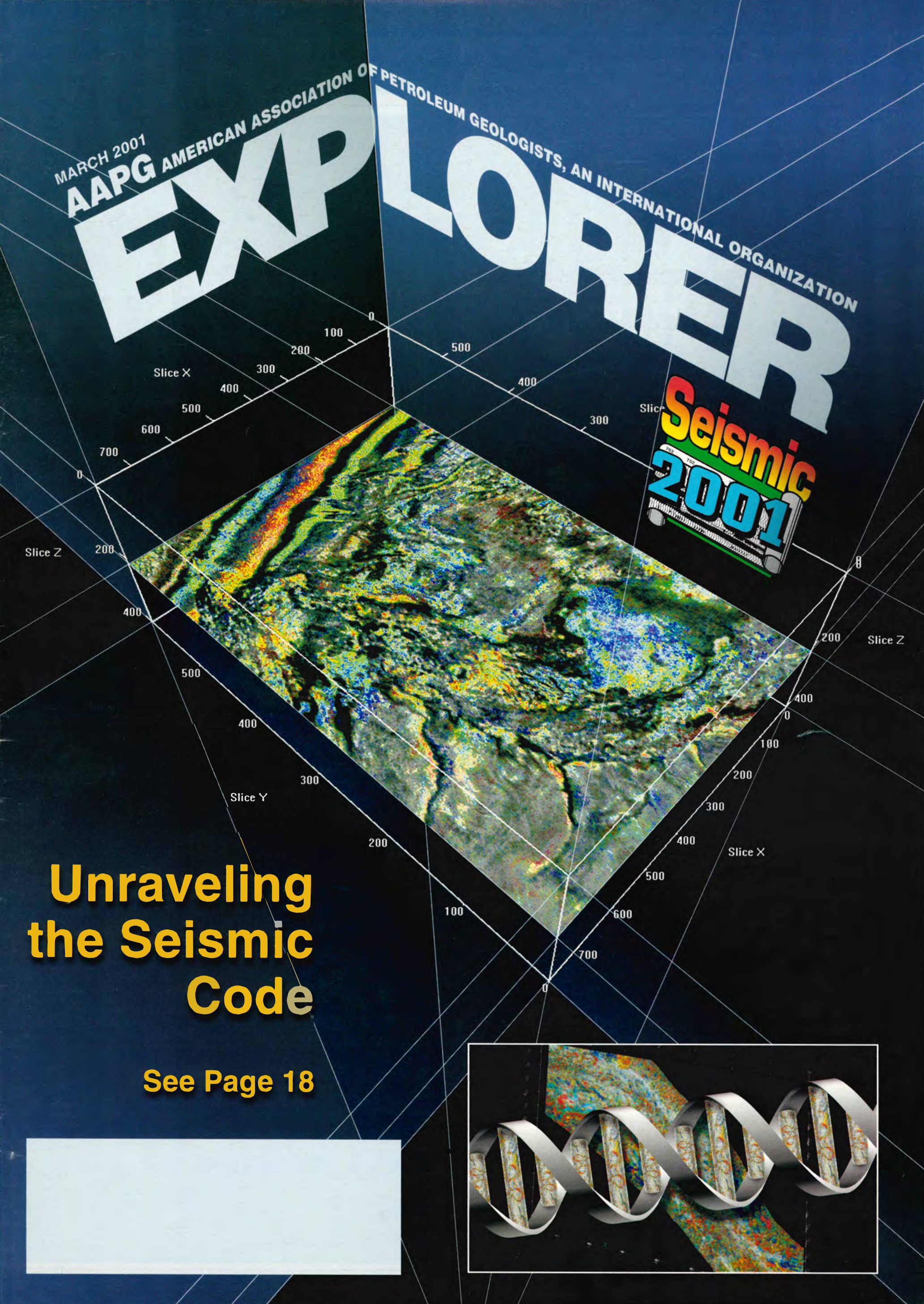
MARCH 2001
AAPG AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, AN INTERNATIONAL ORGANIZATION

EXPLORER



Unraveling the Seismic Code

See Page 18

Vol. 22, No. 3
March 2001

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On the cover: A new technology that applies DNA research concepts to seismic interpretation may give geologists a new tool in the hunt for hydrocarbons. The cover, designed by Rusty Johnson using data provided by Chroma Energy and WesternGeco, shows an example of it, depicting a deep-water GOM turbidite image of associated canyon, braided stream, channel, depositional lobe and crevasse splay.

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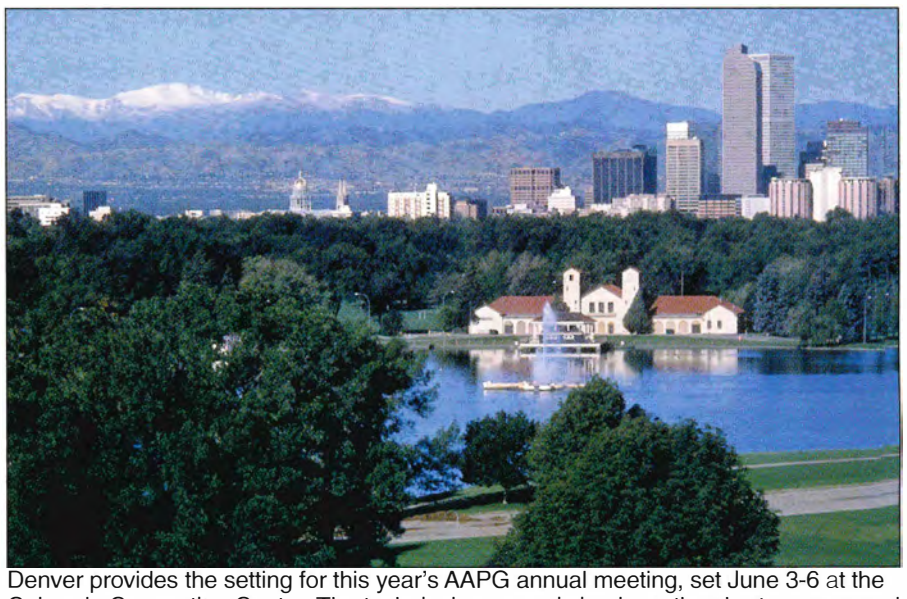


Denver provides the setting for this year's AAPG annual meeting, set June 3-6 at the Colorado Convention Center. The technical program is in place, the short courses and field trips are planned, and the time to start making plans to attend is now. See story on page 23.

Photo courtesy of the Denver Metro Convention and Visitor's Bureau

PRESIDENT'S COLUMN

Wisdom, Experience Offer New Slogan

Continuing our conversation . . .

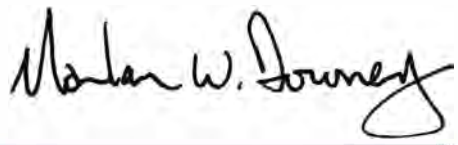
High prices for oil and gas are causing corporate managers to discover investing for growth. This novel business concept suggests that you can make more money if you have more oil and gas to sell.

For this concept to take off, I think we need a new management slogan. I offer "Seven Steps to Growth," or "Bigger Is Better," or perhaps "You Can Never Be Too Big Or Too Rich."

And do I have any advice for managers seeking a growth strategy? Certainly! And I offer it freely:

"Be bold, be bold – but not too bold."

The quote is from a 16th century poet; the wisdom is from experience.



DPA Energy Stats

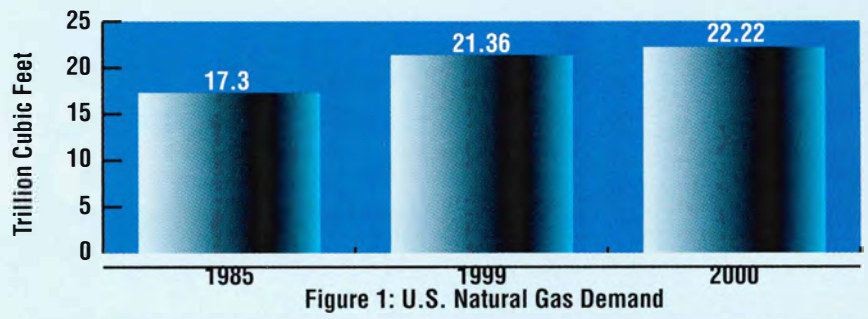


Figure 1: U.S. Natural Gas Demand

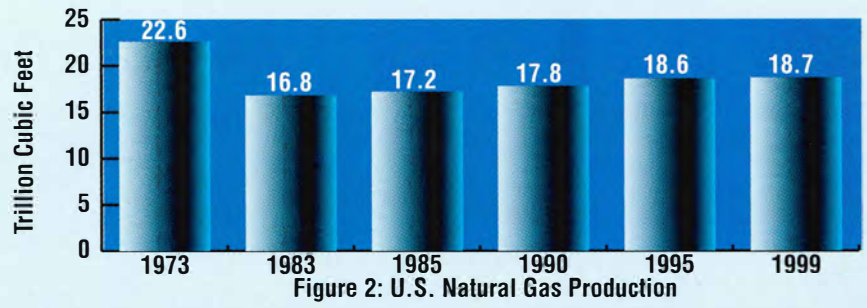


Figure 2: U.S. Natural Gas Production

Natural gas presently supplies about 25 percent of the nation's primary domestic energy requirements.

Gas demand is skyrocketing, particularly as a "clean" fuel for electric power generation. Recent studies by the EIA, Gas Research Institute and the National Petroleum Council (NPC) indicate annual demand will grow to as much as 32 TCF over the next 15 to 20 years. In its 1999 study, the National Petroleum Council projected annual demand to reach 29 TCF as early as 2010.

Security analysts at Dain Rauscher Wessels Inc. estimate that more than 275 new gas-fired power plants are planned to begin operation by 2006. These new electric power plants are expected to consume an additional 8.5 TCF/year.

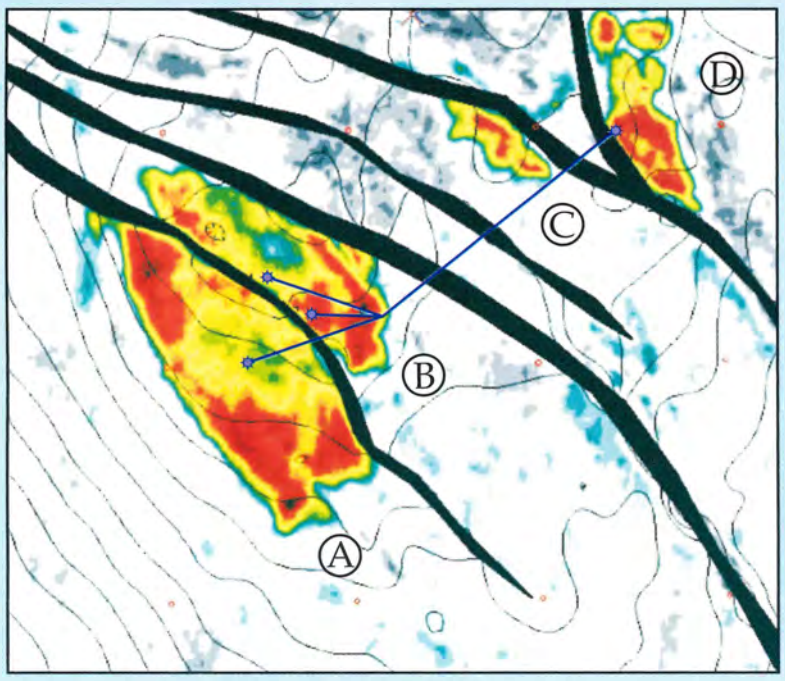
Data provided by the Division of Professional Affairs.

CAN YOU IDENTIFY BYPASSED PAY?
THE DIAMOND COMPANIES CAN!

With commercial quantities of hydrocarbons becoming harder to locate and produce, using yesterday's conventional technology approach could leave you at a competitive disadvantage. Our "Bypassed Pay" indicator is only one of a suite of integrated geophysical tools designed to reduce risk by "seeing" what conventional technology cannot.

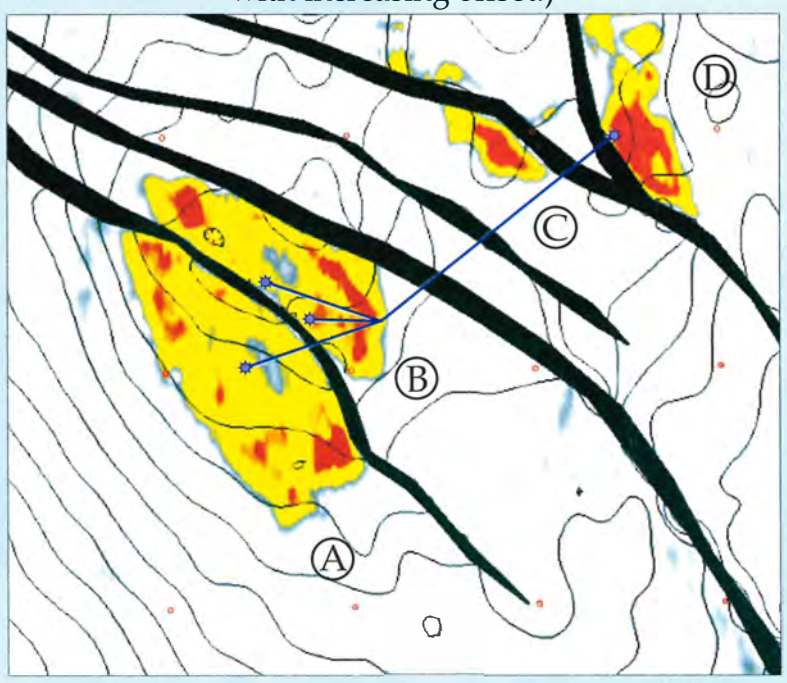
♦ As an example, let's look at a so called "depleted field" that went offline in the mid 1990's. ♦

CONVENTIONAL 3-D AMPLITUDE EXTRACTION MAP
(Reds and yellows indicate strong amplitude values.)



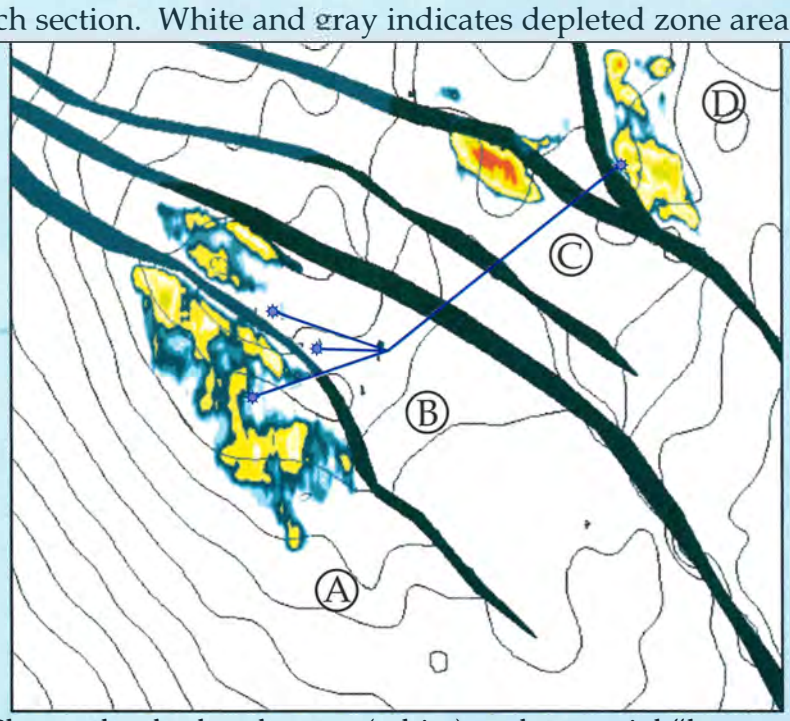
Shows strong amplitudes related to a depleted area around abandoned wells in fault blocks A, B and D.

3-D AVO STRENGTH EXTRACTION MAP
(Reds and yellows indicate amplitudes increasing with increasing offset.)



Shows a positive AVO response related to the depleted areas. (Beware of hydrocarbon indicators such as AVO and bright spot technology as they cannot differentiate between low and high hydrocarbon saturation.)

3-D DENSITY CONTRAST EXTRACTION MAP
(Red, green and yellow indicate areas of hydrocarbon rich section. White and gray indicates depleted zone areas.)



Shows the depleted zones (white) and potential "bypassed pay" in red, green and yellow. (The Density Contrast derivative can discriminate between low and high hydrocarbon saturation.

OBSERVATIONS / IDEAS

1) Notice the updip hydrocarbon potential in fault blocks A and B as seen on the 3-D Density Contrast map.
2) Notice the "missed opportunity" in fault block C as seen on the 3-D Density Contrast map.
3) Notice the bypassed pay in fault block D that was not produced completely. This is because the well was not drilled in the optimum location.
4) Imagine being able to generate higher yields in existing fields, reevaluate old or declining fields, optimize new fields and explore efficiently by applying this exciting new technology.
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Contractors Compete for Competence

Personnel Issues Loom Large

By KATHY SHIRLEY
EXPLORER Correspondent

Personnel issues are looming large for geophysical contractors.

With every down cycle in the petroleum industry, geophysical providers face the challenge of re-staffing – and this time it may be more difficult than ever before.

"Today we are still 25 to 30 percent below our high employment figure, up slightly from the trough when we were down about 35 percent of our work force," said Scott Smith, corporate vice president of human resources with Veritas DGC.

While most companies lost staff during this most recent slump, each company took the hit in different areas. CGG Americas, for example, felt the impact in its processing operations mainly in Europe.

"The downturn was pronounced and it forced us to look at our cost structure," said Jonathan Miller, president of CGG. "The downturn was not uniform around the globe, however, and we were more severely impacted in Europe where the market fell off more rapidly, particularly in the North Sea and some of the African arenas.

"Processing is a very people-intensive part of our business, so it took the biggest hit," he added, "although the impact was felt across the board."

Smith said Veritas saw the most dramatic decline in its land crews.

For today's geophysical companies, restaffing their seismic crews and other key personnel after the most recent industry slump could prove an enormous challenge.
Photo courtesy of WesternGeco

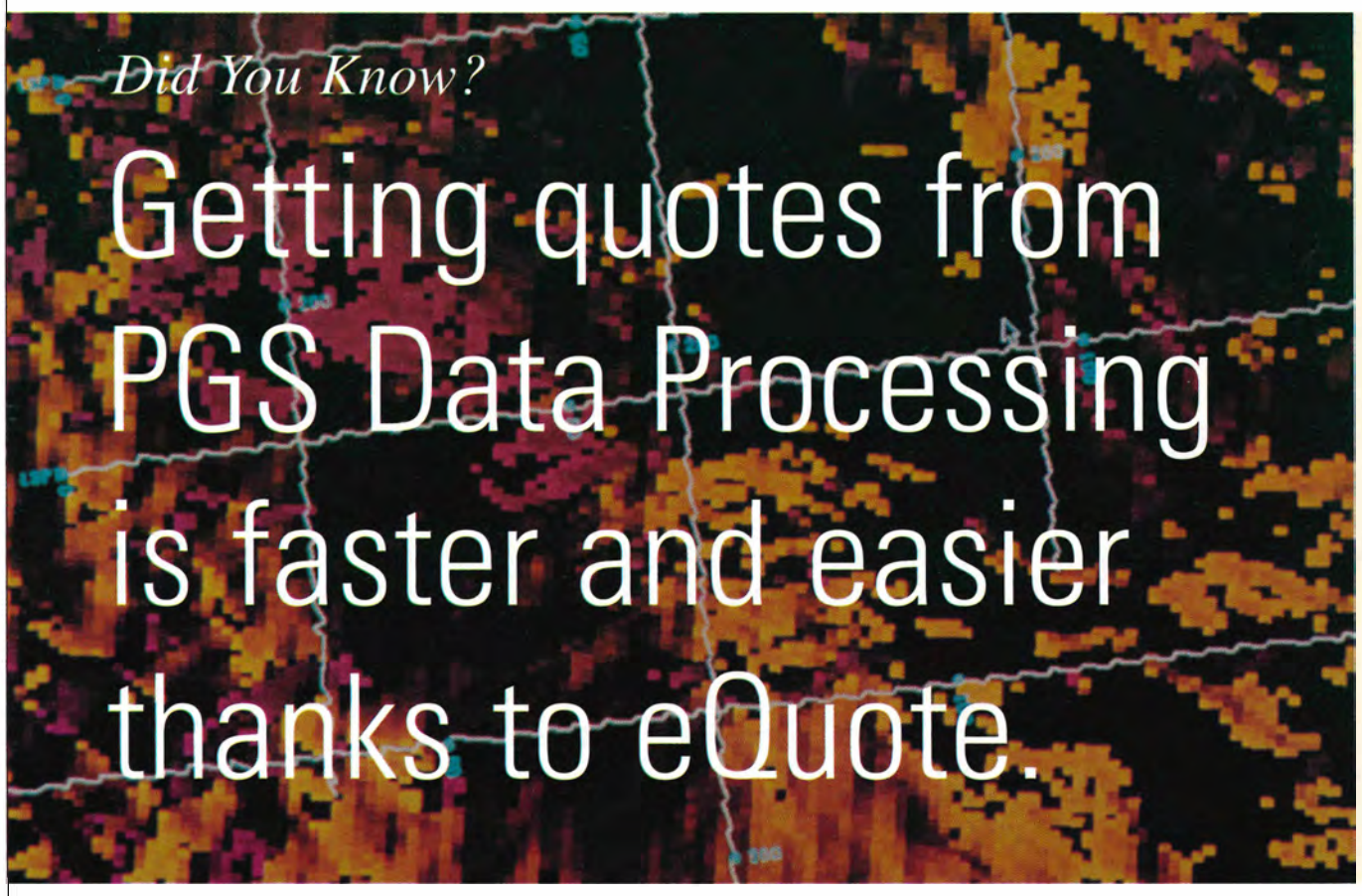
"When work commitments disappear, the crews are reduced," Smith said. "However, the processing, exploration and technological areas of our company actually grew in this down cycle.

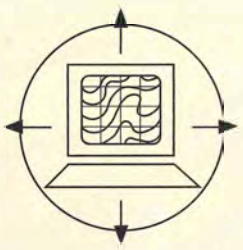
"Due to the mega-mergers of some of the E&Ps there was an impressive pool of talent available to us, and we took advantage of it," he continued. "We've added an entire division of 40 to 50 highly technical explorationists in the last two years, including geophysicists with reservoir knowledge, interpretation knowledge and other specialties.

"We continue to collaborate with our contractors on the interpretation and reservoir modeling front," he said.

See **Human Resources**, page 8

EXPLORATION SERVICES | RESERVOIR SERVICES | PRODUCTION | MULTI-CLIENT 3D DATA





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CAN YOU IDENTIFY NON-BRIGHT PAY?

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Using Diamond's proprietary rock property extraction procedure, we are able to identify and recognize hydrocarbon-bearing reservoirs that don't exhibit the conventional "bright spot" response. The 3-D Density Contrast Extraction methodology allows us to "see" what others cannot on conventional seismic data.

What makes this technique so unique is its ability to differentiate between high and low hydrocarbon saturation in both bright and "non-bright" pay.

This is one of the most **"significant"** reservoir characterization breakthroughs in recent times and will revolutionize the search for hydrocarbons. (And, you heard it first, from us at Diamond.)

Let's look at two examples:

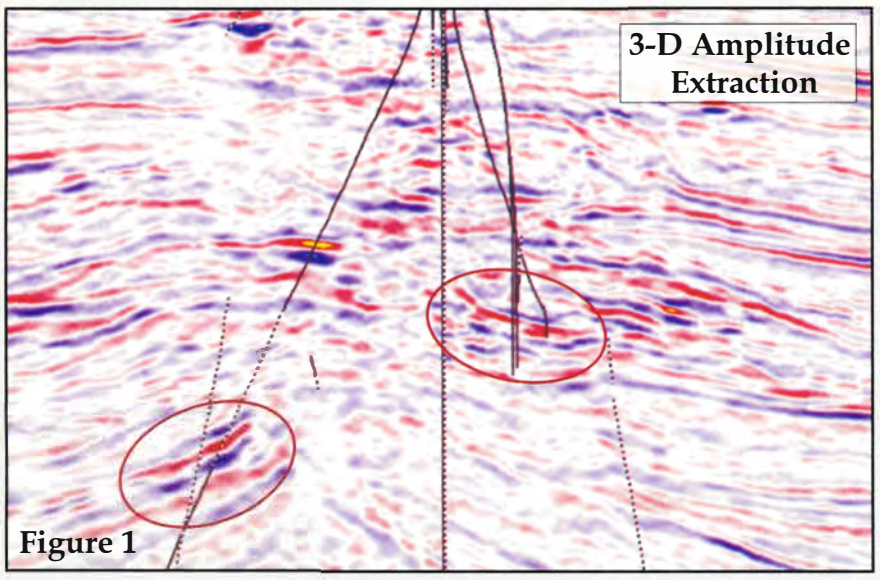

Figure 1

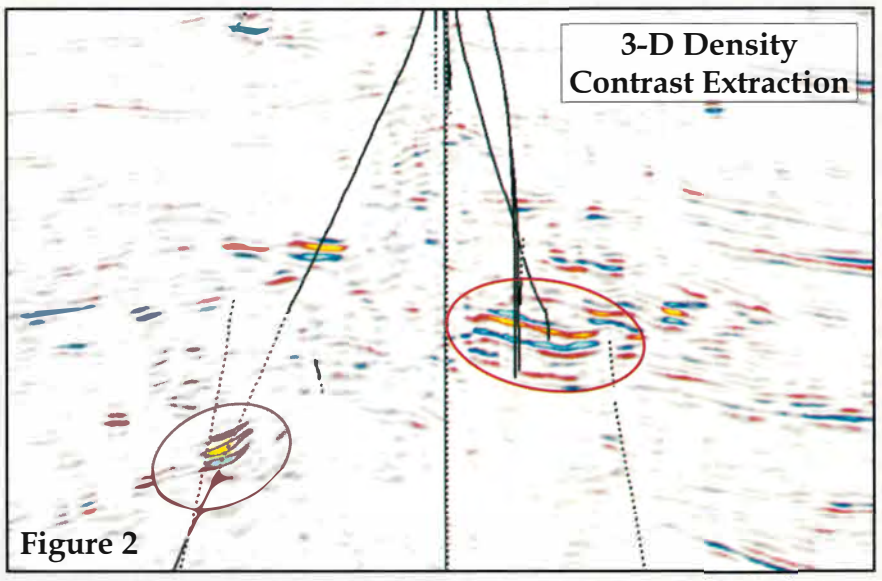

Figure 2

Figure 1 shows a conventional 3-D seismic profile in which we've circled events that are associated with non-bright pay. Notice there are no distinct brightness variations around these pay zones relative to the surrounding area. Compare this same profile to the 3-D Density Contrast Extraction in Figure 2. As you can see, these pay zones have an associated density anomaly on the Density Contrast extraction, not evident in Figure 1.

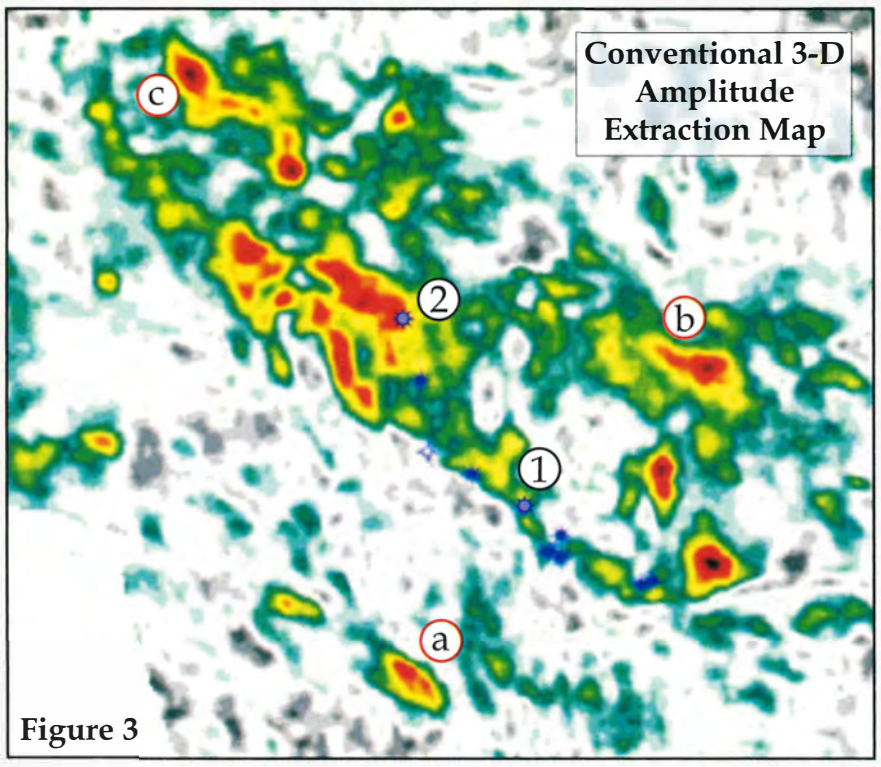

Figure 3

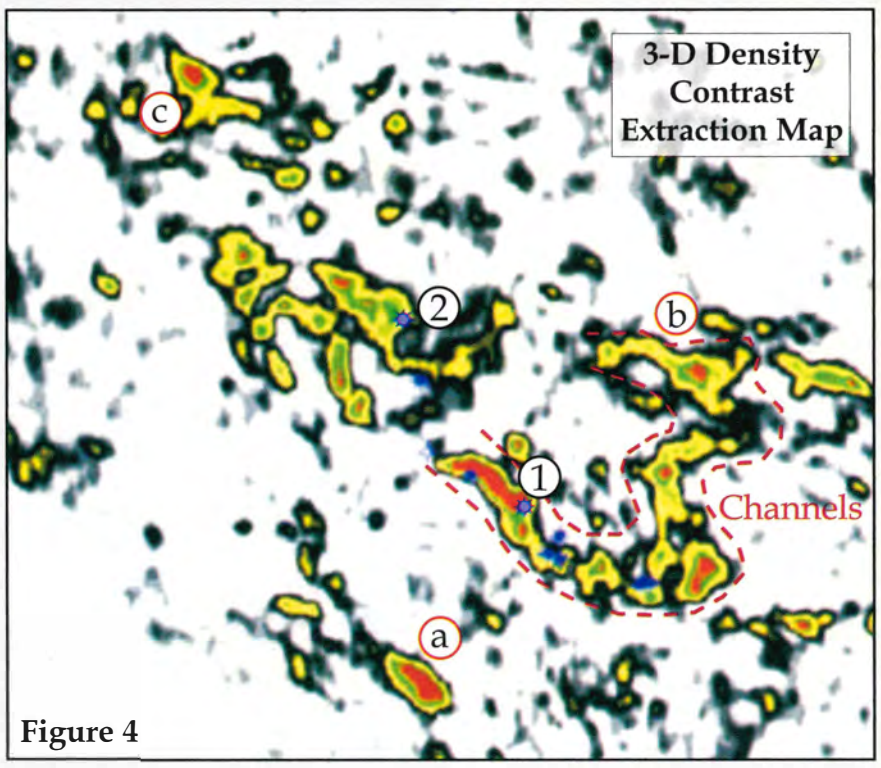

Figure 4

OBSERVATIONS / IDEAS

1) Notice the well defined channel system on the Density Contrast Extraction (figure 4) that is not evident on the amplitude extraction (figure 3).

2) Well No. 1, the field's top producer (2000 bbls/day), does not penetrate a strong amplitude anomaly (figure 3) but it does penetrate the strong density anomaly within the channel system as seen in figure 4.

3) The No. 2 well tagged the brightest part of the conventional amplitude anomaly (which is also within the corresponding density anomaly, but not the optimum location) and it only produced 1000 bbls/day.

4) Notice the missed opportunities in areas a, b and c.

5) Since the Density Contrast tool identifies the sweetest (optimum) part of the reservoir, **field development costs could be reduced by as much as 50%! (Fewer wells to deplete the reservoir will translate into significant savings!)**

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Human Resources

from page 6

"This is an opportunity for us, and we have positioned ourselves to meet the need."

Wanted: Experienced Crews

Getting business back on a steady footing requires experience, and experience is one of the intangibles that are, unfortunately, in too short of supply today for many contractors.

"As the cycle turns back up there never seems to be enough experienced people to manage all the activities you have on your plate," Smith said. "We get spread pretty thin on experience.

"Experienced personnel bare the brunt of hiring and training new workers and less experienced employees," Smith said. "The good news is that once we get through this difficult phase we do have a whole new generation of experienced people. Under the time constraints we are faced with during these upswings in activity, people can get five years of experience in two years."

Miller said one of the challenges facing CGG is finding demographic balance in the work force.

"Like many of the major oil companies today, some seismic contractors have too big an experience imbalance in their employee population," he said. "For the health of any business you need to have balance of experience levels, so that is an issue we will be addressing."

He used some of CGG's land crews to illustrate this point.

"We found we had some land crews that were tremendously productive, and we studied those to see why," Miller explained. "We found that these productive, dynamic land crews had a mixture of very experienced party chiefs and new hires who were coming on board with energy, eagerness and new ideas.

"That magical mixture of the two groups resulted in the ideal set-up, and we want to duplicate that throughout the company."

Recruiting Prizes

To meet that goal, recruiting is an important issue for CGG and other geophysical contractors.

"We need to recruit highly qualified people who can benefit from the guidance and experience of our personnel," said Peggy Moore, human resources manager with CGG. "We are now actively going back to universities and recruiting graduates.

"Certainly, the industry cycles over the last 15 years have impacted student numbers and we are not getting as many calls and resumes as we have in the past," Moore said, "so it's up to us to get out and find the right people."

"One of the realities today," Miller added, "is that there is a much smaller pool of highly qualified young people from which to choose, and we are competing with not only other geophysical contractors, but oil companies as well. So we have to find different ways to tackle this issue."

For instance, his company has expanded its focus and is looking at a wider variety of nationalities.

"We have identified talented people in other countries where we traditionally have not recruited in the past," he said.

Veritas focuses its recruiting efforts on a few key schools that have graduates in the pertinent disciplines – and those schools can change over time. And Smith agrees that companies must expand their search to other countries.

Veritas recruits in every country where the firm has a processing center. The company currently has about 20 entry-level positions for processing geophysicists around the world, and 10 openings for more experienced processing geophysicists.

"We do recruit around the world and we consider geophysicists, physicists and math majors," Smith said. "We realize we are competing with other segments of our own industry as well as other industries for these people.

"Geophysicists have the option of going with major oil companies or any seismic contractor," he continued. "Math and physics majors are highly sought after by a multitude of industries like technology and teaching, just to name a couple. That makes it tough."

Both Smith and Miller agreed that it's important for geophysical companies to continue recruiting even during the down cycles.

"We've figured out that you can't take a year off from recruiting entry level talent," Smith said. "It's just too hard to start up again. Plus, it helps your reputation with universities if you remain stable and you can get priority on those campuses.

"So, we never completely stop recruiting," he continued, "it's just the number of recruits that varies."

Developing Expertise

Once those recruits are hired, training becomes the next important task for contractors.

"We like to move our young people around so they can receive exposure and initial training in a wide variety of positions and responsibilities within the company," Miller said. "That way they develop competencies across our product line.

"Plus, employees want that training, they want to continue to expand their expertise and they are not as patient in their career development as older age groups were," Miller added. "Conversely, they challenge their managers and supervisors to be the best they can be."

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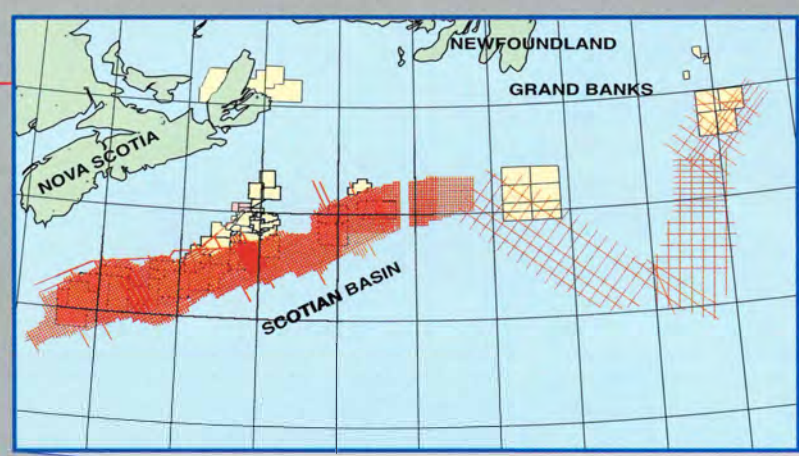
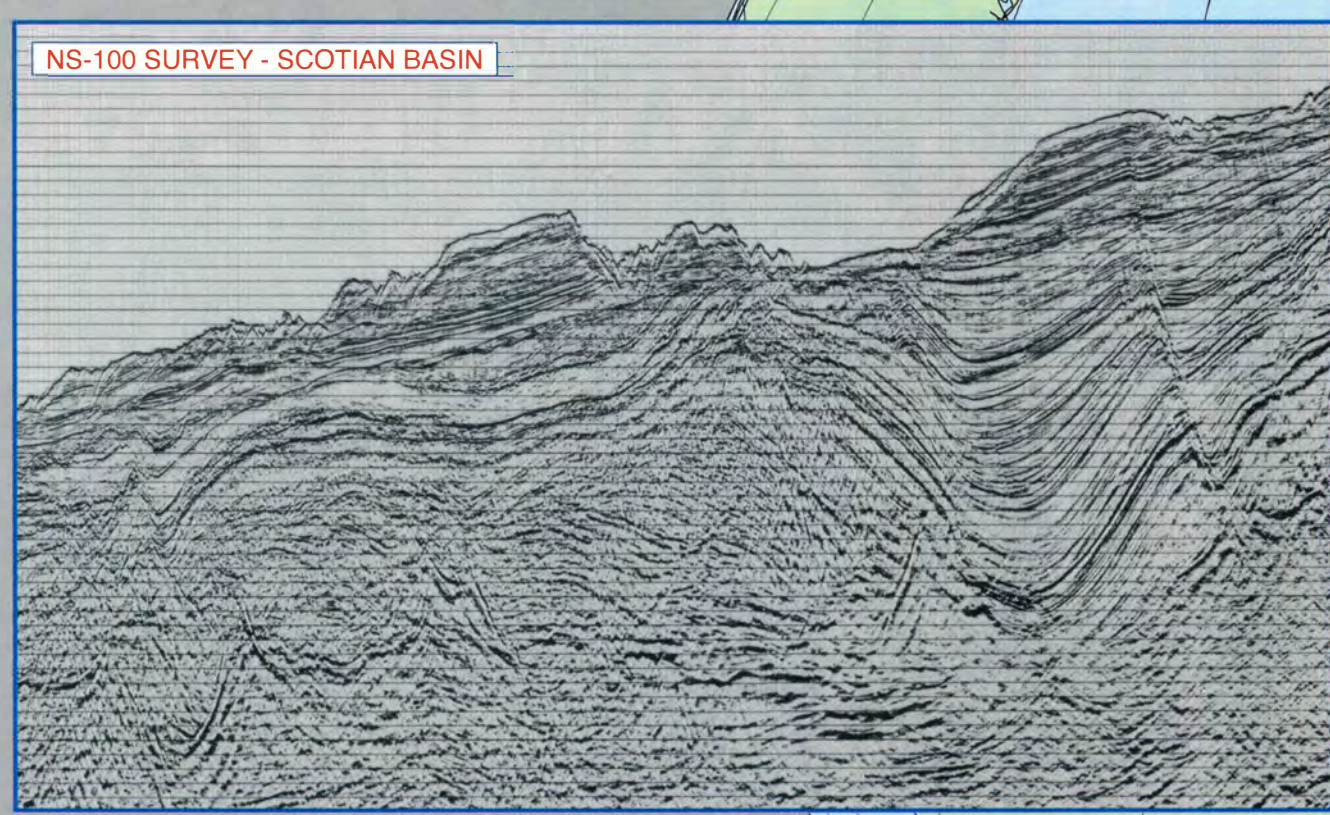
ATLANTIC



EASTERN CANADA



The geological similarities and existence of oil and gas discoveries in the conjugate basins of offshore Eastern Canada, Morocco, and Portugal/Spain has generated considerable exploration interest in the North Atlantic margin. TGS-NOPEC Geophysical Company has acquired in excess of 60,000 kms of new non-exclusive seismic data over these regions. For an opportunity to review data contact one of our regional offices list below.

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Exploring a world of opportunities

Pacific Section/GSA Meets April 9-11

AAPG's Pacific Section will join with the Geological Society of America's Cordilleran Section for this year's annual Section meeting, to be held April 9-11 at the Sheraton Universal Hotel in Universal City, Calif.

Fifty-one theme-related technical sessions have been set for the meeting, covering a variety of topics that range from the latest in computer technology to environmental issues to tributes to famed geologists.

Also scheduled are seven workshops, 13 field trips, two K-12 educational activities and an exhibition, held in the Sheraton's Grand Ballroom.

Keynote speakers for the April 10 All-Convention luncheon are Sharon Mosher, president of GSA, and AAPG president-elect Robbie Gries.

Technical sessions include:

- ❑ New Insights in Structural Geology/Tectonics.
- ❑ Three-D Visualization and Geologic Modeling.
- ❑ Geology Beyond Earth: Recent Results From the Planets and Their Moons.
- ❑ Successful Grant Writing.
- ❑ Petroleum Geology of California Basins.

The meeting's preregistration deadline is March 19. To register, or for more information, go online at the Section's Web site, http://psaapg.org.

"With competition from other industries people are leaving the oil business and not coming back."

continued from previous page

Smith said his company offers "soft skills, as well as technical training.

"We require our employees to take 45 hours of training a year," he added, "60 percent in technical areas and 40 percent in soft skills such as how to do effective presentations, interpersonal skills and customer relations."

Of course, it's not just technical employee needs that pose a challenge for geophysical contractors. Unskilled labor can be trained relatively quickly, but that labor pool also has more choices today than ever before, making it difficult to find the best possible employees.

"Today there are a lot of competing businesses for a shrinking unskilled labor pool," Smith said. "They can go to work for Wal-Mart or any number of places and it's easier work than life on a field crew. I've found people are less inclined to do this kind of hard work."

Indeed, Smith said it is "a challenge to find people who like to work outdoors, like to be away from home for extended periods and like difficult, rugged work. We find ways to get it done, but it is definitely more difficult than it used to be – and it gets more difficult with every cycle in this industry.

"With competition from other industries people are leaving the oil business and not coming back."

And, if the pay doesn't reflect the risk-work-reward factors, who can blame them for not returning? According to the U.S. Department of Labor, this is a problem shared by a number of industries—from construction to manufacturing. The competition for these workers is expected to intensify.

'Pay A Concern'

One big wildcard in the geophysical industry today is the recent merger of Western Geophysical and Geco-Prakla.

"It's too early to tell if there will be much personnel fallout from that merger, but I've been surprised at the few number of people that have become available due to this deal," Miller observed. "You have to respect your competitors, and I think Western-Geco has done a good job of protecting its key employees."

With the challenges in recruiting and retaining employees, pay is an ongoing concern for geophysical contractors.

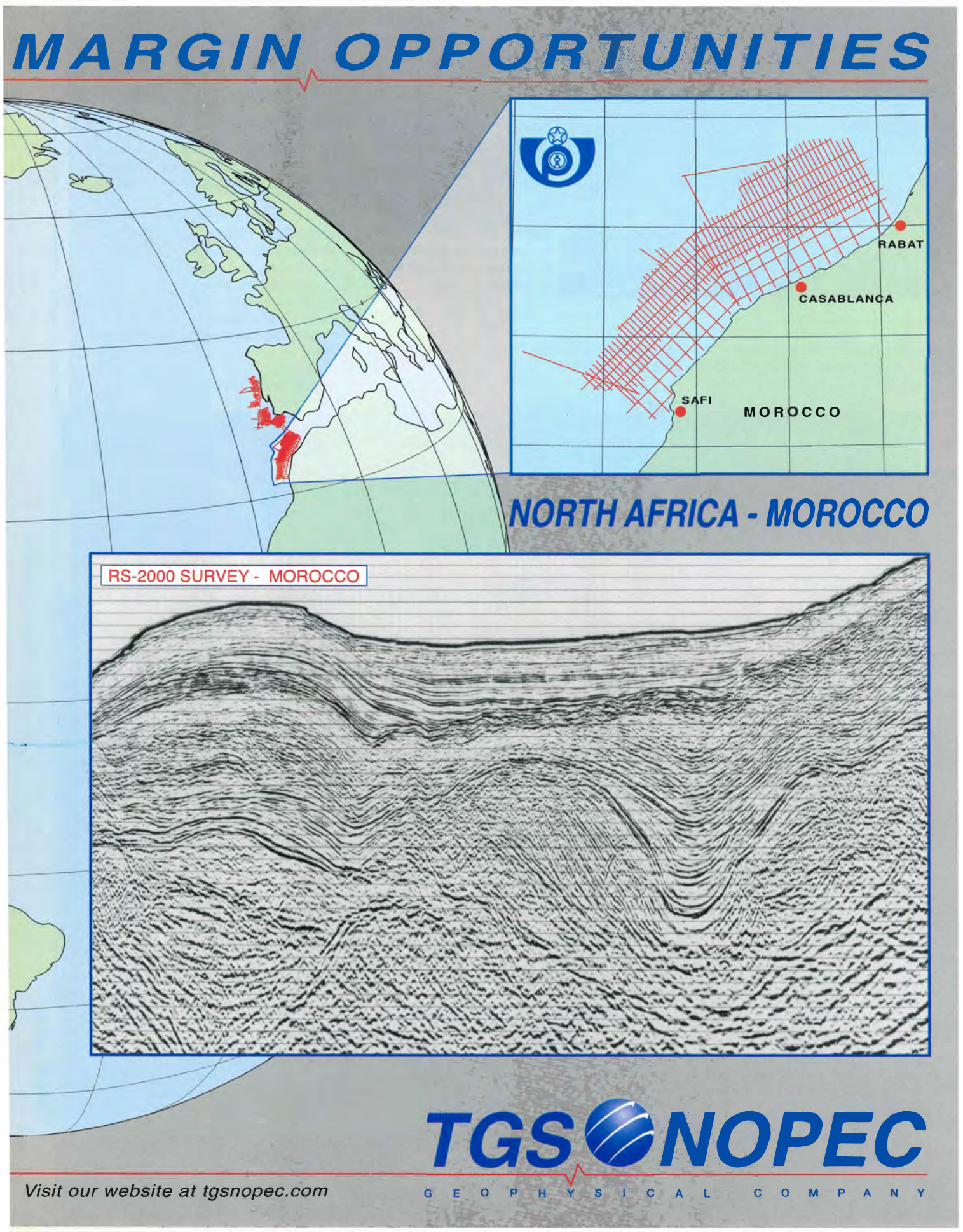
"As in every previous up cycle, salaries are going up from the bottom to the top in our businesses," Smith said. "Most employees have a lot more options than they used to. More and more industries seem willing to take technical personnel and teach them the ways of their industry. That's always been true of support services, but for the first time we are seeing that same trend on the technical side.

"We now view all our employees as people with options and we need to be more creative in how we compensate them," he continued. "You have to be a lot more open to doing whatever it takes to attract and keep your technical staff."

In addition to salary, that includes training, global opportunities, a compatible company culture and technology.

"In our business it's often the quality of people you associate with and the cutting edge technology that attracts people," Smith said. "We really are a people-intensive business, so if we don't manage well in the down cycle it definitely constrains us in the up cycle.

"We try to maintain our level of experienced people across the company during the difficult times," he added, "because we know those people are our best weapon when things get better." ❑



Current Technology

3-D Reveals Furrows on Gulf Floor

Erik D. Scott will present an in-depth look at the study team's findings at the AAPG annual meeting in Denver.

His paper, "Revealing Regional Deep-Water Gulf of Mexico Seafloor Features Through 3-D Seismic," will be presented at 10:40 a.m. Monday, June 4.

Scott's co-authors are Frank Peel and Carl Taylor, both with BHP Petroleum, and William Bryant with the Department of Oceanography, Texas A&M.

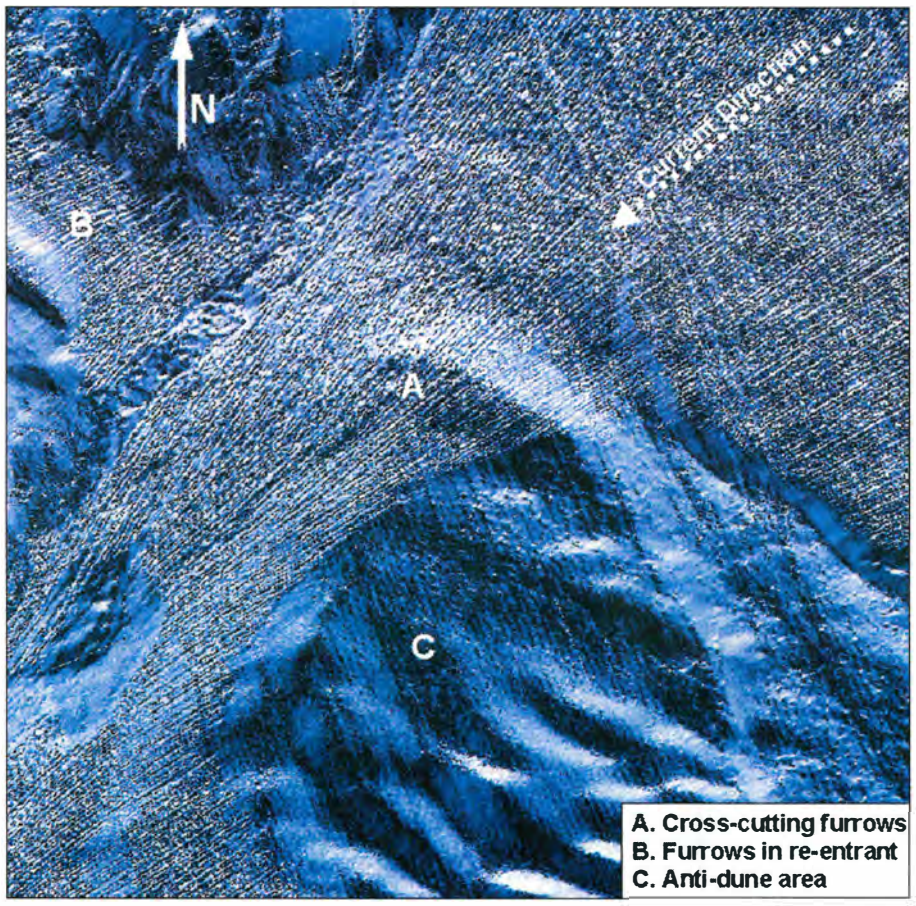
By LOUISE S. DURHAM
EXPLORER Correspondent

Buoyed by respectable commodities prices and armed with a passel of innovative drilling technologies, oil and gas finders increasingly are casting their collective eyes toward the potential for big finds in the deep-water Gulf of Mexico (GOM).

Of course, finding the "big one" is only the beginning in this tricky operations environment.

Once the find is confirmed, the operator has the thorny problem – among other issues – of moving the product to market. Pipeline and other infrastructure placement, however, is no easy undertaking in thousands of feet of water, which is rife with unknowns.

Using 3-D seismic data, however, scientists can map the seafloor at greater depths and higher resolution than ever before to garner critical information to aid in deep-water development.



Images courtesy of Erik Scott

Dip azimuth map of the seafloor in the Gulf of Mexico's Walker Ridge. The linear nature and regional extent of the furrow field are evident.

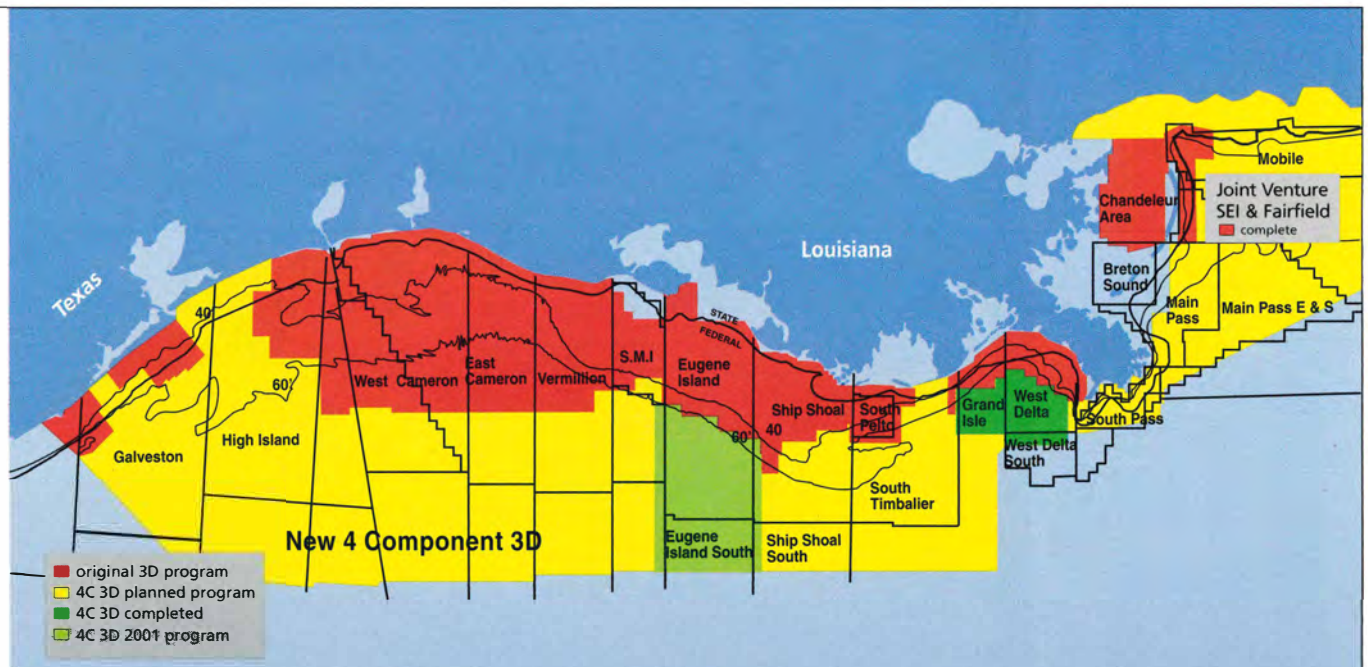
A recent mapping project using high-resolution 3-D, for instance, has identified some "new" old features on the muddy ocean bottoms. The data derived from the study can be a powerful assist to determine the initial location of deep-water facilities and pipeline paths, and to help define the parameters of additional site-specific investigations.

The research effort was a joint undertaking between BHP Petroleum and the Texas A&M Department of Oceanography.

The seismic data set used by the study team covers the seafloor along the Sigsbee Escarpment on the continental rise across an area of more

See **Furrows**, page 12

Take another look, a deeper look.



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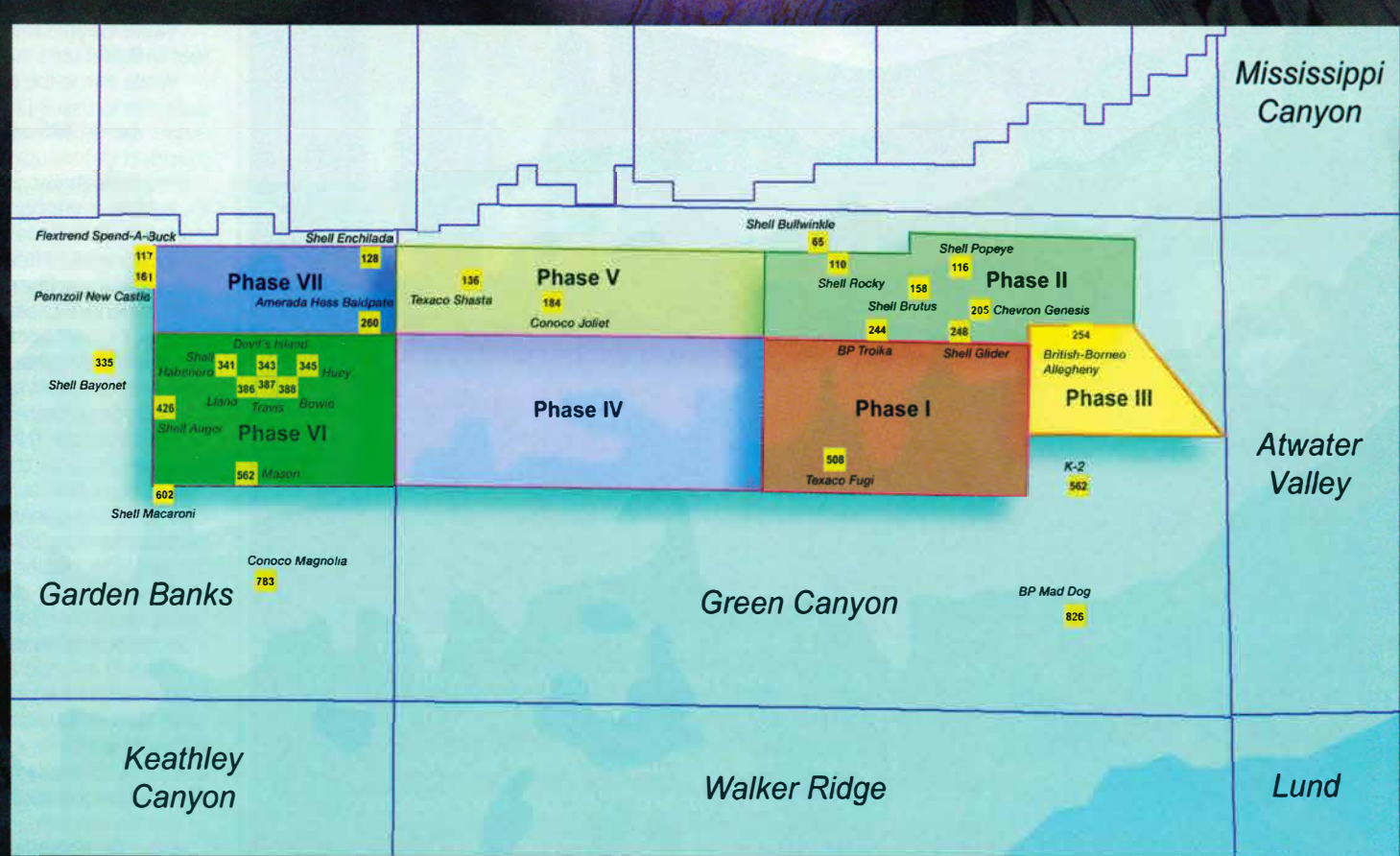

Green Canyon spec data from the 3D Specialists

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Phase II	78 blocks (available today)	**Phase VI**	84 blocks (proposed)
Phase III	38 blocks (available 3/01)	**Phase VII**	48 blocks (proposed)
Phase IV	126 blocks (in progress)		

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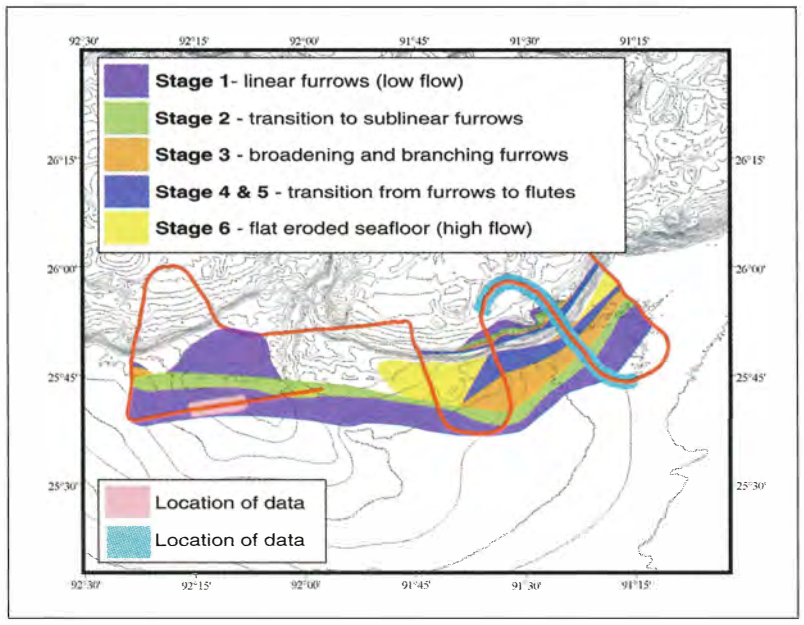
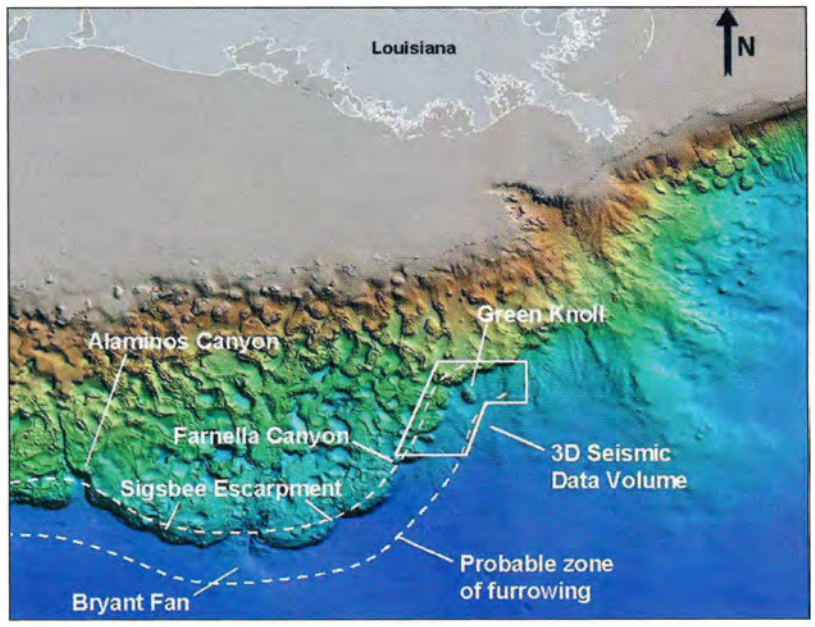


Left, furrow development in the Gulf of Mexico is identified by the deep-tow survey results over the Bryant Fan.

Right, a northern Gulf of Mexico seafloor map based on NOAA Seabeam data. The location of the study area is outlined, along with the deep-tow survey and DSV Alvin dive locations.



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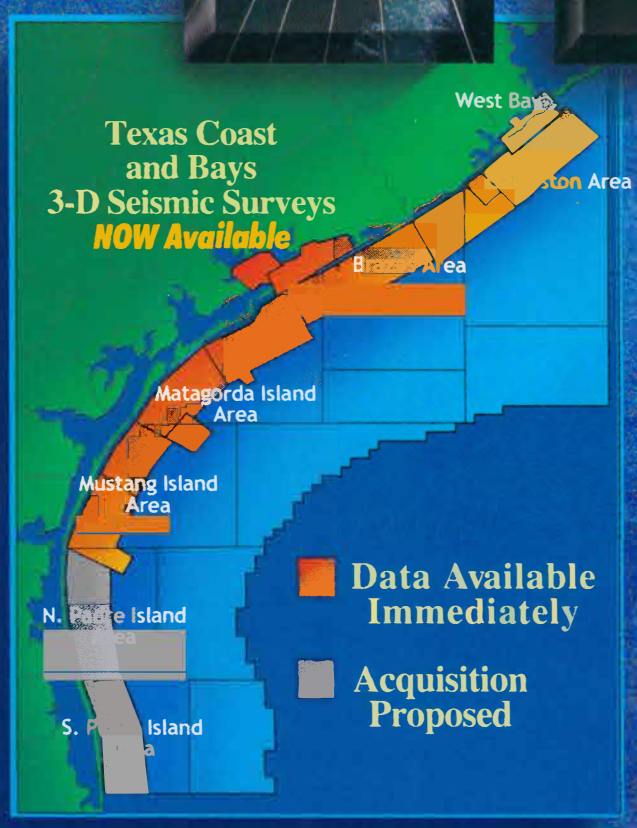

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New Ideas for New Frontiers

Furrows

from page 10

than 165 GOM OCS blocks in the western Atwater Valley, southern Green Canyon and eastern Walker Ridge protraction areas.

Water depths there range from 4,000 feet to 9,000 feet.

While this is the first mapping exercise to use 3-D data on a regional scale, the GOM seafloor has been mapped before using a mélange of methods, with varying resolutions.

"Maps covering the whole of the northern Gulf of Mexico and more have been generated from such data sources as gravity, magnetics, satellite sensors and 2-D seismic surveys," said BHP geologist Erik Scott. "Until recently, however, the highest resolution data sets with the most extensive coverage have been surface-towed, multi-beam, side-scan sonar (NOAA Seabeam) and long-range sonar (GLORIA)."

These data sets, he noted, have been used to generate maps with approximately a 30-meter resolution on the seafloor, but the resolution is lower at deep and ultra-deep water depths because of the increased travel time from source to receiver.

"Two-D seismic data provide a higher resolution of the seafloor," Scott said, "but because of their nature of a lattice of separate lines, they lack the spatial resolution to define subtle features on the seafloor."

An Excellent Reflector

Three-D seismic surveys, thanks to their close spacing of data points, offer greater spatial resolution than does 2-D seismic to map the seafloor and illuminate subtle features.

In the past, however, cost and technology limitations restricted those surveys to limited areal extent of usually less than 25 GOM OCS blocks – which meant maps generated from those data provided a postage-stamp look in a regional context of the northern GOM.

With the growing movement toward progressively deeper waters to explore for hydrocarbons, 3-D seismic surveys are now available on a regional scale. For instance, the former WesternGeco acquired and processed a regional 3-D seismic data set in the Green Knoll/Walker Ridge area.

The seafloor makes an excellent acoustic reflector, producing a strong horizon to map, according to Scott. By mapping the seafloor reflector on the

continued on next page

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WesternGeco data, he and his peers constructed a higher resolution map than previously possible and came up with an intriguing discovery.

"The data revealed a set of regionally extensive furrows – a previously unknown Gulf of Mexico seafloor feature," Scott said.

"Early investigations show the erosive style of the furrows change in a predictable pattern in conjunction with an increase in current flow velocities," he continued, "and the erosional features of the furrow field indicate the presence of strong ocean bottom currents."

Seafloor maps derived from the seismic data depict a field of regionally extensive bed forms comprised of furrows, anti-dunes and other related features on the sea bottom on the abyssal plain south of the Sigsbee Escarpment and around Green Knoll – a prominent feature rising more than 2,000 feet from the surrounding surface.

The bed forms also have been imaged with a deep-tow survey over the Bryant Fan area further to the southwest.

Although the survey area shows only the partial extent of these bed forms, Scott said, it is sufficient to illustrate the regional nature of the features.

Seeing Proves Believing

The most prominent attribute on the regional dip azimuth map created by the research team is a set of linear features that extend from Green Knoll and off both the east and southwest edge of the survey area. They are much like the bed forms imaged over the Bryant Fan area that were identified as sedimentary furrows, roughly 10 meters deep, 30 meters wide and spaced about 100 meters apart in an area 10-25 kilometers wide, lying to the south of the Sigsbee Escarpment.

Such sedimentary furrows are longitudinal bed forms that are found in fine-grained sediments caused by bottom-current erosion. They are found in myriad environments, including lakes, rivers, shallow marine settings and on the continental rise.

The research team noted that initial investigations of the data show that the furrows change in a predictable pattern in conjunction with an increase in current flow velocities, according to findings by J.R. Allen, who performed controlled flume experiments on furrow formation in 1969.

Scott said the transition in furrow morphology from increasing flow velocities is clearly shown in the deep-tow data from Bryant Fan.

"The experimental work by Allen and the nature of the furrows that have been identified from maps from the regional 3-D seismic data indicate bottom currents of up to two knots and possibly stronger have occurred," Scott said.

"In fact, a current meter south of the Sigsbee Escarpment measured a two-knot current on the ocean bottom in a southwesterly direction."

Characteristics of the furrow field on both a regional and a local scale are illuminated by the seafloor dip azimuth map. The map indicates the current that formed the furrows and related features is flowing along the Sigsbee Escarpment from the northeast toward the southwest.

Besides the linear nature of the furrows, a host of cross-cutting relationships can be observed. Whether these indicate multiple current events or a change in a single event is currently unknown, according to the research group.

The furrow field wraps around Green Knoll, providing evidence of the topography's influence on bottom currents along the Sigsbee Escarpment.

Scott said direct observations of the sea floor at two locations in the furrow field confirm the presence of the furrows. Dives were made in the DSV Alvin in the Farnella Canyon area (Walker Ridge 805) and off the southeast corner of Green Knoll (Walker Ridge 35). The general seafloor was flat to slightly undulating and interrupted by erosional furrows scouring into the muddy surface.

Future Impact

The potential for strong bottom currents in the deep-water GOM could impact energy industry activity.

For now, three wells have been drilled on the continental rise, one is currently drilling and another is planned. The wells haven't encountered any significant currents, and although current meters gave no indication of strong currents, they were in place only long enough to drill the wells.

The regional extent of the furrow field will affect pipeline placement. Regional seafloor maps can help direct the pipeline path and also assist in the initial design of the pipeline, indicating in general terms which parameters to engineer to.

It's not known how often bottom currents might occur over the life of a producing field – and neither the strength nor the duration can be surmised. Scott said it appears the currents occur over geologic time rather than over field production time, and could occur on the order of every 10, 50, 100, 1,000 or 10,000 years.

And we're not talking cataclysmic-style events.

"It doesn't appear it's a one-off event where all of a sudden a huge current comes and forms the furrows," Scott said. "My personal opinion is that pulses of higher current flows come through that form furrows, and there are constant currents that keep them open.

"The data we have show there are currents today at Green Knoll, where we found furrows with the Alvin, but 60 miles away there are no currents at all," he said. "But there are scours and flute marks to provide evidence that currents were there, just not for a while.

"It's clear that seafloor and near-seafloor maps from regionally extensive 3-D seismic data can aid in the development of the infrastructure in the deepwater Gulf of Mexico." ❑

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What Is a Major Virtue of Seismic Contractors?

Being Nimble in a Fluid Industry

By KATHY SHIRLEY
EXPLORER Correspondent

If there's one thing seismic contractors understand it's change. Technology, terms of contracts, markets, customers, even the companies themselves – nothing about this business stays static for long.

So they know about earth-shaking activity; talk to them about change, and you're on solid ground.

Here's what they say: Today, while nobody is prepared to proclaim that the most recent severe downturn is over for seismic contractors, companies are beginning to see a light at the end of the tunnel.

That means they're also trying to predict what their roles will be in the next new world of oil.

Not surprisingly, industry spokesmen see shifts in their business that will open new markets for 3-D seismic data.

"We are moving into what I call the 'solutions period' of our business in which we will be providing information for the reservoir and production side of the business," said Steve Ludlow, vice chairman of Veritas DGC and president of the International Association of Geophysical Contractors.

"We as an industry have to highlight and prove the value of 3-D seismic data beyond the exploration phase and make that attractive to our customers.

"Today most reservoir studies are based on geology and petrophysical data," Ludlow continued. "We believe seismic can enhance and spread information further over a reservoir. In most cases reservoirs are much more heterogeneous and complex than initial models indicate, and we think we can work in a collaborative environment with clients to more clearly delineate that heterogeneity."

Offshore seismic operations has kept the geophysical industry afloat during good times and bad. Indeed, the seismic industry has gone through good times and bad times during the past decade, and while no one in the industry is too eager to declare the most recent downturn ended, officials agree that a light can be seen at the end of the tunnel. Their question now is: What's next?

Photo courtesy of WesternGeco

Historically, seismic data gets left behind and engineering takes over at some point in reservoir and field development.

"(But) if we can produce seismic images with superior resolution, it becomes quite valuable in the production phase and can help define the best way to produce a reservoir," he said.

Gary Jones, president of WesternGeco, agreed.

"Without question reservoir applications are where the new growth in our industry will be," Jones said.

"Deep-water potential has been pushing exploration in the Gulf of Mexico and other places around the world for well over 10 years, and now that some discoveries have been made companies are looking at appraisal and development plans. They are recognizing the value of 3-D seismic in that stage because they need to get it right on these projects where they are investing billions of dollars."

Jones said he was "seeing more commercialization of time-lapse 3-D seismic" on the Gulf of Mexico shelf and the North Sea, which are mature provinces.

"This technique provides fluid monitoring information that can maximize and extend reserves through additions and revisions rather than through new exploration," he said, "as well as increase the recovery factor."

Big Things in Smaller Packages

Over the past decade, a tremendous amount of 3-D seismic

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data was shot, and oil companies spent a great deal of money on 3-D seismic. That effort was primarily aimed at widespread, relatively coarse, exploration coverage.

"The ballgame in the 1990s was speed, wider tows on the cables in the offshore, and getting costs down to cover large areas so people could look at regional sets of seismic data," WesternGeco's Jones said. "The industry recognized that basin-wide coverage did provide a tremendous amount of value."

Today, however, Jones said a number of customers have indicated that in their view the next phase will be to shoot smaller segments with much higher resolution on a proprietary basis.

"We've been talking for years about moving geophysics into reservoir development, and I think we are finally at that stage," he said. "New technologies in the seismic industry will be geared toward providing the finer, more precise measurements and processing necessary for this new market.

"I suspect customers will discover that these small, patch proprietary surveys for reservoir characterization will be inadequate – that's just how exploration 3-D seismic coverage started," Jones continued. "But small patch surveys begin to overlap and migration aperture overlaps, diluting the value of the data.

"I'm not uncertain we won't as an industry re-shoot the Gulf of Mexico, for example, with very high-resolution technology to provide broad coverage for reservoir management."

Jones also sees seismic's move into reservoir characterization as an outgrowth of the "asset management team" approach within oil companies. Asset teams include geophysicists, geologists and production and reservoir engineers, and each is learning enough about the other disciplines to recognize the value each brings to a project's overall success.

Processing Priorities

Advances in processing will be critical as seismic moves into production applications.

"Processing is increasingly becoming the area where a contractor can make a difference," said Bert Chenin, vice president of marketing for CGG Americas.

"Seismic data has become more and more of a commodity product with few differences in acquisition," Chenin said.

"I am convinced that within a few years we will use geophysics to manage reservoirs. That's the area in which much of the research and development efforts and funds are focused," he added, "developing new techniques to improve the transformation of seismic data into knowledge."

Chenin also believes the shifting focus toward reservoir characterization also means longer-term relationships between contractors and oil companies.

"The exploration period is by nature extremely important, but very short," he said. "Producing and managing reserves is a long-term proposition, so we will have to find new ways to relate to our customers."

Ludlow said Veritas has made the commitment to processing advances as well.

"We recently acquired RC², a software company that's developed a reservoir interpretation program, which demonstrates our commitment to the reservoir business and our fundamental belief that's the new direction for seismic contractors," Ludlow said. "We've gone from a company with virtually zero internal knowledge on reservoirs three to four years ago to (now) having nearly 500 man-years of reservoir knowledge across a very broad spectrum of the disciplines that encompasses."

He acknowledged that production engineers are not yet great believers in the benefits of seismic to their business.

"They've done it the same way for many years and been very successful, so we still have a great deal of internal marketing to do at oil companies before this concept is embraced," he said. "We will have to demonstrate the value of seismic to reservoir characterization."

"I'm not uncertain we won't as an industry re-shoot the Gulf of Mexico...."

Average production from a reservoir is in the neighborhood of 35 to 40 percent of reserves, Ludlow said, (so) "if we can demonstrate to customers that through better reservoir modeling with seismic data that figure can increase to 60 to 70 percent, that's huge."

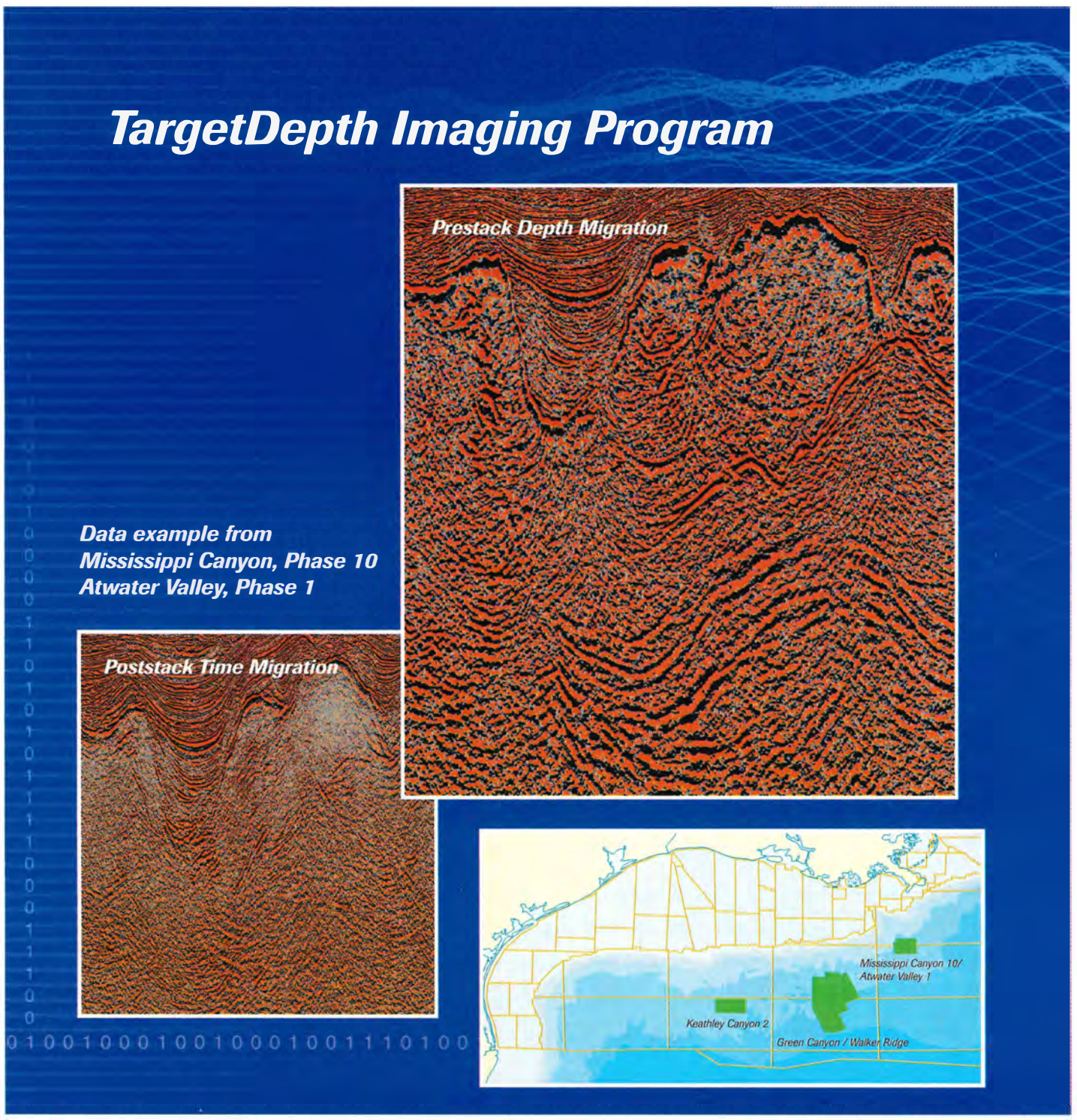
Finally, the growing importance of natural gas to the energy mix around the world also will be good for the seismic industry, according to Jones.

"Nobody disagrees that natural gas is the fuel of choice for the future," he said. "Projections indicate that demand for gas could far outstrip oil demand, by as much as 60 percent or more."

He believes the seismic industry has a "unique ability to detect natural gas due to velocity changes induced in sediments when they are filled with gas.

"We can make direct detection of natural gas, making 3-D seismic data absolutely vital to gas plays," he said. "We can service the industry and society by helping to map and develop natural gas resources society needs."

See **Outlook**, next page



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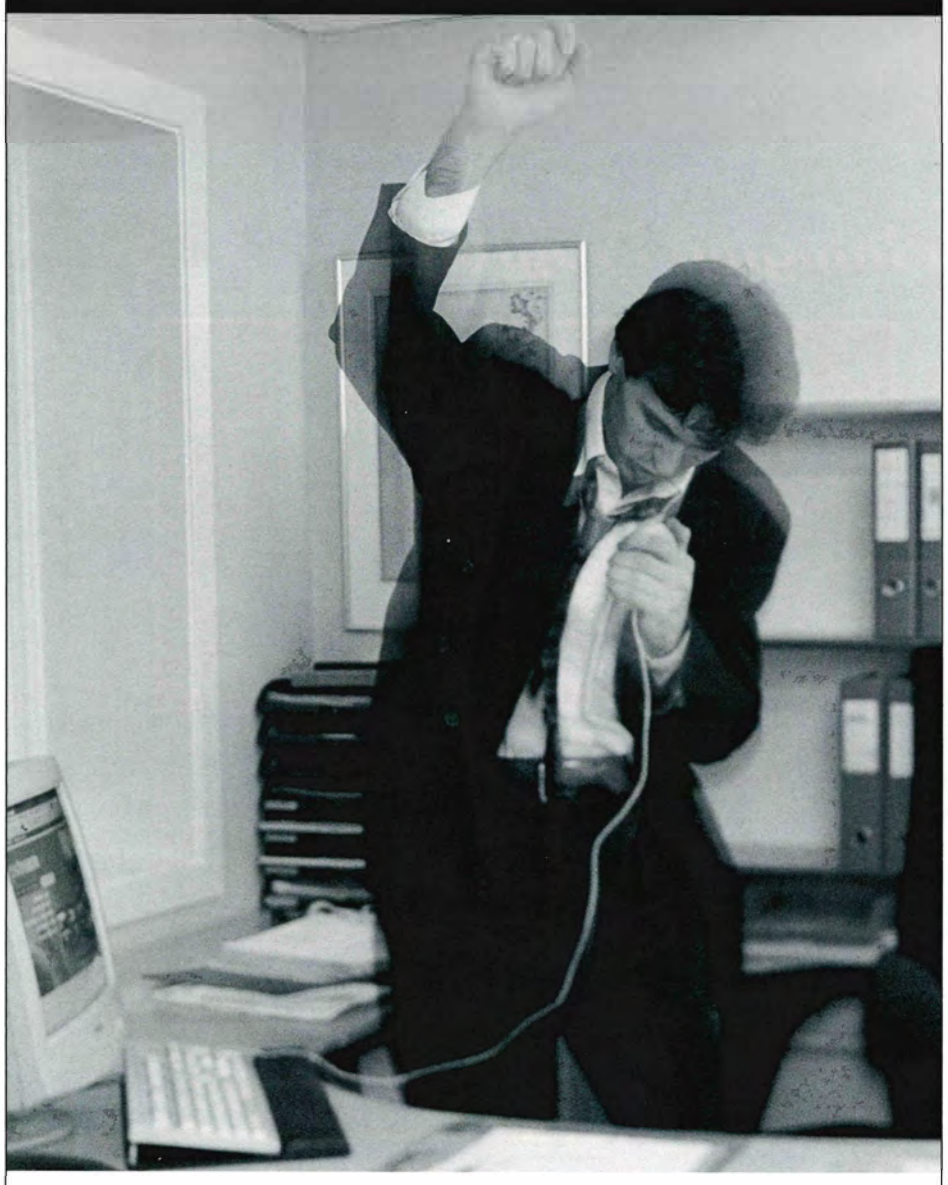

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Past Changes Prepared Contractors for Today

For seismic contractors, the past three decades have forced them to adopt – and adapt to – one business approach after another.

"Just 25 years ago seismic contractors worked exclusively under term contracts shooting proprietary surveys for oil companies," said Gary Jones, president of WesternGeco. "We had steady long-term contracts to work together with oil company personnel. All the risk was borne by the oil company and we simply provided a service."

Following the Arab oil embargo in the mid-1970s the seismic industry saw the first hints of what was to come.

"For the first time, albeit on a very small basis, we saw the advent of the turnkey contract under which contractors were paid per kilometer," Jones said.

By the mid-1980s turnkey contracts had grown to about 40 percent of the business.

"This migration was a function of the maturing industry, well understood field methods and a need to field a lot more crews," Jones said. "Of course this also meant shifting some of the risk to contractors."

By the late 1980s the increasing risk to contractors and lack of control over the surveys made the turnkey proprietary model untenable, he said – and that's when seismic companies began looking at non-exclusive, multi-client surveys as a standard business practice.

"In the past, non-exclusive shoots were a mechanism to fill in the gaps between proprietary jobs," according to Jones. "Also, we began to realize that small 3-D seismic surveys were creating large overlaps and it was more efficient for us to take control with the large survey, multi-client business model."

Jones added that, with today's rates, terms and conditions, "the proprietary business model for conventional work is a non-performing business in the classic land and marine acquisition contracting. The returns currently available in most of the world do not justify further investment – or even continuing operations in many areas.

"Terms, conditions and rates for the contractors need to improve substantially for this aspect of the business to remain viable."

Steve Ludlow, vice chairman of Veritas DGC and president of the International Association of Geophysical Contractors, agreed.

"Non-exclusive or speculative data today takes up a huge percentage of our company resources," he said. "We've moved from a purely service industry into what I call the information age of our business, with large data libraries and a growing number of spec surveys.

"In recent years even non-exclusive 3-D surveys have changed in that they are not always pre-funded by oil companies," he said. "Often the burden is 100 percent on our balance sheets, and that changes the focus of a company."

Contractors today must have very strong balance sheets, Ludlow continued, because "these surveys aren't cheap – we are talking tens of millions of dollars per survey."

Non-exclusive surveys are a well-run, well-funded business today that is as much a priority as proprietary surveys, he added.

"We produce the best possible product using the most advanced acquisition and processing techniques."

And, the marketplace decides what product it wants.

– KATHY SHIRLEY

Outlook

from previous page

Strategy Sessions

How are companies approaching the brave new world of seismic contracting? There seems to be a different formula for every firm.

❒ "We are a specialty shop," said Lynn Chenault with Grant Geophysical. "We specialize in land and transition-zone seismic. We are a worldwide company, but we are able to move around quickly in the geographical regimes in which we choose to operate."

Historically, Grant does "everything from large multi-client international jobs to one-week shoots onshore the U.S.," and has positioned itself to be "agile and quick" to take advantage of onshore projects other contractors have turned away from.

Grant prides itself on being open to a variety of approaches to the contractor-client relationship, and has become partners with selected customers on specific projects.

"You have to be flexible and creative," Chenault said. "Many independent companies don't have the deep pockets of major oil companies, and we have to find ways to make projects work. As the marketplace has changed we've had to change as well. We are doing things today we never thought of before."

He said the seismic industry has become a bi-modal business, bifurcating into a group of big oil companies and big seismic providers and a second tier of independent oil producers and smaller, more specialized seismic contractors.

He expects that division to continue.

❒ CGG Americas, among the world's oldest geophysical companies, derives revenues from every market within the geophysical industry. For example, CGG's subsidiary Sercel is the industry's largest geophysical equipment manufacturer.

"We think being a force in every spectrum of geophysical activity is unique and allows us to position ourselves for the future," Chenin said, adding that their expertise in geophysical hardware and software, and data acquisition and processing

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"will allow us to develop the 'intelligent' reservoir management technology that the market needs.

"You do have to react to the marketplace," he continued. "Twenty years ago we were very active in the U.S. onshore market, where we had up to 30 land crews operating simultaneously," he said. "However, in the last 10 years we recognized that the onshore market was becoming extremely competitive and profits were slim, so we decided to exit that business."

The company is now focusing on marine acquisition in the Gulf of Mexico, with its primary focus being North America.

❒ Ludlow said Veritas doesn't try to be all things to all people. Instead, the firm looks for regions where it can be the first or second biggest player and develop a high level of expertise in those areas.

"We are one of the top companies onshore Canada, in the Gulf of Mexico and in parts of South America where only one or two seismic companies are active," Ludlow said. "We also dominate the South East Asia 2-D market.

Ludlow believes contractors need to have a solid idea of which markets they want to serve.

"For example, people ask why we aren't in the ocean bottom cable business," he said. "I think that market is already over supplied, and it would cost us in the range of a large eight to 10 streamer 3-D vessel to get an OBC crew up and running.

"That market is so competitive all we would be doing is moving the crew around at our expense and working for zero margin," he added. "There's enough supply out there already."

❒ WesternGeco, of course, is a unique situation. Since the merger of Western Geophysical and Geco-Prakla, the new firm has "a role as the industry leader," Jones said.

"We need to set the tone for the business and assume the leadership mantle in areas such as safety and environmental issues," he said. "We are challenged to meet society's conflicting demands of more energy and less of a footprint on the environment."

He believes that "what sets our company apart is that we are present geographically everywhere, and we are present technologically in just about every niche in the industry.

"That's really a first," he continued. "Historically this has been a business of local niche and technology players. It's been exciting meshing the two companies.

"However, we understand that being large doesn't mean much," he said. "We have to earn business by delivering superior service, quality, technology, safety and environmental responsibility."

An Abundance of Riches?

Technology is definitely an area where geophysical contractors have excelled. That trend will continue, but some industry spokesmen see those advancements slowing down.

"Oil companies have virtually eliminated research and development programs, leaving it to contractors," said Dick Miles, Grant Geophysical's president and chief executive officer. "But the geophysical industry today simply doesn't have the funds for a large research and development effort, so the whole cycle of technology advancement, which in the past has been rapid and continuous, will slow down."

That, he said, makes the future of the geophysical industry a little hazy.

"Technology has always opened new markets and allowed the industry to thrive," Miles said. "The next few years will be interesting."

In fact, Miles and Chenault believe the industry has a couple of more lean years to weather before any substantial recovery begins.

"Seismic contractors did a very good job in the 1990s of shooting large 3-D seismic surveys, and there is still a big bubble of prospects out there that don't need further seismic," Miles said. "There is also a big bubble of speculative data on the shelf that will feed another bubble of prospects.

Miles added that he went to a talk by the president of a small independent oil company recently who said his firm has an inventory of 200 prospects ready to drill – "about a two year backlog," he added.

"Clearly, we are not in the free fall that we experienced a year ago," Jones said. "Business has stabilized. The question now is, will it remain at this level with modest growth, or are we going to have more expansive growth in the near term? I don't think anybody really knows right now."

What everyone is sure of is that in the long-term, seismic will always have its place.

"Technology has always opened new markets and allowed the industry to thrive."

"When we interview customers and ask them what is the most important technologies in the last 20 years, they all say 3-D seismic by a wide margin," Chenin said. "Any report you read about our industry says that 3-D seismic far and away has created the most value for oil companies of just about any other tool, and that's because of 3-D's inherent ability to reduce risk.

"That isn't going to change in the future," he added. "Oil companies know they need seismic technology to succeed." ❒

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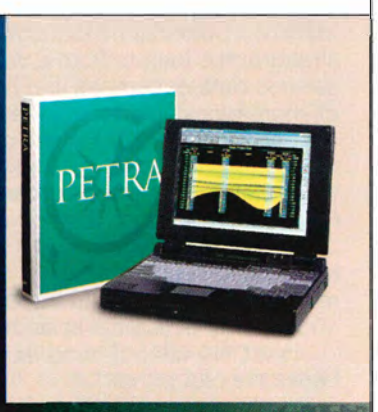

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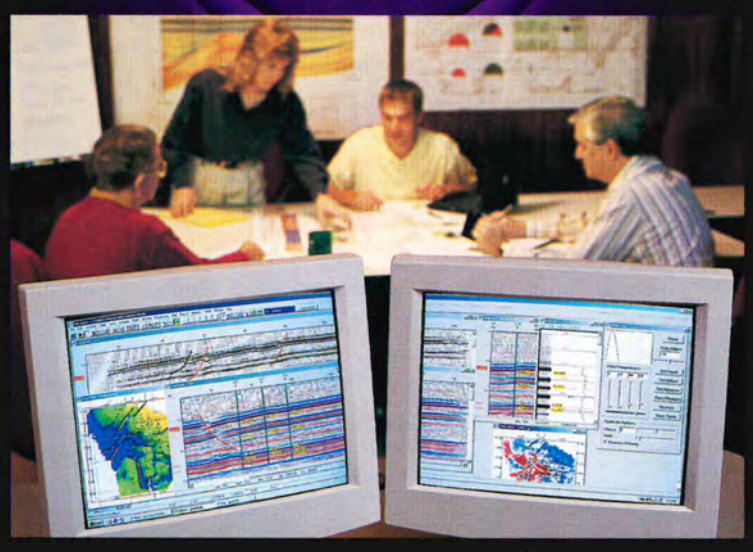

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Technology Sorts Out 'Data Genomes'

Patterns Reveal Seismic's Tales

By LOUISE S. DURHAM
EXPLORER Correspondent

You've heard it before: Three-D seismic is a blessing there's so much data, and it's a curse there's so much data.

This may be a truism, however, that has outlived its time.

A whole new technology has emerged that can tear into massive volumes of 3-D data to not only develop a play concept, generate leads and qualify prospects, but to do so at something akin to lightening speed.

It's been used, for instance, to identify a potentially productive stratigraphic feature from a volume of seismic data encompassing 50 offshore blocks, scanning the whole shebang in 32 hours to highlight and automatically map all the look-alikes in the data volume for that particular reservoir type.

The technology is called ImageGenetics™, a pattern recognition process that traces its origin to the biological sciences.

It's a DNA-kind-of-thing, and here's the blueprint:

The human genome is made up of only four letters of the alphabet, which combine with one another to form a pattern that then combines with other patterns to form patterns of patterns, or textures. It's this hierarchy of increasing complexity that lets the four simple features build the entire human genome.

Recognizing the potential to unravel other complex data sets by looking for the same type of pattern repetition using the same sort of hierarchal structure of DNA, Fred Young at Chroma Graphics invented and patented the ImageGenetics process.

Along with the computer graphics and medical fields, the oil and gas industry was quickly identified as an ideal market for the technology.

This encouraged the company to organize its Chroma Energy subsidiary, which comprises a team of oil finders focused on mining large volumes of data to generate qualified drilling prospects.

The technology is different from the standard approach the geophysicist has typically taken, said Peter Duncan, chief operating officer at Chroma Energy.

"We've always broken the seismic data down into attributes such as amplitude, instantaneous phase or whatever," Duncan said, "and draped the attribute over the structure to see what the distribution of that single attribute tells us about the geology.

"What Chroma does is define a new set of attributes that are data derived and made up of snippets of the data itself – just like the biological snippets used to analyze DNA – and look for patterns of those attributes and then textures of those patterns," he said. "And that's the significant leap forward."

Powerful Tool

Dallas-based consulting geophysicist Mike Forrest said the pattern recognition technology "enhances the value of 3-D data sets with detail interpretations of geomorphology and stratigraphy that are not possible using standard time slices."

The initial step in implementing the technology is to use an analog or play concept and derive a set of patterns and textures that highlight and illustrate how a play concept exhibits itself within the data.

"I can extract unique patterns and find a type code that lets me see my perception of a play concept," said Peter Whitehead, president and CEO of Chroma Energy. "The images we extract of the geology are more definitive than ever before.

"We visualize the textures and patterns with a full 32-bit voxel visualizer and false color imagery to reassemble multi-attribute combinations of these textures and patterns in a powerful, illuminating way," he continued.

"It's like giving the interpreter a paint brush to paint the geology onto the textures and patterns that now can be recognized in the

continued on next page

Seismic 2001

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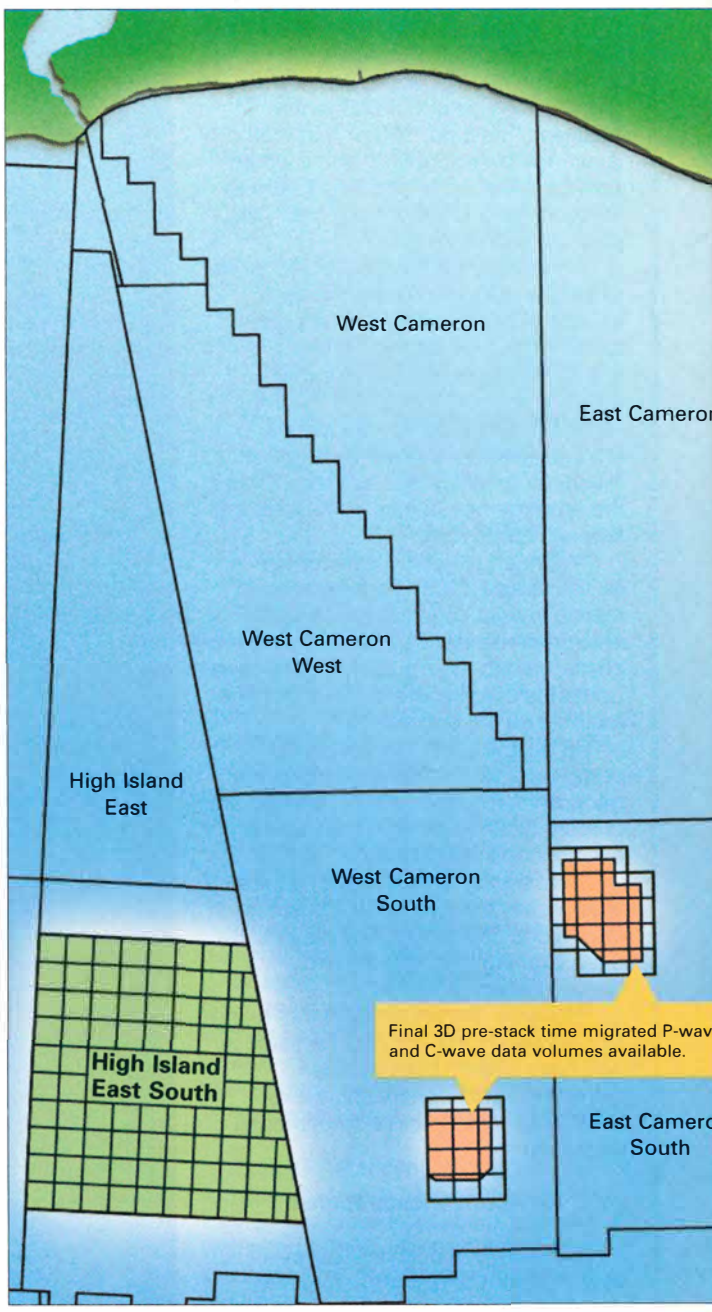

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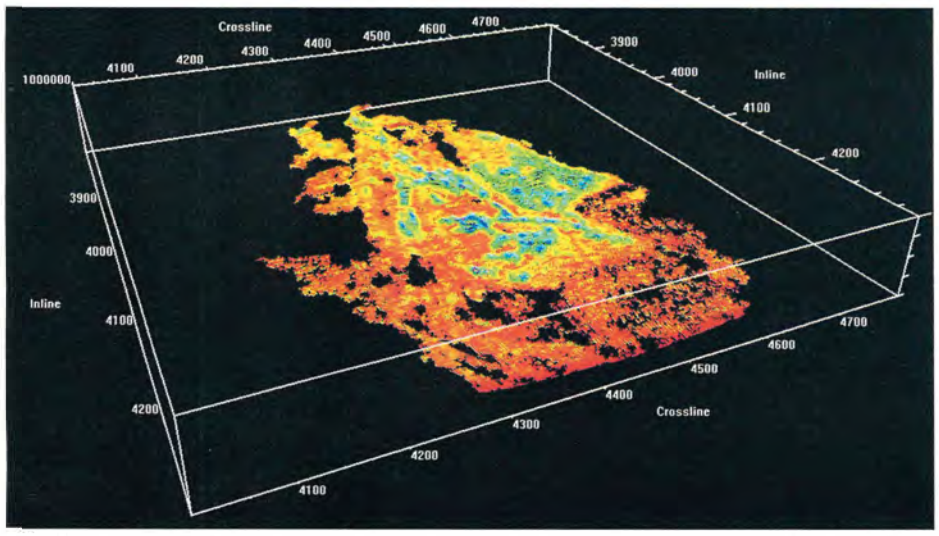
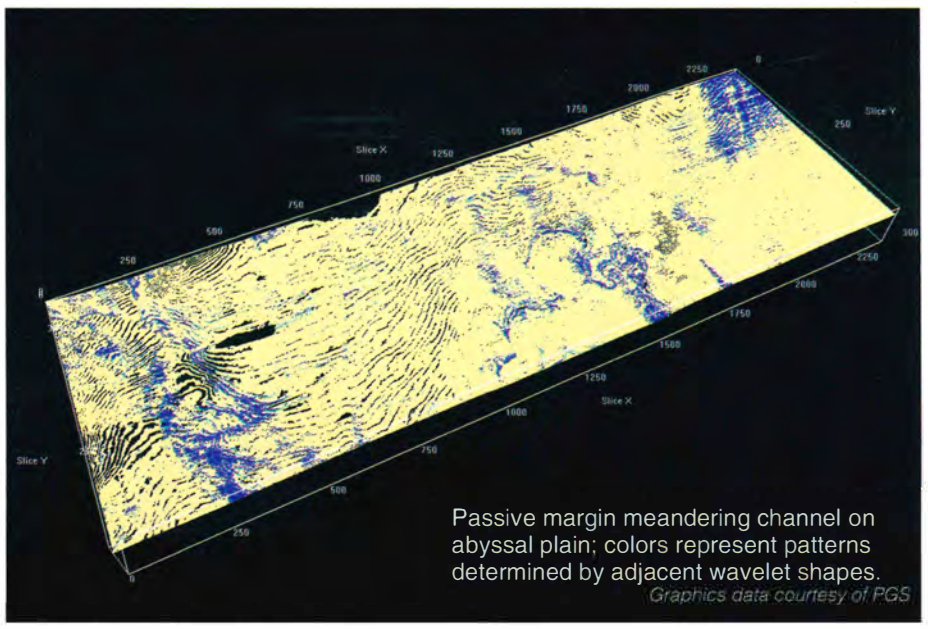


This image, created via Chroma Energy's patented process, depicts visualization of geobody textures used to image 3-D heterogeneity in the rock properties of a turbidite fan lobe in the Gulf of Mexico's Mensa gas field.



Passive margin meandering channel on abyssal plain; colors represent patterns determined by adjacent wavelet shapes.
Graphics data courtesy of PGS

continued from previous page

seismic data."

Once the geology of interest is identified, the computer rapidly locates similar occurrences in the data set to quickly create an unqualified lead list. The search is then further refined by drilling down into the data, telling the computer, for example, to isolate the sand bodies and divide each thickness into different colors to show structure within a sand body itself.

By taking something that looks the same and breaking it apart into constituent pieces, the interpreter can begin risking such variables as the kind of communication likely to be encountered within the reservoir, and using it to qualify leads and prospects.

Evolutionary Technology

The technology is garnering some true believers in the real world of E&P.

"What I like about it is it takes me where I haven't been before in looking at the pattern data, relationships it finds and how it combines different patterns of characters to identify things in seismic not in a normal view," said Michael Hiner, chief geophysicist at Unocal's Spirit Energy 76.

"You can interrogate a pattern data set to look at just thin beds, for instance, and with just a few motions on the menu it will quickly highlight those events for the whole volume. It's very powerful."

So far, Hiner has used the tool on three Gulf of Mexico projects.

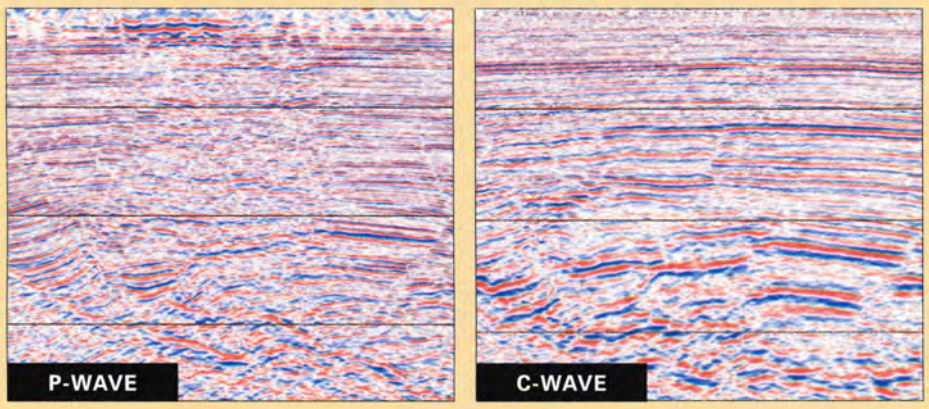
"We're still evaluating two, and on the other one we've come to some conclusions and found the tool did as we tasked it to give us solutions we didn't have in a classical interpretation," he said. "What remains is to test those conclusions against the drill bit."

ImageGenetics™ might be used along with some of the other seismic packages on the market that are employed to highlight stratigraphy, such as Coherence technology.

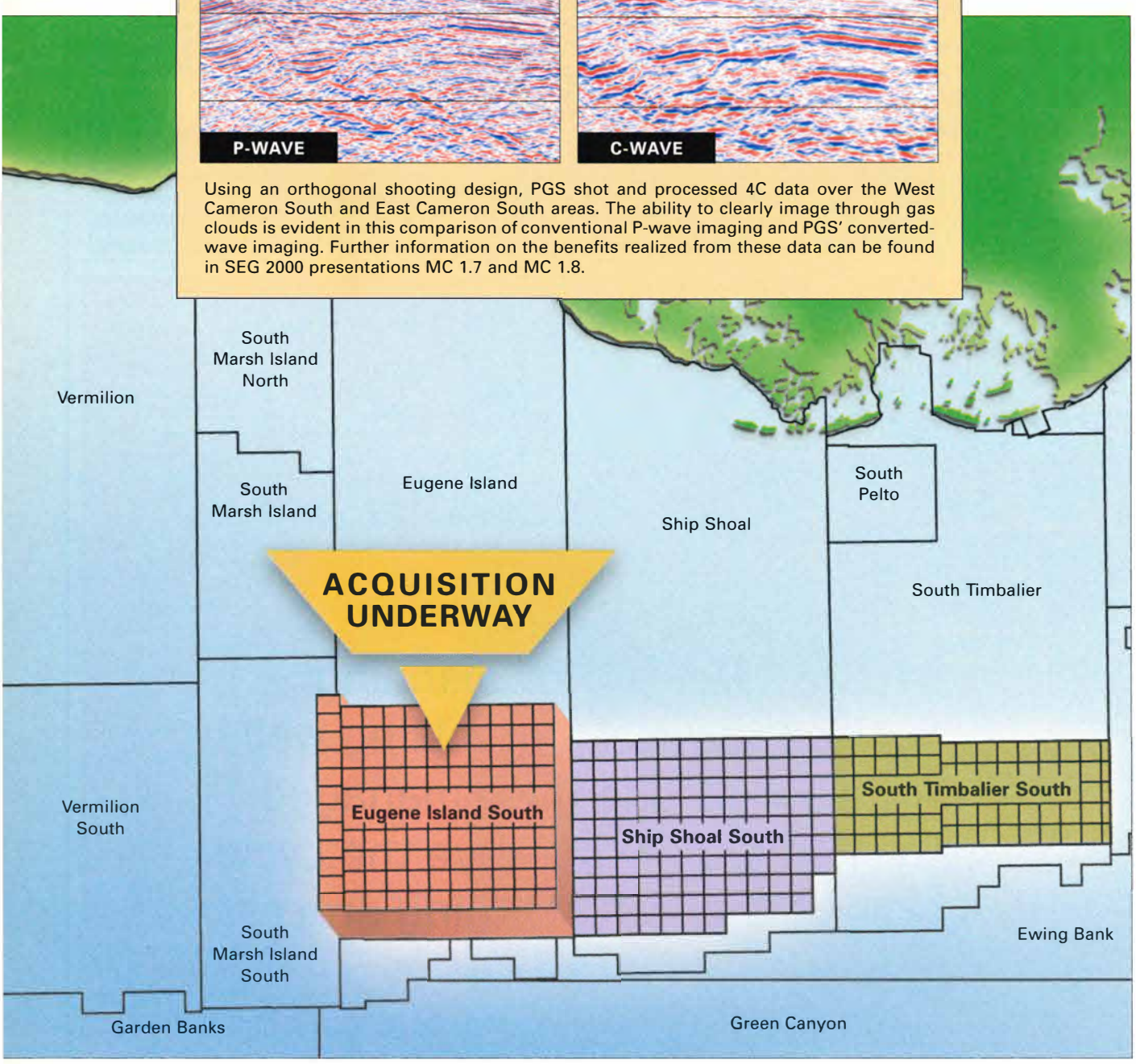
"Coherence looks for discontinuities and highlights the edges of bodies, and you infer what's in between those edges," Duncan said. "Our tool looks for similarities and paints the geobodies, so it's exactly the complement to Coherence."

See **Image**, page 21

4C DATA VOLUMES DELIVERED IN DECEMBER 1999!



Using an orthogonal shooting design, PGS shot and processed 4C data over the West Cameron South and East Cameron South areas. The ability to clearly image through gas clouds is evident in this comparison of conventional P-wave imaging and PGS' converted-wave imaging. Further information on the benefits realized from these data can be found in SEG 2000 presentations MC 1.7 and MC 1.8.



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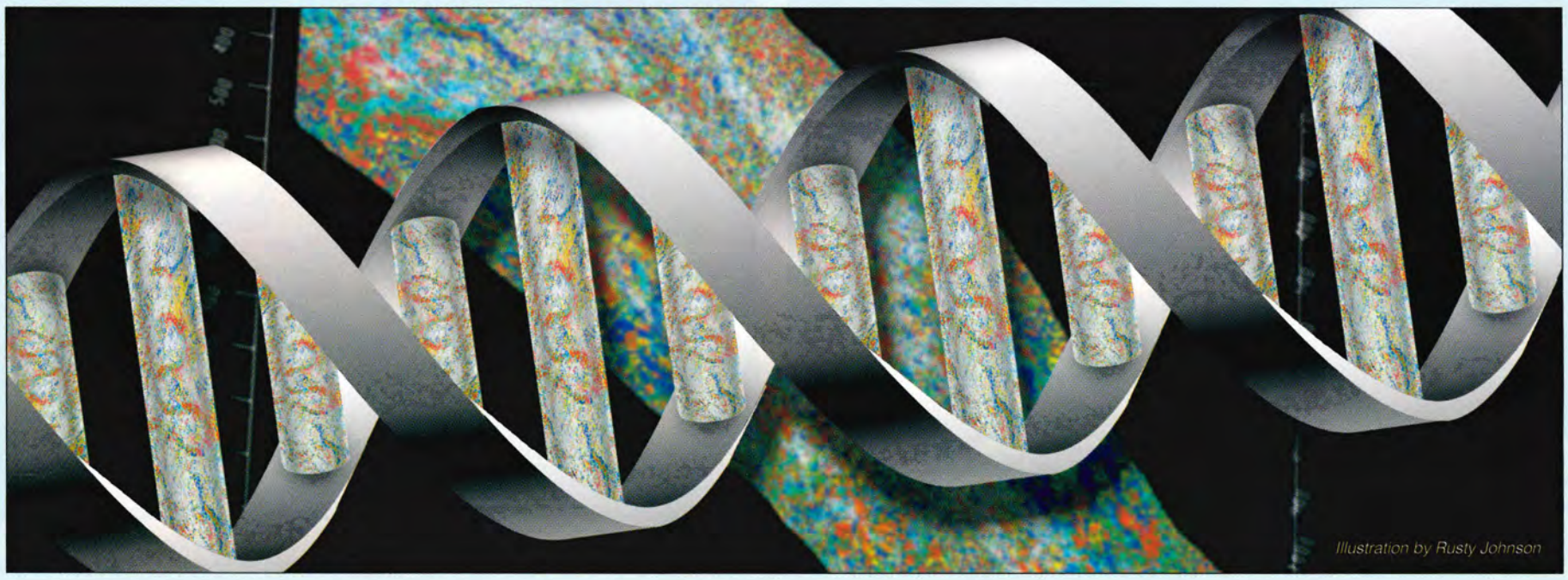

Seismic, Biology 'Genomes' Analogous

The mammoth task of determining the three billion-letter DNA sequence of the human genome was recently completed – but this milestone in understanding the most complex systems known to mankind is, in fact, only a beginning.

Identifying which parts of human DNA contain genes and then determining the role of those genes in governing cell function are challenges that will occupy geneticists for future decades.

Understanding the seismic "genome" is an analogous challenge.

Distinguishing signals from noise and determining their geological significance requires a similar congruence of powerful computerized tools and interpretive expertise.

Seismic "genes" are manifest as patterns and textures in the seismic image – recognizable to the trained explorationist but not to the computer. These patterns and textures are the trace shapes and depositional geometries seen in the seismic.

Current computerized tools provide little more than an electronic pencil to enable the explorationist to draw an interpretation into the computer.

Overwhelmed by data, facing ever-tighter deadlines and supported by computerized drawing rather than searching tools, it is difficult for today's explorationist to use the range of seismic "genes" that are already well understood, let alone search for new ones.

ImageGenetics™ technology takes nature's principle of encoding complex systems as DNA sequences and attempts to use it to decode complex natural systems into their basic DNA. It generates the "DNA" of any seismic data, pre- or post-stack – and this seismic "DNA" then can be searched for "genes," or patterns, that code particular geologic characteristics, the company said.

If so, the explorationist could be able to use this to construct an explicit template of seismic "genes" that characterize a play concept, and then search large volumes of data for all leads that exhibit the same characteristics.

– LOUISE S. DURHAM

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Image

from page 19

It's also a complement to the tried-and-tested Stratimagic application, according to Hiner, who used both techniques on the three GOM Unocal properties.

Still, there are some fundamental differences in the two technologies:

❒ Stratimagic is a mapping tool that requires the user to first identify a horizon or zone of interest to be evaluated. The application is based on Neural Networks, which is a branch of artificial intelligence computing that addresses mainly shape recognition.

❒ ImageGenetics™ is a volume tool that looks at a whole volume of seismic data with no preparatory work. The interpreter drives the process, rather than a Neural Net.

"Our goal and intent," Hiner said, "was to learn what the tools can do, test them against each other and see if we get similar results and if there's a breakout in stratigraphy in one over the other."

Hiner noted he would use both tools on the same project today because of the evolutionary state of the new technology.

"Stratimagic is established, vetted by our company and others in the industry, and it's a reliable tool that everybody understands," Hiner noted. "Still, if I were walking into a new survey for the first time where I didn't have a specific horizon I was interested in, I would use the Chroma tool to look at the whole volume without having to do anything more than set it up.

"We learned that both Stratimagic and the Chroma tool are able to identify very subtle stratigraphy and enhance our view of that stratigraphy," he continued, "and give us internal details on some of the stratigraphic features that we could not get with other more classical interpretations."

To experiment, they used some channel geometries they had picked using StratAmp in Landmark that were "quite exciting," but the internal detail around the channels couldn't be seen.

When Stratimagic was used on one of the intervals, it was able to look inside the channel and show changes in wavelet character within the channel geometry and also outside, Hiner said.

The Chroma tool was next used, and "we ran it blind, not telling the Chroma staff what we were looking for," he continued.

The geoscience staff at Chroma detected the channels, focused in on them and then, "in a horizon sense generated the same kind of detail that we had gathered in Stratimagic," Hiner said.

In a break with the traditional approach taken by service companies to sell or license seismic application software, Chroma intends to keep its new tool close to the vest.

"We'll keep the ImageGenetics algorithm and ChromaVision tool proprietary to our clients who partner with us on projects where we share in the risk and proportionate reward," Whitehead said. ❒

Shoemaker Lands on Asteroid

The late astrogeologist and AAPG member Gene Shoemaker continues to have a dynamic presence in the universe.

In mid-February, a NASA spacecraft named in his honor became the first man-made instrument to land on an asteroid when it touched down on Eros – the conclusion of a five-year mission in which the robotic spacecraft became the first to explore an asteroid in detail.

The NEAR Shoemaker, a 1,100-pound spacecraft, slowly descended and bounced on Eros' rocky surface at a speed of 3.5 to 4 miles an hour before coming to a rest, after a journey of two billion miles and a full year in orbit around the asteroid.

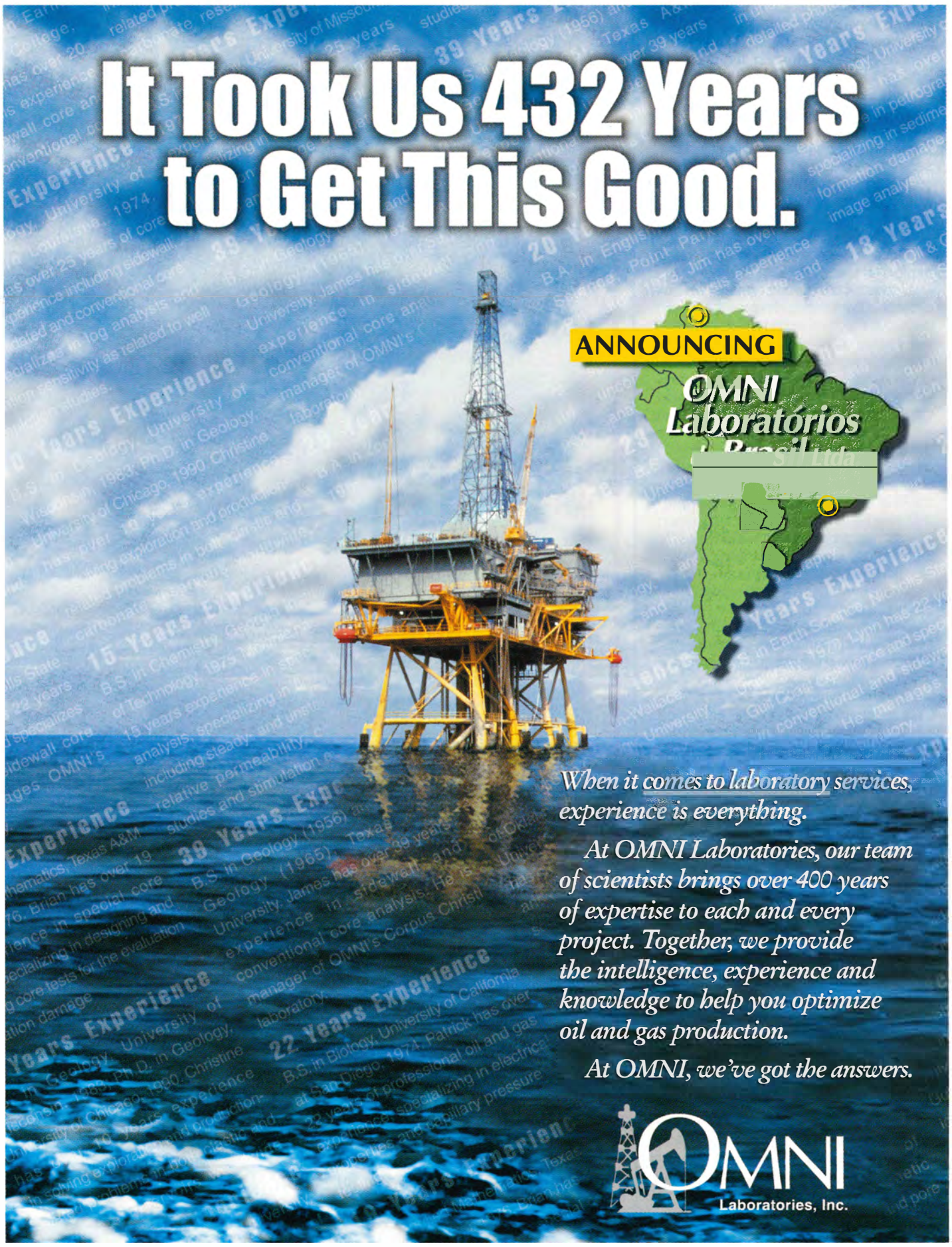
Eros is 21 miles long, eight miles wide and about eight miles thick – about twice the size of Manhattan island, with a shape that has been described as like a potato, peanut or a ballet slipper. It is the largest of the so-called near-Earth asteroids, and is about 196 million miles from Earth.

The NEAR (Near Earth Asteroid Rendezvous) Shoemaker is solar powered and could transmit signals for months, even though the project was slated to end in late February.

Because of the mission, scientists already have learned that Eros is a solid body of uniform composition made of a material that is probably older than Earth.

Pictures taken during Shoemaker's descent can be seen online at near.jhuapl.edu.

Shoemaker's widow, Carolyn, an astrogeologist, will speak at the AAPG annual meeting in Denver (see page 23).



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Another Gulf Dome Yields Secrets

By KATHY SHIRLEY
EXPLORER Correspondent

Re-exploring salt domes that are underdeveloped is a time-honored tradition in the Gulf Coast.

Esenjay Exploration and Grant Geophysical teamed up using state-of-the-art 3-D seismic to unlock more secrets shrouded by Gulf salt domes.

"The piercement salt domes along the Texas-Louisiana Gulf Coast have undergone several episodes of exploration, dating back to the 1920s, when torsion balance gravity measurement techniques were used to define the features," said Lynn Chenault, a consultant with Grant Geophysical.

"While this technique didn't allow for very accurate delineation, it did get people in the neighborhood."

A round of marginally successful exploratory drilling resulted from these gravity measurements, and that drilling provided some additional insight into salt domes – and was at least successful enough to stimulate additional exploration using refraction seismic to delineate the outlines of the salt bodies.

Later, 2-D seismic was added to the exploration mix.

"More subsurface information emerged from this drilling, and geologic theories were formed on deposition and charge around these structures, explaining the numerous dry holes suffered in the process," Chenault said.

"Through every exploration cycle we learned something about the geology of salt domes," he continued. "By the 1940s there was a huge body of knowledge about salt tectonics in the Gulf Coast – but with the advent of 3-D seismic it was apparent the industry could once again redefine these structures using the new technology."

That's exactly what's going on today.

"We have taken all the information available from earlier rounds of drilling and shot a new 3-D seismic survey on a salt dome in southeast Texas, which we think is still highly prospective," Chenault said.

"In fact, there was an independent operator in Houston who was active in the early days of salt dome exploration, who collected a massive amount of literature on those efforts and left it to the Houston Public Library. One of our guys uncovered that collection and has been mining it for our current program."

Opportunities Await

Three-D seismic has been important because it illuminates untested geologic objectives and more complicated traps and migration paths than were previously interpreted.

A round of exploration employing 3-D seismic was interrupted in the 1990s when oil prices cratered. As a result some 3-D surveys acquired during this aggressive effort went undrilled.

Add to that the fact that some salt domes were never shot with 3-D prior to the price collapse, leaving plenty of opportunities to re-explore these features.

Esenjay and Grant shot 50 square miles of 3-D seismic data over the partnership's first target in late 1999 and early 2000. The survey was a conventional marshland acquisition, using shot holes and semi-amphibious equipment. The firms have identified several drilling targets and are currently dealing with land issues on the first project.

"The first well should be drilled by March, but where we drill initially depends on which areas get title cleared first," Chenault said.

The companies are targeting natural gas in Oligocene-age sands at 10,000 to 15,000 feet.

Shallow production was established on this salt dome in the 1920s, but subsequent rounds of unsuccessful, expensive deep drilling based on refraction and 2-D seismic condemned the feature as unproductive.

Conventional wisdom based on earlier rounds of activity held that the deeper targets were starved for sand. However, Esenjay and Grant's 3-D seismic data appear to have illuminated missed opportunities on the previously lightly tested flank of the

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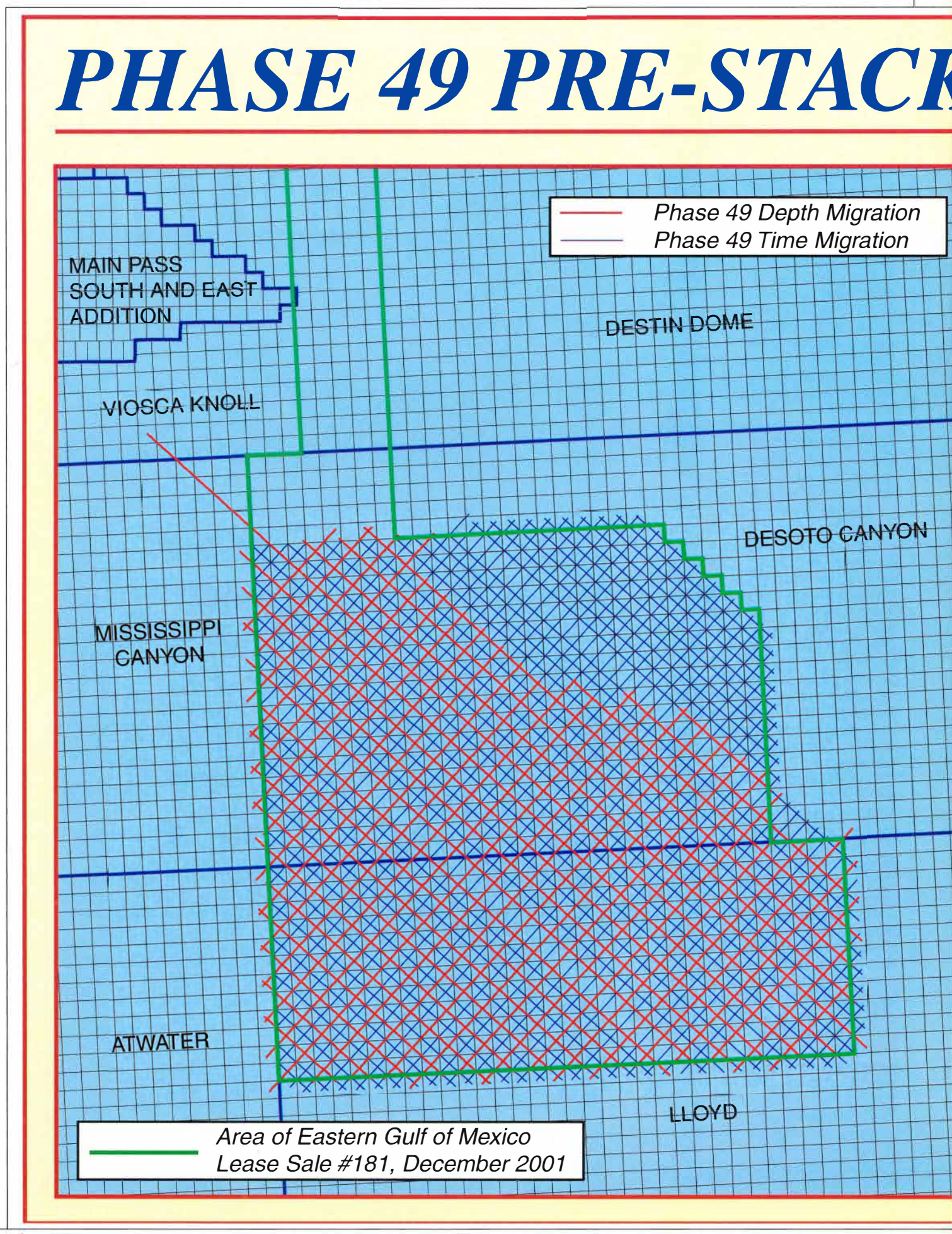

Special Forums Planned for Denver Meeting

Spring is almost here, and that means it's time to start planning to attend the 2001 AAPG annual meeting in Denver, which will be held June 3-6 at the Colorado Convention Center in downtown Denver.

The official meeting announcement has being mailed to the membership, and is also available online on the AAPG Web site at www.aapg.org.

This year's meeting theme is "2001: An Energy Odyssey."

The 82-page announcement features a greeting from general chairman Steve Sonnenberg and provides all of the information members need in planning their trip, including details about the technical program, forums, education courses, field trips, speakers, exhibition area, housing and leisure activities, as well as some general information about visiting the Denver area.

Also slated for the Denver meeting are several special attractions, including an Interactive E-Poster session and the Career Transition Workshop.

This year's meeting will feature four special forums, all at the convention center. They are:

❒ **History of Petroleum Geology: Petroleum-Geology History in Selected States**, to be held from 1-3 p.m. Sunday, June 3.

❒ **Public Lands Access**, which is the first joint DPA, EMD and DEG forum, to be held from 3-5 p.m. Monday, June 4.

❒ **The Michel T. Halbouty Lecture: Through a Crystal Ball**, a newly established lecture series, this year sponsored by the Astrogeology Committee and featuring a presentation by Carolyn Shoemaker, planetary advisor at the Lowell Observatory in Flagstaff, Ariz.

❒ **Applied Sustainability Forum: Integration of Metrics and Applications**, a DEG forum to be held at 8 a.m. Wednesday, June 6.

A large, varied technical program has been prepared for the meeting, based on the following themes.

✓ Business, Opportunity and Vision.
✓ Environment.
✓ Technology.
✓ Gas.
✓ Petroleum Systems.
✓ Depositional Systems and Sequence Stratigraphy.
✓ Reservoir Geology and Characterization.
✓ Structure and Tectonics.

A reminder: April 26 is the preregistration deadline.

For more information, go to the AAPG Web site at www.aapg.org.

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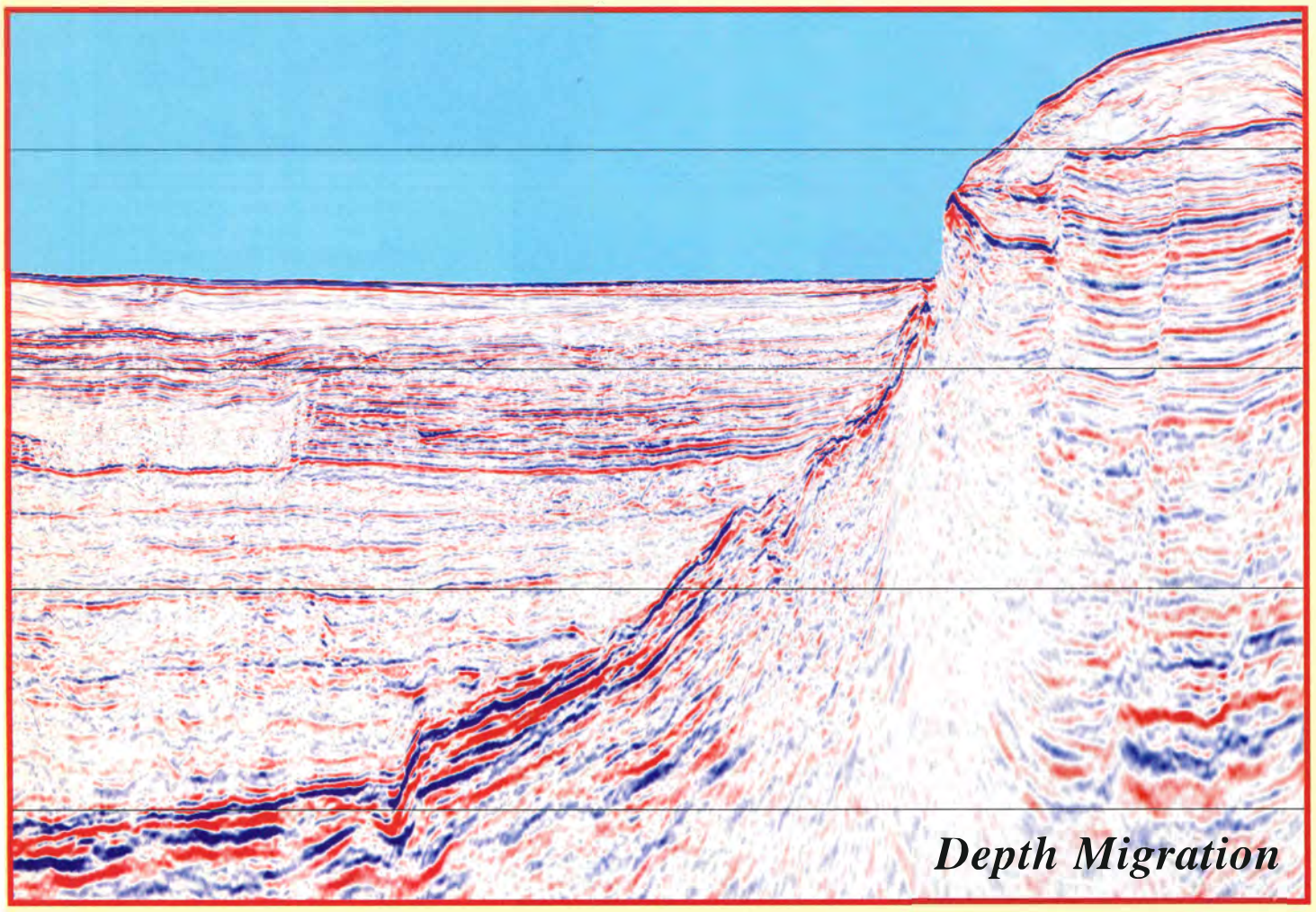

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dome.

Whites in Sight

Getting updip from the production is relatively simple with the improved resolution of the 3-D seismic.

"This particular salt dome has had a great deal of drilling on one flank, but is sparsely drilled on another flank, which we believe could be more productive," Chenault said. "That's the case for many salt domes that have productive and non-productive quadrants in the feature."

According to Chenault, the northeast quadrant is pushed up and the traps are breached, while the southwest quadrant has not seen as much uplift and no thinning because this is a late growth dome.

"We think the reservoir sands go all the way to the dome," he said, "unlike some of these features that are early growth domes and sands tend to pinch out towards the dome."

Esenjay and Grant's long-term plans are to locate additional "white spots" on the map to target with 3-D seismic.

"White spots are places on the map that are not leased up and haven't been shot with 3-D seismic," Chenault explained. "We are hoping to extend what we learn on this first project to other salt domes. There appear to be quite a few white spots, especially in Louisiana, so we have some room to run with this concept."

Chenault said the land, technical, and commodity price issues have slowed activity on these salt domes.

"It's a challenge to put together a lease position onshore," he said. "The minerals are often severed from the surface and there are multiple landowners to deal with. It does get complicated, and many companies opt to go offshore where things are more straightforward."

But, he added, "that's left a real opportunity for companies willing to tackle the obstacles.

"This partnership was a good fit for both companies. We wanted to get some 3-D seismic shot on the Gulf Coast, since that's our core business, and Esenjay was looking for somebody to help them get 3-D seismic shot over some of these targets."

Esenjay didn't have the capital to purchase the seismic outright, so Grant has taken an equity position in the area of mutual interest covered by the partnership.

"This is a unique business deal," Chenault said, "but something we are likely to see more of in the future." ❒

Tax Break Rekindled Interest

Shale Gas Exciting Again

By KATHY SHIRLEY
EXPLORER Correspondent

Shale gas production is certainly nothing new in the United States. In fact, the first commercial gas shale well was drilled in New York in the late 1820s – nearly 40 years before Colonel Drake drilled his famous oil well in Pennsylvania.

Still, there's a new – some might say urgent – sense of excitement when it comes to the role of shale gas production in today's energy mix, as well as its potential for the coming years.

"Over the next decade we expect the gas industry will continue to expand the shale gas play frontiers as new areas are evaluated and we learn more about the geology of shale gas resources," said David G. Hill, manager, emerging resources, with the Gas Technology Institute.

Gas shales, he said, are classified as continuous type natural gas plays – accumulations that are pervasive throughout large geographic areas and offer long-lived reservoirs with attractive finding costs.

"The major exploration risk in most shale gas plays is generally not the drilling of a truly dry hole, but rather in not obtaining economically viable gas production rates," Hill said. "Most shales have very low matrix permeabilities and require the presence of extensive natural fracture systems to sustain commercial gas production rates."

In shale reservoirs, natural gas is stored three ways:

✓ As free gas within the rock pores.
✓ As adsorbed gas on organic material.
✓ As free gas within the system of natural fractures.

These different storage mechanisms, Hill said, affect the speed and efficiency of gas production.

Modern gas shale production was initially spurred by the Section 29 non-conventional fuels production tax credit, but that tax credit expired in 1992, and operators have continued to expand gas shale programs. Today over 28,000 gas shale wells produce nearly 380 billion cubic feet of gas yearly from five U.S. basins:

❒ Appalachian.
❒ Michigan.
❒ Illinois.
❒ Fort Worth.
❒ San Juan.

In 1998 fractured shale gas reservoirs supplied 1.6 percent, or .3 trillion cubic feet of total U.S. dry natural gas production and contained 2.3 percent or 3.9 trillion cubic feet of total U.S. proved natural gas reserves. Over the past decade shale gas production has increased by a factor of 2.5, growing from 148.6 billion cubic feet of gas in 1989 to 380 billion cubic feet in 1999.

The shale gas resource base in the lower 48 states is significant. According to GTI, gas-in-place resource estimates for the five main gas shale plays total 581 trillion cubic feet of gas, and recoverable resource estimates range from 31 to 76 trillion cubic feet.

These figures are considered conservative since estimates for the Barnett Shale in the Fort Worth Basin and the Lewis Shale (see related story, page 26) are not available.

Hill commented that "each new shale gas play has presented technical challenges that operators have to overcome by identifying and solving shale-specific problems.

"But," he added, "success in these relatively low-cost plays has sparked a resurgence of industry interest in evaluating the production potential of the shale gas resources present in basins throughout the United States."

continued on next page

An Atrium Shale outcrop at the Paxton Quarry in northern Michigan.

Photo courtesy of Gas Research Institute

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A Stimulating Story

The first shale gas production in the United States came from the Appalachian Basin, where by 1926 the Devonian shale gas fields were the world's largest known occurrence of natural gas. At year-end 1999 the basin contained over 21,000 gas shale wells, producing approximately 120 billion cubic feet of gas a year.

Technically recoverable resource estimates for the Appalachian Basin range from 14.5 to 27.5 trillion cubic feet of gas.

The basin's Devonian-age shales extend from southwestern New York to eastern Kentucky and central Tennessee. The majority of its shale gas production has been from the Big Sandy and associated fields in Kentucky and southwestern West Virginia, where the primary target is the Huron member of the Upper Devonian Ohio Shale.

Well recoveries vary considerably, ranging from less than 100 million cubic feet of gas to more than one billion cubic feet. The average well produces 250 to 350 million cubic feet over a productive life of 30 years.

"One of the biggest technical challenges in the Ohio Shale has been in the area of stimulation," Hill said. "While some wells flow gas naturally, over 90 percent require some form of stimulation to achieve commercial production rates."

Over the years the Appalachian Devonian shales have been a test bed for a variety of stimulation technologies that include:

- ❒ "Shooting" a well with gelatinated nitroglycerine.
- ❒ High energy gas fracturing.
- ❒ Nitrogen- and carbon dioxide-based foam fracturing.
- ❒ Straight gas fracturing without proppant.
- ❒ High angle and horizontal completions.
- ❒ A number of variations on basic fracturing fluids and chemicals.

Two more recent innovations are the use of liquid carbon dioxide and sand, and cryogenic nitrogen.

As with most stimulation applications, Hill said, no single technique or fluid system has worked universally.

"The proximity to large East Coast markets, low transportation costs, long lived reserves and high success rates will continue to make the Ohio Shale an attractive target in the Appalachian Basin," he said.

"However, considering the maturity of the play, the greatest challenge to continued success will be expanding the productive limits of historic play areas with new stimulation technologies."

A Tale of Two Basins

The Antrim Shale in the Michigan Basin spurred the current gas shale interest in the United States.

Initially the Section 29 tax credit spurred activity in the Antrim Shale, but new technology, an understanding of the mechanisms controlling production and operational efficiency gains by operators have sustained activity in the play.

The Devonian-age Antrim Shale reaches a depth of about 3,000 feet in the center of the basin. Operators, however, are developing the shale along the shallow northern and western rim of the basin, where well depths range from 400 to 2,500 feet and wells cost about $240,000 to $280,000 to drill and complete.

The primary targets are the Lachine and Paxton members of the Lower Antrim.

Resources estimates range from 35 trillion to 76 trillion cubic feet of gas, with technically recoverable gas reserves estimated at 11 to 18.9 trillion cubic feet. The average well in the Antrim Shale produces around 116 thousand cubic feet of gas a day, and production has grown from 12 billion cubic feet from 154 wells in 1988 to over 190 billion cubic feet of gas from 6,500 wells in 1999.

In fact, the 221 Antrim Shale wells drilled in 1999 accounted for three-quarters of the drilling activity in the Michigan Basin.

"The Antrim play will continue to develop," Hill said, "as operators evaluate new completion technologies, recomplete wells in the upper Antrim Shale, conduct restimulation programs and test new areas for production potential."

"The greatest challenge to continued success will be expanding the productive limits of historic play areas with new stimulation."

The New Albany Shale in the Illinois Basin has a long producing history, too, but activity in this region has not progressed at the same rate as the Ohio Shale or the Antrim Shale.

In the 1990s activity in this play was driven by success in the Antrim. Many of the players in Michigan considered the New Albany a viable target and approached it using the Antrim model for development.

Activity in the New Albany Shale peaked in 1996 with 90 wells, but has since declined to just 16 wells in 1999.

Operators are currently experimenting with various drilling and completion techniques in an attempt to improve well performance and reduce costs. Well costs have ranged

See **Gas Shales**, page 33

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1,000 Recompletion Candidates

Lewis Not Overlooked Anymore

By KATHY SHIRLEY
EXPLORER Correspondent

The San Juan Basin – the largest producer of natural gas in the Rocky Mountain region and the proving ground for coalbed methane production in the United States – is once again a prolific source of unconventional natural gas resources.

Today operators in the basin are in the early stages of expanding production from the fractured Lewis Shale, a zone long overlooked in favor of the conventional reservoirs that lie above and below it.

Historically, that Upper Cretaceous target was rarely completed in the San Juan Basin. From 1950 through 1990 only 16 wells that encountered extensive Lewis natural fracture systems while drilling for deeper Mesaverde and Dakota objectives that have produced from the shale.

Production rates from those 16 wells ranged from one to 10 million cubic feet of gas a day per well, and ultimate recoveries ranged from five to 70 billion cubic feet.

In 1991 Burlington Resources, one of the dominant players in the San Juan Basin operating over 6,500 of the basin's 18,255 active wells, began adding the Lewis to existing Mesaverde completions in specific areas, said Hans G. Dube, Lewis Shale project coordinator and reservoir engineer with Burlington.

Through 1997 approximately 101 Lewis completions had been made in existing and new wells, commingled with Mesaverde or Dakota production. By year-end 2000 the firm estimates it will have completed 556 wells in the Lewis Shale.

Burlington estimates it has as many as 1,000 remaining Lewis Shale wells as recompletion candidates.

"Since the mid-1980s, development of the prolific Fruitland Coal has dominated activity in the basin," Dube said, "but Fruitland production hit a plateau at about 2.8 billion cubic feet of gas per day and has now begun to decline.

"In the last several years," Dube said, "the focus of San Juan Basin activity has returned to reservoirs such at the Dakota, Mesaverde and Pictured Cliffs sandstones, as well as the Mancos and Lewis shale intervals, which lie between these more conventional reservoirs."

An Economic Play

The Lewis Shale play is a large, basin-centered, continuous type natural gas accumulation that covers 1,100 square miles and contains an estimated 96.8 trillion cubic feet of gas-in-place distributed over a gross thickness interval of 1,200 to 1,500 feet.

The key difference between the Lewis Shale and those in other basins, according to David G. Hill, manager, emerging resources, with the Gas Technology Research, and Charles R. Nelson, a principal project manager with GTI, is that operators are not developing the Lewis as a stand-alone play. The zone is completed as either a secondary completion zone in new wellbores targeting deeper conventional sandstone reservoirs, or as a recompletion target in existing wells, where gas from the Lewis is commingled with production from deeper zones.

Hill and Nelson recently reported on fractured shales in GTI's *Gas Tips*.

Production from Lewis Shale completions averages about 100 to 200 thousand cubic feet of gas a day, and exhibit very shallow, stabilized annual decline rates of about 6 percent, they said. Lewis Shale completions produce very little water or condensate and provide incremental projected economic recoverable reserves of .05 to 2.0 billion cubic feet of gas per well.

While this commingling strategy makes the Lewis Shale extremely economic – an incremental cost of only about 30 cents per thousand cubic feet – it also makes it difficult for operators to quantify the incremental production rates, reserves and corresponding value of the Lewis. So, in 1998 Burlington Resources initiated a study to characterize the Lewis Shale gas potential in the San Juan Basin in an effort to optimize exploitation, Dube said.

(The study was the subject of a paper recently presented by Dube and other participants in the program at the Society of Petroleum Engineers annual meeting.)

"The program encompassed geological, petrophysical, reservoir stimulation and production data

continued on next page

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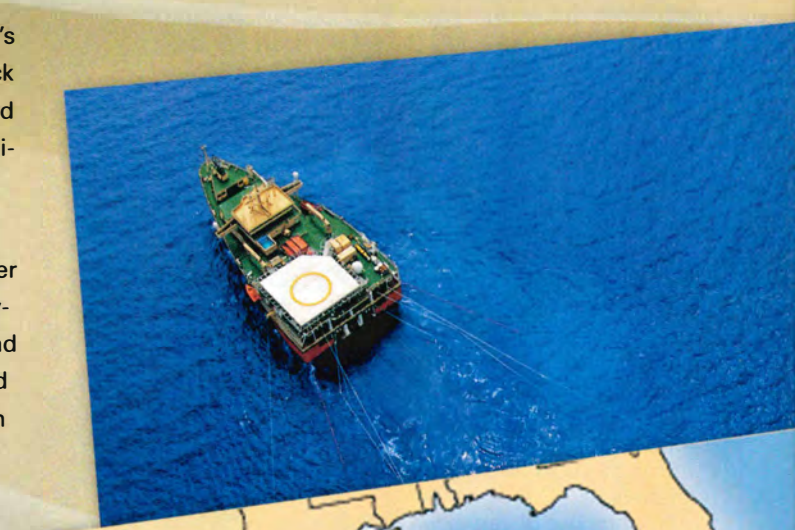

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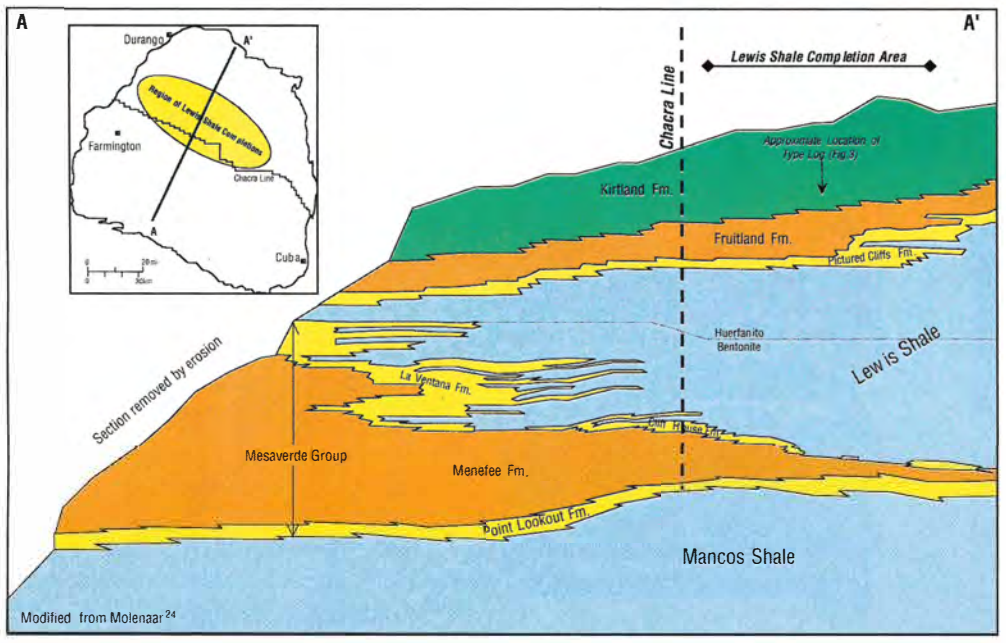
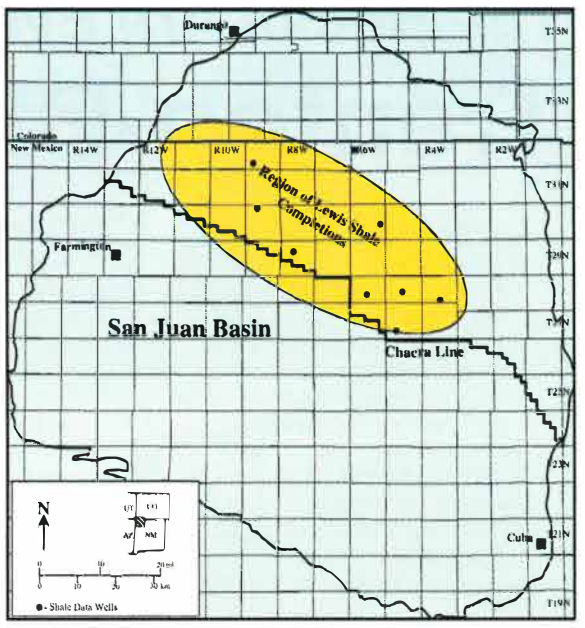


Left: Cross section of the San Juan Basin, the largest producer of natural gas in the Rocky Mountain region and a prolific source of unconventional natural gas resources.

Right: Region of Lewis Shale evaluation and completions.

Graphics courtesy of Hans G. Dube



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analysis," Dube said. "From this data reservoir characterization, completion optimization and forecasting models were developed that indicate commercial Lewis potential through much of the San Juan Basin in both new and existing wells."

Geology Lessons

The Campanian-age Lewis Shale is 1,000 to 1,500 feet thick and lies above the Mesaverde Formation and below the Pictured Cliffs Formation – both gas prone reservoirs. The Lewis was deposited as a lower shoreface to offshore, open-marine sediment during a major transgression-regression cycle of the Western Cretaceous Interior Seaway, according to Glen Christinsen, Burlington's Lewis Shale geologist.

The Lewis is informally divided into four members. The lower three are capped by a regional flooding surface, while the Ute member transitions upward to the Pictured Cliffs.

In descending order the four intervals are:

- ❐ The Ute.
- ❐ The Navajo City.
- ❐ The First and Second Benches of the Otero.

The Navajo City and the First and Second Otero intervals have been Burlington's focus in the Lewis.

What has Burlington learned as a result of its Lewis Shale study?

In the area of reservoir characterization the program indicated that average matrix gas porosity and permeability are 1.72 percent and 0.0001 millidarcies respectively, making the zone's natural fractures a necessity for commercial production. The good news is that based on bulk permeability measurements, core data and FMI log data, most of the Lewis Shale appears to contain some natural fractures with local variations in intensity.

Two types of natural fractures were observed in the Lewis: Macro-fractures, which are larger, more conventional natural fractures, and micro-fractures, which are very small, hairline fractures within the matrix.

Based on tests in some of the better producing areas, Burlington estimates that average daily Lewis production from these areas will likely range between 100 and 130 thousand cubic feet per well initially, with average estimated ultimate recoveries between 300 and 500 million cubic feet of gas from each well. ❐

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Trenton-Black River Play Expands

By KATHY SHIRLEY
EXPLORER Correspondent

For the first time in a long time, an exploration play in the Appalachian Basin is sparking the interest and imagination of oil companies around the country, thanks largely to advances in seismic operations, drilling technology and geologists' understanding of a complex play.

The productive zone lies in the formations of the Ordovician-age Trenton-Black River, which started the John D. Rockefeller empire over 100 years ago and is once again padding the bottom lines of Appalachian Basin operators.

Charleston (W.Va.)-based Columbia Natural Resources touched off the recent frenzy of activity there when the firm brought in some impressive wells on its acreage in New York's Finger Lakes region.

This was unexpected. The Trenton-Black River has not been a major target in the Appalachian Basin because the zone is deeper than traditional producing reservoirs in the basin.

But the firm's geoscientists had been studying the Trenton-Black River for years – and all that work finally has come to fruition.

Columbia's success with its basin-wide deep drilling program is proving that the Appalachian Basin still holds tremendous potential – and the lower 10,000 feet of sediment are virtually untested.

"This is the most exciting thing to happen to the Appalachian Basin since the early 1950s," said Alan Fairman, business manager with Fairman Drilling in DuBois, Pa. "We are even starting to get inquiries from large independents based in the Southwest."

Kathleen Sanford, with the New York State Department of Environmental Conservation's Division of Mineral Resources, agreed.

"We hear reports of dozens of landmen in New York, and a recent state lease sale seems to bear out those reports," she said. "In a 1999 state lease sale we had record bids as high as $312 per acre for some acreage in Schuyler County – our previous high bids were in the $60 to $70 range. That lease sale was held just a couple of weeks after a successful discovery well happened in Steuben County, and landmen who were in Wyoming and Louisiana at that time tell us they heard about the well."

Currently the state is preparing another lease sale, and 23,000 acres have been nominated.

"That's a tremendous amount of acreage to be nominated in New York, and we are expecting the same level of interest that we saw at the 1999 sale," Sanford said. "All 23,000 acres nominated are in the Trenton-Black River play area."

Good Indications

Today four fields are producing deep gas from the Trenton-Black River in Steuben and Chemung counties of southwestern New York, and the wells in these new fields, according to those involved, have been phenomenal.

Columbia in 1999 had expanded its Trenton-Black River program and made a discovery in Roane County, W.Va., that was geologically similar to its wells in New York.

Richard Beardsley, vice president of geology and geophysics with Columbia, said the company's last two wells in West Virginia were the largest wells in the northeast United States in terms of open flow rates.

In fact, the West Virginia discovery well – drilled to 10,300 feet on Columbia's Vineyard Ridge area – demonstrated an open-flow rate estimated at approximately 50 million cubic feet of gas a day.

Bottom hole pressures initially gauged at 6,600 pounds per square inch – highly unusual for typical Appalachian Basin production – were sustained through the first month of production.

The second well in the Cottontree Field posted a natural flow from about 9,600 feet and was operationally similar to the discovery well.

Columbia has completed a five-mile, eight-inch gathering line connecting the new field to Columbia Gas Transmission's nearby high-

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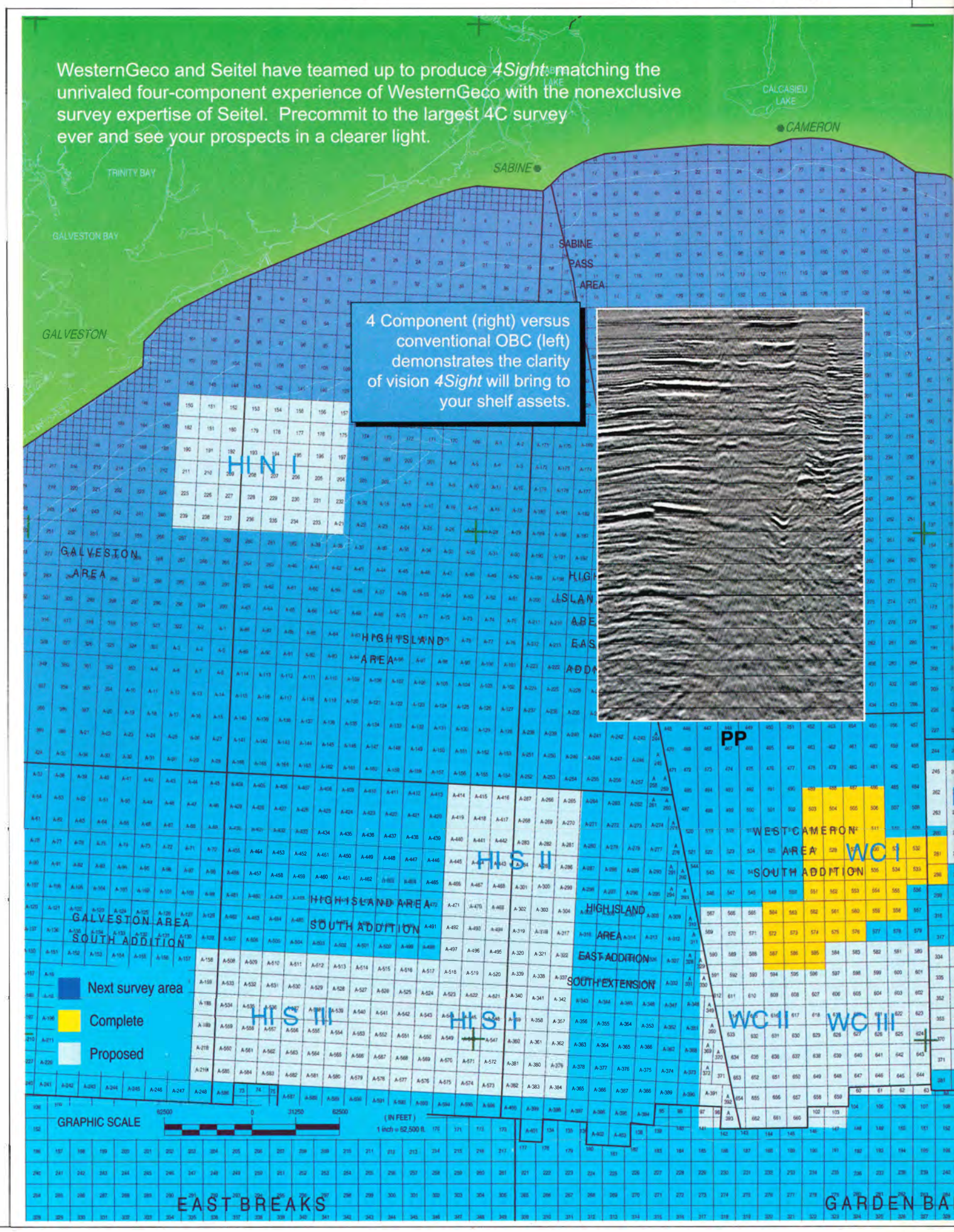
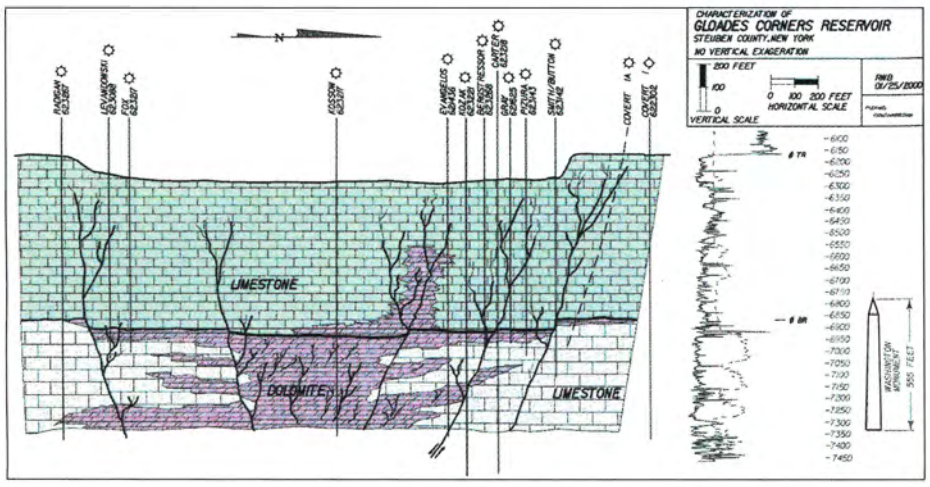
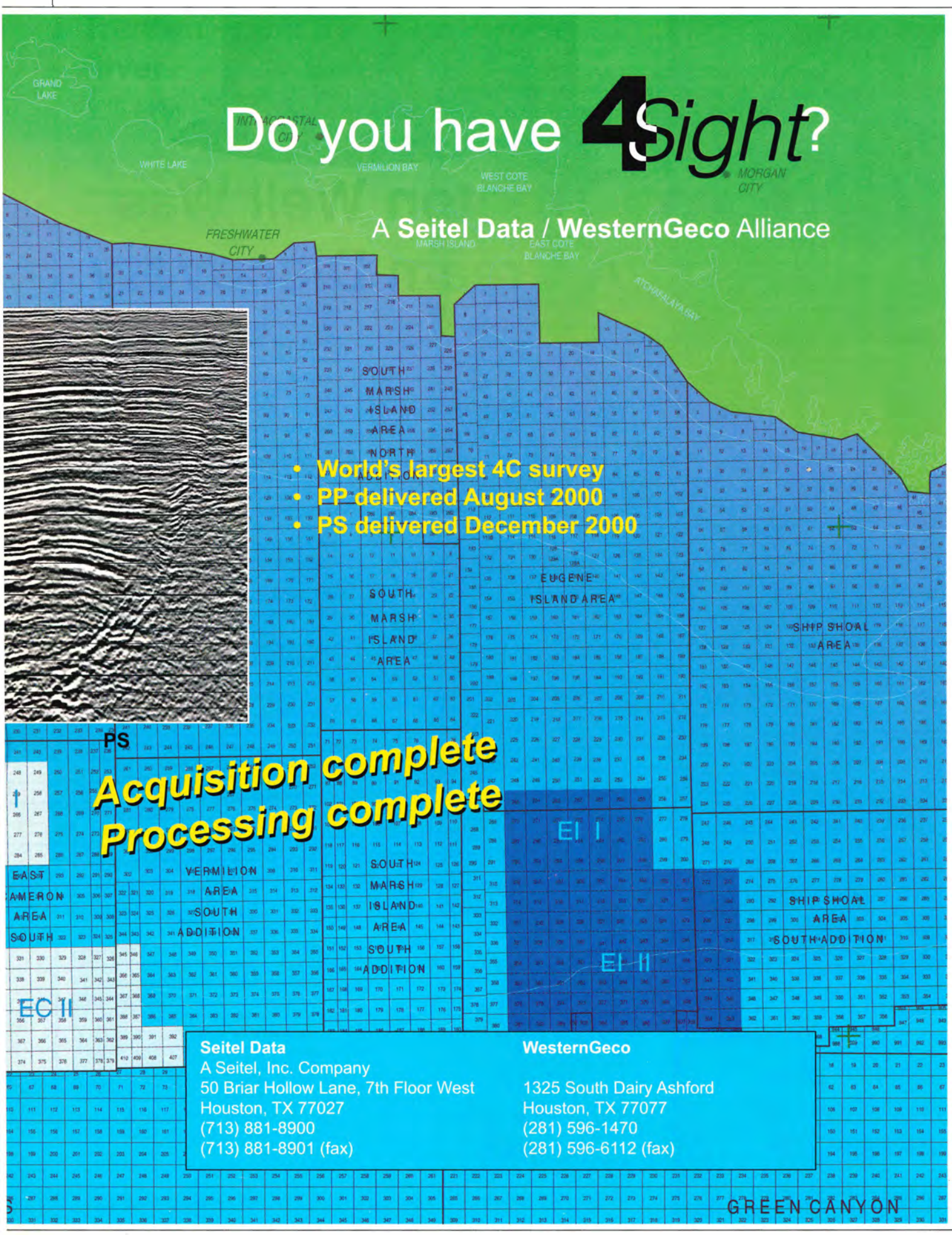




For the first time in a long time, the Appalachian Basin is causing excitement in the oilpatch. Above, a cross section of the Gloades Corner reservoir, a success story for the Trenton-Black River play. Right, workers at Well #1 in the the New York State Reforestation Area 2, Schuyler County, N.Y.



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pressure interstate pipeline. Since the gathering line was completed the firm is averaging about 7.4 million cubic feet of gas a day from the field.

Today Columbia is drilling its fifth well in the Cottontree Field. Beardsley said the West Virginia prospect is more than 20 years old.

"Advances in drilling technology that now allow us to drill to 10,000 feet and deeper at a reasonable cost, combined with the successes in the Trenton-Black River in New York, brought this West Virginia prospect to the forefront," he said.

These recent wells aren't the first Trenton-Black River wells in the state.

"The first Trenton-Black River well was drilled in 1936 and burned the rig to the ground," he said, chuckling, "a good indication hydrocarbons were present."

Patience Pays Off

The New York activity that touched off the interest in the Trenton-Black River has been a long time coming as well.

Columbia first began studying the Ordovician formations in the early 1970s, when the firm was looking for Devonian reefs in New York and acquired about 900 miles of seismic data. Scientists didn't confine themselves to Devonian targets, however, and looked at additional horizons on the seismic.

"At that time we also looked at old wells that had penetrated what we believed were hydrothermal reservoirs," Beardsley said. "We modeled this area after what we saw in western Ontario, where some old fields dating back to 1917 produce from hydrothermal reservoirs in the Trenton-Black River.

"That production in Ontario, coupled with the Lima-Indiana Field, which started the seven sisters for John Rockefeller, certainly indicated the Trenton-Black River formations were worth examining in the Appalachian Basin," he added. "Our work and samples we saw indicated that a deep-seated heat source generated a hydrothermal cell that provided mobilization of magnesium rich waters deep in the reservoir, which created hydrothermal cave systems."

The one-and-a-half-billion-year-old Greenvillian Orogeny likely became the fundamental route for all the deep-seated basin features found in this play area.

See **Trenton – Black River**, page 31

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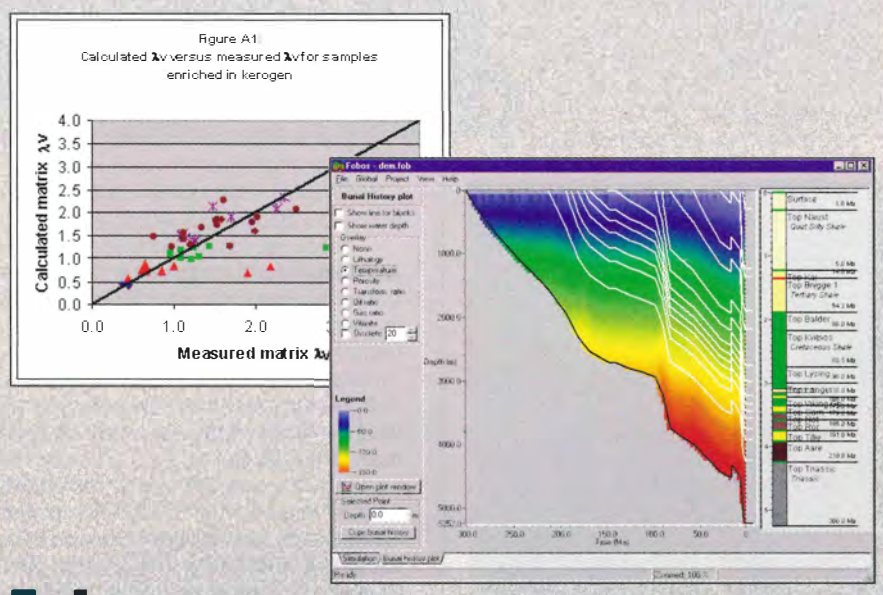

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Illustration by Rusty Johnson

Trenton Well Was A Dream Discovery

The "expertise" of a psychic is to thank for the discovery of the Albion-Scipio Field in Michigan.

AAPG Editor Neil Hurley recounted the story of the find in the AAPG Treatise Atlas, Stratigraphic Traps 1 volume.

Ferne Bradford, whose maiden name was Houseknecht, lived on a dairy farm in 1955 in southern Michigan when a family friend and practicing psychic, "Ma" Zulah Larkin, told her about a dream she had. Ma Larkin told Bradford she had seen Ferne in a dream, walking on a farm with "stucky stuff" on her hands. She was sure it was oil.

However, the closest thing to an oil find near the Bradford farm was over 50 miles away. In 1943, Continental Oil drilled 253 feet into the Trenton, recovered a five-foot section of porous rock with bleeding oil and drillstem tested 22 feet of oil-cut mud.

For whatever reason, Conoco decided to plug back the well to produce gas from the Devonian Traverse Formation.

On the professional advice of the psychic, Bradford arranged for the the No. 1 Houseknecht to be spudded in May1955. The target Devonian gas was dry – as was the Bradford family bank account.

But Ferne was persistent. After all, she had the advice of a professional psychic going for her.

Drilling was a stop-and-go operation, depending on how much cash Ferne Bradford could muster at the time.

Eventually, the well penetrated the Trenton – in September 1956, 16 months after it was spudded. However, Hurley wrote, it was not until January 1957 that the well encountered oil production at 3,900 feet. The discovery was for 140 barrels a day with considerable quantities of gas.

The well had discovered what was to be the 14,500-acre Albion-Scipio Field, which is 30 miles long and a maximum of one mile wide, with an original oil-in-place of 290 million barrels. It is classified as a giant field by American standards.

Both Ferne and Ma reportedly thanked their lucky stars.

– LARRY NATION

Seismic Advances, Better Understanding Has Helped Trenton-Black River Exploration

Much of the recent success going on today in the Applachian Basin can be traced to old Trenton-Black River fields – some of which are giants in the annals of oil industry lore.

America's first real oil boom began in what is today called the Lima-Indiana Trend of Ohio and Indiana, where the Trenton-Black River is only about 1,400 feet deep, around 260 miles long and varies in width from less than one mile in Ohio to greater than 50 miles in central Indiana.

Over the years the Lima-Indiana trend has produced an estimated 500 million barrels of oil from around 100,000 wells, said Brian D. Keith with the Indiana Geological Survey.

The Trenton-Black River Albion-Scipio Field discovery in southern Michigan grabbed attention in the late 1950s (see above). The giant field has produced over 200 million barrels of oil from around 4,000 feet.

"For years people have looked for analogous areas to these big fields," Keith said. "Success has come through a combination of understanding the settings under which the Trenton-Black River is productive, and advances in seismic technology."

For more information on Trenton-Black River history, read the EXPLORER online at www.aapg.org.

Trenton-Black River on New York 'Hit List'

Fields Make Big Impact on State's Production

At the end of 1999 – the latest production figures available from the New York State Department of Environmental Conservation's Division of Mineral Resources – three Trenton-Black River fields were producing in New York.

❒ Columbia Natural Resources **Glodes Corner Field** came on line in 1996, and in 1999 produced 2.5 billion cubic feet of gas from 10 wells at depths ranging from 6,600 to 7,700 feet.

❒ Columbia's **Muck Farm Field** was discovered in 1998, and in 1999 four wells produced 431 million cubic feet of gas from between 6,800 and 7,800 feet.

❒ Pennsylvania General Energy's **Wilson Hollow Field** was discovered in 1999, and one well produced 58 million cubic feet of gas that year from around 9,700 feet.

DEC records show that at the end of 1999 33 wells had been completed in the Trenton-Black River in New York, and 15 of those reported some production.

And what a difference those wells are making to the state's production. DEC's Kathleen Sanford said that in 1986 New York's production was 34.8 billion cubic feet of gas, and 89 percent of that total was from 4,800 Medina and Queenston wells; none was from the Black River formation.

By 1999 the state's production declined dramatically to 16.1 billion cubic feet of gas, but over 18 percent of that total was from just 15 Black River wells.

Through the end of 2000 the state issued permits for about 40 additional Trenton-Black River wells.

New York and West Virginia are not the only regions where operators have banked Trenton-Black River fields. The search has paid off in northeastern Ohio, where CGAS Exploration of Columbus recently discovered the York Field in Ashtabula County.

That Trenton-Black River field was drilled based on 2-D seismic, and today the firm has six producing wells with plans for additional drilling and field extension using 3-D seismic.

– KATHY SHIRLEY

Trenton – Black River

from page 29

"Basically, we are now looking at areas where major separation and rotation of the basin created networks of faults and fractures that provided conduits for the hot water," he said.

Columbia's first test of the Trenton-Black River in 1980 was a dry hole.

"(But) we took the information gleaned from that well and developed geologic models for the play," Beardsley said.

The first Trenton-Black River discovery in New York came in 1986 at Columbia's Gloades Corners Field, but a combination of industry and corporate problems added 10 years before that first discovery came on line.

"It was difficult to generate management interest for a new play concept in a region isolated from pipelines, but by the mid-1990s we revisited the area and drilled a successful offset well one mile from the Glodes Corner discovery," Beardsley said.

The company then built a pipeline to service the region, and that, according to Beardsley, "was the key to expanding the drilling program."

Today Columbia has made 10 new Trenton-Black River field discoveries in New York – seven solo and three through joint ventures.

Seismic Clarity

Columbia's success and new seismic studies sparked several additional operators to join the play.

Fairman Drilling and partner East Resources of Pittsburgh currently have about 30,000 acres under lease in West Virginia and are continuing to expand their holdings. The firms were drilling their sixth Trenton-Black River well at year-end and this year plan to drill about 18 wells in south central New York.

By mid-year the partners plan to begin testing acreage in West Virginia, according to Alan Fairman.

East Resources first approached Fairman Drilling in early 1998 about establishing a joint venture to purchase regional seismic and develop some prospects in the play. Reports from the firms' geologic consultants, Orion Resources Consulting in London, Ontario, indicated some very promising

See **Big Play**, next page

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Big Play

from previous page

potential.

Next, the two companies shot about 40 miles of additional seismic to identify drill sites. At the same time the firms began acquiring acreage, and by the summer of 1999 had about 180,000 acres under lease.

Today the joint venture has acquired over 150 miles of new seismic and has 250,000 acres, Fairman said.

Fairman and East Resources drilled their first well in March 1999 and made a discovery at the No.1 Broz in Chemung County. The well was drilled to 9,303 feet and initial open flow estimates were in excess of 15 million cubic feet of gas a day. That well will be going on line later this year.

"The rocks are everywhere – the key is finding the fracture systems that allow these dolomitized reservoirs."

A dry hole just north of the discovery well followed, but last summer the firms' third test, the No. 1 Whiteman, was a success. That well, sited seven miles west of the Broz, was drilled to the Black River at 9,511 feet, encountering natural gas shows of over 12 million cubic feet of gas a day.

The joint venture's fourth well was drilled seven miles north of the Whiteman well in Schuyler County on state lands. The SRA 2 No. 1 well went to 8,770 feet and found a natural gas flow of over 30 million cubic feet of gas a day.

Last fall the two companies completed a one-mile offset to the Broz that flowed an estimated 15 million cubic feet of gas daily. Currently the joint venture is sidetracking its sixth well after drilling into an unproductive section of the Black River at 10,400 feet.

By mid-year three of East Resources and Fairman Drilling's wells are expected to be on production.

"Following Columbia's success, this play was appealing to our company because we had the capabilities to drill to these depths, and due to availability of acreage in New York," Fairman said.

"Also, Orion Resources had experience with the Trenton-Black River in Ontario, and the firm's geologists said the features on our seismic were far more pronounced than what they see in Ontario."

The economics of the play is an obvious plus.

"Our wells have cost from $850,000 to $1 million to drill to about 10,000 feet, but once they go on line we could have situations where we will pay out the wells in just a couple of months," Fairman said. "When was the last time you saw that in the Appalachian Basin?

"These wells are not typical Appalachian Basin discoveries. The potential for large production volumes is significant – the formation we are drilling into is 350 to 400 feet thick, but we have only drilled into the top 30 to 40 feet because of the large amounts of gas we have coming out the flow line.

"That's a nice problem to have."

Pennsylvania General Energy is the third major player in the New York Trenton-Black River play. Late last year the firm was drilling its fifth Trenton-Black River well after netting four-for-four successful wells.

Analogous Possibilities

Generally the Black River is a shallow-water carbonate overlain by the deeper water Trenton formation, which is an argillaceous limestone.

The productive zones in these Ordovician carbonates are centered on fault or fracture systems. The carbonates have been dolomitized by hot, magnesium-rich water tracking up the faults and fractures, said Robert Trevail, with Orion Resources.

Seismic has been important to recent successes, and in general operators are looking for:

❒ Structural depressions over the dolomitized zone.

❒ Vertical displacement of the underlying Precambrian basement surface.

❒ A change in character on seismic records within the dolomitized zone.

Non-porous limestones typically bound the reservoirs.

"Unlike traditional plays where you look for highs on the seismic, we are looking for lows – slumps that indicate a dolomitized zone," Trevail said.

Now that geologists have a better understanding of the properties of productive Trenton-Black River plays the Appalachian Basin – as well as the entire eastern United States – could see a boom in activity searching for analogous settings.

"The Trenton-Black River formations are pervasive over an enormous area of the north and eastern regions of the country," said Brian Keith of the Indiana Geological Survey. "The rocks are everywhere – the key is finding the fracture systems that allow these dolomitized reservoirs,"

Fairman agreed.

"When you look at a map you can see that the Trenton-Black River runs all the way from the St. Lawrence Seaway to Kentucky," Fairman said. "With a better geologic understanding and improvements in seismic technology, there's no reason to think that analogous plays won't be found in other regions."

And that's good news for operators in the northeast where big, exciting exploration plays don't come along every day – or every decade, for that matter. ❒

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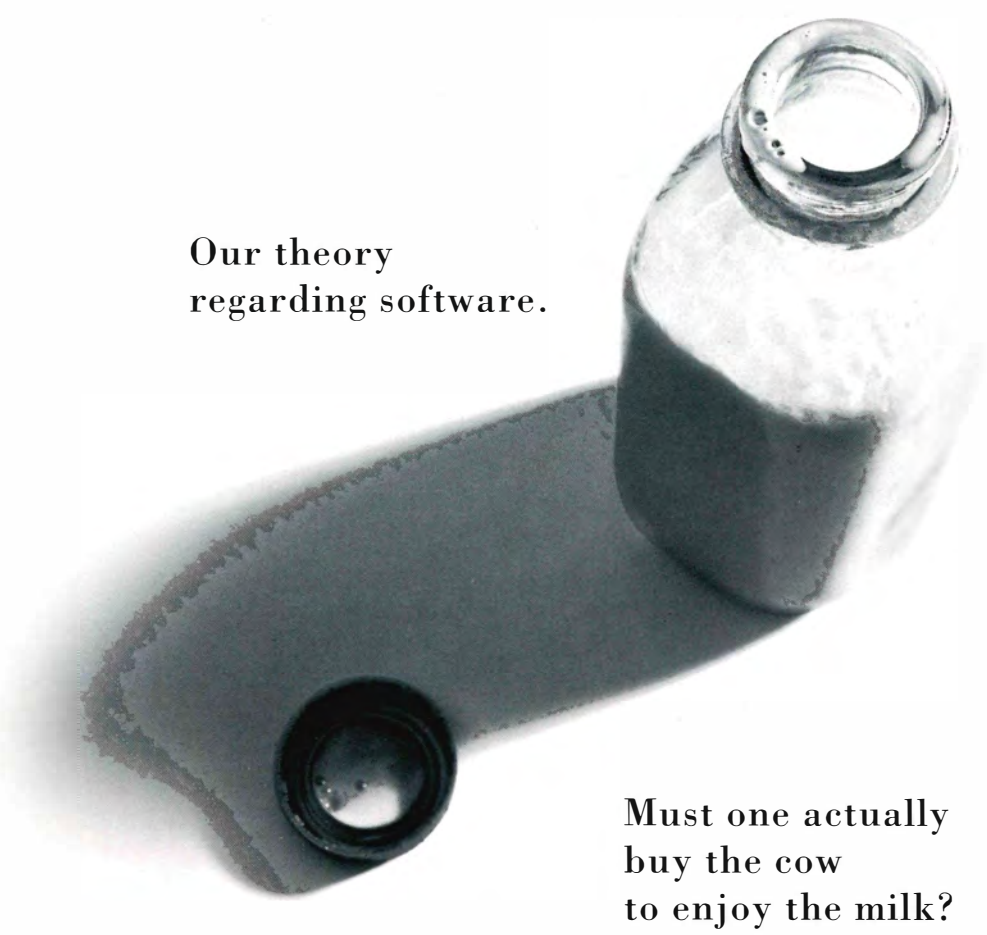

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Gas Shales

from page 25

from $100,000 to $150,000, depending on water lifting requirements and the type, number and size of stimulation treatments needed.

Efforts also are under way to better identify the mechanisms controlling gas occurrence and productivity.

Gas resource estimates for the New Albany Shale range from 86 to 160 trillion cubic feet of gas with estimates of technically recoverable reserves ranging from 1.9 to 19.2 trillion cubic feet.

The Barnett – and Beyond

Mitchell Energy & Development Co. has been developing the Barnett Shale in the Fort Worth Basin in the northeast sector of central Texas since 1981.

The Mississippian-age Barnett Shale is one of the most uniform statigraphic units in the basin, outcropping along the flanks of the Llano uplift in central Texas, where it is about 30 to 50 feet thick.

The shale dips gently and thickens to the north, reaching a maximum depth of around 8,500 feet and a maximum thickness of almost 1,000 feet near the Texas-Oklahoma border.

Barnett Shale production was first established in the Newark East Field in Wise and Denton counties, where it grew from less than one billion cubic feet of gas from 25 wells in 1985 to 19.2 billion cubic feet from 306 wells in 1995. During the past five years, production has more than doubled to 40.6 billion cubic feet from over 500 wells.

The Barnett is found at 6,500 to 8,000 feet in the Wise and Denton counties area and is about 500 feet thick. It is divided into lower and upper intervals by the Forestburg Limestone.

AFE Oil and Gas Consultants expanded the Barnett Shale play area in 1997 with a discovery in Dallas County, approximately 12 miles southeast of the Newark East Field. The firm continued to expand its play area with three wells in northeastern Tarrent County.

"Initially, Mitchell Energy completed only the lower Barnett interval, using massive hydraulic fracturing treatments," Hill said. "Well costs typically ranged from $600,000 to $800,000, including $200,000 to $300,000 in stimulation costs."

In 1998 the firm experimented with a new stimulation technique that employed water as the fracturing fluid, required significantly less proppant and was about 60 percent less expensive than the conventional stimulation treatments.

"The technique proved successful," Hill said, "and has since been implemented field wide."

Last September Mitchell Energy demonstrated a technique for economically completing the upper Barnett Shale interval, increasing reserves in their core area by 25 percent, or 250 million cubic feet per well, and expanding the play to previously marginal areas.

This new completion technique in combination with a 50-acre spacing infill well drilling program is expected to allow Mitchell Energy to increase its Barnett Shale gas production and open up new areas for exploitation.

Hill said while the bulk of gas shale production has come from these reservoirs in the San Juan, Appalachian, Michigan, Illinois and Fort Worth basins, there are a multitude of opportunities to expand shale gas activity in other regions of the country.

"Three key advantages of shale gas plays are moderate exploration costs, high success rates and slow production decline rates," he said. "The rapid growth in the late 1980s and early 1990s in the Antrim Shale, which is being repeated today in the Fort Worth and San Juan basins, is driven by the powerful economic incentives of low risks and low reserve finding costs.

"Each of these plays has presented new technical challenges for operators to overcome," he added, but "their success has sparked a resurgence of industry interest in evaluating the production potential of shale gas resources in basins throughout the United States." ❑

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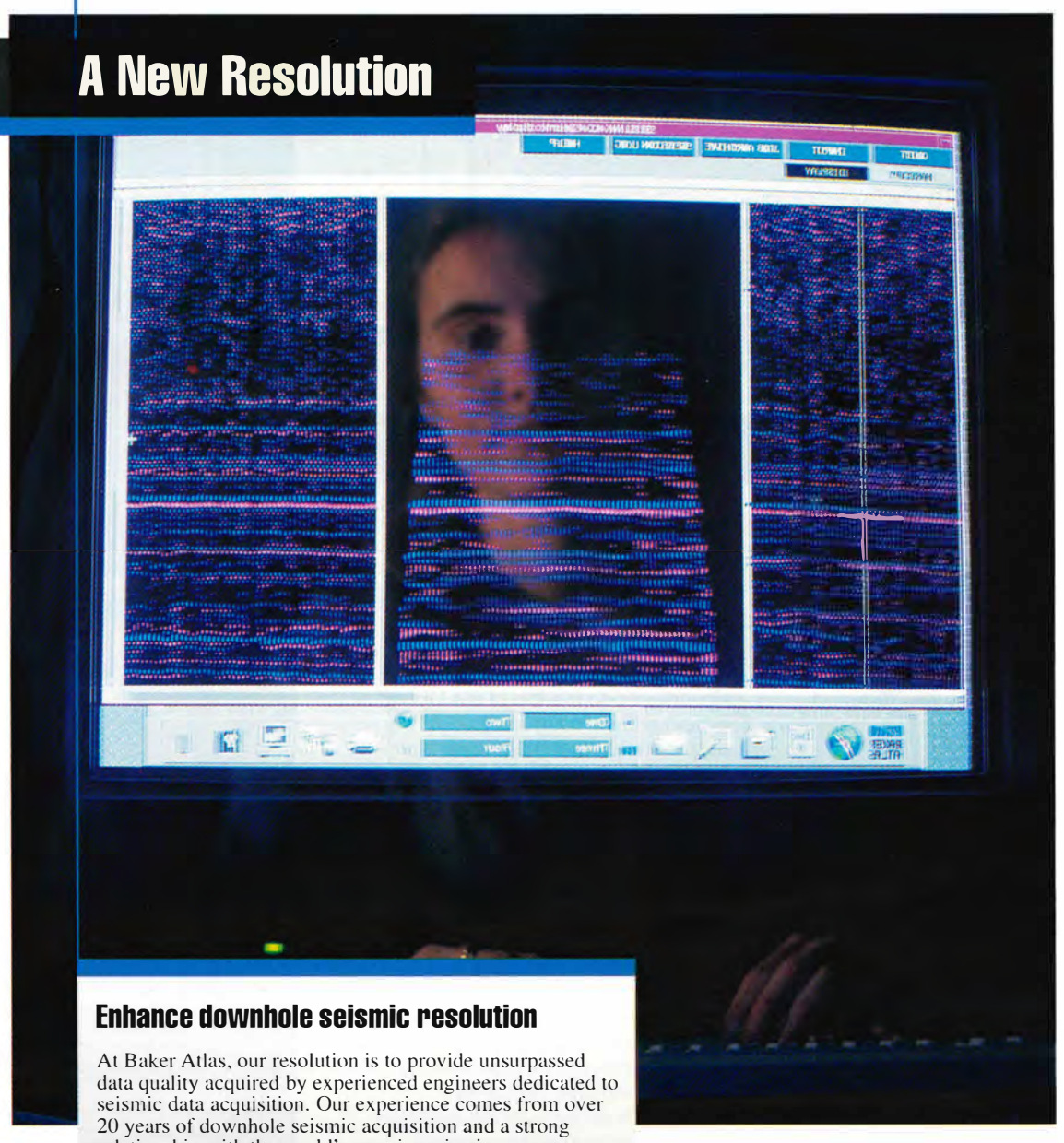

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GEOPHYSICAL CORNER

Seismic Has Its Multiple Attributes

The Geophysical Corner is a regular column in the EXPLORER, produced cooperatively by the AAPG Geophysical Integration and SEG Interpretation committees, and edited by R. Randy Ray. This month's column is titled "The Power of Multiple Seismic Attributes in Revealing Geologic Understanding."

By WALTER E. JOHNSON
RICHARD O. LOUDEN
DONALD D. LEHMAN
and DUNCAN L. EDWARDS

Analysis of 3-D seismic data with several types of seismic attributes can reveal geologic factors that control the location of productive algal mound reservoirs in the Paradox Basin.

Routine seismic mapping of the producing interval did not reveal the presence of a regional strike-slip fault that is clearly shown using attribute analysis. This previously unknown strike-slip fault controls the local stratigraphy and extends for over 30 miles.

Although each attribute when used alone has some level of ambiguity, it is important to note that when a number of attributes with different mathematical algorithms yield similar results, the reliability of the geologic interpretation is enhanced.

Several commercially available seismic attributes, along with attributes generally incorporated within most workstations, collectively have had a significant impact on the understanding of how and where the algal mound reservoirs form, and indicate that their stratigraphic development is often not a random act. The purpose of this article is to demonstrate that the small cost of time and money required to perform attribute analysis is far outweighed by the increased understanding of the geologic dynamics of an area.

The ability to map more geologic detail will ultimately result in reduced risk of drilling dry holes.

* * *

Miller Energy, of Kalamazoo, Mich., and its partners completed the Miller Horse Canyon 1-10 in 1998 for an initial potential of 960 barrels of oil per day and 940 MCFG/D from a depth of 5,850 feet from an algal mound reservoir. The well was featured in the 1999 EXPLORER.

Figure 1 shows the location of the Paradox Basin in the southwestern United States, where shelf carbonate buildups within the Pennsylvanian basin have produced oil and gas since the 1950s.

Generally these carbonate buildups are the result of algal debris from *Ivanovia* (these *Ivanovia* algal skeletons are much the same size as cereal corn flakes). In the 1980s it became generally known that there could be a seismic expression resulting from these carbonate buildups, but the 2-D seismic data that existed then added little to the understanding of the genesis of these features.

Figure 1

Figure 2, a geologic cross section through the discovery well, is a good reference for the various geologic strata that will be mentioned throughout this article. The well was completed in an Upper Ismay carbonate buildup; however, the test also encountered a deeper Desert Creek carbonate buildup that is further revealed with attribute analysis.

A seismic tuning effect owing to thickness changes in the Hovenweep shale creates a mappable high amplitude that indicates where the shale is extra thick, as shown in

Figure 3. This thick resulted in a positive "island" that existed during the time of deposition of the Upper Ismay. The island is outlined in black and will be shown on subsequent displays.

Note in Figure 2 how the Hovenweep thick is located to the left of the discovery well.

The isochron thickness map of the Upper Ismay (from the top of the Hovenweep to the top of the Upper Ismay) shown in Figure 4 demonstrates that there is an atoll shape of increased thickness of Upper Ismay surrounding the Hovenweep island.

* * *

A series of different seismic attribute displays are shown in Figures 5 through 10, which reveals a linear fault zone that affected the formation of the Hovenweep thick and thus the locations for mound development. The attribute analyses include several types of methods, including multivariate analysis, edge detection, spectral decomposition, wavelet cross-correlation and wavelet classification.

The amplitude map of the Desert Creek horizon demonstrates a

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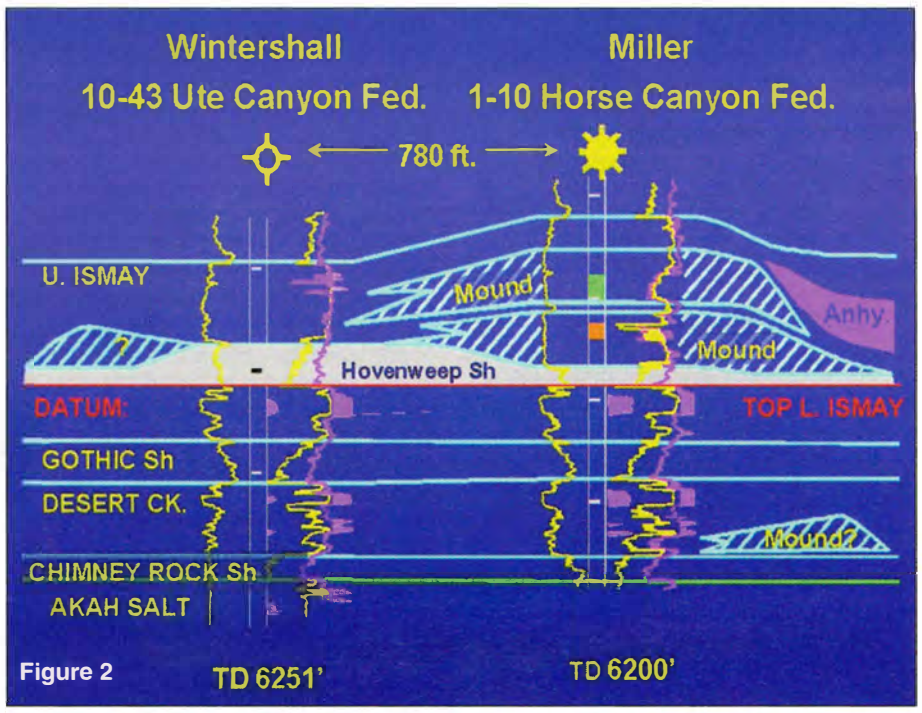
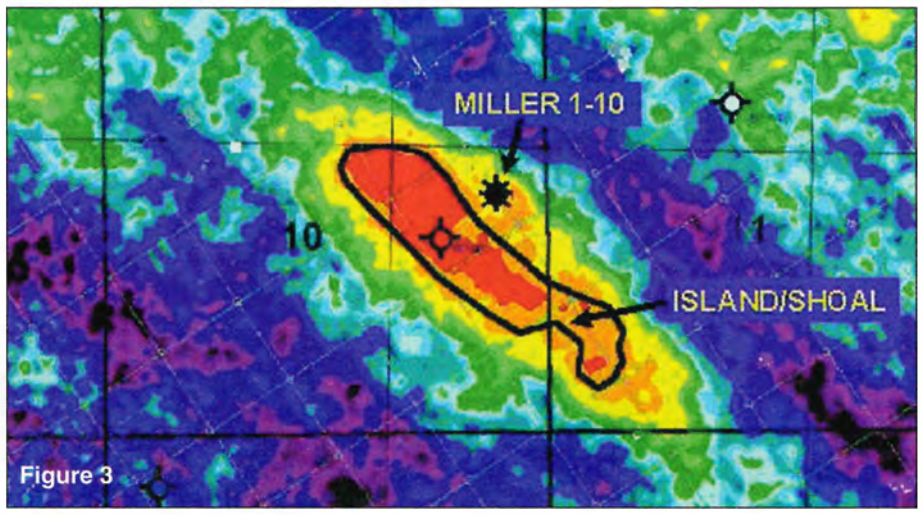


Figure 2



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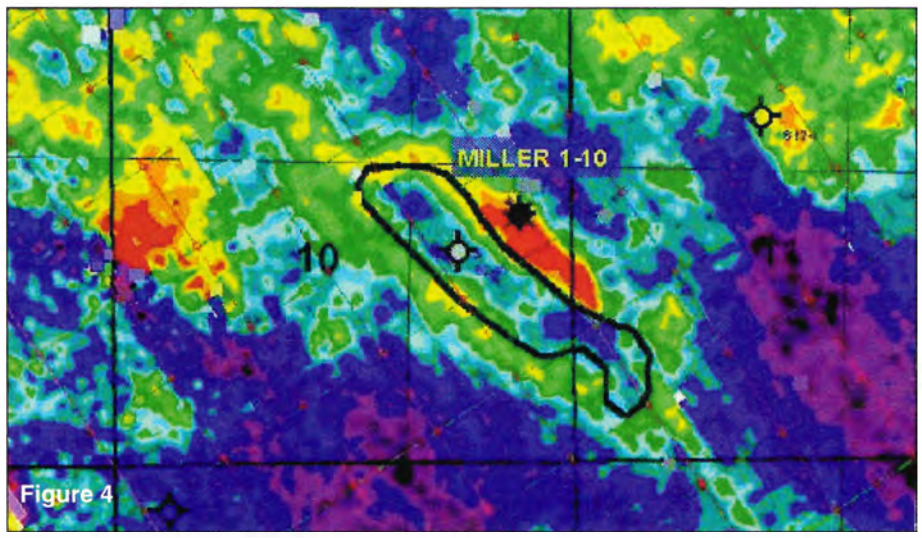

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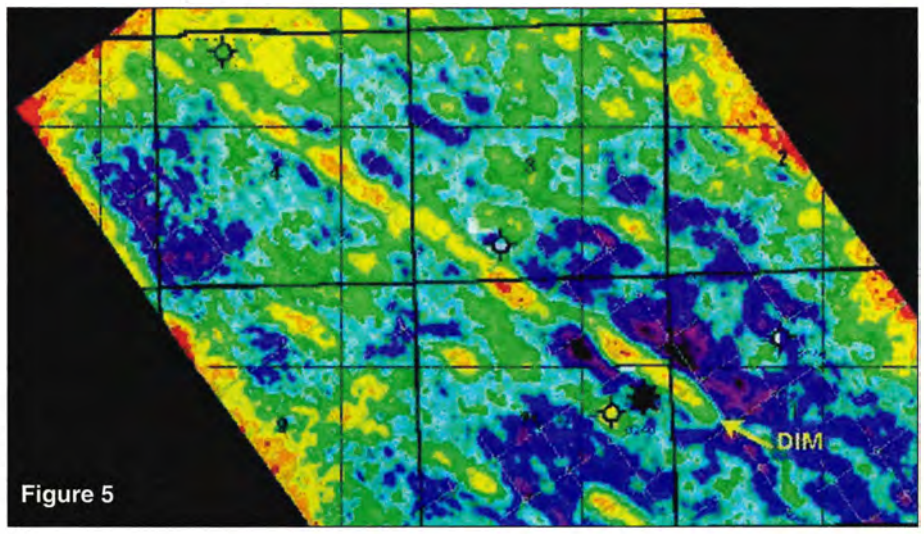


Figure 5

Figure 1 – Location of Paradox Basin.

Figure 2 – Stratigraphic cross section through the discovery.

Figure 3 – Hovenweep amplitude map indicating Hovenweep thickness.

Figure 4 – Upper Ismay isochron map showing atoll character of algal mounds.

Figure 5 – Desert Creek amplitude map showing NW-SE lineament.

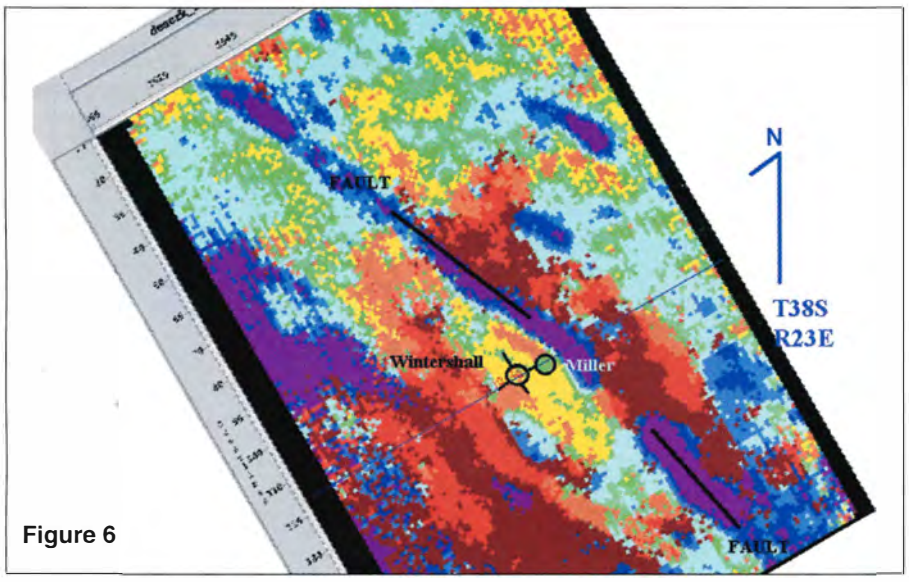


Figure 6

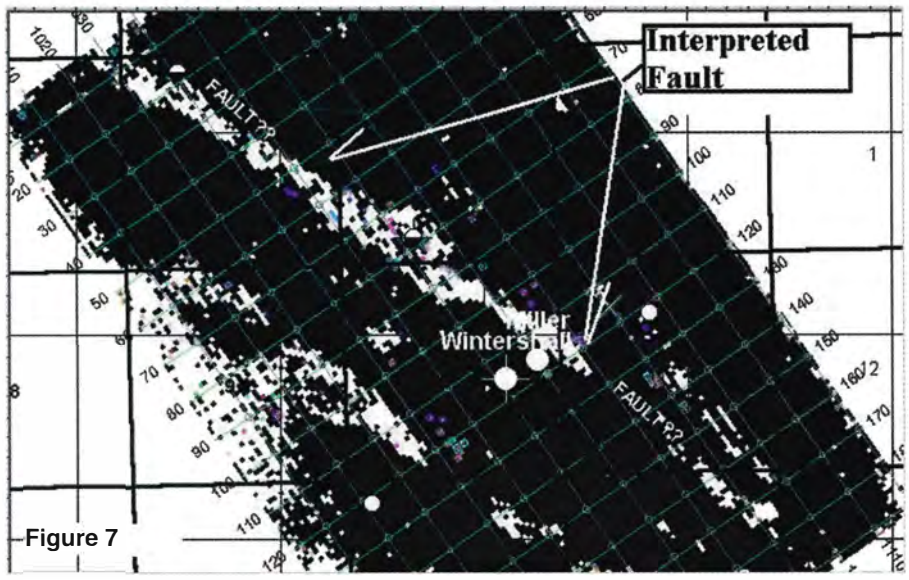


Figure 7

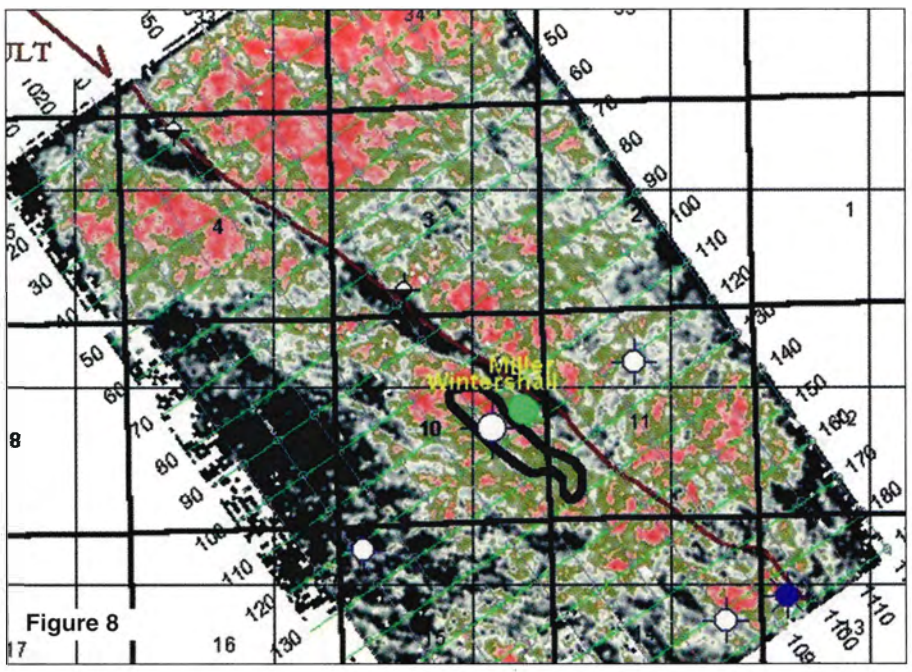


Figure 8

Figure 6 – Wavelet classification map output at Upper Ismay horizon showing NW-SE lineament.

Figure 7 – Multivariate attribute analysis at Upper Hovenweep showing NW-SE lineament.

Figure 8 – Edge detection horizon slice through Upper Ismay.

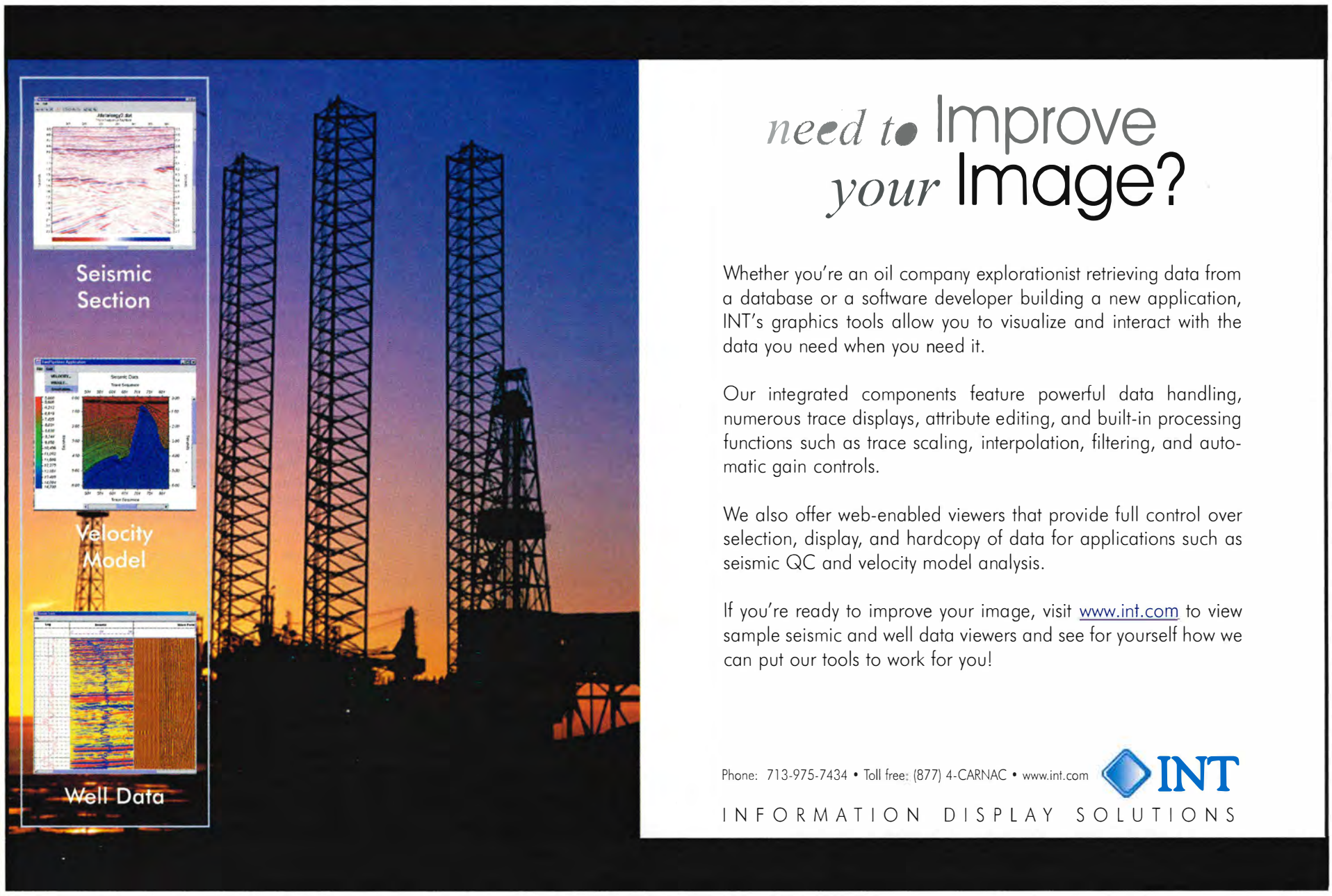
continued from previous page

distinctive NW-SE trend (Figure 5). Originally it was believed that this NW-SE trending amplitude anomaly was related only to the Desert Creek carbonate buildups.

An attribute process that could be characterized as "wavelet classification" was run on the shallower Upper Ismay seismic horizon – and again, the NW-SE trend was observed. This wavelet classification technique divides the horizon wiggle into 12 characteristic wavelets, and then makes a color map indicating areas of similar wavelets. Small changes in the wavelet character often reveal significant geologic features like porosity and thickness changes (Figure 6). Field analyses from other fields on trend with the fault demonstrate that the "atoll model" is not unique to this discovery.

Another attribute, which can be classified as multivariate attribute analysis, combines the properties of

See **Seismic Attributes**, next page



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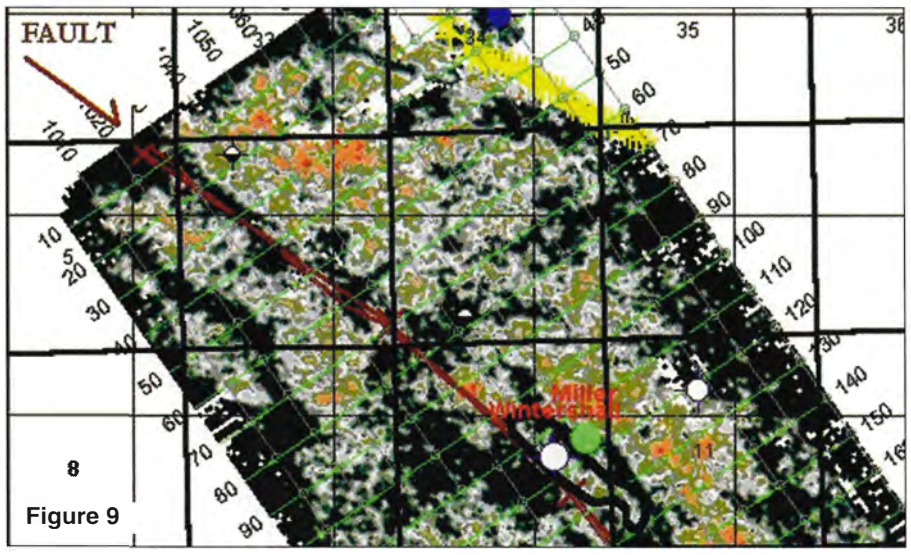


Figure 9 – Edge detection horizon slice approx. 1500 ft below Upper Ismay.

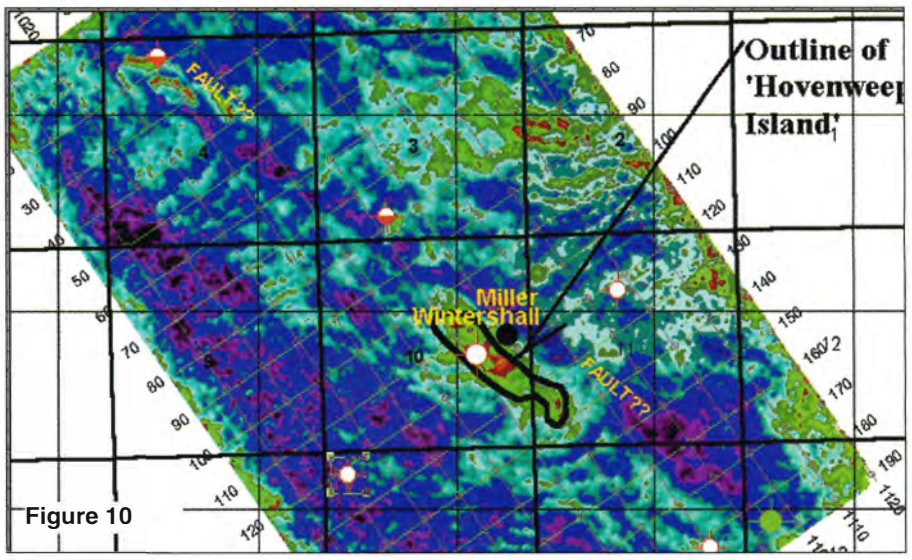
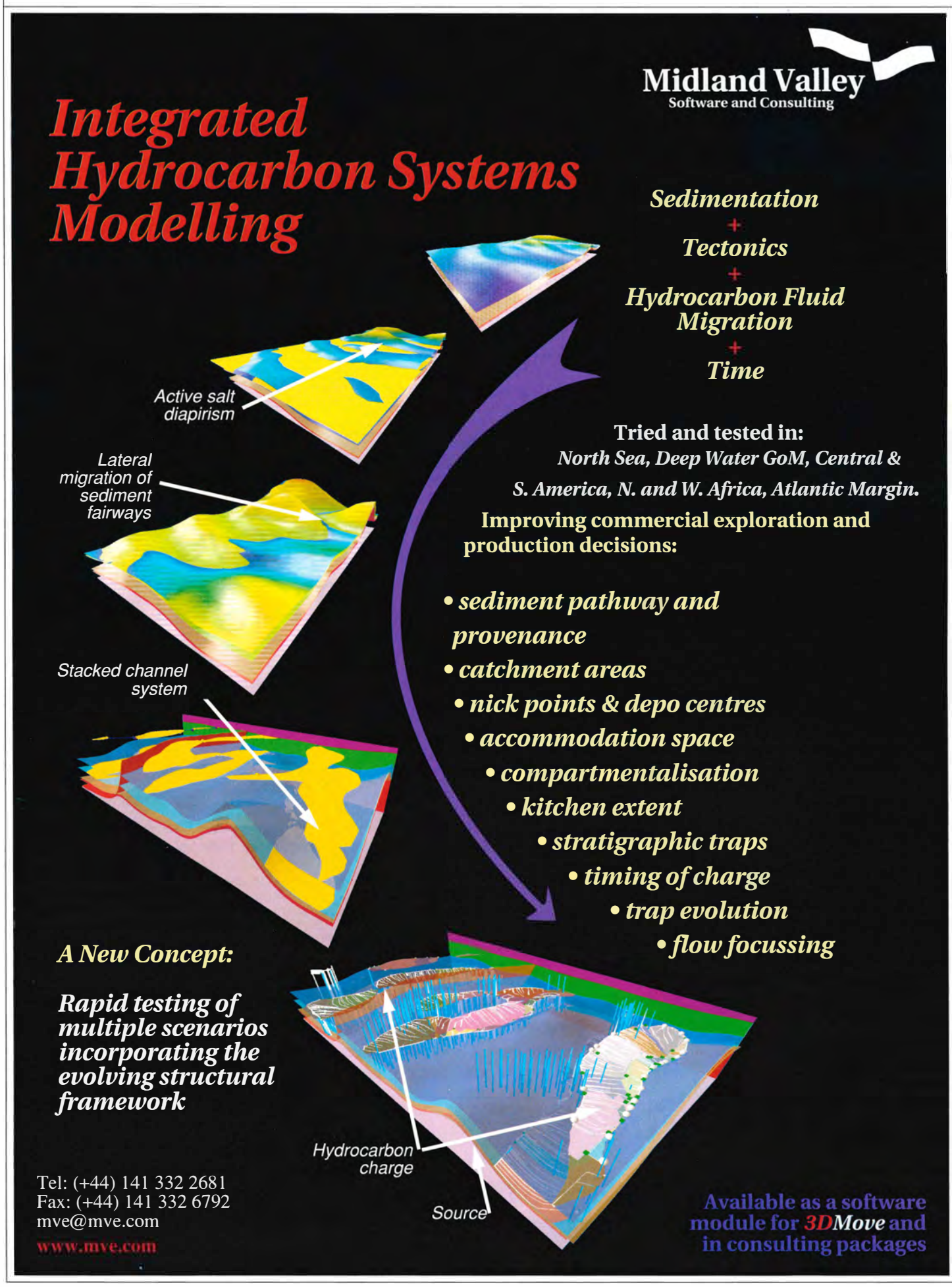


Figure 10 – A Horizon slice through the top of the Akah Salt – note the amplitude dim approximates the Hovenweep "Island" area leading to postulation of salt dissolution.



Seismic Attributes

from previous page

autocorrelation, amplitude and phase of seismic traces. The output from the multivariate attribute analysis of the Upper Ismay is shown in Figure 7, and also demonstrates this same strong NW-SE trend.

It is important to note that both the wavelet classification map and the multivariate attribute analysis have entirely different mathematical algorithms, and yet both show the same NW-SE lineament. One therefore has to give more credibility to the lineament being the result of a geologic phenomena rather than some "black box" artifact.

The multivariate attribute analysis creates a cube output that allows one to evaluate a lineament (fault?) spatially throughout a seismic data volume.

* * *

Edge detection technology has been used in the seismic industry for several years, and is designed to compare each trace of the data with its neighbors in order to map dissimilarities. Figure 8 (previous page) is the edge detection horizon slice of the Upper Ismay horizon. A fault was interpreted through the linear discontinuity on the horizon slice. This package also has the advantage that it creates a cube of data output that can be loaded on the workstation to be interpreted at different time or horizon slices.

Figure 9 is another coherency slice that is approximately 1,500 feet below the Upper Ismay, and again this same lineament can be mapped. Two-D seismic has been shot in the area for decades, and this very small-offset fault (or perhaps zone of weakness) has not been observed. In fact it was not even observed on the 3-D data until output was displayed and interpreted using the various attribute packages.

Figure 10 is an amplitude map of the top of the Akah salt, and it is believed that the dim shown in green and red is the result of salt dissolution.

Note how the amplitude dim conforms with the overlying Hovenweep thick. We postulate that the fault may have been a conduit to cause dissolution of the Akah salt. A horizon slice slightly above the Akah salt has a very distinctive linear pattern

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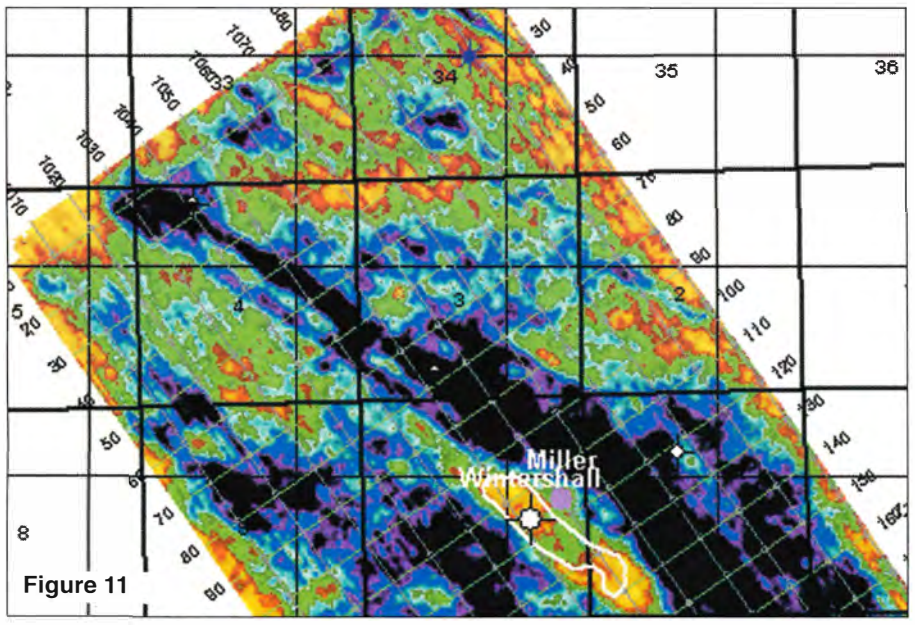

Figure 11

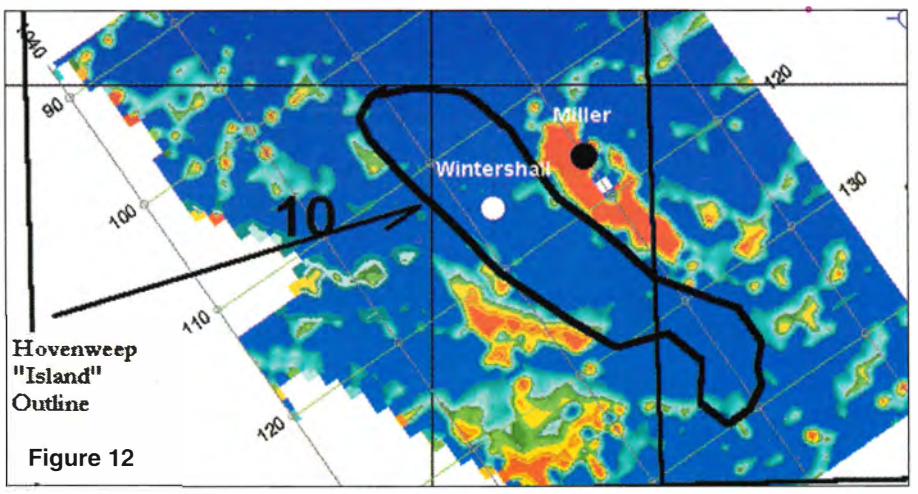

Figure 12

Figure 11 – Spectral decomposition at the Upper Ismay showing NW-SE fault along with other features.

Figure 12 – Crosscorrelation with trace from successful well indicating additional locations.

continued from previous page

that also could be the result of differential salt dissolution.

As another attribute comparison, spectral decomposition is a very precise frequency measurement tool that can also be viewed as a wavelet measurement tool. Figure 11 is the result of spectral decomposition over the Upper Ismay horizon, and again one can see the fault, Hovenweep "island," and the flanking atolls.

Many workstations have add-on packages that allow some trace processing. A horizon windowed seismic wiggle from the area of the producing well was cross-correlated with the entire 3-D volume, and those areas that had similar correlation values were mapped on the workstation to produce Figure 12.

Note the similarity between Figures 12 and 6 (page 35). Both the cross-correlation and wiggle classification mapping techniques indicate strong potential for new drill site locations on the south side of the Hovenweep "island."

Conclusions

The enhanced geologic understanding gained from the various attribute analyses far outweighs the small costs and interpretation time required trying them.

The similar patterns that emerge by running many different techniques reinforces the interpreter's confidence when mapping subtle geologic variations. This improved geologic understanding leads to reduced risk in both development and exploration projects.

Often seismic interpreters are discouraged from mapping anything but the primary producing zone. Our experience on this stratigraphic play shows that attribute analysis of the section surrounding the producing reservoir leads to a better understanding of the porosity development in the productive zones, as well as showing how to project the extension of the trend for further prospecting.

(Editor's note: Walter Johnson is a consulting geophysicist, Denver; Richard O. Louden is a consulting geologist affiliated with Thomasson Partner Associates, Denver; Donald Lehman, former exploration manager for Miller Energy, is now with VuCom Data Services in Kalamazoo, Mich.; and Duncan Edwards is an independent consulting geophysicist in Rutherfordton, N.C. ❑

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BUSINESS SIDE OF GEOLOGY

What Is the Chance for Success?

By PETER R. ROSE

As exploration professionals, half our job involves estimating various geotechnical parameters that characterize our prospects and plays. Most of us, however, have had little or no training in effective estimating methods.

In last month's column we reviewed six ways to improve our estimates of the **variable factors** – uncertain parameters such as productive area, average net pay, HC-recovery factor, recoverable reserves, flow rates and project costs.

This month we'll discuss effective methods for estimating **existence factors** – our confidence (= probability) that key geologic requirements such as HC-charge, reservoir and closure have been satisfied in the subsurface by Mother Nature.

* * *

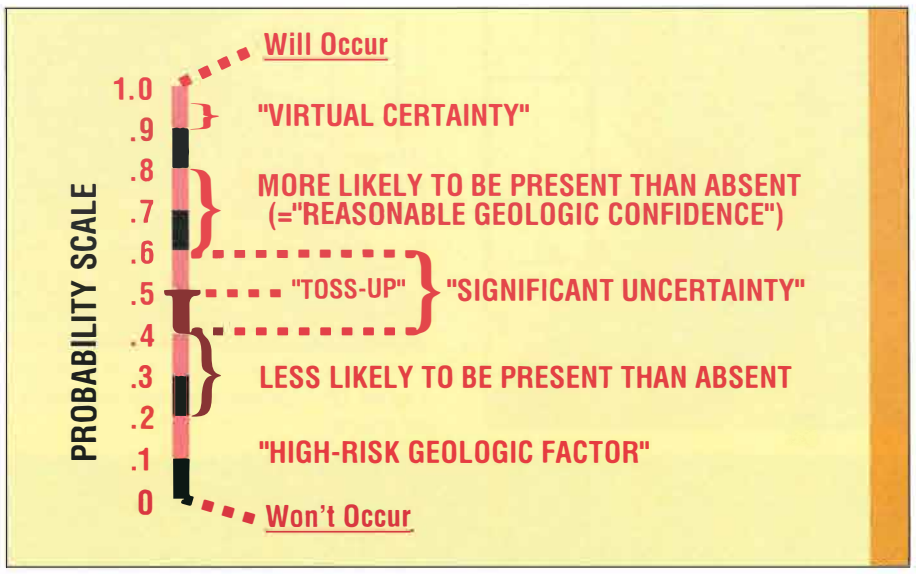

Figure 1. Subjective expressions of confidence.

The general industry convention is to estimate the **variable factors** as probabilistic ranges, whereas the **existence factors** are estimated as unique decimal fractions, whose product represents the chance that a reservoired, detectable (i.e. flowable) accumulation is indeed present at depth.

Most experienced evaluators agree that better results are obtained by assessing the different geologic attributes separately, rather than estimating only the prospect chance of geologic success. Naturally, this assumes that the individual geologic attributes are statistically independent – that the presence of reservoir rock is not influenced by the existence (or absence) of HC-source rock or closure.

For single-objective prospects, this usually isn't a problem – but for multizone prospects, it does have to be considered. For now, let's keep it simple.

The reason why we need to estimate the geological chance of success and failure (= Pg and Pf), of course, is that they are key items in calculation of Expected Present Value (EPV) of the venture, i.e., its chance-weighted present monetary value. (Often we recognize that geological success may not be commercial success, so to arrive at the chance that the well will be completed, reduce Pg proportional to how much of the prospect reserves distribution is greater than the commercial threshold.)

Here are eight tested tips to help you make better estimates of your prospect's chance of geological success:

❒ Be sure you have a geological model for the prospect in mind before you start, well supported by maps and cross-sections.

Having a proposed drilling location on the map will help you focus on the problem.

❒ Review the prospect with the most knowledgeable professionals – the prospect team.

Consider all evidence objectively and rigorously, taking into account quality and quantity of data. Maintain a courteous, professional tone throughout your deliberations – you don't want to suppress any pertinent data or ideas. Remember, the objective is not to sell the prospect, it is to evaluate it honestly.

❒ Use a probability scale (Figure 1) to help geoscientists and engineers sense and express their individual subjective confidence in the existence of the various geologic attributes.

For each chance-factor, ask, "What can hurt us here?" As a reality check, try to estimate the chance of failure (i.e., non-existence), rather than existence.

❒ Remember that geologic chance of success has nothing to do with economics – it's only an estimate of the chance that Mother Nature has caused a flowable reservoir accumulation of oil and/or gas to be present.

❒ Before the group finalizes its consensus probability for each chance factor, ask each member to

continued on next page

Spring Break Expo Readied for Students

Set March 16-17 at OU

Planning continues for AAPG's first Spring Student Expo, set March 16-18 at the University of Oklahoma in Norman, Okla.

The Spring Expo, a follow-up to last fall's successful Expo at Rice University in Houston, is designed to mutually benefit geoscience students interested in petroleum careers and petroleum industry representatives seeking intern and full-time employees.

This Expo will provide the opportunity for students to showcase their work in poster format and to network with industry representatives, who are also invited to present exhibits to promote their exploration, development and service activities. Over 60 companies have been invited to participate in this event, including small/mid-size companies as well as majors.

Those industry representatives, in turn, will be presenting exhibits that promote their companies' exploration, development and service activities.

This event is scheduled to take advantage of Spring Break for a number of Mid-continent and southern coastal universities, as well as the many area mid-size and independent companies.

The weekend event will start with an Icebreaker and buffet on the evening of March 16, beginning at 5 p.m. An all-day poster and exhibition sessions and interviews will be held the next day. The Expo will end Saturday evening with a St. Patrick's Day party and featured speaker Deborah Sacrey, president of Auburn Energy, who will speak on "Visualization Technologies in Earth Sciences."

The Expo is hosted by the University of Oklahoma School of Geology and Geophysics, The Sarkey's Energy Center and the Oklahoma Geological Survey.

For more information contact Sue Crites at scrites@ou.edu. ❑

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continued from previous page

independently write down his/her estimate – then record them for the group.

Discuss "outlier" estimates – many of these reflect either important unique knowledge, or incorrect or incomplete knowledge that may be modified. If anyone then wishes to revise his/her estimate, enter it, and then average the estimates.

❒ Remember that changing a chance-factor from 0.3 to 0.4 has a much bigger impact on Pg than a change from 0.8 to 0.9, so spend more time on the lower chance factors (= critical risks).

Remember that estimating is not exact – beware of false precision.

❒ For each geologic chance-factor, compare other prospect chance-factors – i.e., "Are you as confident of Reservoir as you were of Closure?"

Compare estimated probabilities against previous estimates for counterpart prospects. Are estimates consistent, considering data quality and quantity, and known geological characteristics of the trend?

❒ Faithfully keep track of your estimates and compare them against actual outcomes.

Are you usually anticipating critical risk correctly? What were the actual success-rates of different risk-classes of your prospects?

Learn from your experiences!

(Peter R. Rose is managing partner, Rose & Associates, LLP, Austin, Texas.) ❑

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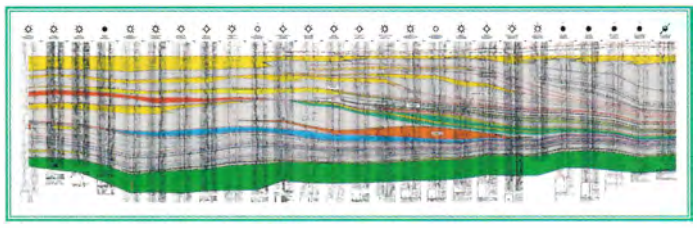

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There's the Forum; Where's the Public?

By JANET BRISTER
Web Site Editor

"Why isn't there more traffic on the Public Forums?"

That's the question asked of me in an e-mail just before I started writing this article.

It's a good question, because I believe the Public Forums are one of AAPG's best kept secrets – certainly when it comes to Web activity.

Why don't we change that?

Our world is shrinking through the Internet. Virtual communities are popping up everywhere. People can discuss matters through their computers with others all over the world.

That's what the AAPG Forums are meant to provide – a place for scientists to discuss papers, books, articles, ideas. The topics are unlimited.

And getting to the Forum page is easy, because AAPG's Public Forums have a shortcut link on AAPG's home page. As these forums develop we may categorize topics to make them even more convenient for the browser.

What will you find there? Currently posted are job opportunities as well as some questions and comments from members about a variety of matters and issues of importance to geologists and earth scientists.

After each posting is a number enclosed in parentheses. This is how many times the comment has been viewed.

Each posting may be replied to either publicly or privately. The public posting will "thread" down after its initial comment. The private posting goes to the originator of the posting you just read.

continued on next page

FOUNDATION UPDATE

Foundation General
Olufemi E. Akinmade
Philip Robert Allin
In memory of Henry Grady Collier Jr.
Karin Andreassen
Jose Raymund Lim Apostol
Byron Jean-Jacques Beck
Jonathan Mark Blank
Francesca Di Cesare
Michael D. Dollins
Hernando Duenas
Trevor Elliott
Lee Wayne Ethetton
Angus John Ferguson
Carlos Elmer Ferro
Eduardo J. Garcia
Matias Ghiglione
Peter Gordon Gray
In memory of Don R. Boyd
Paul Vincent Grech
Matthew A. Gregory
Lisa C. Hall
David Hardy
Diane Westen Hill
Andreas Hoie
James Edmund Iliffe
Stephen Leslie Karner
Scott Allen LaBaume
Manfred Lierz
Lee J. Lindman
Tien-Wen Lo
Pamela E. Luttrell
Putri Yunalis Md Yunos
Francisco D. Orta Benitez
Harry Ptasynski
In memory of Dougald Harris Thamer
Melvin Erwin Rauch Jr.
Emilio Rocha
Nigel John Russell
Souvick Saha
Inessa Y. Segalovich
Dicky Eddy Soedigdjo
Daniel Starck
Jessica Brooke Steffen
Robert Isaac Terry Jr.
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In memory of John G. Seay

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Sean Jared Mitchell
Jessica Lynn Thomas
Brad Calvin Wohler

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Grants-in-Aid Fund
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Nedra Keller Hansen
In memory of Kenneth Keller
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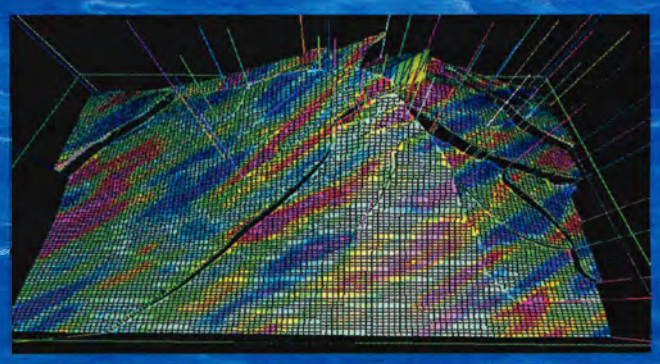

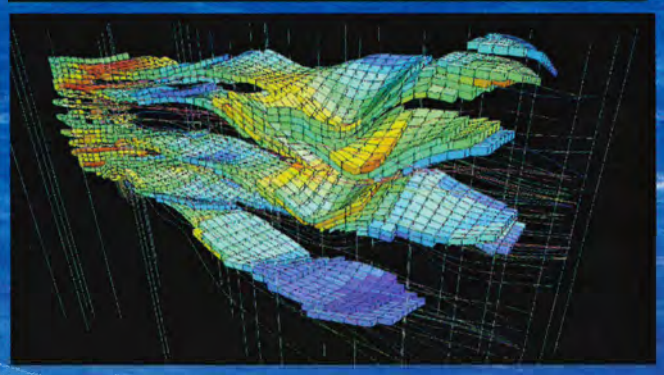

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Job opportunities are intermixed with comments, questions and items being sought. However, there also is an Employment Forum that has been added, which can be reached through the Careers area (look under "About AAPG"). This should consolidate information for those looking for employment or employees.

Meetings have been posted here, and perhaps we'll soon see some lively discussions about the global climate comments that were made in the February EXPLORER.

Look for "Discuss It" beside EXPLORER articles that are posted on the Web. This links directly to the public forums where you can make your statement and discuss it with your peers.

Here's the best part: The public forums are free. Registration is needed (only because it adds validity to your comments). At all times, these forums are monitored to assure the quality of postings.

Posting Tip

If you pay a premium for your Internet time, consider composing your comments in a word processing document offline. Then, log back onto the Internet. Go to the forum and copy the content of your file, then paste it into the text field for your forum posting.

The forums do support attachments, but remember to keep the format down to one that any computer platform will be able to view (JPEG or GIF for graphics and RTF or TXT for text).

Search and Discovery

The following articles were posted to Search & Discovery (http://www.searchanddiscovery.net) during January and February.

Search and Discovery is a free Internet journal published by AAPG/Datapages, dedicated to the upstream petroleum industry.

❒ Post-Drilling Analysis of the North Falkland Basin, by P.C. Richards and B.V. Hillier (adapted for Internet).

❒ New Exploration Concepts for the Edwards and Sligo Margins, Cretaceous of Onshore Texas, by Dale A. Fritz, Terry W. Belsher, James M. Medlin, John L. Stubbs, Robert P. Wright, and Paul M. (Mitch) Harris (adapted from AAPG BULLETIN).

❒ Pseudowell Logs for Characterizing Deepwater Fan Reservoirs: The Tanqua Karoo "Laboratory" Model, by J.B. Thomas (adapted from AAPG Memoir 72).

❒ Tectonostratigraphic Framework of the Columbus Basin, Eastern Offshore Trinidad, by L.J. Wood (adapted from AAPG BULLETIN).

❒ Tectonic Control on the Creation of Supergiant Fields in the Central and South Caspian Area, by Steve Hall and Vanessa Sturrock (adapted from The Houston Geological Society Bulletin).

❒ Misener Sandstone in Northern Oklahoma, by Masera Corp.

Authors are invited to submit original material. Please send manuscripts (or inquiries) to editor@searchanddiscovery.net.

Good browsing! ❒

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Economics of Worldwide Petroleum Production	June 25-29
Coring and Core Analysis	June 25-29
DENVER, COLORADO	
Geological Applications of Logging Measurements	June 11-15
Neural Network Synthetic Logs and Resistivity Inversion	June 11-15
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Applied Decision Analysis with Portfolio and Project Modeling	June 18-22
Petroleum Finance and Accounting Principles	June 18-22
The Petroleum Geology of Southeast Asia	June 18-22
Oil and Gas Teams: How to Make Them Work	June 25-29
JACKSON HOLE, WYOMING	
Compressional Structural Styles (Includes fieldtrip)	June 25-29
KUALA LUMPUR, MALAYSIA	
Presentation Skills for the Petroleum Industry	June 11-15
Personnel Supervision in the Petroleum Industry	June 18-22
Management Practices for Petroleum Industry Executives	June 25-27
LONDON, ENGLAND	
Presentation Skills for the Petroleum Industry	June 4-8
Basic Petroleum Geology	June 4-8
Petroleum Geochemistry for Exploration and Development Geologists	June 4-8
Basic Seismic Interpretation	June 4-8
Sandstone Reservoirs	June 11-15
Thermal Modeling of Petroleum Generation	June 11-15
Seismic Survey Design, Data Acquisition, and Processing	June 11-15
Formation Evaluation – Basic and Intermediate Concepts	June 11-22
3-D Seismic Interpretation and Applications	June 18-22
Petroleum Sedimentology: Modern Tools	June 25-29
Biostratigraphy: Production and Exploration Applications	June 25-29
Introduction to Seismic Stratigraphy: An Exploration Workshop	June 25-29

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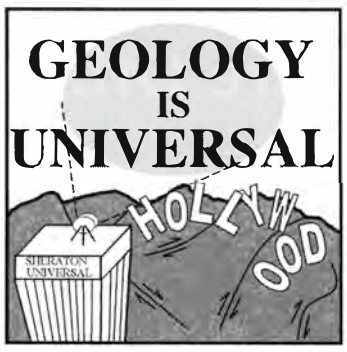

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PROFESSIONAL NEWS BRIEFS

Walter B. Ayers Jr., to visiting professor, geosciences, department of petroleum engineering, Texas A&M University, College Station, Texas. Previously principal consultant, Schlumberger Holditch-Reservoir Technologies, College Station, Texas.

Craig J. Coleman, to program director, Geoscience Technology Training Center, North Harris College, Houston. Previously consulting geologist, Houston.

Joel A. Degenstein, to Utah technical director, Rockies production district, El Paso Energy, Houston. Previously technical manager, Rockies district, Coastal Oil and Gas, Houston.

Susan R. Eaton has started SR ECO Consultants, Calgary, Canada. Previously vice president-exploration, K2 Energy, Calgary.

Will Gaston, to principal consultant, Gaston & Associates, Irvine, Calif. Previously environmental attorney and consultant, Newport Beach, Calif.

Stephen A. George, to vice president and manager, West Canada operations, URS Corp., Calgary, Canada. Previously vice president and office manager, Yucca Mountain nuclear waste disposal project, URS Corp., Las Vegas, Nev.

Dennis Giovannetti, to exploration geologist, Western Gulf of Mexico Shelf, BP, Houston. Previously exploitation geologist, offshore Louisiana, Vastar Resources, Houston.

L. Robert Heim, to senior exploration geologist, Ardent Resources, Pittsburgh. Previously geological consultant, L. Robert Heim Geological Consulting Services, Pittsburgh.

Chuck Holman, to software sales manager-Latin America, Roxar, Houston. Previously geophysical consultant, RH Resources, Houston.

Scott C. Key, to vice president-business development, energy services division, NuTec Sciences, Houston. Previously deep-water reservoir development manager, Vastar Resources, Houston.

Thomas M. LaHouse, to president-business development, energy services division, NuTec Sciences, Houston. Previously chief geophysicist, Vastar Resources, Houston.

Robert Lander, to scientific advisor, Geocosm, Austin, Texas. Previously technical director, Geologica, Stavanger, Norway.

Mark C. Leach, to geophysicist, Vintage Petroleum, Tulsa. Previously senior geophysicist, Phillips Petroleum, Bartlesville, Okla.

Greg McMahan, to geologist-Arkoma team, Chesapeake Energy, Oklahoma City. Previously senior geologist-Oklahoma gas team, Marathon Oil, Oklahoma City.

Richard A. Parker, to principal technology manager, geosciences, GTI Colorado, Arvada, Colo. Previously principal technology manager, geosciences, Gas Technology Institute, Chicago.

Mitch D. Pavlovic, to business development geologist, Baker Atlas GeoScience, Houston. Previously geologist, Baker Atlas GeoScience, Houston.

Tom Plawman, to staff geophysicist, Phillips Alaska, Anchorage, Alaska. Previously senior geophysicist, Schlumberger-Holditch Reservoir Technologies, Houston.

Stacey Quarles, to senior geophysicist, deep-water Gulf of Mexico, Nexen Petroleum, Dallas. Previously senior geophysicist, deep-water Gulf of Mexico, Vastar Resources, Houston.

Steven M. Roth, to senior sales engineer, NuTech Energy Alliance, Humble, Texas. Previously senior exploitation geologist, Stocker Resources, Los Angeles.

Phil Salvador, to geological advisor, Dubai Petroleum (Conoco), Dubai, U.A.E. Previously geological advisor, Conoco UK, Aberdeen, UK.

Patricia A. Santogrossi, to chief geologist, Chroma Energy, Houston. Previously principal geologist, deep-water exploration, Vastar Resources, Houston.

Rick Schmitt, to vice president and general manager-Yemen, Occidental Oil & Gas, Houston. Previously general manager-Australia/Indonesia, Canadian Occidental Petroleum, Calgary, Canada.

Dick Selley, to emeritus professor in sedimentology and petroleum geology, and senior research fellow, Imperial College of Science, Technology and Medicine, London, England. Previously professor of applied sedimentology, Imperial College, London.

Frank C. Sheppard III, to senior explorationist, Stone Energy, Houston. Previously senior explorationist, Basin Exploration, Houston.

J.W. "Jim" Tucker, to chief geologist, Computational Geology, Houston. Previously consultant, Houston.

Kirk H. Van Sickle, to geophysicist, Stone Energy, Houston. Previously independent geoscientist, Houston.

John M. Winterman, to executive vice president-worldwide exploration

continued on next page

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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).

2001 U.S. Meetings

March 10-13, Southwest Section, AAPG, annual Section meeting, Dallas.

April 9-11, Pacific Section, AAPG, annual Section meeting, Universal City, Calif.

April 25-28, Society of Independent Professional Earth Scientists, annual meeting, Galveston, Texas.

April 30-May 3, Offshore Technology Conference, Houston.

June 2-3, SEPM, 75th anniversary mid-year meeting, Denver.

June 3-6, AAPG annual meeting, Denver.

June 3-6, Rocky Mountain Section, AAPG, annual Section meeting, Denver (concurrent with AAPG annual meeting).

June 16-20, Society of Professional Well Log Analysts, annual meeting, Houston.

June 20-23, History of the Oil Industry-Symposium and Field Trips, co-sponsored by AAPG, Oil City, Pa.

Sept. 9-14, Society of Exploration Geophysicists, annual meeting, San Antonio.

Sept. 22-25, Eastern Section, AAPG, annual Section meeting, Kalamazoo, Mich.

*Sept. 23-26, The Society for Organic Petrology, 18th annual meeting, Houston.

Sept. 30-Oct. 2, Mid-Continent, AAPG, annual Section meeting, Amarillo, Texas.

Sept. 30-Oct. 3, Society of Petroleum Engineers, annual meeting, New Orleans.

Oct. 17-19, Gulf Coast Section of Geological Societies, AAPG, annual Section meeting, Shreveport, La.

Oct. 31-Nov. 4, AAPG Foundation Trustee Associates, annual meeting, Tucson, Ariz.

Nov. 5-8, Geological Society of America, annual meeting, Boston.

2001 International Meetings

June 11-15, European Association of Geoscientists and Engineers, annual meeting, Amsterdam, The Netherlands.

June 18-22, Canadian Society of Petroleum Geologists, annual meeting, Calgary, Alberta, Canada.

July 15-18, AAPG International Regional Conference, St. Petersburg, Russia.

continued from previous page

and business development, Occidental Oil and Gas, Houston. Previously vice president-worldwide exploration, Occidental Oil and Gas, 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, rockwell@aapg.org; or submit directly from the AAPG Web site, www.aapg.org/explorer/pnb_forms.ht

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INTERNATIONAL BULLETIN BOARD

International Awards Honor Three

The AAPG Executive Committee has honored two prominent AAPG members with newly established awards for technical presentations at AAPG international conferences.

In addition, a new Best Student Poster award that honors a well-known Turkish geologist also has been created for international meetings, and work on establishing a new named student paper award for international meetings is expected to be completed soon.

The new awards are:

❒ The **Gabriel Dengo Award**, given for excellence in presentation of a technical paper. It is named for Dr. Gabriel Dengo, an influential Central American geologist who died Aug. 4, 1999.

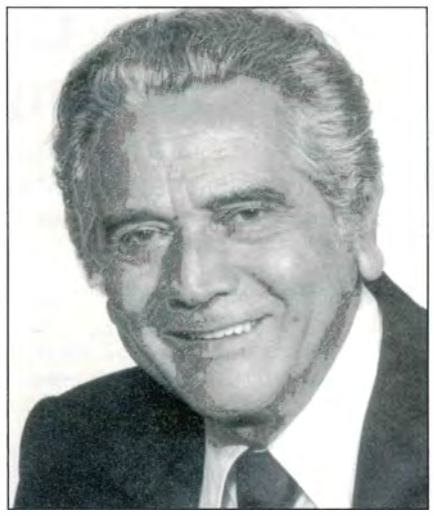
This award consists of a wooden plaque with an inscription of the Gabriel Dengo Cup; the awardee's name will be placed on this silver cup, which will be kept at the AAPG headquarters office in Tulsa.

❒ The **Ziad R. Beydoun Memorial Award**, given for excellence in presentation of a technical poster. It is named for Dr. Ziad Beydoun, emeritus professor of geology at American University of Beirut and a leading authority on the geology of the Middle East. He died March 7, 1998.

This award consists of a wooden plaque with the AAPG logo and $500.

❒ The **Ozan Sungurlu Award**, given for the best student Poster at the international meetings. It is named for Ozan Sungurlu, a leading Turkish earth scientist and explorationist who died Nov. 26, 1990.

This award consists of a wooden plaque with the AAPG logo and $500.



Dengo

Beydoun

Sungurlu

These awards will be presented for the first time at the AAPG annual meeting in Denver on June 3, to paper and poster winners from the AAPG Bali 2000 international conference and exhibition.

The names for the awards were selected from a distinguished list of international geoscientists who contributed greatly to the earth scientist community and oil industry of their respective countries and surrounding regions.

Gabriel Dengo

Gabriel Dengo was a role model to hundreds of young geologists, and is remembered for his enthusiasm for geological processes and his understanding rock signature from the field to the model.

His knowledge covered a wide range of earth sciences, and he received the Michel T. Halbouty Human Needs Award during the 1995 AAPG annual meeting in Houston.

Dengo was born on March 9, 1922, in Heredia, Costa Rica. He received a bachelor's degree in agronomy from the University of Costa Rica; bachelor's and master's degrees from the University of Wyoming; and a Ph.D. from Princeton University.

From 1947 to 1949 he worked on Coast Ranges of Venezuela, including the geological study for the Caracas-La Guaira highway. He was among the first of Harry Hess's students working in Venezuela for what became the very successful Princeton Caribbean Research Program.

After graduation, he returned to Venezuela to work for the Ministry of Energy and Mines, during which time

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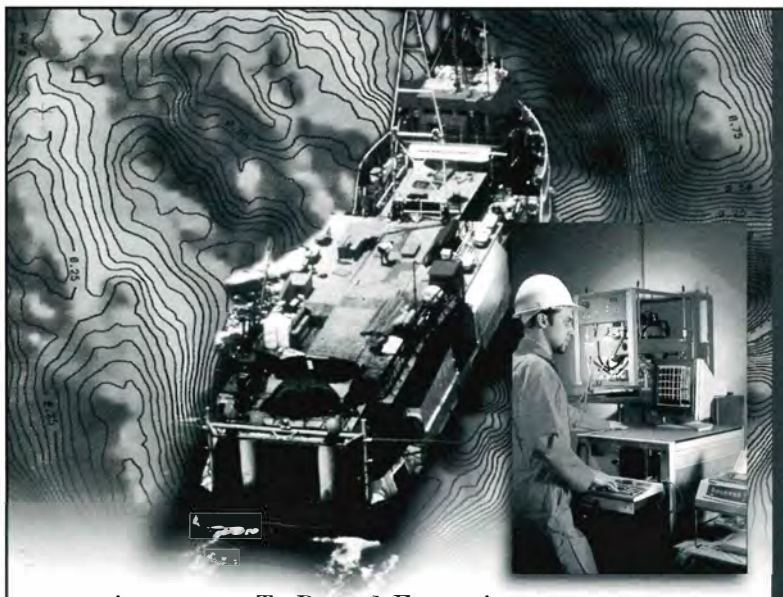

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he helped discover one of the largest iron deposits in the Guyana Shield.

Dengo returned to Costa Rica in 1952 as field geologist for Union Oil of California, mapping mostly in the jungle. In 1956, the company moved him to Guatemala as resident geologist, and in 1962 they transferred him to New Orleans as subsurface geologist.

He then returned to Guatemala and eventually was appointed deputy secretary to the General Secretariat for Central American Economic Integration. In 1965, he transferred to the Central American Research Institute for Industry (ICAITI) to organize a geological research group. He worked in several countries of Central and South America and in the Caribbean, eventually becoming deputy director and, in 1975, director of ICAITI.

He left in 1979 to work again for the Ministry of Energy and Mines in Venezuela, and in 1981 he returned to Guatemala as chief geologist for the Usumacinta River Electrification Project, a joint project with the Federal Electrification Commission of Mexico.

In 1989, he returned to ICAITI as technical manager, and he founded the Center for Geological Studies of Central America as a means to channel many of his scientific contributions.

Ziad R. Beydoun

Ziad R. Beydoun was a prominent geologist in the Middle East and is largely responsible for surveying and mapping the region's rock successions. He spent his life in the field, mapping a vast region never before seen, mostly in the desert.

Friends called him a "wonderful conversationalist and humanist, adept at switching between Arabic, English, French and Turkish and their cultures – totally at home at any setting."

He was born in Beirut on Dec. 9, 1924, and initially was schooled in Palestine (Haifa and Jerusalem) and American University of Beirut; at the close of World War II he studied geology at St. Peter's College, Oxford.

After the demise of Palestine, his family fled to Lebanon, and he started working for Iraq Petroleum Company (the former Turkish Petroleum Company). He spent five years subsurface mapping in Lebanon, Syria, Iraq and the Gulf States, before shifting to field work in the Aden Protectorate (Yemen) as a geologist with the Hadramout Survey.

His work in Aden was awarded with a Ph.D. degree at Oxford University and a publication by the British Overseas Geological Survey.

He joined Partex and participated in the discovery of oil in Oman by PDO. In 1963 he became a geological expert to the Lebanese Ministry of National Economy, and shortly thereafter joined American University of Beirut. In 1970 he was appointed full professor and chairman of the geology department there, as well as special advisor to the Council for Scientific Research.

Despite the horrors of civil war in Lebanon, Beydoun continued alone in the department and, against all odds, to lecture and guide his students.

In 1985 he returned to London and joined Marathon Oil. He was appointed scientific director of a UNDP/World Bank project on the hydrocarbon study of the Red Sea/Gulf of Aden region, and at the invitation of the Yemeni government led the committee that pulled together the geology of Yemen, published as part of the International Lexicon of Stratigraphy.

He was an associate editor of the BULLETIN, and he authored over 50 articles and two books, including *Arabian Plate Hydrocarbon Geology and Potential – A Plate Tectonic Approach*, published by AAPG in 1991 in the Studies in Geology Series.

Ozan Sungurlu

Ozan Sungurlu was a role model to many young geologists, creating opportunities for them to get the international education and modern geological thought overseas.

Sungurlu was born in Gumushane, Turkey, in 1939 and completed his education in Eskisehir and Istanbul. After graduating from the Istanbul University in 1964, he started his career as field geologist at the Mineral Research Institute (MTA) and joined Turkish Petroleum Corporation (TPAO) in 1969.

His interest in integrated geological processes started during his university education, where he became a researcher utilizing data and field relationships to question established dogmas for the geological problems in Turkey. His extraordinary interest in fundamentals of geological thought drove him to solve the complex regional geology of Turkey, especially the events from the Mesozoic to Present.

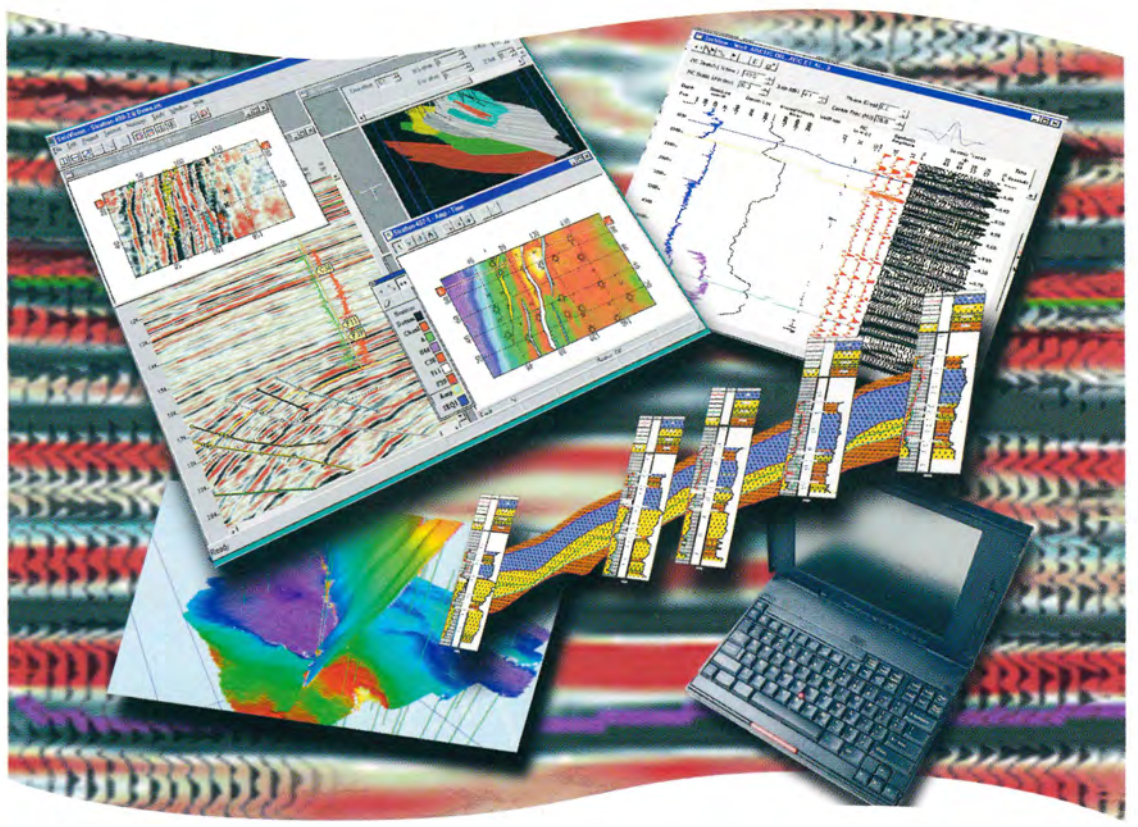
His leadership skills were recognized early in his career at TPAO with increasing responsibilities, and he became vice president of exploration in 1987.

He continued to be technically active, publishing on the structural geology and petroleum systems of southeast Turkey and regional geology of the Turkish portion of the Tethyan region. He also contributed greatly to the geological studies at both TPAO and Turkish academe, initiating collaborative field studies with Istanbul Technical University where he personally proposed studies on critical problems.

He revolutionized exploration activities in Turkey by bringing together geologists and geophysicists to work side by side at all scales of exploration activities – and during his tenure Turkey opened investment opportunities for international companies.

Sungurlu was a great supporter of AAPG, encouraging TPAO participation at international meetings, utilizing the AAPG Distinguished Lecture Program and encouraging affiliation of Turkish Petroleum Geologists with AAPG.

(Editor's note: Pinar Yilmaz prepared information for this article. More information on the awards and complete biographies of Dengo, Beydoun and Sungurlu can be found on the AAPG Web site at www.aapg.org.) ❑



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EDUCATION CALENDAR

2001 SCHOOLS, SHORT COURSES

An Overview of Exploration Play Analysis
March 19-21, Houston

Introduction to Concepts and Techniques of Petroleum Geology
April 3-5, Houston

* Structural Styles and Hydrocarbon Traps in Compressive Basins
April 23-27, Houston

Reservoir Characterization: Principle Methods and Case Studies
May 7-8, Dallas

High-Resolution Well-Log Sequence Stratigraphy
May 14-18, Denver

How to Evaluate Carbonate Reservoirs from Well Logs
June 2-3, Denver
(with AAPG annual meeting)

* Deep Water Sands, Integrated Stratigraphic Analysis
June 2-3, Denver
(with AAPG annual meeting)

* Prospect Evaluation "Surgical Theater" and Workshop
June 2-3, Denver
(with AAPG annual meeting)

E&P Methods and Technologies
June 7-9, Denver
(with AAPG annual meeting)

Applied Subsurface Mapping
July 9-13, Dallas

* Overpressure in Petroleum Systems in Deep Water Plays
July 14-15, St. Petersburg, Russia
(with AAPG regional international meeting : Register through AAPG convention department)

Well Log Analysis and Formation Evaluation
Aug. 7-10, Austin, Texas

Probability and Statistics for Exploration and Exploitation
Aug. 20-22, Dallas

Introduction to the Petroleum Geology of Deep-Water Clastic Depositional Systems
Sept. 8-9, San Antonio
(with SEG annual meeting)

Quantification of Risk – Petroleum Exploration and Production
Oct. 8-11, Houston

Terrigenous Clastic Depositional Systems and Sequences – Applications to Reservoir Prediction, Delineation and Characterization
Oct. 16-17, Shreveport, La.
(with GCAGS Section meeting)

Practical Salt Tectonics
Oct. 29-31, Houston

* Advanced Risk Analysis for the Energy Industry
Nov. 12-13, Houston

2001 FIELD SEMINARS

Carbonates

Carbonate Sequence Stratigraphy, As Illustrated By Lower Cretaceous Platform Carbonates, Central Texas
April 16-20
Begins in San Antonio
Ends in Austin, Texas

Sequence Stratigraphy and Reservoir Distribution in a Modern Carbonate Platform, Bahamas
June 25-30
Begins, ends in Miami, Fla.

Arid Coastline Depositional Environments
Nov. 4-9
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 22-28; April 30-May 6
Begins, ends in Salt Lake City

Wave-Dominated Shoreline Deposits, Book Cliffs, Utah: Depositional Models for Hydrocarbon Exploration
May 14-22; Aug. 20-28
Begins, ends in Grand Junction, Colo.

* Cretaceous Outcrops of the Western Interior, Ferron Sandstone, Fall River Formation and the Muddy Sandstone – Utah, Wyoming and South Dakota
June 7-14
Begins in Wyoming
Ends in South Dakota
(following AAPG annual meeting)

Clastics – Modern

Modern Clastic Depositional Environments
April 18-24; May 18-24; Sept. 12-18
Begins in Columbia, S.C.
Ends in Charleston, S.C.

Modern Deltas
Sept. 10-14

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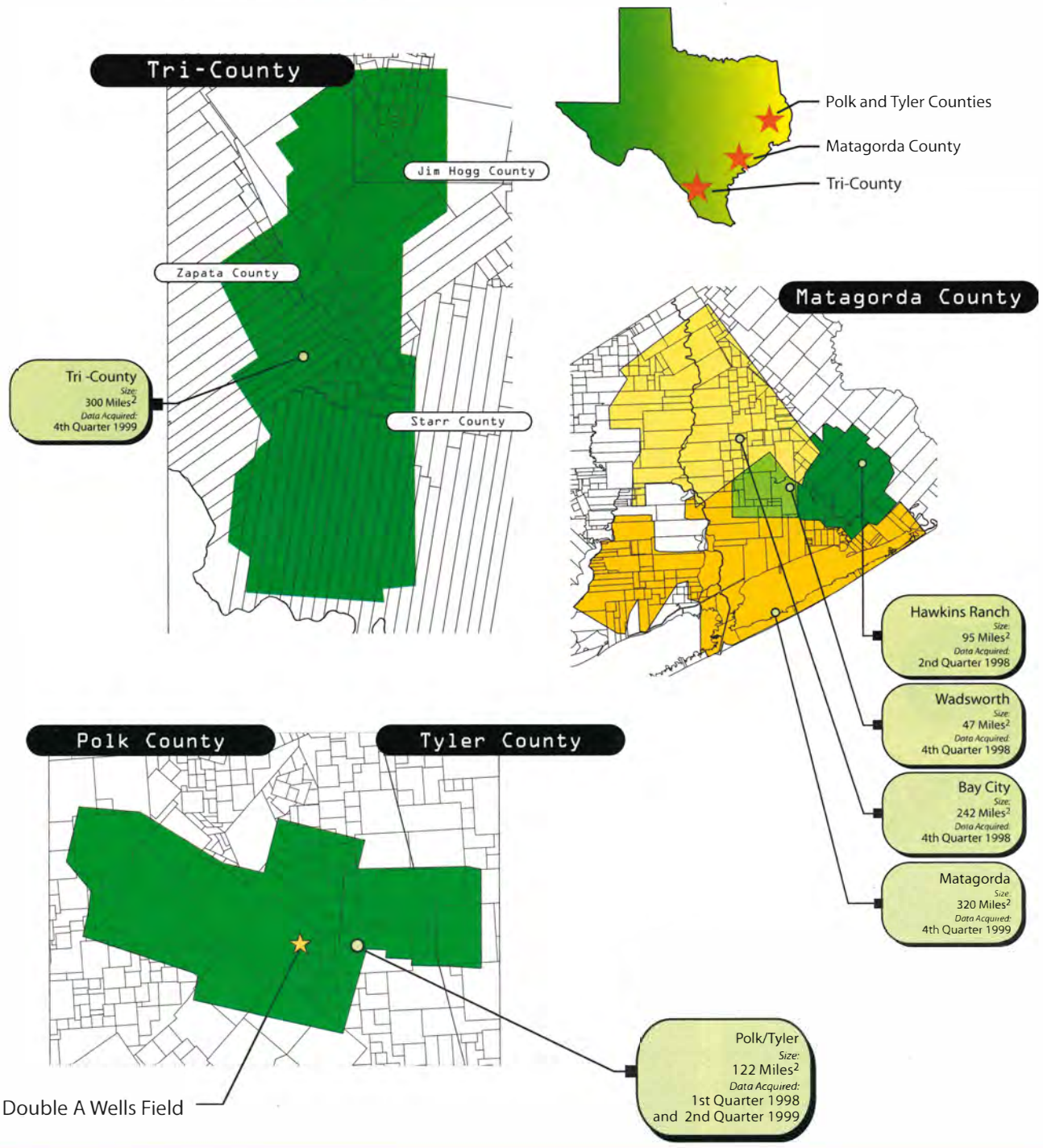

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Climate Gets Geological View

A new Studies in Geology publication that tackles the timely subject of global climate change has been released by AAPG – and will be available at a special sale price for a limited time.

Geological Perspectives of Global Climate Change, edited by Lee C. Gerhard, William E. Harrison and the late Bernold M. "Bruno" Hanson, is a scientific approach to a topic that is stirring controversy worldwide.

The introductory sections address the major and minor physical controls, or drivers, that affect earth's climate. Several chapters describe the naturally occurring range of variation of climatic conditions and illustrate past changes in global temperatures.

Additional topics include:

❒ Case studies that show how ancient temperature conditions are determined.

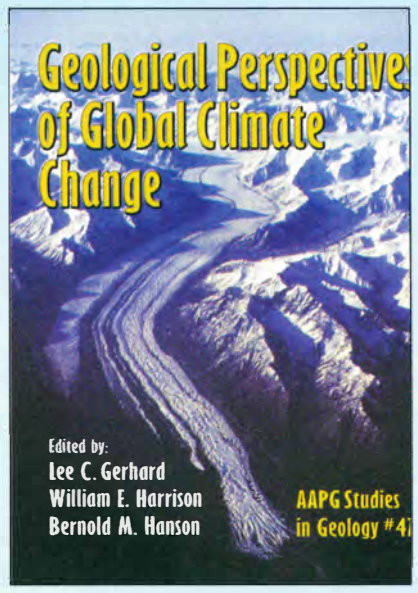
❒ New techniques that have significant potential as proxies for assessing paleoclimates.

❒ Several chapters that demonstrate the magnitude and length of duration of numerous temperature variations that have occurred during geologic time periods.

Although many of the studies are oriented toward geoscientists, the book likely will be of interest also to life, earth and atmospheric scientists; educators; research workers; and policymakers seeking access to a broad range of paleoclimatic studies.

A special pre-publication sale will be held through April 15, when the book will be offered for $69 in hard bound and $39 in soft bound. After the sale, the book's price will be $79 for hard and $49 for soft.

To order, call 1-800-364-2274 (USA and Canada) or 1-918-584-2555; or visit the AAPG online bookstore at http://bookstore.aapg.org.



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Begins in Baton Rouge, La.
Ends in New Orleans

Sequence Stratigraphy

Sequence Stratigraphic Influence on Sandstone Reservoir Characteristics of Cretaceous Foreland Basin Deposits
June 24-29
Begins in Rock Springs, Wyo.
Ends in Steamboat Springs, Colo.

Sequence Stratigraphy Field Seminar: Sequences and Facies on an Active Margin
Oct. 14-19
Begins, ends in La Jolla, Calif.

Tectonics and Sedimentation

Exploration Potential, Tectonic Framework and Depositional Systems of Strike-Slip and Extensional Basins
March 31-April 6
Begins in Palm Springs, Calif.
Ends in Las Vegas, Nev.

Grand Canyon Geology via the Colorado River, Arizona (An AAPG Geotour)
June 10-18
Begins in Marble Canyon, Ariz.
Ends in Marble Canyon; South Rim, Ariz.; or Las Vegas, Nev. (following AAPG annual meeting)

Utah-Nevada Overthrust Belt and Eastern Great Basin Tectonics
June 18-22
Begins in Salt Lake City
Ends in Las Vegas, Nev.

E&P in Thrusted Terrains, Practical Applications of Structure and Stratigraphy in the Montana/Alberta Thrust
Aug. 5-10
Begins in Great Falls, Mont.
Ends in Calgary, Canada

Submarine Fan and Canyon Reservoirs, California
Sept. 17-21
Begins, ends in San Francisco

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MEMBERSHIP AND CERTIFICATION

The following **candidates** have submitted applications for membership in the Association. 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
Fisk, Lanny H., PaleoResources Consultant, Sacramento (Reinstate)

Colorado
Johnson, Edward Allison, U.S. Geological Survey, Denver (Reinstate)

Louisiana
Lee, Stephen Hugh, Louisiana Division of Natural Resources/OC, Baton Rouge (D.L. Billingsley Jr., M.E. Dunham, L.G. Frizzell); **Ryan, David I. Jr.**, Chevron, Metairie (G.H. Rhoads, T.A. Medary, A.T. Hymel)

Texas
Chester, Judith S., Texas A&M University, College Station (M.C. Schroeder, J.H. Spang, C.C. Mathewson); **Cooper, Katherine H.**, BP, Houston (K.K. Thomas, R.L. Boyce, S.H. Hall); **Frederick, Ronald Maurice**, independent, Midland (D.M. Mitchell, J.E. Roberts, T.W. Williams); **Pish, Timothy Alexander**, Waterous & Co., Houston (S.A. Thompson, C. Harrison, J.S. Gross); **Sullivan, E. Charlotte**, University of Houston, Houston (D. Rutan, P.T. Gordon, W.R. Dupre)

Australia
Hicks, Timothy Richard, Santos, Brisbane (M.A. Webster, R.S. Heath, S.C. Lang); **Smith, Barry Lyle**, Mosiac Oil N.L., St. Ives (Reinstate);

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Brunei Darussalam Tromp, Jan Pieter, Brunei Shell Petroleum, Seria (S.J. Drake, J.R. Booth, P.A. Allman Ward)

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Hrvatovic, Hazim, Geological Survey B&H, Sarajevo (W.P. Grün, Z. Hernitz, Z. Ivkovic)

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Radford, Thomas William, BP, Cairo (W.J. Sercombe, A.C. Laing, J.W. Stewart)

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Chiluka, Vishnu Kumar, Oil & Natural Gas Corp., Mumbai (K.C. Gandhi, D.K. Panda, R.K. Upadhyaya); **Chowdhury, Subhadeep**, Enron Oil & Gas India, Mumbai (G.M. Greene, M. Ajith, G. Ghosh)

Indonesia
Specht, Thomas D., Caltex Pacific Indonesia, Sumatra (W.C. Richmond, M.J. Kisucky, B.J. Katz)

Niger
Harouna, Moussa, University of Niamey, Niamey (J.D. Pigott, R.M. Slatt, J.M. Forgotson Jr.)

Nigeria
Aworanti, Olajide Awokunle, Globuf International, Warri (A. Adesida, E.D. Van Riessen, R.C. Millspaugh)

Pakistan
Siddiqui, Fareed Iqbal, Pakistan Petroleum, Karachi (N.K. Siddiqui, M. Sharif, S.U. Siddiqui)

Saudi Arabia
Robinson, Nelson Martin Jr., Saudi Aramco, Dhahran (A.K. Norton, B.R. Naini, J.A. Al-Hajhog)

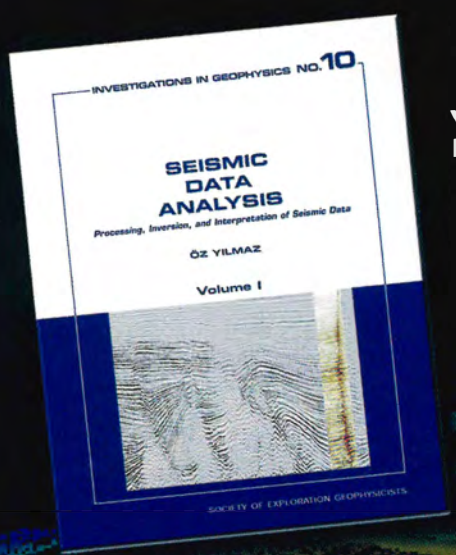
New Publication

Seismic Data Analysis

Processing, Inversion, and Interpretation of Seismic Data

Öz Yilmaz

Öz Yilmaz has expanded his original volume on processing to include inversion and interpretation of seismic data.



Volume I
Fundamentals of Signal Processing
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Velocity Analysis and Statics Corrections
Migration
Dip–Moveout Correction and Prestack Migration
Noise and Multiple Attenuation

Volume II
3–D Seismic Exploration
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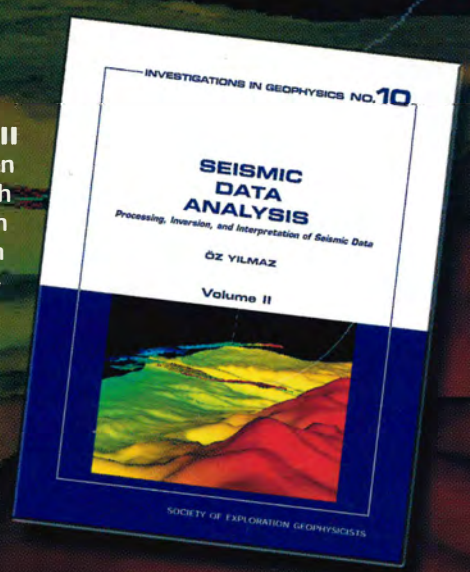
Earth Modeling in Depth
Structural Inversion
Reservoir Geophysics



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IN MEMORY

Donald R. Boyd, an Honorary member of AAPG and a leading geologist for the Gulf Coast region, died Dec. 20 after a long illness. He was 66.

Boyd, who also received AAPG's Distinguished Service Award, was a former president of the Houston Geological Society and the Gulf Coast Association of Geological Societies.

Last fall GCAGS honored him with the establishment the Don R. Boyd Medal for Excellence in Gulf Coast Geology, the group's highest honor.

Addy, Richard Victor, 80
Slidell, La., May 30, 1999
Bowers, Sydney Dana, 77
Las Vegas, Nev., May 16, 2000
Boyd, Donald Ray, 66
Corpus Christi, Texas
Dec. 20, 2000
Cunningham, Kimberley Ivey, 46
Boulder, Colo., Dec. 20, 2000
Garaas, Howard A. (EM 56)
Englewood, Colo.
Goodman, John Vollmer, 96
Upper St. Clair, Pa., Dec. 5, 2000
Greenwell, Ray Derry, 69
Sun City Center, Fla.
Dec. 10, 2000
Heatzig, William Grant (AC 68)
Boca Raton, Fla.
Holme, James Desmond, 77
Dallas, Nov. 13, 2000
Howard, Walter Kingsley, 76
Olney, Ill., Dec. 4, 2000
Kershner, John Martin (EM 49)
Broken Arrow, Okla.
Martin, James Littell Jr., 84
Austin, Texas, June 18, 1999
Perusek, Cyril Joseph, 85
Midland, Texas, Jan. 4, 2001
Robertson, William F. Jr. (EM 51)
Casper, Wyo.
Seay, John G., 57
Midland, Texas, Dec. 18, 2000
Steenland, Nelson Clarence, 81
Houston, Dec. 3, 2000
Tanner, William Francis Jr., 83
Tallahassee, Fla., April 9, 2000
Thamer, Dougald Harris, 71
Bakersfield, Calif., Jan. 5, 2001
Willis, George Frederick, 66
Dallas, Nov. 13, 2000

(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.)

New Orleans Authors Receive Murray Award

The GCAGS/GCSSEPM Grover E. Murray Best Published Paper award was presented at the 2000 Gulf Coast Association of Geological Societies' annual meeting in Houston.

The Grover E. Murray award goes to Richard H. Fillon, of New Orleans, and Paul N. Lawless, with CNG in New Orleans, for the paper "Lower Miocene-Early Pliocene Deposystems in the Gulf of Mexico: Regional Sequence Relationships."

The 2001 GCAGS annual Section meeting will be held Oct. 17-19 in Shreveport, La.

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READERS' FORUM

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.

Don't Drill ANWR

Since 1985 I have been a continuous member of AAPG. I'm an experienced geophysicist with years in oil exploration, borehole geophysics and, for the last five years, earthquake analysis. My professional resume reflects the variability of our common professions, and (I hope) the flexibility and adaptability that we all need to handle inevitable challenges.

I understand the various mentalities and motivations under which the geosciences both benefit and suffer. I feel that those of us with geological, geophysical and special technical knowledge have not only the opportunities to be involved in the future of natural resource policies, but also the responsibility to use our special skills, talents and insights to shape those policies.

With the inauguration of the new administration in Washington, it is essential that we, as thinking scientists and professionals, as well as collectively as the AAPG, make the right natural resources decisions.

The critical issue that demands our concern NOW is wilderness awareness and preservation. This issue is best focused in the contentious debate over opening the Arctic National Wildlife Reserve coastal plain to oil and gas exploration.

Exploration in the ANWR must NOT, and I repeat, NOT happen.

Consider the following:

✓ At this time global society is absolutely dependent upon petroleum exploration, production and consumption. This is a fact that every geoscientist and citizen knows.

✓ This dependence will continue for decades at least. This is a fact that every geoscientist and citizen knows.

✓ Petroleum reserves in the earth are fixed and will be exhausted. This is a fact that every geoscientist knows, but most citizens without our privileged knowledge, do not truly understand.

✓ Unaltered natural and wilderness areas of our planet are fixed in number and will be exhausted without conscious protection. This is a fact that most citizens know but most geoscientists seem not to.

It is because of our closeness to these geologic realities that we must lead in intelligent policymaking.

❒ First, we must continue to apply the best ideas, technology and effort to locate and produce the oil and gas on which we all depend. This becomes increasingly important as global petroleum is depleted.

❒ Second, we must limit petroleum consumption through innovative and comprehensive conservation measures. This will extend the lifetime of global oil resources and has benefits in cleaner air, water and eased global warming.

Note that conservation does not equate to recession or job loss in the oil industry. It allows us the time to develop technologies to take advantage of the most difficult opportunities and to extract resources with maximum efficiency.

❒ Third, we must recognize that alternative energy resources WILL be developed. This has been said for years, but we must know that it is true.

We can be part of this without conflict of interest or abandoning our ties to the oil industry. The industry and AAPG must be leaders in new ideas and stride into the future. It will benefit us all to envision and recreate our professions as energy professionals, not just petroleum professionals.

❒ Fourth, it is essential to always examine the "bigger picture" as closely as we examine a difficult geologic or geophysical challenge. We must look at the consequences of our decisions and policies in terms of quality of life.

This means global quality of life. It is no longer enough to make decisions based on economics or politics alone.

Therefore, as we continue to provide the resources that our society needs, we must make all of our decisions with an eye to consequences, inevitable resource changes and quality of life. We must realize that most of our difficult decisions are now critical decisions that cannot be undone later.

AAPG must not allow itself to be an unthinking instrument of the oil industry's traditional economics.

Don Blakeman
Golden, Colo.

No Fuel Price Revolt

In the January EXPLORER there is reference made to the anger of the consuming public over the increase in fuel prices last year. As evidence of this anger the author cites that "Fuel prices drew angry protests in England and throughout Europe."

Yes, there were protests; however, these protests were not directed at the price of fuel. The objective of the protests was to get the governments of the targeted countries to decrease the onerous taxes collected on fuel. These were tax protests, not protests over the high price of fuel.

For the most part consumers have exhibited an enlightened attitude towards higher oil prices, and have acknowledged

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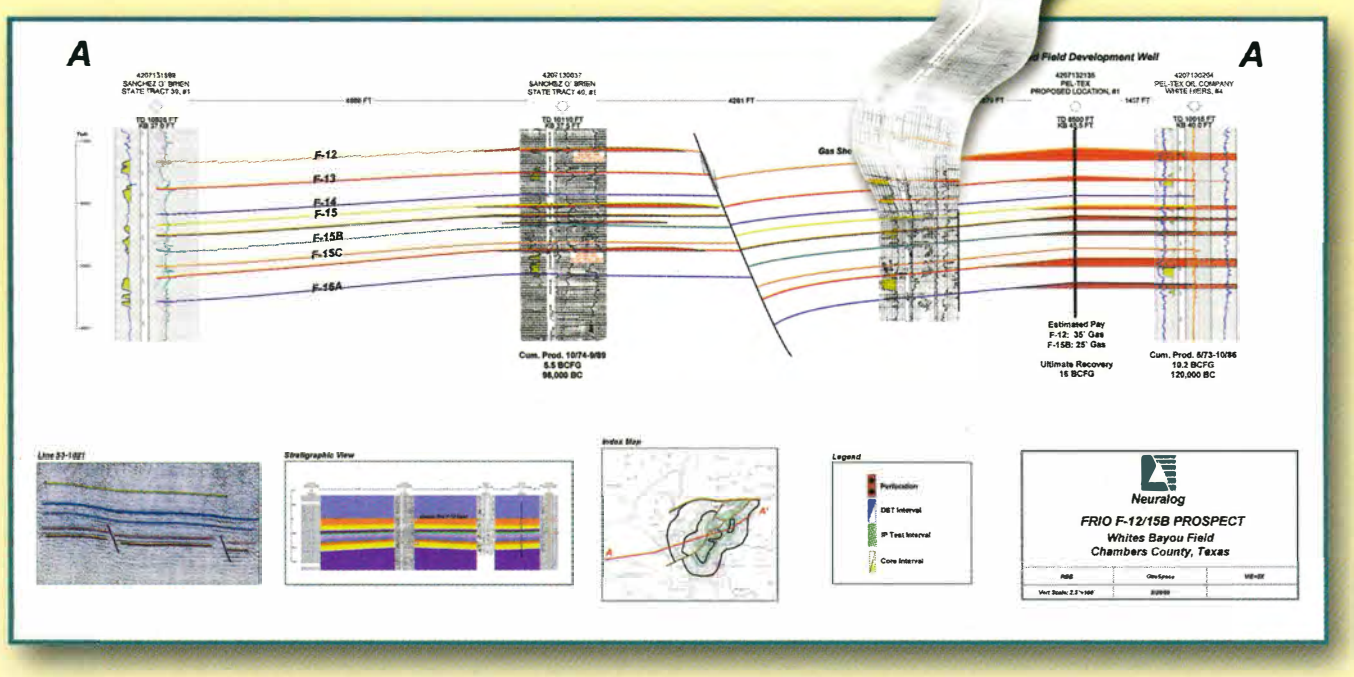
NeuraSection Montage



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the fact that in order to provide an adequate supply of the fuel products so much in demand higher prices are necessary.

We, as a professional society and as members of an industry constantly under siege in the media, must be careful not to misrepresent events to our collective detriment. Facts must be presented correctly to the extent that they prevent damage to our position in the eye of the public.

Marc Maddox
Midland, Texas

Taking Sides

I am disappointed by the AAPG siding with the environmentalists about man-caused global warming.

There is no proof that the human factor is causing the 1.5-degree warming, or that it is a warming, or just a variance in temperature. This last summer the EXPLORER had an article and presented other natural factors that could be the cause of the warming, and also that the CO_2 was going down in some cases.

We are scientists and geologists. We study the earth and its history. For 90 percent of the earth's time it has been warmer than now – especially during the Cretaceous, (when) deciduous trees grew north of the Arctic Circle and the average temp in the Arctic was 69 F. This has been proven by the fossil record.

So let us start to try to educate the public and disavow what the environmentalists are doing; man is not the cause of all the earth's problems, and we will all burn up. I am sure the people in the Midwest will agree that the earth is not warming.

Randy Pochel
Fresno, Calif.

Good for Don

I thoroughly enjoyed the December EXPLORER article about AAPG member Don O'Nesky. The background on the Electoral College was timely and informative. Our membership is fortunate that someone with Don's stature, knowledge and understanding of petroleum issues had the honor and the opportunity to represent the interests of our industry as well as the values of our great nation.

As to my "good friend and colleague" David Rosen's recent criticism of the article as partisan, and his lament "What about we Texans who supported the vice president?": I guess this is just another circumstance where there is no "controlling legal authority."

As for this Texan, I am optimistic there will be less importance placed on the initiatives and policies promoted by the "past" vice president's *Earth in the Balance* philosophy and more emphasis on an effective and rational energy policy for our country.

Michael "Doc" Weathers
Midland, Texas

Michigan Basin's Reef Play

The background of Shell's entry into the northern Michigan Basin Silurian reef play is as interesting to explorationists as is its technical development as recently described by Marlan Downey ("Wildcat Recollections," March 2000 EXPLORER).

The story began with the assignment of Pete Lucas to Shell's Pittsburgh division in 1961 specifically to study the potential of the pre-Devonian strata in the Michigan Basin, where the 100+ million BOE Scipio Field had recently been found and developed in fractured Ordovician Trenton dolomite.

(This account is wholly from memory as Shell's Division exploration manager in both Pittsburgh and Oklahoma City at the time of these events, but I am confident it is correct.)

Using mainly well logs and records plus samples and cores available at the Michigan Geological Survey, Lucas mapped the geologic history and resulting sedimentation of the Michigan Basin pre-Devonian strata. This work indicated that during Silurian Salina time the south flank of the basin, where minor pinnacle reef production already existed, fluctuated somewhat in its position, whereas the non-productive and sparsely explored north flank had been relatively stable.

He postulated that reef development on this flank accordingly might be more pronounced.

To expedite Lucas' studies, area stratigrapher Rex McGehee, and senior geologist Bob Weismann accompanied Lucas to Michigan where they examined all available remaining cores and samples. In a dry hole drilled by Brazos (Dow Chemical), located some 30 to 40 miles southeast of Traverse City, minor reef detritus with good oil shows was noted in the samples and identified as being off reef basinward material.

A potential arcuate trend favorable for reefs about 15 miles in width was defined, extending from Presque Isle County on the northeast to Mason County on the southwest.

In the summer of 1962, a 12-stack downdip seismic line was shot by a Shell R&D crew, starting a few miles southeast of Traverse City and extending through the Brazos dry hole. Ed Hubbard and "Toppy" Topppenberg, geophysicists in the Pittsburgh Division, supervised this work and did the initial interpretation of the results. A possible reef anomaly was indicated lying a few miles up-dip to the north of the Brazos dry hole by the absence of events at the critical level.

During the next two years, Shell did minor additional seismic work but did not lease any acreage.

In 1964, the Pittsburgh division was disbanded and Lucas was reassigned to Shell's R&D in Houston. Geologic supervision of the play remained under district geologist Reed Peterson, assisted by senior geologist John Cochran, who along with Hubbard and Toppenberg were all reassigned to the Oklahoma City division. Shortly thereafter, Amoco drilled a minor Silurian discovery in Presque Isle County whereupon Shell assembled a large crew of lease brokers and acquired over one million acres located essentially along the potential reef trend as initially defined by Lucas' subsurface studies.

One of Shell's initial wildcat reef discoveries as described by Downey was located on the anomaly that had been indicated on the original seismic line.

Paul W. Fairchild
Lakeway, Texas

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Southwest Section Meets in Dallas

"2001 – A Geologic Odyssey" is the theme for this year's Southwest Section's annual meeting, set March 10-13 at Brookhaven College in Dallas.

The meeting will be held in conjunction with the grand opening of the Ellison Miles Geotechnology Institute at the college, named in honor of the AAPG member who made a major donation toward its construction.

The meeting's program features a free short course on "Development Geology, Reservoir Characterization and Reservoir Management."

To register, or for more information, go online to www.southwestsection.org, or www.dgs.org; or contact the Dallas Geological Society at 972-756-1883.

DEG

from page 55

that influence or impact the search for, and recovery of, oil and gas.

✓ Secondly, of the more broad-based environmental issues that are related to our basic mission, the linkage must be demonstrated.

One might envision a pyramid of DEG activities with E&P petroleum environmental geoscience issues at its peak and being supported by a series of second-, third- and fourth-level issues. Such a concept acknowledges and recognizes the important roles of those issues, which, at first glance, may not appear to be in the mainstream of division interests.

Indeed, some part of our efforts could be directed toward examining and transmitting to the AAPG the roles played by ground water modeling, biodegradation of hydrocarbons, subsurface contaminant plume mapping and related activities.

However, there are also many environmental activities that should remain outside our "peripheral" ones, and we must leave these to other disciplines.

* * *

We must do a better job of focusing our division on topics of major interest to our industry, both nationally and internationally.

The United States has policies, practices and protocols with which geoscientists work as they seek fossil energy while also protecting the environment. Many parts of the world that hold substantial potential for giant oil or gas accumulations, however, are in areas where such policies and practices are less well developed.

Because E&P programs are the first ones to be deployed in such regions, it rests largely within our profession to devise the protocols needed to protect sensitive environments and ecosystems.

We can do exemplary environmental work as we conduct E&P activities in arctic tundra, lush rainforests, pristine mountainous terrain and delicate tropical waters. DEG should help lead such efforts.

We look to you, our division membership, as well as all members of the Association to help us be successful. I encourage you to get involved and join with us as we strive to fulfill our mission for AAPG. ❑

THE SOCIETY FOR ORGANIC PETROLOGY (TSOP)

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ANNUAL MEETING ANNOUNCEMENT AND CALL FOR PAPERS

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MEETING PROGRAM

SUNDAY, SEPTEMBER 23: Pre- meeting **short course** on "Biomarkers in Oil-Source Rock and Oil- Oil Characterizations and Correlations". Instructor: Dr. Marcio Rocha Mello

MONDAY- TUESDAY, SEPTEMBER 24- 25: **Oral and poster presentations.** General technical sessions plus special session co-sponsored by Houston Organic Geochemical Society (HOGS) on "Geochemistry of the Deep- Water Gulf of Mexico.

WEDNESDAY, SEPTEMBER 26: **Field trip** to Offshore Drilling Platform Museum, Galveston, Texas.

TSOP PRESENTS A $250 STUDENT PAPER AWARD.

SUBMIT ABSTRACT BY JUNE 1, 2001, TO COLE ROBISON (ADDRESS BELOW). SEE WEBSITE FOR FORMAT AND DETAILS.

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Texaco Group, Inc.
E& P Technology Div.
3901 Briarpark Drive
Houston, TX 77042 USA
Phone: (713) 432-6828
Fax: (713) 838-4628
E-mail: robiscr@texaco.com

VISIT US ON THE INTERNET AT: WWW.TSOP.ORG
Meeting details
Society and membership information
Student Research Grant
(Deadline May 15, 2001)

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The Institute for Energy Research is seeking four new PhD-level geoscientists. IER is an applied research institute with a global portfolio of research and service projects for the oil and gas industry. Service projects include reservoir characterization, petroleum systems analysis, and high-resolution hazards assessments. Active research programs include 3D reservoir modeling, deltaic and turbidite sedimentation, and multidisciplinary issues in enhanced oil recovery.

We seek scientists with industry or academic experience and a publication record. Experience with Landmark software is an advantage. The following specializations are priorities.

1. Seismic stratigraphy. Experience in sequence stratigraphy and sedimentology is required. Skills in subsurface mapping and well log correlation are desirable.
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4. Reservoir characterization. Experience in petrography, reservoir diagenesis, and modeling required. Experience with fission track analysis desirable.

Individuals with skills in closely related sub-disciplines (e.g. basin modeling, geochemistry, and structure) are encouraged to apply.

These are soft money positions. The successful candidates will initially participate in on-going projects and will be strongly encouraged to help establish new research and service projects.

IER is part of the Department of Geology and Geophysics and enjoys strong interaction with faculty, students, and post-docs. We have state-of-the art laboratories in nearly all geoscience sub-disciplines and a complete suite of Landmark software. There are strong links to the Petroleum Engineering and Applied Mathematics programs on campus.

Review of applications will commence on March 30th. However, all positions will remain open until the desired individuals are on board. Salaries are competitive with industry standards.

Please submit applications to:

Dag Nummedal
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BASIN ANALYSIS/EXPLORATION GEOPHYSICS UNIVERSITY OF ALASKA FAIRBANKS

The Geophysical Institute and the Department of Geology and Geophysics at the University of Alaska invite applications for a 12-month (9.75 months research, 2.25 months teaching) tenure-track Assistant or Associate Professor position to begin fall, 2001. We seek a creative scientist with expertise in both quantitative modelling and geophysical exploration methods and research interests in applying these methods to the interpretation of sedimentary basins and mountain belts. A Ph.D. in an appropriate field is required and experience in the interpretation of 2-D and 3-D seismic reflection, gravity, and well data is highly desirable. Teaching responsibilities include undergraduate and graduate courses in exploration geophysics and basin analysis. The successful candidate is expected to develop an externally funded research program, supervise M.S. and Ph.D. students, and collaborate with existing faculty of the Tectonics and Sedimentation research group with interests in structural geology and tectonics, clastic and carbonate stratigraphy and sedimentology, geochronology, and paleomagnetism. An important objective of this position is to help the group expand its research into the subsurface, particularly in Alaska's basins with petroleum potential. Additional opportunities exist to interact with Institute researchers in crustal dynamics, seismology, volcanology, remote sensing, and glacier and sea ice studies. Relevant research facilities include the Arctic Region Supercomputing Center and the Geophysical

See **Classified Ads**, next page

THE DEPARTMENT OF EARTH SCIENCES

DALHOUSIE UNIVERSITY

PETROLEUM GEOLOGIST

Applications are invited for a probationary tenure track position at the assistant professor level. The successful candidate will establish a vigorous externally funded research programme, and will assist in undergraduate and graduate teaching. Workers in all areas of petroleum geoscience are encouraged to apply. The successful candidate will be strongly competitive in original research within the NSERC funding system, as well as able to interact with industry on practical problems in the local area. A Ph.D. is required and post-doctoral experience in academia or industry is expected. In an exceptional case, the appointment may be at a higher level, if experience warrants.

Dalhousie University's Strategic Research Plan gives special emphasis to oil and gas studies. The Department has strong connections to Canada's leading federal marine research institution, the Bedford Institute of Oceanography, and a rapidly expanding local petroleum industry. For more information on the position and the Department you may access http://is.dal.ca/~es/es-home.htm.

Applicants should submit a c.v., a statement of research/teaching objectives, and the name, address, phone number and e-mail of four referees. The deadline for applications is March 27, 2001. Late applications will be considered if the position has not been filled. Applications should be sent to:

Chair, Petroleum Geology Search Committee
Department of Earth Sciences
Dalhousie University
Halifax, NS, Canada, B3H 3J5
Phone: 902-494-2358, Fax 902-494-6889
E-mail: earth.sciences@dal.ca

Dalhousie University is an Employment Equity/Affirmative Action employer. The University encourages applications from qualified women, Aboriginal peoples, racially visible people and persons with a disability. In accordance with Canadian Immigration requirements this advertisement is directed to Canadian citizens and permanent residents.

AAPG Continuing Education — In Conjunction with Annual Meeting

How To Evaluate Carbonate Reservoirs From Well Logs
Instructor: George B. Asquith
Will a reservoir produce hydrocarbons? This is a particularly troublesome question in carbonates because frequently the answer is anything but straight forward. There is a review of carbonate pore types and how changes in pore geometry and hydrocarbon saturation affect resistivity.
• June 2-3
See page 2 for details

Prospect Evaluation "Surgical Theater" and Workshop
Instructors: Peter R. Rose, Gary P. Citron, and Jeffrey Brown
Innovative, "surgical theater" teaching methods utilizing real exploration data distinguish this offering, which is designed for geologists, geophysicists, engineers and managers. Participants will observe and participate as multidisciplinary evaluation teams review and risk several representative prospects from the Rocky Mountains and offshore Gulf of Mexico. • June 2-3
See page 3 for details

Deep-Water Sands, Integrated Stratigraphic Analysis - A Work-shop Using Multiple Data Sets
Instructor: John M. Armentrout
The workshop is organized for geologists and geophysicists with an introductory knowledge of stratigraphy and sedimentation. The two-day hands-on workshop consists of a series of exercises and lectures focused on deep-water deposits of sand-prone facies, most often called turbidite systems. Exercises involve the integration of seismic record section, wireline logs, and biostratigraphic data.
• June 2-3
See page 2 for details

AAPG/SEPM Field Seminar Sequence Stratigraphy Revealed by Cretaceous Outcrops of the Western Interior, Ferron Sandstone, Fall River Formation, and Muddy Sandstone, UT, WY and SD
Leader: Michael H. Gardner
The focus will be on how process geomorphology, sedimentology, stratigraphy, structural geology and tectonics, reservoir characterization, and petroleum geology information are integrated in sequence stratigraphic analysis and clastic reservoir prediction. Particular attention will be placed on comparing alluvial to shelf depositional profiles from both active and passive margins of the Western Interior Cretaceous Seaway. • June 7-14
See page 8 for details

E&P Methods & Technologies: Selection and Application
Instructors: Alistair Brown, Rich Chambers, Dave Hawker, Dave Marschall, Fred Hilterman, Martin Jackson, Gregory F. Kushnir, Jim A. MacKay, Jory Pacht, Bob Pearson, David A. Wavrek. Course Convener & Organizer: E. G. (Skip) Rhodes
This is a broad spectrum course that targets members of integrated teams through middle managers up to and including business unit leaders. Anyone who must design and select exploration and development teams will benefit from this course. The course will have value not only to geoscience professionals, but also to reservoir engineers and managers of all disciplines who supervise oil-finding teams. • June 7-9
See page 3 for details.

An AAPG Geotour

Grand Canyon Geology Via the Colorado River, Arizona
Leaders: John E. Warme, Stephen A. Sonnenberg
This 9-day excursion provides a trip of a lifetime. Participants will encompass 188 miles from Lee's Ferry to Whitmore Wash, studying the Paleozoic Permian to Cambrian and Precambrian formations exposed in the Canyon. Emphasis is on paleoenvironments, bounding unconformities, and overall geological history of the sedimentary formations.
• June 10-18
See page 9 for details

New Hedberg Conference in 2001!

Near-Surface Hydrocarbon Migration: Mechanisms and Seepage Rates

September 16-19, 2001, in Vancouver, BC, Canada

To find out more details or place your name on the invitation list, please check out the conference announcement on our website at www.aapg.org/education/hedberg/vancouver.html or contact Debbi Boonstra in the AAPG Education Dept.

OTHER JUNE EDUCATION OFFERINGS

Utah-Nevada Overthrust Belt and Eastern Great Basin Tectonics
Field Seminar Leader: Robert C. Laudon
For exploration and development geoscientists who want to observe in field exposures the size and complexities of the mega-structure. The leading edge anticlines that contain the vast majority of oil and gas associated with thrust belts of the world will also be examined. • June 18-22
See page 9 for details

Sequence Stratigraphy and Reservoir Distribution in a Modern Carbonate Platform, Bahamas
Field Seminar Leaders: Gregor Eberli, G. Michael Grammer, Paul M. (Mitch) Harris
A core workshop (one-day) is combined with the examination of modern deposits on Great Bahama Bank. Cores and log data from a seven hole transect in the Great Bahama Bank area provide a unique opportunity to assess the sequence stratigraphic distribution of facies in platform carbonates. • June 25-30
See page 6 for details.

Sequence Stratigraphic Influence on Sandstone Reservoir Characteristics of Cretaceous Foreland Basin Deposits
Leader: John C. Horne
This field seminar utilizes concepts of sequence stratigraphy and depositional environmental analysis to characterize siliciclastic reservoir intervals and to depict the compartmentalization of their reservoir flow units. Through outcrop examples and subsurface analogues, this field seminar presents characterizations of the parameters affecting the distributions of siliciclastic reservoir-potential intervals.
• June 24-29
See page 9 for details

For complete details contact:

AAPG Education Department,
P.O. Box 979,
Tulsa, OK 74101-0979 USA
Phone: 918-560-2650
Fax: 918-560-2678

E-Mail: educate@aapg.org

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Requires an advanced degree in the geosciences or a related discipline with 8 years or more post-degree work in your area including at least 5 years successful R&D experience in an oil industry setting. Applicant must demonstrate creative, innovative and original thinking, and be willing to lead and work within teams with diverse education, training and levels of expertise. Advanced knowledge of computer science and programming is highly desirable.

For a detailed description for the above position, please refer to our website www.jobsataramco.com. For consideration, please send a resume to **Aramco Services Company, reference code 06E-EXPLR, in one of the following ways: E-mail: resumes@aramco.com (please cut and paste rather than send an attachment); Fax: (713) 432-4600; Mail P.O. Box 4530, Houston, TX 77210-4530.**

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Technische Universität Berlin

Technische Universität Berlin (TUB) invites applications for the permanent position of

University Professor in Exploration Geology

(Professor C 4)

Reference: FB 9 - Faculty "Civil Engineering and Applied Geosciences"

Advertisement No.: 9-123 (deadline for applications 31.3.2001)

Duties: Teaching and research in exploration geology (development, dynamics and resources of sedimentary basins with special emphasis on hydrocarbons) within the study course "Geoengineering and Applied Geosciences".

Requirements: The successful candidate will be expected to teach the specific concepts and methods of exploration geology as well as basic geological principles. Prerequisites include outstanding knowledge and practical experience in the fields of hydrocarbon exploration, basin modelling, seismic and sequential stratigraphy, regional geology and applied remote sensing.

The successful candidate will also be expected to establish an innovative research program as part of the existing interdisciplinary project "International Geosystem Analysis" including research on "Fossil Groundwater".

A broad spectrum of applied geosciences and related engineering departments at the TUB as well as various other geoscientific institutions in Berlin and Potsdam (Free University, Geoforschungszentrum Potsdam, Potsdam University) offer excellent conditions for successful research. A close cooperation with the jointly established professorship for Organic Geochemistry and Hydrocarbon Systems of TUB and Geoforschungszentrum Potsdam will be expected.

Prerequisites: Applicants must hold a doctorate/PhD in geology and must have an outstanding record in research, excellence in teaching as well as practical experience. Due to the strong emphasis on Applied Geosciences for research and teaching in our department great importance is attached to experiences in related industrial companies. The formal regulations governing this appointment are contained in § 100 BerlHG (Berliner Hochschulgesetz); information will be sent on request.

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Phone: ++49 30 314-72628; e-mail: burkhardt@tu-berlin.de
Internet: Faculty: http://www.mindepos.bg.tu-berlin.de
Study course: http://www.studienbuero.bg.tu-berlin.de

Applicants should send a curriculum vitae, a statement of research perspectives, teaching concepts and references to
Präsident der Technischon Universität Berlin

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Please quote advertisement number: 9-123

TUB is an equal opportunity/affirmative action employer; women are explicitly invited to apply. In case of equal qualification seriously handicapped person will be given preference.

Classified Ads

from previous page

Institute's Geochronology Laboratory and staffed machine and electronic shops.

Please send a UA application, resumé and publication list, statement of research and teaching experience and interests, copies of key publications, and names, addresses, telephone numbers, and e-mail addresses of three references to: Wesley K. Wallace, Chair, Basin Analyst/Exploration Geophysicist Search Committee, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-7320, USA; phone (907) 474-5386, fax -5163, e-mail wallace@gi.alaska.edu. Screening of applications will begin on April 1, 2001, but applications will be accepted until the position is filled. The vacancy announcement is posted at: *http://www.gi.alaska.edu/admin/human_resources/*. Additional information is available on the Geophysical Institute at *http://www.gi.alaska.edu/*, on the Tectonics and Sedimentation research group at *http://www.gi.alaska.edu/TSRG/*, and on the Department of Geology and Geophysics at *http://www.uaf.edu/geology/*.

For purposes of collective bargaining, this position is represented by a union. The successful candidate will be obligated to pay to the union an agency fee as a condition of employment.

The University of Alaska is an equal opportunity/affirmative action employer and educational institution. Your application for employment with the University of Alaska is subject to public disclosure under the Alaska Public Records Act.

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STAFF GEOLOGIST

A Louisiana-based independent oil and gas exploration firm is seeking a new Level II geologist. Qualified applicant must have 3-5 years experience as a petroleum geologist, with a minimum of a B.S. degree in geology or geosciences. Interior Gulf Coast Salt Basin experience is preferred. A good background in well log analysis and familiarity with geophysical methods and application is a plus. Applicant must be able to work in an integrated team environment led by a small staff of experienced explorationists using advanced technology in exploration and evaluation. Responsibilities will primarily be production geology/ property management and associated well site work. Additional responsibilities will include directed area mapping and prospect generation. Salary would be commensurate with experience as a beginning Level II geologist. Excellent benefits are offered. Please fax or send resume and salary history to:

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

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EOE

DIRECTOR'S CORNER

We Are What We Were Back When

Not a lot has changed: It still takes people with energy, imagination and luck to find petroleum.

By RICK FRITZ

In the 1960s my father, like his father before him, became a pumper – so I became a pumper's son. Talk of oil fields was always a part of my life.

Most often the talk was the "nuts and bolts" talk of oil field laborers like my grandfather, great uncles and cousins who also made their living as pumpers, roustabouts and roughnecks.

Recently, I attended an event that took me back to those conversations of my younger days. The Houston Geological Society sponsored a field trip to Beaumont a few days before the official 100th anniversary of Spindletop, and I was fortunate enough to go along with them.

* * *

As a boy I remember hearing about the big discoveries around Tulsa – Glenpool, Burbank and Cushing fields. I also heard stories about the people who found and developed these discoveries.

We lived not far from Bartlesville then, so I especially heard and read a lot stories about the Phillips family.

The discovery of Spindletop marked the start or acceleration of many events in U.S. history:

❒ It was the start of the Liquid Fuel Age.

❒ It was the start of land speculators, wheeler-dealers, roughnecks, pumpers – and petroleum geologists.

❒ It was the real start of the oil business.

Sixteen years later AAPG was founded to provide professionalism and a voice for science and information in the petroleum business.

When I was a teenager, I met my first petroleum geologist out in the oil patch. I was, of course, impressed with his snappy dress and fine automobile. But most of all I was impressed by his ability to "see" beneath the surface and imagine what was down there.

It was at that time that I decided to be a petroleum geologist.

* * *

As I looked around at the attendees to the Spindletop field trip, many reminded me of the explorers who had come before us. Clearly, the spirit of exploration of Patillio Higgins and Captain Lucas is still alive. Except for technology and information, not a lot has changed. It still takes people with energy, imagination and luck to find petroleum.

When I started college in 1970 I was advised *not* to be a petroleum geologist because there was no future in it. I dove in anyway. After my first geology course I was hooked. After I attended my first AAPG convention as a student, I knew I was in the right place.

When Michel T. Halbouty gave his speech at Spindletop last month, he reminded us that this is still an exciting time for our industry – that there is still great opportunity for all of us.

This energy age has been built on the men, women and legends that came before us.

Ours is not a sunset industry. It is clear that our nation, more than ever, needs energy – needs the reserves – that petroleum geoscientists can find.

This is an exciting time for AAPG – and we look forward to the opportunities of the future.

Rick

Core Mission Remains

DEG Has a Focus On Diversity

By MICHAEL "Doc" WEATHERS
DEG President

It is useful for me to pause occasionally and reflect on why I do certain things. In my first eight months as president of the Division of Environmental Geosciences I have done this many times, but have frequently extended the question to include:

"Why is the DEG doing this – and how does it affect our parent organization?"

For me, much of the answer lies in why our division exists.

When I read the major purposes of AAPG, I find an unequivocal coupling of the "e" in *exploration* with the "e" in *environmental*. The wording, *"…exploring for, finding and producing these materials (petroleum) in an economically and environmentally sound manner"* does not leave a lot of latitude for other interpretations.

More detailed (but mutually reinforcing) language is found in our DEG bylaws. The role of the DEG is to serve as the *environmental arm* of AAPG, and this is reflected well in our bylaws.

Our primary purposes involve:

✓ Educating the membership on important environmental matters that affect E&P activities.

✓ Communicating the association's commitment to protecting the environment while responsibly developing resources.

✓ Supporting research on the possible environmental consequences of E&P practices.

These all imply a close relationship between E&P and environmental practices.

* * *

The wide range of interests, philosophical positions and employers of DEG members has occasionally prompted our division to adopt a broader "practical" mission than that described above. This is expected of an organization that seeks to simultaneously align both industrial and environmental interests.

The range of issues that the DEG has pursued over the last few years reflects such diversity. Our division has developed positions and endorsed activities on:

❒ Global warming.

❒ E&P site assessment.

❒ State and federal environmental policies and regulations.

❒ Deforestation.

❒ Coalbed methane.

The range of topics of papers published in our DEG quarterly publication, *Environmental Geosciences*, is even greater. For example, recent issues of our journal have contained studies on ground water modeling, coastal hazards, environmental risk assessment, air quality regulations, soil geochemistry, detection of petroleum in ground water, biodegradation of petroleum and mapping subsurface contaminant plumes.

This level of diversity in DEG activities largely results from the diversity of our membership.

The December 2000 data for membership-by-employer show consultants and independents to be the largest group within DEG, followed by oil companies, environmental firms, government (all levels), service companies and educational institutions.

With such a range of employer expectations, it is reasonable that DEG activities – including topics addressed in *Environmental Geosciences* – be so diverse.

It is interesting to note that the largest category in the December summary was students. Student members account for nearly 25 percent of our DEG membership, and an overwhelming majority of these students in the recent past have been international.

* * *

An examination of what DEG has done over the last few years suggests that we are covering a broad waterfront, and attaching importance to a wide range of activities. This presents both a potential problem and a potential opportunity.

The problem aspect results from what may be perceived as a dilution of our organizational energies and efforts to the extent that we suffer an identity crisis. A logical extension of this notion is that we have strayed from our fundamental mission and have become an organization attempting to address all environmental issues for all geoscientists.

However, I am also drawn to the potential for opportunity. I think there is a path forward that allows us to exploit our diverse membership while maintaining the primary focus of our division to pursue our original charter – and emerge as THE internationally recognized organization that specifically addresses environmental issues related to exploration and production activities.

I believe that we can adhere to our original AAPG mandate and adopt the added responsibility of demonstrating how some of the "peripheral" aspects of environmental geoscience support the DEG mission.

Coastal geohazards, for example, might be seen as a major departure from our mission. However, beach stability, coastal flooding and accelerated increases in sea level are often identified as second- or third-order consequences of a phenomena that DEG is currently addressing, namely global warming.

The popular party line on these issues involves an assumption that the industrial revolution, powered by fossil energy, has yielded increased levels of greenhouse gases. These have created increased global temperatures that, in turn, are responsible for increases in sea level.

The DEG has been one of the major forces working to demonstrate that temperature variations of the last 150 years are somewhat trivial when compared to those that have occurred through geologic time.

* * *

Perhaps, then, our challenge is two-fold:

✓ First and foremost, we must remain focused on those environmental issues

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