



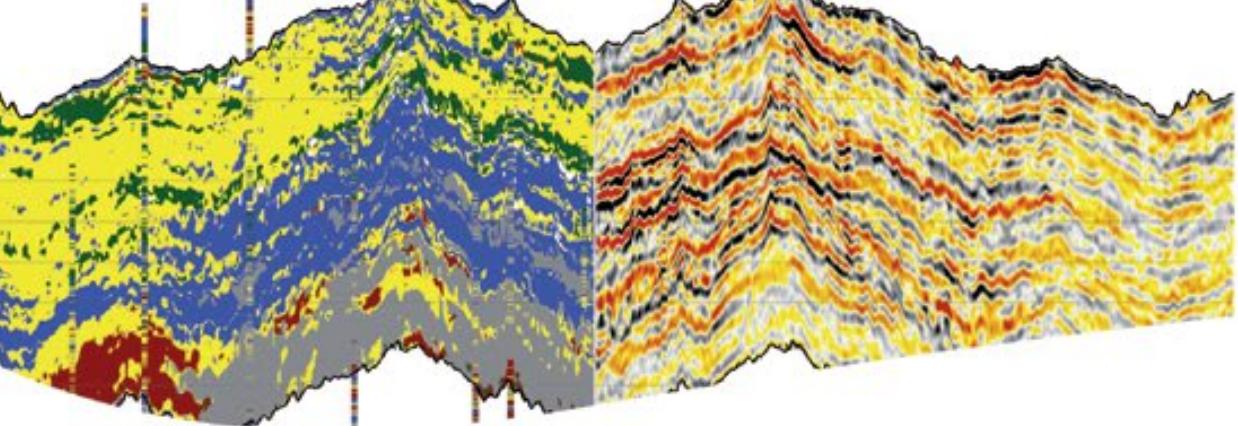
EXPLORER

May 2018

Finding Oil,
Protecting the Earth

See page 8

AAPG



Maximize Production

With CGG's Reservoir Optimization Packages



Optimize well locations, orientations and completion intervals with CGG's integrated multi-client Reservoir Optimization Packages (ROPs).

Designed to solve the particular imaging and reservoir characterization challenges of these plays, CGG's advanced technology is used to generate predictive reservoir models of the key properties controlling production in shale and other plays. These packages include 3D seismic, rock property volumes, correlated to mineralogical data from cuttings and core analyses, and calibrated geomechanical models to optimize location and completion strategies.

To learn more, visit us at AAPG ACE booth #1027

Datalibrary.nala@cg.com

cg.com/ROP

CGG
Passion for Geoscience

The Golden Age of Super Basins

Affordable and abundant energy for generations!

I was pleased to serve as the organizer, general chair and creator of the AAPG Global Super Basins Leadership Conference. I will remember it as a highlight of my year as AAPG president and my entire career. I would like to share a few observations resulting from this conference.

The theme of the 2018 conference was "Actionable Intelligence in the World's Richest Basins." Participants heard at least 10 new play ideas that are yet to be developed. We expect many of these presentations will be available to participants of super basin conferences and to AAPG members in the future. Many basins are currently being written up for articles in the AAPG Bulletin. Plans are being considered for a second AAPG Global Super Basin Leadership Conference possibly in late January 2019 in Houston. A wrap-up of the meeting can be found on YouTube entitled, "AAPG's Global Super Basins Leadership Conference 2018 Wrap-up."

I shared a happy moment with Ibraheem M. Assa'adan, Executive Director, Saudi Aramco reflecting on the challenge of presenting each of the world's greatest petroleum basins in a 30-minute time frame! For the Arabian basins, that exceeds 15 BBOE a minute. As we covered 20 of the world's top basins in two days, it became clear that the conference time frame constrained presenters to illuminate highlights, key elements, and what makes each of these basins unique or extraordinary. Presenters commented that time limits helped them focus on the big picture about basins they know so well. Thanks to Ibraheem and Aramco for their support and generous sponsorship of the super basin initiative.

Super basins have a world class petroleum system. Most possess more than one great source rock that has



attained peak oil and gas thermal maturity. Source rocks often occur in the toe of slope distal facies clinoforms (like the Utica shale in the Appalachian Basin, and the Vaca Muerta shale in the Neuquen Basin in Argentina). It is advantageous when source rocks occur low within the column of sediments infilling the basin. Clinoforms attached to prograding shelf margins of this infill can impact resource extraction. Many super basins have regional evaporates sealing the entire basin and reducing leakage to the surface (like the Permian Basin). Often, due to hydrocarbon generation and effective trapping, super

If I had a time machine that could take me anywhere, why would I want to go back to the previous peak, when the new peaks are even better? We are in "the good old days"! And now is the time to take geoscience to greater heights.

basins have components of high pressure in all or portions of the basin.

This sedimentary infill is affected by the structural setting of the basin. Intracratonic basins can build on a pre-existing rift (for example, the Anadarko Basin); some are in gentle down warps associated

with tectonically active fold and thrust belts (the Appalachians and Western Canada Sedimentary Basin). Some occur on passive margins, accumulating great

See Breakthroughs page 4 ►

STAFF

Managing Editor
Brian Ervin
bervin@aapg.org

Art Direction/Production
Matt Randolph
mrandolph@aapg.org

Graphics Support
Ben McNett

Advertising Coordinators
Companies A-K
Mike Taylor
1-918-630-5672
mtaylor@aapg.org

Companies L-Z
Tracy Thompson
1-918-560-9414
tthompson@aapg.org

CORRESPONDENTS

David Brown
Louise S. Durham
Barry Friedman
Emily Smith Llinás

TABLE OF CONTENTS

- 8** Stanford University's "flipped classroom" Earth Science Program encompasses **energy resources** and **environmentalism**.
- 12** Origins and Exploration: A **new study** rewrites the book on **Papua New Guinea**.
- 14** The University of Oklahoma's **STACK-MERGE-SCOOP Consortium** educates students and industry alike.
- 20** University Lands: How **oil** fuels **higher education** in **Texas**.
- 22** **Saudi, Inc.**: The **oil kingdom of Arabia** is seeking to diversify its economy and its energy portfolio.

REGULAR DEPARTMENTS

Historical Highlights.....	16
Geophysical Corner.....	18
Foundation Update.....	24
In Memory.....	29
Classified Ads.....	29
Director's Corner.....	30
Divisions Report (EMD)	30

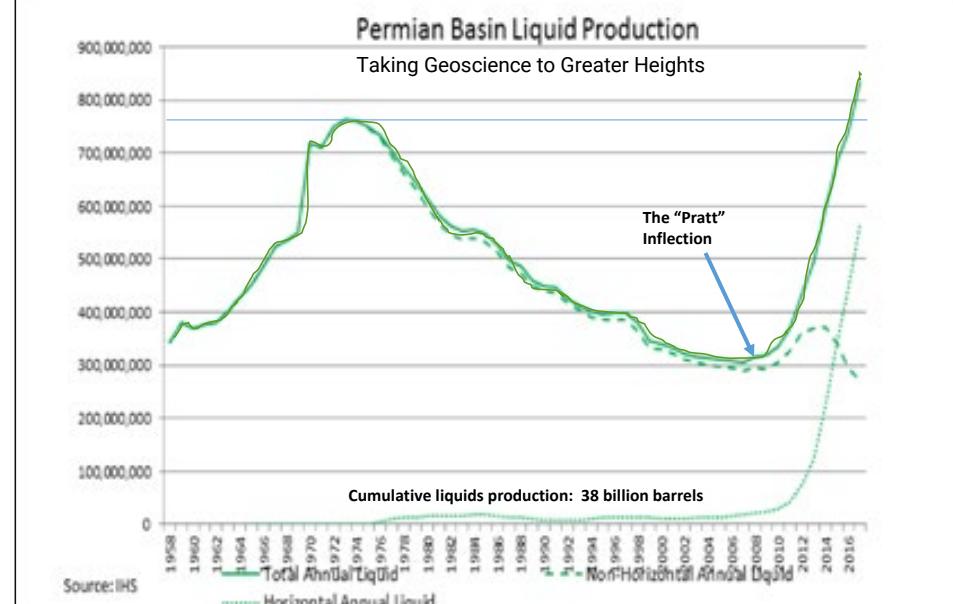
ON THE COVER

Submarine canyons are among the kinds of environments that create the special geologic circumstances for oil and gas to accumulate, but they are typically too far beneath the ocean to study. For this and other reasons, Stanford University's Stephan Graham takes students on field trips to this exposed ancient submarine canyon at Point Lobos State Natural Reserve in California. See story on page 8.

OU Consortium

Page 14





23-25 July 2018 • Houston, Texas

UNCONVENTIONAL[®] RESOURCES TECHNOLOGY CONFERENCE

FUELED BY SPE • AAPG • SEG



The integrated event for
unconventional resource teams

Registration Now Open!

For more information please visit:

URTeC.org



Sponsoring Organizations:



Breakthroughs from page 3

sedimentary thickness (the Gulf of Mexico and Brazil).

Premier technologies driving the energy renaissance are created through engineering breakthroughs in unconventional tight reservoirs and shale by hydraulic fracturing of horizontally drilled wellbores. Clay, silica, and carbonate mineralogy play an important role in brittleness of targeted landing zones. Rapid improvements in latest generation completions result from optimizing horizontal drilling length, spacing of proppant stages, pressures of fracture stages, types of fluids and proppants, stress field orientations, and staying in the best landing zones.

The production graph of the Permian Basin shows that oil production (solid heavy green line) peaked in about 1976. A long decline from the 1980s to 2005 ensued, and the Permian Basin was "left for dead" by many large companies. Miraculously, swift adoption of hydraulic fracturing combined with horizontal drilling began a basin rebirth around 2006. My colleague Allen Gilmer and I refer to this as "the Pratt Inflection."

Please note that the new peak of current production surpasses the greatest known historical peak of the glorious Permian heyday in 1976. At least eight other super basins have similar peaks. Many global basins are in "standby mode" pending access and resolution of above-ground issues. If I had a time machine that could take me anywhere, why would I want to go back to the previous peak, when the new peaks are even better? We are in "the good old days"! And now is the time to take geoscience to greater heights.

Infrastructure is critical to the development of super basins. Alaska and western Canada are two notable examples where abundant resources currently exceed take-away capacity. The Permian Basin, highly mature from an infrastructure standpoint, also needs more infrastructure to transport associated gas.

In addition to renewal of basins by unconventional resources, some previously mature super basins have seen conventional resources reborn through enhanced seismic imaging of rocks that were previously difficult to image, as evidenced by the subsalt play in the Gulf of Mexico and the Pre-Salt Play in Brazil, or around basement highs in the North Sea. In the case of Pre-Salt in Brazil, seismic reveals an untouched, hidden world below a shallow more explored basin.

Attend the Salt Lake City Convention

Every year since 1993, I have attended the AAPG Annual Convention and Exhibition. I do not claim that my 25 straight years of

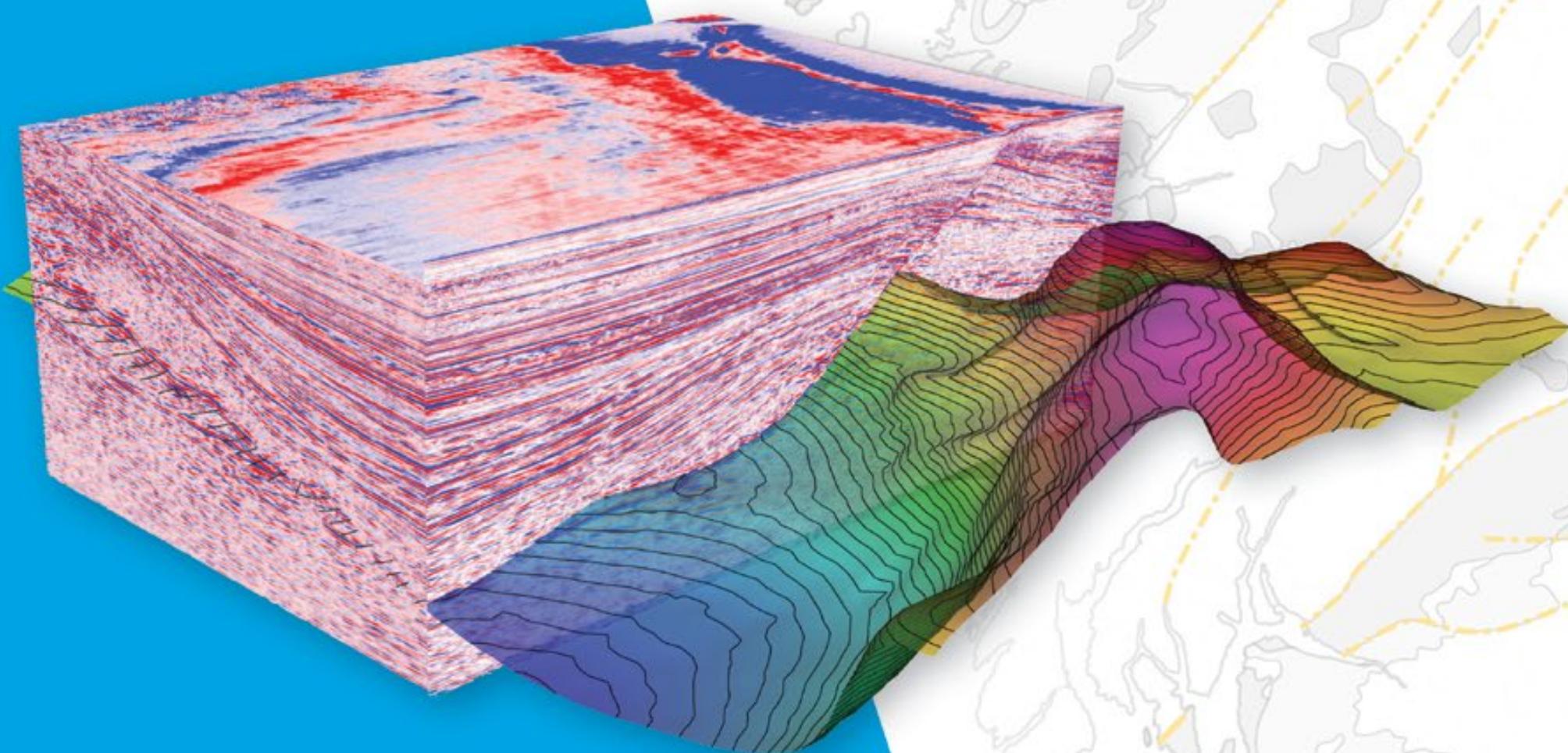
See SLC page 6 ►



midland
valley

Petroleum Experts Ltd.
Company

Move2018 at AAPG ACE



Visit the structural geology experts
at booth #727, Salt Lake City, Utah
20 - 23 May 2018

Or visit mve.com/move-latest

Midland Valley
2 West Regent Street
Glasgow G2 1RW, UK
t: +44 (0)141332 2681
f: +44 (0)141332 6792
e: info@mve.com

mve.com

AAPG ACE 2018 Organizing Committee



SLC from page 4

participation are a record. I am pleased to say that many others feel as I do and have been committed to attending conventions for longer than I have. I expect all who attend conventions remember great moments – technical presentations, field trips, short courses and memorable conversations.

What is your greatest memory of an AAPG event that made a real difference or possibly changed your life? Come to Salt Lake City, Utah, May 20-23, and let's remember previous great moments together and forge new ones.

In my presidential address at the opening ceremony on Sunday, I plan to speak about how geoscience matters. That evening at the Icebreaker, and Tuesday morning, Bob Merrill and I will be in the AAPG Bookstore, signing copies of Memoir 113: Giant Fields. Then, I will chair a forum on super basins on Monday morning. That afternoon, I will chair the 20th

Discovery Thinking Forum with co-chair Paul Weimer. On Tuesday afternoon, I will chair the Innovation Forum with co-chairs Henry Pettingill and Niven Schumacher. Come say hello at these and other events!

AAPG's future lies in our younger members. In the accompanying photo, take a good look at the committee organizing this year's ACE. I especially want to thank General Chair Michael Vandenberg and Technical Program Chair Lauren Birgenheier for taking on heavy lifting roles. They are extraordinary leaders! I want to thank the entire team and I am proud of them all for stepping forward to lead. Please join me in thanking them when you see them at ACE.

Membership Engagement

This year the Executive Committee voted that the House of Delegates lead membership recruitment and retention efforts for all AAPG. House Chair Dave Entzminger, Bill Stephens, Cheryl Desforges and others are looking at ways to expand

this initiative.

AAPG does a lot to reach out to younger prospective membership: the Imperial Barrel Award, student chapters, the Distinguished Lecture Program, the Visiting Geoscientist Program (10,000 visits a year!), and YP initiatives. By June, I will have spoken to about a thousand students in dozens of universities about AAPG. I am pleased that we held our AAPG Leadership Days summit on the University of Houston campus last November. My message was, "Be a part of the energy solution; be a lifelong learner (AAPG education can help); and be engaged in your professional societies at a local and AAPG level." Say "yes" to membership and lifelong participation! I am confident that future AAPG Executive Committees will continue and expand these efforts.

Living Our Values

Last month I wrote about the need for geoscientists to make the case that Geoscience Matters to top industry leaders

and CEOs. I am proud to report AAPG is "walking the talk." AAPG presented a special Presidents Award to Scott Sheffield, Pioneer's chairman of the board. Mr. Sheffield has long been a supporter of integrated approaches to energy solutions that value geoscience and AAPG. Pioneer has been a responsible corporate citizen by dealing proactively with above-ground issues. We applaud his leadership.

We also acknowledge Bob Fryklund, vice president of IHS Markit, who will receive a President's Award for promoting geoscience and AAPG to the highest levels of Industry through activities at CERA Week and his contributions to the inaugural AAPG Global Super Basin Leadership Conference. I look forward to presenting Bob this award at the AAPG Corporate Advisory Board annual meeting at ACE, helping to further raise AAPG profile with top industry executives.

Charles A. Sternbach



NeuraSection is the platform that lets you connect with your data. With **new touchscreen** capabilities and **SmartRibbons™**, you'll be almost as close to geology onscreen as you are in the field. Call us today to get your **hands-on demo** and quote.

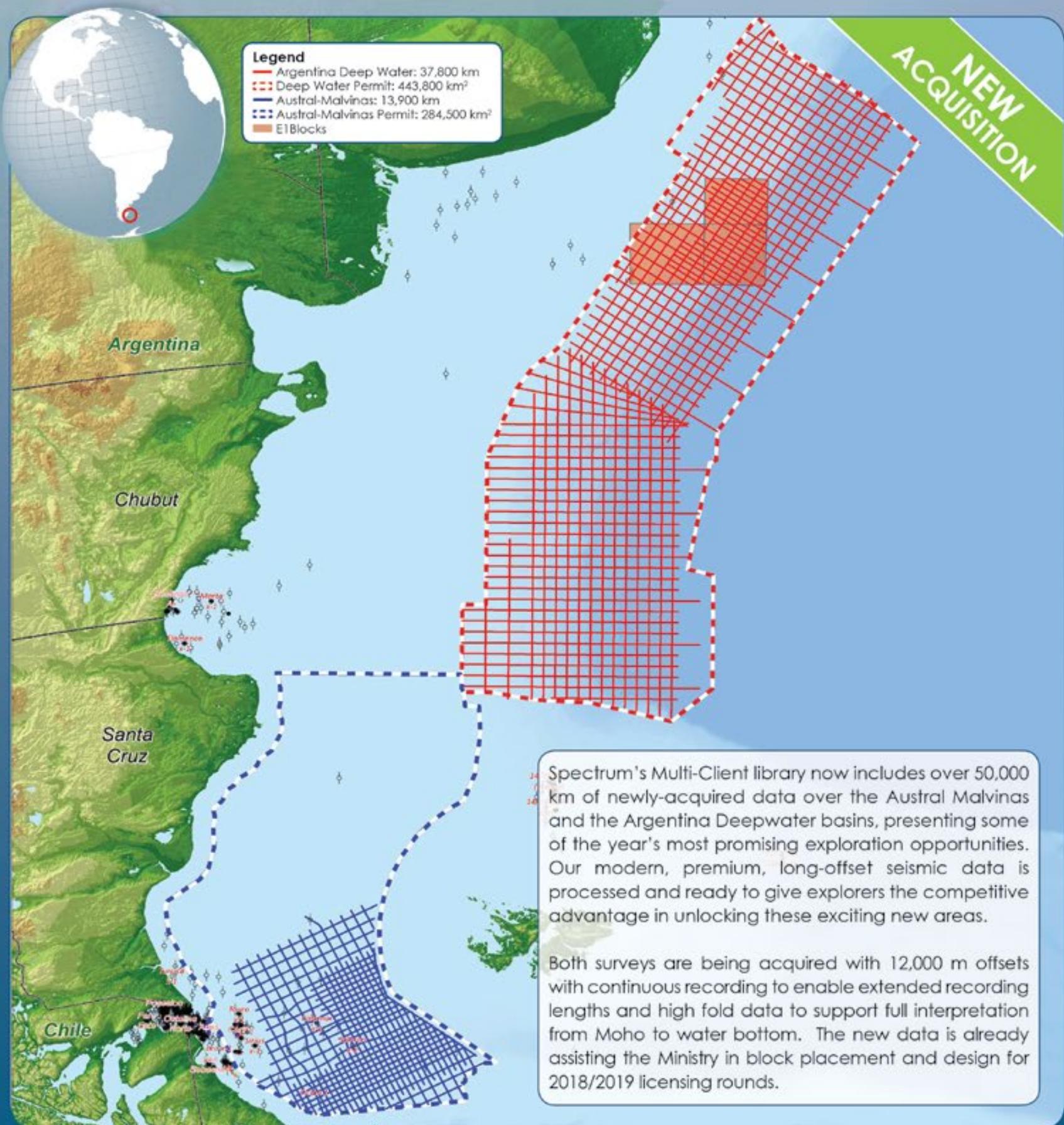
please
~~Don't~~
Touch.

Neuralog

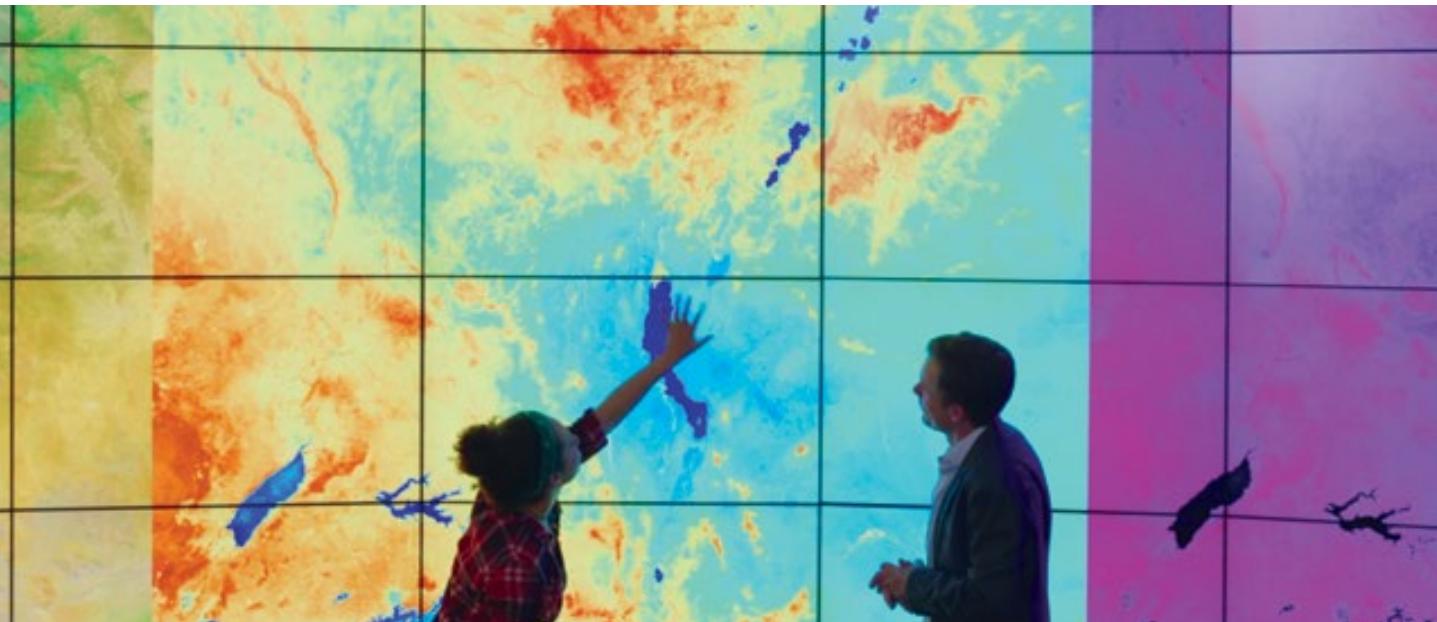
Houston, TX | p. +1.281.240.2525 | neuralog.com

Offshore Argentina

New Multi-Client 2D Seismic For 2018 Licensing Rounds



Stanford's Earth Science Program Benefits Energy, Environmentalism



Geoscience education is turning out to be a good fit for the modern university, and an especially good way to position students for the future.

In part that's because of the nature of Earth Science studies, said Stephan Graham, dean of the geoscience school at Stanford University in Stanford, Calif. – just a mile away from Palo Alto and its Silicon Valley buzz.

Geology students are trained in field work and lab work, taking a hands-on and in-person approach to science. That fits right in with current ideas about university instruction.

"They're basically all about less emphasis on lectures," he said.

Graham, who earned his doctorate in geology at Stanford, has a practical science background. He began his career in the 1970s as a petroleum geologist, first with Exxon Production Research Co. and then with Chevron USA.

He joined the Stanford faculty in 1980. After working his way through a number of leadership positions, including a stint as acting dean in the School of Earth Sciences, he assumed the full-time office with the big title last November.

And it is a big title, even by academic

standards. His full title is: Chester Naramore dean of the School of Earth, Energy & Environmental Sciences at Stanford, Welton Joseph and Maud L'Anphere Crook professor of geological sciences and professor, by courtesy, of geophysics and of energy resources engineering.

Marriage of Disciplines

Stanford today teaches through blended learning, a combination of digital media and traditional classroom instruction. Graham said this approach includes the "flipped classroom," where instructional

material is made available online.

"What the professor would deliver by lecturing is produced as online material that students review before they even get to class," he said.

A major advantage for students is being able to interact with their professors and each other in a learning environment, instead of sitting through a series of lectures in class.

"You learn more by actively doing than by just sitting and listening," Graham noted.

Another aspect of teaching at Stanford, as at many other universities, is an emphasis on interdisciplinary studies, which have "come to the fore because there is so much to be learned in the interstices between the traditional disciplines," Graham said.

He cited the cooperation among geologists, geophysicists and engineers in the oil and gas industry as an example of the interdisciplinary teamwork needed to tackle complicated challenges.

"The problems we're looking at now are so much larger and so much more complex, there's really no other way to attack them than in an interdisciplinary or multidisciplinary approach," he said.

Collaboration between the geoscience school and the SLAC National Accelerator Laboratory shows the serendipity possible in a relationship between disciplines, according to Graham. SLAC is operated by Stanford on behalf of the U.S. Department of Energy, which provides funding for the laboratory.

See Computing page 10 ▶

U-PITCH
INVENT AND INVEST
at URTeC

Now Presenting: U-Pitch 2018

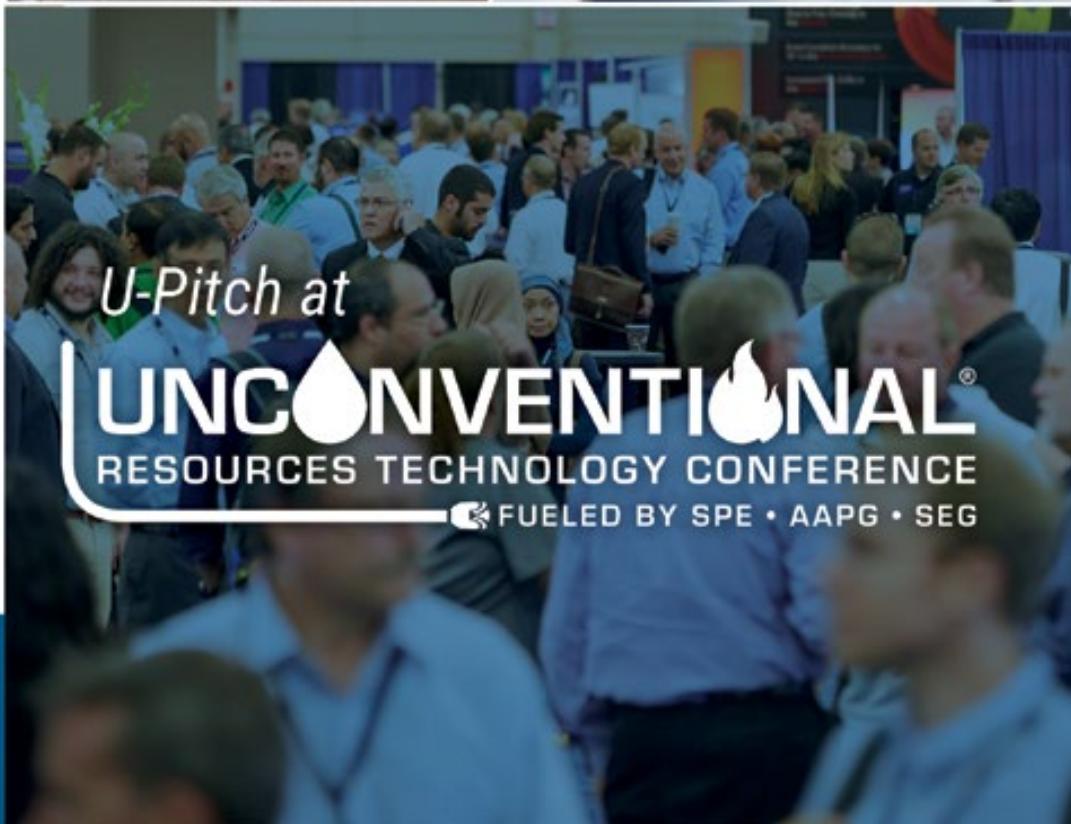
23-25 July 2018 | George R. Brown Convention Center | Exhibit Hall

What Is U-Pitch?

U-Pitch is a forum connecting entrepreneurs, investors, and potential partners. With thousands in attendance at URTeC 2018 over a three-day period, U-Pitch is a great opportunity for presenters and investors to meet and lay the groundwork for future success.

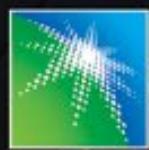
Apply now to be a Presenter at URTeC.org.

To learn more about Presenting, Investing, or Sponsoring contact Susan Nash at snash@aapg.org.



explore our opportunities

أرامكو السعودية
saudi aramco



The future of energy is bright, with today's creative minds looking at challenges in new ways. A career at Saudi Aramco will give you an opportunity to work at the forefront of technology and innovation. We are continuing to advance our exploration program – finding new fields, adding reserves, and developing more efficient methods to optimize recovery and production.

As part of our network of engineers, you will have access to unparalleled resources from one of the world's leading energy companies combined with a team of colleagues dedicated to excellence and collaborative thinking.

We are seeking experienced professionals in unconventional reservoir engineering to join our world-class team in Saudi Arabia.

Apply now at www.aramco.jobs/aapgex

where energy is opportunity™

Computing

from page 8

Founded in 1962 as the Stanford Linear Accelerator Center, SLAC has become known for discoveries using its two-mile-long particle accelerator – the first particle containing a charm quark was identified there.

It's also known for high-energy X-ray imaging. That capability has helped the geoscience school study and evaluate very finely grained low-permeability and low-porosity rock, the kind associated with unconventional oil and gas plays, Graham said.

"This is a marriage of disciplines we hadn't even thought of a few years ago," he said.



GRAHAM

Many university departments in Earth sciences have moved more into the environmental aspects of earth sciences. Some of them have moved quite far in that direction.

A New Golden Age

Computing has reshaped the academic world, as bigger and bigger collections of data are being passed through ever-more-powerful processors. Working with geophysical data and other Big Data sets is putting geoscience students in a good place for future careers.

"It's also true for all the Earth imagery that's being done, all the satellite imaging," Graham

added. "It's opening doors to things that were unimaginable a few years ago."

Opportunities in earth science now range from Google Earth to the planet itself, and even beyond.

"This in turn is opening up all kinds of nonconventional opportunities for geoscience students," Graham observed. "We sitting here in Silicon Valley really see the bleeding edge of all this, but those opportunities are available

around the world."

Planetary science today is expanding into new frontiers, thanks in part to data from private investment in space launches, Graham said.

"There's been a resurgence, a renaissance, of space exploration. We're in kind of a Golden Age of space exploration," he noted.

Some older geologists can remember when mice squeaked instead of clicked, but university students today grew up with enormous computing power at their fingertips. Many can't remember a time before smart phones.

"Most of them are so at ease with all things computational it allows them to bring to the table skills older generations wouldn't have developed," he said.

Environmental Emphasis

Graham is an expert in sedimentary geology and a fellow of the Geological Society of America. His honors include the Sproule Award, the Levorsen Award and the Murray Memorial Distinguished Educator Award from AAPG, the Mitchum Award from the European Association of Geoscientists and Engineers and the Pettijohn Medal for Sedimentology from SEPM.

As dean of Stanford's geoscience school, Graham oversees 65 faculty members and more than 550 students. Stanford acknowledged a broader scope for the school in 2015, when the School of Earth Sciences became its School of Earth, Energy & Environmental Sciences.

Graham said he disagrees with anyone who thinks that the oil and gas industry is somehow at odds with the world's environmental and sustainability needs.

"Nothing could be further from the truth. Anyone involved in the energy extraction business has to be keenly aware of the environmental issues," he said.

Students entering college now do see more importance placed on the environmental aspects of geoscience, Graham observed.

"They've noticed that many university departments in earth sciences have moved more into the environmental aspects of earth sciences. Some of them have moved quite far in that direction," he said.

And he believes that universities should equip their geoscience students with the tools to understand and deal with environmental and sustainability issues.

"It's the responsible thing to do, particularly as we educate students for living in this century," Graham said.

At the same time, the geoscience school puts an emphasis on practical applications of science, including courses in sedimentary and petroleum geology, and on applied research.

"Stanford, and particularly this school, has always been able to walk the line between basic research and applied research," Graham noted.

For the coming decade, Graham sees continued growth in computing-related instruction, with more and bigger data sets and faster and better processing. And like many other universities, Stanford has begun reaching out to nontraditional students and those who may be first in their family to attend college.

"Stanford in recent years has paid special attention to low-income students and first-generation college students," making beneficial financing packages available, he said.

But graduate students seeking a master's degree or doctorate in geology don't have to worry about financing. In that regard, Stanford's geoscience school is extremely lucky.

Graham said all grad students in the geoscience school, not just Stanford graduates, are "fully stipended and supported" in their quest for advanced degrees. ■

Interpretation® upcoming submission deadlines

FEBRUARY 2019

Distributed acoustic sensing and its oilfield potential

Submission deadline: 1 May 2018

Special section editors: Ge Zhan, Yingping Li, Ali Tura, Mark Willis, and Eileen Martin

Permian Basin challenges and opportunities

Submission deadline: 1 June 2018

Special-section editors: Sumit Verma, Olga Nedrub, Ron Bianco, Richard Pagel, Fangyu Li, Tao Zhao, Mohamed Zobaa, Robert Trentham, and Joon Heo

MAY 2019

Interpretable seismic velocity

Submission deadline: 1 August 2018

Special section editors: Jianxiong Chen, Alfred Liaw, Xianhuai Zhu, Xin Wang, Tao Li, Priyank Jaiswal, Yafei Wu, and Xin Cheng

Near-surface impact on seismic exploration

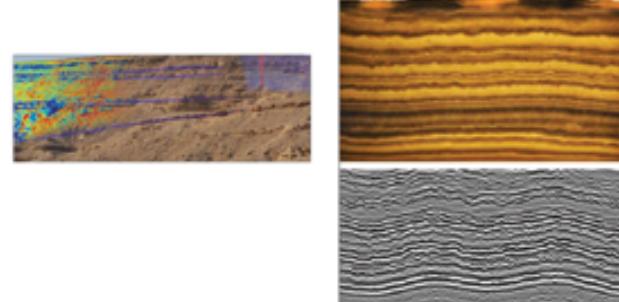
Submission deadline: 1 August 2018

Special section editors: Claudio Strobbia, Daniele Colombo, Rick Miller, Andreas Laake, and Cedric Schmelzbach

Seismic geometric attributes

Submission deadline: 1 October 2018

Special section editors: Ximeng Wu, Hongliu Zeng, Haibin Di, Dengliang Gao, Jinghuai Gao, Kurt Marfurt, and Saleh Al-Dossary



AUGUST 2019

Insights into digital oil field data using artificial intelligence and big data analytics

Submission deadline: 1 October 2018

Special section editors: Vikram Jayaram, Andrea Cortis, Bill Barna, Atish Roy, Deepak Devegowda, Jacqueline S. Floyd, Pradeepkumar Ashok, Satyam Priyadarshy, Aria Abubakar, and Chiranth Hegde

Petrophysical analysis for shale reservoir evaluation: Methods, progress, and case studies

Submission deadline: 1 October 2018

Special section editors: Guochang Wang, Shu Jiang, Timothy R. Carr, and Matthew Boyce

Geologic and geophysical characterization of ultra-deep reservoirs

Submission deadline: 1 October 2018

Special section editors: Rui Zhang, Shu Jiang, Yongsheng Ma, Zhiwen Deng, Jiajia Sun, and Ximeng Wu

Machine learning in seismic data analysis

Submission deadline: 1 October 2018

Special section editors: Haibin Di, Lei Huang, Mauricio Araya-Polo, Youzuo Lin, Anne Solberg, Tao Zhao, Ximeng Wu, Vikram Jayaram, Jun Cao, Satinder Chopra, Erwan Gloaguen, Saleh Al-Dossary, Ghassan AlRegib, and Hongliu Zeng

Working with 2D seismic data

Submission deadline: 1 December 2018

Special section editors: Don Herron, Brian Horn, Rachel Newrick, Cian O'Reilly, and Tim Smith

*E-mail interpretation@seg.org to inquire about submitting manuscripts past the submission deadline. Some sections may have increased flexibility regarding submission and review dates.

To submit a paper, visit <https://mc.manuscriptcentral.com/interpretation> and select the appropriate topic from the manuscript type options. For submissions not associated with a special section, select "Technical Paper." To suggest a topic for future special sections, e-mail interpretation@seg.org or contact one of the editors.

A joint publication of SEG and AAPG
Interpretation®
A journal of subsurface characterization



Interpretation, copublished by SEG and AAPG, aims to advance the practice of subsurface interpretation.

Offshore Gabon 3D

New Multi-Client 3D Seismic in Open Acreage + Regional 2D



Spectrum, in collaboration with the Direction Générale des Hydrocarbures (DGH) are undertaking a number of shallow water 3D seismic surveys in open blocks, to provide the industry with state of the art 3D broadband data. A variety of plays are targeted to allow a new generation of oil exploration in these prolific basins.

Seismic is being acquired in both north and south of the country. The 11,500 km² southern survey, now complete, is the definitive dataset to image the pre-salt and, for the first time, intra syn-rift plays can be targeted. In the North, acquisition of a 5,500 km² 3D survey has now begun and will image pre and post-salt targets. Further acquisition is planned in Central Gabon, at the western edge of the Ogooué Delta where the under-explored shallow water plays are post-salt, proven and close to existing infrastructure.

Data will be made available for future License Round evaluation facilitating immediate activity when the blocks are awarded.

New Study Revises Papua New Guinea's Geologic Origins

On Feb. 26, 2018, Papua New Guinea experienced a 7.5 magnitude earthquake that killed 140 people and produced 200 aftershocks over two months.

Earthquakes are nothing new for the 460,000-square-mile Commonwealth nation located northeast of Australia and east of Malaysia. Papua New Guinea, called PNG by locals and neighbors, is highly complex, in terms of society and geology.

John Chambers, AAPG member and PNG country manager with Santos Limited, said the country shares similarities to its southern neighbor.

"The Papuan Basin is very similar in its early evolution to other basins along the northern and western margin of Australia with Triassic-Lower Jurassic rifting, a sag phase with shallow to deep marine sedimentation in the Upper Jurassic to Cretaceous and then a passive margin phase with shelf carbonates in the Tertiary," he said.

"The difference in PNG is that compressive tectonics along the northern margin of the Australian plate has resulted in reactivation of the extensional terrain and formation of a thrust belt beginning in the late Miocene," Chambers added.

The geology fascinates Rob Holm, New Zealand native and senior geoscientist at Frogtech Geoscience, who began researching PNG during his doctoral studies at James Cook University 10 years ago.

"Compared to many regions around the world, Papua New Guinea is a relative 'blank slate,' and there is a very real opportunity to come up with new and exciting ideas," he said.

Holm recently completed a six-month project with Frogtech Geoscience, an Australian-based company that provides multidisciplinary regional studies focusing on the geological basement.

The project, PNG SEEBASE, considers geological origins dating back 250 million years and concludes that much of Papua New Guinea formed on the eastern margin of Queensland, Australia, not adjacent to northern Australia as many theories propose.

Conflicting Models

Holm said studying PNG geology unearths a plethora of different and conflicting models to explain the development of the region. He credits the sheer number of contrasting models to the lack of data and evidence regarding the region's history.

Holm's team at Frogtech searched for answers by collecting and integrating diverse sources of data within the company's global terrane framework and performing regional tectonic reconstructions.

"Creating continuous tectonic reconstructions provides an opportunity to test different scenarios for where specific terranes were at certain times and to explore the different plate boundaries that would



Santos Exploration Papua New Guinea Country Manager John Chambers with his wife Dawn at the Goroka Sing-Sing Festival.

result," he said. "This work has a habit of creating eureka moments that highlight relationships between far removed geologic phenomena and suddenly everything 'clicks' and the model explains the elusive links between discrete ideas and evidence."

A Long Journey

Holm said the study's most important finding is that PNG traveled a long way to get to its current location.

"Past studies of Papua New Guinea assumed that these terranes largely formed in place. These ideas first emerged prior to a time when mainstream plate tectonic theory was widely adopted, but in the intervening time these ideas have not been widely challenged or scrutinized in scientific literature," he said.

The Frogtech study combines data from throughout the region and purports that much of PNG formed along the eastern Gondwana margin comprising part of the Tasmanide

Orogenic Belt of eastern Australia.

Holm noted that the findings have important implications not only for the geology of PNG, but also for the development of eastern Australia and the wider region.

"These allochthonous terranes potentially record geological events that can fill the gaps in the regional Southwest Pacific geological record that have not been previously considered," he said.

From Theory to Practice

For Holm, the study results impact not only the geoscience community, but also the PNG population, whose economy depends on the oil and gas and minerals sectors.

"This study seeks to provide a regional knowledge base that gives explorers more certainty in their models, reduces the risk in exploration, and may open frontier regions to new ideas and target generation," he said. "Any study which promotes exploration success will provide growth in the economy and critical



Rob Holm

support to the developing regions."

Exploration success and economic development are key goals for Chambers, who has worked in PNG since 2006.

As country manager, Chambers oversees Santos' interest in the PNG LNG Project, which produces gas from the Hides and Kutubu Fields discovered in the 1980s. In late 2016, Santos along with its partners Oil Search and ExxonMobil made a discovery at Muruk-1.

Despite recent discoveries, PNG remains underexplored, primarily due to lack of infrastructure.

Chambers noted that, like most Australian Mesozoic basins, PNG is gas prone with some oil, but until LNG exports began in 2014, there was no route to market for significant volumes of gas. As a result, exploration activity in PNG lagged behind that of other regional basins.

Improving infrastructure is a key objective for Santos and other companies in the region, Chambers said.

"Now that the PNG LNG Project is up and running, our objective is to ensure that there are sufficient gas supplies for the existing project plus expansion for many years to come," he said.

Santos aims to build additional plants to bring gas from provinces isolated from the company's current plant at Port Moresby. PNG's mountainous, jungle covered terrain make doing so a challenging task.

"Not only do we face the normal challenges of geology, we have complex logistical challenges in construction of infrastructure in remote and mountainous parts of PNG," Chambers said.

Exploration companies often use helicopter-portable rigs to reach areas with no roads.

Opportunities for the Community

Chambers described how bringing energy to remote areas of PNG provides tangible benefits for the population.

"Many of the communities in the highlands of PNG have lived in isolation from the outside world for thousands of years," he said. "Naturally they have their own cultural values and views of the world that differ from those who are more familiar with the modern world. However, when you engage with people and try to understand what they want in their communities it is almost universally along the lines of better medical, schools, markets for their produce. If the oil and gas business can help bring some of these positive changes, then we can be a force for good."

For Chambers, investing in PNG requires a long-term commitment.

"PNG is an exciting developing country with a lot of potential and a need for responsible investment that benefits not only the investing company but the local people and the nation as a whole," he said. "The population is growing fast, and there is a need to create jobs for an emerging workforce and to develop the nation's infrastructure."

Keeping Geology in Mind

Holm said an understanding of geology and geologic risk not only helps promote exploration success and long-term development; it also keeps residents safe in the short-term.

"PNG lies in a very active geological region encompassing several active plate boundaries, and characterized by very large earthquakes and active volcanism," he said. "An understanding of the regional geological framework is essential in comprehending the natural hazards the country faces, and our ability to prepare and mitigate for such disasters," he said.

For now, Holm and Chambers work to promote geological understanding and economic development that might make PNG's next earthquake less of a tragedy. ■

Oblique 3D SEEBASE image of subduction zones and intrusives arc basement in PNG

HERE'S JUST A FEW OF THE THINGS TO SEE AND DO AT ACE 2018...

A CITY FULL OF EXCITEMENT AND EXPERIENCES



TURBINATOR II



THE WORLD'S FASTEST WHEEL-DRIVEN CAR



A NIGHT AT THE NATURAL HISTORY MUSEUM OF UTAH



RED BUTTE GARDEN



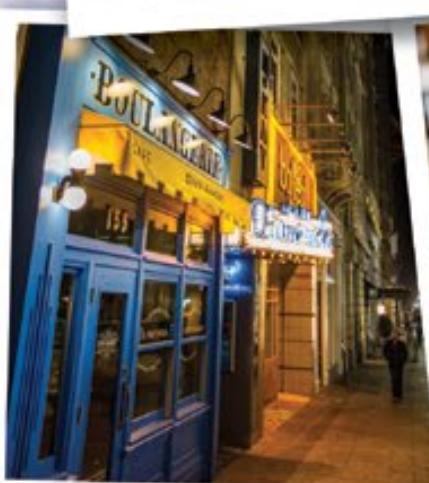
ENJOY ALL THE FLAVORS OF SALT LAKE CITY



UTAHRAPTOR



TEMPLE SQUARE

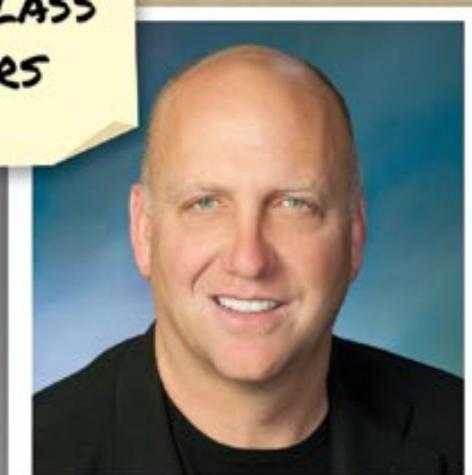


SEE THE MAIN SIGHTS OF SALT LAKE



UNWIND AND GRAB A DRINK WITH COLLEAGUES

WORLD-CLASS SPEAKERS



MICHEL T. HALBOUTY LECTURE: THE DISCOVERY OF THE PIKKA FIELD ON THE NORTH SLOPE OF ALASKA

ALL-CONVENTION LUNCHEON: THE PERMIAN BASIN - A VIEW FROM A LOCAL INDEPENDENT

VISIT A PACKED EXHIBIT FLOOR



POSTER PRESENTATIONS



3,000+ FEET OF CORE!



200+ EXHIBITORS



HEBER VALLEY HISTORIC RAILROAD, PROVO CANYON EXCURSION

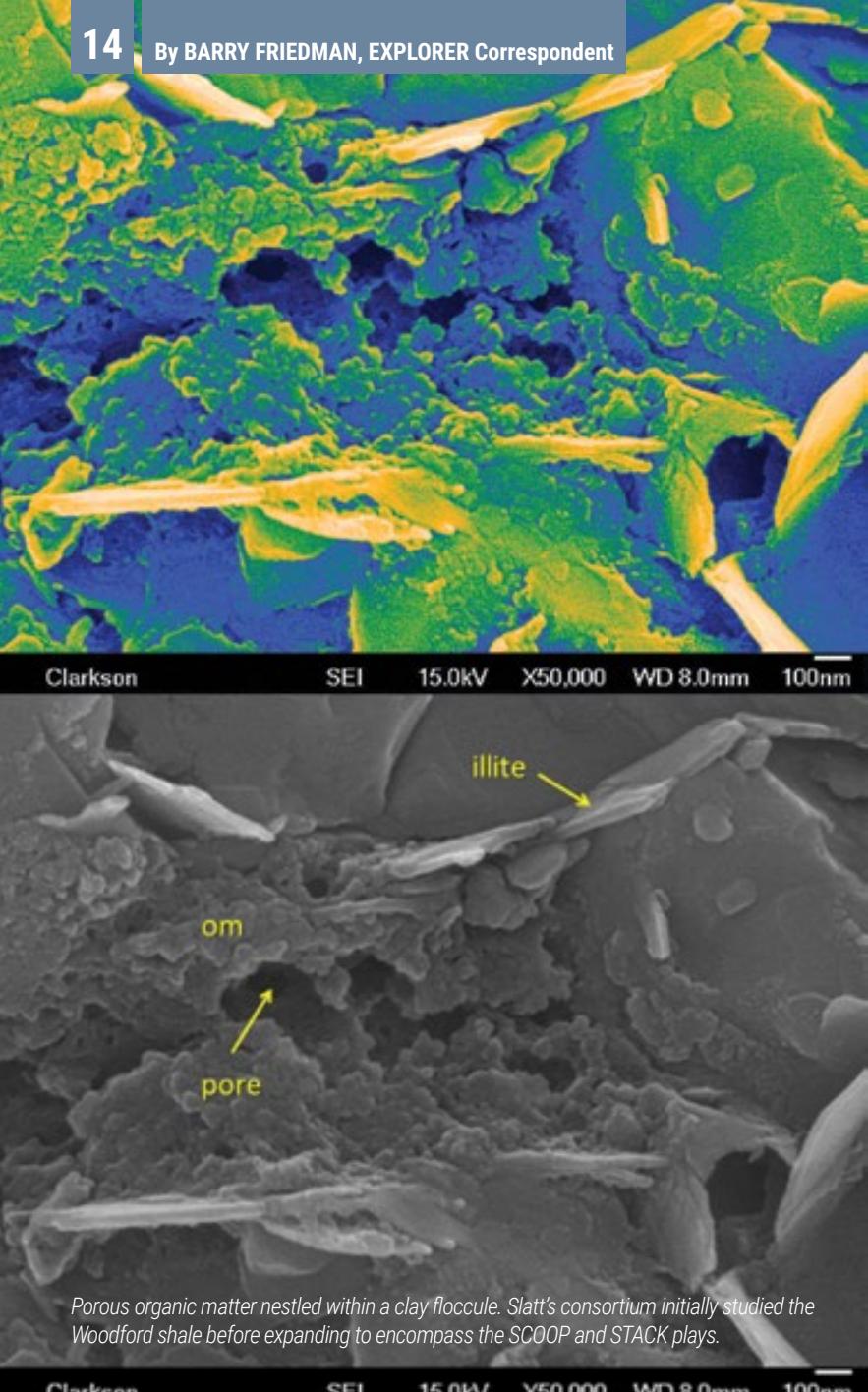


20-23 May 2018 • Salt Lake City, Utah

ACE 2018
ANNUAL CONVENTION & EXHIBITION

Register Now at
ACE.AAPG.org

Use promo code ACE18EXP for best available pricing



Porous organic matter nestled within a clay floccule. Slatt's consortium initially studied the Woodford shale before expanding to encompass the SCOOP and STACK plays.

UNIVERSITY ISSUE

OU Consortium Makes 'Profound Impact' on Industry and Education

In the past few years, it has become very difficult for university faculty interested in unconventional shales to raise government or private funds for student support and equipment for their research projects. Several university organizations have taken to organizing consortia of oil and gas companies to raise the necessary funds.

That's AAPG Honorary Member Roger M. Slatt, director of the Institute of Reservoir Characterization and Gungoll chair professor of petroleum geology and geophysics at the University of Oklahoma, explaining why he and the university did exactly that.

"I initiated the Consortium in 2012, under the name Woodford Consortium," which, he said, was a time when "unconventional shales" were flourishing and serendipity appeared.

It started with a need.

"I had a number of eager, talented graduate students. Also, shales (more precisely, mudstones) have always been my favored and most challenging research topic, having co-authored a book on the subject in 1990, and having since studied a variety of shales while in both industry and academia," he explained.

Staking a Claim

He said his initial plan was to compare the stratigraphy of a number of different shales around the United States; unfortunately, he wasn't the only academician/scientist who thought that would be a great idea.

"I soon learned that other universities had 'staked their claim' to their local shale, so I decided to do the same with the Woodford in Oklahoma. Although there are other such shale studies being done in other Oklahoma institutions, including

the university's College of Earth and Energy at University of Oklahoma, to our knowledge, ours is about the longest standing and most inexpensive unconventional shale consortium in the state," he said.

Inexpensive, perhaps, but still costly. And it is why such consortia are structured the way they are.

"Student financial and logistical support has come almost solely from a very modest fee required of companies to join the Consortium," said Slatt.

The funds are used to provide student research assistantships. This, in turn, has allowed Slatt to attract and support excellent graduate students who can both continue their training at a high level and do the work industry often can't.

"Time is a serious constraint in industry offices, which often leads to only a broad-brush approach to things like mapping, measuring a core section," he said.

And here Slatt introduces two wonderful terms: "lumpers" and "splitters."

Such broad-brushed geoscientists are called lumpers.

"At the opposite end of the spectrum are splitters," he said, "who work at a much smaller scale for a better understanding of localized stratal features."

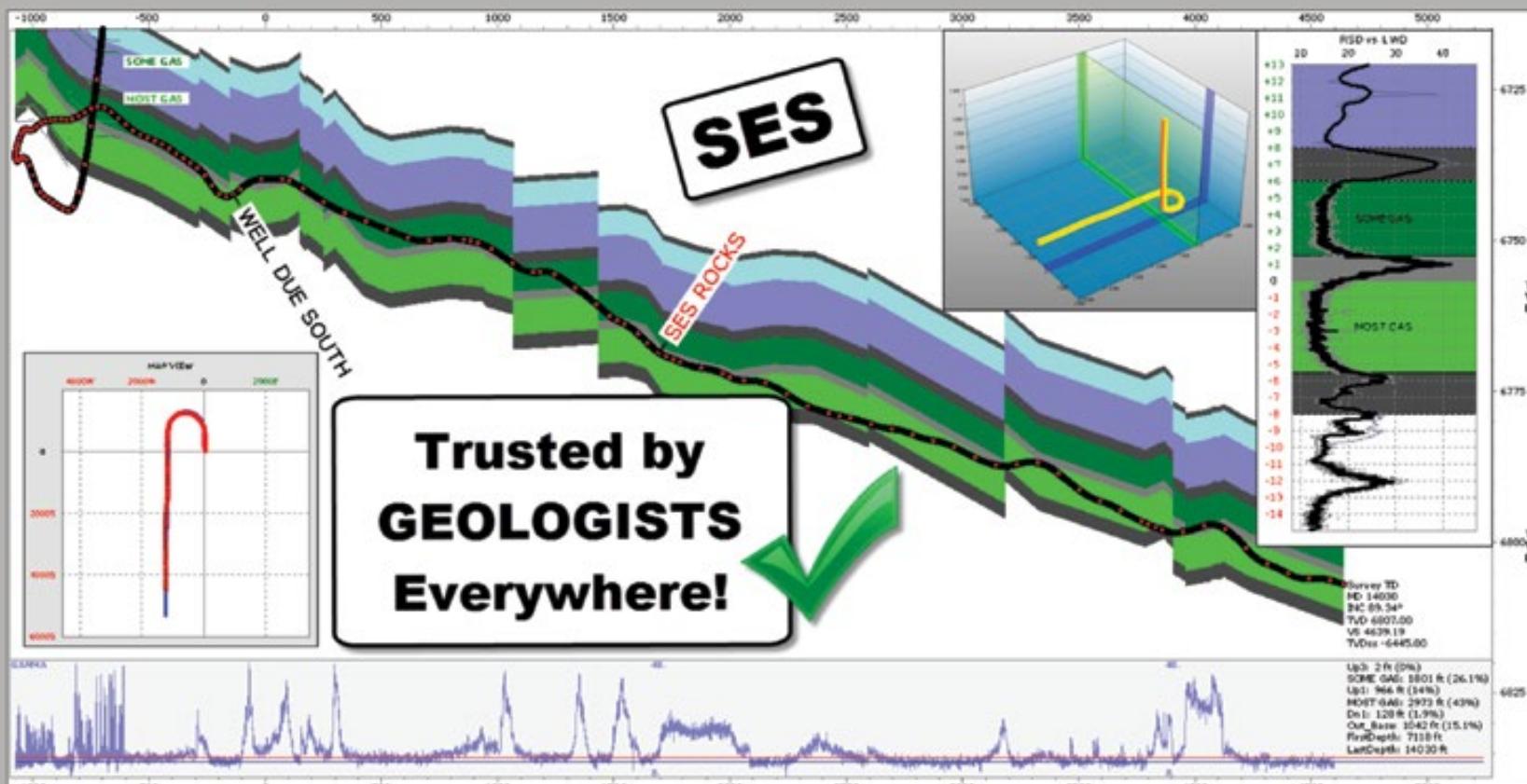
Eventually the twain will meet back up again.

"Generally, when we begin a project, we are at the lumper scale, but work our way down to the splitter scale, which is more time consuming, but also more revealing of smaller features that may influence production. We generally complete a project by upscaling back to the lumper stage if required," Slatt explained.

Specifically, the Consortium has been funded

Continued on next page ►

Steer & Study Horizontals, with *Confidence!*



SES is for geologists who are dissatisfied with drafting or gridding-tool methods of geosteering horizontal wells. **SES** is 3D technical geosteering software that makes wellbore stratigraphic tracking quick-n-easy, accurate, and easily shared. Unlike any other geosteering software, **SES** provides a complete suite of software features to handle your horizontal drilling needs.

To learn more and get a free trial, please contact us at: www.makinhole.com Phone 720-279-0182 support@makinhole.com



◀ Continued from previous page

through the years by 31 companies and is presently subdivided into four phases, each of 1.5-year duration.

"Recently we changed the consortium name to 'STACK-MERGE-SCOOP Consortium' to reflect expansion of our student-led research program from the Woodford to the Sycamore (Meramec) mainly in the Merge and adjacent areas of Oklahoma," Slatt said.

"STACK" stands for the Sooner Trend (oil field), the Anadarko (Basin), and Canadian and Kingfisher (counties). "SCOOP" stands for the South Central Oklahoma Oil Province.)

Not all companies are active at all times. Presently, 19 companies are involved in STACK. What they get for their time and funding include quarterly and final-phase reports, which are provided through a proprietary Consortium website.

"Our student group also lead single-company field trips and core workshops, which are always popular, and periodically provide relevant information and opinions to members."

Evolving Mission

The companies that make up the consortia funding base not only change, but Slatt emphasizes the underlying mission of the work changes as well.

"The initial focus was on the stratigraphy of the Woodford, but a number of observations and questions led us to expand into geomechanics, geochemistry, geophysics and geochemistry and their applications," he said.

Slatt's students have now completed 30 theses and dissertations, and related publications on the Woodford. Specifically, the work carried out by them, includes:

- ▶ Developing workflow for integrated resource shale characterizations and a robust depositional model for Oklahoma Woodford
- ▶ Providing key properties to select horizontal landing zones
- ▶ Locating sweet spots from well log and seismic mapping of rock properties
- ▶ Applying outcrops to subsurface characterization
- ▶ Relating fracture and micro-fracture development to rock types, lithology to TOC content, and laminations to breakability
- ▶ Inputting into brittleness index calculations
- ▶ Developing methodology for X-ray fluorescence (XRF) chemostratigraphic analysis for determining rock
- ▶ Assisting in determining seismic/acoustic properties of shale types
- ▶ Creating an inexpensive technique for pore evaluation; identified pore types/geometry
- ▶ Educating students and current industry personnel for shale screening and evaluation
- ▶ Compiling library of theses/dissertations/data available on Woodford and other shales
- ▶ Leading workshops
- ▶ Introducing drone technology to shale outcrop characterization

Slatt said the academic and corporate missions mirror each other so well precisely because they have different objectives.

"As an academic institution, the primary goal of the Institute and this Consortium is education. Our students have completed several integrated shale (and other) studies which involve rocks, logs and seismic, so that upon completion, masters and doctoral graduates are well versed in aspects of shale characterization, want to work in the petroleum industry, and can hit the ground running when starting a job. Studies like our Woodford project are ideally suited for

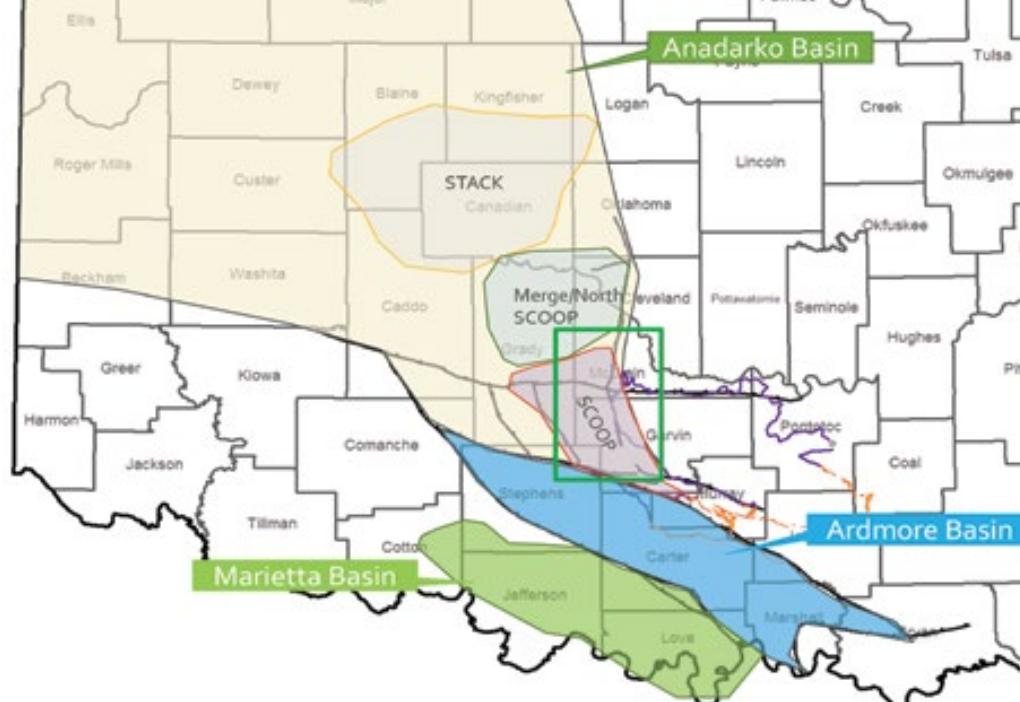
academia because prospective students are numerous, enthusiastic and have a longer time interval to complete a more thorough project than their industry counterparts," he explained.

An added bonus: the relationship doesn't end at graduation.

"We have developed good rapport with some of the member companies and work closely with them, sometimes leading to student employment upon graduation," Slatt added.

One industry executive, Kraig Koroleski of Echo Energy in Oklahoma City, commenting on the Consortium, said, "The work you have completed with your students is astounding, and this work will have a profound impact on the academic and industrial communities for many years."

"I can only hope," said Slatt, "that we do have and maintain that profound impact." □



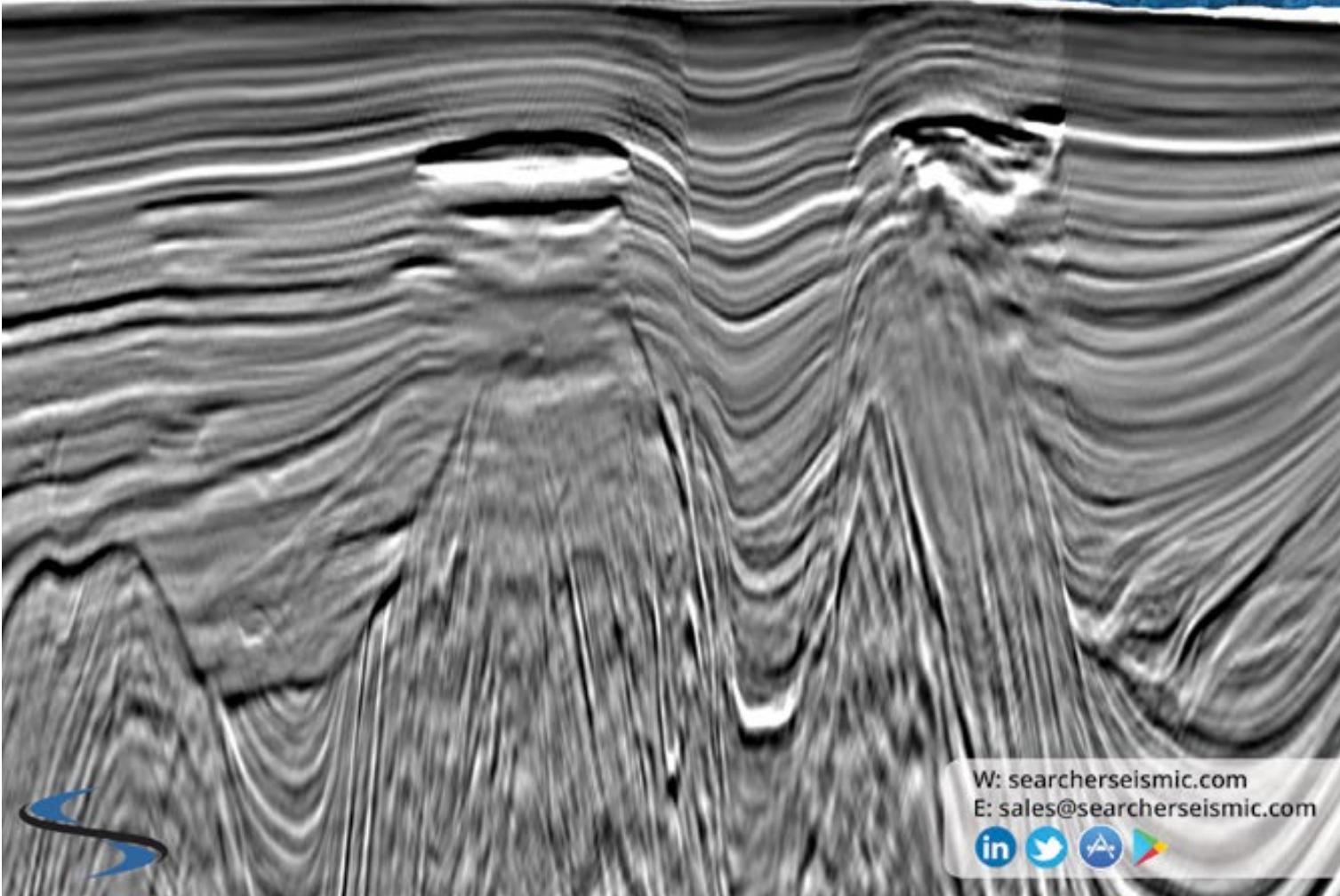


Searcher Seismic

Searcher in ARGENTINA

Malvinas Basin 2D Reprocessing
Offshore Argentina Seismic & Well Database
Argentina Basin Analysis Report





W: searcherseismic.com
E: sales@searcherseismic.com

Historical Highlights

Exploration Lessons from the Land of 'Magic Realism'

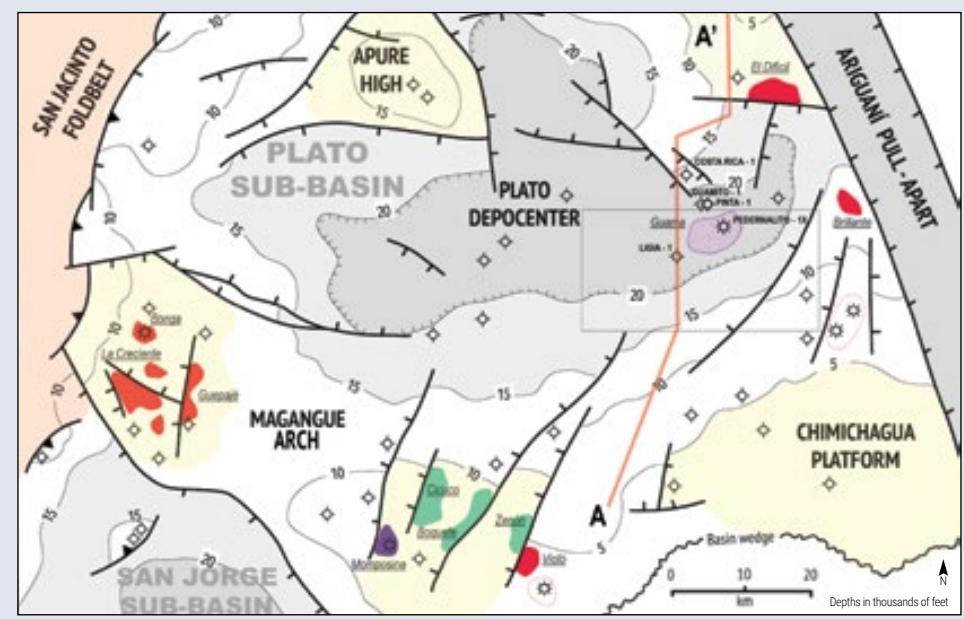
Imagination, an integrative approach to old-fashioned geology, plus advanced technologies played a leading role in the 2010-13 discovery of the Guama Field in the Plato Region of the Lower Magdalena Basin of Colombia.

Thinking out a shallower opportunity above a deeper turbiditic prize was just the beginning, though: poor trap image, a sand reservoir with even poorer log signature and challenging reservoir quality and conditions made Guama the poster child of a nice discovery facing a steep road to commerciality.

Basin Context and Early Exploration

The Plato Depression is home to the first sizable discoveries in the LMB. Back in 1942 and 1964, the El Difícil and Cicuco fields had been found in Miocene carbonates sitting on uplifted basement blocks that outlined the depocenter below the cattle and rice-rich region not far away from Aracataca, birthplace of Colombia's well-known writer, the late Gabriel García Márquez, and the inspiration for his beautiful "magic realism" literary style.

A first glance of the thick and shaly



Miocene section that fills entirely the Plato Depression was obtained by well Costa Rica-1. This well had been proposed by Imperial Oil's regional geologist K.F. Dallmus in a 1943 letter to O.C. Wheeler, ostensibly looking at a southern analog to El Difícil, discovered by Shell the year before. Costa Rica-1, finished in December of 1946, drilled through more than 10,000 feet of massive Miocene shales, encountering almost no sands.

New seismic readings prompted renewed interest in the deep Plato, where explorers interpreted turbiditic correlatives of the oil-rich carbonates and sands. Thus, wells Guamito-1 and Ligia-1 were drilled in 1975 and 1980 by Chevron and Ecopetrol, finding condensate-filled sands regrettably unable to sustain commercial flow.

Fast forward to 2009: Pacific Stratus, a company that in 2008 had signed the Guama E&P Contract with Colombia's Agencia Nacional de Hidrocarburos (ANH) with a view at the deeper (greater than 12,000 feet) "turbidite" play, was preparing to drill the first commitment well for one of several deep prospects defined with recently acquired 2-D seismic data. Concerns over the deep test, however, started growing after Petrolifera's La Pinta-1 well, a twin to Guamito-1, found that the turbiditic sands might not be as good as expected.

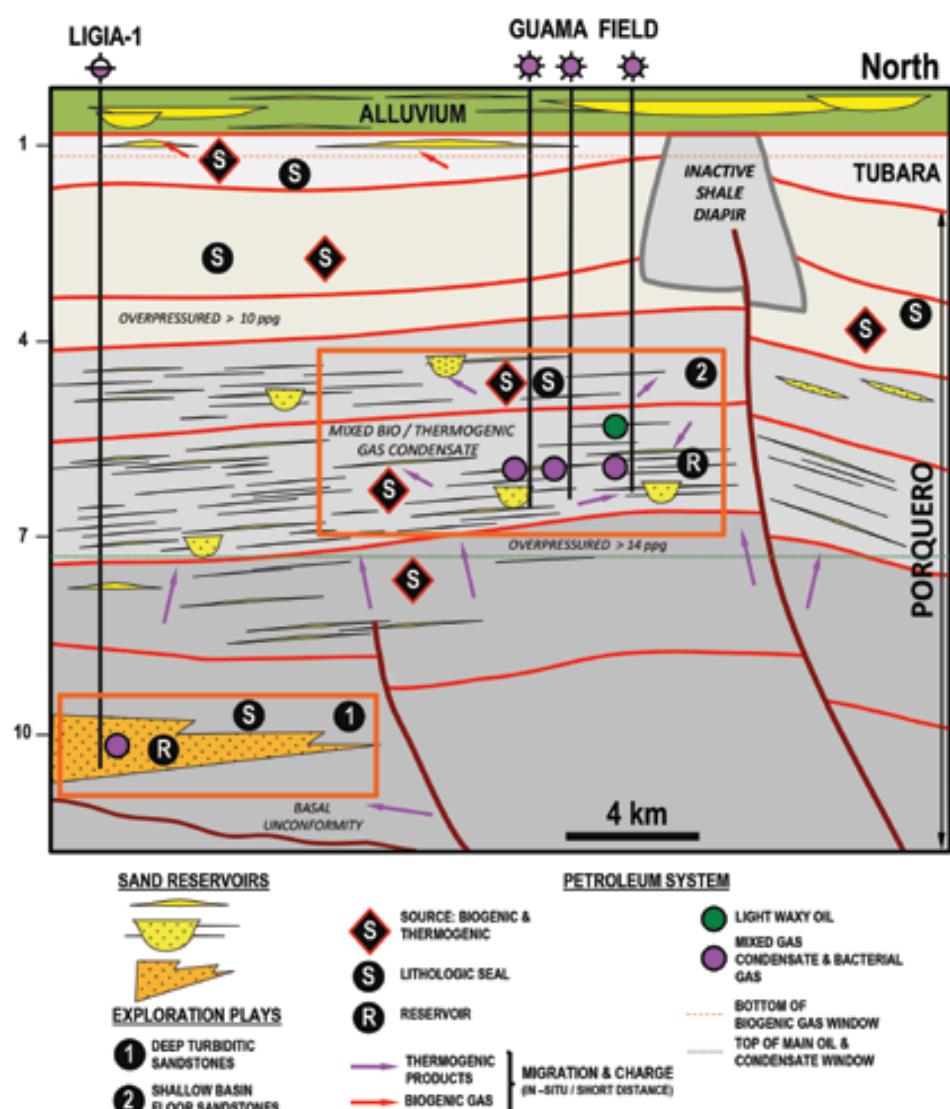
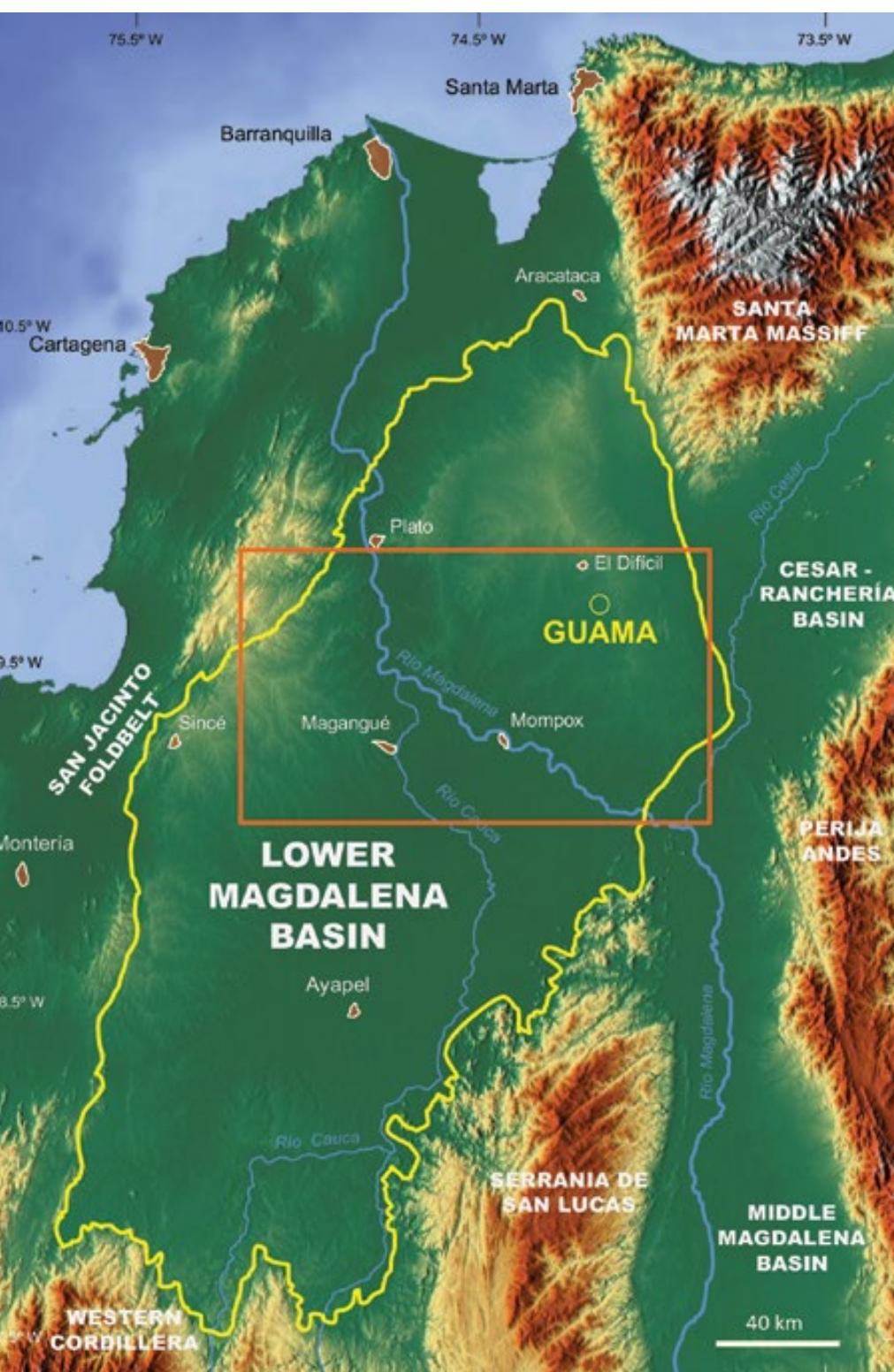
Further uncertainty over reservoir quality added little attractiveness to a well that would drill through hefty thicknesses of Porquero Formation marine shales, notorious in the region for their ability to complicate drilling operations and junk exploration wells.

Change of Paradigm

With this concern in mind, in 2010 the operator carried out a first seismic inversion to reduce the uncertainty of reservoir presence in the new prospects. This first inversion showed a spectacular pattern of basin floor lobes at target level extending across the prospects – but also showed that the sands that proved to be poor in the Ligia-1 and Guamito-1 wells shaled out towards the prospects. This piece of evidence was definitive in slashing the proposed deep test.

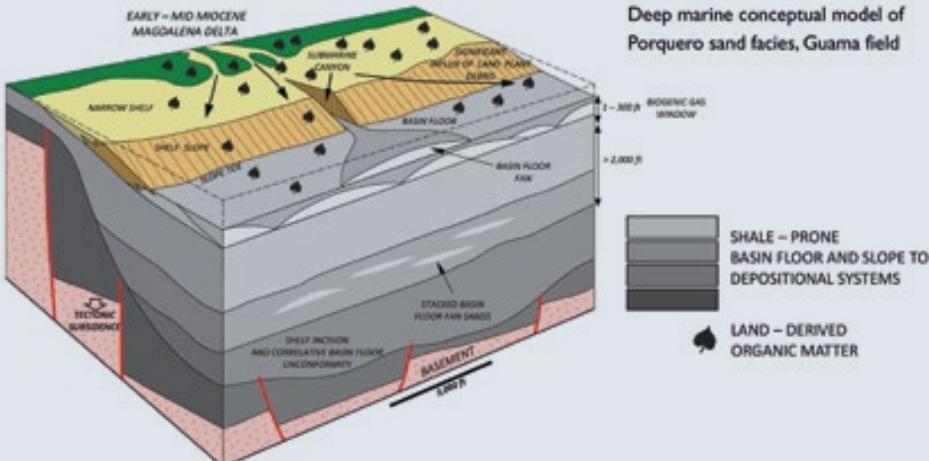
Explorers then began looking instead at gas chimney-like features that had been noticed on older data near the prospective area, which suggested that some gas might indeed be present at shallower (and cheaper!) depths. If only there were sands ...

Continued on next page ▶



Juan Francisco Arminio graduated with a degree in geological engineering from Universidad de Oriente in Venezuela and holds a master's in basin evolution and dynamics from Royal Holloway, University of London. He developed his career with PDVSA in production, exploration and new business development, moving afterward to Colombia as exploration manager for Pacific Stratus, later Pacific Rubiales Energy. Currently with New Stratus Energy, he is also a post-grad professor at Universidad Simón Bolívar, Venezuela.





Standing, right to left: Vicmar Azuaje, Mario Di Luca and Trino Salinas (seismic interpretation and modeling), Jose G. Betancourt and Eduardo García (green poster) both petrophysicists, and Gonzalo López and Juan Vargas, geologists. Sitting: Diana Ruiz, reservoir engineer and Juan F. Arminio, project manager. Screen: Lino Castillo, reservoir geologist. Credits to: Jairo Lugo (VP Exploration), Angel Dasilva (exploration geophysicist), Santosh Ghosh (sedimentologist), Suhas Talukdar (organic geochemist), Juan Tavella and Omar Pimentel and their teams (seismic modeling), Rudyard Vega (reservoir engineer), Ivan Leyva and Franklin Yoris (geologists) and Gabriel Alvarez (geophysicist).



◀ Continued from previous page

A 3-D survey was run in early 2010 in lieu of the first commitment well, something that improved the exploration outlook of the block: the new data showed that the vertical features now looked more like shale diapirs. This new data also showed amplitude anomalies at depths of less than 7,000 feet that faded out well before reaching the shale diapir flanks; AVO analysis indicated them to be gas-prone.

Discovery and General Geology

With a new well commitment and not much time to spare, well Pedernalito-1X spudded in September 2010. The name of the well, itself a blink at the historic Pedernales diapir play of Eastern Venezuela, became premonitory: gas condensate was short-tested from just a few feet of interpreted pay in laminar sands scattered sparsely and irregularly over the more than 1,700 feet thick interval of Porquero massive marine shales, albeit at rather unimpressive flow. This prospective succession, defined between well-defined unconformities, was in turn buried under a shale-prone overburden of more marine shales, also crossed by unconformities; it reached almost to the surface and was capped by a thin recent alluvium. Mineralogical analyses indicated that the sands, fairly porous but laminar and scattered in irregular multi-laminae cycles, were rich in clays that strongly affected reservoir permeability and log response. The shales, in addition, were proven to be quartz-rich, which in turn exacerbated an already poor log contrast.

If only the trap were discernible on seismic and the pay showed up in logs, and only if the wells flowed better ... why had it to be that way?

To address so many issues, good old geology helped jump-start a workable model: reconnaissance bio by the late Herman Duque-Caro and high-definition biostratigraphy by María Bolívar helped interpreters assign Early, Middle and Late Miocene ages within the complex unconformity architecture of the whole Porquero section, which revealed the equally complex tectonic evolution of the basin as well as a deep marine environment for the prospective Porquero. Meanwhile, fine sedimentological work associated it with a deep basin floor environment installed just north of the Early/Mid-Miocene Magdalena River Delta, the reservoir sands representing overbank and submarine channel facies. In this context, the structure dips gently to the northwest, while locally the beds are up-folded by PSDM-defined shale diapirs, of which two have been mapped in the area. The diapirs are cut off by the recent Magdalena River alluvium and have no surface expression, so they are considered inactive.

See Seismic page 23 ▶

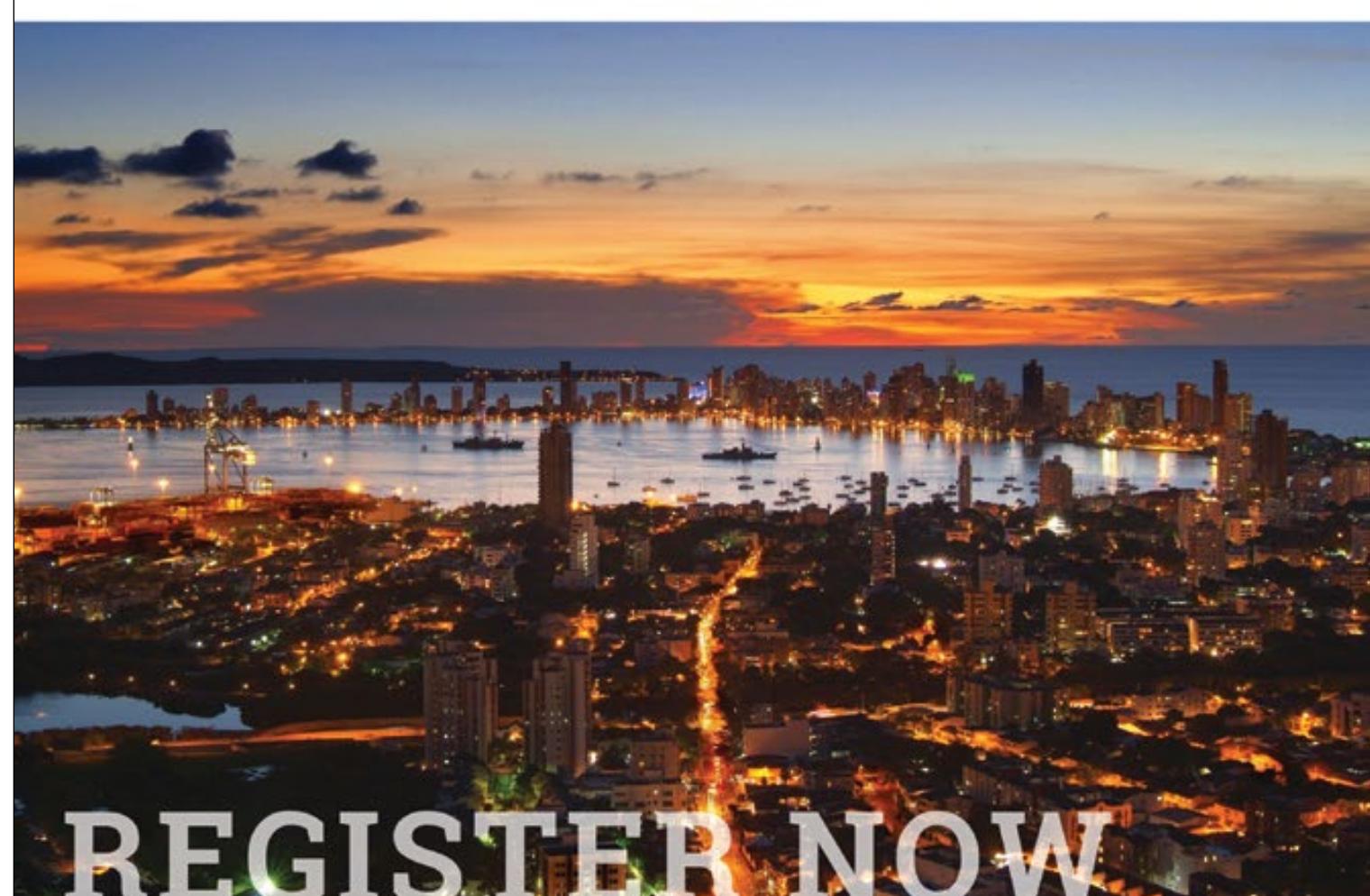


Energy Opportunities Conference

Exhibition and B2B Session

Hilton Hotel and Convention Center

Cartagena de Indias, Colombia



Conference Sessions:

- A Regulatory Framework for the 21st Century
- Challenges and Opportunities for Offshore Exploration
- Best Practices for Unconventional Exploration & Production
- New Technologies and New Analytics
- Latin America Investment Outlook & Legal Framework
- Empowering Communities and Protecting the Environment
- The Future Energy Matrix
- Connecting Industry and Government

B2B Session:

- One-on-one meetings with current and future partners



High impact sponsorship and exhibition packages available!

For more information visit:

energyopportunities.info

Geophysical Corner

Intra-Basement Intrusions in the STACK Area of Oklahoma

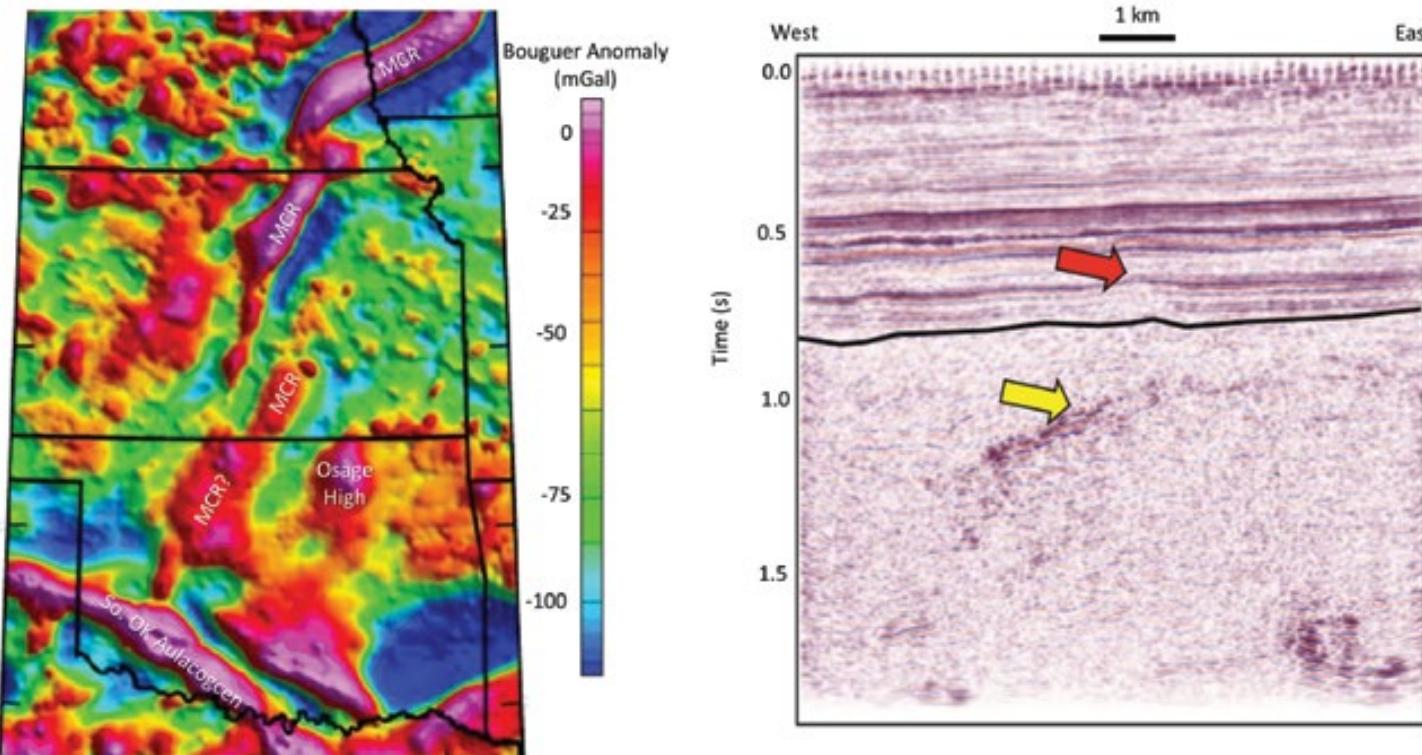


Figure 1: (a) The residual Bouguer anomaly map showing the extent of the Midcontinent Rift extending from Lake Superior, through Kansas, and thought to continue into north central Oklahoma. (b) An image from a legacy survey acquired over the Osage High showing a hypothesized intrusion dipping up the east. The black horizon indicates top of basement, while the red horizon indicates the top Mississippi Limestone. (After Elebiju et al., 2011.)

Although fractured basement rocks can sometimes form hydrocarbon reservoirs, such as found in Vietnam and Venezuela, in general they are considered to have insufficient porosity to contain significant amounts of hydrocarbons. The top of basement also often represents a major unconformity. While a given seismic acquisition and processing program might accurately image the overlying moderately dipping sedimentary section, more steeply dipping features in the basement might be poorly imaged, resulting in a low frequency, "wormy" character. For these two reasons, relatively little has been published on the appearance of basement features in 3-D seismic data volumes.

In many parts of the world, basement faults control shallower faulting in the overlying sedimentary cover. Such faults can enable fluid migration up and down. Hot fluids from below can diagenetically alter fault zones in the shallow section. Wastewater injection from above can

find its way into the basement, potentially "lubricating" previously "locked" faults. In addition to fluids, magma can also flow within the basement and depending on the age of magmatism, into the sedimentary column. These magmatic flows may follow previous zones of weakness.

The revitalization of old basins by technological advances in producing unconventional reservoirs has justified the acquisition of modern, high-density 3-D seismic surveys of areas that were thought to be well understood. In Oklahoma, these surveys provide new images of the basement that was previously thought to be relatively homogenous granite and rhyolite.

While extrusive and intrusive igneous rocks sometimes form good hydrocarbon



CHOPRA

reservoirs, more often they pose an interpretation hazard. In the absence of well control and a clear understanding of the seismic polarity, volcanic mounds can be misinterpreted as carbonate buildups, lava-filled incised valleys as turbidites and sills as bright spots. Although mafic dikes and sills are well-documented in the sedimentary column of the North Sea, Australia and offshore Brazil, and andesitic features in the sedimentary section of Mexico and Argentina, their appearance internal to the basement is less well documented. Fortunately, a suite of papers in the August 2017 issue of Interpretation on volcanics provided new insights into the seismic geomorphology of intrusive and extrusive igneous features. Using concepts of seismic geomorphology, coupled with an understanding of the Midcontinent Rift from gravity and magnetic surveys, these analogues provide insight into the character of these previously unseen features in recently acquired 3-D seismic data.

The Midcontinent Rift and the Osage High

From gravity and magnetic surveys, the North American Midcontinent Rift appears to continue southward into Oklahoma (indicated by the "?" in figure 1a). Shallow basement (about 3,000 feet) also occurs over the Osage High, where legacy surveys suggest the presence of igneous sills stepping up to the east. The Wah-Zha-Zhi well reported in the December 2012 AAPG Explorer drilled 7,000 feet into basement in this area encountered rhyolite, granite and gabbro. A recent August 2017 special section on the subsurface expression of igneous features published in the AAPG-SEG journal Interpretation provides additional insight on seismic geomorphology, reflection strength compared with that of the host rocks, cross-cutting relationships and "stepping" of the reflectors.

In 2016, TGS acquired and processed a 3-D wide-azimuth seismic survey over Kingfisher, Canadian and Blaine counties of Oklahoma in order to image the Meramec, Woodford, Osage and other targets that form the Sooner Trend Anadarko Canadian and Kingfisher, or "STACK" play. The quality of these images is vastly superior to older seismic images in the same area, where the suite of stepping-up-to-the-west sills seen in figure 2 are significantly better focused than similar features seen on legacy surveys such as in figure 1a. The overlying sedimentary structure in figure 2 is gently dipping to the left of this image, such that we can discount these steeply dipping events as being multiples. Yellow arrows indicate the "stepping up" features seen in sedimentary column of the North Sea, Brazil and New Zealand. These "steps" are sometimes misinterpreted to be faults, although some of these offsets are due to faults observed as lineaments in the curvature attribute extracted on the basement map. Flatter events indicated by the green arrows are either flat-lying, potentially volcanoclastic sediments, or flat-lying intrusive sills. Some of the discontinuities correspond to faults (in green) that continue into the sedimentary cover (black curves).

Figure 3a shows a time-structure map of the sill indicated by the red arrow in figure

Continued on next page ▶

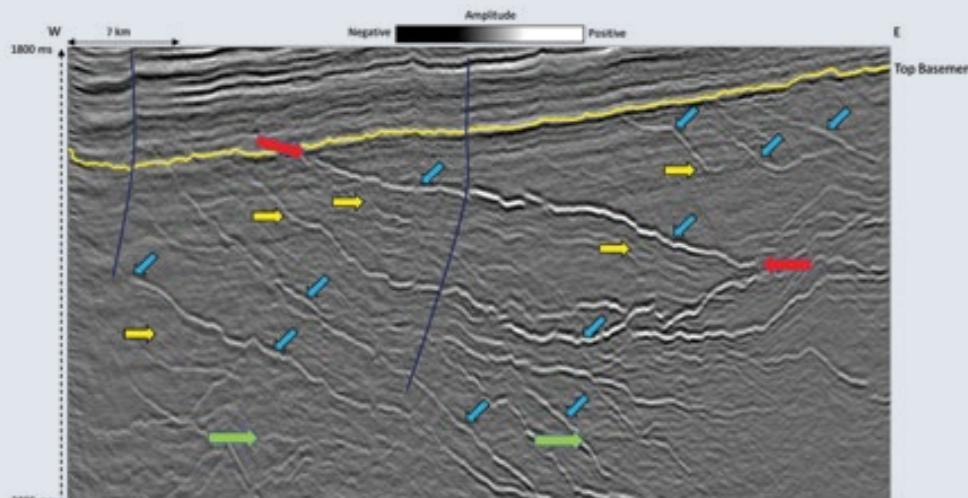


Figure 2: A vertical slice through a modern, high density, wide-azimuth survey acquired to image the Stack play of northern Oklahoma. This survey also images the deeper basement and the hypothesized southern extension of the Midcontinent Rift (indicated by the symbol "MCR?" in figure 1). We interpret the steeply dipping strong reflectors indicated by the cyan arrows to be sills that potentially follow earlier zones of weakness. Yellow arrows indicate vertical steps in these sills where we can image the sill. Other offsets might be faults that offset them, some of which continue into the sedimentary section (blue curves). While events that gently dip to the west (paralleling the top basement) may be multiples, flatter events are reflectors in the basement that either existed before the sill emplacement or are additional flat-lying sills. Red arrows indicate the sill mapped in figure 3. Data courtesy of TGS in Houston.

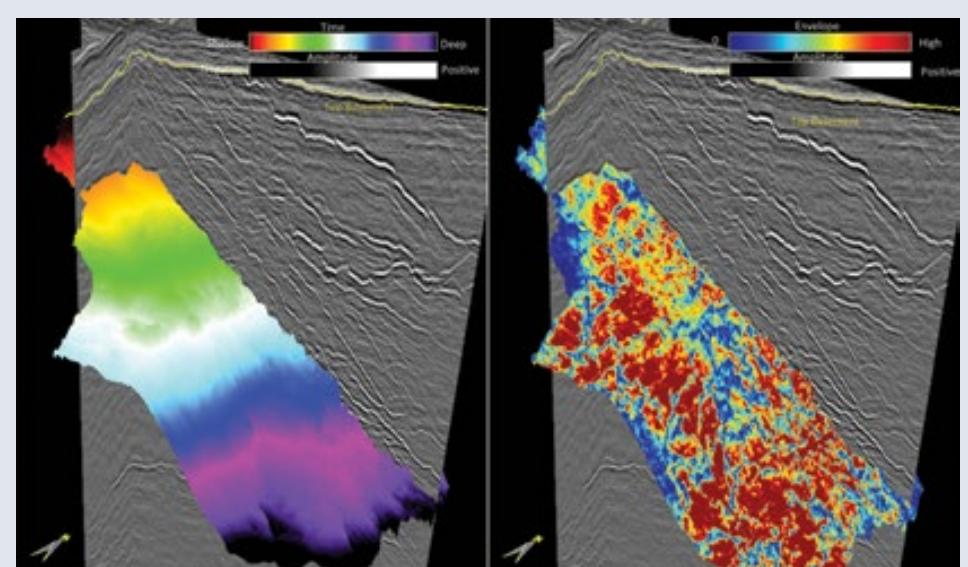


Figure 3: (a) Time-structure map of the picked intrusive event indicated by the red arrow in figure 2 with representative vertical slices section through the seismic amplitude volume. Abrupt changes in this time-structure map correlate to "step-up" features. (b) The corresponding horizon slice through the instantaneous envelope (also called reflection strength) along the same horizon, which we interpret to represent the heterogeneity of the sill thickness. Data courtesy of TGS in Houston.

◀ Continued from previous page

2. Discontinuities in this map correspond to "step-up" features in the sill. If we assume that the host rock is relatively homogeneous granite or rhyolite, the lateral changes in reflection strength shown in figure 3b correlate to lateral changes in sill thickness. Figure 4 is a photograph of an outcrop analogue, intruding through a sedimentary section. Note how the sill climbs using a series of step-ups through the relatively flat-lying strata. Smaller sills extend from the main intrusion, sub parallel to the relatively flat-lying sedimentary layers.

Our Interpretation

Magma typically forms during break up of continents as a result of decompression and partial melting of the asthenosphere. It can intrude laterally or vertically through the rock layers above depending on the rock types, the localized structures prevalent there, and more importantly the state of stress in the areas. Our current hypothesis is that these intrusions were fed by the magmatism that created the Mid-Continent Rift System when the North American craton began to split during the Precambrian about 1.1 billion years ago by thinning of the lithosphere due to convection of the hot but solid asthenosphere. None of these intrusions cut through the overlying Cambrian sediments that lie above the top basement.

This igneous bodies appear to be inclined sheets flowing from a deep source point (maybe from a series of sub vertical dikes that cannot be imaged in the seismic data) that also extends outwards like many of the studies we have seen before from the European side of the North Atlantic margin. In this part of Oklahoma, the few wells that tag basement find it to be felsic in composition (granite or rhyolite) although there is a lack of information about its nature and extension. Using this assumption, the high reflectivity between the felsic basement and the igneous intrusions indicate a change in magma composition. Therefore, we interpret the composition of these inclined sheets to be mafic (having more magnesium and iron rich minerals such as pyroxene and olivine) which have higher impedance ($\rho \approx 3.0 \text{ g/cm}^3$, $v_p \approx 7 \text{ km/s}$) compared to their felsic counterpart ($\rho \approx 2.7 \text{ g/cm}^3$, $v_p \approx 6 \text{ km/s}$). This difference in magma composition is consistent with a continental rift setting in which continental crust that is melted by conduction of the hot Asthenosphere would create felsic magma, whereas magma that intruded near the upper crust through discontinuities such zones of weakness have retained their original mafic composition.

Summary

Surface seismic studies have dramatically changed our perception of igneous systems due to the possibility of studying igneous bodies in 3-D. Such high-quality data promise to provide a much deeper understanding of the Midcontinent Rift. Such studies help understand the occurrence of sills or

intrusive bodies in sedimentary rocks. The transport or flow pathway mechanisms include the intrusion of magma along faults or compliant lithologies. Three-dimensional surface seismic data help us understand the shapes of such intrusive bodies, interpret or understand rock deformation mechanisms and map flow pathways that magma might have followed. As these bodies offer high acoustic impedance contrast than the different sedimentary rock layer interfaces, they are conspicuous by their higher amplitudes. ■

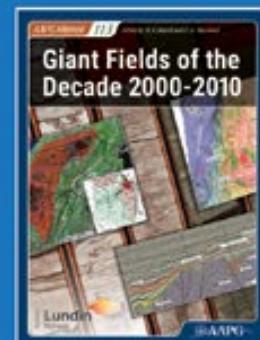
(Editors Note: The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for TGS, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer.)



Figure 4: A photo showing igneous sills rising through a sedimentary section in Greenland, showing a morphology similar to the hypothesized sills seen in the basement features shown in figures 2 and 3. Note how the sills "step up" into the shallower section. Photo courtesy of John Howell (pesgb.org.uk/events/event-240).

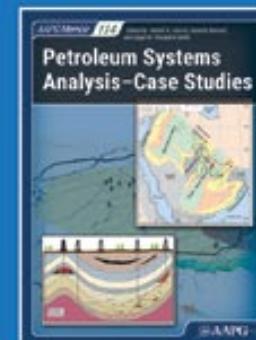


Purchase AAPG's Newest Releases at ACE 2018



Memoir 113: Giant Fields of the Decade 2000-2010

Edited by R. K. Merrill and C. A. Sternbach
Product #1284
Member: \$89.00
List: \$178.00



Memoir 114: Petroleum Systems Analysis—Case Studies

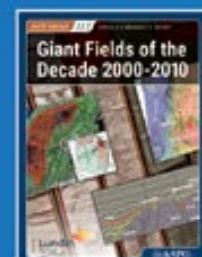
Edited by Mahdi A. AbuAli, Isabelle Moretti, and Hege M. Nordgard Bolas
Product #1285
Member: \$169.00
List: \$338.00

Don't forget to grab other great products and browse AAPG titles pertinent to the Rocky Mountain area, such as:

- Studies 65: Application of Structural Methods to Rocky Mountain Hydrocarbon Exploration and Development
- Wyoming Geological Association Publications on DVD
- Four Corners Geological Society Publications on DVD

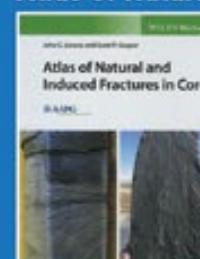
New! Author Book Signings at ACE 2018

AAPG Memoir 113: Giant Fields of the Decade 2000-2010



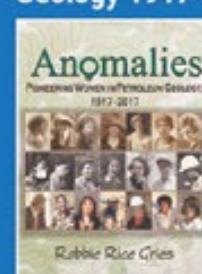
Days and Times:
Sunday, 20 May
5:30 p.m.–7:30 p.m.
Tuesday, 22 May
9:00 a.m.–12:00 p.m.
Location: Exhibition Hall, AAPG Center
Authors: Charles Sternbach and Robert Merrill

Atlas of Natural and Induced Fractures in Core



Days and Times:
Tuesday, 22 May
2:00 p.m.–4:00 p.m.
Location: Exhibition Hall, AAPG Center
Author: John Lorenz

Anomalies: Pioneering Women in Petroleum Geology 1917-2017



Days and Times:
Monday, 21 May
9:00 a.m.–12:00 p.m.
Tuesday, 22 May
2:00 p.m.–4:00 p.m.
Location: Exhibition Hall, AAPG Center
Author: Robbie Rice Gries

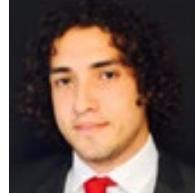
A World of Culture, Oil and Golf



Days and Times:
Wednesday, 23 May
9:00 a.m.–12:00 p.m.
Location: Exhibition Hall, AAPG Center
Author: David Allard



Kurt Marfurt
currently serves as the Frank and Henrietta Schultz Professor of Geophysics within the ConocoPhillips School of Geology and Geophysics.



Lennon Infante-Paez is a Student Member of AAPG and a doctoral student at the University of Oklahoma.



2018 Conjugate Margins Conference
Halifax, Nova Scotia, Canada | August 19-22, 2018

Registration Now Open

Themes:

- Geodynamics - Rift to Drift
- Stratigraphy and Sedimentology
- Regional Geology
- Geochemistry and Petroleum Systems
- Exploration Thinking for the Atlantic Conjugate Margins

Geoscience Data Rooms

Pre-meeting Excursions and Course:



- "Petroleum Systems of the Paleozoic and Mesozoic Basins of Atlantic Canada" (Excursion)
- "Onshore Equivalents of the Cretaceous Reservoir Rocks of the Scotian Basin: Detrital Petrology, Tectonics and Diagenesis" (Excursion)
- Two-day course on "The Geology of Salt-Bearing Passive Margins" (Course)

Post-meeting Course and Workshop:



- One-day workshop on "Atlantic Canada Reservoirs, Facies and Sequences" (Workshop)
- Four-day course on "Salt Tectonics Field Seminar: Diapirs and Associated Deformation" (Course)

conjugatemargins.com



University Lands: How oil fuels higher ed in Texas



Given the escalating costs that are essentially synonymous with higher education these days, college endowments are becoming increasingly important.

Texas hopped onto this bandwagon long, long ago.

Not surprisingly, this entailed land – and oil.

The activity leading to the creation of a fund of this sort essentially kicked off in 1839, however, long before oil became a part of the picture.

This was the year the Congress of the Republic of Texas granted 220,000 acres of land for the establishment and endowment of a university. Additional grants added another couple million acres by 1883, and the Texas legislators gave the land to the University of Texas when it opened that same year.

Known as University Lands, this acreage sits for the most part in the Permian Basin in

West Texas, famous today for its prolific oil and gas production.

Revenue from the Lands, which comprise 2.1 million acres in 19 counties, is under the aegis of the Permanent University Fund, which is one of the largest university endowments in the United States. It manages both the surface and mineral interests derived from the properties.

The revenue stream benefits more than 20 educational and health institutions across both the UT and Texas A&M systems.

Income from the PUF is divvied up two-thirds to UT and one-third to A&M.

This discrepancy stems from the so-called "divorce" between the two in the 1880s, with the latter being the offspring and UT being larger, according to David DeFelice, senior vice president for oil and gas development at the UL office in Houston.

[Continued on next page ▶](#)



Nuns N' Roses

How the Santa Rita well got its name

In 1838, when President Mirabeau Lamar addressed the third Congress of the Republic of Texas, urging members to establish the foundation of a vast system of education, neither he nor the Congress could have truly envisioned the ultimate outcome, at least as it exists today.

The event triggered a series of land grants used for the establishment and endowment of a university, which led to creation of the University of Texas system.

The assembled package, dubbed University Lands, was essentially open land used for cattle grazing, farming and hunting.

The picture slowly began to change in 1921, when the Santa Rita-1 well spudded in Reagan County in the Midland Basin of the Permian, four hours prior to expiration of the applicable permit.

It would be another two years before production.

Owing to a unique chain of events, the well's name originated in New York with a group of Catholic nuns who had been encouraged by stock salesmen to invest in certificates. Afterward, when second-guessing kicked in and uncertainty clouded their enthusiasm, they consulted with their equally skeptical priest. He suggested they invoke the

aid of Santa Rita, who was the patron saint of the impossible.

One of the well's owners – Frank Pickrell – later was handed a sealed envelope containing a red rose that had been blessed by the priest in the name of the saint. Following instructions, he carried the rose back to Texas to the top of the derrick, where he scattered the petals over the rig and declared "I hereby christen thee Santa Rita."

Two years after the spud date, oil came flowing up the borehole, triggering what many folks claim to be the discovery well in the Permian Basin as opposed to an earlier well in Mitchell County, which produced 10 bopd

when completed.

The Santa Rita-1 was plugged many years later in May 1990, after producing 131,775 barrels of oil, according to the Texas State Historical Association.

Earlier, in 1958, the University Board of Regents had moved the Santa Rita's walking beam and other equipment to the UT Austin campus.

The American Oil and Gas Historical Society noted that subsequent to the dedication, the student newspaper described the well "as one that made the difference between pine shack classrooms and modern buildings." ■

◀ Continued from previous page

Oil and gas price volatility always lurks in the oil patch, so operators are eager to jump onto the next new advance in technology and production methods. Indeed, the much welcome onset of hydraulic fracturing in wells in this region played a big role in revving up well drilling on the Lands and, in turn, revenue.

Managing UL with Geoscience

It's unlikely there will ever be a dearth of greenbacks to go around, with the Lands harboring large accumulations of now-familiar, hydrocarbon-rich productive reservoirs. Think horizontal drilling target industry darlings such as Spraberry and Wolfcamp, for example.

In 2017, the Texas Tribune reported the value of the PUF to be \$19.5 billion, notably more than the \$10.7 billion in 2010. Prior to the most recent crash in prices, the Lands were kicking out a mega-amount of \$1 billion annually.

Contrast this to the beginning stage of the Lands oil production when the initial well – the Santa Rita-1 well in Reagan County – kicked off production in May 1923. The first royalty payment on Aug. 24, 1923, tallied \$516.63 (see sidebar).

Surface income from varied sources on the Lands, such as grazing leases, wind power generation and a commercial vineyard and winery goes into the Available University Fund. The AUF distributes the monies according to provisions laid out initially by the 1876 Texas Constitution and some later amendments.

The UT system revamped its approach to managing the Lands in 2015 when it organized a development team skilled in geologic and engineering expertise and

See Geoscience page 29 ▶



Short Courses

A wealth of information in a short period of time, ACE Short Courses are an effective and efficient way to build your knowledge and skills. Check out all the amazing topics offered this year:

Saturday, 19 May

- ACE SC 01 | Petrography of Mudrock Hydrocarbon Reservoirs (RMAG)
- ACE SC 04 | Fracture Characterization (PROWESS)

Saturday, 19 May–Sunday, 20 May

- ACE SC 05 | Concepts, Models, and Case Studies of Dolomitization - With Applications to Hydrocarbon Exploration and Development (AAPG)
- ACE SC 07 | Advanced Sequence Stratigraphic Applications for Exploration (SEPM)

Sunday, 20 May

- ACE SC 09 | Chemometric Tools to Establish Petroleum Systems, Predict Physical Properties, and De-Convolute Mixed Production (AAPG)
- ACE SC 10 | Tricky Carbonates Made Simple (UGA)
- ACE SC 11 | Sequence-Stratigraphic Analysis of Shales and Mudstones: Key to Paleoclimate Archives, Subsurface Fluid Flow, and Hydrocarbon Source, Reservoir and Seal (SEPM)
- ACE SC 12 | UAVs and Virtual Outcrops – from Data Collection to Final Interpretation (AAPG)
- ACE SC 14 | Unconventional Resource Assessment and Valuation (EMD) - (AAPG)

Thursday, 24 May

- ACE SC 15 | Petrophysical Evaluation of Unconventional Reservoirs (PTTC)

Thursday, 24 May–Friday, 25 May

- ACE SC 16 | Rock and Seismic Sequence Expression of Carbonate Systems – Exploration and Reservoir Characterization (SEPM)

Sign up, register, and find out more at ACE.AAPG.org
(Use promo code **ACE18EXP** for best available pricing.)

Profit and Power: The Rise of al Saud, Inc.



Other royal families have their crown jewels.

For the ruling al Saud family in Saudi Arabia, the crown jewel is Saudi Aramco.

So, the Saudi government's plan to take up to 5 percent of Aramco public in an IPO is a huge development, not just in Saudi Arabia, but in the oil and gas industry and in the world.

This isn't your typical national oil company or normal stock sale, according to Ellen Wald, a Middle East scholar and a consultant on geopolitics and the energy industry.

Wald chronicles the rise of Saudi Arabia and Aramco in her new book "Saudi, Inc.," published by Pegasus Books in April.

She gave two principal reasons for researching and writing a book about the Saudis and Aramco:

First, "I wanted people to understand

"There's real change going on in the kingdom . . . I think that Saudi Arabia will always be in the oil and gas industry, in the energy industry, but it will be a much more diversified energy industry."

that this is a very smart, very savvy and very strategic group of businessmen. And they've been that way from the start," she explained.

"The other thing I wanted people to understand is that this is about profit and power. It's not about religion, or ideology," she added.

Wald is a nonresident scholar at the Arabia Foundation, a Washington, D.C., think tank focused on business and geopolitics in the Middle East. She earned a doctorate in history at Boston University and has taught at universities in the United States and England.

While some Westerners might think of

Aramco as a somewhat dysfunctional state oil company, Wald said it is anything but that.

"In many cases, governments that run national oil companies do not prioritize the needs of the company," she noted. "In the case of Saudi Arabia, the al Saud family prioritized the long-term profitability of the company. That's always been the priority for them."

As a result, Aramco grew into a potent force in global petroleum supply. Saudis have estimated the company's market value at \$2 trillion; some analysts put that number as low as \$400 billion. In either case, it's an

enormously valuable operation with vast oil and gas resources.

American Connection

Wald said one key to understanding al Saud is the family's relationship with the United States. Even the name "Aramco" references the former Arabian-American Oil Co., although the business is now officially the Saudi Arabian Oil Co.

"People should appreciate how much of a relationship this has been between the Americans and the Saudis, but it was a relationship where there was give and take," with continual negotiations, Wald said.

"In terms of the history, American petroleum geologists were very important in getting the Saudi Arabian petroleum industry started. In fact, they were the ones who discovered oil out in the desert," she noted.

Aramco's DIY Approach

Another important aspect of Aramco is the company's hard-won competence in creating its own infrastructure for production, according to Wald. She cited development of the supergiant Shaybah field as an example.

"The Shaybah field is out in the Empty Quarter, near the border with the United Arab Emirates. They actually discovered that oil back in the 1960s," she said.

Economics delayed field development for 30 years, then horizontal drilling created a path to production. But the remoteness and sand-dune ruggedness of the field area were serious challenges, and contracting bids for buildout work went sky high.

Saudi Arabia's oil minister decided

Continued on next page ▶

*Shaping the future
in a changing
energy landscape*



**SPONSORSHIP AND
EXHIBIT OPPORTUNITIES
AVAILABLE NOW**

Registration Opening July 2018

ICEevent.org

◀ Continued from previous page

Aramco would do the work itself at half the quoted prices and pledged to complete the project on schedule.

"He said, 'You know what? We're going to do it ourselves, and we're going to do it better and faster.' And they did," Wald said. "It was an incredible feat for the company to do that."

Aramco also gained a reputation for attracting talented people, recruiting intelligent and capable Saudi students, providing educational opportunities and promoting from within, Wald said.

"They have always prioritized the education of Saudi youth, often sending them to universities overseas to become geologists, engineers, petroleum engineers," she noted.

After al Saud set an eventual goal of assuming management of Aramco, "the Saudis took their time, learned the company, and rose up through the ranks," she said.

A Multi-Generational Story

Wald begins "Saudi, Inc." with the efforts of Abdul Aziz ibn Saud to recapture his family's ancestral home, Riyadh, from the al Rashid tribe in 1902.

She then explores the development of Saudi Arabia and the company that became Saudi Aramco, through interviews, history and numerous anecdotes:

- Abdul Aziz named Riyadh capital of the newly founded Saudi Arabia in 1932. Thanks to Saudi modernization efforts, by 1965 the population of the former mud-walled village had ballooned to 225,000. Today, more than 6 million people live in Riyadh.

- When King Saud – son of Abdul Aziz – visited remote settlements in the kingdom, a village daughter would sometimes be offered as a potential bride to strengthen ties to the royal house. Saud, an affable man who disliked social friction and avoided saying "No," ended up with 41 wives.

- Ali al-Naimi, a Bedouin from eastern Saudi Arabia, had no education when he joined Aramco as a 12-year-old office boy in 1947. Taking advantage of company scholarships and internal promotion, he became the company's first Saudi chief executive officer in 1988.

This multi-generational story provides insight on how Aramco got to where it is, where it might be going, and what events shaped today's Saudi Arabia.

Why did the Saudis resist internal pressure to nationalize their oil and gas resources? How did terrorism scar the psyche of the al Saud? Why did Aramco gain a role as the world's swing producer for crude oil, then reject it – and then embrace it again?

Plans to take a part of Saudi Aramco public, the country's Vision 2030 plan, recent moves toward social liberalization and the influence of Saudi crown prince Mohammed bin Salman mark a new direction for Saudi Arabia, Wald said.

"There's real change going on in the kingdom," she observed.

At the same time, she thinks it's unlikely the Saudis will drift far from their traditional economic and political power base.

"I think that Saudi Arabia will always be in the oil and gas industry, in the energy industry, but it will be a much more diversified energy industry," she said.

For example, Saudi Arabia and venture capital fund Softbank recently announced plans to build the world's largest solar power installation. That's not a random new interest, Wald explained. In the 1970s, Aramco was already using advanced solar panels from an Exxon subsidiary to power

some of its equipment.

"This (solar energy) has been a vision former Aramco CEO and former minister Naimi has had for a long time," she noted. "The Saudis see this as part of where the industry is going."

And she predicted Saudi Aramco will be "playing a bit of catch up" downstream in the future, making improvements to its refining operations and branching out more into petrochemicals.

Overall, Wald expressed admiration for the Saudis and especially Aramco – while also reserving respect for those American men and women who traveled almost halfway around the planet decades ago, to a remote company enclave in Dhahran, Saudi Arabia, to begin building a world-scale energy colossus.

"It definitely took a certain spirit to go out there and do that," she said. ■

Seismic from page 17

Technology Isn't Everything – But It Helps A Lot

Absent a sufficiently accurate seismic image, the project kept relying on seismic attributes analyses: the second inversion was run after Pedernalito-1X and this time elastic attributes, including Poisson ratio, were used to locate Cotorra-1X (2011) and a third inversion after Cotorra-1X helped locate Manamo-1X (2012) and Capure-1X (2013), after which a fourth elastic inversion was conducted.

In all, four successful wells, total depth at around 7,000 feet, were located entirely

on seismic attributes as confidence grew in the inversion model as more control data and consistent results were obtained from different workflows run with identical datasets by two different contractors.

On the petrophysical side, pay sands were still very much invisible to conventional log suites. Besides, well performance in short tests suggested that the initial Simandoux evaluations were underestimating the gas pay in all wells, a notion confirmed later by the extended tests. Thus, during the project a workflow evolved gradually in which the final pay discrimination is based on elastic rock properties, magnetic resonance, gamma spectrometry and well-site mass spectrometry, among other indicators.

See **Geochemical** page 26 ►

Coming Soon:

A Photo Contest to **EXPLORE**

**Enter to Win the First Ever EXPLORER Photo
Contest – Have Your Image Featured**



Here's a hint:
Photos with a
story behind them
go to the front of
the line.

Keep reading your monthly EXPLORER and check online at EXPLORER.aapg.org for ongoing announcements on this contest!

AAPG EXPLORER



"The future belongs to those who prepare for it."
- Ralph Waldo Emerson

Your support of AAPG Foundation programs is crucial to our success – and reflects your personal commitment to fulfilling our mission! Whether your support is for a specific program or the general cause, 100 percent of your contribution goes to its intended use.



Contributing to the Foundation as part of your dues payment is an easy and important way to make a difference – and an essential part of ensuring the Foundation's tax exempt status. Every contribution – small or large – is important. Contributions are strictly voluntary. The suggested contribution is \$2 per year of membership.

Thank you for supporting the AAPG Foundation!

Foundation Update

The Legacy Mission: Supporting Geoscience

(Editor's Note: This article corrects last month's Foundation Update, which incorrectly reported that the named grant was established for longtime AAPG Member William E. "Bill" Galloway.

William Galloway, an Emeritus and award-winning Member of AAPG, continues to reside in Austin, and remains active as professor emeritus in the Institute for Geophysics at the Jackson School of Geosciences. He is the recipient of three A.I. Levorsen awards, the Grover E. Murray Memorial Distinguished Educator Award, the Wallace E. Pratt Memorial Award and, in 2016, the John W. Shelton Search and Discovery Award.

We deeply regret and apologize for the error and resulting confusion to both families.)

There is a great deal of consideration that goes into establishing a lasting legacy. Donors want to support efforts that are meaningful to them. Families want their loved ones to be remembered for life-long achievements. Finding the right purpose and the right intent is very similar to going on a mission.

It is no small coincidence that AAPG includes such aims as "advance the science of geology," "promote the technology of exploring," "foster the spirit of scientific research" and "disseminate information" as components of its mission statement. These ideas resonate with many of those who donate each year or establish endowments with AAPG Foundation.

The Chandler and Laura Wilhelm Named Grant

AAPG members Chandler and Laura Wilhelm place a high priority on geoscience education. They met while they were both pursuing their masters' degrees in geology at the University of Colorado.

"Being a petroleum geologist has enriched my life in ways that I could not have imagined when I was a student contemplating what to do with a degree in geology," Chandler said.

Throughout the Wilhelms' careers and their lives, AAPG had special meaning to them both.

Laura's graduate thesis examined foraminifera of the Mancos Shale in western Colorado, and upon graduation, she worked as a paleontologist for Amoco Production Company in Denver. Chandler and Laura married in 1984, and they made their home in Houston. Laura continued her career as a micropaleontologist until after the birth of their third child, at which time she decided to focus full-time on guiding their children to adulthood. Laura's energy and contributions to her family and her community include volunteering at schools and her church, where she serves as the Opportunity Endowment Fund chair, which supports charitable missions across the globe. In addition, she is an accomplished artist and art historian who studies mosaics and the history of the art form in ancient cultures.

After earning his master's degree, Chandler began his career with Shell Oil Company. As a petroleum geologist and organizational leader, he worked at Shell's global deepwater exploration and appraisal evaluation, Arctic exploration and unconventional exploration and appraisal programs. He has traveled the globe, making notable discoveries of "deepwater fields in Angola, Brazil, Nigeria and the Gulf of Mexico, along with multiple



WILHELM



GALLOWAY

unconventional plays in British Columbia, Alberta, the Texas and Louisiana Gulf Coast, the Delaware Basin in West Texas, Pennsylvania and Argentina."

At AAPG, Chandler has served as president of the Division of Professional Affairs, is a Trustee Associate of AAPG Foundation and of the American Geosciences Institute Foundation. He has been honored with AAPG's Distinguished Service Award and co-authored two Discovery Thinking papers presented at the AAPG annual meeting and co-authored a DPA special publication, "Heritage of the Petroleum Geologist."

When the Wilhelms considered how their education in geology laid the foundation for both of their careers, they wanted to give others similar opportunities. Together they decided to establish the Chandler and Laura Wilhelm Named Grant.

"My wife and I established this fund," Chandler said, "to help students who desire to enter this great profession realize their educational goals."

The B. Glenn Galloway Memorial Grant

His wife of 43 years described Bedford Glenn Galloway as having "a ceaseless wonder of the beauty of God's world around him," noting that he left "a legacy of love for wild places." Glenn Galloway's love of the outdoors included hobbies such as "rockhounding, geology, archaeology, flint-knapping, Native American lore and artifacts, mountaineering, backpacking, hunting" and more, reflecting his connection to nature.

"While hiking on mountain trails, he would stop to point out bear scratches on a tree, some interesting rocks or geologic sites, a patch of blueberries or a rare alpine flower that others might quickly pass by," said his wife, Diane Caylor Galloway. Upon his recent passing, Diane and their son Gregory wanted to find a suitable way to honor Glenn's life and his love of "wild places." The family decided to establish a scholarship: the B. Glenn Galloway Memorial Grant.

Diane knew that the AAPG Foundation would be a good choice because her family had dealt with her father's bequest to AAPG Foundation years earlier. She knew that they would receive a letter and often a photo of the grant recipient each year.

"We have the pleasure of sending him or her a letter of congratulations," she said. They also tell the recipient about Glenn Galloway and at the close of each year, the family can reconnect with the recipient, "read a summary of the research and what they learned, thanks to the grant they received."

See Legacy page 26 ►



2018 GRANTS-IN-AID RECIPIENTS

The American Association of Petroleum Geologists Foundation and the Education Awards Committee are proud to announce the Grants-in-Aid recipients for 2018.

The Foundation's Grants-in-Aid program is a highly competitive grant program promoting research in the geosciences. Grants are made to provide financial assistance to master's or doctorate level students whose thesis research has application to the search for

and development of petroleum and energy mineral resources, and/or related environmental geology issues.

In 2018 the program awarded 124 graduate students across the world with a total of \$283,500 in research funds. These funds are available annually thanks to our named grants, most of which bear the name of generous donors and innovators in the energy industry.

AUSTRALIA

- James Cook University**
Christopher Yule
Gustavus E. Archie Memorial International Grant
Monash University
Adriana Travati
Gustavus E. Archie Memorial International Grant
University of Adelaide
Hugo Burgin
Grants-in-Aid Funds
University of Western Australia
Joseph Sciborski
David Worthington Named Grant
University of Western Australia
Jesse Vitacca
David Worthington Named Grant

CANADA

- Simon Fraser University**
Sarah Schultz
Gordon I. Atwater Memorial Grant
University of Alberta
Martin Schwanger
Jean G. Funkhouser Memorial Grant
University of Calgary
Simon Poirier
Robert K. Goldhammer Memorial Grant
University of Ottawa
Tyler Billington
Martin D. Hewitt Named Grant
University of Saskatchewan
Fernando Valencia
Frank E. Kotlowski Memorial Grant
Mayra Zuniga
Donald F. Towse Memorial Grant

CHINA

- China University of Petroleum-Beijing**
Tao Hu
Grants-in-Aid Funds
Hui Li
John Teagle Memorial Grant
Guoping Liu
Grants-in-Aid Funds
Xue Zhang
John W. Robinson Named Grant
Zhengfu Zhao
Robert & Carolyn Maby Memorial Grant

INDIA

- Indian Institute of Technology-Bombay**
Ashutosh Tripathy
William E. Gipson Named Grant

IRELAND

- University College-Dublin**
Arif Hussain
Grants-in-Aid Funds

MALAYSIA

- Universiti Kebangsaan Malaysia**
Ekundayo Adepehin
Grants-in-Aid Funds

NEW ZEALAND

- The University of Auckland**
Stephen Brennan
W. David Wiman Memorial Grant

NIGERIA

- University of Benin**
OGHENEKIOJA ABELE
Merrill W. Haas Memorial Grant

NORWAY

- University of Tromsø**
Amando Lasabuda
Grants-in-Aid Funds

SPAIN

- University of Barcelona**
Rodolfo Uranga Moran
Chandler and Laura Wilhelm Named Grant

UNITED KINGDOM

- Cardiff University**
Roberto Loza Espejel
Grants-in-Aid Funds
Durham University
Miles Wilson
James E. Hooks Memorial Grant
University of Leeds
Tim Cullen
Arthur A. Meyerhoff Memorial Grant

UNIVERSITY OF MANCHESTER

- Kévin Boulesteix
The Institut Français du Pétrole Grant
Zoe Cumberpatch
Gustavus E. Archie Memorial Grant
Ardiansyah Koeshidayatullah
Fred A. & Jean Dix Named Grant
Timothy Ohiara
Peter W. Gester Memorial Grant
Gustavo Pereira
Wallace E. Pratt Memorial Grant
Euan Souter
Donald A. & Mary O'Nesky Named Grant
Jack Stacey
Grants-in-Aid Funds

UNITED STATES OF AMERICA

ALABAMA

- Auburn University**
Shifat Monami
Norman H. Foster Memorial Grant
David Worthington Family Grant

ARIZONA

- University of Arizona**
Walter Alonso
Kenneth H. Crandall Memorial Grant
Scott Meek
Alexander and Geraldine Wanek Memorial Grant

ARKANSAS

- University of Arkansas**
Joshua Blackstock
Thomas A. Hendricks Memorial Grant

CALIFORNIA

- Loma Linda University**
Samuel Andrade Abdala
J. Ben Carsey, Sr. Memorial Grant
San Diego State University
Joshua Kelly
Raymond D. Woods Memorial Grant
Emma Vierra
Marilyn Atwater Memorial Grant
Yuval Levy
(Joint doctoral program at University of California, San Diego)
Harold J. Funkhouser Named Grant
Mark Korte-Nahabedian
John E. Kilkenny Memorial Grant
Stanford University
Zachary Burton
Lawrence W. Funkhouser Named Grant

COLORADO

- Colorado School of Mines**
Mark Hansford
J. Elmer Thomas (Past-Presidents) Memorial Grant
Robert Pearigen
John and Erika Lockridge Named Grant
Matthew Steidmann
Grants-in-Aid Funds
Wylie Walker
Grants-in-Aid Funds
Leilaka Welcome
John and Erika Lockridge Named Grant
Colorado State University
Aleksandra Novak
Fred Tietz Named Grant

CONNECTICUT

- University of Connecticut**
Queenie Chang
John H. and Colleen Silcox Named Grant
Jonathan Smolen
R.E. McAdams Memorial Grant
Rebecca VanderLeest
Paul Danheim Nelson Named Grant

FLORIDA

- University of Miami**

- Emma Giddens
Gustavus E. Archie Memorial Grant

IOWA

- Iowa State University**
Chanse Rinderknecht
Garth W. Cayor Memorial Grant
University of Iowa
Justin Rosenblume
Grants-in-Aid Funds

KANSAS

- Kansas State University**
Spencer Brower
Barrett Family Named Grant

UNIVERSITY OF KANSAS

- Craig Bennett
Raymond C. Moore Memorial Grant
Thomas Neal
Nancy Setzer Murray Memorial Grant
Ling Peng
Grants-in-Aid Funds
Ian Thompson
Grants-in-Aid Funds

KENTUCKY

- University of Kentucky**
Meredith Swallow
Grants-in-Aid Funds

LOUISIANA

- Louisiana State University**
Vann Smith
Edward B. Picou Named Grant

MICHIGAN

- University of Michigan**
Tristan Childress
Roger W. Stoneburner Memorial Grant

MISSOURI

- Missouri University of Science and Technology**
William Chandonia
Grants-in-Aid Funds
Edward Duarte
Grants-in-Aid Committee Named Grant
Xin Zhan
SEAPEX Named Grant

NEBRASKA

- University of Nebraska - Lincoln**
Justin Ahern
Rodney A. Bernasek Memorial Grant

NEW HAMPSHIRE

- Dartmouth College**
James Busch
Richard W. Beardsley Named Grant

NEW YORK

- Binghamton University**
Elizabeth Klonowski
R. E. McAdams Memorial Grant
Mebrahtu Weldegebrhiel
R. Dana Russell Memorial Grant
Kristian Olson
Grants-in-Aid Funds
Syracuse University
Nicolas Perez
Charles B. and Marilyn C. Fritz Memorial Grant

NORTH DAKOTA

- University of North Dakota**
Adeoduyin Adeyilola
James E. Hooks Memorial Grant
Chunxiao Li
Allen & Eleanor Martini Named Grant

OHIO

- The Ohio State University**
Fengyang Xiong
Michael S. Johnson Named Grant

OKLAHOMA

- Oklahoma State University**
Ibukunoluwa Bode-Omoleye
Horst and Jessie von Bandat Memorial Grant
Regina Dunseth
Ohio Geological Society Named Grant
Jim Karsten
David Worthington Named Grant
Georgina Lukczki
Richard C. Hasson Memorial Grant
Jingyao Meng
Grants-in-Aid Funds
Chase Watkins
Hugh D. Miser Memorial Grant
Alejandra Santiago Torres
Kenneth O. Stanley Memorial Grant
Mercy Achang
Grants-in-Aid Funds

UNIVERSITY OF OKLAHOMA

- Feng Cheng
Jon R. Withrow Named Grant

UNIVERSITY OF OREGON

- Andreina Liborius
Jon R. Withrow Named Grant

UNIVERSITY OF TEXAS AT AUSTIN

- Carlos Molinares-Blanco
Jon R. Withrow Named Grant

UNIVERSITY OF TEXAS AT EL PASO

- Emilio Torres Parada
Kenneth H. Crandall Memorial Grant

UNIVERSITY OF TEXAS AT SAN ANTONIO

- Jerson Tellez
Jon R. Withrow Named Grant

UNIVERSITY OF TEXAS AT DALLAS

- Joshua Miller
Jon R. Withrow Named Grant

UNIVERSITY OF TEXAS AT SAN ANTONIO

- Jon R. Withrow Named Grant

TEXAS

- Baylor University**
Bulbul Ahmed
Grants-in-Aid Funds
Rice University
Eric Barefoot

- David Worthington Named Grant*

- Joyeeta Bhattacharya*

- Grants-in-Aid Funds*

- Tian Dong*

- Grants-in-Aid Funds*

- Rahul Sudhakar*

- Sherman A. Wengerd Memorial Grant*

- Chenliang Wu*

- Meckel Family Named Grant*

- Texas A&M University**

- Szu-Ting Kuo*

- Michel T. Halbouty Named Grant*

- Ben Richards*

- James W. Milliken Memorial Grant*

- Texas A&M University, Corpus Christi**

- Sajjad Abdullaftikam*

- Michel T. Halbouty Named Grant*

- Texas Tech University**

- Giovanni Zanoni*

- Eddie David Named Grant*

- University of Houston**

- Shelby Johnston*

- Fred A. & Jean Dix Named Grant*

- Lucien Nana Yobo*

- Gustavus E. Archie Memorial Grant*

- Manuel Paez*

- L. Austin Weeks Memorial Grant*

- Carolina Ramon Duena*

- James E. and Elliole B. Wilson Memorial Grant*

- University of Texas at Arlington**

- Ohood Alsalem*

- Arthur A. Meyerhoff Memorial Grant*

- Yuxiang Zhang*

- Grants-in-Aid Funds*

- University of Texas at Austin**

- Kristina Butler*

- Grants-in-Aid Funds*

- Cody Draper*

- William Dow Hamm Memorial Grant*

- Peter Schemper*

- Donald R. Boyd Memorial Grant*

- Logan West*

- Classen Family Named Grant*

- University of Texas at El Paso**

- Kate Grisi*

- Horst and Jessie von Bandat Memorial Grant*

- David Lankford-Bravo*

- Alexander and Geraldine Wanek Memorial Grant*

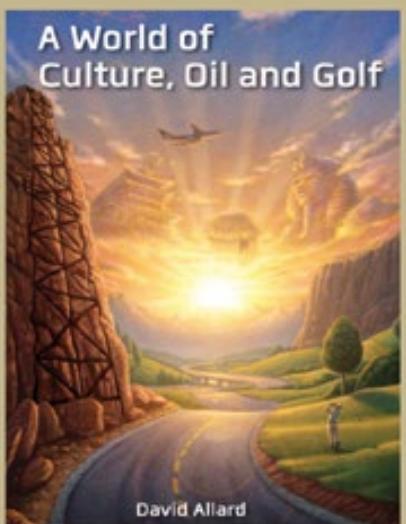
- Piper Poe*

- Grants-in-Aid Funds*

VIRGINIA

- Virginia Polytechnic Institute and State University**

- Alexandra Nagurny*



"A World of Culture Oil and Golf" is a fascinating look into the global oil business and what it's like to be an insider traveling the world and navigating the amazing array of locales and personalities. I truly enjoyed it and would recommend it to readers of any age."

-David W Miller II, author of Hard Knocks
MBA: The Search for Business Success and Job Satisfaction

Buy the book here: www.davidallardauthor.com or Amazon.com - Still \$21.49

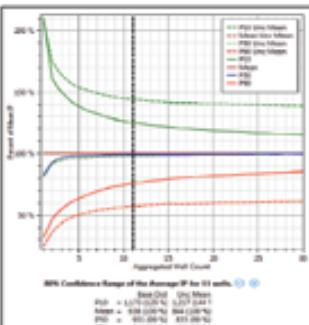
ProjectRA

Project Resource Analysis & Cash Flow Tool

LSI, the software company of Rose & Associates

Software for the Integrated Probabilistic Economic Modeling of Unconventional Projects to Address the Challenges of:

- Multiple play segment characterization
- Forecasting from limited data sets
- Pilot-sizing and confidence of achieving the mean
- Modeling type well decline variability
- Full-cycle economics
- Modeling in either scoping or detailed development mode



Contact us at www.roseassoc.com or 713-528-8422

REGISTER TODAY!

23-25 July 2018 • Houston, Texas

UNCONVENTIONAL[®] RESOURCES TECHNOLOGY CONFERENCE

FUELED BY SPE • AAPG • SEG

SHORT COURSE SPOTLIGHT:

Applications of Organic Petrography in the North American Shale Petroleum Systems

Sunday, 22 July

This full-day course will present a comprehensive examination of organic petrography applications in the North American shale plays, discussing reflectance analysis, fluorescence microscopy, SEM and other micro-spectrometry approaches to characterization of organic matter in shale reservoirs.

Join presenters Dr. Paul Hackley, US Geological Survey, and Brian Cardott, Oklahoma Geological Survey, as they discuss organic petrography and its applications.



Brian Cardott



Dr. Paul Hackley

To view this short course and others, visit URTeC.org.

Sponsoring Organizations



Endorsing Organizations



Legacy

from page 24

Diane knows that the grant she established in her husband's name receives the same reliable care, transparency and attention to detail as her father's legacy. "We know in advance that the funds will be handled well, and that each year we will be contacted with the recipient's name," and most importantly, Diane's family has a loving reminder of Glenn Galloway, "the gift that keeps on giving, thanks to AAPG Foundation. This is a wonderful way to establish a legacy to remember your loved ones in a way that also helps others."

Each year, AAPG Foundation receives donations for grants and scholarships to assist deserving geoscience students, student organizations and educators. The Grants-in-Aid program awards

graduate-level research in the geosciences. Applicants are awarded based on merit, and in part, on the financial needs of the applicant.

There are a total of 124 graduate students from across the world who are Grants-in-Aid recipients for 2018, with a total of \$283,500 in geoscience research funds awarded.

The impact of AAPG members' generous support keeps the mission and promotion of geoscience education, research, technological advancement and high ethical standards of the AAPG Foundation intact. Learn more about how you can make a contribution of support to the program of your choice at Foundation.AAPG.org. The AAPG Foundation is a 501(c) (3) public foundation, qualified to receive contributions in support of educational and scientific initiatives or projects related to the geosciences. ■

Foundation Contributions for March 2018

General Fund

Robert James Ardell
In memory of John Amoruso and John W. Skelly
John M. Cockrane Foundation of Columbus Foundation
Grant in memory of John M. and Anne H. Cochrane
Kevin E. Erickson
Elizabeth Ann Hajek
Robert Alexander Hefner, IV
Syed M. Hussain
Gary and Mary Mercado
From the Mercado Giving Fund at Fidelity Charitable
Edward Gilpin Murphy
Kurt Edward Neher
Mark A. Olson
Jeffrey Daniel Rosenthal
Nicholas William Taylor

Mr. and Mrs. John D. Sistrunk
In memory of Ronald Ray Sistrunk

Education Fund

Grants-in-Aid Fund

Howard William Kiatta
In memory of John Amoruso

James A. Hartman Student Fund
John & Mary Jo Hjerpe
Grant from the Hjerpe Family Fund at Fidelity Charitable
In honor of Jack Threet

Lawrence W. Funkhouser Named Grant
Chevron Matching Employee Fund
Matching gift given by Donald Downey
In memory of William C. Corea

Military Veterans Scholarship Fund
Chevron Matching Employee Fund
Matching gift given by Jennifer Rothfuss
In memory of George Tress
Chevron Matching Employee Fund
Matching gift given by

Charles Rubins
Scott Cameron and Penny Bowen
Grant from the Cameron/Bowen Family Charitable Fund at Fidelity Charitable

In honor of Jack Threet
Raymond Paul Henkel
Grant from Dr. Raymond P. Henkel Charitable Fund at Fidelity Charitable

Terry J. Mather
Robert Edward Webster

Teacher of the Year Award
Donald W. and Susan E. Lewis
In memory of Randy Ray and Art Johnson

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

Geochemical

from page 23

Petroleum System

All four wells of the 2010-13 campaign short-tested gas condensate and the last one, Capure-1X, also flowed some light oil. Moreover, dry and rich gas observed from almost surface down to total depth suggested that the source column had to be thicker and shallower than the known basin-wide source, Oligo-Miocene in age, older and deeper than the Miocene of the Guama Field.

For this reason, and with exploratory implications in mind, geochemical analyses were commissioned and the results were rather surprising: biomarkers showed the rich gas to be a 70/30-percent mixture of biogenic methane and thermogenic condensate. Besides, the mandatory rock/fluid correlation confirmed the logically expected relation between produced hydrocarbons and the surrounding Porquero shales. These deep marine shales, Van Krevelen graphs reflect, are rich in terrigenous matter and sourced both condensates and light oils originated in a very early generation window, where vitrinite reflectance in the Guama reservoirs would not exceed 0.5 percent.

With all this in mind, it seems that a description for the Porquero petroleum system that is functioning in the Guama Field requires one single shale source scattered along a very long column, generation of bacterial gas and

thermogenic products and in-situ and short distance charge to laminar sands, dispersed over an equally thick section.

Wrapping It Up

In a challenging price environment, immediate development may or may not proceed, but the lessons that the Guama case offers are all out for the taking.

First, Guama is good case of exploration that started with a play in mind – deep and expensive in this case – that evolved with flexible geological thinking and timely use of technology to a shallower, cheaper exploratory concept.

Second, as an exploration project, Guama incorporated reservoir management aspects, including critical data acquisition, such as geomechanical and mineralogical parameters, in order to anticipate information required for the field development plans.

Finally, what a curiosity that such a complex and bizarre petroleum system, so challenging to coming up with models, had to be found in the very land of magic realism!

(Editor's Note: 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.)



2018 L. AUSTIN WEEKS UNDERGRADUATE PROGRAM

The American Association of Petroleum Geologists Foundation and the Education Awards Committee are proud to announce the L. Austin Weeks Undergraduate Grant Program recipients for 2018.

The L. Austin Weeks Undergraduate Grant Program annually awards undergraduate geoscience students and student-led organizations with \$500 grants. The grants are intended to support the educational expenses both inside and outside of the classroom.

In 2018 the AAPG Foundation provided \$86,000 to 98 students and 74 student-led organizations.

CONGRATULATIONS TO THE 2018 RECIPIENTS!

STUDENTS

BANGLADESH

University of Dhaka
Md Mesbah Uddin Bhuiyan
Md Ariful Islam
Nusrat Mehnaz
Sadia Afroze Rojoni

CANADA

Carleton University
Evelyn Tennant

COLOMBIA

Universidad Nacional de Colombia
Sofia Mantilla Salas

Egypt

Suez University
Amr Ahmed
Raghdah Ahmed
Muhammad Bassiouny
Mohamed Elzoghy
Menna T-Allah Muhammad

INDIA

Indian Institute of Technology (ISM)-Dhanbad

Aditya Amber
Yash Jain
Suraj Kumar
Alok Kumar
Khushbu Kumari
Yashee Mathur
Akash Patel
Taichengmong Rajkumar
Sumit Kumar Saw
University of Delhi
Achal Anand
Aditya Jain
Prayukta Mohanty
Shubhangi Narayan
Saamragyi Nayak
Indian School of Mines
Sourav Mukherjee
University of Petroleum and Energy Studies
Arun R
Ashutosh Sharma

INDONESIA

Bandung Institute of Technology
Rio Gouw
Dhyandra Nugrahantita
Faiz Ulwan
Brawijaya University
Jihan Hardiyanti Arief
Diponegoro University
Dede Sationda Tarigan
Astri Yunita
Hasanuddin University
Nurul Lulusu
Universitas Gadjah Mada
Mohamad Rahmat Cahyadi
Evo Dika
Nur Indah Setyawati
Irine Permatasari
Muhamad Rizky Rama Putra
Ichsan Ramadhan
Guritno Safitri Muchitawati
University of Padjadjaran
Aldyno Febryan Putra
University of Pembangunan Nasional "Veteran" Yogyakarta
Dynasty Hadyan Saputro
Albertus Irianto
Indah Mahdyia Ananda
Destamika Pramudianti
Christophorus Enggar Suryo Pradipto
Universitas Trisakti
Debbi Garneta
Faiz Nafi

MALAYSIA

University of Malaya
Farisha Emmalin Faheem Chughtai
Mariah Zaidi
Universiti Teknologi Petronas
Ashwini Rajasekaran

MEXICO

Universidad Nacional Autonoma de Mexico
Fernando Berumen Borrego

NIGERIA

University of Lagos
Anuola Osinaike

ROMANIA

Babes-Bolyai University
Iulia Andreea Ilies
University of Bucharest
Alexandru Badescu
Francesca Manaila
Sonia Sortan

UGANDA

Makerere University
Adrine Nuwasima

UNITED KINGDOM

University of St. Andrews
Joseph Axe
Olivia Gubbins
Keele University

UNITED STATES OF AMERICA

ALASKA
University of Alaska-Anchorage
Ryan Daniels

CALIFORNIA
California State University-Fresno
Kaitlyn Allen
San Diego State University
Bonnie Flynn

GEORGIA

Columbus State University
Chance Seckinger
University of South Carolina
Jahleel Stone

IDAHO
Idaho State University
Braedon Warner
University of Idaho
David Bethke

ILLINOIS

Northern Illinois University
Lillian Lueck

INDIANA

Purdue University
Jack Fekete

IOWA

University of Northern Iowa
Paige LaPlant

LOUISIANA

Louisiana State University
Cameron Gernant

MICHIGAN

Grand Valley State University
Nicholas Priehs

MISSOURI

Missouri State University
Brooke Benz
Tessa Mills
Clayton Sansoucie

NEVADA

University of Nevada-Reno
Alison Cramer
Thomas Ott

NEW YORK

Hamilton College
Emily Alexander

NORTH CAROLINA

University of North Carolina at Chapel Hill
Theresa Jones

NORTH DAKOTA

Minot State University
Jesse Dalle

OHIO
University of Cincinnati
Tara Lay
Whittenberg University
Quintin Muhlenkamp

PENNSYLVANIA

Slippery Rock University
Maraina Miles
California University of Pennsylvania
Katharina Pankratz
James Bader

TEXAS

Baylor University
Emily Blackaby
Texas A&M University-Kingsville
Lauren Hall
Trinity University
Asmara Lehrmann
University of Texas at Austin
Davd Wiggs

UTAH

Utah State University
Evan Millsap
Logan Carey
Mikaela Pulsipher

PERU

National University of Engineering (UIN) Student Chapter
National University of Saint Augustine (UNSA) Student Chapter
National University of San Marcos (UNMSM) Student Chapter
Jorge Basadre Grohmann National University (UNJBG) Student Chapter

POLAND

AGH University of Science and Technology Student Chapter
AMU Institute of Geology in Poznań Student Chapter
University of Warsaw Student Chapter

PORTUGAL

University of Lisbon Student Chapter

ROMANIA

Bucharest Student Chapter (BSC) at University of Bucharest
IASI Student Chapter at Alexandru Ioan Cuza University

UGANDA

Makerere University Student Chapter

UNITED KINGDOM

Imperial College Student Chapter
University of Manchester Student Chapter

UNITED STATES OF AMERICA

CALIFORNIA
California State University Long Beach Student Chapter
California State University Bakersfield Geology Club
Muckers Coterie Undergraduate Earth Science Club at University of California Santa Barbara

COLORADO

Colorado Mesa University Student Chapter
Colorado State University Student Chapter

IOWA

University of Iowa Student Chapter

KENTUCKY

Bluegrass Student Chapter at University of Kentucky

MICHIGAN

Grand Valley State University Student Chapter

MISSOURI

Association of Environmental and Engineering Geologists at Missouri University of Science & Technology
University of Missouri Student Chapter

MONTANA

University of Montana Student Chapter

NEW YORK

Binghamton University Student Chapter
Syracuse University Geo Club

NORTH CAROLINA

Geology Club at North Carolina State University

OKLAHOMA

University of Oklahoma Student Chapter
University of Tulsa Student Chapter

TEXAS

Lamar University Geological Society
University of Texas at Dallas Student Chapter
Texas A&M University Student Chapter
Texas A&M University-Kingsville Student Chapter

UTAH

University of Utah Student Chapter

WEST VIRGINIA

West Virginia University Student Chapter

WISCONSIN

University of Wisconsin-Madison Student Chapter

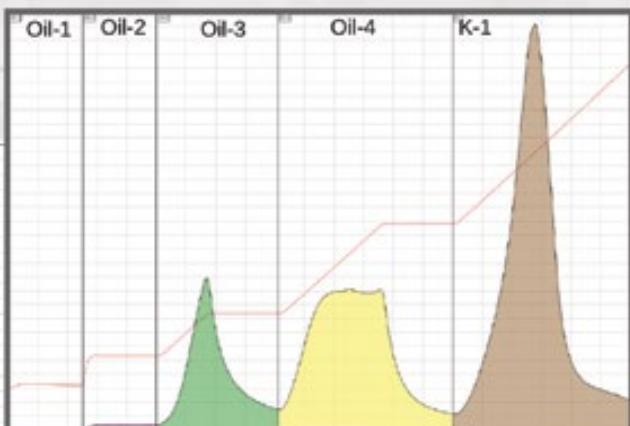
VENEZUELA

Universidad Simon Bolivar Student Chapter

Re-think your Pyrolysis

S1, S2, S2 shoulder & Tmax data

with HAWK-PAM



Classical Pyrolysis

- Evaluate Mobile oil / Fluid Saturation
- Accurate Kerogen Tmax
- Separate S2 shoulder from Kerogen
- API Gravity prediction from drill cuttings and cores



REGISTER NOW

BOLIVIA 2018
Geosciences Technology Workshop

Optimizing Exploration and Development in Thrust Belts and Foreland Basins

6-8 June 2018

Los Tajibos Hotel and Convention Center, Santa Cruz de la Sierra



Photo by: Hugo Santa Cruz

Session Themes:

- I: Petroleum Systems and Complex Structural Geology
- II: Data Integration and Enhanced Subsurface Imaging
- III: Technologies to Reduce Risk and Optimize Production
- IV: Future Exploration Potential in Bolivia and Beyond

Poster Session – Tools & Technologies to Optimize Exploration and Development

Supporting organizations:



Contact latinamerica@aapg.org for exhibition and sponsorship opportunities.

28

By MARTY HEWITT, AAPG Treasurer

EXPLORER MAY 2018

Dues Increase: Some Financial Background



nues in 2016 comparable to those revenues from 2007. Our expectation has been and continues to be that revenue growth will be difficult to develop in the short term. As can be demonstrated from the expense numbers above, your Executive Committee and staff have diligently cut and controlled costs where we can. Staff and professional travel, meeting expenses and governance costs all have been significantly reduced. Unfortunately, the decrease in revenues was too much and too fast for the expenses to be brought back in line.

Steps Taken Thus Far

As you are aware, to help reduce the recurring staff costs, in November 2015 a voluntary retirement program was implemented. In February and December 2016, we had more cuts at the staff level as part of our reorganization, with an overall reduction of our total support staff of over 33 percent.

Fortunately, the Association's finances are backstopped by our Investment portfolio – our "rainy day" fund. This portfolio, which has been expertly managed by the AAPG Investment Committee, has flourished in the bull market over the past couple of years. This has afforded us the opportunity to set aside \$3 million to terminate the Association's defined benefit pension plan and free up future executive committees from the financial swings to which our defined benefit plan subjects us each year. Given our strong portfolio performance, we have still been able to maintain approximately one year of operating expenses in the fund.

As the saying goes, "you can't cut your way to prosperity." In the future we need to be aware that so much of what we do as a society is dependent on the surpluses generated by our events, though we anticipate that the rebound from the industry, when it does happen, will take longer for our events and meetings, and may not get back to the same levels as before.

Your Executive Committee has been working diligently on a business plan that considers diversifying our revenue stream with additional profitable activities. For example, the inaugural Super Basins Global Leadership Conference was held recently in Houston and was very well received, generating a modest surplus for the Association. We also continue to look at new ways of leveraging AAPG's intellectual property and there are several promising opportunities under evaluation.

Looking Ahead

As we go forward, we will align the organization's short-term, long-term and strategic goals and objectives with its ongoing financial capabilities. We will continue to target an annual balanced budget with modest surpluses over the long term and ensure our investment portfolio has an annual managed growth target of 5-6 percent over the long term.

However, AAPG cannot rely on investments expectations alone to support future activities and programs. Therefore, it is especially important in an association such as ours that we stop to review and evaluate the myriad of programs we offer on an annual basis.

AAPG has challenges and opportunities. However, I want to assure you that AAPG is financially sound and your Executive Committee will continue to focus on providing value to you as a member through programs and services by strategic deployment of financial resources. ☐

We are concerned, however, that without a serious reconsideration of the programs and activities the Association undertakes, we will have very little likelihood of improving our net outcome from operations in the short to intermediate term.

To put this in perspective, we have effectively lost a decade's worth of revenue growth in two fiscal years, 2015 and 2016, with reve-



Geoscience

from page 21

located in Houston. Another office sits in Midland.

This gear switching in 2015 coincided with the appearance of Mark Houser, former president and CEO of EV Energy Partners LP. Houser came on board as the first CEO of the University Lands Office.

He hired geoscience and engineering staff and brought in a legal team to the Houston office.

DeFelice noted, "We have two geologists, a geoscience manager, engineering manager and a few engineers."

"We cover a lot of ground," he emphasized. "There are several large companies who operate here, and we also have 200-plus operators we refer to as 'partners,' which is a win-win situation."

He mentioned that more than 20,000 wells have been drilled on the Lands. When horizontal drilling into shale became the next new development inaugurating a whole new era, especially in the Permian, the properties took on even more allure for operators. About 2,000 horizontal wells were initiated on the properties.

Easy access to vast amounts of well and log data stored in the UL library, in addition to other online information, aid the action considerably.

"The roles off our staff members are to add as much value to the Lands as possible," DeFelice said. "That translates to having a good understanding of the subsurface from a geoscience and engineering perspective, employing best practices in terms of completions."

EMD

from page 23

technology and renewable energy. We are growing in our support to the rare-earth elements on which modern technology depends, especially those produced from fossil fuel sources such as coal. The EMD has a mission that covers a broad spectrum of the goals for AAPG and the growing needs of professionals in the global energy workforce.

THE Benefits of EMD

I offer three proofs that the Energy Minerals Division offers the value and opportunity we have just discussed. First, take a look at our offering at this year's Annual Convention and Exhibition in Salt Lake City.

The EMD is sponsoring sessions in global unconventional systems, oral and poster sessions on "Finding the Sweet Spot: New Tools and New Ideals to Get the Most from Unconventional Systems," oral and poster sessions on North American unconventional systems, and poster

Leasing Opportunities

With that goal as a focus, a forum was scheduled for late April, with a number of active companies on the invitee list. Several were on deck to present on best practices.

If you're wanting a piece of the action, the next lease sale is set to occur Sept. 19.

Just don't expect this to be a slam-dunk deal with drilling targets virtually shouting at you.

"Last year, most of the bidding was where people were comfortable," DeFelice said, "but we did sell riskier."

When complete, the Sept. 2017 sale generated more than \$118 million in total revenue, according to UT. About 43,724 acres were leased via the sale process, with some acres garnering more than \$12,000. The average price per acre lease was \$2,700.

"There's even more acreage now that we think is underexplored, and a lot of this coming up this year may be underexplored," DeFelice commented.

He noted, for example, that although their Delaware Basin acreage for the Wolfcamp is fairly leased up, the possibility exists to exploit some new ideas on the northern Central Basin Platform. This includes the potential for new horizontals in the San Andres.

Given the action in the Permian, it's easy to overlook that the Lands are causing a bit of a stir to the immediate west in the Orogenic Basin, which extends into southeastern New Mexico and hosts a plethora of Pennsylvanian and older rocks.

Torchlight Energy Resources is at work on the University Founders A 25-1H well, targeting 1,300 feet of pay dubbed "WolfPenn." The kickoff date for hydraulic fracturing was set for April 23. According to Torchlight's web site, its lease covers the majority of the Orogenic in Texas. ■

sessions on unconventional systems of the western United States, petrophysics of unconventional systems and on global shale systems.

We will display more than 3,000 feet of lacustrine core in the exhibit hall and we are sponsoring short courses and field trips.

EMD, jointly with the Division of Environmental Geosciences, is sponsoring a top-notch EMD/DEG luncheon speaker in Rikki Hrenko-Browning, CEO of Enefit American Oil, who will discuss oil shale. This promises to be an outstanding talk.

Second, and probably the quickest proof, can be found on our EMD committees web page where you can see all that we do: (AWAITING TINY URL).

As a final proof, the EMD believes that its mission is so important to the success of our mutual global energy needs that we offer our membership for free to those who are Members of AAPG. You can join at ACE, online, or when you send in your membership renewal.

For me, I believe that the 'mission' of the EMD is critically involved with the future of our global energy resources. I hope you agree and join us! See you in Salt Lake City! ■

GEOLOGICAL GLOBE OF THE EARTH

**AVAILABLE IN
18" AND 30" SIZES**



**NEW
K-T BOUNDARY.
CRETACEOUS.
JURASSIC,
AND
TRIASSIC GLOBES**

WWW.REALWORLDGLOBES.COM

In Memory

Jim W. Adams , 88	Midland, Texas, March 9, 2016
George A. Alcorn , 85	Houston, Texas, Oct. 10, 2017
John J. Amoruso , 87	Houston, Texas, Jan. 29, 2018
Michaela Bernecker , 54	Athaibah, Oman, Nov. 3, 2017
Andrew George Bittson , 66	Houston, Texas, July 24, 2017
William Dave Blankenship , 91	Denver, Colo., Aug. 5, 2015
James O. Breene, Jr. , 84	Englewood, Colo., Nov. 25, 2017
Don Forrest Carlos , 95	Glendale, Calif., Oct. 14, 2017
Virgil St. Clair , 84	Dallas, Texas, Nov. 13, 2014
Weyman W. Crawford , 94	Houston, Texas, Nov. 9, 2017
Stanley Lloyd Cunningham , 79	Oklahoma City, Okla., Nov. 29, 2017
Charles Edmund Cusack, Jr. , 92	Gonzales, Texas, Sept. 7, 2017
John Lee De Vault , 79	Houston, Texas, Aug. 24, 2016
Arthur Stanley Dickinson , 92	Houston, Texas, March 30, 2017
Donald Allen Ehman , 86	Tucson, Ariz., Jan. 8, 2018
Charles Eldridge , 87	Houston, Texas, March 3, 2018
Samuel Raynes Evans , 90	Houston, Texas, July 26, 2017
Thomas Reilly Fluellen, Jr. , 95	Houston, Texas, Oct. 21, 2017
James A. Hartman , 90	West Des Moines, Iowa, Jan. 17, 2018
Donpaul Henderson , 71	Cypress, Texas, Dec. 24, 2017
Kingdon R. Hughes , 85	Addison, Texas, Sept. 18, 2014
William Wynn Kelly, Jr. , 65	Lexington, Ky., Oct. 18, 2016
Robert John Knox , 96	Brighton, Colo., Dec. 16, 2017

Frances E. La More, 93
Houston, Texas, July 21, 2017
Nancy Lindsley-Griffin, 74
Jacksonville, Ore., Nov. 20, 2017
Joseph Lintz, Jr., 88
Reno, Nev., Dec. 18, 2009
Patric Harold Monteleone, 73
Spring, Texas, Nov. 7, 2017
Michell Frederic Nielsen, 87
Boerne, Texas, Sept. 6, 2017
Christopher Arthur Rautman, 67
Albuquerque, N.M., May 12, 2017
R. Randy Ray, 65
Lakewood, Colo., Dec. 5, 2017
Michael A. Rogers, 90
Kingwood, Texas, Aug. 19, 2017
William Dake Rose, Jr., 89
Brookeville, Md., Dec. 23, 2017
Kweku-Mensah O. Sagoe, 69
Lago, Nigeria, Fe. 16, 2018
William C. Schmidt, 94
Tulsa, Okla., Dec. 17, 2017
Richard Schneider,
Parker, Colo., Nov. 10, 2014
John William Skelly, 93
Ardmore, Okla., March 10, 2018
Henry Irwin Snider, 85
Richmond, Va., Jan. 9, 2018
Donald Charles Swanson, 93
Houston, Texas, March 23, 2017
Richard S. Vormelker, 81
Tripoli, Libya, March 8, 2018
James Frederick Williams, 81
Billings, Mont., April 6, 2011
Walter Lewellyn Youngquist, 97
Eugene, Ore., Feb. 20, 2018
Donald Lowell Ziegler, 94
Windsor, Calif., Jan. 31, 2018

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

Classified Ads

MISCELLANEOUS

More companies **CHOOSE SES** from 23 geosteering apps. 3D petroleum engineering logic is uniquely embedded under the hood making it more accurate and valid for all directional drilling. SES contains practical, exclusive, enabling technologies that help get results. 18 years in the making and always getting better! Free trial and training available.

www.makinhole.com
Stoner Engineering LLC

Dry Erase Geological Globes of the Earth

Beautiful handmade globes for gifts, office or lab. Pangea globes now available.
See explanatory notes online at

www.realworldglobes.com

Unique Petroleum Geology focused field trips on shelf to basin sedimentary transitions, source rock sequence stratigraphy, extensional and compressional tectonics. Courses are designed for multi-disciplinary resource exploration teams with special emphasis to tie subsurface data to outcrop. Small class size with jeep transportation. For more information contact riograndegeologyfieldtrips@gmail.com

CLASSIFIED ADS
You can reach about 37,000 petroleum geologists at the lowest per-reader cost in the world with a classified ad in the EXPLORER. Ads are at the rate of \$2.90 per word, minimum charge of \$60. And, for an additional \$50, your ad can appear on the classified section on the AAPG web site. Your ad can reach more people than ever before. Just write out your ad and send it to us. We will call you with the word count and cost. You can then arrange prepayment. Ads received by the first of the month will appear in the subsequent edition.

Director's Corner

Homeward Bound to ACE in Salt Lake City

It had been a long and arduous journey. A journey of a thousand miles and more from the banks of the Mississippi across the grasslands and the badlands of the North American continent.

By horse and by wagon they traveled. Most, however, made the journey on foot, step by step, pushing their worldly possessions ahead of them on primitive handcarts – a back-breaking feat of stamina and persistence.

They were fleeing, actually. Exiled from Nauvoo, Ill., after violent clashes with local settlers, these members of The Church of Jesus Christ of Latter-day Saints, led by a man named Brigham Young, were in search of a new home, a place where they could live and worship as they wished, without fear of persecution.

The year was 1847. And they were almost there.

It was high summer, the month of July, and these Mormon pioneers, following guides, slowly descended a narrow canyon. The hot summer sun toasted the grass stems and leaves of scrub oak along the banks of a small, rushing brook of cool fresh water. There weren't many trees here, other than the scrub, but they'd seen tree-covered mountains in the distance and majestic mountains with pockets of snow nestled deep in the rock. And as they paused to wipe the sweat from their faces, looking around, they must have felt a sense of anticipation. Could this be for us?

On July 24, as legend has it, they reached the mouth of the canyon, opening a vista that to this day never ceases to amaze. Standing several hundred feet above the valley floor, a magnificent valley opened in front of them, bounded to the east and west by mountain ranges. And to the north, in the distance, shimmering in the sun, by an enormous lake.

Brigham Young in ill health, suffering



CURTISS

Utah is known as the "Beehive State," and the enterprising and industrious settlers – for only the enterprising and industrious survived – saw opportunity in trade and seized on it with entrepreneurial zeal. It's an approach to life that is deeply rooted in the culture.

from Rocky Mountain spotted fever, made his way to the front of the group, his eyes capturing the view.

"This is the place," he declared.

He actually said more, but these were the words that stuck. This is where the Mormons would call home.

And so they set to work making a home for themselves in this State of Deseret. An experiment that continues to this day.

From Settlement to State of the Art

The lake, it turned out, wasn't worth much. It was salty – extremely salty. But streams and brooks from snow melt in the mountains drained into the valley. There were fish, fowl and game to fill stomachs as the settlers began to cultivate the land.

Others followed their path, some to settle in the valley, but far more made a brief sojourn on their journey west. Gold had been discovered in California and the promise of fortune lured the adventurous and the greedy from near and far. "Go West, young man," goes the saying and Salt Lake City – the crossroads of the West – served as a place to refresh and resupply.

Utah is known as the "Beehive State," and the enterprising and industrious settlers – for only the enterprising and industrious survived

– saw opportunity in trade and seized on it with entrepreneurial zeal. It's an approach to life that is deeply rooted in the culture.

Education was important to them. And within three years of arriving in the valley, Brigham Young and the State of Deseret governing assembly established the first university – what would become the University of Utah.

Tapping into the State's entrepreneurial spirit, last year the "U" was ranked the top university in the United States for technology commercialization and its faculty and students routinely place it in the top three in the country for the number of university-filed patents.

Culture was important, too – especially music. And just one month after Brigham Young made his pronouncement, the settlers founded the Mormon Tabernacle Choir. It would take several decades more to build the tabernacle, but from the beginning, the sound of singing voices filled the valley.

Listening to classical radio recently I heard a Deutsche Grammophon recording of baritone-bass soloist Sir Bryn Terfel and the Mormon Tabernacle Choir singing Marta Keen Thompson's song, "Homeward Bound."

Over a melancholy pennywhistle, Terfel sings of tension: the tension between a quest for freedom and adventure:

*Bind me not to the pasture
Chain me not to the plow
Set me free to find my calling
And I'll return to you somehow.*

And that continuous and persistent desire to belong, the need to feel part of community, to have a place to call home:

*If you find it's me you're missing
If you're hoping I'll return
To your thoughts I'll soon by listening
And in the road I'll stop and turn
Then the wind will set me racing
As my journey nears its end
And the path I'll be retracing
When I'm homeward bound again.*

You can see why the choir has recorded this song several times. It speaks to the history of the Mormon people: industrious, entrepreneurial and deeply rooted in community, building a place called home.

As a geologist it also speaks to me, particularly as I reflect on our upcoming Annual Convention and Exhibition (ACE) in Salt Lake City. Perhaps this analogy is a stretch, but these are the same attributes we seek to embody as petroleum geologists and AAPG members.

So as you pack your bags, as you begin your journey to Utah – Utah! Land of high desert, alpine ranges, and beautiful red rocks – to gather with your people, your fellow geologists, listen to the song: You're homeward bound.

David K. Curtiss

By DOUG WYATT, EMD President

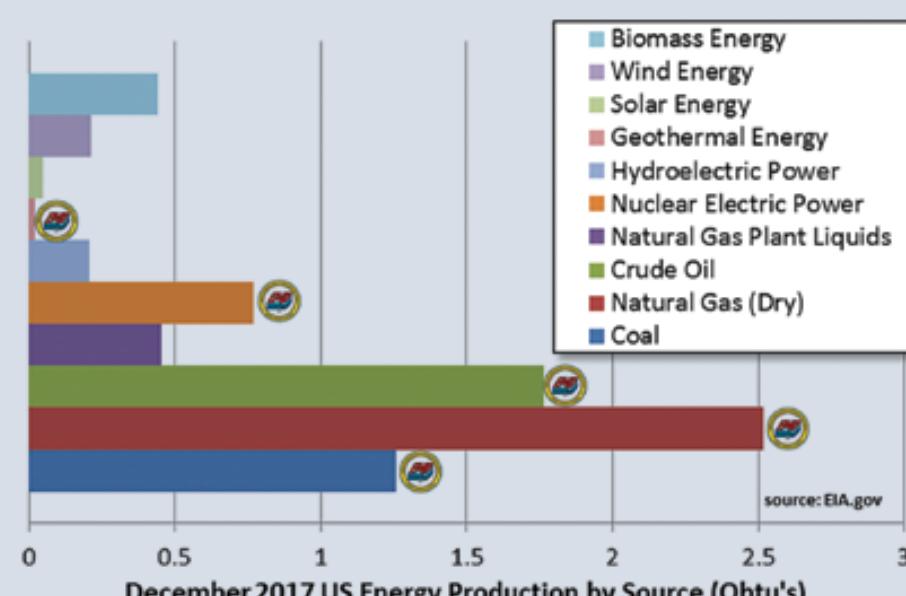
Divisions Report: EMD

Join the EMD Mission



WYATT

"Oil and gas – now and into the foreseeable future – dominate. However, other earth science-dependent and earth-derived resources are increasingly sought and utilized."



In a vibrant, active and expanding global energy workforce, many professional organizations and opportunities exist. We can't belong to all of them and participate in any meaningful way, so we have to choose those that best fit our professional goals, opportunities and needs. We must also choose those that best benefit our employer, especially if we hope for them to pay our membership fees!

There are many choices, so how do we choose?

In the parlance of my co-workers at NASA – what mission do we join?

EMD's Mission

Considering the scope of the global energy market and the demands of the future, the geoscience understanding and technology needed to adequately utilize and protect our planet, and the need to grow and develop future earth scientists, AAPG is a go-to choice. AAPG is diverse, covering all aspects of fossil energy as well as many aspects of other energy sources. To drill deeper, to understand the specifics of various other energy sources, and to understand the global energy mix and future – which mission of AAPG to choose? If you consider the figure below, then I hope to prove that the Energy Minerals Division's mission is critical.

This figure is a simple bar chart of

energy production by source for December 2017. This chart shows data for the United States but the overall distribution can easily be extrapolated to the remainder of the planet. The units are in quadrillion British Thermal Units (BTU's). As expected, oil and gas – now and into the foreseeable future – dominate. However, other earth science-dependent and earth-derived resources are increasingly sought and utilized. The mission of the EMD is highlighted by the location of the EMD logo. For coal, EMD's mission includes just about everything, including coal-bed methane production. For dry natural gas, EMD's duties and goals include unconventional as well as tight gas resources and methane hydrates. For crude oil, the EMD works with shale, bitumen and heavy oil resources. In nuclear electric power, the EMD mission covers uranium resources and utilization, and the same for geothermal. This figure alone proves the value of the EMD mission for our future global needs.

In summary – for the global energy mix, the AAPG EMD has the responsibility, the mission, for the energy sources of bitumen and heavy oil, coal, coalbed methane, gas hydrates, geothermal energy, oil shale, shale gas and liquids, tight gas sands and uranium. We also maintain the state of the science and art with energy economics and

See EMD, page 29 ►

Make Better Decisions on Brazil Opportunities

Santos Vision, Brazil
– Area 1: Now Available
– Areas 2-5 Early Out: Now Available
Better pre-salt images using advanced
processing and imaging techniques.
Book a data show,
email: nsha.info@pgs.com

The art of seismic



SEISMIC SUCCESS

LIBRARY • ACQUISITION • PROCESSING

View the art of seismic at Geoconvention Booth #415 and AAPG Booth #407
Subscribe to our newsletter on seitel.com & enter to win a seismic painting

SEITEL 

seitel.com