FEBRUARY 2017 100 AAPG ANNIVERSARY

EXPLORER

Stream of Knowledge

Rediscover the joy of geology at ACE.

Vol. 38, No. 2
FEBRUARY 2017

100TH AAPG ANNIVERSARY
EXPLORER

PRESIDENT'SCOLUMN

Benefiting from the Old and the New

BY PAUL BRITT

I do some regular work for a small oil company that has two very capable petroleum engineers. Last week, the younger of the two told me they were trying to guess if was I closer in age to him (early 50s) or to the senior engineer (late 60s), who is also the chief operation officer of the company. After the younger engineer left the room, I told the other, "Well, you can tell he's not in his 30s or he would have already Googled me and had that answer."

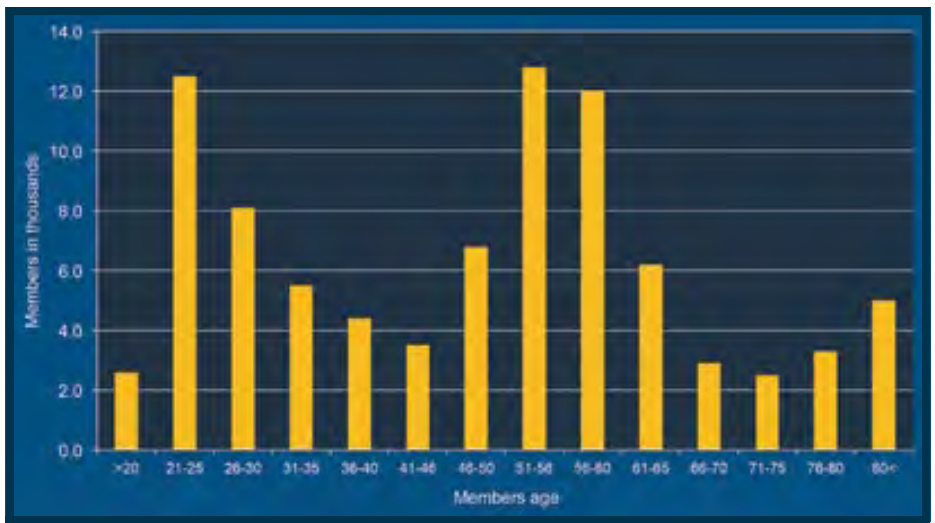
This speaks to two areas of interest: age distribution within the industry, and to the way each group deals with data.

First, consider the former within AAPG. As seen in the demographics chart, we have a bimodal age distribution in AAPG. Everybody knows that. The gap in the middle would be the students who graduated during the 1990s and a relatively slow period for the industry.

Now, picture the chart in ten years. The large group is now 60-plus and mostly retiring or otherwise moving out of the work force. What that means is the latter group, which is currently 26-35 years old, will become the largest age group when they are 36-45 years old.

And, with regard to dealing with data – the former group, for the most part, grew up (professionally speaking) with more limited and sporadic point well data in dealing with conventional prospecting. Online data was not available and geologic data libraries flourished. The use of detailed well data, hand-written scout cards, as well as old and obscure well logs were frequently the key to a prospect or a new play.

Today, the commercial online services have captured or acquired a lot of the well data, and today's plays – even older, established plays – have in some cases almost an order of magnitude more well data available. At least in the North American market, that is.



AAPG Members: Demographics in Oil and Gas

So it appears that the old well data, some of which will never be captured electronically, is less important, or they may even be unaware of its existence.

The bottom line is that both realities are true. The older geologist needs to be using the abundance of well data now available, and many are. The younger geologist needs to be aware that not all the data is available yet on the computer, and there may be clues out there that could make, or break, a prospect.

Student Chapters

And, all of that speaks to another pair of related considerations: AAPG's need for students, and students' need for AAPG. Even as they inherit and develop technological tools undreamt of by older geologists at their age, young and aspiring geologists still need the experience and knowledge we have to offer. And, we need them to replenish and revitalize our membership demographics.

I've mentioned it a bit in earlier columns, but one of the exciting parts of being president is meeting students and student chapter members from around the world. With all of the students I meet, be it in Thailand, Africa, Kentucky or Mexico, it has always been a great experience. I am thrilled to see students so motivated about geoscience and have tried to be encouraging, even in the current industry condition.

AAPG has about 300 student chapters, which arrange get-togethers and activities at their local level.

When I was in school, professors mentioned the AAPG Bulletin as a great source of geologic information, and AAPG as the premier petroleum association for geologists. Two years later, I graduated and joined AAPG to get the benefits of membership, including the Bulletin. The reality of the present day is that most student members drop their membership, at least for a while. But, hopefully they still recognize the Association as the premier geoscientific organization and come back at some point in their career.

Imperial Barrel Award

The Imperial Barrel Award (IBA) is a vital program for raising awareness about AAPG among students and recruiting younger Members. IBA is a competition for students to work with real-world geological and geophysical data to identify and present a prospect to management, in this case management being the IBA judges. The IBA is regarded as a unique program that gives students an experience almost equivalent to an internship at a company. Teams must demonstrate rigorous and technical evaluations, work to a deadline, work within a team, make decisions based on incomplete or inadequate data, and give presentations to a panel of senior industry experts.

IBA 2017 is under way, with teams of four or five students from each school advancing to the Section or Region semi-final competition. This year, 160 teams have entered and are in the process of receiving datasets consisting of real-world well data and 3-D seismic volumes. Each school obtains the necessary workstation software and each student learns to use the software in preparation of receiving the dataset. The dataset may have some key well data omitted in order to gauge the results of the student prospectors against real-world results, and the teams have eight weeks to work the dataset.

The Sections and Regions will hold semi-finals. In past years the competitions were in person, but this year, owing to recent budget and sponsorship

See **IBA**, next page

STAFF

Managing Editor
Brian Ervin
bervin@aapg.org

News Editor
Kelsy Taylor
ktaylor@aapg.org

Art Direction/Production
Matt Randolph
mrandolph@aapg.org

Graphics Support
Ben McNett

Advertising Coordinators

Companies A-K	*Companies L-Z*
Mike Taylor	Tracy Thompson
1-918-630-5672	1-918-560-9414
mtaylor@aapg.org	tthompson@aapg.org

CORRESPONDENTS

David Brown
Louise S. Durham

TABLEofCONTENTS

REGULARDEPARTMENTS

ON THE COVER:

The Upper Cambrian microbial mounds in central Texas are just one of the geologic attractions on offer in this year's slate of field trips at the AAPG Annual Convention and Exhibition in Houston. For more information, see page 28, and visit the ACE website at ace.aapg.org to register.

Left: The century-in-the-making birthday bash will be in Houston in April at our centennial ACE, but AAPG's actual birthday falls in this month. The Association was officially born Feb. 10, 1917, when geologists from throughout Oklahoma and surrounding states gathered in Tulsa for lectures and technical presentations at the Hotel Tulsa. Pictured is the plaque commemorating the event at AAPG headquarters. For the full story, see next month's Explorer, and don't miss the celebration in Houston.

Vol. 38, No. 2

The AAPG EXPLORER (ISSN 0195-2986) is published monthly for Members by the American Association of Petroleum Geologists, 1444 S. Boulder Ave., P.O. Box 979, Tulsa, Okla. 74101-3604, 1-918-584-2555. email address: postmaster@aapg.org. Periodicals Postage Paid at Tulsa, OK and at additional mailing offices. POSTMASTER: Please send address changes to AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101. Canada Publication Agreement Number 40063731. Return undeliverable Canadian address to: Station A, P.O. Box 54 • Windsor, ON N9A 6J5 • email: returnsIL@imex.pb.com.

Advertising rates: Contact Mike Taylor or Tracy Thompson, AAPG headquarters. Subscriptions: Contact Brian McBroom, AAPG headquarters. Unsolicited manuscripts, photographs and videos must be accompanied by a stamped, self-addressed envelope to ensure return. The American Association of Petroleum Geologists (AAPG) does not endorse or recommend any products or services that may be cited, used or discussed in AAPG publications or in presentations at events associated with AAPG. Note to Members: $6 of annual dues pays for one year's subscription to the EXPLORER. Airmail service for Members: $55. Subscription rates for non-members: $75 for 12 issues; add $72 for airmail service.

Photo by Derek Blanchard

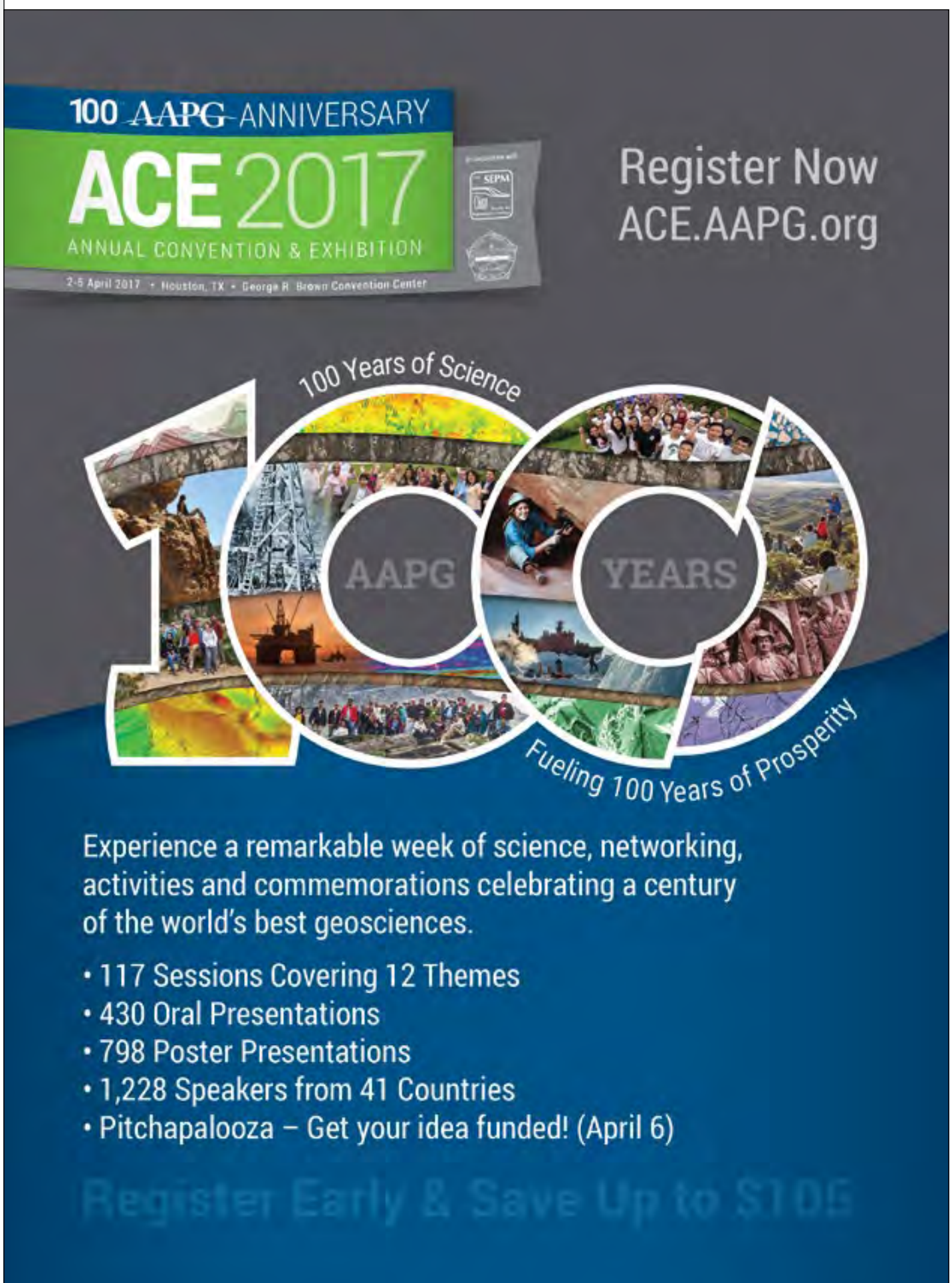
AAPG President Paul Britt (front row, second from left), AAPG Past President and current Bureau of Economic Geology Director Scott Tinker (front row, fourth from left) and conference chairman David Blanchard (front row, third from right) with members of AAPG's Nairobi Student Chapter at a showing of Tinker's "Switch" at the inaugural African Energy and Technology Conference in Kenya.

IBA
from previous page

constraints, it will be held as a virtual competition via Webex. Each Region or Section may have at least three judges and there are on average about 11 teams in each Section/Region. Each Section/Region will advance one team to the finals, to be held Saturday, April 1, in Houston before the AAPG Annual Convention and Exhibition.

The finals are open to everyone, and I encourage you to stop in and see what the IBA is all about.

Paul W. Britt



Register Now for the Celebration of the Century

By DAVE RENSINK, ACE 2017 General Chair

This has been a challenging environment in which to organize a major petroleum conference, particularly one celebrating AAPG's 100th anniversary. Therefore, I want to thank the organizing committee for dedicating the time and effort it takes to put together a program, which is more than worthy of a celebration of this magnitude. Their names and photos are in the meeting announcement, so if you see them around the office or at the conference in April, please thank them and acknowledge their tremendous effort.

RENSINK

If you have not already registered, please do so before the rates change. The cost of registration depends upon AAPG membership status, but the rates increase at midnight March 2, so registering now will bring significant savings.

The Centennial Gala

Also, I hope to see you at the Centennial Gala on Monday night. It may or may not be the social event of the century, but it's certain to be an unforgettable and enjoyable evening celebrating AAPG's rich, 100-year history.

Along with the cocktails and camaraderie, the gala will also include a highly anticipated address by Pulitzer Prize-winning author and energy scholar Daniel Yergin. He is vice chair of IHS and founder of IHS Cambridge Energy Research Associates, but is probably best known as the author of the best-selling and award-winning oil industry history, "The Prize: The Epic Quest for Oil, Money & Power," as well as the newly released "The Quest: Energy, Security, and the Remaking of the Modern World." Yergin is world renowned as one of the foremost experts and thinkers about oil and energy, so his keynote address is a rare opportunity you don't want to miss.

And, as if that's not enough, there's music: following Yergin's presentation, Lesli Wood and her band will perform.

Sponsorship

An event with the scope of AAPG's centennial anniversary Annual Convention and Exhibition (ACE) comes with its share of expenses, so we want to thank our generous sponsors, like Chevron, ExxonMobil, Saudi Aramco, Shell, Statoil and others.

We are still accepting sponsorship contributions, and no amount is too small.

However, the bigger the contribution, the greater the impact and the more name recognition and exposure you'll have at the George R. Brown Convention Center in Houston where ACE 2017 will be, as well as in the ACE 2017 program book and ACE website.

There are multiple options available for sponsorship, and you will find everything you need to know on the website: ace.aapg.org.

We hope to see you in Houston in April.

Middle East Student Conference Launches

By KELSY TAYOR, EXPLORER News Editor

The first annual Middle East Geoscience Student Conference is set to launch Feb. 26 through March 1 in Al Ain, United Arab Emirates.

The event will give students the opportunity to advance their knowledge, discuss new opportunities, expand their horizons and share their expertise and interests with other students and professionals.

Hyra Dalisay, an organizer of the event, explained that the four days will be filled with oral presentations from a variety of experts about innovative topics, poster presentations, panel discussions with leading experts in the field, a technical course and a field trip.

Attendees will also have the opportunity to participate in a number of challenging competitions during the conference. The competitions will include the Imperial Barrel Award Program, aimed at graduate students from universities around the world. For the competition, teams will analyze a dataset and present their findings to a panel of industry professionals. Up for grabs are scholarship funds for their university's geoscience department.

Geo-Quiz will also be included in the competitions. The challenge will allow students to compete as teams and against one another. Teams will go head to head during quiz rounds, attempting to answer timed questions. The winning students will receive travel grants to Paris, France for the 79th EAGE Conference and Exhibition to be held in June.

The Middle East Challenge Bowl will round out the competitions with another fast-paced clash of teams competing in quiz rounds. The winning team will represent the Middle East Region during the SEG International Exposition and 87th Annual Meeting in Houston this September.

The idea for the conference was developed during a committee meeting between AAPG, the European Association of Geoscientists and the Society of Exploration Geophysicists.

Dalisay said that the attendees of the meeting decided to collaborate in new ways to create quality events in the region.

"Since all of the societies host student events every year, the three societies joined forces once more to bring the region an exciting annual event for geoscience students," she said.

Dalisay explained that they are expecting to have 80 students in attendance from more than 13 universities and seven different countries.

It's hoped that the conference will grow each year and become a valuable event for the students.

"Certainly, with the growing youth in the region, we expect this to be a successful conference that will engage regional geoscientists while working together with the industry to enhance their technical skills," she said.

To learn more about the Middle East Geoscience Student Conference, visit megsconf.com.

Executive Committee Candidates for 2017-18 Announced

Officer candidates for the 2017-18 AAPG Executive Committee have been announced, and videos that allow the membership to become more familiar with them, their careers and their thoughts are currently in production and will be available by the end of this month.

This year's slate includes contests for four offices. The person elected president-elect will serve in that capacity for one year and will then be AAPG president for 2018-19. The terms for the vice president-Regions and secretary posts are 2017-19.

The candidates are:

President-Elect

❒ **Denise Cox**, Storm Energy, Panama City, Fla.

❒ **John Kaldi**, professor, Australian School of Petroleum, University of Adelaide, Adelaide, Australia.

Vice President-Regions

❒ **David Cook**, (retired) ExxonMobil, Maldon, England.


COX


KALDI


COOK


KRYZWIEC


FABER


JOHNSON

❒ **Piotr Krzywiec**, Polish Academy of Sciences, Warsaw, Poland.

Secretary

❒ **Meredith Faber**, Noble Energy, Houston.

❒ **Laura Mauro Johnson**, Anschutz Exploration Corp., Golden, Colo.

As with last year's election process, all candidates will be presented to the AAPG Membership via two brief videos:

- One video, a "mini-bio" featuring personal photos, provides a quick look at the candidates' professional career as well as their involvement with AAPG.
- The second video features a Q&A format, allowing the candidates a chance to share their thoughts, priorities and visions for AAPG.

Also, refer to the material included with the January EXPLORER for biographical information on all candidates, as well as their responses to the statement, "Why I accepted the invitation to be a candidate for an AAPG office."

(Associate and student members are not eligible to vote – but to upgrade your membership status, contact your delegate or an AAPG member services representative.)

Ballots will be mailed in the spring.

Gurgaon, India has become a hub of industry and technology and is one of the fastest growing cities in the world, and its appetite for energy is expected to keep pace over the next century.

Photo courtesy of Ding Yuin Shan

As in other major urban centers in China, Hong Kong is undergoing rapid economic and infrastructure development. Consequently, China is expected to overtake the United States as the world's largest consumer of energy liquids in 15 years.

Demand Growth in the Developing World

By DAVID BROWN, EXPLORER Correspondent

It is conventional wisdom among energy analysts that in the decades ahead, demand growth in oil and gas consumption will come mostly from developing countries. There are signs, however, that future increases in energy demand will be more gradual than expected, with no booming surge in consumption.

CARUSO

> **"Whenever you're investing in technology for the long term, the results are unpredictable. Look at our own case in the U.S. No one thought the United States would be exporting crude oil 10 years ago."**

SMITH

Guy Caruso is senior adviser for the Energy and National Security Program of the Center for Strategic and International Studies, a policy research organization in Washington, D.C.

He's also a former head of the U.S. Energy Information Administration (EIA) and the president-elect of the United States Association for Energy Economics (USAEE).

"Probably 75 percent of all energy demand growth is going to be in countries we would call 'developing,'" Caruso noted. "Everybody's outlook has most of the growth in the developing countries, but that's a broad category that includes China and India."

In the latest edition of its World Energy Outlook, the International Energy Agency (IEA) contrasted energy demand growth in developing nations with demand declines among members of the Organisation for Economic Co-operation and Development (OECD), a group of 35 mostly economically advanced countries.

"With total demand in OECD countries on a declining path, the geography of global energy consumption continues to shift towards industrializing, urbanizing India, Southeast Asia and China, as well as parts of Africa, Latin America and the Middle East," the report's summary said.

In the next 20 years, "China and India see the largest expansion of solar photovoltaics (PV); while by the mid-2030s developing countries in Asia consume more oil than the entire OECD," it predicted.

Blunted Boom

Caruso said more efficient use of energy has tempered demand in the world's highly developed nations.

"We're using energy far more efficiently in the U.S., the E.U. and Japan than we were in the 1970s and '80s," he observed.

"Transportation is a much bigger part of our energy consumption than it is in the developing countries, and it's getting more efficient. And it will continue to get better," Caruso said. "In developing countries, they're still using a lot of energy in the industrial sector and that's less efficient."

BP forecast significant energy-demand growth for China and India in its Energy Outlook to 2035, issued last year. The world's overall energy consumption is expected to increase by 34 percent between 2014 and 2035, in BP's estimate.

"China's share in global energy demand rises from 23 percent in 2014 to 25 percent in 2035, while its growth contributes 32 percent to the world's net increase," BP's Outlook said.

"Energy production (in China) as a share of consumption drops from 82 percent in 2014 to 80 percent by 2035, making the country the world's largest net importer of energy," it forecast.

By 2032, China will overtake the United States and become the world's largest consumer of energy liquids, BP predicted.

India also will see big increases in energy consumption over the next 20 years, BP said. It forecast India's oil imports to rise by 161 percent and its demand for natural gas to increase by 155 percent. Renewables and other energy sources will have only a gradual affect on India's consumption, it predicted.

"India's energy mix evolves very slowly over the Outlook, with fossil fuels accounting for 87 percent of demand in 2035, compared to a global average of 79 percent. This is down from 92 percent in 2014," BP said.

"India's share of global demand rises to 8.7 percent in 2035, accounting for the second largest share of the BRIC [Brazil, Russia, India and China] countries with China at 25 percent, Russia 4 percent, and Brazil 2 percent," it added.

Slowed Growth

While the world's developing countries are expected to generate the largest share of energy demand growth in coming decades, the questions "How much?" and "How fast?" remain difficult to answer with any certainty.

"The crystal ball is pretty cloudy," said Jim Smith, professor of finance and Cary M. Maguire chair of oil and gas management at Southern Methodist University in Dallas, and a part-president of USAEE.

"The growth rates are potentially fast but there is a kind of lack of track record in responding to an economic downturn, which India and China are both struggling with now," Smith said.

Current estimates point to slowing growth in energy demand in developing nations, with BP expecting demand growth to fall to about 1.4 percent per year after growing at 2.3 percent per year from 2000 to 2014.

And several trends also indicate slower-than-expected growth:

▸ Environmental awareness:

Increased use of energy to spur economic development has had a significant impact on the environment in developing nations, particularly in China, but also in India.

"In both of those countries, the problem is the environment," Smith observed.

He said public concern about the environment in many developing countries has less to do with climate change than with direct effects on air quality and water quality. Problems with land pollution and trash generation also affect many emerging nations.

Consequently, he said, those countries will have to take environmental effects into account when planning future energy use.

"The national health statistics demand that. The population is beginning to demand that," Smith said. "Once you attain middle class, you become more discreet in how you want to live."

But Caruso said energy demand should still increase in developing countries this century, with environmental concerns only a mitigating factor.

"Most of the developing countries are attempting to increase their efficiency and to factor in the cost of local pollution on carbon emissions, but their emphasis is on economic growth," he said. "Climate change is important, but it doesn't appear to be important enough to have a major effect."

▸ Increasing urbanization:

Energy demand growth from increased development is "happening more slowly that it did in the E.U. and the U.S. because another trend that's going on in the developing countries is increasing urbanization," Caruso said.

"It's a combination of the sectors where the energy is used and the demographics of the particular country. That's especially true in China," he noted.

Rendering courtesy of prideworldcity.com

Pride World City in Maharashtra, India is the largest real estate development in the region so far, but it's just one of many mega projects in India, with more expected in the decades to come.

See **Subsidies**, page 14

Must There Be an OPEC?

By DAVID BROWN, EXPLORER Correspondent

"The Prize," Daniel Yergin's sweeping history of the global oil and gas industry, includes an instructive anecdote about OPEC and its members.

OPEC called for a general meeting in Bali in December 1980. Iraq and Iran, two of OPEC's founding members, had been at war with each other since September.

What's more, Iraq had just captured Iran's oil minister as he visited the battlefront near Abadan.

With OPEC member nations seated alphabetically, as was customary, Iraq and Iran would be adjacent at the meeting. Indonesian oil minister Subroto offered to seat his delegation between the two countries' delegates in an attempt to lessen tensions.

The Iranians, who had earlier threatened a boycott, brought a large photograph of their captive oil minister into the meeting and insisted on displaying it, a portrait, as the head of their delegation.

In the end, the Iranian delegates were allowed to make the symbolic gesture. The OPEC oil ministers began their deliberations with a photo of the Iranian official staring out at them from an otherwise empty chair.

And the meeting went on as planned.

The terms "resilient" and "flexible" are not often used to describe OPEC. But they might be the best two words to characterize the organization.

Bhushan Bahree is senior director for global oil for IHS Markit in Washington, D.C., and a long-time OPEC observer. Asked if OPEC could continue to be an influential factor in the global oil business for the rest of this century, he offered an expressive response:

"Why not?" he said.

"I imagine it will just continue, because the rules are so flexible and the costs are so low," Bahree said. "There is really no enforcement mechanism in OPEC, which is its weakness and also its strength, which has allowed it to survive."

During the past 56 years, OPEC's member countries have sometimes cooperated and sometimes refused to cooperate. Sometimes they have literally been at war. At times they have set and followed production quotas; many times they have cheated on them or ignored them.

The Comeback Cartel

Columnists, bloggers and pundits wrote OPEC off for dead as oil prices plummeted during the past three years and the organization's members looked powerless. Texas Congressman Joe Barton signaled the demise of OPEC to CNN in February 2016.

"What we've done by repealing the export ban is put the U.S. producer in the driver's seat. Quite frankly OPEC and Russia literally don't know what to do. So we've killed OPEC. It's gone," CNN quoted Barton as saying.

"So should markets now take OPEC seriously? Can action by the cartel sustain higher crude prices over the long term? Probably not. Like a desert mirage, the image of an OPEC resurrection vanishes when approached," wrote Emile Simpson last October in Foreign Policy.

Then OPEC re-emerged in dramatic fashion. It announced an agreement for broad production cutbacks to lift crude oil prices and, more importantly, to reduce the world's chronic surplus of crude stores.

OPEC ministers and officials at the Secretariat.


BAHREE

> "To a large extent, the price formation is a product of the market. OPEC is an important part of that, but only one part."

Saudi Arabia took a limited role as swing producer again.

And the agreement showed just how much the Saudis depended on cooperation from other OPEC members.

"If you look at the 1980s, OPEC 'died' many times over. OPEC doesn't have to die. It just becomes dormant," Bahree said. "It will continue to be effective at some times, and ineffective at some times."

OPEC's Mission

OPEC – which calls itself the Organization of *the* Petroleum Exporting Countries – was founded in Baghdad in September 1960, when Iran, Iraq, Kuwait, Saudi Arabia and Venezuela joined together to coordinate energy policy.

They later were joined by Qatar (1961), Indonesia (1962), Libya (1962), the United Arab Emirates (1967), Algeria (1969); Nigeria (1971), Ecuador (1973), Gabon (1975) and Angola (2007).

At first OPEC's headquarters were in Geneva, Switzerland, then in 1965 the organization moved its offices to Vienna, Austria, its home for more than 50 years.

According to Article 2 of OPEC's official operating statute, the organization has three aims:

"A. The principal aim of the Organization shall be the coordination and unification of the petroleum policies of Member Countries and the determination of the best means for safeguarding their interests, individually and collectively.

"B. The Organization shall devise ways and means of ensuring the stabilization of prices in international oil markets with a view to eliminating harmful and unnecessary fluctuations.

"C. Due regard shall be given at all times to the interests of the producing nations and to the necessity of securing a steady income to the producing countries; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on their capital to those investing in the petroleum industry."

The average person might simplify that to say OPEC tries to set and meet higher price targets for oil, but is willing to increase production modestly to soften markets when high oil prices threaten consumption.

And those are exactly the two things OPEC has not been very good at doing, Bahree said.

"They've had much less success in curbing price increases when they've risen for supply and demand reasons," he noted. "And they're not so successful in getting prices up to targets."

"To a large extent, the price formation is a product of the market. OPEC is an important part of that, but only one part," he said.

Then and Now

In some ways, OPEC appears to have changed little over the decades. Bahree cited a 1983 announcement by Saudi Arabian oil minister Ahmed Zaki Yamani of a "landmark" OPEC deal on oil prices.

Yamani proclaimed "strong indications that this time everybody means business" and said the organization "was not ruling out a price war if non-OPEC producers want it," Bahree recalled.

"That could have been last year. Or in 2014," he observed.

But in some other ways, OPEC progressed and adapted.

Bahree identified three areas where OPEC has changed through the years:

- A growing attempt to conduct market research and to understand the complexities of the global energy market: "Since the 1990s, they've become much more keen on market research. There used to be very little," Bahree said.
- A reduction in friction between OPEC and energy-consuming nations, particularly as represented by the International Energy Agency: "That hostility has slowly disappeared to the point where they now cooperate in many areas," Bahree noted.
- An interest in working together with non-OPEC producers, especially Russia: "The Russians have been involved in OPEC agreements before, mainly because OPEC tried to get them involved," he said. "They need much more weight, which only Russia can deliver."

In 2017, OPEC will hold the sixth go-round of annual discussions it has formally named the OPEC-Russia Energy Dialogues – either not noticing or not caring that this results in the acronym OPEC-REDs. Bahree said the outreach effort is something new for OPEC, but added, "I think it's a bigger change for Russia."

Looking back 40 years, in 1977 OPEC produced two-thirds of the non-Communist world's oil supply. Its share of total world production has fallen, and now shale oil and other tight oil production in the United States has added a new twist.

OPEC's interest in analyzing the global energy market and working with other producers as it moves into the future undoubtedly reflects that lessened clout in manipulating total crude production. Bahree sees this as a plus.

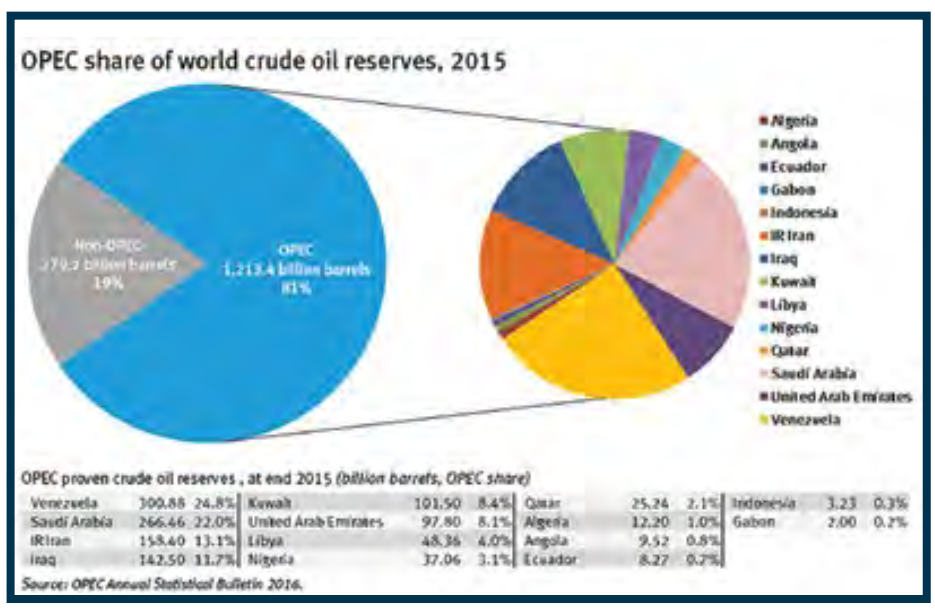
"Given that OPEC has a lot of data from its members, I think one of the positive developments has been their emphasis on trying to understand the industry better," he said.

Bahree noted that in recent years, OPEC has also tried to have more communication with consumers, and has undertaken a continuous increase in communications in general.

"One aspect of that is that the past six months have shown how well OPEC has managed its public relations," he observed. "They've learned how to manage market expectations better."

"It's soft gains there, but gains nonetheless," he said.

See **Saudi Arabia**, page 13



OPEC proven crude oil reserves , at end 2015 *(billion barrels, OPEC share)*

Venezuela	300.88	24.8%	Kuwait	101.50	8.4%	Qatar	25.24	2.1%	Indonesia	3.23	0.3%
Saudi Arabia	266.46	22.0%	United Arab Emirates	97.80	8.1%	Algeria	12.20	1.0%	Gabon	2.00	0.2%
IRIran	158.40	13.1%	Libya	48.36	4.0%	Angola	9.52	0.8%			
Iraq	142.50	11.7%	Nigeria	37.06	3.1%	Ecuador	8.27	0.7%			

Source: OPEC Annual Statistical Bulletin 2016.

OPEC Agreement Raises Hope, Skepticism

By DAVID BROWN, EXPLORER Correspondent

Here's a three-word graduate course in economics: supply and demand.

When OPEC announced a six-month agreement to curb production and reduce the world's crude-supply surplus, responses came from two main camps.

The first group included those who believed the move would materially affect the global supply of crude oil.

"This deal is significant. It sends a very strong message to the market and it should help the market find a balance," said Simon Flowers, chief analyst for Wood Mackenzie in Edinburgh.

"It remains to be seen how well they stick to the plan, but if OPEC hadn't come to an agreement the probability is that oil prices would have fallen to $40 per barrel, perhaps even lower," he added.

Flowers has a cautiously optimistic outlook for the price of crude oil this year.

"We expect it to trade at an average of $55-60 in 2017, which shows that the agreement is very significant indeed. However, this does depend on OPEC being very careful to meet the terms of the agreement," he said.

OPEC members agreed to reduce oil production by almost 1.2 million barrels a day. Saudi Arabia said it would limit its daily oil production to just over 10 million barrels – a cut of around 486,000 barrels a day from recent levels.

Iraq, now the second-largest producer in OPEC, agreed to cut 210,000 barrels a day from October 2016 levels. The United Arab Emirates consented to reduce crude output by 139,000 barrels a day and Kuwait by 131,000 barrels a day.

OPEC ministers and officials gather for the recent production agreement.

In a concession to Iran, where production had been constrained by international sanctions for a decade, the country would be allowed to increase oil production slightly to about 3.8 million barrels a day.

Additionally, 11 non-OPEC countries later agreed to reduce output by 558,000 barrels a day. Russia pledged the largest reduction, saying it would try to cut production by as much as 300,000 barrels a day.

OPEC members Libya and Nigeria weren't included in the reduction plans; Indonesia was recalcitrant and its OPEC membership was suspended. All together, 10 OPEC oil ministers promised that their countries would reduce crude output.

Easier Said Than Done

Skeptics quickly observed that a lot of people would have to keep their promises in order to make a meaningful dent in the world's oil supply. And producers in the United States are free to go right back to drilling.

That camp of opinion doubted if OPEC could swing production low enough to stabilize and then increase crude oil prices over the long haul.

"Whilst this is the first agreement to cut output in eight years, the deal will be hard to police. It is also based on the expectation that major non-OPEC countries such as Russia will voluntarily reduce their output," said Jayesh Parmar, partner in the Baringa Partners consultancy in London.

Parmar said oil prices could rise sharply in the short-term, "but I don't expect the price momentum to be sustained."

The critics also noted that an understanding-in-principle to cut production was a long way from a full commitment by participating OPEC members.

"The first thing that has to happen is that they have to get an agreement," said Michelle Foss, chief energy analyst for the Bureau of Economic Geology at the University of Texas (UT) at Austin.

Foss said the world is "just sloshing in product," a situation exacerbated by the amount of crude oil now coming from nontraditional sources.

"We've got a lot of barrels coming into the market in the first half of 2017," she said. "I've suggested at UT that we can expect oil in the $40s all year."

North American production is another

See **Optimistic**, page 14

Eastern Mediterranean Becoming a Hot Spot

By DAVID BROWN, EXPLORER Correspondent

The eastern Mediterranean Sea could become the hottest offshore play in the Middle East area, depending on the outcome of a key exploration attempt later this year.

This Mediterranean offshore expanse is a Miocene playground with a large sandbox and carbonate reservoir potential, as evidenced by Eni's supergiant Zohr field offshore Egypt, a 2015 discovery.

Now Total plans a 2017 exploration well on deepwater Block 11 offshore Cyprus, to the north of and contiguous to Zohr's Egyptian Shorouk offshore block.

It's the first time in the region that a carbonate rather than a sand reservoir has been targeted, according to Graham Bliss, senior director of plays and basins research for IHS Markit in London, and lead author of an analysis series examining upstream energy competition in the eastern Mediterranean.

"As it relates to Block 11, we assume that Total will not merely be drilling the northerly margin of Zohr field, but that they are testing a genuinely independent prospect. In addition, it is our initial assumption that there is no problem with source rock, and if a discovery is found, it will be gas," Bliss said.

The IHS Markit analysis also pointed to some possibility of oil potential in a deeper but unproven Cretaceous target on the Cypriot block.

Projected spud date for the Total exploration well is now in May, although the project has already gone through one delay. IHS Markit considers it "one of the most critical wells drilled globally in 2017 for the E&P industry, especially given the slowdown in exploration drilling worldwide."

Bliss said he has not seen any prospect data for the well, but "I would guess that this is a moderate to high-risk prospect. However, before we can adequately begin to assess the risk level, there are a number of key questions that will need to be addressed:

- "Do carbonates extend along the Eratosthenes High into Block 11? If so, are they the same carbonate reef buildup facies as those found in the Zohr discovery?
- "Was the subsidence rate of the Eratosthenes High in Block 11 such that it enabled a carbonate reef to build significant thickness?
- "If present, do these carbonates have the same diagenetic history as in Zohr and, as such, would they provide the same very high-quality reservoir, enabling among other things, a minimum number of development wells?

"A negative outcome for any of these questions could lead to the prospect being a dry hole, or an uneconomic discovery," he noted.

The Economic Question

And economics will be key to success. Another giant field in the area is Noble Energy Inc.'s Leviathan gas field in the Levant Basin offshore Israel, just now being sanctioned for commercial production expected by the end of 2019.

"The Eastern Mediterranean is a complex jigsaw of new energy supply chasing growing gas markets. A large discovery in Total's Block 11 would be in direct competition with Leviathan and other large fields in the area," Bliss said.

"For this reason a range of gas market opportunities is important for new supply in the region. These markets could be Egypt, Turkey, Greece or the rest of Europe. Widening the breadth of marketing opportunities is as much a political issue as it is one of pipeline technology – the market potential drives investment," he added.

For exploration to progress, Bliss said commercialization opportunities must be clarified and political hurdles resolved to prop up investor confidence, and to minimize both business and operational risk.

"Without such market opportunities, several existing and (potential) future

Continued on next page

Continued from previous page

discoveries in the area will become stranded," he said.

Eni caught the world's attention two years ago with the Zohr discovery, which reportedly has in-place resources of 32 trillion cubic feet (Tcf) of dry gas and possible recoverable resources of about 20 Tcf.

The company has drilled five wells on the Zohr structure to date, confirming a large gas accumulation and the existence of a very high-quality reservoir, according to IHS Markit. Zohr Field Phase 1 is due to come on-stream this year.

"The existence of a carbonate reef play, which Zohr has proven to be, is very different from the turbidite sand-play discoveries in the Israeli Levantine and the Egyptian Nile Delta Basin," Bliss said.

"If the Zohr carbonate play extends northward into Total's Block 11, then the potential for a significant discovery in Block 11 exists, resulting in profound implications for the region," he observed.

Current conditions favor Egypt as the regional commercialization hub for all of the eastern Mediterranean, Bliss said. He sees a likely gas price of between $4-6 per thousand cubic feet for a Block 11-type development if gas is exported to Egypt.

"This is due to both its domestic market potential and its established liquefaction capacity, which enables export of incoming gas. Depending on the outcome of Total's program in Block 11, 2017 could be a significant year for the region, and we could see competition and investment really begin to heat up," Bliss said.

Exploration Outlook

Geopolitics play a part also, with Cyprus split into pro-Turkish and pro-Greek factions, although "the regional geopolitical landscape is not static," he observed.

Turkey's interest in reducing reliance on Russian gas imports and in importing both Israeli and Cypriot gas could provide an important boost to the island's reunification discussions. Recent meetings in Geneva marked one of the few times since 1974 that Turkish and Greek Cypriots sat down together at the negotiating table, he noted.

"We at IHS Markit envision a large discovery in Total's Block 11, though not necessarily as large as Eni's Zohr discovery, to be economically viable with the sort of gas price expected for Zohr," Bliss said. "Such an economically viable discovery would certainly encourage further exploration within the eastern Mediterranean."

That exploration outlook is directly tied to product economics. An important factor could be the establishment of a range of market monetization possibilities for a Block 11 discovery.

"It is the reality of this wider opportunity for monetization options that will encourage further exploration in what has the potential to be an increasingly tight region in terms of new gas supply, from Israel, further Egypt and now Cyprus, but also, in the longer term, from Lebanon," he said.

Bliss said the eastern Mediterranean "is undoubtedly a hot spot at present."

"The breadth of play types, both new and well-established, that exist in the area and the range of potential markets must encourage further exploration interest. One problem for newcomers, however, is access to acreage," he noted.

Most of the attractive offshore acreage in Israel, Egypt and now Cyprus is taken by established players, in many cases either majors or large independents, Bliss said. Big prospectors in the region include Eni, Shell, BP, Total, ExxonMobil and Rosneft.

"The extent and speed of future offshore exploration activity here will be driven by these established players. In addition, exploration enthusiasm will also be driven by whether a range of monetization opportunities exists or not.

"So the eastern Mediterranean might be considered a rather unique spot compared to other areas around the world, and exploration enthusiasm there may not be reflected in other places," he said.

Saudi Arabia
from page 10

Saudi Arabia in the Driver's Seat

If there's a feeling that OPEC exists because it has to, that it represents a necessary producers' lever on output and prices, Bahree disagrees. He noted that various other entities, from Standard Oil to the Texas Railroad Commission in the United States to the oil majors at a later date, all have had an effect in the market at one time or another.

"I don't know that OPEC needs to exist. If it didn't exist, something else would," he said.

Even though OPEC's members have developed differing national goals and sometimes-conflicting strategies, "these are countries acting together for their own interest. If we take OPEC overall, it's not joined together by much of anything other than oil," Bahree observed.

"Essentially you have Saudi Arabia as the key enforcer or leader, just *de facto*, because it is the one with excess capacity," he said. "A recurring theme of OPEC is Saudi Arabia's massive production and its ability to vary it, which used to be considerable."

As long as Saudi Arabia remains OPEC's lynchpin, there's a reason to believe that a somewhat dysfunctional organization could continue to exist and function for the next 100 years.

Why not?

"The day Saudi Arabia says, 'We don't want to be part of OPEC,' for whatever reason, that would be different," Bahree said.

Subsidies
from page 8

A tenet in the oil and gas industry once held that "everyone in China and India will want a car," leading to a boom in fuel demand and energy consumption. Now even in developed countries, a shift to urban living has lessened the demand for private vehicles.

▸ Reduced subsidies:

Energy consumption is subsidized in a number of developing countries. Some subsidize gasoline prices or hold prices artificially low. India has a program of subsidizing diesel fuel for agricultural uses, Smith noted. Now there's a trend to reduce subsidies and introduce market forces in energy consumption.

"It started in the Group of 20, which is a combination of developed and developing countries, to take on the subject of subsidization," Caruso said. "The other area where there is a lot of subsidization is in the producing countries. Gasoline is very cheap in Saudi Arabia, in Iran, Iraq."

Governments might favor the idea of reduced energy-consumption subsidies, but actions that lead to higher energy prices often generate social unrest.

In December, the Mexican government announced it would increase gasoline prices, in some cases by 20 percent. The immediate effect of the price hikes was rioting, with four dead, at least 300 stores ransacked and more than 700 people arrested, officials said.

The Known Unknown

One trend with an uncertain effect is the continuing introduction of technological advances in developing countries.

"Whenever you're investing in technology for the long term, the results are unpredictable. Look at our own case in the U.S. No one thought the United States would be exporting crude oil 10 years ago," Smith said.

Caruso believes technology will be a critical factor in allowing developing countries to continue growing economically while reducing their ratio of energy use to output units. He said it's "better to grow at three percent and become much more efficient."

"Technology has made a big difference in both the demand side and the supply side," he said. "The key is going to be technological innovation, if we're going to crack this code."

Optimistic
from page 11

important piece of the world crude-supply equation and independent producers "have no choice but to monetize the acreage they're leasing. That's the situation in the United States and it's not easy to fix," Foss said.

Global oil supply is a hard thing to control, she noted. She's skeptical that OPEC can stick to an equitable agreement without members cheating, and she's skeptical that the rest of the world will also consent to hold down crude production.

"The third bit of skepticism is that all the new barrels that are scheduled to come into the market are actually going to come in, and that's going to undermine the agreement," Foss said.

Optimistic Realists

As last year ended, a third group began to emerge in response to the supply reduction agreements.

That camp assumed cheating on quotas would take place and reduction targets wouldn't be met – but also, that there would be enough cuts to start whittling down the world's crude surplus, leading to higher oil prices.

"At this juncture, the OPEC output cut could swiftly tighten the supply and demand balance in the first half of 2017. The agreement may not be fully adhered to, but even at partial implementation, there would likely be steady implied stock draws during 2017," said Ann-Louise Hittle, principal analyst for Wood Mackenzie.

"In terms of implementation, (the OPEC agreement) is unlikely to be fully implemented. Even if it's only implemented halfway, it's going to materially affect production," said Jim Burkhard, chief of oil market research for IHS Markit Ltd.

What the agreement does is put a more stable floor underneath world oil prices, Burkhard noted.

"It diminishes the size of the downsize risk. Without that deal, it looked like we were headed into another year of surplus production over demand," he said.

Burkhard agrees that U.S. production capacity continues to be "the elephant in the room right now." He said the industry's cost structure has deflated remarkably over the past two years, lowering breakeven points for domestic producers.

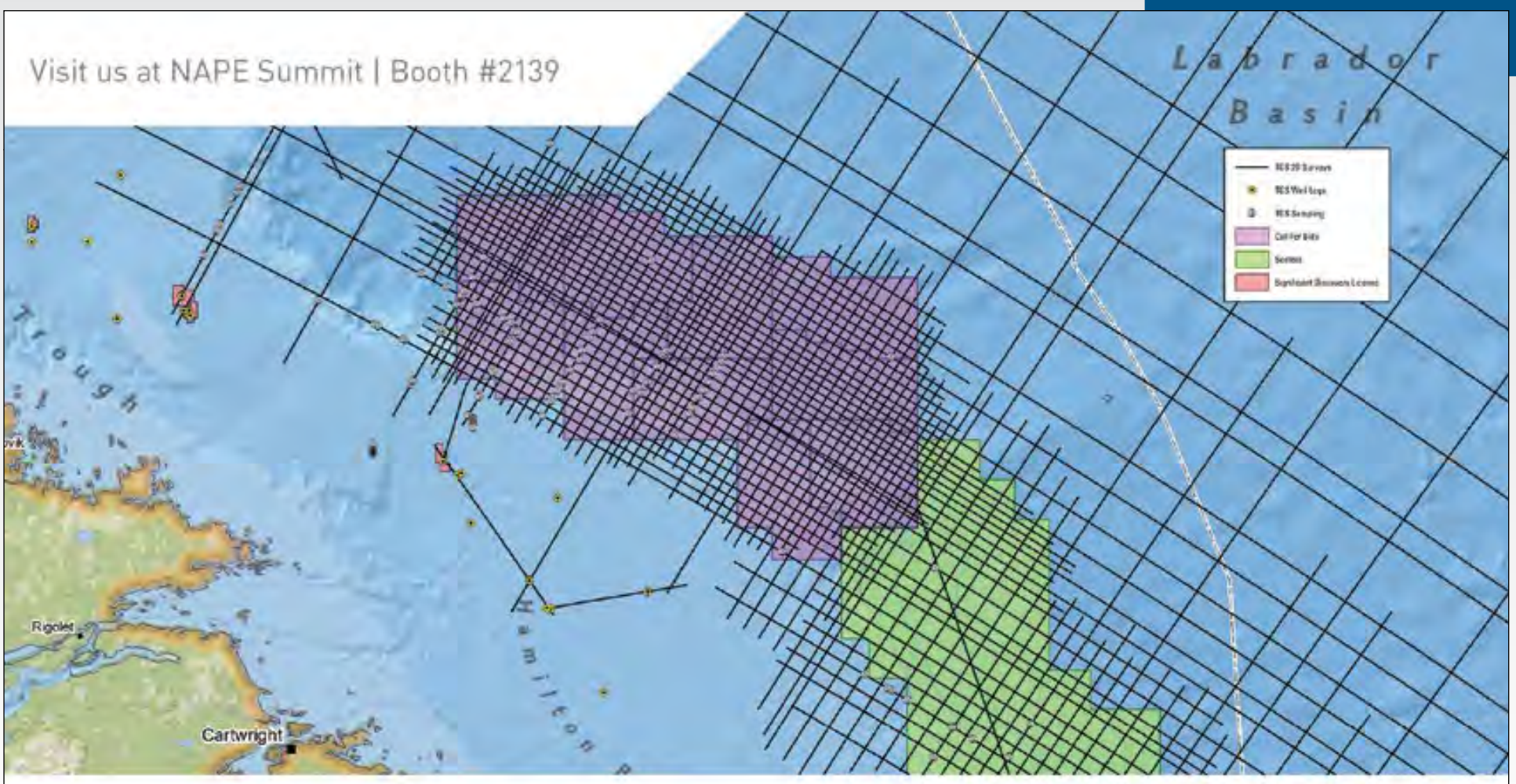
"It comes down to something simple: the oil price and the amount of financing available," he said. "How much money is flowing to West Texas and Oklahoma? We know there are lots of prospects that can be drilled."

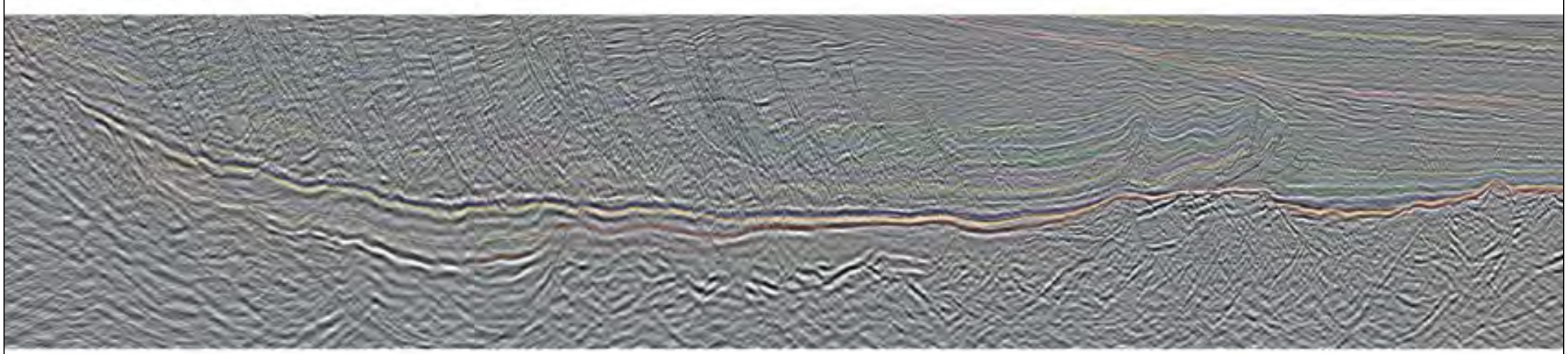
Based on recent experience, independents can be expected to boost drilling and output when U.S. crude prices exceed $50. Neal Anderson, Wood Mackenzie president, said "it's challenging (for them) until oil approaches $50, and then they cautiously go back."

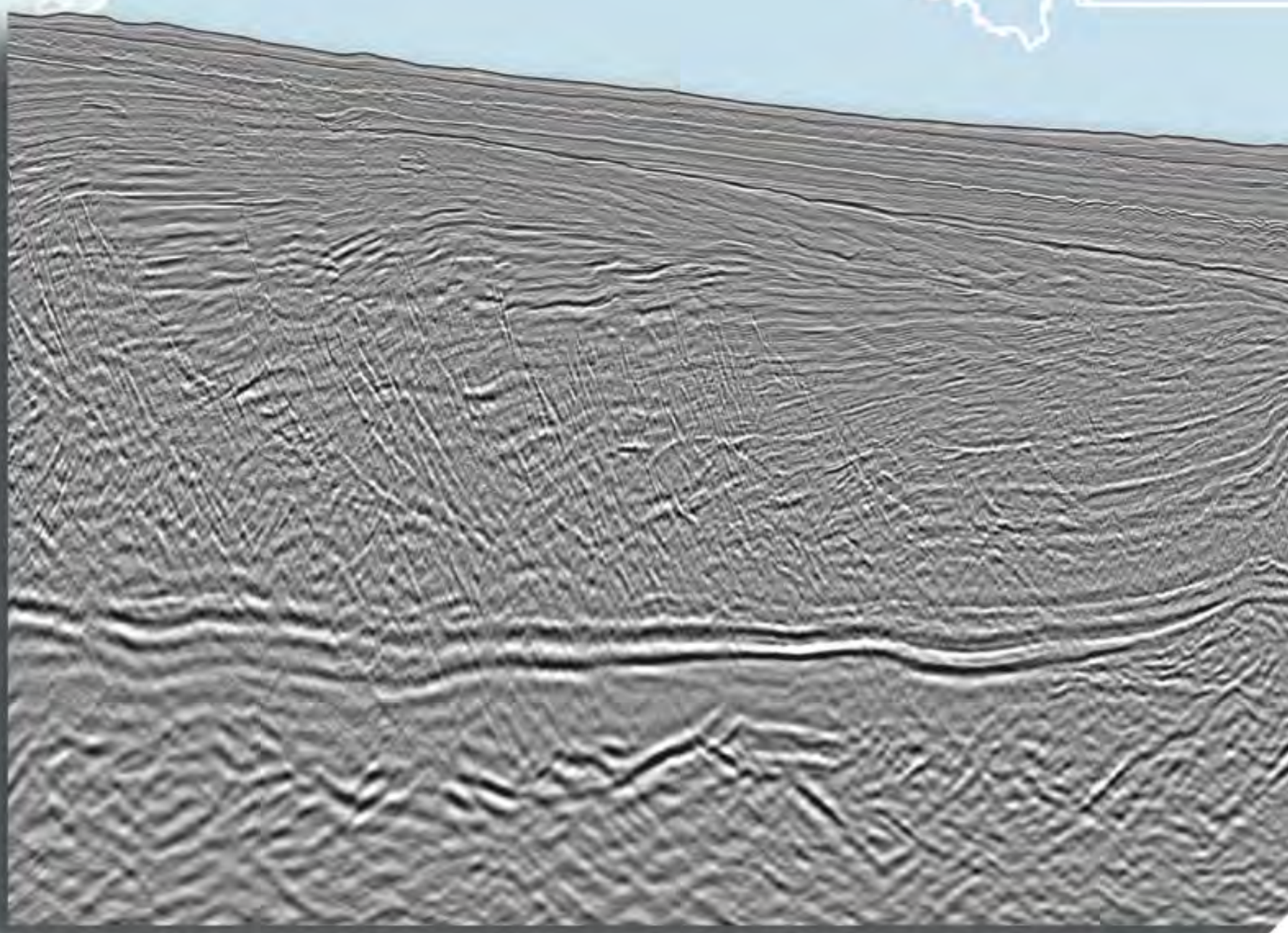
In regard to the question of whether or not the production-reduction agreements will lift oil prices during the remainder of 2017, the consensus opinion appears to be "yes," "no" and "maybe."

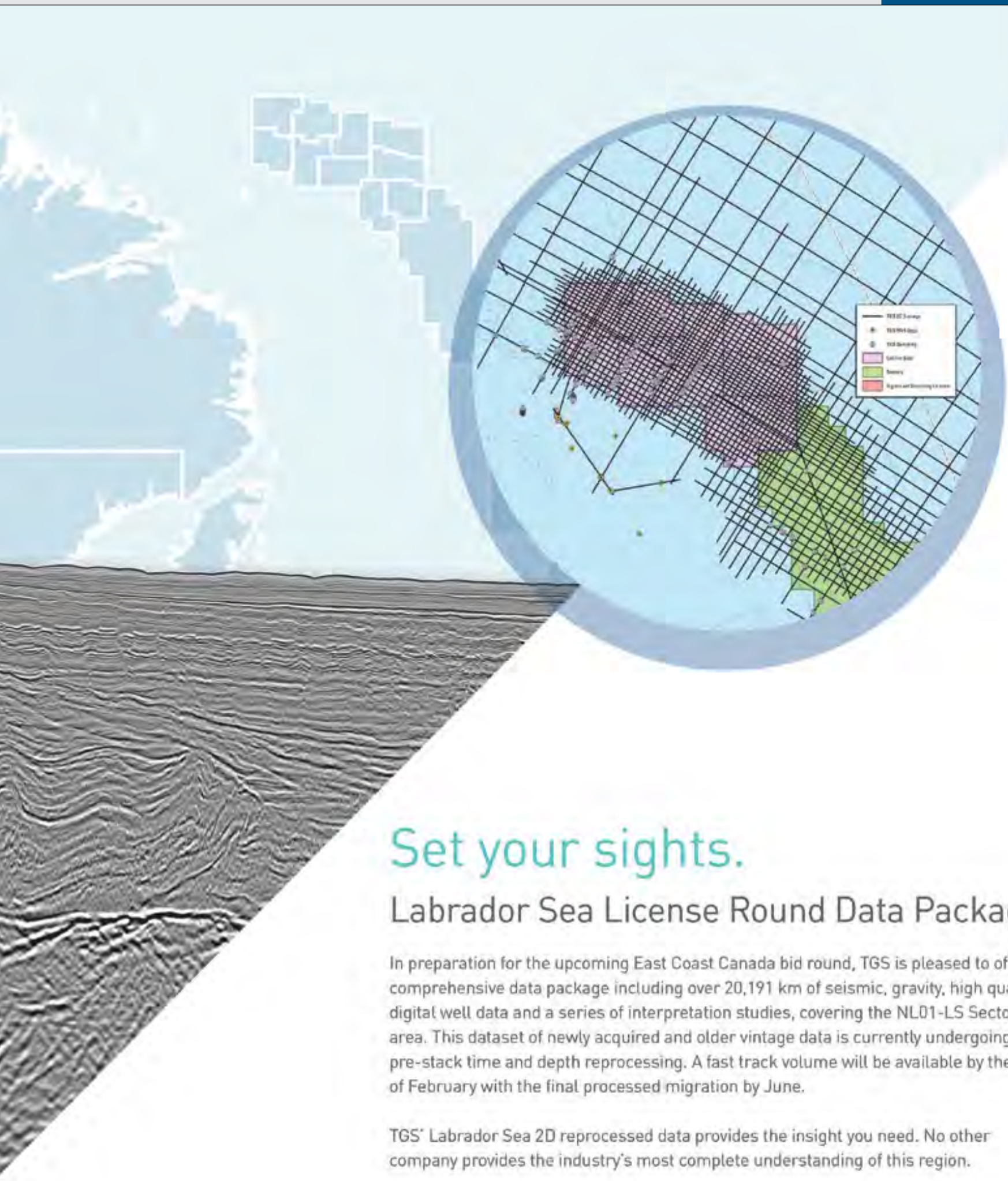
How will OPEC's actions affect oil prices and industry activity over the next 12 months? We'll know for sure in about a year.

In the meantime, keep an eye on crude oil supply and demand.









Set your sights.

Labrador Sea License Round Data Package

In preparation for the upcoming East Coast Canada bid round, TGS is pleased to offer a comprehensive data package including over 20,191 km of seismic, gravity, high quality digital well data and a series of interpretation studies, covering the NL01-LS Sector area. This dataset of newly acquired and older vintage data is currently undergoing pre-stack time and depth reprocessing. A fast track volume will be available by the end of February with the final processed migration by June.

TGS' Labrador Sea 2D reprocessed data provides the insight you need. No other company provides the industry's most complete understanding of this region.

See it here.

See the energy at **TGS.com**

PGS TGS

Historical Highlights is an ongoing EXPLORER series that celebrates the "eureka" moments of petroleum geology, the rise of key concepts, the discoveries that made a difference, the perseverance and ingenuity of our colleagues – and/or their luck! – through stories that emphasize the anecdotes, the good yarns and the human interest side of our E&P profession. If you have such a story – and who doesn't? – and you'd like to share it with your fellow AAPG Members, contact Hans Krause at historical.highlights@yahoo.com.

The Oil Sands Pioneers of Alberta

By FRANCES J. HEIN

Wildfires might be what come to mind when most people think of northeastern Alberta, owing to recent news coverage of the record evacuation of about 88,000 people from the Fort McMurray area. Current events notwithstanding, however, northeastern Alberta is historically best known for its huge bitumen resources.

Here the world's largest bitumen accumulation occurs, with initial established reserves of 177 bbl, and remaining established reserves of 165 bbl. The largest bitumen deposit is in the Athabasca oil sands area, which includes the Fort McMurray area.

BUTLER

Topographic map of Alberta with highlights showing the Athabasca, Cold Lake and Peace River oil sands deposits.

Signed photograph of S.C. Ells, at "McMurray Tar Sands," 1928 (from Provincial Archives of Alberta A12023).

Alfred von Hammerstein (from Alberta Heritage, 2000).

Early Exploration and Entrepreneurs

Although debatable, there is some evidence that "pre-contact" First Nations people used the heavy oil seeping from bitumen outcrops for waterproofing of clothing, canoes and heating.

One of the first Europeans to see oil sands was Chief Factor Henry Kelsey at the York Factory trading post on Hudson's Bay in Manitoba. In 1719, a Cree native guide named Wa-Pa-Su gave Kelsey a sample of bituminous sand. Later in 1778, the notorious explorer Peter Pond was credited – along with charges of killing two people while dueling – for giving the first recorded description of the Athabasca oil sands.

In 1848, the Scottish explorer Sir John Richardson did the first geological assessment of oil sands along with his expedition in search of his fellow explorer Sir John Franklin, who had gone missing during his 1845 expedition in search of the Northwest Passage (the wreckage of his two ships wouldn't be discovered until as recently as September 2014 and September 2016, respectively, the latter owing to local Inuit oral history and knowledge).

Richardson identified the principal component of the oil sands as quartz and correlated them to the Devonian Marcellus Shale of New York. From the late 1800s to early 1900s, the Canadian Dominion Department of Mines sent field parties to drill and map the oil sands. This work was led by Sidney Ells, an engineer who located and mapped all of the bituminous-sand outcrops, drilled hundreds of shallow cores and took bulk samples for testing. Ells' work became the key baseline study for all the following detailed work in the area.

By the mid-1900s, an early oil sand industry included the Abasand plant within Fort McMurray and the Bitumount plant about 90 kilometers north along the banks of the Athabasca River.

One of the more colorful characters at this time was Count Alfred von Hammerstein. Originally born in Germany, he came to Canada for the Klondike Gold Rush in the Yukon. He only got as far as northern Alberta where he saw the bituminous-sand outcrops along the Athabasca River. He then moved back to Edmonton and in the summers he and his team drilled for oil beneath the "tar sands." In 1906, they used a cable rig to drill for oil in the Devonian limestone along the banks of the Athabasca River, hoping to find "pure oil pools" beneath the degraded, oil-sands outcrops.

They never found oil, but did find salt, so they set up a salt extraction plant. Hot water was pumped down a vertical well to dissolve the subsurface salt, which was then pumped up through a producing well to the surface. The salt brine was then evaporated and transported by rail for use as table salt.

Another prominent promoter was R.C. Fitzsimmons (founder of Bitumount), who saw many uses for bitumen, including pavement, fuels, roofing and medicine. However, he had to shut down operations at Bitumount due to insolvency and in 1938 fled Canada to avoid his creditors.

Max Ball was the founder of the Abasand plant. He graduated from the Colorado School of Mines, where he studied engineering, then worked for the U.S. Geological Survey, mapping coal in Wyoming. In 1930, Ball was in Edmonton when the Alberta Research Council (ARC) plant closed, and Ells convinced him to prospect for oil sands on the Horse River. Ball purchased the old equipment from the ARC plant, moved to Fort McMurray and started building the Abasand plant in 1930 and completed it in 1936. Abasand produced more than 250 tons of oil sands per day and was only shut down after World War II when demand for bitumen products declined. Ball later became director of the Oil and Gas Division of the U.S. Department of the Interior.

Later University, Government and Industry Work

John A. Allan, a professor of geology at the University of Alberta, published on the oil sands in early government reports on the mineral resources of Alberta. In 1929, Karl Clark at ARC (along with Sidney Blair) patented his hot-water process for extraction of bitumen from the oil sands. In 1930, Clark started producing bitumen at the Bitumount plant, pumping up to 300 bpd. The product was used for paving roads in Edmonton and Jasper and as roofing. In 1949, Clark made "The Athabasca Tar Sands" known to a world audience by publishing a popular article in Scientific American. That same year, a commissioned detailed government report by Blair confirmed that bitumen recovery from the oil sands could be profitable.

In 1947, Ned Gilbert, a junior and the only Calgary employee of Sun Oil (now Suncor Energy), developed prospects in northeastern Alberta, obtaining the first two oil sands permits in the Bitumount area and later leases in Suncor's present Firebag in-situ area. Gilbert heard a rumor that the Sun Oil head office in Philadelphia was planning "to get out of the oil sands leases." As a very young junior he had the courage to write to the leadership team in 1951 to persuade them to acquire more than 50,000 acres at a bargain price of $1.40/acre. The estimated resource was 800 million barrels of bitumen.

In 1957, Maurice Carrigy joined the ARC and began working with the geology department. After decades of work, the detailed bedrock geology of northeastern Alberta (Map 240) was published by Green, Mellon and Carrigy (along with a number of ARC reports and bulletins). This became an updated baseline geology that, together with Ells' earlier work, provided the basis for much of the later geology, exploration and development in the Athabasca oil sands area.

A Changed Game

Throughout the 1970s, most of the oil sands industry was surface mining. However, in Alberta, only 20 percent of the oil sands are in areas with thin overburden such that it can be surface-mined; the remaining 80 percent is too deep and would need to be recovered by in-situ technologies. In 1978, Carrigy and Clement Bowman (founding chair of Alberta Oil Sands and Technology Research Authority, or AOSTRA) heard about Roger Butler's work on thermal in-situ technologies.

Butler developed his ideas while at Imperial Oil in the 1970s and later took over as head of technical programming for AOSTRA. Butler is considered the "Father of SAGD" (i.e. steam-assisted gravity drainage). At the time of early development, industry considered SAGD a "boondoggle." However, AOSTRA embraced the concept with the building and running of the AOSTRA Underground Test Facility (UTF) northwest of Fort McMurray. The results from UTF made a "game changer" for in-situ oil sands recovery, and a success story of technological breakthrough for unconventional energy development.

In all cases, with the development of the oil sands industry in Alberta, it was the collaboration of the entrepreneurs, the government, university scientists and industry-players that brought this unconventional energy-industry to fruition. Without the entrepreneurial spirit and dogged determination, this development would not have been as successful as it is to today. It is the multidisciplinary approaches and collaboration, particularly with the AOSTRA model, that make this a success story.

HEIN

Frances J. Hein is with the Alberta Geological Survey (Alberta Energy Regulator) where she has worked on oil sands for about 19 years. She was co-editor of the AAPG Studies in Geology 64 on oil sands and heavy oil; and in 2014, received the Canadian Provincial and Territorial Geologists' national award for her work on oil sands and other unconventionals.

Playmaker's Forum to Explore the Delaware Basin

By KELSY TAYLOR, EXPLORER News Editor

The Delaware Basin Playmaker's Forum, presented by the AAPG Division of Professional Affairs, will be held Feb. 22 in Midland, Texas.

The forum will include presentations given by leading experts from companies who have been successfully operating in the basin. A few of the presentations will be:

- John Polasek of Occidental Petroleum Corp., Oxy's Interdisciplinary Method to Improve Well Performance and Achieve Profitable Production Growth
- Randall S. Miller of Core Laboratories, Tight Oil Reservoir Targets in the Delaware Basin
- Sarah Rittenhouse and Joanna Fritz of Devon Energy Corp., Generation of a Regional 3-D Pore Pressure Model for the Wolfcamp Formation in the Delaware Basin, New Mexico and Texas
- Donald Burdick of Panther Energy Company II, Building an Asset in Uncertain Times-The Panther Energy Delaware Basin Story

The Delaware Basin has been heating up again as companies vie for remaining plots of land.

The Delaware Basin is located in the southwestern portion of the Permian Basin, straddling Texas and New Mexico.

Susan Nash, AAPG's director of innovation and emerging science/technology, explained that it contains numerous vertical pay zones and new underexplored resource and shale plays. In addition, all of the zones can be exploited effectively with pad drilling.

During the downturn in the oil industry, many companies with operations and infrastructure in the basin struggled but are beginning to find their footing once again.

"It's a place where companies that have invested heavily in gaining expertise in the latest techniques used in shale plays can have tremendous pay-off, as their knowledge allows them to effectively produce a complex stacked play that combines conventional reservoirs with resource plays," said Nash.

Competition for sweet spots in the area have been heating up and can be fierce, she said.

"In January alone, several massive acquisitions were announced. They included WPX Energy's acquisition of Panther Energy Permian holdings for $775 million in cash, Noble Energy's acquisition of Yates Petroleum for $2.5 billion and the record-breaking ExxonMobil's acquisition of the Bass Family's Permian assets for $5.6 billion in stock," she explained.

Today, 105 active horizontal rigs sit in the Permian and the number is expected to increase as companies secure acreage while oil prices are still low and productive leases are still available.

In a place where one acre can fetch as much as $40,000, it's surprising to discover that companies are willing to pay the price.

"The Delaware Basin is one of the only places in the United States where companies can drill, complete and produce at a relatively low price. In some cases, operators are able to make money even at $25 per bbl.

"With companies able to hedge at $50 per barrel through the second quarter of 2018, it's all about doing efficient factory drilling and really understanding the reservoir. This involves very detailed geological, geomechanical and geochemical studies as well as typical reservoir simulations. Economics are based on right around 1,900 Boe/d at more than 70 percent oil.

"So, in an environment where most experts do not expect to see oil prices rise much in 2017, the Delaware Basin is a perfect place to test just how low one can go in operating costs.

"If you are one of the companies that has invested heavily in the Delaware Basin, you are going to need to learn from the successful operators. And, you're going to have to learn fast," said Nash.

The Delaware Basin Playmaker's Forum will be a great way to do so.

"The quick, effective knowledge transfer from the engineers and geologists who are doing the hands-on work in the Delaware Basin is the goal of the one day event."

To learn more about the forum, visit http://aapg.to/delplaymkr.

The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, TGS, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer.

Enhancing Seismic Discontinuity Attributes with Creative Workflows

By SATINDER CHOPRA and KURT J. MARFURT

Seismic discontinuity attributes such as coherence and curvature are routinely applied to 3-D seismic data volumes to delineate faults or fractures, channel and reef edges, and other geological features. Such attributes are very helpful in interpretation, though the quality of the attributes generated depends on the quality of the seismic data in terms of coherent noise, incoherent noise and frequency content.

Once the 3-D seismic data reaches the interpreter's workstation, it is presumed that the data have undergone optimal imaging and are free of processing artifacts such as multiples and over- and under-migration. We believe this to be true in most cases; and in those cases where it is not true, there is little the interpreter can do to correct the problem and the job becomes one of avoiding the interpretation of artifacts as geology. While the interpreter does not have the tools, expertise or time to reprocess seismic data, there are several steps that can be taken to precondition the data for subsequent attribute and impedance inversion analysis, some of which (such as structure-oriented filtering and trim statics) have been presented in this column over the last few years.

One of the more valuable data conditioning tasks is spectral balancing, or even enhancement, of the seismic data. Both of these processes need to be carried out carefully, with improvements in well ties to the seismic data, with well data being a critical validation step.

One of the processing strategies that may not be familiar to interpreters is to aggressively filter the data to facilitate a given process, but not to apply that filter in the final workflow. A classic example is to aggressively filter noise components to facilitate interactive velocity analysis. Once an accurate velocity analysis has been done, it is used to migrate the original (noise contaminated) rather than the filtered data, allowing migration to filter noise and enhance signal. We can do the same to precondition data for attribute analysis where we need to preserve edges, but not preserve amplitudes and phases.

Data Conditioning Workflow for Coherence

We describe the sequential steps in data conditioning workflow for coherence as follows:

1. Assuming that the input seismic data are preconditioned using structure-oriented filtering at the very least, one can compute the first derivative in almost any interpretation software package. The derivative does two things – it multiplies each frequency component by the frequency, f, resulting in spectral "bluing," and it rotates the phase of the data by 90 degrees, so that the peaks and troughs of the amplitudes are transformed into zero crossings (figure 1b). In figure 2, we show a segment of a seismic section from the preconditioned input seismic data volume (figure 2a), and an equivalent section after computing the first derivative of this data (figure 2b). The average frequency spectra for the whole seismic volume and for the time window displayed are shown in the insets. Notice how the frequency spectrum shifts to the higher frequency side for the first derivative data. The first derivative data can be used as input to attributes such as coherence or curvature. If random noise has been previously suppressed by structure-oriented filtering, the resulting attributes often exhibit greater detail.

2. If increasing the contribution of higher frequencies helps the coherence image, perhaps eliminating the low frequencies could help as well. We do

Continued on next page

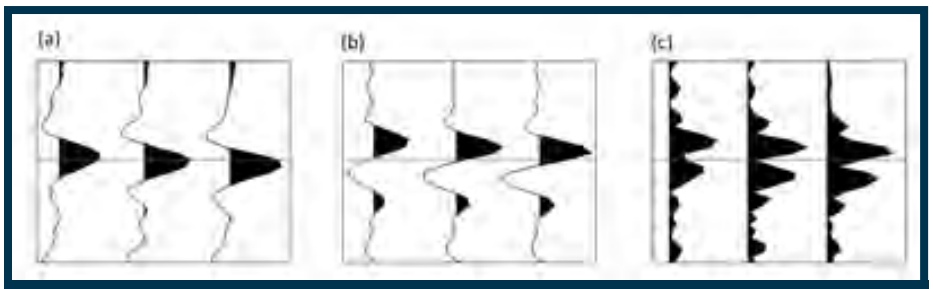


Figure 1: Comparison of (a) the input seismic traces with (b) first derivative of the seismic traces in (a), and (c) the absolute value of the first derivative traces in (b) displayed on a magnified scale. Note, the rotation in the phase of the wavelets by 90 degrees in the first derivative display compared with the input seismic traces, as well as how the negative amplitudes are flipped as positive when the absolute values of the first derivative traces are computed. Data courtesy of Arcis Seismic Solutions, TGS, Calgary.

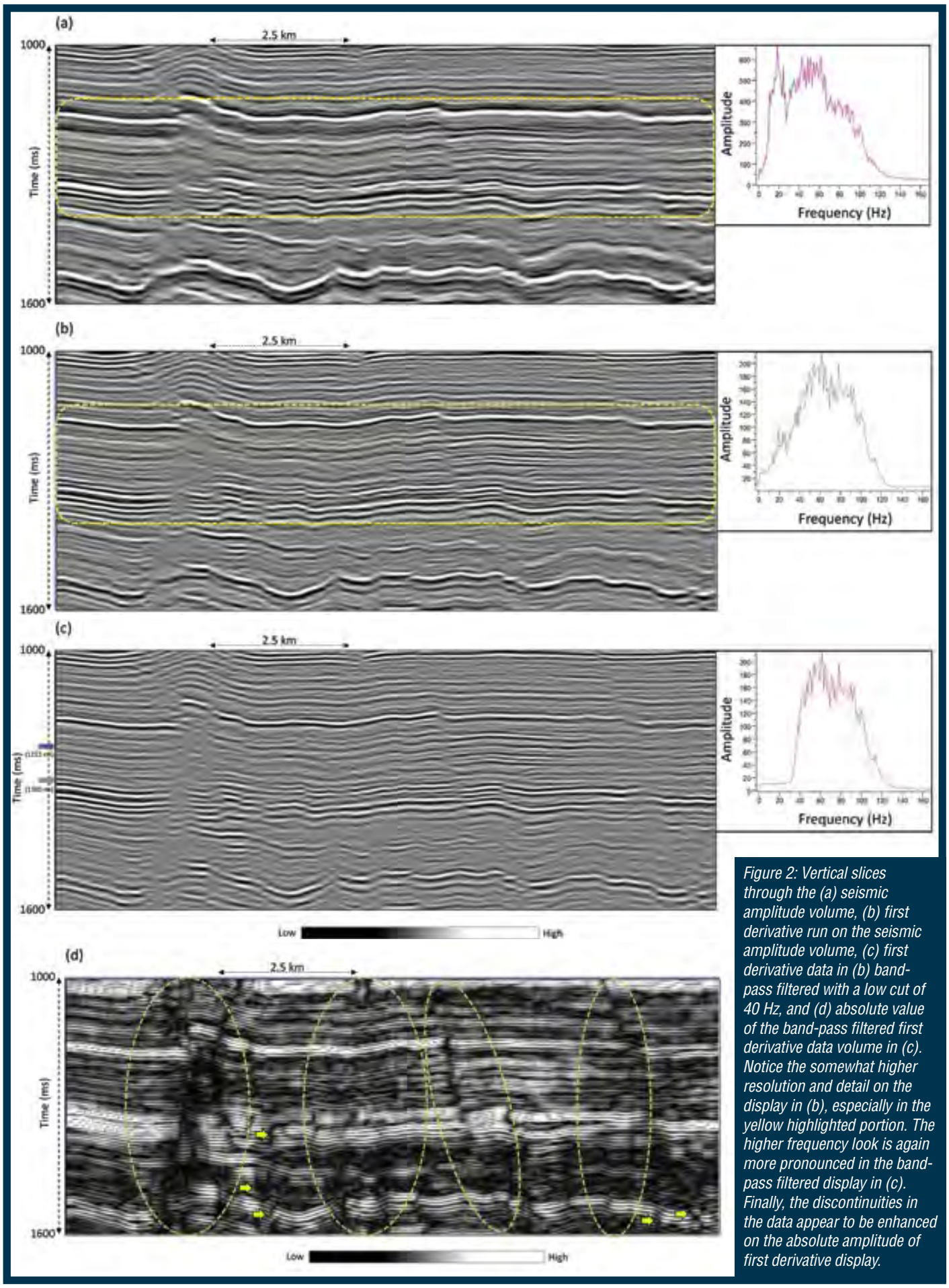


Figure 2: Vertical slices through the (a) seismic amplitude volume, (b) first derivative run on the seismic amplitude volume, (c) first derivative data in (b) band-pass filtered with a low cut of 40 Hz, and (d) absolute value of the band-pass filtered first derivative data volume in (c). Notice the somewhat higher resolution and detail on the display in (b), especially in the yellow highlighted portion. The higher frequency look is again more pronounced in the band-pass filtered display in (c). Finally, the discontinuities in the data appear to be enhanced on the absolute amplitude of first derivative display.

Kurt Marfurt is an AAPG Member and professor of geophysics at the University of Oklahoma.

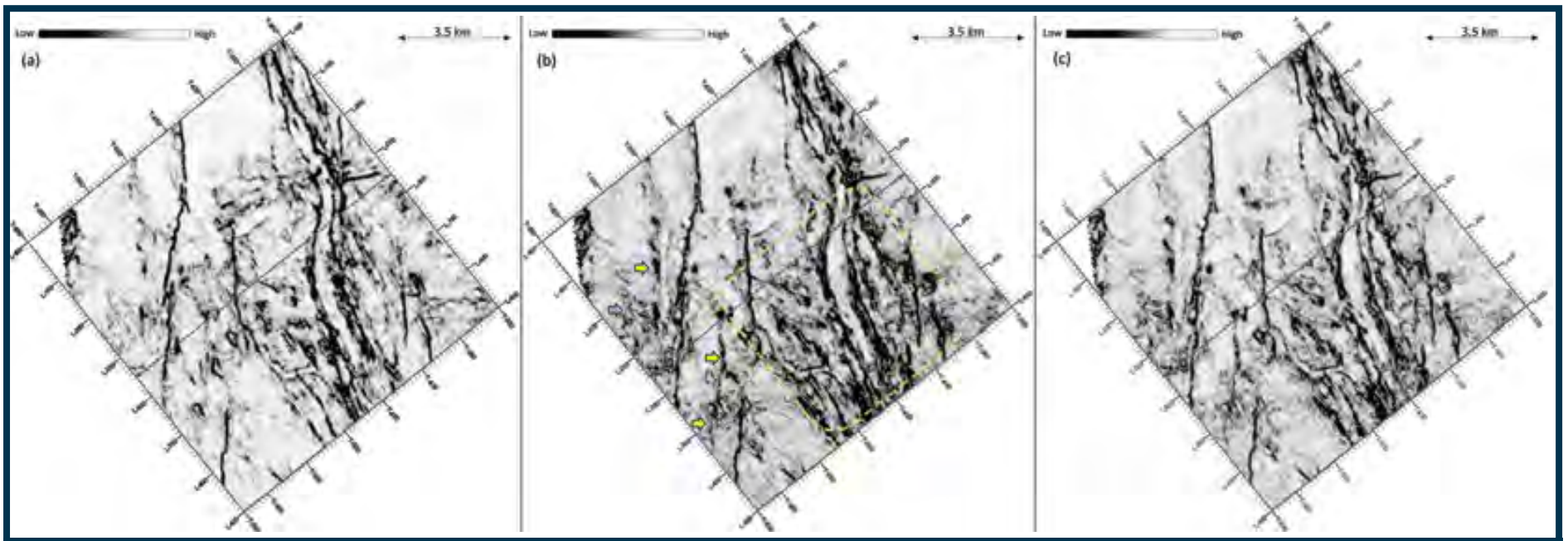


Figure 3: (a) Time slices at t=1300 milliseconds through the energy-ratio coherence volumes computed from the (a) input seismic data shown in figure 1a, (b) the low-cut filtered first derivative of the input seismic data shown in figure 1c, and (c) the absolute value of the low-cut filtered first derivative of the input data shown in figure 1d. Notice the improved detail of the discontinuities seen in (b) as indicated with the yellow and cyan arrows but also in the yellow highlighted area. The display in (c) shows similar level of detail as in (b) but shows higher contrast between the low coherence faults and the high coherence background.

Continued from previous page

so in figure 2c where we have applied a low-cut 40 Hz filter to the results shown in figure 2b, resulting in an image that appears to be of higher frequency.

3. The previous two filters are linear. We might further extend the apparent frequency by taking the absolute value of each sample, or more simply, change all negative amplitude values to be positive. As seen in figure 2d we notice that the faults are defined much better, and the effect is seen equally well for structural or stratigraphic discontinuities.


CHOPRA

> **"All the steps... can be quickly carried out by an interpreter on a workstation with the available interpretation software package."**


MARFURT

Conclusion

The three processes above damage the true amplitude and phase of the data, and therefore cannot be used for subsequent impedance inversion or even simple bright spot analysis. However, these three filters do not significantly alter the location of discontinuities and of stratigraphic configuration.

We demonstrate the value of such filtering by computing energy-ratio coherence attribute on the input, the data in step 2 (first derivative) and then the data in step 3 (first derivative with bandpass filter). Notice the improvement in continuity and resolution of the coherence anomalies (arrows in figure 3). All the steps mentioned earlier can be quickly carried out by an interpreter on a workstation with the available interpretation software package.

Like our processing analogy of velocity analysis, the interpreter now co-renders the improved coherence volumes with the original seismic data volume.

Geophysical Modeling for the Next Century

By LOUISE S. DURHAM, EXPLORER Correspondent

It wasn't until the mid-to-late 1990s that geologists and geophysicists began to move beyond laboring only on their respective turf.

As 3-D seismic gained prominence in the industry, the two professions realized they needed each other, and the ensuing synergy soon became routine.

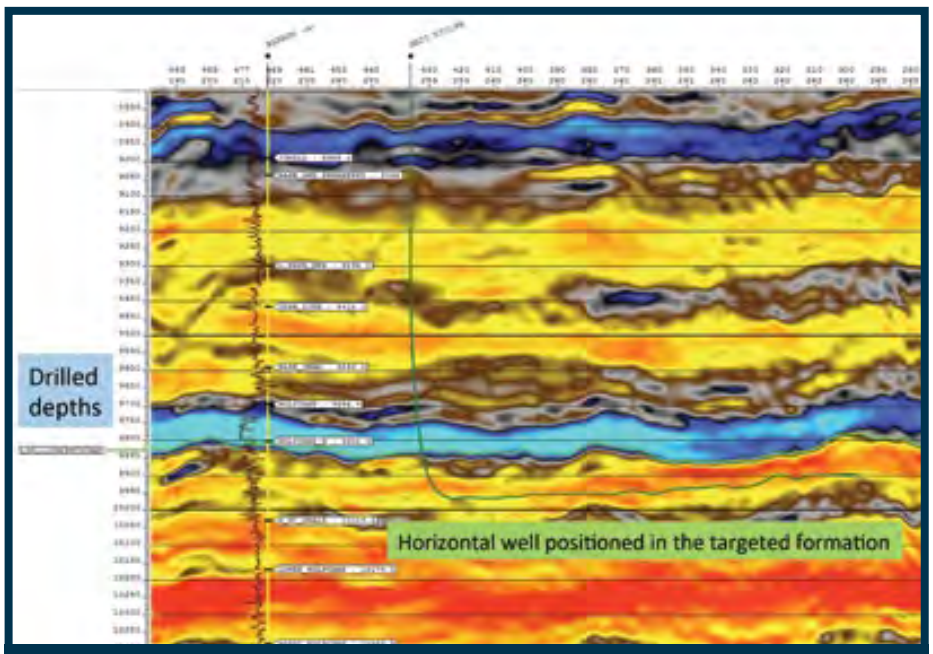
Geophysical data quickly became invaluable to the geologist as a means to create 3-D geological models to visualize aspects of the subsurface over sizeable areas, in both working basins and frontier areas.

Today, model building expertise has been refined significantly. Among innumerable applications, it's now becoming a must-have for horizontal wells, which often are more complex than previously thought. And, in the century to come, ongoing advances in the underlying technology will make it even more indispensable, faster and far less expensive.

Given the borderline-wild leasing activity currently occurring in the Permian Basin, where certain land prices zoomed upward toward $40,000 per acre at one time recently, it's timely to take a look at the role that models can play in the Permian drilling action.

The basin overall harbors a plethora of shale zones that ordinarily demand horizontal wellbores in order to give up their usually voluminous hydrocarbon volumes in the most efficient and cost-effective manner.

It's not unusual to drill a lateral and to perforate every 100 to 200 feet or so, with the idea being that the reservoir is the reservoir. But that's a pricey undertaking, which increasingly is being considered not only unnecessary, but even a bit foolhardy.



A seismic line of impedance that has been converted to depth, showing the Wolfcamp B target in the Midland Basin. Graphics courtesy of Fasken Oil and Ranch Ltd.

In the Permian, the rocks range from conventional sandstones all the way to mudrocks and everything in between, often with many low permeability, tight interbedded zones.

Smart, or Caveman?

The experts at longtime industry player Fasken Oil and Ranch Ltd. in Midland, Texas have honed considerable expertise in this region.

"What I've seen in these tighter, low permeability rocks is advances in petrophysical analysis, so over the next decade I see us coming up with very robust techniques for petrophysical evaluation," said senior geologist Stonnie Pollock at Fasken.

"The reason this has to take place is we're dealing with nanodarcy and microdarcy permeability rocks and dealing with rocks rich in TOC (total organic content)," Pollock noted. "But a lot of that organic richness is immovable oil, or bitumen.

"Some of the advances we'll see is how to better understand how much of those hydrocarbons are movable versus immovable," he added. "We're already seeing some of that as some of our more experienced petrophysicists and geochemists are beginning to unlock that."

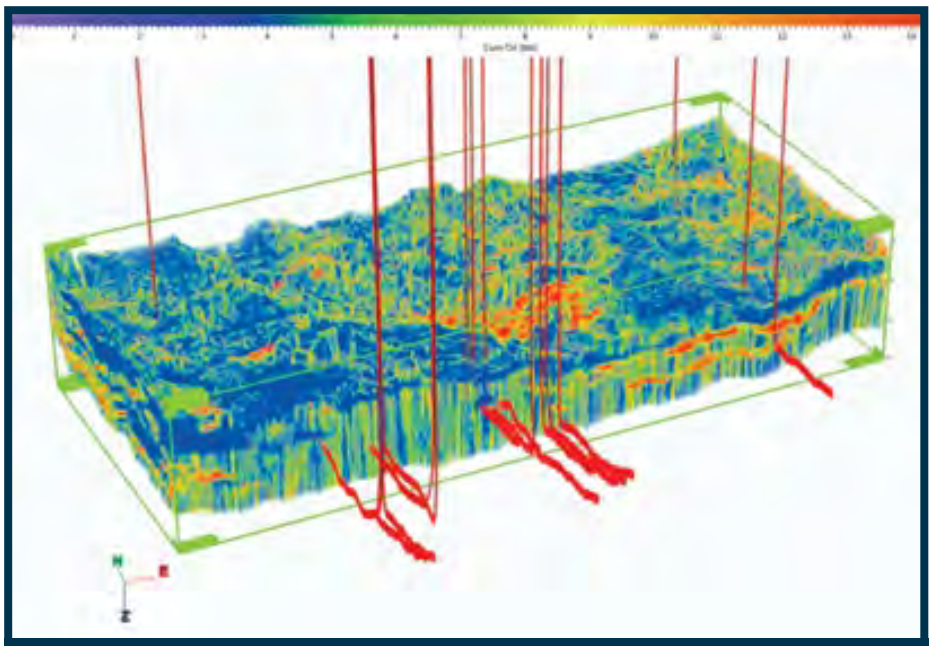
Pollock also mentioned that there will likely be increasing technology in the realm of geochemical acquisition tools and more advanced software and computer modeling, and he emphasized that nanotechnology will be a big part of the industry for modeling and measurement in the future.

This will meet some far-ranging needs.

"With horizontals, there needs to be much more advanced mineralogical and petrophysical modeling to determine where to drill the laterals and where to initiate your completions because you have to frac all this type rock," noted Fasken geophysicist Ron Bianco.

For so long, the lateral drilling rationale was that the well is in the

Continued on next page



This is a 3-D volume on the Middle Wolfcamp Shale created using seismic. Colors represent the probability of production. The well paths show the perforated intervals.

Continued from previous page

same pay zone for thousands of feet, so completions theoretically could occur in the rock over the entire length of the lateral. Pollock noted, however, that geologists and geophysicists can see changes occur in the lateral direction in the target interval.

The practice of perforating at predetermined, equally spaced intervals all along the lateral may soon be over, according to Glenn Winters, chief geophysicist at Fasken.

"In the future, people are going to want to measure and model the best quality even in the lateral direction, and we'll see advances in this and more selective fracturing," Winters said. "You can call it smart versus caveman completions," he added.

"Already, people are looking at their seismic, looking at where they have digital logs and saying they're going to place these perfs only in zones they think are the best," Winters said. "That's where the modeling and integration are going to come in."

Finer Models

Although there are tools to measure rock properties through the horizontal wellbore, they are pricey and can significantly raise the mechanical risk. This mechanical impact explains why there's little logging acquisition in horizontal wellbores. The Fasken team predicts there will be advances in that realm.

"Our logging will get better, and we'll be able to integrate that with our engineering production and our seismic data," Winters said. "Right now, we're at the beginning of trying to use seismic data to forecast where we think we'll see better reservoir rocks.

"In the future, I see us using the production we have and reintegrating that in the forecasting with the logging tools we have in order to come up with a better and finer model – 'finer' meaning better lateral and vertical resolution," he commented.

Better Data Management

Pollock added that better logging information used in combination with the right technology can yield a gamma ray model showing clay or shale content. With continuous logging, they could use the information to change the model as it's created. Winters joined in, emphasizing that modeling software is advancing dramatically, which is going to help considerably.

"The reason the future is so exciting is because for the first time in our industry, it seems like companies and individuals have the ability to purchase fairly inexpensive computer capacity that's finally met the technology we've been pushing," Bianco said. "Now you can buy computers with capacity to run huge neural network modeling looking at all kinds of reservoir attributes, and do it overnight or in a day instead of the three to four months it used to take.

"I can change my model and completely revamp all the reservoir qualities overnight or in a few hours," he said. "Now we all will be able to do modeling in-house and put our own spin on it.

"Modeling is the way of the future, and neural networking technology gets better every day," he noted. "I think that statistical analysis is going to solve most of the problems we have in any of the basins where we have a high amount of data."

The Human Factor

Still, caution is the buzzword.

Pollock noted that a model is nothing but a theory without proof of hard evidence, indicating that uncertainty lurks wherever.

Maintaining geological meaning during modeling is key and is the most formidable challenge in the process, according to Bianco.

The service companies clearly are skilled with applying the data, but Winters emphasized that things can be misunderstood unless the geoscientist(s) is doing the work.

"You must be careful with the model as anyone with good computer software can model anything," he said. "You must have a good geologic analog and understand the geometry and the reservoir attributes of those intervals, or the model is meaningless."

He mentioned for example that someone could interpret a carbonate debris flow extending for several miles, while another person might limit it to a half mile.

"We can do things so quickly now, and as long as there's good geological and geophysical understanding, I think we'll see huge improvements in earth models," Winters added.

Policy Watch is a semi-regular column in the EXPLORER covering the legislation, regulation and politics pertaining to the science and profession of petroleum geology.

POLICYWATCH

The Mess is Part of the Magic

By DAVID CURTISS, AAPG Executive Director

All eyes were drawn to Washington, D.C. last month as the United States inaugurated Donald J. Trump as its 45th president.

It was a hard-fought and divisive political season – one that has raised anxiety levels both in the United States and abroad. It is now up to the new president and the Republican-controlled 115th Congress to get to work.

Confirming President Trump's nominees for Cabinet-level and other senior government positions is a significant first task facing the Senate. And, they're hard at work meeting privately with nominees, questioning them publicly in hearings and giving all of us a first look at how they would manage their Cabinet agencies in service of the American people.


CURTISS

> **Hold your nose if you must, but come into the sausage factory and be part of the solution.**

Diversity is Good

President Trump is not a part of the Republican establishment, nor does he present himself as such. This has caused much questioning in Washington and in capitals around the world about what we can expect from his administration.

His nominees to fill the Cabinet and other senior posts include loyalists, political opponents, former military officers and business people. It's a varied bunch, ranging from Rex Tillerson, former chairman and CEO of ExxonMobil, and Rep. Mike Pompeo (R-Kan.) to retired Marine Corps Gen. James Mattis and Gov. Nikki Haley (R-S.C.).

Listening to their testimonies to Senate committees reveals a notable diversity of opinions expressed by the nominees.

The president, tweeting on Jan. 13, expressed his support: "All of my Cabinet nominees are looking good and doing a great job. I want them to be themselves and express their own thoughts, not mine!"

Diversity is good.

And if the president is able to harness the talent of his Cabinet and cultivate a productive working relationship with House Speaker Paul Ryan (R-Wis.) and Senate Majority Leader Mitch McConnell (R-Ky.) there is a possibility of making significant progress. That's what the president and congressional leaders have promised.

A Nation of Laws

But what if that prospect frightens you?

I have Republican friends, Democrat friends and non-U.S. friends who are all concerned about the direction the country may be heading. The despondency some of them felt on election night was incapacitating.

Even so, the sun came up the next morning.

I don't say that to be flippant, but rather to provide some perspective. Our nation is governed by laws, written by Congress and signed by the president.

Yes, this issue of "legislating by executive order" is real. But those executive orders only last until the president who signed them leaves office. One of President Trump's first jobs upon taking office was to decide which of President Obama's executive orders to adopt.

Laws passed by Congress persist. They are the law of the land. And if you've ever been exposed to the legislative process, you know it's not easy to get them passed. Changing them is equally difficult.

"To retain respect for sausages and laws, one must not watch them in the making," is how Otto von Bismarck famously put it.

I've written before about my experience as an American Geosciences Institute (AGI) Congressional Science Fellow, now named after AAPG past-president William Fisher. And in my final column for AGI's Geotimes magazine in December 2002, I wrote the following:

"The past year has given me opportunity to see the U.S. government in action from the inside, and I marvel. Success was hardly assured when the Founding Fathers gathered to declare independence from Britain, and yet their actions set in motion an experiment in self-governance that has proven remarkably resilient over the past 226 years. Far from smooth sailing, our nation's history is full of struggles, some of which threatened to destroy the republic, others that tore at the basic fabric of our society. Through it all, though, Lincoln's admonition that our government was and must remain 'of the people, by the people, and for the people' and that such government 'shall not perish from the Earth' provided a foundation that our elected leaders have not undermined.

Admittedly, in Washington it is especially easy to be swept away by an overly romanticized patriotism that merely feeds the cynic's view that it is all a sham. The reality, though, is that while our system of government is far from perfect, it works because the people are involved. As citizens we too often abdicate the responsibility of engaging in public discourse and debate, an essential element of good government, because it seems so mean spirited and nasty. And yet, how else do you balance ideological extremes and arrive at an acceptable solution? At times, the whole operation does seem to land in the ditch, which might (ahem) characterize the current situation in Washington.

See **Election**, page 28

Honoring the Pioneering Women of Geoscience

By KELSY TAYLOR, EXPLORER News Editor

This year's Annual Convention and Exhibition will feature a special forum titled "Pioneering Women in Petroleum Geology," which will be held April 1 in the George R. Brown Convention Center in Houston.

The forum will celebrate the many women who paved their way through history while building a foundation for women in geoscience today.

Robbie Gries, an organizer of the event and member of the Professional Women in Earth Sciences Special Interest Group (PROWESS SIG), said she feels that it's important to share the stories of these women, since so many have been lost in history.

The forum will include four panels presented by a variety of expert speakers. Each will begin with a portion of a new documentary, titled "Rock Stars: Pioneering Women in Petroleum Geology," followed by presentations and discussion.

The topics will focus on the earliest women in the field, the managers, the first well site women and micropaleontology pioneers, as well as the impact that World War II, the military and the years following the war had on the women.

GRIES

> "The women in our history deserve to be remembered and honored. And if we know more about them, we can appreciate their accomplishments for the better and can learn from their struggles and their successes."

In addition, a keynote presentation will be made over lunch and there will be plenty of opportunities for networking during the event.

To add a little flare to the forum, a costume contest has also been planned. AAPG's Young Professionals Special Interest Group developed the idea, Gries explained, to "encourage everyone to dress in an era while representing women from the early 1900s, women in WWII, women in the 1950s, the 1970s and the 'Dress For Success' 1980s."

A "Celebration Wall" will be displayed just outside the forum, in easy view of the rest of the Convention.

"The wall will be an awesome display of 100 of the earliest female petroleum geologists, who overcame enormous barriers and developed an amazing path for those who followed in their footsteps," said Gries.

She said the event brings attention to an important aspect of the history of AAPG and of petroleum geology.

"The women in our history deserve to be remembered and honored. And if we know more about them, we can appreciate their accomplishments for the better and can learn from their struggles and their successes," she said.

To that end, Gries and fellow volunteers have been working on a book, "Anomalies: Pioneering Women in Petroleum Geology: 1917 to 2017." It chronicles the lives of the women through memories that were shared by their family and friends. The book will be released during the forum.

The event is made possible by the collaboration and support of AAPG's PROWESS SIG, the Association of Women Geoscientists and the Society of Exploration Geophysicists Women's Network Committee.

For more information about the forum, visit http://aapg.to/ace2017100.

Frank Harrison Jr. Honored by the Foundation

By TAMRA CAMPBELL, Administration Team Coordinator

Longtime AAPG Foundation supporter and leader Frank Harrison Jr., a founder of the group's highly successful Trustee Associates, is this year's recipient of the AAPG Foundation Chairman's Award.

This award, given in recognition of those who have made extraordinary contributions (monetary or service) to the AAPG Foundation and who call attention to the role and value of the Foundation, will be presented April 4 at the Chairman's Reception during the AAPG Annual Convention and Exhibition in Houston.

Harrison's relationship with the Foundation began in 1978 when he was invited by James E. Wilson to become a founding member of the Trustee Associates, a distinguished group of donors who provide support for Foundation fundraising efforts and counsel and leadership to the Trustees.

Harrison, believing the Foundation is essential to the future of AAPG, said setting up the Trustee Associates was among the most important decisions made by the AAPG Foundation. Since that time, he has called attention to the Foundation through service as chairman for the group (2000) and sponsored more than 14 new Trustee Associates.

In 1986, when the Foundation became an Oklahoma non-profit organization, Harrison was appointed as a Regular Member of the Members of the Corporation, a seat he still holds.

The members of the Members of the Corporation meet annually to keep abreast of Foundation activities and business.

This lifelong Louisiana resident and Louisiana State University (LSU) graduate (1950) served as president of AAPG from 1981-82. Harrison's optimism about the oil and gas industry during his presidency prompted the Executive Committee members to give him a sign that read "Optimistic Oil Company – Frank W. Harrison, president." After giving thought to the name and his outlook about the oil and gas industry, Harrison did indeed establish the Optimistic Oil Company, where he serves as president.


HARRISON JR.

After he graduated from LSU with a bachelor's degree in petroleum geology, Harrison served in the U.S. Army from 1951-53. He then worked as a geologist for Union Producing Co. and Seaboard Oil Co. in New Orleans.

In 1956 Harrison moved to Lafayette, where he accepted a position as the district geologist for Trans-Tex Drilling for a year before joining American Natural Gas production as head geologist. In 1959, he began his successful career as an independent and consulting geologist in south Louisiana.

Harrison, an AAPG Honorary Member, has served on numerous committees since joining AAPG in 1954; his service as a Visiting Geoscientist, as well as

Continued on next page

MVSP Mission Briefing

By HEATHER ANDERSON, MSVP Committee Chair

The mission of the AAPG Foundation's Paul and Deana Strunk Military Veterans Scholarship Program (MVSP) is that of sustainment.

At its core, sustainment is the provision of personnel, logistic and other support required to maintain and prolong operations or combat until successful accomplishment. The MVSP likewise is in the business of sustainment through the provision of highly qualified personnel to industry by providing financial support to military veterans studying geoscience with the goal to pursue a career in the oil and gas industry.

Deana and Paul Strunk have boldly led this program's charge. Through theirs and other generous contributions, the program has grown quickly, awarding scholarships just one year after its creation in 2014.

Over the past two years, the Foundation's MVSP has distributed 20 scholarships in the amount of $2,000-$4,000 to deserving veterans. Focusing to support university-level veteran geoscience students, these scholarships will provide necessary educational financial support to aid in veteran's transition from rucksack to backpack.

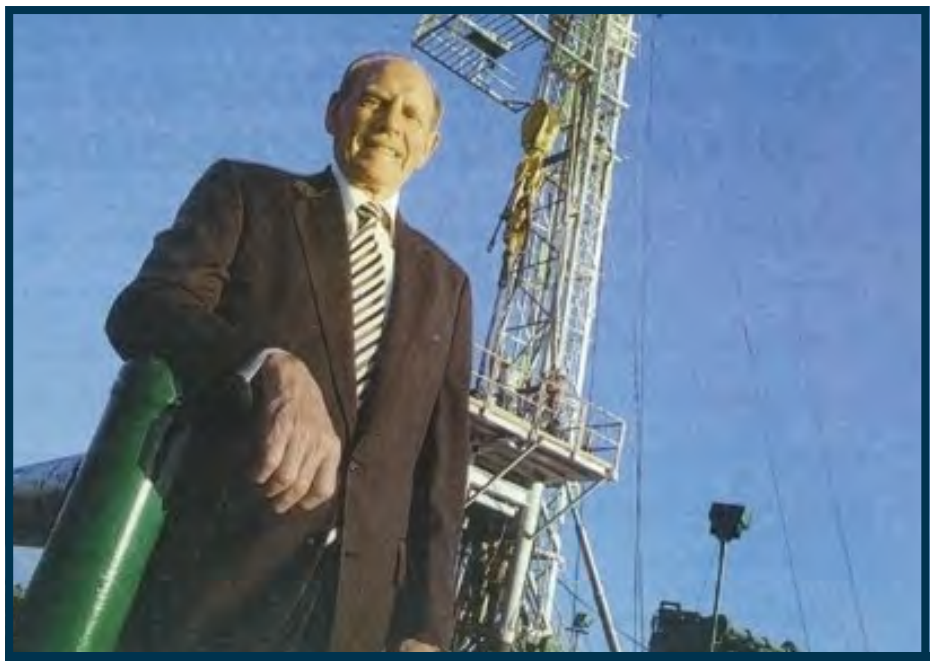
Call to Arms

Oil and gas prices might be low, but financial need remains high. And now, amid the downturn, AAPG Members and non-member supporters are needed to continue to sustain and maintain financial support of the MVSP and other programs within the AAPG Foundation.

AAPG and its member community have a strong history of sustainment, support and investment in the next generation of geoscientists.

No contribution is too small. In fact, even a small donation can be made big through employee charitable donation matching programs. Many employee matching programs double or even triple individual contributions.

Our industry is in the midst of the "great crew change." The impact of your contribution will be lasting as you support student veterans, the next generation of leaders in our industry.



This image of Harrison is from the Winter 1997 cover story of Louisiana Business magazine entitled, "For Frank Harrison the oil business is the ride of his life."

Continued from previous page

a committee member for that program and the Distinguished Lecture program allowed him to share his optimism about the oil and gas industry and the need for innovative thinking and sound geological reasoning to develop drillable plays with future geoscientists.

Harrison has given generously of his time – both personally and professionally – by serving on boards and holding offices for many other organizations. His professional affiliations include service as president of the Gulf Coast Association of Geological Societies (1980); Lafayette Geological Society (1961-62); the American Geosciences Institute (1989-90); and the Louisiana Oil & Gas Association (1977-78).

Harrison received the Colonel Edwin L. Drake Legendary Oilman Award in 2003, honoring a lifetime of achievement within the oil and gas industry by The Drake Foundation.

Harrison is the 19th recipient of this award. Past award honorees include Michel T. Halbouty, L. Austin Weeks, James E. Wilson, Merrill W. Haas, Hugh Looney, Lawrence W. Funkhouser, Fred A. Dix Jr., Robert W. Esser, Eugene F. "Bud" Reid, Jack C. Threet, John W. Shelton, David Scott "Scotty" Holland, William E. Crain, Herbert G. Davis, Richard A. Baile, Charles Weiner, William L. Fisher and Donald A. O'Nesky.

Foundation Contributions for December 2016

General Fund
Lee B. Backsen
Robert O. Beringer
George R. Bole
Claude E. Bolze
Louis C. Bortz
In memory of Myron K. Horn and Donald R. Hembre
John E. Chatfield
Dr. and Mrs. Kenneth W. Ciriacks
Robert L. Countryman
In memory of A.T. "Toby" Carleton
Henry C. Dean Jr.
Byron and Connie Dyer
Mason L. Dykstra
Weldon G. Frost
In memory of Harry O. Waller
James M. Funk
Anonymous
Robert E. and Betty K. Hilty
Charles Kerans
In honor of Dr. William L. Fisher
Hermann D. Lebit
Steven R. Lockwood
Jim and Carolyn McGhay
Susan M. Morrice
Jerome N. Namy
John F. Polasek
Eddie W. Rhea
Sarah Springer and Rusty Riese
Kenton N. Riggs
John W. Robinson
Duane H. Sackett
In memory of B.W. Lynch
David C. Salter
John J. Schneider
Carlton and Patricia Sheffield
Elliott M. Simonberg
Grant from Elliott Simonberg Fund
Philip H. Stark
Edward J. Stockhausen
Stephen M. Strachan
Phillip G.V. Tungeln
Michael and Lynn Wisda
Robert and Edith Zinn
Grant from Robert and Edith Zinn Charitable Fund

Amoruso Special Publications Fund
John and Camille Amoruso

Awards Fund
Foundation Chairman Award
William and Marilee Fisher
Robert R. Berg Outstanding Research Award
Josephine F. Berg

Digital Products Fund
Baylor University
Doris and John Shelton

Distinguished Lecture Fund
Willis R. Brown
Grant from Willis R. Brown Trust through Fidelity Charitable
Sarah Springer and Rusty Riese

Education Fund
Bruce and Carol Appelbaum
William C. Burkett
Jack P. Martin
Duane E. Meaux
In memory of Robert J. Meaux
Rita Monahan
Susan S. Nash
Gene E. Richards
In memory of E.T. Hill
James F. Trickett
Gordon K. Yahney

Grants-in-Aid Fund
Lee and Joanne Billingsley
In honor of Stew Chuber
John S. Isby
Anson Mark
In memory of Fred S. Jensen
Jeffrey A. May and Karen A. Crossen
Teresa M. O'Neill
In memory of Brian J. O'Neill
R.J. Bottjer and Sara L. Peyton
Eastern Section Named Grant
James McDonald
In honor of Dr. Paul Potter
Fred A. and Jean C. Dix Named Grant
Paul H. Dudley Jr.
In memory of Fred Dix
Frederic A. Tietz Named Grant
Frederic A. Tietz
James E. Hooks Memorial Grant
Kent A. Bowker
Jean G. Funkhouser Memorial Grant
David Funkhouser
In memory of Jean Funkhouser
John H. and Colleen Silcox Named Grant
John and Colleen Silcox
Lawrence W. Funkhouser Named Grant
Jean K. Funkhouser
In honor of L.W. Funkhouser
Ian W. Moxon
Mruk Family Named Grant
April L. Parsons
Ohio Geological Society Named Grant
James McDonald
Paul Danheim Nelson Named Grant
Dietrich H. Welte
Raymond C. Moore Memorial Grant
Robert W. Scott, PhD
Roger W. Stoneburner Memorial Grant
Jean K. Funkhouser
In honor of Richard K. Stoneburner
Weimer Family Named Grant
Robert J. and Ruth Weimer

James A. Hartman Student Leadership Summit Fund
Chevron Matching Employee Fund
Matching gifts given by Richard Ball

Imperial Barrel Award Fund
Steven H. Brachman
David R. Cook
In honor of Kristen Wooden
David J. Entzminger
David E. Lange

Deana and Paul Strunk Military Veterans Scholarship Program
Barry W. Acomb
John and Camille Amoruso
Norbert E. Cygan
In honor of SOTEX Veterans
Michael C. Fauquier
Michael C. Forrest
Paul M. Guerino
In memory of Michael Spalo
Paul and Tina Hoffman
Curtis C. Humphris Jr.
Don D. Irwin
Robert M. Mason
David G. Morse
Arthur L. Paquett
April L. Parsons
H.W. "Dub" Peace II and Norma J. Peace
In memory of Jon Withrow
Henry S. Pettingill
John and Kate Spaid
William and Pamela Stephens
Paul and Deana Strunk
Patrick M. Tolson

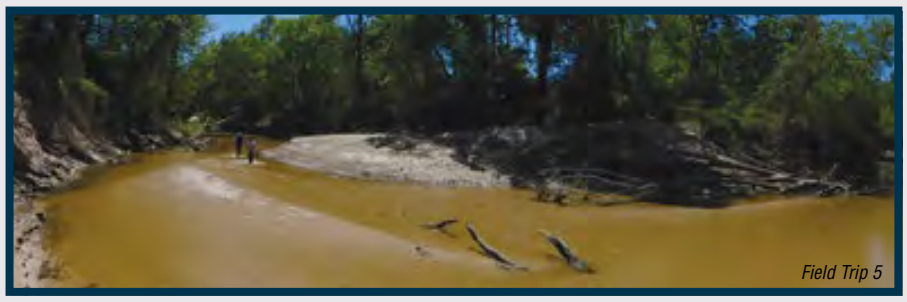
E. F. Reid Scouting Fund
Terri Duncan
Bryan Haws

L. Austin Weeks Memorial Fund
Martin and Arlyn Shields
Geoscientist Without Borders Program

L. Austin Weeks Undergraduate Grant Fund
Willis R. Brown
Grant from Willis R. Brown Trust through Fidelity Charitable

The monthly list of AAPG Foundation contributions is based on information provided by the AAPG Foundation office.

"ProTracks" is an ongoing feature of the EXPLORER, offering news and information pertinent to getting started or getting better in your career. Keep up-to-date with the YPs on Facebook, Instagram, Twitter and LinkedIn.


Field Trip 5

Field Trips Set for ACE

The AAPG Annual Convention and Exhibition will feature a variety of field trips that will bookend the meeting, spanning from March 26 to April 8.

Anyone interested will have the opportunity to visit an exciting location while learning from leading experts in the field.

Many of the trips are located near the Convention Center in Houston, while others will be out of state.

Before the meeting, the field trips will include a look into unconventional carbonate mud depositional environments and facies distribution; Upper Cambrian microbial carbonate mounds; fluvial and coastal clastic sedimentology and ichnology in modern environments and core; and meandering creek systems. A tour of the NASA Space Center is also available.

Following the meeting, field trips will explore shelf to basin sequence framework and facies architecture of a Cretaceous carbonate ramp; unconventional source rock reservoir fields; stratigraphic framework for the Cutoff Formation and implications for Upper Bone Spring and Avalon Reservoirs; reservoir analogs of modern Galveston Island and the Brazos River; Spindletop Hill; and the deepwater deposits of the Pennsylvanian Ouachita Trough.

Registration is currently open for the field trips. To register or learn more, visit http://aapg.to/ace2017ft.


Field Trip 9


Field Trip 11

A scientific field excursion to examine the geology and petroleum systems in outcrop of Western and Central Cuba and the relationships to the adjacent offshore tectonic, structural and depositional systems of the SE Gulf of Mexico and Proto-Caribbean

Highlights

- **7 days traveling across Western and Central Cuba viewing the following geologic formations:**
- **Middle-Upper Jurassic clastics and carbonates analogous to the "Norphlet-Smackover"**
- **Cretaceous carbonate platform to deep-water debris breccia beds equivalent to the prolific reservoir of southern Mexico**
- **Tertiary carbonate and deep-water clastic syn-orogenic strata**
- **Mesozoic strata related to opening of the Gulf, Mesozoic source rocks and inversion tectonics**

Drs. Manuel Iturralde and Evelio Linares, both leading authorities on the geology of Cuba, are principle trip leaders assisted by Mssrs. Osvaldo Lopez, Paul Crevello, Mateu Esteban and James Pindell

***To register or this field trip or for further details*: contact**
Paul Crevello, GeoExplorers Nonprofit Corporation
excursions@GeoExplorers.org


The YP Meet and Greet is a yearly hit at ACE.

Turning it to (Theme) 11:

Highlighting YP Activities at ACE 2017

By the Young Professionals Special Interest Group

Despite the fact that we're still a couple months out from the 100th Anniversary AAPG Annual Convention and Exhibition (ACE) in Houston, it's never too early to start planning your meeting itinerary.

With all the fantastic events and technical sessions planned, it's easy to get lost in the program. However, those of us in the Young Professionals (YP) Special Interest Group (SIG) would like to help you navigate your ACE experience by telling you about a few events you should definitely plan to attend.

On Sunday, April 2, come visit us in the George R. Brown Convention Center from 2 to 3 p.m. for the YP Meet and Greet. This event is a perennial favorite among meeting regulars and a definite must for students and YPs attending their first ACE. With the help of our experienced professional volunteers and sponsor Noble Energy, we'll be fielding all of your industry questions and providing tips and tricks that will make your meeting a success. Come participate in some of the best networking ACE has to offer.

The Future of Energy

After you've started your meeting off on the right foot by attending the Meet and Greet, make sure to end on a high note by spending the afternoon in the joint AAPG and Division of Professional Affairs (DPA) Theme 11 Forum aimed at students and early-career professionals on Wednesday, April 5.

According to Forum co-chairs Tim Rynott and Stephanie Nwoko:

"We welcome all YPs and students to ACE 2017 Houston. Two very important timelines are converging, making this one of the most important conventions in history. AAPG is boldly moving into its second century of existence, while the oil and gas industry is simultaneously recuperating from its version of the 'Great Recession.' The Great Crew Change is accelerating. Period.

"We need to act now to properly equip the next generation of geoscientists to take on the responsibility of fulfilling the world's future energy needs. This is the goal of Theme 11: Future of Energy. Today's YPs will soon be tomorrow's leaders! You will be leading AAPG into the next 100 years and it is imperative that you are prepared for the task at hand.

"Our forum, 'Essential Tools for the Next Generation of Geoscientists,' is a blueprint for future energy industry architects as drawn by some of the biggest names in the business. The invited speakers, which include three former AAPG presidents, are all distinguished geoscientists in the oil and gas industry. They will share talks which will emphasize the importance and relevance of today's YPs and students, particularly in light of the current industry downturn. We have the pleasure of welcoming Chandler Wilhelm, Shell vice president and current DPA president, as the keynote speaker for the event. This forum is the first of its kind and your participation will make it even more special. See you in Houston."

The Theme 11 Forum will be held in the George R. Brown Convention Center from 1:15 to 5:05 p.m. in Room 351, and abstracts are currently available online at ace.aapg.org. Both the YP Meet and Greet and the Theme 11 Forum are included with ACE registration, so register today.

Want more information on the YP SIG?

Visit us online at aapg.org/youngpros or find us on social media. Like us on Facebook at AAPG Young Professionals Special Interest Group and follow us on Twitter and Instagram @aapgypsig.

Election

from page 24

Ironically, this usually happens around Election Day. Time for the people to grab the reins and put things aright – that's resilience.

So the next time you cringe watching C-SPAN or cable news, remember that in our republic the mess is part of the magic. Then grab your pen and write your congressional representative, get involved and join the debate. Hold your nose if you must, but come into the sausage factory and be part of the solution. Whether it is in your local school, PTA, university, church, on a mountaintop, outcrop, or maybe even Congress, you've got something to offer and I look forward to hearing your story."

The mess is part of the magic. I still believe that.

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

IN MEMORY

Julie LeFever Leaves Lasting Legacy

By KELSY TAYLOR, EXPLORER News Editor


LeFEVER

Julie LeFever was dedicated to geology and sharing her passion for it with others. Following her recent passing in December, she will be remembered for the impact that she made in the field.

LeFever's interest in geology was sparked by her surroundings while growing up in California. She studied the subject in college, earning her bachelor and master's degrees in geology from California State University Northridge.

In 1980, LeFever moved to North Dakota and became involved with the North Dakota Geological Survey where she served as a subsurface geologist. Her role expanded nine years later when she was asked to oversee the Wilson M. Laird Core and Sample Library in addition to her previous responsibilities.

LeFever was dedicated to her role in the library, which serves as a valuable resource for students, researchers and professionals in the oil industry. It houses more than 70 miles of core and 34,000 boxes of drilling samples. LeFever was known to be able to point to a box and describe its contents in detail.

In 2013, the library was expanded – an effort spearheaded by LeFever. When construction was complete, she was honored to find out that one of the new labs in the building was named after her.

During her career, LeFever became one of the top experts for the Bakken Formation and was known throughout the United States as one of the best sources of information about the area.

In order to share her research with others, she completed more than 100 publications about the Williston Basin alone.

LeFever joined AAPG as a student member in 1976. In 2015, she was presented the John D. Haun Landmark Publication Award from the Rocky Mountain Section of AAPG. It honored her 1992 paper entitled, "Does Bakken horizontal drilling imply a huge oil-reservoir base in fractured shales?"

To honor her many accomplishments during her career and the impact that she made for geology, LeFever was selected to receive AAPG's 2017 Robert Berg Outstanding Research Award. She will be recognized for her achievement during this year's Annual Convention and Exhibition in Houston.

Philip Brown, 87
Calgary, Alberta, Nov. 11, 2016
Donald Hattin, 87
Bloomington, Ind., June 24, 2016
Elmer Herbaly, 94
Littleton, Colo., Feb. 28, 2016
Dan Hughes, 87
Beeville, Texas, Oct. 5, 2016
Elwin Peacock, 88
Houston, Texas, Dec. 10, 2016
Bernard Lynch, 90
Houston, Texas, June 3, 2016
Othal Plemmons, 95
Midland, Texas, Nov. 20, 2016

EMD

from page 30

AAPG Young Professionals Special Interest Group). There are nearly 800 people in that online community. (They also have Twitter, LinkedIn and Instagram.)

- Volunteers with nothing to do: Believe it or not, these people do exist. Sometimes, they're just waiting to be asked. It's hard, as a newcomer, to know how to get involved until you do. Who do you ask? I'd encourage you to get out there and talk to your local geological societies, student groups and YP meetups. Announce that you're recruiting mentees and mentors. Ask all the geologists you know. The YP SIG is about to launch a call for mentees as well, so we can begin matching skills to the desire to learn.
- Where do mentors go for resources? If we try to treat mentoring or teaching like a magical skill that some people are imbued with and others aren't, we won't get very far. Just like teaching, writing or any other skill, mentoring requires practice. I would advise you to leap right in, but be patient with yourself. Get feedback, read articles, talk openly with your mentee about what works for them. Talk to more experienced mentors. I have a personal library of references I'm happy to share. I'd also like to gauge interest in starting a mentoring SIG: a common space to share experience and advice, vent on occasion and provide a venue for making connections.

So, get out there and find someone to help you out, and build the next 100 years!

DIRECTOR'S CORNER

Learn the Art of the Deal at NAPE

By DAVID CURTISS

Our primary focus here at AAPG is the science of petroleum geology.

The principal means by which we serve that focus are developing and delivering periodicals and organizing events through which you have the ability to learn and share about new advances in the science and technology of finding and producing oil and natural.

But, while petroleum geology is an essential part of the oil and gas business, it alone is not sufficient. Many of our Members aren't simply petroleum geologists, but are also entrepreneurs and business people. In fact, if you look back to AAPG's founding, one of the principal objectives was to provide the public with a means of identifying professionals in the oil business who hold themselves and each other to ethical standards.

That's why AAPG isn't simply a scientific society, but a professional association of petroleum geologists. How we conduct ourselves, how we conduct our business, matters.

This month, we will gather with fellow oil and gas professionals who share our values to focus on an essential piece of the oil and gas business: the deal.

The NAPE Summit, a partnership of the American Association of Professional Landmen, the Independent Petroleum Association of America, AAPG and the Society of Exploration Geophysicists, is scheduled for Feb. 15-17 in Houston, and is dedicated to just that activity.

The largest event of its kind, bringing together entrepreneurs, scientists, landmen and financiers, the NAPE Summit


CURTISS

> How we conduct ourselves, how we conduct our business, matters.

is an opportunity to network with others in the oil and gas business, discuss opportunities and structure business deals that will lead to the finding and production of new oil and gas reserves.

At the heart of the Summit is the exhibition floor. With nearly 15 acres of exhibition space and an anticipated 1,000 exhibitors, this is the place to meet attendees and look at deals on Thursday and Friday.

Continuing and expanding on a successful feature from last year, the exhibition hall will include two theaters – one for U.S. prospects and the other for non-U.S. prospects – where exhibitors will be able to talk about the opportunity they brought to the show.

NAPE Business Conference

On Wednesday, the NAPE Business Conference will be an opportunity to hear executives and business experts talk about the oil and gas business, trends, opportunities and challenges.

This year, the headline speaker will be Bryan Sheffield, founder of Parsley Energy, who will speak on the "changing landscape of the Permian Basin."

The conference will also feature a panel discussion on how the oil and gas industry can improve its communication with the American public on the topics of energy, communications, a global energy outlook and exploration and production forecast for the United States, as well as discussion on deal-making.

If you are looking for a one-day investment in yourself as a business professional, you should make the time to attend the NAPE Business Conference.

On Tuesday, registrants for the Business Conference will also have the opportunity to participate in a seminar presented by the Association of International Petroleum Negotiators (AIPN). The full-day seminar will be split in two sessions: the morning session will focus on the differences between oil and gas operations in the United States and the rest of the world. The afternoon session will look at how negotiations differ between the United States and outside of the country, examining the impact of culture on how you get to a deal.

There's a big wide world out there to explore, and this seminar offered by NAPE and AIPN combined with the international prospect exhibitors on the show floor could take your business in an entirely new direction.

A General and Geologist

The NAPE partners have a strong commitment to giving back, and an important feature of the Summit each February is the charity luncheon on Thursday. Since 2009, the luncheons have raised and donated millions of dollars to support veterans' charities. The partners cover the cost of the luncheon so that every dollar raised goes to support veterans.

This year our speaker will be Gen. Colin Powell, former U.S. secretary of state and, before that, chairman of the Joint Chiefs of Staff. Powell has had a long and distinguished career in public service, both in the military and civilian positions.

He is also a recipient of the Presidential Medal of Freedom, the nation's highest civilian award. In fact, he's received it twice, the second time with distinction.

Oh, and did I mention that his undergraduate degree is in geology?

I'm looking forward to hearing Gen. Powell at the NAPE Summit, a can't-miss event for oil and gas professionals from around the world.

DIVISIONS REPORT: EMD

Mentoring Leaders for the Future of AAPG

By ANNE DRAUCKER, EMD President, and JON ALLEN, Young Professionals Co-Chair

As AAPG celebrates its 100th year, we continue to work hard to ensure the next century will also be successful. Many excellent efforts and discussions have been centered on growing Young Professionals (YP) membership in AAPG, culminating in the formation of AAPG's first Special Interest Group (SIG) in 2015. In addition to the ongoing work by the YP SIG, its leaders, members and champions in AAPG, we would like to expand the involvement of the general membership to be our partners in this effort.

One of the more common questions we hear from Members is: where will the next generation of leaders come from, and how can I help?

An Alternative to Burnout

Many people have had negative experiences when trying to recruit volunteers and officers from a population of people new to AAPG (students, YPs, new hires at their companies, etc.) This has been an ongoing issue for the Energy Minerals Division (EMD) as well. We rely heavily on the same core group of veteran volunteers, and have varied in our success in recruiting and retaining new core volunteers.

Why is that?

Our tendency is to find people with potential or interest, then immediately load them down with "opportunity" to spend all their energy on our priorities, and we burn them out.


DRAUCKER

> Show people the ropes. Your workload will be lightened, you'll make a new friend and you might start someone down the path of greater AAPG involvement ...


ALLEN

Instead of continuing that trend, we would like to work with you, the AAPG Membership, to establish a mentoring culture.

I've been best able to explain the issue through analogy: Imagine you were the head of a department in a company and you met a new hire. After chatting with this person, you thought that they might have some leadership potential.

Do you then:

A) Immediately offer them a supervisor position, starting tomorrow?

B) Refuse to let them adopt any responsibility, ever?

C) Work with them over time to develop their potential, find their aptitudes and give them the tools for success, so when they are ready to step into a supervisor position, they have a strong foundation?

I might have biased those choices.

Obviously, you would do neither A nor B in your business.

So, why then, do we do this in AAPG?

Why do we not seek out new volunteers and gradually ease them in to leadership, setting them up for success?

Well, several barriers exist:

- Most AAPG volunteer positions do require a strong level of commitment. If someone is going to volunteer, we don't really have "starter positions." That's not necessarily a bad thing, but we do need to be aware of it, and of what we're asking of people.
- Those who seek new volunteers don't know where they're hiding.
- Those who want to volunteer don't know where they can go, especially if they want to give back, but only have a limited amount of time or other resources.
- Mentors don't always know where to go for resources. Building a new generation of leaders isn't easy or simple, but it's a skill we can develop like any other.

The Challenge

Are these barriers surmountable? I'd argue that they are, and that we're making progress.

This brings me to my challenge.

This year, I've challenged every EMD leader to mentor one person. I'm not restricting the challenge to mentoring YPs only – just asking our officers to find one person who shows interest and bring them in to whatever they are already doing. I asked, hoping a few would show interest, and was overwhelmed at the response. People were just waiting to be asked!

Every single leader in EMD agreed to take on a mentee this year. We didn't invent new positions or responsibilities, we are just asking people to help us out. Suddenly, our pool of potential leaders doubled (probably, I haven't actually counted).

So let's apply this model to the previously listed barriers:

- High levels of initial commitment: Don't ask for this. You'll be turned down and miss out on potential new leaders. Instead, ask for small helps. Show people the ropes. Your workload will be lightened, you'll make a new friend and you might start someone down the path of greater AAPG involvement without asking for his or her firstborn child.
- Where are all the potential volunteers? The YP SIG is working hard on this. Jon says: They're everywhere! If you don't have someone to mentor now, try contacting the YP lead in your Section or Region. They know where to find them. Also, feel free to "like" the YP Facebook page (search for

See EMD, page 29