AAPG EXPLORER
MARCH 2013

Legends of the Falls

Every setting tells a story

See page 8

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Vol. 34, No. 3
March 2013

AAPG EXPLORER

PRESIDENT'S COLUMN

Think About It: New Ideas Equal New Success

By TED BEAUMONT

I can remember hearing, way back in 1977, the president of a major oil company that I worked for say that the United States had run out of oil and gas – there was not much left to find and develop.

It seemed like a defeatist attitude for the leader of an oil company to have, and I wondered why I was working there.

In that context, the possibility that the United States could be energy independent – as suggested by several studies, including a recent forecast by the International Energy Agency – is astonishing to me. It also is amazing to consider that we petroleum geologists made it happen, along with a little help from our engineering colleagues.

It all brings to mind Parke Dickey's famous 1958 quote: "Several times in the past we thought we were running out of oil, whereas actually we were only running out of ideas."

* * *

The ideas brought forth by petroleum geologists have literally changed the world – again and again and again.

AAPG members Dan Stewart and George Mitchell most recently demonstrated this when they persisted with their belief that shales could be gas reservoirs – and eventually brought in the Barnett Shale play. Because of their ideas – their vision – and determination the world will never be the same.

Daniel Yergin, vice president of IHS, calls it the "unconventional oil and gas revolution." He says that it "is having a bigger impact across the country, including in non-producing states, than is generally recognized."

According to an IHS report released this January, in the United States the


BEAUMONT

unconventional oil and gas play provided over 1.7 million jobs and $63 billion in annual government revenues in 2012. By the end of this decade the numbers could grow to three million jobs and $113 billion in annual revenues to the U.S. government.

Many of those new jobs are in states without unconventional oil or gas production.

Instead of building facilities to import LNG – like we planned to do in 2008 – the United States is building facilities to *export* LNG. American energy is so inexpensive that industries are moving back to the United States from China.

And what about the rest of the world?

There are many formations in basins around the world that appear to have tremendous potential for unconventional oil and gas production, including (just to name a few):

- The Bowland Shale of the Bowland Basin in the United Kingdom.
- The Vaca Muerta of Argentina's Neuquen Basin.
- The La Luna Shale of the Middle Magdalena Basin of Colombia.
- The Karoo Supergroup of South Africa.

* * *

Of course, the main impediment to unconventional oil and gas exploration everywhere is politics. And obviously, not all conditions – political, financial or geological – are equal around the world.

A prominent German AAPG member, for example, recently told me that energy in Germany is three times more expensive than U.S. energy.

Eventually, maybe, the tremendous financial benefits that the United States enjoys from the unconventional play will persuade non-U.S. politicians that their perceived worries are exaggerated and they will give the play a chance.

Wherever and whenever politicians give geologists the freedom and incentive to look for unconventional oil and gas, we have demonstrated we will find it – and it will make life better for the citizens of the countries where it is discovered.

Often, all it takes is a little thought – and there's always plenty of room for new ideas.

Ted Beaumont

Voting Begins for AAPG Executive Committee Slate

Ballots have been mailed and online voting is now open in the election of new officers for the AAPG 2013-14 Executive Committee.

Voting will remain open through May 15.

To assist in the voting process, a special AAPG candidate insert has been included at page 5 in this EXPLORER, offering a convenient compilation of biographies and individual information for all candidates.

Candidate bios, written responses to the question of why they accepted the invitation to stand for office plus video comments from each candidate, mostly filmed at last year's Leadership Conference in Tulsa, remain available online at www.aapg.org.

The 2013-14 Executive Committee will take office July 1.

The person voted president-elect will serve in that capacity for one year and will be AAPG president for 2014-15. The vice president-Regions and secretary will serve two-year terms, and the editor will serve a three-year term.

The slate is:

President-Elect

❒ **Randi S. Martinsen**, University of Wyoming, Laramie, Wyo.

❒ **Kay L. Pitts**, Aera Energy, Bakersfield, Calif.

Vice President-Regions

❒ **István Bérczi**, MOL Hungarian Oil and Gas, Budapest, Hungary.

❒ **John G. Kaldi**, Australian School of Petroleum, University of Adelaide, Adelaide, Australia.

Secretary

❒ **Richard W. Ball**, Chevron Upstream, Southern Africa SBU, Houston.

❒ **Sigrunn Johnsen**, independent consultant with ProTeamAS, Stavanger, Norway.

Editor

❒ **Colin P. North**, University of Aberdeen, Aberdeen, Scotland.

❒ **Michael Sweet**, ExxonMobil Production, Houston.

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REGULAR DEPARTMENTS

Scan this for the mobile version of the current web Explorer.


Photo courtesy of Carlton Brett

ON THE COVER:

Some people come for the water, but geologists know that the dramatic cliffs at New York's Taughannock Falls provide a terrific showcase for the Geneseo Shale. The valuable location will be part of a field trip offered during this year's AAPG Annual Convention and Exhibition, which will be held in Pittsburgh May 19-22. See story page 8. Photo by Joe Shlabotnik.

ON THIS PAGE:

Class is in session, courtesy of AAPG award-winning professor Carlton Brett, who believes in the teaching potential of a good geological field trip. Story on page 32.

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'Interpretation' will debut this fall

AAPG Joins SEG For New Journal Venture

The American Association of Petroleum Geologists (AAPG), the world's largest professional geological society, will join with the Society of Exploration Geophysicists (SEG), the largest international society dedicated to applied geophysics, in the publication of a new, peer-reviewed journal for advancing the practice of subsurface interpretation.

Interpretation will comprise papers directly related to the practice of interpretation of the Earth's subsurface for exploration and extraction of mineral resources and for environmental and engineering applications.

Partners: AAPG and SEG officials signed the papers to become joint publishers of a new journal called "Interpretation." Participating were (seated, left to right) SEG President David J. Monk and AAPG President Ted Beaumont, and (standing, left to right) AAPG Executive Director David Curtiss and SEG Executive Director Steven Davis.

The journal, a peer-reviewed quarterly, was announced in October by SEG, which is the operator. The first issue will be completed in August and will include a special section on interpreting stratigraphy from geophysical data. The second issue, scheduled for November completion, will include a special section on interpretation for unconventional resources. Submissions are closed for those two issues.

Submissions are open for the February 2014 issue, which will include special sections on seismic attributes and pore-pressure prediction and detection.

Former SEG Editor Yonghe Sun is the publication's editor-in-chief. AAPG will appoint a deputy editor-in-chief. The editorial board will include members of both AAPG and SEG. The organizations will take turns appointing editors-in-chief for three-year terms.

The organization not selecting the editor-in-chief will select the deputy editor-in-chief.

"This journal will provide a valuable forum for the interpretation community and an opportunity for members of this community with AAPG and SEG affiliations to work together," said AAPG Editor Steve Laubach.

"The participation of AAPG promises to enhance greatly the journal's potential in advancing the shared art of interpretation by geologists and geophysicists," Sun said. "Geophysical data derived from remote sensing are often incomplete and geophysical solutions are invariably non-unique, so much so that the conceptualization of the subsurface requires tight integration of techniques of multiple disciplines, among which geology and geophysics are first and foremost."

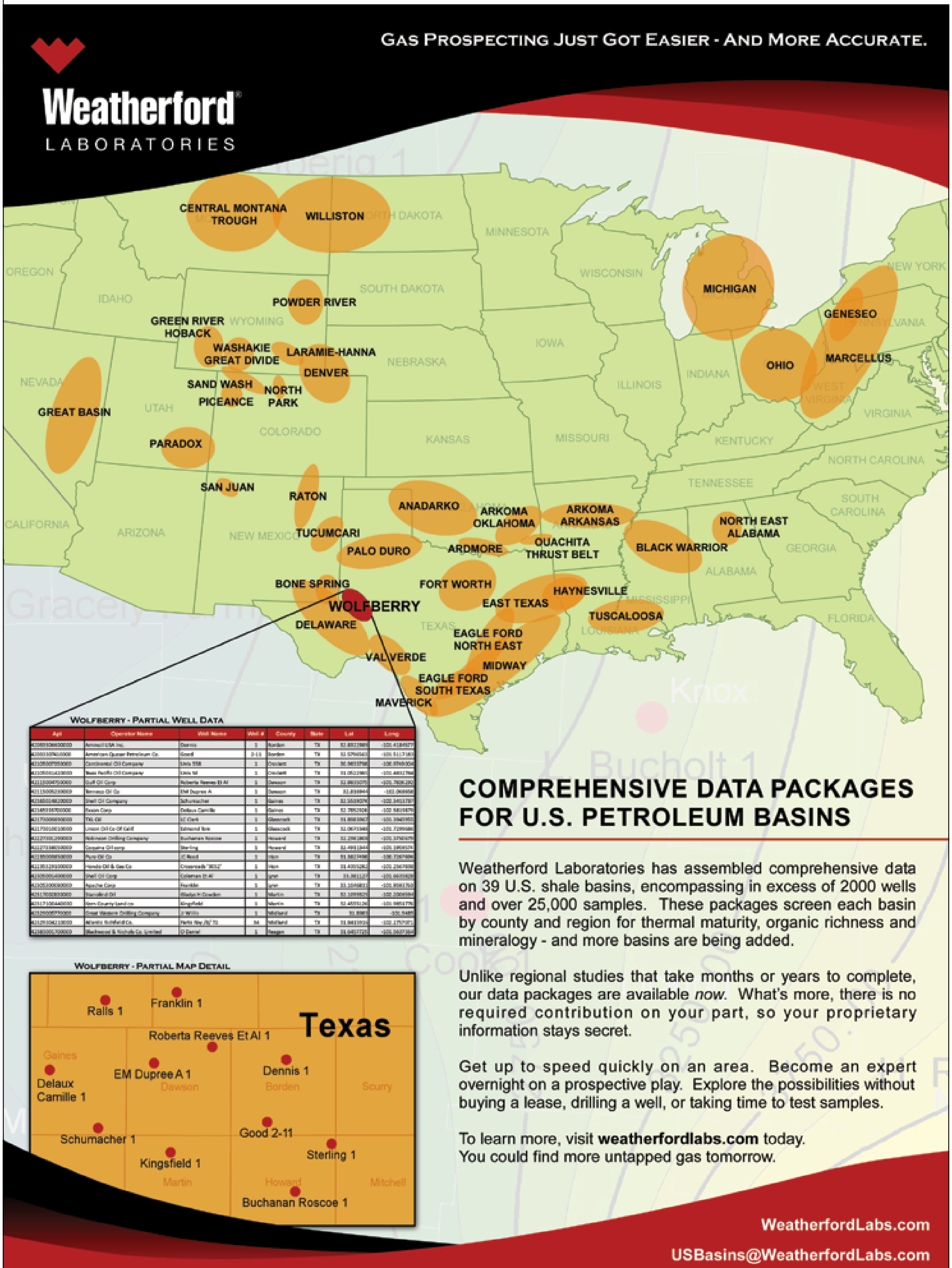
The journal aims to accelerate innovation in interpretation for resource exploration, exploitation, and environmental stewardship.

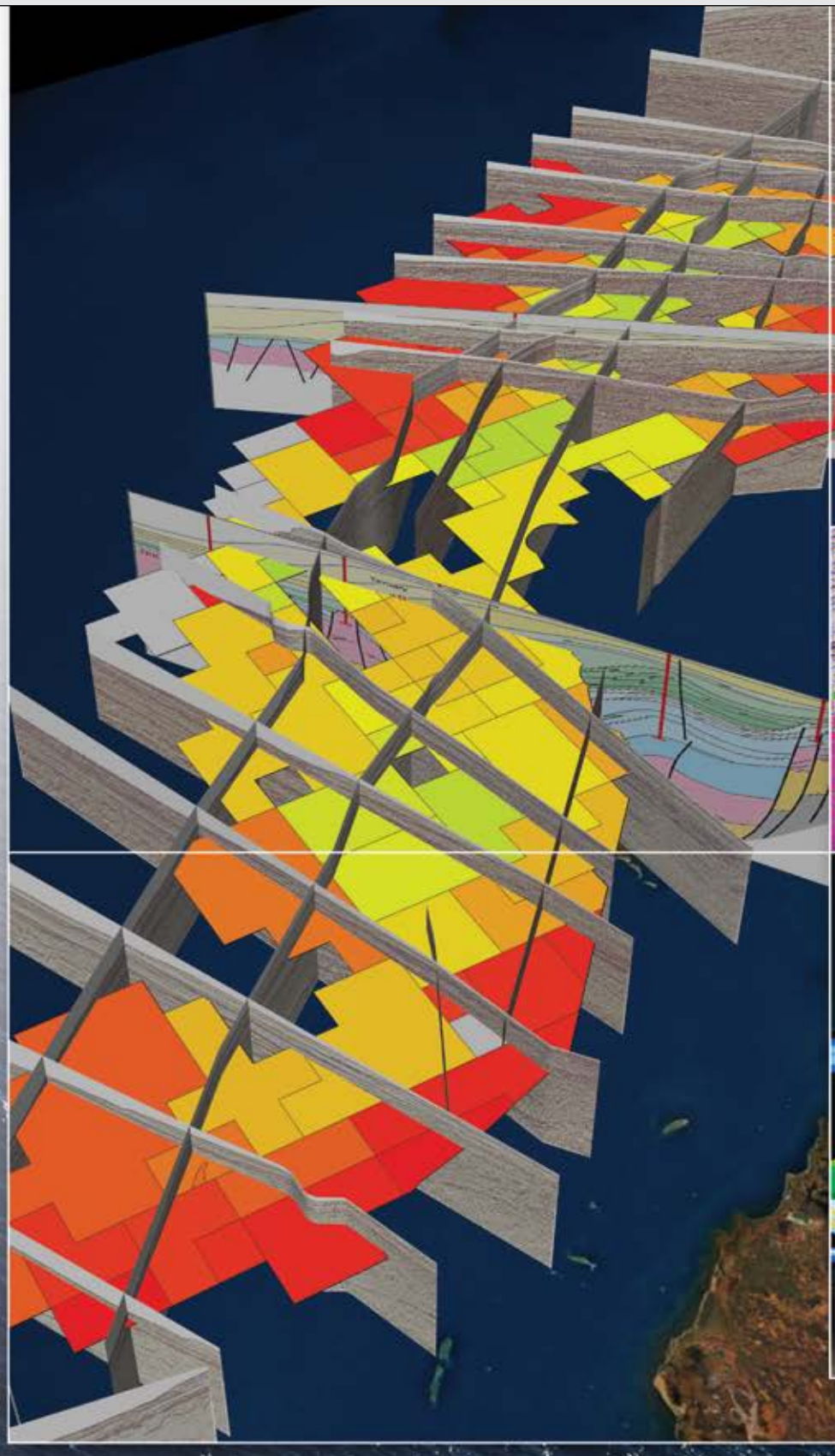
An Interpretation article is not required to contain an interpretation but should help advance the practice of interpretation. Articles that describe interpretation methods and applications involving integration of multiple data sets to quantify as well as visualize subsurface structure are strongly encouraged.

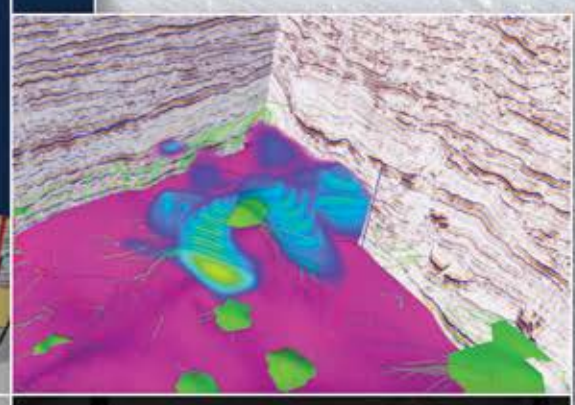
Relevant contributions include but are not limited to those that advance:

- Geophysical or geologic concepts and principles of interpretation.
- Correlation and calibration with engineering data.
- Planning and evaluation of alternative completion strategies via case studies.
- Development of algorithms for interpretation tools.
- Interpretation through explication of workflows, pitfalls, observations, insights, technical challenges and tutorials.

Learn more and submit articles through the journal's website: www.seg.org interpretation. E







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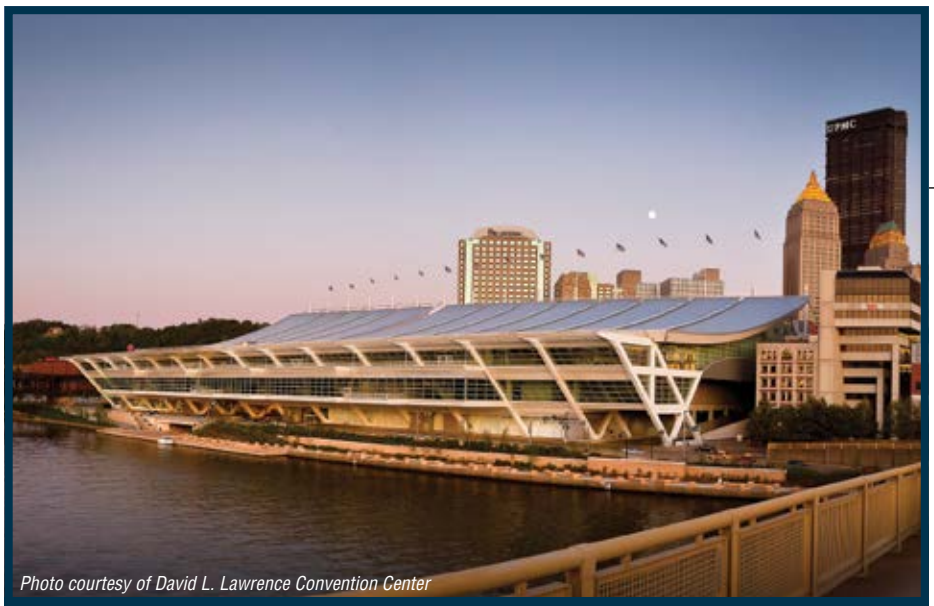


Photo courtesy of David L. Lawrence Convention Center

Pittsburgh's David L. Lawrence Convention Center will be the site of this year's AAPG ACE.

First Registration Deadline Arrives for Pittsburgh ACE

Online registration for this year's AAPG Annual Convention and Exhibition is now available – and the first deadline for reduced registration fees is arriving this month.

That deadline arrives March 25, to be exact.

The 2013 ACE will be held May 19-22 at the David L. Lawrence Convention Center in Pittsburgh – the first time an ACE event has been held there, and the first time since 1986 for AAPG to hold its annual meeting in the eastern United States.

This year's theme is "Go Deep: Making the Play With Geotechnology," and a substantial part of the varied, far-reaching technical program will deal with the eastern U.S. shale plays that are dominating much of the industry's current activity.

For example, this year's Michel T. Halbouty Lecture, an annual ACE feature funded by the AAPG Foundation, will feature Jeff Ventura, president and CEO of Range Resources, who will discuss "Range's Path to Discovery and Commercialization of the Marcellus Shale."

Other examples can be found in the short course offerings ("Basic Tools for Shale Exploration"), field trips ("Devonian Gas Shales of the Appalachian Basin," "The Marcellus Shale in South-Central Pennsylvania, Eastern West Virginia and Western Virginia"), forums and throughout the oral and poster presentations.

Other highlights include:

- Sunday's opening session, featuring an address by AAPG President Ted Beaumont and the bestowing of AAPG honors to the Association's and profession's best, led by Sidney Powers Memorial Award winner Dietrich Welte and Michel T. Halbouty Outstanding Leadership Award winner Stephen A. Sonnenberg.
- James Palm, CEO of Gulfport Energy, will be this year's All-Convention Luncheon speaker, talking about "Proving Up the Utica's Liquids Window."
- The Discovery Thinking Forum will be held on Monday, making it the seventh presentation of the AAPG100th Anniversary Committee's program recognizing explorers who have made a difference. This year's forum theme is "Important Discoveries Expanding Resource Play Concepts."
- A special Energy Policy Forum will be held on Tuesday, titled "Demand Side of the Natural Gas Price," moderated by AAPG's GEO-DC Director (and EXPLORER Policy Watch columnist) Edith Allison.
- The AAPG Imperial Barrel Awards ceremony once again will be presented in a colorful, exciting setting immediately preceding the opening session, open to all attendees.
- As always, the exhibits hall will be filled with the latest technology, information and energy services – and will be the site for the annual Icebreaker reception, daily refreshments, the Cyber C@fé and the AAPG International Pavilion.

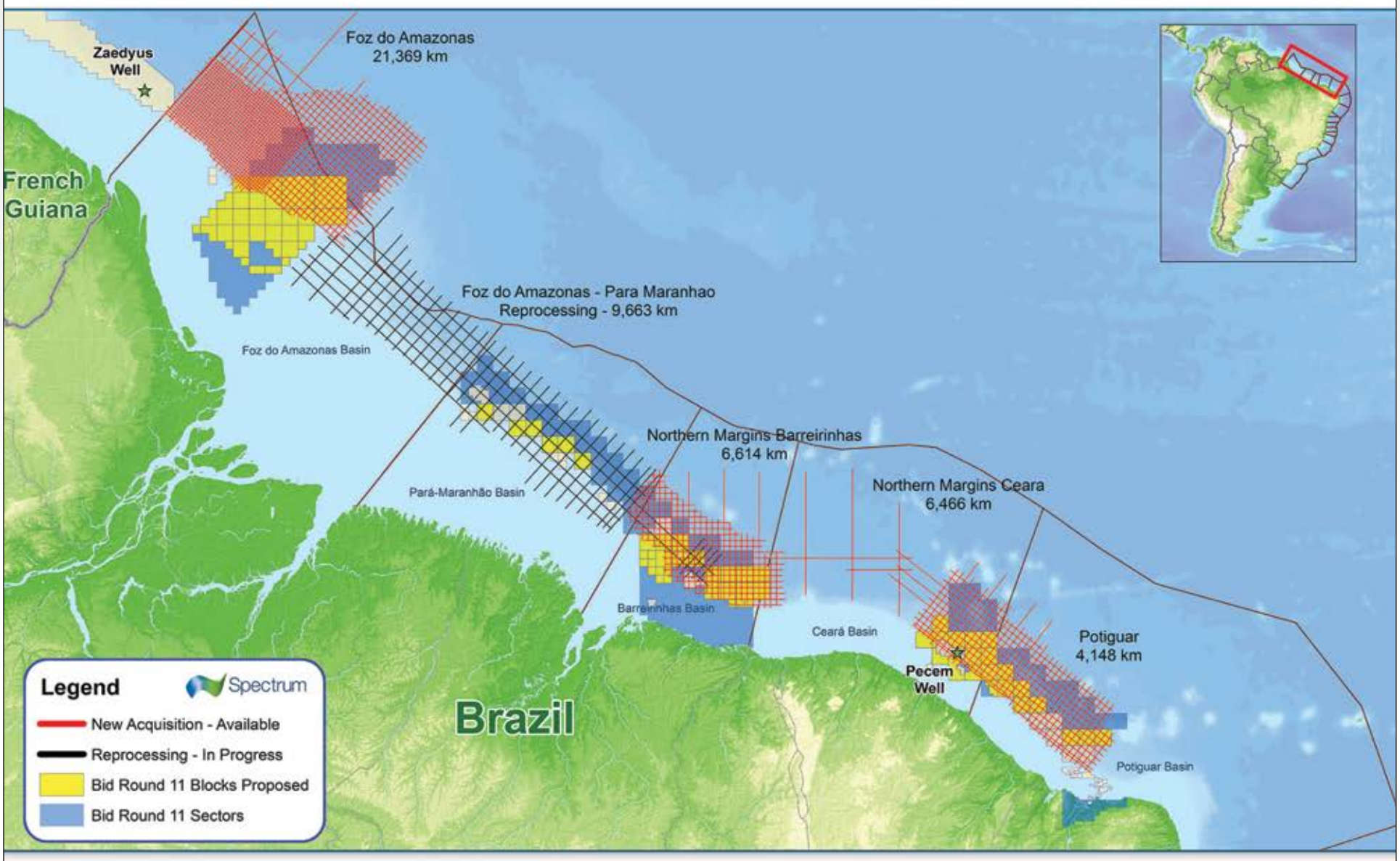
As in past years, a discounted fee schedule will be offered to those who register early for the meeting – and members who register on or before March 25 can save $200 off the full price.

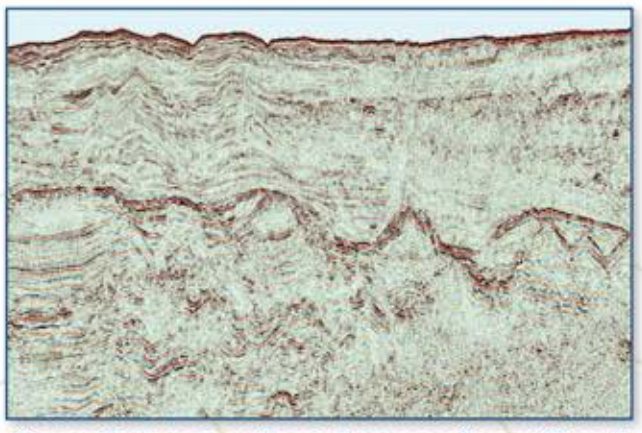
Details of the meeting – including the complete technical program, field trips, short courses and various events – can be found in the official ACE announcement that accompanied the February EXPLORER.

To register, and for more ACE information, go to www.aapg.org/ACE.

Equatorial Margins Brazil

Multi-Client Seismic - Amazonas, Ceara and Barreirinhas Basins





Canyon Features from Foz do Amazonas Survey (Phase I)

Brazil's Round 11 has released their preliminary schedule with the closing of the round on 14 – 15th of May 2013.

Spectrum is active in five basins along the Equatorial Margins of Brazil. We have PSTM and PSDM data available for each of the Foz do Amazonas, Barreirinhas and Ceara surveys all of which were acquired with 10,000 m offsets and 13 second record lengths. In addition we have completed acquisition of a 4,200 km survey in the Potiguar basin and fast track migrated stacks are now available for this survey. Final data from the Potiguar survey will be available in April.

Spectrum has also started reprocessing 26,000 km of recently released public domain data from the Foz do Amazonas, Para-Maranhao, and Barreirinhas basins which will be available in Q2 2013.

Our Multi-Client team is committed to delivering high quality data in advance of the upcoming Round 11. Companies participating in Spectrum's programs will have a competitive advantage in this round.

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SEISMIC 2013

Seismic Companies Poised for 2013 Rebound

By BARRY FRIEDMAN, EXPLORER Correspondent

There is a palpable sense among those who track such things that oilfield service companies will have a better 2013 than 2012. And considering that the big three – Halliburton, Schlumberger and Baker Hughes – all had disappointing fourth quarter earnings' reports, this news couldn't come at a better time.

Geophysical companies represent an important part of the industry's overall picture, and overall, the state of the their part of the industry was a bit mixed at the start of the year, according to various analysts.

Challenges that the industry faced last year, according to various reports, included:

- A bearish business environment caused by market prices.
- A very bullish (and perhaps oversupplied) marketplace for hydraulic fracturing services.
- The high cost of various materials.

Analysts are expecting a rebound in 2013, however, thanks to offshore operations, international growth during 2012, and the simple fact that some activity will be necessary for operators to retain possession of potentially valuable shale targets.

More signs of improvement can be found in the price of stock for the big three companies; in early February all were up – in the case of Halliburton, up about 16 percent.

"I am very proud to say that our company delivered industry-leading revenue growth in 2012, resulting in a record year," commented Dave Lesar, chairman, president and chief executive officer of Halliburton.


LESAR

Analysts say many companies may have pulled back too much in 2012, and an adjustment is due.

Lesar sees even more light at the end of 2013 – for his company as well as his peers in the oil services industry.

The reasons, according to analysts, are three-fold:

- Many companies may have pulled back too much in 2012, and an adjustment is due.
- Rigs are becoming more efficient, allowing more wells to come online that need to be fracced and completed, padding the profits of these large oilfield-services companies.
- Rigs are becoming cheaper.

Specifically, well costs are falling (some analysts say about 5 percent and predict futures savings through the end of the year), as is the cost of fracturing, which is down between 15-30 percent.

These two factors will add to an already healthy bottom line – and more drilling.

"From a revenue perspective," Lesar said in his company's earning report, "we set new records this year in all of our regions and both of our divisions."

That translated to revenue of $7.3 billion in the fourth quarter for his company, which was up 3 percent sequentially and represented highest quarterly revenue in company history.

"All three of our international regions and eight of our 12 product lines set new revenue records," he said.

International's Impact

A closer look at Halliburton's report indicates the importance of the international arena for geophysical companies.

According to its Q4 earnings press release, the hot spots in 2013, will continue to be:

- Latin America – Revenue was up 14 percent sequentially, despite a 2 percent drop in the rig count, and adjusted operating income increased 25 percent sequentially.

Increased drilling fluids service activity, along with higher software sales in Mexico and Colombia, led the growth for the region.

- Eastern Hemisphere – Revenue grew 11 percent sequentially, and operating income increased 35 percent sequentially, driven by year-end sales of completion tools, software and other equipment. The company expects activity levels to grow in 2013.

- Middle East/Asia – Revenue and operating income increased 14 percent and 46 percent, respectively. The growth was driven by higher year-end software, equipment and completion tools sales, as well as increased service activity in Saudi Arabia and Australia.

- Europe/Africa/CIS – Revenue and operating income increased 8 percent and 23 percent, respectively, compared to the prior quarter. The was due in part to:

✓ Seasonally higher year-end completion tool sales in Angola and the North Sea.

✓ Greater demand for drilling services in the North Sea and Russia.

✓ Increased service activity in East Africa.

Unfortunately, that excitement was balanced by North America reports, where revenue was down 5 percent for the company compared to the previous quarter.

Operating income was down 22 percent compared to adjusted third quarter results, driven mainly by an unusually high post-Thanksgiving decline in activity levels with key customers and continued pricing pressure around hydraulic fracturing contracts.

"Our North America margins," he said, "are also temporarily being negatively impacted by the upfront roll out costs of

See **Rebound**, page 14

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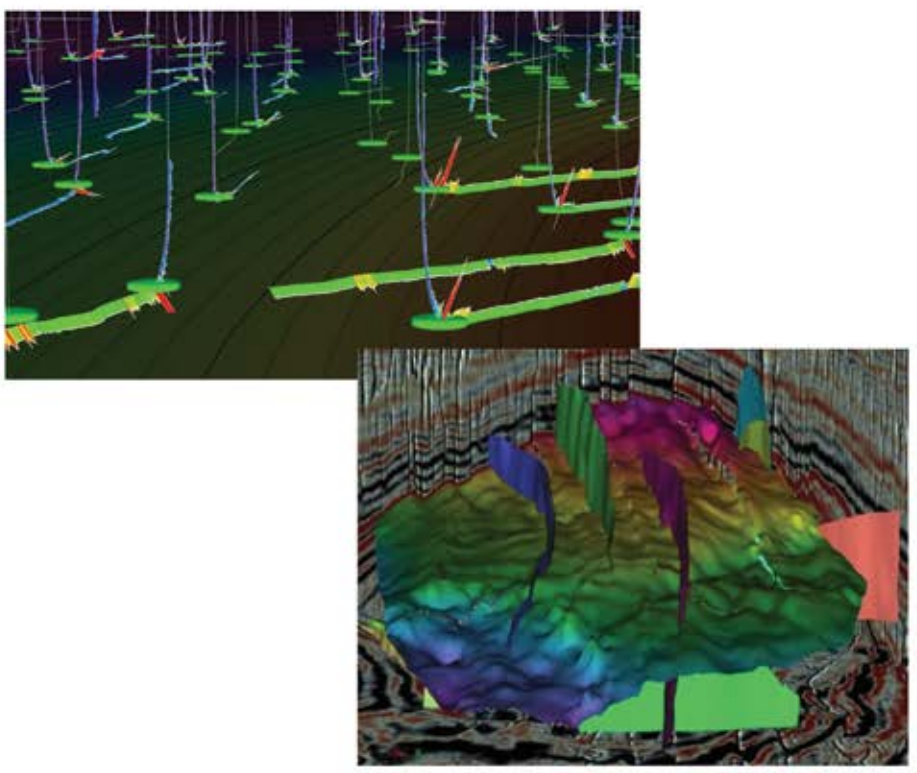

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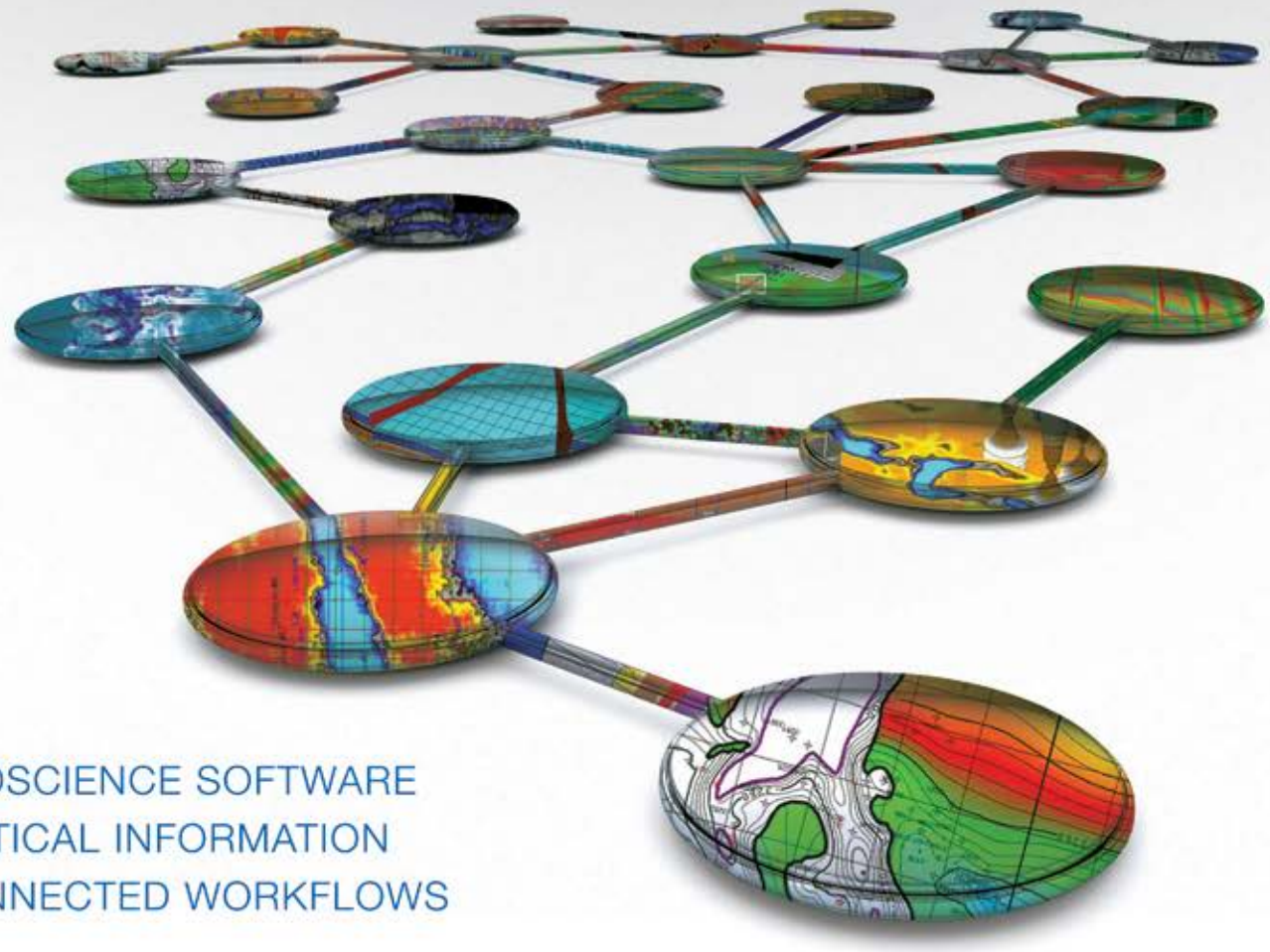

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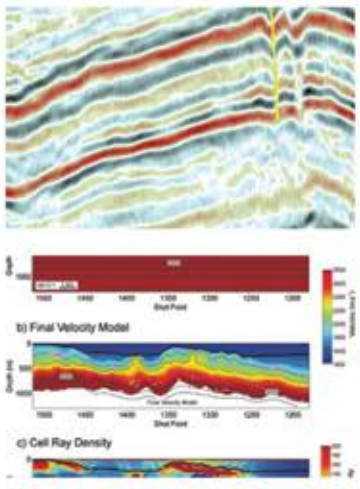

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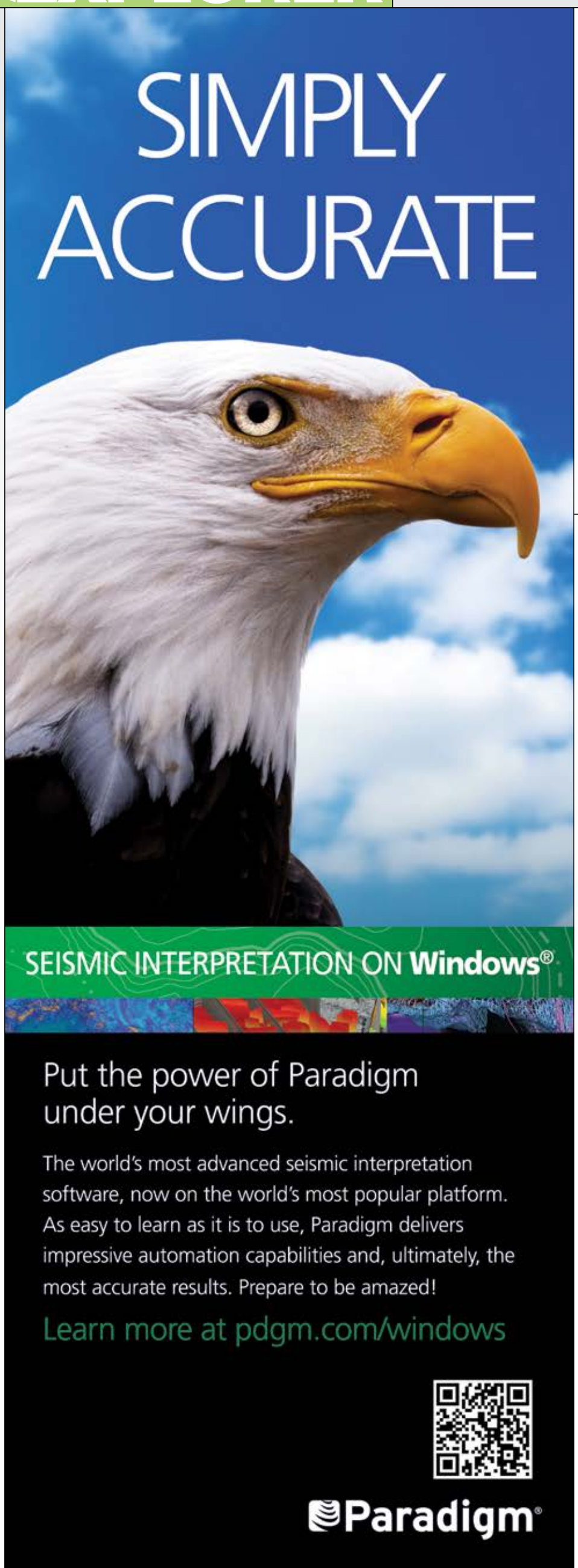
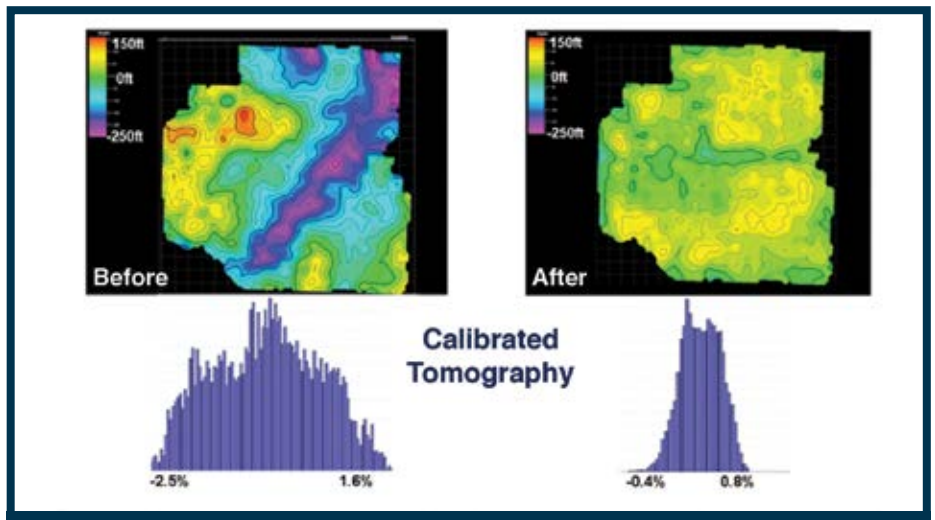




Results of a reservoir level seismic surface depth tie to the available well control. The purple trench (upper left) is associated with near-surface velocity variations modeled using three-term tomography. The tightening of the well tie histogram (lower right) provides more confidence in the depth of the interpreted surface after advanced imaging.

Maximizing recovery in 3-D

Pulling It All Together

By LOUISE S. DURHAM, EXPLORER Correspondent

Once upon a time, a shale zone was looked on as a source rock for hydrocarbons or as a seal to prevent oil and gas below the zone from moving upward and escaping into other formations.

It was only several years ago that the shale world's hydrocarbon treasure was targeted directly by the drill bit.


JOHNSON

These seemingly ordinary, organic-rich tight rocks were recognized as actual reservoirs and quickly became major go-to drilling objectives, triggering a whole new era in the petroleum industry.

It's all been possible technically and economically because of horizontal drilling and hydraulic fracturing – multi-stage fracturing for the most part.

But if you tend to think a shale is a shale, think again.

"Some geological assumptions early on were that shale in a reservoir unit is pretty much homogeneous," said Greg Johnson, principal area geophysicist at WesternGeco in Denver. "If you drill evenly and fracture evenly, it will produce, and we'll extract the maximum resource.

"Since then, it's been recognized that there's variability in production even between adjacent horizontals," he said. "The challenge becomes the design of the infill drilling program and how best to maximize the ultimate recovery of resource from each field in a timely fashion."

Enter 3-D seismic data.

'Something Meaningful'

It likely comes as no surprise that 3-D data are being viewed as the way to reduce drilling cost overruns and maximize ultimate recovery from a shale-producing field – and for relatively minimal additional cost.

Johnson emphasized the key is processing the seismic data specifically for these types of plays without taking shortcuts owing to perceived time and cost constraints.

"I'm on the surface seismic side of things," he noted. "We can cover a large land position with our seismic data as opposed to borehole data, which is just at the borehole and then extrapolated between measurement points.

> **"The challenge is to couple those two sets of data together into something meaningful."**

"The challenge is to couple those two sets of data together into something meaningful, and that's what our work does," Johnson said. "It's an integrated workflow that pulls all that technology together and tries to describe the heterogeneity we're seeing in the production side.

"Land 3-D seismic data are normally acquired with multiple azimuth directions between source and receiver positions," Johnson noted. "Multi-azimuth seismic data enable superior imaging, and if the azimuthal information is carried correctly through all imaging steps, multi-azimuth inversion techniques utilizing both residual travel times and amplitudes can be effectively used for reservoir property description."

The data are migrated in offset vector tile (OVT) format, which affords a way to sort the input data in a manner such that when multi-azimuth information in the seismic data is referenced, it refers to direction and azimuth between a source and receiver when the data are recorded.

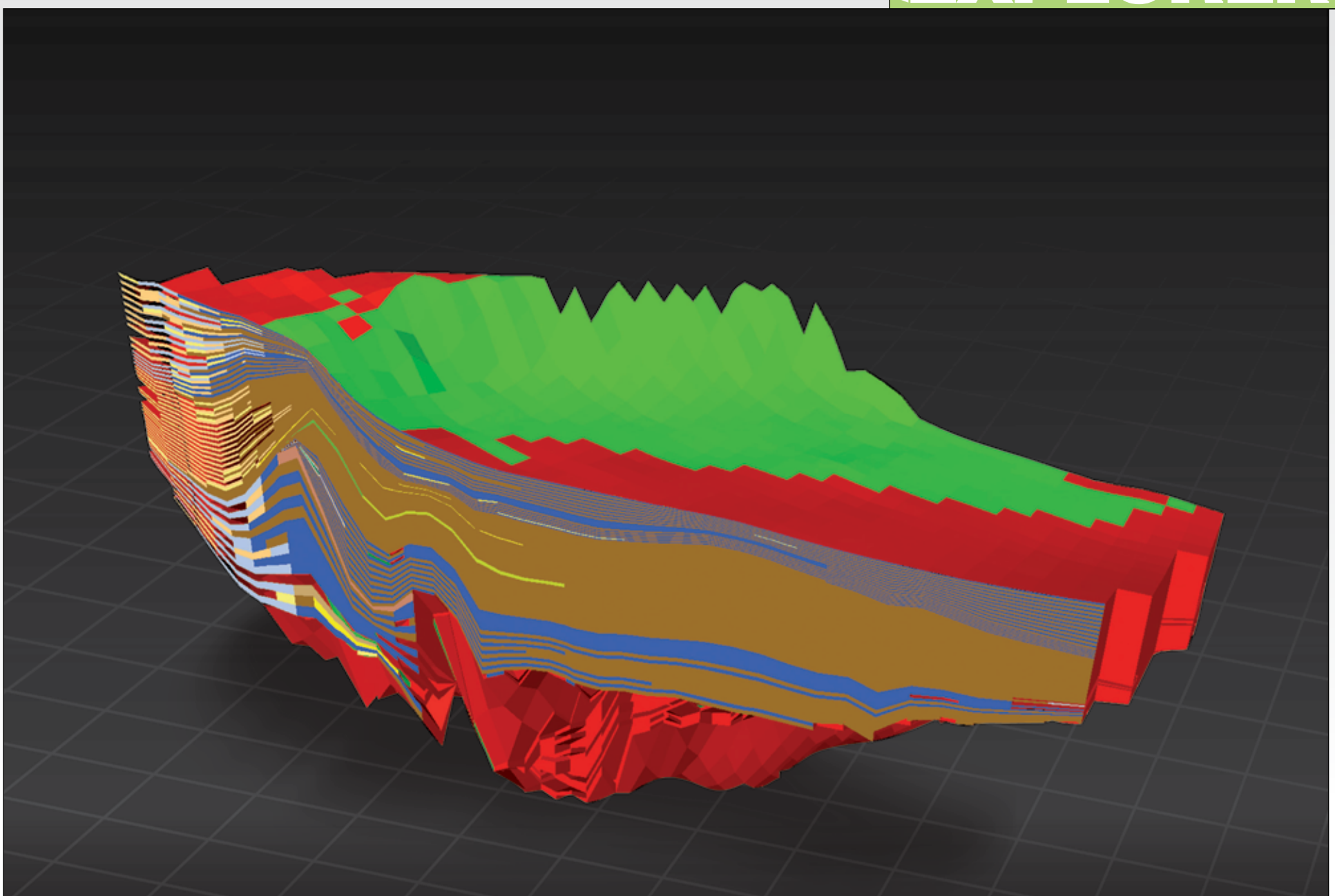
Once the geoscientists lay out the surface pattern of the source and receivers, the azimuth of those vectors is a critical information component in the data.

Johnson noted that in the past this information was lost when the data were migrated. Everything got mixed together in the final image.

OVT enables preservation of the azimuthal source-receiver information through the migration, meaning it can be analyzed post-migration.

"The tomography process performed

See **Imaging**, page 14



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Imaging
from page 12

following migration works better when we preserve the multi-azimuth information in the data," Johnson emphasized. "Tomography allows us to update the velocity model in much more detail than without it."

Getting Real

In the past, 3-D surface seismic data were recorded in time. The source was fired, and the noise was picked up and recorded in time.

"Traditionally, processing has stayed in the time listening domain called two-way time, or the time for the energy to go down, hit the reflector and come back up," Johnson said. "We're working to produce an image or cross section of the earth that is not in time but actual depth – drillers work in the real earth.

"Now, when we migrate the seismic, we actually transform it from two-way time to depth on output, collectively called depth migration," he noted. "This advanced imaging becomes even more advanced when you can go from time to depth, and at the same time you're doing that you actually calibrate to known depths of the wells.

"Performing that all in one step makes the migration more accurate in terms of the information it carries through," Johnson added.

Needed: Integrated Effort

It's essential to recognize the unconventional puzzle, e.g. variability in productivity rates, cannot be solved without all hands on board.

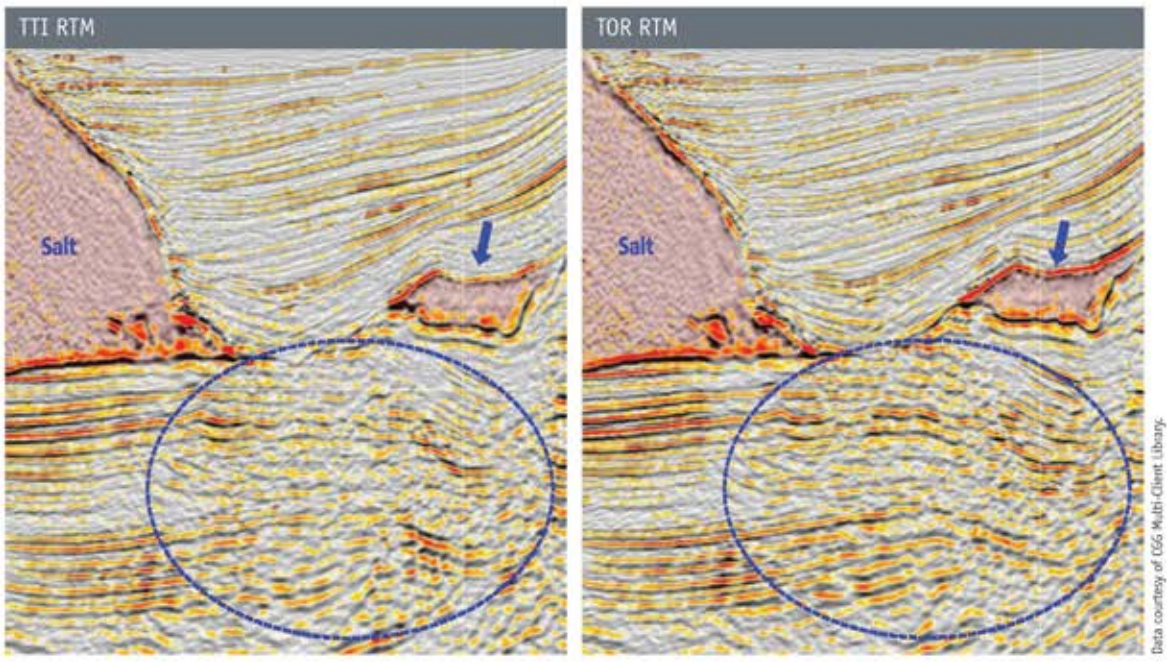
"It has to be an integrated multi-disciplinary effort of geologists, geophysicists, petrophysicists," Johnson emphasized. "All of the different data measurements that are made have to all come together on these projects; that's the goal here.

"We're bringing in the data from the wells right up front in the work we do," he said. "Our version of advanced imaging achieves high image fidelity (flat gathers) and optimal seismic-to-formation ties by means of the imaging step, requiring little if any post-imaging calibration.

"Inversion processes can then be done with greater confidence in the accuracy of the results."

Tilted Orthorhombic RTM

Solving subsalt challenges



TTI RTM is a widely used technology, but it struggles to reconcile azimuthal velocity variations in the presence of fractured, tilted overburdens.

Hence CGG has developed a suite of **Tilted Orthorhombic (TOR)** algorithms. **TOR** tomography resolves inconsistent residual moveout among azimuths, caused by uneven stress and fractures within the overburden.

The velocity model produced by **TOR** tomography, with more accurate descriptions of overburden velocities, is then utilized by **TOR** RTM to provide significant subsalt imaging improvements.

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HoD Sets Agenda For Pittsburgh

The AAPG House of Delegates will vote on a constitutional amendment regarding delinquent dues payments at the group's meeting May 19 in Pittsburgh, right before the start of the AAPG Annual Convention and Exhibition.

The full language of the amended wording is available for review at aapg.org/bylawschanges.cfm.

Delegates also are expected to consider a proposal to change the boundary between AAPG's Asia Pacific and European Regions, according to HOD Chair R. Randy Ray, as well as a proposal to create a new technical division of AAPG called the "Petroleum Structure and Geomechanics Division."


RAY

The boundary change would result in moving five Central Asians countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan – to the European Region from the Asia Pacific Region.

The PSGD proposal comes from a group of about 200 people who have been meeting informally at AAPG annual meetings since 1997, under the leadership of AAPG Editor Stephen Laubach and Peter Hennings.

"The group is interested in aspects of structural geology, including faulting, fracturing and seals, which are influenced by rock's mechanical properties," Ray said. "This also incorporates the study of stresses and pressures at reservoir level that affect drilling and completion procedures.

"The topic has broad appeal and will attract existing members as well as draw new members to AAPG from other professional societies with like interest," he added.

Delegates also will vote on new officers for the HoD, who will begin service immediately following the HoD adjournment. The candidates are:

Chair-Elect

❒ **Paul Britt**, independent geologist and president of Texplore, Houston.

❒ **David Dolph**, team lead-Global Exploration, Nexen Petroleum International, Calgary, Canada.

HoD Secretary/Editor

❒ **Mark Rainer**, senior geologist, Jones Energy, San Diego.

❒ **Dan Billman**, president, Billman Geologic Consultants, Mars, Pa.

Rebound
from page 10

our 'Frac of the Future' initiative, by our commitment to our customers to remain active in the North America natural gas basins at lower margins and by our decision to stack equipment during the fourth quarter."

With these frac costs decreasing, as well as other factors, Lester sees things improving.

"In 2013, we anticipate the North America rig count will improve from fourth quarter levels," he said. "We are focused on rebuilding margins as we … reap the benefits of our strategic initiatives, and look at all of our costs."

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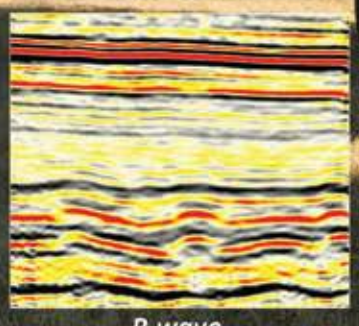
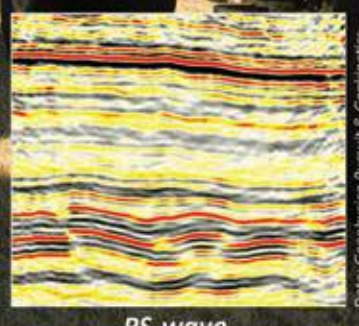


P-wave



PS-wave

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SEISMIC 2013

Finding production trends, parameters

Eagle Ford Data Base Provides a Sweet Spot

By LOUISE S. DURHAM, EXPLORER Correspondent

Unconventional shale plays are nothing if not complex.

The booming Cretaceous Eagle Ford play in south Texas is a prime example.

Covering 11,000 square miles, it's a depth-driven resource with oil produced as deep as 8,000 feet in the northwest, continuing through condensate and natural gas liquids and on to dry gas as deep as 12,000 feet to the southeast.

Production tallies more than 1 MMboe/d from 3,500 producing wells.

The spoiler for the operators?

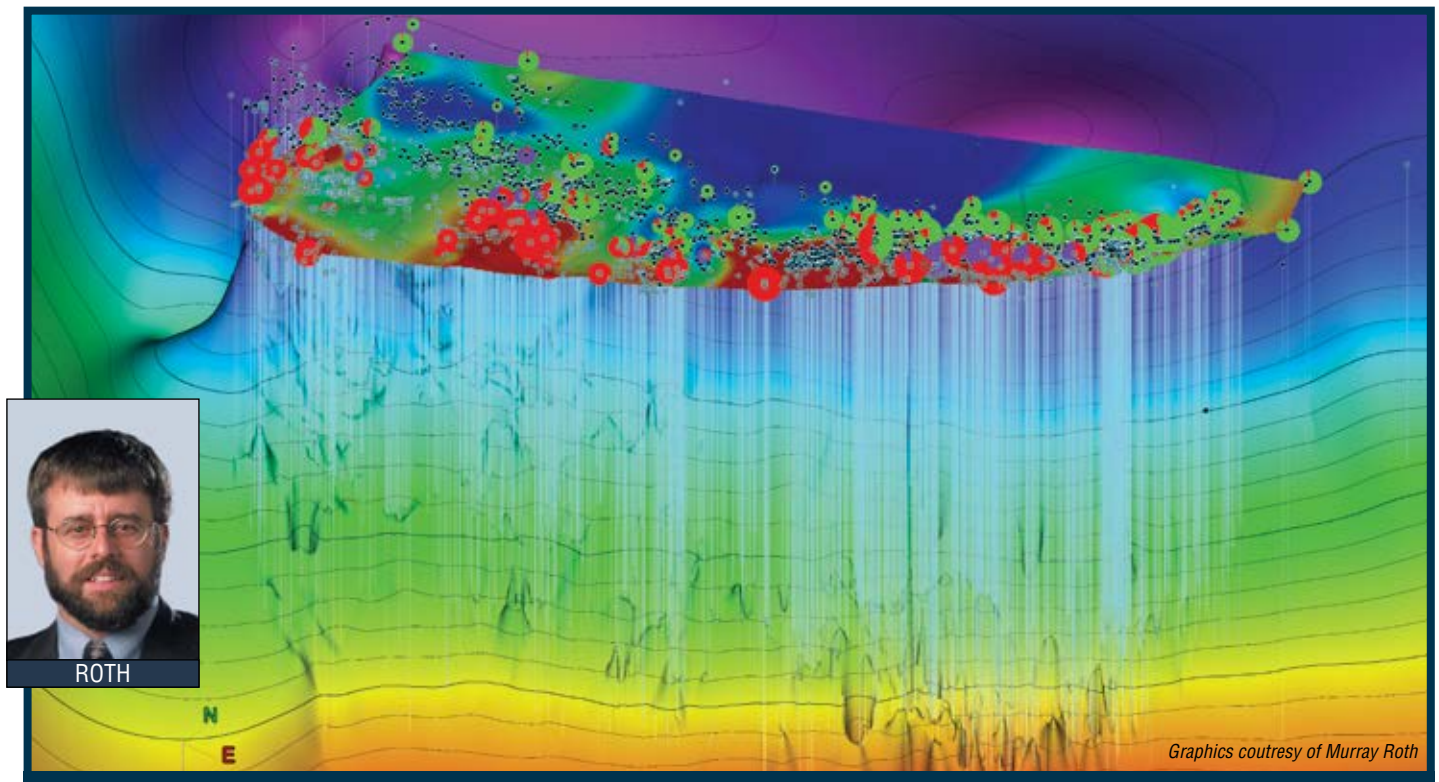
Variable well production makes it difficult for these folks to high-grade sweet spots and optimize well spacing and completions.

Even so, some operators are using the factory approach to field development, laying out a systematic horizontal well pattern across prospective acreage.

In addition to variable production volumes, there's a high degree of variability in well length and orientation, number of fracture stages, and hydraulic fracturing volumes and rates, according to AAPG member Murray Roth, president of Transform Software Services in Highlands Ranch, Colo.

Roth should know.

He and his team created a regional data base of more than 3,500 producing Eagle Ford wells with reported drilling, completions and production engineering data, merged with available geologic top, geochemistry and other relevant data.



ROTH

Current oil and gas wells in the Eagle Ford: Production is mapped and highlighted as bubbles for selected wells; total well depths shown and contoured as depth surface.

They then used predictive analytic techniques to correlate geologic and drilling/completion engineering data with individual well performance to highlight production trends and optimal engineering parameters.

Isolation Play

Once Roth and his team had contoured the maps, depth and thickness could be determined.

"Depth matters," Roth said, "because you have more pressure the deeper it is, and it's more likely to be natural gas.

"Now you also have an economic dilemma, and you have to move updip

See **Eagle Ford**, page 18

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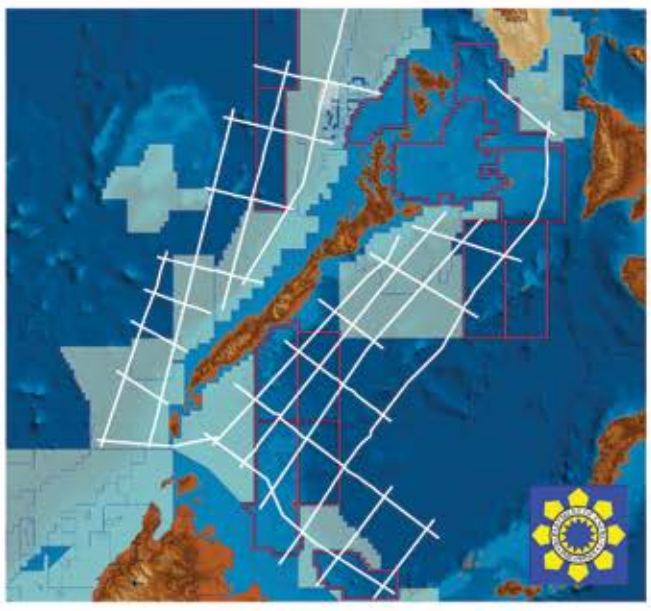
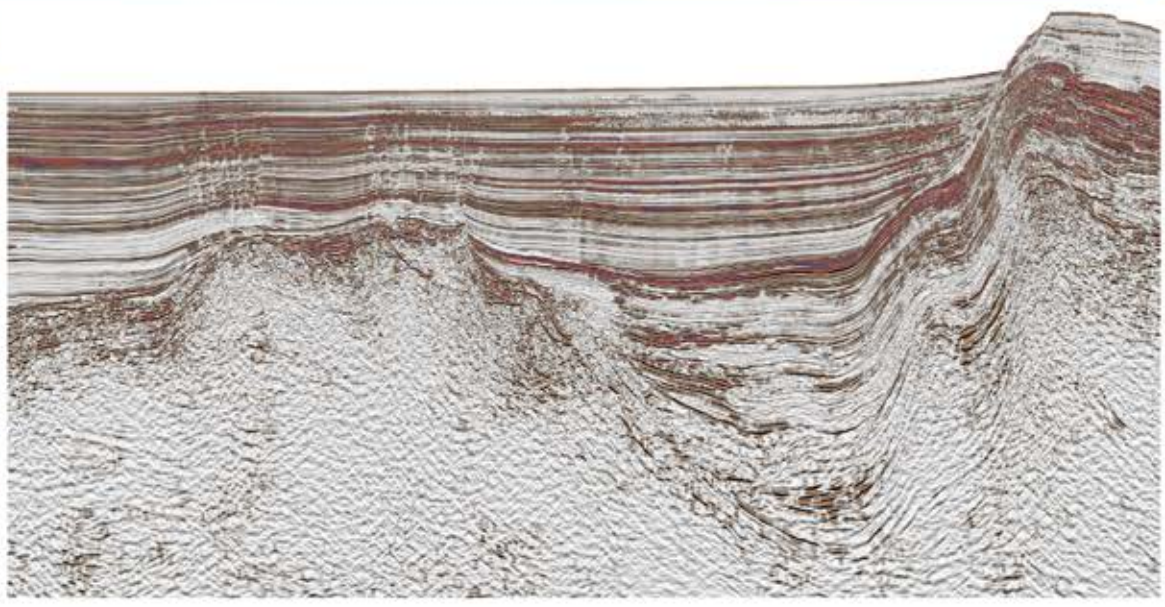
Pala Sulu 2D Seismic Survey

6,206 KM - East and West Palawan - Philippines





The Pala Sulu 2D Seismic Survey

- The Pala Sulu 2D new acquisition comprises 6,206 km of long offset 2D seismic data over the Palawan, Mindoro-Cuyo, Sulu Sea and Sandakan Basins which provides the first consistent link between these basins and provides a unique opportunity for companies to understand the regional tectonic and stratigraphic framework of the area with a modern high quality dataset.
- The ability to fully evaluate the extent and potential of the Philippines' petroleum systems has been restricted by limited data availibility over the distal and deeper water areas. Results from the new survey suggest the development of Paleogene grabens and half-grabens are significantly more extensive than previously suspected and allows for evaluation of new and existing play concepts throughout the basins and promotes new ideas for acreage release blocks.
- The presence of four working petroleum systems including pre-rift, syn-rift and post-rift settings, with a myriad of associated play types are evident in the data.

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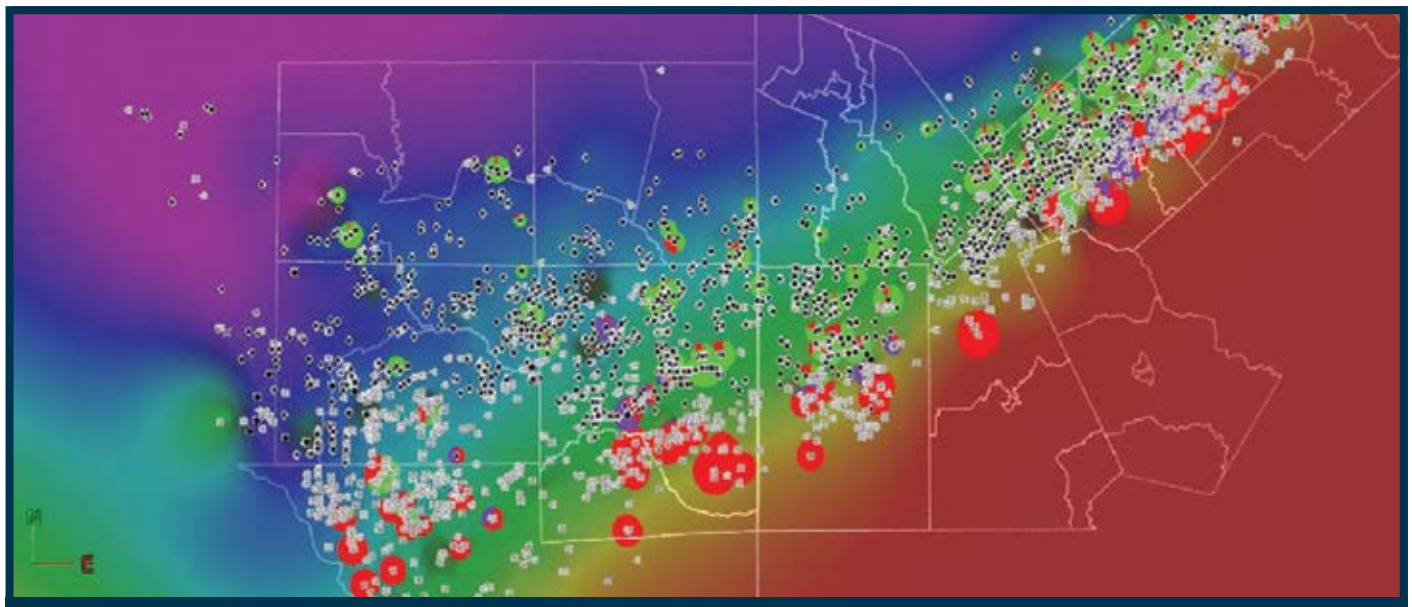

A data base like this – including total depth and other production data – has become a valuable predictive tool in the Eagle Ford play.

Eagle Ford

from page 16

to find the balancing act with your geochemistry to know where the sweet spots are," he noted. "You can make a depth map, a thickness map and put production on top of that, but a picture doesn't pop out.

"There's something else, and clearly it's the variability in the engineering," Roth said. "Even after 3,500 wells, it's difficult to map geologic sweet spots because the wells were drilled and completed in a different way.

"You can't cross-plot this," he stated. "You have to let the engineering and the geology speak for themselves in an integrated model and see what emerges from that."

He explained that this entails making a model and taking the engineering variability out of the model. By mathematically correcting for that variability, you acquire not just a geologic map but a map where production is scaled by this variability.

"I'm taking out the fact that I'm looking at a well, and it's a long well, and across the county is a short well, and the fact they have three times difference in production won't help me to understand the geology unless I remove that contamination from my geologic data," Roth said.

"The technique is about trying to isolate or normalize out the engineering and the geologic effects," he emphasized.

Otherwise, deceit takes center stage.

Imagine if you created a production map using real production values. There would be a rush to run out and buy acreage in a supposed sweet spot. Then comes the realization that the geology actually is pretty crummy, and people had overcompensated by drilling really long wells.

"You're being deceived by production because this is not a comparison of apples to apples," Roth noted.

Getting a Clear(er) Picture

Horizontal length would be the principle parameter to compensate for if the permeability in the Eagle Ford was normal, e.g. darcy, millidarcy versus nanodarcy.

"The additional nuance and complexity of normalization is completions in addition to the drilling," Roth said. "The complexity in these unconventional plays because of micro-permeability means the geology by itself is not a good factor on sweet spots if you're looking at production as a metric."

Think of it this way: Two wells are drilled with 10,000-foot laterals and one produces maybe five times as much oil, but it underwent 30 fracture stages vs. none for the other.

The resulting picture does not define the geology.

A map was created over the course of the workflow during the transform project to indicate what the rocks likely would produce if every well was drilled and completed the same way.

To get a clear picture of what's going on in the subsurface, you must remove the drilling and completion effects.

"Using a non-linear or multi-variate technique, based upon transforming variables into linear predictors of production, has proven to be a robust and reliable approach for assimilating and understanding the constraints for unconventional well production," Roth said.

He added they used publicly available engineering data and seismic data provided by Global Geophysical to construct the integrated production prediction model for the Eagle Ford.

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SEISMIC 2013

An unconventional idea

Open to Interpretation

By LOUISE S. DURHAM, EXPLORER Correspondent

Production from unconventional resource plays, principally shale deposits, is transforming North America into a major energy force.

To get to this point, however, has been a supreme challenge to geoscientists, drillers and many other industry participants.


WINTERS

Unconventional tight sand plays have been around for some time, but the fairly recent proliferation of E&P in numerous different shale formations represents a kind of whole new – and complex – world for these experts.

For starters, production variability among these dense low permeability rocks can be extreme – even between neighboring wells.

After years of conventional resource E&P, operators who opt to take on the unconventional targets quickly find that this entails a kind of back-to-the-books effort to determine what exactly is going on.

Valuable Data

The obstacles and pitfalls involved in this switch are very familiar to the folks at Fasken Oil and Ranch Ltd., which has been a part of the oil and gas industry since the 1940s, when oil was discovered on the west Texas C Ranch, long owned by David Fasken. The company is celebrating its centennial anniversary.

After decades-long production from conventional carbonate and sand reservoirs, the company shifted its focus to a plethora of drilling targets in low permeability formations such as the Spraberry, Wolfcamp and Cline Shale.

Fasken also owns large acreage blocks in the high profile Eagle Ford shale and the Bone Spring horizontal play.

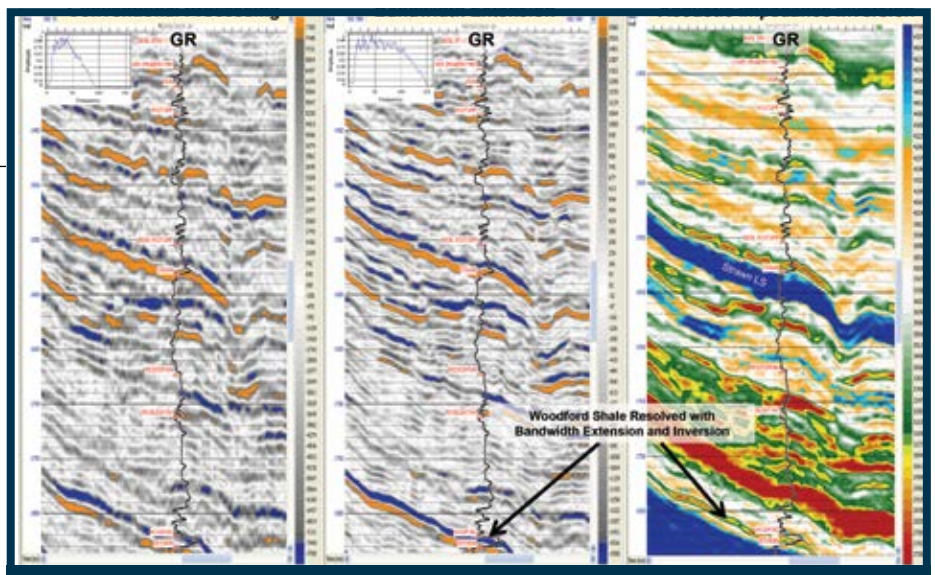
AAPG member Glenn Winters, chief geophysicist at Fasken, noted that geophysics plays a major role in optimizing production performance by well placement, especially in tight oil reservoirs. When it comes to staying in zone and monitoring the drilling process, geophysical data are invaluable.

"Getting to depth is a critical duty in order to generate well paths for horizontal wells," Winters noted. "Using different techniques in combination, such as converting volumes to depth by stacking velocities by the processor or utilizing p-wave inversion data and taking seismic horizons to depth several ways, helps to create the boundaries for the drilling engineer for the well path."

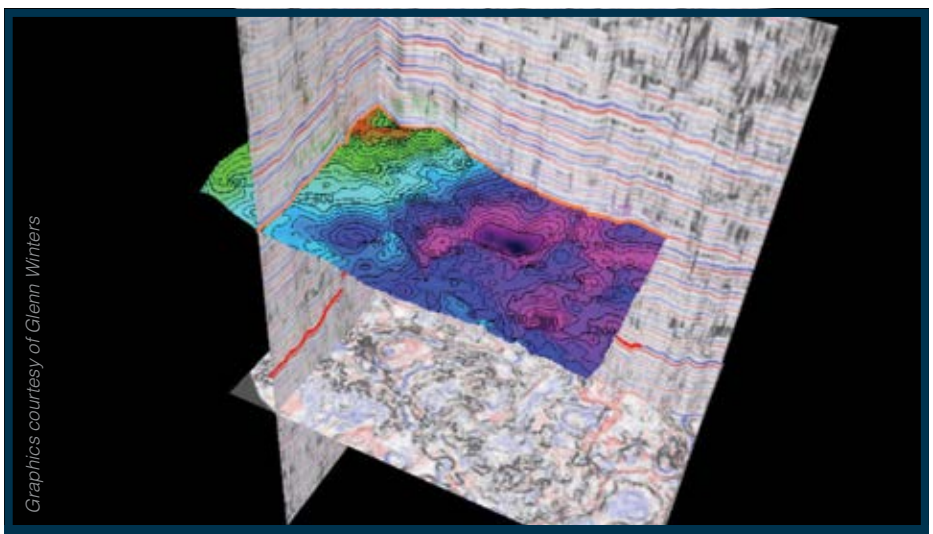
Different Strokes

Fasken is using different geophysical techniques to evaluate key factors in its

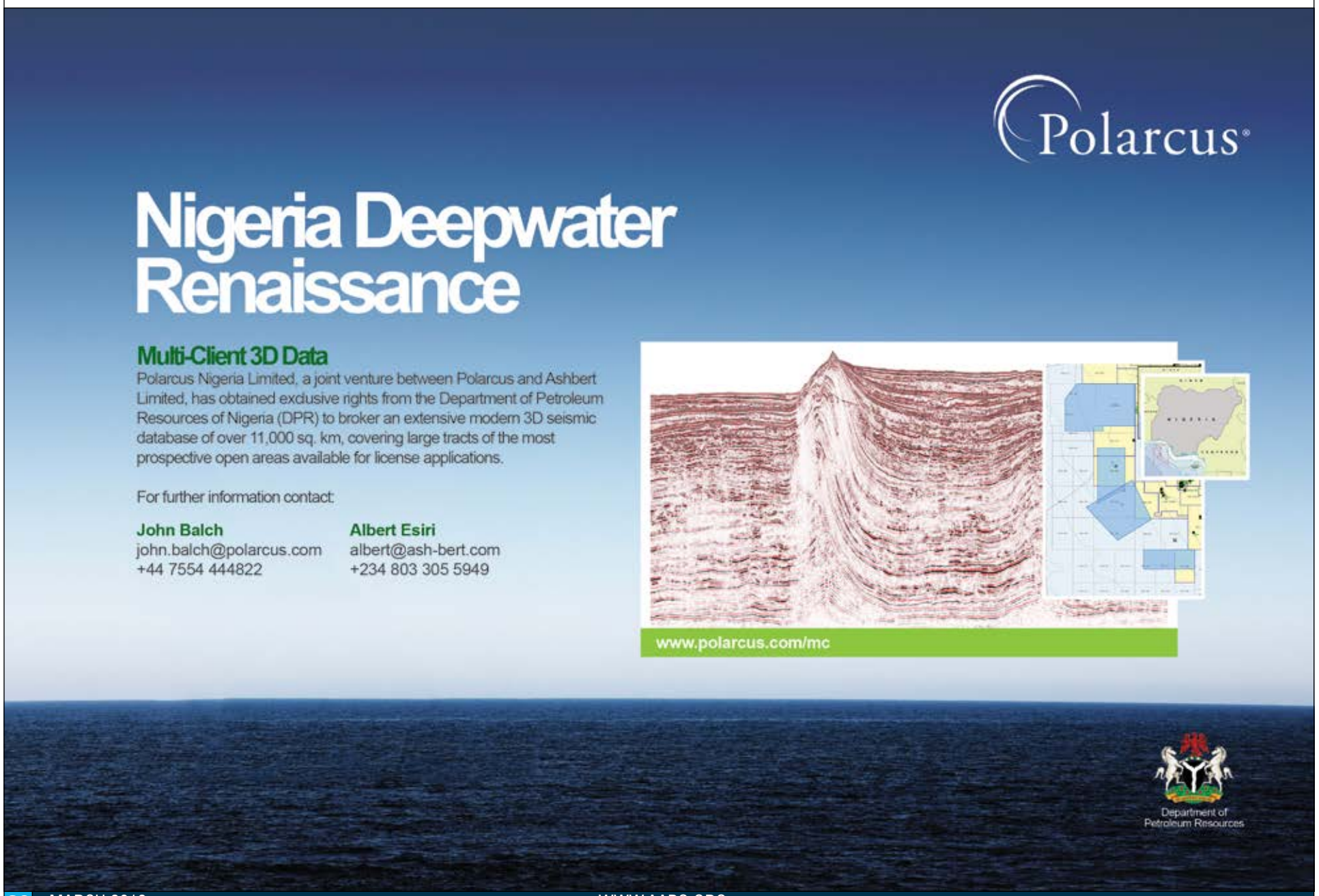
See **Interpreting**, page 22



Time volume sections: This example demonstrates the use of bandwidth extension to get better resolution from conventional seismic, and inversion to see the geology that gave us the seismic reflections to begin with. The gamma ray curve overlaid shows a very good correlation with the inversion result.


Graphics courtesy of Glenn Winters

Depth volume sections with coherency and structure and depth slice.



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Pore-pressure Prediction and Detection

Knowledge of pore pressure informs both tactical and strategic aspects of the exploration process. Tactically, predrill prediction of pore pressure allows for more effective, less expensive drilling operations, and real-time detection of pore pressure allows for safer well management. Strategically, the value of pore pressure lies in the ability to predict reasonable ranges of column heights and to infer likely hydrocarbon seals. Increasingly, pore-pressure estimates are high-visibility efforts which require the latest and greatest in multidisciplinary interpretative tools.

The editors of INTERPRETATION (http://www.seg.org/interpretation) invite papers on the topic **"Pore-pressure prediction and detection"** for publication in the February 2014 special section or supplement. Contributions are invited on interpretation across the broad spectrum of "pore-pressure-applicable geosciences" – geology, geophysics, geomechanics, clay mineralogy, sequence stratigraphy, petrophysics, core analysis, geochemistry, real-time wellbore and drilling monitoring, etc. – as these are applied in the analysis of overpressure for informing drilling practices and hydrocarbon seal analysis:

- case histories of challenging well pore-pressure interpretations, and what was learned
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- impact of predrill- and postdrill-pressure prediction/detection on recognition of regional or local hydrocarbon seals
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Interested authors should submit their manuscripts for review no later than 30 June 2013. In addition, the special section/supplement editors would like to receive a provisional title and list of authors as soon as possible. Authors should submit via the normal online submission system for INTERPRETATION (https://mc.manuscriptcentral.com/interpretation) and select this topic in the manuscript type dropdown option. The submitted papers will be subject to the regular peer-review process, and the contributing authors are also expected to participate in the review process as reviewers.

We will work according to the following timeline:

Submission deadline
30 June 2013

Peer review complete
26 October 2013

All files submitted for production
9 November 2013

Publication of issue
February 2014

Special section editors:

Dan Ebrom
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INTERPRETATION special section

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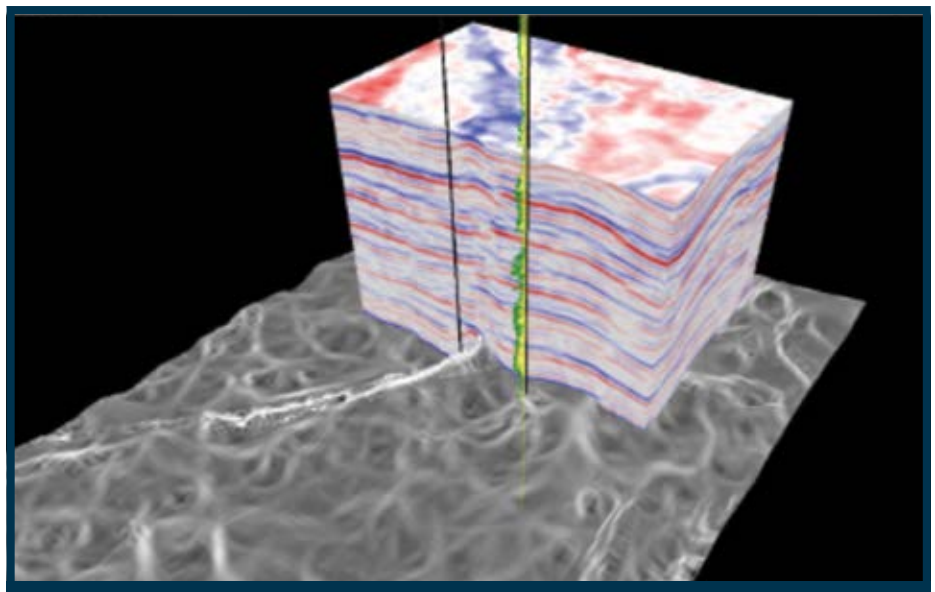

Choosing the right data set for interpretation is a crucial step in dealing with the challenges of unconventional resource plays. Shown here, depth volume sections with coherence slice and well logs and microseismic events.

Interpreting
from page 20

three play areas.

"For the everyday interpreter, there are obstacles and pitfalls in dealing with unconventional resource plays," Winters said. "These can pop up in the realm of seismic data reprocessing, which data volumes to use (and when), depth conversion and integration of microseismic in 3-D volumes.

"It's imperative to choose the right data set for interpretation," he said. "It's fairly common that I work with four or more data volumes that could consist of structural, high bandwidth, inversion, depth, and attributes such as coherency, geobodies or others."

After choosing the appropriate volume, Winters explained that they begin looking at the best way to display the data as slices, line and crossline, or else look at the combination of volumes in visualization software.

"We need to determine which attributes can maximize efficiency for the task at hand," he commented. "If I just want to identify locations for major structural elements in multiple formations, I may use one volume to interpret and just draw faults, in contrast for placement of a horizontal well in a single formation where the fault contacts and position are crucial to the well path."

Regarding the exceptional production variability often observed between adjacent wells in shale horizons, Winters noted that one of the lessons learned from analyzing seismic data in the Wolfberry play is that the geology can change somewhat abruptly. Intervals found in the stratigraphy of one well may not exist in the next one; this can be seen using the appropriate seismic data.

He emphasized that optimizing well locations and drilling the best wells at the beginning enhances production and cash flow.

Working Together

The Fasken team also is looking closely at integrating microseismic data into the interpretation process.

Winters indicated that a lot of small companies are very interested in doing this. Yet accessing high-end microseismic software requires big bucks, and many of the smaller companies likely won't use the product often enough to justify the cost.

He is a big believer in time lapse microseismic monitoring, noting that Fasken at one time laid out a permanently bedded array comprised of cemented geophones buried 200 feet deep over 16 square miles in the Wolfberry. This was done in an attempt to allow them to monitor completed wells in the area and to be prepared to monitor horizontal completions in selected formations in the future.

This can provide the key to determine how those formations fractured differently, according to Winters.

When the time comes to refracture a tight oil zone with declining production, time-lapse microseismic monitoring can be the big factor in helping to detect where the fluids exited the reservoir following the initial injection.

"We have to understand the fracture treatment before we can effectively refracture and enhance the stimulated reservoir volume," Winters said. "We have to know the results of that initial treatment in order to design a refracture program.

With all things shale, it's imperative that engineers, geologists and geophysicists all work together in these unconventional plays, in order to accomplish their objective(s).

Winters emphasized that this includes communicating with one another in an understandable language so that everyone is on the same page.

3-D Seismic Symposium Set in Denver

The 19th annual 3-D Seismic Symposium, jointly sponsored by the Rocky Mountain Association of Geologists and the Denver Geophysical Society, will be held Tuesday, March 5, at the Sheraton Denver Downtown Hotel in Denver.

This year's symposium will highlight 12 presentations, concentrating on case histories in resource plays using large-scale 3-D seismic surveys. Case studies include Rocky Mountain projects in the Niobrara, Bakken and Piceance, along with other analog plays from the Fayetteville, Marcellus, Eagle Ford and Western Canadian basins.

This year's keynote speaker will be AAPG member Thomas Jorden, chairman, CEO and president of Cimarex Energy, offering his perspective on 3-D seismic and resource plays.

Registration and additional information is available through RMAG (rmag.org), DGS (denvergeo.org) or the 3-D Symposium websites (3dseismicsymposium.com).

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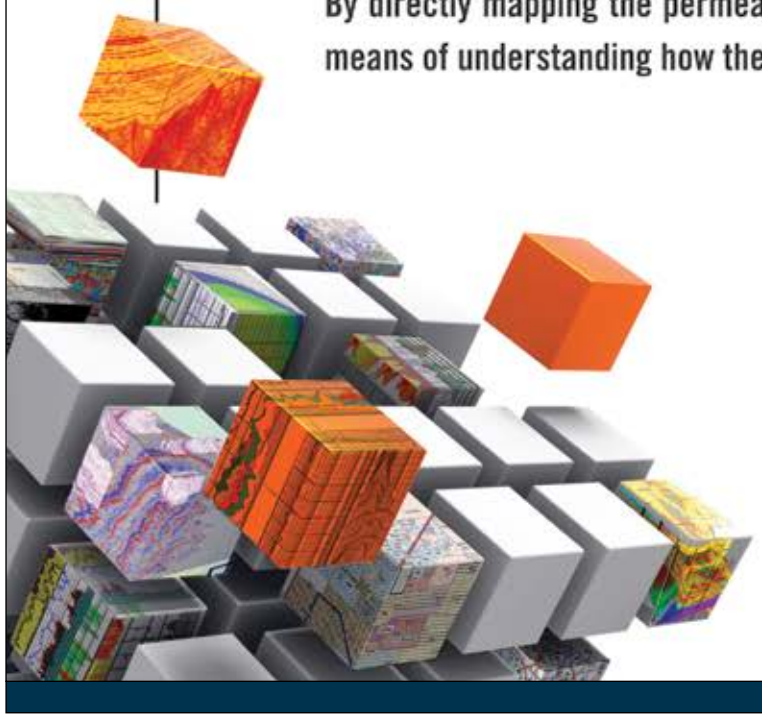

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Jacobi hired by New York DEC

AAPG Member Tapped for Fracture Review

By KEN MILAM, EXPLORER Correspondent

Being asked to provide a study on fractures and seismicity has put one AAPG member at the epicenter of the contentious debate over hydraulic fracturing in New York.

Robert Jacobi, a University of Buffalo professor for 33 years (now part-time) and consultant, was hired by the state Department of Environmental Conservation in early February for the study as part of its environmental review of hydraulic fracturing, known to much of the public as "fracking" (and to the industry as "fracing"), agency spokeswoman Lisa King told Bloomberg News.

Anti-"fracking" activists jumped on the appointment, saying Jacobi's ties to the drilling industry, particularly his current work with Pittsburgh-based EQT, a natural gas drilling company, would put the study's findings under a cloud.

"It raises questions about whether the DEC is just following the lead of industry on this or is taking their work seriously," Kevin Connor, director of the Public Accountability Initiative, a Buffalo-based group that studies ties between business and government, told Bloomberg.

Jacobi, who was president of the AAPG Eastern Section in 2008-09 and received nine AAPG Certificates of Merit, as well as the Eastern Section's Outstanding Educator Award, told the EXPLORER that his part in the study was "primarily assembling work already completed by myself and others ... (and) reviewing published literature and consultants' reports to various agencies.


JACOBI

> He accepted the task "desiring to be a good citizen, examining issues and providing data to those who needed to make decisions."

"There is no new science involved," he said.

New York has banned hydraulic fracturing until it completes its environmental studies and draws up regulations.

"Governor (Andrew) Cuomo made a promise to let the science alone drive his decision," Katherine Nadeau, water and natural resources program director for Environmental Advocates of New York, told the news service. "If he intends to keep that promise he must empower unbiased experts openly, and honestly review fracking's (sic) true public health and environmental impacts."

Nadeau later told the EXPLORER, "We have been watching these issues for years to make sure Gov. Cuomo stands by his promises and that unbiased experts are openly and honestly reviewing the data.

"Flags are raised by his ties to the University of Buffalo Shale Institute, which was closed last year," she added, "because of ties to industry interests ... under a veil of bias."

Asked about finding qualified experts without ties to the industry, she said, "It would be difficult to find someone completely detached, but the ties to the Shale Institute raise questions."

Being a Good Citizen

Jacobi said the "anti-fracing" sentiment in of some zealots in New York has become "like the Salem witch trials – being fact-based is not a part of it. You're anti-fracing or you're dirt."

He acknowledged that concerns about fracing's potential effects on water supplies are legitimate, but said his 20-plus years' of work in the Appalachian Basin stands on its own and bristled at what he called attacks on his professional and scientific integrity.

"Of course there are issues that need to be resolved and understood – that was one of the reasons the Shale and Society Institute was founded, to look at these issues with unbiased science," he said. "There have been accidents, especially in the beginning.

"I was a consultant to both (the state and EQT) at the same time, but in terms of my own conduct, I don't think there is in any way a conflict," he said.

"The faults are where they are. What we know is what we know. I'm the one who knows most about where the faults are," he said.

"The point is that my work – combined with that of my students and colleagues – stands on its own, and is of such a caliber that the data, concepts and conclusions are in demand by both environmental groups and oil and gas companies," Jacobi said.

Jacobi said the state asked him to assemble data on "fault systems with respect to seismicity, induced seismicity from fracing – whether fracing could affect the water tunnels of New York City, fluid migration, anything to do with faults."

He accepted the task "desiring to be a good citizen," he said, "examining issues and providing data to those who needed to make decisions."

Taint Necessarily So

Jacobi said the debate seems more contentious in New York than other areas.

"We need a dialogue about how to fix the energy problem we're in," he said.

"Quit fracing and gas supply decreases

See **Jacobi**, page 28

AAPG GEOSCIENCES TECHNOLOGY WORKSHOPS

INFORM DISCUSS LEARN SHARE: THE AAPG GTW EXPERIENCE

Exploring and Producing Fractured Reservoirs in the Middle East

Keynote Address: Ahmad Jaber Al-Eidan, Kuwait Oil Company

22-24 April 2013 • Dead Sea, Jordan

This GTW will be opened by plenary sessions that will overview the history of the fractured reservoirs of the Middle East. Key elements of the variability of the region's fractured reservoirs will be examined through utilizing available geological, geophysical, geomechanical and engineering techniques through case studies. A better understanding will be gained of the impact and interaction of the structural setting and stress regime on reservoir scale fractures for development and exploration.

E&P Data Management

6-8 May 2013 • Muscat, Oman

Oil and Gas Exploration and Production is dependent on data and accumulated knowledge to make the right decisions. A Huge amount of seismic and well data is being acquired, processed, and interpreted to reduce risks in making decisions in every step in the exploration & production process.

This workshop will focus on E&P data and knowledge management through a comprehensive technical program with presentations and discussions to share experiences, case studies, strategies, solutions, and other relevant elements in data and knowledge management.

Challenges of New Frontier Off-Shore Deep Water Hydrocarbon Basins: Focus on the Levant Basin and East Mediterranean

27-29 May 2013 • Beirut, Lebanon

Today, the Levant Basin – located in the East Mediterranean Region – has earned its position as a new Frontier Hydrocarbon Province.

This workshop will be an opportunity to improve our understanding of sediment supply and basin filling, organic matter distribution and biogenic vs. thermogenic hydrocarbon generation through the presentation of global case studies and analogues.

Looking Ahead of the Drilling Bit

3-5 June 2013 • Istanbul, Turkey

Accurate prediction of formations and target zones, pore-pressure and stratigraphy are critical for safe and economic drilling operations and remains a major problem facing drillers worldwide. The recent upsurge in horizontal and subsalt drilling in the Middle East and North Africa has renewed the need for optimum methodologies and technologies particularly suitable for the region. This workshop will focus on the geological challenges associated with the drilling in our geologic environment, recent case histories and the latest developments in technology and processes, and to serve as a forum that integrates pertinent ideas of future applications as well as research.

For information on these AAPG GTW's, please log on to our website at http://middleeast.aapg.org.

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Venue: Imperial College London

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- Lord John Browne
- Professor Scott Tinker (Director, Bureau of Economic Geology, Texas)
- Dr. Bruce Levell (VP Emerging Technologies, Shell)
- Malcolm Brown (Senior VP Exploration, BG Group)
- Bryan Lovell (former President, Geological Society of London)
- Professor Joe Cartwright (University of Oxford)
- Emeritus Professor John Woods (Imperial College & the 2007 Joint Nobel Peace Prize Winner)
- Mike Daly (VP Exploration, BP)

Further information and registration details:

Further information and registration details can be found at:
www.geolsoc.org.uk/oilcentenary13
or contact Steve Whalley at the Geological Society, using the following email address:
steve.whalley@geolsoc.org.uk

The meeting is jointly convened by Imperial College London and by The Geological Society of London, supported by the American Association of Petroleum Geologists, The Society of Petroleum Engineers and by the Petroleum Exploration Society of Great Britain.

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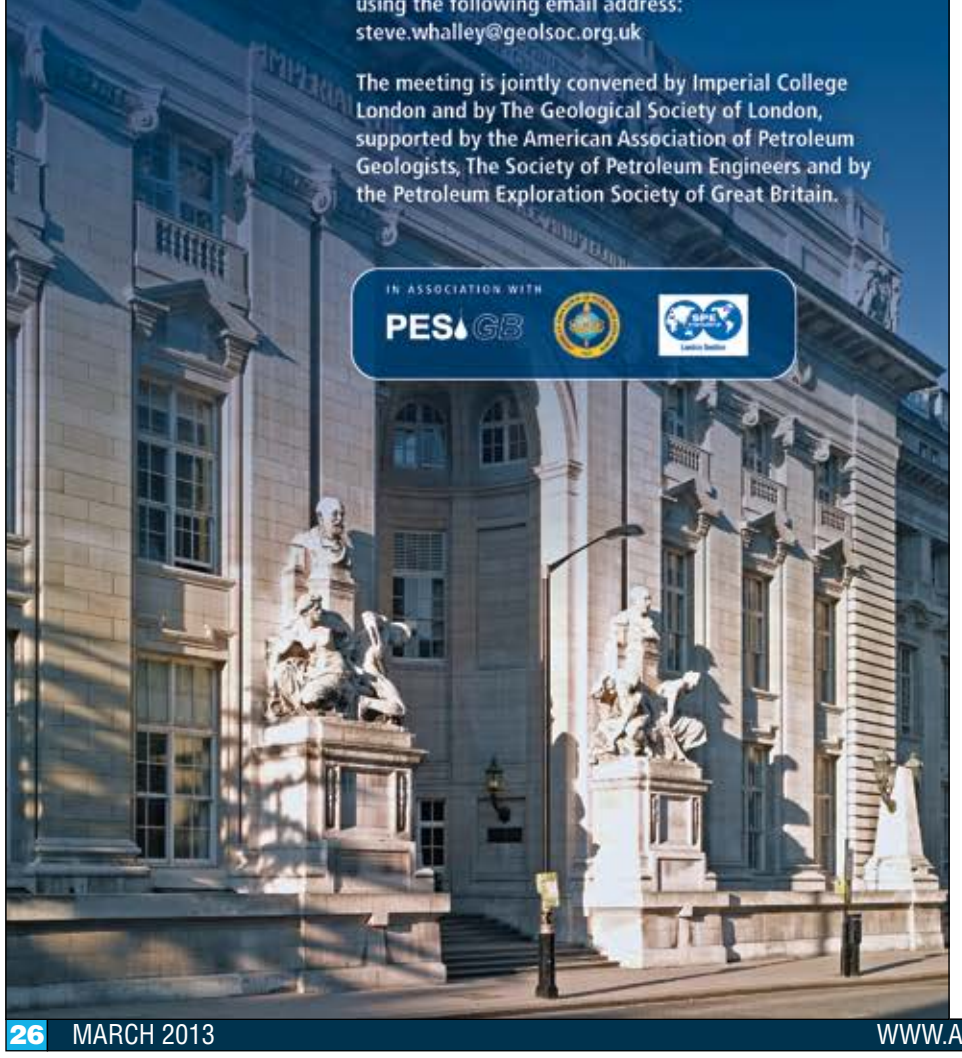

The 'third wave' has begun

Looking Deeper Into Fracturing's Impacts

By DAVID BROWN, EXPLORER Correspondent

Wouldn't it be great if we understood everything that was happening in hydraulic fracturing?

We aren't there yet.

"We've made tremendous progress. There's no question about that. But I don't think you'll find anyone who would say we've optimized what we do," said AAPG member Mark Zoback, professor of geophysics at Stanford University's School of Earth Sciences.


ZOBACK

Recent work by Zoback and his colleagues found that slow slip along misoriented or poorly oriented faults can contribute to high production rates in very low permeability reservoirs.

That response to hydraulic fracturing doesn't show up in routine microseismic monitoring. Understanding this overlooked slippage is key to knowing what occurs in the reservoir following hydrofracturing, Zoback said.

How important is it?

"I don't think shale gas could be produced in many of these reservoirs if this wasn't happening," he said.

In March, Zoback will be the kickoff speaker in Denver at the 19th annual 3-D Seismic Symposium, jointly sponsored by the Rocky Mountain Association of Geologists and the Denver Geophysical Society.

He will speak on "Reservoir Geomechanics Applied to Stimulation of Shale Gas/Tight Gas/Tight Oil Reservoirs."

Zoback's highly regarded text, "Reservoir Geomechanics," is now in its fifth printing from Cambridge University Press, and he brings a reservoir perspective to the development of unconventional resources.

Geologists have long believed that the presence of existing faults and the orientation of those faults can contribute to high production rates in shale gas plays.

Zoback's work indicates those considerations can be even more important than most geologists expected.

More Than Micro

According to Zoback, improved knowledge about hydraulic fracturing's effects on the reservoir can be seen as a third wave of understanding in unconventional resource development.

At first in shale gas plays, "the concept was to make the biggest fracs possible," Zoback noted. "High gel content fluid was used to carry as much sand as possible as far as possible."

Later, more hydraulic fracturing jobs utilized "slickwater," or low viscosity fracturing fluid with friction-reduction additives.

"People then realized you're not making that big of a frac, and you're not using that much sand," he said.

The burst of stimulation from hydraulic fracturing was compared to a micro-earthquake around the well bore, and technicians used monitoring of the microseimic activity to image fracture growth and subsurface response.

That captured the immediate effects of the hydrofracturing. But in addition to induced fractures, other faults in the reservoir can and do become active, according to Zoback.

"I'm saying there are other faults that are slipping slowly, and they are contributing to the production," he said. "More was happening than the microseismicity."

Faults misoriented for slip in the stress field usually would not be expected to be capable of slipping on their own, Zoback

See **Zoback**, page 28

Program Set for Inaugural URTeC

The technical program has been set for the inaugural Unconventional Resources Technology Conference (URTeC), a joint venture that will bring together the key disciplines and technologies engaged in the development of North American unconventional resource plays.

URTeC, sponsored by AAPG, the Society of Petroleum Engineers and the Society of Exploration Geophysicists, will be held Aug. 12-14 in Denver.

The technical program boasts papers dealing with innovations, best practices and experiences in integrated approaches for North American unconventional resource plays.

The technical program includes 20 themes applicable to unconventional resources and appeals to engineers, geologists and geophysicists, including:

- Unconventional Project Development.
- Unconventional Reservoir Characterization.
- Unconventional Shale Plays.
- Unconventional Tight Oil/Tight Gas.
- Unconventional Coal Seam/Bed Methane.
- Formation Evaluation of Unconventional Reservoirs.
- Fracture Characterization.
- Reservoir Monitoring.
- Organic Geochemistry.
- Well Performance Prediction.
- Three-D Seismic Applications.

The three technical program co-chairs are AAPG Honorary Member and past president Steve Sonnenberg, with the Colorado School of Mines; AAPG member Ken Beeney, with Devon Energy; and Luis Baez, with BG Group.

Online registration will be available April 1.

For more information, visit the URTeC website at www.urtec.org.

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- Great oil/gas fields of the Rocky Mtns.: A historical perspective
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- Gas marketing in the Rockies: Forum discussion
- Emerging oil shale and oil sand resource plays
- Geologic and environmental aspects of hydraulic fracturing

Field Trips

- Lacustrine microbial carbonates: Modern and ancient
- San Rafael Swell and Henry Mtns. Basin
- Wasatch Mountains: Scenic trip through time
- Nine Mile Canyon geology: Green River and Wasatch Fms.

Other Convention Events

- All-convention luncheon: Geology of Mars, Utah analogs, and the latest discoveries of the Curiosity rover
  Dr. Rebecca Williams, Planetary Science Institute
- Several pre- and post-meeting short courses
- Night at the new Natural History Museum of Utah
- Guest hospitality suite and three days of special activities

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For convention details visit: rmsaapg2013.com

Zoback

from page 26

said. High pore pressure from hydraulic stimulation can induce slip, however.

He called the misoriented faults "old and dead" faults.

"This is the story for these misoriented faults: The stresses in the Earth are pressing them shut," Zoback explained. "The high fluid pressure in the hydraulic fracture can reawaken or reactivate these faults."

Zoback said the effect of fault slipping on production helps explain why microseismic has not been a good predictor of production rates resulting from successive hydraulic fracturing stages.

"The conventional model of what happens in hydraulic stimulation is that you've got these traditional planes surrounded by microseismic events," he said. "But it's actually very difficult to account for the gas production based on microseismic."

All In the Timing

In a paper he prepared with Arjun Kohli, Indrajit Das and Mark McClure from Stanford University, Zoback wrote:

"The fact that elevated pore pressure initiates slips on misoriented planes is well known from fault mechanics.

"What is not well known is that while slip on a critically stressed fault could propagate rapidly as a micro-earthquake when triggered ... induced slip of misoriented planes will propagate slowly and go undetected during normal microseismic surveys.

"Simply put, the reason for this is that slip on a portion of a misoriented fault will only occur when the pore pressure is anomalously high. Thus, slip will propagate along a misoriented fault only as rapidly as the pore pressure propagates along it."

In contrast to the fracture growth measured by microseismic, the pressure-induced slow slippage of misoriented faults appears to persist for tens of seconds over tens of meters, he said.

Improved knowledge of reservoir changes from hydraulic fracturing brings several possible implications. One is that shale gas development should proceed from a predictive perspective, rather than hydrofracing with regularized spacing, volumes and rates, Zoback observed.

Zoback's studies drew on data from hydraulic fracturing in the Barnett Shale and laboratory friction measurements on samples from the Barnett, Eagle Ford, Haynesville and Fort St. John shales. The principles of slow fault slippage generally apply everywhere, he noted.

"I think it's a fairly ubiquitous phenomenon. It's not limited to this one case," he said.

Composition of shales does make a difference, with higher clay content being associated with slower slipping, Zoback said.

> **"The high fluid pressure in the hydraulic fracture can reawaken or reactivate these (misoriented) faults."**

Unique Challenges

Just as high pore pressure can reactivate misoriented faults, pore pressure increase has been cited as a cause of induced earthquakes from disposal of wastewater in injection wells.

Hydraulic fracturing is different, "because in any given hydrofrac you're only pumping for about two hours and you're affecting only a small volume of rock," and noticeable tremors from hydrofracturing are very rare, Zoback explained.

The combination of horizontal drilling and hydraulic fracturing led to a revolution in developing low-permeability reservoirs in the United States. In other parts of the world, the same concepts haven't always brought success.

Zoback said reservoirs and production challenges in unconventional resource development are unique and take time to understand, anywhere.

"In the United States, the Floyd Shale was kind of a bust in Mississippi and Alabama. Not too many people know about it," he noted.

Success should spread as our understanding of specific resource plays increases and our knowledge of what results from hydraulic fracturing improves even more, according to Zoback.

"I'm very optimistic," he said.

Jacobi

from page 24

almost half in two years," he commented. "Nobody wants that lost gas replaced by coal because it's 'dirty.' Nobody wants nuclear. Nobody wants hydro because you have to dam rivers.

"We all want windmills," he continued, "but apparently not in our view. For example, wind turbines are evidently not beautiful offshore Cape Cod. We all want solar, but Sierra Club and HRDC sue big solar on the California border. The sentiment seems to be think liberally but reject locally."

In a written response to the initial Bloomberg report, Jacobi said that "it is also ironic that I and the science are being cast as 'tainted,' when many environmental groups have used my fault maps in attempts to stop fracing."

He continued.

"I brought to the DEC proprietary data from oil and gas companies that outside people could not have known – data that promoted safer margins, based on our knowledge (or in some cases, lack thereof) of faults," he said. "I argued for safe margins, and I have given advice to individuals, environmental groups and government agencies gratis for years and years concerning faults and their effects (such as seismicity).

"According to these critics, all that advice must have been 'tainted' too," he said, "even though the data were gladly used by all those people, groups and agencies who approached me asking for advice.

"My hope," he concluded, "is that anti-fracing has not become a religion that cannot embrace data from perceived heretics."

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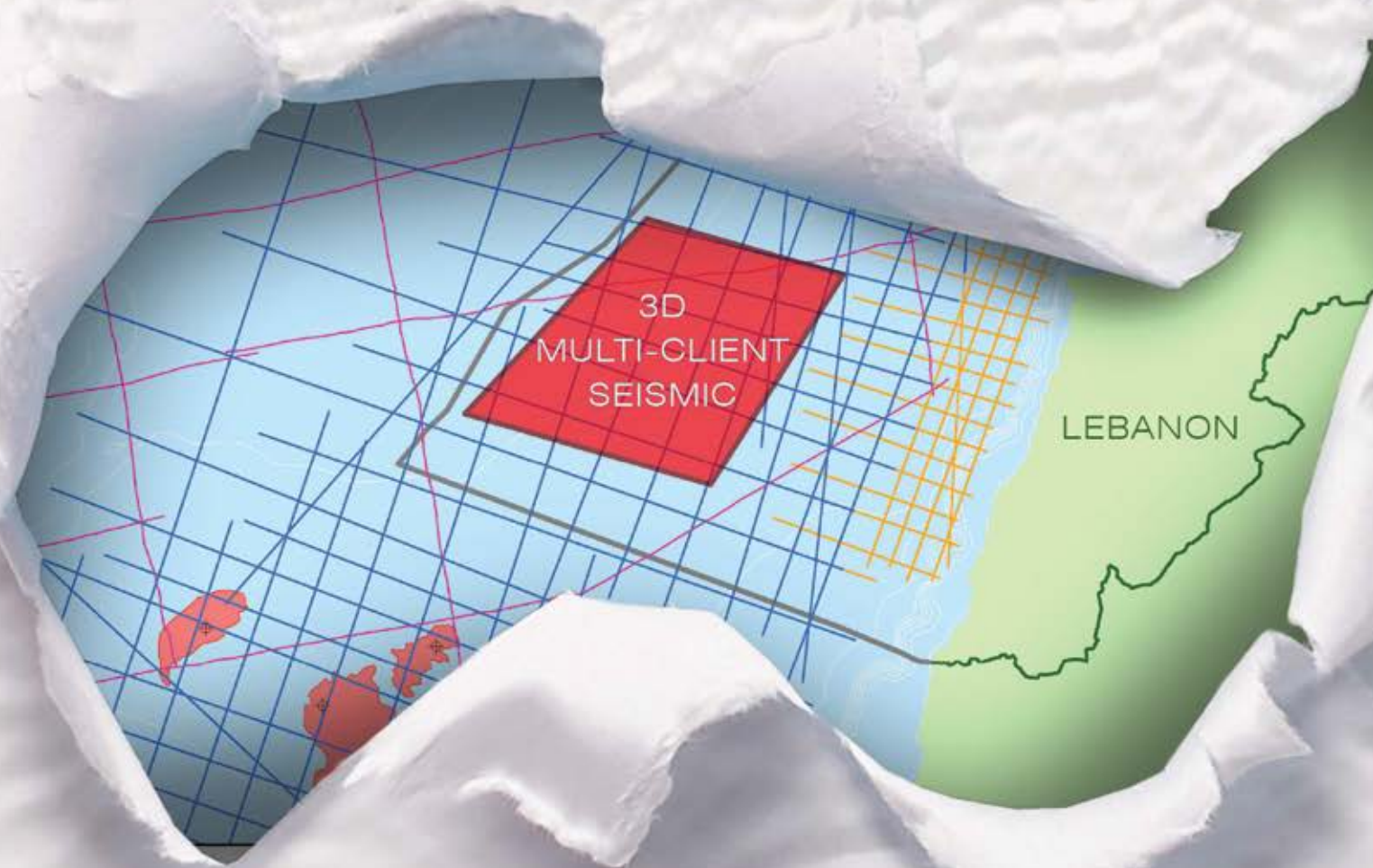

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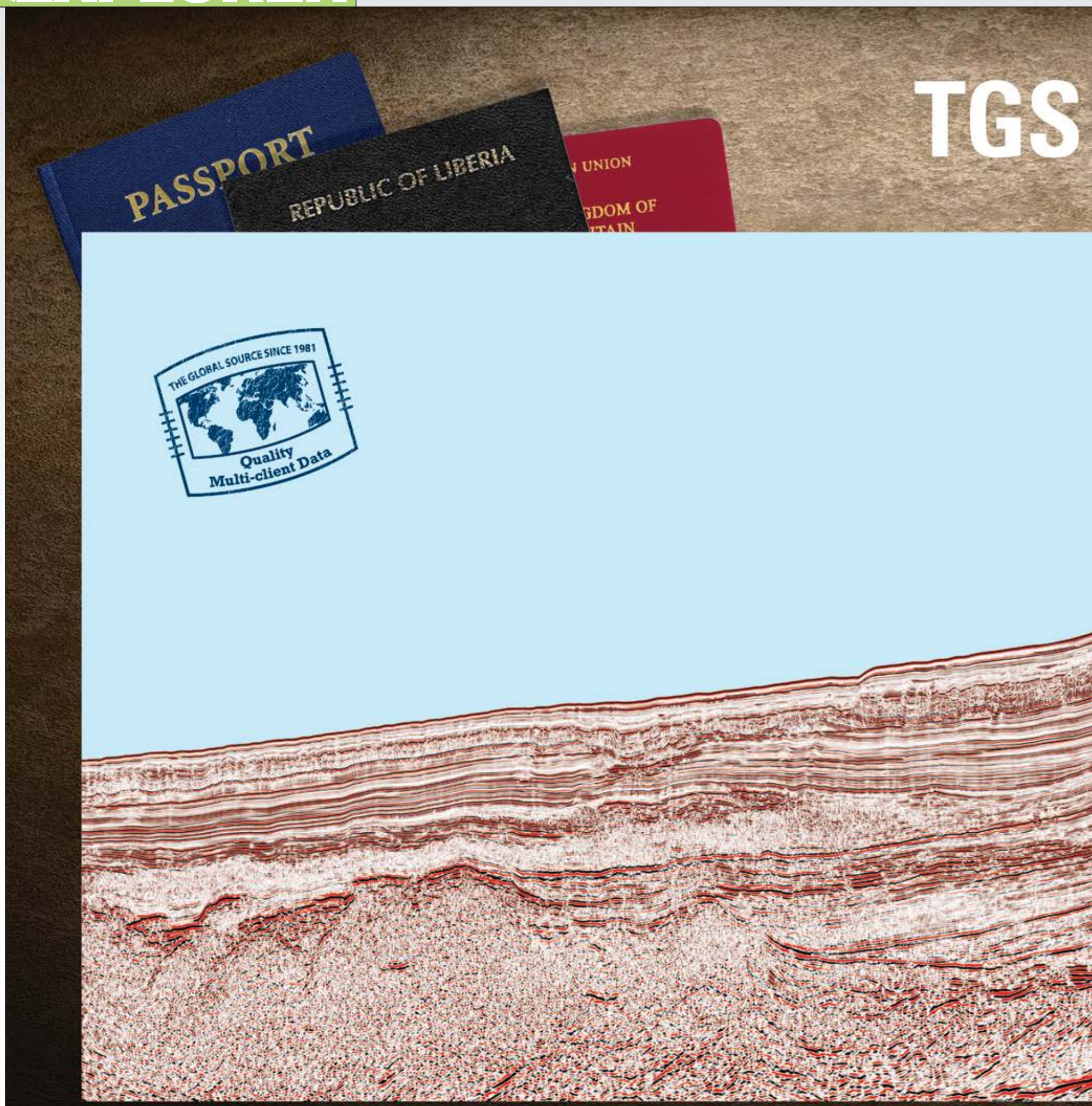

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Data processing will be performed by TGS and will be available to clients Q4 2013, prior to the Liberia 2013 Bid Round.

The survey is supported by industry pre-funding. Additional clients are invited to license the data at Early Participation Plus rates before the end of March 2013, prior to the license fees applying thereafter.

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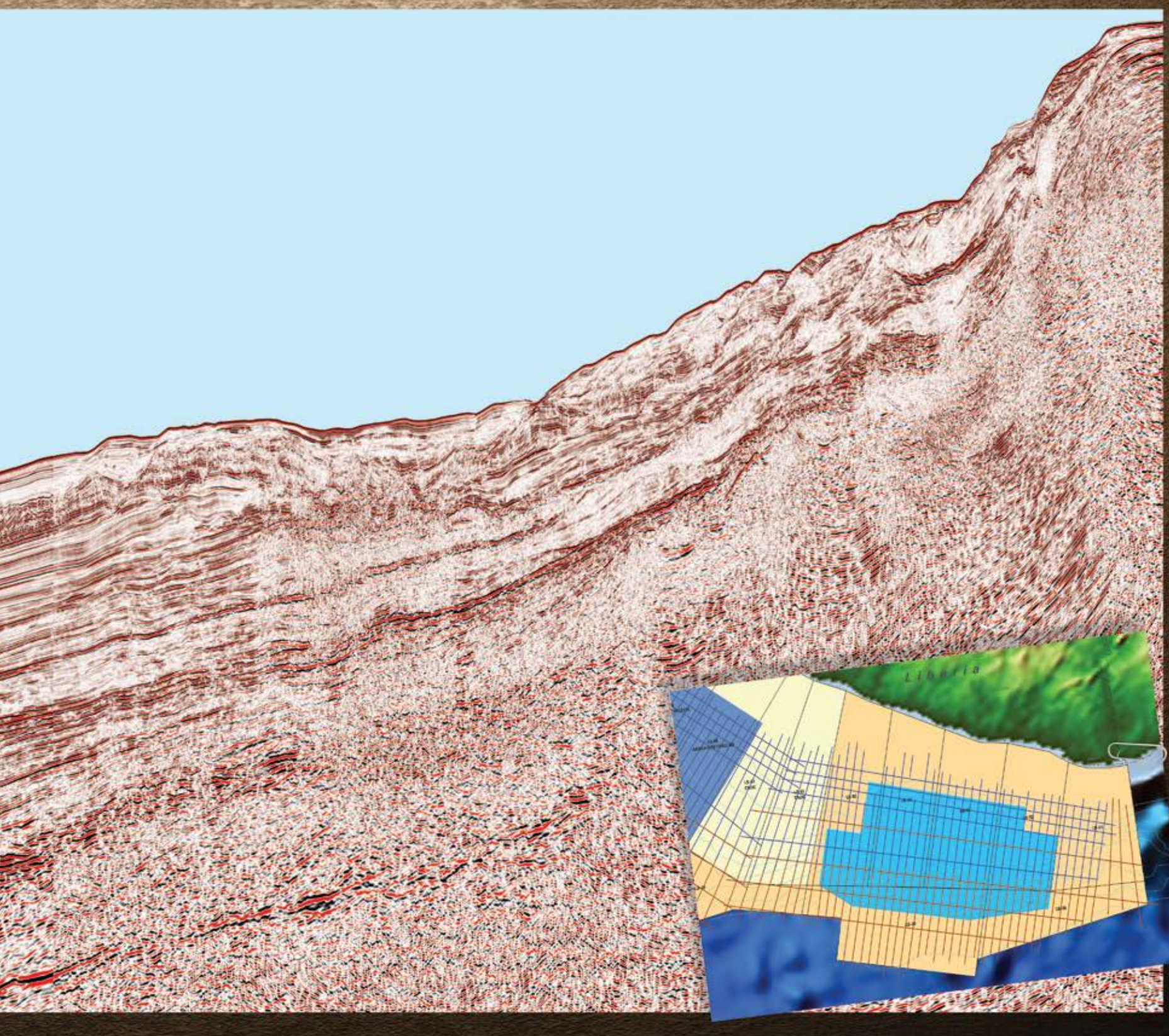

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The Earth is his classroom

Brett Finds The Balance

By BARRY FRIEDMAN, EXPLORER Correspondent

You would expect Carlton E. Brett, one of this year's recipients of the AAPG Grover E. Murray Memorial Distinguished Educator Award winner, to love education.

He doesn't.

He loves teaching.

The distinction?

Brett, in addition to all his researching, editing and writing duties, also is the undergraduate director of geology at the University of Cincinnati.

That job, he readily admits, is a necessary evil – emphasis on the evil.

"So much of it is one more stupid report," he says. "It's all this junk."

He administrates the duties of education, though, for two reasons:

"To get back to the classroom, and to get back into the field."

Let's take the second first.

"The possibility of direct involvement of students at all levels in new field research keeps what might become routine activities vibrant and inspiring," Brett said.

His motivation; his students' needs.

"Every student is used to virtual stuff, but it's the real stuff," he continued. "They need real experience."

It's why he gets out of the "office" as much as possible; it's why, when he's in the classroom, he makes it come alive.

"I still very much enjoy using traditional lectures to present the core concepts of a course," he said, but he then combines them with hands-on and laboratory exercises, including non-conventional, multi-media approaches – everything from the chalkboard and overheads, ELMO to PowerPoint, and traditional slides to videos and websites.

"I frequently have images on three screens at once," he said, "creating a 'three ring circus' effect."

A Delicate Balance

In his juggling, Brett has found the balance – his niche.

"I do not think that my colleagues who work in purely research positions in museums or surveys have the advantage of this ongoing inspiration," he said.

But he wants to emphasize that there is no either/or, no line of demarcation between classroom instruction and fieldwork in education.

"Teaching and research are sometimes seen as antithetic activities in a university," he said, "and, indeed, because time is limited, this could be the case. But I have never believed in this statement."

He makes sure it's not.

He talks abut how his research in paleontology, stratigraphy and modern marine environments enables him to bring novel findings and concepts directly into the classroom.

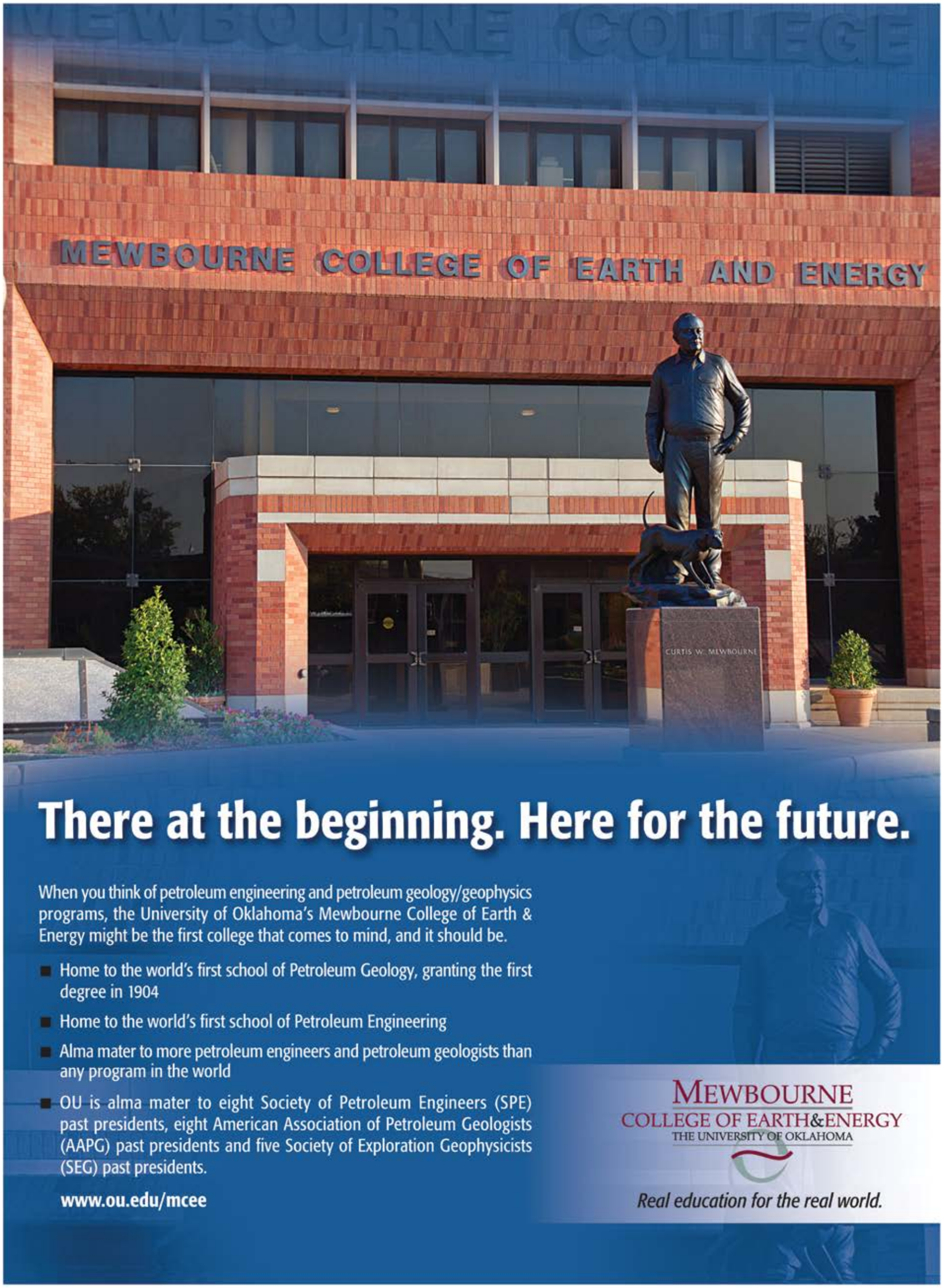
"It informs my teaching and brings a level of credibility, currency and enthusiasm

See **Brett**, page 34

Photos courtesy of Carlton Brett

Carlton Brett, one of this year's recipients of the AAPG Grover E. Murray Memorial Distinguished Educator Award, with his students in one of his favorite classrooms.

Brett, with students near Canyon City, Colo.: "There is simply no substitute for these types of field experiences ... Virtual experiences cannot take the place of the spontaneity of outcrop study and the thrill of real discovery."



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Improving E & P Effectiveness

Another teaching opportunity for Professor Brett.

Brett

from page 32

to teaching that could not exist without this direct experience," he said.

They feed each other.

"Some of my most productive lines of research have come from seemingly simple questions raised by introductory students on field trips."

The enormity of those questions, whether in the classroom or on the side of the road, never gets old – nor does "the realization that we do not really have answers to some of these most basic questions."

The Busy Body

Brett has co-published five books, over 230 scientific papers and 70 field trip guides; has been a museum curator; received the Digby McClaren Medal for Lifetime Achievement in Stratigraphic Paleontology; revised the bachelor's curriculum at Cincinnati, proposing a corresponding bachelor arts program; been principal research adviser to more than 50 students.

He's self-effacing, antsy; he also is sitting in his driveway in Ohio when we talk.

That's important.

"Ohio is not so good," he says, laughing, about what it has to offer in terms of fieldwork.

"Kentucky is grand – I have been all over the world and there's no place like it. Just stop the car and just get out."

This, too: "Kentucky cops are fine."

And Ohio cops?

He laughs. He's now wishing he hadn't made that crack about Ohio.

And when he's out in the field, whether it's Kentucky or Morocco, looking at his students, he sees the promise in each of them, even as he sees their differences, their uncertainty.

"Geology students are plugged in," he said. "Chemistry and engineering students not so much. It's like, 'You figure it out.'"

Winning the AAPG Murray Distinguished Educator Award in a way affirms that, under his tutelage, many have in fact figured it out.

Brett is humbled and gratified by the award, but still overwhelmed at the challenge and its scope.

"I frequently receive notes from former students, including some who are not employed in Earth sciences, saying that they were inspired by my classes," he said.

One student wrote " ... your enthusiasm and passion for what you do demands my utmost respect and inspires me to find a field and occupation that makes me feel the same way." Another wrote, "I really enjoyed your class; thank you for being what a professor should be."

What Brett likes about that last letter is he nearly failed the kid.

"He wrote this after he got a D."

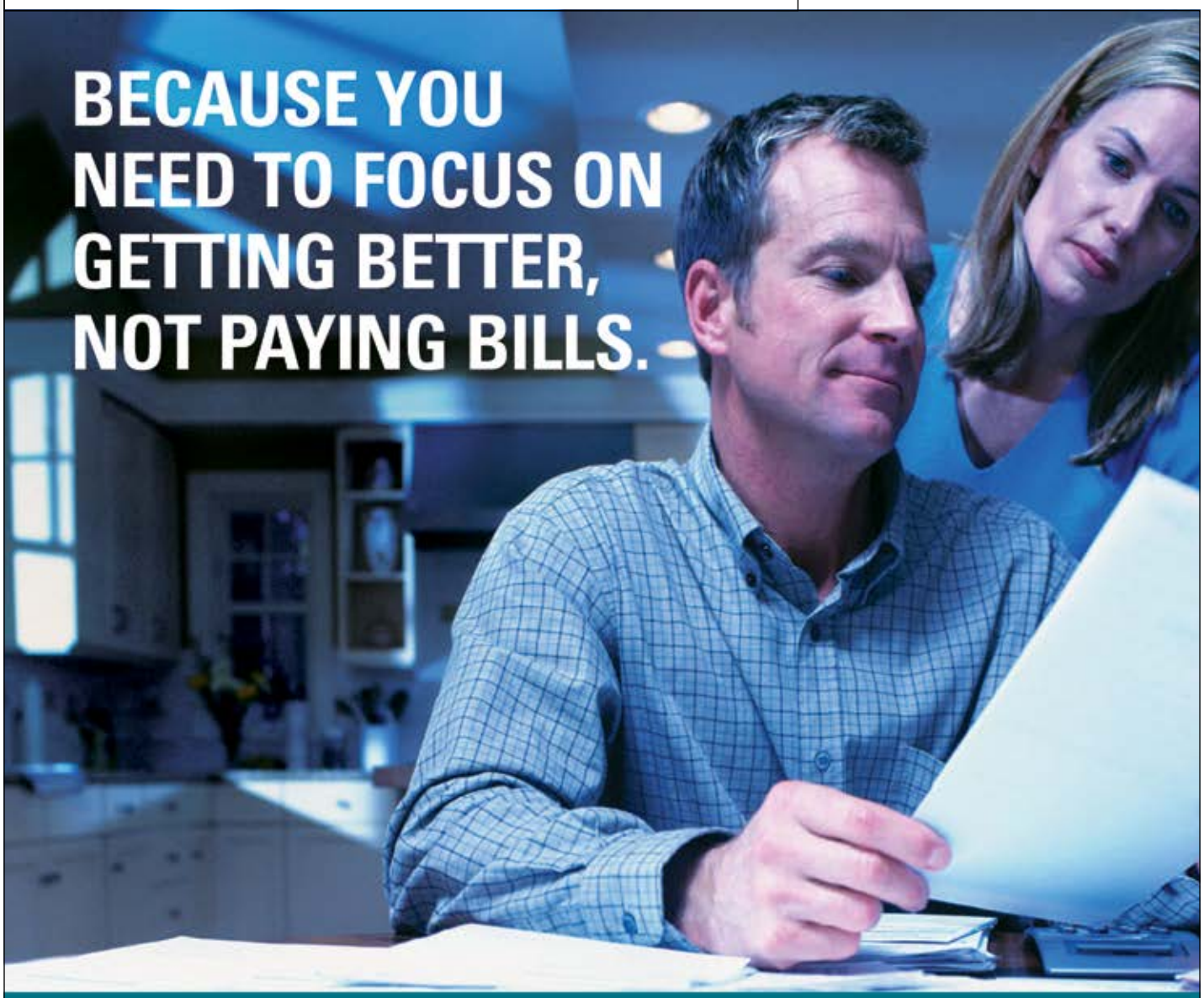
In Pursuit of Honor

To Brett, whose mother taught English and father taught math, teaching is – wait for it – in the blood.

And teaching geology for him is nothing less than teaching about humanity – something that should be honored, protected.

"There's an aesthetic to it," he said. "It's not just science. There's grandeur. It's not just rock knocking. That's insulting."

When he is on one of these field trips, amidst that inexplicable beauty – for instance, on the 10-day trip to Colorado and Utah that he hosts twice a year for his students – he says he sees, "Some of the grandest ideas ever. We are time lords."



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A 'huge' Mid-Continent resource

OSU-Industry Consortium Eyes Mississippian

By KEN MILAM, EXPLORER Correspondent

Industry and academia are teaming up to pump up productivity in the Mississippian of the Midcontinent United States.

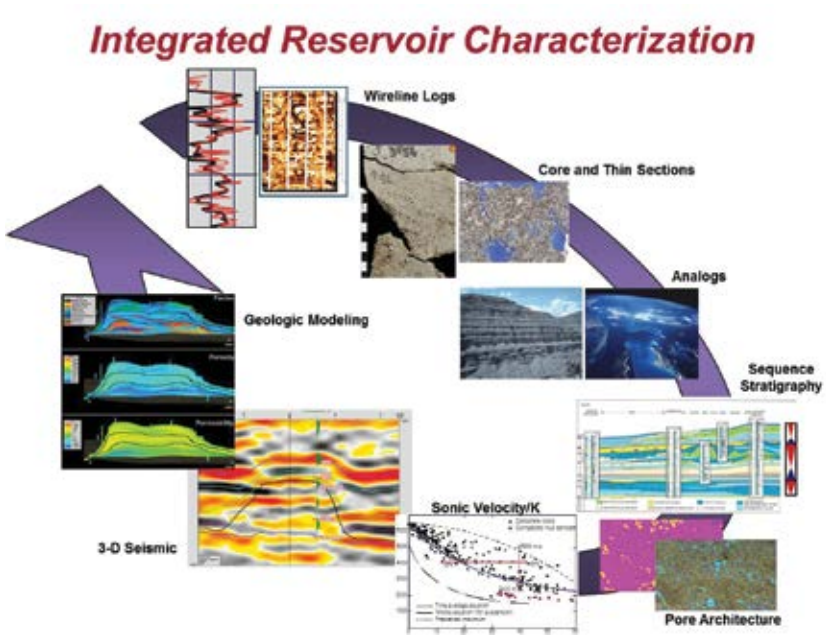
The three-year project, launched in November, weaves together the expertise of 11 domestic and international oil and gas companies and the Oklahoma State University Boone Pickens School of Geology.

Despite substantial production over the last four decades from more than 14,000 vertical wells, Mississippian resource plays are the least understood of any in North America, said AAPG member Michael Grammer, OSU professor and project director.

The interdisciplinary project's purpose is to describe the lower Mississippian carbonates based on depositional environment/geometry and modern sequence stratigraphy, and define the diagenetic overprint in order to understand and predict more accurately reservoir characteristics, controls and distribution, Grammer said.

Grammer said low-porosity limestones – so-called unconventional reservoirs – "may be significant producers in this interval and ... a detailed understanding of the geology will enhance horizontal drilling applications in this unit."

He estimates hydrocarbons in the interval at five billion to six billion barrels of oil equivalent in place, calling it a "huge domestic resource ... virtually in our own backyard."



Beneficial for All

The Mississippian covers much of northern Oklahoma and southern Kansas and is part of the Silurian-Devonian-Mississippian petroleum system consisting of rich source rocks (Woodford Shale) encased in limestones and dolomites, he said.

It is a thick carbonate sequence of complex reservoirs consisting of fractured limestones, tripolitic cherts and porous dolomites. In addition to multiple reservoir types, there are multiple fluid levels that effect productivity in these oil prone reservoirs, he said.

The OSU team includes five faculty members and 11 graduate students. Their general areas of responsibility are:

✓ Grammer, integrated reservoir characterization and carbonate petrophysics.

✓ AAPG member Jim Puckette, regional stratigraphy and sedimentology.

✓ AAPG member Darwin Boardman, biostratigraphy.

✓ AAPG member Jay Gregg, diagenesis and fluid modeling.

✓ Jaiswal Priyank, geophysics and rock mechanics.

Companies initially involved include Chesapeake Energy, Devon Energy, Marathon Oil, Newfield Exploration, SandRidge Energy, Longfellow Energy, Red Fork Energy, Tip Top Energy (Sinopec), Chaparral Energy, Unit Corporation and SM Energy.

"Technical work will be performed primarily by OSU with input from consortium members to high-grade needs or to help establish additional questions to be addressed, and possibly through access to some of their analytical capabilities," Grammer said. "Some of the consortium members will be sharing data for a reduction in membership subscription."

Membership is for two years minimum, at $35,000 per year.

"It is already scheduled for at least three years," Grammer continued. "The minimum two-year buy-in will allow the original members to get third-year data and interpretations at no cost."

Benefits are expected to flow both ways, Grammer said.

"Graduate students will be intimately involved with the research and will be presenting their findings both at annual

See **Consortium**, page 39

AAPG FOUNDATION

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- **Mark Shuster** VP Exploration Middle East-North Africa

Note – The AAPG Foundation gratefully acknowledges Shell, Schlumberger and hundreds of their employees who support the AAPG Foundation with their contributions.

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Sneak Peek: BULLETIN Offers 'Ahead of Print'

By JANET BRISTER, AAPG Website Manager

The AAPG BULLETIN has expanded its online presence to include a preview of upcoming BULLETIN articles.

The feature is called "Ahead of Print," and by accessing the site at http://bulletin.aapg.org/ you will see an altered layout designed to get science into your hands more quickly than ever before.

AAPG Editor Stephen Laubach said that "among the new services and processes that can be considered as best practices of association and commercial publishers, 'Ahead of Print' is on the top of the list.

"It not only makes manuscripts available earlier, but is a huge step toward keeping the AAPG BULLETIN a journal of choice for authors," he said.

According to Jim Blankenship, AAPG director of geosciences, this isn't just a new webpage but a site where "there is something new inside."

This collection of papers includes manuscripts that have been peer reviewed and approved for publication, but have not been sent to final production or copy editing.

These articles are available online only and are part of the BULLETIN article collection. They are provided in the same formats as other BULLETIN articles – HTML and PDF – however, the PDF version "will not have the final polished look of a typical BULLETIN article," according to Blankenship.

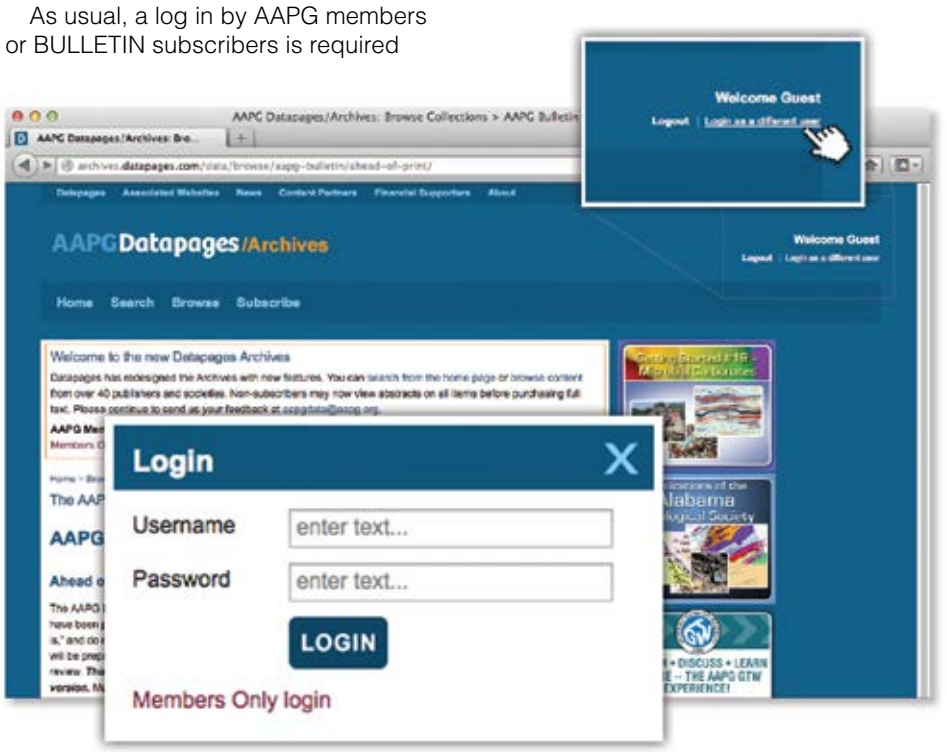
This early online availability keeps the BULLETIN competing with other scientific publishers' practices.

"It allows manuscripts to be used, searched and cited three to five months in advance of actually showing up in the final edition of the monthly release," Blankenship said.

What to Look For

As usual, a log in by AAPG members or BULLETIN subscribers is required to read more than just the abstract. Without the login, articles will be available on a "pay-per-view" basis.

Here are a couple of scenarios to help the AAPG member or BULLETIN subscriber take advantage of these new articles successfully; scenario one depicts logging in and then browsing the pre-print articles, while scenario two depicts browsing the pre-print articles and then logging in.



- *Scenario One* – Before clicking on "Ahead of Print," pay attention to the welcome message up and to the right, which will say either "Welcome Guest" or "Welcome Member."

"Welcome Guest" indicates you are *not* logged in.

"Welcome Member" indicates you are logged in and you should have full access.

In the event you are not logged in, locate and click on "Members Only Login." It will be text to your right.

Upon successfully logging in through Members Only, locate and click on "Bulletin Online" – first item found in the top green bar – and you will return to this new BULLETIN landing page.

- *Scenario Two* – For this scenario, I'm assuming your curiosity got the best of you. You forgot about logging in and simply wanted to see the articles provided.

However, something has caught your attention, and now you want to actually read the article and view more than the abstract. (see tip below)

Look to the top right of the article page: Does it say "Welcome Guest?" Then to see further detail, you must click on "Login as a different user" found just under the welcome line.

Continued on next page

Consortium

from page 36

meetings for the consortium members to be held here at OSU, but also will be presenting at professional venues such as regional and national AAPG meetings and geological societies," he said.

"Students will be exposed to real-world issues with firm deadlines and will be utilizing real-world data and state-of-the-art analytical and modeling approaches, equipment – and software," he said.

"The project as developed is basically a regional exploration to development scale reservoir characterization of several zones in the 'Mississippian,' so OSU students will be exposed to all facets of this type of project in a similar manner to what they will be doing in their professional oil and gas careers," he said.

Project Goals

Grammer provided the following project goals:

- Characterization of reservoir types – Establish a comprehensive understanding of the reservoir rock framework through core, sample and outcrop analysis with litho-descriptions, thin sections, SEM, XRD, porosity, permeability and rock mechanics measurements.

- Depositional model – Based on rock data define and map depositional facies to understand facies-porosity controls and potential reservoir distribution in the subsurface.

- Stratigraphic framework – Establish a sequence stratigraphic framework for the basis of regional correlation and recognition of unconformities that control paleokarst and mineral diagenesis.

- Petrophysics – Characterize petrophysical signatures, including sonic velocity measurements for both reservoir and seal facies to establish the predictability of reservoir and non-reservoir facies in the subsurface.

- Reservoir development – Evaluate key early and late diagenetic processes that produce or occlude reservoir porosity and permeability; characterize microporosity and nanoporosity, and fracture density.

- Reservoir geometry – Map key reservoir zones in relation to unconformities and the Mississippian subcrop.

- Geofluids analysis – Determine the timing of generation and migration of petroleum and other geofluids relative to reservoir development.

Continued from previous page

Alternatively, if you are at the end of the abstract look for "AAPG Member" and locate the text, "Please login with your Members Only username and password."

Both links provide the same dialog box.

So, DO NOT fill in the fields of this dialog box if you are a member of the AAPG. These fields are not for AAPG Members but for Datapages customers with Datapages accounts paying for each article viewed.

Instead, find in the dialog box the text "Members Only login" and click that link.

Complete your log in through Members Only. Find the "Bulletin Online" link and continue your browsing.

Usage Tip – Copy Before You Click

During Scenario Two, I noticed that I was not returned to the article I had originally selected.

Instead, once I completed my log in I was returned to the BULLETIN landing page. I had to browse through the articles and make my selection again.

To avoid this, copy the URL of your article before you log in. Then you will be able to paste this into your browser once you have successfully logged into Members Only.

Good browsing!

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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@yahoo.com.

A Truly Massive Stimulation Technique

By JOHN C. LORENZ

After World War II, the United States suddenly found itself with nuclear explosives, a tool for which there were few obvious uses other than spectacular and indiscriminate destruction. The government therefore initiated a program to investigate benign uses for the tool – almost like a boy seeing what could be blown up with a new box of firecrackers.

This program of turning weapons to peaceful uses was called Project Plowshare – after the biblical reference to "beating swords into plowshares" – and the actual explosions were referred to as "shots," or "PNEs" (Peaceful Nuclear Explosions.)


LORENZ

Large volumes of gas were known to be present in these reservoirs, but the gas did not flow readily into wells.

Most of the proposals envisioned large-scale earth-moving projects, such as the excavation of new harbors and the building of canals – including a new one across the Isthmus of Panama – but one of the few facets of the Plowshares program to actually be tested outside of the Nevada Test Site addressed the problem of unlocking natural-gas resources in low-permeability sandstones of the U.S. Rocky Mountain basins.

Large volumes of gas were known to be present in these reservoirs, but the gas did not flow readily into wells.

The main problem ultimately turned out to be that drilling and completion techniques of the day were damaging the all-important natural-fracture production mechanism – but this was not yet understood, because the technology (seismic, image logs) and data base (core, outcrop studies, detailed well tests) did not yet exist to allow recognition of the pervasive natural fracture system or support the development of effective completions.

This data deficit eventually was addressed and successful techniques were developed through characterization projects such as the U.S. Department of Energy-sponsored MultiWell Experiment ("MWX"), but before such approaches were tried – and before it was realized that what we didn't know was hurting us – the philosophy seems to have been one of forcing engineering solutions onto the problem.

U.S.	USSR
• Gasbuggy ‣ New Mexico, 1967 ‣ 29 kt	• "Field A" ‣ Kuybyshev, 1965 ‣ (2) 2.3 kt plus (1) 8 kt
• Rulison ‣ Colorado, 1969 ‣ 40 kt	• "Field B" ‣ Perm, 1969 ‣ (2) 8 kt
• Rio Blanco ‣ Colorado, 1973 ‣ (3) 30 kt	• Unreported ‣ Ob, 1979 ‣ 21 or 100 kt

They Had a Blast

Three actual nuclear stimulation attempts were carried out in the United States, in 1967, 1969 and 1972, in the San Juan and Piceance basins of New Mexico and Colorado. The Soviet Union conducted three similar experiments during the same time period.

The technique in the United States was to drill a well into tight, natural gas reservoirs and place a 1,500-pound "nuclear device," or "physics package," at the bottom of the well.

The expectation was that blast-related microfractures would propagate a few hundred feet out from a blast-and-collapse induced chimney of rubble, providing myriad pathways for gas to flow back to a re-entry well drilled into the chimney. Success was measured by comparing the post-shot gas flow rates and estimated recoveries to the rates and recoveries from nearby conventionally drilled wells, although this turned out to be a difficult comparison because of the inconsistent well-to-well production characteristics in such reservoirs.

Information is scarce, but the Soviets took a different approach, focusing on oil resources in limestone reservoirs. Their technique was to emplace the nuclear device in a dedicated well in the middle of a producing field, with the expectation that a blast would open fractures across the field. Pre-stimulation production rates for the surrounding producing wells were then compared to their post-stimulation rates.

Both countries claimed technical success, but several factors contributed to the termination of these projects, and the last such test was apparently carried out in

See **Nuclear Blast**, page 42

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Photo courtesy of llnl photos via flickr

A man wearing 1961-era protective equipment (coveralls and a hard hat), standing on the rubble pile that fell from the roof, partially filling the project Gnome blast cavern.

Nuclear Blast

from page 40

1979 near Ob in the USSR.

In the United States, the economics were marginal at best: A 10-fold production increase was the target, but the reported increase was a factor of between two and five, calling into question the claim of technical success.

The essential, but as-yet-unrecognized natural fractures in the reservoirs were undoubtedly damaged by crushed and melted rock. Moreover, the blast-related microfractures expected to form in the wall rock surrounding the chimney apparently did not form. These microfractures were reported from thin sections cut from the evaporitic wall rock of the blast cavern of the 1961, three-kiloton preliminary Gnome experiment conducted at 1,200-foot depth outside of Carlsbad, N.M.; microcracks apparently did not develop as extensively in sandstones at the 4,000-8,000 foot depths of the actual tests. However, investigators did not physically enter and investigate the blast caverns as they had at Gnome.

Even though natural gas production was enhanced during these tests, the limited degree of improvement would have been insufficient to support the high costs of the contemplated field development program of nuclear completions.

In addition, not surprisingly, the produced gas was somewhat radioactive, although the degree of radioactivity is rarely specified in reports. Radioactivity would have diminished over time, but at least initially the economic balance would have been eroded by the need to dilute the test well gas with gas from conventionally drilled wells in order to bring radioactivity down to acceptable levels for commercial use.

Another problem was that the BTU value of the gas from the shot wells was significantly diminished, since the blast converted some of the formation rock and natural gas into non-flammable CO_2 and water vapor.

Ultimately, however, the public was not ready to burn this gas: A national environmental consciousness was beginning to develop at about this time, there were significant liability concerns, and the World War II "get it done at any price" attitude was beginning to fade.

In the end, operators did not clamor for the technology.

Rulison Shot Results

- 4.9 Seismic event
- 43 kiloton yield
- Chimney: 76 ft radius, 350 ft height (calc.)
- Fracturing: 222-370 ft radius (calc.)
- 200-400 percent production rate increase
- 200-400 percent recovery increase
- "Considerably less" radioactivity of the gas
- 11 percent water vapor, 26 percent CO_2

An Understanding

In a purely scientific sense, the nuclear experiments in low-permeability sandstones did not significantly enhance gas production because they put the cart before the horse, applying a new technology in the hubristic expectation that the inherent power of that technology would make the geologic complexity and the unknowns of the reservoirs irrelevant.

Geology, if considered at all, was an after-thought: The few geologic reports in the Plowshares literature are simplistic even for the 1960s – and the significance, even the presence, of natural fractures in the reservoirs, was not recognized let alone appreciated.

This was an era when the very existence of open natural fractures at depth could be and was still being debated.

Although the nuclear tests applied an innovative technology to a recognized, long-standing problem, they reinforced the lesson that one needs to understand a problem in order to have realistic expectations of solving it.

Editor's note: John Lorenz, a past president and elected editor of AAPG, has worked for the Peace Corps (Morocco), the U.S. Geological Survey, Sandia National Laboratories and, for the last five years, has been a consultant in naturally fractured reservoirs (FractureStudies LLC). He has won multiple AAPG awards, including the Jules Braunstein Award, the Distinguished Service Award and two A.I. Levorsen Awards. He holds a commercial pilot's license and a Ph.D. from Princeton University.

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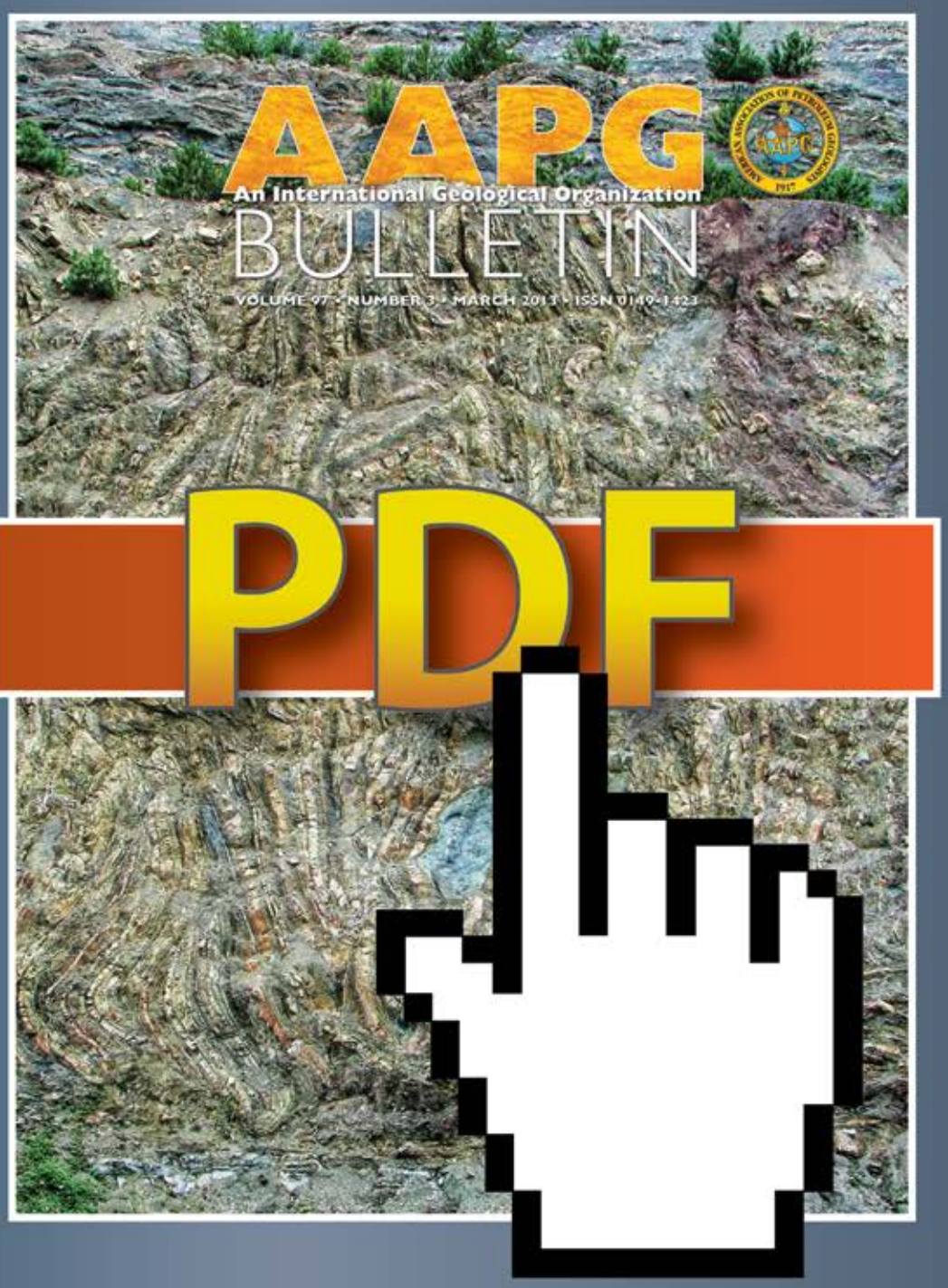

Article highlights include:

Recognized for the First Time

E&P Note

Lianbo Zeng, Hui Su, Xiaomei Tang, Yongmin Peng, and Lei Gong

A newly documented fractured reservoir with low matrix porosity exists in the Dongpu Depression, China. Compaction and cementation prior to peak hydrocarbon generation and migration has resulted in low permeability and porosity.

Mud-Filtrate Invasion

Ankur Gandhi, Carlos Torres-Verdin, Ben Voss, Federico Seminario Gros, and Johnny Gabulle

The common stratigraphic framework method is used in this paper to examine and quantify the effects of mud-filtrate invasion on apparent resistivity, nuclear, and magnetic resonance logs. It is a dominant factor in the abnormally low apparent resistivities that were measured in this study.

Exploring the Black Sea Basin

Şamil Şen

The aim of this paper is to show why exploration has been unsuccessful to date and where future exploration opportunities can be found. No oil or gas fields have been discovered in exploration drilling because they did not penetrate potential Upper Jurassic-Lower Cretaceous reservoirs.

Carbonate Reservoirs

Andrea Rustichelli, Emanuele Tondi, Fabrizio Agosta, Claudio Di Celma, and Maurizio Giorgioni

This article addresses sedimentological and diagenetic factors that determined pore network characteristics of the Oligocene-Miocene Bolognano Formation, Majella Mountain, central Italy. This study could provide some additional criteria useful for reservoirs quality evaluation.

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AAPG EXPLORER

The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer. This month's column deals with phase unwrapping and discontinuities.

GEOPHYSICALCORNER

Out of Phase Doesn't Mean Out of Luck

By MARCILIO MATOS and KURT MARFURT

Interpreters use phase each time they design a wavelet to tie seismic data to a well log synthetic. A 0-degree phase wavelet is symmetric with a positive peak, while a 180-degree phase wavelet is symmetric with a negative trough. Given a 0-degree phase source wavelet, thin beds give rise to ±90-degree phase wavelets.


MATOS


MARFURT

Mathematicians define phase using a "complex" trace, which is simply a pair of traces:

- The first trace is the measured seismic data, and forms the "real" part of the complex trace.
- The second trace is the Hilbert transform of the measured data, and forms the imaginary part of the complex trace.

Note in figure 1a that when the real part of the trace is positive, the imaginary part is a minus-to-plus zero crossing. In contrast, when the real part of the data is a minus-to-plus zero crossing, the Hilbert transform is a trough.

This latter phenomenon allows us to use the "instantaneous" Hilbert transform to generate an amplitude map of a thin bed that was previously picked on the well log as zero crossing of the measured (or real) data.

Now let's map both parts of the complex trace on the same plot.

As you may remember from high school algebra, the real part is plotted against the x-axis and the imaginary part against the y-axis. We plot the same 100 ms (50 samples) of data "parametrically" on the complex plane.

Note in figure 1b that the waveform progresses counterclockwise from sample to sample.

We map this progression using the phase between the imaginary and real parts. If we use the arctangent to compute the phase, we encounter a 360-degree discontinuity each time we cross ±180 degrees (figure 1c). Note how peaks and troughs in figure 1a appear at 0 degrees and ±180 degrees in figure 1c.

Now, if we computed the phase by hand, we would obtain the much more continuous phase shown in figure1d.

Figure 1d is an "unwrapped" version of figure 1c, and in this unwrapped image, note there is still a discontinuity at t=850 ms; however, this discontinuity is associated with waveform interference (geology) and not mathematics.

Such discontinuities form the basis of the "thin-bed indicator" instantaneous attribute introduced 30 years ago.

* * *

The above discussion illustrates the concept of phase unwrapping and discontinuities based on the complex trace used in instantaneous attributes.

A more precise analysis can be obtained by applying the same process to spectral components of the seismic data.

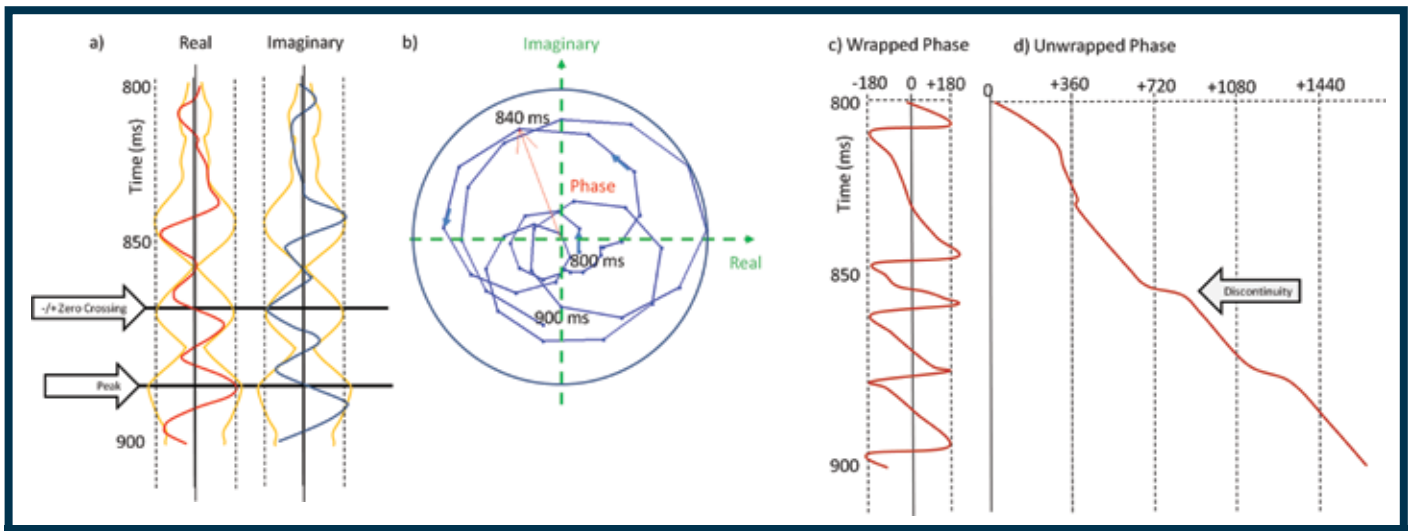

Figure 1 – (a) The "complex" trace composed of the original measured trace, d(t), (the real part, in red) and its Hilbert transform, $d^H(t)$, (the imaginary part, in blue) extracted from the survey shown in figures 2 and 3. The envelope and its reverse are plotted in orange. Note how it "envelopes" the real and the imaginary trace (and indeed any phase-rotated version of the trace). (b) The complex trace plotted parametrically against time on a complex plot. Each time sample can also be represented in polar coordinates as a magnitude and phase, with phase being measured counterclockwise from the real axis. (c) The wrapped phase computed as ϕ=ATAN2[$d^H(t)$,d(t)]. The definition of the arctangent gives rise to discontinuities at ±180^0. (d) The unwrapped phase, retaining only discontinuities associated with waveform interference (geology and crossing noise).

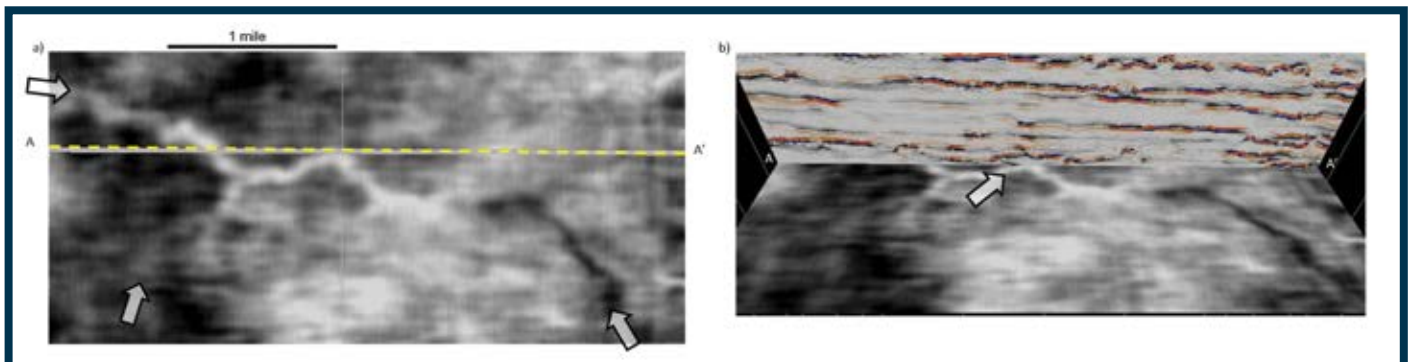

Figure 2 – (a) A time slice at t=842 ms through a data volume acquired over Stratton field, south Texas. Block arrow indicates a channel that gives rise to an amplitude anomaly. (b) The same time slice co-rendered with a vertical slice through the corresponding spectral phase residue volume. Seismic data courtesy of the University of Texas Bureau of Economic Geology.

Spectral decomposition is a well-established interpretation technique. The seismic data are decomposed into a suite of spectral components, say at intervals of five Hz.

Most commonly we use spectral magnitude components to map thin bed tuning, while some workers use them to estimate seismic attenuation, 1/Q. The phase components are less commonly used, but often delineate subtle faults.

Here, we will show how the identification of discontinuities in the unwrapped instantaneous phase discussed above can be extended to unwrapped phase of spectral components.

Let's illustrate the use of such discontinuities by applying them to the well-studied Stratton Field data volume acquired over a south Texas fluvial-deltaic system by the University of Texas Bureau of Economic Geology.

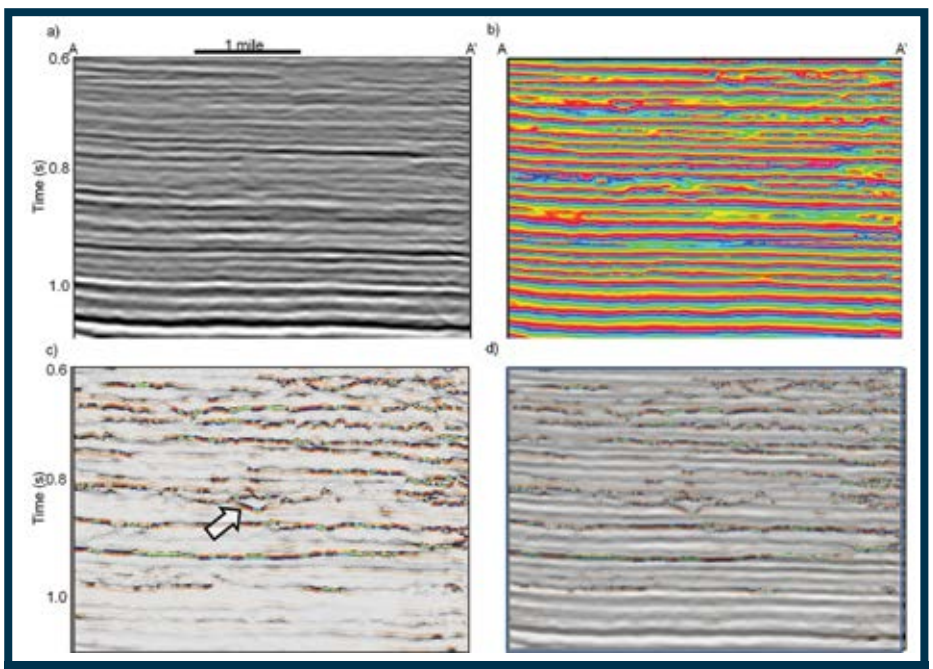

Figure 3 – Vertical slices along line AA' shown in the previous image through (a) the seismic amplitude, (b) the instantaneous phase, (c) the phase residue and (d) the co-rendered phase residue and seismic amplitude volumes. The instantaneous phase is plotted using a cyclical color bar. The phase residues are color coded by the magnitude and frequency of the spectral components at which they occur.

* * *

In our Stratton Field example, thin channels give rise to tuning effects and subtle amplitude anomalies as shown in figure 2a. While we can detect the channel system on time and horizon slices, they are difficult to see on vertical slices through the seismic amplitude data (figure 3a).

Determining the thickness of the channel on the seismic amplitude image is even more difficult. The corresponding slice through the instantaneous phase volume (figure 3b) shows a subtle change, but again, does not help delineate the channel.

One approach to improving this image is to unwrap the instantaneous phase volume (as we did in figure 1d), and compute its vertical derivative, thereby highlighting phase discontinuities due to waveform interference (in this case geology). Our approach is based on the computation of phase residues of spectral components computed at five Hz intervals, which provides not only an image of waveform interference, but also a measure of our confidence in the interference pattern (provided by the corresponding spectral magnitude) and

Continued on next page

Inaugural Baku Conference Had an Integrated Appeal


DVORAKOVA

The first jointly held "International Geological and Geophysical Conference on Integrated Approach for Unlocking Hydrocarbon Resources," offered last October in Baku, Azerbaijan, proved to be a big success in terms of both content and attendees.

The conference, organized by the Azerbaijan Society of Petroleum Geologists, Azerbaijan National Committee of Geophysics and EAGE local chapter jointly with AAPG, SEG and the Russian Association, drew nearly 300 participants.

Among the countries represented were Great Britain, Bulgaria, Germany, Georgia, India, Iran, Kazakhstan, Norway, Russia, Romania, Austria, the United States, Ukraine and France.

Natig Aliyev, Azerbaijan's minister of industry and energy, opened the conference with a talk on the region's current activity well as its potential.

Other opening session speakers included AAPG European Region President Vlasta Dvorakova, AAPG member and SEG First Vice President William Abriel, and EAGE representative Roald van Borselen.

Some of the conference highlights included:

- A plenary session on Azerbaijan's exploration potential.
- A talk by Christian Giudicelli, general manager of Total E&P Azerbaijan, on renewed exploration activities in a mature oil province.
- Presentations on the giant and major oil and gas accumulations of the South Caspian Basin.

"I felt the conference was a success … maybe the strongest conference in Baku, with good representation from around the world and a very high level of student participation," said AAPG member Gregory Riley, BP's vice president of exploration geology. "I certainly enjoyed the mixture of geology and geophysics."

Riley also led a post-conference field trip for the event.

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the frequency component at which it occurs.

Figure 3c shows this computation, where the hue component of color corresponds to the frequency of the discontinuity and the intensity or brightness to its strength. A block arrow clearly delineates the top and bottom of the channel.

Figure 3d co-renders the phase residue image with the original seismic amplitude using 50 percent opacity.

* * *

Thin meandering channel are often visible on amplitude time slices (figure 2). Phase residues add the third dimension.

In a subsequent article, our colleagues will show how phase residues provide a powerful tool for geobody extraction and interpretation.

(Editor's note: Marcílio Matos is a research scientist for Signal Processing Research, Training and Consulting, and co-investigator for the Attribute Assisted Seismic Processing and Interpretation Consortium at the University of Oklahoma, Norman. Marfurt, an AAPG member, is with the University of Oklahoma.)

Advance the Way You Analyze Mud Gas

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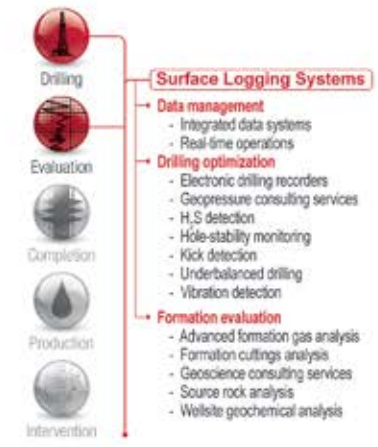

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Edith Allison, director of AAPG's Geoscience and Energy Office in Washington, D.C., can be contacted at eallison@aapg.org; or by telephone at 1-202-643-6533.

POLICYWATCH

Making the Leap From Research to Innovation

By EDITH ALLISON, GEO-DC Director

In a November 2012 report, the President's Council of Advisors on Science and Technology (PCAST) reported that a historically strong commitment to research and development (R&D) by government and industry has assured the United States leads the world in technology and innovation.

The report's primary concern, however, is on preventing the United States from falling behind other countries because of a relative decline in U.S. government and industry R&D spending.

The Council recommended actions to stimulate research and its transformation into new products, including:

✓ Additional funding for both government and industry R&D.

✓ Simplification of government procedures for cooperative work with academia and industry.

✓ Improvements in science, technology, engineering and mathematics (STEM) education.

The Council concluded that with increased R&D investment and improved research efficiency the United States could maintain its global lead in innovation.

* * *

The PCAST report does not specifically consider the status of petroleum industry R&D. However, the industry has similar problems – and it could benefit from changes recommended to the larger science and technology community. For example:

ALLISON

With increased R&D investment and improved research efficiency the United States could maintain its global lead in innovation.

- Innovative techniques, derived from decades of basic and applied research by the federal government, academia and industry, have fueled growing U.S. oil and natural gas production.
- Fundamental or basic research is the foundation and prerequisite for applied research and development – but basic research funding has declined. Over the past several decades industry R&D, paralleling overall U.S. R&D, has shifted away from basic research to more applied studies and development. Recently R&D spending has declined relative to corporate net income.
- The petroleum industry faces a shortage of scientists, engineers and technicians, exacerbated by retirements of its aging work force.
- Industry can benefit from continued cooperative work with universities and federal national labs.

U.S. R&D Spending

According to the report, total U.S. R&D spending is about 2.8 percent of gross domestic product (GDP), a share that has changed little over the past 50 years.

However, since the early 1960s the government share of R&D has declined from 65 to 30 percent, and the industry share has increased from 35 to almost 70 percent. This funding shift is paralleled by a shift of emphasis from basic or fundamental research to applied research and product development, which is now the dominant focus of industry: Industry funds 48 percent of all applied research and 78 percent of development in the United States.

Federal government R&D spending was $140 billion in 2012. This spending goes primarily to the Department of Defense (53 percent), and the National Institutes of Health and other health agencies (22 percent).

Federal agencies that provide the majority of support for the physical sciences receive smaller shares of government R&D funding: Department of Energy (7.6 percent), NASA (7.4 percent) and the National Science Foundation (3.8 percent).

Petroleum R&D Spending

Statistics on R&D spending by the U.S. petroleum industry are available from the Energy Information Administration's Financial Reporting System (FRS), which collects detailed financial data on 27 major energy producing companies, including multi-national corporations based in the United States.

The FRS companies reported spending $2.8 billion on R&D in 2009. It is notable that FRS companies doubled their R&D spending from 2000 to 2009; however, because net income increased even more rapidly over this interval, industry R&D declined as a percentage of net income.

Oilfield service companies represent a major share of U.S. R&D, although data equivalent to the FRS reports are not available. The four largest oilfield service companies that operate in the United States spent over $2 billion on global R&D.

The industry R&D universe also includes company-supported R&D at universities and cooperative studies with government agencies and national labs.

Declining R&D

A major cause for concern, according to the PCAST report, is that U.S. R&D is declining relative to Asia. U.S. spending as a percent of GDP is now lower than that of South Korea and Japan (both near 3.5 percent), and Asia performed a slightly larger percentage of global R&D

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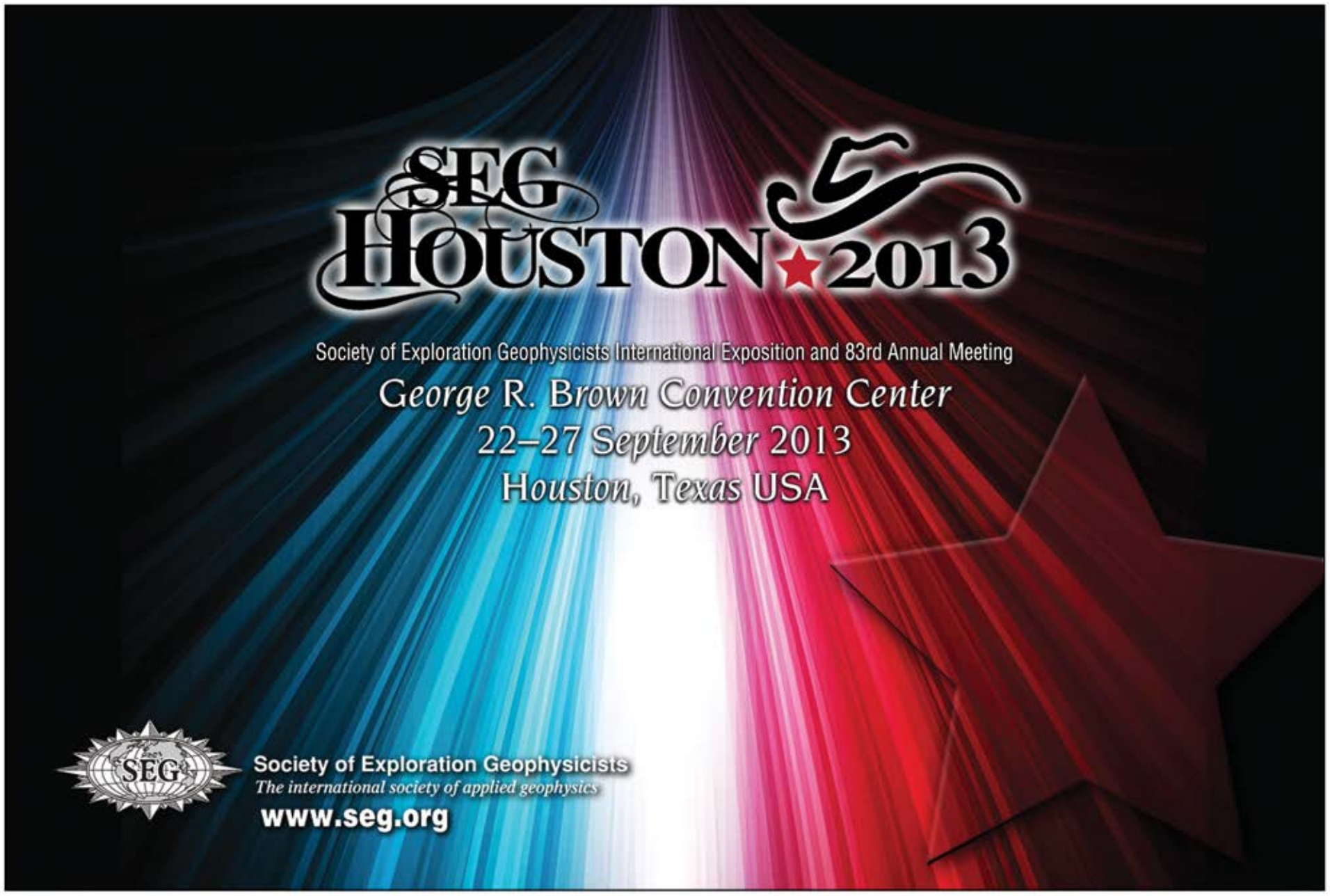

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(32 percent) than the United States (31 percent).

Other statistics suggest this could be a growing trend – in 2008 China produced more doctorates than the United States, and in 2007 the European Union published more scientific papers than the United States.

In the petroleum industry, U.S. superiority in R&D may also decline as the national oil companies expand their R&D capabilities.

Foundational research continues to decline as the petroleum industry has shifted toward more applied research and development. This started with the company mergers and research facility closings of the 1980s and continued with the expansion of service-company R&D.

Role of Federal R&D In Industry Innovation

Some readers may be skeptical of the value of federal R&D to the petroleum industry – many government and industry leaders share the belief that oil and gas R&D should be left to industry.

The weak support for government petroleum research has contributed to budgets that vary frequently in size and technical focus.

For example, the latest addition to federal oil and natural gas funding is the Research Partnership to Secure Energy for America (RPSEA), which receives $50 million per year from federal oil and gas royalties. The use of federal royalty funds was intended to mitigate the funding fluctuation associated with the usual budget processes. However, RPSEA will end in 2014 – about six years after its first R&D award.

Despite government research deficiencies, many industry innovations in areas such as hydraulic fracturing, 3-D seismic and reservoir simulation are outgrowths of government research in oil and gas and in computation technology.

- Federal research at national labs and through industry-government cooperative projects was critical to commercializing tight gas and shale gas production. Government studies of eastern U.S. gas shales and western U.S. tight gas reservoirs, and national lab research into the fracture behavior of tight sandstones all started in the mid-1970s. Government-industry collaboration through the Gas Research Institute in the 1980s and 1990s advanced the technology, and a production tax credit from 1980 to 2002 stimulated industry research and experimentation that made these resources commercial.
- Basic government research has led to other industry innovations: 3-D seismic and multi-phase, multi-component reservoir simulation would not be possible without supercomputers and parallel computing designs that came from the national labs.

Recommendations

The report contains many recommendations to keep the United States at the forefront of global innovations. Among those most relevant to petroleum innovations are:

- **The United States should aim for increased R&D funding levels of 3 percent of GDP.**

One mechanism for encouraging this would be to make the R&D tax credit permanent and increase it from 14 to 20 percent. In addition, changes in the tax code could make the credit more useful to small- and medium-size companies.

- **Federal budgeting procedures should be revised to stabilize research-funding levels through time.**

Instead of annual R&D proposals, federal agencies would develop long-range plans and budgets much as the military does for new weapons systems.

- **The federal government should simplify the procedures for universities and industry involved in government-supported R&D.**

- **STEM education should be expanded by using the recommendations of the 2012 PCAST report, "Engage to Excel."**

Changes in visa requirements could allow students and researchers from abroad to stay in the United States – an idea that also has appeared in congressional proposals for immigration reform.

CVD Event Set April 16-18

AAPG Congressional Visits Day (CVD), an annual event that provides an opportunity for AAPG members to discuss petroleum science and energy issues with decision makers in the legislative and executive branches of the federal government, will be held April 16-18.

This year's CVD will start with a Tuesday afternoon briefing on how Congress works and the legislative process, ways to make your visits successful and issues of concern to Washington.

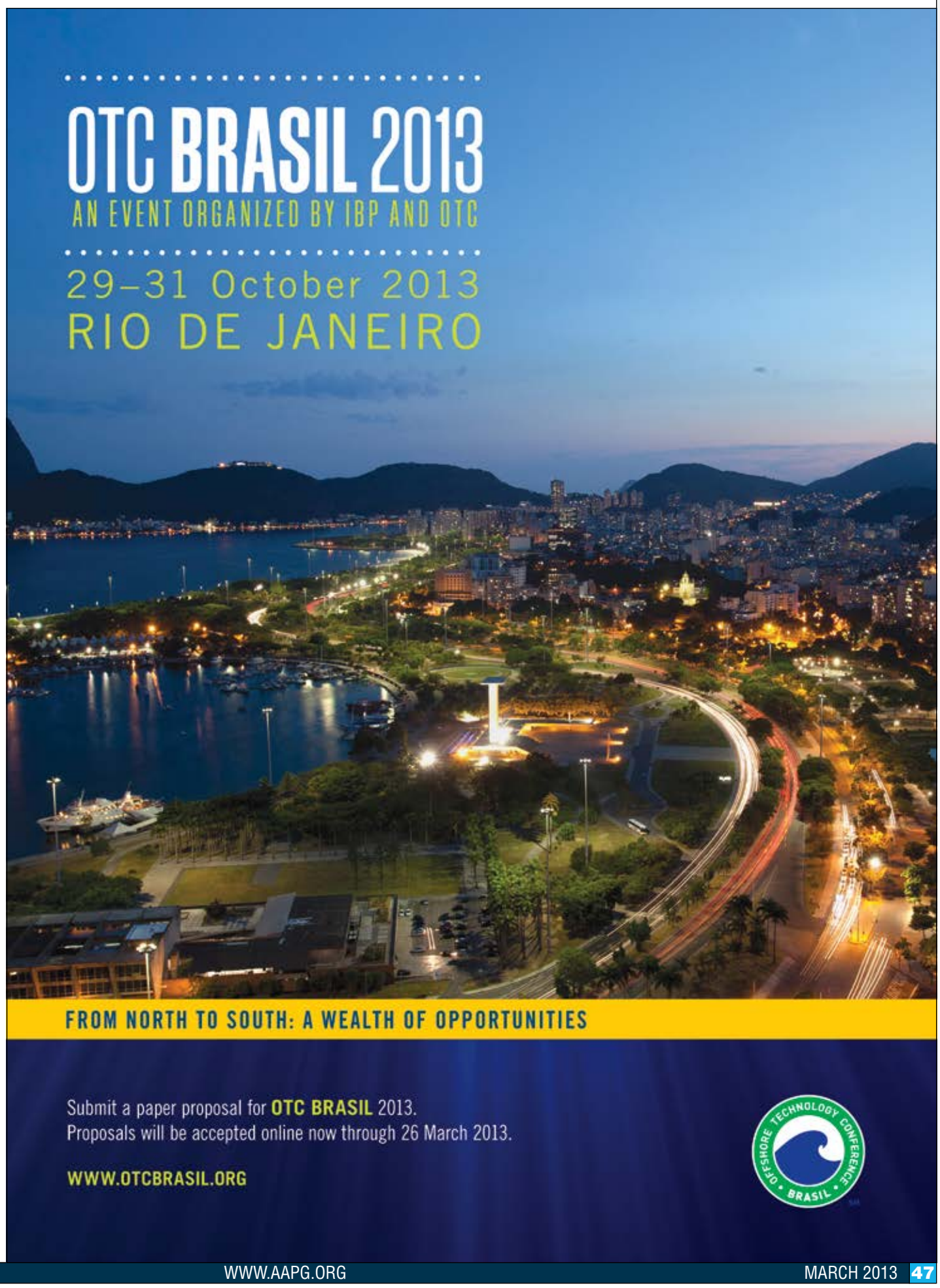
Wednesday will be devoted to small-group visits to executive branch and congressional committee offices, and Thursday will be devoted to small-group visits to congressional offices.

AAPG staff will provide training, briefing materials and will schedule the meetings.

To register, or for more information, contact Edith Allison, director of AAPG's GEO-DC office, at (202) 643-6533; or email eallison@aapg.org.

Please register by March 15 to allow AAPG staff to make appointments with specific congressional offices.

A block of rooms has been reserved for participants at the Army and Navy Club, but reservations for these also are required by March 15. Call (202) 628-8400.



Four-year support for students

Chevron Makes Million Dollar AAPG Commitment

By VERN STEFANIC, EXPLORER Managing Editor

Chevron Corporation has made a multi-year commitment for AAPG student programs.

Chevron's generous commitment of $1 million over four years – $250,000 per year – will support the Student Member Dues program and a new program to aid faculty sponsors of AAPG's many Student Chapters around the world, and will help fund the AAPG and AAPG Foundation's IBA program.

The commitment was announced by Steve Shirley, manager of Earth Science Technical Relations at Chevron Global Upstream and Gas in Houston.

Briefly put, Chevron's commitment to AAPG's Student focus will directly benefit AAPG members in two ways:

- For students, applicants for AAPG membership can choose to allow Chevron to pay their dues for the year – which is $10 (US).
- For faculty sponsors of an AAPG Student Chapter, Chevron will pay their AAPG dues.

"Chevron understands the importance of enabling students from around the world to benefit from AAPG membership and programs, as education opens the door of opportunity," Shirley said. "As an industry, our future depends on attracting and retaining talent and leaders to take on the tremendous challenges of supplying energy to growing economies worldwide."

"This continued and expanded partnership with Chevron will enable us to attract geoscience students into petroleum geoscience and ensure the availability of a future workforce," said David Curtiss, AAPG and AAPG Foundation executive director.

SHIRLEY

> **"Our future depends on attracting and retaining talent and leaders to take on the tremendous challenges of supplying energy to growing economies worldwide."**

"Chevron recognizes the need to cultivate students and support student programs to ensure they have exposure to geosciences information and data, education and are made aware of geoscience career opportunities," said David Lange, AAPG deputy executive director.

Chevron's announcement extends the company's involvement with and support of AAPG Student activities – a commitment that started in late 2006.

The four-year Chevron commitment to the IBA also was hailed as a significant impact on the exciting and growing program.

"It is a great help and a reflection of confidence in the AAPG and AAPG Foundation IBA Program as we work on fundraising to have Chevron join a number of our other top sponsors in making such a commitment to the long term success of IBA," said David Cook, who with Chuck Caughey is the current IBA Committee co-chair.

AAPG currently has 10,679 Student members and 272 Student chapters (110 in the United States, 162 internationally).

Student Sponsorship

Ever since Chevron first announced specific support for students in 2006 "it has been one of the most popular items to come up in conversation with students worldwide,"

See **Chevron**, page 51

The guidelines for those wanting to utilize the AAPG Student Chapter Faculty Advisor Sponsorship Program are:

- This program will pay the membership dues of an Active AAPG Student Chapter faculty advisor at a maximum North America standard dues level, currently $105 (US) or $125 (US) for those outside North America.
- Chevron will pay the dues of any AAPG member who serves and remains an AAPG Student Chapter faculty advisor if the member so elects. Only one faculty advisor per Chapter may be covered under this program at any given time.
- Your contact information: Name, school where Chapter is located, and Chapter's mailing address may be sent by AAPG to Chevron if you elect to have Chevron pay your dues under the program.
- A Faculty Advisors dues sponsorship may be renewed each year under this program upon confirmation of the Student Chapter's Executive Committee that the individual is serving as the Chapter's faculty advisor and receipt of the Faculty Advisor Sponsorship Renewal form.
- The sponsorship included in this program is for membership dues only, and additions such as airmail publication options or Divisional membership shall remain the responsibility of the individual member.

For more information on the program go to students.aapg.org/corporatesponsorship/faculty.cfm.

THANK YOU CHEVRON!

AAPG WOULD LIKE TO THANK CHEVRON FOR ITS SPONSORSHIP OF STUDENT MEMBERSHIP DUES.

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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 report is provided by Ross Clark, president of AAPG's Canada Region.

Some Downs, But a Lot That's Up in Canada

By ROSS CLARK

What's up with Canada, eh? This seems like the perfect time to summarize Canadian oil and gas activity in 2012. With all the talk around unconventional resources, pipeline approvals, environmental footprint of oil sands production and United States energy independence, what's happening in Canada?

* * *


CLARK

In Canada, serious exploration opportunities are being pursued in unconventional oil and gas resources.

First, we have had some significant downs – total wells drilled and commodity prices mostly, and increasing export capacity is still sometime in the future.

On the upside, Encana's Deep Panuke gas field on the Scotian shelf should be on stream by the time you're reading this with capacity of 300 mmcfg/d. Serious exploration opportunities are being pursued in unconventional oil and gas resources.

▸ Drilled wells.

One indication that activity is down and not up in Canada is the number of wells drilled in 2012. Operators drilled 11,070 wells, down 14 percent from 12,869 in 2011.

This is the second lowest count in the last decade, according to the Daily Oil Bulletin (Jan. 28, 2013). Only 2009 had fewer wells drilled.

This is largely reflected in the shift to horizontal drilling for oil targets versus vertical well gas targets, as Canadian gas prices continue to feel the squeeze from extraordinary gas production growth in the United States and generally warmer winters.

▸ Commodity prices.

Commodity prices always are good for discussion – and sometimes, some heated debate. Canada finds itself in a position not dissimilar to where the country was a few years ago, with current prices for various products settling at steep discounts to world and North American commodity markets (see accompanying table).

Probably of most significance to Canada is the beginning of a significant discount to West Texas Intermediate (WTI) for Canadian light crude oil and a widening differential between light and heavy crudes.

Historically the differential has been small, with Canadian prices a few percent and a few dollars lower, but in 2012 Light Sweet at Edmonton to WTI prices were discounted 7 percent, or about $7 per barrel.

However, of note is the trend – in December 2012 the spread was 16 percent, or $13.99.

Of even more interest is the widening differential between heavy and light crude prices. The price differential more than doubled between 2009 and 2012 ($10.55 to $21.54), but in December 2012 the differential was over $30 per barrel.

If the trend continues or stays the same, corporate capital budgets and government budgets will be significantly impacted.

▸ Unconventional opportunities.

This is not an exhaustive list of activity or operators, but is intended to summarize the newer projects that are in the de-risking stage and their potential impact as they mature as exemplified by the Saskatchewan Bakken oil development.

Shale gas

✓ Duvernay: It is still early in the de-risking phase of the Devonian Duvernay play – but with attributes characterized as being similar to the Eagle Ford, there is a great deal of interest in the success of the play.

The majority of activity is located in central Alberta near Kaybob; others are exploring at Willesden Green.

As of late December 2012, according to public records, there have been approximately 90 horizontal wells licensed and 50 rigs released since 2010 spread across 18 operators. Public information available from the Energy Resources Conservation Board on performance is very sparse mostly due to the very recent activity.

Shell Canada is the most active driller. They have licensed 17 wells and drilled six, but there is no public information on performance.

Celtic Exploration is the next most active driller, having licensed 15 wells and rigs released 12. Their best well, based on public information, after the first four months of production settled in at just over three mmcfd with potential of about 60 bbls/mmcf of C3+ liquids or about 660 boepd.

Other operators active in the play are Husky Oil Operations (eight licensed wells, three drilled), Trilogy Resources (eight licensed wells, five drilled), Chevron (five and three) and Talisman (five and four).

Encana Corporation is exploring the Duvernay further south at Willesden Green, where it is shallower and probably less liquids' rich. Public records indicate

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Chevron
from page 48

said Mike Mlynek, AAPG member services assistant manager who works directly with students and student programs.

He added that improvements have been made to the membership processing system to ensure speed and accuracy.

"During this past year AAPG has worked hard to eliminate manual data entry processes and mistakes due to handwritten applications," Mlynek said. "The applications are now handled completely online, increasing the speed and ease in processing new AAPG Student memberships."

Student applicants can pay online by credit card ($10) or choose the Chevron Sponsorship. Students will login – or create a new account if not already in AAPG's system – and then complete the profile information.

Once the profile is complete the student will click on the "New Applications" link in the gold ribbon at the top of the page. The student applicant can then choose the proper membership form and complete the remaining details.

Applicants will receive an email for each step of the process that is completed: profile (new applicant only), submission of application form and acceptance into AAPG.

For questions, contact students@aapg.org.

To join AAPG as a Student member, go to https://appmanager.aapg.org

Faculty Support

The new, Chevron-sponsored Student Chapter Faculty Advisor Sponsorship Program is expected to help those who have become advisors and encourage other faculty members to get involved with the Chapters.

"I am extremely excited about this new program," Mlynek said. "The faculty advisors are absolutely vital to having successful AAPG Student Chapters and in having a successful Student Chapter program overall – they serve as the glue in keeping Student Chapters active and engaged in AAPG and our many programs targeted at the student demographic."

Mlynek sees many benefits to this program.

"Of course, the hope is that it will serve as a 'perk' to those tireless faculty members who serve AAPG in the role of a Chapter's faculty advisor, but it will benefit AAPG and students as well," he said.

"The Student Chapter Committee in the past few years has encountered a number of problems due to a lack of faculty advisors," he said. "We ran into issues where we could not create new Student Chapters at a university because there was not an AAPG member or Associate with paid dues who could serve as the Chapter's advisor, which is a requirement to forming a Chapter."

There also have been active, "very engaged" Chapters that were unable to benefit from programs, such as the Student Chapter Book Gift or the L. Austin Weeks Grant, because the faculty advisor's dues were unpaid.

"With Chevron lighting the torch on another successful program, we anticipate these issues will disappear," Mlynek said.

"Chevron is proud to support the AAPG in engaging students and advisors through these programs," Shirley added. "It is important for advancing earth science technology and developing the profession."

Continued from previous page

they have licensed eight wells and rig released six.

Oil

✓ Southern Alberta Bakken – The "Alberta Bakken," as it has been called, also is very early in the de-risking phase, although much has been learned; the moniker has come to describe the petroleum system that encompasses reservoirs both above and below the Bakken Formation.

Horizontal completions have been made in the Bakken, Exshaw and Big Valley.

Since the first wells came on stream in late 2010, there have been over 130 wells (mostly horizontal) drilled to test the various reservoirs. Peak production was 1,300 bopd and 1.5 mmcfg/d from 22 wells.

Currently there are 33 producing wells making 400 bopd and 700 mcf/d gas. The best wells have first-three-month average production of about 300 boepd.

The top four horizontal well drillers are Deethree Exploration (29 licenses, 15 producers), Murphy Oil (26 licenses, five producers), Crescent Point Energy Corp. (22 licenses, eight producers) and Shell Canada Limited (14 licenses, four producers).

✓ Saskatchewan Bakken – The Bakken of southeast Saskatchewan, although mature, continues to be an active area.

There were 202 wells licensed and 103 producing wells drilled from January to December 2012. These wells were producing about 10,000 bopd, or about 100 bopd per well. Total Bakken production as of October 2012 was nearly 60,000 bopd from approximately 2,000 active wells with cumulative production of over 90,000,000 bo.

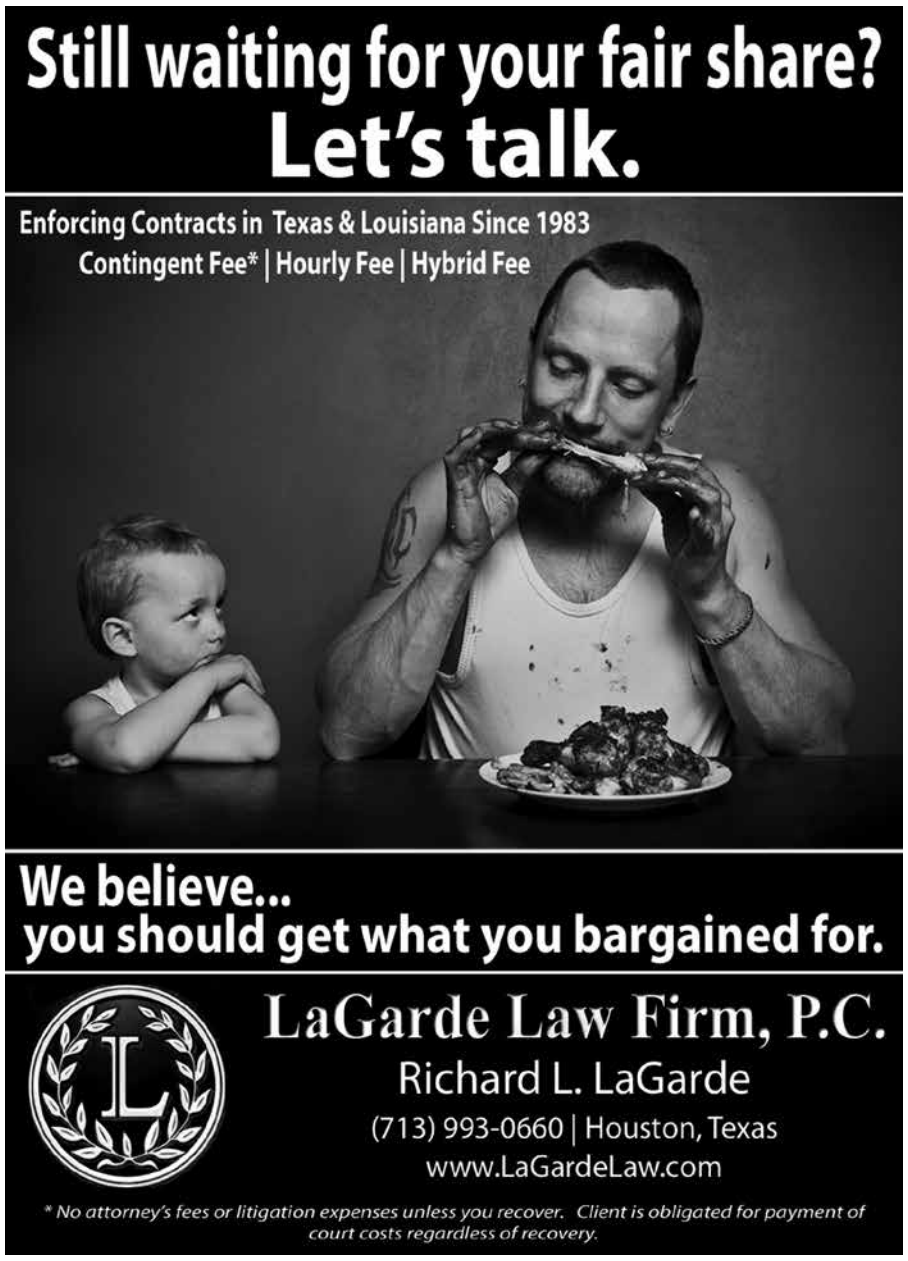
Although 17 different operators licensed horizontal wells targeting the Bakken Formation, PetroBakken Energy continues to be the top driller, having licensed 106 wells. Crescent Point Energy was the number two operator with 34 wells.

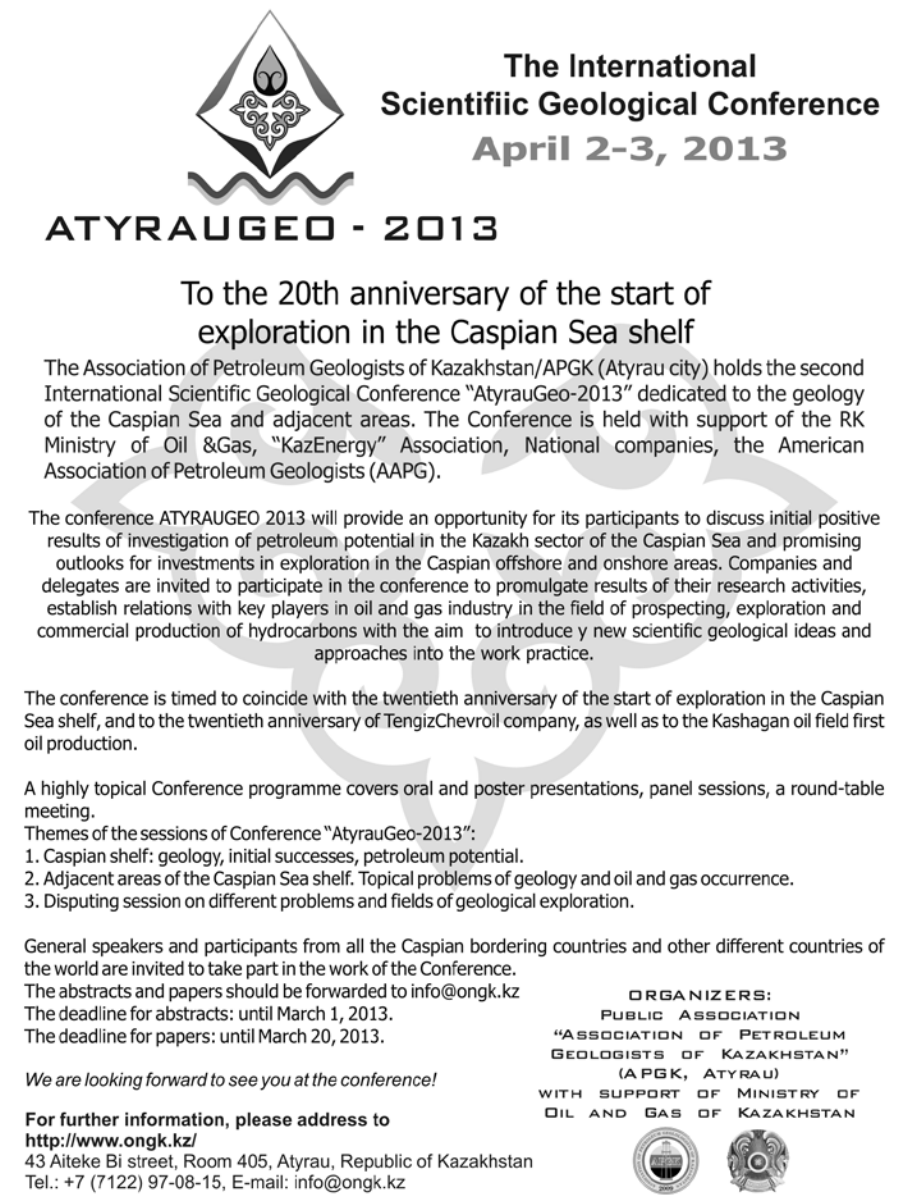
✓ Northwest Territories Canol Shale – MGM Energy spudded the East MacKay I-78 well on January 27, 2013. The well is targeting the Canol Formation shale and Bluefish member of the Hare Indian Formation on Exploration License 466B in the Central Mackenzie Valley. The well is a vertical test to be drilled to a depth of approximately 2,050 m.

Other players in the region are Husky (two wells drilled this past winter), ExxonMobil, Imperial, Shell and ConocoPhillips (three wells drilled).

The Canol shale play is said to be larger in areal extent than the Eagle Ford. The Canol shale is the principle source rock for the Norman Wells oil field discovered in 1920. Over 220 million barrels of oil has been produced from the Devonian Kee Scarp Formation.

The Canol shale is known to be naturally fractured and brittle due to chert and dolomite cementation, which should make the Canol shale a good candidate for exploitation using horizontal multi-stage hydraulically fractured wells.





A joint publication of SEG and AAPG

Interpretation

A journal of subsurface characterization

Seismic Attributes

Seismic attributes are an integral part of modern 3D seismic interpretation workflows. Used in conjunction with seismic amplitude and 3D visualization, attributes accelerate conventional analysis and highlight subtle features that may otherwise be overlooked. Because attributes quantify frequency, amplitude, phase, and configuration of seismic reflectors, they serve as input to pattern recognition and clustering software to extrapolate interpreter seismic stratigraphic analysis to large 3D volumes. Finally, attributes correlated to well-log, microseismic, and production measurements provide an estimate of reservoir properties away from the available well control.

The editors of INTERPRETATION (http://www.seg.org/interpretation) invite papers on the topic "**Seismic Attributes**" for publication in the February 2014 special section or supplement. Contributions are invited on algorithmic innovations, effective workflows, data conditioning, and integration of seismic attributes with geologic and engineering measurements. We anticipate contributions on:

- attribute interpretation workflows to map tectonic deformation,
- attribute interpretation workflows to map depositional environment,
- attribute interpretation workflows to map diagenetic alteration,
- attribute interpretation workflows to map geohazards,
- attribute prediction of petrotypes,
- attribute algorithmic innovations,
- attribute response to improved data conditioning (e.g., footprint suppression, bandwidth extension,…),
- attribute correlation with AVO, impedance inversion, and azimuthal anisotropy products,
- attribute calibration with microseismic, image log, production log, ECS, and other modern tools, and
- attribute fracture characterization.

Interested authors should submit their manuscripts for review no later than 1 June 2013. In addition, the special section or supplement editors would like to receive a provisional title and list of authors as soon as possible. Authors should submit via the normal online submission system for INTERPRETATION (https://mc.manuscriptcentral.com/interpretation) and select the Seismic Attributes Special Section option in the manuscript type dropdown box. The submitted papers will be subject to the regular peer-review process, and the contributing authors are also expected to participate in the review process as reviewers.

The submissions will be processed according to the following timeline:

Submission deadline
15 June 2013

Peer review complete
26 October 2013

All files submitted for production
9 November 2013

Publication of issue
February 2014

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INTERPRETATION special section

CALL FOR PAPERS

SPOTLIGHTON

Advice to the wise

These Habits Are Good

By LOUISE S. DURHAM, EXPLORER Correspondent

Good habits can lead to good things, including successful oil and gas wells.

Really.

AAPG Honorary Member Dan Tearpock, chairman emeritus at Subsurface Consultants & Associates (SCA), has written and taught extensively on the topic of habits, to the benefit of many companies as well as individual prospectors.

TEARPOCK

Specifically, he's focused on how and when to apply a philosophical doctrine – also known as "the 10 habits" – for successful prospect generation and evaluation.

Anyone wanting to make better investment decisions in the realm of oil and gas prospecting may want to pocket a list of the habits, which Tearpock provided:

- All subsurface interpretations must be geologically and geometrically valid in three dimensions. (Too often subsurface structure maps, cross sections and seismic interpretations are made without much consideration given to establishing a three dimensional framework – or verifying the interpretation is even possible in three dimensions).

- An interpreter must have a sound background in structural geology, stratigraphy, sedimentology and other related disciplines for the tectonic setting being worked.

- All subsurface data must be used to develop a reasonable and accurate subsurface interpretation.

- All important and relevant geologic structures must be mapped and the maps integrated to compose a reasonable and accurate subsurface picture.

- Mapping of multiple horizons is essential to develop reasonably correct, three-dimensional interpretations of complexly faulted areas.

- Accurate correlations (well log and seismic) are required for reliable geologic interpretations.

- The use of correct mapping techniques and methods is essential to generate reasonable and correct subsurface interpretations.

- Interpretive contouring is the most acceptable method of contouring subsurface features.

- All work should be documented.

- Sufficient time and detail are required to generate reliable prospects (don't be too anxious to drill the next dry hole).

This Door Swings Both Ways

Developing a successful product, i.e. good prospect, is only part of the value of the 10 habits; they can be used in both directions.

"If you drill a dry hole, the company asks what went wrong and they may hire an expert to come in and reverse engineer the prospect, tear it apart to find where the mistakes were to cause a dry hole," Tearpock noted. "We call this step forensic geology.

"They may find you didn't use the 10 habits correctly, so you made a mistake in interpretation and drilled a dry hole.

"That's the marvelous aspect of this philosophical doctrine and the habits in it," he said. "It can be used both ways.

"What some people do is when they drill successful wells, they tear them apart and see what the team did to drill this successful well," Tearpock said. "They use the habits again to go in and see what they did and then find they pretty much followed a philosophy similar to these habits – and that's why they had success."

Tearpock is quick to note that this philosophical doctrine is not exclusive to SCA.

"Some people have come up with these habits on their own," he said, "and I don't know how many."

Spreading the Word

To illustrate the value of the doctrine, he noted that a company with offices worldwide hired SCA to evaluate all of their prospects for the coming year following a year marked by far too many dry holes.

SCA sent out three teams for four months and evaluated a hundred proposed prospects, along with some of the dry holes from earlier. They determined what the explorationists were doing wrong.

"For the most part they weren't using the habits at all, except for the European division working the North Sea, which was running at an 85 percent success rate on exploration prospects," Tearpock said.

"This group had a 150-page manual that was literally like taking our 10 habits and expanding on them to a great degree.

"We found that the VP of exploration and several other explorationists there had come from the company that originally conducted the study of why certain people and teams are more successful than others," he said.

"They brought that knowledge with them to their new company, put it into practice and showed the success it can provide" Tearpock noted.

He emphasized that the habits can and should be used by all of the oil and gas companies to generate better prospects and to invest in fields having upside potential by applying these methods prior to a purchase.

Where there is interest in participating in someone else's prospects, he noted these principles will help to determine which are better than others.

Equally important, in the situation of too many dry holes the habits can be used in the "post-mortem" to zero in on the cause(s).

"ProTracks" is an ongoing feature of the EXPLORER, offering news and information pertinent to getting started or getting better in your career. Meredith Faber is vice chair of AAPG's Young Professionals Committee.

PROTRACKS

Africa Region YPs Find Collaboration Works

By TUNBOSUN AFOLAYAN and KENE C. MBA

The benefits and impact of effective collaboration were easily evident at the AAPG Young Professionals' booth at the 2012 Nigerian Association of Petroleum Explorationists (NAPE) conference, held Nov. 11-15 in Lagos, Nigeria.

Young Professionals (YPs), under the sponsorship of NAPE-AAPG YP, had a successful outing at the conference. The post-conference reflection exercise conducted by organizers and positive feedback received at the event demonstrated the strength of collaboration.

With AAPG present in many countries/regions and affiliated with strong regional societies, close collaboration is key to success – especially with the emergence of the Young Professional initiative, whose target audience is a major subset of AAPG's focus.

Collaboration started in the early planning for the NAPE conference, allowing various competing programs with the same target audience to coexist.

The NAPE-AAPG YP focused on delivering quality programs and ensuring maximum participation from the conference attendees. This focus helped define the planning strategy for the program.

An inclusive agenda of activities was initially drawn, and then activities with similar objectives were eliminated or refined as necessary.

The culmination of this effort was a YP program that actively engaged students and young industry professionals while maintaining their interest and excitement.

This process delivered the much talked about Young Professional & Student Program at the NAPE conference, which included:

- The YP Career Mentoring Session, which focused on delivering motivating speech sessions to students.

The session was intended for a broad audience and focused on themes such as careers with oil and gas operating companies and service companies, financial aid for further study, job hunting, interviewing tips and entrepreneurship.

- The YP NAPE basin evaluation competition, which was designed to help university students utilize provided data sets to showcase their understanding of oil and gas field development activities.

- The Barrel Odyssey activity ensured that the YPs and students enjoyed the process of networking by engaging various pre-selected company representatives at each booth.

This activity allowed participants to experience first-hand knowledge of the companies in attendance, understand how each company or organization fits into the oil and gas industry value-chain and, above all, experience a more rewarding and engaging conference.

- The YP Meet-N-Greet event was well-attended, bringing together industry mentors and mentees to initiate and build relationships in an informal atmosphere. The mentors' wealth of experience and knowledge was willingly shared with eager mentees in one-on-one or group discussions.

Judging by the participants' feedback, the continuation of these events is warranted. The conference experience demonstrated not only the willingness and availability of YPs and students to participate in positive professional engagements, but also the generosity and commitment of more experienced geoscience professionals to share knowledge and develop mentoring relationships.


AFOLAYAN


MBA

Given this outcome, the question that arises is whether all the YP- and student-targeted activities would have been possible with different organizing committees planning various events with similar themes in an already hectic conference schedule?

The answer: Probably not.

Success is what quality driven by collaboration ensures, and that we achieved for YPs and students at the NAPE conference.

* * *

To become a part of the YP in Africa, email Tunbosun Afolayan at tunbosun.oke@gmail.com, or visit the YP Committee page (aapg.org/youngpros/) to contact your Region/Section representative.

Editor's note: Afolayan, the Africa Region lead for AAPG's YP Committee, is a production seismologist for Shell Petroleum Development in Warri, Nigeria. Mba is a senior geologist with Mobil Producing Nigeria, an ExxonMobil affiliate, in Lagos, Nigeria.

Foundation Funds a Plethora of Programs

By NATALIE ADAMS, AAPG Foundation Manager

The AAPG Foundation proudly supports the endeavors of the world's largest professional geological society, AAPG. Although AAPG is a member-driven organization, the Foundation is able, under its 501(c)(3) guidelines, to support AAPG's educational and scientific activities that benefit the geologic profession and are available to the general public.

AAPG's purpose is to foster scientific research, advance the science of geology, promote technology and inspire high professional conduct. The AAPG Foundation's programs and activities that support AAPG, directly and indirectly, are:

The Power of Education

- James A. Hartman Student Chapter Leadership Summit
- Publication Pipeline
- Teachers' Day Program at the AAPG Annual Convention and Exhibition
- Student Field Trips at the AAPG Annual Convention and Exhibition

The Power of People

- AAPG Honors and Awards, including the Imperial Barrel Award
- Foundation Awards, Grants and Fellowships – the Grants-in-Aid Graduate program and the L. Austin Weeks Undergraduate Grants

The Power of Public Outreach

- Distinguished Lecture Program
- Michel T. Halbouty Lecture
- Region Special Lecture
- Visiting Geoscientist Program
- Energy Resources Library

The Power of Science: Online Resources

- Digital Products GIS-UDRIL University Subscription
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- Search and Discovery

The Power of Science: Publications

- Amoruso Special Publications
- AAPG BULLETIN
- Newly Released Publications Program-University Subscription

Other Foundation-Supported Programs

Aside from supporting AAPG's programs and services, other educational and scientific opportunities have been identified in the geologic community that receives support from the AAPG Foundation. They are:

- Continuing Education – the Bookout Scholarship Program
- E. F. Reid Scouting Program
- K-12 Programs – Geology Kitchen Video Web Series and AGI's Earth Science Week Program
- OSU GIS Consortium
- Switch Energy Project

Your financial support enables the AAPG Foundation to continue providing for these and more programs and services.

For more information or to donate, visit foundation.aapg.org, or call toll free (855) 302-2743.

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January 2013

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James A. Hartman Student Chapter Leadership Summit
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Chesapeake Operating Inc.
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Search and Discovery Fund
Katherine Clare
In memory of Wesley G. Bruer

Wallace Pratt BULLETIN Fund
John Sawyer Ross

The monthly list of AAPG Foundation contributions is based on information provided by the AAPG Foundation office.

Charles J. Hoke, 97, of El Dorado, AR, passed away on Sunday, December 30, 2012. He was born on August 21, 1915 and was a graduate of the University of Illinois. He served as a former trustee of Lyon College and retired from Murphy Oil Corporation where he was Executive Vice President and one of the original employees. He was an Emeritus member of the American Association of Petroleum Geologists and also a member of the Geological Society of America and the American Petroleum Institute.

Daughter Linda Hoke Bledsoe of El Dorado, talked with Natalie Adams, Manager of the AAPG Foundation for some time about her dad's love of rocks. "He decided as a small boy that he wanted to know why rocks formed the way they did," she said. When Adams called, Bledsoe instantly recognized the name of AAPG. "I've heard those four letters my whole life," she said rather reminiscently.

Hoke left a substantial contribution in his will for the AAPG Foundation designated to the Pratt Bulletin Fund. Bledsoe said that her dad saved every issue since he joined AAPG in 1938. We honor him for his love, his life and his legacy.

The AAPG Foundation is a proud supporter of the AAPG Bulletin and is grateful for contributors like Charles Hoke, who make this support possible. In addition to leaving this legacy gift, Hoke was a consistent annual contributor, which he almost always gave in memory of a dear and respected colleague.

For more information or to make a contribution go online to foundation.aapg.org.

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EX 3/13

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

READERS' FORUM

It's Time

It's time for Congress, the administration and related government agencies in Washington, D.C., (EPA in particular) to recognize and accept fossil fuels as the principal suppliers of energy for our nation's needs for decades to come.

Contrary to public opinion and media hype, there is a lack of scientific evidence that emission of carbon dioxide (CO_2) by the burning of fossil fuels has ever contributed, or likely ever will contribute, to global warming.

It is time to reduce and, where possible, eliminate the huge subsidies supporting alternatives (solar, wind, biofuels), none of which can compete with fossil fuels for efficiency or cost. Alternatives will not be needed for some time as we now have an abundance of fossil fuels resulting from new technology in drilling and producing oil and natural gas.

Meanwhile, energy companies driven by the free market are in the business to research and develop the technology required to make these alternative fuels viable and affordable – and will do so, in the due course, without government intervention.

It is time to develop a North American energy policy (United States, Canada and Mexico). The three working together will result in energy self-sufficiency, thus freeing the United States from importation of oil from those who are not our friends. All that is required for a North American energy policy is to free up our own areas (e.g. offshore, Alaska, etc.) for drilling, and open our borders and build a few pipelines (Keystone XL, for example) to bring oil and gas from Canada, Alaska and Mexico to the U.S. market.

Dick Baile
Houston

PROFESSIONAL newsBRIEFS

John Austin, to geologist, Arena Energy, The Woodlands, Texas. Previously geologist, Newfield Exploration, Houston.

Francis "Frank" Bifano has retired from Hess Corp. after 28 years of service. Bifano is now a business and technical consultant, splitting his time between Houston and Hershey, Pa.

Greg Flournoy, to district geologist, RKI Exploration and Production, Oklahoma City. Previously principal geologist, Schlumberger, Oklahoma City.

Matt D. Gentry, to vice president-engineering and business development, Forge Energy, San Antonio. Previously chief operating officer, Antares Energy, Houston.

Allen Hunter, to deepwater geophysicist, Stone Energy, Houston. Previously senior geophysicist, Nexen Petroleum, Plano, Texas.

Mohit Khanna, to head of subsurface development, Petrofac – Integrated Energy Services, Gurgaon, India. Previously chief development geologist, Salamander Energy, Bangkok, Thailand.

S.J. Mazzullo, to professor emeritus and president, Mazzullo Exploration, Wichita, Kan. Previously professor of geology, Wichita State University, Wichita, Kan.

Robert E. "Bob" McKee has retired from consulting geologist. He resides in Gillette, Wyo.

Kehinde Olafiranye, to exploration geoscientist (Nigeria onshore/shelf exploration), Shell Petroleum Development, Port Harcourt, Nigeria. Previously research postgraduate, Imperial College London, London, England.

Ralph A. Stone, to principal geoscience manager, SOCO International, London, England. Previously geoscience consultant, Marathon Oil, Warsaw, Poland, and Houston.

Scott E. Thornton, to senior geologist, PanAtlantic Exploration, Houston. Previously exploration geoscientist, Sequence Stratigraphic Associates, Houston.

Michael W. Webb, to senior geoscience adviser-in situ resources, Suncor Energy, Calgary, Canada. Previously manager of geology and geophysics, MacKay River asset team, Suncor Energy, Calgary, Canada.

(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.)

IN MEMORY

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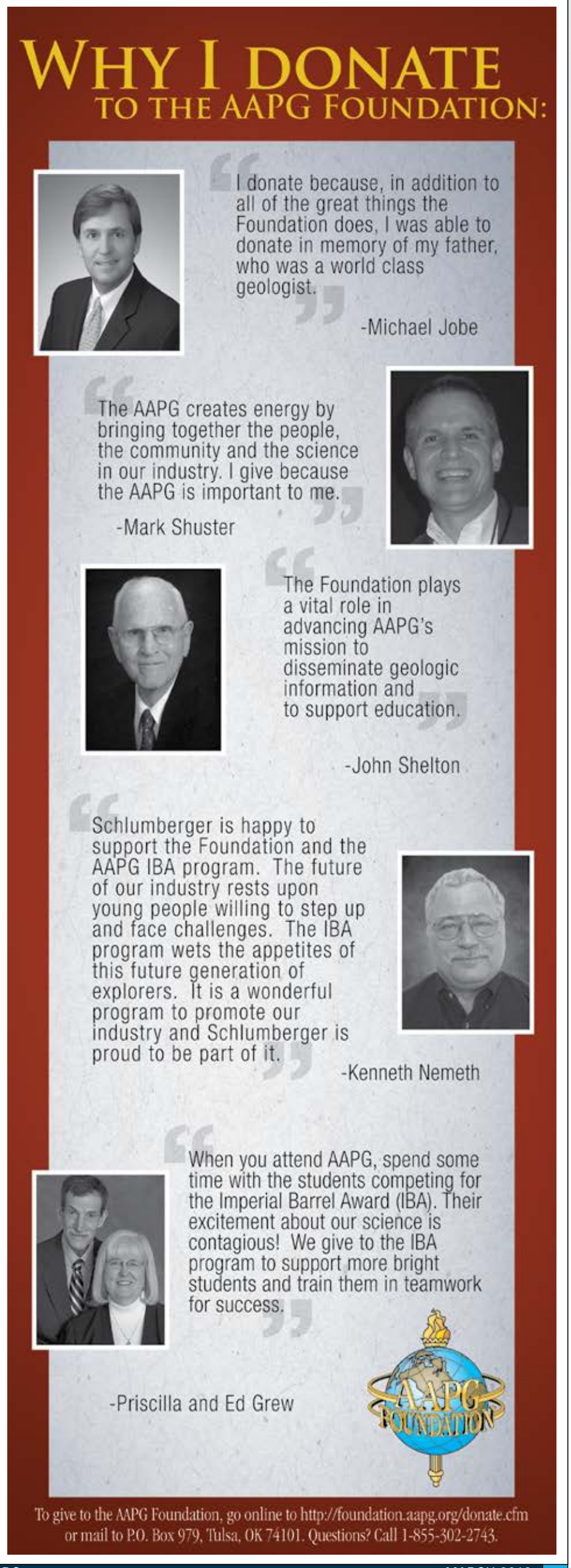
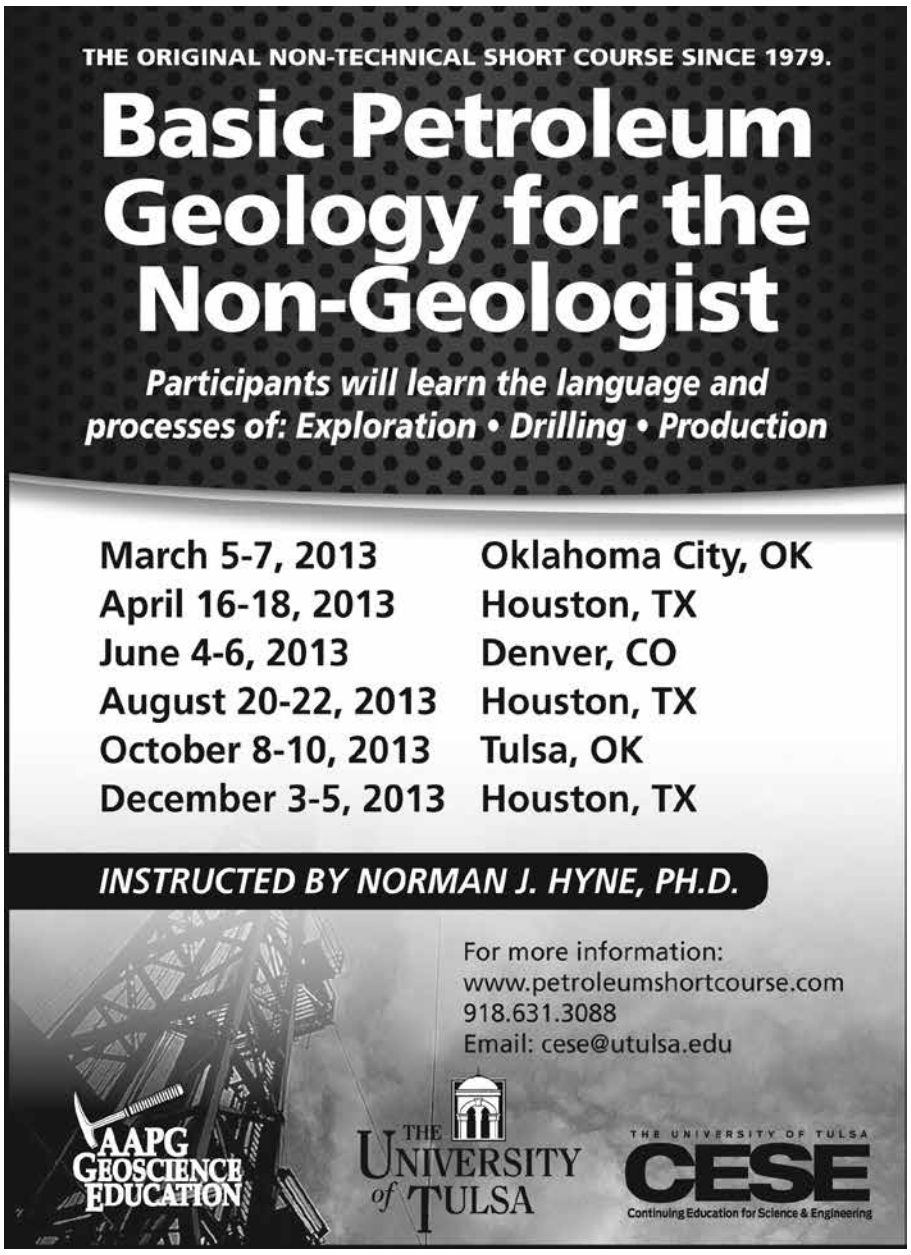
Dallas, Oct. 20, 2011
Rick White, 50
Bobcaygeon, Canada, May 2, 2012

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





COMMENTARY

‘Endorsers’ and Integrity

By OLIVER L. CAMPBELL

Though not a geologist, I can claim an early association with them.

When I started with Shell in Caracas, Venezuela, in 1953, my office was close to a couple of young geologists who sat at a slanted table with rolls like toilet paper. They told me these rolls, which had lines like a present day ECG, were seismic prints. They spent all day unrolling them and making marks on them. Then, when I was sent to Lagunillas, I went in a jeep into the wilds, accompanied by two National Guard soldiers in case we were stuck up, to pay the seismic crew’s wages.


CAMPBELL

* * *

This article aims to show why I take some pronouncements from geologists with a pinch of salt.

As a young oil field accountant in the early 1950s I was naive and took what the geologists and petroleum engineers said as gospel. My faith started to crumble, however, when eminent geologists predicted that at the current production rate, the world’s oil reserves would run out in 40 years.

This did not match my own experience in the oil fields round Lake Maracaibo, where our oil reserves were steadily increasing as more oil was being found than was being extracted.

I saw the same was happening elsewhere in the world – more oil was being produced yet reserves were not going down. Despite this, the figure of 40 years remained unchanged.

At the end of the 1950s and into the 1960s, a number of new and substantial oil provinces were discovered, including Nigeria, Libya, the North Sea and Alaska (Prudhoe Bay). After these discoveries, geologists quietly dropped the predictions of how long oil reserves would last.

This was just as well, because subsequently other oil provinces were found – and who knows how much more oil remains to be found offshore in deep waters and in the Arctic and Antarctic?

I saw geologists as the prophets of gloom and doom because, 50 years later, their concern about how long reserves would last switched to worrying about how soon peak oil production would be reached. Some thought it was, like the Day of Judgement, close at hand, and the main exponents of this were the geologists Colin J. Campbell and AAPG member Jean H. Laherrére. Their book, “The End of Cheap Oil,” published in 1998, predicted peak oil would be reached in 2000, later updated to 2006 and 2008.

Chris Skrebowski, the consulting editor of Petroleum Review, placed it at 2010, plus or minus two years.

Obviously, it has not happened – and it just goes to show, however expert you are in your field, making predictions is a dicey business.

Campbell and Laherrére based their prediction on two main premises:

- The world has been largely explored and no more large oil provinces remained to be found.
- Improvements in technology would not be important.

They were wrong on both counts. Since then new provinces have been found offshore in the Gulf of Mexico, the Bay of Bohai, offshore Angola, offshore Brazil, offshore French Guiana and in the Barents Sea. On land, shale rocks such as those in the Bakken (Montana) and Eagle Ford (Texas) have been discovered with the potential to produce large amounts. Oil sands, like those in Athabasca, and extra heavy oil, such as that in the Orinoco Belt, have all added to reserves.

New technologies include 3-D seismic surveys, which allow wells to be drilled over accumulations and not be equally spaced out on a grid as it was in my young days. The cluster, where some 30 wells can be drilled from one site, horizontal drilling and hydraulic fracturing have all increased production efficiency.

My mind still boggles at Total’s technology, which can upgrade an extra-heavy crude of 8 degrees API from the Orinoco Belt to a viable light crude of 32 degrees API.

The way a drill pipe can twist and turn and then go parallel along the reservoir for half a mile or more does not cease to astonish me.

* * *

Geologists make much of the Hubbert Curve – but is it useful for calculating world-wide peak oil?

Economist Michael Lynch makes a telling point about this curve when he states, “The primary flaw in this type of model is the assumption that recoverable petroleum resources are fixed, when the amount of oil which can be recovered depends on both the total amount of oil (a geological factor which is fixed), and also dynamic variables like price, infrastructure and technology.”

We have seen how an increase in oil prices has brought further reserves into play. This has happened with offshore reserves and, more recently, with shale oil reserves in the United States.

What would Hubbert think about U.S. oil production today?

- It peaked at 10.0 million b/d in November 1970, went down to 4.0 million b/d in September 2008, then climbed up to 6.9 million b/d in November 2012, largely due to oil extracted from shale rocks.
- The EIA estimates production will reach an average of 7.3 million b/d in 2013 and 7.9 million b/d in 2014.

Also, it is estimated some 4.0 million b/d of shale oil will be produced by 2020 bringing total U.S. production up to 10 million b/d and equalling the previous peak.

But I wonder how much of this is hype?

I am skeptical, because the per-barrel costs of producing shale oil are high, and oil companies may decide other options are more attractive, certainly in the short term. I suspect this will put a brake on the growth of shale oil.

* * *

Of course, peak oil will happen sometime. Production already has peaked in some provinces like the North Sea – but as one province declines, so another grows. The date keeps being put further back and the proponents of imminent peak oil are keeping mum.

I place a lot of faith in our scientists and engineers to come up with solutions for producing more oil e.g. from the huge, worldwide reserves of shale rocks which contain kerogen. Another possibility is to increase the recovery factor.

Continued on next page

CLASSIFIED ADS

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Reservoir Modeler – Houston

ExxonMobil Upstream Research Company has an immediate opening for a Reservoir Modeler at its Upstream Research Laboratory located in Houston, Texas. The successful candidate should have a solid background in geology coupled with a strong interest in digitally characterizing reservoir scale features using existing and innovative techniques. This position primarily supports our broad and diverse reservoir modeling research portfolio, while at same time being flexible enough that the individual's skillset could be applied to a broad range of geologic modeling challenges. The candidate filling this position will be expected to immediately contribute to on-going projects as well as formulate and direct future endeavors. Collaboration is required with corporation geoscientists and engineers with a broad range of disciplines, including seismic interpretation, stratigraphy, formation evaluation, reservoir engineering and software developers.

Candidates should have the following qualifications:

- A Ph.D. or M.Sc. in Geologic Modeling or related field.
- A B.Sc. in Geology or related field.
- Ability to use standard coding languages (e.g. MATLAB, C++ etc) applied to geologic modeling algorithm creation/manipulation.
- Understanding of fundamentals of industry standard geologic modeling algorithms and workflows (Geostatistical Modeling, Object Based Modeling, Multi-point Statistics Modeling).
- Demonstrated willingness to take risks in research while maintaining objectivity.
- Creative, adept at team work, and able to drive projects to completion.
- Strong communication, organization, and interpersonal skills.
- Industry or post-graduate experience in reservoir modeling would be a plus.

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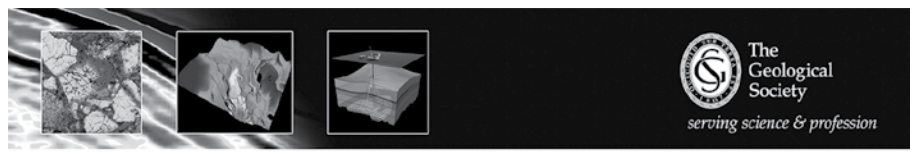

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Microbial Carbonates in Space and Time: Implications for Global Exploration and Production
19-20 June, 2013
The Geological Society, Burlington House, Piccadilly, London

Microbial carbonates occur globally throughout the stratigraphic column, from the Archean to the present day. They constitute principal reservoirs of the recent pre-salt discoveries offshore Brazil, producing fields in the Middle East, and are the targets of the pre-salt play offshore Angola. Further development of our understanding and knowledge of microbial carbonates has significant implications for future worldwide exploration and production of these intriguing deposits.

Over the 2 days conference we invite geologists, petrophysicists, geophysicists and petroleum engineers to examine challenges in exploration, appraisal and production associated with microbial carbonates in various parts of the stratigraphic column.

Organising Committee:
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Dan Bosence, Royal Holloway University of London
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Erwan Le Ber, Royal Holloway University of London
Tim Pritchard, BG Group

Key themes to explore include:

- Marine vs. Non-marine microbial facies and textures
- Reservoir Characterisation:
  - Scaling up - from microbial processes, textures to facies and geobodies
  - Formation Evaluation - advances in data acquisition and evaluation
  - Reservoir scale seismic imaging and attribute studies
  - Diagenesis and preservation
- Regional and basin settings
  - Play Characterisation - seismic imaging, relationship to hydrocarbon source and association with hydrothermal activity
- Microbial carbonate analogues - ancient to modern

For further information and detailed abstract guidelines please visit www.geolsoc.org.uk/carbonates13 or contact:

Steve Whalley, The Geological Society, Burlington House, Piccadilly, London W1J 0BG
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www.geolsoc.org.uk/petroleum

Continued from previous page

There is pressure to produce more gas, which the emerging economies need. At present, much of this demand is met by transporting LNG. In the future, as more shale gas is found, indigenous gas can replace LNG imports. But it looks as if geologists have overstated resources, and we need to sort out fact from the hype.

Estimates of Poland's resources have come down from 5.3 trillion cubic metres, to 3.0 trillion and now to just 1 trillion. It is still good news for western Europe, which wants to depend less on Russian supplies.

Shale gas was recently found near Blackpool (England) and, on the basis of two wells drilled, the company estimated there are resources of some 200 trillion cubic feet. I thought it was another case of hype since the figure was later revised to 150 trillion cubic feet (see February EXPLORER). However, there are now rumors the British Geological Survey is about to increase the figure substantially. Either way, it is good news for the U.K., which will depend less on Russian gas as North Sea supplies run out.

* * *

Geologists are no longer prophets of gloom and doom, but it seems to me they have gone the other way as endorsers of hype. I use the word "endorsers" intentionally, as I suspect it may not be their fault, but that of their bosses who want to keep the share price up with announcements of exaggerated discoveries.

I have a great regard for geologists and I hope they will maintain their integrity and not be pressured into any form of hype to please the shareholders.

DIRECTOR'S CORNER

AAPG's Publishing Legacy Adds New Chapters

By DAVID K. CURTISS, AAPG Executive Director

AAPG is a science publisher. It's a tradition that dates back to our founding. And our flagship journal, the BULLETIN, and our special publications are usually a core part of a petroleum geoscientist's professional library.

Last month was a big one for AAPG science publishing.

▸ AAPG's associate editors were invited by Elected Editor Steve Laubach to gather in Houston on Feb. 4 to discuss improvements to the BULLETIN's editorial process, select publication awards and talk about developing a short course for aspiring young authors.

That evening the attendees were inducted into the Charles Taylor Fellowship. The fellowship, named after the BULLETIN's first editor, Charles H. Taylor, was established by AAPG's Executive Committee to recognize the vital contributions that all current and former associate editors have made to ensuring that AAPG maintains high standards of published science.

▸ Then on Feb. 7, at a meeting convened by AAPG President Ted Beaumont and SEG President David Monk, my SEG counterpart Steven Davis and I signed a memorandum of understanding for AAPG to join as a partner in the new journal Interpretation.


CURTISS

Ensuring that AAPG remains a relevant and successful science publisher is vital to our long-term objectives.

(See related story, page 4.)

Interpretation, launched by SEG late last year, is a peer-reviewed quarterly designed to publish papers on the science and practice of interpreting data to better understand Earth's subsurface, particularly as it relates to the exploration and extraction of resources and for environmental and engineering applications.

This journal fills an important space in science publishing and our participation is the outgrowth of an enhanced and evolving partnership with SEG.

▸ Finally, last month marked the launch of a new BULLETIN feature.

Editor Laubach has been working closely with Beverly Molyneaux, AAPG's managing editor of technical publications, and Geoscience Director Jim Blankenship to ensure that BULLETIN authors' manuscripts are published as quickly as possible.

The result is a new website for the BULLETIN (bulletin.aapg.org) and a new feature called Ahead of Print (see related story, page 38). There you will find manuscripts that have been peer-reviewed and accepted for publication, but have not yet gone through the lay-out and production process.

Ahead of Print gives our members and subscribers the ability to access AAPG science as soon as it's accepted. This benefits users and is an important step in attracting authors to publish in the BULLETIN.

Ensuring that AAPG remains a relevant and successful science publisher is vital to our long-term objectives. Last month's activities build upon a strong foundation and position us for the future.

And there are further improvements to come.

I'd like to leave you with one more thought:

Most of us are consumers of the science information published by AAPG. We sift through the online BULLETIN archives and *Search and Discovery* for papers or presentations that will help us better understand an exploration concept or the geology of a particular region.

That's great! That's what these resources are meant to do – to help you do your job better.

But those papers and presentations are only there because someone took the time – usually personal time – to put words on paper, to draft figures and to edit and revise. They probably didn't do it for fame and fortune (although I wouldn't dismiss the possibility). Instead they likely saw this contribution as a way to improve their own understanding, to enhance their professional standing and to step into the role of teacher, contributing to the scientific discourse.

They decided to become active participants in advancing our science.

What paper or presentation is locked inside you?

DIVISIONS REPORT

More Challenges, More Opportunities

By TOM J. TEMPLES, DEG President

Once again, Hollywood is on the offensive against the oil industry – a documentary titled "Greedy Lying Bastards: Big Oil's Dirty Secret" is scheduled for release this month.


TEMPLES

According to a February press release, the film's director, Craig Rosebraugh, wanted to "undertake a project that would uncover the hidden agenda of the oil industry and provide answers as to why we as a nation fail to implement clean energy policies and take effective action on important problems such as climate change."

The film claims that the oil industry has waged a campaign of lies designed to thwart attempts to stop climate change by using its influence to minimize regulations and to sustain unnecessary subsides that are crushing the economy.

Climate change, as we all know, has been a controversial issue for many years now, and when combined with the debate on hydraulic fracturing has kept our industry in a somewhat negative spotlight.

As earth scientists, we all have studied the earth's history and know that climate change is a real phenomenon, driven by suns cycles and changes in the earth's orbit – and one thing is certain: We will have periods of global warming and global cooling, and these cycles are part of our earth's history since its beginning.

The debate is not whether we have caused climate change through the use of fossil fuels, but how much influence have we had on the natural trends here on earth.

* * *

Geology is the least taught science in our school's curriculum. Most students get little if any exposure to earth science.

Recommendations by the National Science Education Standards for grades 5-8 include:

- Structure of the earth system.
- Earth's history.
- Earth in the solar system.

This usually is taught as part of one eight-week unit.

Additional instruction recommended for grades 9-12 includes:

- Energy in the earth system.
- Geochemical cycles.
- Origin and evolution of the earth system.
- Origin and evolution of the universe.

Few if any schools offer a class in earth science in high school. Contrast that with courses offered in chemistry, biology and physics. Almost all high schools in the United States offer at least one if not more classes in these subjects.

Data compiled by the National Science Teachers Association compared the number of teachers in 2005 that taught other sciences:

- ✓ Biology – 52,697 teachers.
- ✓ Chemistry – 27,947 teachers.
- ✓ Physics – 16,301 teachers.
- ✓ Earth science – 15,611 teachers.
- ✓ Physical science – 25,499 teachers.

Of all the major sciences taught, the smallest number of teachers is in earth science – so is there any surprise that there is so much controversy and misinformation about climate change and the effects of hydraulic fracturing in the press today?

I encourage you to get involved in these debates. It is only through the dissemination of correct and factual information that we can have a profound influence on events and the future of our industry.

* * *

Now would be a great time to visit the DEG website, at deg.aapg.org, because there we are attempting to give you the resources necessary for you to participate in these debates.

On our website you'll find links to articles of interest, plus a section devoted entirely to shale gas, including links to peer-reviewed papers, articles, datasets and conference proceedings.

* * *

Many upcoming AAPG meetings will have sessions devoted to environmental issues.

The upcoming Pacific Section annual meeting, for example, set April 19-24 in Monterey, Calif., has a section devoted to "Remediation and the Environment," and there will be a section at the AAPG Annual Convention and Exhibition in Pittsburgh focusing on "Energy and the Environment."

Here are some of the topics that will be covered:

- Environmental risks in deep offshore and frontier areas.
- Water risks and mitigation strategies from onshore unconventional resource development.
- Understanding stray gas.
- Air quality concerns from oil and gas production.
- Regulatory issues with hydraulic fracturing.
- Advances in carbon capture and geologic storage in North America.
- CCS and CCUS.
- Resource development for a healthy society.

And with the increased interests on unconventional resources internationally, DEG also will participate in a special session on hydraulic fracturing at the AAPG International Conference and Exhibition in Cartagena in September. This session will include a presentation and a panel discussion.

* * *

As always, we need to get involved at all levels and get the word out to politicians and the public.

Take any opportunity to speak to the public and the regulators. AAPG members – and DEG members in particular – are in a unique position to spread the truth since many of us live and work in non-oil patch parts of the United States and the world.

The DEG hopes that this and other efforts in the coming year will keep you engaged. If you are not a DEG member, consider joining and getting involved in DEG and the environmental side of the energy industry.

DEG will continue to do its best to keep those issues in front of the AAPG membership.

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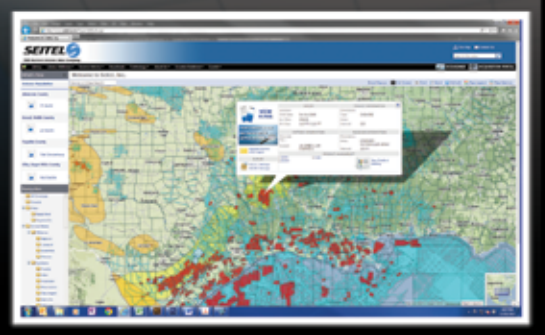

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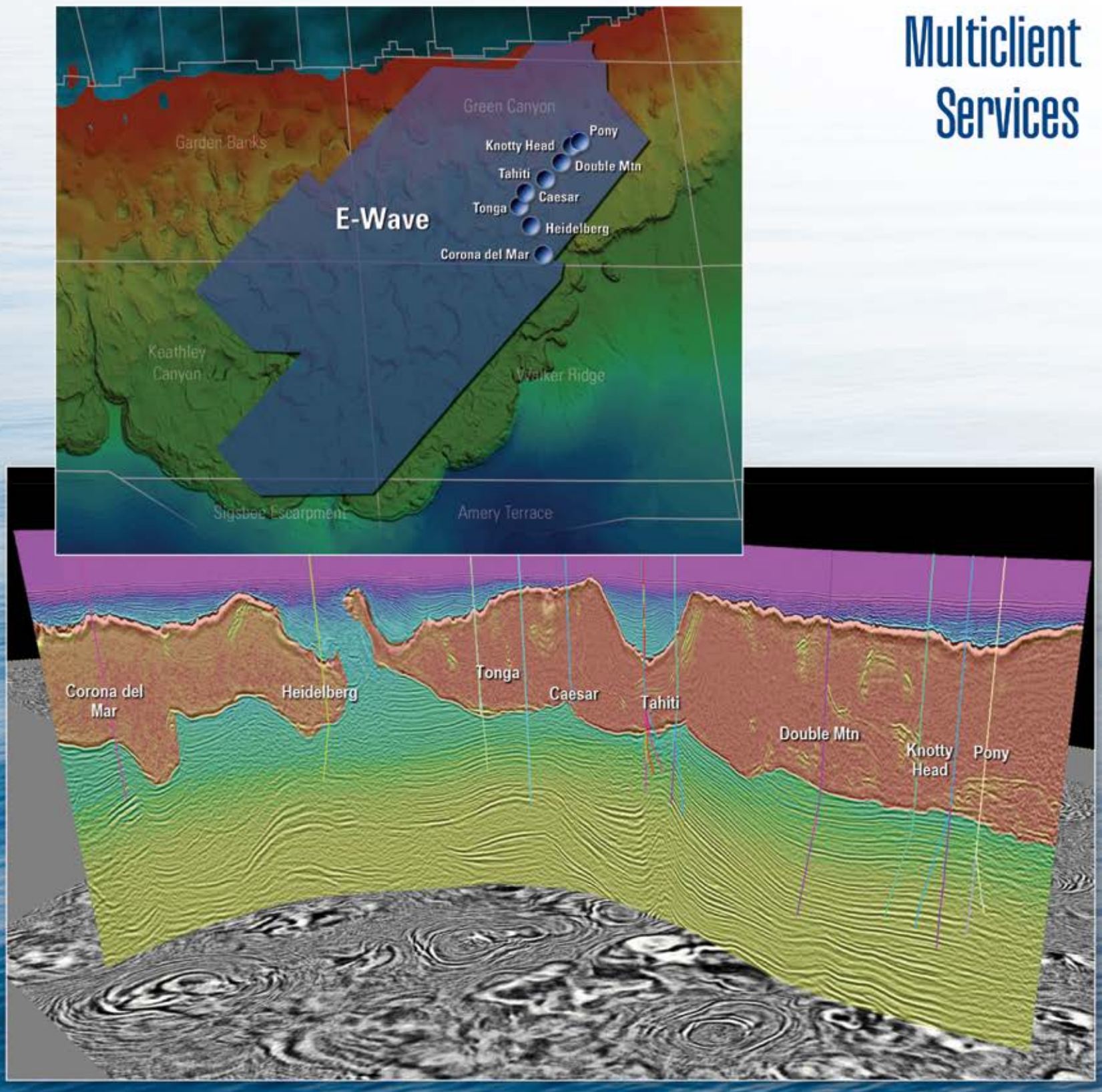

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