AAPG AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, AN INTERNATIONAL ORGANIZATION

EXPLORER

NOVEMBER 2006

Exploration Innovations

Lights! Camera! Action!

New Ideas Inspire New Shale Plays

See page 6

Vol. 27, No. 11
November 2006

AAPG EXPLORER

On the cover: This month's EXPLORER celebrates and examines some of the innovations that are driving successful projects in surprising places all over the world – including some new approaches in the U.S. Mid-continent involving shales. The cover shot of Desoto Drilling's initial rig at its first Fayetteville Shale well is a good example of exploration innovation. See story on page 6. Photo courtesy of Southwestern Energy Co.

CONTENTS

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PRESIDENT'S COLUMN

New Dues Structure Being Considered

By LEE T. BILLINGSLEY

In previous columns I have exorted members to recruit other geoscientists to join AAPG; we can do better at getting more geologists to join, both in the United States and internationally.

An example of the U.S. growth potential comes from a study last February of the Houston Geological Society (HGS). Surprisingly about 50 percent of HGS members have not joined AAPG!

An unknown but significantly smaller percent of international geologists are AAPG members. A growing, vibrant membership will increase benefits for all.

While an increasing membership does mean more revenue from dues, those dues only account for about 16 percent of our total revenue. On average, each member spends about $108 per year on AAPG products and services, such as publications, short courses and conventions.

What does AAPG do with money collected for such products and services? We use that revenue to offer more. We publish new books, initiate new short courses, send more Distinguished Lecturers, plan new conventions, etc.

It stands to reason, then, that if we want to continue to offer more products and services, we will need to replenish and even increase our membership.

The wave of new petroleum geoscientists in the United States, reacting to the economics of higher product prices, will help our numbers in the next few years – but our largest growth potential is international.

* * *

Last year's Executive Committee (EC) attempted to make it easier and more desirable for international members to join AAPG. We considered two general initiatives:

❒ Increase international representation on the EC.

❒ Install a graduated dues structure.

We recommended the first initiative, and the House of Delegates' (HoD) Constitution & Bylaws Committee and HoD leadership constructively altered it. The resulting proposal created two vice president positions, one for U.S. Sections and one for international Regions. The proposal passed overwhelmingly in the HoD and in the general vote of AAPG members.

The second initiative was not recommended from the EC to the HoD last year, because we simply needed further study of the concept. Subsequently, an ad hoc Graduated Dues Committee received data from AAPG staff, deliberated and reported a range of choices to the current EC in late August.

Your current EC accepted the report from the ad hoc Graduated Dues Committee and unanimously recommended a graduated structure to the HoD's Constitution & Bylaws Committee.

That committee, along with the HoD and EC leadership, will confer in early December in an attempt to craft any bylaws changes that might be necessary to implement a new dues structure.


Billingsley

The EC's recommended changes are designed to meet the following criteria:

✓ Increase overall number of members. (We cannot increase the number of new members at the expense of existing members.)

✓ Increase affordability for low- and moderate-income members.

✓ At a minimum, break-even on each member's dues versus cost of membership.

✓ AAPG staff must be able to easily and cost-effectively administer any new dues structure.

* * *

As we consider a proposed graduated dues structure, I think it is important to consider the question, "Why does AAPG want more international members?"

Some answers:

✓ Job performance – The United States has about 1.6 percent of global proven oil reserves and about 4 percent of proven global gas reserves, yet U.S. geoscientists play a disproportionately larger role in global E&P. U.S. geoscientists need international input to effectively do their jobs.

✓ Reserve growth – Some large future petroleum reserve growth areas are in areas with relatively low current salaries for geoscientists (Russia, India, Nigeria and China come to mind). AAPG needs technical input from members in these areas.

✓ Networking – International connections are beneficial to a wide range of members, from independent consultants to academics to management at super-majors.

✓ Technical input – AAPG is striving to be the dominant creator and curator of applied geoscience technical information worldwide, especially in digital and GIS

See **President**, next page

Candidates' Bios, Responses Online

Biographies, pictures and statements from all candidates for AAPG office are now available for viewing on the AAPG Web site, www.aapg.org.

The candidates were given the opportunity to respond briefly to the subject: "Why I Accepted the Invitation to be a Candidate for an AAPG Office."

Responses and biographical information were provided by each candidate and edited only for grammar, spelling and format.

This information, which will remain online through the election period, also will be provided as hardcopy in the January EXPLORER.

Online balloting will be made available in the spring of 2007. Ballots will be counted on May 16. ❑

Outside the AAPG European office at Imperial College in London, England.

AAPG's First Satellite Bureau

European Region Office Opens

By CAROL McGOWEN
Sections and Regions Manager

The AAPG European Office, the Association's first Region satellite bureau, opened in London, England, with little fanfare in early September.

The office is located in room G22, Royal School of Mines, Department of Earth Science & Engineering at the South Kensington Campus of The Imperial College.

Past AAPG vice present Steve Veal serves as part-time director of the European Office, which is intended to be a model for other Regions.

The London office will serve as a portal to the Association, bringing AAPG closer to its members by providing a local and regional point of contact. Its three operational functions are AAPG services, AAPG products and European Region Council support.

Acting as an extension of AAPG headquarters while also providing logistical support to the European Region Council, the office will work with the Region Council and AAPG headquarters staff to:

✓ Support conferences and other educational programs.

✓ Market AAPG products and services.

✓ Facilitate membership growth within the region.

✓ Promote AAPG participation in regional geoscience programs.

✓ Network with AAPG members and affiliate societies within the region.

The college will provide office space to AAPG at no charge for a period of one year, "subject to extension or termination of the agreement, or other adjustment, as mutually agreed upon" by Imperial College and AAPG.

The office space itself contains little more than the essentials – a desk, two chairs, a file cabinet and bookshelf. But just down the hall the location offers access to a large conference room plus a sizeable training lab equipped with about 25 computers.

A nearby plaque on the door of the training lab acknowledges the donation made by AAPG and the AAPG Foundation that provided seed funding for the training center in 2002, with both giving $50,000.

AAPG will provide all funding for the European Office for its first year of operation, with the goal of the office becoming self-supporting within the third year of operation. By implementing revenue-generating programs in partnership with the European Region Council, the Region's contribution to the office budget is expected to increase each year.

Ultimately, the Region will contribute a fair percentage of the European Office budget equivalent to its share of the three operational functions.

Progress toward the goal of financial self-sufficiency will be assessed annually by the AAPG Executive Committee, AAPG executive director and European Region Council.

Present office hours at the Imperial College site are 9 a.m. to 5 p.m. on Tuesdays and Thursdays. Contact the office by calling +44 207 594 3283 – or when in London, stop by for a visit. ❑

President

from previous page

form. Increased international membership will improve this effort.

✓ Social – It's the right thing to do; facilitating an improved standard of living around the world is very satisfying for all of us.

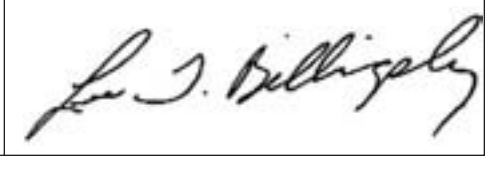
* * *

Several years ago AAPG decided to become an international organization, instead of remaining a domestic organization with a few international members. We are gradually taking steps necessary to reach our desired global scope.

A graduated dues structure that allows affordable membership for more geoscientists is a step in the right direction.

For now, adios, auf Wiedersehen, Dosvidanya, bayi, G'day mate, ciao, Au revoir,

'Til next month,



Barnett Teaches Lessons

Shales Require Creative Approaches

By DAVID BROWN
EXPLORER Correspondent

Challenges in both new and old shale gas plays are forcing operators into innovative approaches.

The spread of shale prospects into new areas has even resulted in cutting-edge geology and geochemistry.

"They're finding out that mineralogy is very important," said Brian Cardott. "A shale is not just 'a shale.'"

Cardott is an organic petrologist and coal geologist at the Oklahoma Geological Survey in Norman, Okla., and serves as chair of AAPG's Energy Minerals Division Gas Shales Committee (see related story, page 49).

Gas shales could hardly be a bigger story.

By current estimates, the shale resource in the United States could total 500 to 700 trillion cubic feet of gas in place.

In his presentation on Oklahoma shale potential, Cardott includes a map showing 19 U.S. shale gas basins.

There's plenty of area left to roam, plenty of room to run.

Some of the most innovative thinking in shale exploration and development today has resulted from a changed perspective.

Downhole tools, 3-D seismic, micro-seismic, geochemical logs and special analysis software are being applied as operators begin to see shale plays more in terms of reservoirs than of producing zones.

These type of "resources plays in general seem to be of interest to the industry," said Scott Reeves, executive vice president in the Houston office of Advanced Resources International.

"It's one of the more interesting unconventional plays because it's so undefined," he added. "But where the real opportunity lies is international."

For a current overview of shale gas and a look at Canadian potential, Cardott recommended the 2006 Geological Survey of Canada report "The 'Shale Gas' Concept in Canada: a Preliminary Inventory of Possibilities" (Open File 5384).

"One of the biggest challenges in shales today is where to find them and where they can be productive, because no one has done an overall assessment," Reeves said.

Even when a potential shale play can be targeted, operators must confirm the presence and producibility of gas, he noted.

Photos courtesy of Southwestern Energy Co.

The spread of shale prospects into new areas has resulted in cutting-edge operations, like those at the DeSoto Drilling Inc. rig #3 (above), captured at sunset, south of Quitman, Ark.

"The first thing is to make sure you have the hydrocarbon resource in place," Reeves said. "Second, you've got to have the deliverability."

Where We're Headed

Both Cardott and Reeves were part of the "Mid-continent CBM & Gas Shale Symposium" in Tulsa in October.

Cardott discussed "Frontier Gas-Shale Plays of Oklahoma," and Reeves delivered the keynote address, "Unconventional Gas: Where We've Been and Where We're Headed."

In talking about Oklahoma plays, Cardott identified three key questions to be resolved:

✓ What is the minimum thermal maturity needed for shales containing oil-generative organic matter to be economic gas shales?

✓ What is the importance of natural versus induced fractures?

✓ What is the importance of free gas versus sorbed gas?

Questions about thermal maturity, organic matter content and shale composition have become increasingly important to geologists working the new shale-gas plays.

Vitrinite reflectance is the most common thermal maturity indicator for Oklahoma shale, with a lower oil-window cutoff of 0.5 percent Ro, according to Cardott.

As new plays develop, geologists are realizing that shale type, composition and mineralogy can be critical factors. In Oklahoma, the Woodford shale resembles the silica-rich Barnett, Cardott said.

By contrast, the Caney shale is more clay rich.

Operators have found that clay shales in general do not respond as well to

See **Innovations**, page 8

Fayetteville Innovations Paying Off

By DAVID BROWN
EXPLORER Correspondent

Southwestern Energy Co. of Houston pioneered the Fayetteville shale play on the Arkansas side of the Arkoma Basin.

Innovative techniques helped the company increase Fayetteville gas production from 20 million cubic feet per day in May to 50 million at the beginning of August this year.

The company invested more than $160 million in the Fayetteville during the first half of 2006, including more than $40 million for drilling rigs to be used in the play.

AAPG member John Thaeler, senior vice president of Southwestern Energy operating company SEECO Inc., described three areas of innovation:

❒ **Well-bore construction and drilling.**

"We purchased 11 drilling rigs, of which eight have been delivered, specifically designed for drilling shale-play depths in the Fayetteville shale," which range from 1,500 to 6,500 feet deep in the company's area of interest, he said.

In addition, the company operates two shallow rigs in the Fayetteville.

Those rigs drill the shallower, vertical section of the holes, then the deep rigs later drill horizontal wells with laterals up to 4,000 feet, Thaeler said.

❒ **Reservoir characterization.**

"We've taken a great deal of effort to conduct a full core acquisition and analysis program throughout the area to better understand depositional models and facies," Thaeler noted.

Also, the company devotes a technical team to studying the Fayetteville shale, including geology, geophysics, reservoir engineering, production engineering and drilling engineering.

"They are tasked with acquiring and then analyzing the data as soon as it comes in, and integrating that information into our operational plans," Thaeler said.

"This allows us to continuously innovate while we stay focused on maintaining an active drilling and operations program," he added.

❒ **Improving recovery efficiencies.**

"We have evolved the fluids we're using, and we have gone completely to horizontal drilling now. We've moved from nitrogen-foam fracs to slickwater and cross-linked gel stimulation," Thaeler said.

The company also finds that acid-soluble cements can reduce treatment pressure requirements, and it continues to study new applications in completion technology, he added.

Through July, the company had completed 105 wells in the Fayetteville shale, 54 of them horizontal. The cost of a completed slickwater horizontal well in the play averaged about $2.1 million.

Southwestern Energy continues to expand its Fayetteville play area, moving east into Arkansas' White County and also testing deeper Moorefield and Chattanooga shales. ❑

Innovations

from page 6

fracture stimulation as silica-rich shales.

"They're at the start of the learning curve for the Caney shale more than the Woodford," Cardott noted.

Barnett Lessons

Two years ago, the Barnett shale play in Texas was barely out of its infancy; today it's the grandfather of Mid-continent shale gas.

Reeves said lessons drawn from the Barnett can help geologists better understand new shale prospects, even when characteristics differ.

"What we've seen is that the presence of brittle material in the shale really helps," he said.

"This has been documented in the Bakken and Mancos. On the gas side, it's been discussed widely only in the Barnett. People have suggested the presence of brittle material seems to lead to more productive wells," he added.

The low predictability of shale gas production can be an obstacle for operators working in new play areas.

Reeves said his company utilizes its COMET3 reservoir simulator designed for non-conventional reservoirs like coalbed methane and shale gas.

"In the early stages of development you don't have enough data to drive it, but people still need to make decisions," he said.

To counter the scarcity of data in new plays, Advanced Resources has successfully coupled its reservoir simulator with a Monte Carlo simulation approach, Reeves said.

"The beauty of it is that it captures all of the possibilities of the physics," he explained.

Frac job in progress at the site near Damascus, Ark.

Fractured Learning Curves

As a means of measuring the calculated formation pressure of a potential shale gas reservoir, Schlumberger has developed a wireline system and analysis methodology.

Learning curves also apply to drilling and fracing in new shale plays. A shift from vertical to horizontal drilling opened up shale zones more effectively and boosted initial production rates in the Barnett.

According to Schlumberger, there were only four horizontal wells in the Barnett shale in 1999. By the end of 2004, there were 744.

Operators now approach most shale plays with the expectation of horizontal drilling.

"A lot more attention is being given to horizontal wells in shale than has been given in the past," Reeves noted.

He said horizontal applications in shale could follow the more advanced approaches used in coalbed methane development, such as pinnate-pattern drilling.

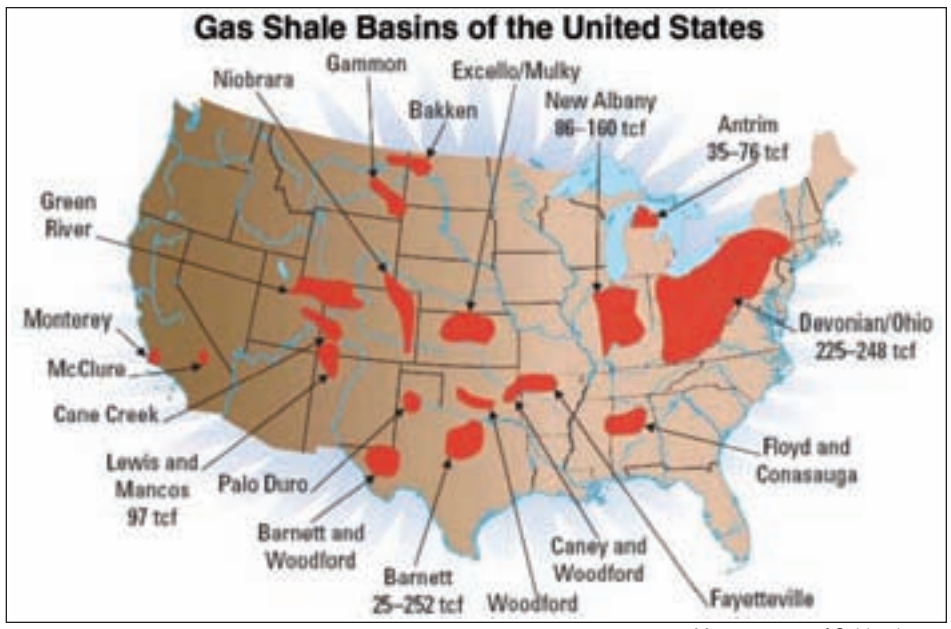
"I don't see why that would not be applicable in shale," he said.

Studies, testing and debates continue over the most effective methods of fracturing gas shales.

"For 150 years, shale gas was mostly from fractured reservoirs," Cardott said. "The better potential is when you can fracture the reservoir yourself."

Yet the best fracing approaches for shale aren't obvious, as operators focus on the characteristics and importance of natural fractures and on the right frac

See **Shale Gas**, page 10



Map courtesy of Schlumberger

Shale Gas

from page 8

fluid-proppant combinations.

In new play areas, hole placement in relation to natural fractures may determine optimal drilling direction.

Early on, industry considered natural fractures essential for good shale gas production. Then their importance was downplayed – but the current view once again emphasizes the value of naturally fractured reservoirs.

Operators avoid highly fractured areas in some shale plays, however, hoping for better control of fracture treatments.

Almost all fracs in gas shale horizontal wells have aimed at creating multiple traverse fractures in relation to the borehole. A new theory of long fracing proposes the creation of longitudinal fractures.

The geological setting of a shale play also affects fracing decisions. Cardott said shale operators found that the presence of a natural frac barrier kept their wells from watering up.

"Then they discounted certain areas that don't have the frac barrier because they wanted to stay away from the water. Now if they do everything correctly, they can have a good well without the frac barrier," he said.

That approach helped the Barnett play move out of its core area and could have applications in Mid-continent shale plays.

An early thought held that gel fracs are not effective in shale, leading to a preference for water, slickwater or nitrogen-foam fracs.

Current work targets enhanced pumping fluids for better fracturing and more efficient suspension and delivery of proppants, as well as better proppant design.

An Innovative Approach

Several factors will determine the future of shale gas plays.

Most of them point to the need for continued innovation.

Natural gas prices have fallen while shale development costs have zoomed upward. Operators seem likely to concentrate on improved exploration, production efficiencies and best practices to control costs.

A combination of current knowledge and new approaches will be needed as shale plays move into more geologically complex areas.

And the opening of shale gas plays outside the United States will require innovative techniques to overcome new challenges.

Because shales and settings can vary so widely, operators say there is not one "biggest problem" in approaching a new play area.

Instead, shale plays present a series of problems to be solved and obstacles to be overcome. Shale exploration and production requires continuous innovation.

"Almost every shale play has undergone a watershed event – and frequently that happens by accident," Reeves noted. "They limp along for a while and then somebody discovers a little trick, and the thing just explodes."

In the future, Reeves expects shale gas operators to borrow a page from coalbed methane production and utilize nitrogen or CO_2 injection for enhanced recovery.

"If you're looking out on the horizon that may be a technology to consider," he said. "What you're probably looking at there is what's going on with enhanced coalbed methane."

In the United States, operators have moved well up the shale gas learning curve but still have plenty of room for experimentation and new ideas.

Oddly enough, a better understanding of shale has driven the industry back to geoscience for prospect evaluation, drilling placement and steering, and reservoir analysis.

Said Reeves:

"I'm a petroleum engineer and I've been doing unconventional gas pretty much my whole career. It became painfully obvious – put your money into finding the right place to drill in the first place." ❑

AAPG Honorees Named

Bouma Picked for Powers

Arnold H. Bouma, who has a sequence named after him because of his discovery of dividing deepwater turbidites into intervals, has been named the 2007 recipient of the Sidney Powers Memorial Award.

Bouma, an adjunct professor at Texas A&M University, heads the list of those persons being honored this year by the Association.

AAPG awards, approved by the Executive Committee, are presented annually to recognize individuals for service to the profession, the science, the Association and the public.

As a recipient of the Powers Medal, Bouma is bestowed the Association's highest honor.

In addition, this year's slate of honorees includes a new award – the inaugural Michel T. Halbouty Outstanding Leadership Award, approved earlier this year by the Executive Committee to honor those who have provided excellence in Association leadership (see related story).

Receiving the inaugural Halbouty Outstanding Leadership award is John Amoruso, of Amoruso Petroleum in Houston, an AAPG Honorary member, former AAPG president and member of the AAPG Foundation Corporation.

Bouma, Amoruso and their fellow honorees will be recognized at the opening session of the 2007 AAPG Annual Convention, April 1-4 in Long Beach, Calif.

An interview with Bouma will be published in a future EXPLORER, and biographies and citations of all award winners will be included in a future BULLETIN.

Those award winners approved by the Executive Committee and who will be honored along with Bouma in Long Beach, Calif. are:

Michel T. Halbouty Outstanding Leadership Award

❒ John J. Amoruso, Amoruso Petroleum, Houston.

Honorary Member Award

Presented to members who have distinguished themselves by their accomplishments and through their service to the profession of petroleum geology and to AAPG.

❒ Edward D. Dolly, The Houston Exploration Co., Denver.

❒ Marlan W. Downey, Dallas.

❒ Daniel L. Smith, Sandalwood Oil and Gas, Houston.

Outstanding Explorer Award

Presented to members in recognition of distinguished and outstanding achievement in exploration for petroleum or mineral resources, with an intended emphasis on recent discovery.

❒ Dan B. Steward, Republic Energy Co., The Woodlands, Texas.

Distinguished Service Award

❒ Adekunle A. Adesida, Shell Petroleum (Nigeria), Lagos, Nigeria.

❒ Alfredo E. Guzman, Pemex, Veracruz, Mexico.

❒ Andrew Hurst, University of Aberdeen, Aberdeen, Scotland.

❒ John C. Lorenz, Sandia National Laboratories, Albuquerque, N.M.

❒ Erik P. Mason, Shell Oil, Katy, Texas.

❒ Valary L. Schulz, Matador Resources, Dallas.

Grover E. Murray Distinguished Educator Award

Presented for distinguished and outstanding contributions to geological education, both at the university level and toward education of the general public.

❒ Janok Bhattacharya, University of Houston, Houston.

❒ A. Eugene Fritsche, retired (emeritus – California State University at Northridge), Winnetka, Calif.

❒ Stephan A. Graham, Stanford University, Stanford, Calif.

Special Award

Presented to individuals and organizations whose area of work may not qualify for one of the existing awards, but are worthy of Association recognition.

❒ Richard D. Fritz, executive director, AAPG, Tulsa.

❒ Marcus Milling, executive director of the American Geological Institute in Alexandria, Va., since 1992.

Milling died Oct. 17 after a long illness.

continued on next page

Bouma

Halbouty Leadership Award

The newly defined Michel T. Halbouty Outstanding Leadership Award will be given in recognition of outstanding and exceptional leadership in the petroleum geosciences. It is AAPG's second most distinguished award, second to the Sidney Powers Memorial Award. Only one award is given during any one calendar year.

In 2005 the name of the award was changed from the Michel T. Halbouty Human Needs Award to the Michel T. Halbouty Memorial Human Needs Award. The award name was changed to the Michel T. Halbouty Outstanding Leadership Award and amended by Executive Committee action earlier this year.

The recipient must be an Active (includes Honorary, Emeritus and Life) member of the Association. A candidate must be living at the time of selection and be willing to be present to receive the award at the time and place designated by the Executive Committee, normally at the annual convention.

This award and the Sidney Powers Memorial Award shall be mutually exclusive. The award's namesake was a legendary international wildcatter. He died in 2004. ❑

continued from previous page

Public Service Award

Presented to recognize contributions of AAPG members to public affairs – and intended to encourage such activities.

❒ **Peter T. Flawn**, retired (president emeritus, the University of Texas at Austin), Austin, Texas.

❒ **Lee C. Gerhard**, Thomasson Partner Associates, Lawrence, Kan.

❒ **Edward M. Warner**, Expedition Oil Co., Denver.

Pioneer Award

Presented to long-standing members who have contributed to the Association and who have made meaningful contributions to the science of geology.

❒ **W. Herbert Hunt**, Petro-Hunt, Dallas.

Wallace E. Pratt Memorial Award

Presented to honor and reward the author(s) of the best AAPG BULLETIN article published each calendar year.

❒ **Shankar Mitra, Gerardo Correa Figueroa, Jesus Hernandez Garcia** and **Antonio Murrillo Alvarado**, for "Three-Dimensional Structural Model of the Cantarell and Sihil Structures, Campeche Bay, Mexico," which appeared in the January 2005 BULLETIN. All are with the University of Oklahoma, Norman, Okla.

Robert H. Dott Sr. Memorial Award

Presented to honor and reward the author/editor of the best special publication dealing with geology published by the Association.

❒ **Amos Salvador**, for AAPG Studies 54, *Energy: A Historical Perspective and 21st Century Forecast*. Salvador is with the University of Texas at Austin, Austin, Texas.

George C. Matson Award

Presented to honor and reward the best oral presentation at the AAPG Annual Convention in Houston.

❒ **Steven H. Brachman**, for "Integration of 3-D Seismic With Geologic Knowledge Can Detect Non-Amplitude Combination Traps and Discover New Pay Zones in the 600 BCF Mature Play, Northern Lafourche Parish, Louisiana." Brachman is with Pogo Producing, Houston.

Jules Braunstein Memorial Award

Presented to honor and reward the best poster presentation at the AAPG Annual Convention in Houston.

❒ **George W. Shurr, Thomas Haggar** and **Sarah A. Chadima**, for the poster "Exploration Strategies for Ultra-Shallow Microbial Methane on the Eastern Margin of the Williston Basin." Shurr is with GeoShurr Resources, Ellsworth, Minn., and Haggar and Chadima are both with the South Dakota Geological Survey, Vermillion, S.D.

Geosciences in the Media Award

Presented for notable journalistic achievement in any medium, which contributes to public understanding of geology, energy resources or the technology of oil and gas exploration. Granting of this award in any year is discretionary.

❒ **Michael J. Economides**, a prolific author with 11 books either authored or co-authored to his credit, and with two more books in press; honored for his most recent best-seller, *The Color of Oil*. Economides is one of the most recognizable names in the energy industry and is a professor at the Cullen College of Engineering, University of Houston.

He will be the featured speaker at the All-Convention Luncheon at the 2007 AAPG Annual Convention in Long Beach, Calif. ❑

Jack 2 Success Proves Theory

Deep Lower Tertiary Playing Well

By LOUISE S. DURHAM
EXPLORER Correspondent

When Chevron in September announced a flow test of 6,000 barrels of oil per day from its Jack 2 well – which tapped the Lower Tertiary age deposits in the Walker Ridge area of the deepwater Gulf of Mexico – and simultaneously noted potential reserves as high as 15 billion barrels for the region, the mainstream media hype machine kicked into high gear.

For starters, the Jack prospect/field was compared to a find more typical of the giant fields of Saudi Arabia and Iraq rather than the United States.

A congressman in Washington, D.C., prattled on about how such a discovery with the potential to increase the nation's reserves by billions of barrels in one fell swoop will go far to ensure that Americans have affordable (i.e., cheap) gasoline.

There even were reports the Jack 2 well already was producing 6,000 barrels a day, when, in fact, any production to come from this well – or others in these same rocks – is years away.

Much of the inaccurate commentary making the rounds stems from a lack of understanding of the vast difference between a field discovery and a geologic play.

In other words, the news was exciting. But the full story is yet to be known.

A Lot of Risks

To date, about 15 fields have been discovered in the Lower Tertiary play, which spans about a 300-mile swath across the GOM.

The Jack 2 well (the original discovery well in the field was drilled in 2004) was drilled in 7,000 feet of water to a subsea depth exceeding 20,000 feet. A third well apparently is being planned to help with appraisal of the field.

For the moment, the Jack 2 well's real significance is that it was the first flow test conducted successfully in any of the Lower Tertiary discoveries in the deepwater GOM.

For the first time operators have hard evidence that hydrocarbons can flow commercially in these rocks they have eyed longingly since way back.

The rocks in this play are the same age as the productive Wilcox formation onshore Texas, according to Paul Weimer, professor of geology at the University of Colorado.

"The sands probably came from both the Appalachians to the north and northern Mexico and the Rocky Mountains to the west," Weimer said. "They're called sheet sands because of the environment where they're deposited, which is at the base of a slope in unconfined settings.

"They're deep marine sands with a widespread areal extent," Weimer said, "which means the possibility of good continuity and conductivity."

The GOM areas where discoveries have been made in the Lower Tertiary play are the Walker Ridge and Keathley Canyon areas – about 250-plus miles southwest of New Orleans – and the Alaminos Canyon area farther to the west.

"In Alaminos Canyon, the play has a distinct structural style," Weimer said. "That's what's called the Perdido fold belt. There's a lot of structural relief, there's been some shortening and contraction there and the folds are salt-cored.

"In contrast, where discoveries have been made in Keathley Canyon and Walker Ridge, the structures are salt-cored but deformation is not as extensive, resulting in simpler structures.

"What a lot of people don't understand is most of the play in the Keathley Canyon and Walker Ridge areas lies below shallow allochthonous salt, and that's key," Weimer said. "Imaging below salt with 3-D seismic is one of the biggest challenges in exploration, so it's taken a lot of special geophysical acquisition and processing to be able to image these structures.

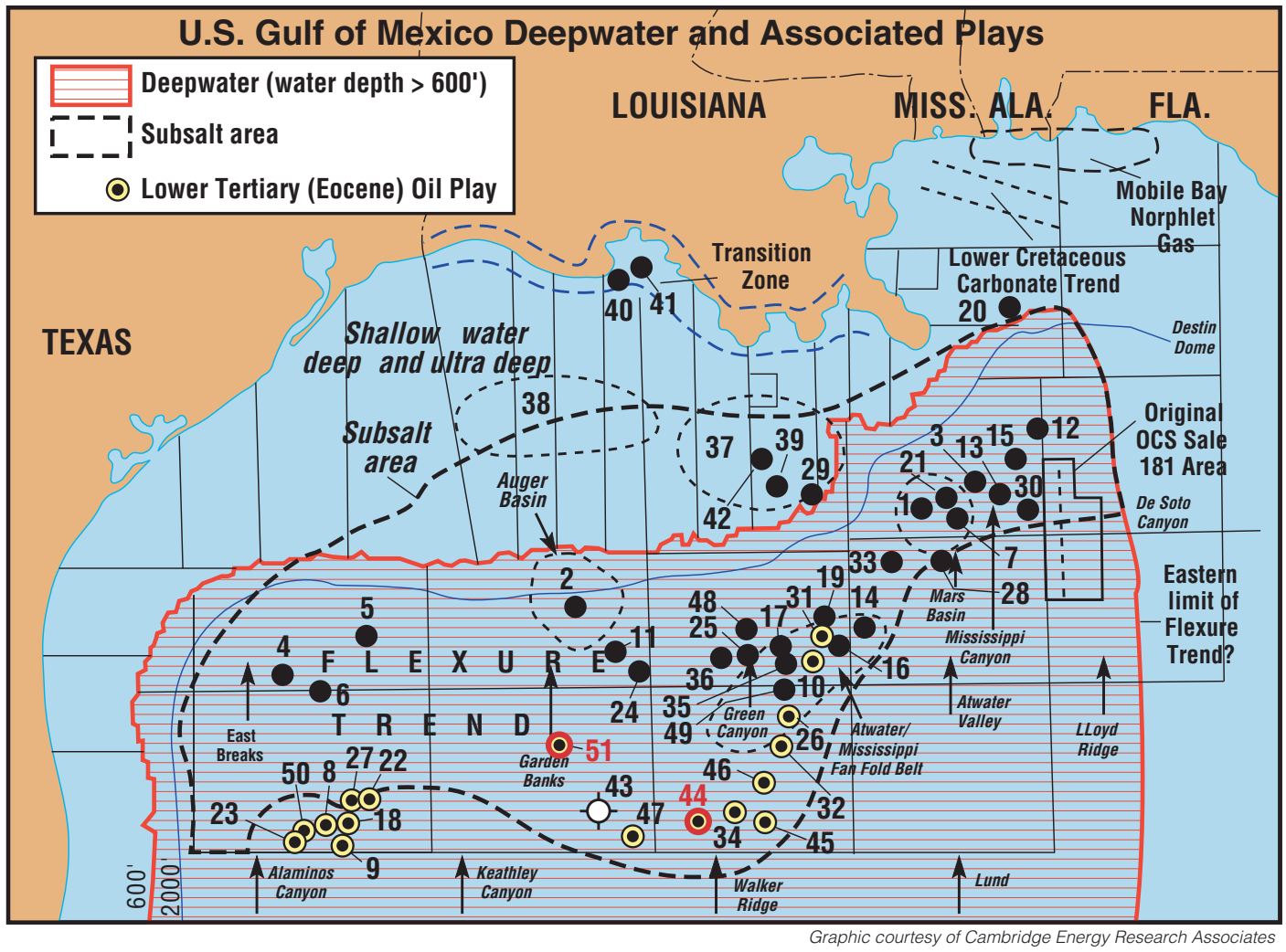
"It's still high risk," Weimer noted, "because you're always dependent on what processing algorithms you use among other things. If it weren't for the shallow salt and difficulty in imaging these structures, many of these features may have been drilled a decade ago."

Indeed, advances in seismic data acquisition and processing to enable subsalt imaging, along with the ability to drill in water depths of close to 10,000 feet, represent an array of exploration innovations introduced and refined over the last several years.

Once discovered, these Lower Tertiary fields present a number of significant challenges to be addressed – not the least of which is the geology.

Reported sand porosities average perhaps 18 percent, which is not too shabby. Permeabilities, however – which are key to flow potential – are in the lower ranges. Unlike the one-half to 1 darcy permeability of the high-rate producing younger Miocene sands at some of the big Gulf fields, such as Thunder Horse and Mars, the Lower Tertiary rock may have permeabilities in the 10-30 millidarcy range.

continued on next page



1. Mars Field
2. Auger Field
3. Mensa gas field – 5,412' WD
4. Diana Field
5. East Breaks 602, 642-3, Nansen & Boomvang Fields
6. Hoover, Madison, Marshall Fields
7. Ursa – third largest oil & gas field
8. Great White discovery
9. Trident discovery
10. Mad Dog development & deep prospect
11. Magnolia/Entrada development
12. Aconcagua Field
13. Thunder Horse, largest oil discovery, N. Thunder Horse
14. Neptune development
15. Nakika Field
16. Atlantis development
17. Holstein Field
18. Tobago discovery
19. K2/Timon/Marco Polo, K2 North complex
20. Canyon Station
21. Princess development
22. Tiger discovery
23. Hammerhead discovery
24. Red Hawk Field
25. Tahiti development
26. Cascade discovery
27. Silvertip discovery
28. Telemark discovery
29. Tarantula subsalt development
30. E. Gulf discoveries – Independence Hub
31. Shenzi discovery & deep dry hole
32. Chinook discovery
33. Sturgis discovery
34. Saint Malo discovery
35. Puma discovery
36. Constellation development
37. Treasure Island–ultra deep shelf area
38. Treasure Bay–ultra deep shelf area
39. Shark ultra deep dry hole
40. JB Mountain field (deep shelf)
41. Mound Point field (deep shelf)
42. Blackbeard 32,067 foot failure
43. Sardinia dry hole (thick Eocene sand)
44. **Jack discovery/production test**
45. Das Bump prospect (discovery?)
46. Stones discovery
47. Hadrian discovery
48. Knotty Head/Pony discovery
49. Big Foot discovery
50. Great White West discovery
51. **Kaskida discovery**

Graphic courtesy of Cambridge Energy Research Associates

continued from previous page

"This means more diagenesis in the Lower Tertiary reservoirs, which is not as abundant in the Miocene and younger reservoirs," Weimer said. "This affects how long and how well you can produce the reservoirs."

A Play With Legs

Speculation over the play is widespread in the industry. In part, this can be traced to what has *not* been said by the principles. Details of the Jack 2 flow test – conducted in the upper 40 percent of the 350-foot pay zone – such as choke size, pressures and whether facilities were constrained are being held tight, so even the experts must try to back-out the potential as best they can.

Still, Jim Flanagan, regional manager for the Gulf of Mexico team at IHS Energy noted there are plenty of indications the companies think this play has legs.

"Projects are in competition for corporate cash, and they have a rigorous way of building a batting order of prospects," Flanagan said. "That tells me these things they're drilling out here in the Lower Tertiary trend stack up well

See **Jack**, page 18

Quiet Find Trends Well for Keathley

By LOUISE S. DURHAM
EXPLORER Correspondent

There's been much applause about Chevron's recent announcement of a 6,000 bopd test at the Jack 2 well in the Walker Ridge area of the deepwater Lower Tertiary play in the Gulf of Mexico.

But to many industry watchers, the Kaskida well discovery to the northwest of Jack 2 in Keathley Canyon Block 292 – announced about two weeks earlier – was far more significant in a number of ways.

The BP-operated Kaskida well reportedly was drilled in almost 6,000 feet of water to a depth of 32,500 feet.

The well encountered 800 feet of net pay, compared to 350 feet in Jack 2. In fact, the reported pay section is greater than any of the other discoveries thus far in the Lower Tertiary trend in the Gulf.

But the significance of the Kaskida goes far beyond the amount of net pay.

"The BP well is the first established pay in the Keathley Canyon protraction area," said Jim Flanagan at IHS Energy. "It shows the trend does continue between the areas to the east – where Cascade, Chinook, St. Malo and Jack were drilled – and what's over to the west, where you have the Perdido fold belt and the Great White discovery made by Shell and some of the other discoveries made in that area.

"The BP well lends support to think that the trend actually extends from the Perdido fold belt area over to Chinook and Cascade," Flanagan noted.

The intrigue doesn't stop here.

"It was a dry hole, but it reported 1,100 feet of sand in it. What this is telling you is that the Keathley Canyon block has a lot of reservoir potential."

"Far more important than that discovery is that to the southeast part of the block in Keathley Canyon, Unocal drilled the Sardinia well several years ago," said Bob Esser at Cambridge Energy Research Associates.

"It was a dry hole, but it reported 1,100 feet of sand in it," Esser said. "What this is telling you is that the Keathley Canyon block has a lot of reservoir potential. All they need to do is find the trapping mechanism, which obviously was not there for Sardinia but is there for the Kaskida well."

This serves to underscore the importance of the timing of oil migration and the need to have structure in place prior to migration.

"If migration in the Keathley Canyon area was occurring at the same time as it was over in Walker Ridge," Flanagan said, "then you would want to identify structures at least as old as the Jack and St. Malo structures."

Industry interest in this locale clearly is huge.

"In the last lease sale covering this area in August, six of the 10 highest-bid blocks were in Keathley Canyon," Esser noted. "Those in the Kaskida well know the potential of this area, and those and others bid heavily on Keathley Canyon blocks.

"With all this new interest and the blocks already owned," Esser said, "we would expect a heavy drilling slate coming up fairly soon.

"Where Chevron talks about three to 15 billion barrels in the trend, Keathley Canyon is where a lot of it will take place to get up to that number." ❑

Five DL Tours Set in November

November will be a busy month for AAPG's Distinguished Lecture program with six speakers offering their talks.

On tour in November are:

✓ **Marian J. Warren**, this year's Haas-Pratt Endowment speaker, will continue her tour of the eastern United States through Nov. 10. She offers two talks: "An Exploration Case History – How We Made a High-Impact Gas Discovery in a Maturing Basin (Western Canada)," and "Extensional Faulting, Paleodrainage Patterns and Impact on Hydrocarbon Reservoir Quality and Distribution During Foreland Basin Subsidence – A Case Study from the Cretaceous of Alberta."

✓ **Stephen Creaney**, this year's J. Ben Carsey Endowment speaker, will tour the western United States Nov. 6-17. His talk is "Global Petroleum Evaluation – The Role of Integrated Regional Analysis."

✓ **Jacob B. Lowenstern** will tour the eastern United States Nov. 6-17. His talk is "Intrusion, Deformation and Degassing at the Yellowstone Caldera."

✓ **Steven L. Bachtel** will tour the eastern United States Nov. 27-Dec. 8. His talk is "Seismic Stratigraphy of the Miocene-Pliocene Segitiga Platform, East Natuna Sea Indonesia: The Origin, Growth and Demise of an Isolated Carbonate Platform."

✓ **Michael R. Hudec** will tour the western United States Nov. 27-Dec. 8, offering two talks: "Advance Mechanisms of Allochthonous Salt Sheets – Implications for Predicting Subsalt Pore Pressure," and "Evolution of Suprasalt Minibasins in the Deepwater of the Gulf of Mexico."

For specific dates and other tour information contact Karen Dotts, the DL coordinator, at 1-918-560-2621; or e-mail to kdotts@aapg.org. ❑

Jack

from page 15

economically on a worldwide basis with everything else they have to drill.

"If they could drill someplace else and get a bigger bang for the dollar," Flanagan said, "they would have done it."

One question weighing on a lot of minds is how low oil prices can drop before nerves become frayed. This is costly territory, not just in terms of drilling in such water depths, but in terms of the humongous cost to build pipelines and other facilities in remote areas, such as this play.

"If you're drilling in some of the deepest, most expensive areas of the Gulf, you have to be concerned about costs and commodity prices," Flanagan said. "But the leases are long-term, and they don't have to make drilling decisions right away – and they're not making things economic based on $60 to $70 oil."

Taking The Long Way

Production from the Petrobras-operated Cascade and Chinook fields on the trend's eastern edge reportedly will begin in late 2009. It is anticipated the company will deploy a FPSO (floating production, storage and offloading facility).

Significant production from the play is not expected until perhaps 2012-14, and fields will come on variably during that time frame, according to AAPG member Bob Esser, senior consultant and director of global oil and gas resources at Cambridge Energy Research Associates. He noted one of the reasons for the long time to significant production is it takes six months to drill a well here.

Without a good deal of factual information from operators in the play, it's challenging to put together production outlooks. But determining numbers that are in the ballpark is doable, according to Esser.

"By 2012-2014 we think we can expect these fields to be capable of producing about 800,000 barrels of oil per day," Esser said. "That's from fields we know about so far that have already been discovered. That would be 800,000 barrels a day we wouldn't have to import.

"The deepwater right now can produce 1.2 million barrels a day, and this would get it close to two million a day or a little more.

"Right now, we figure the play has two to three billion barrels discovered," Esser added. "Rather than being the tip of the iceberg, the iceberg has been discovered – it's just coming a little further out of the water now. Instead of being seven-eighths under water, it's maybe just 75 percent under now."

To put the play into perspective, Esser noted they think it's the most significant oil trend to be discovered since Alaska's Prudhoe Bay Field in 1968.

Prudhoe was initially assessed with the potential for about 9.8 to 10 billion barrels recoverable, according to Weimer. He said that number is approximately 14.5 billion barrels ultimate recovery now, owing to improved reservoir management and new technology.

"The Lower Tertiary in the deepwater has the potential to be as big as Prudhoe Bay," Weimer said. "Fifteen billion plus-or-minus is not out of line for the trend, but it will take many fields and years to develop. There are extremely difficult conditions to develop it in.

"The deepwater Gulf of Mexico presents an enormous challenge." ❑

Stacked Coal Seams Previously Overlooked

Coalbed Gas Frontier Being Tapped

"Here's an area very much like the Powder River Basin – folks have drilled through the Horseshoe Canyon for decades, and everyone missed its potential. Technical innovation has altered perception."

Photos and graphics courtesy of James Lee

Innovative technology – here, involving nitrogen fracture processes – are helping to make Alberta's once over-looked and under-considered Horseshoe Canyon Formation play a success story.

By SUSAN R. EATON
EXPLORER Correspondent

It is truly a great North American coalbed methane frontier.

Alberta's Western Canadian Sedimentary Basin (WCSB) is underlain by numerous, stacked coal seams permeated with methane, and contains twice the amount of gas in place than all of the CBM basins in the continental United States combined.

In 2005, the Canadian Gas Potential Committee estimated that coalbed methane resources for the WCSB and several small, isolated sedimentary basins in British Columbia represented a staggering 528 trillion cubic feet of original gas in place, with marketable volumes of between 11-45 trillion cubic feet.

Lessons from a 25-year history of CBM exploration and production in the United States are being adapted by Canada's nascent unconventional gas industry, creating a made-in-Canada technological road map for the WCSB to extract CBM riches.

Horseshoe Innovations

At AAPG's recent international conference in Perth, Australia, AAPG member Paul Gagnon presented a paper titled "Latest Learnings from the World's Largest 'Dry' Coalbed Methane Play: Horseshoe Canyon Coal and Rock Package, Southern Alberta."

"Canadians have been a very quick study on what their American counterparts have been doing in this unconventional play – not only in employing but *improving* the technologies," said lead author Gagnon, an American geologist who splits his time between Denver and Calgary, Canada.

Canadian E&P firms and service companies have tackled the CBM challenge, he said, by pioneering innovative nitrogen hydraulic fracturing processes and constructing special-purpose-built drilling rigs and coil tubing units.

In an industry where each geological basin experiences its own unique R&D learning curve – and in an industry that's secretive about technological developments – Gagnon and his Canadian co-authors from Western Gas Resources Canada Co. and BOE Solutions described how they've developed an E&P tool kit for the Horseshoe Canyon Formation, successfully integrating geological and engineering practices to unlock the unconventional play.

They assert that their learnings from the WCSB can be applied globally in the exploration for analogous coals.

Gagnon views the Horseshoe Canyon as a coal and rock package comprised of stacked tight gas sands, shales, silts and coals. The rock package contains between five to 30 coal seams, distributed throughout the 600- to 1,300-foot-thick stratigraphic section. The coal seams are generally discontinuous, making geological correlations across the basin challenging.

He believes that the adjacent sands and shales also contribute to overall natural gas production from wellbores.

"Here's an area very much like the Powder River Basin," he said. "Folks have drilled through the Horseshoe Canyon for decades, and everyone missed its potential.

"Technical innovation has altered perception," he continued.

"A number of unconventional reservoirs are coming out of this very mature basin, and the Horseshoe Canyon is one of them."

Facts and Figures

Canada's CBM industry is not even a decade old – the first experimental wells were drilled during the late 1990s.

On Dec. 31, 2005, the Alberta Energy and Utilities Board reported:

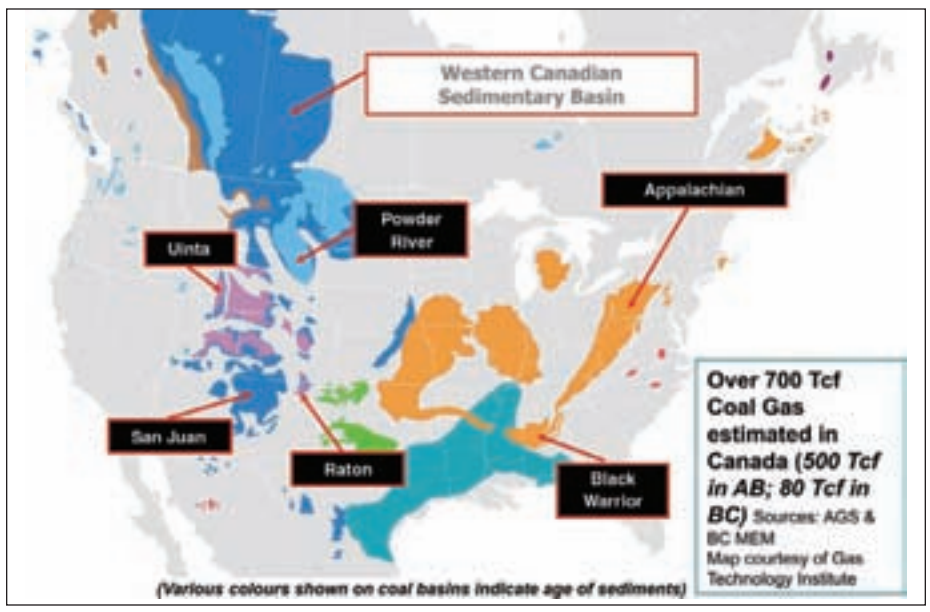
✓ There were 7,764 CBM wells in Alberta.

✓ In 2005 alone, 54 percent (or 4,189) of the province's total CBM wells were drilled – this count includes both new drills and previously drilled conventional wells that were recompleted in coals.

✓ At Dec. 31, the total cumulative gas production from coals was 74 billion cubic feet.

More than 95 percent of Alberta's

See **WCSB**, page 24



Basins	Potential Resources (tcf)	Daily Production (mmcf/d)	Producing Wells
WCSB	528	30 - 40	>700 drilled
San Juan	85	~2,000	>3,600
Powder River	39	~1,000	>11,000
Uinta	10	280	>580
Raton	10	~160	>1,100
Piceance	99	4	40-50

Alberta's Western Canadian Sedimentary Basin (WCSB), underlain by numerous, stacked coal seams permeated with methane, contains twice the amount of gas in place than all of the CBM basins in the continental United States combined.

Looking for the Sweet Spots

Cleats Are Keys to Solid Footing

By SUSAN R. EATON
EXPLORER Correspondent

Coalbed methane can be described as a permeability "challenged" reservoir.

Permeabilities in Alberta's Horseshoe Canyon coals range from one to 100 millidarcies, often resulting in formation damage during drilling and completion operations.

Accordingly, some wells are drilled with air, to reduce formation damage while drilling.

The key to commercial success – from the exploration phase to field development – hinges on understanding the fracture or cleat systems that form part of the coal's fabric. Successful companies have identified geological fairways or sweet spots where large densities of open fractures are developed, ensuring good reservoir permeability or conductivity.

Classified by rank or degree of metamorphism, coal grades from peat (at the lowest rank) to anthracite and graphite at the upper end of the continuum. The networks of cleats or fractures formed during coalification result from the stress that the rocks are under and from the dewatering process.

Face cleats form the dominant fracture set in coal – they are parallel to the maximum stress and extend laterally for up to a meter, cutting through bedding. Butt cleats, the secondary fracture set, are oriented perpendicularly to the face cleat and parallel to minimum stress.

Butt cleats frequently terminate in face cleats.

Coals in Alberta have a severe tectonic overprint – a relict compressional stress – due to the influences of the Laramide Orogeny. Even in Alberta's adjacent prairies, this relict compressional stress has resulted in face cleats that are generally oriented perpendicular to the Rocky Mountain Front (southeast-northwest), and are vertical and usually open – unless filled with mineralization.

Cleat spacing is on the order of millimeters to centimeters.

According to Brian McKinstry, manager of geology for Western Gas Resources Canada Co. and a co-author of the Horseshoe Canyon paper presented in Perth, the insitu stress fields of Alberta's coals also have been influenced by their shallow depths – or lack of overburden – and by isostatic rebound due to glacial retreat.

(At writing, Western Gas Resources Co., including its Canadian subsidiary, had just been acquired by Anadarko Petroleum.)

"There is a reorientation of the stress field through production of the well," said McKinstry, who described coal as a very dynamic reservoir. "You get alteration of the stress field, often requiring re-fracs."

Tools That Help

The Canadian industry in a very short period of time developed state-of-the-art laboratories to characterize Alberta's coals, McKinstry said – their physical properties including permeability and gas content.

Working with the Alberta Research Council, E&P operators built state-of-the-art mobile laboratories to measure desorption of gas from cores. Towed behind trucks, these portable labs are deployed to the lease during drilling and coring operations.

McKinstry also used an innovative split tube wireline core retrieval system, resulting in excellent core recovery rates.

"I needed core back fast," he said, "to minimize the amount of lost gas."

Many Canadian operators are completing previously untested coal zones in standing wells, in efforts to characterize the Horseshoe Canyon.

"It's a very good and cost effective reconnaissance tool," said Paul Gagnon, lead author of the Perth paper.

In fact, some Canadian operators are "saving" the Horseshoe Canyon coals for uphole completions, after deeper, productive zones have been depleted.

Hyrdraulic fracturing completions are used to prop open the production pathways in CBM reservoirs, connecting the cleat systems.

To date, nitrogen hydraulic fracturing has been the most successful stimulation process used in the Horseshoe Canyon – nitrogen is pumped at high rates, without proppant, through coiled tubing and using a selective cup-type packer to isolate each coal seam during the completion.

Leveraging off its experience in measuring hydraulic fracs in CBM reservoirs, American-based Pinnacle Technologies opened its Calgary office in late 2002. Pinnacle uses its tiltmeters in the field to measure the characteristics of downhole fracs – their height, width, orientation and distance propagated from the borehole.

Tiltmeters are deployed on the surface of the ground, down the treatment well on a wireline where the frac is propagating and often down an adjacent, observation well.

Data collected from tiltmeters are crucial to understanding how to position CBM wells in a field development scenario. ❑

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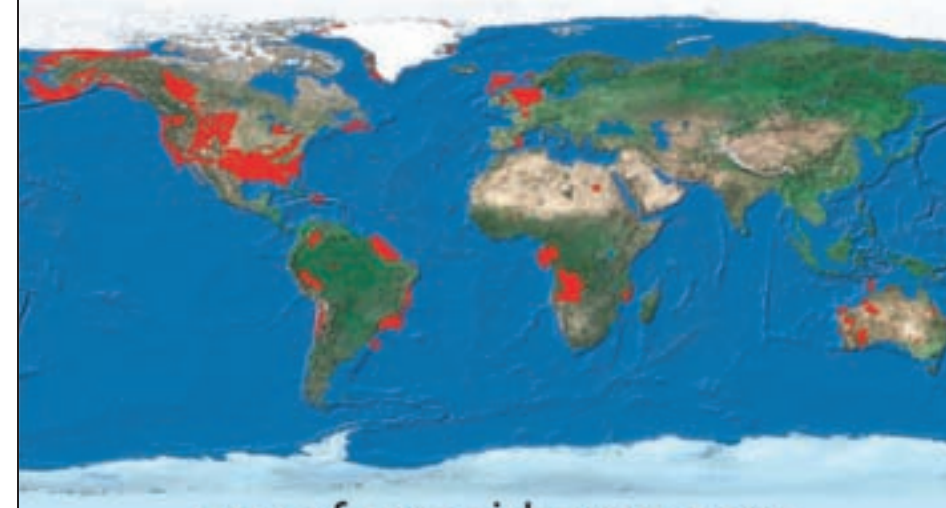

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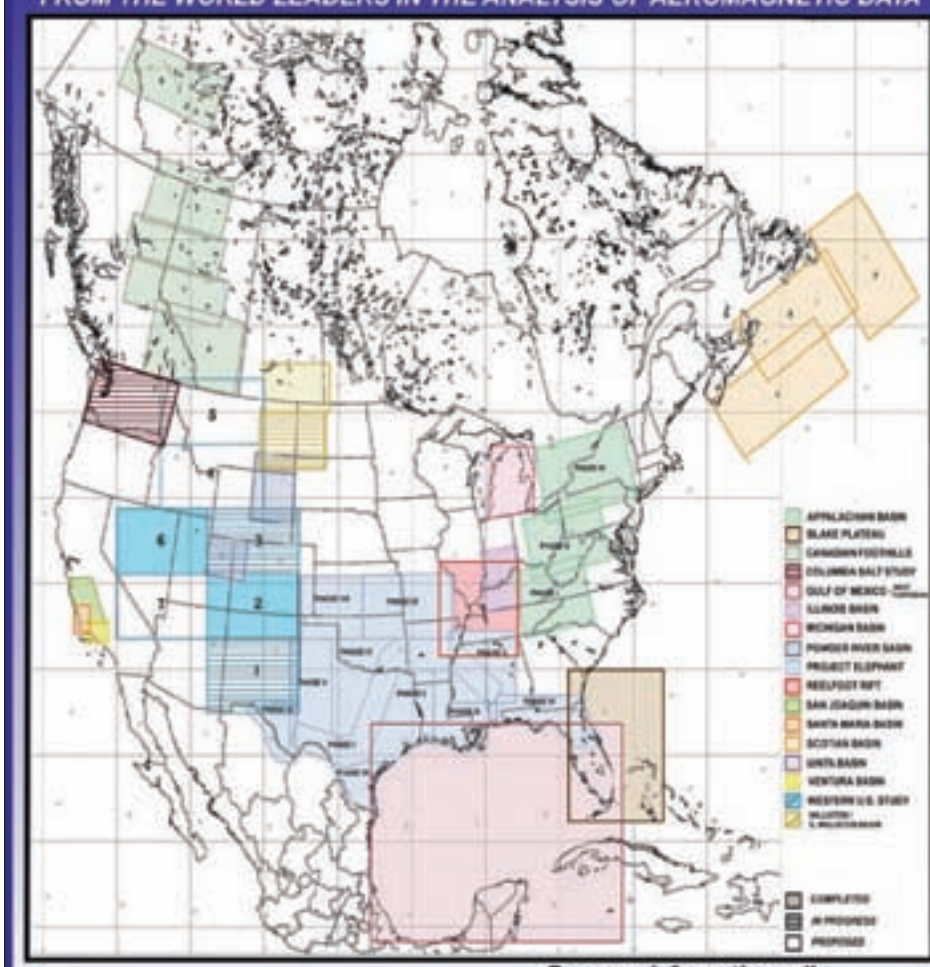

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WCSB

from page 20

CBM wells have been completed in the Late Cretaceous, dry Horseshoe Canyon and Belly River coals. Wells targeting the stacked Horseshoe Canyon and underlying Belly River coals are drilled vertically to depths between 300 to 2,400 feet.

CBM production from Alberta's Horseshoe Canyon is approaching 500,000 cubic feet per day – and the Canadian Society for Unconventional Gas (CSUG) predicts Horseshoe Canyon production to climb to 700,000 cubic feet per day sometime next year. According to CSUG, the Horseshoe Canyon resource is estimated at 66 trillion cubic feet, making it the largest dry CBM play in the world.

To date, just 4 percent of the Alberta's CBM wells have been completed in Early Cretaceous Mannville coals, ranging in drilling depth from 2,300 to 4,300 feet. The Mannville wells – several commercial projects have been recently announced – are drilled horizontally through the coal seams, with horizontal reaches of up to a mile.

Analogous to "conventional" CBM reservoirs in the Lower 49, the Mannville coals produce significant volumes of saline water before flowing natural gas. The saline water is reinjected into deeper geological formations, often taking advantage of nearby dry holes.

CSUG estimates that coals in the Mannville contain a natural gas resource of 300 trillion cubic feet.

The remaining 1 percent of Alberta's CBM wells has been completed in shallow (2,000-foot drill depth) Late Cretaceous Ardley coals, which produce fresh water. CSUG estimates that the Ardley Coal's resource potential at 53 trillion cubic feet. Exploration in the Ardley is in its earliest evaluation stage.

Photo courtesy of Paul Gagnon

For explorers, a beautiful site: Horseshoe Canyon strata near Drumheller, Alberta.

Gagnon and his co-authors estimate that CBM production in Western Canada could reach 16 percent of the total Canadian gas production. With 3,000 new wells forecasted annually, the ultimate potential development could include 30,000 wells, yielding a potential of 15 trillion cubic feet of marketable natural gas from a play fairway encompassing about 12,000 square miles.

On average, Horseshoe Canyon wells produce between 100 to 150 thousand cubic feet of natural gas per day. Based upon a well density of four wells per section, Gagnon estimates recoverable reserves of between one to two billion cubic feet per section.

Storm Clouds Forming?

Resource plays like CBM – with their associated long-life reserves – have the potential to change the oil and gas industry in Western Canada, offsetting current and projected declines in conventional natural gas production.

Growing resistance from surface landowners, however, combined with escalating costs at public land auctions, increased drilling and completion costs, a four-year low in gas prices and public calls for a moratorium on CBM activity have prompted Canada's unconventional explorers to inhale deeply.

Indeed, during the past six months many CBM operators have stepped back and are re-evaluating their options – and cutting back their drilling programs.

"As we move through the pilot E&P phase, we've entered into the 'soft' technology innovations," said Gagnon, a volunteer vice president with CSUG.

The Society's mandate, he explained, is the factual and collaborative exchange of knowledge on unconventional gas amongst government, industry and all public stakeholders.

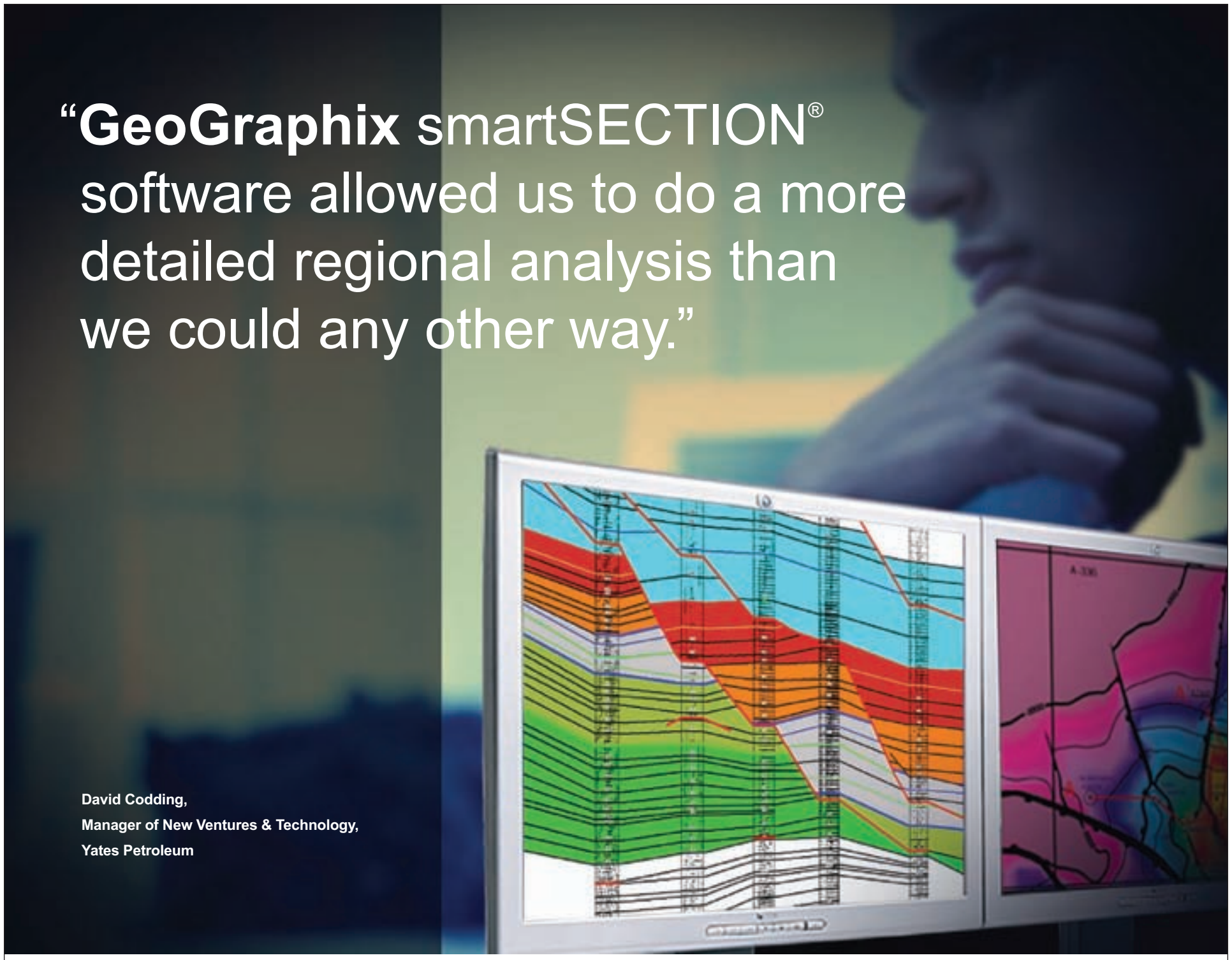
Rural landowners are focused on two main issues:

✓ Protecting their shallow aquifers and water wells from damage during drilling and completion operations.

✓ The environmental footprint from CBM development – including well density, road access, cumulative impacts and noise emitted from compressors.

A parallel path of hard and soft technology is required to ensure that the CBM industry is widely accepted in Western Canada, Gagnon said.

"The unconventional industry must be proactive in consultation and community involvement." ❑



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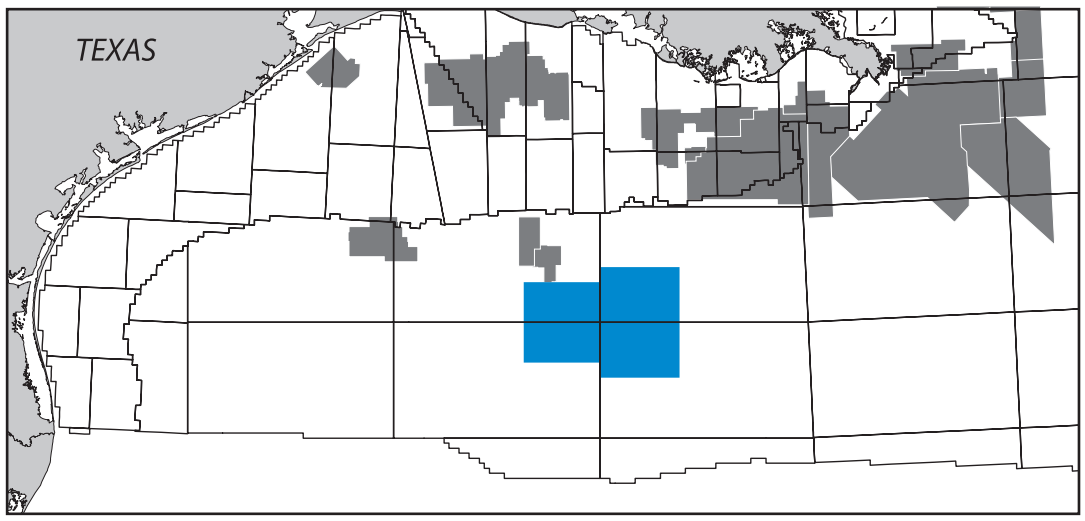
TGS has acquired approximately 240 OCS blocks of its ***Stanley*** Multi-Client 3D seismic survey located in the Garden Banks, Keathley Canyon, Green Canyon and Walker Ridge areas of offshore Louisiana. It is anticipated that close to 200 OCS blocks will be processed through pre-stack depth migration and available for the March 2007 OCS sale. When complete, ***Stanley*** will cover 600 OCS blocks in an area with a high number of lease expirations over the next few years. ***Stanley*** will yield the first new long offset PSDM data over this complex salt-influenced region.

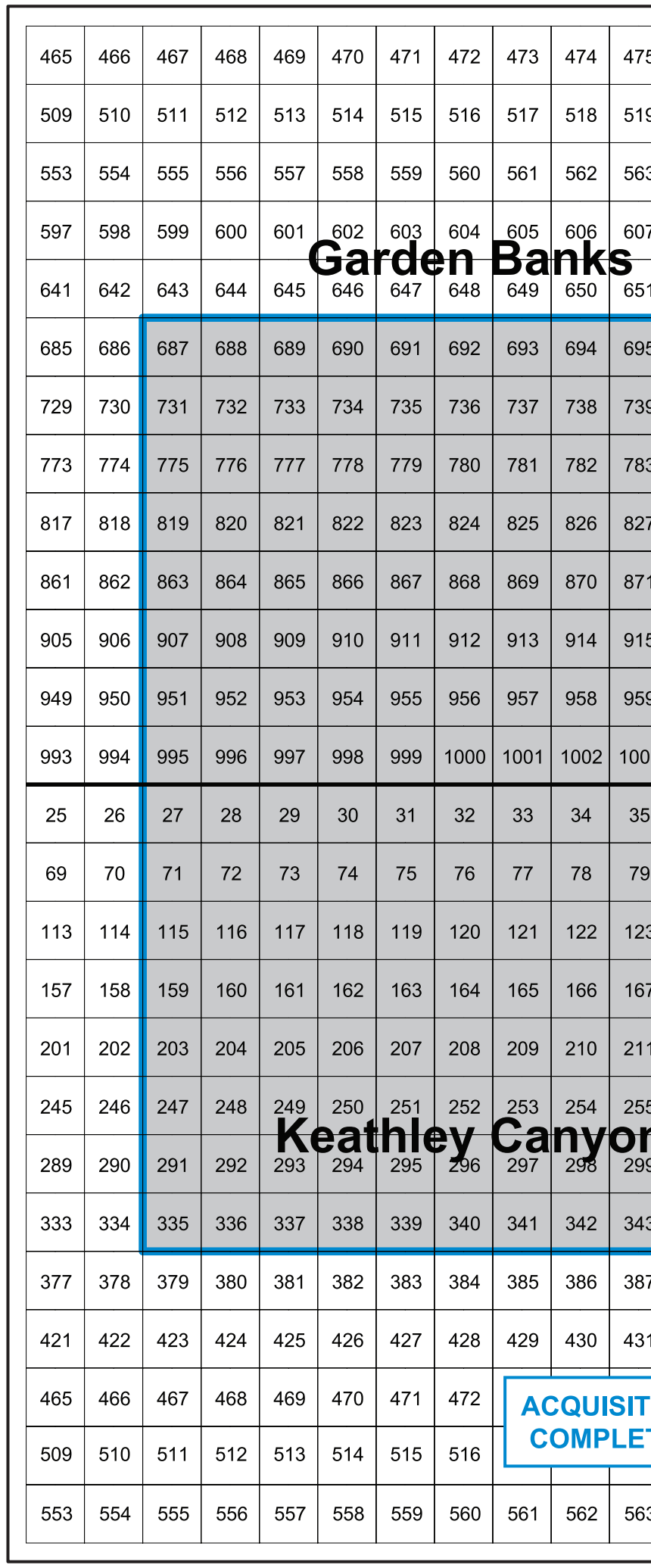
For more information please contact a TGS representative at 713-860-2100.



PARAMETERS

- Far Offets - 9350 meters
- Group Interval - 12.5 meters
- Record Length - 13 seconds
- Fold - 144
- Source Depth - 7.5 meters
- Cable Depth - 18 meters
- Orientation - North/South
- Crossline - 40 meters
- Quality - Excellent
- Timing - Ahead
- Value - Priceless

* Estimating From 10/05/06



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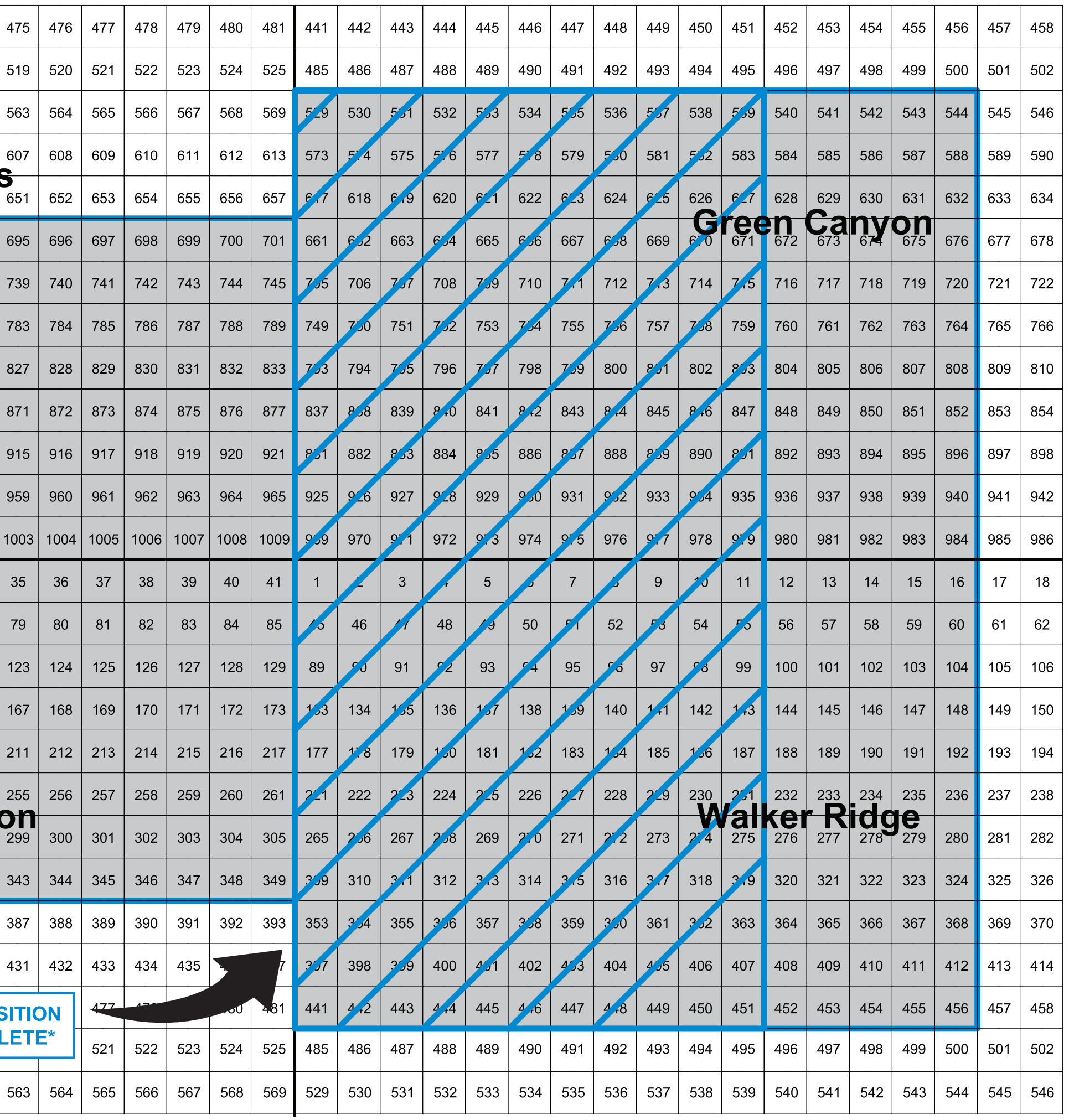

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Making Many Connections Count

PTTC: Passing On the Good Word

By LOUISE S. DURHAM
EXPLORER Correspondent

Since 1994, the Petroleum Technology Transfer Council (PTTC) has been a recognized force in the realm of technology transfer in the oil and gas industry.

Regional workshops, regional Web sites and newsletters have been used to connect producers, the service sector, consultants, researchers and others to needed data and technology information, according to Don Duttlinger, the PTTC executive director and an AAPG member.

A number of its successes include technology transfer in the realm of exploration, some of it bordering on – or directly tied to – exploration innovations, including:

A number of its successes include technology transfer in the realm of exploration, some of it bordering on – or directly tied to – exploration innovations.

Photo courtesy of Mark Hoffman, PTTC Appalachian Region

Studying the cores: One way that PTTC helps in the industry's transfer of information.

❒ Geologic Play Book of Trenton-Black River Exploration in the Appalachian Basin.

Operators today are increasingly interested in exploring/exploiting the hydrocarbon potential of the Appalachian region. In a timely move, the Appalachian Oil and Natural Gas Research Consortium recently completed a two-year study of exploration in the Trenton-Black River (TBR), which culminated in the "Play Book," according to Lance Cole, PTTC project manager.

The project, which was directed by AAPG member Doug Patchen (who serves as director of PTTC's Appalachian Region), accomplished its goals, Cole noted:

✓ Developed an integrated structural-stratigraphic-diagenetic model for the origin of TBR hydrothermal dolomite reservoirs.

✓ Defined possible fairways within which to conduct more detailed studies leading to further development.

✓ Developed an integrated, multi-faceted resource assessment model of TBR reservoirs.

The study identified two separate plays: a hydrothermal dolomite play on the western side of the basin and a fractured limestone play on the eastern side.

The study also estimated a 90 percent probability of finding an additional 2.7 Tcf of gas in these two plays, and at 50 percent probability the volume increases to 6 Tcf, Cole said.

❒ In-Field Exploration with CT (coil tubing) Re-Entry Drilling.

"This is a whole technology area that's evolving," Cole said. "The coil tubing drilling re-entry business in the U.S. has taken off like gangbusters.

"Although not true exploration," Cole noted, "profitably developing new reserves in existing mature fields certainly can be considered economic exploration."

BP has been using the technology successfully for some time in Alaska, and the company conducted a pilot CT re-entry drilling program in Cleveland tight gas sands in the Anadarko Basin in late 2005-06. It entailed:

✓ Re-entering an existing Cleveland completion.

✓ Kicking off a horizontal leg.

✓ Drilling into an undrained portion of the reservoir.

The results, presented in August at PTTC's Microhole Technology workshop, showed the three wells completed came in at 40 percent, 55 percent and 130 percent of baseline results from grassroots vertical wells, according to Cole.

He noted the results were sufficiently encouraging for BP to expand from the pilot to an ongoing program of re-entries in the area.

❒ In-Field Exploration – Re-Fracing to Access New Reserves.

This technology represents yet another category of "economic exploration" furthered by frac mapping capabilities, which are being used more commonly by producers, Cole said.

In several reservoirs – including the Barnett shale and the Wattenberg Field in Colorado – operators have discovered when wells are re-fraced after a period of time, the fractures have a different orientation, which, in effect, accesses new reserves. This is similar to the concept of CT re-entry drilling.

❒ Core Locator.

This is a GIS system that enables explorationists to find what cores are available and where they are located. The system was developed by PTTC's Rocky Mountain Region, and it currently includes data identifying the location of nearly 260,000 cores.

Cole referred to the system as "a geologist's dream."

❒ Unconventional Gas – A Focus on Gas Shales.

PTTC's Rocky Mountain Region was a partner in the recent Rocky Mountain Association of Geologists conference focusing on "Shale Gas, From Grassroots Exploration to Production." The more than 1,500 attendees picked up key insights on how to duplicate the successful Barnett Shale "experience," according to Cole. ❑

Funds Cutoff Spells PTTC Obituary

By LOUISE S. DURHAM
EXPLORER Correspondent

It's often said nothing lasts forever – which often might be a good thing.

Not necessarily so in the case of the Petroleum Technology Transfer Council's (PTTC) funding status.

The high profile, 12-plus-year-old organization serves as a technology transfer medium for both new and old ideas that are successfully applied by oil and gas industry producers.

PTTC traditionally has been funded primarily by the U.S. Department of Energy, with the funds matched by the states, regional-lead organizations and industry contributions in the form of time and expertise, according to Don Duttlinger, PTTC executive director and AAPG member.

But the DOE has served notice to the PTTC: It will cut off its money supply to the organization at the end of this year.

In fact, the federal government is bidding farewell to the whole base DOE program, which includes:

✓ Advanced drilling and completions.

✓ Advanced diagnostics and imaging.

✓ Conventional oil and gas program.

✓ Enhanced oil recovery.

✓ Deeptrek program.

✓ Microhole technology program.

✓ National gas and oil technology partnership.

✓ Petroleum Technology Transfer Council.

✓ Stripper well consortium.

✓ University and intern program.

"It wipes out all conventional oil and gas research, just zeroes it out," Duttlinger said. "That in itself is quite amazing."

It's especially amazing given that it's coming at a time when congressional leaders and the public at large are being quite vocal about the need for "energy independence." This desired-yet-elusive goal could take several giant steps backward without continued technology advances and the dissemination of technology how-to, such as PTTC provides.

"Through the years, DOE's natural gas and oil research, development and demonstration program has effectively contributed toward technologies that have had a real impact on the rate of discovery and improving the extraction efficiencies of our U.S. domestic reserves," said Gene Ames, PTTC's chairman:

"These increases only come when new or under-applied technologies – whether they come from government, academia or industry – are taken off the shelf and put to good use," he said.

"That's where the outreach and connection made possible by our network come into play," Ames noted. "There is no other organization that has a better understanding of the technology needs of independent producers, regardless of the region, basin or play they are in."

It will be an uphill battle from here for PTTC, but the group is determined to move forward.

"It looks bleak for now," Duttlinger said, "and we must make sure people realize this is real. The programs have been cut.

"We're concerned people won't realize what's gone until it is gone," Duttlinger added. "We're taking the approach to see if industry values the technology transfer mission and will step up to fund and continue this program.

"We'll be going to industry for money," Duttlinger said, "and we're testing the waters with a few small companies. We haven't completely given up on federal funding, but if in any becomes available, it won't be our foundation like in the past but more an auxiliary – we are transitioning to a primarily industry-funded organization."

No matter how much of the funding slack may be picked up by industry, a long-time functioning entity such as PTTC will be transformed – perhaps into something even better.

Duttlinger, in fact, expressed the group's commitment to efficiently delivering even more value than in the past, both on a regional and national scale. ❑

Industry? No. Discovery? Maybe.

Drake Well Postage Stamp Sought

By BARRY FRIEDMAN
EXPLORER Correspondent

Elvis has one, as does Henry Fonda, Marian Anderson, the Civil Rights movement and even Kermit the Frog.

The oil and petroleum industry *used* to have one, but today? No, it doesn't.

And according to some passionate people, it not only wants one but it *needs* one.

We're talking about a postage stamp, and the efforts of a group of petition-driven people to make a stamp honoring the 150th anniversary of the Drake Well a reality.

It's a national effort, and like Uncle Sam himself, it needs you – or, specifically, your signature on a petition that says:

"The undersigned hereby urge the Citizens' Stamp Advisory Committee for Stamp Development to issue a commemorative stamp in 2009 for the 150th anniversary of the Drake Well oil discovery that launched the modern American petroleum industry."

While this may only be of interest to those playing a spirited game of Trivial Pursuit, oil philately started in 1919, when the world's first postage stamp to depict oil derricks of the Baku oilfield was issued by the National Republic of Azerbaijan.

So why doesn't an industry that has had such an indelible – you should excuse the expression – stamp on the American experience not have one in this country?

After all, it did have one about 50 years ago, when the postal service issued a $.04 stamp honoring the first 100 years of the country's petroleum industry.

Now, according to Lois McElwee, coordinator for the Oil City, Pa.-based Oil 150 Committee, it's time for another.

"This is a chance," she says, "to recognize the momentous national and international achievements that followed from the Drake Well oil discovery."

Shifting Strategies

You'd think that getting a commemorative stamp issued would be as easy as calling your favorite congressman and having him or her twist a few arms and call in some favors.

It's not that easy.

The United States Postal Service's Citizen's Stamp Advisory Board, based in Arlington, Va., is in charge of deciding who and what gets honored with a stamp, and honors are allotted in 50-year increments, meaning the stamp for the Drake Well, if it is to be approved, must be issued in 2009.

Complicating the effort is the fact that the advisory board already turned down a recent similar request for a stamp

honoring the 150th anniversary of the American oil industry.

Advisory board officials apparently didn't care a lick about that idea.

Want to sign the petition? Contact the Oil 150 Committee at the Oil Region Alliance, P.O. Box 128, 206 Seneca St., Oil City, Pa. 16301; telephone – 814-677-3152 or 800-483-6264; e-mail – lmcelwee@oilregion.org. Or, contact the Citizens' Stamp Advisory Committee, Stamp Development, U.S. Postal Service, 1735 North Lynn Street, Room 5013, Arlington, Va. 22209-6432.

"The Citizen's Stamp Advisory does not publicize why it rejects a nomination," McElwee said, "but there has been some discussion that the Postal Service has changed policy, deciding in recent years not to commemorate industries anymore."

That's when – and why – the Oil Region Alliance, which organized the Oil 150 Committee, came up with a new approach: They decided to shift the focus of the stamp away from the petroleum industry generally and toward the Drake Well specifically.

"Rather than give up on the idea of a commemorative stamp, we then specifically nominated the Drake Well success for consideration," McElwee said.

According to Randy Seitz, president of the Alliance:

"The Drake Well as the birthplace of the oil industry in 1859 deserves commemoration. This is a big story. They don't get any bigger. A special stamp will do this national story justice."

The American Refining Group, the Ohio Oil and Gas Association and the American Oil and Gas Historical Society joined the Oil 150 Committee, the Oil Region Alliance and the Drake Well Museum in nominating the Drake Well.

McElwee, though, admits the perception of the oil industry in general may have played a part in the earlier decision to reject the stamp.

"The public perception of petroleum is

See **Stamp Petition**, page 32

Distinguished Instructor Tour Set

Vitor Abreu, AAPG's inaugural international Distinguished Instructor, will offer his presentation in November, starting with a two-day stop at the Associacó Brasileira de Geólogos de Petröleo in Rio de Janeiro, Brazil, Nov. 9-10.

Abreu will then move to the West Indies Nov. 13, speaking to the Geological Society of Trinidad & Tobago.

Abreu, with ExxonMobil Exploration in Houston, is offering a two-day short course on "Sequence Stratigraphy for Petroleum Exploration," which is a "hands-on" introduction to the concepts and practical applications of sequence stratigraphy.

Through a mix of lectures, in-class work sessions and exercises the course will review:

✓ Basic concepts and terminology of sequence stratigraphy.

✓ The stratigraphic building blocks of depositional sequences.

✓ Recognition criteria for the identification of depositional sequences and their components in outcrops, cores, well logs and seismic.

✓ The application of sequence stratigraphy in non-marine, shallow marine and submarine depositional settings.

✓ Implications for play element prediction in petroleum exploration.

Abreu

Frank Peel, with BHP Billiton in Houston, is slated to be the first domestic DI speaker. Details and tour dates will be announced later.

For more information contact Karen Dotts at AAPG, 918-560-2621; or e-mail kdotts@aapg.org. ❑

Stamp Petition

from page 30

a concern for the Drake Well stamp and the Oil 150 celebration efforts," she said. "When it comes to the stamp consideration, though, perceptions aren't a listed criteria for consideration they could come into play.

"On the other hand, one of the Citizen's Stamp Advisory requirements is that the topic be relevant."

An Educational Tool?

A look around the world shows that stamps honoring the petroleum industry appear, as you'd expect, in oil producing countries like Oman, Saudi Arabia, Azerbaijan and Iran. But according to India's The Tribune, an additional 170 non-oil producing countries have issued more than 2,500 stamps relating to the refining, transportation and marketing of petroleum products. India alone has 10 such stamps.

What professions and personalities get honored in the United States range from the sublime to the ridiculous.

In 2006, a U.S. stamp was issued for African American actress Hattie McDaniel; to celebrate marriage; Disney; the 2006 Winter Olympics; favorite animals in children's books; Benjamin Franklin; Sugar Ray Robinson; the Amber Alert; Katherine Ann Porter; and one featuring two blue birds kissing.

McElwee believes that the effort to obtain a stamp provides "an opportunity to educate the nation about the many ways petroleum impacts our lives everyday."

As such, she says, the current stamp petition has been to many different locations around the country from schools, libraries, county fairs, conventions and symposiums.

If approved, the Postal Service will select the artist who will execute the design of the stamp. If they do elect to commemorate the Drake Well, McElwee says the committee plans to use an image of the Drake Well is in the design.

"I am not sure that they could commemorate the Drake Well without an image of it being incorporated but, there is no agreement on design," she said.

Ultimately, though, it will be the members of the Citizen's Stamp Advisory – and not the industry, the various committees or even AAPG members – who decide.

McElwee says she has heard that all decisions on stamps for 2007 and 2008 have been made, and those for 2009 – the year in question for Oil 150 – are being made now.

You wonder if Kermit had this much trouble. ❑

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WashingtonWATCH

OCS Offers Something to Think About

By DON JUCKETT
GEO-DC Director

This month's comments will focus on the Outer Continental Shelf (OCS) and a trio of current activities.

ChevronTexaco's deepwater Jack-2 discovery provided some front page print and, for a few, a sense of wonder about the technology that made it possible (see story, page 14) – but it sent only a small ripple through the ranks of Washington policymakers who by-in-large had their attention focused on the mid-term elections.

By the time this column appears, more than 60 days of the U.S. Interior Department's Minerals Management Service (MMS) 2007-2012 Five-Year Plan "final" comment period will have expired.

You still have time to make your opinion register and be heard on OCS access. AAPG members are encouraged to participate in the final comment period for the MMS 2007-2012 OCS Five-Year Plan and Draft Environmental Impact Statement.

The comment period for both of these items opened in August and will close on Nov. 24 and Nov. 22, respectively.

MMS must hear from affected stakeholders and consumers of oil and gas at every step in the process.

Providing comments to MMS is a straightforward process that can be done online or by post. All required information can be accessed from the GEO-DC Action Alert area on the AAPG Web site. That area includes sample language for a comment, or you can modify as you wish.

Members are encouraged to make their opinions known. Improving access to the OCS is vital to continued health of the U.S. energy portfolio and will impact the future of AAPG and its members.

* * *

I have heard members comment they don't believe they can impact the process. A little arithmetic might help to convince you that the converse is true:

The previous MMS comment period elicited slightly more than 35,000 comments, of which 27,000 supportive comments for OCS acreage expansion.

Consider there are approximately 22,000 U.S.-based AAPG members. If each member submitted a comment, AAPG members alone could dominate this public comment process.

And if each of you convinced one non-member to submit comments … Just a thought!

* * *

Concerning OCS legislation, Congress adjourned for the election recess in September, leaving both the House and Senate versions of OCS access legislation still unreconciled.

Leadership from both committees issued press announcements indicating discussions would continue when the 109th Congress resumes after the mid-term elections. Statements from the House and the Senate were replete with finger-pointing and charges of lack of political realism of the other legislative body.

Both expressed some level of optimism for a compromise before the end of the session.

Time will tell whether the posturing ahead of the mid-term elections will fade with the return of Congress and before a new Congress is sworn in. If the national interest is truly served, there is a chance for OCS legislation to pass in the 109th Congress.

Just a thought!

* * *

It has been a little more than a year since hurricanes Katrina and Rita hit the U.S. Gulf Coast.

One of the most significant lessons from the oil and natural gas perspective is the fact that those two storms, despite the tremendous damage to infrastructure (including platforms destroyed, production interrupted, pipelines and other downstream infrastructure damaged and rigs blown off position for long distances) – all devastating to the production, transportation, refining and distribution systems – did not create a situation that heralded the end of oil and gas operations in that part of the Gulf.

To the contrary: One year later, most of the production capacity has been restored, transportation capacity is largely back and a significant part of the refining capacity is re-established.

Tragic and costly as those events were, they demonstrated some more subtle lessons that need to be reinforced with more complete analysis and documentation:

✓ Steady technological progress in safety and environmental protection that has become common practice in the everyday offshore operations.

As MMS has stated repeatedly in its press releases and in public presentations, the near unimaginable destruction resulted in no environmental challenge from loss of wellhead integrity. The hardware worked as it was designed.

✓ The risk of so much of domestic production focused in the Gulf of Mexico. Loss of almost 25 percent of domestic production along with the related transportation and refining capacity was instrumental in the rapid crude and natural gas prices run-up. Many of us watching the gasoline prices ratchet up wondered out loud if greater access to areas currently in moratoria status might preclude a similar set of circumstances in the future.

Is this an opportunity for Association members to pause and analyze these events, and consider adding these lessons in a formal fashion to AAPG's outreach efforts? Seems like a great opportunity for collaboration between DPA, DEG and the Outreach Committee.

Just a thought!

(Editor's note: Don Juckett, head of AAPG's Geoscience and Energy Office in Washington, D.C., can be contacted at djuckett@aapg.org, (703) 575-8293.)

GEOPHYSICAL CORNER

S-Waves and Fractured Reservoirs

(The Geophysical Corner is a regular column in the EXPLORER, edited by Bob A. Hardage)

By BOB A. HARDAGE
and MICHAEL V. DeANGELO

In last month's Geophysical Corner we showed that fracture orientation across fractured-reservoir intervals can be determined by azimuth-based analyses of S-wave velocities and reflection amplitudes.

This month, we return to the same 3C3D seismic data used last month and show how attributes determined from fast-S and slow-S data volumes allow patterns of relative fracture intensity to be determined in a qualitative, not quantitative, manner.

* * *

In Figure 1 of last month's article we showed that in a fractured medium, a converted-S wavefield segregates into a fast-S mode and a slow-S mode, and that the azimuth directions in which these fast-S and slow-S modes orient their polarized displacement vectors differ by 90 degrees. Knowing the polarization directions of these two S-wave modes across this particular study area, we processed the 3C3D data to create a fast-S image volume and a slow-S image volume.

(The procedures used to segregate S-wave data into fast-S and slow-S images are exciting topics to geophysicists but are not appropriate to describe in this article.)

We show here in figure 1 a vertical slice from the fast-S volume and the corresponding vertical slice from the slow-S volume. The two fractured carbonate intervals A and B are labeled on each display, as well as several horizons interpreted near these two reservoir intervals.

Differences between these fast-S and slow-S images include:

✓ Reflection events A and B arrive approximately 50 ms earlier in the fast-S domain than they do in the slow-S domain.

✓ At certain image coordinates, there are differences between the magnitudes of fast-S and slow-S reflection amplitudes from targets A and B. Two of the more obvious examples are labeled SR1 and SR2.

✓ The fast-S time thicknesses across intervals A and B expand and contract in ways that differ from the expansion and contraction pattern of slow-S time thicknesses.

Some of these relative time-thickness changes are difficult to see by visual inspection of figure 1, but numerical analyses of the isochron intervals between interpreted horizons show numerous examples of such behavior.

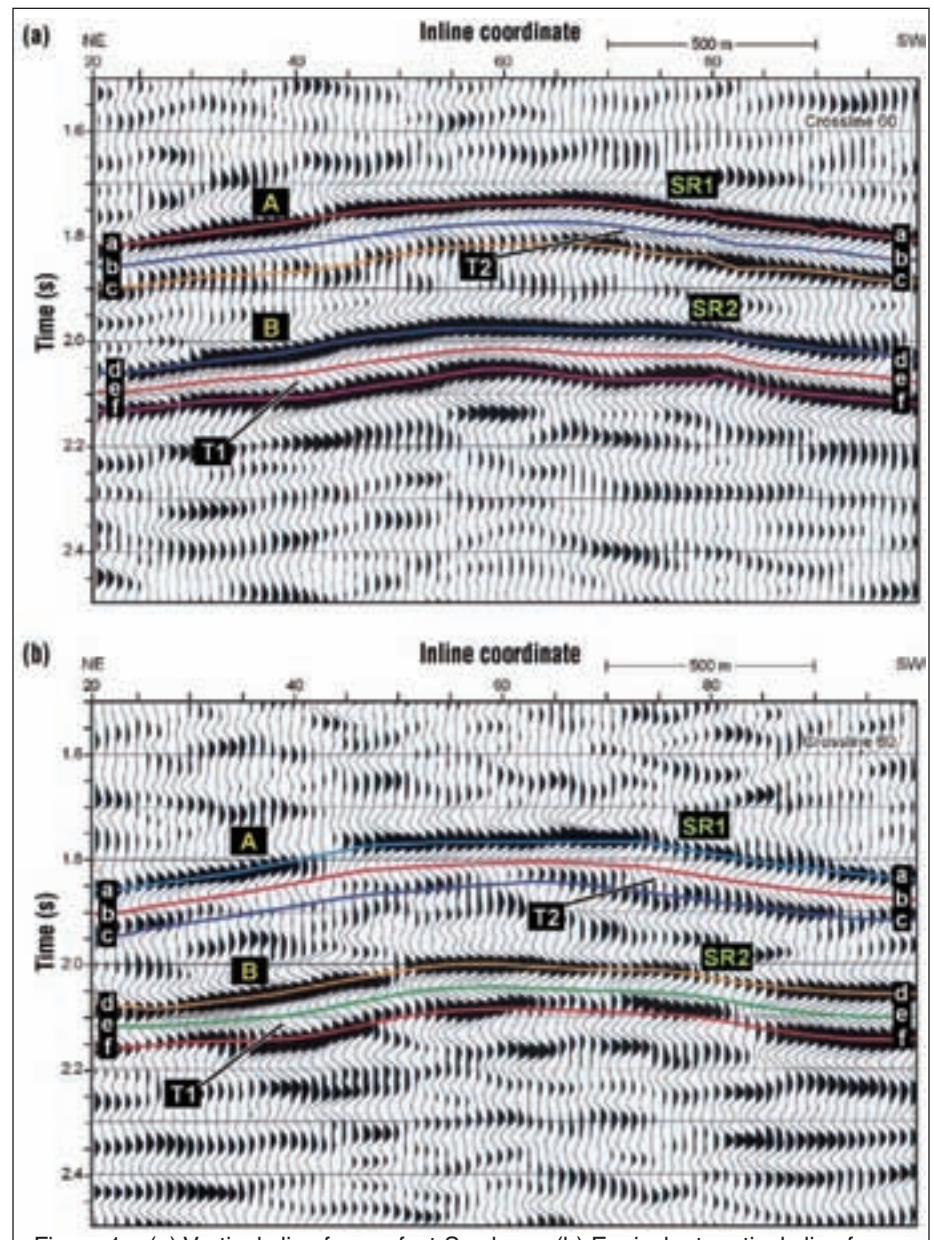


Figure 1 – (a) Vertical slice from a fast-S volume. (b) Equivalent vertical slice from the companion slow-S volume. A and B are reflections from fractured carbonate reservoirs. Horizons aa through ff are used to measure fast-S and slow-S time thicknesses and amplitude attributes across fractured intervals A and B. SR1 and SR2 define image coordinates where slow-S reflectivity diminishes but fast-S reflectivity does not. T1 and T2 define locations where a fractured interval shows an increase in time thickness in slow-S space that is not observed in fast-S space.

Two locations where the time thickness of a reflection wavelet expands more in slow-S image space than in fast-S image space are labeled T1 and T2.

Local Difference: Reflectivity

The units bounding fracture intervals A and B have seismic impedances that are less than the impedances of fracture units A and B. This statement applies to most fractured targets and their bounding units.

Fast-S and slow-S reflectivities across targets A and B are controlled by the magnitude of the differences in impedances across the top and bottom boundaries of A and B. When fracture intensity and fracture openness increase locally, the difference between slow-S and fast-S velocities increases. Fast-S velocity changes little (usually not at all) when fracture intensity increases, but slow-S velocity decreases and becomes closer to the magnitude of the S-wave velocity of its lower-impedance bounding unit.

As a result, slow-S reflectivity diminishes, but fast-S reflectivity does not when fracture intensity increases.

To define locations where relative fracture intensity increases, we thus search the fast-S and slow-S volumes to find coordinates where S-wave reflection amplitudes diminish but fast-S amplitudes change little or not at all.

Two image coordinates where this type of reflectivity behavior occurs in figure 1 are labeled SR1 and SR2. The common interpretation of these differences in fast-S and slow-S reflectivities is that a relative increase in fracture intensity and/or fracture openness occurs at locations SR1 and SR2.

Local Variations: Interval-Time Thickness

When the slow-S interval-time between horizons aa and cc increases (figure 1b), two possible explanations are that (1) the thickness of reservoir A has increased or (2) reservoir A has a constant thickness, but slow-S velocity has lowered because of an increase in fracture intensity.

Other arguments may be proposed in different geological settings, but in this case, these two explanations were the most plausible.

Option 1 can be verified by measuring fast-S interval time between horizons aa and cc (figure 1a). If the reservoir interval thickens, fast-S interval time should increase. If fast-S interval time changes little, or not at all, then option 2 (increased fracture intensity) is accepted as the explanation for the increase in slow-S time thickness.

Two image coordinates where slow-S time thickness increases more than does fast-S time thickness are labeled T1 and T2. Increased fracture intensity is expected at each of these locations.

Prove It!

What we have demonstrated is that comparisons of fast-S and slow-S reflectivities and time thicknesses across fractured intervals allow locations of relative increases in fracture intensity and openness to be identified.

These S-wave behaviors indicate only qualitative variations in fracture intensity, not quantitative variations.

Proving the validity of predictions of fracture intensity requires extensive calibration of fast-S and slow-S attributes with reliable fracture maps across prospects. Such investigations are ongoing and will be reported in time.

For the present, we show you here the latest logic that seems to allow long-range, seismic definition of relative fracture intensity across multicomponent seismic image space.

Acknowledgment: This research was funded by sponsors of the Exploration Geophysics Laboratory at the Bureau of Economic Geology.

(Editor's note: Hardage and DeAngelo are both with the Bureau of Economic Geology in Austin, Texas.) ❑

REGIONS AND SECTIONS

(Editor's note: Regions and Sections is a regular column in the EXPLORER offering news for and about AAPG's six international Regions and six U.S. Sections.

News items, press releases and other information should be submitted to the EXPLORER/Regions and Sections, P.O. Box 979, Tulsa, Okla. 74101.

Contact: Carol McGowen, AAPG's Regions and Sections manager, at 1-918-560-9403; or e-mail to cmcgowen@aapg.org.)

By CAROL McGOWEN

In mid-September, while visiting London to meet with AAPG European Region president John Brooks and AAPG European office director Steve Veal, I had the rare opportunity to view William Smith's geological map of Great Britain – the first geological map.

Each year thousands of tourists, students and locals walk through the halls of the Geological Society of London at Burlington House, Piccadilly, to see the historic map hanging on the wall, concealed behind blue velvet curtains. (The curtains not only protect the watercolor paint, which fades under ordinary light, but also add an element of drama as they are ceremoniously opened by the Society staff.)

To understand the cultural significance surrounding Smith's map and its presence within Burlington House, consider the prevailing class structure of 19th century England: The Geological Society of London could be called a "gentlemen's club," and about half of its members were also members of the Royal Society. GSL membership fees at the time were around 5 Guinies or 1-1/2 British pounds – a substantial sum at the time.

Smith was not without linkages to important, wealthy people, but himself was an artisan and tradesman who earned his living digging canals and draining land, without the privilege of independent income.

It was in 1820 – while Smith was in debtor's prison and unable to solicit a sponsor to publish his work – that George Greenough, an early president of the society, commissioned the drawing of his own map, using one of Smith's unpublished maps as a base.

Although Smith was never recognized as a GSL Fellow, in 1832 he became the first recipient of the Williston Medal, which to this day is the GSL's highest honor.

* * *

To view the map I was led by Edmund Nickless, GSL executive secretary, and Jackie Maggs, administrative secretary, through dimly lit hallways and peeled back polyvinyl-covered and taped doorways leading to a small room. The map had been removed from the wall and laid on a large table, carefully protected from temporary construction dust and debris, and was itself covered with polyvinyl sheeting and secured with heavy tape.

As Nickless began to tell the story of Smith and his rival Greenough he slowly removed the tape to reveal the hand colored and shaded outcrops of England and Wales.

I was first struck by the map's immense size and scale. The six-feet-wide by nine-feet-high map covers tens of thousands of square miles in area and is drawn at a scale of five miles per inch.

It was amazing to realize that Smith's depiction of the north-eastward trending outcrop patterns through England and Wales have remained essentially undisputed for nearly two centuries. (The water mark on this map reads 1828.) Apart from its size, from a distance of only a few inches I could appreciate the shear beauty of the colors and Smith's technique of coloration – each of the strata colored bold at the base and fading out until it meets the rock stratum above it.

As Nickless reminded, Smith's greatest contribution was the use of fossils to determine the age of rock and to correlate rocks stratigraphically over great distances – the tool that bestows on geologists the confidence to predict.

See **Regions**, next page

Smith's map, which changed the world.

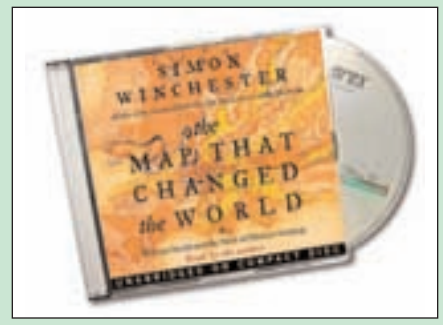
Bookstore Offers Smith Options

Want to know more about William Smith and his map? The AAPG Bookstore can help in five ways, including one way that is brand new:

✓ Simon Winchester's acclaimed book *The Map That Changed the World – William Smith and the Birth of Modern Geology* (paperback): Product No. 634. Member priced at $13.

✓ New this month in the Bookstore, *The Map that Changed the World* as an audiobook on CD: Product No. 960. Member priced at $36.

✓ The actual 1815 map, as re-



published by the British Geological Survey. Measures 36 by 52 inches. Color. Product No. 428. Member priced at $26.

✓ Smith's 1820 map, also re-published by the British Geological Survey. Measuring 26 by 31 inches. Color. (This smaller map is popular and may be more suitable for framing or display.) Product No. 429. Member priced at $22.

✓ William Smith's famous "Cross Sections of 1819," re-published by the Geologial Society of London in poster format. Product No. 498. Member priced at $19.

Ordering and more details available from the Bookstore online at bookstore.aapg.org. ❑

Regions

from previous page

* * *

Beginning in January three maps will be on display at the Geological Society of London – George Greenough's 1820 map and William Smith's 1828 map of England and Wales, together with MacCullough's 1830s map of Scotland. The three maps together will show the entirety of Great Britain geology.

And On the Other Side Of the Atlantic …

By what means William Smith's map arrived in Buffalo, N.Y., is unclear. What knowledge exists of the map's early history in AAPG's Eastern Section comes from the Buffalo and Erie County Library and now-deceased Chancy Hamlin, once president of the Buffalo Society of Natural Science (later renamed the Buffalo Museum of Science).

In the 1930s, in the midst of the Depression, Hamlin set out to collect all the major works of science, including William Smith's map. Along with Smith's map, Hamlin purchased Smith's four volumes of prints, *Strata Identified by Organized Fossils* (1816-1819), as well as preliminary prints of fossil drawings done by Smith's engraver and printer, James Sowerby, with hand-written notes by Smith himself. Hamlin would later be inducted into the French Legion of Honor for his work with museums.

To purchase these major scientific works, Hamlin enlisted the financial support of Buffalo locals at a time when the city was much larger than now and had a broad ethnic base. During March 1938, Hamlin appealed to the ethnic pride of nearly 25 nationalities that had immigrated to the area from England, Wales, Greece, Holland, Italy, Spain, Sweden, Poland, Romania and Ukraine, and raised money by holding an enormous Mardi Gras festival attended by 6,000 people.

Then in 1996, the Buffalo Museum of Science, needing money for its endowment fund, decided to sell Hamlin's collection. The Buffalo and Erie County Library stepped in and traded an incomplete set of Audubon's *Birds of America* for William Smith's map and complete set of fossil prints, together with works by Galileo Galilei, Francis Bacon, Charles Lyell's *Principles of Geology*, Nicholas Steno and others – a collection of 196 first edition volumes. Hamlin named the collection "Milestones of Science." These historical works are now part of the Buffalo and Erie County Library's permanent collection.

Smith's 1815 "Map That Changed the World" was on display at the AAPG Eastern Section 35th annual meeting in Buffalo in October. ❑

HoD Announces Officer Candidates

Officer candidates for the AAPG House of Delegates have been announced for 2007-08. The election will be held at the April 1 HoD meeting in Long Beach, Calif., during the Annual Convention.

The chairman-elect will be HoD chairman in 2008-09, serving also on the AAPG Executive Committee.

The candidates are:

Chairman-Elect

❒ **George Bole**, Houston.
❒ **Sandi Barber**, Houston.

Secretary/Editor

❒ **David Farmer**, Midland, Texas.
❒ **Robert E. Webster**, Irving, Texas.

PROFESSIONAL NEWS BRIEFS

David Allard, to exploration manager-central USA, Apache, Tulsa. Previously exploration manager-North Sea, Apache, Aberdeen, Scotland.

Terry Axtmann, to senior staff geologist-North Africa, Pioneer Natural Resources, Woking, UK. Previously chief geoscientist-Mid-America, ConocoPhillips, Houston.

Nicole Baylor, to associate geologist, Chesapeake Energy, Oklahoma City. Previously student, University of Oklahoma, Norman, Okla.

Timothy L. Clarey has received the 2006 Alumni Achievement Award from the department of geosciences at Western Michigan University. Clarey is professor of geology at Delta College, University Center, Mich.

Dave Curry, to senior geological adviser-petroleum systems, Devon Energy, Houston. Previously senior exploration geologist, ExxonMobil Exploration, Houston.

Harold G. Davis, to senior geological adviser, Devon Energy-Western Region, Oklahoma City. Previously senior reservoir geologist-deepwater GOM and Alaska development, ENI, Houston.

Matthew Duke, to subsurface manager-venture gas, Chevron Australia, Perth, Australia. Previously manager-base business, Chevron Thailand E&P, Bangkok, Thailand.

Richard Easley, to manager-geosciences, Mid-continent asset team, Dominion E&P, Oklahoma City. Previously geological adviser, Dominion E&P, Oklahoma City.

Mark Germinario, to division exploration manager-Fort Worth western division, EOG Resources, Fort Worth. Previously geological specialist, EOG Resources, Fort Worth.

Graham Goffey, to exploration and business development manager, EastCoast Energy, London, England. Previously general manager-international, Paladin Resources, Western Australia.

Charles A. Jackson, to manager-North America exploration, Noble Energy, Houston. Previously manager-Gulf Coast exploration, Noble Energy, Houston.

Douglas Jordan, senior geologist, Chesapeake Energy, Oklahoma City. Previously geological specialist, EOG Resources, Oklahoma City.

Jan Konstanty, to senior manager-portfolio and prospect appraisal, Wintershall, Kassel, Germany. Previously head of exploration portfolio management, Petroleum Development of Oman, Sultanate of Oman, United Arab Emirates.

Thomas R. Loftin, to geologist, Ballard Exploration, Houston. Previously senior geologist, Cimarex Energy, Tulsa.

Peter MacKenzie, to vice president of geoscience, Triana Energy, Worthington, Ohio. Previously president, MacKenzie Land & Exploration, Worthington, Ohio.

Kim Morrison, to onshore exploration team leader, Woodside Energy, Libya. Previously project leader-Asia Pacific new ventures, Shell International, Rijswijk, Netherlands.

Paul Roberson, to consultant geophysicist, BG Group, Reading, England. Previously senior petroleum geophysicist, BHP Billiton Petroleum, London, England.

Philip Schenewerk, to petrophysicist, Newfield Exploration, Tulsa. Previously senior staff reservoir engineer, Vintage Petroleum, Tulsa.

Robert Schexnayder, to associate geologist, American Shoreline, Corpus Christi, Texas. Previously staff geologist, JD Consulting, Corpus Christi, Texas.

John Seitz has been named vice chairman of the board for Endeavour International and will continue to serve as a consultant to the company. Seitz was previously co-chief executive officer of Endeavour.

D. Mark Steinhauff, to geophysicist-technical studies, upstream ventures, Saudi Aramco, Dhahran, Saudi Arabia. Previously company expert-sequence stratigraphy and regional geology, ExxonMobil Exploration, Houston.

George Strother-Stewart, to associate, Sproule Associates, Calgary, Canada. Previously senior geologist, Sproule Associates, Calgary.

Jason Wallgren, to associate geologist, Chesapeake Energy, Oklahoma City. Previously geologist, Eagle Oil and Gas, Dallas.

John G. Williams, to executive vice president-exploration and production, Index Oil and Gas, Houston. Previously manager-exploration geoscience, ConocoPhillips, Houston.

(Editor's note: "Professional News Briefs" includes items about members' career moves and the honors they receive. To be included, please send information in the above format to Professional News Briefs, c/o AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101; or fax, 918-560-2636; or e-mail, smoore@aapg.org; or submit directly from the AAPG Web site, www.aapg.org/explorer/pnb_forms.cfm.)

MEMBERSHIP AND CERTIFICATION

The following **candidates** have submitted applications for membership in the Association and, below, certification by the Division of Professional Affairs. This does not constitute election, but places the names before the membership at large. Any information bearing on the qualifications of these candidates should be sent promptly to the Executive Committee, P.O. Box 979, Tulsa, Okla. 74101. (Names of sponsors are placed in parentheses. Reinstatements indicated do not require sponsors.)

Membership applications are available at www.aapg.org, or by contacting headquarters in Tulsa.

For Active Membership

Illinois
Johnson, Michelle M., Continental Resources, Mount Vernon (R.L. Snyder Jr., A.E. Booth, B.K. Richards)

Oklahoma
Cope, Caleb Casey, Penn Virginia, Tulsa (M. Stamper, A. Close, J. Puckette); **Mirzadeh, Tahereh A.**, Halliburton Energy Services, Oklahoma City (J.R. Murlin, J.B. Tapp, G.H. Timson); **Younger, Paul Tracy**, Chaparral Energy, Edmond (reinstate)

Texas
Elibiary, Nabil Y., IPR Group of Companies, Carrollton (reinstate); **Gardner, Henry**, self-employed, Houston (reinstate); **Hart, Dennis**, Whiting Petroleum, Midland (L. Wagner, J. Southwell, R. Hill); **Hope, Jenny**, DTE, Fort Worth (reinstate); **Janes, Erin Morgan**, Geoscience Earth & Marine Services, Houston (J.L. Honganen, M.J. Kaluza, D.R. Phu); **Martin, Archie Hugh III**, self-employed, Dallas (reinstate); **Osburg, James Cliff**, Shaw Environmental, Midland (reinstate)

Canada
Fu, Qilong, CCEC/U of Regina, Regina (H. Qing, R. Shirkie, Robert Munday); **MacKenzie, Janet Lea**, Highpoint Resources, Calgary (L.A. Dagdick, M. Armanious, D.A.D. Scott)

England
Bukovics, Christian, Shell, Brookwood (J.R.V. Brooks, R.D. Fritz, J.C. Dolson)

France
Soulhol, Bruno, TOTAL, Paris La Défense (J.J. Jarrige, M. Blaizot, J.J. Biteau)

Indonesia
Chandrahayat, Sukanda, PT Horizon Geoconsulting, Jakarta (A.H. Satyana, H. Darman, F.H. Sidi)

Scotland
Jones, David William, Shell UK Exploration and Production, Aberdeen (J. Underhill, M. Hempton, M. Shepherd)

Certification

The following are **candidates** for certification by the Division of Professional Affairs.

Petroleum Geologist

Texas
Pittman, Lewis Stanley, independent geologist, Dallas (Society of Independent Professional Earth Scientists)

Singapore
Dunderdale, Ian David, Gaffney, Cline & Associates, Singapore (P. Donais, C. Toland, S.R. Clowers)

Petroleum Geophysicist

Texas
Carr, Matthew B., Osprey Petrophysics, Houston (G.T. Davis, J. Gross, R. Cooper, S. Ryan, U. Strecker)

FOUNDATION UPDATE

Foundation (General)
Ahmed El-Tayeb Adam
Toru Akutsu
Nasser Mohammad Al Ghamdi II
Nawal A. Al-Rushaid
Jon Karl Anderson
Nils Andresen
Jeffrey Keith Austin
Hans Gerhard Ave-Lallemant
Armando Enrique Avella
Izaskun Azpiritxaga
Tanwi Basu
Byron Jean-Jacques Beck
Amran Benguigui
Paul Eric Bergum
Mark Alan Bloom
Louis Chapman Bortz
In memory of Earl Gordon "Griff" Griffith
Patricia K. Boyd
In memory of Robey Clark
William Brooks Jr.
Stephen J. Buckner
Susanna Sofia Calvo
Alejandro Carrillo-Chavez
Alan R. Carroll
Chris J. Carson
Bob G. Carter
Mauricio Cherroni
Michael Gerard Colley
Evelyn Evalle Cortez
Thomas E. Covington
Luis Arturo Crespo
Joost Harmen De Weerd
Paul H. Dudley Jr.
In memory of Phil Brogan
Godwin Emmanuel Eboh
Sandra L. Eichelberger
Nuala Patricia Ewins
Hercinda Cordeiro Ferreira
Gaylon Freeman
Michael Ray Fulford
Pedro Xavier Gama
Daniel Peter Gatto
William E. Gipson
In memory of Robert M. Leibrock
Robert D. Gunn
In memory of Jim Lewis and Robey H. Clark
Catherine L. Hanks
Yasunori Higuchi
James Andrew Hook
Chuck D. Howell Jr.
W. Clay Hunter
Andrew R. Imrie
Scott Andrew Irvine
Sasi Dharan Kinattukara
Harold Paul Le Blanc Jr.
David Marshall Levin
In memory of Bob Berger
Hugues Longuepee
Rene E. Manceda
Ryo Matsumoto
Donald Paul McGookey
In memory of Charles M. Hartwell
James M. McKeown II
Ramses Gabriel Meza Martinez
John Gregory Moore
Christopher Keith Morley
Robert Mark Negrini
Daniel Oritsegbeyiwa Ogbe
Luis R. Porras
Robert Lloyd Pott
Harry Ptasynski
In memory of Bill Walter Roberts
Walter Carroll Pusey III
Syed Muhammad Raza
Debora Rodrigues De Miranda
Stefanie Roemer
Andrew Samuel
Abdul Latif Setyadi
Toshiaki Shibasaki
Charles Glen Shortridge
Charles J. Sicking
Edward J. Stockhausen
Philip Allen Teas
Sanjeev S. Thakur
Celestine I.C. Ugwu
Maarten Vanneste
Niels J. Ventzel
George Vinson
In memory of Charles Dobbs and George Landry
Rudy C. Wildenstein
David Anthony Winter
Chaoqing Yang

Awards Fund
Babatope Olaleye

Michel T. Halbouty Human Needs Award
Randi Susan Martinsen

A.I. Levorsen Memorial Award
Sarika Kala Ramnarine

Continuing Education Fund
James Kenneth Booher
J. Pieter A. Dietvorst

Digital Products Fund
Kenneth Aniess

Louisiana State University Alumni
Thomas M. Talley

Distinguished Lecture Fund
Taizhong Duan
Donald Leroy Hansen
In memory of Robert Berg
Jeffry A. Smith

Grants-in-Aid Fund
Philippe Demeur
Donald Leroy Hansen
In memory of Donald Weinkauf
John D. Haun
In memory of Robey Clark
Thomas Earl Jones
Robert J. Weimer
In memory of Bob Berg, Jim Lewis, Robey Clark and Earl Griffith

Barrett Family Named Grant
Mary S. Hubbard

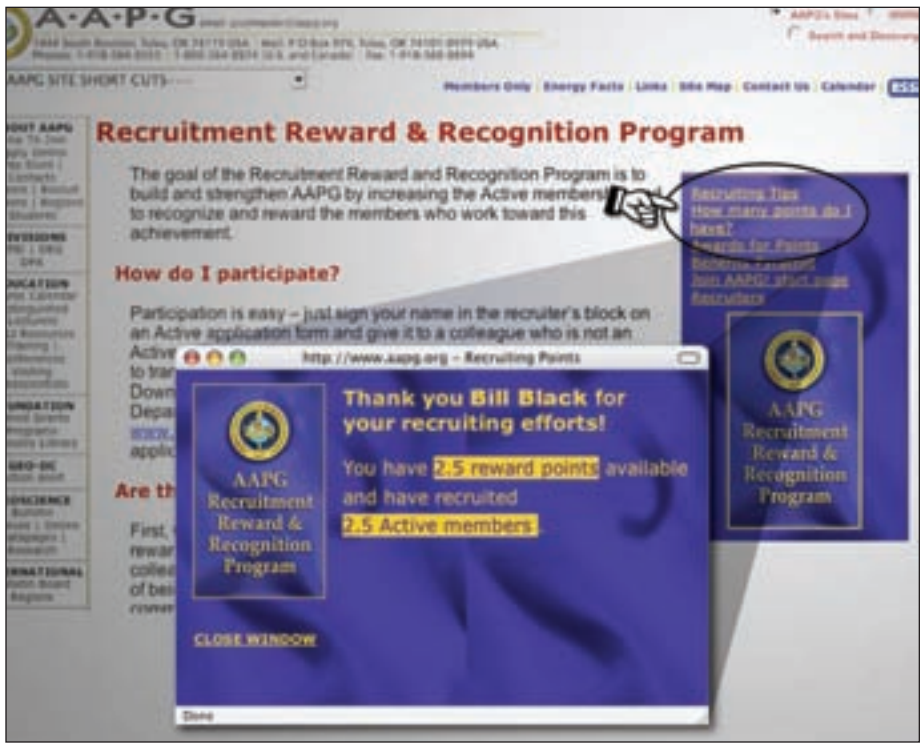
Herbert G. and Shirley A. Davis Named Grant
Herbert G. Davis
In memory of Dorsey R. Buttram

Robert K. Goldhammer Memorial Grant
Arnout J.W. Everts

L. Austin Weeks Memorial Undergraduate Grant
Jean K. Stoneburner

K-12 Fund
Robert McCray Altany
Frank L. Campbell
H.C. Jamison
In memory of Robey Clark
Richard Michael Parker
In memory of Jack G. Klatt
Edward Carl Roy Jr.
John Patrick F. Welch

Katrina Emergency Relief Efforts
Robert McCray Altany



WWW.UPDATE

'Recruiter' Link Added to Site

By JANET BRISTER
AAPG Web Site Editor

"Word of mouth" is the strongest advertising and personal contact is the most persuasive motivator.

Active members of AAPG are being asked to use these powerful tools to recruit other people to become Active members.

"Other" includes those who are Associate members or have allowed their membership to lapse. It also means those who have never "bothered" to join AAPG.

Now, AAPG is keeping track of the recruiting success of AAPG members.

At www.aapg.org/recruit you may learn about the recruiting program. Spelled out are the rewards to be given to members and the recognition they will receive for their efforts.

Members may redeem their recruiting points along the way. Points may be used for fossil and rock specimens or AAPG Bookstore credits.

It's just another reward for doing a colleague a favor.

What You Need to Know

When inviting members to join AAPG simply remember: www.aapg.org/join. This Web location is the starting point for the online application process.

(And remind your new recruit to put your name in the "recruited by" field so you may receive credit for your efforts.)

Other tools have been provided to assist the membership to recruit new members. These also are found in the recruiting "zone" where the Benefits Pyramid is linked along with recruiting tips.

The pyramid illustrates the advantages of being a part of AAPG and its divisions. It spells out the benefits from member services through educational and career advancement.

At any time you can check your collected, redeemable points by clicking on "How many points do I have?" You'll be asked for your member number; then click "continue" and you'll be fed the results.

The "Recruiters" link gives the list of AAPG Active members who have recruited and can be sorted alphabetically or by total number of recruits.

Good browsing! ❑

Commentary

'Hockey Stick' Takes A Whack

We share Jeff Howdeshell's desire for good science, as expressed in his August letter to the EXPLORER's Readers' Forum. We particularly agree that "AAPG is a scientific organization dedicated to the advancement of the science."

We disagree with most of what Howdeshell says in the rest of his letter.

Geological observations and data provide nearly all of the evidence from which inferences can be made regarding past climate change. Geologists have more data and more knowledge than any other group of scientists regarding the climate history of the earth!

Because of the politicized nature of this debate, geologists should feel obligated to present highly relevant information that sheds light on the nature of climate change. The general public has heard growing alarms of coming catastrophic climate changes, and the causal factor is stated to be combustion of fossil fuels.

Recently, the IPCC has retracted a number of its earlier conclusions. The Mann et al (1998,1999) "Hockey Stick" graph presented in the IPCC report in 2001 said, in essence, the earth is experiencing a warming trend that has not been observed in the past 2000 years. The "Hockey Stick" discounted historical records documenting the Medieval Climatic Optimum, when the Vikings colonized southern Greenland and grew wheat, and also discounted the Little Ice Age. The earth is currently experiencing a natural warming trend following the end of the Little Ice Age.

The Ad Hoc Committee Report to the House Committee on Science, authored by Edward J. Wegman, George Mason University; David W. Scott, Rice University; and Yasmin H. Said, The Johns Hopkins University, examined the statistical methods used in the "Hockey Stick" Global Warming Reconstructions, and in summary said:

❒ Their use of principal components (statistical) analysis was incorrect and unsupportable inferences were drawn about the current magnitude of global warming relative to the historical past.

❒ There is a tightly knit group of individuals who passionately believe in their thesis and (1) have a self-reinforcing feedback mechanism and (2) their work has been sufficiently politicized that they can hardly reassess their public positions without losing credibility.

(The full report can be found at http://energycommerce.house.gov/108/home/07142006_Wegam_Report.pdf.)

We further refer everyone interested in this subject to "Environmental Effects of Increased Atmospheric Carbon Dioxide," by Arthur B. Robinson, Sallie L. Baliunas, Willie Soon and Zachary W. Robinson (2001). Frederich Seitz, past president, National Academy of Sciences (USA) and president emeritus, Rockefeller University, added a cover letter to this paper. We quote from it:

"Research data on climate change do not show that human use of hydrocarbons is harmful. To the contrary, there is good evidence that increased atmospheric carbon dioxide is environmentally helpful."

The authors concluded that:

✓ "Surface and atmospheric temperatures have been recovering from an unusually cold period known as the Little Ice Age. Indeed, recent carbon dioxide rises have shown a tendency to follow rather than lead global temperature increases."

✓ "The radiative contribution of doubling atmospheric CO_2 is minor, but this radiative greenhouse effect is treated quite differently by different climate hypotheses … While CO_2 has increased substantially, the large temperature increase predicted by the IPCC models has not occurred."

✓ Because of the difficulties of comparing the radiative CO_2 greenhouse effect with correction factors that dwarf the CO_2 effect, it is not surprising that the computer models have not accurately predicted the actual temperature trend. At present, science does not have sufficient comprehensive quantitative knowledge about the earth's atmosphere to permit reliable theoretical calculations. Each hypothesis must be judged by empirical results.

✓ Since 82 percent of the CO_2 rise during the 20th century occurred after the rise in temperature, the CO_2 increase cannot have caused the temperature increase.

continued on next page

Climate Card Comment Period Ends

The member discussion of the proposed Global Climate Change Card (July 2006 EXPLORER) closed Oct. 1 with 106 comments posted on the AAPG Web site. The comments remain available on this site for viewing.

The card, purveying information and data concerning climate change, was proposed to be used by geologists as a communications vehicle to talk with the non-scientific public about global climate change.

Concerns over the card's content and appropriateness prompted the Executive Committee, lead by then-president Peter R. Rose, to open a member's only Web site discussion to gather member comments.

The 2006-07 Executive Committee, headed by President Lee Billingsley, has taken the comments under consideration with a decision on the card's outcome to be announced later.

READERS' FORUM

Climate Change

I was a little amused by the letter titled "Back Off," (Readers' Forum, October EXPLORER) and the request for the AAPG to " … back off and leave the question of global climate change to the scientists who are responsible for its study…"

I beg your pardon, but that has a familiar ring to it.

I remember back in the early 1970s, hearing something very similar about those in our profession who took a stand for a concept called "plate tectonics" that was contrary to existing scientific thought. They were told basically the same thing by those who had not analyzed the data and drawn the same conclusion about forces within the earth.

AAPG is the premier association of students of this earth, and if any group of scientists are "responsible" for studying the earth and its long-term climatic changes, members of the AAPG should be that group.

Unlike the letter's author, I have not been a member of the AAPG for 54 years, but I am approaching 30 years of membership, and as a member of the world's largest association of earth scientists I would be extremely disturbed if we as an organization did not analyze the data and draw a conclusion on an issue so important.

There is always a diversity of opinion, and I am sure there are members of the AAPG who still don't believe the plate tectonic model, but we as scientists should draw conclusions from what the data is telling us – and in this case that is exactly what AAPG has done.

My own examination of available data has led me to conclusions similar to those expressed in the public outreach card, and I think that we as scientists have a responsibility in a world gone crazy to be a sane voice and state the obvious. This we must do regardless of those within or without, who cannot or will not acknowledge the validity of the data or conclusions drawn from it.

Robert Guy Stanton
Fruit Heights, Utah

After reading "Back Off" I just had to throw in my two-bits worth. I have been an AAPG member for 50 years and I agree with the issuance of its Climate Change Policy Statement.

It goes without saying that conservation, reduction of air pollution, development of alternate energy sources and more efficient vehicles should be a top priority of Industry and government. But sadly, global warming has been politicized and is being used by those who don't really know or understand (or care for that matter) about the geologic history of the earth.

Editor's note: Letters to the editor should include your name and address and should be mailed to Readers' Forum, c/o AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101, or fax (918) 560-2636; or e-mail to forum@aapg.org. Letters may be edited or held due to space restrictions.

Maybe they are right, that some kind of a catastrophic melting of the ice caps is going to take place. Our country should hope for the best and prepare for the worst. But the last time I looked, Google listed some 59,600,000 Web sites for global warming. It has become an industry with a life of its own.

As for predicting future climate change, nobody knows what is going to happen. One might as well inspect the liver of a sacrificial goat. So in this matter, stick to your guns.

Neil W. Hamilton
Easton, Md.

In post-2000 literature the broad scientific community has stated over and over again that humans are a (the) principal cause for climate change owing the introduction of green-house gases. Solving this condition is perhaps the greatest challenge that we now face.

I hope AAPG can be part of the solution rather than a forum that ignores or – even worse – impedes efforts that embrace a solution.

A small book that I recommend to all is *Field Notes From a Catastrophe: Man, Nature and Climate Change*, by Elizabeth Kolbert. Let me share one line from the book:

"To refuse to act, on the grounds that still more study is needed or that meaningful efforts are too costly or that they impose an unfair burden on industrialized nations, is not to put off the consequences, but to rush toward them."

This topic needs to be front and center for all in the energy business, and AAPG is not doing itself proud by tolerating the

See **Forum**, page 47

continued from previous page

✓ "Not one of the temperature graphs shown in figures 4 to 7, which include the most accurate and reliable surface and atmospheric temperature measurements available, both global and regional, show any warming whatever that can be attributed to increases in greenhouse gases."

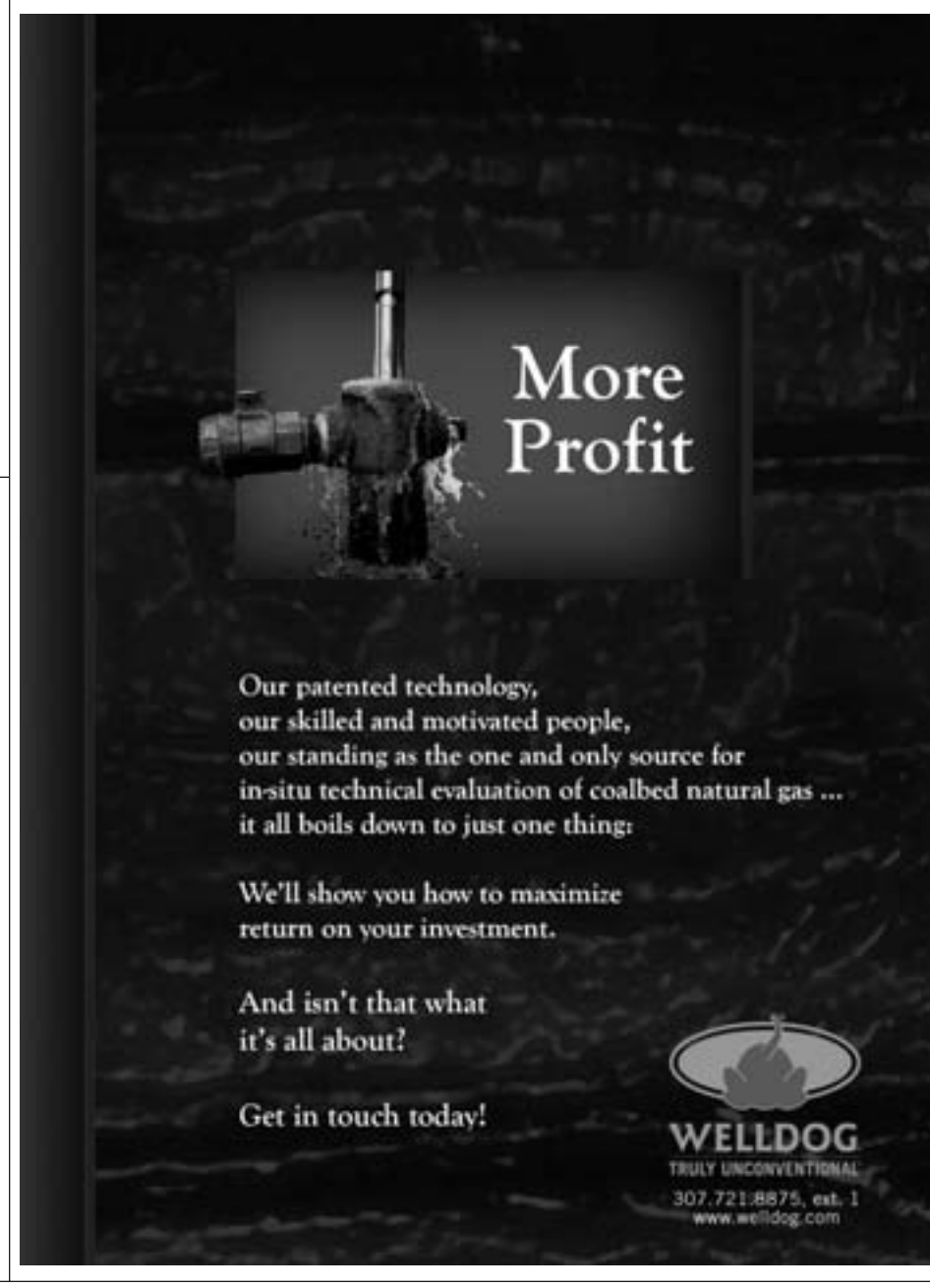
✓ "Mankind is moving the carbon in coal, oil and natural gas from below ground to the atmosphere and surface, where it is available for conversion into living things. We are living in an increasingly lush environment of plants and animals as a result of the CO_2 increase."

The articles of Fischer, H., et al 1999, and Siegenthaler, U., et al 2005, document that a rise in CO_2 lags the rise in temperature. Khilyuk, L.F. and G.V. Chilingar, 1999, in their figure 7 show the onset of higher temperatures a few hundred years before subsequent increases in CO_2 levels. These data all suggest that temperature rises drive increases in CO_2, not the other way around**.**

Our proposed Climate Change Card is an attempt to present some of the rationale behind why we believe past, present and future temperature changes are caused by natural phenomena beyond the abilities of man to control them. By giving geologists these data we believe it will be possible to do a better job of geoscience outreach to the public.

Good science starts with knowledge of the literature, so as not to replicate past experiments and to become informed about the current science. We have submitted a recent reading list to the AAPG Web page and recommend this to all other interested parties so that all may better understand the current state of knowledge in the climate sciences. All of our work is heavily fortified with state of the art science. If anyone has data to bring to this discussion, please do so, so we may truly communicate.

Lee Gerhard, Lawrence, Kan.
Bill Pollard, Fort Worth
Ray Thomasson, Denver



CLASSIFIEDADS

POSITION AVAILABLE

U.S. Geological Survey Mendenhall Postdoctoral Research Fellowship Program

The U.S. Geological Survey (USGS) invites applications for the Mendenhall Postdoctoral Research Fellowship Program for Fiscal Year 2008. The Mendenhall Program provides opportunities to conduct research in association with selected members of the USGS professional staff. Through this Program the USGS will acquire current expertise in science to assist in implementation of the science strategy of its programs. Fiscal Year 2008 begins in October 2007.

Opportunities for research are available in a wide range of topics. The postdoctoral fellowships are 2-year appointments. The closing date for applications is November 15, 2006. Appointments will start October 2007 or later, depending on availability of funds. A description of the program, research opportunities, and the application process are available at http://geology.usgs.gov/postdoc. The U.S. Geological Survey is an equal opportunity employer.

* *

The Ohio Geological Survey (OGS) seeks applications for the position of Supervisor, Energy Resources Group. The successful candidate will be a highly motivated geoscientist with a thorough understanding of the energy industries (especially oil, gas, and coal), and a proven record of research, publishing, project management, and supervision. The candidate should also have experience in securing research grants and working with the public and industry associations. A Master's degree (minimum) in geosciences, publications record, and petroleum industry experience preferred. The complete job posting is available on the ODNR Website (www.ohiodnr.com/jobs). The Ohio Department of Natural Resources is an equal opportunity/affirmative action employer.

* *

Devon Energy is looking for a Geological/Geophysical Advisor

POSITION SUMMARY
- Responsible for regional framework and lead generation in the Shelf and Deepwater Gulf of Mexico.

ESSENTIAL FUNCTIONS
- Expertise in deep water depositional systems
- Proficient in workstation interpretation (knowledge of Landmark system a plus)
- Understanding of sequence stratigraphy principles
- Ability to integrate subsurface information into interpretation.

ADDITIONAL FUNCTIONS
- Understanding of basin modeling techniques
- Understanding of petrophysical fundamentals
- Strong project management skills
- Strong interpersonal skills with the ability and desire to work within multi-disciplinary team
- Independent, self-motivated, creative, results oriented
- Strong communication and presentation skills

PREREQUISITES
- Degree in Geology or Geophysics
- 5+ years of recent industry experience in successful prospect generation
- Minimum of 3 years experience in GOM Deepwater prospect generation
- Proven track record as a hydrocarbon finder

Interested candidates, please submit a resume to Chad Davidson, chad.davidson@dvn.com.

* *

Department of Earth and Ocean Sciences The University of British Columbia

ASSISTANT PROFESSOR IN PROCESS SEDIMENTOLOGY

The Department of Earth and Ocean Sciences, University of British Columbia, seeks an individual with outstanding research and teaching capabilities for a tenure-track Assistant Professor position in the general field of process sedimentology. We especially seek an individual whose research is at the leading edge of his/her field. Examples include, but are not limited to, application of sedimentary geology or stratigraphy to environmental processes or natural hazards, paleo-environmental systems, biogeochemical and diagenetic processes of sedimentary systems, sedimentary facies modeling, physical sedimentary systems and the interface of sedimentology/stratigraphy with 3-D seismic for hydrocarbon-related studies. An individual who combines field-based research with a strong quantitative component is desirable.

The successful candidate will have a Ph.D. and preferably postdoctoral experience. He/she will have a demonstrated capability or potential to carry on an active, externally funded research program of international caliber and to supervise graduate students. An ability to contribute to the undergraduate and graduate teaching needs in the various programs offered by the Department, and a willingness to engage in collaborative research with Departmental colleagues, will be criteria for selection. The Department comprises a diverse and dynamic faculty of 46 scientists with research expertise in the solid and environmental Earth sciences extending from Earth's mantle, through the crust, near-surface, oceans and atmosphere to the planets. For more information about the Department and its research and teaching programs, please visit our web site at www.eos.ubc.ca.

UBC hires on the basis of merit and is committed to employment equity. We encourage all qualified persons to apply. Canadians and permanent residents of Canada will be given priority. The position is subject to final budgetary approval. Although the appointment is advertised at the Assistant Professor level, applications from exceptionally qualified, more senior individuals will be considered, particularly if they address under-representation of designated equity groups such as women, aboriginal people, visible minorities or persons with disabilities.

Applicants should send their curriculum vitae, a statement of research capabilities and interests, a statement of teaching experience and interests, and the names and complete contact information for three persons of high standing who are willing to provide letters of reference to Dr. Paul L. Smith, Head, Department of Earth and Ocean Sciences, The University of British Columbia, 6339 Stores Road, Vancouver, BC V6T 1Z4 Canada. E-mail: ProcessSed@eos.ubc.ca; Confidential fax: 604-822-9014. The deadline for applications is January 22, 2007.

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Exploration Seismology Position

Assistant or Associate Professor of Geophysics. The New Mexico Institute of Mining and Technology invites applications for a tenure-track faculty position the Geophysics Program with specialization in controlled source seismology. The position is an appointment within the Department of Earth and Environmental Science (www.ees.nmt.edu).

Applicants must have a Ph.D. in Earth Sciences or a related field at the time of appointment, as well as a significant record of research productivity. We seek a leader in controlled source seismology specializing in innovative acquisition, processing, and/or interpretation with emphasis on hydrocarbon exploration and/or recovery. Potential for excellence in research, teaching, and industry collaboration are the most important qualifications. Women and underrepresented minorities are encouraged to apply.

Responsibilities include the development of a vigorous, independent, and externally funded research program supporting M.S. and Ph.D. students, teaching two to three graduate or undergraduate courses per year, student advising, spearheading new research and teaching connections within EES and with other partners, and service to the department, institute, state, national, and international Earth Science communities.

New Mexico Tech, located in the central Rio Grande valley community of Socorro, specializes in science and engineering education and research, with a present enrollment of approximately 1800 undergraduate and graduate students. The Earth and Environmental Science Department incorporates an integrated undergraduate program in Earth Science in association with strongly interacting graduate programs in Geophysics, Geology/Geochemistry and Hydrology. Geophysics is part of the EES Department, consisting of 21 faculty and 120 undergraduate and graduate students. The Geophysics program hosts the on-campus IRIS PASSCAL Instrument Center and EarthScope USArray Array Operations Facility (www.passcal.nmt.edu). Additional geoscience expertise on campus includes the Bureau of Geology and Mineral Resources, New Mexico's geological survey (geoinfo.nmt.edu), and the Petroleum Recovery Research Center (baervan.nmt.edu). For further information on the position and on New Mexico Tech see www.ees.nmt.edu/professional_ops.html and www.nmt.edu. For detailed inquiries, contact search committee co-chairs Rick Aster (aster@nmt.edu) and/or Susan Bilek (sbilek@nmt.edu).

Applicants should submit a statement of research and teaching interests and goals, a curriculum vitae, and the names of three or more references to: Seismology Search, Human Resources, Box 133, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801. Official transcripts of pre-and post-graduate studies will be required if selected to interview. To receive full consideration, all materials must be received by 12/15/06. Email applications cannot be accepted. New Mexico Tech is an equal opportunity/affirmative action employer.

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continued on next page

Forum

from page 45

camp who think climate change is a non-issue or even a "hoax."

David G. Howell
Walpole, N.H.

The Corniche

Kudos to Dave Blanchard for his perserverance in trying to get a traffic tunnel built under Cairo's busy Corniche (October EXPLORER).

My daughter was a high school friend of Deana Blanchard and made that same crossing over the Corniche with many of their other high school friends, many times. Cairo is a wonderful place to live and work, but for the thousands of ex-pats and millions of Egyptians living and working in Cairo, road safety ranks as a major (if not *the* major) concern that only recently seems to be getting the attention it deserves from the government.

A pedestrian bridge recently was installed over another pedestrian trouble spot along Maadi's autostrade. This to the benefit of the hundreds of pedestrians that cross it every day as well as the thousands of drivers who previously feared that a pedestrian could unexpectedly dart out in front of their fast moving vehicles.

Ex-pats living and working in a foreign land have an obligation to leave their adopted country or city a little better than they found it. Dave Blanchard and John Dolson are excellent examples of how this is being accomplished in Egypt.

Thomas Maher
Cairo, Egypt

'Exotic' 4-D

Regarding your story on the use of 4-D seismic (October EXPLORER): I feel that the time lapse technique has very much potential for utilization in reservoir management, but there are certain aspects that need more attention. These are related to repeatability of the survey in space, resolution, variability in amount of fluids present, type of lithology, etc.

More research is needed so that 4-D results can give us changes only related to type of fluids, amount of fluids present in the reservoir with time.

I think now industries have enough data to evaluate, calibrate and model it to give information about the fluid dynamics in the reservoir with time for efficient reservoir management and enhanced recovery of hydrocarbons.

Vinay K. Sahay
Bombay, India

continued from previous page

ASSISTANT PROFESSOR-RESEARCH

(Sedimentary Basin Analysis-Petroleum Geology) The Louisiana State University's Louisiana Geological Survey invites applications for a research faculty position in sedimentary basin analysis-petroleum geology at the Assistant Professor-Research level. Research will be focused mainly on basin analysis and the many aspects of sedimentary geology related to petroleum formation, maturation, migration, and accumulation within Louisiana's petroleum systems. A variety of other projects dealing with the State's petroleum reserves are also potential areas for both original and applied research. **Required Qualifications:** strong academic record; Ph.D. in Sedimentary Geology/Petroleum Geology or in a related field of geosciences from an accredited institution; experience within the oil and gas industry in exploration and production; understanding of petroleum system analysis, especially in terms of modeling and simulation; proven experience in successful grant writing; **(Required Research Projects)** strong background in subsurface geology, especially in creating and interpreting geologic maps and cross-sections; working knowledge of applying GIS to aspects of geologic research. **Special Requirements:** ability and willingness to travel to various locations, over a few days at a time as well as other travel as necessary. **Responsibilities:** presents research results at appropriate conferences; submits papers in appropriate journals or Geological Survey publications; makes contribution to other petroleum technology forums. Salary and rank will be determined by the successful candidate's qualifications and experience. An offer of employment is contingent on a satisfactory pre-employment background check. Application review will begin immediately and will continue through November 15, 2006, or until a candidate is selected. Applications should send a full resume (including e-mail address and a salary history), a one-page statement outlining short-term and long-term visions of research while at the Geological Survey, and contact information (e-mail, telephone number, & mailing address) for three references to: Search Committee, Louisiana Geological Survey, Room 3079 Energy, Coast & Environment Building, Louisiana State University, Ref: #016129, Baton Rouge, LA 70803.
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SECTION CHIEF – Energy Research Section - Kansas Geological Survey-The University of Kansas, Lawrence. Full-time position at academic rank of senior scientist to lead the section, conduct advanced research and disseminate information about Kansas energy resources. Requires Ph.D. in the geosciences, research emphasis in energy resources, record of peer-reviewed scientific publication, and experience developing and supervising a scientific program. Prefer background with an emphasis on petroleum. Possible academic appointment in appropriate department at the Univ. of Kansas. Women and minority candidates are especially encouraged to apply. Complete announcement and application instructions at http://www.kgs.ku.edu/General/jobs.html. Priority date: Jan. 16, 2007. Annette Delaney, HR, hr@kgs.ku.edu or (785) 864-2152. KU is an EO/AA employer.

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Director, University of Wyoming School of Energy Resources

The University of Wyoming invites applications and nominations for the position of Director, School of Energy Resources. With new funding from the Wyoming Legislature, the school provides an outstanding opportunity for a visionary leader to build an interdisciplinary organization that will address energy resources in a higher education setting. For more information, please visit http://www.uwyo.edu/SER/.

The Director will report to the VP for Academic Affairs. We seek an energetic leader with proven scientific and administrative skills. Preferred qualifications include: 1) an earned doctorate; 2) an internationally recognized record of teaching and research in energy-related fields; 3) administrative experience demonstrating vision, managerial ability, and communication skills; 4) leadership needed to create synergy with other university programs and with industry; and 5) a commitment to integrating academics, research, and the school's outreach mission.

Applications should include a CV and a letter describing qualifications and experience. For finalists, the search committee will also ask for three references. Screening will begin in November 2006, but applications will be accepted until the position is filled. The University of Wyoming is an equal opportunity - affirmative action employer with an institutional commitment to diversity. We encourage women and members of under-represented groups to apply.

Please send applications and nominations to:

SER Director Search, c/o Dr. Myron B. Allen
Vice President for Academic Affairs
University of Wyoming
1000 E. University Ave. Dept. 3302
Laramie, WY 82071

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Job Opportunity: Technical Sales Professional

Geo-Logic Systems, LLC of Boulder, CO seeks a dynamic sales professional to manage worldwide marketing and sales of LithoTect, the premier Geology Interpretation program. Candidates must possess a proven record in client prospecting, marketing, and sales. Degree in Geology is preferred, as well as 5 to 10 years experience in marketing/sales of geological software to the O&G industry. Compensation package: base + incentive program + benefits. Location is flexible. Start Q1, 2007.

Please e-mail resume, inclusive of salary history, to info@geologicsystems.com. All inquiries are strictly confidential.

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Houston based independent oil and gas company is seeking experienced geoscientists for prospect generation in its domestic operations. Applicants must have 5+ years interpretation experience of Gulf of Mexico 3D seismic data and application of latest geophysical methods and tools. Desired qualification is a degree in Geology or Geophysics. Competitive compensation package.

Send your resume to:
AAPG Communications Department
BB/S1
P. O. Box 979
Tulsa, OK 74101

See **Classifieds**, next page

PETROLEUM GEOSCIENCES
THE PETROLEUM INSTITUTE
ABU DHABI, UNITED ARAB EMIRATES

Positions: The Petroleum Geosciences Program of The Petroleum Institute, Abu Dhabi, United Arab Emirates (UAE), is seeking outstanding candidates to begin January 2007 or August 2007 for several possible positions. Appointment at Assistant Professor, Associate Professor, Professor, and Distinguished Professor will be considered, depending on qualifications. Ph.D. from a first-rank university is required for all positions. Teaching experience and petroleum industry experience are desirable. Experience with carbonate rock systems is also advantageous.

Geoscience Educator: Successful candidate will be primarily responsible for coordinating multiple sections of introductory geoscience, teaching introductory and other undergraduate geoscience courses as needed, and supervising undergraduate laboratories. Research opportunities exist, but research will not be a main responsibility. Ph.D. in a relevant area of geoscience and several years of university-level teaching are required. Candidates must have strong interpersonal, communication, and organizational skills. Candidates must also have a commitment to excellent teaching and have demonstrated use of modern, innovative educational methods.

Reflection Seismology: Candidates must have expertise in seismic acquisition and processing, with skills in advanced processing, seismic inversion, seismic imaging, and multi-component analysis, or in seismic interpretation, including interpretation of seismic attributes. Successful applicants for the possible position will teach undergraduate and graduate courses, develop an active research program that impacts the UAE petroleum industry, and engage in institutional service work. Opportunities exist to work with PI industry stakeholders in research.

Petrophysics-Rock Physics: Petrophysicist with experience in carbonate well log interpretation and rock physics techniques is requested. Rock physics techniques must include fluid substitution, seismic/rock physics reservoir characterization, AVO, and monitoring of recovery processes. Candidates should have good IT, data management, rock laboratory, and teaching skills. Successful applicant will be working in a multidisciplinary department with oil industry projects and teach undergraduate and graduate courses.

The Petroleum Geosciences will consider additional applicants, particularly in the areas of organic geochemistry, stratigraphy and sedimentology, structural geology with experience in fractured reservoirs, quantitative geologic modeling, and petroleum geology, which would support the Program's educational goals.

Salary/Benefits: Salary is competitive and commensurate with qualifications and experience, with an excellent benefits package, including housing and furniture allowance, educational allowance for dependent children, annual air passages and medical care. The UAE levies no income taxes.

Institution: The Petroleum Institute was created in 2001 with aspirations to establish itself as a world-class institution in engineering in areas of significance to the oil and gas and the broader energy industries. The Petroleum Institute's sponsors and affiliates include major oil companies, including four of the five major oil companies in the world. The campus has modern instructional laboratories and classroom facilities and is now in the planning phase of three major research centers on its campus. The Petroleum Institute is an affiliate institute with Colorado School of Mines and in the process of signing working relationships and collaborations with other major universities and research institutions around the world to capitalize on joint collaborations and research areas of interest. For additional information, please refer to the PI website: www.pi.ac.ae.

To Apply: Application materials must include (1) a letter of interest, which addresses the applicant's qualifications for the position; (2) a current resume; and (3) the names, email and business address, and home and business telephone numbers of at least three references. Electronic Submission is greatly preferred, and should be sent to The Recruiting Coordinator at The Petroleum Institute (recruiting-coordinator@pi.ac.ae) and submission of materials as an MS Word/PDF attachment is strongly encouraged.

Candidates are encouraged to submit an application as soon as possible and no later than **15 November 2006**, although applications will be considered until vacant positions are filled.

Call for Papers:

Unconventional Challenges-Innovative Solutions

American Association of Petroleum Geologists

Southwest Section Convention 2007

Hosted by:

North Texas Geological Society 1923

Wichita Falls, Texas April 23-24, 2007

A special theme session will be reserved for papers and posters on unconventional resources and methods. However, all topics related to the petroleum geology of Texas, southeastern New Mexico, southern Midcontinent, and frontier exploration areas are welcome.

Students are encouraged to deliver oral or poster presentations. Travel support is available for student presenters.

Transactions will be prepared in CD-ROM format which will include abstracts and optional papers/slides. Deadline for abstract submittal is January 1, 2007. Abstracts in .doc or .rtf format should be attached to an email sent to bbrister@gunnoil.com; Alternatively, abstracts may be submitted in .doc or .rtf on a CD-ROM mailed to Brian Brister, Gunn Oil Company, PO Box 97508 Wichita Falls, TX 76307, 940-723-5585. Authors wishing to submit papers, figures, or slides should notify their intent by the abstract deadline. Papers/slides for publication in the CD ROM are due February 1, 2007.

A closer view, with scale, of fractured Woodford Shale in the Arbuckle Mountains of southern Oklahoma.

EMD

from page 49

is well known that micro-fractures are essential for shale-gas production, natural fractures are beneficial in some settings (e.g., the gas cap in an anticline) but may be detrimental if they extend out of the reservoir zone and either leak gas or connect with sources of water. Thermogenic methane may be associated with oil from oil-generative organic matter in the oil window where the oil may decrease the permeability and impede the movement of gas.

All shales are not alike, even those containing the same type and amount of organic matter at the same thermal maturity.

Mineralogy is very important for a successful well completion. Gas production is dependent on the ability to create fractures, the presence of natural fractures or the occurrence of interbedded permeable lithofacies.

Some words of wisdom that I received from a gas-shale operator are to treat gas shales as fine-grained tight-sand reservoirs. Silica-rich shales behave better during fracture stimulation than clay-rich shales.

* * *

Many questions remain to be resolved in evaluating gas shales. For example:

What is the importance of faults and natural fractures?

What are the contributions of free gas and sorbed gas?

What is the drainage area?

What is the minimum thermal maturity needed for shales containing oil-generative organic matter to be an economic gas shale?

How does gas migrate by diffusion in shales?

Does amorphous organic matter have a role in gas diffusion?

A large amount of data must be compiled, modeled and evaluated before venturing into a gas-shale play. You will never have all of the answers. Operators have told me that sometimes the best thing to do is to go with the information that you have and drill a well.

* * *

To learn more about gas shales, I encourage you to become an EMD member and access the Gas Shale Committee area of the EMD members-only Web site (http://emd.aapg.org/) for articles, presentations, reference lists on gas shale and shale, Web links and a calendar of gas shale meetings, short courses and workshops. ❑

Classifieds

from previous page

FOR SALE

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WANTED

Want to purchase minerals and other oil/gas interests. Send details to: P.O. Box 13557, Denver, CO 80201.

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Wanted oil and gas prospects. We pay geologists plus ORR. Will buy or lease prospects less than 7000 feet. Prefer Rockies. Confidentiality assured. Bestoso Oil, 2833 N.E. 24th Place, Ft. Lauderdale, Florida 33305 or EdBestoso@aol.com.

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Illinois Basin Prospects Wanted

I am interested in oil prospects in the Illinois Basin. These drilling prospects can be leased or unleased. No partial interests. All contacts confidential. If you have any prospect, please contact us.

Daniel E. Laib
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DIRECTOR'S CORNER

Plan Provides Road Map to Goals

By RICK FRITZ

To make a strategy complete, it is critical to build a tactical plan with measurable goals and action items to complete those goals.

Several years ago I took a course on public speaking at the recommendation of then-President Robbie Gries.

The first night we were given a homework assignment to do three things outside of our comfort zone, and we were to "push the limit." This technique is designed to put you at ease with speaking in front of a large audience.

I decided to make a plan, and for the first part of my homework I decided to go eat (that's always my first choice).

I went to a popular family-style steak place and asked the hostess to seat me in the middle of a large crowd. I brought my notebook with me, and for my first course I ordered several appetizers. The waiter asked if anyone was joining me and I replied in the negative. After sampling the appetizers, I made a big production of writing my opinion in my notebook.

Next, I ordered a salad with *all* the various dressings on the side. This drew a few looks, including another raised eyebrow from the waiter. After trying the various salad dressings, I leaned over to a man in a group next to me and announced that I was an "independent food critic" and inquired which steak he preferred. He told me, and I promptly ordered the steak he recommended – plus most of the sides. As the food arrived, I would consider each bite, make a face and log my opinion in my notebook.

By the end of the night, people were coming over to me and giving me their opinions while the waiter stood by my table looking over my shoulder at my opinions. One customer even whispered "this isn't a very good steak place," and recommended another establishment.

I wondered why he was there.

* * *

Most things in life require a plan that comprises a purpose, goals and action items. I could have said, "I want to do my assignment," but that is just a mission statement unless you are willing to establish a plan.

To make a strategy complete, it is critical to build a tactical plan with measurable goals and action items to complete those goals.

AAPG recently completed our strategic plan (it was in the November 2004 EXPLORER and is located on the AAPG Web site). The big audacious goal from the strategic plan was to make AAPG indispensable to the petroleum geoscientist."

The plan also contains six goal areas:

1. Advance the Science.
2. Continuous Professional Development.
3. Public Awareness and Understanding.
4. Membership and Member Services.
5. Financial Strength.
6. Global Presence.

To achieve these goals, we are building a five-year business plan. We contracted with a consultant, Hermann Eben, to help facilitate the building of our metrics. It is not a formal plan that you would take to the bank with lots of beautiful prose. Rather it is streamlined with each entity of AAPG using the following outline to build the plan:

✓ Purpose.
✓ Current reality (you must know where you are starting).
✓ Goals with metrics.
✓ Action items with who and when.
✓ Special financial considerations.
✓ If needed, a summary or recommendation.

This is the first time in AAPG history that all the leadership and staff has been asked to consider their goals, set their metrics for the goals and establish the action items to reach those goals.

The purpose of this plan is to allow us to easily review and track all of the goals and metrics and to have a measurable system of reaching our goals. It also allows us to remove some of the clutter.

AAPG has a wonderful and colorful history of service to its members. Since the beginning in 1917, AAPG has distributed scientific information to its members and the general public. Now we are at a time of great demand and need worldwide.

I believe this plan is one of the most critical steps we have made to make AAPG truly indispensable to its petroleum professional.

* * *

Of course, everyone is an "independent food critic," and our members are the best critics for this plan. We encourage everyone's best ideas as we complete this important guide for our future.

Energy Minerals Division

Gas Shales Tricky to Understand

By BRIAN J. CARDOTT
EMD Gas Shales Committee Chair

The success of technological plays such as the Barnett Shale and other shales has proven the potential of shale-gas resources – and if the recent number of technical sessions, short courses and workshops on gas shales is any indication of its significance, gas shales will be an important component of the world gas supply in the future.

Shale traditionally has been regarded as a hydrocarbon source rock or seal. Following applied research and experimentation by government, academia and industry over the past few decades, shales currently are recognized as complex gas reservoirs that require unconventional thinking to produce gas.

It has taken many decades to reach the current understanding of how gas is stored in coal beds and how to produce the gas (coalbed methane). In many ways, shales are even more complex than coals, and our knowledge of shale-gas production is still at the beginning of the learning curve.

Shale as a rock is defined as a "fine-grained detrital sedimentary rock," but can vary in mineralogy (e.g., clay, silicate and carbonate minerals), texture and fabric. Shale as a rock formation (e.g., Caney Shale) contains a mixture of grain sizes and lithologies (e.g., black and gray shales, siltstone, limestone). Gas shales are thought of in the lithostratigraphic sense.

Gas shales are self-contained petroleum systems (hydrocarbon source, migration pathway, reservoir and seal). Low-permeability gas-shale plays are recognized as technological plays – and advances in horizontal drilling, fracture stimulation, micro-seismic fracture mapping and the application of 3-D seismic data have contributed to their success.

Photos courtesy of Brian Cardott

As gas shales become an increasingly important part of the world's energy picture, targets such as Oklahoma's Woodford Shale could be increasingly valuable.

* * *

Excluding the petroleum engineering completion issues (e.g., slickwater and cross-linked gel fracture stimulation), the geologic approach to gas shales is to evaluate the source rock and reservoir properties. Recent articles and presentations have described important variables and have classified gas shales based on the presence of biogenic, thermogenic or mixed methane.

Some important variables include:

✓ Depth, thickness and lateral extent of the shale (to define the play boundaries).
✓ Type (oil or gas generative), quantity (total organic carbon), thermal maturity and adsorptive capacity of organic matter.
✓ Type (e.g., biogenic, thermogenic, or mixed methane), amount (gas content), composition (e.g., methane, carbon dioxide, nitrogen) and Btu content of gas.
✓ Pore structure and distribution.
✓ Mineralogy of the shale (important in designing the fracture stimulation).

Some variables may be either beneficial or detrimental to gas production. For example, even though it

See **EMD**, page 48