



# AAPG EXPLORER

DECEMBER 2011

## **Sign of Success** A proud Colombian tradition

See page 16





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**PRESIDENT'S COLUMN**

# Random Musings From 35,000 Feet (10,675 m)

By PAUL WEIMER

*(In flight: The first draft of this column was written on the airline's paper napkins while flying over the North Atlantic.)*



WEIMER

**... One can only truly understand economics once one has lived through a few economic cycles, preferably in different countries.**

I recently returned from two glorious weeks in the Dolomite Mountains (three-day field trip), followed by the AAPG ICE meeting in Milano, then 1.5 days in The Hague, where I had the singular pleasure of interviewing Ken Glennie and Koenraad "Koen" Weber (the 2005 and 2012 AAPG Sidney Powers' Medalists, respectively) for the 100th Anniversary Geo-Legends program. The learnings from this trip and previous AAPG travel are simply overwhelming; but time on the airplane means time to think, time to extract and collate meaning from all these events. In the last few months, I have had the extraordinary opportunity to visit 12 countries and interact with many geologists and students. A few musings regarding the future ...

\* \* \*

As an undergraduate, I had a distinguished history professor whose specialty was economic history; I can distinctly remember him stating that one can only truly understand economics once one has lived through a few economic cycles, preferably in different countries. My recent travels have underscored this observation; specifically, the integral role that petroleum and other extraction industries play in the countries' economies.

Two countries on my itinerary illustrate this point. First is Colombia, which I first visited in 1994, and at least once a year since 2006. The rapid evolution in

Colombia's petroleum industry and its impact on the country's economy is most impressive. Second is Australia, where I taught in 2001, 2004, and 2011. This last visit impressed me with how much stronger Australia's economy is, and how this country managed to avoid the brunt of the 2008 Global Financial Crisis in large part due to the relative strength and growth of the Asia-Pacific economies and their demand for resources. For both Colombia and Australia, the extractive industries play a key role for their present and future economies.

\* \* \*

Several articles recently published in the mainstream media are beginning to recognize how the global resource base is being altered with unconventional and conventional discoveries and their many economic, political, and diplomatic implications. North American industry has a long way to go in its efforts to share our learnings on unconventional resources and their impact with the world. AAPG will play an important role in this education process.

Globally, I am curious to see how different countries will pursue the development of conventional and unconventional plays. Clearly, the geologic conditions necessary for economic development of unconventional resources are not the same or do not exist in all sedimentary basins.

Some countries are not likely to develop their unconventional resources for decades due to ongoing large investments required for the development of their conventional resource base, such as Brazil. Yet other countries clearly are approaching their unconventional resources with greater immediacy, e.g. Colombia and Argentina.

In addition, there have been substantial offshore discoveries in many sedimentary basins globally that lack the long-term infrastructure for development, e.g. Mozambique, Tanzania, Sierra Leone, Morocco, Israel, and French Guiana. How long will it take for these discoveries to be developed? What will be the impact on their countries? How will these discoveries change global politics and diplomacy? As the unconventional resource plays are

developed, what will be their impact on global prices and markets?

\* \* \*

After arriving in Sydney in August, I read a national newspaper on the flight to Adelaide. The articles and editorials regarding the pros and cons of drilling and hydraulic fracturing were remarkably similar to those published in the United States and Canada – only the names of individuals needed to be changed. This shows that all countries are debating the many challenges of energy policy, the proper mix in terms of energy choices, and appropriate environmental policies. CO<sub>2</sub> sequestration – the myths and the facts – is also an important part of the discussion.

Where are we headed? Those places (states, provinces, and some countries) that already have an industry development infrastructure appear to have less ongoing confrontation. The battlegrounds appear to be in those states/provinces/countries that have *not* had a significant petroleum base before the unconventional resource opportunities came along. To ensure future success, we must educate regulators that unconventional resources have different development needs than conventional resources.

The global debate regarding hydraulic fracturing and CO<sub>2</sub> sequestration is rapidly moving beyond fact-based discussion and entering the stage of non-science-based, non-reasoned policy. I am reminded of Mark Twain's observation: "*Get your facts*

[See President, next page](#)

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**ON THE COVER:**

The Huron-1, a deep gas-condensate discovery in the Colombian Eastern Cordillera foothills, is located on a triangle zone formed during the Andean orogeny (Late Miocene-Pliocene). The well is an example of the exploration success that Ecopetrol has experienced in Colombia.

To the left, a look at Colombia's first shale well, the Sueva 1, currently being drilled by Nexen in the Eastern Cordillera highlands near Bogotá.

Photos courtesy of Mario de Freitas.



## Meet the Candidates

**B**ioographies and individual information for all AAPG candidates for the 2012-13 Executive Committee are available online at [www.aapg.org](http://www.aapg.org).

The material includes each candidate's written response to the question of why they accepted the invitation to stand for public office, plus a brief video statement by each candidate that was filmed at the recent AAPG Leadership Days event in Boulder, Colo.

The president-elect winner will serve in that capacity for one year and will be AAPG president in 2013-14. The vice president-Sections and secretary will serve two-year terms, beginning July 1.

Ballots will be mailed in spring 2012. The slate is:

### President-Elect

- ☐ Donald D., Clarke, geological consultant, Lakewood, Calif.
- ☐ Lee Krystinik, Fossil Creek Resources, Arlington, Texas.

### Vice President-Sections

- ☐ Thomas E. Ewing, Frontera Exploration Consultants, San Antonio.
- ☐ Kenneth E. Nemeth, Schlumberger Seismic Reservoir Characterization, Houston.

### Treasurer

- ☐ Rebecca L. Dodge, Midwestern State University, Wichita Falls, Texas.
- ☐ Deborah K. Sacrey, Auburn Energy, Houston.

## President from previous page

*first, then you can distort them as you please."* AAPG needs to assemble a good response with strong scientific background with the facts from the locations in the United States and Canada where the hydraulic fracturing has happened. We are moving quickly to assemble such information.

Having now visited several countries, I better understand that one of the fundamental challenges for AAPG's future success is the fact that companies, in general, simply are not engaged with university geoscience departments. This is a key impediment to the retention of

student members, and to the very future of our industry. A future column will discuss this situation.

\* \* \*

Finally, I was once again reminded of the significant impact that individuals can make to the broad cross section of society. The Dolomites field trip, which I was so fortunate to attend, was co-led by AAPG member Piero Gianolla, professor at the University of Ferrara. Piero has spent a substantial portion of his career studying the spectacular geology exposed in the Triassic strata of the Dolomite Mountains in northeastern Italy. From 2005 to 2009, Piero spent significant time working with the local administrations to establish the Dolomite Mountains as UNESCO World Heritage Site for their geological and landscape values.

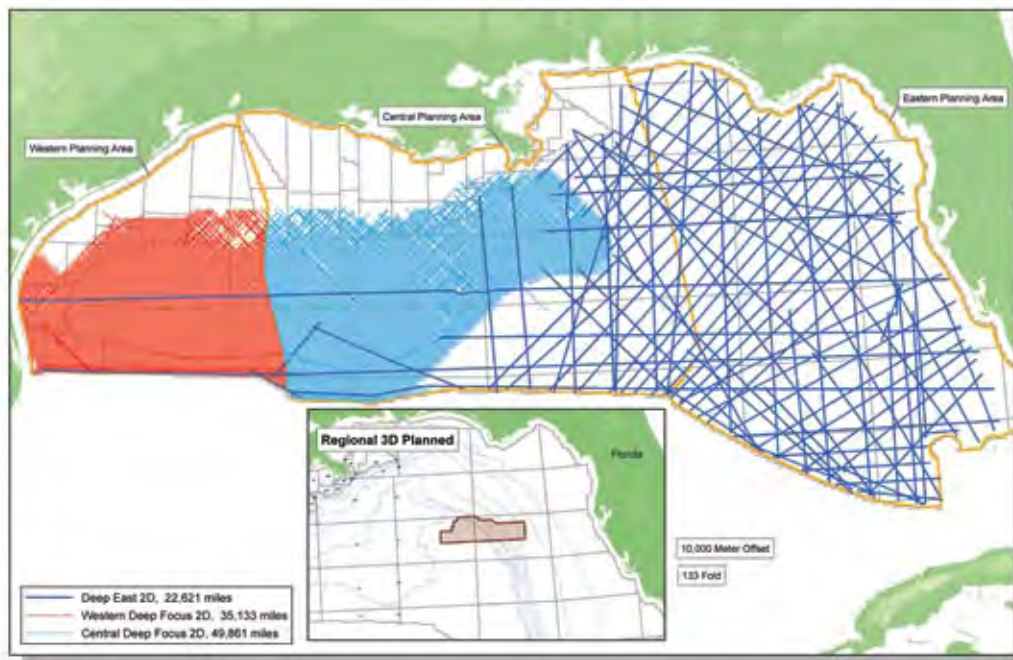
Future generations will benefit from this extraordinary contribution. Piero's story will appear in an issue of the AAPG EXPLORER in early 2012.

*Grazie Piero per il tuo entusiasmo e per un incredibile lavoro. BRAVO!!!*

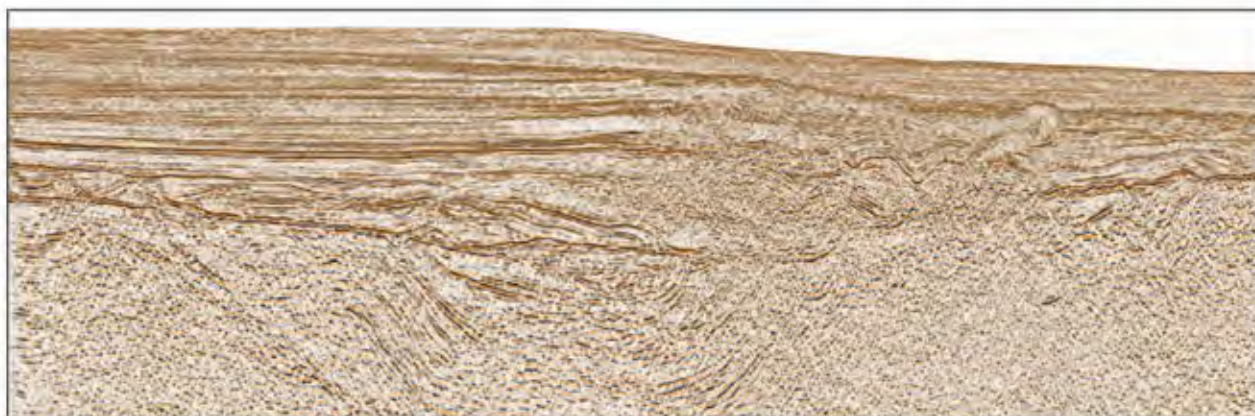
The jet engines hum ... and the beat goes on ...

*Paul Weimer*

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## Texas Board Pulls License Proposal


**T**he Texas Board of Professional Geoscientists in early November unanimously voted the immediate withdrawal of proposed rules concerning the removal of exemptions for petroleum geologists from licensure.

The proposed rules were criticized in a letter signed by AAPG President Paul Weimer and DPA President Marty Hewitt that was presented a week before the board shelved the proposals.

The Texas board also unanimously approved a draft opinion that reaffirmed the exemption of geoscientists working in the exploration and development of oil, gas or other energy resources, base metals and precious or non-precious minerals – including sand, gravel or aggregate – from licensure under the Texas Geoscience Practice Act.

The AAPG letter noted that the proposed changes “would have a negative impact on the oil and gas industry with a significant loss of employment for geoscientists who did not elect to participate in initial licensing under the grandfather clause in the act.

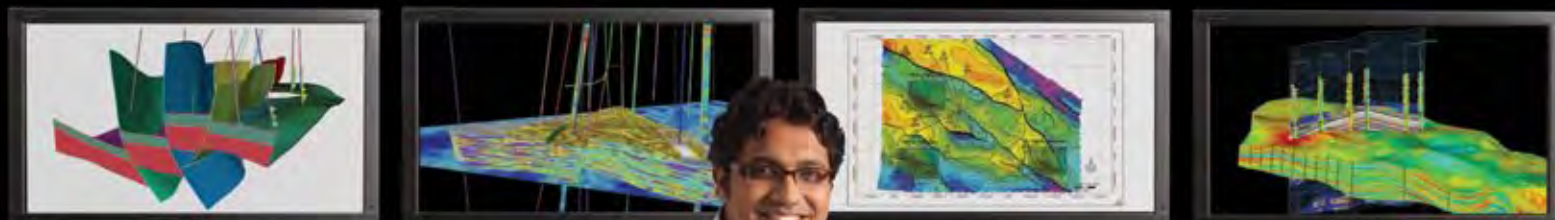
“They did this with the understanding that their work would be exempt, and would not be subject to the act in the practice of oil, gas, energy resources and minerals exploration and development,” the letter continued. “These geoscientists would most likely suffer a serious setback in their careers while seeking to qualify for their license.”

The letter also stated that the Texas Act has become a model other states have followed in the development of their own rules. If other states were to follow suit, the ability of Texas geoscientists to pursue business outside of the state would be negatively impacted by the requirement to be licensed in those other states. 



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*'It's not just theoretical'*

# New Modeling Technologies in the Pipeline

By DAVID BROWN, EXPLORER Correspondent

**D**ownhole reservoir monitoring is a concept that's generated a lot of buzz. Too bad it's also generating a lot of fuzziness.

Part of the confusion comes from so many new tools and techniques jostling for the industry's attention. And more developments are coming.



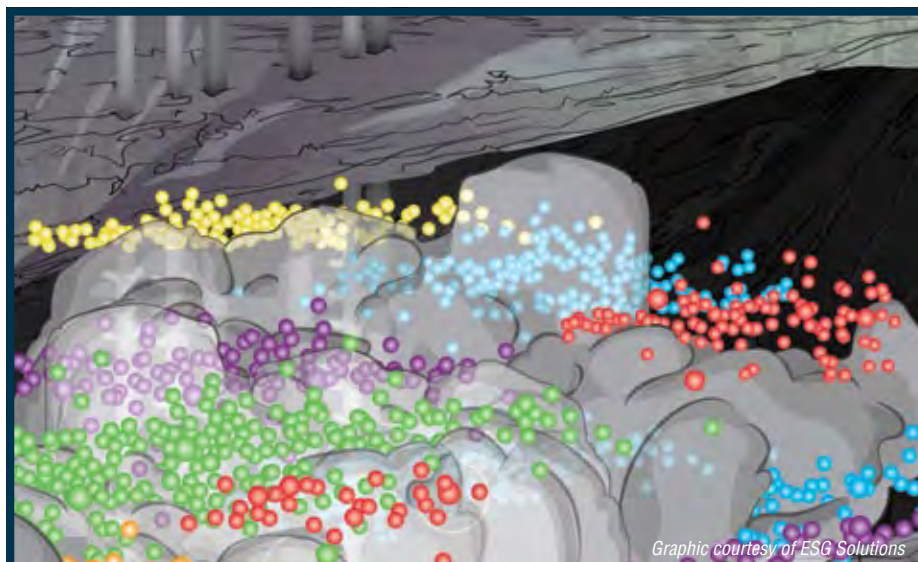
AMINZADEH

Fred Aminzadeh is executive director of the University of Southern California Reservoir Monitoring Consortium (RMC) in Los Angeles. He served as president of the Society of Exploration Geophysicists in 2007-08.

Aminzadeh listed 16 research areas of high importance for future reservoir work, ranging from integrated reservoir management to underwater acoustic communication.

The RMC has identified six of those for high-priority research, he said they are:

- ▶ Optimized hydraulic fracturing for shale.
- ▶ Physical models to monitor reservoir fluid.
- ▶ Microseismic/micro earthquake (MEQ) to map reservoir structure.
- ▶ Time-lapse petrophysics for reservoir monitoring.
- ▶ MEQ and seismic integration for shale reservoirs.



Continuous monitoring has multiple benefits beyond optimizing production and maximizing reservoir life, including casing failure, fracture spread and reservoir containment.

▶ Tomography-based reservoir modeling.

"It's not just theoretical," Aminzadeh said. "Some of these things are being tested in the lab now."

### Geophysical Techniques

In its early days, conventional reservoir monitoring typically involved 4-D seismic and a comparison of static, analytic "snapshots" of the reservoir.

As monitoring advanced, the industry began looking for less expensive and more continuous techniques, with additional emphasis on temperature and pressure monitoring.

Aminzadeh described three categories of geophysical techniques used in reservoir monitoring, the physical properties they measure and the reservoir properties inferred:

▶ Type 1: Four-D surface seismic, vertical

seismic profiling, cross-well seismic. Physical properties measured – Changes in amplitude, arrival time, waveform. Reservoir property inferred – Fluid saturation, pressure changes.

▶ Type 2: Microseismic or passive seismic.

Physical property measured – Rock shear failure with stress perturbations. Reservoir property inferred – Fluid flow pathways, flow anisotropy.

▶ Type 3: Borehole and surface electromagnetic changes.

Physical property measured – Electrical resistivity changes. Reservoir property inferred – Saturation 4-D changes.

The new or improved approaches now under development will not only expand the horizons of reservoir modeling, but should also strengthen the industry's capabilities.

"Time-lapse petrophysics is something that's not much talked about, but it's very important," Aminzadeh said.

"Tomography has been talked about a lot," he continued, "but what has happened in the past is that tomography has been used to create a static picture of the reservoir."

See [Reservoir](#), page 8

## ABSTRACTS NOW ACCEPTED FOR ATC 2012

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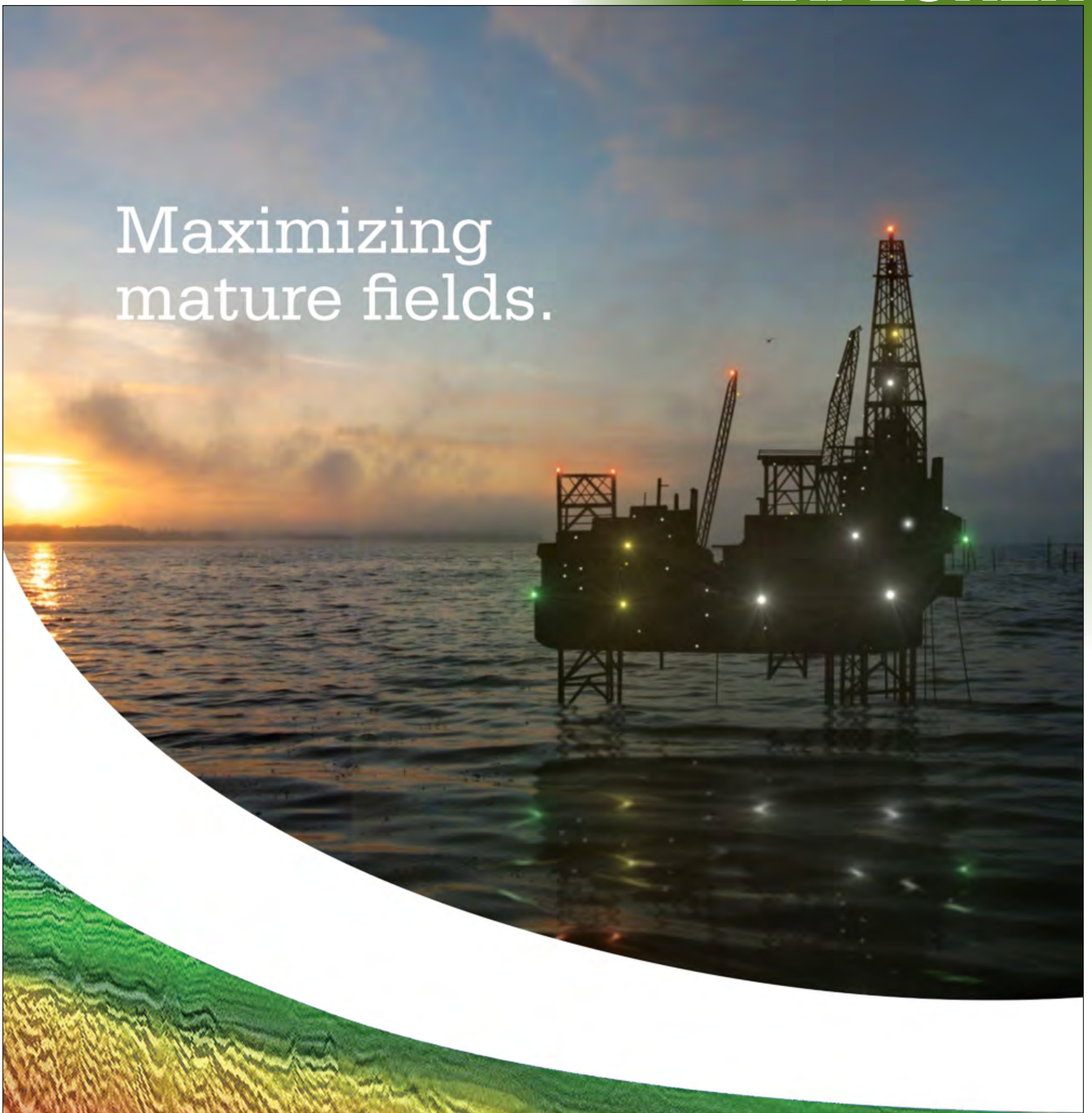
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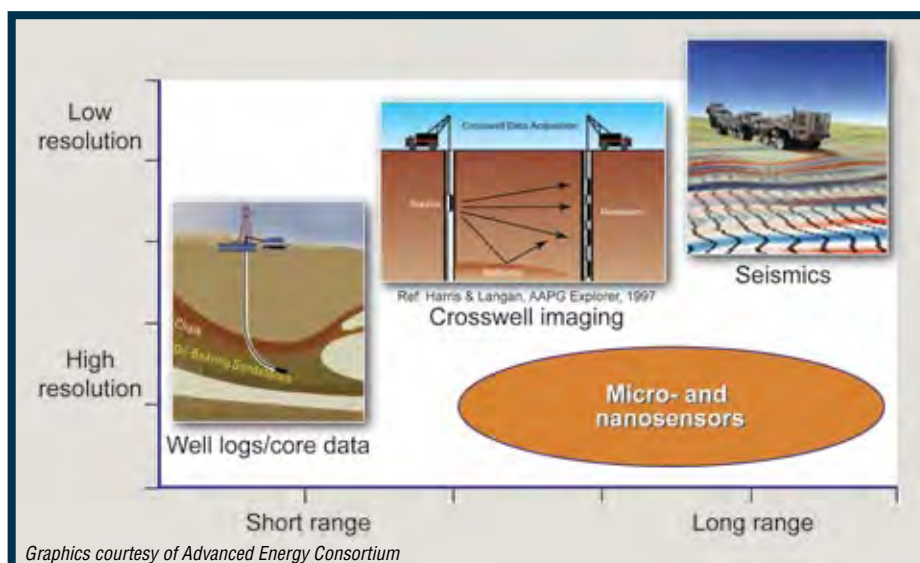
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Graphics courtesy of Advanced Energy Consortium

Newly developed micro- and nanosensors could provide higher resolution measurements from the inter-well reservoir space.

*No oil left behind?*

## Nanotech Research Making Strides

By LOUISE S. DURHAM, EXPLORER Correspondent

The three-year-old Advanced Energy Consortium (AEC) has a lofty goal to locate and extract the billions of barrels of potentially available petroleum supply remaining in place following conventional recovery.

To get from here to there the organization – managed by the Bureau of Economic Geology, University of Texas – is funding scientific research in the infinitesimally small and unexplored nanorealm.

“The AEC is focused specifically on application of nano-scale technologies to the exploration and improved recovery of oil and gas,” said Sean Murphy, AEC program manager. “The goal is to develop subsurface micro- and nano-sensors that can be injected in oil and gas wellbores.

“These incredibly small sensors can migrate out of the wellbores and into and through pores of the surrounding geological structure to collect data about the physical and chemical characteristics of hydrocarbon reservoirs,” he noted.

Interest in AEC research has spread beyond the oil and gas companies.

A recent national meeting of the American Chemical Society included a special session on nano-technology for the oil and gas industry. Twenty-three papers were presented, with 90 percent of them authored by researchers funded by the AEC.

The organization is focused on three specific areas, which Murphy summarized:

► **Contrast agents.**

Molecules or nanoparticles having augmented electromagnetic, acoustic or other properties that can be dispersed in fracturing or injection fluids in order to increase the ability to sense the spatial extent of those fluids by using available borehole, surface and borehole-surface-imaging techniques.

► **Nanomaterial sensors.**

Molecular and material-based sensors, predominantly fabricated using bottom-

up techniques (chemical synthesis and/or self assembly, most of which require retrieval and interrogation). They show an irreversible and detectable state change upon exposure to discrete or threshold-level variations in physical or chemical conditions in the reservoir.

► **Microfabricated sensors.**

Sensors (predominantly) fabricated using top-down techniques that can continuously measure physical or chemical reservoir properties. They are able to store or transfer data back to the wellbore, and have a demonstrable path toward further miniaturization. These include micro- and nanoelectronics, microelectro-mechanical systems (MEMS) and nanoelectro-mechanical systems (NEMS) devices and their supporting subsystems.

**Focusing on the Next Step**

The AEC is in the process of transitioning from a scientific-dominated startup phase to a more focused research and development phase, according to David Chapman, AEC project manager.

A common metric to gauge the maturity of technology was developed by NASA. Dubbed Technical Readiness Levels (TRL), developing research is measured on a scale of 1-10.

“Most of the work we’re doing now is in the two to five range,” Chapman said. “We decided that as a group, we’ll take our work to the TRL six and seven, which entails a technology demonstration.

“In the case of oil and gas, that would be a demo in a field environment,” he noted. “We want to take things as far as a demo and then likely pass it to industry.”

Contrast agents are the first they will demonstrate in the field, with magnetic contrast agents being the most near term.

“Contrast agents are of particular interest to our members because of the potential to enable higher resolution, real-time imaging to delineate the location and path of fluids injected into the reservoir,” Murphy emphasized.

“With contrast agents, we’re using the



MURPHY

See Consortium, page 14





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# 'Nano Balls' Prop Shale Fractures

By LOUISE S. DURHAM, EXPLORER Correspondent

**N**anotechnology is the field of science defined by the nanometer, which is the equivalent of one-billionth of a meter and appears poised to make a significant impact in the oil and gas industry, demonstrating that minuscule particles are suited for big jobs.

It's currently playing a role in the contentious hydraulic fracturing segment of the industry, among other applications.

One of the latest examples is the new fracking proppant stemming from nanotechnology research at



BARRON

Rice University's Smalley Institute for Nanoscale Science and Technology (SINST) in Houston. These new agents

will help to optimize production from unconventional oil and gas wells.

Ordinary proppants, typically made

**The big advantage in these lighter, more uniform proppants is that they're all the same size, so the hydraulic fracturing process requires less water, chemicals and additives.**

up of sand grains or ceramics, are dispersed into the formation along with the injected fluids. Their purpose is to keep the fractures open when the fluid injection ceases. As the pressure drops, the rock ordinarily will collapse without the support of substantive proppants.

"We were out to make proppants that are lighter and stronger than previous materials," said Andrew Barron, Welch Chair of chemistry and professor of materials science at Rice. Barron spearheaded the research effort, which was initially funded by the Advanced Energy Consortium (AEC) at the Bureau of Economic Geology at University of Texas at Austin. The AEC funds scientific research in the nanorealm.

Nano-proppants OxBall and OxFrac are light, high-strength ceramic proppants, which evolved out of the nanotechnology research at the SINST. They are being produced at a Texas-based company founded by Barron.

"OxBall is heavier and slightly larger, and OxFrac is lighter and smaller," Barron said. "They're essentially the same type of thing but have different applications. For example, OxBall is more suited for west Texas type oil and OxFrac for shale gas like the Barnett.

"The material can be tailored especially for particular mineral types, in terms of whether you're in west Texas, Oklahoma or wherever," he noted. "It can be designed to be optimum for different reservoir types."

OxBall currently is being used to enhance production from the deeper Haynesville and Eagle Ford plays.

The big advantage in these lighter, more uniform proppants is that they're all the same size, so the hydraulic fracturing process requires less water, chemicals and additives.

### A Practical Explanation

Here's a simple take on how it works:

Picture a bucket filled with ping-pong balls. Spaces exist where the surfaces don't touch. The balls are all uniform size, so they pack uniformly and create "porosity" providing significant space for all and gas to flow.

In contrast, if the proppant being used has particles of varying shapes and sizes, such as the grains in commonly used, relatively inexpensive sand, they pack tighter, and the rate at which oil and gas come out of the well is slower.

"The flow rate with same-size proppant particles can be as much as 100 percent higher than using traditional ones," Barron emphasized.

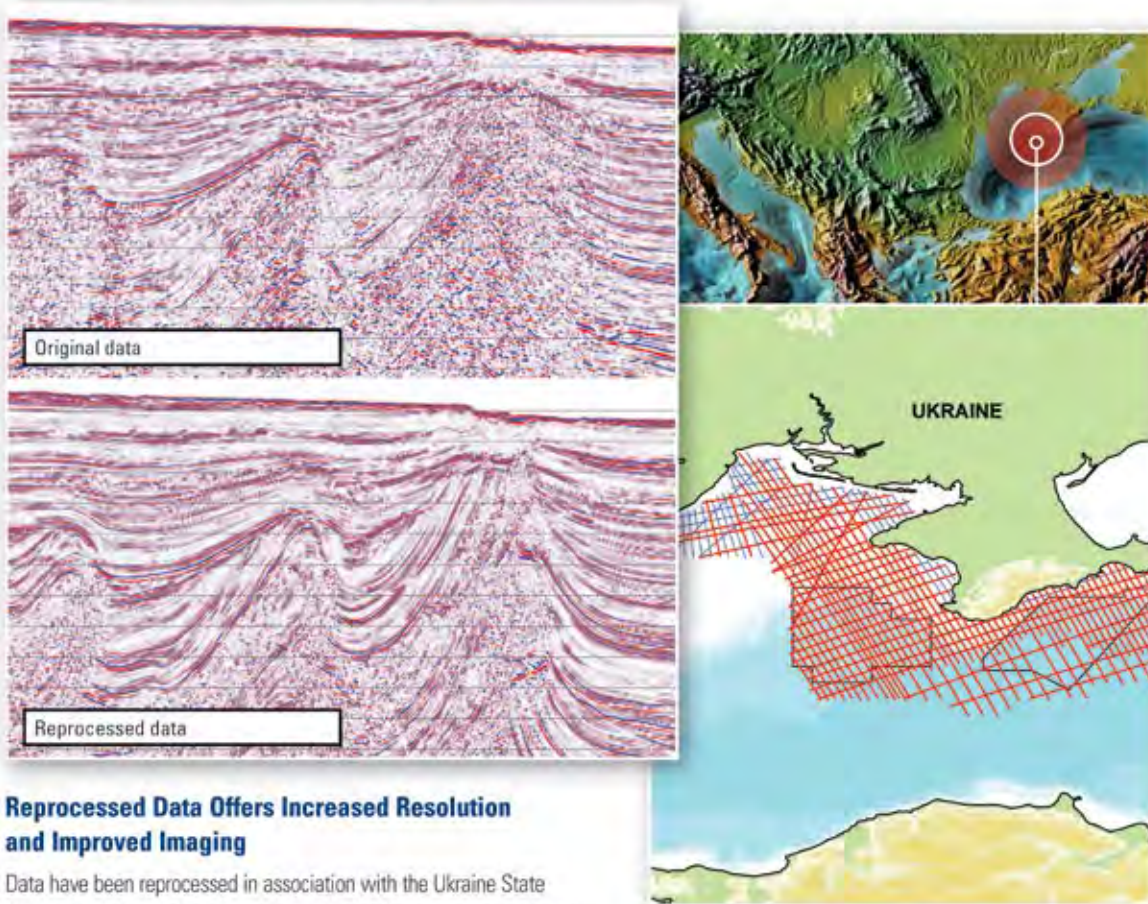
Another consideration is downhole injection.

Where fluid is pumped down the borehole with varying-sized proppant particulates, their tendency to aggregate will limit how far down they can be pumped.

Barron noted the company puts together a number of different materials to make the ceramic proppants. One is waste material from China, Russia, Ukraine and U.S. power stations (coal-powered power stations). They use this as a base and use various different minerals – nano-crystalline minerals – to create the proppant.

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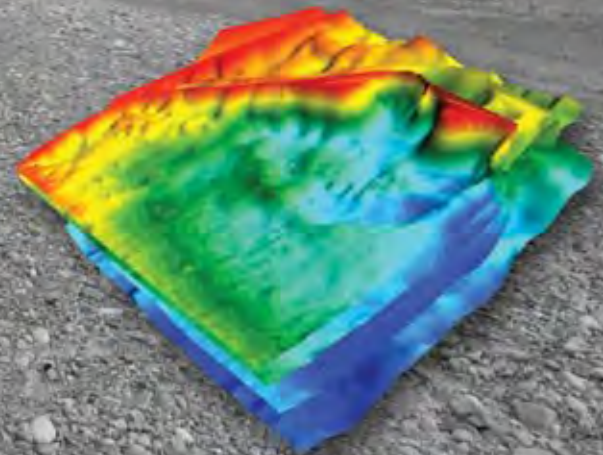
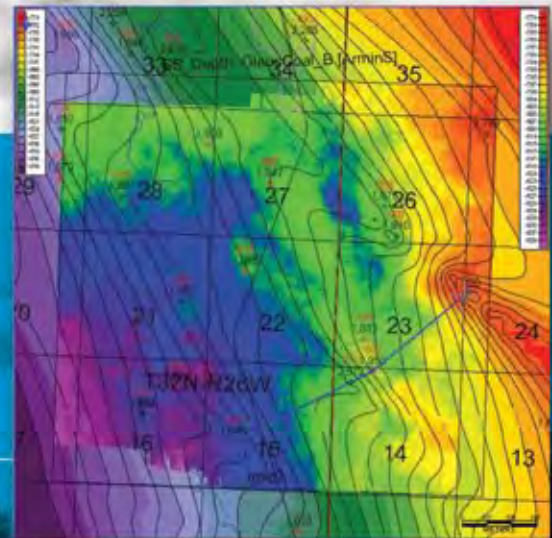
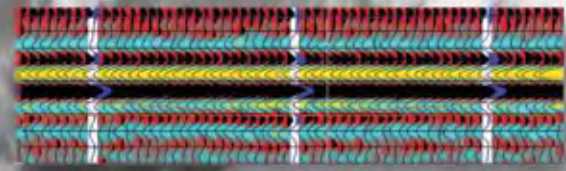
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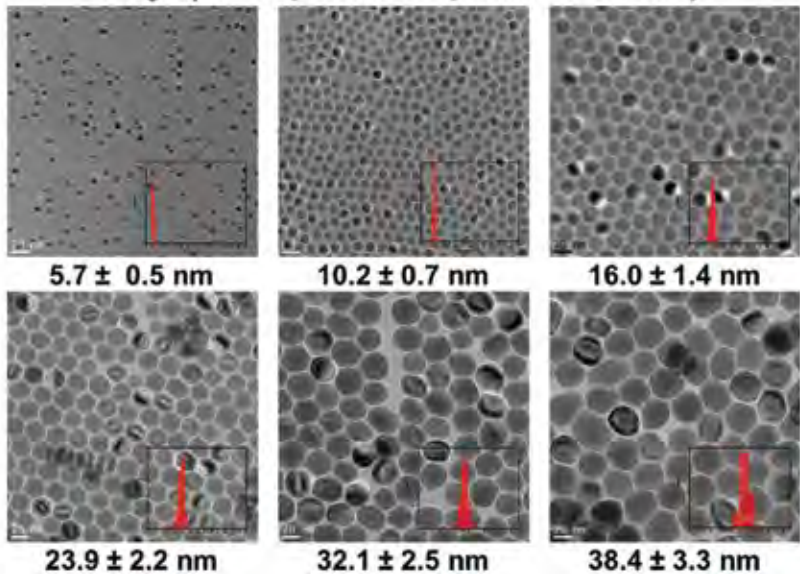
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**Fe<sub>3</sub>O<sub>4</sub> nanoparticles (5 nm to 40 nm)****Consortium**  
from page 10

properties of nano material without having to do a lot to them," he said. "In the case of magnetic nano-particles, the particles themselves have a magnetic permeability, or susceptibility that's an inherent property of that nano-particle.

"The magnetic strength is enhanced because of the size of the particles, to the point it gives us the capability to do things we can't do with bulk materials," Murphy noted. "We coat the particles so they have

*These transmission electron microscope (TEM) micrographs illustrate the Colvin (Rice University) Group's ability to synthesize magnetite (Fe<sub>3</sub>O<sub>4</sub>), controlling nanocrystal grain sizes and size distributions (histograms).*

long-term stability in the reservoir, and they can move through the reservoir or fracture.

"It's their inherent properties we're leveraging, so that's what makes them our near-term project," he continued. "Nano-materials and micro sensors will take a lot more integration, so they will be longer term projects for us."

Existing geophysical tools can be used to develop images using these magnetic nano-scale, material contrast agents.

Regarding contrast agents, Chapman said they will require hundreds of kilograms of the material – more than typically manufactured by most chemical plants.

The extent and efficiency of waterfloods are currently getting the once-over by the researchers.

"If we can image where the flood goes by adding magnetic contrast agents to it, that would give the ability to see where the fluids are moving," Murphy said. "We're challenging ourselves to do a magnetic waterflood demo in the next couple of years."

**Impact on Fracturing**

The AEC already is reporting nano-tech success stories, one of which focuses on hydraulic fracturing.

In this case, nano-proppants have been developed via a program initially funded by the AEC at Rice University's Smalley Institute for Nanoscale Science and Technology, which is a technical partner. These stable, uniform-size proppants have considerable potential to enhance hydraulic fracturing applications (see article on page 12).


They already are being used commercially.

In addition to these advanced proppants to help keep the fluid injection-created fractures open, the possibility exists that benign nano particles can be added to the hydro-fracking toolkit to detect the extent and intensity of the fracking process.

The particles must be custom-designed so they will be both stable and mobile within the fluids.

Nano particles can be made up of any kind of material. In fact, any chemistry can be scaled down to nano-scale size particles, and the researchers are investigating a wide range of chemistries. Materials used must be stable and able to survive in the harsh reservoir environment, which can be thousands of feet underground.

In addition to the array of ongoing research by U.S. universities, companies and other AEC participants, the group is planning to expand its scope geographically.

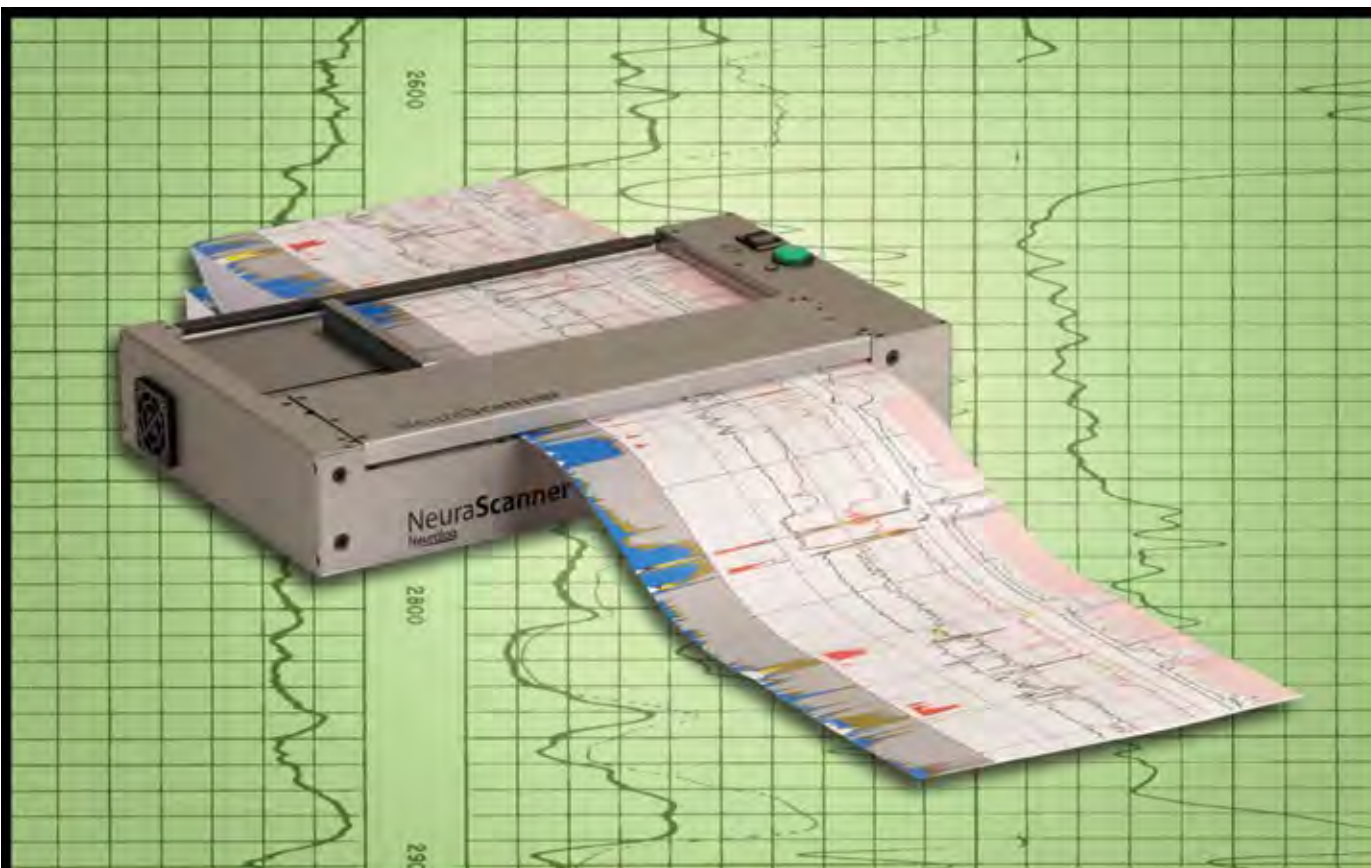
"We're looking to initiate some new projects," Murphy said, "which will probably be international in scope, funding the best research universities in the world for some of that research." 

**Matson Wins Levorsen**

**A** APG member Shane Matson, with Spyglass Energy in Tulsa, has won the A.I. Levorsen Award for the best paper at the recent Mid-Continent Section meeting.

Matson's paper was "Subsurface Mapping and Reservoir Characterization of the Mississippian Strata Using Recently Acquired FMI and PEX Well Log Data From Horizontal and Vertical Well Bores in Northeast Oklahoma."

Co-authors were AAPG members Charles Wickstrom and Steve Tilley, both with Spyglass Energy, and Gregory Flournoy, with Schlumberger Oilfield Services, Oklahoma City.

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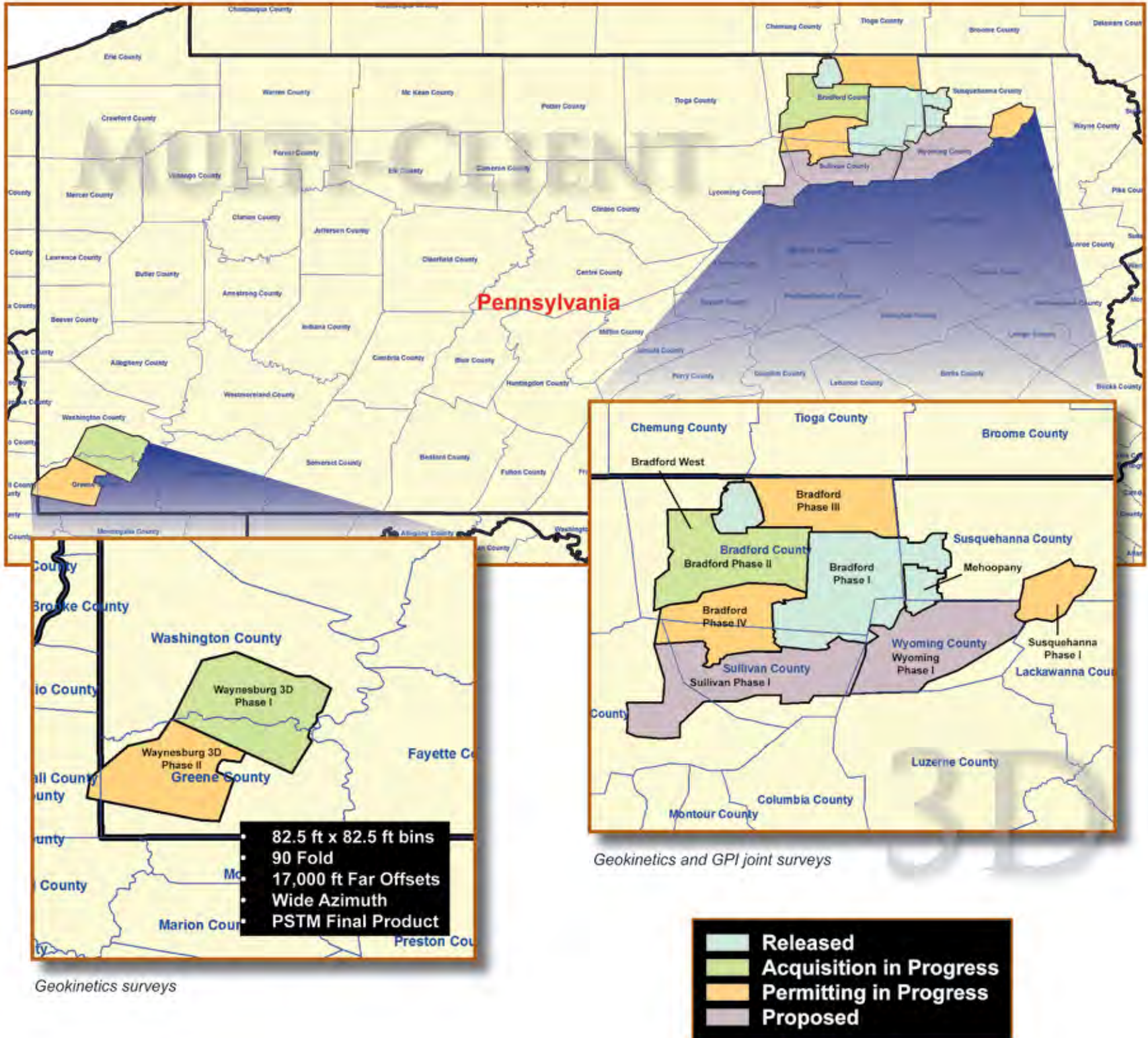
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Photos courtesy of Mario de Freitas

Aerial view of foothills over Rio Cusiana in Tauramena area.

**HISTORICAL HIGHLIGHTS**

# Colombia's Ecopetrol: A Legacy of Principles

By MIGUEL RAMIREZ and VICTOR RAMIREZ

**W**ith Colombia rapidly approaching a historical production record of one million barrels of oil per day, and Ecopetrol, the state oil company, celebrating its 60th anniversary, it is worth reviewing the events that led to these milestones.

There are relevant lessons that Colombia should not forget, and that have application not only in other Latin American countries but around the world.

The first commercial oil well in Colombia

was drilled in 1918. For many decades the country was a modest producer, yielding 100-150,000 BOPD.

After the discoveries of Caño Limón in 1983 and Cusiana-Cupiagua in 1992, production rose to a peak of 820,000 BOPD, which then gradually declined to 520,000 BOPD.

Colombia's oil and gas production has rose to record highs because of:

- ▶ Recent organizational changes at Ecopetrol.

- ▶ The creation of the National Hydrocarbons Agency – generally known as ANH by its initials in Spanish.

- ▶ The establishing of more investor-friendly fiscal policies, which have attracted over 130 E&P companies from around the world.

- ▶ A period of high oil prices.

Underlying these positive results are two important historical facts of Colombia's petroleum industry:

- ▶ The government's strict honoring of contracts with private companies.

- ▶ A great deal of pragmatism of the political and business leaders in dealing with international oil companies.

Ecopetrol was born out of the reversion to the Colombian state in 1951 of the De Mares Concession in the central part of the Middle Magdalena Valley. It is the site of the La Cira-Infantas field (EUR 800 MBO), which was for many years Colombia's largest oil field – a prominent surface anticline that produces from shallow Tertiary continental sandstones.

### Reversion Ceremony

At midnight on Aug. 25, 1951, the reversion of the De Mares Concession was formalized at a surreal ceremony held at the town of Barrancabermeja. It was attended by government and industry officials, including Manuel Carvajal, minister of industry; L.P. Maier, president of Imperial Oil; managers from operator Tropical Oil Co. (a subsidiary of Imperial Oil); Emilio Sardi, the first president of Ecopetrol; the bishop of Barrancabermeja; and others.

The ceremony took place at the exact date and time on which the Supreme Court had ruled the concession should expire after a total of 30 years.

Surprisingly to some, this reversion occurred in a peaceful and amicable way, according to the terms and conditions agreed in the original concession document 30 years before, a period of high labor unrest and political upheavals – not only in Colombia but throughout Latin America, including the expropriation of private oil companies in Mexico in 1938.

Maier said at that moment, "This is to my knowledge the first time in the history of the



M. RAMIREZ



V. RAMIREZ

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See **Colombia**, page 18



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Modern facilities for oil production in eastern Llanos.



The 1951 reversion sparked celebrations throughout Colombia.

**Colombia**  
from page 16

petroleum industry in which an important property, developed by private capital under a concession, returns to the patrimony of the state by virtue of the strictly legal expiration of the contract.”

Minister Manuel Carvajal replied saying, “As rightly pointed out by Mr. Maier, the event that we are celebrating today has world repercussions. Different has been the fate of exploration contracts celebrated in other countries where misunderstood nationalism has resulted in political and international commotions in order to obtain what Colombia has received by complying strictly with the agreed commitments.

“From now on, the field will be developed by the Empresa Colombiana de Petroleos, Ecopetrol.”

This reversion and the creation of Ecopetrol are widely considered as the most significant events in the history of Colombia’s oil industry in the first half of the 20th century. It stirred deep patriotic emotions around the country. At the exact moment of the signing of the concession’s transfer the national anthem was played, bells in churches tolled, river steamers on the Magdalena River sounded their sirens and cars honked their horns through the country, all displaying the country’s joy in receiving “the oil riches.”

**Background**

How did all this happen?

The story begins in 1905, when Colombian land speculator and promoter Roberto De Mares obtained a concession from the government, which eventually allowed Standard Oil of New Jersey to enter Colombia, a company that became the dominant force in the Colombian oil industry in the first half of the 20th century.

De Mares traveled to the United States many times to promote his concession. In 1914 his efforts began to pay off when Standard sent geologist F.C. Harrington to Colombia to study the area.

Although Harrington’s assessment was positive, Standard took no action.

That same year De Mares signed a deal with M. Benedum, J. Tress and G. Crawford, who had experience developing fields in Mexico. On May 20, 1916, they incorporated in Delaware the Tropical Oil Co., and subsequently De Mares transferred the concession rights to Tropical Oil.

Work began in the area with the drilling of the discovery well Infantas 2.

In 1920, Standard Oil reached an agreement with Benedum, Tress and Crawford to purchase Tropical Oil for \$100 million – but because of the delay in beginning to build a petroleum refinery, which was part of the concession obligations, Tropical requested an extension to complete the construction of the plant.

The government granted an extension and fixed Aug. 25, 1921, as the refinery’s on-stream target date. The decree granting the extension implied that the concession should end 30 years after this date.

Relations between Jersey and Colombia were difficult through the years because of different legal interpretations of the contract. Critics long argued that because exploration activities had begun in 1916, and because the transfer of the concession’s rights to Tropical Oil occurred on June 14, 1916, that date should have been the beginning of the 30-year-term, and therefore the concession should expire in 1946 and not in 1951.

At stake was the economic value to the

See **Ecopetrol**, page 30

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Let the data crunch begin

# South Dakota Primps for Shale Suitors

By KEN MILAM, EXPLORER Correspondent

Staffers at the South Dakota Geological Survey these days are probably digitizing in their dreams.

Actually, they are working on a project that could be something of a dream come true for petroleum hunters frustrated by the dearth of data in a promising but under-examined region.

South Dakota hasn't been a big player in the current U.S. energy mix, but State Geologist Derric Iles said he believes activity in the hot Bakken Formation is poised to move south – and he wants to be ready for it.



ILES

The South Dakota Oil and Gas Initiative work plan, progress updates and online features can be seen at [www.sdgs.usd.edu](http://www.sdgs.usd.edu).

Let the data crunch begin.

Putting decades of paper well data online is “chewing up half my staff,” Iles said.

However, the benefit to the industry “could be huge,” said former AAPG president Steve Sonnenberg, professor of petroleum geology and head

of the Bakken Research Consortium at the Colorado School of Mines.

Wildcats have been drilled in South Dakota since at least the 1950s. Despite some producers and plenty of oil and gas shows, the real action was always back in the Bakken.

“Plate tectonics cheated us,” Iles said.

The Bakken pinches out just north of the state border, the encompassing Williston

Basin and several related units extend into northern South Dakota, he said.

“There are plenty of rocks there” worth looking at, Sonnenberg said.

AAPG member Dudley Bolyard has had his share of disappointments in the state, but believes oil is there to be found.

“The number 30 sticks in my mind ... it must be the number of dry holes I drilled up there,” Bolyard said.

“I’m retired and don’t intend to go back,” he said. “But because I’m retired, I can speak frankly – the hydrocarbon shows indicate good potential.”

### Small But Significant Precedent

The area’s complex geology includes “spectacular drainage anomalies that need seismic evaluation,” sand and chinks that could be “prime targets for biogenic gas,” and numerous other intriguing features, Bolyard said.

Because the Red River Formation was production-proven, those other shows were “just rocks in the way of the pay zone,” Iles said.

Promise lies in the Minnelusa, Englewood and Three Forks formations, among others, he said.

“The Tyler Formation is all the rage in North Dakota right now,” Iles said. “The Minnelusa in South Dakota is the same formation. Maybe the states should get together and use the same names.”

Water wells long have been a source of gas shows in the state – near the state capitol in Pierre is the “Flaming Fountain” veteran’s memorial. Workers excavated a lake to be filled by artesian water. When the well was drilled it produced enough gas to fuel a perpetual flame – “an awful lot of gas for a water well,” Bolyard said.

While South Dakota hasn’t been drilled as densely as some other states, it still has year’s worth of historical drilling records.

Iles’ staff is busy organizing and scanning all types of relevant records to be accessible through a user-friendly website with plenty of bells and whistles, he said.

January is the target date for completing a “one-stop shopping site” for consultants, industry and regulatory users, Iles said.

It incorporates three main data sets:

- ▶ Map browsing by field, operator or company name, oil and gas geophysical logs, regulatory permits, drillers’ logs and similar information.
- ▶ Information pointing to deep potential deep thermogenic or shallower biogenic deposits.
- ▶ Some 62,000 records from the state’s Water Rights Program, including reports from private farm, ranch and other wells.

“We have turned our activities upside-down at the Geological Survey to make this happen,” Iles said.

At present, South Dakota’s yearly petroleum output is surpassed by its northern neighbor each week, he said.

That may be changing. Iles said land activity is picking up, though actual drilling hasn’t, yet.

“North Dakota is going gangbusters,” he said, “and it is moving south.”

Bolyard and others also believe there are many promising spots for successful, economical ventures.

“If I were a younger man,” he said, “I’d be back in there.”

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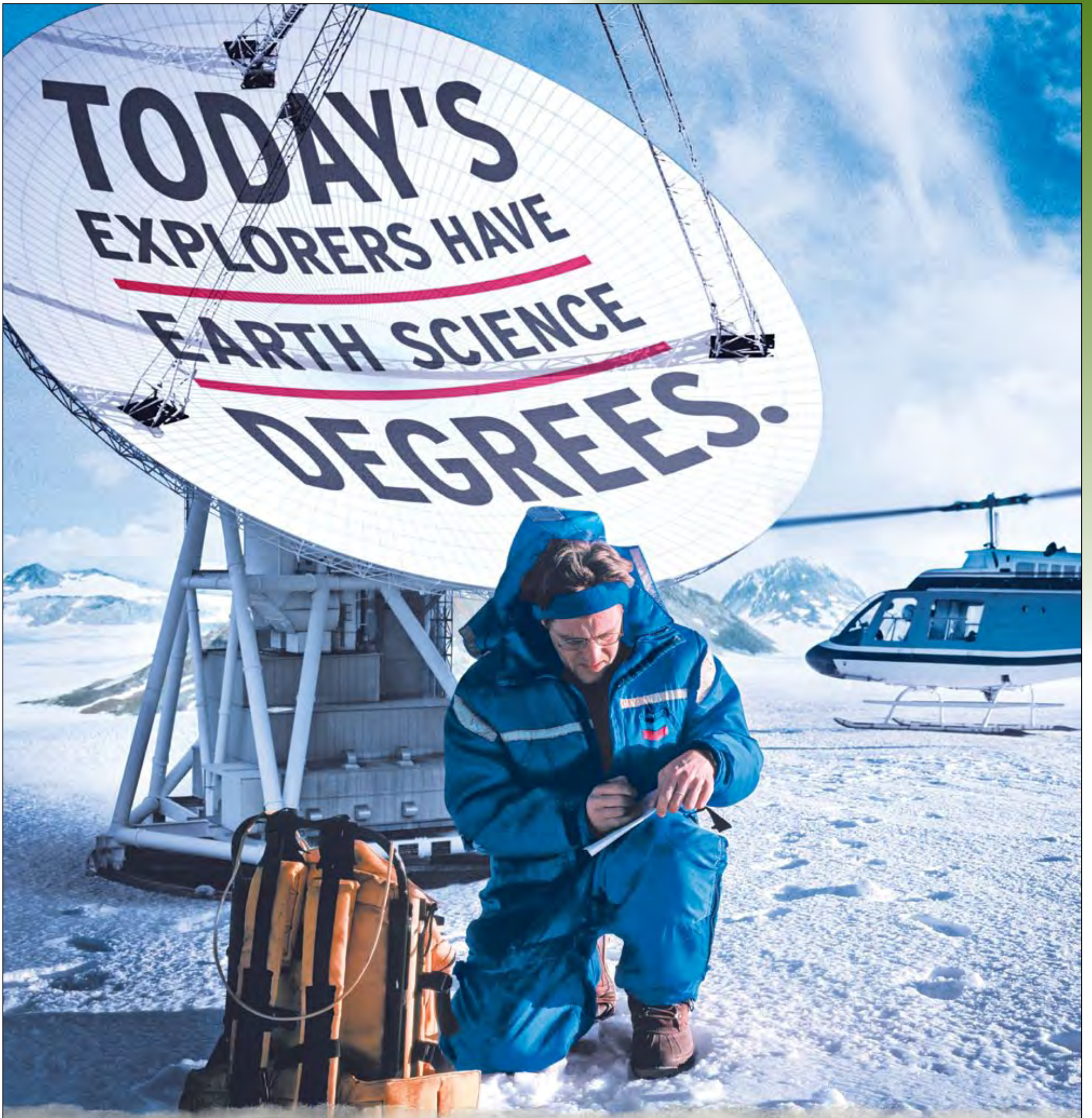
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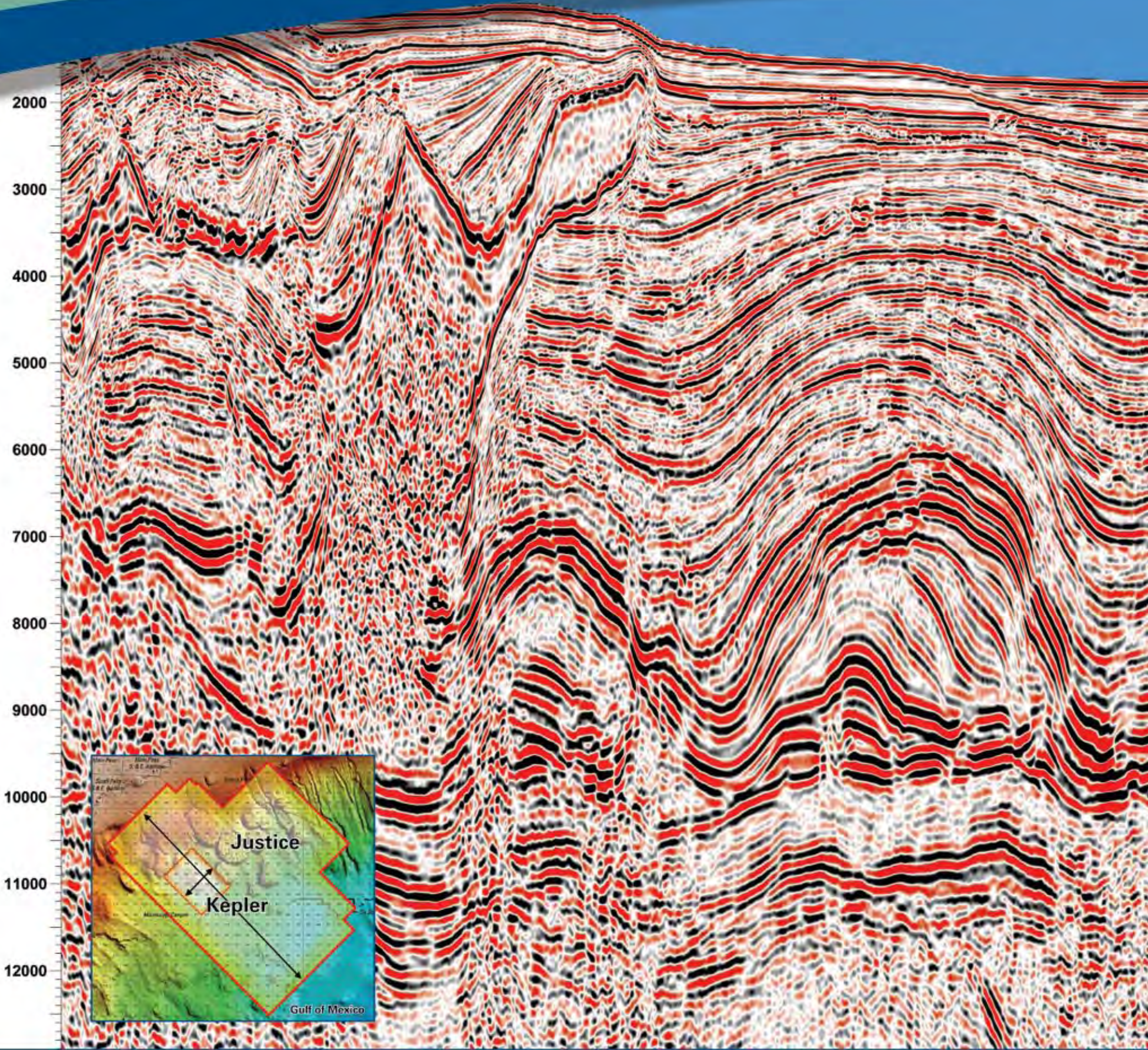


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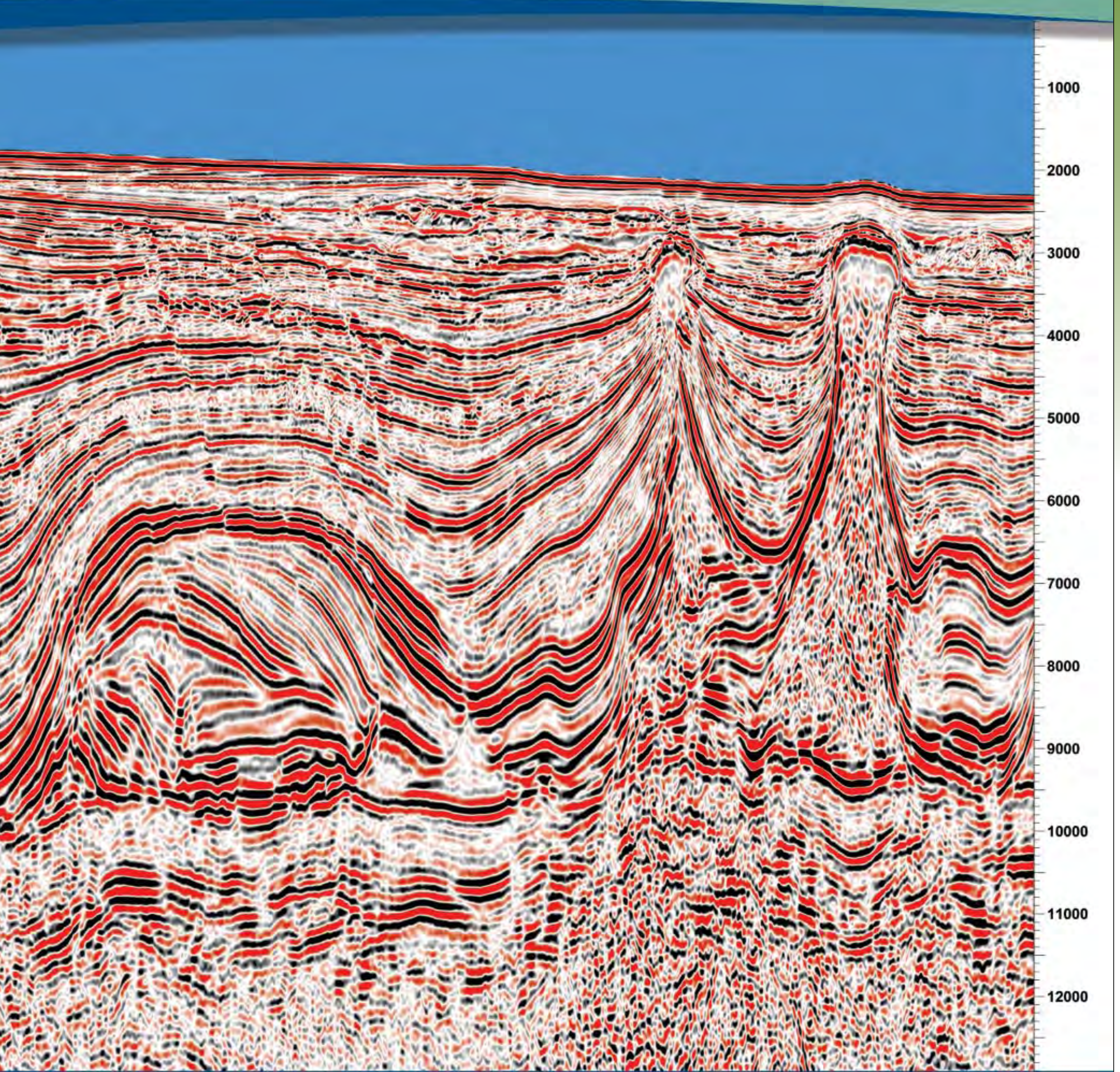
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# Program, Big Crowds Make Milan a Winner

By VERN STEFANIC, EXPLORER Managing Editor

**A** strong technical program plus an historically inspiring setting helped make the 2011 International Conference and Exhibition a world-class winner, attracting attendees from around the globe.

Attendance for the October event in Milan, Italy – the first ICE ever held in that country – totaled 1,989, making it the fifth largest ICE in AAPG history, trailing only the meetings in Perth (2,626), Calgary (2,281) and Rio de Janeiro (2,214 and 2,146).

Adding to the onsite excitement was not only an embrace of creative thought but also the element of diversity – attendees came from 70 countries, with the top countries being:

- ▶ United States (418)
- ▶ Italy (406)
- ▶ United Kingdom (298)
- ▶ Norway (91)
- ▶ France (65)
- ▶ Netherlands (62)
- ▶ Germany (60)
- ▶ Brazil/Canada (53)
- ▶ Australia (47)
- ▶ Indonesia (40)

The conference featured 280 oral presentations and 200 poster sessions; an International Pavilion that boasted representatives from 15 countries; and 76 exhibitors who showcased the latest in exploration technologies.

Several of the technical sessions attracted standing-room-only crowds, confirming what organizers called a technical program that covered “all the hot topics of petroleum geology.”



## ... And The Travel Stories Were Exciting, Too

**I**CE attendees from the United States thought they had left the “ice” behind in Milan, but a freak early autumn storm that produced record snowfall in the eastern United States made for adventurous return travel from the ICE.

As an example, for Houston geologists Craig Dingler (with his wife Mary Kae) and Gretchen Gillis, it meant diversion from the Newark (N.J.) airport to hours on the tarmac in Syracuse, N.Y., until it was possible to land at Newark airport, clear customs and attempt to

re-book missed connections to Houston. The Dinglers were able to secure the last airport hotel room and a flight the next day.

Gillis arrived at her hotel to discover it had no electricity, so she returned to the airport for a night on the floor with many stranded travelers before leaving early the next day.

Her advice? “No matter where you travel, you might find yourself somewhere rainy or snowy, so choose sensible footwear, bring plenty of cash

and make sure you have whatever you need to survive on a hard floor for a night or two!”

Memories of an excellent conference and world-class networking outweighed the travel inconveniences, she said.

Even with the delays, the Houston group probably had a briefer journey than the 16 student chapter members from Bucharest, Romania, who drove to Milan in four cars – a total of 2,000 kilometers and two days each way.

All, no doubt, had memorable travels.

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### Deepwater Reservoirs

24-25 January 2012 • Houston, Texas

You have seen many changes in the last year in deepwater exploration and development, with new activity in offshore Gulf of Mexico, subsalt Brazil, west Africa, Mozambique, as well as in the Mediterranean and in Asia-Pacific regions. AAPG is bringing together industry-recognized experts in geology, hydrogeology, geophysics and engineering to share knowledge and experience about interdisciplinary methods to achieve more profitable, repeatable results in deepwater offshore exploration and production.

This two-day workshop is ideal for geoscientists and engineers who are actively involved in deepwater exploration, development, and technical studies. The goals of this third annual Deepwater GTW include providing a forum that showcases integrated studies of deepwater reservoirs, affording ample opportunity for dialogue and lively group discussions, and facilitating multi-disciplinary innovation in these challenging environments. We hope to evaluate “lessons learned” and new technologies as they apply to multiple regions around the world.

### New Directions in Carbonates

27 - 29 February 2012 • Fort Worth, Texas

New enhanced drilling techniques (geosteering in horizontal wells) combined with new technologies and a better understanding of how to economically produced hydrocarbons in carbonates have revitalized exploration for and development of carbonate reservoirs.

Presentations will discuss different types of porosity, and the processes that both enhance and inhibit reservoir productivity. In addition, permeability issues are also addressed, and the new technologies and techniques that allow a closer and more detailed analysis of both permeability and porosity, with careful attention paid to drilling fluids and completions (including hydraulic fracturing and waterfloods).

Join us to learn and discuss new and revitalized plays, new technologies, and case studies / experiences involving the Mississippian in Oklahoma and Kansas, the Permian Basin, new carbonates in the Texas Panhandle and North Texas, and more. The workshop crosses the disciplines and features presentations involving engineering, geology, and geophysics.

### Eagle Ford Play

26 - 28 March 2012 • San Antonio, Texas

Join us for an interdisciplinary workshop that focuses on the exploration and production life cycle of an Eagle Ford unit or field.

We will start by defining the Eagle Ford through its geochemical, geological, and geophysical profiles. We will then take a look at the geological framework, including basin analysis to gain an understanding of the depositional environment, and the regimes that influence structure and stratigraphy.

The presentations will include a discussion of determining where to drill using old and new seismic (including full azimuth seismic), how to determine sweet spots, and which well logs to run and how to reevaluate old ones.

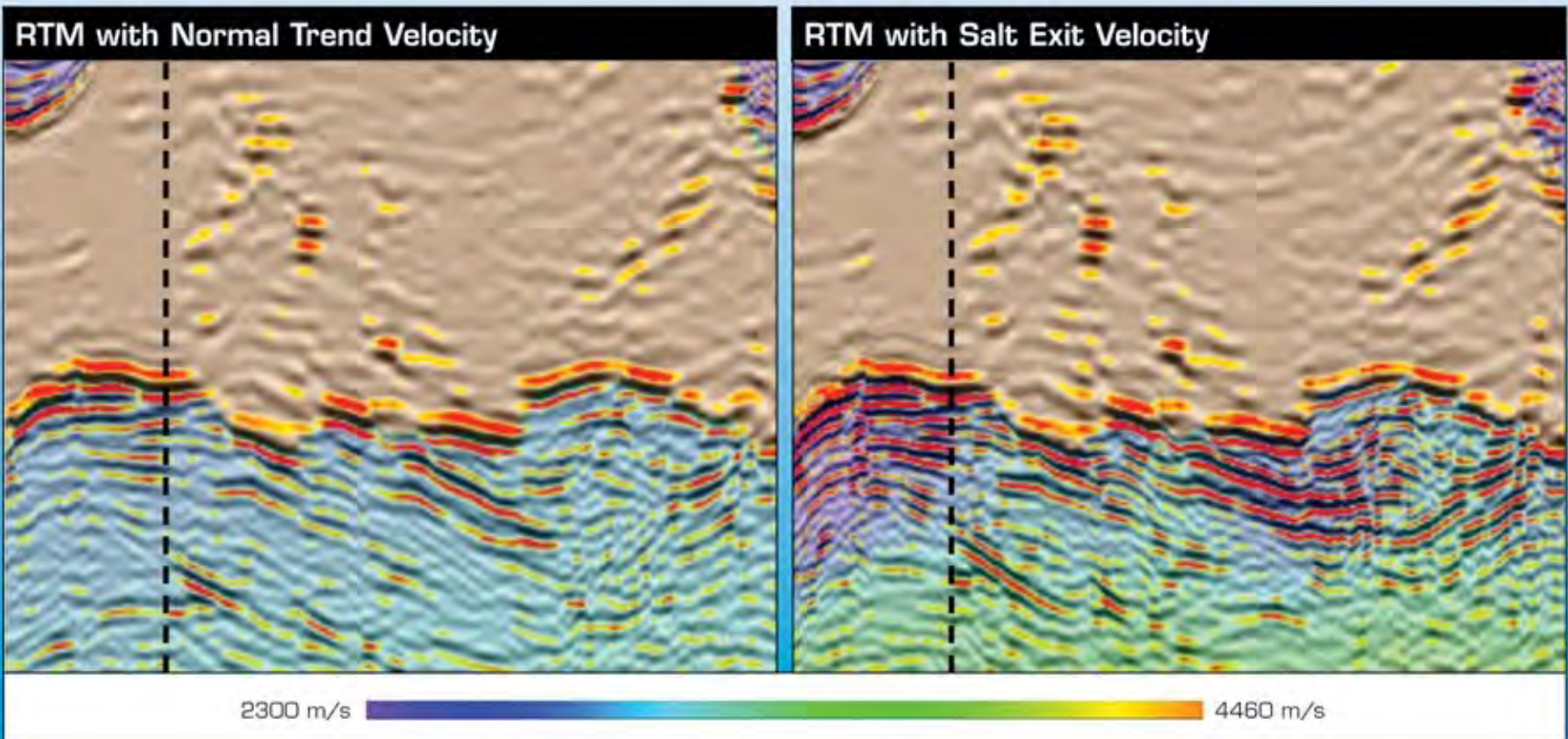
Reservoir characterization as it applies to case studies and field development will be examined, and there will be presentations on how to optimize drilling and completion operations, including considerations of drilling fluids, geosteering, hydraulic fracturing, proppant selection, frac fluid selection, and geomechanical considerations. We will conclude by examining future directions, with a view to field development, refracting operations, enhanced oil recovery, and stimulation.

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



# Safer Drilling with Superior Subsalt Imaging



The benefits of more accurate salt exit velocities are demonstrated clearly on these Gulf of Mexico Green Canyon WAZ results presented by Li et al. EAGE 2011. The salt exit velocity was measured to be within 4% of the actual velocity at well location (black line). Data courtesy of CGGVeritas data library.

<b>CHALLENGE:</b>	Time-Lapse Field Monitoring	Unconventional Resources	<b>Subsalt Imaging</b>	Reservoir Characterization	Multicomponent Processing
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## New Salt Exit Velocity Inversion (SEVI) method that provides a powerful solution for subsalt challenges.

The CGGVeritas SEVI method utilizes two-way wave-equation modeling and RTM 3D angle gathers to accurately predict salt exit velocities through analysis of seismic amplitudes at the base of salt. With conventional workflows it is difficult to estimate salt exit velocities due to limited angle illumination.

Accurate salt exit velocities help identify subsalt overpressure zones, which are potential drilling hazards, and enable the calculation of effective stress to aid well design. Furthermore, the salt exit velocities can be used to constrain high-resolution tomography, leading to greatly enhanced subsalt images.

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- Fred Li,  
CGGVeritas Imaging Supervisor



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## 'Few More Fundamental Issues in the World Than This'

BY LARRY NATION, AAPG Communications Director

**T**ony Hayward sees the global energy crisis at the top of the agenda for the planet to solve, "as there are few more fundamental issues in the world than this."

Hayward cites the future growing demand for energy and said energy security is crucial in a world where reliable, cheap and plentiful energy is taken for granted.

Speaking to a DPA luncheon crowd at the ICE in Milan, the former BP CEO and now CEO of the multi-billion-dollar Vallares, a publicly held stock investment company focused on the energy sector, saying there is "no magic solution" to ensuring energy security, and that realistic approaches are vital.

Hayward, an AAPG member who gave a special presentation on the Cusiana discovery in Colombia at the AAPG Annual Convention and Exhibition in 1994 in Denver, sees three key areas to look for answers to the energy situation:

► **Diversity** – "We are creating diverse supplies – diverse from what it is as well as where it comes from," he said.

He noted "Iraq has the potential to produce 10 million barrels a day in the next 20 years," and also cited the potential of the U.S. continental shelf areas.

"We must be realistic about the contribution renewables and unconventionals can make to the energy mix," he added, and he was optimistic



HAYWARD

that nuclear power can rebound from the setbacks from the Japan earthquake.

► **Competition** – Hayward said competition fosters the efficiencies and new technologies that are needed.

► **Efficiency** – "This is the easiest way

to ease the growing demand – including appliances and making auto engines more efficient," he said.

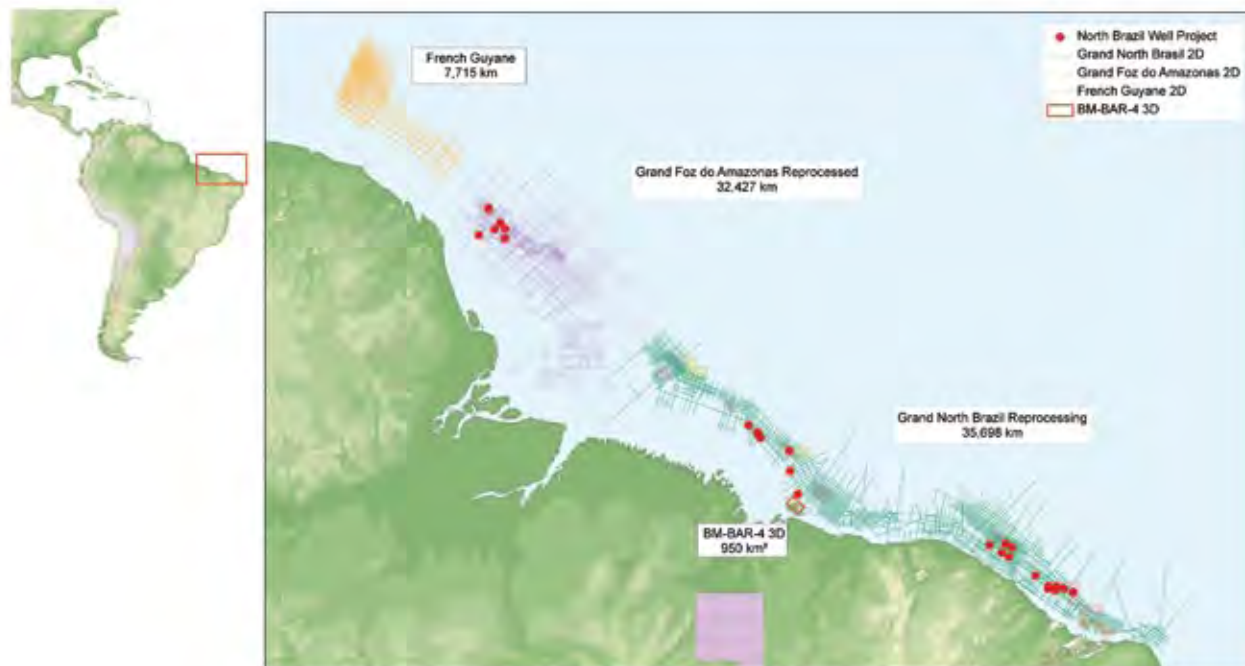
Hayward noted that it is important to choose the lowest cost-energy pathway to lower emissions – which for the foreseeable future is natural gas.

Also, he said "growing U.S. gas reserves loom large in the marketplace, with supplies growing 12-fold in the last decade and gas offering the greatest potential to lower greenhouse gases."

On the climate change issue, Hayward said he is "seeing an emergence of realism."

"The key is alignment – not agreement," he said. "There can't be a one-size fits all solution."

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## Could Public Opinion Kill Shale Gas?

**I**n the court of public opinion, "the right technical solution can come second to public opinion," said Richard Davies of the Durham Energy Institute at the University of Durham (England), at the featured speaker luncheon at the 2011 AAPG International Conference and Exhibition in Milan.

"Public opinion could kill shale gas," he said.

So what does it take for the petroleum industry to avoid the political and financial backlash in a harsh public relations climate – especially in the debate over the fracking of shales?

Davies noted the importance of "selling" the idea of shale production, because of the huge resource it provides as well as its impact on jobs, tax revenue and the general boost to the economy.

He also noted there are different approaches to the shale conversation on a country-by-country and state-by-state basis, since "there are different drivers in a changing landscape and the need for shale gas varies."

Davies admits he doesn't have all the answers, but his experience with the 2006 Lusi mud volcano blowout in Indonesia did teach some lessons.

According to Davies, who was at the forefront of the scientific investigation of the Lusi incident, the debate over whether the cause was by an earthquake or by drilling for oil was conducted with a 99 percent certainty it was caused by drilling.

One of the lessons of Lusi is for the industry to admit there are "black swan" unpredictable events that can occur – as well as that there have been some operations issues in the past.

He strongly suggests looking for early-stage consultation on the up-front of a project with science injected into the public debate with the goal being buy-in from all groups. "A collective approach is required to reverse the growing concerns of the public," he said.

Davies also noted that engaging in the collaboration, "You must accept that the result of the consultation is not what you wanted – or expected."



DAVIES

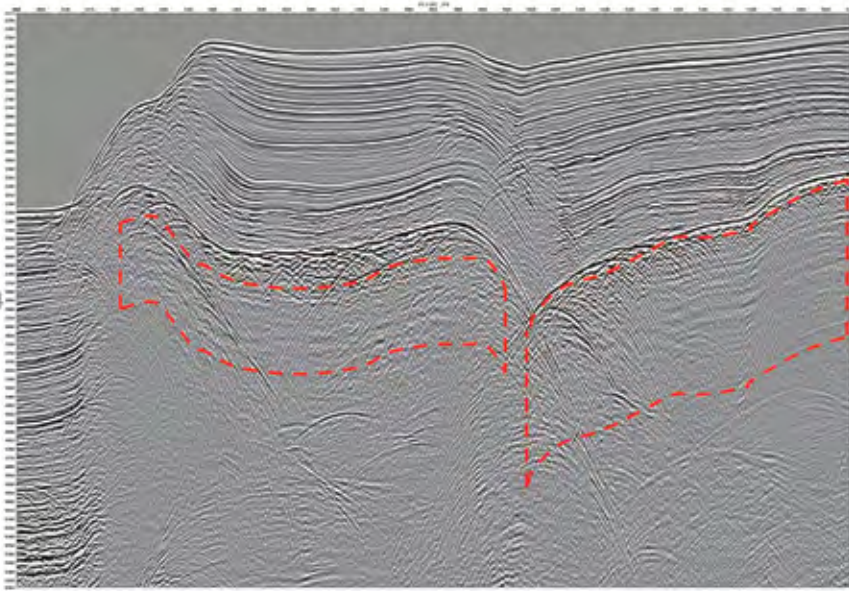
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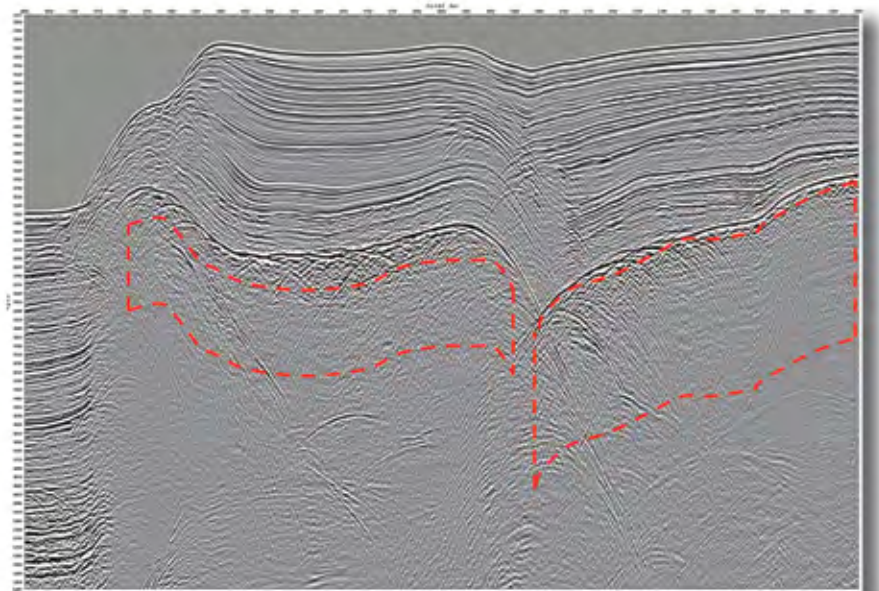
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*Gulf of Mexico Data Showing Interbed Multiples Off the Top of Salt*



*Gulf of Mexico Data with Interbed Multiples Attenuated*

*The high reflectivity top of salt in the Gulf of Mexico is often the source of strong interbed multiples that are recorded at later times and often mask weaker base salt and subsalt reflections. This in turn makes the interpretation of the base salt and subsalt reflectors quite challenging as seen in these images.*

Strong interbed multiples often mask weak primary reflections from the reservoir interval, but Interbed Multiple Attenuation (IMA) in 3D, a very compute intensive process, is now available to solve the problem. GXT's new 3D IMA technology extends SRME concepts to attack interbed multiples in both land and marine environments. The result? Better interpretation, increased certainty, reduced drilling risk. 3D IMA. See it at work at [iongeo.com/ima](http://iongeo.com/ima).

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## REGIONS and SECTIONS

# Keepin' Busy in Europe

By JEREMY RICHARDSON, Director-AAPG Europe Region

**A**APG's Europe Region has a new president: Welcome to **Vlasta Dvorakova**, who has been a very active president-elect over the past couple of years before assuming the presidential reins in June.

Vlasta works for the Czech Geological Survey in Brno, Czech Republic.

\* \* \*

Since the last Europe Region column in the EXPLORER in June we experienced a busy summer in Europe:

► It started with our second annual Aberdeen Education Week held at the Treetops Hotel in Aberdeen, Scotland. Under the watchful eyes of Julie Bell, our AAPG Europe Education Committee chairperson, we had 12 speakers putting on a varied program over four days, covering drilling, petrophysics, geophysics and unconventional.

Also included was a well-organized field trip to the eastern side of Highland fault, led by Stuart Archer from Aberdeen University.

► In October we ran a joint conference with the Moroccan Association of Petroleum Geologists, held in the excellent Congress Centre in Marrakech.

Over 80 technical presentations, an exhibition and a set of field trips into the Atlas Mountains ensured that this was a very comprehensive study of the region – and a chance for companies to plan for the future. ONHYM were present at the event in force and offered delegates a chance to meet and question the national oil company of Morocco.

(See related story on page 29.)

► And, writing this from Milan Linate Airport, I am just returning from a very successful AAPG International Conference and Exhibition in Italy. Just over 2,000 delegates attended a really intense technical conference program and exhibition.

(See related stories on pages 24 and 26.)

► Our final event for 2011 was a two-day conference on carbon sequestration, held in late November in association with the Geological Society in London.

The excellent program was put together by John Gluyas and his team.

\* \* \*

Now we in the AAPG Europe Region are busily looking forward to a packed program for 2012, and I hope you will be able to join us at some of our events.

We start the new year with the second of our educational courses at Paris VI University in France, looking at "Rift Basin Geology and Basin Modeling," and we continue with an education theme into February with a week-long program at Lisbon University, where the lecturer will be AAPG member Hugo Matias, an experienced geophysicist working for Repsol.

March also will be a busy month for us with the running of APPEX, the annual Prospect and Property Expo. Plans are well under way for this event, and we are planning to have in excess of 85 booths, a packed conference program and more than 500 delegates.

It really is the best international event to buy or sell deals, expand into new areas, find new partners or just meet and network with like-minded industry delegates and executives.

March also is the month for the Europe finals of the AAPG Imperial Barrel Award competition, set March 18-19 in Prague, Czech Republic. We currently have 15 university teams entered in this exciting competition, which will be judged by eight industry experts.

We are expecting as many as 25

See Europe, page 31

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## AAPG Marrakech Meeting Draws 200-Plus Delegates

By DAVE COOK

The AAPG Europe Region joined with the Moroccan Association of Petroleum Geologists to hold the second International Joint MAPG and AAPG Conference and Exhibition in Marrakech in early October.

The conference theme, "Northwest Africa: Building on Past Success to Unlock Future Potential," attracted more than 200 delegates and 10 exhibitors to the Mansour Eddahbi Palais des Congress for a comprehensive program of oral and poster presentations.



COOK

Delegates on a pre-conference field trip to the Ourika valley investigated the relationship between active tectonics and sedimentation in the High Atlas.

The first MAPG-AAPG conference took place in Marrakech in 2007. Since then, exploration activity has gathered pace, with acquisition of seismic data and exploration drilling taking place in both onshore and offshore areas. As a result of technological improvements, new exploration concepts have led to notable gas discoveries in Morocco and Mauritania.


Despite this surge of activity, however, the sedimentary basins of northwest Africa remain generally under-explored – and further potential exists for both conventional and unconventional resources.

The conference addressed the regional geology of northwest Africa with sessions on tectonics, stratigraphy, sedimentology and magmatism. Individual sessions were devoted to exploration in Morocco and Portugal. There were topical sessions on structural geology, including salt and shale tectonics. Other sessions covered exploration methods and technology, such as deep seismic profiling and non-seismic methods. The posters covered a wide range of subjects and included a number of student contributions.

On the final evening, participants attended a gala dinner at Borj Bladi on the outskirts of Marrakech, where delegates – while enjoying a typical Moroccan dinner served in a tent – were entertained by traditional Moroccan dancers. After dinner there was a display of horsemanship, with lots of gunfire and the opportunity to ride a camel.

The AAPG Europe Region thanks the conference co-chairs, Gabor Tari and Haddou Jabour, and the Advisory and Scientific Committees for creating an excellent technical program. The AAPG London office handled all the logistics very effectively under the leadership of the London director, Jeremy Richardson.

Thanks also go to our patron, the Ministry of Energy, Mines, Water and Environment of Morocco, and to our sponsors, ONHYM, Circle Oil, Prospectiuni and Kosmos Energy.

Delegates and exhibitors commented favorably on the conference, and the Europe Region looks forward to further co-operation with the MAPG in the future. 

*(Editor's note: Dave Cook is the past president of AAPG's Europe Region.)*



Regering van Aruba

### NOTICE FROM THE GOVERNMENT OF ARUBA

concerning applications received from third parties to enter into agreements with Compania Arubano di Petroleo N.V. (CAP), for the exploration for and the production of hydrocarbons offshore Aruba in accordance with Article 4 of the Petroleum Ordinance Offshore Aruba.

The Minister of Finance, Communication, Utilities and Energy, acting as the representative of the sole shareholder of CAP, serves notice that CAP has received applications from third parties to enter into agreements for the exploration for and production of hydrocarbons offshore Aruba.

In accordance with Article 3, subclause 1, of the 'Ordinance containing rules concerning the exploration for and the production of petroleum in the marine areas adjacent to Aruba, as well as in the subsoil thereof' CAP has the exclusive right to enter into agreements with third parties for the exploration for and production of hydrocarbons.

Companies wishing to submit a competing application may do so before January 31st 2012. Applications must be directed to the Managing Director of CAP, p/a Utilities Aruba N.V., Schelpstraat 12, Oranjestad, Aruba.

Successful applicants will need to submit a work program and demonstrate their technical and financial capacity to conduct exploration, and their commitment to conduct the proposed work program in a diligent manner in accordance with industry best practice. Applicants will also be required to provide evidence demonstrating their proven capability to conduct oil and gas exploration in an environmentally safe manner.

A technical information pack is available free of charge on request.

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# Euler Curvature Can Be a Calculated Success

By SATINDER CHOPRA and KURT J. MARFURT

Several (12, we think) types of seismic-based curvature attributes have been introduced the last few years – and of these, the most-positive and the most-negative curvatures described in last month's article are the most popular.

Most-positive and most-negative curvatures provide more continuous maps of faults and flexures than do maximum and minimum curvatures, because the latter tend to rapidly change algebraic sign at fault and flexure intersections.

Other attributes, such as mean curvature, Gaussian curvature and shape index, also have been used by a few practitioners.

We describe here a technique called Euler curvature, which has valuable applications.

An attraction of Euler curvature is that it can be calculated in any desired azimuth across a 3-D volume to enhance the definition of specific lineaments. When this apparent curvature (the Euler curvature) is computed in several specific azimuths, the results are quite useful for interpreting azimuth-dependent structure.

The flow diagram in figure 1 explains the method for computing azimuth-dependent Euler curvature.

## Applications

Mapping the intensities of fracture sets has been a major objective of reflection seismologists. Curvature, acoustic impedance and reflection coherence currently are the most effective attributes used to predict fractures in post-stack seismic data.

We describe here the application of Euler curvature to a 3-D seismic volume from northeast British Columbia, Canada. We use an interactive workflow to utilize Euler curvature much as we do in generating a suite of shaded relief maps.

Figure 2 shows 3-D chair displays through volumes of Euler curvature calculated at azimuths of 0, 45, 90 and 135



CHOPRA



MARFURT

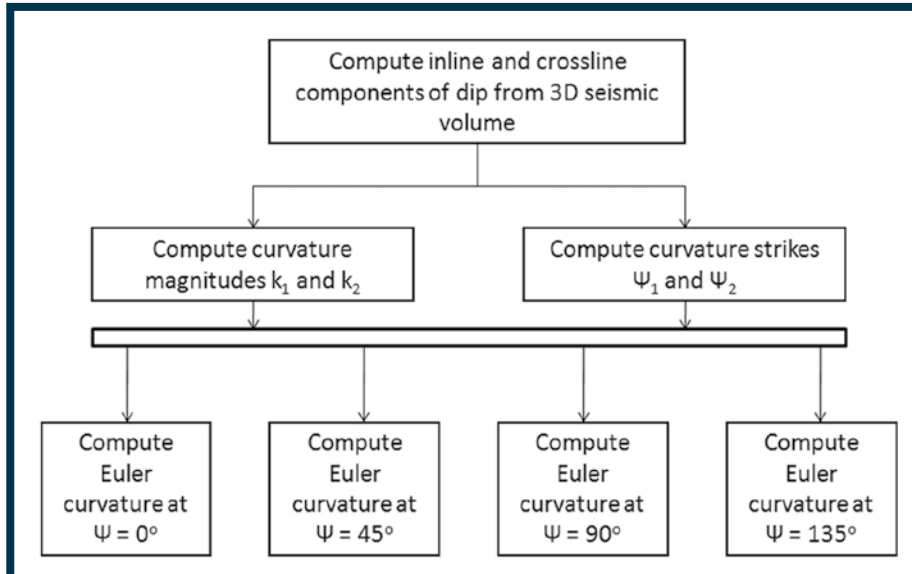


Figure 1 – Flow diagram showing the computation of Euler curvature.

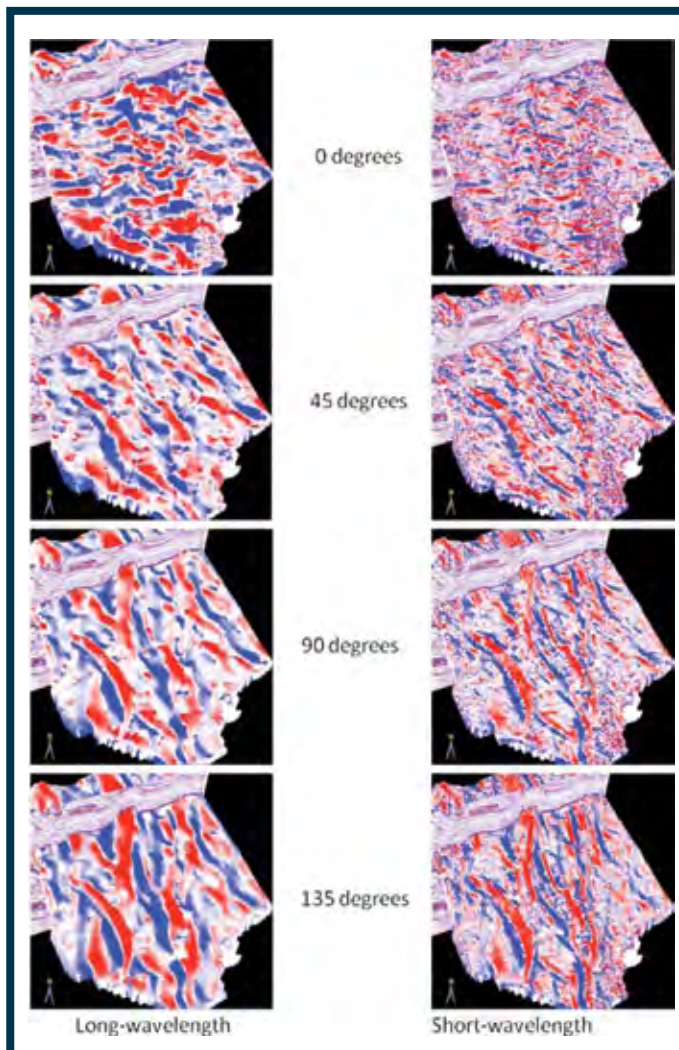


Figure 2 – Three-D chair views showing an inline vertical slice correlated with a suite of Euler-curvature volumes calculated at different azimuths. Azimuths are labeled in the center column. (Left) Long-wavelength estimates. (Right) Short-wavelength estimates.

degrees from north. The left column shows long-wavelength curvature calculations, and the right column displays short-wavelength calculations.

Notice how east-west lineaments stand out when north-south curvature is estimated (azimuth = 0):

► When curvature is estimated in an azimuth of 45 degrees, northwest-southeast lineaments are pronounced.

► When east-west curvature is calculated (azimuth = 90 degrees), north-south features events are emphasized.

► When northwest-southeast curvature is estimated (azimuth = 135 degrees), events slightly inclined away from north-south are better defined.

The analysis area shown in these figures spans approximately 100 square kilometers.

As emphasized in last month's article, short-wavelength displays show more lineament detail and resolution than do long-wavelength displays. That principle is illustrated again by the displays in figure 2.

The important concept presented here is that there are obvious advantages in calculating Euler curvature on post-stack seismic volumes, because azimuth directions of curvature can be chosen to highlight lineaments in preferred directions.

## Conclusions

Euler curvatures calculated in desired azimuthal directions produce better definitions of targeted lineaments.

Depending on the desired level of detail, either long-wavelength or short-wavelength estimates can be calculated. Short-wavelength Euler curvature would be more beneficial for observing fracture lineaments.

This work is in progress, and we hope to calibrate seismic-based lineaments determined with this technology with lineaments interpreted from image logs.

## Acknowledgments

We thank Arcis Corporation for permission to show the data examples, as well as for the permission to publish this work.

(Editor's note: AAPG member Satinder Chopra is with Arcis Corp., Calgary, Canada, and AAPG member Kurt J. Marfurt is with the University of Oklahoma, Norman, Okla.)

## Ecopetrol from page 18

nation of five years of oil production and refinery profits from 1946 to 1951 – and also whether the concession could be extended at the end of the 30-year term.

In 1941 the government notified Tropical Oil Co. that its concession rights would end on Aug. 25, 1946.

The company rejected the decision – and facing an impasse, the government requested the Supreme Court settle the issue.

In 1944, the Supreme Court ruled – in a controversial decision – that the expiration date of the contract was Aug. 25, 1951,



and that on that date all the reserves, assets, equipment and the refinery would revert to the nation.

The court's decision left the government in a quandary, however, as to what to do with the concession at the moment of its reversion. Hence, the government in 1944 created the National Petroleum Council, a technical advisory entity attached to the Ministry of Petroleum, which began exploring options to manage the concession: private company, JV between the government and private investors, and state oil company.

After failed efforts to find private investors – both Colombian and foreign – the Colombian government created Ecopetrol on Jan. 9, 1951. After long and difficult negotiations the government signed a contract by which International

Petroleum Colombia (an affiliate of today's ExxonMobil) provided technical assistance in running and managing the field for three years and for the upgrading of the Barrancabermeja refinery for another 10 years.

The refinery finally reverted to the state in 1961.

## Corollary

Starting from humble origins 60 years ago as the administrator of the La Cira-Infantas field, Ecopetrol today is a modern petroleum corporation. It is Colombia's largest oil and gas company, accounting for about 60 percent of the country's total production.

It is the fourth largest company in Latin America and one of the top 40 oil

companies in the world.

It is involved in upstream activities in Brazil, Peru and the U.S. Gulf Coast. It also owns the main refineries in Colombia, most of the network of oil and products pipelines, petrochemical plants and is now entering into the bio fuel business – and it has set itself a production target for 2015 of 1.3 million BOPD.

Breaking with the traditional Latin American state oil company mold, Ecopetrol has been partially privatized. It is listed on the NYSE and on the Toronto, Lima and Bogota stock exchanges, and about half a million Colombians now own shares in it.

(Editor's note: Miguel Ramirez is president of the AAPG Latin America Region, Victor Ramirez is the Region's president-elect.)



**Europe**  
from page 28

university teams to enter the European competition, which not only will take a lot of organizing, but makes this a very expensive program for the AAPG.

If your company is looking to recruit the highest caliber students, then sponsoring this event and coming along to meet the students – who will be in an actual work environment as they present datasets and answer your tough questions – will allow you a choice of well over 100 potential hires.

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contribution can help maintain the competition's high standards. Incidentally, the IBA global finals will take place at the AAPG Annual Convention and Exhibition in Long Beach at the end of April.

- Further events coming up include:
- ▶ A conference and field trips in Copenhagen.
  - ▶ An Education Week in Hungary.
  - ▶ A series of European lecture tours.
  - ▶ A Europe Region conference and Exhibition in Barcelona, Spain, in October.
  - ▶ Two Geoscience Technical Workshops.
  - ▶ A conference in Azerbaijan.
- For dates, full details and subsequent announcements visit our AAPG Europe Region website at [www.aapg.org/regions/european.cfm](http://www.aapg.org/regions/european.cfm).

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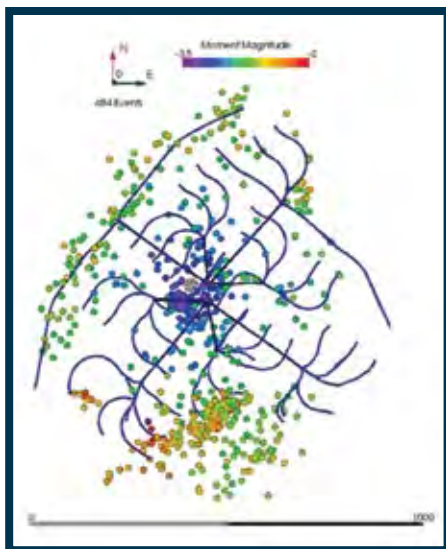
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**Monitoring**  
from page 8

intense schedule coming up in 2012," Holley said.

"We're seeing not only a lot of growth in the industry, but a lot more diversification within the industry in the area of fiber optics," he observed.

Holley said fiber optics monitoring is even being utilized in shale-gas and heavy-oil reservoir environments.

DTS is the "bread and butter" application for Pinnacle, which is essentially Halliburton's fiber optics arm, he said.

"I think the advances for DAS are going to be larger in the coming year," he noted, "with the idea that it can be more of a complement to DTS."

Microseismic monitoring and fiber optics sensing are only two of the many and varied approaches being applied to reservoir monitoring now. Other developments include:

- ▶ The use of coiled tubing to deploy downhole sensors, including in-tubing DTS.
- ▶ Ground-penetrating radar applications for monitoring.
- ▶ Four-D microgravity for fluid monitoring and gas-injection assessment.

Beyond that, there's the problem of high pressure, high temperature and the additional challenges of placing sensors in live wells.

And if anyone is starting to become comfortable with the current picture, Aminzadeh named a number of areas that could bring breakthrough changes in the future, including nanotechnology, signal processing developments, 4-D geophysics, cloud computing, advanced sensors and pattern recognition/artificial intelligence.

Today, downhole reservoir monitoring isn't a practice that can be described easily, but one that requires monitoring.



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**FOUNDATION UPDATE**

# Projects Funded

By NATALIE ADAMS, AAPG Foundation Manager

**A**APG Foundation trustees approved funding for two projects during their recent meeting at AAPG headquarters in Tulsa.

Proposals were approved for:

► The **Region 4 Science Collaborative** in Houston, which will receive \$6,000 for three "More! Rocks in Your Head" workshops.

Region 4 provides professional development for 53 school districts and more than 83,000 educators in and around Houston.

► AAPG's **Publications Pipeline** project, which will receive \$6,000.

This program strives to improve geoscience education in countries abroad by providing used geoscience books and periodicals at no cost to eligible libraries that request them.

This additional funding will enable the Publications Pipeline Committee to meet costs associated with their storage facility in Houston.

To make a donation (financial or publication) to the initiative, contact the Foundation office. The value of donation and shipping costs are deductible.

The trustees reported that Foundation assets totaled \$36.1 million as of Nov. 1. A complete summary will appear in the December BULLETIN.

The Foundation's "Meeting Challenges ... Assuring Success" campaign has been a success, reaching \$35.2 million in pledges and contributions. To date, over \$22.3 million have come in the form of contributions with the balance of \$12.9 million remaining in pledges to be fulfilled over the next few years.

Current trustees are: **Bill Fisher** (chair), **John Amoruso** (vice chair), **Jim Gibbs** (secretary), **Bill Gipson** (treasurer), **Ray Thomasson** and **Paul Strunk**.

\* \* \*

In other Foundation news:

► **John P. and Erika Lockridge** have established a new Named Grant-in-Aid for a student studying geology at the Colorado School of Mines.

The purpose of the AAPG Foundation's Grants-in-Aid program is to foster geoscience research by providing financial assistance to graduate students whose thesis research has application to the search for and development of petroleum and energy-mineral resources, and/or to related environmental geology issues.

Grants are based on merit and, in part, on financial need. Although the program's focus is the support of qualified candidates for master's or equivalent degrees, qualified doctoral candidates also are encouraged to apply.

Grants range from \$1,000 to \$3,000.

To establish a named grant to support your favorite college or university's geology department, contact the Foundation office today.

► The Foundation is funding a Stanford School of Earth Science carbonate course, made possible by the generous donation of AAPG member **Stewart Chuber**. This course will be held in December.

► Two new members have been added to the AAPG Foundation Trustee Associates. They are:

✓ **Rita Monahan**, of Houston.

✓ **Terry J. Mather**, of Centennial, Colo.

The AAPG Foundation Trustee Associates, formed in 1978, was created for the purpose of supporting the AAPG Foundation, providing counsel and leadership to its Trustees, lending support to its fundraising efforts and guiding the scientific and educational agenda which it overwrites.

Today there are more than 275 Trustee Associates who support more than 30

See **Foundation**, page 34

## WHY I DONATE TO THE AAPG FOUNDATION:



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### 2011 International Petroleum Technology Conference (IPTC) RESCHEDULED!

The International Petroleum Technology Conference (IPTC) Board of Directors, in consultation with the Host Organisation, PTT Exploration and Production Public Company Ltd. (PTTEP), has decided to postpone the 2011 IPTC due to the current flooding in Thailand.

While we were extremely reluctant to postpone this important conference, our priority is always the well-being and safety of our conference delegates, visitors and exhibitors. Floods that have engulfed a third of the country, and much of suburban Bangkok, are moving closer to the centre of the capital city, and are severely disrupting transport, and affecting electricity, water supplies and the availability of local personnel and materials.

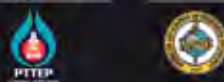
After careful consideration, it has been decided that the 5th edition of IPTC will be rescheduled to 7-9 February 2012, but will still be held at the Bangkok Convention Centre at CentralWorld. We encourage all industry professionals and organisations to actively participate in the newly scheduled event.

IPTC is contacting authors, speakers, exhibitors, sponsors, registered conference delegates, teachers and students individually on the details regarding the rescheduling of the event.

Please direct enquiries, or requests for additional information, to Jenny Chong, IPTC Senior Event Manager, e-mail [jchong@iptcnet.org](mailto:jchong@iptcnet.org); [jchong@spe.org](mailto:jchong@spe.org) or contact IPTC c/o SPE Asia Pacific Office (Kuala Lumpur)  
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**Foundation**  
from page 33

funds and programs, thereby dramatically accelerating its ability to support scientific educational programs.

To find out more about the Foundation Trustee Associates visit [foundation.aapg.org](http://foundation.aapg.org).

► Some holiday cheer: Donors who give \$200 from now through the end of 2011 will receive a beautiful AAPG Foundation Christmas ornament.

To receive the ornament, send your donation to the Foundation at P.O. Box 979, Tulsa, Okla. 74101. 



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Larry Nation  
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The AAPG Bulletin is a technical journal that is recognized in the industry as the leading peer-reviewed publication for information on geoscience and the associated technology of the energy industry.

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**Article highlights include:**

**Mudstones are heterogeneous**

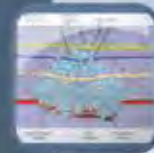
*Andrew C. Aplin and Joe H. S. Macquaker*



Muddy successions are typically interpreted using sequence stratigraphy. Early bioturbation homogenizes mud, and early chemical diagenesis causes cementation. The nature of deeper burial diagenesis is pre-conditioned by depositional and early diagenetic characteristics of the mud.

**Reconstructing an extensively karstified unconformity**

*Hongliu Zeng, Robert Laucks, Xavier Janson, Guizhong Wang, Yiping Xia, Bingheng Yuan, and Ligui Xu*



High-quality 3D seismic supplemented by core and outcrop data in the Tarim Basin, western China, provide a rare opportunity to characterize in exceptional detail the 3D geomorphology of a deeply buried Ordovician unconformity and the related paleokarst drainage system.

**Reflectors in deep water levees**

*Zishann A. Kahn, Bill Amott, and André Pugin*



It has been assumed that dipping reflectors in levees reflect stratal dip that occurs from the vertical stacking of individual levee beds that vary laterally in thickness. However, this paper raises the possibility that dipping reflectors may record lateral changes in lithofacies rather than dip.

**2011 Annual Report and Index**



The 2011 Annual Report includes reports from the president, treasurer, editor, Advisory Council, House of Delegates, Foundation, and AAPG divisions, sections, and committees.

The index for 2011 is also included. Papers are listed by title, author, and key word.



Members may access the AAPG Bulletin online at: [www.aapg.org/december\\_bulletin](http://www.aapg.org/december_bulletin)



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## PROTRACKS

# Website Captures, Displays Passion for Geology

Passion and ingenuity have led AAPG member Daniel Minisini on a personal mission to talk to famous geologists – with a video camera in his hand – and share their thoughts on a website he has created.

Launched about a year ago, his website, called Minigeology ([www.minigeology.com](http://www.minigeology.com)), includes 36 video interviews where Minisini has asked notables to chat with him on-camera about various topics ranging from creativity to the science.

"One thing they all share is a passion about geology," Minisini said. "And, oh yes, when they talk about geology, they move

their hands a lot!"

Minisini's own attraction to geology was prompted by, well, geologists.

"In Friuli, the little Italian region where I come from, geologists are hikers, wine-tasters and soccer referees. In high school, I was all of them. It was natural to complete my profile matriculating at the department of geology at the University in Bologna."

There, his professor, Fabio Trincardi, introduced him to marine geology, and Minisini spent a total of about a year on a research vessel on various missions.

"I spent my last year of university at the University of California,

Santa Cruz, where I was tremendously exposed to multiculturalism," he said, "and where I learned to always share ideas.

He returned to Italy to earn a doctorate in geology, focusing on continental margins

He then joined Eni in Milan as a seismic stratigrapher for deepwater environments, and is now with Shell Oil in Houston as a research geologist focusing on sedimentology of gas shales.

It was in Houston, already sensitized to the exceptional geologists around him, that he initiated minigeology.com. At the Houston Geological Society he met AAPG Honorary Member Charles Sternbach, who shares his passion for capturing the heritage of the legends of the profession (see box below) and encouraged him in his efforts.

Minisini said the main goal of his website is to catch the mindset of thought leaders and others in earth science and learn how they approach a problem, their work, life.

Minisini wants to share that with the earth science community. Minigeology is a round table where all can upload their own videos and interviews.

Minigeology is informal – and the interview format yields a short spontaneous discussion.

A sampling of the site includes:

▶ An interview with Bob Folk, who stands



MINISINI

# AAPG2012

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Submit an abstract for the AAPG 2012 International Conference & Exhibition.



[www.AAPG.org/Singapore2012](http://www.AAPG.org/Singapore2012)

Industry professionals and students are invited to submit abstracts to the AAPG 2012 International Conference & Exhibition (ICE). The technical program committee encourages abstracts that relate to any of the topics listed below. Final sessions and formats (oral or poster) are determined by actual submittals. Abstracts must be submitted online. See complete specifications at [www.AAPG.org/Singapore2012](http://www.AAPG.org/Singapore2012).

### Theme 1: Exploring and Developing Asia Pacific's Petroleum Provinces

*Petroleum Systems, Recent Exploration Results and Developments in the Asia Pacific Region*

- China, Korea, Japan, Mongolia
- India, Bangladesh
- Indonesia
- Australia, New Zealand, Timor Leste, PNG
- Malaysia, Thailand, Brunei
- Philippines, Vietnam, Cambodia, Myanmar, Laos
- Pakistan, Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
- Cook Islands, Fiji, Maldives, Marshall Islands, Micronesia, Nauru, Nepal, Palau, Papua New Guinea, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan, Tonga, Tuvalu, Vanuatu

### Theme 2: Trap, Source, Reservoir and Seal Definition

*Structural Applications in Exploration and Development*

- Asia Pacific Regional Structure
- Rifts, Wrenches, and Island Arcs
- Fractured Reservoirs
- Structural Styles and Play/Prospect Implications

### Seals and Traps

- Seals: Empirical versus Deterministic Assessment
- Recognition of the Subtle Trap
- Case Studies

### Coals, Shales and Source Rocks

- Lacustrine Source Rocks
- Marine Source Rocks
- Coals as Source Rocks

### Marine Clastic Reservoir Systems

- Depositional Systems and Stratigraphy of Marine Deposits
- Outcrop Analogues for Reservoir Characterization
- Shallow Marine Systems – Modern and Ancient Analogues
- Deep Marine Systems – Modern and Ancient Analogues
- Sequence Stratigraphy of Reservoir Successions
- Advances in Reservoir Models

### Non-Marine Clastic Reservoir Systems

- Depositional Systems and Stratigraphy of Non-Marine Deposits
- Outcrop Analogues for Reservoir Characterization
- Sequence Stratigraphy of Reservoir Successions
- Advances in Reservoir Models

### Carbonate Reservoir Systems

- Carbonate Reservoir Systems of South East Asia
- Tectonic Influence on Carbonate Platform Architecture

- Seismic-Scale Geometries of Carbonate Reservoirs
- Porosity and Fluid Detection in Carbonate Reservoirs
- Advances in Reservoir Models

### Theme 3: The Past is the Key to the Future

*Lessons from Mature Petroleum Provinces*

- New Opportunities in Mature Basins
- Case Studies of New Life from Old Fields
- Recent Giant Discoveries

### Building on Our Heritage

- Historical Review of Great Plays / Great Explorationists
- Upstream of Upstream: Training the Next Generation
- Methodologies for Improving Interpretation and Mapping Accuracy

### Theme 4: Facing the Future's Challenges Today

*Hydrocarbon Generation, Geopressures, and Fluids*

- Geochemical Processes
- Basin Modeling Advances
- Dynamic Fluid Flow in Reservoirs
- Pore Pressure Prediction
- Petroleum Geomechanics
- Hydrodynamics

### Applications of New and Emerging Technologies

- Seismic Applications to New Play Identification
- Seismic Applications to Field Developments
- Seismic Acquisition, Processing, and Reprocessing Techniques and Challenges
- Improved Visualization Technology

### Unconventional Hydrocarbon Resources

- Coal Bed Methane Technology and Applications
- Shale Gas Exploration and Developments
- Gas Hydrates
- Igneous Rocks and Processes in Petroleum Systems Analysis

### Energy and the Environment

- Developments in Geothermal
- CO<sub>2</sub> Geosequestration (Carbon Capture and Geological Storage)
- Alternative Energy Resources
- Water, Water Everywhere: Hydrogeology and Water Resource Issues
- HSE: Safe Operational Practices

### How Deep is Too Deep?

- Operating in the HP-HT Environment
- Imaging Deep Prospects
- Reservoir Quality

**Deadline:  
9 January 2012**

## See Minisini, page 40

A few clicks on the Minigeology.com indicates why Minisini's talents and interview skills are a good fit to contribute to the AAPG Geo-Legends program, which captures videos of 100 AAPG geo-legends for AAPG's centennial celebration in 2017.

Daniel joins others already committed to that effort; collectively, this group has interviewed about 40 legendary geologists for the AAPG "100 Who Made a Difference" program.

AAPG President Paul Weimer describes its purpose as "to identify those individuals who made major contributions in applied geology.

To date, we have interviewed people who:

▶ Changed exploration concepts with their discoveries.

▶ Made major scientific contributions, fundamental to exploration and development.

▶ Are individuals with long-term scientific contributions and service to the applied geoscience community.

– CHARLES STERNBACH





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**WWWUPDATE**

# Member Candidates Now Listed Online

By JANET BRISTER, AAPG Web Editor

When people join AAPG they first experience the Association's first bylaw, which stipulates "in the BULLETIN or by other suitable means, the applicant's name (for membership) and the names of the sponsors" are to be published for 60 days.

For 25 years the names appeared monthly in the AAPG EXPLORER. This was "suitable means," but publication schedules added up to 30 days to the membership application process.

That's why the AAPG website is now the "other suitable means" where applicants awaiting approval are publicized.

This page is updated dynamically, which means when your browser loads the web page the content on it is pulled from a database displaying the most current information.

This brings the publishing time frame down to exactly 60 days for Active members to weigh-in about those who have applied for Active status or have applied to reinstate their AAPG membership.

**Have It Your Way**

The default sort for the list is a chronological order off the publish date. However, you are not limited to this view.

We have made the table sortable by every column. There are arrows in each heading that indicate the direction of your sort. A second click will sort in the opposite direction.

You may combine your sort with another column by holding your shift key down when you click on a new column.

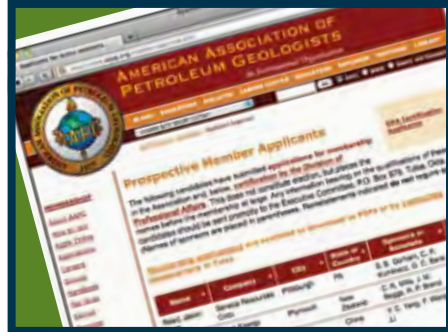
For example, if you want to sort by state or country and then by name you would take the following steps:

- ▶ Click on the "State or Country" column.
- ▶ Hold down your shift key.
- ▶ Click on the "Name" column.

You have visual confirmation of this sort by the arrows in the column head.

To clear your sort, simply reload the page and the default sorting choice (publish date in descending order) returns.

*Good browsing!*



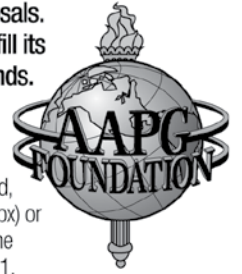
## REQUESTS FOR FOUNDATION FUNDING

If you have a funding need that matches the priorities of the AAPG Foundation, please submit to Natalie Adams at nadams@aapg.org. For more information, go to foundation.aapg.org and click on the "Funding" tab.

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

### TO CONTRIBUTE

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





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## PROFESSIONAL news BRIEFS

**Maher H. Ayyad**, to professor of petroleum geosciences, Cairo University, Cairo, Egypt. Previously deputy exploration manager and consultant, British Gas Egypt, Cairo, Egypt.

**Barry Borak**, to portfolio manager-energy and infrastructure, TIAA-CREF, Boston, Ma. Previously principal/partner, Huff Energy Fund, Morristown, N.J.

**Nowell Briedis**, to senior geoscience consultant, Maersk Oil and Gas, Stavanger, Norway. Previously senior technical professional-adviser, ExxonMobil, Stavanger, Norway.

**Victor G. Carillo** has been appointed president and chief operating officer, Zion Oil, Dallas. Previously executive vice president, Zion Oil, Dallas.

**Peter Dorrins**, to president and chief operating officer, Junex, Quebec City, Canada. Previously chief operating officer, Junex, Quebec City, Canada.

**Lee Higgins**, to exploitation manager-Permian Basin, BHP Billiton-Petrohawk, Tulsa. Previously with Broad Oak Energy, Dallas.

**Tiffany Hopkins**, to regional geoscience supervisor, Noble Energy, Denver. Previously geoscience coordinator, Chesapeake Energy, Oklahoma City.

**R. Geoff Ice**, to manager of geology, Fairway Resources, Southlake, Texas. Previously vice president, Rosewood Resources, Dallas.

**Hugh Mackay**, to CEO, Europa Oil and Gas, Abingdon, England. Previously chairman, Avanna Resources, Copenhagen, Denmark.

**Bill Torguson**, to chief geologist, Mohave Oil and Gas, The Woodlands, Texas. Previously contract geologist, Mohave Oil and Gas, The Woodlands, Texas.

**Rick Van Derck**, to exploration manager-Tunisia, New Zealand Oil and Gas, Tunisia. Previously chief geoscientist, Crystal Bay Geosciences, Minden, Nev.

**Kirk H. Van Sickle**, to exploration consultant, Square Mile Energy and Kiwi Energy, Austin, Texas. Previously exploration consultant, Square Mile Energy and Kiwi Energy, Houston.

### Minisini from page 36

in front of his 1927 Sorby microscope and tells about some of his proudest discoveries.


► Hugh Jenkyns explains the significance of his pioneering work on oceanic anoxic events.

► AAPG Honorary Member Harrison

"Jack" Schmitt talks about what it is like to be the first geologist to walk on the moon, and why we must go back.

Minisini said by asking the "right" question he hopes these interviews will lead the viewer to ask his or her own questions in their own research or exploration.

One question Daniel likes to ask is, "What does a geologist do?"

A notable response: "They tell stories." 

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## IN MEMORY

Leon S. Ditzell Jr., 87  
Denver, July 28, 2010  
Richard Oliver Donley Jr., 85  
Tulsa, Oct. 8, 2011  
Robert John Emmanuel, 86  
Durango, Colo., June 14, 2011  
Robert M. Owens, 85  
Houston, June 30, 2011  
Joseph Precup, 83  
Spring, Texas, April 15, 2011

Edward William Ricketts, 63  
Midland, Texas, Sept. 15, 2011  
David A. Waldron, 84  
Wooster, Ohio, Sept. 9, 2011  
John Blaine Williams, 89  
Houston, June 10, 2011  
*(Editor's note: "In Memory" listings are based on information received from the AAPG membership department.)*

## CLASSIFIED ADS

### POSITION AVAILABLE

#### DIRECTOR NEW MEXICO BUREAU OF GEOLOGY & MINERAL RESOURCES

The New Mexico Bureau of Geology and Mineral Resources is seeking a new director and state geologist. The bureau is a research and service division of the New Mexico Institute of Mining and Technology (New Mexico Tech), located in Socorro, New Mexico. With close to 60 employees, the bureau serves as the state geological survey, with a long-standing reputation for excellence in research, service, and outreach. Our mission includes research on the geologic framework of the state, with an emphasis on applied geosciences and the state's geologic resources; and the gathering, preservation, and dissemination of geologic information to the geoscience community, state and federal agencies, and the general public. The director manages the administrative, personnel, and financial affairs of the bureau, including direct supervision of a significant portion of the professional staff, and must be proactive in seeking additional, external funding to support new and ongoing programs. As a division of the university, the bureau works in collaboration with other divisions of the university. The director reports directly to the university president. As state geologist, the director serves on several state advisory commissions. Requirements include a Ph.D. in the geosciences, ten years of professional experience, and five years of administrative experience. Anticipated appointment date: as soon as filled, but no later than September 2012. Salary: Negotiable. Full details of the position and information regarding application procedures may be found at [www.geoinfo.nmt.edu/DirectorSearch](http://www.geoinfo.nmt.edu/DirectorSearch) and at [www.nmt.edu/hr-jobs-at-nmt](http://www.nmt.edu/hr-jobs-at-nmt). For more information about the application process, contact JoAnn Salome in Human Resources at 575-835-5955 ([JSalome@admin.nmt.edu](mailto:JSalome@admin.nmt.edu)). For more information about the position itself, contact L. Greer Price, search committee chair, at 575-835-5752 ([gprice@gis.nmt.edu](mailto:gprice@gis.nmt.edu)). For full consideration, application materials must be received by March 1, 2012.

#### Petroleum Exploration Geologist Newfield Exploration Tulsa, OK

Seeking Geologist, responsible for conducting detailed prospect analysis and play fairway assessments within the Mid-Continent Region plus the generation and presentation of prospect ideas and leads to management. This position would be located in Tulsa, OK.

The successful applicant will generate and update maps, logs, cross-sections and corporate databases with new tops, correlations, shows and other pertinent geological data. Develop regional, multi-county stratigraphic framework and subsurface correlations. Minimum qualifications, ten years of experience, knowledge of Mid-Continent upstream oil and gas, experience with conventional and un-conventional plays, experience doing play-fairway analysis assessments. Send resume to [klefler@newfield.com](mailto:klefler@newfield.com).

#### Assistant Research Professor in Sequence Stratigraphy, Northern Arizona University

We invite applications from individuals with research experience and expertise in sequence stratigraphy. Minimum qualifications include an earned doctorate conferred by August 1, 2012 in the geosciences; teaching experience at the college level; and research experience using modern methods of sequence stratigraphy. Preferred qualifications include: experience with integrated field and subsurface research in sequence stratigraphy; demonstrated use of seismic reflection data in research; demonstrated use of state-of-the-art subsurface exploration and

production software; demonstrated ability to teach (a) advanced undergraduate and graduate courses on sequence stratigraphy, and (b) specialized topics courses; experience or potential for multidisciplinary collaboration with individuals within and outside of academia including the oil and gas industry; experience or interest in advising and mentoring graduate students; demonstrated experience in effective science communication; and, demonstrated experience in, or commitment to, working with diverse communities. NAU is an AA/EEO/MMDV Employer. For a full position description and application instructions, visit the university website at <http://hr.nau.edu/>.

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Binghamton University seeks applications for a tenure-track position in sedimentary basin research at the assistant or associate professor level. We seek exceptional candidates with research and teaching interests in basin-scale processes. Areas of interest include but are not limited to: clastic depositional systems; basin-scale diagenesis; geophysical modeling; depositional modeling; tectonic modeling; and modern stratigraphic analysis. A fundamental understanding of well logs and seismic analysis is essential, although candidates need not be expert in these petrophysical tools.

The successful candidate must develop and sustain a nationally recognized, externally funded research program in basin analysis. We also expect the candidate to develop a strong record of teaching and mentoring students and teach an undergraduate course in structural geology and undergraduate and graduate level courses in his/her area of expertise. We are seeking candidates who will strengthen existing research programs in geochemistry, sedimentary geology, or Earth surface processes with the potential to interact with geologists, environmental scientists and engineers on the Binghamton University campus.

Candidates must have a Ph.D. with a focus in basin research or a related field, at the time of appointment; preference will be given to candidates with post-doctoral research or industry experience. Interested candidates should submit a letter of application, curriculum vitae, statements of research and teaching interests, and names and contact information of at least three references to the Binghamton University Interview Exchange site at <http://binghamton.interviewexchange.com>. For further information about the position visit the Geological Sciences and Environmental Studies website ([www.geology.binghamton.edu](http://www.geology.binghamton.edu)) or contact Professor Karen Salvage by email: [ksalvage@binghamton.edu](mailto:ksalvage@binghamton.edu).

Women and minorities are encouraged to apply. Binghamton University is an equal opportunity/affirmative action employer. Applications will be considered until the position is filled, but priority will be given to those received by January 15, 2012.

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## AAPG GEOSCIENCES TECHNOLOGY WORKSHOP



INFORM DISCUSS LEARN SHARE: THE AAPG GTW EXPERIENCE



# "Unconventional Hydrocarbon Plays in Asia"

15-16 March 2012  
Singapore

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*Unconventional hydrocarbon plays have begun to gain significant attention and investment in Asia, representing the latest frontier for these disruptive technologies that have already changed the face of upstream oil and gas in North America. To improve your understanding of the distribution and quality of Asia's unconventional hydrocarbon plays, register now for AAPG Asia Pacific's third Geosciences Technology Workshop.*

*Targeted at a geotechnical audience, the forum focuses on exploration for, and not marketing of, unconventional assets. The workshop will look into resource identification, play mapping and distribution, characterization, resource (volume) estimation and analysis, produceability, best practices and global analogues which can be tapped to significantly reduce the technical risks in these resources.*

*Technical experts on CBM, shale gas and tight oil plays in US and Australia have been enlisted to provide global analogues, together with experts working on frontier opportunities in China, India, Pakistan and Indonesia. Proposed sessions will cover shale plays, coal seam gas plays and other alternate hydrocarbon plays. There are still slots available to share your expertise.*

- Presentations/Dynamic Discussions/Case Studies from experts in the Industry, including Dr. Christopher Schenk of USGS, Dr. Zao Caineng of Petrochina, Arnout Everts of Leap Energy, and Prithiraj Chungkam of IHS
- The event will include an evening Icebreaker on 14 March and Group Dinner on 15 March

#### Who Should Attend

- Unconventional Resources Geoscientists
- Unconventional Resources Asset Managers
- Unconventional Resources Engineers
- Asian Regulators managing potential unconventional plays

**Sponsorship Opportunities:** Join us by being a sponsorship partner to enjoy the great benefits of exposure at this event. Contact Adrienne Pereira ([apereira@aapg.org](mailto:apereira@aapg.org)) to learn more about the different Corporate Sponsorship Packages Available.

**Program and Registration details can be found at**  
<http://www.aapg.org/gtw/singapore2012/index.cfm>

## AAPG GEOSCIENCES TECHNOLOGY WORKSHOP



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### FRACTURED CARBONATE RESERVOIRS

15-17 February 2012, Bali, Indonesia

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The goal of the Geosciences Technology Workshop is to promote open discussion of the state-of-the-art on fractured carbonates. The forum is intended to promote collaboration on the impact of fractures in carbonates at both large and small scales. A range of session topics will integrate detailed observations and perspectives from inter-related fields of research such as structural geology, geomechanics, geophysics and reservoir engineering to better understand and predict the presence, distribution, controls and impact of fractures in carbonates.

Proposed sessions will include: structure & geomechanics; seismic identification; diagenesis; reservoir characterization; outcrop studies; SE Asia reservoir examples; worldwide reservoir examples; unconventional carbonates and the role of fractures; and a half-day core workshop.

- Keynote Address from Mateu Esteban, Repsol and Syamsu Alam, Pertamina
- Chairs include Awang Satyana, BPMigas/ Sigit Sukmono, ITR / Benyamin Sapiie, ITR / Alit Askaria, Talisman Jakarta/ Philip Bassant, Chevron Jakarta/ Ron Noble, Niko Jakarta/ John Warren, Chulalongkorn University, Bangkok/ Chris Zahm, University of Texas-BEG/ Conxita Taberner, Colorado School of Mines /Toni Simo, Exxon Mobil / Stacy Reeder, Schlumberger; and other Industry Experts
- Presentations/Dynamic Discussions/Case Studies from experts in the Industry
- Core Workshop with case studies from Cepu, Pangkah Fields, and others
- Evening Icebreaker on 14 February and Group Dinner on 16 February

#### TECHNICAL PROGRAM CONVENORS:

- Julie Kupecz, Pearl Energy Jakarta Indonesia (a Mubadala Company) ([julie.kupecz@pearlenergy.com](mailto:julie.kupecz@pearlenergy.com))
- Robert Park, Sherwood Holdings, Jakarta ([park.rk.sm@sherwood-holdings.com](mailto:park.rk.sm@sherwood-holdings.com))
- Sigit Sukmono, Institut Teknologi Bandung ([ssukmono@pgsc.or.id](mailto:ssukmono@pgsc.or.id))

#### INTERESTED IN GIVING A PRESENTATION?

SEND A SHORT SUMMARY AND CV TO ADRIENNE PEREIRA.

**WHO SHOULD ATTEND?** Geotechnical professionals from industry and academia, both those actively working these topics and those wishing to learn more.

Sponsorship Opportunities: Join us by being a sponsorship partner to enjoy the great benefits of exposure at this event. Learn more about the different Corporate Sponsorship Packages Available. Contact: Adrienne Pereira, Programs Manager, AAPG Asia Pacific-Singapore



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**More information at <http://www.aapg.org/gtw/bali2012/index.cfm>**



FACULTY POSITION IN  
PETROLEUM GEOLOGY

**ConocoPhillips**  
SCHOOL OF  
GEOLOGY &  
GEOPHYSICS  
The University of Oklahoma

The world's first School of Petroleum Geology was founded at the University of Oklahoma more than a century ago and the legacy continues with the Mewbourne College of Earth and Energy. Now the ConocoPhillips School of Geology and Geophysics at the University of Oklahoma invites applications for the position of Associate Professor/Professor in petroleum geology. Depending on experience and qualifications, the successful candidate may be appointed as a tenured Associate or Full Professor in an endowed Professorship or Chair in the ConocoPhillips School of Geology and Geophysics, and is expected to add significantly to the University's petroleum geology/geophysics education and research programs. Applications are being solicited from both academia and industry.

The successful candidate must have a demonstrated research record and the vision to establish and lead a strong multidisciplinary research program in petroleum geology. The position includes the opportunity to work with the Mewbourne School of Petroleum and Geological Engineering and the Oklahoma Geological Survey. The ConocoPhillips School of Geology and Geophysics possesses both state-of-the-art field and laboratory based geological and geophysical facilities and equipment, including a new field camp. A qualified applicant should have demonstrated expertise in a range of geological technologies to define and better understand geological features, concepts, and technologies related to oil and gas exploration and production, and should be an excellent educator with commitment to both undergraduate and graduate (M.S. and Ph.D.) education. A Ph.D. in geology or related field is required. Salary and benefits will be competitive and commensurate with experience and anticipated potential.

Review of candidates will begin February 1, 2012, and continue until the position is filled. The anticipated starting date is August 15, 2012. Applicants are requested to submit a vita/resume, statement of research and teaching interests, and a list of five references who can be contacted, including names, phone numbers, email, and complete mailing addresses. Applications and nominations should be addressed to Petroleum Geology Search Committee, ConocoPhillips School of Geology and Geophysics, University of Oklahoma, 100 E. Boyd Street, Rm. 710, Norman, OK, 73019-1009.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Women and Minorities are encouraged to apply.



Photo courtesy of David Vance

*Residual oil zone (ROZ) CO<sub>2</sub> injection manifold: The development of ROZs is estimated to increase producible oil reserves in the United States by 30-to-50 percent or more.*

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feet being the average.

Carbon dioxide as used for EOR programs is a commodity that has value and an associated cost. The specific value/cost is established in contracts between the suppliers and consumers of that carbon dioxide; as such the specific costs are often closely held and considered proprietary.

However, a useful rule of thumb is that the cost of 1,000 cubic feet of carbon dioxide is 2 percent of the cost of a barrel of oil.

When carbon dioxide is used for enhanced oil recovery, a portion is retained in each usage cycle – with ultimately 90 percent to 100 percent of it irretrievably retained, despite rigorous recovery and recycle. Those recapture efforts are driven by the fact that the carbon dioxide is a commodity, must be purchased and has significant value.

\* \* \*

There is another word for that retained carbon dioxide: "sequestration."

For a practical illustration, currently three billion cubic feet of carbon dioxide is handled each day in the Permian Basin. Of that, two billion cubic feet are new stocks and one billion is from recycle. The two billion cubic feet is for new projects, project expansions and what's needed to replace that which has been retained or sequestered.

Although to date not a primary driving factor in the development of this


resource, there also is a perspective regarding the control of greenhouse gas emissions.

Carbon dioxide is used as a commodity for EOR during which sequestration takes place; this is increasingly being recognized as a viable and practical means to implement greenhouse gas control as part of a profit-making commercial activity.

The DOE literally is in the process of shifting its focus on the management of carbon dioxide from carbon capture and sequestration (CCS), where the carbon dioxide is to be managed as a regulated waste, to carbon capture and utilization (CCU), where carbon dioxide has very real economic value. For example, on Oct. 21, a senior DOE official at a federal coal advisory board meeting in Washington, D.C., announced the decision to officially shift the focus from CCS to CCU.

The bottom line is that the development of ROZs is estimated to increase producible oil reserves in the United States by 30-to-50 percent or more.

In addition, the process provides a means to sequester carbon dioxide that is driven by economics, not regulation, thereby offsetting unavoidable parasitic costs associated with carbon dioxide capture.

That represents two significant opportunities for moving the hydrocarbon energy sector into a viable future. 

*Editor's note: Vance is principal scientist, ARCADIS-US Inc., Midland, Texas, and is a member of the DEG CO<sub>2</sub> Sequestration Committee.*

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The University is an Affirmative Action/Equal Opportunity Employer and applications will be accepted without regard to age, race, color, sex or national origin. Applicants must have proof of legal authority to work in the United States as well as all PhD requirements completed at the time of the appointment. Women and minorities are encouraged to apply.



**DIRECTOR'S CORNER**

# Being 'Active' in AAPG Is Important

By DAVID K. CURTISS, AAPG Executive Director

Last month we talked about why a geoscientist engaged in petroleum exploration and production should be a member of AAPG. After receiving that question from a fellow member, I offered two reasons:

- ▶ For access to the science.
- ▶ For professional development.

This month let's talk about taking your AAPG membership to the next level.

The first step that I encourage you to take, if you haven't already, is to become an Active member of AAPG.

\* \* \*

The Association has several membership categories: Student, Associate and Active, as well as Honorary and Emeritus, which are both special designations.

Because of a host of legacy decisions, we also have a large number of geoscientists who are eligible to be Active members but are currently Associate members. That was my story – having joined AAPG as a Junior member, I was subsequently moved into the Associate category and sat there for many years.

But for those who are eligible, moving to Active membership is a simple process that requires little effort. All you do is complete a brief form, contact three AAPG members (at least two of whom are Active members themselves) who are willing to serve as sponsors, and submit it to our membership department.

Our membership team then manages your transfer application from start to finish: Contacting your sponsors and delegate, posting your name and sponsors for review, and communicating



CURTISS

**For those who are eligible, moving to Active membership is a simple process that requires little effort.**

with you throughout the process.

But why is becoming an Active member important?

Three reasons immediately come to mind:

▶ AAPG is a member-led association, and only Active members are allowed to vote in association elections.

▶ Active membership is a prerequisite if you would like to run for one of the AAPG's elected positions, or join and be certified by the Division of Professional Affairs.

▶ AAPG's divisions, Sections and Regions are allocated seats on the Advisory Council based on membership. Having a seat on the council requires a minimum of 750 Active members.

\* \* \*

Again, I urge you to become an Active member of AAPG – but if you are ineligible or choose not to, there is another step you can take to maximize your return on membership that is open to all of our members: Get involved with AAPG and its programs.

The Association has two divisions that are open to all members: the Energy Minerals Division and Division of Environmental Geosciences. Each division emphasizes different technical and professional areas and concerns, but both play important roles in AAPG's goal to advance the science of geology and promote technology.

And they are looking to add new members.

Our standing committees are another great opportunity to get involved. They provide a venue to actively contribute to the Association's programmatic activities.

Young professionals, in particular, should consider committee involvement, because committees are a great place to hone and showcase your talents and begin developing a professional network that will benefit you throughout your career.

\* \* \*

AAPG's principal mission is advancing and disseminating the science and technology needed to find and responsibly develop energy – so the final way I'd encourage you to get involved is to present your scientific activities and insights at an

AAPG meeting, and to write and submit it for publication in an AAPG journal or other publication.

We are an Association of geoscientists, and I can think of no better way to establish your reputation as a scientist than presenting and defending your views to your peers. Preparing an abstract and slides for a talk, or a manuscript for publication, takes time and effort. But in reality it is an investment in yourself, your career, your future.

\* \* \*

As 2011 draws to a close, many of us will be celebrating holidays with family and friends. Enjoy the celebration, some rest and relaxation.

But also take some time to think about the coming year. Do you have specific professional goals that you would like to accomplish? Consider becoming an Active member of AAPG if you're eligible.

And I urge you to expand your involvement with AAPG by joining a Division, contributing to a committee or presenting your science at an upcoming meeting.

With planning and preparation, 2012 can be a year of significant professional growth. And AAPG is here to help you do that.

Happy holidays and best wishes for a healthy and prosperous New Year!

**DIVISIONS REPORT**

## Residual oil zones

# A Tale of Two CO<sub>2</sub> Opportunities

By DAVID VANCE

The use of injected carbon dioxide for enhanced oil recovery (EOR) is a process that was first used on Jan. 26, 1972, at the SACROC unit in Scurry County, Texas. Since then carbon dioxide-enhanced oil recovery in primary production zones has expanded across the Permian Basin in west Texas and eastern New Mexico, and to a more limited extent in Kansas, Mississippi, Wyoming, Oklahoma, Colorado, Utah, Montana, Alaska and Pennsylvania – and in other countries.

Last year it was estimated that there are 114 active carbon dioxide injection projects that inject over two billion cubic feet of carbon dioxide per year – from largely geologic sources – to produce 280,000 barrels of oil per day.

It also is estimated that 10,000 of those barrels are being produced from a type of newly recognized oil deposit that is still in the process of being characterized – and is beginning to be perceived as a significant source of future oil production: the residual oil zone, or ROZ.

The basic concept of the ROZ is a zone in which oil is not present at saturations that have historically been



VANCE

**It currently is estimated that there are 30.7 billion barrels of ROZ oil in the Permian Basin, and that 11.9 billion barrels of that are producible using carbon dioxide EOR.**

thought to be required for primary or secondary oil production (typically over 50 percent). Under current economic conditions, viable production can take place from ROZs with oil saturations as low as 20 percent to 25 percent.

To do this requires the injection of carbon dioxide.

\* \* \*

Residual oil zones are associated with petroleum migration and primary production areas:

▶ "Brown Fields" are ROZs located beneath existing primary production zones.

▶ "Green Fields" are ROZ zones with no associated primary production.

Aside from purely commercial projects, a series of strategic projects for the development of ROZs for petroleum production and utilization/control of carbon dioxide in the United States is under way in the Permian Basin of Texas and New Mexico, with funding directly from the DOE and the Research Partnership to Secure Energy for America (RPSEA, a DOE program). These projects include the creation of a regional groundwater model to evaluate groundwater sweeping and formation of ROZs in the San Andres along the Northwest Shelf and Central Basin Platform bordering the Delaware Basin.

The field application of the results of that modeling program also is under way, and petroleum, water and gas (including

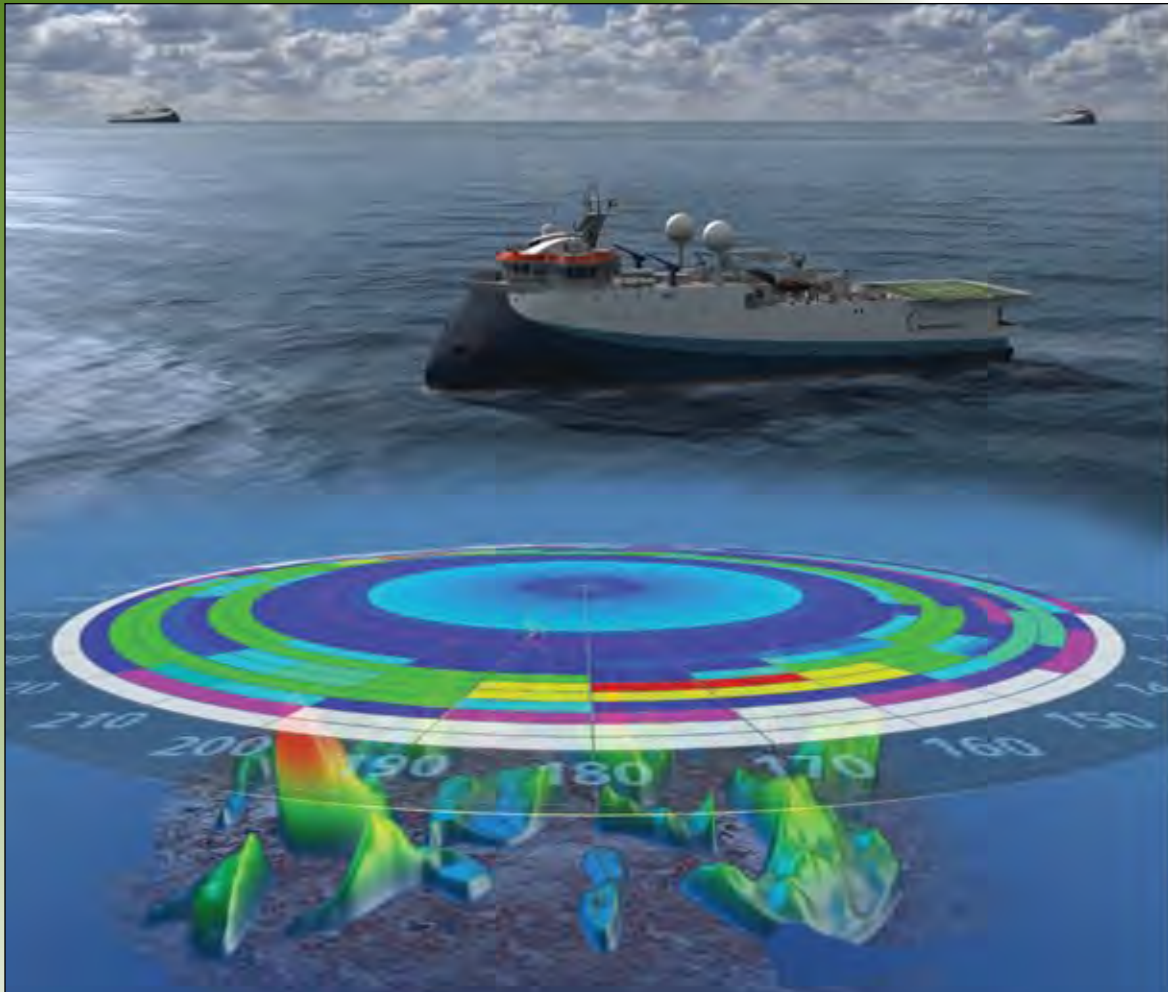
flash gas) are being collected from ROZ production wells in their native state and during carbon dioxide flooding to more closely evaluate the biological/chemical/physical processes that govern the formation and location of ROZs – and the specific response of those ROZs to carbon dioxide flooding.

It currently is estimated that there are 30.7 billion barrels of ROZ oil in the Permian Basin, and that 11.9 billion barrels of that are producible using carbon dioxide EOR. Furthermore, it takes somewhere in the range of 6,000 to 20,000 cubic feet of carbon dioxide to produce a barrel of oil, with 16,000 cubic

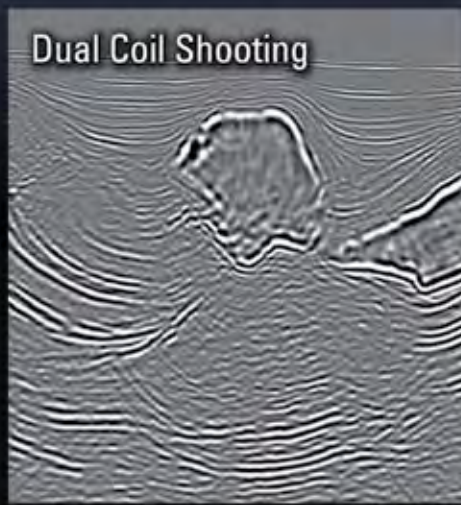
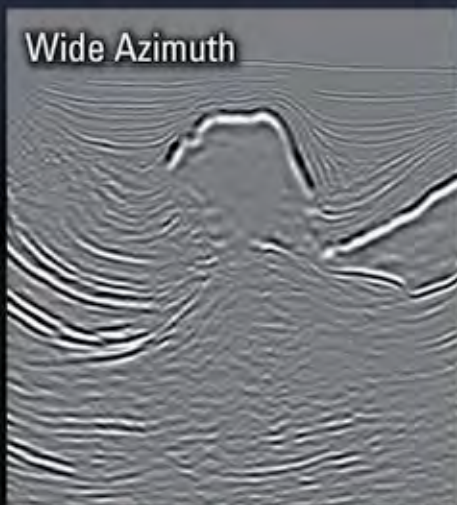


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