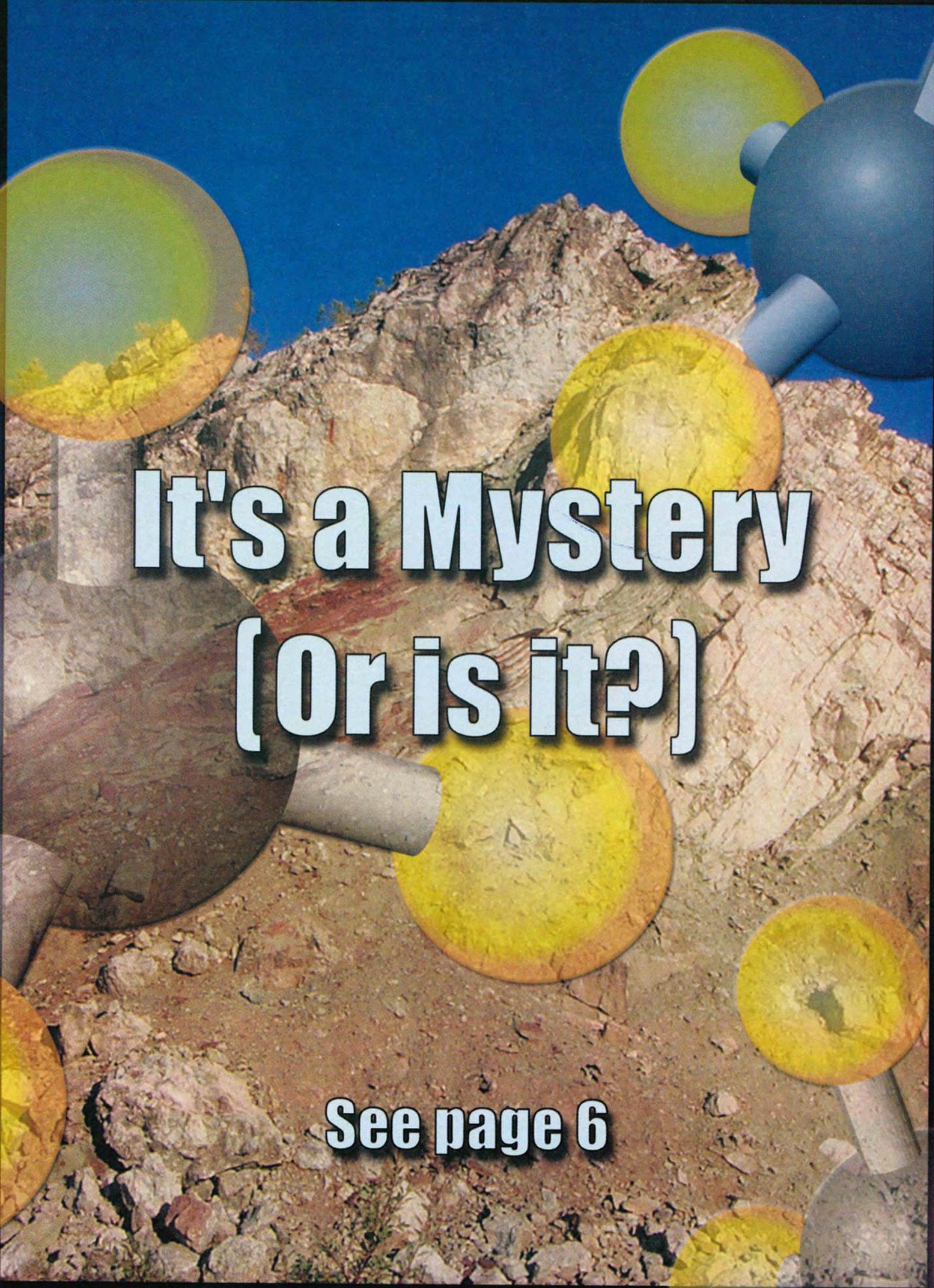


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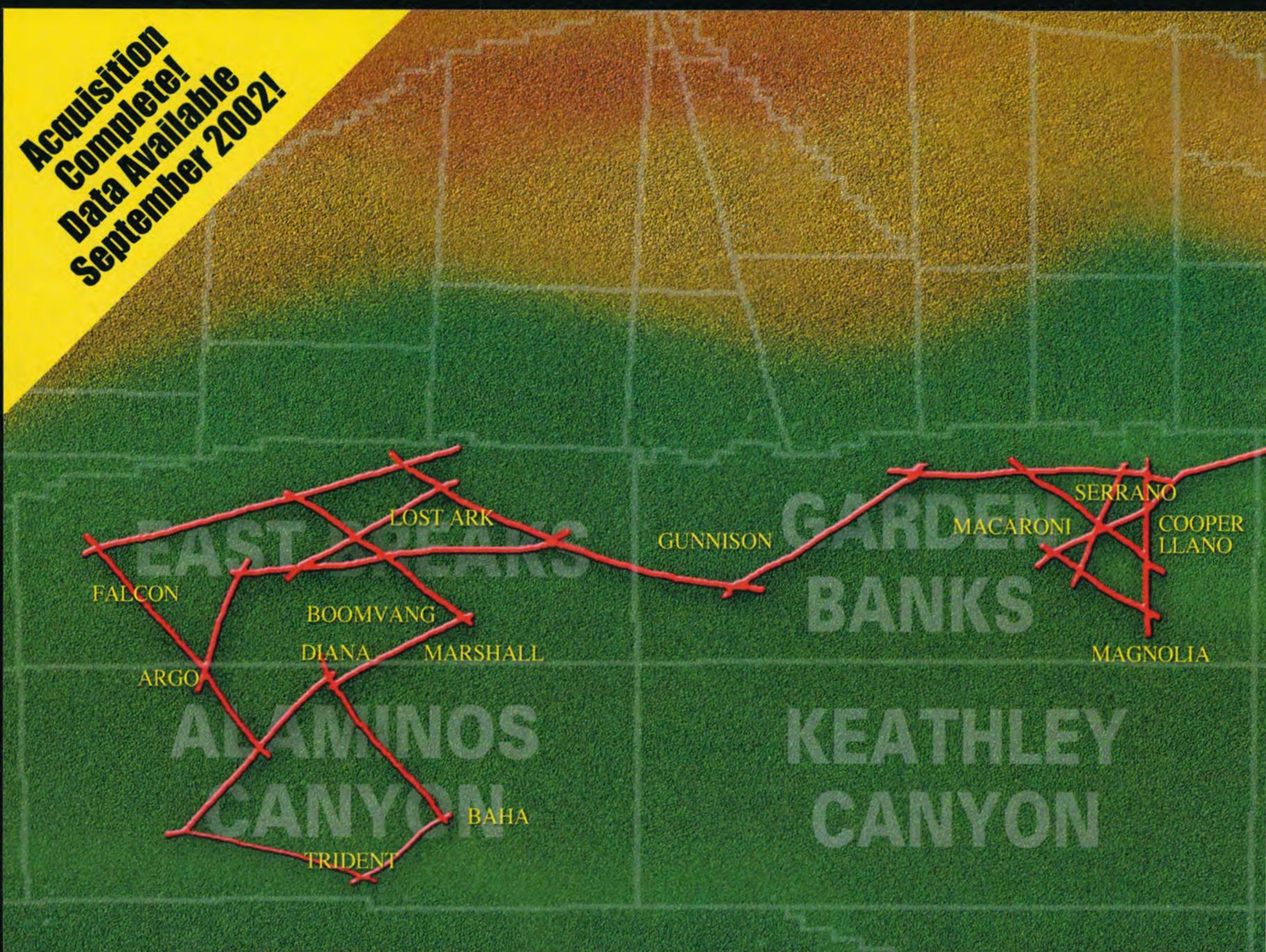


It's a Mystery (Or is it?)

See page 6

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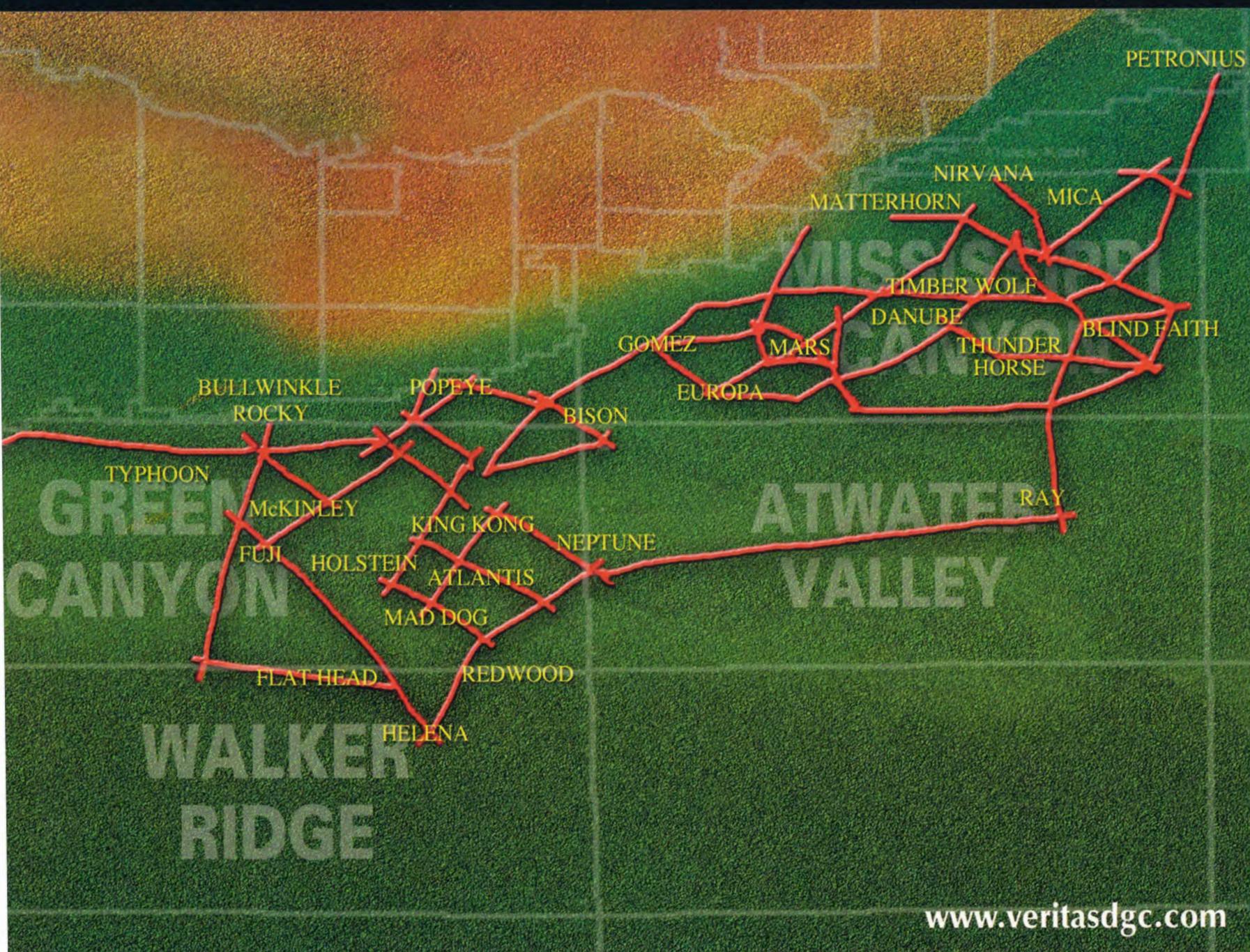


Long-Offset Deepwater Well Tie

Veritas Marine Surveys adds to its extensive deepwater Gulf of Mexico library with a long-offset 2D well-tie survey. This program consists of over 5350 full-fold 2D kilometers in four distinct geographic areas. The Long-Offset Deepwater Well Tie program will deliver 10,000-meter offsets for the first time in the deepwater Gulf of Mexico. Lines will be extended 10 kilometers past the wells to provide full fold data a minimum of five kilometers on each side of the wells. Over 100 wells will be tied in this survey.

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On the cover: A debate that has blown hot and cold over the past several years is about to get hot again. The subject is whether the origin of hydrocarbons is organic or abiogenic, and an AAPG Hedberg Conference set next June in London, England, may go far in providing some answers. Story on page 6. Cover photo, by Ilka von Dalwigk, shows a limestone outcrop that is part of the down-faulted Paleozoic sequence within the Siljan Ring impact structure in Sweden – an important site in the ongoing debate. The cover design is by Rusty Johnson.

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STAFF

AAPG Headquarters – 1-800-364-2274 (U.S. & Canada only), others 1-918-584-2555

Communications Director
Larry Nation
e-mail: lnation@aapg.org

Managing Editor
Vern Stefanic
e-mail: vstefan@aapg.org

Editorial Assistant
Susie Moore
e-mail: smoore@aapg.org

Correspondents
David Brown
Susan Eaton
Kathy Shirley

Graphics/Production
Rusty Johnson
e-mail: rjohnson@aapg.org

Advertising Coordinator
Brenda Merideth
P.O. Box 979
Tulsa, Okla. 74101
telephone: (918) 560-2647
(U.S. and Canada only:
1-800-288-7636)
(Note: The above number is for
advertising purposes only.)
fax: (918) 560-2636
e-mail: bmer@aapg.org

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PRESIDENT'S COLUMN

Portfolio of Benefits Just Part of Success

BY DAN L. SMITH

I have been an active petroleum explorationist for 44 years. I attribute this to one primary reason – my active membership in AAPG for the same length of time. (My personal testimony.)

* * *

AAPG is an association of individuals who voluntarily come together to solve common problems, meet common needs and accomplish common goals. We are unique in that members are the owners, customers and work force – all at once.

Members don't do anything that they don't want to do, and volunteer only if they see that they will gain value and personally benefit from the services and products delivered.

Membership is built and retained through perceived personal benefits. In reality, it is not just the products and services that are the keys to AAPG's success. It is the benefits that are derived by taking advantage of these.

We must define what constitutes value and ensure that value is delivered. Leaders must articulate these benefits and provide a constant stream of information to the membership. Good leadership comes from the middle, not from the top.

AAPG offers an incredible suite of products and services, and they are growing rapidly in response to stakeholders' needs (the value proposition).

Realization of the benefits leads to only one conclusion, which I mention frequently – that to maximize your success as a geoscientist, you cannot afford to be without AAPG involvement.



Here are keys to AAPG's sustaining success:

- Maintain a reputation for value by offering a portfolio of services and products that are continually created, marketed, delivered, managed and evaluated.
- Create an enjoyable culture based on trust and high communication. Member experience must be rewarding.
- Have a flexible infrastructure that allows the association to quickly seize opportunities to create value. This requires a rational, open and less political organization.

Do these things, and my theme of "Value, Value, Value" will have meaning.

Dan L. Smith

Barcelona Deadline Draws Closer

For those who want to present a paper or poster at the AAPG international meeting in Barcelona, Spain, now is the time to get serious about your effort.

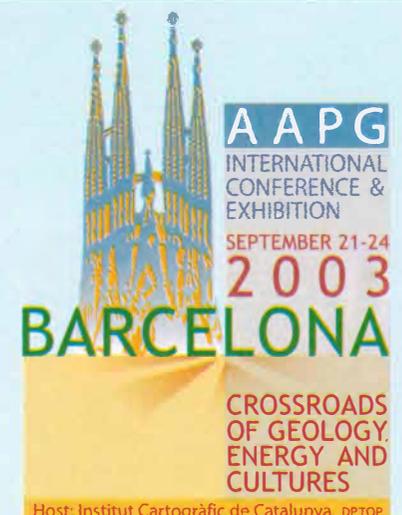
The abstract deadline for the 2003 Barcelona meeting is Dec. 12.

"Crossroads of Geology, Energy and Cultures" is the theme for the international conference and exhibition, which will be held Sept. 21-24. Hosts are the Institut Cartografic de Catalunya. The general chairman is Jorge/Jordi Ferrer, Exxon Annuitant, Barcelona.

Planning committee members hope to provide a technical program of 350-400 presentations over the three days, covering a range of issues relevant to petroleum professionals all over the world.

The main technical themes are:

- Crossroads of Regional Geology.
- Crossroads of Field Geology.
- Crossroads of Business and Energy Transport.



- Crossroads of Technology.
- Other Technical Topics (student poster session).

Speakers will have 30 minutes for their talks, including time for questions. Poster sessions will use an "informal presentation format," with electrical outlets available for those who want to include a computer- or video-based presentation.

For more information, refer to the Barcelona meeting insert at page 42 in the October EXPLORER, or go online to the AAPG Web site at www.aapg.org/meetings/. Abstracts are being accepted via the site.

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*Hedberg to Get to the Nub of the Matter***Gas Origin Theories to be Studied**

By DAVID BROWN
EXPLORER Correspondent

The debate about cooking up hydrocarbons keeps getting hotter.

Some scientists insist that all petroleum comes from abiogenic processes, with hydrocarbon development occurring in the Earth's mantle.

Most geochemists and petroleum geologists remain convinced that crude oil and natural gas have organic origins.

Look for this dispute to intensify in 2003, with new heat coming from an unexpected venue. In June, AAPG's typically sleepy Hedberg Conference could be the spark that sets off scientific fireworks.

Hedberg conferences address topics proposed by AAPG's Research Committee. They take place in informal settings, with attendance limited to 80-100 persons.

On June 9-12, however, a Hedberg Conference will be held in London with the theme "Origin of Petroleum – Biogenic and/or Abiogenic and Its Significance in Hydrocarbon Exploration and Production."

"The timing is right," said Barry Katz, a ChevronTexaco Fellow in Houston and a member of the conference's program committee. "Historically, what has been the big issue is that there's essentially a Western and an Eastern school of thought.

"On the Western side, we've gone through what you've typically done in the scientific method," he noted. "The Russian arguments have been just that, arguments. We have yet to get them in a room to see what they have on the table."

Katz said he hopes the leading theorists from both sides will attend, so "we can have a balanced view and get everybody to talk to each other. That's what the Hedberg conferences are all about."

Is It Commercial?

An explorationist might dismiss the entire controversy over petroleum origination, except for two key points:

□ Theorists of abiogenic petroleum tend to see hydrocarbons as not just abundant but super-abundant, with no possibility of constrained supply.

□ Petroleum generated by abiogenic processes could occur anywhere, so exploration need not be limited to sedimentary basins, or to depths of only a few miles.

Modern theory directly links petroleum origination to organic detritus, according to Michael Lewan, a research geochemist for the U.S. Geological Survey in Denver.

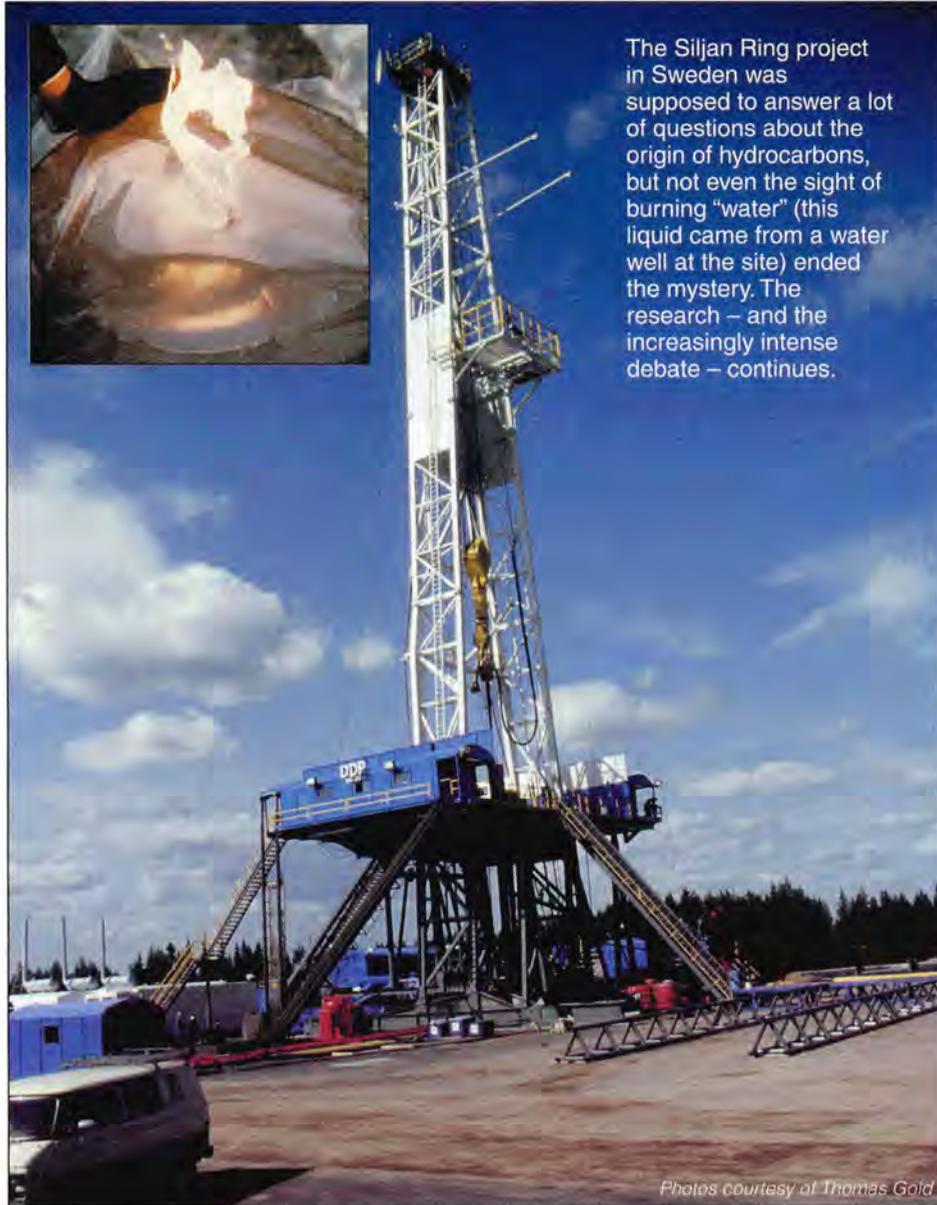
"The modern, organic theory of the origin of petroleum states that a portion of the lipid fraction of micro-organisms deposited in anaerobic sediments is the original source of petroleum," he said.

Proteins and carbohydrates make up 85-95 percent of the weight of these micro-organisms, and are rapidly degraded by microbial activity, Lewan said.

The remaining 5-15 percent can be preserved in anaerobic sediments, representing "unique depositional conditions that result in organic-rich, sedimentary-rock intervals in some stratigraphic sequences," he explained.

Lipid material preserved in the original sediments polymerizes into kerogen, an insoluble organic material, Lewan said.

"As these organic-rich rock intervals are heated with burial in sedimentary basins, the hydrocarbon polymers within the kerogen thermally crack through a free-radical mechanism to yield liquid and



The Siljan Ring project in Sweden was supposed to answer a lot of questions about the origin of hydrocarbons, but not even the sight of burning "water" (this liquid came from a water well at the site) ended the mystery. The research – and the increasingly intense debate – continues.

Photos courtesy of Thomas Gold

gaseous petroleum hydrocarbons," he said.

Research in the lab and in the field demonstrates that petroleum development can and does take place in the earth's crust, he stated.

"I feel we've done a very good job of simulating production of petroleum in the laboratory," Lewan said. "Between the lab work and the fieldwork, we've put together a very good picture."

Although hydrocarbons can be produced from inorganic sources, a 1993 study based on helium isotopes found that abiogenic hydrocarbons account for less than 200 parts per million of cumulative global production to date, Lewan said.

"Is it so diffuse that it never really accumulates? Is it focused in certain areas where it can be accumulated?" he asked.

"I don't think anybody has ever doubted that there is an inorganic source of hydrocarbons. The key question is, 'Do they exist in commercial quantities?'"

The AAPG Hedberg Conference on the "Origin of Petroleum – Biogenic and/or Abiogenic and its Significance in Hydrocarbon Exploration and Production," will be held June 9-12 at the Institute of Petroleum in London.

Organizers said the conference is designed to provide an opportunity to present the hypotheses, evidence and data for an organic origin of petroleum and for an abiogenic origin of petroleum through oral and poster sessions, with ample time for discussion and debate.

Day 1 will deal with the origin question. The significance of each

From Russia, With Love

Various other theories oppose the organic-origin explanation. The principal counter-theory is often called the abyssal, abiotic Russian-Ukrainian theory of petroleum.

In 1951, a group of Russian scientists issued a challenge to the theory of organic petroleum origination. They claimed that hydrocarbons are produced from inorganic materials, at upper-mantle to lower-crust depths.

New controversy over that proposal resulted from a paper published in August 2002 in the Proceedings of the National Academy of Sciences (U.S.), "The evolution of multi-component systems at high pressures: IV. The thermodynamic stability of the hydrogen-carbon system: The genesis of hydrocarbons and the origin of petroleum."

This paper, written by J.F. Kenney of Gas Resources Corp. in Houston and

through case study exploration strategies using both models will be the focus of Day 2, and Day 3 will deal with petroleum migration under both origin scenarios.

Organizers are Michel T. Halbouty, of Halbouty Energy; Peter Odell, Erasmus University; Brian Abbott, Institute of Petroleum; Barry Katz, ChevronTexaco; and Ernest A. Mancini, University of Alabama.

For further information see the AAPG Web site or contact Debby Boonstra at the AAPG education department.

three Russian co-authors, rejects the proposal that petroleum can derive from "highly oxidized biotic molecules of low chemical potential."

Drawing on scaled particle theory and simplified perturbed hard-chain theory, Kenney et al. present an evaluation of the chemical potentials and related thermodynamic affinities for n-alkanes. They conclude:

"The H-C system does not spontaneously evolve heavy hydrocarbons at pressures less than about 30 kbar, even in the most favorable thermodynamic environment. The H-C system evolves hydrocarbons under pressures found in the mantle of the Earth and at temperatures consistent with that environment."

They also briefly describe the experimental production of petroleum hydrocarbons using only wetted marble (CaCO₃) and solid iron oxide (FeO), in an apparatus allowing investigation at pressures up to 50 kbar and temperatures up to 1,500° Celsius.

Kenney said there is no real debate about petroleum origination.

"There has not been any 'debate' about the origin of hydrocarbons for over a century," he stated. "Competent physicists, chemists, chemical engineers and men knowledgeable of thermodynamics have known that natural petroleum does not evolve from biological material since the last quarter of the 19th century."

In their paper, Kenny et al. contrast the H-C system with the H-C-O system, "which manifests consistently decreasing chemical potentials with increasing polymerization."

They then discuss reactions involving C₆H₁₂O₆, or glucose, as a "typical biotic reagent." In response, Lewan noted that neither carbohydrates nor proteins are now thought to have a part in petroleum formation.

"Significant scientific advances over the last 40 years have tested, modified and refined the organic theory for petroleum formation in the Earth's crust," Lewan said.

"It is unfortunate that Kenney et al. have chosen to ignore these efforts of other competent scientists, and elevate their inorganic theory on the misconception that the organic theory is based on carbohydrates being the source of petroleum."

The Golden Touch

No one in the United States has been more associated with the theory of abiogenic petroleum than Thomas Gold, a professor of astronomy at Cornell University, now retired.

"The only real opponents to this story (of abiogenic origin) are in Western Europe and in the United States, and they are the professional petroleum geologists," he said.

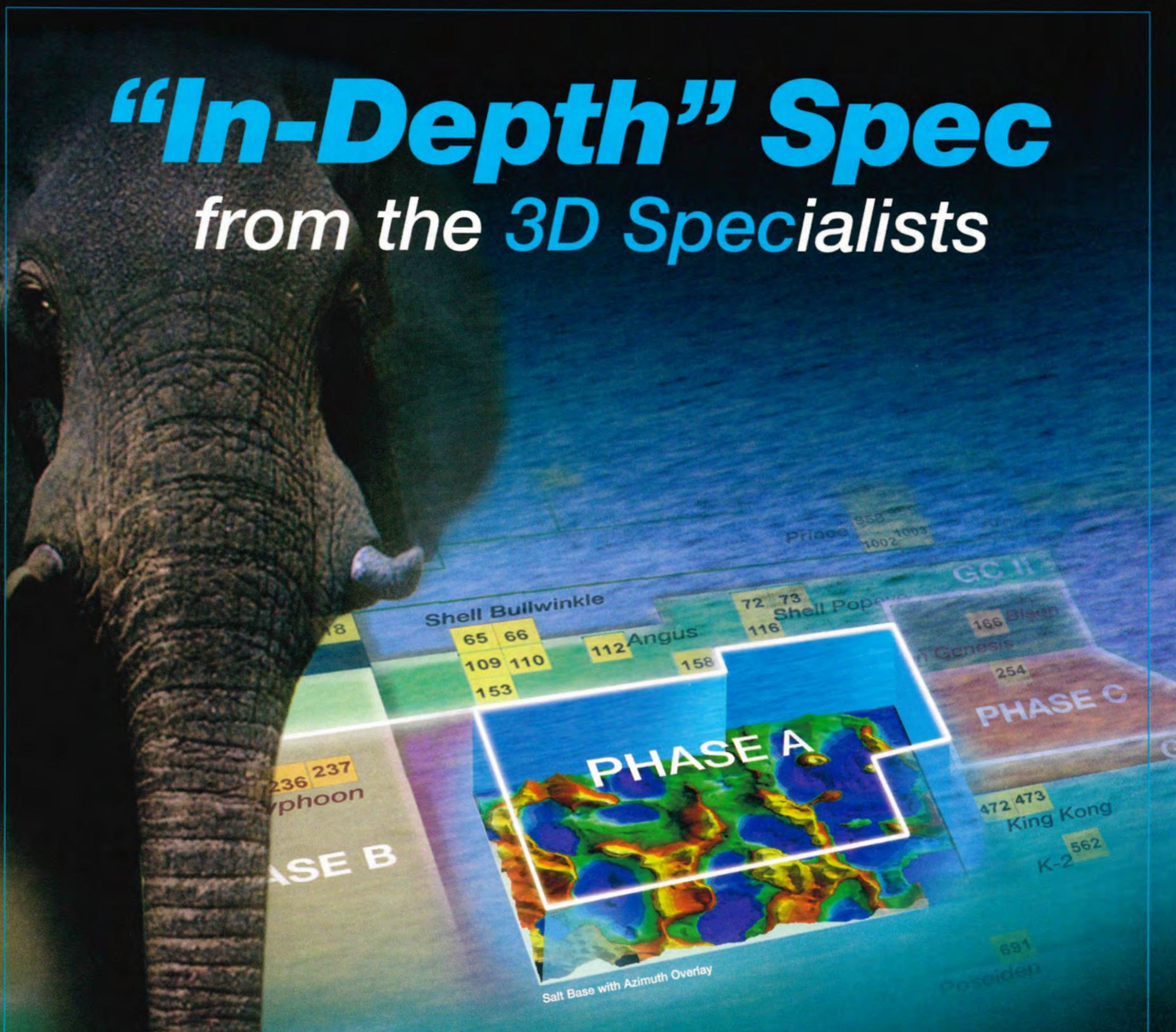
"The subject of organic chemistry was wrongly taken by petroleum geologists long ago to mean chemistry of biologic origins. You can still have a book of organic chemistry that has nothing to do with organisms at all."

Gold most recently explained his theories of the origin of petroleum in his 1999 book *The Deep Hot Biosphere*, which presents the view that life on Earth exists to a depth of many miles.

That helps him explain the apparent organic constituents of petroleum. In

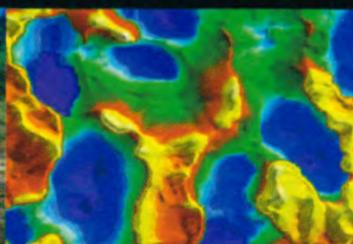
See **Gas**, page 10

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Emerald's 3-D "Density Cube™" Technology...

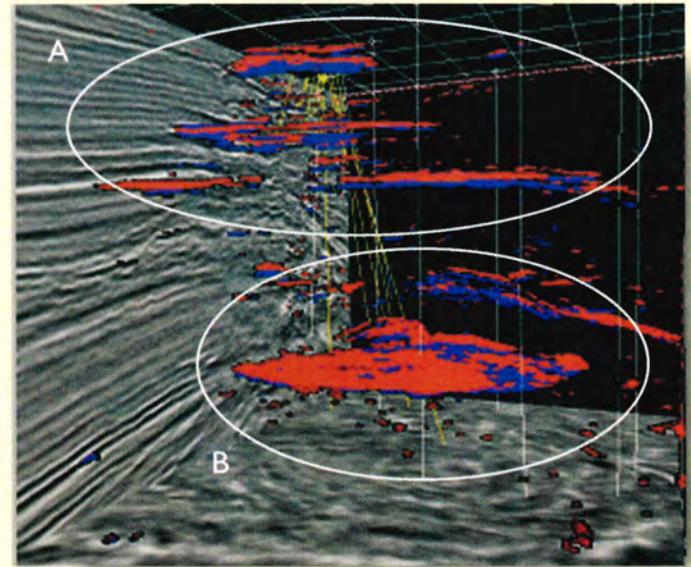
Q. The circled reservoir groups of **field example I** labeled **A** and **B** have been producing over the last 8 years. From the conventional 3-D amplitude and AVO response maps, can you determine which reservoirs have been drained adequately and which contain "bypassed" hydrocarbons?

A. No, unless you possess Emerald's 3-D "Density Cube™" technology!

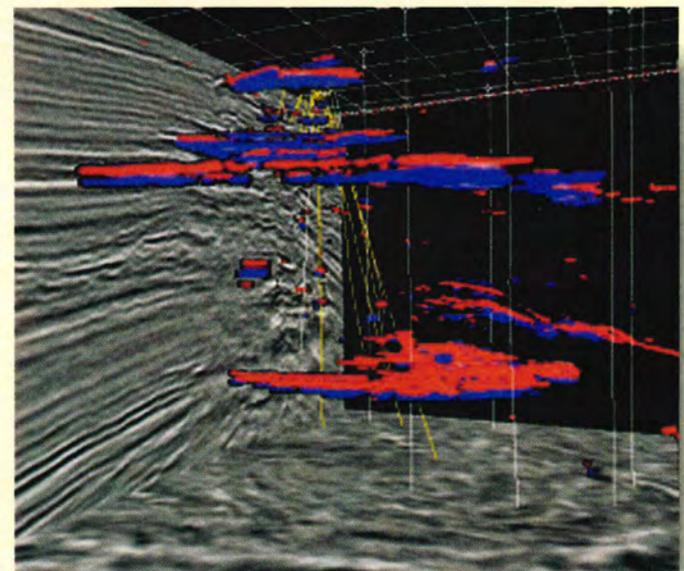
Notice on the 3-D "Density Cube™" example that reservoir group **A** has been completely drained. Also, within reservoir group **B** lies several "bypassed" pay features (and a potential new revenue stream) that has been missed by present production efforts.

Compare how the conventional "state-of-the-shelf" 3-D Amplitude and AVO examples cannot discriminate and/or identify areas of "bypassed" pay. However, Emerald's "Density Cube™" technology does highlight the bypassed pay and can be used for further exploitation of this field.

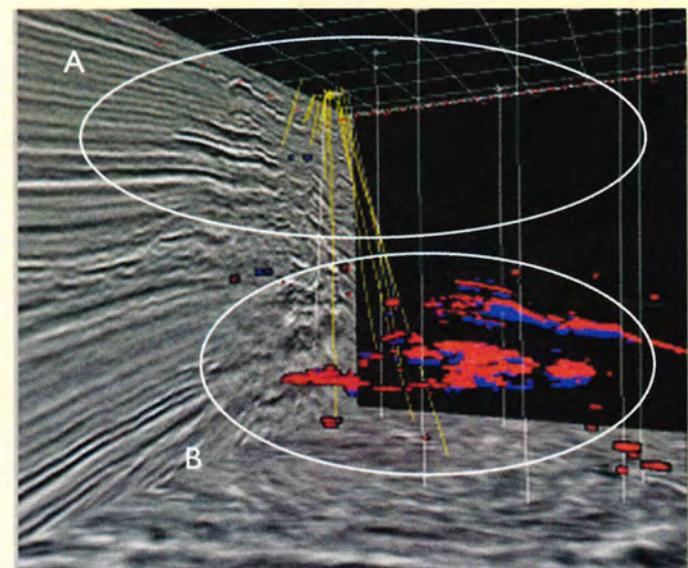
Field Example I



3-D Amplitude



3-D AVO



3-D Density Cube™

Data input to analysis courtesy of PGS

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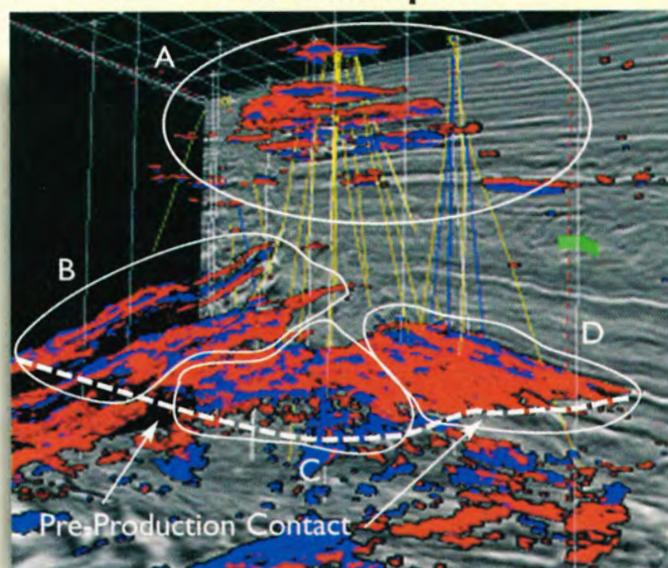
Q. The circled reservoir groups of **field example 2** are labeled **A, B, C** and **D**. Can conventional 3-D Amplitude and AVO maps be used for **Reservoir Monitoring**?

A. **No**, (here we go again), but Emerald's 3-D "**Density Cube™**" technology can ... and quickly!

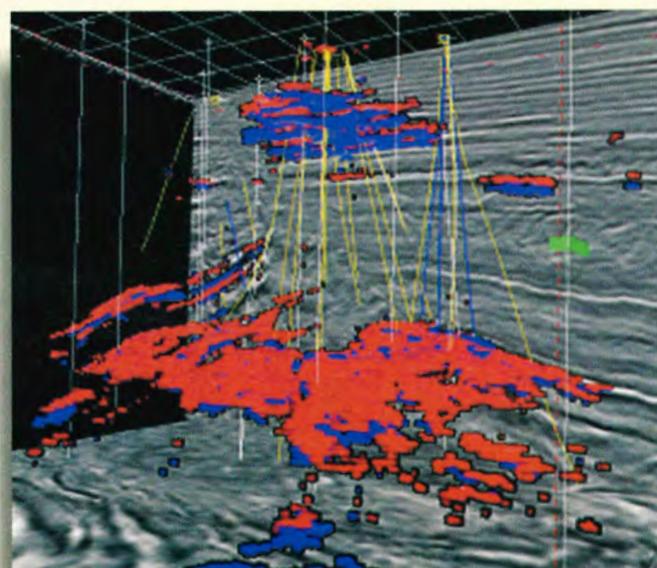
Notice how on the 3-D "**Density Cube™**" example, reservoirs **A** and **B** have been adequately drained. Reservoir **C** identifies an **excellent farm-in opportunity** having not been drained by any nearby wells, as evidenced by the non-movement of the gas/water contact. Also notice how reservoir **D** illuminates the **current gas/water contact** (dotted line) after 8 years of production. Compare how the gas/water contact has moved up dip since production started. (This is an excellent example of **Applied Reservoir Monitoring**.) Neither the farm-in opportunity nor the gas/water contact observations are apparent on the conventional analyses.

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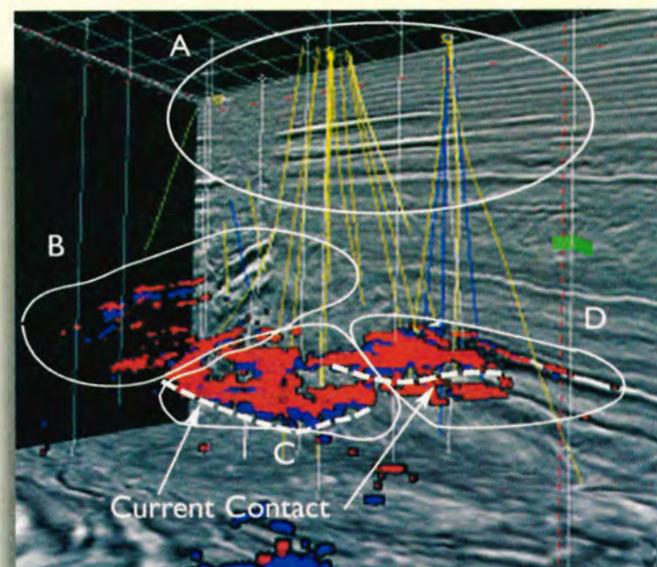
Field Example 2



3-D Amplitude



3-D AVO



3-D Density Cube™

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Gas

from page 6

Gold's view, hydrocarbons form at a depth of 100 to 300 kilometers and take on some organic attributes as they migrate upward.

"Oil is a very good nutrient for microbiology. In 1972, I began to realize that the oil had soaked up biological molecules that the petroleum itself had fed," he said.

Migration also explains another commonly offered piece of evidence for organic petroleum, depletion of the carbon ¹³C isotope, according to Gold.

Photosynthesis and other organic activity favor the stable ¹²C isotope over the stable ¹³C isotope. The resulting ¹³C deficiency is taken as an indicator of organic processes.

Petroleum shows the ¹³C depletion to

an even greater degree than its supposed organic source matter, but in a ratio similar to that of the lipid fractions of those organisms.

Gold theorizes that carbon-bearing molecules diffusing through a porous mass, in any process, results in fractionation that favors the lighter ¹³C isotope.

"Biology is not a nuclear reactor. It can't make carbon-13 or carbon-12. But it's treated in the literature that the ¹²C-¹³C preference is strictly a plant matter," Gold said. "It's quite clear that there is an isotopic fractionation occurring in the migration path."

More evidence of upward hydrocarbon migration from great depth comes from the prevalent occurrence of helium with petroleum, Gold said.

"We have two conflicting pieces of evidence. Petroleum contains helium, which the plants cannot have

concentrated," he said. "Petroleum also contains purely biological molecules, which petroleum-fed biology deep in the ground could concentrate.

"This (upward migration from great depth) is the only explanation I've ever heard of to account for the amount of helium brought up with petroleum."

Petroleum explorationists have good reason to care about the true origin of hydrocarbons, Gold noted.

"For one thing, they always avoid drilling into the basement rock," he said. "They've probably avoided drilling into a large amount of very productive rock."

Also, in Gold's theory hydrocarbons continue to well up from the mantle. He believes depleted petroleum reservoirs are refilling, all over the world.

Seeing Is Believing?

A new perspective on isotopic analysis

of abiogenic hydrocarbons appeared in a letter to *Nature* magazine in April 2002, "Abiogenic formation of alkanes in the Earth's crust as a minor source for global hydrocarbon reservoirs."

Barbara Sherwood Lollar and four co-authors from the Stable Isotope Laboratory at the University of Toronto reported their analysis of gas from the Kidd Creek mine in Ontario, typical of hard rock mines operating throughout the Canadian Shield.

"These gases had been known historically in the mines for a very long period, up to 100 years, but nobody had investigated them until the 1980s. In Precambrian rock, it's not intuitively obvious where these hydrocarbons come from," said Sherwood Lollar, a professor of geology at the university.

According to the authors, the Kidd Creek gases were composed of methane, ethane, H₂ and N₂, with minor concentrations of helium, propane and butane.

"We knew that these were unusual in composition. They don't look like thermogenic. They don't look like microbial," Sherwood Lollar said.

An unusual pattern of $\delta^{13}\text{C}$ values among C₁-C₄ alkanes provided evidence of abiogenic formation. Additional support came from study of $\delta^2\text{H}$ values.

"The inverse relationship of ¹³C isotope depletion and ²H isotope enrichment between C₁ and C₂ for the Kidd Creek samples supports a polymerization reaction as the first step in the creation" of higher hydrocarbons, the authors concluded.

Because the isotopic signature differed markedly from that of thermogenic or bacteriogenic hydrocarbons, Sherwood Lollar theorized an origin in water-rock interactions.

"The gases are found intimately associated with these saline groundwaters and brines, with up to 10 times the saline content of oceans," she said.

Identification of the ¹³C-²H inverse relationship in abiogenic gas allowed comparison with isotopic ratios in commercial gas reservoirs. The study found no meaningful presence of abiogenic hydrocarbons in commercial natural gas production.

"Based on the isotopic characteristics of abiogenic gases identified in this study, the ubiquitous positive correlation of $\delta^{13}\text{C}$ and $\delta^2\text{H}$ values for C₁-C₄ hydrocarbons in economic reservoirs worldwide is not consistent with any significant contribution from abiogenic gas," the authors said.

"The key point is that abiogenic hydrocarbons have been talked about for a long time, but until now we didn't have a very good constraint on what they looked like," Sherwood Lollar observed.

Katz said Western science recognizes that abiogenic hydrocarbons can result from natural processes, including the possibility of hydrocarbons originating at great depth.

"I don't think anybody's arguing that gas couldn't be generated from the mantle," he said.

However, even the Russian scientists he has worked with accept the organic origin of petroleum found in large, commercial accumulations.

"I've worked with geochemists and basin modelers at what was the Soviet Union's Institute for Foreign Geologic Studies. They were working with the same concepts we were," he said.

If abiogenic petroleum exists in amounts large enough for economic production, he hopes details of the science involved will be presented at the London Hedberg.

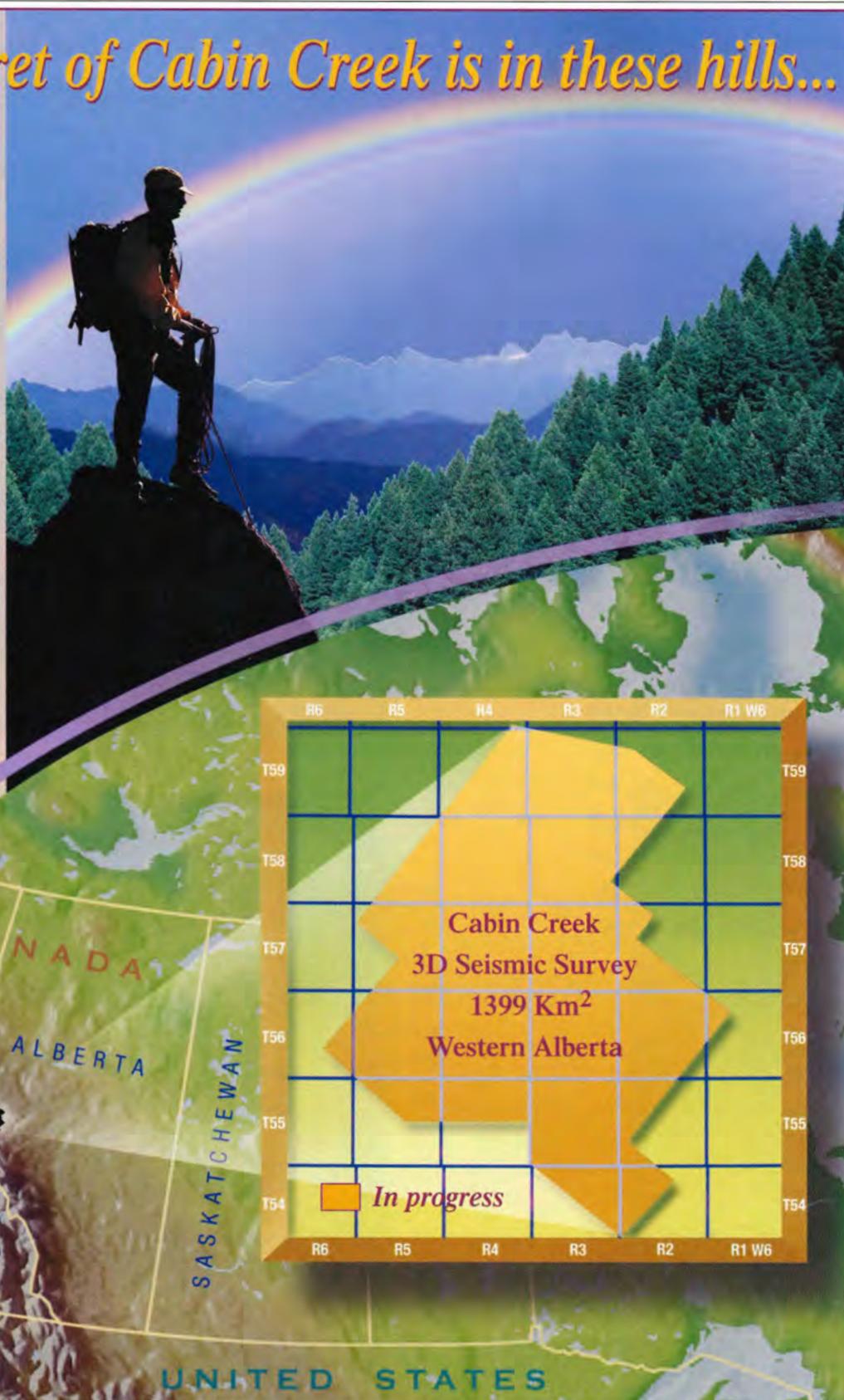
"I have yet to have anyone show me that there are commercial quantities of these hydrocarbons," Katz said.

"I'm a scientist, so I have to keep an open mind. But I need to see some evidence." □

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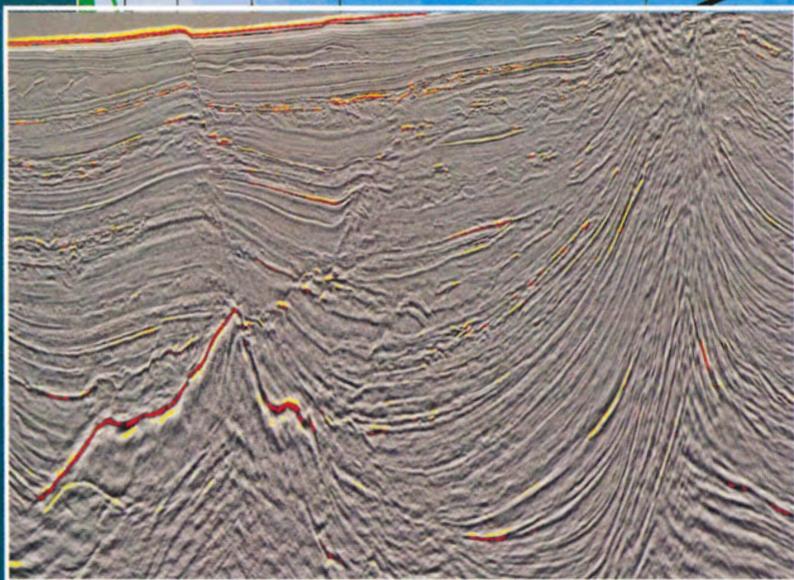
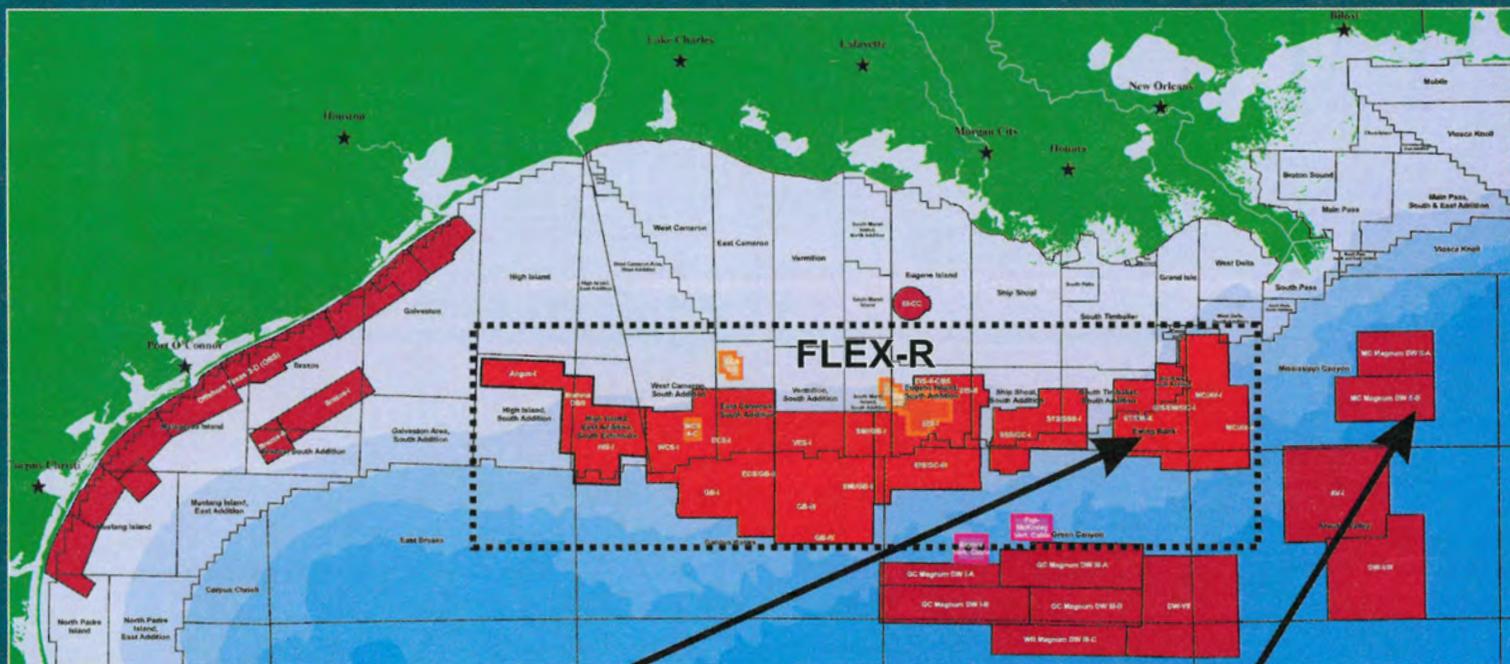
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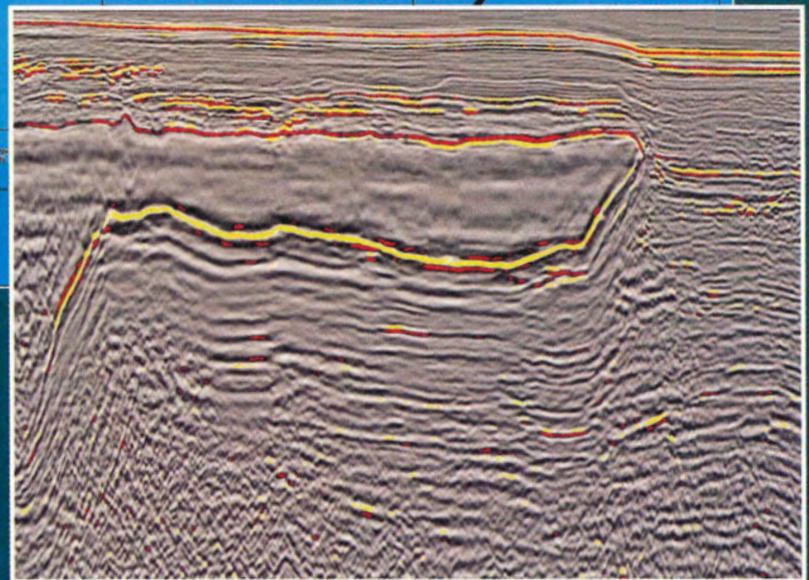
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Session Suggestions Sought for Dallas

The AAPG annual meeting in Salt Lake City is next on the association's meeting calendar, but for many it's time to start thinking about the 2004 meeting in Dallas, too.

Specifically, it's time for you to share your ideas about potential technical sessions.

Preliminary planning for the 2004 meeting already is under way. The session will be held April 18-21 in Dallas, with theme "Embrace the Future - Celebrate the Past."

The AAPG technical program committee, headed by Janok Bhattacharya (janokb@utdallas.edu) is seeking member input regarding technical sessions.

Do you have ideas about what hot new

plays and technological breakthroughs will lead our future successes both domestically and internationally?

What session themes will allow us to best reflect on reasons for our past exploration and reservoir production successes (and even failures)?

What new environmental issues are we likely to face? How do we foster high ethical standards?

How can AAPG provide better outreach in K-12, as well as providing stronger opportunities and encouragement for the next generation of petroleum geologists that we will need through our universities and colleges?

Ideas should be sent by Dec. 15 to janokb@utdallas.edu, to be considered by the technical program committee. □

Prizes Up for Grabs

How to Recruit a Member? Just Ask

By LARRY NATION

AAPG Communications Director

Chatting with a couple of new members of AAPG makes it apparent what it takes to "persuade" a colleague to join AAPG.

And what does it take? Not much.

For instance, Mary Purcell, of Williams Production in Colorado, signed up at the recent Rocky Mountain Section meeting in Laramie, Wyo.

Why?

"Because I should have years ago," Purcell said. "They had a sign-up booth and it was very convenient and easy. It was there, I had the time and I just did it."

Then there's William J. Thompson, of the Texas Railroad Commission in Corpus Christi, Texas, who had been reading the EXPLORER and BULLETIN passed along from co-workers, all the while intending to join AAPG after he served the three years in the profession required to join as an Active member. However, with "a little urging" from a supervisor, he signed up as an Associate member and will upgrade to Active in about a year.

A recent geology graduate of Texas A&M Corpus Christi, Thompson is working in environmental geology with the TRC.

So, with a word here and an invitation there, AAPG's ranks are joined by fellow colleagues. Members are finding out it is easy to recruit for AAPG.

And keep in mind that with AAPG's Membership Enhancement Development Program, a member who recruits a new member will "get stuff," which includes a desk flag for everyone who recruits one new member, and special lapel pins for those who recruit three or more.

Prizes also will be provided at each meeting through a drawing of those who sign up a new member. The goal is to gain 1,000 net new members.

The top recruiter will receive a travel voucher, four nights lodging and registration fees for the 2003 AAPG international meeting in Barcelona, Spain. This Grand Prize winner will be announced in May at the AAPG Annual Meeting in Salt Lake City.

That's good news, because there is plenty of time to bring in new members - and maybe win the trip to Barcelona.

As of press time, there were three members who had brought in two new members each - and they were tied for the lead toward the Grand Prize. Consequently, the Grand Prize is very much up for grabs.

Recruiting kits, which contain a list of member benefits, contest information, a "recruiter button" and, most importantly, new member applications, are available by contacting AAPG at 1(800) 364-AAPG (In U.S. and Canada); or by e-mail to driggs@aapg.org.

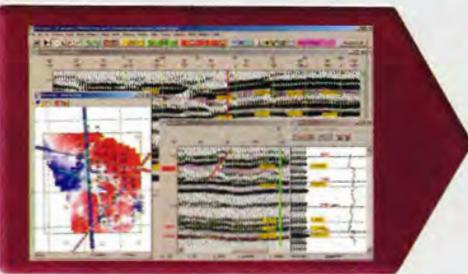
Also, recruiter kits, member applications and contest rules and information all are available on the AAPG Web site at www.aapg.org.

Keep in mind that recruiting members is not a hard job - usually it's just a matter of asking "Are you a member of AAPG? No? Well, let me show you how to join."

"It's time to join, you know." □

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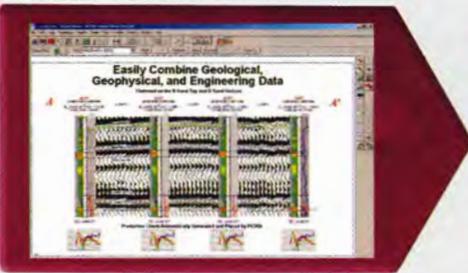
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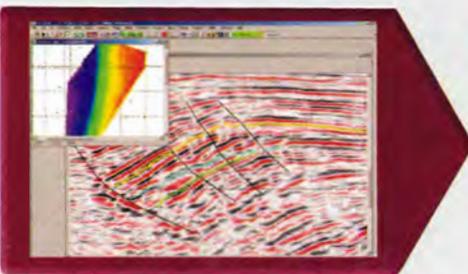
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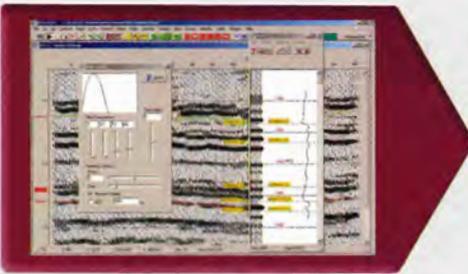
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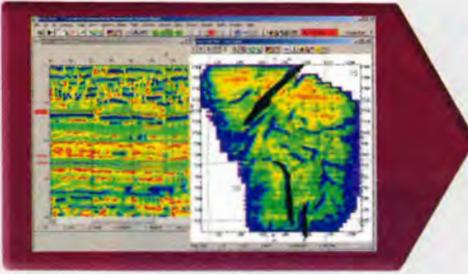
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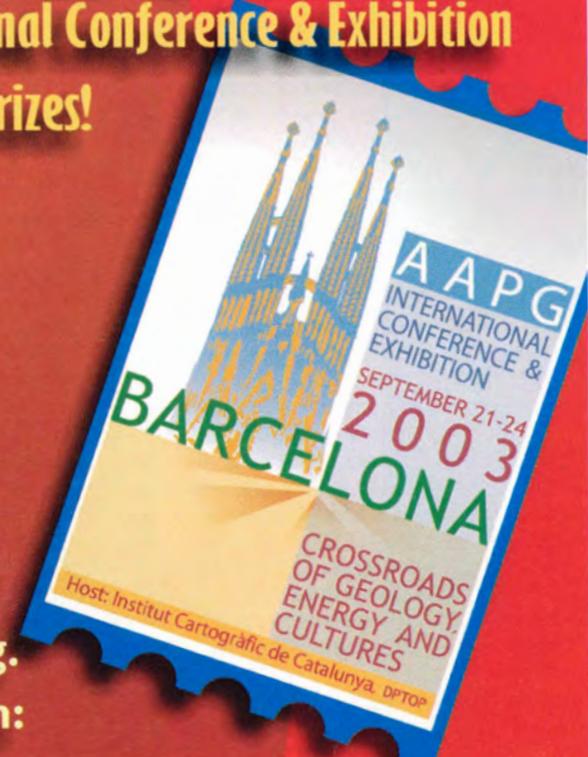
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AAPG Summit Got to the Point

Message Again Goes to Capitol

By LARRY NATION

AAPG Communications Director

Even as portions of the National Energy Policy were being drafted, the second AAPG President's Conference on National Issues presented information to decision makers in Washington, D.C., on "Energy & Environment: A Partnership That Works."

The half-day session, held September 23 at the Reserve Officer Association Building across the street from the U.S. Capitol, included presentations on supply and demand issues, industry environmental practices and impact and evidence of environmental responsibility – with the intent to bring a view of rational science into the policy debate.

Presentations were highly visual, with short, to-the-point topics that pulled few punches before the audience of about 50 that included U.S. Senate staffers and top management from three regulatory agencies.

The program was spearheaded by Lee Gerhard, of Gerhard & Associates, with logistical support provided by Carl J. Smith, newly named director of the West Virginia Geological Survey, and David Applegate, of the American Geological Institute. Environmental activist and lawyer Victor Yannacone provided a lunch-time address (see page 21).

AAPG President Dan L. Smith opened the meeting, stating that geologists fully appreciate their role as stewards of the earth – and as environmentalists they deploy the science and technology responsibly to provide the energy that provides for civilization.



Smith Clarke Fisher Gerhard Harrison Hogg

The Message

□ In presenting current energy supply and demand figures, Pete Stark, of IHS, noted that there is no near-term decline in oil supplies and crisis policies are not required. However, he said, with a world demand growth of 56 percent and a U.S. demand growth of 31 percent projected for 2020, actions must be taken now for an orderly transition to alternate sources of energy.

□ Charles Mankin, Oklahoma State Geologist and director of the Sarkey's Energy Center at the University of Oklahoma, told the group that:

- ✓ Production of oil and gas can be increased in the United States.
- ✓ External sources of crude can be diversified.
- ✓ Gas-to-liquids technologies should be pursued aggressively.

"Or," Mankin said, "we can forget the lessons from recent history and continue

business as usual."

□ Gerhard, in providing a historical view of environmental impact, showed the technological advances that have provided environment-friendly exploration – as well as photographic evidence of regeneration of the environment by earth processes of areas formerly polluted.

□ In a presentation of current environmental practices, William Harrison, of the Kansas Geological Survey and past president of AAPG's Division of Environmental Geosciences, noted that "good environmental stewardship is consistent with good project economics."

□ Don Clarke, of the City of Long Beach, Calif., gave a visual tour of the exploration and production – past and present – in the Los Angeles urban environment. In giving apologies to

Frank Sinatra and the song "New York, New York," Clarke noted, "If we can do it here, we can do it anywhere."

□ John Hogg, vice president of exploration of Atlantic Canada Exploration for EnCana, noted the astounding production and environmental success of the Hibernia, Terra Nova, Sable and Deep Panuke projects in the Grand Banks and the Scotian Shelf area of the North Atlantic Margin.

He noted that the prospective geology extends Florida, but production instead stops abruptly at the U.S. maritime border – because of environmental concerns.

□ In providing a session-ending summary, William L. Fisher, of the University of Texas at Austin, noted that the U.S. demand will never again allow it

See **Washington**, page 21

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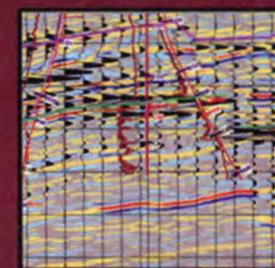
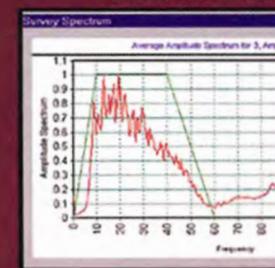
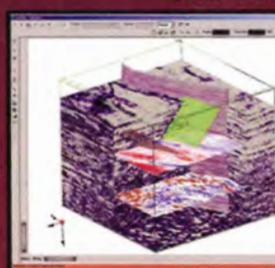
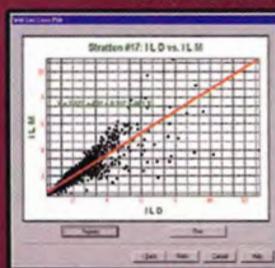
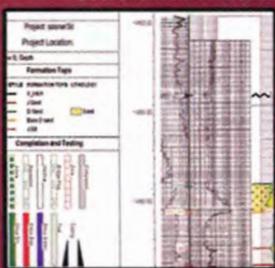
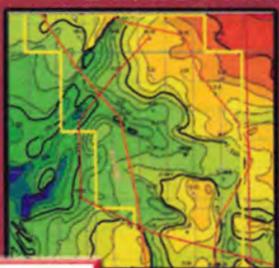
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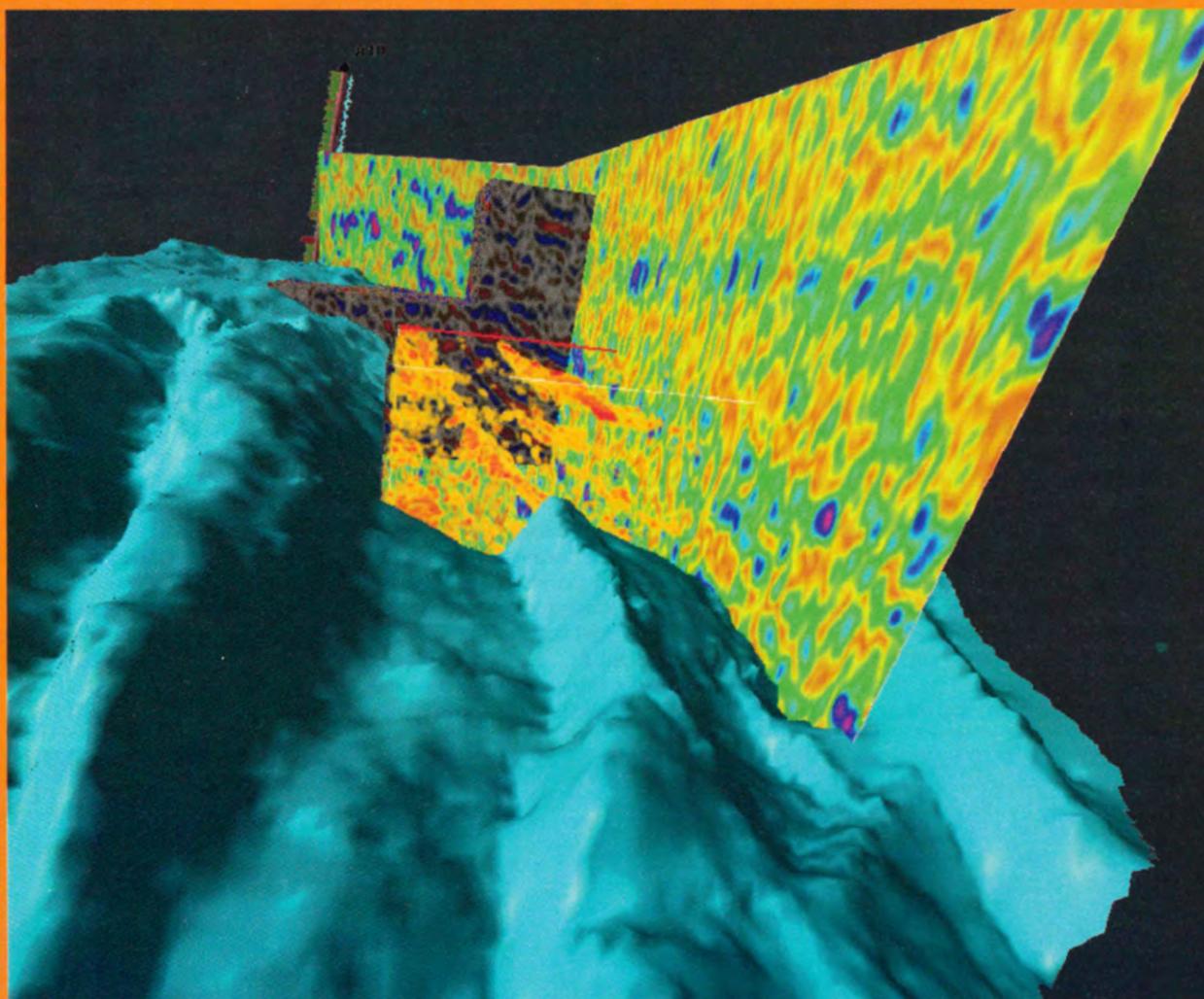
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APPEX Speakers Give Insight

Finding Capital Goes Beyond 3-D

By SUSAN EATON
EXPLORER Correspondent

The seismic data show an impressive structural closure in the hundreds of meters ... the associated amplitude anomaly may indicate the presence of a world-class gas accumulation.

The prospect is drill-ready. In fact, the prospect has been drill-ready for 12 months.

But despite the surge in global commodity prices, the prospect's sellers are still looking for a dance partner, whether in the form of private equity capital or a joint venture partner.

In August, the prospect's sellers set up shop in one of the nearly 300 booths at the APPEX 2002 conference in Houston to market their prospect.

APPEX 2002 attracted about 2,000 participants, and provided a showcase for a multitude of prospects ranging from small, stratigraphic traps onshore Texas to large, structural closures in the overthrust belts of Peru and Canada.

Sellers, however, were unanimous in their lament: "It's a tough market out there to raise money for deals."

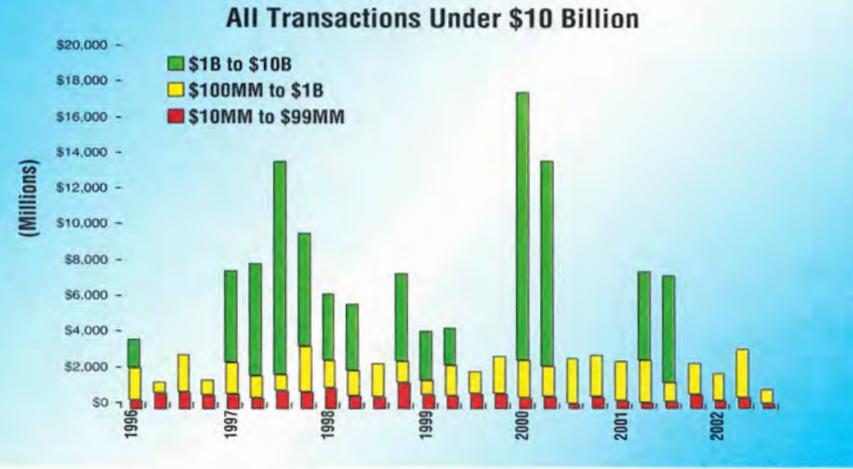
But is this lament based upon reality or perception? Or is there a disconnect between what the financiers are looking for in "winning deals" and what the explorers or sellers are presenting at APPEX?

Equally important, what does the future hold for sellers courting capital?

* * *

Capital Sources

Public Equity Transactions
(Market Cap < \$1 Billion)



Source: J.S. Herold Database

Total A&D volume is driven by large deals.

The answers to the above questions were presented at the APPEX Dealmakers' Conference. Five speakers, representing a broad cross-section of the financial community, outlined the key criteria they use to source capital for domestic and international oil and gas projects:

- Frank Weisser, managing director of Weisser, Johnson & Co.
- Brent Bechtol, vice president of EnCap Investments.
- Amiel David, vice president of Duke Capital Partners.
- Gregory Moroney, managing director

of Deutsche Bank.

□ Jim McBride, managing director of Fleet Boston Financial.

The financiers spoke of the need for seasoned management teams to turn geology and geophysics into quick cash flow, to reduce risk and increase rate of returns. The name of the game has changed during the past year, they said, and the hurdles for oil and gas companies to raise capital have been raised a couple of notches.

And while capital is still available for E&P activities, their message was clear:

"Show me the money."

"By any measure, the changes of the last year have been huge," Fleet Boston Financial's Jim McBride said, adding that in the wake of the events of September 11 and the Enron, Arthur Andersen and WorldCom scandals, investment in public markets has evaporated and the mezzanine financing has collapsed.

"As investors have searched for safety and security, they've gone to the bond market," McBride said.

He cited the example of the XLE, the Energy Select Sector Fund; despite the fact that commodity prices were up, the fund was down 21 percent with the overall market.

"The number of IPOs (initial public offerings) is a direct correlation for the investment appetite," McBride continued, pointing to the fact that as of August 2002 only one energy IPO had been successful in the domestic marketplace.

According to McBride, \$2.5 billion of capital capacity has been taken out of the mezzanine financing. This financial vehicle has seen significant players exit during the past year - Aquila, Mirant, TWC and Shell Capital.

He remained optimistic, however, that new mezzanine financiers would emerge to fill the void.

McBride's sentiments were echoed by Frank Weisser of Weisser, Johnson & Co., who said "we've suffered the biggest one-time demise of the mezzanine players that we've had in 15 years."

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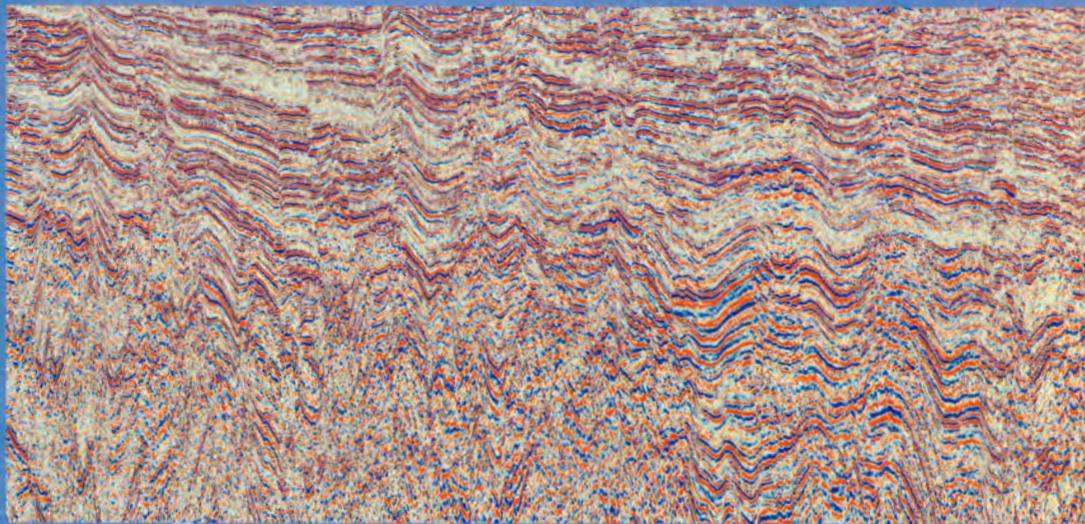
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Mezzanine financing, as defined by Weisser, is "senior debt tied to developmental drilling – it's project or corporate-like financing that permits development properties to change hands."

Weisser's firm is busy refinancing companies that were financed last year by mezzanine players who have departed.

"There's certainly a shortage of dollars," Weisser said. "Right now it's tough on almost every front – the public market doesn't exist for all practical purposes, and the banks are being cautious for reasons not even related to E&P risks."

"For small- to mid-size companies, it's about as bad as it's ever been."

According to Brent Bechtol of EnCap Investments, public capital markets for the energy sector – public equity and debt financing – have plummeted from \$5.0 billion funded in 1997 to \$0.90 billion in 2001.

Acquisitions and Divestments Market

The feeding frenzy of corporate E&P mergers and acquisitions (M&A) in 2000-2001 tracked climbing commodity prices. Despite even higher commodity prices in 2002, the industry has been characterized by corporate retrenching – companies have restructured to shore up balance sheets, and have trimmed budgets.

The steep decline in M&A activities, Weisser said, is the result of companies trying to preserve their existing reserves base and existing production.

Ironically, companies like Williams, Calpine Corporation and El Paso Corporation are busy divesting their recently-acquired upstream- and mid-stream assets.

"I want them to be at financial risk ... This way, they have a vested interest and a very strong incentive to be successful ..."

"These assets are now on the block at a more favorable price than when these companies acquired them," Weisser mused.

'A Sellers' Market'

Bechtol described the current business environment as "a sellers' market."

During the past 12 months, according to Bechtol, some \$3.5 billion of private equity capital has become available, including several new funds.

"EnCap's business philosophy," Bechtol said, "has been capital preservation with upside – that is, acquire and exploit." He described providing capital required to move PUDs (Proven Undeveloped Reserves) to PDRs (Proven Developed Reserves). His company's niche is sourcing capital for domestic development activities.

"The lifeblood of our business is backing management teams who are making acquisitions and drilling upsides," Bechtol said. "You're just not buying proven reserves, you're buying a team with a proven track record."

While the financiers acknowledged the fact that E&P companies need to grow through the drill bit, they said that the private equity markets have been historically adverse to pure exploration.

In terms of financing stand-alone, wildcat exploration prospects, the financiers were unanimous in their advice to sellers – look to friends, family and business contacts, or find a joint venture

partner.

EnCap, according to Bechtol, finances exploration as one of several elements in a company's portfolio; such a portfolio might include:

- ✓ Daily production.
- ✓ A corporate acquisition for additional reserves.
- ✓ A development drilling program to exploit upside.
- ✓ A separate exploration drilling program.

EnCap might also take economic advantage of a "good promote" in an exploratory prospect.

Bechtol pointed to the emergence of some equity capital sources capable of funding exploratory drilling – Warburg Pincus and Energy Spectrum Capital – who have a greater tolerance or capacity for risk.

The Cost of Capital

The cost of capital varies, according to Amiel David of Duke Capital Partners:

- ✓ Senior lending or debt (usually banks) is one to two percent above the prime lending rate.
- ✓ Mezzanine financing is about 12-17 percent.
- ✓ Equity capital is more than 25 percent.

Bank debt, mezzanine financing and private equity capital are secured by reserves and/or assets. The placement of significant equity capital often guarantees financiers a seat on the company's board of directors.

Duke Capital Partners places private equity capital in start-up companies who engage in exploration activities.

"If you put equity into exploration, you need a rate of return north of 25 percent," David said. "If a company is prudent, it won't borrow money to do exploration, because it's too risky."

From an investor's perspective, David said he looked for several key criteria:

✓ A Company must have a track record of keeping its capital expenditures (CapEx) within budget. CapEx overruns, according to David, reduce a company's ability to complete a drilling program and book reserves.

✓ He likes to see 60-80 percent of a company's daily production hedged on an annual basis – this guarantees a known cash flow, and demonstrates the company's ability to pay down debt and fund ongoing E&P activities.

✓ A company must have an exit strategy – defined over a three- to five-year period – whereby it builds its asset base, adds value and prepares itself for sale or merger.

David described the final criterion in a "winning deal": A company must be willing to take a piece of the action.

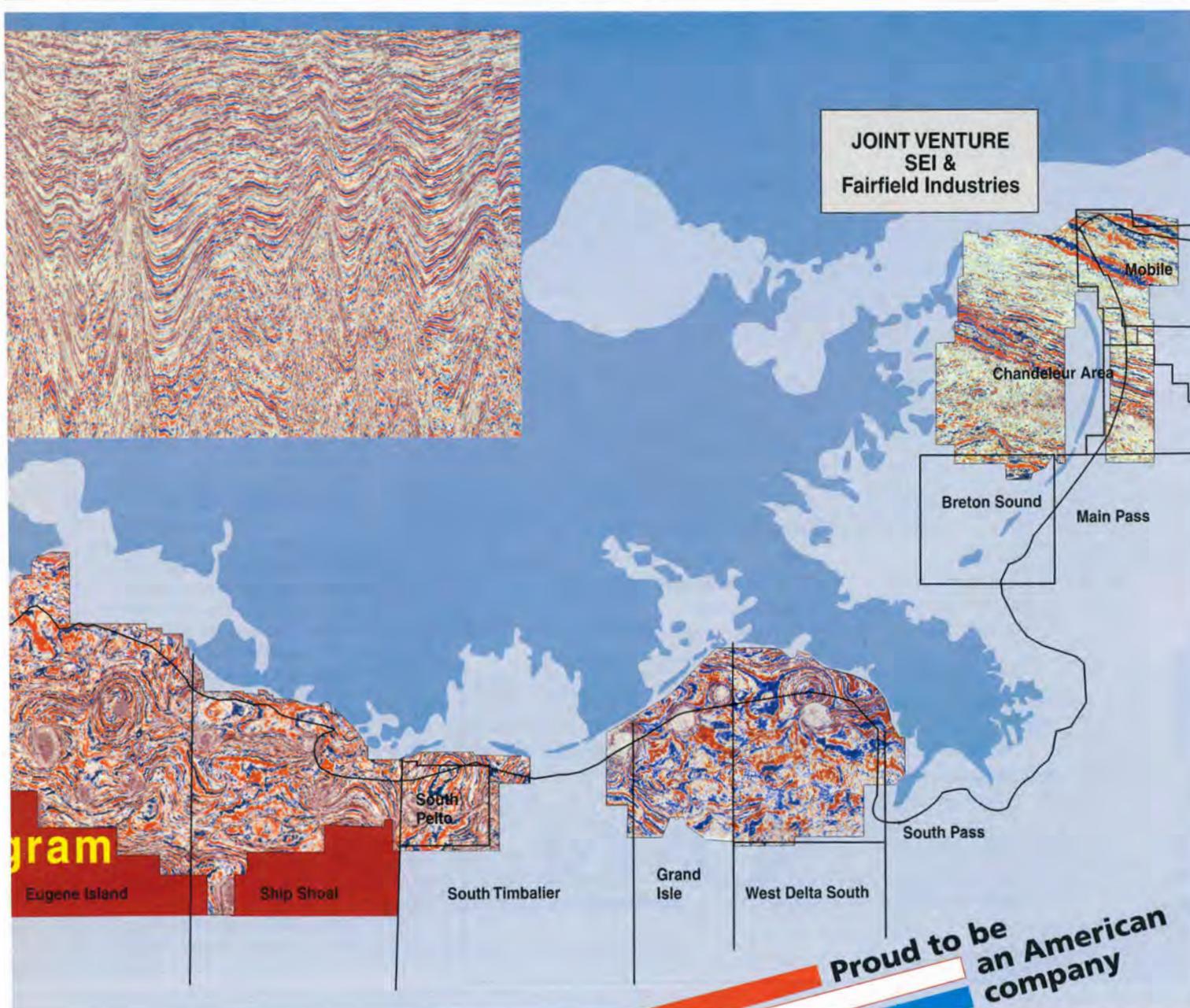
"I want them to be at financial risk as well," he said. "This way, they have a vested interest and very strong incentive to be successful when they put their money in."

Not All Created Equal ...

"Not all projects are created equal," said Gregory Moroney of Deutsche Bank. "In this particular economic environment, the financing is just as important as the geology and the geophysics."

Moroney outlined how his organization evaluates international projects seeking

See **Financing**, page 19



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Ancient River Systems Provide Targets

West Africa Basins Share Secrets

By KATHY SHIRLEY
EXPLORER Correspondent

Activity and success in the prolific West African margin is no longer confined to high-profile plays in the Niger Delta of Nigeria and the Congo Basin of Angola. Companies of all sizes are probing the virtually untouched basins all along the western coast, from Morocco to South Africa.

And in doing so, they are unlocking many of the geologic secrets critical to finding potentially massive oil and gas deposits.

"The industry's geologic knowledge of

"There are regions all along West Africa where ancient river systems created the same ... situation that's seen today in the Niger and Ogooue deltas and Congo fan."

the West African margin began in the Congo fan and Niger delta," said Paul Dailly, staff geologist for West Africa for Amerada Hess Corp., "and over the last

several years we have extrapolated that knowledge to other basins."

Dailly was part of the team with Triton Energy that made the basin-opening

Ceiba discovery in Equatorial Guinea's Rio Muni Basin.

"In West Africa there are a number of key elements to hydrocarbon accumulations," he said. "Obviously, there is the source rock, which is developed over large areas of the region, but more locally specific are large river systems and deltas that provide reservoirs and the sedimentary thickness to mature the source rock."

In addition, the major successes in West Africa have been found in basins with mobile substrates – either salt or shale, he commented. In Angola it's salt and in Nigeria it's typically shale.

"For years everyone believed you had to be close to one of these big river systems like the Niger, the Congo or the Ogooue in Gabon to find the right combination of mature source rocks, reservoirs and traps" he said. "Consequently, for the last 20 to 30 years these three areas have been the focus of exploration."

As the shallow water portions of these deltas were played out, exploration efforts began moving to the deepwater – but major international oil companies quickly dominated these plays, leaving little opportunity for independents.

Smaller companies, in turn, had to go in search of new geologic concepts and plays along the West African margin.

"In the last five to six years there has been a growing realization that these deltas and fan systems have been in their present position since the middle Tertiary, when there was a large uplift of the continental margin that reset the drainage patterns for the whole continent," he said.

Through time the areas where these river systems have been dumping sediment has changed, and further analysis led to the conclusion that other places along the margin also have all the key elements necessary for hydrocarbon accumulations.

"There are regions all along West Africa where ancient river systems created the same type of situation that's seen today in the Niger and Ogooue deltas and the Congo fan," he said.

These ancient river systems account for major recent discoveries in the Rio Muni Basin in Equatorial Guinea and offshore Mauritania.

"Today we know there are a number of basins that have been overlooked but have the same elements," he added. "They just aren't as obvious as the Congo and Niger systems."

Stratigraphic Focus

When Triton first began exploring in the Rio Muni Basin it sought areas downdip of older wells that didn't find commercial accumulations but did provide evidence of an oil prone source rock – this had been proven in wells drilled by Elf Aquitaine and Total in the late 80s early 1990s when they drilled several wells in the Rio Muni's shallow waters.

"Due to Late Cretaceous and Tertiary uplift, turbidite reservoirs were only preserved in the deepwater and structurally low areas – these wells simply missed the reservoir further downdip," Dailly said. "These reservoirs are turbidites, similar to the deepwater fields in Angola, but they are Late Cretaceous age rather than Tertiary."

The Ogooue delta just south of the Rio Muni Basin has proven reserves of over

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continued from previous page

two billion barrels – and Triton saw quite a few similarities between Rio Muni and the Ogooue delta.

"We thought there was a good case to be made that the Late Cretaceous sands of the Ogooue delta would also be present in the Rio Muni Basin," he said. "That turned out to be the case. We found similar Campanian age reservoirs. Everyone had been so focused on Tertiary turbidites that the Cretaceous reservoirs were not tested.

"We saw no reason to expect that the Cretaceous turbidites wouldn't be just as prospective."

Triton saw one conventional structure on its acreage, and naturally that was the first prospect the firm tested, resulting in the Ceiba Field.

"This was another reason companies stayed away from the Rio Muni Basin – they could only see one structure and didn't think there was much else to drill," Dailly said. "The three dry holes we drilled after Ceiba told us a great deal about the charge and reservoir systems and about the rock physics. This allowed us to focus in on a stratigraphic play."

Since then the firm has been drilling incised channel systems with updip pinchouts that create stratigraphic trapping geometries – and has made five additional oil discoveries.

"Drilling in the Rio Muni Basin has demonstrated that the Aptian salt basin found in Angola and Gabon continues further north than previously thought," Dailly said, "and likely extends into Cameroon as well."

Areas of Interest

Other salt basins around the margin

are essentially completely unexplored. The Senegal Basin, for example, has good oil shows updip, evidenced by a heavy oil accumulation, but downdip in deepwater is virgin territory.

"We know going in that this area at least has a source rock," Dailly said. "Whether that source is mature in our block is a different issue, but at least we have some comfort that it was deposited."

Mauritania is another example. Last year Woodside Petroleum drilled the Chinguetti 1 discovery, which preliminary reserve estimates total 180 million barrels.

"This basin is another example of a paleo delta system that was deposited on top of salt with a thick enough section to mature the source rock and cause the salt to move, which in turn created structuring," Dailly said.

Another area that has people excited, he added, is offshore Morocco, where the same elements of an old river system deposited over salt come together.

A mobile substrate, either salt or shale, is a key element all along the West African margin because it provides both the trapping geometry and focus for hydrocarbon charge. The age of the salt or shale isn't critical, according to Dailly; the salts off northwest Africa are Jurassic compared to Aptian in the Gulf of Guinea and offshore Angola.

An Analogous Approach

"You can match basins fairly well between offshore West Africa and offshore Brazil using plate reconstructions," he said. "For example, we were fairly confident that the Rio Muni Basin was the conjugate basin to the

Sergipe-Alagoas Basin in Brazil, which has produced a considerable amount of oil. Early on that was one of the reasons we felt Rio Muni may contain a working hydrocarbon system."

Hence, the company did field work in Sergipe-Alagoas to help understand the geology of Rio Muni.

Understanding the tectonic setting offshore West Africa is critical to understanding the distribution of hydrocarbon play elements.

Triton/Amerada Hess also used a combination of satellite gravity data and large-scale regional seismic data to reconstruct the structural evolution of the margin. Onto that structure map were overlaid the play elements of reservoir system, source system and traps.

"This has allowed us to focus on the areas that might have been overlooked in the past," he said. □

Financing
from page 17

funding.

He advised that E&P companies – unless they are majors with deep pockets – re-evaluate their strategies of exploring internationally in new basins without any existing infrastructure. He emphasized that only projects with assets or resources that can be sold offshore or "monetized" for hard currency are candidates for capital investment in emerging markets.

"You don't have a company-maker if you can't sell it and convert it to U.S. dollars," Moroney said.

In a case study, Moroney presented how Deutsche Bank took the lead in structuring a \$2.5 billion deal to develop the Barracuda and Caratinga offshore oil

fields in the Campos Basin of Brazil.

Petroleo Brasileiro S.A. (Petrobras), due to budgetary restraints, could not develop the fields. In a deal negotiated between 1998 and 2000 – one that weathered the devaluation of Brazil's currency – Deutsche Bank created a capital structure that included an offshore holding company that owned the production infrastructure and leased it back to Petrobras.

Mechanisms were in place for lenders to take oil in lieu of cash, if necessary, and to hedge Brazilian production. Financing was comprised of a unique partnership between international public and private financing sources, as well as the first-ever international cooperation between leading providers of Political Risk Insurance (PRI).

"Private equity has a small appetite for going offshore," Moroney said. "Fund managers want to do deals, but the only

agencies who have the time and the patience (for international deals) are the World Bank and multi-lateral lenders."

Moroney suggested that E&P companies need to understand how the investment community values – or discounts – an E&P opportunity or asset. For example, the market is discounting the value of Talisman Energy's resource in the Greater Nile Oil Project in Sudan because of the geopolitical risk in the war-torn country. Talisman's 25 percent share nets over 60,000 bbls per day.

Closer to home, Moroney pointed to the 30 Tcf of stranded natural gas in Prudhoe Bay.

"These reserves are not carried on the shareholders' books," Moroney said, "nor will they be given any value by the markets until the Alaskan pipeline is constructed." □

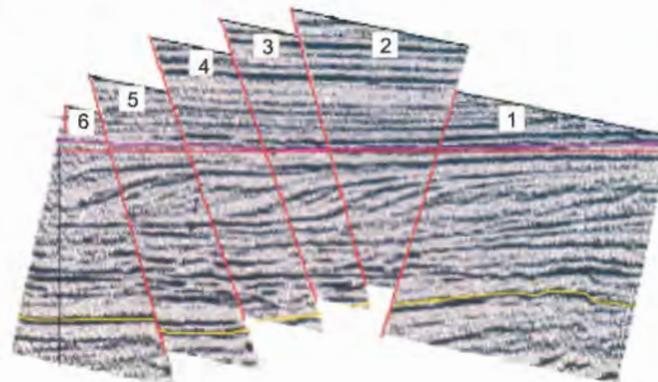


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Geologist Offers a New Theory

Gulf's Evolution Makes the Shakes

By KATHY SHIRLEY
EXPLORER Correspondent

The New Madrid seismic zone in Missouri has long intrigued scientists because, according to conventional geologic theory, large earthquakes clustered in a tectonically quiet region are difficult to understand.

But at least one AAPG member is challenging the crowd.

New Orleans independent geologist Jack M. Reed believes the origin of the earthquakes lies beneath the Gulf of Mexico.

That's not all.

Reed, a retired Texaco geologist-geophysicist who has been studying the region's geology for over 40 years, says the accepted theory of a quiet geologic evolution of the Gulf of Mexico Basin is fundamentally flawed and needs to be revised.

According to him, the Gulf was and is tectonically active – and it is the likely origin for not only the New Madrid seismic activity, but also for the Middleton Place-Summerville seismic zone near Charleston, S.C.

"For all the years I have worked the Gulf of Mexico Basin, I have been forced to accept the 'passive' Gulf formation theory, which holds that the only movement in the basin is updip sedimentary loading that moved the salt southward," Reed said. "But there is little evidence to support this theory, and it doesn't fit what is observed geologically or geophysically.

"As Hugh Wilson said (1993), 'It would be geologically unusual for such a large basin as the Gulf of Mexico to remain almost tectonically undisturbed for 170 million years while major orogenic disturbances repeatedly struck bordering areas.'"

Reed, over the years, has gathered evidence that supports plate motion in the Gulf basin. Thick salt and sedimentary sequences in the basin mask this tectonic motion, but there is enough basin and peripheral evidence to show plate readjustment is occurring – evidence, he says, in the form of volcanics, earthquakes and rift zones that are accompanied by magnetic, refraction, seismic and gravity data.

Questions? Answers!

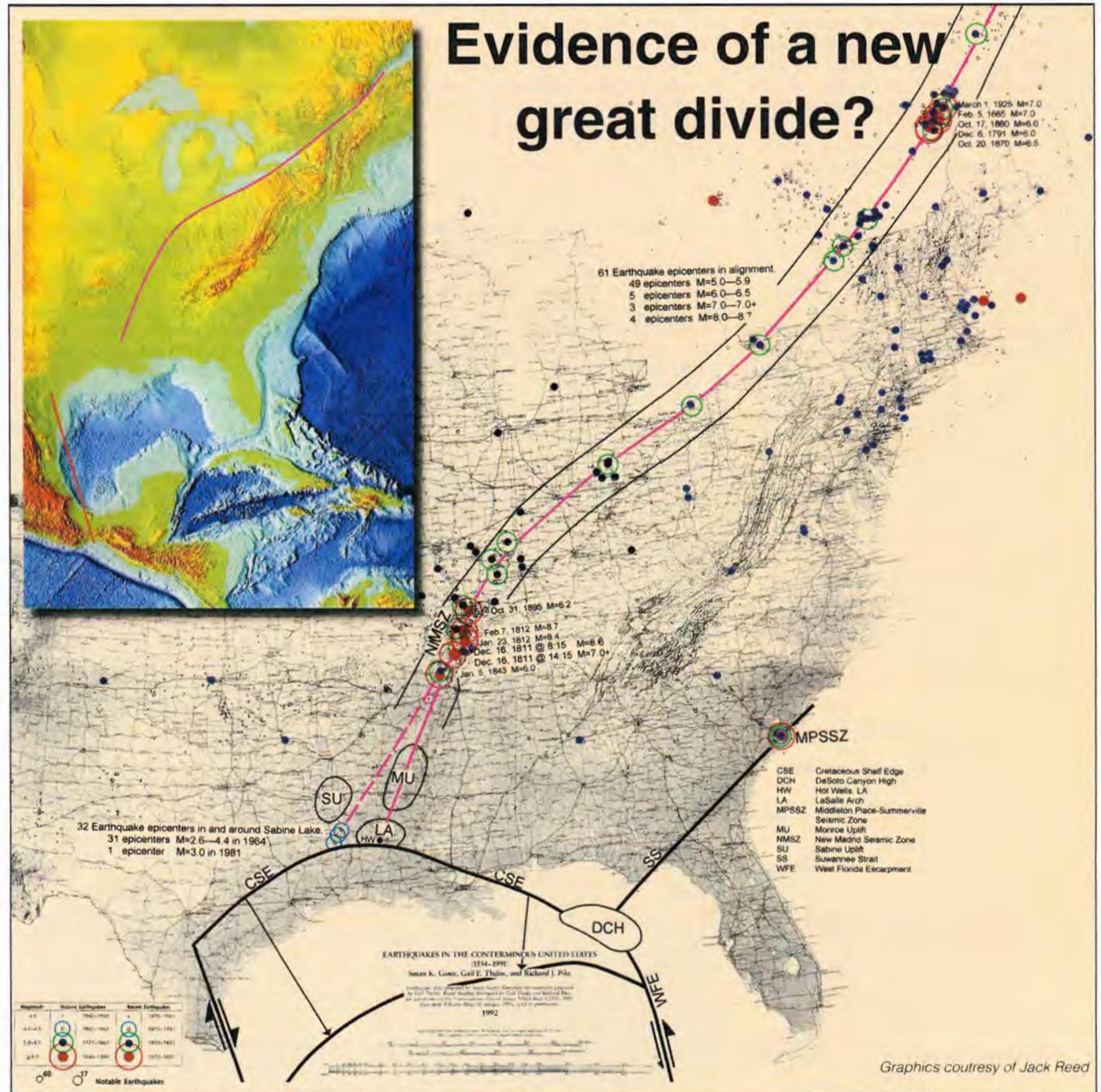
One piece of this evidence, according to Reed, is the apparent connection of the New Madrid seismic zone with the Gulf rift features to the south.

"This northeast trending earthquake zone appears to connect with the northeast trending Monroe Uplift, the LaSalle Arch and, possibly, to an active seismic zone located in and around Sabine Lake on the Texas-Louisiana border," he said.

This complex of doming and seismic centers is similar to another Cretaceous age triple juncture located in the northeastern Gulf of Mexico Basin. Doming of the DeSoto Canyon High during the Jurassic to Cretaceous created this triple juncture, which includes the Cretaceous Shelf Edge, the Suwannee Strait and the West Florida Escarpment.

If the New Madrid seismic zone is indeed part of a triple juncture, he continued, there should be an expression of this limb trending along a line in a northeast direction.

So Reed conducted a study using data from the U.S. Geological Survey's National Earthquake Information Center and the



Graphics courtesy of Jack Reed

USGS map, "Earthquakes in the Conterminous United States." He only studied earthquakes measuring at least magnitude 5, and found that while most of the earthquake centers are random with no alignment, there is a well-defined earthquake trend extending northeastward from the New Madrid seismic zone across the United States to Canada, where it joins with the St. Lawrence River seismic zone.

Within the boundaries of this earthquake alignment there are:

□ Sixty-one seismic points that have a magnitude of 5 and greater.

□ Several large earthquakes dating to the early 1800s, all measuring over magnitude 8, all occurring within a couple of months of each other, all centered in a northeast trending line.

□ The two 5+ earthquakes that occurred earlier this year in northern New York state and southern Indiana.

"There is definitely some form of movement occurring along this trend," Reed said, "and it appears to be active today."

As he continued that trend south of New Madrid he found that it was in line with the Monroe Uplift.

"Suddenly I could see that this area had doming much like I had seen at the DeSoto Canyon in the Gulf," he said. "This entire zone through the United States is suffering some type of tectonic activity that

I believe is tied to the deeply buried tectonics in the Gulf of Mexico."

Answers? Questions!

Reed has developed an interpretation, which he is quick to point out is just a theory, on this tectonic activity:

✓ As Africa jammed into North America and thrust up the Appalachians, there were compressional forces acting along the front of the mountain range.

✓ This force caused long linear thrust faults to form in front of and parallel to the uplifting mountain chain.

✓ Not only was the lithosphere thrust upward to form the Appalachians, some of the lithosphere was thrust downward into the asthenosphere. The result was a long, prominent bulge extending into the asthenosphere over the length of the Appalachians.

✓ As separation from Africa occurred and the North American continent began to move westward, tensional forces came into play in the trailing edge of this moving plate. The long lithospheric downward bulge became an impediment to this plate motion as it moved over and through the asthenosphere.

✓ This action caused a drag in plate motion with tensional forces being the greatest along a line in front of and parallel to the Appalachians.

"The results would be gradual separation of the lithosphere," he said, "likely along the older thrust fault trend."

Reed believes this rifting certainly impacted the Gulf of Mexico as well.

He also concedes that even with the years of research, several unanswered questions still exist about the Gulf's origins:

□ Regarding one of the most accepted theories, that updip sedimentary loading moved the salt masses in the Gulf seaward: Where is the original salt basin?

"If this salt mass movement was reversed by paleo-reconstruction and moved back to the original salt deposition basin, which would be directly south of the Cretaceous Shelf Edge, the original salt thickness would have to be in a six-figure range to accommodate this huge salt mass," he said. "It would dwarf the Himalayas."

□ Regarding salt distribution and the sub-horizontal, allochthonous salt flow theory: Wouldn't the salt have to be vented to an open, deepwater environment where it would, very questionably, remain unprotected for several geologic stages until covered by sediments of a later period?

"This theory doesn't take into consideration the role of the Interior basin and the Cretaceous Shelf Edge," he said,

See **Rift Theory**, page 35

A Quite Quotable Energy Tour-de-Force

Lawyer Makes Case for Exploration



Yannacone

In providing the lunch-time address, activist lawyer and AAPG member Victor Yannacone, of Long Island, N.Y., gave a wide-ranging address that stressed the necessity of becoming active in the political

process and communicating views to the public and media.

A pioneer in the environmental movement, Yannacone and his wife founded the Environmental Defense Fund in 1967 and won several environmental victories including the first air pollution case brought in an American court. He also was counsel for Vietnam veterans in the Agent Orange case and coined the phrase and created the field of Environmental Law during the DDT litigation of 1966.

"Rational science must become the basis for national resource policy, especially our national energy policy," Yannacone told the luncheon audience.

"There is no rational justification supported by a fair preponderance of credible scientific evidence for a moratorium on exploration of the Outer Continental Shelf for oil and natural gas anywhere off the East Coast, the West

Coast, or the Gulf Coast," he said. "Yes, even off Florida."

On other topics, he had this to say:

On Ethics

"It is the lawyers without conscience and the law school professors without principle that brought us Enron and the business failures that followed in the wake of the mergers and acquisitions craze of the '80s.

"It is the accountants without integrity who have destroyed our confidence in the American free enterprise system and the heart of industrial society – the markets.

"While the vast majority of the American people were unaware and uninformed, those who knew the dirty little secrets kept silent and allowed the barons of big business to hide behind the trappings of power and conceal the fact that they are moral midgets."

* * *

"We have allowed lavish rewards to be heaped upon men and women without honor, integrity, character or principle, who

Washington

from page 14

to be energy self-sufficient in the hydrocarbon economy.

Hemispherical independence,

made the elegant edifices of business – the banks, the brokerages and the boardrooms – whitened sepulchers of biblical proportions.

"The independent oil and gas industry was not built by vulture capitalists taking advantage of gullible investors. It was built by men and women of vision who were willing to take great personal risks for the benefit of society, only seeking a reward commensurate with their risk – something for something; not something for nothing!"

On Civilization

"It is time to lift the siege and scatter the hoards of loud-mouthed Luddites who seek to halt the advance of human civilization and who demonize the effort to find and make wise use of our oil and natural gas resources."

* * *

"Millions of barrels of oil, billions of cubic feet of natural gas, thousands of tons of coal, metals and economic minerals support Western civilization. If all that oil and natural gas and coal and

however, is a possibility.

He also noted that limited access to exploration, while a continuing struggle, remains in defiance of logic.

"If we can live with it in Los Angeles, the Western Gulf or the Scotian Atlantic Margin," he said, "we can surely do it in the Rockies, the Eastern Gulf and in ANWR." □

metals and economic minerals are not readily available each day on demand, industrial civilization as we know it will cease. Western industrial civilization is built upon cheap oil, gas, food and water."

On National Energy Policy

"Our national energy policy is 'Cheap energy for us at any price to anyone else.'"

* * *

"If the phrase 'national energy policy' is not to become the latest oxymoron, like 'corporate responsibility' or 'legal ethics' or 'generally accepted accounting principles,' all of us who provide the support our elected representatives need to do their job, must insist that rational science become the basis for public policy."

On Land Use Policies and Ideology

"The most pernicious is the idea that all of the public lands exist solely as scenic vistas, and their principle use is as the playgrounds of the rich and powerful. The other ideological extreme is that the public lands exist for the benefit of the soulless, stateless multinational conglomerate financial institutions, so that a few people can make a great deal of money without providing any real beneficial use of the public lands.

"We have to reach a balance between these two extreme positions." □

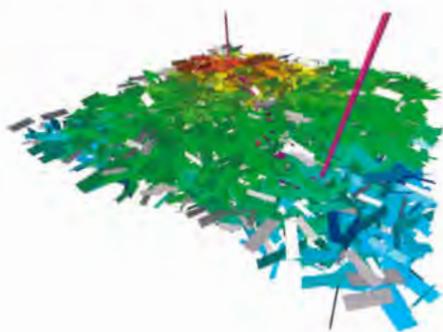


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Katharine Lee Avary

West Virginia Geological & Economic Survey, Morgantown, West Virginia

Born 1955, Atlanta.

Academic Training:

1976 – Emory University, Atlanta, B.S., geology
1977 – University of North Carolina, Chapel Hill, M.S., geology

Experience:

1978-present – West Virginia Geological & Economic Survey, Morgantown, W.Va. (Petroleum Geologist, 1978; Assistant Head, Oil and Gas Section, 1992-97; Head, Oil and Gas Section, 1997-present)
1982-present – West Virginia University, Department of Geology and Geography (Adjunct Assistant Professor, 1982-92; Adjunct Associate Professor, 1992-98; Adjunct Faculty Member, 1998-present)

AAPG Activities:

Member since 1984; member of EMD
1978-1984 – Co-coordinator, Appalachian Basin, COSUNA (Correlation of Stratigraphic Units of North America) project
1982-1989 – Committee on Statistics of Drilling
1997-2003 – House of Delegates
1999-2000 – HoD Nominations Committee
2000-2002 – HoD Honors and Awards Committee
2002-2003 – HoD secretary-editor
2000-2003 – Youth Education Activities Committee
2000-2003 – Mentoring Committee
1999-present – Faculty Sponsor, West Virginia University Student Chapter

Affiliated and Associated Societies and Sections:

1996 – Technical Program chair, Eastern Section meeting
1996-2000 – Eastern Section Officer
2001 – Eastern Section Nominations Committee chair
2002-present – Eastern Section Honors and Awards Committee
1998 – Logistics and Special Events Coordinator, Southeastern Section Geological Society America Meeting
Member: Geological Society of America, SEPM, Appalachian Geological Society, Pittsburgh Association of Petroleum Geologists, Pittsburgh Geological Society, Society of Petroleum Engineers

Other Professional Affiliations:

1988-1993 – West Virginia University Chapter Sigma Xi Officer; Member, National Speleological Society

Honors and Awards:

Eastern Section Distinguished Service Award
Eastern Section Special President's Award
Eastern Section Certificate of Merit
Eastern Section Public Service Award

Community and Civic Affairs:

2000-present – Cheat Lake Environmental and Recreational Alliance (CLEAR) board member

Publications:

Authored or co-authored 19 abstracts and 9 papers on unconventional gas resources, reservoir characterization and heterogeneity, fractured reservoirs and bedrock geologic mapping.

**Why I Accepted
The Invitation to be a Candidate
For AAPG Office**

By KATHARINE LEE AVARY

I consider it an honor to be asked to run for AAPG secretary. I believe that I can contribute to the organization from which I have received so many benefits, and welcome the opportunity to do so.

AAPG has provided me with many resources both tangible and intangible over the last 18 years I have been a member, and before that as a student and early in my working career. The publications, short courses, field trips, meetings, distinguished lecturers, Web site and the digital library are all tangible benefits that I have used. The intangible benefits are the connections

See **Avary**, page 24



Avary

**AAPG C
For**

Editor's note: Candidates for AAPG office have subject: "Why I Accepted the Invitation to be a Candidate" biographical information provided by each candidate and responses also will be available through the AAPG website. Ballots will be mailed in the spring. Printed here are Katharine Lee Avary and Robert L. Countryman. (J.F. Gratton and Ronald A. Nelson appeared in the president candidates Erik P. Mason and Douglas J. Nelson. Candidates were asked to limit their responses to 200 words.)

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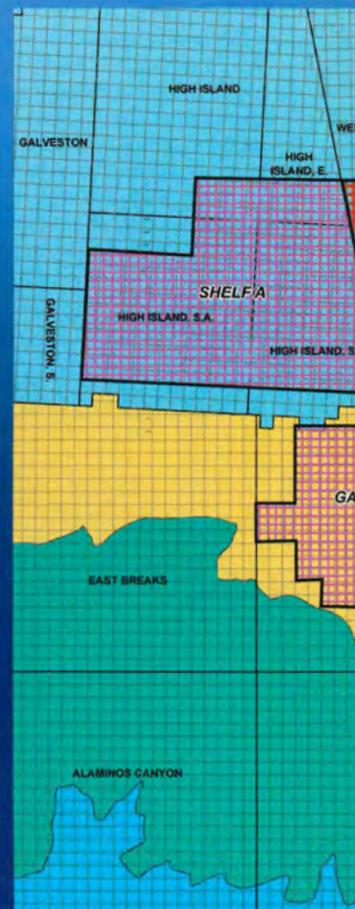
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Avary

from page 22

I have made over the years with other like-minded people in our international organization.

I have been involved in local societies, AAPG committees, Section meetings, Section offices, the House of Delegates as a delegate, committee member and as secretary-editor, but I think the most rewarding activity for me in recent years has been as a student chapter faculty advisor. Students are the future of our organization and our profession, and I

encourage all members to locate a student chapter near you and volunteer or contact a university or college about starting a student chapter near you if there isn't already one in place.

If elected, I intend to do what I can to assist in continuing development of programs for all members, with a particular emphasis on those for students. I believe that AAPG is providing more and more benefits to every member, from undergraduate student members to emeritus members. Access to the digital library is a remarkable asset to all members wherever they are located if they have access to the Internet. I believe communication is the key to any group's success, and I think that an important part of the role of the AAPG secretary is to foster communication

among members of the Executive Committee as well as between the Executive Committee and the membership of the AAPG. The increased ability to communicate electronically and reach every corner of the globe rapidly provides tremendous opportunities to all members of AAPG, and I want to continue to use this resource as effectively as possible.

I think my experience as an officer of a Section and the House of Delegates will be beneficial to me if I am elected secretary. As I attend various meetings in the next year, I look forward to expanding my network of AAPG members. □

Countryman

from page 23

AAPG, and it convinced me that I wanted to be a part of this organization.

Because of this experience, I've always felt that one of the principal things AAPG needs to do, at all levels, is to provide these kind of low cost opportunities to geologists everywhere. It is at this one-on-one level that people decide to join and to become "lifetime members" of AAPG. The opportunity to get to know and work with other petroleum geologists is one of the greatest benefits of AAPG membership and also one of the most rewarding.

During my career, I have been very involved in the San Joaquin Geological Society and Pacific Section. I have served as president of both societies, as well as on numerous committees and in many other roles. Over the past decade, I've become more involved with the national AAPG where I have served on the Advisory Council, in the HoD and as membership chairman. I've enjoyed every minute of it and this wide background and experience has educated me in how the AAPG operates while allowing me to get to know many of the people, both staff and volunteers, who make AAPG work.

AAPG, and society in general, is undergoing rapid change – much of it driven by changes in technology and expectations. While change is generally a good thing, it sometimes creates frictions. The past few years in AAPG have been tumultuous ones with much debate and discourse on what changes to make and which directions to take. I have had the opportunity to be involved in some of these debates, and it has convinced me that, in addition to good ideas, anyone involved in an AAPG leadership position needs to maintain a calm demeanor, a sense of humor, a willingness to listen to and to respect the opinion of others, combined with the ability to negotiate and compromise in order to meet the greatest needs of our membership.

If given the opportunity, I would very much like to continue to apply my experience and personal skills toward finding the solution for the problems that will face the Executive Committee in the coming years. □

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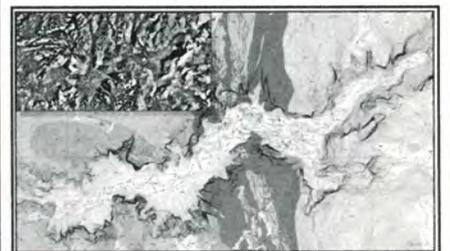
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"It is not true that prices rise quicker than they fall. Many times, retail prices lag far behind wholesale prices going up, and vice-versa," said Dan Gilligan, president of the Petroleum Marketers Association of America.

There is another factor at work here: Gasoline sellers never, never want to lower the price of gas. Wholesalers charge retailers the maximum amount possible, because they're in business, too.

Nobody says, "Hey, the cost of oil is going down, we'll slash our prices" or "Well, the holidays are over, so let's crank down the gas price."

Gasoline sellers want to keep prices as high as they can for as long as they can, to make a dollar or to recover costs. They won't lower their price until inventories build up and they have to move product.

As always, supply and demand rules.

Related question: How much money do gas stations pocket from these higher gasoline prices?

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INTERNATIONAL BULLETIN BOARD

(Editor's note: This column is devoted to international items of note to the AAPG, including the activities of AAPG-related groups around the world. This month's column is by APPEX London 2003 General Chairman Steve Veal.

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

By STEVE VEAL

APPEX London 2003, the international version of AAPG's successful Prospect and Property Expo, will be held February 17-20 in London, England.

AAPG will present and expand the second version of its popular prospect and property exhibition at One Great George Street near the heart of London. It will be held in conjunction with the Institute of Petroleum's ever popular "IP Week," Europe's annual focal point for leading figures of the oil and gas industry.

Last year, more than 1,200 people participated in IP Week activities, highlighted by the IP annual dinner. This year's featured dinner speaker will be Philip Watts, chairman of Royal Dutch Shell.

Last year's program set a high standard of excellent prospect opportunities, a comfortable business environment and a select audience that took time to discuss and investigate each presentation. In short, a true

exploration experience.

The mere fact that APPEX London existed last year reflects the determination of those involved, a gracious effort by the Institute of Petroleum and an insight for opportunity from those companies that exhibited.

* * *

The Thursday technical symposium of the IP Week program will be organized and convened by AAPG.

Chaired by Wolfgang Schollnberger and Jeff Aldrich, the program is titled "Perspectives on the Upstream Business of Oil and Gas." Presenters will include industry analysts and corporate executives in a moderated forum of regional business climates and strategies for growth.

Sessions include issues and outlooks on Global Upstream, North Sea, Western and Eastern Europe, Middle East and Africa.

You are encouraged to register early both for the IP Week program and the APPEX London expo. IP Week attendees will receive free access to the APPEX exhibition, and there will be one-day APPEX viewer only passes as well.

For more information about exhibiting at or attending APPEX London, check out the AAPG Web site at www.aapg.org. Viewer registration information and details of the IP Week program can be found at www.ipweek.co.uk.

We look forward to you joining us and the rest of the exploration industry at this truly innovative international set of programs. □

Skills, Knowledge Needed for Future

Teaching Geology Faces Challenge

By HANNES E. LEETARU
JOHN KALDI
and RAMI KAMAL

The key challenge to maintaining a robust petroleum industry is ensuring an adequate supply of well-trained professionals now and in the future.

Education in petroleum disciplines is more critical than ever, as the industry work force is aging, and employee numbers are dwindling through attrition. This is compounded by a "productivity gap" of somewhere between eight to 10 years, from the time students take up studies to the time they accumulate enough knowledge and experience to be productive petroleum geoscientists or engineers.

With these sobering assertions as a background, the AAPG sponsored a workshop at the annual meeting in Houston titled "Summit on Teaching Petroleum Geology: Where Do We Go From Here?" About 40 participants from 20 universities representing eight different countries attended, plus recruiters and training-related managers from seven oil and service companies.

The summit's goal was to discuss what is needed to train the next generation of geologists for the petroleum industry.

Summit findings included:

Industry Demographics

Our industry is "graying", with few young people filling the ranks of those who are near retirement. Between 40 to 70 percent of the geoscientists in the industry will be eligible to retire within the next seven years.

Issues at the Universities

✓ Attracting undergraduate geology students.

At the undergraduate level there is a significant problem of attracting geology majors. In the United States, Australia, and the United Kingdom the lack of earth science programs in the kindergarten to high school level limits the number of students who want to major in geology.

✓ Negative perceptions of industry.

Students hesitate to enter a graduate program in petroleum geology because of the perceived lack of job security.

✓ Funding declines from governments.

Federal and provincial/state governments have decreased their support of higher education markedly in

all countries surveyed. Most departments are surviving by outside grants and "contract research."

Industry Requirements

✓ Geological.

In most countries a master's degree with the thesis option is required as the entry ticket into the petroleum industry. The thesis is considered important training for independent work. The coursework component should include a strong background in basic geosciences, including some geophysics coursework.

Chris Heath's survey of U.S. and U.K. oil companies suggests that senior line managers view field mapping skills as not terribly important. Recruiters who were present at the summit, however, disagreed, unanimously wanting the new geological recruit to have had a strong field-oriented background.

This apparent dichotomy of responses was clarified during discussion periods: Oil companies rarely have need for geologists to go out and do field mapping, but these same companies want their employees to have a firm background in field work so as to understand scale, stratigraphy and structural relationships - all of which are best learned by looking at

rocks in the field.

✓ Non-technical.

All companies wanted new geological recruits to be able to think - not just regurgitate by rote memory. All viewed the ability to collaborate with others (team work) as extremely important.

Presentation skills also are of critical importance; most companies require the interviewees to make technical presentations during the interview process.

✓ Desirable, but not necessarily required.

Geological and geophysical workstation skills on a UNIX platform are desirable. This does not mean that the companies want universities to train technicians to know all of the software functions. A strong candidate will not jeopardize employment chances by not having these skills.

✓ Internships.

The importance of participation in industry internship program cannot be understated. Every company wanted the recruit to have done an industry internship, preferably with their own company. For some companies industry internships are

desired but not required, but for other companies an internship is a requirement for employment.

Where Do We Go From Here?

□ Universities should not train the student to be a technician. A greater emphasis needs to be given to presentation skills, exposure to numerous outcrop examples, and to teamwork.

Basic geology courses are still a necessity for creating a functional geologist. Geology departments must continue to require all masters graduate students to work on a thesis.

□ The requirement by many oil companies of an internship in the petroleum industry should be communicated to all universities. It would be a disservice to graduate students to prepare for a career in an oil company, and then find that they have a low chance of employment because they did not spend a summer with an oil company.

□ As traditional university funding sources dry up, most departments are faced with difficult strategic decisions: do they forgo the role of fundamental research in favor of the more lucrative contract research areas?

Companies should consider increasing their funding of applied and fundamental petroleum research that involves both graduate and undergraduate students.

□ Companies need to have relatively steady recruiting and avoid the cyclic pattern that is now common. Most of the recruiting is occurring in a handful of schools. The industry needs to broaden the number of schools that they recruit from.

□ The student expo sponsored by AAPG needs to be expanded to be part of all Section meetings and a major part of the national and international AAPG meeting. Student and faculty involvement in the AAPG meeting needs to be encouraged.

□ Universities must accept that changes to traditional formats of degrees, courses, research and general ethos are required to survive. To replace professional staff in five years time, companies need to be currently investing in universities to safeguard earth science education. □

New Listings for Search & Discovery

The following articles have been posted recently on AAPG's online journal, Search and Discovery (www.searchanddiscovery.net):

□ "Sand Conditions as Indicated by the Self Potential Log," by B.W. Wilson and R.H. Nanz, classic Shell Development Co. EPR Memorandum Report 51, which presents concepts and applications that have been used for more than 40 years.

□ "Some Structural Styles on Reflection Profiles from Offshore Niger Delta," by Deborah E. Ajakaiye and Albert W. Bally, excerpts from AAPG Continuing Education Course Note Series #41, *Course Manual and Atlas of Structural Styles on Reflection Profiles from the Niger Delta*.

□ "Reservoir Geology of ERT (Penn Sand) Field, Potter County, Texas: A Case For Cores," by Robert W. Von

Rhee, adapted from oral presentation to Tulsa Geological Society, Oct. 1, 2002.

□ "Animation Model of West Central South America from the Early Jurassic to Late Miocene, with Some Oil and Gas Implications," by Terry Li Arcuri and George H. Brimhall.

□ "The Eocene and Oligocene Paleo-Ecology and Paleo-Geography of Whale Valley and Fayoum Basins: Implications for Hydrocarbon Exploration in the Nile Delta and Eco-Tourism in the Greater Fayoum Basin," a guidebook for a recent AAPG field trip. Authors are John Dolson, Ahmed El Barkooky, Fred Wehr, Philip D. Gingerich, Nina Prochazka and Mark Shann.

□ Abstracts for the recently held GCAGS annual convention in Austin, Texas, and for the Eastern Section meeting in Champaign, Ill.

www.update

AAPG Divisions Share AAPG Site

By JANET BRISTER
Web Site Editor

There are three divisions of AAPG, and each of them have their own Web site. Have you explored these and their resources?

☐ DEG – The Division of Environmental Geosciences offers a lot of information about their organization as well as some helpful fact sheets on ISO standards and coalbed methane. You can also download a membership application and get details on how to submit an article to their science journal.

☐ DPA – The Division of Professional Affairs has applications available for certification as well as their certified membership's directory. Besides offering their newsletter online, they also stay current with state registration issues and provide testimonies shared before various government bodies.

Contract models for geoscience services and confidentiality agreements are also provided.

☐ EMD – The Energy Minerals Division is loaded with information about the division and its sections. They've also provided a technical area discussing topics that include: coal, coalbed methane, gas hydrates, geospatial information systems (GIS), tar sands and uranium, to highlight a few.

If you're not a member of a division of AAPG, you can still explore their sites and benefit from the information they've provided online. However, joining any or all of these divisions is made easy through their online resources.

* * *

Can you guess your way to a Web address?

When you are in a hurry and wanting to look for someone or something, have you ever tried to enter a URL into the address/location box in your browser without accessing a search engine?

For those of you who prefer Internet Explorer (IE) for your browsing experience try this time-saving tip next time you're in a rush. (Note: Some of the following will apply to Netscape, but not all.)

You don't have to type "http://" each time you enter a URL (Web address). HTTP stands for "hyper text transfer protocol," which means your browser will access files written in HTML "hyper text markup language." IE assumes you are wanting to view HTML pages.

Since most Web sites are commercial sites, it will also assume the ending of the Web address is ".com," and IE will insert that as well. So if you typed "aapg" into the address box of IE it will look for www.aapg.com – which by now many of you have found to be a physical fitness equipment company. Yes, they got that URL before we did.

But don't bother with the http://; simply using www.aapg.org will save a few keystrokes and a few seconds. Same would be true with many companies – and you could skip the .com part. However, if you want to see how good you are at guessing, the following suffixes will help:

- ✓ .com – commercial business
- ✓ .edu – educational institution
- ✓ .gov – government agency
- ✓ .mil – military

✓ .net – miscellaneous (and many internet service providers of various sorts)

✓ .org – non-profit organizations
Many people try doing a simple search by typing a company name or product into the address box and then pressing [enter]; however, this usually is more time consuming than going to your favorite search engine to do the same thing.

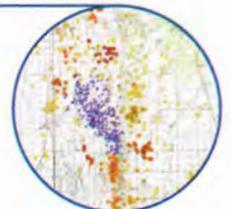
Good browsing! ☐

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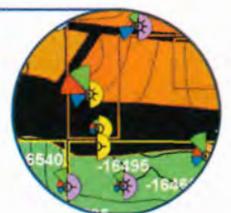
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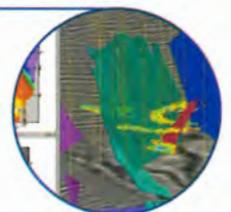
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BUSINESS SIDE OF GEOLOGY

Incentives Had Better Be in Sync

By PETER R. ROSE

"Whatever you subsidize, you get more of."

Referring to government incentive and assistance programs, that quote was attributed to Milton Friedman, the Nobel Prize-winning economist from the University of Chicago.

The business version of that statement is:

"Whatever you incent, you get more of."

All too often, however, functioning incentives – both official and unofficial – of different parts of companies are not aligned so as to mutually reinforce what is best for the parent firm.

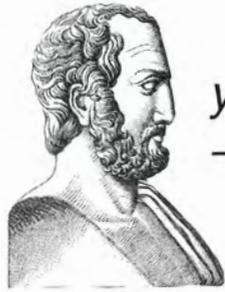
Sometimes such incentives actually may work against each other.

My first encounter with such problems occurred when I was with Shell in the 1960s, in trying to coordinate exploration data needs with the goals of our drilling department. We needed rock data – cores or sidewall samples – to calibrate our borehole logs, seismic and cuttings records.

From the viewpoint of the drilling engineer, however, our request represented increased costs, time and hole-integrity risks.

We were being rewarded for making a successful new play, which required us to locate the correct reservoir facies, whereas he was being rewarded for drilling a trouble-free well as cheaply as possible.

Our respective reward systems were not aligned.



Take a hard look at your stated incentives – are you really rewarding the behavior you want?



* * *

Here's a second example:

During the 1980s and early 1990s, several companies reported drilling an embarrassing number of obligatory dry holes in international contract areas. Many of these dry holes, at the time of drilling, were recognized as having no chance of finding oil or gas, but the contracts which had been signed several years earlier before additional data had been acquired required them to be drilled anyway.

How did this happen?

The business folks who obtained international concessions were being rewarded by how much acreage could be acquired in certain nations or regions, and sometimes they were not in effective liaison with the regional explorationists and play-makers, who were mapping future potential trends based on geotechnical criteria.

The result? The company was

acquiring a lot of land – some under very attractive terms – but much of it was not very prospective.

Naturally, low historical success rates by the company's exploration department did not encourage the management to award incentive bonuses to geoscientists! Once again, key incentives were not aligned.

* * *

As E&P companies of all sizes seek to become more efficient (and thus optimize their economic performance), they inevitably come to grips with the necessity of central coordination of their portfolios. The reason is straightforward: Individual business units simply cannot have the perspective to select those projects that are best for the parent organization, to maximize the likelihood of meeting its goals for cash flows and growth.

Sometimes this sets up tensions between the operating business units and headquarters. Understandably, business units want to maximize their autonomy, whereas headquarters wants to be sure project selection optimizes portfolio performance.

Commonly, the problem is that whereas the incentives for the headquarters staff are aligned with corporate performance, incentives for business units are focused more on local performance metrics than on corporate goals.

A third example: At the local business unit level, the goal might be "to get three exploratory wells drilled this year."

Such a goal focuses on activity rather than adding value. All too often, this sets up a "dash for cash" that results in business unit A's good projects not getting drilled because available budget went to business unit B's prospects, which were rushed through, overestimated and oversold.

Result: the corporate portfolio underperformed, even though business unit B may have achieved its own goals of getting more of the drilling budget.

Solution? Take a hard look at your stated incentives (as well as the unstated ones!). Are you really rewarding the behavior you want? Are you just rewarding activity, or actual creation of corporate value?

continued on next page

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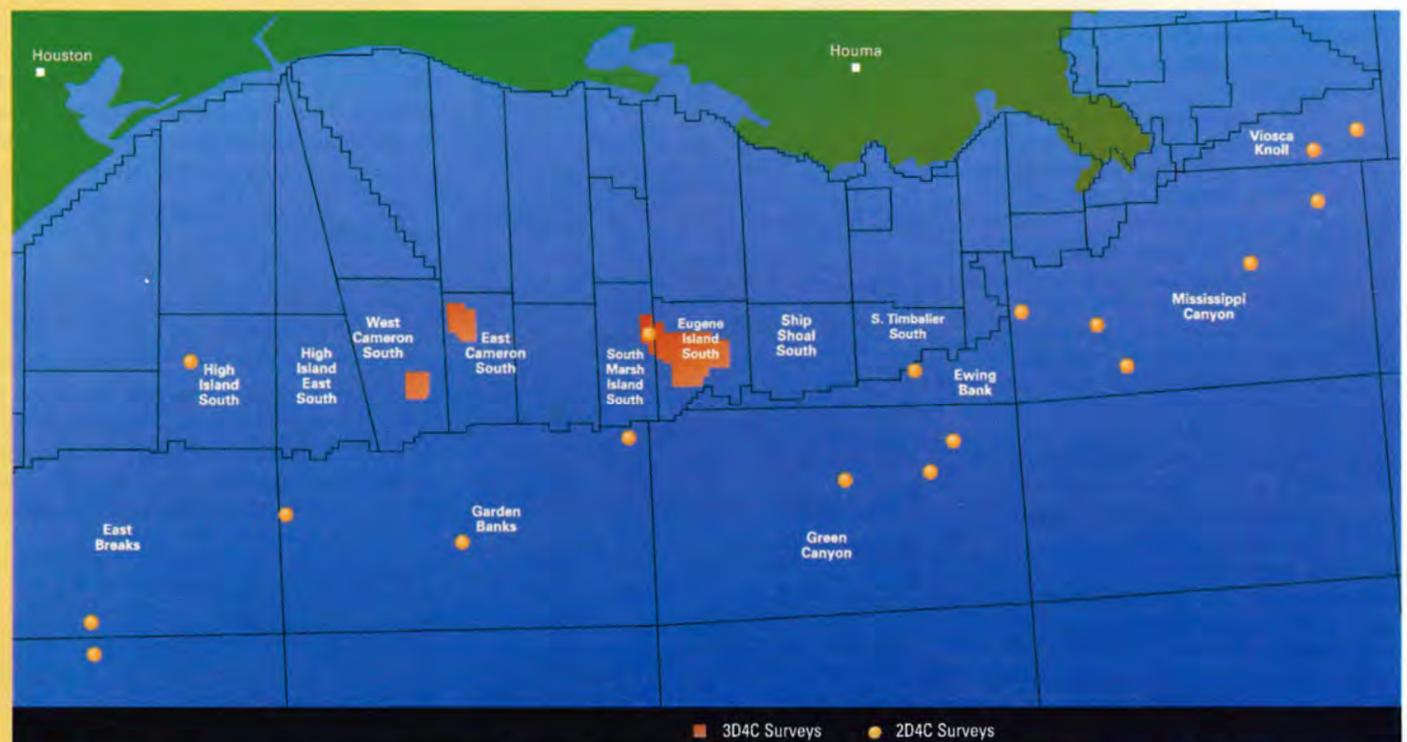
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Spring Student Expo a Great Place to Meet, Hire

Hey students! Want a job? Here's an idea for you.

Hey companies! Want to hire young geologists? This idea is for you, too.

The next AAPG/SEG Spring Student Expo, designed to be a network meeting place for geoscience college students and potential energy industry employers, will be held March 14-15, 2003 at the Sarkeys Energy Center at the University of Oklahoma in Norman, Okla.

The spring expo is an outgrowth of AAPG's successful annual Fall Student Expo, which was started in Houston five years ago. Both events

bring company representatives together with students for the goal of recruiting young people into the energy industry.

The 2002 spring expo attracted over 100 students majoring in geosciences-related disciplines attending from 37 colleges and universities, representing 18 states, as well as Canada and Venezuela.

The 2003 spring expo, now sponsored jointly by AAPG and SEG, also provides an opportunity for students to showcase their work in poster format and to network with industry representatives.

This expo will provide another opportunity for employers from small to mid-size companies to interview potential summer interns, part-time or full-time employees. Also, larger companies who formally recruit on campuses each fall are offered an additional opportunity to recruit future potential employees. Energy-related organizations and companies also will have the opportunity to host exhibit booths and network with students.

Company personnel will be able to informally talk with students during an icebreaker the evening of March 14, as well as during the poster session

and more formal onsite interviews on March 15. Sponsoring companies will be provided with student resumé and abstract books in early March to help plan tentative interview schedules.

The expo's hosts are the University of Oklahoma Sarkeys Energy Center, the School of Geology and Geophysics, and the Oklahoma Geological Survey.

Information brochures and registration forms are available from Sue Crites at (405) 325-8971 or via e-mail: scrites@ou.edu.

Also, watch the AAPG Web site for details. Registration is due by Jan. 5.

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The goal of everyone should be, "What's good for the portfolio is what's good for the company – and my business unit is just one cog in that wheel."

Whenever I'm asked to help client companies correct chronic under-delivery of promised E&P reserves, I ask, "What are your geoprofessionals being rewarded for – creating value, or getting wells drilled?"

In all our discussions with senior managements, one of our key counsels is: "Take a hard look at your incentive systems, both stated and unstated – be sure you're really rewarding behaviors that are aligned with your corporate goals."

Remember: "What you incent, you get more of!"

* * *

Recommended Reading: *The Clash of Civilizations and the Remaking of World Order*, Samuel P. Huntington (Simon & Schuster, 1996).

In one of the most important books of the last decade, Huntington provides the thesis and documentation that a globalized, integrated world economy along the Western model will not eventuate in the 21st century, because the other seven dominant world cultures will be able to hinder and suppress free-market functions. Very strong stuff.

Read it, you'll like it!

(Peter R. Rose is senior partner of Rose & Associates, Austin, Texas.) □

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GEOPHYSICAL CORNER

Simple Seismic, Complex Fractures

The Geophysical Corner is a regular column in the EXPLORER, edited by Denver consultant R. Randy Ray. This month's column is the second of a two-part series, dealing with fracture properties and azimuthal seismic data.)

By BOB PARNEY
and PAUL LaPOINTE

Last month we recognized how recent advances in the processing of 3-D seismic data are providing valuable new tools for the imaging of fracture properties between wells. In order to interpret this data it is necessary to understand how fracture patterns influence the seismic data, and to understand the types of fracture heterogeneity that are likely to occur at this newly imageable scale.

This month we discuss the interpretative steps needed to extract the complex properties of natural fracture systems from the simple seismic fracture models used during processing.

Discrete Fracture Network (DFN) models have provided an important tool to make the connection between seismic properties and reservoir.

Interpreting Multiple Fracture Set Properties

The determination of fracture azimuth and intensity is usually based on the assumption that there is a single dominant fracture orientation, typically vertical.

Frequently, fractures occur in several sets with cross-cutting orientations (figure 1), and generally multiple sets are necessary in order to get well-connected plumbing for long-term productivity in the absence of high matrix permeability.

A number of attributes can be extracted from the seismic data. They can be grouped into two major categories:

- Attributes that sample fracture orientation.
- Attributes that sample fracture intensity.

Orientation attributes such as the fast P or S wave velocity azimuth were initially interpreted as the dominant fracture orientation. In the case of multiple fracture sets, the seismically sampled orientation is a function of the relative intensity of each fracture set.

The net effect of multiple sets appears to be an average azimuth weighted toward the dominant set, although some data appear to show the seismic azimuth switching from one set orientation to another with no intermediate orientations apparent.

For example, in an area characterized by a single dominant regional fracture trend orientation, any additional second fracture set may cause the attribute to appear to rotate away from regional trend, although there is no actual rotation of either of the fracture set orientations.

Anisotropy: Fractures or No-Fractures

In the early development of anisotropic seismic analysis it was thought that high levels of anisotropy, as measured by the difference between the fast and slow P and S wave velocities, indicated a high level of fracturing. It is becoming clear that the influence of multiple fracture sets complicates the

seismic intensity measurements.

For example, where fracturing is intense, the seismic properties used to characterize orientation tend to become more isotropic. Small variations in any one set can produce apparent rotations of the interpreted fracture orientation. Isotropy in these seismic properties also exists when fracture intensity is very low.

Thus, the magnitude of the anisotropy does not in itself differentiate between regions of high fracture intensity and low fracture intensity.

Other attributes such as interval velocity must be used to differentiate between an absence of fractures and an excess of fractures.

The Next Step: Calculating Permeability

Once the attributes of the natural fracture system have been mapped, the next step is to take these attributes and use them as a predictive tool.

This process, however, is not as simple as identifying fracture properties at a potential drilling location, as it is the connectivity between the well and the fracture network that is critical. Seismic attributes do not yet quantify any aspects of fracture network connectivity.

For example, in figure 2a the same five fractures occur in each of the two sample volumes, and would exhibit similar seismic attributes. However, only the network on the right (figure 2b) would be conductive.

In order to assess the connectivity of a reservoir, the next step after obtaining the fracture attributes from the seismic data is to use DFN models to understand the consequences of fracture orientation and intensity on permeability.

The DFN approach models fractures as two-dimensional polygonal planar objects, like playing cards, located in three-dimensional space (figure 3a). Each fracture is characterized by its surface area and shape, and has flow

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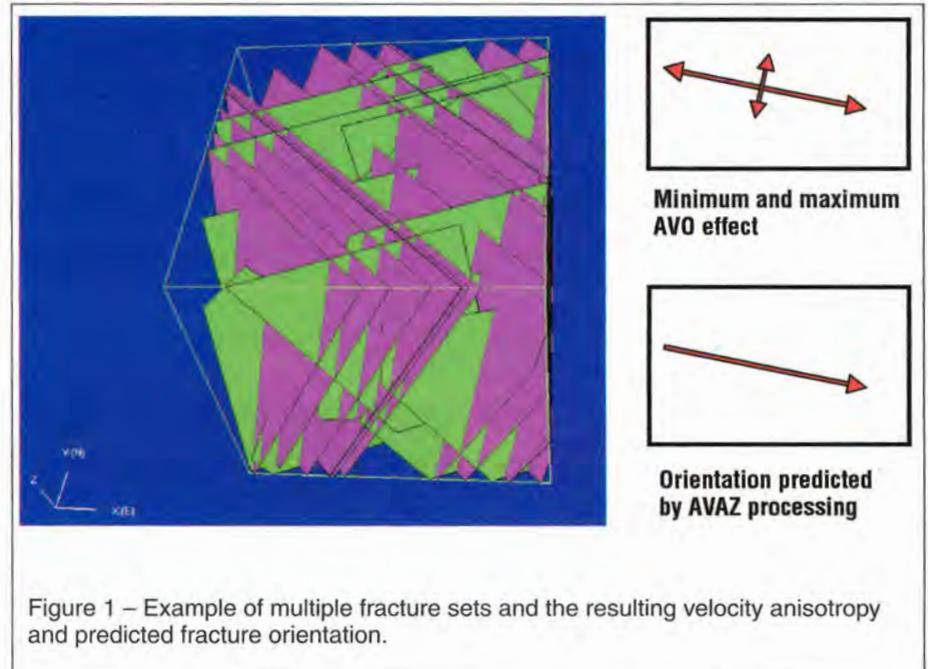


Figure 1 – Example of multiple fracture sets and the resulting velocity anisotropy and predicted fracture orientation.

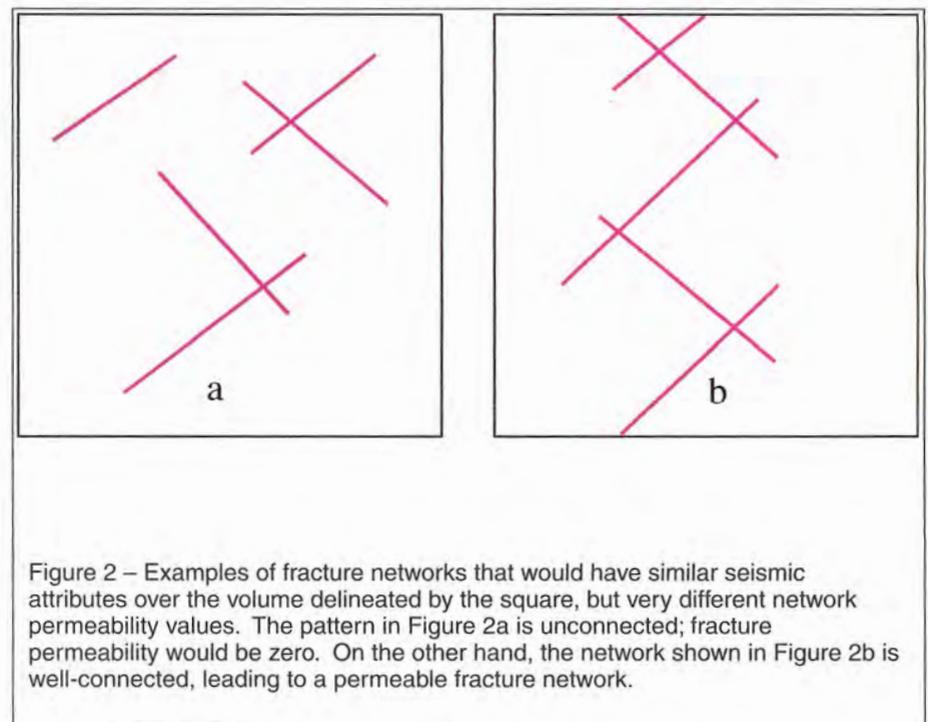


Figure 2 – Examples of fracture networks that would have similar seismic attributes over the volume delineated by the square, but very different network permeability values. The pattern in Figure 2a is unconnected; fracture permeability would be zero. On the other hand, the network shown in Figure 2b is well-connected, leading to a permeable fracture network.

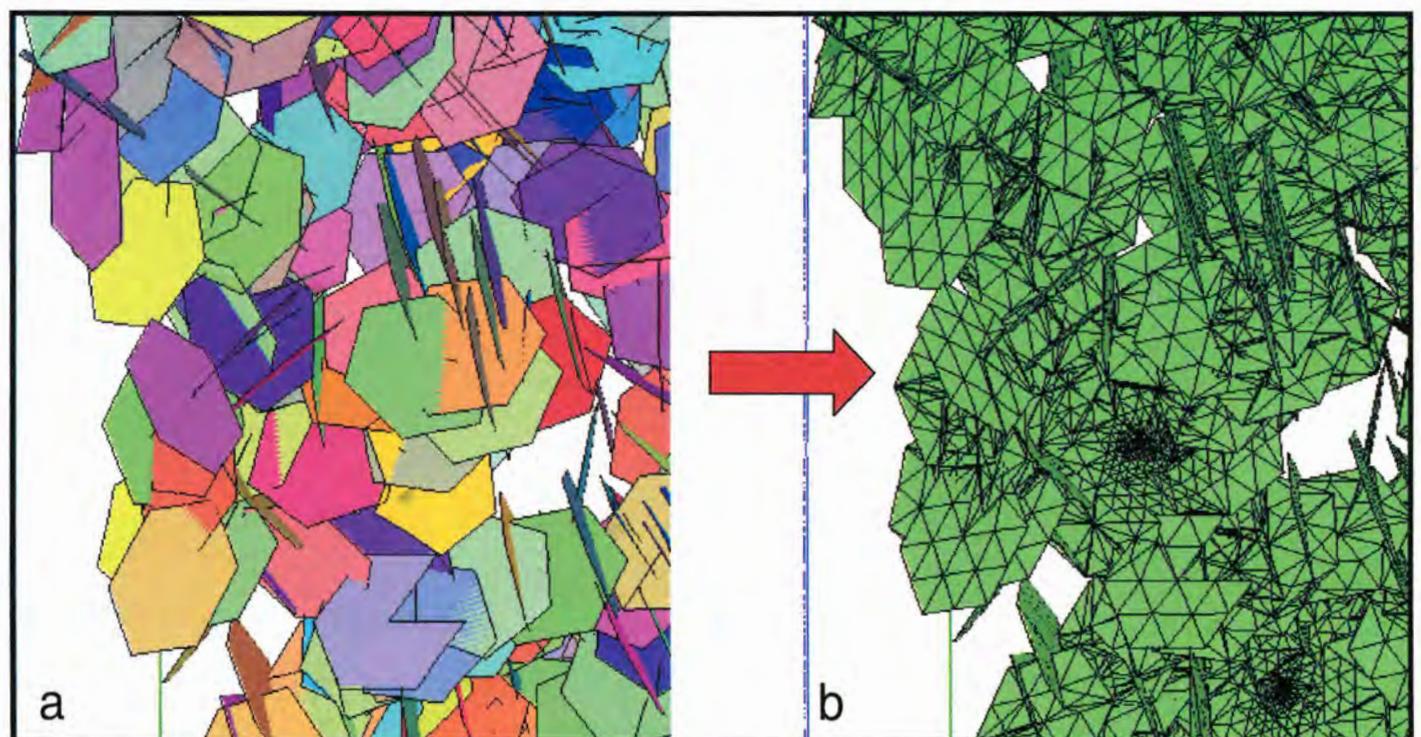


Figure 3 – Conversion of a DFN model of fracturing into a finite element mesh for use in simulating flow and transport through the fracture network. DFN models make it possible to calculate the network permeability at any scale, and thus provide the link between seismic attribute data and permeability values.

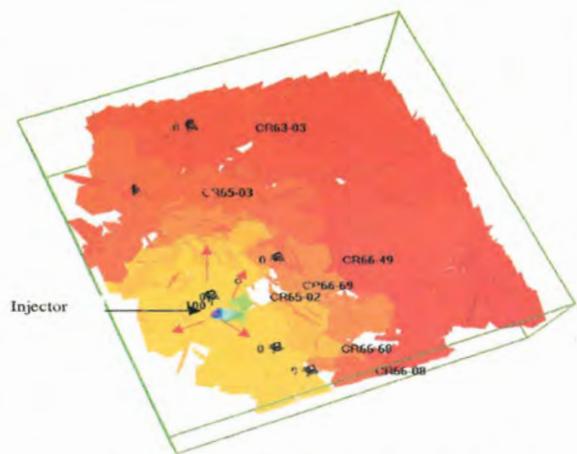


Figure 4 – Snapshot of pressure in the fractures after injection. The colors indicate the pressure variations in the network (Blue colors indicate high pressure, red indicates low pressure). Red arrows show direction of flow out from the injector into the fracture network.

Figure 5 – A DFN model with fractures curling around the structure of a plunging anticline. The cyan and blue colors indicate higher permeability, and the magenta cells with lower fracture permeability. Note the high permeability corridor set up along the crest of the anticline.



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properties such as permeability, compressibility and aperture.

Network models can be formed based on an interpretation of seismic attribute data, engineering data and image log data as available.

Once fractures are generated, a finite element mesh can be constructed according to the fracture geometry (figure 3b), and a flow solution can be obtained that takes into account the connectedness of the fracture system.

Figure 4 shows an example of a pressure pulse spreading through a fractured reservoir in response to injection.

Seismic + Fractures = Permeability Prediction

The DFN approach can be combined with seismic attribute mapping by first developing an interpretation of the link between attributes and fracturing.

For example, the difference between the fast and slow P or S velocities can be used to control the fracture intensity of one fracture set within the DFN reservoir model, and the rotation of the P or S fast velocity azimuth can control the generation of the second fracture set.

Once the DFN model has been generated, a grid can be placed over the model and a finite element mesh used to calculate the potential volume of flow within each of the grid cells.

In figure 5, a DFN model is displayed with a grid populated by fractures, with the colors in each grid cell indicating the calculated permeability values. In this case, a high permeability pathway has evolved along the crest of the anticline due to the structural control of fracturing.

Summary

Recent advances in the processing of 3-D seismic data are providing valuable new tools for quantifying fracture properties between wells. In order to make use of this new information, it is necessary to:

- ✓ First interpret the connection between the seismic measurement and the naturally occurring fracture sets.
- ✓ Connect the fracture pattern to reservoir parameters through techniques such as DFN modeling.

Although uncertainties abound, these attributes provide new insight into notoriously difficult reservoirs, and promise to enhance recovery through focused engineering efforts. □

Editor's note: Bob Parney (bparney@axisgeo.com, 303-831-0544) is with Axis Geophysics, Denver, and Paul LaPointe is with Golder Associates, Redmond, Wash.

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EDUCATION CALENDAR

Short courses are listed here in chronological order; field seminars are sorted by subject matter, subsorted by date.

2003 Short Courses

Quick Look Mapping Techniques for Prospect Evaluation
March 4-5, Fort Worth
(with Southwest Section meeting)

Reservoir Engineering for Petroleum Geologists
April 7-8, Dallas

An Overview of Exploration Play Analysis
April 9-11, Austin

Introduction to Concepts and Techniques of Petroleum Geology
April 23-25, Dallas

Introduction to the Petroleum Geology of Deep-Water Clastic Depositional Systems
May 8-10, Salt Lake City
(with AAPG annual meeting)

Coalbed Methane
May 10, Salt Lake City
(with AAPG annual meeting)

E&P Methods and Technologies
May 15-17, Salt Lake City
(with AAPG annual meeting)

Applied Subsurface Mapping
July 14-18, Dallas

2002 SHORT COURSES

Quantification of Risk
Nov. 11-14, Dallas

Terrigenous Clastic Depositional Systems and Sequences – Applications to Reservoir Prediction, Delineation and Characterization
July 22-23, Austin

Well Log Analysis & Formation Evaluation
Aug. 5-8, Austin

Quantification of Risk – Petroleum Exploration & Production
Aug. 18-21, Golden, Colo.

Practical Salt Tectonics
Sept. 3-5, Houston

Pore Pressure Prediction in Practice
Sept. 20-21, Barcelona, Spain
(with AAPG international meeting)

Geostatistics for Seismic Data Integration in Earth Models
Sept. 20, Barcelona, Spain
(with AAPG international meeting)

Structural Geology and Hydrocarbon Accumulations in Selected Basinal Regimes
Sept. 25-26, Barcelona, Spain
(with AAPG international meeting)

Deepwater Sands – Integrated Stratigraphic Analysis
Sept. 25-26, Barcelona, Spain
(with AAPG international meeting)

Structural Styles and Traps
Oct. 11-12, Tulsa
(with Mid-Continent Section meeting)

Log Analysis of Shaly Sands
Oct. 22, Baton Rouge, La.
(with GCAGS Section meeting)

Siliciclastic Sequence Stratigraphy
Oct. 25-26, Dallas
(with SEG annual meeting)

Fractured Reservoir Characterization and Modeling
Nov. 10-14, Austin

2003 Field Seminars**Carbonates**

Carbonate Reservoirs: Physical Reality Meets Virtual Reality in Middle Eastern Carbonates
March 30-April 3
Begins, ends in Muscat, Oman

Carbonate Sequence Stratigraphy: Outcrop and Subsurface Seminar
April 26-May 3
Begins, ends in El Paso, Texas

Controls on Porosity, Distribution in Carbonate Reservoirs
Dates Pending
Begins, ends in Almeria, Spain

Sequence Stratigraphy and Reservoir Distribution in a Modern Carbonate Platform, Bahamas
June 23-28
Begins, ends in Miami, Fla.

*Carbonate Reservoir Characterization: From Rocks to Fluid Flow Simulation Using Sequence Stratigraphy, Paradox Basin, Utah, USA

May 15-19
Begins, ends in Durango, Colo.
(co-sponsored with SEPM, held in conjunction with the AAPG annual meeting)

Clastics – Ancient

Clastic Reservoir Facies and Sequence Stratigraphic Analysis of Alluvial-Plain Shoreface, Deltaic and Shelf Depositional Systems
April 27-May 3
Begins, ends in Salt Lake City

Wave-Dominated Shoreline Deposits and Foreland Basin Stratigraphy, Book Cliffs, Utah: Depositional Models for Hydrocarbon Exploration
June 9-17; Aug. 18-26
Begins, ends in Moab, Utah

Clastics – Modern

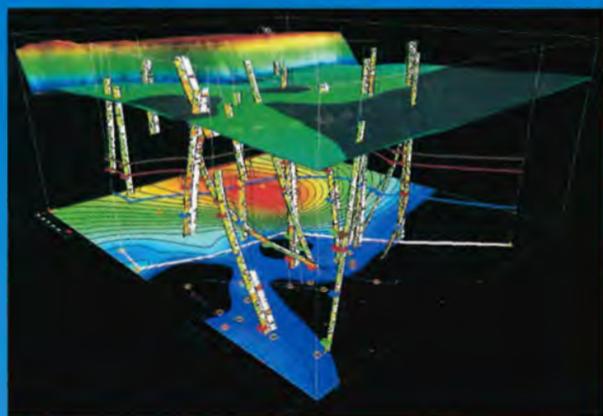
Modern Clastic Depositional Environments
April 13-19; May 12-18;
Sept. 22-28
Begins, ends in Columbia, S.C. and ends in Charleston, S.C.

Modern Deltas
Sept. 8-12
Begins, ends in Baton Rouge, La. and ends in New Orleans

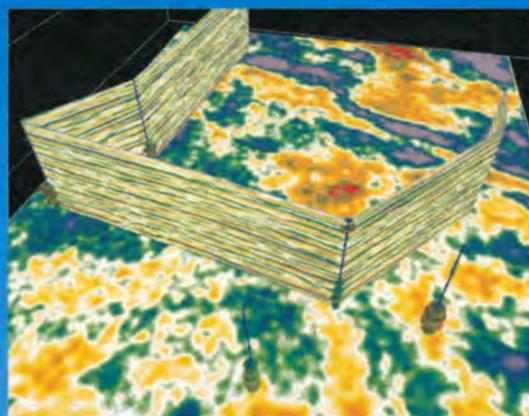
Sequence Stratigraphy

Sequence Stratigraphy Field Seminar:

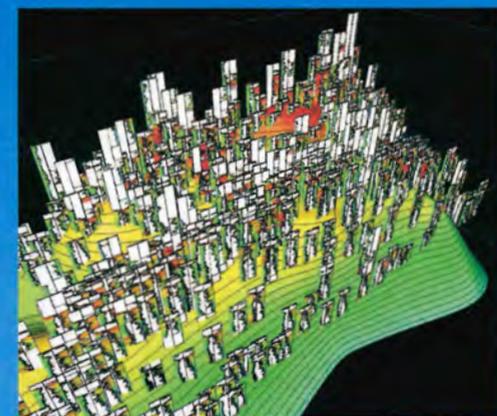
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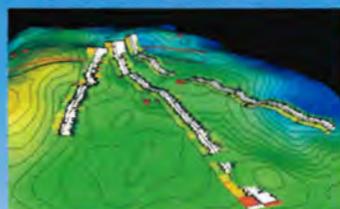
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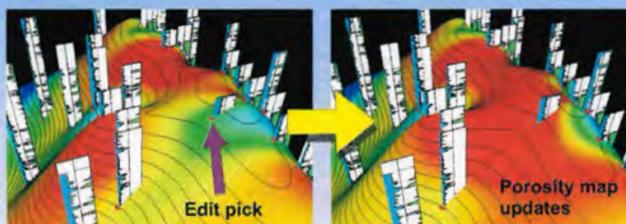


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BULLETIN Review System Online

Another step into the digital world has been taken by the AAPG BULLETIN, which now offers an online submittal, review and editing system.

The BULLETIN's Rapid Review System now digitally accepts papers for consideration, allows reviewers to review, editors to edit, authors to follow their papers through the process, all online from a central, easily accessible Web site.

"Experience at other scientific journals suggests that this capability should knock off several months of the submit-to-print turnaround time for a manuscript," said AAPG Elected Editor John Lorenz, who added that the system "will contribute significantly to solving the chronic headache of publication backlogs."

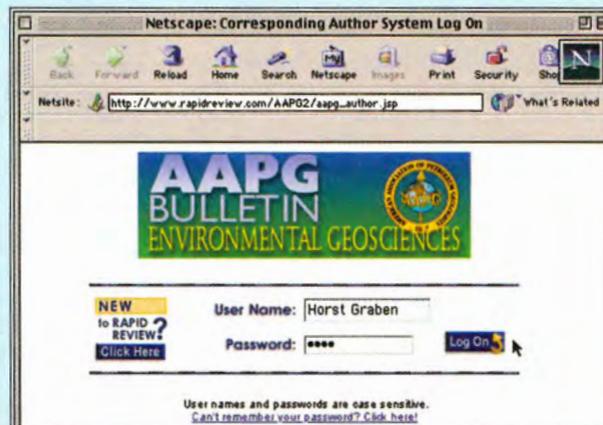
"We already have seen reduced shipping and

reproduction costs, quicker responses from reviews and improved reliability in getting manuscripts between far-flung physical locations," Lorenz said.

The BULLETIN will continue to accept mailed-in hardcopy manuscripts via the traditional process without prejudice. However, most of these will be converted to electronic format and entered into the system at AAPG headquarters.

"This is the wave of the future," Lorenz said, "and we expect/hope that the preponderance of submissions will be through this system within a year."

Instructions to BULLETIN authors can be accessed at http://www.aapg.org/pubs/bulletin_submit.htm.



continued from previous page

Sequences and Facies on an Active Margin

Oct. 12-17
Begins, ends in La Jolla, Calif.

Tectonics and Sedimentation

Exploration Potential, Tectonic Framework and Depositional Systems of Strike Slip and Extensional Basins

April 26-May 2
Begins, ends in Palm Springs Calif., and ends in Las Vegas

Salt and Extensional Tectonics – Paradox Basin

June 1-6
Begins, ends in Grand Junction, Colo.

E&P in Thrusted Terrains, Practical Applications of Structure and Stratigraphy in the Montana/Alberta Foothills

July 15-21
Begins, ends in Calgary, Canada

Submarine Fan and Canyon Reservoirs, Calif.

Sept. 29-Oct. 4
Begins in San Francisco
Ends in Bakersfield, Calif.

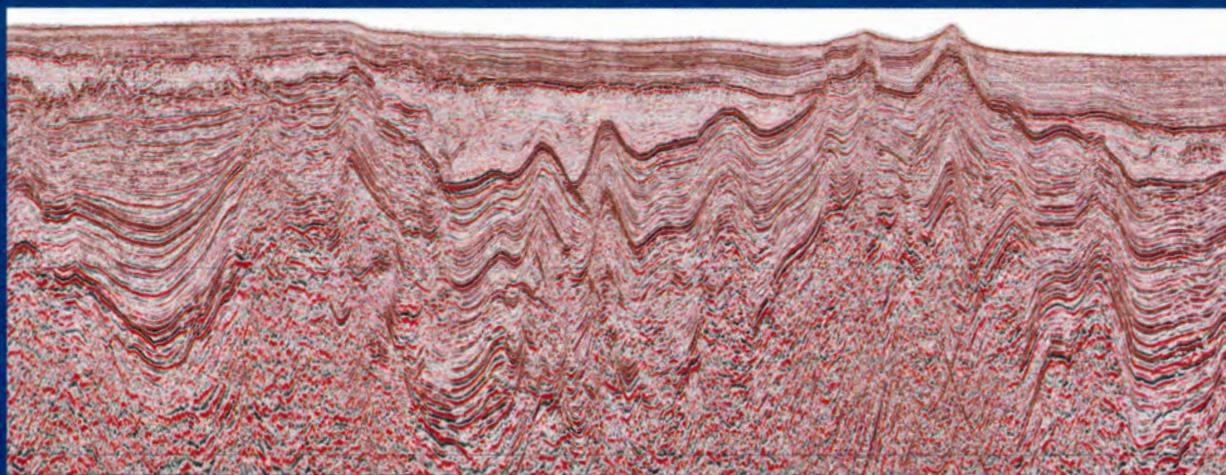
A Geotour

Grand Canyon Geology via the Colorado River, Ariz.

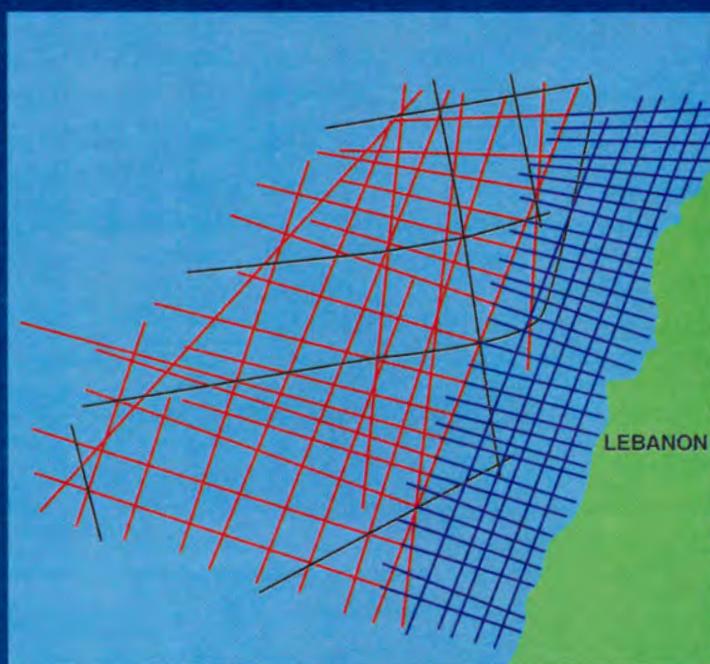
May 3-10
Begins in Marble Canyon, Ariz., ends in Marble Canyon or South Rim, Ariz., or Las Vegas (preceding the AAPG annual meeting in Salt Lake City) □

Offshore Lebanon

'The definitive dataset' with which to evaluate this previously unexplored country, in preparation for Lebanon's first comprehensive offshore licensing round



PSDM Section Offshore Lebanon

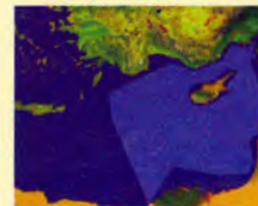


Total Lebanon Seismic – over 5000 kms



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- 2000 Spectrum/Fugro data
- 2002 Spectrum/Fugro data (with Fugro LCT grav/mag data)



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FOUNDATION UPDATE

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PROFESSIONAL NEWS BRIEFS

Jeff Ahbe has formed Ahbe Capital Investment Group, Greenwood Village, Colo. Previously vice president-exploitation, exploration and corporate development, Union Pacific Resources, Calgary, Canada.

Gardner Howard, to owner, Rodeo General Store, Maui, Hawaii. Previously international and domestic business development manager, H&H Star Energy, Traverse City, Mich.

Tim Marchant, to general manager, BP International, Abu Dhabi, United Arab Emirates. Previously exploration manager, ExxonMobil Saudi Arabia (Southern Ghawar), Al Khobar, Saudi Arabia.

Marisé Mikulis, to energy industry manager, Microsoft, Houston. Previously chief marketing officer, Upstreaminfo.com, Houston.

Ron Rhodes, to managing senior vice president, Ryder Scott Co., Houston. Previously senior vice president, Ryder Scott Co., Houston.

Patricia A. Santogrossi, to chief geologist, Knowledge Reservoir, Houston. Previously chief geologist, Chroma Energy, Houston.

Michael Sternesky, to vice president, business development, Knowledge Reservoir, Houston. Previously vice president, sales, Upstreaminfo.com, Houston.

Berry H. "Nick" Tew Jr. has been named state geologist and director of the Geological Survey of Alabama, and supervisor of the State Oil and Gas Board, Tuscaloosa, Ala. Previously director of Geographic Information Systems for the Alabama geological survey, Tuscaloosa. He also is an adjunct faculty member, University of Alabama's department of geological sciences.

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

Rift Theory

from page 20

which separates the Interior and Exterior salt basins and is described in most literature as a simple Lower Cretaceous carbonate bank build-up.

"If this is true, why does a much younger Cretaceous feature divide the lower Jurassic salt basin into two parts?"

"Why is there a strong magnetic response along the length of the feature?"

"Why has there been igneous intrusives found along the shelf edge?"

According to Reed, tectonic plate separation apparently began along the Cretaceous Shelf Edge with the separated plate moving south, causing rifting in a zone of the basin that contained a very thick section of Jurassic salt.

This reorganization of tectonic plates in

the basin would cause major orogenic movements along the bordering areas.

The rift cutting northeast through the United States, where earthquake activity has been documented in New Madrid as well as other points, is just one of these major orogenic movements. Others are:

□ The Late Miocene Trans-Mexico neovolcanic belt, which extends across Mexico to the Gulf Coast but apparently it never extended into the deep Gulf of Mexico Basin.

□ The east-west trending mountain ranges of Guatemala, Honduras and Nicaragua, which were formed under compressional forces, according to Reed. These mountain ranges extend offshore in the Caribbean Sea as seamounts.

□ Another example within the deep Cayman Trench, where there is a sea-floor spreading site building in a deep trench

environment.

Sea-floor spreading is generally found along mid ocean ridges and forms high positive features. However, this site in the deep Cayman Trench is an extreme negative zone and prominent north-south trending spreading ridges have been generated. This zone is located east of the left lateral transform offset of the Caribbean plate.

So, the obvious question for Reed is, what's the exploration potential of this rift zone that cuts through North America?

"Not much," Reed conceded. "But if you want waterfront property you should buy land around Indianapolis. In a couple of million years this acreage could be overlooking the Strait of America that separates western (and) eastern America!" □



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DEG Slate of Officer Candidates Announced

The DEG ballots will be distributed to members in February 2003, for return to DEG by March 15, 2003.

President-Elect 2003-2004 (President 2004-2005)

Ken Vogel
 University of Texas at Austin, M.A. Geology
 University of Wisconsin-Madison, B.S. Geology and Geophysics
 Senior Associate, Leggette, Brashears & Graham, Inc., St. Paul, Minnesota



Vogel

Why I accepted the invitation to be a candidate for DEG President-Elect

The depth and scope of environmental issues affecting the petroleum industry continues to grow. Environmental concerns affect every aspect of our daily business and personal lives to some degree. As a result, our profession is increasingly challenged to become better environmental stewards while working in an economic climate of great uncertainty. DEG is a critical resource for all AAPG members who need to stay abreast of rapidly changing environmental issues.

Having previously served DEG as a Charter member, committee member, Associate editor, and Secretary/Treasurer, I accepted the invitation to be a candidate for DEG President-Elect with the desire to continue DEG's mission to act as a dynamic and creative resource within AAPG.

Don Clarke
 Joint MS program
 California State University, Northridge, Los Angeles, & Long Beach
 B.S. Geology from California State University, Northridge



Clarke

Why I accepted the invitation to be a candidate for DEG President-Elect

I accepted the nomination to run for DEG President-Elect on the condition that if I am elected I will use the position to increase the awareness of the energy industry to the environment and to accurately share our industries knowledge of the environment with the general public. I feel that many of our industry's problems on environmental

issues stem from lack of information. Typically our industries scientists talk over the heads of the public and just as typically the public is swayed by biased news reports that are not backed by science. We need to join in and get accurate information out in understandable terms.

Vice President 2003-2004

Dr. Ian W. Moxon
 Ph.D., Geology, Stanford University
 B. Sc., Geology, University of California, Los Angeles
 Geologist, BP America Production Company, Houston, TX



Moxon

Why I accepted the invitation to be a candidate for DEG Vice President

I am running for Vice President of DEG to participate in the AAPG's objectives of educating its members, supporting research, and communicating scientific information to government agencies about the effects of exploration and production on the environment. These efforts are important to enhancing the vitality of our profession while improving environmental performance of our industry. Environmental performance is one of the more controversial lenses through which the petroleum industry gains the attention of the public, media, and policy-makers. Achieving excellence in environmental performance can lead to enhanced public reputation and financial performance for our industry, and therefore merits active engagement in these issues.

Kenneth G. Johnson
 BS, Geology, Union College, New York
 MS, Geology, Michigan State University
 PhD, Sedimentology, Rensselaer Polytechnic Institute
 Professor of Geology Emeritus, Skidmore College, Saratoga Springs, NY



Johnson

Johnson has been a member of AAPG since 1960, and is a charter member of DEG and an associate editor of *Environmental Geosciences*. He has served as Eastern Section (ES) representative on the DEG Advisory

Board and has been the recipient of the DEG Research Award. His AAPG activities include treasurer, secretary, vice-president and president of ES-AAPG; general chair of an ES annual meeting; member, Nomination and Election Committee of the AAPG House of Delegates; member of the 1984 AAPG delegation to People's Republic of China; communicator, AAPG Committee on Governmental Affairs; DEG representative on the Distinguished Lectures Committee; ES Distinguished Service Award; AAPG Certificate of Merit; ES Honorary Member Award and ES Certificate of Merit.

Secretary-Treasurer 2003-2005 (Two-year term)

Brenda Kirkland
 Ph.D., Geology, Louisiana State University
 M.S., Geology, Texas A&M University
 B.S., Geology, University of Texas
 B.A., German, University of Texas
 Adjunct Faculty, Department of Geosciences, Mississippi State University



Kirkland

Why I accepted the invitation to be a candidate for DEG Secretary-Treasurer

As an educator I teach students the need for a balance between environmental issues and our fundamental dependence on petroleum products and ore minerals. I show them that knowledge of earth systems allows us to use natural resources responsibly. As a citizen I am aware of extreme viewpoints on environmental questions. I recognize how much I have profited from membership in AAPG/DEG and work on the Continuing Education Committee. By adding to existing course offerings, journal articles, and the Web site, DEG can provide solid, unbiased scientific information and contribute a much-needed, educated, and balanced perspective.

Mary L. Barrett
 Ph.D., Geology, Johns Hopkins University, Baltimore, MD
 M.S., Geology, Stephen F. Austin St. University, Nacogdoches, TX
 B.S., Geology, Stephen F.



Barrett

Austin St. University, Nacogdoches, TX
 Associate Professor of Geology, Centenary College of Louisiana

Why I accepted the invitation to be a candidate for DEG Secretary-Treasurer

I accept the invitation to be a candidate for DEG Secretary-Treasurer, as it allows me to serve AAPG at a time when environmental debates are often lacking in sound geoscience principles, especially in key issues concerning the petroleum industry. My background in both the petroleum industry and environmental geoscience education, plus my involvement in several environmental issues within my region, have made me acutely aware of what can happen when scientifically literate people do not speak up or get involved. Hydrocarbon development and usage require careful environmental decision-making based on sound science; DEG promotes such standards. □

DEG Officers/Contacts

President
 Robert J. Menzie, Jr.
 (713) 296-3457
 Fax: (713) 296-3401
rjmenzie@marathonoil.com

Vice-President
 Steven P. Tischer
 (915) 697-7489
 Fax: (915) 699-1978
stischer@arcadis-us.com

President-Elect
 Rima Petrossian
 (512) 936-2420
 Fax: (512) 936-0889
rpetross@twdb.state.tx.us

Secretary-Treasurer
 William Sarni
 (303) 232-0193
 Fax: (303) 232-0394
wsarni@pendergast-sarni.com

Environmental Geosciences Editor
 Gerald R. Baum
 (410) 554-5525
 Fax: (410) 554-5502
gbaum@mgs.md.gov

Past President
 William E. Harrison
 (785) 864-3965
 Fax: (785) 864-5317
harrison@kgs.ukans.edu

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REPORTER Editor
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DEG and EMD have initiated an effort to publish a book on the Geological Sequestration of Carbon Dioxide. Manuscripts for consideration are currently being solicited. If you have an interest in either working on this project or submitting a manuscript, please contact either Robert Menzie, DEG President (see contact information on this page) or Rebecca Dodge, EMD President (770) 830-2376 or rdodge@westga.edu.

READERS' FORUM

Significant Volumes

I recently attended a meeting where a speaker discussed ANWR and repeated the observation that the estimated oil resources of the Coastal Plain portion was only a "six-month supply" for the United States.

At current rates of consumption (3.6 billion barrels at 20 million/day) this statement is most misleading, as it implies:

☐ The volume of oil isn't a significant amount.

☐ The entire amount might be produced in that six-month period.

Knowing the audience had a limited understanding of the oil industry and wouldn't be able to evaluate those two implications, I pointed out during the Q&A period that 3.6 billion barrels of new oil was a significant amount that would increase the U.S. reserve base by about 20 percent.

I also pointed out that oil fields are produced over lifetimes of 20 to 30 years or more, not six months as implied, because basic reservoir engineering principles limit production to 10 to 15 percent of a field's reserve. I hope some attendees recognized the "pitfalls" of the "day's supply" argument that was being used in opposition to oil development.

We in the oil industry know from experience that 100 million-barrel oil accumulations are uncommon, and that billion-barrel accumulations are a rarity. The public, unfortunately, doesn't. But a quantification of "what is significant" can be derived from the industry's cumulative production and proved reserve information that is available

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.

through the Energy Information Administration.

Those industry-wide summations can be used to help individuals understand what constitutes a "significant volume." They show that during the 1859-2001 time period:

✓ Oil production has been developed in 32 states.

✓ The median cumulative production per state is about 1.5 billion barrels (for the 25 states with more than 100 million barrels cumulative the median is 1.8 billion).

✓ Only five states have a cumulative production of more than 10 billion barrels (Texas, California, Louisiana, Alaska and Oklahoma).

Against the three points of this volumetric framework, the significance of ANWR's 3.6 billion barrels is not difficult to evaluate – especially when you consider that the 2,344 square-mile-area of the Coastal Plain could have a cumulative production larger than the median volume of the individual oil producing states.

Comparisons with proved reserves also quantifies "significance" as the 3.6 billion barrels would be:

✓ A 16.8 percent increase in the December 31, 2000, proved oil reserve for the United States of 22 billion barrels.

✓ A 74 percent increase in the December 31, 2000, proved of 4.8

billion barrels for the state of Alaska.

With a demonstration of significance for the "six-month supply" in the Coastal Plain of ANWR, decisions to not open it to exploration and possible development will have to be based on other social, safety or economic factors. Its potential resources are significant.

I urge readers to use the volumetric information to help the public understand what is a "significant volume" in the exploration and production sectors of the oil and gas industry.

Donald L. Ziegler
Windsor, Calif.

Try Something New

In the view of a number of distinguished explorationists, it appears that present day seismic surveys are correctly acted upon at a rate of somewhat less than 20 percent. After 70 years of seismic use and a present batting average of less than 20 percent for rank wildcats, it's time to try something new ...

Kathy Shirley's two articles on direct hydrocarbon indicators (DHI) (September EXPLORER) were an inspiration.

In my opinion, there are but two reasonable direct hydrocarbon indicators:

☐ Well logging with coring and

analyses, which requires previous drilling.

☐ Temperature anomaly technology, which, when compared to seismic, appears to be four times as efficient, less than one percent as costly, takes less than one percent of the time to generate, is vastly superior in the environmental impact and requires no permitting. Yet these costs are minor when compared with the leasing and drilling of dry, or noncommercial holes.

DHI efforts are far from new. Lectures on acoustic amplitude identification of hydrocarbons occurred at least 40 years ago in the United States, and in Algeria, France and Germany in 1964. As far back as 1962, a major oil company seismologist and an assistant area manager for a service company worked with acoustic amplitude identification of hydrocarbons – but ... they couldn't find any manager willing to be the first to modify existing equipment to test the new exploration method's potential.

Seismic waves are initiated at or near the surface and are reflected back to the surface for both a downward and upward travel path. At the same location and depth, net heat transfer is only an upward affair with little concern for reflection.

Seismic interpretation requires a number of survey lines, control reference wells and considerable geologic study. The data is generally processed until it agrees with the interpreters preconceived ideas. Temperature anomaly technology is

See **Forum**, next page

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MEMBERSHIP AND CERTIFICATION

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

For Active Membership**California**

Dvorkin, Jack P., Stanford University, Stanford (S.A. Graham, A. Aydin, L.B. Hubert)

Certification

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

Petroleum Geologist**Texas**

Coker, Christopher Oluyinka, ExxonMobil Exploration, Houston (P.D. Snavely III, A.A. Adesida, M.W. Davis); Ray, Robert H., El Paso Production, Houston (C.R. Hird, D.H. Turner, T.L. Davidson); Reid, Sue Ann Tomlinson, consultant, Midland (Society of Independent Professional Earth Scientists)

Colorado

Hu, Guonong, Kerr-McGee, Denver (Reinstate)

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Louisiana

Yarbrough, Edward Louin, Franks Petroleum, Shreveport (Reinstate)

Nebraska

Blankenau, Daniel Francis, Coranco Great Plains, Wahoo (D.J. Becker, B.B. Bowden, M.P. Carlson)

Texas

Akewusola, Taiye Sheriff A., Mobil Producing Nigeria, Houston (Reinstate); Argent, John David, Amerada Hess, Dallas (S. Santoni, P. Lowry, H. Ladegaard); Cornell, William C., University of Texas at El Paso, El Paso (P.C. Goodell, G.R. Keller Jr., D.V. Le Mone); Cutten, Vaughan, Shell Deepwater Services, Houston (R.S.C. De

Ruiter, M.B. Patterson, M. Scherer); Tadewald, Bruce Howard, Howell Petroleum, Houston (J.H. Hearne, T.T. Mather, K.R. Obert); Veillerette, Antoine Marcel, TotalFinaElf, Houston (D.W. Miller, W.H. Schoellhorn, P. Imbert); West, Robert Colin Jr., consultant, Houston (T.E. Johnson, J.M. Hancock Jr., J.A. Ragsdale)

Argentina

Rebore, Luis Osvaldo, IHS Energy Group, Buenos Aires (H.J.A. Welsink, A.J. Tankard, R.M. Sneider)

England

Whitehead, Martin, Granby Enterprises, Caterham (Reinstate)

Germany

Finkbeiner, Thomas, GeoMechanics International, Mainz (P.B. Flemings, M.D. Zoback, J.B. Filbrandt)

Indonesia

Lisapaly, Leonard, University of

Indonesia, Depok (C.A. Caughey, S. Sukmono, P.M. Lloyd)

Nigeria

Okungbowa, Joseph I., ExxonMobil, Benin City (A.O. Akinpelu, V.A. Braimah, O.S. Adereti)

Poland

Greenspoon, Michael David, Apache, Warsaw (S.R. Schutter, D.L. Stoudt, D.F. Wetherbee)

Republic of Croatia

Saftic, Bruno, University of Zagreb, Zagreb (T. Malvic, Z. Ivkovic, Z. Hernitz)

Ukraine

Polivtsev, Anatoliy V., Institute of Geology & Geochemistry Fuels, Lviv (B.P. Kabyshev, A.A. Kitchka, V.G. Omelchenko)

Vietnam

Le, Vinh Nhut, Unocal Vietnam, Ho Chi Minh City (D.G. Cable, L.D. Phan, F.W. Shepherd) □

Forum

from previous page

more of a stand-alone method, with a single traverse generally yielding answers by breakfast time on the day of the survey, with geology and conventional geophysics being useful but not essential.

All current exploration methods should be questioned and each new technology should be evaluated. I find a high number of serious errors related to temperature and heat transfer in our textbooks and publications and must conclude that the Europeans have become more innovative than we in the United States.

Our industry seems to be falling apart. Too many great-minded people

are being replaced by those who are younger, lower priced and much less capable. Accountants appear to be running too many companies at a waste of billions in mistakes. We need to get rid of all our "Don't confuse me with the facts, my mind is made up" top management. We have a lot of hard working, smart people out there, but our management falls short.

Lloyd Fons
Houston



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To submit a paper contact Mike Ledet by 12/15/02 at (504)593-7690 or Michael_M_Ledet@dom.com. For general information contact George Rhoads at (504) 592-6873 or grhoads@chevrontexaco.com.

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<http://www.utdallas.edu/dept/geoscience/>. UTD is an Affirmative Action/Equal Opportunity employer that is committed to fostering diversity in its student body, faculty, and staff.

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Interested candidates should submit an application, curriculum vitae, statement of research interests (including future research pursuits), statement of teaching interests (including new courses), and the names and addresses of three references. The position will be subject to availability of funding. For full consideration, applications must be received by January 15, 2003; however, applications will be accepted until the position is filled.

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See **Classified Ads**, next page



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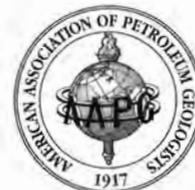
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The Petroleum Institute in Abu DhabiProgram Faculty, Petroleum Geosciences Engineering

The Petroleum Institute in Abu Dhabi is seeking applications for faculty for the Petroleum Geosciences Engineering program. Program faculty report directly to the Program Director who has overall responsibility for leadership of the Petroleum Geosciences Engineering program. Applicants should possess an earned PhD degree in Geology, Geological Engineering, Geophysics, Geophysical Engineering, or a closely related field; relevant industrial experience is also highly desirable. Appointments at all levels (Assistant Professor, Associate Professor, Professor) are available.

Program faculty in Petroleum Geosciences Engineering will teach undergraduate and graduate courses, develop an active research program, and will engage in professional service and institutional and professional committee work. Opportunities to interact with PI industrial stakeholders and local industries will be a key feature in the development of a research program. Petroleum Geosciences Engineering faculty will work closely with the Program Head to develop departmental budgets and appropriate departmental and institutional staffing plans.

The Petroleum Institute opened in September of 2001 in newly-constructed "start-up" facilities, which provides interim space required for instruction while a new grass-roots permanent campus is built. Architectural design for the permanent campus is complete, with a view to occupancy in the fall of 2004. Petroleum Geosciences Engineering program faculty will have the opportunity to interact with the facilities design process, and will be involved in decisions on the specification of departmental infrastructure as well as for acquisition of equipment and hiring of faculty and program administrative staff. The Program will have an operating budget that is being sized for excellence in the area of faculty development and the provision of program resources.

The total compensation package includes a 12-month base salary, an expatriation allowance, and a benefits allowance that covers housing, utilities, initial furnishings, transportation (automobile purchase loan), health insurance and annual leave travel.

An appointment is desired in early summer, 2003, and should continue for at least three years. The Petroleum Institute is affiliated with the Colorado School of Mines, and additional information can be found at the PI provisional website: www.mines.edu/pi.

Interested candidates should submit a letter of application and a detailed resume to:

Ms. Dixie Termin
Center for the Development of the Petroleum Institute
1700 Illinois St.
Colorado School of Mines
Golden, Colorado 80401 USA

Candidates are encouraged to submit applications as soon as possible but no later than January 31, 2003; transmission of materials by email is encouraged. Please send all electronic submissions to piapp@mines.edu.

EMD

from page 41

□ Non-carbon based energy resources including uranium and geothermal energy, discussed by Warren Finch and Dennis Nielson, respectively, are poised to grow in importance in future years.

□ Jeremy Platt summarizes the economics of some of these resources, including the phenomenal growth of

Wyoming coal from the Powder River Basin over the past 10 years.

□ Spectral analysis of airborne and satellite imagery play an important role in the early stages of exploration for these resources, as discussed by Roger Kolvoord and EMD President Rebecca Dodge.

John Dyni edited the poster, which was designed by graphics illustrator Chris French.

The poster will be available to EMD members for \$6, and to others for \$12, plus postage and handling. Look for ordering details soon in the EXPLORER. □

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from previous page

consists of 9 full-time faculty as well as approximately 40 undergraduates, and 40 graduate students. Please send all materials to:

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Pennsylvania General Energy Corp., an oil and gas exploration and production company, currently has an opening for an entry-level geologist in our Warren, Pennsylvania office. The successful applicant should have a petroleum background/emphasis. The minimum requirement for this position is a BS in Geology; MS preferred. This position will provide an excellent opportunity for career growth in the geological/petroleum field. Competencies should include, but are not limited to the following: excellent interpersonal skills,

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DIRECTOR'S CORNER

AAPG Offers Pyramid of Value

By RICK FRITZ

A few weeks ago my son Ian, 10 years old going on 16, had a friend over named Austin.

I overheard a conversation while I was in the kitchen as they were walking into the den. Ian said, "Who was that guy we learned about in school today? You know, the one who cut off his ear."

Austin replied, "Oh yeah, I think his name was Vincent Van Gogh. He was a painter or something."

"Yeah," Ian exclaimed, "I can't believe he cut off his ear! I think it was for his girl friend ..."

"Right," Austin said, "It was for his girl friend!"

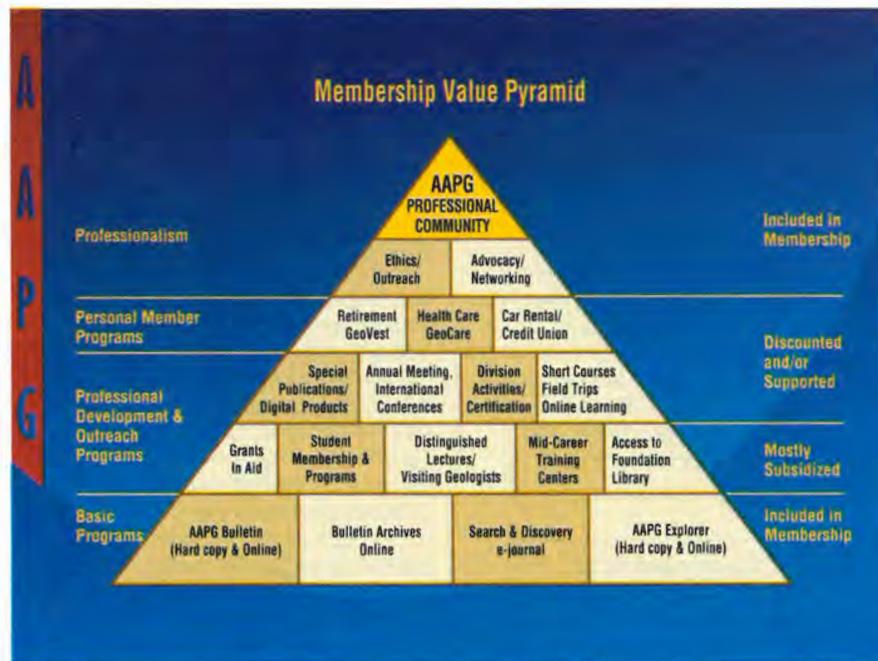
The boys stopped talking and I sensed that there was a moment of reflection going on. Finally, Ian said with commitment:

"Well, now we just give 'em roses."

Change is often good – but even good changes aren't always productive unless they are effectively communicated.

I went through an exercise recently with groups of the AAPG staff, where we asked them to name the benefits of AAPG membership. Collectively, the staff knew about most of AAPG's benefits, but clearly some of the newer benefits were not as familiar to everyone. I, for example, did not know that any AAPG member has access to AAPG's credit union.

Since most geologists and geophysicists are visual learners, we decided to build a graphic to



communicate the value of AAPG benefits – a "Value Pyramid," which shows most of the benefits provided by AAPG.

The pyramid's foundation is composed of all the benefits that are part of the basic dues package – the BULLETIN and the EXPLORER are the cornerstones, and recently we have added the digital BULLETIN archives online (1917 to the present) and "Search and Discovery," AAPG's new e-journal.

The next layer represents benefits that are most subsidized: grants-in-aid, mid-career training centers, student membership, distinguished lecturers, etc. The AAPG Foundation funds many of these programs.

Discounted or supported professional programs make the next layer, and they include AAPG publications, conferences and educational programs. New products and services include CD-ROM only special pubs, Interactive Online Learning and the AAPG Prospect and Property Exposition (APPEX), which is now in both Houston and London on an annual basis.

AAPG's GeoCare medical and life insurance are part of AAPG's personal services. GeoVest is our new retirement program. In addition to car rental discounts with Avis, we are in the process of adding limited legal services for members.

The question now is, "What else can AAPG do to improve the value of membership?" I stress "value," because benefits are just features unless members know about them and know how to use the products and services we offer.

For example:

- ✓ We are developing a registry to help members find jobs.
- ✓ We are looking into the cost of general outplacement services for members who have lost jobs.
- ✓ We developed APPEX to help members sell prospects.

Are there other things we can do?

No matter how many products and services AAPG develops, the apex is still the key part of the pyramid. Developing a sense of professional community is the single most important goal of any professional association. Benefits are important, but without professional development in the form of advocacy, networking, outreach and ethics, then an association just becomes another vendor.

I agree with Ian; roses are better. We need your support, ideas, and participation in making AAPG a better association for our profession.

Resources Visually Highlighted

EMD 'Unconventional' Poster Due

By JOHN R. DYNİ

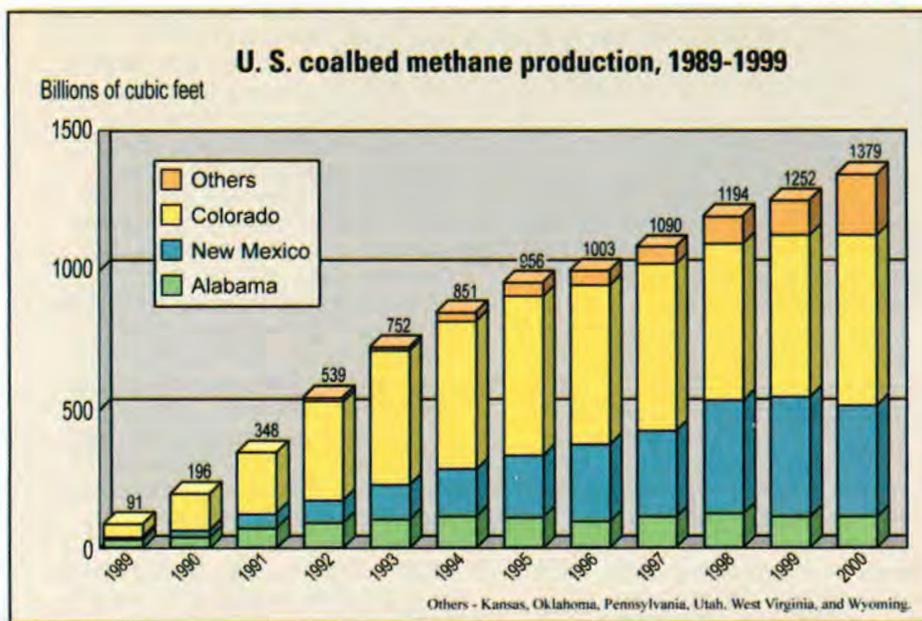
The Energy Minerals Division has prepared a new color poster titled "Unconventional Energy Resources of North America," soon to be published by AAPG.

The poster, measuring 36 inches by 68 inches in landscape format, includes information on each of seven energy commodities and two activities administered by the division. These include:

- ✓ Coal.
- ✓ Coalbed methane.
- ✓ Natural gas hydrates.
- ✓ Oil (tar) sands.
- ✓ Oil shale.
- ✓ Geothermal energy.
- ✓ Uranium.
- ✓ Geospatial information (remote sensing).
- ✓ Energy economics.

The poster is aimed not only at the professional geologist, but also to earth sciences departments at universities and colleges, as well as to the general public.

EMD members provided the poster's text and illustrations. The information was arranged in panels on each commodity and activity around a map of North America (scale 1:9,000,000). The map depicts the generalized distributions of the nine energy commodities in United



States, Canada and Mexico.

Conventional oil and gas resources, wind and solar energy are not included.

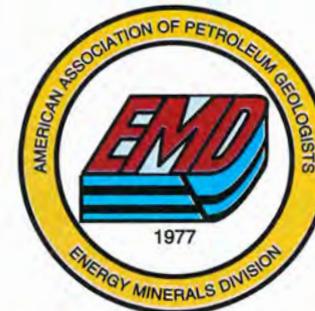
However, this is what is included – along with the EMD members responsible for the contribution:

- Andrew Scott and Ronald Grubbs outline in the introduction the scope and

future utilization of these unconventional resources in the United States.

□ They also provide the panel on coal, showing tables on coal production by region and coal consumption by industry sector.

- Walt Ayers demonstrates the growing importance of coalbed methane



with graphs on reserves and production of coalbed methane over the past decade.

□ Natural gas hydrates, still in its earliest developmental stage, encompass large prospective areas in coastal waters and northern land areas of North America as outlined by Tim Collett.

□ Oil sands, mainly in Canada, provide an important productive resource, as shown by Brian Rottenfusser.

□ John Dyni provides data on oil shale, including data on the giant Green River deposits in western United States, which have promise for future exploitation.

See **EMD**, page 40

*Short- to Medium-Term Exploration Map of Colombia:***Is Now the Right Time to Invest?**

THE NEW exploration map of Colombia targets large structures of more than 300 million barrels of oil reserve potential, located along under-explored, technically complex, high-potential regions and plays.

The exploration map also targets smaller structures with less potential, but significantly lower risks. However, the focus of this article is primarily on the high-potential areas, their general geology and the ideal timing for initiating exploration.

High Potential

Because of the geological prospectivity of the country, the new contract and new royalty scheme (which varies according to production rates), the availability of data and the openness of Ecopetrol and the Colombian government to foreign investment, some of the areas with the best potential have been almost entirely contracted by multinational companies.

These companies and consortia have the necessary economic muscle to successfully accomplish exploration programmes.

Companies such as Petrobras, Lukoil, BP, TotalFinaElf, Nimir, Talisman and Repsol YPF have contracted exploration acreage in the Llanos foothills area—along the trend that contains large discoveries including Cusiana and Cupiagua.

Ecopetrol and the incoming government will place special emphasis on attracting foreign E&P investment.

Competition for acreage along the Llanos foothills is tough and there is only a small area available for contracting. Now is not the best time to be trying to enter these areas. It is arguably too late. E&P companies must enter through leveraged farm-ins, rather than through a direct contract with Ecopetrol.

The Llanos foothills area was the site of significant exploration success in the early 1990s and is one of areas where the most interesting exploration activity is taking place – a successful well was drilled by Repsol YPF and TotalFinaElf last year and high-impact wells will be drilled by BP and by Ecopetrol this year. Other large companies are acquiring 2-D and 3-D seismic data in the region and will begin drilling activities within the next two years.

Conversely, other regions are in their intermediate stages of contracting and high-potential acreage remains available. The time to invest in these regions might be right now. The new government will develop strong relations with private industry; it will strengthen the armed forces and the rule of law.

Ecopetrol and the incoming government will place special emphasis on attracting foreign E&P investment, creating a window of opportunity for companies interested in capturing under-explored, high potential acreage in regions close to markets and infrastructure. There are

significant possibilities available along the western foothills of the middle and upper Magdalena valley, in deeper horizons (mostly Cretaceous in age) beneath old fields and in mature basins that produce from Tertiary reservoirs.

In the medium-to long-term exploration areas, Ecopetrol has recently approved a new contract for frontier areas, where geological and geophysical information is limited. These areas are offshore, primarily in the Caribbean regions, but also in the Pacific. In the Caribbean offshore areas, seismic coverage is enough to define leads, but insufficient to define prospects.

Giant Steps

The history of Caribbean offshore exploration process has been awkward; most of the seismic has been acquired since 1999, but the last well drilled was around 20 years ago. Since then, offshore exploration worldwide has taken giant conceptual and technological steps—companies that have technical experience in offshore exploration will have significant competitive advantages when signing large exploration blocks offshore Colombia.

The frontier-area contract consists of a 70% share of production for the E&P company, after royalties, until cumulative production reaches 250 million barrels of oil or 3.75 trillion cubic feet of gas. After this, and after 200% of exploration and development investment and expenses have been recovered, a multiplying factor (the R-factor) will affect the E&P company's production share. The R-factor could decrease the production share to 35% for the E&P company for the duration of the contract. However, in economic models, the R-factor is applied only to very low-cost offshore development scenarios, and only in very late stages of field development.

In practice, the new contract protects the upside of encountering large fields offshore. Exploring in offshore areas is complicated by geological and commercial risks, because the region is gas-prone. A limited local market poses commercial risks when considering exploration investment, whereas development of large projects that require significant quantities of gas is restricted by lack of significant gas supply.

Once this knot is disentangled, by visionary thinking and taking some manageable risks, as happened in Bolivia, the offshore Caribbean region will see significant competition for acreage. The timing for exploration in this area is close to ideal and companies are encouraged to study the region, prioritise large areas and then focus areas of interest.

A recurrent theme in the general perception of the country and in the news is security. Although security issues are a concern for potential investors, Colombia has the necessary additional components to attract risk capital for exploration activities. This is proved by new firms entering Colombia and by an expansion of companies operating in the country. Multinational E&P

companies manage security very well and, together with governmental institutions, Ecopetrol and 40 million Colombians believe and trust that things will improve within the next few years.

Improving Situation

Strengthened Colombian armed forces, US aid and anti-terrorist policies, technology and a dramatic loss of sympathy nationally and internationally for terrorist groups (formerly, and inaccurately, described as leftist guerrillas) have reduced terrorist activities. However, security concerns are key to timing. If the situation improves dramatically, Colombia will be upgraded as an exploration region from an investment point of view. But by then, it might be too late. When is the timing perfect and when is it too late?

In Colombia, the fundamentals of exploration are favourable. The main technical advantage of exploration in Colombia is very rich source rock, which is shared with neighbouring countries, such as Venezuela, Trinidad and Ecuador. This source rock, the La Luna formation, was deposited over a very broad and large marine seaway, which extended from northern Peru to Trinidad during mid Cretaceous times, when the sea level was high.

The La Luna has generated more oil than any other source rock and has produced the planet's largest accumulation of hydrocarbons—Venezuela's Orinoco heavy-oil belt. In Colombia, the La Luna Formation is distributed throughout most of the main basins and along the eastern and western foothills of the eastern Cordillera.

In Tertiary times, the present-day central Cordillera suffered uplift and erosion. Sediments produced by this erosion were transported towards the east by major river systems. During those same times the Guyana shield was subject to uplift and vast amounts of sediment were carried towards the west. Rivers flowing to the east met the ones flowing to the west along a central river system that ultimately flowed north, towards Venezuela.

These ancestral fluvial to marginal marine systems are the main reservoirs of Colombia, particularly the Mirador Formation of the Llanos and eastern foothills of the eastern Cordillera and the La Paz, Esmeraldas and Mugrosa formations of the middle Magdalena valley. Although most of the reservoirs in Colombia are represented by clastic-dominated sequences, fractured carbonates and fractured cherts are becoming a new play that deserves special attention from companies with experience in fractured reservoirs.

During late Tertiary times, the eastern Cordillera was uplifted and its foothills folded, forming most traps to be prospected within the next few years. These traps vary in size and potential according to the region of Colombia.

In general trap size diminishes moving away from the eastern Cordillera foothills towards the flat regions of the Llanos plains and the

Magdalena valley. The quality of seismic data improves towards the flat regions and the depth to target also decreases.

This generalisation has exceptions, such as the 900 million barrel La Cira-Infantas field, in the flat, middle Magdalena valley, and the 1.1 billion barrel Caño Limón field, in flat regions of the Llanos basin. Colombia offers a variety of opportunities, ranging from high risk, high-reward, deep, large and complex traps, appropriate for large integrated companies, to lower-risk, lower-reward, shallower and easier-to-image structures, appropriate for medium-sized or smaller companies. As a result, Colombian upstream opportunities suit the exploration portfolios of large, medium-sized and small oil companies.

Prospective Acreage

Timing is a critical issue when considering where to invest. Some areas in Colombia are currently restricted to acreage contracting by direct negotiation, because most prospective acreage has been awarded to large E&P companies. Other relatively unexplored areas remain available, but are being studied by the E&P industry. It may be appropriate to invest today, given that the perception of the security risk in the country might improve significantly in the future. Other areas remain more distant in terms of timing, but once a few key commercial issues are overcome, acreage will be quickly licensed and competition will intensify.

Colombia is open for business and welcomes foreign investment in petroleum activities. Ecopetrol shares technical information and its knowledge of basins, plays and leads; our vision is to become the partner of choice in the country's petroleum business. We invite companies to visit our website (www.ecopetrol.com.co), our information bank (www.BIP.com.co) and our offices in Bogota for a complete technical presentation of any area of interest.

Tomas Villamil, PhD,
Exploration Vice-President, Ecopetrol.
Calle 37 No. 8-43, piso 8.
(Bogotá-Colombia)
Phone: +571 234 5041
Email: tvillami@ecopetrol.com.co

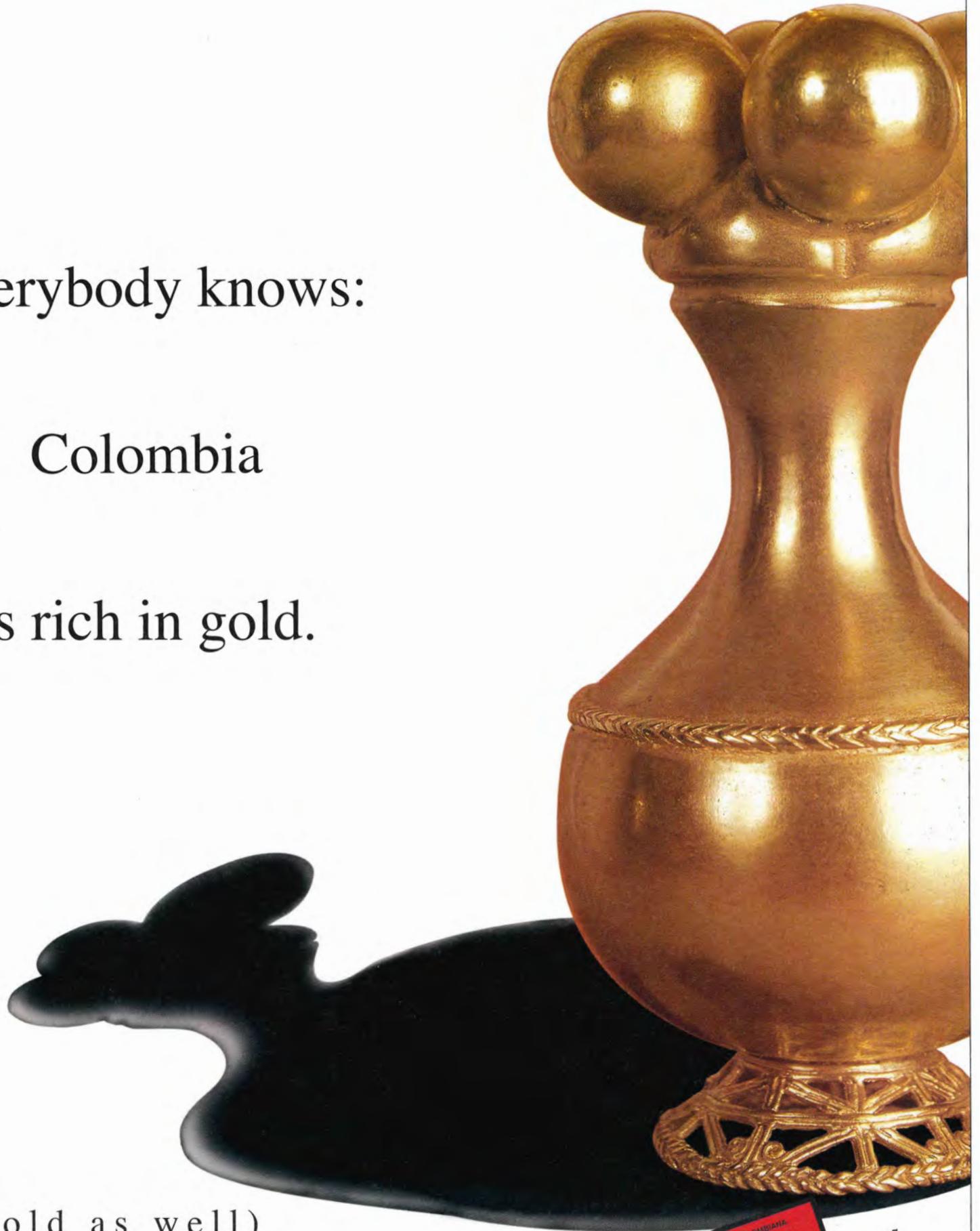


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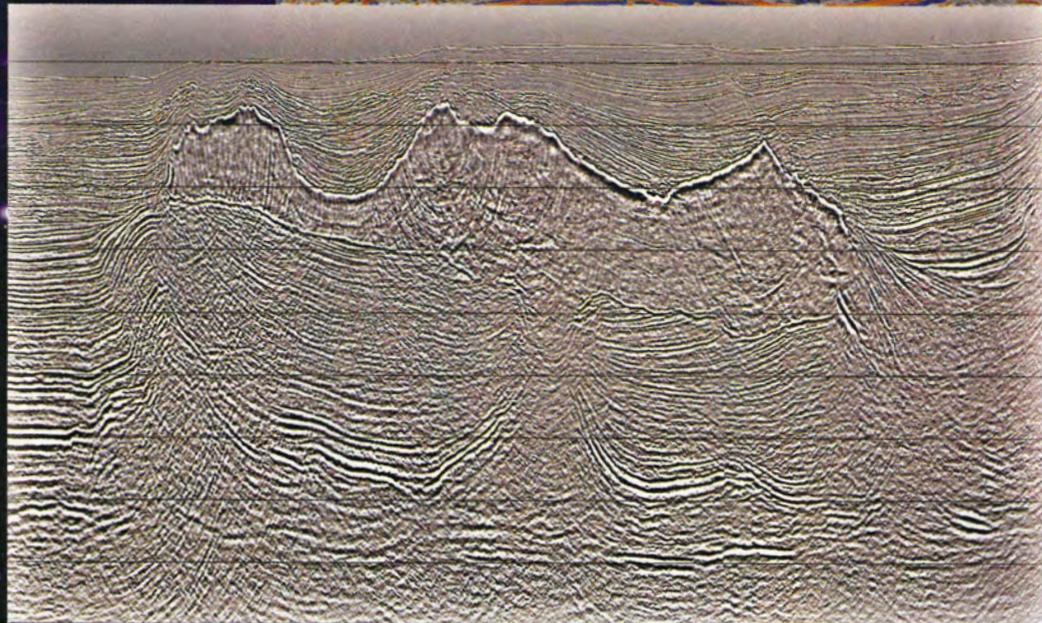
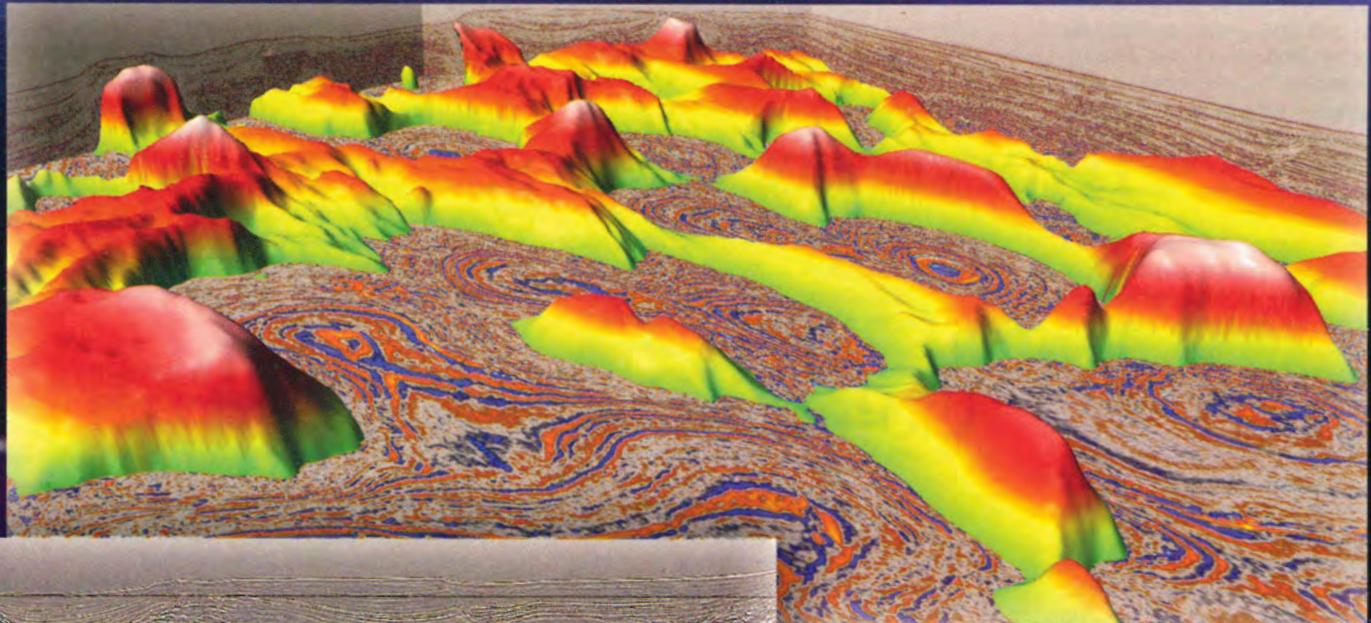
Contact: Ecopetrol, Exploration and Production VicePresidency.
Phone: (57-1) 234 54 82 Fax:(57-1) 234 56 75. Email: atovar@ecopetrol.com.co Bogota Colombia.



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