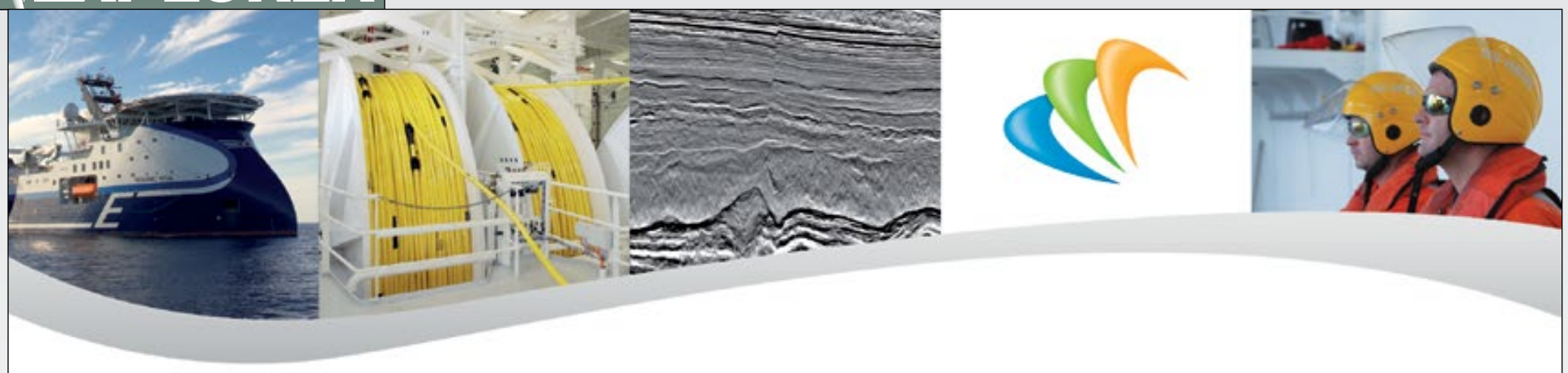
AAPG EXPLORER
NOVEMBER 2015

# Going Down, Or Heading Up?

*Perspective matters in downturns. So does innovation.*



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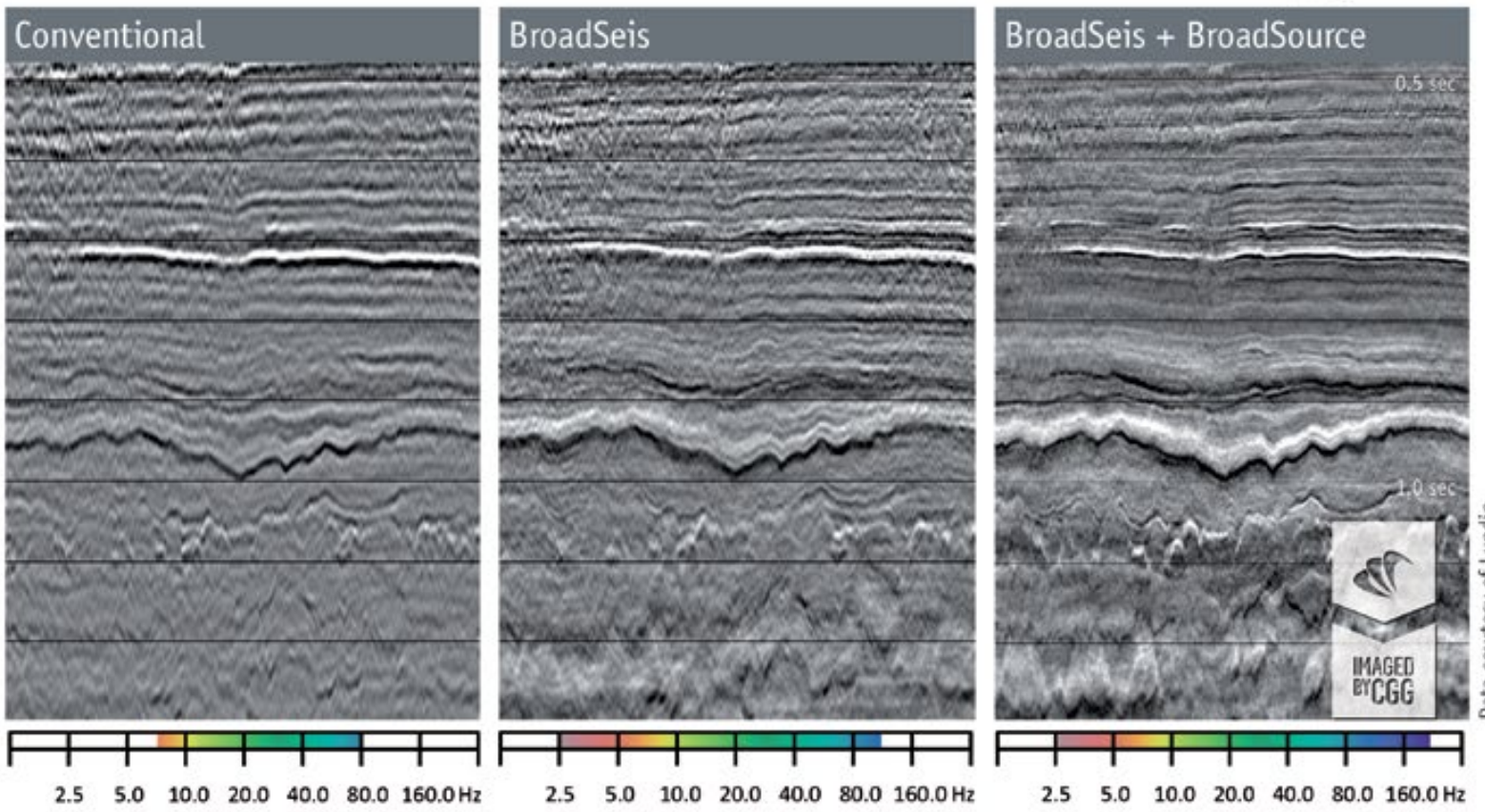
Lundin Norway

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Passion for Geoscience

Vol. 36, No. 11
November 2015



PRESIDENT'S COLUMN

# The Business of AAPG

BY JOHN HOGG

When I ask our members why they joined our Association, most say they joined for the science.

Some say they joined for professionalism and ethics, some say they joined for the significant digital data offered through Datapages; the BULLETIN, Search and Discovery and our historic digital archives.

Members rarely, if ever, say they joined for our conventions – either the Annual Convention and Exhibition (ACE) or the International Conference and Exhibition (ICE).

In fact, the department that generates the majority of revenue yearly for AAPG is our convention department – from our annual and international meetings.

* * *

So how is our yearly revenue generated?

Let's start with membership dues; they generate about 11 percent of our yearly revenue.

On average, ACE and ICE account for approximately 32 percent of our revenue each year.

Interestingly, when we look at the average number for attendees at ACE (2011-15), we see that of the total attendance, on average 32 percent are members and associates. The number goes to 41 percent if we include students. For ICE (2011-15) members and associates equal on average 22 percent of the total – a number that jumps to 28 percent when student members are added.

In other words, our conferences and exhibitions attract many more non-members than members – every year, at every event!

HOGG

**Our challenge during the downturn is that when the industry is down ... our principal revenue sources – also are all down.**

The core of shared-events for AAPG include:

- The Unconventional Resources Technology Conference, (URTeC).
- The Arctic Technology Conference (ATC).
- The North American Prospect Expo (NAPE).
- The Offshore Technology Conference (OTC).
- The International Petroleum Technology Conference (IPTC)
- The Middle East Geoscience Conference (GEO).

These shared-events account for approximately 22 percent of AAPG's total revenue each year.

Our AAPG Regions generate revenue each year through regional conferences, APPEX-events, GTWs and other co-branded events, which generate approximately 8 percent of our yearly AAPG revenues.

The remainder of our revenue is generated through our EXPLORER advertising, publication sales, revenue from Geoscience World (GSW) and North American-based training events – approximately 27 percent of our revenue base.

Thanks to our staff, working every year with our volunteers, AAPG provides scientific and professional services to our members and non-members.

Our challenge during the downturn is that when the industry is down, conference attendance, exhibitor participation, sponsorship and advertising – our principal revenue sources – also are all down, lowering our revenue base and impacting our budget.

What does this mean?

For the last two years (our fiscal year starts July 1) we have been running deficits – but your Executive Committee, working closely with the directors, continues to look for ways to weather the downturn and focus on adding value to the membership.

* * *

In October we held our first AAPG Mid-Year Business Meeting – a new event that allowed all of the AAPG Divisions, Executive Committee, Advisory Council, House of Delegates, Region and Section presidents and invited Young Professionals to meet for three days in Houston.

It was a chance to have these leaders not only complete their mid-year meetings but also meet together as a group for joint sessions.

One of the highlights was when past AAPG President Lee Krystinik presented the findings of the Ad-Hoc Committee on Governance, appointed last year by then-president Randi Martinsen.

Lee's committee did an outstanding job of looking at how our organization is governed through the Executive Committee, Advisory Council and House of Delegates, and made a number of recommendations for each of the bodies to consider moving into our second century.

An article on the meeting will be included in the December EXPLORER, and Lee's report soon will be available to all members.

I look forward to the future deliberations by the three bodies on the suggestions made by his committee.

* * *

Speaking of ACE – the next one will be held in June in my hometown of Calgary, Canada.

Abstract submissions are now closed, and were at a record number of 1,800-plus. Paul MacKay, the general chairman, Jen Russel-Houston (general vice chair), Ryan Mohr (general technical chair) and their entire Organizing Committee have done an outstanding job of putting together a great program featuring amazing field trips and short courses.

All of that, combined with the Canadian Society of Petroleum Geologists International Core Conference, will again put Calgary on the geoscience map.

I hope you can attend!

Finally, for those of you in the Twitter-verse, I would like to update you on my progress as the first AAPG president to Twitter: After a slow start – single digits! – I'm climbing toward 100. To be exact, I'm now at 55 followers – so if you are on Twitter, follow me at @AAPG President.

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## REGULAR DEPARTMENTS



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

## ON THE COVER:

This view over the Strait of Hormuz is an example of the geology on offer this month through two field trips in the AAPG Middle East Region. The first will be a field trip to the Kharaib and Shuaiba Formations in Ras Al Khaimah, United Arab Emirates, Nov. 24-25. The other will also be Nov. 24 to the Modern Sabkha Environment in Abu Dhabi, United Arab Emirates. The Strait of Hormuz connects the Persian Gulf and the Gulf of Oman and is an important strategic location for international trade, through which one-fifth of the world's petroleum passes.

To the left is another view of the Strait of Hormuz.

Photos courtesy of Jim Mandelli.

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# Job Searching When Jobs Are Scarce

By JESSIE HOLLAND, AAPG Career Services Committee Chair

As far as hiring is concerned, the oil and gas industry is in a difficult phase at the moment.

Widespread layoffs coupled with minimal hiring means there is a large pool of qualified candidates all clamoring for a limited number of open jobs.

Now more than ever, it is important to use a professional approach in your job search and employ every tool available to make yourself stand out from the pack.

Companies that have job openings in the current environment can afford to be very selective, searching for candidates with exactly the right combination of skills and experience. Many hiring managers are turning first to consulting engagements with the option to convert the consultant to a full-time employee should they prove productive and compatible. This is especially so with "start-ups" that are building portfolios, needing consulting help during the evaluation phase and full-time staff once they start to grow.

HOLLAND

> "One vital misconception regarding the role of a résumé is that a résumé will get you a job."

How do you get the attention of these hiring managers?



### Getting an Interview

Whether for full time or consulting roles, a well-prepared résumé is essential.

The résumé is a document almost every professional has prepared at some point in their career. Writing one can be a daunting task, trying to summarize a lifetime of professional achievements and skills without alienating the reader within the first six seconds.

What should you include? What should you leave out?

One way to approach this problem is to answer the question, "What am I trying to achieve with this résumé?"

"One vital misconception regarding the role of a résumé is that a résumé will get you a job. In reality, your goal when writing a résumé should be to get an interview," notes Hal Miller, president of Subsurface Consultants & Associates, a specialist geoscience consulting and training company. "Your success in a job search will hinge on your interview, and a well-written résumé will get you that interview."

With that in mind, résumés should contain enough information to quickly catch the attention of a decision maker and ensure you get invited to that critical, face-to-face interview.

For positions in the geology, geophysics and reservoir engineering community, there are three key pieces of information for which recruiters and managers are looking:

- What are your areas of specialization within your technical discipline?
- What geographical areas of the world, plays, and depositional environments or reservoir types have you worked?
- What software are you capable of operating?

"When companies engage a consultant, they typically have a specific problem that needs to be resolved," observed Tim Riepe, business development director with SCA. "It is likely to be project-specific and have defined technical deliverables, with the tasks performed on whichever software the company uses. No learning curves, no training."

A good résumé containing the right information will allow a recruiter (and, later, a hiring manager) to identify your suitability for a specific assignment almost immediately, so focus as much of your résumé as you can on the three key areas above. Keep it factual, objective and detailed enough to supply sufficient evidence that you can provide the solution to the company's problem.

One tool that could make your résumé stand out would be to attach a map that shows the specific areas or fields that you have worked in the vicinity of the hiring company's area of interest.

### Making First Contact

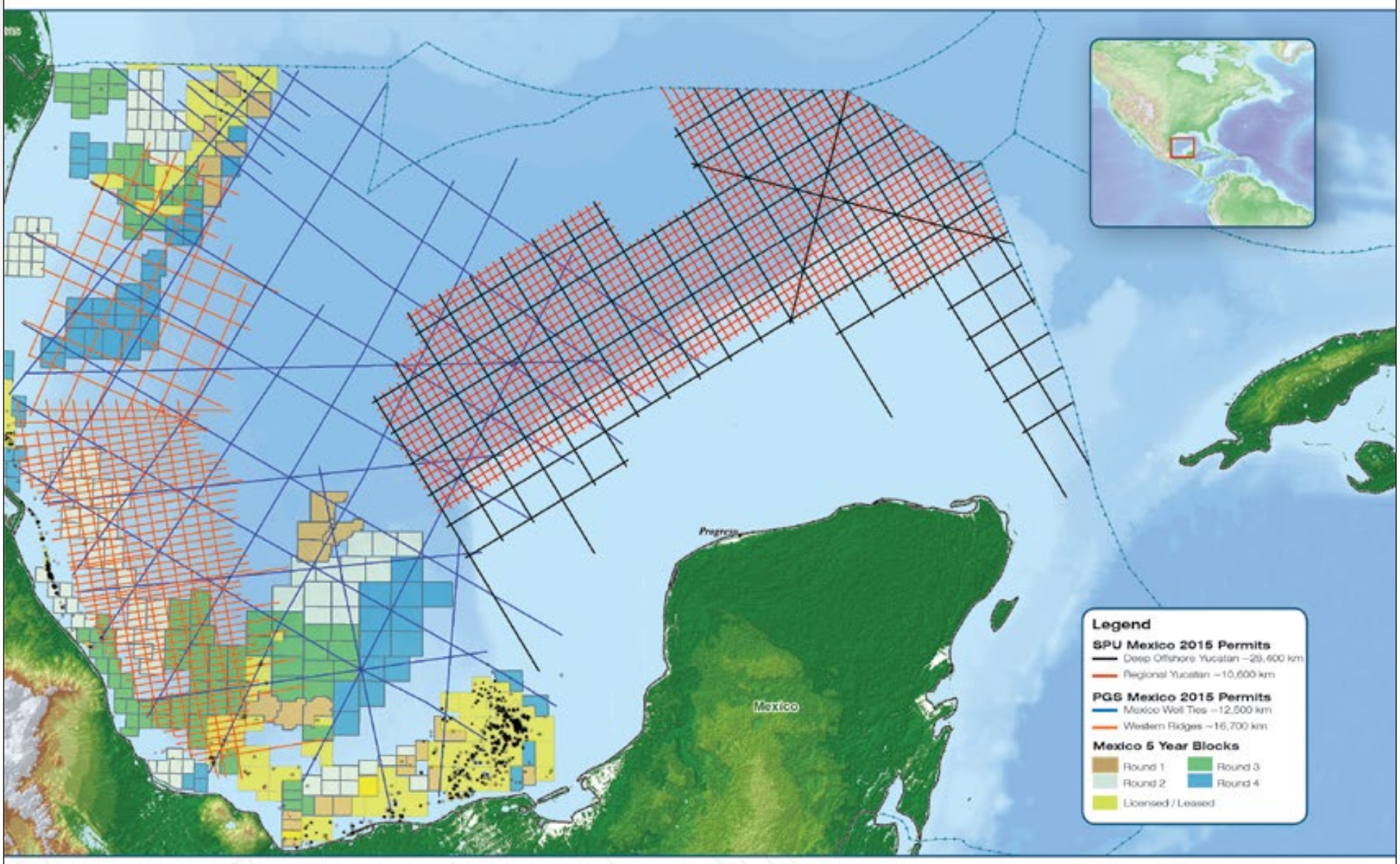
Making initial contact with a company or applying for a job can also be a minefield.

After interviewing hundreds of job seekers over the past few years, we rarely speak with people who have been able to successfully control

See **Job Search**, page 14

# Mexico GoM

## Newly Acquired Multi-Client 2D Seismic




Spectrum's latest long-offset 2D seismic survey offshore Mexico is a collaborative effort with PGS and Schlumberger, spanning approximately 80,000 km. The survey provides seamless broadband seismic coverage across the Gulf of Mexico from the Yucatan Platform in the southeast, to the Perdido Fold Belt in the northwest, tying key wells in producing hydrocarbon basins and sampling emerging pre-salt plays. These strategically placed surveys will help provide greater insight to clients preparing for subsequent licensing rounds.

*Marrying mineral and subsurface interests*

# A Match Made in the Oil Patch

By HEATHER SAUCIER, EXPLORER Correspondent

While the outcry against the petroleum industry drilling in residential areas is as high as ever, a small, privately-held petroleum and real estate company in Midland, Texas, is making headlines for pulling off what some might consider an impossible feat: creating communities where people are willingly moving onto active oil and gas fields and living harmoniously with the industry.

Fasken Oil and Ranch Ltd. – a small operator not well known outside the Texas borders – has been featured in local news coverage for its planning, design and operations in the oil patch.

Its owners' ability to see the "big picture" combined with simple, yet meaningful courtesies toward the community makes the company a prototype for operating in populated areas, said AAPG member Dexter Harmon, exploration manager for Fasken.

"There are all kinds of people just dying to buy a lot and build a house here. They ask all the time, 'When will lots be available?'" Harmon said.

"As a matter of fact," he added, "they are getting impatient."

Photo by Dexter Harmon, courtesy of Fasken Oil and Ranch Ltd.

*An oil well is part of the scenery for residents of Fasken's apartment complex.*

### What's the Catch?

It is only fair to note that Fasken has a major leg up on most operators. It holds both mineral and surface rights to the 165,000 acres it owns in the Midland area, and it is simultaneously developing its land for hydrocarbons and real estate endeavors.

This obviously reduces major conflicts like the May 2014 one experienced in Denton, approximately 330 miles northeast of Midland. Denton residents voted to ban hydraulic fracturing, citing environmental damages, health concerns and nuisances created by the industry.

The vote was overturned in June after Texas Gov. Greg Abbott passed a law prohibiting local bans on hydraulic fracturing.

Yet, despite Fasken's built-in immunity to the recurring conflict between mineral and surface rights owners, the company has taken extraordinary measures to develop its land – so much so that residents are quickly filling up its apartment units and office buildings and are excitedly awaiting the single family homes to come.

### How It All Began

David Fasken, an attorney from Toronto with mining experience, purchased 222,600 acres northwest of Midland from a rancher in the early 1900s. He incorporated the Midland Farms Company in 1913 and sent his son, Robert, to oversee its operations.

Robert's son, also named David, followed in his footsteps.

When oil was discovered in the Permian Basin's North Cowden and Mabee fields in the 1940s, the Fasken family leased much of its acreage to Stanolind Oil and Gas Company, thus opening the door to their first venture into the petroleum industry.

The family later acquired ranchland near Laredo, Texas – never realizing such a purchase would one day put them in the middle of the Eagle Ford play. (The company currently is developing real estate in and near San Antonio and Laredo.)

In the Midland area, the Fasken's ranchland turned into a thriving oil patch. It operated as such for decades, prompting the Midland Farms Company to become Fasken Oil and Ranch in 1995.

The Fasken family then opted to turn part of its land into commercial and private real estate developments because it was no longer suitable for ranching.

In 2009, the idea for a master-planned community called The Vineyard was being tossed about, Harmon said, noting it is one of the largest Midland has ever seen. Sitting on roughly 1,000 acres of an active oil field west of Midland, 320 acres are under development and have been dedicated to the city.

The acreage is home to four office buildings, including the company's 60,000-square-foot headquarters, an elementary school named after a Fasken family member and the first phase of a 352-unit apartment complex, which reached 88 percent occupancy in less than two weeks after its grand opening.

In the works are four additional office buildings, the completion of the apartment complex, a large townhome project, two neighborhoods comprising more than 800 upscale single family homes, retail strip malls, restaurants, a new high school, a nine-hole golf course designed to tie into an adjacent country club's courses, trails and lots of green space – a welcome sight amid the region's dusty plains.

### Marrying Industry and Real Estate

About the time Fasken was contemplating The Vineyard, the Wolfberry play was taking off in Midland, breathing new life into the Permian Basin through breakthroughs in horizontal drilling and hydraulic fracturing.

Knowing oil and gas activities would increase, Fasken opted to first drill its Wolfberry wells and construct the needed

See **Fasken**, page 8

## Industry, Communities Can Successfully Coexist

*David Entzminger, past president of the AAPG Southwest Region, lives in Midland, Texas and is a proponent of Fasken Oil and Ranch Ltd. He believes that Fasken can serve as an example for oil and gas companies struggling to find a balance with the communities in which they operate.*

*In his words:*

ENTZMINGER

The oil industry and cities have a very long history of working together. With compromise on both sides, it is possible and mutually beneficial for populated areas to have producing wells within and around a metropolitan area. Noise, air and water pollution must be considered, monitored and minimized when producing hydrocarbons in a city, but should happen anywhere.

Los Angeles area is a great example how the oil industry has developed very large fields in a metropolitan area. The Los Angeles City Oil Field is about four miles long and a quarter mile wide. Of the 1,250 wells once drilled on the field, and of the many derricks that once covered the hills north of Los Angeles, little aboveground trace remains.

*A decorated oil derrick towers over Beverly Hills High School.*

On the west side of L.A. are the still-productive Salt Lake and Beverly Hills fields. Ten miles east-southeast of L.A. is the Brea-Olinda Field, the first to be worked in the region.

There are many producing wells within the city limits that are in the middle of subdivisions. Most people don't even know they are there because they blend into the landscape (see April 2012 AAPG EXPLORER). The giant Wilmington Field, which stretches from Carson to Long Beach, Calif., still produces today from three manmade islands in the harbor west of Long Beach. Much care was taken to make these islands blend into the landscape and reduce the noise from the hundreds of producing wells.

So how does Fasken fit into this story?

The public needs to know that the oil and gas can be developed safely in a heavily populated area, if the public, politicians and the petroleum industry work together for the benefit of all.

Fasken has large land holdings on the northwestern edge of Midland. As the city has grown and the shale oil boom has emerged, these two entities have merged.

Fasken has taken a proactive approach that illustrates the blending of the oil industry and population growth being compatible and healthy. It has many wells on its property and has built an office complex, apartment complex, an elementary school and have plans for a golf course and housing development all around this developing Permian Wolfberry oil shale play.

A few miles south of Fasken is the Grassland subdivision, where I live. Within the past year, Diamondback Energy has drilled or is drilling at least 10 long-reach horizontal wells (roughly 7,500 feet long) underneath my subdivision. They have pumped massive fracs that no one in the subdivision has felt, and most people don't even know they have these wells under them.

Diamondback and Fasken even ran a 3-D seismic survey through our subdivision that most homeowners didn't even know occurred, as it was done with the utmost care to be unobtrusive.

The petroleum industry can and has been a good partner with the public, as it has done for many decades.

# Fasken

from page 6

infrastructure, such as roads, facility lines and access ways to pipes, pump jacks and batteries. Its vertical wells were drilled with generous, 40 acre-spacing, which equates to 16 wells per square mile, to accommodate future real estate development, said AAPG member Jeff Bryden, a geologist with Fasken.

Tighter well spacing was used in areas not planned for residential use.

Fasken geologist and AAPG member Stonnie Pollock said that because the drilling of horizontal wells leaves less of a footprint, the wells can more easily be constructed after residential sites are developed without disrupting communities.

"We planned the well locations and the locations of the streets with future residents in mind," Harmon said. "We have tried to be a good neighbor from the very beginning."

Prior to planning The Vineyard, Fasken's general manager, Norbert Dickman, and others took a trip to California to study how the state managed to successfully locate million dollar homes and businesses adjacent to pumping units. Upon returning to Midland, Chuck Hedges, Fasken's general counsel who also oversees real estate development for Fasken, met with the city of Midland to help write rules and regulations that would be respectful toward future oil patch residents, Harmon said.

"We worked with the city to develop the rules," Harmon said, "and we stayed within the rules."

### Checklist

High on Fasken's list of priorities for developing The Vineyard were the following items:

▸ **Water –** Realizing fresh water is a valuable commodity in west Texas, Fasken drilled to 1,700-foot depths to retrieve brackish water, and then led the industry in treating and using brackish water in the well drilling and completion process in the Permian Basin, Pollock said.

"Fresh water is very limited out here," he said, "and we don't want to exploit that for oil and gas reasons."

Fasken also plans to treat brackish water and use it to irrigate the development and golf course.

▸ **Seismic** – When Fasken began shooting 3-D seismic lines within the city limits in March it went out of its way to inform the public of its activities and to avoid disturbing the peace, said AAPG member Glenn Winters, chief geophysicist for Fasken.

Not only did the company help publicize its activities in the local media and distribute flyers to residents, it shot seismic strictly during school hours (8:30 a.m. to 3:30 p.m.) to avoid conflicts with rush hour traffic.

Furthermore, although the company was ready to acquire seismic data last November, it waited for the holiday season to pass, Winters added.

"We are good corporate citizens here," he explained. "We serve on boards in our own respective organizations, and we are part of the Midland community."

▸ **Well operations** – Unlike many operators, Fasken limited the hours of hydraulic fracturing operations.

"When we get close to houses and to people, we shut off the motors and pumps at 7 p.m.," Harmon said. "Of course it takes us longer to complete the job, but we don't want to bother our neighbors during evening and night hours."

▸ **Communication –** Fasken isn't shy about pointing out what they see as a bias against the industry by mainstream media, but the company believes operators should have a louder voice when informing the public of its intentions and processes.

"The oil and gas industry often doesn't get a fair shake, and as a result we sometimes don't say enough because we are afraid we will get misrepresented," Pollock said. "But the industry and state and local regulatory agencies must do a better job at educating the general public."

Fasken employees have walked door-to-door to talk to residents about the seismic acquisition and horizontal drilling processes. They explain that new horizontal wells will be located 6,000 to 10,000 feet below the ground, and that the hydraulic fracturing process will not disturb them.

The company also makes its way into local public schools to teach students about the drilling process, Bryden added.

### Common Sense

Having developed apartments and single family homes in Laredo prior to embarking on The Vineyard, Harmon said the company learned many lessons about how to properly develop real estate, such as constructing alleyways to access homes to achieve a cleaner look in a community.

Yet when it came to developing real estate in an oil field, The Vineyard is the company's nascent venture. With no pre-existing model to follow, executives remembered the ruffled feathers of nearby residents of unincorporated Gardendale, Texas, where operators drilled around the clock and close to homes and businesses.

"People there threatened to incorporate and write ordinances that prevented drilling," Pollock said.

Wanting to avoid similar fallout, Fasken simply took a "common sense" approach, Harmon said, reiterating the company's desire to respect residents, conserve water, drill away from homes and keep nuisances to a minimum.

Because Fasken's reputation precedes itself, the oil fields on which The Vineyard sits can be likened to white noise or wallpaper.

"People know this is an active oil field. They see the wells out there, but they know everything we do is first class. We're not going to be working out there 24 hours a day with bright lights shining into their windows. Our headquarters are here so we can oversee everything and take care of things," Harmon said.

"It's the Golden Rule: Treat other people how you'd want to be treated," he added. "That's what we're doing."

# Producing Dissolved Methane From Groundwater

By LOUISE S. DURHAM, EXPLORER Correspondent

Methane gas is nothing if not controversial.

It's widely reviled by activist groups and others as a threatening greenhouse gas, but prized by consumers for its use as a fuel and its role in generating electric power.

It's the principal component of natural gas, followed in concentration by the heavier hydrocarbons ethane, propane and butane. It also is created naturally in many instances, as in decomposition of plant and animal matter.

Methane occurs as a concentrated energy source where it is produced as natural gas from large, high-pressured reservoirs. It flows easily to surface production facilities as a relatively pure and easily processed product.

Not widely discussed is methane's presence in low, or diffused, concentrations in ground water.

Utah-based professional geologist and AAPG member Gary Player is focused on spotlighting this occurrence and touting the advantages in producing the gas.

Player is the inventor and owner of a patent pending process for extracting commercial quantities of dissolved natural gas from ground water existing in deep, saline aquifers.

He noted that commercial extraction of methane gas from ground water has already occurred for several decades in Japan, where world-class quantities of iodine have been produced along with the gas.


PLAYER

> "Large resources of dissolved methane are usually present wherever thick sequences of sandstone or other porous rocks are saturated with ground water below depths of about 2,500 feet."

"Large resources of dissolved methane are usually present wherever thick sequences of sandstone or other porous rocks are saturated with ground water below depths of about 2,500 feet," Player commented.

He explained that the depth is crucial to ensure sufficient water pressure to keep the methane in solution.

### Sand Bed Methane

The potential for production of dissolved methane, or sand bed methane (SBM), is huge.

"The total area of all the geological basins most prospective for dissolved methane production in the continental United States and Alaska is about 450,000 square miles," Player said.

If wells were eventually to be developed from only one zone on 80-acre spacing throughout that entire area, he noted that this would add up to 3.6 million wells.

"If each well produced an average of 300 thousand cubic feet of gas per day, they would produce more than a trillion cubic feet per day, or 394 TCF per year," he emphasized.

It gets even better.

Player noted that dissolved gas production is a benign process.

"The easiest zones for completion are in hydro-pressured aquifers pressured only by the weight of overlying deposits of ground water," he said. "The dissolved gas is separated from produced water at ground level in tanks, with gas extracted from the top of the tanks in low pressure pipelines and water draining out the bottom in a second set of pipelines.

"Water is filtered and transported in anaerobic pipelines and injected back into the same aquifers from which it was produced," he said.

"Produced gas may then be compressed for sale into existing utility gas lines, or burned locally in gas turbines for generating electricity" he added.

A bonus: In arid areas, a small proportion of the produced water may be recovered and treated for agricultural use.

Most of the water, however, will be returned to the source reservoir to preserve reservoir properties, such as porosity and permeability, and to inhibit surface settlement.

If you're all revved up and ready to develop your own dissolved gas deal, Player has a list of criteria for you to use as a guide to select an area for implementation:

- Proof of hydrocarbons in a basin.
- Presence of thick, porous and permeable rocks (usually sands and sandstones).
- Presence of old, 'blown down' gas fields with pipelines and other infrastructure in place.
- Availability of markets for immediate sale of produced gas.
- Old well records, including electric logs, mud logs, gas heating value tests, etc.

Meanwhile, Player has already implemented two successful projects: Honey Lake Basin in northern California, east of the Sierras, and Gill Ranch gas field in Madera County, California, in the San Joaquin Basin.

He remarked that the Gill Ranch test in 2013 was key to his efforts.

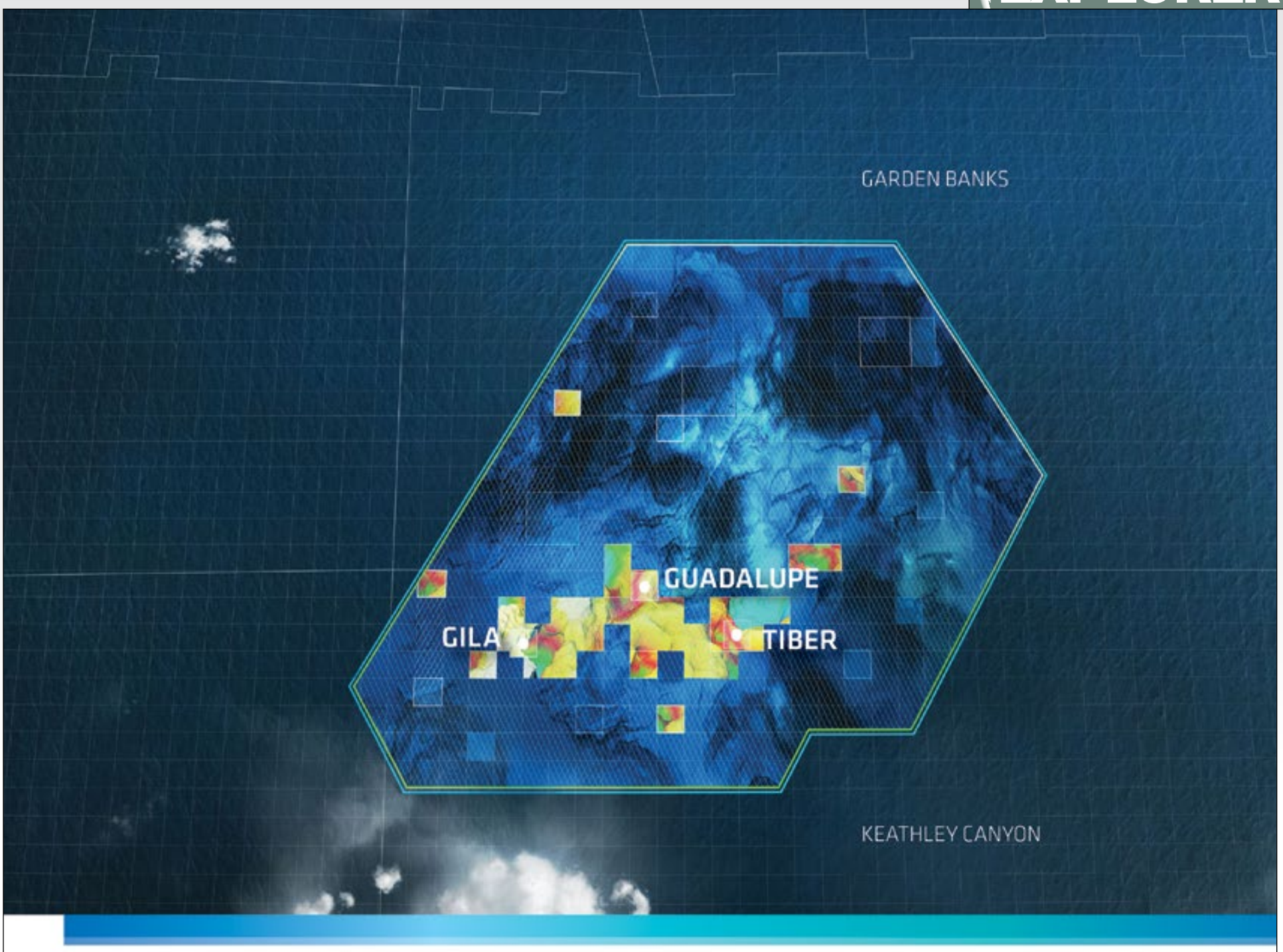
"The gas/water ratio was even better than projected," he said, "and it confirmed a lot of the work that had been done."

### Costs and Reality

That said, it's time to move on to the big question: Cost.

Player commented that a major cost of

See **Aquifers**, page 14



# Sensor Innovation Electrifies Exploration

By LOUISE S. DURHAM, EXPLORER Correspondent

The gloomy oil industry scenarios widely reported by the media tend to overlook the ongoing technological innovations that are positioned to bring additional hydrocarbons out of the ground more economically.

GroundMetrics in San Diego is attracting considerable attention in this arena.

The company identifies itself as a full service survey and monitoring company and the world leader in the development of land-based electromagnetic/resistivity sensor systems.

Among its breakthroughs, it notes innovations in sensors, power transmitters and 3-D computational models, methods and analytics.


WILKINSON

> **"It's that electric field we detect, and by processing and interpreting the results we can understand the geology down to wellbore depth and out as much as two miles from the wellbore."**

To the point, the firm has developed and patented a fundamentally new sensor system technology that it says is transforming enhanced oil recovery, mature field development and hydraulic fracturing monitoring.

In testimony to its expertise, GroundMetrics was recently dubbed one of the "Ten Most Promising Energy and Clean Technology Companies" at the 13th annual Rice Alliance Energy and Clean Technology Forum – and it's been covered in Forbes magazine, Reuters and other major news outlets.

"The underlying science for our eCube sensors was developed by Quasar Federal Systems for the U.S. Department of Defense," said Mark Wilkinson, vice president of unconventionals and geophysics at GroundMetrics. "For application of that science in the space of oil and gas, all of that was developed by GroundMetrics."

### An Electric Effect

Wilkinson emphasized that its rapidly deployable, capacitive electric-field sensor eCube is 100 times more sensitive than competing sensors – and also more stable.

The relatively new technology can be used on its own or to supplement seismic data.

The company's surface-based system can see both between and beyond wellbores, enabling multiple-mile resistivity imaging. In fact, depth capability exceeds 10,000 feet with a lateral extent of more than two miles beyond the boreholes.

The result is a comprehensive view of subsurface data and the movement of fluids within a reservoir.

Traditional surface-operated resistivity systems are restricted to shallow underground targets. They actually can be non-functioning in certain terrains such as frozen tundra, volcanic rock and areas subject to extreme temperatures.

The wellbore is central to application of the new, advanced technology.

With the eCube sensors placed on the earth's surface, the wellbore is used as a transmission antenna, according to Wilkinson.

"We hook an electric source to a wellbore, or for certain applications we lower an electrode into a wellbore on a wireline, to inject current into the earth," he noted. "The electric field created by injecting that current, we can detect at the earth's surface.

"The current is injected into the earth by the wellbore, and that creates local electric fields from the wellbore to the surface," he said. "Those electric fields are affected by the geology.

"It's that electric field we detect," he added, "and by processing and interpreting the results we can understand the geology down to wellbore depth and out as much as two miles from the wellbore."

### Primary Applications

Wilkinson emphasized that the primary applications for this technology are:

- Improved or enhanced oil recovery.
- Hydraulic fracturing monitoring.
- Brownfield exploration.

He elaborated on the potential for brownfields.

"Because you need the wellbore for transmitting, we can come in and find resistive bodies in and around producing and abandoned wells," he noted. "If a client understands their geology well and can interpret those resistive bodies to be bypassed pay, we can find those.

"What we're measuring is resistivity in the subsurface," he said, "and if that can be mapped and interpreted to be an accumulation of hydrocarbons, we can help with brownfield exploration."

There are industry players who view the

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## Job Search
from page 4

their job searching activities solely through online job applications. Most applicants report significant challenges to measuring success from corporate website applications. Unless you get the call to interview, there is rarely sufficient feedback to know if you were competitive, for what reason you were rejected, or if your résumé was considered at all.

As a consulting company, SCA makes new connections with highly qualified and experienced technical professionals on a daily basis.

"It never fails to amaze me that these applicants seem to fall through the cracks because the online résumé gathering systems can't make the connections between the right candidate and the right job," said Matt Nowak, SCA business development director. "Hiring managers approach specialist consulting companies like SCA with in-house technical capabilities to identify the right person because they know that the consultant will be screened, vetted, interviewed, and referenced before a résumé ever reaches the hiring manager's desk."

It is a good practice to research and interview any recruitment company that approaches you to be sure that you are getting the best possible representation.

Do they understand your technical discipline?

Do they have a good network of hiring manager contacts or do they simply submit résumés to online portals?

Do you have colleagues or contacts within your network who can recommend an agency and vouch for their service?

Although it may be tempting to send your résumé to every available job posting for which you feel qualified, such a scattergun approach can make you look desperate and significantly lower your perceived market value. Furthermore, applying for a job for which you are simply not qualified makes any recruiter question your ability to understand your own capabilities, or even to read a job description.

When applying for a new position, less is generally more. Make all applications focused and, wherever possible, add a cover sheet or customize your résumé summary to detail exactly why your skills and experience are a match for the role.



## Aquifers
from page 10

SBM production would involve bringing the gas-charged water to the surface to separate the gas from the water. It's possible to choose locations where production costs are minimized by naturally occurring hydrologic conditions.

For example, he mentioned the Santa Margarita formation west of Fresno, Calif., where water from about 3,500 feet below ground level will rise to within 150 feet of the surface when either sealed behind casing and perforated, or completed in an open hole with slotted liners and gravel pack.

"Water can then be pumped economically, or brought to the surface by gas lift," Player said.

He emphasized that no one has questioned the technology, which he has been promoting for several years.

Indeed, the advantages Player summarized point to a win-win:

- Giant resources of dissolved SBM are present in several basins in Alaska, California and other states and provinces.
- Areas to begin development can be identified quickly and easily from existing well data, with no need to locate structurally specific drill sites with expensive geophysical surveys.
- Vertical wells and low angle directional wells can be drilled to relatively shallow depths (less than 8,000 feet) with proven completion techniques.
- Environmentally and politically suspect hydraulic fracturing will not be required for sand bed dissolved methane recovery.
- Drilling costs will be in the realm of 10 percent of the funding required for directionally drilled hydraulically fractured wells.
- Widespread dissolved gas resources can be used to replace alternative fuel supplies, such as hydraulically fractured gas and coal.

But someone has to jump in and take the reigns to make this work.

"It seems that each time someone is ready to proceed with a project, the stock market collapses," Player said. "And everybody wants to recover their money in six months."

Tack on the ongoing commodity price dilemma, and this becomes a familiar refrain echoing throughout the oil patch.

## New Technology
from page 12

current downturn to be a less-than-prime time to promote new technology, even if it offers the opportunity to create more efficiency and improve the economics.

Wilkinson couldn't disagree more.

"In times like this when oil companies are struggling to find ways to be profitable, it's these times they will try a new technology," he said. "So the companies that still have budget are snapping up what we're offering because right now they need new technology."

GroundMetrics lays claim to a blue chip customer list with a history of repeat business.

"All have repeated," Wilkinson noted, "or are currently planning follow-up work."

# India Gets Aggressive About Oil Exploration

By HEATHER SAUCIER, EXPLORER Correspondent

While exploration has slowed in many parts of the world in response to the industry's lagging downturn, India is moving full steam ahead to encourage exploration and production on a domestic and international scale.


PRADHAN


MODI

After a decline in production over the last decade, the country – which is fiercely battling growing energy demands – is making bold moves to open its underexplored oil and gas fields and to enact policies that make exploiting them more enticing.

"Since most of our country's old and mature fields are on the decline, there is obviously an urgent need to have a quantum jump in the exploration efforts," said B.N. Talukdar, the director general of India's Directorate General of Hydrocarbons (DGH), in a recent public statement.

Appointed to his post in 2013 to assist with India's petroleum reforms, Talukdar said, "The country immediately needs to enhance the hydrocarbon resource kitty and its production from both existing and to-be-discovered hydrocarbon resources. This calls for huge supplemental efforts by private and multinational companies who could be attracted for making investments in this sector of the country."

Dharmendra Pradhan became India's minister of state for Petroleum and Natural Gas in 2014 on a platform of pushing the country's petroleum industry forward. Pradhan has spoken publicly of multiple policy reforms that have or will be enacted, including:

- Gathering more geoscientific data on underexplored areas.
- Allowing access to the country's unconventional resources.
- Deregulating diesel fuel and implementing new natural gas pricing.
- Introducing fiscal policies and incentives to reduce the notorious red tape in contracting processes.

"The people of the country have large expectations from the new government, and this government is dedicated to the welfare of the poor," Pradhan said on India's "Elections" website. "The Indian economy has an important role in the world economy, and I would endeavor to make contribution to this effect."

### Exploring India

For years, India has relied on the production of major discoveries in the Krishna-Godavari, Barmer and Assam basins, leaving many of its 26 sedimentary basins virtually unexplored, said Vinay Sahay, AAPG Geoscience Student Chapter coordinator of the Asia Pacific Region (which includes India, Pakistan and Bangladesh) and chief editor of the International Basic and Applied Research Journal.

(Of India's 3.14 million square kilometers of sedimentary basins, 1.3 million square kilometers are located in deep waters and 1.84 square kilometers are on land or in shallow waters.)

Graphic courtesy of DGH

"Indian companies have focused much on enhanced recovery from already producing oilfields in addition to nearby, relatively small discoveries," Sahay said. "There has been less focus on Greenfield regions, thus large oilfield discoveries and large reserve additions are comparatively less."

India's last hydrocarbons assessment of 15 of its 26 sedimentary basins took place 16 years ago.

Based on that assessment, the DGH estimates that 28 billion tons of conventional oil and oil equivalent are located in 15 of India's sedimentary basins and offshore areas. However, until last year, only in-place hydrocarbon volumes of roughly 11 billion tons could be established through exploration by India's national oil companies and private/joint venture companies, leaving an estimated 17 billion tons, or 61 percent of resources, in the "yet to find" category, according to the DGH.

Because of the dearth in data, the U.S. Geological Survey (USGS), which assessed four provinces in India in 2012 for their hydrocarbon potential, could only estimate the amount of undiscovered, technically recoverable oil and gas based on broad ranges, explained AAPG member Tim Klett, a research geologist with the USGS who performed the assessment.

For example, in the Mannar Basin, an offshore basin between India and Sri Lanka, estimates for crude oil ranged from 234 to 837 million barrels, resulting in a mean of 483 million barrels.

All in all, however, in the Assam, Bombay, Cauvery and Krishna-Godavari provinces, the USGS estimates a total mean value of 3.5 billion barrels of crude oil, 79 trillion cubic feet of natural gas, and 1.7 billion barrels of natural gas liquids, Klett said.

The resources are there.

Getting them out of the ground has been an issue for decades, despite the fact that India is the fourth largest consumer of energy after China, the United States and Russia.

"India is one of the fastest growing economies in the world," reports the DGH. "Strong GDP growth rates gave resulted in a surging demand for energy including oil and gas."

Regardless of when India hit its energy threshold, its leaders have decided the time has come for the oil and gas to begin flowing again.

### More Data Required

"Exploration is essential for enhancing domestic production in India," Pradhan said. "Geoscientific data on nearly 48 percent of the more than three million square kilometers of Indian sedimentary basins is either scarce or unavailable."

The government plans to gather data on roughly 1.4 million square kilometers through 2-D seismic surveys over the next five years and drill a limited number of parametric wells.

It also plans to reassess its known resources and include information on all 26 basins.

In order to acquire geophysical data in underexplored areas, the government has developed a new policy for geoscientific data generation to carry out nonexclusive, multi-client, geoscientific surveys and activities, according to the DGH.

The DGH also reports that a National Data Repository is currently in development to house all available exploration and production data. It will allow all operators to view India's data from anywhere in the world.

### Joining the Shale Movement

In its 2011 assessment of the Assam, Bombay, Cauvery and Krishna-Godavari provinces, the USGS estimated that those areas contain a technically recoverable mean volume of 6.1 trillion cubic feet of potential shale gas.

The Oil & Gas Year (TOGY) estimates shale gas reserves to be between 300 and 1,200 trillion cubic feet.

Yet, in the past, operators exploring for conventional hydrocarbons could not apply for shale oil or gas rights in their exploration licenses. The country only allowed a license for a single item, such as oil or gas. A new policy implemented in 2013 changed that.

"We are evolving a Uniform Licensing Policy which will allow operators to explore for and produce all types of hydrocarbon resources including shale gas and oil in an awarded area," Pradhan said. "There is an urgent need to … explore and develop other unconventional hydrocarbon energy resources like shale gas and oil, coal bed methane and gas hydrates."

The DGH estimates that India's coal bed methane resources are at 92 trillion cubic feet. In fact, India has the fifth largest proven coal reserves in the world.

To encourage exploration in all of India's 26 sedimentary basins, the government is currently working to invite bids for a new round of exploration and building infrastructure to allow hydrocarbons to be taken to market.

"Improving infrastructure will decrease transportation costs and the cost of petroleum and its products," Sahay said. "This will enhance companies' profit margins."

In addition, the country will provide more data on gas hydrates to encourage exploration.

### Focusing on Gas

A gas supply deficit has longed plagued India.

Globally speaking, gas comprises roughly 24 percent of the energy market, whereas in India, that number is a mere 8 percent.

According to a 2014 report from the IHS, an "unmet gas demand now represents a considerable drag on India's economy and the cost of maintaining subsidized, low gas prices has become unsustainable," stated

See **Deregulation**, page 16

## India Woos International Producers

In September, India approved the Marginal Fields Policy and the auction of 69 discovered state oil fields to private companies. As reported by TOGY, the fields have been surrendered by India's national oil companies.

The purpose was to stimulate interest in developing them alongside larger, maturing fields.

The fields hold resources worth an estimated $10.6 billion.

"Our government is working on multiple fronts … to accelerate the pace of activities of the oil and gas exploration and production sector," said Dharmendra Pradhan, India's minister of state for Petroleum and Natural Gas.

Ultimately, it is the hope of the country to reduce its dependence on imported energy from 70 to 50 percent by 2030, according to Prime Minister Narendra Modi.

While tangible changes are occurring, time will reveal whether or not India will become more attractive to international explorers.

– HEATHER SAUCIER

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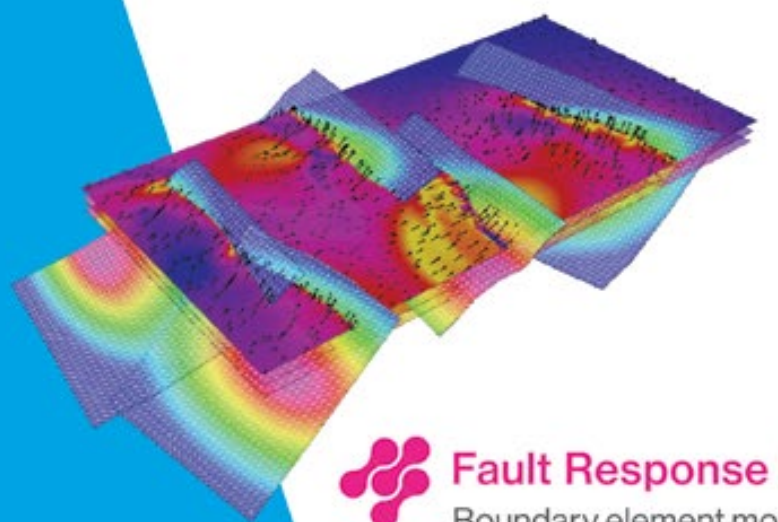

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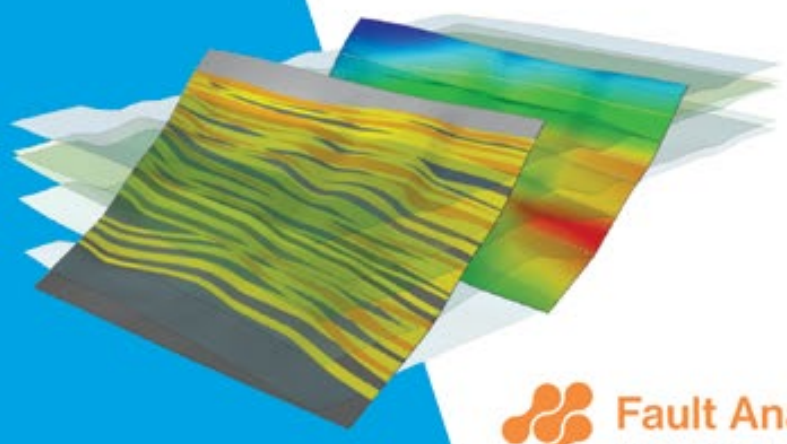

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midland valley

## Deregulation
from page 16

Rajiv Biswas, chief economist of Asia Pacific at IHS.

The report also stated, "the long-term distortion of India's gas pricing regime has brought about a major gas supply shortfall, acting as a brake on economic activity."

Longing for greater energy independence, India in 2014 deregulated diesel fuel and announced a revised formula for raising the price of domestic gas.

"These issues of fuel subsidies and remunerative pricing for domestic gas have been on the table for a long time, and both of these steps will add new potential to the Indian oil and gas industry," said Reetu Ragini, AAPG Young Professional lead and secretary for the Asia Pacific Region.

Deregulating the price of diesel combined with natural gas pricing mechanisms have created an equal playing field for the international players to compete with the national exploration and production companies, Sahay said.

After diesel regulation, now private companies such as Reliance Industries Ltd. have begun selling diesel and petrol from their own service stations, he added.

"Essentially, the country has liberated natural gas pricing, giving operators more incentive for exploration," Sahay said. "Companies are now free to fix the price of natural gas and sell it in the market. The market will decide the pricing."

"The current set of policy reforms increases the price of domestically produced gas, thereby stimulating additional domestic exploration and production activity," Biswas stated in the IHS report, which added that India's gas pricing reforms represent an important policy shift and should stimulate domestic production, soften growth in reliance on expensive LNG and accelerate India's economy.


*Figure 1. Generalized map showing the boundaries of the Bombay Shelf, Cambay Delta, Cenozoic Reservoirs, Krishna–Godavari Basin, Northern Cauvery Basin, Mannar Basin, and Sri Lanka Shelf assessment units (modified from Wandrey, 2004a, b). The Sri Lanka Shelf assessment unit was not quantitatively assessed in this study. Inset map shows locations of Bombay, Assam, Cauvery, and Krishna–Godavari Provinces (Wandrey and Law, 1998).*

New gas pricing is expected to increase the exploration and production of natural gas, with special emphasis placed on deepwater discoveries.

Oil and Natural Gas Corporation, a multinational oil and gas company in India, plans to raise its output by more than 80 percent by 2019. The country also will import greater volumes of liquefied natural gas (LNG) by building more infrastructure, including new LNG terminals and expanding its gas grid by 15,000 kilometers of pipelines.

"Crude oil and natural gas is a vital source of primary energy in India," said Secretary Saurabh Chandra in a recent public statement. "It is more efficient, convenient, and a cleaner source as compared to other fossil fuels like coal."

### Revamping Policies

Despite the fact that India has allowed 100 percent foreign direct investment, it has not typically been appealing for exploration because of policy blockades, hazy regulations regarding production-sharing contracts and the pricing of commodities and subsidy mechanisms, Ragini said.

Furthermore, some say that even after blocks were allocated to operators, obtaining statutory clearances from the Ministry of Defense, Ministry of Home Affairs and Ministry of Environment, Forests and Climate Change remained a herculean task.

However, through major policy overhauls, the government is creating an operational framework it says will "incentivize investors." New fiscal policies and incentives, combined with a regime that is ultra transparent and stable, are believed to be the foundation for a healthier business environment.

One change includes a recent move to a revenue-sharing model from a cost-recovery model. This new production-sharing contract framework allows international companies to recover their costs before they pay the government its share of revenue.

The government will also modify the contractual regime to facilitate investors to avoid micro-level management and reduce regulatory requirements, Pradhan said.

Investors will find the decision-making process to be "fast and effective" following the removal of "roadblocks," Chandra said.

In addition, the government plans to adopt the Open Acreage Licensing Policy, which will allow upstream companies to bid for any oil and gas block without waiting for the bidding announcement, as is the current policy.

According to the DGH, "The Cabinet Committee of Economic Affairs has approved the proposal regarding relaxations, extensions and clarifications at the Development and Production stage … for early monetization of hydrocarbon discoveries. These reform initiatives will help the monetization of some of the pending operational issues which are hampering E&P operations and create better business climates for investment."

# Project Seeks Improved Hydrocarbon Detection

By LOUISE S. DURHAM, EXPLORER Correspondent

Companies spend massive sums of money to drill exploratory wells in the often-challenging offshore environment, with no guarantee of success.

Prior to drilling, they run up multimillion-dollar tabs acquiring and interpreting seismic and other kinds of expensive data.

No one would question that these commonly acquired data are essential to the exploration process.

Unfortunately, the information they provide is lacking in two key regards:

- They can't definitively identify the presence of a petroleum system.
- The quality and usefulness of seismic data can be dramatically altered by thick salt sequences, which occur routinely in areas like the Gulf of Mexico and the Red Sea.


SCHRYNEMEECKERS

> "We emphasize that seismic is important, essential, but it doesn't answer the question of whether you have hydrocarbons."

"Typically, (companies) will do a multi-beam seismic study and pick their large structures where they hope to define if these structures are charged or not," said AAPG member Rick Schrynemeeckers, business development manager for U.S. territory at Amplified Geochemical Imaging LLC (AGI). "Then they come in to take piston cores based on predetermined sites.

"And this has not always worked well," he added.

When Anadarko implemented its Marco Polo field program, the project focused on improving the detection and mapping of hydrocarbons from petroleum systems by augmenting seismic and satellite data with additional technologies.

### Surveying Marco Polo Field

Marco Polo occurs in a salt bounded mini-basin in Green Canyon Block 608 about 175 miles south of New Orleans in the Gulf of Mexico. Production emanates from reservoirs within a Pliocene-age supra-salt sandstone.

Anadarko enhanced the traditional approach by employing an autonomous underwater vehicle (AUV) geophysical survey using several technologies to acquire high-resolution seafloor and near-seafloor characterization.

"This effort included our ultra-sensitive hydrocarbon system that provides hydrocarbon detection with a thousand times greater sensitivity than traditional methods," Schrynemeeckers said. "The system can identify hydrocarbons from both macroseepage and microseepage."

He noted that hydrocarbons were identified at various intensity levels in 100 percent of the core samples, negating the need to be directly over the expulsion feature or to be there during the actual event.

"Traditional macroseep detection schemes only average a 10 percent probability of detecting hydrocarbons," he emphasized, outlining the reasons for this:

- Lack of macroseeps over the area of interest.
- Lack of sensitivity in traditional hydrocarbon detection methods.
- Hydrocarbon seeps often are small features not readily recognized by 3-D seismic data.

"We emphasize that seismic is important, essential," Schrynemeeckers said. "But it doesn't answer the question of whether you have hydrocarbons, especially in subsalt basins where you need to know because of high salt content or thrusting and folding."

### How It's Done

He discussed the procedure that comes into play once the operator opts to take piston cores.

"Traditional methods essentially take a slice out of the piston core and analyze the gas that comes out of the core," he said. "The problem is the amount of hydrocarbons in that small piece of piston core material is not much to measure.

"On the vessel, we put an absorbent inside a jar with the piston core," he said. "It's something that looks like a fat shoestring with a Teflon exterior and absorbent pellets inside.

"As the hydrocarbons off-gas from the core, they move through the membrane and concentrate on the pellets, which keep pulling hydrocarbons out of the headspace to concentrate them more and more," he noted. "That's how you get a thousand-fold increase in detection sensitivity."

Schrynemeeckers provides a simple comparison between the method employed by AGI and the traditional approach, saying the company's concentration methodology yields a bucket full of hydrocarbons,

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## Red Sea
from page 20

compared to a thimble-full using the traditional method.

"This gives us more to work with," he emphasized.

### Impact Player

It was serendipitous that the Marco Polo environs sparked yet another, although geographically distant, project.

Marco Polo is flanked by two subsalt fields, sitting beneath a salt canopy measuring between 10,000 and 15,000 feet in thickness.

"It begged the question if the more-sensitive hydrocarbon detection method could detect the microseepage of hydrocarbons from subsalt reservoirs," Schrynemeeckers said.

Before long, this was proven out in a Red Sea field having a complex geologic system.

The area was overlain by 8,000 feet of evaporitic salt and anhydrite sequences that harbored interbedded shale sequences.

Ultra sensitive hydrocarbon mapping was utilized to enhance knowledge of the structure and perhaps add clarity to the boundaries of the hydrocarbon accumulations.

Liquid hydrocarbons were detected through the 8,000-foot salt sequence.

"Subsequent to the study, a well was drilled based on the survey results and produced 800 bopd," Schrynemeeckers said," lending credence to the hydrocarbon probability maps generated by the survey."

# AAPG Donates Textbooks to Cambodian University

By KRISTI EATON, EXPLORER Correspondent

The Cambodian Institute of Technology (ITC) – locally known as "Techno" – got a major boost recently in the capital city of Phnom Penh when another donation of textbooks was finalized by the AAPG Publications Pipeline Committee.

The donation, which totaled more than 1,360 kilograms of books, shows the excellent cooperation between AAPG and the ITC, according to AAPG Member Chea Samneang, a lecturer in the Department of Geo-Resources and Geotechnical Engineering at ITC, as well as the faculty adviser for the AAPG-ITC student chapter.


McWALTER

Michael McWalter, treasurer for AAPG's Asia Pacific Regional Council, took part in the recent handover ceremony at the school, which is the only university in the Southeast Asian country to offer students the opportunity to study mining and petroleum.

The textbooks are "very helpful to strengthen the reading and educational capacity in both academic and research to students and lecturers" who are studying in the fields of geology, petroleum geology and engineering, mineralogy and more, Samneang said. The school hopes to receive additional textbooks in the future from AAPG.

The ITC established the AAPG-ITC Student Chapter in 2013, Samneang noted, and the Department of Geo-Resources and Geotechnical Engineering is one of seven departments at ITC that focuses on mining, petroleum and the geotechnical fields.

"So the basic concepts of geology and petroleum geology are very important for students and lecturers within this department for their research and future career," he added.

The Department of Geo-Resources and Geotechnical Engineering was founded in 2011, Samneang said, and the department must focus on maintaining enough materials, learning space and high-quality staff to teach students, so the textbook donation is very important and useful in the department's mission.

Cambodia, a country of 15 million people wedged between Thailand, Vietnam and Laos and often known for its brutal genocidal regime known as the Khmer Rouge, is a net importer of oil and gas resources.

But, Samneang said, the Cambodian government has given approval for several international oil and gas companies to begin exploration in the hydrocarbon sedimentary basins covering the country in both offshore and onshore areas.

Samneang said the most potential is the area known as Block A. The Cambodian government is planning to develop and produce oil and gas in the next few years to support growing national demand, he said.

KrisEnergy holds a 55 percent interest in Block A and is close to reaching a deal with the government to extract oil from it, according to the Phnom Penh Post, an English-language daily newspaper.

KrisEnergy provided the transport of the books from Houston to Phnom Penh. Representatives from the Singapore-based company were also on hand at the handover ceremony.

In 2013 (the most recent year for which data is available) Cambodia consumed 28,000 barrels of oil per day, according to the U.S. Energy Information Administration. That was down slightly from the year before, when the country consumed 28,900 barrels per day on average.

# What We're Learning Now Will Pay Off in the Future

By SUSAN NASH, AAPG Director of Education and Professional Development

One of the challenges in a downturn is moving quickly enough to take advantage of opportunities and to adapt to changing times.

Success in a downturn requires knowledge of the opportunities, the techniques and technologies that can be deployed for maximum positive impact.

This report lists some of the emerging insights and lessons learned from current AAPG education department events, courses and research conferences.

To start, the tools and techniques we tend to use in a shale play boom are different than in a decline. First and foremost, in the unconventional boom we saw activities escalate on a massive scale, starting with leasing and reconnaissance geology, to an "ops tempo" that was staggering – horizontal wells were drilled to assure that leases were held by production.

The drilling frenzy did not abate until later in the game, as prices fell and it became more difficult to acquire capital.

Now, the focus is on reservoir optimization and finding ways to take advantage of opportunities:


NASH

**Lessons learned during a boom and a subsequent downturn may be painful and expensive, but it's best to think of them as investments in the future.**

**Identify underperforming assets that could be good acquisition candidates.**

Perhaps the first thing that comes to mind in a downturn is to seek distressed properties. It's simple as a concept – but technically it's not simple at all, and it's easy to make a mistake if one does not understand the geology or the latest engineering lessons learned.

**Assess and evaluate opportunities to purchase and to sell.**

All the obvious candidates never seem to make it to the market. So in a downturn like this it's important to be able to look at more subtle differentiators. This is a case where data mining techniques can be quite useful. However, which are the attributes that make most sense? And, how can we assure ourselves that our data set is relevant and not corrupted with flawed or incompatible data?

Geologists who know how to take and refine data sets and then to identify opportunities will do well.

**Form new geologist-engineer teams.**

What are the engineering realities geologists need to know? What are the geology realities engineers need to know?

We think we know – until we actually talk to each other. Good communications can help in many different stages of exploration and development.

For example, they can help to avoid geohazards when geosteering, select the proper drilling fluids, understand where and how to use certain frac fluids and how to design an effective waterflood that will help recover the petroleum remaining in a fractured carbonate, or in a stratigraphic trap consisting of fluvial deltaic sand bodies.

**Combine geochemistry and geomechanics for innovative completions, extensions and workovers.**

A few examples include new acidizing procedures in carbonate reservoirs, or determining the location of lobes in deep marine clastics/turbidite reservoirs.

**Investigate the real reasons for production decline.**

"We lost pressure" and "it went to water" are viable reasons, but there are often unexpected reasons, many of which have to do with ill-advised attempts at cost-savings. For example, a failure to implement a good corrosion-control program or to use biocides could result in scale, slime and the generation of hydrogen sulfide, resulting in production declines. Poor understanding of the reservoir pressures and temperatures also could result in paraffin build-up.

Geologists are sometimes far from production discussions, they should be actively involved in production discussions, because their insight into the reservoir fluids, the behavior of gas, fracture networks and pore architecture can be valuable.

**Clean up your data.**

More is not always better.

Problems with nomenclature and incompatible log data can completely corrupt the study – this is especially the case in formations that consist of laterally discontinuous units, such as a granite wash. Data mining techniques vary, and the research design needs to be more rigorous than ever. Otherwise, you run the risk of making very dangerous and bad decisions based on flawed data and misguided algorithms.

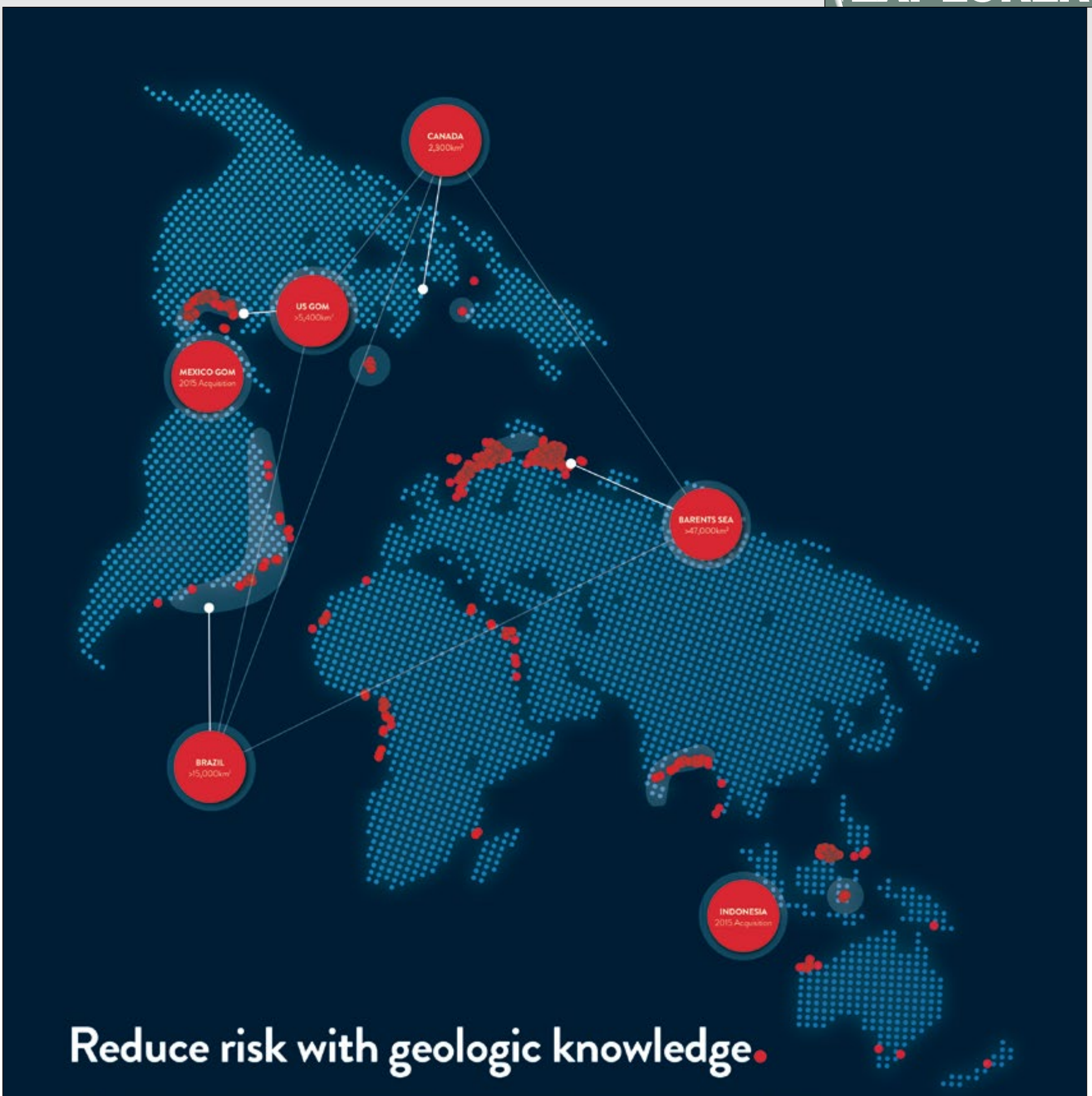
**Petrophysics.**

Logs, cores and even mud logs tend to be cut during downturns. It's a mistake. The more information you can glean, the more likely you are to gain insights about the rock properties and the fluids in the formation.

## Conclusion

Now more than ever, geology matters. New techniques and technologies are only successful if we understand the nature of the rocks themselves, along with the structure and behavior of reservoir fluids.

The lessons learned during a boom and a subsequent downturn may be painful and expensive, but it's best to think of them as investments in the future. They will pay off, particularly if we keep an open mind, communicate across disciplines and are willing to think, dream and be bold.

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## *Gulf Coast land loss:*

# Who Is To Blame?

By LOUISE S. DURHAM, EXPLORER Correspondent

There's long been much ado about the ongoing loss of coastal wetlands in south Louisiana.

Angst about coastal issues overall increased considerably after Hurricane Katrina led to breaches in parts of the levee system protecting New Orleans.

The ensuing deluge of water was almost surreal.


McLINDON

Louisiana is a busy working coast, rife with oil industry pipelines, floating rigs, boats, ports, fisheries and more. Both the state and the United States in general benefit economically from activity here.

Unfortunately, the region is also a frequent target for the many hurricanes and tropical storms that enter the Gulf of Mexico.

The coastal wetlands are a buffer of sorts to storm surges and subsequent land loss, which can jeopardize flood protection infrastructure.

There has been considerable finger pointing in the effort to zero in on the culprit(s) responsible for the disappearing land.

Not surprisingly, many fingers point to the oil and gas industry with its several thousand linear miles of pipelines in the region.

### The Usual Suspects

A state-proposed Coastal Master Plan designed to sustain the coastline debuted in 2012, carrying an estimated minimum price tag of $50 billion, some of which would be covered by the BP Macondo spill payout money.

Spurred by the encouragement of activist and author John Berry, the South Louisiana Flood Protection Authority East sued numerous oil companies operating in the state, claiming they bear responsibility for all of the lost land area and, therefore, the cost of restoration.

The lawsuit is currently being appealed.

The oil and gas industry readily admits to causing 36 percent of the erosion.

So who, or what, is at fault for the remaining loss of 64 percent?

Blame Mother Nature, specifically subsidence, say a number of experts.

Chris McLindon, deepwater exploration geologist at Lafayette-headquartered Stone Energy, has studied the subject in detail, much of the effort on his own time.

He has shared his research findings through numerous papers and presentations at professional gatherings. Recently, he appeared as a guest expert on a segment of Al Jazeera America's program focused on the 10th anniversary of Hurricane Katrina.

"Subsidence has been a topic of discussion in south Louisiana for 20 years or so," he said. "It's been in a state of flux owing to the evolution of technology to measure the rate of subsidence."

### When the Levee Breaks

Katrina apparently served as a wake-up call to the scientific community.

McLindon remarked that a study conducted by noted scientists concluded that it's likely the catastrophic levee failure in New Orleans was caused by subsidence due to faulting.

"They didn't come right out and say it," he said, "but it's clear what they meant.

"They were using satellite imaging technology to measure subsidence right there," he noted. "Rates also can be measured using tidal gauges and geodetic leveling.

"Efforts to measure how much elevation benchmarks have subsided created a whole new batch of data," he added.

"I have made the case that we have been able to measure land loss since 1932 because of the earliest vintage of aerial photography we have to measure the change," McLindon said. "If we could have measured the change over the past 5,000-6,000 years, we would have measured 30,000 square miles of land loss.

"This is only the most recent manifestation of what has been a natural component of the construction of the marsh, which is the delta cycle.

"Deltas built and then were abandoned, and the abandoned delta ultimately subsided below the surface, and the entire area of the delta that may have existed 3,000 years ago has been 'lost.' All we're seeing now is a manifestation of a process that has been going on for millions of years, but we're only able to measure it over the last 80 years.

"The public is left with the impression that (the huge) figures quoted as land loss are only applicable to the last 80 years, when they actually are the most recent expression of what has been a natural process all along."

### Industry Involvement

The New Orleans Geological Society (NOGS) is working on a proposal to study subsidence and the effect of geological faults on subsidence.

Rather than acquiring oil and gas company 3-D surveys, NOGS determined the best approach is to get the surveys donated to universities so that researchers could implement the effort.

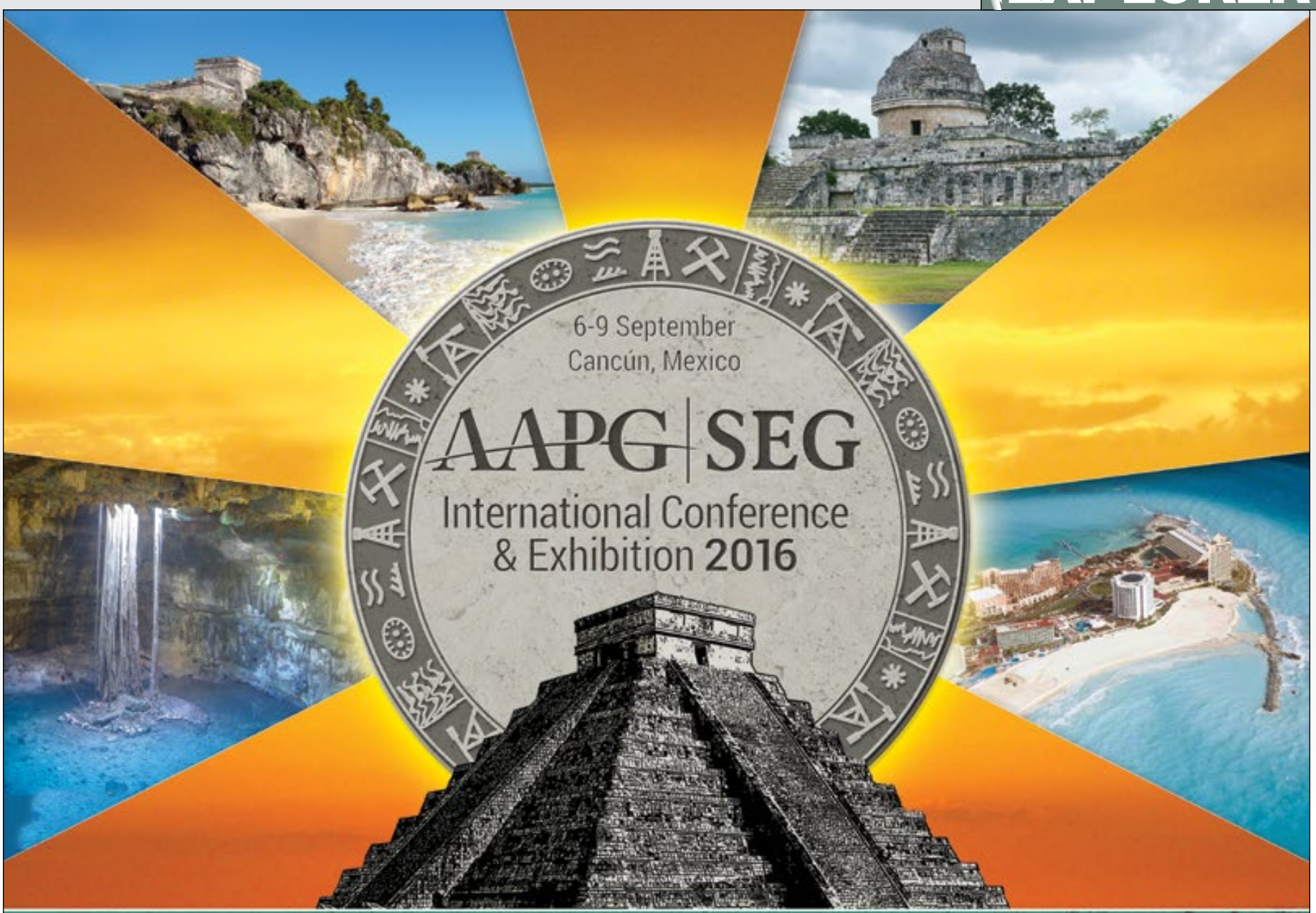
"Industry has the capability to offer to other entities a much more detailed and accurate assessment tool than they have available otherwise by getting 3-D surveys into the hands of institutions and having them produce faulting and subsidence interpretations that result in a predictive model of where relative sea level rise will have the greatest impact," McLindon said.

"Successful mapping of faults and subsidence across the coast could have broad applications for infrastructure planning," he emphasized.

The initial seismic donation was a 500 square-mile 3-D in Plaquemines Parish, which went to the University of Texas at Austin, courtesy of WesternGeco.

"They mapped 28 faults and found very distinct surface expressions basically causing land loss at the surface," McLindon said. "It was a strong premise to move forward with this."

NOGS has arranged for a second donation of an industry survey to go to the Coastal Research Laboratory at the University of New Orleans.

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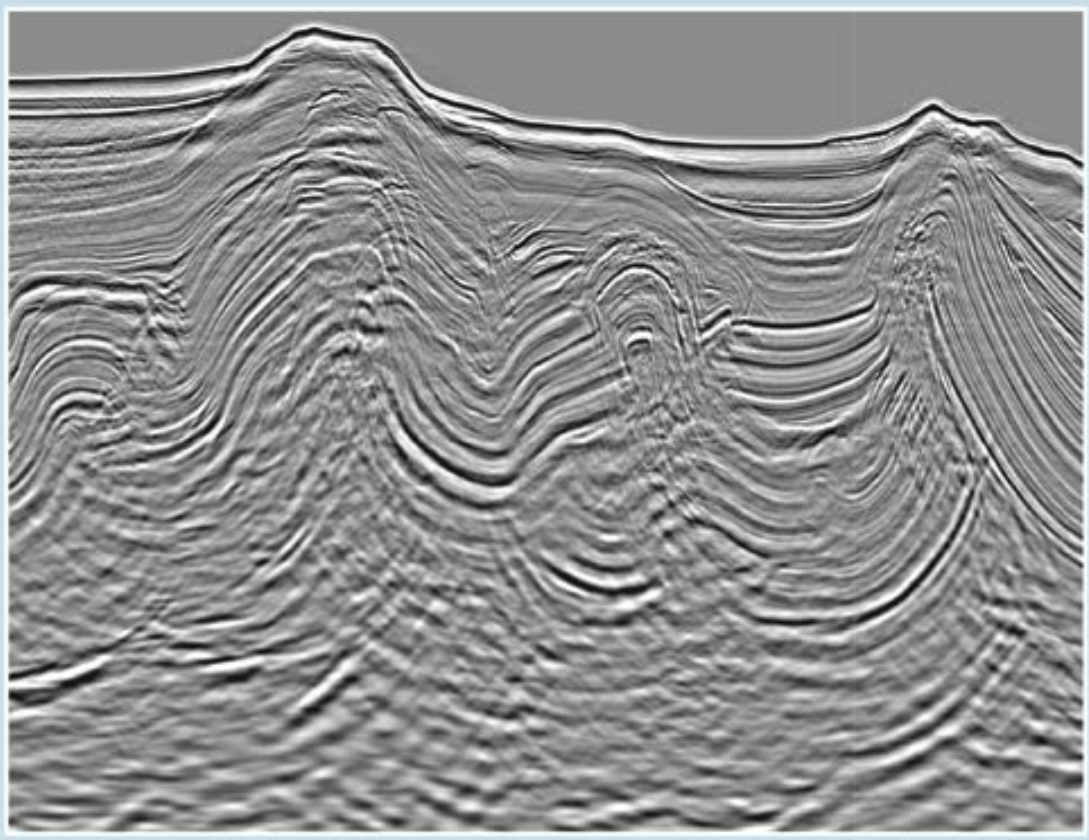

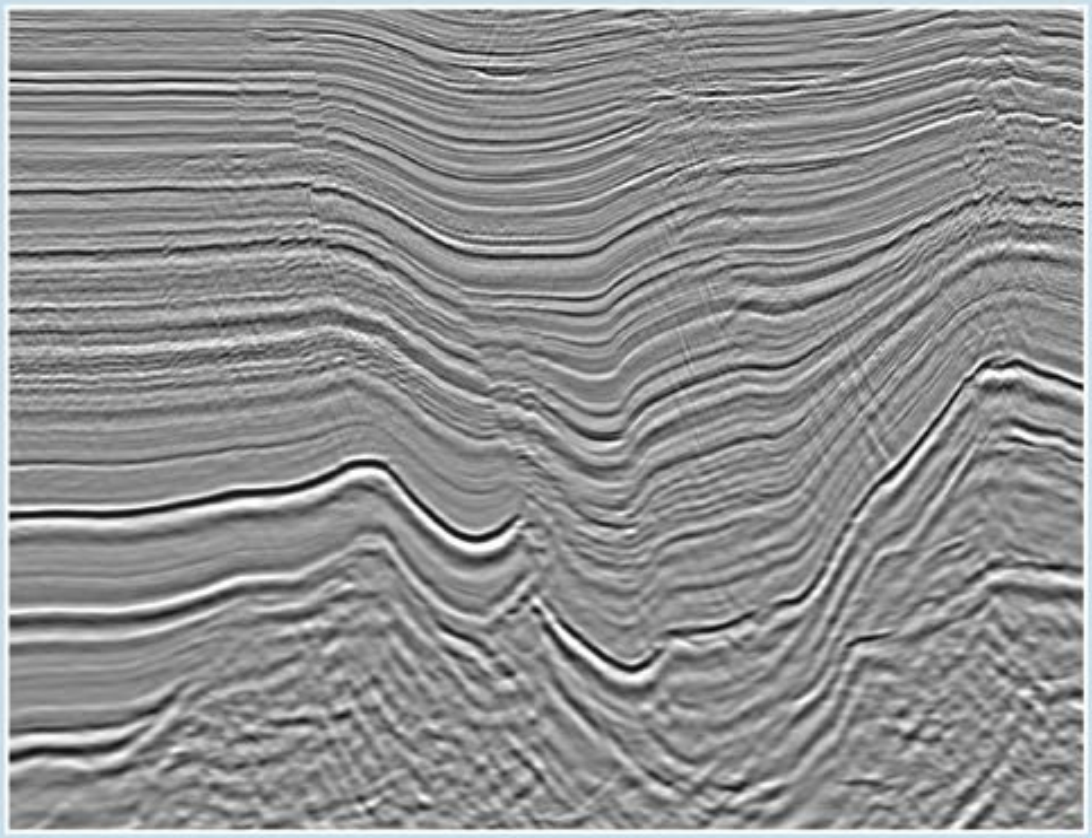

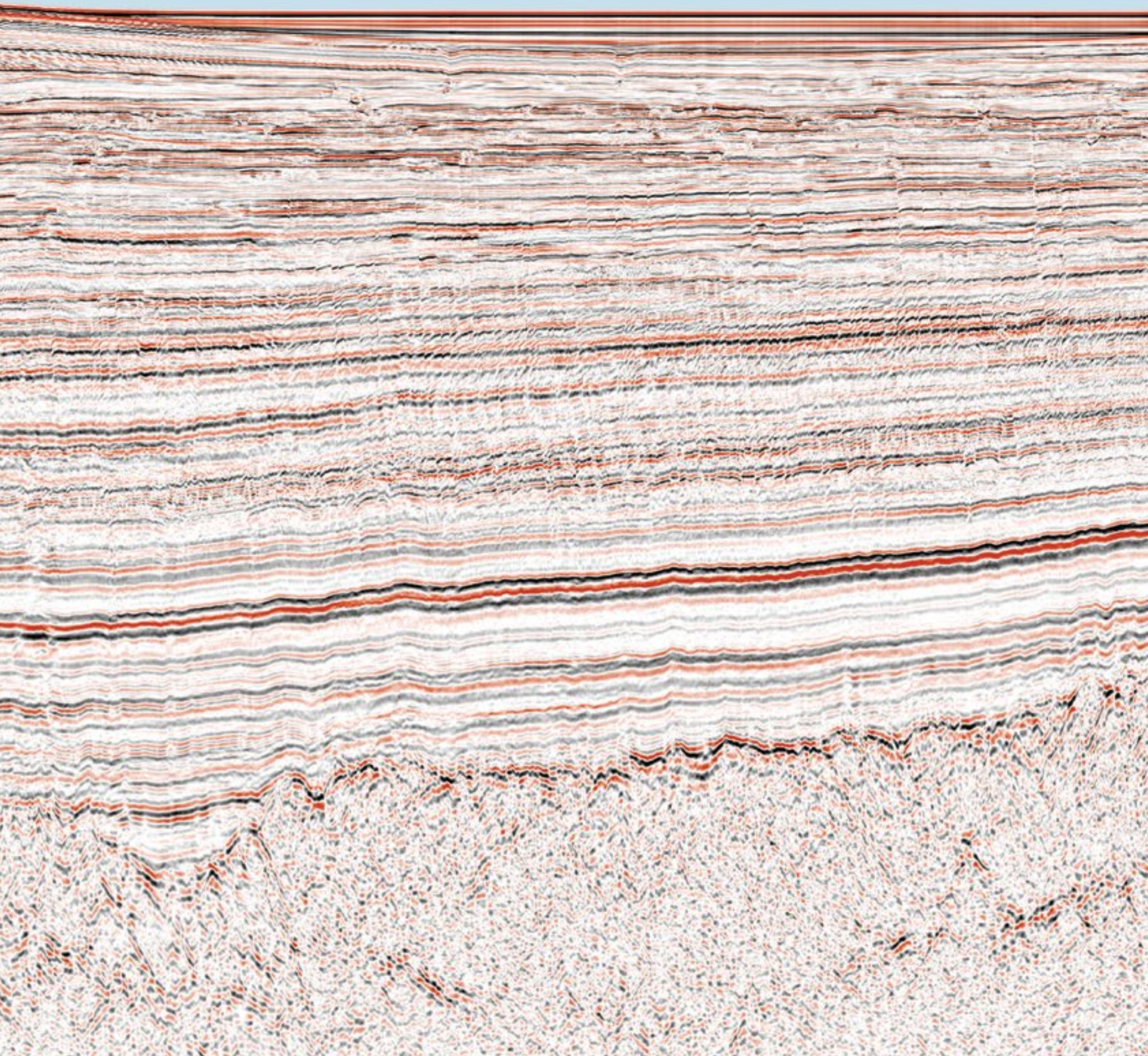

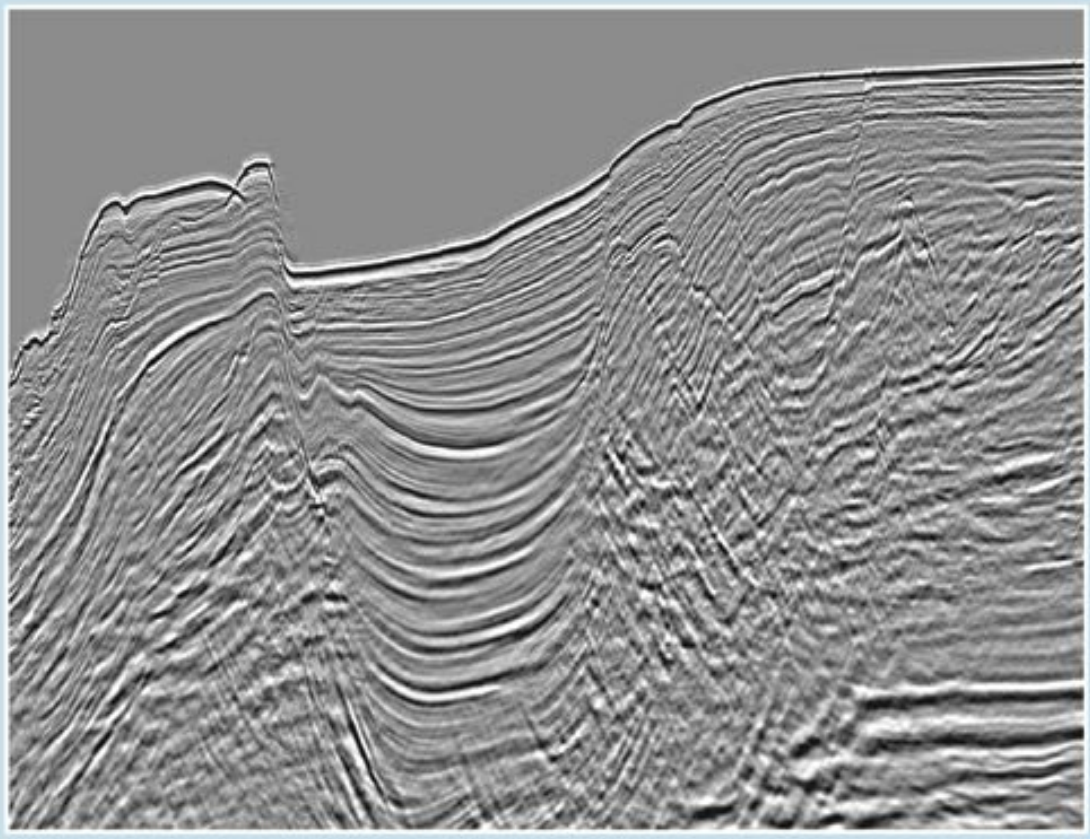

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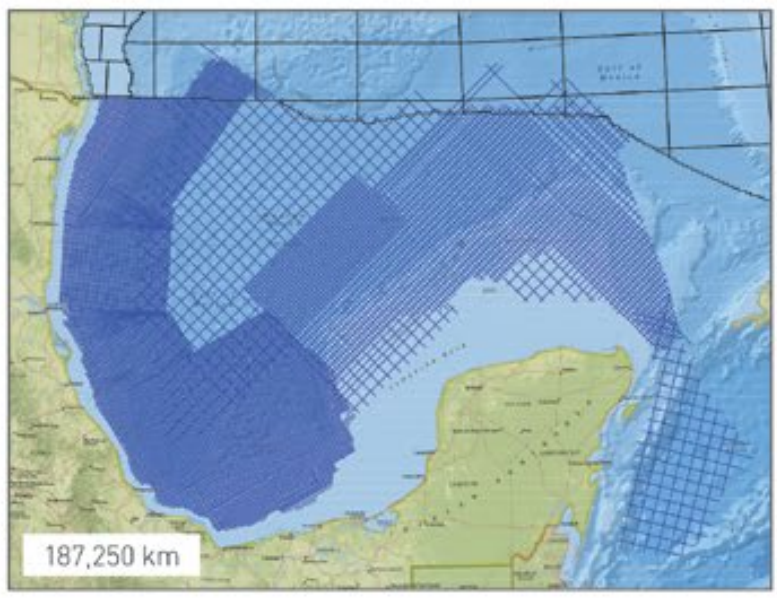


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*The hunt for 'cosmic dandelions'*

# Do Comet Hydrocarbons Have Biogenic Origins?

By KEN MILAM, EXPLORER Correspondent

Hydrocarbons in comets or asteroids likely were formed like those on Earth – biogenically, according to AAPG member Prasanta K. Mukhopadhyay.

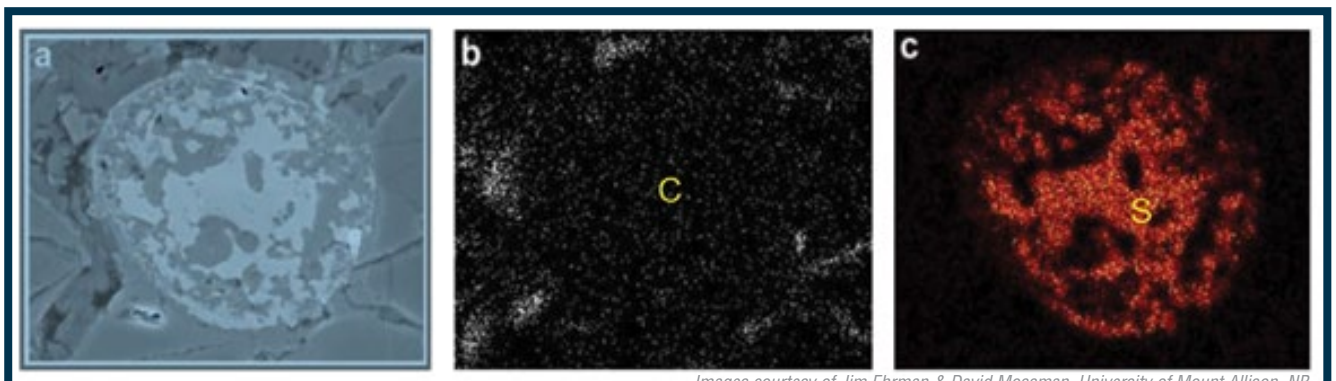
Yes, you read that correctly: "biogenically," as in, "arising from life" – in this case, extraterrestrial life.

Mukhopadhyay likens meteorites known as carbonaceous chondrites (CCs) to "cosmic dandelions," spreading hydrocarbons and life-forming elements throughout the solar system.

Oil and gas hydrocarbons found on planets and moons may come from comets or asteroids and share biogenic and maturation signatures with Earth source rocks, Mukhopadhyay said.

"From the standpoint of the presence of hydrocarbons and PAHs (polycyclic aromatic hydrocarbons), I believe that both life and hydrocarbons could be universally connected," Mukhopadhyay said.

Further, he said the solar system's unconventional petroleum system could eventually provide fuel for space travelers and interplanetary colonists.




Images courtesy of Jim Ehrman & David Mossman, University of Mount Allison, NB

*(a) SEM image of a sample of the Murchison carbonaceous meteorite showing partially mineralized organic remnants. (b) EDS carbon map and (c) sulfur map of the same remnants. In 2004, NASA astrobiologist Richard B. Hoover controversially described this type of organic component as a well-preserved bacterial cell with a possible flagella.*

MUKHOPADHYAY

> **"I am a geochemist – when life began is not my business. My business is how the hydrocarbons formed."**

## Scientific Support

"Part of my concept is that thermal degradation nannobacteria and other archaeoprokaryotic organisms, related hydrocarbons and other molecules in the CCs derived from the comets or asteroids may be cosmic 'dandelions,'" he said, "preserving, growing and distributing hydrocarbons and life-forming ingredients through soft landing of meteorite showers and purging as comet dust in the solar system."

Mukhopadhyay, a Halifax, Canada based organic petrologist and organic geochemist, said his research and that of others suggests these CCs, or meteorites, were derived from asteroids, comets or the planet Mars.

"Since 2004, I have conducted some comprehensive research on more than 20 carbonaceous meteorites (CCs, or carbonaceous chondrites) using organic petrology (using transmitted and incident light microscope), organic geochemistry (organic carbon analyzer, Rock-Eval pyrolysis and pyrolysis gas chromatography-mass spectrometry), scanning electron microscope and SEM-EDS (SEM with energy dispersive X-ray spectrometer), sometimes in association with other scientists from Mount Allison University, New Brunswick, Canada," he explained.

"My data suggested that these CCs are all organic-rich and contain abundant macromolecular components," he said, "and biomarkers similar to kerogen and bitumen occur within petroleum source rocks as we have seen in the terrestrial source rocks that have generated oil and gas. Remarkable bacteriomorphic structures and other kerogenous microstructures preserved in CCs closely resemble remnant terrestrial palynomorphs of microbial (prokaryotic and archaeoprokaryotic) ecosystems established on Earth over 3.5 billion years ago.

"All CCs that were examined contain solid, bitumen-like components," he said.

"My data corroborates the earlier concept by astrobiologists that (certain) meteorites contain fossil cyanobacteria, extraterrestrial l-amino acids, nucleobases and water," he added. "Similarly, various publications (e.g. Geochimica et Cosmochimica Acta) by various geochemists and astrogeologists also support my idea on the organic origin of these hydrocarbon-like components in the CCs over the last 20 years.

"Recent data by the European Space Agency's Rosetta Probe that landed on Comet 67P/Churyumov-Gerasimenko may also support the presence of hydrocarbons on that comet," he said.

## New Corroborating Data

Rosetta's Philae lander recently "reawakened," and Mukhopadhyay said he is excited by the potential findings in the data that may be returned.

"They found as the comet goes toward the sun, when facing the sun, it ejects gases and hydrocarbons," he said. "That's exactly that what my concept is.

"In effect, the information encoded in the CCs constitutes a cosmic analog to terrestrial geopolymers or macerals in organic-rich source rocks (kerogen type II) and their derivative liquid and/or solid hydrocarbons," he continued.

This, he said, may raise these questions:

- Is oil and gas within our solar system mostly biologically derived (possibly from the thermal degradation of nanobacteria and other archaeoprokaryotic organisms)?
- Is there a close relationship between the origin of early biota and universality of the presence of unconventional oil and gas within various planets in our solar system?"

Mukhopadhyay discussed his findings in a presentation at this year's AAPG Annual Conference and Exhibition (ACE) in Denver, and he is preparing a related presentation for an upcoming conference for SPIE, the International Society for Optics and Photonics.

The geochemist has been studying CCs for years, and in a 2009 paper he and his co-authors suggested a "biologically-derived, universal, unconventional petroleum system throughout the solar system."

"My concept could be validated if any core drilling data on Comet 67P/Churyumov-Gerasimenko or on Mars is available in the future," he said. "However, my organic petrology, SEM-EDS and geochemical data (especially pyrolysis GC/MS of Murchison, Orgueil and Tagish Lake CCs) clearly indicated the organic origin of these carbonaceous chondrites (meteorites) as they contain bacterially-derived hydrocarbon species."

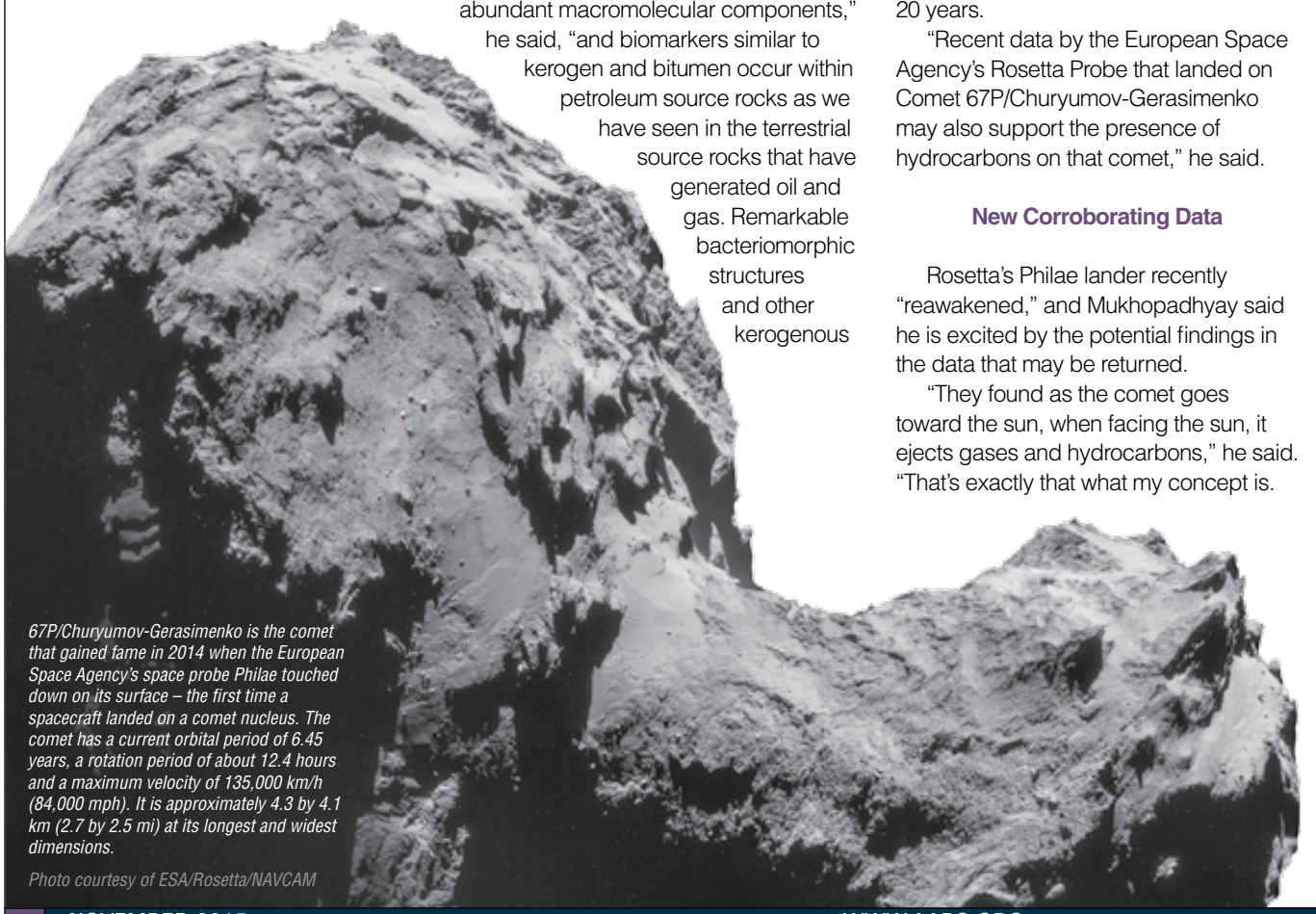
He said his study and modeling of CCs indicate two temperature-influenced categories of organic compounds:

- Low temperature – less than 200 C degrees – acted on organic remains to form oil, gas and some asphaltene.

Geochemically, the CCs are "remarkably close" to oil-prone kerogen type II and II-III source rocks found on Earth, he said.

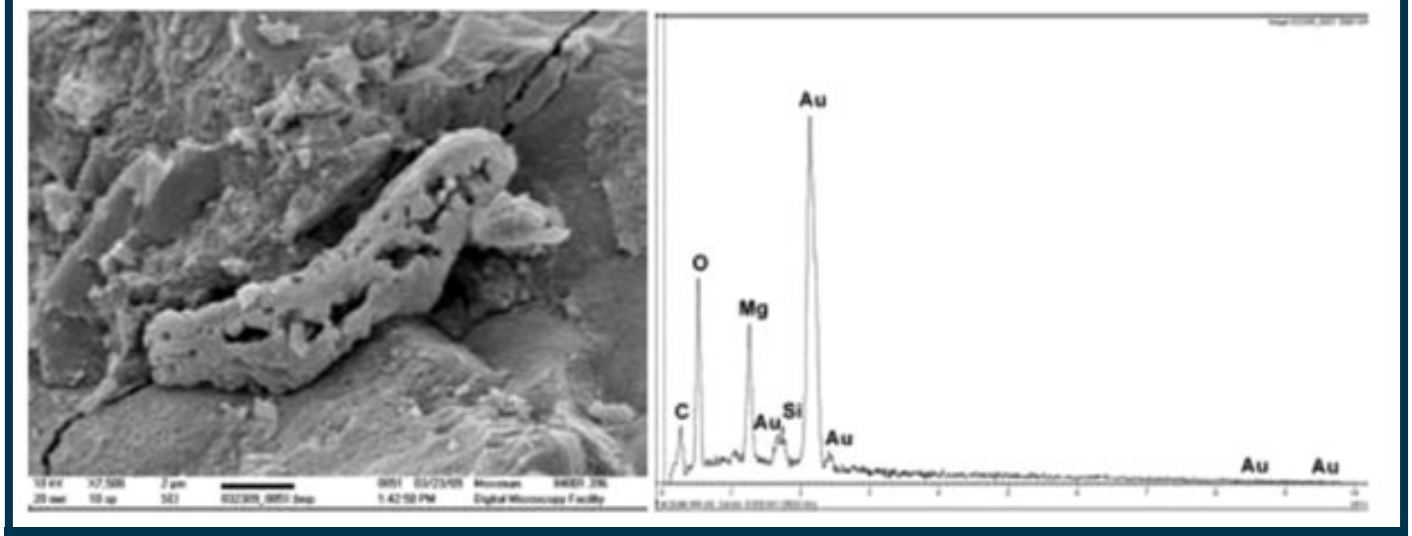
He proposes they were formed in relatively cold and humid areas of the early solar system, comets and interstellar dust "where microbial-like and slightly evolved organic communities could have

See **Organic Petrology**, page 32



*67P/Churyumov-Gerasimenko is the comet that gained fame in 2014 when the European Space Agency's space probe Philae touched down on its surface – the first time a spacecraft landed on a comet nucleus. The comet has a current orbital period of 6.45 years, a rotation period of about 12.4 hours and a maximum velocity of 135,000 km/h (84,000 mph). It is approximately 4.3 by 4.1 km (2.7 by 2.5 mi) at its longest and widest dimensions.*

*Photo courtesy of ESA/Rosetta/NAVCAM*




*(Left) Evidence, according to Mukhopadhyay, of organic remains (possibly bacterial bodies, visible in the central part of the SEM image) from the ALH 840001 CC, partially replaced by minerals. (Right) A representation of the elements present in the same region.*



## Organic Petrology

from page 30

developed."

He said it is not surprising that comets and CCs contain key life-forming elements like hydrogen, oxygen, carbon and sulfur.

▸ High temperature organic remnants were found in some of the CCs he studied. He likened the extreme superheated environment to that around hydrothermal vents in earth's oceans.

In his 2009 paper, he stated, "Even in such an extreme environment, biological life and hydrocarbon generation are intimately linked."

### What Does It All Mean?

Some readers – particularly science fiction fans – might recognize Mukhopadhyay's concept as "panspermia" – the idea that life originated elsewhere and was "seeded" on Earth as microbes that evolved into the more complex forms that populate the planet today.

There is, of course, a range of connotations evoked with that word.

"Directed panspermia" was the premise of the 2012 Ridley Scott-directed movie "Prometheus," which featured an advanced alien race having deliberately planted life on Earth to give rise to the human race.

While directed panspermia was advanced by no less than the Nobel Prize-winning co-discoverer of DNA, Francis Crick, Mukhopadhyay's hypothesis isn't quite so extreme. His concept is more aligned with the "soft" variety of panspermia: That it was natural processes, not ancient alien scientists, responsible for life arriving on Earth.

Of course, his concept still necessarily includes the existence of extraterrestrial life, which inevitably raises some eyebrows.

"It could be coincidental and surprising that these materials have a similar composition of the terrestrial source rocks that originated from various palynomorphs. Therefore, I do not have any alternative explanation," he said.

He said the idea of extraterrestrial biogenic hydrocarbons drew opposition early on, but has garnered growing support, especially since about 2009.

He said his geochemical work indicates certain CCs found in South Africa and Australia basically contain 3.8 billion year old source rock.

"There is hydrocarbon-type material there – I'm not saying life," he said.

He said research points to life and hydrocarbons originating very close together in the early universe.

"Life is universal," he said.

If Mukhopadhyay and the others are correct, it would obviously have far-reaching philosophical and religious implications about man's place in the universe, but Mukhopadhyay said that shouldn't be a factor in considering his hypothesis.

"I believe that any scientists conducting space research should be honest and candid in his/her research findings and should not be biased with any preconceived notions, ideas or religious beliefs. Space science could be an ocean of new knowledge that could open up a new dimension of human knowledge," he said.

"I'm a geochemist – when life began is not my business," he said. "My business is how the hydrocarbons formed."

*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.*

# Venezuela's Oil: Crucial in World War II

By LUIS XAVIER GRISANTI

World War II was the bloodiest armed conflict in the history of mankind. More than 60 million people died. As the world commemorates the 70th anniversary of the defeat of Nazi Germany, it is worth recognizing the role Venezuela played in securing the oil needs of the Allied Nations.

Venezuela, a traditionally pacifist nation, played a crucial part in supplying the energy requirements of the Allies – a role that earned its recognition as a secure and reliable supplier of oil to world markets.

With an output of 563,000 barrels per day, Venezuela was the world's top oil exporter and third largest producer in 1939, after the United States and Soviet Union.

The notable role Venezuela played in the defeat of Nazism and fascism, however, was not limited to the increase of oil production during the war. Venezuela continued augmenting its crude output during the postwar period to support the Marshall Plan, thus helping Europe to recover from the devastation of war.



LÓPEZ


GALLEGOS

### The Democratic Transition of Venezuela (1935-48)

Venezuela made its contribution to the Allied victory while carrying out a difficult process aimed at establishing a democratic system of government.

On Dec. 17, 1935, the 27-year-long dictatorship of Gen. Juan Vicente Gómez ended with his death. The world was suffering from the distressing effect of the Great Crash of 1929. Raw material prices collapsed. The gross domestic product of industrialized nations dropped 20 percent and unemployment rates exceeded 25 percent.

The Great Depression of the 1930s was the main underlying cause of the ascension of Nazism to power in Germany, largely because it raised doubts about the benefits of liberal democracy and free enterprise. The Marxist theory of social justice in a classless society and the egalitarian proposals of National Socialism attracted intellectual elites and masses of workers.

However, the strategic vision of U.S. President Franklin D. Roosevelt, through audacious social reforms, was key to the re-establishment of confidence in democratic values and in restoring economic prosperity.

Venezuela was tempted neither by real socialism nor by the German's concept of National Socialism. Rather, the country chose to follow a transition toward democracy within its own model of a mixed market economy.

Under the leadership of two democratically minded generals, Eleazar López Contreras (1935-41) and Isaías Medina Angarita (1941-45), a comprehensive set of substantive political, economic and social reforms was introduced. These reforms included the founding of the Central Bank of Venezuela (1939) and of the Supreme Electoral Council (1936) and the enactment of the first labor law (1936).

Venezuela advanced its individual and civil liberties under President Medina.

The president and the members of Congress, however, were not elected through universal suffrage – a right that would be introduced during the presidency of Romulo Betancourt (1945-48), when a Constitutional Assembly (1947) instituted, for the first time, the popular and direct election of the head of state. Venezuelan novelist Romulo Gallegos was the first democratically elected president of Venezuela.

### The Petroleum Reform

The reforms endeavored by presidents López and Medina encompassed the petroleum industry. The arduous struggle for democracy in 20th century Venezuela is closely linked to the emergence of petroleum as the cornerstone of the country's economy.

Since 1926, the hydrocarbons industry, operated by the international oil companies (IOCs) under the concessionary regime, had surpassed agriculture as the principal component of the GDP and of the fiscal and foreign exchange revenues.

Venezuela's support of the titanic effort of western democracies and the Soviet Union to defeat the Nazis can best be appreciated in the context of its democratic transition process. Venezuela needed to expand its oil output to help the cause of freedom; but, likewise, the country had to foster its nascent democracy and its economic development, while increasing its fiscal revenues (which accrued mainly to the IOCs).

In 1938, Mexican President Lázaro Cárdenas nationalized the oil industry; but Venezuela's President López, even though he suspended oil concessions, decided otherwise. Venezuela opted for a moderate model of "resource nationalism" through a progressive strategy of increasing state control over the administration of its non-renewable natural resource.

The nationalistic reforms undertaken by López comprised, among others, the founding of the National Confederation of Workers and the Labor Union of the Oil Workers of Cabimas, and the passage of the first labor law. The Hydrocarbons Law was amended, too, while the Institute of Geology was founded, which later became the geology department of the Universidad Central de Venezuela (UCV).

On Nov. 6, 1939, the United States and Venezuela signed the Treaty of Trade Reciprocity, two months after the beginning of WWII. The United States was Venezuela's first trading partner. The treaty mandated a 50 percent reduction in the levies charged by U.S. Customs to the imports of crude oil from Venezuela, while the United States eliminated quantitative restrictions to 90 percent of the country's exports.

When Medina took office on May 5, 1941, he announced what he described as "the Petroleum Reform."

The purpose of the reform was to increase fiscal income, promote the refining industry in Venezuela, expand employment, improve the value of hydrocarbons and unify the concessionary regime while respecting the lawful rights of the IOCs.

Medina sent the attorney general of Venezuela, Gustavo Manrique-Pacanins, to inform Roosevelt and his top aides about the scope of the petroleum reform.

In a letter to the American president, Medina pointed out:

See **Visit**, page 36


GRISANTI

Luis Xavier Grisanti is CEO of the Venezuelan Hydrocarbons Association, the IOCs chamber. He is also a professor of geopolitics and economics at UCV and Universidad Simon Bolívar; former manager of international marketing planning at PDVSA, deputy finance minister and ambassador of Venezuela to the European Union. He received a bachelor's in economics from the George Washington University, a degree in international business from Georgetown University, and a master's of management and of international relations from the Université Libre de Bruxelles.


*President Medina makes a state visit to the United States and meets President Roosevelt at the White House on Jan. 19, 1944. Right: Roosevelt's speech at the state dinner, offered to Medina.*


*President Isaías Medina-Angarita addresses the U.S. Congress in January 1944.*

*Venezuela's oil tanker Perdernales transported oil from the refineries around Maracaibo, Estado Zulia, to Aruba. A German submarine sank it on Feb. 16, 1942.*


*German submarines attacking oil tankers in the sea lanes between Lake Maracaibo and the Curacao and Aruba refineries.*



## Visit
from page 34

*"The Venezuelan nation … recognizing and respecting, at all times, the legal rights (of the IOCs), as established in our juridical system, endeavors to rectify illegitimate situations, illicit and unlawful, with the purpose of obtaining for Venezuela a fair return for the exploitation of its subsoil wealth."*

Roosevelt fully understood Venezuela's position. He indicated that his country did not seek any special treatment for the American companies beyond those applied to all international oil companies under the law. He asked for the continuous support of Venezuela toward the efforts of the allied nations to defeat the Berlin-Rome-Tokyo axis by guaranteeing the supply of petroleum from Venezuela.

In January 1944, Medina made an official visit to the United States, held talks with Roosevelt and addressed a joint session of Congress.

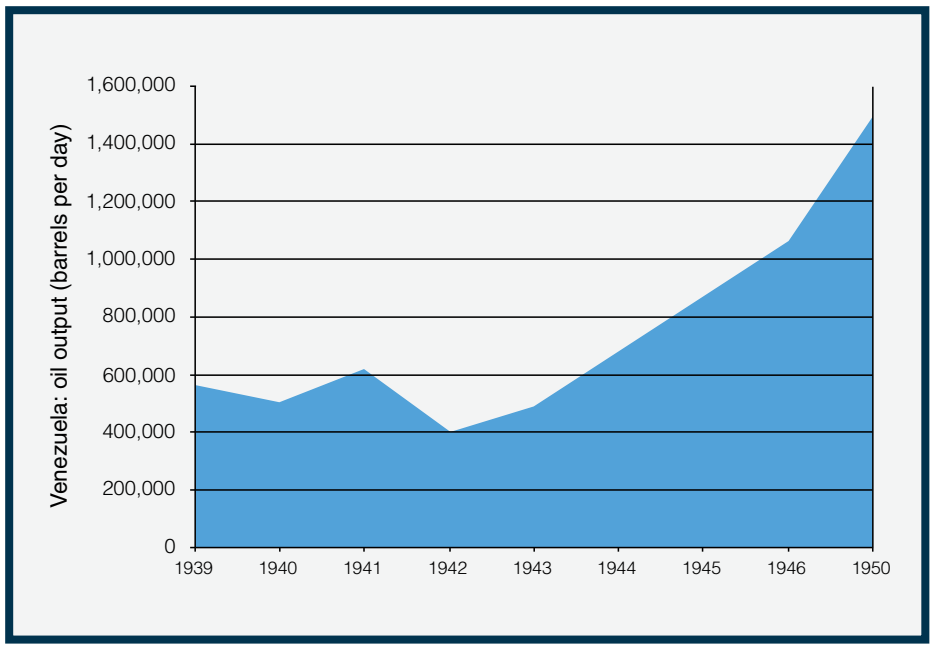
In early 1943, Medina appointed a presidential commission empowered to draft a new piece of hydrocarbons legislation. The new hydrocarbons law, passed by Congress that year after a heated public debate, became one of the most stable legislative frameworks in the history of Venezuela. It encouraged a substantial surge in foreign direct investment by strengthening legal security and guaranteeing contractual stability to the concession holders.

The hydrocarbons law gained such credibility that the next president (and Medina´s fierce opponent), Romulo Betancourt, and his minister of development, Juan Pablo Pérez-Alfonzo (notwithstanding the fact that as a congressman he had abstained from voting in favor of the new law two years earlier), ratified it in 1945. The IOCs complied with the new legislation, new oil concessions were granted, and Venezuela received significant quantities of foreign investment, which allowed the country to substantially raise oil output during (and after) WWII.

### Oil Defeats Nazism

Like most Latin American countries, Venezuela declared its neutrality through a decree signed by President López on Sept. 13, 1939, 13 days after the invasion of Poland. Remember, the United States did not enter the war until after the Japanese attack on Pearl Harbor on Dec. 7, 1941, and the Soviet Union did it only after

See **Output**, page 38




## Output

from page 36

Hitler's invasion of its territory on June 22, 1942. Nevertheless, Venezuela acted in solidarity with the Allied nations.

Venezuela had been increasing its oil output since the 1920s, reaching a level of 539,000 barrels per day in 1939. That year, the United States produced 3,650,000 barrels per day. The start of the military conflict affected Venezuela's production in 1940, when it dropped to 504,000 barrels per day.

On Dec. 9, 1941, two days after the attack on Pearl Harbor, Medina abandoned the country's neutrality and made public his solidarity with the United States and the Allies. On Dec. 12, Venezuela froze the assets of foreign nationals from Axis countries. He also wrote a letter to Roosevelt, repudiating Japan's aggression and expressing his solidarity with the United States. That year, Venezuela's output reached a new historic height of 622,000 barrels per day.

On Dec. 31, Venezuela broke diplomatic relations with Germany, Italy and Japan and installed armored defenses to its oil installations. Intelligence reports pointed to preparations by Nazi Germany to invade the American continent, starting with Venezuela, in order to take control of its strategic petroleum industry.

The hostilities expanded to the coasts of Venezuela.

Om Feb. 14-16, 1942, German submarines torpedoed seven oil tankers that plied the shipping lanes between Lake Maracaibo and Aruba, as well as Lake Maracaibo and Curaçao. Two tankers were sunk (the *Monagas* and the *Pedernales)*.

Medina reaffirmed his commitment to guarantee the supply of Venezuela´s oil for the war effort and strengthened cooperation with the Allied nations. The U.S. Army and the Navy were allowed temporarily to use Venezuelan military bases. Nevertheless, output fell in 1942 to 402,000 barrels per day.

In April 1942, high-range defense batteries were mounted in Puerto La Cruz, Carirubana and other oil locations. On June 15, Congress granted Medina special powers to protect the petroleum facilities, and a system of convoys began to escort Venezuela's oil tankers.

On July 17, 1942, the first income tax law was enacted and it was applied to the IOCs. Until then, concession holders only paid royalty and other minor levies. On Aug. 3, the Venezuelan head of state sent a new letter to Roosevelt, informing him of the scope of the new hydrocarbons legislation, underscoring that the aim of the new law was to increase the nation´s benefits from the hydrocarbons industry while guaranteeing the legitimate rights of the IOCs.

On March 13, 1943, Congress passed the new hydrocarbons law. It raised the royalty rate to 16.67 percent and stipulated that the IOCs should refine at least 10 percent of its crude output in the country. The country recovered its output level in 1943, to 490,000 barrels per day.

Oil production continued to climb, reaching 704,000 barrels per day in 1944 and 885,000 barrels per day in 1945, when the Allies acheived victory.

Between 1939 and 1945, Venezuela's oil production rose 64 percent (or 120 percent from the low point in 1942).

### The Marshall Plan

Venezuela's oil output continued to rise during the postwar period, backing the energy requirements of the Marshall Plan.

Production broke a new record in 1946, reaching 1,063,000 barrels per day. Four years later, in 1950, output climbed to 1,496,000 barrels per day. In summary, between 1940 and 1950, Venezuela tripled its petroleum production.

Venezuela not only contributed considerably to the victory of the free and democratic nations over the totalitarian dictatorships led by Nazi Germany. The country also designed and executed its petroleum strategy with such ability and prudence that it was able to apply nationalistic public policies successfully, while at the same time stimulating investments from the IOCs, consolidating the juridical security of the nation and increasing both its output and its fiscal revenues for the benefit of its people.

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SEG Society of Exploration Geophysicists

AAPG Advancing the World of Petroleum Geosciences

*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.*

# Wide Range of Topics Covered During GEO-CVD

By COLLEEN NEWMAN, AAPG Policy Communications Adviser

On Sept. 30, AAPG Executive Director David Curtiss and 10 AAPG members participated in a day of visits to Capitol Hill to discuss the importance of strong federal investments for geoscience research and education.

"Talking to policymakers is public outreach, and our goal with GEO-CVD is to help Congress better understand the important role the geosciences play in everyday life," said Curtiss, who was joined for the event by executive directors from the American Geosciences Institute, the Geological Society of America and SEPM/Society for Sedimentary Geology.

Geosciences Congressional Visits Day (GEO-CVD) is organized by AAPG in conjunction with other geoscience organizations, including the American Geosciences Institute, the American Geophysical Union, the Geological Society of America, the National Groundwater Association, the Seismological Society of America, the American Meteorological Society of America, SEPM/Society for Sedimentary Geology and the Soil Science Society of America.

Combined, these societies hosted 53 geoscientists this year who were able to reach out to their senators and representatives in 22 states and the District of Columbia – as well as professional staff from the Senate Commerce, Science and Transportation Committee, the House Science and Technology Committee, the House Natural Resources Committee and various House and Senate appropriations subcommittees that provide funding to the National Science Foundation (NSF) and the U.S. Geological Survey (USGS).

*Making an impact: AAPG members joined with representatives from other geoscience groups to participate in this year's Geosciences Congressional Visits Day.*

* * *

One of the major topics of discussion this year was the reauthorization of America COMPETES legislation, originally passed in 2007 to address the need to invest in STEM education as well as scientific research and development, to ensure that the United States is able to remain competitive globally.

Earlier this year the House passed a reauthorization of COMPETES (HR 1806) that cuts funding for NSF's Geosciences Directorate (GEO) by 12 percent from this year's funding levels.

In addition, the fiscal year 2016 House Commerce, Justice and Science appropriations bill, which provides funding for NSF, increases overall funding but would cut funding to GEO by over 16 percent.

One of the major reasons for these cuts seems to be that some House Republicans perceive the geosciences to be mainly focused on climate research.

As a result, AAPG and the other geoscience organizations with a presence in Washington, D.C., have been working hard to educate congressional staff on the diversity of disciplines within the geosciences – including oil and gas development – and the benefits of these areas to the economy and society.

GEO-CVD participants were able build upon these educational efforts by sharing their various backgrounds and experiences.

In the Senate, the Commerce, Science and Transportation Committee has signaled that it would like to write a COMPETES bill that is more palatable to the scientific community. According to staff, the Senate Commerce, Science and Transportation Committee could release a bill by the end of the year.

The primary authors of the Senate COMPETES bill are expected to be Senators Cory Gardner (R-Colo.) and Gary Peters (D-Mich.).

Having AAPG members engaged in these conversations is important because they are able to give good examples of how investments in geoscience research and education are critical to the long term success of the workforce and the economy – particularly in oil and gas producing states such as Texas, Louisiana, Colorado, Ohio and Pennsylvania.

For example, while making visits to the Texas delegation, Dreadless Stubbs made the point that many independent oil and gas companies do not have the capital to build their own scientific research laboratories, particularly in a lower price environment.

An increase in federal funding for geoscience research, therefore, would help these companies acquire technologies – such as more accurate geochemical data – to make the hydraulic fracturing process

See **Geosciene Funding**, page 43

PROTRACKS

Meredith Faber (left of center, third row back) among her fellow YPs at the recent GCAGS annual convention in Houston.

# Finding Opportunity In Downturn

By MEREDITH FABER, AAPG Young Professionals Committee Co-Chair

Nostalgia has a weird way of working into our lives.

For some, a smell might evoke a particular sentiment. A sound might cause a certain memory to bubble to the surface. Seeing a specific photo might transport some back to a point in their personal history.

A place can have nostalgic significance, too.

Field geologists have a certain affinity for the areas they study – and as much as I could count myself in that camp, my nostalgic place is far less exotic. I confess that I have affection for the giant, hulking, vaguely cruise ship-like George R. Brown Convention Center (GRBCC) in downtown Houston.

Those of you who have been to the GRBCC are probably scratching your collective heads at this point, but for me, it is a place of many firsts: In the early 1990s, my parents took me and my siblings to our very first trade show there. Much later, in 2006, I visited the GRBCC yet again for my very first AAPG ACE. I was interviewed and hired for my very first job in a GRBCC hall in 2011. Three years later, I participated in my very first technical committee as we planned ACE 2014, which was held in the GRBCC.

Finally, this past September, I had the privilege of serving as poster chair, my very first time in that role, for the 65th annual Gulf Coast Association of Geological Societies convention, which was hosted by the Houston Geological Society (HGS) and organized in none other than the GRBCC.

GCAGS 2015 was itself a meeting of firsts.

- It was the first (but we hope, not last) time the organization partnered with the AAPG-SEG Student Expo.
- It was also the first time the AAPG Young Professionals (YP) Committee has ever sponsored video games and BBQ for the sake of networking.

On the meeting's first day, YPs and students gathered outside the opening session ballroom in the GRBCC for the Young Professionals' and Students' Meet and Greet, which was generously sponsored by Chevron. Participants enjoyed appetizers and conversation before adjourning to the ballroom for the GCAGS 2015 awards presentation.

The next day, YPs also had the opportunity to attend the GCAGS 2015 social event: BBQ, Beer and Bytes – An Evening at St. Arnold's Brewery. This sold-out event combined the old-school BBQ of local favorite Gatlin's, with old-school arcade games from local shop, Joystix Classic Games and Pinballs. Attendees also enjoyed a brewery tour, networking with fellow geoscientists and giveaways courtesy of Seitel.

YP and student attendance to the St. Arnold's event was bolstered by the HGS YP group, the NeoGeos, who sponsored 20. The NeoGeos also sponsored 20 YPs who had recently been laid off to participate in one of the many GCAGS 2015 short courses.

They similarly facilitated the attendance of 20 more to the Division of Professional Affairs Luncheon during the meeting, where speaker Charles Goodson (PetroQuest) gave his thoughts on "How to Survive and Thrive in Good Time and Bad."

The current industry downturn has made the job market a daunting place for new graduates and YPs, but meetings like GCAGS 2015 provide a venue for new opportunities and professional growth – and perhaps some came away with a new fondness for the GRBCC as well.

For more information on the YP Committee and how you can get involved with YP events in your area, visit our website at aapg.org/youngpros and contact your Region or Section YP lead.

*The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer. This month's column deals with controlled-source electromagnetic (CSEM) technology impact on exploration investment decisions.*

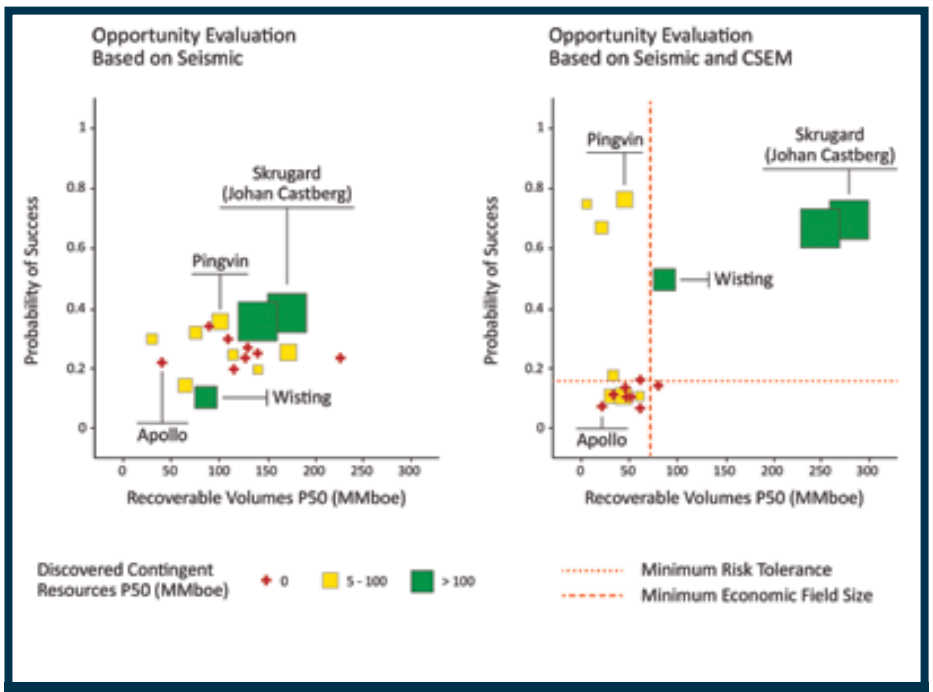



*Figure 1 – 18 Barents Sea prospect evaluations compared to well outcomes. Left: Reasonable PoS and P50 volume predictions made from publicly available seismic and geological information. Right: Updated predictions, taking the seismically-focused evaluation as a prior, and updating with 3-D CSEM information.*

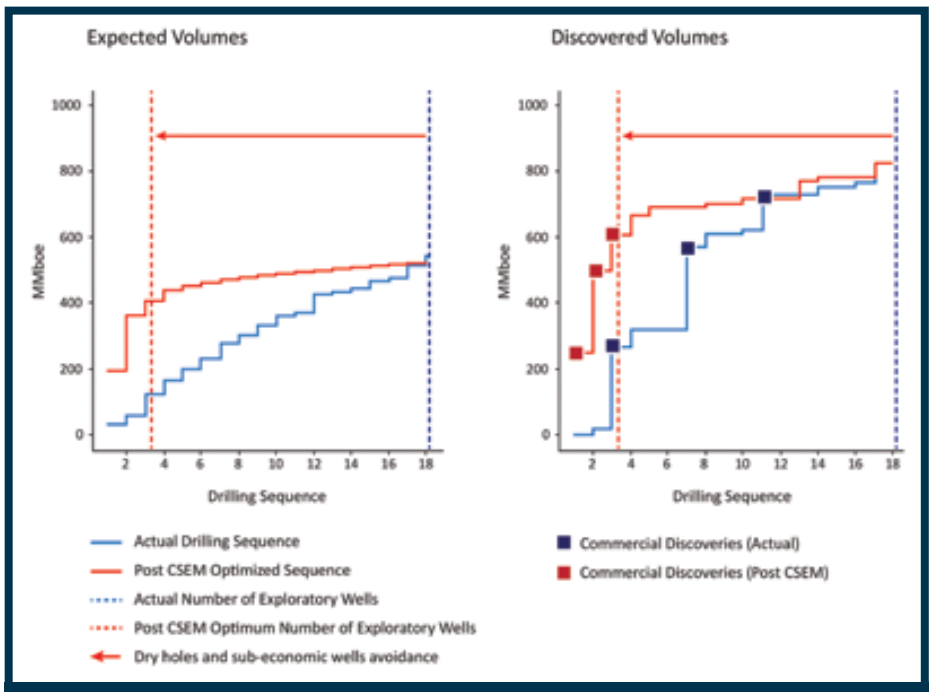



*Figure 2 – Impact of CSEM on drilling sequence and number of exploratory wells, optimized based on decreasing expected hydrocarbon volumes (left). Impact of optimized drilling sequence on actual commercial discoveries (right): A three out of three success rate for the post-CSEM sequence; three out of 18 for the actual drilling sequence.*

# Additional Data Helps Investment Decisions

By DANIEL ZWEIDLER, DANIEL BALTAR and NEVILLE BARKER

The often-volatile outcome of exploration investment decisions is tightly linked to the level of uncertainty in the geological interpretation and associated value assessment.


ZWEIDLER

In order to evaluate subsurface opportunities, information is needed. This comes at a cost, affecting the profitability of the investment.


BALTAR

Successful exploration companies carefully consider the type of information required to make their decisions, and how the information is to be utilized to minimize uncertainty.


BARKER

In this environment, the potential impact of new information has to be balanced against both its cost and the ease with which it can be embedded into existing decision-making processes.

## CSEM Technology

Seismic methods provide information about the acoustic impedance contrasts between geological layers, allowing for structural definition of geological features and depositional systems analysis. Lateral changes in acoustic impedance and amplitude-versus-offset (AVO) effects provide constraints on lithology and fluid presence.

In contrast, controlled-source electromagnetic (CSEM) technology provides information on subsurface resistivity. In sedimentary basins, resistivity is driven primarily by the quantity of brine in the sediment.

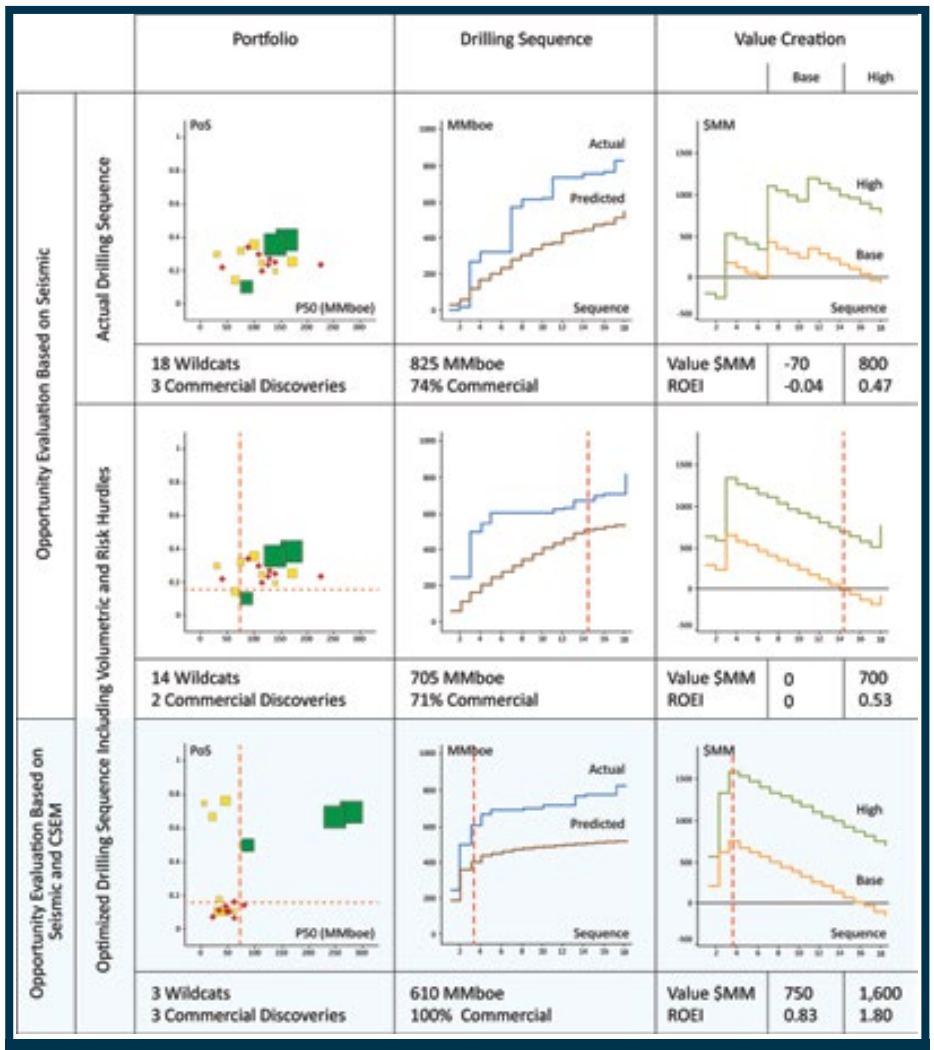



*Figure 3 – Summary of the impact of CSEM-enabled investment decisions. The original drilling sequence of 18 exploratory wells delivered three commercial discoveries, with a negative Return on Exploration Investment (ROEI) based on a 60 $/boe world. A drilling sequence based on volumes and risks updated with CSEM information would have delivered three exploratory wells for three commercial discoveries, for an ROEI of 0.83 also based on a 60 $/boe world.*

CSEM information also provides constraint on the area and anomalous transverse resistance (net thickness x resistivity contrast) of buried resistive layers.

Hence, the use of CSEM-derived resistivity has the potential to improve our understanding of both fluid distribution and the size of resistive bodies (net rock volume) in a basin.

Conveniently, fluid assessment and net rock volume are two of the largest uncertainties in the conventional opportunity-evaluation workflow; hence, CSEM can potentially reduce some of the largest known uncertainties in exploratory prospectivity evaluation.

Until recently, workflows designed for explorers to handle the CSEM information have been lacking. Instead, technical domain experts have tended to focus on integration approaches designed for lower-uncertainty environments.

This is now changing as Baltar and Barker describe in their 2015 article – "Prospectivity Evaluation with CSEM" – for First Break magazine.

## Impact on Investment Decisions

The authors had the good fortune of having access to a best-in-class CSEM dataset in order to analyze its realistic value potential today. The said dataset, from the Norwegian sector of the Barents Sea, covers 18 wells drilled in the period 1988-2015, with half from 2013-14, and only one prior to 2007.

When looking at economic considerations, three of the drilled prospects were arguably successful; all others turned up dry or well below a reasonable economic size.

A quantitative evaluation of the covered prospects based on geological and seismic information leads to a portfolio without obvious clustering (figure 1, left plot).

Baltar and Barker's 2015 article outlined an interpretation workflow designed to integrate the CSEM information into a "seismic technology" portfolio such as this. The approach is based on a Bayesian update to the risk assessment (as widely used in industry for AVO, fluid seeps and other direct hydrocarbon indicators), extended into a coupled risk/volume update in order to account for, and leverage, the additional volumetric sensitivity of the CSEM information.

Resistivity volumes derived from CSEM data-driven processing (rather than a more complex product, integrated at the data level) are used as input in order to maximize transparency of information uncertainties and minimize

Continued on next page

Continued from previous page

the risk of interpretation bias. When trained explorers applied this workflow, the portfolio of opportunities now exhibits clear polarization and clustering (figure 1, right plot).

What would happen if we could wind back time and optimize the drilling sequence based on this new portfolio evaluation (figure 2)?

Answer: The first three wells to be drilled would be commercial discoveries; any subsequent wells (which should not be drilled based on reasonable risk and volumetric hurdles) would be dry or technical discoveries.

From an exploration efficiency perspective we are looking at drilling three instead of 18 wells with the same overall commercial success.

One could argue that this comparison is unfair, as the original sequence could never be optimized in this fashion due to license timing and well commitments.

In order to address this argument and quantify the potential impact of consistent use of CSEM at a portfolio level, we have calculated the return on exploration investment (ROEI – defined as the net present value divided by the exploration and appraisal investments) for three alternative drilling sequences (actual, optimized without CSEM, and optimized with CSEM) and two oil price scenarios ($60 and $80 per barrel).

Out of the three sequences, only the CSEM portfolio delivers a return above parity in both price scenarios (figure 3).

### Conclusions

CSEM technology has grown from its initial research form into a commercial tool with at least one clear value proposition: Known exploration uncertainties can be reduced with the combination of regionally extensive 3-D CSEM information and appropriately trained explorers.

Illustrated here with a dataset from the Barents Sea, the authors have witnessed similar performance in a range of settings globally. We have demonstrated the impact-potential on investment decisions, which has a corresponding effect on exploration capital efficiency.

Harder to quantify is the additional value-potential through reductions in unknown exploration uncertainties, such as hitherto-overlooked play models and missed leads.

The biggest challenge now lies with oil companies, who face the prospect of adapting their exploration workflows and training their people to harness this potential.

Arguably this would be the biggest step-change in the way exploration should be conducted in decades; and like any process change it may be hard to implement, but will undoubtedly be exciting.

Nimbler companies will enjoy the improved capital efficiency. Others may find themselves playing catch-up with this maturing technology.

*(Editor's note: Daniel Zweidler is president of DZA Inc, Ambler, Pa., and Senior Fellow, Mack Institute for Innovation Management, The Wharton School, University of Pennsylvania; Daniel Baltar and Neville Barker are with EMGS in Oslo, Norway. All are AAPG members.)*

## Geoscience Funding
from page 40

more efficient and cost effective.

Although geoscience funding was a major topic of discussions, many AAPG members also discussed other hot topics impacting the energy industry during their meetings, including legislation moving through the House and Senate that would lift the ban on oil exports.

AAPG Honorary member Skip Hobbs visited with offices in Connecticut and Massachusetts, which are generally not supportive of the oil and gas industry – but in those meetings he found that many of these offices were open to considering some type of legislation addressing oil exports.

In addition to its participation in GEO-CVD, AAPG also holds a two-day CVD in the spring. Both events offer AAPG members excellent opportunities to cultivate relationships with congressional staff.

Participants also have been able to offer themselves as impartial and reliable resources for congressional staff that are looking for technical information on key issues impacting the oil and gas industry.

In the upcoming AAPG CVD, participants once again will have the opportunity to discuss energy policy issues with their senators, representatives, committee professional staff, the Congressional Research Service and federal agencies, including the U.S. Department of Energy and the U.S. Department of Interior (both the Bureau of Ocean Energy Resources and USGS).

And please note, we welcome non-U.S. AAPG members to attend AAPG-CVD. Energy policy is global, and policy decisions made by one country impact others.

Also, U.S. policymakers are interested in global energy policy developments and their implications for the United States. Last year, for example, we had two AAPG members from Canada participate who were able to arrange a meeting with the Canadian Embassy to discuss issues such as Keystone pipeline and oil sands.

If you would be interested in participating in AAPG's upcoming CVD in March, please feel free to contact either of us on the GEO-DC team: Edie Allison, at Eallison@aapg.org, or Colleen Newman, Cnewman@aapg.org.

# Geology's All Stars Lined Up For Distinguished Lecture Tours

By BARRY FRIEDMAN, EXPLORER Correspondent

The AAPG Distinguished Lecturers, as the name suggests, represent a program that offers the best and brightest of today's geoscientists, practitioners and big thinkers who are brought together with the next generation of leaders – geology students and young professionals, as well, as seasoned professionals who are members of Geological Organizations by way of a special lecture series presented throughout the world.


JACKSON

It is a tour, in a sense, of geology's all stars.

Established in 1941, the program is now involved with more than 500 affiliated societies and universities around the world.

For the past two years, it has been the job of two men – Matthew D. Jackson (Total Chair in Geological Fluid Mechanics at Imperial College in London), and R. Craig Shipp (geohazards assessment team leader for Shell International E&P Inc. in Houston) – to manage the proceedings.

Aided by a stellar committee of past Distinguished Lecturers and experts in academic, government and industry fields, these two sift through the vast number of qualified people in various disciplines to establish nothing less than a Who's Who in the industry.

> "The Distinguished Lecture Series is a great way to advertise the industry and the Association."


SHIPP

### Choosing the Team

Shipp, who has been involved with the program for the past five years and its co-chair for the past two, wants to clear something up first about the process: there is no application process.

"You don't volunteer. You do nothing. You are asked by the committee, because someone has seen your work," he said.

Which is just the first step.

"The committee members nominate candidates by providing evidence as to why these people should be included in the nomination list."

"The committee members," Shipp said of the committee, " have an interest in the potential lecture topics; they have been around in these areas – many are former Distinguished Lecturers themselves – and they nominate only those whom they believe are worthy."

Three finalists in each of 12 categories are chosen and are then voted on by the entire committee. The committee members then vote on the nominated candidates by a secure online vote, which automatically tabulates the results; afterwards, the DL co-chairs review the results and name the DL's, breaking any tied nominations by reviewing the nomination comments.

And the categories are as diverse as the people chosen to represent them. (See accompanying story, next page.)

Of the chosen Distinguished Lecturers, Shipp said the committee focuses on the work, not the flash.

"Frankly, controversial people that are out there saying things that are not supported by a lot of good work are not generally going to be nominated," he said. "We're looking for well-documented relevant, important work."

That's because the audience to whom the Distinguished Lecturers speak is a specific one.

"We're talking about geological societies and university students. That's the demographic, so, frankly, this list doesn't pick up a lot of people on the very edge of things."

Shipp believes it gives students a look into the future by showing them the present and the past.

"The Distinguished Lecture Program shows students that there are people doing the work. This is the stuff that people do. These are the issues. It's where they get the exposure to those in the mix," he explained.

He also knows there are benefits to organizations like AAPG.

"The Distinguished Lecture Series is a great way to advertise the industry and the Association," he said.

Shipp sees all the possibilities and challenges yet to be fully realized. He understands that together, all the specialization makes it work.

When asked, as the industry moves forward, whether it's the "vision guys" or the "nuts and bolts guys" who will be leading the conversation as we move through the 21st century, he answered, "Man, I just don't think you can have one without the other. And, frankly, we have both."

Shipp is, by definition, a "future trends" guy.

To some extent, though, doesn't everyone in the industry have to be?

"I clearly don't disagree with you," he answered.


CANTRELL


DORE


FERRILL


GARMEZY


HAMPSON

# 2016 Distinguished Lecturers

By VERN STEFANIC, AAPG EXPLORER Managing Editor

The AAPG-AAPG Foundation Distinguished Lecture program, the Association's flagship initiative for sharing the latest in scientific thought, concepts and advances, starts its new season in November with a lecture tour of North America.

But that's just the first step of an ambitious schedule for the 2015-16 season that will send speakers to each of AAPG's Regions – Africa, Asia Pacific, Canada, Europe, Latin America and the Caribbean and Middle East.

The season starts with a tour by Distinguished Lecturer **John Holbrook**, with Texas Christian University, Fort Worth, Texas, who will tour western North America Nov. 9-13, and eastern North America April 18-29.

He offers five lectures:

✓ "A Tale of Earthquakes Past and Yet to Come: A Cautionary Account of New Madrid Faulting from the Mississippi River."

✓ "Funny Things Meanders Do: Process and Variability in Modern and Ancient Point Bars."

✓ "Time In the Rock: A Fluvial View Toward Preservation of Time and Process in the Stratigraphic Record."

✓ "New Views on Old Surfaces and the Evolving Evolution of the Sequence Stratigraphic Paradigm."

✓ "Connectivity Within and Between Channel Belt Reservoirs: A Trip Down the Mississippi."

The season's slate of speakers also includes:

**Dave Cantrell**, of Saudi Arabian Oil Co., Dhahran, Saudi Arabia, who is this year's Roy Huffington Distinguished Lecturer.

Cantrell will tour the Asia-Pacific Region Feb. 2-20, offering five lectures:

✓ "New Tools and Approaches In Reservoir Quality Prediction."

✓ "New Tools and Approaches in Carbonate Reservoir Quality Prediction: A History from the Shu' Aiba Formation, Saudi Arabia."

✓ "Dolomites: The Good, the Bad and the Ugly in Carbonate Reservoir Performance."

✓ "Microporosity in Arab Formation Carbonates."

✓ "Digital Outcrop Models: A Tool for Reservoir Characterization and Teaching."

**Tony Dore**, with Statoil, London, England, who will tour the Europe Region April 18-29, offering two lectures:

✓ "North Atlantic Extension and Break-Up: Challenges, Controversies and Implications."

✓ "The Arctic: A Tectonic Tour Through the Last Great Frontier."

**David Ferrill**, with the Southwest Research Institute, San Antonio, who will tour eastern North America Jan. 25-29, and western North America April 4-8.

He offers two lectures:

✓ "Mechanical Stratigraphy and Normal Faulting."

✓ Mechanical Stratigraphic Controls on Fracturing (Jointing) and Normal Faulting in the Eagle Ford Formation, South-Central Texas."

**Larry Garmezy**, retired from Shell Global Exploration, Houston.

Garmezy, this year's Shell Distinguished Lecturer, will tour western North America in March and eastern North America in April, offering two lectures:

✓ "Play-Based Exploration: Applying Depth and Breadth of Geoscience Understanding."

✓ "The Similarities and Differences in the Hunt for Unconventional and Conventional Hydrocarbons."

**Gary Hampson**, reader in sedimentary geology for the Department of Earth Science and Engineering at Imperial College in London, England.

Hampson, this year's Allan P. Bennison Distinguished Lecturer, will tour Africa Feb. 22-March 9, offering two lectures:

✓ "Outcrop-Based Reservoir Models: Fieldwork-Derived Numerical Laboratories to Constrain and Mitigate Subsurface Uncertainty."

✓ "Reinterpretation of Sea-Level-Driven Stratigraphic Architectures as the Product of Autogenic Behaviors and Variations in Sediment Flux."

**Barney Issen**, with Chevron in Houston, is both this year's J. Ben Carsey Distinguished Lecturer and the AAPG/SEG Inter-Society Distinguished Lecturer. His tour dates are yet to be announced, and he will be offering three lectures:

✓ "Rethinking the Goals and Methodology of 3-D Seismic Interpretation."

✓ "What You Will Do in Your Career Hasn't Been Invented Yet."

✓ "Technology and Innovation Are the Engines That Create Exploration Opportunities: Examples From the Deepwater Gulf of Mexico."

**Jeroen Kenter**, with ConocoPhillips in Houston, this year's Haas-Pratt Distinguished Lecturer, will tour the Middle East Region in March, offering two lectures:

✓ "Carbonate Petrophysical Rock Typing Road Map: Flexible and Fully Integrating Geological Attributes, Petrophysical Properties and Dynamic Behavior."

✓ "So Different, Yet So Similar: Comparing and Contrasting Siliciclastic and Carbonate Slopes and Predicting Mineralogy and Texture Ahead of the Drill."

**Tim Lawton**, of the Universidad Autonoma de Mexico in Queretaro, Mexico, and this year's Dean A. McGee Distinguished Lecturer.

Lawton will tour the Latin America Region Feb. 7-20 and April 17-30, offering four lectures:

✓ "The Emerging Story of Jurassic Magmatism and Basin Development, Southern U.S. Cordillera and Mexico."

✓ "Monsoonal Megafans and Large-Scale Late Cretaceous Stratal Architecture

See **DL Tours**, page 47

*Editor's note: Regions and Sections is a regular column in the EXPLORER offering news for and about AAPG's six international Regions and six domestic Sections. For information and questions involving the Asia Pacific Region contact Adrienne Pereira, programs manager, at apereira@aapg.org.*

# Despite Oil Prices, Middle East Geoscience Moving Forward

By ROBERT KUCHINSKI, AAPG Middle East Region President

As we move into the final quarter of 2015, the global oil and gas industry continues to readjust to the ongoing softness of world oil prices.

While the current slump in oil prices has created uncertainty and hardships for many geoscientists in the industry, the AAPG is working not only to assist members with career programs to reduce the pain of redundancy, but also to support members seeking to develop their careers as geoscientists.

In the Middle East, massive oil and gas reserves aside, the industry also has had to make adjustments to cope with this new price environment. Despite this current malaise, the AAPG in the Middle East continues its mission to promote this region as the global center of excellence for petroleum geology.

With the expectation that the last barrel of oil produced on the earth will come from the Middle East, the talent, technology and techniques to do this will possibly be shaped by the industry in the Middle East. This exciting prospect drives the AAPG in the region to deliver high-quality and relevant learning opportunities to the geoscience community in the Middle East.

In doing so, the AAPG also endeavors to shape the geoscience community in the region.

A good example of this is the strength and energy of student and Young Professional involvement in AAPG activities. This strength and energy were highlighted by the third-place finish by the team from King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia, at the global AAPG/AAPG Foundation's Imperial Barrel Award competition held in May at ACE in Denver. This was the fourth time in six years a team from the Middle East finished in the top three in the global competition. Congratulations to Mohammed Al-Bahrani, Ardiansyah koeshidayatullah, Muhammed Hammad Malik, Faisal Al-Shuhail and their faculty adviser – Khalid Ramadan, for their tremendous efforts.


*The team from King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia, at the global Imperial Barrel Award competition held in May at ACE in Denver.*

The success of the Middle East teams at this prestigious international event confirms the preeminence of petroleum geoscience in the Middle East.

The factors responsible for this success can be linked to the following:

- Geoscientists in the Middle East get to work on the largest oil and gas fields in the world. These fields, which will continue to produce well into the future, will benefit from the latest technical innovation to ensure maximum recovery.
- The Middle East has outstanding sedimentary geology and a complete geologic column. Geoscientists in the Middle East are able to view much of this column in surface outcrops that are mostly free of feature-covering vegetation.
- The Middle East has extremely prolific carbonate reservoirs. Geoscientists in the Middle East can work on these difficult-to-understand reservoirs with many of the top global experts in carbonates.
- The transition of many Middle East countries to knowledge-based economies has seen an extensive investment into post-secondary education. New universities in the Middle East bring new facilities to grow the instruction of petroleum geology.

The points listed above are the pillars that support AAPG's strategy and vision in the Region. Over the coming months and years this vision will guide AAPG in ensuring geoscientists in the Middle East have access to high-quality learning and networking opportunities.

The AAPG believes these opportunities also will benefit geoscientists from all corners of the world.

To illustrate this, the technical program for GEO2016 (the largest geoscience conference in the Middle East to be held in Bahrain in March 2016) promises to be extremely rich. A record number of 625 abstracts were received for this event from more than 37 countries around the world.

So while the industry adjusts to the new oil price environment, the AAPG continues to promote the Middle East as the global center of excellence for petroleum geology, where geoscientists from around the world can learn and expand their knowledge.

## PROFESSIONAL newsBRIEFS

**Joan Barminski**, to pacific regional director, U.S. Bureau of Ocean Energy Management, Camarillo, Calif. Previously regional supervisor of the Pacific Region Office of Strategic Resources, U.S. Bureau of Ocean Energy Management, Camarillo, Calif.

**Sharma Dronamraju**, to director, AKD Professional Solutions, Houston. Previously senior geoscientist, Petrobras, Marathon Oil, Houston.

**Tom Earley,** to new country entry adviser, Steamboat Springs, Colo. Previously country manager, ConocoPhillips, Dhaka, Bangladesh.

**Donna Goldstein** has retired from Anadarko Petroleum in Denver. She will reside in Westminster, Colo.

**Stuart Harker**, to director, Morningside Petroleum Geology Consultancy, Edinburgh, Scotland. Previously vice president geology, Circle Oil, Finchampstead, London.

**Jay Mitchell**, to managing director, ORIX Energy Capital, Dallas. Previously director-oil and gas, CLG Energy Finance, Plano, Texas.

**Ross Peebles** has been selected as interim CEO of Global Geophysical Services, Houston. Previously senior vice president and chief operations officer-North America, Latin America and Eastern Hemisphere, Global Geophysical Services, Houston.

**Robert Strauss**, to adjunct professor geology, Dallas Baptist University, Dallas. Previously exploration team lead, Nexen Petroleum, Houston.

**Paul Wagenhofer** has retired as chief geophysicist, New Zealand Oil and Gas, Wellington, New Zealand. He will be a consultant in South Burlington, Vt.

*(Editor's note: "Professional News Briefs" includes items about members' career moves and the honors they receive. To be included, please send information in the above format to Professional News Briefs, c/o AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101; or fax, 918-560-2636; or e-mail, smoore@aapg.org; or submit directly from the AAPG website, www.aapg.org/explorer/pnb_forms.cfm.)*

## Watkins Wins GCAGS A.I. Levorsen Award

AAPG member Elizabeth A. Watkins, with Petrobras America, Houston, has won the A.I. Levorsen Memorial Award for the best paper presentation at the recent Gulf Coast Association of Geological Societies annual meeting.

She won for the paper "A Geology-Based, Non-Seismic Attribute Method to Generate Facies, Lithology and Petrophysical Parameters in the Chinook and Cascade Fields, Walker Ridge, Gulf of Mexico."

She'll be recognized at the next GCAGS annual meeting, set Sept. 18-20 in Corpus Christi, Texas.

## DL Tours

from page 45

in the Southern Cordilleran Foreland Basin, United States," or "Late Cretaceous Fluvial Systems in the Southern Cordilleran Foreland Basin, USA, as a Consequence of Thrust-Belt Development and Monsoonal Climate."

✓ "Sediment-Dispersal Systems of the Mexican Interior Basin: Late Cretaceous-Paleogene Source-to-Sink Analysis of Northern and Central Mexico."

✓ "Early Permian Erg Deposits, Paradox Basin, Utah: A Large-Volume Sink for Sediment Delivered to Western Pangea by Transcontinental Rivers."

▸ **Pete Rose**, consultant based in Austin, Texas, is this year's AAPG Ethics Lecturer, and will tour upon request.


ISSEN


KENTER


LAWTON


ROSE


WELLNER

His subject is "Cognitive Bias, the 'Elephant in the Living Room' of Science and Professionalism."

▸ **Julia Wellner**, of the University of Houston, will tour western North America Jan. 25-Feb. 5, and eastern North America March 7-18.

She offers three lectures:

✓ "Antarctica's Sedimentary Archives of Past Glacial History: Tools for Understanding Climate Change."

✓ "Antarctic Geologic Drilling Programs: Field Work in Extreme Environments and Preparing for the Next Drill Site."

✓ "Marine Geological Record of Ice Retreat in the Antarctic Peninsula since the Last Glacial Maximum."

For specific dates, lecture sites or to reserve your speaker today visit the Distinguished Lecturers page within the Career Section of the AAPG website; or contact AAPG Distinguished Lecture coordinator Lorry Oldefest, at 918-560-2621.


# A Look Back at ICE 2015

**By BRIAN ERVIN, EXPLORER Assistant Managing Editor**

This year's AAPG-SEG International Conference and Exhibition (ICE), held for the first time ever in Melbourne, Australia, was by all accounts a technical and networking success.

Despite the daunting challenges currently faced by the industry, the event drew nearly 1,400 of the world's best and brightest geologists, geophysicists and engineers from about 40 different countries, who ranged from students and young professionals to seasoned veterans of the industry.

Hosted by the AAPG Asia Pacific Region, SEG, the Australian Society of Exploration Geophysicists (ASEG), the Petroleum Exploration Society of Australia (PESA), the conference incorporated PESA's Eastern Australasian Basins Symposium (EABS), which featured recent advances in the understanding of petroleum basins along Australia's eastern margin and across the Tasman Sea to New Zealand.

Highlights included:

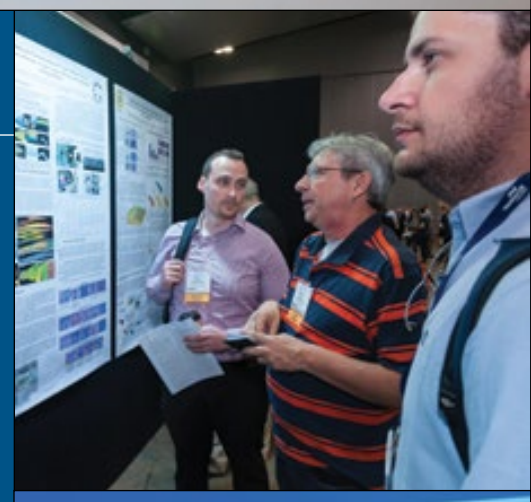
- The opening ceremony, with ICE 2015 General Chair Phil Loader of Woodside Energy serving as master of ceremonies.
- Ian Macfarlane, Australia's Minister for Industry and Science, sharing insights during the plenary session.
- The Reg Sprigg Memorial Symposium, which detailed Australia's major petroleum provinces.
- Discovery Thinking forums.
- The Marita Bradshaw Symposium I and II, honoring the career of recently retired Marita Bradshaw.
- A special talk by renowned "rock star," geologist and television personality Iain Stewart at the featured speaker luncheon.

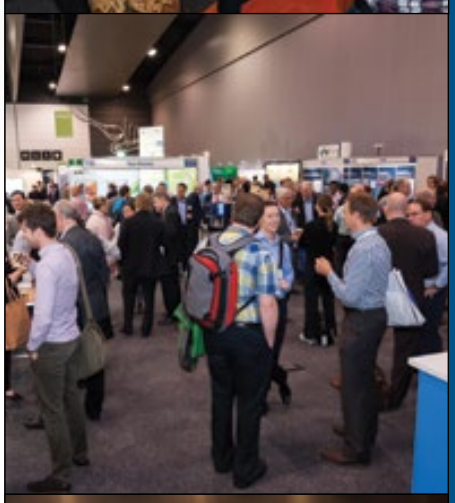
The Melbourne meeting was the first ICE held under the collaborative efforts of AAPG and SEG, a joint venture designed to co-present ICE around the globe in order to provide members and the greater global oil and gas industry with the highest level of geosciences information and data exchange opportunities.

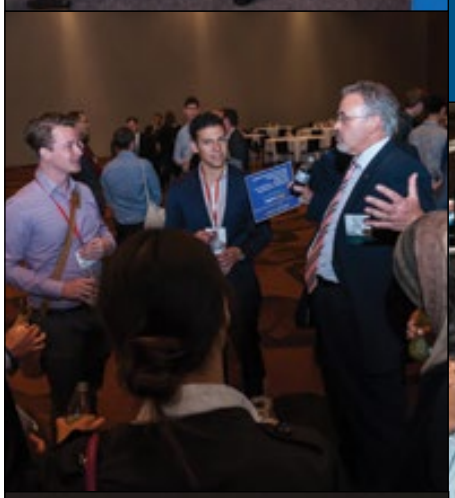
There will be two ICE events in 2016:

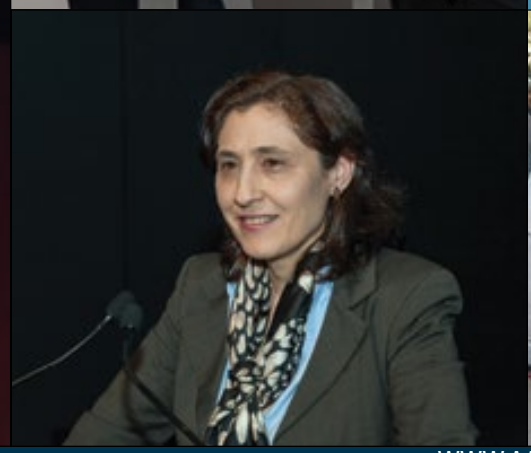
- April 3-6, in Barcelona, Spain.
- Sept. 6-9, in Cancun, Mexico.

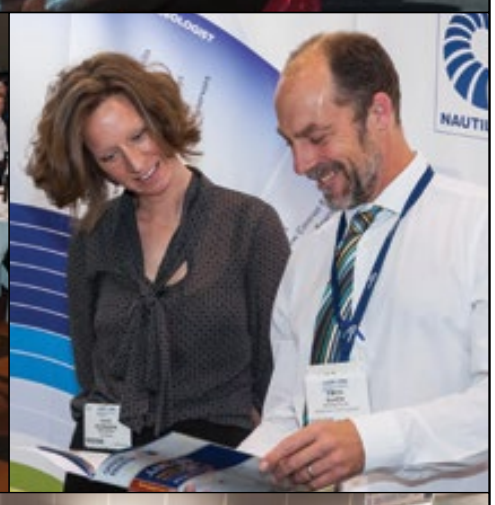
For more information on these meetings go to www.aapg.org/events/conferences/ice. E











AAPG Africa Region | SHORT COURSE

## Sequence Stratigraphy: Concepts Principles & Applications to Clastic Depositional Environments

22-24 February 2016 | Lagos, Nigeria

### Who Should Attend?

The course is designed for geoscientists, geophysicists, biostratigraphers and engineers needing a fundamental understanding of the principles and applications of sequence stratigraphy, and to apply them to exploration and production projects. The course also will benefit graduate students interested in learning the principles, concepts and methods of sequence stratigraphy.

### Course Summary

Sequence stratigraphy provides a framework for the integration of geological, geophysical, biostratigraphic and engineering data, with the aim of predicting the distribution of reservoir, source rock and seal lithologies. It gives the geoscientist a powerful predictive tool for regional basin analysis, shelf-to-basin correlation and characterization of reservoir heterogeneity. This course will examine the underlying geological principles, processes and terminology related to sequence stratigraphic interpretation. The strength of this course is the application of these basic principles to subsurface datasets in a series of well-founded exercises.

### Course Content

- Basic concepts and terminology of sequence stratigraphy.
- The stratigraphic building blocks of depositional sequences.
- Recognition criteria for the identification of depositional sequences and their components in outcrops, cores, well logs and seismic data.
- Controls on sequence stratigraphic architecture.
- The application of sequence stratigraphy in siliciclastic non-marine, shallow-marine and deepwater depositional settings.
- Exploration and production case histories and strategies.

*For more information, contact Delia Kuye, Programs Manager, AAPG Africa Region*
**+234 (0)8094704599 • dkuye@aapg.org**

AAPG Asia Pacific Region | Geosciences Technology Workshops 2016

## *Characterization of Asian Hydrocarbon Reservoirs*

31 March – 1 April 2016
Bangkok, Thailand

**Workshop Themes**
1. Low Permeability Reservoirs
2. Clastic Reservoirs
3. Non-Clastic Reservoirs
4. Enhanced Recovery

**Who Should Attend**
Geologists, Geophysicists, Reservoir Modelers, Sedimentologists, Petrophysicists, Reservoir Engineers, Team Leaders and Managers – especially those working in the Asian Region

**Benefits of Attending**
This workshop provides the opportunity to learn and discuss the latest ideas and technologies applied to Asian petroleum reservoirs which can be utilized to explore for and develop these reservoirs. The workshop provides a setting for networking and sharing of experiences with fellow petroleum scientists interested in developing and producing the hydrocarbon resources of Asia.

**http://aapg.to/aprgtw2015bangkok**

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# Trustee Associates Gather in Colorado Springs

By KRISTI EATON, EXPLORER Correspondent

More than 60 AAPG Foundation Trustee Associates and their guests traveled to Colorado Springs recently for the 38th annual Trustee Associates meeting, which mixed business, networking and relaxation.

Trustee Associates Chairman Stewart Henry selected the Broadmoor Hotel in Colorado Springs as the site for the event, which ran Sept. 9-12.

"I think everyone really liked it," Henry said. "The Broadmoor is on everyone's list of top 10 resorts in the country – it's really famous."

Nearly 100 years old, The Broadmoor features golf courses, tennis courts, indoor and outdoor pools, shops, spas and more, and has hosted celebrities, politicians and sports stars. The hotel is a member of the National Trust for Historic Preservation's Historic Hotels of America.

The meeting followed the same successful schedule as in past years, Henry said. It started with a party on the evening of Sept. 9.

The following day began with a short business meeting where Bob Esser gave a short talk about the oil prices and the economy. Foundation Trustee Chairman Jim Gibbs and Executive Director David Curtiss provided updates on Foundation activities and programs, including the recently created U.S. Military Veterans Scholarship, followed by a day of golf and dinner and another day of off-site activities to various locations.

"It's usually just a fun meeting," said Henry, who added that a highlight for him was the Saturday evening dinner and awards banquet.

A Dallas-based investment group updated the Trustee Associates on the Foundation's assets and investments, Henry said. Another presentation featured the group Geologists Without Borders, an organization that supports humanitarian work around the world. Foundation awards and the Trustee Associates were updated on the distribution of scholarships, including the recently created U.S. Military Veterans Scholarship.

But the meeting wasn't all work and no play. As part of the activity selection, the Trustee Associates and their guests could choose from a variety of attractions, including the U.S. Air Force Academy Cadet Chapel – a modern architectural marvel housing several different religious worship sites; an active mine; or they could stay close to the area and focus on their golf game.

"There's a lot to do in the immediate area, and we always play golf, and, of course, the golf courses are right there so we didn't even need to take a bus anywhere," Henry said.

Continued on next page

*A geology field trip to the nearby Garden of the Gods was just one of the activities on offer at the recent AAPG Foundation Trustee Associates gathering in Colorado Springs, Colo.*

*Trustee Associates Chairman Stewart Henry delivers some remarks at one of the business meetings.*

Continued from previous page

A closing dinner on Saturday evening capped off the event.

Next year's Trustee Associates meeting is scheduled for Oct. 19-23 at the Mauna Kea Beach Hotel in Hawaii. In 2017, the Trustee Associates will head to Rockport, Maine.

* * *

The Trustee Associates are the Foundation's major donor group and the annual meeting provides the Foundation with the opportunity to update the group on programs and activities, and acknowledge and thank the Trustees for their support of the Foundation, said Tamra Campbell, administrative coordinator for the AAPG Foundation.

"Many in the group not only support the Foundation financially through donations, but volunteer their time to serve the Foundation on various committees," Campbell said. "Along with getting updates on the Foundation business, the Trustee Associates have the opportunity to catch up with old friends and make new ones. It was a great week filled with great conversation and laughter."

Established in 1967, the AAPG Foundation works to create and execute scientific and educational opportunities through tax-deductible gifts and contributions from AAPG members and corporate entities. The AAPG Foundation Trustees started recognizing a distinguished group of donors known as Trustee Associates in 1978.

Requirements to become a Trustee Associate include being invited by three Trustee Associates and contributing $15,000 to the AAPG Foundation over a five-year period.

There are more than 280 Trustee Associates today who support the AAPG Foundation, provide counsel and leadership, support fundraising efforts and guide the scientific and educational agenda. The Trustee Associates help support more than 30 funds and programs and are governed by bylaws.

At the end of the 2015 Trustee Associates meeting, a new group of officers took over. Richard D. Fritz is now chairman, Larry Jones is vice-chairman and Peter MacKenzie is secretary-treasurer.

## Foundation Contributions for September 2015

**General Fund**

Christopher D. Althoff
Jason J. Asmus
Ray L. Bellande
Don M. Brown
C. Hobson Bryan III
Chevron Matching Employee Fund
*Matching gift/by Jeffery A. Nunn*
John M. Cockrane Foundation of Columbus
*In memory of John M. and Anne H. Cochrane*
John R. Copland
Chris J. Donofrio
Michael J. Dropkin
Lynne Feldkamp
*In memory of Robert M. Sneider*
James M. Funk
Wayne P. Johnson
Kenneth E. Lake
Marathan Oil
Richard V. Martin
Jay P. Mitchell
Richard P. Mott
William H. Nichols
Kazuhiro Ogawa
Richard E. Paige
Mike A. Pentilla
Steven B. Savage
Theresa F.F. Schwarzer
Paul M. Strunk
Robert E. Tehan
John M. Yater
Yu Ye

**Digital Products Fund**

Chevron Matching Employee Fund
*Matching gift/Jeffery A. Nunn*

**Distinguished Lecture Fund**

*J. Ben Carsey Distinguished Lecture Fund*
Dorothy C. Sumner

Education Fund
Chris J. Donofrio

Grants-in-Aid Fund

*Bernold M. "Bruno" Hanson Memorial Environmental Grant*
Dorothy C. Sumner

*Classen Family Named Grant*
Willard J. Classen Jr.

*Edward B. Picou Jr. Named Grant*
Chevron Matching Employee Fund
*Matching gift/Jeffery A. Nunn*
Christopher L. Coughenour
Paul H. Dudley Jr.
*In memory of Jeffry Chuber*

*J. Ben Carsey Sr. Memorial Grant*
Dorothy C. Sumner

*Kenneth O. Stanley Memorial Grant*
Chris J. Donofrio

*Marta S. Weeks Named Grant*
Marta S. Weeks-Wulf

*Sherman A. Wengerd Memorial Grant*
Anne W. Riffey

*Wallace E. Pratt Memorial Grant*
Dorothy C. Sumner

**Michel T. Halbouty Lecture Fund**
Chris J. Donofrio

**James A. Hartman Student Leadership Summit Fund**
Chevron Matching Employee Fund
*Matching gift/Richard Ball*

**Military Veterans Scholarship Fund**
Paul H. Dudley Jr.
*In memory of Rex Ulricksen*
Sarah Springer and Rusty Riese
Charles and Janet Rubins
*Grant from The Rubins Family Charitable Fund at Vanguard Charitable*

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

## INMEMORY

Modesto Armando Caballero Sr., 89
Mendoza, Argentina, Sept. 19, 2015

Robert Michael McMullen, 67
Winnipeg, Canada, Oct. 26, 2003

Phillip Lloyd Ryall, 81
Bakersfield, Calif., Aug. 20, 2015

*(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.)*

# GeoCare Open Enrollment

AAPG is pleased to provide an excellent resource for those looking to change major medical insurance strategies during 2016. As in the past two years, AAPG's GeoCare Benefits Members' Private Medical Insurance Exchange is available to offer research and assistance toward obtaining the coverage that best suits personal needs and budgets.

If you employ a staff of fewer than 50 employees and do not offer group major medical insurance, the Exchange can also be a resource for your staff. Membership in AAPG is not a requirement for obtaining major medical coverage through the Exchange.

Open enrollment is a period during which new coverage or changes to existing coverage can be obtained without exclusions for pre-existing conditions. For coverage going into effect on Jan. 1, 2016, the open enrollment period began Nov. 1 and continues through Jan. 31 – plenty of time for you to review your current coverage and look into any changes you want to pursue, such as a change in plan or deductible.

For individuals experiencing the termination of their current major medical insurance on Dec. 31, the open enrollment period runs through Feb. 29, 2016.

Individuals may also qualify for special enrollment periods outside of open enrollment if they experience certain qualifying events, such as moving to a new state, certain changes in income and changes in family size (for example, marriage, divorce or the birth of a baby). Dependents turning 26 also fall into this category.

The Members' Private Medical Insurance Exchange provides a marketplace where you can choose from multiple plan designs, options, and premium rates available in your state from a variety of insurance companies. The Exchange employs fully licensed agents, readily available to chat with online or over the phone, to answer any questions or help walk you through the enrollment process.

To ensure that members are assisted in any way necessary without a hitch during open enrollment, the Exchange will have additional agents available and as last year, hours will be extended to accommodate late in the day and weekend enrollment or questions.

For more information go to geocare.saleslinkportal.com, or call 1-877-739-7845 to talk to an agent and get your profile started over the phone.

Once you've logged onto the Exchange and established your profile, any plans researched can be saved so you can come back any time without feeling as though you are starting over.

If you have questions about this or any of the other coverages offered through AAPG's GeoCare Benefits Insurance Program, please visit geocarebenefits.com/aapg, or contact Melissa Hughes or Virginia Thaemert at Creekmore Livingston Inc., at 1-941-639-3333.

## Production Rates

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### Economic Factors

Defining the magnitude of the resource is an important step in the path to commerciality, but for commercial development to proceed, prospect evaluation factors must be understood. These include the same issues as with any gas development: production rates, decline rates, ultimate recovery per well, capital expense (CAPEX) and operating expense (OPEX).

These factors are complicated by the requirement that NGH, a solid material, be converted (dissociated) to gas in the subsurface prior to production. This may be accomplished by any of several methods including depressurization and thermal stimulation. Every dissociation method entails an energy cost that factors into economic evaluations.

In March 2013, Japan conducted a drillstem test at Nankai, sustaining a rate of 700,000 cubic feet/day for six days with dissociation achieved with a downhole electric pump. Extended tests are planned for 2016 and 2017. Commercial production is anticipated within a few years and India may follow soon after.

The Nankai results will answer many of the questions about production rates, production declines and OPEX. Current models indicate that production from NGH reservoirs may attain reasonably high production rates and maintain those rates for years or even decades. But the issue of CAPEX also must be addressed for NGH to move forward as a viable commercial energy resource.

Even with high production rates and low OPEX, the use of current deepwater drilling and production systems makes NGH commercially unrealistic, except by those nations willing to pay a premium for energy security.

Given that the NGH resource occurs in sediments within the upper kilometer beneath the seafloor, the high-capacity systems used in deepwater operations are not needed. New technology is emerging that uses lighter materials, seafloor-based facilities and ROVs. These have the potential to bring the economics of NGH development in line with other gas resources.

* * *

Much is going on in the field of natural gas hydrate. To stay informed as development continues to move forward, the Energy Minerals Division website will have information available for EMD members – and EMD membership is free for AAPG members.

Join and check out information on all of the EMD commodities:

- Shale Gas and Liquids.
- Bitumen/Heavy Oil.
- Oil Shale.
- Tight Gas Sands Coalbed Methane.
- Coal.
- Uranium.
- Geothermal.

## CLASSIFIED ADS

### POSITIONS WANTED

**Two Tenure-Track Assistant Professor Positions in Basin-modeling/Solid Earth Geophysics and Sedimentology**

The Department of Geology at Kansas State University invites applications for two tenure-track faculty positions at the assistant professor level beginning in August 2016 in the areas of: (1) sedimentology and/or stratigraphy, (2) basin-scale modeling or solid earth geophysics. A detailed advertisement for both positions is located at www.ksu.edu/geology. Screening of applications begins December 21, 2015 and continues until the position is filled. Full consideration will be given to applications received by December 1, 2015. Kansas State University is an EOE of individuals with disabilities and protected veterans. Kansas State University actively seeks diversity among its employees. Background check required.

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**Tenure-Track Faculty Position**
**Energy Geoscientist**
**The University of Alabama Department of Geological Sciences**

The Department of Geological Sciences at The University of Alabama invites applications for a tenure-track faculty position in energy geoscience, *beginning August 2016*, to be filled at the assistant professor level. Candidates are invited to apply who have specialties within any field of geoscience pertaining to energy exploration. Scientists with industry experience are encouraged to apply. Candidates must have a strong record of research and must have received a Ph.D. in geology, geophysics, or a related field at the time of appointment. The successful candidate will establish a vigorous, externally funded research program, develop relationships with the energy industry, work closely with the Center for Sedimentary Basin Studies, and attract and advise high-quality graduate students. Teaching responsibilities will include undergraduate and graduate courses in her/his specialty and introductory geology. The department has a broad range of geophysical, geochemical, and computational facilities, in addition to University shared facilities, including the Dauphin Island Sea Lab. Departmental software includes industry standards such as ProMAX, Petrel, TechLog, PetroMod, Move, Petra, Geosoft, ArcGIS, and Matlab. Details regarding existing research programs, equipment and facilities, and departmental activities are at www.geo.ua.edu.

Questions should be directed to *Dr. Fred Andrus (*fandrus@ua.edu*).* Applicants should go to http://facultyjobs.ua.edu to electronically apply for this position. When submitting an application, candidates must provide a cover letter, CV, research and teaching statements, and a list with the contact information for at least three referees. Applications will be reviewed beginning December 7, 2015, and will continue until the position is filled. The University of Alabama is an Equal Opportunity Affirmative Action Employer and actively seeks diversity in its employees.

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**Marshall-Heape Chair in Geology**

The Department of Earth and Environmental Sciences at Tulane University invites applications for the newly established Marshall-Heape Chair in Geology. We seek a scholar with an outstanding international reputation who will be appointed at the Full Professor level with tenure. We particularly seek a broad-based Earth scientist who complements current faculty expertise and offers potential for collaborative research. The Marshall-Heape Chair is expected to lead a widely recognized, externally funded research program that will attract PhD-level graduate students and postdoctoral scholars of the highest caliber. Teaching duties are both at the graduate and undergraduate levels. For full consideration, applications should be received by January 10, 2016, but the position will remain open until filled. Applications should include a curriculum vitae, research and teaching statements that articulate how the mission of the department would be enhanced, and the names and contact information of at least three references. Applications must be submitted electronically via the following link: apply.interfolio.com/31900. Any inquiries may be directed to Dr. Torbjörn Törnqvist, Department of Earth and Environmental Sciences, Tulane University, 6823 St. Charles Ave., New Orleans, LA 70118-5698 (tor@tulane.edu). Further information about the department and university can be obtained at http://tulane.edu/sse/eens. Tulane University is an EEO/ADA/AA employer.

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**Assistant Professor of Geology and Geophysics**

**Missouri University of Science and Technology**

The Department of Geosciences and Geological and Petroleum Engineering invites applications for a full-time tenure-track faculty position in Geology and Geophysics at the Assistant Professor level in petroleum geology with expertise in carbonate reservoirs and basin analysis to begin in August, 2016. Review of applications will begin in November and continue until the search is completed. The successful candidate will be expected to develop an externally-funded research program integrated with excellence in teaching at both the graduate and undergraduate levels with a commitment to interdisciplinary work. Teaching responsibilities will include courses as part of degree requirements as well as in the candidate's area of expertise. The Department currently has 20 full-time faculty, and 371 undergraduate and 309 graduate degree-seeking students with established B.S., M.S., and Ph.D. programs in Geology & Geophysics, Petroleum Engineering, and Geological Engineering. Closely associated departments include Environmental Engineering and Mining Engineering. Local area establishments with active research include the U.S. Geological Survey (Mid-continent Geospatial Mapping Center), Missouri Department of Natural Resources, Fort Leonard Wood, the Missouri S&T Rock Mechanics and Explosives Research Center, Materials Research Center, and Energy Research and Development Center. Interested applicants should submit a cover letter, a current curriculum vitae, a statement of research and teaching interests and experience, and complete contact information for four references electronically to the Missouri University of Science and Technology's Human Resource Office at http://hr.mst.edu/careers/academic/. Applicants should ask for Position Number 00031149 to be included on each reference sent directly to the chair of the search committee, Dr. Wan Yang (yangwa@mst.edu). The final candidate is required to provide copies of official transcript(s) for any college degree(s) listed in application materials submitted, prior to the start of employment. In addition, the final candidate may be required to verify other credentials listed in application materials. Failure to do so may result in the withdrawal of the job offer. All job offers are contingent upon successful completion of a criminal background check. The University of Missouri is an equal access, equal opportunity, affirmative action employer that is fully committed to achieving a diverse faculty and staff. Equal Opportunity is and shall be provided for all employees and applicants for employment on the basis of their demonstrated ability and competence without unlawful discrimination on the basis of their race, color, national origin, ancestry, religion, sex, sexual orientation, gender identity, gender expression, age, genetic information, disability, or protected veteran status.

### MISCELLANEOUS

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## INDUSTRY HIGHLIGHTS

**EMGS signs agreement with Directorate General of Hydrocarbons in India**

Electromagnetic Geoservices ASA (EMGS) is pleased to announce that the Company has signed a multi-client acquisition agreement with the Directorate General of Hydrocarbons (DGH) in India.

For more information, visit *www.emgs.com*

This information is subject of the disclosure requirements pursuant to section 5-12 of the Norwegian Securities Trading Act.

**Golden Software**

Voxler is Golden Software's 3D well and volumetric data visualization software solution. Voxler can display XYZC data in one of sixteen unique 3D display modules.

A free demo version of Voxler 4 is available for download at: *www.goldensoftware.com/demo-downloads.*

**TGS and APPA Announce Africa Stratigraphic Harmonization Project**

ASKER, NORWAY (15 September) - TGS and the African Petroleum Producers' Association (APPA) have signed a Letter of Intent to harmonize the stratigraphic nomenclature of the sedimentary basins of 13 countries in Africa.

For additional information, please contact:
Tel: +44 208 339 4200
Email: *gps-sales@tgs.*com

DIRECTOR'S CORNER

# An Innovation Suggestion: Take A Different Look

By DAVID CURTISS

This issue of EXPLORER has focused on exploration innovation. Our stories covered new technologies that help you better find oil and natural gas, and we discussed new ways of thinking, looking for new approaches to age-old problems.

I'd like to close this month spending a few moments talking about personal reinvention – a type of innovation that each of us should be engaged in during these tumultuous times in our industry.

* * *

While driving to work this morning, I was listening to a podcast featuring Peter Diamandis, a Harvard-trained physician, serial entrepreneur and techno-enthusiast who is perhaps best known as the founder and creator of the X Prize Foundation.

The X Prize Foundation is dedicated to harnessing the power and ingenuity of the "crowd" to tackle significant global issues or challenges, ranging from jump-starting private space flight to improving adult literacy.

And as Diamandis explained on the podcast, while our passions – the things we care deeply about – can be a powerful motivator as we develop our career, the problems we encounter in life can create even greater levels of motivation, spurring us to do things differently, to develop new solutions.

Or as he put it, "problems can be gold mines."


CURTISS

> A different vantage point may enable us to see a solution, to innovate a path forward.

But how do you do that? How do you turn problems into gold? Because when I'm confronting a problem I struggle to see anything beyond how it bothers me.

It does require a shift in mindset, according to Diamandis – and that requires conscious choice.

In the same way that your brain ignores the fire extinguisher on the wall until someone yells "Fire!" Diamandis explains, you have to actively engage the problem differently, from an alternative vantage point.

That is a valuable and necessary skill to develop and hone.

* * *

We know that the current downturn is going to require innovation. Whether it is figuring out the next career step after a lay-off, or keeping a company afloat in the face of low prices and tremendous uncertainty, each of us is going to have to change in the coming year.

Sometimes that process of change is exhilarating. We envision a new future, develop an innovative plan of action and step out boldly to begin building a new future propelled by a sense of possibility.

Sometimes, though, the process of change is slow and plodding. And when it turns out that the plan of action is unrealistic and won't accomplish your objective, it's frustrating and demoralizing.

And then the fears set in and you hear that little voice that says it's hopeless, sapping what little resolve you have left.

I don't know about you, but I can cycle through these emotions – from exhilaration to fear – in just a matter of minutes!

So when you're caught in the grip of fear how do you create the mental space to look at the problem objectively and find a solution?

This requires another shift in mindset and perspective.

One way to shift perspective is to stop focusing on problems, and instead focus on things you are grateful for. There's a reason why fostering a spirit of gratitude is an essential aspect of many religious and spiritual traditions – it takes our focus off ourselves!

Here in the United States we set aside the fourth Thursday of November to celebrate Thanksgiving.

And while travel delays, American football and early Christmas shopping dominate the headlines, the original purpose of Thanksgiving was to celebrate a bountiful harvest. In these less agrarian times, it allows us to focus on things that really matter in life – and to give thanks for them.

"Man is fond of counting his troubles, but he does not count his joys," wrote Fyodor Dostoyevsky. "If he counted them up as he ought to, he would see that every lot has enough happiness provided for it."

Gratitude does not eliminate problems or fear. But it does help us see those things from a different perspective. And that different vantage point may enable us to see a solution, to innovate a path forward.

It can give us strength to carry on during tough times.

DIVISIONS REPORT: EMD

# Natural Gas Hydrate: An 'Emerging Resource' Finally Emerges

By ART JOHNSON, EMD Gas Hydrate Committee Chair

Natural gas hydrate (NGH), a crystalline compound of water and natural gas, has been recognized as a vast potential energy resource for over two decades, but its commerciality has persistently remained beyond the horizon due to technical and economic hurdles.

Drilling and evaluation programs conducted during the past decade, however, have clarified the path forward, and commercial production from NGH is now anticipated for Japan within a few years.

NGH forms under the appropriate conditions of pressure and temperature (figure 1) when there is sufficient natural gas flux. The pressure/temperature conditions for gas hydrate stability are present in sediments along every continental margin in the world and in sediments in permafrost regions.

The first question about commerciality that needed to be answered involved the size and occurrence of producible NGH deposits. Most NGH occurs in shales where it comprises only 1 to 5 percent of the sediment volume. As such, the NGH in shales is not an energy resource.

In contrast, NGH can fill over 80 percent of the porosity in sands.

### NGH Potential

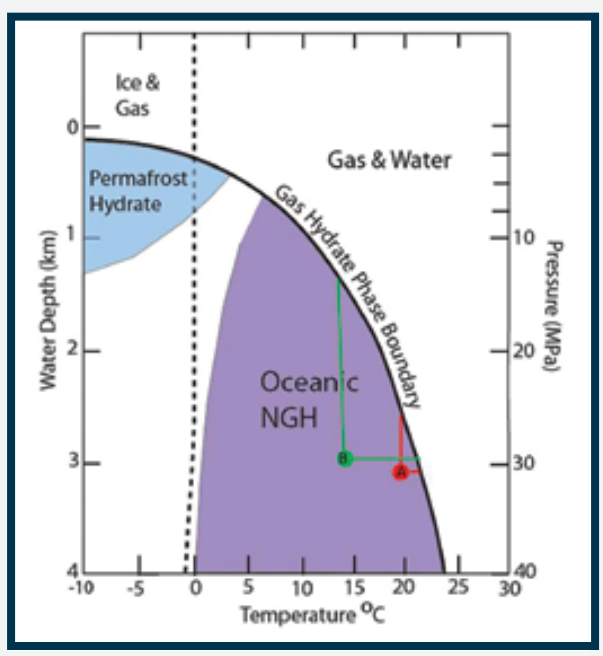
Evaluation programs in the Gulf of Mexico, North Slope of Alaska, Japan, India and South Korea have logged and cored NGH-bearing sands, calibrated seismic methods for predictive models and provided critical information to define the NGH petroleum system.


JOHNSON

> Current models indicate that production from NGH reservoirs may attain reasonably high production rates and maintain those rates for years or even decades.

These programs have involved the combined efforts of several oil companies, service companies, government agencies from the nations involved and many universities. Critical funding and technical guidance has come from the U.S. Geological Society, Minerals Management Service/ Bureau of Ocean Energy Management and the U.S. Department of Energy.

In 2008 the MMS published a detailed evaluation of the NGH resource potential of the Gulf of Mexico, with a mean estimate of 6,717 trillion cubic feet (TCF) of gas present in sandstone reservoirs. The same year, the USGS published an assessment of the technically recoverable NGH potential for the North Slope of Alaska with a mean estimate of 85.4 TCF. The Japanese national NGH program (MH21) released a figure of 1.1 trillion cubic meters (39 TCF) gas in sands within the Nankai area.




These volumes were very encouraging but were limited to relatively small portions of the world.

As part of the Global Energy Assessment undertaken by the International Institute for Applied Systems Analysis (IIASA), a comprehensive evaluation of NGH potential was conducted that assessed every continental margin, worldwide. This 2001 evaluation integrated geological models of likely sand distribution, interpretations of gas hydrate stability conditions and estimates of gas flux.

Given the limited data available for the evaluation, the results covered several orders of magnitude, with a median value of 43,311 TCF gas in place in sandstone reservoirs.

This assessment may have been overly conservative, as the BOEM published an assessment for NGH in the Atlantic in 2013 with a mean estimate of 15,850 TCF in sandstone reservoirs.

See **Production Rates**, page 52

# power play

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