

PROJECT

STARR



STATE OF TEXAS ADVANCED OIL AND GAS RESOURCE RECOVERY

# PROGRESS REPORT

Potter

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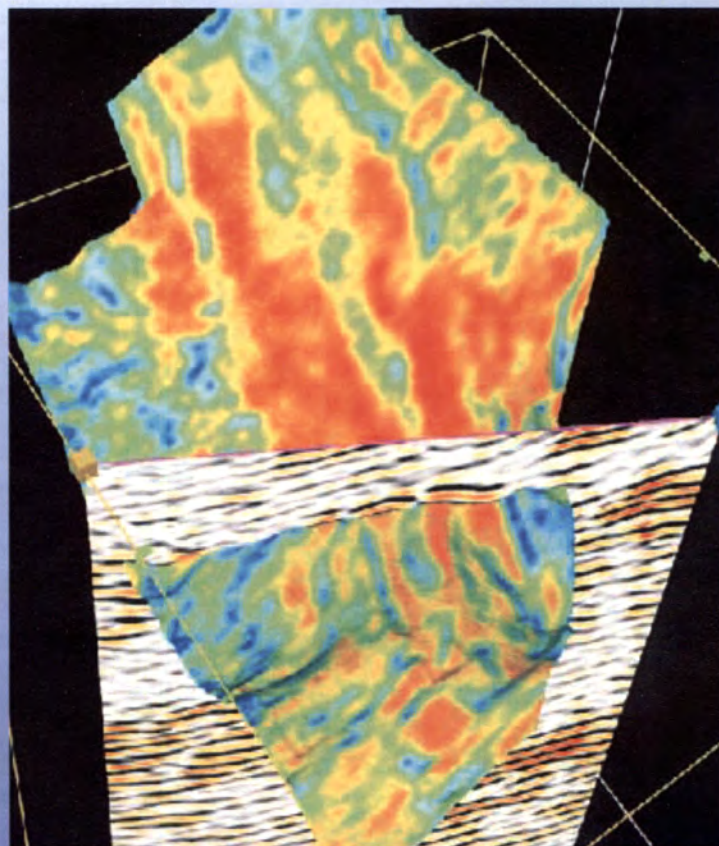
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## EXECUTIVE SUMMARY

The State of Texas Advanced Resource Recovery program, Project STARR, has been successful in its major objective to increase royalty income to the Permanent School Fund and severance taxes to the General Fund through technological and research projects that promote the drilling of profitable oil and gas wells on State Lands and Waters.

The Bureau of Economic Geology (BEG) currently receives funds from the State to analyze State Lands and other Texas properties and then advise and assist operators on how to increase current production or discover new production. The State requires Project STARR to be revenue neutral – that is, Project STARR has to cause an amount of new revenue to flow into the State that equals or exceeds the amount that is appropriated to the program by the Legislature. This progress report summarizes and documents in detail the accomplishments of Project STARR over the last two years (September 2006 through August 2008).

Over the last 2 years, Project STARR has helped companies with whom Project STARR has collaborated generate \$18.7 million in royalties to the Permanent School Fund and \$53.8 million in severance taxes to the State for a total value of \$72.6 million. Relative to total income, Project STARR is revenue positive by a factor of 18.6. The high positive revenue factor is from 55 successful wells drilled in several fields in the State Waters and West Texas, from the highly produced Barnett shale-gas play in Newark East field, from a successful tertiary recovery project in Yates field in West Texas, and from higher prices for oil and gas.

On State Lands, proven oil reserves total 270 million barrels (MMbbl), which is only 8 percent of the 3.43 billion barrels (Bbbl) of oil that is projected to remain within these properties at reservoir abandonment (Holtz and Garrett, 1997). Of the 3.43 Bbbl, 1.6 Bbbl is mobile oil that can potentially be recovered if advanced geological, geophysical, and engineering technologies are applied to State Lands reservoirs.

A similar picture emerges for natural gas in Texas State Lands fields. Cumulative gas production on State Lands is 10 trillion cubic feet (Tcf) (Holtz and Garrett, 1997). The amount of natural gas remaining in the largest State Lands gas reservoirs is estimated to be another 10 Tcf. The amount of natural gas projected to remain unrecovered in these properties at reservoir abandonment using currently deployed technology will almost equal the amount of gas produced to date. With regard to in-place volumes of oil and gas, State Lands reservoirs are nowhere near depletion, and many new deeper exploration targets exist. It is critical to apply new and advanced technologies to finding and extracting these remaining hydrocarbons, and Project STARR provides the advanced technical expertise to help operators effectively deploy these technologies.

Project STARR results have been used to recommend more than 145 infill and step-out wells and 59 recompletions over the project's 13-year duration. Project STARR has also

identified and worked on several prospects in previously undrilled deeper strata. To date, Project STARR has completed studies or is currently working on 30 fields. During the 2 years since the last Project STARR report, these studies have created royalty revenue and severance tax to the State in the amount of \$55.7 million. It commonly takes several years between delineation of prospects and actual drilling of wells; therefore, many more millions of dollars of benefits to the State may result from Project STARR's recent recommendations and successes. Over the 13-year life of Project STARR, ~\$190 million has been added from royalties and severance taxes on the increased production, an average of \$14.6 million per year

## INTRODUCTION

Revenue income to the Permanent School Fund is derived largely from oil and gas royalties from Texas State Lands and from severance taxes on Texas leases (Fig. 1). However, oil and gas royalty income has declined, even though a large hydrocarbon resource base remains on State Lands. In fact, State Lands fields and properties still contain more oil and gas than has been recovered over the decades-long history of State Lands production. Rather than being unobtainable, a large volume of this remaining oil and gas is recoverable through improved scientific understanding and strategic, targeted deployment of advanced recovery technologies. Advanced technology has historically been the realm of major oil and gas companies, but many large companies in their pursuit of economies of scale have abandoned development of mature Texas oil and gas resources. The departure of these large operators has created opportunities for the remaining smaller producers of State Lands fields. Independents, who have no advanced research or development capabilities, are requesting reservoir characterization and exploration assistance from the State of Texas Advanced Oil and Gas Resource Recovery project (Project STARR) (see letters from partners in Appendix A). These independents recognize that without the advanced technology offered by Project STARR, they may miss producing substantial reserves and not recognize additional opportunities on their State Land leases. The Bureau of Economic Geology, The University of Texas at Austin, with funding from the State of Texas and support from the General Land Office and the Railroad Commission of Texas, strives to provide this requested technical support. Opportunities for increased production and associated reserves have been identified, and with the support of allied operators, these opportunities have been or are being drilled. Recent projects are described in the present report. Project STARR's revenue neutrality calculations are typically conducted for the trailing two-year period at the time of reporting. For this report, the calculations cover the period from September 1, 2006 until August 31, 2008.



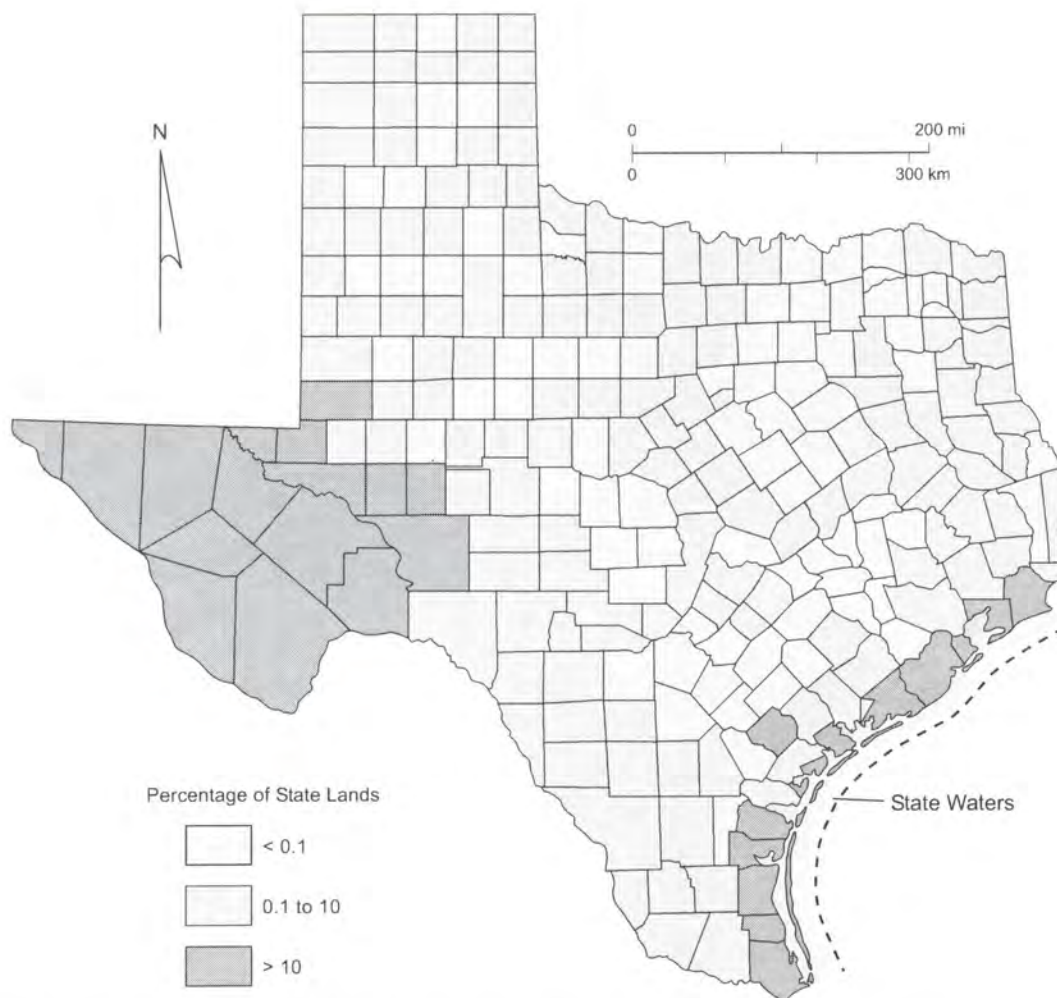


Figure 1: Location of Texas State Lands and State Waters. Onshore counties are shaded according to the percentage of area that is State Lands. Most of onshore State Lands leases occur in the Permian Basin in West Texas and along the Gulf Coast. From Holtz and Garrett (1997).

To date, 31 fields have been chosen for assessment (Fig. 2 and Table 1); 27 Texas operators have been, or are currently, involved in Project STARR (Table 1). Project STARR studies have been used to recommend more than 145 infill and step-out wells and 59 recompletions over the project's 13-year duration (Tyler et al., 1998; Hardage et al., 2000; Loucks et al., 2002a, b; 2004; 2006). Working closely with industry partners, Project STARR has also identified several prospects in previously undrilled, deeper strata. Of the targeted opportunities, at least 105 infill wells and step-out wells, and 35 recompletions have been drilled on State Lands as a result of Project STARR interactions with operators. More than five deeper targets were successfully drilled in Carancahua Bay and Red Fish Bay. Acknowledgment letters from nine partners are presented in Appendix A. Project STARR also presented workshops on the Barnett



Shale gas trend in the Fort Worth Basin during the fall of 2007 and spring of 2008. These workshops were designed to increase operators' knowledge of the geology and engineering of this important Texas gas resource and to promote additional drilling. Since the Project Starr workshops, approximately 1,365 wells have been drilled in the Barnett Shale gas play. Currently, there are four more regional studies underway (described later) that will increase and stimulate production in these strata and regions.

The enhanced STARR project is currently, and has been, conducting four regional studies under the New Venture Studies group and two studies under the Unconventional Resources group. These new endeavors have required adding manpower to the project. We now have 18 full and part-time geoscientists/engineers and 5 undergraduate student assistants associated with the project. This technical staff represents a broad range of skills.

STARR's Reservoir Characterization Group is continuing to apply its advanced methods of identifying additional drilling and completion opportunities in known fields. Additional manpower has allowed us to increase the number of fields from 10 studied last 2 years to 12 this biennium, as well as to apply new technology to these fields. Regional studies of hydrocarbon-producing areas are being conducted by STARR's New Ventures Group. This group is studying the middle Texas Gulf Coast Oligocene Frio section (Regional Frio study) using advanced stratigraphic methods partly developed partly by Project STARR, the North Texas Eastern Shelf exploration trend, the East Texas Woodbine exploration trend, and the Bone Spring play in West Texas (Fig. 2). These studies are designed to increase interest in drilling for new objectives, especially stratigraphic traps and deeper prospects. Project STARR's new Unconventional Resource Group has also initiated studies in shale-gas systems (Fig. 3). The largest gas field in Texas, Newark East field in the Fort Worth Basin, is a shale-gas reservoir. We have completed a detailed study of this unit in the northern Fort Worth Basin and have presented three workshops for industry. Shale gas continues to be one of the "hottest" plays in Texas, with opportunities across broad areas of the state. Several shale-gas studies will be conducted in the next biennium including the Haynesville shale play of East Texas, the Barnett shale in the southern Fort Worth Basin, and the Barnett/Woodford shale-gas play in West Texas. Project STARR is adding to momentum to all of these plays.

Highlights of the present biennium (September 2006 – August 2008):

- Project STARR is revenue positive by a factor of 18.6 and has helped generate \$72.6 million to the Permanent School Fund and the General Fund of the State of Texas during the last biennium. The high positive revenue factor is from 55 successful wells drilled in several fields in the State Waters and West Texas, the highly productive Barnett shale-gas play in Newark East field, a successful tertiary recovery project in the Yates field in West Texas, and higher prices for oil and gas.

- Our reservoir characterization group successfully assisted in completing 24 infill wells in St. Mary's Gold River field, 11 new wells in Gunn Oil's Spur Lake field and MPG Petroleum's Ritchie Farms field, and five well deepening in Danmark's East Texas field Kilgore Unit.
- A comprehensive study of the Barnett shale-gas play was presented to operators in three workshops. This study provided new data and concepts on the shale-gas play in the Fort Worth Basin, and data will be able to be applied to similar Texas shale-gas plays where State Land leases are abundant.
- A regional study of the Woodbine Group in the East Texas Basin was conducted to gain new insights on new exploration fairways and play opportunities. Results will be presented during a workshop in November 2008.
- Several shale-gas studies including the Barnett/Woodford shales in West Texas and the Haynesville shale in East Texas are under way and some of them have been presented to the public in workshops and publications.



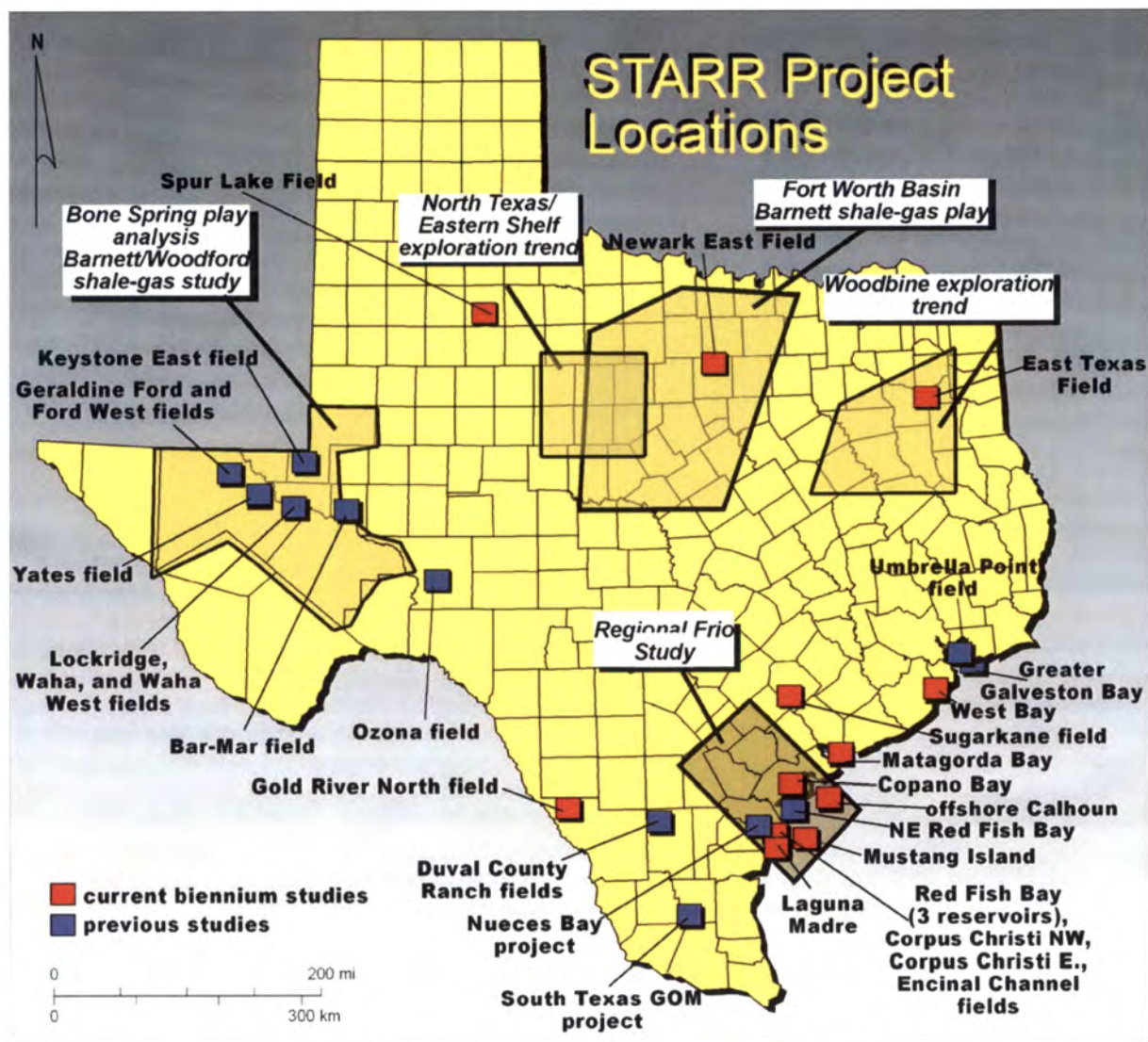


Figure 2: Map showing Project STARR field studies (blue and red squares) and current regional studies (shaded boxes). Thirty State Lands oil and gas fields have been or are being evaluated and five regional studies are currently being conducted.



Table 1: Project STARR field studies.

<u>Field</u>	<u>Operator</u>	<u>Period of Project STARR Interaction</u>
Keystone East field	Bass Enterprises, Hallwood Energy, Pioneer Natural Resources, Vista Resources	1995-1999
Geraldine Ford and Ford West fields: (primary funding by U.S. Department of Energy)	Conoco, Incorporated	1995-1997
Lockridge, Waha, and Waha West fields: (primary funding by U.S. Department of Energy and Gas Research Institute)	Shell Oil and Mobil Oil (now ExxonMobil)	1996-1998
Bar Mar field	Hanson Corporation Union Pacific Resources (now Anadarko), Cross Timbers Oil Co.	1997-1998 1996-1998
Ozona field	Killam Oil	1998 - 1999
Duval County Ranch field	Panaco, Incorporated	1998-1999
Umbrella Point field	Pi Energy	1995-1999
Red Fish Bay field (shallow Frio)	Sabco Oil and Gas, Royal Exploration	1996-1997
Corpus Christi East field (Frio)	Sabco Oil and Gas ,	1998-2000
Corpus Christi NW field (Frio)	Royal Exploration Sabco Oil and Gas,	1998-2000
Encinal Channel field (Frio)	Royal Exploration	1999-2000
Mustang Island 889 field (Frio)	Sabco Oil and Gas	2000-2001
Red Fish Bay field (Middle Frio)	IBC Petroleum, Cinco Boss Exploration,	2001-present
Red Fish Bay field (Deep Frio)	Cinco	2003-present
Mustang Island Offshore (Frio)	Cabot Oil and Gas	2003
Northeast Red Fish Bay Project (Frio)	Cabot Oil and Gas	2003
Laguna Madre (Frio)	Novus	2004-2005
Yates field EOR (Permian)	Kinder Morgan	2004-2006
Galveston-Bay Shelf area study (Frio)	Santos USA Corp	2004-2006
Carancahua and Matagorda Bay Projects (Frio, Miocene)	Brigham Exploration Company	2004-present
West Bay area study (Alligator Point field; Frio, Miocene)	Gulf Energy Exploration Gulf Energy	2005-present
LaSalle, Calhoun offshore (Frio)	Exploration	2005-present
Gold River North field (Olmos)	Huber	2006
Gold River North field (Olmos)	St. Mary's Land and Exploration	2007-present

<u>Field</u>	<u>Operator</u>	<u>Period of Project STARR Interaction</u>
East Texas field (Woodbine)	Various operators	2006 - present
North Newark field (Barnett)	Various operators	2007 - present
Spur Lake field	Gunn Oil Co.	2007- present
Mustang Island (Frio)	Sabco Operating Co.	2006- present
Copano Bay	MPG Petroleum	2007 - present
East Texas field (Moncrief lease)	Danmark Energy	2007-present
Sugarkane field	Texas Crude	2006-present

## HISTORICAL BACKGROUND ON THE PERMANENT SCHOOL FUND

In 1839 the Republic of Texas began designating public lands to be used to benefit public schools. The State of Texas now has more than 13 million acres set aside for revenue generation to assist public education (Fig. 1). In the 169 years since that forward-looking decision was made, billions in revenue for public schools has been generated by agricultural and mineral leasing of these lands, with most of the revenue being derived from royalties and rentals paid by oil and gas leases. At the end of fiscal year 2007 the fund was valued at \$25.3 billion (Texas Permanent School Fund Annual Report, 2007). Land endowment income collected by the GLO, consisting principally of mineral royalties from oil and gas production and bonus payments for leases, was \$388.8 million for fiscal year 2007.

A vast volume of oil and gas remains in State Lands fields (Holtz and Garrett, 1997). Remaining mobile oil on State Lands is estimated to be 1.6 billion barrels (Bbbl) (Fig. 3a), and remaining gas is 10 trillion cubic feet (Tcf) (Fig. 3b). At a conservative value of \$100/bbl oil at an average royalty of 15 percent, the potential estimated royalty to the Permanent School Fund on this oil is \$24 billion. Similarly for gas, at \$8/Mcf with an average royalty of 15 percent, the potential estimated royalty to the Permanent School Fund on this oil is \$12 billion (Fig. 3). The combined potential estimated severance tax to the State is approximately \$13.4 billion. Hydrocarbons that remain are commonly trapped in geologically complex reservoirs, such as (1) tight-gas sandstones, cherts, and carbonates: (2) gas-shales: (3) deep, high-temperature reservoirs: and (4) structurally complex reservoirs that require advanced technologies for successful, cost-effective recovery. The challenge for the State and for public education is that these oil and gas resources must be produced for their value to be realized. With support from the State of Texas, Project STARR and Texas operators are responding to this challenge.

## PROJECT STARR METHODOLOGIES

The philosophy of Project STARR is to work with State Lands operators to

- (1) deploy advanced recovery strategies and newly developed technologies on a field-by-field basis to ensure maximal recovery efficiency,
- (2) encourage exploration in underdeveloped areas or reservoir sections, and
- (3) exploit unconventional hydrocarbon resources.

The most volumetrically significant State Lands oil and gas resources are in the Gulf Coast and the Permian Basin (Fig. 4). Project STARR's approach is to concentrate on these two mature resource areas, where innovative and cost-effective strategies can best be deployed to stem the decline of production. Thirty fields (Fig. 2), including 24 State Lands fields, have undergone, or are undergoing, characterization and extended development with the cooperation of State Lands operators. This maximization of oil and gas recovery from State Lands fields consists of three critical components: (1) reservoir characterization and advanced resource recovery technology deployment in key reservoirs, (2) identification of prospects in deeper untested sections, and (3) transfer of concepts and approaches about recovery optimization to State Lands fields and operators.

Regional areas, where more exploration is warranted and where new insights will generate increased interest in deeper and different exploration play types, are selected for regional studies. These areas are analyzed using the latest sequence stratigraphic principles to help us understand potential reservoir distribution and reservoir quality. Studies also highlight underdrilled production trends and new exploration trends. Shale-gas plays are being investigated across Texas as well. This relatively recent unconventional hydrocarbon resource will play an important role in generating future revenue to the Permanent School Fund.



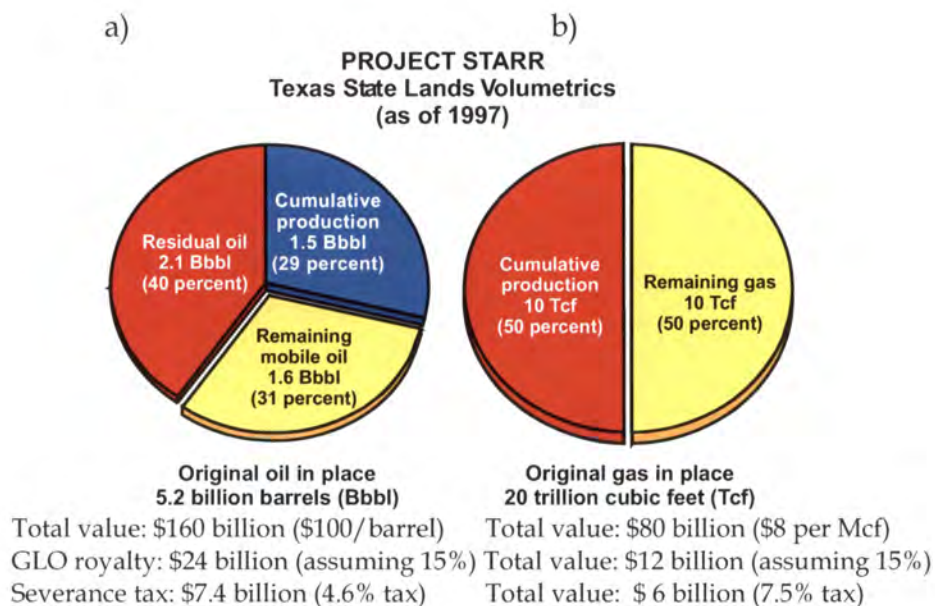


Figure 3: Texas State Lands oil and gas volumetrics. (a) Despite a precipitous decline in revenue from State Lands oil production over several decades, only slightly more than one-quarter of the original oil in place has been produced. Remaining mobile oil is as large a recovery target as all the oil historically produced from State Lands fields. (b) These estimates of gas volumes are conservative because they are based on relatively large gas fields. Cumulative production is only half of the original gas in place. From Holtz and Garrett (1997). Note: values listed below pie charts are for remaining mobile oil and gas.

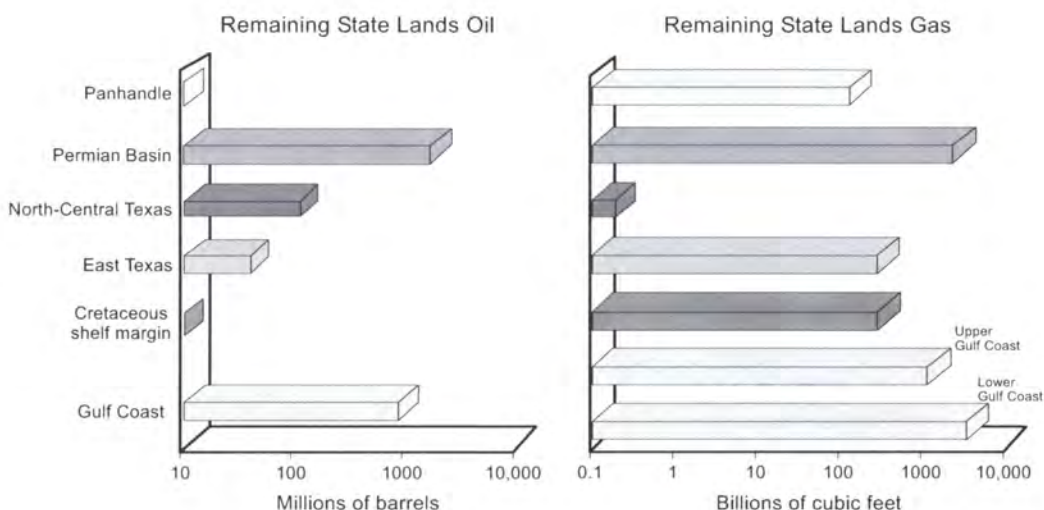


Figure 4: State Lands remaining oil and gas volumes. The Gulf Coast and Permian Basin regions have the most potential hydrocarbon reserves. From Holtz and Garrett (1997).

## Reservoir Characterization and Advanced Resource Recovery Technology Deployment

The advanced hydrocarbon recovery program applied by Project STARR is based on application of reservoir characterization techniques that delineate unrecovered oil and gas in selected Texas reservoirs. Project STARR staff work with operators to deploy advanced reservoir exploitation plans that are based on a thorough understanding of the internal architecture of the reservoir and the effects that depositional systems have on oil and gas accumulation and distribution. Key to this effort is identification of oil and gas reservoirs that offer economic opportunities. Project STARR recruits field operators who are ready to address and redesign, as appropriate, development efforts currently in place on properties that contain these reservoirs. Detailed geologic and engineering characterization projects have created quantitative descriptions of several State Lands reservoirs, identified untapped and bypassed compartments of remaining oil and gas, and defined deeper reservoir targets to drill.

These Project STARR studies include reservoir characterization analyses of the fields displayed in Figure 2 and listed in Table 1. The optimized recovery strategies recommended by Project STARR in these field studies include step-out wells, well deepening, recompletions, targeted infill drilling, injection profile modification, waterflood optimization, and drilling untested deeper targets under producing fields.

### New Venture Regional Studies

Project STARR regional studies are based on applying the latest methodologies of analyzing the stratigraphic architecture of a sedimentary basin. We are using sequence stratigraphic principles that have been developed in major oil company research centers over the past 20 years. We are also applying methodologies developed by Project STARR for Gulf of Mexico stratigraphy (Brown et al., 2004, 2005; Hammes et al., 2007). The studies emphasize potential exploration trends and characteristics of the reservoirs within these new exploration fairways, thus causing drilling to increase in these areas. Deep to ultradeep reservoirs, such as those in the higher risk, deep-shelf gas play (offshore Tertiary sandstone reservoirs between the depths of 15,000 and 35,000 ft) are an example of where new studies are needed to encourage exploration drilling.

### Unconventional Resources

Unconventional hydrocarbon resources, such as shale gas, tar sands, tight gas sandstones, cherts, carbonates, and low-pressure gas, are and will continue to be important hydrocarbon resources for the future of Texas. Shale gas is one of the most active exploration plays in Texas with prospects ranging from far West Texas to the Fort



Worth Basin and East Texas. These plays are affecting large areas of State Lands in Texas. Project STARR is conducting several studies on shale gas to promote this resource, for it should have a great impact on production of gas from State Lands.

### Transfer of Project STARR Technology to Texas State Lands Operators

Success of the advanced recovery initiative, as measured in incremental barrels of oil in the tank and additional cubic feet of gas in the pipeline, is vitally important, but equally important is the transfer of successful approaches of improved oil recovery to operators on State Lands properties. Because technology transfer can facilitate improved efficiencies in State Lands exploration and production, Project STARR has developed a technology-transfer approach that includes workshops, presentations, publications, and digital data sets (CD-ROM's).

In collaboration with the General Land Office and the Railroad Commission of Texas, Project STARR personnel from BEG have provided assistance and advice to numerous operators on optimal development strategies, appropriate well-log suites, styles of reservoir heterogeneity and their effects on oil and gas recovery, evaluation of exploration targets, regional geology and unconventional resources, and approaches to problem solution.

Through the transfer of technology developed by Project STARR to Texas operators, it is envisioned that many remaining State Lands oil and gas reserves will be explored and developed in future decades to sustain the Texas Permanent School Fund. As a result of this State funding, Project STARR has received several awards (Appendix B) and has provided the public with numerous publications, workshops, and lectures (Appendices C and D). Since the last Project STARR report, we have published 32 professional papers and 54 abstracts and talks, have presented 34 lectures, and have given several workshops and led numerous field trips (Appendices C and D). The Project STARR team has published a number of major papers since the last report as well, including 12 papers on the Barnett Shale in various international and regional journals, 10 papers on the Frio Formation, and various papers from many of our other projects. Several new papers on the Barnett/Woodford and Haynesville Gas-shale Plays, and the Woodbine reservoir in East Texas are in preparation or have been submitted to the American Association of Petroleum Geologists for publication. One BEG publication on the middle Frio has been published, and a paper on the Woodbine will also be published.

Several public seminars were presented to introduce Project STARR to potential new operator partners. Project STARR also presented workshops on the Barnett Shale Gas and the East Texas Woodbine plays. The Unconventional Resources team also led several field trips to Barnett Shale outcrops in San Saba, Texas.

Project STARR has also been active in presenting seminars to STARR's industry partners. During the reporting biennium, Project STARR presented private seminars



and workshops on State Lands geology to Gulf Energy Exploration, Brigham Oil and Gas Exploration Company, Texas Crude, Neumin, Danmark Energy, Jones Energy, Branta Resources, MPG Petroleum, St. Mary's Land and Exploration, Devon, EOG, ExxonMobil, and Ameristate.

## Research Developed from Project STARR Program

Project STARR has made a major effort to produce research using the data available from our industry partners. Through our partners, Project STARR is able to review seismic, wireline-log, and core datasets that are not generally available to the public. With permission from the partner and seismic vendor, Project STARR published research results (see earlier section on Transfer of Project STARR Technology to Texas State Lands Operators).

Project STARR made several major contributions to the understanding of exploration and development of sandstone reservoirs on State Lands along the Texas Gulf Coast (onshore and offshore), the Woodbine Formation in East Texas, and the Barnett Shale Play in the Fort Worth Basin:

1. *Understanding growth-faulted, intraslope subbasins by applying sequence stratigraphic principles*— This study of Oligocene Frio Formation intraslope growth-faulted subbasins in the Corpus Christi, Texas, area has continued for the last 7 years. New seismic data sets allowed us to investigate deeper strata and demonstrate through detailed analysis that deposition during relative lowstands of sea level resulted in extensive deep-water reservoirs similar to prolific deep-water reservoirs in the Miocene of the Gulf of Mexico, Brazil, and West Africa. Lowstand depocenters on the low-gradient upper continental slope comprising basin-floor-fan facies, slope-fan systems, and prograding lowstand delta systems exerted sufficient gravity stress to cause major sections of outer shelf and upper slope strata to fail and develop growth faults. The faults sole out deep in the basin, and rotation of hanging-wall blocks mobilizes deep-water mud and forces the mud bodies basinward and upward to form mud (sediment) ridges that constitute the basinward flank of intraslope subbasins above the footwall fault blocks. These subbasins have been prolific petroleum targets for decades and are now the focus of deep prospecting for gas. Lowstand sandstones are principal reservoirs, and synsedimentary tectonics produced anticlinal and fault traps and associated stratigraphic pinch-out traps on the flanks of the anticlinal structures. Understanding the architecture of the faulted subbasins and their chronostratigraphic relationships and depositional processes provides a perspective that can improve deep gas exploration. We have presented these concepts at numerous professional meetings over the

last several years, and have published our results at the 2004 AAPG Bulletin and the 2006 and 2007 GCAGS conferences.

2. *Woodbine Petroleum System* — East Texas field, discovered in 1930, is the largest oil and gas field in the lower 48 States. It has produced 5.42 billion barrels of 39° API oil from >31,000 wells. This current average well spacing is ~4.3 acres; the field has experienced a long-term trend of depletion over the past few decades. Of the estimated 1.58 Bbbl of remaining oil, 70 MMbbl can be produced under current operating techniques, 0.41 Bbbl remaining mobile oil can be produced by depositional-trend-guided deepening and water injection. The ~1.1 Bbbl of residual oil is a target for enhanced oil recovery methods, which will be expensive and have not been demonstrated yet on a significant scale. Our analysis of the Lower Cretaceous lower Woodbine Group, the main producer in the field, indicates that the field's sandstone-body architecture is more complex than previously thought. Our sequence stratigraphic, depositional-environment, and engineering analyses determined that remaining oil is contained primarily in deeper buried, highstand fluvial-dominated deltaic sandstone facies. Apart from STARR's pilot studies in the field, these sandstones have not been systematically studied, and as a result they have not yet been appropriately exploited. The field's primary reservoirs, which are composed of lowstand fluvial, incised-valley-fill successions, are nearly depleted. An article on the results of this study will appear in the *AAPG Bulletin* in early 2009.
3. *Barnett Shale-Gas Play* — Because not much has been published on the lithofacies, depositional systems, or structural overprint of this play, we published three seminal papers in the *AAPG Bulletin* in 2007:  
(1) "Mississippian Barnett Shale: Lithofacies and Depositional Setting of a Deepwater Shale-Gas Succession in the Fort Worth Basin, Texas,"  
(2) "Quantifying the Origin and Geometry of Circular Sag Structures in Northern Fort Worth Basin, Texas: Paleocave Collapse, Pull-Apart Fault Systems, or Hydrothermal Alteration?" and (3) "Natural Fractures in the Barnett Shale and Their Importance for Hydraulic Fracture Treatments."  
More studies are under way, including of all major shale-gas plays in Texas such as the Barnett/Woodford of West Texas and the Haynesville shale of East Texas. Several workshops and presentations on these shale plays are planned for the next biennium. We also published an important review of the state of knowledge of shale and mudrocks (Ruppel and Loucks, 2008), including an introduction to our research findings on nanoscale porosity and its potential importance in gas-shale production.



## CURRENT PROJECTS

### Reservoir Characterization

#### Carancahua Bay Reservoir Study

Brigham Exploration Company has been a partner with Project STARR since July 2004. The STARR team has been supporting Brigham's exploration and development program in the Carancahua Bay of Calhoun and Jackson Counties and recently expanded the project into the Matagorda Bay area (see Appendix A for a supporting letter by Brigham Exploration Company) (Fig. 5). We have been conducting seismic interpretation studies of a 3D seismic survey over Carancahua Bay as well as analyzing wireline-log data (Fig. 6). In August 2007, an additional 3D seismic survey that extended the previous survey farther to the northeast and southeast was interpreted for the purpose of evaluating the Miocene and deep Frio hydrocarbon potential in the area. Project STARR conducted seismic interpretations of the data that resulted in the identification of five (5) slope- to basin-floor-fan prospective leads in the deeper Oligocene-age Frio formation (Fig. 7). Additionally, an extended S<sup>5</sup> benchmark chart was generated for the area to provide better insight into log correlations. Brigham drilled one prospect that resulted in a dry hole in Matagorda Bay's Green Ranch lease; the company is planning to drill another well in Matagorda Bay at the beginning of the year 2009.



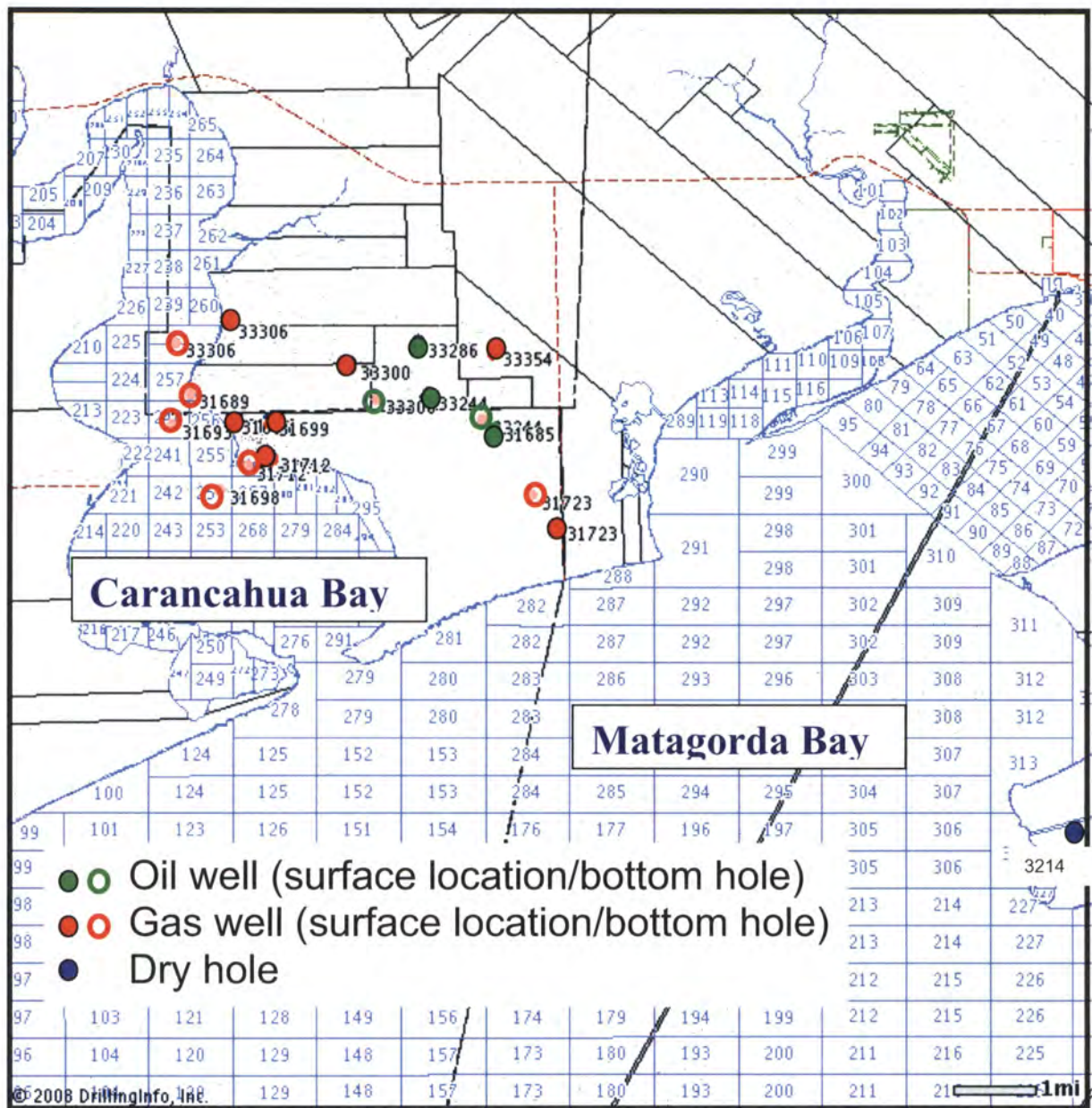


Figure 5: Locations of wells drilled by Brigham Exploration Co. from 2006 to 2008.

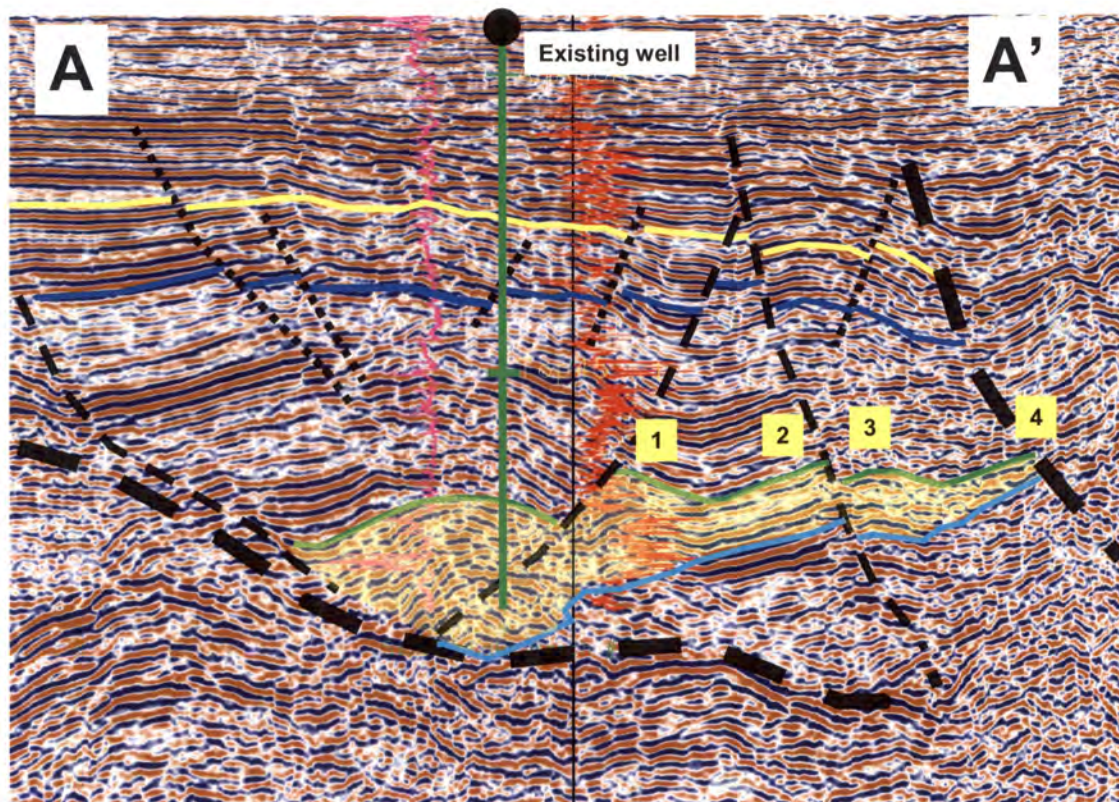
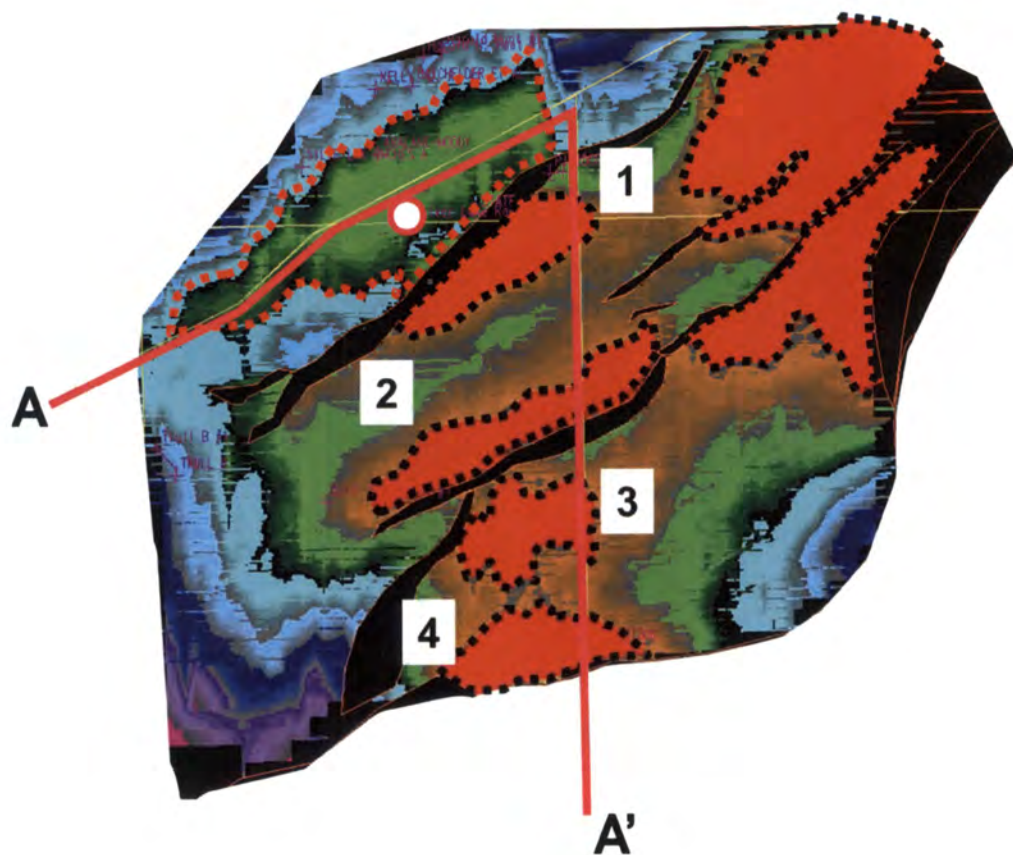






Figure 6: Seismic cross section A-A' (see Fig. 7) showing possible prospects (labeled 1 – 4) in the Matagorda Bay area.





### Legend

-  Identified prospect
-  Gas Field
-  Existing well
-  Seismic cross section A—A'

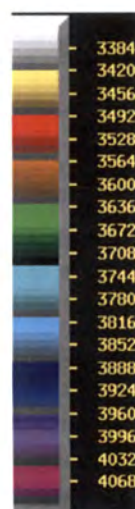


Figure 7: Time-structure map of green horizon in Figure 6 showing possible prospects (numbers 1–4), Matagorda Bay area. Seismic cross section A–A' is displayed in Figure 6.



### Calhoun Offshore Reservoir Study

The Project STARR team has collaborated with Gulf Energy Exploration Company (GEE, formerly known as Daystar Offshore) since fall 2005 in the Calhoun offshore area (Fig. 8) (see Appendix A for a supporting letter by Gulf Energy Exploration Company). GEE holds several leases in the offshore Calhoun County State Waters. Project STARR evaluated the area for sandstone reservoir development and prospect potential in the Oligocene-age Frio Formation and the younger Miocene section (see Loucks et al., 2006 report). A 3D seismic survey was interpreted and analyzed to construct structural and amplitude maps, which resulted in identification of several prospect leads. Because the Frio Formation has not been previously penetrated in this area, interpretation of seismic was conducted and a S<sup>5</sup> benchmark chart was generated to predict the stratigraphy of the currently unexplored area. GEE and partners expect to drill several wells in 2009.

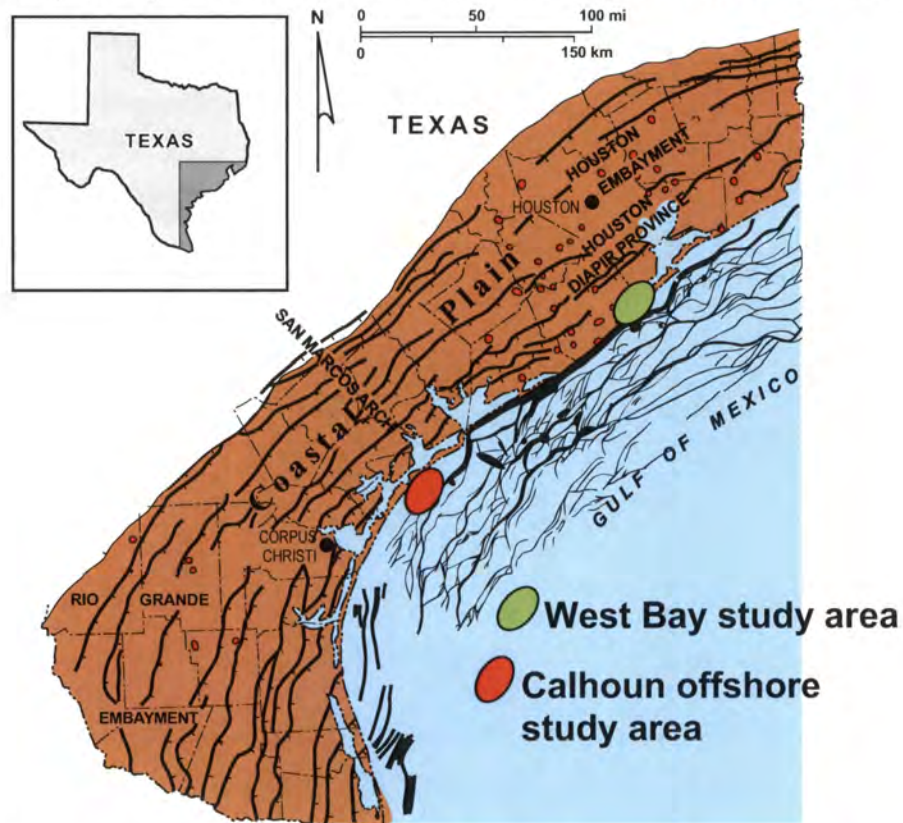
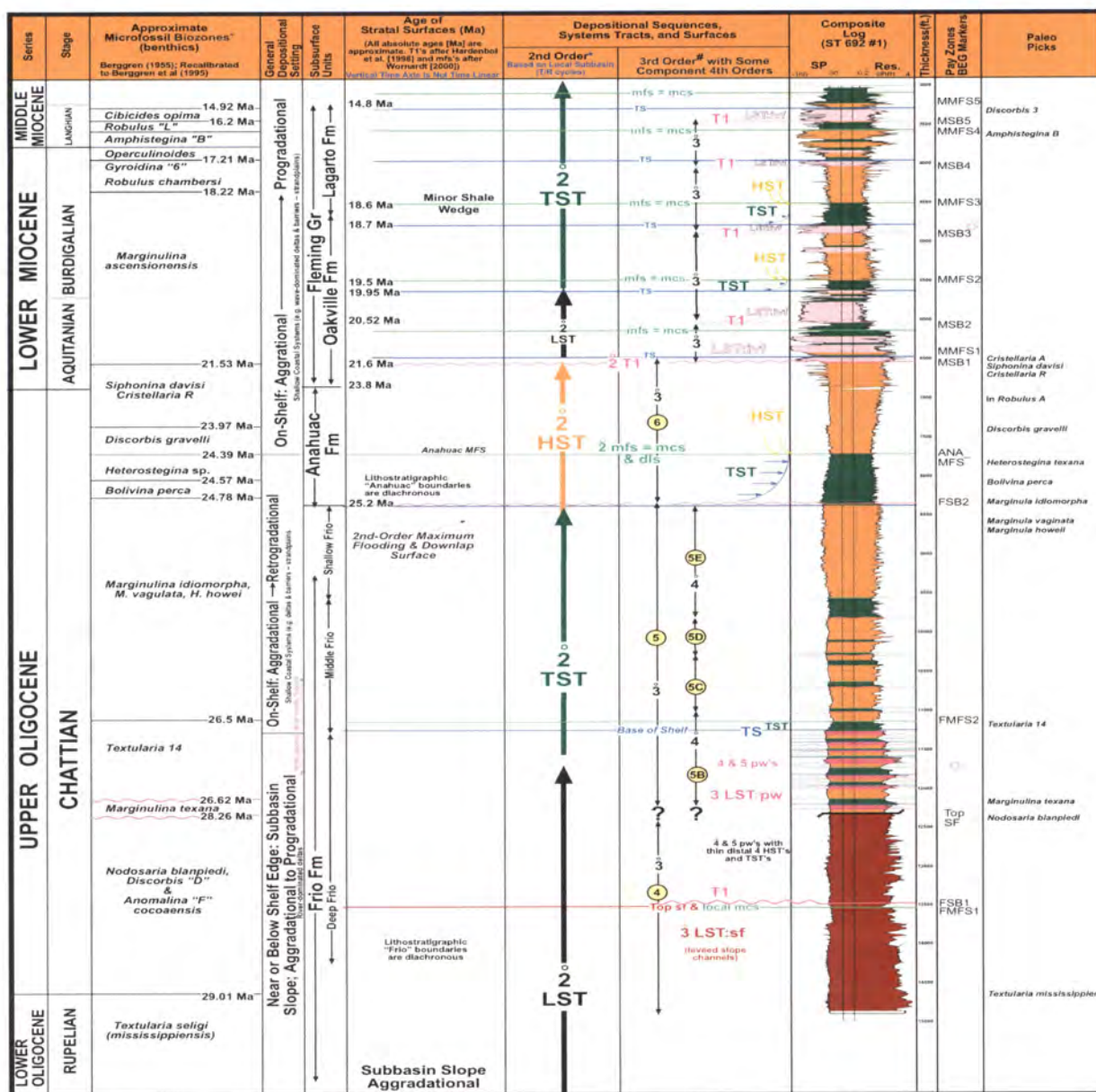


Figure 8: Location map showing study areas for Gulf Energy Exploration. Two areas are currently being investigated for their exploitation potential: the West Bay and Calhoun offshore areas.



### 3rd & 4th Order Systems Tracts

<b>TST</b>	Transgressive Systems Tract
<b>HST</b>	Highstand Systems Tract
<b>LST:pw</b>	Lowstand Systems Tract: incised-valley fill

\*Supersequence (second order) boundaries vary slightly from those of published charts, perhaps because local subsidence history, cycles superimposed on the second order sea-level signal.

† Ages of some biostratigraphic biozones do not agree with some planktonic and foraminiferal zone ages.

‡ Most sequence stratigraphic nomenclature and its associated definitions are from the IUGS (1996) and its subsequent additions.

<b>LST: pw</b>	Lowstand Systems Tract: prograding wedge
<b>LST: sf</b>	Lowstand Systems Tract: slope fan
<b>LST: bff</b>	Lowstand Systems Tract: basin-floor fan

# Oligocene 3 Sequence Designations

SE Designated 4 sequences (#s A-E) in order of deposition

### Sequence Surfaces

<b>T1</b>	Sequence Boundary: Type 1 (on-shelf interval valley ravinement = Maximum Flooding Surface = Condensed Section)
<b>TS</b>	Transgressive Ravinement Surface with Coastal Onlap
<b>top sf or bff</b>	Top Slope or Basin-floor Fan Surface
<b>M34</b>	Marker Bed (top of sandstone bed)
<b>sf</b>	Local Autocyclic Condensed Sec (overlying sf or bff)
<b>mcs</b>	Downlap Surface (dls) (progradational HST or LST: pw)
<b>bff</b>	
<b>T1</b>	
<b>mcs</b>	

Figure 9: Site-Specific Sequence Stratigraphic Section (S5) chart for the offshore Calhoun area showing that slope and basin-floor fans (brown), prograding wedge (pink), transgressive (green), and highstand systems tracts (orange) are present in the area and potential reservoirs.



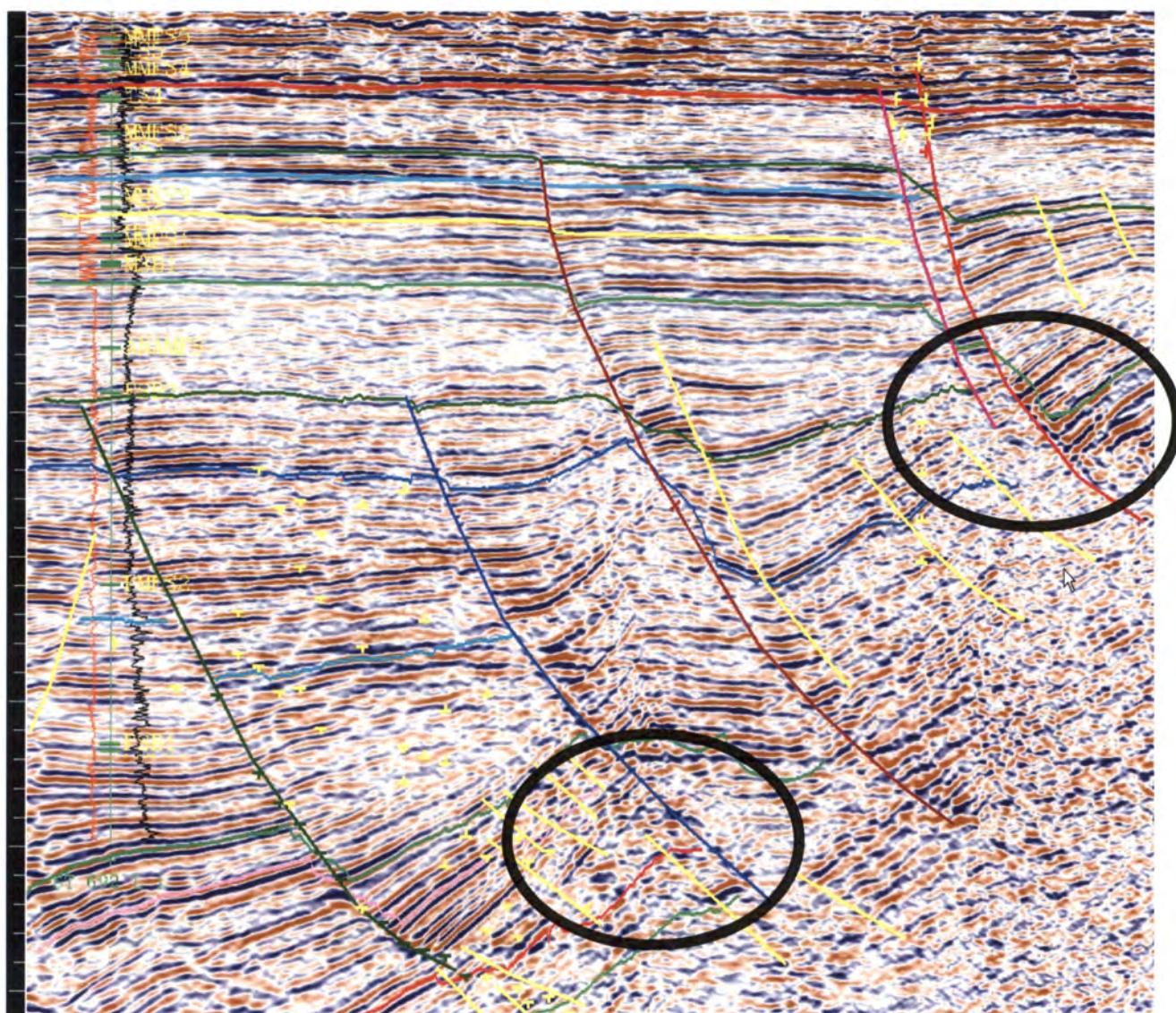


Figure 10: Structural interpretation of a dip line with superimposed type log (from S<sup>5</sup> in Fig. 9) showing structurally dominated play types in the offshore Calhoun area. Potential reservoirs are located in fault blocks with slope and basin-floor fans (black circles).



### West Bay Reservoir Characterization Study

A second project is currently underway for GEE in the Chocolate Bayou/West Bay area of Brazoria and Galveston Counties (Fig. 8). The main objective of this project is to conduct a comprehensive study in the area to identify new prospects in the Miocene section and potential leads in the deep Frio by conducting structural, stratigraphic and 3D seismic interpretations. During the last biennium STARR researchers generated a S<sup>5</sup> benchmark chart that was used to analyze stratigraphic correlations across the area using key wells and sequence stratigraphic surfaces (Fig. 11). These stratigraphic correlations have recently been updated and integrated into a 3D seismic volume that was provided by the operator (GEE). Recent work that was performed using the 3D seismic volume allowed us to generate a comprehensive 3D interpretation for both the Miocene and the deep Frio sections (Fig. 12). State-of-the-art visualization techniques (Fig. 12) have been used in the new STARR Visualization Center at BEG to showcase the exploratory potential of paleo-incised-valley fills and barrier islands as reservoirs.







Figure 12: 3D seismic visualization showing the integration of wireline-log data with seismic in the shallower Miocene section, West Bay – Chocolate Bayou area. Horizontal surfaces represent stratigraphically important horizons.

### Copano Bay Reservoir Characterization Study

The STARR team has been partnering with MPG Petroleum since 2007 in their exploration of the Copano Bay area (see Appendix A for a supporting letter by MPG Petroleum). The objective of this project is to assist MPG Petroleum in assembling the geological framework of the Copano Bay study area (Fig. 13), as well as to refine the 3D seismic interpretation, provide input in the validation of existing leads, and identify new opportunities (Fig. 14). The Ritchie Farms Well No. 1 was drilled by the operator (MPG) in 2008; unfortunately downhole mechanical complications prevented the well from reaching its original proposed total depth. However, the Ritchie Farms Well No. 1 tested positive for gas at a shallower depth and it is anticipated that the bulk of the production will come from this interval. Project STARR is currently assisting the operator in characterization of the stratigraphic intervals that will soon be drilled by the Ritchie Farms Well No. 2. Multiple visualizations have been generated to correlate already-tested intervals in the Ritchie Farms Well No. 1 with the new location and to identify new objectives at depth. At the same time, seismic interpreters are evaluating deeper targets that could be of interest for future drilling campaigns.



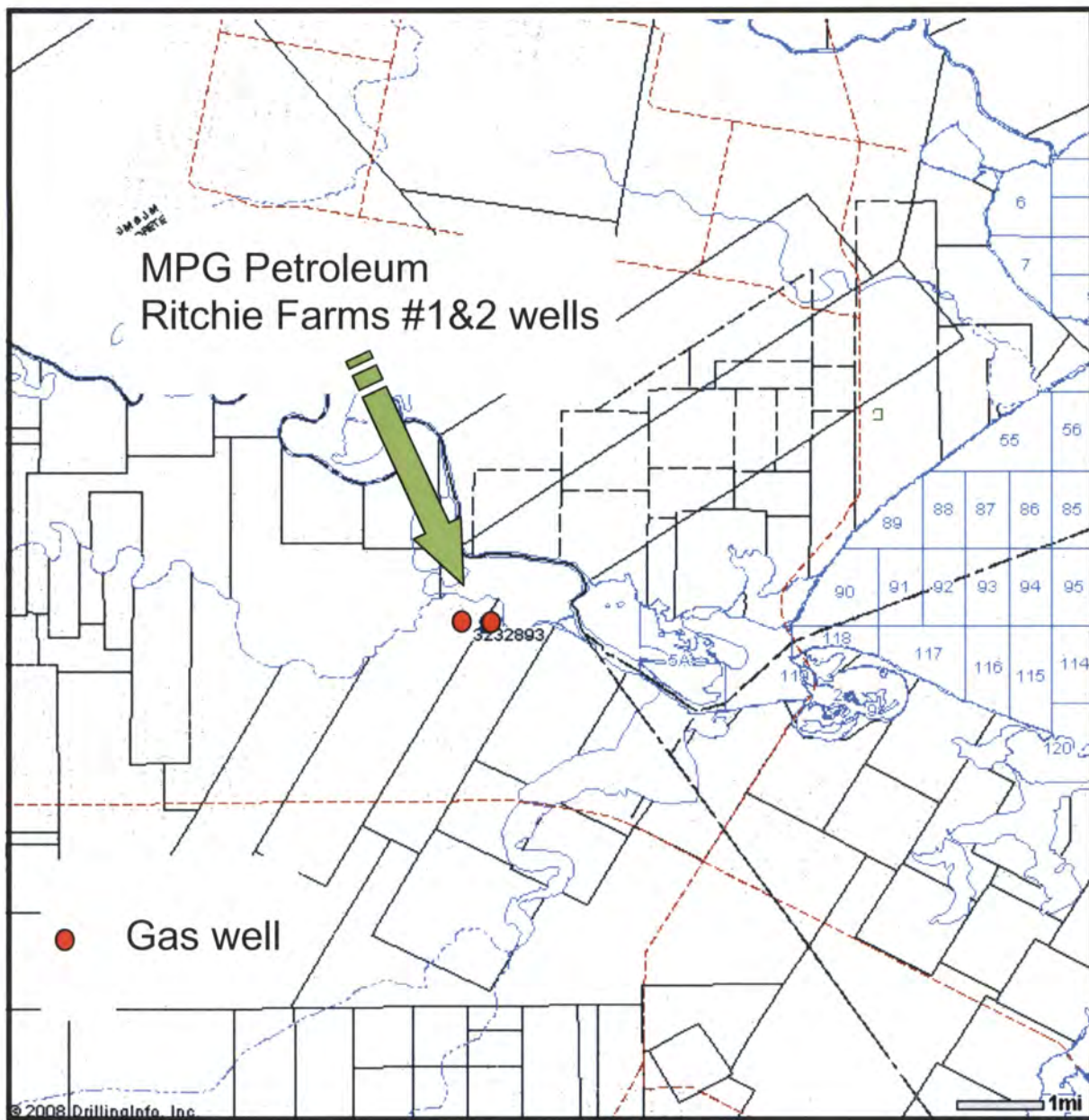


Figure 13: Location map for Ritchie Farms #1 and 2 wells drilled by MPG Petroleum in second and third quarters of 2008, Copano Bay area.

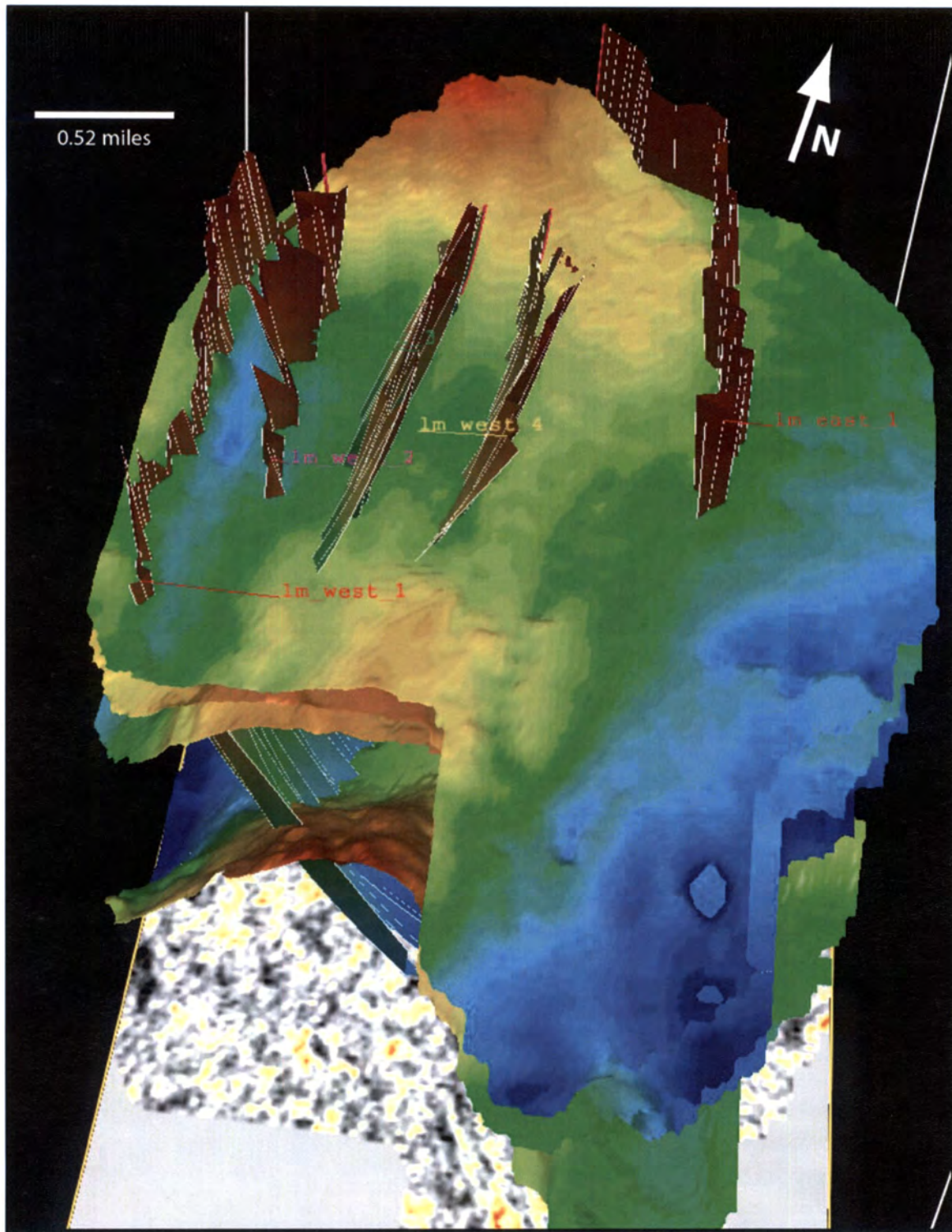


Figure 14: 3D seismic visualization, generated at the new STARR visualization facility at BEG, showing main structural elements—faults and folds—that are present in the Copano Bay study area.



### Northern Laguna Madre/Padre Island

The Project STARR team interacted with the Kindee Oil and Gas Company in evaluating a well that they drilled in the Laguna Madre area (Fig. 15) (see Appendix A for a supporting letter by Kindee Oil and Gas). The team performed a postdrilling evaluation of the reservoir using thin-section and fluid-inclusion data. It was concluded that the poor reservoir quality was related to extensive calcite cementation in fine-grained sandstones. Project STARR was asked about a recommendation for drilling another well close by and it was recommended that any nearby well in the same stratigraphic setting would also have poor reservoir quality because of calcite cementation of the reservoir. Kindee is still considering options within this prospect.

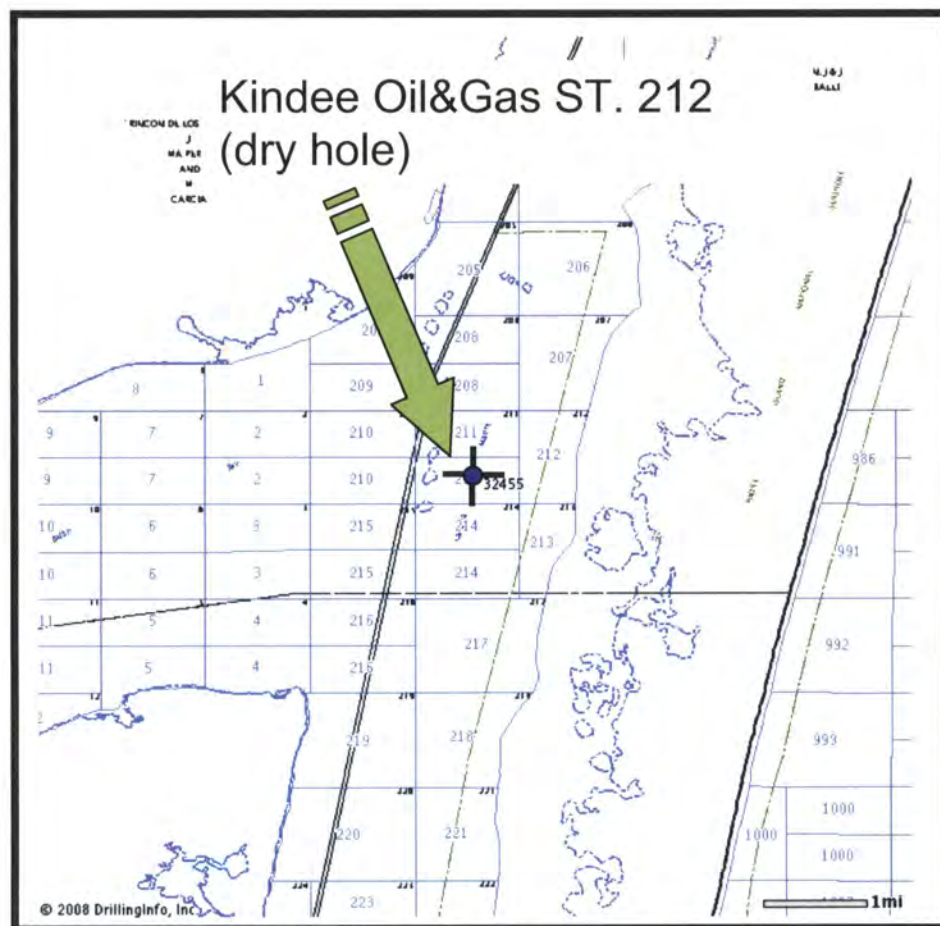


Figure 15: Northern Laguna Madre area showing the Kindee ST. 212 location that was a dry hole.

Seismic Sedimentology and Depositional Systems in the Upper Cretaceous Olmos Formation, Gold River North Field, Webb County, South Texas

The study area is Gold River North field, Webb County, South Texas, which is currently operated by St. Mary's Land and Exploration Company (Fig. 16). The Upper Cretaceous Olmos Formation has been an active exploration target since the 1920's in lithologically and stratigraphically controlled gas traps of deltaic and fluvial sandstones. Our study applied core description and seismic sedimentology and stratal slicing in mapping high-frequency sequences and depositional systems using 3D seismic and wireline-log data in the Olmos Formation. The study will help the operator to target optimal reservoir-quality sands. The Olmos Formation in Gold River North field is characterized by two third-order, shelf-edge deltaic systems (Fig. 17), from which five types of depositional systems were identified using core analysis and sequence-stratigraphic correlations: (1) fluvial plain, which is characterized by fluvial channels, crevasse splays, and swales; (2) deltaic plain, which consists of distributary channels, levees, and crevasse splays; (3) deltaic-front mouth bars and sheet sands; (4) prodelta, which is composed of silty sediments; and (5) incised valleys, which were formed during subsequent lowstand erosion on exposed deltaic sediments. Stratal slices made from the 3-D seismic volume reveal high-resolution sediment dispersal patterns and associated systems tracts on relative geologic time surfaces.



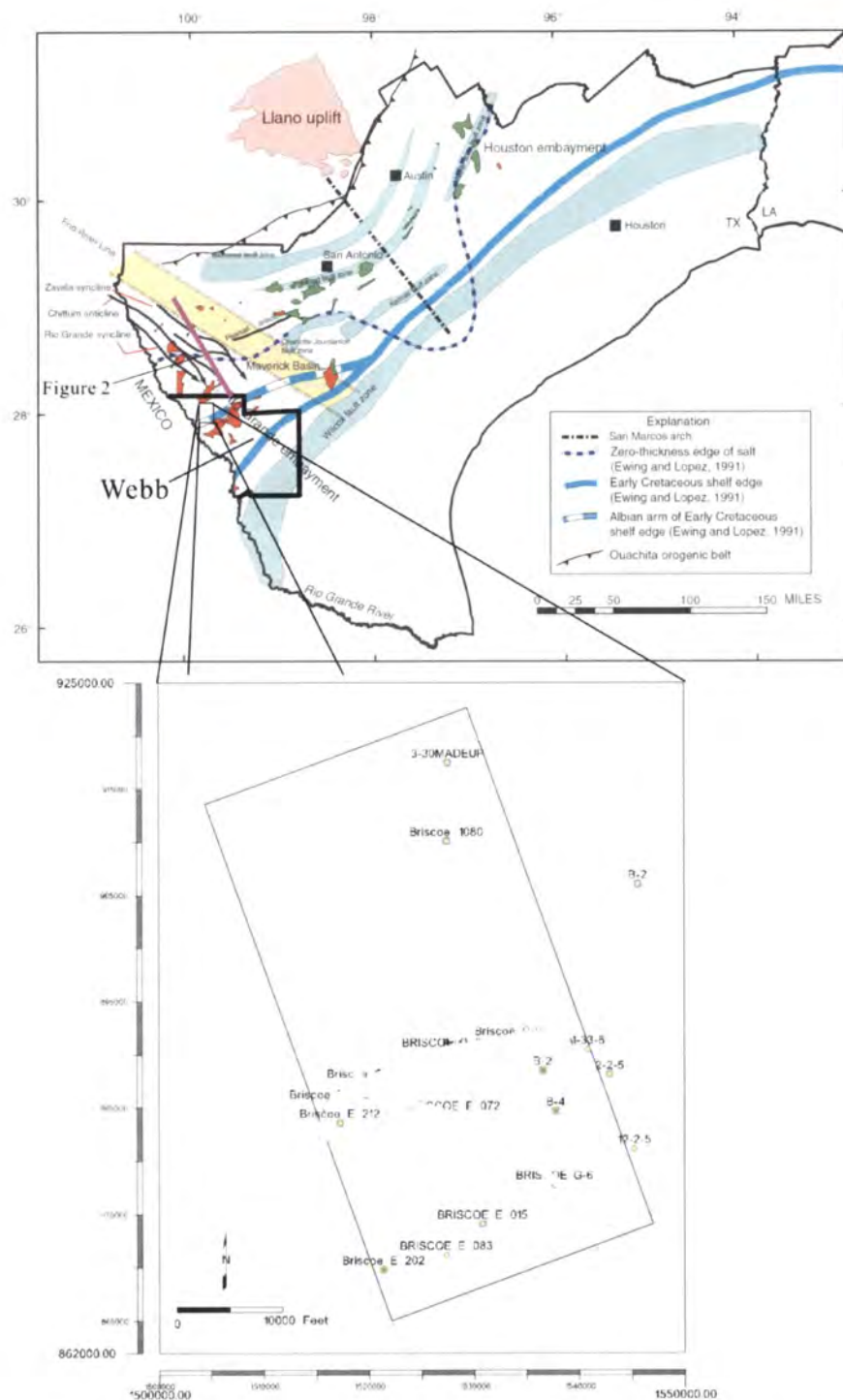


Figure 16: Map of the Gold River North Field study area showing wells and outline of 3-D seismic survey used in this study (inset). Red fields produce mainly gas; green fields produce mainly oil from the Olmos Formation. Modified from Fowler (1956) and Condon and Dyman (2006).

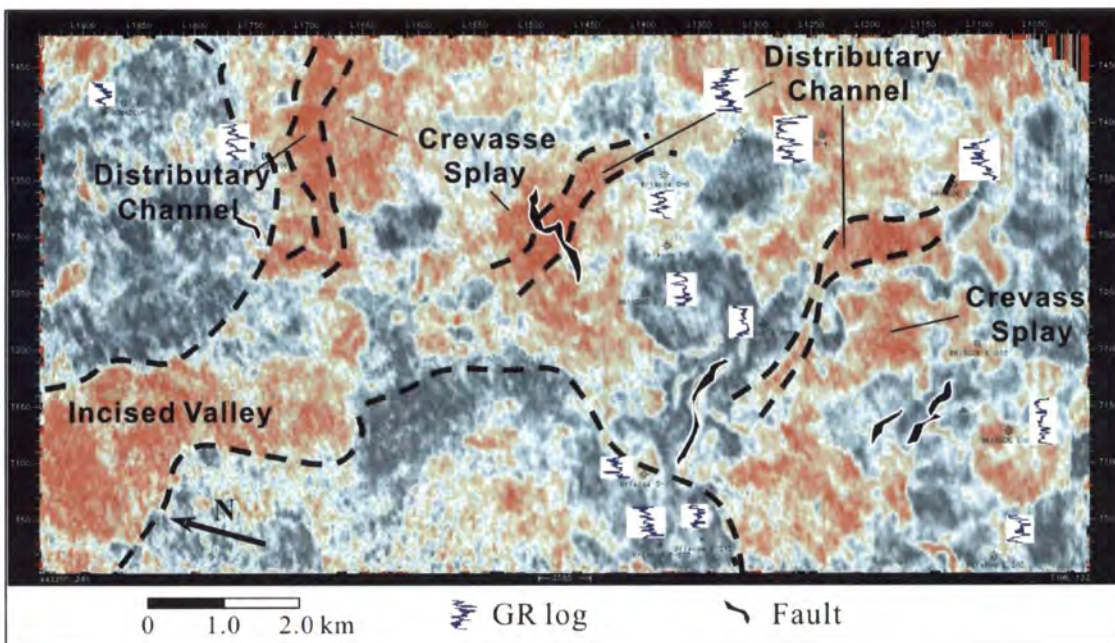


Figure 17: Interpretation of a stratal slice as a deltaic system, Gold River North field, Webb County, South Texas. Gamma-ray logs have been tied to stratal slices for the lithofacies. Red amplitudes correspond to sandstone (possible reservoir targets), and black amplitudes coincide with shale.

#### Eastern shelf, Midland Basin field studies

Petroleum explorationists within Gunn Oil Company of Wichita Falls became aware of BEG research on the application of sequence stratigraphy to underexploited reservoirs on the Eastern Shelf of the Midland Basin from BEG's Report of Investigations No. 197 (Brown et al., 1990). A 2007 presentation by Frank Brown led to renewed activity in this field. Gunn Oil selected one of BEG's 16 sequences delineated on the shelf and has been using BEG's published maps of lowstand, sandstone-rich systems to initiate a detailed subsurface study of incised-valley-fill targets. The Tannehill sequence was exploited using 3-D seismic data and wireline-log interpretation to identify successful drilling sites. Gunn Oil also noted BEG's delineation of lowstand deltaic lithofacies (prograding deltaic wedges), as well as basin-floor submarine fans within the Tannehill sequence, which it is also successfully targeting. These Gunn Oil discoveries occur within an oil province that many geologists have considered to be essentially beyond further exploitation (Fig. 18). Consequently, Gunn's willingness to use new ideas in old, mature oil regions of Texas on the basis of BEG's and STARR's research has led to discovery of considerable new oil production. Gunn Oil geologists acknowledge that BEG's published research and recent review of the geology of the area is responsible for their success, whereas other competing companies in the region continue to apply outdated methods of exploration.



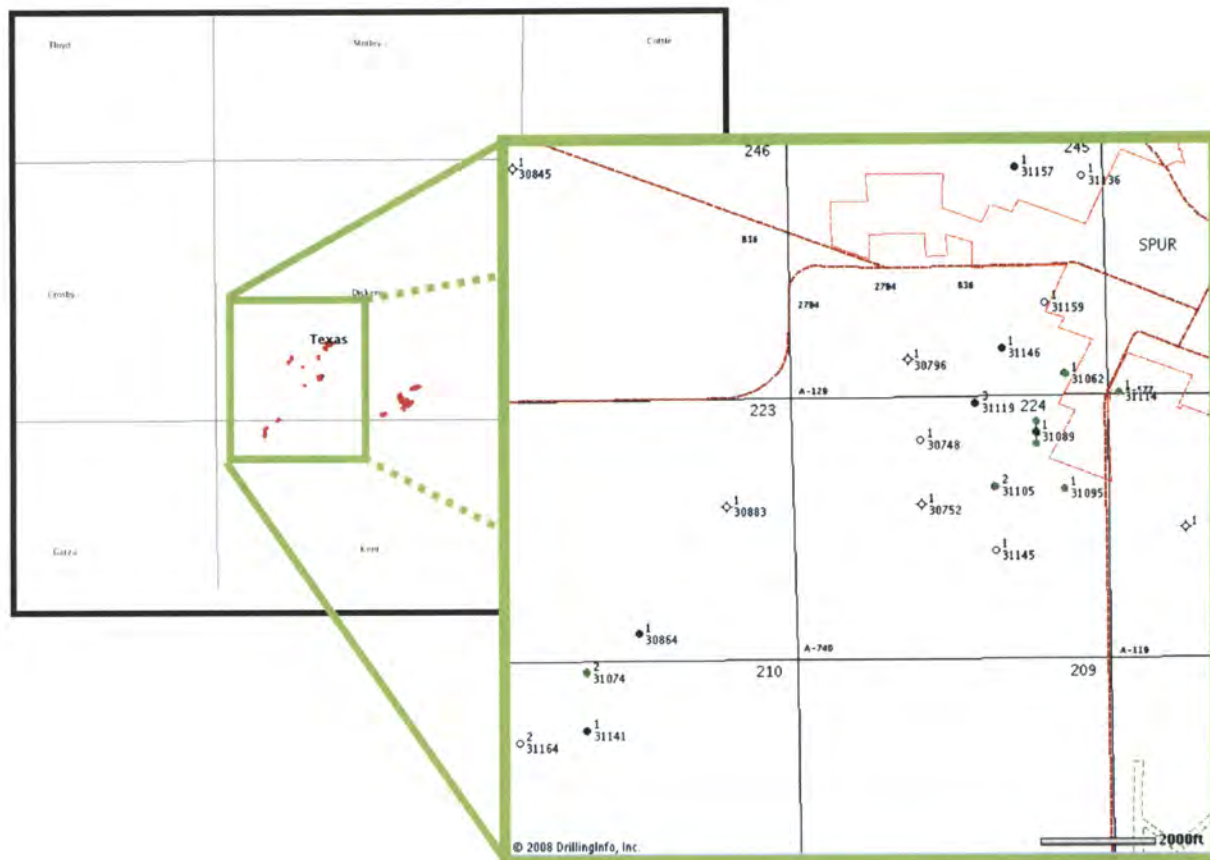


Figure 18: Location map of Gunn Oil wells in Dickens County of the Eastern Shelf in West Texas.

### Woodbine East Texas Field Study

A reservoir characterization study of East Texas field was initiated in early 2007 and completed in mid-2008. The main objective of the project was to help operators devise optimal strategies for additional infield production in East Texas field, the most productive giant oil field in the U.S. lower 48 states (Fig. 19). The field has experienced a long-term trend of depletion over the past few decades. Our research focused on documenting the depositional-facies distribution of the Lower Cretaceous lower Woodbine Group, the field's reservoir interval, and to describe its controls on production potential for deeper Woodbine pay zones and incompletely swept zones.

Our analysis of the field's sandstone-body architecture indicates that it is more complex than what has been inferred in previous studies. Main secondary targets for remaining

oil are locally discontinuous sandstones within a deeper-zone highstand succession of fluvial-dominated deltaic facies (Fig. 20). This section underlies the field's primary reservoir — a lowstand, fluvial, incised-valley-fill succession that truncates the highstand section in the north and west parts of the field. We presented our findings and recommendations to field operators in a workshop in Kilgore, Texas, on October 30, 2007. Subsequent work for Danmark Energy, a major operator in the field, produced several potential well-deepening prospects in the north part of field and recommendations for the design of a waterflood in the central part of field. Additional results of the study will be presented in a core workshop in November 2008 and published in the *AAPG Bulletin* in early 2009.



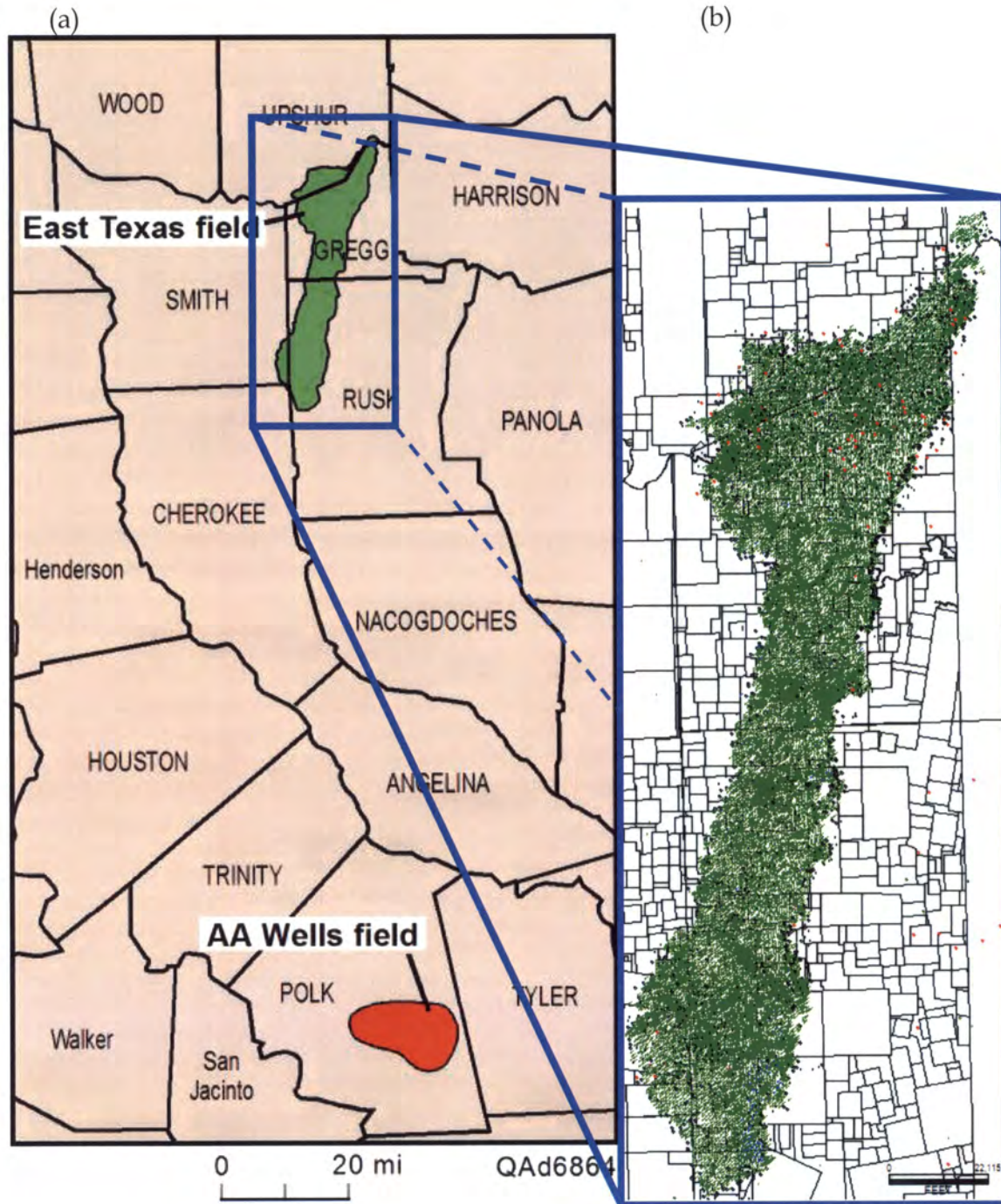


Figure 19: (a) Location of East Texas and AA Wells fields. (b) Close-up of East Texas field, where approximately 31,000 wells have been drilled since its discovery in 1930; 7 Bbbl of oil was in place, 5.3 Bbbl of which has been produced.

## NEW VENTURE REGIONAL STUDIES

### Woodbine East Texas Regional Study

In 2008 a study was initiated to conduct a regional sequence-stratigraphic study of the Woodbine Group in the East Texas Basin (Fig. 19), which is an outgrowth of the reservoir characterization study of East Texas field. Objectives of the project are to identify major systems tracts, regional depositional setting, major depocenters, lithofacies, and potential reservoirs. Integration of sedimentology, sequence stratigraphy, structure, and production data will provide new insights into new exploration fairways and play opportunities.

A major component of the study is to link the stratigraphic framework of productive Woodbine sandstones in the downdip trend in Polk County, located along the Upper Cretaceous shelf edge, to that of the Woodbine Group in East Texas field and adjacent East Texas Basin. Incised-valley-fill systems identified in the lower Woodbine Group in East Texas field (Fig. 20) are hypothesized to have provided pathways for transport of sediment southward to the Woodbine shelf edge in Polk County, where lowstand deltas are inferred to have prograded over a faulted, unstable shelf margin. Our early analysis of 12 cores from deep (>13,000-ft) Woodbine wells in Polk County indicates that the Woodbine was deposited in both shelf and slope depositional settings. Additional work will involve core-to-log calibrations, identifying the stratigraphic occurrence of pay zones, establishing a sequence stratigraphic framework interpretation from wireline-log correlations and tying the stratigraphic framework to that of East Texas field and the updip part of the East Texas Basin.

Initial results from this study will be presented along with other findings from the reservoir characterization study of East Texas field at a workshop at the Houston Core Research Center in November 2008.



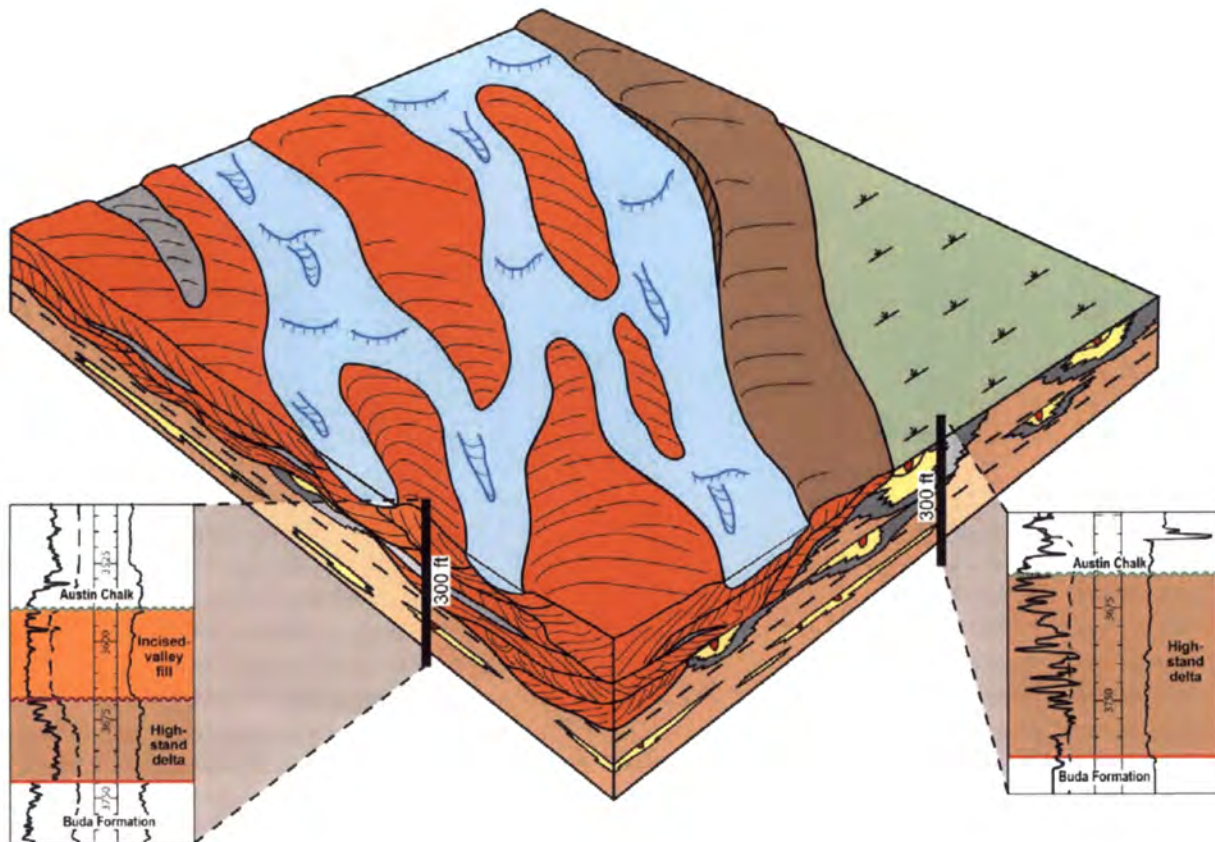


Figure 20: Depositional and reservoir model of the Woodbine showing incised-valley-fill sandstone reservoirs (shown in red/orange).

### South Texas Regional Frio study

The Oligocene Frio Formation, approximately 15,000 ft thick, is an important oil and gas reservoir on the South Texas Gulf Coast. More than 70 Tcf of gas and 8 Bbbl of oil have been produced from the Frio – mostly from upper Frio sandstones and more recently from deeper, lower Frio sandstones. If systems-tract concepts are used, additional reserves are likely to be found in new downdip plays; therefore, an understanding of the regional sequence stratigraphy is critical.

Six third-order sequences have been recognized within the Frio depositional sequence, each of which consists of basin-floor and slope-fan deposits and a prograding wedge deposited off the shelf during a third-order sea-level lowstand. Growth faults, active during lowstand sedimentation, and ceased their influence with rising sea levels, when transgressive and highstand systems tracts shifted shelfward. The shifting of the depocenter in time, in conjunction with fault activity, created a strong volumetric partitioning between the slope and basin and the shelf. Because genetically similar but

noncontemporaneous lowstand depositional systems successively filled each subbasin, this sequence-based approach proved to be a powerful technique in unraveling the complex stratigraphic architecture of the Frio subbasins. Our study focuses on a four-county area in the South Texas coastal area, integrating seismic, wireline-log, and micropaleontologic data (Fig. 21). We reconstructed individual systems tracts for each of the six sequences within the four subbasins that are displayed in cross sections and isopach maps (Fig. 22).

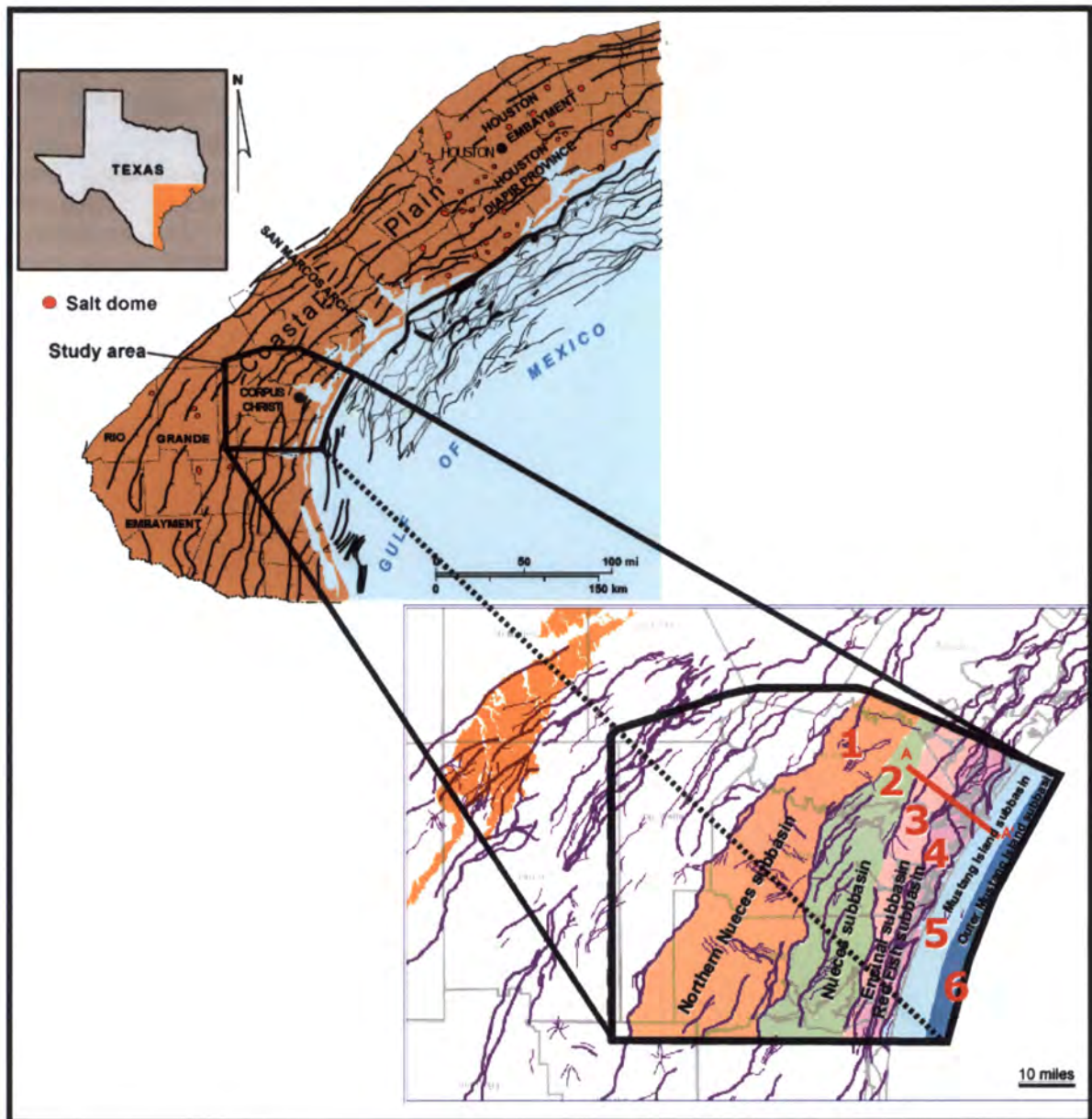


Figure 21: Location map of lower Texas regional Frio study area. Inset shows the six Frio subbasins and cross section A-A' displayed in Figure 22.



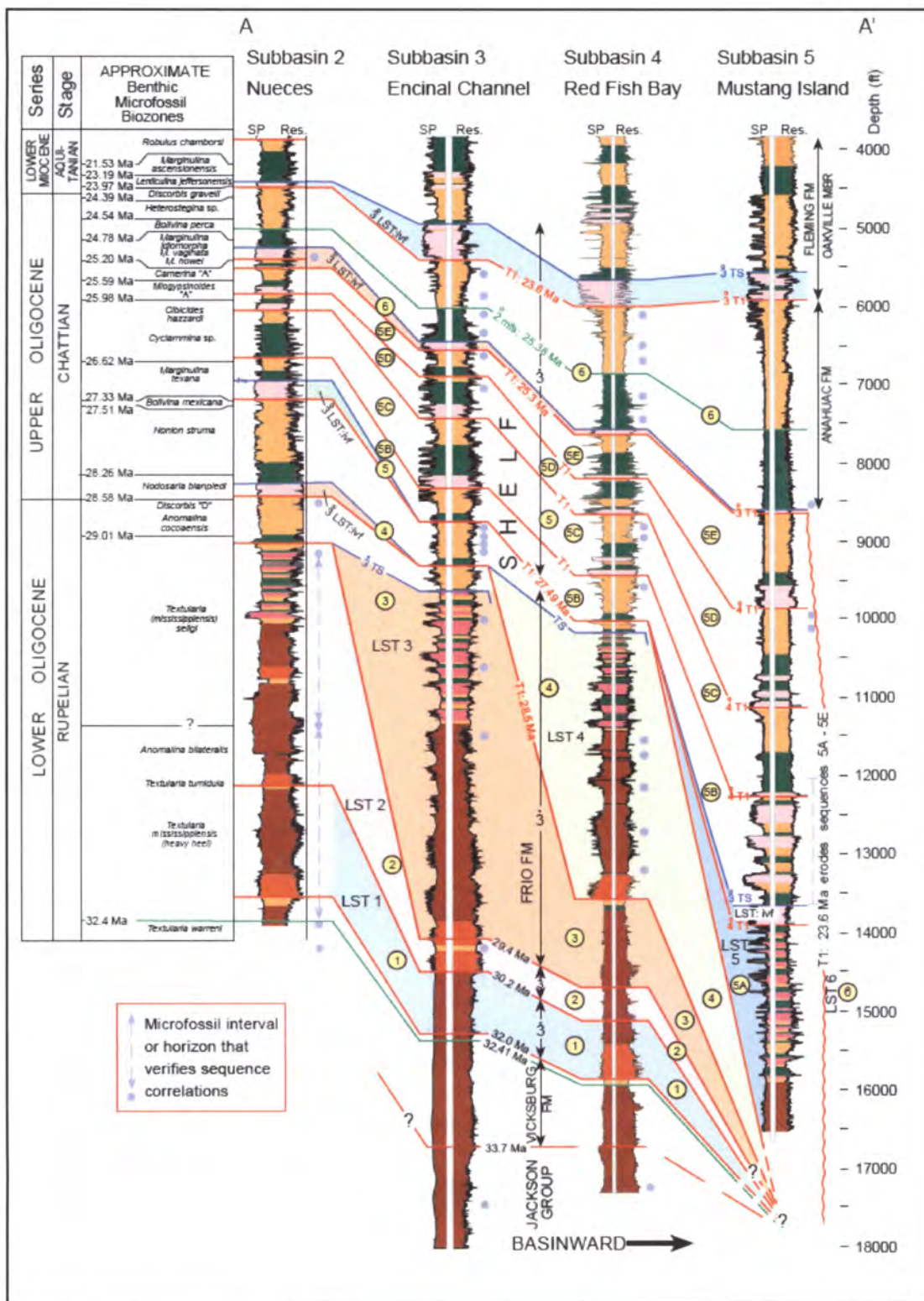


Figure 22: Cross section A-A' of Frio subbasins 2 through 5 (see Fig. 21 for location) showing progressively younger strata from NW to SE.

## Regional Cleveland Gas Project

In April 2008 the STARR project initiated a partnership with Jones Energy, Ltd., to conduct a regional study of the sequence stratigraphy, depositional environments, and related sandstone reservoir trends of the Cleveland Formation in the Anadarko Basin of the northeastern Texas Panhandle (Fig. 23). Jones Energy is currently the primary producer from the very active Cleveland tight-gas-sandstone play in Ochiltree and Lipscomb Counties, Texas, and Ellis County, Oklahoma. The BEG, having previously conducted a basin-scale study of the Cleveland (Hentz, 1994a, b), is in an optimal position to carry out a focused analysis of the unit over its most productive areas. The ultimate objective of this study is to enable Jones Energy to strategically target additional gas wells, which historically have been highly productive in this core area of the play. We will achieve this objective by conducting detailed regional sequence-stratigraphic analysis of the Cleveland Formation and the genetically related, underlying siliciclastic Marmaton Group, which also contains gas-bearing sandstones for which Jones Energy and other operators have explored (Fig. 24). This effort will be supported by depositional-facies analysis of available Cleveland cores.

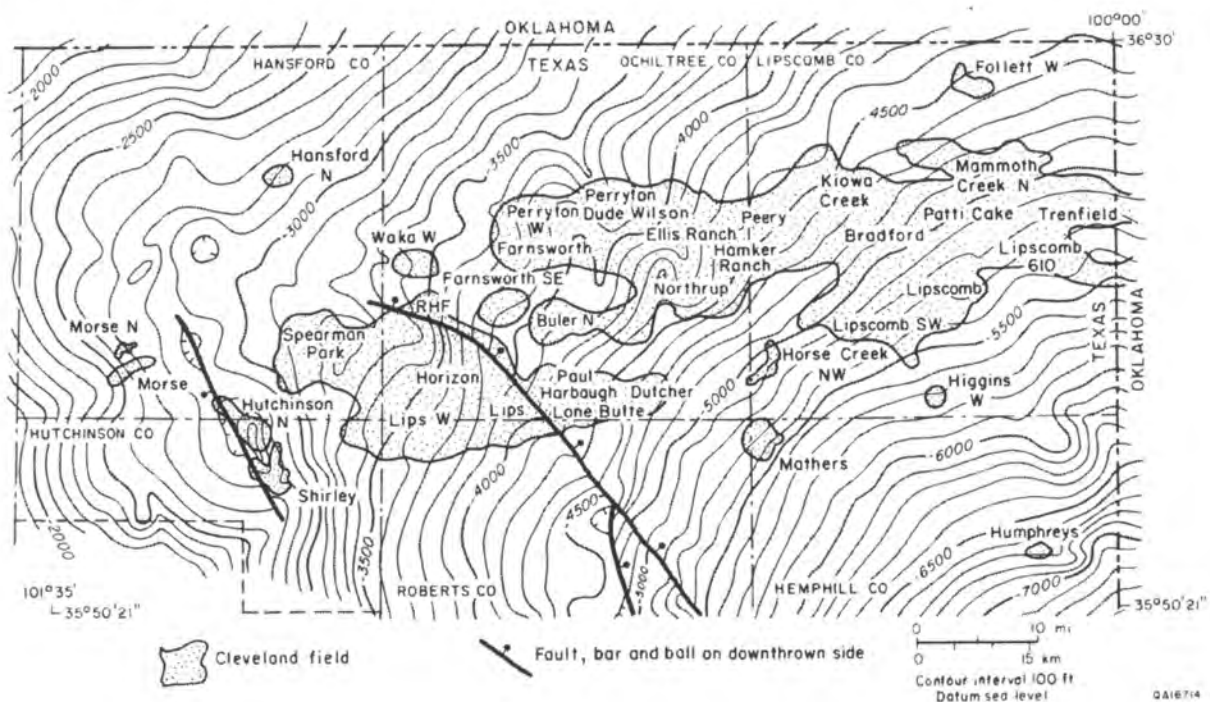


Figure 23: Map of major Cleveland gas fields superimposed on structure-contour map of the top of the Upper Pennsylvanian Cleveland Formation, Texas Panhandle. All fields except Morse, Mathers, Higgins West, Humphreys, and Follett West have produced > 1Bcf of gas since their discovery.



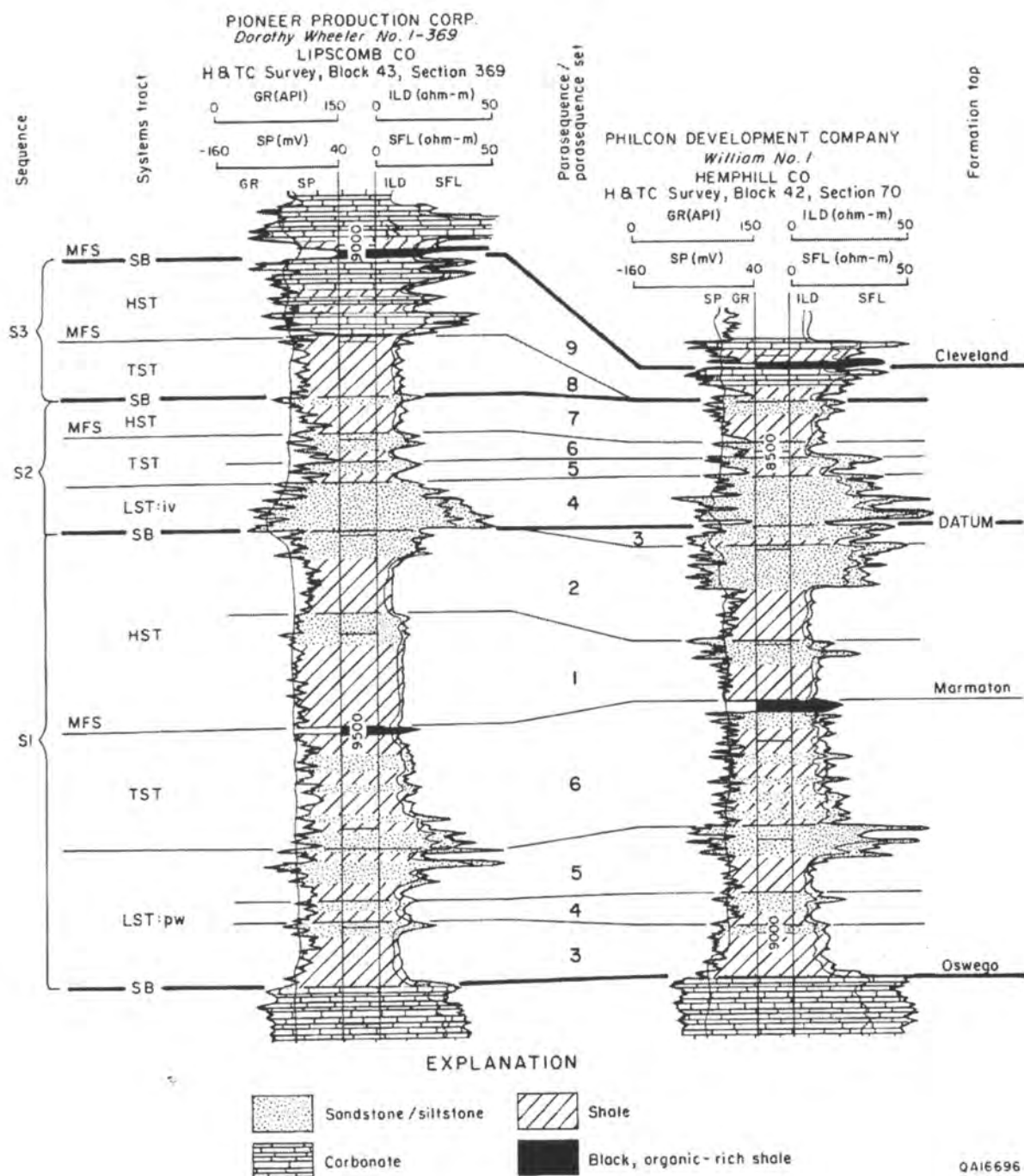


Figure 24: Representative well logs of the siliciclastic Marmaton Group and Cleveland Formation, showing the log expression of component sequences, systems tracts, and parasequences. Wells are located in south-central Lipscomb County (Wheeler No. 1-369) and northwest Hemphill County (William No. 1).

## Eastern Shelf Study

The Eastern shelf project in North-Central Texas (Fig. 25) involves outcrop and subsurface studies for developing depositional models to better explain the geometry and distribution of subsurface oil-bearing sandstone reservoirs. Previously completed surface and subsurface investigations were used to update exploration concepts on this buried shelf (Fig. 26). By revisiting the earlier study by Brown et al. (1990), STARR recognized that untapped hydrocarbons existed in the region, and STARR used the published net sandstone maps of incised-valley-fill lithofacies to promote the untapped resource. These maps included all Upper Pennsylvanian and Lower Permian elongate valley fill (16 stratigraphic levels) within the 25 counties that compose the Eastern Shelf. Recently our revisited results were presented at local North-Central Texas professional geological societies, and as a result, operators began to apply the new approaches in their exploration. A number of new hydrocarbon plays were developed by these operators who began to make new discoveries using these sequence stratigraphic ideas (e.g., Gunn Oil Company, Spur Lake field).

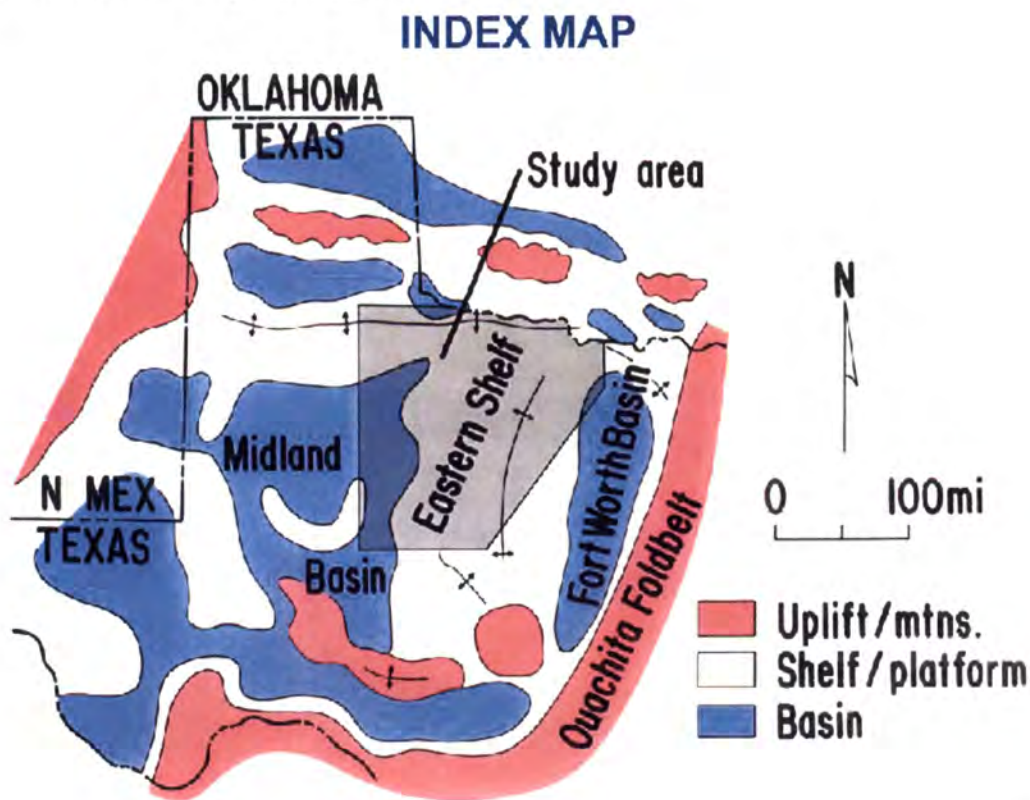


Figure 25: Location map of Eastern Shelf study located at the Eastern Shelf of the Midland Basin.



## CISCO FACIES, EASTERN SHELF, NORTH-CENTRAL TEXAS

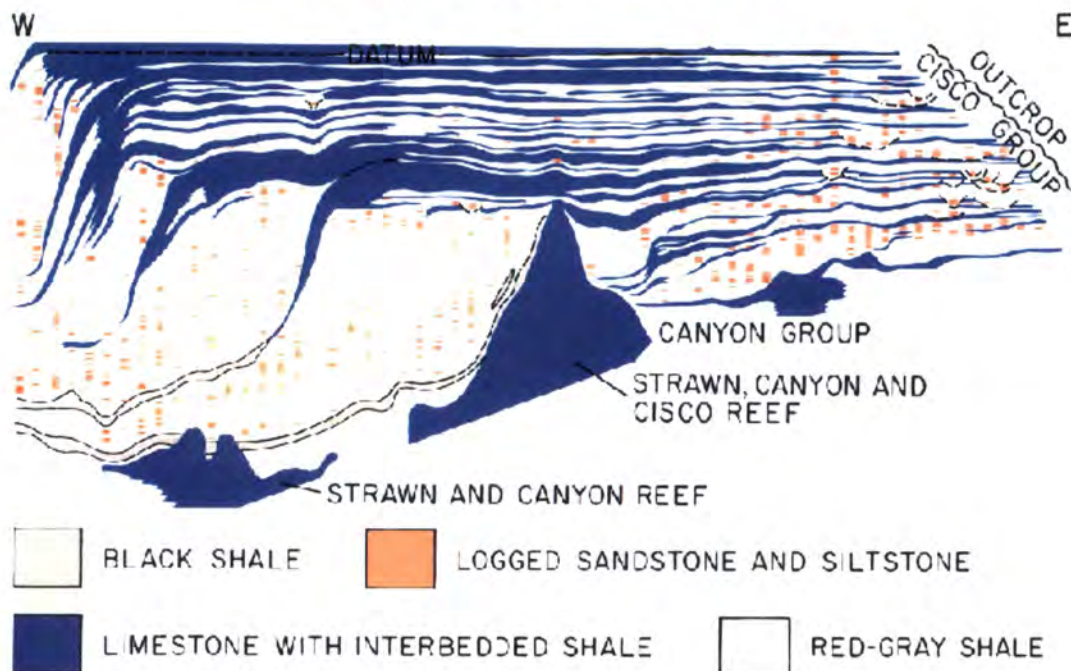


Figure 26: Sequence stratigraphic cross section of Cisco Facies across Eastern Shelf showing locations of sandstone reservoirs (yellow).

## Unconventional Resources

### Northern Fort Worth Basin Barnett Shale-Gas Trend Project

The Mississippian Barnett Shale of the northern Fort Worth Basin (NFWB) (Fig. 27) is a "shale-gas" system composed of a mixture of laminated siliceous mudstone, laminated argillaceous lime mudstone (marl), and skeletal argillaceous lime packstones. The shale is its own source, reservoir, and seal. Newark East field, the largest gas field in Texas, is developed in this Barnett "shale-gas" system. The Barnett Formation continues to be an active target for shale gas in the NFWB, as well as in the adjacent Permian Basin. Much effort has been devoted to understanding exploration methods, completion techniques, organic content, and maturation in this system. However, little has been published on the sedimentology, lithofacies, or depositional setting of these rocks. To help maximize

the resources from this shale-gas system, the STARR Program has analyzed Barnett strata in the NFWB using wireline logs, cores, and outcrops. Our effort has established an understanding of the regional depositional setting (Fig. 28), lithofacies, and pore networks (fractures and nanopores) within the system. Our analysis has helped define exploration limits of production and provide data for defining completion techniques. Especially important has been STARR's research on pore networks in the Barnett Shale. Our group was the first to define and image these nanopores (Fig. 29), and many companies have followed our research lead and concepts pertaining to this subject.

STARR has presented several workshops and field trips to disseminate results on the NFWB Barnett Shale. Each of these seminars has had maximum enrollment, and the course notes were published as a BEG CD-ROM. We also have presented numerous talks at national professional societies, as well as local geological societies. Four of the presentations have won awards. Several papers have been published in the *AAPG Bulletin* and in the *Journal of Sedimentologic Research*.

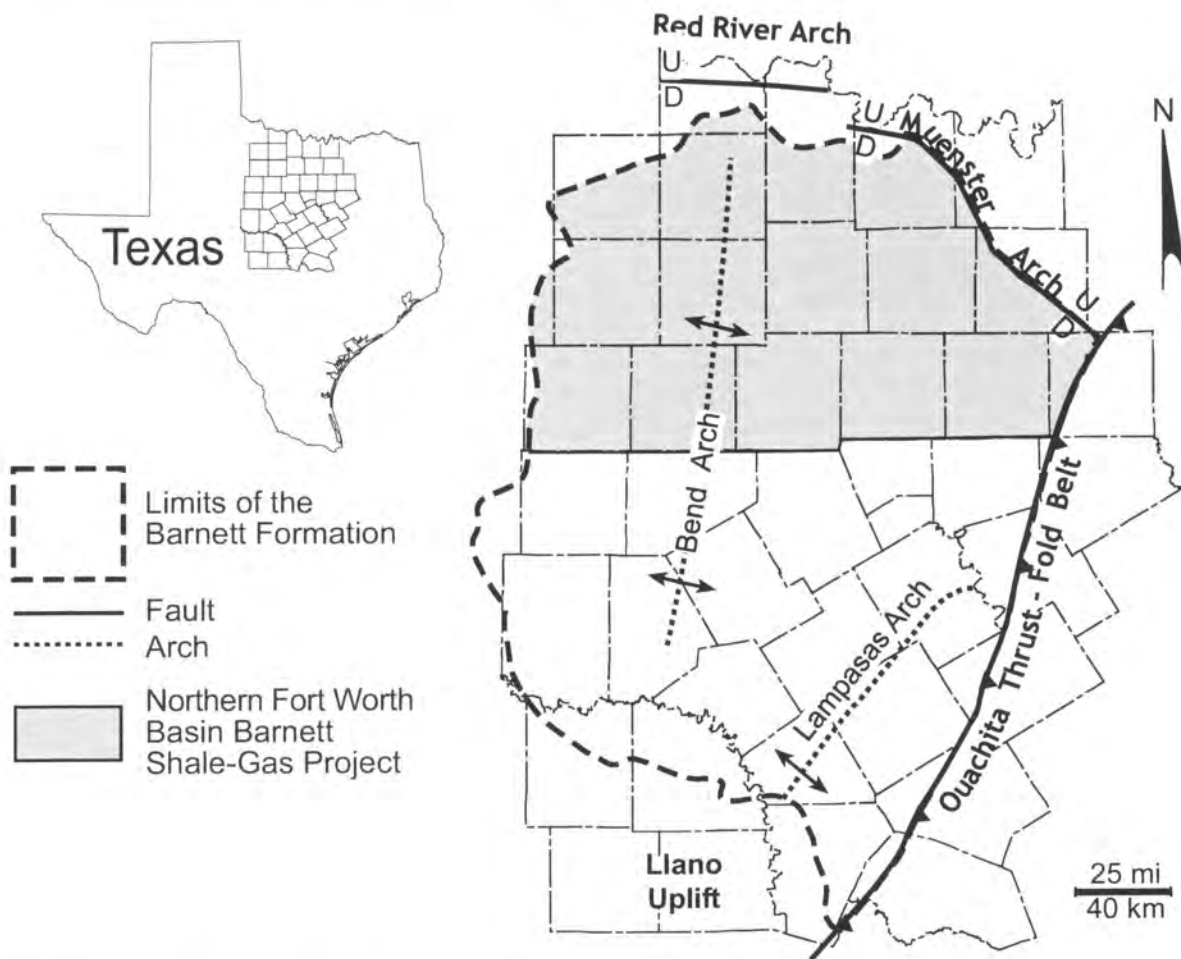


Figure 27: Map showing the location of the Northern Fort Worth Basin Barnett Shale-Gas Project.



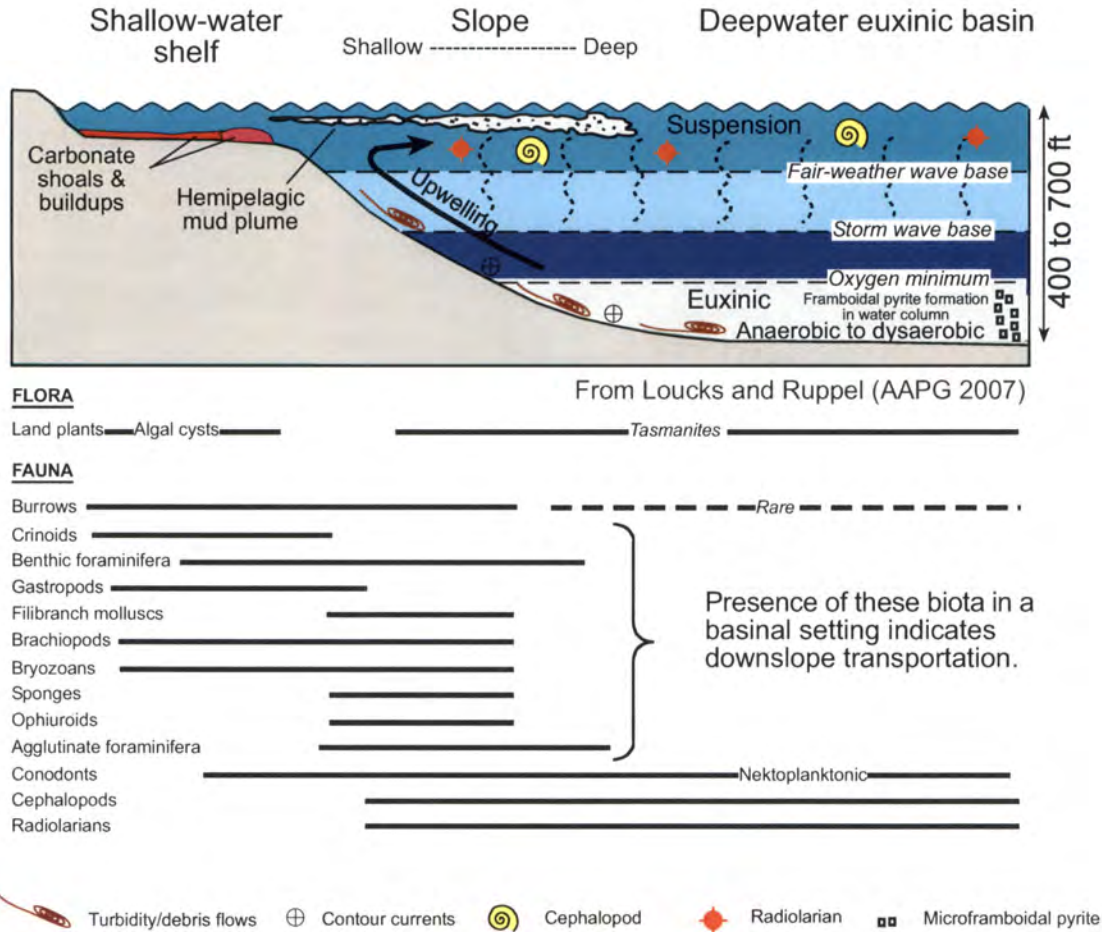


Figure 28: Generalized model of the Barnett Formation showing depositional profile, depositional processes, and estimated distribution of biota.

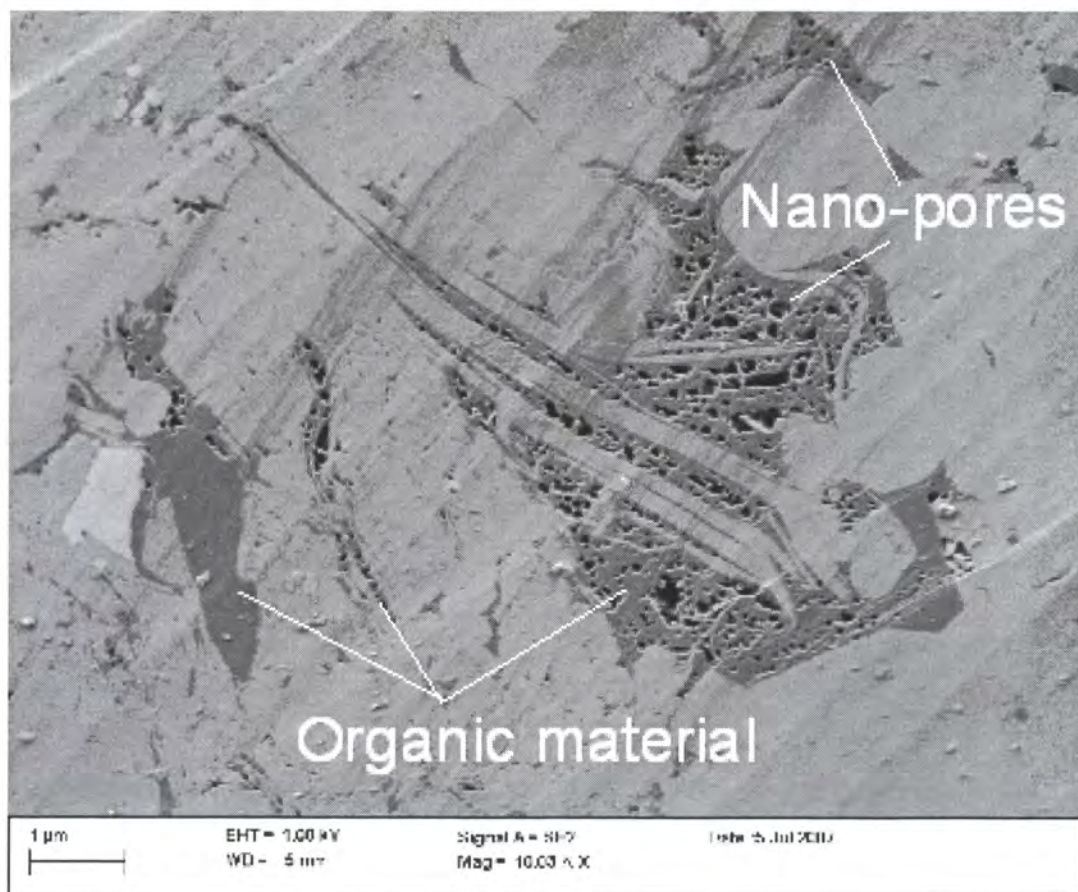


Figure 29: Nanopores in the Barnett Shale are associated with organic material.

#### Southern Fort Worth Basin Barnett Shale-Gas Trend Project

The Mississippian Barnett Shale of the Fort Worth Basin is a “shale-gas” system that has been extensively drilled in the northern part of the basin. The Barnett Newark East gas field in the NFWB is the largest gas field in Texas. Project STARR has completed a regional study of the Barnett depositional setting, lithofacies, and pore networks in the northern area and we have published our results. At present, the shale-gas play extends into the southern area of the basin (Fig. 30) where there is less certainty of success. To help increase knowledge and success in the southern area, Project STARR has started a study of the depositional setting, lithofacies, and pore networks in this part of the basin. We are progressing on logging 30 cores (Fig. 30) through the complete Barnett section in the Llano-Hill County area. These cores will shed new light on the depositional systems in this area. We are also correlating wireline logs and integrating them with cores to establish the stratal architecture of the area (Fig. 31). Initial results show that the depositional setting in the southern area is similar in many ways to that of the northern area, and the same depositional model developed for the northern area can be used. A



limiting parameter of the Barnett Shale in the southern area is that it thins, and the Ro (maturity level) in some areas is too low to have generated hydrocarbons. However, some success is occurring in the northern and eastern parts of this project area. We will be presenting workshops and publishing papers on this study as soon as we complete the research.

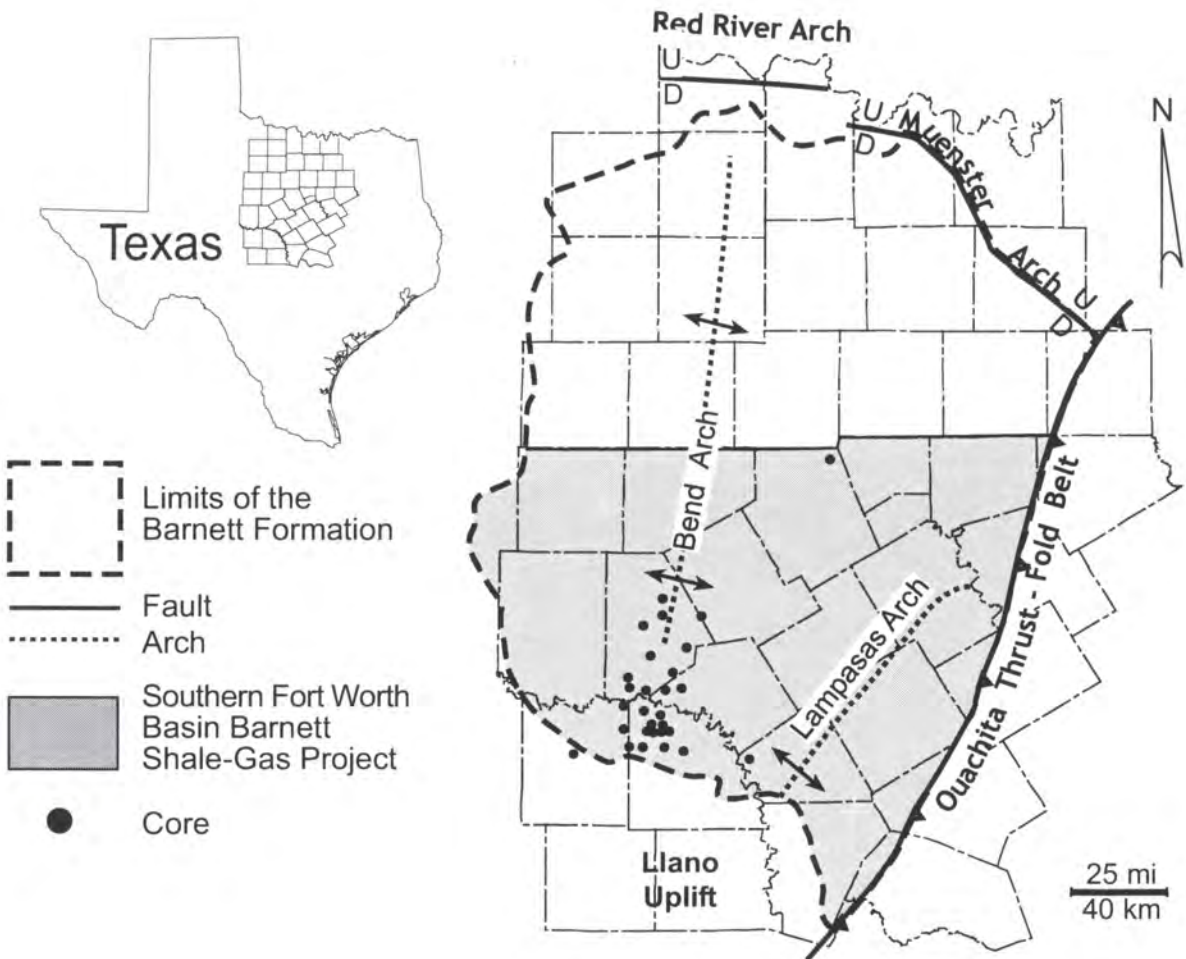


Figure 30: Map showing the location of the Southern Fort Worth Basin Barnett Shale-Gas Project and cores used in the study.

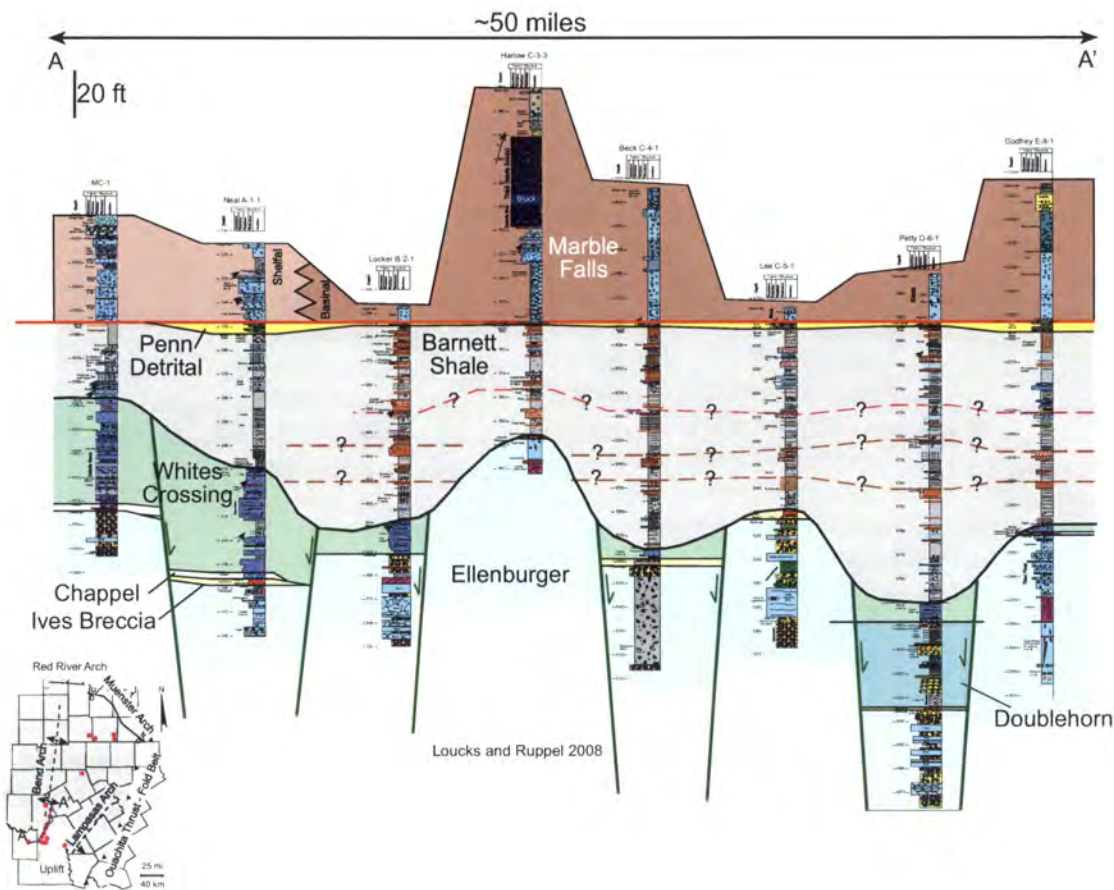


Figure 31: Stratigraphic cross section of the Barnett Shale in the southern Fort Worth Basin based on core.

#### Barnett/Woodford Shale-Gas Fractured Reservoir Study

Following the STARR study of the Barnett Shale in the NFWB discussed earlier, we extended the study into the Delaware Basin. The Barnett and Woodford shales in the Delaware Basin are being evaluated by several operators, who are looking for comparable success to the same formations in the Fort Worth and Arkoma Basins. Fundamental questions of lithotype, fracture style, thermal maturity and in situ stress must be considered. This study focuses on the natural fracture system and how it might impact production and completion strategy.

The geometry of the fracture system, and its propensity to reactivate during hydraulic fracture treatment, depends on the mechanical properties of the rock at the time of fracturing together with the pore-fluid conditions and stress state. These factors change during the history of a shale basin. It is imperative, therefore, to study the diagenetic changes that accompany burial of the shale through time. A University of Texas at



Austin Master's student is currently working on burial history modeling and wireline-log analysis of thermal maturity, focusing on the Delaware Basin. We presented a poster and talk at the West Texas Geological Society meeting in September 2008.

We also developed a testing rig and protocol to measure tensile strength at the margins of calcite-filled fractures and of different lithotypes of the Barnett Shale. Measurements show that calcite-filled fractures are weaker than the surrounding shale (Figs. 32, 33). This fact provides an explanation for why natural fractures reactivate during hydraulic fracture treatments. Results were published in the American Rock Mechanics Association Annual Meeting Proceedings Volume for the San Francisco meeting in June 2008. We also presented these findings at a symposium jointly convened by STARR and a consortium of operators in the Permian Basin in February 2007.

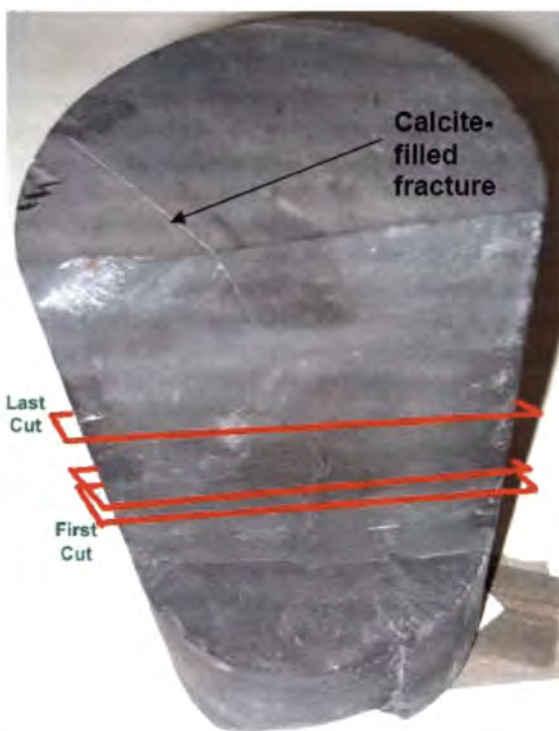


Figure 32: Test-specimen preparation for tensile testing. Red lines indicate the sample cuts made. Most of the slices are ~2.5 mm thick. A calcite-filled natural fracture is present in the top half of the core sample, tapering out approximately half-way down the sample. Slices from the top part contain the natural fracture whereas those from the lower part do not.

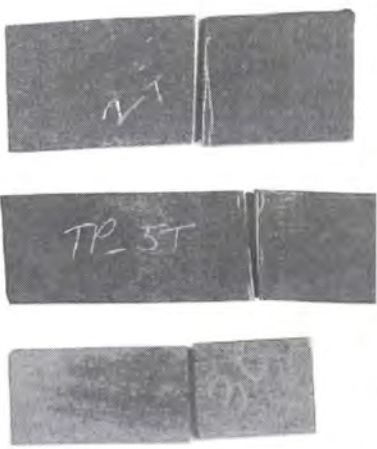

	Specimen	Rupture Strength (MPa)
	Containing fracture	
	TPS-2T	16.9
	TPS-5T	26.6
	Without fracture	
	TPS-9T	42.4
	TPS-11T	44.2

Figure 33: Tensile test specimens and results from the Barnett sample in Fig.32 (from 7611 ft in the Fort Worth Basin). Specimen photographs are arranged so that the top three rows are those with a calcite-sealed natural fracture, and the bottom two rows are specimens with no natural fracture. Rupture strengths for these specimens are shown at right. Specimens with a fracture are approximately half as strong as those without.



## PROJECT STARR'S RETURN ON STATE INVESTMENT FOR CURRENT BIENNIUM (SEPTEMBER 2006 – AUGUST 2008)

Production data from the Railroad Commission of Texas show that Project STARR-related wells have provided \$18,761,000 in royalty revenue for the Permanent School Fund during the past 2 years (Table 2). Revenue numbers for Table 2 are calculated using royalty factors per lease (supplied by the Texas General Land Office) and estimated value of gas, condensate or oil during each month produced. We calculated the average monthly prices using data from the website of the Energy Information Administration (EIA) of the U.S. Department of Energy (<http://www.eia.doe.gov/>). From that website we downloaded two spreadsheets. One contained average monthly U.S. wellhead prices for natural gas. The other contained Cushing, Oklahoma, monthly prices for West Texas Intermediate crude oil. Production values per lease came from the Railroad Commission's "ACTI Texas Oil and Gas Production" database (<http://driller.rrc.state.tx.us/Apps/WebObjects/acti>). Approximately \$54 million (Table 2) in severance taxes associated with these wells has been collected by the State. Relative to royalty income, Project STARR is revenue positive by a factor of 18.6.

The rate of decline in oil and gas production on Texas State Lands is symptomatic of the hydrocarbon production decline in the entire state and nation over the past few decades and is typical for mature provinces. In 1997, a report by the Railroad Commission of Texas titled "Texas Natural Resources Study: A Status Report of the Hydrocarbon Industries of Texas" (Matthews et al., 1997) projects that rates of hydrocarbon production will decline dramatically to low levels within the next decade. Advanced reservoir characterization and technology can help reduce this rate of decline and aid in recovering more hydrocarbons from mature fields before abandonment. Current projections indicate that Project STARR is helping operators generate significant revenue for the Permanent School Fund and the State. Within the last 2 years Project STARR results were used to drill 55 new in-fill and step-out wells and >2,000 wells associated with STARR's regional studies in the State of Texas.

**Table 2: Summary of royalty revenue to the Permanent School Fund and severance tax to the State. Credit is in accordance with methodology approved by the State of Texas Comptroller's office. Time period covered is 9/1/2006 to 7/31/2008.**

Field Name	RRCID for each Well per Project	Lease Royalty Factor	Condensate / Oil Well Head Value (\$)	Condensate / Oil Royalty (\$)	Condensate / Oil Severance Tax (\$)	Gas Well Head Value (\$)	Gas Royalty (\$)	Gas Severance Tax (\$)	Revenue (\$)
<b>CARANCAHUA</b>									
202140									
211783		20.00%	\$794.22	\$158.84	\$29.23	\$15,108.48	\$3,021.70	\$906.51	\$4,116.28
216389		20.00%	\$26,791.01	\$5,358.20	\$985.91	\$179,856.23	\$35,971.25	\$10,791.37	\$53,106.73
216627			\$58,294.44	\$0.00	\$2,681.54	\$89,943.04	\$0.00	\$6,745.73	\$9,427.27
217936			\$134,214.43	\$0.00	\$6,173.86	\$231,883.68	\$0.00	\$17,391.28	\$23,565.14
221134		20.00%	\$713,546.93	\$142,709.39	\$26,258.53	\$980,789.91	\$196,157.98	\$58,847.39	\$423,973.29
226753		20.00%	\$2,064.94	\$412.99	\$75.99	\$151,812.08	\$30,362.42	\$9,108.72	\$39,960.12
226864			\$2,622,740.60	\$0.00	\$120,646.07	\$1,666,554.61	\$0.00	\$124,991.60	\$245,637.66
Totals		4.26%	\$101,784.89	\$4,333.81	\$4,482.75	\$411,853.88	\$17,535.96	\$29,573.84	\$55,926.36
			<b>\$3,660,231.46</b>	<b>\$152,973.23</b>	<b>\$161,333.88</b>	<b>\$3,727,801.91</b>	<b>\$283,049.30</b>	<b>\$258,356.45</b>	<b>\$855,712.85</b>
<b>GOLD RIVER</b>									
13428			\$310,989.39	\$0.00	\$14,305.51	\$100,019.67	\$0.00	\$7,501.48	\$21,806.99
184204			\$6,350.91	\$1,270.18	\$233.71	\$27,294.12	\$5,458.82	\$1,637.65	\$8,600.37
215571			\$346,153.25	\$0.00	\$15,923.05	\$491,642.48	\$0.00	\$36,873.19	\$52,796.24
219269			\$0.00	\$0.00	\$0.00	\$271,083.37	\$0.00	\$20,331.25	\$20,331.25
219778			\$16,623.39	\$0.00	\$764.68	\$210,482.13	\$0.00	\$15,786.16	\$16,550.84
220412			\$18,946.12	\$0.00	\$871.52	\$156,140.79	\$0.00	\$11,710.56	\$12,582.08
220414			\$5,420.18	\$0.00	\$249.33	\$186,511.22	\$0.00	\$13,988.34	\$14,237.67
221192			\$19,430.69	\$0.00	\$893.81	\$202,782.82	\$0.00	\$15,208.71	\$16,102.52
221510			\$0.00	\$0.00	\$0.00	\$1,078,790.60	\$0.00	\$80,909.30	\$80,909.30
222168			\$108,997.95	\$0.00	\$5,013.91	\$482,172.31	\$0.00	\$36,162.92	\$41,176.83
222680			\$175,884.09	\$0.00	\$8,090.67	\$2,172,642.99	\$0.00	\$162,948.22	\$171,038.89
223370			\$0.00	\$0.00	\$0.00	\$301,405.11	\$30,140.51	\$20,344.84	\$50,485.36
223449			\$26,549.84	\$0.00	\$1,221.29	\$362,511.67	\$0.00	\$27,188.38	\$28,409.67
223561			\$22,358.42	\$0.00	\$1,028.49	\$440,006.73	\$0.00	\$33,000.50	\$34,028.99
223905			\$21,964.90	\$0.00	\$1,010.39	\$91,874.01	\$0.00	\$6,890.55	\$7,900.94
223930		11.25%	\$24,500.04	\$2,756.25	\$1,000.21	\$720,716.11	\$81,080.56	\$47,972.67	\$132,809.70
225134			\$13,754.45	\$0.00	\$632.70	\$394,566.50	\$0.00	\$29,592.49	\$30,225.19
225144			\$5,766.74	\$0.00	\$265.27	\$158,538.59	\$0.00	\$11,890.39	\$12,155.66
225798			\$7,568.07	\$0.00	\$348.13	\$141,708.06	\$0.00	\$10,628.10	\$10,976.24
226017			\$4,174.77	\$0.00	\$192.04	\$70,352.00	\$0.00	\$5,276.40	\$5,468.44
226614			\$32,431.74	\$0.00	\$1,491.86	\$332,166.15	\$0.00	\$24,912.46	\$26,404.32
226655			\$1,057.46	\$0.00	\$48.64	\$57,839.92	\$0.00	\$4,337.99	\$4,386.64
227248			\$32,821.41	\$0.00	\$1,509.78	\$368,222.52	\$0.00	\$27,616.69	\$29,126.47
Totals			<b>\$1,201,743.81</b>	<b>\$4,026.44</b>	<b>\$55,095.00</b>	<b>\$8,819,469.87</b>	<b>\$116,679.90</b>	<b>\$652,709.25</b>	<b>\$828,510.58</b>
<b>LA PLAYA</b>									
207584		26.13%	\$731,610.17	\$191,169.74	\$24,860.26	\$5,943,413.21	\$1,553,013.87	\$329,279.95	\$2,098,323.82
Totals			<b>\$731,610.17</b>	<b>\$191,169.74</b>	<b>\$24,860.26</b>	<b>\$5,943,413.21</b>	<b>\$1,553,013.87</b>	<b>\$329,279.95</b>	<b>\$2,098,323.82</b>
<b>LAGUNA MADRE</b>									
150725			\$0.00	\$0.00	\$0.00	\$215,104.84	\$39,846.24	\$13,144.40	\$52,990.63
165716			\$0.00	\$0.00	\$0.00	\$220,356.43	\$40,819.05	\$13,465.30	\$54,284.35
213166			\$78,007.80	\$0.00	\$3,588.36	\$627,089.64	\$0.00	\$47,031.72	\$50,620.08
215096		18.75%	\$117,843.01	\$22,095.56	\$4,404.38	\$747,491.51	\$140,154.66	\$45,550.26	\$212,204.87
216533			\$0.00	\$0.00	\$0.00	\$263,201.09	\$49,350.20	\$16,038.82	\$65,389.02
Totals			<b>\$195,850.81</b>	<b>\$22,095.56</b>	<b>\$7,992.74</b>	<b>\$2,073,243.51</b>	<b>\$270,170.14</b>	<b>\$135,230.50</b>	<b>\$435,488.95</b>



Table 2 continued:

Field Name	RRCID for each Well per Project	Lease Royalty Factor	Condensate / Oil Well Head Value (\$)	Condensate / Oil Royalty (\$)	Condensate / Oil Severance Tax	Gas Well Head Value (\$)	Gas Royalty (\$)	Gas Severance Tax (\$)	Revenue (\$)
<b>MUSTANG ISLAND</b>									
217015									
	12.50%		\$2,880,216.55	\$360,027.07	\$115,928.72	\$18,375,593.05	\$2,296,949.13	\$1,205,898.29	\$3,978,803.21
221570	23.75%		\$4,046,054.13	\$960,937.86	\$141,915.35	\$13,350,041.68	\$3,170,634.90	\$763,455.51	\$5,036,943.61
221667	23.75%		\$648,308.00	\$153,973.15	\$22,739.40	\$1,458,358.75	\$346,360.20	\$83,399.89	\$606,472.65
221704	16.67%		\$3,134,030.53	\$522,348.87	\$120,137.36	\$4,030,483.28	\$671,760.65	\$251,904.20	\$1,566,151.07
224433	16.67%		\$2,342,379.11	\$390,404.33	\$89,790.84	\$20,841,885.36	\$3,473,717.03	\$1,302,612.62	\$5,256,524.82
<b>Totals</b>			<b>\$13,050,988.32</b>	<b>\$2,387,691.27</b>	<b>\$490,511.66</b>	<b>\$58,056,362.12</b>	<b>\$9,959,421.91</b>	<b>\$3,607,270.52</b>	<b>\$16,444,895.36</b>
<b>NEWARK EAST</b>									
<b>Totals</b>			<b>\$116,886,632.34</b>	<b>\$0.00</b>	<b>\$5,376,785.09</b>	<b>\$2,254,086,148.46</b>	<b>\$0.00</b>	<b>\$169,056,461.13</b>	<b>\$174,433,246.22</b>

NOTE: individual wells of Newark East field were hidden because of &gt;2000 wells

25% Oil Severance Tax (\$)	25% Gas Severance Tax (\$)
\$1,344,196.27	\$42,264,115.28

**RED FISH BAY**

215054	20.00%	\$36,773.76	\$7,354.75	\$1,353.27	\$177,198.28	\$35,439.66	\$10,631.90	\$54,779.58
215823	20.00%	\$413,601.95	\$82,720.39	\$15,220.55	\$1,519,939.61	\$303,987.92	\$91,196.38	\$493,125.24
217021	20.00%	\$94,974.69	\$18,994.94	\$3,495.07	\$182,719.89	\$36,543.98	\$10,963.19	\$69,997.18
<b>Totals</b>		<b>\$545,350.40</b>	<b>\$109,070.08</b>	<b>\$20,068.89</b>	<b>\$1,879,857.78</b>	<b>\$375,971.56</b>	<b>\$112,791.47</b>	<b>\$617,902.00</b>

**SPUR LAKE**

69070		\$2,963,150.45	\$0.00	\$136,304.92	\$18,845.85	\$0.00	\$1,413.44	\$137,718.36
69096		\$753,741.22	\$0.00	\$34,672.10	\$18,397.30	\$0.00	\$1,379.80	\$36,051.89
69116		\$2,463,942.37	\$0.00	\$113,341.35	\$16,375.35	\$0.00	\$1,228.15	\$114,569.50
69150		\$3,045,101.41	\$0.00	\$140,074.66	\$3,705.33	\$0.00	\$277.90	\$140,352.56
69203		\$407,306.63	\$0.00	\$18,736.10	\$5,147.97	\$0.00	\$386.10	\$19,122.20
69214		\$18,374.84	\$0.00	\$845.24	\$0.00	\$0.00	\$0.00	\$845.24
69246		\$234,977.78	\$0.00	\$10,808.98	\$0.00	\$0.00	\$0.00	\$10,808.98
69250		\$1,497,117.56	\$0.00	\$68,867.41	\$5,265.87	\$0.00	\$394.94	\$69,262.35
69260		\$137,104.36	\$0.00	\$6,306.80	\$0.00	\$0.00	\$0.00	\$6,306.80
69263		\$263,672.49	\$0.00	\$12,128.93	\$0.00	\$0.00	\$0.00	\$12,128.93
<b>Totals</b>		<b>\$11,784,489.11</b>	<b>\$0.00</b>	<b>\$542,086.50</b>	<b>\$67,737.67</b>	<b>\$0.00</b>	<b>\$5,080.33</b>	<b>\$547,166.82</b>

**YATES**

24061	3.85%	\$86,530,559.64	\$3,335,666.54	\$1,913,482.54	\$0.00	\$0.00	\$0.00	\$5,249,149.08
<b>Totals</b>		<b>\$86,530,559.64</b>	<b>\$1,667,833.27</b>	<b>\$3,826,965.08</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$5,249,149.08</b>

\$234,587,456.06	\$6,202,692.86	\$6,473,110.29	\$2,334,654,034.53	\$12,558,306.68	\$47,364,833.74	\$201,510,395.69
Oil Well Head Value Grand Total	Oil Royalty Grand Total	Oil Severance Tax Grand Total	Gas Well Head Value Grand Total	Gas Royalty Grand Total	Gas Severance Tax Grand Total Sum:	Revenue Grand Total

\$620,269.29 \$6,473,110.29

10% of Oil Royalty Grand Total Oil Severance Tax Grand Total

\$1,255,830.67

10% of Gas Royalty Grand Total

\$47,364,833.74

Gas Severance Tax Grand Total

Estimate of Revenue Neutrality:	\$55,714,043.98
STARR Biennial Funding:	\$3,000,000.00
STARR Funding Multiple: STARR Funding / (10% of Royalty, plus Severance Tax):	18.57

## PROJECT STARR'S PROJECTION ON STATE INVESTMENT FOR 2008 TO 2010 BIENNIUM

Royalty revenue to the Permanent School Fund for the next reporting biennium (September 2008 to August 2010) from incremental oil and gas production may equal or exceed Project STARR's present excellent economic results. This estimate is based on several infill and step-out wells that may be drilled in Gold River North, Newark East, and East Texas fields. Several exploration wells are expected to be drilled in the State Waters offshore Calhoun County. The West Bay/Alligator Point area will have several exploration wells drilled in the deep Frio and up to 20 infill wells in the Miocene section. The greater Matagorda Bay area, including Carancahua Bay, will undergo infill drilling and drilling of several exploratory wells in the deeper Frio. Several ongoing regional studies will stimulate drilling of new step-out wells and new exploration targets, such as the Barnett shale-gas play in the southern Fort Worth and Delaware Basins, the Haynesville shale-gas play in East Texas, the regional Frio and Woodbine studies in South and East Texas, respectively, and the Bone Spring study in West Texas. The amount of revenue will depend on when the wells are drilled within the 2-year credit period, whether the wells produce as projected, and when the regional studies will be finished and reported to the public. The rates of actual and forecasted returns on Project STARR are excellent and fully satisfy Project STARR's revenue-neutral requirement for continued funding. Recent rates of return for the Permanent School Fund have been approximately 10 percent per annum. These rates of return go into the Available Fund of the Permanent School Fund and become part of the General Revenue Fund. Therefore, we estimate that wells affiliated with Project STARR contributed \$1.9 million to the Available Fund during the 2006–2008 biennium. Consequently, total contribution to the General Revenue Fund (including severance taxes) from Project STARR affiliated wells is estimated to be \$55.7 million (Table 2). This value is well above the amount necessary for revenue neutrality.

With sustained oil and gas development funding from the State of Texas, Project STARR has an ultimate goal of capturing an incremental 5 percent of the remaining mobile oil and gas resource on State Lands and Waters that probably would not be captured without the application of advanced technology. This estimate is based on our belief that we can apply advanced technology to identify new reservoirs and apply better reservoir characterization principles than can be done by many of the smaller companies without research and technology resources. The mobile oil resource on State Lands is 1.6 Bbbl. Achieving the goal of 5 percent incremental oil would yield 80 MMbbl and provide a return to the Permanent School Fund of \$1 billion, assuming an average price of \$100/bbl and a 12.5 percent royalty. Similarly, a capture of 5 percent of the 10 Tcf of remaining gas would yield 500 Bcf and generate \$600 million for the Permanent School Fund, assuming an average price of \$8.00/Mcf and an average 15 percent royalty. By achieving these levels of incremental recovery, the Project STARR



initiative could help generate \$1.6 billion in royalties to the Permanent School Fund over the long term.

The wellhead value of additional oil and gas reserves would be \$8 billion and \$4.0 billion, respectively, for a total of \$12 billion. Calculations based on the Railroad Commission of Texas "General Model of Oil and Gas Impact on the Texas Economy" derived from the Comptroller's Input-Output model of the Texas economy can be further utilized to estimate the overall effect of additional oil and gas reserves in terms of economic value, taxes, and jobs created. The economic value of this potential future oil and gas as it cycles through the Texas economy is calculated at \$35 billion (wellhead value multiplied by 2.91). Total potential taxes of \$1.4 billion are derived from severance (4.6 percent oil and 7.5 percent gas of wellhead value), ad valorem (3.95 percent of wellhead value), franchise (0.18 percent of economic value), and sales (2 percent of economic value) taxes. The number of potential additional jobs created equals 229,200, assuming 19.1 jobs are created per million dollars of wellhead value.

## PROJECT STARR REVENUE NEUTRALITY METRICS

Project STARR must demonstrate revenue neutrality to the State of Texas Comptroller's Office each reporting biennium in order to be considered for funding in the next biennium. Starr's revenue neutrality is calculated for two years spanning half of the last and half of the current legislative biennia. For the 2008/2009 biennium we calculated our revenue neutrality from September 1, 2006 until August 31, 2008. This 2-year interval was chosen because our progress report is typically being submitted before the end of the current legislative biennium (i.e., 2008/2009 biennium). Both royalties to the Permanent School Fund and State severance tax can be accounted to the revenue neutrality calculations on the basis of the metrics presented in Table 3. This metrics table was developed in conjunction with the State of Texas Comptroller's Office in 2004 and slightly modified following discussion with the Comptroller's Office in 2006. Five major types of projects are noted in Table 3.

Table 3: Project STARR revenue neutrality metrics.

<b>Type of STARR Recommendation</b>	<b>Expiration period following recommendation (Initial/incremental production must begin before recommendation expires)</b>	<b>Time period for credit following initial production</b>	<b>Royalty Credit (Royalties to PSF)*</b>	<b>Severance Tax Credit</b>
1. Drilling new infill or step-out well in established field	4 years	2 years	100%	100%
2. Drilling new infill or step-out well in established field with multiple reservoir intervals	4 years	2 years following completion of each additional reservoir interval	100%	100%
3. Recompletion - missed pay well in established field	4 years	2 years	100%	100%
4. Enhanced oil recovery (EOR) field project	4 years	2 years following date selected by STARR within a 5-year period from initial operator action	100% of incremental production	100% of incremental production
5. Exploration well	4 years	2 years	100%	100%
5.a. Subsequent development wells following discovery of new field	2 years following initial production from exploration well	2 years	100%	100%
5.b. Copycat wells following discovery of new field	2 years following initial production from exploration well	2 years	25%	25%

\* Project STARR only receives revenue neutrality credit for the fraction of royalty that goes into the General Revenue Fund of the State of Texas. State Land royalties initially go into the Permanent School Fund and a percentage of that fund is transferred to the General Revenue Fund each year. Project STARR receives credit for the amount that is provided to the General Revenue Fund each year.



## RECOMMENDATIONS

Project STARR has been successful by focusing on field-scale studies that are limited in their geographic extent. This concentrated focus on small, reservoir-sized areas leads to immediate incremental royalty revenue flow into the Permanent School Fund because specific areas and specific reservoir depths can be identified where State Lands operators can take recommended actions to increase production. The addition of regional (including unconventional) studies has generated additional funds as operators took advantage of research and leads offered by these studies through workshops and publications.

We recommend that the Project STARR program remain at \$1.5 million per year or \$3 million for the next biennium. The present funding is at a level that allows us to have a strong team with the necessary skills to generate prospects and regional studies. The State was fortunate to have this team in place so that new incremental production (resulting from STARR's efforts) had a high value owing to recent unprecedented increases in oil and gas prices.

Because of the strength shown by Project STARR, the Bureau of Economic Geology was able to initiate an ongoing, independently funded industry consortium study in 2004 titled "Stratigraphic Architecture and Sandstone Reservoir Quality in Deep-Shelf Gas Plays of Texas State Waters," which is directed toward reducing reservoir risk on new, very deep, and high-risk exploration targets on Texas submerged lands. This consortium supports the systematic application of state-of-the-science technology and methods to evaluating tracts of Texas submerged State Lands that have potential for successful prospecting by the private sector. This industry-funded study is augmenting Project STARR efforts in that it is stimulating the very deep shelf gas play under State Waters by reducing reservoir risk. This project, moving into Phase III, has encouraged drilling of more than 10 wells below depths of 15,000 ft in State Waters.

Overall, Project STARR has been successful interacting with State Lands' operators to help them increase their production. Our success rate with the operators is reflected in the revenue generated. We strongly believe that continued funding support for Project STARR will be more than offset by increase in royalties to the Permanent School Fund and severance tax to the State of Texas.

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## APPENDIX A

### 2006–2008 Letters of Cooperation

The following are letters from partner companies with whom Project STARR has collaborated over the last several years. The letters support the strong interaction between Project STARR and industry.





Brigham Oil & Gas, L.P. ♦ 6300 Bridge Point Parkway, Bldg. 2, Suite 500 ♦ Austin, Texas 78730  
Phone (512) 427-3300 ♦ Fax (512) 427-3400

September 25, 2008

To: Ursula Hammes, PI STARR Project

Re: Acknowledgment of STARR support  
Brigham Oil & Gas, L.P.  
General Lee Project  
Matagorda County, Texas

Dear Dr. Hammes:

On behalf of Brigham Oil & Gas, L.P. ("Brigham"), I would like to thank you and the STARR team for your ongoing support of our project in the Matagorda Bay area. We appreciate your insight into the regional geology and the detailed understanding of the local conditions. Brigham is particularly grateful for your assistance in understanding the depositional framework of the deeper, under-explored formations and in the shallow Miocene Sands. The STARR team's structural and sequence stratigraphic interpretations of our seismic data have provided us with encouragement to drill more wells in the future.

Brigham is currently marketing several prospects which we hope to drill next year that are supported by your efforts. In addition, we have several wells that are still producing in the area, which benefited from the encouragement, collaborative information, presentations and products the STARR team has furnished in regard to the structural trapping style, geologic framework and reservoir characteristics of the project area. We look forward to more collaborative efforts with the STARR team on this project and future projects.

Sincerely,

John W. Plappert  
Director of Geophysical Projects



1907 East Old Hwy 80  
White Oak, Texas 75693

Office (903) 297-5101  
Fax (903) 297-5122

March 12, 2008

Dr. Bob Loucks  
Bureau of Economic Geology  
The University of Texas at Austin  
University Station  
Box X  
Austin, Texas 78713-8924

Re: **Pilot Study of East Texas Field  
Successful Results**

Dear Mr. Potter:

I want to thank you and your staff for the excellent job they did with the pilot study of the East Texas Field. The Workshop was very informative and it was quite evident that a lot of hard work was put into this study. You were very effective in explaining the plumbing of this complicated reservoir and the recommendations appear to be very reasonable.

Because of your efforts, we were able to concentrate our well deepening prospects in areas that have a high risk of sand development. As a result, we deepened two wells, the Moncrief #12 and Moncrief #43. Prior to the deepenings, each well averaged 0.5 bopd/410 bwpd. After the deepening, the #12 came in at 79 bopd/0 bwpd and the #43 came in at 36 bopd/1 bwpd. After five months of production, the #43 is producing 13 bopd/4 bwpd and the #12 is averaging 20 bopd/16 bwpd.

With your help, we plan to do more deepenings this year and as we obtain results, I will pass on them to you.

Thank you again for all your hard work in assisting operators in extracting more oil out of the East Texas Field.

Sincerely,

A handwritten signature in dark ink, appearing to read 'P. J. Nault'.

P. J. Nault  
Vice President Engineering





1907 East Old Hwy 80  
White Oak, Texas 75693

Office (903) 297-5101  
Fax (903) 297-5122

July 17, 2003

Dr. Ursula Hammes  
Bureau of Economic Geology  
The University of Texas at Austin  
University Station  
Box X  
Austin, Texas 78713-8924

Re: STARR Program

Dear Dr. Hammes,

Thank you for the in-depth Woodbine sand mapping on the South Kilgore Unit and Moncrief lease. Because of your efforts we are now able to better understand the reservoir geometry and sandstone trends in the Lower Woodbine. This will be particularly valuable in picking deepening candidates on the Moncrief lease. This is the best producing lease in our East Texas field and with this new information, we anticipate increasing our success rate on the deepenings. With the data the BEG provided in the pilot study, we have already had success on two Moncrief deepenings that had initial increased oil of 115 bopd. Both wells have stabilized for a total of 33 bopd of incremental production.

The mapping you provided on the South Kilgore Unit looks promising also. The sandstone trends were much more complicated than we thought and this information will aid us in modifying the injection patterns to get a more efficient waterflood pattern.

Thank you again for all your hard work. Without your help we would be "shooting in the dark" and possibly wasting good money. This program is very valuable to the independent operator that doesn't have the resources or expertise available to properly evaluate reservoirs.

Sincerely,

A handwritten signature in dark ink, appearing to read 'P. J. Nault', with a stylized flourish at the end.

P. J. Nault  
Vice President Engineering



August 29, 2008

Ursula Hammes, Ph.D.  
Bureau of Economic Geology  
The University of Texas at Austin  
10100 Burnet Road, Bldg. 130  
Austin, Texas 78758

**Re: STARR Team Support**

Dear Dr. Hammes:

On behalf of Gulf Energy Exploration Corp., I would like to personally thank you and the STARR team members for your ongoing support of our projects, one being offshore Calhoun County and the other in West Bay of Galveston and Brazoria Counties. Your assessment of the 3D seismic volume in both has been crucial in understanding the regional geology and the detailed understanding of the local conditions and reservoir characteristics.

The STARR team's involvement not only enhanced our understanding of the geologic picture but also in proving up new reserves. We are currently in the process of establishing an extensive exploratory and development drilling program in these two areas.

Again, many thanks.

Sincerely yours,  
Gulf Energy Exploration Corp.

A handwritten signature in dark ink, appearing to read "J. W. Rhea", followed by a horizontal line.

J. W. Bill Rhea, IV  
President, Chief Executive Officer

9101 Burnet Road, Suite 200 • Austin, TX 78758  
512.335.1800



**GUNN OIL COMPANY**  
P.O. Box 97508  
Wichita Falls, Texas 76307  
Phone 940-723-5585

August 8, 2008

Dr. Ursula Hammes  
Project Director  
STARR Project  
Bureau of Economic Geology  
Jackson School of Earth Sciences  
The University of Texas at Austin  
P. O. Box X, UT Station  
Austin, Texas 78713


Dear Dr. Hammes:

This letter will acknowledge the contribution made to our successful exploration program for oil and gas in West-Central Texas by research carried out and published by the State of Texas Advanced Resource Recovery project (STARR) at the Texas Bureau of Economic Geology.

The published research by the Bureau contributed to our successful discovery of oil and gas in several counties in our region of Texas. We hope that this kind of geologic research at the Bureau will continue to receive State of Texas support. We are a small, but successful company that does not have a major research component and therefore, the results of the Bureau's research on new methods of exploration has been very helpful in our search for more hydrocarbons in West-Central Texas.

The Bureau's studies have focused some of the more recent advances in petroleum exploration on the geology of our region, helping us mature our approach to new discoveries. Publications and presentations by the Bureau of Economic Geology significantly speed up our application of the most recent advances in stratigraphic geology.

Sincerely,

  
Gregg A. Norman  
Senior Geologist  
Gunn Oil Company



Petroleum, Inc.

Wednesday, August 20, 2008

Ursula Hammes, Ph.D.  
Research Associate  
The University of Texas  
Bureau of Economic Geology  
1010 Burnet Road  
Building 130  
Austin, Texas 78758

Re: STARR Project

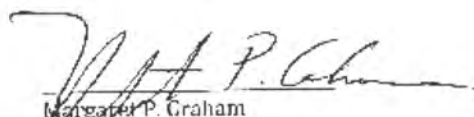
Dear Dr. Hammes:

As owner of MPG Petroleum, Inc. I would like to express how much I appreciate the work your team has done for developing various prospects in the South Texas Gulf Coast. Your regional work on the Frio Formation in South Texas added to a more in-depth knowledge of the geology in our area and has encouraged us to explore deeper and un-explored reservoirs. Based on initial results, we are off to a very good start. Your team's knowledge of seismic modeling and interpretations of our 3D dataset is greatly appreciated. Your knowledge of advanced reservoir characterization helped us greatly in our drilling efforts.

We are planning to drill 2 wells that resulted from interacting with the STARR team and we look forward to continued development well into the future.

Sincerely,

MPG Petroleum, Inc.

  
Margaret P. Graham  
President

8020 N. New Braunfels, Suite 411 • San Antonio, Texas 78217 • (210) 820-4555 • Fax (210) 822-8988

[mpgp.petroleum.com](http://mpgp.petroleum.com)





July 19, 2005

Dr. Robert J. Loucks  
Senior Research Scientist  
The Bureau of Economic Geology  
University Station  
PO Box X  
Austin, TX 78713-8927

Dear Bob:

We at Sabco Oil & Gas Corporation wish to acknowledge our interactions with the STARR team during the past two years. Specifically STARR conducted a short stratigraphic and correlation study for us and our partners, Royal Exploration Company, Inc., in our state water leases in Corpus Christi Bay. The BEG's evaluation of our State Tract 61-1 well was key in developing an adjacent prospect. Our permitted location for the State Tract 55-1 well, which will be drilled this winter, was based largely on the results of the State Tract 61-1. Sabco thanks the BEG and STARR for their support and contributions to our oil and gas exploration efforts, and we look forward to continued future collaboration.

Sincerely,

A handwritten signature in black ink that reads "Ken Schubert".

Ken Schubert  
Geologist  
Sabco Oil & Gas Corporation

1360 Fawcett Blvd., Suite 2300 • Houston, Texas 77055-3350 • 713-840-1990 • 713-840-0122 Fax

777 NORTH ELDRIDGE PARKWAY SUITE 1000  
HOUSTON, TEXAS 77060  
281-577-2300  
FAX 281-677-2900



September 9, 2008

Dr. Ursula Hammes  
PI STARR project  
Bureau of Economic Geology  
The University of Texas at Austin  
University Station, Box X  
Austin, Texas 78713-8924

Re: Acknowledgment of STARR support

Dear Dr. Hammes:

On behalf of St. Mary Land & Exploration Company and the team here in Houston, I would like to thank you and the STARR team for your ongoing support of our project in the Gold River North area, Webb County. Your insight into the regional geology and the detailed understanding of the local conditions continue to help us in our exploitation efforts. We appreciate very much your help in the understanding of the sequence stratigraphy and reservoir potential. Your team's sedimentological interpretations of our seismic data and core description of depositional facies have provided us with encouragement to drill more wells in the future. We are currently drilling and are planning to drill additional wells with encouragement from the STARR team.

My colleagues and I look forward to our continued relationship in Webb County. Thank you again for the support of your team.

Warmest Regards,

A handwritten signature in black ink, appearing to read "D. Purcell".

David K. Purcell  
Chief Geophysicist, Houston  
St. Mary Land & Exploration Company



**TEXAS CRUDE ENERGY, INC.**

(713) 599-9900

• 2801 BUFFALO SPEEDWAY

• HOUSTON, TEXAS 77068

• FAX: (713) 599-9910

MAILING ADDRESS: P.O. BOX 56586

HOUSTON, TEXAS 77256-5586

October 31, 2008

Dr. Ursula Hermann  
Bureau of Economic Geology  
University Station  
Box X  
Austin, TX 78713-8824

Dear Ursula:

On behalf of Texas Crude Energy we wanted to thank you and the STARR team for your interaction with our staff during the past 2 years. We were successful in discovering a new field by completing a well in the Austin chalk of the Suqarkane Cretaceous gas field in Live Oak and Karnes counties and anticipate to drill several more wells in the near future. Your regional knowledge and insight into different plays in Texas has led to valuable discussions and opportunities. Texas Crude thanks the BEG and STARR for their support and contributions to our oil and gas exploration efforts and we look forward to future collaboration.

Sincerely,



Douglas E. O'Brien  
VP Exploration  
Texas Crude Energy Inc.  
Office 713 5999900  
Fax 713 5999910

To: Dr. Ursula Hammes  
Bureau of Economic Geology  
10100 Burnet Rd., Bldg. 130  
Austin, TX 78758

Dear Dr. Hammes:

We at Kindee Oil and Gas wanted to acknowledge the contribution that you and the STARR team made to our project in the Laguna Madre area last year. We appreciate your insight into the regional geology as well as your evaluation of rock and well-log data of one of our wells. We appreciated the regional overview and concepts you provided that helped us better understand our prospects. Your sequence stratigraphic model and diagenetic evaluations will influence any further drilling.

Yours truly,

Jeff Copley  
V.P. Operations  
Kindee Oil & Gas Texas, LLC  
Houston, Texas  
713-334-0986 (office)  
832-457-4056 (cell)

## APPENDIX B

### Project STARR Awards

Project STARR has been honored to receive several excellence in geoscience awards:

- Ambrose, Bill: Past President's Award, Energy Minerals Division of the American Association of Petroleum Geologists, 2008.
- Gale, J. F. W., Holder, J., and Reed, R. M., President's Certificate for Excellence, Energy Minerals Division, American Association of Petroleum Geologists, for poster titled "Natural Fractures in the Barnett Shale: Why They Are Important," AAPG Annual Meeting, 2007.
- Hammes, Ursula, Zeng, Hongliu, Loucks, Robert, and Brown, Frank, 2007, Second Place, Thomas A. Philpott Excellence of Presentation Award at the GCAGS/GCSSEPM Convention in Corpus Christi for paper titled "All Fill—No Spill: Slope-Fan Sand Bodies in Growth-Faulted Subbasins: Oligocene Frio Formation, South Texas Gulf Coast."
- Loucks, R. G., and Ruppel, S. C., 2008, Energy Mineral Division's President's Certificate for Excellence in Presentation, AAPG Annual Convention for paper titled "Shell and Grain Layers in the Barnett Shale: Event Deposition or in-situ Accumulations?"
- Loucks, R. G., and Ruppel, S. C., 2006, A. I. Levorsen Memorial Award, Southwest Section, American Association of Petroleum Geologists, for paper titled "Sedimentology and Depositional Setting of the Mississippian Barnett Shale, Wise County, Texas."
- Reed, R., and Loucks, R. G., 2007, Energy Mineral Division's Best Poster Award, Annual Meeting of the American Association of Petroleum Geologists, for paper titled "Imaging Nanoscale Pores in the Mississippian Barnett Shale of the Northern Fort Worth Basin."
- Zeng, Hongliu, and Loucks, R. G., 2007, Honorable Mention, Best Poster Paper Presented at the SEG 2007 Annual Meeting, for paper titled "Linear Amplitude Patterns in Corpus Christi Bay Frio Subbasin, South Texas."
- Zeng, Hongliu, Loucks, R. G., and Brown, L. F., Jr., 2007, Gordon Atwater Best Poster Award, GCAGS/GCSSEPM Convention in Corpus Christi for paper titled "Seismic Sedimentological Expression of Higher-Order Lowstand Slope Fans and Prograding Deltas in the Frio Formation, Corpus Christi Bay, Texas."



## APPENDIX C

One of the major goals of Project STARR is to disseminate results and new concepts developed by the program. During the last reporting biennium (2006-2008), the following articles, abstracts, and lectures were produced.

### Articles

- Ambrose, W. A., Hentz, T. F., Wang, F. P., Bonnaffé, Loucks, R. G., and Potter, E. C., 2007, Core Workshop: Woodbine Group, East Texas Field, in Ambrose, W. A., and others, Pilot Study of East Texas Field: Geology, Engineering, and Potential Exploitation Workshop: The University of Texas at Austin, Bureau of Economic Geology, State of Texas Advanced Resource Recovery and Petroleum Technology Transfer Council Workshop No. SW0017, 21 p.
- Ambrose, W. A., Potter, E. C., and Briceno, Romulo, 2008, An "unconventional" future for natural gas in the United States: *Geotimes*, v. 53, no. 2, p. 37-41.
- Barton, Mark, and Dutton, Shirley, 2007, A sand-rich, basin-floor turbidite system, Willow Mountain, Texas, USA, in *American Association of Petroleum Geologists Studies in Geology* 56, p. 418-421 [folio-size pages].
- Brown, L. F., Jr. and Loucks, R. G., 2007, Chronostratigraphic ("Wheeler") chart of the Texas Gulf Coast Tertiary system: *GCAGS Transactions*, v. 57, p. 75
- Brown, L. F., Jr., Loucks, R. G., Treviño, R. H., and Hammes, Ursula, 2006, Understanding growth-faulted, intraslope subbasins by applying sequence-stratigraphic principles: examples from the south Texas Oligocene Frio Formation: Reply: *AAPG Bulletin*, v. 90, no. 5, p. 799-805.
- Day-Stirrat, R. J., Loucks, R. G., Milliken, K. L., Hillier, S., and van der Pluijm, B. A., 2008, Phyllosilicate orientation demonstrates early timing of compactional stabilization in calcite-cemented concretions in the Barnett Shale (Late Mississippian), Fort Worth Basin, Texas (U.S.A.): *Sedimentary Geology*, v. 28, no. 1-2, p. 27-35.
- Dutton, S. P., 2008, Calcite cement in Permian deep-water sandstones, Delaware Basin, west Texas: origin, distribution, and effect on reservoir properties: *AAPG Bulletin*, v. 92, no. 6, p. 765-787.
- Gale, J. F. W., and Gomez, L. A., 2007, Late opening-mode fractures in karst-brecciated dolostones of the Lower Ordovician Ellenburger Group, West Texas: recognition, characterization, and implications for fluid flow: *AAPG Bulletin*, v. 91, p. 1005-1023.
- Gale, J. F. W., and Holder, J., 2008, Natural fractures in shales: effects on hydraulic fracture propagation in shale gas reservoirs, in *American Rock Mechanics Association Annual Meeting Proceedings CD*, Paper No. ARMA 08-96.
- Gale, J. F. W., Reed, R. M., and Holder, Jon, 2007, Natural fractures in the Barnett Shale and their importance for hydraulic fracture treatments: *AAPG Bulletin*, v. 91, no. 4, p. 603-622.
- Hammes, Ursula, Loucks, R. G., Brown, L. F., Jr., Treviño, R. H., Montoya, Patricia, and Remington, R. L., 2007, Reservoir geology, structural architecture, and sequence stratigraphy of a growth-faulted subbasin: Oligocene Lower Frio Formation, Red Fish Bay Area, South Texas Gulf Coast: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 272, 28 p. + plate.
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## Hongliu Zeng

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## Workshops

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- Ambrose, W. A., Hentz, T. F., Wang, F. P., Bonnaffé, F., Loucks, R. G., and Potter, E. C., 2007, Pilot Study of East Texas Field: Geology, Engineering, and Potential Exploitation Workshop: a core workshop prepared for STARR and the Petroleum Technology Transfer Council, Kilgore, Texas.

## Lectures

### William A. Ambrose

- Core descriptions of productive Woodbine Group sandstones in AA Wells field, Polk Co., Texas: Implications for regional Woodbine depositional trends in East Texas (with Tucker F. Hentz): presented to Vision Resources, Austin, Texas, August 20, 2008.
- Sequence stratigraphy and reservoir architecture of the Woodbine Group, East Texas field: presented to Vision Resources, Austin, Texas, August 20, 2008.
- Update on progress of Cleveland Formation project: Integration of core description and sequence-stratigraphic correlations (with Tucker F. Hentz): presented to Jones Energy, Austin, Texas, July 31, 2008.
- Sequence stratigraphic controls on complex reservoir architecture in fluvial-dominated deltaic and lowstand valley-fill deposits in the Woodbine Group, East Texas field: presented to Jones Energy, Inc., Austin, Texas, April 3, 2008

### L. Frank Brown, Jr.

- Sequence stratigraphy of Upper Pennsylvanian and Lower Permian, Eastern Shelf of Midland Basin: presented to the North Texas Geological Society, 2007.
- Sequence stratigraphy of Upper Pennsylvanian and Lower Permian, Eastern Shelf of Midland Basin: presented to the West Texas Geological Society, 2006.

### Julia F. W. Gale

- Natural fractures in the Barnett Shale: presented to Society of Petrophysicists and Well Log Analysts, Austin, Texas, June 3, 2007.
- Natural fractures in the Barnett Shale: presented at STARR/Petroleum Technology Transfer Council Seminar, Houston, Texas, November 14, 2006.
- Natural fractures in the Barnett Shale: presented at STARR/ Petroleum Technology Transfer Council Seminar, Midland, Texas, November 8, 2006.
- Rocky Mountain Association of Geologists and Petroleum Technology Transfer Council Shale Gas Core Workshop: presented to U.S. Geological Survey, Lakewood, Colorado, September 26, 2006.

### Ursula Hammes

- All fill—no spill: slope-fan sand bodies in growth-faulted subbasins, Frio Formation, South Texas Gulf Coast: presented to the Louisiana Geological Survey, February 2008.
- All fill—no spill: slope-fan sand bodies in growth-faulted subbasins, Frio Formation, South Texas Gulf Coast: presented to the Houston Geological Society North Side luncheon talk, November 2007.
- Exploring deep Frio systems tracts in growth-faulted subbasins along the South Texas Gulf Coast: exploration, exploitation, and production challenges: presented to the San Antonio Geological Society, San Antonio, Texas, 2007.
- All fill—no spill: slope-fan sand bodies in growth-faulted subbasins, Frio Formation, South Texas Gulf Coast: presented to the San Antonio Geophysical Society, February 2007.
- Presentations to various industry partners (Gulf Energy, Brigham, St. Mary's Land and Exploration, Cinco Natural Resources, Branta Resources, Neumin Production Co., and MPG Petroleum).



## Tucker F. Hentz

- Core descriptions of productive Woodbine Group sandstones in AA Wells field, Polk Co., Texas: Implications for regional Woodbine depositional trends in East Texas (with William A. Ambrose): presented to Vision Resources, Austin, Texas, August 20, 2008.
- Recommendations for waterflood design based on detailed depositional-facies mapping in the South Kilgore Unit, East Texas field: presented to Danmark Energy, Austin, Texas, August 8, 2008.
- Update on progress of Cleveland Formation project: Integration of core description and sequence-stratigraphic correlations (with William Ambrose): presented to Jones Energy, Austin, Texas, July 31, 2008.
- Overview of Cleveland Formation chronostratigraphy and tight gas sandstone trends: presented to Jones Energy, Austin, Texas, April 4, 2008.
- Results and recommendations of Moncrief Survey study, East Texas field: Well deepening for additional recovery: presented to Danmark Energy, Austin, Texas, March 5, 2008.
- New interpretations of reservoir architecture in East Texas field: Sequence stratigraphic and depositional perspectives: presented to Bureau of Economic Geology Colloquium, Austin, Texas, November 30, 2007.
- Introduction to sequence stratigraphy, with application to the East Texas field: presented to the Petroleum Technology Transfer Council, Texas/Southern New Mexico Region workshop "Pilot Study of the East Texas Field: Geology, Engineering, and Potential Exploitation," Kilgore, Texas, October 30, 2007.
- Woodbine stratigraphy and depositional systems: Northern pilot area, East Texas field: presented to the Petroleum Technology Transfer Council, Texas/Southern New Mexico Region workshop "Pilot Study of the East Texas Field: Geology, Engineering, and Potential Exploitation," Kilgore, Texas, October 30, 2007.
- Sequence stratigraphy of the Woodbine Group of the East Texas field: presented at the East Texas Engineers Association annual meeting, Kilgore, Texas, October 10, 2007.

## Robert G. Loucks

- Barnett, Woodford, and related mudrock successions in Texas cores and outcrops: a core workshop prepared for the 2008 American Association of Petroleum Geologists/SEPM (Society for Sedimentary Geology) Annual Convention. Austin/Hill Country April 19-20, 2008.
- Natural fractures in the Barnett Shale: presented at STARR/Petroleum Technology Transfer Council, Seminar, Midland, Texas, November 8, 2006.
- Rocky Mountain Association of Geologists and Petroleum Technology Transfer Council Shale Gas Core Workshop: presented to U.S. Geological Survey, Lakewood, Colorado, September 26, 2006.
- Natural fractures in the Barnett: presented at Rocky Mountain Association of Geologists and Petroleum Technology Transfer Council, 2006 Fall Symposium: Shale gas: from grass roots exploration to production, Denver, Colorado, September 25, 2006.

## Ramón H. Treviño

- Sequence stratigraphy of the South Texas Oligocene: understanding the relationship between shale tectonism and lowstand deposition: presented at the North American Prospect Expo E&P Forum, Houston, Texas, August 22, 2007.



Tools of a petroleum geologist: presented to Austin Area Science Fair Earth Science Experiment students and parents at STARR work area, Austin, Texas, March 6, 2006.

### Fred P. Wang

Wang, Fred, 2008, Production fairway-speed rails in gas shales: presented to the 7th Annual Gas Shale Summit, Dallas, Texas, May 7, 2008.

### Hongliu Zeng

Zeng, Hongliu, 2008, How thin is a thin bed? An alternative perspective: presented to Shell, Houston, Texas, May 19, 2008.

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## Field Trips

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Ruppel, S. C., Gale, J. F. W., Loucks, R. G., and Wright, W. R., 2007, Stop 3: Chappel type section and quarry, San Saba, TX: Mississippian Barnett Fm. mudrocks: stratigraphy, facies, mineralogy, and chemistry: field trip for the Annual Meeting of the Permian Basin Geological Synthesis Program: The University of Texas at Austin, Bureau of Economic Geology.

Ruppel, Stephen, Wright, Wayne, Loucks, Robert, and Gale, Julia, 2007, Outcrop analogs for Paleozoic reservoir systems: examples from the Texas Hill Country: field trip for the Annual Meeting of the Permian Basin Geological Synthesis Program: The University of Texas at Austin, Bureau of Economic Geology.

Treviño R. H., GeoForce SW Young Geoscientist 11th Grade Field Trip: Jackson School of Geosciences Diversity Program, Austin, Texas, June 2007.

Treviño R. H., GeoForce 10th Grade Academy Field Trip in the Southwestern United States: Jackson School of Geosciences Diversity Program, Nevada, Utah, Arizona, June 2007.

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## APPENDIX D

### Past Publications of Project STARR

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## Past Project STARR Workshops and Presentations

Understanding growth-faulted, intraslope subbasins and associated reservoir targets by applying sequence stratigraphic principles: examples from the South Texas Oligocene Frio Formation: presented by Frank Brown at the Houston Geological Society North American Explorations dinner meeting, Houston, Texas, September 27, 2004.

Barnett Shale fracture overview: presented by Julia Gale at Permian Basin Geological Synthesis Project Annual Meeting, Austin, Texas, February 27, 2006.

Gas Reservoir Compartmentalization in Lowstand Prograding-Wedge Deltaic Systems: Oligocene Upper Lower Frio Formation, South Texas: presented by Ursula Hammes at Baylor University, Department of Geological Sciences seminar series, February 18, 2005.

Sequence architecture and structural setting of a growth-faulted subbasin, Frio Formation, South Texas: presented at BEG Friday seminar series 2005, Austin, Texas.

Understanding growth-faulted, intraslope subbasins and associated reservoir targets by applying sequence stratigraphic principles: examples from the South Texas Oligocene Frio Formation: presented by Ursula Hammes at the Houston Geological Society North American Explorations dinner meeting, Houston, Texas, September 27, 2004.

Project STARR: presented by Bob Loucks to the Texas Budget Board, Austin, Texas, August 9, 2006.

Depositional setting, lithofacies, and pore networks of the Mississippian Deepwater Barnett Shale facies in the Fort Worth Basin: presented at Southwest Section AAPG Annual Meeting, Midland, Texas, May 22, 2006.

Understanding the origin and sequence stratigraphy of growth-faulted, intraslope subbasins: examples from the South Texas Oligocene Frio Formation: invited talk presented by Bob Loucks at the Texas A&M ConocoPhillips Lecture Series, College Station, Texas, October 6, 2005.

Revisiting the importance of secondary dissolution pores in Tertiary sandstones along the Texas Gulf Coast: invited talk presented by Bob Loucks to Corpus Christi Geological Society & Coastal Bend Geophysical Society, Corpus Christi, Texas, October 19, 2005.

Three-dimensional architecture of a coalesced, collapsed paleocave system in the lower Ordovician Ellenburger Group, Central Texas: luncheon talk presented by Bob Loucks to Dallas Geological Society, Dallas, Texas, January 11, 2005.

Regional controls on reservoir quality in shallow buried lower Tertiary sandstones along the Texas Gulf Coast: presented by Bob Loucks to Pioneer Oil Company, Dallas, Texas, October 19, 2004.

Approaches to reservoir quality prediction: presented by Bob Loucks to Veritas DGS, Houston, Texas, October 29, 2004.

A multiple origin approach to understanding the development of breccias and fractures in Ordovician carbonate reservoirs: presented by Bob Loucks at South Texas Geological Society meeting, San Antonio, Texas, October 7, 2004.

Regional controls on reservoir quality in shallow buried lower Tertiary sandstones along the Texas Gulf Coast: presented by Bob Loucks to Veritas DGS, Houston, Texas, October 29, 2004.

Understanding growth-faulted, intraslope subbasins and associated reservoir targets by applying sequence stratigraphic principles: examples from the South Texas Oligocene Frio Formation: presented by Bob Loucks to the Department of Geological Sciences, The University of Texas at Austin, Austin, Texas, October 18, 2004.

Project STARR: presented by Bob Loucks to the San Antonio SIPES Chapter, San Antonio, Texas, September 17, 2004.

Project STARR: presented by Bob Loucks at the Houston Geological Society North American Explorations dinner meeting, Houston, Texas, September 27, 2004.

Understanding growth-faulted, intraslope subbasins and associated reservoir targets by applying sequence stratigraphic principles: examples from the South Texas Oligocene Frio Formation: presented by Bob Loucks at the Houston Geological Society North American Explorations dinner meeting, Houston, Texas, September 27, 2004.

Regional controls on reservoir quality in shallow-buried, lower Tertiary sandstones along the Texas Gulf Coast: presented by Bob Loucks at Brigham Oil and Gas Luncheon Seminar, Austin, Texas, September 2004.

Paleocollapse megastructures (suprastratal deformation) related to Lower Ordovician Ellenburger coalesced, collapsed-paleocave systems in the northern Fort Worth Basin, Texas: presented by Angela McDonnell to ExxonMobil, Houston, June 12, 2005

Sequence stratigraphy of the South Texas Oligocene: the relationship between shale tectonism and lowstand deposition: presented by Ramón Treviño to Austin SIPES, Austin, Texas, April 20, 2005.

Sequence stratigraphy of the South Texas Oligocene: understanding the relationship between shale tectonism and lowstand deposition: presented by Ramón Treviño to Corpus Christi Geological Society, Corpus Christi, Texas, December 15, 2004.

Understanding growth-faulted, intraslope subbasins and associated reservoir targets by applying sequence stratigraphic principles: examples from the South Texas Oligocene Frio Formation: presented by Ramón Treviño at the Houston Geological Society North American Explorations dinner meeting, Houston, Texas, September 27, 2004.

Incised valleys from seismic geomorphology and stratal slicing, a Gulf Coast example: presented by Hongliu Zeng to the Austin chapter of SIPES (Society of Independent Professional Earth Scientists), Austin, Texas, January 9, 2005.

Mapping sandstone distribution in high-frequency sequences using seismic sedimentology in Corpus Christi Bay, Texas: presented by Hongliu Zeng at BEG seminar, Austin, Texas, September 30, 2005.

Mapping sandstone distribution in fourth- and fifth-order sequences using seismic sedimentology in Corpus Christi Bay, Texas—an exploration tool: presented by Hongliu Zeng at DOGS soft rock seminar, Austin, Texas, October 3, 2005.



Seismic sedimentology for high-resolution reservoir imaging: presented by Hongliu Zeng to Schlumberger/WesternGeco, Houston, Texas, November 9, 2005.

Understanding the origin and sequence stratigraphy of growth-faulted, intraslope subbasins: examples from the South Texas Oligocene Frio Formation: presented by Robert Loucks and Frank Brown to San Antonio SIPES Chapter, San Antonio, Texas, September 17, 2004.

Reservoir Characterization of the Red Fish Bay Field in the Corpus Christi Area, Oligocene Frio Formation: presented by Ursula Hammes to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

Overview of the Block 889 Area, Offshore Mustang Island, Texas: presented by Ramón Treviño to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

Origins of growth-faulted subbasins in South Texas and sequence stratigraphic analysis of the associated sediment fill: presented by Bob Loucks to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

STARR Program: presented by Bob Loucks to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

Origins of growth-faulted subbasins in South Texas and associated hydrocarbon reservoirs: presented by STARR Group to Cabot Oil Co. Houston, TX, 2003.

Origins of growth-faulted subbasins in South Texas and sequence stratigraphic analysis of the associated sediment fill: presented by Bob Loucks at the University of Oklahoma's Shell Oil Company Invited Colloquium series, Norman, OK, 2003.

Sequence stratigraphy of growth-faulted subbasin in the Frio Formation along south Texas Gulf Coast: presented by Frank Brown to the Bureau of Economic Geology Research Seminars, 2003.

STARR Program: presented by Ramón Treviño and Ursula Hammes to the General Land Office 2003 Summer Lease Sale, 2003.

Identifying fault compartmentalization in the middle Frio sandstones, Redfish Bay, South Texas: presented by Randy Remington to the Bureau of Economic Geology Research Seminars, 2002.

Project STARR – The State of Texas Advanced Resource Recovery Program: presented by Robert Loucks at the Texas Alliance of Energy Producers Annual Convention, Wichita Falls, Texas, April 2002.

Project STARR – The State of Texas Advanced Resource Recovery Program: presented by Robert Loucks at the Desk and Derrick Club Annual Convention, Austin, Texas, April 2002.

Reservoir characterization and advanced resource recovery technology on Texas State Lands: poster session presented at the Gulf Coast Association of Geological Societies Annual Convention, Corpus Christi, Texas, October 1998.

STARR – The State of Texas Advanced Resource Recovery Program: presented by Roger Tyler at the Society of Independent Professional Earth Scientists (SIPES) Convention, July 23, 1998, Durango, Colorado.

State of Texas Advanced Resource Recovery Project (STARR): presented by Roger Tyler at the Railroad Commission of Texas, Regional Technology Transfer Conference, Midland, Texas, May 13, 1998.

Integrated strategies for carbonate reservoir reserve growth: an example from the Ellenburger Group, Permian Basin, West Texas: presented by R. P. Major, G. B. Asquith, B. A. Cain, B. A. Hardage, D. E. Lancaster, and H. Zeng: sponsored by the West Texas Geological Society, Midland, Texas, April 23, 1998, and Houston Geological Society, Houston, Texas, June 25, 1998.

Reservoir characterization of Keystone East Holt field; modeling restricted platform carbonate: presented by Mark Holtz at the Bureau of Economic Geology Seminar, April 22, 1998.

Slope and basin-floor depositional systems, Ozona Sandstone, Val Verde Basin, Southwest Texas: presented by Scott Hamlin at the Bureau of Economic Geology Seminar, April 15, 1998.

State of Texas Advanced Resource Recovery Project (STARR): presented by Roger Tyler at the Railroad Commission of Texas, Regional Technology Transfer Conference, Houston, Texas, April 8, 1998.

Reservoir characterization of Keystone East Holt field: presented by Mark Holtz at the Southwest Section of the American Association of Petroleum Geologists, March 31, 1998, Wichita Falls, Texas.

Reservoir characterization of a deep-water channel-levee and lobe system, Bell Canyon Formation, Ford Geraldine Unit, West Texas (Delaware Basin): core display presented by S. P. Dutton on February 26, 1998, at the Permian Basin Section SEPM core workshop on DOE-Sponsored Studies of Permian Producing Fields, Midland, Texas.

Incorporation of core data into reservoir characterization of a deep-water channel-levee and lobe deposit, Ford Geraldine Unit, Delaware Basin: core display presented by S. P. Dutton at the Sixth Archie Conference on Improving Reservoir Productivity Using Static and Dynamic Delineation Methods, February 10, 1998, Kerrville, Texas.

Petrophysics of the Ramsey Sandstone, Ford Geraldine Unit, Reeves and Culberson Counties, Texas: presented by G. B. Asquith at the Permian Basin Well Log Society, January 15, 1998, Midland, Texas.

The Reservoir Characterization Ford Geraldine Unit: Permian Bell Canyon Formation, West Texas workshop was held on November 21, 1997, in Carlsbad, New Mexico. The workshop was followed by a two-day field trip titled "Facies Architecture of Submarine Channel-Levee and Lobe Sandstones: Permian Bell Canyon Formation, Delaware Mountains, West Texas." The U.S. Department of Energy, the State of Texas Advanced Resource Recovery Project, and the Petroleum Technology Transfer Council jointly sponsored the workshop and field trip.

Reservoir characterization of a deep-water channel-levee and lobe system, Bell Canyon Formation, Ford Geraldine Unit, West Texas (Delaware Basin): presented by S. P. Dutton to Texas Tech University, Geoscience Colloquium, November 14, 1997, Lubbock, Texas.

State of Texas Advanced Oil and Gas Recovery Program—Project STARR: presented by Roger Tyler at the Society of Independent Professional Earth Scientists, November 13, 1997, Austin, Texas.

Petrophysics of the Ramsey Sandstone, Ford Geraldine Unit, Reeves and Culberson Counties, Texas: presented by G. B. Asquith on November 12, 1997, at the Amarillo chapter of the Society of Professional Well Log Analysts, December 2, 1997, at The University of Texas at El Paso, and December 3, 1997, at New Mexico State University at Las Cruces.



Reservoir characterization of channel-levee and lobe deposits Bell Canyon Formation, Geraldine Ford field, West Texas (Delaware Basin): presented by S. P. Dutton at the Bureau of Economic Geology Seminar, November 12, 1997.

Reservoir characterization of Keystone East field, STARR Project: presented by Mark Holtz at the West Texas Geological Society Fall Symposium, October 31, 1997, Midland, Texas.

Methodology of 3-D computer modeling in restricted platform carbonate reservoirs, example from Keystone East Holt field: presented by Mark Holtz at the West Texas Society of Petroleum Engineers meeting, October 2, 1997, Midland, Texas.

Reservoir Characterization of Permian Deep-Water Sandstones, Bell Canyon Formation, Geraldine Ford Area, West Texas (Delaware Basin) was held in Midland in March 1997. This workshop was co-hosted by the West Texas Geological Society. It was attended by approximately 90 people, who received a set of workshop notes.

Identifying Reserve Growth Potential through Integrated Geologic and Engineering Reservoir Characterization was held at the 1996 Annual Convention of the Gulf Coast Association of Geological Societies (GCAGS) on October 2-4, 1996, in San Antonio, Texas. The short course provided an examination of subsurface reservoir analogs to the State Lands Gulf Coast and West Texas oil and gas reservoirs.

Canyon sandstones—a geologically complex natural gas play in slope and basin facies, Val Verde Basin, Southwest Texas: presented by Scott Hamlin to the South Texas Geological Society, San Antonio, Texas, March 1996.