



Appalachian Region

Timely, Informed Technology Decisions

Summer 2007

Our Final Edition - Thanks for Your Support!

Vol. 8 No. 1

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FROM THE DIRECTOR’S DESK

This edition of the Appalachian Region’s On-line Newsletter marks the end of our 12-year effort to host a website for PTTC in the basin. Even as I write this, the new, national PTTC website has gone on line (www.pttc.org/index.html) and includes for each of the now seven PTTC regions much of what we have tried to offer on our pages through the years. When you go to the new site, click on the word “Appalachian” - not on the map - and you will go immediately to a regional site that is organized exactly like the other six regional sites. Information on the site is controlled by the national webmaster, but each region is expected to make contributions to the site several times each year, and to submit calendar items on a regular basis.

The demise of regional websites and regional newsletters, both printed and on-line, is part of the new agreement between PTTC and DOE that places more emphasis on a national website with regional contributions, a national newsletter with regional pages, and the development of “Knowledge Centers” at the national level. At the regional level our focus has been reduced to workshops only, along with

the periodic contributions to the national website and newsletter.

However, because we have hosted the Eastern Section AAPG web pages as part of our website for many years, and because we have always downplayed the activities of our own Appalachian Oil & Natural Gas Research Consortium, we have decided to rename this site, converting the banner from PTTC to AONGRC, and go on much as before, but without the newsletter.

This is not the only news about the new PTTC. In the article below, you can read about the new AAPG-PTTC partnership. The Executive Committee of AAPG and the Board of Directors of PTTC have reached an agreement for AAPG to become the managing partner of PTTC. Details are being worked out by a Transition Committee right now, and hopefully the process will be completed by October 1, 2007.

During the first six months of this year, even after all of our DOE funds and program income had been expended, we struggled on,

helping to set up four PTTC stakeholder meetings, helping ConocoPhillips set up a “Town Hall” meeting in Charleston, and cooperating with the Appalachian Geological Society and the Pittsburgh Association of Petroleum Geologists to co-host two excellent well logging workshops taught by Weatherford. And, we hosted two well-received PTTC workshops here in Morgantown. Details can be found in the articles that follow.

Finally, we re-structured and streamlined our PAG, the group of dedicated industry professionals that volunteer their time, money and expertise to form a Producer Advisory

Group that has the pulse of the industry in the basin. The smaller group of 12 individuals has re-committed to the new PTTC and is working on a list of workshops we hope to develop during the next 15 months.

Please take a few minutes to read the article below. It has been my privilege and pleasure to write these and similar articles for you over the past 12 years.

Doug Patchen

RLO Director

AAPG-PTTC Partnership Announced

For much of the last year, even while the PTTC Board of Directors attempted to continue DOE funding and encourage industry to become members of a new PTTC, they also were looking for a “White Knight” that could ride in and save the day. In the end, the Board was able to obtain additional DOE funding through September 2008, to attract some industry support, and to find in AAPG the White Knight they had been seeking.

The Executive Committee of the American Association of Petroleum Geologists (AAPG) recognized that PTTC was providing a valuable service to all members of industry at the local level, including many AAPG members. Although AAPG offers a variety of workshops for their members, these workshops are usually held at only one or two locations, requiring additional time and money for many members to travel and attend. AAPG realized that by utilizing the PTTC network they could bring these and other workshops to members and non-

members in the basins where they live and work. AAPG also likes the multi-disciplinary nature of PTTC workshops, events that combine geology, engineering, geophysics and software training to help the petroleum professional. With this in mind, AAPG made an offer to PTTC to assume management of the new AAPG-PTTC company.

At the same time, AAPG was aware that PTTC had just signed a new agreement with DOE for transition funding, financial support that would carry PTTC past the end of federal funding into an era of industry funding. Because of this, both AAPG and PTTC were very careful to include DOE in early discussions involving a new partnering arrangement. For their part, DOE, which has always wanted industry to step up and assume a larger role as a financial supporter of PTTC, was quite receptive of the new opportunity for PTTC to be actively sponsored by an organization with more than 30,000 members. Many in DOE have been waiting for this level of industry commitment

ever since PTTC was created, and now that industry has committed at this level of support, some in DOE have expressed a desire to remain involved as a “minority” stakeholder, as a proud parent likes to stay involved with a successful offspring.

AAPG’s focus will be on regional workshops, but the identity of PTTC is important and will be retained. One way, in addition to workshops, to retain this identity is to continue the new national PTTC website and newsletter.

For those of you who had offered to join the new PTTC and had pledged, or even sent a check, we are pleased to announce that this effort will be continued, with a more regional focus. AAPG is a business, and will invest in PTTC as a business enterprise. As such, they expect a return on their investment, and if the regions are successful in this new business enterprise, additional funds will be forthcoming. Individual and company financial support can help the PTTC regions meet their financial return goal.

There will be one additional structural change that is very important to our region. AAPG may choose to reorganize the seven PTTC Regions to more closely align with the six

AAPG Domestic Sections. This would mean that the Illinois-Michigan Region would combine with the Appalachian Region to match the boundaries of the Eastern Section of AAPG. Although this change would not be obvious to industry members in the three basins, it will mean a change in the way in which we will manage the new, expanded area, and will cut into our regional budget, regardless of whether the money comes from DOE or AAPG.

This new alignment of PTTC Regions to match AAPG Sections brings with it the opportunity for PTTC and the AAPG Section Executive Committees and Annual Meeting Planning Committees to work together to develop PTTC workshops that will be attached to AAPG Domestic Section meetings. Here in the Eastern Section of AAPG, we have done this for at least the last four years for meetings in the Appalachian basin, and for the two previous years when the Eastern Section meeting was held in the Illinois basin (2002) and Michigan basin (2001).

As I mentioned above, details are still being worked out, and some things may change, so watch the new PTTC website for further details.

Check Out the New PTTC Website

I encourage you to spend a few minutes examining the new PTTC website. Once again, the address is <http://www.pttc.org/index.html>. When you get there, click on “Appalachian” and visit the pages set aside for our Region. General information (PAG members, calendar, state surveys, state oil and gas agencies, universities with petroleum-related departments, oil and gas associations, professional societies, contact

information) can be found under the buttons on the top of the page. A large block of buttons down the left side offers the opportunity for you to be a sponsor. Clicking on your company name would take the user to your website.

Below the map are five buttons that lead to more technical information for the region. This is the area where the national webmaster

will be soliciting updates and new information at regular intervals throughout the year. Hopefully, it also will be an area where we can recommend where the buttons will lead us.

The pages for all seven regions are formatted the same, so once you learn your way around one region, the others will be easier to search.

Go back to the national homepage and take the time to look under each of the ten

buttons across the top of the page. In addition to the calendar, general information about PTTC, and several buttons leading to numerous links, there are buttons for technology summaries, workshop summaries and workshop presentations. The workshop summaries are organized by general topics, such as exploration, drilling & completions, production, etc. These pages are new and offer tremendous potential for future expansion, including slides and notes from individual presentations, assuming that the speaker will agree to this and submit the slides.

AAPG and SPE to Meet in Lexington

Lexington, Kentucky will host the 2007 Eastern Section meeting of the American Association of Petroleum Geologists (AAPG) and the Eastern Region meeting of the Society of Petroleum Engineers (SPE). Located in Kentucky's beautiful Bluegrass Region, Lexington offers scenic geology and a perfect setting for the discussion of geology and engineering related to energy issues.

ES-AAPG leads off with their meeting at the Hyatt Regency and the new Lexington Center, beginning with a choice between two field trips and a Petra workshop on Saturday, September 15th, and continuing through Wednesday, September 19th, when once again a choice between a field trip and workshop will be offered. In between these workshop-field trip days, the host society, the Kentucky Society of Professional Geologists, will offer a workshop, field trip and Devonian "shalebration" (core workshop) on Sunday, and technical sessions on Monday and Tuesday. The traditional Opening Session and Awards Ceremony will begin at 3:00 pm on Sunday, and will be followed by the Icebreaker Reception in the Lexington Center.

Technical sessions will include papers on eastern basin oil and gas geology; carbon sequestration demonstration and evaluation; tectonics and sedimentation; black shale drilling and production; carboniferous stratigraphy and geochemistry; geology and public policy; oil and gas business and EOR; and coal bed methane. Field trips will be taken to Mammoth Cave and the Nolin River Gorge; the Falls of the Ohio; the Kentucky River Palisades, which is a canoe trip; coal geology along Kentucky Route 15; and the Shakertown area on the Kentucky River.

In addition to the Sunday night Icebreaker Reception, all registrants will be transported to the Red Mile Racetrack for a night of racing on Monday. Guests will be offered the opportunity to visit the Natural Bridge State Resort Park and to spend a morning in the Bluegrass at Old Friends, a nonprofit rescue/retirement operation at Dream Chase Farm, where champion racehorses enjoy their retirement. All in all, it sounds like a great meeting, with a mixture of solid technical events and fun social gatherings.

SPE's Eastern Region meeting will begin with a Golf Outing, workshop and Welcome Reception on Wednesday, October 17 and continue with technical sessions on Thursday and Friday. The meeting will be held at the Holiday Inn North on Newtown Pike.

Technical sessions have been organized around the following themes: coal bed methane; enhanced oil recovery; tight reservoirs;

reservoir/production monitoring; hydraulic fracturing; and gas storage. Other scheduled events include a keynote luncheon; a Kentucky wine country tour and luncheon; and dinner and Monte Carlo Night on Thursday. The technical program promises to offer high quality presentations, and the social events at the SPE Eastern Region meeting are always a lot of fun. Once again, the SPE local hosts have organized a balanced meeting that should be well attended.

AAPG-SPE Eastern Meeting '08 Getting Organized

The Pittsburgh Association of Petroleum Geologists and the Pittsburgh Chapter of the Society of Petroleum Engineers have teamed up once again to host the 2008 AAPG-SPE Eastern Meeting at the Hilton Hotel in the Three Rivers area of Pittsburgh. The meeting will begin with filed trips and workshops on Saturday, October 10th and continue through workshops and a field trip on Wednesday the 15th. Individual session

themes are being developed for the technical program on Monday and Tuesday.

The theme for the 2008 meeting will be "Appalachia - Unconventional Since 1859." The host societies will release a Call for Abstracts in September, beginning with the Eastern Section AAPG meeting in Lexington.

Shale Play Workshop Well Attended

Recent successes in the Barnett Shale Play have attracted the attention of industry everywhere, leading to an explosion of activity in gas shale trends in many parts of the country. Here in the Appalachian basin, names like Barnett, Woodford, Caney, Fayetteville and Floyd have become as well-known as Antrim, New Albany, Huron, Rhinestreet and Marcellus. And, while Appalachian, Illinois and Michigan basin operators have taken a serious look at some of these new shale plays, they also have shown interest in revisiting our older shale plays.

There are certain critical factors common to all shale plays, beginning with the type and

amount of kerogen that is deposited in a shale body, the thickness and extent of the kerogen-rich accumulation, the maturity of the kerogen-rich shale body, and the extent of fracturing and faulting resulting from later tectonics that created permeability pathways. In spite of these common and very important factors, however, every shale play is different, and each requires a slightly different, but integrated approach involving geology, geophysics and engineering in order to be more fully understood. This integrated approach will lead to better exploration, drilling, completion and production strategies and reservoir characterization. Certain data elements are essential to characterize a shale

play, and the acquisition of these data must be considered in the early stages of planning and maintained throughout the effort. In spite of the differences among the various shale plays, by using a consistent and integrated approach, what operators learn from one play can be modified as needed and applied to another play.

The paragraph above summarizes, to some extent, what attendees heard at a recent PTTC workshop in Morgantown called “Comparative Anatomy of Devonian Shale Plays in the Appalachian, Illinois and Michigan Basins.” The workshop organizers wanted to present an overview of various shale plays, allowing attendees to compare and contrast these plays, and perhaps to apply what they learned from one play to another, and to learn the answers to the following questions.

Can a close examination of the anatomy of a new shale play help to resolve still unanswered questions in older shale plays? Or, does each new play bring with it a new set of questions to be answered? What is it that can make a shale a commercial play? How do you evaluate the potential of these shales? What new technology has been developed to exploit these plays? What can we learn from one play that can be applied to other plays? What characteristics are unique to a given play and must be understood to achieve success?

The workshop was designed to present a comprehensive comparative anatomy of three eastern basin shale plays, including discussions of internal stratigraphy, structure, reservoir character, production controls, drilling and development history, and advances in technology as the plays developed. Workshop speakers made a number of points, including the following.

New shale plays require new approaches

and new technology. The focus of operators should be on developing an integrated geologic, geophysics and engineering approach that includes new techniques, rather than continuing to do what they have been doing for decades in older shale plays.

Geophysical (seismic) studies are the only method available to characterize a reservoir prior to drilling. As drilling proceeds, log data can be added to identify sweet spots and determine controls on heterogeneity in the reservoir, including fracture location, intensity and direction. Log data also can be used to determine factors controlling reservoir quality, such as mineralogy, clay content, amount of cementation and presence of natural fractures. Completion planning should consider the location of major and minor faults and the size of the fault’s structurally damaged zone.

Shale petrophysical evaluation studies help delineate the shale gas beds, quantify adsorbed and free gas content, estimate permeability, and predict production. Because methane adsorbs to kerogen in a shale body, a methodology can be applied to determine kerogen content, then convert this to total organic carbon (TOC), and finally determine gas in place.

Shale gas reservoirs are vast, continuous (wide geographic area) accumulations, but highly variable, both vertically and laterally. Variations in anoxic levels and input of coarser clastics and carbonates, plus climate forcing, can result in vertical cycles that repeat over large areas. For example, the classic Upper Devonian section in New York is a series of black shale, gray shale and siltstone cycles ranging over a vertical sequence that extends from the Marcellus Shale to the Lower Huron (Dunkirk) black shale.

Post-depositional diagenesis and structural events are superimposed on the stratigraphic/depositional character of the shale bodies and affect thermal maturity, gas-in-place (GIP) and productivity.

Geomechanical modeling can help characterize stress state and guide completion decisions. If the decision is made to drill a horizontal well, the first question is which direction to drill? A lateral drilled parallel to the direction of maximum stress should result in large induced vertical fractures in the plane of natural fractures extending above and below the horizontal well. If the horizontal well is drilled perpendicular to the maximum stress direction, induced fractures should be perpendicular to the borehole.

What is “a good” gas shale? Typical gas shales are self-sourced and self-sealed, they contain both free and adsorbed gas, they are thermally mature and naturally fractured, and have variations in mineralogy due to changes in silica, clay and organic content. These shales must be fractured to produce economically, but typically wells exhibit long production lives following fracture stimulation.

Common questions early in a play’s life are: How much will an average well produce? How widely will individual wells vary in production? And, how many wells must be drilled, and how long do they need to produce, before production and reserve estimates are reasonably accurate? Of the several reserves techniques available (volumetrics, material balance, decline curve and reservoir simulation), decline curve forecasting and reservoir simulation (modeling) are most commonly applied. Decline curve analysis only requires production data, but the wells must be in decline. Wells that must be dewatered early exhibit

production curves that are inclined, and this analysis can seriously underestimate long-term production and cumulative recovery.

Gas shales are highly complex reservoirs and production from individual wells can be expected to be highly variable. Because most shale plays can be described as statistical in nature, operators need to drill many wells to begin to understand the play. Technology is rapidly evolving, and our ability to maximize recovery will increase as our ability to integrate geology, engineering and geomechanics into better reservoir models increases.

There are two basic types of gas systems: biogenic, in which gas is generated by biogenic metabolism of the organics in kerogen and oil; and thermogenic, in which gas is generated by the “cooking” of organic material. Other gas systems are present between these two end members, and represent various degrees of mixing of end-member gas.

The three Upper Devonian gas shale plays compared in this workshop represent the biogenic (Antrim Shale) and thermogenic (Appalachian shales) end members of the shale systems, whereas the New Albany represents a mixed system, with both biogenic and thermogenic plays in different parts of the Illinois basin.

The Antrim play in the Michigan basin is one of the more mature gas shale plays, dating back to the 1980s. Approximately 8,800 producing wells, with a current average daily production of 44 Mcf/well, have been drilled, and more than 400 wells continue to be drilled each year. Cumulative production is about 2.4 Tcf, with an estimated ultimate recovery of 5.0 Tcf.

Wells are completed in both the Lachine (upper) and Norwood (lower) black shale members of the Antrim Shale. The 12-county play area on the northern edge of the basin is covered with glacial drift, below which are channels carved by a pre-glacial river system. Because the glacial drift is an aquifer, state law requires that casing be set 100 feet below the bottom of the drift and cemented to the surface. Therefore, if a well is mistakenly drilled in a channel, the entire black shale target would be cased and could not be completed. So, an essential drilling strategy is to make use of seismic to map and avoid drilling into these channels.

The Norwood and Lachine members are perforated and then completed separately with light sand nitrogen fracs. Frac size in the upper, thicker Lachine is typically larger than in the lower, thinner Norwood. Many of the earlier wells were not logged open hole, so operators used sample logs, rate-of-penetrations logs, and cased-hole, gamma-ray logs to guide completion. Many operators still don't use open-hole logs, while some use induction and porosity logs akin to the evaluation used in "conventional" reservoirs.

Much of the technically recoverable, but as yet undiscovered gas in the Illinois basin is in the New Albany Shale, but little is known about the small details of this potentially large gas resource. The shale is deeper and thicker to the south, with a major depocenter in southwestern Indiana, where the New Albany has been divided into five members. Four of the five members have appreciable thicknesses of brownish-black shale with TOC in the 8 to 15 percent range. Collectively, the New Albany is an excellent source rock. An estimated 98 percent of all oil and gas in the Illinois basin was sourced in the

New Albany, and much of the gas is still in the formation, particularly in the lower Blocher and upper Clegg Creek members.

The central and southern portions of the Illinois basin entered the oil window during the time of maximum burial in Pennsylvanian-Permian time, and today much of the New Albany remains in the oil window. During the Pleistocene, melting of glacial ice recharged these fractured shales from north to south in the basin. This enhanced microbial methanogenesis, generating biogenic gas along the basin margins, and deeper into the basin over time as fluids continued to migrate. This has resulted in three areas of gas accumulation in southern Indiana. The first area, to the north, is characterized by both biogenic and thermogenic gas and the area is not being recharged today. The second area, to the southeast toward Kentucky, contains both biogenic and thermogenic gas and is being recharged by modern precipitation. The third area, to the southwest, is characterized by saline brines and thermogenic gas and there is no evidence of modern recharge or of biogenic gas.

New Albany Shale gas fields are small and centered in southern Indiana. Gas production is associated with natural fractures, and the current thinking is that fracture density and width are less outside the current area of production. Based on limited data, the primary fracture set was thought to trend N45E with a perpendicular, but minor set trending N45W. A gas-water contact has not been encountered in the New Albany gas fields, but typically these wells produce a lot of water, usually when underlain by a high-porosity carbonate aquifer.

The big difference between the Antrim and New Albany plays appears to be the fracture systems. The Antrim play area is characterized by a strong set of NE-SW fractures, with an

equally strong NW-SE set. Both fracture sets exhibit good connectivity, both are water filled and both are equal in terms of fracture spacing. The New Albany play area, however, according to more recent operator reports, is dominated by a unidirectional, water-free fracture set trending more E-W. In-place gas resource estimates for the Antrim range from 35-76 Tcf, and 86-160 Tcf for the New Albany. For this reason, companies like Aurora have decided to “embrace the water” that carries microbes that generate biogenic gas, and locate the fractures that contain the gas, while being prepared to produce a lot of water. Thus, a fracture identification log is an important tool for their shale programs.

In any shale play a driving principle is to minimize back pressure. John Hunter with Aurora Oil & Gas shared some of their completion and operating practices. In a typical medium radius horizontal, casing would be set at the top of the shale, then the lateral drilled open hole rising from heel to toe. With the pump set in the casing there would be some back pressure from fluid head. An alternative is to drill and case a sump through and below the zone, then move uphole and drill the lateral rising from heel to toe. Fluid would then flow from the toe to the heel, then drop into the sump where the pump is set. Another option is to intersect a vertical producer drilled at the toe of the horizontal. In this case the horizontal trajectory would be downward from heel to toe. Aurora continues this “low pressure” philosophy throughout the surface facilities. Gathering systems use separate large diameter poly pipe for gas and water. For compression modular screw compressors provide more flexibility and are lower cost than reciprocating compressors. CO₂ removal can also be accomplished onsite at low pressure (100 psi), versus the conventional approach of compressing to pipeline pressure (1200 psi) and transporting for third party treating.

The U.S. Geological Survey has defined six continuous Middle and Upper Paleozoic accumulations as Appalachian basin individual resource assessment units, four of which include Devonian shale plays. These four are the Northwestern Ohio Shale Assessment Unit (AU), the Greater Big Sandy AU in Kentucky and southwestern West Virginia, the Devonian siltstone and shale AU in West Virginia and Pennsylvania, and the Marcellus Shale AU. Black shale tongues associated with these assessment units developed within the Acadian clastic wedge following the Acadian orogeny. These fine-grained clastics were further altered by major thrust fault activity on the southwestern side of the basin, creating fracture porosity, and major folding events to the northeast. Deeper burial of the units in the east and basin center versus the shallow western side of the basin resulted in differences in thermal maturity and oil versus gas generation.

Recognition of the vertical and lateral extent of the Middle Devonian unconformity is important to operators in the basin. The effect of the unconformity is less to the east, where the Tully Limestone is still present, and increases in magnitude to the west, placing progressively younger units on top of progressively older units across the unconformity. The first black shale to pinch out westward is the Geneseo Member of the Genesee Formation, followed by the Middlesex Member of the Sonyea Formation, both above the unconformity, and then the Marcellus Shale below the unconformity. At this point, the black Rhinestreet Shale rests directly on the Onondaga Limestone in eastern Kentucky and Ohio.

In spite of the unconformity that eliminates several of the thin black shales, in the words of one speaker, “there are lots of shales,

and lots of gas, the problem is getting it out.” Each shale play is different, and even within one play one area differs from another. Jim Fontaine compared the Barnett Shale to the Devonian shales in the Appalachian basin and concluded that the Appalachian basin shales have lower gas in place, lower pressures and lower reserves. He then discussed how to stimulate the shales effectively, and what has been learned about fracture efficiency through microseismic fracmapping. These studies have indicated that the bigger the better; with increased volumes the stimulated reservoir volume increases, and the more you bust up the rock, the better.

Challenges in the Appalachian basin include developing our knowledge of rock mechanics, reservoir quality, formation depths

and pressures, reservoir transmissibility, fracture complexity and optimal stimulation techniques. Logistical challenges include location size, water supply and disposal, perforation strategy, drilling technology, and drilling and completing horizontal wells. However, according to recent estimates of undiscovered gas resources in the basin, there is good potential in the shales.

The USGS assessment of undiscovered natural gas resources in Devonian black shales in the Appalachian Basin was done on an individual cell (acreage) basis for the shale assessment units. One end product, a map showing the estimated per well recovery of different geographic areas, would seem indispensable to anyone embarking on a gas shale development program there.

Workshop speakers and their topics included the following:

Shale Play Challenges and Technology – presented by Schlumberger-Pittsburgh
Introduction, history and overview – Jeron Williamson (for Chuck Boyer)
Role of geophysics in exploration and development - Brian Toelle
Geology and petrophysics of shale reservoirs - Peter Kaufman
Drilling and completion technology for shale reservoirs - Kirby Walker
Reservoir evaluation and reserves in shale reservoirs – Jeron Williamson
Wrap-up and conclusions – Jeron Williamson

Assessment of Undiscovered Natural Gas Resources in Devonian Black Shales, Appalachian Basin, Eastern U.S.A. - Robert Milici, U.S. Geological Survey

Shale Reservoir Evaluation and Stimulation - Jim Fontaine, Universal Well Services

Geology and History of the Antrim Shale Play, Michigan Basin - William Harrison, Western Michigan University

Geology of the Devonian New Albany Shale Play, Illinois Basin - Chris Swezey, U.S. Geological Survey

Commercialization of Biogenic Gas from Antrim and New Albany Shales - John Hunter, Aurora Oil & Gas Corporation

Geochemical Evaluation and Comparison of Eastern USA Gas Shales to Other Shale Gas Systems in the USA – Dan Jarvie, Humble Geochemical Services, a Weatherford International Company

Proposed “Appalachian Basin Shale Play Research Consortium”- Douglas Patchen, WVGS-WVU

Editors note: Lance Cole, PTTC Executive Director, contributed to this article.

Digital Revolution Workshop Offers a Look Ahead

One of the biggest needs of industry is quicker, more convenient access to a wider variety of data, preferably without leaving their offices. The state geological surveys in the Appalachian basin have made great strides in creating various types of databases, going well beyond the traditional, individual-well-based digital databases that began to be developed in the 1960s. The newer databases, many resulting from cooperative efforts involving multiple state surveys, include field-scale data, as well as scanned images of a variety of basic data. The surveys also are placing a high priority on converting maps and cross sections from older research reports to a GIS that can be accessed by industry users.

Traditionally, public oil and gas databases in the Appalachian basin have contained various parameters associated with site-specific well locations, including tops, formation thicknesses, treated intervals, initial well tests and pressure, and production histories. Each state agency, typically the geological survey, determined the data elements to be stored, created their own format, selected their own operating system, and developed different systems for delivering data to the user, if data were to be provided at all.

More recently, the state geological

surveys participated in cooperative projects to develop basin-wide databases that included information on individual wells and fields. Individual reservoir data were compiled on a field scale for oil (TORIS database for Appalachian basin fields) and gas fields (Atlas of Major Appalachian Gas Plays), and a variety of other data types (stratigraphy, structure, seismic, petrology, geochemistry, production history) were compiled in a database and website for the Trenton-Black River play book project.

These basinwide databases created during recent research projects include digital maps, cross sections and other illustrations that were either works in progress or finished versions in reports and slides used for presentations. References from the literature and lab data generated during the projects also are included in this “new generation-style” database, one that captures in digital form all aspects of previous work as well as new information. This type of database is part of a new trend to capture, organize and deliver, through on-line delivery systems, new and old data and research information that can be sorted in a variety of ways.

PTTC recently organized a workshop in Morgantown to describe and discuss the digital

revolution in database development. Workshop speakers from each of the main producing states in the Appalachian basin discussed several of these new database projects, with an intended emphasis on how Industry can access the final products.

Authors used a combination of power point and on-line live demonstrations of their databases. Speakers from the Pennsylvania Geologic Survey (PGS) alternated, with John Harper presenting an overview of the WIS (Well Information System) and PA*IRIS (Pennsylvania Internet Record Imaging System) and Kyle Imbrogno presenting a live demo of both. WIS originally was for internal use only, but eventually evolved into a system that can be used by visitors to the PGS offices, where survey personnel help the user log on to find information on individual wells.

PA*IRIS was developed to allow industry to access well records from their offices. Essentially, the PGS scanned everything in their files and put it into this system. An expensive software system is required to view the information, so the PGS charges each subscriber a one-time \$5000 fee plus \$500 for annual maintenance.

Originally PA*IRIS included scanned location plats, the completion record (drillers' log) and perhaps a plugging affidavit, but has evolved since '99 to link to WIS, so more detailed information on an individual well can be accessed. This includes interpreted information, such as log tops picked by staff geologists, plus lists of available logs, lists of "canned" reports with data in spreadsheets, and a production module that allows the user to gather production data. ArcReader allows users to view tiff images of oil and gas base maps.

The PGS is planning several new

products that will become part of PA*IRIS. These include 7.5 minute topographic maps with well locations, the ability to view several layers, download capability, interactive tools, etc. They plan 10-15 interactive layers that can be turned on or off, with print capability.

Joe Wells made the Ohio Geological Survey (OGS) presentation, using slides and a live demo to introduce POGO, the Production of Oil & Gas in Ohio database that is updated annually; the digital map series; bedrock geology, on CD or online; and the interactive map series. He spent most of his time on the interactive map series, which includes the oil and gas maps in combination with topographic maps, aerial photos, roads and streams. A print layout feature with scaling options allows you to create a PDF.

Searches can be made on many parameters, but most begin with the state permit number. Ohio has one file, one folder per well, in their system, whereas Pennsylvania has separate files for the plats, well record, plugging record, etc. The Ohio system allows a user to cut and paste well data and create their own shape files. They also have a query string option, allowing a user multiple choices to add to the query string before the search is executed and the data are assembled in a table or on a map.

Rich Nyahay presented New York's ESOGIS, or Empire State Oil & Gas Information System, beginning with a recap of the history of oil and gas database development in New York. Early punch card and tape systems eventually evolved into the on-line system of today. Their goal in New York was to make all subsurface data and information, including all of their reservoir studies, available on the internet. This includes power point slides of numerous talks that presented the results of their research.

To use the site, one must first create an account before you can log in. Creating an account allows you to create different project files for yourself and then to add data to these files using a feature called "my well projects." There is no limit to the number of wells that you can download, but there is a one minute time limit on each download. A project manager feature allows you to create a project, add wells, tailor the data, display the data and download data to the project or export it to Petra.

Nyahay demonstrated the capability of the system, and went through many examples of how to search for data and the type of data that were displayed on well screens. Scanned images of well records, logs and other types of basic information are available, as are production data. A virtual core library allows the user to examine excellent quality core photos or scanned core images.

Subscriptions range from \$2500 to \$25,000, depending on which of five levels you choose.

Mary Behling presented a two-part talk, with part 1 being a description of the West Virginia Geological Survey's (WVGS) oil and gas database, and part 2 a description of a current project to assemble widely disseminated data on five tight gas plays from a variety of sources and deliver the data via an online system.

Current on-line services include "pipeline," a subscription service that allows users to access data on individual wells; production summaries, where queries can be made by well, by county or by years; e-logs, as scanned images in tiff files; focused datasets, mainly from project work, like Trenton-Black

River, coal bed methane, etc); and the PTTC's IMS site, which is hosted by the WVGS.

She then described other services, including new services under development, and pointed out that the survey no longer will conduct customized requests, except to produce well spot maps. This means the survey no longer will produce maps of formation structure, thickness, production, etc as in the past.

The second half of her talk was on what the survey refers to as their "Log Scan" project. Essentially, the goal is to find every piece of data on five tight gas plays in two states, organize the data into a database, and delivery it to users on line. By doing so, trips to the surveys by industry can be reduced or eliminated, and they actually will be able to see more data on line than they would during a survey visit. The reason for this is that many of these data are widely scattered in offices of different people, as well as in file and map drawers, or in the core and sample library.

Brandon Nuttall was the boldest of all speakers, choosing not to use a single slide, but to demonstrate the Kentucky Geological Survey's (KGS) database for his entire talk. However, he did provide a tutorial for the workshop notebook on how to access and roam through the system in search of data.

He began by pointing out that we already had observed how the surveys differed in the way they approached things, but they did not differ in one important respect: their mission, which is to serve the public. To this end, the KGS has taken a bold step to close their oil and gas record room (open by appointment only) and replace it with a system that can display everything in that room right on your computer screen in your office.

To do this, the user needs to download and install a free web browser plug in. No fees are required, no subscription service is necessary.

Nuttall urged attendees not to forget Google when prospecting for data on the internet. Google can lead you to the KGS database, where you can then conduct a criteria-

based search or search through the geologic map service. Because it is all on the web, when you find something of value, you can bookmark and return to it. Poupus must be enabled to view the data.

Many choices are available for data searches, and you can create a database for each search. Wells can be displayed on various maps, including topographic maps and aerial photos.

The summary above is based on a workshop sponsored by PTTC's Appalachian Region in Morgantown, WV on June 5, 2007. Speakers and their topics included:

Pennsylvania Digital Oil and Gas Products and Available Digital Geological Data – John Harper and Kyle Imbrogno, Pennsylvania Geologic Survey

Introduction to Ohio's New On-Line, Oil-and-Gas-Well Maps and Information – Joe Wells and Donovan Powers, Ohio Geological Survey

Updates on New York's ESOGIS (Empire State Oil & Gas Information System) – Richard Nyahay and Taury Smith, New York State Museum Institute

The "Log Scan" Model: A New Approach for Delivering West Virginia's Data – Mary Behling, West Virginia Geological Survey

The New Prospectors: Digital Data Resources at the Kentucky Geological Survey – Brandon Nuttall, Kentucky Geological Survey