What are Super Basins?
Super basins are the world’s most richly endowed petroleum basins each with at least 5 BBOE produced and more than 5 BBOE left to produce. With multiple source rocks, multiple plays, and well-established infrastructure, the top 25 global basins hold potential for 100’s of BBOE future resources thanks to ongoing technological innovations.

Topics:
- What makes each super basin unique and what can we learn from it?
- What is the exploration/production history and what are the major plays with remaining potential, including conventional, unconventional, and field growth?
- What are key innovations in each super basin: adoption of horizontal drilling, hydraulic stimulation, completing and drilling techniques, and seismic imaging that helped unlock the potential and what is needed for further growth?
- How do “above ground” issues like politics, access, mineral ownership, and geography influence realizing the full resource potential of each super basin?
- Will a basin be a regional or global disrupter?
- What are the critical geoscience elements that contribute to success?
Robertson Basins & Plays
The Competitive Edge

The Robertson Suite provides a collection of exploration-focused tools and databases, including Robertson Basins & Plays — the definitive play fairway and petroleum systems database for more than 500 basins worldwide.

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Never Stop Exploring!
Explore all the new AAPG content and events in the New Year

"Those who work to make AAPG a better society enrich both the society and themselves... What are you going to do for AAPG in the New Year?"

A n amazing video and archival celebration of AAPG’s first 100 years is now available online, and it’s a page that every member will want to visit again and again. AAPG’s 100th Anniversary website, including the historic video interviews comprising the GeoLegends sessions, can be found either through a link on the AAPG homepage (under “Resources”), or by going directly to 100Years.aapg.org.

There you’ll find the results of work that has been in progress for more than a decade, directly to 100Years.aapg.org. homepage (under “Resources”), or by going again and again. AAPG’s 100th Anniversary page that every member will want to visit. Never Stop Exploring!

The 100th Anniversary website includes video presentations from the wildly successful Discovery Thinking Forums that have been offered at our ACE annual conventions and ICE international conferences. I’ve been personally involved in this part of the project and I know firsthand that the speakers who are featured are among the industry’s most amazing explorers. The century’s “Top 100 Papers” is a list that includes the geoscientist’s seminal papers, overseen by past AAPG President Randi Martinussen. The “Top 100 Field Trips,” were compiled by past AAPG President Steve Sonnenberg, and former AAPG executive director Rick Fritz.

And, perhaps the site’s most impressive feature are the GeoLegends interviews, a series of 50 videos with 62 key geoscientists who made game-changing discoveries and significant scientific contributions to the profession and industry, all of whom describe their thinking and the efforts that brought success. Produced by Werner and Dolly, those interviewed include 16 Sidney Power Memorial awardees, four Michel T. Halbouty Outstanding Leadership Award recipients and eight winners of the Normian H. Foster Outstanding Explorer Award. The entire site is filled with information that is intriguing, inspiring and, of best of all, an important resource to help enhance your value as a geoscientist.

But be careful — if you binge watch these inspirational talks, you just may go out and find a giant field of your own, develop a new play, create an innovative technological breakthrough or produce more energy to make the world a better place!

Also, as you’ll see explained elsewhere in this issue, there is an exciting new Explorer website that launched this month, which can be found at Explorer.AAPG.org.

Explore Our Annual Meeting

My hat is off to Michael Vandenberg, 2018 Annual Convention and Exhibition (ACE) general chair, and his team for organizing the event around the theme "ACE 101: Bridging Fundamentals and Innovation.”

The meeting will be May 20-23, 2018 in Salt Lake City Utah. There will be seven special sessions (see next month’s Explorer for details). Other highlights include 13 field trips, an incredible core display (massive in scale), and Pre-Salt sessions. Now is a great time to make plans to attend.

Explore the World’s Most Petroliferous Super Basins!

AAPG Global Super Basins Conference in March 2018 will be a new quick-to-market conference. I have been writing about this for a few months, and it is the editorial focus of this issue of the Explorer that you now hold in your hands (or on your device). It is an initiative to help provide all AAPG members the opportunity to share best practices in the most petroliferous provinces around the globe. The speaker list is a “Who’s Who” of basin experts and big thinkers with 29 global speakers including at least three AAPG “Outstanding Explorers.”

At the conference, we plan to engage See Content, page 6 ▶
Move2018
coming soon

Highlights include:

- A brand new 2D Elliptical-Fault Flow algorithm and a new surface construction tool.
- Developments and improved functionality within the horizon/fault extrusion and extension tools.
- Stochastic modelling in Fault Analysis
- Monte Carlo Fracture Response in Fault Response Modelling.
- A new Attribute Query tool and 3D Seismic export capability.
- Map View control of 3D data.

Visit www.mve.com/move-latest for more information

See it first at our Edinburgh Training, 22-26 January
Visit www.mve.com/training to see our full training diary and to register
global energy leaders, energy advisers and members of the investment community. A launch party is available at CERA week Sunday March 4, 2018 to the first 125 people who register for the Mar 27-29 AAPG conference on the AAPG website. Details can be found in companion articles this issue. Plus, we are planning many super basin articles and enhanced content in the AAPG Bulletin, so there’s more to explore!

Exploring Ways to Strengthen AAPG’s Content Engines

In November last year, AAPG leaders met for a working weekend at the University of Houston campus. In addition to handling important aspects of AAPG’s mid-year business, we shared best practices through committee cross talk.

I selected the University of Houston because it is an energetic and forward-looking venue connecting AAPG to a larger multidisciplinary energy community with excellent public outreach opportunities. The AAPG program included more than 50 students. My favorite moments:

- Alan Wegener of AAPG staff gave a great summary of “What’s going right at AAPG?” This was informative, uplifting, and well timed. AAPG staff have been doing a great job in light of a 40-percent reduction in work force over the last several years. A positive tone is appropriate in light of all that has been accomplished by the remarkable men and women of AAPG staff.
- Other highlights included Alyson Anderson Book (executive director of AGI), Steve Sonnenberg (AAPG past president), and Denise Cox (AAPG president-elect) speaking on future work force trends. We featured industry leaders like Paul Mann, Bob Fryklund and Chandler Wilhelm. David Curtiss chaired a Corporate Advisory panel discussion on energy trends for the future, which also included perspectives by Bobby Ryan and Bill Maloney.
- Innovative Revenue growth panel facilitated by Henry Pettingill and Niven Shumacher.
- YP Mini Summit, chaired by Meredith Faber and Jonathan Allen.
- House of Delegates Midyear Meeting, chaired by HOD Chairman David Entzminger and Justin Vandenbrink HOD Secretary.
- Conversations with Section and Region Leadership, facilitated by Vice President of Sections Dan Schwartz and Vice President of Regions David Cook.
- Forward planning by AAPG’s divisions, including a business meeting by the Division of Professional Affairs chaired by DPA President Jim Hill.
- My remarks focused on how AAPG members help provide abundant and affordable energy that positively impacts our environment and economy. Super basins drive sustainability and security – an important part of AAPG’s future.

Explore Your Options to Contribute to AAPG

There are many ways for all AAPG members to contribute. You can present a paper or poster, serve on a committee, chair a conference session, submit an article to the Bulletin, write a book or publication, teach a short course, organize a field trip, speak to students, stand for office and nominate a colleague for an award.

Thanks to AAPG leaders who have contributed in these and other ways. I have personally done all of these and found each experience richly rewarding. You can also contribute to Technical Interest Groups (TIG) or Special Interest Group (SIG) postings online: http://aapg.to/TigsSigsOnline.

Those who work to make AAPG a better society enrich both the society and themselves. So, I end with a question: What are you going to do for AAPG in the New Year?
Geoscience Professionals

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With new discoveries few and far between, energy salvation lies in mature fields

The Imminent Age of the Super Basin

C an super basins save the planet? IHS Markit, the international industry analysis firm, estimates the world will need to replace production of more than 14.5 billion barrels of oil equivalent annually by the year 2040. That shortfall will come from natural declines in currently producing fields. “We need to replace about 40 million barrels of new oil production a day. How are we going to get there?” said Pete Stark, executive director of upstream research for IHS Markit in Englewood, Colo.

Where will all the hydrocarbons come from? A traditional answer would be, “From new oil fields discovered through exploration.” And that’s an excellent answer. But probably wrong.

Newly discovered reservoirs aren’t going to pop up worldwide. Production totals in the 2020s, and beyond, will lead to additional exploration opportunities in the 2030s. There just haven’t been many big, new oil fields found lately.

“The frontier exploration picture for the past half-dozen years has been getting worse and worse,” Stark said. “It looks like last year may have seen the lowest level of conventional discoveries since 1952.”

If conventional exploration efforts aren’t helping much, you might think the new oil will come from a worldwide increase in unconventional resources production. That’s another insightful guess. And, again, probably wrong.

Poland had a big (unconventional shale) effort going on seven years ago. And everybody backed away. “There’s been an effort going on in South Africa,” but it was slowed by popular opposition to hydraulic fracturing. Stark noted.

“The oil exploration results have slumped badly in recent years. A period is imminent during which we’ll see very few newly discovered major oil fields coming online. So major oil discoveries won’t prop up worldwide production totals in the 2020s, and will not lead to additional exploration opportunities in the 2030s. That just hasn’t been the case in a big, new oil fields found lately.

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“The frontier exploration picture for the past hal...
Bottom-Line Benefits of Diversity
How differences make organizations stronger

Heightened creativity. Enhanced problem-solving and decision-making. Improved risk management. These are just some of the benefits of diverse workplaces, according to panelists for “Bottom Line Benefits of Diversity,” a special session held at the AAPG International Conference and Exhibition (ICE) in London late last year.

The session highlighted how diversity benefits both industry and research organizations, providing skills and creativity leading to sounder economic decisions and enhanced scientific inquiry.

Institutionalizing Diversity

For Liz Schwarze, general manager of exploration for Chevron Africa and Latin America Exploration and Production, diversity makes good business sense. A first-generation American born to German immigrants, Schwarze moved frequently growing up. Her ability to adapt to different cultural environments served her well when she joined Chevron in 1990.

“From my first day at Chevron I reaped the benefits of diversity in the workplace – diversity of education/technical degree, diversity of experience level and gender diversity,” she said. “Two of my first three team leads were women and one of our senior managers in the location was a woman, so I never saw any barrier to being successful and moving up in responsibility as a woman. That was empowering from the beginning.”

Schwarze’s talk, “Better Together: the Role of Diversity in Decision Quality,” was about how Chevron’s institutional commitment to diversity and inclusion benefits the company and its more than 50,000 employees.

“Our progress on diversity and inclusion is driven from the top,” she said. “Our chairman recently stated via LinkedIn that the business case for inclusion is simple: if the full spectrum of talent we’ve hired isn’t put in a position to realize its full potential, the company won’t achieve its full potential.”

One third of Chevron employees in the United States are people of color. Women represent 26 percent of the workforce, and 32 percent of leadership positions worldwide are held by women and non-white males.

Schwarze said this diversity helps Chevron maintain its license to operate and to manage risk.

“We have to reach a stage where we don’t talk about diversity anymore ... That’s the goal.”

Chloé Asmar (left) and Linda Lerchbaumer of OMV Upstream presented “Diversity in Central/Eastern Europe as Seen from both the Inside and the Outside.”

See Homogeneity, page 11

NeuraSection is the platform that lets you connect with your data. With new touchscreen capabilities and SmartRibbons™, you’ll be almost as close to geology onscreen as you are in the field. Call us today to get your hands-on demo and quote.
Unconventional resources represent a bright opportunity for the United States’ economic and energy future, but that is in no sense guaranteed.

A misinformed public debate about the impacts and merits of hydraulic fracturing in particular and the oil industry in general threatens that future, so it greatly depends on the industry’s ability to address ongoing controversies and arrive at mutually-beneficial compromises.

That’s according to David S. Gee, senior partner and managing director of Boston Consulting Group.


“Are the prices a little bit about the cost,” he said, “or are they a little bit about the efficacy of the standards, but you can kind of get something that everyone will be equally satisfied…or equally dissatisfied…” said Gee.

The biggest gap in agreement, Gee said, is within the third “bucket.” It’s where the disagreement was before, where it is now, and where, do-doubt, it will continue: the climate.

The question, as he sees it, is whether natural gas should be considered a bridge fuel or whether the industry should move right to renewables.

“Win-win” situation for both, Gee said. Here, Gee said, the goal is what he calls a “win-win” solution for both environmentalists and those in the industry.

“If you actually consistently apply mutually-agreed-to standards, you can do this very safely and in an environmentally-appropriate manner,” said Gee.

“Win-win” plays for the economy, the environment, and a lower-carbon, cleaner-energy future.

“Thank you for the opportunity to change America’s economic and energy trajectory,” Gee will give an update to the report called “America’s Unconventional Energy Opportunity: An Update” at the upcoming AAPG Global Super Basins Leadership Conference in Houston.

Gee believes that while much has changed, much has not, and even that which has, may not change the conclusions of the original report. Gee’s fear now, as it was then, is that a divisive and often misinformed debate about unconventional — and this comes from both business and environmental groups — is, as he wrote then, “jeopardizing a once-in-a-generation opportunity to change America’s economic and energy trajectory.”

The report, as well as the update, is motivated, he said, by that gridlock, which is threatening America’s unconventional energy development.

“The original report came out when oil prices had collapsed, and there was a line of reasoning that the study we did back then was no longer valid,” he explained.

And while Gee and his team are still in the process of updating the report for the conference, he insists that the findings, in fact, are still on the money.

Buckets of Caveats

“There is no inherent trade-off between environmental protection and company profitability,” he said.

There are, however, in his words, “buckets” full of caveats to that statement.

That first “bucket” pertains to the economic impact.

“This is still massive,” he said, but the nature of it has shifted because, while the oil industry continues to drill a lot of wells, even though the prices are a lot lower, the wells are much more efficient. That’s the good news.

The bad?

Margins have been squeezed. But even that isn’t the end of the story.

“The other hand, the lower prices,” he said, “are a bigger boon to customers and end-users.”

The next “bucket,” he said, is the environmental impact at the local site level.

This includes matters of methane, water disposal and the hydraulic fracturing itself. Here, Gee said, the goal is what he calls a “win-win” situation for both environmentalists and those in the industry.

“If you actually consistently apply mutually-agreed-to standards, you can do this very safely and in an environmentally-appropriate manner,” said Gee.

“Is it even, even though the dynamic of the discussion has changed.”

“Since this work has been studied originally” — and this was primarily done on the subject of hydraulic fracturing — “the issues have emerged on the seismicity, which was just becoming an issue, as well as the issue of methane,” he said.

And here, Gee, again reiterated the importance of compromise — a topic he said will be emphasized in Houston.

“We will talk about how the same basic approach applies and that you, again, take reasonably agreed-upon standards,” all will benefit.

He also believes this is exactly the way the industry should go.

The question, of course, on the other side of the debate, is whether environmental groups, especially with their distrust of the Environmental Protection Agency under the current administration, will buy into the standards and participate in the formulation of these agreed-up standards.

“I think – and this is an ‘I think’ — that on issues like seismicity and methane, you can get to win-win scenarios. The industry will complain a little bit about the cost, the environmentalists will complain a little bit about the efficacy of the standards, but you can kind of get something that everyone will be equally satisfied…or equally dissatisfied…”

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His answer:

“We need to refresh the analysis,” he said.

The concern among many in the industry is that if the industry makes the commitment to building the infrastructure needed for gas, the cost would prohibit it from ever moving on.

“We found that’s not true,” said Gee.

His assessment is that even if the infrastructure is built, the economics indicate that the renewables will be so cheap that they will negate those costs. With that in mind, he said it’s still cheaper in the near term to build that infrastructure. As proof, he said, both gas and renewable prices have come down more precipitously since he and his team first made their calculations, and the trend will almost certainly continue.

The End of Coal?

On the subject of coal, Gee was succinct about its future and why, in fact, it has no significant part to play in the future.

“Yeah, it’s gone,” he said.

“It’s just a question now of when the coal plants hit some triggering event, of needing some capital infusion, be it some big back-end scrubber or a revamp. Even the larger, more efficient coal plants can’t survive that economically,” he explained.

What but of the interest, the renewed passion behind coal coming from some sectors, especially the White House?

“Thad part of the dialogue by the administration hasn’t helped anybody. It’s background, unhelpful static,” Gee said.

Ultimately, he said, what will end coal is reality, and it’s only a matter of time.

“The economics is the economics,” he said.

In Houston, Gee also will spend some time on what he calls the “divisive dialogue,” for which both sides are to blame. He points to the recent debate around pipelines as one in which neither side compromises.

As for shale, though, he insisted, “If you do it right, with a set of standards, it’s very, very safe.”

“Larger producers are much better at compliance than the smaller operators,” said Gee.
Homogeneity from page 9

centered on technical or 'below-ground' issues, such as estimating the quality of reservoirs or accessing and developing resources, which we still do, but today the non-technical or 'above-ground' factors increasingly influence the energy landscape," she added.

Schwarz said it is important for employees at all levels to understand how diversity and inclusion benefit the company, and most employees have diversity action plans as a part of their annual evaluation.

"What started with geopolitics now encompasses managing diverse perspectives on everything from limited access to resources, complex fiscal terms, challenging infrastructure needs, supply chain complexities, and a vast array of expectations, local content requirements and human capacity," she said. "We need all of our staff, including subsurface, to be aware and participate."

Tackling Homogeneity

For Chris Jackson, a professor at Imperial College of London, professional associations like AAPG should follow the lead of companies like Chevron and take diversity more seriously.

His presentation, "Recognizing and Rewarding Excellence without Blinkers: a Close-to-Home Case Study," centered on the limited recognition that professional societies give women and minorities. Jackson, a son of immigrants from the West Indies, grew up in the industrial town of Derby in the United Kingdom. He studied geology because he liked dinosaurs, earthquakes and being outside, creating a large part of his professional success to the work ethic his parents instilled in him as a child.

Jackson worked and studied in North Africa, South America, Europe and the United States, and he became involved in the Geological Society of London and AAPG. He noticed early on that there were few other black geologists in his professional circles.

"I go to many of the major research conferences typically held in Europe and North America, and there aren't very many people who look like me," he said. "Fortunately, I'm fairly thick-skinned and don't get intimidated by it, with my interactions with fellow geoscientists being invariably positive."

Jackson increased his involvement with AAPG, participating on several committees and serving as senior editor of the Bulletin. In 2013, he toured the United States as a Distinguished Lecturer.

Though Jackson appreciates the opportunities AAPG programs provide to him and others, he sharply criticizes their homogeneity and has recently let his membership lapse.

"In my opinion, the Distinguished Lecturer (DL) program has an appalling record at recognizing diversity. When I looked at the historical record of DLs from the 1940s on, of the 670 awardees less than 10 percent have been women, with the first female recipient seemingly being in 1982. I can't even bring myself to work out how many minority recipients there's been. Why is that? Why does AAPG have such a poor record of recognizing excellence amongst all of its diverse members?" he asked.

"In fact, the same criticism could be leveled at the list of AAPG Honors and Awards. You could just say that there's not that much diversity out there, such that the awardee list reflects reality, but that's just not true," he said. "There's an issue here. We are not recognizing everyone."

Jackson said that while many AAPG members recognize the problem, some appear unwilling to do anything about it. "AAPG needs to self-recognize this is an issue and make concrete plans to address it," he said.

Jackson suggests publishing a list of all Distinguished Lecturers and all honors and awards recipients and identifying how many women and minorities have been selected.

"We can use that list to motivate people to think more broadly," he said.

Because nomination forms do not, for example, ask about nominees' race or sex, he said those who nominate candidates might consider highlighting that nominees come from a population historically under-
The resurgence of the Permian Basin in the United States led directly to the concept of the “super basin”: a mature basin that can be rejuvenated to produce as much or more oil and gas than it has so far.

Another archetype for super basins lies 1,000 miles southeast of the Permian, in the onshore/offshore Sureste Basin of Mexico. This is the home of the supergiant Cantarell oil field, discovered in 1976, which hit peak production of 2.1 million barrels a day in 2003. Since then, Cantarell’s output has steadily declined.

It’s also the basin where operator Talos Energy recently reported a major crude oil discovery. In July, the company said its Zama-1 well found an accumulation of up to 2 billion barrels of oil after drilling to about 11,100 feet offshore in 546 feet of water, marking what it called “the first offshore exploration well drilled by the private sector in Mexico’s history.”

Talos Energy holds a 35-percent interest in Zama-1, which is operated by Mexico’s state-owned oil company, PEMEX. Similar interest is held by PEMEX’s partner, Premier Oil 25 percent.

“In less than 200 meters of water there is prolific onshore and shallow-water formations. That’s something we can use the creaming curves, or ‘creaming and a half’ – note what we call it, to get more production,” said Mark Shann, subsurface director for Sierra Oil and Gas in Mexico City.

“Once you get your hands on that data, you can use it to drive your exploration campaign. As a company dedicated just to exploring Mexico, we have the luxury of only doing Mexico so we have the time and the focus to do the work,” he noted.

**Anatomy of a Super Basin**

Established producing formations and known source rocks give super basins much of their allure. “You don’t have to go after virgin source rock. There is plenty of low-hanging fruit in the super basins,” said Pete Stark, executive director of upstream research for IHS Markit and co-author of the super basin concept.

“Regulatory environment for traditional conventional exploration doesn’t work well when you need to drill a large number of wells in a timely manner,” he said. Stark thinks macro-economics could, and should, affect policies and ease regulations for super basin development.

**Economic Impact**

He said the impact of horizontal technologies – primarily in North American super basins – has reduced global oil and gas prices and is now energizing consumers worldwide about $7 billion a day.

Shann said he worked at BP for 30 years before joining the small group of professionals that founded Sierra Oil and Gas in 2014. He lived in 13 countries for more than two years each in his BP career, including Mexico and countries in Latin America.

He considers the company’s current area of focus to be a world-class region for oil and gas prospecting. “I’ve always wanted to come back. I have been amazed at the quality of the source rock,” Shann said. “It stands out to me, globally, as one of the key places on the planet to explore.”

Many people in the industry thought the offshore Sureste basin “would not be as prolific as the U.S. Gulf of Mexico, and that has not been the case,” Shann observed. “It’s turning out to be a highly favorable province for companies willing to do the spadework.”

“There are no shortcuts in Mexico. You absolutely have to be a data hound to be successful,” Shann said, adding, “I don’t think Mexico has any shortage of information – its oil exploration history dates back to 1869.”

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**Source:**

Talos Energy’s Zama-1 well is “the first offshore exploration well drilled by the private sector in Mexico’s history.”

**Regulatory Factors**

“By the time we get your hands on that data, you can use it to drive your exploration campaign,” said a company dedicated just to exploring Mexico. “We have the luxury of only doing Mexico so we have the time and the focus to do the work,” he noted.

**Sureste Basin**

The Sureste Basin will be a topic included in a presentation to be given by Ivan Sandrea, CEO of Sierra Oil and Gas, “Mexico, Tampico Mzielinta Basin and Sureste Basin,” at the AAPG Global Super Basins’ Leadership Conference to be held March 27-29 at the Hilton Americas Hotel in Houston.

**Prospectivity of the Sureste**

Using numbers for exploration success and total production, a future outlook for the Sureste can be estimated, he said. “We can use the creaming curves, or the discovery curves, from the U.S. Gulf of Mexico to make a prediction,” Shann said.

“In less than 200 meters of water there is prolific off-shore and shallow-water formations. That’s something we can use the creaming curves, or ‘creaming and a half’ – note what we call it, to get more production,” he explained.

“Sureste looks like a legitimate call, said Stark, “because today’s oil industry has much-improved seismic imaging capability plus a wealth of information and experience to draw upon.”

Shann thinks the Mexican side of the Gulf of Mexico will develop more rapidly than did the U.S. side.

“Sierra Oil and Gas has already accumulated a significant amount of data to assess prospects,” he said.

“We’ve got a dataset where we can look under the salt canopy. It is changing our view of the (basin’s) prospectivity, he explained.

“The company’s data resources include 2,000 wells with logs, 800 wells with core data, 60 wells with source rock information and 500 wells with pressure-temperature information, plus extensive 3D seismic, Shann said.

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**“The Permian Basin is a magical place,” noted AAPG President Charles Sternbach. “A lot of the innovation from the Permian is, if you drill a dozen wells, why not drill hundreds of wells? For me, what’s really exciting is the upscalability,” he said.**

**Economic Impact**

He said the impact of horizontal technologies – primarily in North American super basins – has reduced global oil and gas prices and is now energizing consumers worldwide about $7 billion a day.

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He considers the company’s current area of focus to be a world-class region for oil and gas prospecting.

“Talos Energy’s Zama-1 well is ‘the first offshore exploration well drilled by the private sector in Mexico’s history’.”
Methods used by large companies to target marketing to individual consumers are being applied in the search for energy and mineral resources. The sheer amount of data of all kinds being generated and stored is unprecedented. Researchers are exploring ways to sift through massive amounts of information to tease out patterns that may have been overlooked or not considered before, explained Robert Hazen, executive director of the Deep Carbon Observatory at the Carnegie Institution for Science in Washington, D.C.

Hazen is co-author of a new study published in American Minerologist that examines the use of network analysis in the search for new mineral species. The mineral hazenite is named for him.

“It’s similar to when you order something from Amazon or Netflix,” Hazen said. The companies have access to your recent purchases, plus other information like ZIP code and credit use. By analyzing shopping patterns, “They see there’s a high probability” you will like this product, said Hazen. “There may be some subtle connections, like activities you’ve shared with friends on social media. It’s a very powerful driver for targeted marketing,” he said.

“The techniques apply equally well to the natural world,” he added.

Application to Oil

“Mining and petroleum companies have been doing this for decades, but computers can tease out correlations we didn’t see before,” he said. Explorationists have tons of data relating to distribution of resources, depth, stratigraphy, microbial and biological information, trace elements and much more. “You look for very high dimensional relationships,” he said.

“If I’m looking for oil and I recognize sediment, that’s a one-to-one correlation. We can look at many more variables simultaneously. There may be some complicated non-linear combination that can help maximize our chances of discovery.”

New network analysis visualization methods “can be very powerful in showing trends that might not be obvious to the human mind,” Hazen said. “The idea is clearly applicable to energy exploration.”

Hazen said computerized analysis techniques are being used by medical professionals to gain more accurate diagnoses, and by governments to track possible terrorist activity.

The technique goes beyond traditional geology by amassing data about how and where minerals have formed and using that information to help find other deposits, according to the report by Hazen, lead author Shaunna Morrison, also of the Carnegie Institution, and several other colleagues.

Mineral Challenge

The researchers have launched a project to find and identify new carbon-bearing minerals whose existence has been predicted. Ten new minerals already have been discovered through the project, which invites researchers and amateur collectors worldwide to join the search.

Hazen said models indicate at least 145 “missing” species are yet to be discovered. The researchers have launched a project to identify new carbon-bearing minerals whose existence has been predicted. Ten new minerals already have been discovered through the project, which invites researchers and amateur collectors worldwide to join the search.

Hazen said computerized analysis techniques can help point to specific locations where rare, undiscovered minerals are likely to be found. In addition to locating new minerals, the Mineral Challenge project has been a “transformation in the mineral world. The mineralogy community seems to love it.”

Network visualization techniques can help point to specific locations where rare, undiscovered minerals are likely to be found. In addition to locating new minerals, the Mineral Challenge website reports that the research into carbon mineral evolution is providing a fresh perspective of Earth’s history by addressing suites of new questions, which could influence Earth materials research and education:

- What were the earliest carbon-bearing minerals on Earth?
- Did carbon-bearing minerals play a role in the origin of life?
- How did the evolution of life affect the evolution of carbon minerals (and vice versa)?
- Are there carbon-bearing minerals on the moon and Mars?
- Are humans affecting the diversity and distribution of carbon-bearing minerals?

Hazen added a new undertaking, the Deep Time Infrastructure Project, involves some 50 collaborators and is aimed at gaining new insights regarding Earth’s evolving oxidation states of the atmosphere, oceans and near-surface environments.

He said analytics promise a “very dynamic future ... it will transform science.”

While some discoveries may not have economic applications, “If we understand distribution and diversity, we can make better predictions and better husband the resources we have. It’s a tremendously important part of any approach to earth resources.”

Interactive graphics at dtdi.carnegiescience.edu show how visualizations can be used to explore networks.
When you combine the U.S. and Mexico, onshore and offshore, the Gulf of Mexico basin is one of the world’s most prolific hydrocarbon super basins. Over 250 billion barrels of oil equivalent have been discovered to date, and almost 20 percent (currently 18 percent) of U.S. oil production comes from the Gulf of Mexico.

That’s Cindy Yeilding, vice president of exploration and appraisal at BP, speaking about the petroleum power and potential of the Gulf as a preview to her upcoming presentation at the AAPG Global Super Basins Leadership Conference in Houston, which will include discussion of the region’s production history and the geologic trends, innovation, and, yes— even failures associated with the region.

The realm of the Gulf of Mexico is not just important to the United States.

“We will also highlight the Gulf of Mexico … and the promise it holds for Mexico,” she said.

Life from the ‘Dead Sea’

Industry has been exploring offshore possibilities in the U.S. Gulf of Mexico since the 1930s, when the first wells were drilled in a few feet of water. It was an exciting time, especially in the late ’40s. Unfortunately, however, much of the early “colorful history,” as Yeilding described it, has been lost.

(The U.S. Department of the Interior and the Bureau of Ocean Energy Management has done a good job reconstructing the Gulf of Mexico’s resume in its study entitled “History of the Offshore Oil and Gas Industry in Southern Louisiana.”)

“Exploration in the deepwater U.S. GoM,” Yeilding said, “dates back to the late 1970s,” and like any exploration program, there have been failures, but also perseverance and tenacity.

And a watershed moment.

Yeilding pointed to Shell and BP’s discovery of Mars in 1989, a project about 130 miles southeast of New Orleans. Initial cost of the development was pegged at about a billion dollars.

It’s been a good investment.

According to the website technology.com, Mars produces approximately 21,000 barrels of oil and 25 million square feet of gas. It was and is the largest Gulf of Mexico discovery in more than 25 years and confirmed the presence of a world-class hydrocarbon source and well-developed clastic reservoirs.

“That was the turning point for developers,” Yeilding said.

Yeilding concedes that while many in the industry flocked to the region afterward and made significant discoveries following Mars, there was also a series of expensive dry holes. This was about the time many in the region started characterizing the Gulf of Mexico as “the Dead Sea.”

The relationship between the industry and the Gulf of Mexico has always been a bit on the complicated side.

“We have a love/hate relationship with the salt present in much of the GoM. We battle the seismic imaging challenges created by salt, but we love the salt-related structural complexity that sets up the hydrocarbon system for much of the basin,” she said.

Continued on next page
While there have not been major exploration successes—or ‘elephant-sized’ discoveries—in the U.S. recently, there are still twinkles in the explorers’ eyes, and the basin holds promise for new plays in both the U.S. and Mexico.

The basin still holds lots of promise. Recent advances in seismic imaging have allowed companies to gain more accurate images of the subsurface. Technology has helped with the ability to develop fast paced tie-backs, and we are seeing a lot more of those projects competing for capital in the U.S.,” Yielding said.

For example, the Mexican side of the basin in open—which she calls “enticing”—and has had significant discoveries to date and promising discoveries on the horizon.

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Big Fields Get Bigger

And while the Gulf of Mexico will be the focal point of the presentation, specifically, Yielding is excited about super basins in general, for more than 60 percent world’s oil reserves and resources come from giant oil fields. These basins are where the adage “big fields get bigger” comes to fruition.

“A small increase in recovery, or an additional untapped reservoir, can have a significant impact on production and reserves,” she said.

“We’ve experienced this in several fields in the GoM,” Yielding concluded, “including our Mad Dog field. Mad Dog was initially estimated at four billion barrels of oil in place, but recent appraisal drilling and new geophysical technologies demonstrate that the field likely holds over 5 billion barrels in place.”

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Cindy Yielding, vice president of exploration and appraisal for BP, will present “Gulf of Mexico Offshore Evolution of Past, Present, and Future Plays” at the upcoming AAPG Global Super Basins Leadership Conference to be held March 27-29 at the Hilton Americas Hotel in Houston.

She said that industry persevered in the deepwater because it developed new exploration concepts focused on older and sub-salt stratigraphy.

“We invested heavily in the development of 3-D seismic at scale and advanced 3-D seismic imaging techniques, which dramatically improved our imaging beneath the salt. Eventually this led the way to major sub-salt discoveries such as Thunder Horse, Mad Dog and Atlantis,” she said.

Untapped Promise

As for the future, Yielding said the challenges in the Gulf are similar to those throughout the industry.

“Specifically, in the Gulf of Mexico, dozens of operators have left, moving their investments to onshore fields or other basins around the globe. In the current lower oil price environment, many companies have been tightening their belts and paring back their exploration programs,” she said.

Additionally, co-ownerships, as well as suppliers collaborating to reduce cost, have also increased efficiency.

Yielding calls for a new understanding of the shift by “creating a fiscal and regulatory environment that helps spur development and production in the Gulf of Mexico.”

Specifically, she calls for resetting royalty rates back to the traditional rate of 12.5 percent.

“About a decade ago, in response to high oil prices, U.S. deepwater royalty rates were raised by 50 percent, and many new lease terms were shortened,” said Yielding.

Because of the subsurface complexities of the deepwater, she said, “We would also like to see all leases carry an initial lease term of 10 years, which is often how long it can take to develop a lead into a drillable prospect.”

For all the difficulties and tightening of margins, she is not dissuaded.

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and had more sympathy for them than being afraid about these foreign people being around," she said.

During her doctoral studies in an international research facility in Germany, Lerchbaumer worked with people from other parts of Europe and Asia and learned the benefit of actively interacting with them. "When you are working with people from different backgrounds you have to spend time together, talk to each other to understand the different ways of thinking, working and living. Soon, things become easier and even amusing: you do not only share your different experiences and start to look at scientific problems from more diverse points of view, you also share dinners and introduce your cultures to each other," she said.

Asmar’s earliest exposure to different cultures started at a young age while attending an international school. Her real multicultural experience started during her undergraduate studies in her home country of Lebanon. She later had the opportunity, through OMV, to pursue her graduate studies in earth sciences in Vienna, where she then started her career in the industry.

"Austria was never on my radar," she said, "When I made the decision to move to Vienna, I had to familiarize myself with Austrian culture, beyond the Waltz, Mozart and the clichés we hear about back in Lebanon," she said.

Upon arriving in Vienna, Asmar said she was surprised about how little Austrians knew about Lebanon and the Middle East.

"I thought people would be as curious about my country as we are about Europe in general," she said. "Our education is oriented toward the West. I expected that people here would be a lot more exposed to Middle Eastern history and economics further than the current state of geopolitical affairs. Many times I would get a lot of interesting questions such as: ‘being a woman, are you oppressed back home?’ I would hear stereotypes that I didn’t expect, especially not in the globalized world we live in today.”

Encountering stereotypes motivated Asmar and fueled her determination to help promote the understanding of Lebanese and Middle Eastern culture.

"I want to demystify some of the things that you see on the news," she said, "I want people to appreciate me for being Middle Eastern.”

Lerchbaumer noted that she too thinks it is important to see the individual instead of stereotyping people.

"I simply want to be myself, Linda, not the female Austrian geologist from the countryside," she said.

Both women recognize that their education and profession give them an appreciation for diversity that others might not have.

"We’re in an industry that gives us the privilege to work in diverse environments," Asmar said. "Currently, diversity is being challenged worldwide. Countries are dealing with pressing issues on immigration and asylum seeking. Where we are is almost an exception to the world. We need to share what we have learned.

Lerchbaumer agreed.

"Our industry has been diverse for a long time, but we are also in a different socioeconomic level. We cannot really compare it to, for example, small family run businesses in Austria. It’s just not on their agenda. They have different worries and problems," she said.

Lerchbaumer also recognized that overemphasizing diversity could backfire.

"As soon as you start pushing on being diverse and saying that we have to include this or that group of people, we artificially categorize people and make them sound and feel worse," she said.

Asmar said the best way to avoid resistance to diversity is to be pragmatic.

"Diversity should not be addressed as a philosophical topic. We should be emphasizing the important role of all diversity topics, as a good business decision," she said.

"We should reach a stage in our industry, when the need to talk about diversity would not be something special. People are different, and differences often pose challenges. Nonetheless, the beauty in that is (that) it allows us to keep expanding our horizons, improving and staying curious about the world we live in, especially in the times ahead," she said.

Asmar noted that the understanding of diversity should ultimately go beyond society.

"We are not just talking about nationality or culture or gender. It’s the way you think and communicate. These are key points to keep in mind. In a scientific field, if you don’t make sure that you cover all perspectives, you are not doing your job as best you can as scientists. This comes through interacting with people. If we are not actively embracing our differences, we may miss out on information that’s very relevant and important.”

Diversity Breeds Innovation

Gretchen Gillis, a geologist and panel co-chair and longtime AAPG Member, agreed.

"I have witnessed the benefits of diversity at every stage of my career, starting with diversity of thought among those educated in different universities in my first exploration job,” she said. "Later, at Schlumberger, I experienced the benefits of an extraordinarily diverse workforce in

Continued on next page ▶
That’s the goal,” she said.

Diversity breeds innovation and diversity to be in a diverse environment. A positive life experience is important factors as well. As it was just part of their experience where it was just part of their daily life to be in a diverse environment. That’s the goal,” she said.

“We want to be decent human beings,” he said. “You shouldn’t have to sell diversity to others. You shouldn’t have to say you are diverse to get your money. Diversity breeds innovation and diversity makes good business sense.”

Senior geoscientists who have worked in many petroliferous basins are able to apply their knowledge of analogs,” she said. “Young geoscientists are familiar with the newest concepts in science and can apply their knowledge of analogs,” she said. “Young geoscientists are familiar with the newest concepts in science and can apply their knowledge of analogs,” she said.

Gillis noted how Saudi Aramco developed its Young Leaders Advisory Board to develop dynamic teams with different backgrounds and cultures.

“Attitude and experience are important factors as well. As it was just part of their experience where it was just part of their daily life to be in a diverse environment. That’s the goal,” she said.

“My colleagues represent a broad spectrum of age, culture, and educational backgrounds, including Saudi Aramco employees on assignment,” she said. “My job involves travel to Saudi Arabia, where I see increasing diversity in the workforce — many young women are choosing careers in geoscience, engineering and computer science.”

Gillis noted that workplace diversity goes beyond gender, race and ethnicity, age and life experience are important factors as well. She noted how Saudi Aramco developed its Young Leaders Advisory Board to develop dynamic teams with different backgrounds and cultures.

“At Aramco, we find that diversity leads to innovation, and innovation provides a competitive edge,” she said. She added that organizations find more rigorous solutions when diverse teams address exploration and production challenges.

“Senior geoscientists who have worked in many petroliferous basins are able to apply their knowledge of analogs,” she said. “Young geoscientists are familiar with the newest concepts in science and can be fearless in applying new technology. Diversity breeds innovation and diversity makes good business sense.”

She noted how a quote from Chris Jackson published in a recent article published in The Guardian caught her attention.

“(Jackson) stated that he knows of ‘no other black, full-time, earth science academic in the UK — or in fact, Europe or the U.S.,” she said. “I find that distressing because our science is missing out on the talents of a large group of people, just as it did when there were so few women in the mix.’

The Goal

Jackson said he enjoyed the panel, though he disagrees with the use of the term ‘bottom-line benefits.’

“You shouldn’t have to sell diversity to people. I think it’s odd that we have to have this conversation around the financial driver for it. We should embrace diversity because we want to be decent human beings,” he said.

Asmar said she is looking for hope for the future.

“We have to reach a stage where we don’t talk about diversity anymore. I would like to see if other speakers have had an experience where it was just part of their daily life to be in a diverse environment. That’s the goal,” she said.

The newest concepts in science and can apply their knowledge of analogs,” she said. “Young geoscientists are familiar with the newest concepts in science and can apply their knowledge of analogs,” she said.
The Birth of the Modern Oil Industry in the Northern Carpathians

Various practical applications of oil, gas and other forms of hydrocarbons have been known in different countries and on different continents for centuries. The modern oil industry, however, with oil and gas being used as an effective and economically viable source of energy, began relatively recently, in the mid-19th century, with the discovery of an effective refining process to transform crude oil into lamp oil and the invention of safe and effective oil lamps. These early developments, plus the increased demand for oil (and then gas) by the energy sector, were quickly followed by rapid advances in drilling technologies, petroleum geology, geochemistry and geophysics. As is very often the case in other areas of invention, the birth of the modern oil industry is also a good example of the so-called “parallel thinking,” i.e. of developments or discoveries that were independently achieved at approximately the same time by various people in different places.

By the early 19th century, the required critical mass of knowledge and experience had been reached that – coupled with an increasing demand for hydrocarbons – allowed for the rapid advance of oil and gas exploration and production technologies. The first documented well drilled to produce petroleum, the Bö-Rybat well, was spudded in Baku region (then part of Russia) in 1848. The best known name associated with the birth of the modern oil industry, however, is “colonel” Edwin Drake, who in 1859 drilled his famous well in the Oil Creek Valley in Pennsylvania that led to the first oil boom in the United States.

Full-scale commercial mining operations began in the mid-19th century. They first focused on oil, and later also on coke (coal) and natural gas. It came about because of the hard work and persistence of Polish pioneer Ignacy Łukasiewicz and his vision of the future industrial development of his home country.

Early Life

Łukasiewicz, together with Edwin Drake and other mid-19th century figures, can be regarded as one of the founders of the world’s modern petroleum industry. His life was intimately linked to the complex history of Poland in the 19th century, which until 1918 did not exist as an independent country after being partitioned in the late 18th century among Russia, Prussia and Austria.

He was born in 1822 near the city of Mielec in southern Poland. His father, a member of the local nobility, participated in the 1846 Kraków Uprising, and was arrested and imprisoned. He was released after 18 months in prison in Lwów, in the western Ukraine. He always remained a suspicious figure in the eyes of Austrian officials, though.

His time in Łańcut and in Rzeszów also shaped his political profile: he became involved in various patriotic activities under the guidance of Edward Dembowski, one of the leaders of the unsuccessful 1846 Kraków Uprising, and was arrested and imprisoned.

Upon his return to Lwów, apart from continuing his duties at the “Under the Golden Star” pharmacy, he embarked on another path of his career that focused on practical applications of petroleum. In parallel with Abraham Gesner, who developed a process to refine a liquid fuel – kerosene – from coal, bitumen and oil shales, Łukasiewicz, together with his co-worker and business partner Jan Zeh, developed an effective distillation process of kerosene from crude oil. Then, together with Adam Bratkowski, a local tinsmith from Lwów, he designed an effective and safe kerosene lamp. On July 31, 1853, their lamp was first used in a local hospital in Lwów to illuminate experienced chemist prompted local authorities to give him permission to enroll for graduate studies in chemistry and pharmacy at the Jagellonian University in Kraków. After moving to Vienna in the final years of his studies, Łukasiewicz graduated in 1852 from the university there. Quite possibly in Vienna – then the grandiose capital of one of the world’s largest empires – he was acquainted with the latest information on the practical use of oil and the growing interest in oil deposits.

Łukasiewicz the Oil Pioneer

Historical Highlights

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JANUARY 2018 EXPLORER

In 1854 Łukasiewicz moved to Gorlice in southern Poland, located in a part of the Carpathians well-known for its oil seeps. That year also, together with his business partners Tytus Trzeciński and Karol Klobassa, he established an oil mine in Bóbrka near Gorlice. This mine first deployed hand-dug oil wells, then wells drilled using manually operated percussion-type drill bit on rods and a free-fall drilling apparatus, and finally cable-tool drilling, powered by a steam engine since 1872. All those technical achievements place the Bóbrka oil mine, the branchchild of Ignacy Łukasiewicz and a result of his perseverance and hard work, amongst the first modern producing oil fields in the world. It can be still admired by enthusiasts of oil industry history at the Bóbrka Museum of Oil and Gas Industry – a true “must-see” for any petroleum geologist.

The establishment of the commercially successful Bóbrka field marks the beginning of the pioneering phase of the development of the modern oil industry in the Northern Carpathians. Later, numerous other oil fields were put on production in the western Carpathian oil district, such as Siary, Sękowa, Męcina Wielka, Klęczany, etc. Łukasiewicz had business interests in many of those ventures and he was also instrumental in beginning refineries in Ulaszowice, Siary, Klęczany, Polanka and Chorkówka – all located in the northern Carpathians.

The second phase of development of the modern oil industry in the Northern Carpathians is associated with the development of oil fields in Borysław region, currently in western Ukraine. This rapid oil industry development, triggered by Łukasiewicz’s pioneering activities, also included production of natural gas and ozokerite. Very soon it was realized in Poland that effective oil and gas prospecting required not only luck and business persistence but also professional service: geological, drilling and others. The search for hydrocarbons in the northern Carpathians led, for example, to the development of modern micropaleontology some 20 years before it was used in the U.S. Gulf Coast region. Also, an extensive mapping

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- Bryce Canyon and Zion National Parks
- Surrounding Geology of Utah’s High Plateaus
- Structural, stratigraphic, and topographic transition zone between the Colorado Plateau and Basin and Range Province

Field trip leaders will discuss the local geology of the parks, the regional framework that dictates that geology, and new discoveries and theories based on decades of geologic mapping and research in the region.

17-19 May 2018, Southwestern Utah

ACE.AAPG.org
Relative Rock Properties
An alternative to estimate reservoir properties from seismic data

Estimates of reservoir properties (porosity, lithology and fluids) using seismic data are customarily obtained through seismic inversion in two stages: in the first stage rock properties (P- and S-impedances and density, for example) are computed through elastic inversion and in the second stage the estimated rock properties are inverted to the reservoir properties of interest.

Elastic inversion computes rock properties by minimizing the difference between observed data and data modeled through relationships that incorporate AVO, the offset-varying wavelet and a low frequency model (LFM). Under this scheme inversion software searches for the rock properties that result in the synthetic data that best matches the real data. It is a mathematically complex process. The parameters in available software usually are not intuitive and the sensitivity of inverted properties to changes in input parameters is typically poorly understood by the regular user. Parameterization is done, many times, by iteratively modifying parameters and comparing the inverted properties to their equivalent from well-logs.

The LFM, required when inverting to absolute rock properties, provides the low frequency component (including DC) on which the relative changes from seismic are superimposed. Its frequency bandwidth falls outside that of the seismic and it remains mostly unchanged during the inversion process. The LFM is created from non-reflectivity data, usually well-logs and seismic velocities, and its magnitude is several times larger than that of the relative rock properties’ changes measured by seismic. A small percent inaccuracy in the LFM can result in errors as large as the range of variation of the relative changes.

Many approaches exist to estimate reservoir properties from the inverted rock properties. Some are qualitative and based on defining in cross-plots (or multi-variate space) the clusters of seismic attributes associated to a reservoir property as determined from equivalent properties from well-logs. Model based approaches are deterministic and relate a reservoir property (i.e. porosity) to a rock property (i.e. impedance) using effective media relationships. Sometimes empirical relationships are obtained by fitting the inverted properties to well-log or core measurements of the sought for reservoir property at well locations. The obtained relationship is then applied to the rock properties in the 3D volume to obtain estimates of the desired reservoir property.

The previous methodology is analyst intensive and the reliability of results is strongly dependent upon analysts’ experience. The analyses to compute rock properties and the estimation of reservoir properties are often done by different geoscientists, thus adding uncertainty to the estimated reservoir properties.

Reducing User Input
A methodology is proposed in which relative rock properties are used to compute reservoir (or resource) properties. It reduces user input and simplifies parameterization. In the proposed methodology, each of the components of elastic inversion is done separately and their order of execution is modified.

Under this scheme the seismic wavelet is offset-equalized and phase corrected in the conditioning stage, prior to computing relative properties. The LFM is incorporated, if necessary, when computing the reservoir properties from relative rock properties. The methodology relaxes the need of a rigorous LFM and bypasses the estimation of absolute rock properties.

Figure 1 compares the customary and proposed inversion workflows.

Reservoir properties are computed as a linear combination of relative rock properties. The parameters of the linear equation are obtained from well-log data by least-squares fitting the reservoir property of interest through two or more relative rock properties (regression analysis).

The LFM, when required, is input into the regression analysis as one of the properties through which the reservoir property is fitted. The LFM can be the low frequency expression of any property that mimics that of the reservoir property of interest. In many cases, for example, p-wave velocity from seismic is used as the LFM when computing total porosity. Figure 2a shows a quality control display for the estimation of the linear relationship. In this case, relative Lambda*Rho and relative Mu*Rho, computed at seismic resolution, are linearly combined to obtain a band-limited estimate of porosity.

See Porosity, page 25 ➤

Alvaro Chaveste holds a bachelor’s in geophysics from Montana Tech and has done graduate studies at the University of Houston. In 1983, upon graduation from Montana Tech, he joined GSI in Mexico where he acted as field geophysicist, data processor and administrator. In 1989, when GSI and Geosource merged, he was transferred to Houston where he has worked for Halliburton, Western-Geco, Core Laboratories, Paradigm Geophysical, Geokinetics and Hess Corporation in managerial positions or as a contributor. His interests include rock physics, seismic data processing, AVO/AVA and inversion. Currently he is the president at TraceSeis where he provides services and develops rock physics and inversion software.
New Release

Memoir 113: Giant Fields of the Decade 2000-2010
Edited by R. K. Merrill and C. A. Sternbach
Memoir 113 consists of 16 papers discussing giant fields discovered in the decade 2000-2010, looking at the global characteristics, discovery trends and predictions, field summaries, which discuss trap formation, reservoir rocks, and source, generation, and migration of the hydrocarbons in each field.
Product #: 1284
Member Price: $89
List Price: $178

Memoir 102: Electron Microscopy of Shale Hydrocarbon Reservoir
Edited by Wayne K. Camp, Elizabeth Diaz, and Barry Wawak
The purpose of Memoir 102 is to provide a practical reference for geologists, geophysicists, engineers, and students to gain a better understanding of the various state-of-the-art techniques and applications of electron microscopy for shale hydrocarbon reservoir evaluation.
Product #1197
Regular Price: Member $74 / List $148

Memoir 103: Critical Assessment of Shale Resource Plays
Edited by Jean-Yves Chatellier and Daniel M. Jarvie
10 peer-reviewed chapters covering items from geochemistry, geology, basin analysis, diagenesis, geophysics, geomechanics, and engineering with a main emphasis on shale from North America and Europe.
Product #1200
Regular Price: Member $99 / List $198

Memoir 107: Pinedale Field: Case Study of a Giant Tight Gas Sandstone Reservoir
Edited by Mark W. Longman, Stephen R. Kneller, Thomas S. Meyer, and Mark A. Chapin
15 chapters that describe the history of field development, deposition and diagenesis, geophysical characteristics, the types and abundance of natural fractures, and fluid production characteristics in the field.
Product #1252
Regular Price: Member $144 / List $289

Memoir 111: 3-D Structural Interpretation: Earth, Mind, and Machine
Edited by Bob Krantz, Carol Ormand, and Brett Freeman
This volume sets out to understand more about the convergence of geology, 3-D thinking, and software, which collectively provide the basis for truly effective interpretation strategies.
Product #1280
Regular Price: Member $114 / List $218

More Great Finds!
The cover feature in December’s Explorer (“Petroleum and Populism” on the cover; “Professional Protesters Threaten Energy Infrastructure” inside) discusses how best to counteract environmental protests against the oil industry. The purely defensive measures proposed are an inadequate reaction. The industry has to look deeper, at the roots of the protests.

There are some protesters who are motivated simply by a general and undiscriminating animosity toward the oil industry. Does the oil industry want to take the environmental wind out of the sails of these characters?

If so, addressing the rational concerns of serious environmentalists will help.

In this century, the main environmental concern about the oil industry has been the role of fossil fuels in human-induced climate change. How well has the oil industry responded?

Protests concerning fossil fuels have focused on the producers rather than the consumers of fossil fuels. The oil industry may cry foul, but environmentalists question whether the industry is truly engaging in activities that are consistent with its professed environmental concerns. It is difficult to argue that the oil industry’s acceptance of responsibility to control carbon emissions has been adequate. The oil industry’s readiness to take its share of responsibility may seem limited in some quarters.

We geologists can no longer use as an excuse for inaction our traditional undiscriminating animosity toward the oil industry.

Readers’ Forum

We have a warning from the rocks, and we also have a solution to hand in the rocks: store the carbon dioxide in the subsurface.

Here I should declare an interest: since 2013 I have been advising BHP on climate change and carbon capture and storage.

BHP is currently supporting a research project involving the universities of Cambridge, Melbourne and Stanford, on capillary, solution and mineral trapping of carbon dioxide in the subsurface. Success in that research program would transform the debate on CCS.

There is an AAPG connection here. The Cambridge-Melbourne-Stanford research program was given impetus by a series of conferences on CCS organized jointly by AAPG and the Geological Society of London. Those conferences resulted from an agreement reached in 2010 by President John Lorenz of AAPG with the Geological Society of which I was president from 2010 to 2012.

The oil industry already knows how to pump large volumes of carbon dioxide safely into reservoirs. Let’s get on with doing that on a scale that gives a long-term future for fossil fuels in a low-carbon century. No environmentalist could protest about that. Unless they really were consumed by irrational animosity.

Bryan Lowell
Senior Research Fellow in Earth Sciences,
University of Cambridge, UK

I usually turn to AAPG publications when I need reliable scientific data. What I do not need is this article that spreads “false and misleading information in alarming tones” regarding environmental activists. I come here for the science, not a propaganda piece for an energy lobbyist. I am not what the author would disrespectfully refer to as a “professional protestor,” but I am a concerned scientist who is highly offended that the author would refer to protesters as “extremists.”

These folks are exercising their right to free speech and should not be labeled extremists. Regarding the condescending remarks about the “irony” of protestors using petroleum products while speaking out against pipelines and fossil fuels – that is an easy and lazy route to take. Yes, everyone in America uses petroleum products. So, the author is suggesting that if we speak out against continued investments in fossil fuels and passionately advocate for development of renewables, then we are all hypocrites if we use plastic and drive cars?

If energy companies and certain government administrations were not dragging their feet on investment and transition to renewable energy, perhaps those protesters would have had more alternative non-petroleum products to choose from. The fossil fuels stored in Earth’s sedimentary rocks will eventually be depleted. Let’s move forward today with an urgency toward developing renewable energy. Let’s let go of the debilitating greed of global oil and gas move forward with sustainable cleaner energy sources like wind, water, and solar.

Heather Clifford
Pasadena, Calif.

When working on my story (the October 2017 Historical Highlights column, “Three Women, One Breakthrough”), about the three female micropaleontologists, I was alerted to information about Józef Grzybowski, an earlier pioneer with the proposal of using micropaleo and foraminifera for oil and gas by Piotr Krzywicz of Warsaw (past vice president-elect candidate). His is a sad tale, in his discovery never having been embraced by industry and almost entirely slipping into oblivion.

While working on his geology degree in 1894 at the Jagiellonian University of Kraków, Poland, Grzybowski published his first monograph of microfauna of the Carpathian sandstones. In 1895-96, his doctoral work included work on the foraminifera of the red clays of Wadowice. In 1897, he studied the borehole muds of the oil fields of Krosno which led to his 1898 publication of correlation techniques he developed using assemblages of foraminifera. He worked with thousands of samples from 40 wells and illustrated the correlations in his cross sections. He linked this technique to the...
Professional Service from page 21

program was established in a form of the Geological Atlas of Galicia, consisting of 99 high quality geological maps at a scale 1:75 000, published between 1875 and 1912 and covering almost the entire northern Carpathians and their foreland. 

Łukasiewicz certainly had a far-reaching vision regarding development of the oil industry that, in his opinion, might have fueled economic development of Galicia, then one of the poorest provinces of the Austrian Empire. Apart from his own successful business ventures, he was instrumental in organizing other professional activities as he clearly saw a need for the exchange of ideas and opinions among professionals involved in exploration and production of oil, gas and coke. In 1877 – i.e. 30 years before the AAPG was established – Łukasiewicz coorganized the first Oil Industry Congress, during which the decision was made to establish the National Oil Society ("Krajowe Towarzystwo Naftowe"), one of the world’s first oil industry professional societies. The society ceased to exist in September 1939, at the onset of World War II.

Despite being very busy with his professional life, Łukasiewicz never abandoned his patriotic activities. After the January Uprising in 1863 he supported participants and victims of this and other attempts to set Poland free from its occupants. His charity work was also significant and important, with numerous local establishments such as public gardens, schools, hospitals, local roads, etc., being co-funded from his own resources. In 1873, in recognition of his numerous charitable activities, Pope Pius IX awarded him the title of Papal Chamberlain and the order of St. Gregory the Great.

In 1967 did work begin cataloguing and confirming the utility of his work. Not until almost 20 years later that their discovery was minimized and credit diverted to their male colleagues.

Even after industry embraced foraminiferal biostatigraphy, Polish geologists did not begin to appreciate Grzybowski’s groundbreaking work until 1943 when Heinrich Hilterman of Hannover, Germany, confirmed the utility of his work. Not until 1967 did work begin cataloguing and appreciating the abundant collections of Grzybowski.

SECOND OFFERING OF THE HIGHLY ACCLAIMED PETROLEUM SYSTEMS OF CUBA & SE GULF OF MEXICO

April 8 – 14, 2018

**Field Trip Leaders:** Drs. Manuel Iturralde, Paul Crevello and James Pindell

**Endorsements** Dr. James Lowell, renowned structural geologist “One of the best field trips I’ve ever attended, incredible thrust complexes”, Dr. John Decker, global exploration sedimentologist “Excellent trip, opens up new thinking for opportunities in the Caribbean-GóM region”.

**Sponsoring Organization** GeoExplorers a US Nonprofit Corporation
To register for this field trip or for further details: Contact Paul Crevello excursions@GeoExplorers.org

This seminar conforms to the Department of the Treasury OFAC update of 11/20/2017, 31 CFR part 515.585 (b) 1-6, p.25

http://federalregister.gov/d/2017-26447
Recently the AAPG Foundation received a generous bequest gift – in excess of $600,000 – from longtime member Frank Adler. It was completely unexpected.

In reviewing his file we noted only that Adler was an AAPG Emeritus Member and an occasional donor to the AAPG Foundation, but nothing in his record suggested his intentions. And we wondered: Who was Frank Adler and what prompted him to leave such a generous gift to the Foundation?

His daughter Annette shared his story through a short obituary that began: Frank Adler of Littleton, Colo., passed away on Friday, Feb. 3, 2017 – two days after celebrating his 96th birthday.

He grew up in the New York City area and dreamed of exploring the west. As a youth he prepared himself for this adventure by joining the Boy Scouts and hitchhiking throughout the state.

His dream became reality when he moved to Golden, Colo., to attend the Colorado School of Mines. This community located in the foothills of the Rocky Mountains captured his heart and launched a career that would last a lifetime.

Adler’s Career

After graduating in 1945 with an engineering degree and a brief job with another firm, Adler accepted a position with Phillips Petroleum, where he remained throughout his professional career.

As a young professional Adler saw the value in joining a professional association and so became a member of AAPG in 1945. The Association was a way to network with fellow geoscientists, a reliable way to share the science through collaboration and publications, and a way to preserve the science and history through maps.

His activities with AAPG began with volunteer service in 1960 as a member of the Publications Committee. He went on to serve 14 years as an associate editor (1971-85), a member of the Stratigraphic Correlations Committee (1976-82) and as a delegate for the House of Delegates (1977-78).

A career highlight was being asked to serve as Phillips’ representative for the AAPGs “Big Red Book” – the RMGA’s Geologic Atlas of the Rocky Mountain Region. Published in 1972, this book was an instant classic with its extensive paleo geographic maps.

The book, which had an editorial staff of 26 and authors from 43 separate companies and institutions, took six years to complete and remains to this day a valuable digital publication resource. Adler was reportedly proud to have been part of this project.

He also proudly contributed to many critically important stratigraphic surveys of North American natural resources, including (1976-82) the Correlation of Stratigraphic Units of North American (CONSUNA).

A Love of Rocks, Among Other Passions

While at the Mines he met Martha White, who was working in the president’s office. They were married and celebrated 49 years together. During this time he continued his exploration of the west, with focus on his beloved Four Corners area.

Before and after his retirement, Adler stayed active.

Who are the Trustee Associates?

Rock-solid AAPG members who want to give back to the science and profession that has given them so much.

Are you our next Trustee Associate?

To join simply complete the following checklist:

✓ AAPG Member.
✓ Commitment of $10,000, payable over five years.
✓ Nomination by three Trustee Associates.

AAPG Foundation
P.O. Box 979 • Tulsa, OK 74101-0979 USA
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FAX: 918-560-2642
Toll-Free (US and Canada): 855-302-2743
Email: foundation@aapg.org • foundation.aapg.org

These individuals enhance Foundation impact by:

• Supporting and advocating AAPG Foundation programs.
• Providing counsel and leadership to its Trustees.
• Lending guidance and support to its fundraising efforts.
• Guiding the scientific and educational agenda, which it underwrites.
### Foundation Contributions for November 2017

**General Fund**
- Mohammad Abdullah
- Sophia & G. W. Brock
- John Richard Carson
- Brenton Michael Chentnik
- Norbert F. Csaszar
- Graham Rhys Davies, PhD
- ExxonMobil Foundation
- Robert E. Fox
- John D. Humphrey
- Elizabeth Johnson
- Jim & Carolyn McGhay
- In honor of AAPG’s amazing staff
- Richard Fastabend Meyer
- In memory of Thomas Fitzgerald
- Leslie Owen Niemi
- Elia Pliego-Vidal
- Kenton Nile Riggs
- Dayna Jean Salter
- Robert W. Sullivan
- April R. Wisebaker

**Amoruso Special Publications Fund**
- Phillip & Sarah Forney
- In memory of Elwin Peacock
- Anthony Reso

**Digital Products Fund**
- Bryn Mawr College
- Noelle B. Schoellkopf
- Pomona College
- Elizabeth Johnson

**Distinguished Lecture Fund**
- Elizabeth Johnson
- J. Ben Carsey Distinguished Lecture Fund
- Dorothy Carsey Summer
- Gift of Exxon stock

**Education Fund**
- Steven D. Mitchell
- William Allen Monroe

**GIS-UDRIL Fund**
- University of Calgary
  - ExxonMobil Foundation
  - Matching gift from Wayne A. Schild

**Grants-in-Aid Fund**
- ExxonMobil Foundation
  - Matching gift from Wayne A. Schild
  - Willis Reider Brown
  - Grant from Willis R. Brown Trust through Fidelity Charitable
  - Steven D. Mitchell

**B. Glenn Galloway Memorial Grant**
- Diane C. Galloway
- Memorial Environmental Grant
- Dorothy Carsey Summer

**Imperial Barrel Award Fund**
- Richard Leroy Adams
  - Grant from Adams Family Donor
  - Advised Fund at East Texas Communities Foundation
- Kevin T. Biddle
- In honor of Miguel Uliana
- Chevron
- Elia Pliego-Vidal

**Military Veterans Scholarship Fund**
- Norbert Everett Cygan
  - In honor of Sotex Vets
- ExxonMobil Foundation
- Robert E. Fox
- James A. Gibbs
  - In memory of Deana and Paul Strunk
  - Williams R. Green
  - Paul Michael Guerino
  - In memory of James J. Clarke
  - Stewart Lawrence Henry
  - Bill and Carolyn Holland
  - Charles G. Johnson
  - Rusty Riese
  - In memory of Roy W. Foster
  - Jack C. & Catherine I. Threet
  - In honor of Jim Gibbs and Paul Strunk

**Newly Released Publications Fund**
- Kevin M. Bohacs
  - In memory of William C. Corea

**Wallace Pratt Bulletin Fund**
- Bill and Carolyn Holland

**B. Glenn Galloway Memorial Grant**
- Diane C. Galloway
- Memorial Environmental Grant
- Dorothy Carsey Summer

**ExxonMobil Foundation**
- Matching gift from Wayne A. Schild

### We also recently reached an exciting milestone for the Deana and Paul Strunk Military Veterans Program. Thanks to the generosity of AAPG members, the Foundation hit $1 million dollars in the MVSP endowment.

This will enable the Foundation to award scholarships to even more U.S. military veterans, providing assistance to ease their financial burdens of returning to school.

To all who donated to the fund, thank you. And to those who feel drawn to this initiative, please help us to keep growing this fund. Your gifts will continue to be important and much appreciated.

### Considering leaving a legacy gift through your estate to AAPG Foundation?
Visit foundation.aapg.org/donate/legacy_society.cfm for details.

*   *   *

**Continued from previous page**

and engaged with the Denver community as a fencing instructor for the Mile High Fencing Club in Lakewood, a volunteer guide for Dinosaur Ridge in Morrison, and as a member of the Denver Mining Club and the Colorado School of Mines Alumni Association.

“Dad loved rocks above all else,” his daughter Annette said. “He had walked much of the West at one time or another and knew it very well. He loved to tell stories about his adventures in the mountains to his two grandsons, Bob and Sam.”

After 72 years as an AAPG member Adler’s final act was to leave the unexpected bequest gift to AAPG Foundation – a donation that will serve as a lasting legacy from a man who loved rocks and wanted to give back to the profession that had given him so much.

For that the AAPG Foundation is truly grateful and will use this gift to fulfill the mission and purpose for which it was established.

The monthly list below of AAPG Foundation contributions is based on information provided by the AAPG Foundation office.
The Europe Region Young Professionals had the privilege of hosting several YP events during the recent 2017 AAPG International Conference and Exhibition in London. The theme of ICE, “100 Years of Science Fuelling 100 Years of Prosperity,” was particularly appealing to YPs as many are beginning to see positive industry trends after having endured a tough few years.

The London AAPG YP Chapter has been active since 2011, organising a range of events like networking evenings, career talks, sport events and the famous yearly Christmas quiz. Many of these events are in collaboration with the London Petroleum Exploration Society of Great Britain YPs. And, 2017 marked a special year for the London YPs, as it was the first time we experienced an AAPG technical meeting in our backyard. For many of us, the first opportunity to attend an international AAPG event was even more special because it coincided with the AAPG centennial celebration. London YPs helped to organize the London ICE Student and Young Professionals program, and the hard work paid off as London ICE 2017 was an absolute success.

The conference kicked off with the Student and YP Meet-n-Greet. This initiative was to bridge the gap between students, YPs and experienced professionals. The event commenced with an introduction from London YP President Myriam Cuylaerts and Jon Peachy of Shell. The London ICE Meet-n-Greet also served as the launch of the “Student and YP Networking Challenge,” a competition that provided a platform for enhanced networking by requiring participants to collect signatures from AAPG officers and members within the industry, exhibitors and conference speakers.

Day two of AAPG ICE was another busy one for YPs. Several were engaged in chairing oral sessions as well as judging posters. On the exhibition floor, YP and student poster presentations garnered a lot of foot traffic. That evening, the student and YP reception took place at FOX bar at ExCel, and was graciously sponsored by ExxonMobil, and we thank them for their continued sponsorship of AAPG YP programs.

Finally, during day three of ICE, the results from the Student and YP Networking Challenge were revealed. A few contestants managed to gather all required signatures, and the overall winner was Anouk Beniest from IFP Paris. Anouk left ICE with a new ammonite that will help to decorate her desk.

World-class events like AAPG ICE provide younger AAPG members with exposure to innovative technologies and networking opportunities that are necessary to overcome some of challenges that we currently face. Thank you to all that participated in YP activities at ICE. We had a wonderful time and look forward to building on this experience.
In Memory

William Corea, 65
San Ramon, Calif., Sept. 11, 2017

John Dyni, 85
Lafayette, Colo., Sept. 24, 2017

James Farley
Conroe, Texas, Nov. 9, 2017

Weldon Frost, 86
Longboat Key, Fla., July 2, 2017

Jimmy Gowens, 69
Lenexa, Kan., April 8, 2017

Jason Henthorne, 47
Wooster, Ohio, Sept. 8, 2017

Arthur Johnson, 65
Kenner, La., Aug. 9, 2017

Ludano Lucarelli, 86

John Melton, 86
Santa Fe, N.M., March 31, 2017

Hugues Monrose, 81
Othis, France, Oct. 20, 2017

Franz Nieberding, 67
Lingen, Germany, Oct. 8, 2015

Gary Reid, 62
Broken Arrow, Okla., Aug. 29, 2017

George Rogers, 85
Dallas, Texas, Feb. 28, 2017

Kenneth Sharp, 89
Port Charlotte, Fla., Oct. 24, 2017

Howard Shaw, 92
Santa Maria, Calif., Nov. 20, 2016

Robert Spiller, 67

Michael Welland, 71

David Witschko, 63
College Station, Texas, March 2, 2012

George Witter, 84
Bakersfield, Calif., Aug. 14, 2017

(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.)

Innovations Bring Once-Dying Shale Plays Back to Life

Haynesville and Re-Emerging Resource Plays of the Gulf Coast

DPA Playmaker Forum
26 April 2018
Marathon Oil Conference Facility
Houston, Texas

Join us to uncover the technological innovations that have spurred a spike in production in the Haynesville shale. New completions, refracking, imaging, and analytics are helping the Eagle Ford, Austin Chalk, Tuscaloosa Marine Shale, and more to bigger and better production and recoverable reserves.

Are you a geoscientist, manager, or investment house interested in learning about this new technology and how it can revitalize basins or plays?

Space is Limited!

Registration Opens
15 January

aapg.to/AAPGForumApr2018
The Division members need to advance our knowledge about communications and data management in this new exploration world. New oil is found by new ideas and technologies and we need to know how best to serve our members.”

By JIM HILL, DPA President

DPA Offers New Programs in the New Year

A year ago I had the honor of being elected the new Chair of the DPA. It is now a year later, and I can say without a doubt that it has been the most fulfilling year of my career. The Division is doing some amazing things, and I want to share a few of them with you.

The Division is also planning a new Playmakers Forum. This will incorporate their energy and vision into the division. We are working hard to have these courses ready by the ACE meeting in Salt Lake. The ACE meeting this year will be one of the best with strong technical sessions with a focus on value to those attending. The field trips will be amazing as well.

By DAVID CURTISS

Saying Goodbye to a Champion of AAPG

In the middle of December we received sad news at headquarters. AAPG Honorary Member and leader R. Randy Ray had passed away after a quiet 15-month battle with cancer. He was 66 years old. The news came as a shock as Randy, a private person, did not wish to publicize his illness. But as his wife Kathy wrote in a note to Alan Wegener, AAPG’s managing director for global business, it was his AAPG friendships and committee service that kept him going during the clinical trials and treatments that he underwent.

Feelings of loss are not uncommon when we lose a friend or colleague, and that has proven particularly true in this case. As Alan observed to me, Randy was a champion of AAPG and its staff.

His Impact on AAPG

Vision energized by optimism and enthusiasm fueled his activities. As both a geologist and geophysicist, Randy sought to broaden his own knowledge and perspectives. Attending the AAPG International Conference and Exhibition in Singapore was his first trip outside the United States. He followed it with several visits to APPEX, AAPG’s prospect and property expo in London, accompanied by his younger son.

And while his friends feel a sense of loss, it is his family – his wife Kathy and his sons Austin and Brandon – who were closest to him and bear the heavy burden of sadness and grief during these moments.

But even in mourning there is a possibility for joy.

A Possibility for Joy

I got to know Randy best during his term as chair of the House of Delegates serving on the Executive Committee in 2013. This is a leadership position that requires an ability to balance many diverse interests and opinions. A good listener, Randy solicited and absorbed perspectives from many individuals and processed that input through a primary filter: what is best for AAPG and its members?

He actively used his AAPG experience to broaden his own knowledge and

Curtis

It was affection that … drew Randy to AAPG, SEG, RMAG and DGS – he liked people and they genuinely liked him. These relationships were a great source of both professional and personal satisfaction.

A personal example: When Randy chaired the HoD, he held his midyear leadership meeting in Boulder, Colo., showcasing the hospitality and charm of that college town.

One year later, as a newly-married man, my wife Susan and I checked into the same hotel for a few days. In our room we found a beautiful, small chocolate cake with a hand-written note, “Congratulations and best wishes on your marriage. Sincerely, Randy and Kathy Ray.”

It’s not the size of the gesture that counts. It’s the intent. And I’ll never forget it.

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When AAPG joined with SEG and the Society of Petroleum Engineers to launch the Unconventional Resources Technology Conference in 2013, Randy served as an enthusiastic member of the technical program committee. The following year he served as SEG co-chair for URTeC.

As AAPG President Charles Sternbach eulogized, “Randy is organizing a conference in heaven, it will be multidisciplinary, and the house there will be packed, too!”

When SEG approached AAPG in 2012 about launching a new interdisciplinary journal – Interpretation – focused on subsurface exploration, Randy stepped forward to serve as AAPG’s appointed deputy editor-in-chief. He was committed to the topic, to cooperation between AAPG and SEG and to the journal’s success.

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I got to know Randy best during his term as chair of the House of Delegates serving on the Executive Committee in 2013. This is a leadership position that requires

DPA

The DPA has always tried to give our members relevant education and career development courses. Keeping that in mind, we will be bringing back some of short courses on how to interpret old well logs with an added section on how to get the most out of dipmeter data. There is no question that 3-D seismic has revolutionized interpretations, but in complex geologic areas where the data is poor, a dipmeter can be a very powerful tool. I can say that several of the discoveries with which I was involved were directly related to a solid dipmeter interpretation. The industry has spent billions of dollars acquiring data, and even old data can be of great value if we understand its limitations and how to use it. We are working hard to have these courses ready by the ACE meeting in Salt Lake. The ACE meeting this year will be one of the best with strong technical sessions with a focus on value to those attending. The field trips will be amazing as well.

New Playmakers Forum

The Division is also planning a new Playmakers Forum.
Super Basins are the world's most richly endowed petroleum basins each with at least 5 BBOE produced and more than 5 BBOE left to produce. With multiple source rocks, multiple plays, and well-established infrastructure, the top 25 global basins hold potential for 100's of BBOE future resources thanks to ongoing technological innovations.

GLOBAL SUPER Leadership Conference
Actionable intelligence to profit from the world's most lucrative basins.

Whether you are an energy executive, investor, geoscientist, or consultant, this conference will give you the information you need to be successful in the world's most significant basins. The event will feature regional experts who will share their unique first-hand knowledge of each of the globe's super basins.

Basins From All Over the World!

- Super Basins, Bob Fryklund, Pete Stark, IHS Markit
- Permian Basin, Scott Sheffield, Pioneer
- Overview of Greater Super Basin concept how it might evolve, Scott Tinker, Tinker Energy Associates, LLC
- Appalachian Basin, William A. Zagorski, Range Resources
- Anadarko Basin, Rick Fritz, Council Oak
- Going Beyond the North American Mudock Super Basin Plays: The Unconventional Development of Conventional Reservoirs, Richard K. Stoneburner, Pine Brook Partners
- Williston Basin, Mark Williams, Whiting Petroleum Corporation
- The Western Canadain Super Basin, a Confluence of Science, Technology, and Ideas, Paul MacKay, Shale Petroleum Ltd.
- California, San Joaquin, Kurt Neher, Berry Petroleum Company, LLC
- Alaska- North Slope, David Houseknecht, USGS
- Gulf of Mexico Offshore Evolution of Past, Present, and Future Plays, Cindy Yeilding, BP America
- Global Overview, Robert Ryan, Chevron
- Mexico, Tampico Mizantla Basin and Sur Este Basin, Ivan Sandrea, Sierra Oil and Gas
- Neuquén Basin, Carlos Macellari, Tecpetrol
- North Sea, John Underhill, Heriot-Watt University
- The Arabian Basins: Prolific Producers with bright future still, Ibraheem Assa'adan, Saudi Aramco
- North Africa – a rejuvenated Super Basin, Jonathan Craig, Andrea Cozzi, ENI
- Brazil Pre Salt, Santos Basin, Mario Carminatti, Petrobras
- Western Siberia, Alexei V. Milkov, Colorado School of Mines, Vladimir Vyssotsky, BP Russia, Andrei S. Bochkov, GazpromNeft
- COP Operator Stimulated Rock Volume, Greg Leveille, ConocoPhillips
- Venture Capital Leading Edge Technology, Trond Unneland, Chevron
- Big Picture Geophysics and Reservoir Packages, Brian Horn, ION

General Chair: Charles Sternbach, President, AAPG

Topics:
- What makes each super basin unique and what can we learn from it?
- What is the exploration/production history and what are the major plays with remaining potential, including conventional, unconventional, and field growth?
- What are key innovations in each super basin: adoption of horizontal drilling, hydraulic stimulation, completing and drilling techniques, and seismic imaging that helped unlock the potential and what is needed for further growth?
- How do “above ground” issues like politics, access, mineral ownership, and geography influence realizing the full resource potential of each super basin?
- Will a basin be a regional or global disrupter?
- What are the critical geoscience elements that contribute to success?

SAVE THE DATE
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Learn more about this exclusive conference.

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Santos Basin
Brazil – Santos Vision Area 1

PGS announces the availability of Area 1 from its Santos Vision project within the pre-salt play in the Santos Basin, offshore Brazil. The total project will cover 34,000 sq.km. Exploration plays in Area 1 include: a rift/pre-rift fault-trap play in the west-central part of the area, with prospective siliciclastic reservoirs in the Paleozoic pre-rift through Lower Cretaceous rift succession; a sag/rift limestone edge play (Sagitário trend), involving subsalt structural or paleo-topographic traps in microbial platform limestone; and the Carcará North/Uirapuru sag-rift limestone play, which includes the Carcará discovery in BMS-8 and several significant closures at the base of salt.

Santos Vision Area 1 deliverables will be available for the upcoming license rounds.

Please contact: brazilinfo@pgs.com