Appalachian Region PTTC

Newsletter

Fall 2001 Vol. 2 No. 3

CONTENTS:

FROM THE DIRECTOR'S DESK...

You didn't need to read it here to realize that the world has changed since our last newsletter. In spite of what has happened, and the sorrow and compassion we feel for those most directly affected, we must go on or the enemies of democracy will win. Consequently, after postponing our September 17 workshop on **Advanced Exploitation and Horizontal Well Technology**, we moved forward with a full Fall schedule of workshops and outreach through exhibits at regional meetings of professional societies.

The West Virginia Geological Survey and the Department of Petroleum and Natural Gas Engineering at West Virginia University developed an excellent short course on Reservoir Characterization, and presented a **Case Study of an Upper Devonian Oil Reservoir** on October 23 in Morgantown.

The research team reported the results of a three-year, DOE-funded research project to make direct and indirect measurements of permeability in an oil reservoir, determine flow units, and project these flow units in three dimensions throughout the oil field through the use of Artificial Neural Networks.

On November 1, the Ohio Division of Geological Survey hosted Bob Knoll, who presented the full-day workshop on advanced exploitation technology originally scheduled for September. We actually added a few more registrants to our original list, and Bob gave an energetic performance that left us waiting in anticipation for **Advanced Exploitation Technology, Part B,** which will be held December 14, in the Meadowlands Holiday Inn near the racetrack in Washington, PA. Be sure to watch this website for updates.

Through the cooperation of DOE and Lance Cole, PTTC's Project Manager, we were able to put together a one-day workshop on **Field-Oriented Research Projects for Independents** at the Meadowlands Holiday Inn near Washington, PA on November 8. Six project summaries from DOE's Technology Development with Independents were presented, along with a summary of current research funded through the Stripper Well Consortium.

On October 1, the Appalachian Oil and Natural Gas Research Consortium began a new, two-year project to identify **Preferred Upstream Management Practices** (**PUMP**) in the oil industry. This new, DOE-funded technology transfer program is a high-priority federal program to collect and distribute information that domestic producers can use in their producing fields. One of the first tasks for us is to identify interested oil producers in the Appalachian Basin and invite them to a **Problem and PMP (Preferred Management Practices) workshop** in early December. This new effort will be tied closely to our PTTC project, and results will be made available on this website.

When the PTTC program began in 1995, one of the first things we did was organize three **Problem Identification Workshops**. The results of our workshops were included in a report from PTTC to DOE that listed and prioritized the technical barriers to production as identified by the domestic oil and gas producers who participated in approximately 30 of these workshops, nationwide. We believe that the time has come for a new round of problem identification. Therefore, at the next meeting of the Producer Advisory Group (PAG), one of the items of business will be a new Problem Identification Workshop, to be held in the Spring of 2002.

For the past three years I have enjoyed working with Kevin Smith, of Oxford Oil, in his capacity as Chairman of the Appalachian Region PAG. Unfortunately, the rules under which

PTTC must govern itself state that the term of office for a PAG Chair is three years, so at the next PAG meeting a new Chair and Vice Chair will be elected. Hopefully, Kevin will remain on the PAG and we will continue to benefit from his advice.

Kevin, thank you. It has been a pleasure.

Doug Patchen
Program Director, Appalachian Region

FORMER PTTC CHAIRMAN RETIRES

Leo A. Schrider, Senior Vice President for Belden & Blake Corp. in North Canton, Ohio, and former Chairman of the PTTC Board of Directors, will retire from his full-time position at the end of the year, but will remain with the company in a part-time position for the next two years working on special projects. Schrider served as Chairman of PTTC's Board of Directors from 1999-2001. PTTC Executive Director Don Duttlinger recently praised Schrider for his valuable leadership and unwavering support for PTTC during his tenure as chairman. "Leo has always brought professionalism and key insights to the organization, which purely exemplifies our mission and the relationships necessary in transferring ideas among industry groups," said Duttlinger when Schrider stepped down as chairman. Duttlinger also noted that he is sure that Leo will continue to have continued input through his role as immediate past chair.

Earlier in his career, before he joined Belden & Blake, he was Deputy Director of the US Department of Energy's Natural Gas Technology Center in Morgantown, WV, which is now part of the National Energy Technology Lab. A graduate of the University of Pittsburgh, he pursued graduate work at West Virginia University while posted in Morgantown, and had an appointment as Adjunct Professor at WVU.

Prior to serving as Chairman of the Board of Directors, Schrider had served as the first Chairman of the Appalachian Region's Producer Advisory Group, and then three years as Vice Chairman of the national Board of Directors and Chairman of the important Management and Budget Committee.

It was my pleasure to work with Leo in the formative years of PTTC. We worked closely in those years to select the original PAG members, set up the

Regional Resource Center, and design a program to transfer technology to Appalachian producers. Leo always was available to take my calls, during which he provided valuable input, and commonly hosted meetings of the PAG, either at Belden & Blake or other locations. We all
wish him a long, happy and healthy retirement.

OPTIMIZED EXPLOITATION TECHNOLOGY

Appalachian producers got a real treat on Halloween when Bob Knoll, President of H-Tech in Calgary, presented Part A of a planned two-part short course on the keys to optimizing exploitation in marginal settings. The focus for the October 31 workshop was on exploiting reservoirs through horizontal drilling. The format was an open, informal setting with an energetic, aggressive presentation by the course instructor. Audience participation was requested, and solicited throughout the day, leading to a lively interchange between registrants and Mr. Knoll. Emphasis was placed on failures, and what we can learn from them. Attendees felt that this was one of the best workshops, if not the best, that PTTC has presented in this basin.

The material presented was a condensation of a normal four-day workshop. However, PTTC and Maurer Technology, Inc. negotiated a series of shorter versions in six of the 10 PTTC regions. Thus, we were able to provide this material to Appalachian producers at a greatly reduced registration fee.

The second day of the workshop will be **December 14 at the Meadowlands Holiday Inn** near Washington, PA Part B will be open to anyone who wishes to attend, not just those who attended Part A. If interested, contact Carl Smith at 304-594-2331 to register. Those who did not attend Part A, but register and prepay for Part B, will be sent a workshop notebook in advance so that they can review material covered in the previous workshop.

PROFESSIONAL O&G SOCIETIES TO HOST CONCURRENT MEETINGS IN '03

The Pittsburgh Association of Petroleum Geologists (PAPG) and the Pittsburgh Chapter of the Society of Petroleum Engineers (SPE) have been chosen to host regional meetings of their respective professional societies in September 2003. Furthermore, the two local groups have agreed to host concurrent meetings at the same location. Their decision has been approved by the Eastern Section of the American Association of Petroleum Geologists (AAPG) and the national Board of Directors of the Society of Petroleum Engineers.

The goal of the two groups is to provide a venue where petroleum engineers and geologists can interact freely, taking full advantage of the technical program of each professional society while preserving the meeting traditions of both. The concurrent meetings will be held September 20-24 at a downtown Pittsburgh location. Both societies will register their own members and others who wish to register through them, and set their own registration fees. Each society will convene two concurrent technical sessions, and anyone who registers with either group will be entitled to attend any talk in any of the four concurrent sessions. To facilitate this, the two groups have agreed that all talks will be of the same length, and all session chairs will hold rigidly to the printed schedule, with talks starting on the hour and half hour.

In addition to the technical sessions, PAPG will organize pre-meeting field trips and a post-meeting short course, in a cooperative effort with PTTC. Anyone who registers with either group will be eligible to pay for and attend any of these additional events. The groups will sponsor a joint exhibit area, in which the opening night icebreaker will be held. Poster sessions and a Deal Room will be set up adjacent to the Exhibit Area.

Each group will continue to honor traditions established over the years. ES-AAPG will convene an Opening Session and Awards Ceremony on Sunday afternoon, which will feature brief remarks by national officers and officer candidates, as well as the keynote address by the John T. Galey Memorial Awardee. ES-AAPG also will host their traditional House of Delegates breakfast, ES Council business luncheon, and All-Division luncheon. SPE plans to host their traditional luncheon for all registrants at which they will present their awards and have a special luncheon speaker. This year, in Canton, Ohio, former two-time Heisman Award winner

Archie Griffin was the featured speaker.

Both groups are recruiting volunteers to serve on committees that will work hard to make this first-of-its-kind meeting a success. If you live and work in the Pittsburgh area, you will want to become involved in this first-of-its-kind event.

NEW ROUND OF PUMP AWARDS ANNOUNCED

The Department of Energy has taken a second major step in their new technology transfer program called PUMP - for Preferred Upstream Management Practices. DOE's National Petroleum Technology Office in Tulsa has selected four new projects to compile and disseminate oil reservoir data and best management practices that have proven to be successful in the field.

The University of Texas at Austin and the state geological surveys in Texas, Illinois, New Mexico and Utah will partner with DOE to develop the most complete "portfolios" yet of three of the most significant oil-producing regions in the lower-48 states: the Permian basin in Texas and New Mexico; the Illinois basin in the mid-continent region; and the oil-bearing reservoirs in Utah and surrounding areas.

The Permian basin contains approximately one-fourth of the active production in the United States, and the Illinois and Utah regions have produced more than 4 billion barrels to date, and have the potential to produce billions of barrels in the future, given the right technology.

These four projects join five projects announced last April that will demonstrate and disseminate preferred oil field practices in the Appalachian basin, West Texas, southern California, Kansas and Oklahoma.

The Illinois State Geological Survey (ISGS) will develop an enhanced oil field database using a Geographic Information System (GIS) approach. Existing reservoir maps will be enhanced using the GIS and existing core analyses to create maps that more clearly define reservoir quality, producing zones and pay characteristics. The information will be available on the ISGS and DOE websites in an interactive computer graphic display. Therefore, producers will have access to a complete database of flow zone indicators, thickness maps of reservoir rock quality, thickness maps of porosity and permeability, reservoir geometry and structural components.

TRENTON UPDATE - ROUND 2

Offer it, and they will (continue to) come. On August 6th and 7th we hosted an Ordovician carbonate core workshop and our **Appalachian Update: Trenton-Black River Exploration & Production Round 2** workshop. Although we originally intended this to be a repeat of the May 1st Round 1 workshop for those who were unable to attend that meeting due to a lack of space, the content of the workshop changed slightly, as several speakers could not attend and were replaced by different speakers. So, we not only attracted new registrants, but many repeat attendees as well. In fact, of the 120 industry people who attended the two-day event, 63 were attending their first PTTC workshop in this region, whereas the other 57 were repeat attendees who wanted to hear the drilling and production updates and new speakers.

Dr. Richard Smosna again presented a regional overview of how the Trenton and Black River formations were deposited in the basin as a sedimentary response to plate collision. Dr. Robert Shumaker explained the Grenville basement on which the earliest Paleozoic sediments were deposited, and younger tectonic events that created the Rome Trough, over which these carbonates were deposited, and still younger movements along the margins of the trough that fractured the overlying rocks, creating fractured reservoirs and pathways for fluids migrating from the basement. John Hickman explained in more detail the evolution of the Rome Trough and its affect on the overlying carbonates and the creation of reservoirs. Annette Evans, John Clark and Marc Sterling completed the regional overview portion of the program with a new presentation on speculative seismic surveys.

Kathleen Sanford and Lee Avary returned, but each had updated information on drilling and production in New York and West Virginia, respectively. In addition, Steve Fletcher, Ontario Oil, Gas & Salt Resources Library, Ontario, Canada presented a summary of Middle Ordovician exploration and production trends in the Ontario Peninsula, after which Ian Colquhoun, another returning speaker, explained the formation of fractured dolostone reservoirs in the Trenton and Black River in southwestern Ontario.

Following the afternoon break, Parker Gay again presented his paper on basement fault control on Trenton-Black River oil and gas production in Michigan, New York and West Virginia. John Adams, a new speaker, then presented an economic analysis of Trenton-Black River prospects. Bob Shumaker wrapped up the program with his observations on the structural setting of some Trenton

well locations in West Virginia.

Participants who attended both workshops expressed their opinion that this workshop was superior to the previous one, mainly because new production data were released, as well as the paper that led to a discussion of the economics of the play.

AAPG NAMES FIRST OUTSTANDING EXPLORER AWARDEE

President Robbie Gries and the AAPG Executive Committee have announced that the first recipient of AAPG's newest award, the Outstanding Explorer Award, will be Richard (Dick) Beardsley, formerly with CNR and now Vice President of Triana Energy, for the role he played in locating Trenton-Black River discovery wells in New York and West Virginia.

The Outstanding Explorer Award will be given annually by AAPG to one individual in recognition of distinguished and outstanding achievement in exploration for petroleum and mineral resources, with an intended emphasis on recent discovery. Recipients must be active AAPG members, living at the time of selection, and willing to attend the annual AAPG meeting to receive the award. Beardsley will be given the award at the opening session and awards ceremony next March in Houston.

Individuals considered for this award are those who have played an important role in making a significant petroleum or mineral discovery, or been part of a team that made such a discovery, or have accomplished outstanding earth science exploration which can be demonstrated to be responsible for the discovery of a significant petroleum or mineral resource by others.

Beardsley was recognized as the individual who, more than anyone else, was responsible for the recent discoveries of natural gas in the Trenton and Black River Formations in New York and West Virginia, kicking off one of the hottest plays in the country. More than 200 locations have been staked in the play, which has the potential to extend from eastern Kentucky across West Virginia and Pennsylvania to New York Open flows in the 50 - 100 Mcf/d range have attracted the interest of operators as far away as Texas, Oklahoma, Colorado and Wyoming.

Beardsley used a unique, for the time and basin, approach that led to the initial discoveries. During the 1970s, when his company, Columbia Natural

Resources, was shooting seismic lines in New York in search of Middle Devonian Onondaga reefs, he noticed narrow areas on the seismic where the top of the Trenton Limestone was slightly depressed, but the bottom was flat. He also noticed that basement faults could be interpreted under these small "Trenton sags." Mapping the locations of these Trenton sags indicated narrow fairways across parts of southern New York. Eventually he developed a model involving the migration of hot water from the basement up fault zones to the Trenton Limestone, which dolomitized the carbonates along fractures associated with the larger faults. The sag on the Trenton reflected the volume reduction in the limestone section, and the corresponding increase in porosity. Thus, while others continued to drill highs in the Cambro-Ordovician section, Beardsley convinced his management to drill the first of these subtle sags on the Trenton in Steuben County, New York in 1986.

The Glodes Corner Road field was the first to be discovered, but it was nearly 10 years before other wells were drilled. During this time he persevered in his faith in his interpretation, assembled a team to work the play, and convinced management to continue drilling. Eventually, he picked the locations for the discovery wells for the Muck Farm (1998) and Wilson Hollow (1999) fields in New York, and the Cottontree field (1999) in West Virginia.

We congratulate Dick for this achievement and for being chosen as the first person to receive this prestigious award..

COAL BED METHANE ACTIVITY

The Fall 2001 Session of the North American Coalbed Methane Forum, held Wednesday, October 31 at the Lakeview Resort near Morgantown, featured speakers who updated coal bed methane drilling and production in four Appalachian basin states (West Virginia, Virginia, Pennsylvania, Kentucky) and two Illinois basin states (Illinois, Indiana). In addition, two speakers discussed innovative methods for carbon dioxide sequestration in coal beds, including slant hole drilling.

Virginia continues to lead all Appalachian basin states in coal bed methane activity. In the year 2000, coal bed methane production was 52.9 Bcf from 1924 wells, an increase of 3% from the 1999 total. This increase in CBM production helped offset an overall decline in gas production in Virginia. Total gas production was 71.5 Bcf from 3051 wells, down 0.9% from 1999. The percentage of total gas produced from coal beds in 2000, 74.2%, was a record high.

Permits to drill new coal bed methane wells in Virginia increased 16% in 2000 relative to 1999, with 341 of the 388 total permits in Virginia being issued to drill coal bed methane wells. However, the number of coal bed methane wells reported as completed during the year actually decreased slightly from 1999, to 250 wells. Coal bed methane activity continues to be concentrated in Wise, Dickenson, Buchanan, Tazewell and Russell counties in southwestern Virginia, adjacent to Kentucky and West Virginia.

Katharine Lee Avary reported that coal bed methane activity in West Virginia continues to increase, with drilling in both the northern and southern coal basins. In northern West Virginia, coals in the Upper Pennsylvanian Monongahela Group are the most productive. Many of these wells are actually gob gas wells in the Pittsburgh coal at the base of the Monongahela Group. Most of the recent activity has been in western Monongalia County, adjacent to Pennsylvania, with some activity in Wetzel and Marion Counties.

In southern West Virginia, Lower Pennsylvanian New River and Pocahontas coals are productive. Multiple coal seams in these formations commonly are completed, along with interbedded sandstones on occasion. Drilling programs are concentrated in three counties - Raleigh, Wyoming and McDowell.

New coal bed methane regulations took effect in West Virginia in 1996, and tax credits were reinstated effective September 25, 2000. Both of these actions stimulated coal bed methane activity in the state, according to Avary. Of interest in the future is the ability of

coal beds to sequester carbon dioxide. Consol, Inc. recently received a US Department of Energy award to demonstrate a coal bed methane production technology known as "slant-hole" drilling to drain natural gas from unmineable coal beds, and then to use these slant holes to sequester carbon dioxide.

Coal bed methane well data for West Virginia can be found on the Survey's website at http://www.wvgs.wvnet.edu/www/datastat/datastat.htm. Downloadable data files are available in Excel and ASCII format.

Toni Markowski reported on coal bed methane activity in Pennsylvania. According to Markowski, 7 of 32 coal bed methane pools in Pennsylvania produced commercially in 2000. Activity was concentrated in Westmoreland County, where 302 wells were permitted and 157 wells produce commercially, and Indiana County, where 18 wells are planned for 2002 to add to the 72 commercial producers. Other activity was reported in Fayette, Washington and Cambria counties. Gob wells and vertical wells in which the coal beds are hydraulically fractured are both important in the play, and a new slant well tested 500 Mcf/d from the Pittsburgh and Sewickley coals.

Prior to the regularly scheduled forum, the Gas Technology Institute presented a short course on the fundamentals of coal bed methane reservoir engineering developed by Shahab Mohaghegh and Kashy Aminian, petroleum engineering professors at West Virginia University.

CARBON SEQUESTRATION

Following President Bush's statement that technology offers great promise to significantly reduce emissions, Energy Secretary Abraham announced that DOE would co-fund eight new exploratory projects to study ways to capture and store carbon gases. Each offers an approach to removing global warming gases from power plants or from the atmosphere itself, and methods to securely store them in subsurface geologic formations or in terrestrial vegetation, such as forests. Most of the projects will focus on carbon dioxide, but one will collect natural gas from a landfill. Two of the companies who will study sequestration in geologic formations are located in the Appalachian region.

Consol, Inc., Research and

Development, South Park, Pennsylvania, will demonstrate a coal bed methane production technology known as slant-hole drilling to drain gas from unmineable coal seams. Following production of natural gas from the coal beds, these production wells will be used to sequester carbon dioxide.

Advanced Resources International, Inc., Arlington, Virginia, will study the way in which carbon dioxide is trapped naturally in subsurface formations in the United States, to determine if this knowledge can be adapted for sequestration applications.

Carbon dioxide sequestration in geologic formations includes not only coal beds, but oil and gas reservoirs and deep, saline reservoirs as well. In some applications, production of oil or gas from a reservoir can be enhanced by injecting carbon dioxide into the reservoir. Currently, about 32 million tons of carbon dioxide are used each year in the United States for this purpose. From the perspective of the carbon sequestration program, enhanced oil recovery offers an opportunity to reduce the cost of sequestration, due to the revenues from recovered oil. The integrity of the injected carbon dioxide that remains in the reservoir is well understood and very high, as long as the original pressure of the reservoir is not exceeded. However, due to economic constraints, this application currently is limited to sources of carbon dioxide that are near an oil or natural gas reservoir.

Coal beds typically contain large volumes of methane-rich natural gas that is adsorbed onto the surface of the coal, both in the cleats (fractures) and in the matrix of the coal itself. Tests have shown that carbon dioxide is roughly twice as adsorbing on coal as methane, giving it the potential to efficiently displace methane and remain sequestered in the coal bed. Using carbon dioxide to produce methane from coals has been demonstrated in limited field tests, but more work needs to be done. Again, as in the case of enhanced oil recovery using carbon dioxide, the value of the methane-rich gas produced helps to offset the cost of the carbon sequestration process. Another key factor in this type of research is that many of the unmineable coal beds in this country are near coal-fired electric generating plants that are large sources of carbon dioxide, reducing the cost of transporting the gas to be sequestered.

RESERVOIR CHARACTERIZATION APPROACH PRESENTED

During a recent PTTC Focused Technology Workshop, a research team composed of engineers and geologists from West Virginia University and the West Virginia Geological Survey presented the results of a three-year study to characterize an Upper Devonian oil reservoir, and develop a technique for reservoir characterization that can be applied to other oil reservoirs in the basin. According to their final report, the purpose of the work was to establish relationships among permeability, geophysical and other data by integrating geologic, geophysical and engineering data into an interdisciplinary quantification of reservoir heterogeneity as it relates to oil production.

The Jacksonburg-Stringtown field in West Virginia was chosen as a case study. This field contained an estimated 88,500,000 barrels of oil, of which approximately 20,000,000 barrels were produced during primary recovery operations. Additional recovery from limited portions of the field were realized through a gas injection project, initiated in 1934, and a pilot waterflood, begun in 1981. Results from the pilot flood were encouraging enough that a full-scale waterflood was begun in 1990, involving 8,900 acres in three units, with a target of 1,500 barrels of oil per acre recovery.

Historical patterns of drilling and field development suggest that the Gordon sandstone reservoir is heterogeneous, and detailed reservoir characterization is necessary to understand well performance and address technical barriers to production observed by the operators of the field.

Conventional stratigraphic correlation and core description shows that the Gordon sandstone can be divided into three parasequences which formed along an Upper Devonian shoreline. Five lithofacies were identified within the parasequences, of which one includes reservoir sandstones. Both pay and non-pay sandstones are present, with pay sandstones being characterized by permeabilities in core ranging from 10 to 200 mD, whereas non-pay sandstones have permeabilities less than 5 mD. Conglomeratic zones were present in both sandstone lithofacies, and could have permeabilities consistent with the enclosing sandstones, or have lower permeabilities than enclosing pay sandstones, or higher permeabilities than the non-pay sandstones.

The research team developed a technique to identify electrofacies, based on a linear combination of density and scaled gamma ray best matched correlations made independently based on

visual comparison of geophysical logs. Although the four electrofacies did not exactly match the lithofacies, one of them did match the pay sandstone. This electrofacies is characterized by permeability greater than 45 mD, and is present throughout the oil field, whereas the other three electrofacies are more disconnected.

Two flow units were defined based on the stratigraphic model, geophysical logs and porosity-permeability relationships. Flow units defined by storage capacity-flow capacity relationships did not completely correspond to lithology in the cores. The upper flow unit corresponds to a conglomeratic zone and the upper part of the sandstone below, whereas the lower flow unit is within the lower part of this sandstone.

The distribution of these flow units is the most critical factor in developing a reservoir model that can be useful in enhancing production from the field. However, a lack of evenly-, or widely-distributed permeability data makes prediction of the distribution of these flow units difficult. To overcome this, the team developed a geophysical log-based methodology for flow unit prediction using Artificial Neural Networks (ANN). Input and output data from six cored wells were used to train and evaluate the ANN. Six runs were made, each time holding one well out as a verification set. The final results were improved significantly by including flow units in the input data.

The next step was to apply the ANN to the entire field, using log data from 120 wells. Permeability, porosity and flow units were predicted for each of these wells, and the results were mapped. The flow unit distribution was shown through a set of maps of mean permeability and permeability-thickness for each flow unit. Flow Unit II, the major producing unit, crosses stratigraphic boundaries within the reservoir.

A three-dimensional reservoir model including the flow units, values of permeability calculated with the ANN and injection-rate information were then used as inputs for a reservoir simulator to predict oil production performance for the center-well producers in the pilot waterflood area. The more detailed description of the reservoir that incorporated the flow unit concept provided significantly better results than earlier simulation using more simple reservoir models.

GAS HYDRATES: SAVIOR OR HAZARD?

Methane hydrates. Are they tomorrow's natural gas frontier, or are they merely a dangerous foe for tomorrow's drillers? To help resolve this question, the Department of Energy has selected six new research projects valued at nearly $48 million for new funding.

What are methane hydrates and why are they of interest? First, they are a mixture of natural gas and water frozen into ice crystals, common in permafrost regions like Alaska and offshore areas where high pressures dominate. When the hydrates form, the trapped methane compresses, such that when a cubic centimeter of hydrate melts at room temperature, about 160 cubic centimeters of methane will be released. And second, scientists estimate that if even one per percent of the natural gas trapped in hydrates could be produced, it would more than double America's natural gas supply. That's the what and the why, but not the whole story. Hydrates also pose a potential hazard to current drilling operations, especially in offshore wells drilled through hydrate zones, due to this tremendous expansion when they melt.. This concern is reinforced by the presence of numerous landslide scars detected on relatively gentle slopes of the continental shelf which may be due to hydrates breaking apart at, or just below, the ocean floor. Although a hydrate-induced sea floor slide has never been observed, their presence raises safety concerns for wells being drilled in deeper offshore areas where hydrate encounters during drilling are more likely.

The new projects will examine hydrates in the Gulf of Mexico and Alaska's north slope, and will develop new tools for recovering and analyzing hydrates cores and new models and simulators that can be used to predict the behavior of hydrate formations during production operations.

GAS STORAGE AND PIPELINE RESEARCH

Demand for natural gas is expected to increase more than 40 percent above current amounts within the next two decades as additional gas-fired electric power plants are built and come on-line. The amount of natural gas required to fuel these new electric plants will exceed the current capability of our infrastructure

to store and transport gas. Therefore, to help the nation's gas storage system, DOE's Strategic Center for Natural Gas, part of the National Energy Technology Lab, has selected four new projects to study innovative approaches to gas storage technology. With a total value of more than $2.5 million, these cost-shared projects are designed to identify more areas around the country where natural gas can be stored, making the gas delivery system more responsive to consumer needs.

Currently, more than 400 subsurface formations or depleted reservoirs serve as gas storage reservoirs. These sites, however, are clustered in close proximity to eastern and mid-continent markets. Other large market areas in the south and west do not have adequate access to nearby gas storage reservoirs. In some cases, these areas lack the right geology to develop conventional gas storage reservoirs. In these areas, innovative storage may need to be developed, in salt formations, as hydrates in above ground tanks, or in chilled form in refrigerated rock caverns.

The New York State Museum, through the New York Geological Survey, will use sophisticated reservoir techniques to develop a systematic "blueprint" for removing and disposing of salt water when caverns are created in salt-bearing formations for the purpose of storing natural gas. At present, adequate brine disposal is the primary barrier to using salt caverns for natural gas storage in many areas of the United States, including upstate New York, Pennsylvania, Ohio and West Virginia. The New York Museum project will focus on identifying potential reservoirs that can accept large volumes of brine, while maintaining acceptable environmental levels, near salt-bearing formations that have the potential for gas storage in salt caverns.

A second project with ties to the Appalachian basin is work to be performed by CAES Development Company, LLC of Houston. CAES plans to conduct a proof-of-concept study to establish the potential for full-scale deployment and commercialization of a technology previously developed by DOE. This technology, known as Refrigerated-Mined Rock Cavern Technology, or RMRCT, involves mining large openings in rock in which chilled and compressed natural gas is stored. Using this technique, more gas can be stored in the same cavern volume, reducing mining costs. The project will use a compressed air energy storage facility being built in Norton, Ohio to test how hard rocks react to pressure changes.

The other two projects involve an above-ground, gas-hydrate storage process to be developed by Mississippi State University, and a study by Clemson University to use hydraulic fracturing and acidizing to create underground storage in carbonate formations, preferably near major gas markets or pipelines. The limestone dissolution process and storage

field performance will be modeled, in preparation for an economic analysis. If successful, the project could be applied to big market areas in the Appalachian basin where carbonate formations are widespread. Areas near Buffalo, Columbus, Pittsburgh, Lexington and Charleston, WV possibly could take advantage of this type of technology, as well as any area where limestone formations underlie major pipelines.

SONIC STIMULATION

Sonic stimulation, the process of sending sound waves through a reservoir to free trapped oil droplets, has been used in the last decade to enhance oil production. While results have been positive in some cases, most of these applications were not scientifically sufficient to form a solid theoretical basis. Stimulation experts have concluded that this lack of basic understanding has led to widely varied tools and mechanisms with inconsistent, yet promising, results.

To establish a more scientific knowledge base, DOE has selected Michigan Technological University to conduct a project to calibrate and test sonic stimulation technologies. The project has been designed to establish a link between laboratory experiments and field demonstrations. A test facility in the northern Michigan Silurian reef trend, operated by the university, will be used for all field work. Manufacturers of sonic stimulation tools will partner with the university in this effort. The approach will lead to a unified set of accepted industry standards by which sonic stimulation technology can be applied.

For further information contact Bernadette Ward at 918-699-2033; bward@npto.doe.gov.