

EXPLORER



Petroleum and Populism

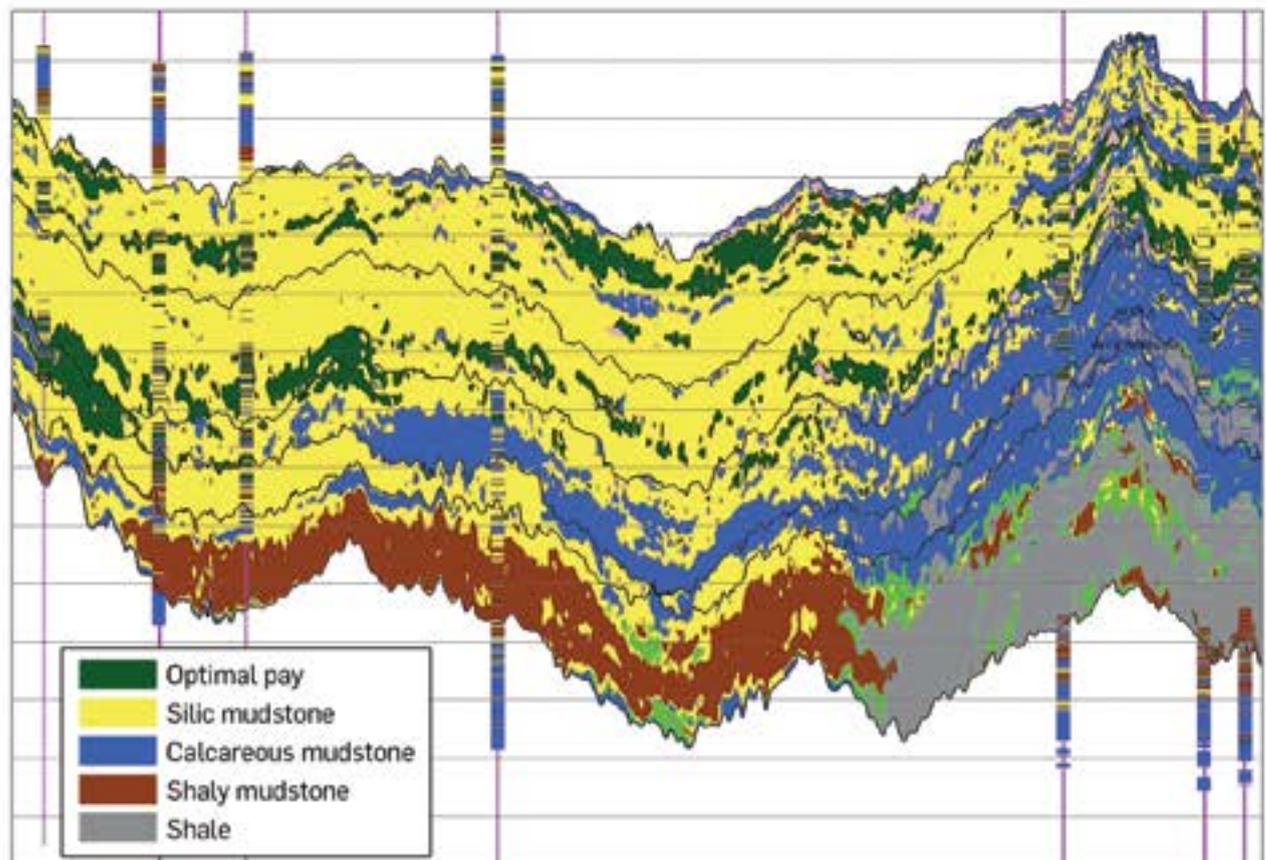
A mismanaged message can doom an oil project.

See page 10.

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Arbitrary line from the CGG Multi-Client & New Ventures Hobo survey in the Midland Basin, showing most probable facies based on lithology classification of prestack inversion results.

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PRESIDENT'S COLUMN

Trying New Approaches

BY CHARLES STERNBACH

As we focus on our core goals of content, finances and membership, we are taking the best of what has worked in the past and introducing new and perhaps transformative approaches for the future. We have talked previously about our core goal of content and how we are proactively acquiring top content for meetings and publications like the Bulletin. This month, let's drill deeper on new approaches to other key goals.

Finance Matters

Your Executive Committee is working hard to improve the long-term sustainability of AAPG. AAPG has cut costs by about \$700,000 for FY 2018 compared to FY 2017. This includes substantial reduction of travel by staff and professionals by about 45 percent and tough, strategic choices on programs (particularly by AAPG Treasurer Marty Hewitt). We are seeking to be efficient and impactful and to focus on core member priorities. We are doing more with less, as is required for our Association to have long-term sustainable programs. But as I also like to say, "You can't save your way to prosperity without investing in the future."

AAPG is working in innovative ways to significantly increase revenue with our intellectual content. We are forming corporate alliances to enhance AAPG's technical relevance and financial profitability. These initiatives will be rolled out in the months ahead with potential for recurring six-figure income to AAPG. Strategic industry alliance models will be singularly transformative for raising revenues. For example, AAPG is working with industry groups that can help AAPG deliver our geoscience and technical



STERNBACH

For each of us, there are reasons to belong to AAPG ... namely, the opportunity for geoscientists around the world to be part of a glorious past as well as the pride of being part of the world's greatest collection of earth scientists.

content using their existing and well-connected distribution platforms. One example is the co-sponsored AAPG-IHSMarkit Global Super Basin Conference in March 27-29, 2018 in Houston. Thanks to support by Daniel Yergin, promotion of the conference at CERA Week in March will help an entirely new AAPG "quick to market" program on the world's largest petroleum basins.

Commercial Value Can Drive Membership

AAPG currently has about 30,000 members, but much larger number of customers totaling about 70,000 people who use AAPG products, services, publications and meetings. We say that AAPG's goal is to be indispensable to the petroleum industry – our products and services must reflect this and so must our marketing. AAPG needs to focus on better products and services and must communicate those opportunities to the entire petroleum industry, not just our members. And by serving this broader market AAPG increases its revenue, allowing it to improve its core products and services and ultimately attract new members to AAPG. It starts by providing value. Thus, Members *and* customers are both vital to AAPG's success.

Membership Engagement

AAPG is reinventing its approach to recruiting and retaining members. This year, the Executive Committee approved the House of Delegates, the voice of the membership, to make it a specific focus. In addition, as a new initiative, we are producing video vignettes that show customers and potential members that AAPG has something for each of us. Joining AAPG 37 years ago was the best career decision I ever made. Over the years, I have had countless conversations with members of all ages. I value these conversations, personal experience and the experience of Vicki Bieghle, AAPG Administration team lead, and her 20-year history with AAPG membership. Drawing on the above, here is a perspective of the core demographics of the AAPG. Students are motivated to solve problems, make society better, help people, use technology and to be a part of successful integrated teams. They are cause-driven and seek adventure. Students are looking to apply their geoscience knowledge to meaningful work, enter industry or academia, and to take root. AAPG is your great adventure! Young professionals and early to mid-career professionals are working to build technical knowledge and experience. They

seek to apply their geoscience knowledge, build professional networks and develop leadership skills. AAPG is your source to build technical knowledge and professional skills. Mid to late-career professionals ("the Boomers") have highly relevant technical knowledge and professional experience. They can apply both knowledge and experience to senior leadership, education outreach, and/or mentoring. AAPG can augment your career with leadership, outreach and mentoring. Semi-retired and retired professionals have extensive career histories and experience and want to stay active. They understand the positive benefits of being technically engaged and socially connected. AAPG is the connection to your legacy projects and lifelong industry alumni. Our membership connection goal is to interview AAPG members from each of these demographic groups to show how AAPG matters to all of us. Being part of something bigger than ourselves is so important in all of our lives. For each of us, there are reasons to belong to AAPG. Yes, we offer programs and world-class conventions. We offer science. We offer connections, contacts and a world of business and professional opportunities. But we also offer even more – namely, the opportunity for geoscientists around the world to be part of a glorious past as well as the pride of being part of the world's greatest collection of earth scientists. Watch for these video testimonials – and, who knows, maybe others made by you! – in early 2018. We all have a story to tell.

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ON THE COVER:

Protesters gathered in front of the legislature in British Columbia, Canada to oppose the Northern Gateway Pipeline project in October 2012. After years of political pressure from environmental activists against this and other projects, Canadian Prime Minister Justin Trudeau eventually imposed a ban on oil tanker traffic on the North Coast of British Columbia, which killed the project. Right: The Dakota Access Pipeline has faced comparable obstacles. See story on page 10.



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The Next 100 Years of Oilfield Invention

By DAVID BROWN, EXPLORER Correspondent

We've already seen some of the oilfield invention and innovation that will happen during the rest of this century.

In science fiction films.

That holographic and virtual reality manipulation Tony Stark does in the "Iron Man" movies? We'll be doing it in the workplace.

"We have been collaborating with GE on the development of some of the first oil- and gas-based applications for the Microsoft HoloLens device," said Lynn Taggart, senior engineer for Devon Energy's Strategic Innovation Group in Oklahoma City.

On its website, Microsoft says "HoloLens is the first self-contained, holographic computer, enabling you to engage with your digital content and interact with holograms in the world around you."

"The device operates not in the virtual reality realm but rather in augmented or 'mixed' reality. This should be a tremendous breakthrough for a number of areas in our industry," Taggart said.

"For example, our geologists and engineers are no longer limited to 2-D imagery like maps and logs. They can now all see the virtual reservoir in full 3-D form, floating in the middle of the room," he added.

So the future explorationist will be looking at a sharply defined hologram with the ability to pull in other virtual projections and data, and to alter the imaged environment at will.

Just like in "Star Trek."



Devon Energy and GE are presently collaborating to develop oil and gas applications for the Microsoft HoloLens. Photo courtesy of Microsoft.



IKONNIKOVA

"Every company already has a department for data analysis, or is about to have one. This kind of integration is a big innovation on its own. This is an unprecedented innovation."

Data Integration

Modeling in three dimensions is one of the three main areas driving invention in the oilfield, along with

Big Data and statistical analysis, said Svetlana Ikonnikova, a research scientist and energy modeler for the Bureau of Economic Geology at the University of Texas at Austin.

"At the moment you see a lot of interest in 3-D models. You cannot drill 20,000-foot laterals without a really good understanding of the 3-D and the geology," Ikonnikova said.

"The question is, 'How can I do a better completion given my understanding of the rocks?' Those models need to explain the relation between the rocks and the completion and the tools being used," she added.

The integration of Big Data and analytics into oilfield operations is already reshaping the industry and will continue to do that for decades, Ikonnikova said.

By definition, Big Data sets are those too large to process without specialized software and greatly enhanced computing power – and those data sets keep getting bigger and more complex every year. People who work with Big Data know what number a "billiard" is.

And it's a really big number.

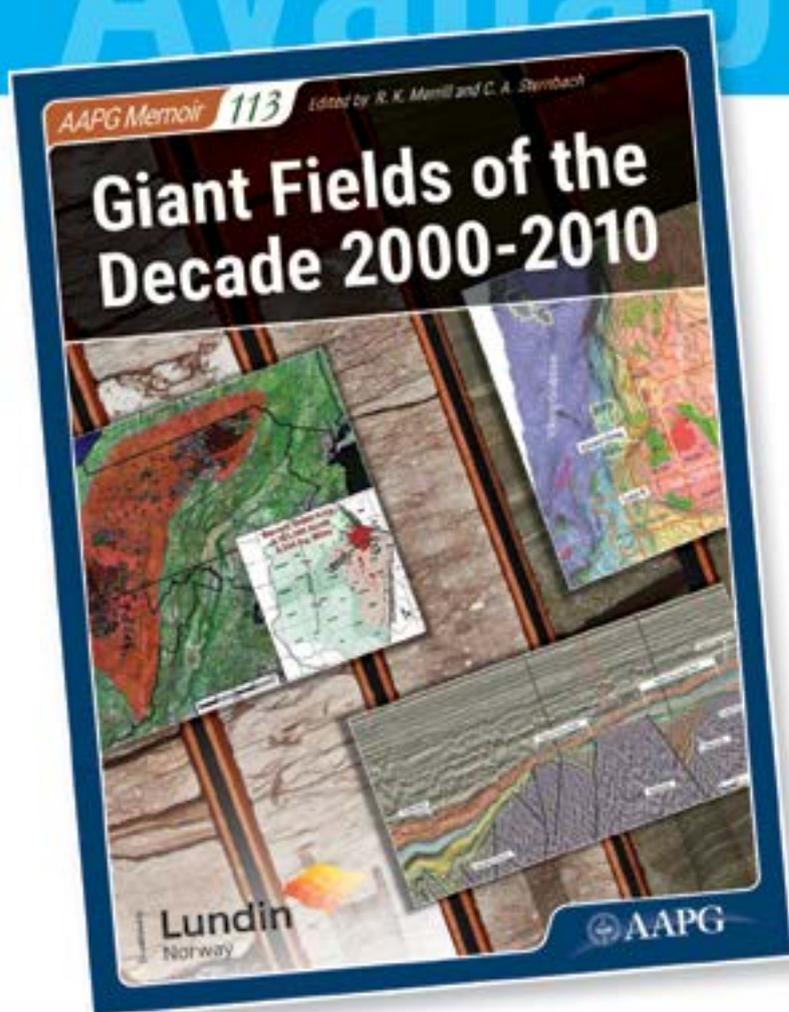
"Every company already has a department for data analysis, or is about to have one," Ikonnikova said. "This kind of integration is a big innovation on its own. This is an unprecedented innovation."

Geoscience could be an especially fruitful area for invention and innovation through the use of analytics, Ikonnikova said.

"Geology was always a little bit underusing statistical analysis. There's a reason for that. Statistical analysis was rough, and not really suited for some

See [Strategy](#), page 13

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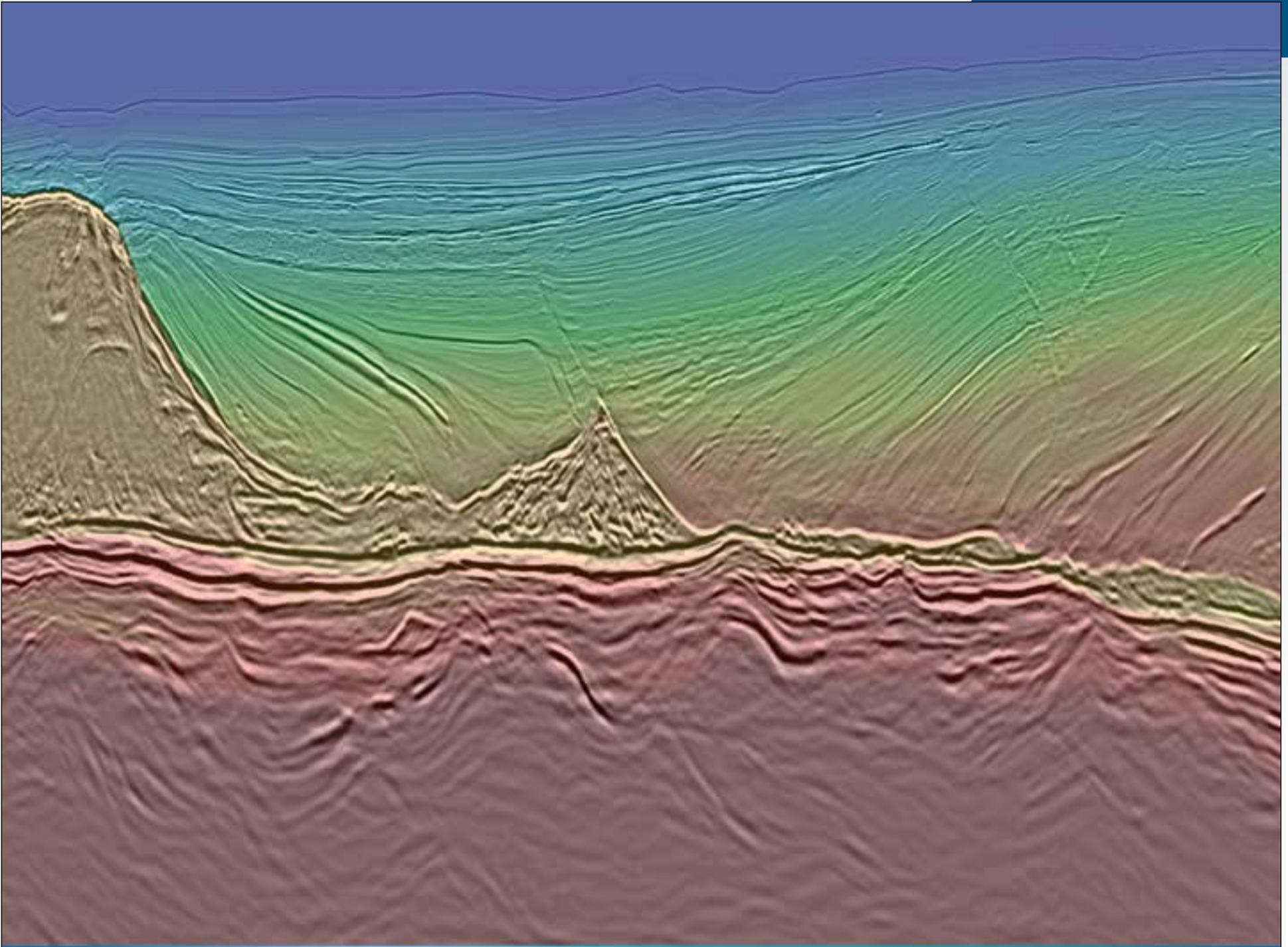


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Santos Basin

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.

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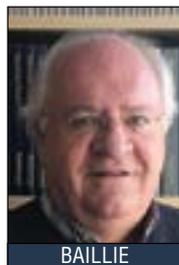
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This Year's Honored Best of AAPG

By BRIAN ERVIN, EXPLORER Managing Editor

Michael C. Forrest is the recipient of the Association's highest honor, the AAPG Sidney Powers Memorial Award.

Forrest is an Honorary Member and is celebrated for his seminal work on bright spots and direct hydrocarbon indicators, which has been employed by oil producers worldwide for the past 45 years and has led to several major discoveries in the Gulf of Mexico shelf area alone.

Forrest has worked as an exploration manager at Shell, was president of Pecten International, and vice chairman and chief operating officer at Maxus Energy.

AAPG Honorary Member **Hans H. Krause** joins him at the top of the awardees list as this year's Michel T. Halbouty Outstanding Leadership Award recipient.

Krause is the editor of Historical Highlights, a monthly column that is a staple of this publication, telling the human stories behind some of the greatest moments and discoveries of the oil industry. Krause draws upon his extensive contacts and experience from his long and illustrious upstream career with Petroleos de Venezuela (PDVSA), Compañía Shell de Venezuela and Maraven.

He is also a tireless and active leader within AAPG, serving in a variety of capacities that have included chairing the History of Petroleum Geology Committee, serving on the ICE Cartagena Organizing Committee and numerous other vital roles.

Gilbert Odior and **David Blanchard** are the recipients of the inaugural Vlastimila "Vlasta" Dvořáková International Ambassador Service Award. This award is given to those who have promoted growth and awareness of the AAPG organization internationally, outside the United States, and created opportunities for the Association to reach a wider audience of geoscientists worldwide. Odior is a member of the Africa Region



HONORS AND AWARDS

and Blanchard is a past president of the Africa Region.

Forrest, Krause, Odior and Blanchard will be recognized, along with the rest of the AAPG award winners, at the opening session of the 2018 AAPG Annual Convention and Exhibition in Salt Lake City, Utah, set for May 20-23.

AAPG awards, approved by the Executive Committee, are presented annually to recognize individuals for service to the profession, the science, the Association and the public.

Biographies and citations of all award winners will be included in a future AAPG BULLETIN.

Joining Forrest and Krause as this year's AAPG awardees are:

Honorary Member Award

Presented to Members who have distinguished themselves by their accomplishments and through their service to the profession of petroleum geology and to AAPG.

☐ **Jeffrey Brooks Aldrich**, MHA Petroleum Consultants, Denver, Colo.

☐ **Edward A. "Ted" Beaumont**, Cimarex Energy Co., Tulsa, Okla.

☐ **Gretchen M. Gillis**, Aramco Services, Houston.

☐ **Jeffrey W. Lund**, Corridor Oil & Gas LP, Houston.

☐ **David G. Rensink**, Consultant (retired), Houston.

☐ **Paul Weimer**, University of Colorado, Boulder, Colo.

Norman H. Foster Outstanding Explorer Award

Presented to Members in recognition of distinguished and outstanding achievement in exploration for petroleum or mineral resources, with an intended emphasis on recent discovery.

☐ **Susan Morrice**, Belize Natural Energy, Belize, honored her role in finding oil in Belize and leading her company in developing a business model that ensured oil production benefited the country and people of Belize.

Robert R. Berg Outstanding Research Award

Presented to honor a singular achievement in petroleum geoscience research.

☐ **Carlo Doglioni**, Sapienza University, Rome, Italy, honored for his pioneering role and expertise in petroleum geochemistry.

☐ **Mark G. Rowan**, Rowan Consulting, Inc., Boulder, Colo., honored for his pioneering role and expertise in petroleum geochemistry.

Distinguished Service Award

Presented to those who have distinguished themselves in singular and beneficial long-term service to AAPG.

This year there are nine recipients of the honor:

☐ **Peter Baillie**, SVP Business Development, Perth, Australia.

☐ **Richard Ball**, Detring Energy Advisors, Houston.

☐ **Steven Brachmann**, Wapiti Energy, Houston.

☐ **Cynthia Huggins**, Aera Energy, Bakersfield, Calif.

☐ **Jon R. Schwalbach**, geoscience consultant, Oxnard, Calif.

☐ **Michael L. Sweet**, ExxonMobil, Houston.

Grover E. Murray Distinguished Educator Award

Presented for distinguished and outstanding contributions to geological education, both at the university level and toward education of the general public.

☐ **Frank R. Etensohn**, University of Kentucky, Lexington, Ky.

☐ **Philip Steven Simony**, University of Calgary, Calgary, Canada.

Public Service Award

Presented to recognize contributions of AAPG Members to public affairs – and intended to encourage such activities.

☐ **Thomas C. Chidsey, Jr.**, Utah Geological Society, Salt Lake City, Utah, honored for his role in educating the public and policymakers on Utah's petroleum potential and production.

☐ **Philip Steven Simony**, University of Calgary, Calgary, Canada.

Pioneer Award

Presented to long-standing Members who have contributed to the Association and who have made meaningful contributions to the science of geology.

☐ **Ian David Maycock**, Hunt Oil (retired), Playas del Coco, Guanacaste, Costa Rica, honored for his contributions and discoveries in the Middle East, including Alif Field the first oil discovery in Yemen.

Continued on next page



SIMONY



CHIDSEY



MAYCOCK



RANNEY



MOHAMED



RALANARKO



KNELLER



DYSKSTRA



FAIRWEATHER



MILANA

BARTONLI

Continued from previous page

Geosciences in the Media Award

Presented for notable journalistic achievement in any medium, which contributes to public understanding of geology, energy resources or the technology of oil and gas exploration.

☐ **Wayne Ranney**, freelance geologist, Flagstaff, Ariz., honored for his acclaimed books on the geology of the southwestern United States.

Young Professional Exemplary Service Award

Presented to Members who have promoted growth, awareness and expanded opportunities within the organization for Young Professionals.

☐ **Ola Adly Fakhry Mohamed**, Khalda Petroleum Company, Maadi, Cairo, Egypt, honored for her leadership and organizational efforts for AAPG in North Africa.

☐ **Dwandari Ralanarko**, CNOOC Southeast Asia, Jakarta, Indonesia, honored for his service and leadership within AAPG Indonesia's YPs and student chapters.

Wallace E. Pratt Memorial Award

Presented to honor and reward the author(s) of the best AAPG BULLETIN article published each calendar year.

☐ **Ben Kneller, Mason Dyskstra, Luke Fairweather and Juan Pablo Milana**, for "Mass-transport and slope accommodation: Implications for turbidite sandstone reservoirs" (February 2016 AAPG Bulletin).



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PINDELL



HORN

Robert H. Dott Sr. Memorial Award

Presented to honor and reward the author/editor of the best special publication dealing with geology published by the Association.

☐ **Claudio Bartonli and Paul Mann**, for AAPG Memoir 108: "Petroleum Geology and Potential of the Colombian Caribbean Margin."

J.C. "Cam" Sproule Memorial Award

Presented to recognize and reward younger authors of papers applicable to petroleum geology.

☐ **Jinyu Zhang, Ronald Steel and William Ambrose**, for "Greenhouse shoreline migration: Wilcox deltas" (AAPG BULLETIN, December 2016).

John W. Shelton Search and Discovery Award

Presented in recognition of the best contribution to the "Search and Discovery" website in the past year.

☐ **Andrew Miall**, for "The Valuation of Unconformities" (Presented at the 2016 ACE in Calgary).

SEG/AAPG Best Paper In Interpretation Award

Presented in recognition of the best contribution to the new SEG/AAPG journal, "Interpretation."

☐ **Krzysztof M. Wojcik, Irene S. Espejo, Adebukonla M. Kalejaiye, and Otuka K. Umahi**, for "Bright spots, dim spots: Geologic controls of direct hydrocarbon indicator type, magnitude, and detectability, Niger Delta Basin" (August 2016).

George C. Matson Award

Presented to honor and reward the best oral presentation at the 2017 AAPG Annual Convention and Exhibition in Houston.

☐ **Paul G. Lillis**, U.S. Geological Survey, Denver, Colo., for "Application of Oil Gravity and Sulfur Content Relationships to Oil Typing and Source Rock Kinetics."

Jules Braunstein Memorial Award

Presented to honor and reward the best poster presentation at the 2017 AAPG Annual Convention and Exhibition in Calgary.

☐ **1. Katie-Joe McDonough, Kenneth McDermott, Elisabeth C. Gillbard, Kyle Reuber, James Pindell and Brian W. Horn**, for "Chronostratigraphy Across a Conjugate Margin Source-to-Sink: Uruguay and Namibia—Why Stop at Basement?"



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JANUARY

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EXPLORER News Site

Coming this January, EXPLORER will launch a new website. Now you can easily read every article from EXPLORER on your desktop, laptop, or mobile device.

Great New Content

The EXPLORER site will also share bonus content from the Bulletin, Interpretation, Search and Discovery, and even book reviews. The site will also feature web-only content including photo galleries and extended articles that are not published in the print edition.

1999-Present

EXPLORER wasn't satisfied with just the latest news, we also brought the convenience of our new website to the past 18 years of EXPLORER. Read every issue from 1999 to present in our beautiful new format.

EXPLORER Newsletter

In addition to the EXPLORER News Site, AAPG will launch a new EXPLORER Newsletter that will arrive Tuesday and Thursday each week featuring EXPLORER headlines, videos, and other bonus content. EXPLORER has you covered from your mailbox to your inbox.

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Professional Protesters Threaten Energy Infrastructure

By HEATHER SAUCIER, EXPLORER Correspondent

The irony has played out over and over again.

Protestors of the Noble Discoverer, Shell's Arctic drilling vessel, bobbed up and down in plastic kayaks off the coast of Seattle in May 2015 holding bright plastic signs in opposition to the industry.

In 2016, thousands of protestors traveled in cars and planes for long distances to fight construction of the Dakota Access Pipeline in North Dakota.

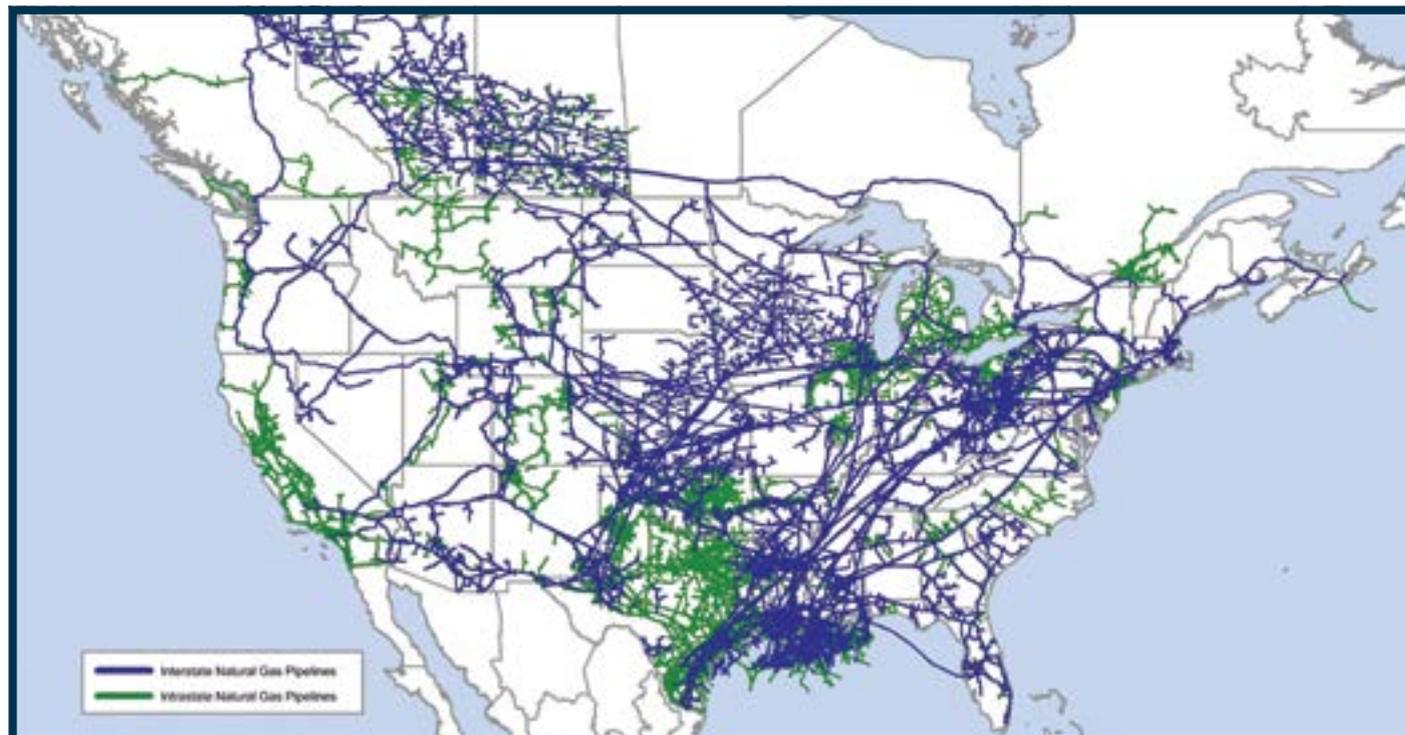
Yet just about everything protestors own – from blue jeans and cell phones to watercraft and picket signs – is made from petroleum products. And everywhere they travel, they rely on fossil fuels.

But, they vehemently oppose fossil fuels and want the world's oil and gas lifeline to shut down.

This desire held by extremists is so strong that protesting industry-related projects is becoming an industry in itself – with a bullseye now set on pipelines. Groups such as Greenpeace, the Sierra Club and Food & Water Watch are harnessing the power of fear tactics and social media to spread falsehoods and misinformation in order to rally large groups of citizens to join their forces and put money in their coffers.

And, they are becoming increasingly successful.

In 2016, when a small group of Native Americans expressed concern about the Dakota Access Pipeline infringing on sacred sites of the Standing Rock Sioux Tribe, it did not take long for



environmentalist groups to hijack the issue, change the narrative and publicly claim that the pipeline would pollute the water of the Missouri River, the primary source of drinking water for the Sioux tribe.

In a matter of months, thousands of people had permanently camped at the Standing Rock Indian Reservation, protesting so vehemently that it cost pipeline builder Energy Transfer Partners approximately \$30,000 a day for security, with an ultimate price tag estimated at

\$22 million.

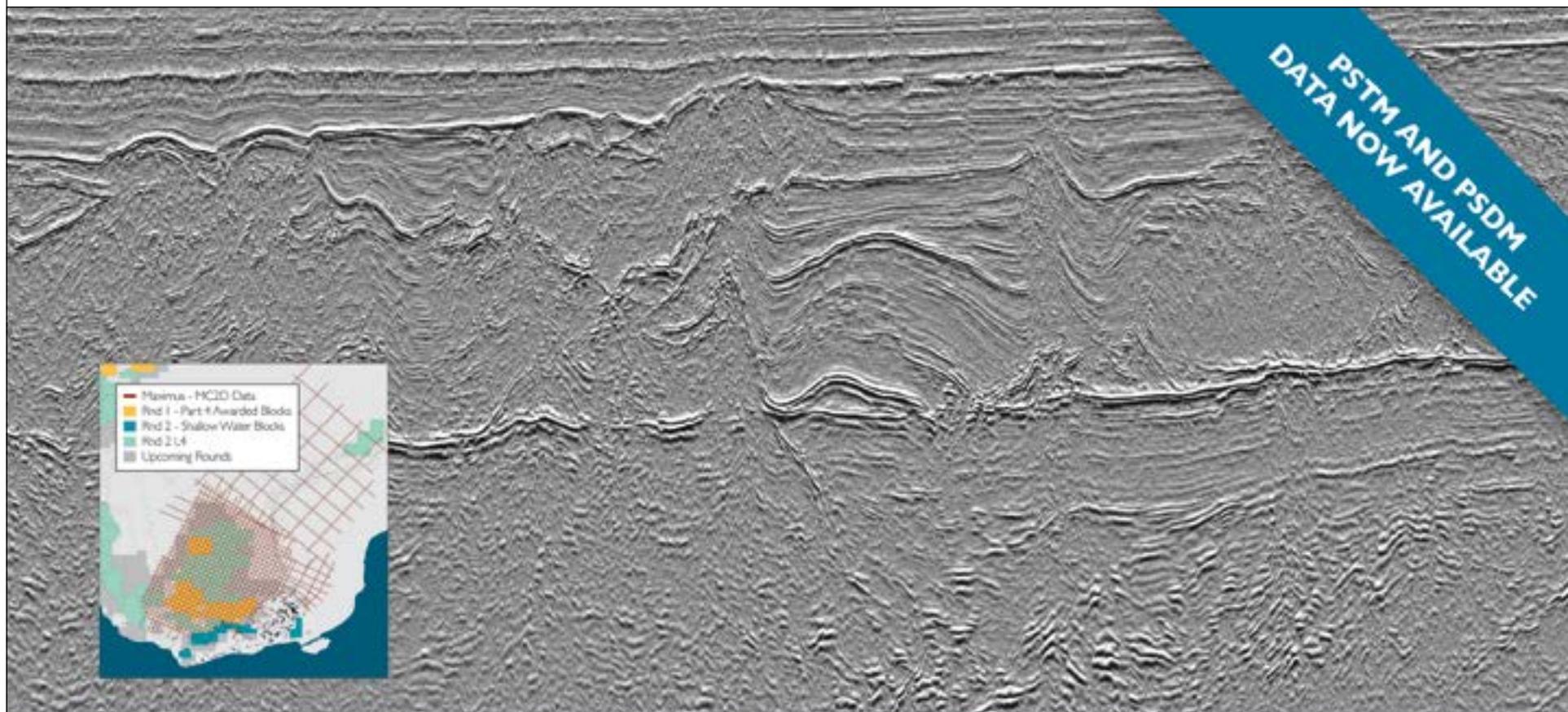
Construction of the 1,100-mile pipeline was shut down last December and was resurrected earlier this year by President Donald Trump with an executive order to expedite approvals.

Insert another piece of irony: Not only were 95 percent of the environmentalists arrested in the protests not residents of North Dakota, they left behind nearly 5 million pounds of trash for the local community to clean up.

In the eyes of many outsiders looking

in, the moral of the story is that the oil and gas industry is at a crucial crossroads. In order to keep projects moving forward without fierce opposition bringing their budgets to blows, it is essential that they trade traditional public relations practices for advanced social risk analyses and proactive strategies to get in front of protesters – who have proven they have the power to shut projects down.

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MCG PRESENTS

OFFSHORE MEXICO

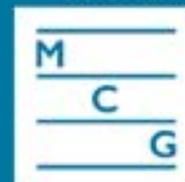
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“Companies can avoid conflicts if they get in front of them, but most don’t want to make the investment up front. They make plans for a project and move forward, hoping no obstacles get in the way. But hope is a poor planning tool.”

Continued from previous page

Is Anyone Ready?

For years, Jim Sisco, president and founder of ENODO Global, a consulting firm specializing in risk analysis and population-centric engagement, has worked on developing social risk analysis tools and tactics to help companies stay ahead of potential crises that percolate in communities around the globe. He helped create an effective system as a former U.S. Navy intelligence officer during Operation Enduring Freedom in 2009 when he was charged with integrating U.S. troops into Afghan communities as seamlessly as possible.

Now working with a wide range of companies, including operators and service companies, he emphasizes that organized extremist groups – which spread false and misleading information in alarming tones via the channels of social media – are a force to be reckoned with. It requires staying ahead of the opposition, continuously monitoring the sentiments of a community in real time, and proactively communicating with the public prior to project implementation.

“The majority of companies do not understand how a crisis can manifest or how to manage one,” said Sisco, who has been featured on HBO’s VICE News

Tonight for his work. “Companies can avoid conflicts if they get in front of them, but most don’t want to make the investment up front. They make plans for a project and move forward, hoping no obstacles get in the way. But hope is a poor planning tool – especially in today’s times.”

Sisco said companies are still relying on outdated public relations tactics: Business intelligence, which is driven largely by geopolitical factors, is often geared toward business elites, not communities. Implementing visible security measures before the project starts creates barriers between a company and the surrounding community and can trigger opposition. Public relations tactics are too often reactive in nature, and corporate social responsibility programs frequently fail to address the true needs of a community, rousing the residents and creating conflict.

“It is fear that drives protests. Fear evolves from not knowing. Companies do not have strategic communication plans that effectively articulate project goals and objectives and how they are going to carry them out,” Sisco said. “If they did and messaged that on social media, it would counter or drown out the activists. Show me one company that is proactively engaging with communities or that can effectively

See [Populism](#), page 12



TransAlaska pipeline, Mt. Sukakpak, central Brooks Range, courtesy of AAPG member Gil Mull.

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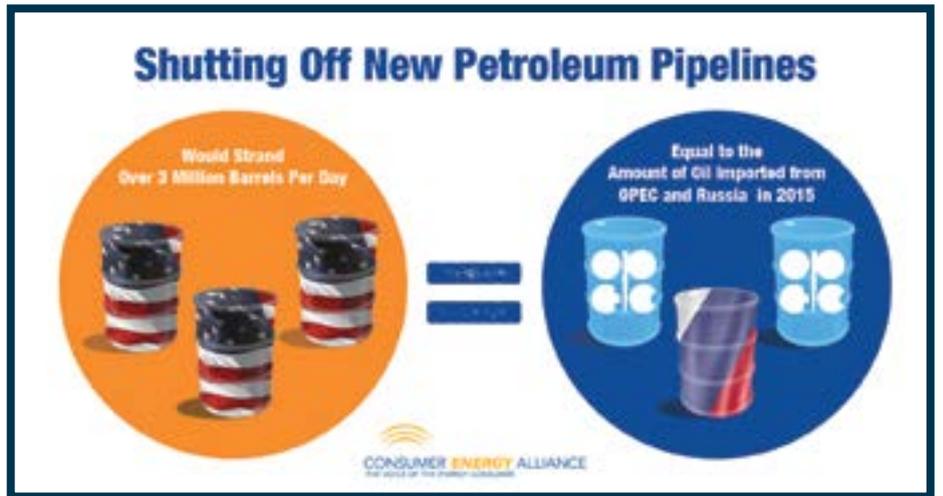
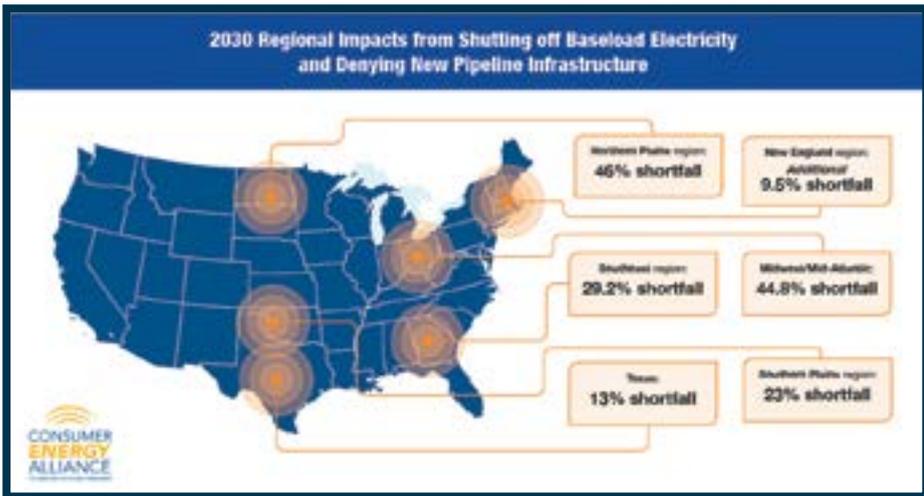
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Populism from page 11

manage social media, and I would argue that there are none."

The End of Pipelines: A Case Study

As early as 2012, protests from environmental groups and landowners began against the Keystone XL pipeline, which was designed to run through Nebraska's environmentally sensitive Sandhills region. Citing concerns such as water pollution and an adverse effect on wildlife, their voices were heard by former President Barack Obama when he vetoed a bill to move the pipeline forward in 2015. President Trump took action last January to expedite the revival of the project.

The Keystone XL and the Dakota Access pipelines are just the beginning of energy infrastructure coming under attack. An article titled "Get Ready for the Trump Pipeline Boom" in a March 2017 issue of

Mother Jones lists eight pipelines as the next targets for activists, including the Trans-Pecos, Bayou Bridge, Mariner East 2, Sabal Trail, Diamond, Atlantic Sunrise, Pacific Connector and Agua Prieta.

In an October 2017 issue of In These Times, the cover story, titled "Pipeline Populism," warned that the protest at Standing Rock "was a dress rehearsal" compared to what future protests of the still embattled Keystone XL pipeline will be. The author wrote, "Whatever the fate of the pipelines, their opposition is poised to endure."

Aware of the burgeoning opposition to energy infrastructure and growing hostility against the oil and gas industry, Consumer Energy Alliance produced a report earlier this year that demonstrated the consequences if planned oil and gas pipelines were prevented from being built.

Called "Families, Communities and Finances: The Consequences of Denying Critical Pipeline Infrastructure," the report concluded that the failure to permit and construct new pipeline infrastructure and the inability to obtain permits and approvals

for coal, natural gas, nuclear and petroleum-fired electricity generation power to maintain the nation's existing power generation would create a shortfall of one-third of the electricity generation needs from the overall U.S. electricity market by 2030.

CEA President David Holt put the study into perspective by explaining that a total of 12 states – California, Florida, Illinois, Ohio, New York, Texas and all of New England – would be in a permanent blackout.

"A lot of these extremists are creating this narrative that ultimately means 'We can't build anything next to anything ever,'" Holt said. "And, if you follow the logical path to that, the people who can least afford to pay more for energy will be the ones who are hurt the worst. If you are at or below the poverty level, you will pay 25 to 30 percent of your monthly income on energy if we stop building pipelines."

Fighting Fire with Fire

There is little question that professional activists and the mainstream media, which

have been echoing their voices, have beat the industry to the punch when it comes to communicating with the public and mobilizing citizens to take a stance.

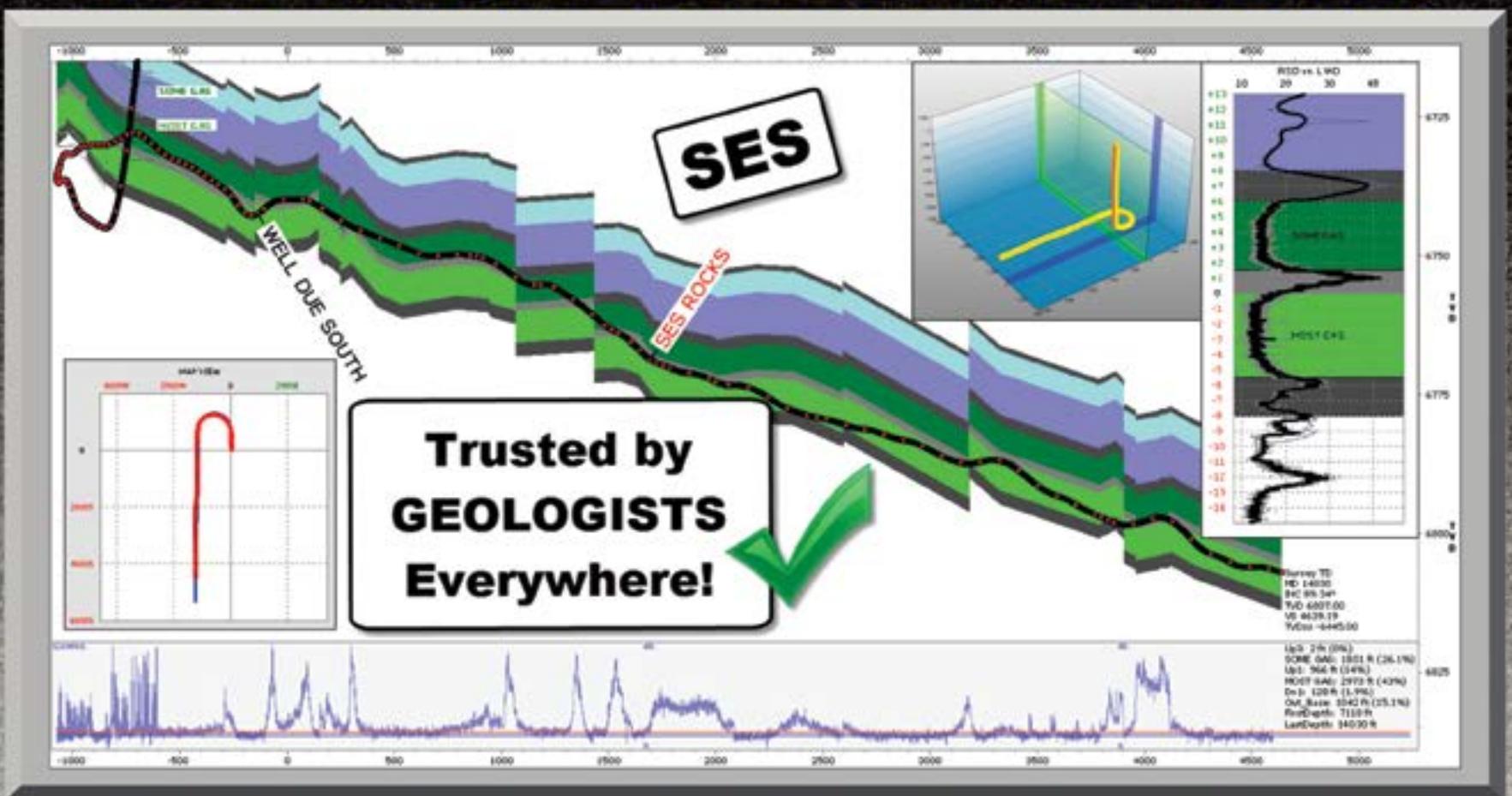
"It's increasingly difficult to have an honest, balanced discussion about what these energy-delivery products mean," Holt said, explaining that many people have been brainwashed by rhetoric and remain closed to the facts. "To go into a community and intentionally spread misinformation or to exaggerate potential implications to scare the public or to misinform elected officials so that rational decision-making is no longer occurring is an abuse of power and an abuse of the system."

In reality, more than 2 million miles of pipelines stretch across the nation to deliver energy to the consumer, and more than 99 percent of those pipelines are safe and effective, Holt said. And unlike barges and trucks, they don't release emissions.

Holt strongly advocates for the industry

See Risk Analysis, page 14

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Strategy from page 4

specific problems,” she noted.

“At the moment it’s just like the beginning of the shale revolution. It’s very similar now in statistics, the way I see it,” she said.

In oilfield invention “there are some trends that are clearly emerging. The primary one, far and away, is the dramatic increase in the type of sensor technologies being developed as part of the digital oilfield concept,” Taggart said.

One emerging area of invention, “and it’s almost a Holy Grail type of thing for measurement, is the development of affordable multiphase-flow sensor equipment. Wellhead mounted, it allows you to know what rates of oil, water and gas you are producing, instantaneously,” he said.

“A little bit different twist to the sensor story is the development of a new hardhat equipped with all kinds of sensors to monitor LEL levels, worker biometrics, etc.,” he said. “It’s one of the first things we’ve seen that deals with worker safety.”

Strategy and Invention

Specific problems also will attract future invention to challenges like mitigating environmental impacts. Ikonnikova cited produced water as one area of technology focus for the industry.

“Now all these tools and approaches are not only used to study production but also in water issues,” she noted. “I think this is coming, because it’s currently being studied by Schlumberger and Halliburton and other companies, how to reuse the water.”

Taggart sees this as part of a continuing trend toward “monetization of things that were previously considered waste streams.”

“To give you one example, is there iodine in your produced water?” he said.

“Companies are actually thinking way ahead now in ways and tools that can prevent negative effects. We see an unprecedented involvement by the industry in all the environmental discussions,” Ikonnikova said.

“I think consumers will come to understand that oil and gas companies are on the same side as they are,” she predicted.

Problem-driven innovation also helps the industry target practical and economic invention, and not simply change for the sake of change, or change because it’s technologically possible.

“You just have to keep your antenna up for things that are not only interesting technologically but also are commercially viable,” Taggart said.

“We have ‘innovation’ in our team name, but we also have ‘strategic,’” said Todd Blasdel, supervisor for Devon’s Strategic Innovation Group.

“Therefore, we try to make sure that we are focused on innovative technologies that align with our strategic corporate initiatives, and that we’re not just chasing a one-off technology with limited upside,” he said.

Blasdel said it’s “exciting” to see so much advancement and to figure out how new and coming technologies can be combined, looking “for ways to understand how emerging Technology A can be coupled with emerging

Technology B to increase overall impact.”

To promote the company’s interest in oilfield invention and innovation, Devon took the unusual step of sending its Strategic Innovation Group staffers to set up a booth at industry trade shows.

“We wanted to raise Devon’s visibility in the industry so people are aware that Devon is fully committed to innovation. Strategic Innovation has a budget to pursue new technologies, new ways of doing things,” Taggart said.

“We want people who have a new technology for oil and gas to think, ‘I need to pick up the phone and call Devon,’” he added.

Taggart said Devon also looks at the question, “Is there something in another industry that can be applied to the oil and gas industry?”

“Borrowing from the aerospace industry, one area that is just now

emerging in Europe is the utilization of high-strength advanced composites in place of steel, for things like casing and tubing. With composites, corrosion is a thing of the past,” he said.

Another future breakthrough could involve detectable proppant and the use of synthetic DNA, Taggart said. Right now the industry has limitations on tagging or fingerprinting proppants to find out where they end up.

“An exciting new technology that’s emerging in the completions area is detectable proppant – the ability to map where proppant resides in the formation,” he noted.

“There are now tracers being developed using synthetic DNA. Rather than only having 30 or 40 tracer profiles available, you can now have trillions of unique tracer fingerprints at your disposal,” he said.

The Google of Oil

Having earned a doctorate in economics and management science from Humboldt University in Berlin, Ikonnikova has a unusual perspective on innovation in oil and gas.

“Now as an economist, what I see is that we need to educate ourselves about the resources and how the industry works,” she observed.

“With low prices you need to find a way to develop your resources more efficiently, meaning at a lower cost per unit of production, more economically. With improved efficiency you also extend the life of the resource and make the resource more affordable,” she said.

She thinks the oil and gas industry until recently has been in the same

See Google, page 14

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By VICKI BEIGHLE, Administration Team Lead

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Devon Tower in Oklahoma City, Okla.

Google from page 13

position as the Internet before online giants like Google and Amazon came along, with unconventional resources now

ushering in a new era of advancement.

"Unconventional resources are the Google and Amazon of the oil and gas industry," she said.

In contrast with the concept that oil and gas is a mature industry, she sees a new threshold instead: "Despite all the Big Data analysis happening now, this is a very young industry," she stated.

Going into a future full of possibilities, it can make sense for the industry to



TAGGART



BLASDEL

support oilfield invention and innovation wherever it can, Taggart observed.

"When we're evaluating a new technology we're always mindful of what the potential financial impact will

be on the company. The bottom line is: Does it improve the bottom line?" he said.

If the future of oilfield invention is a jigsaw puzzle to be pieced together over the coming decades, Ikonnikova thinks the big picture has just started to come into focus.

"I still think there's a lot to learn," she said. "I believe we don't have all the pieces of the puzzle."

Risk Analysis from page 12

to engage with communities, share its plans and address questions to reduce the potential for professional activists to hijack a community's true concerns for the sake of their own agendas.

Because protests are now an almost guaranteed response to unwanted projects, Sisco teamed up with the Texas A&M Engineering Extension Service to provide tools to address professional activists and negative public sentiment in a course called "Introduction to Population-Centric Social Risk Analysis," offered for the first time last June.

The course, which is blazing trails with its on-point curriculum, introduces social risk and techniques to recognize

the factors that propagate instability within communities and across societies.

"By understanding these concepts, a CEO or a first responder will be equipped with the knowledge to make sense of the unpredictable nature of today's dynamic societies and employ proactive strategies to engage different segments of the population," Sisco said.

Ultimately, the energy industry must embrace modern-day tactics to move forward with projects without encountering hurdles that are too high and too costly, Sisco said. Comprehensive social risk analysis is the new brand of public relations needed to stamp out the many fires that are anticipated to ignite.

(Disclosure: AAPG is a founding member of the Consumer Energy Alliance.)

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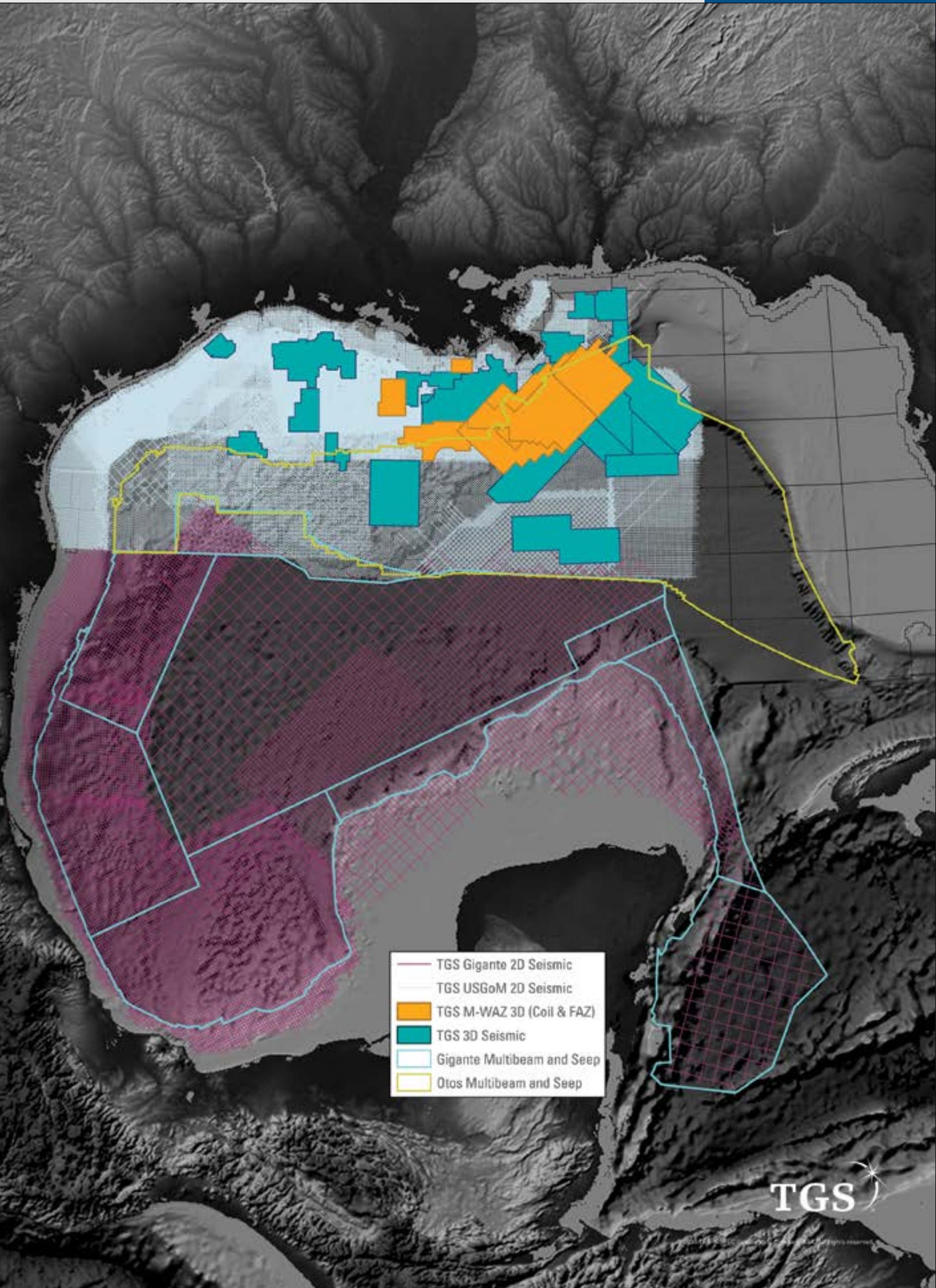
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Historical Highlights is an ongoing EXPLORER series that celebrates the “eureka” moments of petroleum geology, the rise of key concepts, the discoveries that made a difference, the perseverance and ingenuity of our colleagues – and/or their luck! –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

The Rise of BHP and Australia’s Oil Fortunes

By PETER BAILLIE

Australia’s first offshore well heralded a new era of hydrocarbon independence for a continent previously thought to have “the wrong geology” to host significant oil and gas deposits.

That well, East Gippsland Shelf No. 1, drilled in 1964 and ’65, led to the discovery of the Barracouta gas field and was subsequently renamed Barracouta-1.

Long Road to Discovery

This success did not come easily – the early history of oil exploration in eastern Australia was long and frustrating, and not very successful.

The first well, in 1886 in the Coorong region of south Australia, drilled through a little more than 100 meters of Cenozoic sediments before encountering Precambrian basement; the targeted “oil seep” proved to be a modern crust of organic-rich algal material formed in one of the numerous lakes in the area.

In 1900, natural gas was found during water drilling operations near Roma in southwest Queensland and was used for lighting in Roma.

In 1924, another water well encountered hydrocarbons, this time in Victoria: Lake Bunga-1 drilled near Lakes Entrance in the Gippsland region of southeastern Australia encountered small amounts of viscous, heavy (biodegraded) oil at a depth of 326 meters.

The Lakes Entrance pool became Australia’s first known oil accumulation.

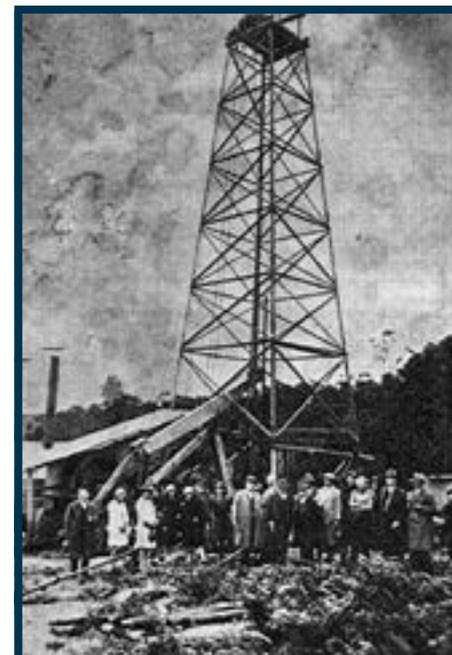
Another 64 wells were drilled in the ensuing years by several companies, including the Point Addis and Pure Oil companies, and by 1941 this area had produced more than 8,000 barrels of heavy oil. The most productive well was the Lakes Entrance oil shaft, which produced 4,935 barrels during World War II.

Lakes Oil Limited took over the operation after the war and by the early 1950s, the Gippsland area started to attract wider attention. Russian emigrée Nicholas Boutakoff of the Victorian Mines Department reviewed the petroleum potential of the state and in 1955 suggested offshore exploration, albeit within the shallow coastal waters within reach of the drilling technology available at the time.

The Bureau of Mineral Resources,



The drillship Glomar III, which drilled East Gippsland No. 1. Photo courtesy of Esso Australia Ltd. and BHP Petroleum Ltd.



Lake Bunga No. 1 in 1924 at Lakes Entrance. Photo courtesy of the Victorian Department of Industry, Technology & Resources.



BAILLIE

Peter Baillie, former president of AAPG’s Asia Pacific Region, is based in Perth, Australia, where he works for CGG. A keen student of history, he believes that modern seismic imaging may unlock significant new discoveries in “mature” basins such as the Gippsland Basin.

Geology and Geophysics

(now Geoscience Australia) flew an aeromagnetic survey of the onshore area of the Gippsland Basin in 1951 and ’52 and the offshore area in 1956. The anomaly trends of the aeromagnetic contour map can be correlated with several known geological structures, some of which could be traced into the deeper parts of the basin. A depth-to-basement map shows a trough east of Lake Wellington and the likely development of more than five kilometers of sedimentary infill.

Woodside (Lakes Entrance) Oil Company Limited was incorporated in 1954, having taken its name from the small town of Woodside located some 157 kilometers from Lakes Entrance. In 1956, the company secured the first offshore exploration license to be granted in Victoria – a 2,600-square

kilometer stretch offshore Ninety Mile Beach that extended 2 kilometers into Bass Strait.

That exploration was unsuccessful.

It is worth noting that in the late 1950s, Boutakoff began consulting to Woodside and suggested they switch their attention to the other side of the country. In 1963, Woodside was awarded exploration rights to more than 367,000 square kilometers off northwestern Australia and went on to become Australia’s first LNG operator and largest independent oil and gas company.

Enter “the Big Australian”

The Broken Hill Proprietary Company Limited, better known today as BHP, was born in 1885 out of the fabulous silver-lead deposits of Broken Hill, which is still today an isolated mining city in the far west of outback New South Wales near

the border with South Australia.

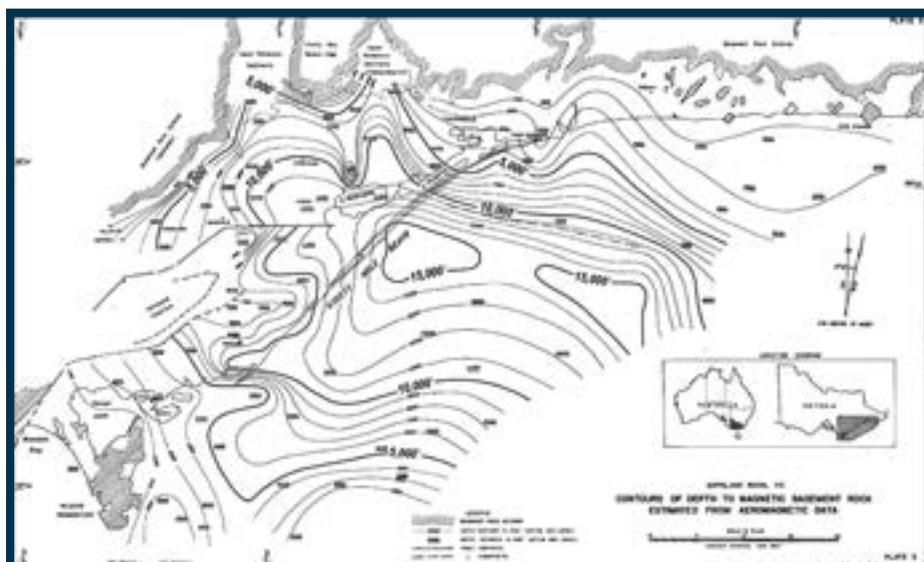
By the early 1960s the company had grown, prospered and diversified to become Australia’s premier industrial company having a plethora of interests including coal and metals mining, smelting, refining, manufacturing and steel production.

Ian Munro McLennan, a giant of the Australian industrial landscape, joined BHP during the Great Depression, became general manager in 1950 and chairman in 1971. Under his stewardship, BHP was transformed into such a sizeable company that it earned its longstanding nickname, “the Big Australian.”

When McLennan joined the BHP board in 1955, he learned that British interests were considering exploring for oil over large parts of New South Wales, specifically the Sydney Basin where BHP had several large coal leases. He immediately sought to cut the invaders off at the pass and set a new subsidiary, Haematite Exploration Proprietary Limited, to undertake oil exploration.

McLennan sought a credible petroleum exploration expert to advise BHP on the petroleum potential of the

Continued on next page



Depth-to-basement map from 1956 aeromagnetic survey showing development of over five kilometers of sediment in the offshore Gippsland Basin

Continued from previous page

Sydney Basin.

Who better than the president of the AAPG?

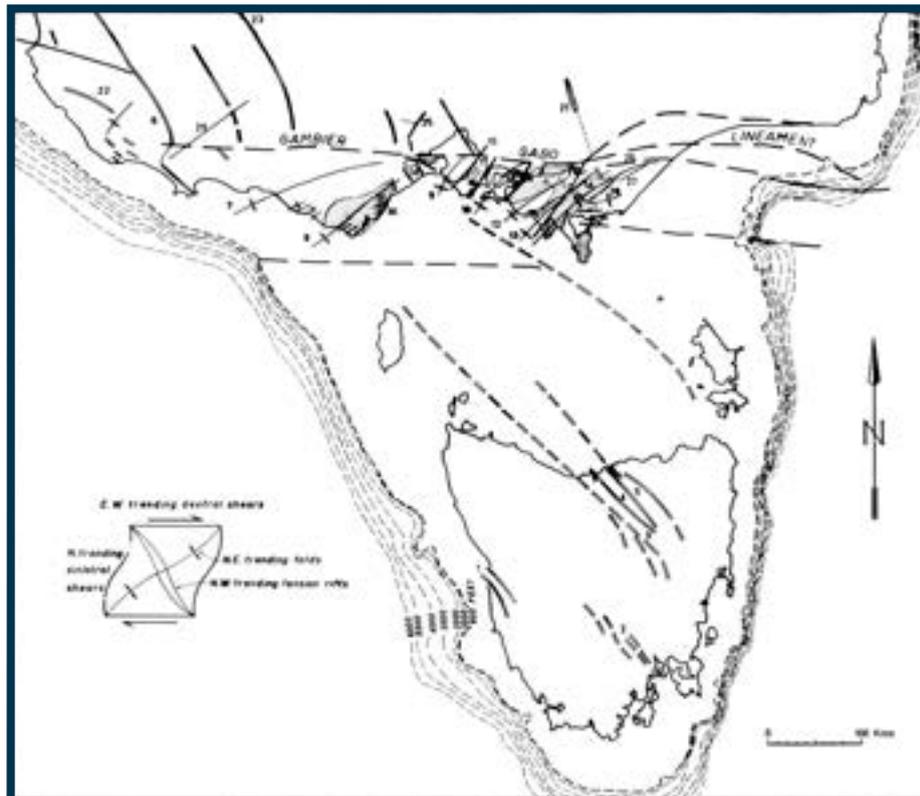
Lewis George Weeks, who was AAPG president in 1959 and one of the most celebrated geologists of the 20th century, joined the Standard Oil Co. of New Jersey (Esso, later Exxon, today ExxonMobil) in 1924, retired as the company's chief geologist in 1958 and set up as an independent consultant. As noted in his 1979 AAPG Bulletin Memorial, his interests were wide-ranging, his observational powers acute, his inferences and deduction based on his observation were sound yet provocative, and he did not hesitate to utilize his excellent powers of expression, both written and oral.

Gippsland Coast Exploration

Weeks, newly retained as BHP's petroleum consultant, arrived in Sydney in March 1960 and promptly (and correctly) informed BHP that the Sydney Basin was likely to be gas-prone and that if they wanted to become an oil company, they should look elsewhere: he knew where they should look, but he would only talk to the boss.

Weeks had done his homework, having studied the area since the 1930s.

He was aware that oil occurred in the Gippsland area (the Lakes Entrance oil seep); he was aware of the comments of Sir Edgeworth David and others that the Tertiary sediments of the Gippsland region probably extended offshore. Furthermore, he had met University of Tasmania Prof. S. Warren Carey at



S. Warren Carey's structural map of Bass Strait.

Princeton University in 1958 where Carey had told him of his ideas on the tectonics of southeastern Australia, and in particular that he believed onshore anticlines of the Strzelecki Ranges extended offshore. He was also aware of recent advances in offshore technology and that production would be possible from such regions within a few years.

Weeks and McLennan met in Melbourne later the same month and subsequently shook hands on a deal whereby BHP would explore for oil in the waters off the Gippsland coast and

Weeks would receive a royalty of 2.5 percent on any future production.

Over the next few months, BHP moved to secure the offshore acreage across much of southeastern Australia and worked with Weeks to design a single-fold seismic survey which was acquired in 1962. That remarkable 1,617-kilometer survey on a grid of approximately 19 by 27 kilometers provided the first glimpse of the structure of the offshore basin and identified most of the basin's major structures in which either oil or gas was found.

Weeks worked with BHP geologists to put together a farmout package that led to the establishment of a partnership with Esso, which was signed on May 12, 1964 and endures to this day.

Era of Discovery

In 1965, after overcoming the many technical challenges of the (then) deepwater and extremely hostile weather conditions, the first well was spudded on Dec. 27, 1964. The discovery was not without some drama, the well took a significant kick and was finally brought under control by activation of the blind rams.

Additional gas reservoirs encountered in 1966 and the discovery of oil in 1967 confirmed the Gippsland Basin as a world-class hydrocarbon province.

Before the 1960s were over, oil and gas production from the Bass Strait fields was under way, and in the more than 50 years since, four billion barrels of oil and seven trillion cubic feet of gas have been produced.

The discovery of oil and gas in Bass Strait was a watershed moment in the history of Australia and BHP: the company was transformed from being a steel maker and a mining company to a serious player in the offshore oil industry – a role it still holds today.

And, Australia achieved a degree of energy independence and self-sufficiency previously unimaginable.

Lewis Weeks (and, indirectly, the AAPG) did pretty well too!

I am grateful to John Davidson for sharing his reminiscences of a 1972 meeting in Houston with Weeks and Carey and to Peter Purcell for numerous discussions and help with this article. 

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Assessing the Influence of Untrackable Horizons on Impedance Inversion

By SATINDER CHOPRA, RITESH KUMAR SHARMA and KURT J. MARFURT

Seismic data can be described as the convolution of the seismic source wavelet with a suite of reflection coefficients. The location and strength of these reflection coefficients are directly related to changes in impedance between adjacent rock units. Conventional seismic mapping is based on picking that part of the seismic waveform (such as a peak, trough, or zero-crossing) that ties the well across the survey, thereby defining a seismic reflector horizon separating different rock units. Because of this relationship, the definition of accurate horizons is critical to the construction of the low-frequency component of the impedance model used in seismic impedance inversion.

Some horizons are easy to pick while others are challenging. Some of the more important horizons are those that span the entire seismic survey, with higher amplitude carbonate and volcanic ash reflectors being relatively easy to pick, and with maximum flooding surfaces somewhat more difficult to pick, but key to sequence stratigraphic mapping. Because the reflectivity changes from positive to negative to zero, according to the impedance of the layers below the horizon, unconformities are the most difficult to pick.

Horizons may have a consistently high amplitude displaying high lateral continuity, or may have a weak discontinuous amplitude exhibiting little continuity. These characteristics of horizons depend on the depositional environment for the subsurface intervals from where they originate, the lateral changes in the overburden, whether they represent a lithologic interface or a sequence stratigraphic boundary, as well as on the signal-to-noise ratio of the seismic data.

Pros and Cons of 3-D Autotracking

In general, 3-D autotracking of horizons works well for interpolating a sparse grid of manually picked lines. In contrast, 3-D autotracking provides disappointing results when attempting to extrapolate picks away from the control points, at least for land data. More commonly, the interpreter first picks a grid of every 20th inline and 20th crossline using 2-D autotracking, correcting errors as

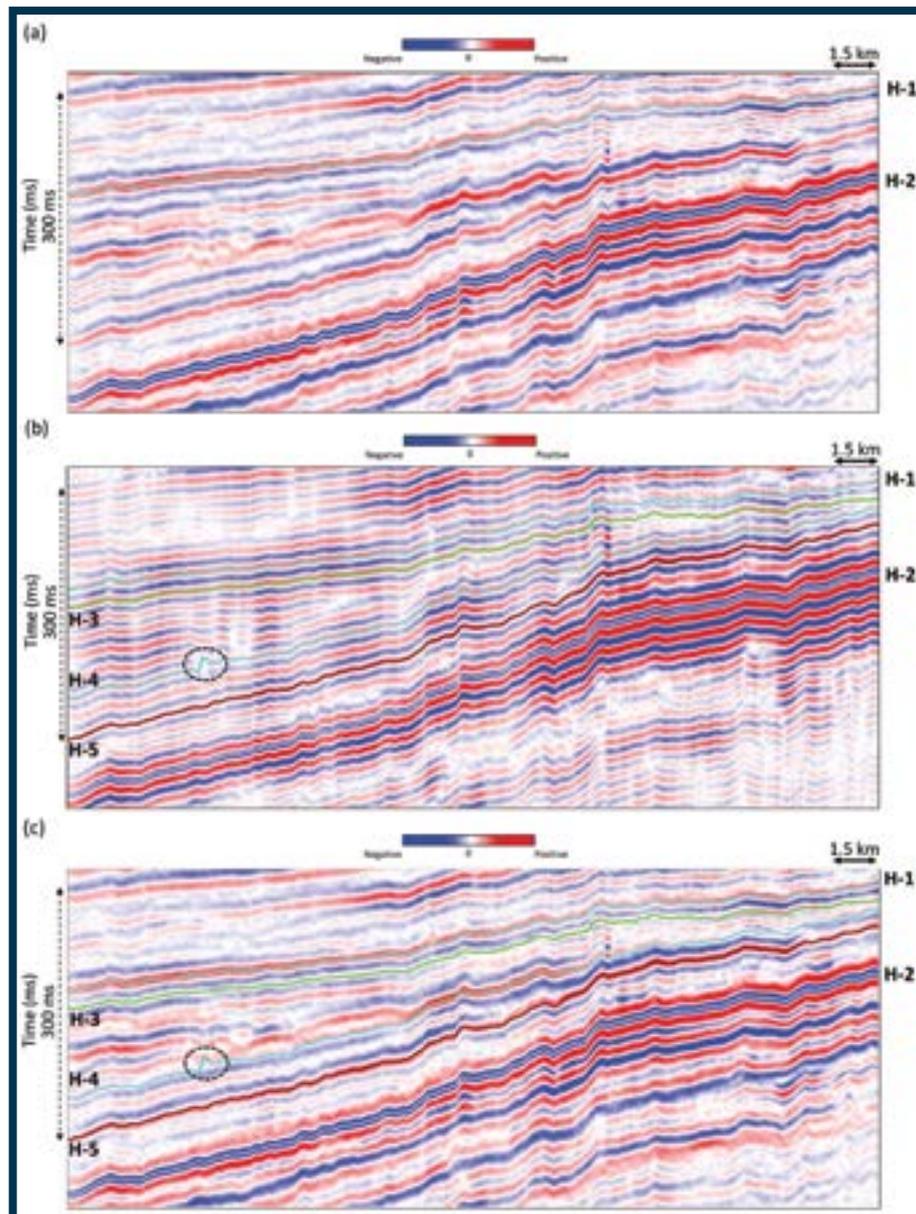


Figure 1: (a) Segment of a seismic section from a 3-D seismic volume from Oklahoma showing a divergence of reflection events from right to left. Horizons H-1 and H-2 are the trackable markers that can be easily autotracked on the data, and the horizons in-between these two markers are difficult to track on the seismic data, even if attempted manually. (b) Equivalent section from the 50 hertz voice component derived from the input seismic data. The intermediate horizons H-3, H-4 and H-5 can now be tracked conveniently, though not autotracked in one go. (c) The same section as shown in (a) with the overlay of intermediate horizons. Notice these tracked horizons do not look out of place. Should some unresolved events as shown in the black dashed circle be present in the data, it will need to be smoothed out before generating stratal slices or for running the impedance inversion. (Data courtesy: TGS, Houston)



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they occur and otherwise helping the process. Today's autotrackers can be quite sophisticated, using more than one "attribute" (including phase, continuity and correlation coefficient) in addition to attributes to provide more robust picks.

Once defined, the 2-D grid of horizon picks serve as seed points for the 3-D autotracker.

Other attributes such as volumetric estimates of reflector dip, coupled with optimization algorithms, provide a means to semi-automatically pick a dense suite of intermediate horizons



SHARMA

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MARFURT

between those picked by an interpreter. Commercial software packages such as PaleoScan from Eliis and the Horizon Cube from OpendTect generate "relative geologic time" surfaces that approximate the Wheeler diagrams we learned in geology class. Such software holds great promise in advancing seismic chronostratigraphy. In the absence of

access to such software, the quantitative seismic interpreter still wants to pick as many horizons as possible to construct an accurate low impedance background model.

Computing the second-derivative of seismic data shifts its frequency spectrum toward higher frequencies, and thus can define some reflections better, making them amenable for tracking. A better alternative for horizon tracking is to make use of voice components. In the March 2015 Geophysical Corner, the authors discussed the generation of spectral voice components from seismic data. Along with spectral magnitude and phase components, voice components are easily computed using a continuous wavelet transform, and are equivalent to a suite of band-passed filtered versions of the data long used in seismic data processing. In interpretation, workers have recently recognized that different voices give rise to improved (or at least different) coherence images. Sometimes the displacement lines up two similar reflectors along the fault, resulting in a "hole" in the coherence anomaly. Such alignment changes with different frequencies, resulting in coherence images computed from these now misaligned voice components illuminating the fault.

In this note, we use spectral components in the opposite manner: "Can we find components that result in more continuous reflectors across the zone of interest?"

Such continuity can be a function of the (frequency dependent) signal-to-

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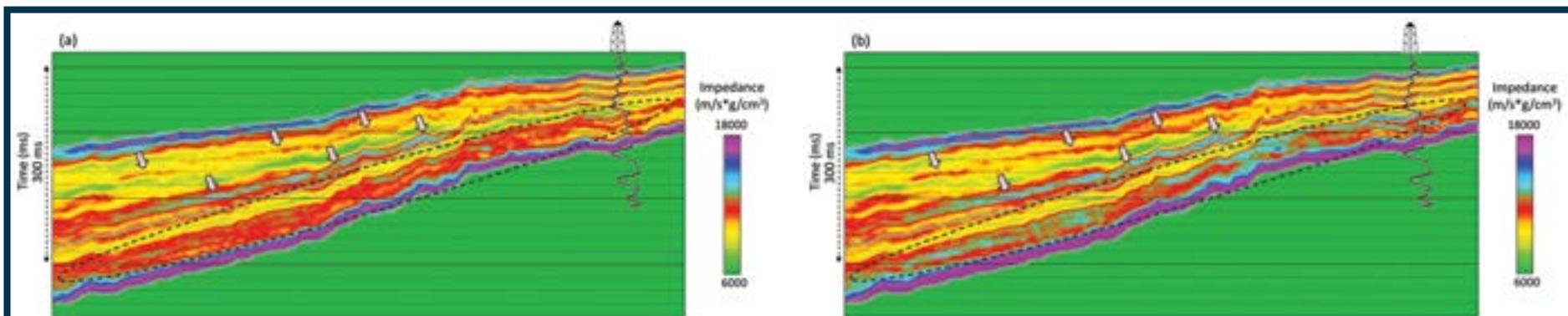


Figure 2: Equivalent impedance sections for the data shown in figure 1. The impedance inversion was generated for a window bigger than the one shown here to avoid edge effects. (a) The impedance section when only H-1 and H-2 markers were used for constraining the low-frequency impedance model derived from well log data. The log overlay to the right is the filtered impedance log through which the section traverses. (b) Equivalent impedance section but now constraining the low-frequency impedance model by including horizon H-4 in addition to markers H-1 and H-2. Notice the overall impedance section shows better-defined stratal layers as marked with pink arrows and also included in the black dashed highlighting ellipses. (Data courtesy: TGS, Houston)

Continued from previous page

noise ratio or to complex tuning effects associated with the underlying geology. If we examine the individual voice components of the input seismic data, we note that a horizon tracked on them may not all fall on the horizon tracked on the input. However, if we pick a horizon on that voice component which is closer to the peak frequency of the input seismic data, the horizon overlaps the one tracked on input data.

We demonstrate the application of voice components for picking horizons that otherwise are difficult to pick on the input seismic data.

Horizon Tracking the Woodford Shale

In figure 1a we show a segment of a seismic section for a 3-D seismic data volume from Oklahoma. It shows a diverging set of stratigraphic reflections from right to left. Horizon H-1 is an easy-to-pick high amplitude limestone marker. H-2 is the top of the Woodford Shale, and is another strong marker. Between these two main markers fall the Meramec and other siltstone horizons that are more difficult to track, with many of the horizons pinching out to the right. Our goal is to define a sufficient number of intermediate horizons to guide the interpolation of the low frequency background impedance model.

In figure 1b we show the 50-hertz spectral voice component computed from the seismic section shown in figure 1a. Note that while horizon H-2 consistently follows a peak, horizon H-1 starts as a peak on the left of the image, and ends as a zero-crossing on the right of the image. More important, notice that now several reflections span the survey as continuous

events, allowing the construction of horizons H-3, H-4 and H-5. Picking these horizons on a coarse grid and then interpolating them using a 3-D autotracker provide three additional surfaces to use in constructing a stratigraphically aware background impedance model. Plotting these picked horizons on the original seismic data (figure 1c) we note that we could have picked H-5 on the original data. In contrast, H-3 and H-4 would be more tedious to pick, but are consistent with an interpretation of overlapping surfaces.

Figure 2 shows the impedance sections equivalent to the sections shown in figure 1, but for the impedance inversion section shown in figure 2a, markers H-1 and H-2 only were used for constraining the low-frequency impedance model. The impedance section shown in figure 2b is drawn from the impedance inversion that used a low-frequency model that utilized horizon H-4 in addition to the two markers H-1 and H-2. Horizons H-3 and H-5 were too close to the main markers and so were left out. Notice that the impedance section in figure 2b exhibits more well-defined strata as indicated with the pink arrows as well as the black dashed ellipses.

In conclusion, we emphasize the importance of constraining the low-frequency models properly so as to better define the subsurface stratigraphic geometries in our areas and intervals of interest. Such geometrical patterns may not be amenable to horizon tracking on the input seismic data. Tools such as spectral voice components can be used for this purpose, and one or more horizons may be tracked on these data and brought into the impedance inversion. The inversion stands to benefit from doing so as we have illustrated. 

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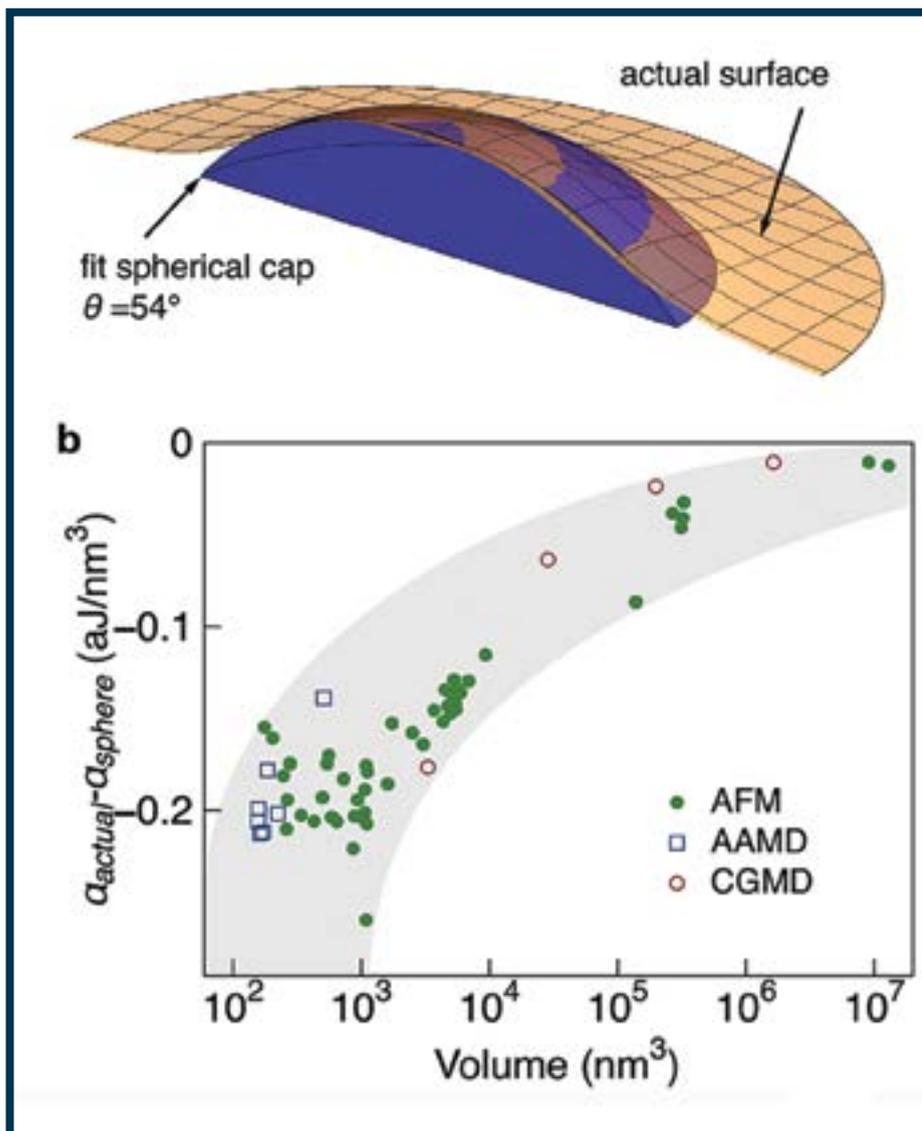
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Oil at the Nanoscale Spells Huge Production Potential

By LOUISE S. DURHAM, EXPLORER Correspondent



Big Oil's next big gusher will happen at a tiny, tiny scale, according to scientists at IBM.

Research at IBM's Nano Lab in Rio de Janeiro, led by Mathias Steiner, manager of industrial technology and science for IBM Research Brazil, yields evidence that everything the industry knows about extracting oil is quite different at the nanoscale.

Here's a quick look at the blueprint.

Imagine an oil droplet that – instead of being spherical, as one might ordinarily think – is flat.

It's what happens when the drop is small – really small.

Think "small" to the scale of one billionth of a billionth of a liter, or an "attoliter."

At the nanoscale, where items typically measure 0.1 to 100 nanometers long, properties of liquid oil molecules behave in different, unexpected ways than macroscopic molecules when in contact with a solid material. A drop of oil actually assumes a whole new shape in this instance.

As droplet volumes ultimately shrink to the attoliter scale, surface interactions become consequential as the droplets take on distorted shapes, ultimately flattening to form layer-like molecular assemblages at the solid surface, according to the IBM scientists. The

ensuing increased surface coverage entails far more wetting than had been accounted for in ordinary macroscopic measurements.

Minimal Scale for Maximum Production

Quantifying wettability, or the affinity of a liquid for a solid surface, presents a challenge to anyone wanting to produce a reservoir to the max. The convoluted liquid shapes that form at the attoliter scale elevate the challenge given their inclination to stay put.

In fact, in this environment a droplet's adsorption energy density has been introduced as a new metric for a liquid's affinity for a surface.

This is significant given that these particular molecules require increased energy for extraction – much more energy than provided by the simulation tools and techniques ordinarily used by the oil industry.

Steiner commented that the world consumed close to 97 million barrels of oil per day in 2016, noting that many barrels are left behind in the producing wells.

"Deep inside the rock, 60 percent and more of a reservoir's oil remains trapped

Continued on next page

Droplet adsorption energy: underestimated at the nanoscale. (a) Comparison of the actual surface with an idealized spherical cap fit to the same data. (b) Difference between adsorption energy for the actual surface and that of the spherical cap approximation. The negative differences indicate that the fitted spherical cap underestimates adsorption energy, just as it underestimates contact area. For volumes larger than 10⁶ nm³ a spherical cap fit provides a robust estimate of the adsorption energy α . (Figure b acronyms: AFM-Atomic Force Microscope Measurement, AAMD-All Atom Molecular Dynamics Simulation, CGMD-Course Grain Molecular Dynamics Simulation.) Image reprinted from Scientific Reports "Adsorption energy as a metric for wettability at the nanoscale."

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The simulation doesn't suggest how to recover 100 percent of the trapped hydrocarbons. But extracting even one percent more can be significant. Brazil ... pumps 2.4 million bopd. A one percent production increase would tally 24,000 more barrels per day, and 8.8 million for the year.

Continued from previous page

in capillaries, which sometimes are only tens to hundreds of nanometers wide," he emphasized.

Producing wells don't yield all of a reservoir's bounty owing to any number of reasons, including pressure problems, oil viscosity, permeability/porosity issues and much more.

Now, the IBM team's foray into the nano-environment provides a whole new perspective on this issue.

Much of the scientists' work in this arena is available in the public domain through "Scientific Reports," an online open access scientific journal published by Nature, said Chris Nay, external communications lead for IBM Research. The array of written material includes discussion about the unique measurement method for revealing properties of droplets at the nanoscale.

Detecting the change in shape at the nano-level encouraged the science team to develop oil flow simulations to better predict oil extraction from the reservoir.

This had to be done differently than with an oil company, where reams of various data are at hand routinely.

"In order to build a computational representation of a reservoir at the nanoscale, we took rock characterization data from public repositories, such as ETH Zurich's Rock Physics Network," Steiner said. "Based on the 'reservoir template' made from the geometrical data, we're now able to deploy the nanoscale wetting and flow science that hadn't been done before."

The scientists then revealed this new template to oil and gas companies to illustrate how their nano-flow simulation serves to address the properties of the oil trapped within the capillaries of their wells.

Admittedly, the simulation doesn't suggest how to recover 100 percent of the trapped hydrocarbons. But extracting even one percent more can be significant. Steiner cited Brazil, for example, which pumps 2.4 million bopd. A one percent production increase would tally 24,000 more barrels per day, and 8.8 million for the year.

He commented that, ideally, with better simulation technology and functional materials, the industry could get much closer to recovering the remaining 59 percent of oil.

Something New from Something Old

Characterization of droplet shapes and activity at the nanoscale is a giant step forward in furthering knowledge of recovery issues, but considerable work remains to be done.

The current focus is on taking the results yielded thus far and using these data to more effectively calibrate flow simulations of oil in nano-capillaries and their networks, according to Steiner.

The IBM team already has devised a dedicated fluid-flow-on-chip platform to enable investigators to provisionally validate flow physics for building increased accuracy simulations that connect flow at the nanoscale with that at greater scales.

"The application of electronic and optical sensing in the platform allows for differentiating between liquids electronically, for determining a liquid's molecular fingerprint, and for monitoring surface wetting dynamics in real time," Steiner commented.

By conducting these flow simulations in computational 3-D representations of true reservoir rock, the research team is currently developing an enhanced oil recovery (EOR) adviser technology that leverages a nano-EOR simulator and integrates various data sources.

EOR became an industry priority years ago, encouraged in large part by the 1973 Arab oil embargo. To the chagrin of many producers, the Big Downturn that got underway in the early 1980s dampened enthusiasm for the pricier methods – carbon dioxide injection, chemicals and more – used to increase oil recovery.

Technology often is key to turning something old into something new, often through increased efficiency, and EOR is an apt target for nanoscience research and application.

The IBM researchers noted that nanoscience-based flow simulations built on reservoir specific data input, including rock tomography and chemical compositions, are anticipated to predict more accurately the efficiency of a specific EOR agent for enhancing oil displacement in a pore network with feature sizes spanning six orders of magnitude on the physical length scale. 

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Understanding Fluid Flow through Shale

By LOUISE S. DURHAM, EXPLORER Correspondent

Oil and gas producers who ply their trade in shale reservoirs have benefited in ways not likely even imagined in years past.

Given shale's role in elevating the United States to a world leader in oil production, it would appear that any technical obstacles to producing from this challenging rock have now been conquered.

Not so.

Granted, hydraulic fracturing technology – which continues to evolve – and other innovations have made all the difference in getting the hydrocarbons to move from this type of reservoir rock into the lateral legs drilled out from the vertical wellbore.

Still, much remains to be learned about these nanoporous shale deposits.

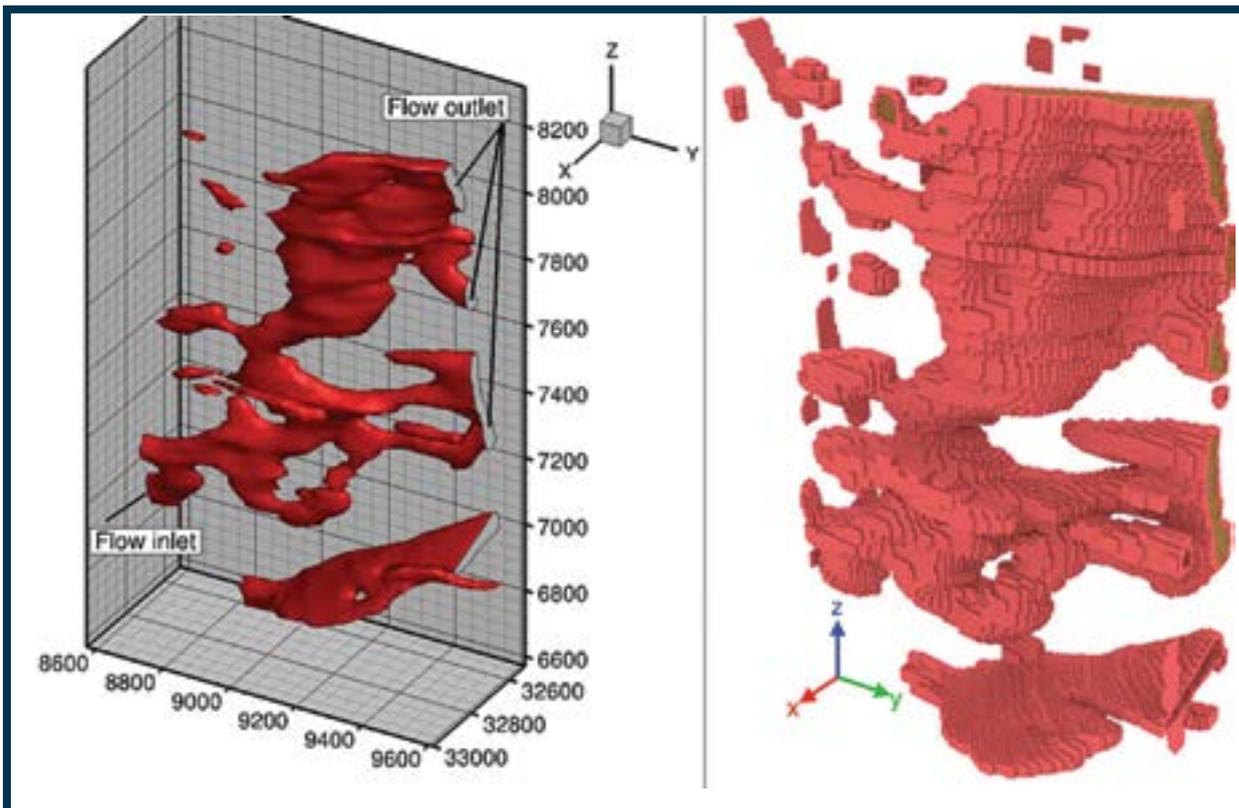
Given the super small silt- and clay-size grains of which shale is comprised, the intervening tiny pores are isolated from one another for the most part. This prevents fluid flow like that with, say, a coarse-grain sandstone having larger, interconnected pores.

Without connectivity, the needed permeability that enables natural flow is absent. The larger, interconnected pores associated with coarse grains, however, ordinarily allow the contained fluids to flow to the well, sometimes encouraged by injected water.

Today, the now-commonplace hydraulically-induced fractures can essentially “connect” the minuscule pores in shale. On the downside, this fails to provide the producers with any understanding of pore distribution and the structure of the shale zone(s) overall, which is crucial to achieve the most effective, efficient production.

The Coarse-Grain Approach

The Energy and Environmental Science & Technology Directorate (EES&T) at the Idaho National Laboratory (INL) in Idaho Falls has scientists working diligently to better understand how fluids might flow through



The pore network of the Woodford shale sample (left) and the fluid that fills the pores according to the computer model (right). Image courtesy of Yidong Xia.

the small pores in shales where the silt- and clay-size particles can measure as small as less than 0.004 millimeters.

INL EES&T computational scientist Yidong Xia commented that new computer simulations can more effectively analyze the underlying physics involved and possibly lead to more efficient oil and gas extraction.

These simulations are less power-hungry than other methods and incorporate high-resolution shale sample imagery, according to Xia.

Using what's dubbed a coarse-grain approach, he and fellow researchers have modeled the nanoscale-

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pore fluid as a collection of particles where each particle represents a cluster of only a few molecules. The scientists then noted an exceptional decline in computational power required to run the simulation.

The model used is a many-body dissipative particle dynamics model (MDPD), which can simultaneously capture both the discrete features of fluid molecules in nanometer size pores and the continuum fluid dynamics in larger pores. Plus, it's relatively easy to parameterize, according to Xia and his colleagues.

These features combined make it especially suited for simulating complex fluid flow in multi-length-scale nanopore networks in shale.

The INL team emphasized that a significant feature of this application is the integration of a high resolution FIB-SEM (focused ion beam scanning electron microscopy) digital imaging technique to the MDPD model for providing 3-D voxel data. These data harbor the critical geometrical and compositional info of shale samples.

Simulations thus far have included a forced two-fluid flow in a late Devonian/early Mississippian-age Woodford shale sample measuring a few millimeters in diameter.

Researchers at the University of Utah oversaw this effort, where the ion beam cut through the sample, yielding slices that were scanned to provide a 3-D image of the rock along with its pore structure at the scale of a nanometer. Xia noted that the images were incorporated into the computer model to simulate

fluid flow throughout the scanned nanostructures.

"Results (from this and other simulations) indicate this model can be used to deliver reasonable simulations for multi-component, multi-phase fluid flows in arbitrarily complex pore networks in shales," Xia and fellow scientists noted in a paper published in the journal "Physics of Fluids."

Wider Application

One sample, however, is just that.

He remarked that simulations using multiple samples throughout the Woodford likely could serve to provide much more than just a cursory glance into the basic physics of its makeup.

The future for this technology is not yet being widely discussed in the public domain.

"We're looking at a very small region of the shale in our (published) articles, but it may not be enough to understand the whole picture," Xia said. "In order to go further, we may need to do a lot more work."

"Shale is very heterogeneous, and our technology is aimed at a much larger scale than has been described," he emphasized. "We want to give a better picture of the (fluid) flow through the shale."

For now, mum's the word, given that research proposals are going out "as we speak," and these type endeavors are always competitive.

Xia emphasized they're not in the business of endorsing technologies or energy sources.

It's all about the science.

"Our focus is to better understand the basic physics of shale," he noted. 

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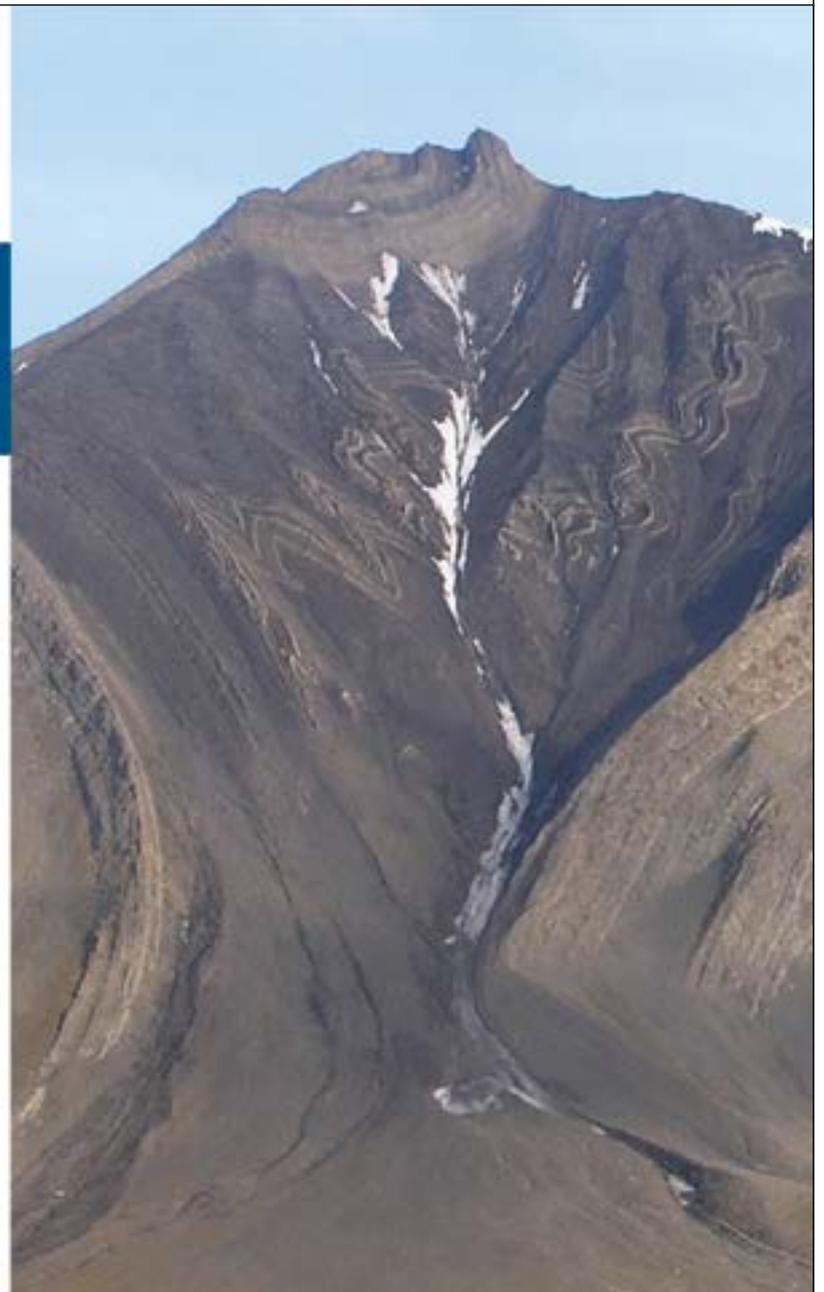
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Geomechanics and pore pressure provide valuable insights and applications in acreage selection and prospect risking, well planning and field development planning, completions, reservoir modeling, enhanced recovery, and eventual field abandonment. Furthermore, geomechanics in particular has been an essential aspect of unconventional hydrocarbon production, providing critical inputs for fracture stimulation, directional drilling and field planning that have drastically changed the industry.

This 2 day workshop will bring together a wide range of geoscientists, engineers and managers to highlight the important and varied roles that geomechanics and pore pressure play from initial exploration phases through to field abandonment. This workshop will also highlight the key aspects and elements that are unusual or unique to geomechanics and pore pressure analysis in Australia and Asia, where basins are often characterized by complicated geology, variable and high-magnitude stress states and anomalous overpressures. Key themes of the workshop will follow the use of geomechanics and pore pressure throughout the well life-cycle.

For more information, contact apereira@aapg.org

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Do You Want to Be a Trustee Associate?

By TAMRA CAMPBELL, Administration Team Coordinator

It all started with one man's vision. Fifty years ago, then-AAPG President Michel Halbouty believed that the Association needed to start a foundation that would work to ensure the future of geosciences and energy development around the world, and he believed that the foundation would succeed only with the full support of the AAPG membership.

Halbouty's vision obviously became a powerful reality. The AAPG Foundation has indeed provided the funding for a huge variety of geoscience projects, publications, lectures, scholarships, grants and other initiatives – all thanks solely to the generous giving of our members.

Literally thousands of lives have been impacted by the Foundation, which wouldn't exist without our members. It's been a wonderful story, told by all of you.

And it's a story that continues.

The Trustees and those of us who work on the Foundation's administrative and program areas often have the privilege of reading untold numbers of thank you letters from grant recipients, emotionally and often dramatically expressing their appreciation and thanks for the financial support they received from the Foundation.

A recent recipient of the Deana and Paul Strunk Military Veterans Scholarship Program, Nicolas Ferry, wrote, "Thank you for your generosity. Without scholarship patrons willing to support veteran students, students such as myself would be unable to pursue advanced degrees in geology."

Ferry, a veteran who served in the U.S. Marine Corps, is now pursuing a geology degree from Northern Illinois University toward his goal of becoming a petroleum geologist.

His sentiments have been echoed again and again by those who have received grants throughout the past five decades from the AAPG Foundation.

New Foundation Goals

At the beginning of 2017 the Trustees established two goals for the AAPG Foundation:

► Make it complete.

The Deana and Paul Strunk Military Veterans program, established in 2012 with an endowment goal of \$1 million, is closing in on that goal, having received gifts of more than \$979,000. The goal is in sight – but it can happen this year only with the help of the AAPG membership.

Once the goal is reached the program will be able to award \$40,000 a year in scholarships to deserving veterans enabling them to achieve their dreams of a career in the geosciences.



Marine Corps veteran Nicolas Ferry.

► Increase the number of members of the Trustee Associates of the AAPG Foundation.

This Trustee Associates are the backbone of the Foundations financial

support, giving 57 percent of the total contribution dollars given to the Foundation.

This group of dedicated donors is made up of AAPG members who want to leave a lasting legacy through the Foundation through their commitment of \$10,000 or more. The purpose of the group is to not only provide help with the fundraising efforts of the Foundation, but to provide counsel to the Board of Trustees.

The Trustee Associates recently held their 40th annual meeting in Rockport, Maine, where they were apprised of Foundation activities and business, congratulated for their generosity and inspired to continue the effort to help ensure the future of geosciences.

And about that goal: Since April 24 new members have joined the group, bringing the total number of members to 275.

Officials now are hoping for and working toward seeing the number increased to 300.

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Deana and Paul Strunk Military Veterans Scholarship



Imperial Barrel Award



L. Austin Weeks Undergraduate Grants



Grants-in-Aid

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

DEG

from page 30

economic growth and research and development. All three sectors intermingle (i.e., social/environmental, environmental/economic and economic/social).

"Sustainability" is the term we use for the area in which all three primary sectors meet and interact. Being energy independent, of course, by definition, implies that our energy needs are available, but availability is not sustainability. The concept of availability refers to something that is present and ready for use, and is well established in the literature of stochastic modeling and optimal maintenance. Availability of a system is typically measured as a factor of its reliability. Reliability is the ability to be relied or depended upon, with regard to accuracy, honesty or achievement. As reliability increases, so does availability. Thus, as we move from the concept of availability to sustainability, the concept of environmental stewardship has evolved over the years into the responsible use and protection of the natural environment through conservation and sustainable practices.

Weighing the Trade-Offs

Reliable and affordable energy is essential to life as we know it. However, behind the convenience provided by today's technology and innovation, behind the scenes, the energy supply chain is quite complex.

It begins with resource exploration and extraction, development of massive distribution systems, and a whole number of storage and refining facilities, among other demands, which all have a footprint of varying dimensions and potential environmental impacts. There is no free ride – it all has a definable impact.

As we move into the realm of energy independence and become an energy exporter, we are confronted with two questions:

Do the social and economic benefits outweigh the environmental effects?

Are the energy sources being developed in the most environmentally sensitive and sustainable manner achievable?

These are two very important questions for our industry to continually ask.

Anybody can be an environmental steward. All one really has to do is be

aware and knowledgeable of the world around you and take the appropriate steps to minimize adverse impact to the environment, regardless of the activities or operations in which you are involved. All industrial operations and activities have some environmental impact, and there is little question when it comes to local issues such as noise, air and water quality, traffic and overall aesthetics. These issues appear to be predominant due to their inherent visibility with the community at large.

In summary, for us humans in social systems or ecosystems, the concept of sustainability is the long-term maintenance of responsibility, which has environmental, economic and social dimensions and encompasses the concept of stewardship – the responsible management of resource use. The role we as geoscientists play enhances the lives of everyone and impacts every aspect of American life, including conventional, alternative and renewable energy, the economy, the environment, water and other resources, transportation, social contracts and overall worker and public health, safety and welfare, and much more. How we communicate this is crucial in whether we succeed. Our efforts to reduce our environmental footprint while maintaining exceptional deliverability and operational results is the goal: environmental sustainability.

ACE 2018

I have had the pleasure of being involved with a large group of hard-working individuals to develop the program for the AAPG 2018 Annual Convention and Exhibition. As part of the program being developed, several leading environmental themes that are relevant and current have been incorporated. They include challenges to the social contract, mitigating environmental impacts in the oil and gas industry, surface and groundwater water quality, carbon management, formation waters and fluid migration, fugitive gas emissions, well integrity, coastal and oceanic environmental challenges, and issues related to well stimulation and high volume hydraulic fracturing operations. When viewed in its entirety, we as professional geoscientists can play a leadership and educational role under the broad umbrella we call environmental stewardship. We as geoscientists are and must continue to be environmental stewards too! 



Mark Your Calendar!

Important Award Deadlines

2017-18

Teacher of the Year Award NOW OPEN!

DEADLINE: JAN. 15, 2018

The AAPG Foundation will award \$6,000 to a U.S.-based K-12 teacher for Excellence in the Teaching of the Earth Sciences. **Nominate a teacher who had a tremendous impact on your choice to enter the geosciences, or apply today!**

L. Austin Weeks Undergraduate Grant Program

OPENS: DEC. 15, 2017 | DEADLINE: FEB. 15, 2018

The L. Austin Weeks Undergraduate Grant program provides \$500 grants to undergraduate students and geoscience student associations (student chapters and clubs) worldwide to help with tuition, books, field trips and conferences.

Inspirational Geoscience Educator Award

OPENS: JAN. 15, 2018 | DEADLINE: MARCH 1, 2018

The Foundation will award \$6,000 to a college or university professor for Excellence in the Teaching of Natural Resources in the Earth Sciences. **Nominate a professor who impacted your career in geology today.**

Deana and Paul Strunk Military Veterans Scholarship Program

OPENS: FEB. 15, 2018 | DEADLINE: MAY 1, 2018

The Military Veterans Scholarship Program (MVSP) is designed to support veterans pursuing geoscience education programs at a four-year college or university. Grants range from \$2,000 to \$4,000 each and are intended to provide financial assistance to veterans who are studying undergraduate level geoscience.

Help us grow these programs.

Contribute to the AAPG Foundation today.

Learn more. Visit foundation.aapg.org



2017 L. Austin Weeks Undergraduate Grant recipients from Texas A&M University at Kingsville.



Tenure-Track Assistant Professor in Remote Sensing/GIScience School of Geography and Earth Sciences, McMaster University

The School of Geography and Earth Sciences (SGES) at McMaster University in Hamilton, Ontario, Canada, invites applications for a full-time, tenure-track position at the Assistant Professor level beginning July 1st, 2018 in Remote Sensing/GIScience.

The successful candidate must have a PhD at the time of appointment in geography, earth sciences, environmental studies/sciences, or a related discipline. We are particularly interested in an individual with a strong background and research experience in Remote Sensing/GIScience applied to earth sciences, resources, water, climate, urban issues, or health. The candidate is expected to develop an externally-funded, vigorous research program and must have a strong commitment to undergraduate and graduate teaching and supervision. The successful candidate will teach within the School's GIScience stream of courses. SGES is home to one of ten East Canada Centres of Excellence.

McMaster University is among leading Canadian universities with 24,000 full-time undergraduate and 3,000 graduate students. SGES has 23 full-time faculty members with expertise in a breadth of fields in geography, earth science, and environmental studies/science. As a multidisciplinary School, SGES welcomes a wide range of students interested in geography and environmental studies and science, earth science, and geographic information science.

McMaster University has a strong commitment to achieving diversity among faculty and staff that reflects the diversity of our student body. The successful candidate will be committed to inclusion and excellence and the search Committee is especially interested in candidates who can contribute, through their teaching and/or service, to the diversity of the academic community. Women, persons with disabilities, First Nations, Métis and Inuit persons, members of racialized communities and LGBTQ-identified persons are strongly encouraged to apply. Gender diversity is being addressed at McMaster University through our policies and actions. One recent action in this area was the completion of a gender pay equity study and a resultant base salary adjustment applied to all female faculty members in July 2015.

Faculty members at McMaster University enjoy numerous personal and professional benefits. University employees are offered an excellent benefits package that includes, but is not limited to,

extended health care benefits, dental care, group life, long term disability, worldwide travel assistance, and a retirement plan. Progressive policies are in place to assist faculty women and men who become parents or are needed to care for family members. Salaries will be commensurate with qualifications and experience.

Applicants should submit a cover letter outlining their research interests, a copy of their curriculum vitae, a brief teaching dossier including a statement of teaching philosophy (maximum of two pages). Academic reference letters are not required at the time of applications, but applicants should provide the names of three (3) referees who may be subsequently contacted.

Complete applications must be made online at www.workingmcmaster.ca/careers (Faculty Positions, Job ID 16774) to the attention of:

Dr. Greg Slater
Chair, Search Committee
School of Geography and Earth Sciences
McMaster University
1200 Main Street West
Hamilton, Ontario
Canada, L8S 4K1

Complete applications that are received by January 1, 2018 will receive full consideration. Review of applications will continue until the position is filled. The effective date of appointment is negotiable, but expected to be July 1, 2018. All applicants will receive confirmation of receipt of their application. However, only short-listed applicants will be contacted for interviews.

All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be given priority. To comply with the Government of Canada's reporting requirements, the University is obliged to gather information about applicants' status as either Permanent Residents of Canada or Canadian citizens. Applicants need not identify their country of origin or current citizenship; however, all applications must include one of the following statements:

Yes, I am a citizen or permanent resident of Canada.
No, I am not a citizen or permanent resident of Canada.

In keeping with its Statement on Building an Inclusive Community with a Shared Purpose, McMaster University strives to embody the values of respect, collaboration and diversity, and has a strong commitment to employment equity. The diversity of our workforce is at the core of our innovation and creativity and strengthens our research and teaching excellence. The University seeks qualified candidates who share our commitment to equity, diversity and inclusion. While all qualified candidates are invited to apply, we particularly welcome applications from women, persons with disabilities, First Nations, Métis and Inuit peoples, members of visible minorities, and LGBTQ+ persons. Job applicants requiring accommodation to participate in the hiring process should contact the Human Resources Service Centre at 905-527-9140 ext. 222-FIR (22247) or the Faculty of Health Sciences Human Resources office at ext. 22207 to communicate accommodation needs.

PROTRACKS



YPs gathered at the Rocky Mountain Section's Happy Hour event in downtown Denver. Photo by Shannon Ridge.

A Night Out with Rocky Mountain YPs

By NIKKI OLIVER, Rocky Mountain Section YP Coordinator

With the shuttering of many Denver offices and an ever-looming specter of low priced oil it was refreshing to see a healthy mix of Young Professionals (YP's) come out for the Rocky Mountain Section's recent Happy Hour on Sept. 28 at Morton's the Steakhouse in Lower Downtown. There were 20 participants from the likes of Whiting Petroleum, QEP Resources, BP, Rocky Mountain Hydrocarbon, Synergy Resources, Sigma Cubed, Crescent Point Energy, World Energy Partners and Crestone Peak Resources.

Many YP's are still looking for work or trying to prove themselves capable of tackling greater roles and responsibilities. This latest entertaining and engaging event provided both résumé critiquing as well as complimentary headshots.

A finely crafted résumé should be constantly evaluated and updated even if you are not actively searching for a new job. In the unfortunate event that you have to go looking for work, being prepared will make the search less daunting. It can also come in handy if you are asking for a raise or new position at your current company. A well-documented history

of your professional activities, including workshops and training may just be the edge you need to remind your higher-ups of how much value you bring to the table.

Putting your best foot forward includes a professional presentation. With the recent explosion of social media pages and the heavy reliance on them by businesses to evaluate candidates and interact with the public, it is imperative that candidates represent themselves well. At the Thursday evening event attendees were offered the opportunity to get a complimentary professional head shot in between noshes of filet sandwiches and crab cakes.

It was a great night out and we look forward to the continued participation of all our YPs. If you're interested in volunteering with the AAPG YP Special Interest Group, or just want to learn more about YP initiatives in your area, visit us online at <http://aapg.org/youngpros> and contact your Region or Section YP coordinator. You can also 'like' us on the AAPG Young Professionals Special Interest Group Facebook page and follow us on Twitter and Instagram @aapgygpsig. 

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- Highlights**
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 - Record of the Proto Caribbean rifting, Mesozoic source rocks, plate convergence and imbricate thrust structures,
 - Middle-Upper Jurassic to Cretaceous clastic and carbonate reservoir analogs to the prolific fields of southern Mexico and the US GoM,
 - Tertiary carbonate and deep-water synorogenic clastic strata, and
 - K-T boundary catastrophic mega-event deposits.

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-GoM 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 11/10/2017, 31 CFR part 515.565 (b) 1-6, p.23; <https://federalregister.gov/d/2017-24447>

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Texas Comptroller of Public Accounts (in Austin). Link to CPA - Program Specialist IV posted 11/15/2017 at <https://comptroller.texas.gov/about/careers/opportunities.php>. Job description at <https://capps.taleo.net/careersection/ex/jobdetail.ftl?job=00001283&tz=GMT-06%3A00>

COMMENTARY

Changing Political Winds Invite Citizen Enforcement

By ERIN POTTER SULLENGER

The Trump administration ushered in a strong political wind with focused attempts to roll back environmental regulations from the Obama administration, including several regulations impacting segments of the oil, gas and coal industries. To date, the Trump administration has taken steps to review or revise regulations such as the Clean Power Plan, the Clean Water Rule and methane rules for the oil and gas industry. It also forecasts plans to reduce funding for enforcement actions and restructuring Environmental Protection Agency (EPA) regional offices.

As a result, the industry might be tempted to relax or postpone environmental compliance activities, especially those that might be new or expensive.

Succumbing to this temptation is risky and could prove more costly in the long run.

One potential risk is an increased frequency of citizen suits. Many major federal environmental statutes contain provisions allowing private citizens or groups to sue alleged violators of those statutes. Citizen suits typically increase in periods of decreased government enforcement, and the current political climate, combined with increased funding for environmental advocacy organizations, creates the perfect storm for a higher than usual citizen suit effort.

Here are a few thoughts about citizen suits as we approach the end of the Trump administration's first year.

Lawsuits Beget Lawsuits

First, citizen suits can result in judgments or settlements, and success on either front creates roadmaps for new citizen suits elsewhere. The "sue and settle" lawsuits against the Obama administration, while not a new strategy, proved highly successful because the administration was seen as a willing participant in the litigation. These suits resulted in consent decrees that altered the scope of rulemaking procedures otherwise required under the Administrative Procedure Act (APA) and judicially achieved regulatory objectives that would have proved difficult to achieve administratively.

Ease of Access to Information

Second, citizen scientists now have access to a variety of tools to investigate and identify instances when a violation may have occurred. Such tools include infrared cameras to capture potential air emission violations, handheld air monitoring equipment, water sampling kits and drones equipped with high-resolution cameras.

Even the data industry submits to environmental agencies is more accessible. The EPA and several state agencies publish compliance data for public review on their webpages. See, for example, the EPA's Enforcement and Compliance History Online (ECHO) database at echo.epa.gov. The EPA's Next

"The pessimist complains about the wind; the optimist expects it to change; the realist adjusts the sails."

- William Ward

Generation Compliance initiative changes the way the industry provides compliance reporting, making electronic reporting the rule and paper submissions the exception (See "Next Generation Compliance at epa.gov).

Post-NOI Strategy

Third, citizen suit statutes require notice to any defendant prior to filing the suit. Depending on the statute involved, the Notice of Intent to Suit, or the NOI letter, must be delivered a minimum of 60 or 90 days before filing the lawsuit. Once a company receives an NOI, it should contact an environmental attorney to discuss strategy. Strategic items to consider are: can the alleged violation be easily remedied; should the company inquire about entering into a consent decree with a regulatory agency; or, should the company engage the noticing party to explore alternatives to litigation.

'Diligent Prosecution'

Fourth, maintaining environmental compliance programs and a relationship with state and federal agencies positions a company for a strong defense in a citizen suit. One viable defense to citizen suits is "diligent prosecution" by the responsible agency. If adequately shown, the court can dismiss the case altogether. One example is the 2007 suit, *Karr v. Hefner*. There, the EPA filed its enforcement action moments before the citizens filed an amended citizen suit. The appellate court upheld dismissal because of the EPA's diligent prosecution.

Never Ignore a NOI

The bottom line is, should your company find itself the recipient of an NOI letter, the decision to ignore it is always wrong.

Despite the apparent roll back of hefty regulatory programs from the Obama administration, the fossil fuel industry should nevertheless maintain compliance programs, stay current on permit renewals and stay informed about actual regulatory revisions. The political winds will surely shift and blow in different directions as subsequent administrations revise regulatory and enforcement priorities to their liking. Staying current with corporate compliance programs will position a company to be able to nimbly adapt to changing regulations and respond to citizen suits.

The foregoing should not be understood as, or considered a substitute for, legal advice. For specific inquiries, please contact Sullenger, or another licensed attorney. 



SULLENGER

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ConocoPhillips School of Geology and Geophysics

The ConocoPhillips School of Geology and Geophysics at the University of Oklahoma invites applications for a tenure-track or tenured position in Exploration Geophysics at the rank of Assistant to Full Professor. Exceptional candidates at the Full Professor level will also be considered for the Frank and Henrietta Schultz Endowed Chair. The candidate must hold a Ph.D. in related fields, have a strong research record, and an interest in teaching both undergraduate and graduate courses and mentoring graduate students. Relevant industry experience is an advantage. Areas of interest can include but are not limited to acquisition, processing, imaging, and interpretation of seismic data with an emphasis in conventional and unconventional petroleum exploration. The candidate is expected to establish an externally funded research program and build collaborations within and outside the School. Salary and start-up funds will be commensurate with experience.

The ConocoPhillips School of Geology and Geophysics, part of the Mewbourne College of Earth and Energy, has a large, vibrant faculty with a broad range of research activities. The School and College maintains strong ties with the petroleum industry. The world's first School of Petroleum Geology was established here a century ago; furthermore, members of our School contributed to the first application of reflection seismology in petroleum exploration. Our research facilities are detailed at <http://www.ou.edu/confer/ioces/geology/Research.html> and include computer labs with PC and Linux platforms networked to a dedicated cluster within the OU supercomputer center. The School maintains a comprehensive pool of geophysical equipment including wired and wireless seismic acquisition systems, active seismic sources, GPR, ERT, magnetics, and gravimetrics, as well as extensive rock physics characterization laboratories.

Review of applications will begin immediately and the search will continue until the position is filled. The anticipated starting date is Fall semester 2018. Applicants can apply online at <http://apply.interfolio.com/44266>. Applicants are requested to submit a cover letter, complete vital/resume, statement of research and teaching interests, and a list of five references who can be contacted, including phone numbers, e-mail addresses, and mailing addresses. Questions, information requests, and nominations should be addressed to Dr. John Figgitt, Chair Exploration Geophysics Search Committee, University of Oklahoma, Sarkeys Energy Center, 100 E. Boyd Street, Room 710, Norman, OK 73019 or ougeophysicssearchchair@ou.edu.

The University of Oklahoma (OU) is a Carnegie-R1 comprehensive public research university known for excellence in teaching, research, and community engagement. In 2014, OU became the first public institution ever to rank #1 nationally in the recruitment of National Merit Scholars. The 277-acre Research Campus in Norman was named the No. 1 research campus in the nation by the Association of Research Parks in 2013. Norman is a culturally rich and vibrant town located just outside Oklahoma City. With outstanding schools, amenities, and a low cost of living, Norman is a perennial contender on the "Best Places to Live" rankings. Visit <http://soonerway.ou.edu> for more information.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Individuals from underrepresented groups are encouraged to apply.

Celebrating 50 Years of the AAPG Foundation

By DAVID CURTISS

This year the American Association of Petroleum Geologists recognized and celebrated a century-long commitment to advancing the science of petroleum geology and the professionalism of those of us privileged to work in this industry.

Oil and natural gas are foundational energy sources. This commodity fuels modern society and serves as feedstock for plastics, pharmaceuticals and fertilizer, among many other products. The world as we know it today would not exist without the diligent efforts of AAPG members. That's a fact that deserves celebration.

Petroleum geologists have to be innovative and creative and "see" the unseen in order to open new plays. Our business also requires us to take a long view, to be thinking about the future as we act today. Consider George Mitchell and Mitchell Energy whose "overnight success" in the Barnett Shale was 20 years in the making. Petroleum professionals need vision.

Rewind 50 years. AAPG celebrated its golden anniversary in turbulent times, in some ways similar to today.

Then AAPG President Michel T. Halbouty, a noted petroleum geologist, oilman and entrepreneur thought about the future – the future of the profession and the future of the Association. And he challenged AAPG: "Let's do what we can today to ensure that AAPG and the geosciences will be strong tomorrow."

And that led to the formation of the AAPG Foundation with the signing of the Declaration of Trust on April 4, 1967.

Under the leadership of Chairman Dean A. McGee, Morgan J. Davis and W. Dow Hamm, the AAPG Foundation embarked on a mission to engage AAPG members and others to maintain and grow a permanent non-profit foundation to support educational and scientific advancement in the field of geology.



CURTISS

The Foundation's Future-Looking Past

That remains the AAPG Foundation's objective five decades later under the leadership of Chairman Jim Gibbs, a past president of AAPG, Vice Chairman M. Ray Thomasson, also a past president of AAPG, Treasurer Lee Backsen, Secretary David Worthington, and Trustees Larry Jones, a past chair of the House of Delegates, and Mike Wisda.

So, as we celebrate a century of petroleum geoscience at AAPG, we're also celebrating a fifty-year commitment to the future of our science at the AAPG Foundation, which was incorporated as a non-profit charitable foundation in the state of Oklahoma in 1986.

And over the past 50 years the Foundation has built a remarkable legacy.

More than 19,800 donors have contributed to the AAPG Foundation since inception. And it's been AAPG members, friends and colleagues who have generously provided 98 percent of the support.

Average annual contributions have grown from \$14,000 in 1969 to about \$1.6 million today, while grants awarded have grown from \$21,000 in 1969 to an average of \$1.5 million today, and the Foundation's asset base has climbed from \$168,000 to \$47 million today.

Much of the asset growth came from a capital campaign co-chaired by past trustees Larry Funkhouser and Jack Threet from 2005 to 2010, and included several substantial gifts, including a \$10 million gift from Marta Wulf-Weeks and the

The world as we know it today would not exist without the diligent efforts of AAPG members. That's a fact that deserves celebration.

Weeks family.

Since 1997 alone, the AAPG Foundation has granted more than \$4.5 million to students in more than 30 countries.

As these numbers attest, Mr. Halbouty's vision of creating a strong foundation for the geosciences, both today and well into the future, is on track at the AAPG Foundation.

In addition to providing direct support to geoscience students, the AAPG Foundation is committed to supporting programs that meet its obligations to provide broad societal benefit.

For example, since 1992 it has supported an annual Teacher's Day in conjunction with AAPG's annual meeting, providing science teachers in the community of the venue that year with direct earth science and petroleum geoscience exposure.

The AAPG Foundation has also provided support to Friends of Dinosaur Ridge, a private charitable organization outside Denver dedicated to conserving and educating the public about the fossil record preserved in a segment of the Morrison Fossil Area National Natural Landmark. And for the past several years, the AAPG Foundation has been an associate partner of the Society of Exploration Geophysicists' Geoscientists Without Borders program, funding projects that clearly demonstrate how the application of geoscience can benefit those living in vulnerable or developing communities.

In addition, the AAPG Foundation provides significant financial support to the AAPG Bulletin and other publications to support and ensure that cutting-edge

geoscience is disseminated broadly throughout society.

Several programs that you'd recognize immediately – the Imperial Barrel Award program, the Distinguished Lecturers program, the Visiting Geoscientists program and the Grants-in-Aid scholarship program – are joint programs between AAPG and the AAPG Foundation. They meet the missions of both organizations, and the AAPG Foundation provides significant financial support to each.

Of particular note is the Deana and Paul Strunk Military Veterans Scholarship program, created to offset educational expenses for U.S. veterans returning to school to pursue undergraduate degrees in geoscience. With substantial support by Deana and Paul Strunk, a past trustee of the AAPG Foundation, this program is approaching its goal of raising \$1 million to support this program well into the future.

Becoming a Trustee Associate

In 1977, the AAPG Foundation trustees authorized the creation of the Trustee Associates program to recognize sustained donors to the foundation. The requirement to join is a pledge of \$15,000, which can be paid over several years. But, the Trustees launched an initiative in Houston earlier this year, lowering the pledge to \$10,000 until we reach 300 Trustee Associates. There's still room for you! Please visit the AAPG Foundation webpage (foundation.aapg.org) for more details.

We're building a strong foundation for the geosciences here at the AAPG Foundation. That's what we've been doing for 50 years, and thanks to each and every one of you who has contributed to this effort. But we're not done yet, and as we look forward to the foundation's next 50 years we need your support.

DIVISIONS REPORT: DEG

Being an Environmental Steward

By STEPHEN TESTA, DEG President

We have been going green for some time, just in case you haven't noticed. With an emphasis on environmental stewardship in the president's "America First Energy Plan," our industry, science and profession have been taking note of the importance of being prominent and proactive in assuring the public and other stakeholders that the energy extraction industry implements environmental stewardship in a manner equivalent to its skill and innovation in extracting the oil, gas and minerals that society needs.

In listening to discussions about climate change not too long ago, I asked myself, "What if energy independence, green jobs, livable cities, clean water and air, environment sustainability – what if we achieved all of this, but it was a hoax and we did it all for nothing?"

I was not sure I would be comfortable with the outcome. Basically, we all want these things – why wouldn't we? And what we know and do not know, and how



TESTA

Reliable and affordable energy is essential to life as we know it. However, behind the convenience provided by today's technology and innovation, behind the scenes, the energy supply chain is quite complex.

we go about achieving these lofty goals, is ultimately what these discussions are all about.

Land Ethic

A good way to begin is by having a dialogue and defining and understanding exactly what "environmental stewardship" is.

Aldo Leopold, in his 1949 landmark book "A Sand Country Almanac," considered the concept of a "land ethic" and called for moral responsibility in our

understanding and interactions with the natural world – that being the land, the animals and the plants that live upon it. Leopold felt that the relationship between people and the land was intertwined, and in the moral code he espoused, caring for people could not be separated from caring for the land.

This concept of "land ethic" would evolve, and in the 1970s, energy production and environmental issues related to the industrial complex and energy resources began to creep into the public's consciousness. Former

President Richard Nixon established the Environmental Protection Agency in 1970 and Greenpeace was formed in Vancouver in 1971. The United States endured the OPEC crisis in 1973 and the Three Mile Island incident in 1979. Environmental concerns would become even more visible through the 1980s and '90s, giving rise to many geoscientists moving professionally into environmental fields and recognizing that all industry has environmental impact and needs resources to address it.

We currently view environmental stewardship as the crossroads between environmental, social and economic sectors. The environmental sector addresses natural resources usage, environmental management and pollution prevention. The social sector includes standards of living, education, community and equal opportunity. The economic sector addresses profit, cost saving,

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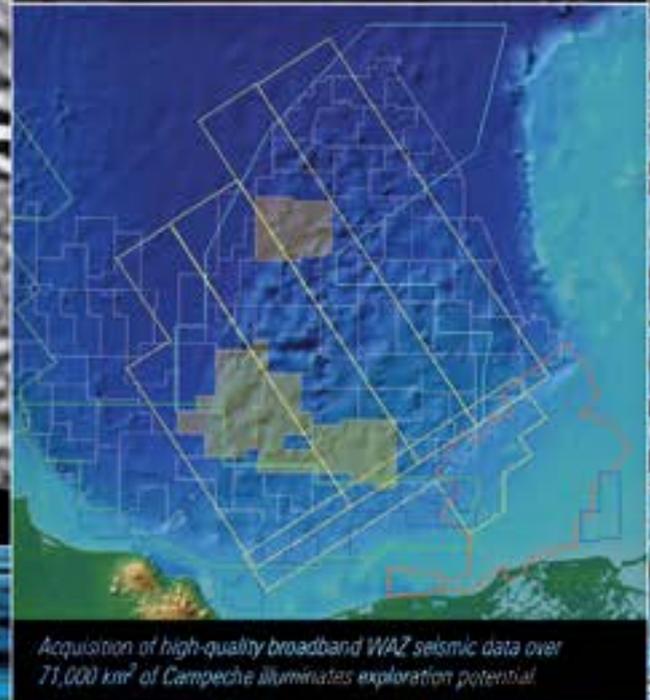
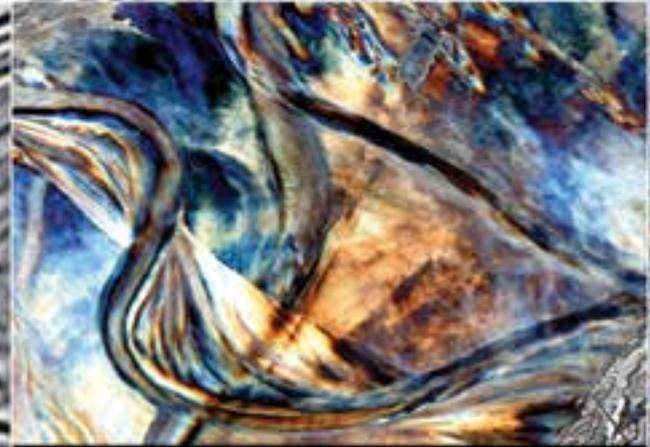
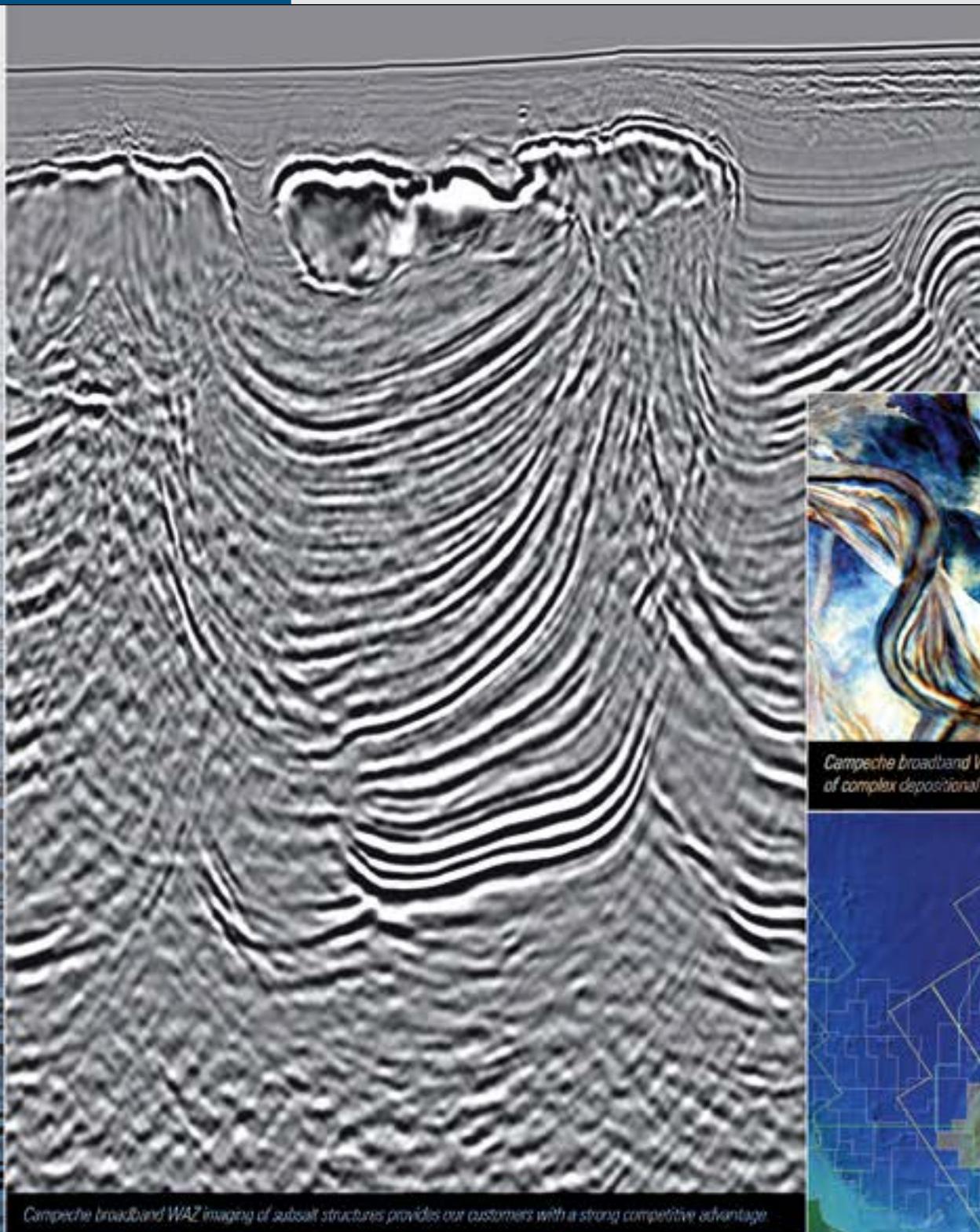


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