AAPG EXPLORER
MAY 2016

Sea Change

The industry's workforce demographics are seeing some course corrections.

Vol. 37, No. 5
May 2016

PRESIDENT'SCOLUMN

YPs Are Needed to Avert AAPG's 'Membership Crisis'

BY PETER LLOYD, VICE PRESIDENT, REGIONS

Four years ago in Long Beach, AAPG President Paul Weimer dedicated much of his conference address to AAPG's demographics. He raised the specter of an aging society and urged everyone to help recruit new, young members. Since that call to arms we have come to sponsor 9,000 to 10,000 students annually and support 350 Student Chapters with a vibrant Visiting Geoscientist Program, the ever-popular Imperial Barrel Award competition, Grants in Aid, Student Expos, the Publications Pipeline and more.


LLOYD

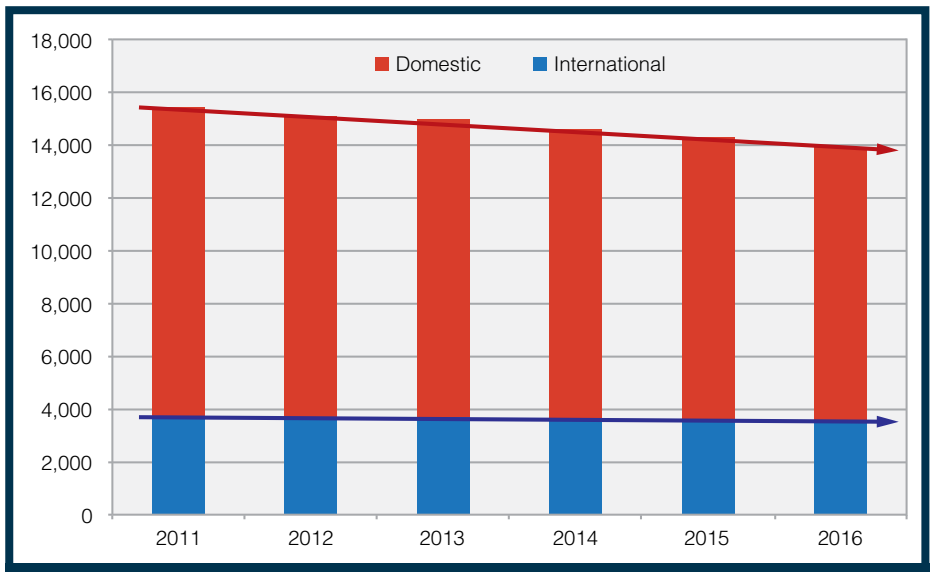
Up to $1.5 million per year goes into a range of student initiatives, not to mention the many hours of dedicated volunteer work from so many of our members. Initiatives, in fact, that run back more than a dozen years and have secured as much as $5 million in sponsorships since Weimer's presidential address.

So what impact have these student programs had in turning around that "age challenged" demographic?

The news is not so good.

Worldwide, we have roughly 300 paid-up "Members" (with voting rights) aged 30 years or younger, and barely 1,000 Members between 31-40 years of age, shared between the Sections and Regions.

Here is the major concern: our organization has a total membership of 38,500, but fewer than 2,500 are under 51 years of age and able to participate fully (as what we used to call "Active" members, now simply "Members", with a capital "M"). We currently have about 14,000 Members. Thus, only 18 percent of Members are under 51. And that's only 6 percent of all member classes combined!



International representation is remarkably steady over time. Paid up actives are 25 percent of international members.

The bulk of our members are either over 50, or sponsored Students who might never make the transition to Young Professional.

And this is not a recent phenomenon we can blame on the oil price. We have seen no net growth since President Weimer raised that red flag four years ago when the industry environment was far more attractive.

Change is Coming, But Not Fast Enough

By-law and governance changes are being worked on by some of our most distinguished members, but it will be some time before they have a trickle-down effect on membership growth. Nor, indeed, was membership growth even the main goal for some of these changes, so I won't comment on them further.

However, I have observed what I consider to be some "best practices" in the Sections, Regions and in some other professional societies that are having a more immediate impact in capturing the interest and energy of YPs. They offer the promise of better transition rates from Students to full Members in these most troubling of times.

So let me share them with you:

Closing the deal! I am convinced our student initiatives are as good as those in any professional society. But we are not "closing that deal." Our students join for free, get sponsored support from all sides for two to three years, but as the very best of them graduate and find jobs, we are failing to welcome many of them on board as worthy fellow professionals. There is a Student to YP "transition bridge," but we still have relatively few "pathfinders" in some parts of our overseas organization to show those young working graduates how to use that bridge. The new YP SIG, co-chaired so ably by Jonathan Allen and Meredith Faber, is proving a wonderful vehicle to make AAPG exciting for YPs and provide that essential Student pull-through.

Providing focus: Tracking who is graduating in those 350 Student Chapters around the world, being able to contact them one-on-one and then recruiting them to be YPs (i.e., closing the deal!) needs to be a focal point for the Sections and in each Region, plus a cadre of volunteers. YPs are ideal candidates to interface with their *alma mater* and other universities, but they cannot do it all alone. AAPG headquarters staff are therefore working on a position within their new organization structure to support these efforts, and this will be critical. Latin America and the Caribbean already have 25 percent of their 50 and under Members involved

See **Initiative**, page 4

How many of you are aware that we have several different levels within the Membership category? We have "Actives" who are fully qualified to vote, run for office and to hold various leadership positions. And we have "Students" and "Associates" who do not yet qualify for full Active membership, or who do, but have not yet completed the paperwork to become "Actives." Recently, the Association has started to refer to all "Actives" simply as "Members," with a capital "M," and the other non-voting categories as "members" with a lowercase "m."

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The Professor Molchanov, a research vessel named for radiosonde inventor Pavel Molchanov located at Grytviken, South Georgia, which is one of the many exotic locales explored by Susan R. Eaton. Image courtesy of SR ECO Consultants Inc.

Susan R. Eaton at Salisbury Plain in South Georgia, which is home to a colony of 300,000 king penguins. Photo courtesy of Stephen Henshall. See story on page 8.

Vol. 37, No. 5

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

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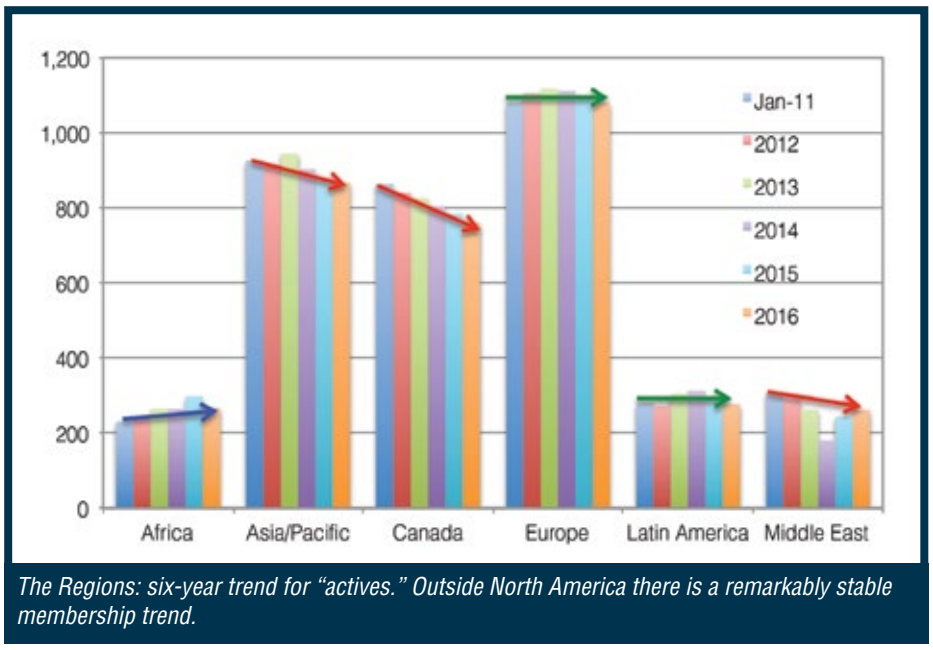

The Regions: six-year trend for "actives." Outside North America there is a remarkably stable membership trend.

Initiative
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in volunteer work and YPs are focused on Students. This is huge, and shows great stakeholder involvement. We encourage more of this kind of focus and emphasis both from volunteers and staff.

Associate to full Member transition: We have good evidence that there are many Associates who are more than qualified for full Membership but do not realize they are not actually full Association Members, nor how easy it is for most of them to become one. We have comparable numbers of Associate members to the full Members in many areas (sadly, many seem to be "lost" crossing that Student to YP transition bridge). This is a huge opportunity to add to our core membership. David Dolph, while he was House of Delegates chair last year, launched a massive initiative that is proving successful in holding up our overall Member numbers. Again, that one-on-one outreach is very effective, and again we'll be looking to headquarters for some leadership and support to target and set up contacts. And let's reward our volunteer recruiters with credits to help buy AAPG publications.

Corporate memberships: This is an interesting route, and need not become a contractual and legal nightmare. It currently costs about $3,000-5,000 for a company to send someone to a weeklong industry course in a city other than their workplace. With training and travel budgets being slashed, companies could put the onus on "self education." Their employees would find a rich hoard of information and data online with AAPG, not least in the Bulletin archives. And for the same price as sending a single person to an industry short course, a company could have 25 young or more mature professionals in their ranks of geoscientists as AAPG Members. I'll let our Section and Region Leaders reflect on lightweight, fast-track methods to reinvigorate this initiative, tailored to the needs of their local companies in their areas. Please reach out to David Curtiss for further help and ideas on this.

Affiliate engagement: I am very concerned that the strong relationships we enjoyed with at least some of our regional affiliates at the turn of the millennium might have been strained, and I fear that we are drifting away from some of them. I'd recommend the Sections and Regions partner as much as possible with our affiliates to create "bespoke" events like GTWs and ICEs and to have our affiliates more involved in the process of nominating HoD representatives, AAPG candidates and awardees and so forth. Improved partnerships and more varied attendance of AAPG events could result in membership growth. In the past, when we had periods of sustained growth, maintaining close relations with our affiliates was an important part of that equation.

I'd like us to use the opportunity of the current headquarters reorganization to reflect the extent to which we should empower the staff to be more proactive with some initiatives (specifically membership) than has historically been the case. But, as noted above, I shall steer clear of the governance debate and David Curtiss's new headquarters organization in this article. But, let both of these initiatives include consideration of how to rebuild that essential pool of 50 and under's, who will be our reservoir of volunteers and future leaders. It is as important a priority as balancing our Association's budget.

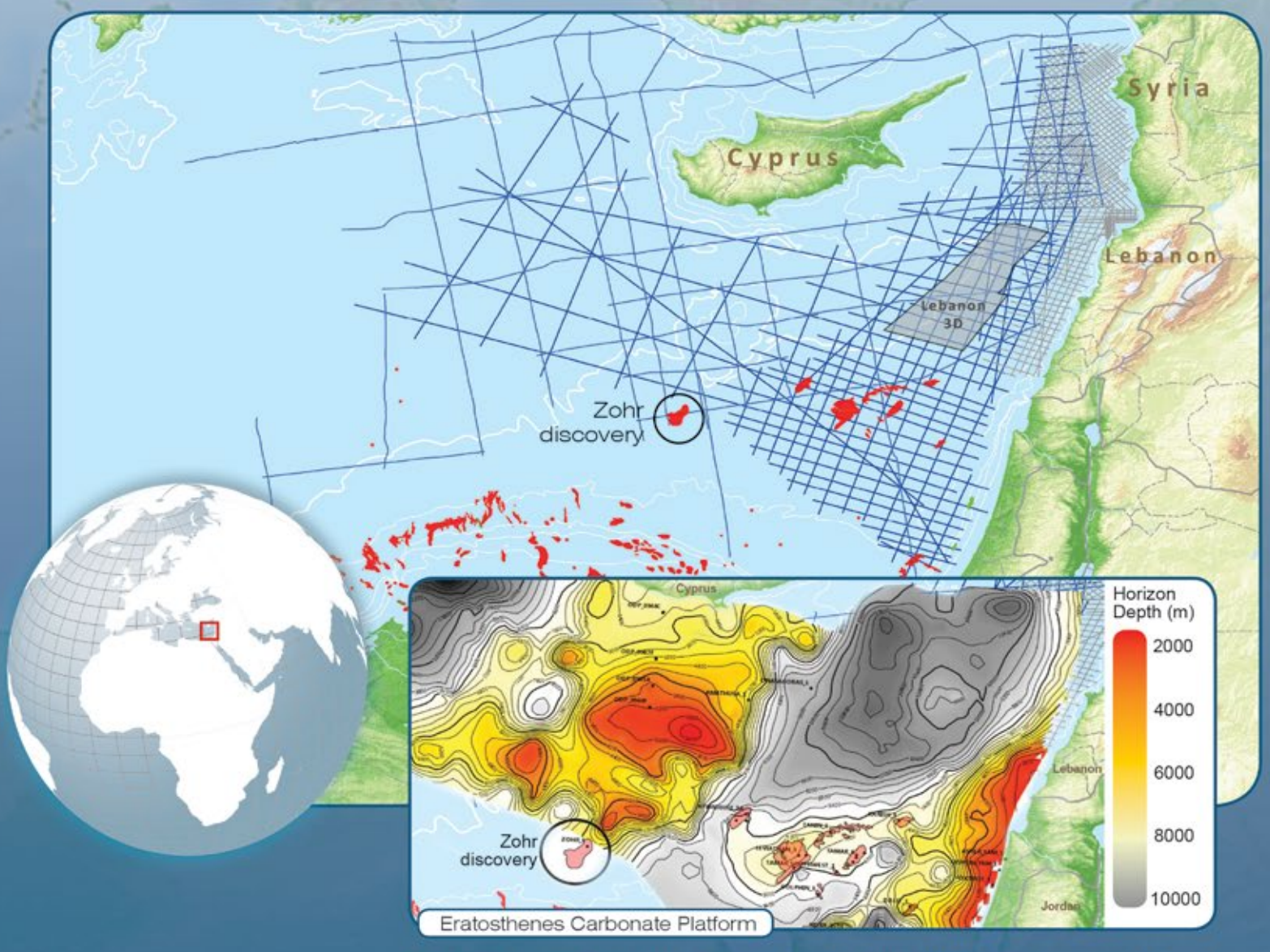
In conclusion, I think AAPG has some world-class programs. But, I fear we have taken it too much for granted that people would simply feel compelled to join our organization. We sometimes forgot that work was needed from AAPG itself to close the deal to sign up potential new members. The huge number of Student members and the easy, low cost, transition they are offered to become Associates and then YPs has lured everyone into believing growth was inevitable and would happen automatically. But it has not. We are in a membership crisis with only 6 percent of the ranks filled with paid up full Members under 51 years of age. We need to focus some of our staff's resources to guide, assist and sometimes lead our oft-overworked volunteers to achieve Student transition, Associate transition, corporate memberships and affiliate society partnering and engagement.

multi-client seismic

EAST MED.

Zohr Opens the Door...

...to a Newborn Carbonate Play in the Mediterranean



The gas discovery in the Zohr-1 well (ENI 2015) has created a step change in the understanding of carbonate plays offshore Egypt and throughout the Eastern Mediterranean.

The new discovery was encountered in shallow water deposited limestone, dating from the Miocene. It is thought to represent part of a much more expansive carbonate platform extending northward and comprising several phases of carbonate build-up around the edges of the Levant Basin.

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Characterizing the Vaca Muerte

By HEATHER SAUCIER, EXPLORER Correspondent

Since the discovery of the Vaca Muerta shale as a commercial play in 2010, one characteristic that has stood out is the formation's incredible thickness – measuring roughly 1,000 feet in its northern reaches.

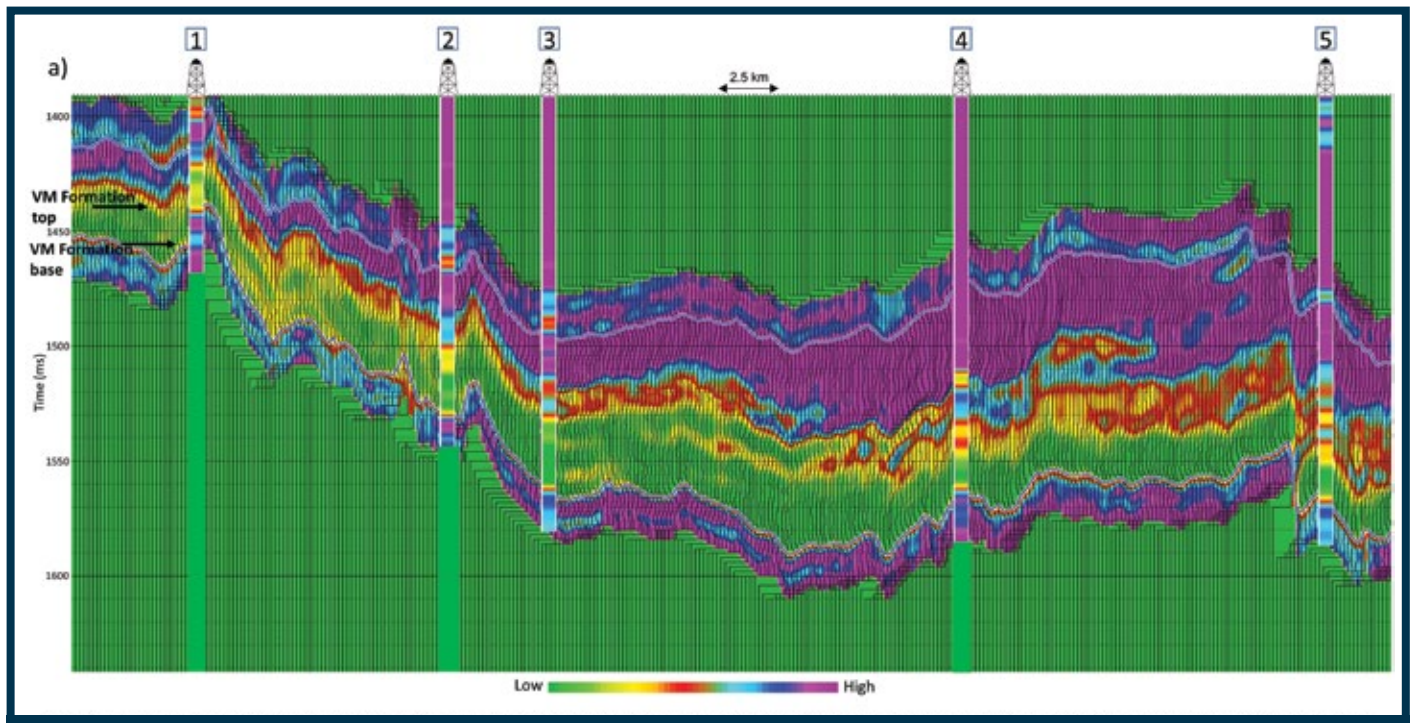
As geophysical companies work to characterize the shale using seismic data, some are finding that, in addition to its thickness, the shale is unique in terms of anisotropy.

"With the interest in developing and exploiting shale resources in Argentina, many companies have undertaken characterization of the Vaca Muerta formation in terms of the elements of shale plays," said AAPG member and award-winning geophysicist Satinder Chopra, chief geophysicist, Reservoir, with Arcis Seismic Solutions, TGS, in Calgary, Canada, and editor of the EXPLORER's Geophysical Corner. "But we are finding that the characterization workflows that have been applied to some of the shales in the United States and in the North Sea do not seem to be applicable to Vaca Muerta."

As a result, geophysicists such as Chopra are developing new ways to help identify the sweet spots of Argentina's emerging shale play.

Not only were Chopra and his team able to successfully characterize Vaca Muerta and subsequently identify ideal locations for exploiting its shale, they have applied their new characterization method to similar shales in Canada, namely the Montney and the Duvernay formations in Alberta.

Hesitant to call the new method of characterization a "breakthrough," Chopra instead said, "This workflow has the potential for good application to other shale plays around the world."



Inverted P-impedance section along an arbitrary line passes through the wells. Part of the line passing through wells 1 to 5 is shown in (a), and the other part passing through wells 6 to 8 is shown in (b). A reasonably good correlation is noticed between the inverted and measured impedances.

CHOPRA

> "This workflow has the potential for good application to other shale plays around the world."

A Successful Shale

For a shale play to be successful, it must have the following key elements:

- Mineralogy.
- High total organic content (TOC).
- Maturation.
- Thickness.
- Porosity/permeability.
- Brittleness.
- Oil/gas in place.
- Pore pressure.
- Depth.

Vaca Muerta, a formation of the Late Jurassic-Early Cretaceous periods in the Neuquén Basin, exhibits all the above elements in a favorable way, Chopra said, explaining that it has served as an important source rock for many conventional oil and gas fields in Argentina for decades.

"An optimum combination of these elements leads to favorable productivity," Chopra said. "The geology of the Neuquén Basin is favorable."

Yet, the workflow implementation for the characterization of Vaca Muerta and subsequently turning it into a successful unconventional play has required a trial-and-error exercise using well and seismic data.

Approached by Pan American Energy to help characterize the formation that the company operates in two blocks, Chopra and his colleagues set out to find the sweet spots that could be exploited for oil production through horizontal drilling and hydraulic fracturing operations.

"Vaca Muerta is a world-class shale play that has unique characteristics that are different from others of its kind," said Luis Vernengo, Pan American Energy's head of geophysics. Vernengo worked with Eduardo Trinchero, a senior staff geophysicist, also of Pan American Energy, on the project.

"We knew it was necessary to find other ways of analysis to take into account its specific characteristics and anisotropy," Vernengo said.

Finding TOC

As with most shale plays, the key to successful development and production is finding a high TOC.

"Better TOC leads to better production," Chopra said.

However, TOC cannot be directly measured using seismic data. It must be estimated indirectly.

Because TOC affects compression velocity (P velocity), shear velocity (S velocity) and density, geoscientists have – in the past – attempted to compute TOC using a linear or non-linear relationship it might have with P-impedance, Chopra said. However, using that approach in Vaca Muerta leaves an element of uncertainty that is too great for an accurate characterization to be made, he said.

"We know that we needed to characterize the Vaca Muerta shale from a different and more efficient point of view," Vernengo said. "The difficulty came when it was time to find a tool or workflow that combines the interpretation of TOC and special seismic processes."

"There is evidence of a linear relationship between the uranium content in shale and its organic content. As a result, a large gamma ray (GR) response is expected for organic-rich shale formations," Chopra explained.

Because a linear relationship appeared to exist between GR response and TOC, as well as with P-impedance, GR was seen as another parameter of interest for characterizing the Vaca Muerta formation, Chopra said.

"This is a much better relationship," Chopra said. "High GR and TOC are characteristics of a better quality shale play."

Using P-impedance and GR volumes, Chopra explained that a Bayesian classification approach was followed to obtain a reservoir model with different facies based on TOC and the associated uncertainty with it.

The first step included defining different facies based on cut-off values for GR and P-impedance computed from well log data, Chopra said. The second step required Gaussian ellipses to capture the distribution of data in a crossplot of GR versus P-impedance.

Then, 2-D probability density functions (PDFs) were created from the ellipses for each of the facies. By combining the PDFs with GR and P-impedance volumes, different facies were identified on the 3-D volume. Post-stack, model-based inversion was used to compute the P-impedance volume, and a probabilistic neural-network approach was used to compute the GR volume. (Only stacked seismic data was available for this case study.)

"Derived P-impedance and GR volumes correlated nicely at blind wells on the 3-D volume, and that gave us confidence in the characterization of the Vaca Muerta formation," Chopra said.

"An overlay of the discontinuity detail in terms of curvature lineaments on the determined TOC content at the level of interest helped in obtaining a more complete picture, which is useful for the planning of horizontal wells."

"It can be concluded that the quality of the Vaca Muerta formation increases with depth, which is trustworthy based on the known geological history," Chopra added.

Believing their chances of a successful discovery have increased as a result of this new approach, Vernengo said Pan American is in good standing in the Vaca Muerta shale patch.

"This tool allows us to efficiently characterize the Vaca Muerta formation in our area, and in any other area of the same basin, through the knowledge and special distribution within the shale associated facies," Vernengo said. "Because of this, we believe that Pan American has advanced knowledge that will help tackle the challenges of shale reservoirs."

Chopra and his team published a paper, entitled "Reducing uncertainty in characterization of Vaca Muerta Formation Shale with post-stack seismic data," on their approach, which can be found at the TGS website (TGS.com).

Next Steps

Determining TOC in shale-resource reservoirs is a "desirable" goal in most projects that aim to characterize unconventional reservoirs, Chopra said.

"This opens the door for more detailed work that should be done to characterize the Vaca Muerta formation," Chopra said. "This workflow has demonstrated that it has the potential for application to other shale plays around the world."

Saying he is "quite happy" with the results, Chopra said that going forward, he and his team will focus on determining the brittleness of the formation using pre-stack data. "We will be working on this in more detail," he said.

"You might think the name Vaca Muerta, the Dead Cow, is irrelevant, but is it?" Chopra asked. "They should call it the Vaca Viva, which is the Living Cow, which Argentina can look forward to for decades."

Don't Call Her a 'Woman Geoscientist'

By BARRY FRIEDMAN, EXPLORER Correspondent

"I'm tired of talking about women in geosciences."

That's Susan R. Eaton, president of SR ECO Consultants, Inc., and not to put too fine a point on this, longtime correspondent for the EXPLORER, when asked about being featured in this very "Women in Geosciences" issue.

"I graduated from university 36 years ago," said Eaton, who has established a successful career in Canada's energy sector, including being the vice president of exploration for three junior oil and gas companies and running her own energy consultancy. She's also the founder and leader of the Sedna Epic Expedition, an organization studying climate change in the Canadian High Arctic comprised of an international team of female ocean scientists, explorers, journalists, movie-makers, photographers, educators and professional scuba divers, "and I tire about talking of women in our sciences, because there are increasing numbers of women in our sciences. I feel like this title puts me in a box."

Eaton is a world-class polar snorkeler and has participated in science-based expeditions to the Falkland Islands, South Georgia, Antarctica, Labrador, Baffin Island, Greenland, Spitzbergen and Iceland. She holds degrees in geology, petroleum geology and geophysics and journalism, and is a founding member of Nature Canada's Women for Nature initiative. A commissioned officer in Canada's reserve army, she was named one of Canada's top 100 modern-day explorers by the Royal Canadian Geographical Society in 2015.

Eaton provides a geological scale for the rope lavas in Thingvellir National Park, Iceland. The mid-Atlantic ridge dissects Iceland here where the North American and Eurasian continental plates are pulling apart at two to three centimeters per year. This rift valley is also where the Vikings established their annual Icelandic Parliament. Photo courtesy of Christine Bernasconi.

So who can really blame her?

In fact, Eaton says, while she suspects that some men may "roll their eyes" when they see this issue and think "Not another issue about women geoscientists," she believes women, too, are not going to appreciate it.

"I think most women would prefer not to have that adjective in front of their title."

A Downturn Blind to Gender

So there you have it.

Eaton is outspoken, refreshing and relentless about this very topic, even while she understands, on many levels, its importance.

"We keep going back to it, though, and that's OK," she said, adding that to call attention to women in the industry, however, in her opinion, serves to diminish women's achievements.

"The oil and gas industry hasn't always been the most magnanimous employer for men or women, because over time, when the price of oil collapses, staff gets fired," she said, regardless of gender.

And here Eaton cuts through the clichéd public relations spin.

"Oil companies are always saying 'Our strength is in our people,' and, yet, when the price of oil collapses, the people who built these companies are gone," she added.

She cited her hometown of Calgary as an example.

"Most of the new hires have been laid off; and, most of my peers, over 45 years of age, have been laid off. There are virtually no gray-haired people left in Canada's E&P companies; Sadder even, there are very few under-30s left, and they represent the future of the E&P industry," she said.

Improving the Message

To talk to Eaton is to hear someone who loves geoscience, loves the oil and gas industry, but, like anyone involved in a long-term marriage, she sees the imperfections and shortcomings.

In the industry's case, she begins with external messaging.

"The industry is not doing a good job. It comes up short in so many areas, which is ironic because most oil and gas companies have large public affairs and media relations departments. That said, I think they fail on many levels in terms of describing what they do for a living and how it benefits the general public. Considering all their assets, all their skilled employees, and all the money they spend, the industry's external message doesn't seem to resonate with stakeholders. In short, communicating

Continued on next page

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what the oil and gas industry does for a living is a public relations disaster," said Eaton, whose consultancy includes managing external communications for the oil and gas sector.

External communications are better in Canada, she said, where the E&P industry is "getting it right," despite acknowledging that the general public trusts environmental groups more than oil and gas companies.

To right this ship, Eaton said, the E&P sector has to start with respect.

"It's not about training the general public; it's about listening very carefully to the general public's concerns and closing the gaps in differences of opinion," said Eaton.

And, here she jumps on the third rail of the industry – both of them, actually – when asked if there was something that prevents the oil and gas industry from being a better at communication with the general public.

"The DNA of the oil and gas industry has often been cloaked in secrecy; oil and gas companies don't willingly share information with stakeholders, unless they're regulated to do so. Case in point: the whole discussion of hydraulic fracturing technology and formulae. It took challenges at the state and federal court levels to force the E&P and service sector companies to divulge the chemical formulae of hydraulic fracturing fluids," she said.

As for climate change, she challenges how the E&P sector in the United States has handled the issue with the public.

"Climate change is not an issue in Europe or here in Canada. It's a done deal. Every major oil company in Canada knows it's happening, and the industry stated that it's part of the problem; ergo, part of the solution," she said.


EATON

> "I believe that to make STEM effective, we must move towards STEAM – the 'A' denoting 'Arts.'"

Part of the problem in the United States, she believes, is that some industry associations don't want to offend their older members, some of whom she calls "the fossils in the fossil fuel industry."

The future of these groups (whose membership is aging demographically) is in attracting younger members, she explained.

"And, these industry associations can't afford not to attract the younger members who accept the body of science behind climate change," she said.

Nonetheless, Eaton said she appreciates what these organizations have allowed her to do in her career.

The AAPG Foundation supported two of her three expeditions to Antarctica, the Falklands and South Georgia, where she filed dispatches for the EXPLORER, from "the Bottom of the World."

"The petroleum industry associations have been amazing to me, in terms of financially supporting me to study climate change in Antarctica. I'm not a climate change scientist, but the skill set developed during my oil and gas career has enabled me to travel to Antarctica, to contribute the geology and geophysical perspectives to the discussion of climate change," she said.

Building STEAM

Eaton was inspired to enter the sciences by her mother, Ann Eaton, who graduated in 1955 with a biochemistry degree and worked as a marine biologist during her career. For decades, she's been giving back as well, especially to young girls, and especially as an advocate of STEM (science, technology, engineering and mathematics), but with one caveat.

"I believe that to make STEM effective, we must move towards STEAM," she said – the "A" denoting "Arts."

"From my perspective, not all children are going to grow up to be geoscientists, mathematicians or engineers. That said, it's important that citizens develop a broad understanding of science and technology, and how it impacts our daily lives, in so many ways."

The future of STEAM education is growing, she said, especially if it's seen correctly and cultivated.

"We talk about getting girls interested in science at a young age… and they're *all* interested in science at a young age. In fact, they tend to perform better in science than boys do in elementary and middle schools. But, by the time girls get to high school, they seem to fall behind in science, primarily due to societal pressures. Often, girls don't want to be known as the smart girl; they want to be known as the cool girl.

"All of this means we've still got a problem of attracting women to geosciences," she added.

But, the 'science geek' girls who continue their STEM studies into college and university perform very well, especially in geosciences, Eaton explained. These young women are generally better educated than their male peers, she added, because "they tend to stay in university for graduate studies."

Her own story, though, and perhaps why magazine issues like these annoy her so, is because – as important as it is to attract women to geosciences, there are other pressing issues at hand.

"Oil and gas people in Calgary ask me, 'How can you call yourself an environmentalist and work in the industry?' I answer, 'How can you not be?' Because the environment is the single biggest issue that the oil and gas industry faces today. And we need to get it right the first time. It's the right thing to do and it's good business."

And it's been a good business for her – a rewarding one, one she still relishes.

"Geologists put things in perspective. I see myself at the intersection of geosciences, communication and environmental mitigation. I'm an earth scientist. And I have a voice, in terms of the environment."

No argument there.

But then one more shot at the whole shebang.

"A lot of women who are scientists probably don't like being called 'women' scientists. But many men may not know that," she said.

They will now.

Photos courtesy of Girl Scouts of Western Oklahoma

Girl Scouts from Oklahoma work on STEM-related activities. Girl Scouts seeks to empower young girls and teach them that they are every bit as prepared to take on a STEM-related career as boys. The organization has partnered with Devon Energy to create STEM kits for the girls.

STEM'ing the Tide of Gender Disparity

By KRISTI EATON, EXPLORER Correspondent

Though great strides have been made to attract more women into the fields of science, technology, engineering and mathematics, there's still room for improvement, according to educators and industry experts. Across the United States, schools, civic organizations, non-profits and oil and gas companies are working to encourage girls and women of all ages to enter STEM fields.

BERRY

"There continue to be many challenges attracting women and historically unrepresented groups to STEM majors and fields."

That's Tricia Berry, who leads efforts to recruit and graduate women from the Cockrell School of Engineering at the University of Texas at Austin. As director of the Women in Engineering Program as well as a board member of the Association of Women in Energy, she works to support and connect organizations that are working toward greater gender parity in the STEM fields.

Addressing the Culture

One of the many challenges she and others mentioned are negative stereotypes about girls' abilities in math and science, which Berry said can adversely affect test performance, decisions with regard to class choice and course of study, as well as girls' and womens' assessment of their own abilities.

Girls, Berry said, often have fewer opportunities to develop spatial skills through toys like legos involving block and construction plans, 3-D video games and other means, which can lead to trouble with STEM coursework as they get older because the skills were not developed at a young age.

Additionally, many of the role models in STEM fields are male, which gives a limited and limiting view to girls and young women regarding possible STEM-related career opportunities, she said.

"And the 'geek' persona is not attractive to a wide variety of women and girls we need to engage in STEM," she added.

Programs like Women in Engineering help to change that by putting the focus on girls and women. Pre-college outreach programs are also numerous, including DiscoverE's Introduce a Girl to Engineering Day and Girlstart After School.

Industry Involvement

Oil and gas companies are making efforts, from outreach programs designed to excite young girls about STEM subjects to creating flexible work environments and improving the climate and culture of an office to make it more hospitable and supportive to all employees.

Oklahoma-based Devon Energy has partnered with the Girl Scouts of Western Oklahoma to offer kits that include STEM-related activities. Girls who complete the activities receive a STEM patch.

The initiative, which was launched last year, was created in partnership between the Girl Scouts of Western Oklahoma and several Devon geologists and engineers, said John Porretto, spokesman for Devon Energy.

The kits are designed for girls in kindergarten through eighth grade and so far, more than 1,400 girls have participated, according to Holly Johns Rowland, fund development manager at Girl Scouts of Western Oklahoma.

"We're all aware of the gender gap in STEM careers: only 20 percent of young women intend to major in a STEM field in

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college, compared to 50 percent of young men," Rowland said. "Subtleties of society and culture reflect the stereotype that girls are not good at or suited for math and science and unconsciously discourage girls."

Girl Scouts seeks to empower young girls and teach them that they are every bit as prepared to take on a STEM-related career as boys, she said. Girls spend more of their lives hearing they are not as good at math and science as boys and that they shouldn't get dirty.

"Social psychological research shows that these stereotypes have negative consequences," Rowland explained. "It's possible that girls are internalizing this stereotype and talking themselves out of achieving in math and science when, in reality, they are doing just as well or better than boys."

A young Girl Scout examines a rock. Oklahoma-based Devon Energy has partnered with the Girl Scouts of Western Oklahoma to offer kits that include STEM-related activities. Girls who complete the activities receive a STEM patch. The kits are designed for girls in kindergarten through eighth grade and so far, more than 1,400 girls have participated.

Progress So Far

So are the efforts working?

In some ways, yes, said Berry.

In 2015, 47 percent of high school students who took the Advanced Placement calculus test were female, while 22 percent of AP computer science test-takers were female, according to data from the National Center for Women and Information Technology.

"We still have few women in fields such as electrical engineering and physics, while the percentages are much greater in biology, chemical engineering and biomedical engineering," Berry said. "Retention of women in STEM fields in college typically mirrors that of male peers. And yet we continue to lose women in the workplace."

That could soon change.

Earlier this year, several oil companies signed a pact in Davos, Switzerland, to work to close the gender gap in the oil and gas industry. According to data from the World Economic Forum, less than 20 percent of workers in the oil and gas industry around the world are women, and only 10 to 15 percent in senior-level positions are female.

The pact is based on two main goals: recruiting a more gender-diverse workforce and opening up all jobs in the organization to women.

The priorities include developing gender-sensitive work-life balance policies, inclusive corporate culture and setting and maintaining goals and objectives for gender diversity.

Improved gender diversity is an important business move, the declaration states.

"This is good for our people, good for our stakeholders, and good for our business," it reads.

PROWESS Committee Empowers Women Geoscientists

By EMILY SMITH LLINÁS, EXPLORER Correspondent

The Merriam Webster Dictionary defines "prowess" as "great ability or skill."

Empowering women to develop those abilities and skills is a key goal of Professional Women in Earth Sciences (PROWESS), an AAPG committee dedicated to increasing the participation and advancement of women in earth sciences and the energy industry, with an emphasis on education, outreach, support, leadership development and retention.

For Marjorie Chan, AAPG member and founding committee chair, PROWESS is a name that empowers women.

"With the long history of women being underrepresented in the earth sciences, the women that do make it often have to show great abilities, skills and perseverance to be accepted as peers," she said.

History

Efforts to promote women's involvement both within earth science and in AAPG started in 2001 during the presidency of Robbie Gries, AAPG's first woman president.

During her term, Gries started a Diversity Committee comprised of women, African Americans, Hispanics, Asians and Native Americans.

"I thought diversity was something that should be better addressed by AAPG. It was not something that many members thought about, but when it was brought to the attention of long-standing members, most agreed that enhanced diversity would benefit AAPG," she said.

The Committee held some workshops at conventions, had brainstorming meetings and honored Isaac Crumbly for his efforts with minorities. Eventually, though, the Diversity Committee lost momentum and dissolved.

At about that time, Chan read a publication listing training instructors for the oil and gas industry and noticed that there were very few female instructors.

"I spoke to a key representative of the company who simply said there just weren't qualified women," she said. "I felt something needed to be done to raise the visibility of qualified women, and to encourage more women. The best way to do this was through the organization with the most clout in the industry – AAPG."

Amanda Haddad, Denise Cox and Barbara Tillotson at the 2015 PROWESS reception.

The AAPG PROWESS Committee was thus born: with support from the Association for Women Geoscientists (AWG) and from AAPG members and staff, Chan became the founding chair in 2006.

Though she no longer serves on the Committee, Chan said she has enjoyed watching PROWESS grow and develop.

"I have been thrilled to see the Committee and its activities evolve over the last decade as strong women have devoted a lot of time and effort to host speakers, collect data and produce AAPG articles. This PROWESS Committee makes a strong statement that diversity is important to the AAPG membership," she said.

Current Chair Barbara Tillotson joined PROWESS three years ago when she returned to the United States after spending time overseas.

"I wanted to become more involved with AAPG and thought joining a committee would be great," she said. "I got on the website and chose PROWESS. I liked the mission statement on helping to develop young professionals in the oil and gas industry," she said.

Tillotson, who spent several years mentoring high school students in science, technology, engineering and math, (collectively referred to as "STEM" subjects) thought involvement with PROWESS could help her continue pursuing her passion for encouraging young women to study science.

"The percentage of females graduating in sciences is not equal to the percentage of females in the population," she said. "Additionally, the ratio of women graduating with geology degrees is not the same as the ratio of women pursuing geology careers. We need to work on that."

Tillotson said she is determined to help women address the issues that keep them from pursuing careers in earth sciences.

"Some issues are women specific. That's where we can help with the networking. We can talk about how to balance personal/family life, personalities," she said. "Sometimes women have a little bit harder time being influential or feeling like they have a seat at the table. A lot of times they do (have a seat at the table), but they don't feel that way."

Subcommittees

Getting women a seat at the table is a primary focus of PROWESS, whose members accomplish their work through six subcommittees:

- The ACE Short Course Subcommittee organizes courses aimed to further geoscience careers, focusing on "soft skills" asking for promotions and assignments and technical skills, including petroleum

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Subcommittees

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economics, leadership development and decision-making.

- The Mentoring/ACE Networking Reception Subcommittee helps geoscientists in all stages of their careers to connect with peers and receive guidance from those who are farther along their professional path. The Subcommittee facilitates e-mentoring between young and seasoned professionals and organizes face-to-face networking receptions at AAPG ACE.
- The Nominations and Awards Subcommittee works to identify both AAPG and affiliated society award and leadership opportunities for which PROWESS members may be eligible.
- The Pioneer AAPG Women Subcommittee aims to inspire and promote women in petroleum geology through the many stories of trailblazing women in the energy industry. These stories of pioneering women geologists will be showcased at the AAPG 100th Anniversary Celebration at ACE 2017 in Houston and will be featured in a video and a special publication.
- The International Concerns Subcommittee serves as a discussion and cooperation forum for women working throughout the world and strives to address issues unique to women and to encourage members to develop both technical and leadership skills that add value to their profession.
- The Social Media/ Website Subcommittee aims to use social media to engage, support and energize current and prospective women in the oil and gas industry and to establish PROWESS as a dynamic organization for women in energy.

Still Relevant in the 21st Century

PROWESS leaders note that, although women have made tremendous progress in the geosciences over the past few years, there is still plenty of work to be done.

"Women have come a long way professionally over the last 45 years since Affirmative Action and Equal Employment Opportunity Commission rulings were initiated in the U.S., but still have some gaps in top-level opportunities," Gries said. "There are no women CEOs in the medium-to-larger oil and gas companies, and there are several other areas where opportunities are not as available to women. The U.S.still has the worst maternity leave options in the western world."

Gries added that, for AAPG's growing international membership – 42 percent of total members in January 2016 – salary discrepancies and promotion opportunities continue to be a challenge.

These global challenges inspired Jeffrey Aldrich, president of AAPG's Division of Environmental Geosciences, to become involved with PROWESS and the International Concerns Subcommittee.

"I joined PROWESS at the urging of my friend Denise Cox, and the realization that I am currently mentoring, mostly through email and social media, several women geoscientists in many different nations," he said.

"I have been privileged to have been based in several countries and have witnessed firsthand both societies that generally do not discriminate on the basis of gender (Singapore) and those that regularly do (U.S.A., UK, South Africa)," he said.

"As a firm believer that the professionalism of AAPG is one of the key areas that AAPG truly makes a difference, I found that the goals of PROWESS were the same goals that I was trying to advance."

Benefits to AAPG

PROWESS founders and leaders note that the Committee has had a tangible impact on both AAPG and its membership.

"Our report on retention of women in oil and gas was well received by the Corporate Advisory Board, and provides a statistical base for future studies on women in industry," Gries said. "Our programs at conventions have been influential and mentoring has been productive. It is a good think tank for any issue regarding gender diversity."

Chan affirmed that PROWESS influences AAPG by raising awareness among members of the role women can and do play, and what they add to the fabric of science and technology.

"Diversity can help AAPG and companies achieve more success. This is also why several major companies have been supportive of PROWESS. PROWESS is important in educating current and future generations of petroleum geologists," she said.

Tillotson noted that PROWESS still has work to do within AAPG.

"Women's role in AAPG has been improving, and it's a lot better than it used to be," she said, "but there is still work to be done."

She noted that, though women make up 21 percent of AAPG members, not a single woman was nominated for AAPG Honors and Awards in 2016.

"The numbers are not going to be equal between men and women, but the number of women nominees should not be zero," she said.

Getting Involved

PROWESS advocates affirm that the Committee provides lasting benefits to AAPG, to industry and to the members themselves.

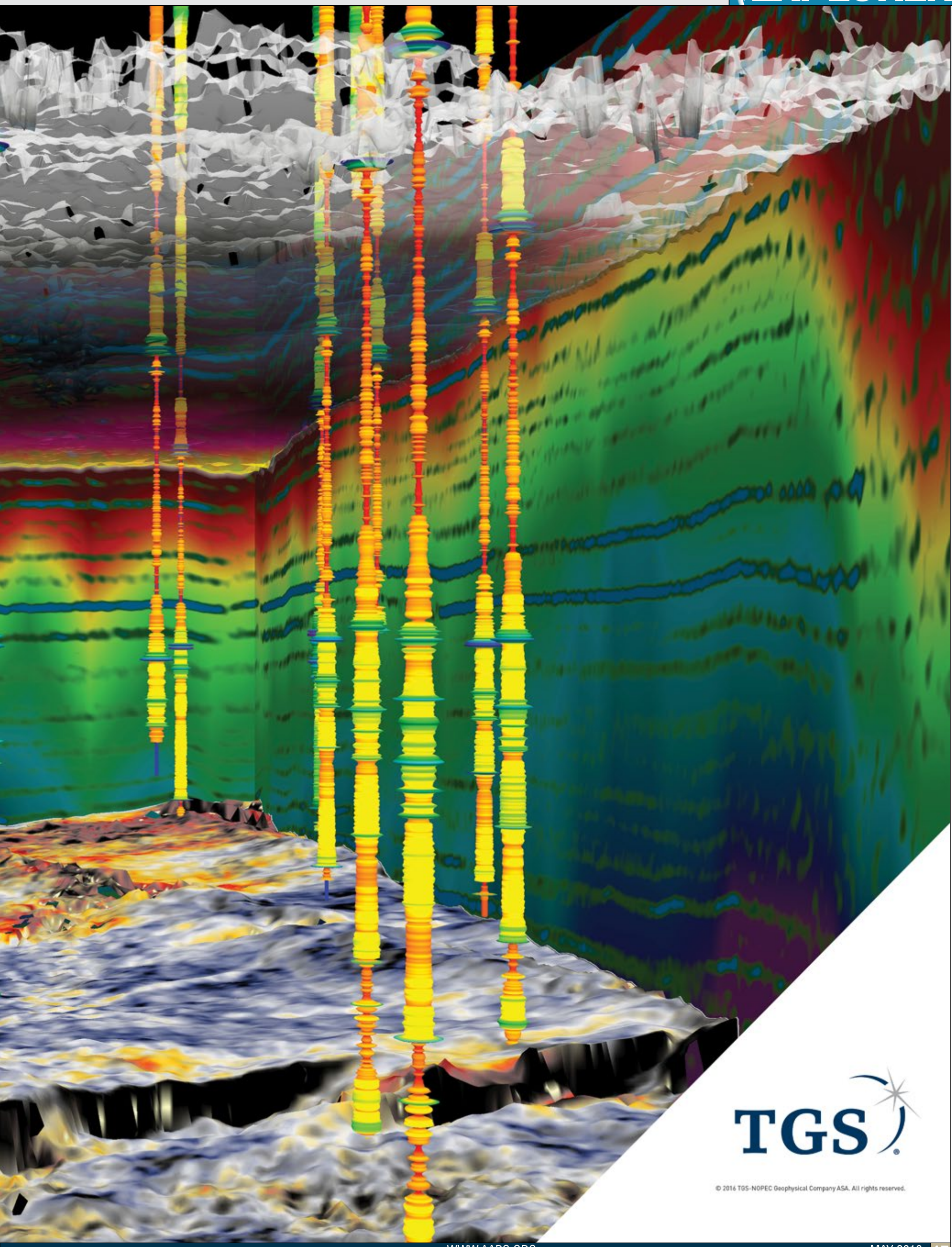
For Gries, every committee in AAPG offers an opportunity for members to network, develop friends and enhance their career.

"PROWESS is no exception," she said. "Women, and a few men, who have worked on projects for this committee have developed lasting relationships and opportunities to know and admire other hard working AAPG members."

Chan agreed.

"PROWESS is a terrific way to connect in a proactive way. It is a commitment to make good things happen for AAPG members and their professional development," she said.

To learn more about PROWESS, visit the AAPG website, AAPG.to/prowess. Contact prowess@aapg.org to join and to volunteer for a subcommitee.



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.

Oxy Libya: Giant Strides For a Small Company

By RICHARD H. VAUGHAN

When Occidental Petroleum Corporation was reorganized in 1959, its total oil production was some 100 barrels per day. By the time Moammar Gaddaffi nationalized the industry in 1969, Oxy Libya, the wholly-owned subsidiary, was producing 800,000 barrels per day. Such an amount made Oxy Libya the eighth largest producer in the world – exceeded only by the "Seven Sisters."

Beginnings

In 1959 the old Occidental Petroleum was becoming defunct, but Armand Hammer, a recent investor from Beverly Hills, invested with Oxy as a last gasp and the company discovered several modest California oil wells. Hammer got excited by the ingenuity and grit of the owner of the drilling company – the ever-colorful Gene Reid.

The irascible Bakersfield driller wasn't too sure about teaming up with anybody from Beverly Hills, but after a year of courtship and encouragement from Reid's geologist son Bud, who liked one of my plays, I became the first hire of the newly reorganized Oxy.

Our exploration company consisted of a dusty, galvanized metal office in the oil patch of Bakersfield, a tad larger than a typical drill rig doghouse. Our first drilling success, based on the play I brought was in the Arbuckle gas field, in California's Sacramento valley. Western Gulf Oil Co. (WGO) had discovered the Cretaceous age Forbes turbidite sand gas field, but WGO stopped their development drilling program after several dry holes. Oxy farmed-in and drilled several wells on WGO-selected locations as the price of admission to take over their leases.

These initial wells were dry holes. However, they were followed by ten successful gas producers, which started Oxy on a successful series of gas discoveries in the Sacramento valley. We grew out of our little office and started to add friends and old schoolmates we knew and trusted.

The Question

Hammer, as Oxy's chairman, flew to Arbuckle to see his new gas wells among the walnut orchards.

On the way home he asked me an unusual question: "If you could operate any place in the world where would it be?"

This was not a question a young California geologist would have a well-thought-out answer to on the tip of his tongue. However, the Oil and Gas Journal and other trade publications were reporting with some regularity the discovery of major new oil fields in the Sirte Basin of Libya.

When Libya was created by the United Nations after World War II and opened up to concessions, the industry initially concentrated in the western portion of the country adjacent to the gas producing areas of Algeria. It was years later that Esso opened the discovery of the Sirte Basin. Thereafter, all of the operators, i.e., Mobil, Amoseas, Oasis and BP, were making billion barrel discoveries. By the terms of the original concessions, they were going to have to relinquish the majority of their acreage without having thoroughly explored it. Another round of concession granting was coming up and a grand scramble was obviously going to take place. Hammer realized this and in 1963 created the wholly owned subsidiary – Oxy Libya.


VAUGHAN

Richard H. "Dick" Vaughan received bachelor and master's degrees in geology from Stanford University after having served a tour in the Navy during World War II. He held positions at several companies mostly as a field geologist until he was hired as chief geologist for the reorganized Oxy in 1959. He retired from Oxy in 1983 at which time he was executive vice president in charge of worldwide exploration. Thereafter, he started his own E&P and consulting company which today is managed and run by his son Jeffrey K. Vaughan. Their current principal activity is geological support in the redevelopment of the Round Mountain oil field in Kern County, Calif., where production has been increased from 600 to 12,000 bopd.

International Exploration Company

Oxy Libya (made up of geologist C. James "Jim" Blom, geophysicist Jim Mercer and I) scrounged up 12 electric logs, five core histories and zero seismic data. We were off to the races! We were not likely to obtain any seismic data or any other data from the major companies already competing there. We did, however, have some regional, non-proprietary gravity and magnetic mapping.

It became apparent to us that most of the discoveries were related to old structural highs: horst blocks, granitic and/or volcanic islands and arches of various sorts in the ancestral seas. Mobil's billion-barrel Amal Field was located on one of the old island type ridges. They followed up the field discovery with a few wells further along the ridge, which were all dry holes on top of a barren ridge.

The Clue

A truly fortuitous bit of information came in one of our five core histories from a Pan American well way off the crest of the Amal Ridge, almost in the trough. The core descriptions noted numerous remains of reefoid fossils. Reef material certainly did not migrate uphill to get this far off the ancient island and it hadn't come from the barren granitic high itself. It had to have come from someplace in between, i.e., off the flank of the old basement high.


Dick Vaughan explains OXY's bid to the Minister of Petroleum Affairs, Faud Kabazi at bid day in Beida on July 31, 1965.

Needless to say, Oxy Libya was not taken very seriously by the existing majors in Libya. Those who cared to talk to us learned we had next to no data and had never drilled, operated or even bid on any properties outside of California. We concluded that we would have to somehow make a big impression when bidding day came a little over a year later.

Friends in a Foreign Land

I met Frank Fuller, the regional manager for Geophysical Service Incorporated (GSI), a worldwide seismic contractor active at that time across the Middle East. He casually mentioned one day that the first digital seismic crew other than two that were operating currently in Saudi Arabia would be coming available. Two of the Aramco partners had two years of proprietary rights to these crews for financing the study of this new digital seismic with Texas Instruments – GSI's parent company. He stated that the new digital seismic would revolutionize the industry as it was a night and day difference in quality over the old analog. So we signed Oxy up for a digital crew a year before the first concessions would even begin. From back home, our three-man Oxy Libya team was viewed as a bit rogue.

We befriended a young attaché at the U.S Embassy in Tripoli who appreciated our David vs. Goliath relationship with the major companies. We learned that King Idris was a fair and honorable man from a remote, tiny village named Kufra deep in the Sahara Desert. Kufra was defined by a small, but very fresh water oasis with several palm trees and some 150 people. King Idris greatly wanted to improve his village by introducing modern forms of agriculture if there was more water. We also learned that he did not like how the existing producers had been flaring all the associated natural gas.

Bidding Day

Bidding day, July 31, 1965, was coming up and we wanted to place bids on two concessions. Concession 102 we knew would be heavily sought after as it was a previously defined basement high and many players were openly talking about it. Concession 103 was off the Amal Ridge where we had our core data revelation and the old Mobil dry holes.

We came up with a game plan and had an ornately crafted, Italian leather-bound binder draped with silk ribbons in the color of the Libyan flag to present on bidding day. As the oil minister, Faud Kabazi, picked up our handsome binder among all the plain paper stacks, he smiled and let out an audible sigh of admiration. I happened to be sitting at the table with the large Mobil contingent and heard the manager scold their lawyer, "Why the hell didn't you think of that?"

Within the bid, we included terms to drill for water at the Kufra Oasis and bring in a knowledgeable farmer to experiment with growing different crops nearby. We also included a pledge to submit designs on how to use the natural gas to be beneficial in a fertilizer plant.

We won both bids – Oxy Libya was in business!

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AAPG Education Upcoming Education Events 2016

AAPG HEDBERG RESEARCH CONFERENCE CENTER

Mudstone Diagenesis: Implications for Exploration and Development of Unconventional Reservoirs

October 16-19, 2016, Santa Fe, New Mexico

The purpose of this conference is to foster the free exchange of new ideas among leading experts from industry, academia, and government on the controls and impacts of inorganic and organic diagenesis on mudstone hydrocarbon generation, reservoir properties and seal quality.

This conference will promote the exchange of new ideas among the leading experts from industry, academia, and government on the controls and impacts of inorganic and organic diagenesis on mudstone hydrocarbon generation, reservoir properties and seal quality.

Until recently, most researchers investigating shales concentrated their research efforts towards understanding: (a) hydrocarbon generation and expulsion, (b) seal capacity and (c) overpressure generation. Most data used to support these investigations were derived from organic geochemistry, relatively low magnification optical petrography, and bulk rock characterizations. Notably lacking from these studies is the characterization and evaluation of the potential impact of mudstone diagenesis.

New analytical techniques in scanning electron microscopy (SEM) have allowed investigating mudstone properties down to the nanometer scale. New SEM observations of mudstone micro-texture have revealed the presence of authigenic cements, and have captured various stages of the transformation of organic matter during petroleum generation. An improved understanding of mudstone organic and inorganic diagenesis is required to advance the ability to better predict shale reservoir quality and heterogeneity.

FORUMS

LAST CHANCE!

2016 Pacific Section AAPG Playmaker Forum: Finding Value in Mature Basins

May 13, 2016, Bakersfield, California

We'd like to invite you to register and participate in the 2016 Pacific Section AAPG Playmaker Forum: Finding Value in Mature Basins! This special one-day event will be held on Friday, May 13th, 2016, at Aera Energy in Bakersfield. It will focus on adding business value via exploration, development, and innovation in our West Coast petroleum provinces. We have a lineup of great talks; currently they include presentations on the regional geology of the Ventura basin, recent exploration successes in the San Joaquin basin, development projects in the L.A. basin, and the Monterey Formation. The Playmaker Forum will be a great way to learn more about our fascinating Pacific Section petroleum provinces, facilitate industry networking, and visit with friends and colleagues. This event is especially relevant in light of the current oil-price environment our industry faces. We're excited about Finding Value in Mature Basins, and we hope to see you in May!

GTW

LAST CHANCE!

New Thinking and Value Propositions: ProActive Steps Now

May 17-18, 2016, Houston

The goal of this two-day workshop is to proactively create opportunities for yourself and your company in a low price environment. You will learn how to bring value propositions to operators. Revitalize reservoirs for less than the cost of plugging and abandoning, paid for by increased production. Rethink reservoirs and push paradigm shifts that will result in breakthroughs. We will discuss how to use these times to pilot new products and technologies and thus position innovative companies to boom when conditions improve. This event is for engineers, geologists, geophysicists, land professionals, and entrepreneurs. Register Today

SCHOOLS AND SHORT COURSES

Basic Seismic Interpretation

May 17-18, 2016, Tulsa, Oklahoma

The course consists of lectures on fundamental topics including basics of petroleum geology, seismic response, velocity, resolution, seismic migration, seismic correlation and mapping techniques, and quantified interpretation. Lectures are supported by hands-on exercises, and the second day of the course includes two practical correlation and mapping projects. Each participant receives a copy of SEG Geophysical Monograph Series #16, First Steps in Seismic Interpretation, by Donald A. Herron.

"Old" (pre-1958) Electric Logs: A Quick Review

May 19, 2016, Tulsa, Oklahoma

The course consists of lectures on the different "old" well logs, what they measure and how they are used in the analysis of a potentially hydrocarbon productive zone. The importance and how to make bore hole and thin bed corrections to the non-focused resistivity logs will be outlined in detail. The different rules used to analyze the old resistivity log will be presented with examples. The different unique problems presented to the log analyst when working with older well logs will be outlined and discussed in detail.

Quick Guide to Carbonate Well Log Analysis

May 20, 2016, Tulsa, Oklahoma

The course is designed to be of benefit to geologists, engineers and technical support people who are involved in oil and gas exploration and production in carbonate reservoirs. As the title states, this is a quick guide that concentrates on methods used to analyze carbonate reservoirs. It is an advanced course and assumes the course participants are already well informed about basic well logging principles.

Introduction to Oil Sands Thin Section Analysis

June 18, 2016, Calgary, Alberta, Canada

This course is designed for the beginner to seasoned professional who would like a review of unconsolidated oil sands reservoir petrology. This includes geologists, petrologists, asset teams, R&D teams, and petroleum engineers.

Upon completion of the course, participants should be able to have a basic understanding of important concepts of oil sands on the micro scale including:

- Unconsolidated oil sands/sandstone reservoir petrology
- Interpretation and application of thin section data into reservoir management
- Theory of oil sands fabric analysis – qualitative (descriptive) analysis
- Texture and fabric analysis for reservoir management
- Introduction to quantitative analysis (image analysis)
- Obtaining reservoir properties from thin sections
- Microscopes and thin sections
- Making thin sections and common artefacts
- How/Where thin section analysis data can be used (ie. Geomodels/Sand Production)

Advanced Geochemical Technologies: Methods That Reveal the Rest of Your Petroleum System

June 19, 2016, Calgary, Alberta, Canada

The course is geared toward exploration/development geologists, especially those engaged in basin modeling and/or geochemical applications. Although several new technologies and methods will be presented in this course, no particular knowledge or experience is required to understand them and benefit (i.e., beginners will benefit).

The technologies and methods to be presented in this course have been underutilized compared to the wealth of new understanding they can bring forth when applied to petroleum system analysis and modeling. Participants will learn:

- New skills for identifying where deep sources occur
- Methods for determining their provenance from analysis of liquids
- Technology for determining co-sourced oil mixtures
- Latest techniques for constraining the age of an oil source from analysis of an oil sample (age-related biomarkers)

Integration of Petroleum Geochemistry and Reservoir PVT Analyses for Evaluation of Hydrocarbon Resource Plays

June 18, 2016, Calgary, Alberta, Canada

The content is designed for novice to intermediate level geoscientists or as a refresher for advanced students. Managers with a financial background have also benefitted from this course. Upon completion of this course, participants will:

- Know how to integrate data from source rock, mud gas, produced oil & gas, and reservoir engineering to better understand and exploit 3-D details of petroleum systems.
- Understand how source rock, stable carbon isotope and biomarker geochemistry can be used to determine quantity and type of generated hydrocarbons and migration distance and direction within source rock and tight oil plays.
- Discover a greater understanding of the nature and productivity of resource plays and co-located conventional reservoirs through the integration of hydrocarbon phase behavior (using PVT analyses) and these geochemical data.

Check our website for discounted fees for Laid-Off Geologists, Geoscientists and Students

www.aapg.org/career/training/

Dick Vaughan at the 14,860 bopd test of the D-102 well, which was OXY's first international discovery in early 1967.

Sahara

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Send Money and Farmers

With our newly won concessions we got to work. We hired a friend and well-respected farmer from back home, Archie Frick, to come to Libya to start experimenting with crops at the Kufra Oasis. We also deconstructed and flew over a water-drilling rig to Libya. With Archie overseeing the water well drilling at Kufra, he reported that they kept bailing fresh water from deeper and deeper, drastically surpassing any expectations we had. In fact, Archie found a 2,500 foot fresh water column in the middle of the Sahara Desert that was recognized as the largest unknown aquifer in the world. Aluminum irrigation pipe was flown over from home and every crop Archie planted seemed to thrive. Grains, vegetables, alfalfa and fruit trees flourished at Kufra which greatly pleased the king. We also followed through and developed and submitted to the oil minister plans for a fertilizer plant.

Spud Time

Oxy Libya's first exploratory drilling activity was in 1966 on Concession 102, which was geologically dominated by a large granitic knob that had been an island in the Paleocene sea. The prior operator drilled the crest of the granitic high and found nearly dead oil shows, but no reservoir quality rock. Oxy's discovery well D-102 was located on the westerly flank of the knob and encountered porous, coarse granitic wash sediments fringing the old island. The discovery well was tested at a rate of 14,860 barrels per day of clean 36.2 gravity oil and became the second largest discovery in Libya's history. Eight subsequent follow-up wells tested at an average of nearly 10,000 BOPD each. The field was named Augila after a nearby very small desert village. We were on the map and any grumblings from back home turned to excitement!

One Line Wonder

After the discovery of Augila, we commenced with our seismic program based on our concept of exploring off the structural highs to see if we could find where the reef material had come from on the Block 103 concession. Through mostly dumb luck, we located our first and only digital seismic line parallel to and along the flank of the Amal Ridge. GSI's Frank Fuller called a bit breathlessly from London and informed us he would hand deliver our very first seismic line shot on Concession 103 the next morning. Upon arrival at our office before saying hello, the very first question he asked was why we had located the line where we did. He then asked if we had ever seen a pinnacle reef on a seismic line. "No!" was the answer from the two California geologists and lone geophysicist. He then produced an example analog line from Mexico in the Tampico area that had a well-defined pinnacle reef.

Then he unrolled our first flank, digital seismic line: there were five, quite prominent pinnacle reefs jumping off the page and staring us in the face. What are the odds of that happening on our one and only flank seismic line? With the help of several subsequently shot dip lines, these reefs were determined to be about one mile in diameter and about 1,000 feet thick. With all the subsequent seismic we shot, we did not find any additional reefs. They were all imaged on our first line. Another curious aspect of these reefs was that they all had a seismic "sag" beneath them. We surmised this could be due to high porosity, possibly slowing the seismic waves down. The average porosity of these reefs would turn out to be about 34 percent.

The Reef

After the seismic discovery of the pinnacle reefs, the drilling rig was contracted and the first well was spud in 1967. The top of the reef was contacted around 9,300 feet, as detected by the mud loggers with a big drilling rate break.

Continued on next page

Continued from previous page

The wait for "bottoms up" to give us our first physical evidence of what might lurk beneath ticked by with the mud pump counter diligently clicking away. The ink-filled pens finally began to inch to the right then abruptly shot off the chart on every back-up scale with the gas alarm singing and coring commenced. Every day more boxes of core were air-freighted off for analysis at Robertson's Research facility in Wales. One thousand feet of oil saturated, porous reef was penetrated in all, matching our seismic estimate closely. The recoverable reserve calculations were in the order of one billion barrels.

Big Campfire

Five separators were as many as we could beg and borrow from the local operators for the production test. We plumbed them up to every conceivable valve on the Christmas tree and hammered anchors over the flow lines out into the Libyan Desert. The initial production test easily maxed out the five separators at over 40,000 barrels per day. The ground roll was so dramatic that it temporarily shut down a seismic crew operating 20 miles away.

The best of the reefs was selected for initial development. Gas from an adjoining reef was injected into the top of the reservoir. Water from an underlying, higher pressured zone was "dump-flooded" into the bottom to maximize rate and recovery.

Forty wells were drilled and completed in the first developed reef. The wells had oil/gas separators capable of processing 40,000 BOPD per two wells. One well was plumbed to handle 80,000 BOPD and exceeded that amount.

D.I.Y.

After the discovery of the pinnacle reef fields on Concession 103, it became even more imperative that some way had to be found to get all of this oil to market. Understandably, the other operators were less than thrilled to have this quantity of new oil competing in an already fully supplied market. They therefore refused to transport Oxy's oil to the coast in their existing pipelines. Oxy at that point retained the Bechtel Corporation to design and build a pipeline to the coast and a marine loading facility where there had been nothing but miles of sandy beach. A 135-mile long 40-inch diameter pipeline was laid to the Mediterranean coast terminating at the small village of Zueitina. This was accomplished in record time by utilizing three pipe-laying spreads simultaneously. A harbor was created for the service vessels and an offshore facility was built for loading the tankers, the first of which arrived in February 1968. In addition to the pipeline and loading terminal, five large storage tanks each with a capacity of approximately half a million barrels were erected at Zueitina for storage cushion between tanker arrivals. Additionally, a desalination plant was built to provide fresh water for the nearby villages.

We Get Our Own Stamp!

A giant ceremony was made to commemorate the opening of the Zueitina terminal. The new sand "freeway" through the desert would first be driven on by a car carrying King Idris followed by dozens of others in a grand procession. As the king's car passed, sheep were sacrificed (which apparently was not fully appreciated by our wives, who were in the non-air-conditioned and very last car with the king's wife). Once again the king was very pleased with Oxy Libya and presented us with a national postage stamp of our joint accomplishment.

By the summer of 1969, those 40 wells were producing 800,000 BOPD. At that time Oxy Libya became the eighth largest producer in the world. Gaddaffi spoiled the party on Sept. 9, 1969, after leading a *coup d'état* on Sept. 9. All of the other Oxy fields were never or only partially developed. One million barrels a day had been within sight.

I've been extraordinarily privileged to have worked with the amazing friends that comprised our team that forged Oxy. In the ensuing 15 years we went on to discover 10 BBOE. Not too bad for a little company from Bakersfield!

Commemorative stamps from the Ministry of Petroleum Affairs issued after the opening of the Zueitina Oil Terminal in 1968.

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

Spectral Decomposition For a More Accurate Image

By RONGFENG ZHANG

When seismic data is decomposed into individual frequency components, as is done in spectral decomposition, some subsurface features, such as channels, can be distinguished at certain frequency components.

There are several ways of performing spectral decomposition of seismic data in terms of the mathematical method adopted, such as short-time Fourier transform (STFT), continuous wavelet transform (CWT), S-transform etc. Each method has its own strengths and weaknesses.

Seismic Uncertainty

Seismic data, especially 3-D seismic data, are critical and indispensable in many cases. However, its significance and degree of trustworthiness vary among geoscientists, especially geologists.

The disparity could be greater if the target area has good drilling coverage. This is because the seismic data is a collection of subsurface events, which include reflections, diffractions and refractions, as well as noise and other factors unrelated to subsurface geology. Though spectral decomposition of seismic data may reveal and enhance geological features, it can also introduce artifacts and uncertainty.

The author's article in the February 2014 issue of the EXPLORER explained the most significant artifact, the so-called side-lobe effects, which are the extra events caused by the algorithm employed rather than by the subsurface geological features. In that article, a new method was introduced to suppress these artifacts. The essential idea was to use a wavelet extracted from the acquired seismic data itself to do the decomposition, which is data-adaptive, because the extracted wavelet is different in different datasets and in different areas. The results show better images due to largely reduced artifacts.

The subsequent research and applications indicated that a single wavelet used to do spectral decomposition is often not adequate, because the wavelet can and often does change spatially, even in the same dataset, as seen in figure 1, where the space-varying wavelets extracted from seismic data in Taranaki Basin, New Zealand are shown.

Improvement Through Space-Varying Wavelets

The extracted wavelets have the same location of inline and crossline as that of the seismic data volume because at each inline/crossline location, a single wavelet will be extracted. Figure 1 is actually a time-slice view of these extracted wavelets. Using these space-varying wavelets instead of a single wavelet to do the decomposition makes noticeable improvements, as seen in figure 2, where time slices from the 30 Hz frequency volumes after spectral decomposition were performed using a single wavelet (figure 2a) and space-varying wavelets (figure 2b) are shown, respectively. They look quite similar, especially in the east area, right beside the roughly north-south fault. However, noticeably cleaner images of several meandering channels in the west area in the right image can be easily discerned. Note that the color bar and the scale bar are the same for both figure 2a and figure 2b for comparison. Figure 3 is a close up of the southwest corner (indicated with a rectangle in figure 2) where the channels are located. The improvements are believed to be the result of further reduced artifacts compared with the result obtained using a single wavelet. In this case, we see a big overall change of seismic data characteristics between the west and east side of the fault. A single wavelet is clearly not able to represent the whole dataset. A space-varying wavelet is more appropriate. At each inline/crossline location, a single wavelet is extracted using seismic data around the location. Eventually, there are the same number of wavelets being extracted as the number of traces in the seismic dataset. Furthermore, only a small portion of the seismic data in the time interval of interest is selected.

Obviously, the space-varying wavelets bring out geological aspects that may not be seen with the use of a single wavelet.

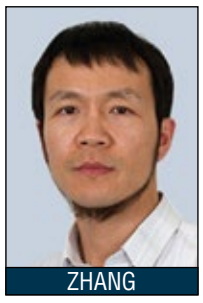
Because the space-varying wavelets are extracted in a time and range of interest, it will carry the information within that range and is of interest to us. Therefore, these extracted space-varying wavelets themselves will reflect subsurface geology in that time range and are potentially interpretable.

Comparing figure 1 with figure 2, it can be seen that the two images look similar; for example, compare the north-south big fault and the block of data in the west and east.

Further investigations are needed to explore this benefit in more detail.

The author would like to thank Geomodeling Technology Corp. for their support.

Rongfeng Zhang is a senior geoscientist with Geomodeling Technology Corp.



ZHANG

> The significance and degree of trustworthiness (of 3-D seismic data) vary among geoscientists, especially geologists.

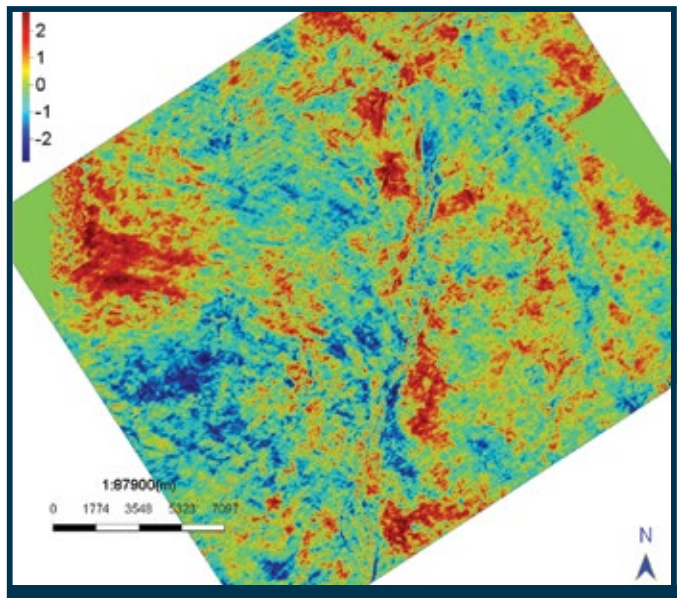


Figure 1: Map view of the extracted space – varying wavelets from seismic data in Taranaki Basin, New Zealand.

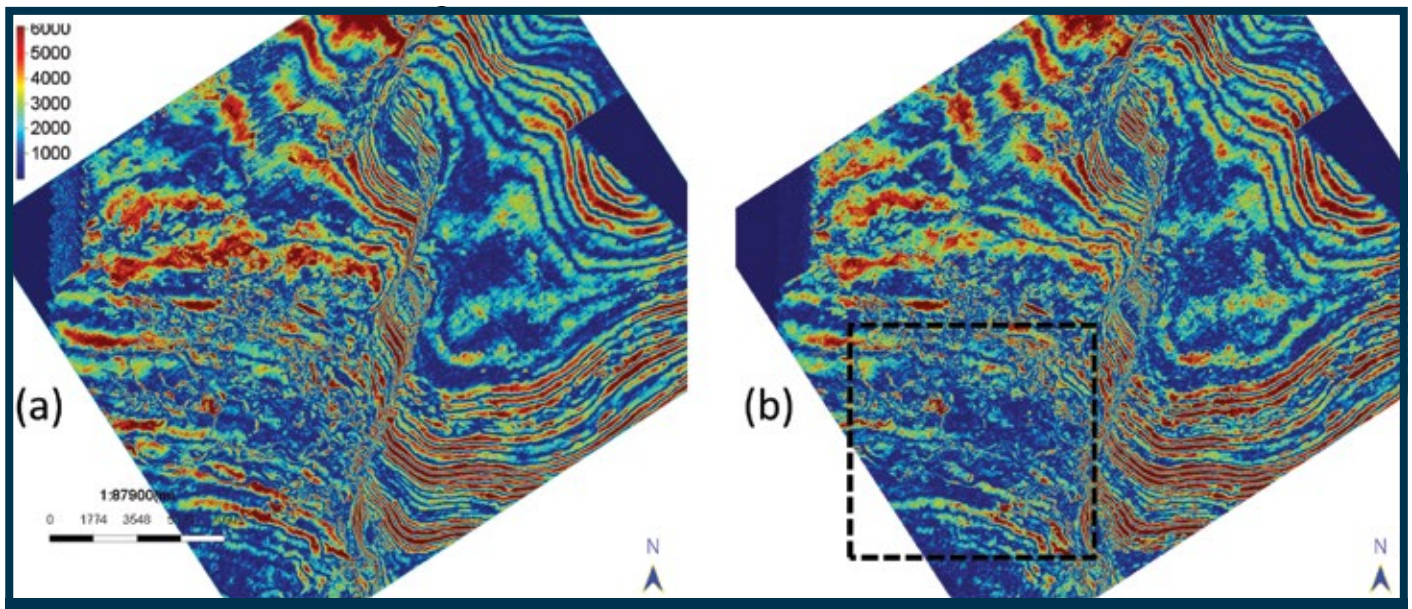


Figure 2: Time slices from 30 Hz frequency volumes obtained with spectral decomposition using (a) a single wavelet, and (b) space-varying wavelets. Notice the overall more distinct image in (b).

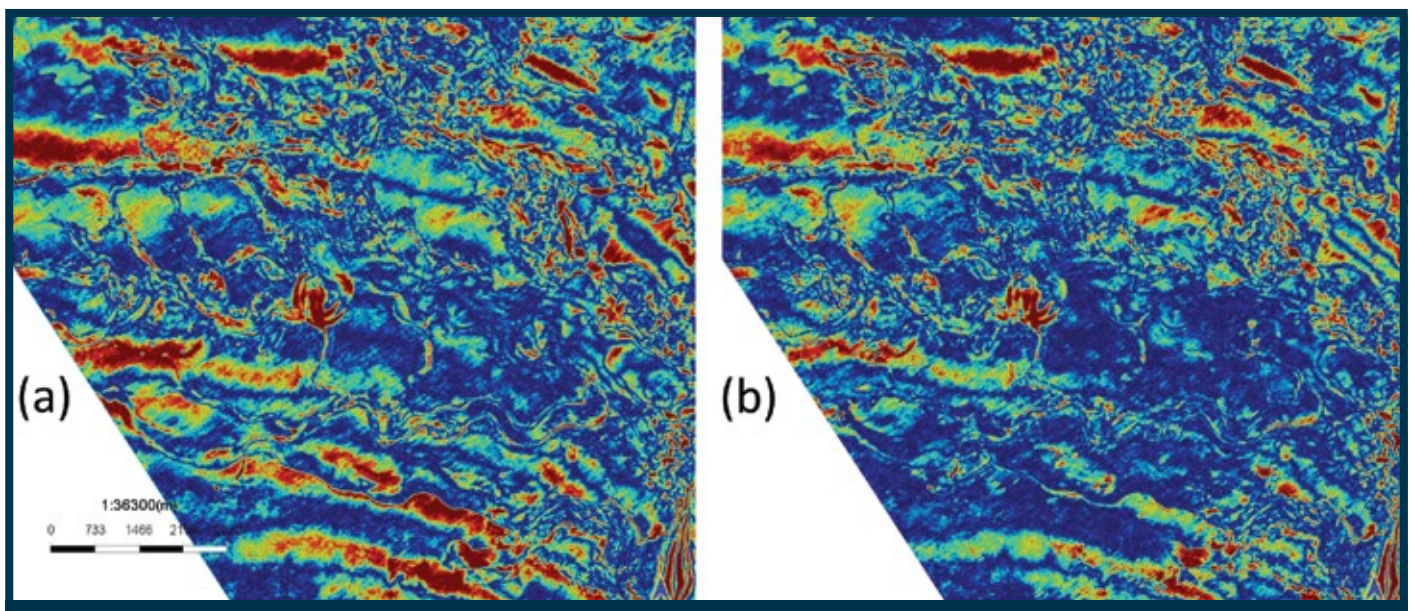


Figure 3: Zoom of a small area as indicated by the dashed rectangle in figure 2b. Notice the overall clarity of the image in (b).

A Journey with AAPG:

From Student to Professional Geologist

By JOYANTA DUTTA, Asia-Pacific Region YP and Development Geologist for Chevron Bangladesh

I enrolled in the Department of Geological Sciences of Jahangirnagar University, Bangladesh, back in 2005 without knowing much about geology and its applications. In a developing country like Bangladesh, where many of the affiliated sciences are not well recognized and popular among students, I had no clue about the petroleum industry and its link with geology.

In 2006, one of my professors introduced us to AAPG and I became a member of the AAPG Student Chapter. Under the umbrella of AAPG, I started attending different seminars and conferences held in the country where I came to know about the petroleum industry in detail. I was always excited to participate in these meetings and interact with experienced professionals in the oil and gas industry. The free Bulletins and magazines I got from AAPG as a student member also help me stay updated on the global petroleum industries and the latest technologies. I started dreaming about becoming an oil and gas professional in my future career.

I became the president of my university's AAPG Student Chapter in 2009. During this time, I had the unique opportunity to arrange a seminar at my university with Dr. Joseph Lambiase, who at the time was president of AAPG's Asia Pacific Region. I became acquainted with some officials from different international oil companies working for Bangladesh, specifically Dr. A.H.M Shamsuddin (Shams), chief exploration geologist of Chevron Bangladesh and sponsor of Bangladesh's AAPG Student Chapters.

Joyanta Dutta wrote the winning non-technical article of the AAPG Middle Region Young Professionals 2016 Article Contest.

Through my interaction with Dr. Lambiase, I learned about a scholarship in petroleum geosciences in Thailand. After completing my master's in geophysics and securing the highest CGPA in both bachelor and masters' studies from my department, I applied to the scholarship program. I received a scholarship to Chulalongkorn University and started my classes there in August 2011.

Later, when I was planning to do my thesis work, I was contacted by Dr. Shams who proposed to have my research work sponsored by Chevron Bangladesh.

After successfully completing the research work, I got a job offer from Chevron. I joined the company as an earth scientist in October 2012. To date, I have planned development wells, worked operations in an over-pressured zone and generated a 3-D earth model – the first in the country.

Despite my busy schedule, I continue to stay involved with AAPG. In 2014, I became the country representative for the AAPG Young Professionals.

Looking back on my education and professional career, I found that having a close relationship with a big association like AAPG was very helpful. It inspired me to become a professional in the petroleum industry and is now helping me build a professional network, which will certainly help grow my future career too.

(Editor's note: This was the winning non-technical article from the AAPG Middle East Region Young Professionals 2016 Article Contest.)

Inspiring the Future of Energy in a Downturn

By APRIL STUART, AAPG Foundation Program Coordinator

Long heralded as a pioneer in the petroleum geology industry, L. Austin Weeks made a name for himself not only in the field, but as a generous benefactor who paid his success forward. Not only is he the namesake for the AAPG Foundation's highest honor, the L. Austin Weeks Memorial Medal, but he is also the founder of one of the Foundation's most vital programs for advancing geoscience education.

Weeks, along with his wife Marta, made a significant contribution to the Foundation in the late 1990s that went on to support thousands of students in their pursuit of geoscience education.

The gift paved the way for aspiring geologists to take field trips, attend geology conferences and apply funds toward tuition costs and the purchase of tools to use in the field, like rock hammers, compasses and more.

Expanded Reach

The program was initially earmarked for Student Chapters but expanded in 2014 to provide aid to more individual students and their student-led geoscience associations.

This expansion has garnered a great deal of interest and attention over the past couple of years and has provided a new avenue of opportunity for students who hadn't previously been exposed to AAPG to learn about the myriad benefits of the Association.


NELSON

> "I have found that there is a large group of undergraduate students out there, both domestic and international, that are very dedicated to our profession."

It generated so much interest that the Foundation went on to form an official committee of judges to take on the tasks and lengthy process of reviewing, scoring and selecting top applicants each year.

When asked who among Foundation volunteers would be able to assist with coordinating the selection process amidst the growing demand for grant funds, Ron Nelson enthusiastically stepped forward to assume the leadership role as chairman.

He recruited a team of judges to assist with the process and is currently working on a formal scoring process to standardize the application assessment process, which will enable judges to score using a normalized ranking method.

Nelson is a longtime AAPG volunteer who has provided guidance in various selection processes within AAPG for many years, and whose service continues to provide a level of continuity in AAPG Foundation endeavors.

Harnessing Talent

Nelson's work in leading the committee is inspired by two driving motivations: tapping students' talent and working with a very talented group of professional geoscientists.

"I agreed to chair this review committee because it is an important part of the AAPG Foundation donation portfolio," Nelson said. "And because I enjoy facilitating the work of a very focused and knowledgeable group of volunteers."

The new committee consists of a strong roster of AAPG and AAPGF supporters, including Lee Billingsley, Scott Cameron, Denise Cox, Don Clarke, Bob Countryman, Jim Funk, Jennifer Goodwin, Priscilla Grew, Terry Hollrah, Neil Hurley, John Kaldi, Joe Lambiase, Steve Laubach, Don Lewis, John E. Lucken, Jim McGhay, Peter MacKenzie, Bill Monroe, Victor Ogunmola, Kay Pitts, Borden R. Putnam III, Dave Rensink, Rusty Riese, Valary Schulz West, Charles Sternbach, Paul Weimer and K.C. Weiner.

Nelson said the quality of the top applications is remarkable, showcasing the importance of being able to provide funds.

"Over the last couple of years of reviewing the undergraduate grant applications, I have found that there is a large group of undergraduate students out there, both domestic and international, that are very dedicated to our profession and will work tirelessly to advance their knowledge and career," Nelson said. "This deserves our combined support."

When asked what would motivate his peers to support this effort, Nelson shared that "AAPG Foundation donors should consider donating to the AAPG Foundation L.A. Weeks Undergraduate Grant program because this support comes at an important time in the students' career that can solidify their career choice, especially in the low price environment our industry is experiencing today."

If you are interested in supporting undergraduate students through the L. Austin Weeks Undergraduate Grant program, contact programs coordinator, April Stuart, at (918) 560-2664 or astuart@aapg.org.

CLASSIFIEDADS

POSITIONS WANTED

DEPARTMENT OF GEOLOGICAL SCIENCES, UNIVERSITY OF FLORIDA
Research Assistant Professor, Micropaleontology

The Department of Geological Sciences, University of Florida in association with the Florida Museum of Natural History, invites applications for a Research Assistant Professor with expertise in micropaleontology, especially Foraminifera. The successful candidate will be expected to improve the stratigraphic and systematic microfossil collections at the Florida Museum of Natural History, develop independent research projects utilizing those collections, and teach one undergraduate paleontology course and one other course as appropriate. This is a twelve-month, full-time, non-tenure track position. It is renewable annually upon successful review, with an expected maximum term of three years. A Ph.D. in geology or a closely related field is required. The salary is competitive and commensurate with qualifications and experience and includes a full benefits package.

For additional information please contact Dr. John Jaeger, Department of Geological Sciences, University of Florida, P.O. Box 112120, Gainesville, FL 32611-2120. Review of applications will begin on April 18, 2016 and will continue until the position is filled. Candidates must apply online at http://explore.jobs.ufl.edu/cw/en-us/listing/ Job Requisition # 496762. For full consideration, the application should include: (1) cover letter, (2) curriculum vitae, (3) statement of research and teaching experience and goals; and (4) the names of three colleagues who might be contacted for letters of recommendation.

The final candidate will be required to provide an official transcript to the hiring department upon hire. A transcript will not be considered "official" if a designation of "Issued to Student" is visible. Degrees earned from an educational institution outside of the United States must be evaluated by a professional credentialing service provider approved by National Association of Credential Evaluation Services (NACES), which can be found at http://www.naces.org/.

The University of Florida is an Equal Opportunity Institution. If an accommodation due to a disability is needed to apply for this position, please call (352) 392-2477 or the Florida Relay System at (800) 955-8771 (TDD). The selection process will be conducted under the provisions of Florida's "Government in the Sunshine" and Public Records laws.

MISCELLANEOUS

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Jack Conklin
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Matching gifts given by Bruce Wiley
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John P. and Laura C. Moffitt
Sarah Springer and Rusty Riese
John and Kate Spaid

L. Austin Weeks Undergraduate Grant Fund
Abigail T. Hymel
In memory of Jerry Markowitz

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

AAPG Visits With Washington Policymakers

By EDITH ALLISON, Geoscience and Energy Policy Office Director

At AAPG's 2016 Congressional Visits Days (CVD) on March 15 and 16, AAPG members participated in 27 meetings with members of Congress and executive branch agencies that research or regulate oil and natural gas activities.

Member visits are an important supplement to visits by AAPG's Washington, D.C. staff. A personal story from a constituent who is an AAPG member can help policymakers understand and remember how decisions made in Washington affect people and businesses in their district.


ALLISON

> Our meetings coincided with a surge of interest within Congress for opening the Atlantic OCS to oil and gas development.

Additionally, AAPG members provide a unique scientific perspective to the political landscape that may otherwise be shaped by strongly worded rhetoric from trade associations and environmental organizations.

In CVD meetings, AAPG members not only gather insights into how the government works, but they also establish a personal connection with their senator or representative to enable future discussions back home.

AAPG members have interest and expertise in many issues that are important in Washington this year. The two that engendered the most discussion are potential oil and gas leasing of the Atlantic outer continental shelf (OCS) and produced water reuse and seismicity caused by wastewater disposal.

AAPG members also encouraged the continued funding of federal oil and gas research to develop advanced exploration and production technologies and to train the next generation of geoscientists.

Produced Water

The Congressional Research Service (CRS) – our first meeting on March 15 – is the non-partisan office Congress relies on for answers to technical and legal questions. CRS scientists and engineers questioned AAPG members about produced water treatment and reuse, reflecting their sense that this is a developing issue for Congress. The issue reflects concerns about how to reduce water consumption for hydraulic fracturing, which competes with municipal and agricultural demands in arid parts of the country. In addition, wastewater treatment is important in reducing the volumes of water injected in disposal wells that may be implicated in induced seismicity.

At another meeting, the Department of Energy (DOE) Oil and Natural Gas program managers described their research on beneficial use of produced water. The DOE-managed Research Partnership to Secure Energy for America is in the final stages of several projects to demonstrate produced-water treatment and reuse.

Shortly after CVD – on March 28 – the U.S. Geological Survey released their assessment of the potential for damage to homes and buildings from induced seismicity near wastewater disposal wells.

AAPG members also met with the Environmental Protection Agency (EPA) scientists that prepared the study on potential impacts of hydraulic fracturing on aquifers, now being peer reviewed. The EPA scientists were interested in learning from AAPG members how hydraulic fracturing technology is improving. We all agreed that technological innovations are helping to reduce the environmental risks of hydraulic fracturing. The EPA's problem is how to document rapidly improving technology in a report that has taken almost five years.

Atlantic Oil and Gas Leasing

Our meetings coincided with a surge of interest within Congress for opening the Atlantic OCS to oil and gas development. That concern was prompted by the March 15 release of the proposed 2017-22 oil and gas-leasing program, which excludes the

See **Leasing**, page 28

Producers Turn to Big Data in Downturn

By KEN MILAM, EXPLORER Correspondent

As the industry grows leaner, its data banks grow ever fatter.

With data in the terabyte and exobyte range, many petroleum companies have launched "big data" initiatives to use the vast amounts of information to increase success rates and trim costs.

Information is collected by more and more devices deployed at all stages of exploration through production and delivery.

Halliburton's chief data scientist, Satyam Priyadarshy, is well-versed on the topic.

"When we think about big data, it's a confusing term. The definition we use is leveraging all the data by actually taking advantage of emerging technologies and analytics to create actionable and new insights from the data," Priyadarshy said.

"'All the data' means historical industry data, plus real time collections and future data from mobile devices — it's a continuous process," he said.

"The more data you add, you will get new patterns and will be looking for efficiencies," Priyadarshy said.

The speed with which data can be collected and viewed, often in real time, can provide "actionable insight at the field level," he said.

In addition to geologic challenges, the industry faces rising extraction costs, environmental restrictions and sometimes turbulent international politics.


PRIYADARSHY

> "The more data you add, you will get new patterns and will be looking for efficiencies."

Competitive Edge

In a 2013 Microsoft white paper, "Drilling for New Business Value: How innovative oil and gas companies are using big data to outmaneuver the competition," the authors note that companies are using data from myriad sources to make more confident data-driven decisions.

"Big data technology has applications across the entire oil and gas value chain – from geology and exploration to production and operations, transport and refining, and retail," the paper stated.

"Relying on historical drilling and production data from local sites, for example, can help scientists verify assumptions when new surveys are restricted by environmental regulations. Similarly, reviewing information, such as weather patterns and ice flows, from data marketplaces can help analysts make connections with operational processes, such as the impact of storms on rigs," the authors of the paper wrote.

In a May 2015 Forbes article, contributor Bernard Marr said, "Production forecasting is one of the first jobs – determining the likely output of the reservoir is key to determining what resources should be spent on collecting it. When this decision is data-led, operators can have more confidence that this will be done efficiently."

Writing in Analytics magazine, Adam Farris, senior vice president of business development for Drillinginfo, suggests the industry should do more.

"Other industries are embracing big data analytics, but the oil and gas industry is just now getting the concept. The oil and gas industry has dealt with big volume, variety and velocity, but must start thinking beyond self-made boundaries to truly capture the benefit awaiting," Farris said.

"The oil and gas industry needs more cross-fertilization. As oil and gas companies awake to the potential of analytics, many jobs will be created for data scientists, opening a portal for new applications and ideas to enter the industry," he said.

Rise of the Machines

Farris also predicted that smarter machines will aid in interpretation and decision-making.

"Soon we will not just capture data and view it, which still requires experienced personnel to make a large number of decisions. We will have smarter solutions, with built-in intelligence, so computers can make simple decisions, while indicating a set of potential outcomes to the user in more difficult situations, helping with faster decisions based on best practices. Ultimately, costs for these operations will be cut and production will go up," he said.

Priyadarshy said complex algorithms allow analysis of data from multiple sources in a much shorter time. This, in turn, allows faster decision-making.

But it's not just about saving time, he said.

"How can I improve efficiency?" he said.

"We are looking for a return on innovation — return is long-term. If I get 1 million traces, I may save five days. If I get 5 million traces, will I save fives times as much? Not really. We are looking for new insights," he added.

EMD
from page 30

EMD's sponsored theme of Oil Sands, "Responsibly Exploring and Developing Vast Bitumen Resources," includes talks on facies, stratigraphy, reserves, caprocks and environment plus a general poster session on oil sands.

The full program details are found at ACE.AAPG.org.

EMD Workshops

The EMD is also sponsoring a workshop to highlight the global nature of the oil sands and heavy-oil resource, advances in recovery technologies, and the contributions resource geoscientists are making to the challenges of environmental protection, social license and sustainable energy development.

The EMD, along with the Society of Exploration Geophysicists (SEG) and AAPG's Division of Environmental Geosciences (DEG) will host a joint, multidisciplinary, technical Oil Sands and Heavy-Oil Workshop: "Furthering the Collaborations and Sharing the Learnings." This engaging and interactive one-day workshop will be held Sunday, June 19, and includes several talks and panel discussions covering investment, geology, reservoir engineering, geophysics, environment challenges and risk. Speakers include presenters from the Canadian Energy Research Institute, Suncor Energy Inc., University of Calgary, Devon Energy, Terra-IQ, Shell, NEXEN CNOOC ULC, University of Alberta and Alberta Energy Regulator/Alberta Geological Survey.

Workshop information can be found at ACE.AAPG.org/2016/program/workshop.

EMD Luncheon: 'Green' Energy Solution

With the impact of current low natural gas and oil prices on unconventional resources, we are pleased to announce that our speaker at the EMD Luncheon on Wednesday, June 22 is Reg Olson, a former senior adviser of mineral resources with the Alberta Geological Survey, whose talk on uranium is titled "A Look Back in Canada and Forward to a Possible Worldwide 'Green' Energy Solution."

In addition to Olson's talk, during the luncheon EMD will host its annual Honors and Awards ceremony recognizing those who have served the organization with distinction in various capacities, as well as presenting awards for the best oral and poster presentations from the 2015 ACE in Denver (see the accompanying EMD 2016 Honors and Awards announcement).

We encourage all AAPG members to discover the "unconventional" aspects of EMD – and we look forward to seeing you at the EMD sessions, workshop and luncheon in Calgary.

Lastly, the EMD would like to thank all volunteers (theme chairs, abstract reviewers and future session chairs) who are helping to create our program this year. The EMD is always looking for new members and volunteers. To become a member of EMD, just log onto the AAPG website, click on "My Profile," find the Involvement tab to view your Division status and finally locate and click the "Join EMD" button.

Leasing
from page 26

Atlantic OCS. House and Senate members representing Atlantic and Gulf Coast states declared their interest in allowing Atlantic leasing. Many legislators are also interested in providing revenue sharing for states outside the Gulf Coast that have or may develop offshore production. Many of the congressional members with whom we met expressed interest in holding hearings on Atlantic oil and gas leasing and asked if we could recommend expert witnesses.

At a meeting with senior scientists and managers at the Bureau of Ocean Energy Management (BOEM), AAPG members conveyed their disappointment about the omission of Atlantic OCS leasing and encouraged BOEM to continue processing permits for Atlantic seismic surveys. AAPG visitors also asked members of Congress to continue to push for seismic permitting so that exploration companies and BOEM will have a better idea of the potential resources for future leasing considerations.

Federal Research

As Congress is working on legislation to fund the federal government, starting Oct. 1, the House Budget Committee is considering cutting geoscience research at the National Science Foundation and other government agencies.

AAPG members explained to their legislators the importance of federal geoscience research to maintain strong geoscience departments and develop the next generation of geoscientists. Federal research is especially important when industry research funding has dropped and students are taking additional classes in expectation of future increases in hiring by the oil and gas industry.

If you missed this congressional visit you can participate next year or you can join members of AAPG and other geoscience societies for Geoscience Congressional Visits Day (Geo-CVD) in September. For information about Geo-CVD 2016 or AAPG CVD 2017 contact Edie Allison at eallison@aapg.org or Colleen Newman at cnewman@aapg.org.

Awards
from page 30

The EMD Distinguished Service Award is given in recognition of a member's continuous, outstanding, exceptional and meritorious service to the Division:

- Jeremy Boak, in honor and recognition of many years of dedicated service to the EMD as chair of the Oil Shale Committee and as president, 2013-14.

EMD Past President's Award is given to recognize a year of dedicated, energetic service to the Division by its past presidents:

- Fran Hein, in honor and recognition of outstanding leadership and dedicated service to the EMD as president, 2014-15.

The EMD Certificate of Merit is presented to persons contributing to the overall success of the Division's activities by service at national or international annual or biennial meetings of the Division, by outstanding service on committees, or through other significant forms of service to the Division (such as at AAPG Section Meetings). This award recognizes recent or cumulative outstanding contributions, such as serving as a member of the local EMD planning committee for an annual meeting:

- Fran Hein, for outstanding service as EMD vice co-chair at the 2015 AAPG International Conference and Exposition (ICE) in Melbourne, Australia.
- Simon Horan, for outstanding service as EMD vice co-chair at the 2015 AAPG ICE in Melbourne, Australia.
- Jeff Aldrich, for outstanding service as EMD vice chair at the 2015 AAPG ACE in Denver, Colo., and for tabulating the EMD technical session judging results from the convention.

EMD Presentation Winners for Denver 2015 AAPG ACE

The Frank Kottlowski Memorial Award is presented to the author(s) of an oral presentation that is judged to be the "best oral paper" in any EMD-sponsored technical session at an AAPG ACE:

- James F. Reilly, for "Surviving the Red Planet: Preparing the Visiting Geologist to Live and Work on Mars."

A President's Certificate for Excellence in Oral Presentation may be presented to the author(s) of a runner-up oral paper:

- Gregory S. Benson, for "Fitting Deterministic Arcuate Map View/Sigmoidal Cross Section Surfaces to IHS Beds in Heavy Oil Fluvial Point Bars."
- Paul Oldaker, for "Twenty Years of CBM Production and Monitoring of the Pine River Subcrop and Gas Seeps, No Depletion."

A Loyd Carlson Memorial Best Poster Award is awarded to the author(s) of the best poster presentation in any EMD-sponsored session at an AAPG ACE:

- Xuejun Wang, Lirong Dou, Yuguang Zhao, Demin Mao, Qunwei Zhang and Xiaodong Wei, for "Fractured Granite Basement Reservoir Discoveries in the Bongor Basin of Chad."

A President's Certificate for Excellence in Presentation may be presented to the author(s) of a runner-up poster paper:

- Lin Ma, Kevin G. Taylor, Peter D. Lee, Kate J. Dobson, Patrick J. Dowey and Loic Courtois, for "Multi-Scale 3-D Imaging and Quantification of Pores, Organic Matter and Minerals: An Example From the UK Carboniferous Bowland Shale."
- Cosima Theloy, Jay E. Leonard and Sarah C. Smith, for "Comparison of Yet-To-Find Methods for the Determination of Recoverable Reserves From the Bakken: An Uncertainty Assessment Approach."

The honorees and awardees will be recognized at the EMD Luncheon being held Wednesday, June 22 at the 2016 AAPG ACE in Calgary, Alberta.

DIRECTOR'S CORNER

Diversify Your Options Through Lateral Thinking

By DAVID CURTISS

Last month I had the privilege to attend the AAPG-SEG International Conference and Exhibition (ICE) in Barcelona, Spain.

It was the first ICE under a new joint venture with the Society of Exploration Geophysicists that they operated, and it accomplished our principal objective: to create an opportunity for AAPG and SEG members to gather together to learn and to network.

That's more important than ever in the current industry downturn – improving skills, understanding and building the relationships our business is built on.

At ICE Barcelona we had several events dedicated to students. They have spent years studying, preparing to embark on a career, full of hope and anticipation of a bright future in petroleum geology. But after a crash in oil prices and massive layoffs across the industry, the prevailing feeling is one of uncertainty.

Now what?

As someone who finished graduate school in the low oil-price environment of mid-1990s and then experienced the sickening slump of the late-'90s, I can relate to these young people.

The traditional approach to career growth, of course, is to finish your degree and obtain either a job or internship with a major E&P company. You usually want to establish your professional pedigree by getting hired and trained by a super major or major, so you try to get into the biggest company you can. That may be where you stay your entire career or, more likely, at some point you move on to another firm, including perhaps the service industry or consulting, and eventually, retirement.


CURTISS

> If you've mapped out your career in your mind and you're convinced it has to look a particular way, you're falling into a linear-thinking trap.

Widen Your Field of Vision

This linear approach has stood many AAPG members in good stead and served the industry well, but in the current economic climate it's very difficult to get a toehold with that first job. There aren't many positions and there are a lot of people competing for them.

As I spoke to students in Barcelona I told them it's time to engage in some lateral thinking.

This isn't a new concept, and lateral thinking is something we can all employ, whether freshly-minted graduates or seasoned veterans looking for the next career move.

In fact, it's common in our cyclical industry that petroleum geoscientists have to pivot, change and reorient to launch and advance their careers.

How do you take the knowledge and skills you have, and perhaps gain additional skills, and then apply them to our industry? And what are some of the alternatives out there to consider?

Continued Education

If you're just starting out, an obvious choice is to stay in school.

You might pursue an advanced degree in geosciences, or pivot and extend your skills by pursuing business or legal studies. I'm a firm believer that to be an oil and gas professional, you need to understand how your science and exploration skills fit into the bigger picture. After all, we don't do science for its own sake; we do it to find and produce more petroleum, generating economic value for ourselves and society, and fueling the world.

A decade after completing my technical graduate studies, I returned to school to obtain graduate training in business while working full-time. These additional studies took up virtually all of my free time over the course of two years, but I have never regretted that investment of time and energy.

I've counseled several younger friends to do likewise in the years hence, and they, too, haven't regretted the experience. If you continue doing technical work you'll have a grasp of the administrative and financial side of the business. And if you want or need to pivot your career, you'll be able to leverage your geoscience expertise in the business or financial sectors. I know people who have done both.

Public Sector Options

Another opportunity exists in the regulatory and policy side of the oil and gas industry.

Contrary to the perception conveyed by today's media, the petroleum business is a highly regulated industry sector.

Producing the oil and natural gas the world needs is in everyone's best interest, as is ensuring it is done safely and in an environmentally responsible manner.

That requires knowledgeable professionals, and who better than trained geoscientists to serve in these roles?

Even if you work in a regulatory agency for only a few years before transitioning into an industry position, you'll understand how to effectively work with regulators, and that's a valuable skill.

There are several senior U.S. government officials who are AAPG members, using their technical and policy expertise to develop good policy and ensure the safe production of the nation's energy resources. The U.S. government is looking to hire more people like them – perhaps someone like you.

Work For Yourself

Perhaps the ultimate in lateral thinking is pursuing an entrepreneurial path. How can you take your geoscience knowledge and life experience to create value?

You might identify a need companies have that you can fill, becoming a part of the service sector that supports finding and producing hydrocarbons.

Or, you could assemble a team of geoscientists, engineers and equity to start your own oil company or partnership.

The entrepreneurial path takes unique skills and mindset, but who knows what you could create?

Here's the point: If you've mapped out your career in your mind and you're convinced it has to look a particular way, you're falling into a linear-thinking trap. You have no options if things don't work out the way you hope.

Lateral thinking, in contrast, forces you to broaden your field of view, looking left and right, up and down for all the ways you can leverage your unique skills and experience. It's here you can see opportunities, and with a dash of courage you step into the unknown and into your future.

DIVISIONS REPORT: EMD

Strong and Informative EMD Technical Program At ACE

By SHARLEEN OVERLAND, EMD Vice Chair, and BOB TREVAIL, EMD President

AAPG's Energy Minerals Division (EMD) is excited to present a strong and informative technical program at the 2016 AAPG Annual Convention and Exhibition being held in Calgary, Canada, June 19-22 (plus pre- and post-events).


OVERLAND

> We encourage all AAPG members to discover the "unconventional" aspects of EMD.


TREVAIL

EMD has an intriguing program this year, covering a variety of unconventional energy topics of current interest to both EMD and AAPG members.

EMD Vice Chair Sharleen Overland and the theme chairs organized 13 oral sessions (99 talks), six poster sessions (79 posters), one joint workshop (with DEG and SEG) and the annual EMD Luncheon.

EMD's sponsored theme of Unconventional Resources, "Continuously Evolving and Expanding What We Know and Exploring What We Don't," includes EMD's unconventional spectrum in:

- Space.
- Alternative energy.
- Coal.
- Coal-bed methane.
- Oil shale.
- Unconventional plays (local and international).

In addition, recent advancements in pore scale techniques, microscale imaging, technology, source potential, maturity, stratigraphy and reservoir evaluation will be covered.

Poster topics include:

- Advancements in technology.
- Reservoir characterization.
- Geostatistics.
- Reservoir and fluid analysis.
- International.
- North American and other energy mineral plays.

See **EMD**, page 28

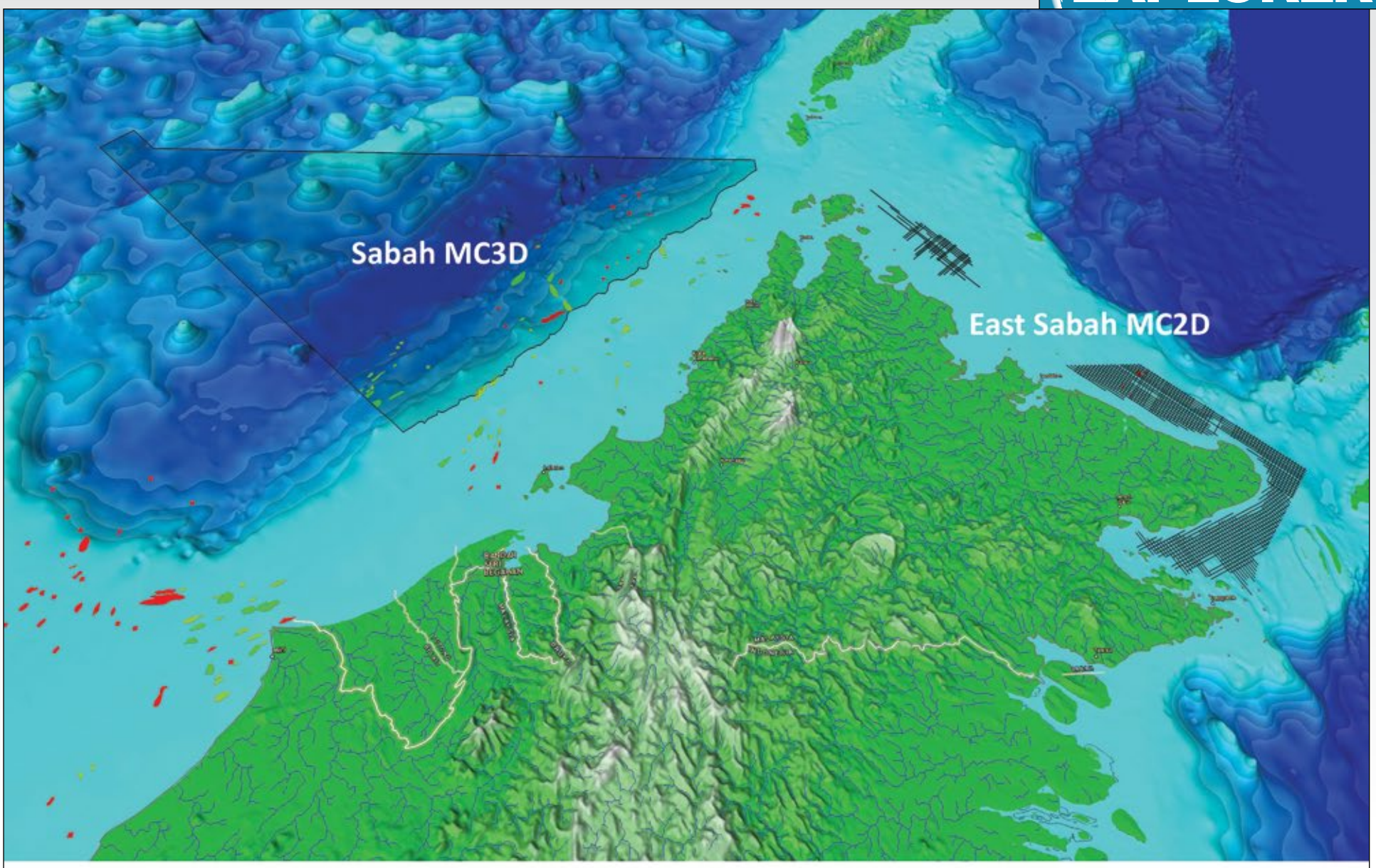
EMD 2016 Honors and Awards

AAPG's Energy Minerals Division (EMD) is pleased to announce the recipients of its 2016 awards for service to the organization and for presentations (oral and poster) given at the 2015 Annual Convention and Exhibition (ACE) in Denver.

EMD Honorary Membership is bestowed upon Division members who have distinguished themselves by their service to the Division and devotion to the sciences involved with energy minerals geology:

- Peter Warwick, in honor and recognition of many years of dedicated service to the EMD, including serving on EMD commodity committees, serving as principal editor of AAPG Studies in Geology 62, serving as EMD vice president and serving as EMD president.

See **Awards**, page 29



Malaysia adopts MultiClient

Data access model to unlock the potential offshore Sabah

Malaysia's new pilot MultiClient program has the potential to be the world's largest.

Aligned with the aim of maximizing resources for growth, multi-sensor acquisition will open deeper play fairways, qualify reservoir distribution, reduce exploration risk, and ultimately the cost of hydrocarbon production.

PGS, TGS, and WesternGeco, the industry's three largest MultiClient companies, have joined forces to ensure the success and longevity of this industry first for Malaysia.

Explore the untapped potential by searching our data library pgs.com/sabah, or contact sabah@pgs.com

In partnership with:

PGS TGS WesternGeco