AAPG AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, AN INTERNATIONAL ORGANIZATION

EXPLORER

APRIL 2002

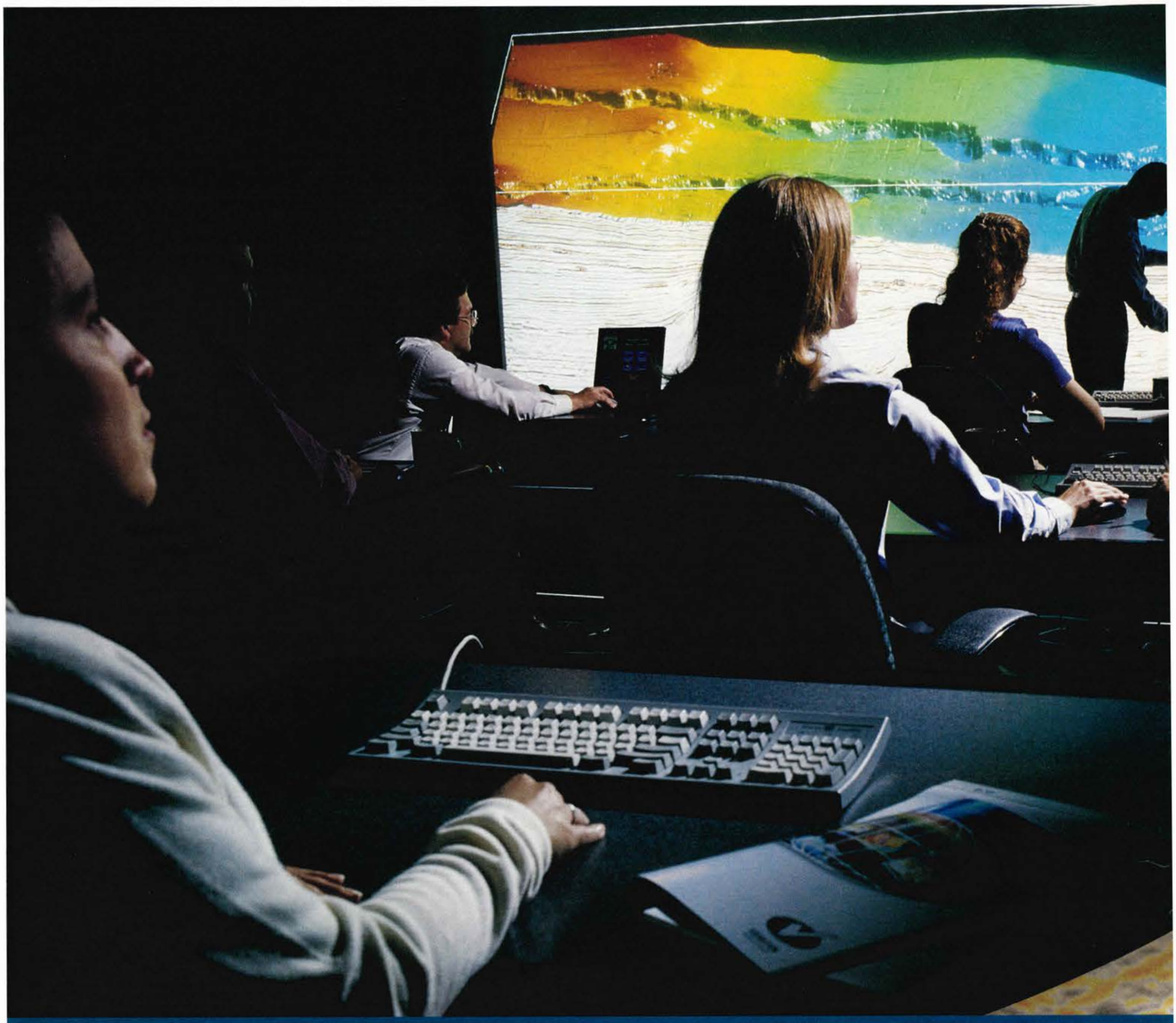
Something of Value

To Many People ...
But In Many Ways

See page 6

Vol. 23, No. 4
April 2002

AAPG EXPLORER



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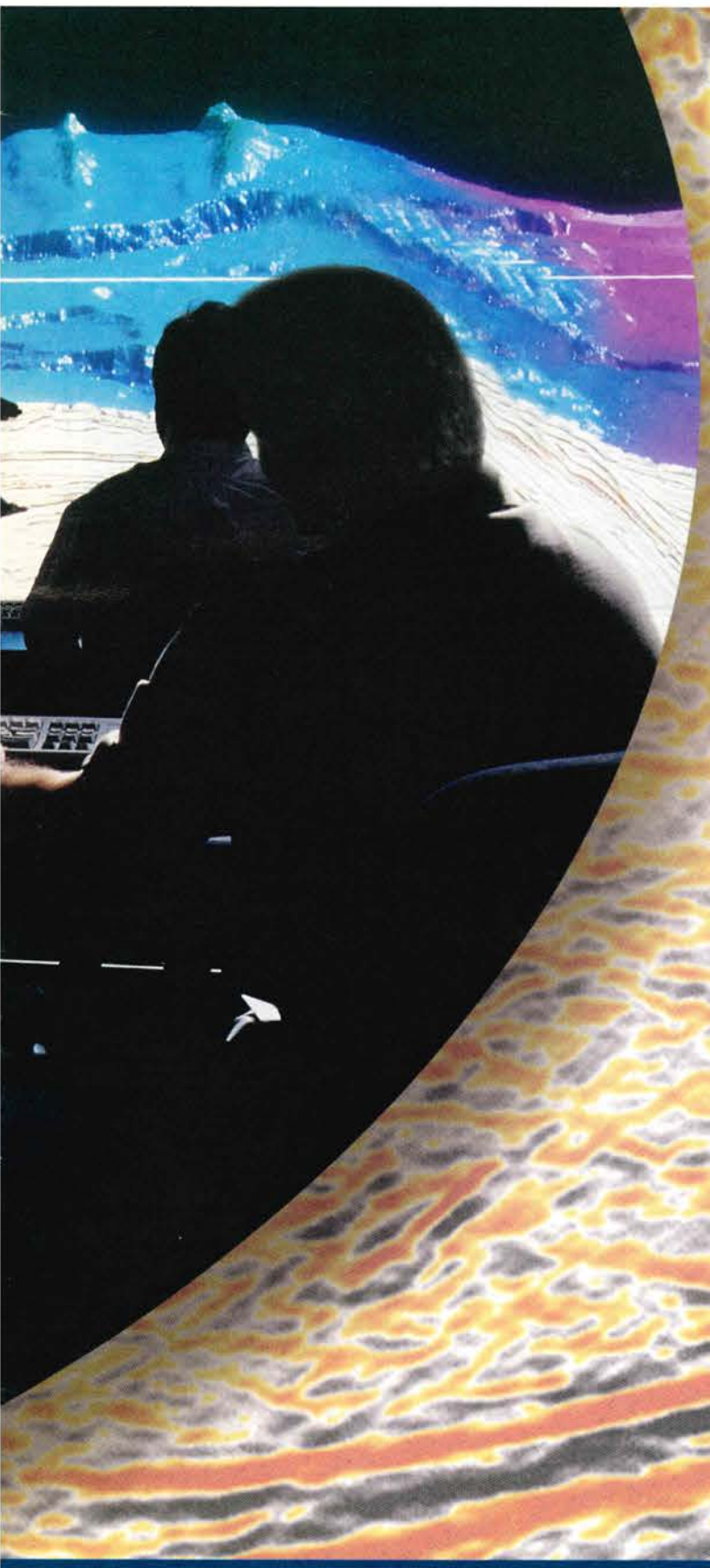

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Geophysical Integrity

On the cover: Exploration on federal lands is becoming a hot topic in the United States, often because regulations and the permitting process require companies to follow a time-consuming, detailed process before work can begin. Another issue: The lands are valuable to people who have very different opinions on land use issues. See story on page 6. The cover photo shows South Fork of Mill Creek, near Moab, Utah. Photo by Jerry Sintz, courtesy of the Bureau of Land Management.

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PRESIDENT'S COLUMN

Are We Ethical Wimps? Or Just Prudent?

By ROBBIE GRIES

The Enron case is a major ethical wake-up call for our industry. Meanwhile AAPG has been struggling with its commitment to the Code of Ethics for several years.

We want to be resolute and reputable with our commitment to ethics – but we also contend with living in a highly litigious world.

We may be at a crossroad and need to decide if we will do what is necessary to make the Code of Ethics meaningful, or if we should just scrap it.

If we decide to keep our Code of Ethics, we need to practice it, teach it and enforce it.

Gries

Practice It!

By committing to practice it, we individually must adhere to this code, and we especially need to set this standard within and for our companies – because individuals do set the standards for companies.

As individuals, daunting of a task as it is, we would have to commit to filing complaints when they are truly valid, especially when doing so can protect others from similar harm. And we have to develop the wisdom NOT to file personal and frivolous suits. A grievance MUST be absolutely provable, or it wastes everyone's time – and makes the plaintiff the fool.

I am as guilty as the next person in not filing grievances, not wanting to get sidetracked from what I love to do and be forced to do what I despise – becoming embroiled in a legal dispute.

From my own experience, I expect we are just not bothering. Why? Well, like me, many may just not want to mess with the hassle. Like most people in this industry, I have had my share of dishonest encounters. I have declined the fight because I didn't wish to endure the financial and emotional expense.

Some have declined the fight because they don't have any confidence that AAPG can deliver on our Code.

Let's Teach It!

Did you have an ethics class in your university program? Does your alma mater offer one now?

I will never forget the great Edgar Owen, author of the *Trek of the Oil Finders* (AAPG Memoir 6), teaching ethics at The University of Texas at Austin when I was a student. His words are indelibly burned into my memory.

Wouldn't it be a step forward if every petroleum geology curriculum taught professional ethics?

Most companies do publish their ethical expectations. But wouldn't it be more effective if they provided regular instruction on ethical behaviors AS DEFINED by that company. This is more important because we have so many multi-national, multi-cultural companies today. We cannot assume that people of every culture in the world define ethical behavior consistently. No culture has a monopoly on the best definition of ethics.

Therefore it is incumbent upon a company to state policies and to teach employees with examples demonstrating their expectations.

And I believe AAPG could offer a service by creating classes and visiting lectures on ethics, so that within our organization the message is clear and our expectations are unambiguous.

And Let's Enforce It!

Our Ethics Committee, our Advisory Council and our Executive Committee all play a role in this enforcement. We will have to be more resolute, and painstakingly careful.

And we must be protected in this effort. If these three bodies are asked to stand up to uphold AAPG's standards, they must be insured against litigation – because it WILL happen! And it could happen often.

This means making a financial commitment with AAPG's budget. Legal battles cost money, cost time and cost emotional toil.

Are we ready to invest our dues this way?

If not, then we cannot expect geologists to volunteer their time making these difficult decisions while risking their own financial and mental wellbeing.

Or ... Should We Scrap It?

So maybe we decide it is asking too much. Maybe we decide AAPG cannot uphold the Code of Ethics. Maybe we don't want to spend our time and association money that way. Maybe we would rather spend time doing geology, finding oil and gas and reading a new technical paper.

Is it more prudent to acknowledge the cost is too high, the goods are not deliverable?

This is an important decision for all members to think about and to voice their preference.

Are you willing for a portion of your dues to be dedicated for ethics enforcement?

Are you willing to stick YOUR neck out?

Willing to serve the association by being on an Ethics Committee?

Robbie Gries

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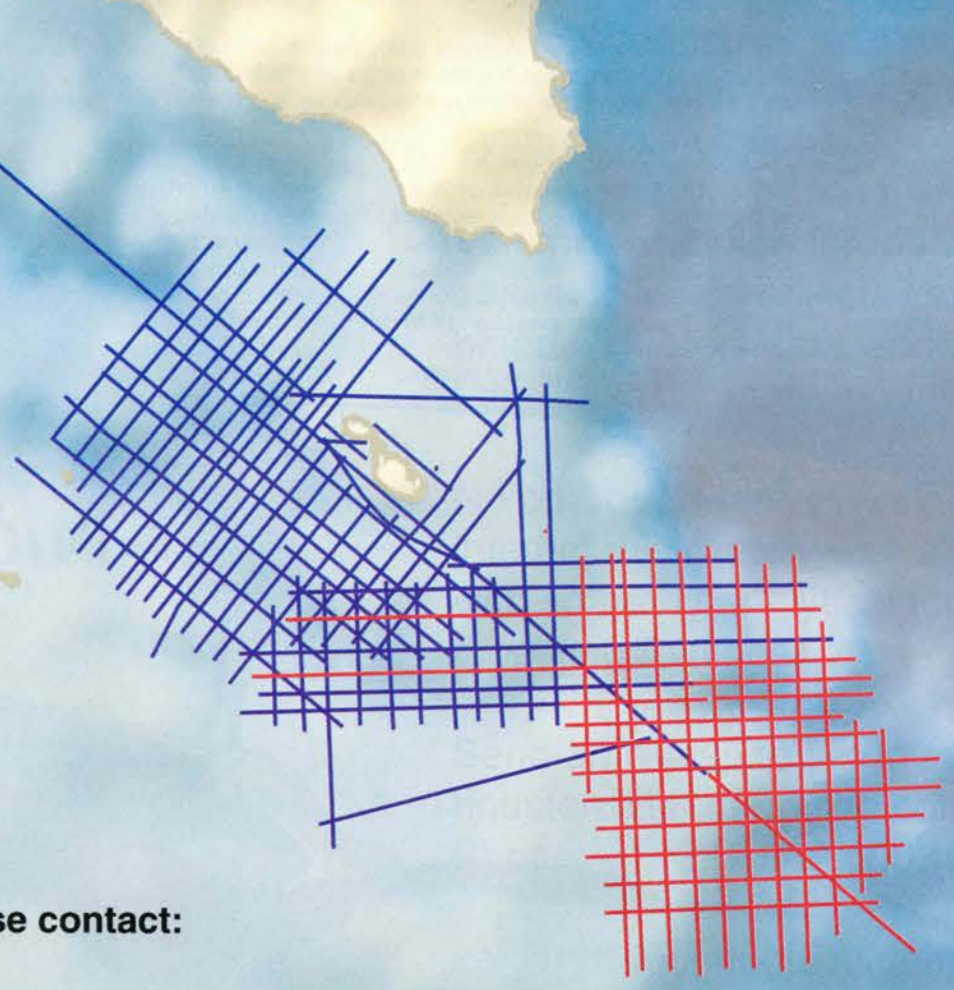

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Exploration Window Narrows

'Traffic' Jams Seismic Permits

By DIANE FREEMAN
EXPLORER Correspondent

Future regulations, an increasingly important and time-intensive step in seismic exploration – particularly on federal lands – could make Rocky Mountain projects a seasonal business, says a geophysical advisor with WesternGeco in Denver.

Stuart Wright told the Rocky Mountain Association of Geologists at its annual 3-D seismic symposium to plan well in advance when trying to obtain a federal permit for a seismic survey.

Wright, one of several speakers at the RMAG's annual symposium in Denver, made his remarks just days before a headline-grabbing action halted a seismic operation – involving his company – just outside of Arches National Park in Utah.

In late February, an Interior Department appeals officer halted oil exploration near Arches, saying the project could cause irreparable harm to the area.

The action came after environmentalists blamed the Bush administration for inadequate environmental studies.

The seismic operation was going on a few miles from the northern border of Arches, outside the area being proposed as a wilderness area. Arches is a 76,518-acre preserve famed for its 2,000 arches and other geologic marvels carved by wind and water from sheer red sandstone cliffs.

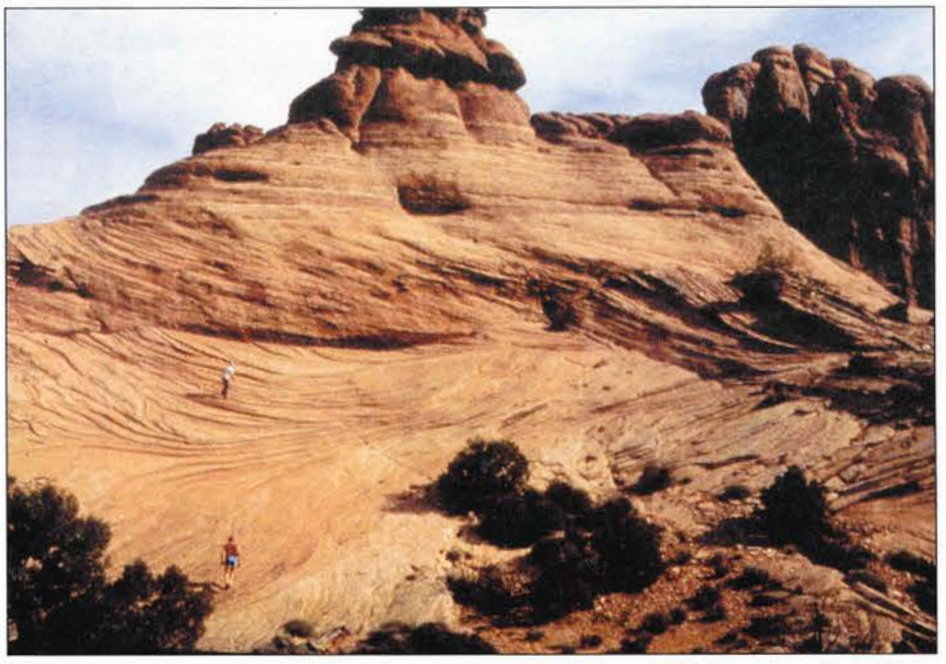


Photo courtesy of John Balsley

The American West is attractive to many people, for many reasons – and its popularity and value to many groups are two reasons why federal permits allowing exploration are an increasingly time-intensive effort. Above, a scene from Arches National Park.

Officials for the Bureau of Land Management, however, said they had taken the concerns of those who question the project into account before activity began. The BLM now plans to provide the Interior's Board of Land Appeals with additional information justifying the project, said Utah BLM spokesman Don Banks.

The WesternGeco project involves several seismic trucks driving across the desert. Among the objections raised were concerns that the traffic could destroy a thin crust of bacteria that forms over the desert soil and prevents erosion and weed growth.

It would take up to 300 years for that crust to regenerate, the USGS said.

Because of the stoppage, WesternGeco was facing the prospect of starting the project from scratch in the late summer.

The area may be a nesting habitat for the threatened Mexican Spotted Owl.

'Tis the Season

Wright's remarks, in retrospect, seemed to anticipate the delay at Arches, as he reminded the RMAG symposium crowd that a small window for seismic activity remains open between August to mid-November.

"There is much time involved in the permitting process," he said. "You need to know how it can affect your cycle time rendering it profitable or unprofitable."

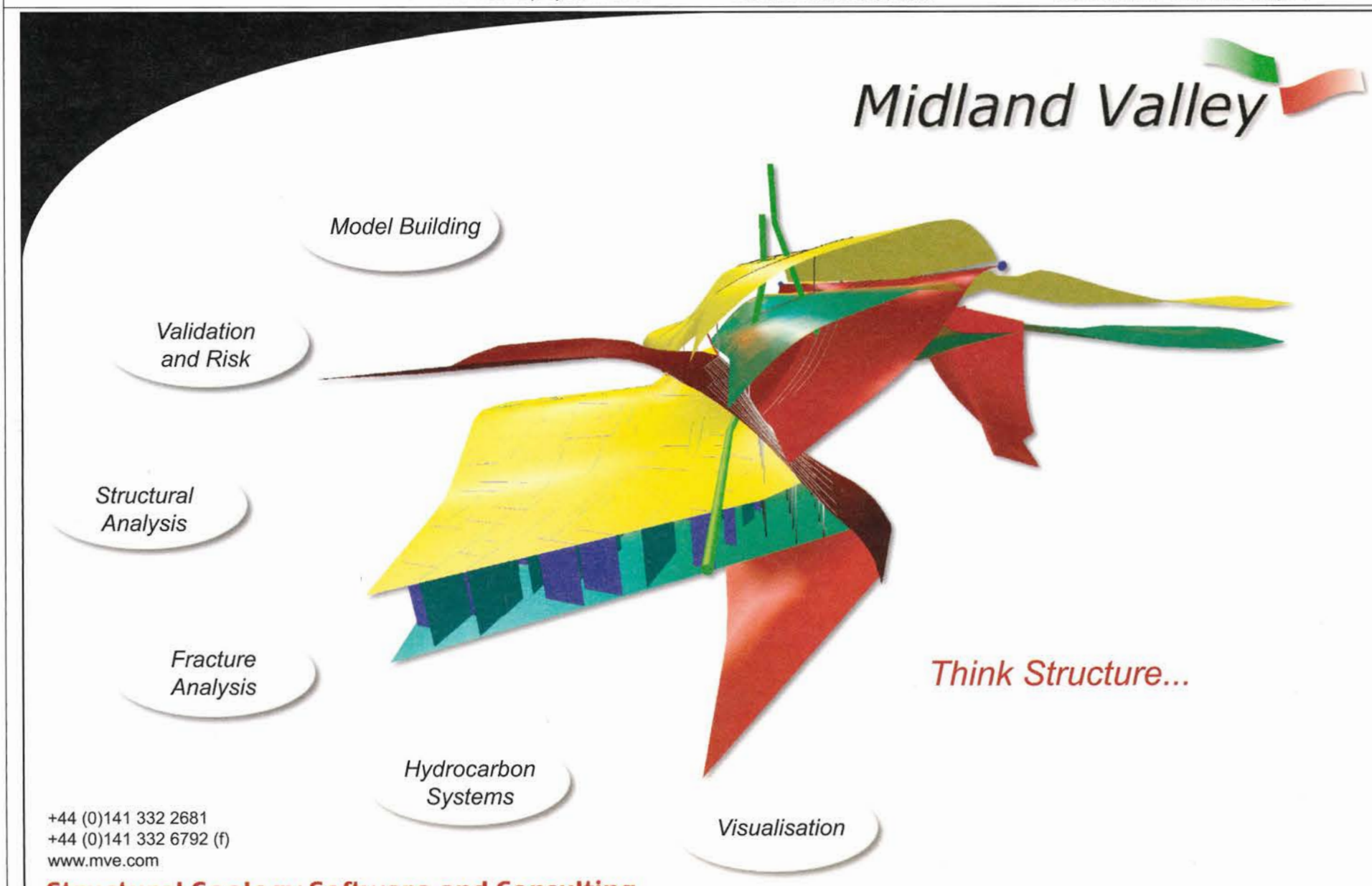
Vehicle traffic from the seismic shooting process is one of the biggest factors in the argument against granting permits on federal lands, he said.

If the prospective area happens to fall within a national park, national monument, wilderness area, wilderness study area or other less common areas of special consideration, projects are automatically subject to regulatory review, Wright said.

Land controlled by the BLM, U.S. Forest Service or state administered property, may be subject to other factors that may influence exploration activity, he added.

He told the organization that they should expect it to take 90 to 120 days to obtain a federal permit for seismic on

See **Seismic Permits**, page 9



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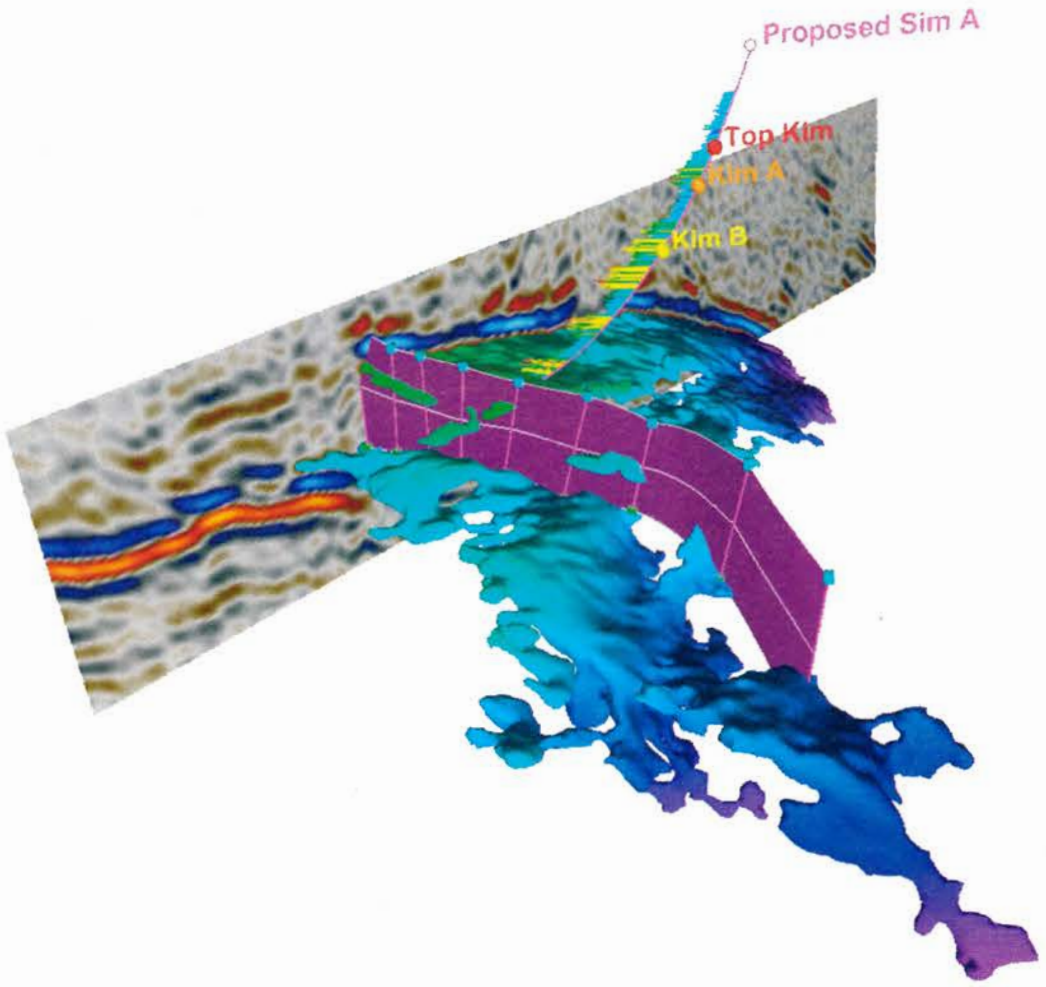

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Data Combined

Digits Improve Business Decisions

By DIANE FREEMAN
EXPLORER Correspondent

Money talks.

And if you want to make your money to talk faster, louder and longer, take a look at who's listening – especially those of you who need funding for your next project.

And then take a look at today's newest technology.

That's the advice of Bill Keach, a research geophysicist with Landmark Graphics, who was the keynote speaker at the recent 3-D Seismic Symposium sponsored by the Rocky Mountain Association of Geologists, an annual one-day event in Denver that draws geologists from around the country.

Keach said that geologists can make better economic decisions by combining 3-D seismic data with reservoir simulation – and he added that now more than ever, geologists need to compete for capital from the market and from other industries.

"Every process must improve technology," he said. "We've replaced the head count in the industry with better technology and a better knowledge base."

With technological data, he reasoned, geologists can dismiss bad well prospects faster while keeping the good ones.

Of course, Keach's message is old news to many young interpreters, many of whom already appear enthusiastic about digitized data.

But many "older ones" tend to still work with paper – sometimes defiantly.

With digitized data, Keach said, geologists can do better science in a shorter time to make a better economic decision.

He noted that about 60 percent of the human brain is devoted to the visual process – a big impact on the use of 3-D visualization, he said.

Keach noted that accurate reservoir characterization and delineation are critical to the success of a project.

"Recent advances in seismic resolution mean that seismic data can be used to directly estimate reservoir properties," he said.

At the same time, rapid advances in software and hardware development have enabled new work flows for geoscientists. In fact, the traditional interpretation methods of line by line picking can be bypassed altogether, he said.

Examples of Success

Nick Purday, Keach's Landmark Graphics colleague, described a case study of a Devonian Reef play in the Western Canadian Sedimentary Basin to the group.

He said a company had analyzed a reservoir to locate oil and gas deposits, where there were approximately 162 million barrels of oil and gas in place in this field.

The company merged its 3-D data with well data.

"Now they are able to image porosity on the seismic data," he said. "They went back to the original well data and built cross sections throughout the entire field."

With all this data, they were able to build up quite a complex picture to help understand the risks they faced, he said.

Purday showed the group a slide presentation of the reef structure and encouraged them to view it as if it were an Excel spreadsheet; he noted that geocellular models can look great but they don't really prove anything until they are put through a simulation.

Best yet, the cost of integration for this project was insignificant compared to the data acquisition and the value generated, he said.

A second case study included a field with several big faults and a large gas cap. The field contained more than 100 million barrels of oil and had been inactive for 20 years. However, there was no gas market in this particular part of the world.

"The challenge was to drill horizontal wells into the oil leg so that wells do not cone out," he said. "They must be accurately mapped."

The operator needed to build a detailed geometric model to see where the oil legs were, he said, and it did so by combining 3-D seismic and good well data.

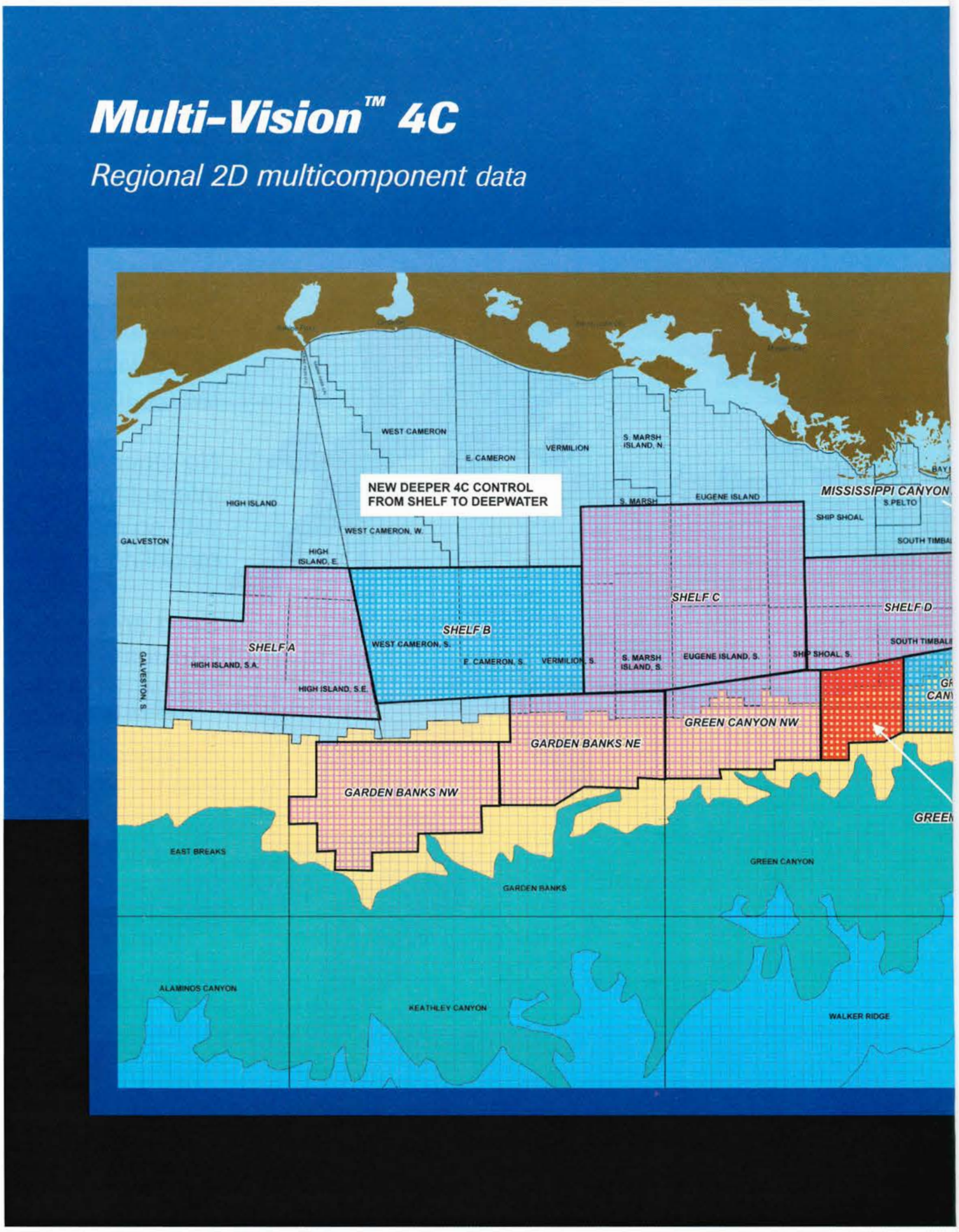
"The result was that every well was successful," he said, "and all wells were within a five-feet prediction."

This type of successful well planning eliminated costly sidetracks, Keach said, and resulted in an efficient and profitable production.

In a third study, scientists built a geocellular reservoir model to determine if a horizontal or a vertical well would be more practical.

A geologic model can be tested through reservoir simulation to test multiple drilling and economic scenarios, he said – and combining simulations is exactly what allows geologists to use science to make better business decisions.

And that helps those with the money to hear so much better. ❑



Seismic Permits

from page 6

BLM land and an additional 15-40 days for actual acquisition of data from a 20-square-mile survey.

In Wyoming alone, 31 million acres – half the land in the state – is federally controlled.

In all, it takes about 137 days – four to five months – to obtain federal permits, he said. And that is an optimistic estimate.

Then there is a brief window in August and September when companies are allowed to shoot seismic.

"We're heading toward a seasonal period where we can only shoot when the tundra is not frozen," he said. "The only activity is in the late summer and early fall when crews will work."

A seismic crew member at work in Utah near Arches National Park – a project that was halted in late February after questions that the operation may harm the environment.

Photo courtesy of WesternGeco

And Don't Forget ...

Other timing factors also come into play, he noted.

✓ The Bureau of Land Management will not approve seismic surveys unless there is no activity on the winter range. Although it is dependent on the weather, these restrictions could preclude seismic activities from mid-November to late April.

Even if it's not a particularly harsh winter, it may be difficult to obtain a permit, Wright said.

✓ The window of opportunity gets even smaller because of raptor nesting like those of the red tail hawk, which could halt seismic operations from February through July.

✓ The time restriction imposed for sage grouse strutting is the same as for raptor nesting, he said, but the avoidance distances are usually much greater.

✓ Elf calving restrictions are imposed from May 1 to June 30.

✓ Hunting season may also cut into the window of time – and, generally, hunting seasons are most common in the autumn.

"To date, they haven't restricted a lot of seismic because of that," Wright said, "but it's headed our way. It's already happening in California."

Wright remarked that in California crews cannot shoot seismic when ducks are nesting and they can't shoot when hunters are out hunting the ducks, either.

"The weather is a big potential problem because of the archaeological requirement," he said. If there is snow cover, archaeological elements may not be obvious.

"That's not an uncommon thing in the West," he added.

The Waiting Game

He said the four to five months of time required to obtain federal permits is optimistic at best and can slow down at various stages.

He described the procedure to acquire a federal permit to shoot 3-D on a 20-square-mile property on lands administered by the BLM.

❒ First, there is a seven-day process to file a notice of intent to obtain federal permission to proceed with surveying. The survey itself can take about 24 days, he said.

❒ Next, there is a 17-day biological survey, which can overlap the earlier survey. If required, biologists will examine the area for plant and animal species. That could include all organisms that are considered threatened or endangered.

❒ The archaeology survey, one of the major steps in the process, can take from five to seven weeks.

Archaeologists must analyze all vehicle travel paths and delineate site avoidance routes.

❒ Next, there is usually a 30-day review by the state's Historic Preservation Office.

"You may have to submit a report to the Indian tribes in the area," he said, which could delay the process an additional 30 days.

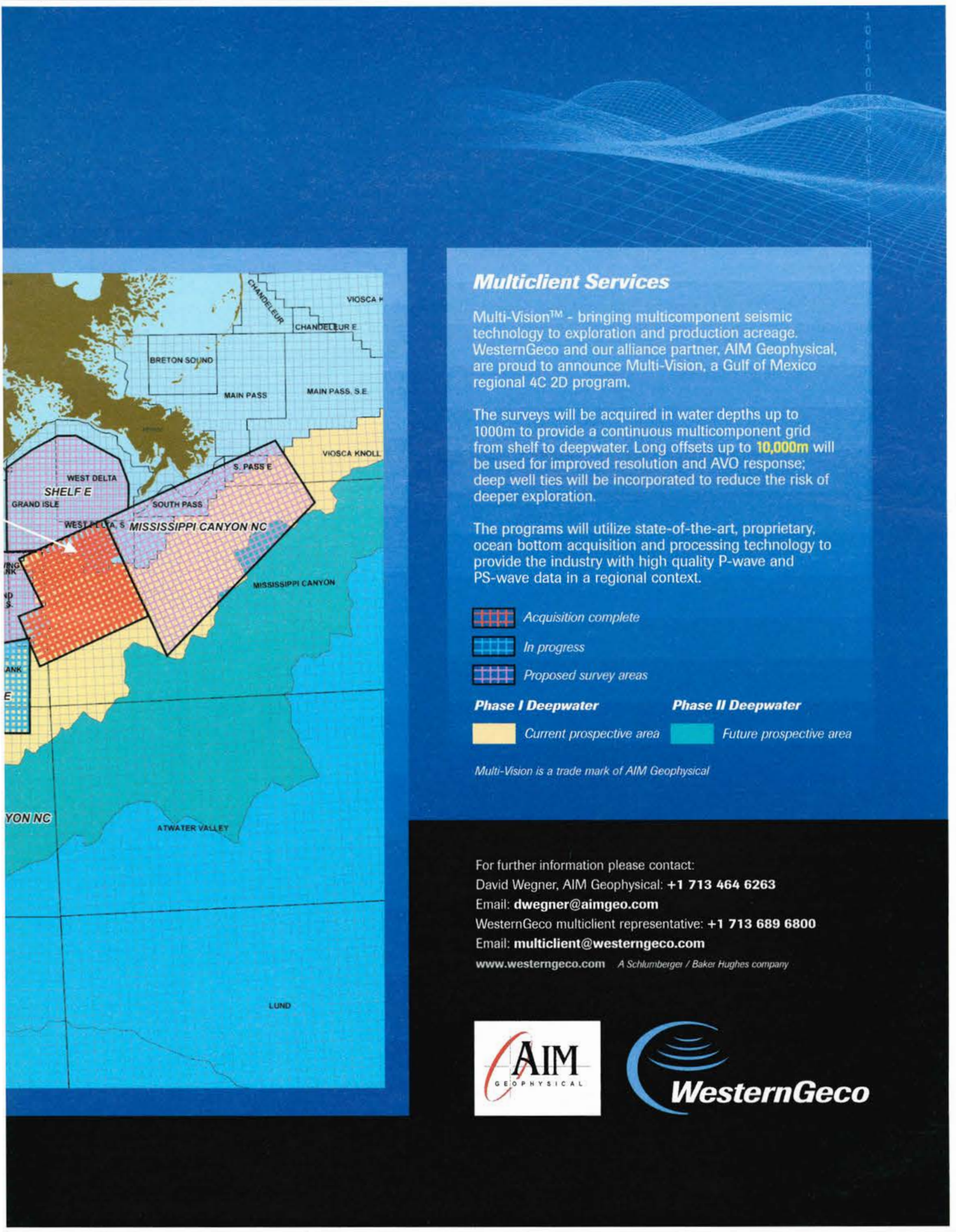
❒ Following that is a 30-day public comment period. Special interest groups may submit comments on the last day of the public comment period to draw out the procedure, he said.

Noting the WesternGeco seismic shoot near Arches, Wright talked about how groups were trying to stop it from proceeding.

"Seismic isn't the problem," he said, "but (some) know it's the first step to drilling."

❒ Finally, it takes another 20 days for data acquisition, he said.

When towns, railroads, interstate highways, topographic barriers and private landowners are considered, the process for acquiring seismic data on federal lands can become even more complicated, he said. ❑



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Phase 4W	8,200m streamer Kirchhoff PSTM	112 blocks (Acquisition 80% complete)
Phase GB-HR	9,000m streamer PSTM 25m X-line!	317 blocks (In progress)
Phase MC-AT	8,000m streamer PSTM	171 blocks (In progress)
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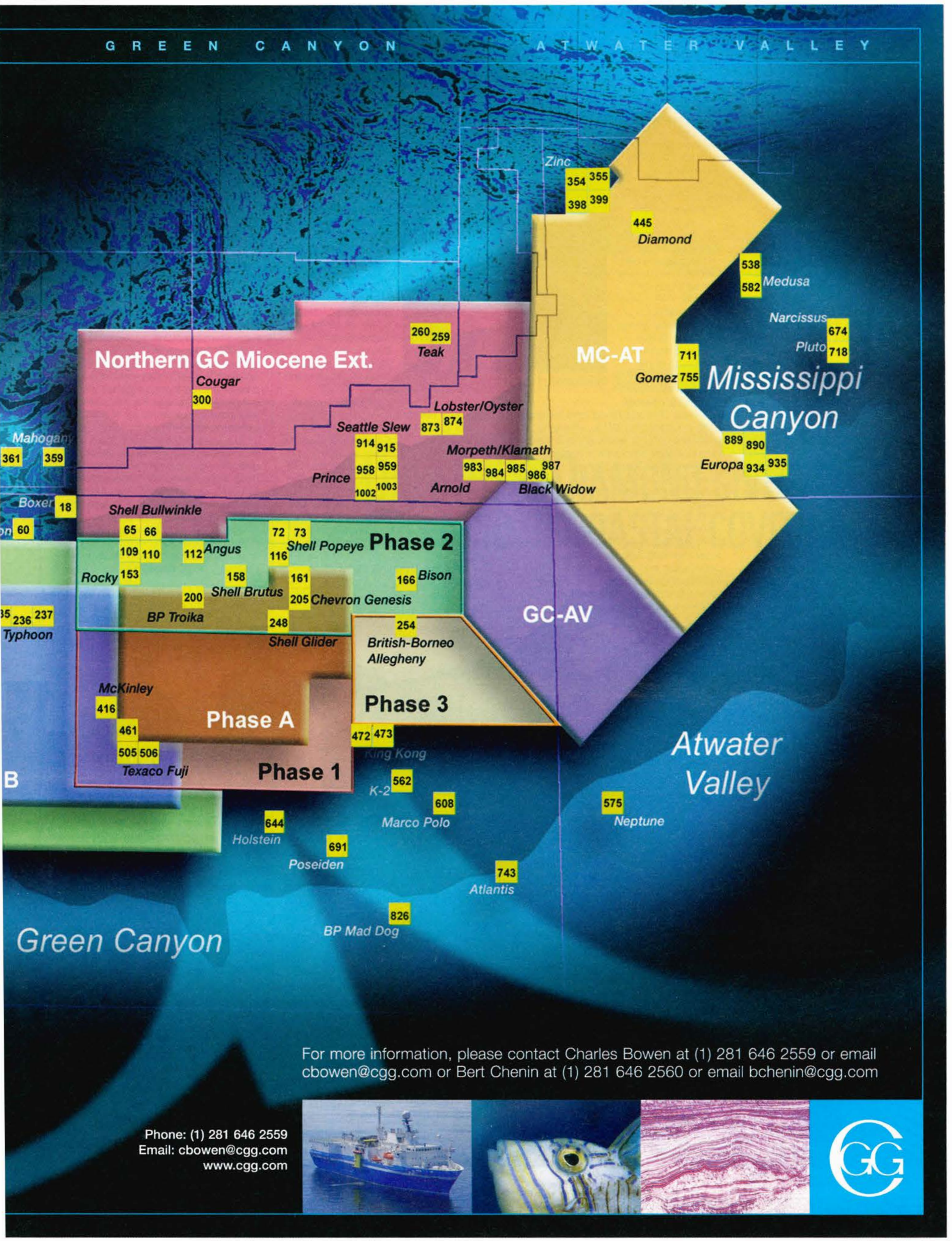
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Beardsley Gets Explorer's Award

Appalachia Basin Is Still Intriguing

By KATHY SHIRLEY
EXPLORER Correspondent

Call it a tale of two entities.

On the one hand you have Richard Beardsley, who grew up in Oil City and Titusville, Pa., surrounded by the history and lore of the oil business.

It's not surprising that he has devoted his career to unraveling the mysteries hidden deep within the oldest producing basin in the world.

On the other hand, there's the Appalachian Basin, which, despite over 100 years of activity, remains largely unexplored.

Explorer and field. You don't need binoculars to see the link that's coming.

Beardsley for most of his career has been working to prove the tremendous potential in the basin's deeper reservoirs – and recent discoveries in the Trenton-Black River formations are long-awaited pay-offs for years of study.

Beardsley, who received AAPG's inaugural Explorer's Award in Houston at the recent annual meeting, presented a paper at the meeting titled "The Appalachian Basin, The Most Drilled and Least Explored."

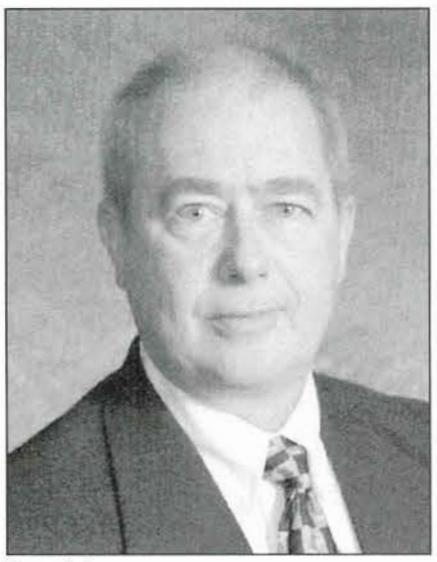
When he talked, he knew what he was talking about.

Getting Started

After graduating from Penn State University in 1969, Beardsley first went to work for Chevron Geophysical in Houston – and quickly discovered he missed the mountains.

"I spent all the time I could stand in Houston," he recalled. "I told my wife that as soon as we had $2,000 in the bank we were leaving."

True to his word, he headed back to the Appalachians in 1972, believing he had a job waiting for him with Quaker State in Pennsylvania. Unfortunately, things were slow at that time, and no hiring was being done there.



Beardsley

Fortunately for Beardsley, however, Columbia Gas was hiring, and he landed a job in Charleston, W.Va., where he remained until his retirement last March. He's now vice president of geology and geophysics for Triana Energy, a company founded exclusively to pursue new exploration targets in the Appalachian Basin.

Successful? He was responsible for identifying each of the first four major Trenton-Black River discoveries made in recent years in Appalachia – and his persistence and insistence that the Appalachian Basin holds potentially prolific fields in deeper reservoirs has spurred a revival, attracting new investors and reviving exploration activity throughout the region.

"Since early exploration in the 1850s in Titusville ... most activity in the basin has been of a development nature, spurred at times by serendipitous wildcat discoveries," Beardsley said.

Studious approaches to exploration in the basin remained "rather erratic" through the mid-1990s, he said, and a systematic approach to the overall configuration of the basin was needed.

"For future exploration to succeed (here), an integrated model incorporating all of the available geologic and geophysical data must be interpreted to allow for rational deep exploration in the basin," he said.

"Gas has been proven to exist in the deep formations of the basin," he said, "and rationale must be developed to exploit those hydrocarbon provinces."

An Eye-Opening Experience

It was as a young geologist in 1974 – "much influenced by my peers," he said – when Beardsley first decided the Appalachian Basin's future was tied irrevocably to future reserves in the Lower Paleozoic section.

"The main part of these reserves were suspected to be in the Middle to Lower Ordovician Trenton and Black River formations, whose historic significance can't be overstated," he said.

The Lima Indiana and Albion-Scipio fields in Indiana, Ohio and Michigan had, in addition to being the start of Standard Oil in the late 1800s, already produced in excess of 600 billion cubic feet of gas and 600 million barrels of oil.

"The 200 million barrels of oil and 200 billion cubic feet of gas from Albion Scipio had been produced from a dolomitized epigenetic feature whose surface area only encompassed 6,400 acres of real estate," he said. "But, since it was rumored that no seismic character existed over these two prolific fields, I was at a loss, since my technical background was in geophysics."

The Lima Indiana Field in Ohio and Indiana was the first Trenton-Black River discovery, but the zone is only 1,400 feet deep there. The trend is about 260 miles long and varies in width from less than one mile in parts of Ohio to greater than 50 miles in central Indiana.

About 100,000 wells have been drilled in the trend.

The giant Albion Scipio Field discovery in the late 1950s in southern

continued on next page

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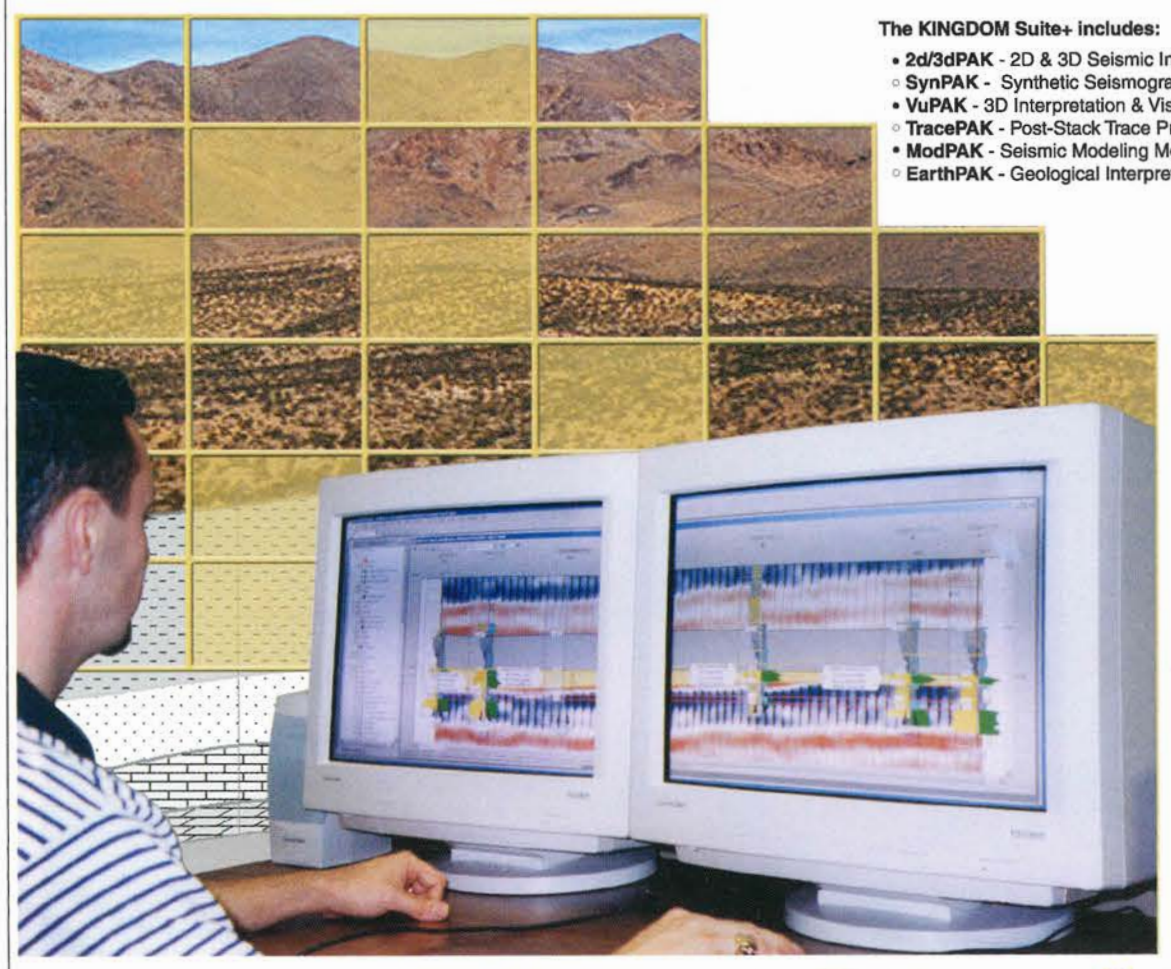

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continued from previous page

Michigan was an eye-opener, producing from the Trenton-Black River formations at about 4,000 feet. The excitement was touched off when a well was shut in after encountering lost circulation just below the top of the Trenton. Craters began to form around the location, so the well was allowed to flow unrestricted for 25 hours.

According to reports, the well produced an estimated 15 million cubic feet of gas and 4,000 barrels of oil a day.

Looking Deeper

Beardsley became intrigued with the deeper potential of the Appalachian Basin early in his career with Columbia.

"We knew the Trenton-Black River was present throughout the Appalachian Basin, and it was the same age dolomites as the prolific Ellenburger in west Texas, the Red River in the Williston Basin, the Lima Indiana Field and the Albion-Scipio," he said. "We just had to solve the geologic puzzle in the basin."

Beardsley had the luxury of surface exposure of most of the stratigraphic section. The Middle Ordovician outcrops on the basin's west side in the Adirondacks is almost identical to outcrops around Lexington, Ky., with the same fossil assemblage and same depositional environment.

The basin's biggest exploration effort was in the 1960s and 1970s, when Exxon arrived looking for elephants at 19,000 feet. The firm ran an extensive program of dynamite seismic lines and drilled five wells in West Virginia and several in Kentucky.

"They didn't have the success they were hoping for," Beardsley said, "although one well in Jackson County (West Virginia) was productive."

Extremely high pressures coupled with a bad cement job created too many problems, however, and the well was abandoned.

New York State Natural also had a deep drilling program in New York in the 1970s, and some of those wells provided good structural control for basin geologic studies. That well data was important because the geologic complexity of the Appalachian Basin severely hampered seismic quality at depth.

Columbia had drilled some deeper wells in the basin's shallower portion in north central Ohio and in Kentucky that encountered large flows of gas.

(One well drilled in the 1930s in Roane County, West Virginia, went to 9,700 feet. When it hit the top of the Black River formation, gas flows ignited and burned the rig down.)

At one time Columbia held the record for the deepest cable tool well, according to Beardsley.

"Production wasn't established, and we were just going well to well to see if we could establish additional gas flows," he said.

"We didn't have any way to determine estimated ultimate recovery because we didn't have any production – and the logs in these fractured sections were of poor quality and not suited for evaluation."

In the final throes of Columbia's Steuben County (New York) Devonian reef play, Beardsley mapped a pronounced graben at what he assumed to be the Knox or Little Falls Unconformity interval, beneath a relatively undisturbed Devonian/Silurian section.

Subsequent interval evaluations showed the mapped reflections to be much too shallow to reflect the configuration of the Knox unconformity.

Since the reflections were indicated to be in the Middle Ordovician carbonates, the only available solutions were modeled to be dissolution and collapse, or epigenetic or diagenetic alteration of the fabric of the native limestone.

Beardsley relied on information from Trenton-Black River fields in Ontario, Canada, where the first Trenton-Black River field was discovered in 1917 – just across Lake Erie from the northern margins of the Lima Indiana Field.

(Activity in Ontario has continued intermittently through today. Ordovician pools currently account for about 75 percent of Ontario's annual oil production.)

"We contracted with scientists at the University of Texas to generate a model of what the reservoir would look like if we shot seismic – then we actually acquired seismic data in the area using the

See **Trenton-Black River**, page 20

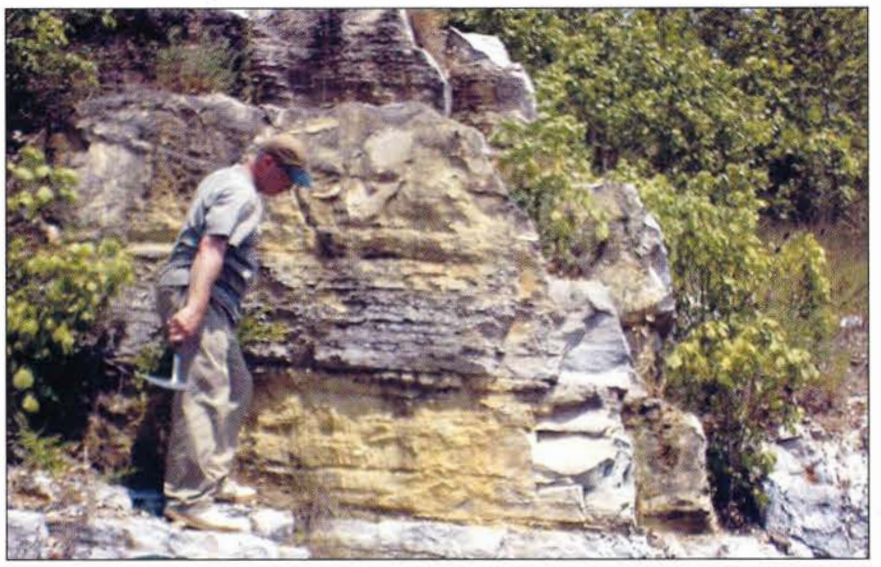

Photo courtesy of Kentucky Geological Survey, University of Kentucky

Mineralized fractures – note differential erosion, especially at knee area.

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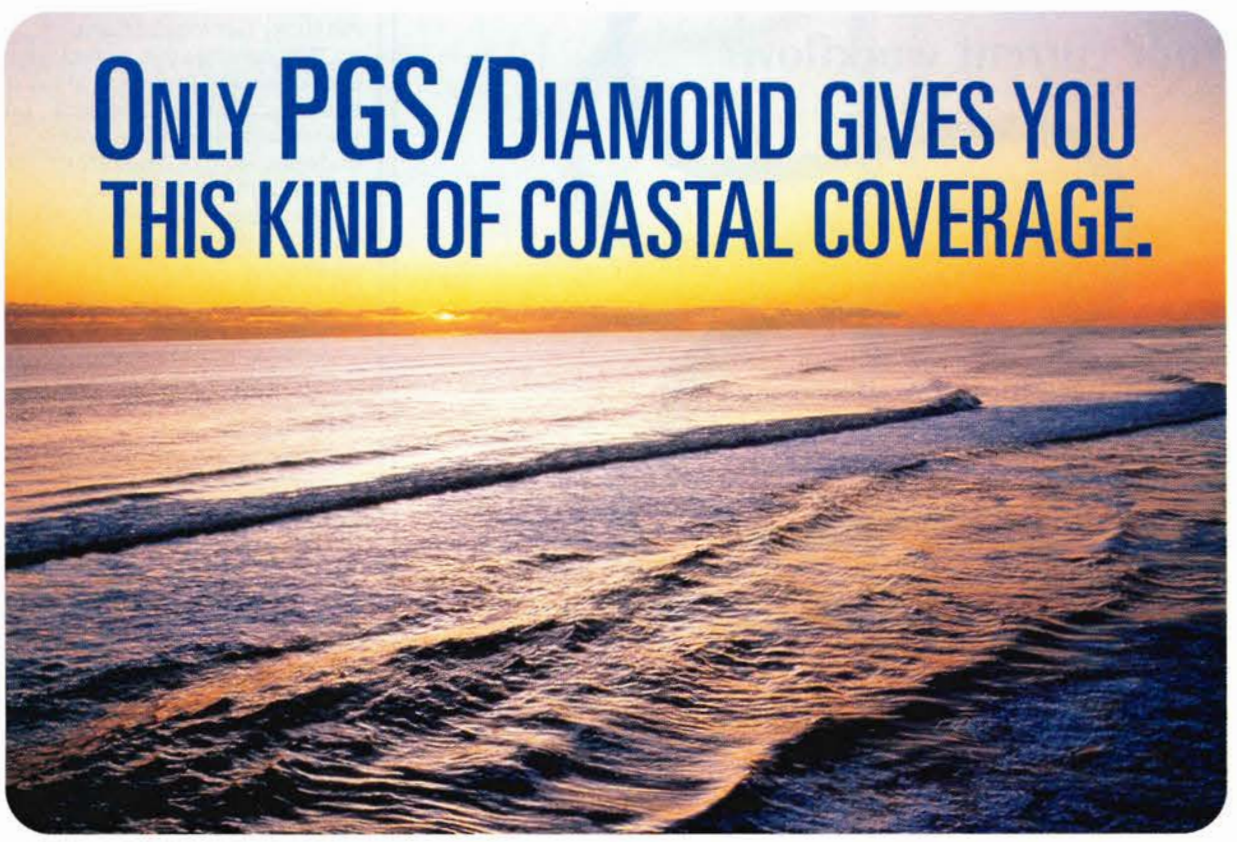

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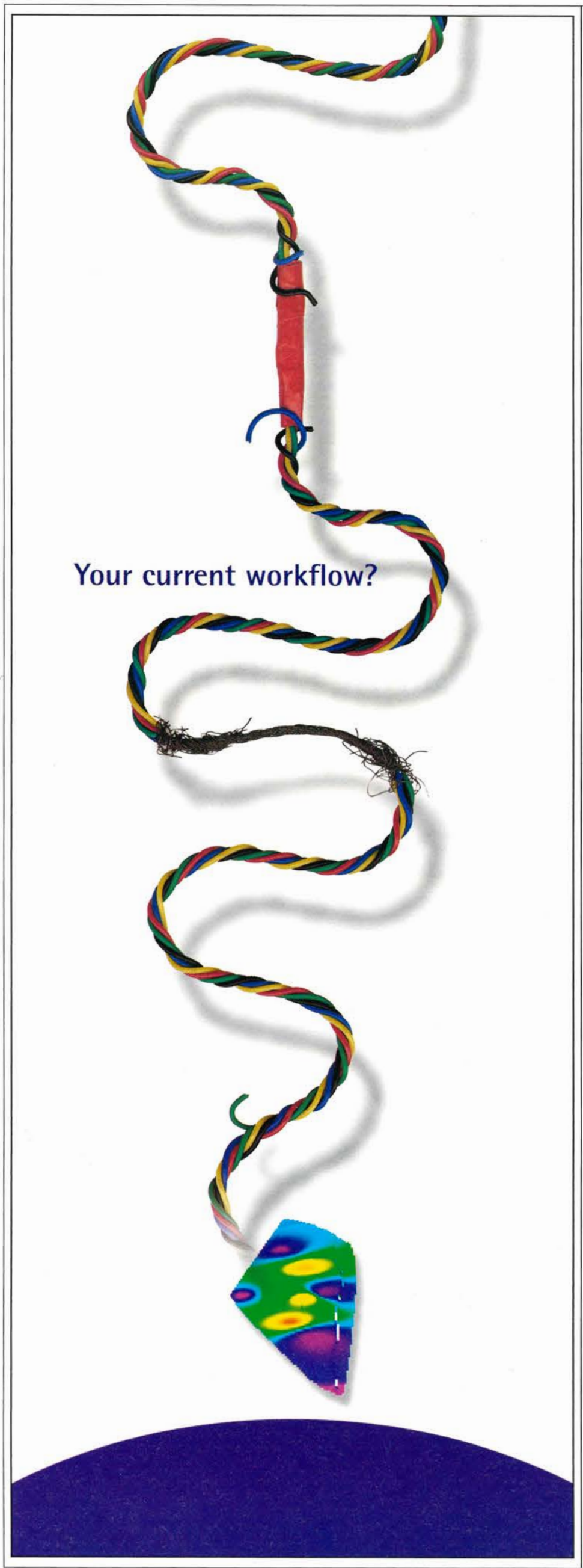


Precambrian?

Deep East-Mid Con Is Barely Touched

By KATHY SHIRLEY
EXPLORER Correspondent

Some projections put the United States natural gas needs at 30 trillion cubic feet of gas in the next 20 years. But if domestic production is to be a big part of that projection, exploration strategies are going to have to dig deeper.

That's true in basin-centered gas plays in the Rockies, it's true in the Gulf of Mexico and it's especially true in the eastern Midcontinent, where producers have barely touched any zone below 4,000 feet.

"In most areas of the eastern Midcontinent, the vast majority of oil and gas tests have penetrated only a few thousand feet," said James A. Drahovzal, geologist and head of the Energy and Minerals Section of the Kentucky Geological Survey.

"Not only has this limited amount of data obscured our vision of the deep economic potential," he said, "but it has also provided us with a poor understanding of the early geologic history of the region."

But seismic data acquired over the past 10 years – along with a few key deep tests – have begun to shed new light on the deep structure and stratigraphy of the eastern Midcontinent.

One of the more significant changes in scientists' understanding of the region has been the discovery of geographically extensive sedimentary rocks below the Precambrian unconformity, which has shifted the economic basement substantially deeper.

Some of these sedimentary rocks are tectonically complex, since they are part of both rift-basin settings and fold and thrust belts that were previously unknown or poorly understood.

The area's deep Cambrian basins also are becoming better understood as a result of seismic data and some deeper wells – and mapping of the deep structures, Drahovzal said, is providing a better picture of the control they exert on the development and distribution of important shallow prospects.

New Clues to Consider

This deeper sedimentary section was first uncovered about 13 years ago when the Ohio Geological Survey drilled a well in Warren County in southern Ohio, on the crest of the Cincinnati Arch. The well was expected to reach crystalline basement at a depth of about 3,500 feet, but instead penetrated nearly 2,000 feet of a red lithic arenite below the Cambrian Mount Simon Sandstone.

The discovery generated widespread attention, and the Cincinnati Arch Consortium was formed to study the new basin – funded by six companies interested in the potential for hydrocarbon source rocks or reservoirs in the new formation.

"Prior to this well, everyone believed that Pre-Cambrian granites underlaid the area," Drahovzal said. "We really didn't know what this discovery meant at the time, and we still don't have a good handle on the age of this sandstone. It may simply be an older part of the Cambrian section, but many of us think it is Precambrian.

"We really didn't know what this discovery meant at the time ... Of course, this is still controversial."

"Of course, this is still controversial," he added, "but our best guess is it's Mesoproterozoic, which would make it in the range of one billion years or more old."

This thick section, called the Middle Run Formation, fills part of what has become known as the East Continent Rift Basin.

The basin's extent has not been defined – data is fairly limited – but about 14 wells west of the Grenville Front have now penetrated this lithic arenite.

Another important well was drilled about four years ago in Hart County, Kentucky, on the west flank of the Cincinnati Arch. The KII No. 1 Brooks drilled 1,815 feet of what appears to be the lower part of the Middle Run Formation. The basal 200 feet in this well is a cleaner quartz arenite.

Plus, the well had a blow of gas that spewed mud onto the rig floor.

In the last several years two additional wells in the area have encountered this red lithic arenite.

Whetting the Appetites

The East Continent Rift Basin is bounded on the east by the Grenville Front and possibly on the west by normal block faulting. Gravity and magnetic data suggest that the basin may be connected on the northern end with the Midcontinent Rift System in southern Michigan.

The southern boundary is poorly defined, but the basin likely extends into northern Tennessee.

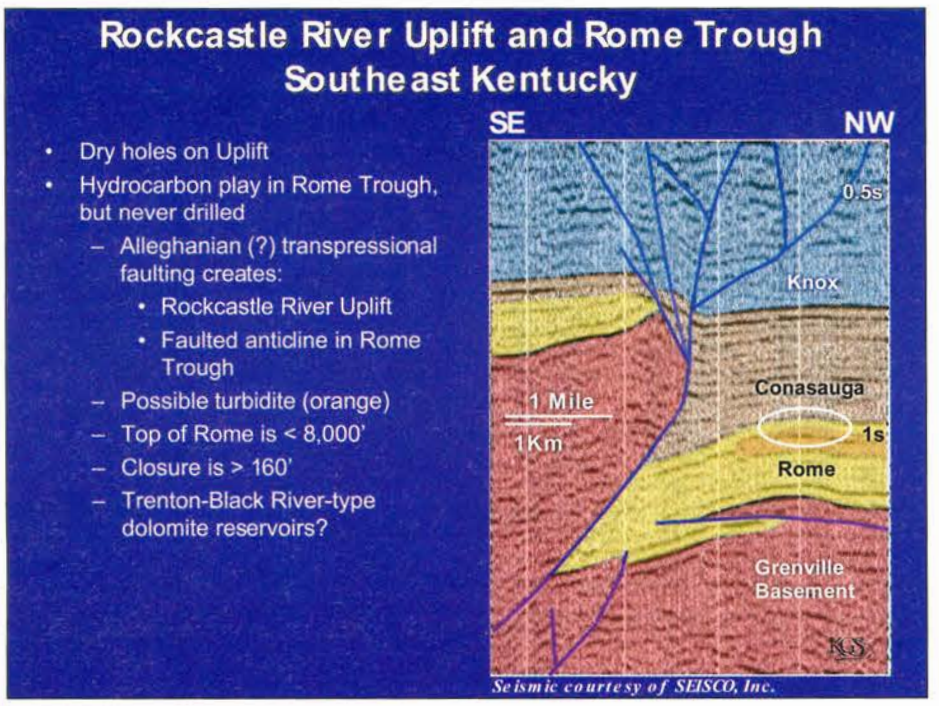
Magnetic modeling and seismic data indicate that the basin deepens eastward, reaching depths of 27,000 feet on its eastern side under the Cincinnati Arch.

continued on next page

James A. Drahovzal, head of the Energy and Minerals Section of the Kentucky Geological Survey, presented the paper "The Deep Natural Gas Potential of the Eastern Midcontinent, USA" during the AAPG Annual Meeting in Houston.

Drahovzal's paper was part of the session on "North American Resources: Remaining Exploration Potential Onshore."

Other papers in the session looked specifically at remaining potential in Canada, Wyoming, Montana and the Appalachian Basin.



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"These nuggets of information whet our appetite about what appears to be a fairly extensive new sedimentary section," Drahovzal said. "There is a possibility that this sandstone could contain natural gas, even though it is very old."

What's needed now is more study to identify structures in the section.

"We now have this basin that covers large parts of western Ohio, eastern Indiana and much of western Kentucky with evidence of a deep sedimentary section." he said.

"We're not sure how thick this interval is, but in some places it is anywhere from two to more than seven kilometers."

As part of this work, an ancient eroded mountain belt called the Hoosier thrust belt was discovered lying in the western part of the East Continent Rift Basin beneath the English Basin. The English Basin is interpreted as a Mesoproterozoic and Neoproterozoic depocenter. Both proprietary and published seismic sections show a complex structural basin, part of which has been cut by west-vergent Neoproterozoic thrusting that has truncated the earlier east-vergent Hoosier thrust belt.

The Hoosier thrust belt appears to have formed as the result of contraction developing during the earlier of the several episodes of Proterozoic orogeny.

The north-south thrust and fold structures of the eroded mountain belt form potential natural gas traps. These structures were first recognized in northern and western Kentucky, but recent seismic data in southern Indiana has greatly enhanced the understanding of the structures' distribution.

Obviously, a better understanding of these deep Proterozoic sequences and their effect on overlying Paleozoic rocks is important to future petroleum resource exploration.

For example, Drahovzal said seismic data from the Hoosier thrust belt in southern Indiana indicates a ramp anticline structure with a flat spot at its crest that could indicate an oil/water or gas/water contact.

"This is a beautiful anticlinal structure at about 12,000 feet, and it's never been drilled," he said. "It looks as if it could be composed of sedimentary sandstone, but we're not certain if this is part of what's now known as the Middle Run Formation in the East Continent Rift Basin or not."

Deep Fan Deposits

This newly discovered basin isn't the only area with deeper potential in the eastern Midcontinent. The Rough Creek Graben is an asymmetric basin containing up to 18,000 feet of pre-Knox Cambrian sedimentary fill near its northern boundary, the Rough Creek Fault Zone, and it may be an important target for deep natural gas.

Most of the pre-Knox drilling has been near the northern boundary fault. However, the fault zone was reactivated at least twice since its initial formation in the Cambrian – once during the Ouachita orogeny, when high-angle reverse faulting took place, and again during the Jurassic, with normal faulting as the Gulf of Mexico began to open.

See **Mid-Con Potential**, page 21

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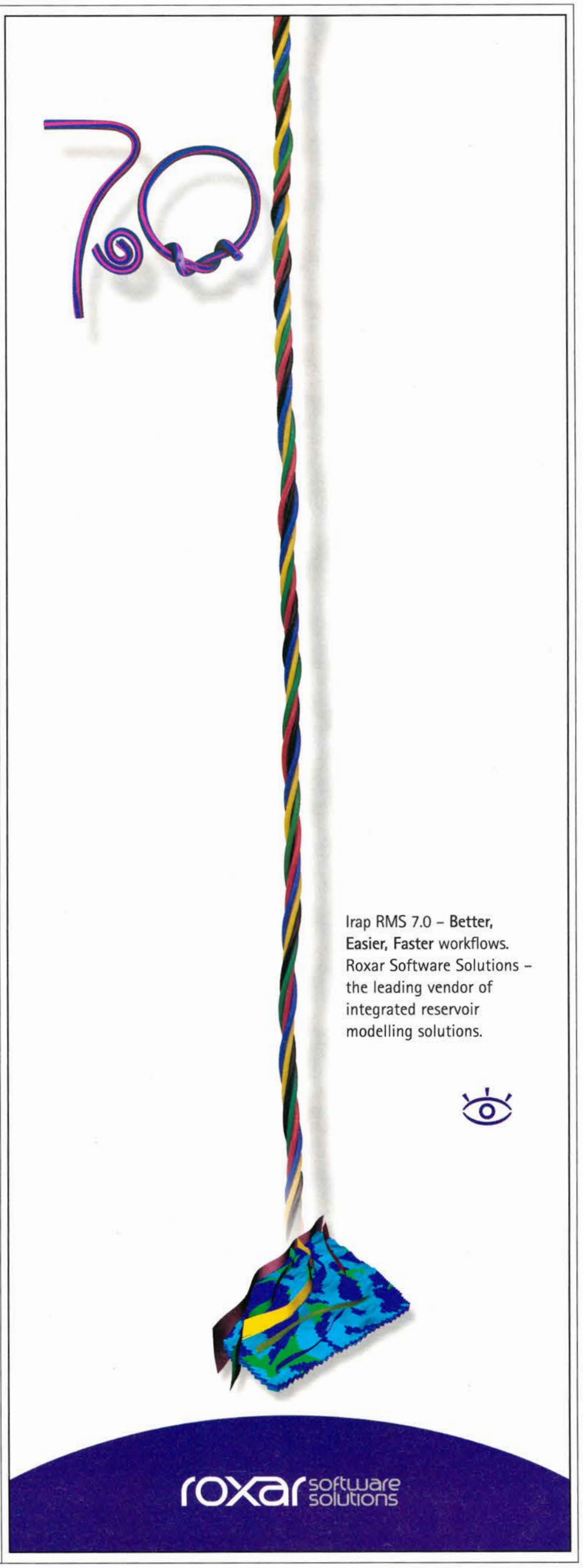

But Areas' Charms Attracting a New Crowd

NW Europe Faces Middle-Age Angst

By KATHY SHIRLEY
EXPLORER Correspondent

Northwest Europe has been an important oil and gas producing province for decades, but exploitation is now the order of the day.

Indeed, much like the U.S. Gulf of Mexico shelf, major oil companies are concentrating on emerging plays elsewhere – mergers, acquisitions and the divesting of assets all are changing the face of the industry in Northwest Europe.

So what do these changes mean for new and old players in the region?

London-based Paras Consulting has provided answers to that question, having started a study that looks at the emerging trends and what they mean for Northwest Europe.

That work, presented in Houston at the recent AAPG Annual Meeting, is a detailed analysis of industry upstream performance between 1995-2000 based on information available in the public domain that includes capital expenditures, proved reserves movements by source, production and other operational data, according to Ian Norbury with Paras Consulting.

"In a global context, Northwest Europe has been in decline as a focus for upstream investment since 1995," Norbury said.

He points to statistics showing how the proportion of worldwide upstream capital expenditures directed at the area, including acquisition expenditures, declined from 24 percent in 1995 to just 11 percent in 2000. The proportion of worldwide exploration and development investment declined from 26 percent to 17 percent.

"At the same time finding and development costs on a BOE basis have increased by around 20 percent," he said.

Also, investment has declined in absolute terms since 1995. According to information from government agencies, investment increases in exploration and appraisal peaked in 1997 and in development activity in 1998, but was followed by a steep decline to 2000 in response to lower oil prices. Exploration and appraisal investments in 2000 amounted to 53 percent of 1995 levels, and development investments were only 74 percent of that seen five years earlier.

Perhaps even more ominous was this: Investments failed to revive in 2000 when average oil prices were sharply higher.

Trend Setters

The number of exploration and appraisal wells drilled in Northwest Europe since 1995 mirrored this trend. Exploration and appraisal drilling peaked in 1997, fell dramatically in 1998 and 1999, but picked up in 2000 – although drilling remained 25 percent below 1995 levels.

According to forecasts, the number of exploration and appraisal wells was lower in 2001.

"There are obviously factors other than oil price influencing these trends," Norbury said. Contributing factors include:

❒ Diminished returns from finding and development investment and activity in Northwest Europe, both in absolute terms and relative to other regions.

❒ Companies continuing to switch the focus of upstream budgets to other areas, with worldwide deepwater exploration and to some extent North American gas the primary beneficiaries.

❒ Many companies in the region adopting more exploitation-led strategies with relatively more funds from already reduced budgets directed at development.

❒ A larger share of annual budgets aimed at acquisition of proved reserves rather than organic growth.

While these trends clearly indicate that Northwest Europe has entered the mature phase of its upstream history, the region – particularly the United Kingdom – remains quite attractive to smaller players and new entrants.

"Northwest Europe has an attractive fiscal/political regime," Norbury said. "The UK is one of the top three in the world. Estimates of yet-to-find resources are still large, although these new reserves will be spread over smaller fields.

"Also, opportunities to acquire existing production are increasing as some of the larger companies sell assets," he added, "which is a trend we expect to increase."

Obvious Choices?

There are problems, however, these new entrants and smaller companies will have to tackle. Opportunities to operate and therefore control activity and investment are difficult to find. The region has long license tenure, which tends to preclude acreage turnover.

"Because of the license arrangements, some of the major international companies like Shell are sitting on acreage most people would say is under-explored, making it hard for newcomers to get a foothold," Norbury said. "Plus, partnerships in many blocks are quite diverse, which can result in a poor strategic alignment. It can also be very difficult for newcomers to access export infrastructure.

"All these factors are blocking new

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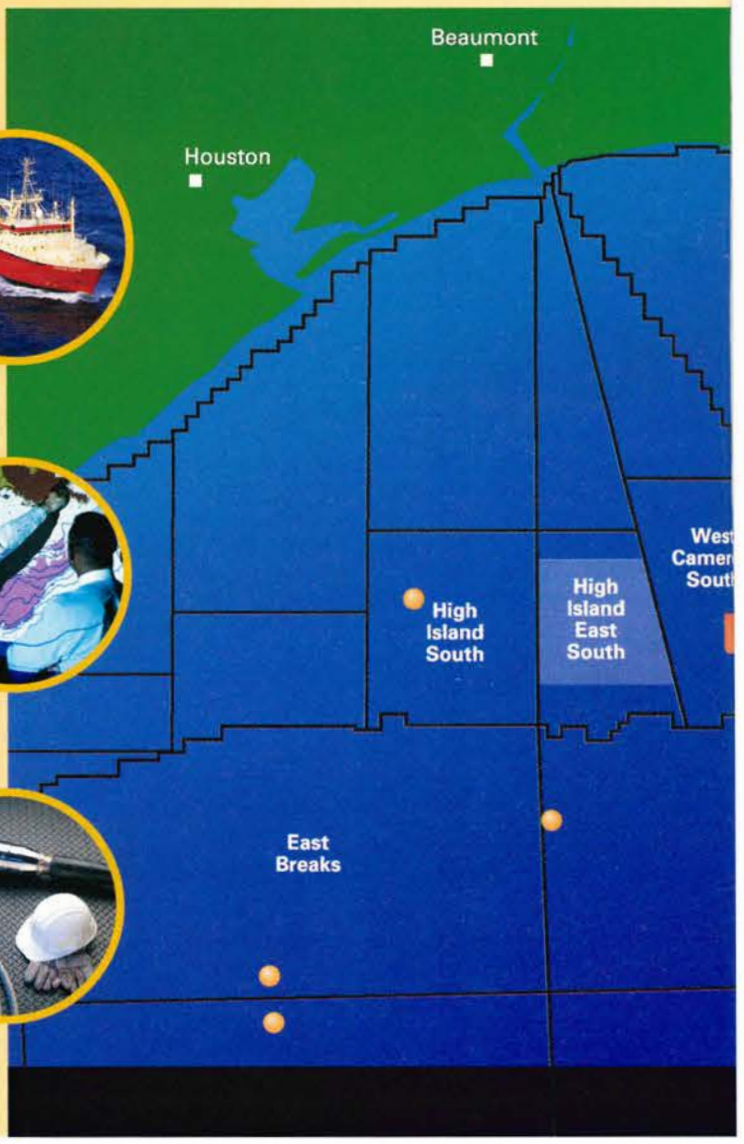

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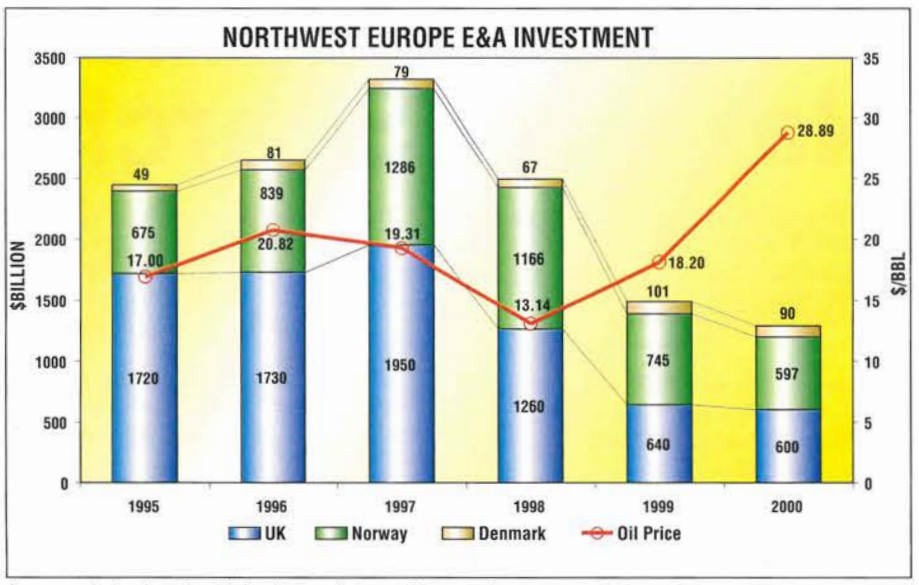
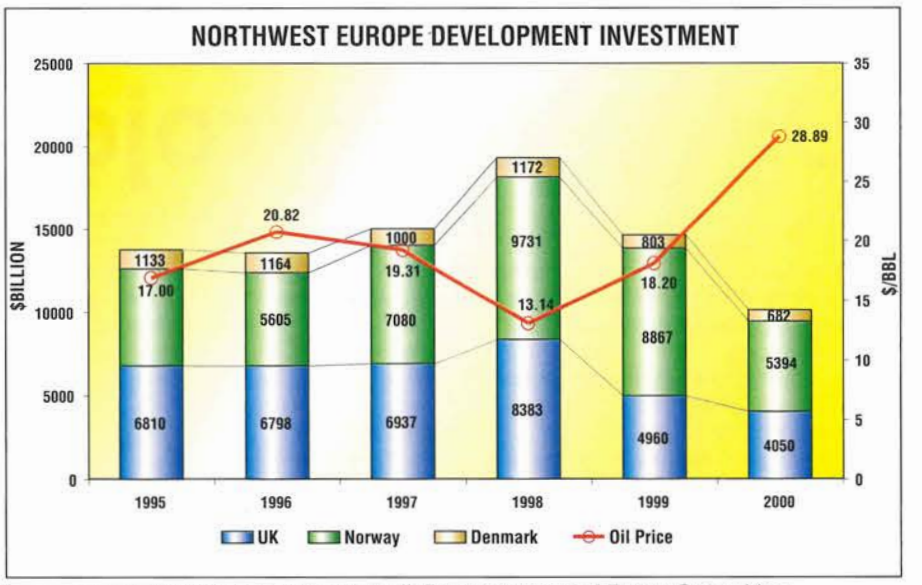
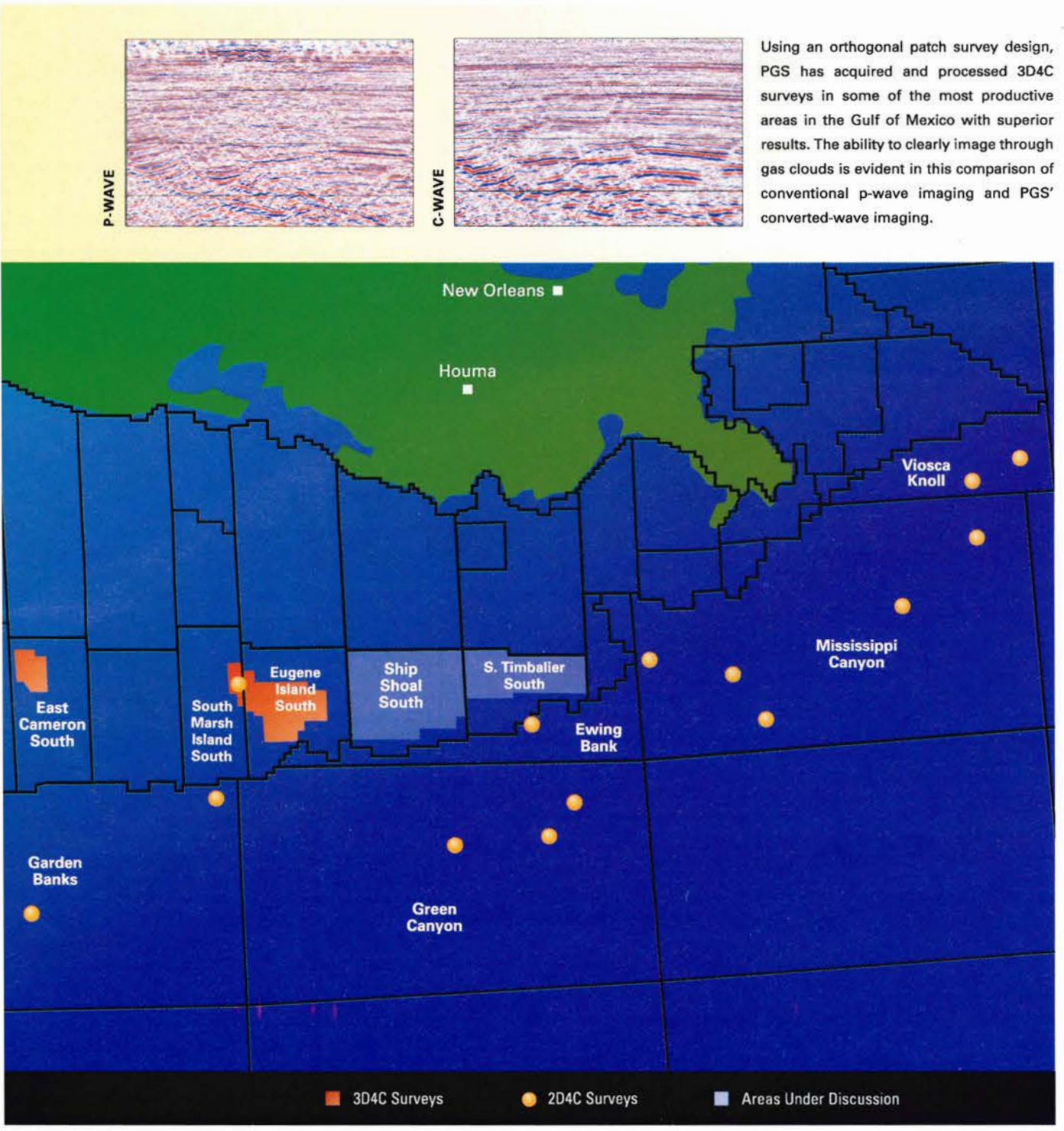




A recent study of activity in northwest Europe has revealed not just exploration and development data, but financial trends as well. Data courtesy of Paras Consulting.



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investment in Northwest Europe, particularly the UK," he said. "It is refreshing that the UK government has acted to alleviate this to some degree – in the new initiative, the government has stated that it will use its statutory powers to compel companies to invest within much shorter deadlines or relinquish licenses to other companies that are willing to invest."

Many of the region's emerging trends are a result of a combination of shifts in global strategies, particularly of the larger companies, and of sharply lower oil prices from 1997 to 1999, Norbury added. When prices collapsed companies began to emphasize cost reduction and operational improvements with severe cutbacks in discretionary spending, particularly for exploration. Firms high-graded existing portfolios toward low cost and low risk production and reserves replacement.

Both large and small companies turned to mergers and acquisitions as a means to lower costs and replace reserves.

"In 2000, with higher prevailing and predicted oil and gas prices, we again saw a shift in emphasis globally in Northwest Europe from cost reduction back to growth," he said, "although companies continued to use mergers and acquisitions as the engine to drive growth and value creation."

Some clear strategic trends have developed in Northwest Europe as a result of the fluctuations in the petroleum industry over the last six years.

"Even before the recent flurry of merger activity, the major operators in the region, almost without exception, were reappraising their portfolios and commitments within Northwest Europe as global strategies were redefined," Norbury said. "This is continuing, even though the oil price trend in 2000 and beyond has greatly improved profitability in the region.

"The larger operators like Shell, ExxonMobil, ChevronTexaco, BP and TotalFinaElf all have significant positions around the globe in exploration hotspots as well as in major discoveries under development or planned for development," he continued. "These positions offer low-cost, high-impact opportunities that, with the exception of the Norwegian Sea and perhaps other parts of the Atlantic Margin, are generally lacking in Northwest Europe.

"The choices for investment for the larger player seem obvious."

Open Doors

Although these large companies are maintaining a strategic presence on the Atlantic Margin, they have retrenched in Northwest Europe, with an emphasis on maximizing the value of legacy assets and infrastructure through development of profitable satellite fields and focused near-

See **NW Europe**, page 19

www.update

Directory Project Narrows Search

By JANET BRISTER
Web Site Editor

Let's say you are looking for something on the Web, and so you go to your favorite search site (I prefer Google myself) and type in your query.

Bam! You receive 25 pages of possible links and begin sifting through them, hoping to find what you seek.

So far, so good. But once you get to a site you might have another question: Where has this information come from? By reading it you discern "it ain't right," so you back up and start over again.

And the search continues.

Thus goes the challenge of finding useful information on the Internet.

Conclusion: It's a jungle out there!

Wouldn't it be nice if someone would take the time to cut through the chafe and prequalify the information you search?

Wouldn't it be nice if someone would categorize this information so that if you're researching and looking for specifics with only vague details to use that you would have a smidgen of hope of finding the proverbial needle in this digital hay stack?

Maybe somebody has.

Recently we heard about the Open Directory Project: http://www.dmoz.org.

Their "about" page states: "The Open Directory Project is the largest, most comprehensive human-edited directory of the Web. It is constructed and maintained by a vast, global community of volunteer editors."

This attempt at self-organization of the Internet is edited by those who care enough to cull out the bad and offer only the best content.

One of AAPG's members became a volunteer editor two years ago and has asked to be identified as "rockypine" in order to maintain his editorial anonymity as an ODP net-citizen.

Rockypine noted that the ODP provides cross-links to Web sites meaning: Organizations aren't slotted into one predetermined category but may actually appear in multiple locations, such as "Drilling Contractor" and "Petroleum Exploration."

Since sites are reviewed and described by the volunteers, more general questions such as "Who sells petrophysical software?" or "Who maintains a file of formation tops for sale?" are better answered.

But once rockypine became involved he realized the task is enormous – and more editors are needed.

The About page of www.dmoz.org tells how you can become such an editor.

For those using the ODP site, rockypine offers this one tidbit: "Most exploration and production Web sites are listed in various subcategories in two areas:

✓ Business/Industries/Energy/Oil and Gas.

✓ Science/Earth Sciences.

* * *

What is a search engine?

Sure, we've all used them – but did you know there are basically two kinds of search engines?

One is rather bogus in that the engine actually searches a database of sites submitted by the people who created those sites, rather than the entire Internet. Part of the criteria submitted is where their information should appear in that site's information tree, e.g. Science > Geology > Petroleum. This is usually limited to one location.

Other sites actually have robot software that crawls around the Internet identifying new sites – or even new information within old sites – and adds that to the database already collected. Search results then usually appear in order of most recent and most likely to match your search criteria.

These robots mostly look for key words and depend greatly on the individual Web designers' knowledge about special tags to ensure their site is found for the right reasons. They often result in options littered with link rot or, worse yet, links that point to a short apology for a business concept that didn't work out.

Of course, when you search within a specific site you are using a search engine there as well, but it is geared to only that site.

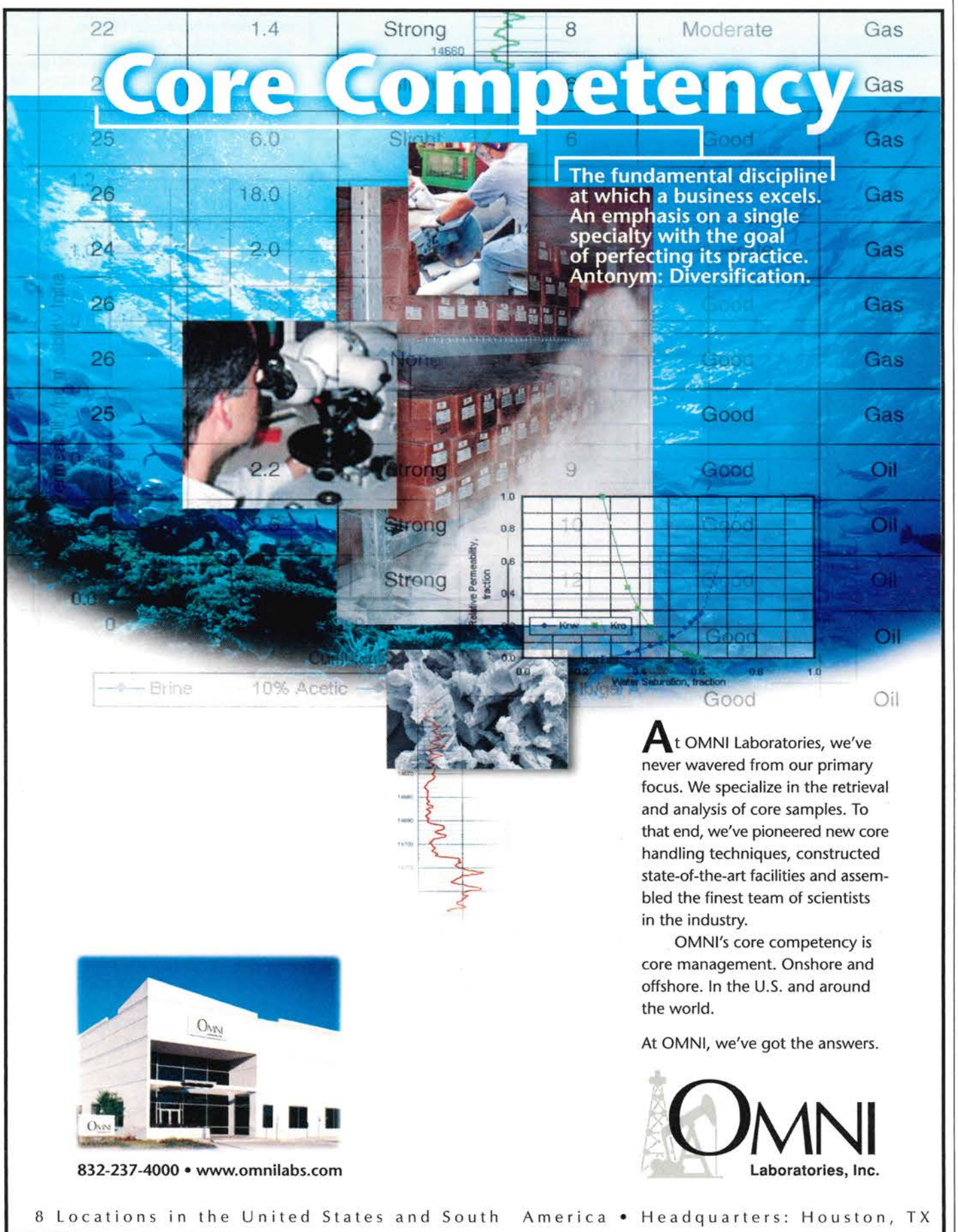
It's getting there that is the problem ODP is attempting to change.

* * *

Volunteers created the Oxford English Dictionary, and it has become the definitive source on words.

The Open Directory hopes to accomplish the same by becoming the definitive catalog for the World Wide Web.

Good browsing! ❑



NW Europe

from page 17

field exploration.

Simultaneously, some are divesting non-strategic assets – creating opportunities for smaller independents and niche companies to stake their claim.

Large independent companies like Kerr-McGee and Talisman claim to have a clear focus of where they can prosper by exploiting their competitive strengths, he said.

"Their strategies have been generally low-risk and characterized by strategic acquisitions to provide a basis for growth through operating efficiency gains, technology initiatives on existing fields, a more high-tech approach to development and focused, low-risk infrastructure-led exploration," Norbury said. "The objectives are cost savings, increased production and reserves and, therefore, a longer productive life for some mature assets."

Mid-sized companies such as Amerada Hess, Conoco, British Gas, Enterprise and Agip are all long-established players in Northwest Europe with some core upstream operations. While these firms recognize that the region's growth potential is limited, they are still committed to at least modest growth in Northwest Europe. They have seized appropriate opportunities and have undertaken some relatively minor rationalization.

In contrast, the strategies of other mid-cap companies like Marathon and Murphy – long-time players but on a small scale – focus on harvesting long-standing assets with no aspirations for significant growth.

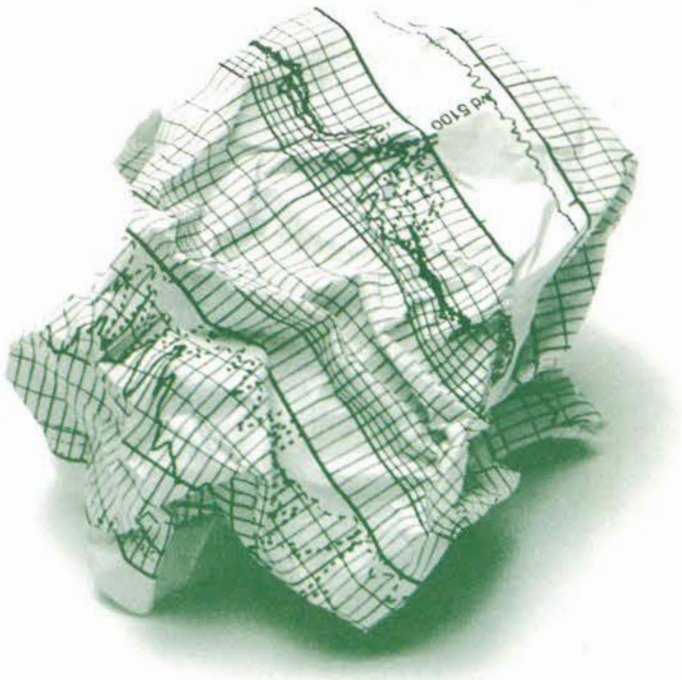
Through the years Norway has been somewhat of an anomaly in the region. Companies participating in Norway are primarily major firms operating large development projects. There are few newcomers and historically there was little in the way of asset trading.

But even the Norway scene may be changing. Privatization of state ownership and likely asset sales by Statoil could increase diversity and competition in Norway.

In general, consolidation and the emergence of new global strategies has had the most profound impact on Northwest Europe.

"Of course, it's too early to know if the mergers and acquisitions will be successful strategies in as much as they result in longer-term performance gains," Norbury said.

But if other mature regions around the globe are any indication, there's still plenty of life remaining in the region. After all, the Gulf of Mexico shelf has yet to sing its swan song – and Northwest Europe will likely stay in step. ❑



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Trenton-Black River

from page 13

parameters developed from the model," he said.

"We had almost a perfect match between the model and the seismic data."

* * *

Based on this dolomitized model and the subsequent seismic, in 1976 Columbia selected a well location flanking a basement high on a horst block within a 5,200-foot-wide graben system.

The results were less than satisfactory, with six feet of dolomite in the 1,100-foot-thick Trenton-Black River section drilled with a show of 77 thousand cubic feet of gas a day, and salt water from the dolomite.

Two years later, another feature was drilled in the central part of a 2,000-foot wide graben five and a half miles north of the first well. This well had a 400-foot thick section of dolomite, but since only marginal shows of 12.3 thousand cubic feet per day were recovered, no stimulation was attempted and the first well was plugged and abandoned.

"In 1985, with courage and ignorance again on my side, and after having passed on a vice president slot at Columbia Natural Gas to get the prospect drilled again, the 1980 Kossow well was offset 400 feet to the north by the Evangelos well," Beardsley said.

Although the well only gauged 517 thousand cubic feet a day, on initial stimulation the well open flowed 8.3 million cubic feet daily from five completed intervals in the dolomitized Black River zones.

"Subsequent completion attempts damaged the well," he said, "but I began to feel this was what I was born for."

At that time, the potential play covered the basin's entire flank from western Ohio to the Adirondack dome. Two additional wells were drilled 15 miles from the Evangelos and initial results were very encouraging geologically, although thermal maturities were anomalously high.

The main problem with the central portion of the play was secondary dead hydrocarbon cement or bitumen in the created pore spaces. Low porosities and permeabilities due to cementation by this dead oil were not economically important due to the extreme thickness of the potential reservoir and the intensity of fracturing in the reservoir.

Beardsley said total gross pay interval was estimated to be 500 to 1,000 feet, with effective porosity of 1.2 percent and permeability ranging from .002 to eight millidarcies in core records. Recovery was estimated to be about 90 percent in this fractured reservoir, and each well was estimated to be capable of draining 250 to 320 acres.

No significant contaminants were present in the gas stream.

The gas was suspected to be richer because of lower thermal maturation both to the east and west of the area drilled, with good oil potential in the play's Ohio, West Virginia and Kentucky portions.

Finger Lakes Activity

The Finger Lakes (New York) portion of the play at that time had 13 seismically defined prospects over 50 miles for a total of 650 potential well locations.

Volumetric reserves per well were on the order of 20 billion cubic feet of gas, which equated at the time to Columbia's throughput for 13 years and 26 times the reserve base from 6,000 wells.

Four or five additional prospects were being defined each year, and if successful depletion rates of 50 billion cubic feet of gas per year could be attained it would take Columbia until 2267 to deplete the reservoirs, he said.

"We had hundreds of locations in New York and were picking up more and more acreage as we identified additional prospects. Unfortunately, Columbia declared bankruptcy in 1990 and surrendered most of the acreage in the play because of cost constraints."

However, 10 years after its Glodes Corners Field discovery and the subsequent bankruptcy, it was still Columbia that proved the Trenton-Black River could be a major producer in the Appalachian Basin. Many of the leases Columbia had to relinquish were picked up by other companies, and today are productive from the Trenton-Black River.

"In many cases companies didn't do any exploration," he said, "they just went back into the courthouses and found leases we had recorded back in the 1980s."

Following Columbia's emergence from bankruptcy, Beardsley again touted the basin's deeper Trenton-Black River potential, and in the mid-1990s the firm began a dedicated exploration effort in the Finger Lakes region, touching off the basin's biggest exploration play in over 100 years.

Today several new Trenton-Black River fields have been discovered in New York, and in 1999 Columbia expanded its production with a discovery in Roane County, West Virginia.

Two of the wells drilled in West Virginia were the largest wells in the northeast United States in terms of open flows, proving there is a great deal of running room in the deeper Trenton-Black River.

Beardsley said there is another 10,000 feet of sediment that has been virtually untouched below the Lower Ordovician Trenton-Black River zones.

"Some of the biggest gas fields in Ontario produce from a basal clastic section just beneath the Ordovician in the Shadow Lake area," he said. "Today's seismic is very good quality and shows multiple prospects in many different depositional environments that are just waiting to be tested."

Beardsley is humbled by the impact of this deeper potential in the Appalachian Basin.

"These discoveries will not only have an impact on Columbia and the oil and gas community," he said, "but will be important to the entire nation." ❑

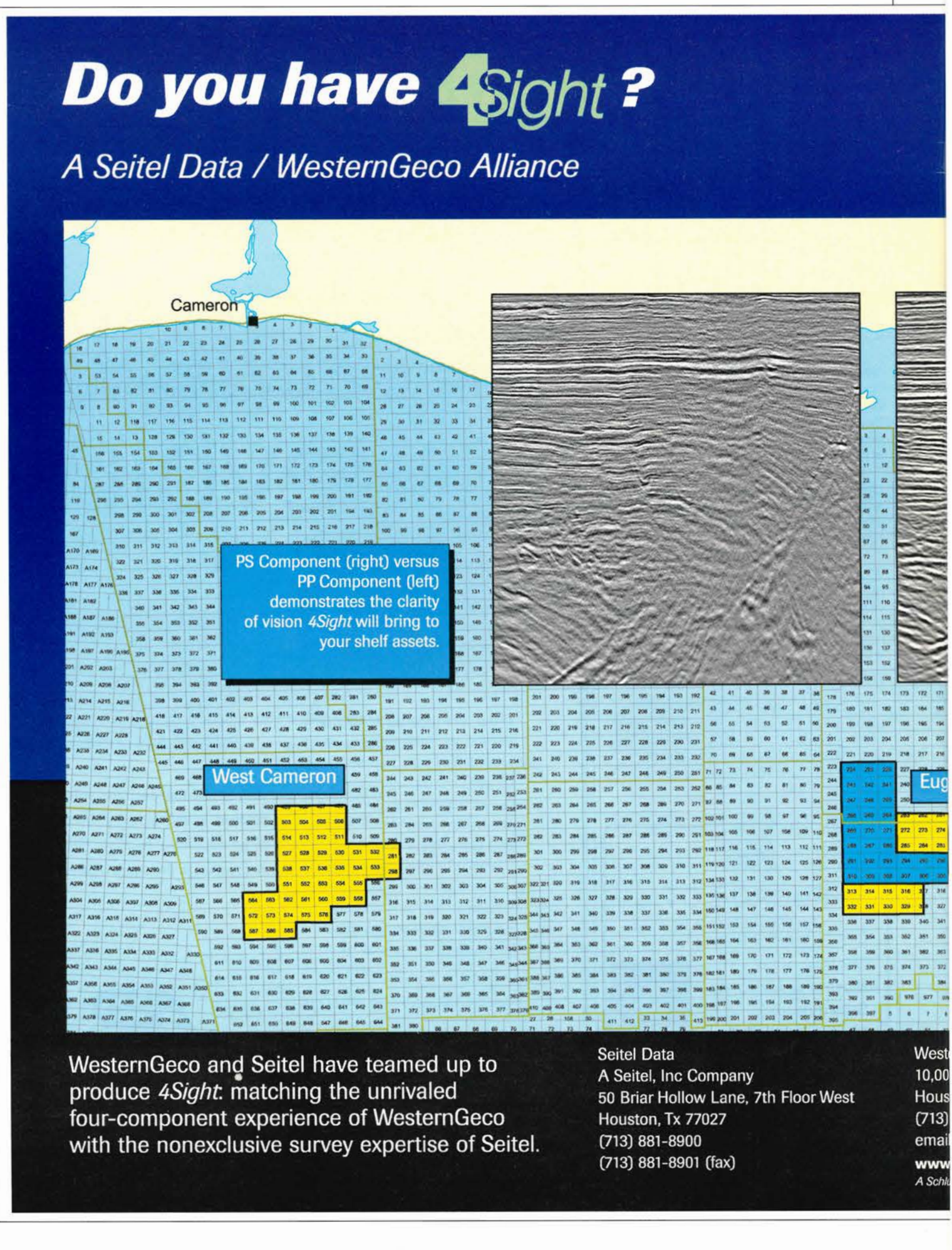


Photo courtesy of Kentucky Geological Survey

Detail of the mass of T-dolostone body found near Lexington, Kentucky.

Mid-Con Potential

from page 15

The past exploration strategies are questionable, because the reservoirs near the boundary fault are certainly breached as evidenced by the extensive faulting by dead oil shows.

That doesn't mean the Rough Creek Graben is devoid of potential structures. There is strong seismic evidence that the graben has basin-floor fan complexes that could be excellent hydrocarbon reservoirs just as they are in other parts of the world.

Drahovzal and other scientists believe these reservoirs would be the most prospective in the areas of the graben away from through-going fault zones where the hydrocarbons could be preserved. Both oil and gas shows in shallower Cambrian rocks suggest that Cambrian source beds are present in the deep part of the rift.

The southern updip edges of both the northern and southern fan complexes should be optimum positions for possible production. The fans are very deep in the basin's western part – 22,500 to 30,000 feet below sea level – and there is only sparse seismic data in the eastern part of the Rough Creek Graben, but the depth to basement shallows in that direction and similar fan complexes are probably present in that area.

Additional data and further study are necessary to confirm this potential.

"We do see evidence of these very deep fan deposits on seismic in the western part of the Rough Creek Graben," Drahovzal said. "They appear as mounded reflectors. Fan complexes are of 10 excellent reservoir rocks. We are just now getting seismic data in areas where the fan deposits shallow to the east, and we hope this new data will prove these structures are present there as well."

My Old Kentucky Rome

Kentucky's Rome Trough, a graben that contains a thickened section of the Cambrian-age Rome and Conasauga formations, is another area with deep gas potential.

A research consortium of the Kentucky, West Virginia and Ohio geological surveys currently is completing a two-year study of the pre-Knox stratigraphic interval in the Rome Trough. The study is funded by the Department of Energy and four energy companies.

Unlike other deep targets, the Rome Trough has actually achieved some production, specifically from the Homer Field in Elliott County, Kentucky.

Drahovzal said seismic indicates some structural settings in the pre-Knox interval that could contain hydrocarbons. One example is adjacent to the Rockcastle River Uplift.

"The south side of the Rome Trough is defined by the Rockcastle River fault system in southeastern Kentucky," he said. "This fault system was active during the Cambrian as evidenced by the thickened Cambrian – Rome and Conasauga – units to the northwest."

He said that during the Cambrian, the fault was likely a normal fault formed during a period of extension. Later – presumably during the Alleghanian – oblique, compressional stresses from the southeast resulted in the formation of a transpressional fault zone that uplifted the southeast block to form the Rockcastle River Uplift.

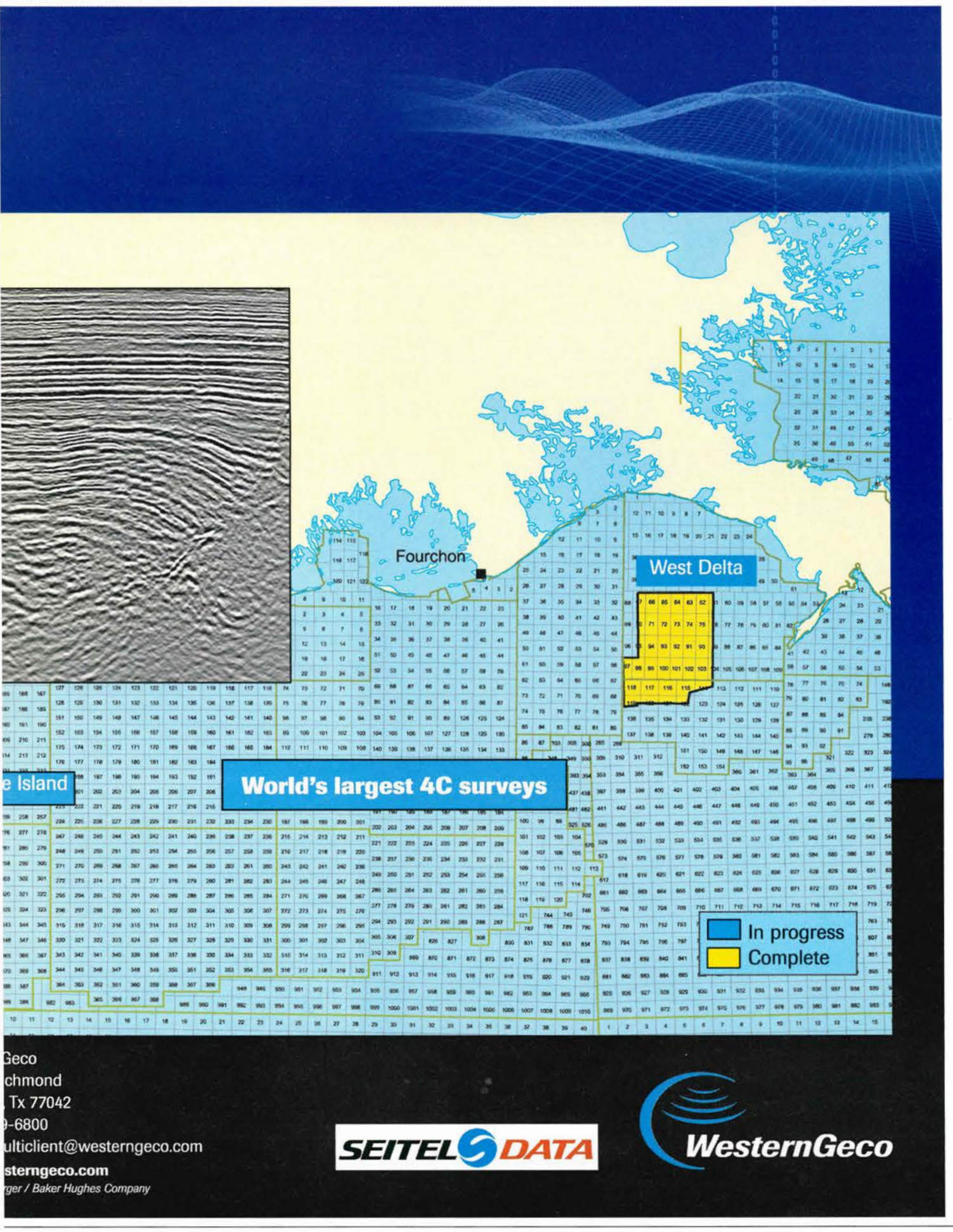
Compressional stresses also resulted in the faulting and folding within the graben to the northwest.

"These folds on the downthrown side of the Rockcastle River fault zone could be prospective as source rock is known to be present in the Rome Trough and production is present to the north in Kentucky within the Rome Formation," Drahovzal said. "Near the crest of the anticline, in the upper part of the Rome Formation, is a possible turbidite."

The depth to the top of the Rome in this area is a little less than 8,000 feet.

"It is these kinds of prospects that will need to be examined further and tested if we are to reach a 30 Tcf natural gas future," he commented.

"The deep structures of the eastern Midcontinent have the potential for containing reserves of natural gas, and future exploration strategies will need to consider them." ❑



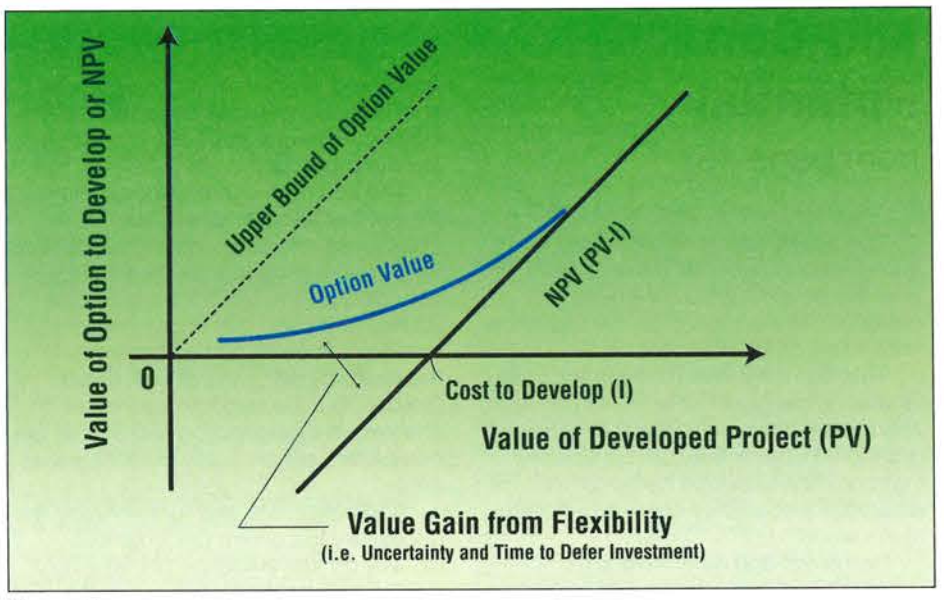


Figure 1.

BUSINESS SIDE OF GEOLOGY

There's No Shortcut to Real Options

Last month, we discussed the basic concepts of Real Options, and some of the shortcomings in conventional DCF analysis of E&P projects.

By JAMES BURNS

The mathematical insight that allows valuation of options involves the creation of a portfolio of risk-free debt (i.e. government bonds), the asset (whether it be a share of stock or an oil and gas project) and an option on the asset.

By constructing the portfolio correctly, it can be both risk-free and self-financing.

Once this is done, the value of an option to acquire the asset (or invest to develop it) is a function of the uncertainty of the economic return the asset will generate (which can be estimated) and four factors that are known:

✓ The exercise price.
✓ The risk free rate of interest.
✓ The current value of the asset.
✓ The time remaining during which the option can be exercised.

By pricing the risk (chance) in the project explicitly the method does away with the need to estimate risk-adjusted discount rates.

The connection to standard net present value is very simple: If one looks at the Black-Scholes formula for pricing call options and sets the uncertainty factor to zero plus the time remaining prior to expiry of the option to zero, the formula says the option's value is equal to the asset's value less the exercise price.

In a real options context this would equate to the net present value being equal to the present value of future cash flows less the investment required to realize them.

In simple terms, when you calculate a net present value you are calculating an option price assuming no uncertainty in outcome and no time available to defer investment. Calculating the uncertainty factor is a much more precise exercise than estimating a risk-adjusted discount rate, which makes option-pricing the preferred method for analyzing investments under conditions of uncertainty.

* * *

Several criticisms of the real option approach are mentioned repeatedly:

❒ First, the reasonable comment that, used incorrectly, it is merely a black box where one can specify some relatively unchallengeable assumptions of uncertainty and produce a precise (but not accurate) value for a risky investment.

To be frank, real option analysis is frequently dismissed as a flaky approach used to justify higher lease bonuses and inflated acquisition prices by undisciplined – or worse, unethical – analysts and prospectors.

❒ Second (and related), specifying option value requires that a company have the discipline to act when the method requires it.

This means that if value is predicated in part on the option to abandon a project at a specific decision point if results fall below a certain expectation, then abandon you must if all conditions of the analysis prevail.

❒ Third, most other criticisms flow from a single shortcoming of the method.

The mathematics underlying the

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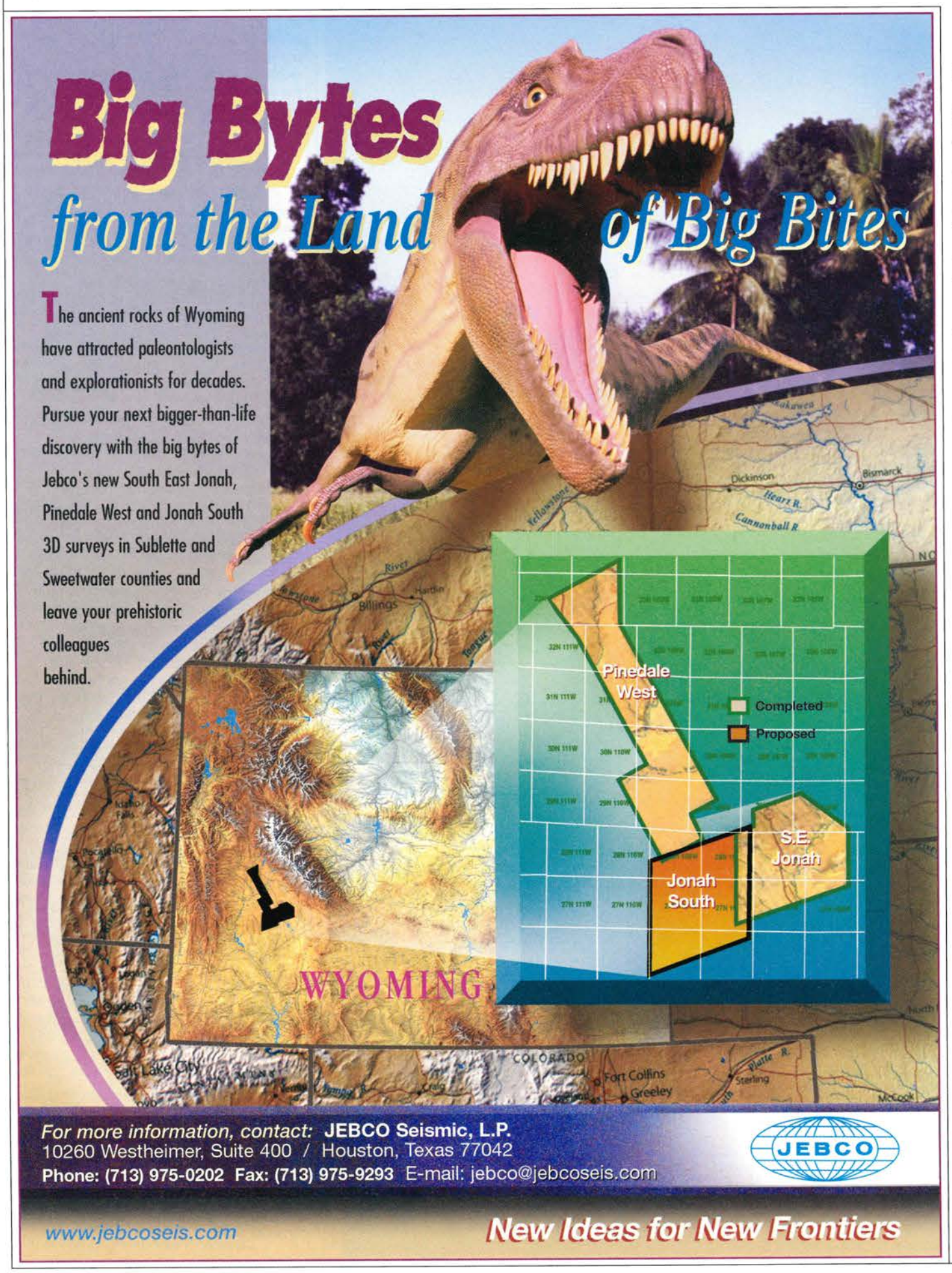

Pacific Group Sets Meeting In Anchorage

"Energy Frontiers: A 2002 Perspective" is the theme of this year's Pacific Section annual meeting, which will be held Mary 18-23 in Anchorage, Alaska.

The conference is being convened with the Western Region of the Society of Petroleum Engineers.

The technical program, which will be held at the Sheraton Anchorage Hotel, includes an AAPG-SPE symposium on North Slope Gas Resources, as well as oral sessions on:

❒ Geology of the Brooks Range and Southern Colville Basin, Alaska.

❒ New Development Opportunities and Integrating Technologies.

❒ Triassic Paleogeography of Alaska: Implications for Source and Reservoir Rock Deposition.

❒ Geophysical Techniques in Arctic Regions.

❒ Shifting Paradigms and Application of New Technologies in Mature Development Areas.

❒ North Slope Petroleum Systems.

❒ Tectonics of the Circum-Arctic.

❒ ANWR Coastal Plain – Geology and Petroleum Potential.

❒ Beyond the Petroleum Window – Mineral Resources of the Pacific Rim.

❒ Unconventional and Shallow Gas Resources of Alaska.

❒ Resource Development Outside the North Slope, Alaska.

❒ NPRA: The Emerging Frontier.

Also planned are pre- and post-meeting field trips that include visits to Prudhoe Bay, the Kenai Peninsula, Cook Inlet, Resurrection Bay and Kenai Fjords.

The meeting's theme "highlights the challenges, high stakes and excitement offered through technology to deliver our energy future," according to Gordon Pospisil, the technical program co-chairman.

"With all the recent focus and emphasis on the substantial Arctic resource base, this meeting promises to be ... very timely," he added. "The broad format of this joint conference promotes emphasis on innovation and cross-discipline approaches to oil and gas development."

Advanced registration will be accepted (online is the preferred method) through April 18.

For more information contact Jennifer Petersen, telephone – (907) 564-5451, e-mail – Jennifer.Petersen@bp.com; or visit the Section's Web site at www.aapg-spe-2002.org/index.html.

continued from previous page

theory is intractable and the insight of the replicating portfolio approach is not as intuitively satisfying in a real option context as it is in evaluating financial options where the underlying asset, usually a share of stock, is freely traded in a public market.

If one wishes to understand the method there is no real shortcut – although the math involved in the binomial lattice approach is not that difficult, and the calculations can be done with a spreadsheet.

Real option valuation of complex oil and gas investment decisions is not easy, but it does provide a much better approach to such decisions – and, when done properly (rather than by some shortcut, cookbook approach), it actually prevents the kind of over-valuation of risky investments that it is often accused of enabling.

The true value of the approach is not that it provides an estimate of the value of undertaking a specific investment, but rather the discipline of approaching a complex set of decisions as a series of embedded options – and developing a strategy to manage the project as uncertainty resolves.

* * *

For those interested in pursuing the subject further there are several excellent books that are intended for practitioners rather than financial theorists. These include:

❒ Martha Amram and Nalin Kulatilaka's *Real Options: Managing Strategic Investment In An Uncertain World* (Harvard Business School Press, 1999).

❒ Thomas Copeland and Vladimir Antikarov's *Real Options: A Practitioners Guide* (TEXERE, 2001).

❒ Gordon Sick's *Capital Budgeting with Real Options, Monograph Series in Finance and Economics, Monograph 1989-3* (Salomon Brothers Center for the Study of Financial Institutions, Leonard N. Stern School of Business, New York University, 1989)

❒ Lenos Trigeorgis' *Real Options: Managerial Flexibility and Strategy in Resource Allocation* (MIT Press, 1999)

❒ "Journal of Applied Corporate Finance," Volume 13, Number 2 (Summer 2000) & Volume 14, Number 2 (Summer 2001), published by Stern Stewart & Co. These were special issues devoted to Real Options and both contain excellent papers on the subject.

(Editor's note: Burns is manager of acquisitions and evaluations with Dominion Exploration Canada Ltd., Calgary.)

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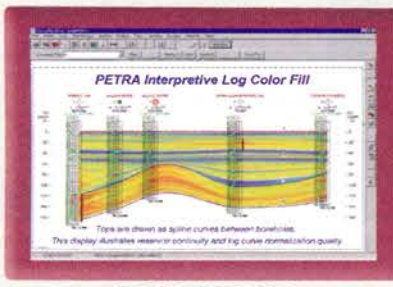

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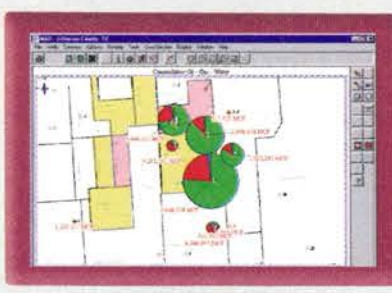
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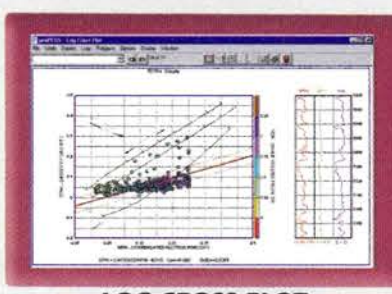
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GEOPHYSICALCORNER

Borehole Images Can Identify Trends

The Geophysical Corner is a regular column in the EXPLORER, edited by R. Randy Ray. This month's column is titled "Borehole Imagery Resolves Channel Trend."

By CONNIE DODGE KNIGHT

Borehole imagery is one type of open-hole log that provides high-resolution data for improved reservoir characterization.

Borehole images are used to:

✓ Characterize fracture and fault systems.

✓ Interpret stratigraphic discontinuities.

✓ Quantify pay in thin-bed packages.

✓ Interpret environments of deposition.

✓ Resolve sandstone-body geometry and paleocurrent orientation.

Borehole imaging tools have evolved from diplogs and dipmeters. Diplogs, which identify bedding orientations, have been most commonly applied to structural analyses.

Over the past several years, borehole-imaging resolution, borehole coverage and interpretive capabilities have improved significantly. Instruments such as the Simultaneous Acoustic Resistivity Imager (STAR Imager℠) provide a vertical resolution on the order of 0.4 inches (1 cm).

One application of high-resolution borehole imagery is sedimentologic analysis of reservoir sandstone.

We present borehole images and core from the Frontier Formation on the Moxa Arch of southwest Wyoming. The core provides "ground truth" for sedimentary structure identification and gives us confidence in the technique of using borehole imagery to identify sedimentary structures.

The borehole image also provides information about sedimentary strike and paleocurrent direction.

Geologic/Economic Context

The Frontier Formation contains both marine and non-marine gas reservoirs that make up multiple stratigraphic sequences. Frontier gas reserves on the Moxa Arch of southwestern Wyoming (figure 1) exceed one trillion cubic feet of gas – but due to reservoir heterogeneity, Frontier fields contain scattered dry holes and marginal producers.

In order to reduce drilling and completion risks, borehole imagery is being used to augment facies identification in a sequence-stratigraphic

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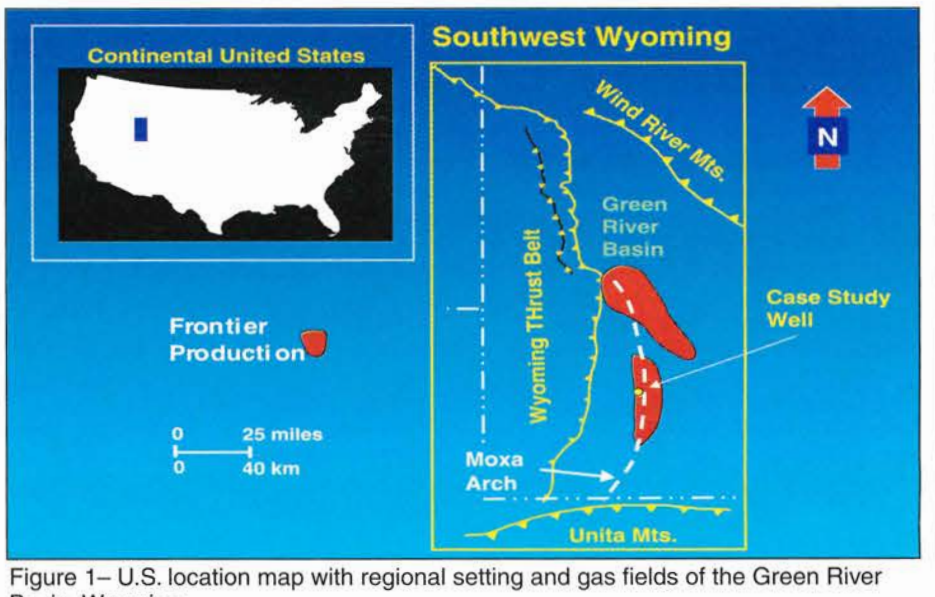


Figure 1– U.S. location map with regional setting and gas fields of the Green River Basin, Wyoming.

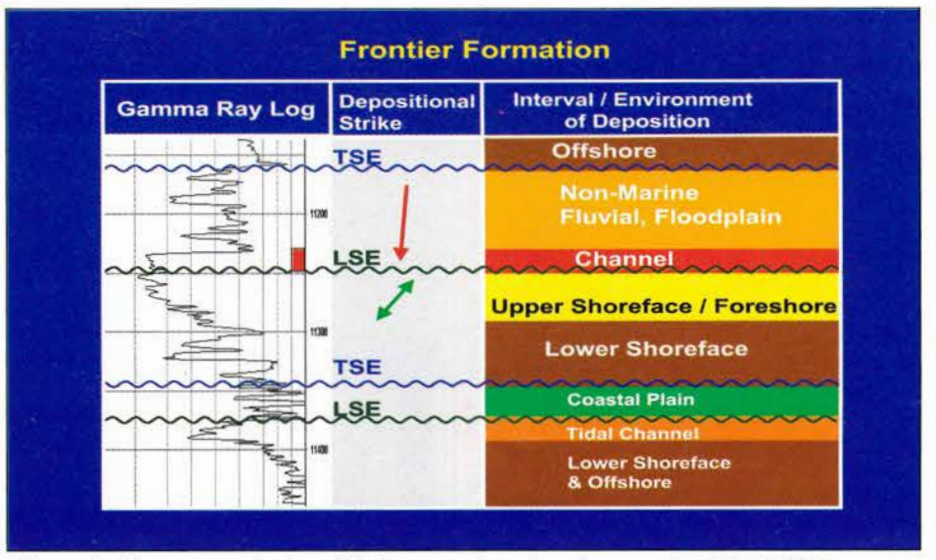
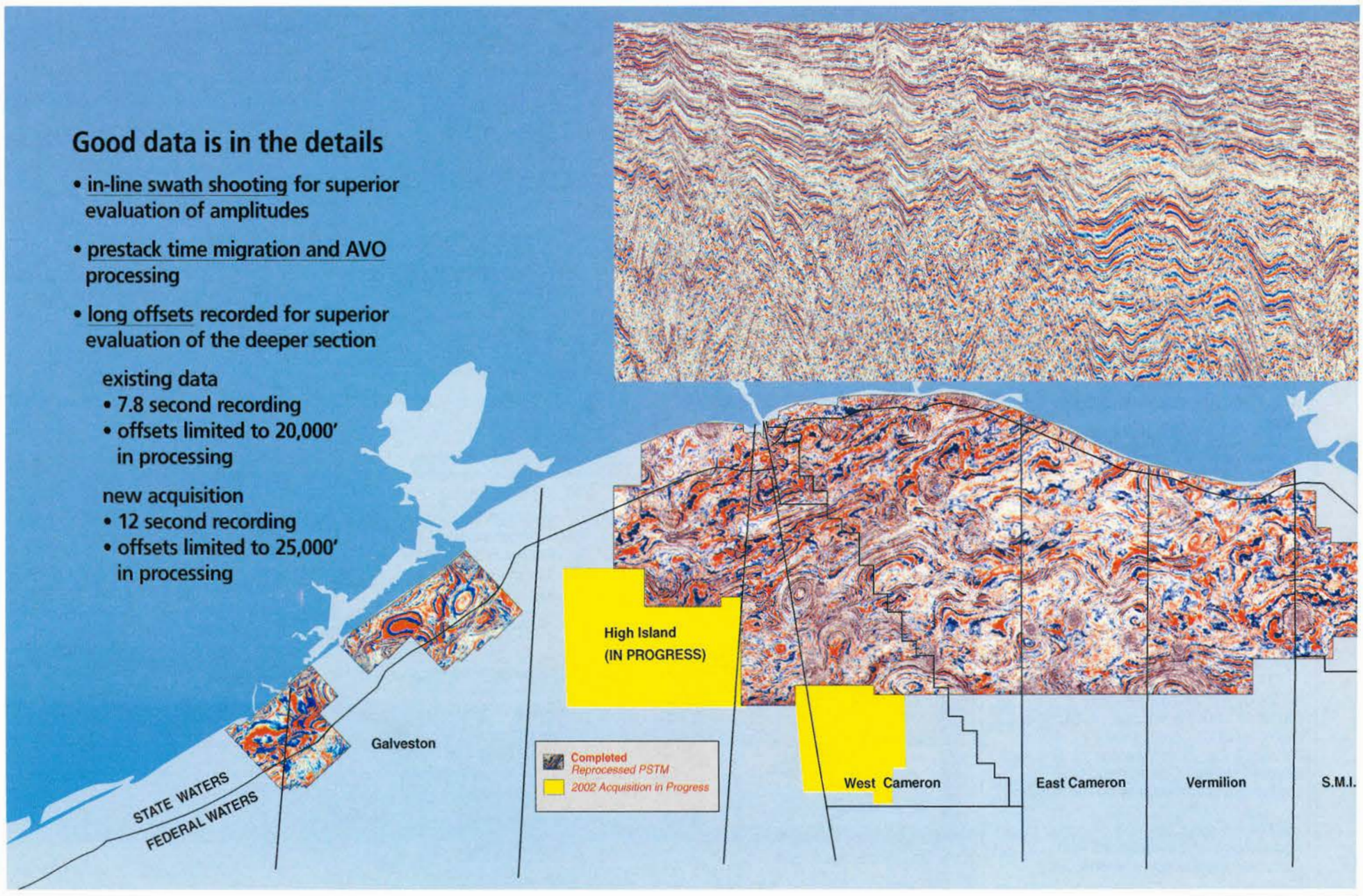


Figure 2 – Sequence stratigraphic framework and environments of deposition interpreted using borehole imagery. Each Transgressive surface of erosion (TSE) and Lowstand surface of erosion (LSE) is a sequence boundary.



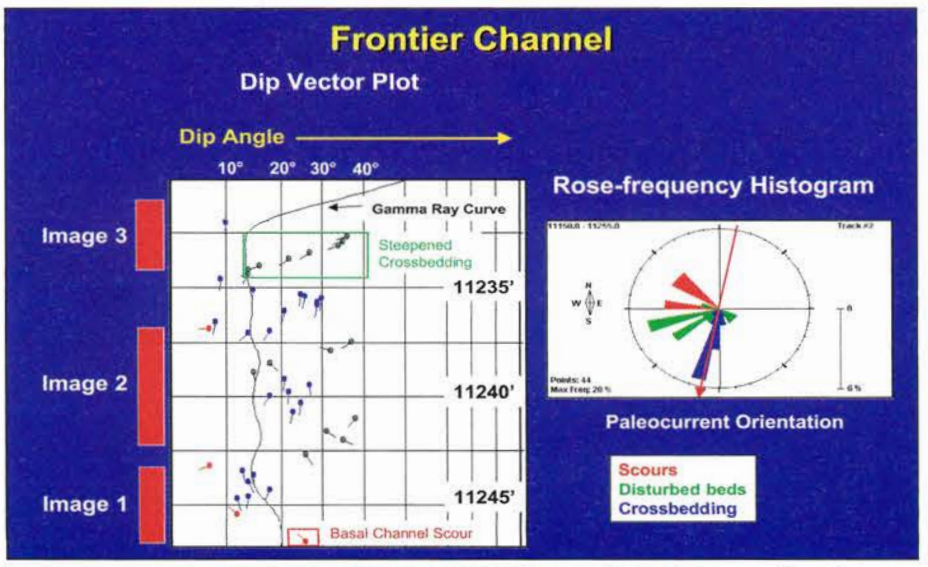


Figure 3 – A dip-vector plot and rose frequency diagram illustrate how sedimentary structures are used to interpret sandstone-body geology and paleo-current flow direction.

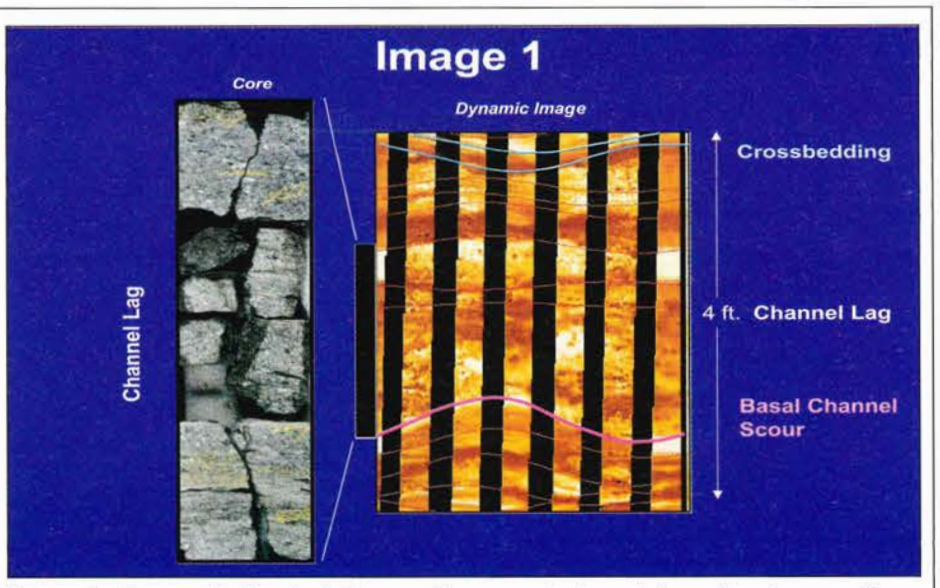


Figure 4 – Core and a borehole image of lowermost channel deposits referenced in figure 3.

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framework, and to delineate sandstone-body geometries and paleo-transport orientations.

Our case study well (figure 1) was drilled along the western limit of commercial Frontier gas production.

Figure 2 shows a gamma ray log and environments of deposition interpreted using borehole imagery. This well produces gas from upper shoreface, foreshore and fluvial sandstones, but the primary reservoir (highlighted with a red bar) is a channel sandstone deposited on a lowstand event (LSE).

The combination of core and high-resolution borehole imagery were used to better understand the reservoir geometry of this 15-foot thick reservoir.

Methodology and Sedimentology

All bedding structures were picked as dip vectors utilizing Vision™ software:

❒ The regional structural dip was determined.

❒ Bedding structures were interactively classified using DipInt interpretation software.

❒ Structural dips were rotated out for sedimentologic analyses.

The azimuths and dip angles of each vector population were then presented as dip-vector plots and rose-frequency diagrams so that the paleo-flow direction could be evaluated.

Figure 3 provides an overview of the sedimentologic analysis. Three categories of color-coded dip vectors are shown. The vertical positions of borehole image/core displays presented as figures 4 to 6 are shown.

Figures 4 through 6 present core and interpreted "dynamic" borehole images of the channel reservoir. Borehole microresistivity data can be displayed as either static or dynamic images. Dynamic images have variable contrast applied to the data in a small moving window in order to show subtle details more clearly.

Dynamic images are presented here because they were found to be more useful for identifying bedding features characterized by a limited resistivity contrast. On borehole images, planar bedding features that intersect the borehole are manifest as sine waves. Sine-wave amplitude is a function of bedding dip, such that steeper bedding dip angles correspond to steeper sine waves.

Figure 4 shows a channel lag deposit overlying a basal channel scour.

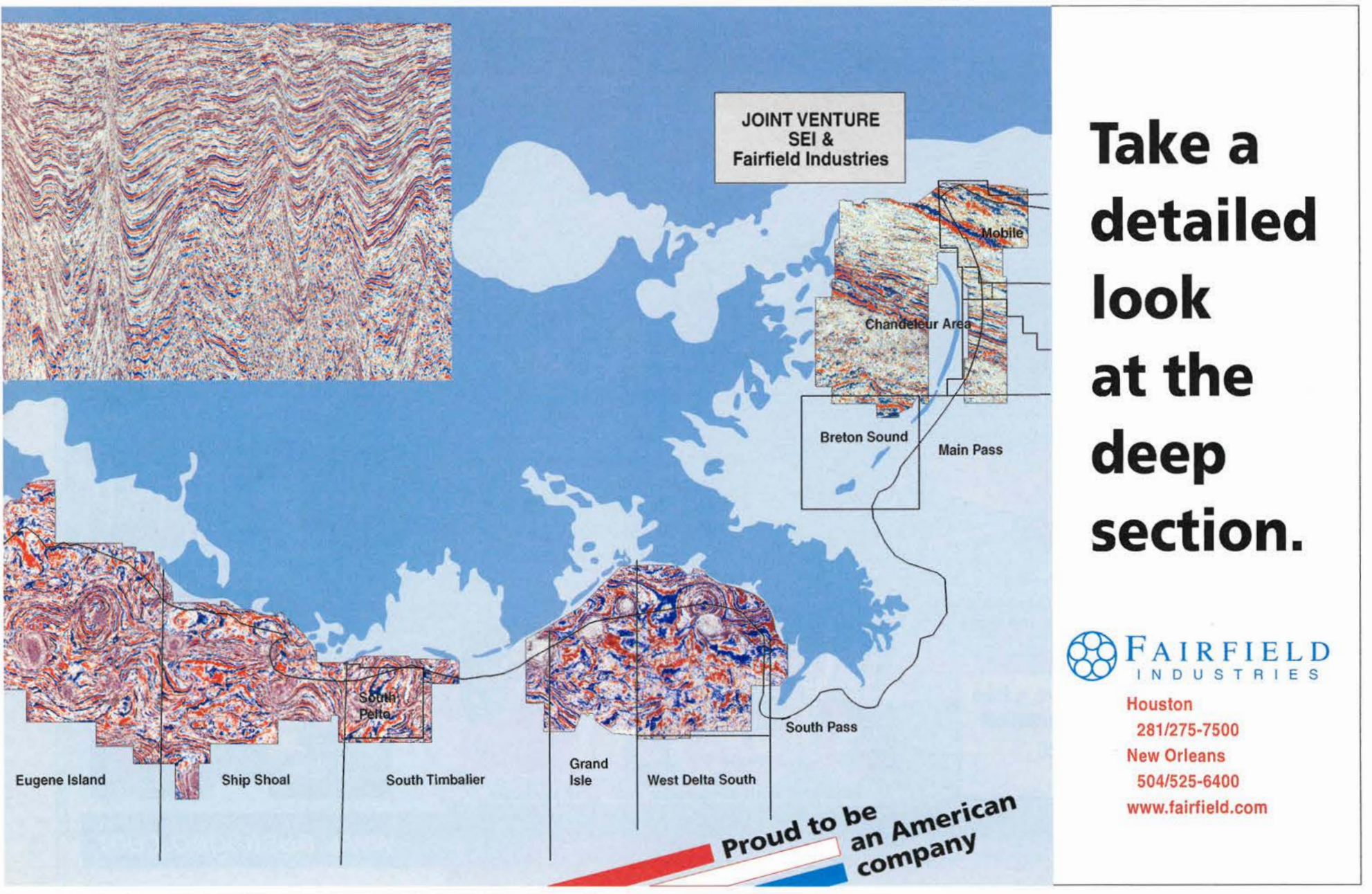
Referring back to figure 3, we see that the basal scour dips at an angle of approximately 25 degrees. The pebbly nature of the channel lag is discernable from both the core and the borehole image.

Figure 5 shows an image and core of carbonaceous material, crossbedding and a water-escape feature, all features characteristic of channel facies.

In figure 6, the core photo shows non-planar crossbedding, a channel lag deposit and upper mottled shale. The corresponding borehole image shows steeply dipping crossbeds, a channel scour, an overlying channel lag deposit and mottled shale. The steeply dipping crossbedding is also highlighted on figure 3.

Collectively all of these sedimentary

See **Borehole Images**, page 27



AAPG, Foundation Make Grants

Training Center Opens in London

A new center for the training and development of professional-level geoscience skills was dedicated at Imperial College, London, England, in February, the first international venture for AAPG-funded training centers.

It is one of six operating centers sponsored by AAPG, and the first to be located outside the United States.

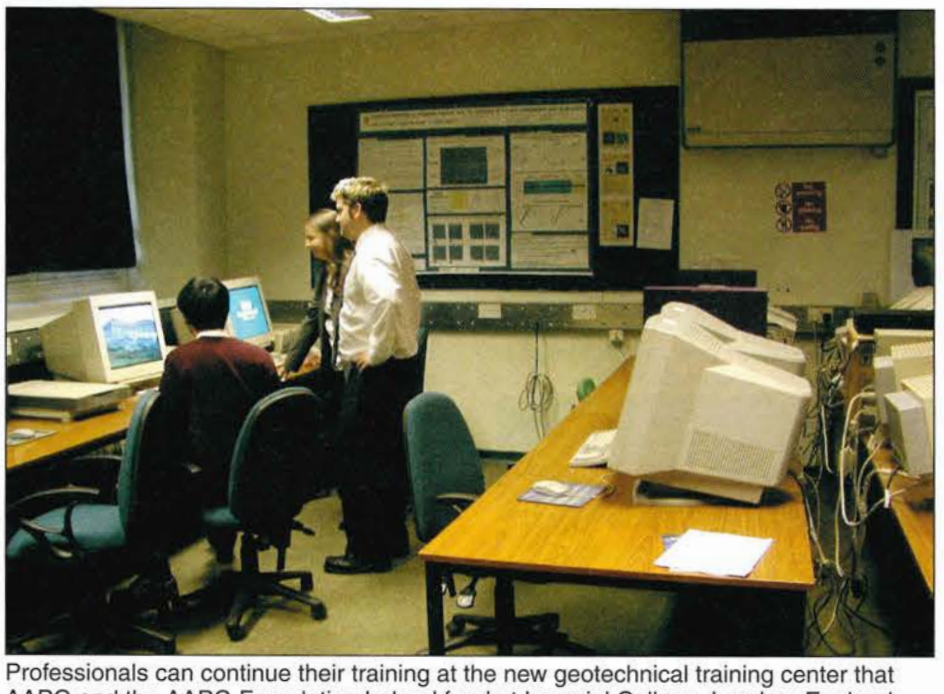
Also in November Foundation Trustees approved $25,000 as seed money toward a new mid-career training center in Canada. The "Canada Geoscience Technical Training Centre" will be located at the University of Calgary as part of its department of geology and geophysics.

The funds are aimed at creating the centers that focus on state-of-the-art training for mid-career geoscientists, and in some instances provides financial assistance for attendees.

AAPG has made gifts totaling $309,000 and the AAPG Foundation has donated an additional $246,500 to fund the training centers.

AAPG and the AAPG Foundation each provided $50,000 in seed funding for the London facility. An additional $10,000 was donated from the Society of Exploration Geologists. The Joint Association of Petroleum Exploration Courses has also donated £60,000.

The European Geoscience Technology Training Centre will offer a range of training courses to geologists, geophysicists and petroleum engineers at various points in their careers, using the latest and most relevant tools in petroleum exploration and development.



Professionals can continue their training at the new geotechnical training center that AAPG and the AAPG Foundation helped fund at Imperial College, London, England.

The Centre is a joint collaboration between Imperial College, the Geological Society and the Petroleum Exploration Society of Great Britain.

The Centre comprises three adjacent computer laboratories in the Royal School of Mines building at Imperial College's South Kensington campus. Two rooms are equipped with a total of 30 PC workstations and a Unix-based laboratory is equipped with 6 twin-screened workstations.

Software donations have been received from a range of service sector companies, including major donations from Schlumberger and Landmark Graphics.

Speaking at the opening ceremonies, AAPG President Robbie Gries highlighted the progress that had been made in the past by petroleum geologists who had been prepared to "Think Outside the Box," and how necessary it will be to continue if new reserves are to be identified and exploited.

AAPG has made gifts totaling $309,000 and the AAPG Foundation has donated an additional $246,500 to fund the training centers.

Other mid-career technology centers that have received funds from both AAPG and the AAPG Foundation include:

- Houston – North Harris College Geoscience Technology Training Center.
- Midland – Midland College Petroleum Geotechnology Training.
- Dallas – Ellison Miles Geotechnology Institute, at Brookhaven College.
- Golden, Colo. – Colorado School of Mines.
- Bakersfield, Calif. – Cal State University-Bakersfield. ❑

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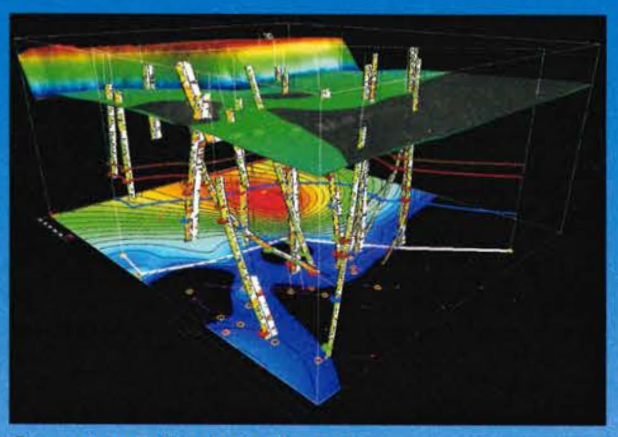
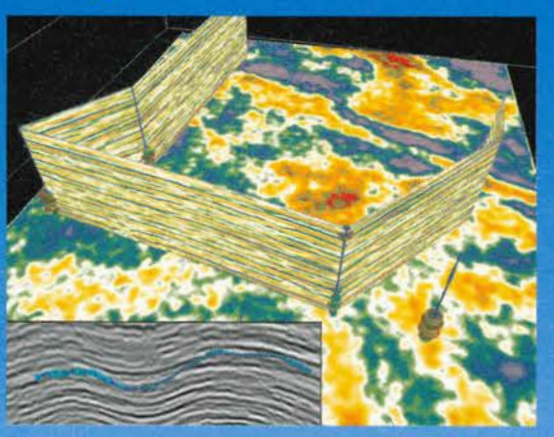
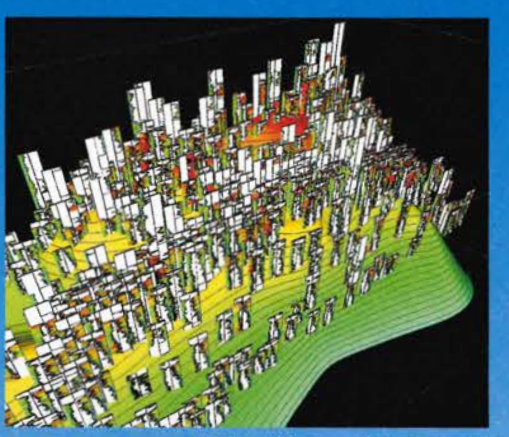


One-step seismic horizon adjustment to well logs



Correlate vertical and horizontal wells using seismic in 3-D



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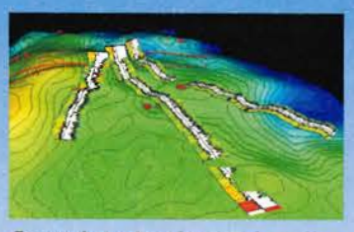

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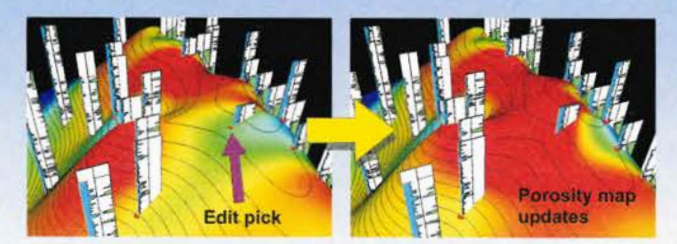

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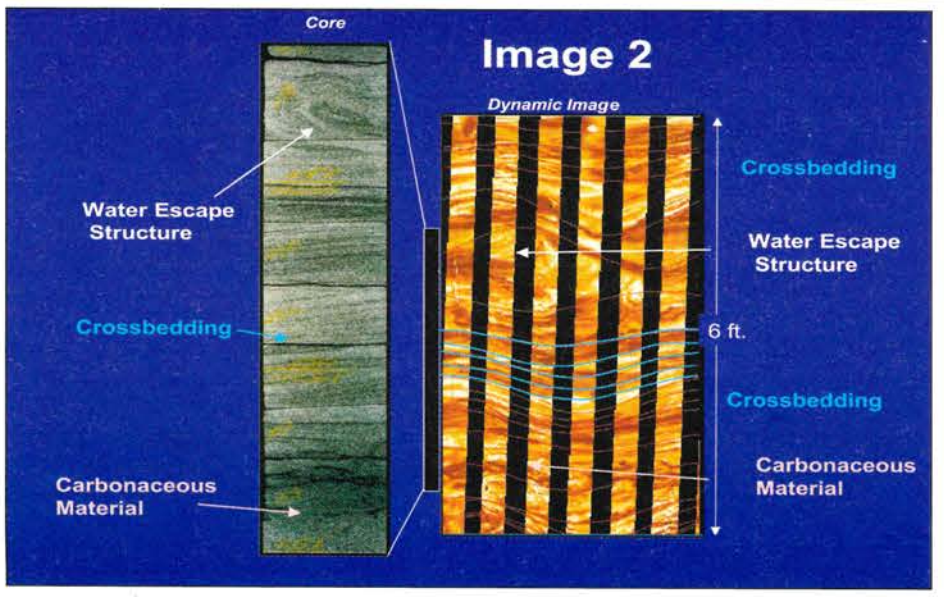

Figure 5 – Core and borehole image of middle channel deposits referenced in figure 3.

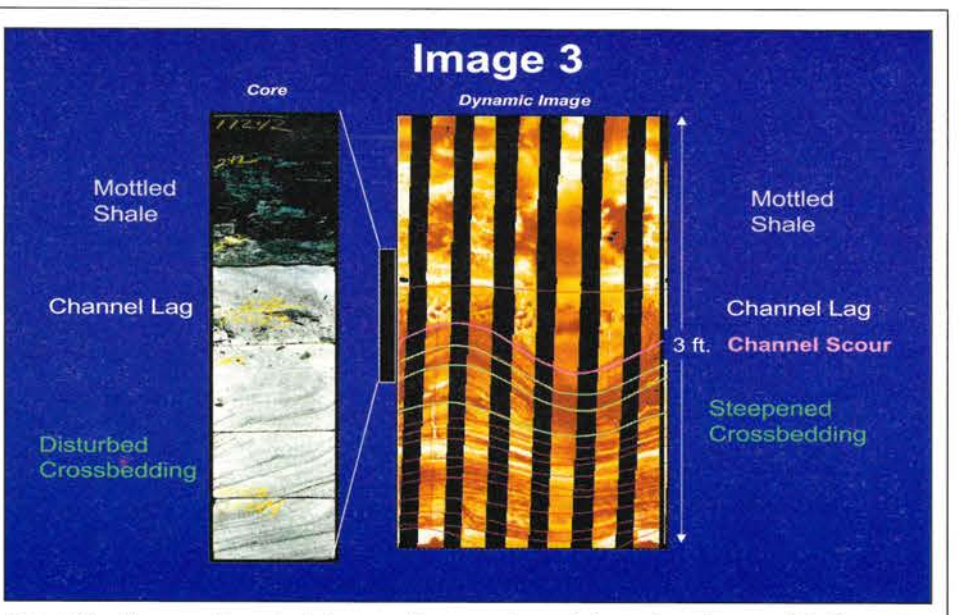

Figure 6 – Core and borehole image of upper channel deposits referenced in figure 3.

Borehole Images

from page 25

structures are used to interpret paleocurrent flow direction – but crossbedding dips are the best paleocurrent direction indicators. The rose-frequency histogram in figure 3 shows that crossbeds dip to the south-southwest. Disturbed beds and channel scours dip generally perpendicular to the paleocurrent flow direction.

The over-steepened crossbeds referenced earlier, which dip perpendicular to the crossbed dip direction, are interpreted as slumped material from cut-bank failure. In general, a southern paleo-flow direction is interpreted at this location.

Based on outcrop studies and other oriented well data, the overall regional Frontier paleo-flow direction has been interpreted to be from west to east. A southward flowing Frontier channel system at this location is significant, because it may represent an isolated depositional system that is yet not drained by existing development wells.

Borehole imagery will be used in this portion of the field to further evaluate reservoir geometry and extent.

Summary

High-resolution borehole imagery can be used to identify sedimentary structures and for defining paleo-current trends. Sedimentary structures visible in Frontier core are clearly evident on new high-resolution borehole images.

In our case study well, a southerly flow direction is interpreted that predicts an unexpected trend of local Frontier reservoir facies. Interpretation results will help identify future infill drilling locations to improve reservoir drainage.

(Editor's note: Knight is a consulting geologist in Golden, Colo. She interprets borehole images and integrates diverse data for prospect generation and field development. E-mail: cknight.99@alum.mines.edu)

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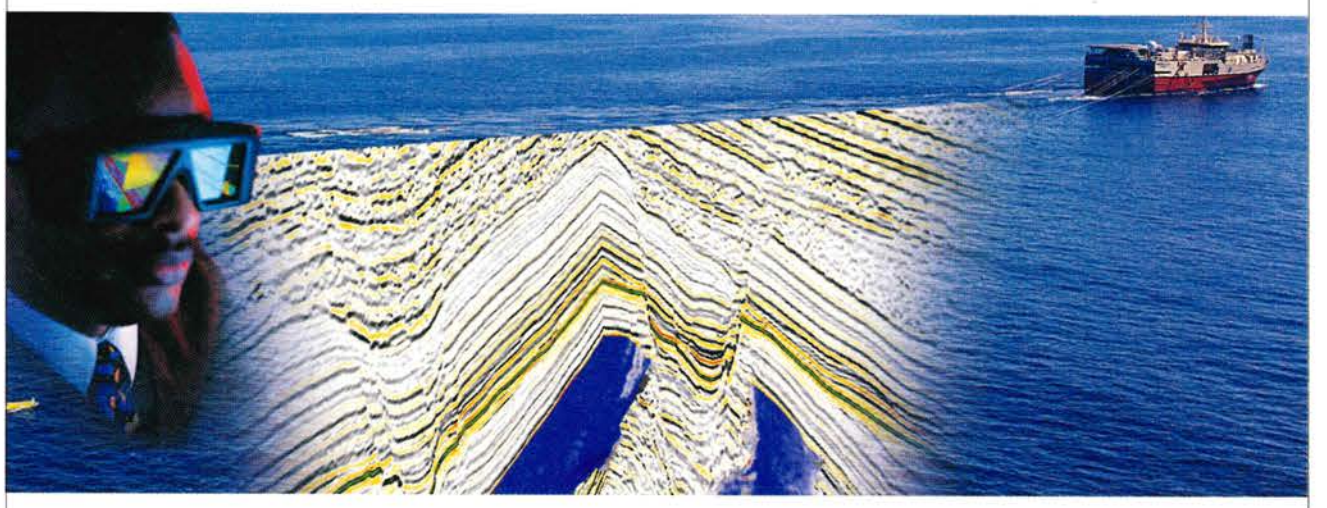

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INTERNATIONAL BULLETIN BOARD

Cairo Meeting Set For October 27-30

(Editor's note: This column is devoted to international items of note to the AAPG, including the activities of AAPG-related groups around the world.

News items, press releases and other information should be submitted to the EXPLORER/International Bulletin Board, P.O. Box 979, Tulsa, Okla. 74101; telephone – 918-560-2616; fax – 918-560-2684; or e-mail – dfree@aapg.org.

This month's column was prepared by John Dolson, David Blanchard and Samir Abdel-Moaty.)

Kom W. This Neolithic rubble pile of pottery shards and stone implements lay buried on the barren desert floor an hour south of Cairo, Egypt, in the Fayoum Basin.

Eight thousand years ago, this stone-age village thrived along the shoreline of ancient Lake Moeris, long since withdrawn miles to the south to what is now Lake Qarun. Lush grasses and vegetation rimmed a lake teaming with birds and other wildlife.

How do we know this? Thousands of flint sickle blades have been excavated in and around this site. Each sickle blade was attached to a stick with twine and tar. The tar must have come from the oil seeps of Gebel El Zeit, over 230 kilometers to the southeast along the shores of the Red Sea. A well-developed trade network and culture was already in place here when American Indians were nomadic hunter-gatherers.

Oil provided an important part of the Kom W people's natural resources.

* * *

"Ancient Oil – New Energy."

We can't think of a better theme for Cairo 2002, the international petroleum conference and exhibition that will be held in Egypt on Oct. 27-30.

Today, the bustling population of Cairo and large potential markets for hydrocarbons around the Mediterranean region continue to demand these resources:

❒ Giant gas fields are being discovered and developed in deep-water trends of the Nile Delta.

❒ LNG projects are under way.

❒ In the Red Sea, deep-water drilling is targeting elusive sub-salt reserves.

❒ The Gulf of Suez, a classic mature basin, and Western Desert continue to yield new discoveries and reserves, fueled in large part by the application of state-of-the-art seismic imaging and data integration.

This conference, however, is not just about Egypt. It covers the entire circum-Mediterranean, north and west African and Middle East region, with other sessions covering new discoveries in Australia and Indonesia.

It is also the first joint AAPG/EPEX/SEG/EGS/EAGE conference ever held. A robust program of 25 oral and poster sessions will yield up to 250 papers and 350 poster sessions. The sessions and short courses cover major themes such as technology trends, business challenges, gas marketplace strategies and the petroleum potential of frontier as well as mature basins and plays.

Technical sessions also bring critical technologies to the forefront. Topics to be covered include:

✓ Advances in petroleum systems.
✓ Horizontal drilling.
✓ Well completions.
✓ Techniques for exploring sub-salt.
✓ Unconventional plays in mature basins.
✓ Unraveling complex traps.
✓ Applications of geostatistics.
✓ Advances in logging.

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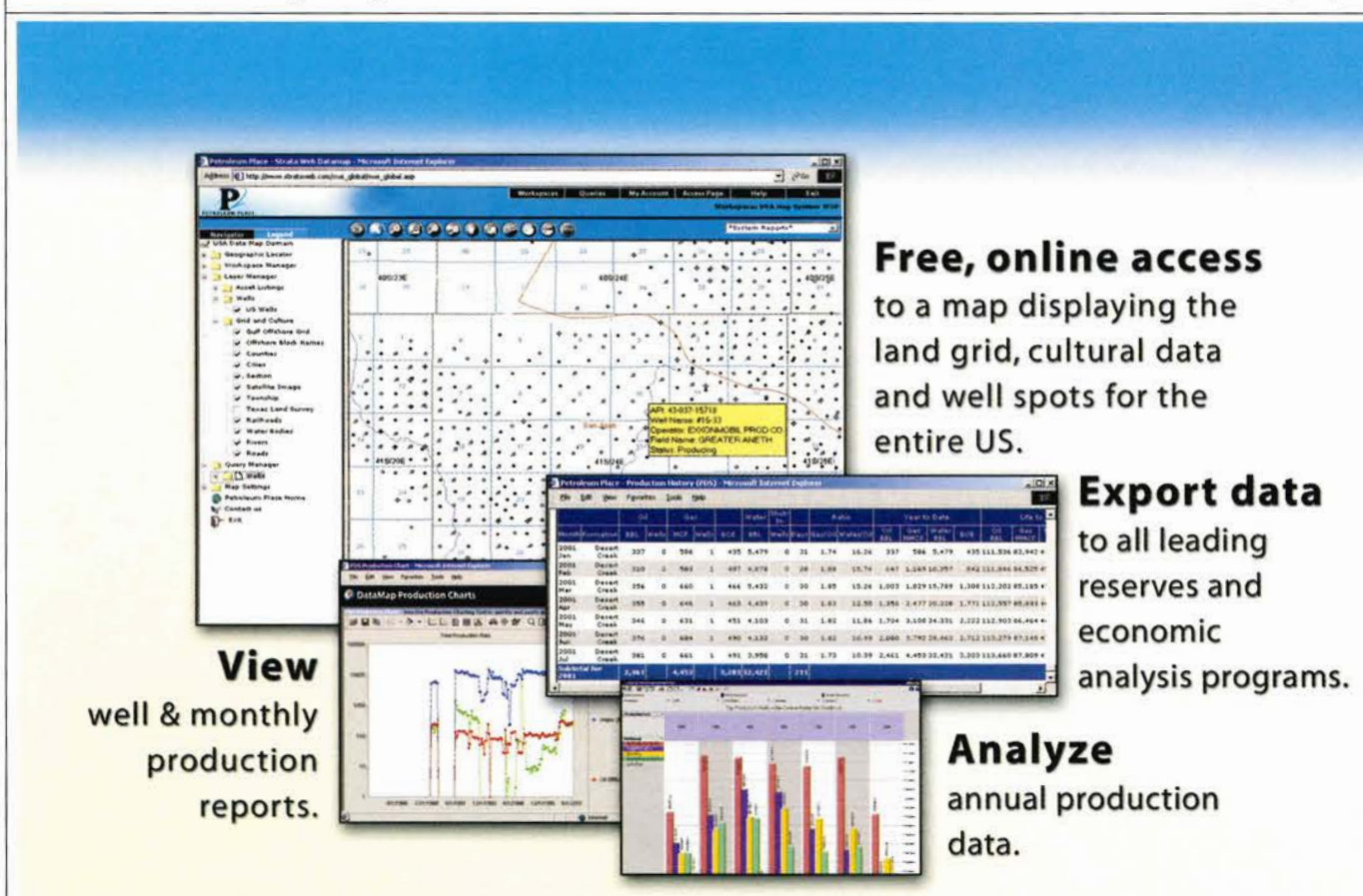

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Ten field trips and additional spouse events combine archeological, cultural and scenic stops with world-class geological exposures. Attendees are urged to arrive early and leave late for this conference, as the travel opportunities in Egypt and surrounding countries provide a spectacular venue for the entire family.

Pre-conference trips include:

✓ The Atlas Mountains of Morocco.

✓ Modern rift structure and stratigraphy of Kenya (plus spectacular wildlife vistas).

✓ The petroleum systems and archeology of Jordan (includes stops at Petra and crusader castles).

✓ The geology of the Pyramids.

✓ The Syrian Arc Jurassic inversion structures of North Egypt.

✓ The Eastern Sinai rift structure and stratigraphy.

The latter two trips end in Sharm El Sheik, with the further opportunity to scuba dive or snorkel in the Red Sea.

After the conference, try a trip to Bahariya and Farafra oases, combining an evening camel safari and Bedouin feast with exposures of Syrian Arc wrench faults and non-marine Upper Cretaceous sequence stratigraphy. Seismic scale, high resolution syn-tectonic rift sequence stratigraphy of the Sinai margin, Egypt, features a state-of-the art look at sedimentation in an active tectonic province (the trip also ends in Sharm El Sheik).

The Mesozoic carbonate systems of Oman provide another great trip, with an emphasis on fracturing, faulting and subsurface analogues.

If staying in Egypt, take the Cairo-to-Luxor field trip, examining Red Sea rift sedimentation and tectonics, snorkel on reefs at El Quseir, visit the oldest gold mines in the world and end in the spectacular Valley of the Kings at Luxor – with an option to go on to Abu Simbel on the following day.

Finally, a two-day trip to Whale Valley and the Fayoum Basin, Egypt, features desert scenery, a graveyard of 390+ fossil Eocene whales and sea cows, Neolithic, Pharonic and Greco-Roman ruins, petrified forests, Upper Eocene estuary deposits and ancient Pharonic basalt quarries.

Those who have ventured to far reaches of the planet will appreciate the unique experiences and insights that only the AAPG field trip leaders can provide. For those not so familiar with globe-trotting, there are a multitude of experiences in Cairo to satisfy your curiosity and provide the highest levels of comfort and security.

So get out your planners and block off late October and early November for a great conference and a chance to visit Egypt and surrounding areas!

One last note: The call for abstracts deadline is April 23.

For more information on attending, exhibiting, and/or sponsoring contact the AAPG Convention Department, telephone – (918) 560-2679; fax – (918) 560-2684; e-mail – convene@aapg.org or visit the AAPG Web site, www.aapg.org.

(Editor's note: Dolson is senior geological associate, BP-Egypt; AAPG Team Leader, Egypt; and field trip chair, Cairo 2002. Blanchard is exploration and asset manager, Ocean Egypt Companies, and vice chair, Cairo 2002. Abdel-Moaty is exploration manager, Nile Delta, BP-Egypt, and vice chair, Cairo 2002.)

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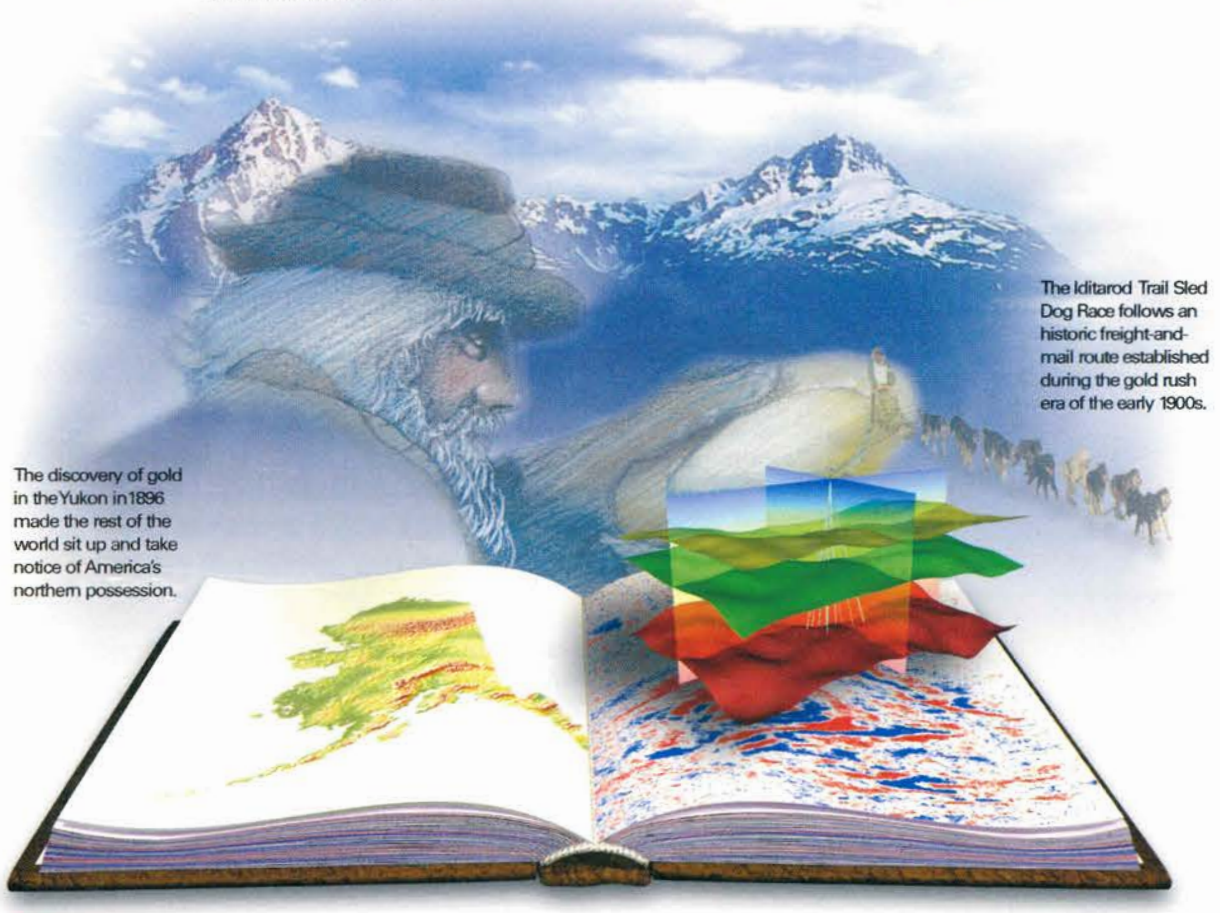

The Iditarod Trail Sled Dog Race follows an historic freight-and-mail route established during the gold rush era of the early 1900s.

The discovery of gold in the Yukon in 1896 made the rest of the world sit up and take notice of America's northern possession.

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PROFESSIONAL NEWS BRIEFS

Wayne C. Ackerman, to senior reservoir engineer, Shell International E&P, The Hague, Netherlands. Previously principal project manager, Gas Technology Institute, The Woodlands, Texas.

Tony H. Almond, to senior explorationist, Sandalwood Oil and Gas, Houston. Previously exploration geologist, Lee, Hite & Wisda Ltd., Houston.

Pratt Barndollar, to frontiers exploration manager, Devon Canada, Calgary, Canada. Previously chief geophysicist, Samson Canada, Calgary.

Kevin Beacom, to president, EKB Resources, Pine, Colo. Previously general manager-Denver operations, System Technology Associates, Denver.

Harry Bockmeulen, to business development director, Williams International, London, England. Previously consultant, Caracas, Venezuela.

William E. Crain has received the William B. Heroy Jr. Award for Distinguished Service from the American Geological Institute. Crain retired in 1994 as vice president of Chevron's worldwide exploration and production activities. He is a consultant in Danville, Calif.

Eric Frodesen, to geological advisor-international exploration, Kerr-McGee, Houston. Previously senior staff explorationst-international, Texas Star Oil and Gas, Houston.

Rich Frommer, to senior geologist, Samson Resources, Denver. Previously with HS Resources/Kerr-McGee Rocky Mountain, Denver.

Lee Gerhard has been elected to the Kansas Oil and Gas Hall of Fame, located in El Dorado, Kan. Gerhard is principal geologist with the Kansas Geological Survey, Lawrence, Kan.

Mark E. Hargis, to geoscience manager, Legend Natural Gas, Houston. Previously district geologist, Pogo Producing, Houston.

Dean Hennings, to Murchison subsurface manager, Kerr-McGee North Sea (UK), Aberdeen, Scotland. Previously senior geophysicist, Kerr-McGee North Sea (UK), Aberdeen.

Brian Horsfield, to professor of organic geochemistry and hydrocarbon systems, Technical University of Berlin, Germany, and leader of the organic geochemistry and hydrocarbon systems research group, GeoForschungsZentrum, Potsdam, Germany. Previously with Forschungszentrum, Juelich, Germany.

James S. Kwasny, to senior geological engineer, Shell E&P, Houston. Previously senior geologist, North Central Oil Corp., Houston.

Kenneth Mohn, to exploration vice president, Fugro Geosciences, Houston. Previously with TGS-CALIBRE Geophysical, Houston.

Denis Mougenot, to chief geophysicist, Sercel, Nantes, France. Previously area geophysicist, Argas, Dhahran, Saudi Arabia.

David H. Murphy, to assistant field manager, mineral and lands, U.S. Bureau of Land Management Kemmerer Field Office, Kemmerer, Wyo. Previously geologist, U.S. Bureau of Land Management Winnemucca Field Office, Winnemucca, Nev.

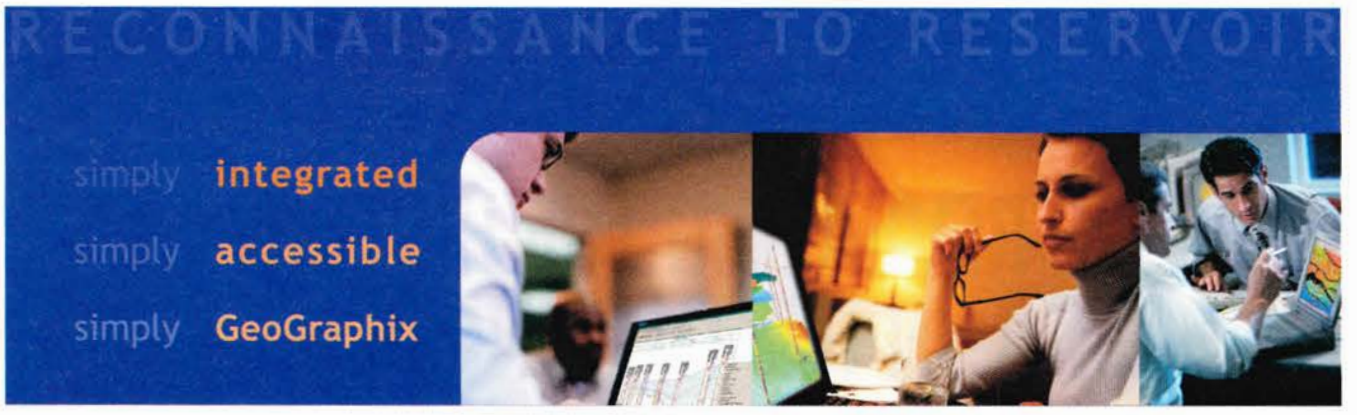
Benjamin J. Sloan, to exploration geologist, Southern Africa new ventures, ChevronTexaco, San Ramon, Calif. Previously geologist, Angola exploration, Texaco, Bellaire, Texas.

Conrad Todd, to principal geoscientist, Resource investment Strategy Consultants, Perth, Australia. Previously exploration manager, Lundin Malaysia Ltd., Kuala Lumpur, Malaysia.

Bill Torguson, to geological advisor, Devon Energy, Houston. Previously senior staff geologist, Mitchell Energy, The Woodlands, Texas.

Richard A. Wasteneys, to consultant, international exploration and production, Port Townsend, Wash. Previously associate partner, energy strategy practice, Accenture, Houston.

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



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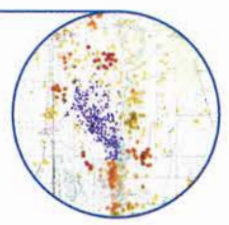

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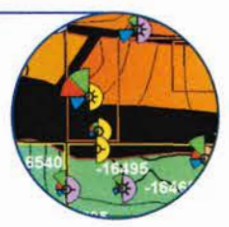

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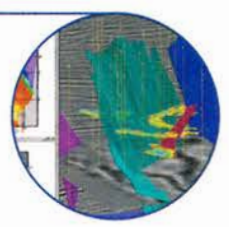

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Thomas Named Geoscience Director

John B. "Jack" Thomas has been named AAPG geoscience director, assuming the position held on an interim basis by John Shelton since January.

Thomas has been an active consultant since his retirement from BP Amoco in 1999. His career with Amoco included assignments in exploration and production, research and technical risk evaluation, manager of coalbed methane exploration and manager of the Integrated Studies Section and supervisor of the Petrophysics Research and Training Group.

He previously was a partner and director with Reservoirs Inc. in Denver; an exploration geologist with Mobil in various locations; and also has taught at College of William and Mary and the University of Oklahoma, where he also earned his doctorate.

He holds bachelor's and master's degrees from Miami and Ohio Universities.

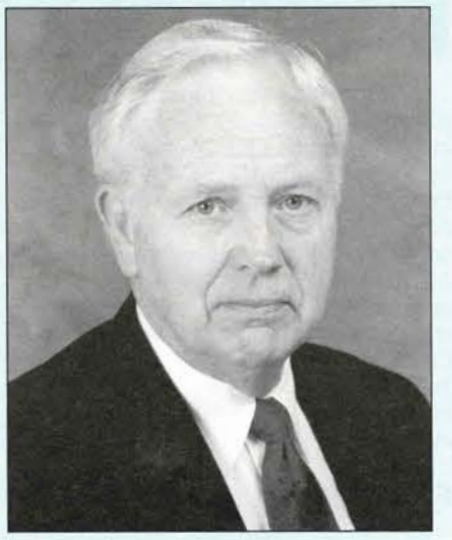
He has published more than 24 works on petrology, clay mineralogy, petrophysics and reservoir studies.

A member of AAPG since 1965, Thomas has served on the Education, Distinguished Lecture and Publication committees.

As geoscience director, Thomas will oversee the activities of the education department, scientific publications and the BULLETIN, as well as AAPG Datapages.

AAPG's geoscience department has been restructured since January, when Shelton accepted the interim leadership. As Executive Director Rick Fritz noted in his February column, changes were made to modernize the operation for maximum efficiency to prepare for AAPG's digital future.

Geoscience has been divided into three departments: production, services and marketing. ❑



Thomas

Nummedal Starts DL Tour In Amsterdam

AAPG continues its 2001-2002 season of international Distinguished Lecturer series in April, as Dag Nummedal begins a two-week tour of western Europe.

Nummedal, with the Institute for Energy Research's Department of Geology and Geophysics, University of Wyoming, Laramie, and also the current president of SEPM, will be offering three lectures:

✓ Falling Stage Systems Tract in Siliciclastic Systems and Its Control on Reservoir Architecture and Exploration Strategies.

✓ Hydrocarbons of the South Caspian Basin: How Exploitation Depends on the Understanding of the Neogene Paleoclimate.

✓ Internal Tides and Bedforms at the Shelf Edge.

During his tour, which begins April 15 and ends May 1, Nummedal's scheduled stops include:

- ❒ Amsterdam, Netherlands.
- ❒ Zurich, Switzerland.
- ❒ Bonn, Germany.
- ❒ Berlin, Germany.
- ❒ Copenhagen, Denmark.
- ❒ Stavanger, Norway.
- ❒ Bergen, Norway.
- ❒ Oslo, Norway.
- ❒ Madrid, Spain.
- ❒ London, England.
- ❒ Southampton, England.

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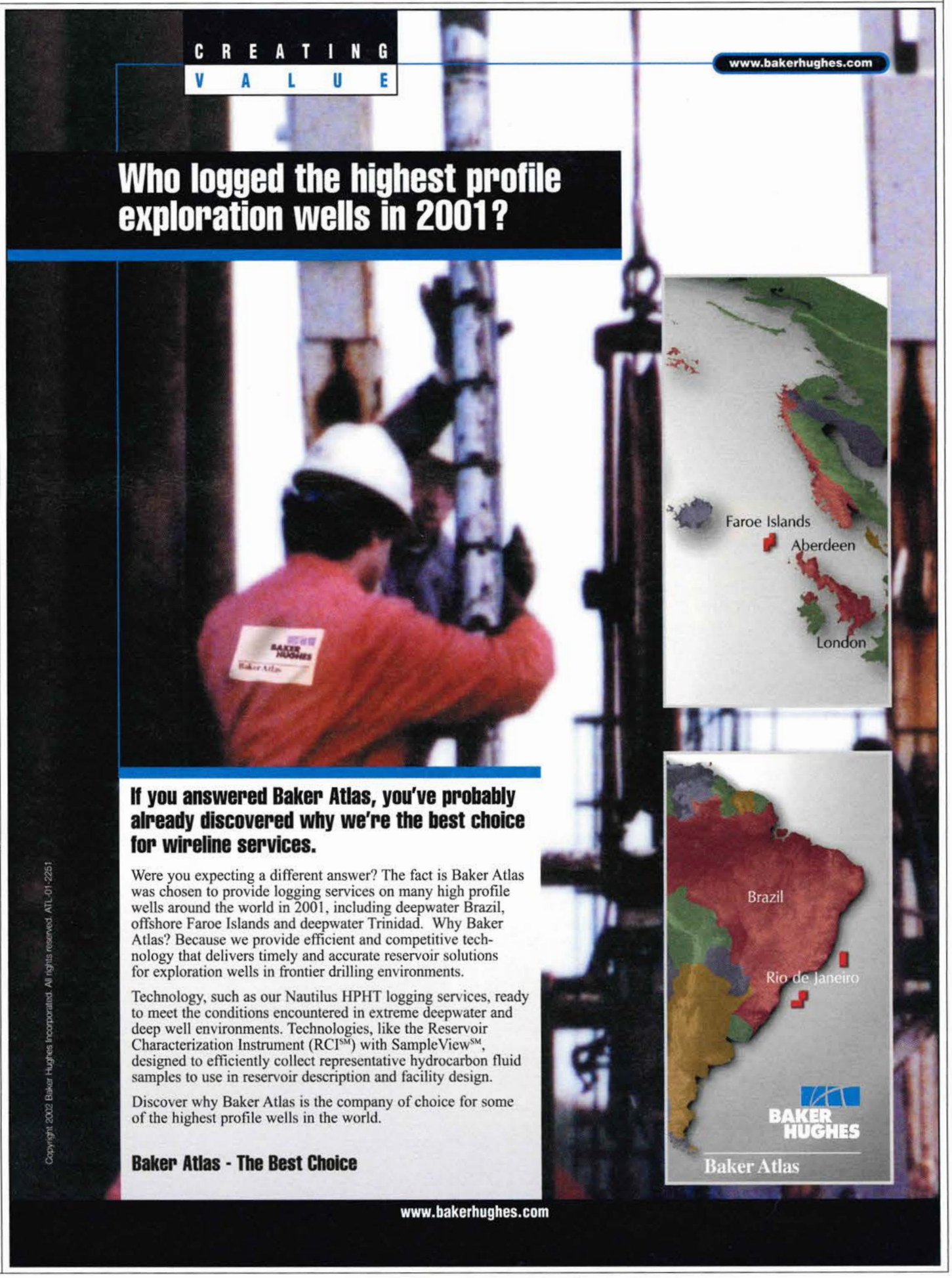

MEMBERSHIP AND CERTIFICATION

The following **candidates** have submitted applications for membership in the Association and, below, certification by the Division of Professional Affairs. This does not constitute election, but places the names before the membership at large. Any information bearing on the qualifications of these candidates should be sent promptly to the Executive Committee, P.O. Box 979, Tulsa, Okla. 74101. (Names of sponsors are placed in parentheses. Reinstatements indicated do not require sponsors.)

For Active Membership

California
Naidoo, Devamonie D., ChevronTexaco Overseas, San Ramon (C.F. Kluth, D.A. Medwedeff, G. Schoenborn)

Colorado
Goodier, William Richard, retired, Littleton (Reinstate); **Weber, Jeffrey L.**, Fidelity Exploration & Production, Denver (Reinstate)

Louisiana
Caswell, Scott E., Delta-T Geophysical Consultants, Shreveport (J.R. White Jr., P.L. Lakin, G.J. Zerrahn); **Ellison, Guy Cornwell**, Eloil Ltd., Lafayette (Reinstate)

New York
Rasbury, E. Troy, SUNY Stony Brook, Stony Brook (A.H. Saller, G.M. Grammer, P.M. Harris)

Ohio
Grubaugh, William A., CGAS Exploration, Columbus (J.C. Olds, P. Mackenzie, L.H. Wickstrom); **Venteris, Nicole Lee**, CGAS Exploration, Columbus (L.H. Wickstrom, P. Mackenzie, J.L. Forman)

Texas
Archer, Robert Adam, Knowledge Reservoir, Houston (J.M. Yarus, R.L. Chambers, M.L. Sweet); **Beltran, Martha Z.**, Geoquest-Schlumberger, Houston (G.E. Stachura, J.S. Enos, P.R. Morelos); **Brownlee, Diane Kathleen**, Brookhaven College, Dallas (L.S. Pittman, N. Kumar, J.D. Robertson); **Butaud, Todd W.**, Anadarko Petroleum, Houston (Reinstate); **Grantham, Randie Lane**, Kerr-McGee Oil & Gas, Houston (B.O. Clear, H.J. White, L.L. Warner III); **Klopf, Thomas Robert**, consultant, Kingwood (Reinstate); **Lundquist, Jason**, BP, Houston (S.C. Barnette, J.H. Gamber, R.L. Boyce); **Sabalburo, Eugenio Luis R.**, Halliburton, Houston (Reinstate); **Soelistyo, Tony Basoeki**, Unocal Indonesia BPP, Sugar Land (M.C. Boehm, Y.J. Partono, S.W. Reksalegora); **Wherry, Stephen Douglas**, Marathon Oil, Houston (Reinstate); **Willis, Brian J.**, Texas A&M University, College Station (Reinstate); **Wilson, Aaron Bailey Jr.**, Marathon Oil, Midland (Reinstate)

Wyoming
Garcia-Gonzalez, Mario, IER-University of Wyoming, Laramie (D. Nummedal, R.J. Steel, R.C. Surdam)

Argentina
Viera, Atilio Fernando, Pluspetrol E&P, Buenos Aires (D.A. Kokogian, C.E. Cruz, M.E. Rosso)

Australia
Zurcher, Derick, Geoservices, Adelaide (S.C. Lang, D.A. Cooke, G.L. Parsons)

Azerbaijan
Huseynov, Vugar Namaz, SOCAR, Baku (S.M. Mamedova, A.A. Narimanov, I.F. Guliev)

Brazil
Bruhn, Carlos Henrique, Petrobras/E&P-Corp/Engp/CR, Rio de Janeiro (P.V. Zalan, R. Mosmann, N.C. Azambuja Filho)

Canada
Al-Aasm, Ihsan Shakir, University of Windsor, Windsor (R.A. Rahmani, F.J. Longstaffe, G. Masson); **Hu, Yuanxian Greg**, Petro Canada, Calgary (R.J. Knight, P.D. Flach, Q. Liu); **Johnson, Christina Louise**, Anadarko Canada, Calgary (J.P. Collazos, M.J. Jennings, D.H. Krentz); **Liu, Shumin**, Devon Canada, Calgary (J.W. Pelletier, R.C.M. Gunn, R.E. Moulton); **Williams, Dean Adam**, Pioneer Natural Resources Canada, Calgary (D.A.D. Scott, J.L. Spring, T.A. Dillabough)

England
Ali, Gholipour, BHP Billiton, London (P.N. Samson, P.E. McIntosh, R.A. Hill)

France
Masset, Jean-Marie, TotalFinaElf, Paris (Reinstate)

Philippines Republic
De Leon, Marietta Moraleda, National Institute of Geological Sciences, Quezon City (R.A. Reyes Jr., A.A. Morado Jr., F.A. Navarro)

Republic of Croatia
Durekovic, Miro, INA-Naftaplin, Zagreb (L. Dubravko, Z. Hernitz, Z. Ivkovic)

Russia
Ablia, Enver Alekseevich, Moscow University, Moscow (R.R. Gries, V.G. Kuznetsov, N.V. Koronovsky)

Certification

The following are **candidates** for certification by the Division of Professional Affairs.

Petroleum Geologist

Texas
Brehm, Dwight E., Scope Operating, Fort Worth (C.A. Mitchell, P.M. Caserotti, R.G. Green); **Desautels, David Albert**, Occidental, Houston (S.W. Stearns, J. Conklin, J.C. Corbett)

Petroleum Geophysicist

Colorado
Thomasson, M. Ray, Thomasson Partner Associates, Denver (R.R. Ray, J.E. Blott, E. Berg)

Texas
Gregg, Mark Endacott, Kiwi Energy, Houston (Society of Professional Earth Scientists)

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MEETINGS OF NOTE

Editor's note: Meetings listed here are sponsored by AAPG or an affiliated group. An asterisk denotes a new or changed listing. For further information on these listings contact the AAPG convention department (convene@aapg.org)

Also, a comprehensive list of earth science meetings is maintained by the American Geological Institute on its Web site, which can be accessed via a link from AAPG's Web page (www.aapg.org).

Groups are urged to check the list before scheduling meetings, both to avoid conflicts and to report meetings that are scheduled.

2002 U.S. Meetings

May 1-4, Society of Independent Earth Scientists, annual meeting, Lafayette, La.

May 6-9, Offshore Technology Conference, Houston.

* May 18-23, Pacific Section, AAPG, annual Section meeting (with the Society of Petroleum Engineers)z, Anchorage, Alaska.

June 6-8, Southwest Section, AAPG, annual Section meeting, Ruidoso, N.M.

Aug. 27-29, APPEX (AAPG Prospect and Property Exposition), AAPG, Houston.

Sept. 8-11, Rocky Mountain Section, AAPG, annual Section meeting, Laramie, Wyo.

Sept. 29-Oct. 2, Society of Petroleum Engineers, annual meeting, San Antonio.

Oct. 2-4, Eastern Section, AAPG annual Section meeting, Champaign, Ill.

Oct. 6-11, Society of Exploration Geophysicists, annual meeting, Salt Lake City.

Oct. 27-30, Geological Society of America, annual meeting, Denver.

Oct 30-Nov. 1, Gulf Coast Section of Geological Societies, AAPG, annual Section meeting, Austin, Texas.

2002 International Meetings

April 15-17, GEO2002 Conference, Bahrain.

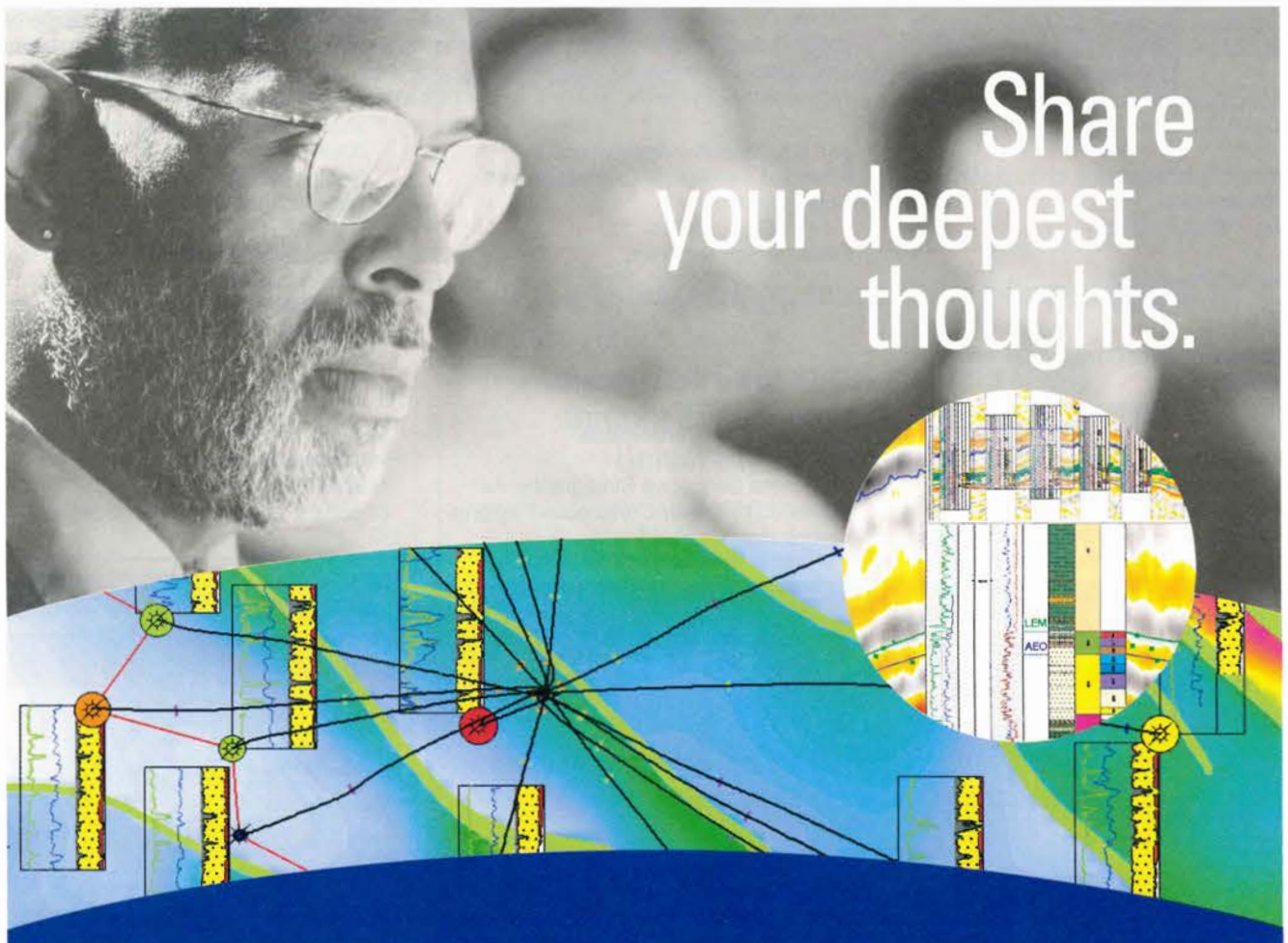
May 26-29, Geologic Association of Canada/Mineralogical Association of Canada, annual meeting, University of Saskatchewan, Saskatoon, Canada.

May 27-30, European Association of Geoscientists and Engineers, annual meeting, Florence, Italy.

June 2-6, Society of Professional Well Log Analysts, annual meeting, Oiso, Japan.

June 3-7, Canadian Society of Petroleum Geologists, annual meeting, Calgary, Canada.

Aug. 31-Sept. 4, Society for Organic Petrology/Canadian Society for Coal and Science and Organic Petrology, joint annual meeting, Banff, Canada.



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EDUCATION CALENDAR

2002 SCHOOLS AND SHORT COURSES

Fractured Reservoir Characterization and Modeling
April 22-26, Austin, Texas

Reservoir Characterization: Principle Methods and Case Studies
May 2-3, Houston

High-Resolution Well-Log Sequence Stratigraphy
May 13-17, Denver

Reservoir Engineering for Petroleum Geologists
June 17-18, Houston

Applied Subsurface Mapping
July 8-12, Dallas

An Overview of Exploration Play Analysis
July 22-24, Dallas

Well Log Analysis & Formation Evaluation
Aug. 6-9, Austin

Probability and Statistics for Exploration and Exploitation
Aug. 19-21, Houston

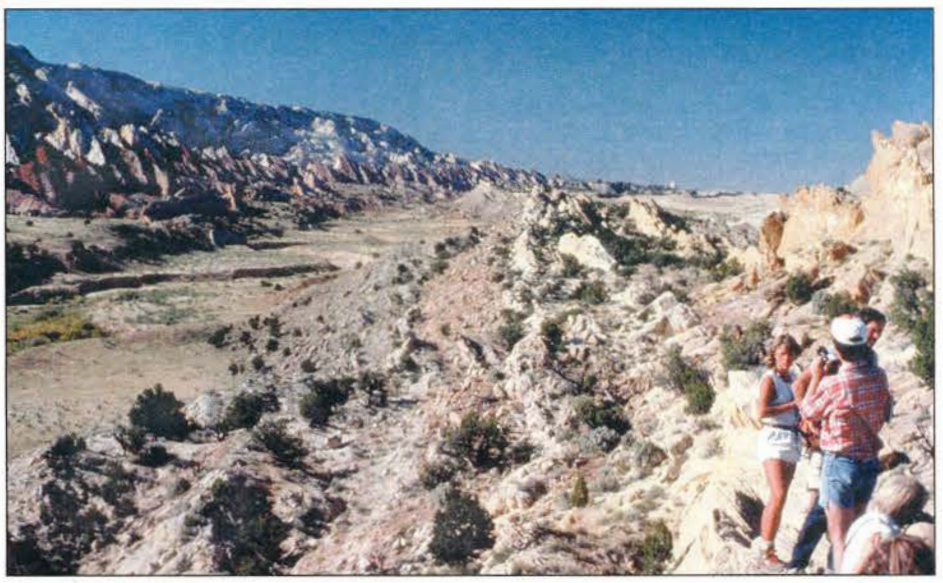
Quantification of Risk
Nov. 11-14, Dallas

Characterization of Compartmentalized Reservoirs
Sept. 23-27, Houston

Structural Styles and Traps
Oct. 5-6, Salt Lake City
(With the SEG annual meeting)

Terrigenous Clastic Depositional Systems and Sequences – Applications to Reservoir Prediction, Delineation and Characterization
Oct. 21-22, Dallas

Practical Salt Tectonics
Oct. 29-30, Austin, Texas
(with GCAGS Section meeting)



A chance to view the architectures of river-dominated deltas and the meanderbelts that fed them will be offered in the AAPG field seminar "Clasitic Reservoir Facies and Sequence Stratigraphic Analysis of Alluvial-Plain, Shoreface, Deltaic and Shelf Depositional Systems," offered April 21-27. Above, the Waterpocket Fold.

2002 FIELD SEMINARS

Carbonates

Carbonate Sequence Stratigraphy, As Illustrated by Lower Cretaceous Platform Carbonates, Central Texas
April 8-12
Begins in San Antonio
Ends in Austin, Texas

** Carbonate Reservoirs: Physical Reality Meets Virtual Reality in Middle Eastern Carbonates
April 10-14
Begins, ends in Muscat, Oman
(with GEO/2002, Manama, Bahrain)

Controls on Porosity Types and Distribution in Carbonate Reservoirs
June 2-7
Begins, ends in Almeria, Spain

Sequence Stratigraphy and Reservoir Distribution in a Modern Carbonate Platform, Bahamas
June 24-29
Begins, ends in Miami, Fla.

** Syntectonic Carbonate Sedimentation in Extensional Regimes: Seismic Profile Analyses and Outcrop Analogues from the Atlas Mountains
Sept. 22-28
Begins in Rabat
Ends in Fez, Morocco

Arid Coastline Depositional Environments
Nov. 3-9
Begins, ends in Abu Dhabi, U.A.E.

Clastics – Ancient

Clastic Reservoir Facies and Sequence Stratigraphic Analysis of Alluvial-Plain, Shoreface, Deltaic and Shelf Depositional Systems
April 21-27
Begins, ends in Salt Lake City

Wave-Dominated Shoreline Deposits, and Sea-Level Change, Book Cliffs, Utah: Depositional Models for Hydrocarbon Exploration
June 10-18; Aug. 19-27
Begins, ends in Moab, Utah

Clastics – Modern

Modern Clastic Depositional Environments
April 24-30, May 23-29, Oct. 2-8
Begins in Columbia, S.C.
Ends in Charleston, S.C.

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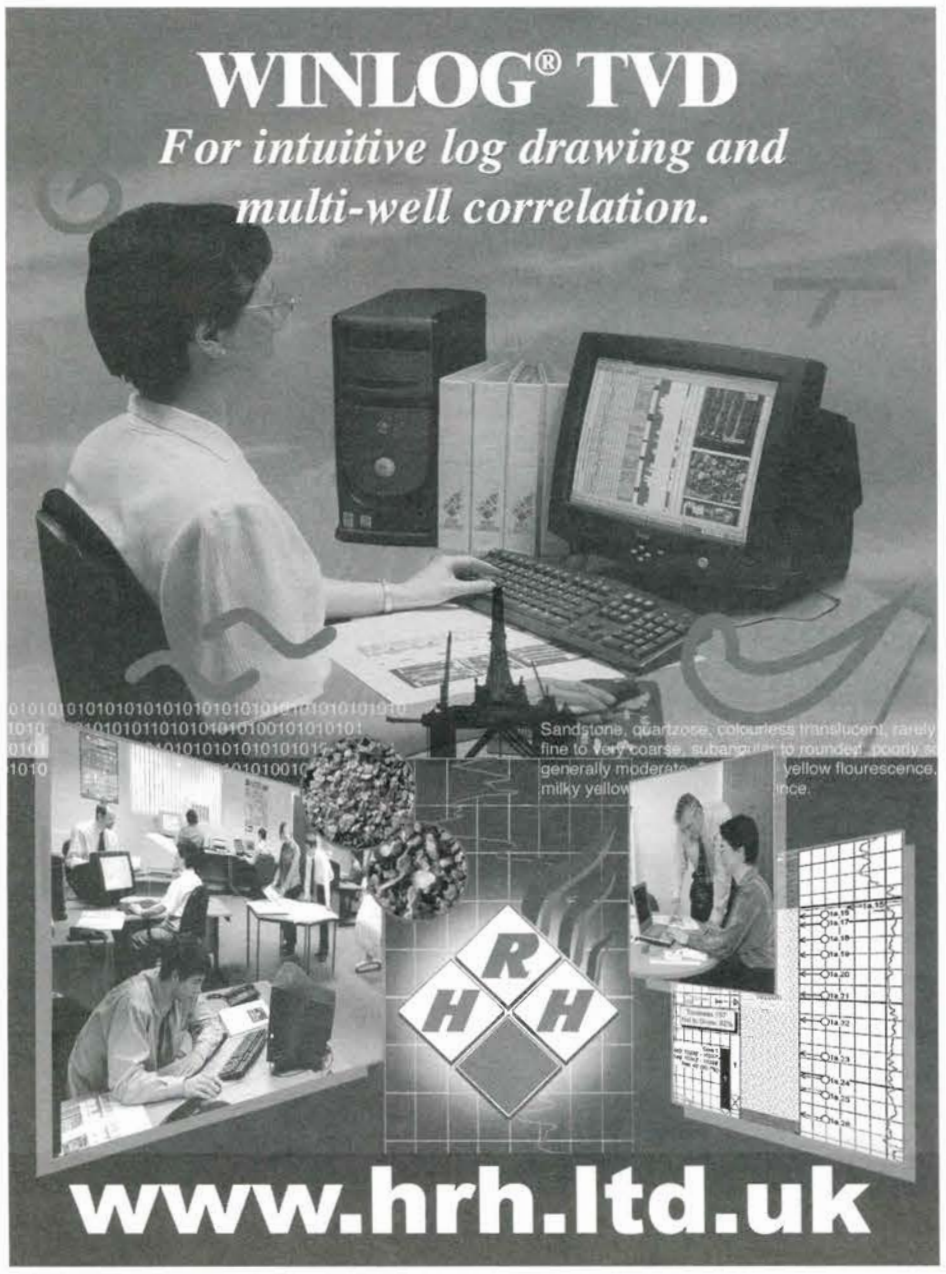

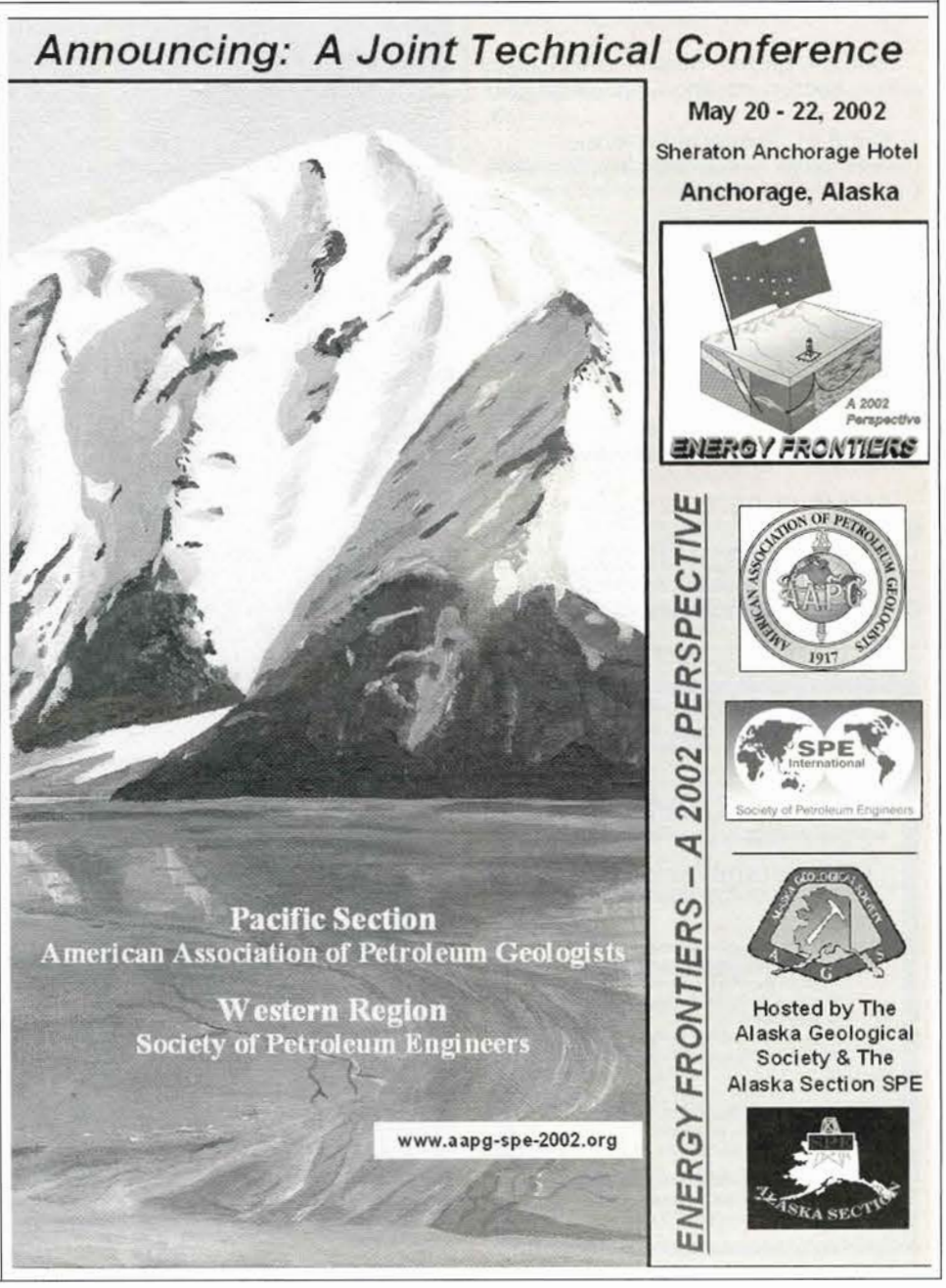

IN MEMORY

Baillie, Andrew Dollar, 88
Calgary, Sept. 26, 2001
Deschner, Henry W. (EM '55)
Corpus Christi, Texas
Forbes, Robert Briedwell, 77
Kingston, Wash., Dec. 1, 2001
Frisby, Raymond Lamar, 67
Junction City, Ark., Jan. 14, 2002
Hayes, Chauncey Loren Jr., 76
Tulsa, Jan. 14, 2002
Hough, Leo William, 87
Raceland, La., Oct. 22, 2000
Hunt, Vernon G., 78
Tyler, Texas, Nov. 25, 2001
Kessler, L. Gifford II, (AS '70)
Houston
Maxey, James Roy, 92
Enid, Okla., Jan. 22, 2002
Wilson, James Ralph Jr., 80
Amarillo, Texas, Nov. 4, 2001

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

continued from previous page

Modern Deltas
Sept. 9-13
Begins in Baton Rouge, La.
Ends in New Orleans, La.

Tectonics and Sedimentation

Exploration Potential, Tectonic Framework and Depositional Systems of Strike-Slip and Extensional Basins
April 6-12
Begins in Palm Springs, Calif.
Ends in Las Vegas, Nev.

* Outcropping Oil Fields – From Seeps to the Subsurface
May 13-21
Begins, ends in San Francisco

* Salt and Extensional Tectonics – Paradox Basin
May 19-24
Begins, ends in Grand Junction, Colo.

E&P in Thrusted Terrains, Practical Applications of Structure and Stratigraphy in the Montana/Alberta Foothills
July 15-20
Begins, ends in Calgary, Canada

Submarine Fan and Canyon Reservoirs, California
Sept. 16-21
Begins, ends in Bakersfield, Calif.

Geotour

Canoeing with Lewis & Clark: Geology of the Upper Missouri River Breaks National Monument, Montana
May 20-27
Begins, ends in Great Falls, Mont.

** New AAPG course or field seminar.*
*** Revision of an AAPG course or field seminar.*

AAPG Education Offerings
May 2002

Reservoir Characterization
Principle Methods and Case Studies
Instructors: Jeffrey M. Yarus, Dennis R. Prezbindowski
May 2-3
See Education Calendar page 2 for details.

High Resolution Well-Log Sequence Stratigraphy
Application to Exploration and Production
Instructors: C. Robertson Handford, Jeffrey A. May
May 13-17
See Education Calendar page 3 for details.

Outcropping Oil Fields - From Seeps to the Subsurface
Leaders: Jere Jay, Steve Graham, Tor Nilsen
May 13- 21
See Education Calendar page 10 for details.

Salt and Extensional Tectonics in the Paradox Basin, Utah
Leader: Michael Hudec
May 19-24
See Education Calendar page 10 for details.

GEOTOUR

Canoeing with Lewis & Clark
Geology of the Upper Missouri River Breaks National Monument, MT
Leader: William Hansen
May 20-27 • Please refer to details on the inside of the back cover of the Education Calendar

Gates of the Mountains, Upper Missouri River

For details contact:

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MODULE 2: OUTCROP ANALOGS OF FLUVIAL VALLEY-FILL RESERVOIRS
MODULE 3: CORRELATION OF FLUVIAL GAS RESERVOIRS IN STRATTON FIELD, SOUTH TEXAS
MODULE 4: SEISMIC STRATIGRAPHY
MODULE 5: DETERMINATION OF NET PAY IN FLUVIAL/DELTAIC ENVIRONMENTS
MODULE 6: INTERPRETING SILICICLASTIC SEQUENCE STRATIGRAPHY FROM WELL LOGS
MODULE 7: SEISMIC ATTRIBUTES
MODULE 8: THIN-BED INTERPRETATION
MODULE 9: PRINCIPLES OF ONSHORE 3-D SEISMIC DESIGN
MODULE 10: STRATIGRAPHIC CALIBRATION OF 3-D SEISMIC DATA USING VERTICAL SEISMIC PROFILES
MODULE 11: DESIGNING VELOCITY CHECKSHOT SURVEYS AND INTERPRETING CHECKSHOT DATA
MODULE 12: SEISMIC MODELING
MODULE 13: PRODUCTION HISTORY ANALYSIS FOR RESERVOIR CHARACTERIZATION
MODULE 14: ANALYSIS OF INITIAL FLUID CONDITIONS FOR RESERVOIR CHARACTERIZATION
MODULE 15: PRESSURE-INTERFERENCE TESTING

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READERS' FORUM

Fuel Cell Details

Please explain to me why the fuel cells described in "The Future Isn't Here – Yet" (March EXPLORER) do not violate the Second Law of Thermodynamics.

If you've got hydrogen, then you can react it with oxygen and generate heat, etc. It's unclear what the polymer electrolyte membrane does for the reaction and the generation of electricity, but I'm a geologist, not an electrical engineer or chemist ... It's the reformer that is required to liberate hydrogren from a hydrogen-rich source – methane is commonly mentioned by fuel cell enthusiasts – that bothers me.

The Second Law dictates that entropy is increased both when hydrogen is produced by the reformer and when it is oxidized again into water. You have to add power to the system to drive the dissociation reaction in the reformer; more power than you get from the oxidation reaction.

Please explain why this article did not describe a perpetual motion machine a little better.

David M. Abbott Jr.
Denver

A Note of Caution

Regarding the report on Canadian exploration as per a paper presented at the AAPG Annual Meeting (March EXPLORER): A few words of caution and economic reality to counter the impression of enthusiasm as presented by the speakers at this session appear warranted.

No one doubts the potential for additional petroleum discoveries in Canada's varied basins, not least of which in the Western Canada Sedimentary Basin, which is far from "drilled out." The argument I make (see Skipper, 2001, AAPG Memoir 74, etc.) is that we must be cognizant of the "rate of conversion" of these potential resources (assuming they exist) to productive capacity i.e. booked reserves.

(The "rate of conversion" concept applies to all energy alternatives).

As with the requirements of some regulatory bodies for reserves (both proven and probable) and undeveloped reserve numbers to be couched with some expression of capital required to convert undeveloped reserves to developed reserves, so too should resource estimates be tagged with the costs expected to convert them to sources of supply.

Using reasonable historical projections for Canada's (or the world's) cost of supply would get members' attention!

We are seeing the debate unfold about the Alaska gas pipeline, the Mackenzie Valley gas pipeline and, recently, the "stranding" of the Hebron oil field development on the Grand Banks. Clearly, when it comes down to the wire, we all appreciate the economic realities. These realities are not just about the expected price of oil and gas in the future, but also about the ability to finance such undertakings.

Volatile markets with today's prices frequently below the threshold required for project sanction will not induce financiers to enter the fray.

Tar sands developments pose their own risks and are not to be undertaken by the "feint hearted." Recent commissioned projects in Alberta have experienced cost overruns, and the spike in gas prices in 2000-2001 (and unscheduled plant maintenance) pushed operating costs much higher than the "hoped for" C$12 per barrel for those already on production. These multibillion dollar projects remain robust, perhaps aided by favorable royalty and tax treatment.

My forecast span (to say 2025) preaches one of caution in our expectations and projections. In recent studies, Canada will need to prove and exploit its non-conventional resources in the WCSB if it is to maintain any level of present productive capacity.

One also has to deal with the issue that as gas prices might rise, that does not mean a "frontier strategy" becomes viable. I do not mean this in just the geographic sense of moving into the Arctic, but also in the technological sense that with higher prices (and netbacks) the traditional basins will also look more attractive as the industry tackles the broader parts of the "resource triangle" (with infrastructure in place, exhaustive databases available, etc.).

We do not really know how much resource in CBM or tight gas sands can be converted at higher prices in the WCSB, but success in pilot ventures could dampen the enthusiasm for the arctic for many investors.

Big projects (Alaska) bring huge volumes of "banked gas" into the markets with probable reduction in product prices – this risk is being assessed. The LNG option might be a viable alternative to bring small, easily absorbed, increments of new supply into the uncertain marketplace – it may also be more palatable for some investors.

I will stick to my view that much of Canada's petroleum resource will remain orphaned for a long time yet. In all likelihood, I won't be around in 2030 to see if I am wrong!

Keith Skipper
Calgary, Canada

Editor's note: Letters to the editor should include your name and address and should be mailed to Readers' Forum, c/o AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101, or fax (918) 560-2636; or e-mail to forum@aapg.org. Letters may be edited or held due to space restrictions.

Thorough Reading

Here are my data, gleaned from the pages of the February EXPLORER, concerning the mixed-up usage of the word "data."

In eight occurrences the word is used with a singular verb. On only two pages, 25 and 26, is it followed by a plural verb.

Some dictionaries say both usages are acceptable, but point out that the singular verb users are primarily literary types while the plural users are

continued on next page

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Housing Reservation
➤ Deadline .....September 6, 2002

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For further information or assistance, call Brenda Merideth at (918) 560-2647 or (800) 288-7636 (Canada and USA).

continued from previous page

scientific. So, it seems the EXPLORER tilts toward the literary world. But not decisively; on page 22 we find "the data is" and on page 25, in the same report, we see, "the data are."

My hope is that the AAPG editors will formulate and publish a usage ruling for "data."

Roger L. Corbeille
Metairie, La.

Inspiring Example

Pasquale Scaturro (February EXPLORER), you are my idol!

I am a junior geology major at Illinois State University, and most my life all I have ever wanted to do is travel to remote places and do things no one has ever done or only dreamed of doing. Geology is my passion – and so is traveling.

School is tough right now, but reading this article inspired me and reminded me of why I love geology so much. Thanks.

Liz Pigg
Springfield, Ill.

Correction

Regarding your article "Lots of Discoveries in Lots of Places" (January EXPLORER): The operator of Block 15-1, Vietnam is mistyped. The operator is not Carigali but CLJOC.

I'm quite sure, because I took part in the project last year.

Hyunjoon Kim
Egham, England

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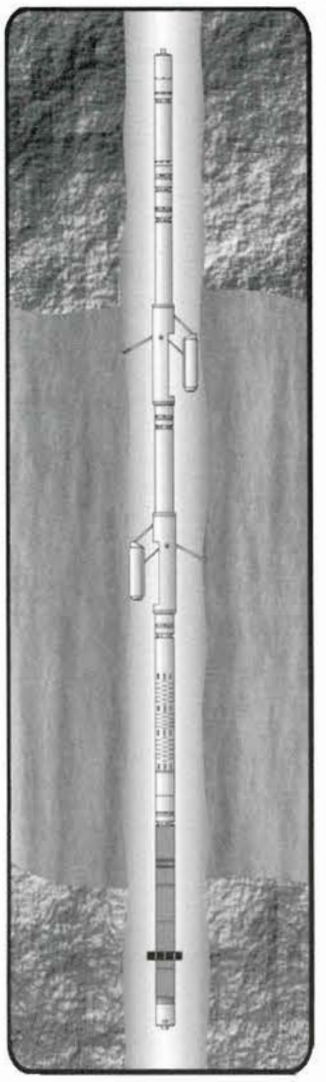

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DIRECTOR'S CORNER

AAPG's Library Deserves Applause

By RICK FRITZ

"I consider the AAPG Foundation Energy Resources Library a very valuable resource and an important part of my AAPG membership."

I never have liked the term "One of the best kept secrets," but in this case I will make an exception – I want to talk about the AAPG Foundation Energy Resources Library.

Actually the Foundation Library is not a secret to all, because it is used already by many AAPG members.

But many of you need to know that it can be a valuable resource in your work, study and job preparation.

The library was started as a very small reference library for the in-house editors and grew over time with support and funding by the AAPG Foundation. It was moved to its present location on the second floor of the Weeks Tower when the building was completed in 1978 and established as a public service. Except for a short period it has remained in the same location.

We have two librarians – Mary Kay Grosvald and Karen Piqune – who keep the library running and provide an important service to members.

As you know, this year I have been emphasizing AAPG's services, especially new services to members. While the Foundation Library is not a new service, technology has increased its value significantly. In addition to the hardcopy library, the librarians have access to AAPG's virtual library as well as Internet reference sites and use of the national Interlibrary Loan System.

Physically, the library has a complete collection of AAPG published materials along with most AAPG affiliated societies' publications.

In addition the library also contains:

- ❒ Eighty-five geoscience journal subscriptions.
- ❒ Current geoscience books and maps.
- ❒ Energy related reference books, dictionaries and bibliographies.
- ❒ Petroleum statistical reference e-sources.
- ❒ Worldwide petroleum industry directories and geological societies directories.
- ❒ Other material of interest to petroleum geologists.

And now the entire library collection is available on the Web! You can search the libraries' collection by going to AAPG's homepage (www.aapg.org) and clicking on Library Resources under "shortcuts," or you can go directly to www.aapg.org/foundation/library/index.html. The gateway to your search is "Impact Online Book Search."

If you want a more personalized search, the librarians can provide standard searches, which normally take 48 hours, or they can provide same day expedited searches. They can provide results either hardcopy or, in many cases, in digital format.

They specialize in searching for geologic information on specific geographic areas, especially potential oil and gas exploration areas. Of course, they perform standard subject and bibliographic searches as well.

General information searches are free. Custom searches for AAPG-published material costs $10 per request for a title and author search, and $25 for full text. They also can perform GeoRef Database literature searches for 67cents/minute, with a minimum charge of $15. Photocopying and delivery fees apply.

Now here is the best part – you do not have to be present to win! Just call Mary Kay and Karen with your needs and they will work for you – from finding a single reference to researching information on a particular area of interest.

They are quick, helpful, very good at what they do, and they really enjoy their work.

To underscore the point, here's a portion of an unsolicited testimonial sent by letter to AAPG President Robbie Gries by member Barry Faulkner of Bend, Ore.:

"I consider the AAPG Foundation Energy Resources Library a very valuable resource and an important part of my AAPG membership. Mary Kay's diligent GeoRef search and use of the Interlibrary Loan System, as well as the time she spent locating and copying references, resulted in providing data I could not have found any other way."

(The Foundation Library is open from 8:30 a.m. to 4:30 p.m. CST. The telephone is 918-560-2620; fax is 918-560-2642; and e-mail is library@aapg.org)

More Than One Charge

DPA Offers Range of Benefits

By ROYCE P. CARR
DPA President

Certification is only one of the offerings of the Division of Professional Affairs.

While traveling for DPA I am always asked common, recurring questions:

"Why should I become a member of the Division of Professional Affairs?"

"What does DPA do for its members?"

Many view DPA membership as a certification organization. Certainly, that is one of the many things DPA does. We currently certify petroleum geologists, petroleum geophysicists and coal geologists.

However, this is not the only charge of the Division of Professional Affairs!

Here are a few of the many other things DPA offers:

- ✓ "Gold standard" certification, which transcends local, state, national and international boundaries.
- ✓ Specialty certification (petroleum geophysicists and coal geologists).
- ✓ Professionalism.
- ✓ Improved Credibility.
- ✓ Competency standards.
- ✓ Ethical standards.
- ✓ Active voice – Governmental Affairs Committee.
- ✓ Continuing education.
- ✓ Career planning.
- ✓ Consulting agreements.
- ✓ Registration monitoring.

Through our Governmental Affairs Committee we have developed the following position papers:

- ❒ United States National Energy Supply.
- ❒ Climate Change Policy.
- ❒ Tax Reform.
- ❒ Natural Gas Supply Concerns.
- ❒ United States Land Withdrawals.
- ❒ Offshore OCS Access.
- ❒ National Petroleum Reserve-Alaska Access.
- ❒ Alaska National Wildlife Refuge Access.
- ❒ Reformation of the Endangered Species Act.
- ❒ Reformation of the Clean Water Act – Wetlands Access.
- ❒ Regulation of Hydraulic Fracturing.
- ❒ Grandstaircase-Escalante Monument Access.
- ❒ Research and Development Needs of the Domestic Petroleum Industry in the 21st Century.
- ❒ Preservation of Geological and Geophysical Data.
- ❒ Professional Geologist Licensure and Standing in Texas.

These papers are written to positively impact legislation and government decision-making. Our goal is to work with legislators at the local, state and national level and educate them on the aspects of decisions that impact our practice of geology and geophysics. It is amazing how little government knows about the profession we practice and the products we seek to find!

* * *

One final item I wish to mention is the monitoring of state and United States territorial registration of geologists and geophysicists.

The DPA State Registration and Licensing Committee constantly monitors registration that covers the practice of geology and geophysics. If a registration bill does not conform to the Suggested Practices Act, which is endorsed by AAPG and DPA, then the committee works through local geologists, geophysicists and legislators to get a bill that complies with the Suggested Practices Act.

Currently the following states have geological registration and/or licensure law:

Alabama, Arizona, Arkansas, California, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Maine, Minnesota, Mississippi, Missouri, Nebraska, North Carolina, New Hampshire, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Washington, Wisconsin, Wyoming and the U.S. Territory of Puerto Rico.

States currently in the process of passing legislation include New York and Utah. The passage of any legislation that affects the practice of our profession can be detrimental to both DPA and AAPG membership.

As I conclude and prepare to attend our annual meeting in Houston, I hope I have addressed the questions, "Why should I become a DPA member, and what does DPA do for its membership?"

Furthermore, I encourage you to contact any DPA member and obtain an application. You will be glad you did, and DPA will continue to look out for the best interests of petroleum geologists, petroleum geophysicists and coal geologists. ❑

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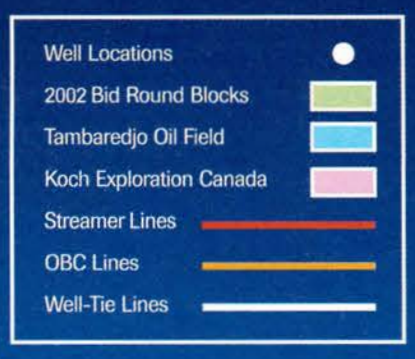

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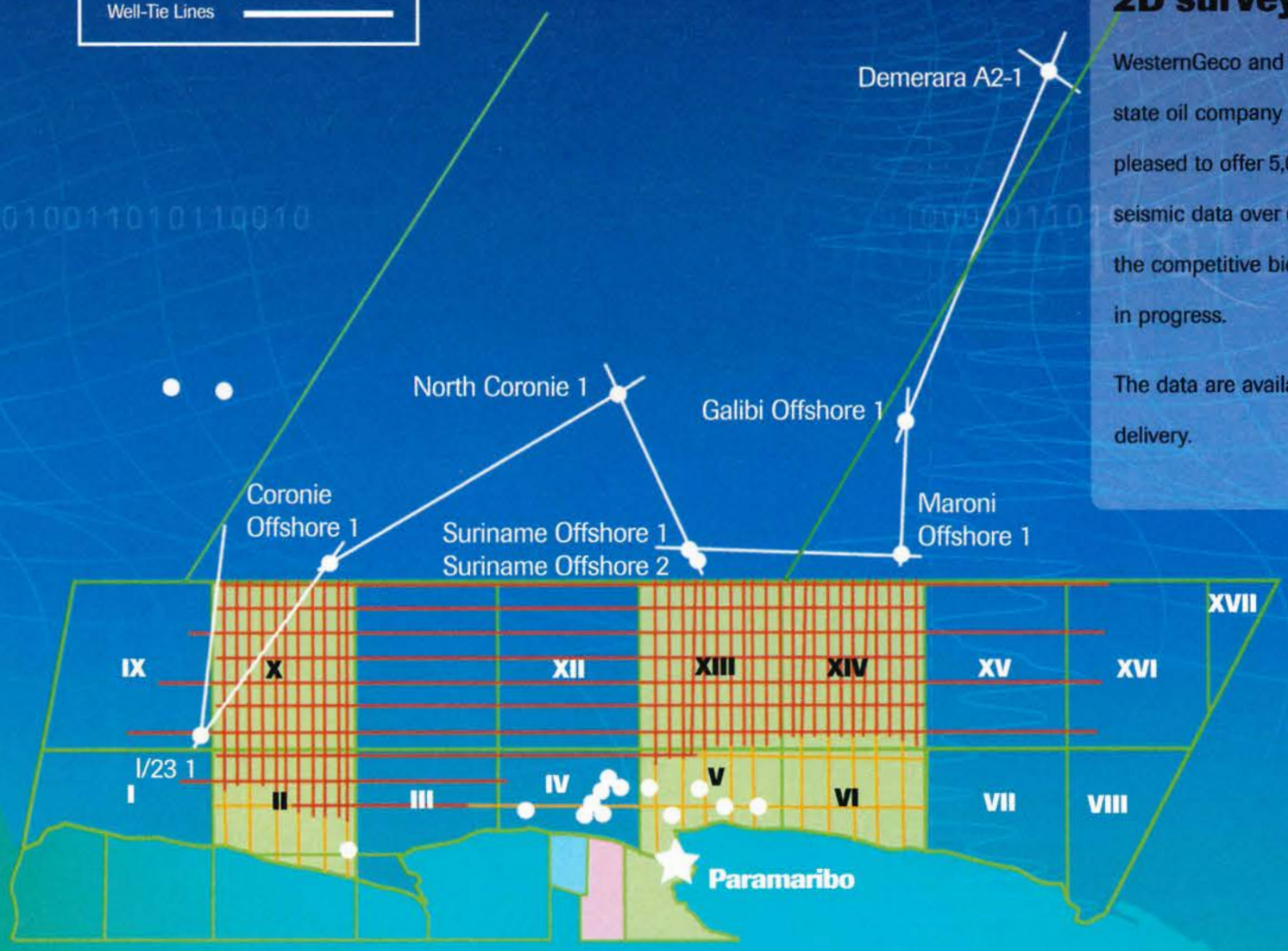

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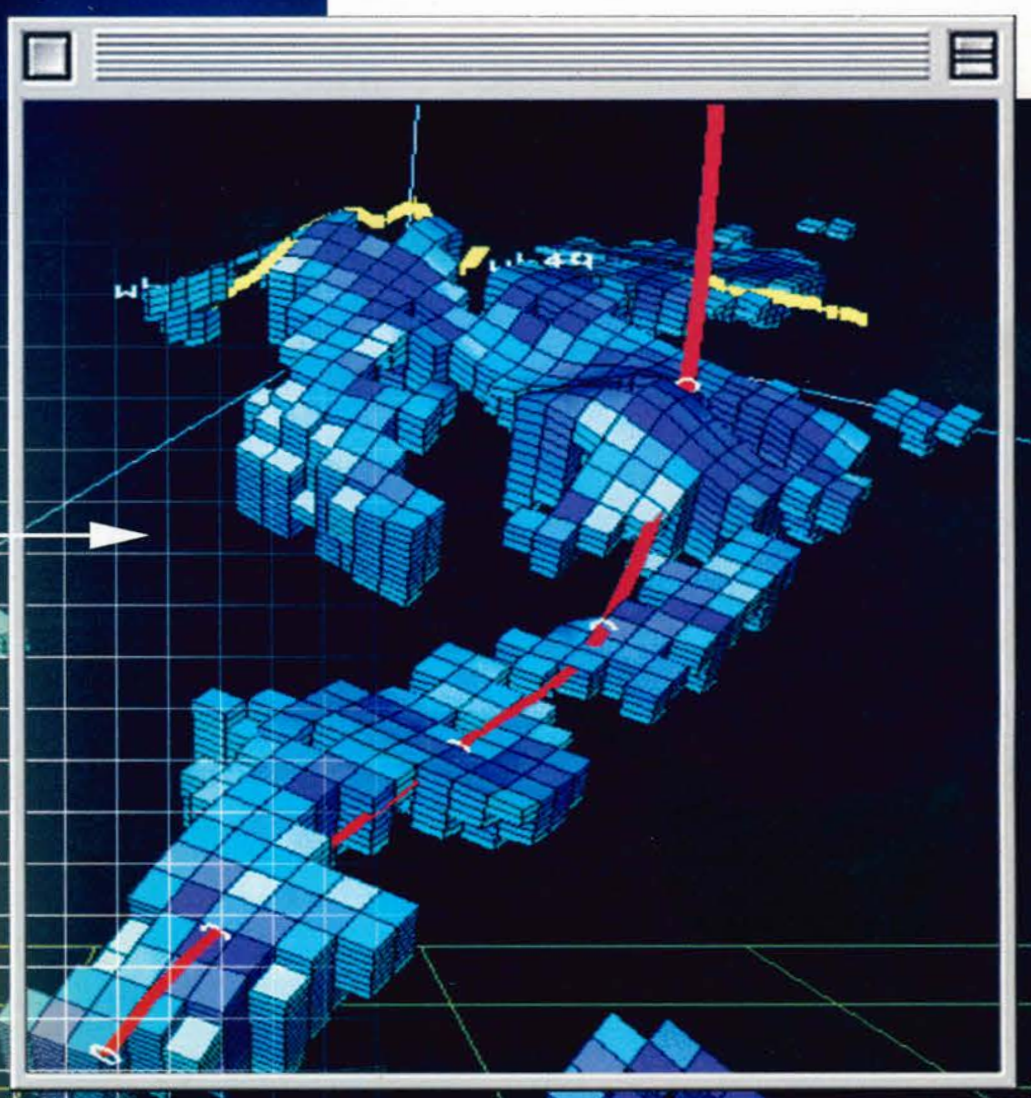
WesternGeco

"Did we miss anything?

I need to identify more reserves and increase production. I've already got a number of wells including multilaterals in this field, and the porosity and permeability distributions in these carbonates are still very tricky.

Are there any productive sweet spots left to drill?"



After building a reservoir model based on inverted seismic impedance and well data, WesternGeco identified a series of potential sweet spots in weathered carbonates. This additional pay was reached through geo-steering horizontal wells, resulting in increased production.

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