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Vol. 33, No. 7
July 2012

AAPG EXPLORER

PRESIDENT'S COLUMN

Concepts Shift Creates Ripples of Change

By TED BEAUMONT


BEAUMONT

In North America onshore, the resource play has caused a dramatic shift in the exploration objectives of many, if not most, independent and major petroleum companies. No longer do companies explore for "conventional" targets – instead they focus almost entirely on resource plays.

As a result, many if not most North American exploration geologists – who work onshore are creating prospects that are potential new resource plays.

Outside of North America, industry is just beginning to explore for resource plays.

* * *

Changing basic concepts of anything that you are very familiar with can be especially challenging.

Gas shales for example, required changing our thinking about basic petroleum geology. Ten years ago not many of us imagined we would have to change our concept of shales as only source rocks or seals, to shales as reservoirs – reservoirs that have nano-darcies of permeability and are economic.

No one could have imagined the huge impact this conceptual change would have on the petroleum industry.

Now, the petroleum industry accepts the premise that shales are effective gas reservoirs where they have the right amount of organic matter, maturity and brittleness.

Shale gas reservoirs in the United States have reversed the natural gas production decline predicted by M. King Hubbert, who in 1956 predicted that U.S. gas production would peak about 1970 and that U.S. oil production would peak about 2000.

In retrospect, as far as gas is concerned, the actual U.S. gas production trend followed the Hubbert decline prediction pretty closely until sometime in the early 1990s, when the decline trend began to reverse.

Today, we are actually producing more gas in the United States than ever (figure 1).

Few thought this was possible. Natural gas is a finite resource and at some point natural gas production will decline. Now it will happen sometime in the future.

Hubbert was a very capable and highly respected geologist. His predictions of peak U.S. oil and gas production looked good to many people. In fact, his peak oil production curve still looks good (see figure 2, from Ahlbrandt 2011, after Charpentier 2005), but that may be changing as well.

During this coming year, AAPG will examine the impact of the resource play on our science. The resource play concept opens up many questions:

- How has petroleum geology changed as a result of the resource play?
- How has it changed our concept of the petroleum system?
- What will the future petroleum geologist need to know to be effective?
- How will we explore and develop resource plays?

See **President**, next page

Figure 1

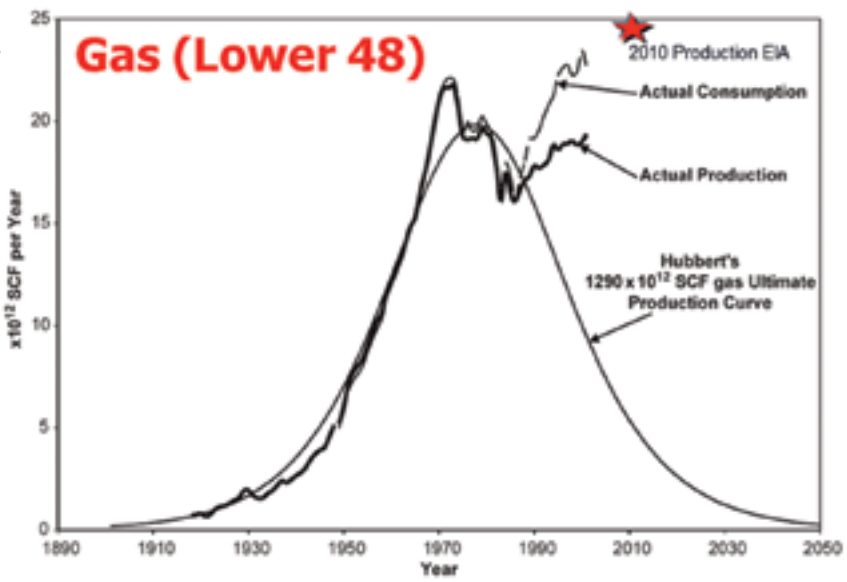
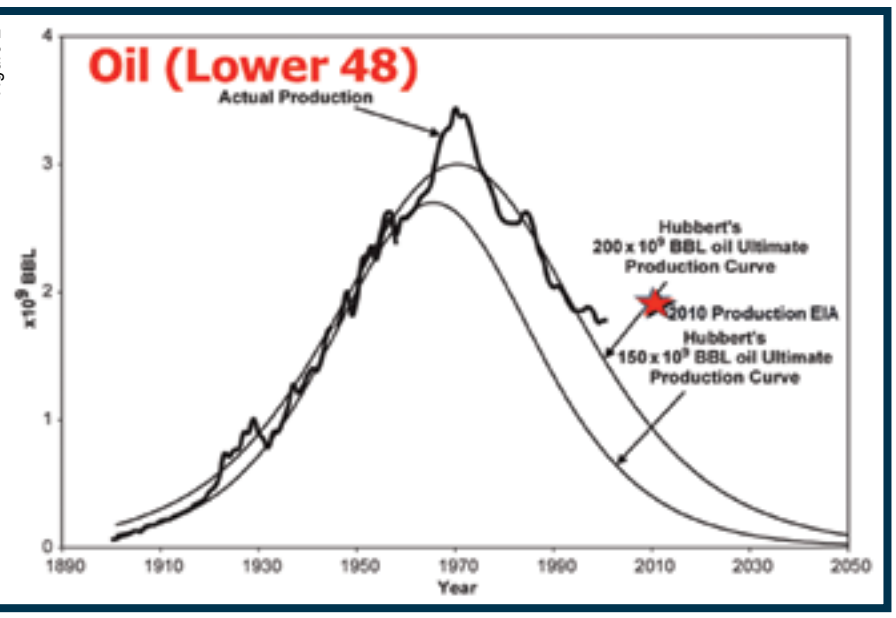


Figure 2



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REGULAR DEPARTMENTS

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Photo courtesy of Krystal Pearson

ON THE COVER:

A group of AAPG members and others studying – and enjoying – the Apennine Mountains in central Italy, on a spot that is very close to the upcoming AAPG short course plus field trip, "Application of Structural Geology in Prospecting in Thrusted and Extensional Terrain," which will be held Aug. 27-31 in Perugia, Italy. Registration at reduced rates remains available online through July 16, at www.aapg.org/education/shortcourse. Photo by Debbi Boonstra.
Left: Something new is emerging from the Austin Chalk. See page 32.

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

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AAPG Officer Candidates Announced

AAPG officer candidates have been announced for the 2013-14 term.

Biographies and individual information for all candidates will be available online in mid-July at www.aapg.org.

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

Ballots will be mailed in spring 2013.

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.

President
from previous page

- What tools will we need to evaluate them or explore for them?
- Where will new resource plays be located?

* * *

The emergence of the resource play could be termed a "black swan event." Black swan events are unpredictable events that have huge, long-term impact.

In retrospect, black swan events always look like they should have been predictable, but they aren't. Some examples of black swan events include the creation of the Internet, Google or 9/11.

Obviously, we can't predict what will happen this year, either in our personal lives or for our collective efforts toward AAPG. But there are two things that I know:

- AAPG needs to be ready to aid its members as they adjust to changing concepts, like the resource play.
- The 2012-13 AAPG Executive Committee is well qualified to lead us – it has a good balance of industry and academic experience.

Our president-elect is Lee Krystinik. Lee is principal founder of Fossil Creek Resources, where he initiated a successful horizontal drilling play in the Cleveland Sandstone in north central Oklahoma.

Vice president-Regions is Stuart Harker, whose company, Circle Oil of Aberdeen Scotland, is exploring the North Sea.

Vice president-Sections is Tom Ewing, who is recognized for his many outstanding contributions to sorting out the geology of the U.S. Gulf Coast, where he is currently exploring for oil and gas with Yegua Energy Associates.

Editor Steve Laubach is senior research scientist with the Texas Bureau of Economic Geology in Austin. Some of his current research includes the emerging field of structural diagenesis, which considers fracture cementation.

Secretary Denise Cox is successfully prospecting for oil and gas in the west Texas Permian Basin with her company, Storm Energy of Panama City, Fla.

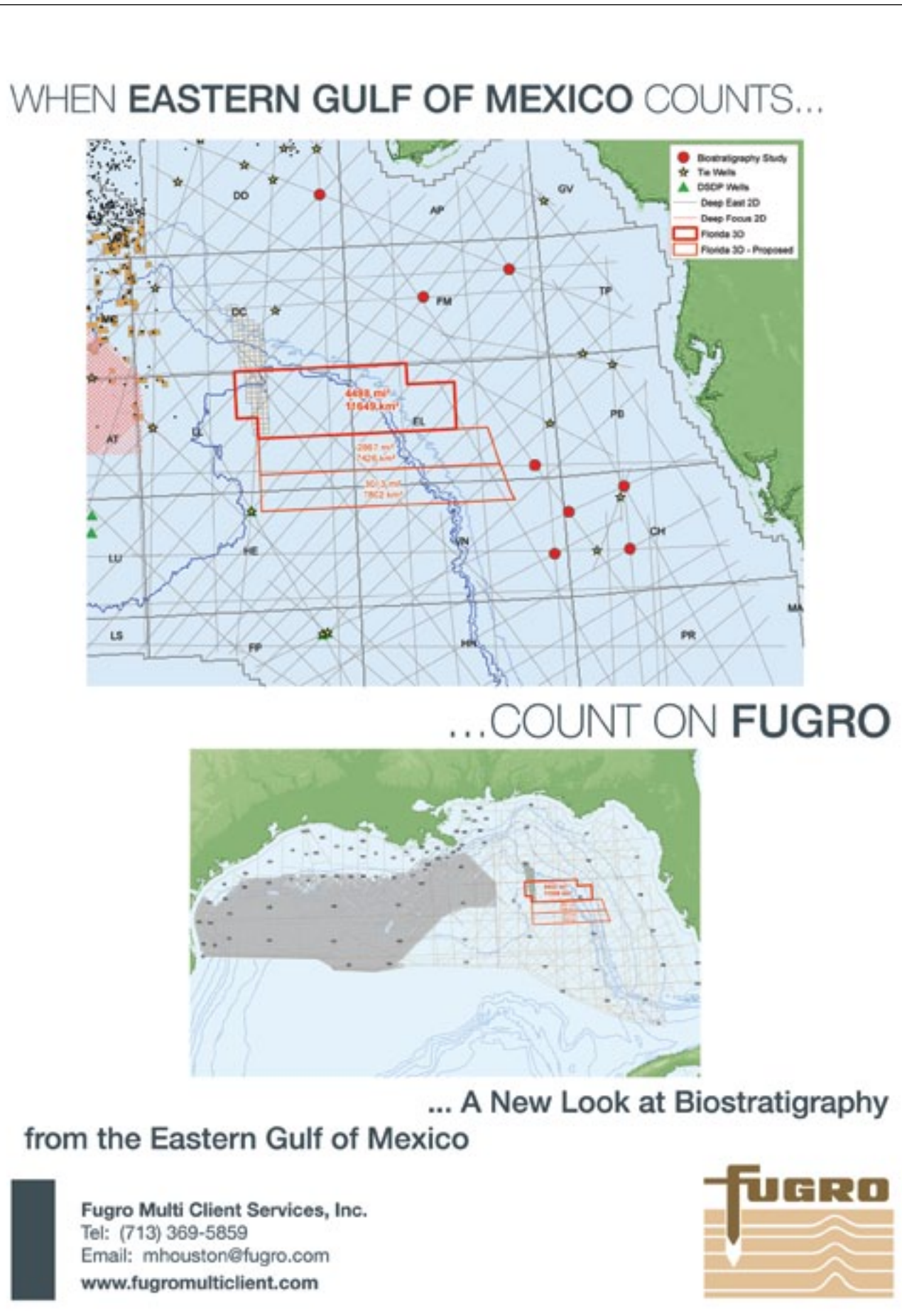
Treasurer Debra Sacrey is a successful Texas Gulf Coast independent/consulting geophysicist/geologist with the company she founded, Auburn Energy of Houston, Texas.

Chair of the House of Delegates is R. Randy Ray, independent geologist in Denver and chief geophysicist for Underground Energy Co.

Black swans and various challenges may both come our way this year, but we have a team that's ready to respond for the good of AAPG.

I am very excited about the next year.

Ted Beaumont



Hickenlooper Set for RMS

Colorado Gov. John Hickenlooper, a former oilman and current member of AAPG, will be the All-Convention luncheon speaker at this year's Rocky Mountain Section meeting, set Sept. 9-12 at the Twin Rivers Convention Center in Grand Junction, Colo.

It is the first time Grand Junction has hosted the annual RMS event.

The meeting theme is "Vintage Geology – Perfectly Aged," and the technical sessions will include updates on the most recent work on resource plays across the region, the sedimentary and structural architecture of the latest plays in the Rockies and the impact and future of energy minerals.

The All-Convention luncheon will begin at 11:45 a.m. on Monday, Sept. 10.

For online registration or more information about the technical program go to rmsaapg2012.com.

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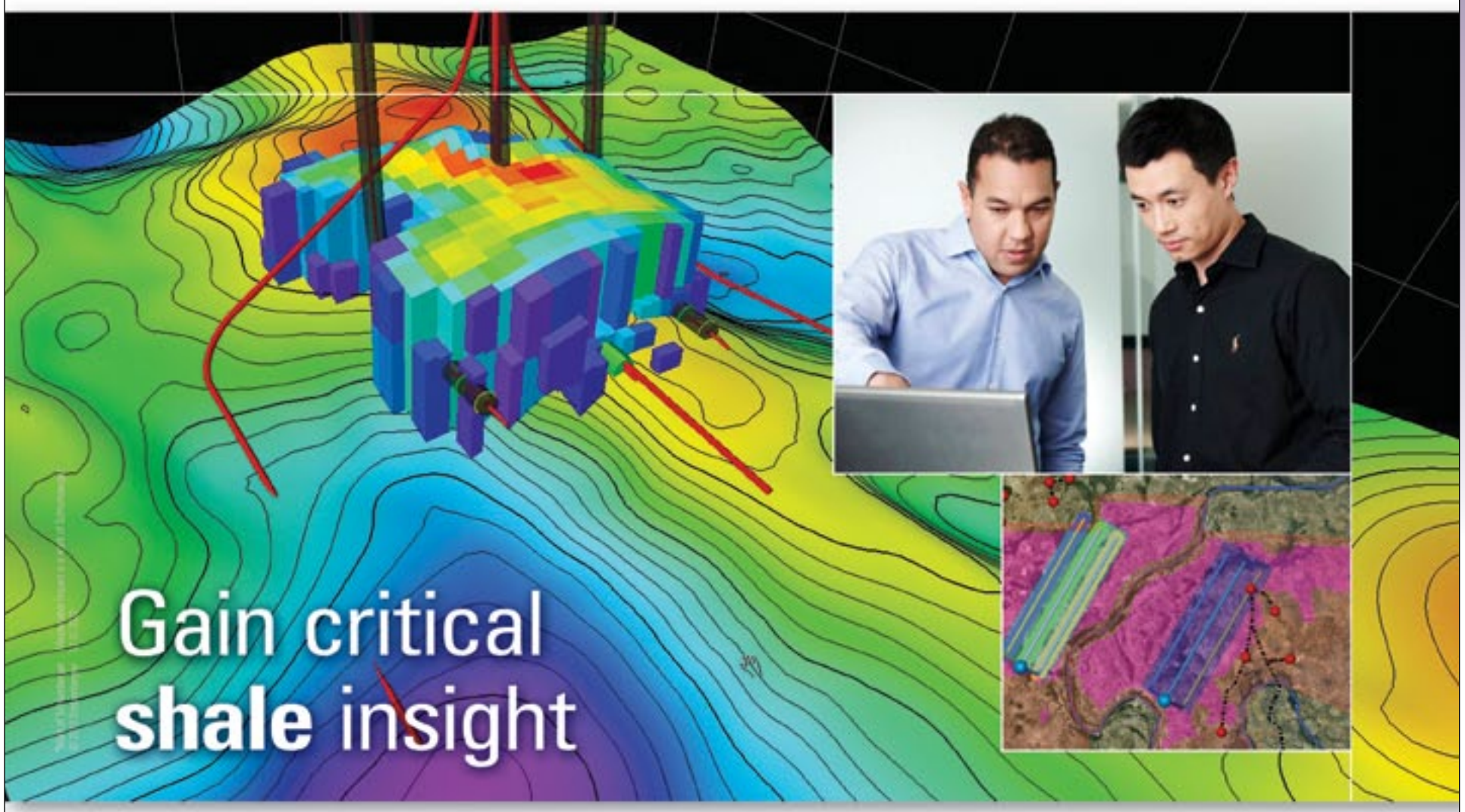

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Beaumont Takes Helm of AAPG

Edward A. "Ted" Beaumont, senior geologist with SM Energy in Tulsa, assumed the presidency of AAPG on July 1.

Beaumont, a native of Albuquerque, N.M., holds a bachelor's degree in geology from the University of New Mexico and a master's from the University of Kansas. He served as an exploration geologist with Cities Service Oil Co. and was AAPG science director from 1980-85 before becoming an independent consultant.

He was co-editor with the late Norman H. Foster for the AAPG Treatise, which was a multi-volume project commemorating AAPG's 75th anniversary in 1992, and was also editor of Exploration Techniques in North America and numerous other papers.

He and Foster won the AAPG Special Award (now Harrison Schmitt Award) in 1991 for their work on the Treatise, and Beaumont received an AAPG Distinguished Service Award in 1992.

He joined SM Energy in 2010 as senior geologist and is an AAPG Foundation Trustee Associate.

Joining Beaumont on the Executive Committee is **Lee Krystinik**, principal and founder of Fossil Creek Resources in Arlington, Texas, who recently was voted president-elect and will serve as AAPG president in 2013-14.

Krystinik holds a bachelor's in geology from the University of Texas at Arlington and a master's and doctorate in geology from Princeton University.

He has served as research geologist for the U.S. Geological Survey, and was with Reservoirs Inc. and Union Pacific Resources before becoming a consultant. He was global chief geologist with ConocoPhillips before founding Fossil Creek.

Others elected to the 2012-13 AAPG Executive Committee are:

❒ Vice president-Sections – **Thomas E. Ewing**, geoscientist and partner, Yegua Energy Associates, and geoscientist, Frontera Exploration Consultants, San Antonio.

❒ Treasurer – **Deborah K. Sacrey**, owner, Auburn Energy, Houston.

Both the vice president-Sections and treasurer will serve two-year terms.

Others on the 2012-13 committee – and serving their final year of their term of service – are:

❒ **Denise M. Cox**, Storm Energy, Panama City, Fla., secretary.

❒ **Stuart D. Harker**, Circle Oil Plc, Finchampstead, England, vice president-Regions.

❒ AAPG Elected Editor **Stephen Laubach**, Bureau of Economic Geology, Austin, Texas.

Also on the new committee will be **R. Randy Ray**, an independent geologist in Denver and chief geophysicist for Underground Energy Co., who has assumed the chair of the House of Delegates.

Members of the 2012-13 AAPG Advisory Council are:

❒ Paul Weimer (chair), Boulder, Colo.
❒ David G. Rensink, Houston.
❒ John C. Lorenz, Edgewood, N.M.
❒ Andrea Reynolds (president-EMD), Pittsburgh.
❒ Tom J. Temples (president-DEG), Clemson, S.C.
❒ Charles Sternbach (president-DPA), Houston.
❒ Jeffrey W. Lund, Houston.
❒ Jon Schwalbach Jr. (Pacific Section), Ventura, Calif.
❒ John Robinson (Rocky Mountain Section), Littleton, Colo.
❒ David C. Harris (Eastern Section), Lexington, Ky.
❒ Mary E. Broussard (Gulf Coast Section), Lafayette, La.
❒ Debra P. Osborne (Southwest Section), Midland, Texas.
❒ Robert D. Cowdery (Mid-Continent Section), Wichita, Kan.
❒ Martha Lou Broussard (Gulf Coast Section), Houston.
❒ Paul J. English (Canada Region), Calgary, Canada.
❒ Peter W. Baillie (Asia/Pacific Region), Singapore.

The representatives for the Europe, Latin America, Africa and Middle East Regions are yet to be announced.

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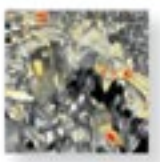

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A video and .PDF of Ed LoCricchio's presentation, "Granite Wash Play Overview, Anadarko Basin: Stratigraphic Framework and Controls on Pennsylvanian Granite Wash Production, Anadarko Basin, Texas and Oklahoma," are accessible at searchanddiscovery.com. The talk was given in the Discovery Thinking Forum during the AAPG Annual Convention and Exhibition in Long Beach, Calif.

'Discovery Thinking' unveils Granite Wash

Assumed 'Simplicities' Masked Hidden Potential

By DAVID BROWN, EXPLORER Correspondent

The Granite Wash play enticed operators into the eastern Texas Panhandle and far western Oklahoma, where they thought they were fully exploiting an attractive hydrocarbon accumulation.

The truth: They weren't.

Cordillera Energy Partners LLC in Greenwood Village, Colo., found that producers had been overlooking promising pay zones across the 2.5-million-acre Wash.

AAPG member Ed LoCricchio, senior geologist for Cordillera, said bypassed pay started to become apparent when the company compared wells within a defined area.

The Granite Wash is the result of clastics shed from the Amarillo Uplift and Wichita Mountains from early Pennsylvanian through early Permian. The Desmoinesian Wash, which is the interval targeted by most operators today, attained gross thickness as much as 3,400 feet.

LoCRICCHIO

The Desmoinesian Wash can be subdivided into at least 11 productive benches, separated by regionally correlative shales that are also frac barriers.

"The problem is when one examines a well reported as a 'Granite Wash' producer, that vague term could refer to an individual zone, combination of zones or all 11 zones over 3,000 feet of section," LoCricchio said.

That was a significant realization, LoCricchio said – and a key to his new understanding of the Wash's history and potential.

Cordillera now estimates the total recoverable resource potential of the Granite Wash, which produces both natural gas and liquids, at more than 500 trillion cubic feet of gas equivalent.

LoCricchio presented an overview of the Granite Wash in the Discovery Thinking forum at the 2012 AAPG Annual Convention in Long Beach – and later told the EXPLORER how Cordillera had unraveled the mystery of Wash stratigraphy.

What's In a Name?

Among the problems that confounded analysis of the play, LoCricchio listed:

- The perception that the Granite Wash contained only one or two reservoirs.
- A limited number of published studies.
- Analysis limited to subsurface study only, with no outcrops.
- Over 30,000 wells to correlate (which LoCricchio called "a blessing and a curse").
- Petrophysical challenges, including the presence of radioactive minerals and variable clay content.
- No established stratigraphic framework.

When LoCricchio began looking at the local stratigraphy, the inconsistent nomenclature used by the play's multiple operators presented a major hurdle.

See **Wash**, page 10

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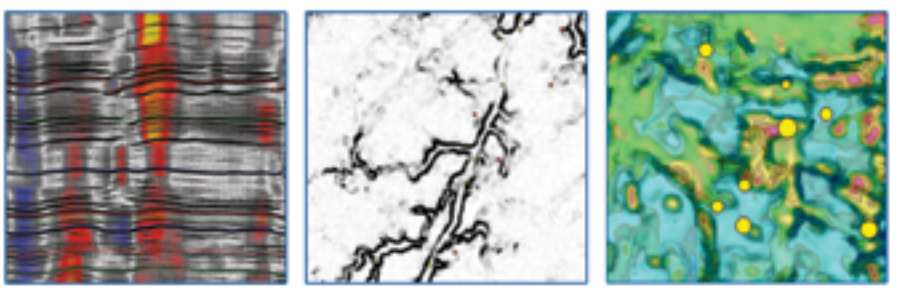

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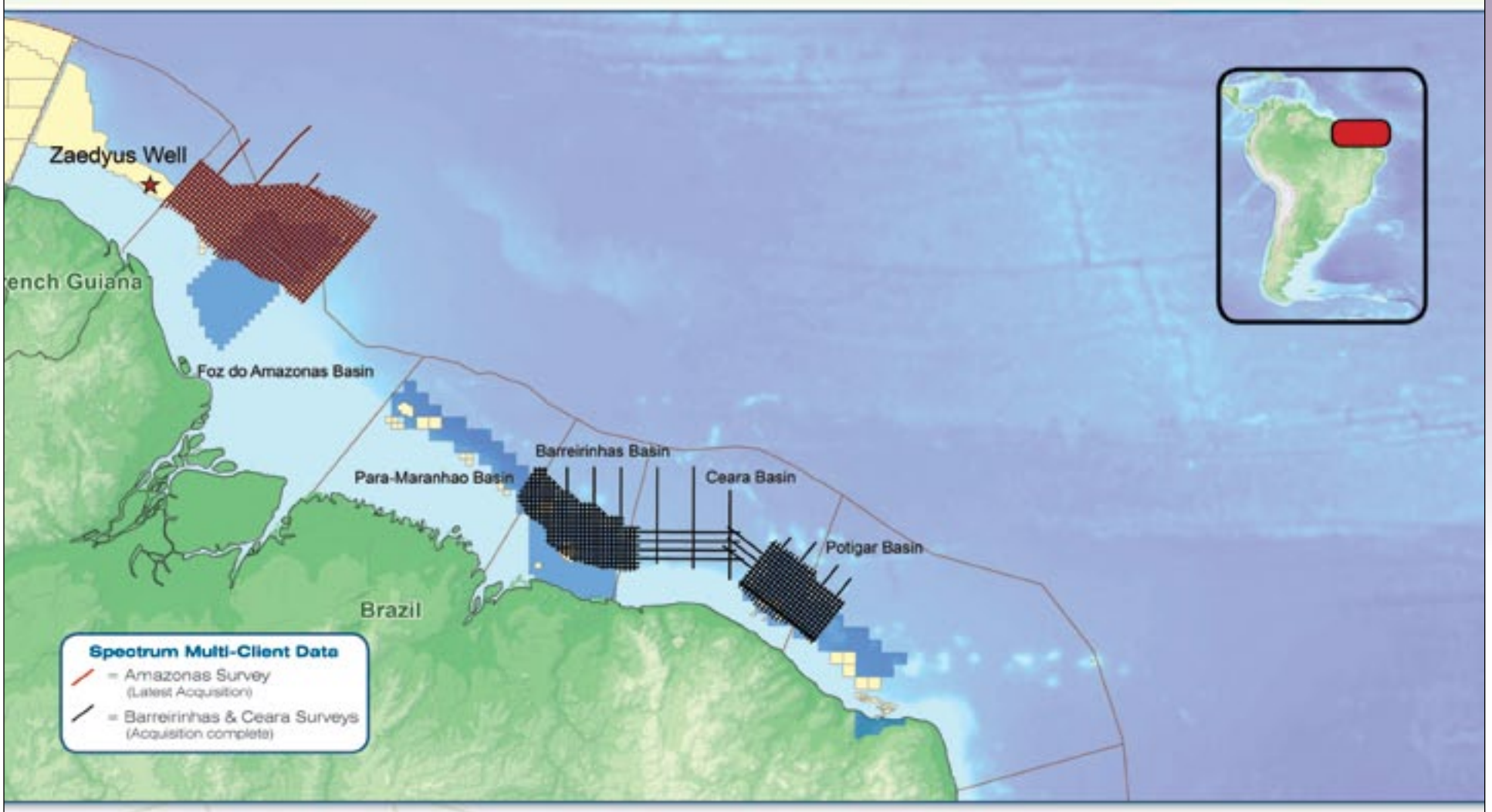
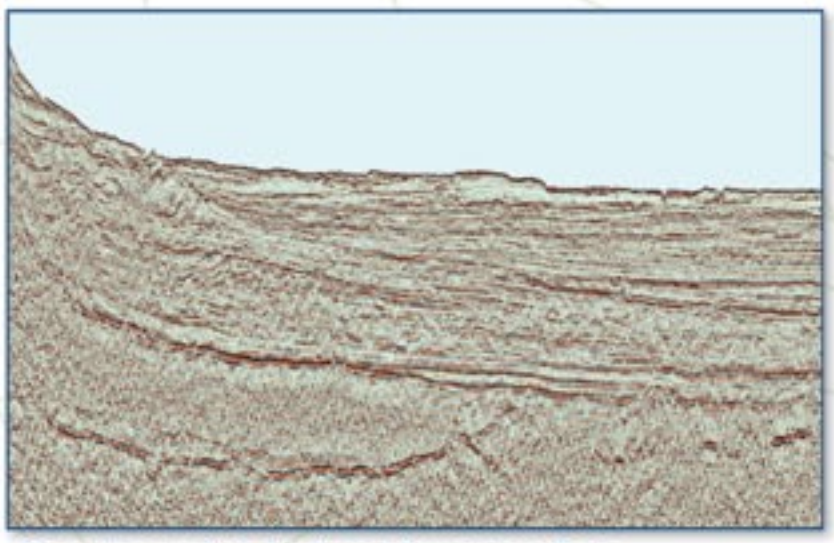


Spectrum Multi-Client seismic coverage offshore northern Brazil



Crustal image from Northwest Barreirinhas Basin

Spectrum is active in three basins along the Equatorial Margins of Brazil. Acquisition is complete on the Ceara and Barreirinhas programs and has commenced on the Amazonas program.

Final PSTM data is available for the Barreirinhas survey now and will be available for the Ceara program this quarter.

All of these surveys are being acquired with 10,000 m offsets and 13 second record lengths.

Companies participating in Spectrum's new seismic programs will have a competitive advantage in the upcoming Bid Round 11.

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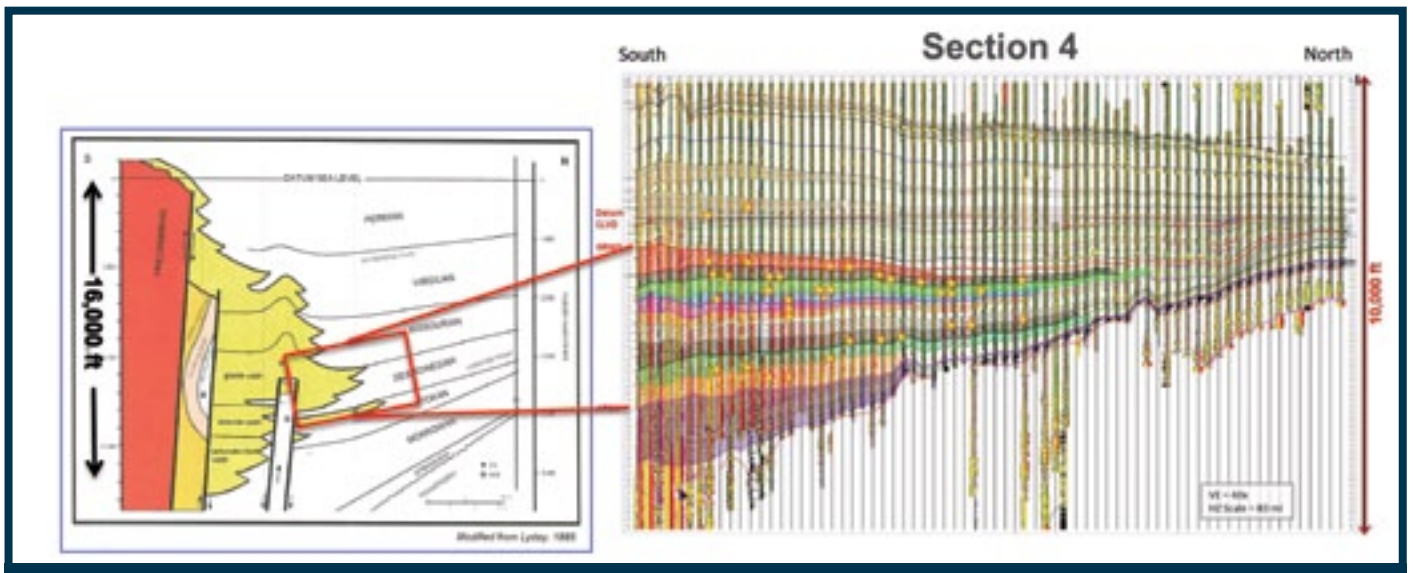
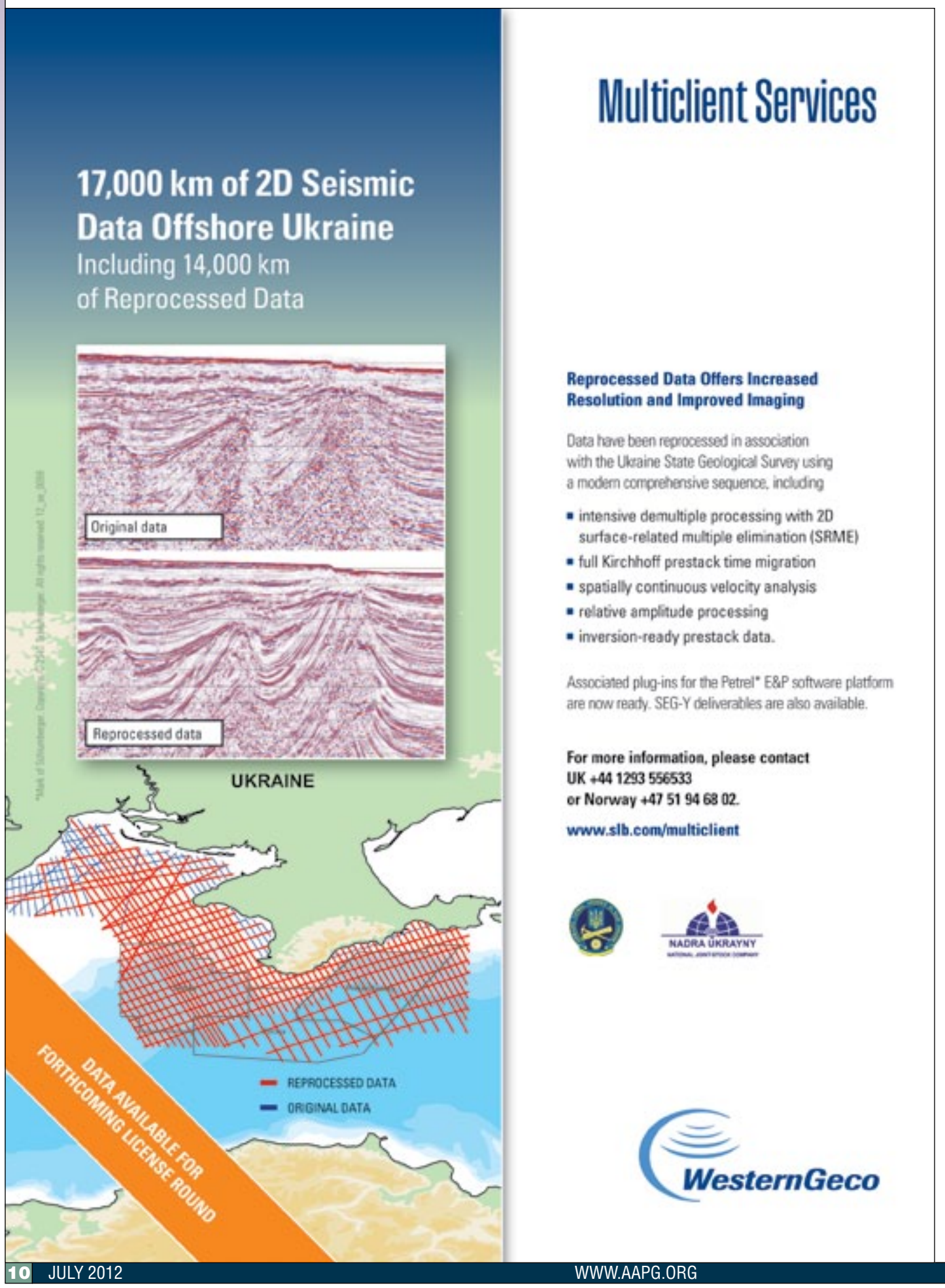


Ed LoCricchio created detailed structure maps and cross-sections, like this one for Section 4, for all surfaces identified in the Granite Wash. In the end, it became apparent that the Granite Wash didn't contain only one or two productive reservoirs, but at least 15 distinct reservoirs.



Wash

from page 8

"The number one thing was the nomenclature problem. If you went back five years there were several established fields – Buffalo Wallow, Hemphill, Stiles Ranch – but everyone was calling the reservoirs different names," he said.

Players extending exploration from the shelf side of the basin into the Granite Wash play compounded the problem, since they also tried to extend their existing shelf terminology and stratigraphic understanding into the Wash play.

LoCricchio described the Granite Wash area as bounded on the south by the Amarillo Uplift and Wichita Mountains, on the west by the Cimarron Arch and on the east by the uplift of the Nemaha Ridge, with a shelf to the north.

The presence of radioactive grains in the Granite Wash often made conventional gamma-ray logs ineffective as a tool for determining net pay, according to LoCricchio.

"I can't tell you how many log images I looked at where somebody took a ruler, you could tell, and tried to establish a gamma-ray cutoff. And they were missing hundreds of feet of pay," LoCricchio noted.

"We also had variable matrix densities that affected the porosity logs," he added.

In addition, the long history of the Granite Wash development had produced logs of all types that were difficult to correlate or compare. There were "multiple logging companies out there, using different tools, and you were comparing logs run all the way from the 1950s up to today," he said.

Therefore, a rigorous log normalization process was required.

The Granite Wash is anomalously underpressured throughout almost the entire Texas portion of the play, LoCricchio noted.

"People were targeting deeper horizons in the past, primarily the Pennsylvanian Morrow and the Devonian Hunton," he said. "Both of those reservoirs are very highly overpressured.

"People would want to drill with overbalanced systems," he observed. "This masked a lot of the shows and what ultimately was proven productive in the Granite Wash."

The Resources

Analysis of the Granite Wash stratigraphy benefited from an excellent core study initially based on only 14 wells.

"Core Labs did a tremendous job," he commented. "It became obvious that there were a bunch of individual stacked pays in there."

Well control provided abundant information. The first Granite Wash well was drilled in 1920, LoCricchio noted, and the play contains tens of thousands of wells, from early vertical wells to numerous horizontals drilled more recently.

Cordillera had to develop another key resource itself. The variable matrix densities complicated density porosity calculations and frustrated attempts to make use of porosity logs.

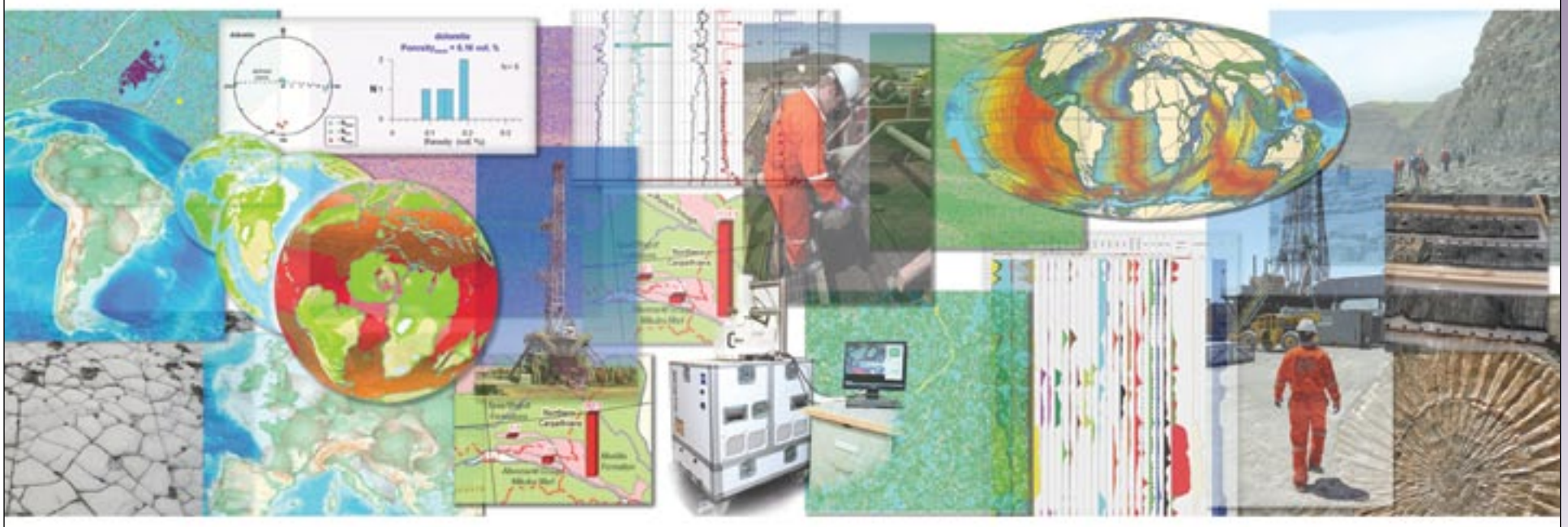
"We saw that we could solve it if we had digital logs – which we did not have," LoCricchio said. "So we had to do that on our own."

He used IHS PETRA software to define zones or formations by surfaces, using identified tops when he could get them from operator reports in the Wash.

"A lot of people would just stop. They wouldn't release any tops. Or when they

See **Nomenclature**, page 48

WHEN **UNCONVENTIONALS** COUNT...



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Map courtesy of U.S. Energy Information Administration

Current and prospective shale plays as of May 2011 – a look at activity that continues to grow.

'Wet' is in

Shale List Grows

By LOUISE S. DURHAM, EXPLORER Correspondent

Production from unconventional reservoirs, particularly shale, has been a boon to U.S. domestic natural gas stockpiles.

It's a blessing that has triggered a curse or two over time.

Engulfed in the thrill – and profits – of it all, the operators in a sense got ahead of themselves, producing extraordinary volumes right on the cusp of unexpected plummeting demand.

Only a few years back, operators flocked into the Haynesville shale gas play in North Louisiana, sometimes forking over $25,000 per acre lease payments as the ensuing drilling boom got under way.

No more. Today, royalty check amounts, field activity, etc., have dwindled. In DeSoto Parish, the core area of the Haynesville play, the drilling rig count plunged from 54 a year ago to 24 as of the second week in March, according to Baker Hughes Inc.

But in this highly cyclical industry, this type situation typically is best viewed as a hiatus.

Gas-intensive plays (such as the successful Fayetteville Shale and the famed Barnett Shale) are temporarily out of the limelight, but wet gas, or natural gas liquids, and oil areas are hot. Some high profile plays, e.g. the Marcellus, which stretches across Pennsylvania into New York, have a sizeable store of both.

Certain liquids-rich unconventional plays are said to hold particular appeal.

Here's a brief look at the North America shale plays:

Avalon Shale

The Avalon Shale sits atop the Bone Spring formation in the Delaware Basin in the Permian Basin's westernmost area.

The Avalon-Bone Spring play at times is called simply the Avalon Shale play, which, in turn, is often dubbed the Leonard. Typically, operators have drilled through the Avalon in search of other reservoirs, yet Avalon potential has been recognized for some time.

In some places, the interval is two layers of shale separated by a limestone layer.

An operator not long into the play in 2010 stated the production stream in this particular accumulation is an even three-way split between crude oil, NGLs and residue gas.

Bakken Shale

The Bakken Shale oil play in Montana and North Dakota continues to be a star attraction in the oil shale arena, where it's been likened to another Saudi Arabia. The widespread Upper Devonian-Lower Mississippian Bakken formation consists of an upper and lower shale member and a mixed siliciclastic carbonate middle member.

The middle section is the prime target of the wells that encounter it about 10,000 feet deep, prior to turning horizontal into the brittle dolomite where multi-stage hydraulic fracturing is applied for more efficient production.

The Bakken extends into Saskatchewan and western Manitoba, where it is also productive.

Barnett Combo

The Barnett Combo play in Texas' Montague and Cooke counties establishes an avenue toward increased oil production rather than natural gas. A well-defined oil window has always been a part of the now-famous Mississippian-age Barnett Shale play, but operators chose to concentrate on the natural gas areas.

The Combo play actually produces a somewhat balanced mix of oil, natural gas and natural gas liquids.

The resource base is said to be one of the world's largest, with oil-in-place ranging from 40 to 200 million barrels equivalent per square mile. Numerous vertical wells having long production histories were drilled.

Bone Spring

The Leonardian-age Bone Spring

See **Shales**, page 14

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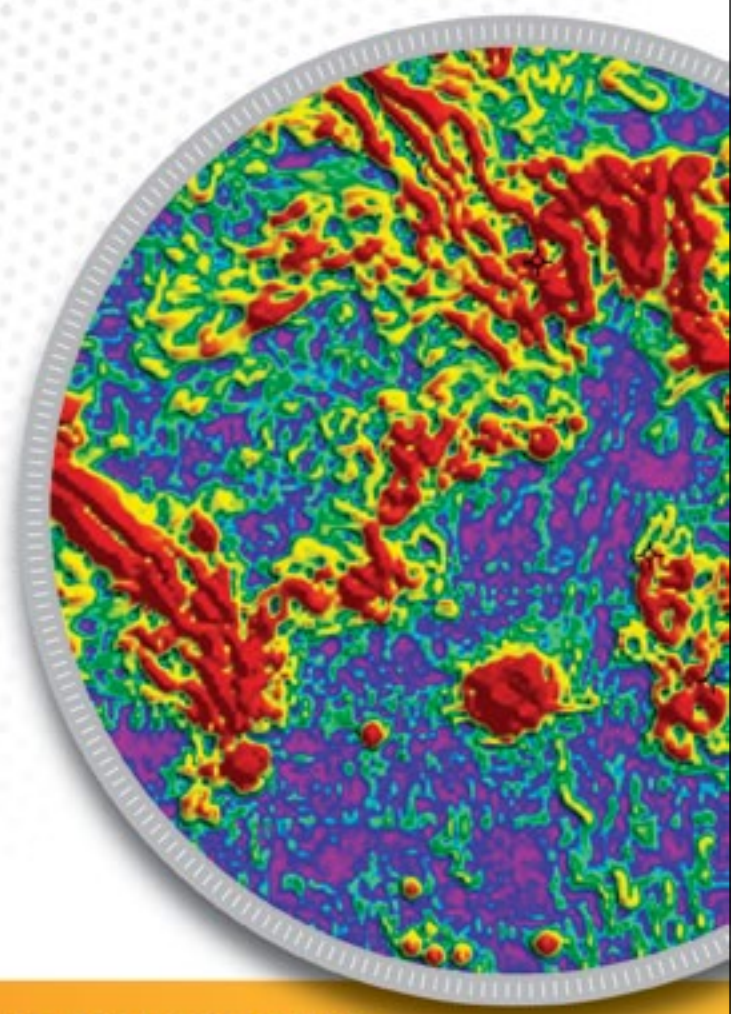

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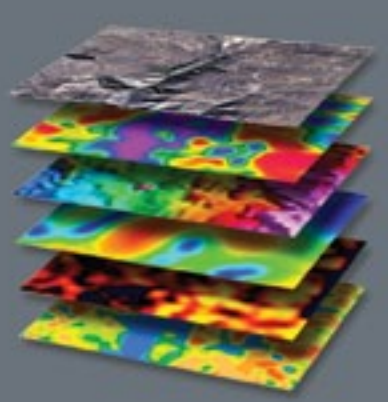

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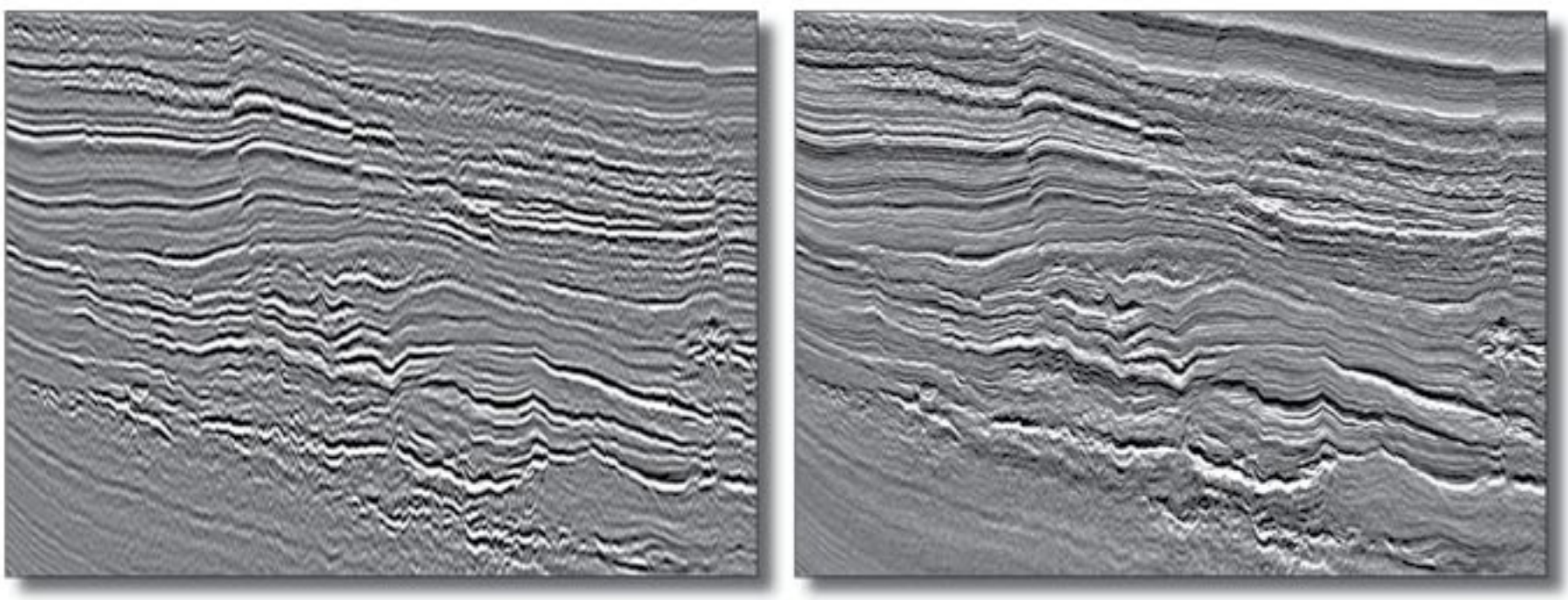

Conventional Processing

WiBand Processing

The example above compares images from the same 2D dataset using conventional processing versus WiBand. The WiBand image has much higher resolution due to its increased frequency content on both the low and high ends of the spectrum and the fill-in of the ghost notches. The streamer was towed at 15 meters in this example. (Data courtesy of Polarcus and Ophir.)

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Shales
from page 12

formation, which spreads into west Texas, has gone through several cycles of fairly sub-par production via vertical wells.

The Bone Spring series includes first, second and third Bone Spring sands and corresponding carbonates, and the shallower Avalon Shale, which also stands on its own as a separate play in some instances.

The initial targets in the Bone Spring were conventional sandstones. Wells then tapped into carbonate lenses and, ultimately, low permeability sandstones. Owing to horizontal drilling technology combined with hydraulic fracturing, very thin sands and other facies are now being produced.

Cana Woodford

The Cana Woodford shale is located in western Oklahoma, and the area has reportedly become a respectable size oil play. Even though the play is mostly liquids-rich with oil, natural gas is also found.

According to Devon Energy, the Mississippian-age Cana is the world's deepest commercial horizontal play with TVDs 11,500 to 14,500 feet and MDs of 16,700 and 19,000 feet.

The Cana Woodford is considerably deeper and more expensive to reach than the Arkoma Woodford to the east. It's said to be one of the most economic shale plays in North America, owing to high volumes of condensate and other pricey liquids.

Cardium

The Cretaceous-age Cardium shale is a sand/shale formation that occurs in Alberta and extends into eastern British Columbia and south into Montana.

Of the 12 billion barrels of oil-in-place estimated by Canada's Energy Resources and Conservation Board, about 1.5 billion barrels have been produced via vertical drilling technology.

The Cardium forms a sizeable stratigraphic trap in its eastern shaleout, creating Canada's largest conventional onshore oil field, Pembina, discovered in 1953.

Parts of the Cardium are undergoing waterflooding, and horizontal multi-fracture drilling technology gets credit for stimulating production today.

Operators are said to be extending the lengths of the laterals, implementing more hydraulic fractures and getting better production and well results on a month-to-month basis.

Cleveland

The Upper Pennsylvanian Cleveland formation can be best described as a tight gas sand made up of fine-grained clean sands frequently interbedded with thin shale.

The Cleveland was discovered in the 1950s as players explored for deeper Morrow objectives. It occurs throughout much of the northeastern Texas panhandle and western Oklahoma.

The formation was initially developed using vertical wells with hydraulic fracturing. Horizontal drilling is today's MO as a means to maximize production potential of the wells and minimize completion expense.

Despite the high oil volumes registered on initial tests and their general classification as oil wells, horizontal Cleveland production on a BOE basis is about two-thirds natural gas, according to AAPG member Dan Boyd, petroleum geologist at the Oklahoma Geological Survey.

Eagle Ford

The Eagle Ford shale play spans a geographic area in south Texas ranging from far western Webb County northeastward to Gonzales County. The shale is long known for sourcing hydrocarbons to Austin Chalk fields as well as the renowned East Texas Field.

It produces a liquids-rich gas stream as well as oil in certain areas of the play. Generally, the oily part is the northern area where lower pressures rule. The play's mid-section reportedly harbors the condensate, or wet gas, window with a sweet spot of high concentrations of light oil. Much drier gas is found in the deeper section of the shale to the south in the play.

Exshaw

The Devonian-Mississippian Exshaw formation correlates with the Lower and Middle Bakken zones in Canada's Alberta and British Columbia. In fact, the two are often referred to as the Bakken/Exshaw interval, which usually is no more than perhaps 40 meters thick.

The Exshaw petroleum system is said to include the over- and underlying limestone reservoirs of the Banff and Big Valley, respectively, which are the most likely candidates for horizontal drilling.

The Exshaw transitions to the Bakken at the Alberta-Saskatchewan border.

Granite Wash

The tight sands Granite Wash play covers parts of western Oklahoma and the Texas Panhandle, covering an area about 160 by 30 miles. (See story, page 8.)

It's been a drilling target and/or pass-through zone for decades using vertical wells. Today, horizontal drilling and completion techniques are proving invaluable to bring up respectable-plus production, reduce dry hole risk and to render some reservoirs highly economic.

Granite Wash reservoirs span almost the entire Pennsylvanian System through the Lower Permian. They are comprised of thick, low permeability sediments shed from the Wichita Uplift. The Wash changes both vertically and horizontally across the play.

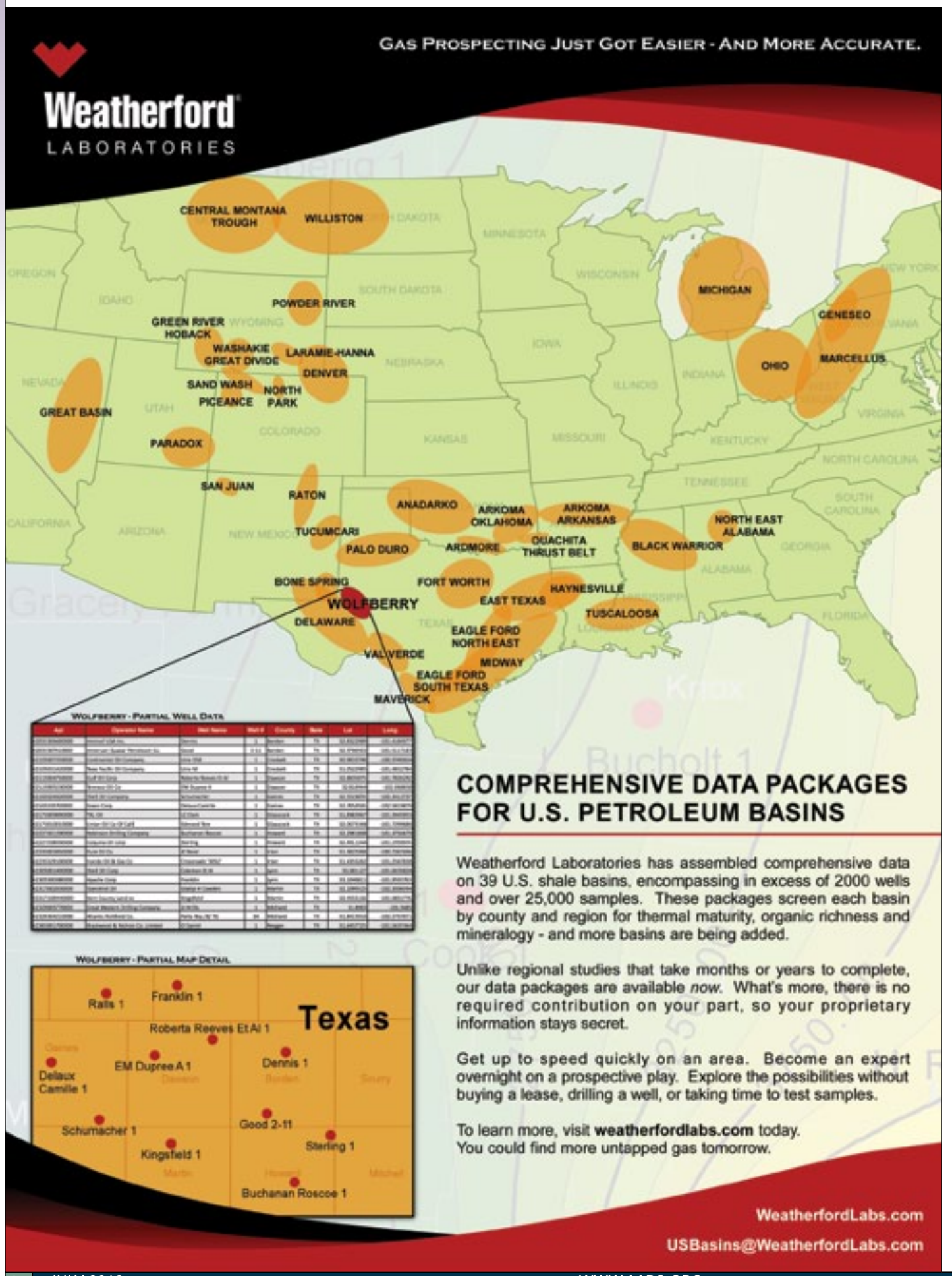
Marcellus

The Marcellus Shale member of the Appalachian Basin's Devonian black shales spans a distance of approximately 400 miles, trending northeastward from West Virginia and into New York.

It's a play having something for everyone in that there are wet gas areas, dry gas areas and areas of varied geological complexity.

Range Resources geologists Bill Zagorski and Martin Emery, both AAPG members, say that one can basically call the two major core areas a northeast dry gas play and a southwest combination NGL/dry gas play.

See **Shale Plays**, page 16



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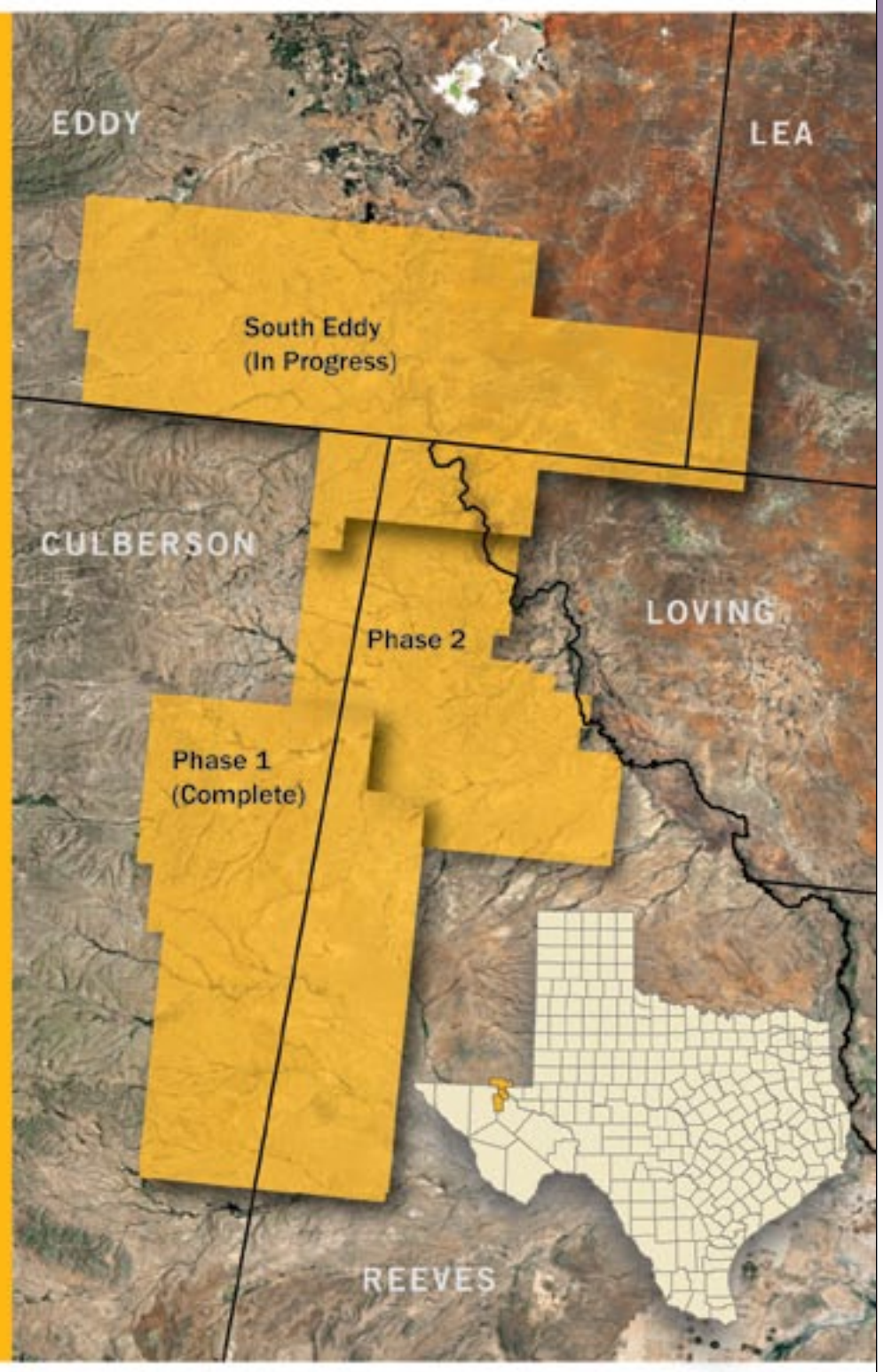

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Shale Plays
from page 14

Mississippi Lime

The Mississippi Lime in northern Oklahoma and southern Kansas looks really good with an oil ratio typically above 50 percent.

Vertical fractures occur in this regional carbonate deposit, which lies beneath the productive Atoka and Morrow sands and above the Devonian-age Woodford and the older Silurian-age Hunton.

Vertical wells have been drilled in this area for decades, where the Lime has yielded only marginal production.

Reservoir quality tends to be poor owing to minor porosity and permeability yet greater than most shale plays. Even so, industry players believe there are sweet spots that will be quite lucrative.

Recent horizontal drilling has yielded some very successful wells.

Monterey

The Miocene-age Monterey shale in southern California has sourced almost all of the oil in California. The Monterey, which is estimated to contain more than 500 billion barrels of oil-in-place, has been produced in one fashion or another for more than 100 years.

It's now being viewed as an unconventional play ripe for application of today's new tools and technologies.

Reportedly, the Monterey producing gross column is hundreds of feet thick at Oxy's Elk Hills field, which the company produces via vertical wells.

The Monterey also produces offshore California, e.g., the South Ellwood field discovered in 1997.

Montney

The Lower Triassic Montney formation is principally a siliciclastic-dominant unit found west of Edmonton in west-central Alberta and northeast British Columbia.

Of the Montney's four distinct pay zones, the upper and lower intervals are said to be the most prolific producers.

It has been reported to be one of the largest economically viable resource plays in North America, with an estimated resource size of 50 Tcf.

Long-viewed as a drill-through zone, the Montney came into its own once horizontal drilling was implemented.

Niobrara

The Late Cretaceous Niobrara Shale extends across New Mexico, Colorado, Wyoming, Kansas, Montana and both North and South Dakota.

The industry has long known that oil was present. It took a combo of horizontal drilling and staged hydraulic fracture treatments, to free the hydrocarbons long trapped in the shales, making the play economic.

The Denver (DJ) Basin in southeast Wyoming and northeast Colorado has been an extremely active area in the Niobrara play.

Tonkawa

The Pennsylvanian-age Tonkawa sand in north-central Oklahoma and south-central Kansas is a fluvial dominated deltaic reservoir.

Drilling depths between 2,200 and 4,200 feet are the norm, but earlier drilling focused on deeper, more productive targets before operators acquired a better understanding of the shallow accumulations.

In the Blackwell Field area in Kay County, north-central Oklahoma, the Tonkawa B sandstone is the main oil and gas reservoir.

Tuscaloosa Marine Shale

The Tuscaloosa Marine Shale extends more than 2.7 million acres across central Louisiana, reaching into southwestern Mississippi. The deep, high-pressure shale occurs between the upper and lower units of the Cretaceous Tuscaloosa formation.

The Marine Shale has thrown oil for years, piquing operators' interest as they drilled through it targeting deeper horizons. Owing to available advanced technology to drill and complete shale zones, it now appears quite possible to commercially produce some of the estimated seven billion barrels held by this particular shale.

The play's western area usually is referred to as the Louisiana Eagle Ford, as the shale there is similar in age and lithology to the liquids-rich Eagle Ford formation in Texas.

Utica

The Late Ordovician-age Utica Shale in the Appalachian Basin occurs much deeper than the geologically younger Marcellus Shale and extends beyond the geographic limits of the highly productive Marcellus.

The Utica is the primary source rock for a number of conventional hydrocarbon-bearing reservoirs throughout the Appalachian Basin.

The impetus for early activity to focus in Ohio is the liquids window found in the eastern part of the state, as well as Kentucky and reaching into Ontario and the St. Lawrence Lowlands of Quebec.

Viking

The Cretaceous-age Viking oil play is a series of legacy oil pools reaching from central Alberta to southwest Saskatchewan. It's a known conventional play produced via vertical drilling using older technology since its discovery in 1957.

The Viking formation is estimated to contain about six billion barrels of original-oil-in-place.

Horizontal wells with multi-stage hydraulic fracturing have revitalized the play. However, its continuous, or blanket, nature has encouraged the mindset: drill a well, find oil.

Wolfcamp-Wolfberry-Wolfbone

The Lower Permian-age Wolfberry play in the Midland Basin is a combo of the packed-limestone Wolfcamp (see story, page 18) and the overlying Spraberry sandstone, often called the Spraberry-Dean to include the underlying Dean sandstone. The Spraberry has long been a go-to reservoir given that it's pretty much fail-safe, essentially guaranteeing production – often in small volumes – over long periods.

The Permian-age Wolfbone (Delaware Basin) is a combo of the limestone/sandstone Wolfcamp and Bone Spring formations. The Wolfbone reportedly is not a development like the Wolfberry, but there are said to be some look-alikes in the geological sense.

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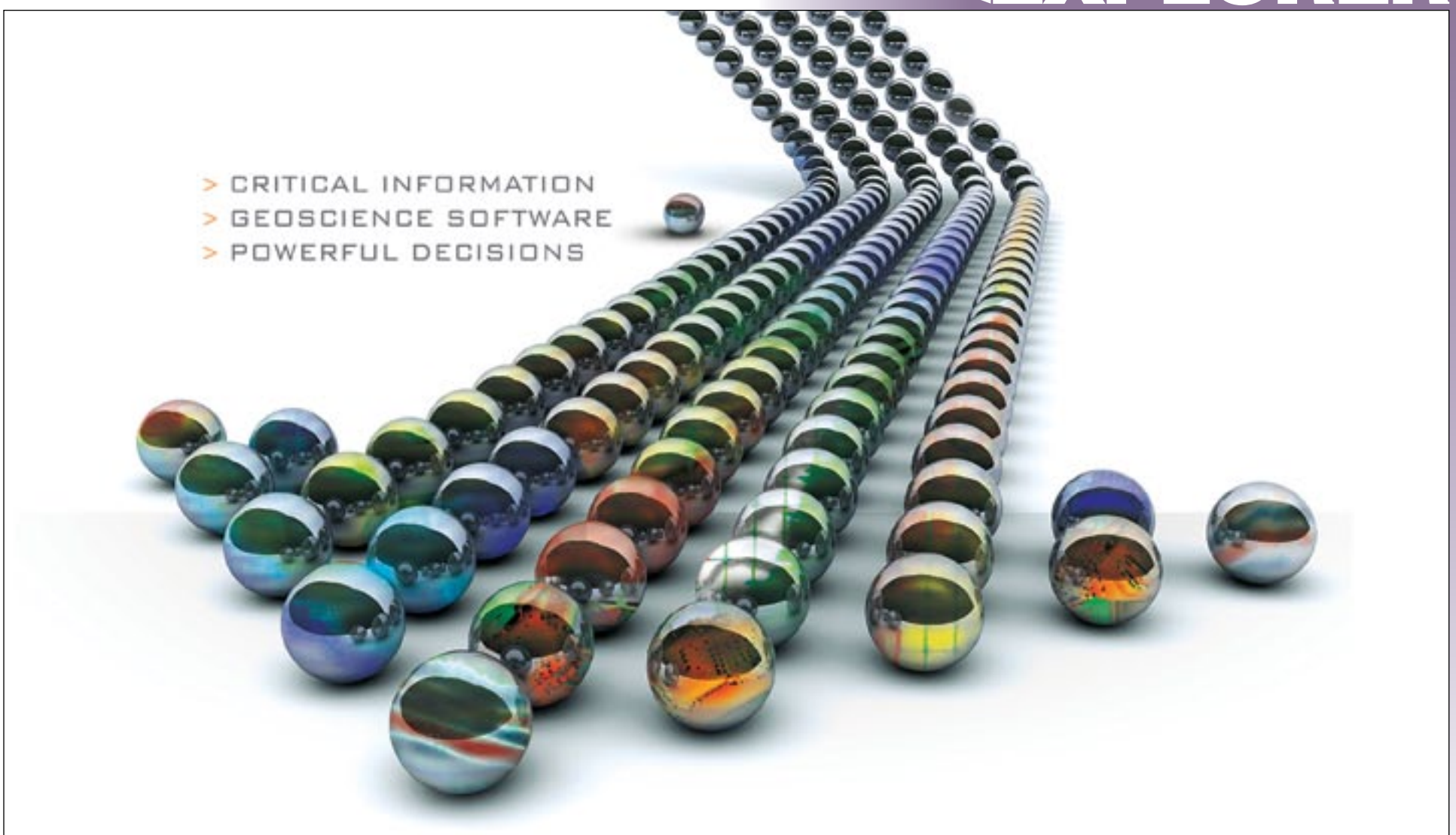

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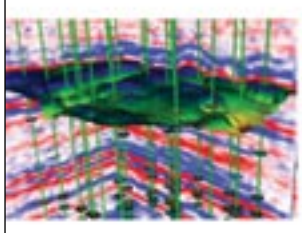
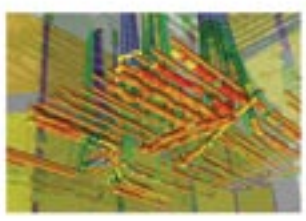
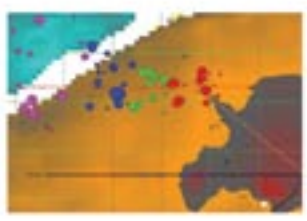
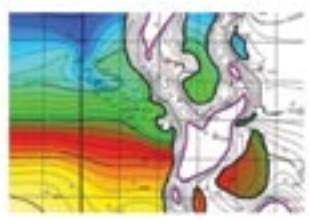

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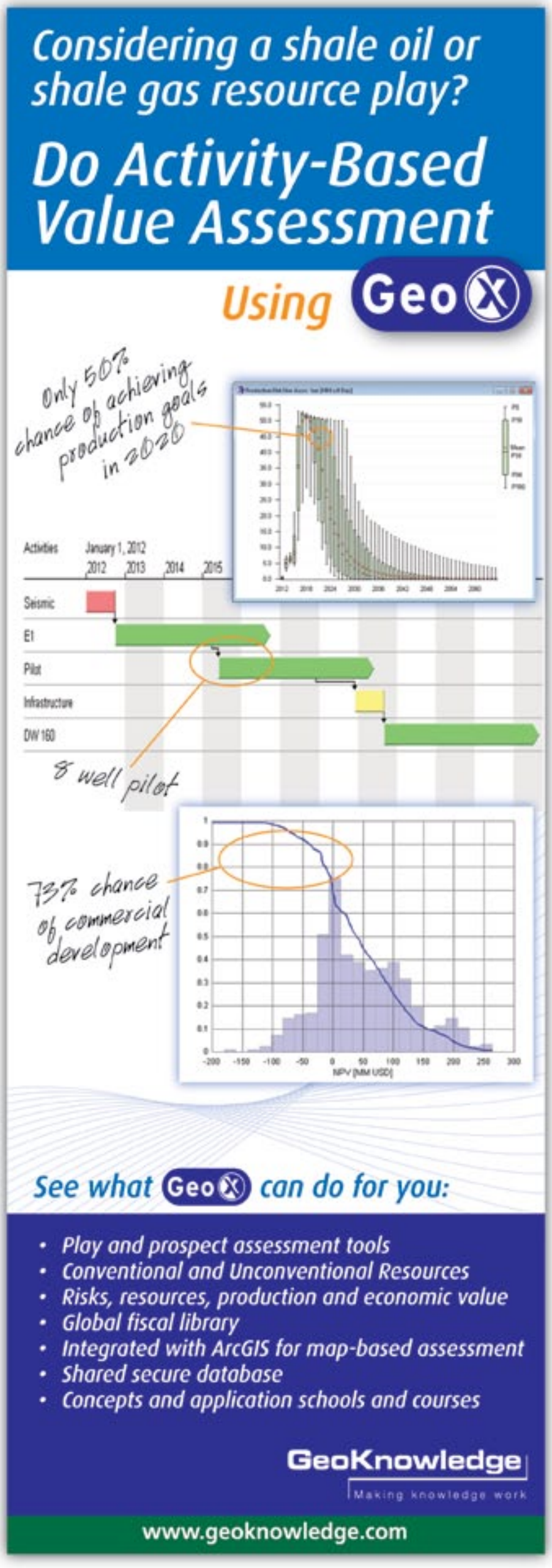

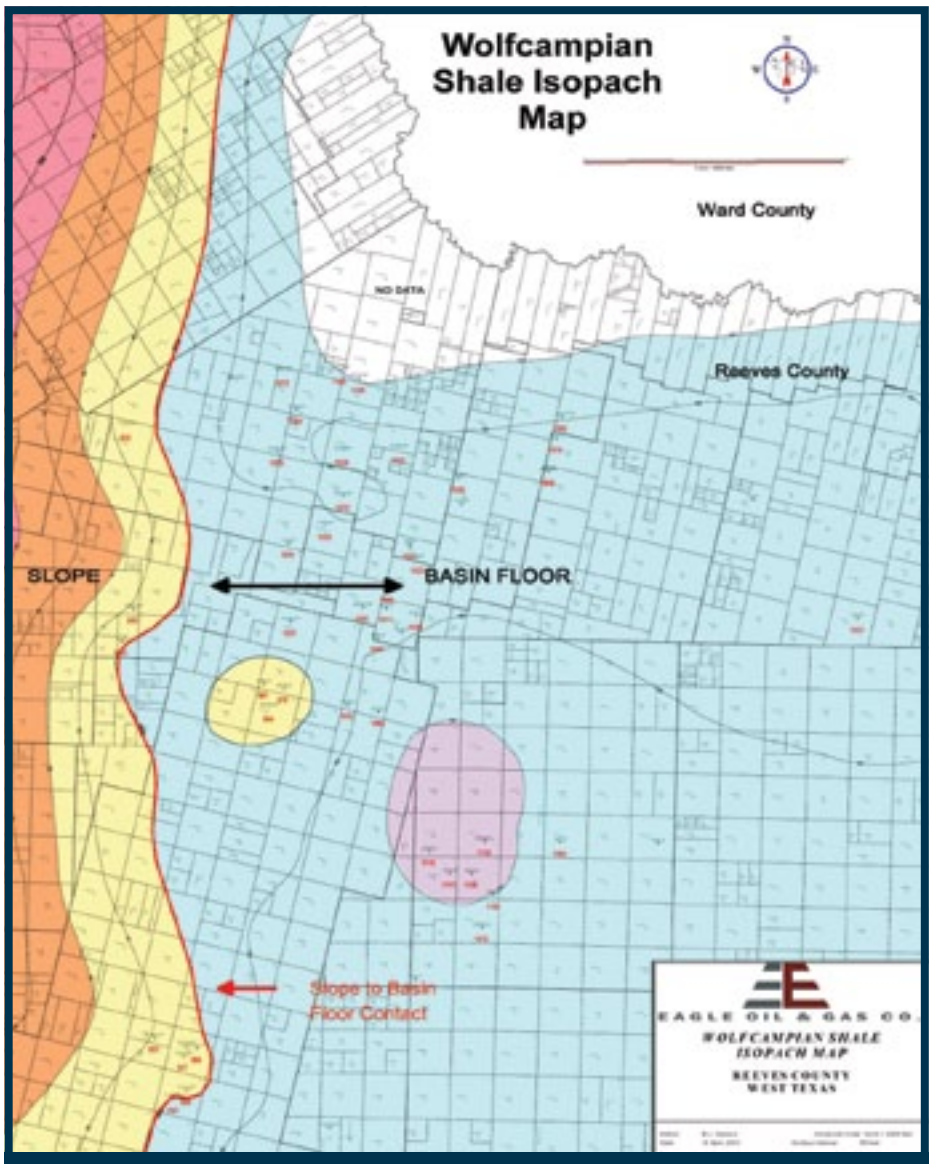

The basin floor (light blue) the Wolfcamp Shale isopach is 1,050' thick (+/- 50') and uniformly thick over a large area. The geologic and economic "sweet-spot" is the proximal basin floor, which has the greatest heterogeneity of grain-size and composition, high TOC and high pressures formed by the trapped hydrocarbons as they cracked from kerogen to oil. In the slope setting to the west, the Wolfcamp Shale thins from 1,050' to less than 750' in 3-4 miles.

Wolfcamp learning

Collaboration Play

By KEN MILAM, EXPLORER Correspondent

There may be no "I" in team, but there certainly is an "E."

In the oil arena, it can stand for Exploration or Engineering. Or both.

In a specific area of west Texas, it also can stand for Eagle Oil & Gas Co.


FAIRHURST

Teamwork – with all three "E"s – is what made Eagle a premier operator in the area, says AAPG member Bill Fairhurst, vice president of exploration and land for the independent company.

It wasn't an easy project to tackle – when Eagle went into west Texas, deep in the heart of the southern Delaware Basin, oil shale plays were a relatively new development.

"It's hard to realize now, that we hardly knew anything about them – there's such an emphasis on them today," Fairhurst said.

The company, however, had some horizontal successes in the Barnett Shale, and it was building on that when their geologists began looking for the next play.

They followed it into the Delaware and the Wolfcamp shale in Reeves and Ward counties.

Early wells in the area were successful – but not terribly so.

Borrowed Expertise

In 2009-10, when many companies in the region were going sideways, Eagle went straight ahead – or, to be precise, straight down.

The company focused first on sandstones above and below the Wolfcamp shale, "which were very attractive to geologists," Fairhurst said.

Drilling produced "shows and flares all the way," he recalled. "The logs look like it's all pay – (and) after completion, the production logs were very valuable to see what's going on.

"We're producing tremendous volumes of water, and minor hydrocarbons from the sandstone," he said. "Most of the oil was from shale and the higher Third Bone sandstones.

"We made some trades with other companies and focused in on Reeves County, on the heart of the play, with vertical wells," he continued.

"We brought technology we had learned in a Haynesville Bossier play to the Wolfcampian shale," he said. "We shortened out the intervals in the shales between the fracing stages ... and pumped at higher rates and volumes to frac the shale like the Haynesville Bossier."

While early wells came in at 300-500 barrels per day, production usually

See **Wolfcamp**, page 20

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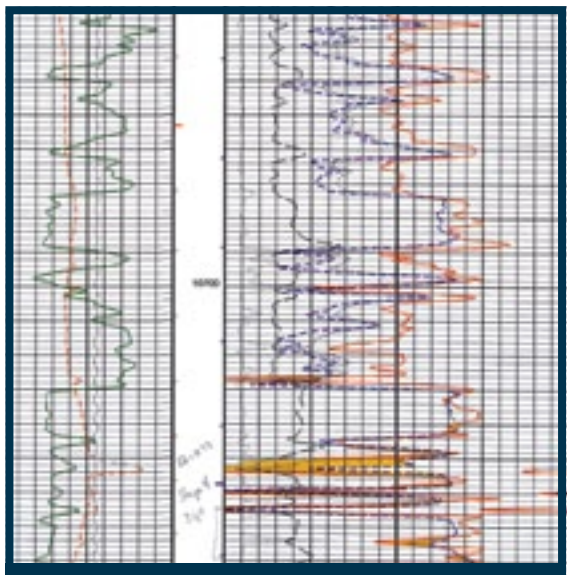
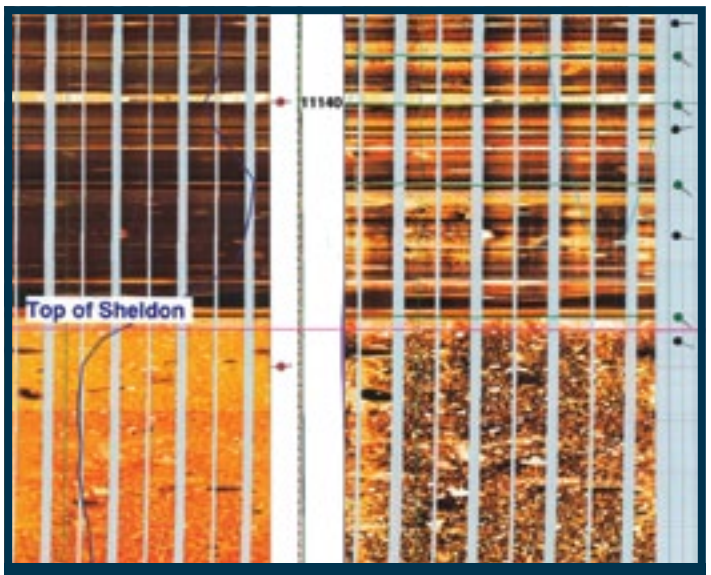
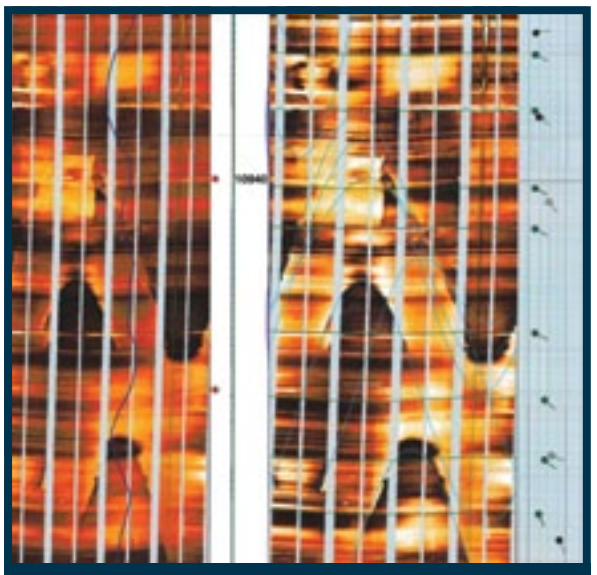


The GR-Formation density/neutron porosity log shows the Lower Wolfcamp interval (Wolfcamp C & D).



Ten-foot interval of a formation microImager of the base Wolfcamp C and top Wolfcamp D, Sheldon Carbonate.



Ten-foot interval of formation microImager, Wolfcamp B. Vertical well shows many fractures dipping at 85 degrees.

Wolfcamp

from page 18

dropped off quickly. But, Fairhurst said, looking at a moving average of wells from first to the 30th, "the trend of production is going up."

"We are applying what we're learning as we go, and that slope of increased production per well today is the same as it was two years ago," he said. "We're still learning and still having just as much impact on the economics."

A Team Win

Fairhurst explained that this all occurred over three years, and that "it was a much more collaborative effort between geology and engineering (than traditional plays).

"We revised our exploration models continually ... working with the engineers on a daily basis," he said. "That's what's been a lot of fun – this is primarily two or three geologists and two or three engineers meeting to share their insights and discuss their interpretations.

"Together, they have moved this project forward," he said.

Fairhurst and AAPG member Mary Lisbeth Hanson Wallace – granddaughter of past AAPG president and legendary oilman Bruno Hanson – presented a poster at the AAPG Annual Convention and Exhibition, and, along with AAPG members Frank Reid and Nick Pieracacos, presented a full paper on the play's evolution at the recent Southwest Section annual meeting in Fort Worth. All are Eagle geologists.

The title was "WolfBone Play Evolution, Southern Delaware Basin: Geologic Concept Modifications That Have Enhanced Economic Success."

According to their presentations, the unconventional Wolfcamp shale is a heterogenetic resource including quartz, carbonate and kerogen. The "sweet spot" appears to be the proximal basin floor, where quartz and kerogen accumulated, with episodic deposition of carbonate debris flows from the shelf.

During maturation large volumes of oil were sealed in place (108 MMBOIP per section). Expansion from kerogen to oil in a sealed system resulted in overpressure and abundant fracturing that has resulted in enhanced productivity.

"Our fracs were in nearly vertical natural fractures, nearly 85 degrees ... the number of fracs we penetrated was just phenomenal," Fairhurst said.

"With fracs 85 feet apart and natural fractures at 85 degrees," he added, "that previously frac-stimulated fracture set is only a couple of inches from the wellbore."

midland valley

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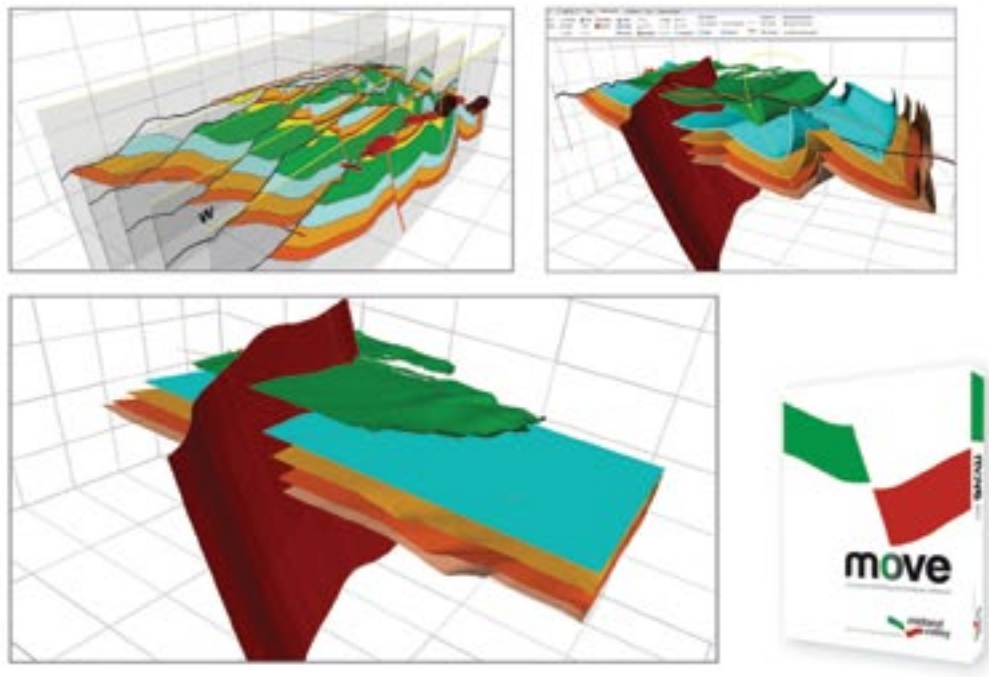

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We live in a material world ...

... and Shales Need 'Material Plans'

By LOUISE S. DURHAM, EXPLORER Correspondent

In the exciting early days of the now-numerous shale plays, which have spread internationally, there was a tendency among some operators and others to think shale production would be a slam-dunk.

Grab a land position, drill some wells and prepare to count the greenbacks sure to follow.

In other words, these long known reservoir-sourcing rocks would automatically yield big volumes of hydrocarbons wherever a drill bit punched into them.

Over-the-top excitement can make you temporarily forget that nothing is simple in this industry.


HASKETT

> "A lot of companies find themselves in plays with no forethought about what they're trying to achieve."

"With the unconventional, it's not a function of 'if you find it, it will be profitable,'" said AAPG member Bill Haskett, senior principal-unconventional practice area leader at Houston-based Decision Strategies Inc. "The unconventional, while not dominated by resource uncertainty, is dominated by resource productivity uncertainty.

"The ability to enter or exit unconventional plays in a manner that creates material opportunity and value for a company is more than luck," he noted.

"You have to be 'material' in what you're doing."

Haskett outlined the meaning of materiality in the context of hydrocarbons:

- How much presence do you need to make the opportunity worthwhile and control your own destiny?
- How much acreage will make the purchase worth the cost, effort and risk?
- How much will ensure leverage to achieve your business goals efficiently?

The bottom line here is that you must define up front what it is that makes you material – or not.

Haskett pointed to a group of medical professionals holding more than 3,000 acres of "decent land" in the Marcellus play via an investment group – and he emphasized that simply holding onto this pricey big chunk of land, particularly where there is no infrastructure, is *not* material.

"A lot of companies," he asserted, "find themselves in plays with no forethought about what they're trying to achieve."

Who's In Charge?

Haskett's suggestion: Your mantra must be Plan, Plan, Plan.

For starters, you can time your entry into a play to best take advantage of the three periods of frenzied activity in new unconventional plays, or what Haskett dubs the Three Frenzies:

- Frenzy #1: Someone has an idea and can't keep it quiet, so the idea happens and people pick up what they think is prime land. A mini-boom occurs.

- Frenzy #2: Proof of concept is shown, and the remaining land gets snapped up quickly by companies of various sizes.

- Frenzy #3: Latecomers, particularly international entities, typically fork over the big bucks to buy entry via asset purchases or even whole companies.

Whether or not to buy in the midst of a frenzy is play-specific, according to Haskett. Much depends on the business pinch points, i.e. those scarce resources that companies will compete for, e.g. product takeaway infrastructure.

There's a need to look at productivity but also to have a full value-chain approach to identify where the business pinch points are early on.

"Companies are advantaged by carrying out value-of-control studies, where you assess what it takes to control an uncertainty, like liquids egress, liquids stripping," he said. "How much would it take to control that business pinch point that all are competing for, or will eventually compete for?

"You will either control your own destiny, or someone else will," Haskett cautioned. "Destiny will be controlled."

See **Strategies**, page 30

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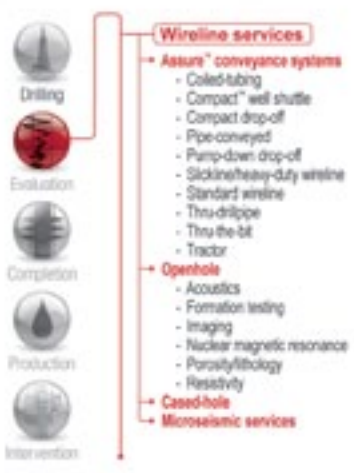

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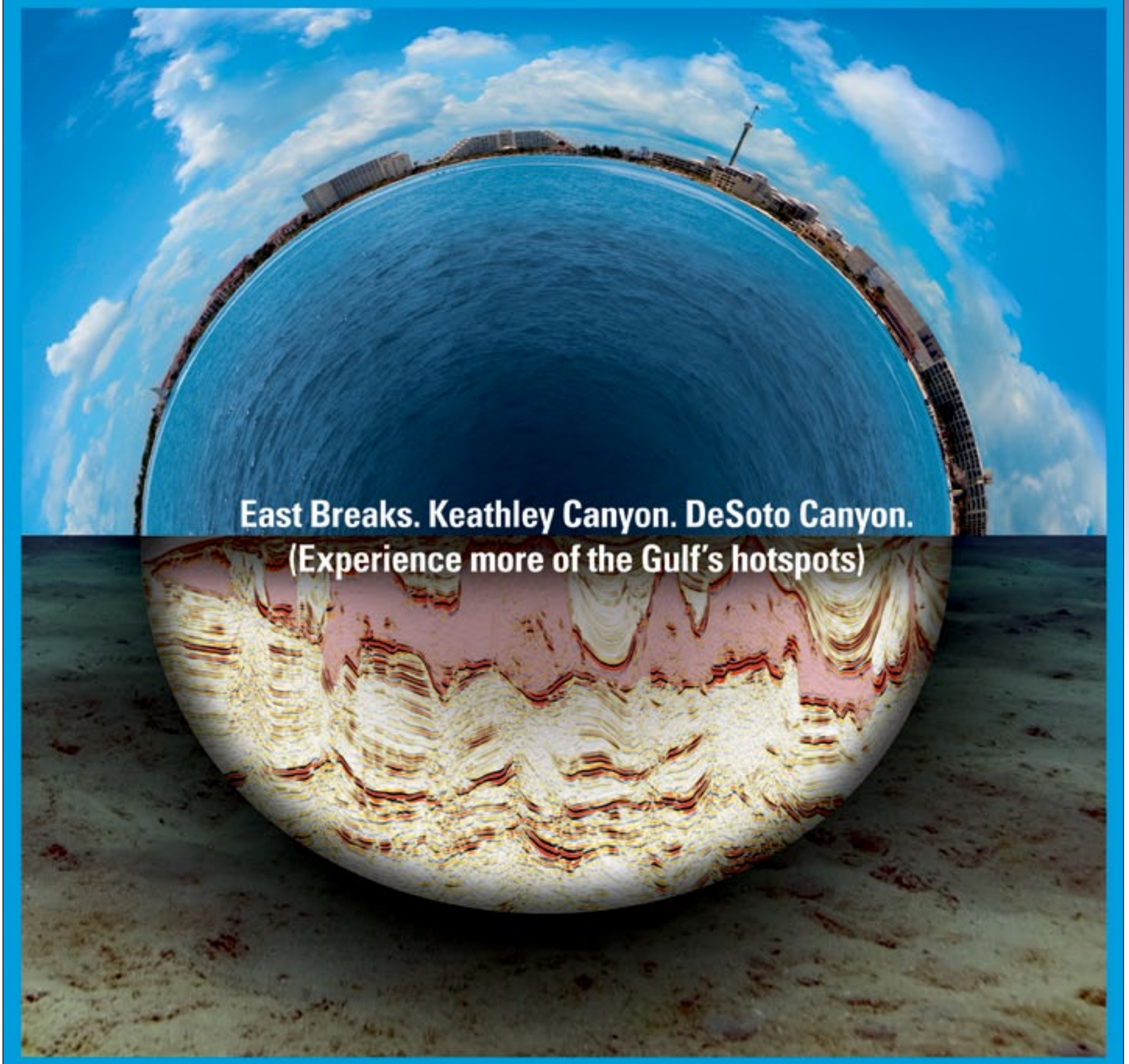

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No proven cases of aquifer fouling

Hydro Fracturing Caution Suggested

By KEN MILAM, EXPLORER Correspondent

The concerns and controversies over the use of hydraulic fracturing has leaped from the United States to across the Atlantic Ocean, and a team of UK experts have offered a report that calls for shale fracturing to be restricted near aquifers.

Richard Davies, lead author of the recent study and the featured speaker at last year's AAPG International Conference and Exhibition in Milan, Italy, urged caution when using hydraulic fracturing in new areas.

The issue of risks vs. benefits in petroleum exploration "has become a rather polarized debate," said Davies, a petroleum geologist and professor of energy, Durham Energy Institute, Durham University, UK.

DAVIES

> "There are simple and well-established techniques that could be introduced to reduce the risk and understand the uncertainties."

Davies, no stranger to the tension often found at the intersection of science and public opinion, also was at the forefront of the scientific investigation of the 2006 Lusi mud volcano on the eastern tip of Java. and was a forum speaker on Lusi at the 2008 AAPG ICE in Cape Town, South Africa.

"We need more reasoned discussion," Davies said.

That was the aim of the study, which examined thousands of natural and artificially induced fractures to see how far they are likely to extend, and how much they pose to water supplies.

The researchers from Durham, Cardiff University in the UK and University of Tromsø in Norway compiled new and published data of fracturing, "of which there is a huge amount available, and much of which seems to be ignored.

"Our paper derives probabilities for hydraulic fracture heights based upon microseismic information from the USA – this should help regulators as it provides an evidence base for decision making," Davies said. "We also examine fracture heights for natural hydraulic fracture systems."

The results indicate hydraulic fracturing should not take place within 600 meters of aquifers used as water supplies, he said.

"When the water supplies are more than 600 meters above the depth of the level of hydraulic fracturing, the data published to date shows that the risk is extremely small," he said. "Based upon microseismic measurements, we've not seen fractures extend upwards that far yet.

"I think it's reasonable to say that we should be cautious when hydraulic fracturing in areas where this has not been done before," he continued. "What we know is mainly empirically based. We learn from experience."

The Tense Intersection

Critics fear harmful compounds in the process' fluids could make their way through the fractures and contaminate water supplies, but Davies said he knows of no proven cases of aquifer contamination from hydraulic fracturing.

Most fracturing occurs at depths that pose little risk, according to the study.

The paper, "Hydraulic Fractures: How Far Can They Go?" published in Marine and Petroleum Geology, determined that chances of fractures extending upward more than 600 meters is extremely small, and the probability of fractures of more than 350 meters was 1 percent.

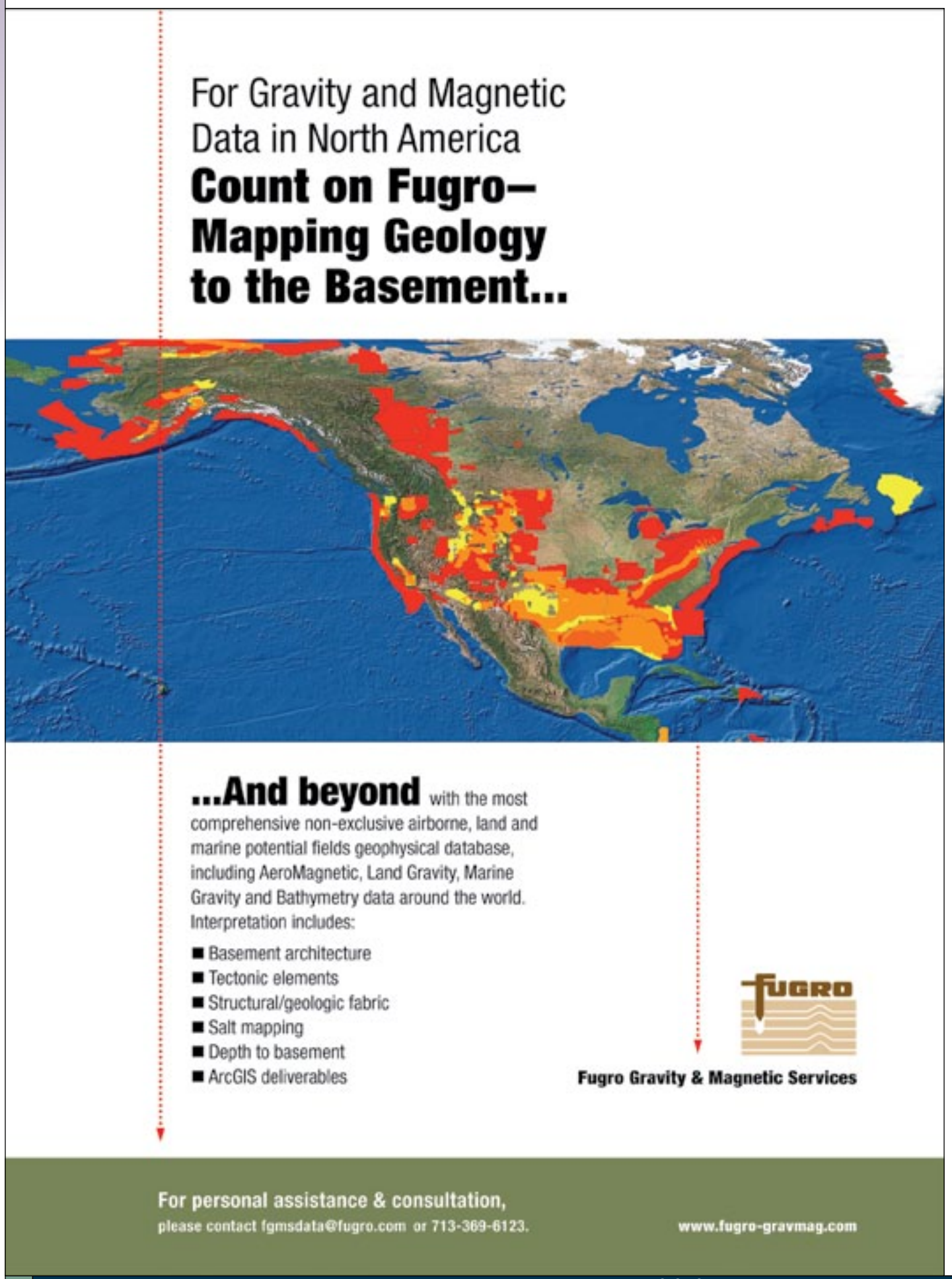
While shallow fracturing is "not very common ... (a) report produced by the EPA on the Pavillion Field, Wyoming, shows that hydraulic fracturing has been carried out with a few hundred meters of aquifers," Davies said.

"There are simple and well-established techniques that could be introduced to reduce the risk and understand the uncertainties," he added. "There are also baseline surveys that could be carried out before drilling starts, and I've heard mention of such precautions by some companies."

Davies talk at the Milan ICE spoke of shale production, and warned that in the court of public opinion "the right technical solution can come second to public opinion … Public opinion could kill shale gas."

He promoted the importance of injecting science into the public debate.

"A collective approach is required to reverse the growing concerns of the public," he said.



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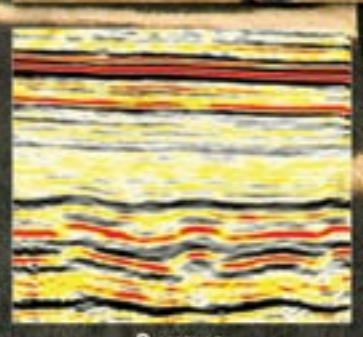

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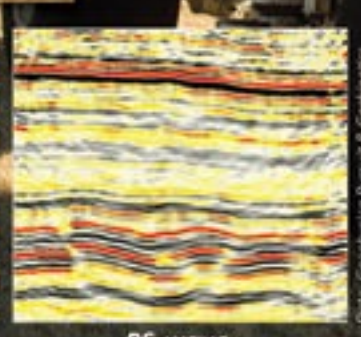

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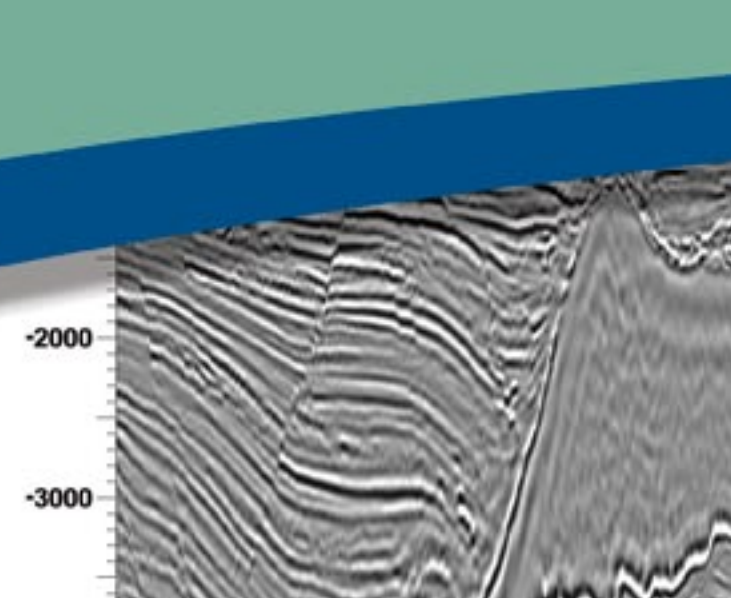

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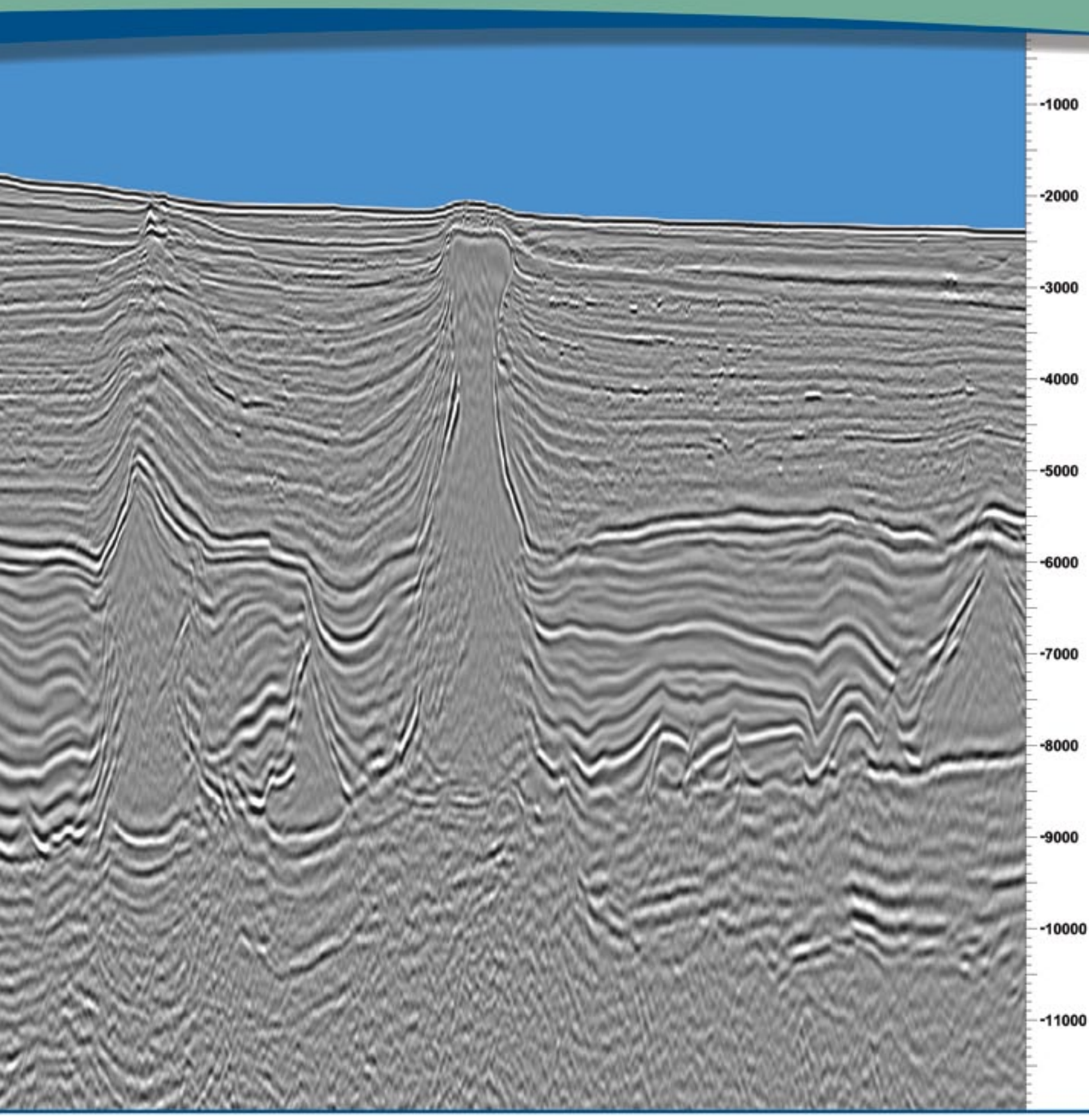

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Sometimes paying up can avoid expensive pain

Teams Finding New Ways to Shale Success

By KEN MILAM, EXPLORER Correspondent

Shale and other unconventional resources are being called the biggest game changer in a generation – and as land and other costs escalate, the industry continues to apply lessons gleaned from the early successes of the Barnett Shale.

One lesson: High-quality 3-D seismic data has emerged as a valuable tool.

Another lesson: Multi-client seismic surveys have allowed operators to share risks and, more importantly, costs of massive surveys.


NEWHART

High-resolution data provides both "offensive" and "defensive" advantages, said AAPG member Richard Newhart, team-lead subsurface and new ventures in Plano, Texas, for Encana, which is involved in underwriting several multi-client programs including the Haynesville with CGGVeritas.

"Defensively, it allowed us to identify, evaluate and avoid geohazard areas or to map subtle structural changes that assisted in our horizontal geo-steering solutions," he said.

"Offensively, the data was valuable in building inversion volumes allowing us to map and predict such critical components as gas in place, fracture width and fracture containment – all properties that we were able to directly tie back to production quality of various areas," Newhart said. "It also had a significant impact on allowing us to correctly risk our portfolio of available locations."

Advanced reservoir characterization, "including seismic inversion and stress analysis, allows us to derive lithological and geomechanical models," said Jo Firth, with technology and services marketing for CGGVeritas, "which can be used to predict hydraulic fracture behavior and reservoir drainage geometry, and to estimate TOC (total organic content), shale and carbonate content, water saturation and porosity, etc."

This can help operators avoid unproductive wells and unnecessary hydraulic fracture stages, Firth said, and also help trim risks by identifying drilling hazards (such as faults) and ductile areas that form boundaries to fracture zones.

Land Rush

Newhart observed that since the early Barnett "land grab" days, leases in shale plays have increased from $500 an acre to $5,000 to $15,000.

"Most resource plays have diverse acreage ownership in their early days," Newhart said. "Funding and annual budget constraints coupled with survey size and complexity would make acquiring this information on a proprietary basis nearly impossible.

"Those lessons were clearly learned by most operators in the Barnett," he added.

As many of the early U.S. shale leasehold agreements begin to mature, "operators want to evaluate their positions more carefully to analyze where they can develop quickly to produce the fastest in order to maintain their lease," said Mike Bertness, vice president of U.S. land multi-client and new ventures for CGGVeritas.

Since 2009, CGGVeritas has heavily invested in its North America shale multi-client data library, Bertness said, including the Haynesville, Bakken (United States and Canada), Montney and Marcellus shale plays, plus active participation in Eaglebine, Utica and the Tuscaloosa marine shale.

"In shale oil plays the terrain is one of the biggest hurdles, as many of the reservoirs are located in the Rockies, so access and permitting become more challenging," Bertness said. "They are still putting a lot of infrastructure in place – such as housing and hotel accommodations to support the influx of people drawn to develop the area – so grabbing land too early is an issue, but waiting too late means you've missed an opportunity.

"Knowing which land to produce first," he said, "is where the 3-D seismic data becomes extremely useful.

"Usually it takes about 12-18 months to permit, survey, drill and record and process the data," he continued. "Most leases are three to five years and oil and gas companies do not start working on a seismic program until they drill a few wells and see the production

See **Horizons**, page 30


Photos courtesy of CGGVeritas

Rising up to the challenge: A helicopter lifts the 3-D instruments to their location.

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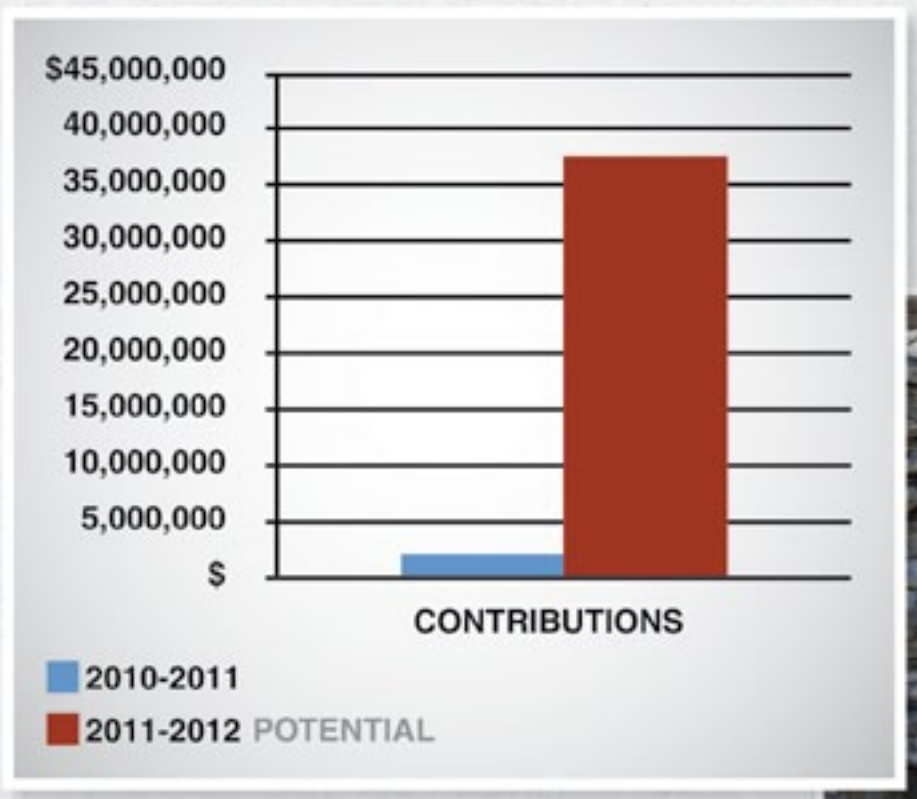

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Announcement

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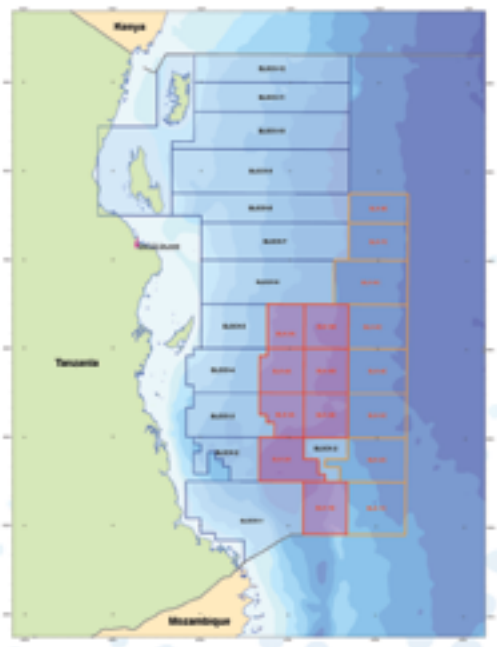
The Government of the United Republic of Tanzania, through Tanzania Petroleum Development Corporation, is pleased to announce the 4th Tanzania Offshore Licensing Round 2012 to be launched on the 13th of September, 2012, just after the HGS/PESGB Africa Conference to be held in Houston, Texas USA. The licensing round will include eight (8) offshore deepwater blocks in water depths of 2000m to 3000m. **ION GeoVentures will manage the logistics of the licensing round on behalf of TPDC.**



New deep offshore blocks

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so they are at least one to two years into their leases before doing seismic, so they end up drilling many of the first wells blind."

Global Impact

Detailed seismic also may help companies in a shale play avoid environmental risks associated with drilling and hydraulic fracturing.

When detailed lithological and geomechanical models of the field are calibrated with well log and core measurements, "they can be used to predict the most productive well locations and also the behavior of induced fractures, such as their direction of propagation and where the rock is too ductile for fractures to form.

"Identifying existing faults and fractures when designing a drilling and completion program, allows these to be avoided, mitigating against the risk of activating them," Firth said.

Microseismic monitoring of the fracture process can allow actual induced fractures to be compared with the predicted ones in real time, according to Firth, which in turn allows faster options.

"In today's economic and environmental climate it is essential to make every well and frac count," Firth added.

Geologists' and the industry's growing understanding of the reservoirs and advanced technology promises to push the growth of shale production, according to AAPG member David Bat, president of Welling & Co., an international market research firm serving the upstream petroleum industry.

Suburban potential: In North America, shale plays seem to be everywhere.

"Short term, operators will continue to focus on oil and liquid rich regions until natural gas prices recover to a more acceptable level," Bat said. "Long run, both unconventional oil and natural gas will prove to be the single largest 'game changer' this generation has experienced in terms of providing the U.S. both energy independence and economic stability.

"As long as operators continue to have access to land and services, and commodity prices remain stable above $60 per barrel of oil and eventually natural gas prices increase to at least $4 per MCF, the markets should exhibit continued stability and strong growth," Bat said.

"Lessons learned from the United States will most certainly be applied worldwide," Bat said, "resulting in similar experiences and economic impact."

AAPG European Region Upcoming Events

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It is the first year that Geologists and Geophysicists have organized a joint conference in Baku. The conference aims to create a platform for geoscientists from different countries to meet, review the latest technological advances and share experience. The technical programme of the conference will include all significant areas of oil and gas exploration and production, tectonics, sedimentology, geophysical and well-log data interpretation and regional geology.

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Find out more, send abstracts or register today. Visit www.aapg.org/baku2012/index.cfm

Strategies
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A Competitive Advantage

Along with other examples, Haskett cited the Marcellus Shale play, noting there was a problem of what to do with the liquids given there were few product lines.

"The companies that saw this early on started looking right away at the business pinch points of liquids extraction, liquids handling," Haskett said, "and this set them up with a competitive advantage.

"Other companies have to deal with the controllers of the business pinch points to get their product to market," he continued. "As soon as you're controlling the assets of other companies, you start to take their profits.

"That's very high level."

He emphasized that a strategic decision-based materiality approach to play entry and exit decisions allows you to prioritize what you're chasing, how much you're chasing and when you're chasing it.

This MO goes right to the heart of competitive advantage.

"Strategy forces you to take a look at the bigger picture in the context of what you can do," Haskett said, "and the details particular to an area.

"If you know upon entry when you're going to exit a play, it makes it a lot easier to figure what you need to control and how you're going to control it," he said.

"If you have a strategic approach, you are well-coordinated and pull out the value and the volume," he emphasized. "But if you just go in to see what you can do, someone else will get the profit.

"The profit's there; it's just a question of who gets it."

Student Poster Winners Named

Student poster award winners for the recent AAPG ACE have been announced. All received financial prizes provided by Shell. They are:

- First place – **Miles Frazier**, University of Manchester, England ($2,000).
- Second place – AAPG member **Ayodeji Oluboyo**, University of Bergen, Norway ($1,500).
- Third place – AAPG member **Christopher Wild**, Cardiff University, Wales ($1,000).
- Fourth place – AAPG member **Rattanaporn Fongngern**, University of Texas at Austin ($500).

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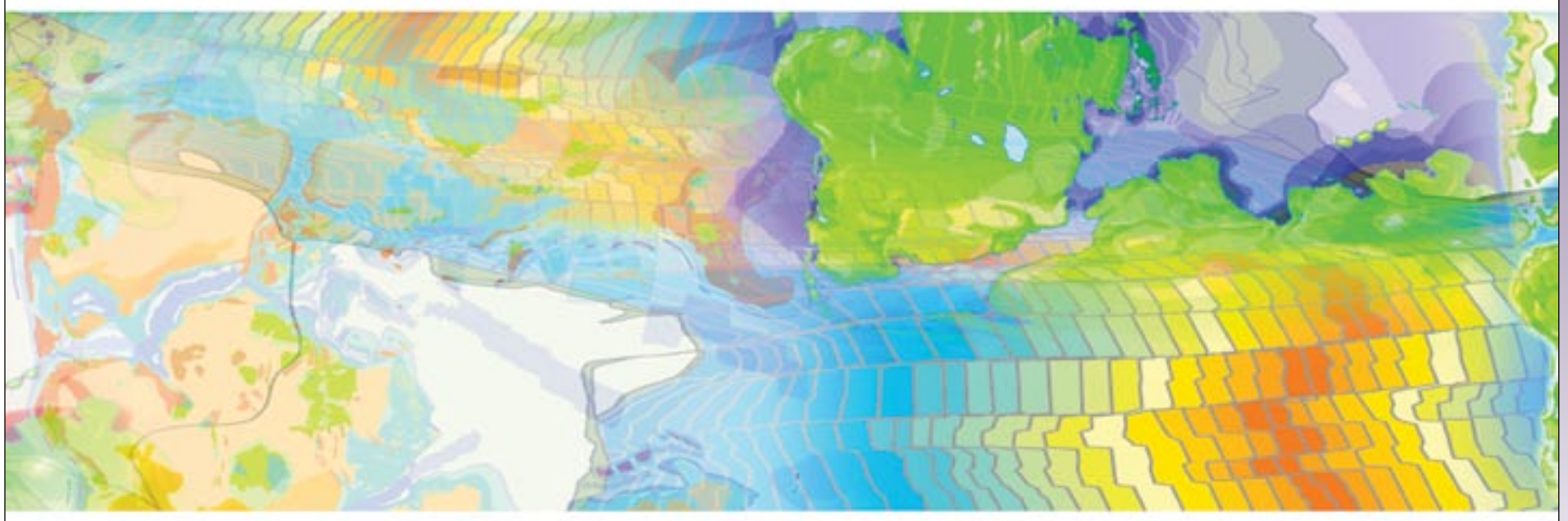

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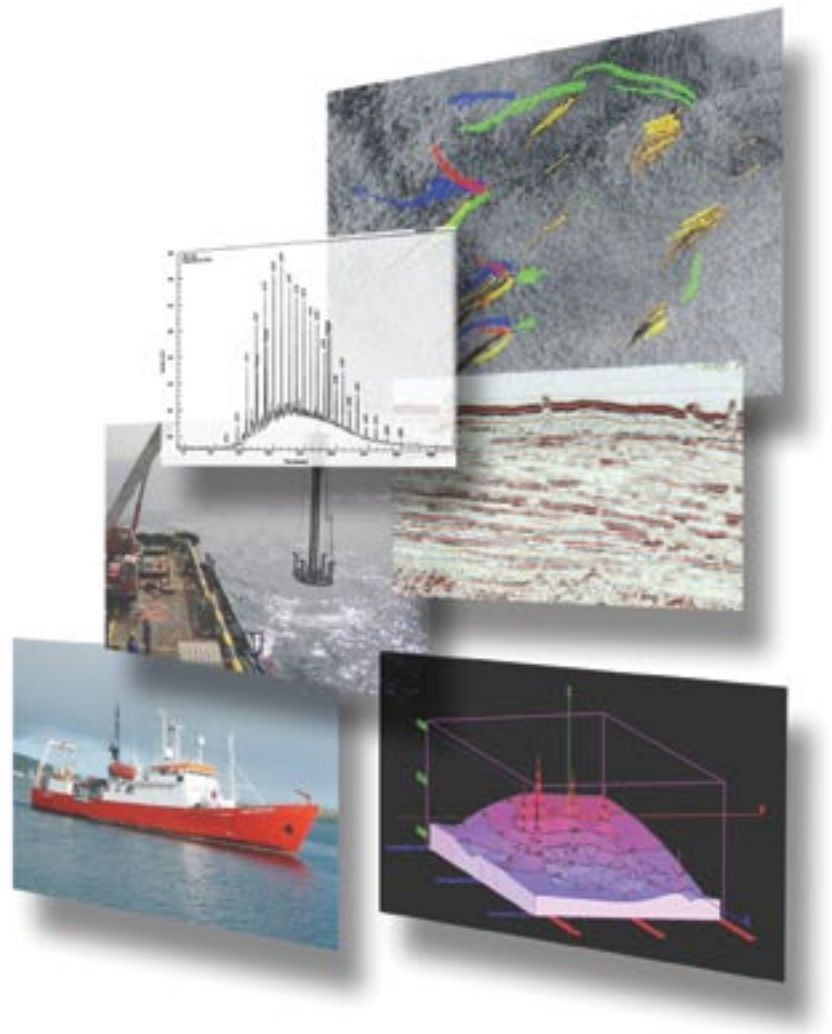

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FUGRO

Austin Chalk Getting Another Look

By LOUISE S. DURHAM, EXPLORER Correspondent

Remember the Austin Chalk horizontal drilling boom that revved up in the late 1980s?

Coming on the heels of one of the industry's most painful downturns, the play quickly morphed into THE place to drill in the United States.


PEARSON

It was a heady time, and south Texas was at the heart of the action.

Even the rustic Dilley Café in the hamlet of Dilley in Frio County had its 15 minutes in both the local and national media as being a kind of headquarters-central for cutting deals, while savoring the local cuisine.

Heck, some folks were actually touting drilling prospects sketched out on their hands, reminiscent of old-time wildcatters.

The play cast a spotlight on the potential of the relatively new technology of horizontal drilling. The near-frenzied activity soon spread across the chalk fairway eastward into Louisiana.

The fractured Upper Cretaceous Austin Chalk Formation had confounded industry players for years when it came to nailing down the intricacies of the plumbing system and identifying sweet spots. Vertically drilled dusters were the rule rather than the exception.

Even with the new lateral drilling technology, the formation continued to frustrate operators.

In addition to seasoned industry types, the highly hyped play attracted a number of get-rich-quick wannabe oil barons. They jumped into the fray willy-nilly, envisioning big old can't-miss fractures awash with oil.


Photo courtesy of Krystal Pearson, USGS

Things change: A new assessment of the prolific Austin Chalk provides a more refined understanding of the Austin Chalk as a hybrid system reservoir.

To be sure, some successful lateral wells were completed in the new play, just not enough to maintain the early momentum – and hype.

Ultimately, even some of the more savvy veteran players began to pack up and go elsewhere as they often encountered dry holes and/or uneconomical production. When some of the pricey deeper wells in Louisiana failed to pan out, it was particularly painful.

Look Again

But it ain't over 'til it's over, and companies continue to drill economic wells – just don't call it a boom anymore.

It may come as a surprise to many industry participants that the Austin Chalk's geology and production potential are still on the radar for some high level researchers.

Think U.S. Geological Survey (USGS).

In 2010, the federal agency released its Assessment of Undiscovered Oil and Gas Resources of the Upper Cretaceous Austin Chalk and Tokio and Eutaw Formations, Gulf Coast.

This was the agency's first assessment of the Austin Chalk since 1995, according to AAPG member Krystal Pearson, Gulf Coast assessment team member and research geologist at the USGS in Denver, who presented a poster on the Chalk at the recent AAPG Annual Convention and Exhibition in Long Beach, Calif.

The Energy Policy Conservation Act of 2000 mandates that the USGS provide such assessments of priority basins in the United States – prioritized based on resource potential and federal land percentage.

These priority basins hold about 96 percent to 98 percent of the known oil and gas resources for the United States.

The assessments use a geology-based assessment methodology based on geologic elements of a total petroleum system (TPS) that includes:

- Petroleum source rocks (quality, source rock maturation, generation and migration).
- Reservoir rocks (sequence stratigraphy and petrophysical properties).
- Traps (trap formation and timing).

Using this approach, the USGS defined three conventional assessment units (AU) and one continuous (unconventional) for the Austin Chalk.

"The USGS assessment methodology defines conventional accumulations as those with good permeabilities and porosities, well-defined boundaries and hydrocarbon-water contacts," Pearson said.

"In contrast, low permeability continuous reservoirs have diffuse boundaries and lack obvious traps and seals," she continued, "although they may be affected by large

See **Austin Chalk**, page 36

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Pesky hydrocarbons just want out

Is the Trap Half-Full or Half-Empty?

By LOUISE S. DURHAM, EXPLORER Correspondent

A number of years ago, past AAPG president Dick Bishop was asked to investigate the challenging topic of percent trap fill.

Bishop, now executive director and chief geologist at U.S.-based consulting and investment firm RSK, noted there has been a long-standing effort in the energy field to predict both trap content, i.e. oil, gas or both, and volume, which is commonly dependent on an estimate of column height.


BISHOP

Studies make the case that the source rock commonly generates more than traps can hold.

"I looked at hundreds of fields in different types of basins and never found a trap I could demonstrate was underfilled but always filled to a spill point or leak point," he said. "I found a lot of traps that were indeterminate because they were so complex – but only a couple of cases where they might be underfilled."

"People were so used to looking at traps in map view that when I said traps were full, they thought of it as down to synclinal spill point," he said, "and not to a leak point.

"There was, and continues to be, misunderstanding and resistance to the idea – until folks take the time to look at some well documented fields themselves."

Bishop, who presented his thoughts at the recent AAPG Annual Convention in Long Beach, Calif., says field observations and geochemical studies make the case that the source rock commonly generates more than traps can hold. Many examples of full to a leak point come from the literature and include the Allan diagram and publications on fault seal.

"The difference between the trap volume and the volume generated by the source determines what can be in there," he noted. "If a source generates X volume and the trap has Y volume available, the smaller of the two will determine the prospect size.

"You have to look at traps in three dimensions in order to find what controls the contact (i.e. where is the leak point), and that affects how one assesses trap volume and risk," Bishop continued. "The key is to ask what controls the contact."

The significance of the observation lies in its implications to understanding the control of contacts and then interpreting fluid movement in the subsurface. This includes such things as gas displacement or predicting oil formation volume factors.

"A distracting question becomes whether this is a worldwide phenomenon or if it happens in only a few well known prolific basins," he said. "But full traps do happen – and after all the basins I've looked at, I think it happens most of the time."

The implications are, he suggests, if full traps happened once, then it could happen twice, and then three times ...

Oil vs. Gas

Bishop stated that charge overwhelming trap capacity applies to both oil and gas fields. However, if both oil and gas are in the system, it implies that gas should displace all the oil.

The question thus becomes one of explaining how oil and gas occur in the same reservoir.

"Explaining how traps have both oil and gas in them probably is not possible to prove, but preferential leakage of free gas is what I have seen," he said.

In other words, the gas-oil contact occurs at a leak such as a fault intersection, across a fault, sometimes through a top seal as a gas chimney or up the fault.

A similar question comes with how oil fields occur in systems with free gas.

"There are a lot of oils in the world saturated with natural gas," he said. "Mother Nature didn't send up just enough gas to saturate that oil field and then stop sending the gas."

The reason the gas didn't displace the oil is interpretive.

"Again, the reason is the top seal or a fault, enabled preferential leakage of the gas," Bishop noted. "The trap is configured such that it leaks free gas, leaving behind saturated oil fields.

"In terms of predicting trap content in plays with both oil and gas available, I don't think there's a consistently good technology to determine pre-drill whether a prospect will be oil, gas or both other than local knowledge," he continued. "We have first principles to make these predictions but we do not have the subsurface resolution required to predict trap content."

You can't address these questions just with basin modeling, he cautioned.

"Forecasting trap content requires

See **Trap**, page 36

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Although the pre-salt region of southeastern Campos Basin is the current focus of exploration in Brazil, especially by Petrobras, other areas in the country present significant play potential. The ANP (Brazilian National Agency of Petroleum, Gas and Biofuels) plans a Bid Round this year to offer operators 174 exploration blocks in sedimentary basins located in the equatorial margin. Half of the blocks are located onshore and half represent offshore opportunities. Unconventional plays should be contemplated in companies' analysis of these blocks.

In this context, AAPG Latin America Region and the Asociacão Brasileira de Geólogos de Petroleo (ABGP) will co-host this interdisciplinary workshop. The workshop begins with the basics of unconventional resource plays, including play evaluation. Later sessions include technical presentations and research from leading companies and universities in Latin America, North America, Europe and the Middle East. Global analogies will examine lessons learned for effective exploration and production methods used in tight gas sands, fractured carbonates, and shale oil/gas reservoirs. Presentations on the social and environmental aspects of unconventional play development, including mitigation, will round out the workshop program. Following each session, all GTW participants will participate in small group discussion and knowledge sharing. The process results in a unique exchange of ideas, experiences, and opportunities for future collaboration.

Hydraulic Fracturing

13- 15 August 2012 • Golden, Colorado (Colorado School of Mines)

This Geosciences Technology Workshop will focus on new developments in hydraulic fracturing with an emphasis on the importance of understanding the geology, rock properties, geomechanics, geochemistry, reservoir fluids, natural fracture systems and the nature of the reservoir itself. The approach is multi-disciplinary, and exploration and production issues will be expanded to consider environmental concerns, new technologies, and new findings about the reservoirs themselves.

The workshop is also intended to bring together technology developers and users with environmental specialists, regulators, and policy makers to find common ground and open channels of discussion and understanding. This should lead to more technology-based and less emotional development of policies and regulations on O&G activities, as well as improve the understanding by the O&G industry of how to avoid confrontation and improve hydraulic fracturing practices to eliminate any potential hazards to the public and surface owners.

Part of the motivation for the GTW is the fact that hydraulic fracturing for both conventional and unconventional oil and gas development and production has become a hot button issue for the public and regulators in most of the United States and Canada where this technology is being used or might be used in the near future. Concern and regulation of hydraulic also is growing in other areas of the world, especially in Europe. There is a disconnect in most places between how the technology is applied and the real and perceived hazards to aquifers and surface owners (including induced-earthquake hazards) that have led to the contentious state of affairs.

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

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Austin Chalk
from page 32

scale structures, such as anticlines and fracture networks.

"Reservoir characterization as either conventional or continuous has strong implications for assessment of undiscovered resources and production strategy.

"The Austin Chalk is a low to moderate primary porosity and low permeability reservoir that requires interconnected fracture networks for oil and gas production," Pearson said. "It behaves as a hybrid system with varied geologic settings contributing to both conventional and continuous hydrocarbon accumulations."

Well, you ask, why keep doing repeat assessments on basins?

"Things change, drilling patterns change, and we have more data," Pearson noted. "We have more well history and just so much more to work with since 1995, so the Chalk needed to be updated.

"Geologic models and concepts have evolved as well," she continued, "and our understanding of how to classify continuous versus conventional is always evolving."

She emphasized that it's not always crystal clear where to draw the lines – as evidenced by the Austin Chalk, with its combo of the two.

Assessment unit lines in essence are geological boundaries in that there must be a geological reason to denote a line.

"You need to have some geological occurrence or setting that's going to lead you to separate either two conventional assessment units from each other, or a conventional unit from a continuous," Pearson said. "That could be regional structure versus local structures, fracture systems and what's contributing to them, oil and gas generation windows ... Not all conventional and continuous reservoirs operate on fracture permeability.

"We could be doing another assessment three to four years from now on the same rocks, the same section," she continued. "We'll use new data at that point with the same methodology as this time and see how the numbers change or not as time progresses."

Pearson emphasized drilling patterns suggest the historic Austin Chalk trend, including Giddings and Pearsall Fields, produces from primarily continuous reservoirs. This is in contrast to other Austin Chalk reservoirs in the region, where production methods, such as vertical drilling, imply it is a conventional reservoir.

This shift in philosophy is likely owing to current drilling focused at the margins of major structures.

"Recent work provides a more refined understanding of the Austin Chalk as a hybrid system reservoir in which lateral drilling programs and reservoir stimulation techniques may only be advantageous in reservoirs that are dominantly continuous," Pearson noted.

Results of that work have not yet been released in print. Meanwhile, there's reason for Austin Chalk players to smile.

Of the four assessment units defined for the Chalk, almost one billion barrels of oil were designated just for the one continuous unit.

The Austin Chalk oil is sourced from the underlying liquids-rich Eagle Ford Shale, which is one of today's leading hot spots for horizontal shale drilling and production.

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Trap
from page 34

consideration of what the hydrocarbons might do in the subsurface that you otherwise wouldn't imagine," he said. "In other words, what are the possibilities?

"When oil and gas are both available to a trap, the best way I know to predict what will be in the trap is to consider the role of leakage," Bishop continued. "It helps to appreciate the no-see-ums in the subsurface – the hydrocarbons that have migrated through these systems and are gone now.

"There's no flag that tells you 'Leroy was here,'" he quipped.

Full to Spill

Traps filled to spill commonly are associated with thick regional seals, because much of the time the faults die into that seal – and the fault then becomes bed seal.

"If the hydrocarbons can't leak up, they will fill to a spill point," he said. "For example, in and around the Gulf Coast, especially south Texas, many four-way anticlines and high side closures are filled to spill point because the faults die in the overlying Vicksburg shale.

"It's the same around here (Houston area) with the Frio sands under the Anahuac shale."

Bishop also cited a number of thick regional seals worldwide particularly in failed rifts and some margin sag basins.

The thick Cretaceous section in the North Sea is such an example.

A Valuable Tool?

The real argument here is not about how common this is globally, but how to use the concept to evaluate prospects if charge overwhelms trap capacity, Bishop said, "and just what are the implications of gas displacement, leak points, things like that.

"Regardless of how one feels about the commonality of 'overcharge,' I do think it's sufficiently common to warrant it becoming a part of everyone's toolkit," he added.

For example, some of the implications include:

- Spill from downdip traps may reduce risk of charge in updip traps.
- Trap risking can be based on number and type of hydrocarbon boundaries as well as top seal quality.
- Given similar stratigraphy, traps with more potential leak points have greater risk than those with fewer leak points.

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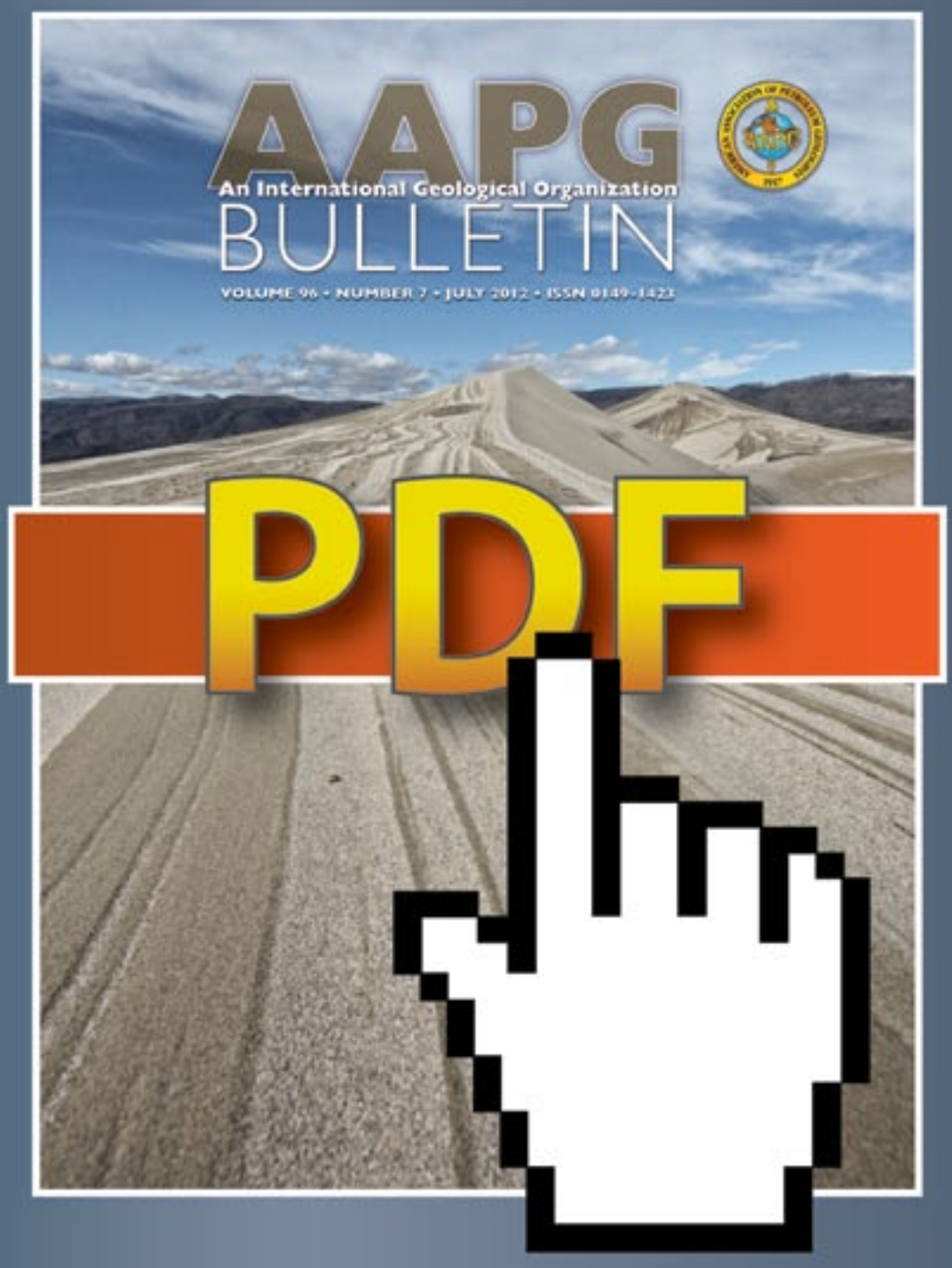

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Article highlights include:

A newly documented boundary

E&P Note

Ziaxing Jiang, Jie Xu, and Guoting Wang

A sedimentary hiatus forms the sequence boundary between the Lower Pennsylvanian Taiyuan Formation and the gas-bearing Upper Pennsylvanian Taiyuan Formation. The hiatus and overlying incised-valley fill can be observed in outcrop, where the presence of bauxite indicates subaerial weathering.

A promising porosity proxy procedure

Claudio Miro Filomena, Harald Stollhofen, and Kees van Ojik

High-resolution sonic logging is a fast and nondestructive method that provides reliable porosity proxies to better interpolate between more widely spaced core plug or wireline log porosity data. This paper examines the applicability of this technique in a gas-bearing reservoir, offshore Netherlands.

A new modeling study

Tucker F. Hentz, William A. Ambrose, and David L. Carr

A three-dimensional model of the Western Canada Sedimentary Basin was constructed and supports the possibility of long-distance migration of oil. All of the modeled source rocks reached the early or main oil generation stages before the onset of the Laramide orogeny.

Lower Atoka depositional systems

Luiyin Alejandra Berbesi, Rolando di Primio, Zahi Anka, Brian Horsfield, and Debra K. Higley

This study in the northern Fort Worth Basin attempts to construct a regional chronostratigraphic framework of the lower Atoka Group to gain a better understanding of the sandstone distribution and depositional settings and to investigate geologic controls on regional production trends.

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 current AAPG-SEG Joint Distinguished Lecturer. This month's column deals with how seismic attribute expressions prove useful in differential compaction.

GEOPHYSICAL CORNER

Differential Compaction: 3-D Attributes Can Help

By SATINDER CHOPRA and KURT MARFURT

Differential compaction has been used by seismic interpreters to map features of exploration interest, such as carbonate build-ups, fans and fluvial channels. However, the 3-D mapping of compaction can take considerable time – and so many times it is not pursued.

CHOPRA

But 3-D seismic attributes such as coherence and curvature can be used to map compaction features.

This month we illustrate the more common differential compaction expressions over paleo channels and carbonate reefs using examples from the Western Canadian Sedimentary Basin.

MARFURT

* * *

Seismic attributes such as coherence and curvature are routinely used for mapping structural features such as faults, folds and flexures:

- The coherence attribute, which is a measure of similarity of seismic traces, has been used for mapping discontinuities that arise at channel edges, or boundaries, of reefs.
- Similarly, curvature is a measure of bending of seismic reflections and has been used to map faults and folds. Calibrated with borehole image log data, curvature can be used to predict fractures. As differential compaction causes the deformation of overlying, previously flat surfaces, such surfaces can be used to map underlying features of interest.

As the name implies, "differential" compaction is a topological change due to lateral changes in the loss of rock volume as it lithifies. Channels that are filled with shale and are separated by sandier interfluves will appear as structural lows. Channels that are filled with sand cut through a shale matrix may appear as structural highs.

Channels incised in older, previously compacted rock, will usually appear as lows regardless of their fill.

In figure 1 we show a chair display for a strat-cube constructed from the coherence attribute volume and a vertical slice through seismic amplitude perpendicular to the thalweg of the channel. The seismic signature of the incised channel is seen at the positions of the colored arrows, the incision being deeper at the location of the yellow arrow, less deep at the location of the orange arrow and lesser at the green arrow.

The disposition of the channel is clearly indicated on the coherence strat-slice.

In figure 2 we show a chair display with seismic amplitude as the vertical section, and for the horizontal section we have overlaid the most-positive (red) and the most-negative curvature (blue) attributes using transparency.

Notice the edges of the channel are seen in red and the axis of the channel is defined in blue. Segments of a deeper channel also are seen in the display and these have been marked with light blue arrows.

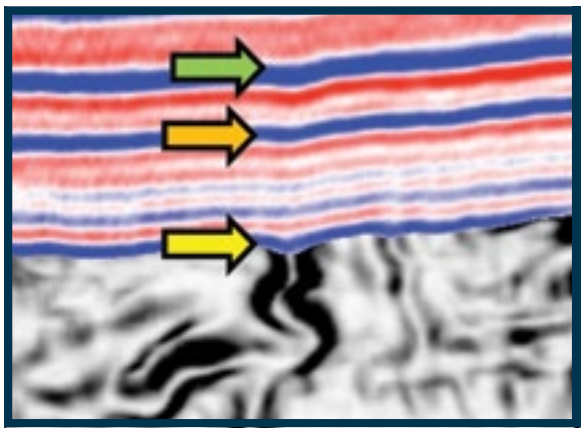

Figure 1 – Chair display showing an incised channel on a coherence stratal slice and its seismic amplitude signature. We interpret the sag over the channel to indicate that it contains more shale than the surrounding matrix.

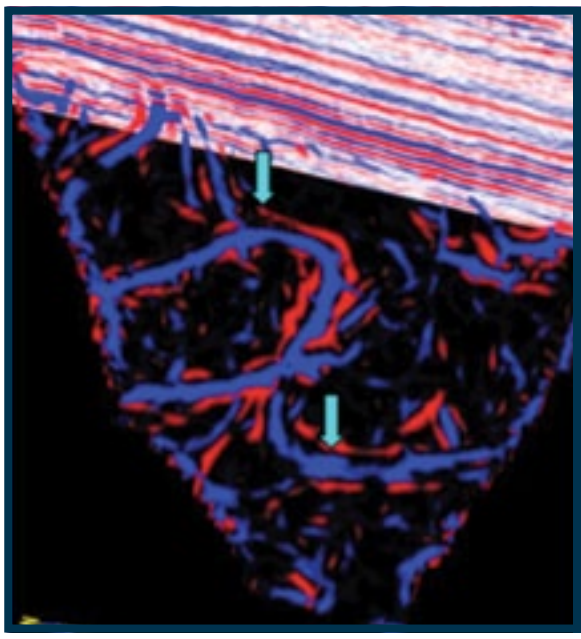

Figure 2 – A chair display of the same volume shown in figure 1 showing a vertical slice through seismic amplitude and a thin strat cube through co-rendered most-positive and most-negative curvature volumes where moderate curvature values are rendered transparent. Sediments within the channel have undergone more compaction and give rise to a strong negative curvature anomaly along its axis (in blue). Levees and channel edges appear as ridges and give rise to strong positive curvature anomalies (in red).

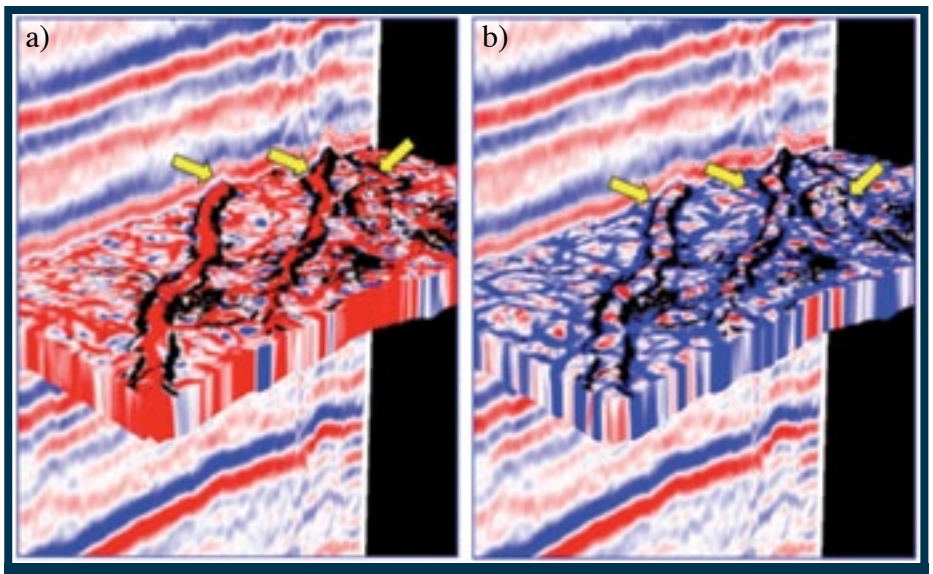

Figure 3 – A chair display showing a vertical slice through seismic amplitude and (a) a strat cube from the most-positive curvature attribute co-rendered with coherence, and (b) a strat cube from the most-negative curvature attribute co-rendered with coherence. Notice in this case we see the edges of the channel very nicely on the negative curvature.

In general, it is easier to reduce pore space – and therefore compact shales – than sand. If the channel is filled with sand, it will appear to have a positive relief feature seen over the length of the channel and slight negative relief feature at the edges of the channel. The coherence attribute picks up the edges of such a channel – however, the most-positive curvature attribute shows the central mound over the channel (figure 3a) and the most-negative curvature defines the edges of the channel as shown with the help of yellow arrows in figure 3b. Such patterns serve as a lithologic indicator.

* * *

Carbonates are stronger and more difficult to compact than sands and shales. While living, the carbonate mound was structurally higher than the surrounding sediments. Once it died it was covered by flat overlying, typically softer, more easily compacted sediments.

Differential compaction between the reef carbonate facies and the off-reef facies results in an image whereby the overlying sediments appear to drape across the carbonate buildup. The extent of the drape would depend on the variation in the compaction of the reefal and the off-reef material as well as the thickness of the overlying sediments.

In figure 4a we show a chair display with the horizon slice from coherence and correlated with the vertical seismic section.

Notice the prominent reef feature on the coherence and the drape of the seismic reflections over it – the most-positive curvature (figure 4b) defines the mound and corresponds to the edges of the reef clearly.

Thus, a clear understanding of the effects of differential compaction can facilitate the rapid interpretation of otherwise subtle, and perhaps otherwise overlooked geological features of interest.

We thank Arcis Seismic Solutions for encouraging this work and for permission to present these results.

(Editor's note: AAPG member Kurt J. Marfurt is with the University of Oklahoma, Norman, Okla.)

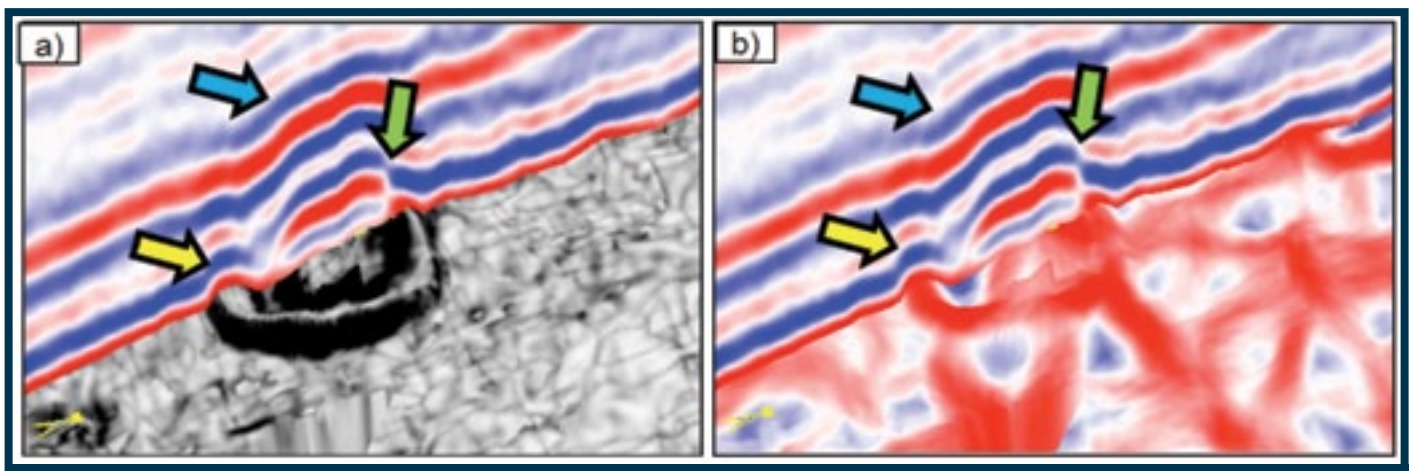

Figure 4 – Chair display of seismic amplitude and stratal slices through (a) coherence and (b) most-positive curvature showing differential compaction over a carbonate reef. Yellow arrow indicates the rim or atoll. Strong compaction often gives rise to discontinuities (green arrow). Note compaction drape well above the structure (blue arrow).

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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.

Photo courtesy of the Beryl Ford Collection/Rotary Club of Tulsa, Tulsa City-County Library and Tulsa Historical Society.

The way it was: Tulsa, shown here in a 1930 view of the downtown area, was THE place to be if you were part of the oil industry in the early part of the 20th century.

HISTORICALHIGHLIGHTS

Tulsa: Oil Capital of the World

By LARRY NATION, AAPG Communications Director

"Tulsa: Oil Capital of the World." It sounds a little boastful, doesn't it? Well, over a century ago when the title was first touted – it certainly was.

When the appellation was declared by Tulsa, it was a boomtown in Indian Territory fast growing into a city with an entrepreneurial excitement fueled by some massive oil fields nearby. And the title was up for grabs.

The "Oil Capital" label was first proclaimed in the mid-1800s by Titusville, Pa., thanks to Edwin Drake's oil find. Soon, nearby Pittsburgh lay claim to the title with its refineries and financial horsepower.

As oil production progressed west to Ohio and the Great Lakes population grew, Cleveland, powered by John D. Rockefeller's Standard Oil, proclaimed itself the Oil Capital with a touted 88 refineries pumping out product shipped via Lake Erie.

But Cleveland? Oil Capital? Really? Besides, the Standard Oil Trust was about to get busted.

Then in 1897 the Nellie Johnstone well blew in near Bartlesville, about 40 miles north of Tulsa. The nearby Red Fork was discovered in 1901 and four years later came the Glenn Pool gusher that opened a giant new field just to the south.

Newspaper images of Oklahoma oil geysers were published over the world. Tulsa was in the center of the new oil-producing universe.

The *Oil and Gas Journal* was established in Tulsa in 1902. Where else? It was where the news was happening. It was the Oil Capital of the World.

Living On Tulsa Time

In 1903 Nebraska brothers Frank, a banker, and L.E. Phillips heard from a missionary to the Osage Tribe of the vast oil deposits in Oklahoma and began their oil hunt. Their first wildcat struck. Their second and third wells were dry and they were going broke. Then, in 1905, the brothers hit the first of 81 wells in a row without a single dry hole.

Twelve years later, they founded Phillips Petroleum Co. in nearby Bartlesville.

James O. Kemm wrote in his book "Tulsa: Oil Capital of the World" that by the time the territory became the nation's 46th state in 1907, nearly 100 oil-related companies were active in the Glenn Pool area alone.

With Tulsa having rail access and green rolling hills, a new corporate generation chose it as their headquarters and began to build their worldwide empires – and homes. Residents were to become the "Who's Who" in the oil industry, including J. Paul Getty, Harry Sinclair and William Skelly.

With the onset of World War I, the value of petroleum and its products heightened the importance of the city – and development of the aviation industry made it more accessible.

By this time, Tulsa was headquarters to 1,500 oil-related companies, and was the decision center for the mid-continent oil fields, which produced two-thirds of the nation's oil. Its refineries produced more gasoline than any other location in the United States and supplied coast-to-coast pipelines, Kemm reported.

In 1917, the most influential geologists in the world gathered at a dinner in Tulsa and AAPG was born and headquarters were established.

In 1923 a group of Tulsa oilmen organized the first International Petroleum Exposition and Congress (IPE), a multi-day exhibition of the latest technology and science. It's stated purpose was to "firmly establish Tulsa for all time to come as the oil center of the entire world."

The first IPE drew 27 exhibits and 14,000 attendees, which at the time was

Continued on next page

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Continued from previous page

pretty heady stuff.

With a certain "wildcatting sophistication," Tulsa assumed a persona and lifestyle that set it apart culturally from the state that didn't repeal prohibition until 1959. The social competition by the "nouveau riche" resulted in elegant mansions and downtown buildings grandly adorned with the art deco flair of the times. It was, as they were remembered, the "Doo-Dah Days."

The IPE also drew the attention of the international press – and if you were doing business in the oil industry, this was the place to be. Major meetings were scheduled in Tulsa around the IPE. Notables were also among the attendees. Aviation hero Charles Lindbergh was present when President Calvin Coolidge opened the 1927 exposition from the White House by pressing a button that caused a simulated gusher to blow wild on the IPE grounds.

Kemm wrote that the 1948 IPE, the first after a World War II hiatus, reportedly drew more than 200,000 but the board of directors voted to hold it every five years due to logistics and financial difficulties.

Pass the Peak

Meanwhile, the post-WWII industry was mushrooming in Houston with companies' activities increasingly becoming more offshore and international – and Houston was a growing hub of decision-making.

Tulsa continued to be known (and to promote itself) as the "Oil Capital of the World" into the 1950s and 1960s. "The IPE grew and reached its peak attendance in 1966 of about 300,000 held in the new IPE Building," Kemm wrote, "then said to be the world's largest building under one roof."

By the end of the 1960s, Tulsa's role in the industry was beginning to diminish as companies focused more operations in Houston.

An indicator of the changing of the guard is the Offshore Technology Conference. Founded in 1969 by 12 engineering and scientific organizations – including AAPG – OTC was a response to the growing technological needs of the global ocean extraction and environmental protection industries. The need for interdisciplinary and cross-sector cooperation was becoming acute, Kemm wrote.

OTC's significance was apparent after the first meeting and larger facilities at Houston's Astrodomain Complex were booked annually for the next 33 years.

Then came the Oil Crisis of 1973-74. With the resulting economic turmoil, everything was being redefined – including the title of "Oil Capital of the World."

In the wake of the tumult, the shift to Houston quickened. (One wonders if that would be the case had air conditioning technology not advanced).

The last IPE was held in 1979 and OTC was the new king of the hill – as was Houston.

Tulsa is still an oil center, thanks to a still-vibrant industry and not to mention it's home to the headquarters of AAPG, the Society of Exploration Geophysicists and SEPM, as well as international headquarters for some major E&P companies and other thriving industry ventures and two refineries.

But "Oil Capital" talk is historical and nostalgic rather than reality.

The previous generations of oilmen and women have left their mark on Tulsa through their philanthropy for the arts and education, and the new generation has picked up that mantle and continues to take pride in the city's heritage.

Some benefits of Tulsa's heritage is it is an attractive place to live and visit – and the museums, art deco and historic residences are daily reminders that the titans who built the oil industry worked and lived in Tulsa and made fortunes here. And major players remain.

Just not as many.

The famous 76-foot-tall Golden Driller, standing in front of Tulsa's IPE building.

EAGE MOU Signed

AAPG and the European Association of Geoscientists and Engineers have signed a Memorandum of Understanding for cooperation between the two associations and further agreeing to develop a series of joint workshops.

The agreement lays the groundwork for annual technical workshops to be developed in Europe beginning in late 2013, with organizing responsibilities alternating between EAGE and AAPG.

"Expanding the cooperation between our two associations will provide significant benefit to our members as we work together to advance the geosciences," said Stuart Harker, AAPG vice president-Regions.

The agreement was signed at the EAGE annual meeting in Copenhagen, Denmark, in early June.

Signing the document were Harker and AAPG Executive Director David Curtiss for AAPG; signing for EAGE were John Underhill, EAGE president, and EAGE Executive Director Anton van Gerwen.

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FOUNDATIONUPDATE

New award

Professor Honored


WACH

AAPG member Grant Wach, petroleum geoscience professor at Dalhousie University, Nova Scotia, has been named the inaugural winner of the AAPG Foundation's Professorial Award recipient.

The honor, to be given annually to a professor for "Excellence in the Teaching of Natural Resources in the Earth Sciences," comes with a $1,000 prize from the AAPG Foundation.

Wach – who personally had 15 nominations for the prize – was one of 16 applicants for the award, which was determined by the AAPG Academic Liaison Committee.

Over the last 25 years Wach has been "directly involved in the advanced training of hundreds of professional geoscientists and engineers who are already highly qualified in their fields," he said.

"I have trained geoscientists and engineers in the lecture room and in the field in Nigeria, South Africa, Trinidad, China, Malaysia, the UK, Colombia, Canada and the United States," he said.

"I have had the opportunity to lecture in extraordinary settings," he added, "from storm swept coasts to the deserts of China."

An article on Wach will be published in a future EXPLORER.

For more details on the Foundation's Professorial Award go to blog.aapg.org/foundation/?p=584.

* * *

In other Foundation news, 84 recipients from 17 countries have been named to receive 2012 Grants-in-Aid from the AAPG Foundation.

The Foundation has awarded $175,000 in grants to the recipients, who were selected from an applicant pool of 310. Selection was based on merit and, in part, on financial need.

Grants range from $1,000 to $3,000 and are made annually by the Foundation to graduate students around the world to those whose thesis research has application to the search for and development of petroleum and energy-related resources, and/or to related environmental geology issues.

Factors weighed in the process included: an applicant's qualifications as indicated by past performance; originality and imagination of the proposed project; support of the department in which the work is being done; and perceived significance of the project.

A complete list of the recipients can be found at foundation.aapg.org/gia/current.cfm.

PROTRACKS

YPs Busy in Long Beach

By NICK LAGRILLIERE, Chair, AAPG Young Professionals Committee

AAPG's Young Professionals initiative took another big step forward with three specific activities at this year's AAPG Annual Convention and Exhibition in Long Beach, Calif.

▸ First, the now-annual YP Meet and Greet event was a big success, attracting more than 150 students, young professionals and experienced mentors.

The large group of people gathered on Sunday afternoon, just preceding the convention's official start, to discuss careers in the oil and gas industry, the benefits of continued membership in AAPG and to enjoy the refreshments.

After an hour of mixing and mingling at the event – sponsored by Noble Energy, which was represented by Tiffany Hopkins – everyone headed off to the Imperial Barrel Awards awards ceremony and the opening session.

▸ Later that Sunday evening a sizeable crowd of young professionals gathered at the nearby Rock Bottom Brewery for the first-ever YP Networking Reception, where attendees enjoyed good food, local beers and the chance to network with other young professionals attending the ACE.

The "YP-only" event gave YPs another chance to share experiences with each other about working in the industry and being a part of AAPG.

▸ Finally, on Monday night Jon Allen, Pacific Section YP lead, announced the winners of the cash prizes for the Networking Challenge, a competition where students and young professionals flexed their networking muscle by engaging with AAPG leaders by collecting signatures around the Exhibition Hall during Sunday's Icebreaker.

Overall the YP activities at ACE were an overwhelming success – and we look forward to an even bigger and better selection of events at next year's ACE in Pittsburgh.

Stay tuned!

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SPOTLIGHTON

Messages muddy the needs

Keeping Science at the Forefront is Difficult

By BARRY FRIEDMAN, EXPLORER Correspondent

"The United States is one of the most poorly mapped countries geologically, among the developed nations … and at the current rate, it will be 75 years or more to complete 1:24,000 scale mapping of most of the country."

For AAPG member M. Lee Allison, geologist and director of the Arizona Geological Survey, the glass is neither half full, nor half empty.

It's often the wrong glass entirely.

"As scientists, we spend perhaps 80 percent of our time discovering, accessing and converting data into formats that we can then use to solve problems," he continues. "Only 20 percent of our time is spent actually doing the analyses and interpretation that are the guts of exploration and discovery.

"Our goal is to flip the 80/20 rule."

And during the 2012 AAPG Annual Convention and Exhibition in Long Beach, Allison talked about that work in a talk to the Energy Minerals Division luncheon – specifically the need for strategic investment in data integration, an area he admits is "not flashy."

The U.S. Geoscience Information Network (USGIN) is a five-year-old partnership between the 50 state geological surveys through the Association of American State Geologists (AASG) and the U.S. Geological Survey that Allison says will bring vast amounts of disparate data together with a growing array of user applications to visualize, process and interpret data – and do so within three years.

Lee Allison, director of the Arizona Geological Survey, speaking at the EMD luncheon.

"We are in the middle of a data revolution that is largely unseen, not only by the public but by most scientists as well," Allison said. "'Big Data' and 'interoperability' (i.e., data integration) are the coming tsunamis."

And Allison has been tracking such "storms" for years – the energy ones, the environmental ones, the political ones. It's been his career, trying to keep science vital, respected and appreciated while navigating the turbulent waters where all dynamics collide.

Guess which are the most severe?

The Good, The Bad and the …

We start in the Midwest.

"When I was on loan to (then-) Kansas Gov. Kathleen Sebelius as her energy adviser," he says, "the most contentious issue we had to deal with was wind energy, and this in a state that called itself the 'Saudi Arabia of wind energy.'"

The critics of wind energy, he said, were as angry, as passionate and as fervent as any anti-oil or anti-nuclear advocates you'll find.

"I think," he adds, "this is true of all the other energy sources as well."

He ticks them off:

- Nuclear – "There has been the battle over what to do with waste storage and, recently, the fears raised by the Fukushima plant in Japan."
- Coal – Air quality and CO_2 issues. Allison believes there is a well-organized and well-funded national "war on coal."
- Hydroelectric dams – Impact fish populations and free flowing rivers.
- Solar plants – Cover too much land and consume too much water.
- Geothermal – He calls this the "forgotten renewable energy … the (?) to wind and solar" because of induced seismicity.
- Natural gas – "Even here," he says, "long touted as a greener alternative to coal-fired power plants, it is becoming integrally associated with hydraulic fracturing, which is the ogre of the moment in the public arena."

There is the good, the bad and the in-between.

Lots of in-between.

"I'm surprised," he says, as an example, "that electric powered cars are considered

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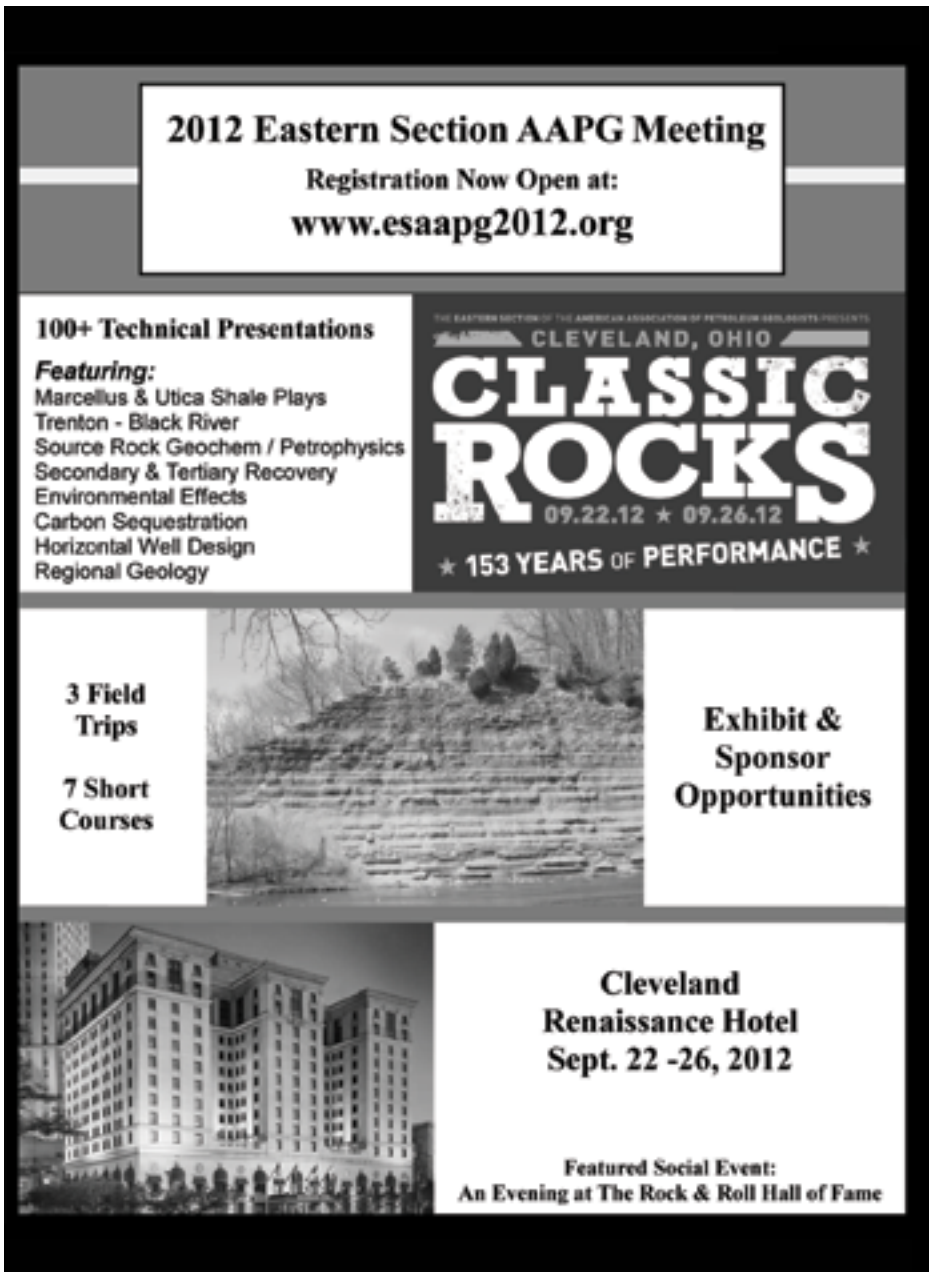

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the ultimate green vehicle, when you realize that much of the electricity produced to power them comes from coal- or gas-fired plants."

Allison, who also is adjunct professor at the University of Arizona, believes that part of the problem with the schema of the national energy debate are the ground rules – and both political parties are to blame.

"Many of the energy debates, and natural resource debates in general, pit economic development versus environmental protection as mutually exclusive outcomes," he said. "The two sides talk past each other on these points, each looking for a tactical advantage to win their case. Nuances and complexities in the 30-second sound-bite debates are tossed aside, and your position on resources becomes a label on where you stand on the wider political and social issues of the day."

And he cites an example from his own state.

"In northern Arizona, the battle to keep federal lands open to exploration and mining was lost as soon as the message was framed by putting 'uranium mining' and 'Grand Canyon' in the same sentence," he said, "even though any potential mines would be many miles from the Canyon and the Colorado River."

They Said/They Said

As of late, the poster child in the national energy tug of war has been the XL Pipeline, which will, if constructed, transport oil 1,700 miles from Alberta, Canada, to a company hub in Steele City, Neb. From there it would then be directed to other pipelines operated by the company to refineries on the Texas Gulf Coast.

Critics say it's an environmental landmine waiting to be tripped; proponents say it will keep energy prices down and create jobs.

"I was driving home from meetings in Phoenix," he says, "and Congress drew a line in the sand to force the president to approve the pipeline to promote economic development and energy security. The president rejected the pipeline on the basis that a rushed decision prevented environmental assessment of something that could have a big impact on water and air quality.

"As I listened to both sides make their cases to the news audiences, my first thought was that this was political theater." (One could imagine, as he listened to the news unfolding on the radio, Allison smashing the dashboard in frustration.) "Both sides played to their core constituencies. Both sides could claim victory for their adherence core principles. It was almost like they jointly choreographed it."

So what needs to be done?

"The energy message needs to be reframed so it's not the stereotype of big uncaring companies out to make a fortune, running over citizens trying to protect the environment," he said.

"In the long term, pitting jobs versus environment is a failed strategy. There are times like now, during a major economic downturn, when the need for jobs carries more weight, and some structural changes may be implemented that have longer term effects. But we are still mostly locked in heavy struggles, project by project."

An Inconvenient Truth

The struggle includes the notion of science itself.

"Since the end of World War II, the nation has made investments in science and technology, in R&D, a national priority," he says, much of which has been preferentially directed to health and medicine research – a direction, he reiterated, that was accompanied by tremendous public and political support.

> "Many of the energy debates pit economic development versus environmental protection as mutually exclusive outcomes."

The point, he says, is that for half a century, scientists were trusted and seen as largely above the political fray.

"That is changing. I was on a discussion panel recently, and one of the other panelists wryly lamented that we have one major political party that doesn't believe in science and the other that will only listen to it when it supports their political objectives."

Which brings us, as this topic always does, to former Vice President Al Gore, generally, and the movie, "An Inconvenient Truth," specifically.

Allison is diplomatic.

"It was a huge initial success in raising public concerns about climate change issues and getting out a message about the impacts of a warming climate. But it also politicized the climate change debate by having the leader of the Democratic Party appear as the main advocate for taking action.

"You can argue the movie thus failed its long-term goal by mobilizing and energizing critics and legitimizing the topic as a major partisan political issue."

And even if you would argue that point, Allison seems to be saying that consensus may never be reached.

"Everything society does has environmental impacts, every energy source has its benefits and its costs, and there is no one-size-fits-all strategy. Hasn't every U.S. president since Carter in the mid-'70s promised to make the country energy independent?"

For Allison, the goal, then, is for the country to maintain a dynamic balance of resources, so the energy system can adapt nimbly to changing technologies, resource availability, environmental impacts and strategic concerns.

Not that anyone, including himself, knows at the moment where that balance is.

"I wish I had a magic solution to this."

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

Going Global

Paul Weimer's analysis of AAPG membership and membership trends in the May EXPLORER's President Column was excellent. I noted with interest that I have been located in the trough between the two membership peaks all my AAPG membership life!

I have always been interested in the female percentage in our industry. I have for many years taught an industry course that draws from oil companies around the world. I typically have around 20 people in a course and the participants are generally young, often within the first five years of employment.

Twenty years ago I observed that the female percentage of my classes was around 20 percent. Ten years ago the female percentage was around 30 percent. Today I think that it must average around 40 percent. In the last couple of years I have taught three courses where the female percentage exceeded 50 percent. These were one each in the United States, Poland and Thailand.

Our business is indeed becoming more and more international as more and more countries want to develop their own energy resources. Yes, AAPG needs to appeal to the worldwide arena and garner more members from around the world; and we must notice that SEG has been more successful in this regard.

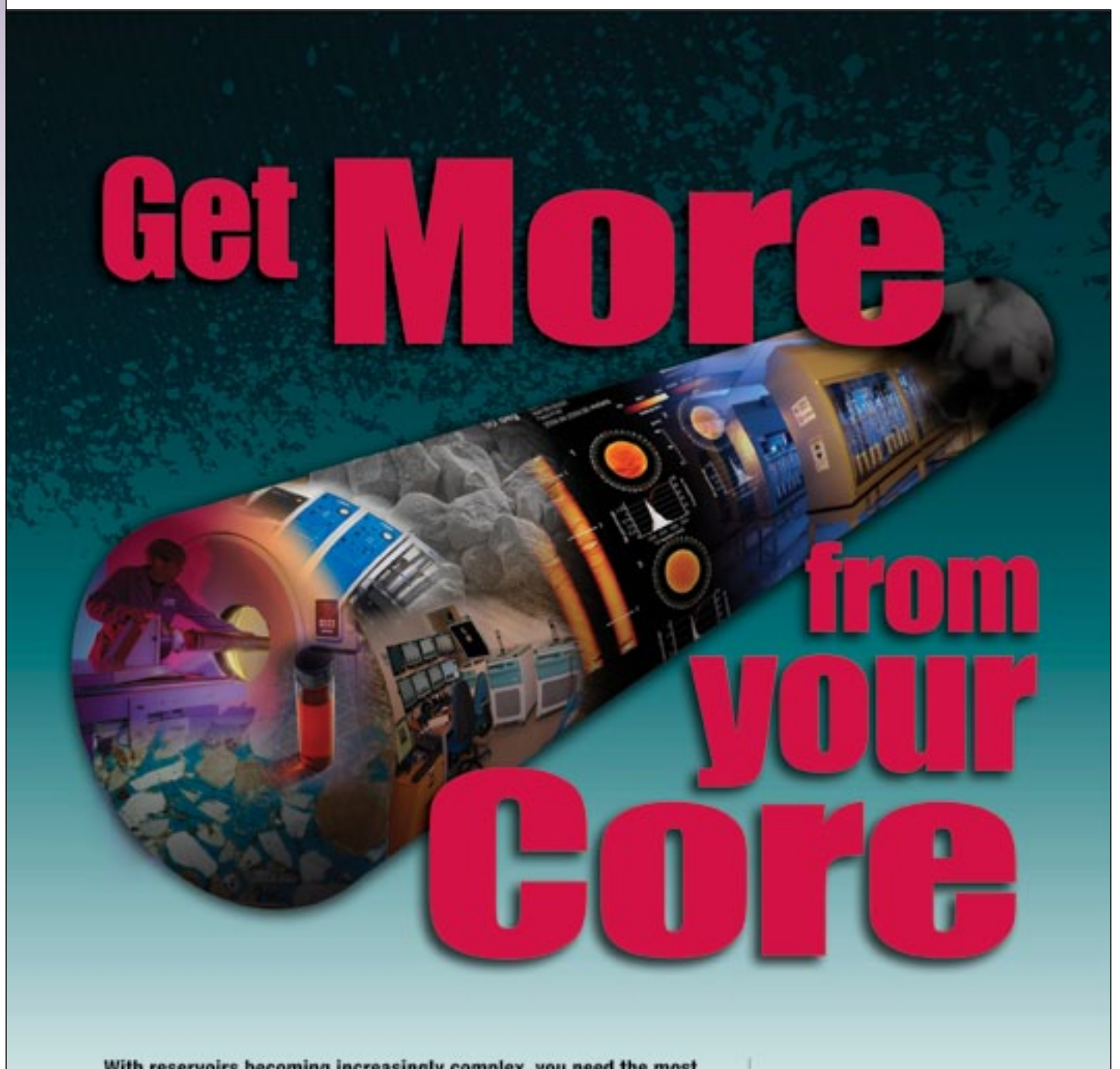
One of the significant shackles that AAPG still carries is the word "American" in its name. Certainly the byline "An International Organization" helps, as do international conferences. But AAPG needs to aggressively shed its American skin. There has been discussion of replacing the word "American," I know, but nothing has been done. And there is a lobby that disapproves. So I believe that AAPG has to decide whether it wants to be American or International, and pursue one course or the other. It will be difficult to enjoy the benefits of both.

So in pursuit of a more international image we should use the term "international" to include all of us. Our business is indeed international or global (I think these words mean the same). We should quit using the terms "U.S." and "international" to indicate opposing groups. This "we and they" syndrome makes it more difficult for the folks in other countries to feel integrated into our society.

Then there is the issue of units. We need to remind ourselves that the United States is the only country that stubbornly hangs onto the whole old imperial system of miles, feet and acres. In the same issue of EXPLORER someone referred to wells with a "40-acre spacing." I have lived in the United States for 30 years and I haven't yet figured out quite what that means. The rest of the world has no idea.

If AAPG wants to lead in the international arena, the organization and its publications must comprehensively embrace metric units.

Alistair Brown
Allen, Texas



Setting the High Standard

AAPG began using the term "frack" in its non-technical publications last year (see May 2011 EXPLORER), and later changed its accepted spelling to "frac" at the direction of the Executive Committee. I recommend using the term "hydraulic fracture" or "hydraulic fracturing" for at least two reasons.

First, as a scientific association, AAPG must set a high standard for proper use of terminology related to petroleum geoscience. The correct technical terms are "hydraulic fracture/fracturing" as defined by SPE (Hydraulic Fracture – a fracture creased [sic] by hydraulic pressure – usually intentional) and the Schlumberger Oilfield Glossary (hydraulic fracturing – A stimulation treatment routinely performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open…).

Second, we should avoid playing into the hands of groups that demonize our industry by making a derogatory association between "frack/frac" and an epithet. While I believe that communicators should strive to address their audiences with clear and familiar language, this should not come at the expense of the reputations of AAPG members, some of whose livelihoods depend on hydraulic fracturing. Done properly, hydraulic fracturing is an effective method for enhancing oil and gas production.

If AAPG finds it absolutely necessary to include the term "frack/frac" to improve Internet searches for AAPG material, then I suggest that the correct term appear with it. For example, AAPG could write, "Hydraulic fracturing, incorrectly referred to as 'frac(k) ing,' is a technology…" The term "frack/frac" could be included as a key word for web pages and documents without appearing on the pages or documents themselves.

AAPG members play essential roles in making reliable, affordable supplies of energy accessible to customers wherever, whenever and in whatever forms are needed. This is the message that opponents of hydraulic fracturing should consider before casting aspersions on our profession.

I urge AAPG members and their colleagues to use the proper term, "hydraulic fracturing," whether writing or speaking.

Gretchen Gillis
Houston

(Editor's note: Gillis is co-chair of the AAPG Public Outreach Committee and past Elected Editor.)

Road Trip

Regarding the article "Geologists Take

Continued on next page

Continued from previous page

CNG Road Trip to Convention," referring to geologists from Southwestern Energy Corp., in the June EXPLORER: Very cool, Southwestern! What a great idea – wish it had gotten more media coverage.

Chase Reid
Dallas

The article will certainly excite and encourage a lot of new consumers to explore this amazing CNG technology. The conversion cost of $5,000 to $8,000 is worth it in the long run – the auto industry should take the lead and bring CNG passenger cars to the market in view of the huge shale gas potential here in the United States.

Sayi Malineni
Baton Rouge, La.

Geology and the Bible

The Bible contains references to geologic processes that all geologists should be aware of. The biblical version of earth's creation in seven days is full of errors (as I noted in my Readers' Forum letter in the July 2005 EXPLORER).

For the sake of brevity I will cite two errors that are especially noteworthy:

- On the third day God said: "Let the earth bring forth grass … and fruit tree(s)" (Gen. 1:11).
- On the fourth day "God made two great lights, one to light the day, and one to light the night and he made the stars too" (Gen. 1:14, 16).

Fruit trees and grass appear late in geologic time. They cannot exist without the energy of the sun. The elements of all life on earth were once part of stars. Stars vary greatly in age. Many stars are just now forming and many others have gone through their life cycle and no longer exist. There is no compatibility between the earth being created in seven days and the age of the earth being more than 4.6 billion years.

In the Bible, earthquakes are used by God to punish sinners. For example: Moses had trouble with certain Israelites so he asked God for help. A great earthquake shook the ground and "the earth opened up her mouth and swallowed them up" (Num. 26:10). When Jesus died a great earthquake occurred and "many bodies of the saints came out of their graves and went into the holy city, and appeared to many" (Matt. 27: 52-53).

Many questions come to mind: How many saints went into the city? Who were they? What did they experience while buried? How long did they stay alive? Did they resume their saintly duties? Did they return to their own graves to be reburied? If this story were true their resurrections would exceed that of Jesus by several orders of magnitude. Many had been dead for centuries.

None of the other gospels or books of the Bible – and none of the historians of the day – say anything about this happening. Entire books should have been written.

Floods in the Bible are best illustrated by Noah's flood – "And the flood was 40 days upon the earth … and every living substance was destroyed" (Gen. 7:17, 23).

Questions are obvious: Where did this water come from? The hydrologic cycle evaporates water from the oceans, clouds rain and the water is returned in the form of rivers, streams, lakes and springs. Present oceans have 18-times the volume of land. To submerge all land, new water would have to be added until the amount reaches at least four times the present volume of the oceans. Changing sea level a foot usually requires decades, even centuries. Extreme climatic changes such as continental glaciations raise or lower sea level by several hundred feet or so. There is no known source of new water that would raise sea level 29,000 feet in 40 days.

Nor is there a mechanism for getting rid of such a humongous amount of water ... the Apocrypha does say that God makes springs in the desert and "pools upon the tops of the mountains that the floods might pour down from the high rocks to water the earth" (4 Ezra 16:60). The writer was probably trying to explain flash floods that suddenly fill dry arroyos ...

The biggest conflict between geology and the Bible is evolution. In Genesis, Chapter 1, God says he made "every living creature after his kind." The term "Intelligent Design" is a new way of saying the same thing, that all life is created by a special creator, the biblical God. Believers reject natural selection and survival of the fittest as cruel, wasteful and requiring millions of years to work. They describe it as a process that is directly opposite to the love, compassion and order of god. Oddly, they fail to see that in the real world life is cruel, wasteful and disorderly. The distribution of fossils in the geologic column fits evolution and enables geologists to date sedimentary rocks. The literalists believe that the sequence dates to Noah's flood and reject evidence that the earth is billions of years old.

Herbert J. Howe
Vancouver, Wash.

Correction

The June EXPLORER incorrectly stated the name of the award that is presented to the second place finisher in the annual AAPG Imperial Barrel Award competition. The name of the prize that the second place finisher receives is the Selley Cup.

It's important to note, because the prize is named after Richard Selley, a professor at Imperial College who in 1976 was the originator of the original concept of the Barrel Award. Selley, who had returned to the Imperial geology department after years of working for oil companies in North Africa and the North Sea, created the competition for students at the school.

Today, the IBA has evolved dramatically into a global competition, with finals held at the AAPG Annual Convention and Exhibition.

The Selley Cup award includes $10,000 in scholarship donations for the second place school, which this year was Khon Kaen University, Muang District, Thailand.

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Online Registration, Reduced Fees Continue for Singapore ICE

Registration continues online for this year's AAPG International Conference and Exhibition, which will be held Sept. 16-19 at the Marina Bay Sands Expo and Convention Center in Singapore.

As always, registering early can result in substantial savings; members who register on or before Aug. 15 can save up to $190 off the regular fees.

The meeting theme is "Asia-Pacific Resources: Fueling the Future," and more than 400 oral presentations and poster sessions comprise the technical program, which will be organized around five areas:

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

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

Special events include:

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

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

Those speakers are:

✓ Arild Jørstad, exploration geoscientist, Lundin ("The New Giant Johan Sverdrup Discovery, Norway").

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

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

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

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

- Scott Tinker, director of the Bureau of Economic Geology and the state geologist of Texas, will be the speaking at the ICE Featured Speaker Luncheon, discussing "The Global Energy Transition: What Will It Take to Make the Switch."
- The movie "Switch," featuring Tinker – and which focuses on the question, "What will it really take to make the transition from oil and coal to alternative energy sources?" – will be screened at a special ICE event.

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

Nomenclature

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reported to the state, they just reported the tops they could pick easily," he noted.

As a result, Cordillera ended up picking many of those tops.

"We picked tops in thousands of wells, resulting in a database with over 200,000 proprietary tops," he said.

The Solution

Cordillera created very detailed structure maps for each one of the surfaces identified in the Granite Wash. LoCricchio said he projected those surfaces into every well in the basin.

"You can then define formations as zones based on those mathematical surfaces," he said.

"Once you have that, you can extract meaningful perf, test and production data based on those surfaces, so all nomenclature issues disappear," he explained.

Because Core Labs had taken an alphabetical approach to designating the Wash formations, LoCricchio used a similar method to label the Wash sections.

He divided the Desmoinesian-age portion of the Granite Wash into 11 zones, separated by regionally separated flooding surfaces. The base of the Granite Wash "F" and top of the "G" turned out to be something of a Rosetta Stone for correlating the stratigraphy, LoCricchio said.

"Once you find that shale bed in any Granite Wash well out there, you can flatten your cross section and begin picking out the shales above and below," he said.

He had an unusual problem in identifying productive zones in the Wash. Instead of having to avoid including zones that weren't productive, he had to keep adding in all the pay zones that were known producers.

"One of the toughest things to do was to make sure you're honoring the pay where there's production," he said.

In the end, it became apparent that the Granite Wash didn't contain only one or two productive reservoirs, but at least 15 distinct reservoirs, according to LoCricchio.

He said it would be theoretically possible to drill out 44 laterals in one square mile, with potentially four laterals drilled within each of the separate, productive pay zones.

"Once we were able to establish a stratigraphic framework," he said, "we were one of the first to demonstrate the potential of each zone across the entire play area."

Right now economics is driving development in the Granite Wash play, where a completed horizontal well with a 4,700-foot lateral can cost in excess of $6 million, according to LoCricchio.

"In the central part of the Wash, the upper zones are liquids-rich and that's what people are going after," he said.

Looking ahead, he sees the future of the Granite Wash in horizontal drilling and deeper horizons. Horizontal drilling revolutionized the Wash play and allowed it to be seen as a resource play, he said.

"It was a great example of new technology enabling development of a giant field in a very mature basin," with decades of development to come, he observed.

"In summary I'd say, pick the thing apart," LoCricchio advised.

"Every time we turn around, we find more and more to go after."

MEMORIAL UNIVERSITY

Tenure Track Faculty Position in Petroleum Geology Department of Earth Sciences, Memorial University

The Department of Earth Sciences, Memorial University of Newfoundland invites applications for a tenure track faculty position at the assistant professor level in the broad field of petroleum geology (Ref.: VPA#EASC-2012-001). Applicants must hold a Ph.D. degree and have a demonstrated record of research and publication. The applicants' specific interests may include, but are not limited to, petroleum geology, siliciclastic sedimentology, stratigraphy, or closely related fields. The applicant must also be able to deliver undergraduate courses focused on sedimentary basins, hydrocarbon exploration, and reservoir characterization. The successful candidate is expected to maintain a vigorous research program, sustain a strong record of peer-reviewed publication and external funding, advise and mentor undergraduate and graduate students, and contribute energetically to the teaching mission of the department. A proven record of effective research and direct involvement with the petroleum industry would be a significant asset. This position is subject to budgetary approval.

Memorial University has one of the largest and most diverse Earth Science departments in Canada. With approximately 30 faculty members, including 2 Canada Research Chairs, over 15 staff members, and leading-edge teaching and research facilities, the department is able to offer high quality undergraduate and graduate degree programs. In addition to its own M.Sc. and Ph.D. programs in Earth science, the Earth Sciences Department participates in Memorial's interdisciplinary graduate program in environmental science (www.mun.ca/science/envs/). The successful candidate will have access to modern analytical facilities managed by the Earth Sciences Department (www.mun.ca/earthsciences/facilities/), as well as those managed by Memorial University's CREAIT network (www.mun.ca/creait). Other research and teaching resources available at Memorial University include the Ocean Sciences Centre, the Bonne Bay Marine Station in Gros Morne National Park, the Labrador Institute, and the Harlow Campus outside London, England.

Applications must be received by 17 August, 2012. Candidates should submit a letter of application with the names and contact information (including email) of three referees, current curriculum vitae, and a statement of planned research program and teaching interests to: Dr. John Hanchar, Head, Department of Earth Sciences, Memorial University of Newfoundland, St. John's, NL, Canada A1B 3X5, or, preferably, email applications in PDF format to: jhanchar@mun.ca. Additional information is available at www.mun.ca/earthsciences/ or by contacting Dr. John Hanchar, Head of Earth Sciences at jhanchar@mun.ca or by telephone at 709-737-2334.

Memorial University is the largest university in Atlantic Canada. As the province's only university, Memorial plays an integral role in the educational life of Newfoundland and Labrador. Offering a diverse set of undergraduate and graduate programs to almost 18,000 students, Memorial provides a distinctive and stimulating environment for learning in St. John's (http://www.stjohns.ca/index.jsp), a very safe, friendly city with great historical charm, a vibrant cultural life, and easy access to a wide range of outdoor activities.

Memorial University is committed to employment equity and encourages applications from qualified women and men, visible minorities, aboriginal people and persons with disabilities. All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be given priority. Partners of candidates for positions are invited to include their resume for possible matching with other job opportunities and candidates eligible for NSERC University Faculty Awards are encouraged to apply.

"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.

PROFESSIONAL newsBRIEFS

Bert Coxe has retired from Shell, Houston, where he most recently was project manager. He also held positions during his career with Shell International E&P. He resides in Katy, Texas.

Neville Crowson, to chief geophysicist/ senior evaluation leader, Energen Resources, Birmingham, Ala. Previously south Louisiana exploration manager, PetroQuest Energy, Lafayette, La.

John L. Ezerskis, to well field supervisor II (operations manager), City Of Dayton Water Supply and Treatment, Dayton, Ohio. Previously independent consultant and adjunct faculty, Cuyahoga Community College, Cleveland, Ohio.

Jonathan Finstuen, to asset development manager-deepwater Gulf of Mexico, Chevron North America E&P, Covington, La. Previously earth science sponsor, Chevron Global Upstream, Houston.

Bill Leslie, to senior geophysicist, Kosmos Energy, Dallas. Previously principal geophysicist, Woodside Energy, Perth, Australia.

Christopher C. Mathewson has been appointed to the Texas Board of Professional Geoscientists through February 2017. Mathewson is a regents professor emeritus and senior professor of geology at Texas A&M University, College Station, Texas.

Peter J. McCabe, to professor of applied sedimentology and director of Schlumberger-QUT Centre for Unconventional Resources, Queensland University of Technology, Brisbane, Australia. Previously theme leader-oil and gas exploration and production, CSIRO, Sydney, Australia.

Les Niemi, director-business development and special projects, Approach Resources, Fort Worth. Previously geoscience adviser, Pioneer Natural Resources, Irving, Texas.

Jan Pluis, to new ventures team lead, Chevron Upstream Europe, Aberdeen, Scotland. Previously exploration adviser, Chevron Europe-Eurasia and Middle East, London, England.

Mark Przywara, to vice president of geosciences, QuattroStar Resources, Houston. Previously executive vice president of geosciences, TriTech Energy Capital, Humble, Texas.

WWW UPDATE

'Deep Index' Coming

By RON HART, Datapages Manager

The Datapages Exploration Objects (DEO) Project, a deep indexing program of "exploration elements" used by E&P professionals, has been approved by the Datapages' governing board and should be available for subscribers and users later this year.

The project will be headed by AAPG member and Datapages board member Peter Wigley, who created a similar deep indexing database for the Exploration Fabric of Africa (EFA) Project last year (see www.efafrica.com).

"We estimate nearly half a million maps, photos, well logs, etc., in the Datapages Combined Archives database," Wigley said. "And we can add georeferencing values and metadata files to each one so these can be easily imported to a desktop GIS application.

"The possibilities," he said, "are huge."

AAPG member Ed Picou, also on the Datapages board, said the project "takes our GIS program to the next level.

"This may be the single most important thing Datapages has done, certainly in the last 10 years," Picou said.

Datapages Inc., a wholly owned subsidiary of AAPG, is the digital publisher for AAPG and the geoscience community. It digitally captures geological publications – including the services of the Archives, *Search and Discovery*, and GIS-UDRIL – and archives them to electronic media, thereby ensuring their future viability.

In confirming the DEO project and endorsing the technology model, AAPG's GIS Publications Committee reinforced the concept, saying in its report that a GIS-based search portal, with spatial and keyword search capabilities utilizing a metadata index, "is the most effective solution and is considered to be an industry standard."

For more information about DEO or the Datapages program go online to datapages.com, or contact Wigley at pwigley@atlas.co.uk.

The AAPG YouTube Channel (www.youtube.com/AAPGweb) now has a playlist of all awards presented at the opening session of the AAPG 2012 Annual Convention and Exhibition in Long Beach, Calif.

You will find individual videos for each award presented in the Sundaay session – and in videos where several people are honored, such as for service or activities, you can take the time line bar and move it to the place where your person of interest is shown.

Bonus: You can help us tell AAPG members this is available by clicking on the "Like" button or posting it to your Facebook page, Twitter or Google+ accounts.

New Feature for Meetings

The meetings landing page (www.aapg.org/meetings) has consolidated all meetings of interest to AAPG members and the industry.

The page's default display is all meetings either run by or associated with AAPG; a click of the display box just under the page headline will cause all other meetings to appear.

All of these columns are sortable, and if you hold down the shift key it will sort on all selected. In other words, you may sort by date and then by location by holding down the shift key while you click on those columns.

Simply refresh the page to start over.

We've also provided you a Section/ Region sort to help you gather meetings geographically.

See the Web blog (blog.aapg.org/ web) for more details.

– JANET BRISTER
AAPG Website Editor

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REQUESTS FOR FOUNDATION FUNDING

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

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

TO CONTRIBUTE

If you would like to establish a fund or contribute to an existing fund, please go online (https://www.aapg.org/eDonation/Core/eDonation.aspx) or contact the Foundation staff by email (foundation@aapg.org), phone (888-945-2274, ext. 274) or mail to P.O. Box 979, Tulsa, OK 74101.

AAPG FOUNDATION

TULLOW OIL

University College Dublin and Tullow Oil plc

Professor in Petroleum Geoscience *Ref: 005238*
Lecturer (x2) in Petroleum Geoscience *Ref: 005237*
Three fixed-term 5-year appointments

University College Dublin and Tullow Oil plc, are embarking on a collaborative initiative to establish three new academic positions in "Petroleum Geoscience" within UCD School of Geological Sciences to create additional academic capacity in this strategically important area. This will build upon existing close research links between Tullow Oil and the UCD School of Geological Sciences with a view to growing and sustaining research and education over a broad range of petroleum-related scientific disciplines.

UCD seeks to appoint an internationally renowned academic to the Tullow Oil Professorship of Petroleum Geoscience and to appoint two Tullow Oil Lectureships in Petroleum Geoscience. For further information, including details on how to apply, please visit *www.ucd.ie/jobvacancies*

Closing date: 23:30 BST on 7 September 2012

UCD is an equal opportunities employer

About UCD
University College Dublin is one of Europe's leading research-intensive universities, with 38 Schools and over 24,000 students. For additional information about UCD, please visit *www.ucd.ie*

About Tullow Oil
Through successful exploration and consistent delivery of major projects, Tullow Oil plc has become Africa's leading independent oil company. For additional information about Tullow Oil, please visit *www.tullowoil.com*

UCD DUBLIN *Extraordinary Possibilities*

MIDCON ENERGY

Company Overview

Mid-Con Energy Operating, Inc. is a rapidly growing and multi-faceted Dallas/Tulsa independent with operations throughout the greater midcontinent region and an appetite for growth in production and reserves. We are currently looking for two Geologists to add to our growing staff in Tulsa, Ok.

Staff Geologist
Responsibilities
Successful candidates will support subsurface studies and participate in decision-making and communication for drilling and operations with multi-disciplinary team and are responsible for evaluating and executing the development of conventional and unconventional reservoirs and secondary recovery projects.

Requirements
- Bachelor's degree (or higher) in geology or geological engineering.
- Up to 5 years' experience in production geology in reservoir characterization field d evelopment planning and exploration work
- Knowledge of building reservoir models and field mapping using PETRA .
- Ability to work in a fast paced interdisciplinary team environment

Senior Developmental Geologist
Responsibilities
Successful candidates will be the geological lead in decision-making and communication for multi-rig drilling efforts and other reservoir development operations, including secondary recovery working closely with multi-disciplinary team.

Requirements
- Bachelor's degree (or higher) in geology or geological engineering.
- Minimum of 10-15 years' experience in production geology
- Experience in reservoir characterization,field development planning and exploration
- Knowledge of secondary recovery operations a plus
- Expertise in designing reservoir models and field mapping using PETRA and integrated field and reservoir modeling studies in a multi-disciplinary team setting, including seismic interpretation.
- Familiarity with JOA's, working with regulators, unitization and deal structures . Good project management and organizational skills.

Mid-Con Energy Operating, Inc. offers competitive wages with an excellent benefits package. To be considered for either of these positions submit your resume to cherndon@midcon-energy.com.

Please visit http://www.midconenergypartners.com/ to learn more about us.

DPA
from page 51

professional interest spotlighting role models, success stories and inspirational members.

DPA looks forward to continuing our support of the GEO-DC office and a new GEO-DC director soon

Welcome to this year's elected DPA board members who will help make our programs thrive: **Valary Shulz** (president-elect), **Paul Pause** (vice president), **Debbie Osborne** (treasurer) and 32 outstanding councilors (and alternates) giving global voice to DPA. Thanks to all candidates for participating in the election.

I encourage every DPA member to serve as a councilor or board member sometime during your career. You will be glad you did – and you can't beat the company.

* * *

Are you an AAPG member but not yet a DPA member?

Are you an energy professional with at least eight years experience (seven years with master's, five years with Ph.D.)?

If so, Rick Fritz (membership chair) and I ask you to join DPA today.

DPA members are committed to a professional lifestyle, networking with 3,000 supportive professionals and improving skill sets to function at the highest levels of proficiency. With three references, you too can be certified by a global organization. It is not about DPA, but what creative individuals can do with DPA. Check out our website at http://dpa.aapg.org/certification.cfm.

* * *

David Curtiss and I like to email each other book recommendations. I would like to share with you a few of my favorite reads (and why), suitable for summer reading. Enjoy!

- "Good to Great," by Jim Collins (thoughts on how mission, focus and right people yield superior results).
- "Physics for Future Presidents," by Richard Muller (how technology impacts public policy).
- "The Greatest Gamblers," by Ruth Sheldon Knowles (a perennial favorite on why wildcatters can't quit – If you are a wildcatter, you will like it).

In closing, I would like to thank our outgoing Executive Committee, led by Marty Hewitt, for a job well done in 2011-12.

CLASSIFIEDADS

POSITION AVAILABLE

Alta Resources, L.L.C.
Houston, Texas

Alta Resources, L.L.C. is an industry recognized leader in shale oil and gas exploration and production. Alta is currently working in partnership with The Blackstone Group, one of the world's largest private equity companies, to aggressively build a portfolio of North American unconventional assets. Alta is seeking a geologist to join our unconventional exploration team. Job responsibilities include geologic analysis and support on new and ongoing projects.

Alta requires:

- 5+ years of experience
- Masters degree in geology
- Self starter with excellent communication, organizational and commercial skills
- Ability to work with a small team of highly motivated professionals
- Unconventional exploration experience a plus

Location: Downtown Houston

Interested candidates please email resumes and cover letters to slynch@alta-resources.com
No phone inquiries please.
All Responses will be held strictly confidential.

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The Department of Earth and Planetary Sciences at McGill University seeks outstanding applicants for a tenure-track Assistant Professor position in the area of Surface Processes. We encourage applications from scientists investigating surface processes that include (but are not limited to) landscape evolution, on Earth and/or other planets, relationships among climate, tectonics and sedimentation, as well as from those studying the sedimentary record of climate and biogeochemistry through time.

Interested applicants should submit a signed letter of interest, a curriculum vitae (including e-mail address) and the names and contact information for three referees, no later than September 30th, 2012 to:

Dr. Andrew Hynes, Chair
Department of Earth and Planetary Sciences
3450 University Street
Montreal, Quebec H3A OE8
E-mail: andrew.hynes@mcgill.ca
Fax: 514-398-4680

McGill University is committed to equity in employment and diversity. It welcomes applications from Aboriginal persons, persons with disabilities, ethnic minorities, persons of minority sexual orientation or gender identity, visible minorities, women, and others who may contribute to diversification. All qualified applicants are encouraged to apply but Canadians and permanent residents will be given priority.

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FOR SALE

For sale, consultants library. AAPG Bulletin and memoirs, GSA Bulletin, Geology Magazine, well logging, geochemistry and more. Email for listing: specify AAPG List, clifton@gbis.com

MISCELLANEOUS

SAMPLES TO RENT

International Sample Library @ Midland – Formerly Midland Sample Library. Established in 1947. Have 164,000 wells with 1,183,000,000 well samples and cores stored in 17 buildings from 26 states, Mexico, Canada and offshore Australia. We also have a geological supply inventory.

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You can reach about 32,000 petroleum geologists at the lowest per-reader cost in the world with a classified ad in the EXPLORER.

Ads are at the rate of $2.90 per word, minimum charge of $60. And, for an additional $50, your ad can appear on the classified section on the AAPG web site. Your ad can reach more people than ever before.

Just write out your ad and send it to us. We will call you with the word count and cost. You can then arrange prepayment. Ads received by the first of the month will appear in the subsequent edition.

DIRECTOR'S CORNER

Shale Success Creates Opportunities

By DAVID K. CURTISS, AAPG Executive Director

No matter where I travel and talk with AAPG members there are two topics that I'm certain will come up in conversation: First the price of natural gas and second the role of shale gas in driving this price.

Earlier this year, natural gas prices sank to new lows in the United States – under $2 per million cubic feet. And while they have rebounded slightly in the past month, the fundamental supply and demand picture provides little hope for a significant rebound in the near term.

This is causing financial distress for several companies whose reserves portfolios are heavily weighted to natural gas and whose gas price hedges (if they had them) are expiring soon. In retrospect, it is easy to question whether these firms made the right strategic decisions. But let's not forget that in the past decade the United States was concerned about its natural gas supply, fearing that it would be unable to meet growing demand.

The industry pivoted quickly from dry gas plays to plays rich in natural gas liquids (NGL) as prices declined. Prices for NGLs have proved more resilient than methane and drilling activity shifted markedly to these plays.

* * *

But while this low price environment is creating hardship for some gas producers, in other parts of the economy it is creating commercial opportunities that will ultimately increase gas demand.

Fortune ran a cover story in April titled "The United States of Natural Gas: How the New 100-Year Supply of Shale Gas is Reviving the U.S. Economy."


CURTISS

But while this low price environment is creating hardship for some gas producers, in other parts of the economy it is creating commercial opportunities that will ultimately increase gas demand.

As the article explains, one beneficiary of the shale gas revolution is the petrochemical industry, which uses natural gas as feedstock for its operations. Dow Chemical is building a new plant in Louisiana and restarting another. Meanwhile Shell is building a new plant in Pennsylvania and contemplating another in Louisiana. These plans reverse a long-standing trend, where for years the petrochemical industry had been moving its manufacturing out of the United States.

The potential for liquefying and exporting natural gas is another opportunity that is attracting investment. Several firms that control LNG import terminals built in anticipation of a gas shortage are now being reconfigured and seeking permits to export LNG. They want to take advantage of the fact that natural gas prices are much higher in other parts of the world, notably Asia.

Faced with the prospect of additional emissions regulation, electricity producers must evaluate whether to replace retiring coal-fired power plants with cleaner burning natural gas turbines. It already is happening in some parts of the world. But given the historical volatility of natural gas prices and the long-term life and low cost of coal-fired plants it is not a simple decision.

In the transportation sector, where unlike power plants the asset life is not measured in decades, the decision to switch fuels appears much more clear. Vehicle fleets are particularly suitable for switching to natural gas, and the current price differential between natural gas and petrol provides a quick payback on the investment.

The city of Fort Worth in Texas, as past AAPG president Scott Tinker showed in the documentary "Switch," is just one of many municipalities taking advantage of this opportunity with its bus fleet. And recently Caterpillar, a large equipment manufacturer, announced that it was teaming with Westport Innovations to introduce natural gas combustion engines into its industrial machinery product line.

The natural gas boom we've experienced in the United States is driving new manufacturing, construction and trade opportunities. Collectively these commercial activities support economic growth and create jobs. This is a good thing, although it's a fact overlooked by those who oppose fossil energy production.

* * *

Fact is, the energy sector underpins the global economy and modern life as we know it and creates opportunities for talented people.

It is not restricted to the United States and it's not slowing down. The International Energy Agency forecast in May that global demand for natural gas would grow by 50 percent by 2035 and overtake coal as the second largest fuel source behind crude oil.

Demand is there. Markets will sort out pricing. So what will it take to ensure the world receives the economic benefits of finding, producing and using this natural gas?

It's going to take rational commercial and policy decisions. That requires people and policymakers who are informed and educated.

And who will tell them if not AAPG and its members?

DIVISIONS REPORT

From Prospect to Discovery, 'Professional' Leads

By CHARLES A. STERNBACH, DPA President

It is a great privilege for me to serve AAPG as Division of Professional Affairs president this year. I can tell you up front that DPA has many exciting new ideas to energize AAPG and this Division.

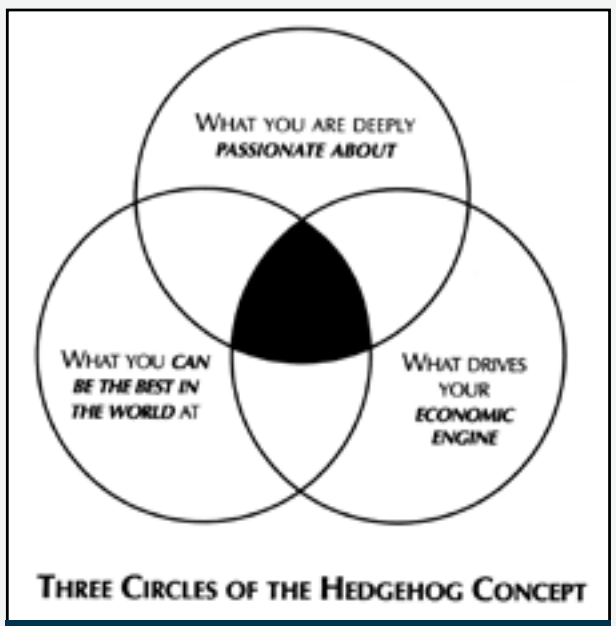

STERNBACH

I believe AAPG and DPA are best in the world at helping professional geologists turn prospects into discoveries. We are passionate about providing global energy while pursuing professional excellence. This success drives the economic engines of our world, our stakeholders, personal economic fortunes and yes AAPG and DPA.

I'd like to emphasize the "P" in DPA with programs that hone professional prospecting skill sets harmonious with AAPG President Ted Beaumont's initiative that we be more effective explorers rooted in fundamental petroleum geosciences. DPA has a key role to play in the conversation about how professionals do their work and in helping to create opportunities for AAPG to better serve its members.

Author Jim Collins outlines that great success occurs at the intersection of:

✓ At what you CAN be the best in the world.
✓ What you are deeply PASSIONATE about.
✓ What drives your ECONOMIC ENGINE.



Graphic from "Good to Great" by Jim Collins, HarperBusiness

Plans for this year build on this key intersection and the DPA business plan:

▸ Play Maker forum: This will be a NEW event featuring talks on hot discoveries by those who know them well, an industry leader luncheon and an educational program on prospect generation, evaluation and screening skills. Discussions are under way with several potential partners about co-hosting this event to expand AAPG and DPA's reach and brand.

Details to follow in future articles.

▸ Maintain and build presence on professional talks, forums and courses at all AAPG conventions. I have asked DPA president-elect Valary Shulz and DPA past-president Paul Britt to proactively seek out programs of the highest quality. DPA will co-sponsor the Featured Luncheon in September at the AAPG International Conference and Exhibition in Singapore, thanks to DPA past-president Bob Shoup.

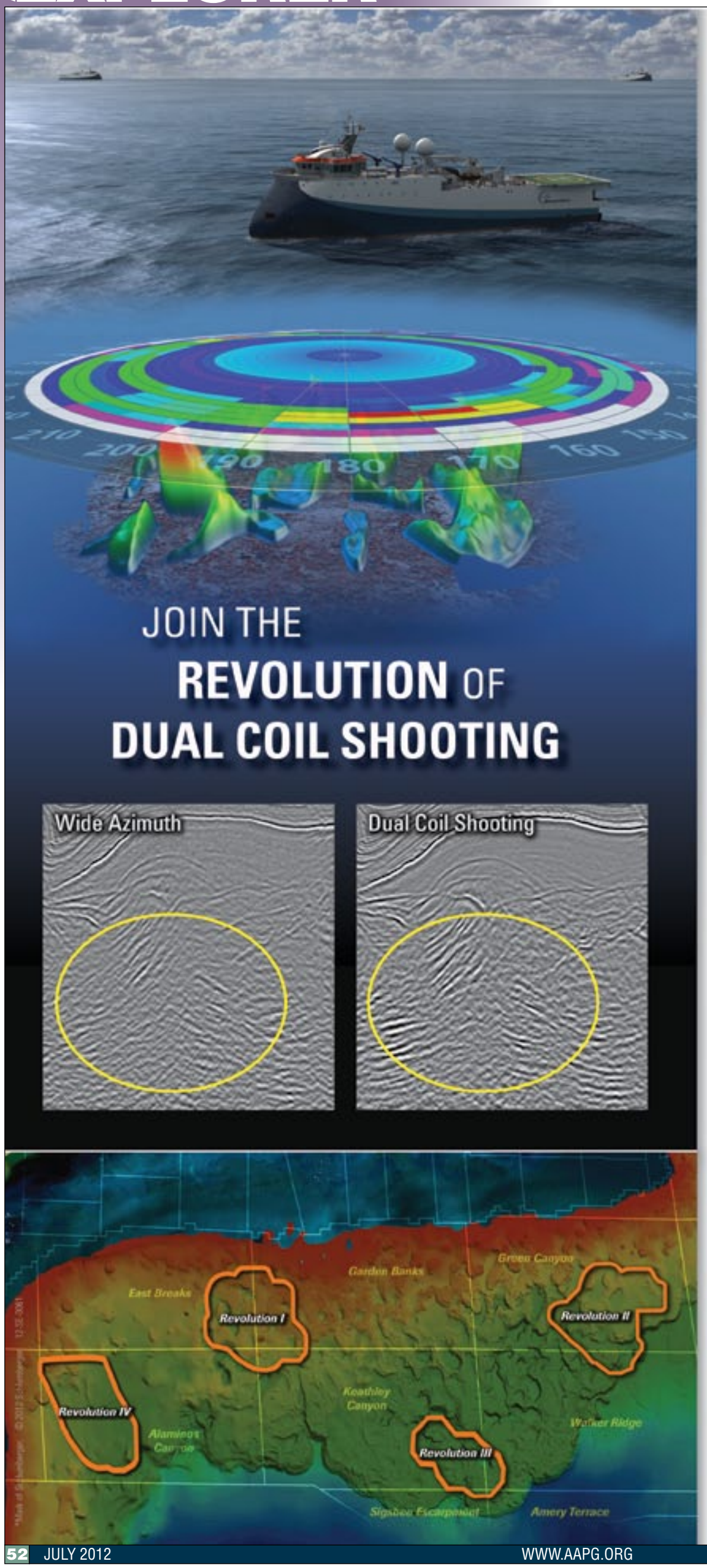
▸ Plans are being made to expand the "Discovery Thinking" forums globally. These forums are co-sponsored AAPG/DPA (since 2008) and originated as part of the 100th Anniversary Committee (when I was its chairman).

I will chair a forum at the Singapore ICE, and have asked past president Paul Weimer to be my co-chair in Cartagena 2013. Ed Dolly will be my co-chair for ACE annual meetings, like Pittsburgh 2013.

These forums focus on professional and technical aspects of significant discoveries. Typical attendance is 500-800 professionals. An expanding legacy (currently about 20 Discovery talks) can be accessed under the Special Collection tab on *Search and Discovery*, at www.aapg.org/explorer/2012/04apr/discovery_forum0412.cfm and www.searchanddiscovery.com/specialcollections/discoverythinking.html.

▸ DPA plans better communication through technology and web page improvements, which will broadcast videos, webinars and professional outreach. Chandler Wilhelm serves as editor of the DPA Correlator newsletter, which features outstanding articles of

See DPA, page 50



Multiclient Services

Revolution Dual Coil Shooting Multiclient Surveys Now Underway in the Gulf of Mexico

Enabled by the Q-Marine* point-receiver marine seismic system, Dual Coil Shooting* multivessel full-azimuth (FAZ) acquisition captures ultralong offset marine seismic data via a circular path. The result—even beneath salt or basalt—is higher fidelity seismic images, delivered efficiently.

The Revolution Dual Coil Shooting multiclient surveys feature 14-km maximum offsets, 3D GSMP* general surface prediction processing, velocity model-building using anisotropic reverse time migration (RTM) and will deliver Kirchhoff and anisotropic RTM final volumes.

To learn more about the Revolution multiclient surveys and Dual Coil Shooting, call +1 713 689 1000 or email us at multiclient@slb.com.

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