8800	540	11	5.	-1	1	35	41	1090	3685	138	PMW	75	40-20	38	44	12.7	14.1	32.
7	8	UNIV. BLOCK 9(DEV.)	54	DOLO	XSA	WD	10500	200	5	3.	-1	1	17	45	645	4540	176			80	15	106	18.5	20.3	19.
							8938.	675.	9.	85.			24.	42.	818.	3741	136.		43.%		30.	698	187.5	201.3	29.

PLAY NAME: (35) YATES AREA

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	YATES(PERM. GUAD.)	26	DO,LS	XSA	GD+GCE	1250	486	10	118.	-1 5	25	30	38	700	82	PMW,PMG	76	40	25	4000	861.3	2000.0	50.
2	8	TOBORG(CRETACEOUS)	29	SS	ZPPS	SG	500		30	86.	-1 3	50	22	30	125	73	WF,T			35	70	39.5	40.0	57.
							1217.	486.	11.	117.		26.	30.	38.	675	82.		50.%		25.	4070	900.8	2040.0	50.

PLAY NAME: (36) SAN ANDRES/GRAYBURG (OZONA ARCH)

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7C	BIG LAKE	23	DOLO	XSA	WD	3000	160	19	20.	-1 2	20	36		1250	125			5		277	126.0	135.0	49.
2	7C	FARMER	53	DOLO	ZPPS	SG	2200	70	10	4.	-1 3	26	30		950				30	45	138	9.9	15.0	11.
3	7C	OLSON	40	DOLO	ZPPS	SG	1800	200	12	28.	-1 3'	35	25		900		WF	65	20	21	61	12.5	14.0	23.
4	7C	SHANNON(SAN ANDRES)	43	DOLO	ZNPP	SG	2400	170	10	24.	-1 2	33	26	290	875		WF		20-40	26	85	9.9	10.6	12.
5	7C	VAUGHN	47	DOLO	ZPPS	SG+GCE	1500	80	14	10.	-1 2	35	28		610		WF		10	30	61	11.2	12.0	20.
6	7C	WORLD	25	DOLO	ZPPS	WD	2600		15	8.		30	27		1000		WF		20	20	215	40.4	43.1	20.
							2705.	153.	17.	17.		25.	32.	290.	1115	125.		17.%		25.	837	209.9	229.7	27.

PLAY NAME: (37) SAN ANDRES/GRAYBURG (S.C.B.P.)

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	7C	MCCAMEY	25	DO,SS	ZPPS	SG+PWD	2200	260	14	18.	-1 3	30	28	135	1615	80	WF	59P	10	30	463	129.1	129.9	28.
2	8	MCELROY	26	DO,SS	ZPPS	SG	2900	1400	16	50.	-1 3	20	32	60	1400	86	WF	64P	10-20	25	2544	411.0	510.0	20.
3	8	DUNE	38	DOLO	ZPPS	SG	3300	800	10	6.	-1 1	25	34	384	1506	88	WF,PMW,G	70	20-10	27	590	149.4	163.9	28.
4	8	WADDELL	27	DOLO	XSA	SG	3500	300	11	12.	-1 2	40	34	484	1650	88	PMW		20	36	443	92.5	97.5	22.
5	8	JORDAN	37	LS	XSA	SG	3500	300	15	20.	-1 2	25	35	424	1550	85	WF,PMW	67	20	30	225	76.8	93.4	42.
6	8	PENWELL	27	DOLO	XSA	SG	3600	400	10	3.	-1 1	35	33	575	1850	108	WF	65	20	35	329	69.3	74.6	23.
7	8	HARPER	33	DOLO	ZPPS	SG	4100	400	10	2.	-1 1	35	36	559	1566	92	WF	66	20	33	168	40.0	45.0	27.
8	8	LAWSON	50	DOLO	ZPPS	SG+PWD	4300	100	10	6.	-1 2	30	37	770	1725	94	PMW	63	40	35	55	13.8	14.1	26.
9	8	GOLDSMITH	35	DOLO	ZPPS	SG+GCE	4100	300	11	12.	-1 2	15	36	757	1712	95	WF,PMG	67	20	33	990	323.2	343.0	35.
10	8	C-BAR	49	DOLO	ZPPS	SG	3500	100	8	5.	-1 3	35	33	399	1412	85	WF	72	40-20	25	59	16.5	19.0	32.
11	8	COWDEN SOUTH	33	DOLO	ZPPS	SG	4600	800	12	3.	-1 1	26	35	380	1760	119	WF	69	40	31	570	128.2	162.4	28.
12	8	FOSTER	35	DOLO	ZPPS	SG	4300	800	10	7.	-1 1	23	35	444	1740	95	WF,PMW	66	40	32	785	220.1	228.8	29.
13	8	COWDEN NORTH	30	DO,SS	ZPPS	SG+GCE	4300	800	10	7.	-1 1	29	35	360	1800	114	WF,PMW,G	66	40	35	1064	340.4	397.0	37.
14	8	MIDLAND FARMS	44	DOLO	ZPPS	SG+LWD	4800	250	14	61.	-1 4	20	32	160	1975	102	WF	61	40	25	775	120.7	154.6	20.
15	8	MIDLAND FARMS NORTH	53	DOLO	ZPPS	SG+LWD	4800	200	12	6.	-1 2	19	29	160	1782	106	WF	56	40	22	51	14.0	15.2	30.
16	8	MABEE	44	DOLO	ZPPS	SG	4700	150	11	8.	-1 2	29	32	100	1905	106	WF	65	20	21	290	67.5	93.0	32.
17	8	JOHNSON	34	DO,LS	ZNPP	SG	4100	200	7	5.	-1 2	22	35	484	1595	94	WF	60	40	35	135	23.8	26.6	20.
18	8	GOLDSMITH NORTH	64	DOLO	ZNPP	SG	4400	200	8	2.	-1 1	25	35	450	1713	95	WF	73	40	35	45	12.4	15.0	33.
19	8	SAND HILLS(MCKNIGHT)	44	DOLO	ZPPS	SG+GCE	3500	500	9	1.	-1 2	40	33	578	1580	86	WF		40-20	40	705	108.8	128.6	18.
							3781.	670.	12.	18.		25.	34.	372.	1661	96.		89.%		31.	10286	2357.5	2711.6	26.

PLAY NAME: (38) SAN ANDRES/GRAYBURG (N.C.B.P.) 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	MEANS	34	DO,SS	ZNPP	WD,GCE	4400	230	8	12.	-1 2	29	31	1100	1900	100	WF	64	40	30	449	138.4	164.7	37.
2	8	EMMA	37	DOLO	ZPPS	SG	4000	183	7	11.	-1 2	20	33	596	1550	104	WF	65	40-20	23	63	18.6	18.8	30.
3	8	FUHRMAN-MASCHO	30	DOLO	ZPPS	SG+WD	4300	295	13	5.	-1 2	30	32	257	1800	95	WF,PMW	72	40	15	330	87.2	89.1	27.
4	8	SHAFTER LAKE(S.A.)	53	DOLO	XSA	SG	4400	400	8	5.	-1 2	25	34	600	1865	105	WF	67	40	30	236	35.3	40.1	17.
5	8A	SEMINOLE	36	DOLO	XSA	GCE+SG	5200	262	13	25.	-1 2	12	35	730	2020	108	PMW,PMG	69	20	27	1150	344.2	470.0	41.
6	8A	SEMINOLE, W.	48	DOLO	XSA	GCE,SG	5100	175	14	21.	-1 2	24	32	300	2020	102	WF,PMG	62	40	35	172	31.9	35.4	21.
							4829.	261.	12.	18.		19.	34.	713.	1944	104.		100.%		26.	2400	655.6	818.1	34.

PLAY NAME: (39) PERMIAN SANDSTONE AND CARBONATE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	HENDERSON	36	DO,SS	ZPPS	SG+LWD	3100	200	14	50.	-1 2	40	31	500	1374	85			10	35	76	14.7	14.8	19.
2	8	HENDRICK	26	LS,DO	ZPPS	WD	2500	750	8	7.	0 3	40	28	150	1400	83	WF		10	30	760	256.0	260.1	34.
3	8	KERMIT	28	LS,DO	ZPPS	SG	2800	600	15	14.	-1 2	35	34	500	1450	83	WF,PMG	51-70	40-10	30	363	104.0	104.8	29.
4	8	EMPEROR(DEEP)	35	SS,DO	ZPPS	SG	2900	350	17	20.	-1 2	42	33	150	1350	80	WF	64	20-10	30	80	23.0	24.0	30.
5	8	HALLEY	34	SS,DO	ZPPS	SG+LWD+G	2700	300	16	20.	-1 2	30	34	300	1324	83	WF	54	20	41	59	16.6	17.6	30.
6	8	NORTH WARD-ESTES	29	SS,DO	ZPPS	SG+LWD+G	2500	600	20	40.	-1 2	35	38	510	1400	81	WF,T	60	20-10	35	749	336.7	351.4	47.
7	8	SCARBOROUGH	27	SS	ZPPS	SG+LWD	3000	450	17	12.	-1 2	40	37	250	1830	85	WF,PMW		20	35	160	36.2	36.8	23.
8	8	WARD SOUTH	29	SS,DO	ZPPS	SG	2400	350	21	40.	-1 2	40	35	510	1400	81	WF		20-10	33	246	99.2	105.8	43.
9	8	PAYTON	37	SS	ZPPS	SG	2000		20	35.	-1 2	20	36	550	1225	81	WF	51	10-5	30	37	13.0	13.7	37.
10	8	FORT STOCKTON	44	SS	ZPPS	SG+LGCE	2800	450	17	35.	-1 3	44	32	739	1410	83	WF	63-66	40	31	101	26.8	29.6	29.
11	8	PECOS VALLEY(HI GRAV	27	SS	ZPPS	SG	1700	400	17	45.	-1 2	35	31	236	700	81	WF		10	34	47	17.6	17.9	38.
12	8	TAYLOR LINK	29	SS,LS	ZPPS	SG+WD	1300	90	15	40.	-1 2	20	32	200	570	84	WF		10	28	76	15.3	15.4	20.
13	8	KEYSTONE(COLBY)	30	SS,DO	ZPPS	SG	3100	550	13	3.	-1 2	34	38	371	1573	87	WF	60	40-20	18	207	57.5	60.9	29.
							2563.	573.	16.	25.		37.	34.	387.	1401	82.		54.%		32.	2961	1016.6	1052.8	36.

PLAY NAME: (40) CLEARFORK PLATFORM CARBONATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	SAND HILLS(TUBB)	30	DOLO	ZPPS	SG+LGCE	4500	250	12	30.	-1 2	40	35	1164	2100	96	PMW,WF	69P	40	31	468	81.1	92.2	20.
2	8	TXL(TUBB)	50	DOLO	XSA	SG	6200	450	9	1.	-1 1	38	35	1198	2900	120	WF	67P	40	30	191	35.0	38.2	20.
3	8	GOLDSMITH(5600)	47	DOLO	XAT	SG	5600	400	15	25.	-1 2	30	38	829	2330	105	PMW,WF	64P	40	23	768	203.6	216.0	28.
4	8	GOLDSMITH(CLEARFORK)	46	DO,LS	ZPPS	SG	6100	200	12	5.	-1 2	25	40	1097	2600	110	WF	69P	40	30	295	58.5	60.6	21.
5	8	COWDEN NORTH(DEEP)	39	DOLO	ZPPS	SG	5100	100	8	7.	-1 2	20	37	283	2150	107	WF		40	30	176	41.2	46.6	26.
6	8	DOLLARHIDE(CLEARFORK	49	DOLO	ZPPS	SG	6500	350	15	10.	-1 2	25	38	545	3175	120	WF	59	40	44	102	30.7	32.1	31.
7	8	FULLERTON	41	DO,LS	ZPPS	SG	6700	500	10	3.	-1 1	24	42	641	3000	117	PMW,WF	54	40	23	1135	211.2	230.9	20.
8	8	KEYSTONE(HOLT)	43	DO,LS	ZPPS	SG	4800	55	18	58.	-1 2	29	40	863	2160	92	WF	67	40-20	40	222	35.9	38.9	18.
9	8	UNION	43	DOLO	XSA	SG	6900	200	11	2.	-1 1	15	33	261	2760	110	PMW		40	30	98	15.1	15.7	16.
10	8A	HARRIS	49	DO,SS	ZPPS	SG	5900		9	11.	-1 2	28	31	159	2400	112	WF	71-75	40	35	148	36.0	43.3	29.
11	8A	FLANAGAN(U. CLFK)	49	DOLO	ZPPS	SG	6300	750	13	3.	-1 2	27	32	450	1875	113	WF,CO2	66	40	25	100	19.5	23.0	23.
12	8A	RILEY N.(U. CLFK)	47	DOLO	ZPPS	SG	6300	60	8	12.	-1 3	33	32	344	2850	107	WF	75P	40	35	106	18.8	19.7	19.
13	8A	ROBERTSON N. (CLFK)	56	DOLO	ZPPS	SG	7100	200	7	19.	-1 2	27	35	640	3100	117	WF	71	40-20	35	275	53.3	67.0	24.
							5968.	350.	12.	15.		28.	38.	742.	2594	110.		85.%		28.	4084	839.9	924.2	23.

PLAY NAME: (41) QUEEN PLATFORM/STRANDPLAIN

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	MCFARLAND	55	SS,DO	ZNPP	SG	4800	325	12	12.	-1 2	34	34	125	2250	108	WF,PMW	67	40	25	130	35.6	38.4	30.
2	8	MEANS	54	SS	ZPPS	SG	4100	250	15	40.	-1 2	35	33	407	1566	102	WF,PMW		80-40	25	113	34.7	36.1	32.
3	8	SHIPLEY	28	SS,DO	ZPPS	SG+PWD	2400	150	20	22.	-1 2	42	35	700	950	83	WF	56	10	30	81	27.7	28.4	35.
							3874.	249.	15.	25.		37.	34.	387.	1640	99.		67.%		26.	324	98.0	102.9	32.

PLAY NAME: (42) WOLFCAMP PLATFORM CARBONATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	UNIV. BLOCK 9(WLF)	53	LS	ZPPS	SG	8400	250	10	14.	-1 2	27	38	600	3500	140	WF,PMG,M	60	80	25	51	23.8	25.0	49.
2	8	BAKKE(WOLFCAMP)	56	LS	ZPPS	SG	8500	200	11	38.	-1 3	25	41	727	3685	133	WF	68	40	35	77	19.2	22.0	29.
3	8	MIDLAND FARMS(WLF)	53	LS	ZPPS	SG	8400	300	13	30.	-1 3	20	41	934	3514	162	WF,M,LPG	58	160	35	44	10.3	10.4	24.
4	8	NOLLEY(WOLFCAMP)	51	LS,DO	ZNPP	SG+LWD	9100	400	9	20.	-1 3	28	37	589	4103	130	WF	75	40	30	77	21.9	22.5	29.
5	8	ANDREWS(WOLFCAMP)	53	LS	ZPPS	SG	8600	250	8	18.	-1 3	27	38	900	3604	127			40	35	53	18.3	20.3	38.
6	8	ANDREWS SO.(WOLFCA	53	LS	ZPPS	SG	9100	200	5	11.	-1 2	22	40	835	3865	127			80-40	35	54	12.4	13.0	24.
7	8	SHAFTER LAKE(WLF)	51	LS	XSA	SG	8400	235	13	28.	-1 2	22	42	800	3468	125	WF	63	40	30	32	12.0	12.2	38.
							8651.	267.	10.	22.		25.	39.	739.	3695	134.		71.%		32.	388	117.9	125.4	32.

PLAY NAME: (43) PENNSYLVANIAN PLATFORM CARBONATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	UNIV. BLOCK 9(PENN)	54	LS	ZPPS	SG	9000	250	12	11.	-1 2	30	40	760	3900	151	WF,PMG	70	80	40	52	10.9	11.3	22.
2	8	TRIPLE-N(PENN.)	58	LS	ZPPS	SG	8900	300	11	7.	-1 1	30	40	715	3850	140			80	40	50	14.4	15.0	30.
3	8	ANDREWS	54	LS	ZPPS	SG	9200	300	7	31.	-1 2	26	40	750	3805	133			40	11	48	14.0	14.3	30.
4	8	BAKKE	56	LS	ZPPS	SG	8900	500	9	13.	-1 2	29	40	900	3880	132			40	35	48	12.0	12.1	25.
5	8	COWDEN S(8790 CANYON	66	LS	ZPPS	SG+LGCE	8800	300	8	4.	-1 1	27	40	550	3957	147	WF		160	43	133	20.5	24.0	18.
6	8	EDWARDS WEST(CANYON)	70	LS	ZPPS	SG+LWD	8700	300	10	5.	-1 2	25	41	1062	3957	140			160	35	111	19.4	24.5	22.
							8893.	320.	9.	11.		28.	40.	787.	3900	141.		17.%		35.	442	91.2	101.2	23.

PLAY NAME: (44) NORTHERN SHELF PERMIAN CARBONATE

07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8A	SMYER	44	DOLO	ZNPP	SG	5900	200	9	8.	-1 2	40	26	62	2100	112	WF	67	40	19	92	29.2	35.8	39.
2	8A	SLAUGHTER	36	DOLO	ZNPP	SG	5000		12	11.	-1 2	20	30	460	1710	108	WF,PMW,G	66	35	34	3600	857.5	1216.1	34.
3	8A	BRAHANEY	45	DOLO	ZNPP	SG	5200	179	9	2.	-1 1	27	32	250	1940	111	WF	68	40	30	158	33.6	39.1	25.
4	8A	ANTON-IRISH	44	DOLO	XSA	SG	5300	700	9	9.	-1 2	22	31	131	2094	107	WF,PMG	51	40	35	450	139.1	190.7	42.
5	8A	LEVELLAND	37	DO,LS	ZNPP	SG	4900		11	2.	-1 1	26	30	425	1700	105	WF,PMG,M	74	40	47	1012	349.9	413.7	41.
6	8A	PRENTICE	51	DOLO	ZPPS	SG	6000	180	12	12.	-1 2	36	28	259	2400	114	WF	73P	40	34	188	44.8	54.9	29.
7	8A	PRENTICE(6700)	50	DOLO	ZPPS	SG	6700	270	6	2.	-1 1	31	28	233	2400	120	WF	73	40-20	24	210	78.3	98.2	47.
8	8A	OWNBY	59	DOLO	ZPPS	SG	6900	165	9	4.	-1 2	17	31	350	2765	118	WF	71	80	58	113	11.0	12.6	11.
9	8A	WASSON, NE.	54	DO	ZPPS	SG	7800	400	5	9.	-1 2	30	30	350	2643	121			40	30	25	10.4	11.4	46.
10	8A	WASSON '72'	40	DOLO	ZPPS	SG	9	400	8	10.	-1 2	24	33	417	2164	118			40	30	291	76.8	82.6	28.
11	8A	WASSON	36	DO	ZPPS	SG+GCE	4900	330	10	4.	-1 2	20	33	700	1850	107	WF,PMW,GM	66	40-20	49	4400	1308.4	1629.0	37.
12	8A	ADAIR	47	DO	ZPPS	SG	4800	140	12	4.	-1 1	27	34	208	1875	103	WF	62	40	37	168	46.5	67.2	40.
13	8A	KINGDOM(ABO)	70	DOLO	YDTR	SG	7800	400	7	5.	-1 2	23	30	190	3015	121	WF	76P	40-20	45	77	19.2	26.8	35.
14	8A	CEDAR LAKE	39	DO,LS	ZPPS	SG	4800	250	14	12.	-1 2	20	33	200	1954	103	WF,PMG	63	40-20	30	344	66.8	96.6	28.
15	8A	WELCH	36	DOLO	ZPPS	SG	4900	180	10	9.	-1 2	24	33	108	2100	96	WF,M,CO2	68	40-20	30	576	116.3	151.3	26.
16	8A	REEVES	57	DO	ZPPS	SG	5600	180	12	3.	-1 2	36	32	264	2000	113	WF	65	40	20	88	21.5	27.0	31.
17	8A	RUSSELL(7000, CLFK)	42	DOLO	ZNPP	SG	7000	700	5	2.	-1 2	25	35	565	2400	127	WF	71	40	40	229	45.7	55.8	24.
							5082.	339.	10.	6.		22.	32.	500.	1871	108.		88.%		41.	12021	3255.0	4208.8	35.

PLAY NAME: (45) DELAWARE SANDSTONE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	8	EL MAR(DELAWARE)	59	SS	YUPP	SG	4500		22	14.	1 2	45	41	575	2151		WF	69	20	21	70	16.7	18.4	26.
2	8	GERALDINE(FORD)	57	SS	YUPP	SG	2600	400	22	49.	1 2	45	41	466	1421	100	WF,M	68	20	15	111	19.1	28.6	26.
3	8	TUNSTILL	47	SS	YUPP	SG	3300	215	25	30.	1 2	38	40	1327	1720	88	WF		20		160	10.1	11.0	7.
4	8	TWOFREDS(DELAWARE)	57	SS	YUPP	SG	4900	210	20	33.	1 2	44	35	441	2385	104	WF,CO2,PM	63	40	25	55	10.3	12.1	22.
5	8	WHEAT	25	SS	YUPP	SG	4300	230	20	19.	0 1	35	36		1850		WF		20		88	20.7	22.0	25.
							3870.	278.	22.	29.		41.	39.	649.	1863	98.		60.%		19.	484	76.9	92.1	19.

PLAY NAME: (46) PANHANDLE GRANITE WASH/DOLOMITE 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	10	PANHANDLE	21	S,C,D	ZPPS	SG+LGCE	2850	350	13	25.	-1 3	37	39	1000	450		WF,PMG,W	62P		35	6060	1336.0	1450.0	24.
							2850.	350.	13.	25.		37.	39.	1000.	450	0		100.%		35.	6060	1336.0	1450.0	24.

PLAY NAME: (47) PANHANDLE MORROW 07 SEP 82

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	10	R.H.F.(MORROW)	56	SS	YI	SG+LGCE	8100	305	15	35.	-1 3	36	36	400	2113	151	WF	64	80	22	59	16.4	16.5	28.
2	10	FARNSWORTH(U MORROW)	55	SS	YI	SG	7900	300	15	48.	-1 3	31	38	164	2203	170	WF	64	80	30	129	34.4	36.1	28.
							7965.	302.	15.	44.		33.	37.	240.	2174	164.		100.%		27.	188	50.8	52.6	28.

MISCELLANEOUS

#	RCC DIST	FIELD (RESEVOIR)	DISCOV DATE	LITH	TRAP	DRIVE	DEPTH (FT)	OIL COL (FT)	PORS (%)	PERMEABILITY AVG (MD)	LOG RANGE	H2O SAT (%)	API GRAV	INIT GOR	INIT PRESS	TEMP (F)	PRODUCTIN TECHNOLGY	UNIT DATE	WELL SPACING (ACRES)	ROS (%)	OIP (MMBBL)	CUM PROD (MMBBL)	ULT RECOV (MMBBL)	RECOV EFFEC (%)
1	1	LYTTON SPRINGS	25	TUFF	YI	SG+GD	1300		6	7.		45	38		650	119	PMW,WF,PM		3	40	90	10.8	10.8	12.
2	2	BERCLAIR(VICKSBURG)	50	SS	XFA	WD,GCE,S	3200	23	33	1000.	1 4	38	27	90	1339	137			10		27	11.2	13.4	50.
3	4	WILLAMAR(WILLAMAR)	40	SS	XFA	SG+GCE	7600	143	23	140.	0 3	25	30	500	3640	200	WF,PMW	51	40	16	95	37.4	39.0	41.
4	4	WILLAMAR,W.(W. WILLA	41	SS	XFA	SG+GCE	7900	160	19	65.	0 2	36	31	465	3650	212	PMW,PMG	51	40	16	161	35.6	67.6	42.
5	5	BRANTLEY JACKSON(SMA	67	DO,LS	XSSF	SG	9200	240	22	25.	-1 3	11	40	839	4321	205	PM	70	160	52	29	10.7	15.0	52.
6	5	CHENEYBORO(COTTON VA	78	LS	ZNPP	SG	9700		6	12.	0 1	25	50	3100	4808	224			160320			2.0		
7	6	MERYGALE-PAUL(SUB-CL	44	SS	ZNPP	SG	4800	235	22	300.	2 3	23	30		2043	159	WF	53	11.1	65	25	11.0	11.1	44.
8	5	CORSICANA SHALLOW	1896	SS	ZNPP	SG+WD+GC	1200	84	27	28.	1 2	55	36	50	300		WF,IM		10	10		40.6		
9	7B	ROUGH DRAW(NOODLE C)	61	LS	YUPP	SG	3900	140	10	178.	-1 3	15	42	214	1690		WF,PM	65	40-80		27	10.3	10.3	38.
10	7C	FORT CHADBOURNE	49	LS	YUPP	SG+MGCE	5400	240	5	28.	-1 2	40	45	250	2230	134	WF,PMG	53	40		98	52.6	53.9	55.
11	7C	PEGASUS(PENN.)	51	LS	XSA	SG	10500	567	7	9.	-1 2	33	44	2000	4567	180	PM,WF	54	80	24	49	14.5	15.0	31.
12	9	SANDUSKY(OIL CREEK)	50	SS	XFBA	SG+LWD	7200	80	17	238.		26	42	1250	2430	142	PMW,WF	65	40	28	20	14.7	14.8	74.
13	10	QUINDUNO(ALBANY DOL)	52	DOLO	ZPPS	SG	4000	150	15	40.		45	48	12000	1014		WF		40	15	48	15.0	15.1	31.