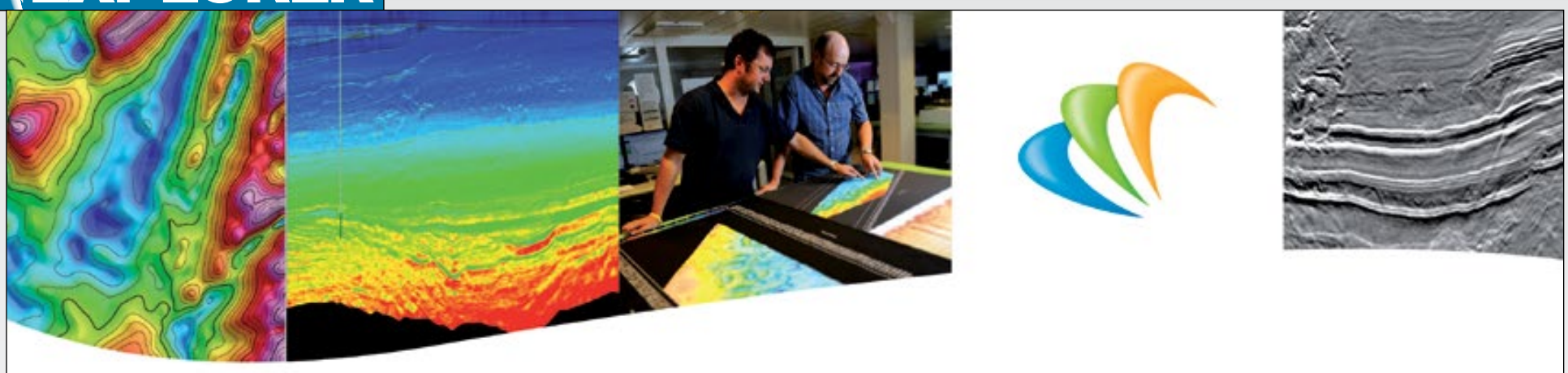
AAPG EXPLORER

SEPTEMBER 2016

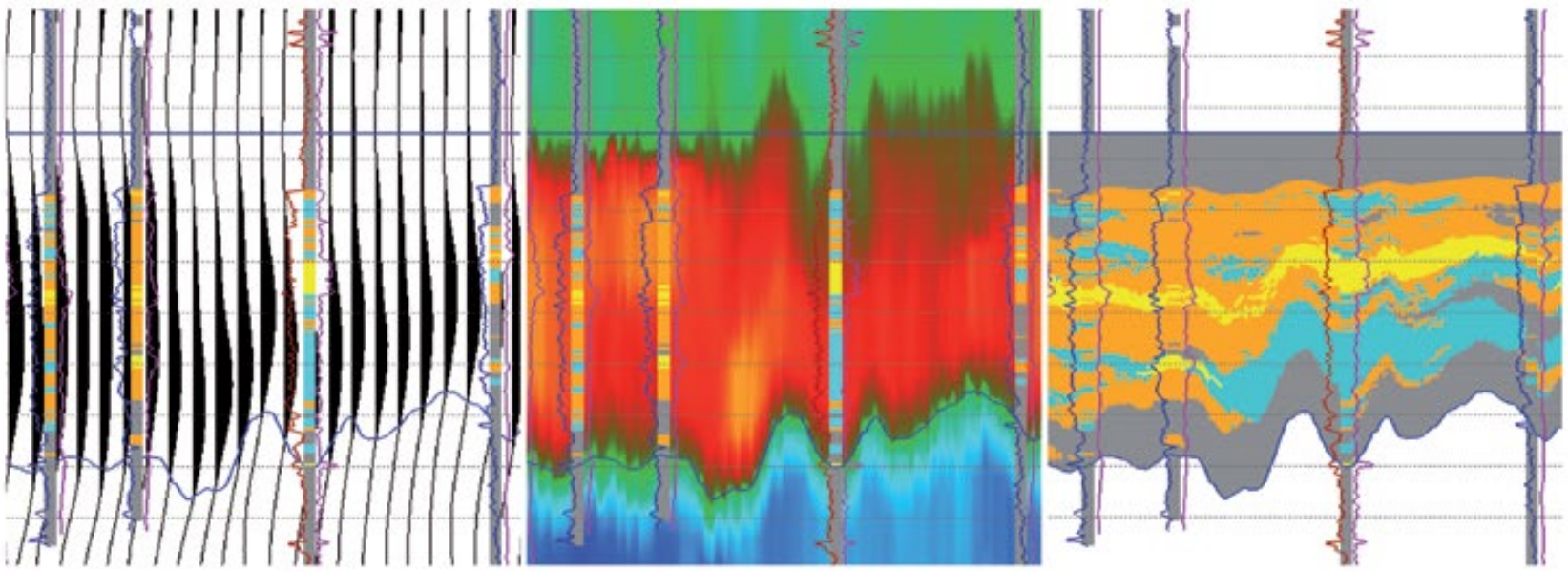
Mammoth of a Discovery

Bringing geoscience to the world.



Optimize Unconventionals

With unique geoscience insight



Jump-start your project with CGG's North American Reservoir Optimization Package. Gain deeper insight into reservoir heterogeneities and key engineering parameters:

- Improve input with customized seismic survey design, acquisition and processing
- Enhance results through an integrated reservoir characterization approach combining geology, geophysics, petrophysics, geomechanics and geochemistry
- Optimize completion design by combining geomechanical properties, treatment pressures and simulation

Discover how CGG's unique integrated technology and holistic workflow drives economic success.

cgg.com/RO

CGG

Passion for Geoscience

Vol. 37, No. 9
September 2016

AAPG EXPLORER

PRESIDENT'S COLUMN

Starting the New Year and a New Century

BY PAUL BRITT

September is the practical beginning of the year – for many in North America, at least: the beginning of the school year for those with school-aged children, the beginning of the program year for many affiliated societies and the beginning of many AAPG-related events.

The International Conference and Exhibition (ICE) 2016 is ongoing in Cancun as you read this issue of the Explorer. It is also host for many of the AAPG Section meetings including the Gulf Coast Section, Eastern Section and Mid-Continent's Field Symposium in between their biennial Convention. And even though it starts in October, I would count the combined Rocky Mountain and Pacific sections' meeting this year. While the Section meetings are not directly AAPG sponsored events, these regional meetings are always well run and well attended.

The Unconventional Resources Technology Conference was held again this year in San Antonio at the beginning of August. It is a joint AAPG-SEG-SPE conference, and was fairly well attended. This was my first opportunity to attend, and it was highly educational for me to hear talks that were outside my area of expertise as well as seeing vendors that I would not have met at an AAPG-only event. Next year, it will be held in Austin at about the same time. I'm looking forward to it.

The Membership Issue

One of the big issues confronting the AAPG leadership is membership.

As I said in last month's column, at the beginning of this fiscal year, we lost 6,598 total Members who had not paid dues for the last fiscal year. This year, the House of Delegates is increasing its efforts to retain and grow membership.


BRITT

> The best way we can help our membership in times of a downturn is to keep them engaged with their professional community.

Probably due to the economic turmoil, our membership is undergoing a large number of dues statements that are being returned as undeliverable, and House Chair Jim McGhay is reviewing different ways to reach out to these missing Members.

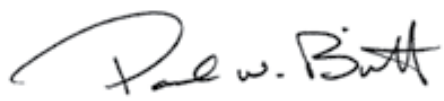
One would be for those of you who know of a Member who has had a change of location or address to encourage him or her to notify AAPG of their new contact information, or to send us contact information for them if you have it.

I'm not trying to just maintain dues income, though. Rather, the best way we can help our membership in times of a downturn is to keep them engaged with their professional community. As a Member of the House of Delegates in the mid-1990's, I once called on a list of unpaid Member renewals and reached a Member who commented that he had lost his job. There was little consulting work, but he was very appreciative that another Member called to see how he was doing. I don't even recall if he renewed, as times were fairly tough then as well, but I do know that he was touched by the effort to keep contact.

The Association is largely driven by events, which fund most of the programs that do not have an opportunity to provide revenue, but are still very important programs for the membership. Curiously, at most of the events, such as conventions, Geoscience Technology Workshops, education conferences and more, nearly half of the attendees are not AAPG Members, in spite of efforts to get them to join at the events. Paradoxically, these non-Members who participate in the events to the level that they do are important to the membership, as they essentially fund the organization as much as the Members do through their participation. Many are either members of sister societies or professionals associated with AAPG Members, but they are a benefit to the membership through their support to the Association with their participation.

This is the third month I've talked about AAPG business and I'm sure many of you are wondering if I am ever going to go on to something more forward-looking. Along that vein (or seam or stratum, if you prefer), I am planning some discussions on the future of the petroleum geoscientist and, in line with our 100th year anniversary, geoscience in the next 100 years.

I'd like to thank the Members who have commented to me about my columns. The feedback is appreciated.



GCAGS Annual Convention Held this Month

The Gulf Coast Association of Geological Societies Annual Convention is set for Sept. 18-20 in Corpus Christi, Texas.

Corpus Christi is an area rich in oil history with an abundance of oil and gas resources. Through the years, many young geoscientists and engineers learned from and gained experience in the region, launching their careers.

The city will serve as an ideal setting for the convention, which will carry the theme "Explore the Future: Looking Back, Thinking Forward." The event will focus on looking back at successful strategies and looking forward to a brighter industry future.

The technical program will boast more than 110 oral presentations and 60 poster presentations.

Four short courses have been planned that will offer information about depositional environments, basin analysis, geopressure for prospect assessment and basic seismic attributes.

Field trips will include a visit to the Rio Grande Delta and Great Sand Sheet; a search for Ice Age mammal fossils; a look at storm signals in the stratigraphic record of the Texas Gulf Coast; and an opportunity to explore the lower Nueces River Valley.

Also, a special workshop will invite teachers to learn about different ways to share earth science with their students in exciting ways.

To register for the convention or to learn more, visit www.gcags2016.com.

STAFF

Managing Editor
Brian Ervin
bervin@aapg.org

News Editor
Kelsy Taylor
ktaylor@aapg.org

Art Direction/Production
Matt Randolph
mrandolph@aapg.org

Graphics Support
Ben McNett

Advertising Coordinators

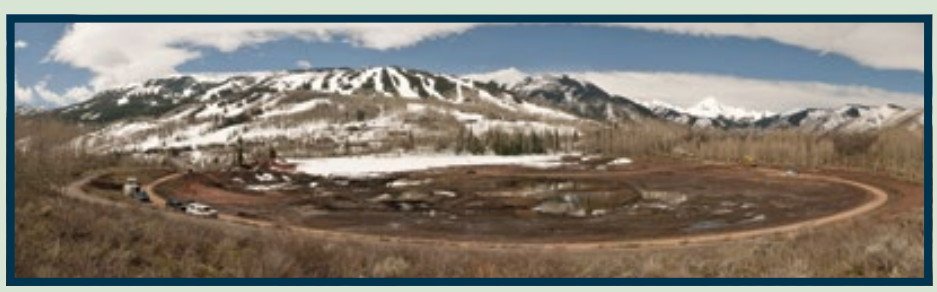
Companies A-K	*Companies L-Z*
Mike Taylor	Tracy Thompson
1-918-630-5672	1-918-560-9414
mtaylor@aapg.org	tthompson@aapg.org

CORRESPONDENTS

David Brown
Louise S. Durham
Barry Friedman
Emily Smith Llinás

TABLE of CONTENTS

REGULAR DEPARTMENTS



ON THE COVER:

Kirk Johnson, sant director of the Smithsonian National Musem of Natural History and one of this year's Geosciences in the Media Award winners, points to one of the many fossils that were found during the Snowmass discovery.

Left: The Ziegler Reservoir near Snowmass Village, Colo., is the site of the fossil discovery discussed on page 14.

All photos and illustrations are courtesy of the Denver Museum of Nature and Science.

Vol. 37, No. 9

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

Advertising rates: Contact Mike Taylor or Tracy Thompson, AAPG headquarters. Subscriptions: Contact Brian McBroom, AAPG headquarters. Unsolicited manuscripts, photographs and videos must be accompanied by a stamped, self-addressed envelope to ensure return. The American Association of Petroleum Geologists (AAPG) does not endorse or recommend any products or services that may be cited, used or discussed in AAPG publications or in presentations at events associated with AAPG. Note to members: $6 of annual dues pays for one year's subscription to the EXPLORER. Airmail service for members: $55. Subscription rates for non-members: $75 for 12 issues; add $72 for airmail service.

Celebration and Solidarity:

Help Sponsor Centennial ACE

By HUNTER LOCKHART, AAPG ACE 2017 Sponsorship Committee Chair

As you are likely aware, next April will mark the centennial anniversary of AAPG: 100 years dedicated to the science of finding oil and natural gas.

The Centennial/2017 Annual Convention and Exhibition (ACE) will serve as our collective celebration of this milestone.

The event will take place in Houston – the energy capital of the world and a city that offers unparalleled opportunity to connect with students, professionals, academics, companies and universities from across the globe.

LOCKHART

For nearly 100 years, AAPG has been the bridge between industry and academia ... and remains the preeminent organization for the advancement of petroleum geoscience at the global scale.

Today, we are unquestionably confronting economic challenges and uncertainties and the light at the end of the tunnel might be difficult to see. However, it is in these difficult times that our industry has the chance to make its greatest advances, in both science and technology. That's what occurred in the past, and I believe it will happen again.

For nearly 100 years, AAPG has been the bridge between industry and academia, the grease in the wheels between service companies and operators, and remains the preeminent organization for the advancement of petroleum geoscience at the global scale.

Call for Solidarity

As professionals, we realize this is a unique time that demands solidarity in our industry. Now is the time for companies to unite in support of AAPG and the geosciences as we never have before.

As such, members of the Sponsorship Committee have planned special recognition for those who elect to support AAPG at the Centennial ACE.

In addition to the standard promotional items provided to our sponsors, we plan on introducing new incentives to encourage greater support from industry. For example, we will be placing a special banner at the booths of presenting companies who sponsor the Centennial ACE. Also, independent companies that offer support will be invited to attend an exclusive celebration in Houston as a pre-meeting event, on the condition that $100,000 is raised from companies with a total staff numbering fewer than 100.

These are just a couple of the numerous and exciting opportunities we plan to provide our sponsors for next year's convention.

Early estimates indicate more than 10,000 professionals will be gathering in Houston for the Centennial ACE, and hundreds of corporations and universities will be represented at the meeting. This will be the event of the year to network with colleagues, present technical work and advertise new products and services – in short, one big scientific celebration!

By sponsoring the Centennial Celebration, you are not only demonstrating your dedication to AAPG and the science of petroleum exploration, but also confirming your commitment to the future of our industry.

I strongly believe we have turned a corner in recent months, and I can see the light shining over the horizon. This light – the light of AAPG – shines brightest in the dark. Now is the start of a new dawn, and the beginning of a new era in the role of the petroleum industry in global society. My company, BHP Billiton, shares in my vision and has already committed to generous support for ACE, along with a number of other leading companies across the globe.

I hope that you, your company or university will join mine and many others' to support the Centennial Celebration of AAPG next year in Houston. Please don't hesitate to contact me or any of my committee members for questions regarding your support for the Centennial ACE.

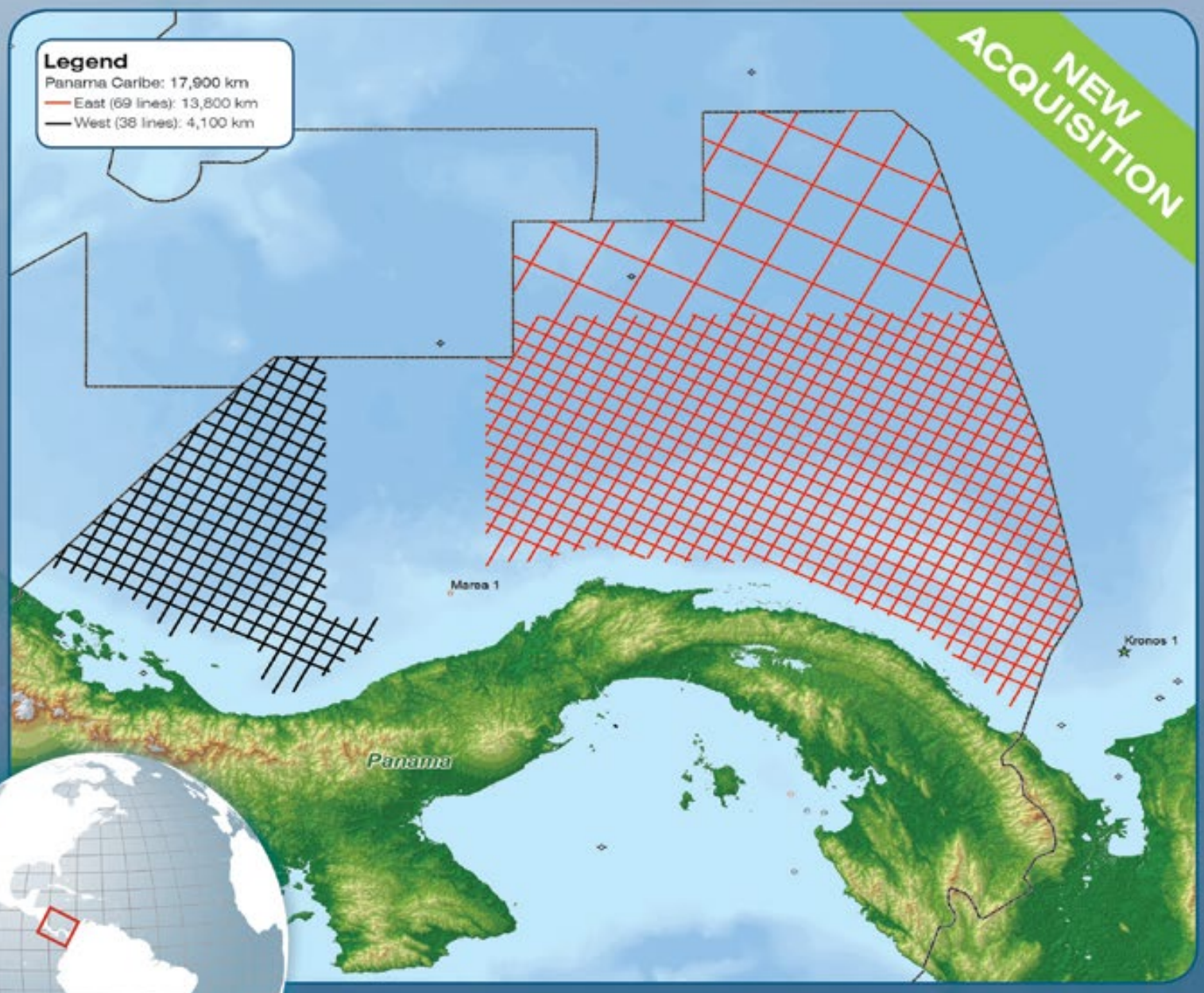
For more information contact: Hunter Lockhart, sponsorship committee chair, at hunter.lockhart@bhpbilliton.com; Tim Rynott, sponsorship committee co-chair, at trynott@gmail.com; Steven Shirley, sponsorship committee co-chair, at steven.shirley@chevron.com; Mike Taylor, AAPG exhibition sales manager, at mtaylor@aapg.org; or Tracy Thompson, AAPG exhibition sales representative, at tthompson@aapg.org.

multi-client seismic

PANAMA

Offshore Panama

New Multi-Client 2D Seismic Data for License Round



Now that the Environmental Permit has been approved, Spectrum aims to commence acquisition of an 18,000 km long offset 10x10 km grid over Panamanian waters in October 2016. This new 2D survey will provide high fidelity images of the subsurface geology, including the prospective Tertiary and Cretaceous section as well as the deeper crustal features.

Final processed data will be available in Q2 2017 in anticipation of a formal license round announcement in H2 of 2017.

spectrumgeo.com
mc-us@spectrumgeo.com
+1 281 647 0602

Spectrum

North America Drives Capital Spending Drop

By DAVID BROWN, EXPLORER Correspondent

When industry analysts predicted a $1 trillion decline in capital expenditures for international exploration and production, it was easy to say, "They must be exaggerating."

They weren't.

In fact, they might have been sugarcoating the outlook.

IHS said its overall forecast for oil and gas capital expenditures in the 2015-19 time frame has now been reduced by $2 trillion from the forecast before the collapse in oil prices.

That's counting spending for all international upstream projects, planned and projected, said Bjorn Hem, IHS principal researcher. Hem is stationed in Norway and Houston, but lately has been working out of Costa Rica.

"A lot of that is basically projects that have been pushed back, delayed, cancelled," Hem said. "Especially this year, you've gotten into a lot of destructive capacity reductions."


HEM

> "In a way it's healthy, what's happening. The oil and gas industry enjoyed so many years of success, and that caused things to become inefficient."

North America Plummet

IHS has issued the latest quarterly updates to its "Global Upstream Spending" and "North American Upstream Spending" reports. Both show a big decline in upstream capital spending, but not in equal measure.

"It's dropped a lot. But if you look at the total spending, a lot of the drop is driven by North America," Hem said. "Things have just moved very quickly there. It's a different market than other regions."

One major difference is the speed of reaction to lower prices. National oil companies and large overseas energy operations tend to have a long planning horizon. Independents in the United States react much more quickly to a price downturn.

"As long as they're not making money, their activity is cut back. It happened very quickly. You've seen a large drop right through 2016," Hem noted.

By comparison, the Middle East is much less affected, with several countries in the region spending to maintain market share and no drop in investment by Saudi Arabia, according to industry research and consulting firm Wood Mackenzie.

Overall, the cuts in international exploration and production capital spending have led to concerns that the industry might not be investing enough to meet future oil consumption demands.

"Even remaining flat could be a challenge for the industry, let alone meeting any expected growth," said John England, vice chairman of Deloitte LLP.

One Deloitte study found that the international oil and gas industry has slashed spending below the levels required to replace reserves. The industry's projected capital-project expenditure level is especially worrisome, Hem said.

"Even if it's not increasing, you need to make very large investments in the oil and gas industry to meet demand," he observed.

Brutal declines in oil prices following years of falling natural gas prices have left much of the industry in a tight spot for capital project development.

"The industry faces a conundrum in that many of the projects our clients plan to build, or are in fact already building, now cost too much to be commercially viable unless oil prices rise considerably," said Chris Pateman-Jones.

"At the same time, the market and investors expect oil companies to grow, or at the least to maintain production levels/market position, meaning that eventually almost regardless of oil price, new projects to replace aging and decommissioned assets will need to be built," he noted.

Pateman-Jones is director of oil and gas capital projects for management consulting firm Ernst & Young in London. The company has tracked international oil and gas megaprojects in recent years.

"It is key for the industry to focus on selecting the best projects – that is, the ones which deliver the highest returns, but also those which are most likely to be delivered on time and budget, and it's important to note here that these two factors are not always positively correlated – and then to deliver them as efficiently as possible," Pateman-Jones noted.

"It is equally important to recognize that to be truly successful, improvement initiatives must be driven throughout the entirety of the project team, seeking to motivate and collaborate with key contractors and suppliers to drive improvement in a way which is not yet natural across the industry," he said.

Positioning for the Rebound

With the mid-2016 pullback in oil prices from the $50 level, many industry observers and analysts essentially have thrown in the towel. "Lower-for-longer" appears to be a consensus opinion.

"Our main story now in terms of the

See **Rebound**, page 8

Rebound

from page 6

forecast is, there's no quick turnaround," Hem said. "We see the recovery as being a long, slow, drawn-out recovery."

Not all the upstream spending reduction has come from budget cutbacks. Oil and gas companies saw a significant drop in their cost of doing business as service and supply companies reduced prices. In U.S. unconventionals, analysts estimate operator costs are 25-40 percent lower on average compared with their peak in 2014.

Also, the industry has cut employee costs through reductions in headcount. But that might become a future problem.

"One of the interesting things we're looking at now is what's going to happen when things start rebounding," Hem said.


JONES

> **"There is no single silver bullet to solve all the problems afflicting project development."**

"If you look at the labor market, the engineering market, those are very flexible in terms of capacity. Getting those engineers or laborers back is much more challenging," he noted.

Industry investment in international exploration and production hasn't come to a standstill. In July, Chevron Corp. announced it would proceed with a $37 billion expansion of its Tengiz oil field project on the Caspian Sea in Kazakhstan. BP said it had approved funding for the addition of a third LNG process train at its Tangguh Expansion Project in Indonesia.

But the number of large projects approved by the oil and gas industry has plummeted from previous years. Wood Mackenzie estimated the global oil industry approved 40 large international projects a year between 2007 and 2013.


ENGLAND

That number dropped to eight in 2015, and only a handful of megaproject budgets have been approved in 2016.

Deepwater drilling looks especially vulnerable. In a forecast of U.S. Lower 48 production that needs to be developed to offset field declines and to meet future demand growth, Wood Mackenzie said only 20 percent of commercial volumes at $60/barrel comes from deepwater projects. By contrast, tight oil accounts for 60 percent of future production commercial volumes at $60.

"Key plays such as Eagle Ford and Wolfcamp dominate the lower end of the cost curve, the latter averaging under $40/barrel," it said.

Reduced capital project spending makes efficiency crucial, and there's good news for the industry in that regard. Project efficiency has been so terrible, so absolutely dismal, that things are unlikely to get any worse.

Ernst & Young evaluated the oil industry's effectiveness in handling large projects coming out of the boom years and issued a report in its Spotlight on Megaprojects series.

"We researched the performance of 365 oil and gas megaprojects and found that 64 percent are facing cost overruns and 73 percent are reporting schedule delays," the EY report said.

Those failures "raise serious questions as to the industry's ability to develop accurate, unbiased FID (final investment decision) budgets/schedules and subsequently to deliver on them," it noted.

Pateman-Jones said "there is no single silver bullet to solve all the problems afflicting project development."

"Instead, there is potential to access the additive effect of many smaller improvement opportunities which collectively could revolutionize development and execution performance," he said.

"Despite the abundant challenges the industry faces, there are many opportunities to improve performance and reduce waste, utilizing learning from other industries and selected new technology to drive efficiency and standardization into project development and execution," Pateman-Jones noted.

Hem blamed a scramble to chase projects during the oil boom for some of the industry's inefficiency woes.

"If you look back at 2013-14, a lot of the big operators weren't doing that well financially. They were going after everything, so to speak," Hem said.

"In a way it's healthy, what's happening. The oil and gas industry enjoyed so many years of success, and that caused things to become inefficient," he observed.

In the end, analysts expect deep cuts in capital spending to create future declines in production. That normally leads to consumption-driven price increases, which ultimately cause increased investment and overproduction.

Everyone recognizes this as the oil industry boom-and-bust cycle, and it hasn't gone away.

"You can say, the lower things go at the moment, the higher things will go in the future," Hem said.

Mexico: A Land of Untapped Potential

By DAVID BROWN, EXPLORER Correspondent

Ah, Mexico.

Tequila. Mariachi. Adobe. Serapes. Does the name also bring to mind a land of intoxicating hydrocarbon prospects, of abundant opportunity for oil and gas exploration?

It should, according to Paul Weimer.

Weimer is an AAPG past president and current director of the Energy and Minerals Applied Research Center in the geological sciences department at the University of Colorado at Boulder.

He suggested the oil and gas business is really three different industries today.

"First, an onshore industry that focuses on the development of unconventional resources primarily in the U.S. and Canada. Second, a global industry that focuses on conventional resources in the onshore and shelf regions. And third, a global deepwater industry," Weimer explained.

"Mexico has an enormous upside potential for these three different play types," he said.

A Pemex drilling rig in the Ku-Maloob-Zaap oil field in the Campeche Sound. Discovered in 1979, the Ku-Maloob-Zaap field is the most productive oil field in Mexico. Photo courtesy of Pemex.

An Unexplored Country

The Mexican oil industry dates back to the late 1800s, but a combination of history, politics, underdevelopment, remoteness and economics have left a startling amount of Mexican territory undrilled and sometimes even unevaluated.

Imagine a huge expanse of Gulf of Mexico prospects that have barely been touched.

"It is a largely unexplored country, given the size of its basins. How well these plays are developed will depend upon the long-term trends in commodity prices, the rules that the regulators develop, and the business terms for contracts," Weimer noted.

"Alfredo Guzman, former AAPG vice president and the 2015 Halbouty Medal recipient, has shown in several of his presentations that there are more exploration wells drilled in some counties in the United States than have ever been drilled in the entire country of Mexico," he said.

Weimer will teach the short course "The Petroleum Industry in the Next Decade in the Americas: An Overview to the Science, Technology and AAPG" at the AAPG International Conference & Exhibition in Cancun in September.

"The specific focus of this course will be on the opening of Mexico to international investment during their Lease Rounds 1 and 2, and the enormous upside potential that exists for all three plays," he said. "A substantial part is to illustrate how companies have had successes in all three plays, and how the students can take these learnings and apply them to the basins in their country."

Offshore

Start with those Gulf of Mexico prospects, now being opened to exploration through lease bidding rounds.

"There's going to be a major leasing for Round 1 in December, so we will get a sense from the IOCs [integrated oil companies] of their relative interest," Weimer observed.

"The Mexican portion of the Gulf of Mexico, and this is substantially more than the U.S. portion, has four main areas," he said.

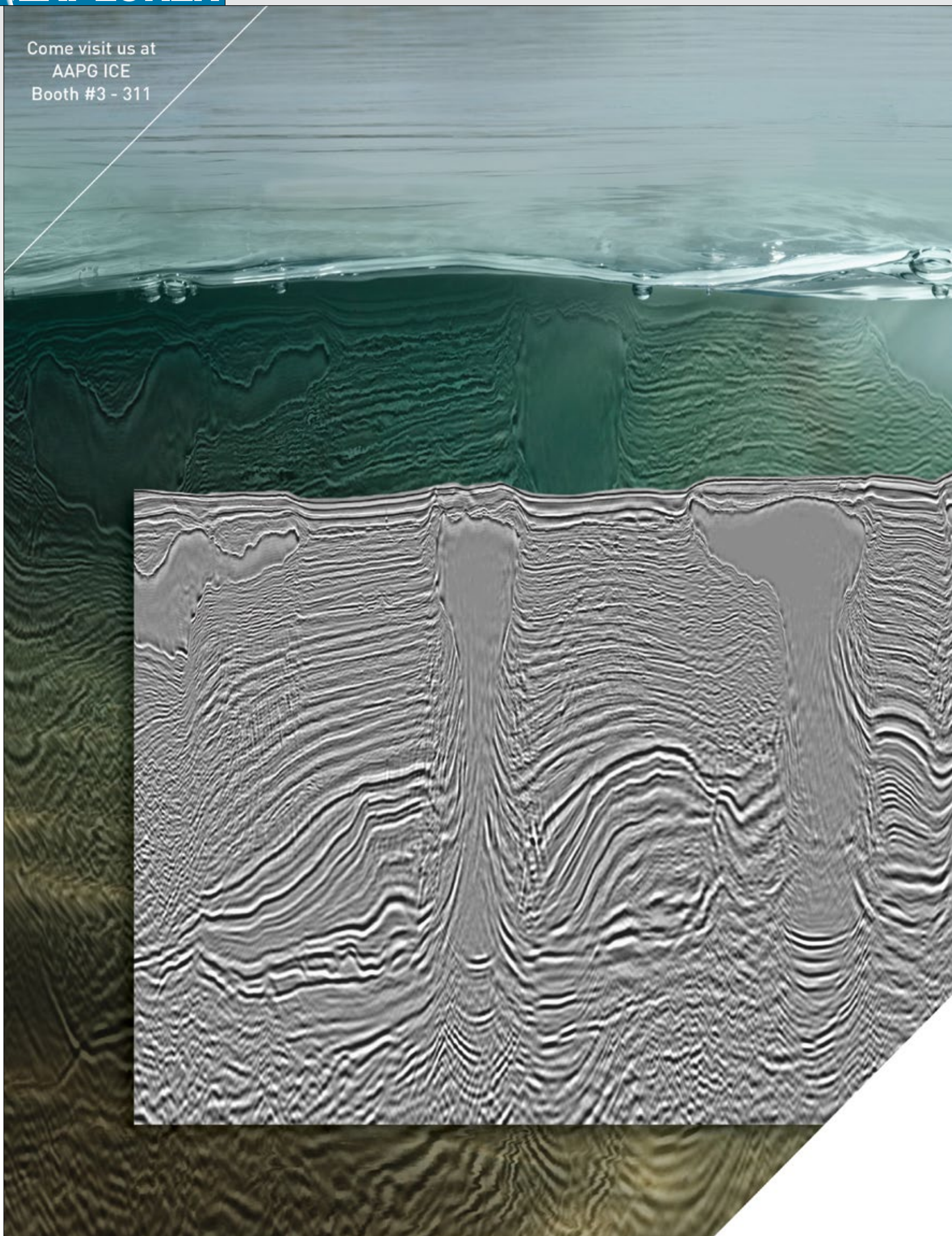
Those areas are:

- The Perdido foldbelt and shallow allochthonous salt extending south of the 26th latitude into the northwest area. "Pemex has announced six discoveries in this area and are seeking partners for development. Five of the discoveries are in upper Paleocene-lower Eocene Wilcox-equivalent reservoirs. One discovery is in the Oligocene Frio equivalent," he said.
- "Farther south, along the southwestern portion, the second area is devoid of salt and is characterized by many extensional structural styles. No discoveries have been announced," he noted.
- "A southern salt province is present, with some similarities to the northern Gulf. Pemex has announced six gas discoveries in Miocene sands. One of the papers in the meeting's Discovery Thinking session will review those discoveries," Weimer said.
- "Campeche Escarpment, a prominent carbonate margin similar to the Florida Escarpment, sits in the southern and southwest area. No wells have been drilled there in deepwater," he said.

Mexico has a long history of good production, and Weimer thinks the rejuvenation of old fields and effective enhanced recovery work are outstanding opportunities for the industry.

Several older fields both onshore and offshore in shallow marine settings were offered in Bids 2 and 3 of Round 1, Weimer said, and additional fields will be included in some of Round 2. Some of

See **Unconventional**, page 18


Come visit us at
AAPG ICE
Booth #3 - 311

Set your sights.
Gulf of Mexico

Declaration WAZ 3D covers 8,884 km2 (381 OCS blocks) in the Mississippi Canyon, DeSoto Canyon, and Viosca Knoll protraction areas of the Central Gulf of Mexico and was acquired to better image deep structural elements while improving subsalt and salt flank illumination.

Through integration with TGS' underlying orthogonal Justice WAZ 3D survey, Declaration provides broadband multi-azimuth (M-WAZ) data with offsets to 16 km. The data is being processed using the latest TGS imaging technology including Clari-Fi and Orthorhombic migrations. Final data will be available by December 2016.

Let's explore.

TGS

See the energy at **TGS.com**

Kirk Johnson and intern Kaitlin Stanley clean a mastodon tusk under the protective covering of a tent.

The Ziegler Reservoir is located new Snowmass Village, Colo. and was the site of a small glacial lake 150,000 to 130,000 years ago.

The Snowmass Discovery

A Story of Mammoth Proportions

By BARRY FRIEDMAN, EXPLORER Correspondent

In 2010, in the town of Snowmass, Colo., while working on a reservoir, a bulldozer operator discovered uncovered fossil bones that turned out to belong to a young female mammoth. When all was said and done, more than 5,400 bones of mammoths, mastodons and other ice age animals were discovered at the site.

And, the town got its reservoir.

During that initial discovery, however, immediate attention was needed.

Which is why Kirk Johnson, the sant director of the Smithsonian National Museum of Natural History in Washington D.C., was called.

When he got to Snowmass, he couldn't believe what he saw.

"The excavation and research was incredible," he said. "As a scientist, these kinds of opportunities only come around once or twice in a career, and that's only if you're lucky."

Ian Miller, a paleontologist at the museum, later joined Johnson at the site.

He was overwhelmed.

"Many scientists never get the chance to be a part of something this big and scientifically important," added Johnson.

And telling this story, with this scientific importance, as adeptly and creatively as they did, is why both men were nominated and ultimately given AAPG's 2016 Geosciences in the Media Award.

Winter is Coming

"In the beginning," Johnson said, "during the fall 2010 portion of the dig, there was a lot of confusion. The developers, the excavating firm, and us were all competing against the coming winter. Things were a flurry."

How volatile was it?

"For the first week, we found a new species of giant animal in the ancient lake every single day."

Once the excavation temporarily closed in 2010 due to snow, Johnson and Miller spent seven months preparing for the "big dig" in the spring and summer of 2011.

"It is highly unusual to get a crystal clear glimpse of this time period at our latitude and at high elevation," said Johnson, "because the best records of climate and past ecosystems from the interglacial periods come from either deep lakes or ice cores. We have few big lakes at our latitude that were around when the Snowmass fossils were first forming, and only the polar ice caps offer long-term records of climate."

These painting of the Ziegler Reservoir, by Jan Vriesen, shows what the area looked like 130,000 and 60,000 years ago. The formation of the lake basin occurred after a glacier spilled out of the Snowmass Creek Valley. The Ziegler Reservoir was dominated by mammoth, camels and deer 60,000 to 45,000 years ago.

Additionally, places of high elevation are not where fossils form. Up in the mountains, for instance, erosion is the main process and streams and rivers bring sediment to the lower elevations.

"As a result," Johnson continued, "your best shot to find fossils of this time period is in the flat plains east of the Rocky Mountains."

Which is why, he said again, Snowmass was such a big deal.

"It's a long term record of animals, big and small, it spanned nearly 100,000 years and is incredibly complete in terms of sediment deposited during that time window."

Communicating the Science

It was an amazing, fruitful time. The Geosciences in the Media Award, though, was awarded not for the find as much as for what happened next.

Once the dig was completed, it was featured on a NOVA documentary called "Ice Age Death Trap" (Johnson admitted that things never got that dangerous) and a book, "Digging Snowmastodon: Discovering an Ice Age World in the Colorado Rockies," was written.

"Anytime something spectacular happens that really does inspire wonder, it becomes an amazing tool for us to communicate science. The Snowmass discovery was that and more," said Johnson.

"The decision to write the book happened organically," said Miller. "Kirk had written such books before and understood the value of telling such a story in a fun, exciting and personal way. As a result, we took copious notes through the project, took tons of pictures and considered the story arc as the actual story played out."

They cranked out the first draft in 24 days.

"We had a few months to catch up on sleep," said Miller, alluding to the 18-plus hours a day they had been working towards the end of the dig.

A New Benchmark

"We accomplished what we had set out to do: clear all the fossils from the footprint site of the dam that was going to impound the slightly expanded and new lake. At the end of the day, it was a win-win-win. The town of Snowmass Village got its reservoir, the construction team finished on time, the museum rescued all the fossils from the footprint of the dam, and the scientists collected unprecedented data."

Considering the glimpse Snowmastodon gave scientists, he called the project "a new benchmark for understanding climate change in the American West."

"We were able to link changes in the Snowmass region to global changes we see in the ice cores from Greenland. This means that when it's warming and cooling in Greenland, it's also warming and cooling in Snowmass, and, as it turns out, also drying and wetting (in other words, more or less rain) – further confirmation that the climate is a global system. We know that the one constant about climate is that it's always changing – nobody can argue with that. The questions really revolve around how fast does it change, how much can it change, what are the consequences of those changes and is it changing today?"

Creating a Better World

For both men, personally, the experience left its mark.

"Working with National Geographic and NOVA really changed all our lives," Miller said, "both of us have had multiple new opportunities through these organizations to partner on projects since the Snowmass dig. Kirk worked with NOVA to produce 'Making North America,' a three-hour special that premiered in November 2015."

Receiving this award from AAPG is further validation.

"It is a gift to have AAPG, our fellow earth and engineering scientists, recognize our efforts in communicating science," said Johnson. "The currency of natural history museums is wonder and inspiration. Unlike elementary and high school, it's your choice if you want to come to a museum. As a result, anytime something spectacular happens that really does inspire wonder, it becomes an amazing tool for us to communicate science."

But it's more than that.

"We all hope to create a better world and I think that we can all agree that science helps us get there. Fortunately, for us as paleontologists, fossils are just one of the best tools to engage all our public audiences in science exploration. The Snowmass discovery was that and more," Johnson continued.

Johnson laughed when asked if there was more he wishes he could have accomplished at Snowmass.

"Had the dig gone longer, the two of us would likely have keeled over!"

What Makes the Eagle Ford So Special?

By DAVID BROWN, EXPLORER Correspondent

The Eagle Ford shale play in South Texas emerged as a leading unconventional prospect even as oil and gas prices crumbled, making it one of the few promising U.S. production prospects in today's price environment.

Despite its history of development, the play remains something of a puzzle even to key operators.

Pioneer Natural Resources Co. of Irving, Texas, is a major player in the Eagle Ford. Its roots in the area go back to the 1990s, well before horizontal drilling and hydraulic fracturing unlocked shale production.

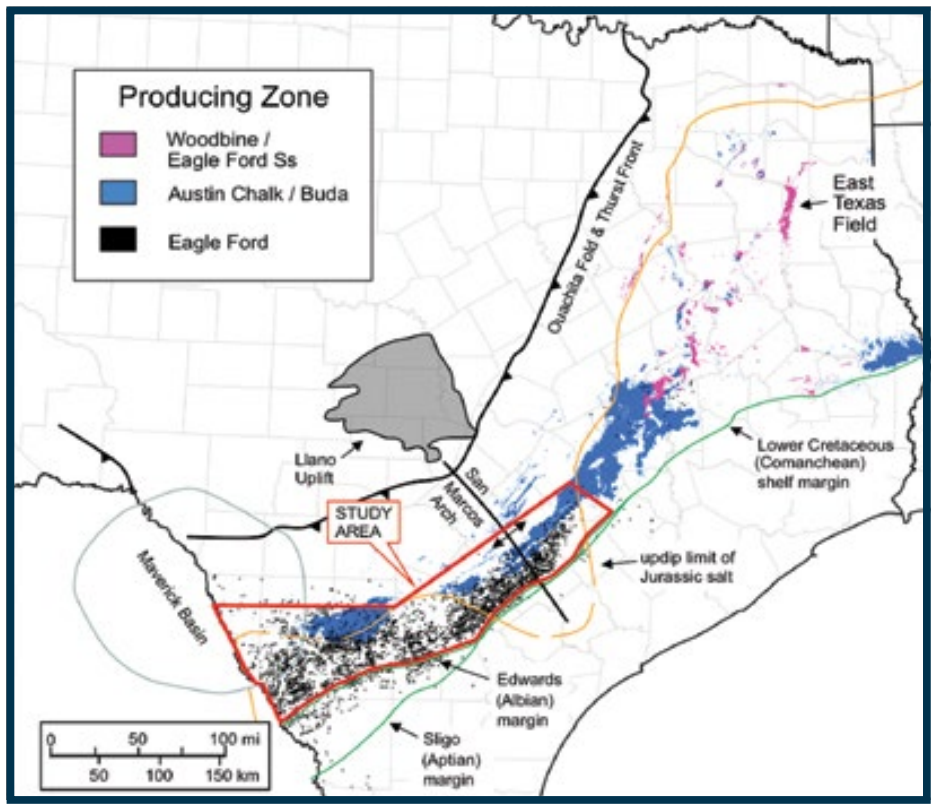
"One thing we're trying to understand is the geomechanics of the Eagle Ford. What people don't know is what's the geometry of fracture systems," said Beth McDonald, Pioneer's vice president of subsurface for South Texas.

Getting the stimulation and completion right is still part-science, part-art, and the company uses all the data it can grab.

"We are trying to use every piece of empirical data plus modeling to help us understand the height and length of these induced fractures and how that changes the mechanics of the system to impact the next well's stimulation," McDonald said.

To get a clearer picture, Pioneer has utilized pressure gauges and interference testing during stimulation, according to Doug Portis, Pioneer's senior geoscience coordinator for South Texas.

"Primarily, I think the answer lies in making a marriage from pressure data back to production. One of the biggest difficulties is that conventional-style modeling does not do a nice job of explaining what's going on in the subsurface," Portis said.



Portis co-authored a chapter for the new AAPG Memoir 110, "The Eagle Ford Shale: A Renaissance in U.S. Oil Production," edited by John A. Breyer, a senior technical consultant in technology application at Marathon Oil in Houston and an emeritus professor of geology at Texas Christian University.

Geological Features

To Portis, one aspect of the Eagle Ford that stands out is the remarkable preservation of the reservoir.

"It's a combination of the flooding and collapse of the shelf margin and the change in global and local sea level," he said. "From a regional viewpoint there's a really nice interplay that sets up the deposition as well as the preservation of the Eagle Ford – it's quite an elegant story."

He said the setting was affected by volcanism and mountain-building tectonism to the west, the open Tethys Sea and gentle shelf to the north, and the Woodbine Delta and San Marcos Arch to the east.

Today, pressure in the play area is a primary performance driver.

"When you look at it regionally, the pressure is the first-order driver. Everything else falls back to clay content, total organic carbon (TOC), porosity. The TOC we have really helps drive the sweet spot," he said.

Thermal maturity windows vary across the Eagle Ford and include dry gas, liquids-rich gas and oil production. Beginning just north of Laredo, the play extends in a dry-gas swoosh to the northeast.

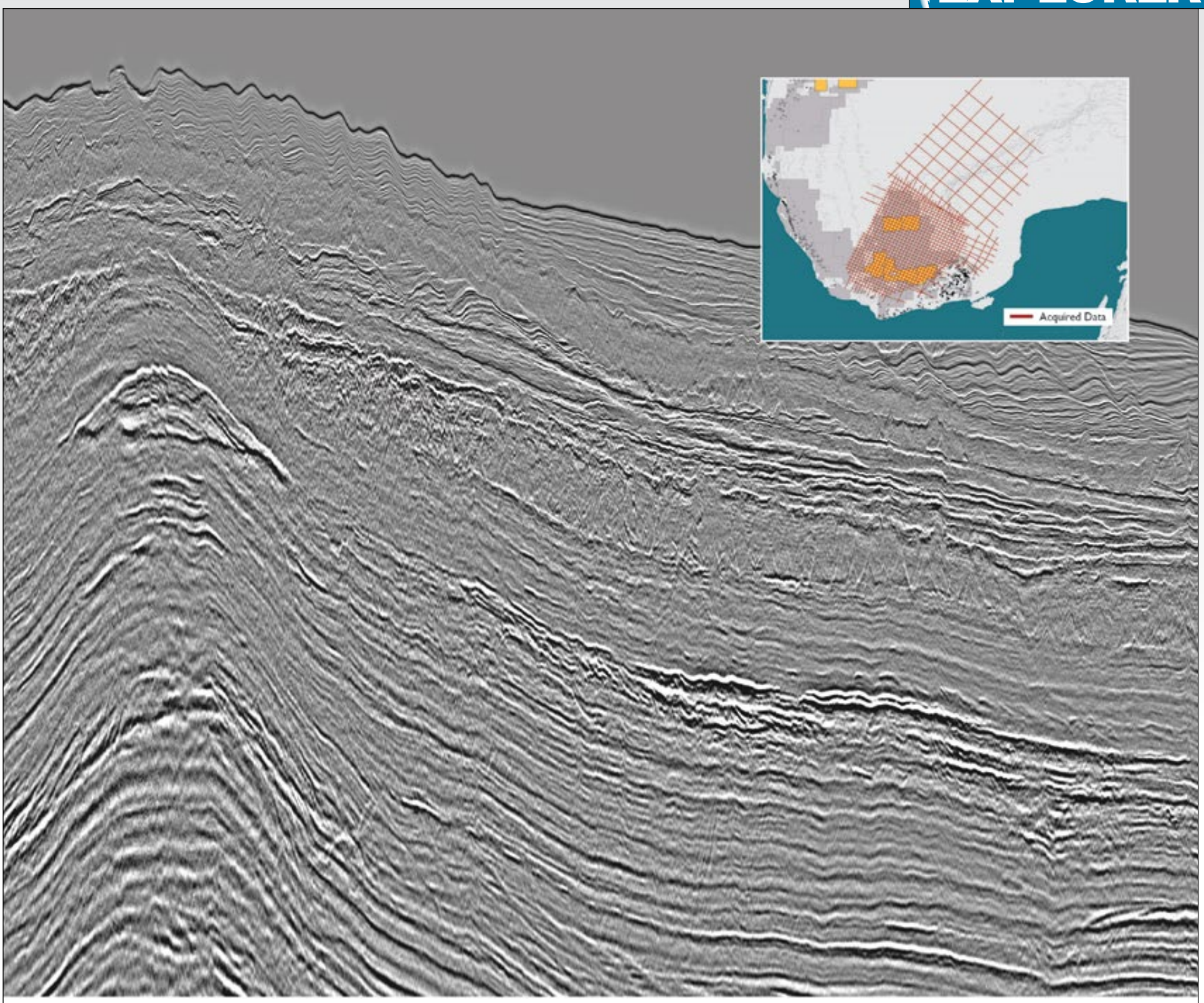
Immediately north of that, in less than a county width, lies a swoosh of wet gas/condensate production. A somewhat wider band of oily production lies to the north and extends several counties farther to the northeast than the other two areas.

Not only does the Eagle Ford contain multiple generation widows, the play is still creating hydrocarbons.

"It's still generating – it is at or above maximum pressure and temperature for generation. It's a strange concept to think about: If you don't drill it, you're going to get more," Portis observed.

Wait just a few thousand years, and the Eagle Ford would be an even more prolific play.

See **Production**, page 18



Unconventional
from page 10

those blocks have been awarded, and drilling likely will begin in the near future.

"I would say that the upside is quite high. All of the below-ground issues are present – fields with plenty of oil-in-place with bypassed pay, with offset and/or deeper targets. With improved geology, geophysics and reservoir engineering, these should be profitable," Weimer said.

Unconventional Resources

In addition to offshore prospects and conventional production, Mexico holds considerable promise for unconventional development in resource plays, Weimer believes.

"The possible unconventional plays in Mexico are similar to what we have had good success in developing in the U.S. and Canada," he said.

"First, they have very rich source rocks, primarily Upper Jurassic, that are in the generation window. In several basins, they sit in areas where there are little structural complications and have good mechanical quality, high pressures and good potential oil quality," Weimer added.

Just like in the United States, many unconventional play strata were drilled through or bypassed in Mexico, before the industry learned how to stimulate and produce tight formations.

"Potential strata have been penetrated by many wells, in some areas. Heavy oil plays also have a high upside. In some basins, a good pipeline infrastructure already exists. I think the above-ground issues will determine if these are eventually developed," Weimer said.

Regulatory Landscape

He emphasized that these prospects won't be developed without operational and financial terms acceptable to the international oil and gas industry, drawing a line between favorable geology and unfavorable regulations.

"A key point that I stress is the separation of below-ground issues – the geology and engineering, and the above-ground issues – the regulators, business terms," Weimer observed.

The most critical future consideration for exploration and development in Mexico "will be the above-ground issues, in terms of the regulators and financial terms," he said.

Production
from page 16

Producing the Eagle Ford

Pioneer entered into the basin in the '90s in Pawnee Field, "a legacy Edwards Reef play," McDonald said.

Petrohawk Energy first announced the opening of the Eagle Ford unconventional play in October 2008, and Pioneer completed its first horizontal well in the shale in June 2009.

"While Petrohawk started horizontals in Hawkville in the south, we drilled a few horizontal wells in the northeast part of the play and established what turned into the sweet spot of Karnes and Dewitt counties, in our opinion," McDonald said.

"We see some variation along our acreage with different performance drivers of varying TOC, pressure, clay content and porosity. Even in our dry gas, we have prolific wells since there is a 'mini-basin' between the margins thickening the Eagle Ford section," she added.

Over time, the company has made some substantial changes to drilling and completions techniques that reduced costs and gained efficiencies, Portis said.

"We leverage our 3-D seismic very heavily," he said. "One other thing that's moved the needle for us is the employment of X-ray fluorescence."

Pressure, organic content, good clays, reservoir integrity and favorable oil-liquids generation combined to make the Eagle Ford a prolific and desirable prospect, but the play does present some special challenges.

"Our major limiting factor in the Eagle Ford is the temperature. We're trying to push the limit and use the temperature to our advantage by using dissolvable plug technology, diversion technology," McDonald said.

"The uniqueness of the Eagle Ford is that we're limited in the number of tools we can run because of the temperature – perhaps only the Haynesville shares that limiting factor with the Eagle Ford," she noted.

To deal with the temperature challenges, "the industry is going to have to innovate," McDonald said.

In stimulation, Pioneer has followed the current trend of other resource play operators in using higher volumes of water and, especially, more proppant.

"We definitely have seen that if we pump more in a tighter cluster spacing, the wells have an uplift associated with that change," McDonald said.

And in drilling, "we've done a great job here recently with our rotary steerables. We set three world records for the longest single run," she noted. "We have some higher horsepower rigs that we could combine with the rotary steerables to see even better results."

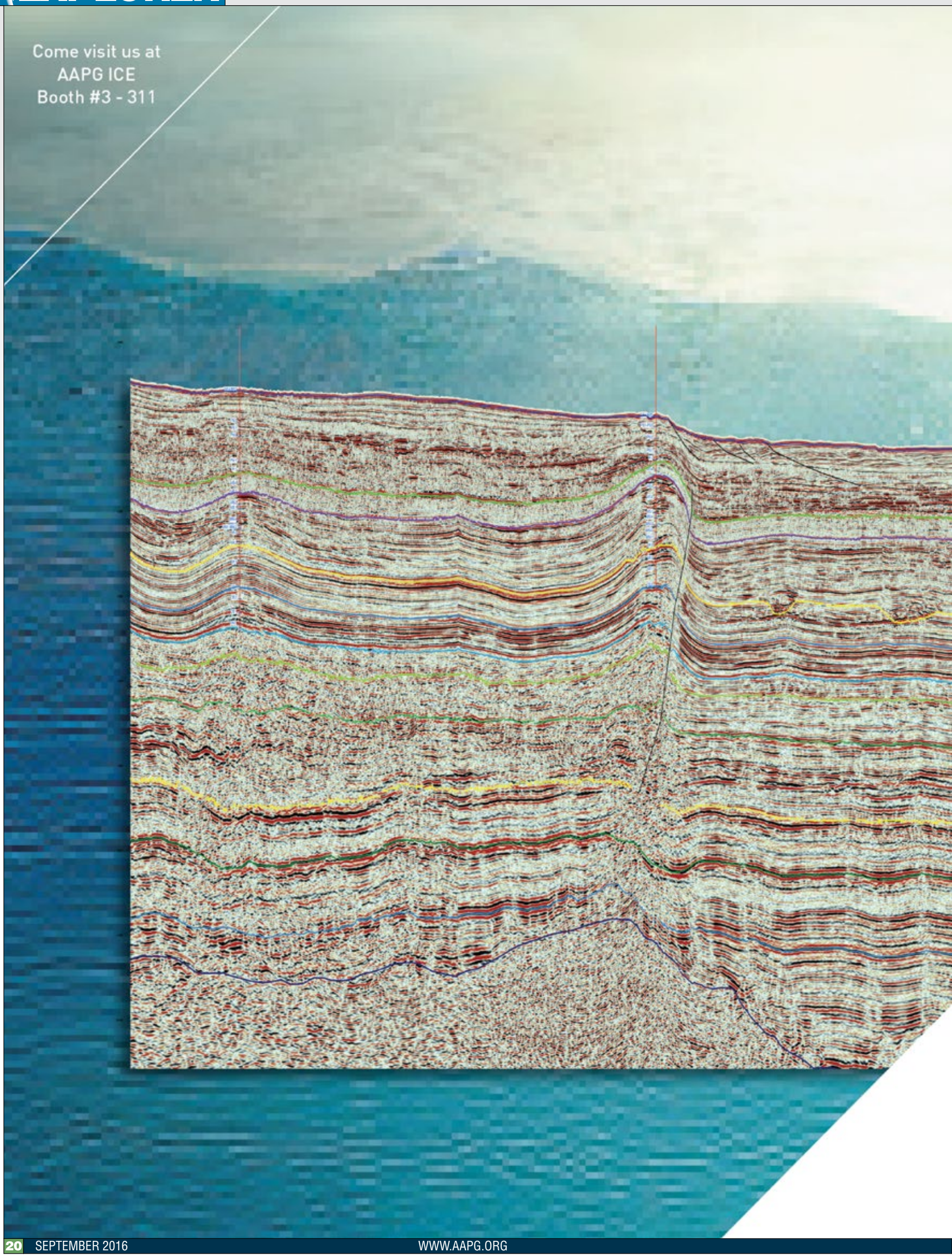
Downturn

The Eagle Ford hasn't escaped the effects of the industry downturn. According to the Texas Railroad Commission, 5,613 drilling permits were issued for the play area in 2014 and 2,315 in 2015.

Oil, gas and liquids production have all declined. Eagle Ford oil production reached a high of 1,174,931 barrels per day in 2015 and fell to about 950,000 barrels per day this year.

Operators are still actively experimenting in the Eagle Ford, trying to unlock the play's full potential.

But "the land grab is all but gone at this point, and more open data and knowledge sharing will benefit the development of the entire basin for all operators," Portis said.


Come visit us at
AAPG ICE
Booth #3 - 311

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

Unifying Threads of Southeast Mexico's Discovery Processes

By JAVIER J. MENESES-ROCHA

Southeast Mexico's petroleum region extends from the Isthmus of Tehuantepec to the Mexico-Guatemala border. It is home to four world-class petroleum provinces: the Isthmus Saline Basin, the Comalcalco Basin, the Macuspana Basin and the Reforma-Akal Trend.

These provinces have yielded 80 percent of Mexico's cumulative production, contain 60 percent of Mexico's remaining reserves and host 53 percent of Mexico's prospective resources.

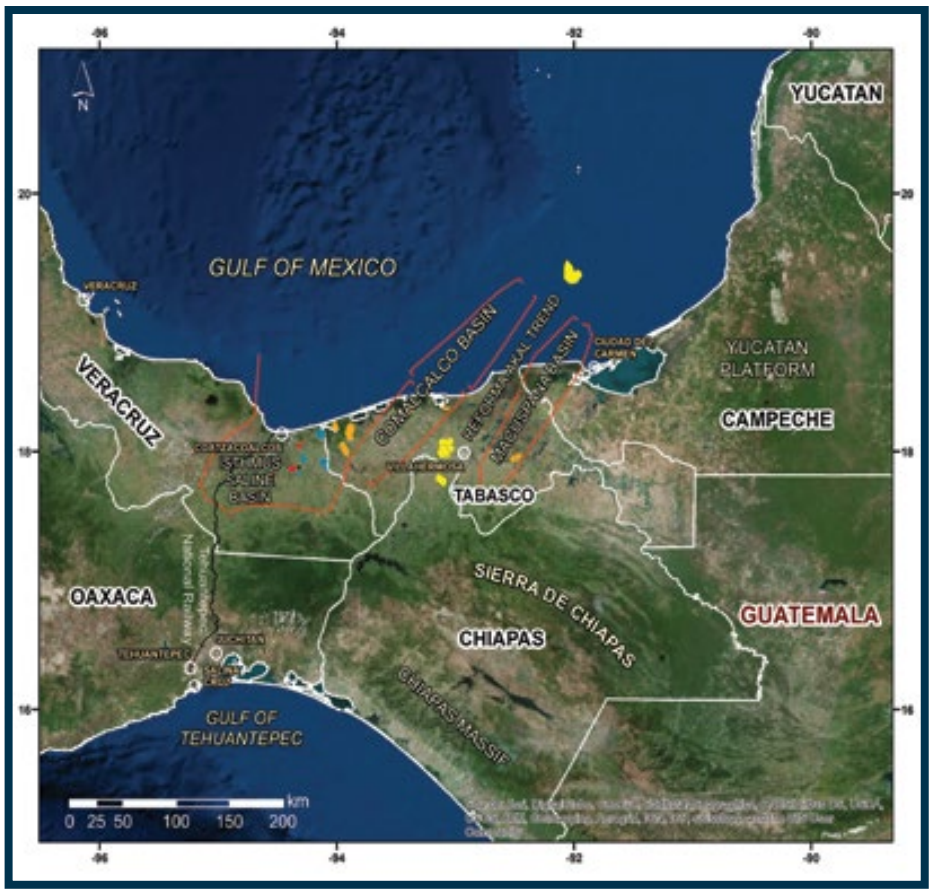
The discovery processes of these provinces were forged through different political, economic and legal frameworks, imprinted indelibly by the history of Mexico. Their development was decisive not only for Mexico's economic progress, but also for the growth of major international oil companies and for that of Mexico's own state oil company, Pemex.

Therefore, knowing about the petroleum exploration history of southeast Mexico is a must for petroleum geologists wishing to find new exploration targets in this territory, and also for those seeking to unveil the unifying threads of a significant chapter of Mexico's petroleum industry history.

The pace at which reserves were discovered in four distinct periods in southeast Mexico provides clues to identifying and drawing on their unifying threads, as well as of the declining or impasse phases that followed each discovery period.

Each period shows that the prime and crucial unifying thread for success has been an intellectual tool, namely geological reasoning, marked by a great deal of imagination, study, hard work, willingness to take risks, persistence, patience, cooperation and competence, all within a business environment of operational autonomy.

Geological reasoning has been the beacon to question dogmas and has been expressed in three historical phases: inductive, deductive and through an inductive-deductive hermeneutic circle.



Induction: Discoveries at the Cap Rock of Salt Domes

This first period, as well as the period to follow, were outlined by closely linked landmarks that blended the petroleum account of the Isthmus of Tehuantepec and the legendary story of the Texas and Louisiana coastal plains.

After the Pennsylvania oil rush in 1874, Agustín Barroso, a Mexican geologist commissioned to find an interoceanic route across the Isthmus of Tehuantepec, published the "Memoir on the Geology of the Isthmus of Tehuantepec." In this report, he described sulfur brines and oil seepages on some mounds located at the northern part of the Isthmus of Tehuantepec, east of the Coatzacoalcos River. He predicted that these oil occurrences would be exploited soon.

Barroso very likely knew that in 1862 the search for salt deposits had led to the discovery of the first salt dome in Louisiana, and that commercial production in Pennsylvania was related to the occurrence of oil seepages on anticlinal structures.

The remarkable commercial meaning of Barroso's harbinger became tangible on the Louisiana and Texas coastal plains. In 1890, Patillo Higgins and Anthony Francis Lucas started prospecting here for oil on the basis of the relationship between sour water springs, oil and gas seepages, and mounds. Their visionary enterprise led them, in 1901, to the famous first great Texas oil strike: Spindletop.

This Texas gusher spurred British contractor Sir Weetman Pearson, who had built the Tehuantepec National Railway, to hire Lucas to assist him in acquiring some coastal plain land next to the railroad. Thus, between 1902 and 1904, Pearson & Son Ltd., which later became Royal Dutch-Shell Group's Mexican Eagle Oil Company, drilled six wells on salt domes located west of the Coatzacoalcos River. The results were meager and Lucas returned to the United States in 1905 - but his initial efforts were seminal.

From 1905 to 1917, four small light oil fields were discovered east of the Coatzacoalcos River, in the mounds described previously by Barroso, at depths between 40 and 800 meters. The San Cristobal-Copoacan, Soledad-Concepcion and Tecuanapa fields produced from dolomites of the salt domes' cap rocks; the Ixhuatlan field produced from Miocene sands overlying the salt domes.

By 1908, the maximum daily production from the largest field (San Cristobal-Copoacan) had increased to 1,540 barrels per day, but by 1915 it was down to 55 barrels per day. In 1915, in the midst of the Mexican Revolution turmoil, cumulative total production from the four fields had reached 2 MMb, the reserves by then being almost exhausted.

During this first period, offshore exploration in the Gulf of Mexico was overlooked, despite the fact that in 1917 Mexican geologist Fernando Urbina had published a report titled "The Submarine Petroliferous Reservoirs" in which he emphasized the economic significance of oil seepages in the Gulf of Mexico continental platform.

Induction-Deduction: Discoveries on the Flanks of Deeper Salt Domes

By 1918, oil production in southeast Mexico was negligible.

Notwithstanding, the legendary discoveries made in the Ebano-Panuco and the Golden Lane areas led Mexico to play a crucial role in World War I and by 1921 it was the world's second largest producer, with a historic output of 530,000 barrels per day – one quarter of the world's production.

Between 1862 and 1911, several hypotheses had been formulated to account for the origin of salt domes, but they were not thought to be reliable deductive arguments useful to find new oil reserves in Texas and the Isthmus of Tehuantepec.

In 1913 and 1916, Everett L. DeGolyer, together with a group of geologists from the Mexican Eagle Company headed by Paul Weaver, visited the Isthmus of Tehuantepec to examine the salt domes, especially the occurrence of oil in Miocene sands overlying the Ixhuatlan salt dome and the oil shows found in two wells drilled on the flanks of the Soledad-Concepcion salt dome.

The field observations in the Isthmus of Tehuantepec, the inspection of similar deposits in Texas and Louisiana, and a critical reading of literature led DeGolyer and his co-workers to new geological thinking that soon proved decisive in overcoming the standstill. They reasoned that lateral sands, like those found on the flanks of the Soledad-Concepcion salt dome, were promising. This inductive argument was backed by the intuition of other European and American geologists who, between 1916 and 1920, thought that refinement of physical instruments could be helpful in mapping oil-bearing subsurface structures.

Suffice to say that, following DeGolyer's recommendation, torsion balances arrived in 1922 in Texas and in 1923 in the Isthmus of Tehuantepec. Seismic refraction and reflection crews began to work in the Isthmus in 1928 and 1933, respectively.

Henceforth, between 1923 and 1935, geological and geophysical methods led to the discovery of oil pools in Miocene sands on the flanks of four deep salt domes located at the western margin of the Tonala River: Filisola, Tonala-El Burro, El Plan and Cuichapa.

By 1938, these fields had become the backbone of oil production in southeast Mexico, with total reserves of around 160 MMbls, a cumulative output of 92 MMbls and by then remaining reserves of 67 MMbls.

A geological map of Yucatan and Guatemala traced by J. Tercier in 1932, showing the location of oil seepages offshore the State of Campeche, is a testimony of the attention given to the hydrocarbon potential of the continental shelf.

The Hermeneutic Circle: Discoveries on the Flanks of Deeper Salt Domes and in Extensional Tertiary Basins

At the time of the Mexican petroleum nationalization in March of 1938, when the world was about to confront the outbreak of World War II, the landscape of Mexico's petroleum industry was not favorable. Daily production had dropped to 105,000 barrels and the only reliable oil pool was the Poza Rica field. Areas within sight were not promising, especially those in southeast Mexico.

In 1939, a group of no more than 10 young geoscientists with Pemex, with solid track records and operating autonomy, faced the challenge of organizing the exploration activities throughout the whole country: selecting the most promising areas for exploration, finding new reserves to increase and sustain hydrocarbon production, and recruiting and training the most suitable graduates from different geological schools within the country.

By 1950, this exploration body had grown to about 100 geoscientists and had the cooperation of renowned former Mexican professors like Ezequiel Ordoñez and that of international consultants.

Pemex exploration leaders Santos Figueroa Huerta, Manuel Rodriguez Aguilar, Jorge Cumming, Antonio Garcia Rojas and Guillermo Salas made the titanic assignment possible by giving general guidelines to the newcomers, such as to keep reading vintage data, conduct limited surface geological mapping in order to familiarize themselves with the geology of key areas, and build or become familiar with the geophysical instruments left by the ousted foreign companies.

Pemex's exploration activities in Mexico were formally launched in 1943 and aimed to understand the essential regional geological framework in order to identify the most promising areas. In southeast Mexico, attention was especially focused on the remote Tabasco areas and the Sierra de Chiapas foothills, where oil seepages and previous geological studies had led to drilling exploratory wells with disappointing results.

By 1947, two northeast-southwest trending minima gravities had been delineated on both sides of the Jalpa High that had been defined by the El Aguila Company, and deeper salt domes were imaged at the easternmost part of the Isthmus Saline Basin. The two minima were interpreted as the Macuspana and Comalcalco Tertiary basins.

The new hydrocarbon laws enacted in 1949 allowed Pemex to grant risk contracts to several American independent companies in order to perform geophysical surveys and exploration drilling offshore,

See **Exploration**, page 24

AAPG Education Upcoming Education Events 2016

AAPG HEDBERG RESEARCH CONFERENCE CENTER

Mudstone Diagenesis: Implications for Exploration and Development of Unconventional Reservoirs

16-19 October 2016 | Santa Fe, New Mexico

The purpose of this conference is to foster the free exchange of new ideas among leading experts from industry, academia and government on the controls and impacts of inorganic and organic diagenesis on mudstone hydrocarbon generation, reservoir properties and seal quality.

Until recently, most researchers investigating shales concentrated their research efforts towards understanding: (a) hydrocarbon generation and expulsion, (b) seal capacity and (c) overpressure generation. Most data used to support these investigations were derived from organic geochemistry, relatively low magnification optical petrography and bulk rock characterizations. Notably lacking from these studies is the characterization and evaluation of the potential impact of mudstone diagenesis.

New analytical techniques in scanning electron microscopy (SEM) have allowed the investigation of mudstone properties down to the nanometer scale. New SEM observations of mudstone micro-texture have revealed the presence of authigenic cements, and have captured various stages of the transformation of organic matter during petroleum generation. An improved understanding of mudstone organic and inorganic diagenesis is required to advance the ability to better predict shale reservoir quality and heterogeneity.

GEOSCIENCES TECHNOLOGY WORKSHOP

Making Money with Mature Fields - Geosciences Technology Workshop

5-6 October 2016 | Houston, Texas

The goal of this workshop is to review mature fields and to identify the amount and nature of oil that can be recovered, and to evaluate competing strategies for economically producing the remaining reserves. In addition to looking closely at fields, we will review new and improved technologies that may help revitalize reservoirs and overcome problems such as low pressure, paraffin, corrosion and more. We will identify companies willing to offer a "no money down" approach, or other forms of innovative financing. In addition to reviewing the technology, we will review case studies.

Themes

- Mature fields: examples and profiles
- Typical issues resulting in oil left behind
- EOR
- New technologies and techniques
- Is there funding? Where? How? Who?
- Reality checks: water, environmental issues, infrastructure
- Opportunities and economies of scale: how to make the economics really work

SHORT COURSES

Petroleum Economics

22 September 2016 | Houston, Texas

New Energy Professionals learn the why's and how's of making investment decisions, i.e., whether and which projects to fund, in an oil and gas company. Fundamentals of petroleum economics are key to understanding how to prepare a project proposal, draft an Authorization for Expenditure request and understand how management makes the funding decisions that it does. Larry Chorn, of Chiral Energy Partners, LLC, has over 30+ years of experience in the oil industry.

Roles and Responsibilities of a Development Geologist, For Beginners

7 October 2016 | Houston, Texas

This mini-short course gets new development geologists started right and helps them understand what is important to know and to do in this role, and what to avoid. The course instructor, Phil Salvador, has worked chiefly as a development geologist for ConocoPhilips, Qatar Petroleum and Afren from 1975 to 2015.

Carbonate Depositional Systems

3-4 October 2016 | Houston, Texas

This course will alternate between lectures and practical exercises involving cores, logs and seismic data.

The course starts with an introductory lecture that summarizes key differences between carbonate and siliciclastic depositional systems, followed by a review of the Dunham classification of carbonate rocks and grain types. An exercise involving outcrop samples will allow participants to describe samples and relate them to depositional environments. The second lecture is on carbonate depositional environments, and it will systematically examine modern environments, outcrop equivalents and subsurface reservoir examples of each environment. An exercise involving cores and logs will illustrate ramp depositional environments and their effect on reservoir architecture during "greenhouse" times.

Carbonate sequence stratigraphy will be discussed in theory and practice. A core-log-seismic exercise will show how predictable variations in reservoir development occur during ice-house cycles on a shelf and isolated platform.

This course will conclude with a discussion summarizing prediction of depositional facies, stratigraphy and reservoir development in a variety of settings.

The Petroleum Geochemistry Toolkit for Petroleum Exploration and Development

3-4 October 2016 | Houston, Texas

The petroleum geochemist's task is to determine if a regionally extensive source rock is present, if the source rock reached sufficient maturity to generate large volumes of hydrocarbons, what type of hydrocarbons will be generated, timing of peak generation (current or historic), and migration of the generated hydrocarbons (trap access). These petroleum geochemistry elements and processes need to be understood to properly assess risk and high grade play in both conventional and unconventional resource play opportunities.

This course will provide sufficient background to better understand basic principles of petroleum geochemistry, how best to use geochemistry in their exploration or development study area, determine the limitations of geochemical data/interpretation, and types of samples and analysis required to evaluate a basin, region, play or well.

www.aapg.org/career/training/

Javier J. Meneses-Rocha worked for Pemex for 32 years in positions that included manager of geological and geophysical integration and interpretation and exploration manager of the southern region. He is past president of the Asociación Mexicana de Geólogos Petroleros (AMGP) and a member of Mexico's Academy of Engineering. He was awarded the AMGP Prize in 2012 for distinguished professional achievements.

Exploration
from page 22

between southern Veracruz and Ciudad Del Carmen, and onshore, in some areas of Veracruz, Tabasco and Campeche.

Between 1947 and 1962, Pemex discovered 35 fields in southeast Mexico. Three of them held proved oil and gas reserves of more than 100 million bboe in Miocene sands associated with salt domes in the easternmost part of the Isthmus Saline Basin (Sanchez Magallanes, Cinco Presidentes and Ogarrio fields). Another found gas and condensate reserves greater than 2 Tcf in Miocene sands in the downthrown blocks of normal faults in the Macuspana Basin (Jose Colomo-Chilapilla Field).

Meaningful discoveries were made in 1958 in Upper Miocene sands of the Comalcalco Basin (Mecoacan and Tupilco fields) and a small but significant oil strike was made in 1960 in Upper Cretaceous carbonate rocks in the Cerro Nanchital Anticline, in the Sierra de Chiapas foothills.

Offshore Coatzacoalcos, the independent company CIMA discovered three small oil fields in Miocene sands associated with salt domes between 1949 and 1959 (Tortuguero, Rabon Grande and Santa Ana fields).

The Hermeneutic Circle Renewal: Discoveries in Mesozoic Carbonate Rocks of the Reforma-Akal Trend

By the mid-1960s the positive results of the exploratory efforts were deemed insufficient for the country's successful industrialization process. By 1965, the national energy consumption had doubled that of 1955. From 1961 to 1965, annual oil consumption had averaged 820 million barrels. The forecast annual consumption for the 1966-70 period was 1,064 million barrels and for the 1971-80 period it was 3,617 million barrels.

Since no meaningful discoveries had been made by 1966, Mexico had to suspend oil exports and Pemex and the independent companies decided not to extend the risk contracts.

The study of the accumulated data, with a mix of imagination, technological creativity and scientific analyses, became of paramount importance.

Field mapping in the Sierra de Chiapas had identified porous Upper to Middle Cretaceous rudist-bearing limestones and dolomites, which showed numerous oil seeps at the crests of thrust-faulted anticlines plunging to the northwest into the Reforma area in the Tabasco Coastal Plain. There, a refraction survey had sketched a high velocity layer that might be correlated with the carbonate rocks exposed at the Sierra foothills.

By 1969, common depth point reflection data and new techniques in processing had improved the image of the high velocity layer. Three on-trend thrust faulted anticlines were seismically mapped in the subsurface beneath a section of sealing shales. Well engineering had by then progressed to enable drilling through the geo-pressured basal Tertiary shale.

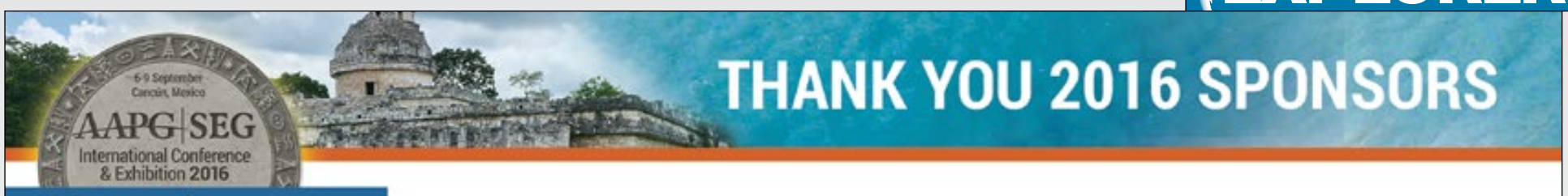
Alternative interpretations were ineluctable. Well results in nearby areas with Mesozoic targets had been disappointing to the extent that some geoscientists thought the high-velocity layer to be Eocene sandstones and conglomerates cut in nearby wells and exposed in the Chiapas Mountains. Others thought this layer could correspond to Cretaceous evaporites seen in some wells in Chiapas to the south.

By mid-1970, sound geological arguments had persuaded Pemex's top management to approve investment for three wildcats in the Reforma area. In 1972, two out of those three wells – Sitio Grande and Cactus – yielded high oil and gas production rates from Upper Cretaceous carbonates. Further wildcats on structures to the north were equally successful in discovering pools in a complex that was later named "Bermúdez."

The Reforma success allowed updating and refining of the paleogeographic maps and encouraged offshore seismic surveys in Tabasco and Campeche waters where oil slicks had been previously reported. In 1976, the Chac-1 well came in as an oil producer in thick, porous and very permeable Upper Cretaceous breccias. Adjacent pools, like Akal, flowed at average rates up to 33,000 bopd and were later combined to become the Cantarell Complex, the largest offshore oil field in the world.

Javier Meneses de Gyves, Pemex's exploration manager, acknowledged the discovery of this field as the crowning accomplishment of his generation and of his 10 predecessors, the founders of Pemex's exploration activities.

See **Fisherman**, page 36



THANK YOU 2016 SPONSORS

Diamond

Chevron

أرامكو السعودية
saudi aramco

Shell

Titanium

ANH
AGENCIA NACIONAL DE HIDROCARBUROS
COLOMBIA

Platinum

WesternGeco
A Schlumberger Company

Gold

bp

ExxonMobil

TOTAL

Silver

BAKER HUGHES

CASA EXPLORATION

ion

TALOS ENERGY

Tecpico

Weatherford

Bronze

Hunt OIL COMPANY

IHS Markit

PETROBAL

REPSOL

Spectrum

Statoil

Patron

BNE
BELIZE NATURAL ENERGY

geoprocesados®

Vitol

Media

AAPG EXPLORER

GEOExPro

The Leading Edge

Petroleum

SHALE GAS INTERNATIONAL

Tradequip International

upstream

See you in London for ICE 2017

Regulator, Operator Dialogue Is Vital

By EMILY SMITH LLINÁS, EXPLORER Correspondent

The regulatory framework governing any given country's exploration and production can make all the difference between a boom or bust oil and gas sector, especially in the low-price conditions of recent years, regardless of what riches are available beneath the earth.

That's why communication and cooperation between producers and policymakers is so important, and that's why the offerings at the upcoming AAPG/SEG International Conference and Exhibition (ICE) in Cancun, Mexico should be of such vital interest to geologists.

"It is very important for explorers to have a two-way dialogue with regulatory agencies to jointly understand what makes projects viable, especially in frontier areas and in a low oil price environment," said Victor Vega, ICE general vice-chair and AAPG Latin America and Caribbean Region president. "It is also interesting to bring regulatory agencies, national oil companies and private companies together to understand the challenges and opportunities in the region and not just from a technical perspective but also from a business point of view."

Along with the high quality technical program available at ICE, there will also be a series of special sessions offering insight into business, political and administrative factors affecting geoscientists and industry.

One such session is the Regulators Forum, "Regulatory Challenges for Unconventional and Deepwater Exploration and Production Activities," to be held Sept. 6, just prior to the ICE Opening Ceremony.


VEGA

> "It is interesting to bring regulatory agencies, national oil companies and private companies together to understand the challenges and opportunities in the region."

The Forum will feature regulatory agency leaders from Mexico, Colombia, Brazil and the United States, who will describe how their agencies' regulatory frameworks are designed to promote sustainable and efficient exploration and production activities.

Panelists will discuss regulatory challenges associated with the development of unconventional resources and offshore fields and examine how lessons learned in the United States and Canada can apply to activities in Latin America and the Caribbean.

Vega organized AAPG's first Regulators Forum while serving as general chair of ICE in Cartagena, Colombia in 2013.

"The feedback we received from the Forum was very positive because people had the opportunity to ask questions and interact with regulatory agencies and highlight some of the challenges and potential solutions," he said. "For the regulatory agencies, it was also an opportunity to interact with other countries to gather key learnings and to share experiences."

Vega will co-chair the Regulators Forum with Hector de Santa Ana, manager of exploration and production at the Uruguay's National Combustible, Alcohol and Portland Administration (ANCAP).

Diverse Perspectives

De Santa Ana has the unique perspective of working as a regulator and an operator simultaneously. ANCAP is a regulatory agency inside Uruguay, supervising offshore exploration activities and promoting new opportunities in the country's frontier basins.

Outside Uruguay, the agency is known through its subsidiary Petrouruguay, an oil company working with partners to produce gas and condensates in the Neuquén Basin in Argentina and developing a mature fields production project in Venezuela's Orinoco Belt.

A 37-year veteran of ANCAP, de Santa Ana said he has seen regulatory agencies' roles change over time.

"I think that today's role of the regulatory agencies in our region is very different than 10 years ago," he said. "Fundamentally, their most important is to generate synergy with oil companies, to promote opportunities and to provide knowledge of resources and tools available in their countries."

He added that today's regulatory agencies are accustomed to facing both difficult and favorable circumstances.

"One of the biggest challenges for regulatory agencies is to adjust their performance and way of thinking to current industry times without losing their sovereignty," he said. "The biggest opportunities are associated with underexplored and frontier basins, as well as fair contract terms and attractive conditions across Latin America and the Caribbean."

Expectations for the Forum

De Santa Ana said the ICE Regulators Forum will give representatives from operators and service companies the chance to connect with the leaders of the regions' regulatory agencies and to learn first-hand about opportunities and challenges in the countries they represent.

He noted that international operators coming to work in Latin America should

See **Forum**, page 36

Discovery Thinking

Understanding the Gulf of Mexico Basin

By LOUISE S. DURHAM, EXPLORER Correspondent

The longtime prolifically productive Gulf of Mexico Basin appears to harbor all the makings of a seemingly inexhaustible supply of hydrocarbons.

This explains why various companies continue to acquire seismic and other data for their geoscientists to evaluate and interpret, often more than once as technology advances. The goal of these efforts is to find new oil and gas sources and to better understand already-producing sources in terms of the hydrocarbon content, the myriad trapping mechanisms and more.

"Interpretation of regional 2-D seismic data from the U.S. onshore and Mexico offshore is the framework for an integrated margin-to-margin basin evaluation," said Brian Horn, senior vice president and chief geologist at ION.

The company has been engaged in acquiring and interpreting such a program for the past 15 years, engaging about 75 employees. It was designed as a regional endeavor from the get-go.

"These data provide unique coverage of the entire Gulf of Mexico Basin from margins to the basin, showing the deeper Mesozoic strata, the underlying basement and, in particular, the pre-salt strata offshore Mexico," Horn said.

Analysis of the seismic character southward to the Bay of Campeche and isopach maps of the entire basin depositional systems through time provide the framework for calibrating maturation modeling and prediction of migration fairways across the GOM, along with the location of depositional systems through time, according to Horn.

"Combining these new data where basement is well imaged with gravity and magnetic data make it possible to constrain the position of the continent-ocean transitions in several areas, including the Yucatan rifted margin and the East Mexican transform margin," he noted.

Horn will delve into many of these particulars when he takes a turn on the dais during the Discovery Thinking Forum session at the AAPG/SEG International Conference and Exhibition (ICE) in Cancun, Mexico this month.

Why the Gulf?

Likely, there are some who question the inclusion of the Gulf basin in such a forum.

Horn turns this kind of thinking upside down.

"While it's not about a specific discovery, the intent of the talk is to emphasize that even though this is the most mature basin in the world, earth scientists continue to find significant oil accumulations," he noted, "and there are still many things about the basin that are not understood."

Progress is afoot given there are datasets covering the entire region that help to put plays and discoveries into the context of where they fit in the basin petroleum system.

"Now that we can at least image the basin in its entirety, we can begin to ask more salient questions about what's left, what we should be looking for, what we have missed," Horn said.

Think about Mexico, for example, which is a new frontier in many ways, even though a lot of the main plays have been discovered.

"In the Campeche salt basin, we know that the Tertiary plays are successful," Horn said. "But there are things we see now with the new seismic that look like they may be a new pre-salt play, and we're imaging those things.

"We have a much better understanding of basin tectonics now and how the Gulf opened, how it grew," he stressed. "You really want to understand the basin as it evolved and see how it changes through time to understand where the hydrocarbons might be."

Over the years, myriad theories and perspectives have been developed about the GOM overall, given its never-ending allure, with the major exception being when it was temporarily dubbed the "dead sea" during one of the industry's more-infamous downturns.

The Big Picture

Don't expect a presentation at ICE that will have all the answers in 40 minutes, Horn cautioned.

"Way more people have worked the area to a greater extent than I," he emphasized. "This (talk) is more about what we've learned and where we potentially could go – and I say this with humility.

"*Discovery thinking* starts by understanding the entire basin, not just one discovery or field, or series of fields," he asserted. "It's about understanding how plays develop and what you need to know from a bottoms-up approach.

"This is the kind of thinking that will lead to future discoveries.

"You don't find the oil on seismic lines," he quipped.

The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, TGS, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer.

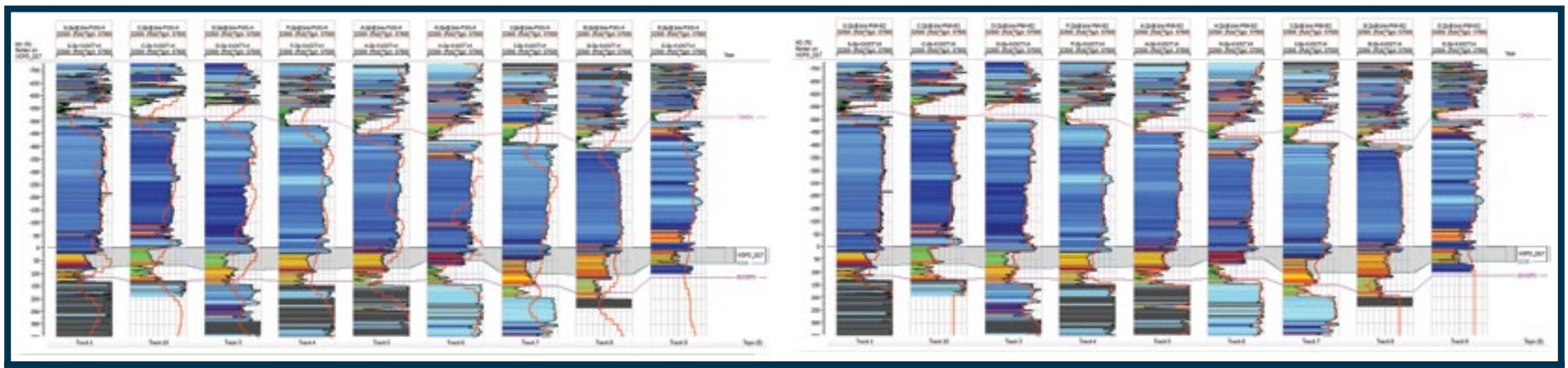


Figure 1a (FWI) and figure 1b (PNN) Zp inversion at wells

Improving Resolution and Clarity With Neural Networks

By CHRISTOPHER P. ROSS

Tight sands by their very nature imply lower porosity and higher interval velocity, and therefore may be seismically thin and difficult to resolve in the seismic record. Targeting lower porosity siltstones instead of sandstones can further increase the degree of difficulty. Nevertheless, with improved drilling and development technologies, tight sands and silts are now often exploration and production objectives. Seismic inversion techniques have been used extensively for these problematic, seismically thin reservoirs for decades since the inversion process removes the wavelet through deconvolution or equivalent techniques, allowing interpreters to get closer to resolving the top and base of these units. However, when working with seismic objectives below seismic tuning thicknesses, there are still limitations. Here, I demonstrate with a thin, spatially varying siltstone reservoir how to improve seismic inversion resolution and better clarity of lithologies using mapping and classifying supervised neural networks.

Geology

The setting for this article is the Permian Basin of West Texas, and it focuses on the Woodford group – a relatively thin, predominantly clastic interval of Mississippian and Devonian age strata situated unconformably between Mississippian and Devonian carbonates. Of interest is the Mississippian-age Woodford Silt, unconformably overlying the organic-rich, black Devonian Woodford Shale. The Woodford Shale ranges from 50 to 200 feet in gross thickness across the 3-D survey, while the silt varies in thickness from 40 to 120 feet, and can be subdivided from core analysis into two parts: a less desirable basal section that is a ripple laminated, argillaceous siltstone (shaley); and a more desirable upper portion described as intensely bioturbated to bioturbated coarse siltstone. Porosity ranges for the upper portion of the silt are 2 percent to 8 percent. While differentiating the upper and lower silt facies would be advantageous, the first-order goal is to determine the thickness and extent of the combined facies of silt, which has similar acoustic impedance ranges with the Woodford Shale. This task is further complicated by significant contrast in impedances with the encasing carbonates.

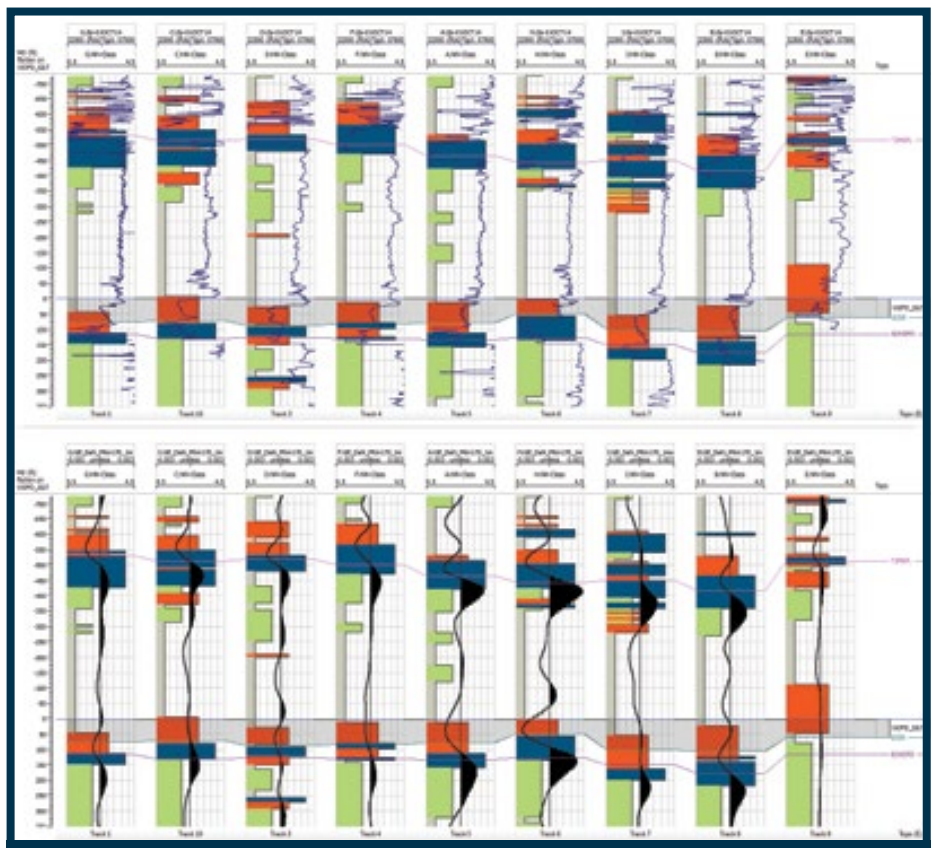


Figure 2a (well Zp) and figure 2b (seismic) with classified seismic facies

Seismic Data and Inversion

The Woodford Silt has a tuning thickness of 127 feet, which is larger than the average silt thickness of 80 feet within the 120 square-mile 3-D survey. Thus the Woodford Silt is below tuning, and attempts to measure the thickness of the silt will be challenging and complicated by the underlying shale, which has similar impedance ranges. In these thin reservoir settings, seismic inversion technology is routinely considered and there are numerous inversion methodologies available to geoscientists. I will discuss and demonstrate results from a prestack inversion variety known as full waveform inversion (FWI), and another known as probabilistic neural network inversion (PNN), which is a post-stack inversion.

FWI is a progressive, prestack model-based process that minimizes the errors between the observed prestack record and the synthetic prestack record by perturbing and constraining the elastic and anisotropic model parameters simultaneously with wave-equation modeling. Well logs may be used as part of the low-frequency initial model building, but are not used directly for the iterative error minimization. Acoustic impedance (Zp), shear impedance (Zs), bulk density (Rho) and the compressional-to-shear velocity ratio (Vp/Vs) are among the typical outputs from an FWI inversion. For this article, the Zp seismic component (volume) of the inversion will be used to assess the silt and shale.

PNN is very different from FWI in several ways: it is a post stack approach; uses multiple seismic attributes and it does not deconvolve a wavelet. Rather, the wavelet is effectively removed through the combination of multiple attributes with various weights. PNN directly uses the well data (Zp in this case) in an error minimization approach, and constrains the attributes and attribute weighting simultaneously. Furthermore, PNN can be computed at sub-seismic sample rates, which does increase the resolution. This is significantly different from the FWI and convolutional-based inversion approaches that remove the wavelet but do not actually increase the resolution.

Inversion Comparison

Comparison of the two seismic inversions is achieved by sampling each seismic volume at the control wells within the 3-D. This will permit direct evaluation of the accuracy of the final seismic impedance response with hard data at the wells, and a better understanding of the impedance profiles with regard to silt and shale. Figure 1a shows the FWI Zp inversion and figure 1b shows the PNN Zp inversion. Higher impedance Devonian and Mississippian carbonates are shaded blue and gray, while the lower impedance clastics are shaded in green, red and yellow. One can recognize the slight shifts in seismic Zp curves (red) with the well log Zp curves owing to time-depth factors in this depth cross-section. However, for the majority of the wells, these are relatively minor shifts and the comparison of seismic inversion accuracy to well data is straightforward.

Overall the FWI inversion follows the low impedance changes observed by the well logs. The FWI Zp inversion also identifies the thicker carbonate units fairly well. All the same, the thinner clastic intervals, while recognized by the FWI inversion, do not exhibit the same dynamic range (hitting the minimum Zp accurately); are broader than the actual formation thickness (apparent thickness); and show artifacts on either side of the interval as the FWI is unable to sample the relative impedance change (high-to-low and low-to-high) sufficiently.

Continued on next page

ROSS

Christopher P. Ross is currently president of Cross Quantitative Interpretation LP, a quantitative interpretation consulting service company based in Santa Fe, N.M. As an applied geophysicist by training, he specializes in technology-driven applications to help mitigate risk and improve drilling decisions for exploration and development projects. Ross began his career as a geophysicist with Amoco Production Company and has worked for various oil and gas companies and contractors as a special projects geophysicist and as a manager of technical groups. He earned a doctorate in geophysics from Georgia Institute of Technology, a master's in applied physics from the University of New Orleans and a bachelor's in geophysics from Virginia Polytechnic Institute.

Continued from previous page

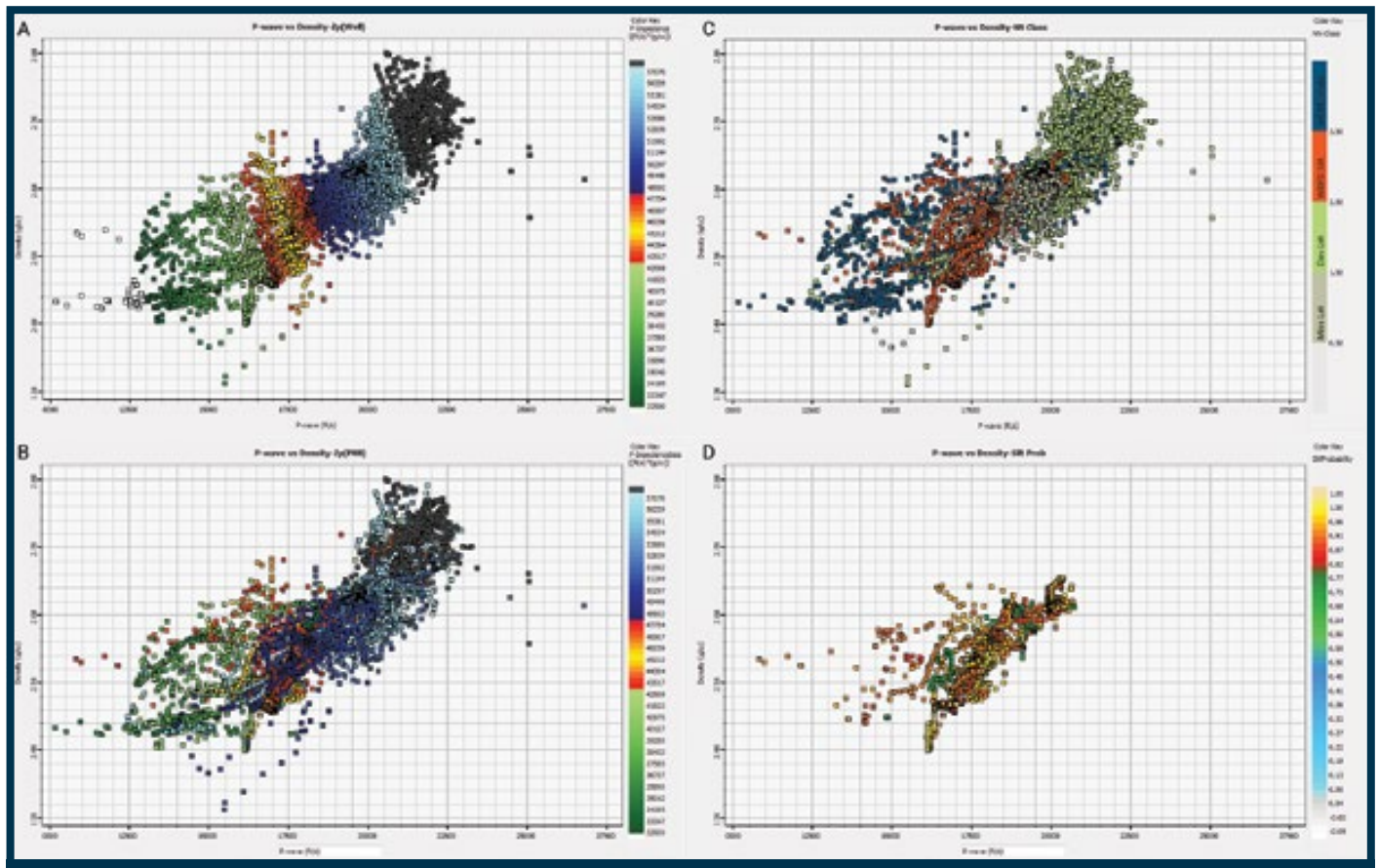
With the exception of Well E (track 9, located on the southern-most edge of the survey), which is problematic for both inversions, much better adherence to the well data is observed in figure 1b, where the neural network Zp inversion follows more accurately the thicker carbonate strata, and better approximates the lower impedance clastic unit's thicknesses. Since it was computed at half of the sample rate of the FWI, it is higher resolution, and the aforementioned comments reflect that. Nine seismic attributes were weighted and combined in a non-linear manner to create this Zp curve, and several of the attributes were from the FWI inversion. The PNN Zp inversion can be thought of as a higher order Zp, and the FWI can be considered as a very good first order approximation. Note that similar PNN Zp answers can be obtained without including the FWI attributes as input.

Reviewing the Mississippian carbonate to Woodford Silt to Woodford Shale impedance profiles in Wells F, A, H, I and B (labeled tracks 4, 5, 6, 7 and 8, respectively, at the base of each well), one observes the higher carbonate Zp to a lower silt Zp, overlying a relatively lower shale Zp. However, Wells C and D (tracks 10 and 3) show that silts can sometimes have equivalent Zp or slightly greater Zp than the overlying silt, which can be problematic for those trusting in a "Zp-only" methodology to map out silts and shales. Moreover, looking at these nine wells, one can see that silt impedance varies from well to well just as the shales do – indicating a variable response across the area that will make it difficult to use a specific Zp color key that reflects solely the occurrence of silt or shale. To remedy this, seismic object detection is used to classify the silts, shales and carbonates.

Seismic Facies Classification

The neural network classification scheme used in this example is a supervised multilayer perceptron (MLP). This is different from an unsupervised Kohonen self-organizing map (KSOM) or unsupervised vector quantizer (UVQ) methodology in two ways: first, it is supervised and therefore exploits the well data to score the quality of the output; and second, it can address non-linear problems that KSOM and UVQ cannot. In essence, the process will map multiple input seismic attributes (Zp included) to a reduced set of output attributes. Here "map" means to "combine and weight" the different seismic attributes to a seismic facies classification volume. For this geological setting, the data will be classified into four seismic facies: Mississippian Carbonate; Woodford Silt; Woodford Shale and Devonian Carbonate. Well data is used to train the seismic attributes to yield a seismic facies log at each CDP. This is the supervised portion of the process, or the feedback that allows the computations to map the attributes to classified seismic facies.

Figure 2a-b presents the seismic object detection classification in the same manner as the Zp inversions in figure 1a-b, by sampling the seismic volumes at the wells. In figure 2a, seismic class is presented as the variable area color-filled log, and well log Zp as the blue curve in each well track. The well Zp is overlain to demonstrate the variability of silt and shale impedance and how the multi-attribute classification approach better captures these variabilities,



Figures 3a-d: velocity-density crossplots with Zp, seismic class and silt probability

or, seeing how the MLP algorithm generalizes the variability of the silt, shale and limestone Zp. Neural networks are good generalizers and will map slightly different inputs to a common output. Again, outside of problem Well E, the classification offers an improved seismic volume to extract lithology information, especially in conjunction with the silt relative probability volume.

To go full circle, I have substituted for the Zp curve an extracted seismic trace from the full stack volume and superimposed it over the seismic facies classification in figure 2b. This demonstrates the improved clarity in identifying the silt using the MLP classification, as opposed to using a "seismic-only," or an "impedance-only" approach. In spite of the seismic amplitude and character differences, well-to-well, the seismic object detection is systematic and better defines the occurrence of silt and shale that matches the petrophysical divisions supplied by the operational petrophysicist and geologist.

Another way to demonstrate the success of this supervised neural network implementation is to view velocity-density crossplots and color-code the plots with Zp, seismic class and probability of silt (from the MLP).

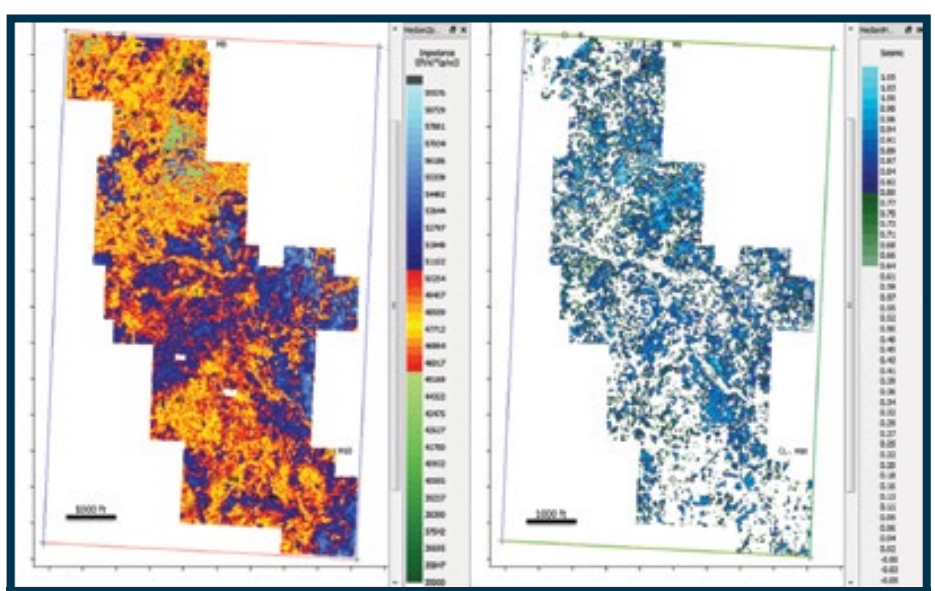


Figure 4a (FWI Zp) and figure 4b (silt probability) horizon slice

The data plotted is from the top of the Mississippian to about 150 feet below the base of the Woodford Shale. In figure 3a, the plot is color-coded by well log impedance which, as expected, places all of the carbonates in the upper-right (high impedance) portion of the crossplot. Figure 3b is the PNN Zp which diverges from the ideal presented in figure 3a (i.e., the seismic inversion data does not show the clear divisions between the different lithologies that the well data Zp shows). While this is very typical of seismic data, it makes the classification effort a non-linear one. To that end, figure 3c shows the same crossplot with the seismic classification posted for each sample. For this display, the carbonates are colored in light green and gray, shales in blue, and the prospective silt reservoir in orange, matching the display colors in figure 2a-b. Examination of this crossplot shows the overlap in sonic and density between the shale and silts, further illustrating a need for a non-linear classification approach. Figure 3d shows the samples with a relative probability of silt greater than 0.65, color-coded by relative silt probability. Figures 3a-d, clearly validates the multi-attribute classification benefits above a Zp-only interpretation.

Horizon slices for the equivalent Woodford silt interval are presented in figure 4a-b. Figure 4a is the median extraction of the FWI Zp and figure 4b is the median extraction of the relative silt probability with a transparency applied to all probabilities less than 0.65. In figure 4a, the red and yellow colors correspond to silt (and some shale) impedance ranges, but one cannot be certain that these ranges are appropriate across the entire 3-D. In contrast, figure 4b portrays the occurrence of silt more succinctly by the extraction of higher relative probabilities of Woodford Silt; thus one is not really concerned with the color range of silt or shale, but rather the effective silt relative probability cutoff – a better concern to contemplate.

Conclusions

Using supervised neural networks for mapping reservoir properties can improve resolution as demonstrated by the PNN Zp inversion, or using such networks for classifying variable lithologies can improve clarity as established by the seismic object detection result. While seismic inversion methodologies should be standard operating procedures for these more difficult geological settings, results can be ameliorated using non-linear neural network approaches that incorporate the inversion outputs and or use alternative multiple attributes. The results presented here reflect the neural network capabilities for tight sandstone or silt reservoirs, and how they can impact exploration and development decisions. These same approaches can be applied to unconventional resource plays as well, using mapping and classification techniques for reservoir parameters.

Thanks to Schlumberger for permission to present the seismic data and thanks to Charlie Mims for his review and comments.

(Editor's Note: This article is from an oral presentation to be given at the Joint Pacific/Rocky Mountain AAPG Sectional Meeting in Las Vegas titled "Improving tight reservoir definition using seismic object detection within the Woodford Formation.")

Seminar Helps YPs Learn To Build Businesses

By EMILY SMITH LLINÁS, EXPLORER Correspondent

Matchmaker. Innovator. Entrepreneur. These were words used to describe geoscientists at the Young Professional (YP) seminar held during the AAPG Annual Convention and Exhibition in Calgary.

Susan Nash, AAPG's director of innovation, emerging science and technology, led the session, "How to Build Your Own Business Opportunities," which taught participants to think creatively, learn continuously and find opportunities to work for themselves. To provide attendees with the tools to put ideas into action, the presentation also included sources of free or almost-free oil and gas data and software.

Citing examples of her experience selling oil and gas prospects and acquiring oil and gas leases as a 22-year-old in Oklahoma, Nash provided concrete tips for starting businesses or working independently.

"Traditionally, geologists are very entrepreneurial. They are good at starting companies. The problem now is that many geologists allow themselves to become compartmentalized, and they no longer can become change agents," she said.


FABER

> "Traditionally, geologists are very entrepreneurial ... The problem now is that many geologists allow themselves to become compartmentalized."


NASH

Reconfigured Role for the Geologist

Participants discussed how the current price environment has accelerated a move toward blended roles and interdisciplinary teams. Geoscientists across the world must be prepared to adapt and think creatively in order to succeed.

"We are seeing a reconfigured role for the geologist that moves beyond prospects," Nash said. This role allows geoscientists to identify candidate wells or fields, propose new studies using big data, or to focus on recompletions, reservoir engineering and geophysics.

Meredith Faber, AAPG YP committee co-chair and geologist at Noble Energy, shared how her role in unconventional exploration has changed as a result of the downturn.

"I'm now one of two geologists in my business unit, so I'm doing tasks I never knew anything about," she said. "I'm working with IT, marketing and legal departments."

Workshop participants discussed how YPs might be more prepared than their older counterparts to respond to this dynamic environment. Millennials are known for their ability to use technology, learn quickly and apply newfound technical expertise on the job. This perception works to the professional's advantage when seeking employment or offering their services to others.

Fomenting Creativity

Workshop participants discussed a fundamental component of entrepreneurial success: creativity. They examined the differences between convergent thinking, which focuses on rules and categories, and divergent thinking, which deliberately breaks a model or paradigm and tries to put it back together.

"You can live with just convergent thinking, but if that's all you have, you won't be able to change careers easily," Nash said. "Divergent thinking enables individuals to ask questions, find new patterns, uncover beliefs shaping assumptions and challenge them."

Participants practiced divergent thinking by looking at a photo of two burros and a Mickey Mouse balloon and identifying what the items had in common.

Faber shared how taking a theater class for fun indirectly helped her at work.

"I started taking long-form improv comedy classes a few years ago and still regularly perform with a troupe in Houston. My habit of advertising our shows to co-workers at Noble attracted the attention of my business unit manager. He asked me to help his leadership program advisees (a group which included my team supervisor) create a video demonstrating the right and wrong ways to deliver difficult feedback and diffuse difficult people in the workplace."

Faber's experience illustrated how following one's personal passion may lead to unexpected opportunities.

Identifying Interests and Opportunities

Nash encouraged participants to think about their ideal job and to take steps to develop their skills in that area. She also advised participants to work in a variety of areas to find out what they like and what they do well.

"Launch more than one personal initiative," she said. "Have two or more going at the same time."

Another key to entrepreneurial success is taking advantage of available opportunities.

Workshop participant James Lindsay shared his experience of working with a startup company providing lease and drilling appraisals.

"I went in managing the rig," he said. "Two weeks into it, we were into mid-stream negotiations, and there was no one else but me to take care of it."

Lindsay said the level of responsibility in a startup company is exciting and uncomfortable at times.

"The weirdest thing was firing contractors. It was hard, but we had to do it," he said.

Lindsay's company sold in June, so he joined other attendees looking for the next

See **Seminar**, page 33

PROTRACKS

Photo by Becca Schemp

Pacific Section YPs Stay Connected in Bakersfield

By BRANDI JOHNSON and BECCA SCHEMP

The Pacific Section's Young Professionals Special Interest Group isn't letting the industry decline get us down. On the contrary, it's the reason we're ramping up.

JOHNSON

SCHEMP

As a group, we realized this is the time to get even more involved and to stay as active as possible. We are getting all of our Pacific Section YP social media connected, becoming more reachable than ever. Our Pacific Section YP group can now be found on LinkedIn and Facebook, with Twitter and Instagram coming soon.

And, of course, there are in-person events, which still have the greatest impact.

We recently held a successful networking event at the Temblor Brewing Company in Bakersfield, Calif. There were about 35 people in attendance from all over California, and even a few Rocky Mountain Section Members who were in town.

Attendees came with a wide variety of experience levels, from those with just a few years in industry, to those newly in transition, current interns and even proactive students in their last year of graduate classes. They all had an opportunity to engage in discussions with a Q&A panel of experienced industry geologists, including a licensed professional geologist. The participants and panelists brought questions and perspectives from several companies and schools, including California Resources Corporation, Gente Oil, Chevron and several AAPG student chapters.

The topics of discussion focused largely on the current downturn and the economic climate of the industry.

The opportunity to hear the more seasoned panelists' experiences with industry slumps helped ease some of the worry of the younger attendees and provided a glimmer of hope that the industry will ultimately persevere.

Bakersfield, like many other cities, has been noticeably affected by lower commodity prices, with many of the resident companies reducing staff over the past year. As a result, many in the industry have had to better prepare and adapt to an uncertain future.

The greatest over-arching message conveyed by the panel was to stay connected and involved with local societies, even when the industry is at a high point, because friends and colleagues are those connections that could one day be your link to a successful career. You can find all of the detailed questions and responses from that event at Facebook.com/groups/PSAAPGYPS.

The Pacific + Rocky Mountain: Joint Section Meeting is coming soon. It will be Oct. 2-5 in Las Vegas. The Pacific Section YP group is proud to be a sponsor for the meeting this year. We will be hosting a Happy Hour Mixer, as well as offering registration fee assistance to Pacific Section YPs.

For more information on the Joint Meeting, visit PSAAPG.org/2016convention, or email the Pacific Section YPs at: psaapgyps@gmail.com.

(Editor's note: Brandi Johnson is the Pacific Section YP lead and a geologist at Chevron; Becca Schemp is Pacific Section Student Chapter liaison and secretary and a geologist at California Resources Corporation.)

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

Oil and Gas Scorecard in the 114th Congress

By EDITH ALLISON, Geoscience and Energy Policy Office Director

The 114th Congress accomplished few of its oil and gas-related legislative goals, in spite of the fact that Republicans, who generally support fossil fuel development, held the majority in both the House and Senate – the first time since the 109th Congress (2005-07).

Energy was a major congressional concern in 2015 but received less attention in 2016, perhaps because it's an election year. Other reasons may include low energy prices, expanding oil and gas exports and little demand for increased Canadian imports. However, there are still enough new and pending oil and gas regulations to worry industry and congressional Republicans. In addition, the 2017-22 Outer Continental Shelf oil and gas leasing plan currently in development is receiving a lot of attention from environmentalists and from Congress.


ALLISON

> **Oversight hearings … are an excellent way to inform the public and constituents about a legislator's position on issues.**

Attempted Legislation

Legislators introduce bills that reflect the interests of their constituents and issues that are in the news, whether of liberal or conservative concern. Legislation both supporting and opposing oil and gas development has been equally unsuccessful. The 114th Congress has passed only 2 percent of the 11,000 pending bills and will pass a few more after the election, which is consistent with the pattern of the past decade.

A couple of exemplary energy bills that are not destined to become law include the Fracturing Responsibility and Awareness (FRAC) Act that would have regulated hydraulic fracturing under the Safe Drinking Water Act. The bill, although regularly introduced since 2008, received little congressional attention this year. A pro-industry bill that will not pass is the American-Made Energy and Infrastructure Jobs Act (H.R. 1330), which would have expanded offshore oil and gas leasing to the mid-Atlantic and California.

Another notable failure was Congress' attempt to stop the Environmental Protection Agency Clean Power Plan (CPP) using the Congressional Review Act of 1996. Using this potentially powerful but little used authority, the House and Senate passed resolutions disapproving the CPP. The president vetoed both resolutions, and Congress did not attempt to override the vetoes.

New Legislation

Just as notable, there have been some important accomplishments by the 114th Congress. The ban on crude oil exports was lifted in December 2015 as a component of a bill that combined multiple appropriation bills to run the government through fiscal year 2016 and a tsunami of "tax extenders" that extend or make permanent expiring tax provisions, including renewable energy production tax credits.

Another success might be on the way.

The 114th Congress saw many bills introduced that would expedite the approval process for LNG export facilities. Now, one has a chance of becoming law as part of a comprehensive energy bill, but its path forward is not clear. Two comprehensive energy bills that passed their respective chambers (House Resolution 8 and Senate Bill 2012) contain provisions expediting the Federal Energy Regulatory Commission and Department of Energy review of LNG export facilities. A conference committee should meet to resolve the differences between the House and Senate bills, leading to votes on the compromise bill during the lame-duck session.

Oversight Hearings

Another major congressional responsibility is oversight of the executive branch.

Oversight hearings help legislators understand issues that might require legislative action. In addition, they are an excellent way to inform the public and constituents about a legislator's position on issues – an important consideration in advance of the November elections.

Continued on next page

Editor's note: "In Memory" listings are based on information received from the AAPG membership department. Age at time of death, when known, is listed. When the member's date of death is unavailable, the person's membership classification and anniversary date are listed.

IN MEMORY

Thomas Herndon


HERNDON

AAPG Emeritus Member Thomas Herndon passed away July 31 at the age of 94.

He was born in Tulsa and joined the U.S. Army in 1943 to fight in World War II. After the atomic bomb, he led 250 troops to survey destruction in Nagasaki, Japan and helped rebuild the country's communication systems.

When he returned, he earned a master's degree in geology. He then worked for the Continental Oil Company, Apache Oil Company and Cotton Petroleum Company.

In 1973, he became an independent geologist and created the Tom Herndon Oil Company.

Peter Burri, 75
Basel, Switzerland, June 10, 2016
Wallace Dow, 79
Tulsa, Okla., June 28, 2016
Herbert Duey, 82
Centennial, Colo., June 24, 2015
Jimmy Kirk, 82
Spring, Texas, June 7, 2016
Robert Near, 87
Arvada, Colo., June 27, 2016
Fred Schall, 100
Houston, Texas, Jan. 11, 2016
Richard Wagner, 87
Casper, Wyo., Jan. 14, 2016

Seminar
from page 30

opportunity.

Jane Cancel, a recent University of Calgary in Alberta graduate and first-time ACE delegate said she attended the workshop to gain knowledge, improve her skills and learn how to take advantage of opportunities during the downturn.

"This seminar was helpful in relaying the information on how young professionals can reinvent themselves for quickly changing times through proactive learning," she said.

Finding Tools

An opportunity discussed at the workshop was working with the large amount of data collected during previous industry booms.

"There's a lot of data out there," Nash said. "Companies did so much drilling earlier; people now have time to analyze it."

Nash noted that proactive geoscientists can use the data to make recommendations for bypassed pays, revitalization or new production.

She encouraged participants to develop strategies and approach companies even during the downturn.

"You may not have the price point to do anything now, but you will be ready when the situation changes," she said. "Your job is that of a matchmaker. It gives you the charge to be entrepreneurial."

Nash reminded participants that they do not have to work at a large company to get access to software. ArcGIS for personal use costs approximately $100 per year. Orange, a product from Slovenia providing data mining and data analysis, is available for free.

She also encouraged participants to seek information from state information sources and geological surveys.

Faber shared how free data sources helped her on a contract position she took in graduate school. She worked for a three-person geothermal company identifying areas with abundant water and high temperatures.

"The job didn't have anything to do with my dissertation, but it gave me experience with Texas Railroad Commission data, and that helped me later on in my career," she said.

Personal Marketing

Nash encouraged participants to market themselves continuously, regardless of their employment situation.

She encouraged them to keep resumes updated with concrete achievements, not just job tasks, and to use technology both to learn and to feature their work.

"Use LinkedIn for mini blogs, to post your work or to share things that interest you. Make two-minute videos and post them on YouTube. Use proactive sharing; it will draw mentors," she said. "Doing so may help you find an opportunity in industry or elsewhere. Keep your options open and be bold."

Nash reminded participants to make short-, mid- and long-term plans and to evaluate progress continually.

Advice was well received by participants like Cancel, who admitted that her short-term goal is "to find employment," while mid- to long-term goals include continuous learning and skill development.

"The phrase 'reconfiguring your role' really stuck with me, and I think it is something that can be applied for my future," she said. "Simply focusing on just geology isn't enough. Blending various roles such as geophysics, engineering, etc. allows us to reinvent ourselves and change our way of thinking."

Continued from previous page

For example, the House Natural Resources Committee, subcommittee on oversight and investigations, and the Senate Energy and Natural Resources Committee, subcommittee on public lands, recently held hearings on Bureau of Land Management and U.S. Forest Service changes in their land use planning process that impact sage grouse conservation and coordination with affected states.

Offshore oil and gas regulations and the 2017-22 leasing plan also came under congressional scrutiny. Congress and the public are concerned about whether Arctic leasing areas should be included in the plan (Atlantic areas disappeared from an earlier version of the plan). The Senate Energy and Natural Resources Committee, chaired by Lisa Murkowski (R-Alaska), heard from witnesses who described the value of Arctic oil and gas development to national security and the economic wellbeing of Alaskans – Arctic energy development would support the infrastructure needed to respond to spills and emergencies that will increase as the Arctic ice cover shrinks. Focusing on environmental protection, Sen. Maria Cantwell (D-Washington), ranking member of the committee, and several witnesses spoke to the need to protect the arctic from spills, and even recommended ending oil and gas leasing on federal lands.

'Excellence in Teaching' Award Nominations Now Open

By SUSIE NOLEN, AAPG Programs Team Leader

The AAPG Foundation is gearing up for another exciting season of supporting and promoting geoscience education – and two key parts of that initiative are now open for your participation.

Nominations are now being accepted for two "Excellence in Teaching" awards supported by the Foundation: the Teacher of the Year (K-12) and the Professorial Award.

Both are possible thanks to the generous financial support provided by donations to the AAPG Foundation.

The Teacher of the Year Award (TOTY) has been presented by the Foundation for the past 20 years, honoring numerous deserving teachers for their exceptional teaching methodology and leadership in communicating geoscience education to K-12 students within the United States.

This coming year will be no exception.

The TOTY winner, chosen from a slate of six finalists selected by each of AAPG's domestic Sections, receives a $6,000 prize along with an expense-paid trip to AAPG's Annual Convention and Exhibition. Honorable mentions and $500 cash awards are given to the five runner-up finalists.

The deadline to nominate a teacher or apply is Jan. 15, 2017.

The Professorial Award – a newer but equally important honor – is awarded annually to a college or university professor who has demonstrated outstanding leadership in the field of geoscience education. The recipient wins $1,000.

Applicants should have a minimum of three years of full-time teaching experience at any higher-education institution worldwide.

Recipients of AAPG's Teacher of the Year Award from left are Karen Waterburg (2016), Sharon Milito (2011), Chris Bolhuis (2013) and Heather McArdle (2014). You can help the AAPG Foundation choose the 2017 Teacher of the Year.

Nominations for this award end Feb. 15, 2017.

* * *

Deadlines also have been announced for other important Foundation programs, including:

- Grants-in-Aid Program – Opens Sept. 15, with a Feb. 15 deadline.

These research grants provide financial assistance to graduate students (currently enrolled in master's or doctoral programs) whose thesis research has application to the search for and development of petroleum and energy-mineral resources, and/or to related environmental geology issues.

Grants range from $500 to $3,000 each.

- L. Austin Weeks Undergraduate Grant Program – Opens Jan. 15, with an April 15 deadline.

Attention students and alumni – make sure your school is represented! These awards will provide $500 grants to undergraduate students and geoscience student associations (student chapter and clubs) worldwide.

- Military Veterans Scholarship Program – Opens Jan. 15, with an April 15 deadline.

The Military Veterans Scholarship Program, the Foundation's newest program, promotes the advancement of student veterans in educational geoscience programs at the undergraduate level. Grants range from $2,000 to $4,000 each and are intended to provide financial assistance to undergraduate veterans who are studying the geosciences.

For more information or to donate to these programs, visit the Foundation website at foundation.aapg.org; or call 1-855-302-2743.

Foundation Contributions for July 2016

General Fund
Erwin W. Adams
Joel A. Alberts
Rui J. F. Baptista
Steven E. Barker
James R. Baroffio
William J. Barrett
Jason R. Baugh
Orville R. Berg
Adam R. Bishop
Christopher H. Bradley
Bruce M. Brady III
Jonathan M. Brady
Lindell C. Bridges
Huyen T. T. Bui
Malcolm Butler
Timothy R. Carr
Peter D. Carragher
Carlos Carvajal
Carlos R. Ceron
Chevron Matching Employee Fund
Matching gifts given by James Swartz, Robert Burnett and Robert Kaufmann
Jason L. Clayton
Michael S. Coffield
Frank B. Cressy Jr.
Chris C. Curry
Graham R. Davies
Matthew H. Davis
Robin P. Diedrich
Arthur J. Diplacido
Rebecca L. Dodge
Preston L. Doll
Michael L. Douglas
Gordon E. Duffy
Thomas L. Dunn
Marc Dupuy Jr.
Frank G. Ethridge
Don B. Felio
Robert B. Ferguson
Robert T. Fetters Jr.
Mark W. Fletcher
John A. French
Pat and Jack Frizzell
In memory of Arden E. "Scotty" Kersey
Richard A. Garrard
Richard H. Gartner
Katie M. Gates
Leon H. Gerlich
Ewa A. Ginal-Cumblidge
David H. Glenn
Ernest Gomez
Domingo L. Graneros
James B. Gresham
Gary S. Grinsfelder
Paul M. Guerino
Donald L. Hansen
Jeffrey W. Harwell
Talaat H. Hassan
Harrison Hastings
Jeanette Henssen
Gregory S. Hinds
William J. Hlavin
Thomas B. Howes
Beth A. Isern
Ragnar E. Johnson Jr.
Amanda R. Jones
Larry L. Jones
Thomas W. Jones
Attila Juhasz
Thomas E. Kelly Jr.
Amanda L. Kern
Stephen R. Lawrence
Kurt M. Ley
Bruce A. Mac Pherson Jr.
R. Heather Macdonald
Paula L. MacRae
Kirk Malinowsky
John P. and Laura C. Moffitt
Rebecca A. Morlier
James C. Musgrove
David E. Noller
Stephan H. Nordeng
Roger K. Nunley
Gbolagade A. Olalere
David R. Paddock P.G.
Terrence C. Plumb
Kenneth R. Quarfoth
Brian G. Reddick
Nathan M. Reese
David R. K. Robertson
John H. Rountree
Jose A. S. Araiza
Sunday K. Shepherd
Donald E. Singleton
Judith T. Smith
Fernand J. Souaya
Gerald E. Stachura
David R. Steele
Neil J. Stefanides
Stephen J. Szydlik
Brandt O. Temple
Johannes H. Thiessen
Clarence N. Tinker
Thomas J. Tourek
James K. Trigger
Robert S. Tucker
Don A. Urbanec
Bram Visser
Duane T. Wagner
William O. Williams
John A. Willott
Lawrence C. Wood
Susan W. Young
Kate E. Zeigler

Awards Fund
Teacher of the Year Award
Weldon D. Carroll

Digital Products Fund
Nexen Petroleum U.S.A. Inc.
Matching gifts given by Jonas Bailey
Bryn Mawr College
Noelle B. Schoellkopf
Indiana University, Bloomington
Mark S. Leonard
Johns Hopkins University
Steven E. Boyer
Michigan State University
David R. Paddock P.G.
Oregon State University
John M. Kachelmeyer
Texas Tech University
Katie M. Gates
Trinity University
Weldon D. Carroll
University of Kansas
Joel A. Alberts
University of Louisiana, Lafayette
David R. Paddock P.G.
University of Nebraska, Lincoln
Donnald E. Johnson
University of Texas
Mendoza Jose J. Hernandez
West Virginia University
Katharine L. Avary

Distinguished Lecture Fund
Thomas L. Dunn

Allan P. Bennison Distinguished Lecture Fund
John A. French

Education Fund
Howard A. Creasey
Donnald E. Johnson

Grants-in-Aid Fund
Classen Family Named Grant
Weldon D. Carroll
Eastern Section Named Grant
Katharine L. Avary
Gustavus E. Archie Memorial International Grant
Robert Weeden
Pittsburgh Association of Petroleum Geologists Named Grant
Katharine L. Avary
Richard W. Beardsley Named Grant
Katharine L. Avary
Robert K. Goldhammer Memorial Grant
Joel A. Alberts
Jason L. Clayton
Matthew H. Davis
Sunday K. Shepherd
Roger W. Stoneburner Memorial Grant
Jean K. Funkhouser
In honor of Dick Stoneburner
SEAPEX Named Grant
Sunday K. Shepherd
Suzanne Takken Memorial Grant
Robert E. Tehan
W. David Wiman Memorial Grant
Weldon D. Carroll
Weimer Family Named Grant
Stuart D. Kerr Jr.

James A. Hartman Student Leadership Summit Fund
Chevron Matching Employee Fund
Matching gifts given by Richard Ball
Katharine L. Avary

Imperial Barrel Award Fund
Cimarex Energy Company
Matching gift given by Anthony Kolodziej
Katharine L. Avary
William A. Monroe

Military Veterans Scholarship Fund
Maurice N. Birdwell
Sarah Springer and Rusty Riese

John F. Bookout, Jr. Military Veterans Scholarship Fund
Weldon D. Carroll

Named Public Service Fund
Hugh Looney Excellence Fund
Weldon D. Carroll

L. Austin Weeks Undergraduate Grant Fund
Katharine L. Avary

Fisherman
from page 24

Hence he proposed commemorating the success with an act of kindness: Cantarell is the surname of Rudesindo, a fisherman who in 1971 showed up at the Pemex general exploration superintendent's office in Coatzacoalcos to report "an oil stain" at the Campeche Bay.

That sequence of successes was followed by vigorous exploration and development drilling campaigns. By 1974, production from this new trend had increased sufficiently to ford the 1973 oil shock and renew exports. And, once again, Mexico had become a key player on the international oil scene.

This geological success was the cornerstone of the country's fiscal revenues for these last three decades.

Corollary

This history shows that in a business environment in which creativity and operational autonomy are encouraged, geological reasoning and diligent exploration strategies are crucial for questioning dogmas. Such questioning must be based on past exploration experiences, actual knowledge and technological breakthroughs, all within the existing regulatory framework.

Geological experience tells us that southeast Mexico still conceals diverse hydrocarbon leads that will demand the talent, technical skills and persistence of a legion of future geoscientists.

Forum
from page 26

be aware of the geological risks associated with the different basins, as well as the logistical, operational and legal challenges of the region.

"They also should know the cultural characteristics of our countries," he said.

He expects the Forum to benefit regulatory agencies as well.

"Basically this Forum will help regulatory agencies by sharing ideas, common experiences and comparing realities," he said. "This will encourage regulatory agencies to emulate good practices and adopt new strategies."

Further Discussions

Forum participants will meet with other agencies at a private regulatory agency meeting held in Cancun the day before ICE. De Santa Ana will facilitate the meeting, which will allow industry players from the region to speak freely and to share best practices and lessons learned.

"The purpose of the Regional Regulatory Agency Meeting is to discuss regional challenges, opportunities and best practices and to strengthen partnerships that will enable our respective agencies to operate more efficiently and effectively," he said. "We hope they go home with new ideas, a common vision and a network of contacts between agencies that enable us to strengthen our bonds."

Strategies for Success

De Santa Ana said he hopes both the forum and the meeting will help participants to promote a common vision of the future, to integrate ideas and to share strategies for being competitive during difficult times.

"I hope to learn a lot," he said. "You learn more in a day of crisis than in 10 years of economic bonanza."

Confirmed speakers at the ICE Regulators Forum include:

- Juan Carlos Zepeda, President Commissioner, National Hydrocarbons Commission (CNH), Mexico
- Orlando Velandia, President, National Hydrocarbon Agency (ANH), Colombia
- Magda Chambriard, General Director, National Petroleum Agency (ANP), Brazil
- Michael Celata, Bureau of Ocean Energy Management (BOEM), United States

For information about the Forum and about ICE, visit ICE.AAPG.org.

CLASSIFIEDADS

POSITIONS WANTED

Earth Systems Evolution – University of British Columbia

The Department of Earth, Ocean and Atmospheric Sciences at the University of British Columbia invites outstanding applicants for a full-time, tenure-track faculty position in Earth Systems Evolution at the level of Assistant Professor.
The ideal candidate will be a cross-disciplinary scientist who draws on modern, quantitative field, laboratory and/or modelling methods to illuminate the fundamental processes that have shaped the Earth through time. We encourage applications from diverse subdisciplines including sedimentary geology, geobiology, climate science, and Earth systems modelling.

The successful applicant is expected to develop a strong, externally funded and internationally recognized research program, successfully supervise graduate students, effectively teach undergraduate and graduate courses, and actively participate in departmental activities. Evidence of teaching excellence and interest in innovative teaching methods is welcomed.

Please follow the application instructions showing in the full advertisement posted at http://tinyurl.com/nvvoots and attach all required documents by October 31, 2016.
For additional information about the department please visit https://www.eoas.ubc.ca/.

MISCELLANEOUS

SAMPLES TO RENT

International Sample Library @ Midland – Formerly Midland Sample Library.

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

Phone: (432) 682-2682
Fax: (432) 682-2718

* *

SES – more companies CHOOSE SES from 22 geosteering software options. SES correlation logic operates on 3D objects with beds oriented in true stratigraphic depth directions. It's more accurate, intuitive, and valid for all directional/horizontal drilling! User Manual available in 5 languages. Free trial and training available.

www.makinhole.com
Stoner Engineering LLC

* *

Dry Erase Geological Globes of the Earth

Beautiful handmade globes for gifts, office or lab. See explanatory notes online at www.realworldglobes.com

DEG
from page 38

Affairs and Energy Minerals Division to lower the cost for attendees. Your input is important and welcomed, and your voice will be heard.

Opportunities exist to become a representative of your Section or Region, serving on a committee or becoming an officer. If you are an AAPG Member, the cost is $25. Student membership is free upon becoming an AAPG member.

"Many hands make light work," as the 16th-century English writer John Heywood said. So, if you are not already a DEG member, please seriously consider joining. We need to help with clarifying public opinion based on misinformation.

On another note, our website underwent many improvements last year. Check it out at AAPG.org/divisions/DEG, and feel free to post information on our blog.

Thank you for electing me as your president for 2016-17. Also, please welcome the other DEG leaders:

- Stephen Testa, President-Elect
- Kristin Carter, Vice President
- Michele Cooney, Editor
- Secretary-Treasurer, Sean Kimiagar
- Immediate Past President, Jeff Aldrich

PROFESSIONAL newsBRIEFS

Lee Billingsley, to president, Windridge Oil and Gas GP LLC, Boerne, Texas. Previously vice president of exploration, Abraxas Petroleum Corporation, San Antonio, Texas.

Julio Gomez, appointed to vice president of global sales, Ikon Science, Houston, Texas.

Alan Hinks, appointed to Environmental Response Activity Review Panel, Michigan Department of Environmental Quality, Lansing, Mich.

John Jeffers, to director of geosciences of the West Virginia Division, Southwestern Energy, Spring, Texas. Previously director of geosciences for new ventures projects, Southwestern Energy, Spring, Texas.

Edward LaFehr, to president, Baytex Energy Corp., Calgary, Canada. Previously chief operating officer, TAQA, Abu Dhabi, UAE.

Kenneth Peters has been awarded the 2016 Alfred Wegener Award from the European Association of Geoscientists and Engineers. He is a science advisor for Schlumberger and a consulting associate professor for Stanford University.

DIRECTOR'S CORNER

AAPG Offers Opportunities for Adventure

By DAVID CURTISS

As a kid I was fascinated with maps. I'd spend hours flipping through our family's world atlas, and geography was one of my favorite subjects in school.

The deep blue of the oceans, the greens and browns of the continents, the elevations of mountains, the flow of rivers, and identifying cities and capitals – there really is a Timbuktu! – mesmerized me. The maps represented real places and I would imagine what it would be like to travel there, mapping out journeys across continents in my mind's eye, anticipating adventure and derring-do.

Now, any world traveler worth his or her salt will regale you with stories of awe and wonder – seeing the world will certainly deliver those. What they often leave out, however, is how you feel after being squeezed into an airplane seat for 14 hours, how adventure often has two travel companions named uncertainty and fear, and that mosquitoes can spoil the romance of any destination.

It was my curiosity about the planet that drew me to geology and a fascination with far-flung locales that led me to the oil and natural gas industry, which is truly a global business.


CURTISS

It was my curiosity about the planet that drew me to geology and a fascination with far-flung locales that led me to the oil and natural gas industry, which is truly a global business.

Upcoming International Events

And between now and the end of 2016, AAPG will be serving its Members with three major conferences outside the United States.

This month from Sept. 6-9, we'll be joining our colleagues from the Society of Exploration Geophysicists (SEG) for the third AAPG/SEG International Conference and Exhibition (ICE) in Cancun, Mexico. Capitalizing on the global industry interest in Mexico and partnering with the Mexican Association of Petroleum Geologists and the Mexican Association of Exploration Geophysicists, we've developed a conference with the theme "Exploring Frontiers in a Competitive Environment."

Under the leadership of General Chair J. Antonio Escalera Alcocer together with General Vice Chairs Victor Vega and Gustavo Carstens, the organizing committee has worked diligently to develop a stellar program featuring geological and geophysical sessions.

In addition, there are special country-specific sessions highlighting current activities in Argentina, Brazil, Colombia, Mexico, Peru and Trinidad, a Regulators Forum discussing the regulatory environment and issues in the region, and the Discovery Thinking Forum.

If you are active in Latin America and the Caribbean, you owe it to yourself to attend ICE in Cancun.

Later this year, from Nov. 14-16, the 10th International Petroleum Technology Conference (IPTC) will take place in Bangkok, Thailand – a joint effort of AAPG, the European Association of Geoscientists and Engineers (EAGE), the SEG, and the Society of Petroleum Engineers (SPE).

Under the theme "Innovation and Efficiency Excellence for our Energy Future," this IPTC will again attract oil ministers and government leaders, senior industry executives and professionals, and top scientists and engineers from academia to investigate how the industry can survive and succeed in a challenging market environment.

Building on a successful history of multi-disciplinary cooperation, AAPG, EAGE, SEG and SPE will showcase the best of what its members are doing in science and technology, providing a forum for learning and the exchange of ideas, as well as ample opportunity for networking with peers from around the world.

Finally, from Dec. 5-7 we are again joining our SPE colleagues for the inaugural Africa Energy and Technology Conference in Nairobi, Kenya.

A joint effort by the AAPG Africa Region and SPE, this three-day regional event focuses on the energy opportunities and challenges facing Africa today. "African Energy in the 21st Century – Paving the way for the future" is the conference theme and the event is lead by an Executive Committee comprised of David Blanchard, AAPG Africa Region past-president; Patrick Obath; and Scott Tinker, AAPG past-president.

Under program committee chairs Bill Bosworth, AAPG Africa Region president, and Gbenga Onadeko, the program committee is building a stellar technical program. Industry experts from across the globe will present technical sessions and participate in panel discussions focused on:

- Exploration Geoscience
- Operations, Engineering and Technology
- Health, Safety, Sustainability and Social Responsibility
- Commercialization and Regulatory

We're proud to work with SPE to bring this event to Africa, and if you are working the continent, it's an event that you should try to attend.

It's a big world out there and AAPG has Members living and working in all corners. It's our pleasure to serve them as they explore and produce oil and natural gas to fuel the planet.

DIVISIONS REPORT: DEG

Bridging the Gap Between Perspective and Reality

By TIMOTHY MURIN, DEG President

A *perspective* is "a point of view," as opposed to a *reality*, which is "the true situation that exists."

With that distinction in mind, consider the following questions with which I have been faced over the last 10 years:

- Was the well water mixed with natural gas coming out of the kitchen spigot a result of recent drilling, or had it already been in the groundwater for decades as a result of near-surface fractures?
- Did hydraulic fracturing on the farm really kill grandpa and some of the livestock and ruin the groundwater?
- What impact does the exhaust from hundreds of trucks needed for each shale well have on air quality?
- Does flowback and production wastewater contain bromine and organic matter? Once they are treated and discharged into a river, and later disinfected with chlorine for public drinking water, do they react to form trihalomethanes, some of which are known carcinogens?
- Does deep wastewater injection and hydraulic fracturing, with associated induced seismicity, cause earthquakes, as has been seen in Youngstown, Ohio and pervasive in Oklahoma?
- Is the industrial revolution the primary cause of global warming? Are there also climatic effects from Milankovitch Cycles which are caused by the earth's orbit around the sun?
- Can CO_2 be safely sequestered for 1,000 years or more?


MURIN

We must be sure that our perspectives have a solid foundation of facts, supported by other research and explained in a true, unbiased manner that can stand up to scrutiny from other scientists and the public.

These are just some of the controversial questions affecting our world today, and topics for which scientists from industry, academia and government are working to provide accurate perspectives.

While attending the recent AAPG Annual Convention and Exhibition in Calgary, I realized what an impact the DEG can have both domestically and internationally on environmental-related topics – on shaping the public's collective perspective on these realities. I was fortunate to meet many from the United States, Canada, Africa, Australia and the Netherlands who share my concerns.

As members of the Division of Environmental Geosciences (DEG), our key purposes (paraphrased from the bylaws) are to:

- Educate the membership and general public about environmental issues associated with the petroleum industry.
- Communicate to the public and government agencies our commitment to protect the environment while responsibly developing the world's natural resources.
- Support, encourage and make research available related to the effects of petroleum/energy minerals exploration and production.
- Aid our members in multidisciplinary expertise to resolve environmental issues.
- Promote environmental self-regulation.
- Establish a liaison with other professional societies to address mutually attainable goals.
- Provide educational opportunities for the AAPG membership related to environmental geoscience and related fields.

The DEG's overarching goal should be ensuring that our opinions are based on sound, science-based research, rather than emotions, monetary benefit or how the information may impact our relationships with others. We must be sure that our perspectives have a solid foundation of facts, supported by other research and explained in a true, unbiased manner that can stand up to scrutiny from other scientists and the public.

To that end, the DEG has a number of standing committees devoted to shaping those perspectives.

They include:

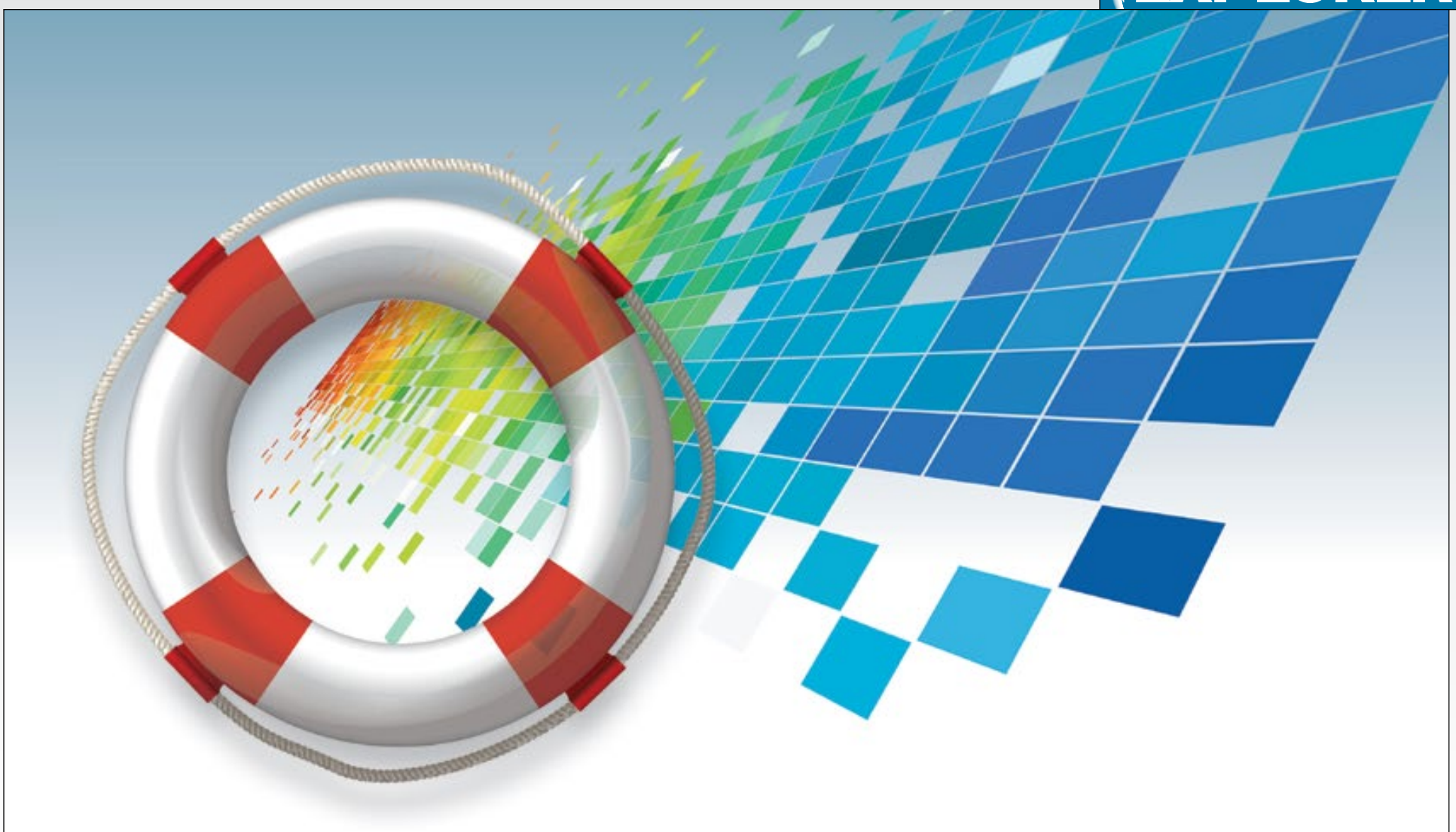
- Annual Meeting Committee
- Publication Committee
- Nominating Committee
- Hydrogeology Committee
- Environmental Geophysics Committee
- CO_2 Sequestration Committee

The Executive Committee, Advisory Board (Sections and Regions) and Committee Chairs are discussing the formation of additional ad hoc committees to cover subjects that include induced seismicity, fugitive gases, air quality and climate change.

Another goal for the Division is to become more active with the Sections, Regions, AAPG affiliated societies, young professionals, universities and students.

The Division is becoming more active at meetings by sponsoring technical oral and poster sessions, and social events like the one we co-hosted at ACE 2016 with the Canadian Society of Petroleum Geologists. We are also planning to hold forums, short courses, field trips and co-sponsor luncheons with the Division of Professional

See **DEG**, page 37



DE-RISK SABAH

Prediction with certainty

– high end technology for Malaysia's basin scale exploration

Multi Sensor technology, a true pre-stack inversion for reservoir properties tied to existing wells on a basin scale, is set to propel Malaysia's drilling success ratio. Access to this high quality regional scale data will remove uncertainty, reduce exploration risk, and ultimately reduce the cost and time to first reserve.

To increase your success rate and generate faster return on your exploration spend, participate in this exciting MultiClient survey. For more information contact sabah@pgs.com

De-risk your portfolio, visit us at www.pgs.com/Sabah

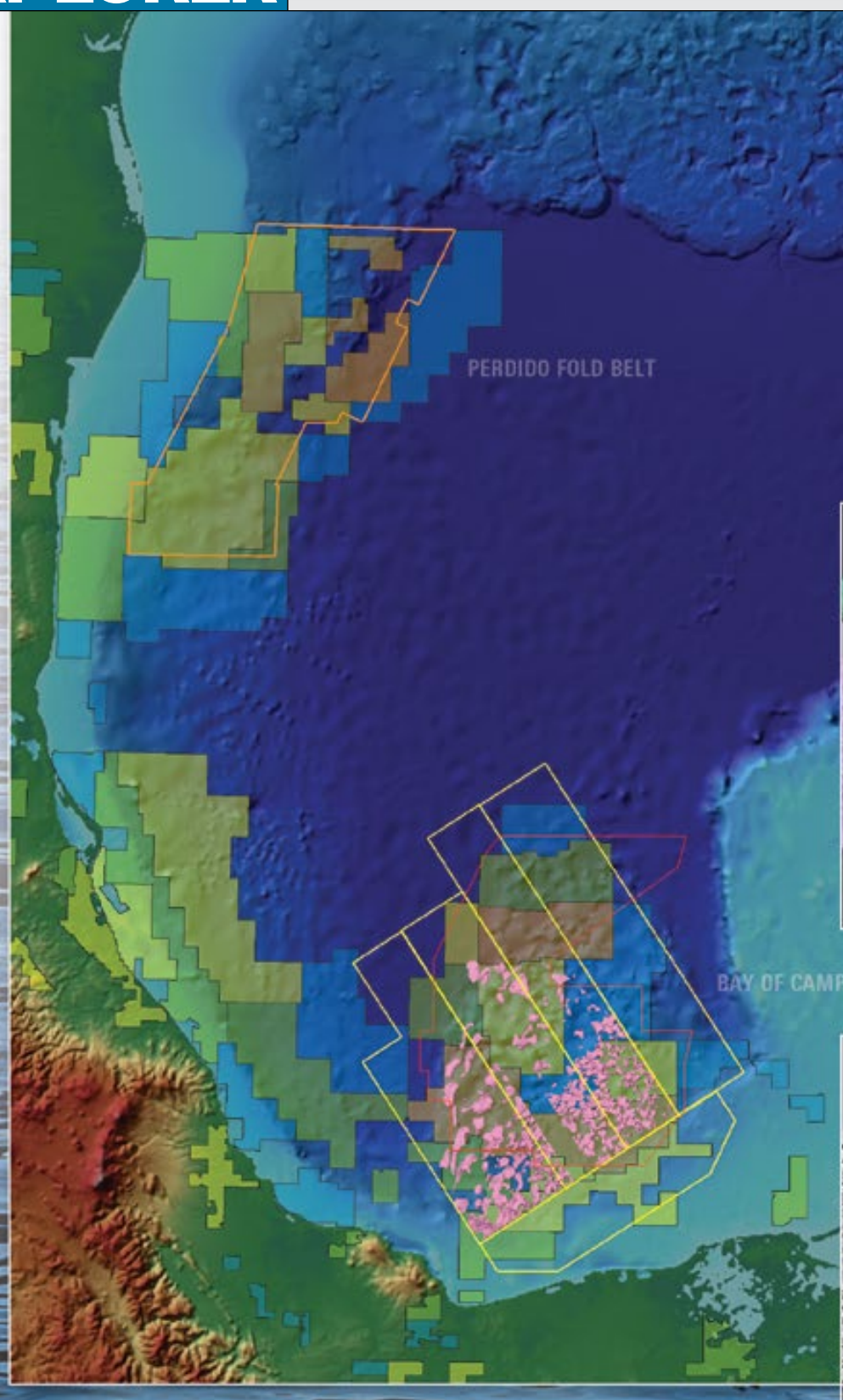
PGS

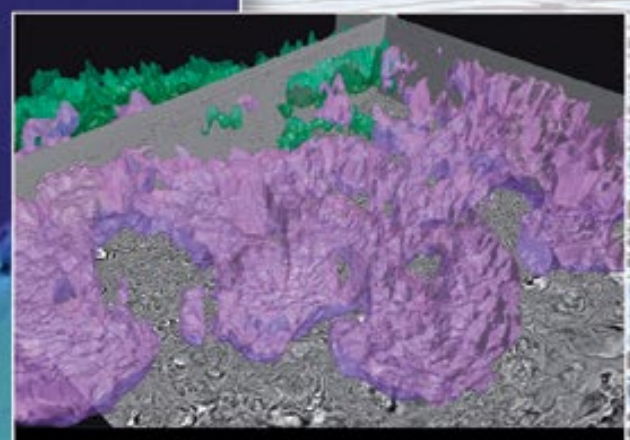
TGS

WesternGeco

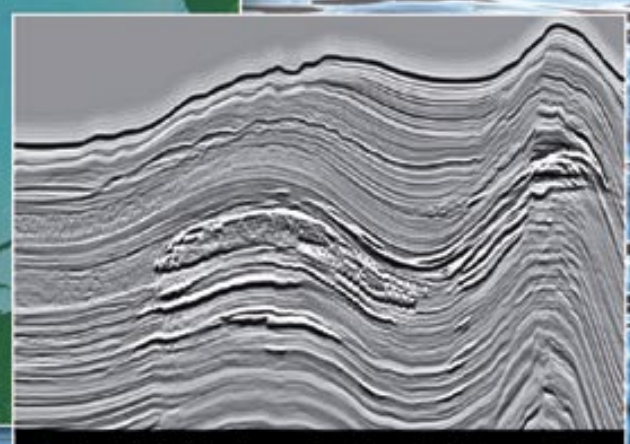
UNLOCK • DE-RISK • EXPLORE

Multiclient Mexico





Complex subsalt and thrusted structures of the Perdido Fold Belt require an advanced integrated solution.



Broadband Kirchoff migration reveals stratigraphic details associated with three- and four-way closures in the Bay of Campeche.

Our commitment to offshore Mexico. Your competitive advantage.

Powered by new technology and an integrated multidisciplinary approach, we are acquiring 60,000 km^2 of high-quality 3D wide-azimuth (WAZ) in Campeche while extensively reimaging legacy data in both Perdido and Campeche. This comprehensive WAZ program is the largest in the world—demonstrating our commitment to offshore Mexico.

Even in complex geology, our data will help you achieve excellent subsurface illumination for key insights into the upcoming Mexico bid round and beyond. Subsurface data evaluation cubes are now available.

Visit us at AAPG SEG 2016 International Conference & Exhibition Cancun Booth No. **3-317**

multiclient.slb.com/Mexico

WesternGeco