PTTC TECHNOLOGY CONNECTIONS
Appalachian Region
Timely, Informed Technology Decisions

Newsletter

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FROM THE DIRECTOR'S DESK

I'm pleased to report that we had a very successful summer and fall season, during which we organized and hosted five workshops, co-hosted a sixth workshop, and made some major additions to our website. The first website addition resulted from a cooperative venture with Sandra Mark, RLO Director for the Rockies Region, who has taken on the rather ambitious task of creating a nationwide GIS of all well locations for which cores are currently archived in public core and sample repositories. To assist her, we provided shape files and spreadsheets for well locations and data for all wells for which the Appalachian basin state geological surveys have archived cores. A link from our website will take you to the final product. Once this project was completed, our summer intern, Geoffrey Hohn, moved on to a second project, and compiled drilling and production data for all Appalachian basin states for the past 20 years. The annual numbers for each state, totaled for the basin, and graphs of 20-year trends can be found on the website under the "Data" link. And finally, we uploaded several articles written specifically for our website by Kashy Aminian, Professor of Petroleum & Natural Gas Engineering at WVU, on coal bed methane and removing water

from wells. Given all of these "new" additions to the website, it recently occurred to us that perhaps we need to place a "hot" button on the homepage to lead users directly to these new additions! So, look for a new button early in 2006.

The workshops began with a familiar theme - **Trenton-Black River core and outcrop analogs** - and we hosted two of them in a six-day period at opposite ends of the basin, Lexington, KY and Albany, NY in early June. On August 16th we moved to the center of the basin and hosted a workshop in Morgantown on **Well Testing: Theory and Practice**. Two September workshops followed, both in Morgantown, in conjunction with regional meetings of the Society of Petroleum Engineers and the American Association of Petroleum Geologists. The first, a two-day short course on **Well Log Analysis**, was a cooperative venture with national AAPG that was sold out well in advance. Approximately half of those who attended stayed two extra days following the SPE meeting, and the other half arrived early for the AAPG meeting. This was our first attempt to "cascade" SPE and AAPG regional meetings in the same location, and it provided us the opportunity to host a workshop of interest to both groups between their meetings. Based on the turnout, this concept worked just fine.

Following the AAPG meeting, we hosted our 100th PTTC workshop, **Rocks to Models: an Introduction to 3-D Reservoir Characterization and Modeling**, taught by Neil Hurley and Matt Pranter on Wednesday, September 21. Again, the turnout was excellent, and believe it or not, at least one registrant attended everything - SPE meeting, logging workshop, AAPG meeting and the rocks to model workshop. He had quite a week in Morgantown.

In October we hosted the latest workshop in our successful **Well Tender** series. Once again we cooperated with the Southeast Ohio Oil & Gas Association to provide this workshop at their annual meeting. Two weeks later, it was off to Knoxville, where PAG member Scott Gilbert organized a workshop on **geochemical exploration**, that was co-hosted by the Tennessee Oil & Gas Association.

So what will be coming your way in 2006? We would like to organize a workshop on public oil & gas databases, and combine it with an early release of statistics on 2005 drilling activity in the basin. We also are planning to develop a workshop on the various shale plays of interest in the east, midcontinent and southwest, namely the Ohio, Antrim, New Albany, Caney and Barnett. The idea is to bring together experts on each play so we can learn how they are similar, i.e., what can we learn from one that we can transfer to another, and how they differ, i.e., what are the characteristics unique to each play that you must understand to be successful? We also have committed to another workshop with SOOGA, a workshop to be hosted by the Kentucky Geological Survey on ArcView, and a workshop on re-stimulation. Other potential topics will be discussed during the January 12 meeting of the Producers Advisory Group (PAG) for the Appalachian Region.

Speaking of the PAG, we elect one third of the PAG to new 3-year terms each December, and then kickoff the new year with our annual meeting in January. If you would like to serve on the PAG, contact Chairman Rick Goings at Dominion in Jane Lew, WV, or myself. And finally, my best to all of you who read this newsletter, surf through our website and support our workshops with your attendance, for a happy holiday season as we approach the end of another successful PTTC year.

Douglas Patchen

RLO Director

Rocks to Models: An Introduction to 3-D Reservoir Characterization and Modeling

Geologists, geophysicists and engineers all need a better understanding of how to characterize reservoirs and how to visualize and modeling them in three dimensions. This course, that was held September 21 in Morgantown, was developed to provide an overview of 3-D reservoir characterization and modeling concepts and methods. The instructors addressed different types of petroleum reservoirs (carbonates, sandstones, natural fractures) and techniques to define and estimate reservoir architecture and properties within a sequence-stratigraphic and structural framework.

The course began with an overview of the objectives of reservoir characterization, analysis of porosity and permeability, and methods used to identify reservoir flow units. Stratigraphically- and structurally-compartmentalized reservoirs were reviewed, and the role and significance of outcrop analogs for reservoir characterization and modeling using case studies was emphasized.

The instructors presented common methods for constructing 3-D geologic models of reservoirs. This portion of the course included an overview of 3-D geologic modeling techniques, common cell-based methods, object-based methods, and the use of 3-D seismic data for conditioning reservoir models.

Most of the examples in the notebook and described from the course slides were from western areas. However, the instructors were quick to point out Appalachian reservoirs that were analogous to these examples, citing the “Atlas of Major Appalachian Gas Plays” as the source for this comparison.

The instructors provided an excellent set of color slides to be copied for the notebook, which was well organized with color tabs to match the course outline. In addition, they provided each participant with a website address where these slides can be viewed and downloaded for personal use.

The workshop began with individual introductions of the two instructors and 30 participants, so that the instructors would have a better understanding of who the individuals were, their interests, the type of work they do and the types of reservoirs that they work. Then the instructors began the course instruction, explaining each slide in detail, assuming no prior knowledge of anyone in the workshop, even explaining at length what each equation and graph could tell us about a reservoir.

Workshop Suggests Outcrop Analogs for Trenton/Black River Dolostone Reservoirs

This workshop was the first of two workshops that were held at either end of the basin - Lexington, Kentucky and Albany, NY - in which lectures could be combined with core examination and optional trips to the field to actually examine outcrop analogs in their natural setting. Therefore, this workshop, like the one that followed six days later, had to be limited to approximately 40 registrants.

David Harris, the workshop coordinator from the Kentucky Geological Survey, recruited five speakers, plus himself, to present the results of research funded by DOE, Trianna Energy and the

New York State Energy Research Development Administration (NYSERDA) that focused on dolostone outcrops and adjacent shallow cores in central Kentucky. This three-year study consisted of three phases: petrography and geochemistry of outcrop samples; shallow, high-resolution seismic shot over the outcrops; and study of a continuous core taken in the vicinity of the outcrop that went entirely through the Trenton and Black River carbonates.

The overall goal of the research project - and of this workshop - was to characterize shallow Ordovician tectonic dolomites in outcrop to help improve our exploration strategies in the search for subsurface reservoirs. Presentations focused on four areas: timing of dolomitization, including relation to structure, hydrocarbon migration and absolute timing; dolomitization effects on porosity; controls on dolomitization, both structural and stratigraphic; and source and pathways for fluids.

Harris began the morning session with an overview of the workshop and a summary of the petrographic and geochemical portions of their study of fault-controlled Ordovician dolomite reservoirs. This presentation was followed by summaries of shallow, high-resolution seismic reflection data shot over several areas of interest, including a Black River porosity zone in Clinton County, KY, and two talks on petrology and fluid inclusion studies of the core funded by Trianna Energy and NYSERDA.

The afternoon session allowed participants ample time to examine the core in detail, having at their disposal the core description, wire-line logs and results of the various research studies. For those who still had not had enough, Harris offered an optional trip to the field to examine the outcrop, specifically the famed “light bulb” structure, in more detail.

Preliminary conclusions include: dolomitization occurred in two major events that differ in timing, style, chemistry and porosity effects; dolomite timing differs from Mississippi Valley Type (MVT) mineralization; more dolomite is not always better for reservoir development; many events happen after dolomitization; and ultimately, porosity is related to the proximity to controlling faults.

Hydrothermal Dolomite Core Workshop and Field Trip Held in Albany

This was the second of two workshops that were held at either end of the basin - Lexington, Kentucky and Albany, NY - in which lectures were combined with core examination and trips to the field to actually examine outcrop analogs in their natural setting. Dr. Langhorne “Taury” Smith, the workshop coordinator from the New York State Museum Institute, recruited two speakers, plus himself, to present the results of Institute research funded by DOE and the New York State Energy Research Development Administration (NYSERDA). This research was essentially a field study of fault-related hydrothermal dolomite in the Tribes Hill Formation of New York State.

The overall goal of the workshop and field trip, according to Dr. Smith, was to give attendees an overview of the geology of the Trenton-Black River hydrothermal dolomite play, with an emphasis on the local structure and fault-related diagenesis. To accomplish this goal, a morning session, developed around formal presentations interspersed with intervals of time for core examination, was followed by a field trip to a quarry where a hydrothermal dolomite body had been excavated for detailed study.

The morning lectures consisted of summaries of the current understanding of the Trenton-Black River play; summaries of wrench faulting and pull-apart basins; and descriptions of an outcrop analog for the play that would be visited in the afternoon. Following lunch in the New York State Museum, the group traveled an hour to the west to a quarry where a large dolomite feature had

been discovered, excavated and studied in detail by Institute researchers.

A 3-D ground penetrating radar survey had been run over the feature in the quarry and six cores had been cut in and adjacent to the dolomite body. These cores were laid out next to the visible core holes in the quarry, allowing participants to get an impression of the three-dimensional extent of the dolomite. Cross sections from one side of the feature to the other, based on the cores and the 3-D ground penetrating radar surveys, were available in the field as well.

Participants really enjoyed this workshop, and stated emphatically that the opportunity to examine core between talks and then go to the field for further examination thoroughly reinforced what they had heard and seen during the lecture portion of the workshop. Having additional cores and cross sections in the quarry was an added bonus.

Preliminary conclusions concerning the play that were presented include: Trenton-Black River dolomite fields formed from hydrothermal fluids flowing up active faults, perhaps during Late Ordovician time; the faults had a clear strike-slip component; and the outcrop analog helps to understand the structural setting and geometry of these faults. Conclusions presented regarding the outcrop in the quarry are: the outcrop overlies a low-angle releasing bend; the left-stepping dolomite bodies and faults formed due to a combination of left-lateral strike-slip and extension faulting; and the structure is elongate, relative to most sandbox models.

Geochemical Exploration Workshop Hosted by TOGA

The Tennessee Oil & Gas Association (TOGA) hosted a PTTC workshop on Geochemical Exploration on October 25 in Knoxville, TN. This workshop was another successful effort in our new program to involve more PAG members in the workshop development process. Scott Gilbert, a PAG member from Tennessee, was our most recent workshop "Champion," a PAG member who gets an idea for a workshop and develops that idea, with assistance from the RLO if requested, culminating in a workshop in his home area. He recruited Deet Schumaker to teach the workshop.

The course began with a introductory section during which the history of geochemical exploration was described, along with various seepage models for hydrocarbon micro seepage. The second section, prior to the morning break, dealt with direct methods of hydrocarbon migration, including discussions of soil gas, adsorbed soil gas, fluorescence and heavier hydrocarbons. After the break, the morning session ended with a discussion of indirect detection methods, both geochemical and geophysical.

The afternoon was devoted to discussions of geochemical survey objectives, survey designs and the method of selection, followed by case histories. The workshop ended with the instructor providing guidelines for inferring hydrocarbon composition, defining anomalies, and integrating geologic, seismic and geochemical data.

EMD Sessions in 2005 Eastern Section AAPG Meeting

Members of AAPG's Energy Minerals Division (EMD) who attended the recent Eastern Section AAPG meeting (Morgantown, WV; September 18-20) were able to take advantage of a technical program that included 4 talks in a Coal Bed Methane session, 10 talks and four posters on CO_2 sequestration, and an EMD/DEG/DPA luncheon at which Dr. Ian Duncan, the featured speaker, made a

presentation on "CO2 EOR: new economic drivers and new strategies."

Although officially not part of the posted EMD sessions, other talks and posters on EMD "commodities" (i.e., coal bed methane, gas shales) were given. These included papers on gas capillary sealing as a mechanism of seal development in the Upper Devonian Dunkirk Shale in western New York State; economic deposits of microbial methane in Upper Devonian fractured black shales; and a basin-wide geologic resource assessment of the Upper Devonian interval in the Appalachian basin. In addition, this poster was available: the Upper Devonian Dunkirk Shale – a late hydrocarbon generator.

The Eastern Section gives awards for the best EMD paper and the best EMD poster presented at their annual meetings. The Ralph L. Miller Best EMD Paper Award will be given to Thomas R. Moore, Illinois State Geological Survey, for his presentation on "Illinois basin coalbed gas: Is there a play?" His co-authors are Ilham Demir and David G. Morse. The EMD best poster award will be given to David Morse, Illinois State Geological Survey, for his presentation on "Coalbed methane research drilling in Illinois – new data." His co-authors are Ilham Demir, Thomas R. Moore and Scott D. Elrick.

A list of the EMD-related talks and posters follows, with a brief summary of most of the talks. Complete abstracts and a listing of all co-authors can be found on the Eastern Section portion of the Appalachian Region PTTC website at: http://karl.nrcce.wvu.edu/esaapg/ESabstracts.html.

Geologic CO2 sequestration – an introduction: L.H. Wickstrom

This talk served as an introduction to the nine papers that followed. As part of on-going research, potential geologic sinks for CO2 are being characterized to determine their quality, size and geologic integrity. Pilot injection projects will begin during the next few years. The experience of the petroleum industry in reservoir characterization, drilling, completion and injection will be needed as this technology progresses.

Siting coal-fired power plants in a carbon-managed future: the importance of geologic sequestration reservoirs: S.F. Greb et al

If, in a carbon-managed future, coal gasification technology will be used to produce electricity and hydrogen from coal, and CO2 is to be sequestered in the subsurface, then existing factors for siting power plants will have to be coupled with geologic criteria to determine optimal plant locations for coal availability, power generation and sequestration opportunities.

The effects of CO2 interaction with coal: Ryan N. Favors and Angela L. Goodman

Lab experiments reveal that with repeated exposure of coal to CO2, subsequent CO2-coal sorption is much faster than the initial uptake and the amount of CO2 sorbed increases, indicating that under these conditions changes in the physical structure of the coal occur.

Improved understanding of regional geologic CO2 storage options through collaboration with oil and gas industry: Neeraj Gupta et al

Battelle has developed a "piggyback" exploration approach to help them improve their geologic understanding of deep reservoirs that are candidates for CO2 sequestration in the Ohio River region. This approach depends on the cooperation of industry members who are planning or conducting exploration in the region to obtain more drilling, cores, wire-line logs and analysis of seismic data. Two Rose Run/Copper Ridge wells and one Devonian shale well have been investigated to date. Ultimately, the results of these cooperative ventures will reduce the cost of sequestration.

Volume fraction analysis of two-phase flows in fractures: Dustin Crandall et al

This research is an attempt to better understand the processes involved when CO2 interacts with a liquid-saturated reservoir, and to derive an empirical equation relating the pressure drop for multi-phase flow through fractures in the reservoir. The work presents a computational analysis of the percent of in-place oil that is displaced by an injected fluid flowing through an idealized set of fractures with varying properties, such as fracture height. The velocity of the invading fluid and fracture height have the most dramatic effect on removal efficiency.

Investigation of brine geochemistry and implications for geologic sequestration of CO2 in deep sedimentary basins: Bruce Sass et al

Brines from the Cambrian Rose Run and basal sandstone in the 9,190 ft-deep American Electric Power Mountaineer Plant well in New Haven, WV were collected shortly after the borehole was completed and again seven months later during detailed hydrologic

testing of potential zones for sequestration. Brine concentrations fall within the high end of dissolved solids range (200,000-325,000 mg/L), suggesting that the solubility, and therefore the reactivity of CO2 with formation waters, would be reduced. Therefore, the main storage mechanism would be containment by caprocks and residual saturation. Geochemical modeling results do not indicate any adverse reactions that would have a negative effect on the injection of CO2 into either of these potential storage formations.

Potential carbon sequestration targets in saline reservoirs of Kentucky: James A. Drahovzal et al

Based on current knowledge, the geologic sequestration option that has the highest potential to meet capacity, safety and permanence requirements in Kentucky is deep saline aquifers. To be effective, these reservoirs wold need to be greater than 2,500 ft deep to ensure storage of supercritical CO2 and would need to accept several million tons of CO2 each year over an anticipated lifetime of 30-40 years. Depending on location, potential zones include sandstones in the Rome, Mount Simon, St. Peter and Rose Run formations, and dolostones in the Copper Ridge Formation.

CO2 sequestration in gas shales of Kentucky: Brandon C. Nuttall et al

Continuous, low-permeability, fractured, organic-rich Devonian gas shales that underlie two-thirds of Kentucky are a possible sequestration target. Side-wall cores, well cuttings and conventional cores were collected and analyzed for their potential CO2 uptake and methane displacement. Initial estimates made from these data indicate a sequestration capacity of 28 billion tons in the deeper, thicker portions of the shale.

Characterization of America's "engine room" for geologic CO2 sequestration: Erik R. Venteris et al

The Midwest Regional Carbon Sequestration Partnership, one of seven regional partnerships funded by DOE, is well positioned to provide a unique opportunity to develop carbon sequestration technologies. The geographic area assigned to the partnership contains 16% of the U.S. population, nearly 22% of the nation's electricity is generated here - 77% of which is produced from coal-fired-power plants - and these plants produce 715 million tons of CO2

annually. Technologies are being developed to capture the flue gas and extract and compress the CO2 for sequestration. Huge potential exists in the region to sequester CO2 in deep saline aquifers, deep unmineable coal beds, organic shales and depleted oil and gas reservoirs.

CO2 sequestration-assisted enhanced hydrocarbon recovery potential in the Midwest regional sequestration partnership: William B. Harrison et al

Extensive, GIS-based mapping of potential CO2 sequestration targets, including oil and gas fields, has been completed for a 7-state region in the midwest and eastern U.S., an area with cumulative oil production of 5.5 billion barrels. In this region, CO2 enhanced oil recovery could amount to hundreds of millions of barrels of additional oil, while more than 2 billion tons of CO2 could be sequestered. One project in the Niagaran (Silurian) pinnacle reef play has produced more than 600,000 barrels of oil and sequestered over 280,000 tons of CO2 since 1996.

Illinois basin coalbed gas: Is there a play? Thomas R. Moore et al

Recent mapping, coring and testing have proven that earlier perceptions regarding Illinois basin coals - namely that they are thin and tight with low gas contents - are too pessimistic. These new data indicate that average aggregate thickness of coals greater than 1.5 ft in thickness is more than 15 ft, and multiple seams are consistently 3-5 ft thick over wide areas. Measured gas contents typically range from 60 to 115 scf/ton, and as high as 175 scf/t. Recent pressure transient tests indicate permeability ranges from 3 to 200 mD. The nature of the coals suggests that gas production rates and recovery will be moderate at best. The optimum stimulation design has yet to be found, and practices like air drilling, nitrogen fracs, radial pulse fracs and other innovative techniques have yet to be tested. Horizontal or multilateral wells may lead to commercial success.

Coal washability data trends in eastern Kentucky: B.L. Overfield, G.A. Weisenfluh and C.F. Eble

Industry coal-quality data, including washability, bench analyses and standard whole-seam proximate data, have been studied with respect to

geographic and stratigraphic variation, in order to develop a classification of Kentucky coals. Three coal-quality data sample sets for eastern Kentucky were selected and analyzed. Results from all three sample sets were then compared to assess trends.

Creating an integrated coal geology and coal mining Geographic Information System in West Virginia: Nick Fedorko and James Q. Britton

The West Virginia Geological and Economic Survey has spent the last 10 years developing a series of resource maps for each coal bed in the state, including: structural contour and outcrop lines; net coal, total coal height and percent parting maps; depth of overburden; bed discontinuities; thickness and elevation control points; and coal quality variation. This effort is supported by other dedicated databases, such as stratigraphic data, coal quality data and underground mine map documents. An integrated system continues to evolve.

Thirty years of coal production in West Virginia "energy crisis to present: Gayle H. McColloch, Jr.

In the 1970s, the demand for energy was high and the price of coal was high, but production was surprisingly low. In the 1980s, prices moderated and production increased. During the 1990s, production continued to increase in West Virginia's southern coal field, but production in the northern coal field stagnated. During this 30-year period, surface mine production increased from approximately 25% of the state's production to over 36% today. Employment declined steadily during the period, and a shortage of miners is anticipated due to the impending retirement of those remaining miners who were hired in the 1970s.

The Upper Devonian Dunkirk Shale – a late hydrocarbon generator: David R. Blood and Gary G. Lash

Hydrous pyrolysis experiments were performed on samples from the basal Upper Devonian Dunkirk Shale in western New York to assess the hydrocarbon generating potential of this rock unit. These samples were immature to early mature and composed predominantly of Type II and lesser amounts of Type III organic kerogen. Based on the samples analyses, it appears that the organic matter of the Dunkirk Shale resists conversion until a threshold level of maturity is reached and the kerogen rapidly decomposes to liquid hydrocarbons. The bulk (>80%) of the conversion reactions require activation energies in the range of 5400-5500 cal/mole, values that are typical of documented late-oil generators, such as the Woodford Shale.

Coalbed methane research drilling in Illinois – new data: David G. Morse, Ilham Demir, Thomas R. Moore and Scott D. Elrick

Data have been released from two wells drilled in eastern Illinois by the Illinois State Geological Survey. Seven coals totaling 24.5 ft in thickness were cored at depths ranging from 756 to 1,114 ft in the James Cantrell #9 Hon well, White County. Gas contents ranged from 78 to 129 scf/t in these coals. Desorbed gas composition ranged from 60 to 82% methane, 16 to 37% nitrogen and 1.2 to 2.0% CO2. Methane saturation ranges from 40 to 64%. Pressure transient tests

indicate permeabilities in the 3 to 35 mD range, with one value as high as 200 mD. Also in White County, ISGS encountered 33 ft of coal in the Howard Energy #C-1 Wassem well. Eight coals were cored at depths ranging from 387 to 966 ft. Gas contents range from 75 to 112 scf/t. Desorbed gas compositions range from 69 to 96% methane, 0.5 to 31% nitrogen and 1.2 to 2.8% CO2. Methane saturation ranges from 24 to 92%. Possible coal oxidation in canisters may have lowered methane and boosted nitrogen composition values for both wells.

A basin-wide geologic resource assessment of the Upper Devonian interval in the Appalachian basin: Ashley S.B. Douds, James A. Pancake and Ray M. Boswell

The Upper Devonian Venango, Bradford and Elk plays comprised one of the most prolific natural gas-producing intervals in the Appalachian basin. During the most recent 5 years for which production data are available, this interval has accounted for more than 90% of reported production in Pennsylvania, and nearly 50% of all completions in West Virginia. However, in spite of the importance of these plays, no resource assessments had been made since 1992. Therefore, DOE's National Energy Technology Laboratory (NETL) recently initiated a resource assessment effort that builds on the 1992 assessment by integrating new data from industry and public sources. Results will be made available on a CD report from NETL.

Stripper Well Consortium Meeting Notes

The Stripper Well Consortium held their annual Northeast fall meeting at the Conewango Club in Warren, PA on October 18th. Executive Director Joel Morrison welcomed 29 consortium members, including 8 speakers, and presented a brief summary of consortium achievements in communications; announced a meeting next spring (April 18-19 at the Nittany Lion Inn, State College, PA; reviewed consortium funding and projects; updated membership numbers; announced new additions to the governing council; and discussed various provisions in the 2005 energy bill, concluding that now is the time for the Stripper Well Consortium to act and to grow. Following these remarks, eight presenters described the status of their SWC-funded projects. A summary of each follows.

Ken Oglesby (Oak Resources, Inc.) described the efforts of his company to develop cutting edge - he referred to it as "bloody" edge - production test technology that would target high water-cut oil wells, wells with 100-1500 barrels per day of oil and water. The challenge was to import production test technology into a small but accurate, portable unit that can be produced at low cost. One unit has been built so far, and it is mounted on a 15-foot, high-clearance trailer on which it can be moved to a well site over rough roads. Five wells have been tested with this portable unit so far, and the goal now is to further reduce the size and cost of the unit and then apply the technology more broadly in the field. According to the developers, the production data that is received from the unit is more

sophisticated, more complete and more accurate than existing technology can provide. The developers of the portable production unit want to create an awareness of the technology, and then hand it off to be produced and marketed. Oglesby believes that if the unit can be demonstrated in the field it will sell itself, but there is a need to develop a strong market in this area if a low-cost unit is to be produced and marketed here. This type of unit could be owned and used by individual production companies, or by service companies, or owned and shared by a small group of producers who have wells in the same geographic area.

Roger Willis (Universal Well Services) presented an update on micro-seismic fracture imaging, a technology that measures "micro" earthquakes created by slippage in rocks that produces P and S waves as the reservoir rock is fractured. This technology can help determine fracture height, length and direction, the drainage area around the induced fracture, and fracture intensity, all of which will help producers determine the optimum well spacing. The technology has been tested in the Bradford Play where sandstones between the upper Fifth and First Bradford were fractured in five stages in several test wells. An isopach map was drawn for each of these sandstones, and the resulting fracture orientation (NE-SW) and length was drawn on each of these maps, thus tying geology and engineering together, with fracture decisions based on sandstone thickness. The data show that the fractures are not well confined within a given sandstone. In fact, the interval from approximately 2100 to 3400 feet that was completed in five stages probably could have been completed in just three stages. This is real-time technology that yields data as the hydraulic fracture is created. It was interesting to note, that the images received from three wells all indicated the same fracture azimuth - NE-SW - but in one well the fracture grew to the NE, in another to the SW, and in another in grew downward. Therefore, the fracture can grow into an area of thicker sandstone, or out of an area of thick sandstone.

Paul Weatherbee (W&W Vacuum) described research that led to the development of the trademarked "W wedge pump," a new light-weight compressor designed for high BTU gas in stripper wells. This simplified, smaller, lighter pump adjusts to compress only the volume of gas that a stripper well produces. The technology is targeted for stripper wells in which something is restricting gas flow. The pump can achieve up to a 3.5 to 1 compression ratio, and pulls a vacuum and compresses at the same time. Currently, W&W Vacuum is developing new seals, and would like to bring two units to this area to be field tested. As an interesting sidelight, this small pump actually resembled a human heart. This attracted the attention of researchers who are developing a better heart pump, and they produced a smaller version the same size as a heart with two pumps, one on the right and one on the left, that pulsate like a human heart and pump the same volume.

Lewis Taylor (Hydroslotter Corporation) described a new hydroslotter technology that is being tested on stripper wells in New York. This process cuts vertical slots through the casing into the reservoir rock. The depth and width at the end of the vertical notch can be engineered. The advantage of this method is the ability to cut through the exact zone of interest rather than relying on an induced fracture actually developing in the zone of interest

versus following an easier path in a non-pay interval. The technology is water-based, using abrasive jets of water heated to the same temperature as the reservoir to reduce the production of waxes in the reservoir near the well bore. A donut-shaped gyroscope orients the cuts to match optimum directions determined from a geologic analysis. The technology has been tested in four wells in New York: an older, previously completed well; one well with a gas-water contact; in a bypassed zone in a third well; and in a problem well with a corroded casing. Reservoirs in these wells included the Onondaga Limestone, Medina Sandstone and Theresa Formation. The speaker concluded that based on results to date this technology has the potential to develop Theresa wells into Bcf wells by cutting vertical notches in the upper 70 feet of the formation.

Timothy Knobloch (James Engineering) described his study to evaluate the effect of completion and production procedures on the ultimate recoverable reserves from Knox Formation wells, both those with Rose Run Sandstone and Beekmantown Dolomite reservoirs. His analysis indicated that historically these wells suffered from the low-cost approach by operators to complete them. A minimal completion was used, then more and still more, as needed, to achieve results. No consensus was reached on the optimum completion or production technology. In the current study, a study group of wells was selected and an analysis of completion and production practices was performed on these wells. Oil and gas databases in five Appalachian basin states were accessed to create a project database, to which additional information not in the state databases was added. It was interesting to note that the speaker stated that this project benefitted from his participation in a PTTC workshop on well test analysis held in August 2005.

Rich Pancake (University of Kansas) discussed a project to control water production by using disproportionate permeability reduction (DPR) in gelled polymer systems. The goal of the project was to increase incremental oil production, reduce water production, and prolong the life of the gels. This approach has been tested in the Bemis-Shutts field near Hays, Kansas, part of the Arbuckle play that had produced 1.6 billion barrels of oil through 1998. Typically, casing is set at the top of the Arbuckle and drilling continues with cable tools another 10 feet into the upper, oil-bearing portion of the formation that usually is about 75 feet thick. A 20-foot water zone underlies the oil zone. When gel is added to the formation, it fills all of the pores it encounters in the karstic dolomite reservoir, and then dehydrates as it is exposed to a pressure gradient. This dehydration process creates preferential pathways for oil in the oil-bearing portion of the reservoir, and decreases the permeability to water by an order of magnitude in these oil pathways. Four wells have been reviewed to date; gel has been pumped into two, with the third to receive gel soon. In the first two wells, water production has dropped from 500 to 140 b/d; oil production is up from 6 to 10 b/d. Typically, the job costs $60,000 per well, based on $15 per barrel for a 4000 barrel treatment.

Robert Watson (The Pennsylvania State University) discussed the interaction of nitrogen/CO2 mixtures with crude oil when first nitrogen and then carbon dioxide are pumped into an oil reservoir. Essentially, he said researchers were applying new

technology using membranes to separate air into its various components to a very old concept of "air flooding." Penn State researchers are involved in two projects, one a PVT study of the interaction of nitrogen and oil, and the second to examine the interaction of nitrogen and carbon dioxide with crude oil, where immiscible nitrogen provides a "blanket" to miscible carbon dioxide. In the first test, in New York, 100% nitrogen was injected into the Chipmunk oil reservoir. After 6 cycles, nitrogen increased from 93.6% to 96.9% of the recovered gas from each cycle, while oxygen decreased from 5.7% to 2.4%. During a second test, a 50-50 mixture of nitrogen and carbon dioxide was injected, beginning in September 2005. This test is continuing in an attempt to answer the question, how many cycles can be completed before problems develop?

Gerald Swoyer (Brandywine Energy and Development Company, Inc.) discussed refitting stripper wells with existing large diameter or open hole completions with spoolable, non-metallic tubing, transition connections, variable diameter seal cups and modified GOAL casing swab to automatically lift fluids and enhance production. Their new tool is shorter and lighter and has fewer parts than their previous tool. Swoyer cited an example of a well drilled in 1986 that had experienced a decline in production, so in 1996 a casing swab was added and production increased until1998 when the GOAL tool was used. The result was that production was maintained from 1998 to 2003, increasing well income by approximately $60,000. To date, 14 wells have been tested with this technology, all with daily production in the 1-7 Mcf/d range. These wells experienced a 2- to 4-fold increase in production, with 5 to 12 month payback (at $5.00/Mcf). Currently, the research is focused on developing better cup connectors.

Special Oil and Gas Session to be Held in Knoxville, TN

Organizers of the Southeastern Section meeting of the Geological Society of America have announced that a special session on **"Burial, Uplift and Thermal History of the Appalachian Basin"** will be held during the March 23-24 meeting in Knoxville, TN. The goal of the session, according to USGS Geologist Dr. Christopher Swezey, is to bring together research focused on the burial, uplift and thermal history of the basin, including the tools used to determine these histories. These tools include fluid inclusions, apatite and zircon fission tracks and indicators of thermal maturity (vitrinite reflectance and conodont alteration index, or CAI) as well as regional structure and stratigraphy. A fundamental knowledge of basin history gained from this session will provide a framework within which one can study the relations between tectonic activity, diagenesis, fluid flow and hydrocarbon and mineral occurrences.

Abstracts are encouraged for this session and the deadline for receiving them is January 5, 2006. Additional details are available from the Geological Society of America at http://www.geosociety.org.

Smith Retires from WVGES; Hohn Named Acting Director

Carl J. Smith retired as State Geologist and Director of the West Virginia Geological and Economic Survey (WVGES) effective October 31, 2005. Associate Director Dr. Michael Ed. Hohn has been named to replace him as Acting Director of the survey.

Carl Smith, a graduate of Columbia University (BA in Geology, 1967) and Indiana University (MA in Geology, 1969) joined the WVGES as a coal geologist in 1973 following four years of active duty in the US Navy. From the mid-1970s until 1989 he served the survey as Head of the Coal Section. In that capacity, he was active in fieldwork related to the coals of West Virginia and worked to develop the physical and chemical coal quality database for minable West Virginia's coal seams. He pioneered efforts in coal quality exploration where a coal quality database is used to determine where in the state of West Virginia specific coals in a specific region are likely to be found that meet a "customer's" grade specifications. Electrical power companies along the east coast and in Europe have used such information to successfully find West Virginia coal to meet their needs.

In 1989 Smith was promoted to West Virginia Associate State Geologist and Deputy Director for Geoscience. He was responsible for overseeing research and dealt with geology and public policy. In December 2001, upon the retirement of West Virginia State Geologist Larry D. Woodfork, Smith was named acting Director of the Survey and State Geologist of West Virginia. On September 29, 2002 he was formally sworn in as West Virginia's ninth State Geologist.

Throughout most of his career with the WVGES, Smith remained active in the Naval Reserve until he retired with the rank of Captain on 1 July 1997. While on active duty he served around the globe, first in Vietnam and later in Guam. While a reservist, he was recalled to active duty in the Middle East, Far East and the UK, working on large military staffs. During Operation Desert Storm, beginning in March 1991, he was assigned duty as Commander, Military Sealift Command Southwest Asia, and served in Saudi Arabia for nearly a year. As the Commodore for a logistic task group and its shore support, he was responsible for in-theater command and control of all the Department of Defense shipping that brought US Army and Marine Corps vehicles, tanks, and ammunition back to the continental United States or Europe. He managed nearly 500 ship movements. He has been awarded the Legion of Merit, the Meritorious Service Medal, two Navy Commendation Medals, the Army Commendation Medal, Meritorious Unit Commendation, Vietnam Service Medal, Southwest Asia Service Medal and various others. He also received the 1990 Naval Academy Commandant's Award.

Smith is a long-time member of the American Association of Petroleum Geologists (AAPG) and is a member of AAPG's Energy Minerals Division (EMD). He served as Eastern EMD councilor (1988-90), chaired the EMD Ad Hoc Committee on Division Organization (1990), served as the Eastern Section EMD program committee (1987-88), and was elected to Vice-President and President-elect of the Energy Minerals Division in 1991. He was notified of his election as EMD President-Elect by fax at his Saudi Arabian-based command headquarters during his active military duty in Desert Storm. He served as national EMD President (1992-93) and worked to develop the Division's visibility, internal communications, and coal geologist certification (and he is so certified). Smith also was a regional coordinator for the AAPG Visiting Geologist program for nearly 8 years.

He served the Eastern Section of AAPG as Technical Program Chairman for its 1988 annual convention in Charleston, WV. He held all of the elective offices in the Eastern Section AAPG from Secretary, to Vice-President, culminating in 1989 in

the Presidency. Carl served the Eastern Section, AAPG as its first archivist until September 2001. He was Chairman of Eastern Section's Annual Technical Seminars (1990-1993) and the Honors and Awards Chairperson 1992-1995. He served the AAPG as Vice-Chairman of the field trips committee for the 1986 national AAPG convention in Atlanta and recently served as AAPG Vice-President for the 1999-2000 term.

The ES-AAPG bestowed a Distinguished Service Award on Smith in 1990, Honorary Membership in 1992, and their highest honor, the John T. Galey Award, in 2002. He received the AAPG Distinguished Service award in 1994 and the EMD Distinguished Service Award in 1998. He was the 1998 recipient of the Indiana University, Department of Geological Sciences, "Richard Owen Award," and received AAPG's second highest award, Honorary Membership, in June 2001.

Dr. Michael Ed. Hohn graduated Summa cum laude in 1972 with a BA in Geology from the State University of New York at Binghamton, and added an MA and a PhD in Geology in 1975 and 1976, respectively, from Indiana University. From 1976-1978 he was a Post-doctoral Research Assistant at the University of Bristol before joining the WVGES as a Geostatistician in the DOE-funded Devonian Shales Program. From 1989 until 2003 he was a Senior Research Geologist and Coordinator of the West Virginia STATEMAP Program. During the time interval (1991-1992) when then Associate Director Smith was serving in the Middle East, Hohn served as Acting Deputy Director and Assistant State Geologist. In 2002 he was named Associate State Geologist of the West Virginia Geological and Economic Survey, and held that position until October 31, 2005 when he was named Acting Director.

He has over 25 years of experience in petroleum and coal geology, with particular interest in geostatistics, multivariate statistics and computer methods applied to problems of resource estimation and mapping. Dr. Hohn has published over fifty papers on subjects including energy resources, and a book on geostatistics, which is in its second printing. He has developed and taught short courses for professional societies and government agencies. His principal area of expertise is geostatistics, and he has applied kriging and conditional simulation to the study of porosity, permeability and hydrocarbon distributions in oil and gas fields, and to the estimation of coal resources and quality. Projects have included carbon sequestration, statistical analysis of production data from Devonian shales, study of reservoir heterogeneity in two Mississippian oil fields, reservoir characterization and modeling of Upper Devonian oil fields, creation of web resources on preferred upstream management practices in the Appalachian Basin, and analysis of sources of uncertainty in estimation of coal bed thickness. He was instrumental in designing and maintaining the initial PTTC website for the Appalachian region. He was principal investigator for several projects funded by USGS, DOE, the former Gas Research Institute (GRI), the Stripper Well Consortium (DOE), and the US Department of Agriculture Forest Service. He has coordinated the work of geologists, petroleum engineers and computer programmers in research that has many times been interdisciplinary**.**

Dr. Hohn has been very active in the International Association for Mathematical Geology, serving as Western Treasurer, Secretary General (1989-92) and President (1992-96). He served as Editor-in chief, ***Mathematical Geology*** (1997-2001) and Deputy Editor, ***Nonrenewable Resources*** (1992-97). He also has been active in AAPG, serving as an Eastern Section officer (1999-2002) and on various committees, including the Committee on Computer Applications, and was Technical Program chair for the Eastern Section's 2005 Annual Convention, and AAPG's representative to the AAAS Section Geology and Geography.

He has received a Distinguished Service Award and Certificate of Merit, Eastern Section AAPG (2002), the Krumbein Medal from the International Association for Mathematical Geology (2002), and a Commendation of Thanks from Military Sealift Command, SW Asia (1992).

We at PTTC wish Carl Smith the best in his retirement and look forward to continuing our solid working relationship with Acting Director Hohn.

Additional Geologic Maps Available for Pennsylvania Quads

Through January 2005 forty two 7.5' quadrangle Geologic Surface Structural maps in west central Pennsylvania had been released for purchase. Recently, an additional 14 maps were released: Bear Knob, Bellefonte, Cameron, Cammal, English Center, First Fork, Hammersley Fork, Port Matilda, Sandy Ridge, Slate Run, Tamarack, Trout Run, White Pine and Young Womans Creek. All 56 maps are available in black and white or colored paper prints, as scanned images or in digital format. For further information, contact Phil Martin at 304-842-4645 or philjakemart@aol.com.

IOGA-NY Hosts Silver Anniversary Meeting

IOGA-NY recently hosted their 25th annual meeting and conference at the Marriott Hotel in Amherst, NY. The technical program organized by PAG member Roger Willis featured a variety of geologic and engineering talks dealing with doing business in New York. The program began with three engineering talks by Mark Miller, Michael Kloecker and Lloyd East, who covered memory production logging, frac sands and hydra-jet perforating and pinpoint stimulation, respectively. Following the morning break, the program shifted to how one can do business in New York, beginning with a talk by Andrew Rudnick that describes the affect that the energy industry has on the ability of New York to attract other businesses to the north east. John Ellison and Diana Gleidman followed with a presentation on insurance issues of interest for all members of the industry, and then John Sano gave an update on DPS regulatory issues and initiatives.

Brad Field led off the afternoon session by describing the "new" New York - new happenings in the DEC, new exposure to the rest of the nation, and new interest and activity in the state, including interest in geo-thermal, alternative energy and the interest of outside companies in taking another look at New York. Jack Dahl followed with a description of drilling "shallow, deep and in the street," i.e., an update on traditional shallow drilling, the more recent Trenton-Black River play and the actual drilling of wells in New York City, on Long Island and even at the Bronx zoo. IOGA-NY Executive Director Brad Gill, another PAG member, summarized recent events that point out that the public's perception of the oil and gas industry is not cyclic, but is progressively getting worse. His conclusion was that industry needs a public education program - now. Rhonda Reda took over at that point and attempted to answer the question, "How can we create a successful education program with a limited budget?" After asking the question, she offered nine ways to accomplish the goal, beginning with developing an energy curriculum for teachers that meets federal and state guidelines while not being state specific; developing and hosting teacher workshops; recruiting energy students at science fairs; a guest speaker program, like "Petro Pro;" assisting in the development of oil field emergency response programs; promoting student safety programs; combining billboard campaigns with radio and TV ads; providing information, questions and answers on websites; and being aware that your well site may provide "photo opps" for others, and end up on their website. So, make it look the best it can look.

Two presentations on power generation, one utilizing stranded gas, the other wind power, completed the Wednesday, full-day session. Thursday's program featured three talks on geology, plays and reservoirs, followed by three talks on the effects of Hurricane Katrina on the industry, a new electronic flow measurement and automation system, and legislative changes affecting land practices in New York.

Taury Smith suggested that the right geologic model can lead to new discoveries in New York and that there is potential in Cambrian and Ordovician rocks other than the Trenton and Black River. From the basement up, these include the Potsdam

Sandstone, Theresa Formation, Beekmantown Formation, the Black River and Trenton carbonates, and the Utica Shale. Gerald Smith then described the various Upper Devonian sandstones at the surface (2000 outcrops) and in the subsurface (200 well logs) in western New York, with a particular emphasis on the stratigraphic framework, lateral continuity and facies changes, structural control and reservoir quality. William Zagorski wrapped up this particular session on geology and reservoirs, with a presentation on fractured reservoirs in New York in an area north of the Finger Lakes. In particular, he discussed older discoveries in the Trenton Limestone, Queenston Sandstone and Lockport Dolomite in the western portion of the area of interest, and more recent discoveries, like Blue Tail Rooster and West Auburn fields, in the eastern portion of the area.

West Virginia Energy Forum Announces Workshop Schedule

The West Virginia Energy Forum Program Coordinating Committee has announced their tentative meeting schedule for 2006. The first workshop, on coal conversion technology, will be held February 23rd in Charleston; the second, on clean power initiatives, will be held April 27th in Morgantown. Additional workshops on the schedule include one on promoting a hydrogen economy (July 27; Charleston), mining industries of the future (September 21; Morgantown) and carbon sequestration (December 6; Charleston). The purpose of this forum is to discuss how West Virginia's energy industries can position themselves to take full advantage of the increased global demand for energy.

Press Release 12/15/05

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Spider-Man 2 murals unveiled at NRCCE

Artwork donated by Columbia Pictures provides inspiration to aspiring engineers at WVU

Even though Peter Parker, alias Spider-Man, is an alumnus of Empire State University, Columbia Pictures chose to donate movie set panels from *Spider-Man 2* to the National Research Center for Coal and Energy at West Virginia University. The unveiling took place Thursday, Dec. 15 at the NRCCE and to everyone's relief Dr. Ock did not attend.

The artwork, depicting West Virginia's energy industries, was copied for the movie from the original 1940s mural by Robert Lepper that hangs in WVU's White Hall.

The work is considered an important example of Machine Age Art in America. Linking the mechanical to the living, and integrating the regional machine age to the nation, Lepper depicted the transformation of West Virginia's natural gas and coal into energy and the goods of coal and energy-related industries such as steel and glass.

"The mural is perfect for the NRCCE since the painting shows innovations in energy, and the NRCCE advances innovations for energy and the environment," said Richard Bajura, NRCCE director.

WVU officials commissioned Lepper to do the painting in the then new Mineral Industries Building in 1940. It was "discovered" a couple of years ago by an art consultant working for Columbia Pictures.

The replica of the mural was painted onto four separate pieces of canvas and affixed to a wall of a bank in the latest Spider-Man movie. It can be seen when Peter Parker and Aunt May go to the bank. It also serves as the background for a fight between Spider Man and Dr. Octavius.

The National Research Center for Coal and Energy is dedicated to advancing innovations for energy and the environment. The center conducts a variety of research and educational programs to help secure the nation's energy needs, protect the environment, and promote economic development. The leaders of the NRCCE hope that Robert Lepper's original work and the replica presented in the NRCCE lobby continue to provide inspiration for aspiring engineers.

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