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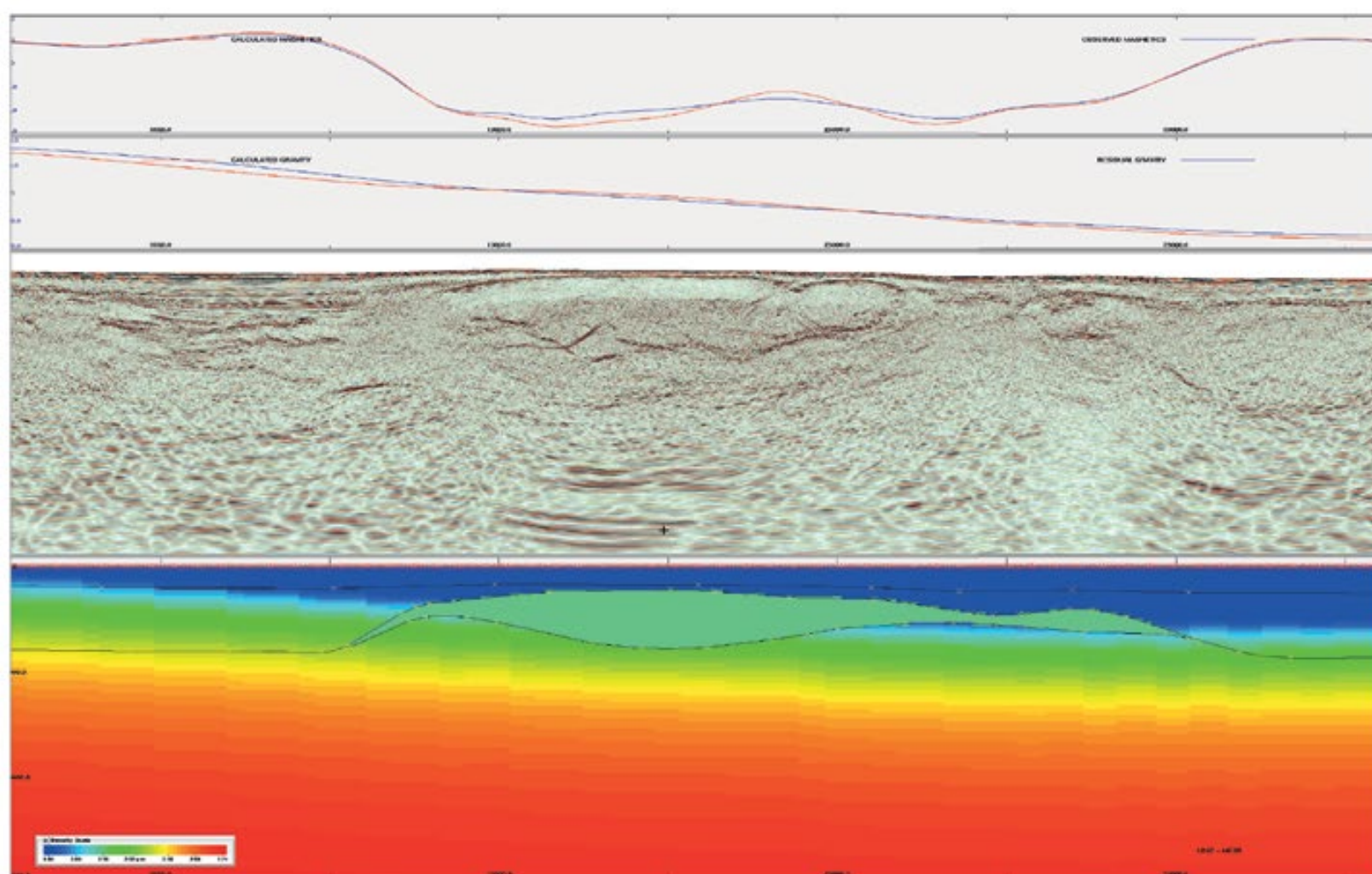
See page 6





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PRESIDENT'S COLUMN

Good Times, Bad Times – We Don't Quit

By RANDI MARTINSEN

Oil prices were at near record highs when I became AAPG president almost exactly one year ago – and immediately thereafter they began to fall.

At the time I'm writing this prices have recovered quite a bit from their low in January, but the fall-out continues, with companies still laying off and cutting back on a lot of things – including travel and training, which strongly affects AAPG's bottom line.

For someone who entered the industry during a time when oil rose *dramatically* to greater than \$10 a barrel as a result of the Arab Oil Embargo, when news headlines were full of "obscene profits" and everyone was a bit giddy about the high price of oil, it's a little difficult to grasp thinking of \$60-plus barrels of oil as "low." However, costs also rose dramatically along with prices over the past 10 years, and the technologies required to produce from very low permeability reservoirs are big-cost items.

So how do we proceed with \$60/bbl (or lower) oil?

We do what we have always done – we get better, we get smarter, we get more efficient.

We figure it out, but we don't quit.

* * *

I've always been a fan of Wallace Pratt and a firm believer in his famous quote "Oil is first found in the mind ... " Well, Pratt as chief geologist for Humble led that company to greatness by going out and exploring and increasing reserves during the depths of the depression, because he knew the economy would



MARTINSEN

As I've said many times to many people around the world, while I believe AAPG provides excellent and cutting-edge geoscience, I believe our most important product is our community.

recover and demand for petroleum would once again exceed supply.

Pratt and Humble did this while most companies were pulling back.

Interesting.

Another petroleum explorer and finder, John Masters, once wrote, "You do not find reserves when it is convenient. You find them when you can." And the best time to look is when no one else is, when everyone else is pulling back.

Interesting.

Mitchell Energy pursued cracking the Barnett right through the downturn of the 1980s. During the downturn, Mitchell collected the data and did the research that would ultimately lead to pursuing economic production in the Barnett once higher prices returned.

Interesting.

So how do we proceed, according to some of our most successful and well-known explorers? We get better, we get smarter, we get more efficient, but we don't quit and we don't shut down. We focus on preparing for the next price rise.

How do we do that?

We hone our technical, geoscientific and soft skills, including how to better sell a prospect and generate financing. As Louis Pasteur said, "Fortune favors

the prepared mind."

We utilize the vast amounts of data we have – and collect more, if need be – to improve our technologies and our geoscience models, or perhaps even develop new ones.

As Marlan Downey likes to say, "I can bring a fool off the streets to cut costs. It takes a GREAT technology to increase REVENUE."

I would add, or a great idea.

And to quote Lee Raymond, former president and CEO of Exxon, concerning the cyclicity of the petroleum industry, "Easy Glum, Easy Glow." This was meant to convey the message to not get overly excited and hyperactive when prices are shooting up, or overly depressed and catatonic when they are headed down – a good message for both high price and low price times.

* * *

This month's EXPLORER and my last column come to you right in the midst of AAPG's Annual Convention and Exhibition in Denver. As so many past AAPG presidents have noted before me, the presidential year goes very fast.

As I've said many times to many

people around the world, while I believe AAPG provides excellent and cutting-edge geoscience, I believe our most important product is our community. We have a fabulous global community of smart, talented, interesting geoscientists who are for the most part really, really nice people. I'm very grateful to have met and gotten to know better so many of these people.

I'm especially grateful for the members of this year's Executive Committee, for their talent, their hard work, their ideas, their humor, their caring.

The only group I may be as grateful to is our AAPG staff. We have a fabulous and very dedicated staff that took good care of me while they were taking very good care of AAPG.

Some of the things that kept the EC busy over the past year include:

► **Implementation of the Three-Year Business Plan.** We have been reviewing progress on how the Three-Year Business Plan is being implemented, including how programs and services are being evaluated in terms of cost versus benefit.

► **Revised Candidate Campaign Policy.** We reduced time and travel commitment for AAPG officer candidates. AAPG candidates for office are no longer requested to attend Section and Region meetings. Instead, candidate biographies and videos are available on AAPG's website so that members

See **Governance**, page 4

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TABLE of CONTENTS

6 A time to drill and a time to research: AAPG luminaries **Steve Sonnenberg** and **Tom Chidsey** on what **Rocky Mountain petroleum geologists** are doing in the downturn.

14 **Colorado's** governor created a **task force** last year to resolve bitter political tensions over **fracturing**. Here's what's happened since.

22 A new OPEC? AAPG member **Joseph Frantz Jr.** talks about how the United States became the **world's top producer** of oil and gas.

30 'Perseverance triumphs': **AAPG Latin America Region President Victor Ramirez** was involved in inaugurating a new deepwater exploration era for Colombia.

32 **Ocean acidification** from **carbon sequestration** is causing massive **die-offs of seafood** species. What's next, and what's being done about it?

36 A story of survival: Before she became a **pioneer within AAPG**, **Anny Coury** had to escape Nazi-occupied Europe ... and typing lessons.



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REGULAR DEPARTMENTS

ProTracks.....	34
Spotlight On ...	36
Regions and Sections	38
Policy Watch.....	40
Geophysical Corner	42
Historical Highlights	44
Foundation Update.....	46
Classified Ads	48
In Memory	48
Director's Corner	50
Divisions Report (DEG)	50

ON THE COVER:

Covenant field, Utah's major 2004 discovery (21 MMBO), producing from the eolian Jurassic Navajo sandstone and Temple Cap formation, in the central Utah thrust belt. Photo courtesy of Michael D. Vanden Berg, Utah Geological Survey. See page 6.

Well log courtesy of Steven Sonnenberg. See page 18.

Left: Colorado has become a hotbed of oil and gas production, and of controversy between industry and anti-frac'ing activists in recent years. See page 14.

Britt, Lloyd, LaReau Elected to Executive Committee

Independent geologist Paul Britt, president of Houston-based Texlore, has been voted president-elect by the AAPG membership for the 2015-16 term and will serve as AAPG president in 2016-17.

Also elected to the incoming AAPG Executive Committee were:

☐ Vice president-Regions – **Peter Lloyd**, honorary professor, Asia Pacific Training Ltd., Falcon, France.

☐ Secretary – **Heather L. LaReau**, senior geologist, Noble Energy, Denver.

Both the vice president-Regions and secretary serve two-year terms.



BRITT



LLOYD



LaREAU

The newly elected officers will begin their duties on July 1, serving on an Executive Committee headed by AAPG Honorary member **John Hogg**, president of Skybattle Resources Ltd., Calgary, Canada, who assumes the AAPG presidency on that date.

Also new on the committee will be **Robert Shoup**, a consulting geologist with Subsurface Consultants and Associates,

Houston, who will assume the chair of the AAPG House of Delegates.

Others on the 2015-16 committee who will be serving the final year of their two-year terms of service are vice president-Sections **Steve Brachman**, vice president of exploration and development at Wapiti Energy, Houston; and treasurer **Jim Tucker**, a Houston-based consultant with Occam Resources. Also serving the final year of his three-year term is elected editor **Michael Sweet**, geoscience technical team lead for ExxonMobil Angola Production, Houston.

Voting results revealed that a little over 30 percent of the 14,826 eligible voters cast ballots in this year's election, and nearly 64 percent of the voting was done online.

Governance from page 3

can become familiar with the various candidates.

► **Formation of Ad Hoc Governance Committee.** It's been more than 50 years since AAPG's current governance structure was established, and a lot has happened to the world and to AAPG since then. The world has grown much smaller as a consequence of jet travel and the Internet, among other things.

At the same time, AAPG has grown much larger and has a more diverse membership.

Perhaps our governance is just fine and no major recommendations will result, but it was felt a "check-up" was warranted.

► **Revised Associate-to-Member transfer form and encouraged eligible Associate members to transfer to Member.** Now that only one sponsor is required to become a Member, we revised the form to reflect that and sent letters to eligible Associates encouraging them to transfer to Member. So far nearly 1,000 have done so, which is about 20 percent of those eligible.

► **HoD initiatives.** We discussed several initiatives with the chair of the HoD, which resulted in four potential amendments to our bylaws coming out of the Constitution and Bylaws Committee of the House this year. (These amendments were slated to be deliberated on by the delegates at the HoD annual meeting May 31.)

The amendments brought forward by the Constitution and Bylaws Committee concern the election of the AAPG Editor; shortening the timeframe (and consequently the time commitment) for AAPG officer candidates; the formation of Technical Interest Groups and Special Interest Groups; and changing the names of the international Regions to conform with actual usage.

We thank the House chairman and leadership for the discussions and look forward to the outcome of the votes on the amendments by the House of Delegates.

► **AAPG-SEG joint ICE.** As part of our efforts to do more things jointly with our sister societies, the first joint AAPG-SEG International Conference and Exhibition is being held Sept. 13-16 in Melbourne, Australia.

I hope you have had a chance to look at the great program for the meeting that was recently mailed to you.

* * *

Our Rocky Mountain colleagues put together a great program for ACE this year, and I hope a good many of you are in Denver right now enjoying the conference.

My wish for all of you now is similar to what it was in December: Good health, great prospects, successful wells, robust employment opportunities and preparedness for the future.

But most of all, may you all feel the passion.

Paul S. Martinson



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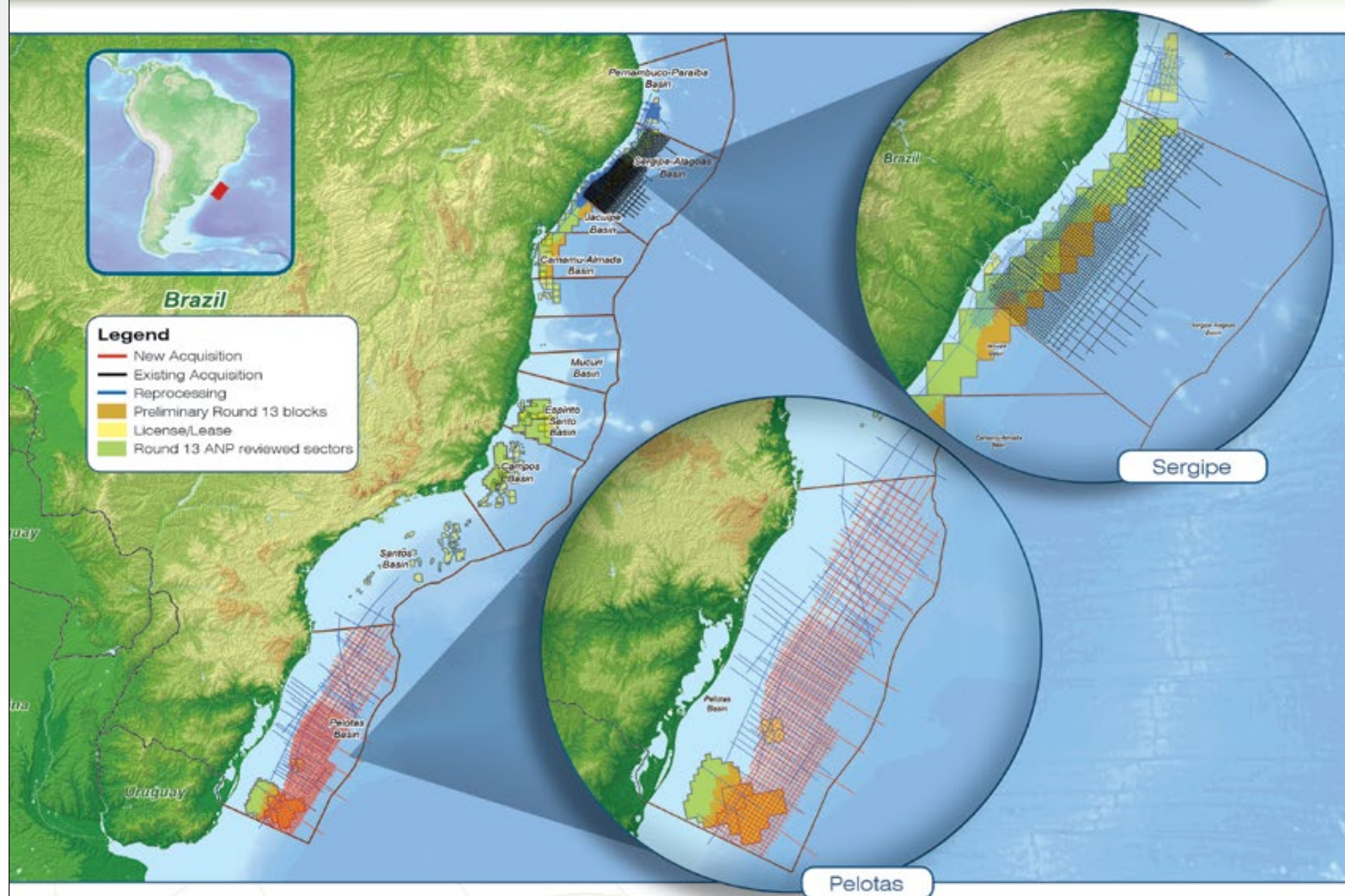
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Less drilling, more research

Current Conditions Allow 'A Time to Regroup'

By DAVID BROWN, EXPLORER Correspondent

Are current conditions in oil and gas creating a big opportunity for petroleum geologists in the Rocky Mountain region?

Some experts say today's drilling slowdown gives geologists time to catch up on recent advances in science, providing a less-hecktic opportunity to analyze data, study reservoirs and create improved models.



SONNENBERG

But industry geologists appear to be doing less of that than you might think, and one word explains why:

Uncertainty.

"When things slow down is a great time to catch up on the science. Sometimes the drilling activity can outstrip the science," said AAPG Honorary member and past AAPG president Steve Sonnenberg, professor of petroleum geology at the Colorado School of Mines in Golden, Colo.

Sonnenberg noted that a wealth of data has accumulated from recent drilling activity in the Rockies, especially in unconventional plays. Geologists can now use that data to develop a deeper understanding of everything from porosity throat sizes to reservoir flow paths.

He called today's downturn a "time to regroup."



Keeping busy: Greater Natural Buttes, Utah's largest gas field (3.3 TCF), producing from tight sands in the Cretaceous Mesaverde Group and Tertiary Wasatch formation, Uinta Basin, eastern Utah.

"My feeling is that people have been so busy trying to stay ahead of the rigs, people now need to go back and look at the data," Sonnenberg said.

Also, he added, "There are a lot of known oil and gas fields, and a lot of those need to be studied for secondary and tertiary recovery possibilities."

Hanging Tough

There's no doubt that industry activity has slowed significantly in Rocky Mountain-area plays.

The number of deployed drilling rigs has dropped by 50 percent or more in many places. According to the Baker Hughes rig count, the number of rigs running in the

Williston Basin fell from 183 in May 2014 to 79 in May this year.

Pioneer Natural Resources Co., Newfield Exploration Co., LINN Energy LLC and WPX Energy Inc. all have announced office closings in Denver.

American Eagle Energy Corp., a small Denver-area oil company, filed for bankruptcy protection in May. Denver-based Whiting Petroleum Corp. put itself up for sale, but then gave up on finding a buyer.

Considering today's conditions in oil and gas, it's ironic that negativism isn't keeping geologists from research. Instead, companies seem to be positioning themselves to leap back into action.

"The rig count has dropped significantly, so people are being selective in what they drill. But there's still a lot of optimism," Sonnenberg observed. "It's more of them drilling to hold the land (leases), and then optimism about the price coming back."

Oil and gas price movements have created what one industry observer called a "knife-edge situation." If prices move 5 to 10 percent higher and look like they might inch up from there, operators may return to more robust drilling programs.

But if prices fall 5 to 10 percent, with the possibility of oil sliding back under \$50 a barrel, companies are ready to make further reductions.

Right now, optimism is winning out.

There's still enough activity in the Rockies

See **Regrouping**, page 8



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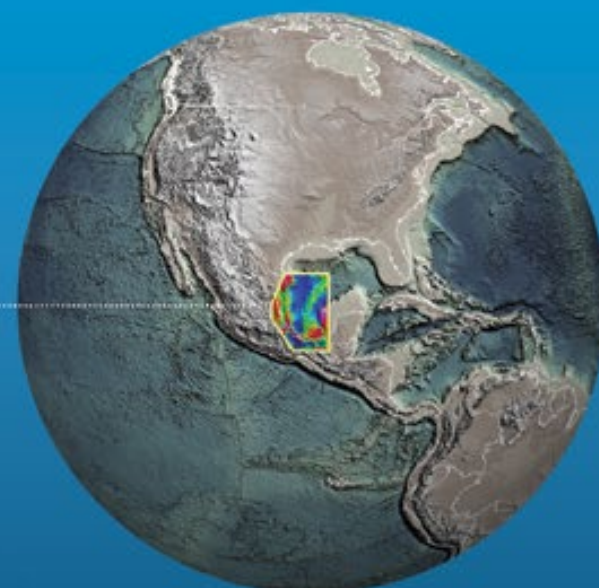
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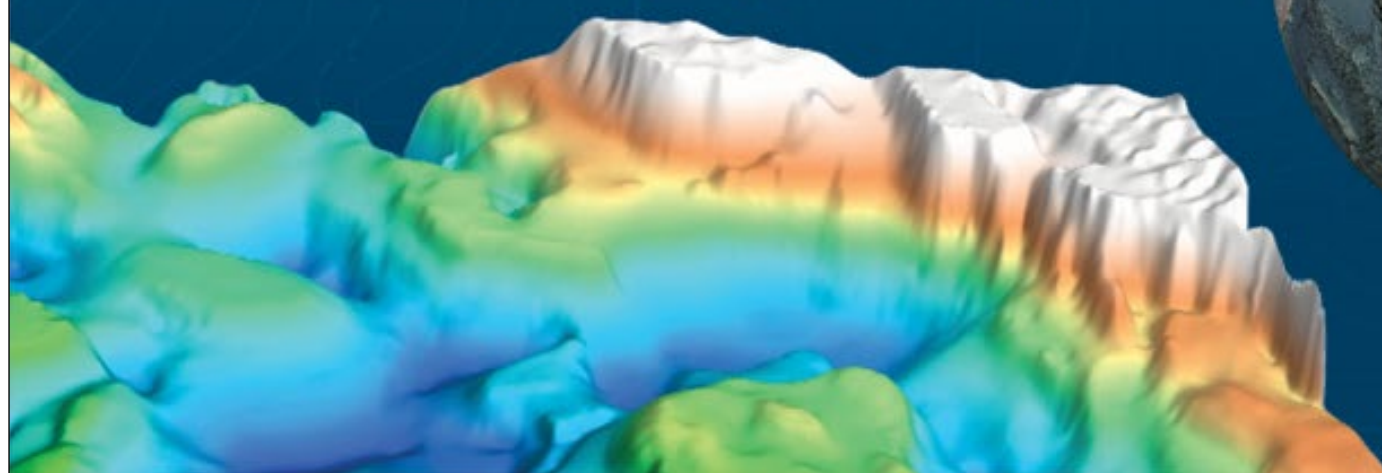
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ICE Program Set, Registration Open

This year's AAPG International Conference and Exhibition (ICE) is set for Sept. 13-16 at the Melbourne Convention and Exhibition Centre in Melbourne, Australia: the technical program has been finalized and registration is open.

Also, for those who register by June 23, there will be a savings of \$305.

This year's theme is "A Powerhouse Emerges: Energy for the Next Fifty Years," which is an appropriate theme for two reasons:

First, ICE 2015 in Melbourne will break new ground as the first-ever ICE co-presented by AAPG and the Society of Exploration Geophysicists (SEG), expanding on existing long-

term collaboration efforts between the two societies on research projects, publications, distinguished lecturers, topical conferences and workshops.

Second, this year's ICE celebrates 50 years since the Gippsland Basin oil discovery that unlocked Australasian market activity.

The conference will be hosted by the Petroleum Exploration Society of Australia (PESA) and incorporates the Eastern Australasian Basins Symposium (EABS).

Philip Loader, ICE general chair, said the technical program is the result of more than 900 submitted abstracts in some 22 themes.

For more information and to register, visit ICE.AAPG.org.

Regrouping from page 6

oil patch to hold geologists' attention. Work in parts of Utah continues to simmer even if plays are no longer at their hottest, said AAPG member Tom Chidsey, senior scientist for the Utah Geological Survey in Salt Lake City.

"I recently spoke to the American Petroleum Institute Uinta Basin chapter," Chidsey said. "There were about 30 people there. Just from talking to them, they still seem to be fairly busy."

Chidsey said he ended his presentation with a picture of a crystal ball. And in the



CHIDSEY

Rockies the crystal ball seems to be a popular image – as in, we don't have one.

It's the same old story of cycles: Everybody can tell you that the oil and gas industry will have a resurgence, but nobody can tell you exactly when that's going to happen.

"The nature of our business, it's always been cyclical. What companies need to do is to be positioning themselves in these plays," Sonnenberg said. "It's also a great time to be looking at all your competitors, to maybe be looking at selective acquisitions."

Prime Time for Research

So who's doing research in oil and gas? Maybe not too surprisingly, the researchers.

Chidsey said his office had just completed a revised and updated Utah oil and gas map.

"There's a lot of information packed in the brand-new map. The last one was 2004, so it was time to update that," he said. "It's all on digital, too."

Companies also are part of the research process, partnering with the survey on subjects of interest to the industry.

"We're doing a study on the tight oil potential of shales. Then we're also finishing up on a project on what to do with wastewater," Chidsey said. "We have industry partners on a lot of these projects, what we call technical advisory board members."

University research programs are benefiting from abundant data from tight sands plays and other unconventional resources efforts, often conducting studies with the cooperation of industry consortia. Sonnenberg leads two major projects in the Rockies.

"I have a big research project in the Niobrara and that's gone on for five years," he said. "And we have a project in the Bakken, and that's been going on for six or seven years."

Of course, research funding does become tighter as industry revenues fall. Chidsey said the survey has been hard hit by lower royalty revenue on federal lease lands. And spending cutbacks by the U.S. Department of Energy have cut grant opportunities, he noted.

But there are bright spots for the nonprofits in the current downturn.

"In the academic world, we are probably going to see an increase of applicants for graduate school," Sonnenberg said.

As companies search for ways to save money, Chidsey hopes they will consider donating core to the survey's collection.

"If companies are looking to cut back and they've been paying to store core, if they want to save money we'd be happy to take it," he said.

The UGS core research center in Salt Lake City holds core from more than 2,100 wells – "That's a lot for out West here," Chidsey said – and cuttings from over 4,900 wells.

Those core samples are accessible for public inspection and research, so "once it's here it becomes available for anyone to look at," he noted.

Chidsey himself went through a layoff experience in the oil and gas industry in 1989. He had three children, the youngest six months old at the time his job disappeared.

Chidsey described it as a period to step back and look at very clear choices in his life.

He ended up joining the geological survey, starting a 25-year tenure at the job and "loving every minute of it."

"It turned out to be the best thing that's happened to me in my career," he said.

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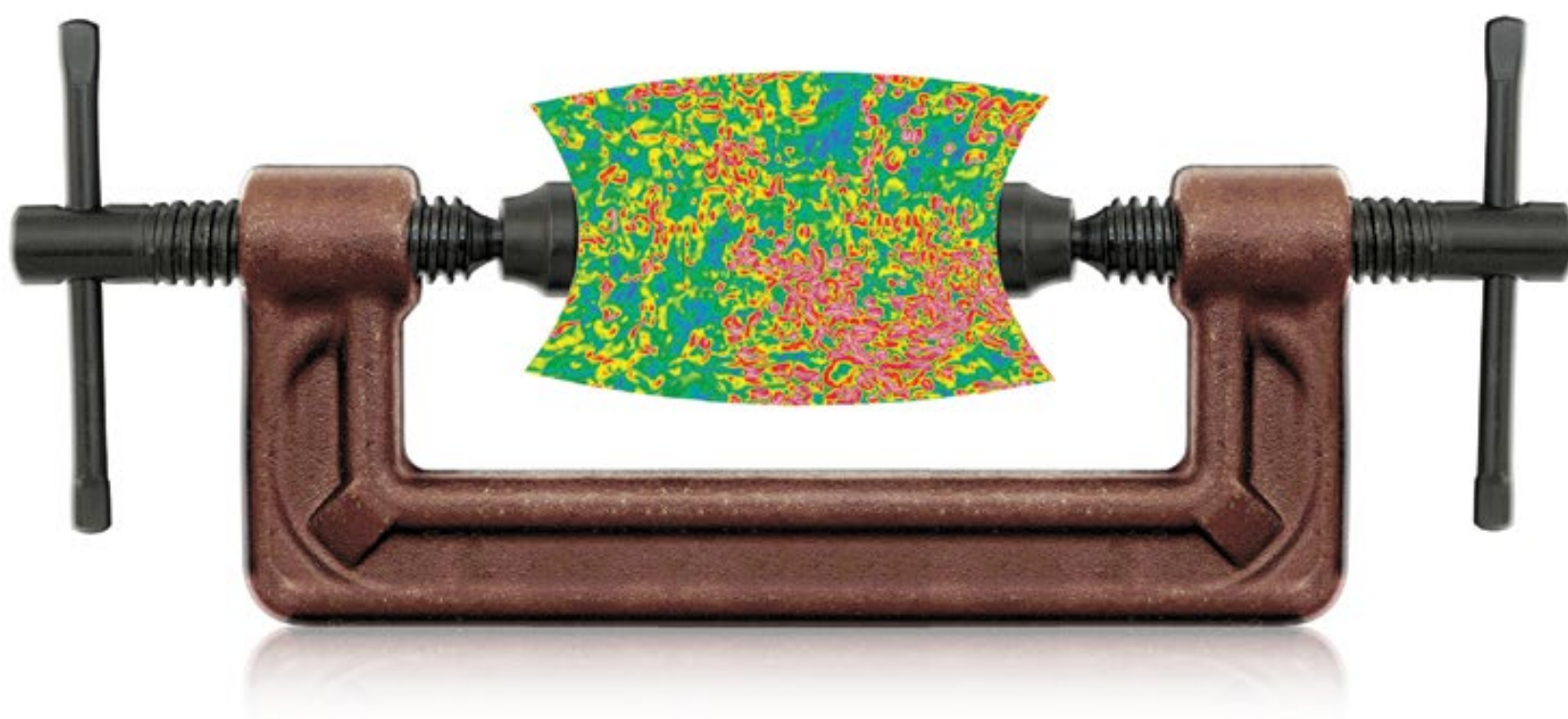
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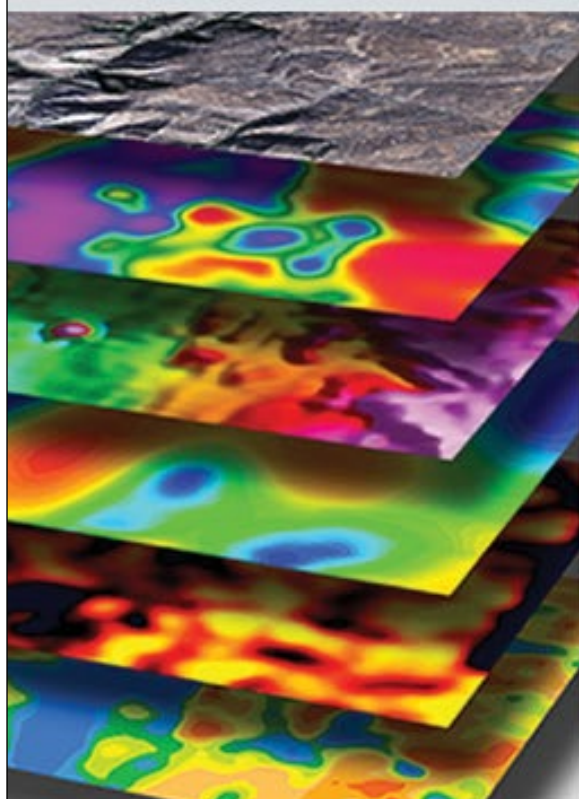
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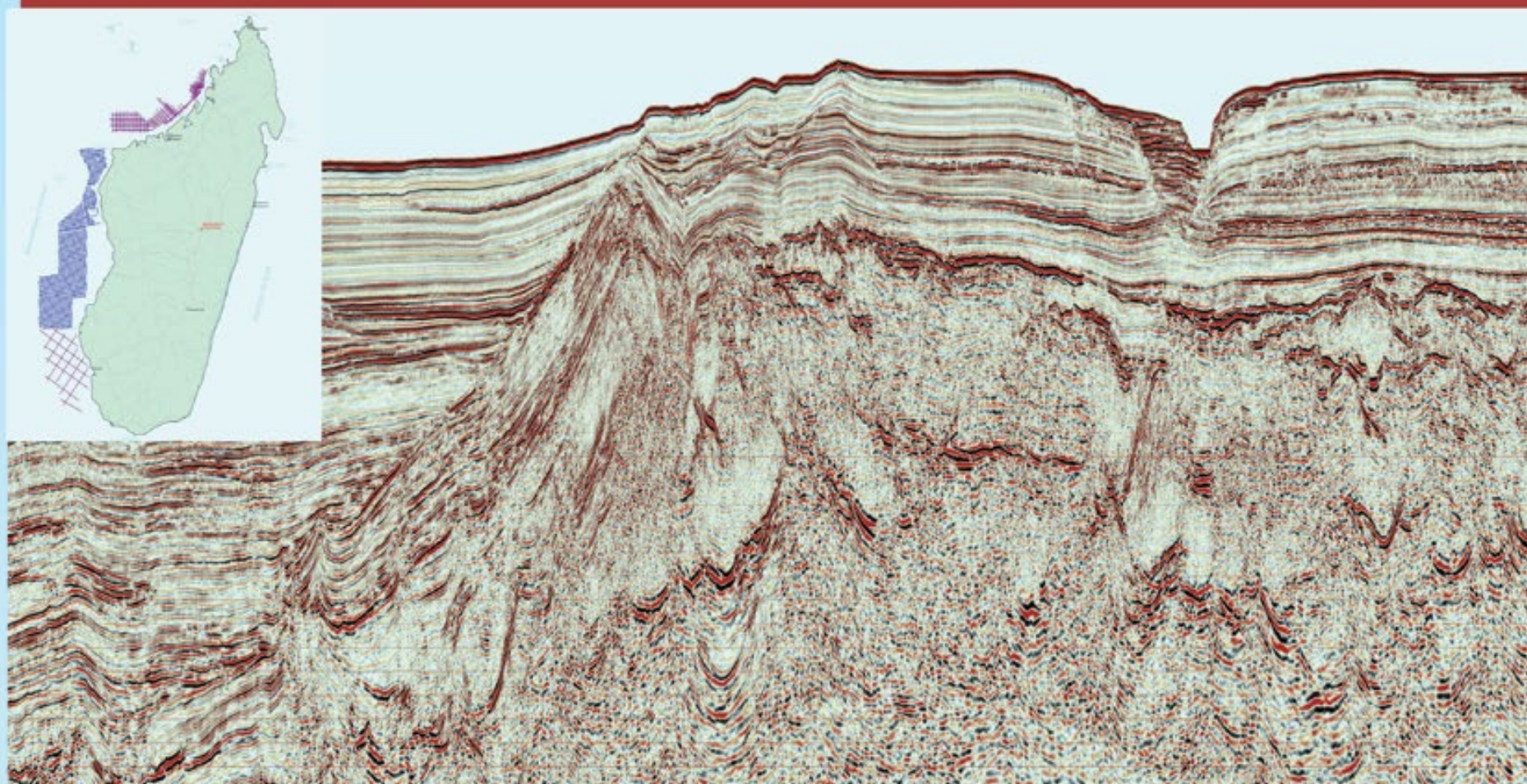


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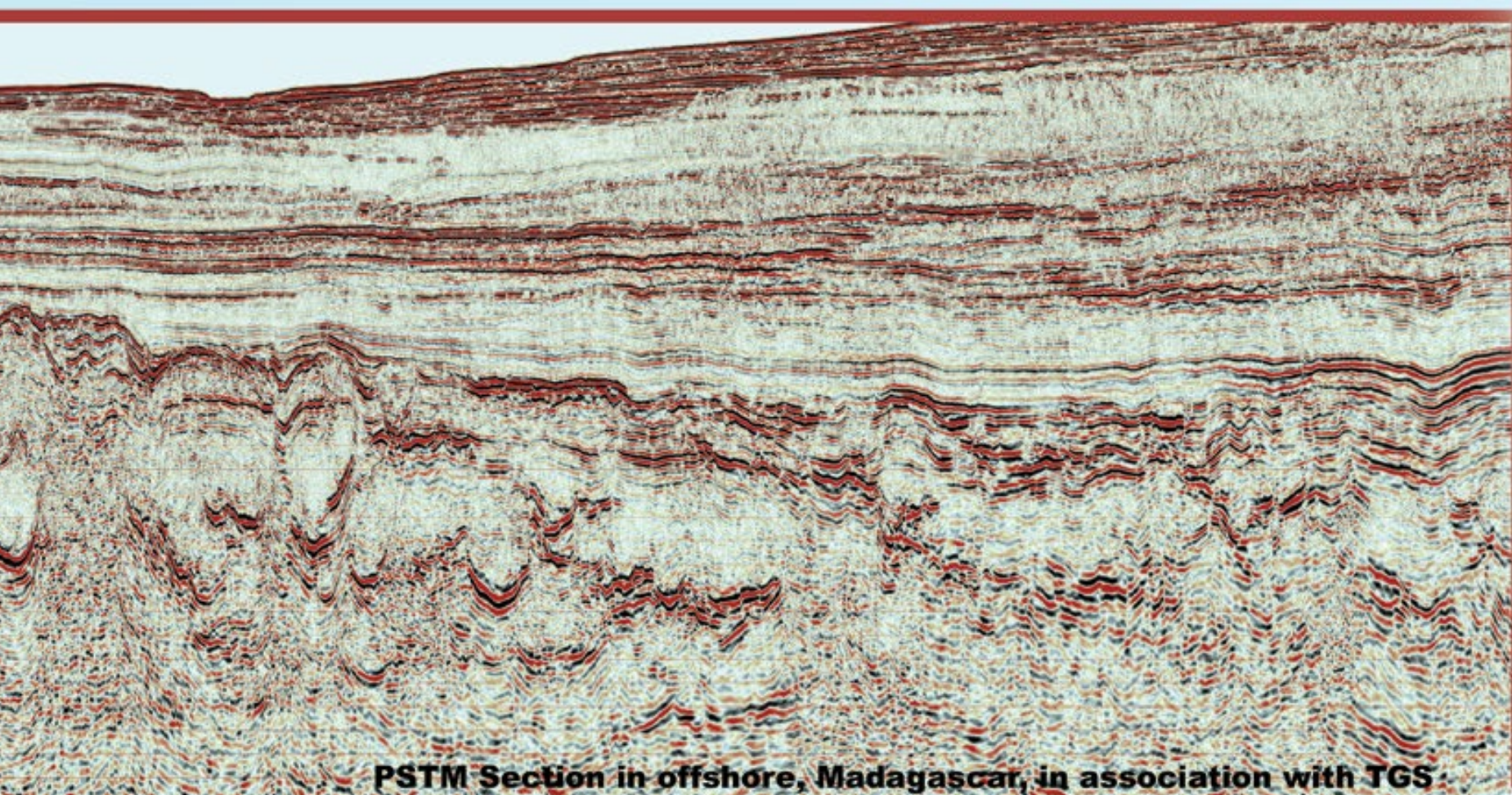
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Utah oil sands 'neglected'

A Resource Waiting To Be Developed

By LOUISE S. DURHAM, EXPLORER Correspondent

This may come as a surprise to a number of industry participants, but Utah is home to the largest oil sand resource in the United States.

Largest, as in an estimated 16 billion barrels of bitumen and heavy oil.

Light sweet crude, it's not.

At least 50 deposits are known to be within and flanking the petroliferous Uinta and Paradox basins in Utah, according to AAPG member Steven Schamel, president at GeoX Consulting in Salt Lake City and current chair of the EMD Bitumen and Heavy Oil Committee.



SCHAMEL

AAPG member Steven Schamel, president at GeoX Consulting Inc., presented the paper "Utah's Undeveloped Oil Sand Resource" at this year's Annual Convention and Exhibition in Denver. It was part of the EMD session, "Other Unconventional Resources: Oil Sands, Bitumen and Oil Shale."

Even so, fewer than 10 of these deposits are of commercial consequence.

"During the three decades preceding the collapse in oil price in the mid-

1980s, Utah 'tar sands' were the object of continuous exploration activity by the petroleum industry and development research by U.S. Department of Energy laboratories and DOE-funded university teams," Schamel said.

"Since then, this significant domestic

energy resource largely has been neglected," he noted.

No one has yet produced it for fuel or on a commercial scale, only in construction for roads.

"They scoop it up from an outcrop and put it on where they want a road paved and run a steamroller over the top of it," Schamel said. "The main pits are being used for that purpose."

"It's a resource waiting there for someone clever enough to be able to figure out where to exploit it," he continued. "I've had clients in the past who I thought had the right technique, but either they couldn't get the leases they needed or drilled wells in the wrong places, or whatever, leading them to leave the state before having a chance to test their method or the resource."

At press time, he noted that a company likely was on the brink of beginning a development project. As with most industry projects today, though, there's a tad of "wait and see" at work here, given the still-dismal oil price picture.

'Waiting to Be Developed'

Schamel provided a straightforward summary of Utah's oil sands, which represent a variety of geologic ages, including lower Eocene, Cretaceous and Triassic-Jurassic:

► Despite the off-the-charts number of 16 billion barrels, the bitumen resource is quite lean overall, except for a few areas: Bruin Point and Seep Ridge on the south flank of the Uinta Basin, Asphalt Ridge and Whiterocks on the basin's north flank, and the center of the Tar Sand Triangle located in southeastern Utah in Wayne and Garfield counties.

► The reservoirs are sandstones, and the bitumens are quite viscous, meaning recovery is complicated. The sandstones are porous but have low permeabilities.

► Bitumen saturations tend to be low, perhaps as a consequence of the arid climate. This plays a role in low-grade bitumen in many locales, such as the Tar Sand Triangle.

► Past failures to produce bitumen are a result of external commercial or technical problems rather than an inadequate resource.

► Later efforts must focus first on intrinsic properties of the deposits, such as the character of the bitumen and reservoir along with bitumen concentration.

Business savvy along with adequate funding – in other words, deep pockets – will go a long way toward keeping a company on site for the time needed to refine its methods to be sure they work.

"This is a resource waiting to be developed," Schamel emphasized.

He cautioned, however, that many deposits are in regions with exceptional scenic attributes and, consequently, high environmental/conservation values. This leads to added regulatory and legal obstacles.



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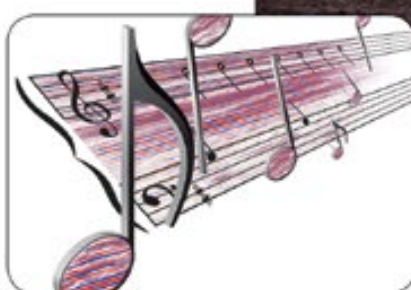
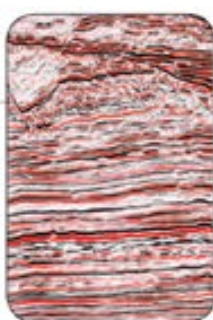
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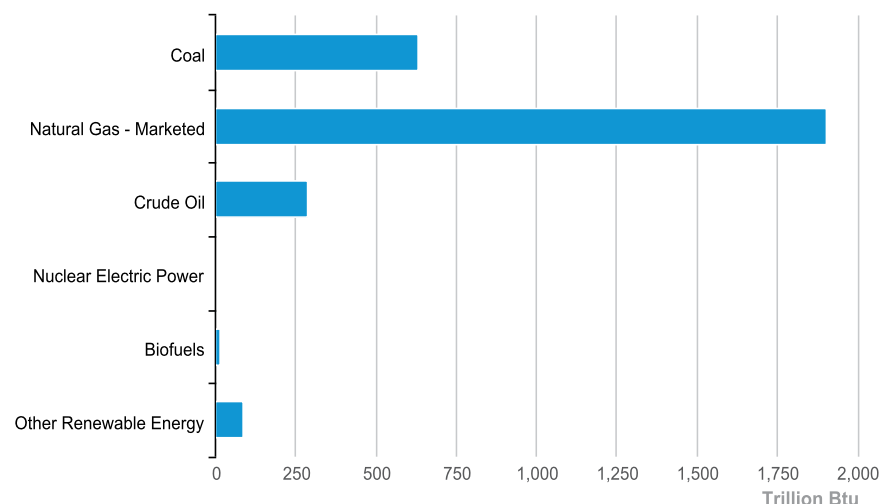
RESERVOIR DRIVEN



Photo courtesy of the Colorado Oil and Gas Association

Colorado's status as an oil and gas production powerhouse has also made it ground zero in the national debate over hydraulic fracturing.

Colorado Energy Production Estimates, 2012



Graphic courtesy of Energy Information Administration

Compromise, or confrontation?

Fracturing Debate Escalates in Colorado

By HEATHER SAUCIER, EXPLORER Correspondent

Some might argue that not much has changed in Colorado politics over the last year – except for the fact that the battle to ban drilling by certain groups has escalated from the local to statewide level.

Recently reported in several Colorado newspapers were the fighting words of Coloradoans Against Fracking member Karen Dike: “We need to have a ban in this state,” she was quoted as saying on behalf of the newly formed coalition. “That would be a ballot initiative in 2016.”

Although Dike later retracted her statement – requesting instead that Colorado Gov. John Hickenlooper use the power of an executive order to ban hydraulic fracturing – any threat of a possible ballot initiative is cause for concern.

“Any time there is talk of a ballot initiative, it is something to worry about,” said Doug Flanders, director of policy and external affairs for the Colorado Oil and Gas Association (COGA). “It’s very easy to get something on the ballot in this state.”

Roughly a year ago, anti-drilling groups, supported by Colorado’s 2nd District U.S. Rep. Jared Polis, a Democrat, were in the homestretch of adding two initiatives to Colorado’s November 2014 ballot that could have given local communities – many of which oppose drilling – unprecedented control over oil and gas operations in the state.

Realizing that a public vote could compromise the economy and jeopardize thousands of jobs in Colorado – which ranks fifth in the country for the production of natural gas and ninth in terms of oil – Hickenlooper swooped in at the 11th hour and proposed assembling a task force in lieu of ballot initiatives to hammer out clashes between industry and communities.

Issues ranged from local versus state control of the industry to setbacks to air quality, dust and traffic.

The governor’s 21-member task force – representing the industry, local communities, and state and local government – put forth roughly 30 proposals, and in February officially voted to support nine recommendations with a two-thirds or more majority (see sidebar page 16).

While hardcore environmentalists and other activists have publicly called the task force a “failure” for not addressing local versus state control issues, many contend



DEA

“The education of the public has advanced, but it has a long, long way to go.”

the task force did just that and, furthermore, was successful in making meaningful compromises.

Three recommendations made their way to the state legislature for a vote. The two most relevant include hiring 12 additional employees for well inspections by the Colorado Oil and Gas Conservation Commission (COGCC) and converting five temporary positions to full-time status at the Colorado Department of Public Health and Environment for purposes of conducting air monitoring and leak detection activities, among other tasks.

Local vs. State

Since Colorado became a state in 1876, battles over local and state control for a host of activities – not exclusive to the oil and gas industry – have been waged, and none have been solved overnight, Flanders said.

“They are solved by years and years of work to find the best path forward,” he said.

AAPG member Peter Dea, president and CEO of Cirque Resources LP in Denver, represented the oil and gas industry on the governor’s task force.

“What we heard loud and clear is that the majority of communities don’t want local control for themselves because they realize the reality of that,” Dea said, adding that civic representatives expressed their sentiments verbally and in writing.

By taking local control, communities would have to bear the brunt of responsibility for industry activity, perform the arduous task of learning all existing rules and regulations, and determine if they should adopt the state’s rules, new rules or a hybrid of both, Dea explained.

“These communities don’t have the technical expertise, the staffing or the budget to do that. They don’t want to succumb to these hearings time and time

again,” Dea said. “They would rather defer to the state for rules and regulations, which is set up to do that, yet have more say in the process.”

Furthermore, he said local communities exercising authority could feel excessive pressure from anti-drilling activists and residents who are misinformed about hydraulic fracturing to place bans on drilling.

“Local control invariably can lead to outright bans on oil and gas activities,” Dea said.

Addressing criticisms that communities did not get their wish for local control over industry, Hickenlooper issued a statement: “... The civic leadership of this state said that’s not the right solution. To say they didn’t resolve (the issue) is inaccurate. They did resolve it.”

“Some folks at the table were calling the task force a failure before it was even finished,” Flanders said. “That is very disappointing. Those people were not looking for a solution but rather for an issue.”

“Ironically, the same hypocrites who want to unreasonably restrict or ban oil and gas are 100 percent dependent on oil and gas directly or indirectly, like all the rest of us,” Dea added, speaking of the need for reliable food, hospitals, medicine, clothing, transportation, recreation, heating, cooling and transportation.

What Went Wrong?

Drilling for oil and gas has taken place in Colorado for more than 150 years, Flanders said. In fact, Colorado has some of the most comprehensive and strict regulations in the country – from site selection, to permitting, to downhole activities, to hydraulic fracturing, disclosure and final site reclamation, according to COGA.

Colorado is the first state to adopt strict regulations on methane emissions from the industry in addition to requiring that

data from all hydraulically fractured wells be catalogued on FracFocus.org. Baseline water testing also is required.

Hydraulic fracturing, a practice that dates back more than 60 years, has increased along with horizontal drilling, which is used to tap oil and gas in the Niobrara Formation in northeast Colorado, said AAPG Honorary member Pete Stark, senior research director and adviser for IHS.

So what prompted two communities in Colorado to try to ban drilling in recent years and others to push for local control?

“Unfortunately, several external forces have driven the anti-hydraulic fracturing movement in Colorado,” Stark said. “Some are against the oil and gas industry regardless of the facts and want to shut it down.”

The Coloradoans Against Fracking coalition is actually funded by the national group Food & Water Watch.

“They have emotion on their side – fear,” Flanders said. “Fear can spread very quickly but it can also be dissipated with some facts and common sense. But that takes time.”

Groups such as COGA, Western Energy Alliance and Coloradoans for Responsible Energy Development, founded by Noble Energy and Anadarko, have helped to quell fears and disseminate facts about hydraulic fracturing, which seems to have become the umbrella under which all gripes about drilling resound.

“The education of the public has advanced, but it has a long, long way to go,” Dea said. “The activists have tried to separate hydraulic fracturing from drilling, and it’s worked, unfortunately. The activists have done a good job in making frac’ing a four-letter word.”

Hierarchy of Property Rights?

Despite fear tactics and misinformation that have led many residents to believe drilling bans are fair and reasonable, the subject of property rights seems to have gotten lost in the shuffle.

And, in Stark’s eyes, it’s a critical legal issue.

“Many homeowners who bought homes in northeast Colorado moved here from other states and said, ‘Wow, I’m in God’s

See Property Rights, page 16

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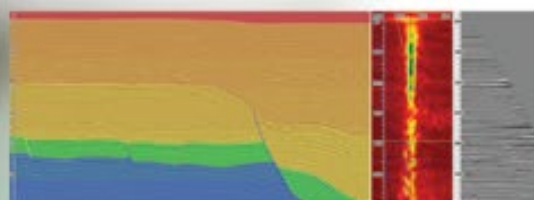
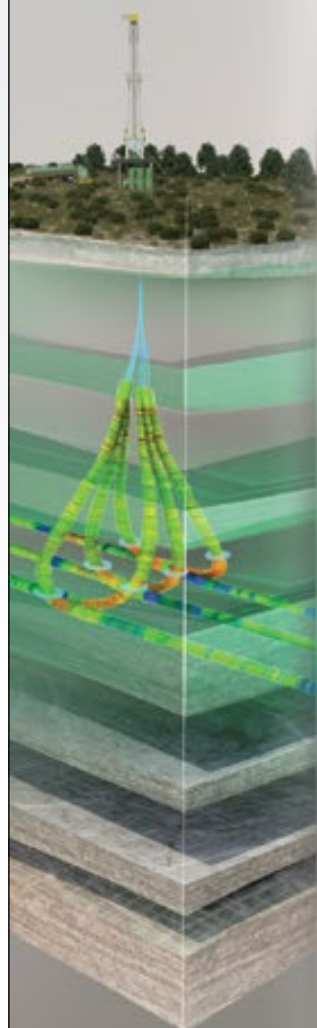
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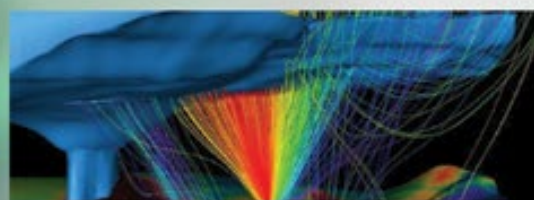
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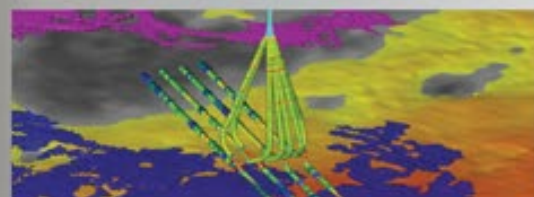
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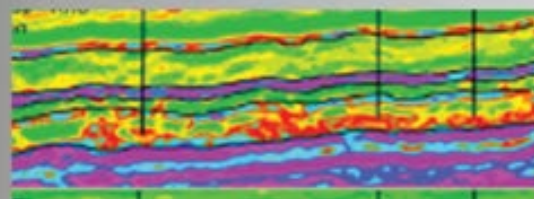
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Colorado Task Force 'Successful'

By HEATHER SAUCIER, EXPLORER Correspondent

Assembled last September to hear from all sides of the drilling debate, Colorado Gov. John Hickenlooper's oil and gas task force – made up of 21-members representing the industry, local communities, and state and local government – was charged with finding solutions and compromises to issues that ranged from local versus state control of the industry to setbacks to air quality, dust and traffic.

Although some members were polarized in their views, AAPG Honorary member Pete Stark, senior research director and adviser for IHS, said he believes on the whole the task force was successful.

"The task force went pretty far down the pike," he said. "It may not have pleased everyone, but it made great progress. Some participants who went in with polarized positions are unsatisfied, but a lot of compromises were made in the middle."

The task force showed that members were willing to compromise on issues including:

- ▶ Adopting a process for enhancing local government participation during the permit review period, and addressing the COGCC's procedures for reducing impacts and conflicts for local communities by adjusting siting or engaging in other mitigations to decrease the impacts of drilling.

- ▶ Requiring operators to submit information, including an estimation of the number of wells and a map of existing well sites and production facilities.

- ▶ Ensuring that local government designee and liaison positions be fully utilized as a conduit for communication



STARK

between local governments and the COGCC by reviewing existing barriers and ways to enhance education and outreach in communities, and expanding the comment period.


- ▶ Implementing and emphasizing a compliance assistance program to help operators comply with complicated and ever-changing rules and policies.

- ▶ Creating an oil and gas information clearinghouse in the governor's office to distribute "accurate, unbiased information to foster an improved understanding of oil and gas industry activities, practices and the federal, state and local regulatory regime."

- ▶ Requesting that the COGCC and Colorado Department of Transportation work to reduce large truck and trailer traffic on roads, highways and public streets, calling the traffic "one of the most serious impacts" of the industry.

- ▶ Recommending that the state bill allowing for the indefinite continuation of rules established in the previous year be passed.

In fact, many task force members and hundreds of citizens in attendance at each task force meeting learned that robust state mechanisms already are in place for communities to have a say in how industry operates in their areas, said task force and AAPG member Peter Dea.

"There are substantial vehicles in place for locals to have input," he said. "Many were pleasantly surprised. And the task force recommended additional ways for citizens to have input throughout the permitting and planning process based on hearing their concerns." 

Property Rights from page 14

country.' Unfortunately they bought property in the middle of a developing oil and gas field and were not properly informed of the situation," Stark said. "The lack of understanding about the property rights of homeowners versus the rights of mineral owners may need to be sorted out in the courts."

To ban industry in Colorado – whose oil and gas industry is responsible for 111,000 jobs, provides \$29 billion in economic output, and contributes more than \$1.6 billion in public revenues with nearly \$500 million to K-12 education annually – is the equivalent of the unlawful taking of property rights, an issue that most homeowners, it can be argued, can understand.

"The oil and gas companies secured their rights by paying for them just like the homeowners paid for their land and their houses," Stark said. "Neither has been judged, to date, to be superior to the other."

Stark noted that in Texas fewer communities have pushed for bans, perhaps because many landowners own mineral rights to their property, making drilling a more tolerable activity once landowners are paid lease fees and royalties by operators.

In Colorado, it may not be enough for an operator to leave a property and local infrastructure in superior condition prior to

their showing up.


"Eventually, some sort of compensation to communities and surface owners might need to be considered," Stark said. "This has worked in a few international oil and gas developments."

The Battle Rages On

Yet, the threat looms of a ballot initiative for a statewide ban.

Sam Schabacker, a senior organizer of Food & Water Watch, said in a statement to The Denver Post that while a ballot initiative for a statewide ban on hydraulic fracturing is not currently planned, "all options are on the table."

If an initiative pops up on the ballot, Hickenlooper expressed minimal concern in an interview with Community Radio for Northern Colorado: "I think if something does go to the ballot box, it will have a much harder time passing, just because so much of what people care about is being addressed and will be addressed."

He continued in a statement on his official website: "We have not rested in addressing the tough issues that come with balancing quality of life with an important and thriving industry. From advances in groundwater protections and methane limits to today's recommendations that ensure the protection of people, industry and the environment, working together is how we always find the right solutions for Colorado." 

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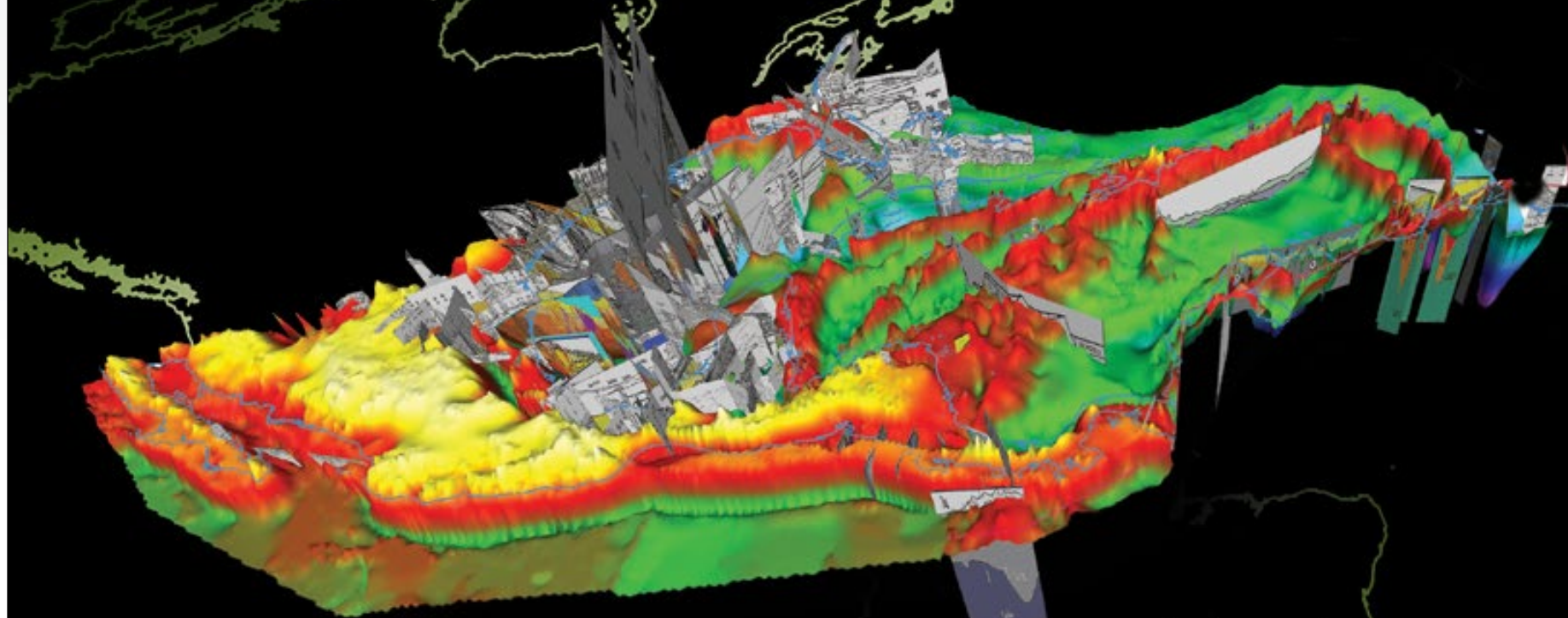
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New life in old areas

Tech, Geology Key to Production in Codell Sandstone

By LOUISE S. DURHAM, EXPLORER Correspondent

The Wattenberg Field north of Denver has become a big deal in the industry since its discovery in 1970 by Amoco Production Company.

It's a twofer, kicking out both oil and natural gas.

To many, mention of the field conjures up thoughts of the upper Cretaceous Niobrara shale, which is a prolific producer there, along with other geologic formations.

The Codell sandstone, for example, is a major pay in this giant field. It occurs as a member of the Carlisle shale formation



SONNENBERG

AAPG Honorary member and past president Steve Sonnenberg of the Colorado School of Mines will present the paper "Geologic Factors Controlling Production in the Codell Sandstone, Wattenberg Field, Colorado," at the Unconventional Resources Technology Conference (URTeC) in San Antonio, July 20-22.

Sonnenberg's presentation will be part of the session on "Western U.S. Case Studies: More Upside in the Rockies!"

found directly beneath the Niobrara, and it overlies the Greenhorn shale, which also contains organic-rich source beds.

"The Codell is situated in a sort of ideal spot, being between organic-rich intervals," said AAPG Honorary member Steve Sonnenberg, professor and Charles

Boettcher distinguished chair in petroleum geology in the Department of Geology and Geological Engineering at the Colorado School of Mines. "That definitely contributes to the production."

Early on, Amoco and other operators ignored the Codell, drilling right through it.

This changed in 1981 when significant shows grabbed their attention.

It quickly became a primary target for vertical wells, which were successfully completed using hydraulic fracturing. Some of these were co-completions with the Niobrara.

Advanced technology entered the picture a number of years later.

Horizontal drilling and multi-stage hydraulic fracturing were applied, and production soared.

Much of this action has been in the same locations as the earlier vertical holes.

"In the last two to three years, people have been drilling it horizontally in the same places where old vertical wells were drilled and increasing production," Sonnenberg noted. "In some cases, production goes from 70 to 700 barrels of oil per day, which is a ten-fold increase owing to horizontal drilling and multi-stage fracturing."

"Together, the Codell and the (connecting) basal Niobrara, or what we call the Fort Hays, is a huge resource play in the Denver Basin," he said.

Sonnenberg emphasized that technology is key to production, essentially giving new life to the resource.

Still, it always goes back to the geology, and he itemized a number of geologic and related factors that are fundamental to the production:

- ▶ Proximity to thermally mature source beds.

- ▶ Thickness.

- ▶ Geothermal gradients.

- ▶ Pressure gradients.

- ▶ Fault-bounded reservoir compartments.

- ▶ Gas-oil ratios.

- ▶ Sufficient reservoir quality.

The Codell is a tight oil reservoir with low porosity, low permeability and abnormal pressure, according to Sonnenberg. He noted that it's a low resistivity-low contrast pay (LRLC) for a variety of reasons, principally the clay content within the sandstone itself.

The sandstone is very fine- to fine-grained and bioturbated, with the depositional environment interpreted to be a shallow marine shelf setting.

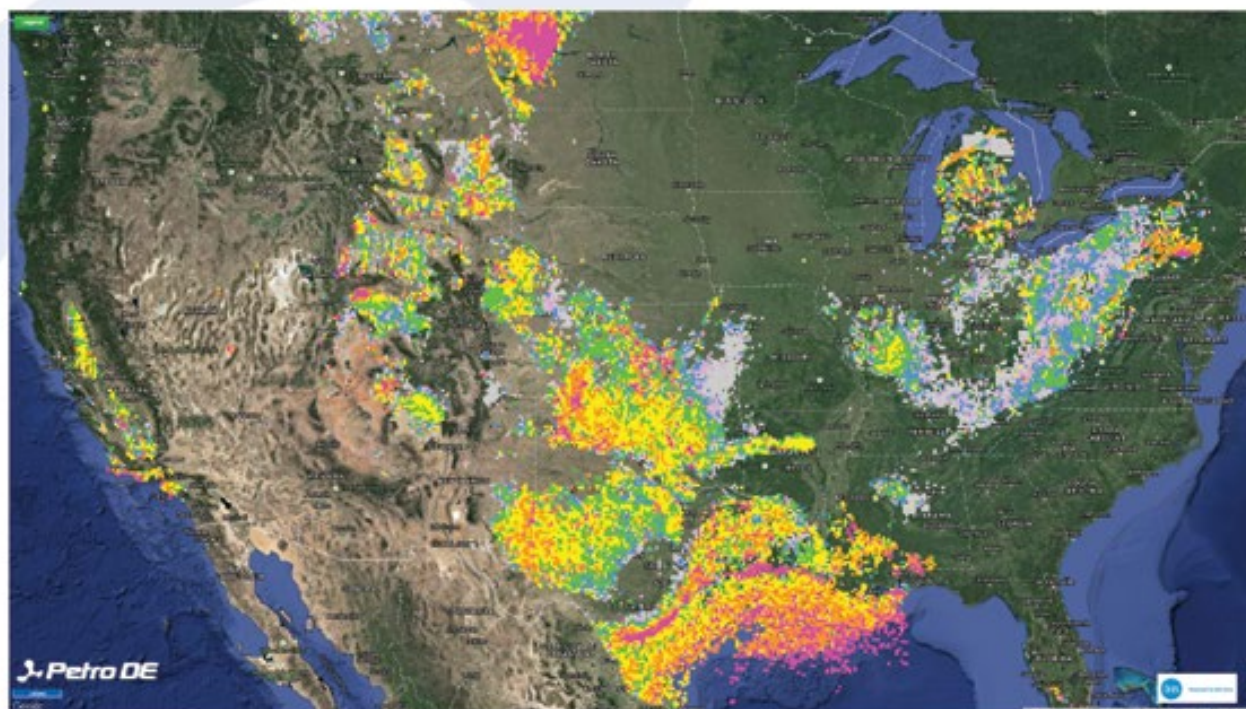
"The fault-bounded reservoir compartments form mainly from a well-developed polygonal fault system," he said. "The polygons are generally about one-and-a-half square miles in size."

"Orientation of the polygons is influenced by pre-existing basement fault systems," he added.

When queried about current drilling activity, given the low oil price environment, Sonnenberg noted that while the rig count has dropped somewhat, a significant amount of the action continues to be economic.

"People are still drilling quite a few wells," he said. "The rig count probably dropped less here because the quality of the production is really known, so people are not only getting after the Niobrara but also this Codell below."

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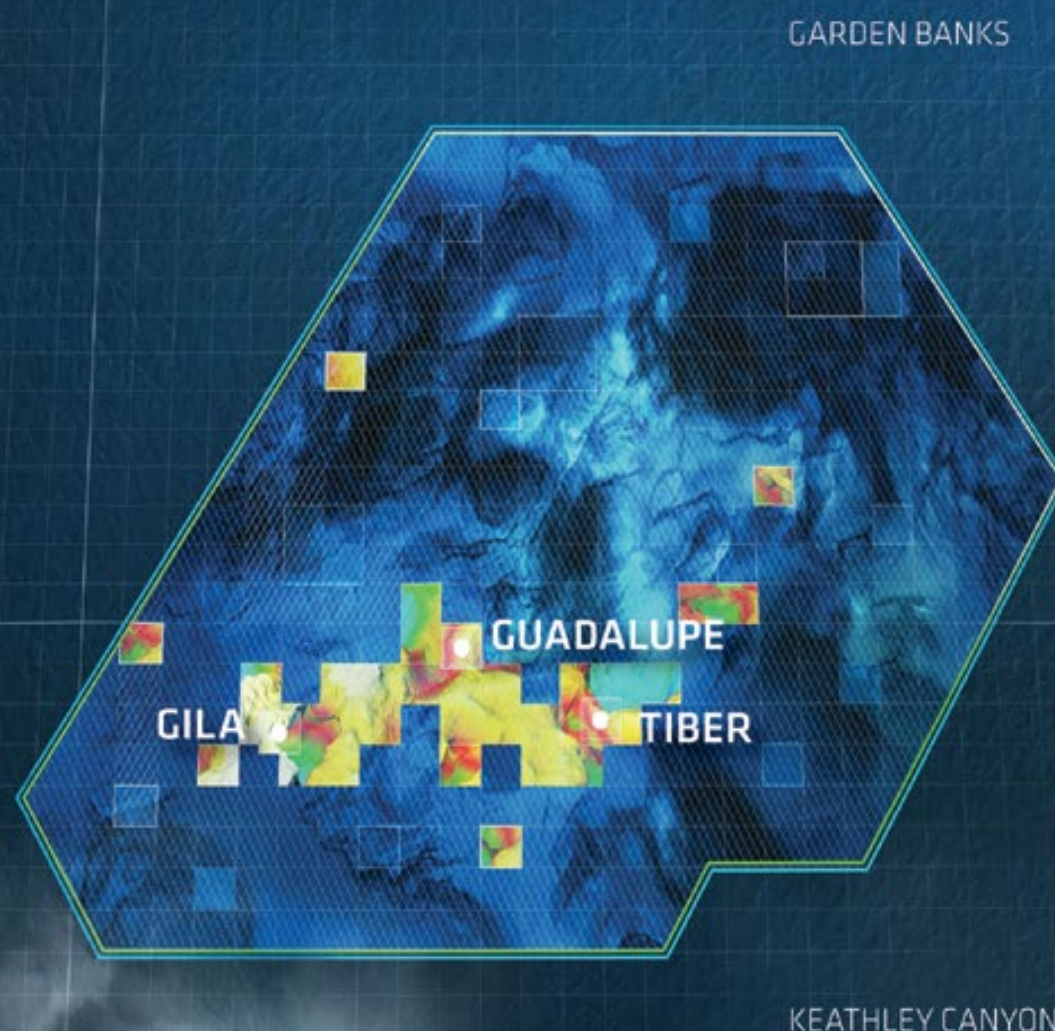
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Assessing Potential of the Rosebud Reservation

By LOUISE S. DURHAM, EXPLORER Correspondent

The upper Cretaceous Niobrara formation is widely known to be a highly commercial hydrocarbon producer, principally in Colorado and Wyoming.

Today, an intriguing program is afoot to assess the hydrocarbon potential of the Niobrara in south-central South Dakota.

Even though the formation is not ordinarily produced in this region, shows of natural gas are not unusual there. Some wells, in fact, are said to have produced gas for individual farms for as long as 20 years.

The current assessment program was initiated in 2012, when the American Indian Higher Education Consortium funded a cooperative education program between the Sinte Gleska University on the Rosebud Sioux Reservation in South Dakota and the South Dakota School of Mines and Technology (SDSM&T).

The aim was to involve Native American students in the energy resource evaluation process to provide educational opportunities that might result in energy exploration and production careers, according to AAPG member Daniel Soeder, research geologist at the U.S. Department of Energy's National Energy Technology Laboratory (NETL) in Morgantown, W.Va.

"Potential benefits to the Sicangu Lakota Oyate from the development of such a resource could include more jobs, economic development and an affordable energy source," Soeder said.

"The NETL has contributed in-kind geological and geochemical analyses and



Sarah Chadima (left) of the South Dakota DENR, and Mikal Bordeaux, a student at Sinte Gleska University, with a segment of Pierre Shale core recovered from a drill hole south of Presho, S.D.

Photo by Foster Sawyer, SDSM&T

expertise to the project," he noted.

He explained that the objectives were to characterize the Niobrara in South Dakota in terms of stratigraphy, composition, depositional environments, reservoir properties, regional trends, structural features, potential productive horizons and areas.

Less Can Be More

The strategy, overall, was designed to use geological data and models to determine gas-in-place and EUR.

Soeder noted that there were no public drill cores available for study in the

proximity of the reservation.

Not to worry.

The project participants undertook a trend analysis using Niobrara drill cores from Nebraska, Wyoming and western South Dakota, which were sampled at the USGS core library in Denver.

"The regional samples indicated that the Niobrara contains organic matter content as high as 6 percent, derived from Type II kerogen, and thermal maturity in the biogenic gas window," Soeder said.

"Porosity in the carbonate units may hold significant quantities of shallow gas," he added.

Meanwhile, the Department of



SOEDER

AAPG member Daniel Soeder and some colleagues from the U.S. Department of Energy's National Energy Technology Laboratory will present the paper "Assessment of Hydrocarbon

Potential in the Niobrara Formation, Rosebud Sioux Reservation, South Dakota," at the Unconventional Resources Technology Conference (URTeC) in San Antonio, July 20-22.

Environment and Natural Resources Geological Survey in South Dakota is acquiring a new core from a well relatively close to the reservation. This might provide additional information given its proximal location.

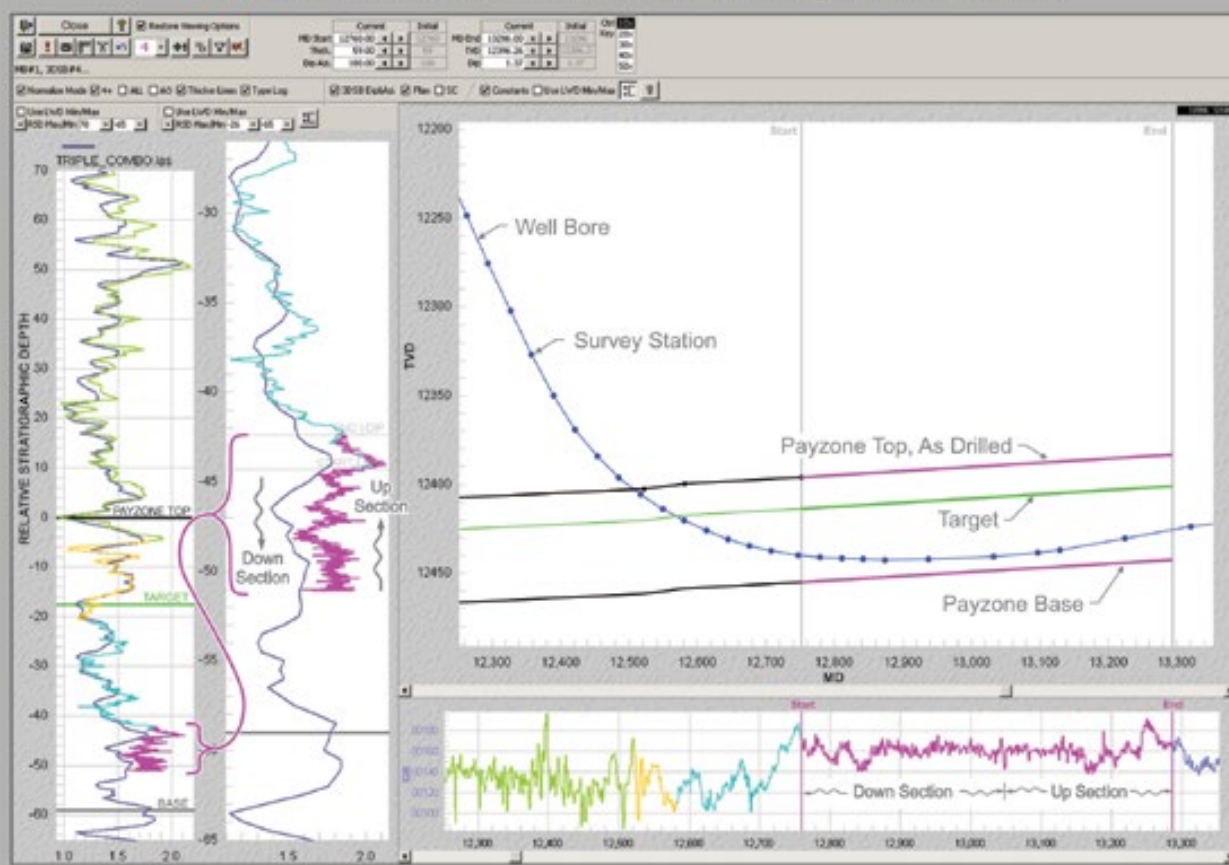
Whatever the final conclusions of the study, the shallow depth of the Niobrara at Rosebud negates the possibility of production of the large volumes of gas desired by the commercial energy companies.

Less can be more, in some situations.

"The relatively inexpensive drilling costs and modest expected production may provide the tribe with a secure and economical energy supply," Soeder said, "suggesting a smaller-scale approach for unconventional gas development that could be applied elsewhere." ■

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Shale play outlook

How the U.S. Became the World's Top Producer

By HEATHER SAUCIER, EXPLORER Correspondent

On the heels of an April 23 article in The New York Times headlined, “A New ‘OPEC’ Emerges: The U.S.,” this year’s Unconventional Resources Technology Conference (URTeC) will take that topic into the field, tracking the country’s shale boom from its inception to turning the United States into the world’s No. 1 petroleum and natural gas producer in 2014 – overtaking Saudi Arabia and Russia.

In a presentation titled, “Shale Plays: How Technology, Governments, Regulators, Academia and the Public Have Changed the World’s Energy Supply and Demand Equation,” AAPG member Joseph H. Frantz Jr., vice president of Engineering Technology for Range Resources Corp. in Canonsburg, Pa., will share his insights on:

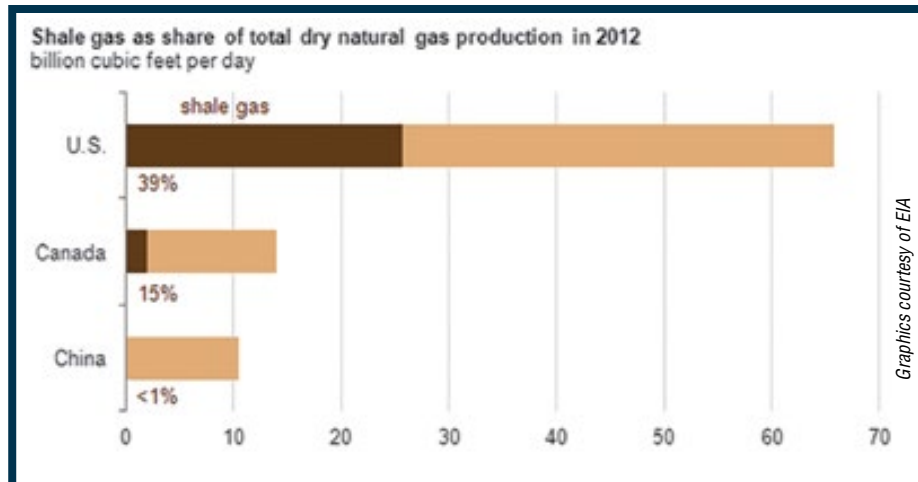
- ▶ The making of shale plays.
- ▶ Their contribution to saturating the gas and oil markets as a result of rapid technological changes.
- ▶ Predictions about how shale energy will power the world.
- ▶ The importance of community buy-in into the industry.

“There are shale reservoirs all over the world, and other countries are looking to the U.S. as the originator of this technology, specifically horizontal drilling and hydraulic fracturing, for access to and knowledge on how to use it,” said Frantz, who has been traveling the United States and Europe as a Distinguished Lecturer



FRANTZ

“There are shale reservoirs all over the world, and other countries are looking to the U.S. as the originator of this technology.”



for the Society of Petroleum Engineers discussing the history and implications of the shale boom to the world.

In addition to the technology that makes the extraction of oil and gas from source rocks possible, Frantz covers the obstacles that can make new shale plays costly at the onset, namely the lack of

manpower, equipment, roads, pipelines, compressors and gas processing systems.

New technology also is responsible for an uptick in production, as wells are now drilled and completed in much shorter timeframes, and spacing between hydraulic fractures has become smaller.

“The result is longer wells, more fractures and more productivity per well,” Frantz said. “As a country, we can produce high volumes faster than ever before from shales.”

Of course, increased production rates naturally have a bearing on the global market, as seen by the dramatic dip in oil prices that began last year. Frantz said this is just one of many price cycles the industry has experienced over the past 50 years.

“In the long term, the world’s energy demand is predicted to increase for decades to come,” he explained. “That demand is going to be filled by a growing exploitation of shale reservoirs.”

Sudden Impact

Getting people on board with shale energy – and the type of drilling and completions activities it takes to produce hydrocarbons from source rocks – is imperative, Frantz said.

He praised industry in the United States for proactive campaigns that separate myths from facts regarding the controversial practice of hydraulic fracturing.

“The industry and regulatory agencies have done a great job of educating people,” he said. “Last year, my family and I drove from Denver toward Grand

See **Safe Practices**, page 24

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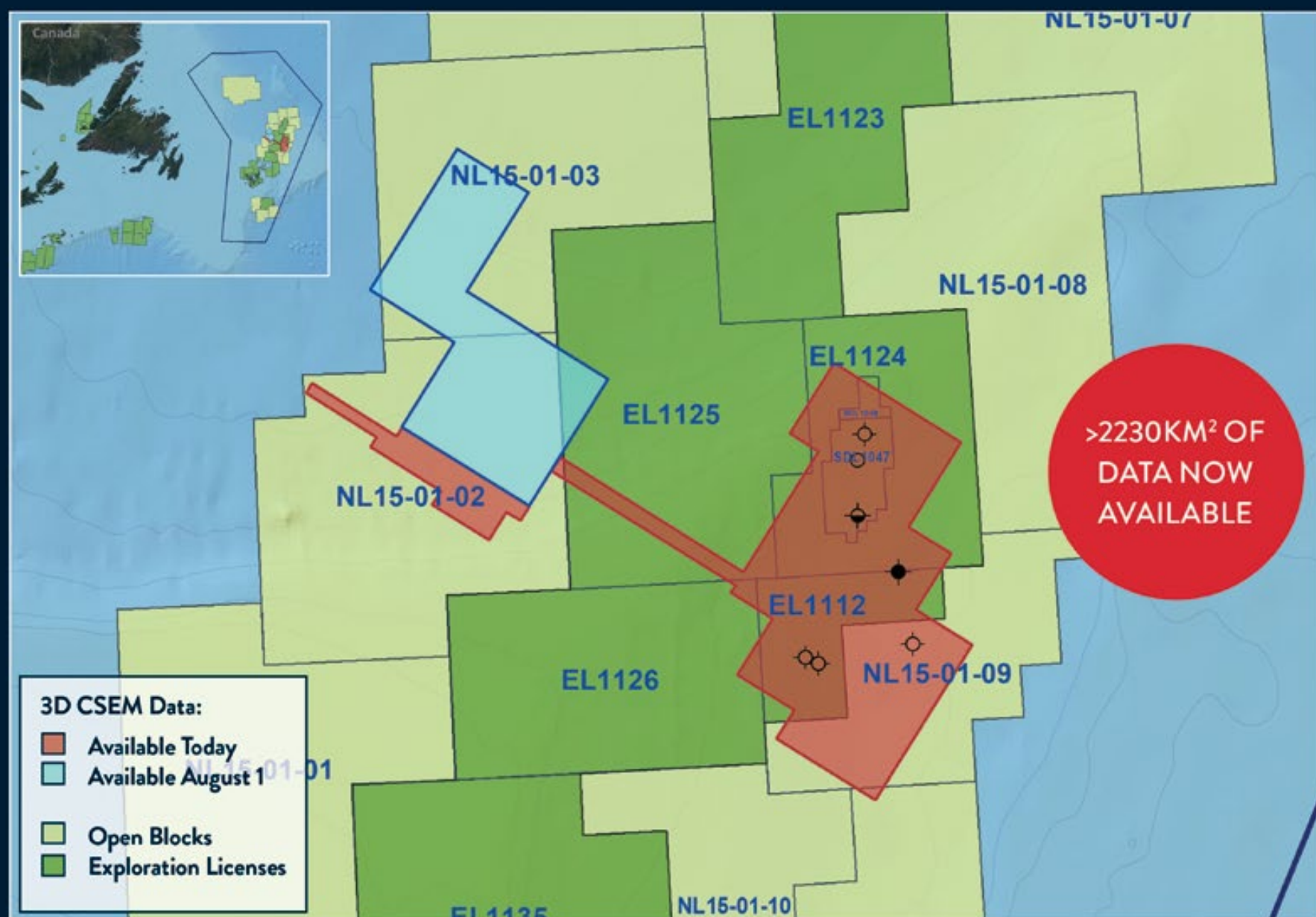
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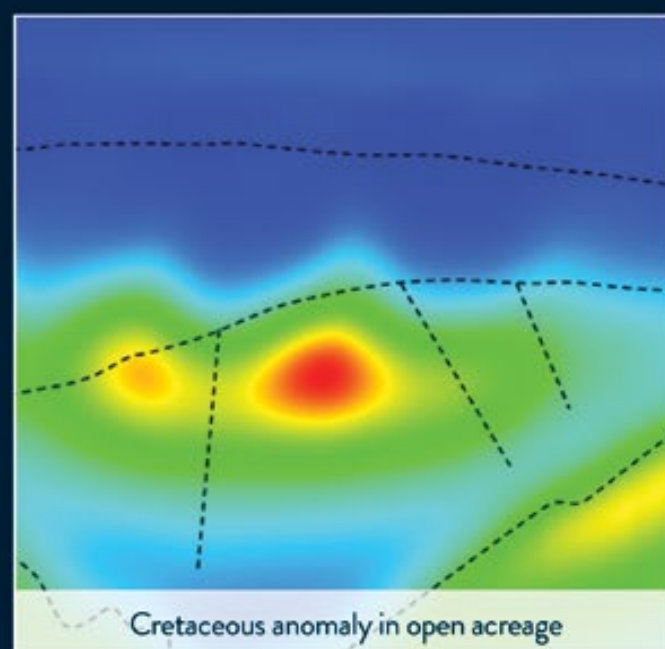
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The June 8 deadline is fast approaching for early registration and a \$100 savings for the third annual Unconventional Resources Technology Conference (URTeC), which will be held July 20-22 at the Henry B. Gonzalez Convention Center in San Antonio.

URTeC is the industry's leading multidisciplinary conference on unconventional resources and is hosted jointly by AAPG, the Society of Petroleum Engineers (SPE) and the Society of Exploration Geophysicists (SEG).


"With a record number of abstracts submitted, URTeC is becoming widely recognized as the premier sharing venue for the cross-disciplinary best practices that define success in unconventional plays," said AAPG program co-chair Skip

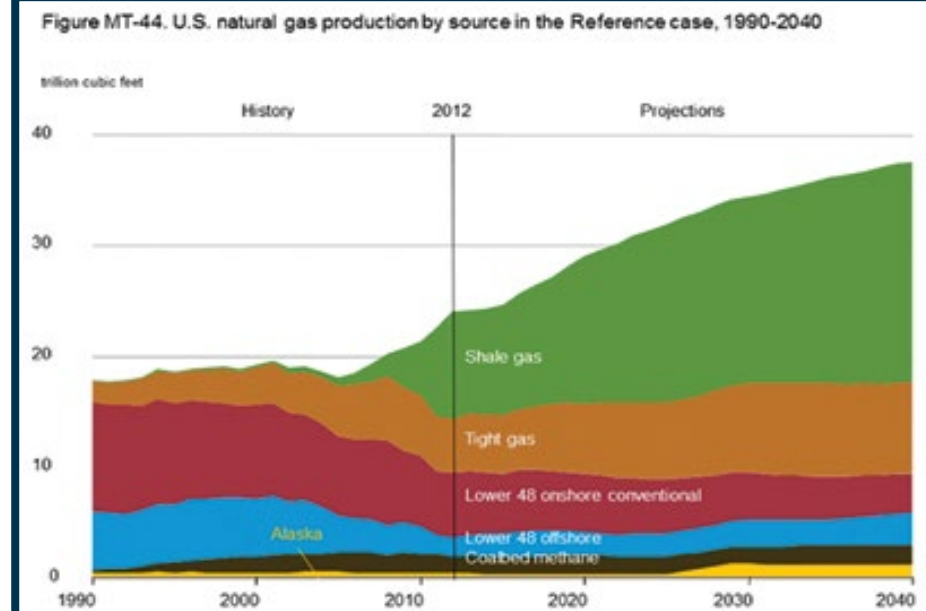
Rhodes, who is director of unconventional resources for Pioneer Natural Resources.

Last year, SPE, AAPG and SEG announced record attendance of more than 5,200 oil and gas professionals at the second annual URTeC held in August in Denver – growth of some 20 percent over the inaugural event in 2013, also in Denver.

More than 230 companies exhibited at the event.

URTeC is designed to fill the unique need for a peer-reviewed, science-based unconventional resources conference that will take an asset team approach to development of unconventional resource plays – similar to how oil and gas professionals work in today's market.

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Safe Practices from page 22

Junction, and all along the interstate were billboards that showed the benefits of the oil and gas industry to the state of Colorado."

Aware that environmental activists have launched efforts in Colorado and in other states to ban hydraulic fracturing as a way to reduce the production of hydrocarbons, Frantz stressed that industry has gone above and beyond to protect people and the environment in developing shale energy sources.

"I've been in the business for almost 35 years and I've never seen our industry collaborate with stakeholder groups at this level to guide how we do our business," Frantz said. "There is more focus on safe practices and protecting the environment now than ever before," he added.


Audiences often ask him if industry is winning the battle against those who oppose fossil fuels and initiate movements to ban drilling. His answer is a resounding "absolutely."

"Polls taken in various states are positive toward our industry," he said. "New York has been a battleground state that has not allowed hydraulic fracturing, but there will be a day when they will open it up, and those communities will be able to receive the same positive benefits that communities in neighboring Pennsylvania have experienced, beyond purchasing gas at a much more affordable price."

In Europe, however, where people typically do not own the mineral rights to their property, operators may have a harder time getting citizens on board.

"In the world today, it seems like there must be some direct benefit to the communities for people to buy in and allow development to occur," Frantz said. "The industry also creates many long-term jobs and new business that can revitalize large areas and communities, like what happened in the Marcellus."

He used his home state of Pennsylvania as an example. There, operators pay a yearly impact fee per well. A substantial portion of the fees is distributed back to the local communities based on the amount of drilling activity in an area, he explained.

"The world needs more oil and gas over the coming decades," Frantz said. "Clearly shale reservoirs have and will provide a significant source of long-term oil, gas and natural gas liquids worldwide. They can quickly ramp up production once full-scale development begins." 

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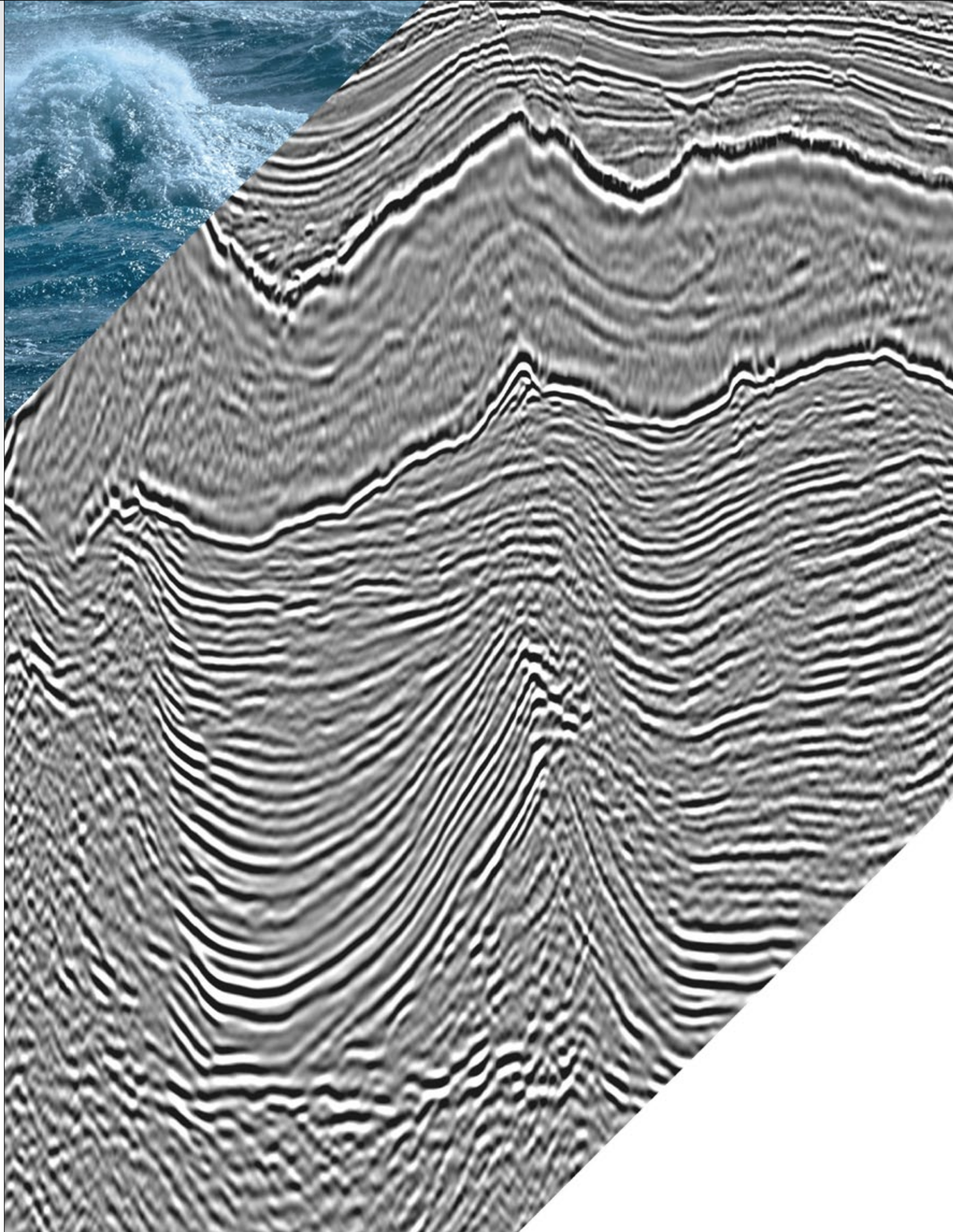
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Opportunities Abound in Mexico

By EMILY SMITH LLINÁS, EXPLORER Correspondent

The word “Mexico” brings many images to mind. For some, it’s mariachis and tequila. Others think of good food and beautiful beaches.

For many in the petroleum industry, though, the word “Mexico” means newfound opportunity.

The Mexican Petroleum Congress, scheduled for June 10-13 in Guadalajara, offers a chance to experience that opportunity.

At a time when many industry events are being postponed or are struggling financially, organizers representing Mexico’s petroleum industry associations are

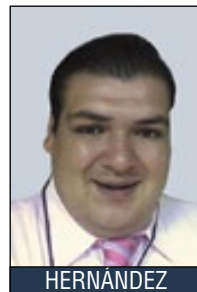


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preparing for a successful, well-attended event.

Everardo Castro, president of the Mexican Association of Exploration Geophysicists (AMGE) and 2015 Congress

“Everybody has an eye on Mexico in order to be part of the business opportunities ...”



HERNÁNDEZ

he said. “We believe that where some see restrictions from the low oil price, most see into the future, and the Congress provides the opportunity to be up-to-date and well-positioned when recovery comes.

“The current situation is temporary and cyclical,” he added, “and it brings enormous opportunities.”

Getting Acquainted With Mexico

The majority of opportunities stem from Mexico’s 2014 Energy Reform, which opened the country’s hydrocarbon industry to private investment for the first time. The first bidding round is under way – and more will follow in coming months.

“Everybody has an eye on Mexico in order to be part of the business opportunities in exploration and exploitation of conventional and unconventional hydrocarbon resources,” said Ulises Hernández, head of reservoir geology for exploration at the national oil company, Petroleos Mexicanos (PEMEX). “There is interest from operators and service companies alike, particularly in times of low petroleum prices.”

Hernández, current president of AAPG affiliate, the Mexican Association of Petroleum Geologists (AMGP), said the Congress is an ideal scenario for networking with potential partners for services, new technologies and joint ventures.

“It is definitely a unique opportunity with excellent timing for all the players in the Mexican oil and gas industry, including those looking for a job or willing to recruit people,” he said.

Sessions will focus on the intricacies of doing business in Mexico, including working with regulators, legal authorities and local communities.

For Hernandez, working in Mexico comes with challenges, though they are not insurmountable.

“I do believe that in most cases, if not all, challenging conditions are harsher in other parts of the world where major and medium-sized companies are actively participating in the local oil industry,” he said.

“One of the first challenges companies are facing is understanding Mexican regulatory framework and contractual terms for the first bidding rounds,” he said. “Once they start operating, particularly onshore, the next challenge will be obtaining the social license to allow them to operate in sensitive areas and meet commitments and goals.”

Castro agreed. “Undoubtedly, it’s necessary to know the legal issues governing Mexican law, as well as understanding and empathizing with local communities, respecting their customs and caring for the environment,” he said. “However, in Mexico there are trained personnel with extensive experience in each of the activities inherent in the energy industry.”

In addition to providing a sound technical program for professionals, Congress organizers see the event as a way to develop future industry leaders.

“We believe that the young people who will replace us in the future should be better prepared to face a more competitive environment, from the moment they leave

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Advanced logs and interpretation

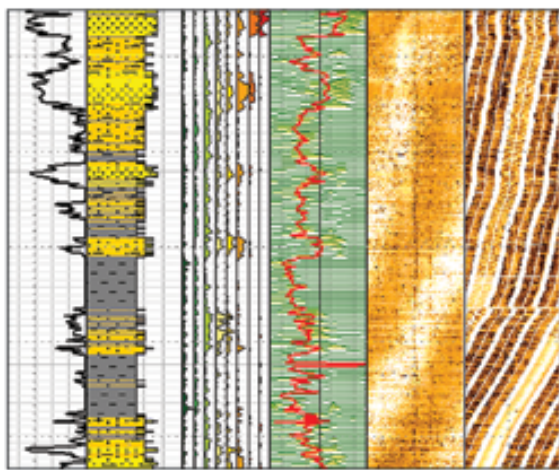
Well logs are indispensable source of subsurface information in exploration, appraisal, and development. The term “advanced logs” here refers to well logs other than the conventional quad combo. They involve, but are not limited to, NMR, image, nuclear, spectroscopy, triaxial induction, etc.

Some of these logs provide direct access to critical petrophysical, geochemical, geomechanical, and geologic information that is either unavailable in quad combo, or requires delicate calibration and modeling in post-well analysis, while the others allow faster logging speed, less logging uncertainty, or higher data resolution.

Advanced logs and subsequent interpretation give a more reliable and comprehensive formation description, which is often the input for constructing geology and reservoir models, and basis for decision-making in drilling and evaluation.

The editors of Interpretation (<http://www.seg.org/interpretation>) invite papers on the topic **Advanced logs and interpretation** for publication in the May 2016 special section. Contributions may include, but are not limited to:

- tool physics for advanced logs (NMR, image, nuclear, spectroscopy, triaxial induction, etc.) and field applications
- interpretation methods for advanced logging data
- integration with core and seismic data
- recent developments in advanced logging techniques and interpretation methods



NMR, FMI, and OBMI help identify reservoir deliverability and formation texture of a sandstone and shale section. Image courtesy Yao Peng.

Interpretation, copublished by SEG and AAPG, aims to advance the practice of subsurface interpretation.

The submissions will be processed according to the following timeline:

Submission deadline:
1 August 2015

Publication of issue:
May 2016

Special section editors:

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Regional seismic beyond the current understanding of marine basins

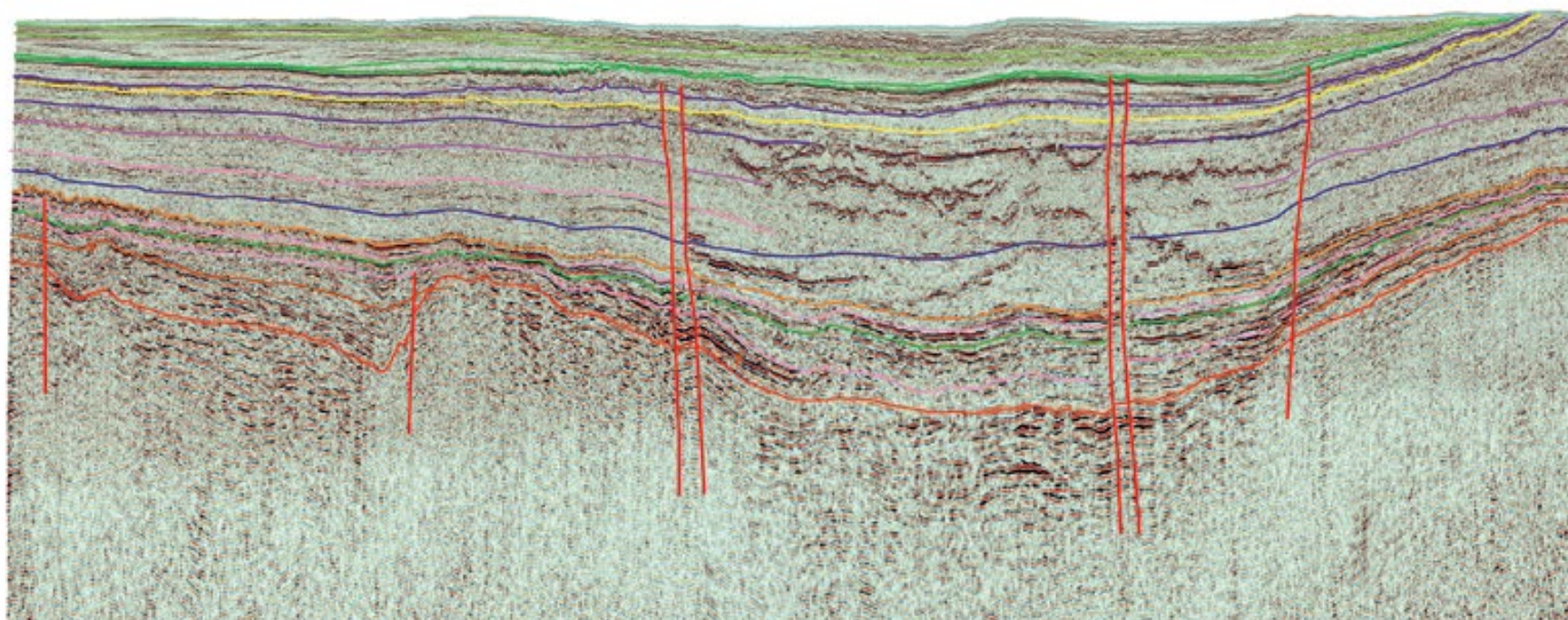
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'Perseverance Triumphs' in Caribbean Discovery

By EMILY SMITH LLINÁS, EXPLORER Correspondent

On Dec. 2, 2014, Colombia's national oil company Ecopetrol and partners Petrobras, Repsol and Statoil informed stock markets in Rio de Janeiro, New York, Toronto and Bogotá of a hydrocarbon discovery in the exploratory well Orca-1, located 40 kilometers north of the coast of La Guajira, in the Colombian Caribbean.

The announcement marked an important milestone in the Colombian Caribbean offshore exploration, which Ecopetrol has developed over the past decade in cooperation with international companies whose expertise has provided great support in undertaking offshore exploratory challenges.

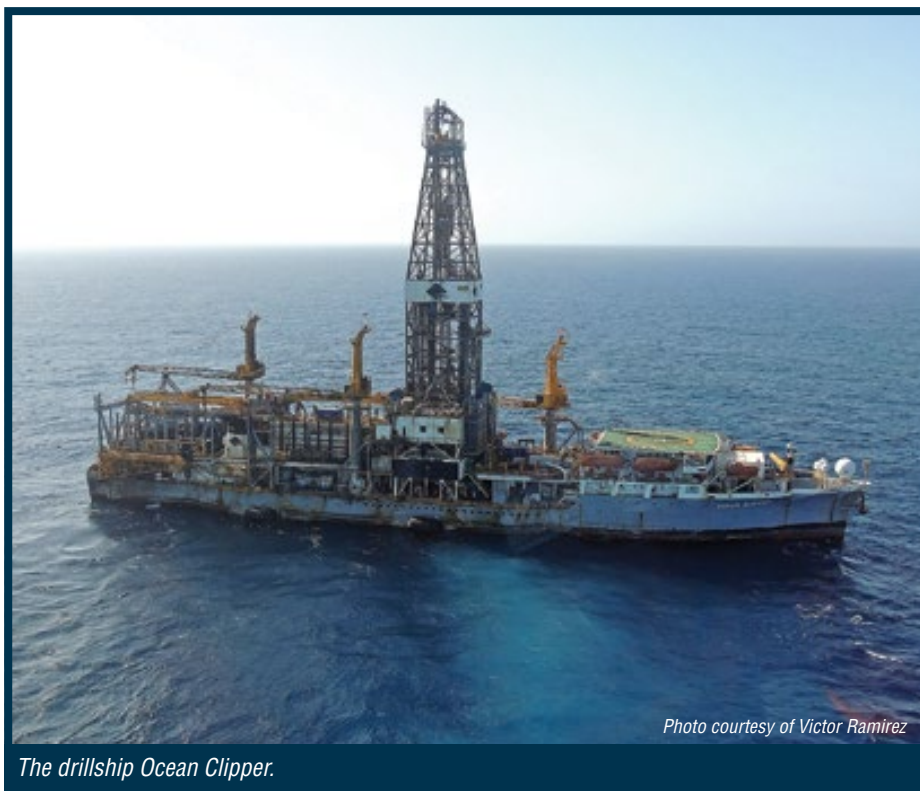
Between June and September 2014, Orca-1 reached the expected depth of nearly 14,000 feet, with a water depth of more than 2,200 feet. Flow tests performed in the fourth quarter confirmed the presence of gas accumulation at a depth of approximately 12,000 feet.

The well, operated by Petrobras and drilled by the drillship Ocean Clipper, fulfilled the commitments set forth for Phase IV of Tayrona Block.

Ecopetrol's Orca-1 project lead is Caribbean offshore manager Victor Ramirez, current president of the AAPG Latin America Region. For Ramirez, the well's initial success provides an impetus for future exploratory campaigns.

"Ecopetrol and its partners are already preparing to quantify the discovery and verify the extent of the Orca play during 2016 and 2017," Ramirez said.

Ramirez also noted that, in addition to



The drillship Ocean Clipper.

Photo courtesy of Victor Ramirez

opening a new chapter in the country's offshore exploration, Orca-1 illustrates a common Colombian colloquialism: "*la constancia vence*," or "perseverance triumphs."

Validity

Technical teams first identified signs of prospectivity in the northeast Colombian Caribbean in 1999, and they spent

subsequent years working diligently to acquire information about the basin's petroleum system.

After a decade of persistence, Ecopetrol's exploration efforts were intensified through key involvements by Petrobras, with its recognized expertise in deepwater exploration, and Repsol, which joined the venture following its Perla discovery in the Venezuelan Caribbean in 2009.

In late 2014, Norway's Statoil joined the venture as a partner sharing exploratory risk.

Ramirez said the common denominator in Colombian Caribbean exploration, both for its longtime involvement and its geographical presence, is Ecopetrol. The company currently holds partnerships in 13 Colombian Caribbean offshore blocks.

"While Orca-1 presents exciting new developments for offshore exploration, it is not the first case of success in the Guajira Offshore Basin," he said.

Just 120 miles due southwest of Orca is the Chuchupa-Ballenas gas complex, which produces about 700 million cubic feet of gas per day. Of this production, about 100 MMPCGD is sold to Venezuela.

The Chuchupa-Ballenas fields are home to shallow water gas accumulations discovered by Texaco in the 1970s. Now operated by Chevron (43 percent) in partnership with Ecopetrol (57 percent), the fields produce gas from Lower Miocene rocks, sandstones and calcareous sandstones younger than the Orca reservoirs.

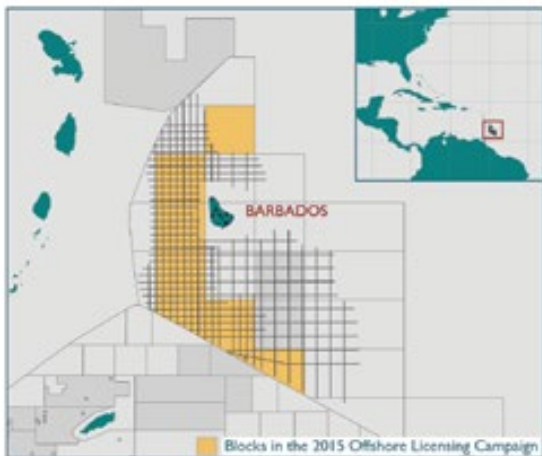
According to Ramirez, fields currently in production and the new Orca discovery attest to the petroleum system's validity in various parts of the Guajira Basin.

"Chuchupa-Ballenas is a shoreline to shallow water accumulation, while

See New Era, page 33

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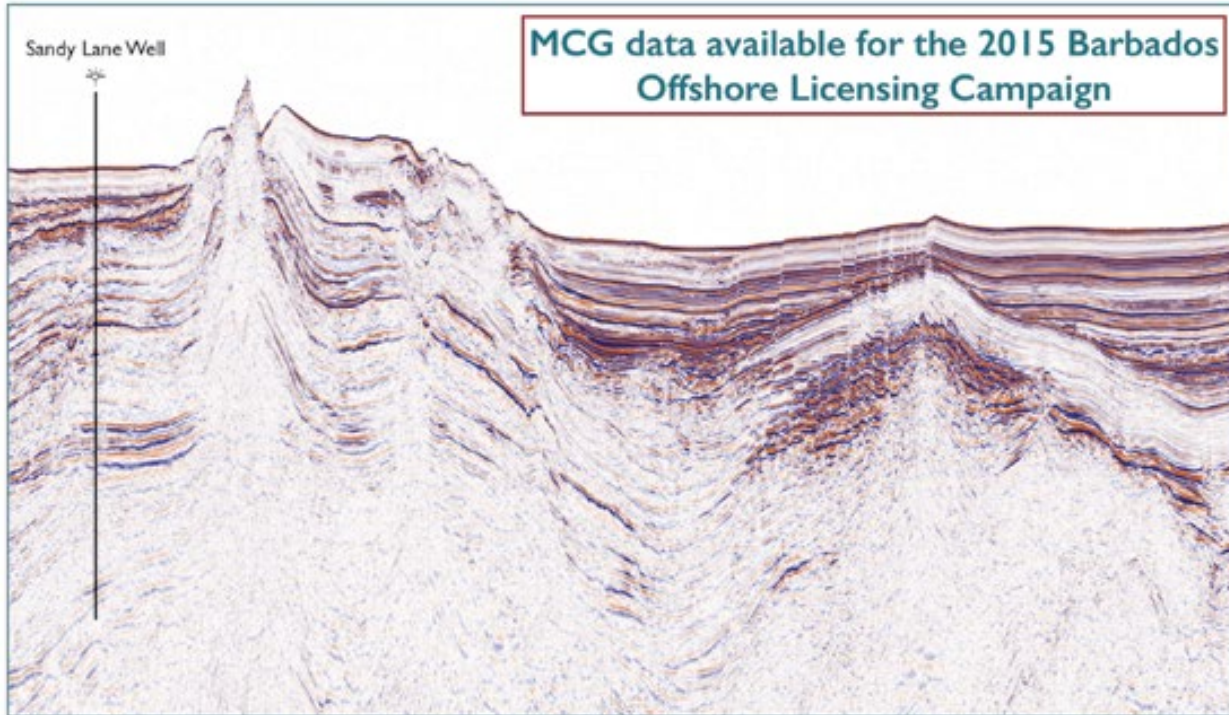
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Fewer carbonate ions available

Ocean Acidification Threatens U.S. Food Security

By PIPER LEWIS, AAPG/AGI Intern

Imagine a future swarming with jellyfish but lacking in oysters, where algal mats smother coral reefs and salmon stocks plummet – a future in which the ocean is more than 100 percent more acidic than today.

The scientific predictions of the impacts of ocean acidification are still evolving, but whatever the future outcome, policymakers struggle to find solutions to these changes.

Since the Industrial Revolution, the ocean has functioned as a carbon sink, extracting at least a quarter of the anthropogenic carbon emitted into



LEWIS

Ocean acidification has already affected the shellfish industry, which is worth \$1 billion dollars a year in the United States.

the atmosphere. However, this carbon sequestration has come with a price: a marked reduction of ocean pH levels.

Scientists at the National Oceanic and Atmospheric Administration (NOAA) anticipate that by 2100, the global ocean

pH will have decreased by .5 and be at least 100 percent more acidic than it is today.

More acidic oceans will affect the security of our food supplies, but scientists and policymakers are considering ways to mitigate the impacts.

Ocean acidification has a major impact on food networks because it changes the chemistry of ocean water and the availability of carbonate ions. Shell-based marine organisms rely on carbonate ions to build their calcium carbonate shells; however, as ocean chemistry becomes more acidic, fewer carbonate ions are available to make those shells. A study conducted by NOAA's Northwest Fisheries Science Center has shown that increased acidity can dissolve the small, carbonate-reliant creatures that form the base of much of the ocean food chain.

While ripple effects from depletion of these small creatures have yet to be acutely felt, ocean acidification has already affected the shellfish industry, which is worth \$1 billion dollars a year in the United States according to the Natural Resources Defense Council.

Oyster larvae have recently experienced sudden die-offs and production has "plummeted by as much as 80 percent between 2005 and 2009" according to the NOAA Pacific Marine Environmental Laboratory (PMEL).

As George Waldbusser of Oregon State University College of Earth, Ocean and Atmospheric sciences explained, oyster larvae "precipitate roughly 90 percent of their body weight as a calcium carbonate shell within 48 hours."

Because young oysters have not yet developed feeding organs at this stage, they "rely solely on the energy they derive from the egg," he said.

Lower pH means there are fewer carbonate ions available in the water, so more energy is needed for the oyster to build a shell, and as a result many oysters die within their first two days. PMEL projects that "acidification could reduce U.S. shellfish harvests by as much as 25 percent over the next 50 years."

Possible Long-Term Solutions

To tackle the issue of ocean acidification in the state of Washington, Gov. Christine Gregoire convened the Blue Ribbon Panel in February 2012 to address ocean acidification at a regional level. Many of the panel's recommendations—increased monitoring, creating forecasting models, researching the effects on marine organisms and ecosystem impact, providing education, and raising awareness—echoed the Federal Ocean Acidification Research and Monitoring Act (FOARAM), which Congress passed 2009.

An Interagency Working Group on Ocean Acidification (IWG-OA), set up under the provisions of FOARAM, fosters collaboration among U.S. federal agencies, including NOAA, the National Science Foundation, the Bureau of Ocean Energy Management, the Bureau of Safety and Environmental Enforcement, Department of State, Environmental Protection Agency, NASA, U.S. Fish and Wildlife Service, U.S. Geological Survey and the U.S. Navy.

Continued on next page

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* Cancer Facts and Figures 2015. The 5-year survival rate for all cancers diagnosed 2004-2010 was 68%, up from 49% in 1975-1977. Although relative survival rates provide some indication about the average survival experience of cancer patients in a given population, it may not predict individual prognosis and should be interpreted with caution.

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AT1145197



Continued from previous page

The IWG-OA produced a Strategic Plan for Federal Research and Monitoring of Acidification, and member agencies have spent an average \$22 million annually on activities related to ocean acidification, including monitoring and research aimed at understanding its biological impacts. However, a 2014 Government Accountability Office report found that several of FOARAM's requirements have yet to be met, including outlining budget requirements, and generating adaptation and mitigation strategies.

Members of the scientific community have been researching adaptive strategies.

The most direct and frequently suggested adaptive strategy is to reduce emissions from, and use of, fossil fuels. Another involves increasing the natural uptake of carbon from the air by planting trees and conserving forests, mangroves, seagrass beds, and salt marshes.

While a shift to renewable or greener energy and additional carbon sequestration from natural sources or carbon capture would positively impact the future ocean, any adaptive strategy will still entail years of mitigation while the ocean's carbon cycle buffers and rebalances: NOAA research shows that current upwelling of deep water off the West Coast reflects the carbon emissions of 30 to 50 years ago.

Possible Short-Term Solutions

Some researchers have proposed strategies with more immediate effect. One such strategy is to seed the oceans with iron; iron dust triggers plankton blooms, which quickly take up carbon dioxide as they grow.


However, out of 12 small-scale tests thus far of the iron seeding theory, only three have shown carbon reduction, though it is still unclear at what exact level of effectiveness. Also, the iron seeding theory has many potential drawbacks, including unforeseen impacts on the food chain and potential depletion of nutrients and oxygen caused by the bloom.

Engineered weathering is another potential strategy, proposed by researchers at Harvard and Penn State. The process would involve extracting hydrochloric acid from the ocean, then exposing it to silicate material for a net alkaline affect. This treated solution would be poured back into the ocean, resulting in increased ocean alkalinity. As a result, the ocean could hold more dissolved carbon in bicarbonate form – the type of carbon used by shell-forming creatures. However, the cost of creating facilities to carry out this process would be prohibitively expensive. The study's researchers also note that more studies to assess the process's environmental impact would have to be done before any implementation.

Bioengineering offers a potential answer for the shellfish industry. While oyster growers have dealt with the threat of acidification through monitoring water acidity and closing intakes to prevent corrosive water from reaching oyster larvae, and adding sodium carbonate to their tanks to help with shell growth, a long-range solution via breeding oysters for specific traits, namely resistance to acidity, is a frequent suggestion in studies on the issue.

* * *

Ocean acidification directly impacts food security and the U.S. economy.

Through bills like the FOARAM Act, and regional work like the Washington State Blue Ribbon Panel, policymakers are working to address these issues. However, our understanding of ocean processes and the impacts of ocean acidification are limited, necessitating further research and monitoring to better understand these systems. Moving forward, scientists will focus on generating adaptive strategies for preventing long-range impacts, and on mitigation strategies to cover the lag time between implementing those adaptive strategies and when they take effect. 

(Editor's note: Piper Lewis is a geosciences policy intern at American Geosciences Institute. She received her undergraduate degree in geosciences from Earlham College. She is particularly interested in ocean sciences.)

New Era from page 30

the accumulation of gas in Orca-1 is a deepwater discovery," he said. "If Chuchupa opened Colombia's offshore frontier, Orca inaugurated the country's deepwater exploration era."

Looking Ahead

And the story does not end here.

The Colombian national oil company, along with its partners, is accelerating its drilling campaign in Sinú offshore and other Caribbean frontier basins.


Southwest, toward the Panama border, Ecopetrol is working hand-in-hand with Anadarko, a partner widely

recognized for its successful operating record in deep water environments.

The Anadarko-Ecopetrol consortium started 2015 drilling two wells in the promising Southern Caribbean frontier province.

Ramirez noted that, despite the industry downturn, Ecopetrol is determined to take advantage of the momentum stemming from offshore Colombian activity and initial successful results.

Plans for 2016-17 include continued tests of proposed concepts, drilling between four to six wells with partner operators and drilling its well in Colombian waters as a direct operator.

"Ecopetrol expects additional good news," he said, "and with this hope, continues strengthening its presence in the Colombian Caribbean." 



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ACE Offers Networking Opportunities for YPs

By JONATHAN ALLEN and MEREDITH FABER, Young Professionals Committee Co-Chairs

By the time this article hits your desk we'll be in the midst of the Association's flagship event, the Annual Convention and Exhibition (ACE), held this year in Denver.

As in past annual meetings, an outstanding technical program that represents the best and brightest developments in petroleum geoscience will be on offer.

However, while the poster and oral presenters will be introducing new techniques, methods and concepts to their colleagues, many ACE attendees



ALLEN

There is a large percentage of professionals working in the oil and gas industry who can thank a member of their network for putting them in contact with a potential employer.



FABER

also will be looking to introduce themselves to potential employers.

The 2015 downturn has taken a toll on all aspects of the industry, especially its work force. And for those left

contemplating their next career move, the Denver meeting was an excellent opportunity to market their skills and experience, and utilize their personal connections.

A major benefit of AAPG membership is the networking opportunities.

Activities like the Young Professionals (YP) Meet & Greet, which has been a staple of AAPG meetings for years, afford students, new graduates and early-career geoscientists the chance to interact with seasoned

professionals, many of whom represent major companies.

In this tenuous economic environment, these interactions are essential to individuals seeking employment. Who you know can be just as important as what you know.

And knowing that can make all the difference in the job hunt.

For example, the only reason one of us (Jonathan) landed an internship – which later translated into full-time employment – was because he was introduced to a team leader at the alumni networking event held at ACE, who asked him to send him his résumé. This took place during the brief downturn in 2008 and 2009.

There is a large percentage of professionals working in the oil and gas industry who can thank a member of their network for putting them in contact with a potential employer, sending in a good word or directly giving them an opportunity. It's important to realize that these opportunities don't just fall into your lap. You need to work for them.

Consulting geologist and AAPG member Kay Schrodt stresses how critically important networking is during the ups and downs of the oil industry and has a number of strategies to maximize the networking opportunities provided by AAPG. At an annual convention, you'll find Kay keeping busy by attending the All-Convention Luncheon, participating in alumni and company-sponsored happy hours, going on field trips and judging oral and poster presentations. Each of these different settings gives you an opportunity to meet or re-connect with other industry professionals and you never know who might hand you their card.

Downturns can be extremely difficult and stressful times, especially for young professionals who may not have a wealth of experience propping up their résumé.

However, if that résumé makes it into a hiring manager's hands by way of a friendly face, your chances of being considered for an interview have increased.

AAPG is responding to the current downturn by creating survival toolkits, compiling lists of the most trusted recruiters in the major industry centers, developing career-oriented newsletters and updating Visiting Geoscientist Program material. The concern this organization is showing toward our members who have been affected is truly admirable.

Our members look out for each other when times are tough. One of the most important things you can do to help your career is get to know them.

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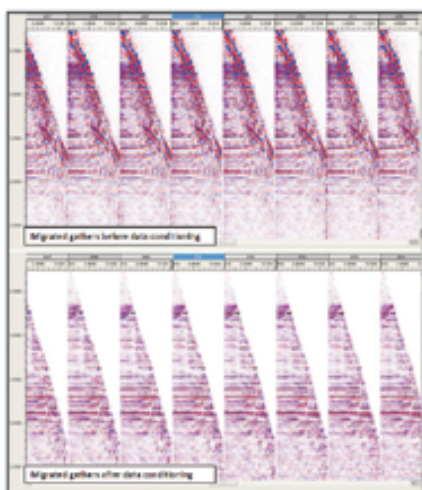
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Seismic data conditioning

Today, most seismic data are processed by external service providers who deliver carefully migrated data volumes to their customers to meet their objectives. Seismic data conditioning is a term commonly used to describe additional interpreter-driven signal enhancement and noise reduction to migrated data to facilitate conventional mapping or improve the behavior of subsequent processes such as amplitude vs. offset, poststack and prestack inversion, residual velocity analysis, amplitude vs. azimuth estimation, and multiatribute facies classification. Such additional processing may be driven by the needs of a particular process, by the addition of new well or completion data, or by a new hypothesis to be evaluated.

We anticipate contributions on:

- common pitfalls and misconceptions about migrated data
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- limitations on linear AVO models at far offsets
- data conditioning and well ties of depth migrated data
- data conditioning workflows to improve the low frequency components necessary to tie production
- data conditioning workflows to improve AVO and prestack inversion
- data conditioning workflows to improve residual velocity analysis
- data conditioning workflows to improve vertical and lateral resolution
- data conditioning workflows to improve anisotropy estimation
- data conditioning workflows to facilitate automated horizon picking and fault mapping
- case studies showing the advantages of data conditioning on stratigraphic objectives
- case studies showing the advantages of data conditioning on resource plays
- post migration coherent noise suppression
- suppression of acquisition footprint
- innovative data conditioning algorithms



An example of (top) "final" migrated gathers and (bottom) the result of further interpreter-driven seismic data conditioning. Images courtesy Doug Cook.

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Coury: 'A Story of Survival'

By BARRY FRIEDMAN, EXPLORER Correspondent

Anny Coury can't type. It's a statement you'd never, never read about nor ask of a male geologist.

And that's the point here. Coury's career in geology – highlighted by 20 years at the U.S. Geological Survey, where she evaluated potential world oil resources – was, in large part, about breaking glass ceilings for women.

Even if she never thought they were that unbreakable. Even if she never considered herself a role model.

For starters, her father didn't want her to type. When she was a little girl, her dad, a chemical engineer in Poland, urged her never to learn to do so, wanting to keep her out of the secretarial pool – wanting her, instead, to become something more.

It was a decision that keeps resonating in her life.

"Can we," she wrote back after receiving a list of questions, "do this by phone?"

Sure.

The first time I called, she was unavailable. She was teaching Yoga.

Anny Coury is 87.

Anny Coury, one of the pioneers of geology – a title she doesn't particularly like (the real pioneers never do) – spent the early part of her career, before the USGS, exploring and drilling in Texas.

By the time she retired she had overseen the operations of her own assigned areas, headed projects, was perhaps the first woman geologist to visit an offshore rig



Coury on Block 610 in 1956.

and rose high in the ranks of the USGS hierarchy.

But put all that aside for a moment, as well as her groundbreaking work, editing "Prospective Hydrocarbon Provinces of the World," which was part of AAPG's "Basins of the World" series.

Hers is a personal story: A love of geology, sure, and the people in it, but a story, more importantly, of survival and modesty, one that goes back to the 1930s and early '40s, when, as a young girl and along with her family, fled from the Nazis through Europe – a journey that would lead them from Paris to Spain to Portugal to New York to the deep South of America and eventually to Fort Worth.

It was a time (you soon learn by listening to her) that defined her, but didn't imprison her.

Three Strikes and a Glass Ceiling

"You want to know why I became a geologist," this woman who finished high school at 15 and graduated from the University of Texas at Austin at 19 asked and laughed. "You really want to know?"

"My father wanted me to be a doctor, but I was not social enough. I mean, I didn't know I wasn't social enough, but I wasn't."

Still, she thought, in her words, it would be a "fine idea" to go into medicine. But then UT geology professor Sam Ellison

talked to her about majoring in geology.

Medicine? She was told to forget it – and to forget it for three reasons.

"He said, 'Number one: you're a woman.' Now remember, this is 1944," she recalled. "Number two, you're Jewish. Number three, you're not a veteran."

"So, I had three strikes against me because there was a quota for women, for Jews, and there was a preference for veterans," she said, "so I thought I'd study geology because I was in Texas and there

was a lot of oil there. So that's what I did."

It was not that geology didn't have similar exclusionary walls; they just weren't as impossible to traverse.

"I think, unconsciously, it attracted me to be in a field that was not normal for women," she said. "I wanted a challenge – so I got my degree in geology and went to Houston and started looking for a job."

Houston, she said, was "where the action was." So there she started knocking on doors.

"First thing they asked me – 'Can you type?'"

She was – maybe because of that – finally offered and took an entry-level position at Hoard Exploration Co., a small oil and gas company, where she correlated old geophysical records.

It was a nice job – but she wanted more.

Continued on next page



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Continued from previous page

She got a job offer from a consultant, J. Brian Eby, who had an office in the Esperson Building near Hoard's offices. Of course, his first question was, "Can you type?"

Merci, papa.

No, she said – a good answer, because he put her to work on prospects.

She knew, though, she wanted to get into exploration, despite being told flat out by some companies, "We don't hire women."

At that time, she says, she knew of only three other women working in petroleum in Houston – Doris Curtis, Joyce Jones and Ann Leeds.

Then Western Natural Gas, a division of El Paso Natural Gas, a company that had leases in South Texas and Canada, offered her a job as an explorer – but there was a hitch.

The chief geologist who hired her said, "You know, if you were a man I would offer you this much."

It was about \$325 a month – about the industry average in 1951 or '52.

"But since you're a woman," he told her, "I can only pay you this much."

It was about \$50-75 less.

"Sure," she said, "I'll take it."

She worked there a couple of years, got to drill her own wells, the chance to look at logs – *her* logs – before anyone else, was offered work on an offshore rig, though, she was cautioned there would not be a special bathroom for her when she got there.

"I told them I was not worried about it."

Was she aware of the inequality?

"You know, I was not aware. I was not unhappy. I was doing what I liked to do; I was getting paid for it. Maybe I was too innocent or dumb to realize what was going on, but I was not dissatisfied."



Coury as a child in Portugal escaping the Nazis.

It was a different time.

An understatement.

It was a terrible time.

Exodus

Her parents were born in Ukraine and Poland, in parts of those countries, more specifically, regularly being absorbed by other nations.

"My parents knew I was going to be an only child, because they knew from their experience, they would have to run," she recalled. "My parents' lives were geared to an eventual escape from Hitler."

And they did.

In grade school, she remembers going to school with her lunch in one hand and her gas mask in another.

When the Nazis came, her family fled Paris. The trek though Europe began, culminating in a moment in a Portuguese embassy, where her father hid in the



Coury at work, checking minerals by maps.

restroom after being told to come back the next day to retrieve the necessary travel documents.

"I cry every time I tell this story," she said, her voice quivering. "He heard the cleaning crew arrive later that night and ventured out and into the office and discovered the consul general was still there. My father ... he ... he got on his knees and begged for visas to save his family."

"And we got them."

An only child – they knew.

Years later, after her mother died – a year after her father (they were both 55) – a nurse asked Coury about her next of kin.

"I didn't have any."

"But, of course now," Coury said, nursing a cold and juggling another call with her daughter, "I made a family, I have kids, grandkids and I'm not bitter."

Not entirely anyway.

"I forgive and forget, but I won't go to Germany," she said. "I don't think

all Germans are Nazis, I don't think all Germans are bad, but they abolished my family."

Today ... and Tomorrow

It's difficult to get back to geology after hearing this, for Anny Coury is more than her résumé, more than a successful geologist in an industry dominated by old white men.

In talking about her career – and Robbie Gries, a past AAPG president, calls it "enormous" – Coury takes it all in stride. She has no regrets, no unfulfilled professional goals.

Indeed, despite the many challenges facing women in general and her specifically, Coury eventually was able to work at places that were "very modern ... in their approach to working professional women."

In fact, at one point in her career (working for Union Texas Petroleum) her boss was the late AAPG member and Pioneer Award winner Frank Sonnenberg, who proved to be a great mentor – he had her working on stratigraphic traps around salt domes – and they remained good friends long after she left the company.

She retired from the USGS in 1995, and as mentioned, she teaches Yoga. She's also a sculptor, and she's traveled throughout the world.

She sees herself as something of an outsider. Still, of her time with the USGS and its scientists, she talks of overcoming not gender, but expectations.

"Most of them are snobbish Ph.D.'d geologists, but I didn't have a Ph.D.," she said. "I didn't even have a master's degree, but I made it to GS-15, top of the grade."

That she did.

And she still can't type. ☒

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GTW Side Trip Goes Inside the Volcanology of Mt. Etna

By RACHEL HENDERSON, AAPG Europe Conference Producer

AAPG Europe's latest Geosciences Technology Workshop (GTW), "Fractured Reservoirs: The Geological, Geophysical and Engineering Tools to Crack Them," provided the opportunity to visit the island of Sicily, steeped both in beauty and an active geological history.

And what is a trip to Sicily without a visit to the tallest volcano in Europe?

The iconic Mount Etna resides on the island's eastern side, boasting a height at the summit of 3,340 meters above sea level and flanks that span more than 1,260 square kilometers, although its eerie presence seems to loom over the island's entirety – and its dangerous beauty lulling you into a false sense of security.

We were lucky enough to receive the VIP treatment, led by volcanologist and Mount Etna expert Carmelo Ferlito, from the University of Catania, who assured us we'd be taking a "unique" tour of what Etna had to offer.

And off the beaten track it was!

Our first stop was to observe the small parasitic cones on the lower flanks of the Etnean edifice, which were somewhat of a precursor for the white-topped splendor we were about to experience. From this point, we were able to experience the complex geological setting that molded Etna's morphology with the Hyblean Plateau fold-thrust belt system in our immediate line of vision.

After a quick stop off and photo opportunity, it was back on the bus to face



Volcanologist Carmelo Ferlito of the University of Catania leading the tour up Mount Etna.

our ascent further up Etna's flanks.

Eventually, the bus could take us no farther, and it was time to begin our ascent up this magnificent stratovolcano. There it was, covered in a meter of unexpected snow, and there we were, questioning if we made the right choice by looking up at the daunting challenge ahead. We decided to go for it, and not look back (or down!).

After a 10-minute climb through the deep powder, our first point of call was a large graben structure, allowing us to understand the extensional rifting that had taken place during Etna's formation,

and plunging us deeper into the complex geological context of the area.

Once we got our breath back and had an opportunity to absorb our surroundings, we continued onward and indeed, upward, sampling Etna's complex petrology along the way. Perfect examples of basaltic and pyroclastic lava flows, heavily vesiculated and dark in color, only had me wishing I had dusted off my hand lens to sample its inner detail.

As our seemingly never-ending ascent continued, we soldiered on through the snow until we reached a prominent NNW-

SSE trending dike, a prominent feature and natural stopping point in the otherwise all white blanket that surrounded us. The dike boasted large feldspathic crystals at around 50 percent of the total composition, and the presence of which could not go unnoticed within its surrounding dark basaltic matrix.

This particular dike had been the subject of some of Carmelo's recent research, who explained his unique theory regarding magma crystallization, with the formation of crystals occurring after the magma had been extruded, and controversially at a fast cooling rate – allowing us one step closer into Etna's complex inner workings.

Continuing the ascent up the white flanks of Etna we finally reached the breathtaking and main focus of our trip: the Valle de Bove, a collapsed caldera, eight kilometers in width, carved into the eastern flank of the Etnean edifice.

No words could describe the views from here, instantly leaving us free of the worries we faced at the beginning of our ascent. It seemed like the natural place to stop for lunch, although a constant haze of gas accompanied us from Etna's summit – a gentle reminder of its dangerous capabilities.

It seemed lunch provided us with a new lease of life, and the energy to begin our descent. Following Carmelo, who seemed at home in the snow, we leaped, ran, slid and fell our way down to the bottom of Etna, where our guided tour ended.



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EAGE/AAPG Tight Reservoirs in the Middle East

4-6 October 2015, Abu Dhabi, UAE

This workshop is the outgrowth of continued cooperation between AAPG & EAGE to develop a series of multi-disciplined gatherings dedicated to understanding, completing & producing tight sandstone & carbonate reservoirs.

The growing demand over time & continuous consumption seemed to be behind the idea of seeking other gas and oil resources in the deep & tight reservoirs. Exploration & development activities have increased in the last few years to cover the Middle East requirement of hydrocarbons where it is highly anticipated to be one of the most attractive & technically challenging areas.

Geoscience Knowledge Management Challenge

26-28 October 2015, Dubai, UAE

This three-day workshop will be dedicated to capturing best practices and lessons learned from knowledge management challenges in a changing oil market. The upstream within the Middle East's NOCs, IOCs and service providers are paying close attention to the issue of knowledge management due to a major demographic shift which has been dubbed as the "Great Crew Change." There are two major events which are occurring simultaneously: experienced professionals are retiring or leaving from companies, simultaneously a large influx of young professionals are joining the workforce, thus creating a noticeable knowledge gap. This knowledge, which is at risk of loss, has a high intellectual asset value for the upstream, and can impact both short and long term plans.

Carbonate Reservoirs of the Middle East

23-25 November 2015, Abu Dhabi, UAE

This three-day workshop is dedicated to sharing knowledge, ideas and workflows in exploring for and developing hydrocarbon bearing carbonate reservoirs of the Middle East. The workshop will emphasize case studies involving field scale reservoir characterization to regional scale lithofacies distribution, depositional models and sequence stratigraphy. This workshop will review case studies via maps, cross sections and well data that illustrate the regional to field scale distribution of lithofacies and how they fit into an overall depositional model and their sequence stratigraphy. Key learnings include the distribution of carbonate reservoirs throughout the Arabian Plate. Issues include both technical and management decision making. Cores from several Middle East carbonate reservoirs will be on display as well as poster sessions.



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QER Addresses Changing Energy System

By EDITH ALLISON, Geoscience and Energy Policy Office Director

News stories periodically highlight flaws in the U.S. energy infrastructure, from northeast natural gas deliverability problems and high consumer prices during cold weather to railroad accidents involving crude oil tank cars.

All of us also are aware that our energy supply is changing, and our infrastructure will need to provide for increasing domestic production in new areas of the country, decreasing total energy demand and the shift from coal to natural gas and renewables.

Concerns over aging or inadequate infrastructure and changes in the energy mix led the Obama administration to focus the first Quadrennial Energy Review (QER) on transmission, storage and distribution infrastructure.

The QER defines the goals for the U.S. energy infrastructure as:

- ▶ Enhanced resilience.
- ▶ Reliability.
- ▶ Safety.
- ▶ Asset security.

The assessment looks specifically at natural gas pipelines, the electric grid, the Strategic Petroleum Reserve and the problems of the rail and barge systems shared by coal, oil, ethanol, grain and other goods.

The review also recognizes several crosscutting needs, including:

- ▶ Increasing the energy workforce.
- ▶ Expediting infrastructure siting.



ALLISON

Several senators complained that the QER did not consider the possibility – and infrastructure impacts – of oil exports.

▶ Improved integration of the North American energy markets.

Infrastructure improvements are constrained by the size of the system: The U.S. energy infrastructure includes

approximately 2.6 million miles of interstate and intrastate pipelines.

To put this in perspective, there are 2.6 million miles of paved roads in the country.

The first Quadrennial Energy Review is supplemented by an additional analysis, "Natural Gas Infrastructure Implications of Increased Demand from the Electric Power Sector."

This supplementary analysis concludes that natural gas transmission and distribution lines are less of a problem than might be expected, given that about half of these pipelines were built in the 1950s and 1960s and are prone to leaks.

It also concludes that natural gas pipeline additions and expansions needed between now and 2030 (ranging from 38 to 42 billion cubic feet

per day, Bcf/d, capacity) would be less than the nearly 127 Bcf/d of pipeline capacity added between 1998 and 2013. This would require expenditures of between \$2.6 and \$3.5 billion per year over the 2015 to 2030 period.

The unexpectedly low additional capacity requirements result from increasing geographic diversity in natural gas supply – from shale basins – and demand, with replacement of natural gas for coal in electricity production in many regions.

The study also sees potential for increased utilization of existing pipelines.

– EDITH ALLISON

We also have about 640,000 miles of transmission lines; 414 natural gas storage facilities; 330 ports handling crude petroleum and refined petroleum products; and more than 140,000 miles of railways that handle crude petroleum, refined petroleum products, liquefied natural gas and coal.

Modernization of the energy infrastructure also is complicated by the long operational life and slow turnover of aging or obsolete pipelines or electric grids; high initial capital costs; predominantly private ownership; a patchwork of local, state and federal policy and regulation; a lack of timely investment; and individual (home or business) production of electricity that does not contribute revenue for grid operation.

The potential for terrorist attacks on infrastructure – including cybercrimes – is a real but poorly quantified risk.

* * *

The QER, consistent with the Obama administration climate action plan, also considers ways to reduce greenhouse gas (GHG) emissions from infrastructure.

Cast iron and bare steel pipelines represent 9 percent of national natural gas distribution systems but

Continued on next page



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Continued from previous page

contribute 30 percent of methane leaks. Replacement of these leak-prone pipelines is estimated to cost \$270 billion.

Many states have infrastructure modernization initiatives, but these programs may require many decades.

In addition, QER recommends increased research into the volumes and sources of GHG emissions from natural gas infrastructure and proposes grants to help reduce diesel emissions around ports and rail yards.

The need to construct new electricity transmission lines over the next 15 years is estimated to be comparable to historical construction levels. New electric grid investments will replace aging infrastructure, help maintain reliability and aid in meeting policy objectives such as state renewable energy goals.

Smart grid technology, improved electric storage and growth in distributed generation all are expected to help reduce construction requirements.

Shared transport – especially rail and barge – for crude oil, ethanol, coal and grains continues to be under strain despite a recent decline in crude oil shipments. The QER recommends increased data acquisition and analysis to understand the causes and impacts of delayed rail shipments.

(Government and industry already are implementing changes in railcar design and operational procedures.)

* * *

The QER proposes about \$15 billion in federal spending and tax credits over a decade – a figure Congress is unlikely to support, even though the amount is a fraction of the private sector spending that is envisioned.

Most of the proposed federal funding is designated for research, analysis, improved data for decision-making, and grants to state and local governments.

Many recommendations in the QER require congressional action to be implemented. Congress has independently determined that it needs to act to improve U.S. infrastructure, although the congressional leadership is approaching the subject in a different way from the executive branch.

At a hearing on the QER, Sen. Lisa Murkowski, R-Alaska, commented that infrastructure improvements depend on private funding commitments that require regulatory certainty and predictability. That would include:

- ▶ A reduction in subsidies and preferences for renewable energy sources.
- ▶ An end to new environmental regulations and multi-year project delays caused by lawsuits.

At the same hearing, several senators complained that the QER did not consider the possibility – and infrastructure impacts – of oil exports, which they view as having strong potential benefits to the U.S. and North American economies.

The Strategic Petroleum Reserve (SPR) upgrades also may be subject to congressional-administration disagreements. SPR was designed in 1975 – when oil was not a global commodity, and before oil production from shales – and is designed to move oil to Gulf Coast refineries that currently have a surplus of crude.

The QER recommends new facilities, some pipeline reversals and new U.S.-flagged ships to move oil between U.S. ports and refineries in the event of a domestic or international supply disruption.

Alternatively, some in Congress question whether we should sell off some SPR oil to pay for repairs, or reduce our storage from 140 to 90 days of imports, or eliminate the reserve.

Congress agrees with the QER goals to increase the energy workforce, expedite infrastructure siting and improve integration of North American infrastructure. In addition, Murkowski and Energy Secretary Ernest Moniz have committed to cooperating on the QER legislative goals.

New bills and a fact-finding hearing have been announced for this spring and early summer. [E](#)

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The South China Sea Deep-Water: Stratigraphy, sedimentology, and resources

As the largest marginal sea in the western Pacific region, the South China Sea (SCS) occupies a unique location at the conjunction of modern Eurasia, Indian, and Philippine Sea plates, and between the largest continent, the Eurasia, and the largest ocean, the Pacific. The basin is characterized by the conjugate passive margins on its northern and Southern sides. It is bounded by a strike-slip fault margin off Vietnam to the west, and has been subducting under the Luzon arc to the east. Over 40 Cenozoic sedimentary basins have been recognized in the SCS, in which only the Cenozoic sediment fills may reach an amazing thickness up to 17,000 m. During the past decades, reflection seismology has played a critical role in the geologic investigation of the SCS, with hydrocarbon resources as the most important attraction. In this special section, we invite contributions on seismic stratigraphy, seismic geomorphology and their applications in deep-water sedimentology and resource exploration in the South China Sea.

The editors of Interpretation (<http://www.seg.org/interpretation>) invite papers on the topic **The South China Sea Deep-Water: Stratigraphy, sedimentology, and resources** for publication in the May 2016 special section.

Contributions may include, but are not limited to:

- regional or local seismic stratigraphic and seismic geomorphologic studies
- deep-water depositional system characterization and basin evolution
- petroleum and gas hydrate systems
- case histories

Interpretation, copublished by SEG and AAPG, aims to advance the practice of subsurface interpretation.

The submissions will be processed according to the following timeline:

Submission deadline:
1 August 2015
Publication of issue:
May 2016

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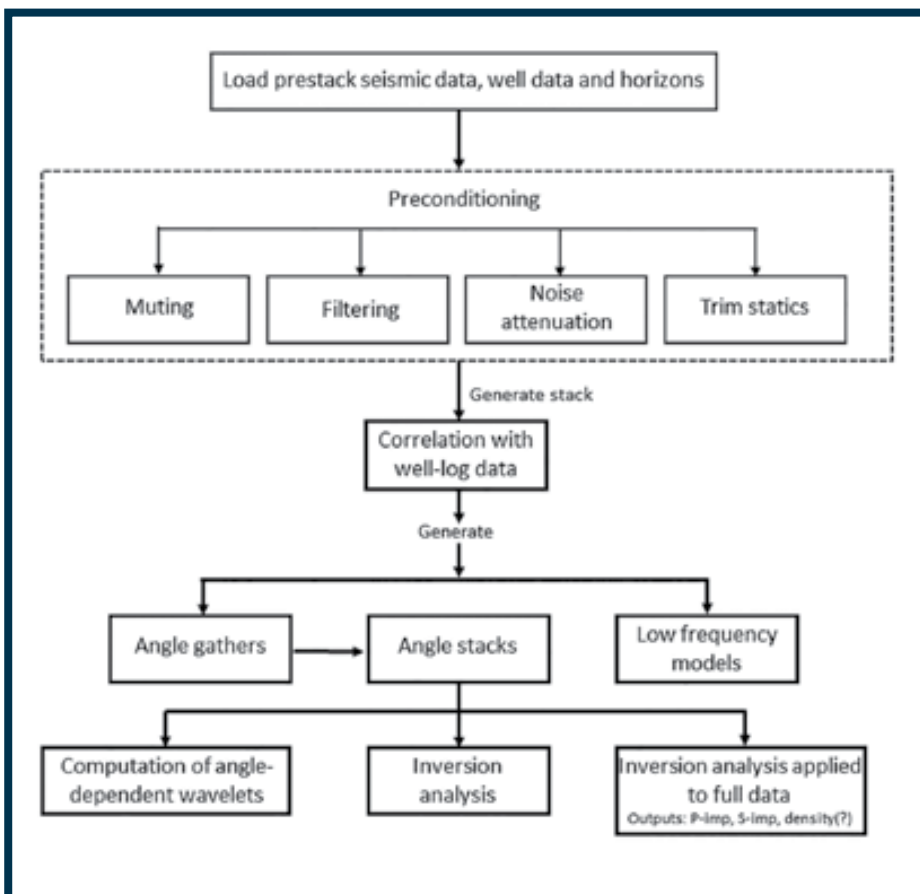


Figure 1 – Workflow for simultaneous inversion.

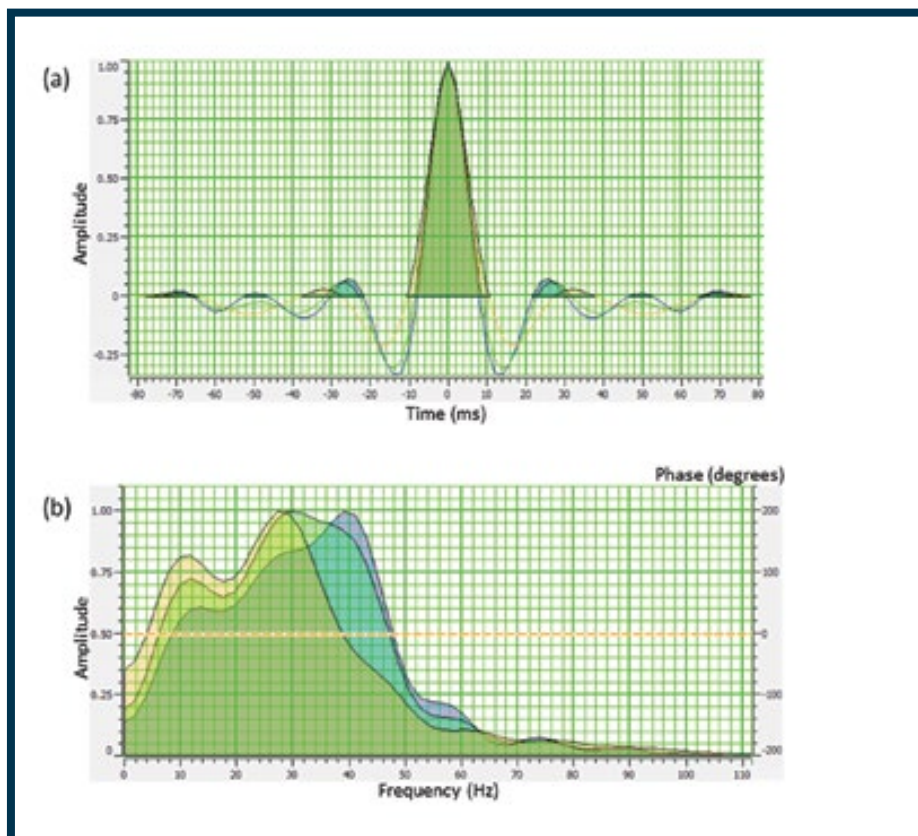


Figure 2 – Three wavelets extracted from the near (blue), mid- (green) and far (light brown) angle stacks, and their amplitude spectra. Notice the frequency content of the wavelet reduces from the near to far angle stack.

Impedance Inversion's Value in Interpretation

By SATINDER CHOPRA and RITESH KUMAR SHARMA

In last month's Geophysical Corner we described the different poststack impedance inversion methods that are available in our seismic industry. In poststack seismic inversion – where there is no mode conversion at normal incidence – it is purely acoustic. P-wave impedance is the only information that can be estimated from poststack inversion of P-wave data.

Prestack inversion can be considered when the poststack inversion is not effective enough to meet the desired objectives, such as differentiation of geologic strata or fluid information.

In a seismic gather, the near-offset amplitudes relate to changes in impedance of the subsurface rocks, and thus depict the correct time of the reflection events. The far-offset amplitudes relate to not only the changes in P-wave velocity and density, but the S-wave velocity as well. The inversion of far-offset amplitudes in a gather yields the elastic impedance (as was described in the October 2012 Geophysical Corner), and can be used for lithology and fluid discrimination.

Thus prestack inversion has an advantage over poststack inversion.

Another significant aspect of prestack impedance inversion is that usually for thin layers in the subsurface, interference effects are reflected as amplitude distortions at different offsets and can be seen after NMO corrections of the seismic gathers. Once the gathers are stacked, however, this information gets lost, and so poststack inversion will not be able to retrieve it. Prestack inversion considers the information in seismic gathers and so is able to provide extra detail, which is not possible with

poststack inversion.

Prestack seismic impedance inversion also is commonly referred to as simultaneous inversion.

* * *

In simultaneous inversion, multiple partial-offset or angle sub-stacks are inverted simultaneously. For each angle stack, a unique wavelet is estimated.

Subsurface low-frequency models for P-impedance, S-impedance and density, constrained with appropriate horizons in the broad zone of interest, are constructed, usually with the use of well log data. The models, wavelets and partial stacks are used as input in the inversion, and the output is P-impedance, S-impedance and density.

The density attribute is stable and useable, only when large offset/angles are available in the seismic gather.

The workflow shown in figure 1 explains the different steps followed in simultaneous inversion. The inversion process begins with the low-frequency model, which is used to generate synthetic traces for the input partial stacks. Zoeppritz equations – or their approximations – are used to estimate the band-limited elastic reflectivities.

Figure 2 shows the wavelets estimated from the near, mid- and far angle stacks for a 3-D seismic volume from the Montney-Dawson area of British Columbia, Canada. The angle-dependent wavelets are convolved with the modeled reflectivities for generating synthetic traces, which are then compared with corresponding real data traces.

The model impedance values are iteratively tweaked in such a manner

that the mismatch between the modeled angle gather and the real angle gather is minimized in a least-squares sense. As a different wavelet is extracted for each partial angle stack and used in the inversion, the angle-dependent amplitude information in the gather is utilized.

Not only are the output components useable for interpretation of the physical rock properties, but the quality of the three elastic parameter outputs is enhanced in terms of better resolution.

In figure 3 we show segments of

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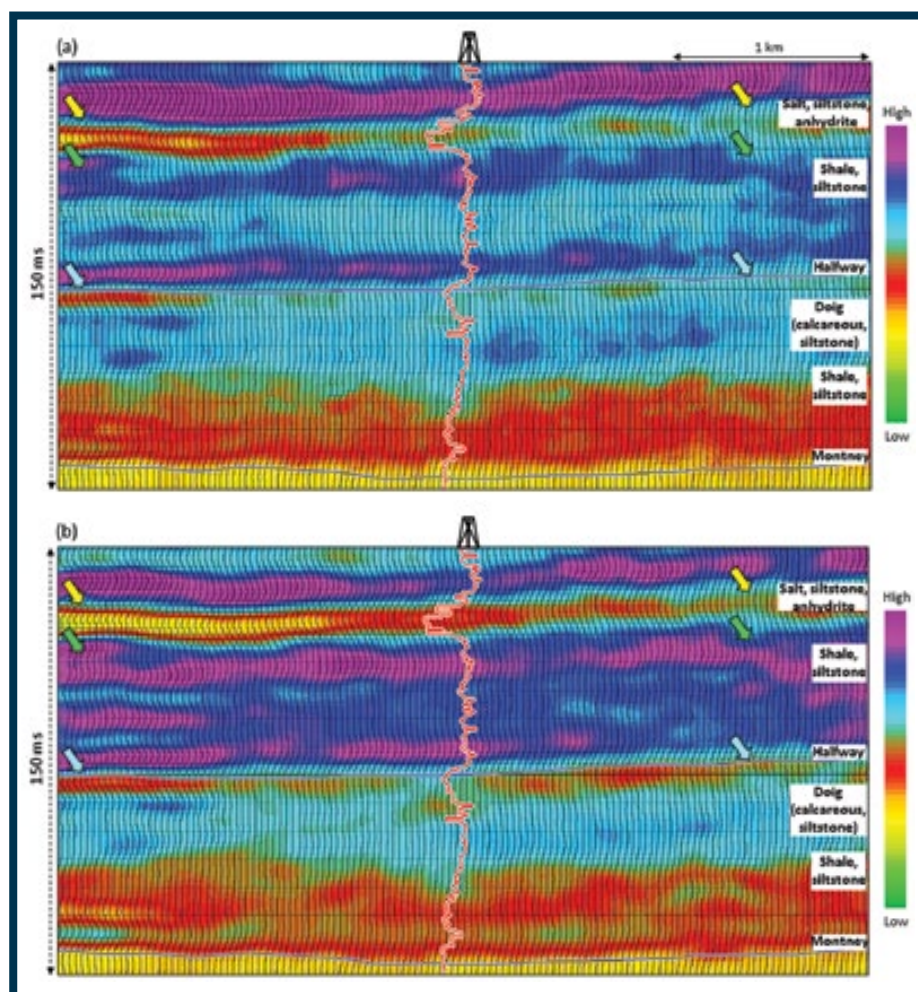


Figure 3 – A portion of a section from P-impedance volume computed using model-based (a) independent inversion, and (b) simultaneous inversion. The yellow, green and light blue arrows indicate the impedance zones (from left to right) that appear much better defined on the simultaneous inversion display in (b) than the independent model-based inversion display in (a).

Continued from previous page

P-impedance sections from the 3-D seismic volume mentioned above:

► Figure 3a exhibits a section from the post-stack impedance inversion carried out on the P-reflectivity derived from prestack data. We refer to this as independent inversion.

► Figure 3b is the equivalent section from simultaneous inversion.

The stratigraphic column for this area was discussed in the May 2015 Geophysical Corner. Shown on the display are the Doig, Halfway (indicated with light blue arrows) and the salt markers (yellow arrows), with shale and siltstone zone (green arrows) in between.

Notice, the different zones are defined much better on the simultaneous inversion section as compared with the independent model-based inversion.

Similarly, we show segments of S-impedance sections from the same 3-D seismic volume in figure 4. Again, the definition of the different zones is seen much better defined on the simultaneous inversion display.

* * *

The discrimination of fluid content and lithology in a reservoir is an important characterization that has a bearing on reservoir development and its management.

Lame's parameter Lambda (λ) is sensitive to pore fluid and is known as a proxy for incompressibility, whereas Mu (μ), the modulus of rigidity, is sensitive to the rock matrix. Referred to as the LMR approach, it consists of determining $\lambda\rho$ and $\mu\rho$ from seismic data (as it may be not possible to delink the effect of density (ρ)).

Once the P- and S- impedances are determined using simultaneous inversion, they are then used to determine the $\lambda\rho$ and $\mu\rho$ attributes. This approach helps in

the determination of fluid and lithology in LMR space by way of crossplotting.

For unconventional reservoirs, such as shale resource formations, besides other favorable considerations that are expected of them, it is vital that reservoir zones are brittle. Brittle zones fracture better – and fracturing of shale resource reservoirs is required for their production.

Among the different physical parameters that characterize the rocks, Young's modulus (E) is a measure of their brittleness. Attempts are usually made to determine this physical constant from well log data, but such measurements are localized over a small area.


For studying lateral variation of brittleness in an area, 3-D seismic data needs to be used.

Computation of Young's modulus from seismic data requires the availability of the density attribute. As stated earlier, the computation of density in turn requires long offset data, which is usually not available.

A new attribute ($E\rho$) in the form of a product of Young's modulus and density has been introduced, which was discussed in the September 2012 Geophysical Corner.

For a brittle rock, both Young's modulus and density are expected to be high, and so the $E\rho$ attribute would exhibit a high value and serve as a brittleness indicator.

The new attribute also can be used for litho-fluid detection, when it is used in conjunction with the product of bulk modulus and density.

All this is possible with prestack simultaneous inversion. 

Next month, we will discuss the inversion of multicomponent seismic data.

(Editor's note: Ritesh Kumar Sharma is with Arcis Seismic Solutions, TGS, Calgary, Canada.)

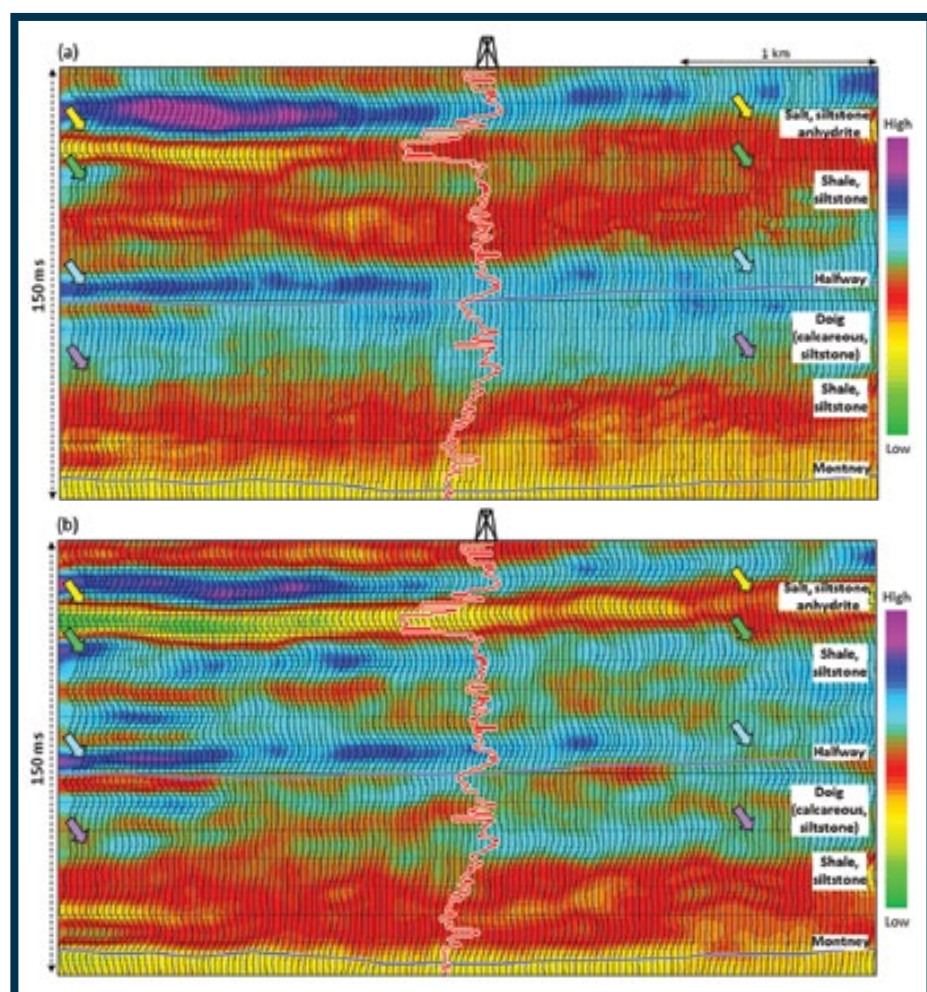


Figure 4 – A portion of a section from S-impedance volume computed using model-based (a) independent inversion, and (b) simultaneous inversion. The yellow, green, light blue and purple arrows indicate the impedance zones (from left to right) that appear much better defined on the simultaneous inversion display in (b) than the independent model-based inversion display in (a).

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A Surprise in the Colombian Foothills

By JAIME CASTILLO

This is the story of the drilling of a costly (\$60 million) Lahee A-1 well in the Colombian foothills, which presented significant deviations from the prognosticated stratigraphy halfway to the objective – and became an operational nuisance.

Nonetheless, it is mainly a story of successful management and prompt response to the geological uncertainty.

Eventually the result was highly satisfactory, as the well:

- ▶ Landed in the best position in a narrow structure.
- ▶ Tested 7,000 b/d.
- ▶ Has produced more than two mbbls of oil since it was completed in May 2009.



CASTILLO



Cupiagua Sur XN1z Platform in the Llanos foothills of Colombia.

The well reached 14,900 feet after 130 days of drilling, which was still 1,200 feet (about 20 days) away from the target and about 1,700 feet (35 days) away from TD. At this point, the stratigraphy was different than predicted, leading to serious concerns about the location of the well relative to the target structure.

The problem was threefold:

- ▶ There was a chance of missing the reservoir, which is always a bad thing, especially in costly wells.
- ▶ Time pressure – This project had specific time limitations for the private partners, given that the producing license

would expire less than one year after completion.

- ▶ Operational – There were about 3,500 feet in the open-hole section, which implied well-stability issues.

Under these circumstances, the subsurface team had the task of evaluating the situation and recommending the way forward minimizing the business impact.

Building Scenarios

The first step was to understand the potential causes of the problem – and the most likely candidates were incorrect

seismic velocities, mapping inaccuracy and incorrect spatial positioning of the seismic events.

Three potential scenarios were defined:

- ▶ The first related to inaccurate time-to-depth conversion, picturing the target horizon to be shallower than its actual subsurface location.
- ▶ The second considered that the mapped seismic reflection had been incorrectly tied and it actually corresponded to a shallower, non-prospective interval.
- ▶ The third scenario was based on the possibility of an important lateral shift on the seismic, resulting in the well drilling in front of the structure.

Having three potential explanations for the XN1z situation was good progress, and the next task was validation.

A quick look at the seismic interval velocities ruled out scenario 1. Anomalous velocities were required to position the reservoir target much deeper than predicted.

The second scenario also was discarded after a fast-track seismic re-interpretation that tied the target horizon to the northwest and southeast well control points in the neighboring Cusiana and Cupiagua fields. This quick mapping exercise supported the presence of the reservoir in the XN1z structure.

During the validation of the third scenario a preliminary reprocessed version of the second existing 3-D seismic dataset became available. In this information, the XN1z structure showed a lateral shift of 300-400 meters with respect to the previous

Continued on next page

The XN1z well was designed to test a relatively small, undrilled fault block in the prolific Cusiana-Cupiagua trend, which is one of Colombia's two most significant discoveries in the last 30 years.

The area of the well itself was part of the Santiago de las Atalayas license, in which Ecopetrol participated with 50 percent and its partners (BP, Total and Triton) held the remaining share. Ecopetrol did not share in the original exploration costs, but after the discovery, as per the original contract, exercised its right to participate in 50 percent of the production costs and benefits.

Most of the contract area reverted to Ecopetrol in June 2010.

When the operators decided to drill well XN1z they were mindful of this deadline, believing the well would pay for itself and return a profit before this date.

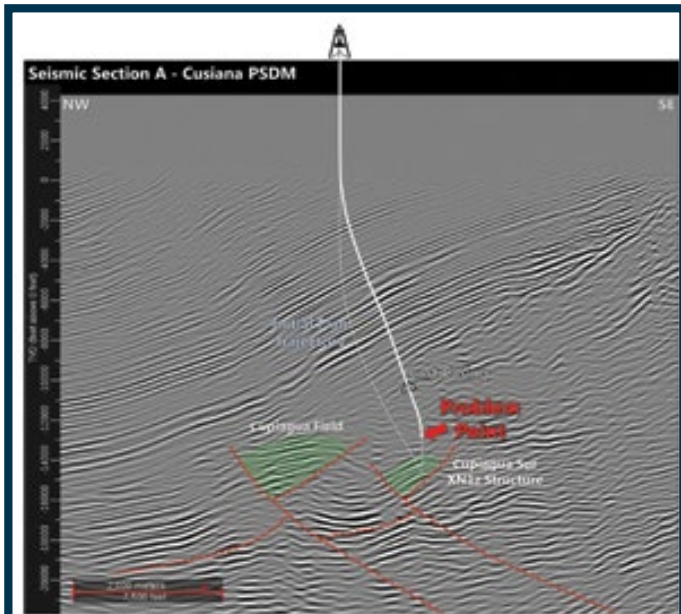
The well was spudded in September 2008 and it was supposed to be completed and producing by April 2009.

Things did not go as planned.

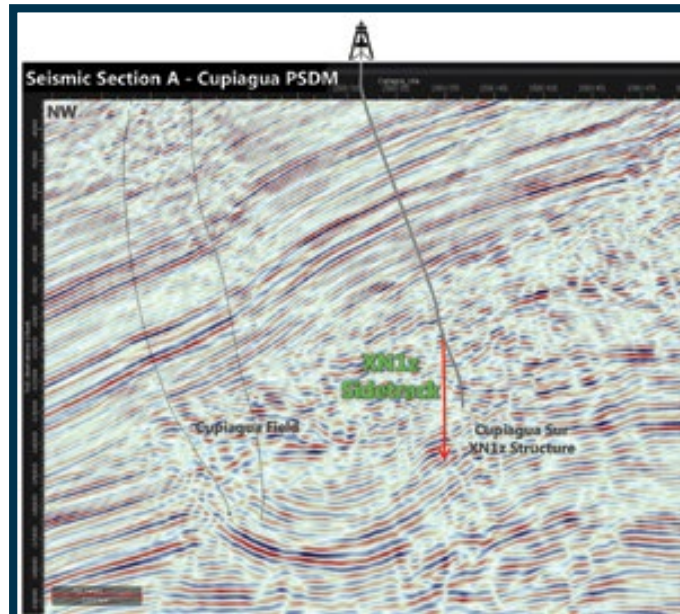
Well Plan

The XN1z well was planned to test and drain a fault block adjacent to the Cupiagua Sur Field. There were two 3-D seismic surveys of the structure and it was decided to plan the well using only the one with the most updated processing version (pre-stack depth migration, PSDM).

The initial well trajectory was “slightly” modified in the last stage of planning, given the requirements for a final vertical section for hydraulic fracturing.



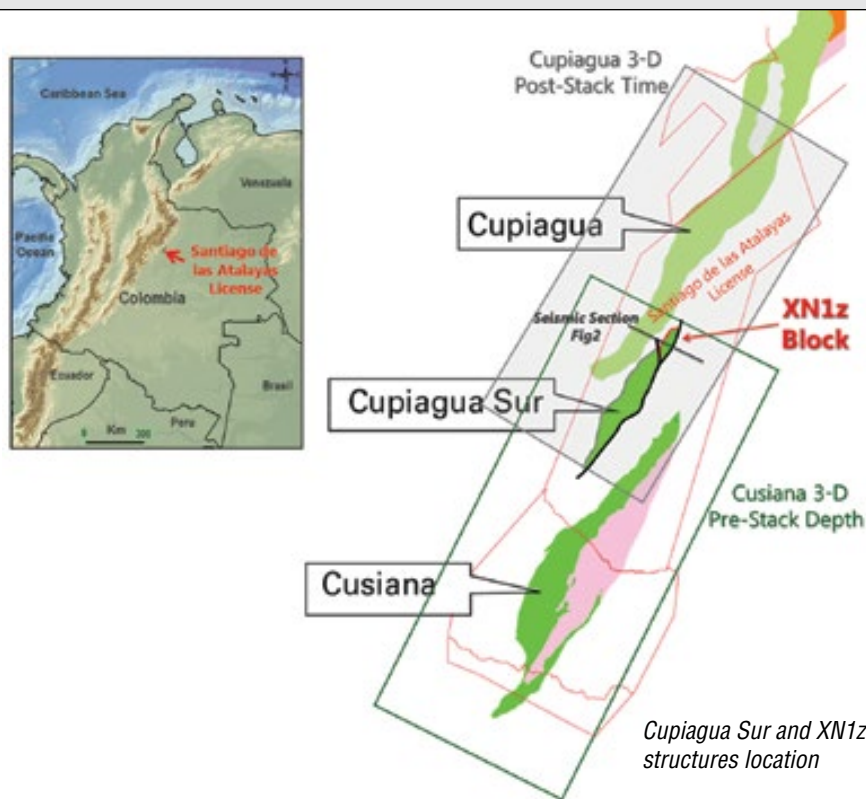
Seismic section from the 3-D survey and XN1z well trajectories.



XN1z side-track trajectory.



XN1z possible scenarios: Time-depth conversion (4a), mapping pitfall (4b) and lateral shift (4c).



Continued from previous page

seismic versions, both in map and cross-sections.

According to the geophysicists, this was due to the anisotropy caused by the layered effect in the overburden wedge.

Unfortunately, in this very short time frame (the rig was waiting for instructions), it was difficult to rule out one of the two seismic data sets available, or to confidently say which one was positioning the geological features more correctly.

The review of the possible scenarios supported the lateral shift of the seismic reflections as the more probable explanation for the difference between the predicted and the drilled stratigraphy in the XN1z well.

Next task: Recommending what to do.

The first choice was to continue drilling up to the planned total depth, confirm the hypothesis, get additional information and plan a geological sidetrack. The second alternative was to stop drilling and make an early sidetrack.

The subsurface team concluded there was enough information to predict that, if continuing in the planned trajectory, the well would probably be landing off the structure – and that it was worth the risk of performing a sidetrack right away.

The next associated challenge was to define the subsurface target coordinates. This required reducing the seismic mapping uncertainty, which was done by remapping the seismic, tracking only the clear, continuous, strong reflection representing the reservoir in each data set, which increased the chances of reaching the reservoir in an optimum location.

This was accomplished by examining all the available seismic versions (time, depth, old and new).

A set of maps for the objective were produced and compared, and the overlapping area for all of them was used in defining the new target.

Stick to the Plan

Finally, it was time to communicate. The subsurface team clearly and openly discussed with the drilling and projects teams the technical support and the reasoning behind the early sidetrack alternative.

The plan also was presented to the upper management and the project partners, highlighting the remaining risks and uncertainties – and then, the

sidetrack well started.

The upper half of the new section was done in 20 days, with a good match to the new prognosis. The stratigraphy in the lower section was, to some point, anomalous and created considerable doubts and tension in the multidisciplinary team and among the decision makers.

The subsurface team had to resist calls to stop drilling and re-design the sidetrack well, increasing the lateral displacement toward the flank of the structure.

The fundamental support to maintain the defined plan was the technical analysis and the consistent methodology used to reduce the uncertainty associated with the seismic data and the mapping.

After 30 days (about 4,400 feet) of drilling, the sidetrack well encountered a siltstone stratigraphic marker with partial correlation, 70 percent certainty of being 20-30 feet above the target level.

Because of the important mud losses experienced and a high risk of stuck pipe events, another difficult decision was made to run and cement the 9 5/8-inch liner.

The well finally, 15 days later, reached the reservoir in the oil leg, validating the third scenario postulated during the framing stage.


The integration of the new seismic mapping, with the drilling data and the structural dips, confirmed that the well landed in an optimal location. Consequently, production delays and reserves losses for private partners were avoided, the well tested 7,200 b/d, and the associated cost savings were estimated to be about US\$7 million.

* * *

Several lessons were derived and applied after this experience, but probably the most important lesson to be used in similar situations, and for planning wells in complex geological settings, is:

Building several geological models that honor the available data, and consider that all of them may have significant probability of occurring.

We often hear about this and build more than one geological model, but we end up applying only our “best” interpretation to any situation and archiving the rest.

A base case is required for planning – but considering alternative scenarios ensures flexibility, contingencies and a better communication of the project’s uncertainties and risks. 

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By APRIL STUART, AAPG FOUNDATION PROGRAM COORDINATOR

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Adam Jackson, Raymond C. Moore Memorial Grant

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Martial Morrison, Edward B. Picos, Jr. Named Grant

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Matthew Rine, Grants-in-Aid General Fund

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Todd Kremmin, William E. & Jean Crain Named Grant

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Jameson Fredericks, Grants-in-Aid General Fund

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Ryan Hillier, Grants-in-Aid General Fund
Lauren Thomas, Grants-in-Aid General Fund

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Cody Stopka, Grants-in-Aid General Fund

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Garrett Brown, Grants-in-Aid General Fund
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- South Dakota School of Mines and Technology
Ethan Melville, Grants-in-Aid General Fund

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- Rice University
Brandee Carlson, David Worthington Named Grant
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Networking from page 28

the classroom, and even before," Castro said.

To that end, the AMGE offers scholarships to outstanding students interested in attending the Congress and has organized the first Student Geollin Geoscience Knowledge Contest as a part of the event.

Hernandez said professional organizations like AAPG and AMGP play an important role in young geoscientists' professional development.

"Local and global technical events and exhibitions give young professionals the opportunity to keep up with advances in petroleum geoscience and technologies as well as meet key people in the industry and start building a network of contacts that will help them better do their jobs and/or find job opportunities," he said.

"Active participation also allows them to develop organizational, communication and personnel management skills that might turn out to be essential in their careers."

Hernandez added that, likewise, students benefit the associations and the industry.

"They provide the means to express and discuss ideas, and access to an up-to-date and historic archive of scientific papers and publications that summarize the evolution and current understanding of petroleum geology in the main petroleum basins of the world," he said.

Castro added that supporting students and organizing events like the Congress helps professional associations serve their members and their country.

"The AMGE has gained a greater

dynamism and commitment to technical excellence. Competitiveness is more important than ever, and our Association is committed to be a bastion of support to our country's energy development," he said.

High-ranking members of the Mexican and international petroleum industry will speak in the Congress's general sessions, which complement a technical program featuring 290 oral session and poster sessions. More than 1,100 operators, service companies and associations will participate in the commercial exhibition.

For Hernandez, attending the Congress in Guadalajara is a perfect opportunity to get connected to the industry in Mexico.

"If you want to be up-to-date with current events going on in Mexico related to the energy reform, bidding rounds, regulation, operators' points of view, Pemex's plans for farm-outs, services and leading edge technology as well as be in touch with petroleum industry professionals as potential employees or employers, the Mexican Petroleum Congress is the place to be," he said.

For Castro, it is appropriate that an historic Congress be held in a historic city.

Guadalajara, named the "Cultural Capital of the Americas" by the Organization of American States, is famous for its architecture, street markets, historical monuments and mariachi music.

The town Tequila, declared a UNESCO world heritage site and birthplace of the famous blue agave drink, is located 60 kilometers from Guadalajara. The Puerta Vallarta beach resort city is a 30-minute flight away.

Tequila and mariachis, beaches and energy. Maybe Mexico really does have it all. [E](#)

PROFESSIONAL newsBRIEFS

Richard Boyd, to supervisor-emerging technology, California Division of Oil, Gas and Geothermal Resources, Sacramento, Calif. Previously geological consultant, Sacramento, Calif.

Dale Fritz, to vice president of geology and reservoir technology optimization, Devon Energy, Oklahoma City. Previously vice president Rockies business unit, Devon Energy, Oklahoma City.

Jay Hightower, to lead geologist, Reatta Energy, Midland, Texas. Previously exploitation/exploration manager, Midland Basin and Eastern Shelf, Apache Corp, Midland, Texas.

James R. Morris has retired from Range Resources, Canonsburg, Pa. He resides in Loudon, Tenn.

Ronald F. Nichols has retired from Netherland, Sewell and Associates, Dallas. He resides in Denton, Texas.

Gary Prost has retired from ConocoPhillips, Calgary, Canada. He resides in Calgary, Canada.

Steve Sonnenberg received the Frank A. Morgan Award from the Wyoming Geological Association, its highest honor. Sonnenberg is professor and Charles Boettcher Distinguished Chair in Petroleum Geology, Colorado School of Mines, Golden, Colo.

Ione Taylor, to executive director-earth and energy resources leadership, Queens University, Kingston, Canada. Previously associate director-energy and minerals and environmental health, U.S. Geological Survey, Reston, Va.

Bernie Vining, to director, Vining Geoscience, London, England. Previously vice president and chief geoscientist, Baker Hughes, London, England.

Ken Whetstone has retired from Newfield Exploration, Houston. He resides in Orange Beach, Ala.

James G. Work has retired from The IPR Group of Companies, Cairo, Egypt. He resides in Katy, Texas.

IN MEMORY

Independent geologist Dudley J. Hughes, an acclaimed wildcatter from Byram, Miss., who received AAPG's Outstanding Explorer Award in 2008, died April 21. He was 85.



HUGHES

Hughes, working primarily in Mississippi and Alabama, developed concepts during his career that opened 65 new fields. Some of his most noted successes included his pioneering work to develop Smackover plays in Alabama and his work with salt-influenced structures extending from eastern Louisiana to the Florida Panhandle, including the Mississippi Interior Salt Basin.

In addition to the Outstanding Explorer (now the Norman H. Foster Outstanding Explorer Award), Hughes also was an AAPG Distinguished Lecturer and in 1996 was inducted into the Mississippi Business Hall of Fame.

* * *

Donald Norman Ballbach, 87
Lafayette, La., Jan. 3, 2015

Clifford Barkell, 94
San Diego, June 21, 2014

Robert William Blaha, 87
Aurora, Colo., Sept. 30, 2014

Darwin R. Boardman II, 63
Stillwater, Okla., Jan. 11, 2015

Billy Jack Brooks, 84
Lawrence, Kan., March 11, 2015

Patrick Daugherty, 88
Wichita Falls, Texas, Aug. 11, 2014

Theodore W. Ehring, 84
Pismo Beach, Calif., Sept. 3, 2014

Billy George Evanoff, 87
Breakenridge, Texas, March 31, 2015

Frederick Roland Haeberle, 95
Delaware, Ohio, March 24, 2015

William Jesse Hill, 90
Midland, Texas, Feb. 5, 2015

Dudley Joe Hughes, 85
Byram, Miss., April 21, 2015

Arthur Vaughan Lewis Jr., 87
Ventura, Calif., March 14, 2015

Paul Russell May, 87
Qatzrin, Israel, Dec. 27, 2014

William J.H. Patton, 86
Calgary, Canada, Feb. 7, 2015

Barry Arthur Reik, 60
San Ramon, Calif., March 15, 2015

John Clarence Rudolph, 90
Polson, Mont., Aug. 1, 2014

Charles Lane Sartor, 92
Shreveport, La., Sept. 24, 2014

Edward Vernon Stephens, 82
Riverside, Calif., Jan. 22, 2015

James A. Whitson Jr., 82
Houston, March 18, 2015

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Listen for the Muse, But Trust Hard Work

By DAVID CURTISS

I still recall the thrill of giving a technical talk at an AAPG annual meeting. It was in Salt Lake City in 1998, and there was a special session on oil and gas discoveries in impact craters. My 1995 thesis at the University of South Carolina was on the petroleum system in the Ames crater in Major County, Oklahoma.

I thought I'd reached the big time.

Unfortunately, impact structures never really emerged as a significant oil and gas play. But I'm happy I had the chance to present my scientific work. And I'd urge you to present yours.

In Denver this month at the Annual Convention and Exhibition we had geoscientists gathering from across the globe to do just that: to stand up in front of their peers and present their scientific work, ideas and theories. In some cases the speakers were world-renowned in their fields. In other cases they were freshly minted graduates, presenting their thesis or dissertation research.

All of these speakers are important to the science and the profession. And this scientific engagement is at the heart of why AAPG exists: to advance the petroleum geosciences by presenting data, testing theories and teaching each other as we go.

When we stop doing this, our science dies.

I was thinking about this issue last month while reading a May 15 New York



CURTISS

This age of instant gratification can easily seduce us to sit around waiting for the muse.

Times op-ed by Leonard Mlodinow, a physicist and author, titled "It Is, In Fact, Rocket Science." In his piece he reflects on the nature of scientific discovery – and a dangerous misconception that threatens to undermine it.

The myth, he explains, is that scientific discovery rarely occurs through epiphany the way popular culture would have us believe.

His teenage daughter's biology textbook suggests that Charles Darwin formulated his theory of evolution while watching finches on the Galapagos Islands. In fact, the theory emerged many years later, back at home.

And the apple hitting Sir Isaac Newton's skull may have caused him to see stars, but it didn't spark a theory of gravity.

"The story vulgarizes universal gravitation by treating it as a bright idea," he quotes historian Richard Westfall. "A bright idea cannot shape a scientific tradition."

The reality is, Mlodinow writes, "Science is just not that simple and it is not that easy."

"The mythical stories we tell about our heroes are always more romantic and often more palatable than the truth," he warns. "But in science, at least, they are destructive, in that they promote false conceptions of the evolution of scientific thought."

And Stephen Hawking's understanding of the nature of black holes was not gained by staring at the glowing embers of a fire, as depicted in the film, "The Theory of Everything." In fact, it was inspired by two other physicists whose work he had seen, followed by months of grueling calculations arriving at an outcome that Hawking didn't like. So, he then spent more months attacking his own theory, trying to disprove it. But he couldn't.

And the result was a paradigm shift in our understanding of black holes.

Hawking is a brilliant mind. But look at this story again:

- ▶ He applied his intellect to build on work of others.
- ▶ He had his own ideas, but was open to having those ideas proved wrong.
- ▶ His process of discovery was one of focus, concentration and doing the work.

This age of instant gratification can easily seduce us to sit around waiting for the muse. Surely, I'll have a brilliant insight soon.

But, as Mlodinow suggests, we may be sitting for a long time. Epiphany as strategy works best in myth.

I don't want to completely dismiss the role of flashes of insight. But to borrow an old saw, we may miss scientific discoveries because they're dressed in overalls and disguised as hard work.

"The truths of nature are subtle, and require deep and careful thought," Mlodinow observes.

That's good news for you and me as geoscientists: Doing the hard work will increase our odds of having something important to say.

David H. Curtiss

DIVISIONS REPORT: DEG

DEG Members' Role: Filling the Information Gap

By JEFFREY G. PAINE, DEG President

The AAPG officer year ends July 1, so this is my last opportunity to highlight issues relevant to DEG and acknowledge many valuable contributions from the DEG team during the year.

So far, we've discussed:

- ▶ The need to move our industry from one that largely reacts to unintended consequences, real or perceived, to one that anticipates issues (September).
- ▶ The importance of maintaining our social license to operate (December).
- ▶ The need to encourage open discourse on environmental topics in formal and informal publication venues (March).

All I would like to add to these is this month's comment on the relationship between issues the industry faces and a role DEG can continue to fulfill as some of these issues reach the general public's awareness.

* * *

Here's a current example: There have been many articles in various news outlets in recent days, weeks and months about induced seismicity in Oklahoma, Kansas, Texas and elsewhere, along with various opinions about the relationship between seismic events and oil and gas activities.

Earthquakes, no matter the size, make good news fodder. I'm sure you've seen or heard more than one recent piece in some media outlet with a sensational



PAINE

Unfortunately, accurate and defensible information on complex subjects commonly takes a while to develop, prepare and disseminate.

(and perhaps inaccurate) headline, lots of opinions expressed – and relatively little accurate and unbiased information.

This seems to be the way public opinion is shaped on most any hot topic: There is quite a bit of early, incomplete information to feed the public's interest, and this early activity disproportionately shapes society's attitude and ultimate response.

The sinking of the Lusitania 100 years ago was accompanied by intense media interest and influenced the United States' eventual participation in World War I. And yet a century later, in 2015, two extensively researched books were published on the subject, revealing new information about the event.

Unfortunately, accurate and defensible information on complex subjects commonly takes a while to develop, prepare and disseminate. By the time the necessary investigations are done, the information is reviewed for accuracy and the results released to the public, the media and the public have

moved on to subsequent sensational events and few news purveyors remain interested in "the rest of the story."

Organizations like DEG, through our website, newsletter, meetings, journal and white papers, can help fill the huge gap between the daily news cycle (which largely shapes public opinion) and comprehensive scientific study that necessarily proceeds at a more stately pace.

To do that effectively, it is imperative that organizations like DEG preserve scientific neutrality, avoid advocacy and make our collective knowledge accessible to the public.

It is a tall order, but one that could greatly improve the relationship between the energy industry and society at large.

* * *

As my term as DEG president comes to a close, I would like to acknowledge the contributions of many who helped make this a productive

and satisfying year. Those individuals include officers **Jeff Aldrich** (who will become president July 1), **Steve Tischer** (secretary/treasurer), **Dirk Nieuwland** (vice president), **Michele Cooney** (Environmental Geosciences editor), **Kristin Carter** (newsletter editor) and **Doug Wyatt** (past president); committee chairs **Laurie Whitesell**, **Doug Peters**, **Charlotte Sullivan** and **Gene Murray**; advisory board members **Tim Murin**, **Allen Waggoner**, **Quin Baber**, **Anne Fix**, **Mary Harris** and **Chris Liebli**; and **Norma Briggs**, the glue that keeps it all together as the AAPG division manager.

Doug Peters led development of the environmental program at the Annual Convention and Exhibition in Denver. **John Hughes** organized the environmental aspects of the International Conference and Exhibition being held in Melbourne this fall and **Bruce Smith** (incoming vice president) and **Mike Jacobs** (past president and advisory board member) helped organize the DEG sessions on environmental geophysics in the oilfield at SAGEEP.

Doug Wyatt also led a team that produced a soon-to-be-released white paper on hydraulic fracturing, a subject in need of timely, dispassionate and accurate information in the space between the daily news cycle and the peer-reviewed literature.

These are but a few examples of acts worthy of acknowledgment. We couldn't have done much this year without contributions from all!



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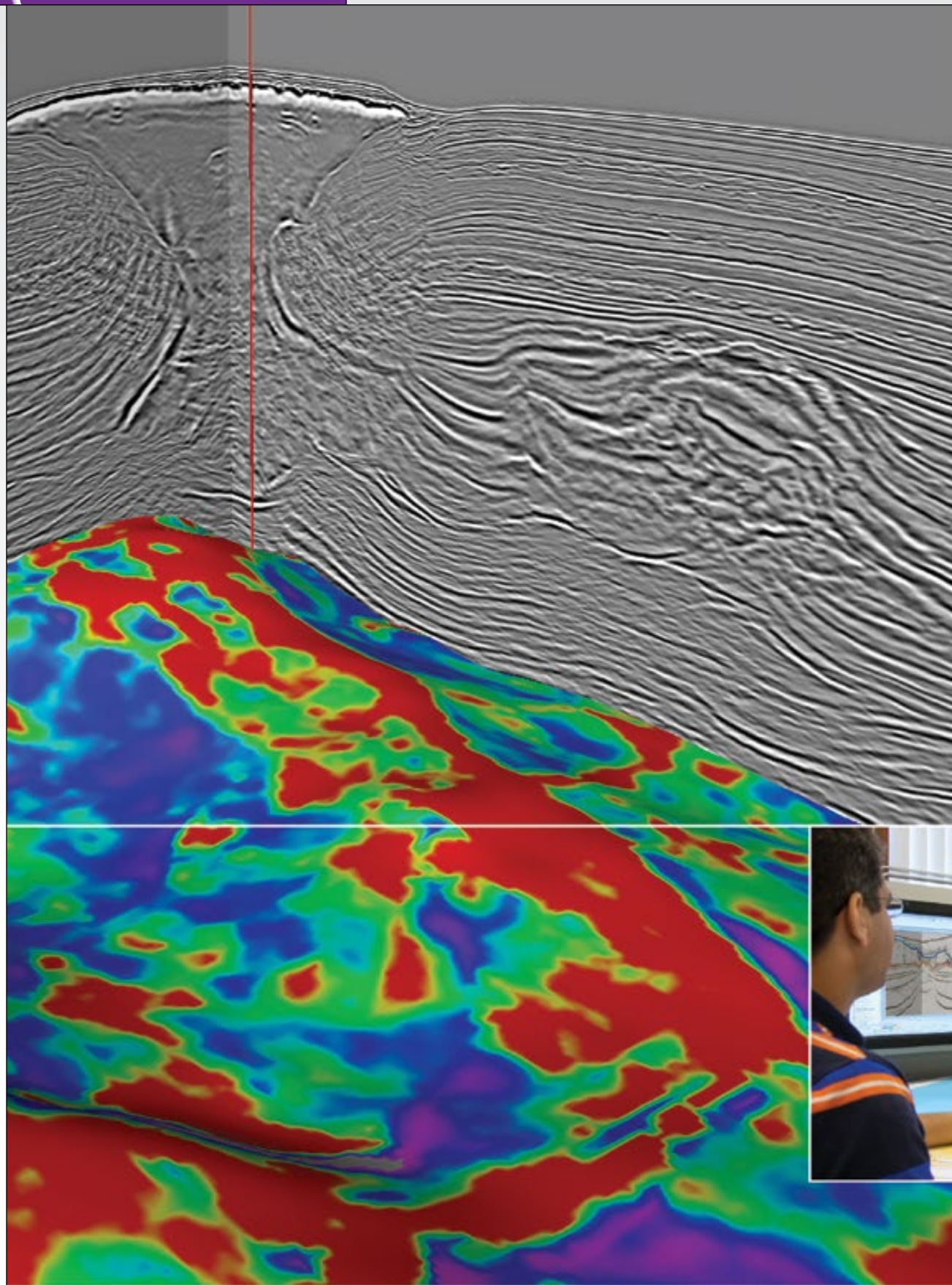


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