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The Class Act

DOE's Field Demonstration and Best Practices Newsletter

Re-developing Red River Carbonate Reservoirs Yields Big Success

Mark Sippel, Luff Exploration Company

Significant oil reserves are being re-developed with the aid of software tools for reservoir characterization and horizontal drilling in thin reservoirs in the Red River Formation as illustrated in **Figure 1**. Depleted and marginal wells in old fields in southwestern North Dakota and northwestern South Dakota are being revitalized to oil rates that have exceeded rates from the initial completions some 30 years ago. Production rates from 16 wells average 62 bopd per well over 24 months after re-entry lateral drilling through casing windows. The average oil rate before re-entry drilling was 20 bopd per well. Projection of primary remaining reserves after re-drilling these wells is over 2,000,000 bbl. Additional reserves will be developed as many of the revitalized wells are scheduled to be included in new waterflood projects that will include horizontal injection wells.

Software Development

Luff Exploration Company has developed software tools and a characterization strategy to better assess reservoir limits, producibility and favorable depositional setting. The Intelligent Computing System (ICS) software uses clustering, artificial neural networks and

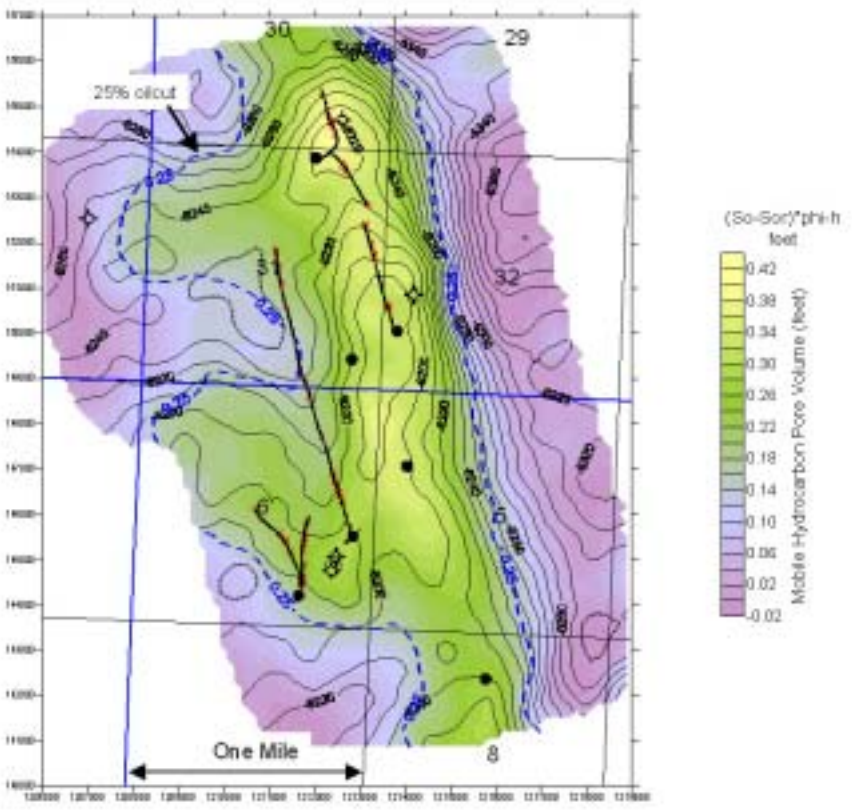

Figure 1. Reservoir transforms at South Amor Field.

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What's Inside

classical regression methods to combine seismic, geologic and engineering data for predictions of reservoir potential. Output can be used to create characterization maps that directly assess oil-in-place and oil production. **Figure 2** shows the control panel for access to the various software routines. The independent nature of the software tools allows the user to develop a charaterization strategy for almost any hydrocarbon reservoir. Output from the software is also used for construction of computer reservoir simulation models. Although the software tool was developed to help integrate seismic, borehole and production data, reservoir charaterizations can be performed with only well data in situations of fields with many wells. Luff Exploration Company is using these tools to quantify reservoir parameters for forming waterflood units, targeting drilling locations and orientation of horizontal drill holes.

Several software tools from ICS are used to transform seismic attributes to reservoir characteristics such as thickness, porosity, permeability, and entrapment pressure. Data from wells within seismic surveys are used as training control to transform seismic attributes to conventional reservoir attributes. Lastly, seismic-transformed reservoir characteristics are combined with well production data from a larger database through a neural network solver to describe oil-water contacts, oilcut and producibility.

Field Trails

The most significant successes have come from exploitation of the Red River B Zone at depths of about 9,000 feet with an average thickness of 7 feet. The Red River B Zone is a thin dolomite reservoir that was deposited in a shallow-

Figure 2. ICS control panel for access to software routines.

shelf setting. A porosity type-log of the Red River B Zone is shown in **Figure 3**. With a thickness of only 4 to 15 feet, change in reservoir development is practically invisible to visual observation of seismic waveform character from field records. However, from evaluation and study of well logs, drill-stem tests and production involving several hundred wells, a good correlation was found for reservoir quality in the B Zone with the thickness of the B Cycle determined from upper and lower bounding anhydrite layers. The thickness of this interval is predicted with good confidence using a neural solver tool to evaluate conventional seismic attributes (amplitude and interval time) and well-log data. **Figure 4** shows the neural-solver prediction and measured B Cycle thickness at well locations from one 3D seismic survey. The figure shows a variation of B Cycle thickness from 43 to 55 feet and prediction with a 50% confidence of +/- one foot. The optimal B Cycle thickness ranges between 44 and 50 feet. Areas that are thinner than 44 feet (approaching a supratidal setting) are likely to have a very thin B Zone porosity interval with anhydrite plugging. Areas that are thicker than 55 feet (approaching a lagoonal setting) will have a thick B Zone porosity interval but poor permeability.

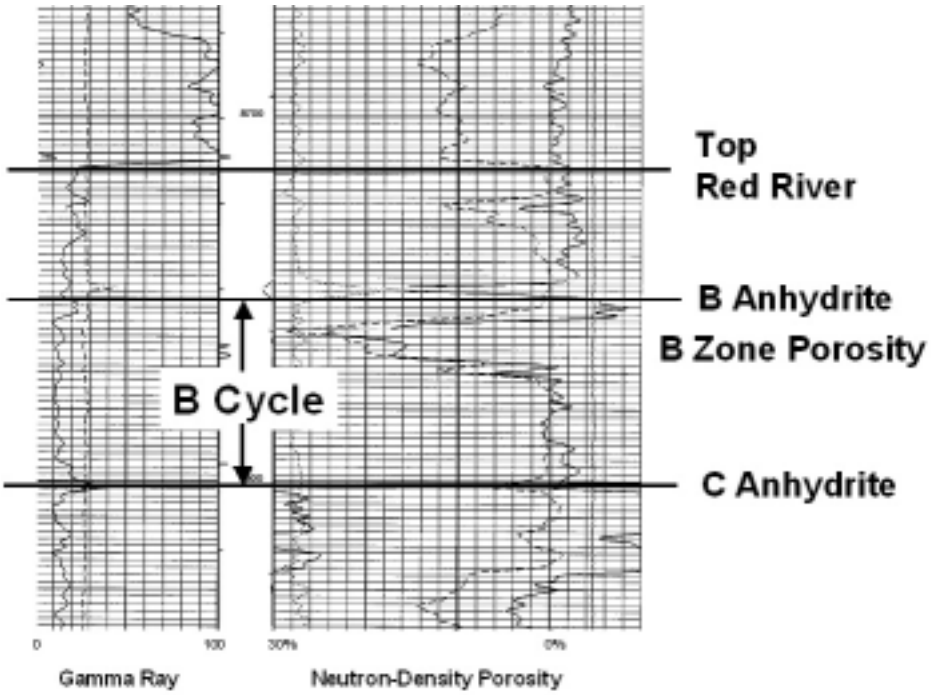

Figure 3. Type-log of the Red River B Zone.

Other software tools from ICS are used to calculate attributes that relate to entrapment potential (both structural and stratigraphic). The depositional and entrapment transforms are then used to predict reservoir producibility. A composite of several reservoir transforms is shown in **Figure 1** for the South Amor Field in Bowman County, North Dakota. The map is of the Red River depth structure with overlays of mobile oil-saturated pore volume and producing oilcut for the Red River B Zone. From map displays such as this, oil-in-place can be estimated and development strategies formulated. From close inspection of **Figure 1**, it can be observed that the producing oilcut contour of 25% does not follow a common subsea datum around the field. Tilted oil-water-contacts or saturation contours are found at other Red River fields in the area. **Figure 5** shows the predicted producing oilcut from the neural solver, using a database from about 50 wells, and the actual producing oilcut from vertical and horizontal completions at the South Amor field. A R-squared correlation coefficient of 0.92 is calculated for the plotted prediction.

From a characterization strategy of transforming seismic attributes to reservoir attributes and finally to production attributes, the original mobile-oil-in-place for the Red River B Zone at the Amor South field is calculated to be about 3,100,000 bbl. At the time the project began in 1997, the cumulative oil production from the South Amor Field was 1,227,948 bbl with a producing rate of 26 bbl per day per well. Based on incremental oil reserves of about 1,000,000 bbl, it was concluded that re-entry lateral drilling and implementation of a waterflood would be economical. At this time, Luff Exploration Company has drilled three horizontal completions that increased the field production from 145 bopd to 396 bopd, before commencing water injection and with reservoir pressure of about 1300 psi. The initial peak rate from the field was 364 bopd in 1981 when the reservoir pressure was almost 4000 psi. At this time, water injection at 1,000 bbl per day has begun in a long horizontal well on the western flank of the field. Two more horizontal producing wells will be added by the end of the year.

Conclusions

To validate the ICS technology several Red River fields were analyzed and 16 wells were re-entered with lateral completions in the Red River B Zone. **Figure 6** shows the average daily production before and after horizontal completions compared to average vertical completion production. As vertical wells the 16 wells had averaged 20 BOPD per well. After 24 months the horizontal completions had produced 43,300 bbl per well, over a 2-fold increase in production. These production figures demonstrate that remaining oil reserves cannot be efficiently produced by vertical completions in the Red River B Zone. Because of high drillings costs at the 9,000 ft Red River B Zone, exploitation of these reservoirs requires confidence in assessing oil-in-place, reservoir limits and identifying the areas of best reservoir quality. Properly applied, the software tools in the Intelligent Computing System can be a benefit to independent operators. To download free ICS software go to the DOE Luff project website at **www.luffdoeproject.com** or visit **www.npto.doe.gov/software**.

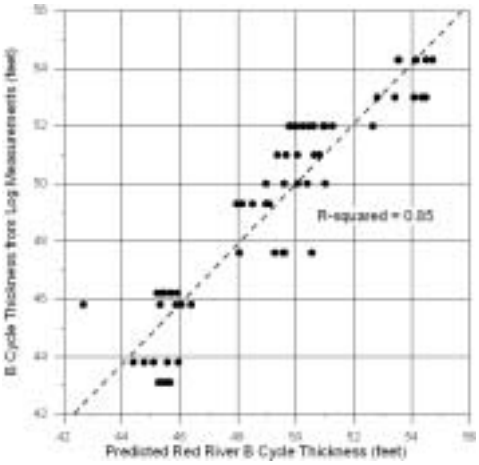

Figure 4. Predicted B Cycle thickness at well locations.

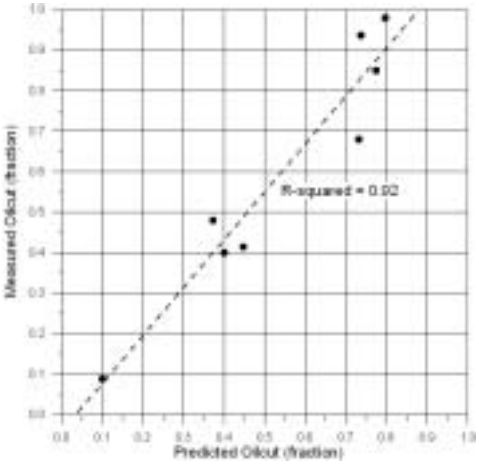

Figure 5. Predicted producing oil cut at South Armor Field.

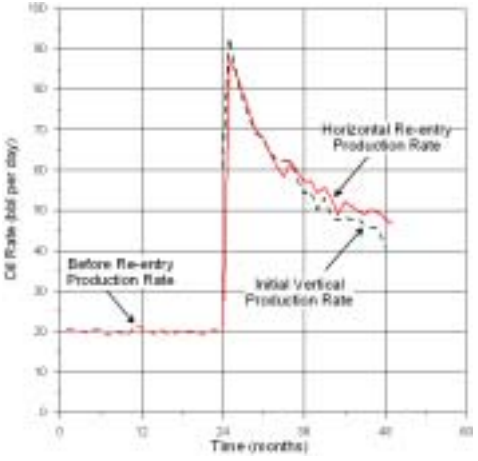

Figure 6. Average daily production from Red River B completions.

Permian Basin Play Analysis

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Introduction

The target of this PUMP project is the Permian Basin of west Texas and southeast New Mexico, the largest petroleum-producing basin in the United States (**Figures 7-8**). The Permian Basin produced 18 percent of the total U.S. oil production in 1999, and it contains an estimated 23 percent of the proved oil reserves in the United States (EIA, 2000). Moreover, this region has the greatest potential for additional oil production in the country, containing 29 percent of estimated future oil reserve growth (Root et al., 1995). More than in any other region, increased use of preferred management practices in Permian Basin oil fields will have a substantial impact on domestic production.

One way of increasing recovery in a reservoir is to apply methods that have been used successfully in similar reservoirs. To do so, however, one must understand how reservoirs group naturally into larger families, or plays. A play is an assemblage of geologically similar reservoirs exhibiting the same source, reservoir, and trap characteristics (White, 1980). Because of their shared depositional and diagenetic histories, reservoirs in the same play have similar production characteristics (Galloway et al., 1983). Characteristics of better known fields may be extrapolated with relative confidence to other reservoirs within the same play. Reservoir development methods that have been demonstrated to work well in one reservoir should be applicable to other reservoirs in the play.

The Bureau of Economic Geology (BEG) and the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) have teamed up to conduct this play analysis of the Permian Basin. The objectives of the project

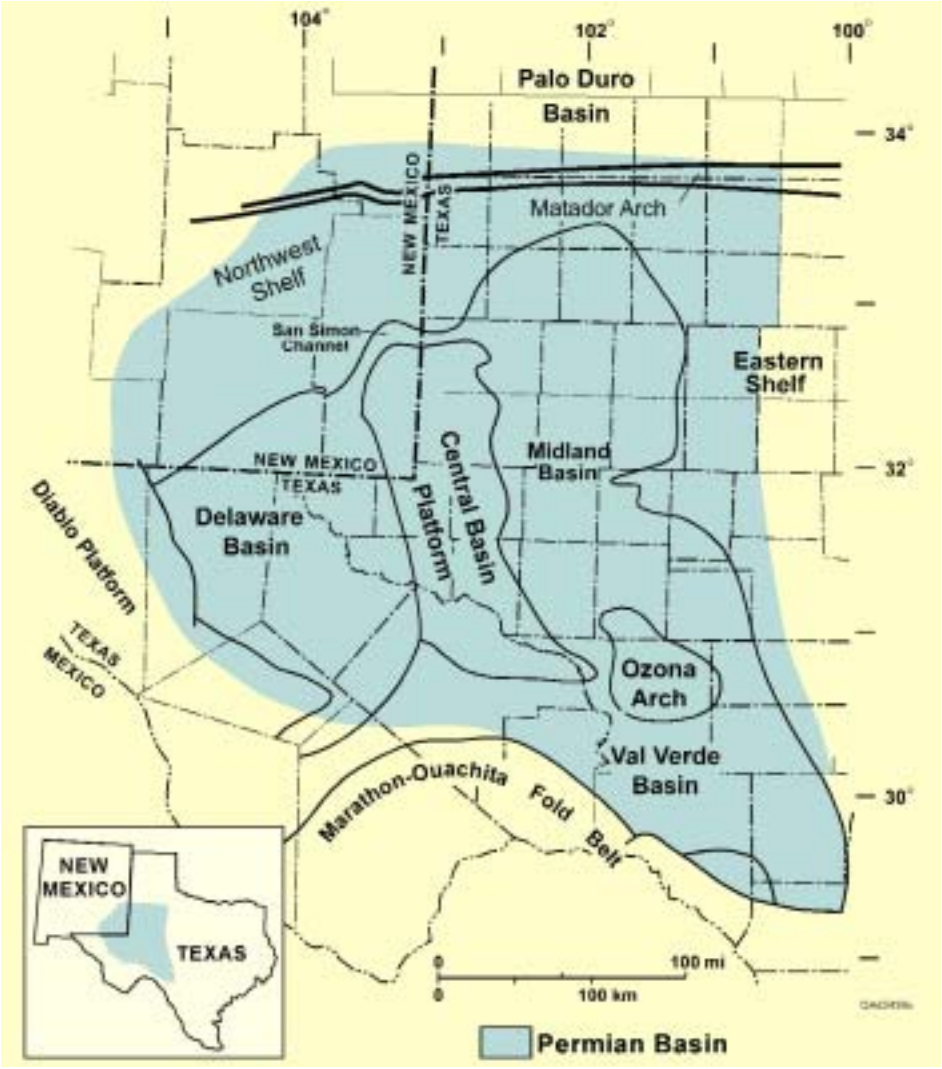

Figure 7. Major subdivisions and boundaries of the Permian Basin in west Texas and southeast New Mexico (modified from Hills, 1984).

are to (1) develop an up-to-date portfolio of oil plays in the Permian Basin of west Texas and southeast New Mexico, (2) study key reservoirs from some of the largest or most active plays to incorporate information on improved practices in reservoir development into the portfolio, and (3) widely disseminate the play portfolio to the public via CD, the Internet, and other media. The oil-play portfolio will contain play maps that locate all reservoirs in a play having cumulative production of >1 MMbbl (**Figure 9**). Play maps will be linked to a database listing cumulative production and other reservoir information. The portfolio will also include a summary description of each play, including key reservoir characteristics and preferred management practices, where possible.

Major Oil Reservoirs

During the first year of this 2-year project, major reservoirs in the Permian Basin (those having cumulative production greater than 1 MMbbl through 2000) were identified, and cumulative production through December 31, 2000, was determined. A total of about 1,000 reservoirs in

Texas and 300 reservoirs in New Mexico had produced >1 MMbbl of oil through 2000. A reservoir database was established that lists the Railroad Commission of Texas (RRC) reservoir number and district (Texas only), official field and reservoir name, year the reservoir was discovered, depth to the top of the reservoir, production during 2000, and cumulative production through 2000. In Texas, cumulative production is listed only under the final reservoir name into which one or more other reservoirs had been transferred.

Thirty-two oil plays covering both the Texas and New Mexico parts of the Permian Basin were defined on the basis of structural and tectonic setting, reservoir stratigraphy, reservoir lithology, depositional environment of the reservoir, and fluid type. Each of the 1,300 major reservoirs has been assigned to a play.

Outlines of the major reservoirs are being mapped and compiled in a Geographic Information System (GIS) by play using ArcView™. The final reservoir shapefile for each play contains the geographic location of each reservoir and all associated reservoir information within the linked dBASE data table. The final GIS product of this process will be an ArcView project file containing the base map, the newly created series of play-specific reservoir shapefiles, and the play-boundary shapefile.

Reservoir Characterization of Key Reservoirs

Reservoir-characterization studies of key reservoirs from three of the largest or most active plays (**Figure 7**) in the Permian Basin are being conducted. Detailed studies of the following reservoirs in Texas are in progress: Kelly-Snyder (SACROC unit) in Scurry County in the Pennsylvanian and Lower Permian Horseshoe Atoll Carbonate play, Fullerton (Clear Fork)

Figure 8. Oil well in the Permian Basin, west Texas.

in Andrews County in the Leonard Restricted Platform Carbonate play, and Barnhart (Ellenburger) in Reagan County in the Ellenburger Selectively Dolomitized Ramp Carbonate play. For each of these detailed reservoir studies, technologies for further, economically viable, exploitation are being investigated. The information on improved practices in reservoir development will be incorporated into the portfolio.

In the SACROC unit, large volumes of platform carbonate previously modeled as layer cake can be shown to consist of erosionally generated slope wedges associated with major eustatic sea-level falls. Complex promontories and reentrants mark the edges of the field, and large windward-leeward asymmetries control reservoir-quality distribution. A 3-D reservoir model developed for the unit using 3-D seismic and wireline data should greatly aid ongoing efforts for enhanced recovery in this reservoir using the water alternating gas (carbon dioxide) (WAG) process.

High-pressure air injection (HPAI) will be tested in the Barnhart (Ellenburger) reservoir, Reagan County, as an economical way to restore energy to pressure-depleted reservoirs and thus recover additional remaining resource. HPAI works by

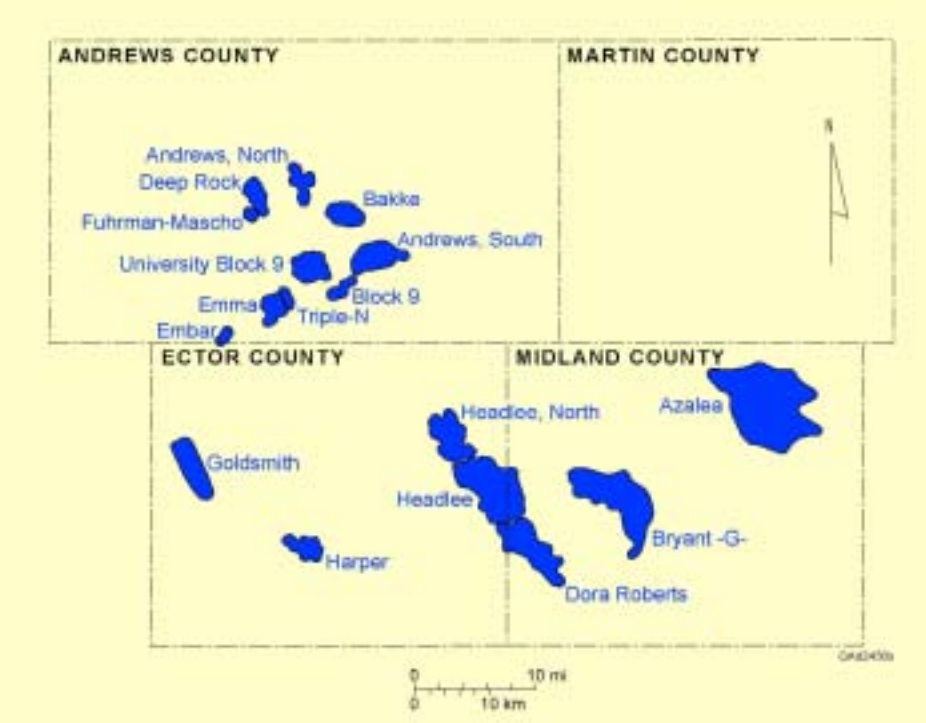

Figure 9. Example of a draft play map of the Devonian Thirtyone Ramp Carbonate play in Texas, showing reservoirs having >1 MMbbl cumulative production.

creating downhole combustion of oxygen and oil to produce flue gas (nitrogen and carbon dioxide) that repressurizes and floods the reservoir (Kumar et al., 1995). Characterization of the reservoir architecture at Barnhart field is critical because of the complexity of the fractured and karsted Ellenburger Group carbonates that compose the reservoir. The distribution of karst features and the distribution, abundance, and orientation of natural fractures and their impact on HPAI are being studied.

The goal of the Fullerton (Clear Fork) study is to develop techniques for improving the resolution and predictability of key reservoir properties leading to the construction of more accurate reservoir models for simulation and exploitation. Cycle-stratigraphic, rock-property, and 3-D seismic data are being integrated to provide a more robust way of predicting the distribution of reservoir rock and fluid properties than is currently achieved through more conventional methodologies.

Goals

The Permian Basin is a mature area in which significant future production will result from improved recovery in existing fields. The goal of the Permian Basin oil play portfolio is to provide operators with information that summarizes typical heterogeneity expected in all reservoirs within a play and describes development methods that have been successfully applied to reservoirs in the play. This information will help operators choose appropriate development methods and apply best practices to their own reservoirs.

References

EIA, 2000, U.S. crude oil, natural gas, and natural gas liquid reserves: 1999 Annual Report, DOE/EIA-0216(99), 156 p.

Galloway, W.E., Ewing, T.E., Garrett, C.M., Tyler, N., and Bebout, D.G., 1983, Atlas of major Texas oil reservoirs: The University of Texas at Austin, Bureau of Economic Geology, 139 p.

Hills, J.M., 1984, Sedimentation, tectonism, and hydrocarbon generation in Delaware Basin, west Texas and southeastern New Mexico: American Association of Petroleum Geologists, Bulletin, v. 68, p. 250–267.

Kumar, V.K., Fassihi, M.R., and Yannimaras, D.V., 1995, Case history and appraisal of the Medicine Pole Hills Unit air-injection project: SPE Reservoir Engineering, August 1995, p. 198–202.

Root, D.H., Attanasi, E.D., Mast, R.F., and Gautier, D.L., 1995, Estimates of inferred reserves for the 1995 USGS National Oil and Gas Resource Assessment: U.S. Geological Survey Open-File Report 95-75L, 29 p.

White, D. A., 1980, Assessing oil and gas plays in facies-cycle wedges: American Association of Petroleum Geologists Bulletin, v. 64, p. 1158–1178.

DOE's Technology Research Initiative for Independent Oil Producers

Overview

Fossil Energy's *Technology Development with Independents* program, now in its fourth phase, and the *Advanced Technology Development for Independents* program, now in its second phase, are aimed at developing and demonstrating technologies which are especially relevant to the operations of domestic independent oil producers. DOE has provided cost-share funding for approved field demonstration projects which incorporate new or innovative technologies that have the potential to increase production, lower costs, or improve environmental compliance in oil production operations. A total of 67 projects have been awarded in 21 different states, with 27 of those projects still active. Cost share information is provided in **Figure 10**.

The *Technology Development with Independents* program specifically targeted projects by smaller independent operators. *Advanced Technology Development for Independents* program, *Phase AT1* included independents in high risk regions. The new focus would provide technical solutions to issues limiting domestic on-shore or off-shore oil and gas exploration and production by independent oil producing companies. The second phase of the this program (issued in December 2002) included any domestic organization that could develop and demonstrate advanced technolog that would benefit domestic independent producers. *Phase AT2* projects include cutting-edge technologies that are not currently in use in the oil field or technologies which would not otherwise be pursued in a particular domestic region without the assistance of the program.

For additional information regarding the *Technology Development with Independents* program contact: Jim Barnes, 918-699-2076; e-mail: **Jim.Barnes@netl.doe.gov**.

For additional information regarding the *Advanced Technology Development for Independents* program contact: Rhonda Jacobs, 918-699-2037; e-mail: **Rhonda.Jacobs@netl.doe.gov**.

Current Active Projects

Technology Development with Independents

American Energies Corp., Wichita, KS, is designing and implementing a low-cost, effective waterflood in Mississippian carbonate reservoirs of the Wellington West field, Sumner County, KS, that demonstrates application of inexpensive but modern tools to build an integrated reservoir model, based on geologic, geophysical, and engineering characterization techniques.

Arnell Oil Co., Littleton, CO, will demonstrate alkaline-surfactant-polymer (ASP) chemical flooding technology designed to produce economical, incremental oil reserves in the Poison Spider field in Natrona County, WY. This project will demonstrate that chemical flooding is applicable to higher viscosity oil reservoirs.

Figure 10. DOE's cost share of the Technology with Independents Program.

Bass Enterprises Production Co., Fort Worth, TX, will acquire and analyze advanced 3C-3D seismic imaging data from a small 3C-3D seismic test patch embedded in a large-scale conventional 3D seismic survey using geophysical data obtained from a seismic survey in Reeves County, TX. The 3C-3D test patch can be incorporated into the conventional 3D seismic survey for minimal incremental cost, providing a low-risk, low-cost option for independents to acquire specific advanced seismic shear wave data across exploration prospects of interest. The 3C data can be analyzed to determine if the converted shear wave reflections provide critical reservoir information (detect faults, fractures, and other facies that influence reservoir performance) that cannot be derived from the conventional 3D seismic data alone. The comparison will provide the information necessary to determine if large-scale 3C-3D data acquisition across the prospect area is justifiable.

Beard Oil Co., Dewey, OK, is installing and testing a new type of low-volume submersible pump (**Figure 11**) to evaluate its ability to lower operating costs in a typical low-production marginal oil field in Washington County, OK. The new submersible pump will be compared with conventional rod pumps to evaluate comparative pump efficiencies and operating costs.

Benson-Montin-Greer Drilling Corp., Farmington, NM, is using new log interpretation methods based on artificial intelligence and neural networks to evaluate oil well recompletion opportunities in the Mesaverde formation in the San Juan Basin in Rio Arriba County, NM.

Crystal River Oil and Gas L.L.C., Encinitas, CA, will test a new polymer gel treatment process that restricts water production in oil wells in the

Figure 11. Running low-volume submersible pump, Beard Lease, OK.

Alameda field, Kingman County, KS. The new polymer gel is comprised of two chemicals, a powdered polyacrylamide polymer (a strengthening agent) and chromic acetate (a cross-linking agent) which together form a high strength thickened gel. The gel will be pumped under pressure into highly permeable, water-saturated zones, significantly reducing permeability to water so that oil can be produced from tighter adjacent rock layers.

DAKFAM, Inc., St. Charles, IL, is deepening and recompleting two idle wells through the lower Mississippian Salem formation in Wayne and Clay counties of southeastern IL. The project incorporates the use of gas gun technology, which uses low-level explosives to generate shockwaves, and high pressure that creates fissures which extend outward in all directions from the drill hole connecting with pre-existing fractures in which oil is trapped. The treatments are enhanced by acidizing the newly fractured network to dissolve limestone around the fractures.

Driver Production, Inc., Okmulgee, OK, is conducting a gas re-pressurization/well stimulation project on a six well, 80-acre portion of the Dutcher Sand of the East Edna field, Okmulgee County, OK. The objective is to produce additional oil by repressurizing the reservoir with excess natural gas that cannot otherwise be economically delivered to local gas gathering systems.

Grand Mesa Operating Co., Wichita, KS, will demonstrate the feasibility of using polymer gel technology to increase the recoverable reserves from Mississippian reservoirs in the Dickman field, Ness County, KS. Inadequate reservoir characterization, drilling and completion design problems, and extremely high water cuts and low recovery factors are limiting the economic viability of this vast resource. If successful, the use of polymer gels will reduce water production, reduce well operating costs, and increase oil production throughout the region.

Marks & Associates, Cypress, CA, uses bio-stratigraphy to establish an age zonation containing biohorizons that can be used as a standard for future drilling in the Blair/Barham field, Santa Barbara County, CA, to increase production, reduce risk and operating costs, and reduce environmental concerns.

Peden Energy, Fort Worth, TX, will demonstrate that micro-turbines are more efficient and less costly to operate than traditional internal combustion engines for electrical generators. They will also install variable frequency drives, with computerized pump

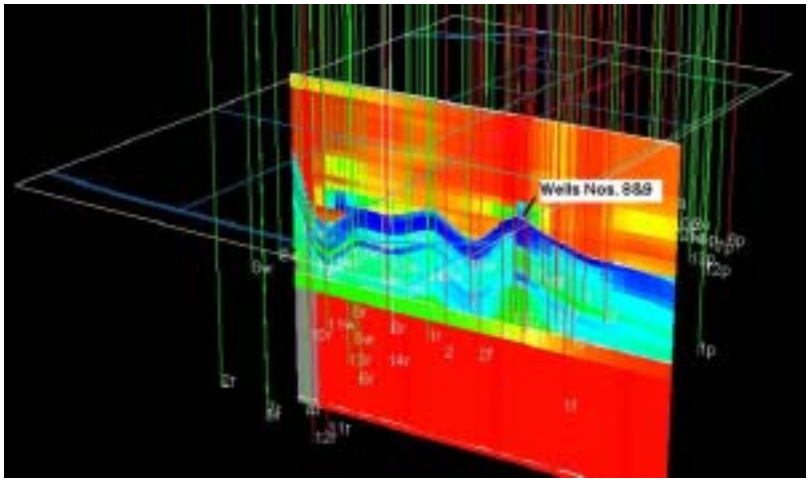

Figure 12. Woodbine Sand 3-D geologic cross section, East Texas Oil Field.

off controllers which respond to the down hole torque demand, adjusting and varying the pumping speed of the well. The greater the torque, the faster the pumping. Conversely, as torque demand decreases, the pump speed is decreased. The demonstration project will be conducted on leases in Cochran and Hockley Counties, TX.

St. James Oil Corp., Laguna Hills, CA, will use a new hydrochloric-phosphonic acid solution to restore oil production in shut-in wells in the Las Cienegas field, Los Angeles County, CA. The new acid treatment system is designed to dissolve severe calcium carbonate "scale" buildup and inhibit the formation of additional calcium carbonate scale. If successful, use of the hydrochloric-phosphonic acid solution could result in returning hundreds of wells to production throughout the area.

Team Energy L.L.C., Bridgeport, IL, will test the feasibility of using two different specially designed types of instrumentation, a fluid density meter and an inductive electrical conductivity meter, which will control the ability of oil well pumping equipment to limit the volume of salt water produced from stripper wells. Because the density and electrical conductivity properties differ between oil and water, the instrumentation should be able to detect which fluid is in the produced stream. The proposed technology will monitor the well to pump off only the oil, and stop the pump when water is detected in the produced stream. Two active pumping wells in the Illinois Basin in Posey County, IN, will be used to confirm the effectiveness of the two different meters.

TENECO Energy LLC, Wheat Ridge, CO, intends to restore production in the East Texas oil field in Gregg and Rusk Counties, TX, by using advanced computer imaging technology (**Figure 12**), new logging tools to locate promising geologic features and high residual oil saturation zones, and selectively perforate promising target intervals in the Woodbine sand.

TENECO Energy LLC., Wheat Ridge, CO, will use regenerating bio-chemicals (e.g., microbes and organic surfactants) to reverse formation damage, restore permeability and improve production in the East Texas oil field (**Figure 13**) in Rusk County, TX. Abnormal deposits of paraffins and asphaltenes, resulting from early exploration and production practices in the 1930s, have severely reduced the productive life of this field. Successful application of bio-chemicals should remove near wellbore paraffin and asphaltene deposits and improve oil production.

Terra Oil Exploration and Production Co., Signal Hill, CA, will run newly-developed cased hole well logs to identify bypassed oil in a selected deep well in the Santa Fe Springs oil field in Los Angeles County, CA. Many productive zones of the field have been waterflooded to recover oil from more permeable sand layers. It is suspected that flooding of selected sands in this area may have bypassed lower permeable, yet oil-saturated sand intervals. Potentially productive zones will be identified, and nearby wells will be re-completed to increase recovery and add bypassed oil to improve production.

Vaquero Energy, Inc., Edison, CA, will develop wireless surveillance equipment suitable and economical for use on low volume producing wells in the Edison field, Kern County, CA. The feasibility of the technology was demonstrated in an earlier project and the continuation involves additional testing of pumping unit vibration/frequency monitoring devices, plus the investigation and testing of other low cost wireless devices which may be appropriate for stripper oil well production monitoring.

Vecta Exploration, Inc., Dallas, TX, will complete a shear wave seismic study using data obtained from a well in Clark County, KS, documenting the imaging quality, costs, and potential benefits of combining shear (S) wave and compressional (P) wave seismic data. Conventional 3D seismic surveys use only P-wave data which is sufficient to identify the shape of a subsurface structure. However, successful

Figure 13. Standard pumping unit, East Texas Oil Field.

drilling often depends not only on the shape of the structure, but on locating rock fractures, detecting porosity trends, and locating subtle areas of trapped oil. Combining S-wave with P-wave data can provide a more complete geologic "picture" of potential subsurface oil and gas bearing formations.

Woolsey Petroleum Corp., Wichita, KS, will study ways to improve "hydraulic fracturing" in the Medicine Lodge North field of Barber County, KS, by investigating geologic and engineering factors critical for designing optimum hydraulic fracture treatments.

Advanced Technology Development with Independents

Enerdyne LLC, Albuquerque, NM, will test a new submersible pump in the Red Mountain Reservoir in the San Juan Basin, McKinley County, NM. The positive displacement, diaphragm type pump will be suspended on the end of a stainless steel wireline cable. Electric power will be sent to the pump through an electrical cable banded to the wireline. Suspending the pump on a wireline permits it to be deployed, and retrieved when necessary, in a matter of hours using a towable trailer with a portable winch. The new submersible pump can cut typical oil field capital and operating costs significantly.

Schlumberger Data and Consulting Services, Pittsburgh, PA, will demonstrate the use of cost-effective key and advanced technologies to better understand the oil reservoirs of the Detroit River and Richfield oil formations in the Beaver Creek field, Crawford County, MI, prior to CO_2 flooding. The project will also demonstrate the use of advanced time-lapse seismic technologies to "see" the CO_2 flood front in "real-time" during CO_2 injection for control and optimization of the enhanced oil recovery operations.

Temblor Petroleum Company LLC, Bakersfield, CA, will re-drill a well horizontally and underbalanced (mud weight less than the reservoir pressure) at 10,000 feet vertical depth in the fractured Monterey formation, in the Santa Maria Basin, Santa Barbara County, CA, to encounter a maximum number of vertical fractures in the reservoir. Cutting edge logging while drilling (LWD) technology will be used to verify the fracture orientation and change drill direction if required. Drilling underbalanced will allow oil and gas to flow freely to the bore hole with the minimum amount of damage to the reservoir.

Utah Geological Survey, Salt Lake City, UT, will conduct a case study of the (Mississippian) Leadville Limestone at the Lisbon field, Paradox Basin, San Juan County, UT, in order to understand the rock characteristics for regional applications. Leadville Limestone accumulations in other areas of the Paradox Basin in Utah and Colorado will be included in the study. The study will include a low-cost, environmentally sensitive field demonstration of new exploration technologies such as surface geochemical surveys of the soil, using a variety of new techniques, to detect where oil or gas may have leaked to the surface. Regional depositional environments will be determined by evaluating rock cores from wells, surface outcrops, and modern analogs. Potential oil-prone areas will be identified based on shows using low-cost microscopic fluorescence of oil in rock samples from wells. The study will be used to target areas for Leadville exploration. The project's aim is to reduce exploration costs and drilling risk, especially in environmentally sensitive areas, and add new oil discoveries and reserves.

Vecta Exploration, Inc., Dallas, TX, will test a new shear-wave seismic technology, designed to locate underground oil-bearing traps often invisible to conventional seismic technologies, to explore for subtle oil-bearing Mission Canyon oolitic limestone reservoirs in the Williston Basin of Mountrail and McLean Counties, ND. The concept employs all four types of shock waves generated in a seismic survey, the compressional P-wave plus the three other major types of shock waves, the horizontal shear SH-wave, the vertical shear SV-wave, and the converted shear C-wave, to image and identify elusive stratigraphic traps.

Independent Producers Share of Domestic Activities

- Approximately 8,000 Independent Producers in U.S.
- Wells Drilled–85%
- Petroleum Produced–40%
- Natural Gas Produced–65%
- Federal Leases Held-46%
- Shallow Water GOM Leases Held-80%
- Deep Water GOM Leases Held-50%

Source: Independent Petroleum Association of America

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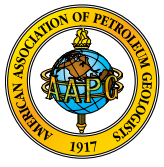

The Class Act

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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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Office of Fossil Energy
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Useful Links:

DOE Technical Project reports
www.osti.gov or
www.npto.doe.gov

Project Fact Sheets
www.fe.doe.gov

Funding Opportunities
www.netl.doe.gov/business

C A L E N D A R

Meetings and Announcements

October 5-8, 2003 SPE Annual Technical Conference, *"Mile High Meeting of the Minds"*, Denver, CO. Visit the DOE/NETL booth # 1545. **www.spe.org**

October 11-14, 2003 AAPG Mid-Continent Section, *"Looking to the Future:Opportunity Through Access"*, Marriott Southern Hills, Tulsa, OK. Visit the DOE/NETL booth # 7. **www.aapg.org**

November 11-14, 2003 Integrated Petroleum Environmental Consortium Annual Environmental Conference, Renaissance Hotel, Houston, TX. **http://ipec.utulsa.edu**

February 8-11, 2004 GTI/DOE Natural Gas Technologies Conference, Pointe South Mountain Resort, Phoenix, AZ. **www.gastechnology.org**

March 2-4, 2004 IADC Drilling Conference, Hyatt Regency, Dallas, TX. **www.iadc.org**

April 17-21, 2004 SPE/DOE Improved Oil Recovery Symposium, *"Clean Sweep Strategies"*, Renaissance Tulsa Hotel, Tulsa, OK. **www.ior2004.org**

April 18-21, 2004 AAPG Annual Technical Conference, *"Embrace the Future, Celebrate the Past"*, Dallas, TX. **www.aapg.org**

Check out our website at www.netl.doe.gov/business for new project funding solicitations