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The Class Act

DOE's Reservoir Class Program Newsletter

Advanced Reservoir Characterization to Maximize Recovery in Slope and Basin Clastic Reservoirs, West Texas (Delaware Basin)

Shirley P. Dutton, Bureau of Economic Geology, The University of Texas at Austin, and William A. Flanders, Transpetco Engineering

"The goal of the project was to demonstrate that reservoir characterization and EOR by CO_2 flooding can increase production from Delaware Mountain Group reservoirs."

Reservoirs in slope and basin clastic sandstones of the Delaware Mountain Group in the Delaware Basin of West Texas and New Mexico contained more than 1.8 billion barrels (Bbbl) of oil at discovery. Recovery efficiencies of these reservoirs have averaged less than 20 percent since production began in the 1920's, and, therefore, a substantial amount of the original oil in place remains unproduced. Many of these mature fields are nearing the end of primary or secondary production and are in danger of abandonment unless effective, economic methods of enhanced oil recovery (EOR) can be implemented.

This project funded by DOE's Reservoir Class Program was conducted by the Bureau of Economic Geology, The University of Texas at Austin, and Orla Petco, Inc. This recently completed Class III project focused on East Ford field in Reeves County, Texas (**Figure 1**).

Reservoir Characterization

East Ford field produces from the Ramsey Sandstone (upper Bell Canyon Formation) in the Permian Delaware Mountain Group. The reservoir characterization phase of the project utilized outcrop characterization, high-resolution sequence stratigraphy, subsurface field studies, and 3-D seismic data (Dutton and Flanders, 2001). Ramsey sandstones at East Ford field are interpreted as having been deposited by sandy high- and low-density turbidity currents that carried a narrow range of sediment size, mostly very fine sand to coarse silt. The sands were deposited in a basin-floor setting by a system of leveed channels having attached lobes and overbank splays. Individual channel-levee and lobe complexes stack in a compensatory fashion and are separated by laterally continuous, laminated siltstones.

What's Inside

Demonstration

The demonstration phase of the project was a CO_2 flood conducted in the East Ford unit. Primary recovery efficiency at East Ford was less than 15 percent as a result of serious producibility problems, particularly high water production without a water drive. The unit did not undergo secondary recovery by waterflooding because waterflooding has not been very successful in other Ramsey sandstone reservoirs (Dutton and Flanders, 2001). Orla Petco began the CO_2 flood in the Ramsey sandstone in July 1995, and the response phase was reached in December 1997. As a result of the flood, production from the East Ford unit has increased from 30 bbl/d at the end of primary production to more than 185 bbl/d in 2001 (**Figure 2**). The unit had produced 180,097 bbl of oil from the start of tertiary recovery through May 2001, and essentially all production can be attributed to the EOR project.

Analysis of the results of the flood suggests that geologic heterogeneities affect reservoir displacement operations. CO_2 injector wells in splay sandstones apparently have poor communication with wells in channel sandstones, perhaps because communication is restricted through levee deposits. Modification of the existing east-west alignment of injectors and producers may overcome the problem of apparently restricted communication between splay sandstones and channel sandstones in the north part of the unit. The south part of the unit is responding well to the existing north-south line of injectors. Recovery is interpreted to be good because the Ramsey sandstones in this area are lobe deposits with better lateral continuity. Recovery might be improved if additional producers were brought on.

Conclusions

The project demonstrated that CO_2 flooding can significantly increase production from deep-water sandstones of the Delaware Mountain Group. Furthermore, the project demonstrated that reservoir characterization provides essential information for designing efficient production strategies (Dutton and Flanders, 2001). Knowledge gained in the study can be applied to more than **350** other Delaware Mountain Group reservoirs in West Texas and New Mexico, that together contain more than **1.5 Bbbl** of remaining oil.

Reference

Dutton, S. P., and Flanders, W. A., 2001, *Application of advanced reservoir characterization, simulation, and production optimization strategies to maximize recovery in slope and basin clastic reservoirs, West Texas (Delaware Basin)*: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for U.S. Department of Energy, DOE/BC/14936-18, 170 p. TCA

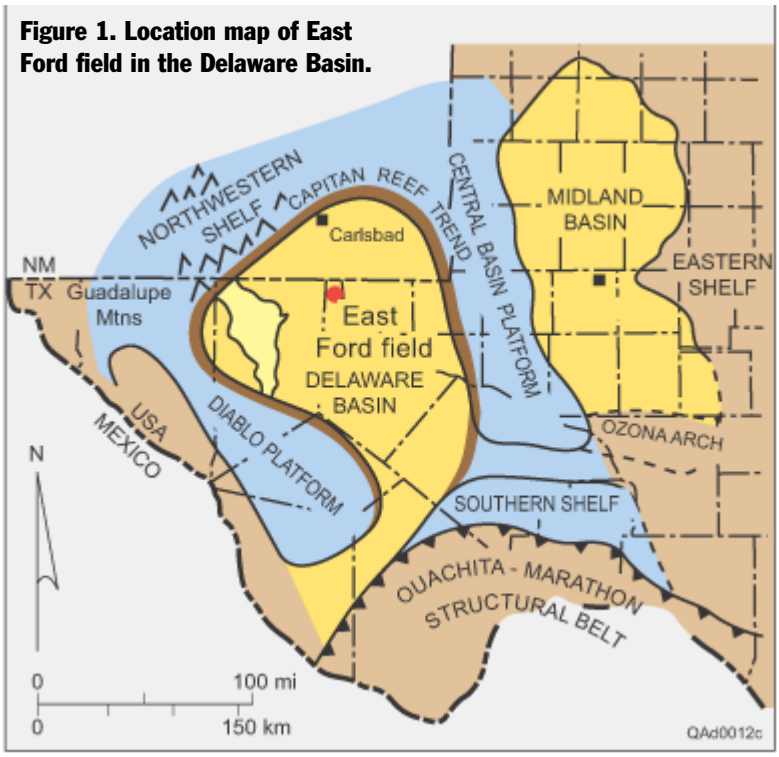

Figure 1. Location map of East Ford field in the Delaware Basin.

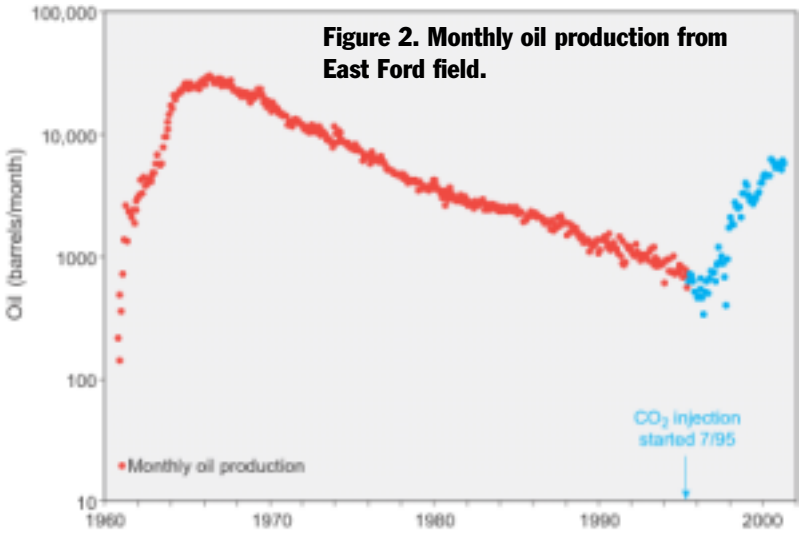

Figure 2. Monthly oil production from East Ford field.

Carbonate Buildups in the Paradox Basin, Targeted for Horizontal Drilling

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Introduction

The Paradox Basin of Utah, Colorado, Arizona, and New Mexico contains nearly 100 small oil fields producing from carbonate buildups within the Pennsylvanian (Desmoinesian) Paradox Formation. These fields typically have one to 10 wells with primary production ranging from 300,000 to 2,000,000 barrels of oil per field and a 15 to 20% recovery rate. At least **200 million** barrels of oil will not be recovered from these small fields because of inefficient recovery practices and undrained heterogeneous reservoirs. The project's primary objective is to enhance domestic petroleum production by demonstration and transfer of horizontal drilling technology in the Paradox Basin. If this project can demonstrate technical and economic feasibility, then the technique can be applied to approximately 100 additional small fields in the Paradox Basin alone, and result in increased recovery of 25 to 50 million barrels of oil.

The project is funded by the U. S. Department of Energy's Class Revisit program in cooperation with the Utah Geological Survey and the Colorado Geological Survey. DOE's goal is to demonstrate technologies to enhance oil recovery and prevent field abandonment, that can be transferred to independent operators throughout the region or applied in similar depositional settings in other basins.
This project is designed to characterize several shallow-shelf carbonate reservoirs in the Paradox Formation, choose the best candidate(s) for a pilot demonstration project to drill horizontally from existing vertical wells, monitor well performance(s), and report associated validation activities. The project team consists of the Utah Geological Survey (prime contractor), Colorado Geological Survey, Eby Petrography & Consulting Inc., and Seeley Oil Company. The work includes description and analysis of cores, determination of regional facies, correlation of geophysical well logs, reservoir mapping, diagenetic analyses, evaluation of permeability and porosity data, and development of horizontal drilling strategies for two case-study fields, Cherokee and Bug, in San Juan County, Utah. From these evaluations, untested or under-produced reservoir compartments can be identified as targets for horizontal drilling.

Figure 3. Location map of the Paradox Basin, Utah, Colorado, Arizona, and New Mexico showing producing oil and gas fields, the Paradox fold and fault belt, and Blanding sub-basin as well as surrounding Laramide basins and uplifts (modified from Harr, 1996).

Geologic Setting

The Paradox Basin is an elongate, northwest-southeast-trending evaporitic basin (**Figure 3**) that predominately developed during the Pennsylvanian, about 330 to 310 million years ago. The Uncompahgre Highlands in eastern Utah and western Colorado initially formed as the westernmost range of the Ancestral Rockies during this period. The southwestern flank of the Uncompahgre Highlands (uplift) is bounded by a large basement-involved, high-angle reverse fault identified from seismic surveys and exploration drilling. As the highlands rose, an accompanying depression, or foreland basin, formed to the southwest - the Paradox Basin. Rapid subsidence, particularly during the Pennsylvanian and continuing into the Permian, accommodated large volumes of evaporitic and marine sediments that intertongue with non-marine arkosic material shed from the highland area to the northeast (Hintze, 1993). The Paradox Basin is surrounded by other uplifts and

basins that formed during the Late Cretaceous-early Tertiary Laramide orogeny.

The Paradox Basin can generally be divided into two areas: the Paradox fold and fault belt in the north, and the Blanding sub-basin in the south-southwest (**Figure 3**). Most oil production comes from the Blanding sub-basin. The source of the oil is several black, organic-rich shales within the Paradox Formation (Hite and others, 1984; Nuccio and Condon, 1996). The relatively undeformed Blanding sub-basin developed on a shallow-marine shelf that locally contained algal-mound and other carbonate buildups in a subtropical climate.

The two main producing zones of the Paradox Formation are informally named the Ismay and the Desert Creek. The Ismay zone is dominantly limestone comprising equant buildups of phylloid-algal material with locally variable small-scale subfacies (**Figure 4A**) and capped by anhydrite. The Ismay produces oil from fields in the southern Blanding sub-basin. The Desert Creek zone is dominantly dolomite comprising regional nearshore shoreline trends with highly aligned, linear facies tracts (**Figure 4B**). The Desert Creek produces oil in fields in the central Blanding sub-basin. Both the Ismay and Desert Creek buildups generally trend northwest-southeast. Various facies changes and extensive diagenesis have created complex reservoir heterogeneity within these two diverse zones.

Project Benefits and Potential Application

The overall benefit of this multi-year project will enhance domestic petroleum production by demonstrating and transferring an advanced-oil-recovery technology throughout the small oil fields of the Paradox Basin. Specifically, the benefits expected from the project are: (**1**) increasing recovery and reserve base by identifying untapped compartments created by reservoir heterogeneity; (**2**) preventing premature abandonment of numerous small fields; (**3**) increasing deliverability by horizontally drilling along the reservoir's optimal fluid-flow paths; (**4**) identifying reservoir trends for field extension drilling and stimulating exploration in Paradox Basin fairways; (**5**) reducing development costs by more closely delineating minimum field size and other parameters necessary for horizontal drilling; (**6**) allowing for minimal surface disturbance by drilling from existing vertical field wells; (**7**) allowing limited energy investment dollars to be used more productively; and (**8**) increasing royalty income to the federal, state, and local governments, the Ute Mountain Ute Indian Tribe, and fee owners.

These benefits may also apply to other areas including: algal-mound and carbonate buildup reservoirs on the eastern and northwest shelves of the Permian Basin in Texas, Silurian pinnacle and patch reefs of the Michigan and Illinois Basins, and shoaling carbonate island trends of the Williston Basin.

The results of this project are transferred to industry and other researchers through establishment of Technical Advisory and Stake Holders Boards, an industry outreach program, digital project databases, and web page. Project results will be disseminated via technical workshops or seminars, field trips, technical presentations at national and regional professional meetings, and papers in newsletters and various technical or trade journals.

Cherokee and Bug Fields

Cherokee field, discovered in 1987, is a phylloid-algal buildup capped by anhydrite that produces from porous algal limestone and dolomite in the upper Ismay zone. The net reservoir thickness is 27 ft, which extends over a 320-acre area. Porosity averages 12% with 8 millidarcies (md) of permeability in vuggy and intercrystalline pore systems. Water saturation is 38.1% (Crawley-Stewart and Riley, 1993). There are currently four producing (or shut-in) wells and two dry holes in the field. Cumulative production as of June 1, 2001 (the latest available information), was 180,845 BO, 3.61 BCFG, and 2,758 BW (Utah Division of Oil, Gas and Mining, 2001). The original estimated primary recovery is 172,000 BO and 3.28 BCFG (Crawley-Stewart and Riley, 1993).

Bug field, discovered in 1980, is an elongate, northwest-trending carbonate buildup in the lower Desert Creek zone. The producing units vary from porous dolomitized bafflestone to packstone and wackestone. The trapping mechanism is an updip porosity pinchout. The net reservoir thickness is 15 ft over a 2,600-acre area. Porosity averages 11% in moldic, vuggy, and intercrystalline networks. Permeability averages 25 to 30 md, but ranges from less than 1 to 500 md. Water saturation is 32% (Martin, 1983; Oline, 1996). There are currently eight producing (or shut-in) wells, five abandoned producers, and two dry holes in the field. Cumulative production as of June 1, 2001, was 1,615,609 BO, 4.38 BCFG, and 3,163,577 BW (Utah Division of Oil, Gas and Mining, 2001). Estimated primary recovery is 1,600,000 BO and 4 BCFG (Oline, 1996).

The fact that the primary-recovery estimates for both fields have been surpassed suggests additional reserves could remain.

Study Results to Date

The typical vertical sequence or lithofacies from the Cherokee and Bug fields, as determined from conventional core and tied to its corresponding log response, helped identify reservoir and non-reservoir rock (such

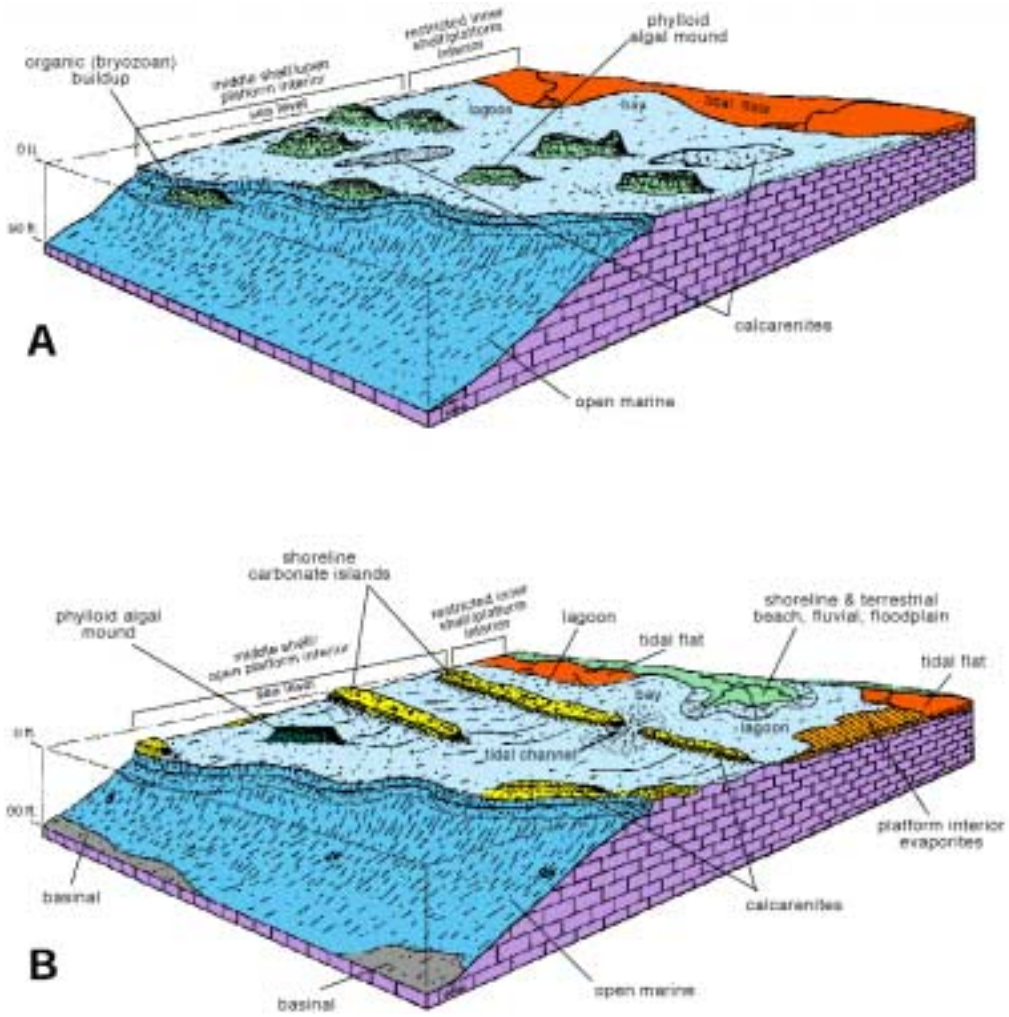

Figure 4. Block diagrams displaying major depositional facies, as determined from core, for the Ismay (A) and Desert Creek (B) zones, Pennsylvanian Paradox Formation, Utah and Colorado.

as false porosity zones on geophysical well logs) and determine potential units suitable for horizontal drilling projects. Structure contour maps on the top of the upper Ismay zone and the Chimney Rock shale and isochore maps of the upper Ismay and lower Desert Creek for Cherokee and Bug fields, respectively, showed carbonate buildup trends, defined limits of field potential, and indicated possible horizontal drilling targets.

The diagenetic fabrics and porosity types found in the various hydrocarbon-bearing rocks of Cherokee and Bug fields are indicators of reservoir flow capacity, storage capacity, and potential for horizontal drilling. The reservoir quality of Cherokee and Bug fields has been affected by multiple generations of dissolution, anhydrite plugging, and various types of cementation which act as barriers or baffles to fluid flow. The most significant and unique diagenetic characteristic observed in thin sections from Cherokee field is intense, late-stage microporosity development along hydrothermal solution fronts. The thin sections from Bug field show extensive, early-stage micro-box-work porosity due to dissolution related to subaerial exposure of the carbonate buildup. Based on cross plots of permeability and porosity data, the reservoir quality of the rocks in Cherokee and Bugs fields is most dependent on pore types and diagenesis. The microporosity in Cherokee field and the micro-box-work porosity in Bug field represent important sites for untapped hydrocarbons and possible targets for horizontal drilling.

Based on these findings, three strategies for horizontal drilling are being developed for Cherokee, Bug, and similar fields in the Paradox Basin (**Figure 5**). All strategies involve drilling stacked, parallel horizontal laterals. Depositional facies are targeted in both the Ismay and Desert Creek zones of Cherokee and Bug fields where, for example, multiple buildups can be penetrated with two opposed sets of stacked, parallel horizontal laterals (**Figure 5A**). The hydrothermally induced microporosity in the Ismay zone of Cherokee field does not appear to be facies dependent and therefore could be drained with radially stacked, horizontal laterals and splays (**Figure 5B**). Finally, much of the elongate, brecciated

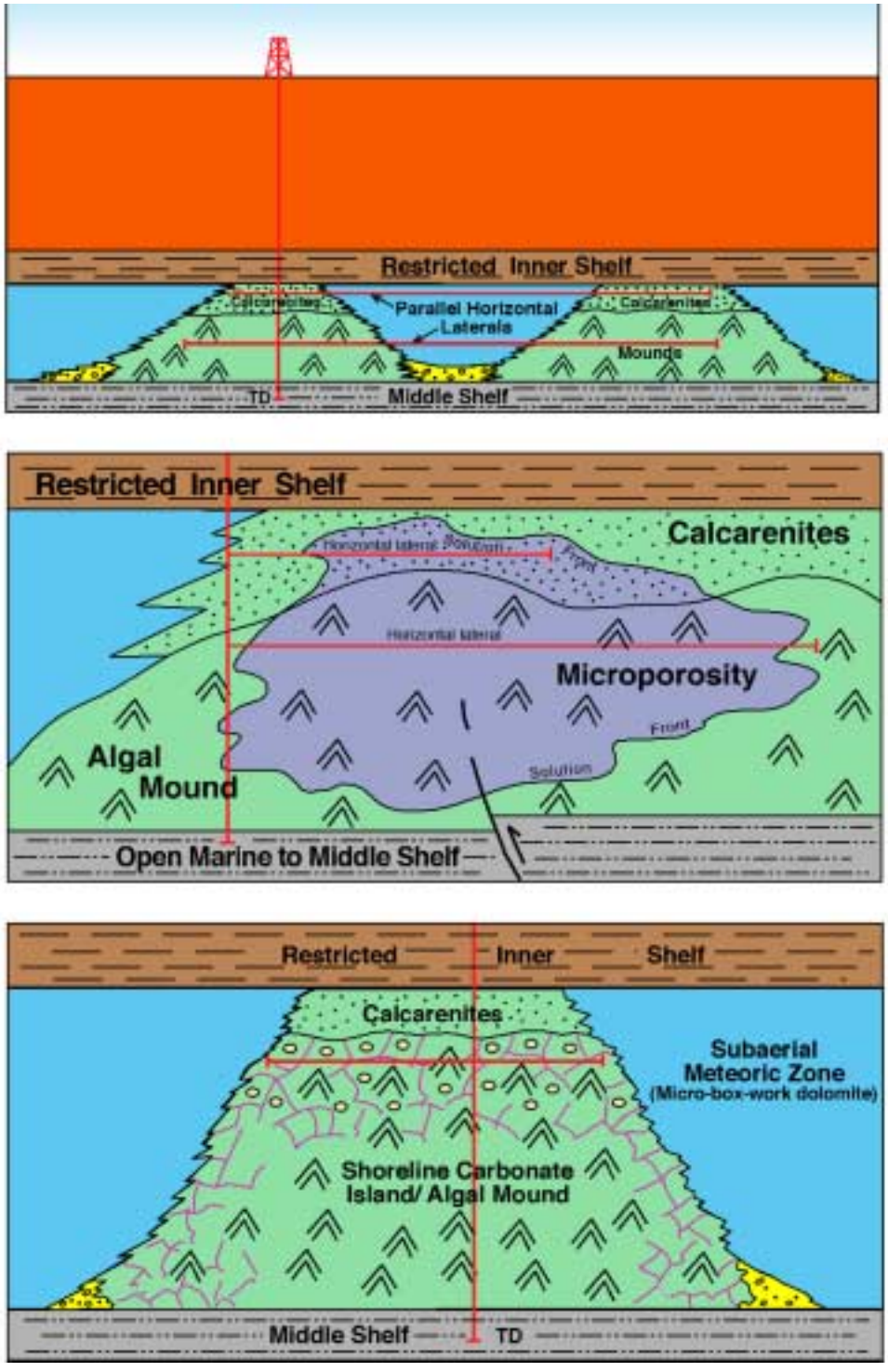

Figure 5. Strategies for horizontal drilling: (A) depositional facies in the Ismay and Desert Creek zones of Cherokee and Bug fields, (B) microporosity in the Ismay zone of Cherokee field, and (C) depositional facies and diagenetic fabrics (micro-box-work porosity) in the Desert Creek zone of Bug field.

beach-mound depositional facies and micro-box-work porosity in the Desert Creek zone of Bug field could be penetrated by opposed sets of stacked, parallel horizontal laterals (**Figure 5C**). However, these strategies are preliminary and will be further refined as additional data are collected and analyzed, and three-dimensional reservoir models are developed for these fields.

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DOE's Near-Term R&D Effort "Field-Oriented Research Projects for Independents"

Walt North, RMC Consultants, Inc.

During the winter of 2001-2002 the U. S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) in co-operation with the Petroleum Technology Transfer Council (PTTC) is conducting a series of one-day informational workshops entitled *"Field-Oriented Research Projects for Independents"*. The workshop series focuses on DOE's field-oriented research program, which targets the needs of U.S. independent oil and gas producers. The purpose of the workshop series is to 1) inform independent producers and other interested parties about future opportunities to work with DOE through various R&D programs, and 2) transfer recent technology research results from a number of DOE-funded, near-term field demonstration projects to independent oil and gas producers and interested parties.

Independents now operate the majority of wells in the domestic U.S., and many of those wells are mature or marginal producers. Marginal wells are defined as gas wells that produce less than 60 mcf/d or oil wells that produce less than 10 bopd. Independents can benefit by learning about new technologies, or new twists with old technologies, that have been demonstrated to be technically and economically feasible. Through NETL, and its Strategic Center for Natural Gas (SCNG) and its National Petroleum Technology Office (NPTO), the U.S. Department of Energy funds several programs focusing on field-oriented research projects for independents. When applied in their proper environment, technologies demonstrated in these projects can positively affect production and profitability, and do so quickly. All those responsible for maximizing production and profitability (geologists, engineers, consultants, operators, etc.) can benefit from learning more about results from these field-oriented projects.

The DOE programs discussed at each workshop include the Technology Development with Independents Program; the Stripper Gas Well Program; the Stripper Well Consortium; the Advanced Drilling, Completion, and Stimulation Program; the Preferred Upstream Management Practices Program; and an upcoming Independents research program to be announced in early 2002. The DOE program discussions include individual program descriptions, applicable technology areas, DOE involvement and/or contribution, and independents participation.

Three major field-oriented DOE programs for independents are:

- Stripper Gas and Oil Well Program—Projects within this program are developing new approaches for identifying under-performing wells, then taking corrective actions. Additional information is available at the **www.netl.doe.gov/scng** web site.

- Technology Development with Independents Program—Projects within this program, all of which were

proposed by small independent oil producers, are demonstrating technologies across a broad range of exploration and production topics. To date, 33 projects have been completed and 10 projects are in progress, summaries of which can be obtained at the **www.npto.doe.gov** web site. Opportunity still exists for independents to participate in future projects.

• Stripper Well Consortium—Guided by an industry governing council, the Stripper Well Consortium funds short-term (one-year) projects proposed by members. Initial projects are halfway through. Interested parties should consider joining the Consortium to participate in future projects funded by DOE. Additional information on the consortium is available at the **www.energy.psu.edu/swc** web site.

Individual projects within these programs have been ongoing for some time, and early results are now available. Each field demonstration project was conducted to demonstrate technologies that either increase production, reduce operating costs, or reduce environmental concerns. Technology advances and project results from six of the most regionally-relevant field demonstration projects are being highlighted at each workshop. Each PTTC Regional Lead Office (RLO) chose projects from the Stripper Gas Well Program and the Technology Development with Independents Program to be presented at their respective regional workshop. The projects were selected to address issues of interest in their regional production operations. The projects include technology areas in lease operations, reservoir simulation, field studies, formation stimulation, seismic interpretation, production monitoring/analysis, and produced water treatment. Overall, the results of thirteen different projects are being presented during the series of eight workshops.

During each of the one-day sessions, speaker presentations by DOE and project performers (the operators) provided the attendees with an overview of the project description and results. Specific project technologies included:

• on-site electrical generation using non-salable lease gas

• marginal expense oil well wireless surveillance system

• reservoir characterization using detailed core-log correlations

• evaluating waterflood success using artificial intelligence

• reservoir modeling using artificial intelligence

• reservoir characterization and modeling of a geologically complex reservoir

• customized acid stimulation treatment

• application of multi-component 9-C VSP seismic technology

• signed-bit 3-D seismic data processing and interpretation

• computer software to monitor stripper gas well production performance

• computer software to identify under-performing stripper gas wells

• selection and treatment of stripper gas wells for production stimulation

• stripper gas well water remediation.

Each speaker presentation is followed by open and interactive question and answer, discussion and comment sessions in which participants and attendees shared their experiences and comments regarding the projects and related issues. Although sometimes lightly attended, the participants and attendees expressed considerable interest in the projects and the DOE programs. Attendees included a wide range of interested parties such as independent producers and operators, engineers, geologists, consultants, investors, land managers, educators and academics, state and federal government personnel, producers association representatives, and others. Each attendee is provided with a workshop notebook (for reference) containing a

brief summary write-up and a printed copy of the Power Point presentation material for each of the projects and programs presented during the series of eight workshops.

One workshop is being conducted at each of eight of the ten PTTC Regions across the country. As of the end of November, six workshops have been conducted and two future workshops are scheduled for early 2002.

Previous workshops:

October 30, 2001, Eastern and Central Gulf Regions, in Jackson, Mississippi

November 1, 2001, Midwest Region, in Evansville, Indiana

November 6, 2001, Texas and Southwest Regions, in Midland, Texas

November 8, 2001, Appalachian Region, in Washington, Pennsylvania

November 27, 2001, Rocky Mountain Region, in Denver, Colorado

November 29, 2001, North Mid-continent Region, in Wichita, Kansas

Future workshops:

February 6, 2002, Texas and Central Gulf Regions, in Tyler, Texas

February 19, 2002, Midwest Region, in Lansing, Michigan.

Log onto the PTTC website at **www.pttc.org** for future workshop locations and agenda details. In addition, insights from several of the projects are summarized in the PTTC national newsletter and on the PTTC website. TCA

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The Department of Energy's National Energy Technology Laboratory's National Petroleum Technology Office is proud to bring you information on field demonstrations that benefit domestic oil producers.

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Contributing to *The Class Act*

If you have a news item or project to feature in an upcoming issue, please contact the editor.

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Watch NPTO Website for new PUMP III Solicitation in early 2002

The Preferred Upstream Management Practices III (PUMP III) Program continues an effort to meet the National Energy Policy (NEP) goals, by encouraging implementation of the most promising and environmentally protective advanced technologies for optimizing the recovery of the Nation's valuable oil resources. The NEP in providing energy for a new century supports efforts to increase oil and gas recovery from existing wells through new technology (NEP, Chapter 5, May 2001). The PUMP III solicitation will open to the public early in 2002.

The PUMP III solicitation is an effort to identify and demonstrate additional solutions to production constraints and bring these into use by the industry. Constraints can be identified as technical, physical., environmental, regulatory or economic.

The program has been increased to provide DOE funding up to $1 million for each project. Projects that involve a field demonstration will require 50% cost share and other projects will require 20% cost share of the total project cost. Projects will not exceed two years in duration so that the results can be transmitted to industry as quickly as possible for implementation.

Proposals under Area 1 will address a technical barrier to production in a region with a demonstrated solution or in Area 2 proposed projects will develop data, systems, or methodologies that enable oil permitting agencies to make decisions more quickly and/or that are based on better scientific information about the environmental risks of a given operation. The compilation of practices that overcome or minimize production constraints will become part of the PUMP Database and used by industry as a publically available source of solutions.

Details on the proposal submission process, deadlines and information on current PUMP program projects can be found on the website **http://www.npto.doe.gov/business/solicit** TCA

Hands-on Workshop for Application Process to Applying Petroleum Technologies on Native American Lands

The Department of Energy, National Petroleum Technology Office is conducting a no cost workshop to demonstrate how to respond to the most recent Native American Solicitation DE-PS26-02NT15379 "Applications of Petroleum Technologies on Native American and Alaskan Native Corporation Properties for the Benefit of the Entire Tribe/Native Corporation". The workshop will be a hands-on demonstration of the new electronic application process - the Industry Interactive Procurement System (IIPS) - required to submit proposals for the solicitation. Attendees will have the opportunity to learn about the solicitation goals and objectives, as well as the step-by-step application process necessary to participate in the program. Computer access to the IIPS will be provided to all attendees. Information on Native American projects previously funded will also be presented.

Solicitation

The U.S. Department of Energy (DOE) supports the development and application of innovative petroleum technologies on Native American and Alaskan Native Corporation lands that increase resource and economic development while protecting the environment. This program is directed toward creating cooperative efforts between the Tribes or Corporations and the oil industry. Details of the solicitation can be found at **http://www.npto.doe.gov**. Projects funded through this program will target:

- Technologies that improve the development and economic value of known oil fields on tribal lands
- Technologies that promote the exploration and identification of undiscovered oil fields on tribal lands
- Technologies that reduce the cost of effective environmental compliance in oil and gas field operations
- Technologies/studies that promote refining capacity on tribal lands

Funding

Approximately $1.2 million of DOE funding is planned for this solicitation. DOE anticipates issuing approximately two to five financial assistance (grant) awards with a project performance period from one to two years in length.

More Information

Details of solicitation DE-PS26-02NT15379 can be found at the following websites:

- **http://www.npto.doe.gov**
- **http://e-center.doe.gov**

Register Today. Space is Limited

To register, please mail, fax, or email the following information by January 18 to:

U.S. Department of Energy
National Energy Technology Laboratory
National Petroleum Technology Office
Attn: Virginia Weyland
One West Third St., Ste. 1400
Tulsa, OK 74103-3519
Fax: 918-699-2005 Attn: Virginia Weyland
Email: **Virginia.Weyland@npto.doe.gov**

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Contact the Stardust directly for accommodations. A limited number of rooms are available at the special workshop rate of $60.00. Ask for the Convention Desk and mention Group Code: **Native**.

Name(s) _____

Title _____

Organization _____

Address _____ **City** _____ **State** _____

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C A L E N D A R

Meetings and Announcements

January 28-30 North American Prospect Expo (NAPE), Houston, TX
www.landman.org

February 6 DOE/PTTC Workshop Series, Texas and Central Gulf Regions, Tyler, TX
www.pttc.org/events

January 28-29 Global Offshore Drilling, Houston, TX
www.marcusevansconferences.com

February 4-6 Engineering Technology Conf. on Energy, Houston, TX
www.asmenews.org

February 6 DOE/PTTC Workshop Series, Texas and Central Gulf Regions, Tyler, TX
www.pttc.org/events

February 19 DOE/PTTC Workshop Series, Midwest Region, Lansing, MI
www.pttc.org/events

February 26-28 Subsea Tieback Forum, Galveston, TX
www.global-energy-events.com

March 10-13 AAPG Annual Meeting, Houston, TX
www.aapg.org

April 13-17 SPE/DOE 13th Symposium on Improved Oil Recovery, Tulsa, OK
www.npto.doe.gov/ior

Visit www.npto.doe.gov/business/solicit for information on future solicitations

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