AAPG EXPLORER
MAY 2012

# Time Travelers

## Making geology an adventure

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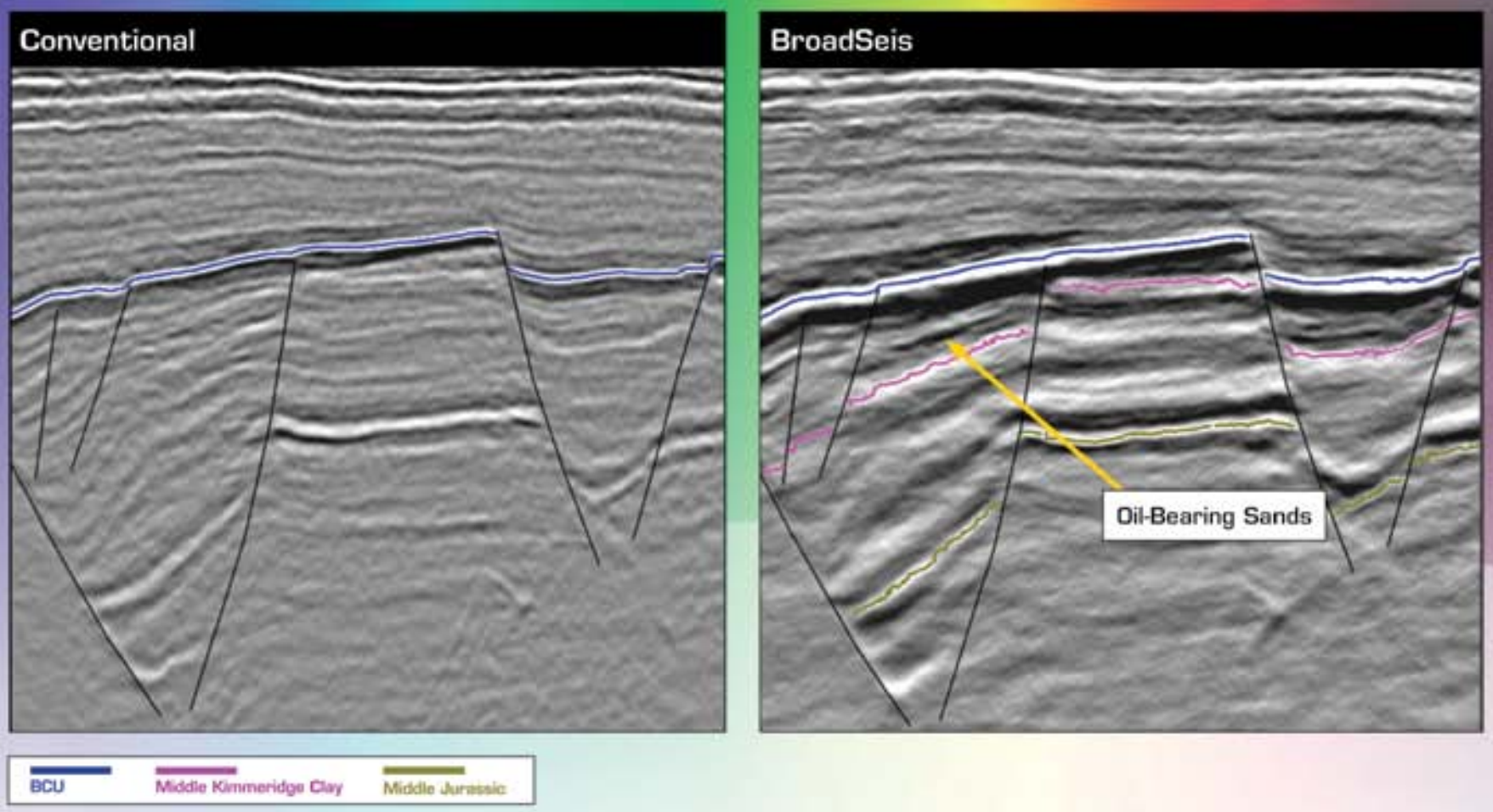
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS AN INTERNATIONAL ORGANIZATION

# BroadSeis - Enhancing Interpretation

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Vol. 33, No. 5
May 2012

AAPG EXPLORER

PRESIDENT'S COLUMN

# Whither AAPG?

By PAUL WEIMER

*This month's column is extracted from my address at the opening session of the AAPG Annual Convention and Exhibition in Long Beach, Calif., on April 22. I thank AAPG staff members Vicki Beighle and David Lange for their extraordinary help in generating these statistics and figures.*

*A recurring theme of my columns is the long-term health of AAPG. In this column I'd like to focus (again) on long-term trends in membership.*


WEIMER

> "AAPG is entering into a new golden age for applied geosciences."

This year I have heard many members express opinions about future membership trends, without the benefit of membership data. Because we're scientists, let's look at the data, the programs that AAPG has implemented, and where AAPG might go in the future.

The following figures illustrate our long-term trends in membership since 1979, so that we can consider the implications of our membership policies.

### Historical Membership Trends

The first eight figures (below and on pages 4 and 5) show the ages of members in groups of five years on the horizontal axis, and total number of members for each group on the vertical axis.

Three comments on the graphs:

1. The statistics are a snapshot from January 1 of each year (mid-year FY calculations). As we'll discuss below, the timing of this snapshot affects how we calculate membership for recent years.

2. The average price of oil for each year is shown in terms of 2012 dollars.

3. The figures show certain specific years when major population cohorts move from one age group to another (e.g. from 31-35 to 36-40).

In 1979, we see a distinct bimodal distribution in the ages of AAPG members (Figure 1). One peak was at ages 26-30 (4,000 members, called hereafter "Baby Boomers"), and the other was around ages 51-55 (almost 4,000 members, called affectionately the "Long-in-the-Tooth" Generation, or LITT). 1979 was

See **President**, next page

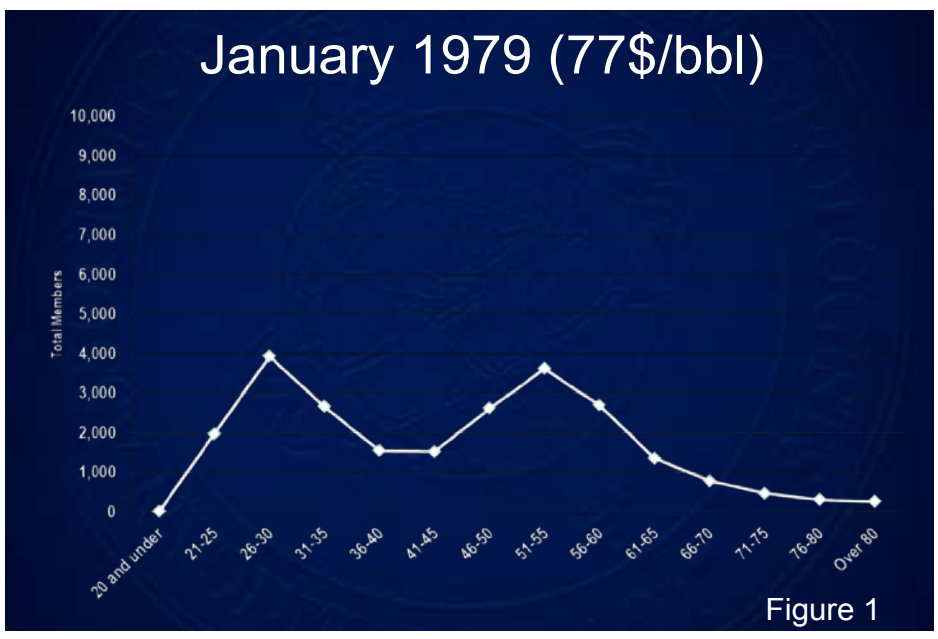

Figure 1

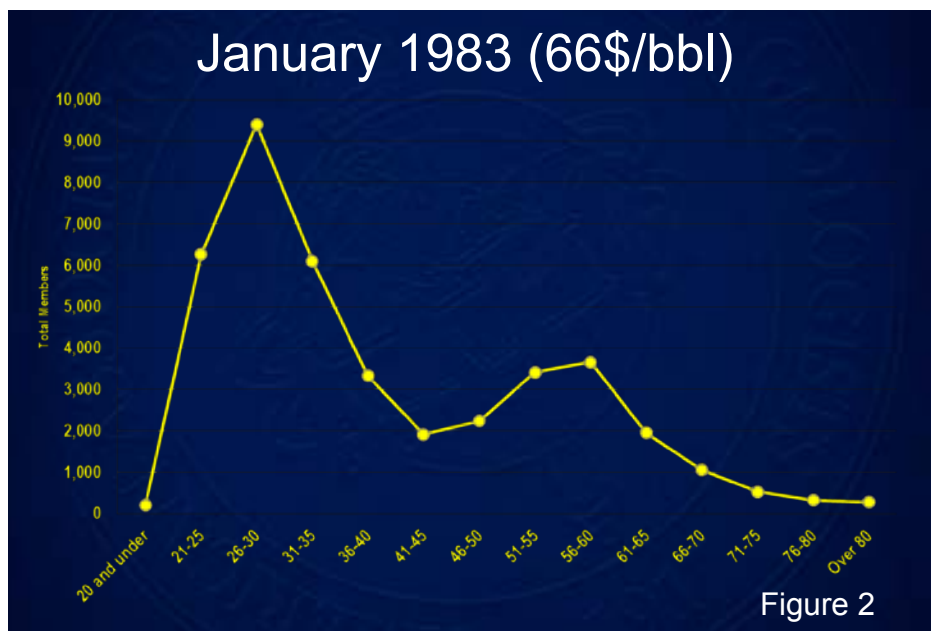

Figure 2

## STAFF

AAPG Headquarters:
1-800-364-2274 (U.S. & Canada only),
others 1-918-584-2555

**Communications Director**
Larry Nation
email: lnation@aapg.org

**Managing Editor**
Vern Stefanic
email: vstefan@aapg.org

**Communications Project Specialist**
Susie Moore
email: smoore@aapg.org

**Correspondents**
Courtney Chadney
Louise S. Durham
Barry Friedman
Diane Freeman

**Graphics/Production**
Matt Randolph
email: mrandolph@aapg.org

**Advertising Coordinator**
Brenda Merideth
P.O. Box 979
Tulsa, Okla. 74101
telephone: (918) 560-2647
(U.S. and Canada only: 1-800-288-7636)
(Note: The above number is for advertising purposes only.)
fax: (918) 560-2636
email: bmer@aapg.org

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## ON THE COVER:

Students from the University of Toronto experienced geology – and an awareness of geologic time – firsthand at the Scarborough geology field camp at the Grand Canyon, thanks in part to a widespread interest in geology sparked by professor Nick Eyles' books and his two popular, often exotic Canadian TV series that have helped bring the story and thrills of geology to the general public. See story on page 20. On this page, Eyles as TV host walks with a camel train en route to salt flats in Ethiopia.

Photos courtesy of Nick Eyles.

Vol. 33, No. 5

The AAPG EXPLORER (ISSN 0195-2986) is published monthly for members by the American Association of Petroleum Geologists, 1444 S. Boulder Ave., P.O. Box 979, Tulsa, Okla. 74101-3604, (918) 584-2555. e-mail address: postmaster@aapg.org. Periodicals Postage Paid at Tulsa, OK and at additional mailing offices. POSTMASTER: Please send address changes to AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101. Canada Publication Agreement Number 40063731 Return undeliverable Canadian address to: Station A, P.O. Box 54 • Windsor, ON N9A 6J5 • E-mail: returnsIL@imex.pb.com

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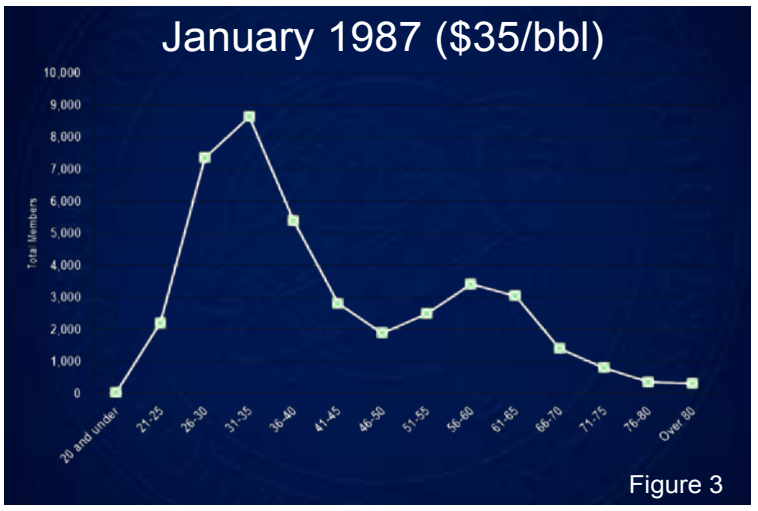


Figure 3

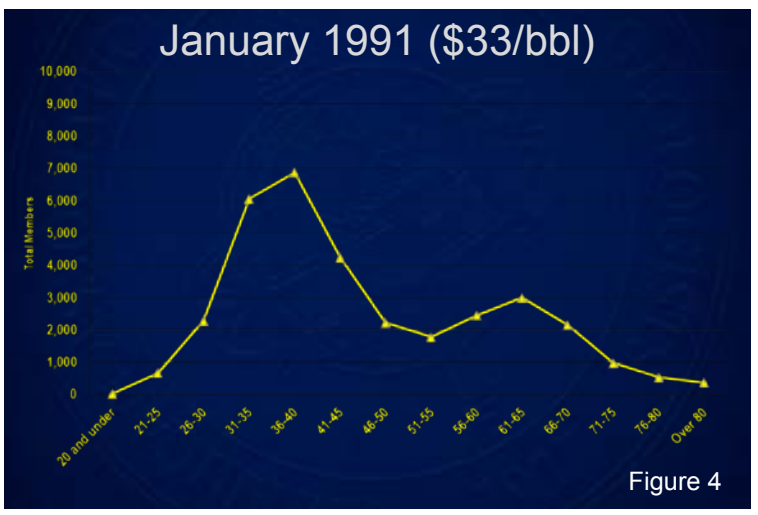


Figure 4

Figure 5

Figure 6

Figure 7

# President
from page 3

the first year that the Baby Boomers became the largest age group in AAPG membership. Many young people joined AAPG at this time due to rising oil prices between 1973 and 1978, and the extensive hiring associated with the rapid expansion of the U.S. oil industry.

By 1983 (Figure 2), the Baby Boomers group, remaining at ages 26-30, has grown to nearly 9,400 members. The LITT Generation has shifted to ages 56-60, but their numbers remain about 4,000. The price of oil has dropped a bit from its peak in late 1979, but industry was still robust.

By 1987 (Figure 3), the Baby Boomers have now moved to the 31-to-35 age group (with a slight decrease to 8,800), and the LITT Generation still resides in the 56-60 group (about 3,200 members). The price of oil has stabilized after its precipitous drop in late 1985 and 1986. The massive downsizing of our industry that began slowly in 1981 and accelerated in 1985 and 1986 began to have an effect on membership.

By 1991 (Figure 4), the Baby Boomers have moved to the age 36-40 group and have decreased in numbers to 6,900. The LITT Generation is now ages 61-65 and has 3,000 members. The substantial reorganization of industry during the late 1980s had begun to take an effect on the absolute number of Baby Boomer members.

By 1996 (Figure 5), the Baby Boomers peak has moved to the age 41-45 group, and has decreased in absolute numbers to 6,000. The LITT Generation is now age 66-70 and 2,200 members. There was a small price increase in oil beginning in late 1995 that lasted for about two years.

By 2001 (Figure 6), the shape of the graph begins to change to a uni-modal distribution, with two significant plateaus to the left and right. The Baby Boomers have moved to ages 46-50, but remain at 6,000 members. The LITT Generation is now ages 71-75 with 2,000 members.

In the year 2006 (Figure 7), there are now about 5,400 Baby Boomers and they have-moved to the 51-55 age group. The LITT Generation has now moved to ages 76-80 and totals 1,300 members. Meanwhile, the student numbers are beginning to increase. Importantly, student sponsorship began in 2003; that is, students' dues were first subsidized.

Finally, in 2011 (Figure 8), the Baby Boomers now number 4,200 and have moved to the 56-60 age group. The LITT Generation are all now 80 or older – in fact, all people past 80 are now included in this group, so there is an artificial increase in numbers to 1,800. Oil prices have recovered after the drop of the late 2008 financial crisis. The number of students has grown substantially and appears to be the dominant age group; but as we will see below, appearances can be deceiving.

The evolution of the LITT Generation and Boomer populations is summarized in Figure 9. The years are now shown on the X axis, and the total numbers of members on the Y axis. In a simplistic way, you can treat these graphs as decline curves from a producing well, although I do not want to push the analogy too far because of statistical problems. The actual movement of these age groups is not as straightforward as these graphs show, but they still illustrate the general migration of membership through time.

Looking at Figures 1 through 9, the key point is obvious. The Baby Boomers are now in a similar decline curve as their LITT forefathers. For AAPG to maintain a large number of members, we must recruit new members to succeed the Baby Boomers.

* * *

Next, let's analyze the programs that AAPG Leadership has implemented during the past decade to see how they've affected membership.

### Student Members

Five programs and policies to increase student memberships have had some success.

✓ **Sponsorship of students' dues.** Halliburton started paying students' dues in 2003; Chevron later took over in 2006, and currently pays the dues for all 11,000+ students.

✓ The **Imperial Barrel Award Program.** This has become one of the premier programs for geoscience students. This year's competition had 100 teams with five persons per team. This translates to 500 students, 70 percent who were from international regions. Participating in the IBA leads to commitment to AAPG – last year, 53 percent of IBA participants became Associate AAPG members, in contrast to the overall 9 percent retention of all student members.

✓ **Grants-in-Aid. This program supports student research.** This year, $185,000 was awarded to 84 students. Note that last year, only 32 percent of students who received grants became Associate members.

✓ The **Young Professional and Students Membership Committee** was developed five years ago, and this has had good success encouraging involvement with younger members.

✓ The **House of Delegates** (HOD) passed the "Student Bridge" program, which allows student members to have the option to remain in the student class after ending academic careers. With the billing cycle for FY2013, 4,656 students who are graduating were changed to Student/YP status and were billed $10 for their dues. We are hopeful this program will assist recent graduates with retaining their AAPG membership.

Now let's look at long-term Student membership trends. As Figure 10 shows, the percentage of Student membership has grown from 6.9 percent in 2003 to 14.3 percent today.

When we compare the number of Student members with Baby Boomers and the LITT Generation (Figure 9), it appears that the Student members are replacing the decline of the Baby Boomers, and becoming the dominant group in AAPG – just like when the Boomers joined in 1979 (Figure 1).

However, the graph in Figure 9 is misleading. The reality is that the number of Student members fluctuates considerably within any one year. Specifically, two dates for Student member numbers are shown in Figure 11 for the most recent five-year interval: March 1 (pre-billing) and June 30 (post-billing).

As you can see, the way that we count our Student members depends on the time of the year. The pre-billing number in Figure 11 is a snapshot of Student membership at its yearly peak – students whose dues have been 100 percent subsidized. The June 30 snapshot shows the numbers of Student members who have decided to keep their AAPG membership and pay dues for the first time. The numbers show a difference of about 2,000 in 2007 and 2,008 increasing to 5,000 in 2012. Thus, Students are not completely replacing the Baby Boomers.

### Graduated Dues and Non-U.S. Membership

The AAPG HOD voted for graduated dues for members at the April 2007 Annual Convention in Long Beach. This allows members with lower incomes to pay lower dues. The purpose was to increase our membership, especially in the non-U.S. arena. Note that the SPE and SEG already had similar policies.

Three figures help us evaluate the effects of graduated dues. As Figure 12 shows, the number of graduated-dues-paying members has increased from 117 in 2008 to 2,140 in FY 2012. About 63 percent of these members are from the

Continued on next page

Continued from previous page

United States, and about 37 percent are non-U.S. (Figure 13). Thus, we conclude that this program has considerable potential for growth in non-U.S. settings.

Next, let's review the distribution of membership in terms of U.S. versus non-U.S. (Figure 14). Since 2001, U.S. membership in AAPG has been essentially flat – hovering around 21,700 members. In contrast, our non-U.S. membership in the same time period has increased from 8,703 to 13,517. Note that both the U.S. and non-U.S. statistics include Student members. Clearly, if AAPG wants to grow or maintain current numbers, we must increase both U.S. and non-U.S. membership. It is important for us to recognize that geoscientists outside North America have different needs and requirements, including a different perspective regarding ethics and membership requirements.

* * *

Finally, let's review three additional important aspects of membership.

### Voting Members

Membership by voting class is shown in Figure 15. Note that one must be an Active, Honorary or Emeritus member to vote. In 1985 we reached our highest number of voting members. Since that time, the numbers of voting members have steadily declined. In addition, the relative percent of voting members has declined during the past five years. Clearly, a large number of Associate members do not convert themselves into Active members. This issue affects the selection of AAPG leadership because only Active members can vote. AAPG is becoming (a) less participatory, at least in terms of voting, and (b) less representative. Two solutions are to increase international Active membership and/or change the structure. AAPG staff has been working on identifying Associate members who appear to be qualified to be Active. Engaging them will help make the Association more participatory.

### Women as Members

The number of women as a portion of membership is shown in Figure 16. Overall membership decreased from 1986 to 1995 (10.6 to 8.3 percent), and has slowly increased every year since then – it is now 1/6 of membership (16.7 percent). As part of the work force in the United States, the trend is toward women comprising more than 50 percent. It is worth noting that today women earn almost 60 percent of all bachelor's degrees and more than half of master's and Ph.Ds. in the United States. AAPG needs to continue to engage this part of the work force in all aspects of the organization.

### Price of Oil versus Membership

The last graph shows the price of oil in inflation adjusted 2011 dollars versus total membership (Figure 17). Curiously, there is not a strong correlation between price and the total numbers of members. It appears that membership increases lag slightly behind boom times.

* * *

What do all of these trends mean?

The future success of our Association depends largely on the recruitment and retention of new members to carry out the missions of the Association. However, it is difficult to project membership trends into the future due to the number of variables – for example, Student retention, non-U.S. membership, and the rate of Baby Boomer decline.

The real question, then, is – whither AAPG? What does AAPG want to be in the coming decades? Primarily a U.S. society with 15,000 members? Or perhaps a global society of 40,000 members or more?

You may recall at the 2011 All-Convention Luncheon, Harrison "Jack" Schmidt (Apollo 17 astronaut and AAPG Honorary Member) observed that the average age of the NASA engineers who worked to place humans on the moon was 26. I think this is a wonderful metaphor for AAPG's future.

From my AAPG travels this year, speaking with members in 25 countries as well as the United States, I have seen the face of the AAPG's future, and I like it! The face of our future is a young face; an international face, speaking multiple languages. These students and young professionals are hungry for knowledge. They see science and technology evolving rapidly – especially in the area of unconventional resources – and they want to apply new techniques now to help accelerate the transformation toward unconventional to conventional resources. What they want from AAPG membership is to access as much state-of-the-art geoscience information as they can. Fortunately, AAPG has the potential to do this.

In summary, here are my key learnings and recommendations for increasing membership and improving the overall health of the Association through services.

▸ *Companies investing in universities globally.*

In nearly all of the countries that I visited this year I was struck by two things. First, students expressed their frustration about the lack of access to AAPG's scientific information. Not all university libraries can provide access to the wealth of AAPG publications. Second, it also became evident that there is a surprising lack of engagement between companies and universities. There are several reasons for this, but the primary reason is a lack of desire on the companies' part. This divide between companies and universities has an immediate negative impact on the future of AAPG in terms of building and retaining memberships, and on the long-term health of our profession.

I have encouraged companies to do two things: (1) Take the time to give talks and speak with students at local universities about the profession. (2) Donate a permanent subscription to AAPG Datapages to increase universities' access to all of AAPG publications.

Here is one scenario. In Country X, let's say that 10 major universities have broad programs in petroleum geology-related fields, and participate in the IBA program. If the five largest companies who operate in Country X gave $30,000 each, their combined gift of $150,000 would give the universities lifetime access to AAPG's publications. I cannot think of a better investment for the future.

Finally, in addition to the IBA program, the AAPG also can help universities by placing more regional lecturers and VGPs into Regions. We are starting to implement this program.

▸ *Cooperation with other societies.*

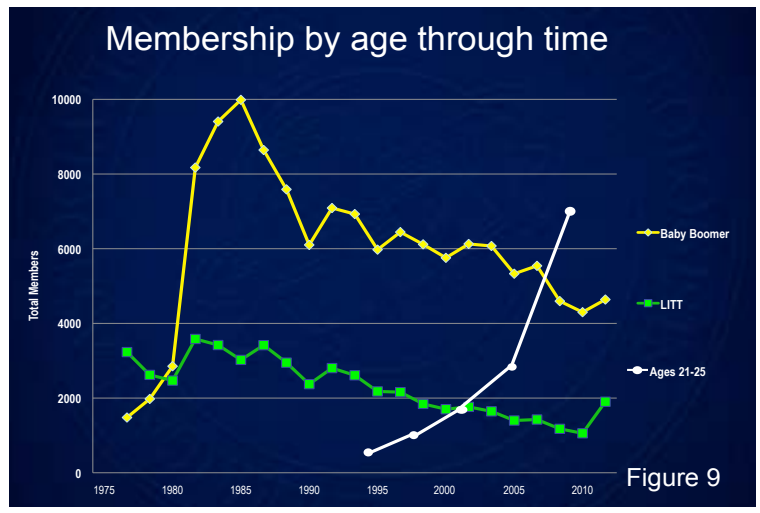
In my January column I discussed the need for AAPG to increase its level of participation with other societies, partly because our members are demanding we do so. In response, we opened the joint office with the SEG in Dubai in early March. Previously, on February 24, select members of the AAPG and SEG Executive Committees met with staff members to discuss additional areas for future collaboration. One surprising fact that emerged was the number of members who belonged to both societies (about 6 percent of SEG). I hope our collaboration will increase so that we can co-sponsor additional events for members.

Another example of cooperation is the EAGE Memorandum of Understanding to increase our joint offerings. We expect to sign this in June. The first joint EAGE-AAPG research conference will be held in Cyprus in early 2013, with plans for subsequent annual affairs around the globe.

AAPG's mission and activities are not always aligned with other societies. However, without more cooperation all associations will lose ground to for-profit organizations, which are diluting the market for high-quality scientific conferences.

See **Whither AAPG?** page 6

Figure 8



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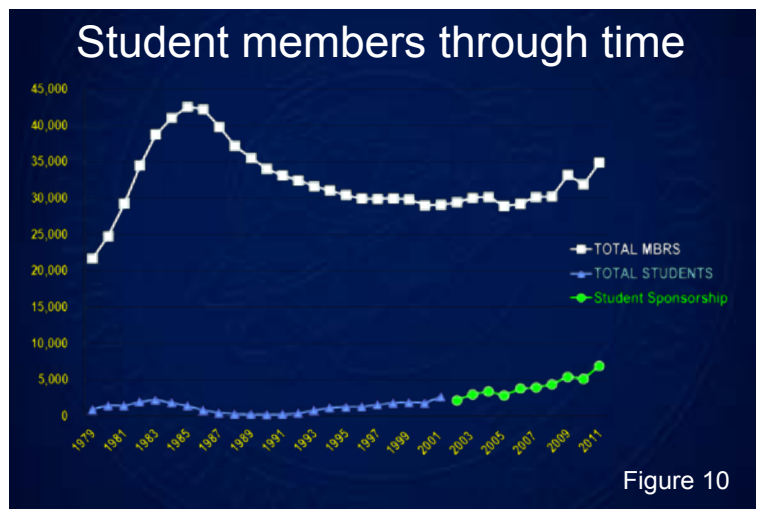
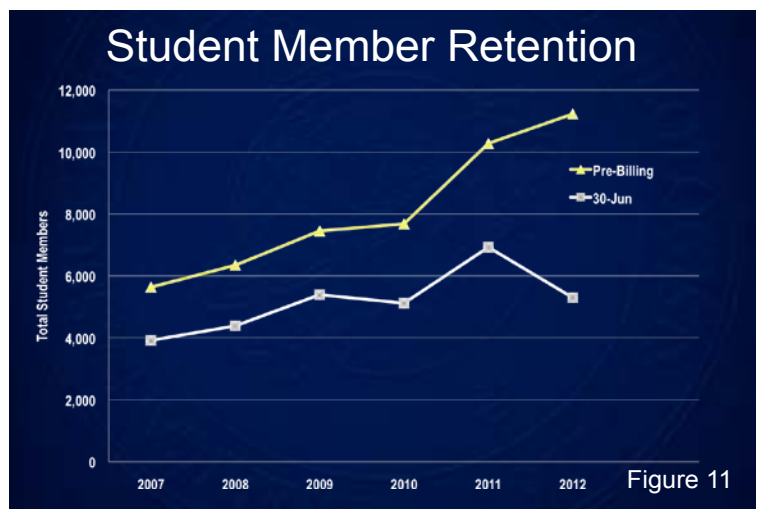


Figure 10



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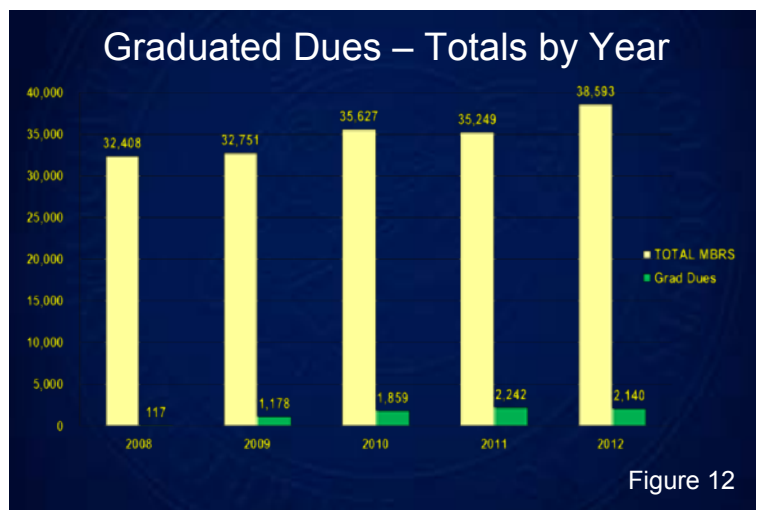
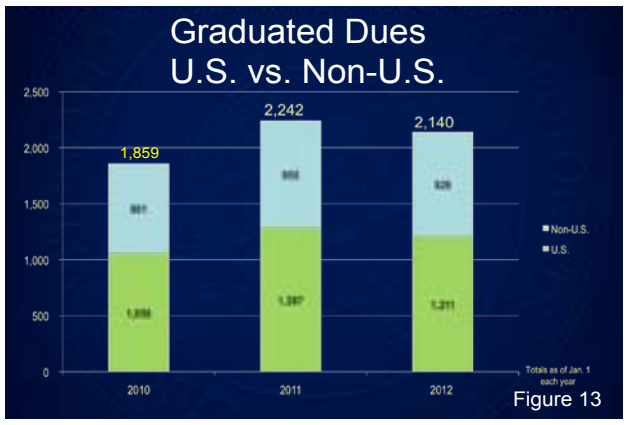


Figure 12



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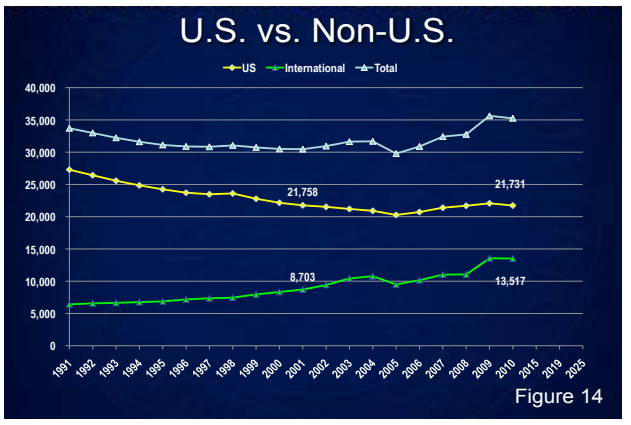

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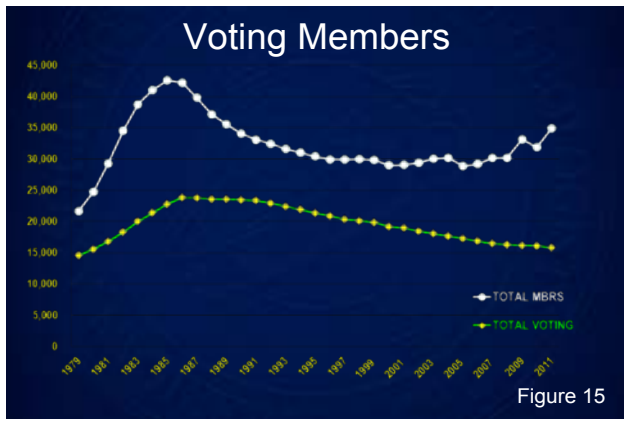


Figure 15

# Whither AAPG?

from page 5

*Reconsidering membership requirements.*

The movement toward membership simplification that began several years ago continued this year, led by members Jeff Lund and Andrea Reynolds. These are a series of positive continuing steps to make the AAPG application experience more efficient (process) and welcoming (qualification and application requirements).

What I learned this year from speaking with many members is that most do not understand the reasons for our membership requirements, and they think the process to become an Active member is unnecessarily onerous. That is one reason, if not the primary reason, for the decline in Active membership (Figure 15). To increase our membership and, importantly, the number of Active members, will require further simplification and re-evaluation of some of our requirements.

*A new golden age for applied geosciences.*

I think the AAPG is entering into a new golden age for applied geosciences due to the confluence of two emerging factors. First, our science has evolved considerably during the past few years – the move toward unconventional resources is challenging many traditional concepts that involve petroleum systems, migration, reservoirs, and porosity systems, while pushing us to develop new methods and technologies to explore for and produce these resources.

Second, we now have the ability to deliver our scientific information almost instantly around the world. In our April column, Steve Laubach, Ted Beaumont and I reviewed our ongoing efforts to improve the Association's abilities to deliver science. This transformation will take two-three years, but I think this is absolutely essential to our future ability to entice new members and retain current members. With these capabilities, we could globally reach the full potential of our influence as a professional society.

* * *

In summary, as we honor the past, we must also begin to ring in the new by embracing the opportunities of the present and future. Our best path forward is to use the influence we have already earned, and apply new learnings to grow membership and the long-term health of the organization.

Paul Weimer

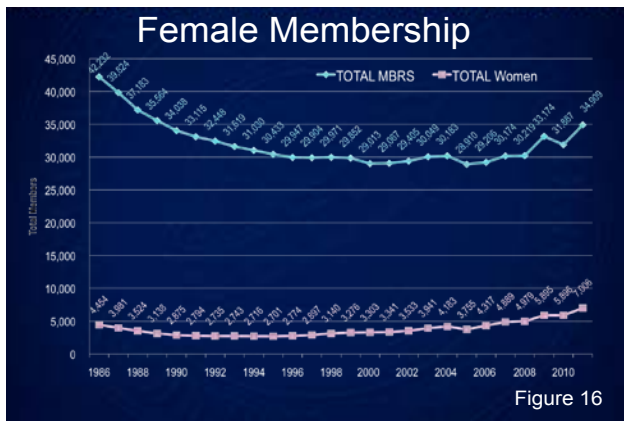


Figure 16

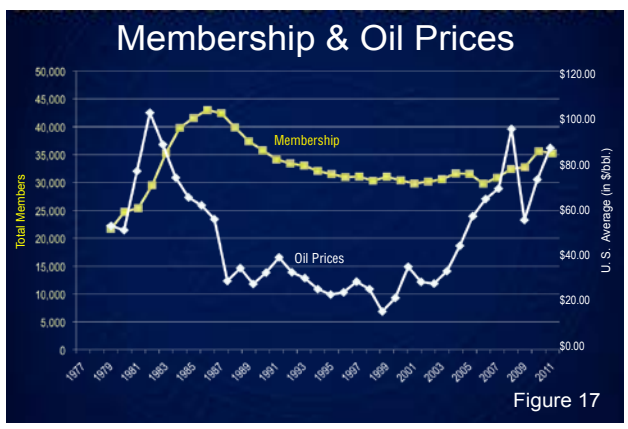


Figure 17

# Online Registration Opens for Singapore ICE

By VERN STEFANIC, EXPLORER Managing Editor

The technical program is in place and registration is now open for this year's AAPG International Conference and Exhibition, which will be held Sept. 16-19 at the Marina Bay Sands Expo and Convention Center in Singapore.

The official Singapore announcement, providing registration/housing information as well as all program and event details, was included as a separate item in the mailing of this EXPLORER.

The meeting marks the first time Singapore will host an AAPG ICE.

The 2012 meeting theme is "Asia-Pacific Resources: Fueling the Future," and more than 400 oral and poster presentations have been selected for the technical program, which itself will be organized around five areas:

- Exploring and Developing Asia-Pacific's Petroleum Provinces.
- Trap, Source, Reservoir and Seal Definition.
- The Past Is the Key to the Future.
- Facing the Future's Challenges Today.
- New Dimensions in Global Unconventional Resources.

Among the specific areas that will draw the technical spotlight are looks at the Asia-Pacific's shale gas potential, shale liquids and coalbed methane plays.

Among the special events that will be part of the program:

- A Discovery Thinking Forum, an ongoing presentation of the AAPG 100th Anniversary Committee's program celebrating significant discoveries, will be held as part of the Singapore technical program – the first time the event has been part of an ICE.

The forum will feature five speakers who will discuss "Important Discoveries and Creative Thinking," with a special focus on Europe and Southeast Asia.

Those speakers are:

✓ Arild Jørstad, exploration geoscientist, Lundin, who will discuss "The New Giant Johan Sverdrup Discovery, Norway."

✓ Fred Wehr, exploration and development manager, Apache, David Phelps and Eric Phinney, discussing "Two Deep Mungaroo Gas Discoveries in the Carnarvon Basin, Australia – Context and Implications for Further Prospectivity."

✓ Bernard Duval, associate professor, IFP, will talk on "Creative Thinking Led to 40 Years of Success in Mahakam, Indonesia."

✓ Lawrence D. "Trey" Meckel III, exploration manager and chief geologist, Tately N.V., will discuss "Exploring a 19th Century Basin in the 21st Century: Seeing the North Sumatra Basin with New Eyes."

✓ Sam Algar, vice president-Asia Pacific exploration, Murphy Oil, will discuss "Deepwater Northwest Borneo: Big Oil from 'Gas-Prone' Source Rocks and Leaking Traps."

- Scott Tinker, director of the Bureau of Economic Geology and the state geologist of Texas, will speak at the ICE Featured Speaker Luncheon, discussing "The Global Energy Transition: What Will It Take to Make the Switch?"

- The movie "Switch," featuring Tinker – and which focuses on the question, "What will it really take to make the transition from oil and coal to alternative energy sources?" – will be screened as a special ICE event.

ICE registration and all program details are available online at www.aapg.org/singapore2012.

*For the first time ever, Singapore will be the site of the AAPG International Conference and Exhibition, which will be held Sept. 16-19.*

*Data sorted and synthesized*

# Program Piecing the GOM Puzzle

BY LOUISE S. DURHAM, EXPLORER Correspondent


SNEDDEN

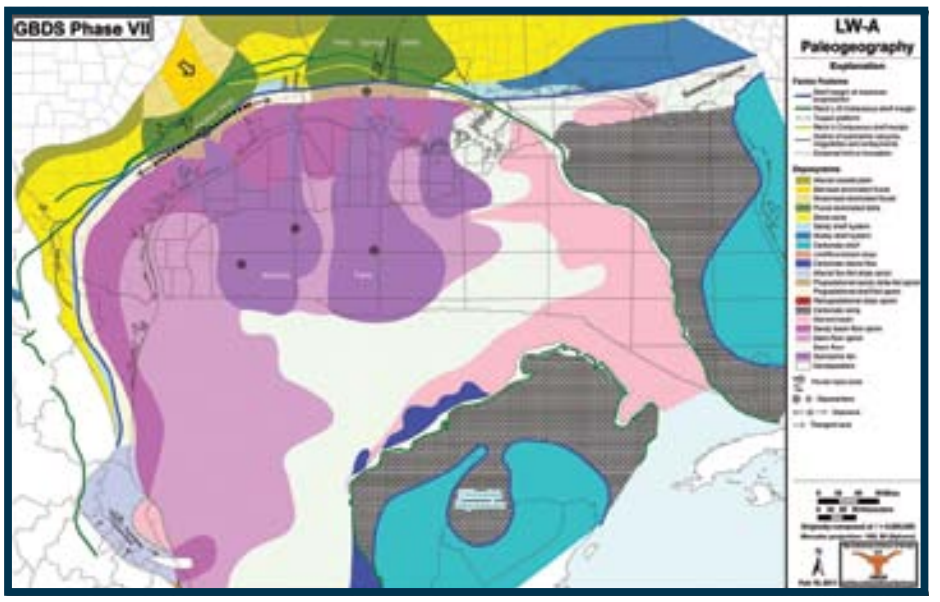

GANEY-CURRY

The Gulf of Mexico was essentially written off for a while in 2010 following the infamous Macondo well blowout – but, activity has been revving up, albeit with renewed regulatory oversight.

Despite the Gulf's long production history, much remains to be learned about the geology here – and an ongoing industry-funded program conducted by the Institute for Geophysics at the Jackson School of Geosciences, University of Texas at Austin (UTIG), is proving to be a rich information resource for GOM players who want to add to their already extensive knowledge of the area.

The 17-year – and counting – Gulf Basin Depositional Synthesis (GBDS) project is based on the premise that the GOM basin is a natural laboratory of sedimentary processes.

Its objective is to assemble and synthesize well, seismic and other data to establish basin-scale depositional history of the Gulf of Mexico, according to AAPG member John Snedden, the program's newly named director and principal investigator.




This position previously was held by AAPG member Bill Galloway, who led the program along with project coordinator and AAPG member Patty Ganey-Curry, from its initiation in 1995 until last February, when he stepped aside to become part-time consultant for the effort.

The project's specific goals are:

- Develop and refine offshore to deep basin stratigraphic correlations.
- Create a GIS data base and construct paleogeographic maps.
- Help guide prediction of reservoir distribution and characteristics.
- Address important scientific questions regarding the GOM depositional evolution.

"The Gulf basin is a world-class petroleum system, with more than 900,000 wells drilled on- and offshore," Snedden said. "The oil industry currently is gathering very expensive well and reflection seismic data in the deepest GOM.

"The basin is a deep hole since the Triassic, with up to 45 percent of the continent's rivers and deltas attempting to fill it," he asserted.

"It's a superb geologic record, he added. "The deep crustal structure is just now being illuminated by UTIG and other refraction seismic studies."

### Putting It In Context

Thus far, the UTIG GBDS team, which includes university students, has focused on the Cenozoic-age sediments, which have sourced many successful discoveries in the region.

"We rely largely on released well data and publications about the Gulf – and it's a huge volume of data – which we sort and synthesize," Ganey-Curry said.

"One thing that draws the companies to fund our project is our ability to organize the tremendous amount of data from the GOM," she said.

Snedden added that another big attraction is the 20 very elaborate paleogeographic maps created by Galloway, which tell a story that helps guide reservoir prediction first and foremost.

Currently, 24 industry sponsors are supporting the program monetarily, with others generously contributing seismic and paleo data. Many of the sponsoring companies are international.

Some of these data can morph into something rather unexpected.

For example, ION Geophysical has put together a unique seismic line from the Florida platform across the entire GOM to offshore Mexico.

See **GOM**, page 12

*Wolfcamp + Spraberry*

# Commingled Wolfberry a Clever Mix

By LOUISE S. DURHAM, EXPLORER Correspondent

Oil industry players have never shied away from creating new terminology.

Certain drilling targets in the Permian Basin are a good example.

Think Wolfberry, Strawberry and Wolfbone, for starters.

The trend here is to come up with catchy monikers for new plays, which really are a commingling of production from more than one formation.

The lower Permian-age Wolfberry, which is one of the hot items on the players' current menu, is the designated name for the packed-limestone Wolfcamp and the overlying Spraberry sandstone combo.

HENRY

> **"There will be a million acres or more involved in this play if it's all drilled out at 40-acre spacing in this area, it should recover about three billion barrels of oil."**

Over the years, the long-productive Spraberry has acquired a reputation for guaranteeing long-term production that is at least so-so in essentially any location where it's tapped.

Where the production is uneconomic, the Wolfcamp may sweeten the pot.

But it works both ways, according to James Henry, CEO and founder of Henry Resources LLC in Midland, Texas.

"As you leave the edge of the Midland Basin (near the Central Basin Platform), the Wolfcamp gets worse and worse, and the Spraberry gets a lot better in the middle of the basin," Henry said. "But the Spraberry becomes worse on the basin edge where the Wolfcamp is economical.

"That's why we drill both," he noted.

Henry talked about his company's experience in the play as part of the Discovery Thinking forum at the recent AAPG Annual Convention and Exhibition in Long Beach, Calif.

His talk was titled "The Wolfberry – How It Started."

He should know: The Midland Basin has been his company's turf-of-choice since 1971, when it began specializing in the Spraberry.

"It pays to stay in the same basin," Henry asserted.

### Close to the Edge

Henry noted the carbonate debris that came off the Central Basin Platform flowed into the Midland Basin. Toward the edge of the basin there were larger chunks of debris, and the lithology was more porous and cleaner.

In the middle of the basin there are more turbidites, mudflows and shales.

"After drilling 14 not-very-good wells, our geology department came up with the idea to drill close to the edge of the basin," Henry said. "So we moved closer – and also used a new fracturing technique that our engineers came up with.

"In 2003, we drilled the Caitlin 2801 in the Sweetie Peck field in Upton County; it was the discovery well because it showed the concept that if you move closer to the edge of the basin, you get more production," he noted.

"We included all of the Wolfcamp," he added, "and not just the top and middle, as Arco had been doing."

Henry credits the former Arco, or Atlantic Richfield Co., for the discovery.

"In the late '90s, Arco began adding the Wolfcamp to the Spraberry," he said. "They drilled about 300 wells in Midland and Upton counties and started trying different things, like different fracturing techniques.

Following BP's purchase of Arco, Henry ultimately latched onto acreage through farmouts and such.

"We took a lot of what Arco pioneered and brought in a consulting engineer who worked for Arco and helped with the development of the fracturing technique out there," Henry said.

"Arco was starting to figure it out when they got bought out, and they would have developed it," he said. "We took it from there.

"We leased about 330,000 acres and have drilled almost 1,000 wells to date in the Wolfberry," he said. "Additional wells have been drilled by other companies."

See **Wolfberry**, page 12

# Voting Deadline Arrives This Month

Voting continues in the election of new officers for the AAPG 2012-13 Executive Committee, but the deadline to participate looms.

Voting will remain open online through the May 15 deadline.

Candidate bios, written responses to the question of why they accepted the invitation to stand for office plus video comments from each candidate, filmed at last year's AAPG Leadership Days event in Boulder, Colo., also remain available on the AAPG website.

The president-elect winner will serve in that capacity for one year and will be AAPG president in 2013-14. The vice president-Sections and secretary will serve two-year terms, beginning July 1.

The slate is:

**President-Elect**

❒ **Donald D. Clarke**, geological consultant, Lakewood, Calif.

❒ **Lee Krystinik**, Fossil Creek Resources, Arlington, Texas.

**Vice President-Sections**

❒ **Thomas E. Ewing**, Frontera Exploration Consultants, San Antonio.

❒ **Kenneth E. Nemeth**, Schlumberger Seismic Reservoir Characterization, Houston.

**Treasurer**

❒ **Rebecca L. Dodge**, Midwestern State University, Wichita Falls, Texas.

❒ **Deborah K. Sacrey**, Auburn Energy, Houston.



## GOM

from page 8

"Part of that line is a seismic line shot by UTIG in 1978 before the Law of the Sea Treaty, where you can't acquire Mexico data anymore," Ganey-Curry said. "It's a really valuable offshore seismic line, because today you can't do that.

"Fortunately, the university kept the old data, and ION went back to the original gathers for that seismic line, reprocessed it and spliced that into the big long regional line that helps paint the entire picture," she noted.

"It's the missing part of the puzzle, if you will," Snedden emphasized.

He commented the GBDS program has been very successful, yielding new insights into the history of the GOM. It provides a context for many recent oil and gas discoveries there, including the Miocene play in Mississippi Canyon and the Paleogene deepwater play in Keathley Canyon and adjacent areas.

### Continual Knowledge Transfer

The UTIG team is not inclined to rest on its laurels.

Members are now in the information gathering stage for what is dubbed Phase IX of this endeavor, which will focus on the Mesozoic sediments.

Snedden said the incentive to start working the Mesozoic can be attributed to two relatively recent deep GOM discoveries in the Mesozoic:

- BP PLC's Tiber well at Keathley Canyon was drilled successfully to the Cretaceous two years ago, by the now-infamous Deepwater Horizon no less, and the well info was only recently released to the BOEMRE. The well tapped into oil in the Paleocene and the Cretaceous.
- The Davy Jones #1 well, drilled by McMoran Exploration on the deep shelf offshore Louisiana, logged 200 feet of net pay in multiple Wilcox sands.

"The Tiber went through 15,000 feet of salt before encountering Wilcox and Cretaceous, so it was a very risky well," Snedden said. "It reached TD at 35,000 feet in very deep water.

"The salt hides many secrets," he added.

"It seems that every year there's a new discovery and a new play and something unusual that the companies want to find out more about, and the GBDS program helps to support that," he noted.

"We're always thinking how we can use our information going forward and always adding more data," Ganey-Curry said. "We've built a big interactive GIS database with our own tools for doing things like cross sections and building maps.

"We deliver a lot to the companies for their participation," she said. "There are always questions to be answered, and there is continual knowledge transfer."

## Wolfberry

from page 10

### The Price Is Right

There's another key factor at work in this big play – the money.

"At the start of 2000, oil was about $20 a barrel," Henry noted. "Because it went up, we could afford to implement these huge fracturing techniques where we're fracturing these 10,000-feet-deep vertical wells with a million gallons of water.

"When this began, the cost to drill and complete a well was $700,000, and now it's $1,700,000," he said. "This is mainly due to increased costs, such as more fracturing stages and adding more Wolfcamp and other formations.

Plays such as this are a big deal for the players and for anyone who uses anything even remotely related to oil, i.e. everyone.

"There will be a million acres or more involved in this play," he predicted. "If it's all drilled out at 40-acre spacing, it should recover about three billion barrels of oil.

"The U.S. Geological Survey said it's the largest discovery in the last 50 years in the Permian Basin."

Henry gave kudos to Dennis Johnson, president of the company when they began pursuing the Wolfberry, noting how much he encouraged everyone.

In fact, the company's engineering manager, the late Van Temple, coined the name Wolfberry in 2002.

*New targets being tapped*

# ‘Blended Plays,’ Technology Awakened Permian

By LOUISE S. DURHAM, EXPLORER Correspondent

Operators’ eyes tend to light up like Christmas trees when talking about the Permian Basin, located in west Texas and southeastern New Mexico.

The basin encompasses an area about 260 miles wide and 300 miles long. Major subdivisions include the Midland, Delaware, Pecos and Val Verde basins along with the Central basin platform, Ozona Arch and the northwestern, northern and eastern shelves, according to the U.S. Geological Survey.

The basin once was covered by the Permian Sea, which was hindered by a restricted outlet when it began to recede. The resulting inland sea evaporated over time in the hot dry locale.

This ultimately led to formation of thick deposits of mineral-rich sediment, creating one of the world’s most productive oil regions.

The “USGS Assessment of Undiscovered Oil and Gas Resources of the Permian Basin Province of West Texas and Southeast New Mexico 2007” report estimated a mean of 41 Tcf of undiscovered natural gas and a mean of 1.3 Bbls of undiscovered oil in the province. Undiscovered natural gas liquids tallied a mean of 1.0 Bbls

Following the initial commercial well discovery in the Permian Basin in 1921 at Westbrook Field in Mitchell County, Texas, exploration and drilling took off. The ensuing production over the years ultimately peaked about two million b/d in the early 1970s. (See related story, page 16.)

The major companies gradually moved on to bigger opportunities, oil prices continued to do their usual cyclic thing, and the Permian’s position as Oil Central became a mere memory.

The Permian Basin rig count reportedly tallied a mere 43 wells in 1999, suggesting the once-roaring giant had been left for dead.

Fast-forward to today, and there’s a virtual beehive of activity in the basin.

The Permian’s cumulative production of more than 30.4 billion barrels through 2000, principally from formations ranging in age from Ordovician through Permian, clearly is on the upswing.


*Discovery well at Yates field in the Permian Basin.*

## It’s No Secret

Beneath this mostly barren land there’s a whole lotta bubblin’ crude that’s being produced, in large part from unconventional plays that often include long-produced conventional reservoirs as well.

In March the basin rig count had soared to 470, according to the *Midland Reporter-Telegram*.

The giant has been resuscitated.

Various strategies, both old and new, are being implemented to rev up oil and liquids production in the current plays:

- Waterflooding has long been successfully applied to reservoirs in the Permian. Ditto for carbon dioxide injection using $CO_2$ supplies moved via pipeline from the Sheep Mountain storage facility in Colorado and Bravo Dome in New Mexico. This process is said to produce 25 percent of the basin’s production.
- Horizontal drilling is increasingly being applied, although many new wells tend to be vertical as in the past. Target zone geology – and cost – rule in this instance.
- Drilling to greater depths below known producing intervals has yielded increased production in numerous instances.
- Multi-stage hydraulic fracturing in both horizontal and vertical wells is key to much of the current successes.

Deeper drilling is responsible for whole new plays, which have taken on a sort of kitschy industry-invented nomenclature. For example, when operators in the long productive Spraberry sandstone opted to go deeper to the packed-limestone Wolfcamp, suddenly there was a “Wolfberry” play, owing to commingling production from these zones along with the

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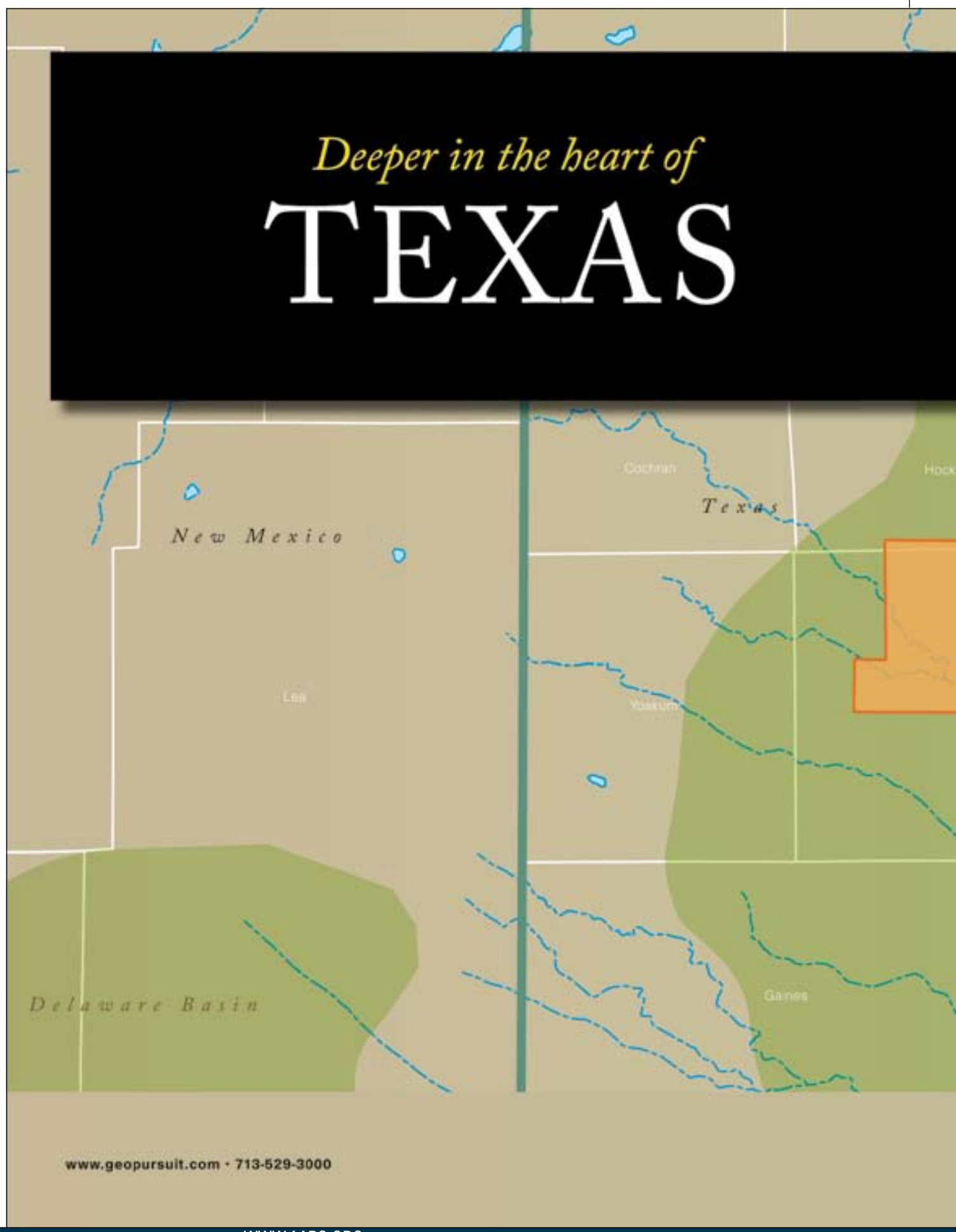

Continued from previous page

intervening Dean formation.

It gets even funkier, e.g., Strawberry (Spraberry and the deeper Strawn) and Wolfbone (Bone Spring and underlying Wolfcamp). The Strawn occurs directly above yet another deeper drilling target, the lowermost Pennsylvania Atoka formation.

In other words, these relatively new plays in general are a result of drilling into and beyond a specific producing zone to deeper hydrocarbon-bearing intervals and combining production.

These may be conventional reservoirs or unconventional. For instance, the widely drilled Spraberry is a tight sand overall with hydrocarbon-bearing shale zones, as well as isolated sandstone lenses that are conventional pay zones.

The key to the Wolfberry play successes is said to be the ability to use multi-stage fracturing on multiple zones in vertical wells and commingling these. The success of the wells can be attributed to more fracture stages into deeper wellbores rather than the size of the fractures, according to Tim Dove, president and COO of Pioneer Natural Resources, the Spraberry's largest leaseholder, driller and producer and a major player in the Wolfberry/Wolfcamp.

### Going Out in the Cline

Horizontal drilling appears to be providing a lot of bang for the buck in varying locales, such as the relatively new Bone Spring shale play (often dubbed Avalon/Bone Spring) in the Delaware Basin in far west Texas and extending into southeastern New Mexico.

Laterals also have been drilled into the Cline formation to the east in Glasscock County where the Spraberry starts to thin, and vertical wellbores ordinarily have tapped the Wolfcamp on the way to deeper zones, such as the Cline, Fusselman and Strawn.

The formerly low profile Cline shale, equivalent to the Cisco, has captured the attention of Tulsa-based Laredo Petroleum and, more recently, other operators.

Laredo's Permian activity is centered on the basin's eastern side about 35 miles east of Midland, Texas, which has long been dubbed capital of the Permian Basin.

The company's production/exploration fairway is about 20 miles wide and 80 miles long. In 2011, it drilled 262 wells (234 operated) on its Permian Basin assets with a 100 percent success rate on the 239 wells that were completed during 2011.

"The overall Wolfberry interval, which is the principal focus of our vertical drilling activities, is an oil play that also includes a liquids-rich natural gas component," said Laredo founder, chairman and CEO Randy Foutch, an AAPG member.

"Prior to our purchase of Broad Oak, the exploration and drilling efforts in the southern half of our acreage block were centered on the shallower part of the Wolfberry," he said. "But the emphasis in the northern half has always been on the deeper intervals, including the Wolfcamp, Cline shale, Strawn and Atoka formations.

"We have identified significant potential throughout our total acreage block for the entire Wolfberry interval from the shallow zones to the deepest," he noted.

Consequently, the company expanded its drilling program to include a horizontal component targeting the Cline and Wolfcamp shales.

"Our Cline shale drilling began after we conducted an extensive technical review, including whole core analysis and single zone testing in vertical wells," Foutch said. "We believe the Cline shale exhibits similar petrophysical attributes and favorable economics compared to other liquids-rich shale plays, such as in the Eagle Ford and Bakken shale formations.

"We have acquired 3-D seismic data to assist in fracture analysis and the definition of the structural component within the Cline shale," he added.

Eighteen wells were drilled as part of the company's Cline drilling program in 2011, and Laredo had two horizontal rigs drilling in the program at year-end. Efforts are under way to optimize well performance according to lateral length, fracture density, proppant amounts and pumping rates.

Laredo also has completed six horizontal wells in the Wolfcamp shale.

"This is all very fast moving," Foutch commented. "No one was talking about horizontal Wolfcamp even 18 months ago.

"We think there will always be vertical drilling in the Wolfberry, but the results in the horizontals are such that you'll see expanding horizontal drilling activity,.

"We were the only ones doing much Cline work until maybe six months ago, and now the industry has picked up on it," Foutch continued. "We anticipate it will turn out to be a pretty spectacular world class horizontal oil shale target."

Permian player Devon Energy recently announced an 18 percent increase in planned E&P spending this year, which includes $350 million budgeted for the Cline shale.

### A Major Development?

The Permian Basin has long been heavily populated by smaller companies like Laredo, veteran-player Henry Petroleum and the like, which adds to the region's allure. Concho Resources snapped up much of Henry's Permian assets in 2008 and has become a major producer in the basin. Concho is among the players showing interest in the Cline.

Ironically, some of the industry heavyweights also are finding the basin to be irresistible, e.g. ExxonMobil (via its purchase of XTO Energy) and ConocoPhillips. Independent Occidental Petroleum continues to be the basin's largest leaseholder and oil producer, where about two-thirds of its production comes from EOR projects based on $CO_2$ injection.

At the end of the day, the Permian Basin's current oil and associated liquids "boom" (yes, you can say it) can be attributed in large part to the huge disconnect between crude oil and natural gas prices.

The now-available technology to economically stimulate the wells, especially long reach horizontals, plays a key role in making this possible.

*Historical Highlights is an ongoing EXPLORER series that celebrates the "eureka" moments of petroleum geology, the rise of key concepts, the discoveries that made a difference, the perseverance and ingenuity of our colleagues – and/or their luck! – through stories that emphasize the anecdotes, the good yarns and the human interest side of our E&P profession. If you have such a story – and who doesn't? – and you'd like to share it with your fellow AAPG members, contact Hans Krause at historical.highlights@gmail.com.*

# Permian: A Basin Full of Stories

BY J. MICHAEL PARTY

Even from the beginning, the discovery well gave a hint that the Permian Basin was going to be a major oil province. That well was the Santa Rita #1 – Santa Rita, the patron Saint of the Impossible.

There are times when exploring and operating in the Permian Basin certainly needed a patron Saint.

To fully understand the history of oil discoveries in the Permian Basin, one needs a broad understanding of its geology.

The area encompassing the Permian Basin, from Ordovician through Mississippian time, was a large intracratonic basin, the Tobosa Basin, with the deepest part located just to the west of Midland.


PARTY

Uplift at the end of the Devonian and early Mississippian exposed some sections to erosion.

Shelf margins developed in the Mississippian, and with the collision of the South American plate with the North American plate at the end of the Mississippian into the Wolfcamp, tectonic activity started and the Central Basin Platform was uplifted in the center of the Tobosa Basin, creating the Midland Basin to the east, the Delaware Basin to the west and the Val Verde Basin to the south.


The uplifting of the Central Basin Platform during the Pennsylvanian and Wolfcamp times were conducive for the growth of reefs and building shelf margins on the edges of the Delaware and Midland basins, with the central part of each basin being filled with clastic and deep water deposits during this period.

The last major geological development was the Permian Reef Complex, which developed rimming the Delaware Basin.

## The Sisters Knew Best

The early exploration efforts in the Permian Basin started in Mitchell County on the basin's eastern shelf, with a 10 barrel-a-day well that opened the Westbrook Field in 1920.

This set off a frenzy of activity in the basin looking for the "Big Lime," or as we know it today, the Grayburg/San Andres formation. This became a very attractive play, especially since the University of Texas Land System had large amounts of leases promoters could get cheap for drilling.

In 1921 the Santa Rita #1 was drilled at a place called Texon – and many stories have been told as to why this location was picked.

One story is that they had to spud a well by midnight, so they offloaded the drilling equipment from a train and were taking it to the location when a wheel broke on the horse drawn wagon. Running out of time, they set up the cable tool rig and drilled the water well to extend the lease.

The more accepted story is that Hugh H. Tucker, a self-taught geologist, had mapped a structural anticline there nine miles wide and 30 miles long.

The Texon Company, headed by Frank Pickrell, decided that instead of drilling the location two miles from the train track they would drill 100 feet from the tracks for convenience. The water supply well was drilled to save the leases and then the Santa Rita was spud in August 1921.

Pickrell reportedly climbed to the top of the rig and sprinkled rose petals that were given to him by a group of Catholic Sisters from back east, who had invested in the drilling deal and told him to christen the well after the patron Saint of the Impossible, Santa Rita.

The Santa Rita #1 blew onto the scene in May 1923. It was possible.

As a side note, story has it that the original location recommended was a dry hole. Maybe there was some divine intervention from the Sisters?

## New Methods Arrive

Early activity in the Permian Basin was mostly confined to where surface mapping, using Cretaceous outcrops, could give indication where structures were in the subsurface.

Transcontinental in 1923 sold a deal to the Ohio Company, based on defined surface structures; to earn an interest they had to drill three wells within three large

See **Permian Basin**, page 18

*Editor's note: J. Michael Party is vice president for Exploration Reliance Energy Inc., in Midland, Texas and served as president of both the DPA and the Southwest Section, and was AAPG secretary. He received the 2000 AAPG Distinguished Service Award.*

# Permian Basin

from page 16

lease blocks in Crockett, Upton and Pecos counties. It was said that no oil existed west of the Pecos River, and there are stories of people having stated they would drink all of the oil found west of the Pecos River.

(This could explain why the Ohio Company drilled all three wells on the leases east of the Pecos.)

After the drilling of three dry holes, these leases were surrendered. The leases west of the Pecos were about to expire when a geologist named Frank Clark convinced the Ohio Company to let its subsidiary, the Mid-Kansas Oil Company, drill the feature west of the Pecos River.

On Oct. 28, 1926, the discovery well for the billion barrel Yates Field announced to the world that the Permian Basin was a major oil and gas producing area.

In 1928 the deepest well in the world was drilled in the Big Lake field to a depth of 8,525 feet. This well was productive in the Pennsylvanian and the Ordovician, opening up a whole new round of exploration.

*Santa Rita #1*

With these deeper targeted formations – and since large parts of the Permian Basin are not conducive to surface mapping – the use of geophysical methods such as gravity, magnetic and seismic could be used to identify structural features for drilling.

Not coincidentally, several stories were published about windows being broken in West Texas towns by seismic crews doing surveys with dynamite.

In 1938, Gulf drilled a well into the large Pennsylvanian Reef complex known today as the Horseshoe Atoll. Even after testing the Pennsylvania section and making oil and water, Gulf did not understand what it had drilled and plugged the well with no further exploration in the area. Humble drilled 200 feet of reef while drilling an Ellenberger (Ordovician) test and never tested its well in the reef, which is now within the Kelly Snyder oil field.

The first discovery in the reef came in 1948 by Sun, and in 1950 Standard re-entered the Humble well and extended the now-developing Kelly Snyder Field.

The first commercial producer was made in the Spraberry Formation within the Midland Basin in 1948. The Spraberry became a promoter's dream – it was almost impossible to drill a dry hole and it covered over 800,000 acres, which is almost the entire Midland Basin.

The Spraberry formation would see a lot of drilling – and become the engine for a lot of personal wealth among small operators in Midland, as well as the foundation for the beginning of companies such as Pioneer Natural Resources.

Pictures and stories abound of celebrities investing in Spraberry wells and promoters using photos of scantly to unclothed women in promotional material, while the Spraberry got the moniker of the largest non-commercial oil field in the world.

## Good Times, Bad Times

In the 1950s, the basin saw lots of drilling for both the Pennsylvanian and the Devonian, with large fields being discovered in both of these formations.

The Dora Roberts field, located south of Odessa, was leased by Cities Service Oil, based on the fact it had a large structural field to the north (Headlee) and to the south (Pegasus) and, best of all, it was available for leasing.

With all of this drilling and the associated gas production, stories are told of driving in the Permian Basin on the darkest of nights without headlights as the skies were lit by the flares from all the oil production.

As Midland and the Permian Basin saw major companies leave the area in the 1950s, the Permian was to set yet another depth record in the late '50s, when the Phillips University EE #1 was drilled to 25,340 feet. This set off the next big round of exploration, this time not for oil, but for gas.

Large gas fields were found in the Delaware and Val Verde basins – one of the largest was the Gomez field. Early seismic showed this feature, but because of the depth and overall size – 10-20 miles across – it was hard for anyone to believe it was as large as the early seismic showed. Most lines came off of the platform and stopped 5-10 miles onto the structure and did not show the faulting down into the basin.

Several of these deep gas fields on the early 2-D seismic would not show the crest of the anticline. Geologists and geophysicists would make structure maps using the dips from dipmeters on the flanks of the structures if available or take seismic dips from 2-D lines and create structure maps.

After yet another bust in the early 1980s – with most major companies pulling out of the Permian Basin – the late '80s and early '90s were dominated by small start-up companies (i.e. geologists, engineers and landmen who became unemployed in the bust) using 3-D seismic to hunt for smaller targets in both the deeper Devonian and Ellenberger as well as the pinnacle reef in the Pennsylvanian.

Most experts were writing off the Permian Basin – it had seen its better days and was just an old mature basin without much more to offer. The major companies that were still active in the basin were managing older fields and trying to get as much oil as they could out of them as they could through secondary and Tertiary recovery methods.

See **Historical Highlights**, page 42


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*TV program also becomes a teaching resource*

# Series Takes Geology Into Living Rooms

By SUSAN R. EATON, EXPLORER Correspondent

In 2010, Nick Eyles, professor of geology at the University of Toronto, was host for the Canadian Broadcasting Corporation's five-part TV documentary series called "Geologic Journey – World."

A first-time TV-show host at that time, Eyles never could have predicted that the top-rated CBC-TV series – viewed by millions of Canadians – would swell the ranks of his first-year university geology course from 350 to over 1,000 students.

Created by CBC-TV's "The Nature of Things," Canada's premier science television program, "Geologic Journey – World" brought geology into the living rooms of Canadians, illustrating how geological processes and society are inextricably linked.

In conjunction with the television series, CBC-TV developed a teachers' resource guide, which has been incorporated into the science curriculum by 70 percent of Canadian high schools.

Telling the Earth's 4.5-billion-year story in a manner that both educates and entertains the general public is no easy task, according to Eyles, a geologist who specializes in glaciology, glacial geology and urban environmental issues. During a nine-month odyssey and geologic journey across every continent save Antarctica, Eyles and the TV crew visited 24 countries – narrowly escaping four volcanic eruptions and six earthquakes.

At ease in front of the camera during his first television role, Eyles was confronted by hostile teenagers brandishing AK-47s in the East African Rift Valley.

In Indonesia, he interviewed a sultan who claimed to be the intermediary between a volcano and his people. Equipped with a gas mask, Eyles braved toxic gases to peer into the guts of a seismically active volcano with a recent history of death and destruction.

"We take viewers on a planetary journey to meet a lot of interesting people living in geologically active areas," Eyles said. "I see the TV series as a way to reposition geology in the broader community.

"You're changing peoples' lives," he added, "and they'll never see the planet the same way."

## A Story to Tell

According to Eyles, the Earth's history is the story of the oceans.

Photos courtesy of Nick Eyles

*Canadian geology professor Nick Eyles, finding ammonites from Jurassic Tethys Ocean marine sediments in the Khali Gandaki Valley, Nepal, that were caught up between the collision of India and Asia during the Himalayan Orogeny – and sharing the experience with his TV audience.*

EYLES

Canadian geology professor, documentary filmmaker, TV host and author Nick Eyles received the AAPG Geosciences in the Media Award during the opening session of the recent AAPG Annual Convention and Exhibition in Long Beach, Calif.

The award is given in recognition of significant journalistic achievements and contributions toward the public understanding of geology and energy resources.

"It's a story of oceans opening, maturing and dying," he said. "The Earth is comprised of super-continents with 400- to 500-million year cycles – they come together and they break up – and geologists have recognized three cycles in the past record."

According to Eyles, the planet is half-way through its latest cycle of tectonic plate reconstruction.

"Geologic Journey – World" followed on the heels of "Geologic Journey – Canada," which aired in 2007.

Eyles, the chief scientific adviser to "Geologic Journey – Canada," also has authored several geology text books, "Ontario Rocks," "Canada Rocks" (with AAPG member Andrew Miall) and "Canadian Shield – The Rocks That Made Canada."

Toronto-based Michael Allder was the executive producer of "The Nature of Things" from 1997 to 2010. "It was a huge feat to film these two television series," said Allder, who also was the executive producer of "Geologic Journey – World" and "Geologic Journey – Canada." "The extraordinary power of nature is humbling.

"The challenge was how to tell this geologic story, and how to build an interesting narrative," he said. "It's far easier to tell stories about four-legged animals."

In order to captivate the audience's attention, Allder's crews filmed the Earth from a helicopter-mounted camera; on the ground, they used jibs and cranes to showcase landscapes and geological features; and in the studio, they combined video with state-of-the-art 2-D and 3-D animation, which lent itself to time simulations.

"I think that the audience is there," Allder said, "it's just a matter of respecting their intelligence."

## Around the World

In "Geologic Journey – World," Eyles described the perfect storm for Egypt's original "Arab Spring." During Ancient Egypt, climate change caused droughts and sporadic flooding of the Nile, precipitating social upheaval and the first Arab uprising against the Pharaohs and high priests.

According to Eyles, many geological terms – including obsidian, opheolite and basalt – originated in ancient Egypt and were later incorporated by the Romans and Greeks.

In the hunt for gold deposits, Egyptian Pharaohs paid their teams of geologists in beer.

Eyles pointed to the world's first geological map, drawn 3,050 years ago by geologists of ancient Egypt. The map, sketched on papyrus paper for Ramses IV, showed a meandering river in the Wadi Hammamat in the Eastern Desert of Egypt.

"This was truly the map that changed

See **Eyles**, page 22

*Up close and personal: Eyles took TV viewers on a journey to the volcanic regions of Chile, including an intimate visit to the Chaiten volcano.*

*The big country: One segment of "Geologic Journey – World" gave Eyles the chance to show viewers the spectacular setting of the Khali Gandaki Valley, Nepal.*

*Preparing for an aerial shoot with a high definition gyro-stabilized camera mounted on the nose of their helicopter. Eyles, left, next to Michael Allder, the series executive director.*

*Out of Africa: Eyles' audience was treated to an aerial look at the stretching of the African plate to form long, fault-bounded blocks along the East African Rift west of Nairobi.*

## Eyles
from page 20

the world," Eyles said, playing off of Simon Winchester's best-selling book, "The Map that Changed the World," about William Smith who produced the first comprehensive geological map of the United Kingdom in 1815.

Traveling further back in human and geological time – to the East African Rift – Eyles described early man, *Homo habilus*, as "a handy-man and perhaps the world's first geologist."

Added Eyles: "To make a tool, you've got to know your rocks."

Jumping continents to the New World, Eyles explored the Ring of Fire and Chile's Nazca plate, a subduction zone that's consuming dying oceanic crust and converting it to continental crust.

"When you melt oceanic crust and add sea water and sediments," he said, "you create andesite with highly explosive eruptions."

Eyles visited the Chaiten Volcano located near the Chile's Pacific Coast – seismically active, Chaiten erupts with regularity, spewing pyroclastics and thick, viscous lava flows that destroy nearby villages.

Equipped with a protective gas mask, Eyles peered into Chaiten's caldera, noting that the volcanic plug was just a year old and represented "a catastrophe in the making."

Interviewing Chileans who lived in Chaiten's shadow and path of destruction, Eyles asked: "Why do you continue to live here?"

After a thoughtful pause, one Chilean man answered:

"This is just as dangerous as living in a big North American city."

### Engaging Students in Geology

"Geology is having a hard time recruiting students from high school," explained Eyles, who points to the game-changer in the science curriculum associated with "Geologic Journey – World."

"Geology gets a bad rap in the media, but mining and the oil and gas industries are fundamental to our society," he said.

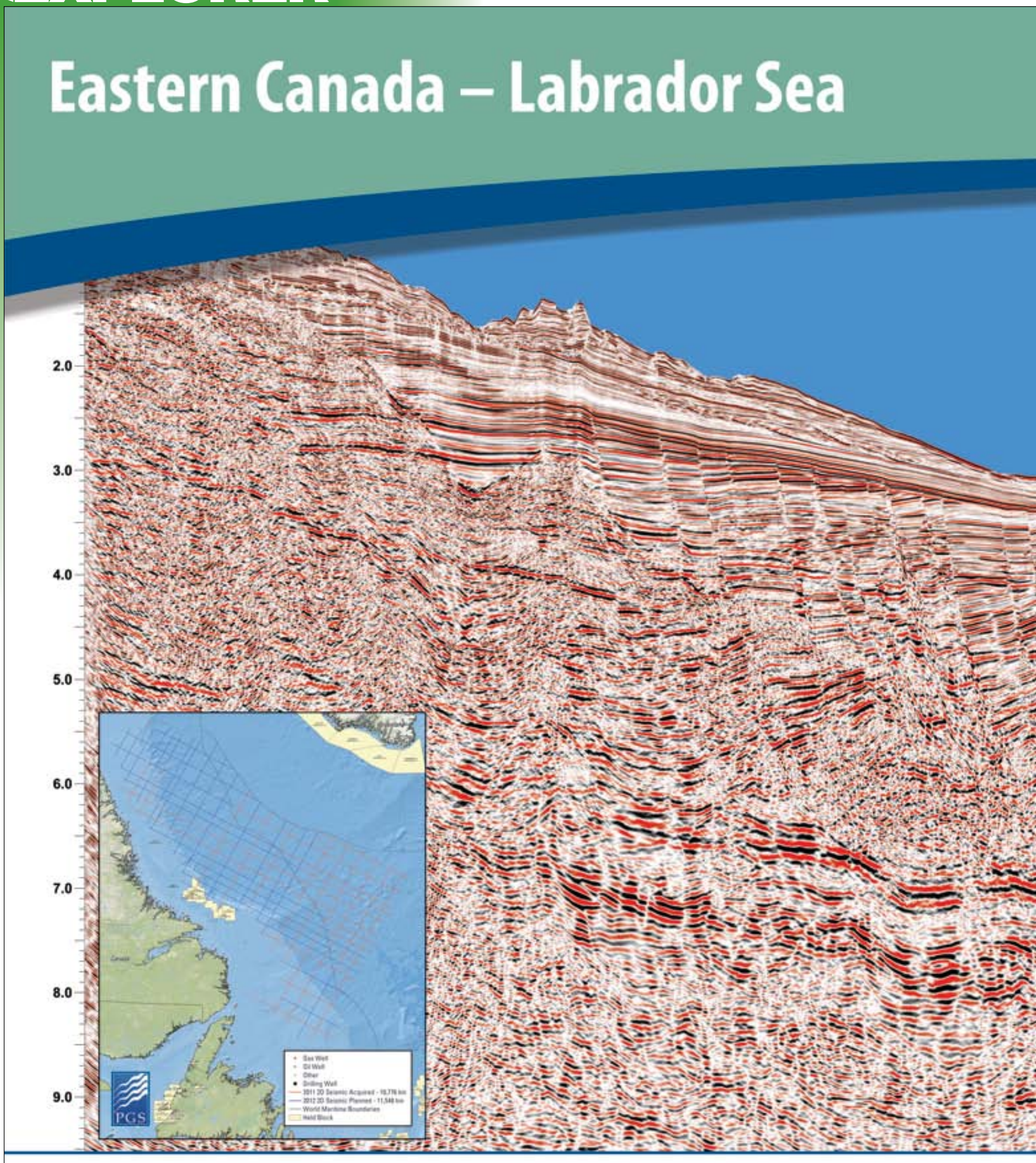
"CBC-TV no longer looks at geology as a source of society's problems," he added.

Eyles has restructured the teaching format for his first-year geology course, closely following the "Geologic Journey – World." Given the urban and multi-cultural make-up of today's student population, he said the television series offers a new way to teach first-year geology at university.

"We go on a world trip during the university lecture series," Eyles said. "The students like it because you've got people who live in these risky geological areas, and it puts a human face on geology.

"Risk is relative," he added. "The audience (including his university students) isn't listening to the professor – rather, they're listening to the stakeholder telling his story."

# Eastern Canada – Labrador Sea

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- Concurrently generating a sequence stratigraphic and play fairway analysis interpretation project

WASHINGTON WATCH

# Geology a Factor in Fracturing Regs

By AARON RODRIGUEZ

*Editor's note: Aaron Rodriguez is the AAPG/AGI spring intern at the American Geosciences Institute. He is a student at Southern Utah University in Cedar City, Utah.*

Geology's role in unconventional natural gas production (via hydraulic fracturing and directional drilling) often is overlooked by the public, but it is a key factor in ensuring that natural gas production is efficient, economic and environmentally responsible.

Not all shale gas formations in the United States are created equal, so it is important that the public understands the differing geology and the advancing technology, while regulators provide appropriate protections that the public has confidence in.

Last month's (April EXPLORER) Washington Watch column compared the rules and regulations for hydraulic fracturing in different states. This month, for comparison purposes, the geology and hydrology of the Marcellus Shale formation, Barnett Shale formation and Wind River Basin are paired with some of their respective state regulations.

Regulatory differences are noted in the "Fact-Based Regulation for Environmental Protection in Shale Gas Development 2012," The Energy Institute, by AAPG member Charles G. "Chip" Groat and Thomas W. Grimshaw.


RODRIGUEZ

> **It is essential that the geology, hydrology and meteorology be considered when devising or revising regulations.**

## The Geology

▸ The **Pavillion Field** of Wyoming's Wind River Basin is extracting natural gas from shallower reservoir rocks (primarily Upper Cretaceous to Eocene sandstones with interfingering conglomerates and mudstones) and deeper source rocks (primarily Cretaceous shales) at depths from 1,000-5,000 feet. There are no significant impermeable layers above the source rocks, so gas can migrate.

▸ The **Barnett Shale** of the Fort Worth Basin in Texas is a classic and immense source of natural gas production. Initially gas was extracted from shallower reservoir rocks (primarily Pennsylvanian conglomerates) and now with hydraulic fracturing, gas is extracted from source rocks (primarily Mississippian shales) at depths of 6,500-8,000 feet. Overlying relatively impermeable layers of limestone help to constrain the gas to the reservoir and source rocks.

▸ The **Marcellus Shale** in the Appalachian Basin, extending through multiple states, is a relatively new play. The source rock, Middle Devonian Marcellus Shale, is overlain by more impermeable shales and limestones, which helps to constrain the gas until hydraulic fracturing is used to extract it at depths of 4,000-9,000 feet.

Given the general geology of these basins, it is clear there is little possibility of any groundwater contamination in the Barnett or Marcellus Shale from hydraulic fracturing because:

✓ The sources are deep.

✓ There are impermeable capping layers.

✓ The aquifers used for water consumption are distant.

There is a greater possibility of groundwater contamination in the Wind River Basin, because there the reservoir and source rocks are shallower and closer to aquifers being used for water consumption. Contamination would only be possible, though, through improper hydraulic fracturing operations, because regulations are in place to protect groundwater.

## Casing

▸ Regulations in **Wyoming** require casing depths for hydraulic fracturing drilling to be "Below all known or reasonably estimated utilizable groundwater," as regulators understand that usable aquifers and reservoir rocks occupy the same geologic units in a sometimes complex way.

▸ Regulations in **Texas** require a casing depth "set and cement sufficient surface casing to protect all usable-quality water strata."

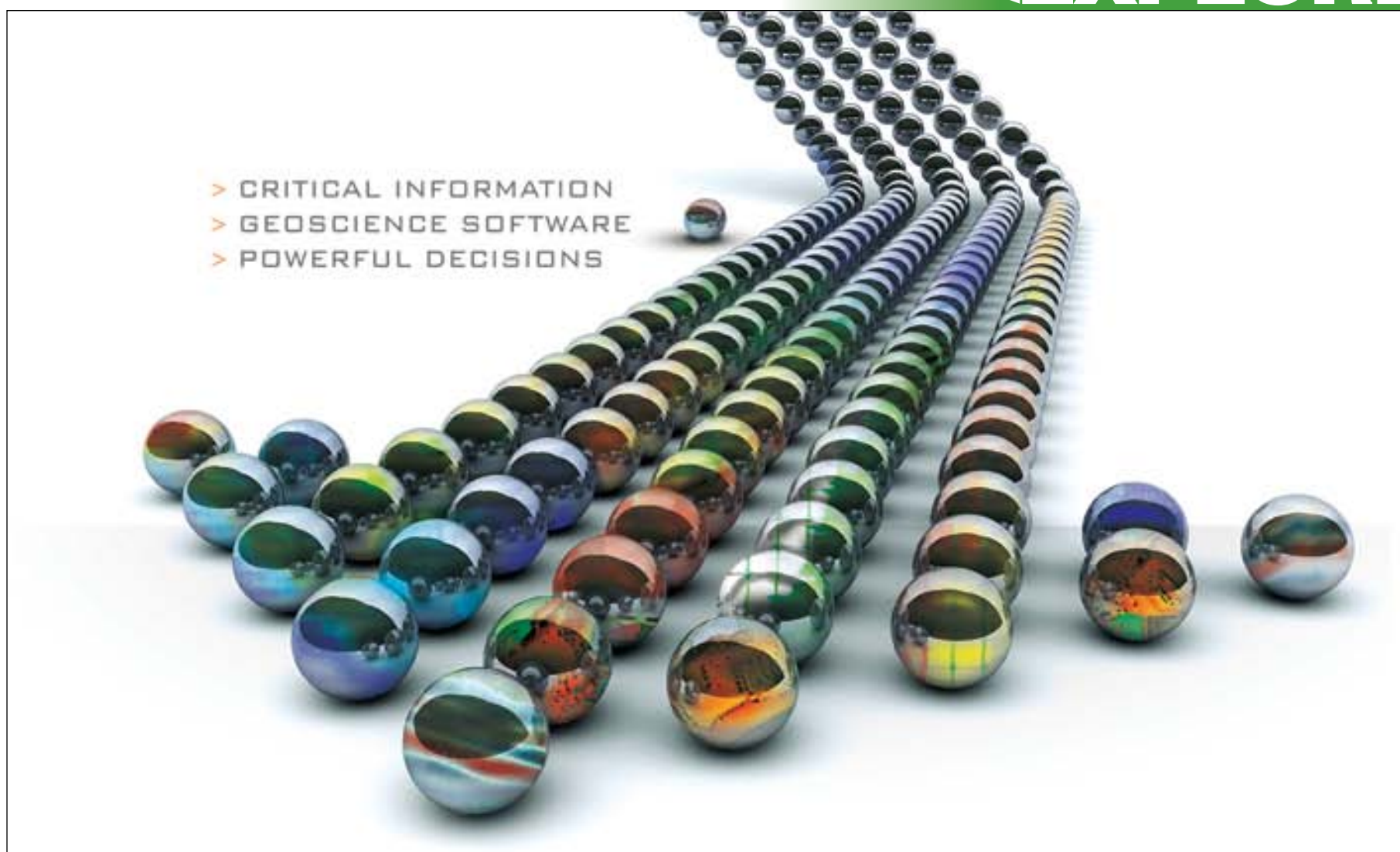
▸ Regulations in **Pennsylvania** and **New York** call for casing depths at 50-100 feet or into "bedrock," "whichever is deeper," recognizing that usable aquifers are shallow and the bedrock can serve as an impermeable barrier without casing to reach the much deeper source rocks.

While groundwater contamination from hydraulic fracturing in these three basins is unlikely, there is greater public concern about the amount of water needed for hydraulic fracturing and how to store flowback waters.

## Source Water

▸ Regulations regarding the amount and source of water used in hydraulic fracturing for the **Marcellus Shale** varies,

See **Fracturing**, page 28

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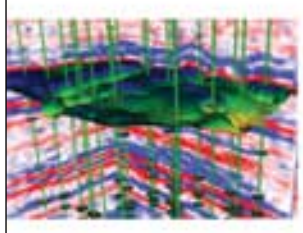
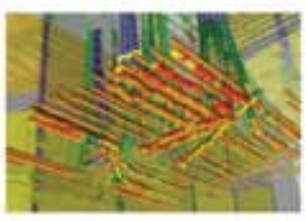
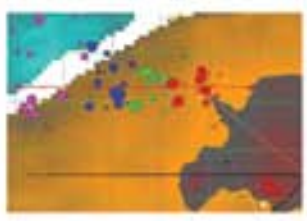
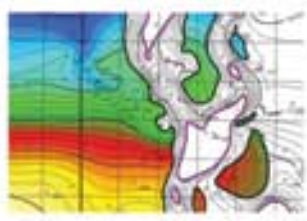

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# URTeC 2013: Major Joint Venture Launched

Three of the world's leading oil and gas professional societies will launch the Unconventional Resources Technology Conference (URTeC) Aug. 12-14, 2013, at the Colorado Convention Center in Denver.

A joint venture between AAPG, the Society of Petroleum Engineers and the Society of Exploration Geophysicists, URTeC will bring together for the first time the key disciplines and technologies engaged in the development of North American unconventional resource plays.

"URTeC will offer multidisciplinary technical and applied science sessions of broad interest," said SPE President Ganesh Thakur, "and the accompanying exhibition will showcase cutting-edge developments in applications such as horizontal drilling, fracture technology, testing, logging and geophysics."

"Successful resource plays demand a multidisciplinary approach; it's the way we're all working," said SEG President Bob Hardage. "Geology, geophysics and engineering are essential components, but individual expertise is no longer enough. In order to effectively develop these resources, our members must collaborate across disciplines. URTeC is designed to support that objective."

The URTeC concept was developed with direction from an industry advisory group led by representatives from Chesapeake, Devon, Anadarko, Shell, Statoil, ConocoPhillips, Schlumberger and many others.

"The oil and gas industry has been encouraging AAPG, SPE and SEG to collaborate in this area for some time," said AAPG President Paul Weimer. "Although our societies frequently work together, URTeC may rank as our most significant joint venture in the United States since we all joined the Offshore Technology Conference in the late 1960s."

Collectively, the three societies represent more than 170,000 members worldwide.

Recruitment for the URTeC technical program committee is under way. For more information and/or to participate on the committee visit the URTeC website at www.urtec.org.



## Fracturing
from page 26

based on different watersheds, water commissions and states.

The toughest restrictions are enforced by the Susquehanna River Basin Commission, which requires approval for any surface or groundwater used in hydraulic fracturing.

The Delaware River Basin Commission requires approval for any surface or ground water in excess of 100,000 gallons per day. The restrictions are strict because there are large population centers and large agricultural communities that tap into surface and groundwater resources.

- In Texas, regulations require disclosure of the total volume of water used in the hydraulic fracturing, but not the source of the water.

The **Barnett Shale** play is next to Dallas-Fort Worth, and there is concern about depleting the main aquifer used for drinking water in the area, so tracking water use will help with water resource management.

- Regulations for **Wyoming** mandate that the source and depth of water supply wells within one quarter mile of the drill site be identified before drilling, but no reporting of where and how much water is used for the hydraulic fracturing is required.

Again the primary concern is to avoid any possible contamination of local water wells for a relatively small population of water users.

### Flowback Water

The storing of flowback waters depends to some extent on the hydrology and climate of the three regions.

- In the humid East, regulations tend to be stricter because surface waters are used for drinking, and water in storage pits does not evaporate as quickly as in arid regions.

The strictest regulations in **New York** require flowback water to be stored in a tank.

**Pennsylvania** has the second strictest regulations requiring that a high-grade seal line the bottom of any above ground pits.

- **Wyoming** requires tanks only where groundwater is less than 20 feet below the surface – otherwise an operator can store the flowback water in a pit with a specific grade liner.
- **Texas** requires operators to prevent pollution of surface or ground waters from storage pits, but has no specific regulations for the pits.

* * *

As unconventional gas production (via hydraulic fracturing and directional drilling), which is common in the arid West and semi-arid Midwest, becomes more prevalent in the humid East, it is essential that the geology, hydrology and meteorology be considered when devising or revising regulations.

Generating energy resources while protecting water resources benefits from sound geoscience, but geoscience is not the only factor used in devising oversight policies.

Population density, economics, other industries, political boundaries, social issues and land and water use patterns are contributing factors that cannot be ignored.

*The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Corporation, Calgary, Canada, and a current AAPG-SEG Joint Distinguished Lecturer. This month's column deals with synthetic seismograms.*

# Geological Factors Can Lead to Poor Matches

By BOB A. HARDAGE

The traditional tool interpreters have used to establish correspondences between subsurface stratigraphy and surface-measured seismic data has been synthetic seismograms calculated from well log data.

In some instances, however, it is difficult to create an optimal-quality match between a synthetic seismogram and seismic data.

We consider here possible geological reasons why poor matches sometimes occur – particularly in stratigraphic intervals where rock properties change laterally.

* * *

Consider the stratigraphic condition diagrammed on figure 1. Here a well penetrates a sand body that has a lateral dimension less than that of the dominant wavelength λ of an illuminating seismic wavefield.

Because sonic and density log data acquired in the well indicate a change in acoustic impedance at the top and base of the sand unit (interfaces A and B), a synthetic seismogram calculation using these logs will create a seismic reflection at the top and base of the sand.

However, surface seismic data will not show such reflection events, because the lateral dimension of the sand body is too small to create a reflected wavefront. For a seismic wavefield having a dominant wavelength λ, the sand body along this particular profile is a point diffractor, not a reflector.

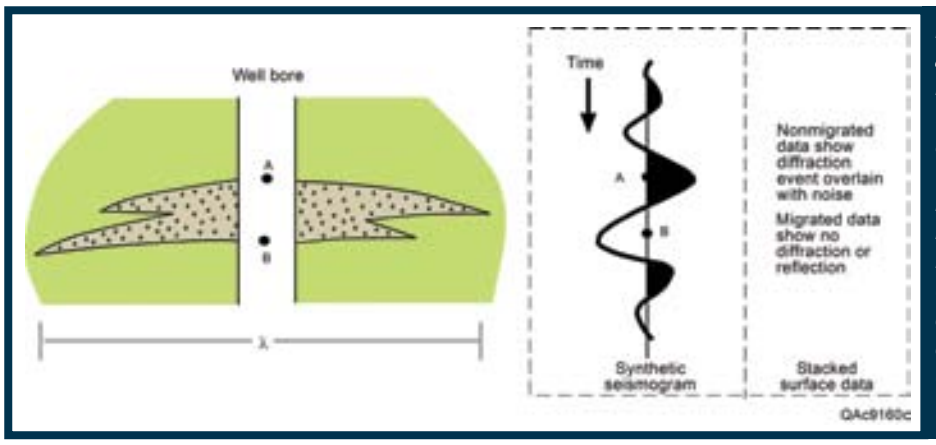



*Figure 1 – A stratigraphic condition illustrating why a synthetic seismogram response may not look like surface-recorded seismic data. The width of the sand body is approximately the same as the dominant wavelength λ of the illuminating seismic wavefield, thus the sand body is a point diffractor, not a reflector, and no seismic reflection event is present. Because log data acquired in the well measure rock properties extending only a meter or so from the wellbore, a synthetic seismogram calculated from these logs will indicate impedance changes at interfaces A and B at the top and base of the sand and show a bold reflection evens from these two interfaces.*

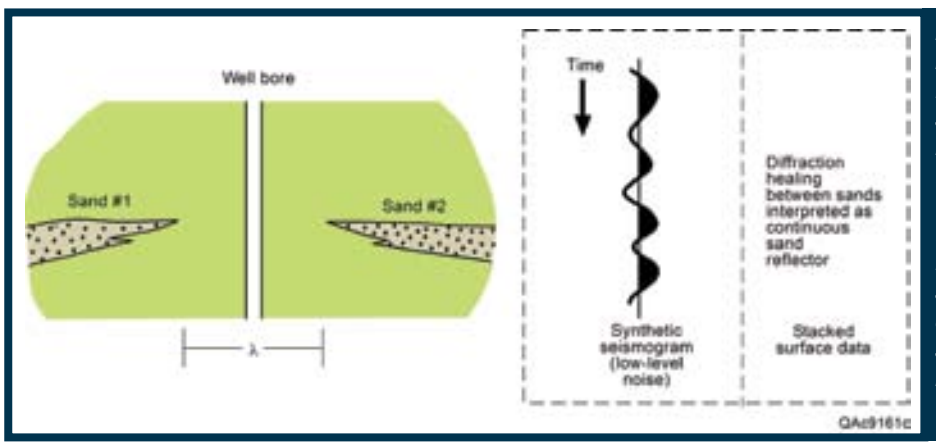



*Figure 2 – A second stratigraphic condition illustrating why a synthetic seismogram response may not match the reflection response seen in surface-based seismic data. The gap between the sand bodies is of the order of the dominant wavelength λ of the illuminating wavefield. Thus diffractions span the gap and tend to leave the impression of a continuous reflection event, even on migrated seismic sections. However, log data acquired in the well do not measure an impedance change, and a synthetic seismogram calculated from these logs will show no reflection.*

You may see a diffraction in unmigrated seismic data, but after the data are migrated the sand body probably would appear as only a mild amplitude variation on one or two data traces – and would be ignored by an interpreter.

The principle illustrated by this example is that a synthetic seismogram will imply a reflection should be at the depth of the sand body, but migrated seismic data would not. This difference exists, even though the log data are correct and the synthetic seismogram calculation is accurate, because log data measure rock properties within only a meter or so of a wellbore.

In contrast, a seismic wavefield averages

Continued on next page

*Editor's note: AAPG member Linda Doran is a teaching assistant at California State University, Northridge.*

# West Coast Student Expo Set

By LINDA DORAN

Just as California petroleum exploration and production are expanding, the AAPG-SEG West Coast Student Expo, held annually at California State University, Northridge, is gathering momentum.

The annual West Coast expo is one of six AAPG-SEG expos held each year, with this year's event set Oct. 11-13. (See box for other upcoming 2012 student events.)

Last year's Expo attracted 30 percent more students than in 2010, with the increase comprising mostly master's level students. Yet, even though the quantity and quality of participants is on the rise, a handful of industry participants have the applicants all to themselves.

"It's basically a gold mine of access to students," said AAPG member Terry Thompson, senior staff geologist with Chevron North America Exploration and Production. "One of the big advantages to Chevron is that most of our industry peers haven't really found out about it.

"I truly believe it's in the best interest of Chevron to have more companies there because that, in turn, will attract an even larger pool of high-quality candidates."

Chevron was one of the West Coast event's founding in 2008. Five companies – Aera Energy, Chevron, Occidental, Conoco Phillips, and Microseismic – sponsored the 2011 Expo. Past industry participants have included BHP Billiton, Encana, Exxon-Mobil, Schlumberger, Swift and Venoco.

Each year the venue has improved, drawing a higher caliber of students from a wider geographic area and a broader range of colleges, Thompson noted.

The 2011 student poster session was exceptional, he added – and AAPG member Cynthia Huggins, a geologist with Aera, agreed.

Southern California applicants represent a "wonderful mix of gender and culture that is just about to make it into the work force," Huggins said.

Overall, a total of 107 students registered for the event, representing 24 schools in nine states. They presented research posters, submitted résumés and met with industry representatives to discuss employment opportunities.

"I think it was a wonderful event," said AAPG Student/YP member Lisa Alpert, a doctoral student at the University of Southern California. "I got a job out of it. I met some people from Aera Energy and I recently started working for them. And it's all because of the Expo."

In a post-event survey, student participants gave high marks to the meeting facilities, food and refreshments, and a local hotel that offered discounted rates to those traveling to the event from outside the Los Angeles area.

Alpert offered advice for students interested in careers in the petroleum industry:

- Present typo-free posters about their research.
- Put some time and effort into giving engaging oral presentations.
- Bring résumés and present them in person, even though they may have submitted them electronically prior to the event.

"It took people by surprise that I had résumés to hand out," she said. "I was surprised that people were surprised."

Beyond receiving potential job offers, students benefit from talking with earth science professionals working industry, said Thompson. They get guidance regarding course direction, participation in the AAPG-sponsored Imperial Barrel Award competition and involvement in AAPG student chapters.

In a special luncheon ceremony, six participants won prizes for their poster presentations. Alpert took first place in the geophysics category, followed by AAPG Student members Chad Severson of UC-Riverside and Lee McAuliffe of USC in a tie for second place.

In the geology category, first place went to Scott Mata of USC and second place went to Elizabeth Seal of CSU Fullerton and AAPG Student/YP member Jozi del Angel of CSU Northridge.

For more information on the AAPG-SEG West Coast Student Expo and the other Expo events go to students.aapg.org/expo/index.cfm.

Two international AAPG Student Chapter events are planned for May:

- The first annual College Symposium of Petroleum Geology, Geophysics and Metallogeny, set May 22-25 at the Industrial University of Santander in Bucaramanga, Colombia. (www.simposiogeologiauis.jimdo.com)
- The third International Geosciences Student Conference, set May 29-31 at the Continental Hotel Belgrade, Belgrade, Serbia. (www.3igsc.com)

**Continued from previous page**

rock properties over an appreciable area having a diameter of the order of its dominant wavelength λ.

* * *

The reverse of this situation also can occur – that is, a synthetic seismogram can indicate no reflection is present at a depth where surface seismic data show a bold reflection.

A stratigraphic condition that could create such a discrepancy is illustrated on figure 2; here a well passes through a gap having a dimension of the order of λ between two laterally extensive sands.

Because log data acquired in the well indicate no impedance changes over the depth interval local to the sand bodies, a synthetic seismogram calculation will produce no reflection event. However, both migrated and unmigrated seismic data will show a reasonably continuous reflection event across the well position, with perhaps a slight amplitude anomaly at the well coordinate.

Again, the log data are correct, the synthetic seismogram calculation is correct and the seismic data are correct – yet the synthetic seismogram and the seismic data do not agree.

The difference is caused by the fact that log data measure geological properties over a distance of one meter or less, but seismic data respond to geological properties over a distance of several tens of meters.

If one-meter geology is significantly different from 50-meter and 100-meter geology, there often will be mismatches between synthetic seismograms and seismic reflection data.

*(Editor's note: Bob A. Hardage is senior research scientist at the Bureau of Economic Geology, the University of Texas at Austin. He was the past editor of Geophysical Corner, and is currently serving as president of SEG.)*

*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 domestic Sections. This month's column is by Joe Ejedawe, with Ejedawe and Partners Nigeria Ltd., in Warri, Nigeria, and immediate past Advisory Councilor for AAPG's Africa Region.*

# Nigeria Potential Waiting to be Tapped

By JOE EJEDAWE

Oil production in Nigeria started in 1958 after the discovery of Oloibiri oil field in 1956. Today Nigeria is ranked sixth in OPEC and fourteenth in the world in the league of oil producers, and has a reserve base of about 70 bboe.


EJEDAWE

All of Nigeria's productive capacity is from the Tertiary Niger Delta Basin, in which some 1,300 exploration wells have been drilled. While most of the onshore and shallow offshore concessions are held by multinationals under a joint venture (JV) agreement with a memorandum of understanding that guaranteed a profit to the operator depending on the price of oil, the deepwater concessions are held under various production sharing contract agreements.

Exploration in the Niger Delta has waned over the years, primarily because of difficulties in onshore operations due to community-related disturbances, including militancy and industry unwillingness to invest as a result of perceived poor operational terms.

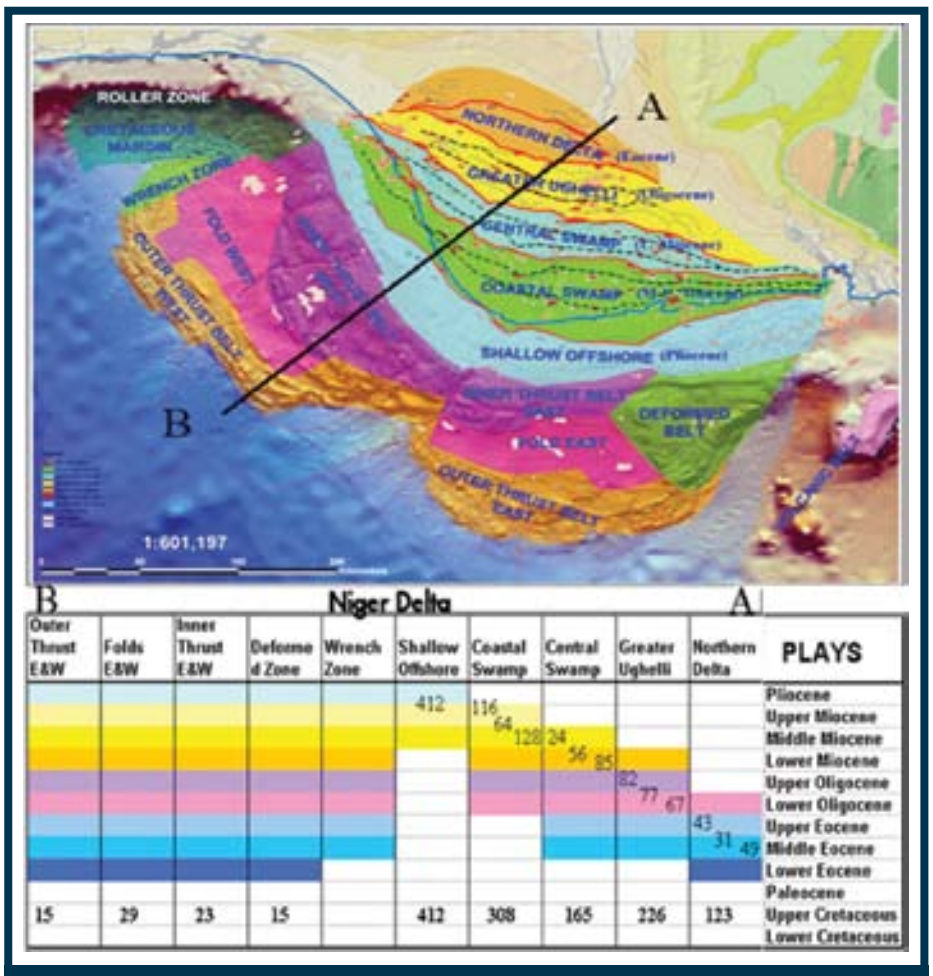
In the past several years, the government's stated objectives of building local E&P capabilities in the areas of operatorship – as well as increased local content, encouragement of new entrants to the exploration scene, expropriation of inactive assets of JV license holders and creation of co-ventures and partnerships through award of marginal fields or blocks to indigenous operators – are additional operational elements to enhance exploration activities.

The Petroleum Industry Bill currently is being discussed in the Nigerian Senate and House of representatives.

After 54 years of oil production and failure to achieve the 2010 aspiration of four million bopd, it is pertinent to examine past performance of exploration drilling to gain some insight into future potential.

Of the Niger Delta's 1,300 exploration wells, 822 have been drilled onshore, 412 in the shallow offshore and 82 in the deepwater (see figure).

For this column, the Middle Miocene Play will be examined in order to illustrate the application of the well look-back as an indicator of the basin's future potential.



*Niger Delta structure and play subdivision; numbers indicate total number of wells drilled in each play and structural belt.*

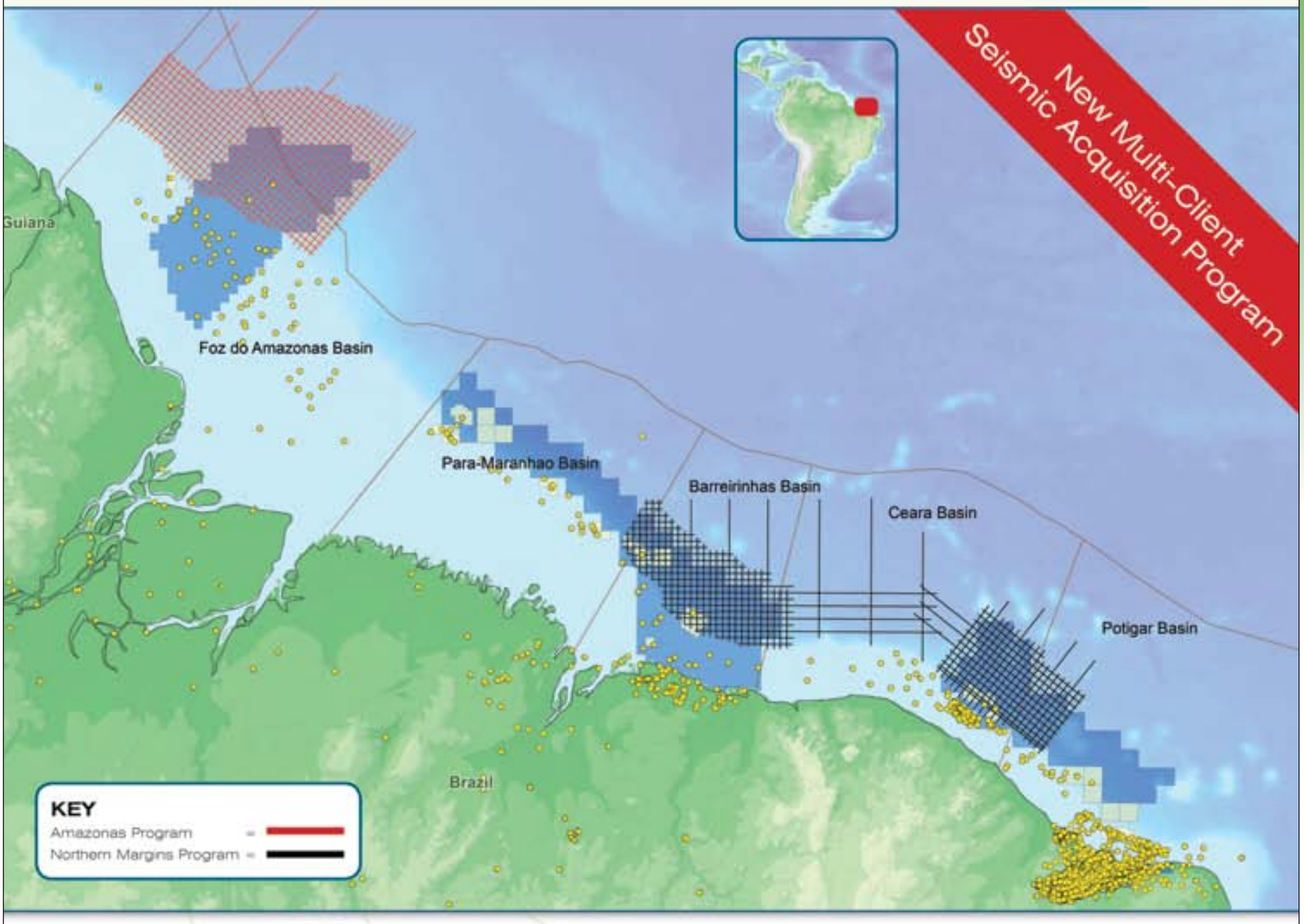
## Geological Background

The Niger Delta is a self-contained petroleum system with source rocks described at discrete levels: the Eocene, the Oligocene and Lower Miocene. The Paleocene and the upper Cretaceous may

See **Niger Delta**, page 34

# Offshore Brazil

## Equatorial Margins Amazonas, Ceara, and Barreirinhas Basins




Spectrum is active in three basins along the Equatorial Basins of Brazil. Acquisition is complete on the Ceara and Barreirinhas programs and has commenced on the Amazonas program. Final PSTM data is available for the Barreirinhas survey now and will be available for the Ceara program this quarter. All of these surveys are being acquired with 10,000 meter offsets and long record lengths. Companies participating in Spectrum's new seismic programs will have a competitive advantage in the upcoming Bid Round 11.

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# Niger Delta

from page 32

also constitute potential source rocks, but their contribution to the Niger Delta oils is not proven.

Onshore, the delta is divided into five extensional depobelts: Northern Delta, Greater Ughelli, Central Swamp, Coastal Swamp and Shallow Offshore depobelts. Sediments contained in these depobelts become progressively younger seaward.

In deep water, the delta is divided into three structural belts: Inner Thrust Belt, Fold Belt and Outer Thrust Belt, developed in a compressional regime.

Some nine plays have been penetrated in the Niger Delta.

Onshore, the plays are developed in association with conventional delta shoreface and shallow marine reservoirs, while in the deepwater the plays are developed in turbidite sands (figure 4).

Each well penetrates no more than two or three productive plays, principally because of the progradational nature in the evolution of the delta. In the deep water however, the plays are vertically stacked, with several plays capable of being reached in each well.

Recognition of this play distribution also determines, to a large extent, the target objective plays in each structural belt. Thus, in the Northern Delta depobelt the primary objective play is the Middle Eocene, while in the Coastal Swamp depobelt the primary play is the Middle Miocene.

In each case, the younger section is developed in predominantly continental facies that lack seals and traps, and may have been shielded from charge by regional seals below.

## Middle Miocene Play Results

The Middle Miocene play is one of the Niger delta's most prolific, and is developed in the North and Central belts of the Coastal Swamp depobelt and in the eastern part of the Shallow Offshore depobelt.

To date, 331 exploration wells have been drilled to test the Middle Miocene as primary or secondary objective, with a success rate of 67 percent. The level of full penetration onshore is only about 18 percent, an indication of remaining potential yet to be explored in the deep play.

In contrast, in the deep water, the level of penetration is almost always full. Here, the Middle Miocene has been penetrated in almost all the wells, as it is often targeted as part of the vertical stack of plays.

While the Middle Miocene is primarily restricted to the Coastal Swamp depobelt, it also is highly productive in the eastern part of the Shallow Offshore depobelt. This part of the Shallow Offshore is adjacent to a very narrow shelf area further updip, and this may have created favorable conditions for development of shelf collapse features feeding reservoirs into a slope environment down dip.

Also, this is a zone of development of complex duplex thrust structures bringing these reservoirs to shallower levels. Other departures from the norm may exist elsewhere in the older depobelts.

## Overall Play Elements

Reservoir presence is usually not an issue in the Niger Delta's Middle Miocene, where onshore reservoir facies are developed in shelf sands and, in deep water, in turbiditic and slope facies sands.

There also is ubiquity of traps of various types. Here again, a distinction is made between the onshore, where most of the traps are structural (growth fault related rollover anticlines), and the deep water, where the traps almost always have a stratigraphic component in association with compressive structures.

Seal development is represented by top seal and fault seal (juxtaposition and shale smear) components, depending on the structural type and the depth of occurrence.

Examination of data for the Niger Delta shows that well failure is attributed to the following factors:

- Fault seal failure – perhaps the most prevalent form of failure in the Niger Delta.
- Lack of a valid trap, which may be due to several factors:
  - ✓ Poor trap definition, especially if drilled on 2-D seismic.
  - ✓ Well positioned off structure.
  - ✓ Change in structural culmination with depth (for wells drilled before deviation drilling).
  - ✓ Structural complexity and inability to reach target with a vertical well.
  - ✓ Absence of stratigraphic pinch-out of the target.
- Poor reservoir development – more prevalent in the deep water and in deeper parts of the onshore.
- Migration by-pass.

* * *

Figure 2 is the play analysis summary for the Middle Miocene – a shorthand depiction of the combination of the four elements of reservoir, seal, charge and trap for each well in the middle Miocene Play of the Niger Delta.

This summary and the underlying database in ArcGIS provide a one-stop location of legacy data on well results for any play and any block in the Niger Delta.

The compilation includes the usual IHSE well data, the post drill analysis evaluation and the various data sources. It forms the foundation on which future more detailed analysis can be based, and it will require regular updates as more wells are drilled.

The low level (18 percent) of full penetration of the Middle Miocene onshore is an indication of the potential in the onshore deep play. This conclusion is true for the other eight plays in the onshore Niger Delta, and clearly indicates a potential for a deep play exploration frontier.

Accessing these levels depends on technological advancement, both in imaging these depths and in drilling over-pressured intervals. Conceptual models of the depositional model for these depths need to be tested in order to incrementally de-risk the opportunities.

*"ProTracks" is a new ongoing feature of the EXPLORER, offering news and information pertinent to getting started or getting better in your career.*

PROTRACKS

# Deal-Making Comes With the Territory

By COURTNEY CHADNEY, EXPLORER Correspondent

Let's make a deal.

That's not just the title of a TV game show. Knowing how to do it can be the key to having a successful career.

For some, deal making comes easy. For some, it's the biggest challenge they'll ever face.

For all, it's a skill that can be honed and refined.

In his book, "Only the Crazy and Fearless Win BIG! The Surprising Secrets to Success in Business and in Life," author Arthur Wylie, identifies six helpful keys to deal making in any industry.

Those keys involve:

MEDELLIN

> **"It separates young professionals that want to fast track their career in a very challenging and competitive economy."**

- Knowing your value.
- Personal relationships.
- Getting buy in.
- Being humble.
- Finesse.
- Swagger.
- Tying it all together.

"Deal making is a craft that, when done well, requires a skillful, visionary and inspired application of key principles and methods to create a desirable end result," Wylie said.

Wylie believes everyone needs to be able to negotiate and make deals successfully in their everyday life, but this skill is especially important to young professionals.

Think about it: interviewing for that first job or internship, increasing your current salary, negotiating grant or project development money, adding positive business relationships to your network or even buying your first home or car.

Most importantly, it can give a young professional the edge:

"It separates young professionals that want to fast track their career in a very challenging and competitive economy," he said.

### A Voice of Experience

AAPG Young Professional member Felipe Medellin, a consulting geologist for BeicipFranlab in Cajica, Colombia, is an example of a young professional whose career has been fast-tracked due to his ability to make deals for his company.

"My very first experience related to sales projects was at last year's AAPG Imperial Barrel Award competition," Medellin said. "At that time, my team and I (Universidad Nacional de Colombia) had to sell our prospect to a high quality panel of geologists, geophysicists, petroleum engineers and managers."

Medellin believes identifying this talent and performing a negotiation/deal making role for his company has allowed him to improve faster and stand out more in the company, especially when it comes to his interpersonal skills.

"The ability to spend time and reunite with several CEOs, managers and technical specialists in different companies in the oil and gas industry will give you enough support to work with people in all levels with different goals," he said.

"You can be known from the very beginning of your career as a person who can handle different issues, and who can face challenges from technical topics to business environment," he added.

So, how does the academic advice presented by Wylie mesh with the real-world reality of a working young professional?

**Know your value.**

First, know your goal, Wylie says. What are you trying to accomplish? While you cannot predict every possible result that the other party desire to reach, you can be in control by showing them what you can offer or do.

"This means researching all the potential benefits and ways that your idea, product or service could help the other party," Wylie said.

"Know it, own it, control it," is Wylie's slogan.

Medellin's take: "Knowing your value can be the easier key, but the challenge is to provide that information or knowledge to your clients or board team. This topic is all about learning how to express yourself."

**Personal relationships.**

People need to feel comfortable when

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## Dealing
from page 36

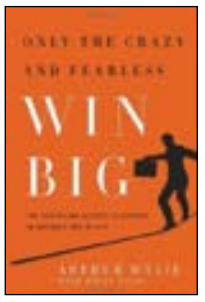
doing business, so conveying to the other side who you are as an individual – along with where your values lie – will make them trust you more.

"You learn about them; they learn about you," Wylie said about relationships. "It's a two-way street. Both parties must feel a chemistry of sorts."

Wylie believes deals can close very quickly and effortlessly when people have come to know and trust you, or if there is a good reputation that precedes you.

To Medellin, this is the most important key.

"If you know most of the board or customer's needs, it could be easier to find the way to involve people in your project," Medellin said. "Since the oil and gas industry is a small network, you can know a large professional spectrum quickly."




**Everyone needs to be able to negotiate and make deals successfully in their everyday life, but this skill is especially important to young professionals.**

To establish relationships quicker, find commonalities – like sports, educations or hobbies. Understand what values are important to them in life and business by looking at their history. And allow the other party to express themselves without interruptions.

"Other decision-making factors are not always based on the facts, hard evidence and rational thinking, but gut instincts, comfort level, emotions, feelings, aptitude to learn, risk tolerance, ego, past experiences and perceived consequences and rewards."

In other words, don't give them a reason to dislike you.

### Get buy in.

This part can be a challenge – but remembering the WIIFM factor can help.

WIIFM is "What's in it for me," and it needs to be made clear to the other party.

"A critical step in artful deal making is to convey and articulate your vision of the outcome in such a way that the opposing party will desire that very same outcome," Wylie suggests.

"It's all about trust," Medellin commented. "If you did a good job in the previous three keys, the panel will trust you, and they will be able to understand the project in the way you do it."

### Be humble.

Have humility with backbone, the author likes to say.

"You have to be humble, but firm." A deal maker or negotiator must always respect the positions of the other people involved. They must be fair and honest and keep their intentions pure. Yet, at the same time, they must show the other party that they have the ability and desire to perform the desired task. Humility with a backbone.

Some suggestions from the author:

- Ask questions to truly understand concerns and goals – even if you think you might already know the answers. Also, show empathy and understanding for their goals, as if they were your own.
- Make sure you are very aware of your body language. Make eye contact, smile when appropriate, nod to show understanding.
- Listen, compliment and do not over-talk.
- Be malleable in your understanding, and show compassion on things you cannot do.
- ALWAYS be in control of your words and actions. If you disagree, handle it respectfully.

"As a young professional, most of the time you don't know all the answers," Medellin admitted. "Being humble is the best way to learn and become a specialist."

### Finesse.

This is "knowing when to do what," Wylie explained.

"Successful persuaders, whether politicians, managers or sales people, are distinguished by a certain style characteristic," he said. "They express their ideas … in a positive and optimistic way. Most importantly, they are themselves."

"You don't want to be untimely or unpleasant to anybody," Medellin added. "This is a small world."

### Swagger.

Have swagger or confidence, the author said – but without being arrogant.

Medellin's view on the importance of confidence: "It isn't only about signing a paper – you need to reach your scheduled goals step-by-step. If you are successful, you can assure a happy ending for the ongoing project, but most importantly, you can obtain doors for the future."

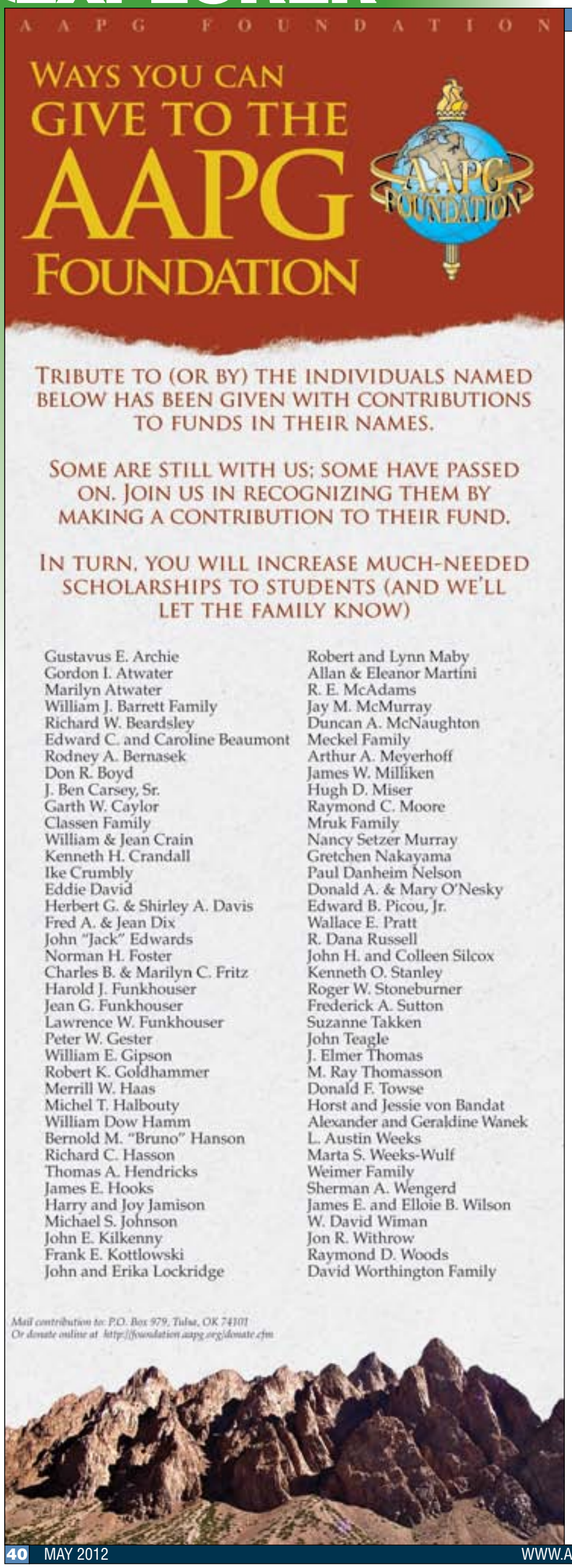
### Tying it all together.

"It's like a car," Wylie said. "You can have the best engine but no wheels, which means you're not going anywhere. Each point is essential and must work together as one cohesive unit to get from point A to B."

Keep in mind, Wylie continued, "Rome wasn't built in a day, so conquering negotiating skills isn't going to happen that quickly either. Start small before attempting to hit the Big Leagues."

Medellin agreed in how important learning is in the process of becoming a successful young professional.

"Don't be afraid to learn," he said. "Yes, we are young, but we are the future – (and) this industry is growing."




## FOUNDATION UPDATE

By NATALIE ADAMS, AAPG Foundation Manager

Saying "thank you" is always at the top of our priority list, but it definitely will be evident in this column – the AAPG Foundation's mission could not be accomplished without the continuous support of the members of the geoscience community.

With AAPG dues payments coming in this time of year, I am reminded of how many supporters the Foundation has.

Contributions to the AAPG Foundation so far this year are 51 percent higher than what was received in January-March 2011.

Thank you to our faithful supporters! Your dollars are working hard to support future geoscientists.

* * *

April was a good month for matching gifts, as more than $2,000 came in from companies like Chevron Humankind and ConocoPhillips.

Many thanks to AAPG members **Richard Ball** and **Christopher Bradley** for remembering the Foundation through the matching gifts program.

Perhaps you work for a company that offers matches for charitable contributions – and if you don't know, we've made it easier than ever to check. Just go to our webpage at foundation.aapg.org/donate/matchinggifts.cfm and type in your company name.

Most matches are dollar for dollar – and some are for more.

* * *

In other Foundation news:

▸ Thanks go to **Marathon Oil Corp**. for endowing GIS-UDRIL subscriptions for the University of Houston and Texas A&M University. These schools now will have access to this extensive online database, which includes thousands of maps.

For more information on how to create an endowed subscription to the university of your choice, visit foundation.aapg.org/GISUDRILUniversitySubscription.cfm.

▸ The AAPG Grants-In-Aid recipients have been chosen for 2012 – and thanks go to **David Sivils** and the entire GIA committee for spending untold hours evaluating more than 300 applications and selecting more than 80 qualified graduate students to receive a total of $175,000 in grants.

The Foundation's Grants-In-Aid program exists to foster research in the geosciences. The grants provide financial assistance to graduate students (currently enrolled in masters or Ph.D. programs) whose thesis research has application to the search for and development of petroleum and energy-mineral resources, and/or to related environmental geology issues.

Grants are based on merit and, in part, on the applicant's financial needs.

And, of course, it's possible because of the wonderful donors who have established named and memorial grants through the AAPG Foundation.

To read more, visit http://foundation.aapg.org/gia/index.cfm.

▸ The **AAPG Pacific Section** deserves a big mention this month for its support of the John E. Kilkenny Memorial Grant.

▸ The Foundation also would like to thank donors **Ed Heath**, **John Kimberly**, **George Sharp**, **Ken Huffman** and **Jonathan Lester** for their generous contributions to the general fund, which exists for the discretionary use of Trustees to support any activity they deem worthy and is in accord with the purposes for which the Foundation was established; i.e., education, charitable and scientific activities related to or allied with the field of geology.

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**Article highlights include:**

### An analog model

*Jianzhao Yan, Xiaorong Luo, Weimin Wang, Renaud Toussaint, Jean Schmittbuhl, Guy Vasseur, Fang Chen, Alan Yu, and Likuan Zhang*

A three-dimensional experiment was carried out to study secondary oil migration under an impermeable cap. Drastic shrinking of sectional area of the migration pathway after oil injection ceased is the main reason why only a small volume of oil and gas was lost during the secondary migration.

### A new Paleozoic thermal history

*Nansheng Qiu, Jian Chang, Yinhui Zuo, Jiyang Wang, and Huili Li*

A new Paleozoic thermal history of the Tarim Basin was reconstructed in this paper using the integrated thermal indicators of apatite and zircon ages, apatite fission tracks, and equivalent vitrinite reflectance data. A new model of apatite He ages with temperature was obtained.

### Channel belt shifts

*Dominic A. Armitage, Tim McHargue, Andrea Fildani, and Stephan A. Graham*

The postavulsion evolution of channel-levee systems is documented offshore of the Niger Delta. In the context of hydrocarbon exploration, investigating up dip in order to identify avulsion nodes increases the chance of locating sand-rich deposits, especially where multiple channels converge.

### Understanding MTDs

*Osareni Ogiesoba and Ursula Hammes*

Mass-transport deposits (MTDs) are economically significant in many hydrocarbon-producing fields. The structure, stratigraphy, acoustic impedance, and petrophysical properties of the shallow Frio Formation were examined to identify MTDs that formed from collapse of shelfal deposits.

*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 website, www.aapg.org/explorer/pnb_forms.cfm.*







## PROFESSIONALnewsBRIEFS

**Jim Barton**, to vice president of geosciences, BASA Resources, Dallas. Previously geosciences manager, BASA Resources, Dallas.

**Wayne K. Camp**, to distinguished geological adviser (company's highest technical position), Anadarko Petroleum, The Woodlands, Texas. Previously senior geological adviser, Anadarko Petroleum, The Woodlands, Texas.

**Steve Charbonneau**, chief geologist, PennWest Exploration, Calgary, Canada. Previously senior geologist, PennWest Exploration, Calgary, Canada.

**Mike Deming**, to senior geoscience adviser, Applied Drilling Technology International, Houston. Previously senior geoscientist, Challenger Minerals, Houston.

**Matt Duke**, to manager-earth science and reservoir services, Chevron Nigeria, Lagos, Nigeria. Previously manager-reservoir management services, Chevron Australia, Perth, Australia.

**Matt Frankforter**, to senior geologist, Hilcorp Alaska, Anchorage, Alaska. Previously exploration geologist, Chevron Australia, Perth, Australia.

**Robert S. Hojnacki**, to geologic operations adviser, BHP Billiton, Houston. Previously senior operations geologist, Vanco Exploration, Houston.

**Jim McCullough**, to global chief geologist, ConocoPhillips, Houston. Previously global geologic adviser, ConocoPhillips, Houston.

## Historical Highlights
from page 18

### The Never Ending Story

As with any oil producing area, there are stories of someone drilling up their last dollar or dulling a bit and making a major discovery. The Permian Basin also has the stories of ingenuity, luck and perseverance on the part of strong men and women who believe in their ideas.

One of the greatest stories about the Permian Basin is the one happening now.

In the late 1990s and early 2000s a couple of companies began drilling the Wolfcamp section in the Midland Basin looking to commingle the Wolfcamp Formation with the Spraberry Formation. The Railroad Commission of the state of Texas allowed this commingling, and the Wolfberry play of the Midland Basin was off and running.

Operators currently can commingle from the Clearfork to the Mississippian – which has lead to the commingling of the Bone Spring with the Wolfcamp in the Delaware Basin ("Wolfbone") and the Wolfcamp with the Clearfork in the southern Midland Basin ("Wolffork").

This is only half of the story; with horizontal drilling technology, the basin has become a hot spot for horizontals wells with the Wolfcamp Shale, Avalon Shale and Cline, to name just a few of the hot horizontal plays being drilled in the Permian Basin.

Places that have not seen leasing in many years are now hot beds of activities. Hotel rooms are hard to come by in Midland, and getting into the courthouses in the counties affected by these plays to check title records is difficult.

Last year, one courthouse in the northern part of the Permian Basin even saw landmen fighting over the title books.

The Permian Basin is once again a hot bed of activity, with major companies obtaining large acreage positions and drilling wells. This is a story of how technology, opportunity and good commodities prices have become the Fountain of Youth for the Permian Basin.

## Foundation
from page 40

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If you have a funding need that matches the priorities of the AAPG Foundation, please visit foundation.aapg.org and click on the "Funding" tab for more information.

All of the AAPG Foundation's funding decisions are made by a Board of Trustees that meets three times annually to review proposals. Applications for grants to projects and programs which fulfill the AAPG Foundation mission are welcomed. Decisions are based on available funds.

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## READERS' FORUM

### The Salary Survey

With a huge portion of our membership in the 25-plus-year experience category, I think it is time the annual salary survey broke out the membership in that group similarly to the other categories: 25-29 years, 30-34 years and 35-39 years. Providing this detail may reveal some pay trends that lumping obscures.

I believe the detailed figures will show that after 20 years, further experience is no longer being rewarded.

I found Mr. Ayling's explanation for the drop in 25-plus-years salaries to be contrary to the situation for most of my peers. His "anecdotal" ideas about participation and bonuses being a big part of our compensation may be true of a small number of independents, but not for the majority of us working for large to mid-size companies. Our salary remains our main compensation.

I know a wide range of 25-plus geologists and none get participation, few get stock options and our annual bonus is a relatively small percent of annual salary (15-30 percent).

In addition to adding the age ranges noted above, how about adding a column showing the number of respondents for each experience category so we can get a feel for the statistical validity? These changes would serve your senior membership very well indeed.

Mark Boehm
The Woodlands, Texas

I think the entry-level position salaries for geologist with a BA/BS degree is grossly overstated. I do not doubt that it merely reflects the data available, but that does not make the statistics meaningful.

The entry level MS degree information appears more comparable to what my peers are offered coming out of a well-respected geology graduate program.

At the company where I work, which is weighted toward equity compensation – especially for senior employees and, to a much lesser degree, younger employees – entry level positions are closer to half of what is being published.

Well, is level of compensation an outlier? Why isn't this being reflected in the polls?

I believe that lower compensation is not being reflected by the professionals at the polls in small companies that do not promote AAPG culture. These companies likely make up a very large portion of the work force, and if AAPG could figure out a way to encourage them to participate, this annual survey – broken down by region – would be much more meaningful.

The high-end salary in the survey for 0-2 and 3-5 categories with a BS is ultimately reckless advertisement. Landing a salaried position – even an internship – at this level is extremely competitive, especially from the supply demand side. Getting a salaried position out of undergrad, let alone an internship that pays decently, is very challenging.

Although this published column is a "survey," it fails to reflect truly what is going on in this industry, in the opinion of a young professional.

Name Withheld
Denver

### Peter Blau and Sherlock Holmes

Regarding your story on AAPG member Peter Blau's position as one of the world's leading experts on Sherlock Holmes (April EXPLORER): Mr. Blau's scholarship on all matters Sherlockian has for many years delighted those of us who enjoy studying the Great Detective's life.

Alexander E. Braun
San Jose, Calif.

### Congratulations, Professor

Regarding your story on Howard Johnson being awarded the AAPG Grover E. Murray Memorial Distinguished Educator Award: Professor Howard Johnson is indeed a fantastic person and geoscientist.

I had the pleasure of working under his guidance when we worked together at Petronas Carigali. He was always supportive, encouraged thinking outside of the box and was always there for you, no matter the time of day.

This mentorship assisted me in my successful efforts to rejuvenate an aging production asset in Malaysia.

I also had the pleasure of being invited as his guest to be part of the "industry panel assessors" at the Imperial College IBA in 2010, where I got a true picture of the success of the IBA as well as his academic teaching capability. All of his students bar none were well advanced beyond their years in grasping the importance of data validity, data analyses, interpretation and presentation.

Professor Johnson is truly deserving of the AAPG Grover E. Murray Memorial Distinguished Educator Award, and I personally will forever remain grateful for his mentorship and friendship over the years.

Congratulations, Howard!

C.Y. McCants
Kuala Lumpur, Malaysia

### Fossil Fuel

With estimated fossil fuel resources sufficient to meet our demand for a century or more, why is gasoline at the pump so high? What is the problem?

The EPA and Department of Interior are the principal agencies mandating ridiculous rules and regulations that are blocking our oil and gas industry from drilling and developing these abundant resources lying in the North American area.

Alternatives? Yes, someday but not today. Why further bankrupt our weak economy when fossil fuels are available now if government would free our oil and gas industry to 'get the job done?'

Remember, fossil fuels provided the energy that built this great country and fossil fuels can provide the energy to rescue our beautiful nation.

Dick Baile
Houston

## IN MEMORY

**Graham R. Curtis**, 85
Lakewood, Colo., March 18, 2012
**Robert Frederick Flege Jr.**, 85
Bend, Ore., March 11, 2012
**James Brooke Furrh Jr.**, 85
Jackson, Miss., Aug. 27, 2011
**Rollin Barnes Harrington**, 89
Edmond, Okla., March 7, 2012
**Douglas J. Howard**, 79
Houston, Feb. 21, 2012
**James Lee Martin**, 78
Houston, March 1, 2012
**Glen Chase Ware Jr.**, 83
The Woodlands, Texas
Feb. 17, 2012
**Stewart William Welch**, 84
Jackson, Miss., March 12, 2012

*Editor's note: "In Memory" listings are based on information received from the AAPG membership department.*

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*You can reach about 32,000 petroleum geologists at the lowest per-reader cost in the world with a classified ad in the EXPLORER. Ads are at the rate of $2.90 per word, minimum charge of $60. And, for an additional $50, your ad can appear on the classified section on the AAPG web site. Your ad can reach more people than ever before. Just write out your ad and send it to us. We will call you with the word count and cost. You can then arrange prepayment. Ads received by the first of the month will appear in the subsequent edition.*

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- Experience in working on a multi-disciplined team
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**MIDWESTERN STATE UNIVERSITY**

The Department of Chemistry, Physics, and Geosciences invites applications for a tenure-track position to begin Fall 2012. We seek candidates with expertise in petroleum geology, source/reservoir characterization, or exploration geophysics. The successful candidate will teach introductory courses, Petroleum Geology, and other appropriate upper-level courses. Experience in developing a successful undergraduate research program will be given special consideration. Requirements include a Ph.D. in geosciences, strong interpersonal skills, and publications in refereed journals commensurate with experience. MSU is a comprehensive public university serving over 6000 students. The Geosciences Program has strong ties with regional petroleum exploration and environmental science communities and is poised for continued growth in the next five years. Send an application letter, CV, statements of teaching and research interests, and the names and contact information of three references to Dr. R.L. Dodge, Geosciences, Midwestern State University, 3410 Taft Blvd., Wichita Falls, TX 76308; email: rebecca.dodge@mwsu.edu. Review of applications will begin immediately, and this position will remain open until filled. This position is designated as security sensitive and requires the finalist to complete a criminal background check. EEO/ADAAA compliance employer

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## EMD
from page 47

engines powered by oil. North Dakota!

Growing up in the Los Angeles Basin near Hollywood, one gets accustomed to news, and in the movie industry, being mentioned in any capacity, good or bad, is good; however, in the energy and resources arena, maybe not so good. Environmental risks always require evaluation and assessment, and certainly there are risks with fracing. It seems that after 60 years of fracing, the process is now under fire from all directions – whatever ails the world today, it's due to some frac job.

The environmental risks when fracing in some cases could include adverse impact to air quality; contamination of groundwater with radioactive elements such as radium, radon and uranium; migration of gases and chemicals used to frac to groundwater; surface spills; earthquakes induced by fracing; casing and seal issues; and even climate change!

Fracing in an old well versus a more recently installed well can be problematic. Release of gas into shallow groundwater zones, and well casing seals and cement issues can also cause concern. Let's not exclude what some have referred to as "negative externalities" pertaining to the side effects of economic activity that negatively affect others and leads us directly away from renewable energy alternatives.

Then there is the question as to whether we are talking about seismically-induced earthquakes via EPA approved underground injection of waste water into deep disposal wells instead of fracing related to oil and gas production.

If that is not enough, there is this business consultant who has taken on the jargon and telling us where and when to "frack" to solve business problems – a means to identify cracks in your organization by digging deep!

* * *

Now I am usually all for earth science being on the front page, and in my view such episodic occurrences provide a unique opportunity for earth scientists to engage, educate and inform the public as to the importance of what we do, how we do it and how we proceed in avoiding adverse environmental consequences.

This is no easy challenge, even among our professional community when the engineering and science is progressing faster than we are – but it is a necessity, and as earth scientists we have an obligation and responsibility to reach out to our stakeholders, which includes the public.

Oil and gas exploration and production has moved past the days when all Jed Clampett had to do was simply aim his rifle and shoot toward the ground.

We seem to be spending a lot of time worrying about how the process and technology is spelled, and less time educating the public and demonstrating how society benefits.

What is EMD doing about all this frac stuff?

EMD, in concert with DEG, is organizing a Geoscience Technology Workshop on "Hydraulic Fracturing: New Controversies and Key Plays (including Niobrara)," set Aug. 13-15 in Golden, Colo.

The workshop is designed to be more technology-based and less emotional, and will cover the development of policies and regulations on oil and gas activities, as well as improve our industry's understanding of how to avoid confrontation and improve hydraulic fracturing practices to eliminate any potential hazards to the public and environment.

* * *

The term "fracking" did not start with the controversies that exist today. The term made its appearance around 1981 in an Associated Press story, with continued usage in trade journals throughout the 1980s.

I am fine with dropping the "k," but more importantly, let's concentrate on what is important – outreach, education and developing a sound energy policy that benefits society and protects the environment.

DIRECTOR'S CORNER

# The Value of Exploration

By DAVID K. CURTISS, AAPG Executive Director

This edition of EXPLORER began with President Paul Weimer presenting a detailed analysis of membership trends in the Association. It's an important topic because these trends are harbingers of AAPG's future – and they should force serious thinking about how we recruit and retain tomorrow's members.

That may look significantly different than it does today.

But I'd like to close this month's issue with some thoughts on one of the core aspects of our science and profession: Exploration. It's a fundamental human drive that has attracted past generations into petroleum geology.

I'm currently reading *Space Chronicles: Facing the Ultimate Frontier* by Neil deGrasse Tyson, an astrophysicist and director of New York's Hayden Planetarium. Tyson regularly lectures and hosts science television programs to promote science literacy – and, like Carl Sagan a generation ago, he is an unabashed promoter of space exploration.

Despite its high price tag, Tyson argues that the value of space exploration is twofold:

✓ First, it advances science and technology in many disciplines, often serendipitously.

✓ Second, bold challenges – such as putting a man on the moon – inspire the best and brightest to pursue science and engineering careers.


CURTISS

**Fact is, our profession and industry are advancing the frontiers of science. And we're doing so to meet the daily energy needs of a growing global population.**

Achieving something so audacious is inherently motivating. Absent such a goal, it is little wonder that in the past decade so many quantitative Ph.Ds. chose instead to pursue careers in financial engineering.

Exploration doesn't happen in a vacuum (except for space exploration, of course). There are factors that drive humans to explore, and Tyson suggests three:

▸ Military competition.

Space exploration has its roots in the Cold War between the United States and the Soviet Union. It is no accident that nearly all of NASA's astronauts were military aviators. And only one scientist ever walked on the moon: Apollo 17's Harrison "Jack" Schmitt, a geologist and AAPG Honorary Member.

▸ Honor and glory.

There are bragging rights to being first to explore or achieve something. As a boy I was inspired by mountaineer Reinhold Messner's feats of scaling Mt. Everest – the highest point on Earth – alone and without oxygen. To an armchair mountaineer that is a superhuman accomplishment.

More recently, explorer and filmmaker James Cameron dove the Marianas Trench – the deepest point on Earth – and demonstrated that we still have much to explore on this planet.

▸ Commercial.

Finally there are the commercial interests that drive exploration. That certainly characterized early traders and explorers – looking for faster or better paths to obtain goods, or deliver them to market. Finding and producing natural resources fits this category, as does the emerging commercial space industry looking to take away the government monopoly on space travel that has existed to present.

The commercial reward of finding and developing oil and natural gas certainly fuels the exploration drive of many AAPG members. But so does the recognition that comes from finding and communicating new scientific discoveries and breakthroughs. It's all exploration.

Fact is, our profession and industry are advancing the frontiers of science. And we're doing so to meet the daily energy needs of a growing global population.

Ensuring an affordable and plentiful global energy supply is an audacious challenge. Energy is the foundation of modern society and enables mankind to explore the stars and the depths.

Can we craft a compelling narrative to attract the best and brightest into the energy geosciences, and to foster that spirit of exploration in the next generation?

It starts with that dream and desire to do important work.

"There are a lot of things I have to do to become an astronaut," says four-year-old Cyrus Corey in *Space Chronicles*. "But first I have to go to kindergarten."

That's a great plan, Cyrus. And take a class in geology the first chance you get.

DIVISIONS REPORT

# Oh, Fraque! Changing Public Perceptions

By STEPHEN M. TESTA, EMD President

I spend a lot of time in downtown Sacramento, the capital of California, and I walk a lot. Something is different. Not since Climategate, the BP spill or the Japan Tohoku Earthquake/Tsunami and Fukushima disaster, has something in earth science captured the public's attention at the local coffee shop and just about every downtown intersection.

I am not referring to the *Wall Street Journal, Los Angeles Times* or the *Bakersfield Californian* – but there it was, on the cover of the *Sacramento News and Report*, the local free newspaper one can find on just about every corner downtown, and on the cover in bold letters:

"OH, FRACK!"

The article was somewhere between advertisements for bartenders and card dealers, medicinal marijuana and entertainment and relationship building. When earth science reaches this level, it must be big. What in the frack is going on, I ask myself.

* * *

Hydraulic fracturing technology was pioneered in the mid-1940s by Halliburton, and arguably questionable as to its early success. But since then, Halliburton states that over 1.1 million separate and successful "frac jobs" have been conducted, and the public has benefited with over 600 trillion cubic feet of natural gas provided to the American consumer as a result of this technology.


TESTA

**We seem to be spending a lot of time worrying about how the process and technology is spelled, and less time educating the public and demonstrating how society benefits.**

In addition, nearly nine out of 10 onshore oil and gas wells require fracture simulation to remain or become viable.

With the growth in the unconventional energy resources, notably gas shales and tight sands, some are boldly claiming we are now in a position to argue against "Peak Oil" and we are going to uncap the spigot, increase jobs and state and federal revenues and provide a real path to clean and affordable energy in the future. The problem is that the general public and proponents of renewable and alternative energy have a different perspective.

* * *

Before we can define what we are talking about, we must first figure out how best to spell it and apparently, this is controversial as well.

"Fracing" is short for hydraulic fracturing. It is said that in an attempt to control the debate, anti-fracing groups prefer the term "fracking" (spelled with a "k") because of its negative connotations (i.e., smack, whack, profanity, etc.) – similar to the term "Peak Oil."

Simply defined – and with a wide choice in source material ranging from The Dictionary of Oil Terms to the Urban Dictionary – I decided to go with something in between, Wikipedia, which defines hydraulic fracturing as the natural propagation of fractures in the subsurface caused by the presence of pressurized fluids (i.e., as in the natural case of the formation of dikes and sills), albeit on a much smaller scale, which allows gas and oil to migrate from source rocks to reservoir rocks.

"Induced" hydraulic fracturing, or what is commonly referred to as a frac job (aka, fracking, fracing, fraccing, the F-word, or whatever), is when fractures in the subsurface strata are generated from a well bore drilled into reservoir rocks that ultimately increases the extraction rates, thus enhancing the recovery of gas and oil.

Then there is formation fracturing, explosive fracturing, refracturing, vertical fracking, high volume hydraulic fracturing, and fracturing simulation. Apparently, there is a whole lot of fracing (my preferred spelling) going on.

The technological advances in horizontal drilling and fracing has opened up shale deposits across the country and globally, bringing interest in large-scale drilling to new regions.

My case in point, being a Californian, I was not pleased to hear that we have fallen from third to fourth place in oil production and now we are behind North Dakota – I have nothing against North Dakota, but North Dakota! The petroleum refining industry, as we know, has its birth in downtown Los Angeles, when Doheny discovered the Los Angeles City oil field and developed a market in changing coal-powered engines for trains to combustion

See **EMD**, page 46

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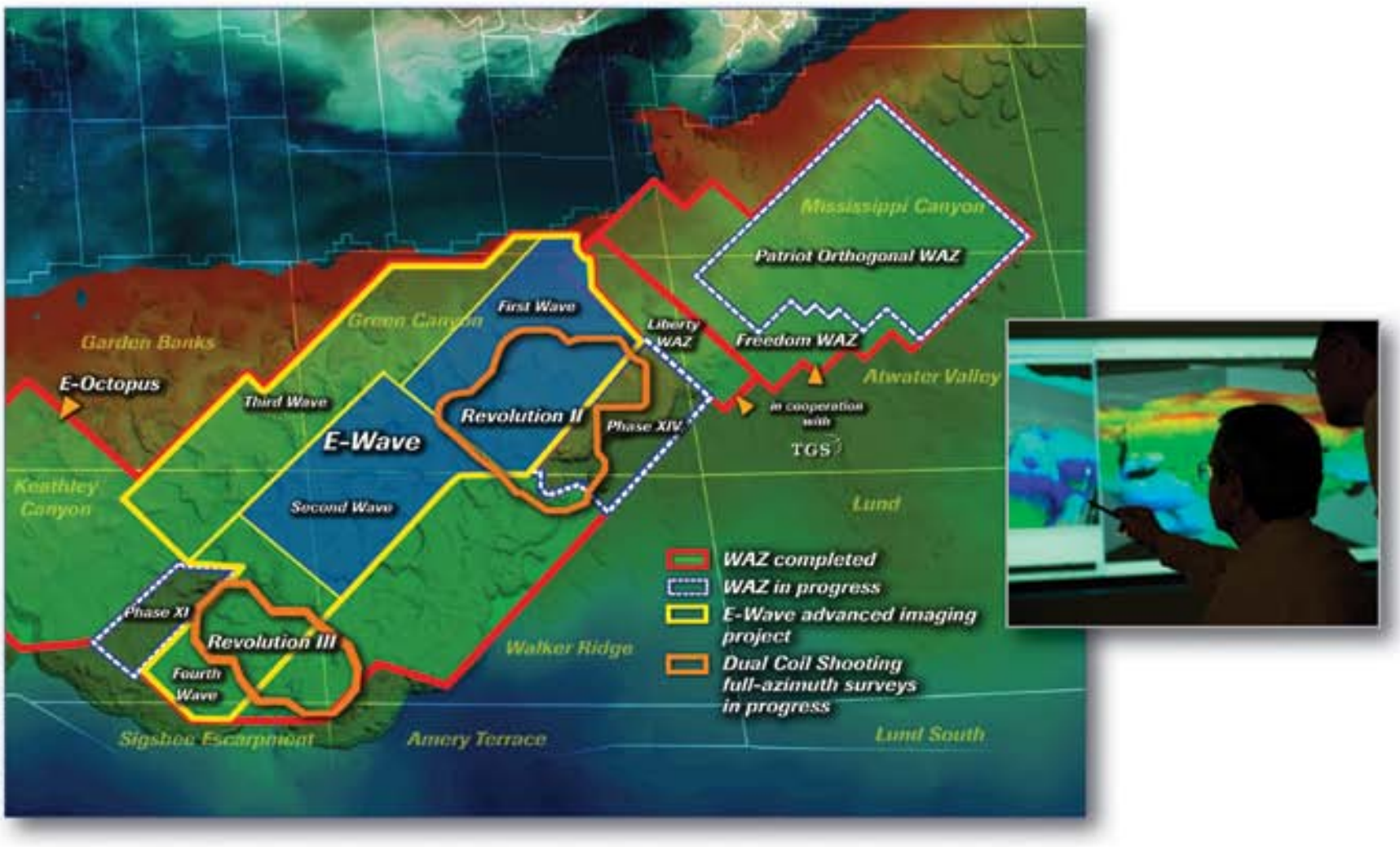


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