



# Newsletter

Fall 2002

Vol. 3 No. 3

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## FROM THE DIRECTOR'S DESK...

I delayed this edition of our quarterly WebNews feature hoping to be able to make an "official" announcement concerning the immediate future of the PTTC program in the basin. However, although nothing official has been received, I feel confident that I can "unofficially" announce that the current PTTC contract, scheduled to end in May 2003, will be extended to September, and will be followed by a new five-year contract. Obviously, we are pleased with

DOE's interest and confidence in continuing our program, and we acknowledge the importance of industry in this decision-making process. Without a strong expression from industry that PTTC has value for them, the program might not have been extended with DOE funding.

Now that our future is more or less secure, at least up to my retirement date, we can get back to the business of transferring technology to Appalachian

basin independents. We are in the process of evaluating and organizing workshops that have been suggested for the current year. Approximately half of these will be our traditional, one-theme, multi-speaker workshops organized by our Appalachian Oil & Natural Gas Research Consortium partners. The other half will be of the “traveling expert” variety, where we will bring a speaker into the basin from another area to offer suggestions that may have application here.

The first offering of the latter variety will be held December 3<sup>rd</sup> in Washington, PA. Ron Nelson, formerly of Amoco (then BP-Amoco, then...) will present a one-day workshop on **“Exploration and evaluation of fractured reservoirs with emphasis on fault-related systems.”** See below for details. Dr. Nelson is a nationally - make that internationally - recognized expert in the fields of structural geology and fractured reservoirs, and we are fortunate, indeed, that he has agreed to present this one-time workshop in our area. This is an opportunity not to be missed for any of you who complete and produce wells from fractured reservoirs. And, how many reservoirs do we have in this basin where fractures are not important?

We are negotiating with Roger Slatt, Chairman of the Geology Department at Oklahoma University, and Sandra Mark, Director of the PTTC program in the Rocky Mountains, for a two-day reservoir characterization

workshop to be held next spring. This workshop, called **“Applied reservoir characterization for the independent operator,”** places an emphasis on compartmentalized reservoirs and routine techniques for detecting these compartments. The first day and a half will be broken into 13 units, including geologic controls on porosity and permeability; seismic detection in carbonate reservoirs; flow unit determination and characterization; basics of sequence stratigraphy; borehole image logs and application; dipmeter logs and application; structurally compartmentalized reservoirs; and reservoirs developed in five different depositional environments. The afternoon of the second day will focus on the effective use of computer technology for reservoir characterization work. Emphasis will be placed on cost considerations for small, independent operators. If you are interested, please contact me, and we will try to bring this highly-successful workshop into our area.

Several people have contacted me with requests for seismic workshops, actually at both ends of the scale. In our attempt to accommodate everyone, we are negotiating for a workshop on 3-D seismic, probably to be held in Pittsburgh, and, at the other end of the scale, a three-day school on seismic interpretation for geologists who have never been trained as geophysicists, but are called on to use seismic in their daily decision-making process.

Another traveling expert workshop under consideration will focus on the environmental aspects of a coal-bed methane play. This workshop recently was offered in Denver, where it was well received, and we hope to be able to offer it here.

Finally, Ron Surdam has agreed to come to the basin with his workshop on **basin-centered gas accumulations and the development of abnormally pressured zones** below a regional pressure seal. This workshop has direct application in a basin like the Appalachian basin that submerged with deposition, and then was uplifted. During the rebound phase pressure compartments formed, and some were broken by fracturing, and this workshop will teach

us how to find the regional velocity inversion surface, gas-saturated zones below it, and the zones that are either under-pressured or over-pressured. Under-pressured zones occur at depth due to leakage of pressure compartments into shallower gas-saturated zones as the rocks are fractured during uplift. However, the deepest portions of the basin may have not leaked yet, resulting in over-pressured compartments in deeper rocks, like the Trenton and Black River carbonates. This promises to be a very interesting workshop.

Doug Patchen  
RLO Director

## WEST VIRGINIA'S GOVERNOR WELCOMES GAS-FROM-COAL-SEAMS PLAYERS

On September 24<sup>th</sup>, Governor Bob Wise welcomed approximately 100 individuals to a conference in Charleston, WV who share a common interest: the further development of gas from coal seams in the Northern Appalachian basin, including southern West Virginia. The conference on "Coal Seam Natural Gas in the Northern Appalachian Basin" was co-hosted by the Interstate Oil and Gas Compact Commission.

During his opening remarks, Governor Wise stated that West Virginia has significant coal deposits and is attractive to coal-bed methane operators. The Governor wants to encourage development of a resource that otherwise would be lost, and his administration is committed to doing so. But, he said, we have a lot yet to do, citing the difference in permits to drill coal-bed methane wells in Wyoming (>

8500) versus West Virginia (~85) last year. The Governor then challenged the industry members present to look hard at the opportunities offered by West Virginia's vast coal and coal-bed methane reserves when they are making decisions as to where to invest. He closed by stating that West Virginia has a permitting process, reasonable tax structure, and state agencies that are willing to work with industry. "We have rewritten the book on West Virginia, including permitting" he said.

Following the Governor's remarks, the group heard from Jim Slutz, Deputy Assistant Secretary for Fossil Fuels, DOE; Daniel Larcamp, Director of Markets, Tariffs & Rates, FERC; Rita Bajura, Director of DOE's National Energy Technology Lab; Robert Stokes, from the Gas Technology Institute; and Dina Kruger, Chief, Non-CO2 Gas and Sequestration Branch, EPA. The morning concluded with summaries of coal-bed methane activity and potential in West Virginia, Ohio and Kentucky, presented by the heads of the oil and gas sections at the respective state geological surveys.

The afternoon session focused on technology and legal issues. Pramod Thakur, Manager of Coal Seam Degasification, Consol Energy, discussed the barriers to coal-bed methane development, including technology, infrastructure, ownership and economics. Production of gas from West Virginia's coal beds is limited by diffusivity, i.e., the coals give up the gas very slowly. His company has developed a lot of coal-bed

methane technology over the past several decades, including a mine shaft with horizontal wells drilled from the bottom; vertical wells that were stimulated by hydraulic fracturing; and slant holes from the surface. He concluded that the development of gas from West Virginia coal beds is technically feasible, economically profitable, and can be done without harming the environment.

Dan Kortum discussed Dominion's commitment to develop their resources in West Virginia, including coal-bed methane drilling and production and building the necessary infrastructure. He suggested that a total basin solution was needed, with partners to share the risk and to create the infrastructure, and that IOGCC could act as a catalyst in this effort.

Joseph Zupanick described new technology developed in West Virginia by CDX Gas, Inc that is now being used in western coal basins. A more in-depth summary is present below.

Liz McClanahan, Jill Harrison and Tom McJunkin discussed legal issues and case studies that have impacted the development of coal-bed methane. Don Oltz, recently retired State Geologist of Alabama, discussed the issue of fracturing coal beds in Alabama and the recent LEAF decision. He suggested that we need to look at coal beds as aquifers with no matrix permeability to water, and wells as low pressure points in the coal beds. Therefore, after

fracturing and injection of frac fluids, these fluids, plus water and gas, all flow back to the well; frac fluids do not stay in the coal beds.

Most of the presentations can be seen on the Interstate Oil and Gas Compact Commission's website at

[www.iogcc.state.ok.us/ISSUES/csng.htm](http://www.iogcc.state.ok.us/ISSUES/csng.htm).

PAG member Rick Goings was present for the conference, and offered his impression that the IOGCC-sponsored event was "a good comprehensive overview of various aspects of the Coalbed Methane issue." He placed particular emphasis on the broad view taken by

organizers, so that "all facets, including the current political climate, legal and ownership issues, technological advances in drilling and production, as well as additional infrastructure (pipeline) requirements were addressed in varying degrees." He also was impressed that the attendees represented a broad spectrum of government, industry and academia professionals.

## SUCCESSFUL MULTI-LATERAL TECHNOLOGY GOES WEST

One of the key technology speakers at the September 24<sup>th</sup> conference on "Coal Seam Natural Gas in the Northern Appalachian Basin," was Joseph Zupanick, Vice President of Operations for CDX Gas, LLC. Mr. Zupanick made, what he termed, the first public presentation of a successful multi-lateral technology developed by his company in West Virginia that is now being used successfully in western basins.

Zupanick stated that opportunity in the Northern Appalachian basin is only moderate, in his opinion, because other areas with higher potential have retarded

development here. Also, high road and location costs in the Appalachian basin have further hurt development. Therefore, unconventional production technology is necessary to develop the coal-bed methane resource in the Appalachian basin.

Dallas-based CDX Gas is a recognized leader in horizontal well technology for the development of gas production from coal seams. CDX currently produces 18 MMcf per day from 29 wells in southern West Virginia, an average of 620 Mcf per well per day. Their approach in Wyoming and

McDowell counties is to develop the Pocahontas No. 3 coal with a dual-well system designed to minimize surface impact, effectively and economically recover the gas reserves, and answer the challenge of a delicate terrain and land obstacles.

Under the dual-system approach, a vertical well is drilled first, creating a cavity in the target coal bed and a rat hole below the coal. This vertical well gives the operator the exact location and thickness of the target coal. Then a horizontal well is kicked off from a second well, follows the coal bed and intersects the cavity created by the first well. This lateral is drilled past the vertical well, and gas is delivered from the lateral to the cavity in the first vertical well. The lateral is drilled under balanced, allowing for low production pressure. The cavity and rat hole act as a down-hole water separator, retaining water and allowing gas to flow to the production well.

The typical lateral is drilled to a horizontal distance of 4800 feet. Then the drill is pulled back along this main branch, and paired branches are drilled at 45 degree angles to the main, yielding a “barbed” appearance in map view. This

process continues back toward the vertical production well, creating a series of barbed branches in what CDX calls a “pinnate” drilling pattern. The final drainage pattern will cover a square area with a series of paired laterals, or barbs, intersection each other at 90 degrees where they join the main branch at 45 degree angles.

Four of these patterns can be drilled from a central well, creating a “quad pinnate” drainage pattern with four producing wells along four main laterals. The entire area covered by the quad pinnate pattern would be 9600 feet along each diagonal of the enlarged square, covering approximately 1200 acres.

The benefits of this system are its repeatability, eliminating stimulation problems with vertical frac wells with a consistent deliverability system; accelerated recovery, requiring a 3-5 year well life; high ultimate recovery, due to the uniform drainage pattern; and economics of scale, because fewer roads and locations are needed.

Mr. Zupanick concluded that “the state of West Virginia has acted as an incubator for our technology development” that has now been transferred to other coal basins.



## AAPG-SPE 203 EASTERN MEETING DATE MOVED UP

The date for the American Association of Petroleum Geologists Eastern Section - Society of Petroleum Engineers Eastern Region combined meeting, previously announced for September 20-24, 2003 has been moved up to September 6-10, 2003. The change was made to avoid a conflict with the AAPG International Meeting in Barcelona.

The two local hosts for the joint meeting, the Pittsburgh Association of Petroleum Geologists and the Pittsburgh Chapter of SPE, continue to move closer to a one-meeting concept rather than the original concurrent meetings concept. Both groups have created and filled their committee structure, and counterparts from both groups are working together to make this a truly memorable event.

PAPG released their **Call for Papers** at the 2002 Eastern Section Meeting in Champaign in early October, and will follow with a mailing to all Eastern Section members. The Call for Papers incorporated the meeting logo and theme, which encourages members of both professional societies who are interested in

“Taking a Closer Look” at the basin, particularly the deeper units, to submit abstracts. Papers are being sought in these areas: case studies, both geologic and engineering; exploration methods; fractured reservoirs; oil field history; deep potential; horizontal drilling and completions; energy conversion technology; and gas storage. In addition, PAPG is interested in offering strong sessions in topics that fall within the disciplines reserved for the Energy Minerals Division and the Division of Environmental Geosciences. Pertinent topics in these areas would include coal geology, coal-bed methane, CO<sub>2</sub> sequestration, gas hydrates, lineaments, and environmental and regulatory issues.

Abstracts are due to Mike Canich at Equitable Production Company in Pittsburgh by March 1, 2003. SPE will release their Call for Papers shortly. For further details go to the meeting website at [www.aapg-spe-2003.org](http://www.aapg-spe-2003.org) on a regular basis.

## TRENTON-BLACK RIVER RESEARCH CONSORTIUM FOUNDED

The Appalachian Oil & Natural Gas Research Consortium and the Appalachian Region, PTTC hosted a meeting for Trenton-Black River Stakeholders on September 25<sup>th</sup> at the National Research Center for Coal and Energy at West Virginia University. The purpose of the meeting was to have the consortium present a research plan for a basin-wide, multi-disciplinary study of the hot deep play, and to ascertain the level of interest among industry participants in joining a new “Trenton-Black River Research Consortium” to fund and conduct the research.

The morning session was organized around suggested task areas: structural geology and seismic investigations; stratigraphy; geochemistry; isotope geochemistry and fluid inclusion studies; petrology; and creating a database and secure website for consortium partners. The afternoon session began with an open discussion, which allowed input from industry regarding their opinion of the research plan and their suggestions for

additional research.

At the end of the day, nearly every company represented had expressed a strong interest in joining this consortium. Consequently, the AONGRC moved forward to write and submit a proposal to DOE to fund a basin-wide study which would produce a play book for Trenton-Black River exploration, which will include all data, interpretations and reports on petrology, geochemistry, isotope geochemistry and fluid inclusions; a resource assessment model and resource number for the play; an integrated stratigraphic-structural-diagenetic model of hydrothermal dolomite reservoir development; and fairways or target areas in which concentrated efforts could be made to expand the play.

Companies who are interested in joining the new consortium should contact Doug Patchen, Lee Avary, Jim Drahovzal, Jon Harper, Taury Smith or Larry Wickstrom as soon as possible.



## TRENTON-BLACK RIVER SESSIONS WELL ATTENDED

One of the highlights of the recent, highly-successful Eastern Section AAPG meeting in Champaign, IL was a session on Trenton-Black River Exploration and Development, during which six papers were presented. This session was very well attended by the majority of the 200 plus registrants. Papers covered a wide range of topics, including an overview of recent drilling activity by Lee Avary; seismic evidence for faulting and fault reactivation by Jerry Blaxton; possible

outcrop analogs for Trenton-Black River reservoirs by David Harris and Taury Smith; and two talks by Joe Fagin and Robert Hickman on extending the play into the Illinois basin.

Abstracts for these and all other talks presented at the meeting have been posted on the Eastern Section website at <http://karl.nrcce.wvu.edu/esaapg/ESabstracts.html>.

## OPERATORS IDENTIFY NON-CONVENTIONAL GAS PLAY NEEDS

Independent producers, representatives from service companies and government employees gathered in Morgantown on August 5 to discuss technology needs to develop cost effective solutions to problems associated with non-conventional gas resources in the Appalachian basin. The meeting was hosted by the Appalachian Region PTTC and Appalachian Oil and Natural Gas Research Consortium, in conjunction with the Gas Technology Institute and

New Mexico Tech, as one of five Focus Group Meetings held around the country. The purpose of these Focus Group Meetings was to identify research necessary to fully develop our gas resources in Devonian shales, coal seams, and low permeability sandstones and carbonates.

The format of the meeting included an overview of non-conventional gas resources and their importance in future gas supply, followed by separate breakout

sessions to discuss technology needs in each of the three non-conventional areas. By the end of each session, Facilitators had listed technology/research needs, which were then prioritized by participants. At the end of the workshop, the total list of needs was prioritized, regardless of reservoir type.

Operators identified the following as their primary needs if they are to continue to develop Devonian shale gas resources: characterization of natural fracture networks; evaluation of multi-lateral drilling in shale reservoirs; the need to extend well life; identifying facies changes within the thick shale sequence; reducing the drilling cost of wells, especially horizontal wells; and producing a synthesis of published data.

Priorities in coal-bed methane plays included: core drilling/evaluation programs; characterization of fracture/cleat systems; the need for gas desorption data, as part of the coring program; evaluating multi-lateral/horizontal drilling; distinguishing between microbial and thermogenic origins of the gas; thermal maturation studies; and obtaining data on water quantity and quality.

The final breakout session focused on discussions of gas produced from tight

sandstones and tight carbonates, like the Trenton-Black River. At the end of the session, one list of priorities had emerged: the need to produce play-based studies and workshops; reservoir characterization; methods to extend well life; creation of better databases; a better understanding of fracture systems (a common theme in all areas); understanding production from multi-layered reservoirs; understanding dolomitization patterns in deep carbonates; optimum stimulation methods; and horizontal drilling.

At the end of the day, workshop participants were asked to examine all three lists of technical needs, and cast votes to create one list of highest priority needs. That list is: reservoir characterization; the need for gas desorption data; extending well life; characterization of natural fractures/cleats; play-based studies; core drilling/evaluation programs; and multi-laterals/reducing well costs.

GTI hosted a final National Focus Group Meeting in Houston in early September, at which the results from all five regional workshops were released. To view the presentations at that meeting go to <http://octane.nmt.edu/uncongas>.

## STRIPPER WELL CONSORTIUM PREPARES FOR ROUND THREE PROPOSALS

The national Stripper Well Consortium is prepared to release their next Call for Proposals from consortium members in late December, with proposals to be due in March 2003. This announcement was made by consortium Director Joel Morrison during his welcoming remarks at the Southern Regional Technology Transfer Meeting, October 17 in Oklahoma City. Proposals should address one of three focus areas: reservoir characterization, well-bore remediation or surface facilities.

The Stripper Well Consortium (SWC) was organized in October 2000, and is about to enter the third year of their initial 3-year contract with the U.S. Department of Energy. Current membership stands at 60, mostly from the northeast, and 27 projects have been funded, at a cost of approximately \$2.7 million. These projects require a

minimum 30% cost share from consortium members.

New projects funded in 2003 include a study to improve injectivity in the low permeability reservoir in Big Sinking Field, KY, and a reservoir characterization study of the Wileyville oil field in West Virginia. The Wileyville study was designed to complement an engineering study of the same field funded by the SWC in 2001.

The SWC will host their Northern Regional Technology Transfer Meeting November 12-13 at the Four Points by Sheraton in Mars, PA, near Pittsburgh. Non-consortium members may attend by registering in advance and paying a registration fee. For further information e-mail [swc@ems.psu.edu](mailto:swc@ems.psu.edu), or visit the SWC website at [www.energy.psu.edu/swc](http://www.energy.psu.edu/swc).

## IOGCC RELEASES NEW REPORTS

The Interstate Oil and Gas Compact Commission has released their 2002 Edition of “Marginal Oil and Gas: Fuel for Economic Growth” and a special publication on “Who Will Fund America’s Energy Future?” that discusses

our petroleum research and development needs in the 21<sup>st</sup> century.

The Marginal Oil and Gas Report discusses both marginal resources, and presents data tables of stripper production during the past 10 years, state rankings in

stripper production, and the number of stripper wells and production, by state, for both oil and gas. In terms of state rankings for the number of stripper oil wells, Ohio ranked 4<sup>th</sup> nationally, Kentucky 7<sup>th</sup>, Pennsylvania 9<sup>th</sup>, West Virginia 12<sup>th</sup>, and New York 16<sup>th</sup>. In terms of stripper oil production, Ohio ranked 9<sup>th</sup>, Pennsylvania 12<sup>th</sup>, Kentucky 14<sup>th</sup>, West Virginia 20<sup>th</sup> and New York 24<sup>th</sup> among the 28 states. These five Appalachian basin states contain more than 75,000 stripper oil wells that produced 10,648,138 barrels of stripper oil in 2001. These totals include the Illinois basin portion of western Kentucky. Total stripper oil reserves in these states is estimated by IOGCC to be 84,226,000 barrels, only an 8 year supply at current production rates.

Pennsylvania, West Virginia and Ohio rank 1, 2, 3 in the number of stripper natural gas wells. Kentucky was edged out by Texas for 4<sup>th</sup> on this list, with New York ranked 12<sup>th</sup> and Virginia 22<sup>nd</sup>. In terms of gas production from stripper wells, West Virginia ranked 2<sup>nd</sup>, Pennsylvania 3<sup>rd</sup>, Ohio and Kentucky 8<sup>th</sup> and 9<sup>th</sup>, New York 16<sup>th</sup> and Virginia 19<sup>th</sup>. These six states have a total of 131,497 wells that produced 511,343,452 Mcf of gas in 2001. Of these states, only Virginia and New York had significant

non-stripper gas production. New York's stripper gas production was 40.6% of their total gas production, thanks to their big Trenton wells, and Virginia's stripper gas production represented only 31.3% of their total production, thanks to a strong coal-bed methane play.

The report on who will fund our energy future reached some interesting, but not surprising conclusions. The report stated that it is evident that the major oil and gas companies do not spend as much on R&D as other industry sectors. In fact, the report states that the petroleum refining industry ranked last among 19 industry sectors in terms of R&D expenditures as a percentage of sales, and the oil and gas field services industry ranked 17<sup>th</sup> among the 19 sectors. The report went on to conclude that it is clear that independents are too small to pay the huge investment required for research and development, and that corresponding cuts in federal spending on R&D have "created a critical situation." The report concludes with "If the United States is to maintain its ability to produce its domestic supplies of oil and natural gas at a reasonable cost to consumers, federal expenditures on R&D must fill some of the void left by industry."

## FRACTURED RESERVOIR WORKSHOP ANNOUNCED

Dr. Ronald A. Nelson, formerly with Amoco, BP Amoco and now Broken N Consulting, Inc will present a one-day PTTC workshop on “Exploration and Evaluation of Fractured Reservoirs with Emphasis on Fault-Related Fracture Systems.” The workshop will be December 3<sup>rd</sup> at the Holiday Inn, Washington, PA.

Dr. Nelson has more than 27 years of experience as a structural geologist, and has taught numerous courses for AAPG and other professional societies on fractured reservoirs. His textbook, “Geologic Analysis of Naturally Fractured Reservoirs” is widely used, and he has lectured on structural geology and fractured reservoirs to oil companies, universities and societies in more than 20 countries. In addition, he has served as President of the Houston Geological Society, as Vice President of AAPG, and currently is a candidate for President-Elect of AAPG.

The workshop will cover the basic elements needed to evaluate fractured

reservoirs, with an emphasis on fault-related fracture systems, such as those in the Trenton/Black River Play in the Appalachian basin. A general sequence of study will be presented, along with the data types necessary to successfully complete the study. Data include outcrop and subsurface rock data, petrophysical data, rock mechanic principles and reservoir performance data. Participants will learn what controls short-term and long-term performance in fractured reservoirs. The workshop will be organized around 10 topic areas, including determination of reservoir properties of a fracture system, predicting production and development problems by reservoir type, predicting and imaging sweet spots in fault-related systems, determining optimum well paths in fault-related fracture systems, evaluating reservoir volume and preparing for reservoir simulation of fractured reservoirs.

For further details contact us, or visit the web at <http://karl.nrcce.wvu.edu>.