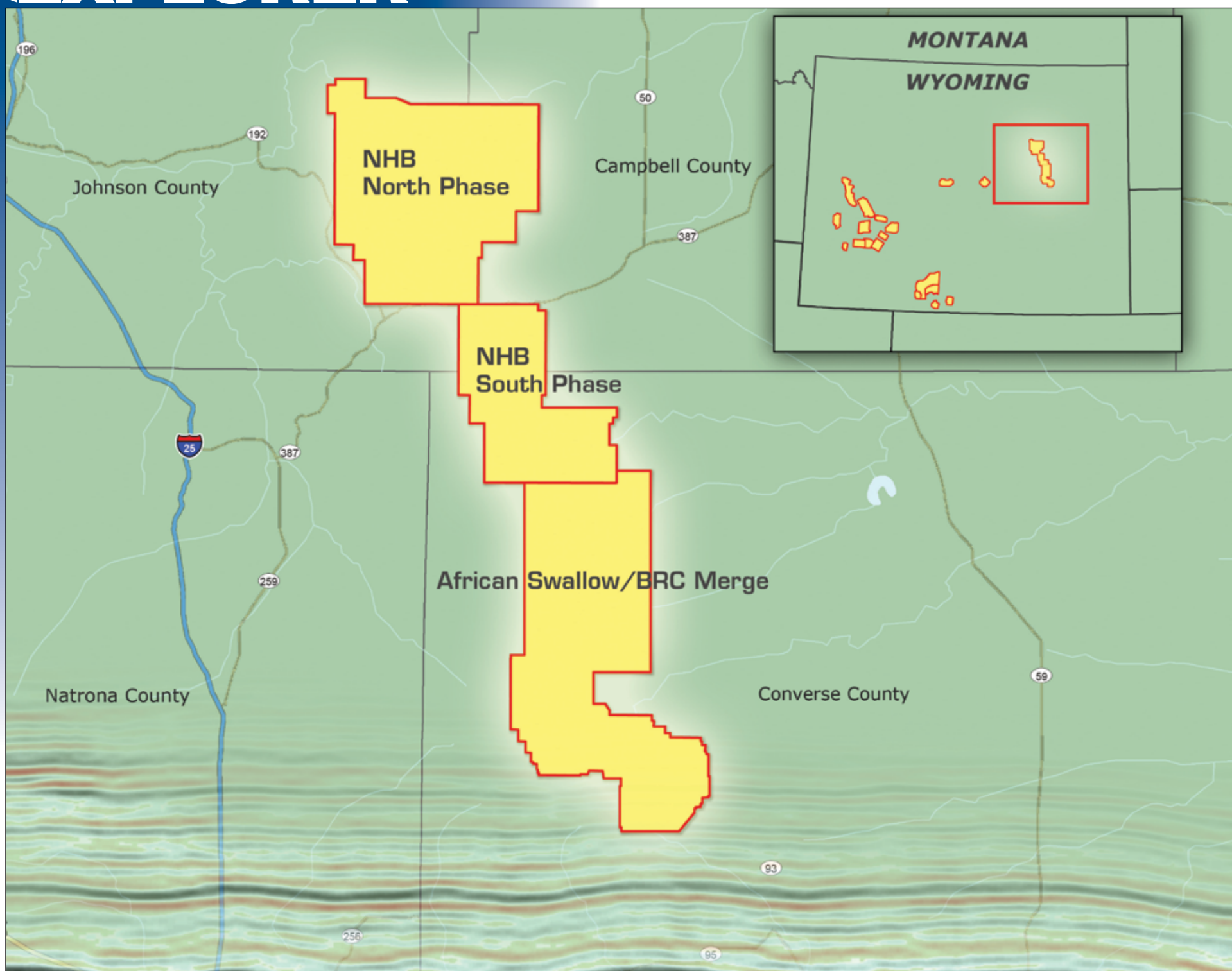


Stairway to Paradise

For geologists, a walk to remember

See page 28



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PRESIDENT'S COLUMN

Fostering AAPG Science

By TED BEAUMONT

My co-author this month is AAPG Elected Editor Steve Laubach, who not only provided valuable information and insight, but a lot of verbiage as well.

In 1988, John Bookout (former president and CEO of Shell Oil Company) observed that there are two types of geologists in the oil business:

► One is the **researcher** who focuses on specific aspects of geology. Researcher geologists contribute knowledge to the decision process. Today, owing to closure of industry research labs, these geologists are not as common in the petroleum industry – at least with respect to job title – as they once were.

► The other type is a **generalist**. These geologists are facilitators and integrators. They know a little bit about many different aspects of the petroleum business and usually are not specialists in any particular aspect of geology. They integrate information from numerous sub-disciplines of geology into a play or prospect concept to convince someone to drill a test well.

They are the petroleum geologists and they comprise the majority of AAPG members.

Of course there always have been geologists who do both – members who make a living as exploration or development geologists and yet who also make important scientific contributions. A glance at the authors of recent AAPG BULLETIN papers reveals that this all-purpose hybrid is alive and well. With less explicit investment in company research labs, these geologists are possibly an



BEAUMONT

AAPG is a community of shared interests: petroleum geoscience.

increasingly important AAPG community.

In any case, we all are trained in and use sophisticated science and technology, and many working petroleum geologists now have specialist knowledge that more than 20 years ago surely would have made them specialists to Bookout.

Yet the somewhat arbitrary distinction

can be useful for thinking about challenges facing the Association.

Petroleum geologists need the products of the researchers. Dedicated researchers have the opportunity to focus on enduring problems and to discover new aspects of geology that petroleum geologists use to create the concepts that lead to oil and gas discoveries.

AAPG Officer Candidates

Biographies and individual information for all AAPG Executive Committee officer candidates are now available online at www.aapg.org.

The person voted president-elect will serve in that capacity for one year and will be AAPG president for 2014-15.

Ballots will be mailed in spring 2013.

The slate is:

President-Elect

► **Randi S. Martinsen**, University of Wyoming, Laramie, Wyo.

► **Kay L. Pitts**, Aera Energy, Bakersfield, Calif.

Vice President-Regions

► **István Bérczi**, MOL Hungarian Oil and Gas, Budapest, Hungary.

► **John G. Kaldi**, Australian School of Petroleum, University of Adelaide, Adelaide, Australia.

Secretary

► **Richard W. Ball**, Chevron Upstream, Southern Africa SBU, Houston.

► **Sigrunn Johnsen**, independent consultant with ProTeamAS, Stavanger, Norway.

Editor

► **Colin P. North**, University of Aberdeen, Aberdeen, Scotland.

► **Michael Sweet**, ExxonMobil Production, Houston.

Until sometime in the middle 1980s, major oil companies conducted geological research. In the United States, at least a dozen major petroleum companies had research labs and many national oil companies had research labs.

So where does AAPG get its science?

Researchers still exist within oil companies, both large and small. But these scientists rarely have the opportunity to focus solely on scientific issues. And there is far less incentive for them to communicate the results of the research that they do conduct.

Currently, geologists in universities, federal and state agencies, and some companies are the primary providers of scientific research to AAPG members through AAPG publications and conferences.

This trend is evident in the affiliations for authors publishing AAPG papers and books. For the last several decades fewer industry-authored papers have been submitted to the BULLETIN or for special publications.

What can or should AAPG do to foster more geologic research?

One role the Association can play is to foster communities of scientific and technical interest that spontaneously arise in response to technical challenges facing working petroleum geologists:

How can we accurately predict reservoir quality or pore pressure ahead of the bit subsalt?

How can we understand what happens during a hydraulic fracture treatment in a

See President, next page

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ON THE COVER:

Malaysia's Langkawi Geopark, a geologic paradise, is the destination of a field trip to be held in conjunction with the upcoming AAPG International Conference and Exhibition in Singapore. Participants will view Setul limestone by boat, then take a cable car up to 700 meters (2,300 feet), to the top of the Cambrian Machinchang Hills and a walk on the famed skybridge. See story, page 28. Photo courtesy of Lee Chai Peng.

At left: Colorado's spectacular National Monument, near Grand Junction, site of the upcoming Rocky Mountain Section meeting. See story, page 10.



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



Photo courtesy of Simon Phipps

President from previous page

naturally fractured rock?

On their own, without prodding, at least a couple of specialized communities of shared scientific interest have sprung up in AAPG. Some of these communities have informal sessions at the annual meeting.

One of these communities, for example, focuses on geomechanics and petroleum structural geology; another group focuses on developments in geochemistry and basin modeling. These communities are partly drawn together by technical challenges and partly by shared interest in a specialized, scientific discipline.

In other words, these are communities with a shared interest in research. But by no means are all the participants "researchers" to the exclusion of "generalists."

AAPG is a community of shared interests: petroleum geoscience.

Just like the two more specialized interest groups mentioned above, AAPG originated when a group of geologists who shared a common interest organized a meeting. They got together at someone's house in 1916 in Norman, Okla., and they called themselves the Southwestern Association of Petroleum Geologists, a name that reflected their parochial geographic interests.

This new group, however, attracted interest from geologists across the United States. With the convention in Tulsa in 1917 and an appreciation that the community needed to serve broader interests, the name was modified to be more inclusive: the American Association of Petroleum Geologists.

But just as AAPG continues to serve

geologists who have interests focused on specific parts of the Earth through our affiliated societies, Sections and Regions, communities exist within AAPG that share common scientific and technical interests – and the Association can serve these members and, in turn, benefit from the process.

The loss of industry research labs removed some of the community support that researchers need. The Association can step in and provide some of this community support by helping to establish and nurture formal groups of shared technical interest. AAPG's highly successful Energy Minerals Division is one such group; the informal communities mentioned above are others.

The Association needs to think about how best to serve the needs of these communities. By sponsoring such groups the Association may benefit from concerted efforts to provide cutting edge papers and

sessions at conventions, and a loyal source of content for the BULLETIN and special pubs in a competitive publishing market.

Specialist communities could also attract new AAPG members. AAPG Elected Editor Steve Laubach noted that when geology students graduate, especially those with advanced degrees, they usually have studied a particular sub-discipline of geology, like geomechanics, and have completed a work of specialist scholarship (a master's thesis for example). Some young professionals therefore may naturally gravitate to communities that share this technical background.

Maybe if AAPG had formal technical groups available to attract and serve those new graduates, we could potentially pick up young new members.

And perhaps the sharp distinction that Bookout made so many years ago needs to be reconsidered somewhat; petroleum geologists have long been scientists and the challenges of exploration and development in the coming decades will only demand more technical expertise that the Association needs to foster as a member benefit.

* * *

How do we fit communities having shared research and technical interests into AAPG's current structure?

We could start new divisions – but maybe there is a better way.

This year's Leadership Days conference, set this month in Tulsa, will address the topic among several others.

One thing is obvious: AAPG's leadership needs to find new sources of scientific information to disseminate to its members.

Help us do that by sharing your ideas about how the Association can support the research enterprise and our own research geologist communities.

Ted Beaumont

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Student Members Must Apply Online

By VICKI BEIGHLE,
AAPG Member Services Manager

The system for processing student AAPG membership applications has changed – as of August, all student applications must be done online.

AAPG will no longer accept or process paper student applications. All student applicants – including those wishing to utilize Chevron sponsorship – will be required to complete the online form.

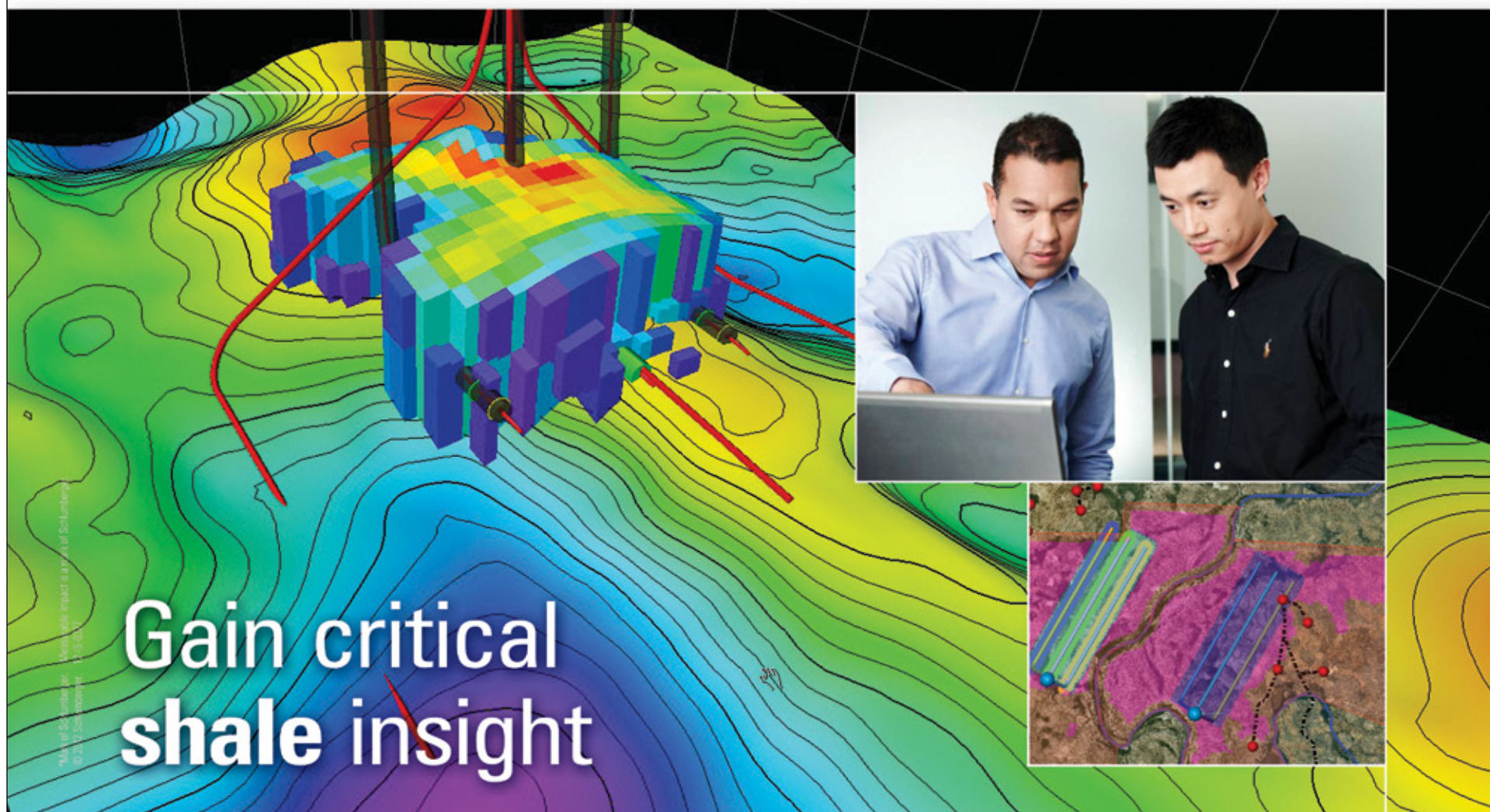
Fortunately, AAPG recently updated its online application process, making it easier than ever to join – even if the applicant chooses to remit payment directly (see related story, page 40).

AAPG recently has been processing about 500 new student applications each month, and the number continues to increase each year. The online application process is faster, more efficient, economical and helps avoid incomplete data fields and/or incorrect interpretation of handwritten information.

We are very excited about this new capability and the increased efficiency and communication it will allow us to provide our members.

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‘...The industry gets it’

Hydro Fracturing Gets ‘Green Tech’ Treatment

By DAVID BROWN, EXPLORER Correspondent

Halliburton received a Spotlight on New Technology Award in May at this year's Offshore Technology Conference.

Nothing new about that. Halliburton has won honors for technology development before.

But here's a sign of the times:

The company got the award for a technology that reduces the environmental impact of hydraulic fracturing.

With so much focus today on the environmental effects of hydrofracturing, service companies are spinning out new technologies that promote greener “frac” jobs.

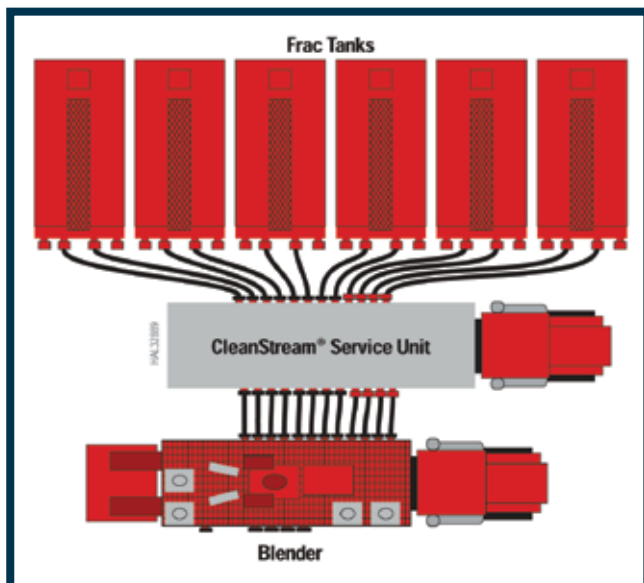
In fact, Halliburton has a whole suite of products designed for environmentally friendly hydraulic fracturing, several of them starting with the word Clean: CleanWave, CleanStim, CleanStream.

The CleanWave technology, which won the OTC award, treats flowback and produced water after fracturing. Using electrocoagulation, the process can recycle water for use in subsequent jobs.

“Essentially, it's electrocoagulation that's enhanced by surfactants or other additives as a means of promoting flocculation of suspended particles,” said Clay Terry, strategic business manager, water solutions for Halliburton in Houston.

Water, Water Everywhere

Minimizing the environmental impact of hydraulic fracturing has become



CleanStream service, intended to help maintain frac fluid integrity and performance while reducing or eliminating the need for chemical biocides, is one of many products designed for environmentally friendly hydraulic fracturing.

especially important as the industry moves drilling into more populated and ecologically sensitive areas, said Mukul Sharma, professor of petroleum engineering and Tex Moncrief chair in petroleum and geosystems engineering at the University of Texas-Austin.

“As hydraulic fracturing becomes applied in areas where there are fairly serious surface access issues, you have

to be careful about the environmental footprint you leave behind,” Sharma said.

“Those concerns are being addressed aggressively,” he noted.

Treating and recycling water to reduce the need for using freshwater in fracturing has been a primary goal of the new, greener technologies.

“What Halliburton is doing is basically telling operators, ‘You don't have to use potable water in putting together your fracturing fluid,’” said Nicholas Gardiner, Halliburton strategic business manager, product enhancement line.

“And when you are talking about using water that is recycled, you're talking about water that otherwise would have been disposed of in a disposal well,” he added.

Reusing water has a dual benefit, according to Terry. Not only does it reduce the demand for freshwater, it also reduces the need to treat water with additives. The use of naturally occurring formation waters or produced water provides a

viable alternative to the need to add salts or other materials to freshwater to protect against clay swelling, he noted.

“This is due to the fact that the natural formation water already has the necessary constituents present at appropriate levels of dissolved solids to control clay swelling, which may be induced by using freshwater alone,” Terry said.

“That concept in itself validates the increased use of flowback and naturally occurring produced waters for fracturing fluid formulation,” he added.

Somewhere between 8 percent to as much as 40 percent of fluid volume used in fracturing flows back during subsequent clean-up operations. Halliburton's CleanWave mobile units treat flowback and produced water at rates up to 26,000 barrels per day.

“Treating 20 barrels a minute is another way to look at it,” Terry said. “They were set at that point because we felt that was the strike point for the industry for using flowback water.”

Recognizing a Need

Sharma sees water treatment as one of two key areas for reducing the environmental impact of fracturing.

“I think we're going to move toward more control in the amount of gas that's flared and the amount of water used,” he said.

See Fracturing, page 8



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Fracturing from page 6

To help reduce the demand for potable water or freshwater, the industry is developing fracturing fluid mixtures based on more saline water.

"Over the past few years, companies have gone to slickwater with polymers that can withstand fairly high salinity," Sharma said.

"The other thing that's happening is the use of CO₂ and nitrogen in hydraulic fracturing," he added, "which is a substitute for water."

The oil and gas industry has to respond to environmental criticisms even when they are false or overblown, said Steve Holditch, director of the Texas A&M Energy Institute.

"Whether it's true or not, we really

The oil and gas industry has to respond to environmental criticisms even when they are false or overblown.

need to make plans to protect the environment better," he said. "It's just a cost of doing business."

Most public criticisms of hydraulic fracturing tend to focus on the potential for water pollution and air pollution and the presence of heavy truck traffic, Holditch observed.

"The air emissions problem is probably a bit more serious, with all the diesel trucks running around out there, all the diesel engines running," he said.

He wants the industry to do a better job of measuring air quality before, during and after fracturing operations, and to find better ways to reduce emissions.

But overall, the industry is taking the right steps toward environmentally friendly hydrofracturing, he said.

"By and large, the industry gets it," Holditch noted. "Everybody is totally aware that these are credible issues and they won't go away."

Going Green(er)

Additional new technologies and processes are reducing the environmental impact of many other parts of hydraulic fracturing operations.

Halliburton's CleanStream service employs an ultraviolet-light, bacteria-control process, allowing operators to significantly reduce the volume of biocides in frac fluid to control bacterial growth.

The company's Advanced Dry Polymer Blender allows frac fluid systems to be mixed from a dry powder, eliminating the need for liquid gel concentrate containing a large percentage of hydrocarbon-based carrier fluid.

"The Dry Polymer Blender enables us to remove huge amounts of hydrocarbons from the fracturing process," said Walt Glover, Halliburton marketing manager, water solutions.

Glover said the company also has developed a "Chemistry Scoring Index" to rank the potential environmental effects of chemical products used in oilfield services. The relative hazards of products that perform the same function can be compared and evaluated.

"Using the Chemistry Scoring Index enables operators to select a suite of chemicals that provides the required performance along with the lowest possible impact on health, safety and the environment," he said.

Service companies and operators alike are incorporating green technologies into the day-to-day aspects of hydraulic fracturing.

"We've actually moved some of our equipment from diesel to solar power. We're adding proppant storage capacity to our fleet with our SandCastle storage bin, which uses solar power to erect itself, then uses gravity to feed the sand into the mix," Gardiner explained.

"It's not always technology. One of the things we're doing for operators is to help them reduce the cost of moving water from one place to the next," Terry said.


As an example, he cited Halliburton's installation of temporary water pipelines to support fracturing operations in Colorado, "which takes a significant amount of truck traffic off the road."

Future developments by the service industry could include environmentally friendly frac fluids. There's already talk about the possibility of creating "kitchen counter" or "kitchen sink" fluids, based on chemicals no more hazardous than those found in and under the typical household kitchen sink.

Halliburton's CleanStim service already is using a frac fluid formulation made with ingredients sourced from the food industry. Components include a gelling agent, crosslinker/buffer, breakers and a surfactant.

Kitchen counter frac fluids are still in the development stage. And the amount of chemicals needed in large-scale hydrofracturing still will be substantial.

"Many of the chemicals that are used in hydraulic fracturing are less hazardous than people use around their households. But the volumes are large, so you have to be extra careful," Sharma cautioned.

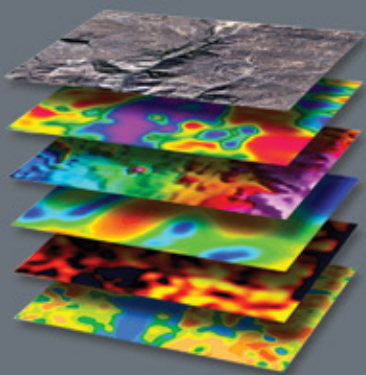
Still, with so many advances taking place now, environmentally green hydraulic fracturing might be right around the corner. 

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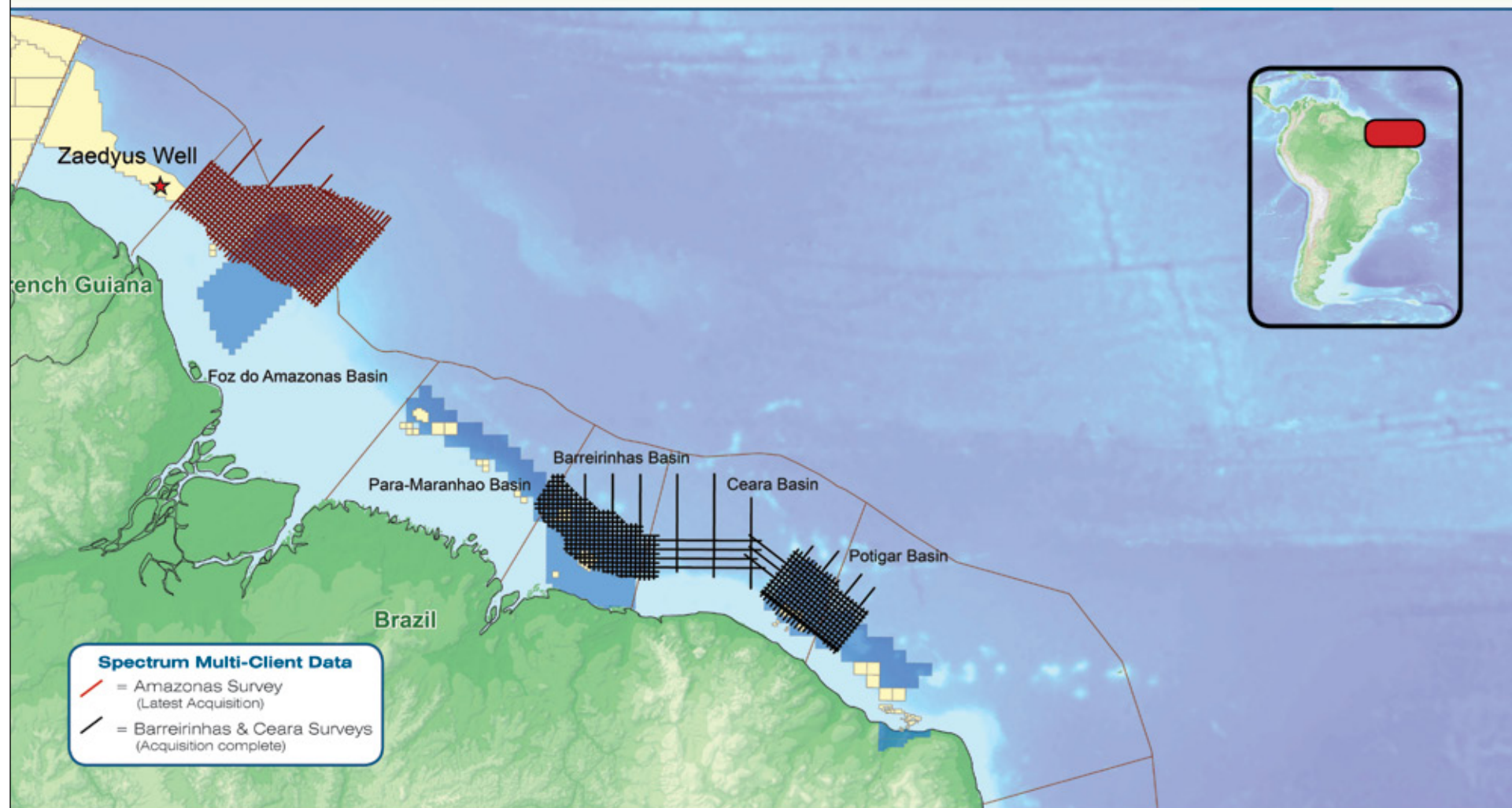


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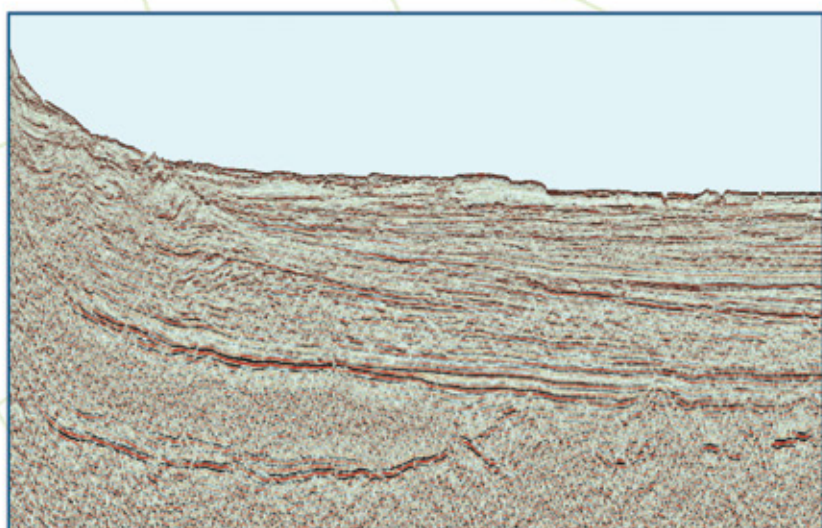


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Crustal Image from Northwest Barreirinhas Basin

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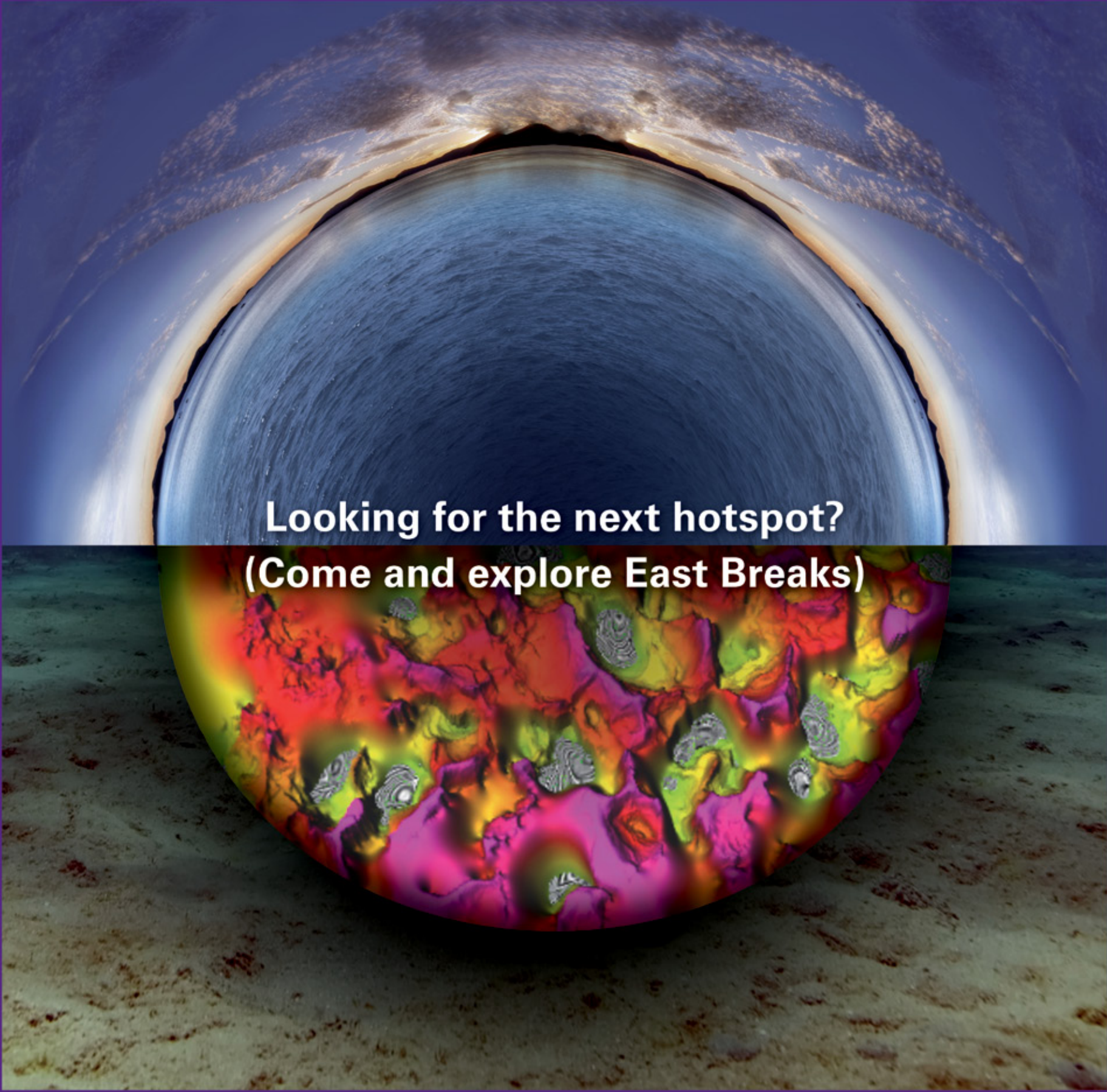
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PROTRACKS

It Was a Very Good Year – And YPs Continue Their Focus on Post-Grads

By COURTNEY CHADNEY, EXPLORER Correspondent

It's been a good year for outgoing chair Nick Lagrilliere and his team of AAPG Young Professionals, who made their focus finding ways to grow YP chapters in industry hubs around the world.

They have made great strides in involving the up and coming generation in the decision making process, Lagrilliere says.

And in return for their efforts the YPs have successfully strengthened their relationship with the AAPG Executive Committee, the House of Delegates, the Divisions and many other standing committees.



LAGRILLIERE

Lagrilliere assures that this is just the beginning; the YPs now are brainstorming ways to retain students and young professionals in the AAPG organization post graduation.

"Every year we lose a huge percentage of our student membership after they graduate," said Lagrilliere, whose day job is with Maersk Oil in Copenhagen,

Denmark. "In addition to that, a large proportion of the members that we do retain end up in the Associate category even though they have the required one year of work experience and a geosciences degree."

Although many factors could be to blame for this pattern, Lagrilliere has his own opinion on the causes.

"To some extent I'm sure it is simply a matter of people choosing to pursue a career outside the oil industry after graduation," he said, "and, of course, there is an element of people not realizing the importance of being part of a professional organization early on in their careers."

Lagrilliere believes there is something AAPG can do about ensuring better retention rates among young members: "The YPs have begun brainstorming ways to show their existing members the benefit of full membership," he said.

The first incentive, "Student/YP Bridge," allows YPs to pay the student membership dues rate for up to two years after their graduation.

"We hope this will encourage them to maintain their membership during those first years in the industry," Lagrilliere said.

"YP is a great way to meet people and expand your network, pick up skills, gain a better understanding of what's available to you in AAPG, and, of course have fun while doing all that," Lagrilliere said.

"Joining the industry can be a quite daunting experience," he added, "and we hope to kick-start people's careers by easing the transition from student to industry professional." ■

Activity from page 10

Scheevel said. Most of them are horizontal, but there are verticals also – they're doing a lot of staged fractures, like in the Bakken."

Despite the diminished yet still respectable level of ongoing activity, the mood is reserved, according to Scheevel.

"People would be optimistic, but we're seeing these fluctuations in oil price," he said. "Several forecasters have come up with mid-sixty dollars for the middle of next year, which gives some people cold feet."

"So much is riding on the 2012 election, and I don't think a lot of people want to commit a lot of effort right now if they can avoid it – they're keeping their powder dry," he quipped.

Vintage Geology

Whether the glass is half full or half empty, the RMS attendees – upbeat or somber – can latch onto a full glass, for real.

The meeting's theme, "Vintage Geology – Perfectly Aged," is apropos in more than one way.

On one hand, the name is a descriptive term for the meeting's technical program, which will include everything from the most recent work on resource plays across the West to the sedimentary and structural architecture of the latest plays in the Rockies, plus the impact and future of energy minerals.

Big-name experts have been added to the list of special speakers, including:

► Colorado Gov. John Hickenlooper, an AAPG member, who will talk on "Hydraulic Fracturing and Colorado's Energy Future."

► Thomas J. Kerr, acting director of the Colorado Oil and Gas Conservation Commission, who will speak on the current oil and gas activity in Colorado.

► Past AAPG president Scott Tinker, who will be presenting a special screening of his commercial documentary film "Switch: Leading a Balanced National Energy Conservation."

And there's one more reason why "Vintage Geology" is so perfect.

Western Colorado is the state's wine country, according to Scheevel, and in addition to wine events planned for the confab, the annual Colorado Mountain Winefest kicks off a mere 12 miles down the road in Palisade, immediately after the meeting wraps.

Scheevel noted that AAPG member Wayne Belding, who is one of a reported 186 Master Sommeliers worldwide, will be on the scene, so perhaps you'll have the opportunity to schmooze and hone your knowledge about the grape. ■

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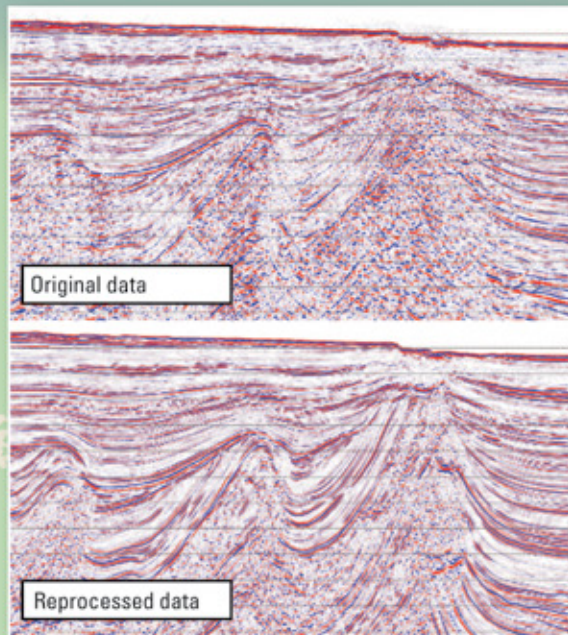
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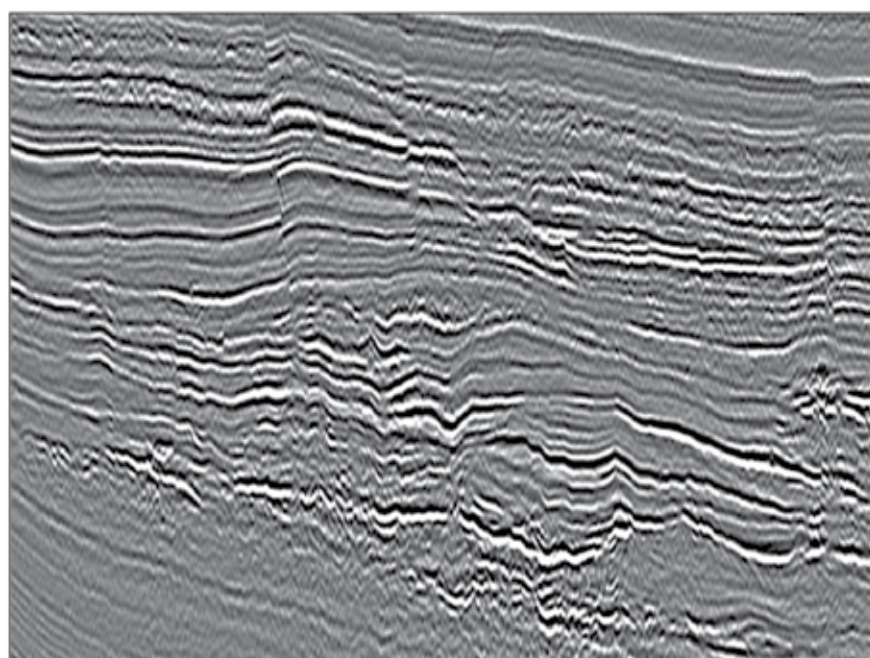


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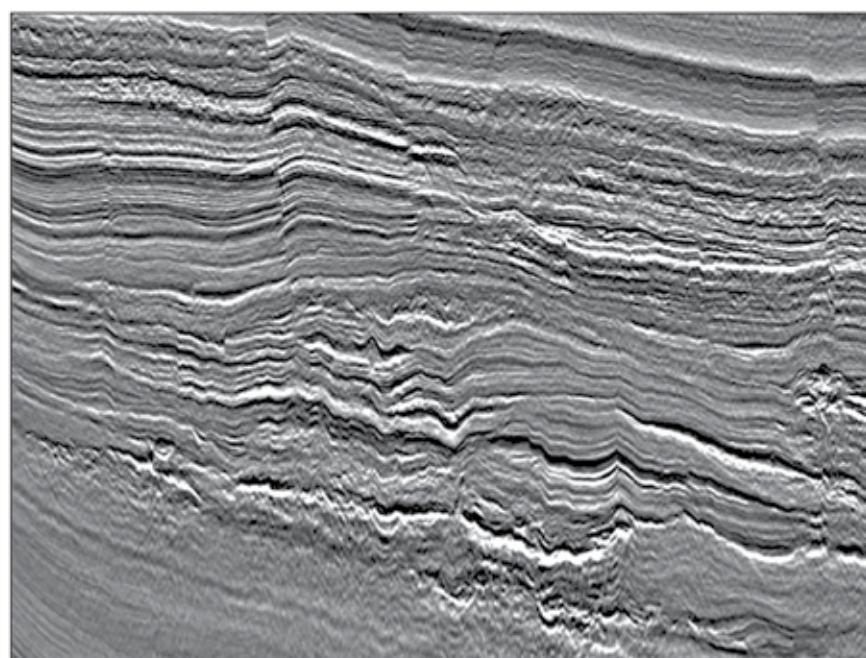
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The example above compares images from the same 2D dataset using conventional processing versus WiBand. The WiBand image has much higher resolution due to its increased frequency content on both the low and high ends of the spectrum and the fill-in of the ghost notches. The streamer was towed at 15 meters in this example. (Data courtesy of Polarcus and Ophir.)

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Mancos-Niobrara Play Full of Surprises

By LOUISE S. DURHAM, EXPLORER Correspondent

For those folks playing the Rocky Mountain region, the Cretaceous Niobrara formation lies in wait for the drillbit over a vast area.

It occurs all over New Mexico, Colorado, Wyoming, Kansas, Montana and both North and South Dakota, according to Denver-based Rocky Mountain expert Randy Ray.

Ray, an AAPG Honorary Member and chair of the AAPG House of Delegates, noted that the Niobrara is part of the Cretaceous seaway that once covered the entire middle region of the United States.



CUMELLA

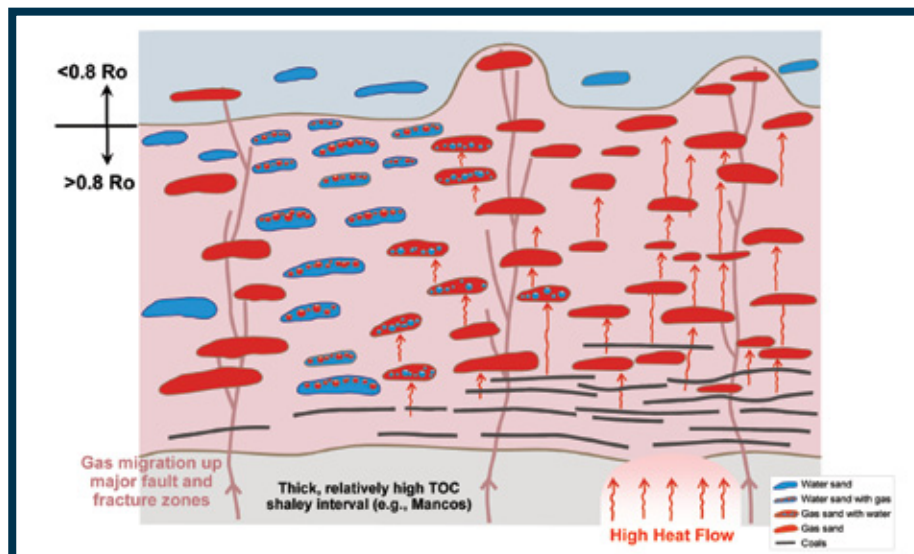
The formation is comprised of an interbedded rich source rock and brittle, basically limestone beds usually referred to as chalk. It fractures naturally because the brittle facies is between more ductile shales.

The Niobrara is one of the few formation names used in essentially every basin in the Rockies. In contrast, nomenclature varies for the shale associated with the Niobrara.

Think Mancos, Cody, Steele, Baxter.

Ordinarily a target for oil production, the Niobrara is proving to be more versatile, depending on where you stake your claim.

Recent drilling into the Mancos-Niobrara shales in the Piceance Basin in northwestern Colorado has identified a significant gas resource in these beds in



In the southern Piceance Basin, gas generation resulting from high heat flow caused high overpressures that produced a pervasive fracture system. Gas migrated vertically up this fracture system and all the sands within the continuous gas interval were highly gas charged. Additional charge from the deeper Mancos occurred along fault zones, resulting in elevated top of gas. This system was less effective in the northern Piceance, where the heat flow was lower and the coals are thinner. Sands intersecting faults receive high gas charge, but the other sands receive less gas charge resulting in higher water production.

the basin's southern part. Numerous vertical and horizontal wells have encountered thick shale intervals with pervasive gas saturation that are locally highly pressured, according to AAPG member Steve Cumella, senior geosciences adviser at Endeavour Corp.

"Historically, the Mancos-Niobrara in the Piceance was regarded as something

that would likely not be very productive," Cumella said. "There was a well drilled in the mid-1990s that had huge shows and required 18-pound mud weight to TD it.

"The idea was that it had hit a local fracture zone, and an offset was drilled that made a Mancos well," he added. "I thought then it was just going to be a fracture play."

AAPG member Steve Cumella, senior geosciences adviser at Endeavour Corp., will present the paper "Mesaverde Tight Gas Sandstone Sourcing From Underlying Mancos-Niobrara," at 8:30 a.m. Tuesday, Sept. 11, at the Rocky Mountain Section annual meeting in Grand Junction, Colo.

Cumella's co-author is meeting general chair Jay Scheevel. The RMS meeting, with the theme "Vintage Geology-Perfectly Aged," will be held Sept. 9-12 at Grand Junction's Two Rivers Convention Center.

Cumella's paper will be part of a session titled "New Ideas in Piceance Creek and Uinta Basins," which is co-chaired by he and past AAPG president Paul Weimer.

Since then, several companies have drilled enough Mancos-Niobrara wells to demonstrate that the Niobrara gas saturation is a lot more pervasive than previously realized and basically is probably a viable resource play.

"The Niobrara is the lower part of the Mancos in the Piceance Basin, and a number of horizontal Niobrara wells have now been drilled," Cumella said. "If not for low gas prices, it probably would be one of the stronger shale gas plays in the country."

See Sourcing, page 18

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The workshop is also intended to bring together technology developers and users with environmental specialists, regulators, and policy makers to find common ground and open channels of discussion and understanding. This should lead to more technology-based and less emotional development of policies and regulations on O&G activities, as well as improve the understanding by the O&G industry of how to avoid confrontation and improve hydraulic fracturing practices to eliminate any potential hazards to the public and surface owners.

Part of the motivation for the GTW is the fact that hydraulic fracturing for both conventional and unconventional oil and gas development and production has become a hot button issue for the public and regulators in most of the United States and Canada where this technology is being used or might be used in the near future. Concern and regulation of hydraulic also is growing in other areas of the world, especially in Europe. There is a disconnect in most places between how the technology is applied and the real and perceived hazards to aquifers and surface owners (including induced-earthquake hazards) that have led to the contentious state of affairs.

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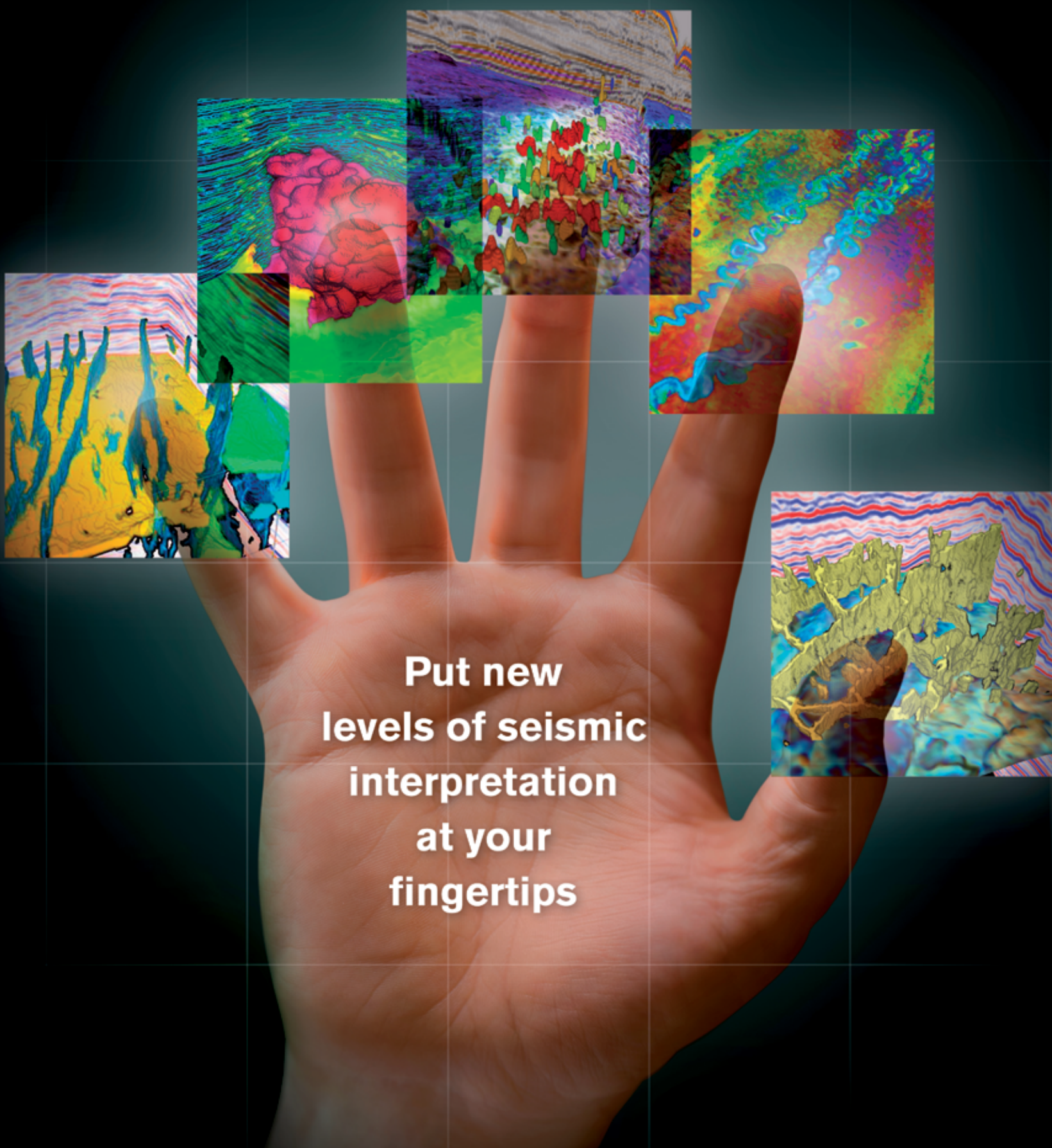
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'Science wells' get to the core of the matter

Shale Play Revives San Juan Basin

By DIANE FREEMAN, EXPLORER Correspondent

The use of preliminary test wells and seismic data have helped lead the way to drilling in an area of the San Juan Basin where many energy companies had given up, says an exploration executive from WPX Energy in Denver.

AAPG member Steven Natali, senior vice president of exploration for WPX, a new spinoff of the Williams Companies, says the Mancos Shale Formation in New Mexico's San Juan Basin now appears accessible to drillers.

For decades operators knew that



NATALI

the Mancos Shale exhibited strong gas shows during drilling along the northern margin of the San Juan Basin.

"We cored eight different clusters, each has its own mineralogy. Four had good reservoir quality. Then we delved further."

"A lot of drillers had tried to drill it and frac it and came up empty," Natali told attendees at the 3-D Seismic Symposium

in March. "So we went to drill some science wells."

The annual conference, as in past years, was sponsored by the Rocky Mountain Association of Geologists and the Denver Geophysical Society.

"In the last few years the San Marcos had been seen as declining," Natali said. "But with the Mancos Shale, the San Juan is about to enjoy a 20-year renaissance."

Identifying the Zones

Natali's company has a legacy acreage position within the Rosa Federal Unit, located in the deepest part of the basin where the Mancos Shale is a uniform 1,800-feet thick.

"In the Rosa unit, it's definitely in a dry gas window. Mancos is relatively uniform and almost all completions in the Rosa area were in a limited area," he said.

The Mancos Shale has similar characteristics over a large area, Natali said – "basically, it's one great big bowl."

WPX's preliminary work began in the spring of 2008, when it began an exploratory program to confirm the presence of continuous, over-pressured gas accumulation. Its original gas in place calculations came up to more than 300 bcf per section trapped within the Mancos Shale section in the Rosa Unit area.

The company drilled four vertical test wells in West Rosa.

"We cored eight different clusters," Natali said. "Each has its own mineralogy. Four had good reservoir quality. Then we delved further. Fecal pellets are laid down in packs with excellent permeability."

"That's where you find the gas and how you're going to move it," he said.

After extensive log and core analysis, four zones were identified as potential prospects. However, the Cyan zone, which contained the most gas in place, looked doubtful since it had a higher clay content, making it a poor candidate for fracture stimulation.

"We spent a lot of time studying natural fractures – the results were that the Cyan would be tough," Natali said. "You're never going to get anything out of it. So we decided to give it up and go for some others."

Focusing on Two

The company decided to focus on two other zones, the Olive and Black zones, which looked more promising.

In 2010 the company acquired a 47-square mile, land and marine 3-D survey over the western half of the Rosa unit and a 35-mile 2-D seismic grid over the eastern portion of the Rosa unit.

Two horizontal wells were drilled into the two different zones in the western portion of the Rosa and four additional vertical science wells were drilled in the eastern half of the Rosa unit with the cutting of additional core.

The two horizontal wells were drilled with oil-based mud during the drilling of the 5,000-foot laterals and tested the Olive and Black zones of the Mancos Shale. Each lateral received 12 hydraulic

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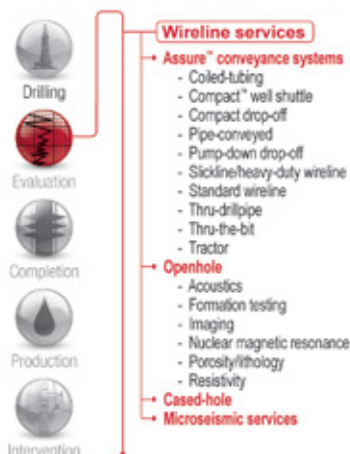
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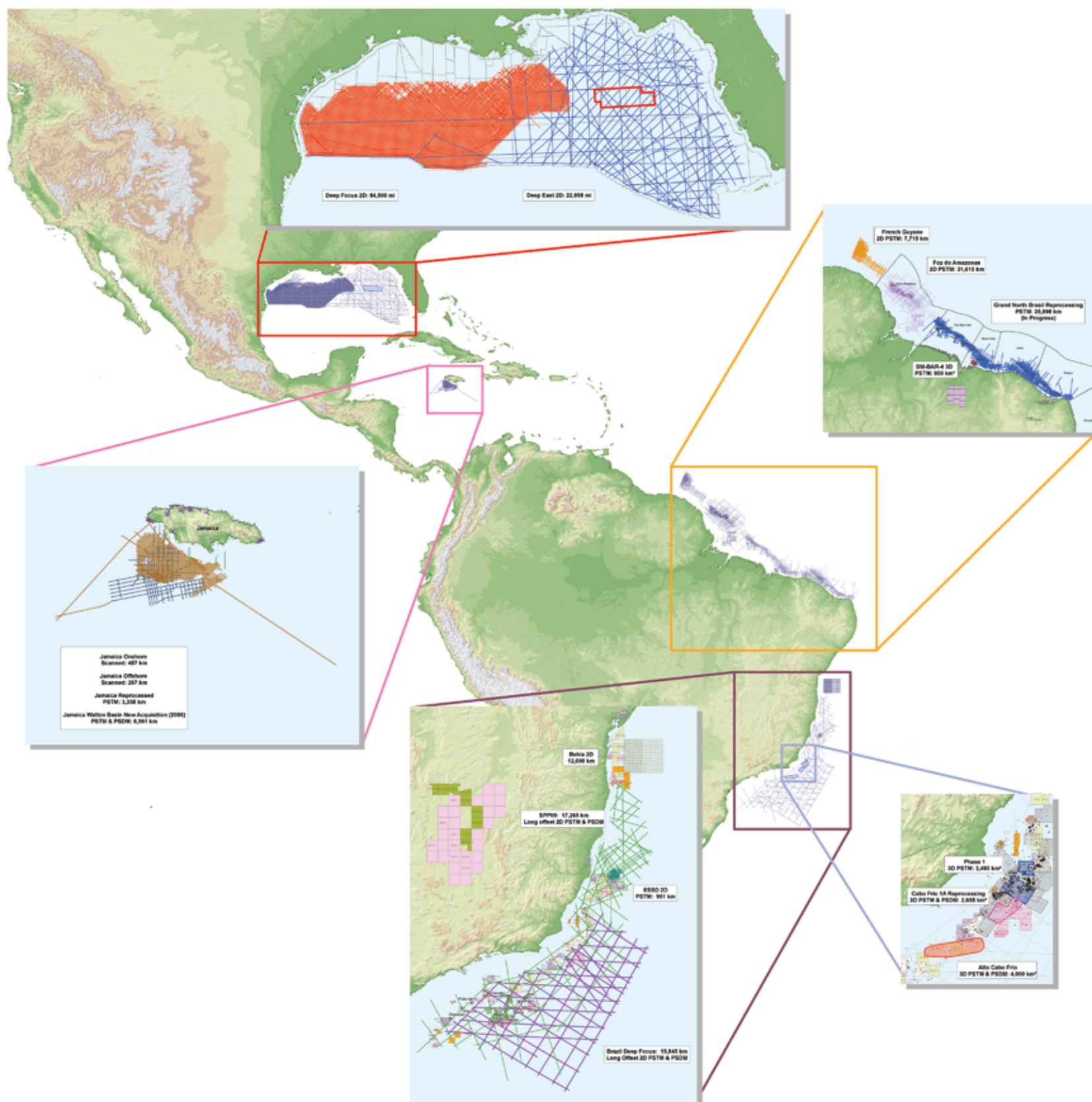
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Sourcing from page 14

"It was a big surprise to me and most others that the Mancos-Niobrara could be a viable resource play," he said, "so that's a significant development."

The Piceance Basin, in fact, is a world-class tight gas accumulation where major volumes of gas have been produced from the tight gas sands of the Cretaceous age Mesaverde group. Cumella commented that geological and geochemical data indicate that the Mancos-Niobrara has been a major source of the gas for the overlying Mesaverde.

"This came as a surprise to most everyone," he noted.

Vertical gas migration from the thick, shaly Mancos-Niobrara likely occurred along fault and fracture zones.

"In the Piceance you have most of the gas being sourced from coals in the lower Williams Fork formation (of the Mesaverde Group), which is the traditional source of Piceance Basin gas," Cumella said. "The thick coals are highly mature in the basin, especially the southern part."

"This would have generated a lot of natural gas that's probably the major gas source for the southern Piceance."

"In the northern Piceance, where the well quality is more variable and the thickness of the gas saturated interval is more variable, it may be that the key to viable gas accumulation in the Mesaverde is the sourcing from deeper horizons rather than local."

"The more recent studies have indicated that the Mancos-Niobrara not only is a significant source for Mesaverde gas accumulations, but it

may be the predominant source in the northern Piceance."

Exploration – Looking Up?

The top of continuous gas saturation rises significantly adjacent to major structural features, such as the Rulison Nose, Crystal Creek anticline and Gilson Gulch graben. Mesaverde gas production is commonly enhanced in these areas.

Cumella said that high capillary pressures are required to achieve the low water saturations that have been measured in the Mesaverde sands with their microdarcy permeability. Such pressures could have been provided by vertical migration of highly pressured gas from the Mancos-Niobrara into the Mesaverde.


"In addition, the highly pressured gas would have enhanced natural fracturing

during migration and filling of the tight sandstone reservoirs, significantly increasing reservoir permeability," he said.

Given the protracted slump in natural gas prices, some players here have moved updip, reportedly chasing liquids-rich production rather than the mostly dry gas. Even so, drilling activity has dwindled rather dramatically.

"Drilling has slowed a lot in the Piceance," Cumella said. "There were a hundred rigs running in its heyday, and my guess is maybe 20 or 30 now."

It's not just the drop in natural gas prices nowadays that's spooky – oil recently has gone wobbly on occasion.

Cumella noted that tight oil play wells can top out at \$10 million or more, and a significant prolonged drop in crude prices could trigger some rig lay-downs even in the oil plays. 

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Mancos from page 16

fracturing stages using plug-and-perf technology, for a total of 5.6 million gallons of water.

The water was brought in from Lake Navajo to the well pad over a three-mile water line, Natali said.

"It had uniform frac performance from stage to stage," he said.

Assuming a 160-acre drainage, the Olive Zone has 5.5 bcf and the Black zone has 6.9 bcf.

"We'll know a lot more in another year," he said.

Hope for the Best

The four vertical test wells drilled in the eastern portion of the Rosa Unit showed core measurements and electric log characteristics similar to those in the western portion. Factors strongly suggest relative uniform reservoir characteristics over a three-township area, he said.

"All core data says east Rosa is at least as good or better than west Rosa," Natali said. "Early indicators are we should see some similar characteristics as west Rosa."

Although well reserves cannot be accurately predicted at present, the wells can reasonably be assumed to be in excess of four bcf each, he said.

"Now we need 3-D of 70 square miles – and we're in the process of acquiring it in east Rosa," he said.


Currently, a purpose-built rig is being constructed and is scheduled to arrive this summer where it will embark on year-round multi-well pad drilling of horizontal wells, he said.

"In August we will start year-round drilling," Natali said. "We will drill eight wells per section and will have buried lines of water coming in."

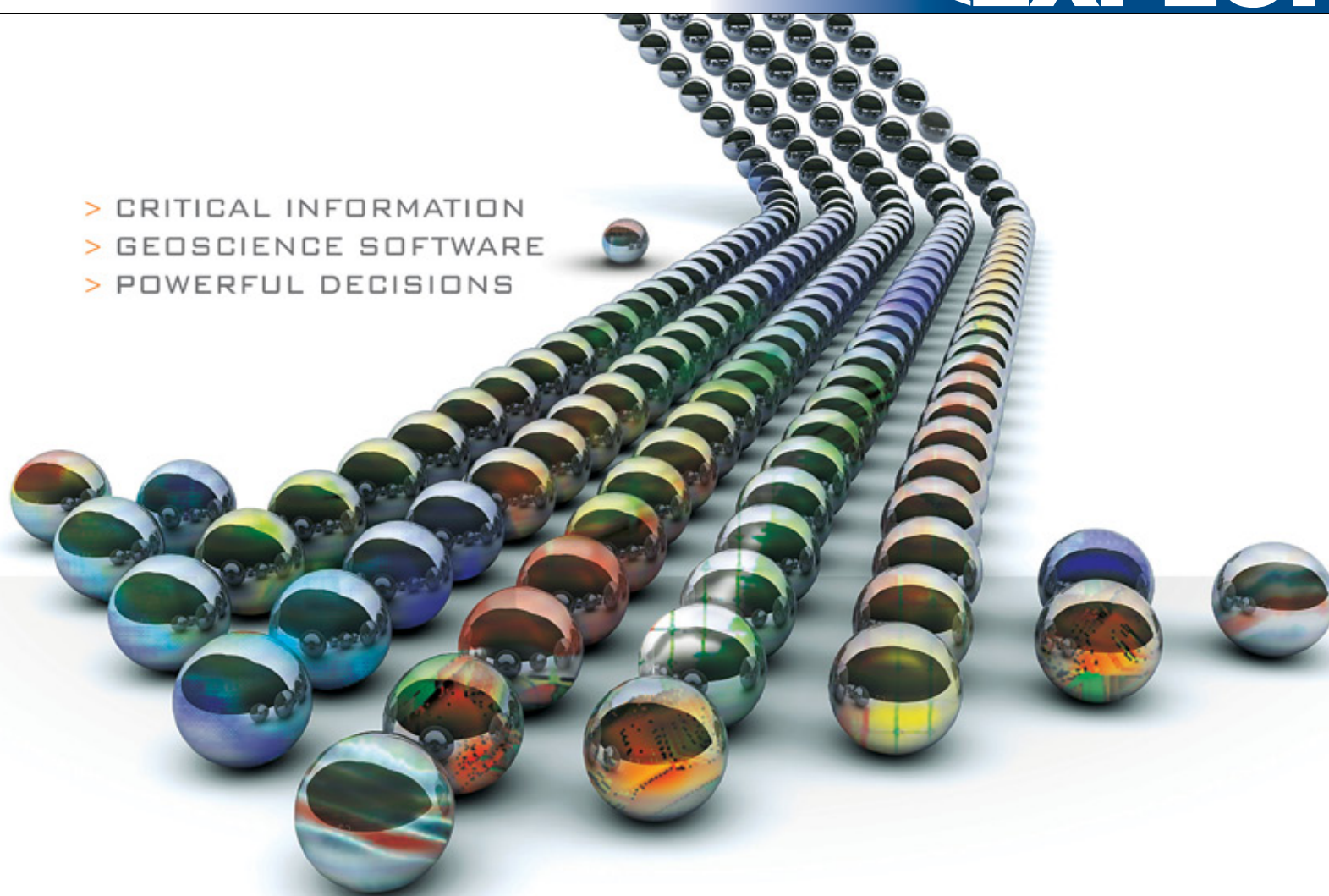
But current low natural gas prices may influence production.

"Gas pricing will determine the pace of production," he admitted. "In 2008 when we started, we thought we'd have \$8.25 per mcf. But we will need to move slowly now. We need to get gas prices up to \$5 per mcf and get costs down to \$6 million."

"Gas prices need to come our way and they will," he said.

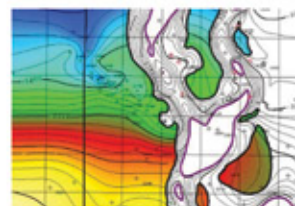
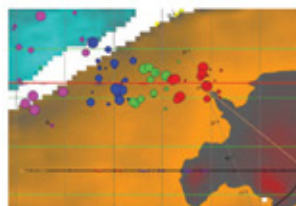
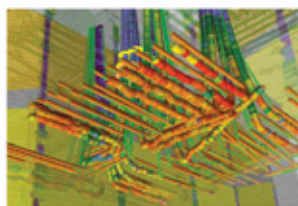
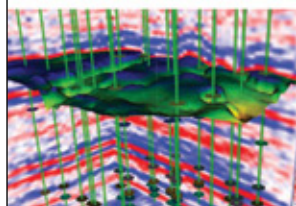
"If all portions of the Rosa Unit were to demonstrate the productivity measured in the first two horizontal wells, total recoverable reserves in the Rosa Unit would exceed 3 tcf of dry, pipeline quality gas," Natali said. 

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'09 Jake well ignited boom

What Is the Tally of Niobrara Value?

By LOUISE S. DURHAM, EXPLORER Correspondent

EOG's horizontally drilled Jake well in Colorado became an industry shocker when it tapped into a copious amount of oil in the Cretaceous-age Niobrara formation.

After the well was drilled in September 2009, it produced an average of 555 bopd during the initial three months of production.

"When EOG released the information, I think everyone was shocked at the production being so big," said Denver-based AAPG Honorary Member and House of Delegates



EISINGER

chair Randy Ray. "We all knew the oil was there, but no one pursued it with the new horizontal drilling and staged fracs that were fine-tuned in all the shale gas plays."

Since the Jake's dramatic debut, more than 400 horizontal well starts targeting the Niobrara have been recorded by the state of Colorado, according to AAPG member Chris Eisinger, Colorado Geological Survey geologist.

"The bulk of the action has occurred in Weld County in the Denver Basin, but Niobrara horizontal production has also been established in the Piceance, Sand Wash and North Park basins," Eisinger said. "At the end of 2011, at least 4.2 million barrels of Niobrara oil have reportedly been produced through horizontal drilling technology in Colorado."

So, what exactly does this plethora of Niobrara tight oil wells mean for the Centennial State?

What Does It Mean?

Eisinger and Colorado Oil and Gas Conservation Commission geologist James Milne, another AAPG member, are working diligently to come up with an answer.

They currently are busy constructing an up-to-date analysis of overall Niobrara tight oil production in Colorado and its estimated value to the economy, using a combination of state and commercial database resources.

Detailed analysis of Niobrara drilling and production activity is valuable for assessing the early success and future potential of the play.

"We're looking at economics, the upfront investment costs like leasing and drilling costs and how that compares to payout time, what the ultimate recovery is for a given well," Eisinger said.

He emphasized that geological and regional variability play a key role in drilling successes, noting that many folks in Colorado hear the word Niobrara and target it wherever it exists at suitable depths, thinking it has to be a potential play target.

The talk and the big action have been about oil, but the formation can produce gas, oil or both.

"In the Piceance, it's more of a gas play," Eisinger noted. "The depth of burial and maturation are more conducive for hydrocarbon conversion to gas – but no

one is looking to produce gas at this time with pricing what it is."

Typical of unconventional plays, the Niobrara tight oil wells apparently have a steep initial decline rate prior to stabilizing.

AAPG member Chris Eisinger will present the paper "Niobrara Tight Oil Success in Colorado: What Do the Numbers Indicate?" at 2:50 p.m. Tuesday, Sept. 11, at the Rocky Mountain Section annual meeting in Grand Junction, Colo.

Eisinger's co-author is fellow AAPG member James Milne.

The talk is part of a session titled Tight Oil and Gas Reservoirs – Where, How and Why?

Milne noted that stable production has been observed between six and seven months after initial production in the Weld County fields. Currently, production of 200-400 bopd is not uncommon for stabilized rates.

"We're trying to look specifically at how long the wells stay stabilized and what the ultimate recovery potential is going to look like if you start taking into account a year or two of production data," Eisinger said.

To his chagrin, data to move the study along are being released very slowly compared to some other plays.

"Things are taking longer to trickle in than they should," he lamented. "That makes the sort of thing we're doing kind of tricky; we need to take the numbers we have and do the analysis, and we're waiting to get additional data."

There are emerging areas for horizontal Niobrara field development toward the southern end of the Denver Basin. As the southward move progresses, the unknowns increase.

For example, geological uncertainty enters the picture in some locales – along with a pushback by some communities that are against drilling.

An Unusual Twist

Another emerging area in Moffat and Routt counties in the Sand Wash Basin in the northwestern part of the state presents an unusual twist.

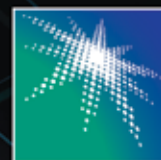
Most players there are drilling vertical wells and fracturing them because the Niobrara is much thicker there, and the geology is different.

"The sweetest zones are not nearly as thick as they are in the Denver Basin," Eisinger said. "There, you have basically A, B, C chalk layers in the Niobrara, and they're mainly putting horizontals in the B."

"In the northwest, the Niobrara is thicker, but the potentially fractured zone is not as thick or well developed, so they mainly do vertical wells with hydraulic fracturing," Eisinger explained.

If the data enable the researchers to define if some Niobrara tight oil areas are truly better than others, it could save a lot of future drilling dollars.

As for Colorado itself, it will have a better handle on the long-term benefits for the state, e.g., potential royalties. ■



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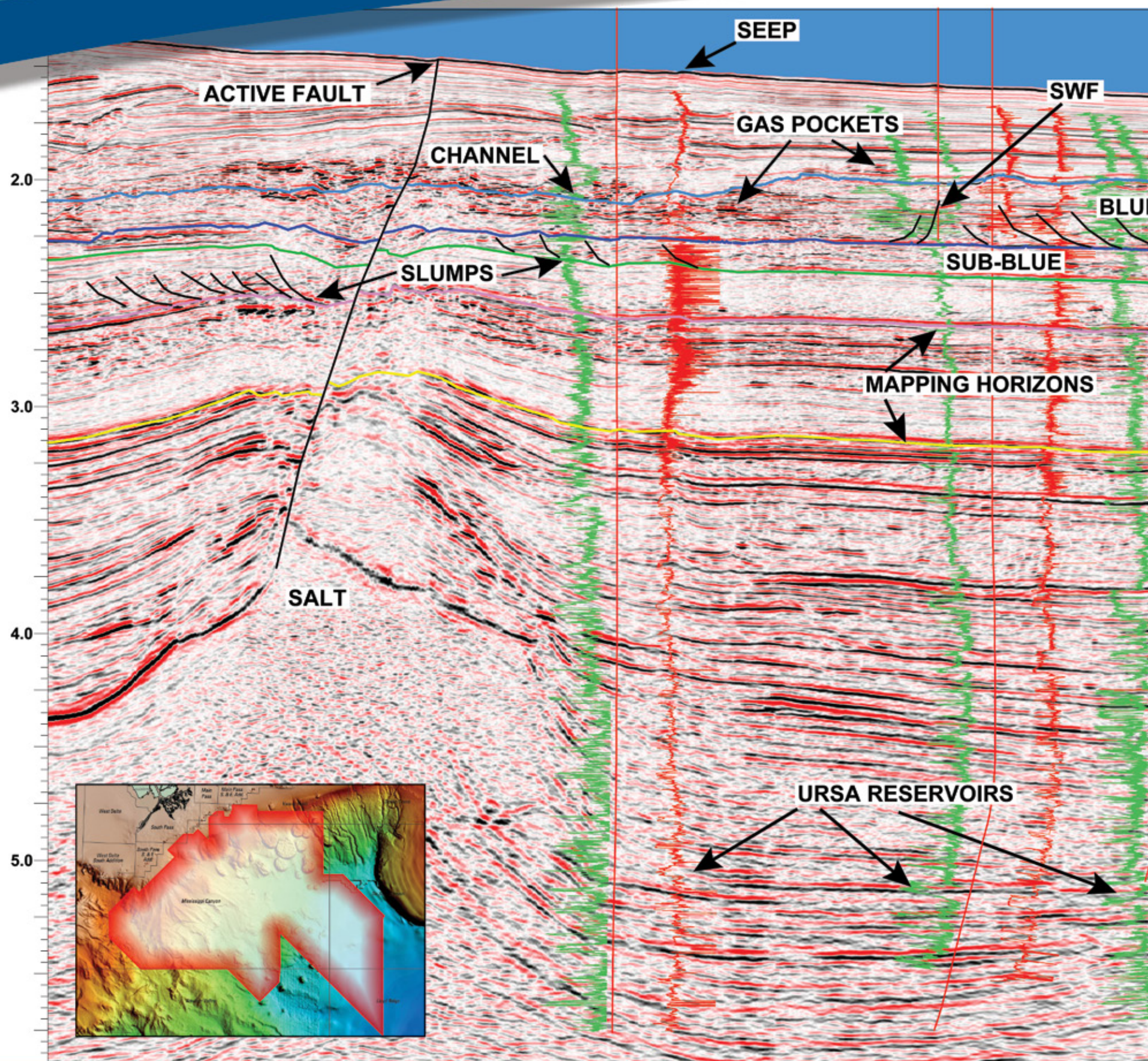
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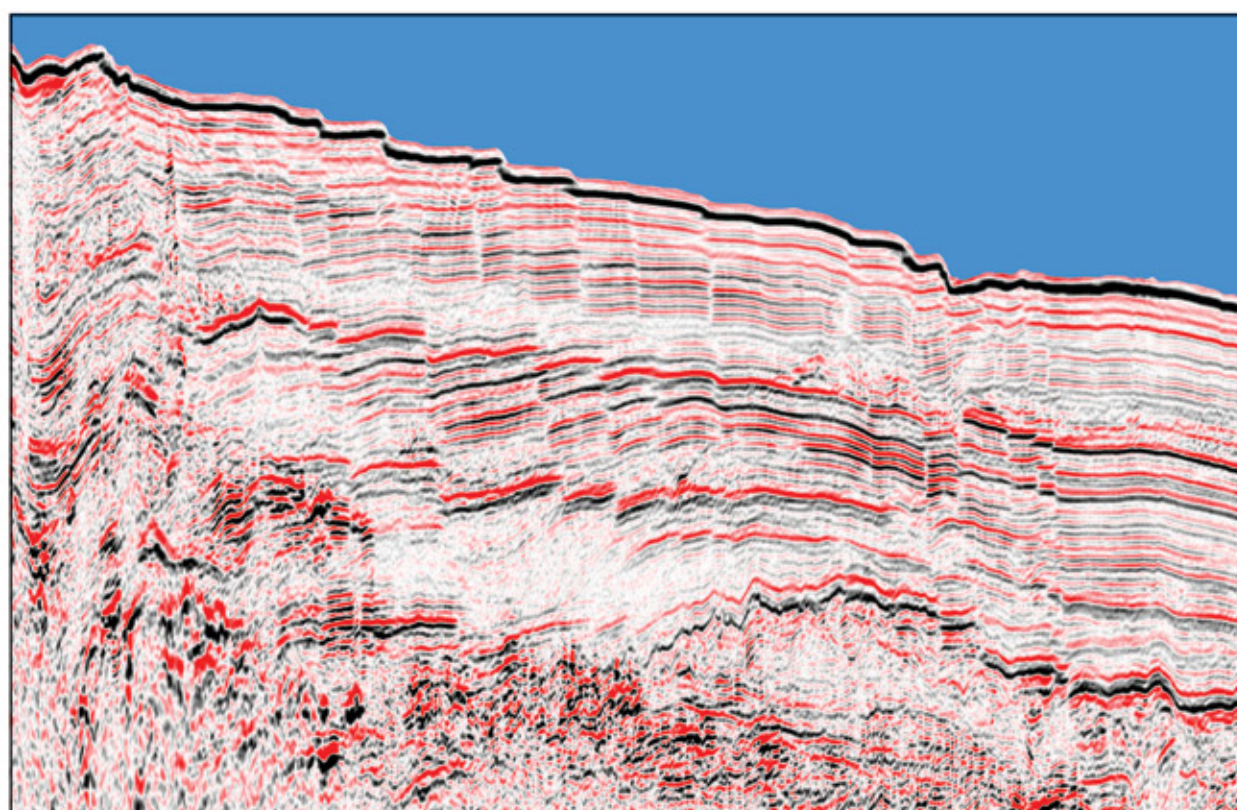
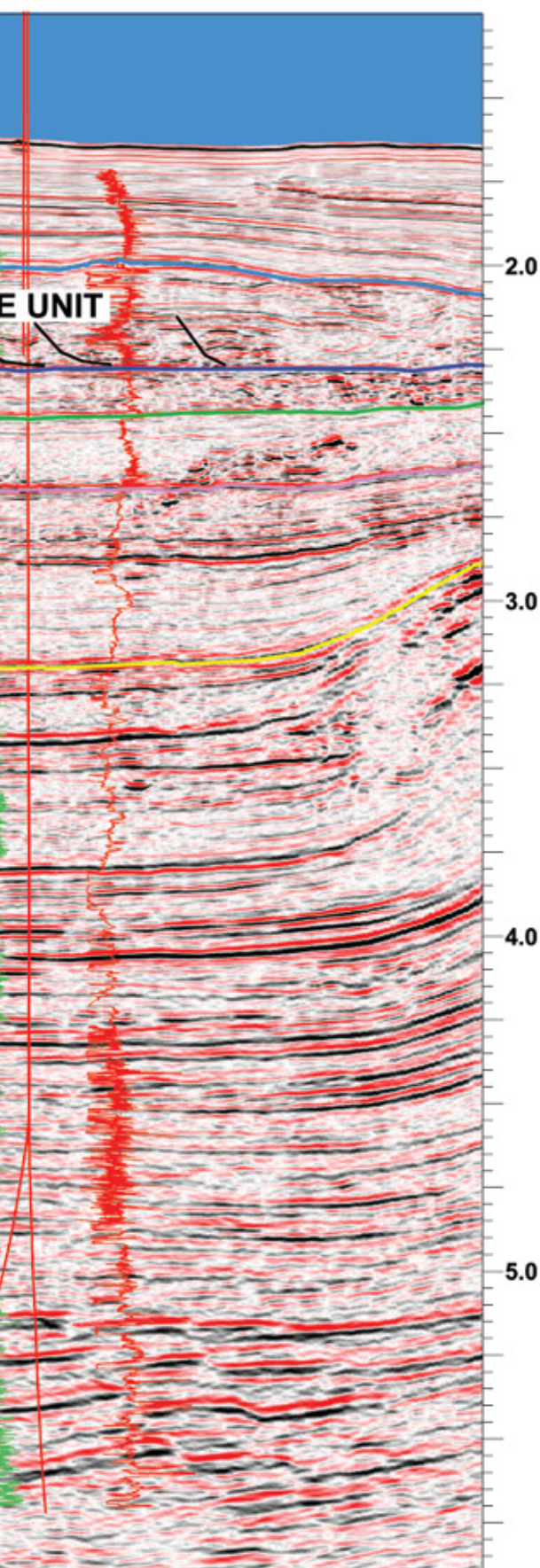
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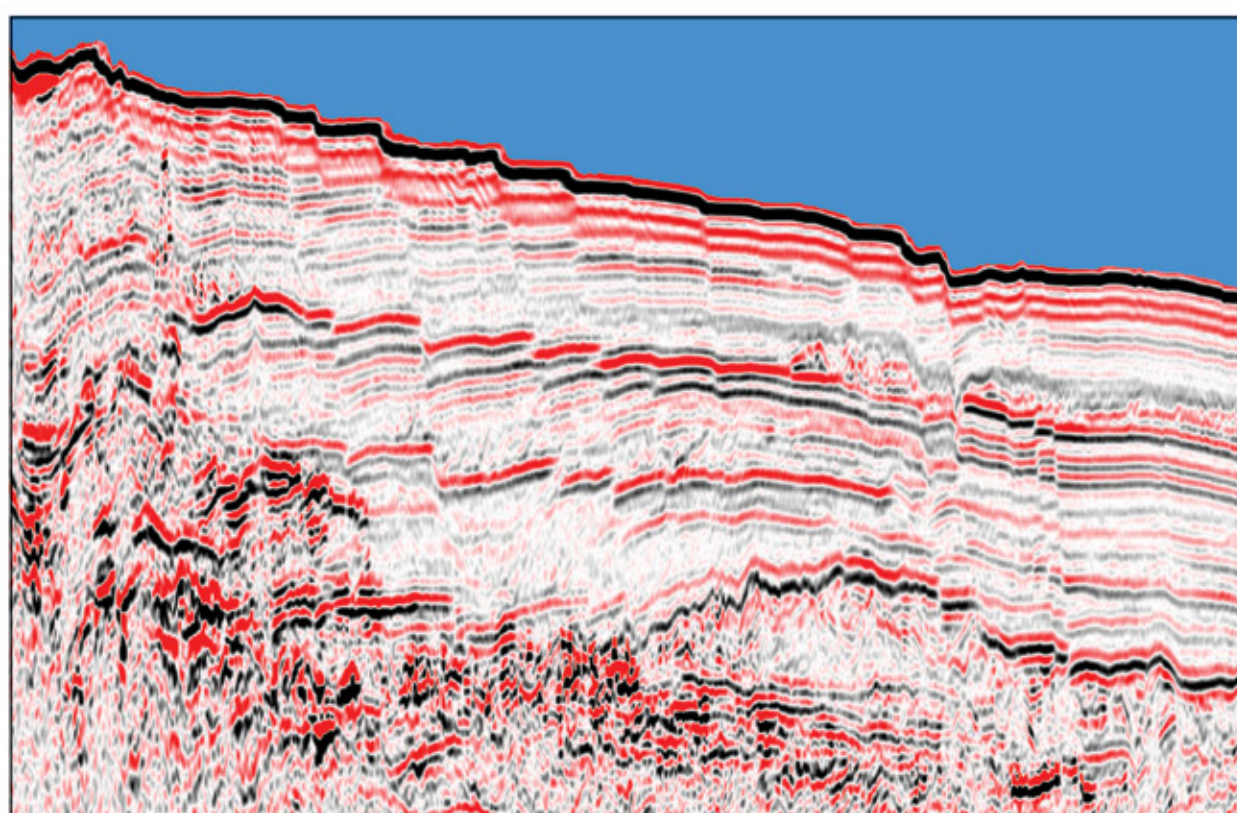
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The Caribbean: Is it From Here or From There?

By KEITH JAMES

The Caribbean has long puzzled geologists. In the first half of the 20th century opinion on its crustal origin was divided between ocean becoming continent and continent becoming ocean – but continent was involved.

In 1966, Tuzo Wilson proposed that the Lesser Antilles volcanic arc (figure 1) was the leading edge of a lithospheric raft moving eastwards relative to North



JAMES

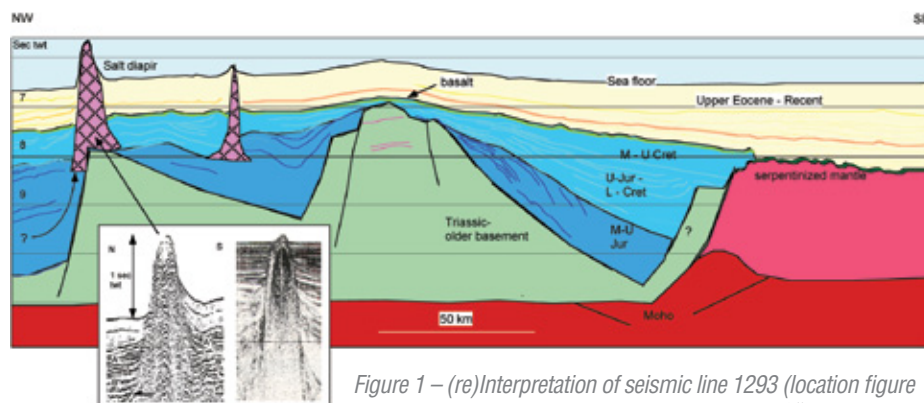


Figure 1 – (re) Interpretation of seismic line 1293 (location figure 1) over the Venezuela Basin. Inset: comparison of “seamount” (left) with drilled, Challenger salt diapir, Gulf of Mexico (right).

and South America, giving rise to the Pacific – and thus, oceanic – origin of the Caribbean. At the same time the “Plate tectonic revolution” was taking shape.

Since then, the most quoted model for the origin of the Caribbean has been that it formed as Jurassic crust in the Pacific, where it thickened to a 20-kilometer pile of basalt in the Cretaceous. This collided with an intra-oceanic volcanic arc, driving it east to form the Greater and Lesser Antilles.

The least quoted model, held by a (Galilean) minority that includes me, is that the area evolved in place between diverging North and South America.

When Wilson advanced his ideas in 1968, Russian oceanographers urged caution until further data were obtained. Today, they, among others, continue to note abundant samples of continental rocks retrieved from deep oceans and highlight Deep Sea Drilling Project (DSDP) samples of mid-Jurassic to Miocene shallow-water deposits and sub-aerially weathered rocks now at depths of one to seven kilometers in the Atlantic, Indian and Pacific.

In the west, Mid-Atlantic Ridge beach sands and continental rocks that puzzled Woods Hole scientist Maurice Ewing (1948, 1949) are generally overshadowed (ignored inconveniences) by the plate tectonic paradigm.

Depending on Data

Earlier, Alfred Wegener (1912) had proposed that continents drifted apart. Original continuity suggested by sedimentology, palaeontology and geometrical fit of shorelines in the south Atlantic was reinforced by the famous Bullard (1965) computer fit of continents along their 2,000-meter deep margins.

This, however, had problems of overlap in Central America and the Blake-Bahama-Florida platform – and ignored data for the Caribbean. British geologist Anthony Hallam (1971) wrote, “Of the alternative initial fits of the continents, that along the boundaries of the Quiet Magnetic Zones is preferred” (see later).

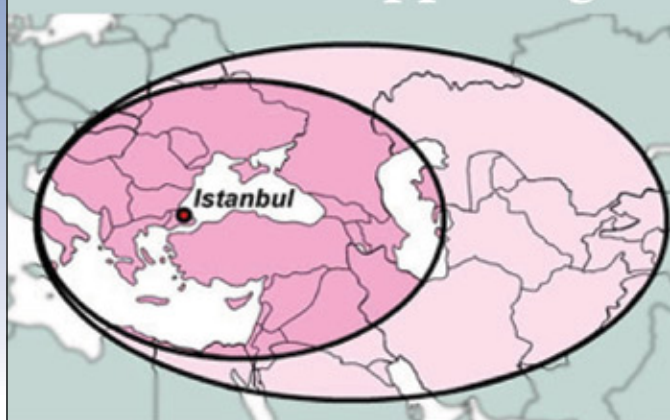
Post-Bullard models creatively reconstructed Middle America by placing continental blocks Maya (Yucatán) and Chortis (Honduras-Nicaragua-Jamaica) (figure 1) in the Gulf of Mexico and alongside southwest Mexico, whence they enthusiastically rotated 135 degrees and 180 degrees anticlockwise into today’s positions.

Or both could have rotated clockwise from the Gulf – there are all sorts of possibilities.

Data, however, would have it otherwise.

A northeast trending Jurassic graben (Guayape F.) crosses Chortis, precisely parallel to a similar feature on the Maya (Rio Hondo F., Yucatan). The grabens continue, offset to the east, the trend of Triassic-Jurassic grabens in the Gulf of Mexico, below the Coastal Plain and along eastern North America, where offshore seismic shows seaward-dipping wedges of reflections and drilling has touched salt diapirs. Neither Maya nor Chortis has rotated – Chortis *always* has been at the western end of the Caribbean, and its presence obviates any plate migration from the Pacific.

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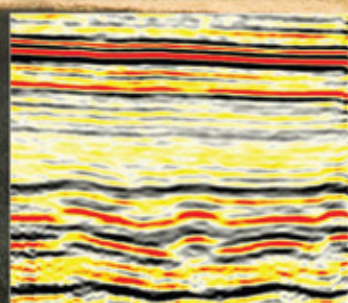
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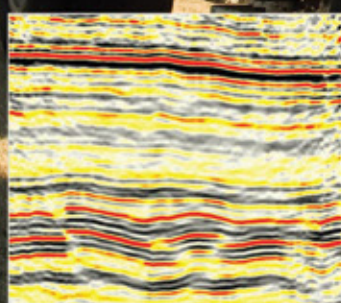
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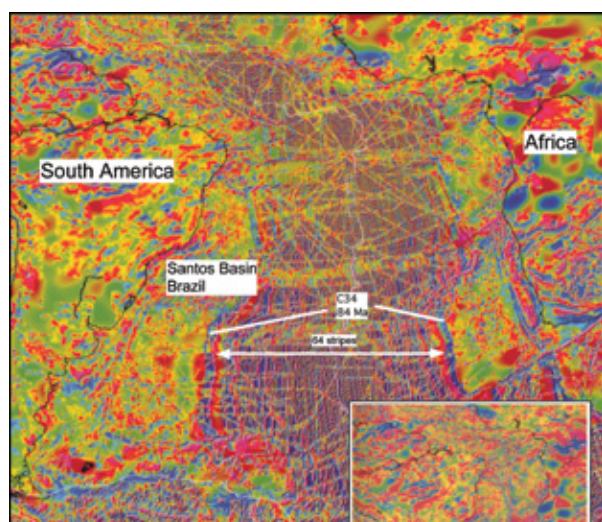


Figure 2 – Magnetic data (from Korhonen et al., 2007, Magnetic Anomaly Map of the World), South Atlantic. Inset: “Pangaea” reconstruction.

Caribbean from page 24

A few DSDP sites on thick Caribbean crust – the Caribbean “Plateau” – reached upper Cretaceous, shallow marine or sub-aerial basalt. Seismic data show wedges of reflections here as well, below the basalt. “Oceanic” eyes interpret these as volcanic deposits. Peaks, surrounded by moats and rising from the sea floor are seamounts.

This data, however, mimic the north Atlantic Vøring, Møre and Rockall Plateaus, where continental basement lies below sedimentary layers five-10 kilometers thick and basalts. This is the classic signature

of submarine extended continent. Thus, in the Caribbean I see continental crust, rifted and extended in the Triassic-Jurassic, Cretaceous carbonates and salt diapirs with rim synclines (figure 1), continuing the geology of offshore eastern North America but including basalt flows.

Some Evidence Emerges

Figure 2 shows magnetic data over the south Atlantic. Magnetic stripes attributed to 84 million years of seafloor spreading appear in the center of the ocean. Between these and land the magnetic signatures of South America and Africa show important continuations offshore. Rather than “Cretaceous Quiet Zone” – oceanic crust formed when the Earth forgot to reverse its magnetic

field for 40 million years – these areas are subsided, extended continental crust.

Reconstruction of South America-Africa along the margins of these extensions provides the good “Pangaeian” fit (figure 2 inset) suggested by Hallam. It shows continental masses significantly larger than currently recognized. Before subsidence, dinosaurs, freshwater fish and snails, mammals and flowering plants migrated merrily along direct, overland routes between Europe, South America, Africa and Madagascar, blissfully unaware of “biodispersal problems.”

Drilling in increasingly deep water (current deep rigs rated to four kilometers) is providing evidence of this considerable continental subsidence. Cretaceous shallow marine limestones offshore Brazil now lie at seven kilometers, below thick salt and more than two kilometers of water. The step into deep water and the amazing recent discoveries there (Tupi/Lula) came after new geological concepts and analogs were imported from the North Sea and Gulf of Mexico.

How does this relate to the Caribbean?

If your curiosity is piqued, compare seismic data over the Santos Basin and the Caribbean “plateau” (hints: mobile salt, shelf break carbonate buildups).

Magnetic data over the Caribbean show extended continent signature – classic oceanic magnetic striping is not present. Detailed magnetic data do show lineaments, but these reflect crustal structure. They trend northeast, parallel to the grabens of Maya, Chortís and North America.

What other data support continental origins for the Caribbean? Crustal thicknesses, tectonic fabric, highly silicic volcanic rocks, gravity data, stratigraphy and palaeontology all converge in this direction.

Shallow marine Eocene and Oligocene (on the Bahamas) limestones now kilometers deep show that geologically recent subsidence occurred here also.

The Big Question

Could hydrocarbons be present in the Caribbean?

The similarity with offshore North America suggests at least a Jurassic system, with associated salt, below the basalts drilled by DSDP.

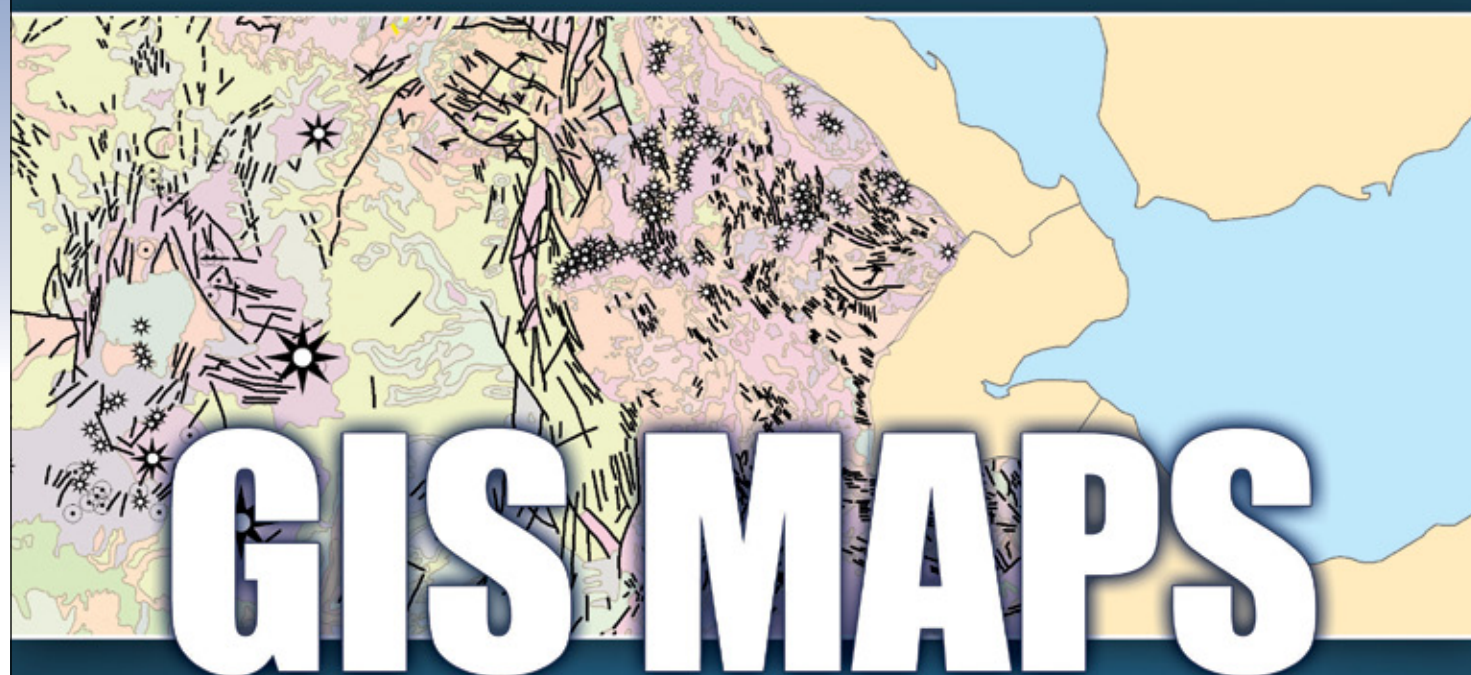
Basalt is not a problem – Ireland’s Corrib Field taps gas from sandstones below basalt and vesicular/fractured basalt hosts oil in Japan’s Yurihara Field. Sub-basalt exploration is under way offshore Norway and India.

I’ll bet the Caribbean carries significant hydrocarbon resources. I anticipate that changes in vision will lead to these and to paradigm shifts in Caribbean and global plate tectonics.

Whichever model one chooses affects the bottom line for petroleum geology:

► If entirely basaltic and derived from the Pacific, the Caribbean will not carry hydrocarbons.

► If formed in-situ, sharing history with northern South America, the Gulf of Mexico and eastern North America ... well, that’s another story.



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Langkawi Geopark is 'expedition' destination

Complex Malaysia Geology a Site to See

By BARRY FRIEDMAN, EXPLORER Correspondent

Comprised of 13 states, and separated by the South China Sea into two regions, Malaysia is known for beaches, serendipity and the magic and mystery of Borneo.

One more thing, too, even if it isn't always featured in the travel brochures.

Let AAPG member Bill Lodwick, a geologic consultant in Kuala Lumpur with more than 30 years of oil exploration behind him, tell you:

"West Malaysia is a paradise for geologists."

And he'd like to prove it – so, along with Lee Chai Peng, retired professor at the University of Malaysia and past president of the Geological Society of Malaysia, they will lead what he calls a "little expedition" in September around some of this geographic treasure trove as part of this year's AAPG International Conference and Exhibition in Singapore.

The pre-conference field trip, sponsored by the South East Asia Petroleum Exploration Society (SEAPEX), will tour Malaysia's Langkawi Geopark, which in 2007 was named a member of the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Global Network of National Geoparks.

"Within it," Lodwick says of the island and the hands-on study of 90 geosites around the group of 99 islands, "are some of the best and most interesting exposures of Palaeozoic rocks in Malaysia, which range in age from the Cambrian to Permian."

And since, as mentioned, Malaysia is where you'll find Borneo (which is divided among three countries: Brunei, Indonesia and Malaysia), you'll also find thousands of tourists drawn to island's spectacular karst, beautiful beaches and warm, welcoming local population.

This trip, then, complete with cable car ride and a Mangrove Swamp Tour, will give geoscientists and the others attending the Singapore ICE an opportunity to see what all the fuss is about.

The Geologic Setting

The breathtaking charm, beauty and vistas of the Langkawi Geopark, in fact, were considered such a national treasure that it was established by the Kedah state government in May 2006, to preserve and display its unique features.

By the following June the Geopark was endorsed by UNESCO – and its World Heritage Site (WTS) designation means this oldest part of Malaysia is now on the geological radar.

"Once it gains geopark status, it will make the city well known to the world," said then-deputy minister of tourism James Dawos Mamit.

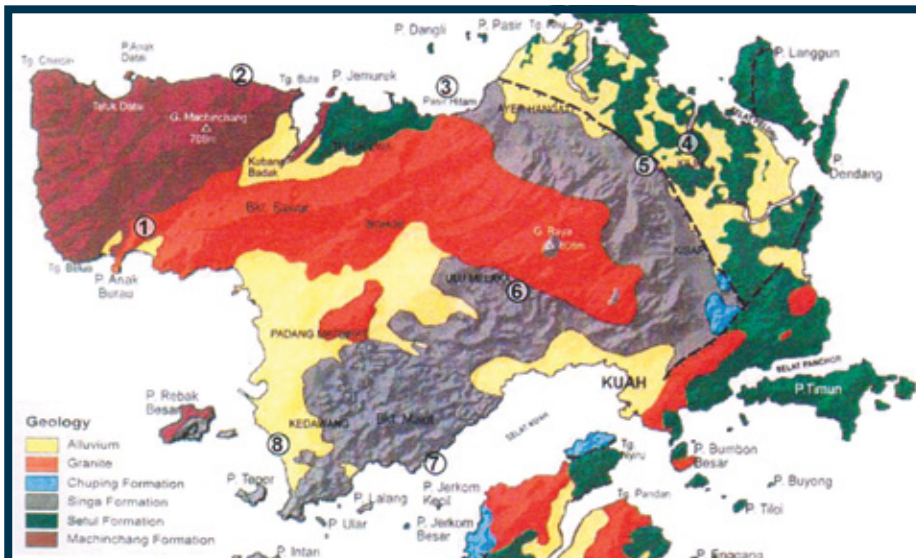
"The most interesting and accessible sites," Lodwick said, "are located on or near



LODWICK



You don't have to be a geologist to enjoy the beauty of Malaysia's Langkawi Geopark – but for geologists, especially, the park's Palaeozoic outcrops provide a beauty all their own.



Geological map of Langkawi islands showing distribution of the various rock formations in the islands (after Mohd Shafeea Leman et al., 2007). Stops on the ICE field trip are numbered.

the main island," and this includes the most complete Paleozoic sequence in this region.

Additionally, it's home to the Cambro-Ordovician shallow marine clastic Machinchang Formation, fossiliferous limestones of the Ordovician-Silurian Setul Formation, Gondwana-derived, glacial-marine pebbly mudstones of the Carboniferous-Permian Singa Formation and Permian Chuping Limestone.

Those on the field trip will see this Setul limestone by boat, as it cruises along the channels running through the mangroves, as well as take a cable car to 700 meters (2,300 feet) above sea level, to the top of the Cambrian Machinchang Hills. Once there, visitors will see the sheer cliffs of faulted quartzitic sandstones rising above the tops of the pristine tropical forest.

A spectacular curved sky bridge, 125 meters (410 feet), is suspended by cables from a single supporting leg – and from it, the cliffs can be viewed from different angles.

Limitations? Potential!

Only a short walk below the cable car station, the shallow marine sandstone outcrops can be examined up close.

Participants, to put this mildly, will be looking down (and up) at history.


"Current theory proposes that the collision of India with Tibet about 50 million years ago created the Himalayas," Lodwick said, "and caused the many slivers of southeast Asia, including Peninsular Malaysia, to alter their structural configuration. It is an integral part of Sundaland, the Southeast Asian part of the Eurasian plate.

"The sedimentary formations contain both clastics and carbonates," he added, "which were deposited within differing palaeo-environments and under different palaeo-climatic conditions."

Lodwick says such a canvas provides a wide variety of rock types that will challenge the minds of geologists.

"In addition, these sedimentary rocks have been intruded by younger granites that have formed interesting metamorphic imprints at their contacts," he said. "The entire sequence also has undergone at least two phases of tectonic deformation, resulting in interesting geological structures."

And of the practical implications for those looking for exploration possibilities, Lodwick says that while no commercial oil or gas deposits have been found on the Malaysian side of the Straits of Malacca, the thicker and more deeply buried extensions of the Tertiary sediments into Sumatra across the Indonesian border are home to many commercial oil and gas fields.

The history, the possibilities and the raw beauty of Malaysia – something to ponder on this "little expedition" while cruising through the mangroves, watching sea eagles dive for fish, tourists lying on the beach and geologists discovering a new paradise. 

Singapore Discounts Still Available

Registration savings are still available for this year's AAPG International Conference and Exhibition in Singapore – but the online deadline is coming fast.

Registering on or before Aug. 15 can save members up to \$190 off the regular fees.

This year's ICE will be held Sept. 16-19 at the Marina Bay Sands Expo and Convention Center in Singapore.

The meeting theme is "Asia-Pacific Resources: Fueling the Future," and more than 400 oral presentations and poster sessions have been selected for the technical program.

Among the specific areas that will draw the technical spotlight are

looks at the Asia-Pacific's shale gas potential, shale liquids and coalbed methane plays.

Also slated is a Discovery Thinking Forum, an ongoing presentation of the AAPG 100th Anniversary Committee's program celebrating significant discoveries, will be held as part of the Singapore technical program – the first time the event has been part of an ICE.

The forum will feature five speakers who will discuss "Important Discoveries and Creative Thinking," with a special focus on Europe and Southeast Asia.

ICE registration and all program details are available online at www.aapg.org/singapore2012.



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AAPG's flagship initiative for science

Speakers Announced for N.A. Lecture Tours

By VERN STEFANIC, EXPLORER Managing Editor

Nine speakers, hailing from both the worlds of academia and industry, have been selected for AAPG's prestigious Distinguished Lecture program for the 2012-13 North American tours.

The lecturers will offer expertise and insight into a variety of topics, ranging from practical applications of the latest scientific and technological advances, to a look at what lies ahead for petroleum geoscientists.

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

North American speakers typically take two tours during the season, one going to eastern locales and one to western locales. Each tour typically lasts about two weeks.

Last year's North American tour slate endured various cancellations due to weather conditions and other factors, but still the speakers logged 72 visits, addressing 5,281 people.

Some of the tours carry specific Foundation-funded designations and purposes. This year they include:

► The Allan P. Bennison Endowment speaker, which is an international speaker who makes a U.S. tour, funded by contributions from the late Allan Bennison, a long-time Tulsa geologist.

This year's Bennison lecturer is **Christopher Jackson**, with the department of earth science and engineering, Imperial College, London, England. He offers two lectures:

✓ "Three-D Seismic Reflection and Borehole Expression of Tectonically Controlled Deep-Marine Reservoirs: Examples From the Northern North Sea Hydrocarbon Province."

✓ "The Impact of Igneous Intrusions and Extrusions on Hydrocarbon Prospectivity in Extensional Settings: A 3-D Seismic Perspective."

He will tour eastern North American groups January 7-18 and western North American groups April 1-12.

► The J. Ben Carsey Endowment speaker, an annual domestic tour provided by contributions from J. Ben Carsey Jr., of Houston, in honor of his father, who



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modeler for Chevron Energy Technology, Houston. He offers two lectures:

✓ "Carbonates – A Challenge for Basin Modelers."

✓ "Petroleum Systems Modeling – State of the Art and Future Directions."

He will visit western North American groups Nov. 5-16 and eastern North American groups March 18-29.

► The Haas-Pratt Endowment speaker, provided by contributions from the late Merrill W. Haas, in honor of famed geologist (and Haas' mentor) Wallace Pratt. The funding is granted for a lecture of an applied nature dealing with the exploration and discovery history of a field, or a subject having economic implications.

This year's Haas-Pratt speaker is **Richard K. Stoneburner**, president of the North America shale production division of BHP Billiton Petroleum.

His lecture is "The Exploration, Appraisal and Development of Unconventional Reservoirs: A New Approach to Petroleum Geology."

He will visit eastern North American groups Oct. 22-Nov. 2 and western North American groups Jan. 28-Feb. 8.

Other Foundation-funded North American lectures this season include:

served as AAPG president in 1967-68.

This year's Carsey lecturer is **Marek Kacewicz**, research consultant and basin

[See Lectures, page 39](#)

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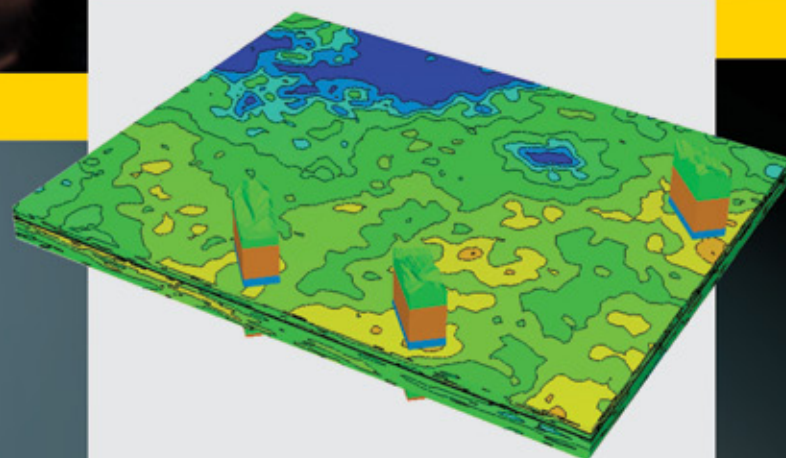



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Abstracts Sought for Pittsburgh ACE

The call for abstracts has been issued for the 2013 AAPG Annual Convention and Exhibition, which will be held May 19-22 in Pittsburgh, Pa.

The event will be held in the David L. Lawrence Convention Center, marking the first time AAPG has tabbed Pittsburgh as its convention locale.

The meeting theme is "Making the Play With Geotechnology," and technical papers and posters are being sought for 12 themes:

- ▶ Global Unconventional Resources.
- ▶ The Appalachian Basin – A Re-Emerging Giant.
- ▶ Emerging Conventional Frontiers.



- ▶ Active Conventional Oil and Gas Fields.
- ▶ Siliciclastics.
- ▶ Carbonates and Evaporites.
- ▶ Energy and the Environment.

- ▶ Analysis of Petroleum Systems.
- ▶ Structural Geology and Neotectonics.

- ▶ Geophysics and Seismology.
- ▶ E&P Technology and Research – the Past and the Future.

- ▶ AAPG and SEPM Student Posters.

Abstracts will be accepted online through Oct. 11. For more detailed information on the themes or on the abstract submission process, go to aapg.org/pittsburgh2013/index.cfm.

REGIONS and SECTIONS

AAPG Making Strides In Diverse Pacific Region

By PETER BAILLIE, President, Asia Pacific Region

AAPG's Asia Pacific Region comprises members living in a geographically large and complex area drawn from the most ethnically and culturally diverse area of the Earth; it includes the "stans" in the west (Uzbekistan, Kazakhstan, Afghanistan), the Indian subcontinent, southeast Asia, north Asia – including China, Korea and Japan – together with Oceania (PNG, Australia, New Zealand).

The region also is home to half of Earth's population with three of the four

most populous countries (China, India and Indonesia; the United States is number three) and seven of the top 12. Economies within the region are heterogeneous; they are mostly emerging markets experiencing rapid growth, the envy of those to the west – we certainly don't suffer from the economic problems currently being endured by the "old" world.

It is certainly fitting that AAPG's next International Conference and Exhibition will be held in the heart of the region this year, at the Marina Bay Sands Convention Complex, Singapore, Sept. 16-19.

An organizing committee has been working with Tulsa staff since 2010 planning the event, and a great technical program (400-plus oral and poster presentations) comprising the latest advances in conventional and unconventional resources has been put together.

The technical program is supported by field trips to some of the classic areas of South East Asian geology (see related story, page 28), short courses and an exhibition displaying industry's latest and greatest.

* * *

In the Region, we are only too aware of our aging membership and are nurturing the wonderful potential resource of our students; the Region has 26 active student chapters, the largest and most active of the whole AAPG.

In this context, it was particularly pleasing to see Khon Kaen University, Thailand, take second prize in this year's Imperial Barrel Award. This effort is even more remarkable given that the students had traveled half way around the world and was the first time they had spoken in public (due to the tyrannies of distance and costs, Asia Pacific finals are held via an online platform).

AAPG is trying hard to increase its profile in the Region. In recent years it has held Geosciences Technology Workshops (GTWs) and short courses in Australia, Indonesia and Singapore – several of these have been in collaboration with sister societies.

AAPG's GTWs deliver up-to-date technical content to members and the industry, and are a flagship product of excellence and one of the things that distinguish us from other societies. Several are in various stages of gestation and we are looking at new locations within the region to hold them. Any help/ideas for new events are warmly welcomed.

A single employee in Singapore, a regional council and an essential cadre of dedicated volunteers serve the members of the vast and disparate Region (see aapg.org/regions/asia_pacific.cfm); more help is urgently needed and we would welcome new faces to take us to new heights.

To volunteer, please contact us through the website, or email Adrienne Pereira in Singapore at apereira@aapg.org.

And don't forget the rapidly approaching ICE. You can find online registration forms and complete details at aapg.org/singapore2012.

See you in Singapore!

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- Admission to the Opening Ceremony and Icebreaker Reception — including a grand introduction to the world of Asian culture, color and excitement
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 - Plenary Session: The Unconventional Resources Energy Revolution — Is Asia Pacific Next?
 - Forum: Discovery Thinking
 - Professor Charles Hutchison Memorial Sessions
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- A chance to network with an international mix of the brightest minds in geosciences
- *Switch*, the new feature-length movie that asks the question: What will it really take to make the transition from oil and coal to alternative energy sources?

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FOUNDATION UPDATE

Funds OK'd for Projects

By NATALIE ADAMS, AAPG Foundation Manager

At the center of the AAPG Foundation is its support of scientific advances in the geosciences and petroleum geology to enable broad availability of geoscience information to professionals and the public, to enhance public awareness of geoscience and energy issues and to provide educational opportunities for students and teachers from K-12 and beyond.

The Foundation accomplishes this each month in a variety of ways, including:

► Funding approvals – The Foundation Trustees recently approved the new 2012-13 fiscal year plan, which includes \$1.4

million in support of a variety of programs.

Funds also were approved for:

- ✓ A web-based video series called the “Geology Kitchen,” now airing on YouTube.
- ✓ Support of the Student Leadership and AAPG Young Professionals Leadership summits, both of which will be held in Tulsa in August in conjunction with this year's Leadership Days conference.
- ✓ AAPG EXPLORER correspondent (and AAPG member) Susan Eaton's upcoming scientific expedition to Antarctica – and the associated outreach and educational program that will follow.
- ✓ The Geology Merit Badge Program at the 2013 Boy Scouts of America National Jamboree.

► Campaign wrap-up – The Foundation's campaign goal of \$35 million was exceeded by over half a million dollars by the end of 2011 – and an additional \$779,025 was received in the first four months of 2012.

Over the course of the campaign, 19,789 gifts were made by 6,748 individual donors. That generosity has enabled the Foundation to increase program endowments, grow existing grants and scholarships, establish new programs and fund new requests for support.

Although the campaign is officially over, we never stop raising funds for the AAPG Foundation. The needs continue, and we hope to continue to build a better foundation for the geosciences.

► Assigning oil and gas interests to the AAPG Foundation is a wonderful way to make a charitable contribution – although not the main reason for giving, contributing a non-operating interest (royalty) in oil and gas property can sometimes provide you with a large charitable contribution deduction.

Bequests are certainly appreciated, but remember that a current contribution can provide you with the satisfaction of seeing your generosity at work.

Contact the Foundation office for details.

* * *

In other news:

► The Foundation Trustee Associates have added some new members to their group. They are:

- ☐ James Henderson, of Dallas.
- ☐ Priscilla Grew, of Lincoln, Neb.
- ☐ Marty Hewitt, of Plano, Texas.

Hewitt will be setting up a Named Grant through the Foundation, and Henderson is using his contribution to increase the General Fund, which is greatly needed. Grew designated support to both funds.


Conversely, the Trustee Associates were saddened at the passing of Sid Bonner, Michael Shearn, Mark Wilson, Stewart Welch and Jimmie Herrington.

For information on the Trustee Associates, visit foundation.aapg.org.

► Finally, many thanks to Devon Energy for making a contribution match available, and also to the Devon employees for taking advantage of those funds by sending in a contribution to be matched.

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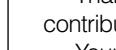
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To these people, and to those who have generously made donations in the past, we sincerely thank you.

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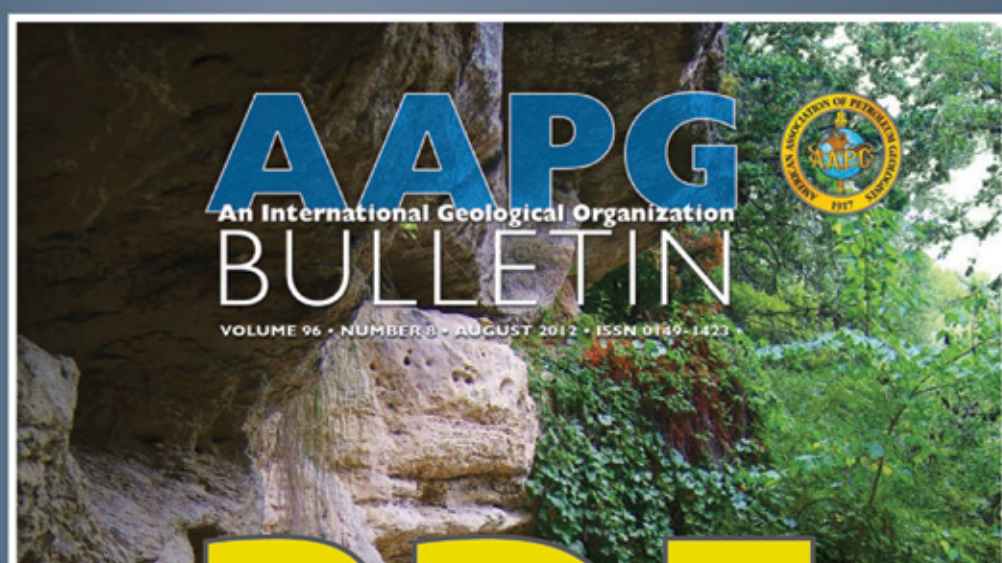
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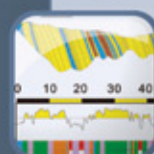


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Article highlights include:

The value of outcrops

Fuge Zou, Roger Slatt, Rodrigo Bastidas, and Benjamin Ramirez



This paper presents an integrated approach to characterization and modeling of deep-water Jackfork Group strata in western Arkansas. These results illustrate the value of three-dimensional outcrop models for reservoir performance simulation of deep-water fields with limited data control.

A shelf-margin succession

Lorena Moscardelli, Lesli J. Wood, and Dallas B. Dunlap



A detailed geomorphological study of the last glacial lowstand shelf-margin system, eastern Trinidad, shows how the characteristics of systems tracts change along strike in the shelf-edge region for time-equivalent units. These changes can be misleading without a complete regional framework.

Two oil charges

Sverre Everre Ohm, Dag A. Karlsen, Nghia T. Phan, Tor Strand, and Gunnar Iversen



The Embla field, Norwegian North Sea, received petroleum at least twice. The flanks have lower permeability due to the presence of biodegraded oil with bitumen. The crest, where the best production occurs, was recharged during the Cretaceous from Upper Jurassic source rocks.

Diagenesis masks properties

Kitty L. Milliken, William L. Esch, Robert M. Reed, and Tongwei Zhang



Mechanical and chemical modifications that occurred across a wide range of burial conditions in the Barnett Shale, Fort Worth Basin, has largely obscured rock texture, fabric, and composition. However, some heterogeneity is apparent from combined petrographic and geochemical analysis.

In Overthrust Settings, Tie, Tie (2-D) Again

By ROB VESTRUM

In the rough terrain of overthrust settings, 2-D seismic data continues to be a standard tool for subsurface mapping – and not only because of economic reasons. Two-D and 3-D seismic surveys are complementary in land environments, because each data type has its own strength and weakness.

Three-D seismic data gives us a three-dimensional image volume of the subsurface, with no out-of-plane energy problems or potential to miss structural details between 2-D profiles. With such limitations in 2-D seismic data, one might argue that a better exploration strategy would be to just shoot 3-D surveys and not bother with 2-D seismic data, which may be getting obsolete.

However, in land seismic acquisition with rough terrain and heavy vegetation, access restrictions make the logistics difficult and expensive to acquire 3-D seismic data with high density. Two-D surveys give us overall higher fold and much higher resolution – and the improved resolution in the shallow section helps us tie surface geology to the subsurface reflectors.

Where 2-D and 3-D data overlap, the 2-D lines can complement the 3-D interpretation with a higher-resolution perspective.



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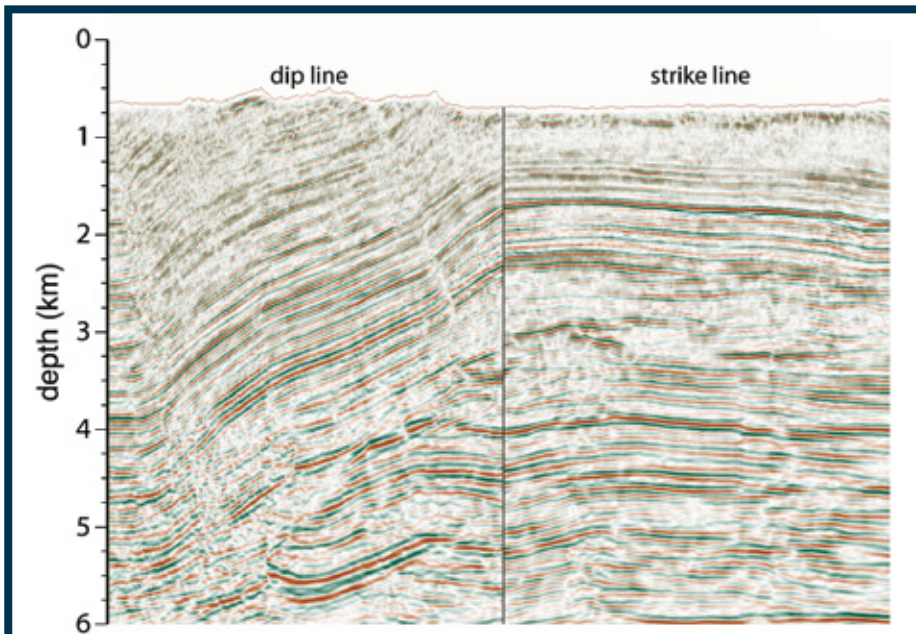


Figure 1 – Correlation between the dip line (left) and strike line (right) at the intersection point represented by the vertical black line in the middle of the figure. Between depths of 3.5 and five kilometers the relatively flat reflectors in the footwall correlate reasonably well, but the dipping reflectors above 3.5 kilometers do not correlate between dip and strike line.

So, for scientific as well as economic reasons, 2-D seismic data will continue to be a mainstay in resource exploration in compressional and transpressional geologic settings.

One of the major pitfalls when interpreting 2-D seismic data is dealing with out-of-plane reflections, especially when trying to tie intersecting lines in structured areas.

Structural geologists and interpretation geophysicists can understand the problem of reflection event correlation across intersecting depth profiles and overcome the difficulty by considering the direction of propagation of seismic energy.

Tying 2-D Profiles in Structure

When processing seismic images in

thrust-belt areas, it is rare that we are able to make a perfect tie between intersecting 2-D lines.

It is possible to manage the mistie in the time shifts and wavelet character differences between lines, but when we have dipping reflectors on our seismic data, the reflection energy will be coming from out of the 2-D plane of acquisition, resulting in a mistie in time that a simple static shift cannot repair.

Figure 1 shows two intersecting depth-migrated lines over a thrust structure in the foothills of the Andes. The left half of the figure shows the dip line. The dips in the overthrust range between 10 degrees and 30 degrees. The right side of the figure is the intersecting strike line.

Note that there is a reasonably good tie between the two lines below 3.5 kilometers depth, where there are relatively flat layers in the footwall. Above the fault (~3.3 kilometers depth at the intersection), the reflectors on the strike line do not line up with the reflectors on the dip line. The layers in the shallow section are dipping, so the reflectors on the strike line are imaged from out of the 2-D plane.

Since we illuminate the reflectors at angles near the bedding-plane normal, if one wanted to correlate these dipping reflectors, then one would need to align the sections along the bedding-normal direction.

Figure 2 shows the improvement in

Continued on next page



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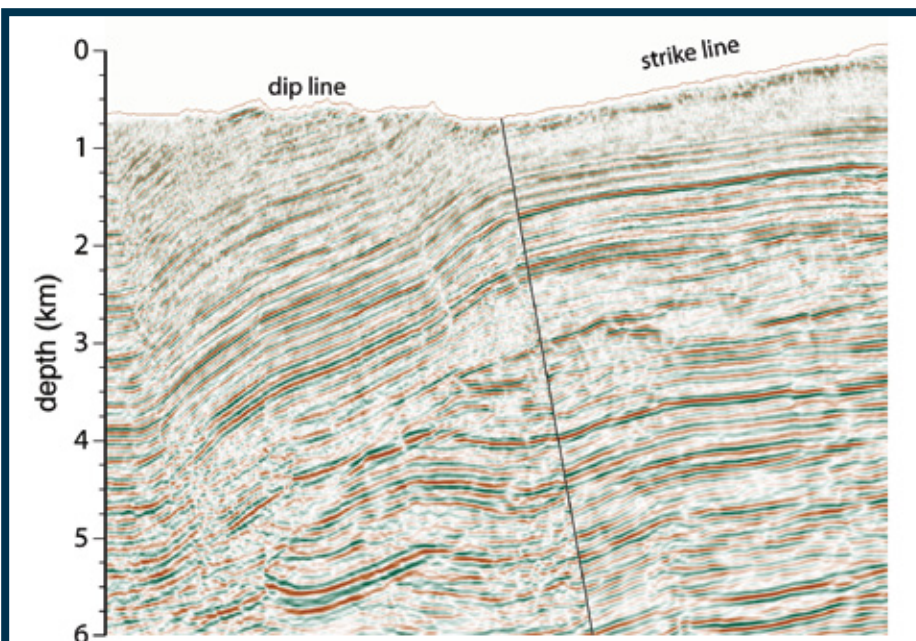


Figure 2 – Correlation between the dip line (left) and strike line (right) when the strike line is aligned normal to the layering above three kilometers. Aligning the orientation of the seismic tie along the direction of energy propagation makes it easier to correlate hanging-wall reflectors between dip and strike lines.

Continued from previous page

reflector alignment in the shallow section if we rotate the strike line 10 degrees counter-clockwise about the intersecting point at the surface. In this orientation, the correlation is along a direction normal to bedding on the dip line.

After the rotation (figure 2), the reflector alignment is significantly improved between dip and strike lines in the hanging wall. The footwall reflectors, which are more flat, do not tie as well in figure 2 as with the vertical tie in figure 1, because the normal-to-bedding direction of these layers is near vertical.

Even though the strike line imaged the subsurface reflector outside of its 2-D plane, we still can correlate the two lines by orienting the strike line in the direction

normal to bedding.

There will still be challenges in creating a 3-D structure map, but at least one may tie the reflectors between lines to ensure consistent mapping over the entire area of 2-D coverage.

Conclusions

When tying 2-D lines in structure, one must not only consider possible differences in static shifts and the phase of the seismic wavelet between intersecting lines, but we also need to consider possible problems with out-of-plane energy.

In reasonably simple geometries with gentle dips, rotating the seismic section at the surface intersection point may simplify the problem of correlating reflectors between dip and strike lines. [E](#)

Lectures from page 30

► **Ronald C. Blakey**, professor emeritus at Northern Arizona University, Flagstaff, Ariz., who will speak on "Using Paleogeographic Maps to Portray Phanerozoic, Geologic and Paleotectonic History of Western North America."

He will be making four tours this season, and his lecture dates are Oct. 8-19 and Feb. 25-29 (eastern North America) and Dec. 3-7 and March 25-29 (western North America).

► **Kathleen M. Marsaglia**, professor in the department of geological sciences at California State University Northridge.

Her lecture is "Chasing Bits and Pieces of New Zealand From Source to Sink: San Provenance Studies in New Zealand Sedimentary Systems and Implications for Hydrocarbon Exploration Across 'Zealandia.'"

Her tour dates are Sept. 10-21 and Oct. 22-Nov. 2 (western), and April 1-12 (eastern).

► **Jeffrey A. May**, retired chief geologist for EOG Resources, who will speak on "Mudrock Reservoirs – Why Depositional Fabric and Sequence Stratigraphic Framework Matter."

His tour dates are Oct. 8-19 (eastern) and April 15-26 (western).

► **Chris Paola**, CSE distinguished

professor at the University of Minnesota, Minneapolis, who will offer two lectures:

✓ "Mass Balance Effects in Depositional Systems."

✓ "Experimental Stratigraphy."

His tour dates are Sept. 24-Oct. 5 (eastern), and March 4-15 (western).

► **Art Saller**, stratigrapher and exploration geologist, Cobalt International Energy, Houston, who offers four lectures:

✓ "Controls on Hydrothermal Dolomites and Their Reservoir Properties."

✓ "Diagenetic Evolution of Porosity in Carbonates During Burial."

✓ "Sequence Stratigraphy of Classic Carbonate Outcrops in West Texas and Southeast New Mexico With Subsurface Analogs."

✓ "Pleistocene Shelf-to-Basin Depositional Systems, Offshore East Kalimantan, Indonesia: Insights Into Deepwater Slope Channels and Fans."

His tour dates are Nov. 5-16 (eastern), and Jan. 14-25 (western)

► **W.C. "Rusty" Riese**, Houston, continues as the AAPG Ethics Lecturer, speaking on "Oil Spills, Ethics and Society: How They Intersect and Where the Responsibilities Reside."

He is available on a request basis.

For more details of the speakers and their topics, or to schedule a lecture date, go online to www.aapg.org/education/dist_lect. [E](#)

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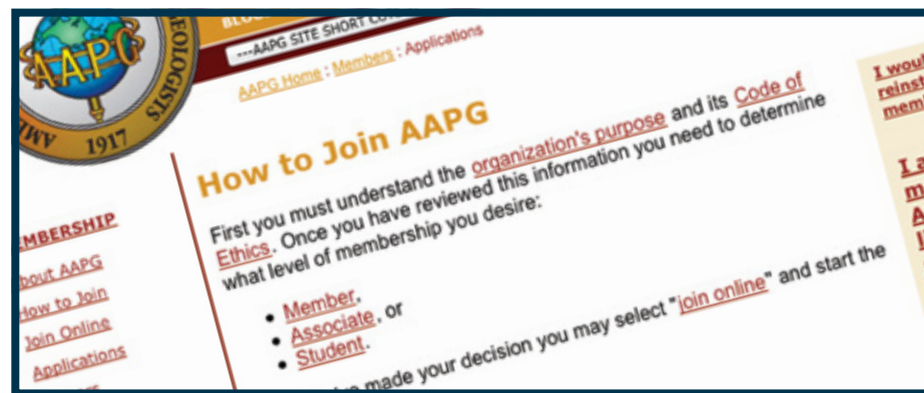

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Application Site Renovated

By JANET BRISTER, AAPG Website Editor

AAPG's online member application site has been renovated – and Member Services is excited about it.

Vicki Beighle, manager of AAPG Member Services Department, says simplification of the membership application process is the new site's best feature.

"It's easy, fast and, unlike previous versions, applicants can remit payment with submission of the form," Beighle said.

"An applicant can save the application in order to complete later," she noted. "It also gives members email feedback about what steps of the process they have completed."

Member applicants can select the graduated dues plan that fits their income. Student applicants can exercise the option of the Chevron sponsorship.

Knowing where applicants are within the processing of their application is an asset. Previously, applicants could wait as long as one month before getting feedback.

Data entry by staff is eliminated, too, as all details go directly into the membership database.

The end result is a quicker completion of the application process.

► The resulting description explains your selection – and if it is correct, click "apply online." If not, hit the back button or click "New Applications" again and make a different selection.

The previous information you provided is carried forward into the full application. Member applicants are asked for education background, work history, the names of three sponsors and graduated dues options. However, if you'd prefer to not enter each of this data, you may upload one document that includes all this information.

Student applicants are asked only for education background details.

At the very end of this page the options of submitting, saving or deleting your application are available.

Once all information is completed, click "submit." At this step you'll be asked for valid credit card details to complete the process.

A confirmation of your submission will be shown on screen and an email is sent with your member number and other details.

Once submitted, you may log back into the system and check the status of your application under the "Submitted Applications" link in the gold navigation bar.

When your application has been accepted you will be notified via email and your status will change in the "Submitted Applications" web page.

Anyone wishing to apply to join the AAPG may use this application process. All start with "New Application" in the gold bar at the top of the Profile Update.

All applicants receive confirmation emails after each submission so be sure to approve "aapg.org" in your email client address book so notifications will land in your Inbox.

Brought to You By ...

Conceiving and instituting these membership processing enhancements required a team effort at HQ; **Brian McBroom**, member services specialist, was tasked with oversight of this project, working closely with AAPG's project manager, **Kerrie Chamberlain**, in AAPG's Information Technology Department.

Their collaborative effort has not only provided a membership application management system that works well for the new applicant, but the behind-the-scenes benefits that speed up the entire application process.

Good browsing!

Next column: Other options for membership application will be reviewed in the new online AAPG Applications Management tool.

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- George Bole



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READERS' FORUM

'American'

Regarding the Readers' Forum letter "Going Global" (July EXPLORER): I am a proud emeritus member of over 50 years with the AAPG.

The AAPG was founded by American geologists in 1917 in the United States of America. I find it extremely offensive to suggest any "shackles" being carried by the word "American" in reference to AAPG's membership. Scientists worldwide, if qualified for membership, can join regardless of race, citizenship, gender, religion or political viewpoint.

I find it even more offensive to say this prestigious organization needs to "shed its American skirt." That's why prospective members want to join this American organization, the AAPG (not the IPGA), in the first place.

I don't know if there is a "lobby that disapproves" of a name change, but as a former member of the AAPG House of Delegates, years ago the proposed name change was voted down. Subsequently, the AAPG added the subtitle to its BULLETIN cover: "An International Geological Organization."

I suppose, according to the writer's reasoning, he also proposes that the Geological Society of America should change its name to the GSI; or that the British Royal Society (BRS founded in 1660) and a global scientific organization should also change its name to the IRS.

Last, but not least, anyone affiliated with the petroleum industry that isn't knowledgeable after 30 years about wells with a "40-acre spacing," or any other "spacing" for that matter, seriously needs a refresher course.

Betty M. Miller
Mt. Pleasant, Mich.

Austin Chalk Redux

Regarding the article "Austin Chalk Getting Another Look" (July EXPLORER): This was a good story, especially for a south Texas resident and ex-Exxon Austin Chalk geologist like me who lived through two Chalk boom and bust cycles.

You didn't provide a link to the U.S. Geological Survey report (cited in the article), so I've attached it here for other interested readers: pubs.usgs.gov/fs/2011/3046/pdf/FS11-3046.pdf.

This is another good link for estimated ultimate recovery from continuous (unconventional) oil and gas resources in the United States, at pubs.usgs.gov/of/2012/1118/OF12-1118.pdf.

Roger Steinberg
Corpus Christi, Texas

Oil Capital of the World

Regarding the July Historical Highlights column on Tulsa's place in the oil industry: I enjoyed the article immensely – but it was a teaser, an appetizer to a full course meal I was hoping to devour. More pictures of the early days of Tulsa becoming the Oil

Capital of the World would have made a nice dessert.

Now seriously, Cleveland – Oil Capital of the World?

I grew up midway between Cleveland, Pittsburgh and Titusville, Pa., graduated from nearby Allegheny College where I did my thesis on one of the local plays, and even participated in drilling several of the shallow oil and gas formations. Having frequented Cleveland in my teenage years, the only oil production I knew of in Cleveland was on the Cuyahoga River, which used to catch on fire and burn down city bridges.

Also, you failed to mention nearby Oil City, home of Pennzoil, Quaker State and Wolf's Head Oil companies.

Todd Knause
Cedar Rapids, Iowa

I certainly enjoyed the article regarding the "Oil Capital of the World."

I began my career in Oklahoma, and lived in Tulsa in the mid-1960s. Tulsa, as with all of Oklahoma, deserves the highest recognition in its deserving place within domestic oil and gas development.

Richard Dalton
Houston

Bible Thoughts

I find it sad that the AAPG EXPLORER keeps publishing letters about the Bible. We all know that there are people who believe the Bible and are petroleum geologists. One doesn't necessarily preclude the other.

The letter by Herbert Howe in July's Readers' Forum is just rehashing an issue that has been discussed since Darwin's "Origin of the Species." It is not going to be resolved. I recall the last series of letters by people who held one side or the other. The amount of vitriol and name-calling was ridiculous.

There are much more pressing issues that can be discussed in the Forum.

Patty Abney
Richardson, Texas

Energy Independence

Our country could be energy independent within five years if we would do these two things:

► First, we need to convert our vehicles to natural gas. This would save 50 percent of our foreign oil.

The Love stores in Oklahoma have natural gas filling stations. The cost of natural gas equivalent is about one-third the cost of gasoline.

The multi-million dollars the "Feds" loan for one ethanol plant would build dozens of natural gas filling stations.

► Second, the "Feds" lifting the ban on 80 percent of our offshore drilling would let our oil companies supply the other half within five years.


Marvin E. Frankamp
Wichita, Kan.

IN MEMORY

Charles Eugene Brown, 86
Graham, Texas, June 24, 2012
Don E. Brown, 84
Tulsa, June 6, 2012
James D. Copen, 87
Casper, Wyo., June 17, 2012
Kenneth Work Germond, 92
Austin, Texas, March 13, 2011
Starr Lanphere, 69
Parks, Ariz., May 25, 2012
Orville Glebe Lundstrom, 95
Houston, Nov. 23, 2011
Robert Hamilton Nanz Jr., 88
Houston, May 20, 2012

Ravindra Prasad Sinha, 74
Mesa, Ariz., April 23, 2012
Francois Tortochaux, 89
Pau, France, July 3, 2011
James Franklin Webb, 64
Houston, March 18, 2012
Ronald E. Wilcox, 81
Friendswood, Texas, Nov. 27, 2010

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



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- Toby Carleton



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2012 WTGS FALL SYMPOSIUM: SEPTEMBER 26-28, 2012

DON'T GET STUCK IN A CONVENTIONAL WORLD

Please plan to attend the 23rd West Texas Geological Society Fall Symposium during the final week of SEPTEMBER. The two and one-half days of technical sessions will feature oral and poster sessions presented by outstanding authors showcasing current research, field studies and other aspects of the Permian Basin and analogous areas. The symposium provides attendees with a chance to network with their peers in a technical setting that also provides opportunities for social interaction.

Keynote: Dr. Scott W. Tinker; Director, Bureau of Economic Geology, University of Texas at Austin.

Some of the Committed topics being presented:

- Hydraulic Fracture Optimization in Unconventional Reservoirs
- Energy Abundance or Energy Crisis; The Political Choices We Make
- Recent Developmental Drilling Successes in the San Andres & Wichita Albany
- Eagle Ford Shale Pore Types & Reservoir Properties from Digital Rock Physics
- Analysis of the U.S. Shale Oil & Gas Supply
- The WolfBone Play in the Southern Delaware Basin
- Primary Migration of Oil/Gas Out of Source Rock Compared to Unconventional Reservoirs Stimulation
- Water, Chemicals, & Fracturing Supplies in West Texas

The Fall Symposium will be held at the Midland Center in downtown Midland, Texas, with *Technical sessions and Poster sessions* taking place on **September 26-27th** with a half day *Core Workshop* on **September 28th**. The symposium will begin at 8:15 am on Wednesday, September 26th with registration beginning at 7:30 a.m. For more information, contact Executive Director, Paula Mitchell at the WTGS office at (432) 683-1573, [wtxgs@wtxgs.org] or General Chairman Jesse White at (432) 688-2467, [jesse_white@kindermorgan.com]. For information on technical sessions, contact Mike Burke at (432) 686-3626, [mike_burke@eogresources.com], Wendell Creech at (432) 894-1612, [wccreech@valverdenenergy.com], or David Osterlund at (432) 682-5241, [davidost@gwdc.com].

An Ethics Luncheon Presentation will take place on Thursday at the Midland Petroleum Club. The presentation will be given by Hermann Eben, founder of "Trim Tab Solutions". This presentation meets the Texas Registration Ethics requirement for Professional Development Hours for Geologists and Engineers.

The Fall Symposium will offer a showing of the documentary "Switch"; a film to build energy awareness, efficiency, and help us move forward together toward a smarter energy future. Presented by Dr. Scott Tinker the film will begin at 7:30pm **Tuesday, September 25th** at *Hollywood Theatre, Midland*. The cost of admission is \$10 ea. and *symposium attendees* may invite guests. Seating is limited to 275 on a "first come, first serve" basis; attendees are urged to 'pick-up' pre-purchased tickets during the regular business hours at the WTGS office at 203 W Wall St., Midland, September 17 – 25. Those tickets not claimed will be available at the Hollywood Theater the evening of the showing.

To register, send completed form with payment to: WTGS P.O. Box 1595, Midland, TX 79702. Credit card payment may be faxed to (432) 686-7827. **Pre-registration and cancellation deadline is September 17, 2012.** A block of rooms has been reserved at the downtown Midland Doubletree, (432) 683-6131. *Remember to ask for the special WTGS Symposium rate which is \$138.* An additional room block is at Country Inns & Suites, (432) 218-7981 located next to the Petroleum Museum; Midland on the West IH-20 service road. *The WTGS Symposium rate is \$160 double & \$170 suite.* We urge all to book early as these room blocks expire 2 weeks prior to the Symposium.

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WTGS Symposium Form 1

EMD from page 43

of the GRF is rich in diagenetic feldspar and dawsonite ($\text{NaAl}(\text{OH})_2\text{CO}_3$), resulting from clay mineral breakdown reactions in the saline lacustrine environment where it formed. The feldspathic mudstone and marlstone are unusual sedimentary rocks (see figure 43).

* * *

The more we look at shale reservoirs, the more complicated it gets (just like sandstone and carbonate reservoirs).

Referring to plays like the Bakken and Eagle Ford as shale oil plays, then correcting that to recognize the

importance of dolomitic and silty rocks of the Middle Member of the Bakken, leaves us with widespread confusion.

I suggest the terms "oil-bearing shale" and "shale-hosted oil" for the rocks on one hand, and products or plays on the other (Allix et al., 2010). These terms clarify that the rock contains oil in accepted form for geologic terminology.

Each formation plotted in figure 1 has been called shale, although the data show many don't fit classical concepts of shale (like Pettijohn's 1975 average shale, highlighted in red) any better than the GRF.

Indeed, in "shale" plays the brittleness needed for hydraulic fracturing comes from low clay mineral content and high framework silicate (Barnett, Monterey) or carbonate (Eagle Ford,

Duverney) mineral content.

Potter, Maynard and DePetris (2005) suggested the term "shale" should be restricted to its original sense of laminated and fissile fine-grained sedimentary rocks (Hoosen, 1747), in line with the word origin from old German and old Norse words for "scale." Shale, as well as traditional mudstone, marlstone and even carbonate mudstone all came from mud, so classing them under the generic name mudstone could be justified.

As for what we can do to define what we mean by shale, I believe a more consistent definition would require a thoughtful effort at consensus within the sedimentary and petroleum geology community. I present a few ideas here, but recognize the significant alteration such a process produces.

* * *

The public, press, financial and industry communities will continue to act like field geologists, and use informal terms. Shale has been an English word for longer than it has been a geologic term. Geologists have to live with that, because we borrow common terms from local languages, rather than creating Latin or Greek terms.

Thinking of the public arena as fieldwork allows us some informality in language.

It is increasingly important for us to engage the public, and in so doing, to consider words and terminology – and their definitions and interpretations – carefully. (*References available at online Explorer*). [E](#)

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DIRECTOR'S CORNER

Managing Seismicity

By DAVID K. CURTISS, AAPG Executive Director

One year ago this month I was sitting in AAPG's GEO-DC office at the American Geosciences Institute in Alexandria, Va., when a 5.8 magnitude earthquake rocked the state. It was the strongest earthquake I had ever experienced. And in a region unaccustomed to feeling such tremors many wondered if hydraulic fracturing, which was dominating headlines at the time, may have been responsible for the quake.

Fast-forward to earlier this year when I experience several earthquakes and aftershocks in Tulsa. These, too, triggered a lively debate in the media about whether they were related to hydraulic fracturing or other oil and natural gas activities.

Getting to the heart of whether energy production triggers seismic activity is the subject of a new study, titled "Induced Seismicity Potential in Energy Technologies," released in June by the National Research Council.

The report focuses on four technologies:

- Geothermal energy.
- Carbon capture and storage (CCS).
- Conventional oil and gas, including enhanced oil recovery.
- Unconventional oil and gas development, such as shale gas, requiring hydraulic fracturing.

The National Research Council is the operating arm of the U.S. National Academies of Science and Engineering, and the Institute of Medicine. And it was commissioned to conduct this study by the U.S. Department of Energy (DOE) after a request from Sen. Jeff Bingaman (D-N.M.), chair of the Senate Energy and Natural Resources Committee.

In his letter to Energy Secretary Steven Chu, Bingaman noted that "much public opposition to the deployment of advanced energy technologies in the United States stems from a lack of clear, trusted information regarding the safety



CURTISS

The risks of inducing seismic activity, particularly from oil and natural gas activities, are low and manageable.

of those new energy facilities for the local communities that are their neighbors. A National Academies study can provide information to these concerned communities ..."

The NRC assembled a diverse group of talented and experienced scientists and engineers chaired by Murray Hitzman of the Colorado School of Mines, an AAPG member. Other AAPG members on the committee were Don Clarke and Julie Schmeta.

As the study noted, "Since the 1920s we have recognized that pumping fluids into or out of the Earth has the potential to cause seismic events that can be felt."

Thus, the study committee's charge was to look at geothermal, carbon storage, and oil and natural gas technologies to determine the likelihood of these inducing seismic events – but also to identify knowledge gaps and areas of additional scientific research that would be helpful in managing any risks associated with these activities.

The report lists three major findings:

- The process of hydraulic fracturing a well as presently implemented for shale gas recovery does not pose a high risk for inducing felt seismic events.

- Injection for disposal of waste water derived from energy technologies into the subsurface does pose some risk for

induced seismicity, but very few events have been documented over the past several decades relative to the large number of disposal wells in operation.

- CCS, due to the large volumes of injected fluids, may have potential for inducing larger seismic events.

According to the report a principal driver of induced seismicity is the volume of fluid extracted or injected into the subsurface and the resulting effect on pore fluid pressure and/or changes in stress regimes in the rocks and around fault zones. When these volumes are roughly balanced the likelihood of triggering seismic activity appears to be lower.

Waste water disposal wells are typically designed to inject into formations with porosity and permeability sufficient to accept large volumes of fluid. So, while there have been several documented cases of induced seismicity related to waste water disposal, the probability of occurrence is low.

Fluid balance is important in geothermal wells, as well. Another factor affecting these wells is the potential for the difference in temperature between the injected fluids and rock to cause contraction and triggering seismic activity. As an example, this has been documented in The Geysers geothermal field in California.

Large-scale injection of super critical

CO₂ over an extended period has not occurred in either the research CCS projects conducted in the United States or the commercial CCS projects overseas. As a result there is insufficient knowledge of its potential to induce seismicity.

The difficulty in predicting induced seismicity is twofold:

- First, we are dealing with complex natural geological systems and, frequently, a lack of fundamental geological data needed to adequately understand these systems.

- Second, we do not have risk assessment models that have been sufficiently validated to be useful tools.

But these models and methodologies can be developed. And the committee urges both increased government cooperation at the federal and state level, as well as an ongoing learning process as energy development progresses resulting in a "best practices protocol" for each energy technology. In fact, they point to a protocol developed by DOE for engineered geothermal systems as a useful template.

Our understanding of the natural systems where we find and produce the energy needed to power modern life improves as we explore and produce. And as the NRC report indicates, the risks of inducing seismic activity, particularly from oil and natural gas activities, are low and manageable.

The complete report is available for download at the National Academies website (www.nas.edu).

David K. Curtiss

DIVISIONS REPORT

Common Wording vs. Historical Terminology

By JEREMY BOAK, EMD President-Elect

For more than 100 years, shale oil has referred to the product of pyrolysis of oil shale, whereas oil shale refers to organic rich (kerogen) rock that has never reached the oil window.

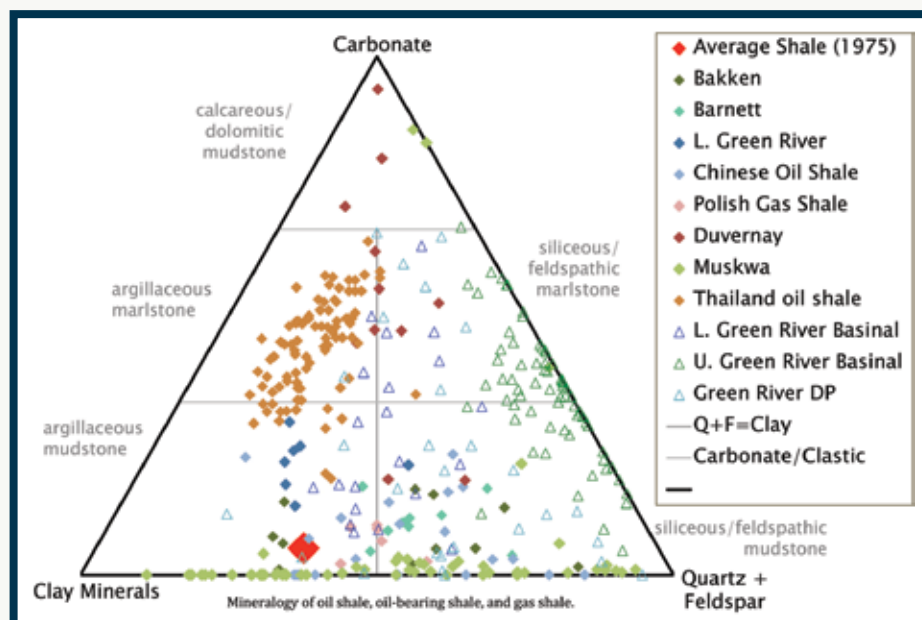
The oil shale industry, operating since the 1850s producing shale oil and electric power, never achieved the size of the petroleum industry – but this does not give the larger industry the right to expropriate the technical term.

Is oil shale a misnomer because the rock does not contain oil and is not shale? Wine grapes contain no wine, but are still wine grapes.

The connotative flexibility of English is why we have so much great poetry and so many lawyers. The language does not care whether oil shale describes a rock that yields liquid hydrocarbons upon being heated in a technologically



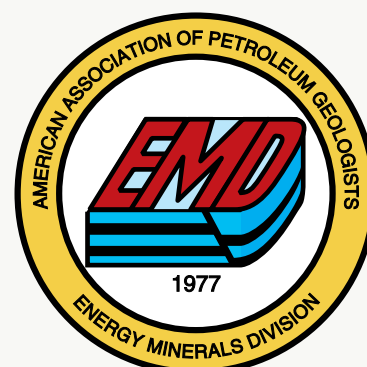
BOAK



complex process, or one that yields liquid hydrocarbons upon being fractured in a technologically complex process.

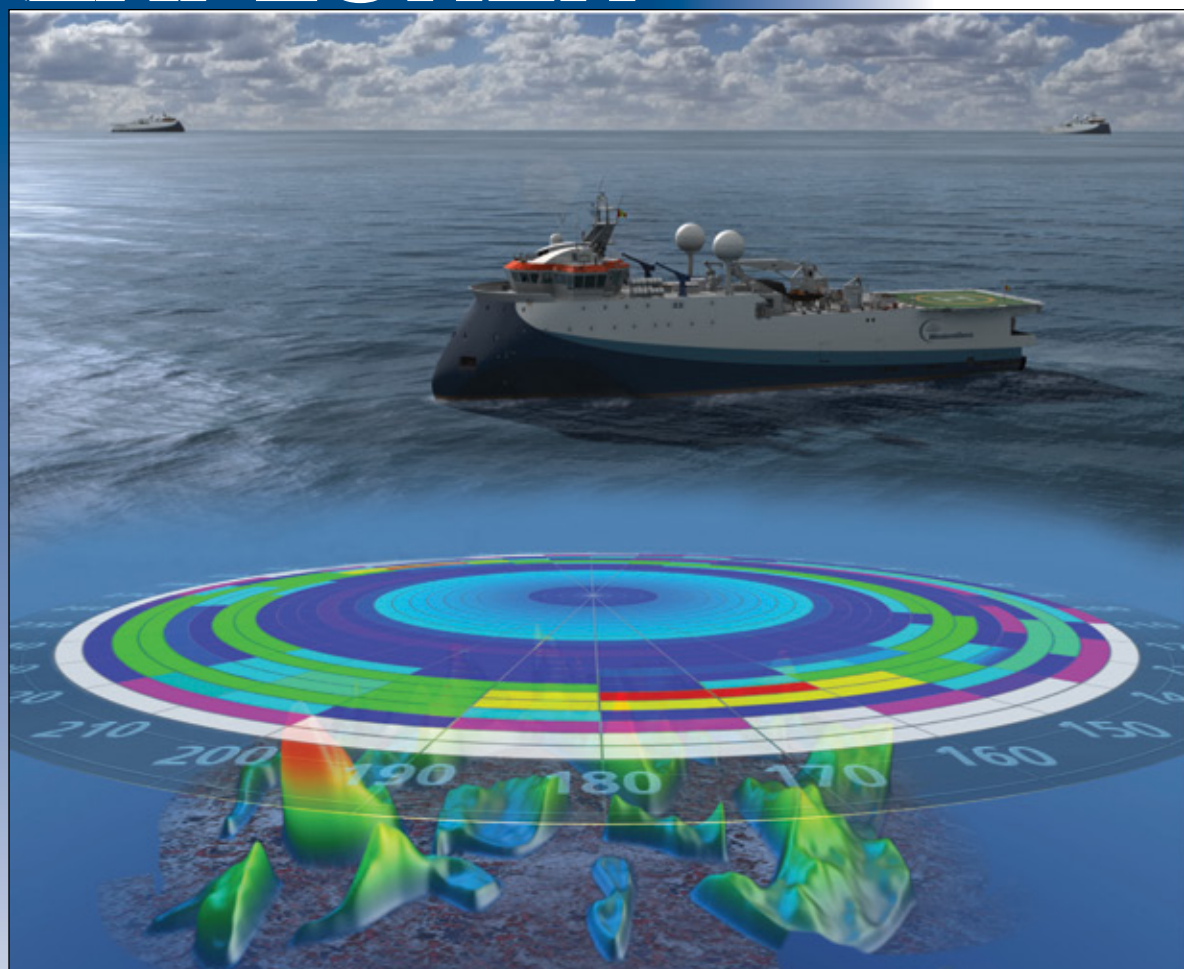
Is the rock properly termed a marl or marlstone – an assertion rarely

accompanied by data? In industry we too easily refer to lithified sandstone bodies as sands, and marlstones as marls. Marl is a term for sediment, not sedimentary rock, and oil shale is lithified.

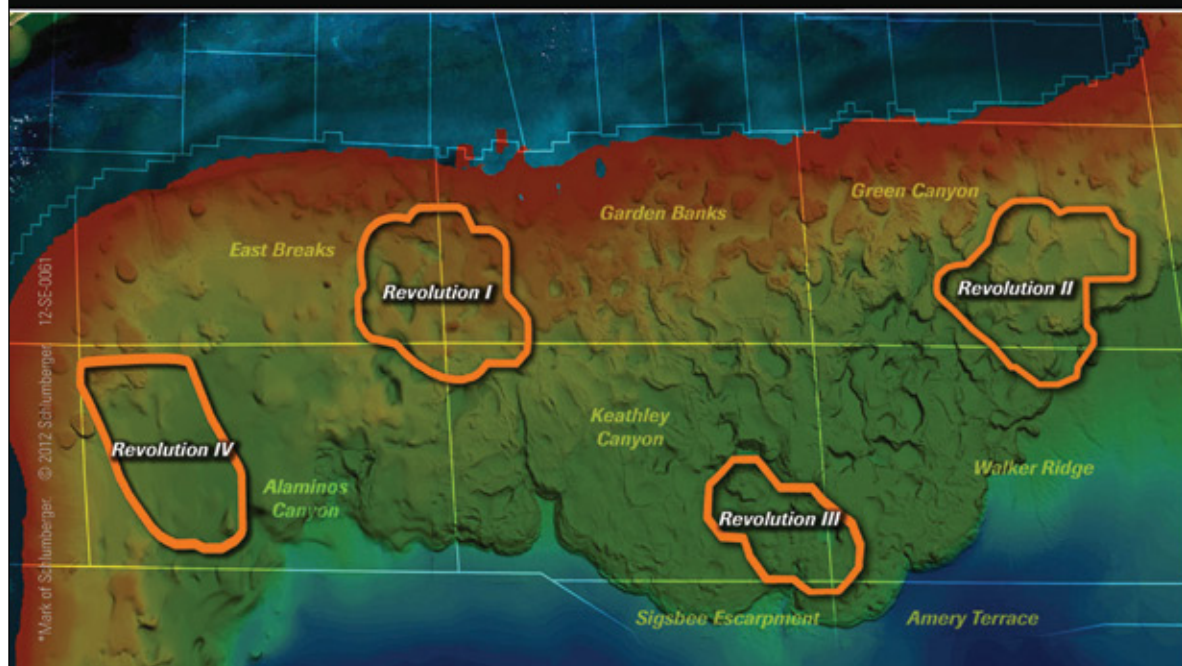
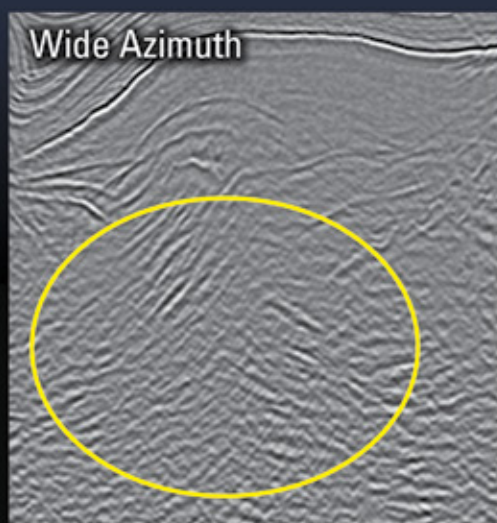


The Mahogany zone of the Green River Formation (GRF), one target in the richest, largest, most famous oil shale deposit, has low clay content. However, the Garden Gulch Member, being tested by American Shale Oil (AMSO) in Colorado, is clay-rich, laminated, and fine-grained – perfectly good shale. Other oil shale deposits contain substantial clay. The clay-poor oil shale

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