



## Mountain Climbing

*Not all peak experiences  
are found onshore*

*See page 24*





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PRESIDENT'S COLUMN

# Doing What We Say We Do: AAPG Business

BY LEE F. KRYSTINIK

This month the question I'd like to consider is:

*Do we do what we say we do regarding our AAPG business activities?*

As I have been learning my way into AAPG's activities as an organization and as a business I have been continually impressed by the incredibly broad range of things AAPG volunteers and AAPG staff are doing.

This can and should be considered something remarkable, of which we all should be very proud.

But it also has caused me to pause and ask myself if, along with our key functions, whether we are engaged in activities that might possibly be diffusive to our primary goals and purpose.

Some of this variability reflects the particular pet projects of a given Executive Committee or past president. In most cases, though, the numerous projects we do within AAPG are driven by energetic and enthusiastic volunteers who have a personal vision – and AAPG has provided money and a path to realizing that vision.

In aggregate we lumber forward, sometimes pulled by the inertia of all those interesting projects and sometimes slowed as various projects pull at odds to one another, thus diffusing the efficiency of AAPG and sucking money into activities that may not be consistent with our primary purposes.

\*\*\*

Numerous conversations with David Curtiss and David Lange, our executive director and deputy executive director, respectively, have led me to the conclusion that our business is in great hands. These



KRYSTINIK

Internal consistency, in turn, allows our business partners worldwide to depend upon what we say we will do.

guys along with their directors and a very hard-working and focused staff are an impressive team, and this year they are bringing the first draft of a **three-year business plan** into effect for AAPG.

The three-year business plan will be developed in concert with and approved by the Executive Committee, tied directly to our primary goals and purposes as stated in the AAPG Bylaws and in AAPG's long-term strategy document.

While the business plans are not considered written in stone, they will reflect a direct linkage to:

- ▶ AAPG's goals and aspirations for the next year and beyond.
- ▶ AAPG's long-term strategy document.
- ▶ Sound, conservative fiscal practice.

In a best-case scenario, the three-year business plan should be a living document, subject to revision on an annual basis but still linked to our long-arc strategic goals as we prepare for AAPG's next century.

Having such a business plan in place will greatly assist in short- and long-term financial planning and in prioritizing expenditures. The plan will make it possible to budget in a fashion consistent with our strategic and tactical objectives, and will help us in funding the things at the core of our forward thrust – perhaps reducing expenditures on things that may not be as closely related to the goals and aspirations of AAPG.

All AAPG departments, Sections, Regions and committees ultimately will be tied into the business plan to assure that all of our activities are consistent with and focused upon the goals and priorities of AAPG.

A significant benefit to AAPG in having an evergreen three-year business plan is that it gives the EC and successive presidents of AAPG an opportunity to do business within a framework that is internally consistent.

Internal consistency, in turn, allows our business partners worldwide to depend upon what we say we will do.

In the process, a consistent business plan also will remove some of the whiplash that can occur in an organization where presidents change each year.

Randi Martinsen, our president-elect, will have input, along with the rest of the Executive Committee, to the three-year business plan. As she takes over the reigns from me next July, her incoming president-elect also will fold into this planning process.

In this way we can establish a consistent business practice that is less subject to the whims of any individual personality. This is critical in establishing and honoring business arrangements – especially in international settings, where a consistent tone and approach over multiple successive years is critical to establishing business credibility and trust.

Another critical aspect of our business planning is the issue of having a buffer in case of a downturn.

As we continue to expand our activities and services, the relative percentage of an operations year that our financial buffer covers becomes smaller. We have now fallen to slightly below a nine-month buffer.

In preparation for that "rainy day" that WILL come in our cyclical business, we will have to direct some of our surplus (when we have a surplus) toward building that buffer to 12-18 months. This has obvious potential implications for limiting expenditures or sun-setting programs at the fringe of our plan.

To build this financial strength, AAPG will have to focus on having more years with a modest surplus and fewer years of deficit. There are several impacts implicit in meeting this need, including where we schedule our ACE and ICE meetings. We would be remiss on behalf of our membership to allow AAPG to go under during an industry downturn because we failed to prepare ourselves properly.

So, let me hear from you ...

If you have suggestions for ways we can be more fiscally prudent and improve AAPG's financial strength, please send a note to me: lee.krystinik@aapg.org.

Let me know how AAPG can better do what we say we will do!

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



Photo courtesy Bureau of Economic Geology.

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## ON THE COVER:

Two examples of how technology and creative thought – and sometimes, a lot of persistence – can result in exploration innovations. Our cover photo is tied to AAPG member William W. Sager, professor in the Earth and Atmospheric Sciences Department at the University of Houston, who was the lead author for a team that in early September announced it had found in the Pacific Ocean a structure that may be the single largest volcano on Earth. Story on page 24. On this page, a West Caicos satellite image resolution – and a hint at how drone technology can be a valuable tool. See page 20.



## Get to Know the Executive Committee Candidates

Videos of all six AAPG officer candidates for the 2013-15 Executive Committee – featuring a new question-answer format – continue to be available online, where they will remain through the election season.

Also available on the website are biographies and individual information for the candidates.

The candidate videos are presented in a new format that shows them responding to six specific questions, intended to allow members around the world to have a better introduction to those running for office.

Those questions include:

▶ When and how did you decide to become a geologist – and why?

▶ What has been your experience

with AAPG?

▶ What is the main issue facing the profession today?

▶ How could you help AAPG be a better association?

▶ Why did you agree to stand for office?

Printed information on the candidates also will be included in an EXPLORER in early 2014. Ballots will be mailed and online voting will begin in spring 2014.

The person voted president-elect will serve in that capacity for one year and will be AAPG president for 2015-16. The terms for vice president and treasurer are two years.

To view the videos, go online to

[www.aapg.org/business/candidates/](http://www.aapg.org/business/candidates/).  
The slate is:

### President-Elect

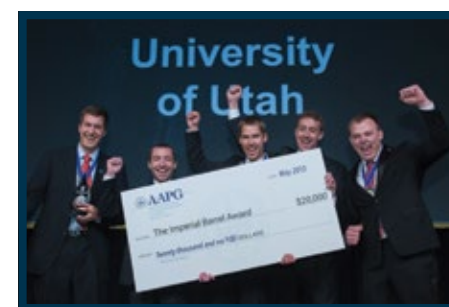
- ☐ Alfredo E. Guzmán, consultant, Veracruz, Mexico.
- ☐ John R. Hogg, MGM Energy Corp., Calgary, Canada.

### Vice President-Sections

- ☐ Steven H. Brachman, Petro-Hunt LLC, Houston.
- ☐ Hannes E. Leetaru, Illinois State Geological Survey, Urbana, Ill.

### Treasurer

- ☐ Vlastimila Dvorakova, Czech Geological Survey, Brno, Czech Republic.
- ☐ James W. Tucker, consultant, Houston.



## Application Time Is Now For 2014 IBA Competition

Applications are now being accepted for a spot in this year's AAPG-AAPG Foundation Imperial Barrel Award (IBA) competition – the world's premiere geoscience contest for graduate students around the world.

The deadline for entry is Dec. 13.

The IBA program is a global basin evaluation competition using real-world datasets. Teams from around the world compete in an eight-week process that includes Region and Section semi-final contests, and then culminates in a finals competition at the AAPG Annual Convention and Exhibition, set April 6-9 in Houston.

The competition is designed to test the teams' collective knowledge in geology, geophysics and other geoscience disciplines as they determine the hydrocarbon potential found in the dataset.

"We are pleased to announce the opening of this prestigious competition and look forward to another year of identifying and awarding best-in-class student teams," said AAPG member David Cook, IBA program co-chair. "Participating in, hosting and sponsoring the IBA competition is an honor and challenge for students, and helps universities and exploration and production companies foster the advancement of petroleum geosciences while building the geoscience human resources required for the future."

"The IBA continues to attract the world's highest achieving petroleum geoscience graduate students who have a unique opportunity to demonstrate both creative thinking and complex problem solving on a big stage," added IBA co-chair and AAPG member Chuck Caughey. "We continue to be impressed with the finalists every year."

The winning team receives the Imperial Barrel Award, individual medals plus \$20,000 for the school's geoscience department.

Second place winners receive the Selley Cup, individual medals and \$10,000 for their school, and third place winners receive the Stoneley Medal, individual medals and \$5,000 for their school.

The remaining teams earn \$1,000 in scholarship funds for their schools plus individual medals for themselves as IBA finals participants.

Last year a total of 107 teams from 30 countries, involving at least 535 students, competed in the program.

Since its adoption by AAPG and the AAPG Foundation, the IBA has awarded more than \$300,000 in scholarship funds.

For more information or to register for the competition go to [www.aapg.org/iba](http://www.aapg.org/iba).

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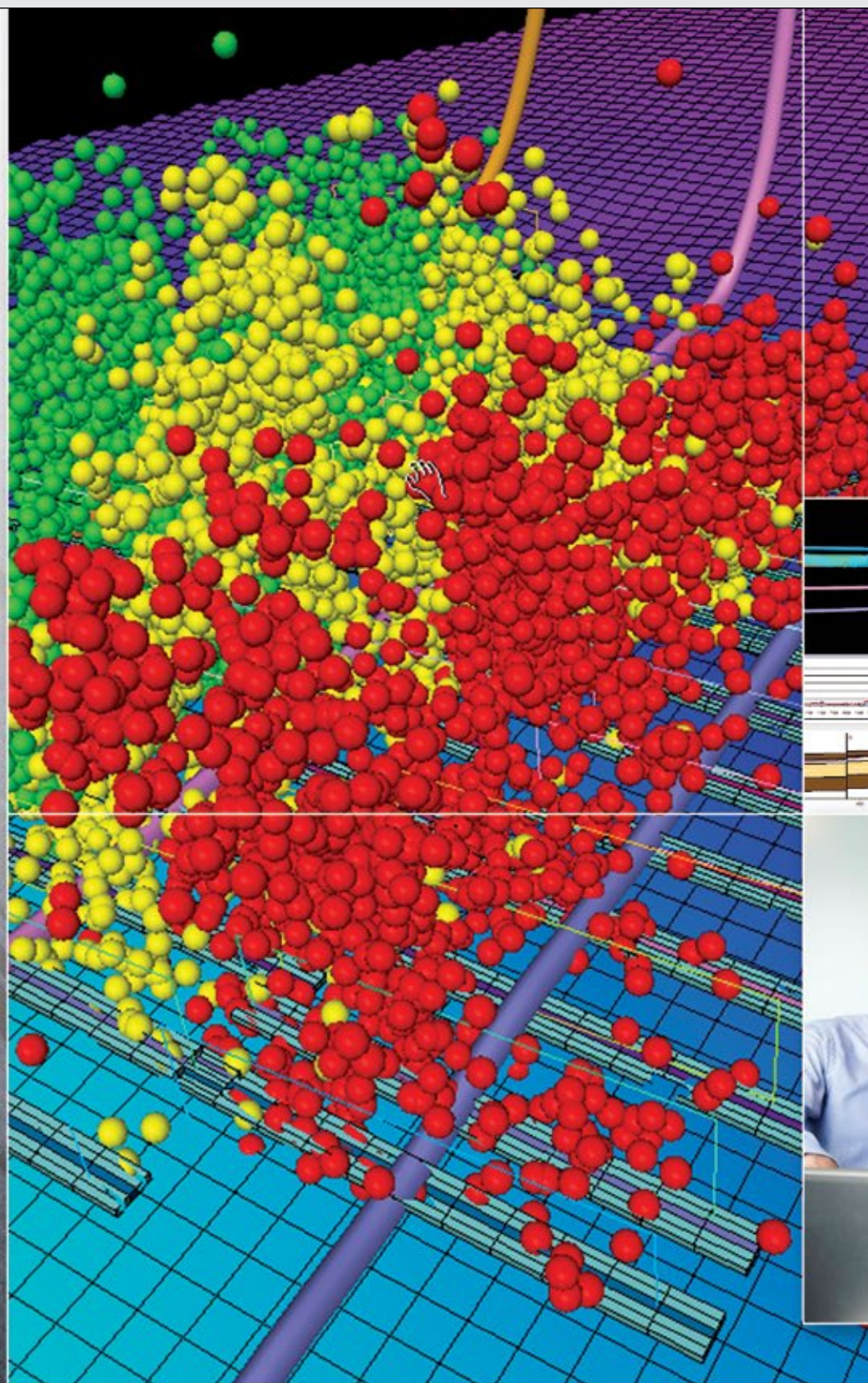
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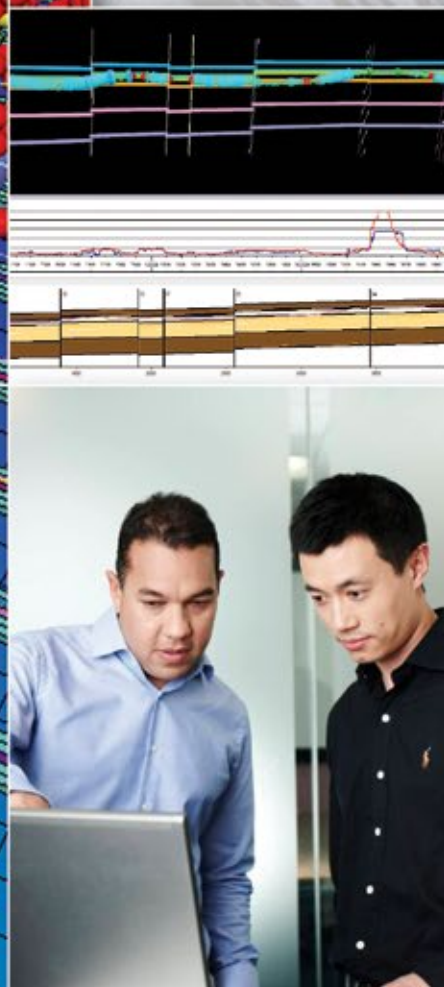
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Coming soon: A whole new world

# Technology Holds the Keys to Industry's Future

By DAVID BROWN, EXPLORER Correspondent

**W**hat technologies could reshape the future of the oil and gas industry?

Observers from the world of petroleum geology, geophysics and engineering discussed that question at this year's premiere Unconventional Resources Technology Conference (URTeC) in Denver.

Predictions ranged from drilling technologies to digital technologies, from large-scale to nanotech, from sweep efficiency to cost efficiencies. The forecasts were partly wish-list and partly punch-list, with a hint of gee-whiz in the mix.

Here are a dozen technologies identified at URTeC that could change the industry's future:

- ▶ Nanotechnology applications, including coatings, laminates, nanoparticulates, advanced sensors and nanoreporters.
- ▶ Technology innovations to achieve fully coupled reservoir simulation.
- ▶ Improved technology to predict where proppant will flow, then identify where the proppant is and what it's doing.
- ▶ Data technologies for sweet-spot identification from minimal information and rapid determination of optimal completion design.
- ▶ Technologies for enhanced oil recovery from nanoperm reservoirs.
- ▶ Technologies that capture and reuse waste heat, flare gas and other sacrificed by-products.
- ▶ Molecular filtration for oil-water-CO<sub>2</sub>



Photo courtesy of Ken Doerr

*One of the coming developments that could change our world: Technology that captures and reuses waste heat, flare gas and other sacrificed by-products. All it takes ...*

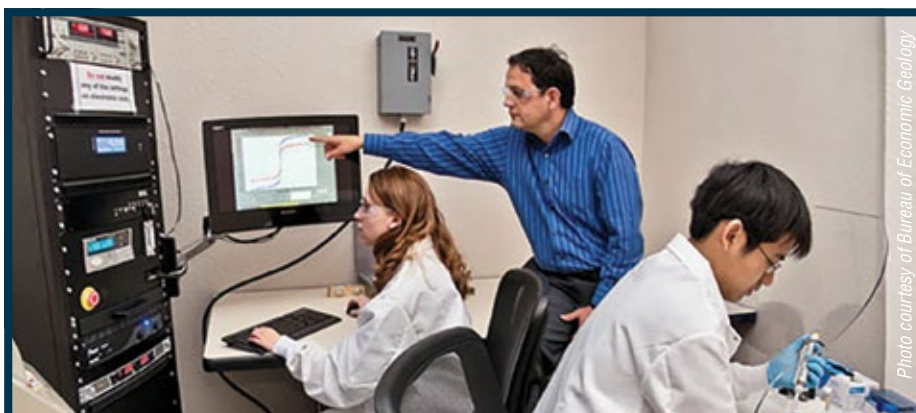


Photo courtesy of Bureau of Economic Geology

*... seems to be the time – and money, of course – needed for researchers to turn their intellectual and theoretical discoveries into something practical.*

separation.

- ▶ Data acquisition in horizontal wells during hydrofracturing.
- ▶ Technology to identify, image and assess producing volumes, including 4-D microseismic.
- ▶ Data technologies drawn from outside the energy industry (i.e., gaming, weather forecasting).
- ▶ Technologies for nonaqueous stimulation/waterless fracturing and the use of "challenged" water in hydrofracturing.
- ▶ Technological efficiencies that improve recovery, reduce capital expenditures and lead to a dramatic reduction in cost per barrel-of-oil equivalent.

## Data Demands

URTeC was a first-of-its-kind meeting on unconventional resources, held last August and jointly sponsored by AAPG, the Society of Exploration Geophysicists and the Society of Petroleum Engineers.

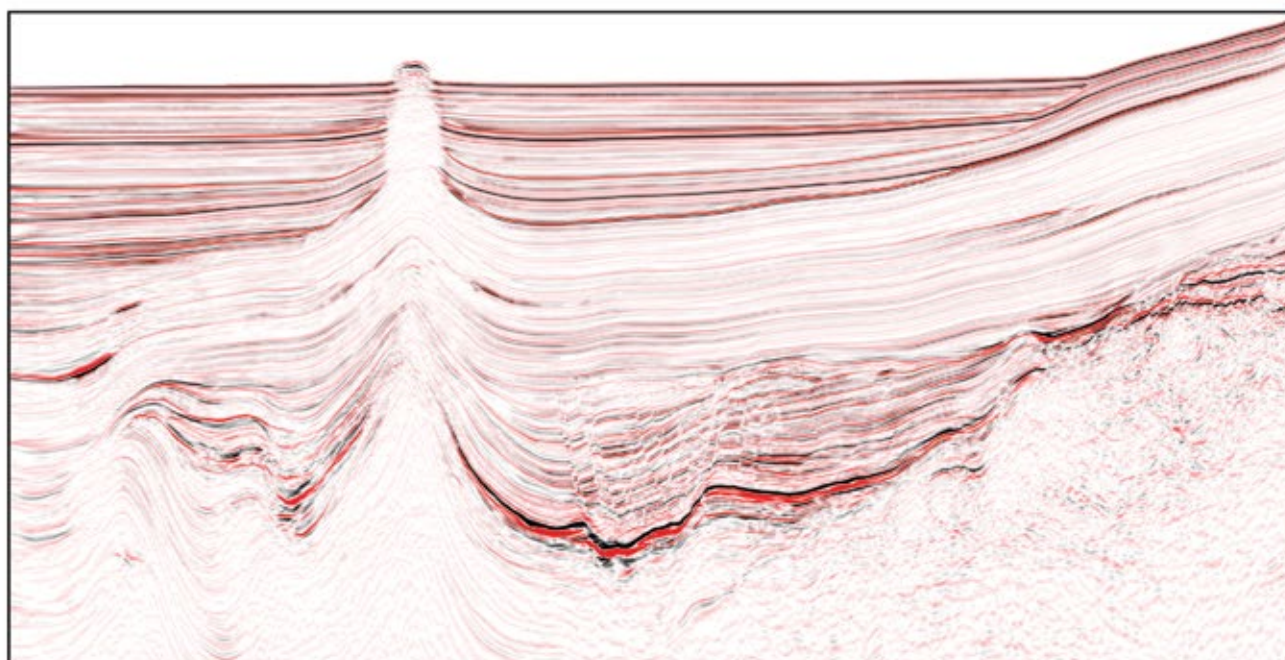
During the meeting AAPG member Mark Zoback, professor of geophysics at Stanford University, moderated an interactive panel discussion on "Technologies That May Transform the Future."

Panel participants, all AAPG members, were:

- ✓ Mike Mullen, president of Stimulation

[See New Technology, page 8](#)

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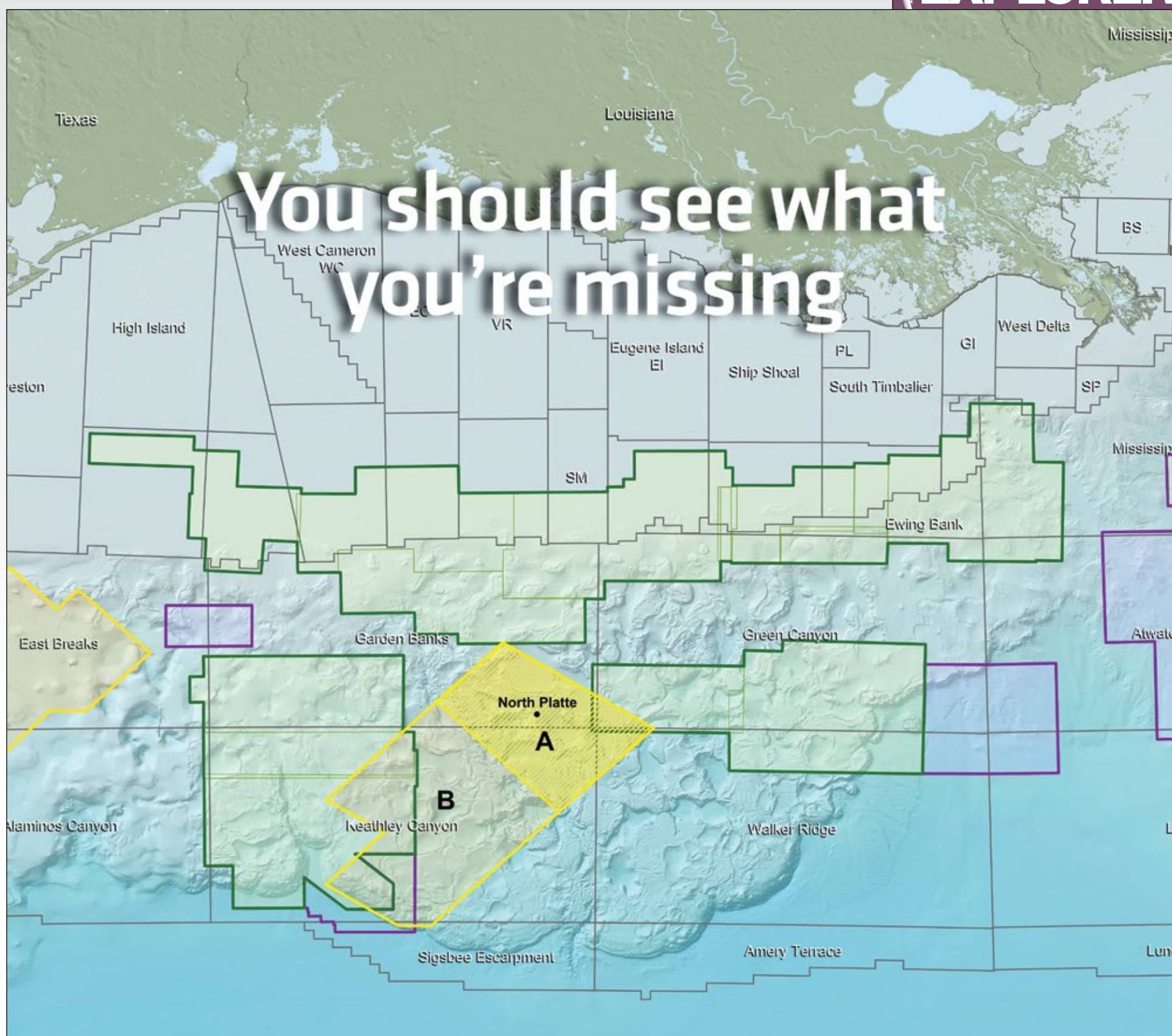
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## New Technology from page 6

Petrophysics LLC in Denver.

✓ Doug Valleau, director of Unconventional Resources Technology for Hess Corp. in Houston.

✓ Greg Leveille, general manager of Unconventional Resources for ConocoPhillips Co. in Houston.

Maybe surprisingly, maybe not, data technologies received an abundance of attention in discussions about the industry's future.

"I think there's huge potential in some of the softer side of information technology," Mullen said.

"One of the issues we have is that we are a very data-intensive industry," he said. "There might be terabytes of data that



MULLEN

you're dealing with. Where do you put all this stuff so you can find it?"

Oil companies aren't the only organizations that deal with huge data volumes, and Mullen thinks the industry could borrow concepts from outside oil and gas. The gaming industry, for example, has its own approach to imaging, and weather forecasts deal with big data daily.

"I can hop on my iPad and see a weather map of the entire United States

**"There might be terabytes of data that you're dealing with. Where do you put all this stuff so you can find it?"**

with a pinch of my fingers," he said. "I think, 'Why can't I do that with my oil and gas data?'"

### Desperately Seeking Consistency

One serious challenge for the industry is acquiring data that is both accurate and consistent. Data collected by state agencies in the United States is notoriously inconsistent and difficult to

utilize, Mullen noted.

"It would be nice if the professional organizations could put out recommended standards on what should be kept in the states," he said.

The continuing process of converting old paper files to digital files will bring benefits for the industry, Mullen said – but it also has challenges.

"The problem with paper well files is that maybe the piece of paper you're looking for or the information from the one particular day you're looking for, someone took that out of the file and didn't put it back," he said.

Companies often assign low-level staffers to create digital information databases, he noted. That can lead to errors, omissions and low quality.

"This is where databases turn into sausage," he said. "The more you know what's in them, the less you like them."



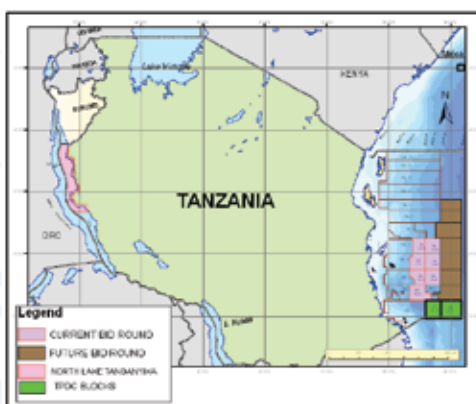
THE UNITED REPUBLIC OF TANZANIA

## Announcing the 4<sup>th</sup> Tanzania 2013 Licensing Round Deep Offshore | North Lake Tanganyika

The Government of the United Republic of Tanzania through Tanzania Petroleum Development Corporation (TPDC) is pleased to announce the 4<sup>th</sup> Tanzania Deep Offshore and North Lake Tanganyika Licensing Round. The delayed 2012 round will now be launched during the 2<sup>nd</sup> Tanzania Oil and Gas Conference and Exhibition.

**When:** Friday, 25 October 2013  
**Where:** Mwalimu Nyerere International Conference Centre  
Dar es Salaam, Tanzania  
**Round Close:** Thursday, 15 May 2014, Dar es Salaam

### 4<sup>TH</sup> TANZANIA OFFSHORE AND NORTH LAKE TANGANYIKA LICENSING ROUND



The round includes the deep offshore sedimentary basins comprising of seven blocks (averaging 3000 sq km: Blk4/2A, Blk4/3A, Blk4/3B, Blk4/4A, Blk4/4B, Blk4/5A, Blk4/5B) and is located between 2000 m to 3000 m of water depths from 40°30'E to 41°40'E and 7°30'S to 9°00'S. Blocks 4/1B and 4/1C are reserved for the TPDC to execute exploration using a strategic partner. The blocks have excellent coverage of modern regional 2D seismic data available from ION Geophysical and WesternGeco.

The North Lake Tanganyika block is located offshore in the western arm of the east African rift system. Lake Tanganyika is the world's longest (650 km) and second-deepest (1500 m) and is covered by sparse 2D seismic data collected in the 1980s during the African Lakes Drilling Project. The data and copy of report will be made available.



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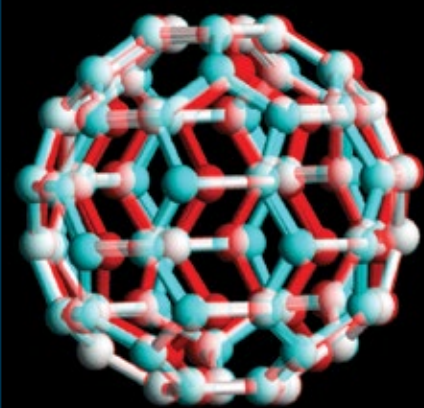
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Graphic courtesy of Gisela Giardino

A buckminsterfullerene – or a "buckyball" – is an important part of nanotechnology.

### Use It or Lose It?

Mullen identified two other changes in the industry where new technology makes a difference – the concept of what producing "pay" is, and the much-anticipated shift in workforce as a generation of older professionals retire.

Concepts of conventional pay cutoffs "are out the window," Mullen said. Unconventional resource plays produce from "unproducible" low-perm zones, tight sands could revolutionize the industry, and ideas about what will produce change constantly.

Years ago, "nobody even thought you could produce gas from coal," he noted.

But maybe no challenge for the oil and gas industry is greater than the coming crew change, as older workers leave the workforce and take with them lifetimes of experience and knowledge.

"I've seen it in my 37 years in the industry," Mullen said. "The predecessor generation to mine, what they took for granted we had to learn all over again, and make it work."

Technology could have a part in easing that shift – if the industry can create true knowledge databases and make them functional.

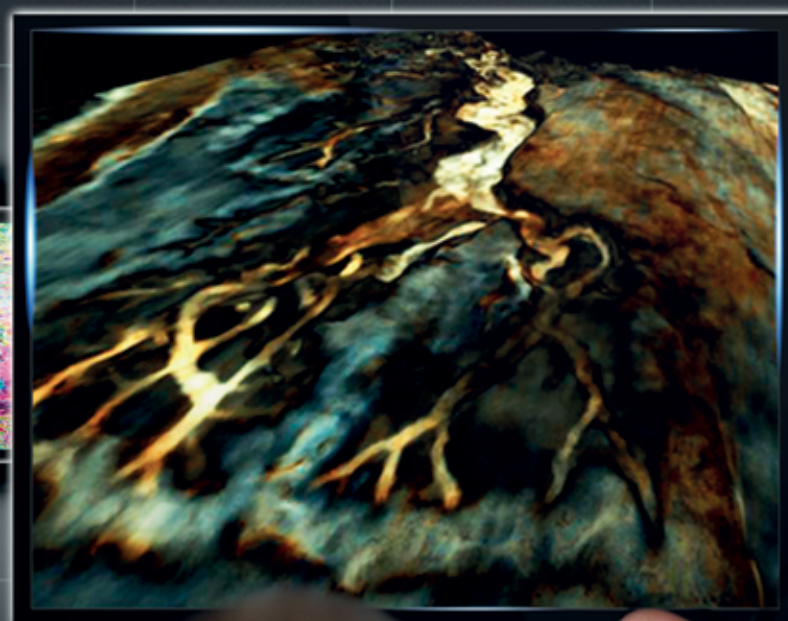
"If there was a database architecture – I keep going back to Google and Bing and the others – that to me is a great idea," Mullen said.

In a time of very rapid technological change, Mullen thinks the industry could do a better job of acquiring and adapting new technologies for its own needs.

"From my viewpoint, I think some companies have done better than others in keeping up," he said. "But I think we lag as a whole in utilizing the technology that has come along." ■



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Big thinking about micro-possibilities

## 'Nano' Potential Growing, and Growing, and ...

By DAVID BROWN, EXPLORER Correspondent

Nanotech researchers are doing something you might not expect.

They're thinking bigger these days. And they're targeting new applications for the oil and gas industry.

The Advanced Energy Consortium (AEC) of the Bureau of Economic Geology at the University of Texas-Austin leads the way in nanotechnology research for the oil and gas industry.

One thing that has researchers excited is the abundance of possible applications for nanotech in exploration and production, said AEC project manager Mohsen Ahmadian.

"You could apply nanotechnology to a lot of different things," he said. "Drilling muds, fluids, lubricants, drill bit enhancement. A lot of those things are already being applied in the industry."

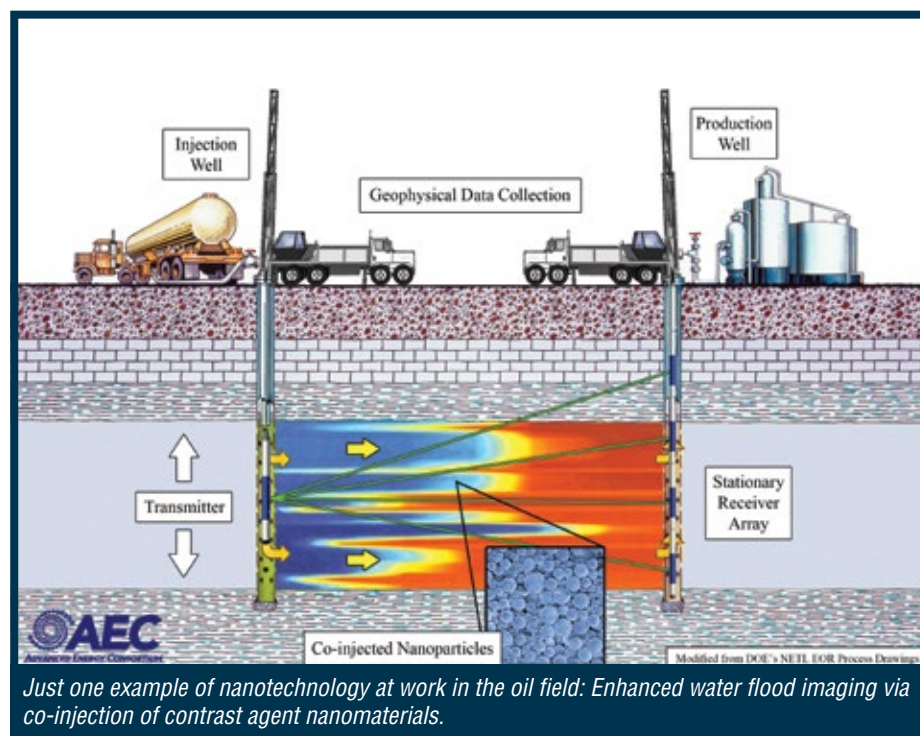
Bigger thinking also has grown out of the rapid development of nanotechnology as a field.

Ahmadian said the number of scientific papers and patents related to nanotech has increased exponentially in recent years. He's also seen more and more interest from the industry.

"Now our meetings are attended by more than 250 people at a time – even the Society of Petroleum Engineers has



AHMADIAN



Just one example of nanotechnology at work in the oil field: Enhanced water flood imaging via co-injection of contrast agent nanomaterials.

sessions on nanotechnology," he said.

Still, in scientific terms, nanotech remains almost a brand-new field. Research is progressing as demand builds in the industry for new and effective applications – for increased oil production, for instance.

"I wouldn't say we are very far away from needing this technology," Ahmadian said. But it's really in its infancy."

### Practical Advice

Ahmadian also said some of AEC's projects already are moving into the practical testing stage. To understand what new nanotech applications might be arriving first, you need to understand what's going on in nanotech research.

AEC has been working in the area for

five years, with most of its research projects really getting off the ground about four years ago, Ahmadian said. The program has spent about \$40 million to date.

"Our initial research was exploratory in nature. We would consider anything anyone proposed to us," he said.

But it became apparent that not all concepts were feasible as applications for oil and gas. Some simply would not work in the harsh environment of the reservoir, Ahmadian noted.

He described four of the current areas for research thrust at AEC:

#### ► Mobility.

In Ahmadian's words, "How do we stabilize a nanoparticle in the reservoir?"

#### ► Contrast Agent.

"This is basically taking some ideas from biomedical applications," he explained.

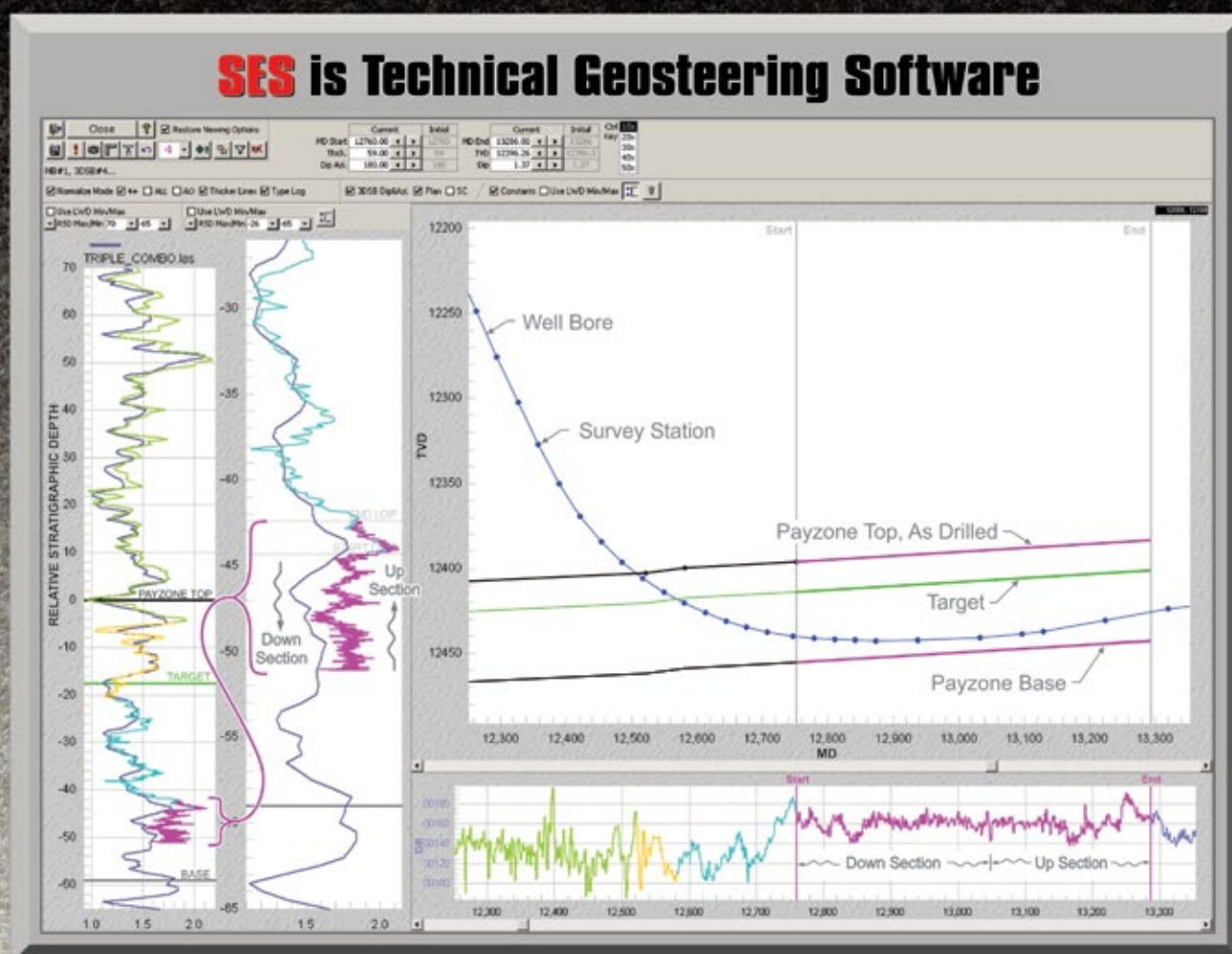
"We are trying to develop some nanoparticles that have acoustic or electromagnetic properties," he said. "And in electromagnetic, there are several areas that could be explored."

#### ► Sensors.

"This is a top-down approach using semiconductor fabrication techniques," Ahmadian said. "It could potentially log the location of the particle as it travels through the reservoir."

See Nanotechnology, page 12

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## Call for Papers Issued for Second URTeC

The call for papers has been issued for the second annual Unconventional Resources Technology Conference – more popularly known as URTeC – a joint venture that brings together the key disciplines and technologies engaged in the development of North American plays.

URTeC, sponsored by the three largest upstream societies – AAPG, the Society of Petroleum Engineers and the Society of Exploration Geophysicists – will be held Aug. 25-27 at the Colorado Convention Center, Denver.

The inaugural URTeC event attracted more than 4,300 geoscientists and engineers.

URTeC is designed to fill the unique

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

This year's technical program co-chairs are AAPG Honorary member and past president Steve Sonnenberg, Colorado School of Mines; AAPG Honorary member R. Randy Ray (SEG), R3 Exploration Corp.; and Luis Baez (SPE), BG Group.

Eleven technical program themes have been announced:

- ▶ Regional Case Studies.
- ▶ Characterization of Unconventional Reservoirs.

- ▶ Application and Integration of Well Data.
  - ▶ Understanding Your Petroleum System.
  - ▶ Optimizing Recovery From Unconventional Reservoirs.
  - ▶ Optimizing Capital Efficiency.
  - ▶ Production Performance of Tight Oil & Gas Reservoirs.
  - ▶ Social Performance (HSSE).
  - ▶ Reserves Forecasting and Estimation.
  - ▶ Long Term Performance.
  - ▶ Emerging Unconventional Plays.
- The call for abstract deadline is Dec. 12.

To submit an abstracts, or for more details about the event and the technical program's sub-themes, go to [www.urtec.org](http://www.urtec.org).

## Nanotechnology from page 10

### ▶ Nanomaterials Sensing.

"For this we are making sensors from the bottom up," he said, "using chemistry instead of using the semiconductor techniques."

Ahmadian said a basic concept is "to co-inject a fluid with nanomaterials that have some kind of contrast signals."

Getting nanoparticles or other nanomaterials into the wellbore and reservoir could have a number of payoffs. Ahmadian cited the example of waterfloods, where nanosensors could help operators understand where and when liquid is escaping into high permeability rock.

"If we know where the fluids are, we can try to divert them away from those high-perm areas," he said.

Development of unconventional resources also could see nanotech applications, with proppant movement and effectiveness and even gas flows measured at the nanoscale.

For those kinds of applications to work, "you need to have certain packaging, certain mobility targeting," Ahmadian added. "You have to have a reported way to distinguish what happened at location X compared to location Y."

It's not easy creating exactly the right nanoparticle with exactly the right characteristics, and then making it do exactly what you want.

"There are a lot of hurdles we need to go through to make something really exotic," Ahmadian said. He called the challenges "a difficult problem."

"I think the sensor concepts are a lot more complicated than some of the other concepts," he said.

**"One thing that's really nice at AEC is that we pride ourselves on developing a new science."**

### Just Getting Started

AEC already has funded almost 40 projects. It has several large-company industry sponsors and holds regular project reviews.

"This is the brainchild of (BEG director and past AAPG president) Scott Tinker," Ahmadian said. "We basically brought together several of the largest oil companies to think about future technologies, primarily looking at bypassed oil."

Today, AEC's nanomaterial sensor projects include smart tracers, reservoir reporters, payload delivery systems and options for clocking and improving enhanced oil recovery.

"Our ideas are really fancy," Ahmadian said. But he noted that some of the most practical concepts are growing out of the fanciest ideas.

"One thing that's really nice at AEC is that we pride ourselves on developing a new science," he said.

How much impact could nanotechnology have?

Think semiconductor chips and computers.

"This is pretty cutting edge," Ahmadian said. "This is sort of like where the semiconductor industry was 50 years or 60 years ago." ■

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The new Houston Saudi Aramco Research Center, dedicated solely to upstream research in geology, geophysics, production, drilling, computational modeling and reservoir engineering.

# Aramco Seeks Innovation At U.S. Research Centers

By HEATHER SAUCIER, EXPLORER Correspondent

**A**ramco Services Company (ASC), the U.S. subsidiary of Saudi Aramco, is establishing three research centers in the United States that focus on upstream and downstream innovations.

The centers, which have state-of-the-art laboratories and top scientists, are developing groundbreaking ideas and technology in areas that include unconventional resources, enhanced oil recovery, nanotechnology, next-generation fuels and advanced materials. Aramco research centers located in

Boston and Detroit are operational and ramping up activities, while a Houston-based center is expected to be fully operational by early 2014.

Specifically:

► The Houston center, which will be ASC's largest research and development center with more than 50,000 square feet, is dedicated solely to upstream research in geology, geophysics, production, drilling, computational modeling and reservoir engineering.

► The Detroit center will conduct downstream research in areas of fuel-engine efficiency and carbon emission management.

► The Boston center is combining both upstream and downstream research with focus on advanced computational modeling and nanotechnology application to the oil and gas industry.

"Research and development have always been the cornerstones of Saudi Aramco's activities," said Mustafa Al-Ali, director of research and development at ASC. "These three U.S. centers join a global network of world-renowned research centers established to leverage existing scientific and academic expertise."

"The U.S. centers are located in ideal places for innovation, collaboration and the rapid development and implementation of solutions to major challenges in the industry," he said.

## Sharing Knowledge

The Houston center is located in the city's "Energy Corridor," a major hub for oil and gas research and development activities. It is near chemical and oil field fluids manufacturers as well as service companies, research and development labs, and top geosciences and petroleum engineering universities.

"This center will allow us to push forward and achieve breakthroughs that not only benefit ASC's parent company, but the energy industry as a whole," Al-Ali said.

The Boston center is adjacent to the Massachusetts Institute of Technology (MIT) and will host upstream and downstream teams. At the Boston center, scientists will be performing upstream research including tight gas fluid flow modeling, basin simulation, in-situ sensing and intervention, and nanofluids and nanotechnology.

Downstream research will include advanced gas and oil nano-based separation technologies.

The Detroit center is strategically located to collaborate with leading automotive research organizations. It is envisioned to play a major role in advancing fuel-engine systems for more responsible automobiles.

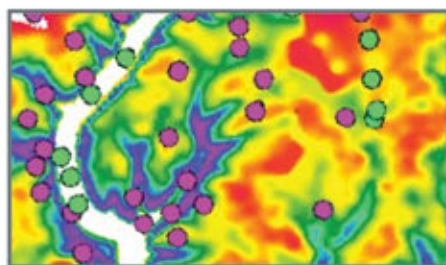
"We are aiming to take major strides in research and development rather than incremental steps," Al-Ali said. "This calls for interdisciplinary teams to supplement our petroleum engineering expertise."

The three U.S. centers are closely aligned with Saudi Aramco's Exploration and Petroleum Engineering Center's Advanced Research Center (EXPEC ARC) and Research & Development

UNLOCK THE POTENTIAL IN YOUR FIELD | #4 IN A SERIES

NOVEMBER 2013

## What lies beneath In Appalachia, geo-hazards revealed with new clarity



Resistivity slice in a gas dominant area of the near surface. Oil seeps (green) and gas plumes (magenta) on the surface are superimposed.

For millions of years, Appalachian gas has migrated toward the surface along naturally occurring faults. Frequently, it gets trapped in shallow structures difficult to see on seismic images. Abandoned and undocumented wellbores, some a century old, compound the problem. Drilling into a shallow gas pocket en route to the Marcellus or Utica Shale can throw a wrench in operations, forcing a producer to set a string of casing and adding up to \$250,000 per well in unexpected cost. Fracing near an orphaned wellbore or unknown fault is every operator's worst nightmare.

Responsible operators want to know the challenges they face "ahead-of-the-bit," so they can avoid geo-

hazards and design their drilling and hydraulic fracturing programs with utmost regard for the environment. To address these challenges, NEOS GeoSolutions has introduced Eco-Assurance™, a program based on its proprietary Multi-measurement Interpretation (MMI) methodology. A combination of airborne magnetic, hyperspectral and electromagnetic (EM) measurements helps to locate orphaned wellbores, reservoir-to-surface fault zones and trapped shallow gas pockets.

NEOS was engaged to conduct a 30-square-mile, basement-to-surface Eco-Assurance survey in Western Pennsylvania. Airborne-acquired hyperspectral data revealed surface oil seeps and gas plumes, along with wetlands, waterways and the condition of local botany. Sensors were calibrated to the hyperspectral signatures of hydrocarbons unique to the area, and anomalies were verified via ground truthing.

Magnetic data helped identify fault zones, orphaned wellbores and other iron-based infrastructure. By overlaying the magnetic data on top of maps of known infrastructure, like farms, well pads and pipelines, NEOS was able to locate dozens of previously unknown sites potentially associated with orphaned oilfield infrastructure. A comparison of these sites and the hyperspectral data indicated if any previously unknown sites were also associated with trace hydrocarbons.

EM data provided insight into trapped shallow pockets from the surface down toward the target shale intervals. NEOS used both active- and passive-source airborne acquisition with proprietary signal processing to generate detailed 3D voxels that could be analyzed both in cross section and in depth slices. An analysis of the EM and magnetic data suggested that hydrocarbons had naturally migrated along fault planes into some areas of the near-surface over the course of geologic time.

Cost-effective Eco-Assurance is proving its worth not just in Appalachia, but anywhere E&P activities are ongoing. Integrating multiple airborne geophysical datasets can inform a road map for environmentally sound and commercially efficient operations.

►►► To learn more about this project or others in the *Unlock the Potential* series, visit: [www.ThePotentialUnlocked.com](http://www.ThePotentialUnlocked.com)

### HIGHLIGHTS

#### KEY TECHNOLOGIES:

- HYPERSPSCTRAL
- MAGNETIC
- ACTIVE-SOURCE EM
- PASSIVE-SOURCE EM

AREA: Appalachian Basin, Pennsylvania

CUSTOMER: Supermajor

FOCUS: Eco-Assurance

TYPE: Unconventional

#### KEY INTERPRETIVE PRODUCTS:

- Shallow gas geo-hazard detection
- Fault detection
- Aquifer mapping
- Orphaned wellbore detection
- Oil seep and gas plume detection

#### CUSTOMER BENEFITS:

Helps producers protect the integrity of drilling and completion operations with detailed data for avoiding geo-hazards and environmentally sensitive areas.





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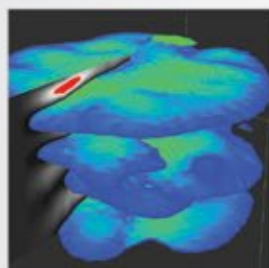
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A full azimuth angle gather from the Barnett Shale visualized in 3D

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*Photo courtesy of the VOG group, CIPR.*

*Is it a bird? Is it a bug? Modern drones might look a bit odd, but they're proving to be valuable tools in gaining data to help better understand geology.*

## Super-size bugs?

# Drone Tech Taking Off

By LOUISE S. DURHAM, EXPLORER Correspondent

**H**ydrocarbon exploration inarguably is benefiting from ongoing advances in technology – even if certain technical apparatuses being used appear to belong in a sci-fi movie rather than the oil patch.

Think drones.

Sometimes looking a bit like super-size bugs hovering in the sky, these unmanned aerial vehicles (UAVs) are being used to meet various needs in the industry, proving to be useful both onshore and offshore.

They can be used, for example, to inspect oilfield equipment and pipelines and to monitor gas flares.

But their significance for the geologist is the ability to acquire up-close, highly detailed images of outcrops, particularly in high elevations where camera-equipped helicopters entail the usual element of risk along with considerable monetary output.

Piloted via remote control, the drones are essentially flying robots. They can safely fly at exceptionally low altitudes, enabling their digital cameras to capture extremely high-resolution images of the surface.

Granted, drones per se are not a new phenomenon, actually being commonplace in the military and in certain law enforcement agencies where they are used for aerial surveillance and myriad other tasks.

They can be small enough to hold in your hand, or they can resemble actual small-size aircraft. Reportedly, there is one the size of a hummingbird, appropriately called a “nano hummingbird.”

These oddities are beginning to make serious inroads into the private sector.

This is due in large part to the availability and incorporation of mini-size electronics and special software programs to handle the various data they can gather.

### Helpful, Or a Nuisance?

But despite their value, drones likely won't be crowding the skies – at least not right away.


There's controversy aplenty surrounding the use of UAVs, given their ability to swoop down almost anywhere with no warning to snap some detailed, high-resolution photos of sometimes-off-limit subjects.

Certain countries, including the United States, have strict regulations for UAVs being used for commercial purposes, and some countries have no restrictions. The U.S. rules reportedly will be relaxed significantly in the near future. A number of entities already are exempt in large part, such as universities, federal and local law enforcement agencies.

There are folks who take matters into their own hands.

Certain private citizens are known to build their own drones, accompanied by special “goggles” to enable the users to view the photo target as if they are looking directly through the camera at work aboard the UAV.

Such homemade packages can even be purchased for a surprisingly low price.

Just don't look for them at your local Big Box emporia. 


## Research from page 14

Center (R&DC) located in Dhahran, Saudi Arabia.

Research centers also are located in Dhahran and Thuwal, Saudi Arabia; Delft, Netherlands; Paris; Beijing; and a technology center in Aberdeen, Scotland.

ASC and Saudi Aramco share knowledge and expertise through the involvement of its professionals with AAPG, the American Petroleum Institute (API), the Institute of Electrical

and Electronics Engineers (IEEE), International Association of Automation, Process Industry Practices, Society of Petroleum Engineers (SPE), Society of Exploration Geophysicists (SEG) and the Society of Petrophysicists and Well Log Analysts (SPWLA).

To support award-winning research, ASC looks for professionals with expertise in geology, geophysics, drilling, reservoir engineering, computational modeling, production technologies, chemistry, materials science and other fields to join its teams and bring their perspective to the many opportunities that lie ahead. 



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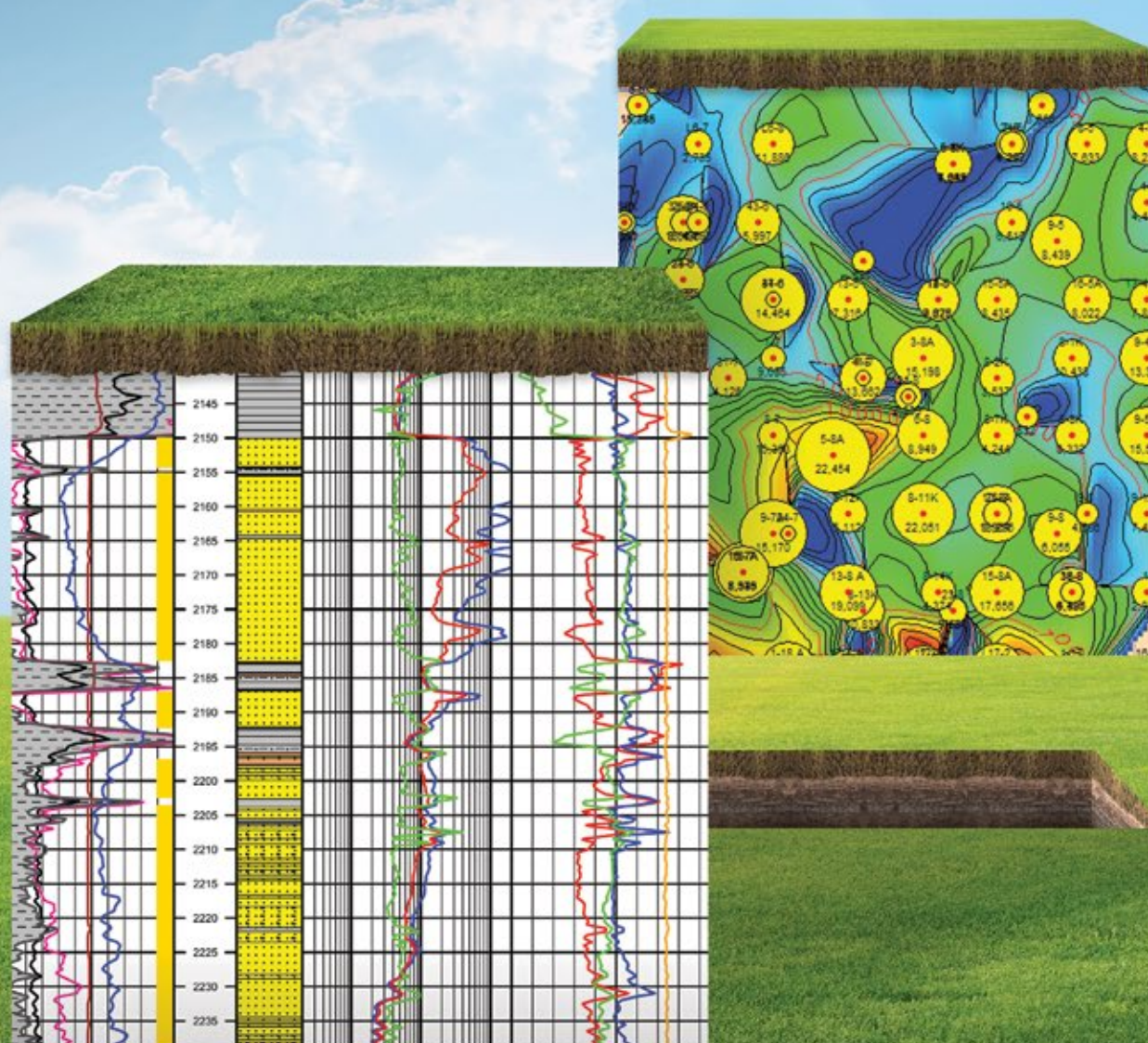
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## Favorable regulations

# Norway Proves to Be Nice for UAV Technology

By LOUISE S. DURHAM, EXPLORER Correspondent

**D**rones, i.e. unmanned aerial vehicles (UAVs), are not welcome just anywhere.

Their reputation as stealth machines performing unwelcome activities tends to overshadow the good side of these robotic conveyances.

Norway is among the countries with relatively less stringent regulations regarding UAV flights.

It's home base for a group of researchers using some exciting applications of varied cutting edge technology, including the drone.



BUCKLEY

The Virtual Outcrop Geology (VOG) research group, based in the Centre for Integrated Petroleum Research (CIPR)

in Bergen, is drawing attention for its involvement in using an array of geospatial technologies – including laser scanning,

**“We help improve knowledge so that new and existing fields can be exploited to a higher potential.”**

image processing and the UAV – to create 3-D virtual models of outcrops of geologic formation.

The UAV technology can take on a significant role in acquiring needed data in inaccessible areas, which a drone often can reach much faster than a pricier helicopter

“The virtual models of the outcrops can be used by the geologists to gain a deeper understanding of geological features and their impact on subsurface reservoirs,” said Simon Buckley, CIPR senior researcher and project leader in the VOG group.

The VOG group was formed in 2004 with the goal to expand the quantitative application of outcrops in reservoirs.

“The main aim of the VOG technique is to obtain high resolution and accurate geometric information that can be used as a framework for interpretations,” he said.

“Ultimately, we don't do exploration,” Buckley emphasized. “We help improve knowledge so that new and existing fields can be exploited to a higher potential.”

### Precisely Accurate

He noted that over the past 10 years the VOG has acquired considerable expertise using 3-D laser scanning to scan surfaces within a centimeter of accuracy.

“The main contribution is the high resolution and precision,” he noted. “This allows the geometry of geological features to be recorded and measured to an increasingly high degree, which can then be used for reservoir modeling, for example.

“In fact, a common use of the virtual outcrop model is to digitize key surfaces that are then exported to a reservoir modeling system and used to build geocellular models.

“Building geocellular models from outcrops creates a bridge between the subsurface and the outcrop analog,” Buckley emphasized. “The models provide an improved understanding of the stratigraphic architecture and can be used to simulate fluid flow in the analog.

“They also can provide a focal point for training and field trips,” he added.

### Assets and Challenges

The specially designed, camera-equipped drone piloted by the research team features eight rotors displayed on spokes emanating from the central body. The accouterment measures only a few feet across and tips the scales at just a few pounds.

It affords a stable platform for the camera sensors, being easily and quickly guided into position over the target area while controlled by an operator nearby on the ground.

“UAVs are proliferating rapidly into many applications,” Buckley said. “We saw the advancements in both the platform technology and the processing methods had reached the point where we could adapt them into our existing workflows.

“Advantages of the UAV are that it provides optimum camera positions for taking images, is fast to use and is cost-effective in relation to lidar equipment,” he noted.

“Challenges are perhaps mostly related to logistics and operation,” he said. “User training is required, weather conditions must be suitable (<10m/s wind speed) and regulations must be taken into consideration.” ■

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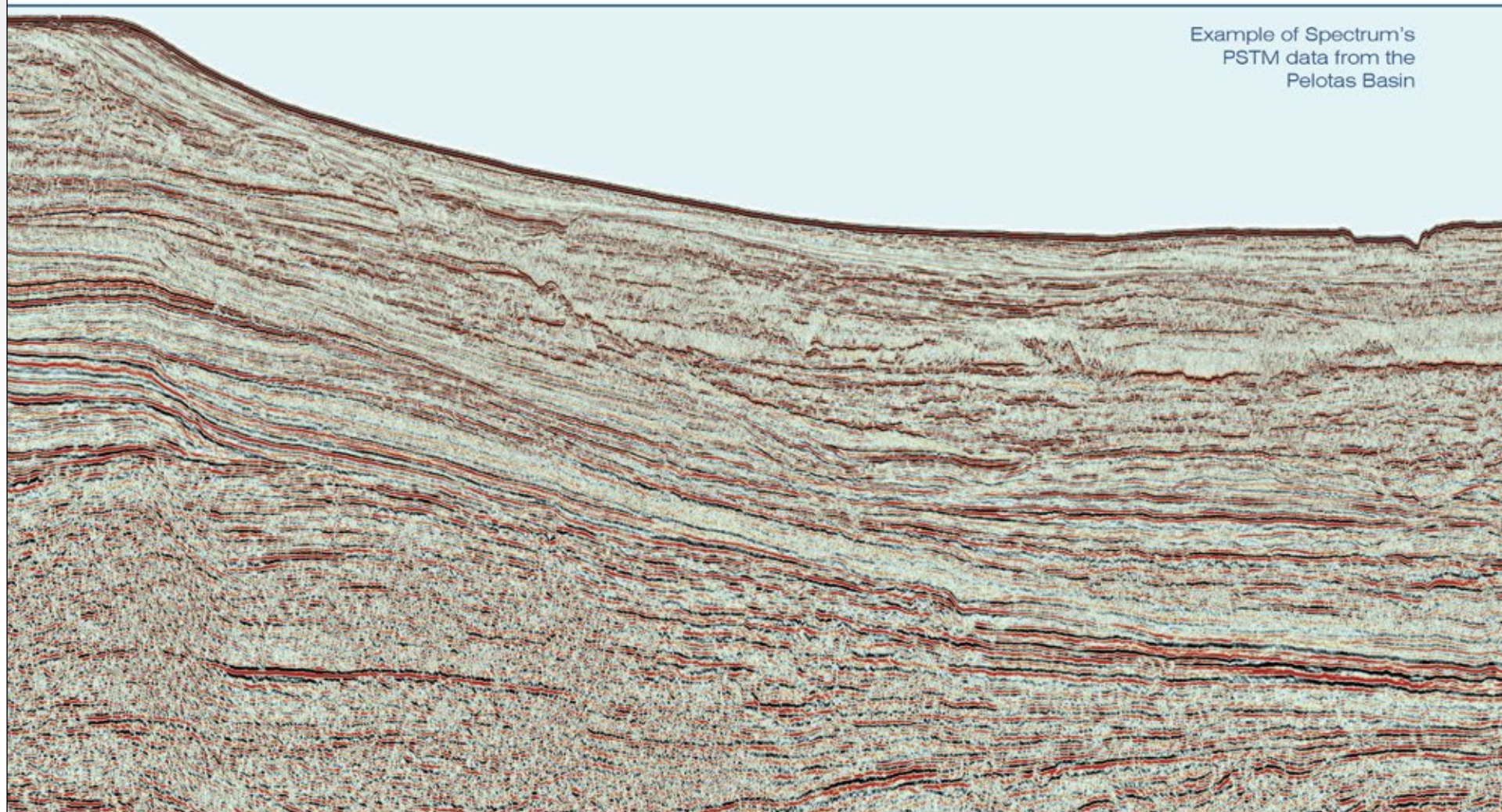


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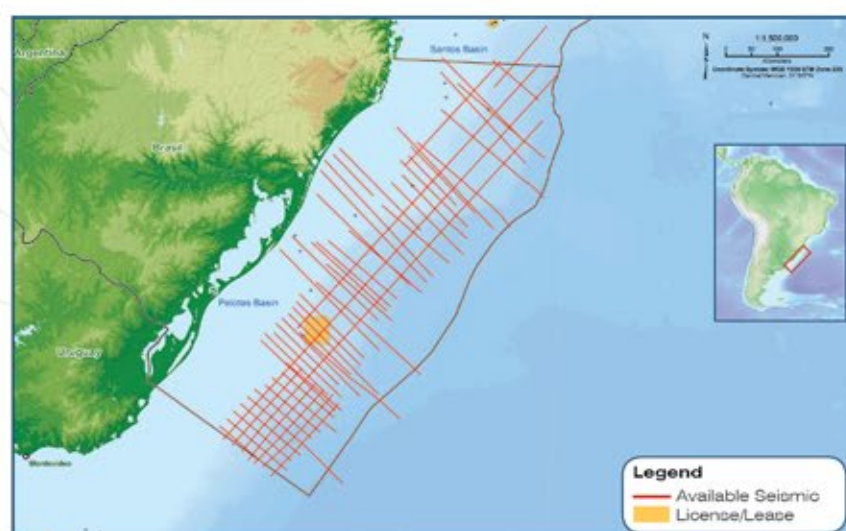
# Pelotas Basin Brazil

New 2D Multi-Client Seismic Available Q4 2013



Spectrum has completed acquisition of 7,500 km of new seismic data and is reprocessing an additional 10,000 km of legacy data. PSTM and PSDM stacks will be available for license Q4 2013.

The Pelotas Basin is an untapped hydrocarbon province comprising a 280,000 sq km passive margin located on the southeast coast of Brazil, bordering Uruguay to the south. Recent high quality 2D seismic data has imaged multiple potential reservoirs, traps, source rocks and direct hydrocarbon indicators in the basin.



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## Interpretation™

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## Induced seismicity: Defining the problem and solution for managing risk

It has been known for years that large volume injection can cause seismicity. Injection of industrial waste, military waste, and water has caused indisputable seismicity in many cases. In tectonically active regions, smaller injection volumes associated with stimulations can also trigger seismicity at levels felt by local communities. While these events have not led to widespread hazard for oil and gas operators, this problem is being recognized as an emerging risk that needs to be managed appropriately.

The editors of *Interpretation* ([www.seg.org/interpretation](http://www.seg.org/interpretation)) invite papers on the topic of identifying the risk factors of induced seismicity and on integrating monitoring data with operation protocols. Contributions are solicited for the following topics:

- interpreting geologic conditions that can lead to a seismic hazard
- integrating seismic monitoring with operations data
- understanding the implications of incomplete or ambiguous data
- designing monitoring networks to meet operational needs
- demonstrating how such systems can meet or exceed specific mandates for detailed geomechanical information

Interested authors should submit their manuscripts for review no later than **1 April 2014**. In addition, the special section editors would like to receive a provisional title and list of authors as soon as possible. Authors should submit via the normal online submission system for *Interpretation* (<https://mc.manuscriptcentral.com/interpretation>) and indicate that it is a contribution for induced seismicity. The submitted papers will be subject to the regular peer-review process, and the contributing authors also are expected to participate in the review process as reviewers.

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

The submissions will be processed according to the following timeline:

Submission deadline  
1 April 2014

Peer review complete  
1 August 2014

All files submitted for production  
15 August 2014

Publication of issue  
November 2014

### Special section editors

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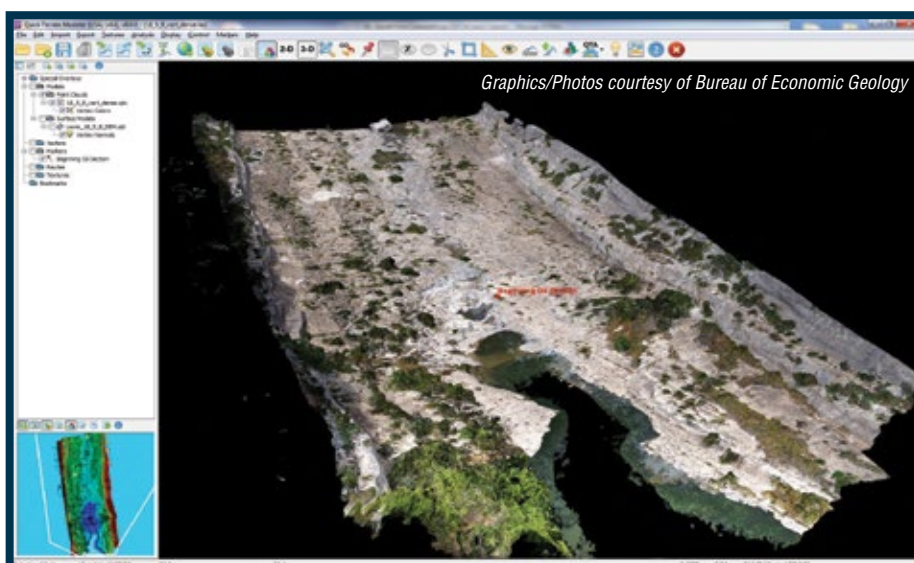
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*Interpretation* special section

# CALL FOR PAPERS



A picture is worth ... ? UAV technology has become a valuable tool in the science and interpretation of geology, as this 3-D model derived from overlapping images shows.

## A 'friendly technology'

# UAV Research: Making A Geologic Tool Even Better

By LOUISE S. DURHAM, EXPLORER Correspondent

There's a seemingly endless array of up-to-the-minute research programs taking place at the Bureau of Economic Geology in the Jackson School of Geoscience at the University of Texas, Austin.

Among its many projects, the BEG is pioneering lidar (light detection and ranging) remote sensing technology to be a valuable tool in the rapid quantitative characterization of outcrop geology.

The technology is being used to investigate both clastic and carbonate systems.

There's more – much more – as the researchers venture still further into the esoteric realm.

"The newest advances we've been doing a lot of research with lately include small UAVs (unmanned aerial vehicle), or drones," said AAPG member Chris Zahm, research associate with the Reservoir Characterization Research Laboratory (RCRL).

The RCRL is an industrial associates program comprised of 30 oil and gas companies that support the research.

Zahm noted that AAPG member Charles Kerans, the principal investigator of the RCRL since its inception in 1987, has been instrumental in bringing both ground-based and airborne lidar, along with the UAV technology into practical and useful forms for over a decade.

"With lidar you send out an active signal, a laser, toward the outcrop, and it has a reflectivity back to a scanner and tells the scanner exactly how far away the outcrop is," Zahm noted.

"Right now, we're using our drones to take photos," he said. "The science and software exist that if you take a photo of some object from multiple locations, you have the ability to create a 3-D model from those photos."

He noted that this is actually photogrammetry, which is a more-than-100-year-old science, commonly used for

the development of topographic maps.

The game plan using the drones is to have significant overlapping of the photos.

"If we take a drone and fly it around over a particular outcrop, we can take a picture from multiple angles and develop a quantifiable 3-D image of that outcrop," Zahm said. "This has been an exciting new frontier we've been dealing with in the last 18 months."

"I find it to be even more attractive to geologists because it inherently puts together the photograph as you might see (the outcrop) if hovering directly over it – kind of like getting a bird's eye view so to speak," he emphasized.

"It can be very realistic," he said. "You can look at the outcrop from many different perspectives, and it can be quantified."

**"This has been an exciting new frontier we've been dealing with in the last 18 months."**

### Comprehensive Coverage

Zahm noted that the UAV enables them to pre-program a flight pattern to be very systematic in how the overlaps work. This beats the heck out of trying to snap overlapping photos through the window of a helicopter.

When conducting a robotic program via the UAV, it acquires a 65 to 75 percent overlap on each picture given that it's pre-programmed to do so, and this gives a higher accuracy or precision to the resulting model.

Using the pre-programmed flight path enables sufficient overlap to be recorded while covering the entire area of interest over the outcrop.

"We get a very high resolution photo looking vertically down on the outcrops,"

See **UAV Technology**, page 22



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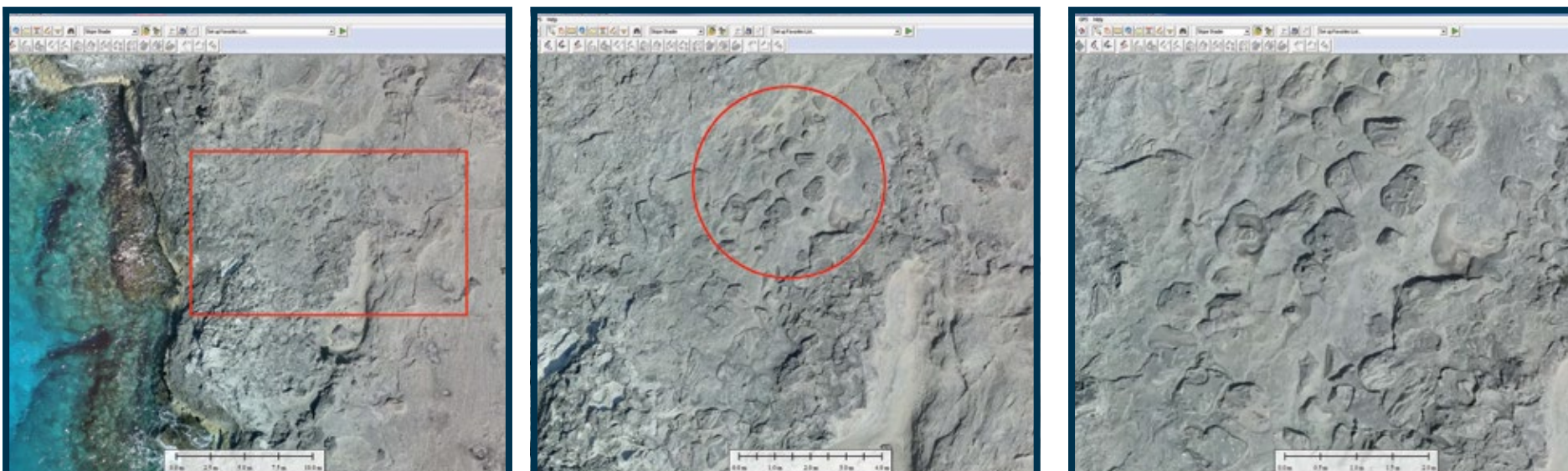


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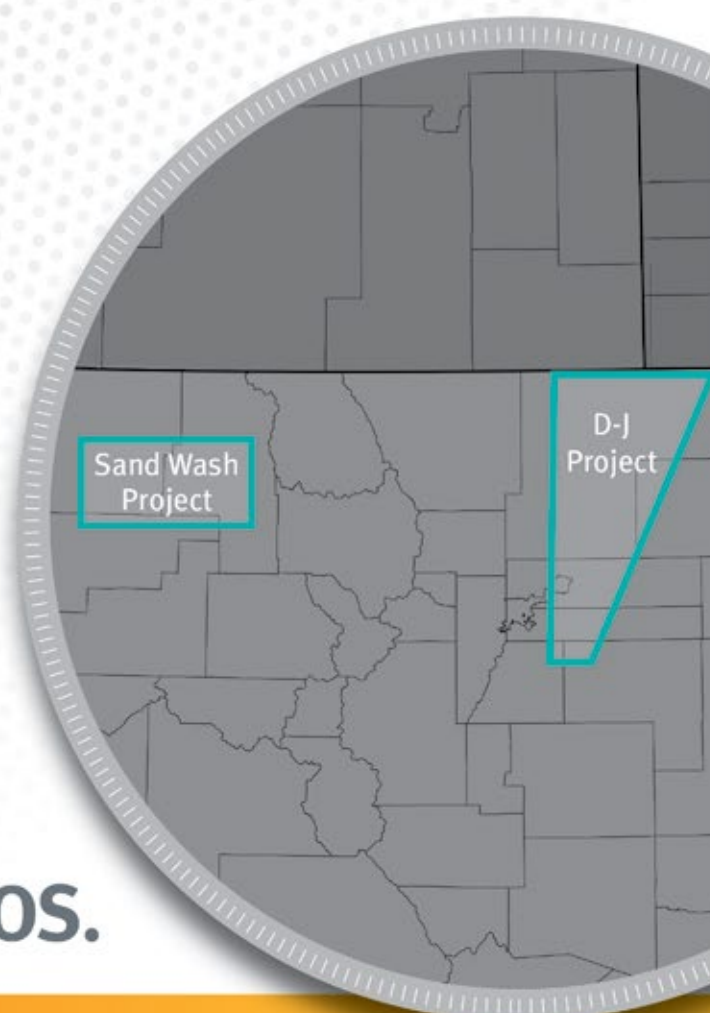




UAV-acquired photostitch of West Caicos Island, illustrating the difference in resolution. The red box (left) is the location of the enlarged image in the center (note the individual boulder conglomerates in the beach facies), which in turn is magnified in the photo on the right for an even-more detailed view.

## LOOKING TO UNLOCK THE SECRETS OF THE NIOBRARA?

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After acquisition is completed in the fourth quarter, data processing and multi-measurement interpretation will follow. Results are expected to be available for license to non-underwriters in the first half of 2014.

To learn more about these programs, visit: <http://tinyurl.com/neos-Colorado>



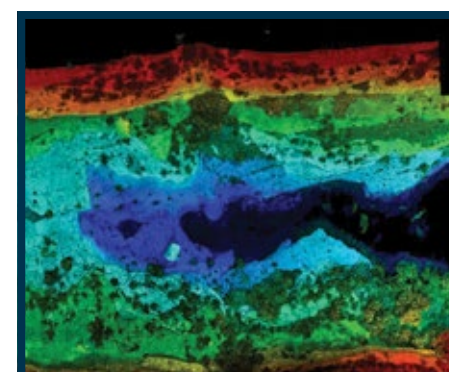
## UAV Technology from page 20

Zahm said. "You can't acquire that level of photograph from commercially available satellite pictures.

"In our photos, we're talking about centimeter to millimeter resolution, which is very different."

Zahm noted that the UAVs the RCRL group uses measure 24 to 30 inches wide. They can carry them to the field and deploy them with the cameras.

"It's sort of like taking a robotic helicopter like your kids play with and making it a useful tool in the field," he jested.



DEM: High resolution that allows for elevation interrogation and detailed mapping.

### Positive Purposes

He is a true believer in the many positive applications for drones.

"When I talk about drones to people, they tend to think about the military aspects, and it's kind of a negative connotation," he noted. "We have to remember that there are benefits as well, and it can be a very friendly technology.

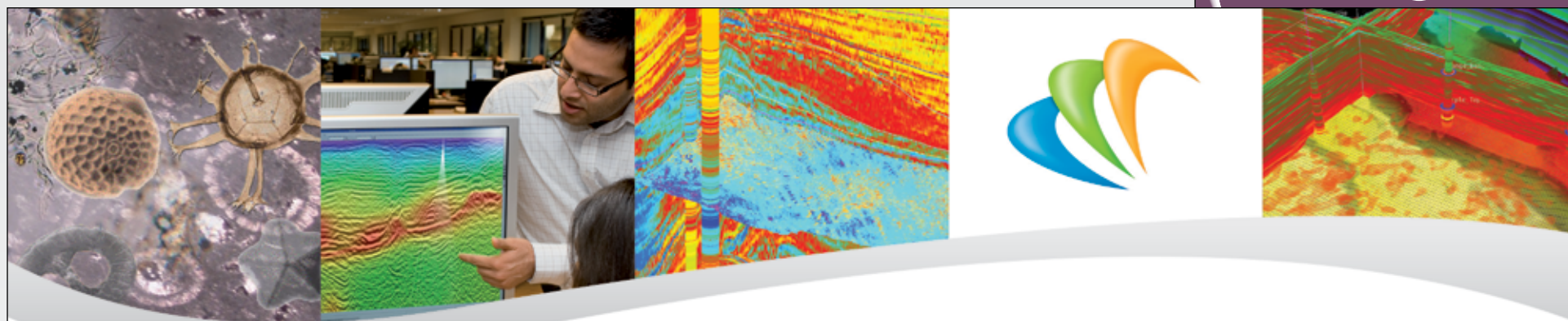
"The application of UAV technology definitely has improved the ease and quality of reservoir characterization," Zahm declared.

To further emphasize the friendly-use aspects, he mentioned a recent situation where a research partner flew a drone over a gathering of UT alums. This resulted in one of the attendees deciding on the spot to use a drone to assess a property of interest to him.

Current RCRL applications of UAVs include:

- ▶ Turks and Caicos (Bahamas) – West Caicos (facies and fracture mapping).
- ▶ China – Permo-Triassic grainstones.
- ▶ Lewis Canyon (Texas) – Fault-related fractures.
- ▶ Canyon Lake (Texas) – Fault-related fractures. ■





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## Historic discovery at sea

# Surprise! It's a Volcano

By BARRY FRIEDMAN, EXPLORER Correspondent

It's good that William W. Sager, professor in the Earth and Atmospheric Sciences Department at the University of Houston (formerly professor at Texas A&M University) and lead author of a study that helped discover the largest single volcano on Earth, has a high tolerance for stupid questions.

All the more noteworthy as Sager, an AAPG member who has received the school's College of Geosciences Award for Distinguished Achievement in Research, has more than 110 refereed articles to his credit.

On the other hand, you find the single largest volcano on earth, people are going to ask how it is possible that everyone else missed something so big.

"Things under the ocean are hard to see," Sager says, anticipating the question, "so we oceanographers have a great deal of difficulty figuring out what is there sometimes."

The difficulty, it seems, is counter-intuitive. The bigger things are, the harder they are to locate.

Sager, who has participated in 41 research cruises, explains it this way:

"Imagine wandering across something the size of New Mexico with a flashlight and trying to figure out what it is," which was the case of the area in question, which came to be known as Tamu Massif (Tamu for Texas A&M; Massif is a geologic term meaning an isolated mountain group, but also is French for – wait for it – massive), located about a thousand miles east of Japan in the Pacific Ocean.

"Indeed, this is an apt analogy because for all of our survey lines, we only crossed a few times," he continued. "So imagine that you are riding across New Mexico on your bike (that's about how fast a ship goes) in the dark with a flashlight. That's about what it is like."



SAGER

### Helpful Innovations

For those who may have missed the announcement, Sager was the lead author for a team that in early September announced it had found the structure – called by others a

"supervolcano" – in the Pacific Ocean.

As reported, the volcano rivals in size the solar system's largest known volcano, Olympus Mons on Mars.

Other scientists already have said that the discovery will lead to the rewriting of textbooks and rethinking of volcanology.

Sager and his team reportedly first studied Tamu Massif nearly 20 years ago, on a research trip to gather data on an undersea mountain range that contains the structure. They didn't realize, however, that it was a single structure.

Technological innovations have since entered the scene.

Specifically, Sager says there were two developments that came together during the past four years that made the discovery – and more on that word in a moment – happen now.

"Number one is that we were able to use the R/V Marcus G. Langseth, which is a former industry seismic ship," he said. "The big sound sources of this ship allowed us to shoot sound waves deep within the volcano and make an image from the returned sound waves."

He says it was like an x-ray profile of the volcano structure made with sound.

"What these data showed us is that on all of our profiles across Tamu Massif, we saw layering that looks like lava flows running downhill from the summit," he said. "In other words, there appears to be

only one source of the lava flows, and that is at the top of the volcano."

The second development, he said, was a result of the cores collected by Integrated Ocean Drilling Program Expedition 324 in 2009, which was completed the year before the seismic survey.

"We recovered lots of lava flow samples," he said. "What was especially interesting is that the lava flows from Tamu Massif were characterized by pulses of flows that are very thick – the maximum we cored is 23 meters, or about 75 feet."

That was huge.

"That kind of flow occurs in places called 'flood basalt provinces' and implies that huge quantities of lava poured out," he explained. "Such lava flows can run long distances, and this is probably why Tamu Massif has a very low slope – about 1 degree or less. You would have trouble knowing which way is down if you were standing on it."

### Back in Your Own Backyard

But getting back to the "discovery" of this, Sager wants to be careful.

"I have tried to be careful with the word 'discovered,'" he said.

And this is because, like other scientists, he knew there were these volcanic mountains called oceanic plateaus in the oceans in the region, so it's not like it was completely foreign.

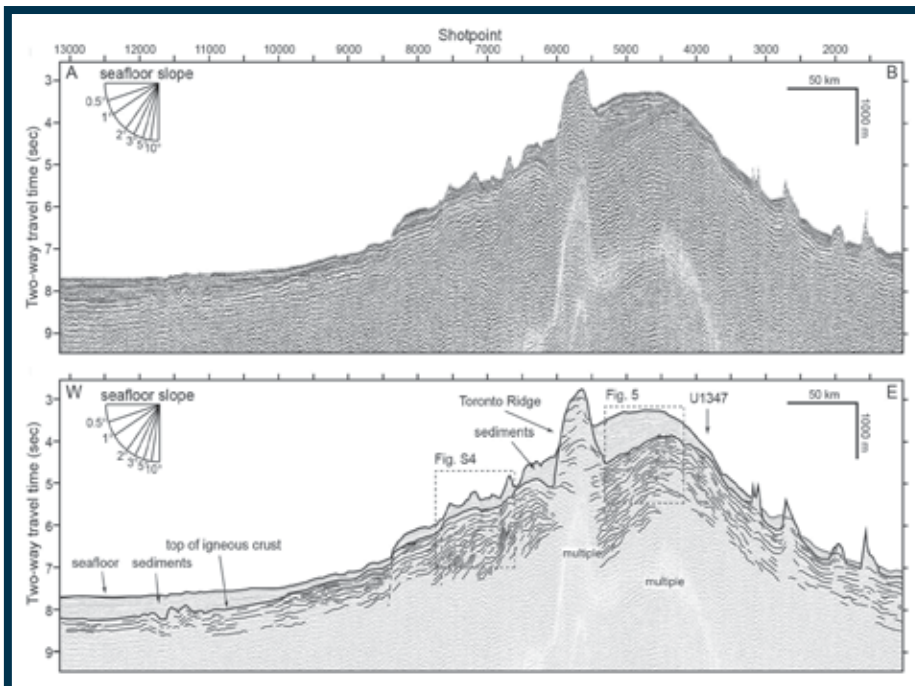
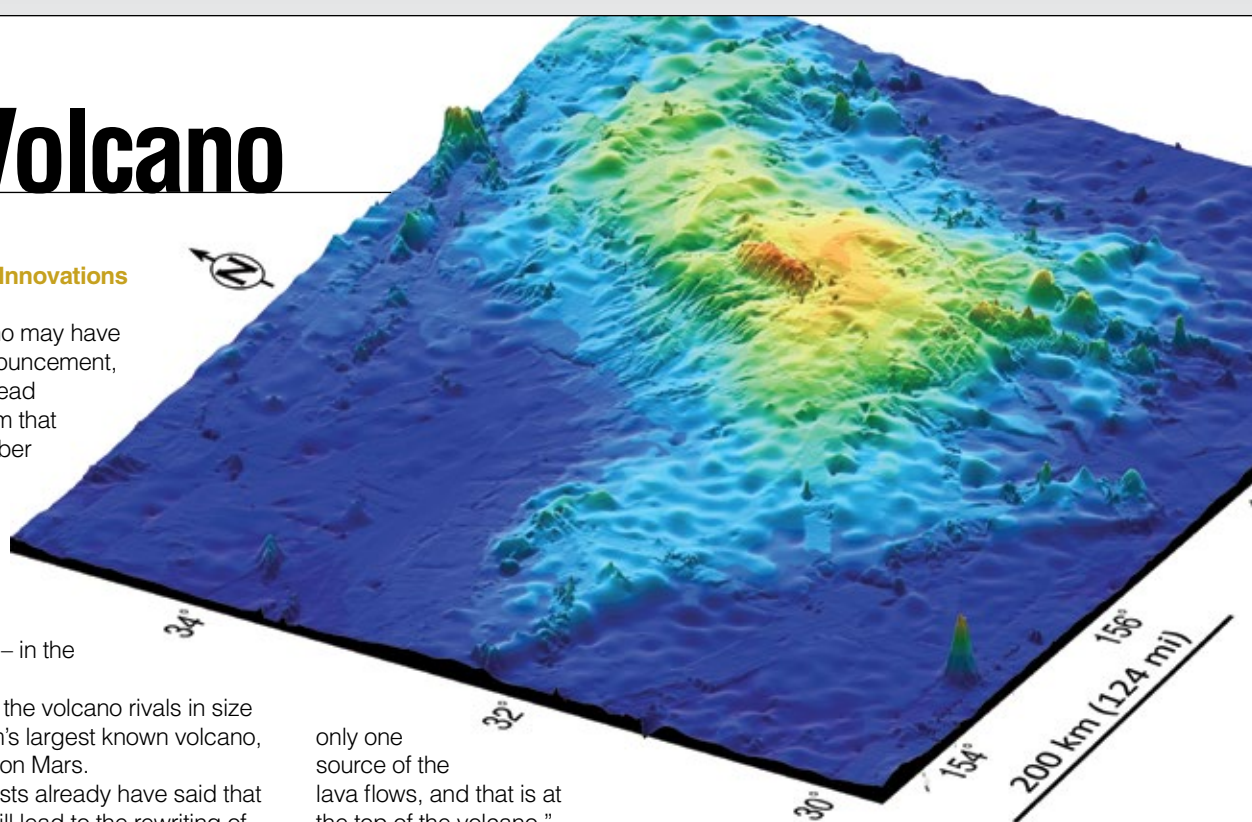
"Indeed, Shatsky Rise (of which Tamu Massif is part) has been known for nearly a century," he said. "We knew that Shatsky Rise and others were there. In the past few decades, we knew that they were volcanic."

But that was when they thought it was a series of volcanoes – not one giant volcano.

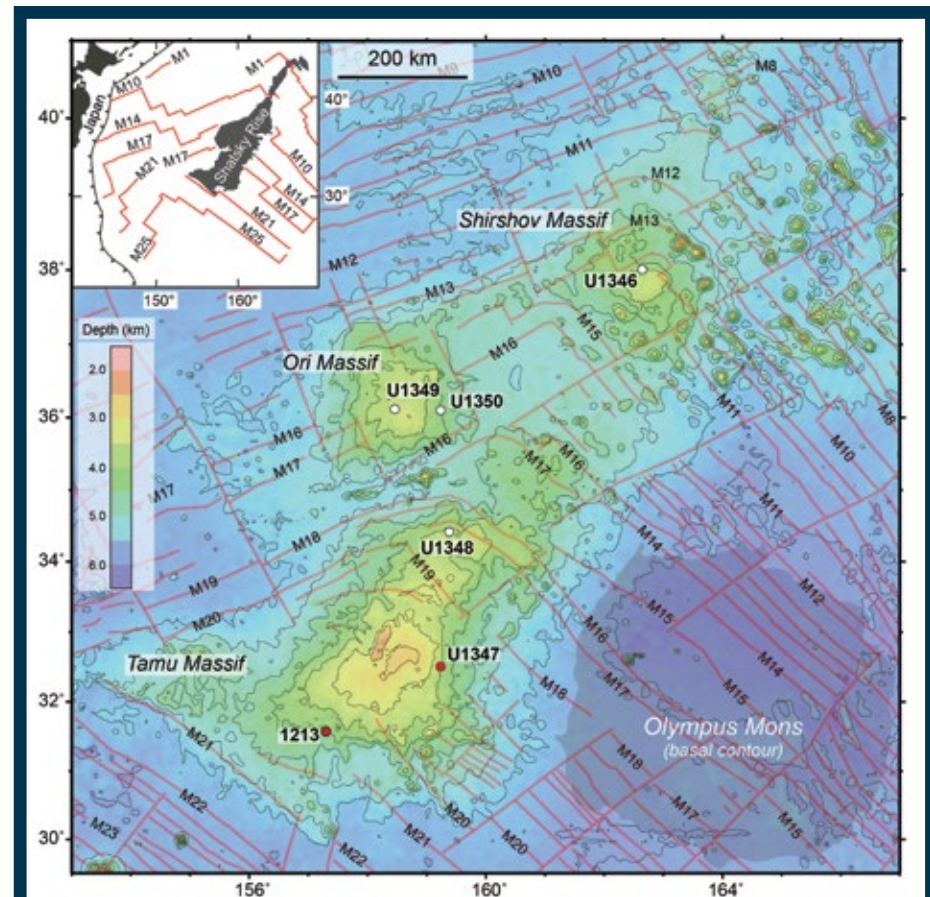
"What happened in this study is that we realized it is a single volcano," he said. "With a volcanic edifice of this size, the more likely thing would have been that it is a complex of volcanoes, similar to the Big Island in Hawaii (which includes Mauna Kea, Mauna Loa, Kilauea, Hualalai and Mahu Kona volcanoes)."

When asked about the enormity of such a find, he says it is almost unimaginable.

"We know that birds are the present-day



A cross section of Tamu Massif, which scientists discovered recently in the Pacific Ocean. The top graphic shows MCS reflection Line AB, across the axis of Tamu Massif (top graphic, MCS data; bottom, interpretation). Dark lines highlight the intra-basement reflectors. MCS data have a nominal fold of 59 and have been processed with band-pass filtering, deconvolution, normal-moveout correction, stacking and time migration. The arrow labeled U1347 shows the position of that IODP site. Dashed boxes show the locations of figure 5 and supplementary figure S4. Vertical exaggeration: 37:1.



See Volcano, page 26





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The team studies cores taken from the Tamu Massif expedition.

## Volcano from page 24

descendants of dinosaurs," he said. "Let's say we didn't know that there were any bigger than the emu or ostrich. But then we discovered fossils of a T-Rex or a bird of similar size. That's what we have here."

To wit, the biggest current volcanoes are on the order of 1/50th of the size of Tamu Massif."

And then there is the comparison to Mars.

"We compared Tamu Massif with Olympus Mons, which is the biggest known volcano in the solar system," he said, "so we are not surprised that there are volcanoes of that scale."

"We just didn't know they were hiding in the backyard."

## Work Continues

Reportedly, there is now no danger of Tamu Massif erupting. But when it did erupt, how powerful was it?

"That's really unclear," Sager replied. "Tamu was a basaltic volcano – that's like Kilauea and Mauna Loa in Hawaii. You can drive up to an eruption and have a look and go have lunch. They are not killer eruptions."

But that doesn't mean it won't ruin your day.

"There was an eruption in Iceland in the 1700s (Laki, or Lakagigar) that had environmental effects in Europe," Sager said, "but civilization was not wiped out."

"We know the age (approximately) of Tamu Massif, and there is no obvious glitch in the geologic record that you could say is a clear environmental effect of this volcano," he continued. "Maybe this type of eruption did a little bit of damage, but not enough to wipe out the flora and fauna."

"It seems likely that it would spew lots of gases into the atmosphere and perturb climate, at least a bit," he said. "But that's something that scientists still have to work on."

And speaking of work, when asked what the future holds for him after helping to find something the size, in fact, of New Mexico, something he found by using the right flashlight, Sager, an AAPG member, is somewhat jaded and uncertain.

"Naturally, I will try to get additional data for Shatsky Rise, but this cool result does not translate into new funding."

How is that possible?

"To get sponsorship from the National Science Foundation, whose funds are stretched thin, I have to convince other scientists that I have a new hypothesis and I can devise a test that will solve the scientific problem that I am proposing – and oh, by the way, it is critical to do it right now."

Even this project, he says, was a tough sell. And this from a man who has won more than 40 research grants, totaling nearly \$4.5 million.

"The seismic survey of which I spoke was turned down four-five times (at one try per year) before my colleague, Jun Korenaga (Yale University), and I finally got it funded."

And it still wasn't easy.

"In fact, we didn't get it funded until the drilling program committed to go out and drill," he said. "So, I already have submitted a proposal to collect magnetic anomaly data over Tamu Massif. The magnetic lineations formed at the spreading ridges tell us about the evolution of the oceanic crust around Tamu Massif. They were formed about the same time, so the surrounding crust will give us clues about Tamu."

"Some colleagues in Germany are proposing to go to northern Shatsky Rise to dredge some rocks for geochemical studies," he added. "They are looking at the later evolution of Shatsky Rise."

"It all fits together to help make a clearer picture."

So, if that all materializes, what then happens next for William Sager, a man who's been doing this type of work in marine geophysics for 30 years, the former holder of the Jane and R. Ken Williams '45 Chair in Ocean Drilling Science, Technology and Education while at Texas A&M?

And in quite possibly the greatest and most accurate answer any scientist, any artist has ever given, he says:

"Don't worry. I'll keep busy." ■

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The Present And Future Of GeoPrediction



## AAPG Team Gives Scouts a Taste of Geology

By CHRISTOPHER STONE, EXPLORER Correspondent

One school of thought says today's teenage boy lives in a multi-media world, and if we want to talk to him we have to go to that place.

On the other hand, the Boy Scouts of America believes today's teenager does not spend enough time in nature.

So what is the most meaningful way to effectively merge these two philosophies?

"BSA is trying to put more science into its outdoor program," according to Rachel Hintz, who sits on the BSA STEM committee. She goes on to say kids have to learn the same lessons in multiple settings for the lessons to be relevant, and she adds many home schoolers are looking to BSA and other youth organizations for science programming.

Every four years the Boy Scouts hold a jumbo-sized camporee called the "Jamboree," and nearly 35,000 teens and adults attend from all parts of the United States.

And since the late 1990s, the AAPG Foundation has provided sponsorship and funding for a team of professional geologists to attend this Jamboree and provide the geology part of the nature study program through teaching the Geology Merit Badge.

This past summer marked the first time BSA held its quadrennial Jamboree in its new 10,000-acre facility near Beckley, W. Va., and they shifted the program to de-



HART



Photos courtesy of Ron Hart



AAPG members, funded largely by the AAPG Foundation, spent their summer sharing the world of geology with Boy Scouts at the quadrennial Boy Scout Jamboree, held near Beckley, W. Va.

emphasize merit badges in favor of having more outdoor experiences.

Hence, it was decided early that geology was an obvious good fit within the new conservation and sustainability emphasis – and the AAPG team was encouraged to develop program aspects to "get the kids out of the tent and into the fresh air."

### Geology Field Trips – Virtual and Real

"Some Scouts may be looking at geology as a career option, where others are casually interested," says Ron Hart, an AAPG/Datapages staffer as well as an AAPG member who for decades has volunteered his time to help organize the Jamboree effort.

"Our challenge is how to engage kids at both ends of the spectrum," he added. "I think we were successful with our multi-level program."

Fellow AAPG members Scott and Jane McColloch, both geologists with the West Virginia Geological and Economic Survey, developed the story for the entire team to use in explaining the geologic history of the Central Appalachians. Scott helped organize staff training in the few days prior to the Jamboree so all the team could have credible information and be consistent in their answers.

The McCollochs also led a guided geology hike for the Scouts with the highest level of interest. They taught the kids how to look for features, collect samples and

See Jamboree, page 44

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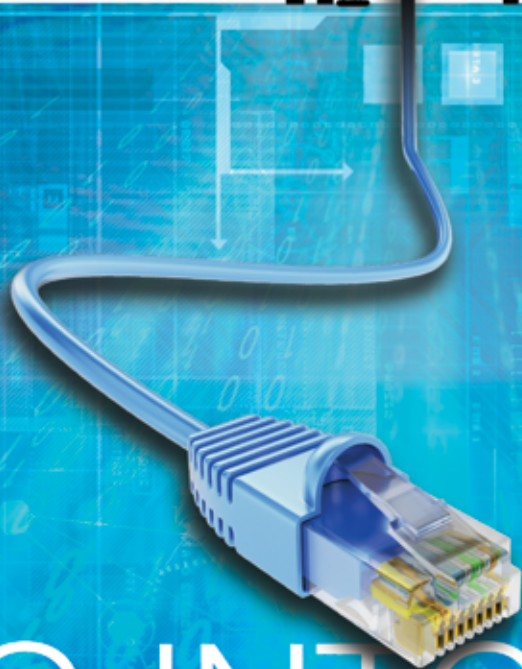


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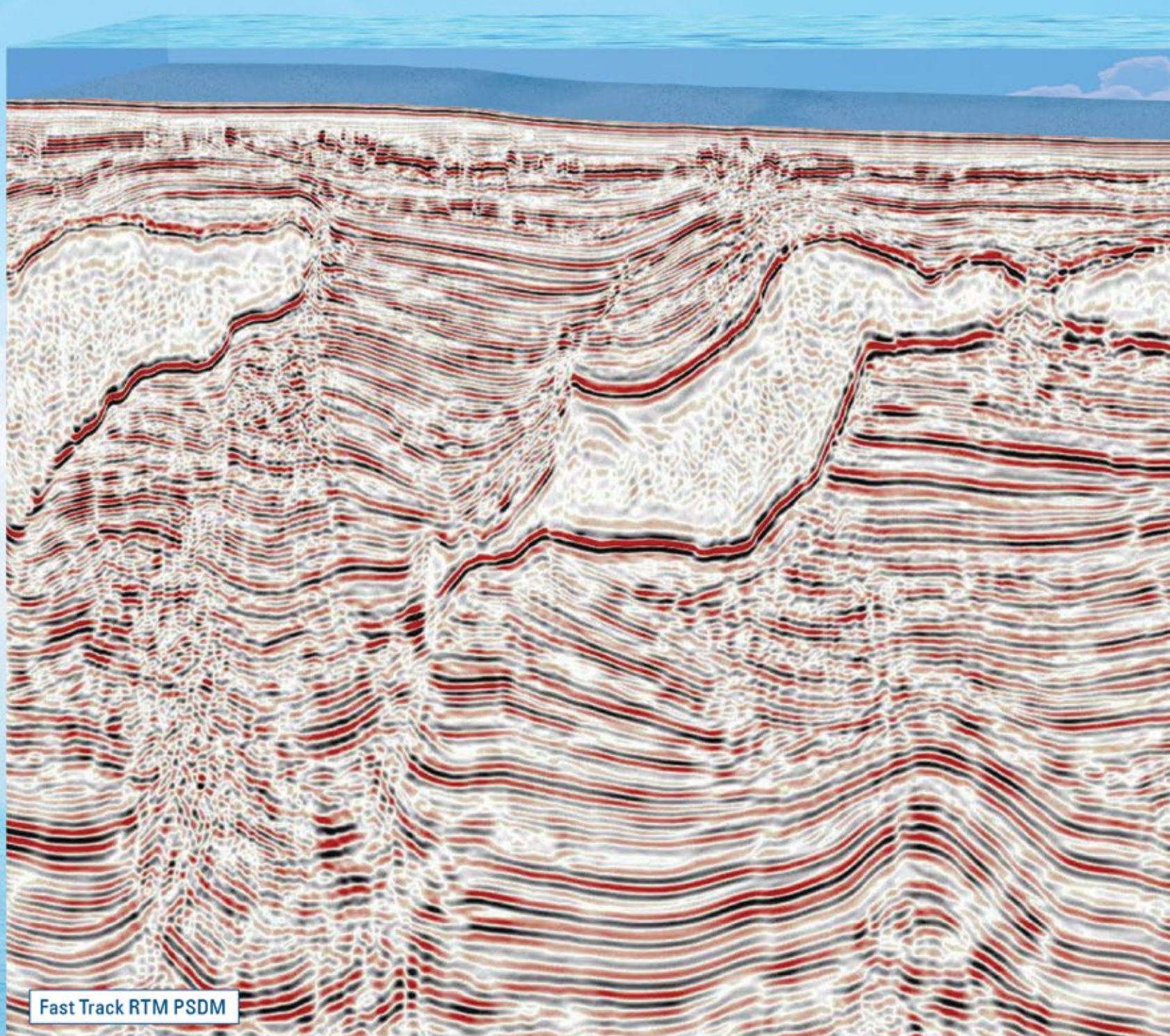
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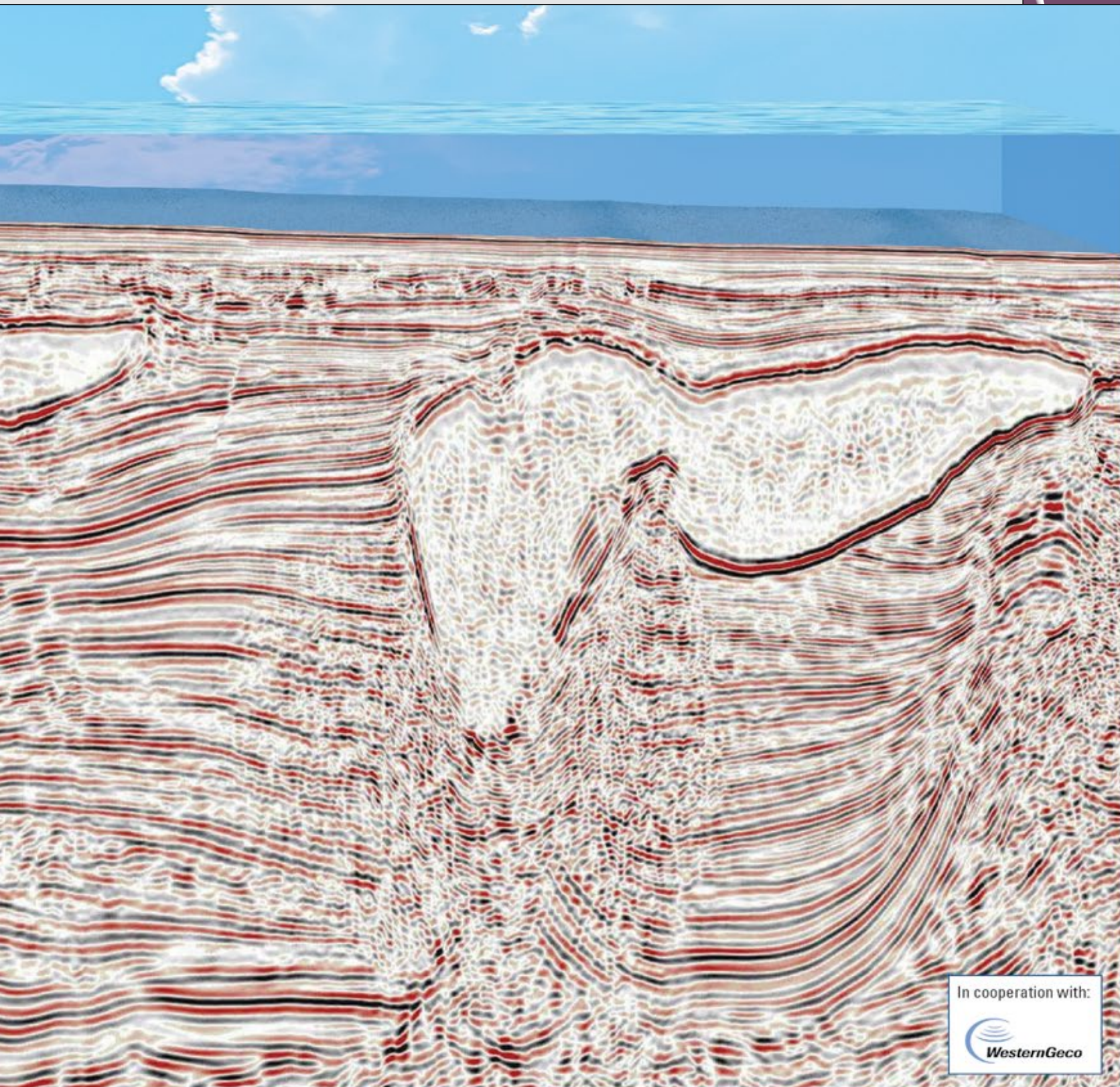
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# YPs Enjoy 'Unforgettable' Experience at ICE

By ANTONIO VELASQUEZ, YP Leader – Latin America Region

This year AAPG's International Conference and Exhibition returned to Latin America, but set for the first time in Colombia – and a perfect phrase to describe the Cartagena meeting is that it featured a "massive and passionate participation of young people."



VELASQUEZ

In fact, an unprecedented number of activities for Young Professionals and students proved to be a huge success, delivering an unforgettable conference experience to both groups.

Here is the summary of the main activities carried out during ICE:

### ► YP Meet-N-Greet.

The ICE Meet-N-Greet took place in room packed by 200-plus participants (the largest group ever) and more than 40 professionals (mentors), including big names in the oil and gas industry.

The event started with welcomes from AAPG President Lee Krystinik, ICE general chair Victor Vega, AAPG Latin America Region president Victor Ramirez, AAPG member services manager Vickie Beighle and yours truly.

YPs, students and mentors actively interacted during the hour-long event, sharing experiences on topics such as



Getting to know you: John Kaldi, AAPG's vice president-Regions, was just one of the participants in the Meet-N-Greet session held in Cartagena before the ICE opening session.

professional growth and employment opportunities while enjoying refreshments and t-shirts provided by event sponsor Shell.

Attendees also learned about the ICE Networking Challenge – and most participated enthusiastically throughout the week.

### ► Art of Interviewing and Career Path.

This activity was featured for the first time at an ICE, facilitated by Regional IBA lead Carlos Santacruz, Latin America Region past president Miguel Ramirez, student liaison Ignacio Iregui and, once

again, yours truly.

The event in some ways resembled the Meet-N-Greet, and even involved most of the same mentors, including past AAPG presidents Paul Weimer and Scott Tinker and Javier Gutierrez, among others.

However, the session also targeted geoscience students and featured a "speed dating" format in which mentors spent 10 minutes per table, rotating frequently to be able to speak with as many people as possible.

The original event was limited to 100 people, but more than 200 individuals

attended, and all were allowed to participate.

Throughout the session, students and YPs (of which there were at least one per table) asked mentors questions about their career plans and how recruiters hire people in the real world.

### ► The Student Chapter Leadership Summit (SCLS).

This was a last-minute addition to the ICE program, but like the other YP/student-oriented activities it was packed with attendees. More than 60 students representing 15 student chapters from throughout Latin America attended the event led by AAPG secretary, and former Student Chapter Committee chair Richard Ball.

The organizers used both games and lectures to address leadership dynamics, career planning and guidance for creating and maintaining AAPG Student Chapters – and SCLS participants appreciated having a leadership activity designed specifically for them.

### ► Student Reception.

Following a popular ICE tradition, the ICE student reception was held the last night of the conference. AAPG and Latin America Region leadership attended the event, and reception organizers presented awards to the winners of the ICE Networking

See ProTracks, page 34

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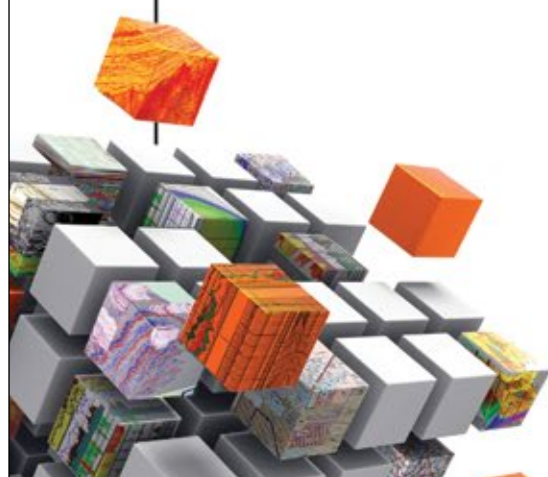
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The editors of *Interpretation* ([www.seg.org/interpretation](http://www.seg.org/interpretation)) invite papers on the topic "Unconventional reservoir development and production" for publication in a November 2014 special section to supplement the journal's regular technical papers on various subject areas.

Contributions spanning multidisciplines are invited. They include, but are not limited to, the following topics:

- case studies on optimization in development and production of unconventional reservoirs
- methods and workflows that lead to improved understanding of unconventional reservoirs
- reservoir modeling and simulation for performance prediction
- petrophysical and geologic studies (laboratory- and outcrop-based)
- integrated multidisciplinary characterization of unconventional reservoirs
- review and tutorial articles

Interested authors should submit their manuscripts for review no later than **1 March 2014**. In addition, the special section editors would like to receive a provisional title and list of authors as soon as possible. Authors should submit via the normal online submission system for *Interpretation* (<https://mc.manuscriptcentral.com/interpretation>) and select Unconventional reservoir development and production in the manuscript type dropdown option. The submitted papers will be subject to the regular peer-review process, and the contributing authors also are expected to participate in the review process as reviewers.

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

The submissions will be processed according to the following timeline:

Submission deadline  
1 March 2014

Peer review complete  
1 August 2014

All files submitted for production  
15 August 2014

Publication of issue  
November 2014

Special section editors

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## REGIONS&SECTIONS

# Global Growth Continues: AAPG Opens Africa Office

By CAROL CAIN MCGOWEN, AAPG Regions and Sections Development Manager

**A**APG's newest regional office, the AAPG Africa Office, opened its doors early October in Lagos, Nigeria, thereby bringing AAPG closer to its many members in Africa.

AAPG's official address in the Africa Region will be housed within the office complex owned by the Nigerian Association of Petroleum Explorationists (NAPE).

AAPG Africa Region President Gilbert Odior announced recently the hiring of Delia Kuye, who will staff the Lagos office as programs manager, AAPG Africa Region.

The establishment of an Africa office and hiring of staff to serve AAPG in the Africa Region is truly an historic accomplishment – and would not have been possible without the longstanding relationship and mutual trust between AAPG, AAPG Africa Region, and the Nigerian Association of Petroleum Explorationists (NAPE).

"I wish to say a big thank you to all the AAPG Africa Region past presidents, executives and leadership for laying the foundation for the AAPG Africa Region Office in Lagos," Odior said.

Kuye, an AAPG member, brings all the right credentials to her new role within AAPG:

► She holds a bachelor's in geology from the University of Reading, England, and a master's in integrated petroleum geoscience from the University of Aberdeen, Scotland.

► After graduation she gained further industry awareness and experience through internships with Marathon Oil in Aberdeen and ExxonMobil in Lagos.

Her education credentials, industry exposure and, most recently, her experience working with a logistics firm in Lagos will benefit AAPG in the Africa Region to expand its programs and services.

### Big Growth, Big Potential

When the Africa Region was formed (along with the other Regions) in 1999, AAPG membership in Africa was at 460 members. Since then, membership in Africa has skyrocketed to 2,721 in 2013, making Africa the third largest Region in terms of members, after the Asia-Pacific and Europe regions, respectively.

Africa, Asia-Pacific and the Europe

Region also share a common demographic; the significant increase in Student and YP membership in these Regions accounts for a large percentage of the total membership growth.

Among her first assignments, Kuye will help with outreach to universities, organizing the 2014 IBA competition as well as a local Student Chapter Leadership Summit.

Shortly after ordering furnishings, phone and Internet for the AAPG Africa Office, Kuye traveled to Tulsa for a week of training and orientation at AAPG headquarters. To say AAPG's

newest Region staff member hit the ground running would be an understatement.

"We shall be improving AAPG's African-based membership and regional presence through intensification of outreach to students and professionals," Kuye commented in Tulsa.

"Communication is among the greatest challenges for this region," she continued. "Nonetheless, working with the Region leadership, we shall work toward eliminating barriers by improving communication and reducing membership challenges."

Almost immediately upon hearing the announcement, emails poured in from across Africa and North America expressing congratulations to the entire AAPG Africa Region leadership team for achieving this important landmark in the evolution of the Region.

"This is the realization of a goal that has been discussed and debated for a number of years," said Africa Region president-elect David Blanchard. "Having a dedicated programs manager will result in growth for the Region and signals a new chapter in attaining increased membership, holding Regional and local events, and attracting more affiliates."

But this major milestone in the Region's development may have been most meaningful to the Region's past presidents, Nahum Schneidemann (also known as President #1, 1999-2001) and Bayo Akinpelu (President #2, 2001-03).

"This is an important event," Schneidemann said, "recognizing the valuable role of NAPE folks in helping to open Nigeria, and eventually Africa, to AAPG activities." ■



KUYE

## ProTracks from page 34

Challenge, as well as for the best poster and oral presentation in the student category.

Food and beverages were provided by sponsor ExxonMobil.

Undoubtedly, the impact of this ICE on a generation of young geoscientists will be far-reaching. The excitement surrounding the Cartagena meeting and increased attention from the Region on the value of belonging to AAPG have resulted in renewed interest in AAPG activities from YPs and students.

Post-ICE, taking advantage of this momentum is the main strategy for keeping YP and student initiatives on track. Increased activity from both YPs and students led to the decision to split the YP/Student liaison role into two separate positions, and to create more local YP chapters (see diagram).

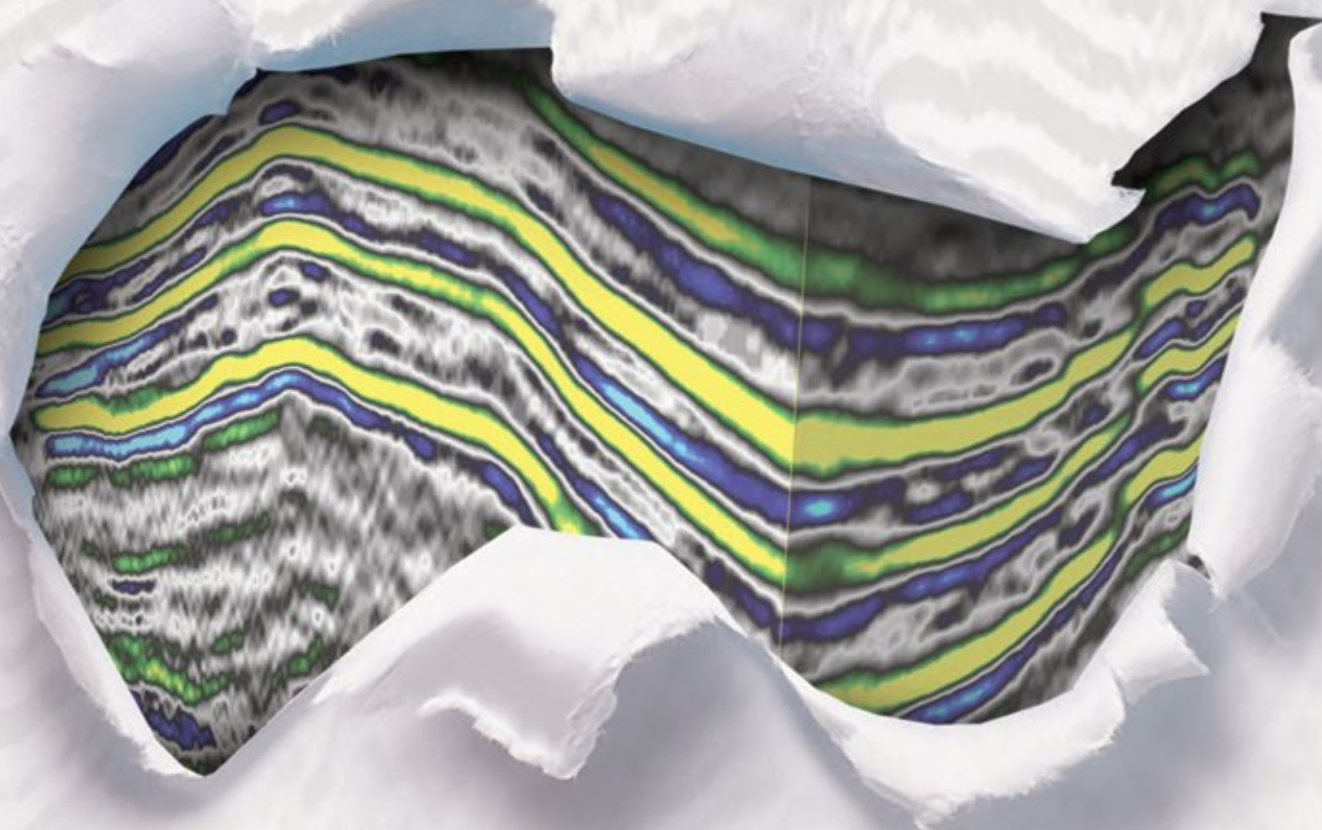
With continued commitment to YP and student programs, the future of the AAPG in Latin America looks very promising.

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Want to know more about YP activities in your area? Visit our website at [aapg.org/youngpros](http://aapg.org/youngpros), and contact your Region or Section representative. ■



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# Board Named, New Chapter Started in Angola

By CAROL CAIN MCGOWEN and DELIA KUYE

**A**ngola is Africa's second largest oil producer, with production in excess of 1.8 million barrels of oil per day and a growing reserves base in excess of about 10 billion barrels of oil. The country boasts huge geoscience activity plus the presence of major oil and gas companies.

Clearly, the need to have a community and forum for the advancement of professionalism and knowledge-sharing among the growing numbers of earth scientists within Angola cannot be over emphasized.

That need – for a dedicated community for geoscientists to come together under a common platform, especially for technical

The AAPG Angola Chapter will host its first field trip on Nov. 9, sponsored by Chevron and led by Chevron geologists Tony Lomando and Ray Garber, both AAPG members, on the study of Mussulo Bay modern sedimentary environments. The event is open to all geoscientists in Angola.

discussion and networking – precipitated the formation of the new AAPG Angola Chapter board.

Geoscience representatives from Chevron, Total, Gaffney-Cline, BP, Exxon and UAN University came together for their first meeting in July, and minutes of the founding meeting showed the board determined to promote recruiting of industry geoscientists for AAPG and

play an active role in the planning and execution of the inaugural as well as future AAPG Angola Chapter events.

The chapter's inaugural event was held Oct. 9 at the Hotel Tropico in Luanda.

AAPG Africa Region secretary Antonio Ingles, Malongo subsurface team earth scientist with Chevron Latin America/Africa E&P in Angola who also serves as the AAPG Angola Chapter board chair, noted,

"With over 200 people in attendance, the success of the inaugural event exceeded expectations."

Among the distinguished guests was Angola's Minister of Petroleum José M. Botelho de Vasconcelos, who gave the keynote speech, in which he:

► Acknowledged AAPG as a world class professional organization.

► Highlighted the benefits to Angola of AAPG's presence in the country.

► Pointed out that Angola became the seventh African country to have AAPG presence, after Libya, Egypt, Nigeria, South Africa, Morocco and Ghana.

The event also included a technical presentation given by Christian Seyve, TOTAL Angola, titled, "Mussulo Bay: A Modern Analog for Key Angolan Oilfields."

Other distinguished guests at the event included Sonangol's administrator for upstream, and managing directors of Chevron, ExxonMobil, Total, ConocoPhillips, BP, Statoil, Maersk Oil and Schlumberger.

Fifteen fourth- and fifth-year geoscience students from Agostinho Neto University helped with the event as volunteers.

## Plenty of Potential

Before the Angola Chapter, AAPG Africa Region supported the Deep Water Offshore West Africa Conference (DOWAC), held in Angola in 2007.

Many members of the AAPG community within and outside Africa Region have had long professional ties with Angola. For example, award-winning AAPG member Tako Koning, program chair for the new AAPG Angola Chapter, served on the organizing committees for all three regional DOWAC Conferences held to date.


Also, the election of Antonio Ingles as secretary-treasurer for AAPG Africa Region 2010-12, followed by his election as Africa Region secretary 2012-14, eventually signified it was only a matter of time before a platform such as this was created in Angola.

"The new AAPG Angola Chapter will provide the opportunities for geoscientists to gather and discuss technical issues and solutions, which will lead to technology transfer within the scientific community working the West Africa oil patch and new contacts made across the main interest groups present in the country and sub region," said Africa Region President, Gilbert Odior. "This is the industry helping itself to become more efficient and effective by sharing learnings in the interests of all."

Schlumberger Angola's managing director David Viela gave the AAPG Africa Region remarks in Portuguese on behalf of Nosa Omorodion, Africa Region member of AAPG Advisory Council and past Region president. Quoting Omorodion, Viela read:

"With the distinguished guests present at this inaugural event as witnesses, I boldly re-echo this belief that the AAPG Angola Chapter will play an active contributory role as a catalyst and repository of ideas that will serve the Angola oil and gas community and the country very well in the drive to grow reserves and increase production."

It was with an obvious sense of pride and relief that Ingles said:

"Overall, I believe we had an AAPG event that honors the AAPG name." 

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*They listened to the professor*

# Core Values: 70 Years of Canadian History

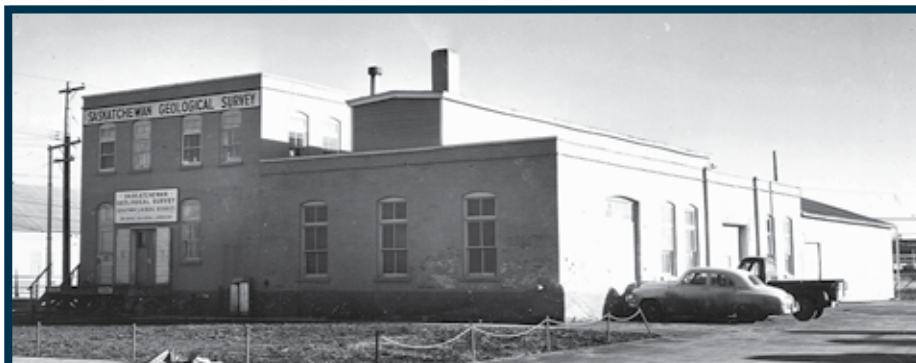
By DON KENT and MELINDA YURKOWSKI

Exploration for oil and gas in Saskatchewan was initiated in 1888 with the spudding of a 472-meter (1,548.5 feet) well near the settlement of Belle Plaine some 32 kilometers (20 miles) west of Regina.

Drilling was sporadic until the early years of World War II, when the need for secure sources of oil brought about a systematic search for hydrocarbons. Paramount in this search were Imperial Oil and its subsidiary, Northwest Company (later known as Norcanols Oil and Gas), both of which obtained large exploration reservations from the government of the day.

Harry Edmunds, a professor in the geology department at the University of Saskatchewan at this time, encouraged the government to acquire and store all subsurface well information, including cores and drill cuttings. The 1941 version of the Saskatchewan Well Drilling Act had clauses pertaining to governmental acquisition of geological materials and specimens, but did not specifically refer to submission of cores.

Edmund's urgings, however, evidently did not go unheeded, as the cores and drill cuttings from the first well drilled on the Norcanols reservation in 1942, Radville No. 1, were acquired and stored at the University of Saskatchewan. These and all subsequently obtained cores and drill cuttings were initially stored on the campus in a shed next to the engineering building,



*The converted chicken processing factory, Regina's first core storage facility.*

Don Kent, a 54-year member of AAPG, was the second geologist assigned to carry out research at the Subsurface Geological Laboratory, where he spent 13 years. The next 25 years

were spent as a professor in the geology department at the University of Regina, and for 11 of his last 14 years he was head of the department. At the end of his last term as head he took early retirement to become a full time petroleum geology consultant. In 2004 he was inducted into the Saskatchewan



KENT



YURKOWSKI

Geological Society's Geoscience Honor Roll for significant contributions to geoscience in Saskatchewan.

Melinda Yurkowski received both bachelor's and master's degrees from the

University of Regina, then took a job with the Saskatchewan Department of Energy and Resources. She is presently assistant chief geologist in the Saskatchewan Geological Survey, head of the Petroleum Geology Branch and geological manager of the Subsurface Geological Laboratory.

and eventually all were later moved to the basement of a Saskatchewan Government Liquor Board Store in downtown Saskatoon.

Laurence Vigrass was among the first graduate students at the University of Saskatchewan to do a master's thesis based on cores and drill cuttings stored at the liquor store. He indicated that the custodian let clients in – but after entry clients had to search for and lay out their own cores.

With these initial steps the province appears to have been the first political jurisdiction in Canada – and possibly in North America – to mandate the preservation of and public access to drill cores and cuttings.

### Discoveries Lead to Changes

Core storage in Regina began after discoveries of hydrocarbons in Mississippian strata in the Canadian portion of the Williston Basin in southeastern Saskatchewan, and in Mesozoic strata in the province's southwest corner.

The first location in Regina to be used for storage was an abandoned chicken processing plant located on the corner of Winnipeg Street and 8th Avenue.

The following quotes regarding this facility are from the recently deceased

See Cores, page 40

## Advancing the Interpretation - Understanding the Prize

### GTW T&T: Deep Horizon and Deep Water Frontier Exploration in Latin America and the Caribbean

8 - 10 December 2013, Trinidad & Tobago, Hyatt Regency Trinidad

Co-Hosted by: AAPG Latin America Region and Geological Society of Trinidad & Tobago (GSTT)



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- Session 2: Is the Cretaceous an Effective Petroleum System?
- Session 3: Deepwater Frontier Exploration—Global Analogues
- Session 4: Drilling and Operational Challenges in High Pressure/High Temperature Environments

For more information and to register:

[http://www.aapg.org/gtw/2013/trinidad\\_tobago/index.cfm](http://www.aapg.org/gtw/2013/trinidad_tobago/index.cfm)



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## Salt basin model building, imaging, and interpretation

The editors of *Interpretation* ([www.seg.org/interpretation](http://www.seg.org/interpretation)) invite papers on the topic of **salt basin velocity model building, imaging, and interpretation** for publication in the November 2014 special section to supplement the journal's regular sections of technical papers on various topics. This is a companion to the special section on **salt tectonic interpretation**.

The recent advances in seismic acquisition (e.g., wide and full azimuth, broadband, ocean-bottom nodes, new sensors) and processing technologies (e.g., 3D preSDM, multiple attenuation, anisotropy, reverse-time migration, and full waveform inversion) and high-performance computing, have enabled imaging of complex salt and associated sediment geometries with increasing structural clarity. With easy finds gone, exploration in deepwater salt basins with high velocity contrasts and complicated salt geometries demands that geophysicists and geologists work as one in the task of interpretive processing.

The purpose of this special issue is to complement the concurrent special section on **salt tectonic interpretation** by providing a comprehensive snapshot of the state-of-the-art in velocity model building and seismic processing for salt basins. Contributions include, but are not limited to, the following:

- Case histories of data acquisition, processing, velocity model building, and imaging in salt basins
- Challenges associated with dirty salt, steeply dipping or complexly deformed sediments
- Challenges created by translated canopy and diapir roofs, low reflectivity zones, and overpressured sediments
- Challenges caused by refractions and postcritical reflections at high-contrast boundaries
- Use of imaging gathers, AVO, seismic attributes, and inversion to aid salt interpretation
- Modeling and illumination studies
- Interpretive processing and scenario testing
- Subsalt and presalt play concepts, well placement, drilling, and completions
- Tutorials and articles that review the state of the art

Interested authors should submit their manuscripts for review no later than **1 March 2014**. In addition, the special-section editors would like to receive a provisional title and list of authors as soon as possible. Authors should submit via the normal online submission system for *Interpretation* (<https://mc.manuscriptcentral.com/interpretation>) and select this topic in the manuscript type dropdown option. The submitted papers will be subject to the regular peer-review process, and the contributing authors also are expected to participate in the review process as reviewers.

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

The submissions will be processed according to the following timeline:

Submission deadline 1 March 2014	All files submitted for production 15 August 2014
Peer review complete 1 August 2014	Publication of issue November 2014

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Interpretation special section

# CALL FOR PAPERS



In the SSGL the cores are cataloged by land location and stored in rows, racks and bins. They are transported to the core examination area by fork lift and laid out on conveyor tables. A significant contrast to the conditions described by Laurence Vigrass.

## Cores from page 40

J.G.C.M. Fuller, the 2012 Saskatchewan Geological Society Geoscience Honor Roll inductee, who arrived in Saskatchewan in 1954 as a raw recruit from a doctorate program at Cambridge to begin employment with the Department of Mineral Resources:

*"On the ground floor of that building and in adjacent sheds, all the cores and cuttings-samples from Saskatchewan wells were stored. The sheds were dark and unheated, requiring in winter a high level of determination and fortitude to undertake any meaningful study, but worse was to come. As the interior storage space became exhausted, core boxes were stacked outside, in the open. It was a management policy barely tolerable for hard-rock mineral cores, but disastrous for halite and potash. When there was a rainfall, the weeds in that part of the yard died."*

*"... I was given a dun-colored cotton coat, and a small partitioned space upstairs in the building to serve as my recovery room after work in the core-sheds."*

### Construction and Expansion

The influx of cores became so great following the 1953 discovery of southeast Saskatchewan's Mississippian subcrop play that the capacity of the converted chicken plant was stretched beyond its limits, and in 1957 construction started on a new Saskatchewan Subsurface Geological Laboratory (SSGL) and core storage warehouse.

This facility was opened in April 1958. Initially the lab had a 45,280-square-foot unheated core storage warehouse and 11,369 square feet of office space that housed a laboratory and core and drill cutting examination space.

Six additions to the warehouse, the most recent in 2012, have increased its size to 98,879 square feet. There presently are about 590,748 meters (1,938,126 feet) of core stored at this facility and over 4.8 million vials of drill cuttings from close to 35,000 wells, all from the province.

Not all of the cores stored at the SSGL were acquired through hydrocarbon-related drilling:

► Currently there are 10,477 meters (34,373 feet) of core from 18 potash shaft pilot holes.

► Cores from each shaft hole include most of the sedimentary succession above

the Middle Devonian Prairie Evaporite, and over 550 cores from potash test wells.

► In addition, recent drilling on a Cretaceous coal prospect has resulted in acquisition of approximately 8,500 meters (27,887 feet) of core.

Other non-hydrocarbon related cores stored at the Subsurface Lab include diamond drill cores from drill holes that had to penetrate a thin cover of Phanerozoic rocks in north central Saskatchewan to access potential mineral deposits in the Precambrian basement. In addition, there are a number of stratigraphic diamond drill cores taken from northern Saskatchewan's Proterozoic Athabasca Basin for uranium exploration, as well as cores from wells drilled to determine the characteristics of Cretaceous diamondiferous kimberlites in the province's central part.

### Making an Impact

The core inventory at the SSGL has been a significant source of scientific information to industry, government and academic geoscientists and engineers, and has been key in the responsible development of Saskatchewan's petroleum sector, which ranks second in Canada in terms of the value of oil production.

Industry is charged a nominal fee to examine core. A no-charge policy for professorial and student research projects has resulted in approximately 60 undergraduate, master's and doctorate core- and drill cutting-related theses.

Saskatchewan government petroleum geologists who are based at the SSGL have made good use of the core storage facility and have published numerous government reports on various aspects of the geology of the subsurface rocks.

The SSGL also plays an important role in educating the public about Saskatchewan's geology and petroleum resources through outreach and education tours to elementary and high school students. Outcrop and core samples are utilized to help explain geological concepts and the geology of Saskatchewan to the touring groups and the students are offered an opportunity to view the warehouse facility.

In addition, touring students are shown an array of drilling bits and are given a short account on drilling processes and procedures. As part of the most recent expansion a 3-D theater was added to the SSGL in support of a major 3-D modeling project of the Western Canada Sedimentary Basin and other geological terranes in Saskatchewan being undertaken by the Saskatchewan Geological Survey.





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# Confused Over Methane Data? Stand in Line

By EDITH ALLISON, GEO-DC Director

Over the past two years large variations in the Environmental Protection Agency (EPA) estimates of the volume of methane released during natural gas production have been used by organizations arguing respectively that natural gas is cleaner than or dirtier than coal.

The data variation is confusing to the public as well as Washington, D.C., policy makers who could choose to restrict or encourage natural gas production based on its assumed environmental impact.

The confusion is justified: It is not simple to estimate how much methane escapes from half a million wells that use varied completion and production techniques.

It is especially difficult to assure the existing small sample of wells reflects the universe of well-completion operations such as flowback and liquids unloading. These operations are poorly sampled and show highly most variable methane emission volumes – more about this later in the article.

The best news is the technologies to reduce fugitive methane emissions, such as green completions, are improving and more widely used.

Also encouraging is the fact that additional studies are expected to define and constrain some of the poorly documented statistics for flowback and well unloading.

\* \* \*

A timeline of methane emission studies



ALLISON

**The best news is the technologies to reduce fugitive methane emissions, such as green completions, are improving and more widely used.**

may help explain how the discrepancies developed:

► The EPA launched its greenhouse gas (GHG) Inventory, a national-level estimate of large and small emitters, 20 years ago.

The GHG Reporting Program (GHGRP), which collects data from the largest GHG emitting facilities in the United States, was launched in response to 2008 legislation.

GEO-DC now has a variety of tools to help you get the latest information on federal energy policy activity that affects petroleum E&P – all without filling your email box with clutter.

► **Daily Tweets** from the GEO-DC director: 140 characters directing you to information about new regulations, scientific studies or major legislation. See @EdieAllisonAAPG on Twitter.

► **GEO-DC blog:** Weekly, slightly longer explanations of regulations or

Most sources, including petroleum refineries, started reporting 2010 emissions to the GHGRP in 2011. Petroleum and natural gas systems and CO<sub>2</sub> injection projects (for enhanced oil recovery or geologic sequestration) reported emissions for the first time in September 2012 (for 2011 emissions).

Only facilities that emit over 25,000 metric tons of CO<sub>2</sub> equivalents (MMCO<sub>2</sub>e)

laws that are in the news. Enter the AAPG Blog Zone on the AAPG website.

► **Policy Watch** column in your AAPG EXPLORER: Every month, featuring in-depth coverage of a topic that is in the news or soon will be.

► **Action Alerts:** Sign up for alerts about draft regulations or pending legislation, with guides for sending a formal response to Congress or a federal agency. Go to the AAPG GEO-DC home page, at [www.aapg.org/geoDC](http://www.aapg.org/geoDC).

are required to submit reports.

EPA received 2011 emissions reports from 1,880 petroleum and natural gas facilities, including natural gas production, processing, transmission, distribution, storage and LNG facilities. These were used to estimate the 2011 Inventory that was released in April 2013.

► EPA's April 2012 GHG Inventory Report for the first time used Natural Gas Star data (industry reports that bragged about methane emissions reduction successes for 8,800 wells) as a surrogate for 2010 emissions from 488,000 wells.

Compared to prior years, the 2012 report revised the estimated 2010 emissions from natural gas systems up by about 11 percent, to 215.4 MMCO<sub>2</sub>e.

► In response to the high EPA estimate, the American Petroleum Institute and America's Natural Gas Alliance (API/ANGA) surveyed industry to collect data from nearly 91,000 wells, which projected that methane emissions from natural gas systems were 102.6 MMCO<sub>2</sub>e – about half the EPA estimate.

More importantly, the API/ANGA September 2012 report pointed out the need for additional sampling of well unloadings, which are poorly sampled but account for 51 percent of methane emissions from natural gas systems in EPA's 2012 report.

See **Policy**, page 44



# AAPG

# FORUM

Two upcoming AAPG Forums – Save the Dates!

## Playmaker Forum 2014 - Learn How to Package your Deal, and Evaluate the Deals you See.

January 23, 2014 – Houston, Texas

The Playmaker Forum will focus on elements, commercial and scientific/technical, required to successfully mature prospects from first insight, leasing, marketing, to discovery. It will focus on necessary skills you can use right away for prospecting, play generation, deal screening and important aspects of professional career development.

### Comments from Attendees of the 2013 Playmaker Forum:

- "Overall good content, good speakers. Opportunity to network good."
- "Discussions/talks were extremely beneficial and many inspiring."
- "Well organized and informative."

For details contact [educate@aapg.org](mailto:educate@aapg.org)

## Mississippian Lime Forum 2014 – Learn Insights for Effective Mississippian Lime Exploration and Production.

February 20, 2014 – Oklahoma City, Oklahoma

The Mississippian Lime Forum will seek to help develop a deeper, more integrated understanding of the reasons for productivity in the play, and will feature presentations by experts, and group discussions that will tie the development of secondary porosity, fractures, and diagenesis to basement structural reactivation, and the syn-depositional tectonism of the Mississippian shelf margin.

### Comments from attendees of the 2013 Mississippian Lime Forum:

- "I really appreciated the opportunity to be involved in the great AAPG Forum. It was unquestionably the best one of these in which I have either been a presenter or attendee."
- "Just wanted to Thank You for your work on the forum I attended yesterday. Thought it was well thought out and the diversity of talks was very good."
- "The recent Mississippi Lime forum in Oklahoma City was an excellent opportunity for operators to come together and learn about the play that the industry is just starting to understand and to develop."

For details contact [educate@aapg.org](mailto:educate@aapg.org)



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was successful in providing an  
integrated approach

“ The wealth of information that I attained — because it was specific to unconventional plays rather than discipline specific — far surpassed most other conferences that I’ve attended in the past. ”

— Nicole Kennedy  
Anadarko Petroleum Corporation

## THEMES

Theme 1: Regional Case Studies  
Theme 2: Characterization of Unconventional Reservoirs  
Theme 3: Application and Integration of Well Data  
Theme 4: Understanding your Petroleum System  
Theme 5: Optimizing Recovery from Unconventional Reservoirs  
Theme 6: Optimizing Capital Efficiency  
Theme 7: Production Performance of Tight Oil & Gas Reservoirs  
Theme 8: Social Performance (HSSE)  
Theme 9: Reserves Forecasting and Estimation  
Theme 10: Long Term Performance  
Theme 11: Emerging Unconventional Plays

## Submission deadline: 12 December 2013

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## Jamboree from page 28

fossils, take notes and mark their location with GPS units.

"These are the things a field geologist does," Scott McColloch said, "and allowing the boys to hold the GPS, the compass and the hammer lets them have the full experience. Kids respond well when they can put their hands on the simple equipment."

"We also tried to engage Scouts who did not have time to sign up for the hike," Hart said. "We developed 17 points of interest on the property where a boy could see a feature and learn something about geology."

For example, BSA built a series of fishing and recreational lakes for the new camp property, "so we developed a story about how engineers use contours to plan the artificial lakes then seal the lake bottoms with bentonite because swelling clay can prevent leaks," Hart said.

"We also developed stories that talked about stream deposition, oil and gas exploration in West Virginia, coal mining, the ice age in West Virginia, and even hydraulic fracturing," he added.

"All these points of interest were marked with a green post, using a QR Code at the top, whereby a Scout could use his smart phone to resolve the Code to a website hosted by AAPG on behalf of the AAPG Foundation. In this way, a boy standing in line for a fun event, or walking across the camp property, is able to learn ways geology touches his everyday life, as seen through random acts of learning.

"A teenage boy is one of nature's more curious creatures," Hart said. "We wanted to capitalize on that with the QR Codes."

### There's An App for That

The AAPG team members also located their points of interest on a GIS-enabled map of the property, using detailed GIS files provided by BSA and location information collected on the group during the planning meeting at the property. With support from both ESRI and NeoTreks Inc., a Colorado Springs-based company that writes mobile apps, the team was able to develop a "geocaching game" based on the geological points of interest.

## Policy from page 42

► EPA released the 2011 inventory in April 2013. The inventory revised the estimate of 2010 emissions for natural gas systems downward to 143.6 MMCO<sub>2</sub>e, a 33 percent reduction from the prior year's report.

This change evidently reflects consideration of the API/ANGA survey results.

► David T. Allen, the Melvin H. Gertz Regents Chair in Chemical Engineering at the University of Texas (UT), and 13 other researchers reported in the September 2013 Proceedings of the National Academy of Sciences on their study of 190 natural gas sites. The study, which was supported by the Environmental Defense Fund, yielded national estimates similar to that in EPA's 2013 report on the 2011 inventory: methane emissions were 0.42 percent of gross gas production,

Other program features included a rock and mineral museum alongside a busy road.


"Half the campers walked past our program tent," Hart said. "We placed our younger staff members on the tables, because younger geologists are more likely to interact with the kids."

AAPG member Greg Hammond was one of those; Hammond works as a wellsite geologist in Alaska and had stories to tell the Scouts about life on a rig.

"And we had two students on staff – Bill Doyle from the University of

Oklahoma, and Alan McCreary from Concord University (W. Va.)," Hart added.

At the other end of the spectrum, AAPG member Charles Bartlett, of Abingdon, Va., went to his first Jamboree in 1947 and came to this summit to help educate this current generation about where energy comes from.

In all, there were 10 AAPG members on staff at the 2013 Jamboree. In addition to those mentioned earlier, the group included Bill Underwood of Bethany, Okla.; Gary Robinson of Aurora, Colo.; and Sherman Lundy of Cedar Falls, Iowa. 

versus 0.47 percent for the EPA 2011 inventory.

The Allen group plans additional studies to better define the emissions profile of pneumatic pumps – the largest source of methane emissions in their initial study – and liquids unloading, a technology defined by few measurements.

\* \* \*

The University of Texas Environmental Defense Fund Study made direct measurements of 150 production sites that included 489 wells that were hydraulically fractured, 27 well-completion flowbacks, nine well unloadings and four workovers.

► Well-completion flowbacks, which clear liquids from the wellbore to allow gas production, showed methane emissions from 0.01 million grams or metric ton (Mg) to 17 Mg, compared with an average of 81 Mg per event in the EPA 2011 national emission inventory, reported in April 2013.

The lower UT results reflect the growth in green completions, in which methane is

captured or controlled – UT samples were collected in 2012, but the EPA data is from 2011.

► Well unloading technologies vary, but the ones of interest divert gas production from the separator, reducing the backpressure and allowing more gas to flow, which lifts liquids out of the wellbore and improves gas flow.

The UT group monitored nine unloading events and the API/ANGA survey used by EPA included several thousand wells. Both studies showed a large variation in emissions levels between wells, while a small number of wells accounted for the majority of emissions.

► Pneumatic pumps and controllers showed higher emissions than in the EPA 2011 inventory, as did equipment leaks.

The UT report highlights weaknesses in all the existing data sets – a fact that should encourage restraint by policy makers and advocates for and against natural gas development. 

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 **AAPG** | BULLETIN

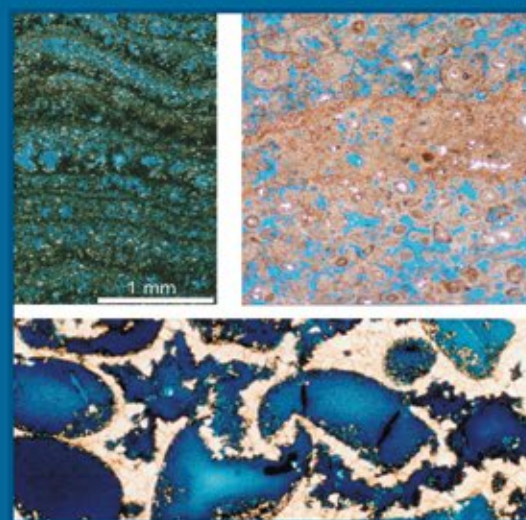
## MICROBIAL CARBONATES, A HEDBERG CONFERENCE ISSUE

*Edited by: Ernest A. Mancini, William A. Morgan, Paul M. (Mitch) Harris, and William C. Parcell*

With the recent discovery of hydrocarbons in microbial carbonate reservoir facies along the South Atlantic margins, industry is keen to further the understanding of the origin and development of nonmarine (lacustrine) to marine microbial carbonates, the nature of the depositional and diagenetic characteristics of microbialite and associated facies, and the sedimentary and petrophysical properties of microbial carbonate petroleum reservoirs.

To help address the shortcomings in available literature on microbial carbonate reservoirs, an AAPG Hedberg Research Conference was held June 3-8, 2012.

This special issue of the Bulletin includes a summary and 12 papers based on presentations at the conference. It is divided into three parts: Reservoir Characterization, Subsurface Studies, and Outcrop Analogs; Reservoir Modeling; and Petrophysics and Geochemistry.



Members may access the AAPG Bulletin online at:  
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# Adding Texture Attributes to the 3-D Mix

By PAUL de GROOT, FARRUKH QAYYUM and NANNE HEMSTRA

In a previous Geophysical Corner ("A New Approach to Stratigraphic Interpretation," September EXPLORER), we introduced a new set of seismic attributes that play an important role in extracting detailed stratigraphic information from seismic data.

The attributes in question were derived from a HorizonCube, an interpretation technique that provides fully interpreted seismic volumes where horizons are automatically tracked between a given set of framework horizons and faults.

This month, we go further and examine one other set of attributes – specifically, texture attributes, and how they can combine with HorizonCube attributes for 3-D segmentation.

\* \* \*

Neural network-based waveform segmentation workflows have proved to be a highly valuable instrument for seismic interpreters to quickly visualize seismic patterns in a relatively thin interval of interest (see figure 1). These networks compare the input vector (the waveform) with a set of pre-calculated vectors that represent segment (cluster) centers.

The resulting segmentation maps show for each position the winning segment center – and such maps often reveal patterns that can be interpreted in terms of geological features.

Neural network-based segmentation also can be performed in 3-D. However, this cannot be done by feeding the neural network with waveforms, as is done in the horizon-guided approach. This is because waveforms change along the application window while segment centers are fixed.

The solution to this problem is to feed the neural work with phase-independent seismic attributes, such as energy, or amplitude spectra derivatives.

There are not that many uncorrelated attributes that can be used effectively for 3-D segmentation, which may explain why 3-D segmentation is not as successful as horizon-guided waveform segmentation.

There are two particular sets of attributes, however, that can combine together to address the challenges of 3-D segmentation:

- Attributes derived from a HorizonCube and that were described in the previous article.
- Texture attributes.

Texture attributes are popular in image



DE GROOT



QAYYUM



HEMSTRA

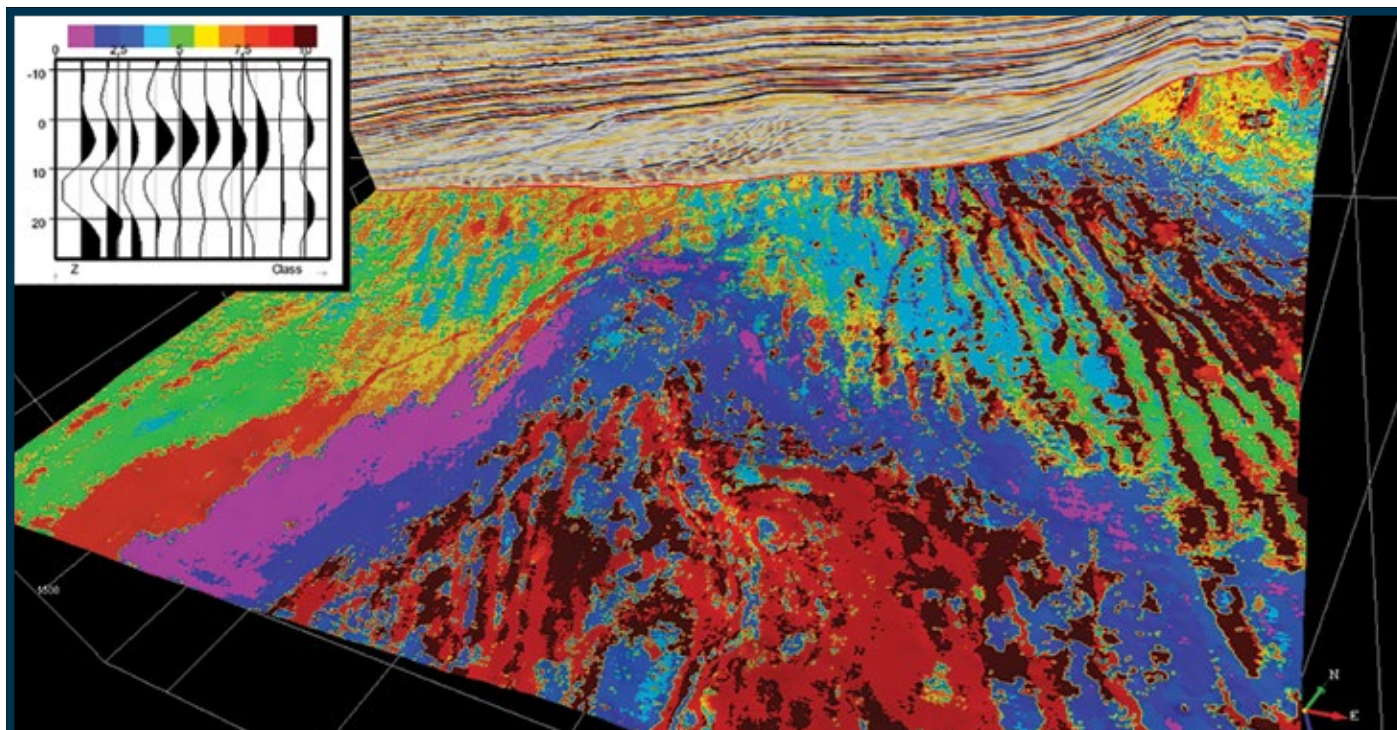


Figure 1 – A horizon-guided UVQ waveform segmentation map.

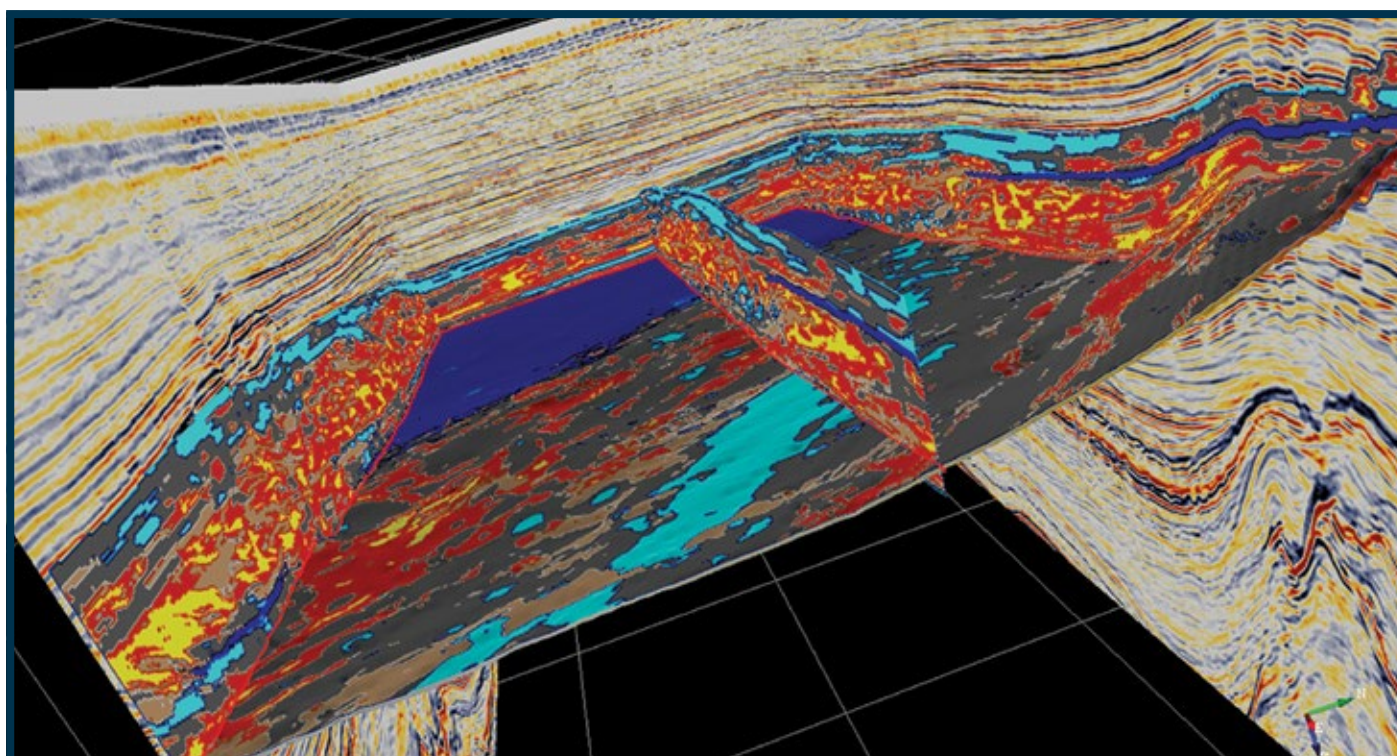


Figure 2 – A seismic display for UVQ segmentation using both texture and HorizonCube attributes.

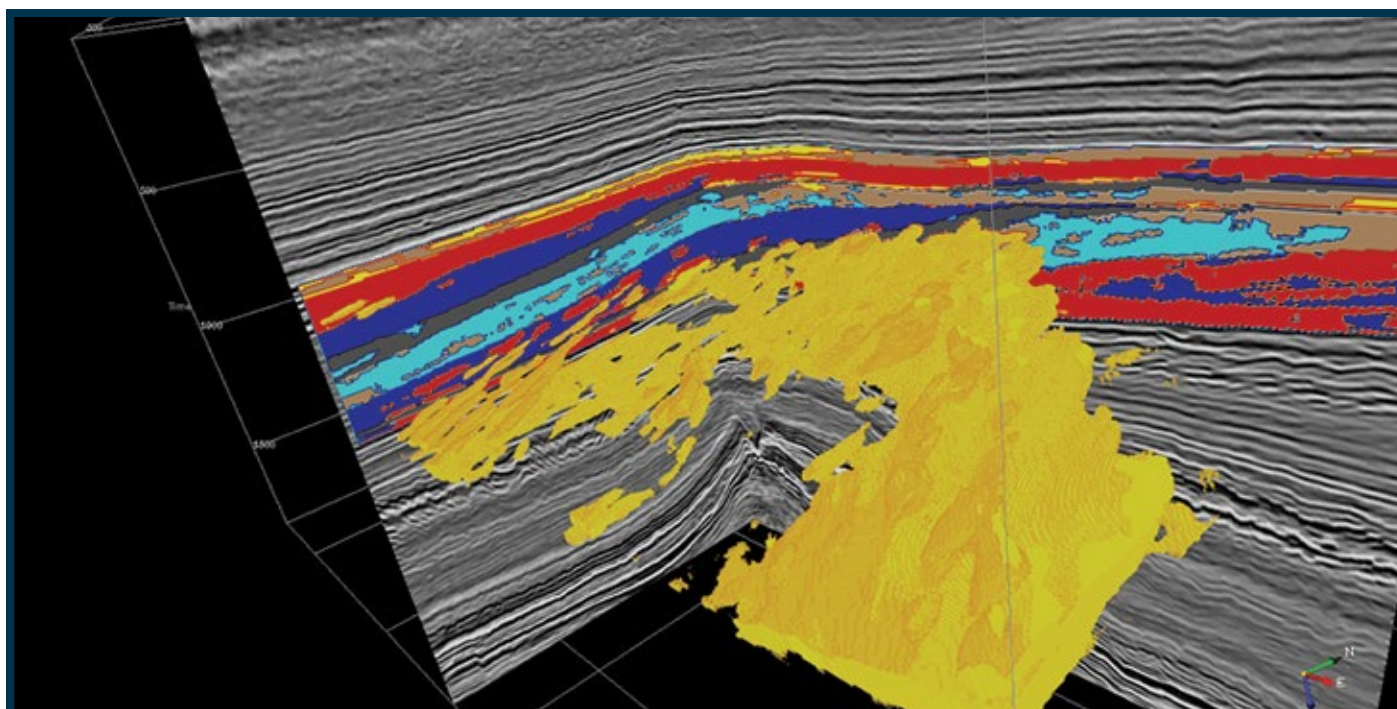


Figure 3 – Systems tracts used as bias for UVQ segmentation.

See [Attributes](#), page 48





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## Attributes from page 46

processing and are used in seismic interpretation to carry out seismic facies analysis and highlight geo-morphological features. They originate from image analysis and are based on the Grey Level Co-occurrence Matrix (GLCM), which describes the relationship between pixels and was developed to capture the roughness or smoothness of an image.

A GLCM is a 2-D matrix of  $N \times N$  dimensions representing the amplitude values of the reference pixel versus the amplitudes of the neighboring pixel. The matrix is filled by comparing each amplitude in the input area (volume) with its direct neighbor and increasing the occurrence of the corresponding

matrix cell.

This is repeated for all amplitude pairs in the input cube, which then are converted into probabilities.

The GLCM thus captures how probable it is to find pairs of neighbouring amplitudes in the area (volume) around the evaluation point.

Texture attributes are computed in two steps:

► First, the GLCM is computed for an area (volume) around the evaluation point.

► Second, a statistical property from the GLCM is returned.

The GLCM input volume can be "dip-steered," meaning that the input follows the stratigraphic layering, which results in sharper attribute responses for dipping strata.

Three groups of texture attributes are computed from the GLCM:

► **Contrast** (contrast, dissimilarity and homogeneity), where measurements are calculated through the use of weights related to the distance from the GLCM diagonal.

► **Orderliness** (ASM, energy and entropy), where interpreters measure how regular the pixel values are within the window.

► **Statistics** (mean, variance and correlation), which are derived from the GLCM.

In each group, the attributes are highly correlated.

Through the use of both texture and the already described HorizonCube attributes, seismic interpreters now have two new groups of attributes that can be used as inputs to UVQ (Unsupervised Vector Quantization) networks for 3-D seismic facies analysis.

★ ★ ★

Figure 1 (page 46) shows a horizon-guided UVQ waveform segmentation map that captured the seismic response below a maximum flooding surface in a wave-dominated Pliocene deltaic setting, offshore Netherlands. The UVQ network was trained to segment the interval of interest into 10 segments.

The UVQ segmentation map reveals several key geomorphological patterns that help to understand the depositional environment and the influence of salt tectonics.

The NW-SE oriented dark brown-red features on the right are sand ridges of 10-20 meters in height, developed parallel to the coast. These features are analogous to present day deposits observed along the Dutch coast.

Furthermore, NE-SW oriented deepwater channel systems are recognized (purple-red, on the left). These narrow channel-levee systems are developed as a result of halo kinetic movement of Zechstein salt in the northeast (upper right) corner of the image. Up-dip these channels cross-cut the sand ridges while down-dip they meander and bifurcate into the basin, where turbiditic deposits could be developed.

★ ★ ★

Figure 2 shows a seismic display for UVQ segmentation using both texture and HorizonCube attributes with energy, variance and correlation for the texture attributes; density and thickness for the HorizonCube attributes; and dip-steered energy as the input attribute for the neural network.

There are six classes in the illustration with it possible to see different behaviors in different areas.


If interpreters have carried out a systems tracts interpretation, they can use this interpretation to more or less force the segmentation to adhere to one's own interpretation through a biased 3-D UVQ as seen in figure 3.

★ ★ ★

In addition to texture and energy attributes, figure 3 illustrates how a systems tract's interpretation is used as bias for UVQ segmentation with, in this case, HorizonCube attributes not used as input.

The illustration shows the impact of using systems tracts as an input and the final segmentation. These classes (such as the yellow class) can then be extracted and seen in 3-D, allowing the interpreters to better define geobodies.

HorizonCube attributes are particularly useful for identification of stratigraphic features – such as pinch-outs, clinoforms, unconformities and condensed sections – whereas texture attributes play an important role in seismic facies analysis and in highlighting geomorphological features.

When combined together, HorizonCube and texture attributes play an important role in 3-D segmentation and in identifying and mapping potential reservoir lithology in seismic data. 

(Editor's note: By AAPG member Farrukh Qayyum, Paul de Groot and Nanne Hemstra all are with dGB Earth Sciences, Enschede, Netherlands.)

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## ICE 2013: Reasons to Smile

By VERN STEFANIC, EXPLORER Managing Editor

**A** new and festive setting, large crowds making their way through jammed halls, an abundance of younger participants and a strong technical program all combined to make this year's AAPG International Conference and Exhibition an affair to remember.

The 2013 ICE was held for the first time in Cartagena, Colombia, attracting about 2,000 participants who represented a diverse, decidedly non-Colombian demographic.

"We had a high number of countries represented, and especially a number of people from other Latin American countries," said Victor Vega, this year's ICE general chair, who added that at press time he has received more than 100 emails and messages from people who were still saying good things about their Cartagena experience.


"It was a very successful meeting," he said. "We delivered a quality product with a diverse set of options, and also provided the students who attended with a unique experience."

"We also succeeded in presenting a flavor of the Colombian culture at the opening ceremony," he added, referring to an unforgettable performance by Fundacion Musica por Colombia, a group of young musicians that started the session

with a stirring rendition of the Colombian national anthem, and then ended it with an emotional and exciting mini-concert.

Vega pointed to four accomplishments that defined the 2013 ICE:

- ▶ The integration of the region into the overall program – local associations proved to be enthusiastic participants.
- ▶ The participation of high level representatives from private and national oil companies, especially in the forums, luncheons and special sessions.
- ▶ The participation of a high number of young professionals and students (see related story, page 32).
- ▶ A "very strong technical program," he said, anchored by such events as the Discovery Thinking Forum, the sessions featuring national and international oil company officials, and the "country sessions," which took detailed looks at the geology, current activities and future potential of important Latin American targets.

The meeting also boasted a large, creative exhibits hall that often provided the setting for special events – and just as often proved to be a popular place for networking, even as attendees were being treated to the latest in geoscience technology. 





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# Showing Cause: Why the Foundation Matters

By NATALIE ADAMS, AAPG Foundation Manager

**D**o you ever wonder why the AAPG Foundation exists?

Most know that it exists to do good things to support the geosciences – but sometimes it's a good idea to revisit the original intent to make sure we are fulfilling the wishes of the founders.

According to the Bylaws, the specific purposes and objectives of this corporation are:

- ▶ To establish a permanent entity to conduct educational, charitable and scientific activities related to or allied with the field of geology.
- ▶ To make contributions to any

organization described in Section 501(c)(3) of the Internal Revenue Code of 1954, with the exception of organizations testing for public safety.

- ▶ To conduct research, both directly and through the promotion, assistance, encouragement, support and furtherance of studies and research, in the field of geology and in sciences related thereto.
- ▶ To disseminate information relating to geology and related fields through lectures, seminars, publications, educational courses, teaching aids, and by other means and materials.
- ▶ To carry on programs of continuing


education in geology and related studies.

- ▶ To assist in career guidance to persons interested in the field of geology or related fields.
- ▶ To assist public and private schools (elementary and secondary) and colleges and universities and technical schools in teaching and education in the field of geology and related fields.
- ▶ To provide scholarships, prizes, awards, gifts, educational loans and other kinds of support to assist or reward persons engaged in the study of and/or pursuit of the science of geology or related fields.

▶ To establish fellowships or "chairs" in colleges and universities in order to further education and knowledge in the field of geology and related fields.

▶ To work with and support (including contributions from the corporation) other organizations with similar objectives which are in themselves tax-exempt educational or scientific organizations under the Internal Revenue Code.

▶ To support activities of other organizations with financial assistance, so long as the activity supported is one in which the corporation, as an organization described in Section 501(c)(3) of the Internal Revenue Code of 1954, may engage and the financial assistance is so utilized.

Our goals are lofty, and our plans are many. To learn more about how the AAPG Foundation is accomplishing these purposes and objectives, or to contribute to our mission, visit [foundation.aapg.org](http://foundation.aapg.org). 

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**Application deadline is December 16, 2013.**

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Balazs Toro, Johnston Canyon, Banff National Park, Canada

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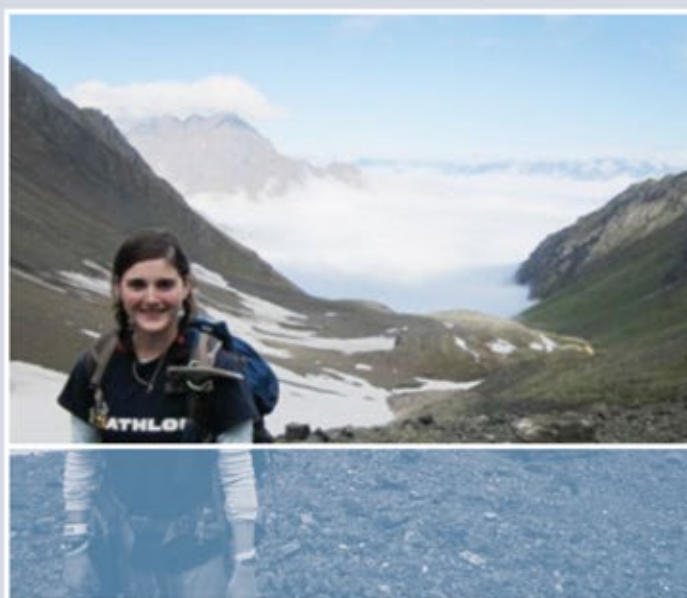
Grants-in-Aid (GIA) awards aspiring geoscience professionals with grant money needed to fund graduate and post-graduate field research. Grants range from \$500 to \$3,000 each.

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Past grant recipients have used scholarship funds to survey lands as far away as the Bogda Mountains of northwest China and as close as Dinosaur National Monument in Colorado, USA. In 2014, the AAPG Foundation awarded more than \$192,000 to 90 graduate students internationally.

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2013 GIA Recipient Erin Donaghy conducting field research near the Alaskan Chugach Mountains.



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## Four DLs Have Speaking Dates In November

**F**our AAPG Distinguished Lecturers will be touring in November, speaking to groups across the United States and Canada.

The Distinguished Lecture program, funded in part by the AAPG Foundation, is the Association's flagship initiative for spreading the latest in science, technology and professional information.

On tour in November are:

▣ **Alastair Fraser**, this year's AAPG Shell Distinguished Lecturer, will be concluding his tour Nov. 1 with an engagement at Western University (Petrolia Pioneers Society) in London, Ontario.

Fraser will tour again in January and February.

▣ **Carl Fiduk**, who offers three talks dealing with the geology of the Gulf of Mexico, also concludes his first tour Nov. 1, with a talk at the University of Missouri-Columbia.

▣ **Don Clarke**, this year's AAPG Distinguished Lecturer, will have three talks.

▶ Nov. 4 – National Academies, Washington, D.C.

▶ Kansas Geological Society/ University of Kansas Geology Department, Lawrence, Kan.

▶ Coast Geological Society, Ventura, Calif.

▣ **Torbjorn Tornqvist**, who offers two lectures on the Mississippi Delta, will have four stops this month.

▶ Bureau of Economic Geology, the University of Texas, Austin.

▶ Colorado School of Mines, Golden, Colo.

▶ University of California at Santa Barbara.



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<b>James E. Hooks Memorial Grant</b> Chevron Humankind <i>Matching gift/Mark Dando</i> John R. Gilbert Jr. Rosann F. Hooks <i>In honor of Lawrence W. Funkhouser</i>		<b>University Research Fund</b> Michael Alaetin Kasli Sr.	
<b>Herbert G. Davis and Shirley A. Davis Named Grant</b> William F. Ripley		<b>Visiting Geoscientist Fund</b> M.A. Custer Tako Koning <i>In memory of K.K. Landes</i>	

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

## INMEMORY

J. Myles Bowen, winner of the 2011 AAPG Pioneer Award, has died. He was 84.

Bowen was a retired Shell geologist who had a long and successful career as an exploration team leader, working (and scoring discoveries) in Venezuela, Nigeria, the North Sea and other international locales.

Bowen wrote of his experiences with North Sea Block 30/16 in the January 2012 Historical Highlights column in the EXPLORER.

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



BOWEN

J. Myles Bowen, 84  
Newton Abbot, England  
June 16, 2013  
Howard Gould, 91  
Dekalb, Ill., Aug. 29, 2013  
Robert Krueger, 83  
Punta Gorda, Fla., April 22, 2013  
David Miller, 79  
Midland, Texas, June 9, 2013  
Donald Paape, 81  
Port Davis, Texas, Aug. 2, 2013  
William Speer, 84  
Farmington, N.M., Aug. 2, 2013  
John Sweet, 60  
Boulder, Colo., Sept. 12, 2013



## GRANTS BENEFIT UNDERGRADUATE GEOLOGY DEPARTMENTS



The University of Nebraska-Lincoln AAPG student chapter pauses for a picture during a field trip to the Book Cliffs in Green River, Utah. Photo taken by Chris Fielding.

This past spring, undergraduate grants were given to students in 61 universities in 14 countries, including 18 states in the U.S.



Undergraduate student award winner, Rebecca Wain.

Many geology departments need help to improve their undergraduate geology platforms. Support the L. Austin Weeks Undergraduate Grant Program today and provide more grants to schools in need of equipment, funds to attend geology conferences, field trips and other opportunities to enhance their geoscience experiences.

Your contribution could make a huge impact for a university's geology department.

Contact the AAPG Foundation today.

AAPG Foundation • P.O. Box 979 • Tulsa, OK 74101-0979 USA  
foundation.aapg.org • Toll Free 855.302.2743



## Coming Soon – A New Website Experience

By JANET BRISTER, AAPG Website Editor

Technological advances seem to happen so quickly that we can feel like the neighborhood dog chasing after the car.

Whatever would we do if we actually caught it?

The AAPG Web team has been chasing the Internet car for the past year. The goal is to rebuild our website content with new technology: responsive search, community discussion boards, global connections, robust calendars and a place to let your voice be heard.

This article is an update, intended to make you aware we've almost caught that car and are about to complete the first phase of this project.

We've listened to members who represent all demographical segments of AAPG, learning what all of you would love to see in this website.

We've observed the practices of those currently using tools available through free services such as Yahoo!, Facebook and Google.

Members have patiently responded to our surveys. We then went a step further and bugged our leadership with more questions about their vision and Association needs.

We've learned this Association is both a social and a professional body of people. They are bonded by the science and careers they have chosen but have discovered deep friendships as they work towards the common goal of discovery.



Sneak peek: You won't find this online, but here's a glimpse of the new AAPG website design.

### Is That Exhaust I Smell?

All this has guided our results. You've seen hints of it here and there. For example, there is a new brand identity that has emerged.

Have you noticed this new branding? The AAPG with the graceful homage to the horizon of our world is now on most AAPG business cards, featured at the footer of many meeting pages and appearing on name badges and other labels.

geosciences and actively seek the next breakthrough.

This new design attempts to push science to the forefront.

We will be pulling papers, abstracts, books and other resources to the surface – relating them to each other through categories, geographical location and global interests and the science served.

We will be connecting people through groups that share common interests and disciplines. We expect it to become a resource for collaboration, mentorship and finding answers or solutions.

### New Car Smell

I've heard some people would like to package that "new car smell" as an odorant, because for many it's that enticing. For all I know, there probably are candles for that purpose.

Well, with this article I hope I have provided a hint of new car smell – and perhaps have planted a seed of expectancy without creating hype.

The bottom line is this: The AAPG website will be noticeably different in January, and there will be no gradual move from the current site to the new.

So get ready for 2014 when you can begin finding, talking, collaborating and contributing more to your career, this Association and the petroleum geosciences.

Good browsing!



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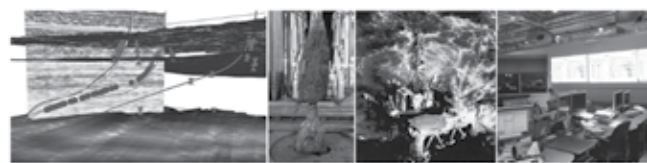
Call for Abstracts - 14 February 2014

## Operations Geology Conference

"The Life-cycle of a well"

26-27 November, 2014

The Geological Society, Burlington House, Piccadilly, London



### CALL FOR ABSTRACTS

Following the highly successful Operations Geology Workshop held in Aberdeen in October 2012, the Petroleum Group of the Geological Society are pleased to announce the dates for the next event, which will be held over two days in 2014. This is also the first call for abstracts. Operations Geologists play key integrating roles at all stages of the life cycle of a well. This conference will look at the life cycle of a well and the contributions of Operations Geology at each stage. It is the intention of the convenors that both oral and poster presentations will eventually be prepared for release in a Special Publication of the Geological Society of London. To that end we invite contributions to the programme sufficiently early to make it possible for Authors to gain necessary permissions to present and publish what we trust will be cutting edge material.

- **Well Planning** - hazard identification (due to rocks, fabric, pressure, stress, geometry etc) and avoidance/mitigation, targeted data acquisition for all disciplines for life of field
- **Execution** - real-time techniques, managing the drilling window, the acquisition and use of integrity test data, appropriate isolation of permeable zones in the overburden
- **After Action Review** - NPT analysis and the learning loop, continuous improvement
- **Emerging Technologies** - the next generation of needs and solutions – logging, formation and gas detection/analysis, real-time well bore stability analysis tools, PPFG tools
- **Professional Competence** - the need to strengthen the available processes for training and the vetting of competence for OGs, particularly in safety critical areas

### CALL FOR ORAL AND POSTER ABSTRACTS:

Abstracts of up to 300 words and up to three colour figures are requested. Abstract Deadline 14 February 2014. Abstracts should be submitted to Nick Pierpoint and Laura Hayward. For further information, please contact Laura Hayward, Events Administration Assistant; +44 (0)20 7432 0983 or E-mail: laura.hayward@geolsoc.org.uk Nick Pierpoint E-mail: Nicholas.Pierpoint@bg-group.com



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## Interpretation™

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Interpretation, a new peer-reviewed journal published jointly by SEG and AAPG, is now available.

This peer-reviewed journal is dedicated to the practice of interpretation of geophysical data – an area where the sciences of both AAPG and SEG overlap.



Published quarterly, the August and November issues are available online at: [www.aapg.org/interpretation](http://www.aapg.org/interpretation). AAPG members can access the Journal by logging into the Members Only section of [www.aapg.org](http://www.aapg.org). Non-members can view a copy by creating a New Customer account.

To continue receiving Interpretation, watch for subscription information coming in December 2013.

Subscriptions are offered for a calendar year only. Special first year prices for the 2014 calendar year are:

Print and digital: \$38 \$50 Digital only: \$25 \$40

To contribute content to the success of Interpretation, visit [www.seg.org/interpretation](http://www.seg.org/interpretation) for details.







## Classified from page 54

exploratory projects, Sklar also evaluates acquisition and development opportunities to complement its exploration portfolio. Further, although Sklar has been a leader in hydraulic fracture stimulation in the industry for some time, it now leverages that experience and combines it with horizontal drilling to extract reserves. Sklar is also currently active not just in primary production, but in a number of secondary recovery projects. In conclusion, Sklar is a growing company and that growth demands that it expand its talent base with valuable people skilled in a variety of disciplines.

The qualifications set forth below are mandatory minimum requirements without which a candidate will not be considered. The responsibilities include a broad range of job functions and are described for illustrative purposes. It is unlikely that an employee would perform all the described functions, and the final job description will be tailored toward the skillset of the candidate and the needs of the company. The position will be filled in Sklar's Boulder, Colorado office. Candidates must have strong interpersonal skills with the ability effectively to work within a multidisciplinary team to achieve project-related goals.

The benefits include:

- Competitive compensation
- Medical, dental, vision, life and disability insurance
- 401(k) with company match up to 3%
- Gym Membership Program
- Company paid parking
- Company furnished cell phone
- Computer and vehicle for business use
- Company paid continuing education.

Geologist Responsibilities:

- Work in an integrated team environment with Geoscience, Engineering and Land Departments to develop drill well, workover and recompletion proposals
- Work with Geophysicists to integrate geological and geophysical data
- Work with Accounting Department to develop schedule of operations and budget
- Generate exploratory oil and gas prospects, create prospect brochures and make prospect presentations
- Screen and supervise third party generated exploratory oil and gas prospects
- Evaluate reserve acquisition opportunities
- Assist in preparation of year-end and semi-annual

reserve reports

- Assist in third party engineering reserves audits and production forecasts

Qualifications:

- At least 10 years of oil and gas industry experience working
- Bachelor of Science degree in Geology required; Masters or PHD preferred
- Substantial work experience in upstream oil and gas industry
- Strong computer and analytical skills. Competent in use of PETRA geological software.
- Demonstrated proficiency in both open-hole and cased-hole log analysis
- Demonstrated proficiency in creating cross-sections, structure maps, isopach maps and key exhibits for brochure and prospect presentation
- Demonstrated use of economic principles to evaluate decisions

### Business Opportunities

Specialty geophysical service company is seeking an active partner or merger with a compatible firm. Established, profitable, debt-free, large on-line database, growth opportunity and loyal clientele. Equity contribution required. Principals only.

Respond to:

AAPG

Attn: Steve Praytor

P.O. Box 979

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### MISCELLANEOUS

### SAMPLES TO RENT

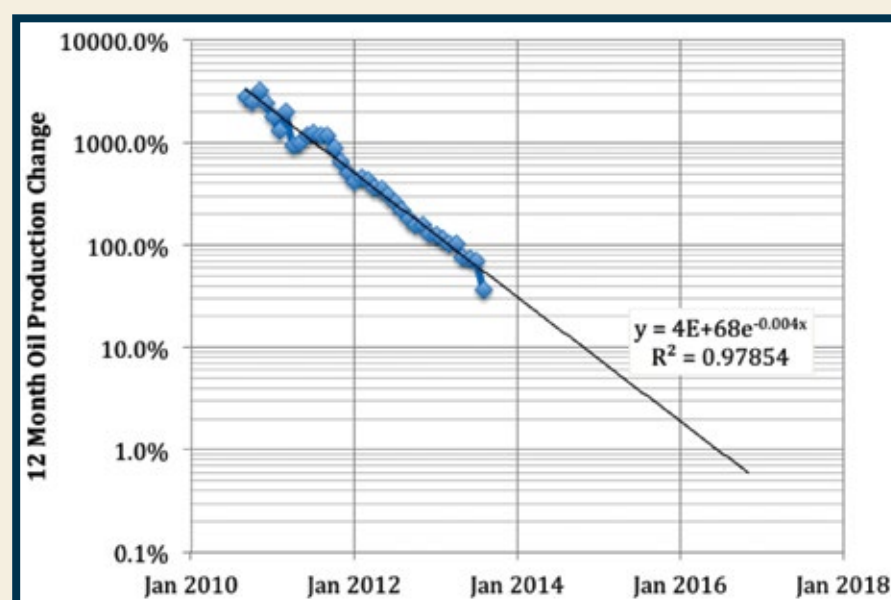
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## EMD from page 58

the peak so simply, but the trend probably won't continue. Production might decline, price fluctuations might cause rates to fluctuate or a new spurt of infill drilling might drive it up again. The change might happen abruptly, or so gradually as to go unnoticed for months. Thirty-five data points are not a lot unless you are a politician.


And when the trend changes, it will look radical to the pundits – but less so to those of us who spend our lives squinting at the details, trying to get an idea of what really is going on.

\* \* \*

One of the pleasures of interacting

with my colleagues in the Energy Minerals Division and AAPG as a whole is that I am exposed to the kind of information and insight that enables me to read through the hype and pontification about our industry. While we all wax speculative once in a while, I do find that the flights of fancy are better grounded in reality.

Sometimes we miss the grand changes by being so rooted in the details, but on the whole, I think the technical focus puts important constraints on the extreme predictions on the jazzy Web pages of energy wizards.

The effort to make available the best technical information in a variety of formats to as wide a community as possible is one of the most valuable efforts AAPG and its technical divisions contribute to our understanding of the future, however unpredictable it might still be. 

# THE UNIVERSITY OF TEXAS AT AUSTIN



## Professional staff openings

### Director of Development & Alumni Relations

Serve as chief development officer for the school, working with key stakeholders and managing a professional staff in development and alumni relations.

### Director of Outreach & Diversity Programs

Manage our award-winning GeoFORCE program and oversee other international and national outreach activities.

For information on these and other employment opportunities, visit [www.jsg.utexas.edu/hiring](http://www.jsg.utexas.edu/hiring).

## Join a School on the Rise

58

Faculty, up 79% since 2005

90

Research scientists at the Bureau of Economic Geology, Institute for Geophysics, & other units

90

\$90 million in annual funding, up \$37 million since 2005

7

National young career awards for recent faculty

The largest endowment and largest alumni network of any geoscience program in the world

400 Research locations worldwide

No. 3 Graduate program for Geology, U.S. News

87%

Growth in graduate enrollment since 2005

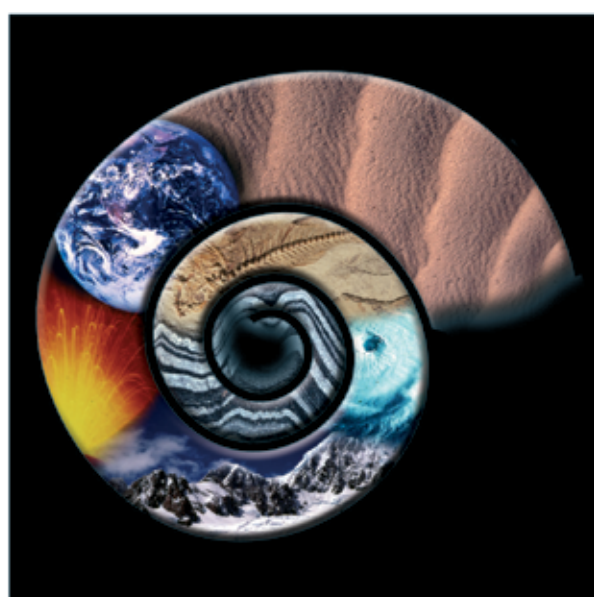
75%

Growth in undergraduate population since 2005



## Director of Petroleum Geoscience Studies (Professor/Reader/Senior Lecturer)

An opportunity exists in the Department of Earth Sciences for the prestigious appointment of Director for the MSc course in Petroleum Geoscience.



The MSc course has been established for over 25 years and has an excellent reputation world-wide. In excess of 500 graduates currently work throughout the global petroleum sector. Royal Holloway is now entering a period of growth, building on the strength of the current course and breaking new ground with the development of a Distance Learning programme that is becoming the training programme of choice for those already in employment. This will maintain Royal Holloway's position at the forefront of global MSc petroleum geoscience training; a key priority of this role.

The successful candidate will be a senior petroleum geoscientist with a proven track record of leadership and management and the ability to make a distinctive contribution to teaching. You will possess the vision and expertise to lead and develop the MSc course to meet the future challenges facing petroleum exploration and production. You will have strong links to and experience of working with the petroleum industry.



This is a permanent leadership position in the team delivering the Petroleum Geoscience programme at Royal Holloway. Flexibility exists to rotate administrative tasks with other team members, creating the potential to establish an appropriate balance between teaching and research. This full and permanent post is based in Egham, Surrey. The College is sited in a beautiful campus near Windsor Great Park and within commuting distance from London. PhD in a relevant field is required. Professorial salary is in the range £59,072 to £109,134, and Senior Lecturer/Reader salary in the range of £48,075 to £55,367 per year, inclusive of London Allowance. For details of the Department see:

[www.rhul.ac.uk/earthsciences/home.aspx](http://www.rhul.ac.uk/earthsciences/home.aspx)

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For an informal discussion please contact:

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Closing Date: Midnight Friday  
17th January 2014

Interviews are expected to be held week commencing  
Monday 17th February 2014

The College is committed to equality and diversity, and encourages applications from all sections of the community. We particularly welcome female applicants as they are under-represented at this level in the Department of Earth Science within Royal Holloway, University of London.



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# AAPG Continues to Navigate the Global Waters

By DAVID K. CURTISS, AAPG Executive Director

Globalization has hit a road bump, according to a special report on the world economy in the October 12 issue of *The Economist*.

Over the past two decades, advances in technology and political choices to encourage the flow of goods, services and capital across borders have contributed significantly to global economic growth. Overall this free flow of trade benefits producers by connecting them to much larger markets and consumers by lowering costs.

But, as we learned during the financial crisis of 2008, this openness and free trade carries not just benefits but also risks.

Fear of a global contagion gripped world markets in 2008 with the collapse of financial giant Lehman Brothers in the United States. Bankers across the globe worried that the conditions observed in U.S. markets would spread to other markets, as they in fact did.

Since then, "(all countries) want to enjoy the benefits of globalization, but as much as possible they now also want to insulate themselves from its downsides, be they volatile capital flows or surging imports," writes Greg Ip, U.S. economics editor for *The Economist*.

Efforts to engineer this type of economic protection can negatively affect economic growth. And it is here that our industry could be affected by this trend, if demand for oil and natural gas softens.

\* \* \*

Mindful of these global economic forces at work, here at AAPG we remain focused on serving geoscientists and other interested stakeholders who are interested in petroleum geoscience – no matter where they may live and work. That is our mission.

By way of example, in September AAPG cooperated with SEPM, the PetroChina Research Institute of Petroleum Exploration and Development (RIPEd), and China University of Petroleum-Beijing to host a research symposium on fine-grained



CURTISS



Some of the participants at the AAPG, SEPM, China University of Petroleum-Beijing and RIPEd-PetroChina joint research symposium on Fine-Grained Sedimentary Systems and Unconventional Resources, held in September in Beijing.

sedimentary systems and unconventional resources.

Nearly 200 delegates and students attended this symposium in Beijing to hear technical talks from China and around the world, to identify some of the key research challenges to better understand these geological systems that can contain significant volumes of oil and natural gas.

But each is unique – and one of the principal benefits of gathering with fellow geoscientists at AAPG events is the opportunity to learn from each other.

AAPG President Lee Krystinik was an honorary convener of the research symposium and observed to me how the technical program prompted several new insights and ideas that he will apply in his own exploration activities in North America.

This is how science – and exploration – advances.

Our hosts were essential to the successful outcome of this symposium:

- ▶ State Key Laboratory of Petroleum Resources and Prospecting (SKL-PRP).
- ▶ Unconventional Natural Gas Institute, China University of Petroleum-Beijing (UNGI, CUP-Beijing).
- ▶ Research Institute of Petroleum Exploration and Development, PetroChina.
- ▶ Chinese Petroleum Society (CPS).
- ▶ Division of Sedimentology, the Geological Society of China (DS, GSC).

And special thanks to the conveners for their efforts and support in launching this initiative, first proposed by Chengzao Jia

to then-AAPG President Paul Weimer and AAPG Asia-Pacific Region President Peter Baillie at the 2012 AAPG Annual Convention and Exhibition in Long Beach, Calif. They are:

- ▶ AAPG member Longde Sun, PetroChina.
- ▶ AAPG member Chengzao Jia, PetroChina and China University of Petroleum.
- ▶ Ningning Zhong, China University of Petroleum.
- ▶ AAPG member Keyu Liu, PetroChina RIPEd.
- ▶ AAPG member Brent Lockhart, Chevron Inc.
- ▶ Tom Bowman, ZaZa Energy.

May this event be the first of many collaborative efforts with our colleagues in China as we seek to collectively advance the world of petroleum geoscience.

\* \* \*

A significant source of AAPG's strength is that it is an association of geoscientists and other interested stakeholders who represent tremendous technical and geographic diversity.

But we have not come together as an association to simply be a collection of technical discipline niches or geographic subgroups – there is little value in that by itself.

The value comes from taking this diversity and focusing it on our stated purposes:

▶ To advance the science of geology, especially as it relates to petroleum, natural gas, other subsurface fluids and mineral resources.

▶ To promote the technology of exploring for, finding and producing these materials in an economically and environmentally sound manner.

▶ To foster the spirit of scientific research throughout its membership; to disseminate information relating to the geology and the associated technology of petroleum, natural gas, other subsurface fluids and mineral resources.

▶ To inspire and maintain a high standard of professional conduct on the part of its members; to provide the public with means to recognize adequately trained and professionally responsible geologists.

▶ To advance the professional well-being of our members.

As an Association we're first and foremost about geoscience. And AAPG's globalization is a vital part of accomplishing these purposes.

After all, the prefix "geo-" is Greek for earth.

*David K. Curtiss*

## DIVISIONS REPORT

# What Does It All Mean? Only Time Will Tell

By JEREMY BOAK, EMD President

A famous physicist once said that prediction is hard, especially about the future. I usually have to check whether it was the theoretical physicist Neils Bohr or the applied physicist Yogi Berra.

(It was Bohr.)

But predicting is a favorite pastime of pundits around the country, generally on the basis of too few data – like deducing the state of the climate from this week's weather. Even their interpretation of what is going on today commonly misses the mark.

A recent story about Shell's withdrawal from a long-lived project on in situ production of shale oil from oil shale was an interesting example of over-interpretation of a small dataset.

The writer portrayed Shell's retreat as sounding the death knell for another



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era of interest in commercializing shale oil production; what he missed was that Shell continues its oil shale work in Jordan – and while both Chevron and Shell have now dropped Colorado projects, ExxonMobil,

American Shale Oil and Independent Energy Partners continue in situ projects in Colorado.

In Utah, Red Leaf Resources and Enfit American Oil are actively pursuing surface shale oil production.

Indeed, for the moment, oil shale appears to be making important advances in many parts of the world.

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The same writer also ignored Shell's dropping of two unconventional oil projects in August in Colorado, one in September in Kansas, and putting up Eagle Ford acreage for sale at about the same time as the oil shale announcement. Clearly, Shell had been forced to retrench due to a less-than-satisfactory performance, and Colorado oil shale was just one of the casualties.

Another pundit recently said Shell had focused too much on gas and missed the unconventional oil opportunity – but again, clearly, it wasn't for want of trying but rather perhaps coming to the table too late.

Despite the Shell announcements, no one is out there proclaiming the end of Shell, or the end of the era for oil-bearing shale plays – least of all the Eagle Ford.

Yet even here, a closer reading of technical data shows that, whatever the pundits say, the Eagle Ford is moving toward maturity.

The figure on page 56 shows a plot of the 12-month percentage increase in oil production from the Eagle Ford. In the early days of the play, the increases were extreme, and even in July a 12-month increase of 36 percent was remarkable (and likely to be revised upward). But on the logarithmic scale it is evident that the growth rate is declining very regularly.

If the trend continues, growth will be less than one percent in another three years, and production will peak somewhere in the range of 750,000-850,000 barrels per day.

It would be nice to think I could predict

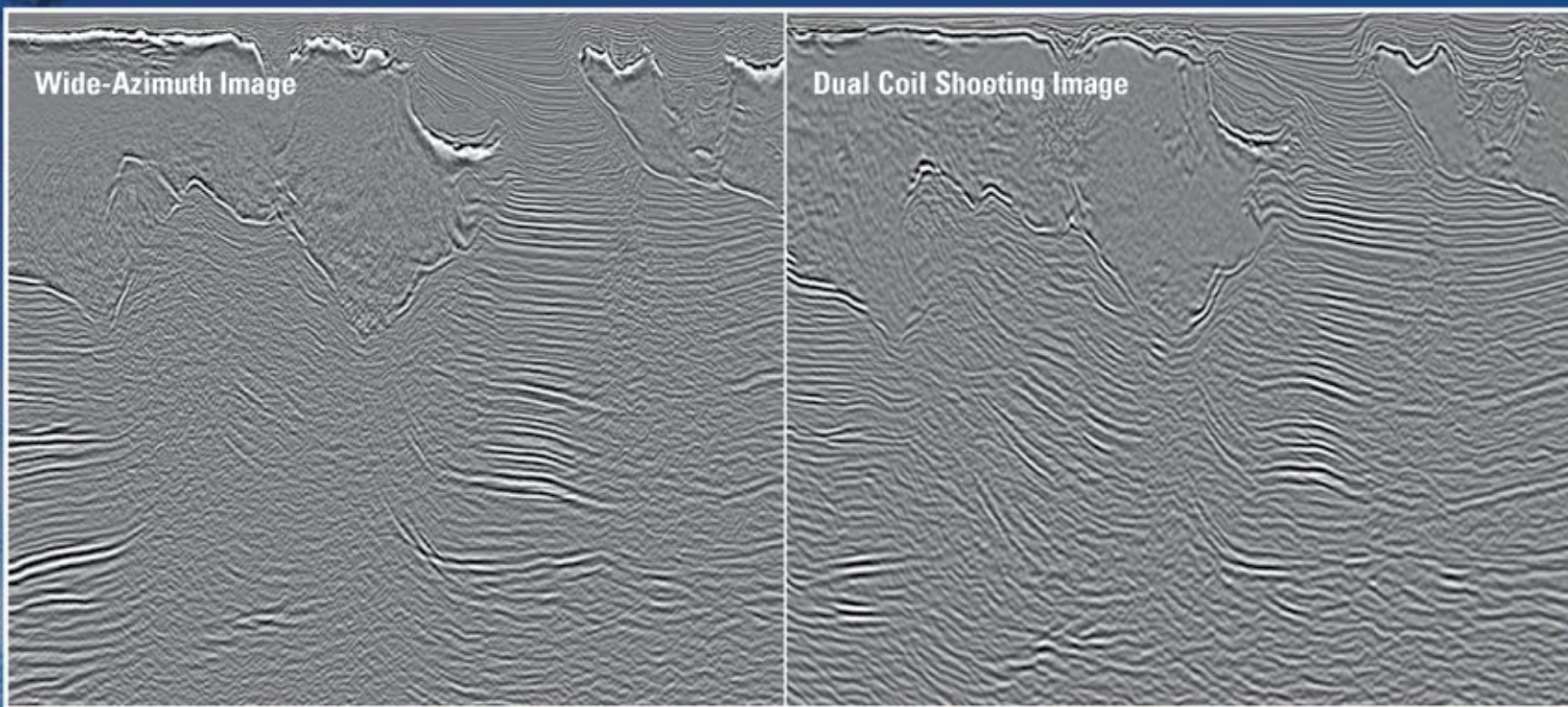
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# Aim high!







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