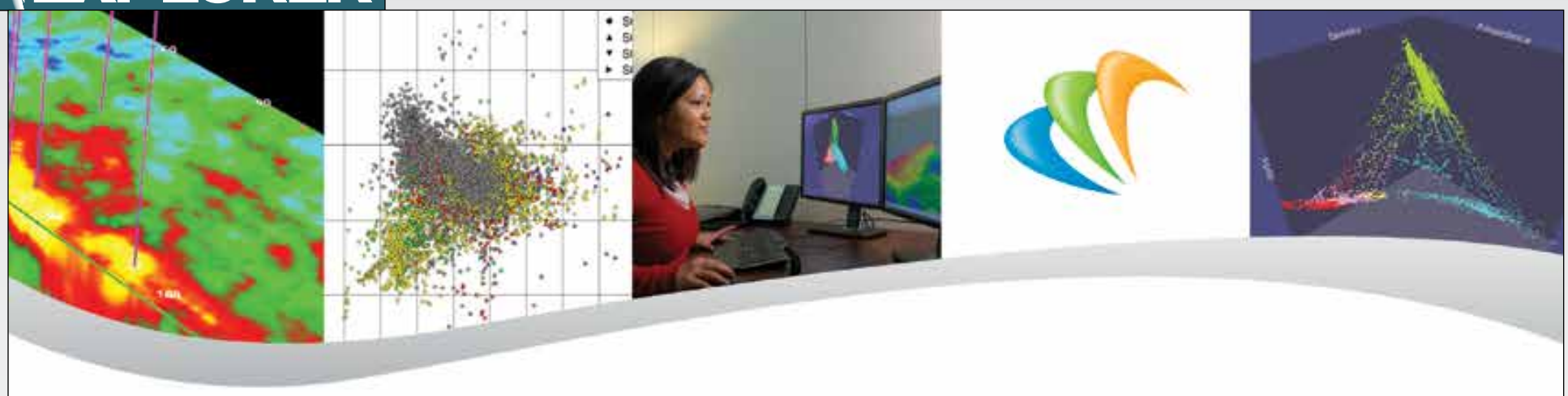
AAPG EXPLORER
AUGUST 2015

Promised Land

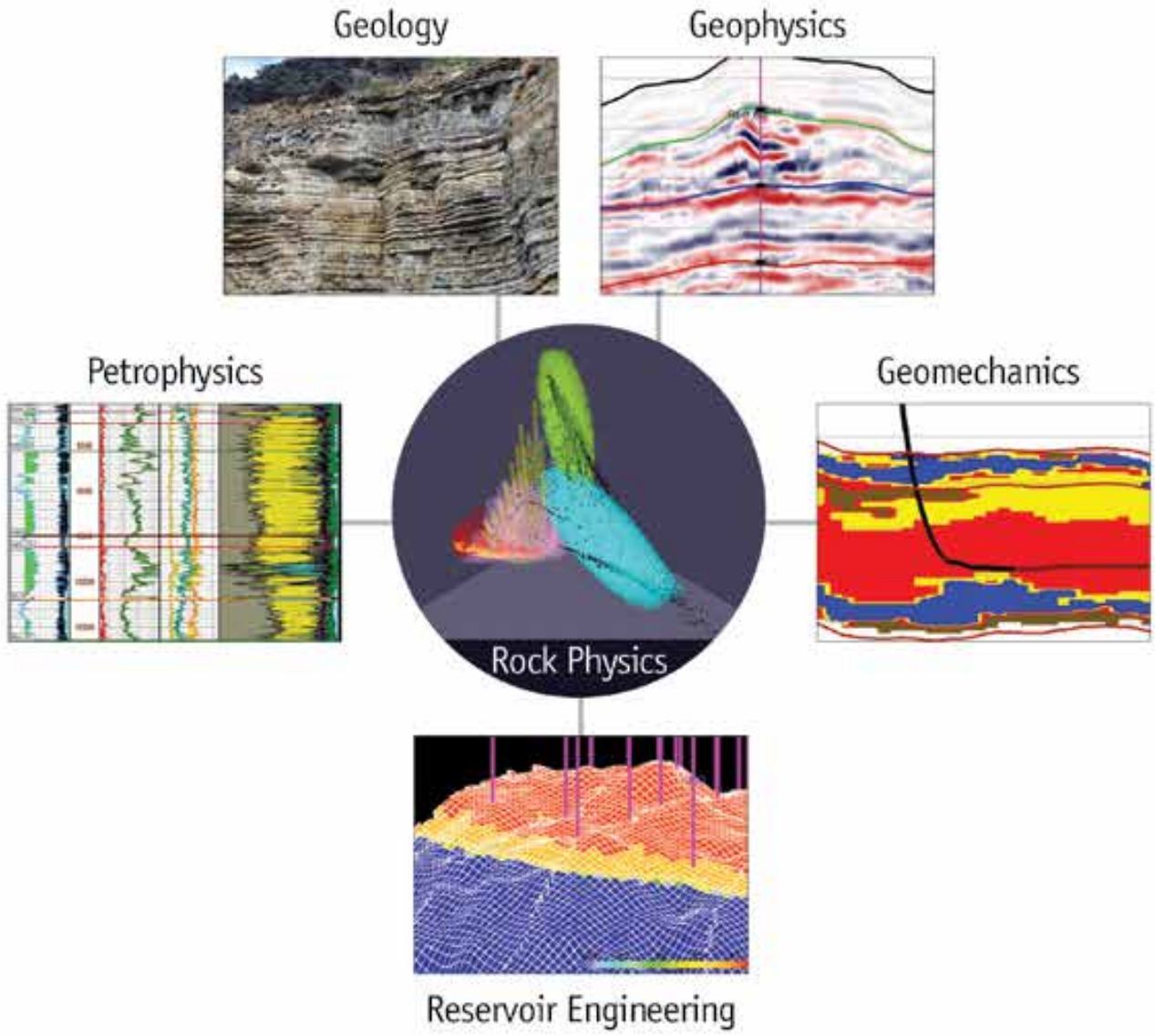
Geoscience education enters new territory.

See page 10



Better Wells from Rock Physics

Innovation, collaboration, and integration from CGG GeoSoftware



Explore fundamental relationships between rock and seismic for clearer understanding of your reservoirs. Geosoftware's superior rock physics workflows integrate all available data to help you select optimum drilling locations.

- Determine consistent properties across petrophysical, reservoir, elastic, engineering and seismic amplitudes
- Relate and understand facies, fluids and seismic properties
- Reduce reservoir uncertainty and minimize drilling risk

Work smarter and achieve your goals with the GeoSoftware portfolio.

cgg.com/geosoftware

CGG
Passion for Geoscience

Vol. 36, No. 8
August 2015

EXPLORER

PRESIDENT'SCOLUMN

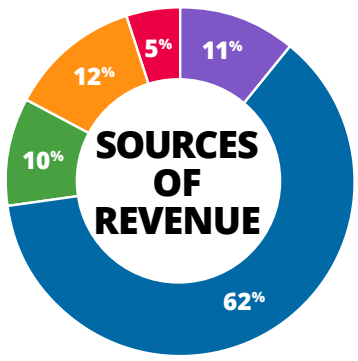
'The Other Side Will Come'

BY JIM TUCKER, AAPG Treasurer

At the close of the recent AAPG Annual Convention and Exhibition in Denver I walked around and thanked as many exhibitors as I could. As I talked to them, I asked their views on current industry economic conditions, since by appearance, they all had likely been through two or three downturns before.

Without fail, they all said "there will be the other side of this slump," and whether it comes in six months or two years, they are working to be prepared for when it comes – and surviving until then.

* * *



Your Executive Committee (EC) also is preparing for the coming year, and recently reviewed and approved the fiscal year 2016 budget.

The staff at headquarters and in the global offices annually prepare the proposed budgets – starting with a clean slate – by building the expected revenue and expenses for the many programs we provide to you, the members.

This budget is then presented to the EC, down to the individual program items and the capital and resources needed to continue the established and any new programs.

The charts you see here summarize our expected sources of revenue and expenses.

The expense focus is on **member service**, particularly education, meetings and publishing. Conferences provide the majority of revenue, and your dues provide 11 percent of our revenue.

Several years ago the Graduated Dues program was created for those in career transitions, and we encourage members to use these reduced dues if needed.

Advertising, such as what you'll find on the following EXPLORER pages and on our website at aapg.org also provides a steady revenue stream, although down from earlier years.

The financial health of our Association is good, but continuation of successful Member programs and conservative projections of income gave us a fiscal 2016 budget with almost a 10 percent shortfall.


TUCKER

The EC has worked to reduce capital and/or defer planned expenses, without cancelling or altering the most important programs. This work will continue throughout the year, as we constantly monitor and modify expenses to match our revenues.

* * *

A big part of AAPG's service to Members and to the profession is our **publishing program**.

Of course, the publishing world based on printed paper is rapidly changing, including the economics of books.

We will continue publishing Memoirs in hardcopy while still investigating reducing costs and inventory, and increasing royalty revenue from electronic publication sources. We receive substantial royalties from Geoscience World for recent BULLETINs, and royalty and service payments from AAPG and other related publications included in Datapages.

The new Datapages Exploration Objects (DEO) georeferenced maps, cross-sections and seismic lines, on which you receive a monthly email update, grows as a revenue source and as an archive.

The EXPLORER continues as a useful information source, and revenue-generator as the leading large-format industry publication. We also began the Interpretation journal jointly with SEG in 2013, and it already provides revenue while growing in popularity.

Our **education programs** have grown in number and global coverage – the popularity of one- and two-day workshops have added to the traditional multi-day topical and multi-topic sessions.

We can quickly add these for emerging interests, and economically present them. And we know how to do these services affordably.

Our **Annual Convention and Exhibition** (ACE) provides substantial income from exhibits, sponsors and delegates, providing the annual setting for hundreds of technical presentations, forums and for needed meetings of committees and boards of our Association.

For over a decade we have sponsored the **International Conference and Exhibition** (ICE) events outside the United States, attracting over 1,000 technical abstracts in recent years, as well as providing field trips and short courses for members who may not be able to travel to the ACE.

This year we will begin to sponsor two of these meetings per year, jointly with our sister society, the Society of Exploration Geophysicists (SEG). Together, AAPG and SEG will provide more pure and applied science to members, in more places around the world.

This change comes at a challenging time, and the EC and AAPG staff members are closely monitoring the economics of these new joint events very closely.

Thankfully, we have an **Investment Fund**, overseen by a committee of members and advised by professionals, which is our reserve fund for challenging times.

When years are good, as was the case in 2014, we place our operating surplus into this fund.

See **Investment Fund**, page 4

STAFF

Managing Editor
Vern Stefanic
email: vstefan@aapg.org

Assistant Managing Editor
Brian Ervin
email: bervin@aapg.org

Communications Project Specialist
Susie Moore
email: smoore@aapg.org

Graphics/Production
Matt Randolph
email: mrandolph@aapg.org

Advertising Coordinator
Steve Praytor
P.O. Box 979, Tulsa, Okla. 74101
Phone: (918) 560-2647 – fax: (918) 560-2636
(U.S. and Canada only: 1-800-288-7636)
(Note: The above number is for advertising purposes only.)
email: spraytor@aapg.org

CORRESPONDENTS

David Brown
Louise S. Durham
Barry Friedman
Ken Milam
Heather Saucier

TABLEofCONTENTS

REGULARDEPARTMENTS

Scan this for the mobile version of the current web Explorer.

ON THE COVER:

The Advanced Field School students of Dalhousie University in Halifax receiving a regional structural overview from instructor Mike Young prior to their independent mapping project in the Poleta Folds map area of eastern California. Photo by student Leigh van Drecht, courtesy of Grant Wach of Dalhousie.

Left: Joe Satterfield (right) and student Nathan Knox working on a geologic map of Paleozoic strata in the Solitario dome, Big Bend region, Texas. Photo courtesy Satterfield.

Vol. 36, No. 8

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

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

Investment Fund
from page 3

We may need to draw on a small amount of it this coming year – but a healthy fund will remain for future years.

* * *

The Executive Committee already has deferred a number of planned programs in our recent budget and continues to monitor the operating income.

Overall expenses are down from fiscal 2015 – and, unfortunately, revenues are projected proportionally lower than our expenses. We have not made all the reductions yet that we may throughout this coming year.

The fact that our financial year is July-June, and our major financial contributor ACE is at the end of each fiscal year, means that final results are always uncertain until the finances close at the end of each June.

Certainly 2016 will be no different, since the ACE in Calgary will be in late June.

But please be assured that we are all looking closely at expenses and income during the coming months.

We look forward to providing all the superior science and member programs through the coming year, as we always do, with only necessary program reductions or withdrawal from investments.

The Association is financially healthy, and we will continue to watch economics closely as we journey through this challenging year.

Career Services: Promote Your Skills Online

By MARILYN TAGGI CISAR

AAPG is your "Career Partner for Life," and the Career Services Committee wants to help members use tools within and outside of AAPG.

LinkedIn is one of those resources that AAPG members may find of great use.

Stick out your hand and say hello.

Have you ever gotten that advice to meet new people and make new contacts?

That's fine, but much of our professional and personal lives now take place online – and LinkedIn is the electronic way of doing just that.

LinkedIn is a way to expand your network to promote your skills and to search for jobs, because it provides the platform for you to showcase your virtual résumé through your online profiles.

LinkedIn can be used for any kind of career opportunity – a new job, collaboration or a speaking engagement.

Pew Research Center reports that LinkedIn is the only social networking site with higher usage among 50-64 year olds than 18-29 year olds!

Create your online profile.

The heart of LinkedIn is your profile. It can be longer than a standard résumé and can highlight your skills, presentations you have given, special projects, research areas, basin studies and anything else you care to share.

It is important that your profile is complete, detailed and up to date.

Others using search engines will be able to find your profile if you include the key words that describe you. A profile for a geologist's set of skills, to name a few, might include greenfield and brownfield exploration, field development, petroleum geology, basin analysis, drilling, well site geology, stratigraphy, sedimentology, mapping, geophysical interpretation, structural geology, carbonate reservoirs, turbidite reservoirs, well log analysis, well log correlation, sequence stratigraphy, reservoir modeling, unconventional reservoirs, horizontal wells, operations and software packages that you are skilled at using.

And don't forget to make your profile public to be accessible to the most people. Upload a professional looking headshot and a 120-word headline about yourself.

A good online profile will help people find you.

Start making connections.

Make sure that you are thoughtful in your choices. It's not the number of connections you have but the quality of the connections. Use the "Get Introduced" tool to use your existing connections to ask to be introduced to some you would like to know.

Create a LinkedIn signature and be sure to include it in all of your emails. You can use LinkedIn's private messaging to request recommendations of your contacts. These serve the same purpose as references in your résumé.

Explore companies using LinkedIn.

Look for people employed by companies you are interested in. Check the Job Openings that match with your profile. All of these are powerful leads in looking for a new position, making new connections and assessing the current business climate.

There are dozens of websites available with suggestions on the best ways to make yourself known using LinkedIn, but it all starts with setting up your profile at www.LinkedIn.com.

Don't delay. Do it today!

(Editor's note: Marilyn Taggi Cisar is a member of the AAPG Career Services Committee.)

Energy Business Degree: 'An Automatic Edge'

By DAVID BROWN, EXPLORER Correspondent


COBURN

> "Every conversation, without exception, on who the company wanted to develop always hinged on two things: broad business acumen, and the other is leadership and being able to work with people."


MARCHIORI

If you plan to get one of the new energy-related business degrees now being offered at select schools across the country, prepare to devote your career to the industry.

That's the message from university educators working in the relatively new energy-themed, advanced-degree programs.

"I tell every student, 'If you don't want to be in the energy industry the rest of your life, you should not be in this program,'" said AAPG member Tim Coburn, director of the School of Energy Economics, Policy and Commerce at The University of Tulsa.

In the past, technical professionals usually returned to school mainly to get an advanced degree in their specialty. A petroleum geologist, for example, might pursue a master's degree or even a doctorate in geoscience.

But in recent years, several universities have begun to offer master's-level business degrees with a very specific focus on energy. Those programs are, for the most part, aimed at people currently working in the industry.

Potential degree candidates should be aware of two other requirements for these programs:

- Bring serious commitment.
- Bring some serious money.

Energy-related business courses come in two broad types. First are master's degrees in business with a focus on the energy industry, which typically have a name like "Master of Energy Business."

Those programs usually take 10 to 24 months to complete, with total tuition costs between $40,000 and $60,000, excluding travel and any required textbooks.

Classes are structured to accommodate students with full-time jobs, but some period of on-campus residency is always involved.

The University of Tulsa has the lightest requirement – two executive-style seminars conducted over the course of the program with other sessions online.

The University of Colorado Denver offers a hybrid Master of Science in Global Energy Management program.

Jim Marchiori, director of Global Energy Management at the school, said the program covers six academic quarters, each of which begins with four days of in-residence classes. The remainder of the coursework is online.

Marchiori said the program targets early- to mid-career professionals who have reached the top of a technical specialty job ladder or who need additional business education to take on more management responsibilities.

"Our average student age is 34," he said. "Almost all of our students, over 90 percent of them, are already employed in the energy industry."

Getting Down to Business

The second type of energy business degrees are Master of Business Administration with a focus on energy. Those MBA degree programs can have a total tuition cost of $80,000 or more.

Energy MBA programs also tend to be tailored for working students, offering evening classes and even online sessions.

The University of Oklahoma's Executive MBA in Energy degree curriculum combines online distance learning with three one-week residencies, including an international study experience.

Some other schools take a traditional, on-campus approach to energy business education.

Tulane University has a 10-month, full-time Master of Management in Energy program beginning each July. Tuition and fees total about $60,000; room, board, books, insurance and incidentals are extra. The Tulane program concentrates on quantitative business skills.

At least a dozen universities in the United States now offer some variation of the energy business master's or energy MBA curriculum, and there are numerous similar programs in other countries.

Employer financial support helps make the cost of energy business degrees affordable for many students. But Coburn said in downturn periods, industry educational assistance is one of the first things to dry up.

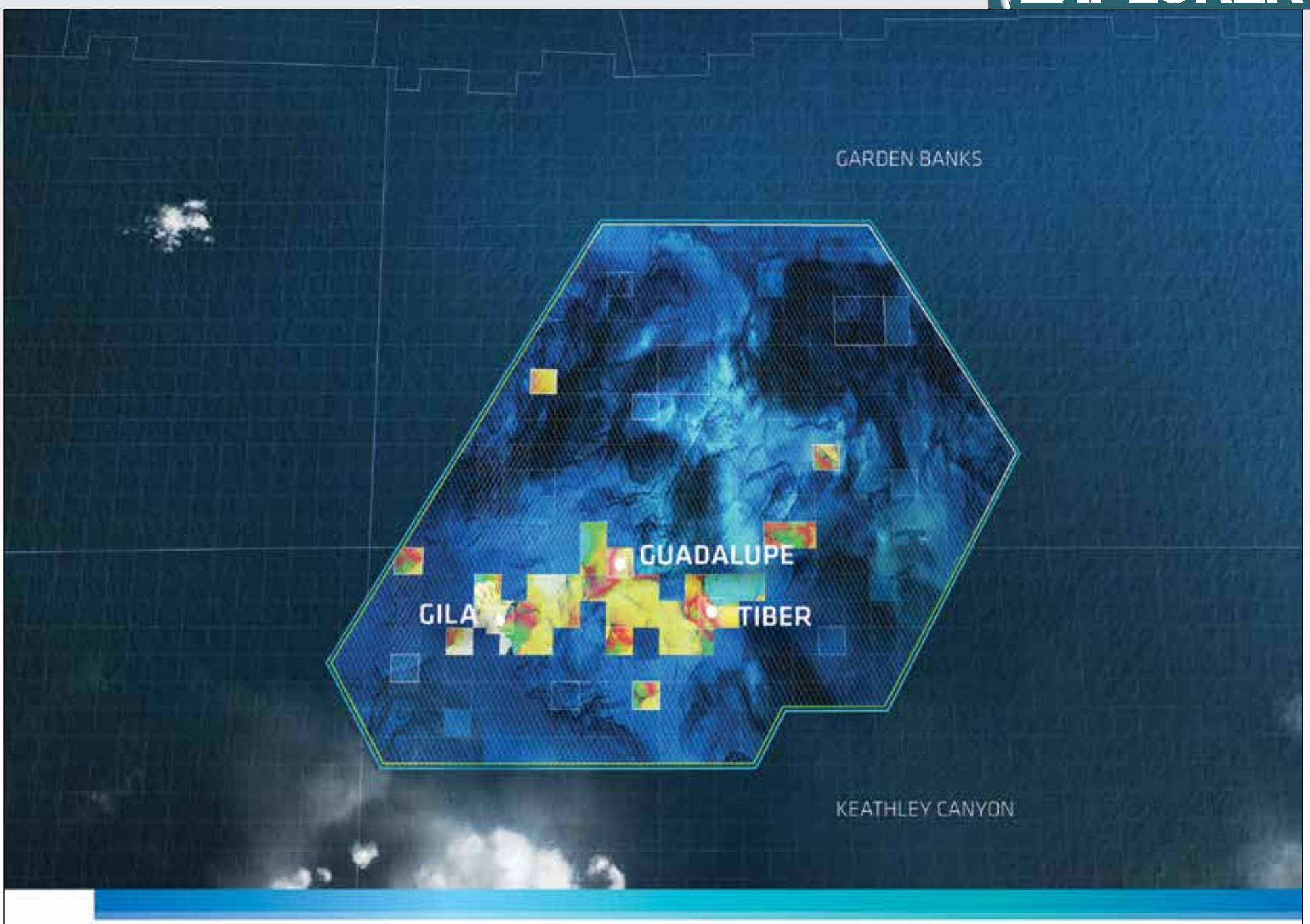
At UC Denver, "when we first started, most of our students were fully supported by their companies," Marchiori said. "That started to go away in the 2009-10 downturn."

The Bottom Line

In developing their energy business courses, universities often consult with businesses about industry needs.

The University of Tulsa had an undergraduate energy business program

See **Graduate Program**, page 8



TRITON.IMAGING NOW

PGS is excited to announce that the first images from its Industry leading Triton survey in the Gulf of Mexico are available.

The survey design has enabled PGS to image targets where Shallow and Complex Salt, and steeply dipping structures have hampered previous exploration. The primary sub-salt exploration target is the Lower Tertiary (Paleogene) Wilcox Formation, including reservoirs with inboard sand accumulations of the Wilcox Group. The reservoir potential of this area has recently been shown with the Tiber, Gila, Guadalupe and North Platte discoveries and initial results within the first available datasets are proving the uplift possible with the Triton Full Azimuth survey design.

To attend a Triton datashow with PGS, please contact gominfo@pgs.com

A Clearer Image

www.pgs.com

MultiClient
Marine Contract
Imaging & Engineering
Operations

PGS

Register Now For ICE 2015

There's still time to register for this year's AAPG-SEG International Conference and Exhibition (ICE) at the Melbourne Convention and Exhibition Centre in Melbourne, Australia, Sept. 13-16.

This year's theme is "A Powerhouse Emerges: Energy for the Next Fifty Years," and the event boasts more than 600 technical presentations; nine field trips to once-in-a-lifetime locations with world-class geologic formations that are normally inaccessible to the public, but are made available to ICE participants; eight short courses; special sessions and forums; networking and social opportunities, as well as activities for students and YPs.

Also, a new speaker has been added to the program: Peter Botten, chief executive officer and managing director of Oil Search will join keynote speakers Ian Macfarlane, the Australian government's minister for industry and science, and Phil Loader, executive vice president of global exploration for Woodside Energy.

This year's ICE is the first to be co-presented with the Society of Exploration Geophysicists. As a collaborative event by two of the world's largest and most trusted scientific organizations, ICE 2015 will offer indispensable professional and scientific development opportunities and a wealth of information on ever-changing global developments and discoveries.

To register, visit ICE.AAPG.org.

Graduate Program

from page 6

and conducted numerous conversations with business executives and managers before creating a graduate degree in the specialty.

"In response to the success of the undergraduate program, the decision was made to put something into place at the graduate level," Coburn explained.

To direct the program, "they were looking for someone with industry experience, with management experience, with teaching experience. I was kind of the intersection of all that," he said.

Today, Coburn finds, companies are "looking for project management skills, in all kinds of projects. They're looking for people who have business savvy, people who know something about the bottom line."

Marchiori also moved into graduate education from the energy industry.

"I, at the time this program was developed, was director of organization capability for DCP Midstream," he said.

DCP Midstream became one of the UC Denver program's founding entities, along with Encana Corp., Pioneer Natural Resources and Venoco Inc., he said.

When his company wanted to groom an employee for management or develop an individual to take on greater responsibilities, business knowledge was always a factor, Marchiori noted.

"Every conversation, without exception, on who the company wanted to develop always hinged on two things," he said – "broad business acumen, and the other is leadership and being able to work with people."

Flex Time

To maximize career opportunity, universities offering energy business degrees define "energy industry" broadly. Students prepare for a possible future in oil and gas, coal, power generation, alternative and sustainable energy and other energy-related businesses.

"Probably 50 percent of our student material and 50 percent of our class time looks specifically at oil and gas, and 25 percent-ish at power generation and public utilities," Marchiori said.

A common procedure requires every student to complete a core group of courses designed to build general business knowledge with specific applications to the energy industry. Students then can choose from a set of additional elective courses.

"We give them all the same core and tell them, 'We want you to be able to flex your career very easily when you leave here,'" Coburn said.

"It always helps them to come in and know what they want to do. One of our hallmarks is the ability, and the agility, to create courses on the fly," he added.

Graduates not only improve their job outlook and become more valuable to their companies; they also gain a broader understanding of how the industry works and how employers make decisions.

"I've dealt with geoscientists over the years and there's a level of frustration when the project that the company decides to pursue isn't the most beneficial project geologically," Marchiori noted.

He emphasized the demanding nature of the course of study in energy business programs, and the level of commitment needed to complete a degree. One of his students dropped out of the program and switched to studying for a standard MBA, Marchiori said.

"It's a rigorous program. They're challenged. It's not just a stamp on their résumé," he said.

Coburn said students can find themselves doing 20 hours of graduate course work a week after spending 50 or 60 hours on the job.

"It takes a commitment and it takes organization," he said. "The thing I see most is people getting behind early, because they haven't set a goal to finish."

Still, Coburn has no doubt about the value of an energy business degree and its importance for individuals wanting to advance their careers in the energy industry.

"It gives you an automatic edge up," he said.

Joe Satterfield waving arms to show axial plane and fold axis orientations to ASU geoscience majors near Muskhog Spring fault, in Javelina Draw, Big Bend National Park, West Texas, during ASU Field Camp, July 2013. Photos courtesy of Satterfield unless otherwise noted.

Changing the image of geoscience education

Between Rocks and the Hard Sciences

By HEATHER SAUCIER, EXPLORER Correspondent

If science has a softer side, the geosciences have somehow claimed it – by unfortunate default.

Perhaps it is the regular slashing of funds for geoscience research at the National Science Foundation. Or, maybe it is because in many states, students on the "college track" are required to take biology, chemistry and physics, which are typically considered "hard sciences."

SATTERFIELD

Nevertheless, many students are never exposed to the geosciences in high school, and as a result, they remain unaware of the need for geoscientists and the many career opportunities that exist.

"The attitude that geoscience isn't a hard science is perplexing, and it goes up to high levels," said AAPG member and 2013 AAPG Foundation Professorial Award-winner James P. Evans, a professor of structural geology at Utah State University, explaining that many in Congress oppose supporting geoscience research.

"Most of us in the geosciences are not too pleased about that," he added.

Yet look around, Evans suggested, and the need for geoscientists – even beyond the energy industry – is pervasive.

"There are really significant issues that we need to deal with as a society," he said, "and they require geoscientists."

Finding and managing water resources is one. So is the need to explore for raw material resources, such as tantalum – a rare earth metal that has become critical to billions of people.

"There are about one or two grams of it in every cell phone, but we have two-three billion cell phones on the planet," Evans said.

"There are all of these cool things that geoscientists do, and I don't see them reaching high school-level kids," he said. "How do we get kids to realize that there is petroleum geology, biological engineering, oceanography, atmospheric chemistry and genetics?"

The most promising solution to date might be the Next Generation Science Standards (NGSS) – an internationally benchmarked set of standards based on the Framework for K-12 Science Education developed by the National Research Council in 2011 (see related story, page 14).

Satterfield and Vaden Aldridge (ASU geoscience major now graduate student at Northern Arizona University) on San Ysidro anticline, northwest of Albuquerque, N.M. during ASU Field Camp, June 2013.

The goal of the NGSS, released in 2013, is to elevate the importance of the geosciences in the nation's schools and begin teaching them at the primary, middle and high school levels.

Location, Location, Location

Utah State University is roughly 20 miles from the southern border of Idaho, a state – unlike Utah – that requires high school students to take a geoscience class.

Not surprising, a fair number of Idahoans enrolling at Utah State are choosing to major in geology and geophysics, Evans said, suggesting that exposure to the geosciences in high school does indeed make a difference.

Students from Houston, Denver or Calgary – North America's major energy hubs – tend to have more exposure to the geosciences because their parents work in the field or because they know people who do.

"Who's heard of geology if they live in Chicago or Minneapolis?" Evans asked.

Television networks such as PBS and the Discovery Channel no doubt take young viewers to exotic places where they can watch oceanographers study marine life or geologists map outcrops in the Himalayas.

Often, pre-medicine and engineering majors are required to take a geoscience class in college, and sometimes that class inspires them to change their major. Evans recalled a former physics major who chose geology as an elective because the class was near the physics building.

Needless to say, he added, she ended up a geologist.

"This is a common theme on college campuses," Evans said, revealing that he decided to double major in engineering and geology after his degree plan required him to take a geology course. "It was super cool and super interesting and a lot more fun than engineering classes."

Evans' wife – a former anthropology major – tells the same story.

Furthermore, sometimes students study geology because they didn't make the grades in advanced math classes that are required in the engineering track. But that's ok, Evans said.

"In the geosciences, we don't care if the kids get Cs in these classes," he said. "The struggle we have in the geosciences is there are not enough students who have taken those classes, such as differential equations.

"It's important that they simply have them under their belt," he said, "so they can do quantitative work."

Back to Basics

In addition to quantitative analysis skills, industry geoscientists also need experience in the field, said AAPG member and 2012 AAPG Foundation Professorial Award-winner Grant Wach, professor of petroleum geoscience and stratigraphy at Dalhousie University in Halifax, Canada.

"We are losing our mentors in the industry who are capable of teaching field schools and training the younger generations. Structural geologists and sedimentologists have a lot of field experience, and many of them are retiring," he explained. "Companies want to see more training in those basic skills for students who are graduating."

Yet, the cost of field camps can be out of reach for many students, at roughly $2,500 per camp, Wach said. (Other professors report average costs closer to $4,000.)

"Field schools are expensive. A bus costs $1,000 a day. The decreases in grants to students and to universities often results in the cost of field schools being passed down to the students," he said.

Approximately 43 percent of undergraduates majoring in the geosciences participate in a field camp, which is an academic program of a minimum of four weeks focused on field tools and methods, as defined by AGI's 2014 Status of Recent Geoscience Graduates report.

However, the numbers of participants are increasing as employers emphasize the need for field experience, said Carolyn Wilson, a data analyst in the Workforce Program at AGI who compiled the institute's report.

Why Geology, Anyway?

According to the AGI report, 66 percent of undergraduate geoscience majors choose a degree in geology.

"Students go into geology because they like the outdoors," Wach said. "There is some backlash about geologists in the energy industry – that it is paradoxical. But geologists are strong stewards of the environment and they want to protect it."

See **Paradox**, page 12

James Evans leads a field trip of students from Utah State University. Photo courtesy of Evans.

Paradox
from page 10

If there is anything paradoxical about geology, it's that it is a science one can both see and not see, Wach explained.

"You can touch the rocks, but you have to be able to think in three dimensions and in the abstract because you can't see the subsurface," he said, noting that at his university, aboriginals and students with dyslexia tend to be drawn to the science.

Evans shared his own theory as well: It is simply "more fun."

If teachers can instill a passion for geology into students while also underscoring the career possibilities and quality of life geologists can have, more high school graduates might be inclined to major in the discipline, Wach said.

Geoscience Haven

At Angelo State University in San Angelo, Texas, a small undergraduate geoscience program, which is arguably one of a kind in its offerings and intensity, has been taking shape over the last five years.

Started by AAPG member and 2015 AAPG Foundation Professorial Award-winner Joe Satterfield and his colleagues, James Ward and Heather Lehto, the program emphasizes field work, undergraduate research and volunteering as teaching assistants. Upon graduation, students will have experienced what many don't encounter until their master's programs.

Students of all majors often choose to take an introductory geology class – complete with a fieldtrip to Big Bend National Park – to satisfy a university science requirement.

Many change their majors to geology after that experience, Satterfield said.

"They generally know little about geology in high school. We are starting to change that," he said.

Satterfield and his students reach out to local middle and high schools and help teachers integrate geology lab activities, such as simulating radioactive decay with M&Ms, into chemistry courses in order to give students real-life applications to what they are studying.

In talking with Satterfield and his geology students, high school and middle school students get a taste of the geosciences early on.

"They learn about my students' backgrounds and future plans and get an idea of the fun of geology," Satterfield said.

No doubt Satterfield's students have much to share, as they take weekend field trips to the Llano uplift of central Texas, Guadalupe Mountains, Rio Grande rift volcanic field, and work drilling rigs near San Angelo.

Students prepare drafted maps, cross-sections and reports – just as they will in the workplace – in three diverse geologic settings in the North American Cordillera: Triassic – Cretaceous siliciclastic rocks in the Colorado Plateau, Mesozoic and Cenozoic gold-bearing igneous and metamorphic rocks in western Nevada, and Cretaceous carbonate rocks in Trans-Pecos Texas.

They work as volunteer lab assistants alongside their professors, and many work on their own research projects, including writing grant proposals, performing field and lab work, and formally presenting their results at regional and national meetings.

"Students here receive a taste of practicing geology at the graduate and workplace level – partly because we choose not to offer a graduate program and partly because class sizes are small," Satterfield explained.

And to top off the program's comprehensive curriculum, students who belong to the university's AAPG Student Chapter attend joint meetings with the San Angelo Geological Society, an AAPG affiliate, and learn from geologists from all over the country.

Not many outside of West Texas have heard of San Angelo – least of all its university's standout geosciences program. But in many ways, it is successfully spreading the word about the importance of the geosciences to young students, and graduating well-rounded scientists who are no doubt competitive in the academic and professional geoscience community.

Next Generation Science Standards

Geoscience Takes Rightful Place in K-12 Curricula

By HEATHER SAUCIER, EXPLORER Correspondent

Misfit no more!

The geosciences – which have typically never shared an equal seat in the classroom compared to biology, chemistry and physics – are now being fully included in many K-12 curricula across the nation.

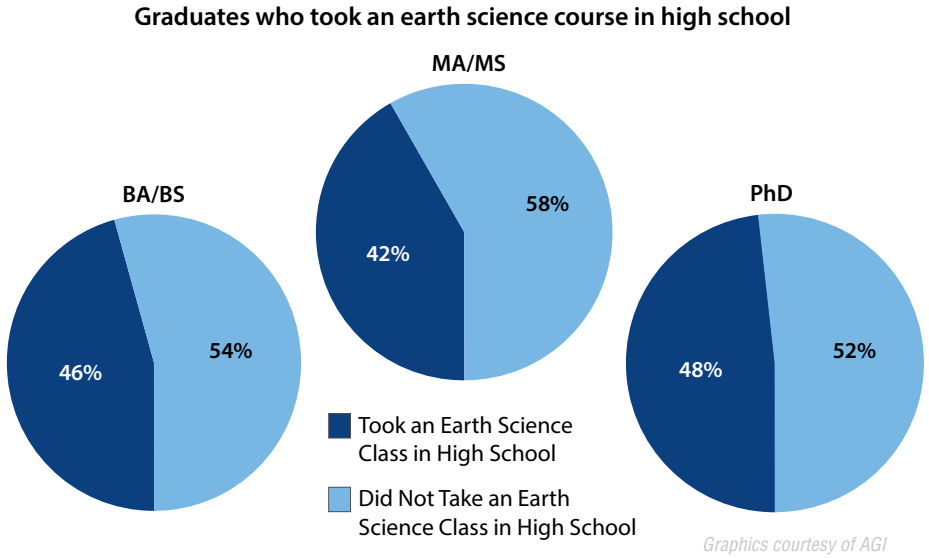

ROBECK

Finally recognized as a relevant body of sciences that affects everyday life, the geosciences can now open students' eyes to a multitude of important principles and careers rarely considered earlier than college.

Yet, difficult challenges lie ahead for the geosciences:

- A lack of awareness of geoscience-related subjects at the college level.
- The need for geoscience professionals with field experience.
- Rampant federal cuts in geoscience funding.
- An increasing demand for geoscientists brought on by the rapid retirement rate of geoscience professors and professionals.

Infusing the geosciences into K-12 classrooms may be the first step to ensuring the nation maintains the expertise and momentum to support the innovation that, in turn, supports the country, said Chris Keane, director of communications and technology and of the Workforce Program at the American Geosciences Institute (AGI).



Graphics courtesy of AGI

Bigger Kid On Campus

After several years of careful consideration, a consortium of educators from 26 states, along with stakeholders in science, science education, higher education and in the industry developed the Next Generation Science Standards (NGSS) – an internationally benchmarked set of standards based on the Framework for K-12 Science Education released by the National Research Council in 2011.

The NGSS calls for direct attention to the geosciences (or "earth and space science," as they are called in the NGSS) for all students grades K-12, and altering the way the science is taught.

According to an API 2014 Status of Recent Geoscience Graduates report, 46 percent of those who graduated with an undergraduate geoscience degree took an earth science class in high school.

"For a long time, geoscience education was sort of considered subordinate or less important. The NGSS really changes the role of the geosciences in school curricula," said Ed Robeck, director of education and outreach and of the Center for Geoscience and Society at AGI. "Geoscience is now considered on par with physical science and life science areas."

Part of the reason for the change is a realization that the geosciences play an important role in the world, Robeck explained.

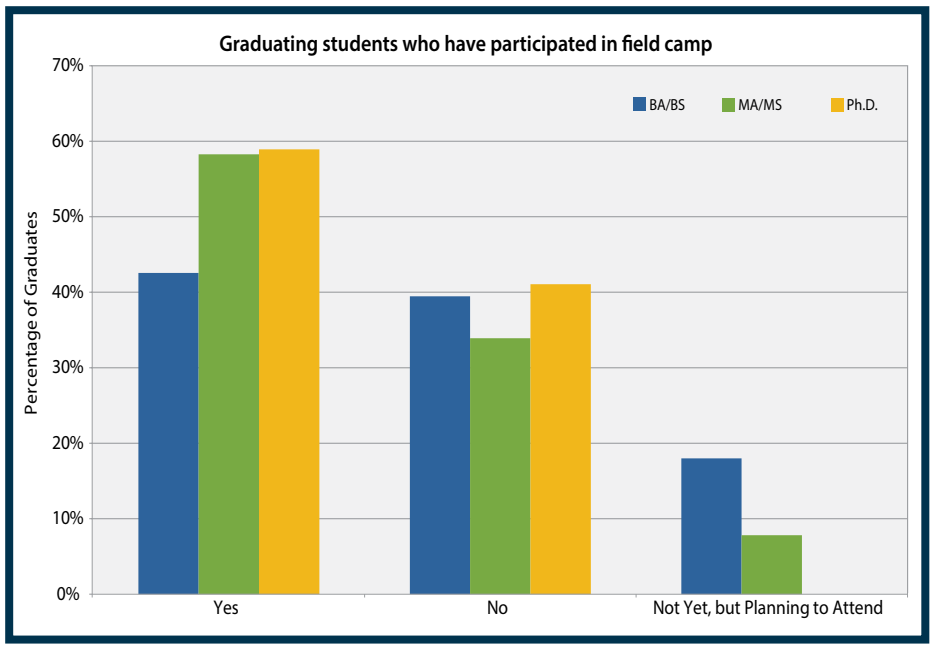
Events such as earthquakes, volcanic activity, energy needs, tropical storms and climate change appear regularly in the news.

"These are events that force people to pay attention to critical issues in geoscience, and they realize that geoscience does matter," he said.

Furthermore, as the U.S. economy shifts to one that is more energy-based, the geosciences are playing an increasingly crucial role in the nation's need to produce skilled and innovative geoscientists who can continue the shale movement, Keane noted.

Another reason for including the geosciences into curricula is to introduce students to a world of specialized sciences and career opportunities at an early age. Rather than stumble upon geology, geophysics or geomechanics in their freshman year – likely because a geoscience course is required or is chosen as an elective – students can enter a university with knowledge of the many options on the academic shelf.

See **NGSS Integration**, page 16



NGSS Integration

from page 14

Making it Happen

The NGSS is not a federally required program, so it is up to individual states to adopt it. To date, roughly 15 states have adopted the standards in their entirety, while others are using modified versions.

Unlike the STEM (science, technology, engineering and mathematics) curriculum that encourages students to excel in those subjects and pursue them as careers, the NGSS is broader in nature and introduces students to subjects to which many have never been exposed, including:

- Earth and space science.
- Earth materials and systems.
- Plate tectonics and large-scale system interactions.
- Roles of water in earth surface processes.
- Biogeology.
- Natural resources.
- Natural hazards.

The NGSS provides a carefully designed sequence for introducing geoscience topics in the kindergarten through grade 12. At the high school level, students will see the geosciences made more distinctive in required classes as well as in breakout classes, such as earth and space courses, which will emphasize geology.

When studying geology, however, students may not find themselves memorizing rock and mineral names.

"They will explore how we can understand geology in a way that helps us to do things like mitigate hazards and decide where to construct buildings, for example," Robeck said. "They will learn about the material that comes from the earth and the minerals we use to make things. There will be discussions about how geology impacts humans and how humans impact geology."

Furthermore, teachers will begin to teach science differently. They will expect students to approach science from a problem-solving perspective. Students will learn to ask questions, investigate, analyze data and design solutions for problems, according to the NGSS.

"Our society is based on innovation," Robeck said, "so we need to encourage students to think innovatively in the classroom."

However, as schools begin to integrate the NGSS into their curricula, the largest missing piece at this time is, ironically, geoscience teachers.

Majoring in Geoscience

In order to get colleges to produce geoscience teachers, the seed for geoscience education as a career also must be planted in elementary, middle and high school.

According to the AGI report, less than 10 percent of geoscience graduates with bachelor's and master's degrees enter the field of education. The NGSS might be the key to encouraging more geoscience majors to pursue careers in the classroom.

"It needs to be impressed upon students that this is a new and burgeoning field, and teachers are needed in the K-12 classrooms," said Carolyn Wilson, a data analyst in the Workforce Program at AGI.

First things first, however: prior to entering college, students must understand that the geosciences exist, and that is one aim of the NGSS.

In addition to majoring in subjects they were exposed to in high school, many students choose fields that promise large paychecks, such as engineering and pre-medicine, Keane said.

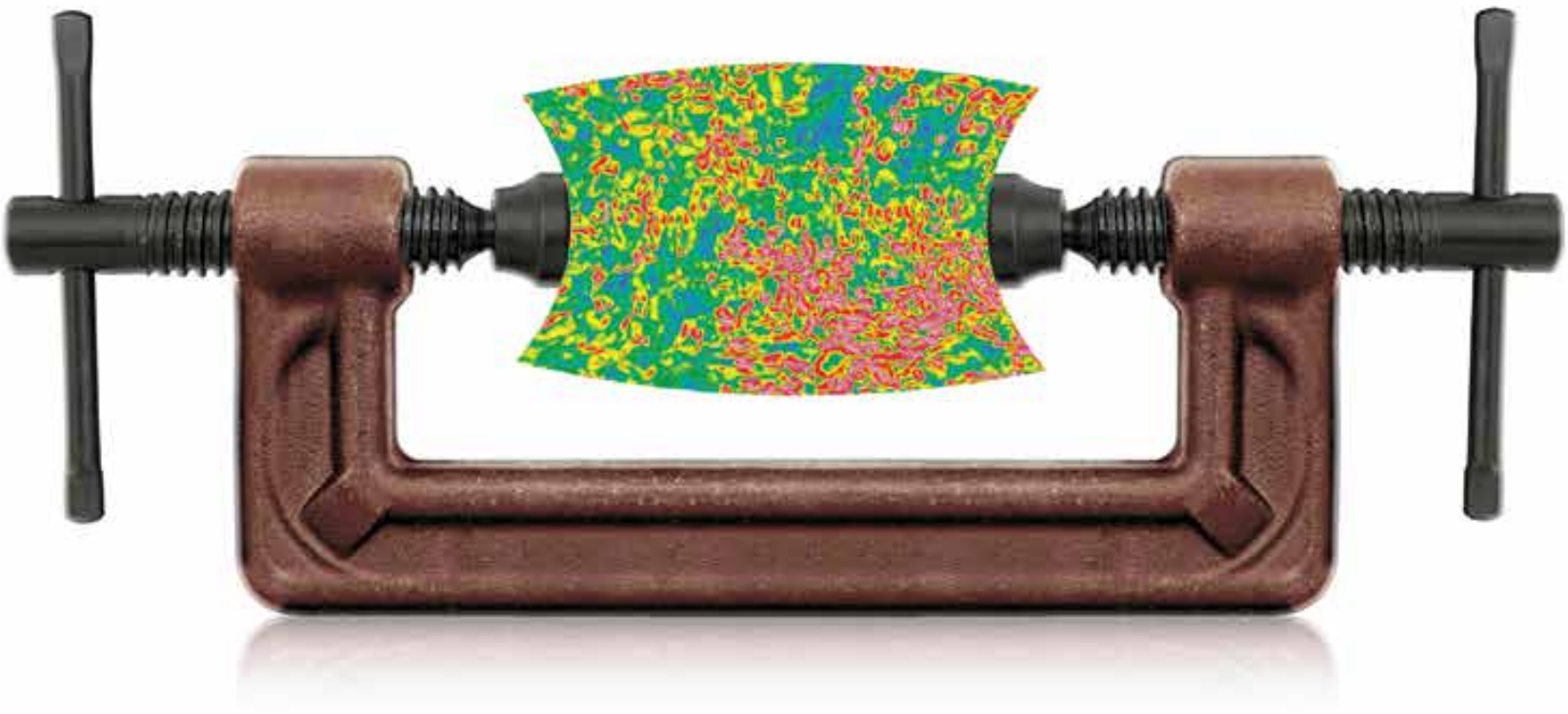
The oil and gas boom that's been taking place in the United States has opened many students' eyes to geology, despite its historical second-rate status in many classrooms.

Many geology graduates are receiving job offers in the energy industry with good salaries without a master's or doctorate degree, Keane said. For example, starting salaries are in the $50,000-$60,000 range, which is slightly lower than salaries offered prior to the 2014 economic downturn.

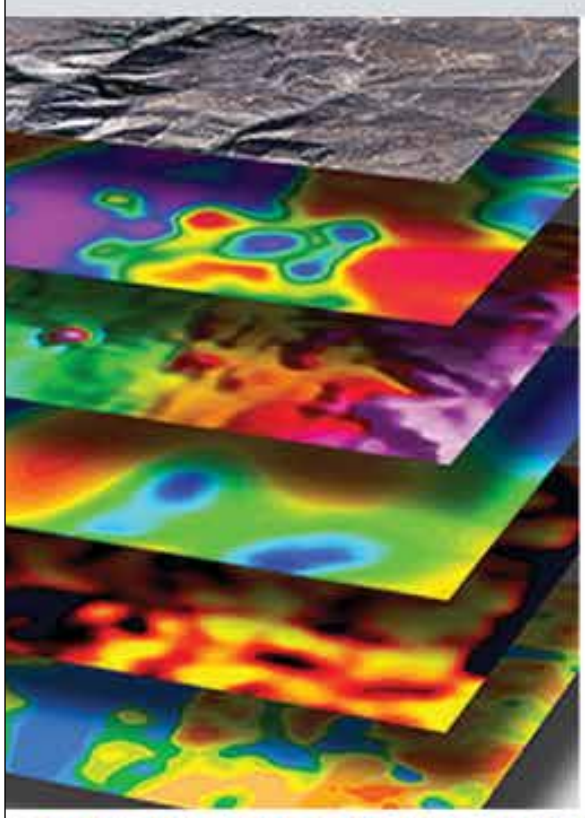
As geology graduates apply for jobs,

See **Field Experience**, page 18

Squeeze the Most Out of Your Existing Data



SEISMIC • WELL LOGS & CORES • POTENTIAL FIELDS • ELECTROMAGNETIC • RADIOMETRIC • REMOTE SENSING



Keep Exploring with the neoSCAN

Low prices and tight budgets don't mean you need to stop exploring. The neoSCAN™ helps you get the most out of your legacy G&G investments by integrating existing data with additional publicly available, multi-physics datasets. In under 100 days and for less than 50 cents per acre, neoSCANs deliver the interpretive products you need to help identify potential exploration leads. Moreover, predictive analytics methods are applied on all neoSCAN projects, providing rich insights that can be used to highgrade acreage in underexplored areas.

Don't feel squeezed by low prices and tight budgets. Let NEOS relieve the pressure.

neosgeo.com

neos

Field Experience
from page 16

more are finding that potential employers prefer candidates with field experience, Wilson said.

"Nowadays, employers expect you to have field experience going into the application process for jobs," she said.

Yet, 43 percent of geology graduates with bachelor's degrees attend a field camp, which is defined as an academic program lasting four or more weeks and primarily focuses on field tools and methods, according to the AGI report.

Fieldwork allows students to know and understand rocks firsthand. While some might view field experience as less necessary with today's highly technical computer modeling, there is no replacement for what is learned in the field, Keane said.

If the NGSS sparks an interest in geology or other geosciences in students at early ages, it is likely they may be more inclined to attend field camps and courses in college, Wilson said.

Biting the Hand That Feeds You

Because the NGSS underscores the importance of the geosciences in the nation's schools, many question why funding for research in the geosciences continues to be cut.

"Research funding for the geosciences is substantially dried up," Keane said.

The budget of the National Science Foundation for the geosciences has been slashed in the past and will face additional cuts – 8 percent, to be exact – if the reauthorization of the America COMPETES Act, which dictates how much federal money should be allocated toward federal research, is approved.

Current funds are largely used to fund ongoing research, so additional cuts in the budget impact the ability to make new awards, Keane explained.

It is not uncommon these days for post-doctorate candidates and faculty members to apply for 10 or more grants before receiving funding for geoscience research, as only 10 to 13 percent of proposals are funded, Keane said.

Cutting research funds in the geoscience fields coupled with efforts to boost the geosciences in the primary and secondary education system is nothing less than contradictory.

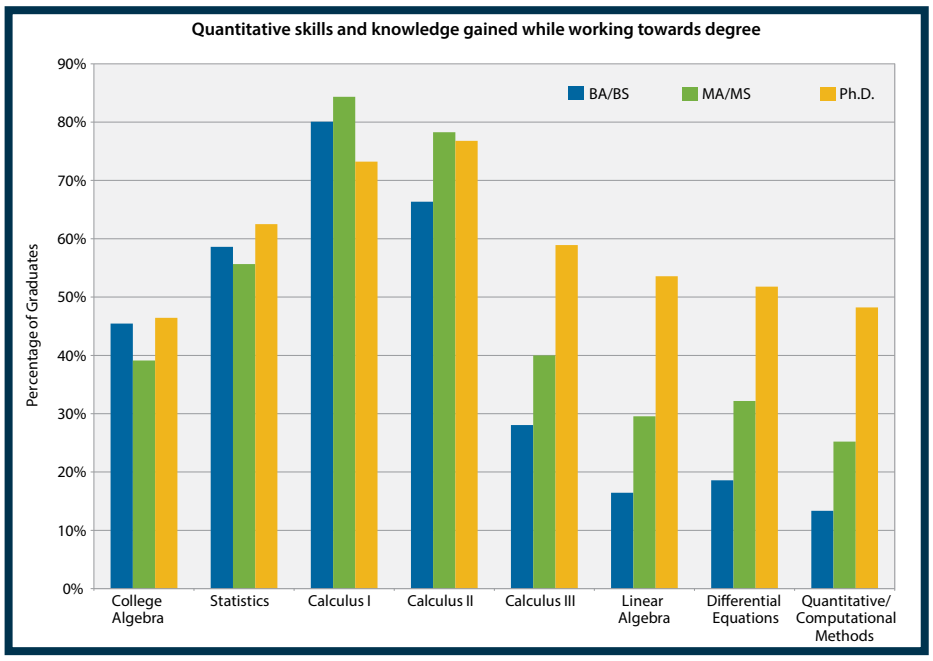
Keane said he is hopeful that the emergence of the NGSS and pressure from geoscience societies can be successful in pushing Congress to restore financial support for the geosciences that have kept innovation in the nation alive.

As funding is whittled away from federal budgets, a large number of experienced geoscientists are coincidentally leaving the workforce to retire. This leaves a mere handful of mentors for younger generations joining the industry.

"The retirement of the Baby Boomers that work in the geoscience fields in private industry is most concerning," Wilson said, "because we are losing a wealth of knowledge."

The same holds true for geoscience faculty members whose funding has dropped, leaving fewer opportunities for new researchers, Keane added.

If the NGSS can plant solid roots in the nation's school systems, open up new career opportunities to students, and elevate the importance of the geosciences in Congress, the cycle that has placed the geosciences at the bottom of the stack of textbooks just might be broken.



Building Support for the NGSS

Building support for Next Generation Science Standards (NGSS), beginning at the local level, is vital if the benefits of the NGSS to the geosciences are to be realized, said Ed Robeck, director of education and outreach and of the Center for Geoscience and Society at the American Geosciences Institute (AGI).

With support from the National Science Foundation, AGI recently partnered with the National Association of Geoscience Teachers to convene an education summit titled, "Implementation of the NGSS at the State Level," in which more than 50 stakeholders from various positions in earth and space science education met to form action networks and to consider what can be done at different levels to support NGSS implementation.

The needs that have to be addressed to implement the NGSS – from teacher preparation to providing expertise to schools – are varied, meaning there are many ways people can have a role in NGSS implementation.

"Every person who has an interest in the geosciences can help by becoming an active voice for geoscience education," Robeck said, "and using their expertise to support teachers' work and student learning."

– HEATHER SAUCIER

University of Kansas mature fields course

Industry, Engineering, Geology Converge

By KEN MILAM, EXPLORER Correspondent

When it comes to providing students "real-world" experience in the classroom, some schools stand out more than others.

Consider the University of Kansas, where one interdisciplinary course teams geoscience and petroleum engineering students to analyze live data from partnering oil companies.

"Each year, instructors approach a company that has a mature field, where there is relatively good data available and the company needs to take some next steps, either drilling some new wells or designing and implementing a waterflood to optimize production," said AAPG member Bob Goldstein, a past winner of the AAPG Foundation's Professorial Award, associate dean of Natural Sciences and Mathematics and the geology department's Haas Distinguished Professor.

GOLDSTEIN

> **"Students learn a lot about communication with one another and performing in a team, with both geoscientists and engineers making sure they do the job correctly.**

AAPG members Tim Carr and Tony Walton, along with Don Green, inaugurated the course about 15 years ago. Green has since retired, and Carr now teaches at the University of West Virginia. Walton continues to teach the course with Reza Barati and others.

"I enjoyed teaching this course more than any other over my career. It was great to work with Tony in the development and teaching of the course," Green said. "It is one in which students reinforce their understanding of reservoir engineering and geology principles that were studied in earlier courses in the respective programs, and bring those principles to bear on a real-world problem."

It is a graduate course for geoscience students and the capstone class for engineering undergraduate students, Walton said.

Industry Involvement

Working in a lab designed specifically for the class, students use company-supplied data to complete a full characterization of the reservoir, perform a history match and run a dynamic model.

State-of-the art industry software is used.

Students work in separate three-member teams. This spring's course had 33 students divided into 11 teams, Walton said.

"The neat part is it involves a real field," Barati said.

After modeling and history matching, students do economic investigation and evaluation of the project, "then look at any differences and see if they can improve (production), or what could have been done earlier with the information of today," he added.

"At the end of the semester, the students pitch their recommendations to the company," Goldstein said. "Imagine the communication experience they get in doing this. As you might imagine, there is a fair amount of nervous energy in the room at the end of the presentations when those professionals, who had been working the field for years, start asking the students questions. What great preparation for the real world."

In some cases, companies have implemented some version of the recommendations.

In other cases, the students' findings match or reinforce the companies' own plans.

"Commonly, the companies have gotten something of value to them," Walton said.

"I love it," Barati said of teaching the course.

"Every time, it's a new project so you never get bored," he said. "Every time you teach it, you learn something yourself."

Integrated Disciplines

Typically, the areas studied are small fields common in Kansas, including about 10 wells, Walton said.

"Because there's so much to cover in class, we really can't deal with large numbers. It's not possible in terms of manpower and the amount the students have to learn – or relearn!" he said.

Data studied include 3-D seismic, well histories, drilling completion and production records and oil, gas and water figures, Walton said.

See **Logs**, page 24

Grover E. Murray Memorial Distinguished Educator Award

Puckette Stands Out For Hands-On Teaching, Fundraising

By BARRY FRIEDMAN, EXPLORER Correspondent

As you probably already know, winners of the Grover E. Murray Memorial Distinguished Educator Award love students, education and helping to train the next generation of geologists.

PUCKETTE

That's to be expected. It's why, frankly, the award exists – why the best educators are honored.

To that extent, winner James O. Puckette from Oklahoma State University fits right in.

But there is something else, too, in his wheelhouse,

Fundraising.

You heard right.

To date, Puckette's efforts at Oklahoma State University, where he has been for the past 15 years (and where, incidentally, he leads the school's annual quest for an Imperial Barrel Award) has raised more than $3.5 million for the school, primarily in petroleum-related projects, but also $440,000 for general education.

"I enjoy working on projects that support students and expose me to aspects of geology that I have not researched before," he said.

"Often these are cooperative projects with other departments and colleges," he added, "and it is through these joint projects we meet new colleagues and in the process keep our learning active."

Puckette leading his OSU geology students on a field trip. Photo courtesy of Puckette.

Puckette is professor of geology and associate professor of sedimentary geochemistry, organic geochemistry and oceanography at the OSU Boone Pickens School of Geology, where, it should be noted, he teaches a majority of the school's petroleum geology courses.

Tactile Geology

Puckette, an AAPG member who serves on four committees, has advised more than 55 graduate students at OSU and served on the thesis/dissertation committees of almost 60.

In the classroom, he believes in a hands-on approach. Literally.

"My teaching philosophy is simple," he said. "Students learn best in the classroom or field when they are involved in the learning process."

He said this comes from his own experience as both student and teacher.

"It seems to me that most geologists are tactile learners," he said. "In lower division courses, I pass mineral and rock samples around the room. I do this in large sections and often have to have

See **Human Affairs**, page 24

10TH ANNUAL

Fundamentals Education Conference

HOUSTON, TEXAS
NOVEMBER 9-13, 2015

Courses Include:

- Subsurface Contouring: The Secrets to Optimizing Your Maps for Oil & Gas Exploration
- Concepts, Models and Case Studies of Dolomitization, with Applications to Hydrocarbon Exploration and Development
- The Petroleum System: An Investigative Method to Explore for Conventional and Unconventional Hydrocarbons
- Fundamentals of Siliciclastic Sequence Stratigraphy
- Rock/Fluid Interactions and Natural Fracture Development and Alteration
- RQ Toolkit: Using Rock Data for Reservoir Quality Assessment
- Reservoir Engineering for Petroleum Geologists
- Practical Geomechanics
- Quick Guide to Carbonate Well Log Analysis
- Clay Minerals in Reservoir Evaluation
- Risk Reduction for Plays & Prospects Using Quantitative Show

Hosted by:

Norris Conference Center- Westchase
9990 Richmond Ave., Suite 102
Houston, TX 77042
Phone: 713-780-9300
Fax: 713-780-9490

Registration and Information
Call AAPG toll free in the U.S. and Canada at 888.338.3387 or 918.560.2650
F: 918.560.2678 • E: educate@aapg.org
W: www.aapg.org/career/training/in-person/education-conference

AAPG | Fundamentals Education Conference 2015
November 9-13, 2015 - Houston, Texas

Upcoming Education Courses

2015 Courses:

LAST CHANCE

Geology in Montana along the Missouri River: Canoeing with Lewis & Clark Field Seminar	**August 17-21, 2015** Montana
Devonian Reef Facies Models, Hydrothermal Dolomitization, and Tight-Carbonate Reservoir Analogues Field Seminar	**Aug. 31-Sept. 4, 2015** Canada
Fractured Reservoirs: From Geologic Concepts toReservoir Models - course plus field trip	**August 24-28, 2015** Casper, WY

Early-bird Rates Expire Soon:

Modern Terrigenous Clastic Depositional Systems	**September 8-15, 2015** S. Carolina
Geochemistry & Modeling of Unconventional Petroleum Systems (with AAPG ICE)	**September 13, 2015** Melbourne, Australia
Complex Geology of the Spanish Pyrenees: Folding, Thrusting & Syntectonic Sedimentation	**September 14-18, 2015** Barcelona, Spain
Lacustrine Basin Exploration	**September 20-27, 2015** Utah
Sedimentology & Sequence Stratigraphic Response of Paralic Deposits	**September 23-30, 2015** Colorado/Utah
Complex Carbonate Reservoirs	**Sept. 26-Oct. 2, 2015** Italy

SHORT COURSES

Fundamentals Education Conference	**November 9-13, 2015** Houston, TX
Practical Salt Tectonics	**December 1-4, 2015** Houston, TX

FIELD SEMINARS

Sequence Stratigraphy, Facies Architecture & Reservoir Characterization of Fluvial, Deltaic and Strand-Plain Deposits	**October 2-9, 2015** Utah

ONLINE COURSES

Giant Oil and Gas Fields Self-paced, 4-week Certificate course	**Online**
Introduction to Shale Gas Self-paced, 4-week Certificate course	**Online**
Unconventional Resources Self-paced, 4-week Certificate course	**Online**
Leadership and Strategic Thinking in the Oil & Gas Industry Self-paced, 4-week Traditional online course	**Online**
Strategic Decision-Making: Current Issues in the Oil Industry Self-paced, 4-week Traditional online course	**Online**

www.aapg.org/career/training/

AAPG Education

Logs
from page 20

"Logs are provided by the company, plus we have access to those from the Kansas Geological Survey and the Kansas Geological Society. Also we have logs from other state agencies when working in those states," he said.

"Many times cores are available and we can get full core reports," Walton continued.

The instructors are familiar with the region and feel comfortable dealing with most of the students' questions, he added.

If not, they can go back to the participating companies for additional information.

Barati said teaming geoscience and engineering students and using real data is good preparation. He said several graduates have said their first assignment after landing a job was "pretty much like what they did in this course."

"Students learn a lot about communication with one another and performing in a team, with both geoscientists and engineers making sure they do the job correctly. It is just great practice for the teams they must learn to function in once they get out into industry," Goldstein said.

"Students need to learn the skills of reservoir characterization, modeling fluid flow in the reservoirs to maximize production and to minimize cost," he said. "They must learn how to work well in interdisciplinary groups of geologists, geophysicists and engineers, and they must learn how to present their results in a credible manner in order for management to adopt a recommendation."

Human Affairs
from page 22

at least three samples of each item of interest. I call on students to tell me what it is they are observing or holding in their hands at that moment."

It works on all levels.

"In upper division courses and graduate courses, I will ask questions of all students, sometimes moving from one chair to the next. Students know they are going to be asked to participate in the teaching process."

This, he believes, makes him a more effective teacher.

"Often they phrase information or relate experiences better than I."

Puckette is one of those instructors – and one of the reasons he was chosen this year to receive the award – who knows that geology doesn't exist in a vacuum. To that end, he teaches a course called Geology and Human Affairs.

"This course is designed for non-science students and since it is a course that may be the only natural science course students will complete in their undergraduate career, I want to show students not only why science itself is important, but how it relates to their daily lives," he said.

And here geography is a friend.

"Since most of our students are from Oklahoma and Texas, an effort is made to use examples from the student's home state," he said.

For 14 years he has also been the main organizer and instructor for the school's geology field camp, located at the Les Huston Geology Field Camp near Canon City, Colo.

One of the characteristics of a good teacher, he feels, is enjoying the moment when a student gets it.

"I enjoy seeing others learn and discover. When a student can relate what they have learned to their hometown or their part of the state or even where they have vacationed, it is a joy seeing that light in their eyes."

Which is not to say that joy is easily come by.

"Today's students are often a product of an education system that told them exactly what they are/were expected to know," he said. "As a result, they want to know exactly what they are expected to do to earn a certain mark or what they are expected to learn for an exam."

His experience in school was, frankly, less rigid.

"I believe that when I was a student we were forced to be a bit more creative than many of the current students who are accustomed to more of a 'cookbook style' learning," he commented.

Puckette, who has published 47 peer-reviewed papers, has been a featured speaker more than 50 times at industry workshops and presented close to 160 oral and poster presentations, says it is a relentless pursuit.

"One challenge for me," he admits, "is keeping up with new technology," which can be both the proverbial blessing and the curse.

"We are blessed with data management technology, and it is a challenge to design exercises for courses that tap into the new technology as a tool, without having students lose track of the fundamental concepts," he said.

His goal is to get students to mentally visualize the spatial distribution of a bed or reservoir "before they represent if using software."

Professional Passion

Talking to Puckette even for a while, and you can see there's a passion in this man, a passion in his love of the profession and the science itself.

His classroom is his memory bank – and all the memories tell stories, even his first one.

"I learned that the students gave me good marks for teaching GEOL 2254 (Mineralogy)," he said.

It was his first course. It should have made him feel good, right?

"I was not pleased with the effort."

A man this self-critical who strives to be better – that more than anything is the definition of a good teacher.

"I am interested in all types of natural science and my passion is my profession," he said. "When asked what I do for vacation, my reply is usually 'go look at rocks.'"

AAPG Imperial Barrel Award 2015

A Joint Program of AAPG and AAPG Foundation

AAPG would like to thank the many sponsors who helped support the AAPG/AAPG Foundation IBA Program.

DIAMOND ($50,000 and above)

Chesapeake Energy
Chevron
ExxonMobil
XTO Energy
Saudi Aramco
Shell
Schlumberger

TITANIUM ($25,000 to $49,999)

Anadarko Petroleum Corporation
ConocoPhillips
devon

GOLD ($20,000 to $24,999)

AAPG Datapages
dGB
HAMPSON-RUSSELL
IHS
ikon
MAERSK OIL
PALISADE
Paradigm
PRA Platte River Associates, Inc.
SeisWare
sirius energy

SILVER ($15,000 to $19,999)

Marathon Oil Corporation

IRON ($5,000 to $9,999)

STONER ENGINEERING LLC

PATRON ($1,000 to $4,999)

HESS

LYNX GEOGRAPHIC INFORMATION SYSTEMS LTD.

AMMONITE RESOURCES PARTNERSHIP

SPONSOR (Up to $999)

PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS

AAPG REGIONS

AFRICA
ExxonMobil
ExxonMobil Nigeria
Shell
Shell Egypt
Stoner Engineering LLC

ASIA PACIFIC
Shell
Stoner Engineering LLC

CANADA
bp Canada Energy Group ULC
Chinook Consulting Services
ConocoPhillips Canada
Husky Energy
Imperial Oil Resources
Murphy Oil Company Ltd.
Nexen
Nexen CNOC UK Ltd.
Stoner Engineering LLC
Talisman Energy Inc.

EUROPE
ADDAX
BG Group
bp Exploration Operating Co. Ltd
CGG
Danubian Energy Consulting
Expert Petroleum
ExxonMobil
Geopetrol International
Hunt Oil Co. of Romania
IHS
IHS Geneva
Lundin
MOL
Nexen
Nexen CNOC UK Ltd.
OMV Expl. & Prod. GmbH
Oryx
Prospectiuni SA
RWE Dea AG
Shell
Solo Oil plc
Statoil
Stoner Engineering LLC
TGS Geological UK Ltd.

LATIN AMERICA
ConocoPhillips
ExxonMobil
Shell
Stoner Engineering LLC

MIDDLE EAST
Petroleum Development Oman
Saudi Aramco
Saudi Geophysical
Stoner Engineering LLC

AAPG SECTIONS

EASTERN
Ammonite Resources Partnership
Appalachian Geological Society
Bennett Systems Ltd
Billman Geologic Consutants, Inc.
Cabot Oil & Gas Corporation
Chesapeake
Pittsburgh Association of Petroleum Geologists
Pittsburgh Geological Society
Stoner Engineering LLC

GULF COAST
Anadarko
ExxonMobil
Freeport McMoRan Oil & Gas
Houston Geological Society
Marathon
New Orleans Geological Society
Schlumberger
Stoner Engineering LLC

MID-CONTINENT
Chesapeake
Stoner Engineering LLC

PACIFIC
Aera Energy
Chesapeake
California Resources Corporation
Stoner Engineering LLC

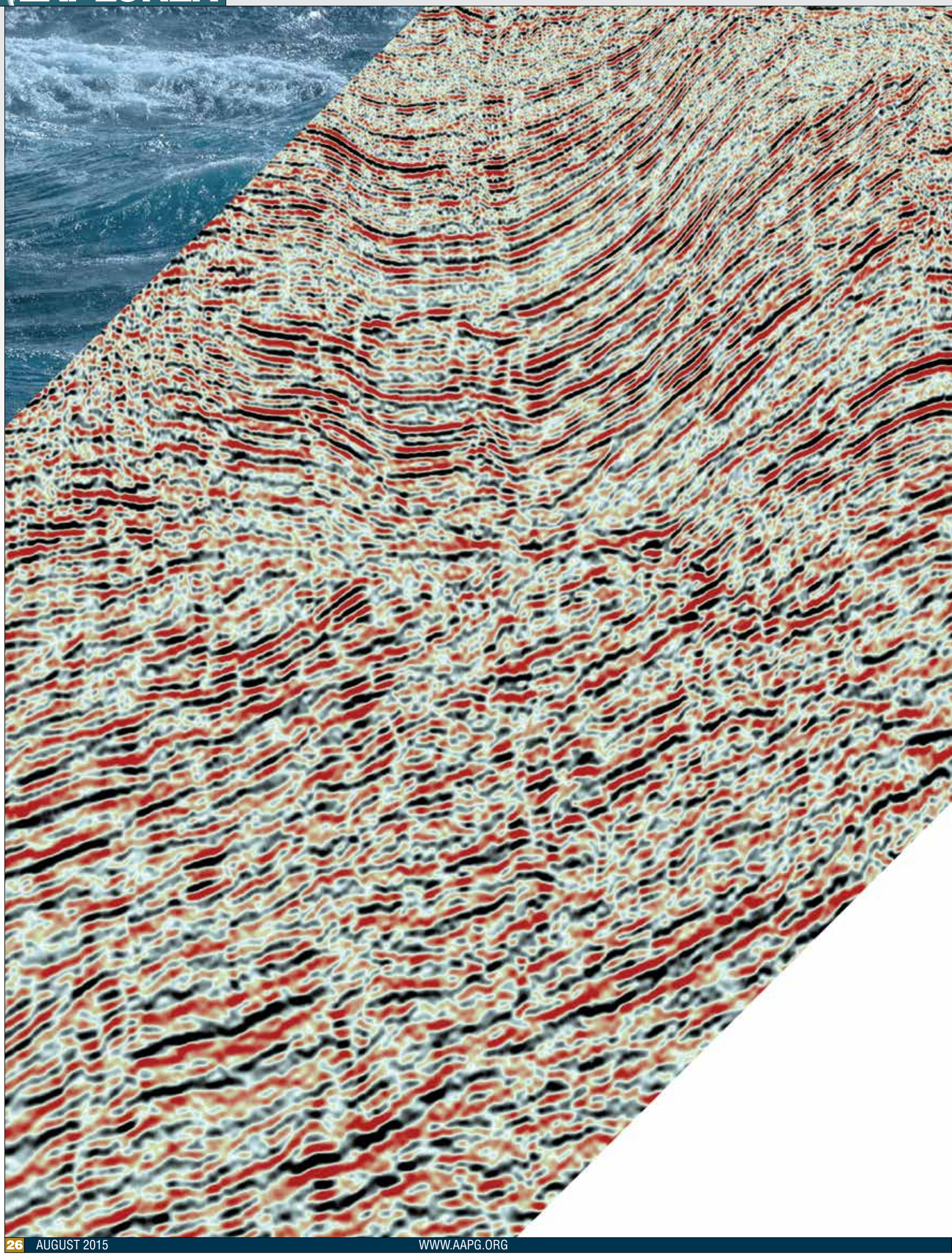
ROCKY MOUNTAIN
AAPG Rocky Mountain Section
Chesapeake
EOG Resources
Stoner Engineering LLC

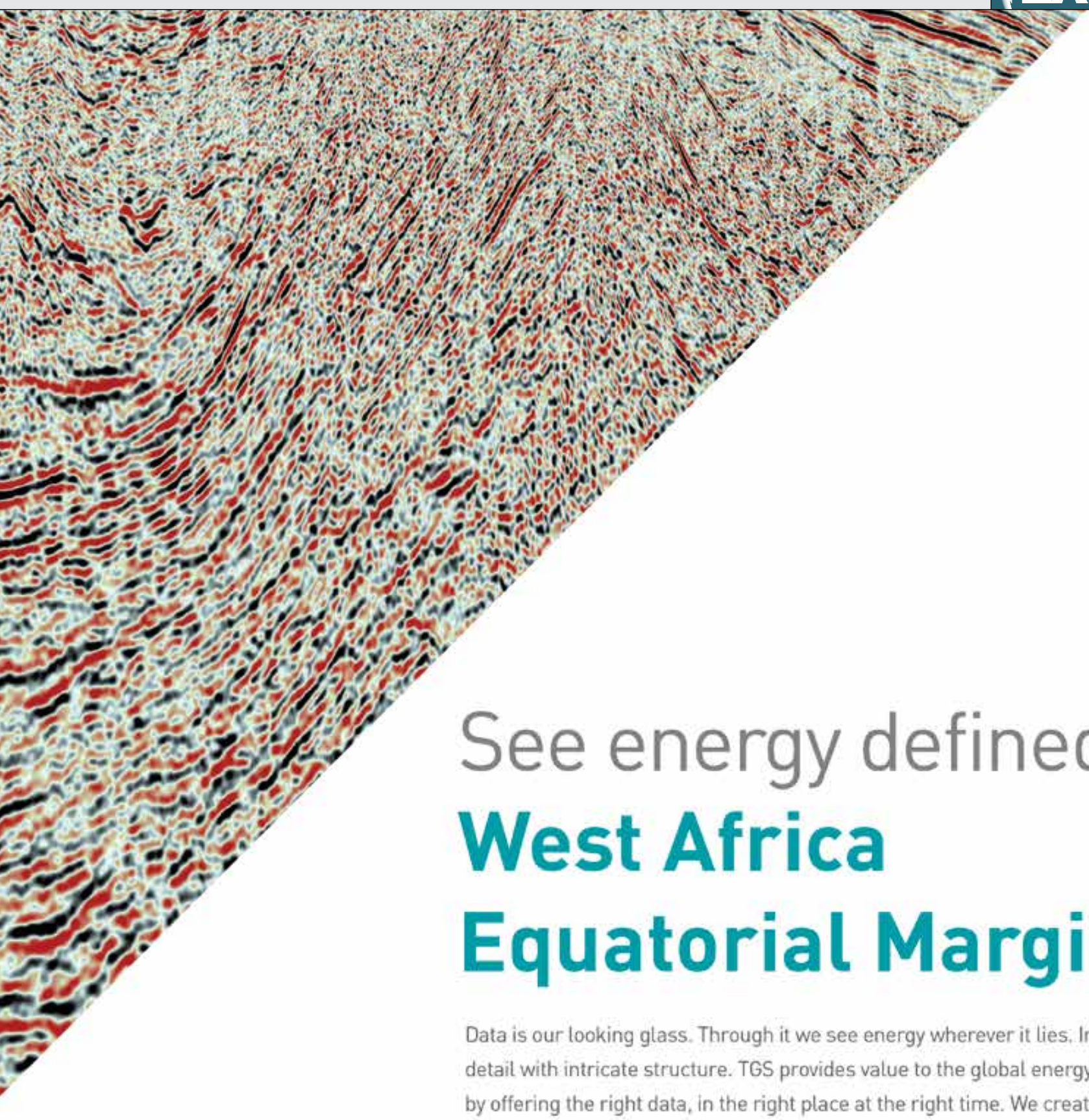
SOUTHWEST
Chesapeake
Stoner Engineering LLC

INDIVIDUAL CONTRIBUTIONS TO THE IBA FUND IN THE AAPG FOUNDATION

Adedayo Adebulehin
Jon Frederic Blickwede
Sofia M. Campbell
Kirt M. Campion
Burns A. Cheadle
David Richard Cook
Jane E. Estes-Jackson
Gretchen M. Gillis
Janice L. Gregory-Sloan
Priscilla C. Grew
Kathleen Wiltenmuth Haggar
Arthur H. Johnson
G. Randy Keller
Anthony Joseph Kolodziej
Michael E. Mathy
Eva P. Moldovanyi
Kay L. Pitts
Eleanour Snow
Donald Henry Sobba
J. Todd Stephenson
Scott L. Stockton
Tyler M. Treece
Karla E. Tucker

Efforts have been made to recognize all sponsors as of print deadline. If your company has been omitted, please accept our apologies. Also, this may not reflect sponsors of IBA Sectional/Regional competitions.





Visit TGS at
HGS/PESGB
Booth B5

See energy defined.

West African Equatorial Margin

Data is our looking glass. Through it we see energy wherever it lies. In brilliant detail with intricate structure. TGS provides value to the global energy industry by offering the right data, in the right place at the right time. We create value by making geoscience driven investment decisions to anticipate and satisfy energy industry needs.

TGS has extensive coverage over the West African Equatorial Margin (from Sierra Leone to Benin). Offerings include:

- 67,000 km of 2D seismic data
- 40,000 km² of 3D seismic data
- 49,000 km of gravity and magnetic data
- 16,000 km of aeromagnetic data
- Digital well log data
- Deepwater borehole data
- Interpretation reports

See the energy at TGS.com

TGS

Mars, or Earth 2.0?

How to Create a New Home of the Red Planet

By BRIAN ERVIN, EXPLORER Assistant Managing Editor

Space probes have viewed it, rovers have explored it, writers have romanticized it and cartoonists have used it for a source of material.

Some scientists, of course, simply marvel at its potential – not just as a potential target to be explored, but also for its potential as the salvation of humanity.

We're talking Mars. And as several AAPG members observe, it's time for the talk to be serious.

"The human species needs a frontier," said Bruce Cutright, project manager at the Bureau of Economic Geology and a member of AAPG's Astrogeology Committee. "It needs to be excited about the future and they need to see that the future is going to be better and be different, and that's what space exploration in general provides."

As Cutright and others see it, the general lack of interest in space exploration today, compared to the collective fervor there was for it in past decades, represents a significant obstacle to human advancement, so it falls to organizations like AAPG to steer the ship of public interest back on course by promoting the next logical giant leap for mankind: the exploration and terraforming of Mars.

"We believe in the spirit of the human frontier, and I think as AAPG members, we are explorationists, and that's fully within the realm of what we talk about as geologists and engineers," Cutright said. "The whole idea of terraforming Mars or colonizing the moon or creating orbital habitats – all of these things that sort of come out of the realm of science fiction – aren't really science fiction."

"It's not merely an academic exercise," added William Ambrose, research scientist at BEG and chair of AAPG's Astrogeology Committee. "It would be part of a grand, integrated plan for the human species to go beyond just the bounds of Earth, because the entire history of the human species has been one of exploration. I think for that to end, and for we humans to be confined to earth for the rest of the history of our species, is unthinkable."

CUTRIGHT

> **"We believe in the spirit of the human frontier, and I think as AAPG members, we are explorationists, and that's fully within the realm of what we talk about as geologists and engineers."**

AMBROSE

"Do I think that Mars is worthwhile? Absolutely. It should be our next step," concurred James F. Reilly, another member of the Astrogeology Committee who also is a former NASA astronaut, exploration geologist and current associate vice president and dean of science and technology for the American Public University System.

The trio made their case through two presentations at the recent AAPG Annual Convention and Exhibition in Denver: Ambrose and Cutright presented "Water and Other Volatiles on Mars: Resource Base and Implications for Terraforming," followed by Reilly's presentation of "Surviving the Red Planet: Preparing the Visiting Geologist to Live and Work on Mars."

Recipe for a New Earth

"We do not, at least in theory, lack the means to do this," Ambrose said about the prospect of terraforming the Red Planet. "We have the technology. Scenarios have been formulated by planetary scientists and engineers. They've basically figured out how this can be done."

Ambrose and Cutright's main blueprint comes from the work of Robert Zubrin and Christopher McKay, a renowned aerospace engineer and a NASA planetary scientist, respectively, who have jointly published a slew of papers and books on the subject.

"The whole goal when we talk about terraforming is to make the existing surface of Mars habitable by humans, and the idea is to try to make it approach the surface environment of earth as closely as possible," Cutright said.

"It's essentially building up a sufficient level of greenhouse gas in the Martian atmosphere so that the process of warming up Mars, and also releasing volatiles takes place without an additional input from various sources," Ambrose said. "And that brings in the possibility of all kinds of terrestrial plants being able to live and prosper in an environment like that, and then suddenly you have the greening of Mars. It might be with anaerobic algae or bacteria or other sorts of extremophiles, but it would begin the process of terraforming Mars in a very short period of time."

Terraforming would never make Mars exactly like Earth, however.

The air pressure would only ever be a quarter, or a third at most, of what the Earth has on most of the surface at or around sea level, so humans would never be able to exist on the surface of Mars without, at the very least, some supplemental oxygen and a pressure suit. At best, Martian atmospheric pressure would be comparable to the thin air atop the Andes Mountains on Earth – which can support human life, if only barely.

"Obviously, it will never be the same," Cutright said. "The Zubrin-McKay approach is, 'How can we take Mars, which is the closest to an Earth-like planet that we've got right now, and move it closer to being an Earth-like planet?'"

The Zubrin-McKay plan offers two main approaches: gradual, and what Ambrose and Cutright called "catastrophic."

The gradual approach would be to slowly create and release greenhouse gases on Mars and let the normal weather patterns spread them around over time, which could be done in two ways.

The first would be by putting a massive parabolic reflector in orbit around Mars – "basically mylar or some kind of aluminized reflector that could capture the sun's rays and focus them down onto the polar areas of Mars and heat up the surface," Cutright said, "just the way you would take a magnifying glass and hold it over a piece of wood or something."

The effect would be to liberate the existing carbon dioxide and water resources from the ice caps and the permafrost into the atmosphere.

The other gradual approach, Cutright described as "basically building greenhouse gas factories that take the in-situ material of Mars, which are basically chlorofluorocarbons, and introducing them into the atmosphere.

"And Mars is rich with a variety of minerals and different chemicals – there is sufficient carbon and fluorine and hydrogen where you can manufacture greenhouse gases from what we call chlorofluorocarbons," he continued. "I think one of the key things to think about is that there is a huge volume of water on Mars, and this is one of the underlying reasons people can look at and talk about terraforming Mars as a practical approach.

"Mars is locked in an ice age. Water and carbon dioxide are already on the planet. You just need a little change to release that into the atmosphere. It actually needs the introduction of greenhouse gases if the planet is to be rendered to the point that it could be habitable for humans," Cutright added.

The "catastrophic" approach to terraforming would be to introduce more volatiles into the Martian climate by finding ice and ammonia-rich comets and asteroids and sending them crashing down to the planet's surface.

It would take two comets roughly the size of the Shoemaker-Levy comet that struck Jupiter 11 years ago to add sufficient volatiles like water, ammonia, carbon dioxide and methane to the Martian atmosphere to increase the atmospheric pressure, they explained.

The best candidates would be in the outer solar system, because it would take much less energy to move them into an orbital path to intercept Mars than it would to divert asteroids or comets closer to Mars.

"The basic issue is what's called the 'Delta-v' – the change in orbital velocity needed to move something around the solar system, because the farther out you go from the sun, the slower the objects are moving," Ambrose said. "It takes less energy to divert even a large object from its existing orbit to bring it into the inner solar system, and through the magic of orbital mechanics, the object can be slowed down with gravitational assists going around one of the other planets – Jupiter, Saturn, even Venus – so when we get the object toward Mars, it's

See **Price Tag**, page 30

Thank you to our 2015 Sponsors

DIAMOND

SM ENERGY

Conference Amenity

EMERALD

Chevron

Registration

أرامكو السعودية
saudi aramco

Program Book

RUBY

ConocoPhillips

Directional Signage, ePapers

devon

Smartphone/Mobile App, Core Station

FairmountSantrol

Notebooks

TGS

See the energy.

Speaker Services Support

SAPPHIRE

Anadarko Petroleum Corporation

Conference Proceedings

Chesapeake Energy

Breakfast Bites

Core Lab

Core Exhibits

ion

Wi-Fi Hot Spot

PIONEER NATURAL RESOURCES

Pocket Guide

Schlumberger

Lanyards

Statoil

Digital Signage

XTO ENERGY

Audio/Visual

TOPAZ

BRECKENRIDGE GEOPHYSICAL

General Fund

DIVERSIFIED WELL LOGGING, LLC

General Fund

ENERGY NAVIGATOR

ePapers

Magnitude

General Fund

petrolink

General Fund

Sanjel

General Fund

STONER ENGINEERING, LLC

General Fund

MEDIA/SUPPORTING ORGANIZATIONS

THE AMERICAN OIL & GAS REPORTER · The BAKKEN · Bakken Oil Business Journal · E&P · AAPG EXPLORER · GEOExPro · HARTENERGY · JPT · The Leading Edge · NAPE · Oil & Gas Journal · Oilfield Technology · Bakken · Oil Journal · Shale Gas International · Tradeshow · Unconventional Oil & Gas Report · World Oil · WorldOils

Price Tag

from page 28


REILLY

actually moving fairly slowly."

It wouldn't require a "big effort" to do this, he said, but it would take a little bit of effort over a long period of time to divert the orbital paths of major comets.

It would take about 10 years to locate and bring the comets into orbit around Mars, and then it would take about 40-50 years for the dust to settle, during which time the other two, more gradual methods could be used in conjunction to gradually warm the planet to habitable temperatures.

So, Ambrose and Cutright said, Mars could be turned into a more Earth-like planet in as short a time as about 50 years, according to some estimates, or up to 250 years according to others.


This view from the mast camera on NASA's Curiosity Mars rover shows dramatic buttes and layers on the lower flank of Mount Sharp. Colors have been adjusted to show the rocks similarly to how they would appear under daytime lighting conditions on Earth. All photos courtesy of NASA.

MSRP On a New Earth?

Of course, setting up gas-factories and orbiting reflectors and moving asteroids around the solar system is going to take some monetary investment on Earth, but the venture defies easy quantification or a simple, straightforward price tag.

"The way that people have looked at it is as a percent of gross domestic product," Ambrose said. "Rather than a straight 'How much is it going to cost?' in terms of dollars, it's 'Could we afford 1 or 2 or 5 percent of the world's gross domestic product to create another earth?' By those analyses, the answer is 'Yes, we could afford that.'"

And it would require some regular maintenance, too.

Mars is no longer geologically active, so it has no plate tectonics, which has two major implications for its habitability:

- First, it has no protective magnetic field like the Earth has, so any intense solar flares in Mars' direction will strip the atmosphere by up to 30 percent at once.

"So the question is, after building up a Martian atmosphere, is it going to survive in the long term? A solution to that really hasn't been fully addressed yet," Ambrose said.

- Second, the lack of plate tectonics also means the minerals in the ground aren't being replenished over the millennia as happens on Earth.

"Our mineral deposits that are so valuable to us here on earth are generally the product of the cycling of convective currents in the mantle and plate tectonics," Cutright said. "We think Mars has had a lot of volcanism, so there may be some very good mineral deposits on Mars, but we just haven't been there to find them. But they are probably more rare than what we would see on Earth."

Both problems can be managed by regular trips to nearby asteroid belts, though.

"Mars is sitting right next to the asteroid belt, which has these huge reserves of platinum group metals, rare earth metals, all of those – iron, nickel, cadmium, chromium – are closer to Mars than they are to Earth," Cutright said. "So when we think of terraforming Mars, we're not thinking only of Mars; we're thinking of the environment it sits in and the other resources that can be brought to bear to make colonization of Mars more attractive."

"But again, because of Mars' weaker gravity and lack of a magnetic field, the terraforming we're talking about is not a process that's going to maintain itself forever. It would require some level of maintenance going forward in the future," he reiterated.

"But it would be nothing more strenuous than our efforts on Earth to protect the environment here," Ambrose added.

(Next month: The benefits of merely trying to turn Mars into a new Earth are manifold and far-reaching – but the human race has some progress still to make.)

Call for Abstracts Now Open

AAPG | SEG
International Conference
& Exhibition 2016
3-6 April • Barcelona, Spain

Submit Now!

Visit BARCELONA2016.ICEEVENT.ORG for submission guidelines and further details.

SUBMIT YOUR ABSTRACT FOR THE 2016 CONFERENCE PROGRAM

Co-presented by AAPG and SEG—two of the geoscience industry's leading professional societies—ICE Barcelona is now accepting presentations for the 2016 conference program. Submit your abstract and take advantage of the unique opportunity to share your insight and ideas with leading geoscience professionals from around the world. As a presenter, you'll benefit from:

- Unique access to an international audience of geoscience and oil and gas professionals from 60+ countries
- Opportunities to share your knowledge, research and ideas with other thought leaders and technical experts
- Integrated conference program covering key technical, strategic and economic issues affecting the advancement of global oil and gas exploration technology
- Networking events designed to facilitate high-level interaction and in-depth discussion among attendees

For questions:
Contact the Technical Program Planner by email at icetech@seg.org.

Presented by:

AAPG
Advancing the World of Petroleum Geosciences™

SEG
Society of Exploration Geophysicists
The international society of applied geophysics

Wolfcamp play in Permian's Delaware Basin

Potentially 'More Productive Than Eagle Ford'

By LOUISE S. DURHAM, EXPLORER Correspondent

Can it be that a dwindling U.S. drilling rig count has become the new normal?

Ask a dozen "experts" what the future holds for the industry, and you'll likely get a dozen different answers.

But there is an indisputable constant: The world continues to run on fossil fuels, crude oil in particular. And, there are pinpoints of light penetrating some of the on again/off again gloom hovering over the domestic E&P scene.

Look, for instance, at the Permian Basin, the old onshore workhorse of the industry, comprising several sub-basins.

The number of rigs exploring in the Permian actually increased by seven during the week of July 6 to a total of 239, according to the weekly rotary rig count released July 17 by Baker Hughes.

It's encouraging also that this region holds an emerging hydrocarbon play with the economic potential to carry select operators through these trying times of low and uncertain oil prices, according to a new analysis by IHS Energy.

It's the Permian-age Wolfcamp formation play in the Delaware Basin on the western side of the Permian Basin.

The Wolfcamp is a well-known producer in the Permian, particularly in the Midland Basin.

In the Delaware, the play is more expensive to develop because of depth and pressure, according to Jerry Eumont, managing director of the financial services group at IHS.

Composed essentially of interbedded shale and limestone, the Wolfcamp formation kicks out impressive volumes of hydrocarbons.

In fact, the IHS study notes that the play has some of the best-normalized production of any U.S. onshore play.

"I've seen productivity in the Delaware Wolfcamp get up to 100-120 boe per thousand feet (of lateral wells drilled)," Eumont said. "In the Midland Basin, it's still around 60-70 boe per thousand."

Effective May 2015, there were more than 3,200 wells producing in the Delaware Wolfcamp, with about 75 percent of these drilled horizontally.

Of that total, more than 475 came on production since January 2014.

Still Growing

The play is considered to have great promise, as it's currently viewed as a kind of adolescent in terms of its maturity, according to Reed Olmstead, manager of IHS' North American Supply Analytics Service.

"The sweet spots are still being defined, because these normalized production rates have not shown signs of flattening," Olmstead said. "This means the limits of the play have not yet been fully delineated, and operators are still learning how to best produce from this reservoir."

Eumont elaborated.

"In the (Delaware) Wolfcamp, the production continues to improve," he noted. "In the Eagle Ford (play), you know what you will get, and the Bakken is consistent for the most part.

"The Wolfcamp production in 2010 averaged 48 boe per thousand feet," he said. "In 2012 it was about 78, and in late 2014 it was 116. We're seeing continuous improvement, and that's why we're saying it's not yet mature.

"It looks like it could grow up to be, economically, possibly more than the Eagle Ford as to productivity," Eumont emphasized.

Olmstead commented that about 150 operators have produced from the Delaware Wolfcamp to date, compared to 90 in the Eagle Ford.

The Central Gas and Southern Liquids sub-plays are two sweet spots currently developing in the play.

Eumont said Cimarex is leading the charge in the Central Gas action in Culberson County, while the Southern Liquids activity in Reeves County is spearheaded by Concho Resources.

Normalized productivity from the sub-plays has increased by more than 40 percent since first quarter 2013, according to Olmstead.

The IHS analysis noted that the economics for both operators in their respective sub-plays are sufficient for drilling through the pricing downturn. But future delineation and possible expansion might be halted until oil prices recover and/or costs fall even further.

Still, many operators appear to be optimistic and eager for a piece of the action.

"In the last two months or so I've talked to 30 or 40 different operators, and at least half of them want to play the Wolfcamp Delaware," Eumont said.

"Not only that, one of the largest oil companies in the world said they think they can make this play work at $55 (oil)," he added.

AAPG Imperial Barrel Award 2015

A Joint Program of AAPG and the AAPG Foundation

Congratulations to the IBA Finalist Teams

Eastern Section
Pennsylvania State University
University Park, PA, United States

Europe Region
Royal Holloway, University of London
London, United Kingdom

Middle East Region
King Fahd University of Petroleum & Minerals
Dhahran, Saudi Arabia

2
$10,000

1
$20,000

3
$5,000

IBA Finalists

All IBA Finalists recived $1,000

Southwest Section
The University of Texas at El Paso
El Paso, TX, United States

Gulf Coast Section
University of New Orleans
Chalmette, LA, United States

Pacific Section
University of Fairbanks
Fairbanks, AL, United States

Mid-Continent Section
University of Oklahoma
Norman, OK, United States

Rocky Mountain Section
University of Montana
Missoula, MT, United States

Africa Region
University of The Western Cape
Cape Town, South Africa

Latin America and the Caribbean Region
Simon Bolivar University
Caracas, Venezuela

Asia Pacific Region
Curtin University
Perth, Australia

Canada Region
Queen's University
Kingston, ON, Canada

Intensity, Strong Bond Propel Royal Holloway to IBA Win

By BARRY FRIEDMAN, EXPLORER Correspondent

Royal Holloway University of London not only won this year's Europe Region Imperial Barrel Award competition, in June it also won the IBA grand prize – the first European school to capture the prize in seven years.

For those unfamiliar, the AAPG/AAPG Foundation's Imperial Barrel Award program is an annual prospective basin evaluation competition for geoscience graduate students from universities around the world.

In it, teams are asked to analyze a set (geology, geophysics, land, production infrastructure and other relevant materials) in the two months prior to their local competition. Each team then delivers its results in a 25-minute presentation to a panel of local industry experts.

Winners then move on to the IBA finals, (this year, held during the AAPG Annual Convention and Exhibition in Denver) to compete for the $20,000 first prize.

The Royal Holloway University IBA team: (From left) Nicola Scarselli, Benjamin Said, Arran Waterman, Stuart Munro, Wan Ching Low and Kimberly Dunn. Photo courtesy of Wan Ching Lo.

Midnight Oil

For Royal Holloway, according to Wan Ching Low, one of the students on the winning team from the school's department of earth sciences, it was an arduous process.

"After finishing classes at 5 p.m.," Ching said of a normal day, "we would head straight to the computer lab to start interpretation work."

And they would stay there until the wee hours of the night.

"The last few weeks, closer to the competition, the work got more intense as we put our presentation results together and did dry runs," she said.

They were working specifically on a dataset that from the Taranaki Basin, offshore New Zealand.

"The challenging part for this project," Ching said, "is time management, where we have to juggle attending classes, the weekly course assignments and to do IBA work, all at the same time."

That work, he added, consisted of 215 2-D seismic lines from 11 different seismic surveys from the dataset to start off

See **Teamwork**, page 37

AAPG EXPLORER

Full Circle: IBA Alumna 'Pays It Forward'

By BARRY FRIEDMAN, EXPLORER Correspondent

It worked the way it was supposed to work.

When the AAPG/AAPG Foundation initiated the Imperial Barrel Award back in 2007, there was a sense – a hope, really – that participating students would take the unique collaborative learning experience with them as they pursued careers in geology and academia, making both the better for it.

And – while it's an overused term – pay it forward.

Which brings us to AAPG member Elizabeth Hajek (she's the one with the baby), assistant professor for Penn State University, which finished second and won the Selley Cup at this year's IBA finals in Denver.

What makes her story so special is that Hajek, who was the team's faculty adviser, was also a member of the University of Wyoming IBA team when she was an undergraduate student.

Elizabeth Hajek (with her son Theo) with the Penn State University IBA team: (From left) Jacob Hagedorn, Scott Karduck, Tramond Baisden, Nathan Stevens and Gabriella Arroyo. Photo courtesy of Hajek.

Benefits of Experience

"When I participated, we had some trouble even getting to a place where we could begin data analysis," she said of that earlier experience.

"That taught me that logistical support, like lining up software packages, is essential to being able to spend your time actually doing the technical work IBA demands," she said. "As an adviser, I spent a lot of time trying to minimize technological barriers in order to help ensure that the team could focus their energy on the geoscience work."

Practically, that meant in late December 2014 she worked with Penn State's IT office to ensure software licenses were up-to-date and her team members had access to the right workstations and servers.

"We also started a few weeks before the datasets were released by practicing loading seismic data, well logs and doing all the basic analyses they were likely to need to do with the competition dataset (interpret faults and horizons, do petrophysical analysis, and build 1-D basin models, for example)," she said.

The students needed to be ready, too, to know their strengths and weaknesses.

"Most of our students hadn't done these things before, so I had them figure out how to do key tasks and make tutorials to teach their other team members," she said.

"Before the dataset was released, my goal was to make sure that every team member could handle data loading, seismic interpretation, well-log analysis, and basin modeling."

Forging a Team

Having gone through the process before, she had first-hand experience on what they could get out of the competition.

"My goal for the students was that they would leave this experience with the confidence that they could use their understanding of first-principles to tackle any task thrown at them in industry," said Hajek.

It was, in every sense, a team sport – by design.

"We didn't have a 'geophysicist,' a 'petrophysicist,' a 'stratigrapher,'" she said. "My hope was that by the end, ideally, each person on the team would be able to explain the process for each step, whether or not they actually did that work themselves."

To ensure this, leadership responsibilities were assigned based on students' interests (a balance of their experience and new things they wanted to learn). In addition, each task or topic (like basin modeling or petrophysics) got a primary and one or more secondary/support people taking responsibility for its completion.

It was unorthodox.

"I didn't lecture," she said. "(I) just hung out and helped re-direct or troubleshoot as necessary."

It worked.

"It was really amazing what they could do by the end of the contest – in many cases they were going from having no experience with something to performing at a level of someone who's taken a few industry classes to learn that skill," she said. "I just did my best to facilitate the process by making sure they had the resources they need to move forward to make decisions and prioritize work towards a final product."

Hajek said she marvels at the students involved: Scott Karduck, Tramond Baisden, Gabriella Arroyo, Jacob Hagedorn and

See **Hard Work**, page 37

New Offerings from AAPG Education

By SUSAN NASH, AAPG Director of Education and Professional Development

Looking for a silver lining in the midst of the "current economic reality"?

Imagine this: You are with a company that possesses both mature fields and shale operations.

Odds are, for at least four years during the shale revolution your mature fields have been neglected, or at least put on hold, as you did everything possible to keep up with the frenetic pace required by shale exploration and development.

But things have changed – and the dramatic collapse in oil prices have brought a dramatic shift in focus as well. Cutting costs and putting drilling plans on hold when possible have become the focus.

And now, more than ever, mature fields are suddenly providing new interest – and perhaps you've decided that new technologies and techniques first used in unconventionals can help optimize your reservoirs and recover what was previously considered unrecoverable.

And, in some cases, you're able to do it for less than $40 per barrel.

It's a thin silver lining, certainly – but it's real, and many companies are grabbing onto it and doing everything they can to mine old data, explore new ways to utilize the new techniques and technologies in mature fields.

But, what are the technologies that can be best applied to mature fields? And, which ones work best?

That's where AAPG education has been committed: bridging the gap and fast-tracking the transfer of knowledge, skills and expertise to apply it where it can do the most good.

The Proactive Response

To that end, the AAPG Education Department has expanded its range of offerings, including several new themed workshops and forum events.

Several focus on local and regional situations, and all are held in communities where it is easy for the local operators and technical experts to gather.

And, it's not just about geologists.

These events are focused on bringing together engineering, geophysics, geochemical, petrophysical and geological knowledge with a concrete goal to solve problems and to discuss the techniques and technologies that worked in revitalizing reservoirs, optimizing operations and improving profitability.

While many of the offerings have a face-to-face component (one, two or three days), they also are hybrid, with materials and interactivity available online after the event.

In addition to being interdisciplinary, AAPG is partnering with local societies such as the South Texas Geological Society, West Texas Geological Society, SPE (Oklahoma City), Pittsburgh Geological Society, Pittsburgh Association of Petroleum Geologists and Oklahoma City Geological Society to provide benefits to members and to increase the opportunities.

Here are some of the specific themes:

▸ Revitalizing Reservoirs – Two-day workshops that look at specific ways to boost production in mature fields, recover previously unrecoverable oil, efficiently complete horizontals that have been drilled but not completed, find bypassed or stranded pay, re-stimulate or apply new methods of enhanced recovery to pinpointed zones that are excellent candidates for significant, cost-efficient hydrocarbon production.

We're emphasizing engineering, geology, geophysics, geochemistry and petrophysics, and we're launching this series in August in Golden.

✓ Aug. 11-12: Golden, Colo.
✓ Dec. 1-2: San Antonio.
✓ Feb. 24-25: Midland, Texas.
✓ TBD: Pittsburgh.

▸ Reality-Based Reservoir Development – A one-day forum event that features hard-hitting, practical presentations and case studies designed to answer the following questions:

✓ What are "engineering realities" that geologists need to know? (Examples include issues about reservoir drive, how models are built, and drainage patterns.)

✓ What are the "geological realities" that engineers need to know? (Examples include issues about fracture characterization, mapping heterogeneity, pore architecture, lithologies, geochemistry.)

We are partnering with the Oklahoma City Chapter of the Society of Petroleum Engineers (SPE) to offer our first on Sept. 24.

These are just two examples, but they illustrate how AAPG is taking a proactive approach to solve real-world problems and take advantage of current opportunities.

We are also supporting the Division of Professional Affairs in their important Playmaker Forum series, as well as their Reserve Forum.

To assure maximum access, the events have extended early bird deadlines, offer discounts for members, and also significant discounts for students and geologists who have been laid off.

For details, go to our website at www.aapg.org/career/training.

Teamwork
from page 34

analyzing and interpreting.

You work that closely with anyone, even friends, of which the team was made, and there is bound to be tension.

There was.

"Since IBA competition emphasizes teamwork, the high intensity of workload would often result in different opinions among the team members," Ching said.

There were debates and disagreements – some heated – but the team always managed to muddle through it.

Or, as Ching put it, where they could "sit down as a team and discuss together whether the ideas proposed are reasonable and fit well within the story of our presentation."

Defining Moments

There comes a time in any competition, whether it's the IBA or the NBA, when the team knows it's on to something special. Ching said there were two things working in Royal Holloway's favor – two moments that stood out.

"The strongest point of our team," she said, "was our incredible bond together and being able to build confidence to speak in front of the crowd. From the start, we worked really well together as a team, although we come from different backgrounds.

"When we started off the project, different tasks were assigned, according to the individual's strength," she continued. "However, we rotated around for the tasks so everyone knew a bit of the others' work and had a bird's-eye view of the whole project."

There was something else, as well, something that any championship team talks about: Experience.

"Also, having presented twice in the Europe Region finals (in Prague, Czech Republic) in front of a full crowd helped to build up our confidence in public speaking, too."

Talking to Ching, you sense that the team placed extra emphasis on its presentation skills.

"The full adrenaline rush of presenting live in front of a full crowd of students and judges does make a huge difference," she said, "and was very helpful in preparing us for the finals in Denver."

In addition to Ching, the winning team members are Arran Waterman, Stuart Munro, Kimberley Dunn and Benjamin Said. Nicola Scarselli is the faculty adviser, and the team received strong emotional support from AAPG Europe Region president Keith Gerdes and the late Vlastimila Dvorakova, past Region president.

As for the award, Ching said the geology department will most likely use the winning funds as a foundation to improve the course for future graduate students.

It comes at a special time, too, because the department is celebrating a birthday of sorts: this year is the 30th anniversary of earth sciences at Royal Holloway and the 30th anniversary of the Master of Science program, which first started as sedimentary basin dynamics by Derek Blundell in 1985.

Ching said the winnings also would be allocated for some of the essentials of any geology department.

Hard Work
from page 35

Nathan Stevens.

"Oh man, they worked so hard!" she said, drawing out those last two words for emphasis. "They easily each put in 60 hours a week during the entire eight weeks – probably more like 80 by the end. "It's a ridiculous amount of time and effort.

"I also have to give our team credit for helping me out, too," Hajek added. "I had a baby in January, so my son, Theo, actually participated in many of our team meetings (he rested in a baby carrier as I bounced around the room trying to keep him content and sleeping). They were very generous about having a tiny helper around the lab!"

She knew the pitfalls, the frustrations.

"I warned them at the beginning that part of the experience is learning how to work with a team under pressure; that inevitably results in some friction," she said. "When you get five smart, creative, independent people (and me) mulling over a compelling dataset, you're bound to get a wide range of perspectives, and when you're exhausted from working long hours, it can be hard to keep a level head about the process.

"We definitely had some 'animated' discussions, shall we say!"

'Great Work Should Be Inspired'

You've read in other pieces about IBA and about the hard work and long hours, all of which Hajek experienced at Wyoming and as faculty adviser at Penn State.

But that isn't the whole story.

"It's also a good lesson (if not a heartbreaking one) about how much work never gets shown," Hajek said. "I think the hardest part of the contest is distilling down an indescribable amount of work into a 25 minute presentation. Literally, weeks worth of someone's effort will get condensed into two sentences on one slide – sometimes not shown at all. But that work has to be done; they couldn't have made sound decisions or given a convincing recommendations without all that work. There are no shortcuts."

In talking about her own experience with IBA as a student, she mentioned the invaluable help of past AAPG President Randi Martinsen, her mentor.

"Her enthusiasm was just so infectious, that I feel like we just kind of got swept along by her motivation. I don't remember Randi being 'tough' on us, but I definitely remember feeling pressure to do great work because she made it so clear how cool, exciting and important exploration is.

"I think that's the way it should be," she says, believing students should be inspired to do great work, not be bullied or pushed into it.

"Also, Randi's always modeled a 'pay it forward' mentality," she said, "so I'm glad to be able to take what I learned and help create valuable learning experiences for up-and-coming students."

In short, she said something you hope she'd say – and something you'd hope every faculty adviser would say about participating in IBA.

"I think any IBA participant, on any team anywhere, will agree that the value of the experience is hard won," she said, "and I doubt many in the midst of the contest would describe it as 'pleasant' or 'fun.'"

But then, if you're lucky, you get to pay it forward. And bring your baby to the award ceremony.

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.

Déjà Vu: Weald Exploration a Familiar Tale

By PETER WIGLEY

Geological investigations in the Weald area of southeast England have occurred for the past two centuries, but recently there has been a flurry of speculation, particularly in the popular press, over the possibility of the Weald basin becoming a major hydrocarbon province with billions of barrels of oil in place.

Over 120 years ago there was similar excitement concerning the discovery of natural gas at Heathfield, in the heart of the Weald.


WIGLEY

The first serious attempt to show the general structure of the Weald was by John Farey in 1806 – a manuscript copy of his 1807 geological section is reproduced in figure 2 (A-A').

The section follows the line of the London to Brighton toll road, and apparently was the result of "traveling notes" made during three coach journeys up and down the road. The section was drawn at a horizontal scale of one inch to a mile and can be accurately located from milestones shown on the section.

Farey clearly shows the anticlinal (his term was "strata-ridge") nature of the Weald and also the denudation of the Chalk and subsequent un-roofing of the anticline.

He also was the first geologist to demonstrate the importance of faults in the region. Although incorrect in some details, and given that Farey had no knowledge of the deep structure, the section is still a remarkable achievement.

However, Farey at that time was subjected to a number of scathing attacks from the geological establishment. Particularly, Robert Bakewell wrote in 1813:

"I confess I do not set a high value on this kind of 'stage-coach geology': It may account, however, for some extraordinary descriptions which have of late years been given to the public."

* * *

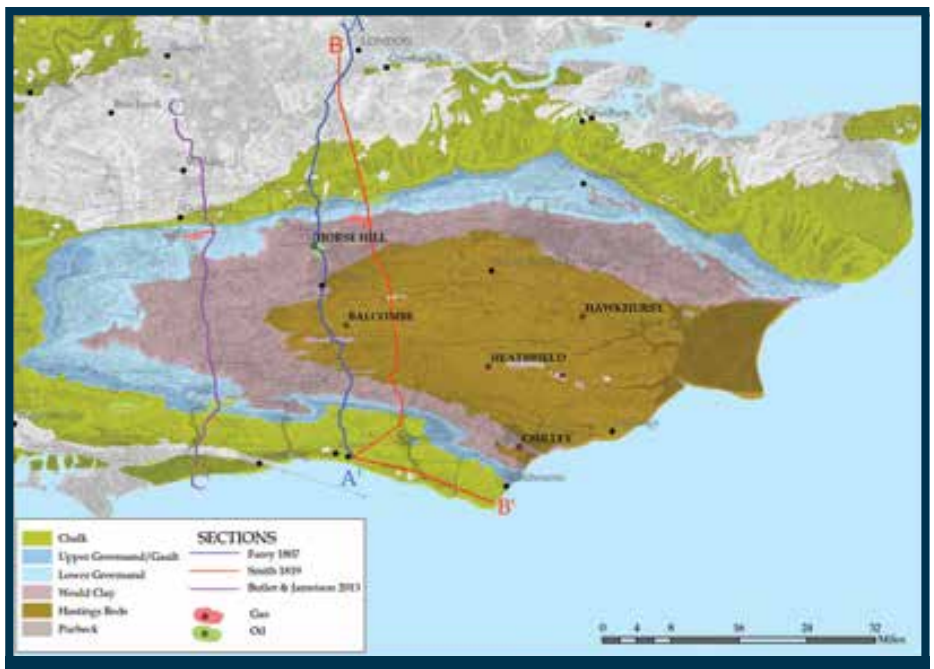


Figure 1 – Location map of the Weald area of southeastern UK showing oil and gas discoveries, geology and the locations of cross-sections given in figure 2.

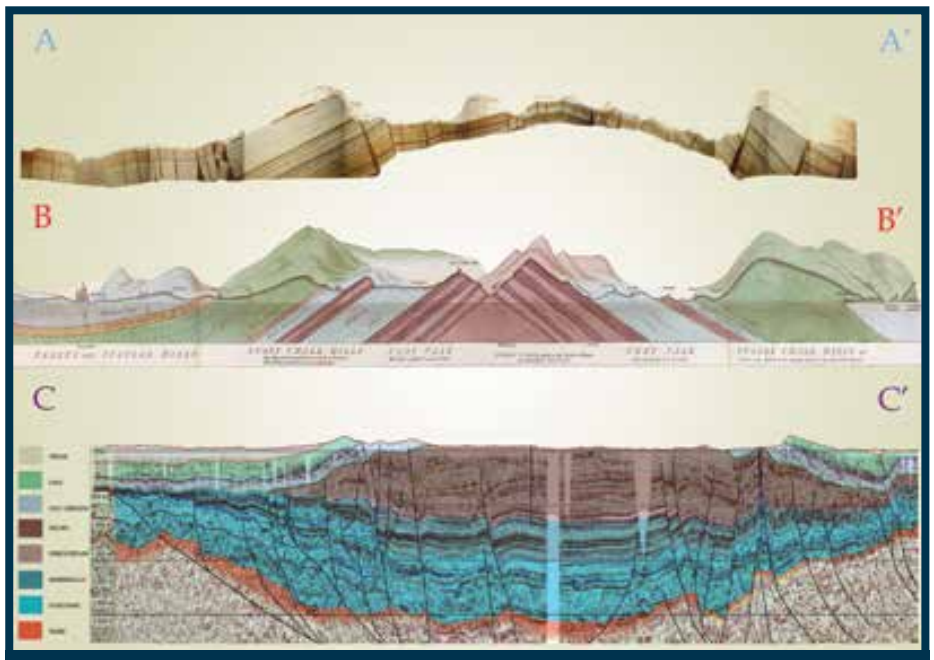


Figure 2 – Geological cross-sections of the Weald by John Farey, A-A' (1807), William Smith, B-B' (1819) and an interpreted composite seismic section modified from Butler and Jamieson, C-C' (2013). John Farey section courtesy of Hugh Torrens.

Farey was a pupil of the great William Smith and a decade after Farey's section Smith mapped the Weald, and in 1819 published a "Vertical Section of Surry [sic] dipping northward. Section in Sussex dipping southward."

Although Smith shows the anticlinal nature of the Weald, he would not have understood the reason for it. Unlike Farey, he was more concerned with the ordering of the strata and had little appreciation of the importance of faulting and structure.

Smith's problem with the Weald was that he was unaware of a thick section, which we now know to be of early Cretaceous age, between the base of the Gault and the top of the Jurassic. Elsewhere in the country he was used to the Gault resting directly upon his Purbeck and Portland rocks, and this led to his misinterpretation of Wealden sandstones and clays as Jurassic rather than Cretaceous.

Farey and Smith's early work was followed by more detailed studies; of note was that of Gideon Mantell, a medical doctor from Lewes.

Working in the central part of the Weald, Mantell suggested that the strata may be freshwater in origin, and he is renowned for the discovery of the dinosaur, Iguanodon (which was named by him).

Further work was conducted by a number of geological luminaries, including W.H. Fitton, Thomas Webster, Sir Roderick Murchison and Sir Charles Lyell.

The Geological Survey commenced work in the Weald in 1855. In 1875 William Topley incorporated its early work into the Memoir of the Geological Survey, titled "The Geology of the Weald."

Based on the results from later deep borings it became apparent that there was a considerable thickness of Mesozoic sediments in the Weald, and it was indeed a basin.

As a result of Alpine movements the basin was inverted and unroofed. The composite seismic section from AAPG member Malcolm Butler (UKOGL, 2013) shown in figure 2 (C-C') gives a good impression of the basin's structure.

Figure 3 – Location of the sub-Wealden exploration and Heathfield gas field. Purbeck beds (light blue) are exposed in the core of the anticline. The 1902 medal commemorated the natural gas discovery.

* * *

Mantell, writing in 1822, first described hydrocarbons in highly bituminous sandstone at Chilley near Pevensey; oil seeps were subsequently recorded at the same location.

In 1836, two laborers sinking a water well to the north at Hawkshurst encountered gas, which was ignited by a lantern – and, unfortunately, resulted in their deaths.

In 1872 a remarkable project, the Sub-Wealden Exploration – an academic endeavor funded by the scientific community, including Charles Darwin and family – was undertaken to discover what lay beneath the Weald's exposed strata.

The project had no stated commercial objective, although popular opinion was that it was intended to search for coal. Indeed, Godwin-Austen had previously suggested that Carboniferous Coal Measures may exist below the Weald.

The exploration committee had an enthusiastic and ever-optimistic secretary, Henry Willett, who documented the entire venture up to completion in 1877.

The bore site was near Netherfield in East Sussex (figure 3). Initial boring was done by the then-conventional percussive "jumper" method, but this was found to be too slow and laborious and was soon replaced by rotary diamond drilling, which was considerably faster and could produce good core.

After drilling a Purbeck section containing thick-bedded gypsum underlain by Portland sandstone, an extremely thick Kimmeridgian section was encountered. At 450 feet there were abundant oil shows from highly bituminous zones, which showed a paucity of fossils.

Due to drilling difficulties the initial bore was abandoned at 1,018 feet, and a new bore started nearby.

Oil and gas shows were again plentiful in the second bore, and at 1,640 feet there was a significant gas discharge and an explosion. All concerned were keen to progress through the Kimmeridge clay and to discover the Paleozoic floor.

This, alas, was not to be, as the Kimmeridge clay proved to be too thick and funds for continued drilling were unavailable.

At the time of the sub-Wealden exploration there was little interest in the oil and gas present in the Kimmeridge clay. However, today these historical indications, together with the recorded intercalated micritic limestones within the shales are extremely relevant to the possible existence of extensive unconventional resources in the Weald basin.

It was not until 1890 that the Paleozoic was reached by boring near Dover. Coal measures were encountered, which eventually led to the development of the concealed Kent coalfield.

A major issue today concerns the environmental impact of drilling – particularly hydraulic fracturing – in the Weald, which has been designated as an area of outstanding natural beauty.

At the time of the sub-Wealden exploration it was locally thought that the operation was intended to produce coal, and Henry Willett in his second Quarterly Report noted, "some persons already see in imagination, the beautiful country around Battle 'black' with grime and soot."

Continued on next page

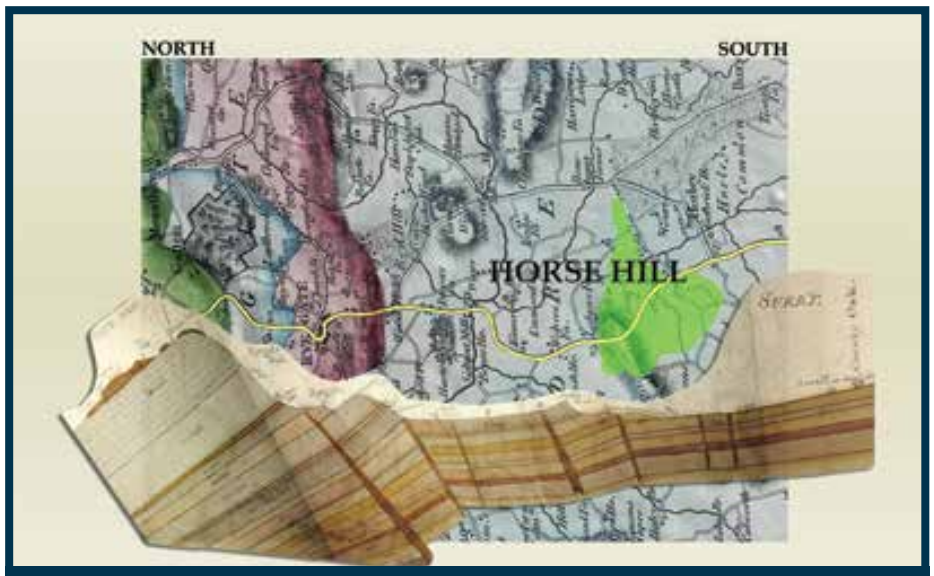


Figure 4 – Illustration of the Horse Hill oil discovery close to Gatwick Airport overlain on William Smith's 1819 Geological Map of Surry, together with part of John Farey's 1807 geological cross-section, which notes the location of Horse Hill on the London-Brighton toll road (yellow) between milestones 25 and 26.

Continued from previous page

* * *

Nearly 20 years after the sub-Wealden exploration an accidental gas discovery was made to the west at Heathfield (figure 3) during the drilling of a deep artesian well.

At 228 feet the foreman noticed that the drilling water in the well appeared to be "boiling." A candle lowered to investigate the phenomenon caused bubbling gas to ignite and flare out of the well.

A year later, another well sunk by the local railway company near the railway station again encountered gas, this time at 312 feet and the gas (produced at 1,000 cubic feet/day) was subsequently used to light the railway station and some 70-80 adjacent houses as well as supply power for several gas engines.

At this time a failed ruby miner named Richard Pearson appeared on the scene, and together with a number of American investors established Natural Gas Fields of England Ltd. in 1901, with Pearson being managing director.

With high hopes, the company drilled six more wells, which apparently all encountered gas, albeit in undisclosed quantities.

"Borings are now being made over some 200 square miles in the county of Sussex," Pearson wrote, "and the writer soon hopes to prove large supplies of gas throughout this territory."

A medal was struck in 1902 celebrating the Heathfield natural gas field, and Pearson negotiated with the railway company to lay pipe along its railway track to connect larger towns to the discovery.

Dreams of a huge discovery, however, were soon to fade; the company went into liquidation in 1904, and Pearson then went on to float South Australian Petroleum Fields Ltd. and try his luck in Australia.

Even so, rumors of a significant Wealden gas belt persisted into the 1930s. A small number of wells were drilled in the Weald both before and immediately after World War II. Although some oil and gas was found, it was considered to be non-commercial.

An interesting aside to the Heathfield gas story is that early accounts of the discovery written in Nature and the Quarterly Journal of the Geological Society of London were by Charles Dawson, who later was to "discover" the remains of Piltdown man, an evolutionary missing link between man and apes.

The discovery was subsequently proved to be possibly the greatest hoax in the history of science – and Charles Dawson remains the prime suspect.

* * *

Following the 1973 OPEC oil embargo there was a sharp rise in onshore UK exploration – including the Weald basin, which reached a peak in 1986 when 26 wells were drilled.

Discoveries, mostly in the Jurassic, were made, but were generally small.

Recently, however, amid the heated debate on the merits of hydraulic fracturing in the United Kingdom, there has been renewed commercial interest in the Weald; the operator of the Balcombe-2 well has targeted micrites within the Kimmeridge Clay, and has confirmed the presence of hydrocarbons.

Most recently, a well drilled north of Gatwick Airport at Horse Hill was reported to have discovered 14-22 MMBO in a conventional Portland sandstone play, and 115 MMBO from naturally fractured hybrid micrites reservoirs within a thick Kimmeridge Clay sequence.

This has given rise to great excitement in the press with talk of the so-called "Gatwick Gusher."

A recent British Geological Survey report on resource estimation of Jurassic shales, however, is less optimistic. BGS estimates that all Jurassic shales in the Weald contain between 2.2 and 8.6 billion barrels of oil in place. A realistic evaluation of shale-oil resources probably will be achievable only after extensive drilling and testing.

The source of gas in the Weald basin is problematic; it is generally thought that Jurassic shales are not mature enough to be within the dry-gas window. Gas present may have been coeval with oil generated within the oil window, then exsolved at shallow depth after uplift.

Alternatively, the gas may have come from deeper sources.

In oil and gas exploration, as indeed in many aspects of modern-day life, there are always analogies and valuable lessons to be learned from history.

(Editor's note: AAPG member Peter Wigley has a bachelor's degree in geology and a doctorate in carbonate sedimentology from University College London. In 1973 he joined ERICO and worked on numerous projects in the North Sea, Africa, Middle East and Southeast Asia. In 1995 he helped start Lynx Information Systems, of which he currently is a non-executive director. He is a board member of AAPG Datapages and the director of the Datapages DEO-GIS Project. He is the editor of the WILLIAM SMITH'S MAPS-Interactive website at www.strata-smith.com.)

The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer. This month's column deals with staged stochastic inversion for structural mapping and 3-D property inversion.

Uncertainty? 'Staged' Inversion to the Rescue

By ARNAUD HUCK, AYRAT SIRAZHIEV, RICHARD HUIS in't VELD, ANDRIES K.T. WEVER and CLAIRE PIERARD

This month's column starts with a staged stochastic inversion scheme that was applied in a southern North Sea Carboniferous setting.

The objective was:

- To understand the seismic character as function of sub-cropping, fluid-fill, net-over-gross, tuning and over- and underburden effects.
- To map key horizons, including certainty quantification.
- To characterize the reservoir in terms of properties.

The result:

Whereas fluid-induced seismic features known from seismic observations could not be reproduced with modeling, the inverted properties do respond to reservoir sections as proven by well data.

* * *

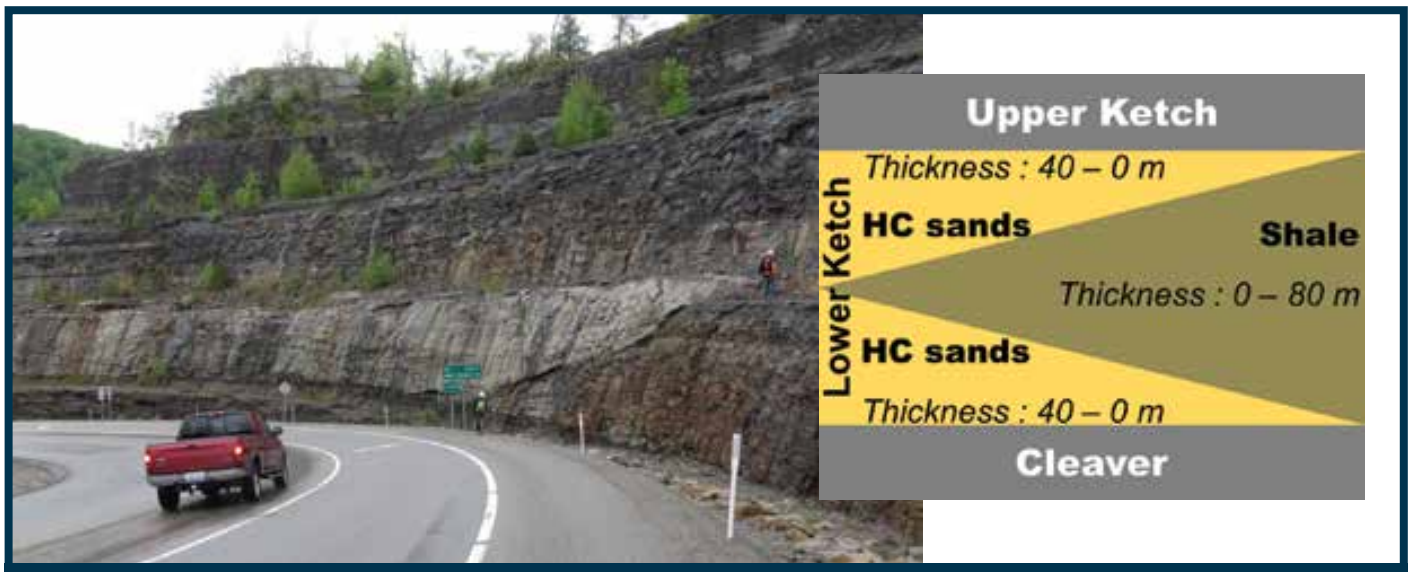


Figure 1 – Carboniferous outcrop example from Kentucky (USA) showing the abrupt delimitation of a channel body in background shales (left), and synthetic modelling such feature by using a shale-wedge in-between two sand bodies (right). Synthetic results for this model are presented in figure 2.


HUCK


SIRAZHIEV


VELD


WEVER


PIERARD

Characterizing Westphalian reservoir sections of the Carboniferous Fairway in the southern North Sea – with geographic extend from the Dutch D-blocks into the UK Quad 44 – is and always has been challenging due to limited seismic data quality at this depth of investigation.

As the reservoirs themselves are virtually transparent on seismic data, in most cases the actual reservoir definition is based on geologic constructions using mapped horizons shallower and deeper in the section.

Also, their fluvial nature causes internal inhomogeneity hard to capture in deterministic property models.

To complement established approaches, a more quantitative route was pursued for both the actual mapping of horizons, including uncertainty quantification, as well as characterization of the reservoir interval in terms of reservoir quality.

To this end, a series of inversion-related studies were initiated focusing on the Wingate gas field.

This column presents results of one of such studies.

Geologic Setting

The fluvial Ketch and Murdoch Formations of late Westphalian C and early Westphalian B age, respectively, build the typical reservoirs for gas production in the Carboniferous Fairway in the southern North Sea.

The best reservoir qualities in these are formed by stacked channel sandstones, which have limited lateral extent and connectivity, as visualized by analog outcrops (figure 1).

Between the Ketch and Murdoch Formations lie the Cleaver and Westoe Formations. Sedimentologically, the Cleaver is an alternating shale-sand sequence with hardly any coal, whereas the Westoe coal formation has significant coal content.

The Murdoch sandstone itself is part of and the top-section of the Caister coal formation. Both the Westoe and Caister coal formations show distinct seismic character due to low-impedance coal streaks interbedded in the background shale.

In 3-D structural terms, the Carboniferous section is split by multiple orientations of faults, each with separate (re-)activation history.

As the coal layers causing the distinct seismic character for the Westoe and Caister formations exhibit truncation, splitting and merging, reliably tracking the correct "regional" marker is not trivial. In cases where the Westoe Coal formation has been eroded, a realistic risk exists of misinterpreting the actual Top Caister Coal formation erroneously as Top Westoe.

Lastly, as the gross package thicknesses changes laterally and well-control is sparse, constructing the reservoir intervals as described by J.J. Lynch in his 2004 submission to the Geological Society ("Visualization and Interpretation of 3-D Seismic in the Carboniferous of the UK Southern North Sea") can be misleading, albeit the only proven method.

Seismic Challenges

Because the Westphalian reservoir sections are virtually transparent against the background shales, the proven method is to map regionally consistent events, and to construct the reservoir sections through geologic modeling as Lynch described.

Moreover, extensive forward modeling shows non-stationarity of the top-Ketch and top-Cleaver picks, primarily depending on the net-over-gross and potential coal content in relation to

Continued on next page

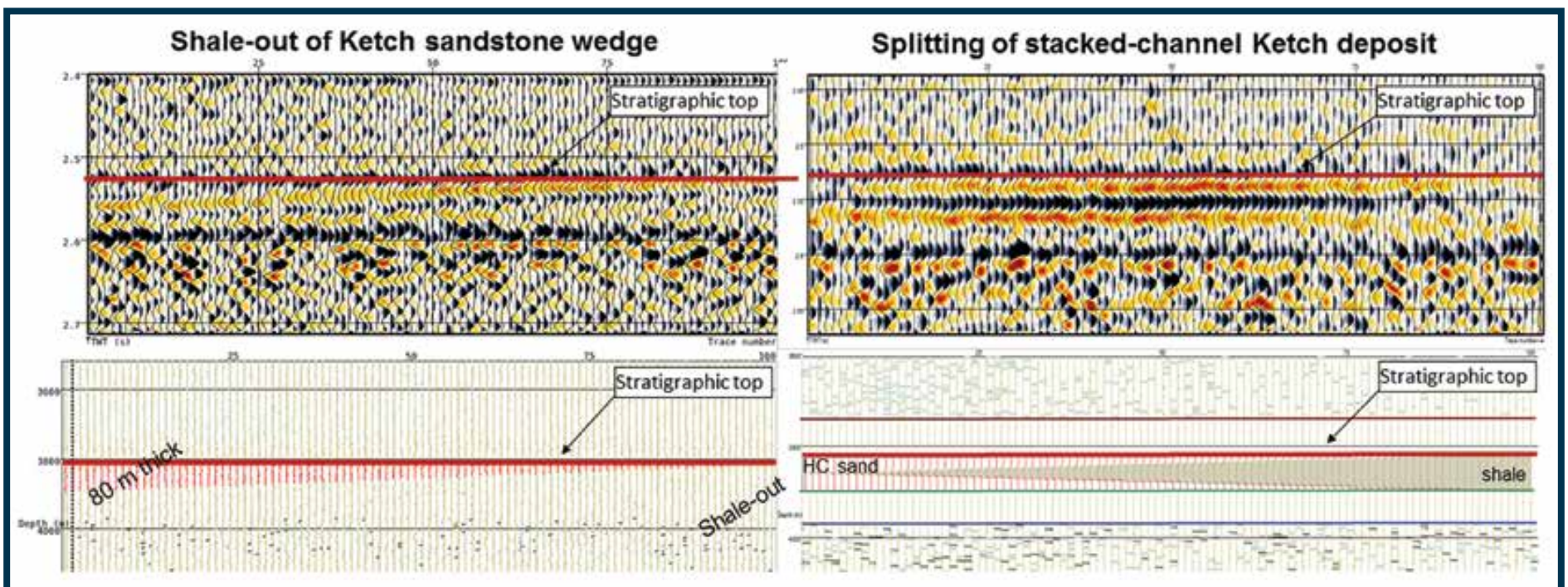


Figure 2 – Synthetic seismic modeling result for analog outcrop derived models. Pseudo-wells representing an extended definition of the rock-physical framework have been used to construct these displays. Left, the continuous shale-out of a single sandstone wedge is modelled. Right, the demerging of a stacked-channel sequence is modelled according to the model from figure 1. Note the indicated stratigraphic tops on the seismic display, and the non-stationarity of the associated seismic pick.

Continued from previous page

tuning, causing any mapping to carry a degree of ambiguity (figure 2).

Despite the fact that seismic features related to fluid-induced effects are observed in the area, it has not yet been possible to validate this under modeled conditions.

Staged Stochastic Inversion

In conventional stochastic inversion, a range of viable target properties is predicted by varying the input model and testing the result against measured seismic.

In this situation however, although well log data showed that both input model (pseudo-log properties) and target properties (porosity, sand content) can be quite similar for the various Carboniferous reservoirs, actual reservoir behavior in terms of production can be considerably different.

Therefore the conventional inversion was modified such as to first invert for the geologic formation, validate its viability, and only then to invert for reservoir properties. This has two advantages:

- First, probability volumes for the presence of a certain geologic formation are created, together with associated Top Formation presence and certainty maps, which constitutes a fully automated and human-bias free interpretation.
- Second, after validating and fixing the geologic formation, the actual target property inversion can be executed with the input model specific for that unit, also considering additional constraints.

This "staged" inversion concept was implemented in the OpendTect stochastic HitCube inversion. Conventional HitCube inversion consists of two major steps: stochastic pseudo-well modeling and synthetic to seismic matching described in Ayeni, Huck and de Groot's 2008 First Break article, "Extending reservoir property prediction with pseudo-wells."

The first step starts with building the model (sedimentological) framework based on the well data with stochastic definition of thicknesses and rock properties. In this case, thicknesses are taken from well-control while considering analog outcrop understandings (figure 1). The properties include those required for forward seismic modeling and any others of interest, such as porosity or coded lithology. They can be drawn from normal or uniform distributions derived from well log data, or defined as constants, linked through formulas, or through functions.

This modeling is followed by the generation of a large number of pseudo-wells, which represent possible geological scenarios not necessarily encountered by actual wells, and which are spatially unaware.

For these pseudo-wells, corresponding synthetic seismic traces are computed.

The second step is the inversion itself. Performed trace-by-trace, the matching process ranks pseudo-wells at each trace location based on the similarity between the synthetic and measured seismograms within a selected time window along a provided seismic horizon.

Thereafter, a user-defined number of pseudo-wells are combined to output a statistical estimate of the modeled properties – for example, average and standard deviation of porosity or probability of each lithology.

The "Staged" HitCube inversion as deployed on this project for stochastic mapping and characterization of the intra-Carboniferous extends the conventional implementation on the following points:

- First, as the Westphalian sequence is angularly truncated by the Base Permain Unconformity with Silverpit Formation on-top, the pseudo-well modeling had to focus on a 150-900-meter thick interval, which is rather large comparing to previous HitCube studies, such as a 4-D Hit Cube for seismic inversion in the North Sea's Blake Field.

The framework model consisted of target Ketch and Caister units together with sufficient over- and underburden. Pseudo-wells were generated by gradually removing units below Silverpit to simulate this sub-cropping pattern.

To adequately capture the associated variability of the geologic as well as the rock-physical frame, a total of 7000 pseudo-wells were input to the conventional HitCube inversion along the Base Zechstein seismic horizon within [-24,350] ms window to produce formation probability volumes based on 100 best models, as well as (maps of) the probability interface, i.e. fully automated and human-bias free interpretations of the intra-Carboniferous formations (such as displayed in figure 3).

This first extension enables the validation of derived geologic scenarios.

- Second, porosity (figure 4) and lithology were predicted using a second and modified HitCube iteration.

The Base Zechstein to Top Caister interval was subdivided into seven chunks of 150-meter bin width with 50-meter overlap, based on its thickness, using additional (manual) interpretation. Sets of around 5,000 pseudo-wells were created for each chunk satisfying the thickness constraints.

A two-stage HitCube inversion was run for each chunk separately. One hundred models that have the best match in a [-24, 350-meter] time gate around Base Zechstein were selected first. Then, on a sample-by-sample basis, a local waveform match in a [-24, 24] ms window was computed.

Only the realizations exceeding such local fit above 0.65 correlations were kept to produce probabilistic results such as displayed in figure 4. Thus, the thickness constraint and the long gate matching ensured selection of geologically reasonable models, while the local matching passed only those parts of these models that locally matched the measured seismic.

Statistical estimates of lithology and porosity were generated using the modified HitCube inversion.

Results

Because of the large number of pseudo-wells used during the two inversion cycles, possible geologic scenarios and rock-physical properties beyond actual well control were captured, analyzed in 2-D gathers (such as figures 1 and 2) and verified against actual seismic. The ultimate product of this is the fully automated and human-bias free interpretation for Top Caister, for which the probability volume is displayed in figure 3.

Although its reliability, of course, is dependent upon the input seismic quality, on a detailed level it does suggest viable 3-D geologic configurations that probably would be rejected by a (human) interpreter.

It should be noted, though, that sufficiently "under-burden" should be captured to generate sufficiently long synthetic-to-seismic correlation length in the matching process. The "false-positive" indicated in figure 3 with arrow A is believed to find its nature in this.

As reservoir property distributions in this part of the Carboniferous are quite tight (typical porosity range is between 9 and 15 percent), the sensitivity of inversion-based output properties proves quite dependent on the input seismic quality.

An example section through the inverted porosity volume is displayed in figure 4: Indicated with B is a porosity lineament that corresponds to good-quality sandstone as proven by well data.

The very local high-porosity feature at C and associated lower-porosity streaks to the left were also confirmed by drilling.

Directly to the right of C, the result seems to be affected by data-quality and not related to geology.

Conclusions

The "staged" stochastic inversion implemented in a modified HitCube scheme is capable of producing results that can help the seismic interpreter with understanding of the seismic beyond actual well-control.

As such, it complements the proven conventional approach outlined by Lynch in a more quantitative manner and allows us to better understand the uncertainty of the 3-D structural configuration.

* * *

The authors thank the partners of the Wingate consortium (Wintershall, Gazprom, XTO UK, Gas-Union) for kindly allowing permission to publish this work, and to WINZ management for their support. This project never would have materialized without Christian Hanitzsch and Frank van den Bos.

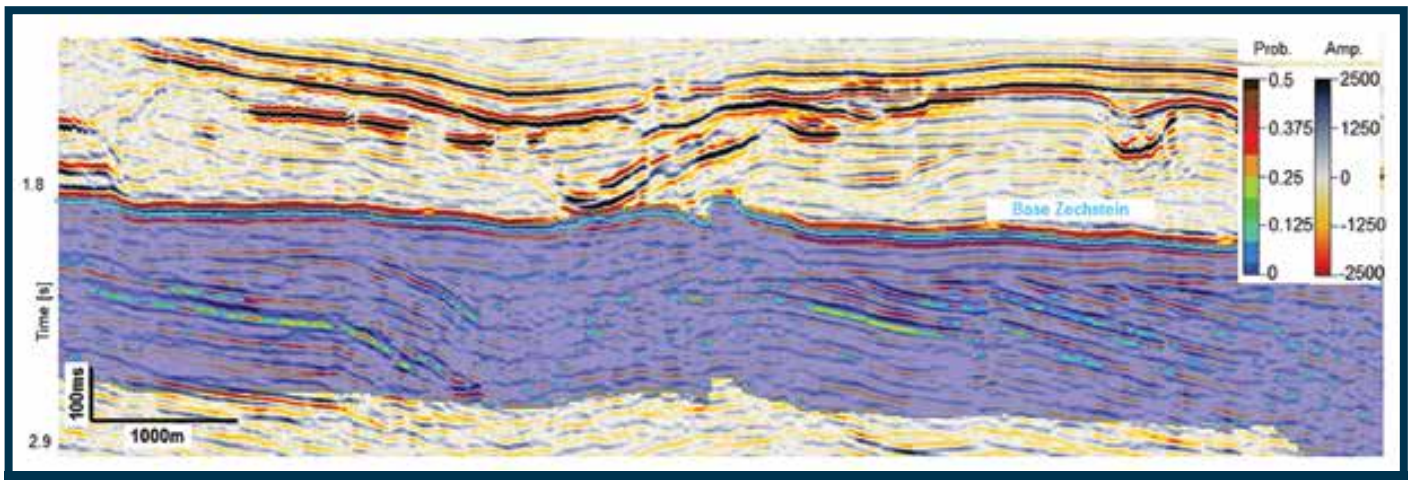


Figure 3 – Top Caister probability volume, as the interface between the Westoe and Caister Formation probability volumes, displayed on top of seismic data. The detected Top Caister (green to red color indicates high probability of being there) matches interpretations (not displayed) relatively well, provided seismic data is at least reasonable. In the left of the image, detection is very good. Indicated with A is a "false positive," likely due to insufficient under-burden in the pseudo-well population.

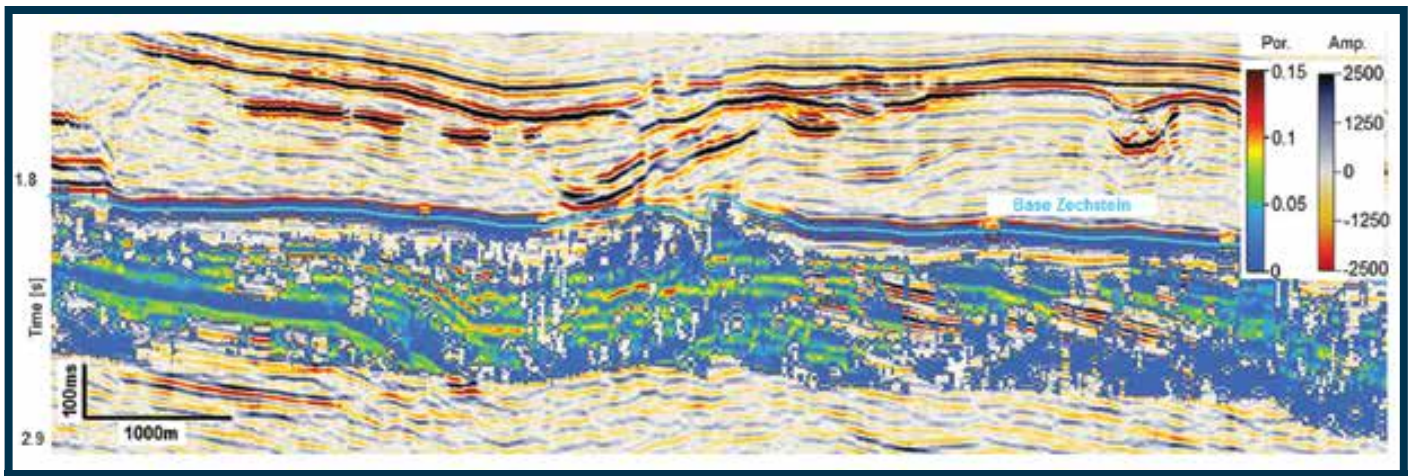


Figure 4 – HitCube inverted porosity; yellow/red indicates high porosities. The porosity streak at B was validated by well data. Feature C was proven to be a localized stacked channel complex, shaling-out to the left, hence the weaker response there.

Edith Allison, director of AAPG's Geoscience and Energy Office in Washington, D.C., can be contacted at eallison@aapg.org; or by telephone at 1-202-643-6533.

Forecast is Good for Water Supplies

By EDITH ALLISON, Geoscience and Energy Policy Office Director

There's been a lot of good news recently about water and hydraulic fracturing.

▶ The Environmental Protection Agency (EPA) recently released a major study finding no instances of water contamination by the hydraulic fracturing process – and only rare instances of groundwater impacts from the broader elements of oil and gas development.

▶ EPA's and other scientists' research into water consumption for hydraulic fracturing found minimal strain on water resources.

▶ Finally, natural gas power generation, which has surged because of the growth in hydraulic fracturing, significantly reduces water use in power generation.

The EPA draft report, "Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources," is essentially a 998-page literature review of the full lifecycle of water involved in hydraulic fracturing, from water acquisition to wastewater disposal.

The report does identify numerous potential situations where drinking water contamination could occur, but identifies only a small number of instances of contaminated drinking water wells caused by surface spills of hydraulic fracturing fluid, or flowback or produced water.

To put this in perspective, EPA tallied 25,000 to 30,000 hydraulically fractured wells per year from 2011 to 2014.

A major complaint by the environmental community is that the study conclusions are unjustified because of a lack of data due to industry's refusal to participate in longitudinal studies. However, EPA states that it has a cooperative relationship with industry.


ALLISON

Water consumption has attracted public concern as population growth, increasing agricultural requirements or drought strain available water supplies.

At the same time, other environmentalists complain that the energy industry was too involved – even to the point of controlling the study.

* * *

Water consumption has attracted public concern as population growth, increasing agricultural requirements or drought strain available water supplies.

The U.S. Geological Survey, in an analysis of well data from 2000-14, reported that hydraulic fracturing of the average horizontal oil well used slightly more than four million gallons of water. Horizontal gas wells averaged about 5.1 million gallons.

Actual water consumption for a particular well varies based on factors including the rock properties, the length of the horizontal leg, the number of separate fracturing stages and the composition of the fracturing fluid.

Water used in hydraulic fracturing can come from surface waters, groundwater aquifers or recycled wastewater. Decisions on water acquisition depend on locally available sources – transporting water is expensive. Generally, surface water is the major source in the eastern United States, and groundwater is used in western states with little available surface water.

Texas hydrologists report that surface and groundwater each supply about half of water used for hydraulic fracturing of the Barnett shale around Dallas-Fort Worth; reuse/recycling provides about 5 percent and brackish water is 3 percent of waters used to stimulate the Barnett shale.

How much of a strain this use places on other water users depends to a large part on the population density, the agricultural or industrial demand for water, and the available water volume.

For example, the EPA conducted case studies of water use in Pennsylvania's Susquehanna River basin, where they found that water management prevents overuse and minimizes risks to individual sources. In the Marcellus shale area, which includes the Susquehanna River basin, essentially all produced water is reused – but that makes

See **EPA Studies**, page 47

Register Now for Geo-Congressional Visits Day

AAPG and other geoscience societies – including the American Geophysical Union and American Geosciences Institute – are once again arranging congressional visits this fall for our members.

This year's event will be held Sept. 29-30 – and it could be your opportunity to be part of the teams that will be meeting and talking with elected officials and their staffs in Washington, D.C.

The registration deadline is Aug. 31.

This year you can expect especially useful and informative meetings, because legislators will not be distracted by election year activities.

Also, the proposed reauthorization of America COMPETES Act, which cuts funding for geoscience research at the National Science Foundation, has stimulated interest in geoscience research and its benefits.

To participate, see the announcement and registration form at the AAPG Washington, D.C., office website, or contact Edith Allison, director of AAPG's Geoscience and Energy Office, at (202) 643-6533; or email, eallison@aapg.org.

PROTRACKS

YP Participation Soars in Mid-Continent Section

By DREW KREMAN and JOE VOYLES


KREMAN


VOYLES

Recently the AAPG YP Mid-Continent Section hosted several networking events in Oklahoma City, intended to grow membership in AAPG – particularly among young professionals entering the energy workforce.

Over the past year and a half, the Mid-Continent Section has held or collaborated on several networking events, including golf tournaments, multidisciplinary forums and local social gatherings among young professionals in the OKC metro.

These events have increased YP interest in AAPG – and participation in the Mid-Continent Section is at an all time high.

Some of the highlights include:

▸ Due to the success of the "Switch" movie screening in March 2013, we decided to host a golf tournament sponsored by Baker Hughes the following September.

The tournament was held at a local golf course in OKC where YPs were paired with seasoned industry professionals, creating a great opportunity for YPs starting out in the industry to mingle with more experienced oil and gas veterans.

The event was highly regarded, and requests for a similar outing were received from YPs and industry professionals alike. With generous funding from both AAPG and Baker Hughes, door prizes and fashionable AAPG YP hats were given to all participants.

▸ During the summer of 2013, OKC Young Professionals in Energy (YPE) hosted the first ever Energy Forum in Oklahoma City specifically for young professionals – a joint effort involving most of the professional organizations in the city; the Oklahoma Young Professionals Energy Forum is "one of the first multidisciplinary events uniting the people who build the future of Oklahoma's energy industry."

After witnessing the great turnout of the event, the AAPG YP Mid-Continent Section decided to collaborate on future forums by having an AAPG YP on the 2014 and the current 2015 planning committee boards. This event is now held each year and has attracted over 400 YPs, interns, and students, who, over the course of the afternoon, listen to panel discussions, visit the vendor exhibition hall, and attend speaker presentations.

▸ The Mid-Continent Section's next event was a networking social held in downtown OKC. This event utilized a "fishbowl" approach to identify YPs or geoscientists interested in AAPG membership and YP committee involvement. Thanks to our generous sponsors, including Toledo Mudlogging and Baker Hughes, the event was catered and included live music from a local OKC musician.

This event was a success with over 70 YPs and students from over 10 companies in the OKC metro. Over 20 YPs were interested in serving on an AAPG committee.

▸ Our first summer of 2015 event was held in June at the Main Event in OKC, is a networking event where YPs mingled while playing video games, laser tag and bowling – or just grabbed a bite to eat.

▸ Finally, and most recently, the 2015 YP Energy Forum was held July 23.

Based on the recent success of Mid-Continent YP networking events, we expected this to be a great event.

Recipients Announced for Military Veterans Scholarship

By APRIL STUART, AAPG Foundation Program Coordinator

The AAPG Foundation has announced the first recipients of the financial aid through its new U.S. Military Veterans Scholarship Program.

Ten veterans who are returning to school to pursue a geosciences education will be receiving $2,000 scholarships to help support them and their families in their efforts to transition to life beyond the military.

With this support, Foundation leadership is hoping the veteran students will be better able to complete geology degrees less encumbered by the financial burden of tuition, which often leads veterans and civilians alike to stall on their studies or pass over opportunities to finish their degrees.

As one can imagine, undergraduate veterans interested in geology are poised to excel in the subject, as their skillsets translate easily to hands-on, applied careers in the geosciences. Veterans possess character traits that lend themselves to the industry, including a strong sense of mission, adaptability, resiliency and leadership.

All of those qualities not only make them excellent candidates to finish degree programs, but also excellent employees upon program completion.

The MVSP Committee, chaired by retired Air Force Lt. Col. and AAPG Foundation Trustee Associate Don O'Nesky, announced that $20,000 in scholarship funds would be given to the 10 veterans in 2015. O'Nesky guided a selection committee of volunteers in its first year and reflected positively on the experience.

"Working with the MVSP in its inaugural year and reading the applications we received gave me faith in this young generation. They are outstanding young men and women," he said. "One thing stood out in letters of recommendation by professors and military supervisors, and that is these young warriors were the leaders in their classes and in their military units."

The 2015 MVSP Committee included AAPG members Heather Anderson, Rick Fritz, Jesse Gilman, Meg Kremer, Matt McKay, Clint Moore, Carl Smith and Earl Wells.

This year the committee spent significant time scoring many outstanding applications. O'Nesky's leadership paved a smooth course for this first-time process, as did the generously gifted time and talents invested by the committee members.

Time to Grow

The depth of gratitude felt by participating veterans is best summarized in the words of U.S. Army Specialist James Campbell:

"It is with great thanks that I accept this scholarship as part of the 2015 U.S. Military Veterans Scholarship Program. To invest in military veterans is the safest bet one can ever make. We are the hardest working and most driven individuals who succeed at anything we put our mind to. Your willingness to extend a little help along the way to a college education is a commendable act that will only motivate me further toward my goals."

"I know that once I have earned my degree and have entered the professional community of the earth sciences that I will make a significant contribution to this pioneering sector of our society. It is abundantly clear that energy and natural resource exploration and management will drive future economies and I can't wait to be part of that prosperous future."

U.S. Army Specialist James Campbell, a recipient of the AAPG Foundation's Military Veterans Scholarship. Photo courtesy of Campbell.

O'Nesky is hopeful that others will consider making a contribution to help expand this valuable program.

"There are more outstanding applicants than we had funds to support," he said. "We need to grow this fund so I would encourage members and companies to contribute to the AAPG Foundation MVSP. Yes, 'companies' – the future employers of these outstanding young men and women."

Every dollar counts. A gift of $50,000 will enable the Foundation to annually award a $2,000 scholarship named on your behalf to a veteran in need for years to come.

Contact the Foundation to learn more about how you can help support this valuable program at (918) 560-2664 or foundation@aapg.org.

The AAPG Foundation is proud to announce the 2015 U.S. Military Veterans Scholarship Program Recipients

James Campbell, Spc., Army, University of Massachusetts Amherst
Hagan Hunter, Lance Cpl., USMC, University of Oklahoma
Calvin Johnson, Lance Cpl., USMC, New Mexico State University
Mark Leung, Sgt., USMC, California Lutheran University
Steven Marshall, Staff Sgt., Army, Miami University
Ryan Rosol, Seaman, Navy, University of Oklahoma
Lukas Smith, Spc., Army, Western Illinois University
Jeffrey Snowden, Sgt., Army, Midwestern State University
Skyler St. John, Spc., Army Oklahoma State University
Wesley Weisberg, AWO2, Navy, Missouri State University

We are grateful for the efforts of the U.S. Military Veterans Scholarship Program (MVSP) Committee for donating their time and talents to select this year's award recipients:

MVSP Committee Chairman: **Don O'Nesky**, Lt. Col., USAF, Retired
MVSP Committee Members:
Heather Anderson, Rick Fritz, Jesse Gilman, Meg Kremer, Matt McKay, Clint Moore, Carl Smith, Earl Wells

This year the number of veterans seeking support through this program was 500 percent greater than the number of scholarships we were able to award. The need is there. Help us raise funds for this worthy cause. Learn more about how you can support the Military Veterans Scholarship Program today.

foundation.aapg.org/programs/military.cfm **+1 918 560 2664** **foundation@aapg.org**

Foundation Contributions for June 2015

General Fund
Najib Abusalbi
Barry W. Acomb
Audrey W. Adams
Matthew D. Adams
Richard Leroy Adams
Larry F. Adamson
Mustajab Ahmad
Beth Ann Aldrich
David L. Allin
Joel R. Alnes
Amazon Smile Foundation
Willis F. Ammentorp
George A. Anderson III
Thornton E. Anderson
Kunio Arai
Karl F. Arleth
Michael Ashton
George A. Ball Jr.
David W. Ballard
Attila Bartha
Paul M. Basinski
John E. Battie
Gerald R. Baum
Alfred E. Bence
Timothy J. Bennett
Paul E. Bergum
Arthur E. Berman
Maurice N. Birdwell
Richard S. Bishop
Peter E. Blau
Douglas Bleakly
James E. Blumthal
John D. Boldock
Max L. Bordenave
Annette H. Borkowski
Louis C. Bortz
In memory of Wililam R. "Bill" Sacrison and Thomas L. "Tommy" Thompson
William P. Bosworth
Todd G. Bown
Nicholas G.K. Boyd III
Jason F. Brand
Donald A. Brice
Charles A. Brinkley
Samuel B. Bristow
Michael D. Brondos
Alex S. Broun
Martha Lou Broussard
Alan L. Brown
Ian T. Brown
Arthur C. Brunton
Bjorn K. Bryn
Donald E. Burch Jr.
Heinz M. Burgisser
Earl P. Burke Jr.
Glenn P. Burke
D. Gregory Cable
Nick Cameron
Ted Cammarata
Frederick J. Campen Jr.
Don F. Carlos
Kenneth W. Carlson
Matthew B. Carr
Larry S. Carter
Scott E. Caswell
Paul D. Cate
Guillaume Caumon
Steven L. Charbonneau
Dongqing Chen
Chevron Matching Employee Fund
Matching a gift given by Noelle Schoellkopf, Robert Burnett, James Swartz, Rafael Esteban Ramirez
Serafinoff
D.V. Chitale
Richard Chuchla
John McRae Colvin Jr.
Jack Conklin
Douglas H. Cook
Gerald R. Costigan
John E. Cramer
Jennifer R. Crews
Joseph W. Cross
David Curtiss
Alex J. Dale
Laurence A. Dale
Ali Dalir
Graham R. Davies
Drew Davis
Anthony E. De La Sota
Henry C. Dean Jr.
Thomas M. Deeter
Daniel F. Doolittle
Kenneth T. Dorbandt
Garnett M. Dow
Verne E. Dow
Mary E. Dowse
David Drover
Louise A. Duffield
William F. Dula Jr.
Joseph P. Dumesnil
Pierre-Orly Dupont
Byron F. Dyer
George K. Edgerton
Grant W. Eisner
Graham Eldridge
Andreia R. Dias Elias
Leo B. Elliott Jr.
Christopher Ellis
William J. Emerson
Joel S. Empie
Frank G. Ethridge
Tristan Euzen
George H. Evans
Steven R. Fekete
Michael J. Ferguson
Robert T. Fetters Jr.
Scott Field
Robert J. Finley
William R. Finley
Gerald G. Forney
Robert E. Fox
Christopher D. Franks
Matthew J. Franks
Danielle Frerich
Larry P. Friend
Earl E. Gaertner
Arthur J. Garden
Douglas A.C. Gardner
Hongxing Ge
Matthew D. Gentry
Lee C. Gerhard
Matthew Gilbert
Melvyn R. Giles
William E. Gipson
David B. Givens
John C. Goss
Timothy C. Grant
Gerhard E. Greiner
David G. Griffin
Jack S. Grow
Edmund R. Gustason
Jose I. Guzman
Mark L. Hales
Gerald E. Harrington
Ayelet B. Harris
David W. Harris
Joe W. Harris
H. Lee Harvard
Jeffrey W. Harwell
Robert D. Hatcher Jr.
Donald E. Hattin
Michael D. Hayes
Steven Hayes
Edward W. Heath
Philippe E. Heer
David R. Henderson
Paul C. Henshaw Jr.
Janet M. Heppard
Philip D. Heppard
Frank C. Hernandez
Mendoza Jose J. Hernandez
Alan P. Heward
Michael Hickman
Debra K. Higley
John C. Hilburn
Steve H. Hill
Gregory S. Hinds
G. Warfield Hobbs
Simon Horan
Philip Hosemann
Kazuyoshi Hoshi
Leigh S. House
Thomas B. Howes
Tanya L. Inks
Joseph M. Jensen
Donnald E. Johnson
Robert K. Johnson
Tony Jolly
Larry L. Jones
John E. Jordan Jr.
Sean Jurkis
William K. Keag
Allen L. Kelley
John E. Kelly
Roy C. Kepferle
Sean Kimiagar
Camille and Francis King
Charles S. King
Kevin C. King
Gary L. Kornegay
Gary R. Kowalczyk
Christopher M. Kravits
Ronald D. Kreisa
Joseph W. Kulik
John H. Lake
Charles W. Landmesser
Donald W. Lane
Gregory M. Larberg
Inger Laursen
Stephen R. Lawrence
Donald C. Le Van
Henry M. Lieberman
William B. Little
Henry Livingstone
Thomas J. Long
Allen Lowrie
Jeffrey W. Lund
David I.M. Macdonald
Jerzy B. Maciolek
Peter MacKenzie
Paula L. MacRae
Thomas M. Maher
William V. Maloney
Keith N. Mangini
W. Dustin Marshall
Carrie M. Martin
David F. Martineau
James A. McCarty
Walter B. McDonald
Austin J. McGlannan
Lacie McIntire
Mike McTeague
Gary M. Mercado
Charlton J. Miller
Kurt D. Miller
Wayne D. Miller
Arthur S. Millholland
Stephen P. Mitchell
Robert M. Mitchum Jr.
Cheryl A. Mnich
Clara-Luz Mora
James C. Morgan
Edward C. Mozley
Steven L. Mueller
Arthur C. Mullenax
Jerome N. Namy
Thomas R. Nardin
Norman S. Neidell
Kathleen M. Neset
Ryan J. Neufelder
John H. Newcomb
Hugh Nicholson
In memory of Robin Nicholson
Susan E. Nissen
Jesus A. Ochoa
Patrick O'Connor
Francisco Olivares Perez
Van Oliver
Richard Allen Olsen
Erik A. Opstad
Charles Folger Oudin III
Jack F. Overstreet
David R. Paddock
Duane Anthony Pankhurst
Cormac Parsons
James Lewis Pear
Per-Aage Pedersen
Michael L. Peffer
James Byron Peterson
Robert Howard Peterson
Michael John Petraitis
Peter Phillip Pickup
Richard Lee Piqune
Robert Starl Pittman
Michael D. Podolsky
John F. Polasek
John Rhodes Polleys
Kelly R. Poret
Edward Joseph Porter
Paul Edwin Potter
Walter Carroll Pusey III
William Moore Quackenbush
Spencer Scott Quam
Garrett James Quinn
Roger L. Reagan
Kevin Wayne Reimer
Anthony Reso
William F. Ripley
Philip Kenneth Roberts
Glenn Scott Robertson
Lloyd Bain Robertson
Roland Gregory Robertson
Nancy Marie Rodriguez
Stanley Edmund Roe
Mark A. Romanchock
Juan Rogelio Roman-Ramos
Justin Rosenblume
Robert M. Rothman
John H. Rountree
Neil Eric Rutherford
Paul Eric Sacks
Deborah K. Sacrey
Scott Theodore Saroff
Sharon M. Sartain
Tim Saxman
Robert L. Scamman
Sven Schaefer
Christian Scheibe
Brooke Ashton Schlemeyer
Wolfgang E. Schollnberger
Kate M. Schwehr
Stanley Paul Schweinfurth
Babawale Oladipo Scott
John David Seale
Clyde Ray Seewald
Aris Setiawan
George Donovan Severson
Douglas Jay Seyler
John W. Shelton
Chuanbo Shen
Charles Glen Shortridge
Neal Edward Siler
Mark Alan Sippel
Lawrence Ralph Smith
Mark Alan Smith
Robert Ryland Smith
George C. Soronen
John Stanfield Spaid
Nicholas Murray Spence
Colin Leonard Stabler
Gerald Edward Stachura
Richard Lawrence Stallings
Robert Kenneth Steer
In memory of William J. Davies
William Thomas Stelzer Sr.
Stephen Malcolm Strachan
Terrell Blane Stroud
F. Michael Strunk
Michael L. Stults
Beth B. Stump
Albert Yen Sun
Stephen J. Szydlik
Kati Tanavsuu-Milkeviciene
David Andrew Taylor
J. Hall Taylor
Nicholas William Taylor
Mark R. Teare
David Paul Thetford
Janet Bauder Thornburg
Jack C. and Catherine I. Threet
John B. Thurmond
Linda Jean Timmermann
Keith Louris Tischler
Thomas James Tourek
Jim Travillo
James Kendall Trigger
Tony John Troutman
Herman C M Tso
Scotty Tuttle
Albert Norton Tyler
Willis Woodbury Tyrrell Jr.
Glen Edward Vague Jr.
Michael David Van Horn
Jan Hendrik van Koeverden
Jan Franklin van Sant
Jose Antonio Varela Montes
Rudy F. Vogt III
Duane Timothy Wagner
William B. Walker Jr.
Gary Michael Walters
Edward Bassett Wasson
Kenneth Joseph Wells
Joann E. Welton
Patrick Whitley
Mark Steven Whitney
Richard Lee Whitney
Peter Hawley Wilkinson
Barton P. Wilson
Tom Wilson
Wilbur Dean Wilson
David Anthony Winter
William Wolodarsky
Timothy Francis Wright
Victor Paul Wright
Zachary Alan Wright
Chih-Cheng Yang
Fu-Pang Yang
John Steven Yantosca
Oscar Yepes
Clifford Hai Yu
Barry Lynn Zinz
Jeffrey Raymond Zoller

Awards Fund
Teacher of the Year Award
Mustajab Ahmad
Stephen Gerard Crumley
Joseph R. Davis
Raymond A. Donelick
Paul Carrington Henshaw Jr.
Heather E. Willems

Daniel A. Busch Library Fund
David Ray Grogan
John B. "Jack" Thomas
Clyde Francis Wootton

Digital Products Fund
Baylor University
Jay Harold Hightower
Nina L. Ronalder
Edwin Leslie Trice III

Colorado School of Mines
Tanya Lynn Inks

Michigan State University
David R. Paddock
Mark Alan Smith

Mount Royal College
Ian Shaw

Oklahoma State University
Zachary Alan Poland

San Diego State University
John Arthur Abeid

Southern Methodist University
Joseph R. Davis

Stanford University
Janet Bauder Thornburg

Texas A&M University
Adam Mattson

Texas Tech University
George Andrew Anderson III

University of Calgary
Ian Shaw

University of California Berkeley
Nicholas G.K. Boyd III
Paul Carrington Henshaw Jr.

University of California, Santa Cruz
Douglas Bleakly

University of Colorado
Douglas Bleakly

University of Louisiana Lafayette
Jonas W. Bailey

University of Nebraska, Lincoln
Chevron Matching Employee Fund
Matching a gift given by James Swartz
Donnald Earl Johnson

University of Oklahoma
Kenneth Aniess
Robert Joseph Wilson

University of Texas at El Paso
Marathon Oil Corp.

University of Wyoming
Nicholas G.K. Boyd III

Virginia Tech University
David Ray Grogan
Arthur Craig Mullenax

West Virginia University
Arthur Craig Mullenax

Distinguished Lecture Fund
Mustajab Ahmad
Earl Clifford Fawcett
Kazuyoshi Hoshi

Dean A. McGee Distinguished Lecture Fund
Simon Horan
Michael G. Webb

Education Fund
Mustajab Ahmad
John Howard Bair
Ted Cammarata
Chevron Matching Employee Fund
Matching a gift given by Peter Chimney
Peter Joseph Chimney
Earl Clifford Fawcett
G.M. "Jerry" Gill
Charles W. Landmesser
Charles Robert Speh
Anthony Edgar Stephenson
Stuart and Barbara Strife

GIS-UDRIL Fund
University of Texas at El Paso
Marathon Oil Corp.

Grants-in-Aid Fund
Jason Randall Baugh
Leigh S. House
William Brian Little
Piotr Karol Misiarz
William L.M. Wilsey

Bernold M. "Bruno" Hanson Memorial Environmental Grant
Jeffrey Brooks Aldrich
Douglas Bleakly
Edwin Leslie Trice III

David W. Worthington Named Grant
Larry F. Adamson

Donald A. and Mary O'Nesky Named Grant
John B. "Jack" Thomas

Eastern Section Named Grant
Katharine Lee Avary
Peter MacKenzie

Grants-in-Aid Committee Named Grant
Chevron Matching Employee Fund
Matching a gift given by Mike Unger
Peter MacKenzie

Gustavus E. Archie Memorial International Grant
Robert Weeden

James E. Hooks Memorial Grant
Mark Alan Dando
Dale Alan Fritz

John D. "Jack" Edwards Memorial Grant
Jennifer R. Crews
Barry C. McBride

Kenneth O. Stanley Memorial Grant
Ralph Arthur Stone

L. Austin Weeks Memorial Grant
Alexander Pearsall Bump

Michel T. Halbouty Memorial Grant
Heinz Martin Burgisser
In memory of Erik Mason

Mruk Family Named Grant
Peter MacKenzie

Ohio Geological Society Named Grant
John L. Forman

Pittsburgh Association of Petroleum Geologists Named Grant
Katharine Lee Avary

Raymond C. Moore Memorial Grant
Gary Michael Walters

Richard W. Beardsley Named Grant
Katharine Lee Avary
Peter MacKenzie

Robert K. Goldhammer Memorial Grant
Andrei Belopolsky
Stephen C. Ruppel
Uwe Strecker

Roger W. Stoneburner Memorial Grant
Jean K. Funkhouser

SEAPEX Named Grant
Stan Fine

William E. and Jean Crain Named Grant
Philip Ernest Charles Reed

Michel T. Halbouty Lecture Fund
Oscar Yepes

James A. Hartman Student Leadership Summit Fund
Katharine Lee Avary
Chevron Matching Employee Fund
Matching a gift given by Richard Ball
Tillman Webb Cooley Jr.
Richard Allen Olsen

Imperial Barrel Award Fund
Mustajab Ahmad
Katharine Lee Avary
Joseph R. Davis
Devon Energy Corp.
Gerhard Diephuis
Gretchen M. Gillis
In memory of Vlastimila "Vlasta" Dvorakova
Cormac Parsons
Michael Joseph Quinn
Edwin Leslie Trice III

Military Veterans Scholarship Fund
George Kenneth Edgerton
Peter Anthony Emmet
Lawrence W. Funkhouser
William E. Gipson
In memory of G. Allan Nelson
In memory of Dudley J. Hughes
Paul Michael Guerino
Samuel and Barbara Guy
In honor of Thomas W. Rollins
Mark Lewis Hales
Ayelet B. Harris
Marguerite C. Kremer
James Diller Lowell
Rusty Riese and Sarah Springer
William Dake Rose Jr.
Charles Robert Speh
In memory of John Jack "KARST" Smallwood

John F. Bookout Jr. Military Veterans Scholarship Fund
Michael Richard Canich Jr.
Valary L. Schulz

Professorial Grants Fund
Mustajab Ahmad
Ayelet B. Harris
University Research Grant
Devon Energy Corp.

Visiting Geoscientist Fund
Mustajab Ahmad
Steven H. Brachman
Tako Koning
In memory of K.K. Landes

L. Austln Weeks Undergraduate Grant Fund
Katharine Lee Avary

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

COMMENTARY

(Editor's note: AAPG Honorary member Roger Slatt is the Gungoll Family Chair in Petroleum Geology and Geophysics, and director of the Institute of Reservoir Characterization at the University of Oklahoma, Norman, Okla. During the past decade he received AAPG's Jules Braunstein Award and the Grover E. Murray Memorial Distinguished Educator Award.)

'Just Give Us One More Chance …'

By ROGER M. SLATT

I doubt if any of today's geosciences students or relatively new hires in the petroleum industry ever heard or saw on bumper stickers the slogan of the 1980s:

"Please just give us one more chance and we won't screw it up ever again."

That slogan was commonplace around Houston, Tulsa, Midland and other petroleum centers shortly after a drastic drop in oil prices and a surge in layoffs, which occurred only about a year or two after the biggest hiring frenzy in petroleum industry history – anyone remember the 1982 AAPG convention in San Francisco, with multiple job offers on the spot?

The lesson was not learned, and this up-and-down story has repeated itself several times since then, as is the case in late 2014-15.

We read and hear a lot about the economic impact of this latest downturn. The news typically is expressed by reporting on lost jobs, lower corporate revenue and a number of other community/government issues.

Less publicity is given to the impact of these downturns on universities that are attempting to educate the next generation of petroleum industry geoscientists and engineers, which have been severely impacted in the following ways, for the following reasons and with the following general results:

▶ Companies are not hiring as many newly graduated geoscientists for full-time employment.

As a result, more master's degreed students are applying for doctorate programs; this seemingly would be beneficial to university geoscience departments, but in reality it puts more pressure on professors and departments to find funds for these students.

Also, not all master's graduates possess the natural inquisitiveness and patience that many professors feel are required for doctorate study. Drivers for students to return to school for graduate degrees may simply be a lack of viable alternatives.

Faculty are aware of this and there is the stigma, valid or not, that a new doctorate student who was laid off by industry will quit and return to industry as soon as jobs become available.

▶ Evidence of the industry environment's impact on student employment is the cancellation or downsizing of some "student recruiting expos" around the country.

The expo program, initiated about 15 years ago in Denver by Susan Morrice, had become a favorite way for companies to recruit large numbers of students. Many of these universities were not recruiting locations for companies, so these expos provided an opportunity for employment interviewing that was otherwise unavailable to some students.

These expos have been extremely beneficial to both students and companies – but the current lack of hiring plans and donations to run the expos led to reductions.

▶ This is the first time I can remember when fewer graduate students have received summer industry internships.

In the past, students received full-time job offers after completing their summer internship – often ahead of graduation.

Also, most companies have insisted on hiring only full-time graduates who have had the summer internship experience.

Although a lack of full-time summer employment may provide students extra time to work on their thesis, it is not always perceived as a plus. Students who have no job awaiting them upon graduation may "linger" and draw out their program, hoping things will turn around. Only time will tell if students without this experience will still be employable when the downturn swings upward.

▶ Funding by the petroleum industry for applied academic research has dropped dramatically since the 2014 downturn.

Unlike the old days, today's student expects financial help in the form of research or teaching assistantships and scholarships – and often shops for the university that provides the most assistance.

Most universities have seen major cutbacks by companies for teaching and research activities, even those that are in the upper tier of universities where companies recruit.

▶ International students have been particularly hard hit by all of the above situations.

In this fiscal environment, companies are reluctant to go through the green card process - nor do companies see any benefit to hiring an international student for an internship, because the company won't hire that student full time upon graduation.

This situation is exceptionally disappointing, because many international students are at the top of the list when it comes to genuine interest, grades, volunteerism, study habits and so on.

It has been my experience that many international students are not yet as touched by the entitlement society we read/hear about so much. I personally have graduated a number of international students who are all doing very well in their industry positions.

Failure to engage such bright international scientists in the industry will only set back an industry.

* * *

So, what are some of the immediate or near-future impacts of the current downturn?

✓ Qualified employees leaving the industry for "more stable" careers.

✓ Loss of enthusiasm among retained employees.

✓ Potentially qualified students not entering university geosciences programs.

✓ Professors reducing the number of graduate students they can handle.

✓ Reduction in numbers of departmental teaching assistantships.

✓ Loss of incremental and breakthrough concepts and technologies.

There are very few companies that have retained research facilities, and the bulk of research is outsourced through consortiums or individual grants to universities or service companies. Reductions in funding will ultimately mean less applied research useful

Continued on next page

Continued from previous page

to the industry.

Solutions to these problems and potential outcomes all seem to center around money, which is the first casualty of severe oil price reductions. However, history has proven us to be a cyclical industry, therefore it is assumed by many that a turnaround will naturally occur.

This may be true, but the world is far different now than 25-30 years ago, and oil and gas play a particularly significant role in global economics and politics as well as popular environmentalism.

* * *

So the old cliché "Please just give us one more chance and we won't screw it up ever again" seems to be revitalized once again.

As an academic, I see industry finances in a somewhat more naïve scope than company financial planners. I wonder why a commitment cannot be made to a new employee for a decent salary at the same time a company is drilling $30-100MM wells?

In the same manner, I wonder why many companies laid off so many employees.

Perhaps the logic was that when times become good again, we'll just go out and rehire!

I cannot conceive of how much money is wasted by laying-off someone with experience who will be replaced in a year or so by someone who will have to be re-trained! Penny wise and pound foolish?

I suggest you read the brief comment by Marlan Downey in the August 2014 EXPLORER who also pointed out the value of the current lull in activity to allow employees time to "catch up and learn" rather than being laid off.

I also wonder how many employees would have been willing to accept pay cuts, rather than being let go with virtually nothing. At least one state geological survey did this, so that no one was laid off.

For international employees, the layoffs had an even more devastating impact since it meant they had to leave the United States within weeks or a month of being laid off.

Old-schoolers in the oil and gas industry were trained to look at the longer-term view of their company's health. The company in turn treated such employees fairly. Thus, the employees came out of a university ready and willing to work for the company.

Those were the days of company loyalty. Somewhere along the line, there was a paradigm shift toward the short-term, immediate profit motive – loyalty was lost and managers focused on quarterly reports as a measure of personal and corporate success.

Unfortunately, too few companies used this approach.

* * *

This is not to say that the universities share none of the blame. Tuition costs are skyrocketing well beyond the rate of inflation, funds for specific purposes are being lumped in with the university's general fund, the ratio of administrators to faculty continues to rise and new mandates are added distractions for the professor trying to do his/her job.

As an academic in a university with a rich heritage of petroleum education and research, I hope that given one more chance, it won't be screwed up again, and we can continue to educate students for a long-lasting, rewarding career in the petroleum industry.

We've all read and heard about the upcoming retirement boom. It is the young people who soon will be a critical component of the companies.

To discourage these people at this time will have a longer-term negative impact on companies than today's short-term profit-loss statement.

EPA Studies

from page 42

up only a small percentage of the amount needed for new well stimulations.

EPA also studied the hydraulic fracturing water use in the Piceance basin within the semi-arid Upper Colorado River basin in Colorado. There the industry reuses 100 percent of large volumes of flowback water and requires very little freshwater.

Obviously, drought conditions impact all water users. After heavy rains in Texas, California is the only major oil and gas producing state experiencing extreme drought conditions – and many are unhappy about water use for hydraulic fracturing, although the industry uses little: 70 million gallons, 140,000 gallons per well, or about 0.004 percent of what California households use annually (California Council on Science and Technology).

Texas has large numbers of hydraulically fractured oil and gas wells, and its Bureau of Economic Geology (BEG) hydrologists have studied the impact on local water supplies. In June, BEG senior research scientist Bridget Scanlon presented some of this information at House and Senate briefings organized by the Washington, D.C., geoscience consortium that includes AAPG.

She reported that in the Eagle Ford play of semi-arid west Texas:

- Hydraulic fracturing accounted for 16 percent of total water consumption in 2013.
- The dominant groundwater use for 2013 was for irrigation, at 62-65 percent.
- Between 10-12 percent of the groundwater went to municipal use.
- Steam electric power plants took 7-13 percent.

The BEG hydrologists have a cautionary conclusion for the Eagle Ford play:

"While regional impacts of water pumpage to support HF are small, localized impacts can be large with estimated water level declines of approximately 100-200 feet in about 6 percent of the western play area."

This column ends with good news for water supplies: Natural gas power generation reduces water use by up to 60 percent relative to coal and nuclear plants.

This has a big impact on water withdrawals for power plants that traditionally make up 38 percent of water withdrawn from U.S. lakes and rivers.

This also reflects the fact that the majority of gas-fired electricity is produced by gas turbines, which do not use steam to drive turbines, or by combined cycle plants, where the waste heat from gas turbines (that do not use water) goes to steam generation units.

READER'S FORUM

An Elected Editor

In the July EXPLORER, the AAPG House of Delegates' wise defeat of the very bad elected editor amendment was reported with one disappointed leader quoted as commenting, "Small groups can also decide the editor position. We should trust our leadership."

This incredulous, ill-advised view suggests that AAPG would be better off with Executive Committee (EC) members appointed by our "trusted leadership," just like the tightly-controlled SPE EC (they don't even have elections).

Thankfully, AAPG has been requiring two nominated candidates for all EC positions since 2000, when the 200-plus member HoD voted near unanimously to require two candidates for the editor, thereby eliminating the last appointed EC office of the past. Now, the greater membership can participate in choosing all of our EC members, and that should never be changed.

In 1970, the HoD was created and entrusted with the Bylaws, and no longer could the EC amend them without final approval of two-thirds of the HoD. Forty-five years later we also can celebrate the fact that we have the most representative governance of all our sister societies, and have two candidate elections for all our EC, AC and HoD offices, which ultimately best represents the collective will of the membership.

Many thanks to the HoD for yet another smart vote to protect our future right to vote on the editorship.

Clint Moore
Houston

Something Missing?

Regarding the May EXPLORER article on AAPG Sidney Powers Memorial Award winner Paul M. "Mitch" Harris:

Amazingly, in your 1,700-word article on Mitch Harris, the words "Gulf Oil" did not figure anywhere. I, along with several hundred others, worked with Mitch at Gulf's Houston Technical Services Centre in the 1970s.

I believe Mitch joined Gulf because of their strong technical reputation with carbonate reservoirs in the United States, Middle East and Angola (Pinda and Toca production).

Mitch also was a colleague and contemporary of carbonate expert Stan Frost.

The article implies Mitch spent six formative years with Gulf prior to Chevron. Gulf's board and management may have left something to be desired, which is why they became the deal or "steal" of the century for Chevron in 1984, but technically Gulf had been a superb outfit – which may be why Mitch joined the carbonate team?

HTSC closed and staff migrated to Chevron after the merger, many of the Gulf people rising to high levels in Chevron. That legacy today has contributed to Mitch's Sidney Powers Memorial Award.

Congratulations to Gulf in addition to Chevron – and, of course, to Mitch!

Dave Bodecott
Motherby, England

PROFESSIONAL newsBRIEFS

Nadeem Ahmad, to director-exploration and reservoir engineering, MOL Oil and Gas, Islamabad, Pakistan. Previously general manager-exploration north and international asset services, Pakistan Petroleum, Karachi, Pakistan.

Zahie Anka, to exploration excellence unit-Middle East and North Africa, Total EP, Paris, France. Previously senior geologist-petroleum system evaluation, Total EP, Paris, France.

István Bérczi, Honorary member and past president of AAPG Europe Region, was awarded the Hungarian Order of Merit Officer's Cross from the president of Hungary for his outstanding achievement in the Earth Sciences, his high standard contribution to higher education and his widely acknowledged activity in professional associations. Bérczi is senior adviser at MOL Group in Budapest, Hungary.

Mike Bowman, to chair of the petroleum engineering program, Texas A&M University, Qatar, Doha, Qatar. Previously chair of development and production geology, University of Manchester, England.

Robert "Bob" James, has retired as advanced senior geologist from Marathon Oil, Houston. He resides in Houston.

Brian D. Nicoud, to petrophysics adviser, Chesapeake Energy, Oklahoma City. Previously senior petrophysicist, EXCO Resources, Dallas.

Dave Pivnik, to manager of subsurface specialties-exploitation, Oxy Oil and Gas, Houston. Previously senior geological adviser, Apache North Sea, Aberdeen, Scotland.

John Snedden, director of the Gulf Basin Depositional Synthesis Project at the University of Texas at Austin, was awarded the A.I. Levorsen Memorial Award for presenting the best paper at the Gulf Coast Association of Geological Societies' 2014 annual meeting. His paper was "Interaction of Deepwater Deposition and a Mid-Ocean Spreading Center, Eastern Gulf of Mexico Basin."

Chris Wickens, to geoscience consultant, CW Exploration, Calgary, Canada. Previously exploration portfolio manager, QGC (BG Group), Brisbane, Australia.

(Editor's note: "Professional News Briefs" includes items about members' career moves and the honors they receive. To be included, please send information in the above format to Professional News Briefs, c/o AAPG EXPLORER, P.O. Box 979, Tulsa, Okla. 74101; or fax, 918-560-2636; or e-mail, smoore@aapg.org; or submit directly from the AAPG website, www.aapg.org/explorer/pnb_forms.cfm.)

CLASSIFIEDADS

POSITIONS WANTED

Faculty Position in Earth and Planetary Science

At Rice University Department of Earth Science

We seek creative and promising candidates across the broad spectrum of earth and planetary science who complement the disciplines represented in our department.

Successful candidates are expected to direct an active research program, supervise graduate research, and teach courses for undergraduate and graduate students. Details about the department and its facilities can be found at http://earthscience.rice.edu

Please send a CV, research and teaching statements, and names of four or more references to esci-search@rice.edu.

All required application materials submitted by September 15, 2015 are ensured full consideration.

Equal Opportunity Employer – Females/Minorities/Veterans/Disabled/Sexual Orientation/Gender Identity

* * * * * * * * * * * * * * * * * * * *

California Division of Oil, Gas, and Geothermal Resources

A rewarding job in the field of oil and gas District Deputy

The State of California seeks an industry leader to direct oil and gas operations in the Bakersfield region. This is a Governor-appointed, senior-level position in charge of a large district office, responsible for permitting, monitoring and enforcement of oil and gas laws related to the development and production of hydrocarbon resources in the southern San Joaquin Valley. This position will be responsible for the oversight of well stimulation, underground injection and other regulations in a new era of public and environmental health and safety. Salary is negotiable and competitive with the industry.

Apply at
www.gov.ca.gov/m_appointments.php
for the position under
Department of Conservation,
Division of Oil, Gas, and Geothermal Resources
Titled "Area District Deputy"
Questions welcomed at (916) 445-9686

* * * * * * * * * * * * * * * * * * * *

The University of Texas at Austin Associate Director

The Jackson School of Geosciences at The University of Texas at Austin invites applications for a leadership position overseeing the Energy Division of the Bureau of Economic Geology. The Associate Director, Energy Division, at the Bureau is responsible for a broad research portfolio comprising over 70 scientists, engineers, and economists with an international reputation for conducting objective, basic, and applied research. For additional information, please go to http://www.beg.utexas.edu/

The Energy Division conducts approximately two-thirds of the current Bureau research effort. This component of the Bureau focuses on research involving energy resources, primarily oil and natural gas. It includes 10 Industrial Associates programs for basic research, as well as numerous sponsored-research projects funded by the State of Texas, the DOE, and individual companies or groups of companies.

Main areas of focus include salt tectonics, carbonate and clastic reservoir characterization, mudrock systems, fracture characterization and prediction, multicomponent seismic applications, computational seismology, geofluids, and energy economics. We are noted for bringing insight and innovation from outcrop and core studies to the evolving science of reservoir characterization. With 70% of in-place reserves typically remaining in the ground at the time of oil field abandonment, this research has enduring economic and societal importance.

The Bureau of Economic Geology, with a staff of 250 including approximately 60 graduate student research assistants, is the oldest research unit of The University of Texas at Austin. We enjoy outstanding IT resources and support. The Bureau has a diverse workforce and extensive laboratory facilities, and operates the largest rock-core collection in the United States (~1500 miles of core). The highly ranked Jackson School of Geosciences is the largest U.S. geoscience program.

Qualified individuals should have a Master's degree in Geosciences at the time of appointment and a minimum of 10 years of managerial experience. Salary will be competitive. Review of candidates will begin August 1, 2015; applications will be accepted until the position is filled. More information and instructions for application are available online at: https://utdirect.utexas.edu/apps/hr/jobs/nlogon/150624020381

The University of Texas at Austin is an equal employment opportunity/affirmative action employer. All positions are security sensitive, and conviction verification is conducted on applicants selected.

MISCELLANEOUS

SAMPLES TO RENT

International Sample Library @ Midland – Formerly Midland Sample Library.

Established in 1947. Have 164,000 wells with 1,183,000,000 well samples and cores stored in 17 buildings from 26 states, Mexico, Canada and offshore Australia. We also have a geological supply inventory.

Phone: (432) 682-2682
Fax: (432) 682-2718

* * * * * * * * * * * * * * * * * * * *

SES – more companies CHOOSE SES v5 over the other 15+ commercial geosteering software options on the USA market; browse its features/pricing/evolution online to see why. SES is niche 3D technical geosteering software TRUSTED by geologists everywhere. Free trial, online training, and class training available.

www.makinhole.com
Stoner Engineering LLC.

* * * * * * * * * * * * * * * * * * * *

StarSteer – the Premier Geosteering Software Solution for the Oil & Gas Industry. Scientific, Modern and Interactive. Integrates all your data for ideal well placement.

www.rogii.com

Join
from page 50

In the coming year EMD is looking to improve and expand its information delivery system through the use of social media applications and email blasts so as to get information into the hands of the membership in a more timely fashion.

EMD also is seeking volunteers to fill a number of vacant section and region councilor positions. Primary duties of a councilor include representing EMD members of their respective section or region on the EMD Council, promoting EMD's interests by ensuring papers and other programs of interest are included in meetings hosted by sections and regions and providing a report on section/region EMD activities at the mid-year and annual leadership meetings.

To paraphrase a famous American president: Ask not what EMD can do for you, ask what can you do for EMD.

As a volunteer, you will find yourself working with an extremely dedicated group of individuals who give freely of their time and knowledge to spread the word about the use of geoscience in the world of unconventional and alternative energy resources.

DIRECTOR'SCORNER

Want To Be A Better Explorer? Turn Off Your Phone

By DAVID CURTISS

Here in the Northern Hemisphere the Dog Days of Summer have arrived, sultry days of heat and humidity. Iced tea enjoyed by the swimming pool or a family trip to the mountains or sea are proven ways to survive the month of August, and this month I hope that you are able to find time to rest and relax.

And yet, if you're anything like me, over the past decade you've noticed that it's increasingly difficult to create the separation from daily responsibilities necessary to truly relax and unwind.

Thanks to technology we're never untethered from job and personal responsibilities. There is an expectation that we'll immediately respond to incoming email. We dip into social media streams that sweep us into our own little online world, never having to look up or look around.

And our actions and behaviors reinforce the mental conditioning that our always-on lifestyle means, in fact, that we are always online.

I do have friends who espouse the virtues of their 1990s era flip phones that only do one thing: make telephone calls. You know, where you actually talk to someone if they answer.

But I'm not suggesting we avoid technology. It's too powerful and enables us to be more productive, both personally and professionally.

However, if we fail to recognize its power and how our brains respond to and crave continual engagement and stimulation, we may fall victim to its dark side.

* * *

Let's conduct a short experiment.

Take out your smart phone or tablet and find the power button. Now place your finger over the button and press. Keep holding until you're prompted to power down your device.


CURTISS

> **Both types of intelligence – fluid and crystallizing – are necessary in our business, but we have to actively cultivate them.**

Go ahead and do that, watching as the last screen pixels dim and go dark.

Now, put the phone or tablet back into your pocket or bag and observe what you're thinking and feeling.

If you're reading a paper copy of EXPLORER go back to reading and notice your reading patterns. Are you actually reading articles, or skipping from titles to sentences, dipping in and out as your eyes skitter across the page?

I wonder what my friends are saying on Facebook.

Oh, how is the stock market doing today?

"If you're like most of us, you're wondering what the Internet is doing to your attention span," writes David Brooks. "You toggle over to check your phone during even the smallest pause in real life. You feel those phantom vibrations even when no one is texting you. You have trouble concentrating for long periods."

Brooks, author and New York Times columnist, used his July 10 op-ed to distinguish between two types of intelligence: Fluid intelligence and crystallizing intelligence.

The online world, Brooks explains, helps create and hone fluid intelligence, the ability to be mentally agile, quickly grasping the general concept and moving on. He cites neuroscientist Susan Greenfield's observation that "expert online gamers have a great capacity for short-term memory, to process multiple objects simultaneously, to switch flexibly between tasks and to quickly process rapidly presented information."

Fluid intelligence is important. If you are a stock trader or air traffic controller you need a strong ability to read the situation as it's unfolding and to react properly.

In contrast, the formation and development of crystallizing intelligence is the result of years of experience, of reading, of absorbing information and exploring relationships between data, discovering and uncovering as you go. It's deep and develops over time.

It is the difference between observing and understanding.

When you ask advice of your mentor you're hoping to tap into their crystallizing intelligence, their wisdom accumulated over time.

* * *

Reading Brooks' column I saw some interesting parallels to the exploration and production business and the development of the next generation workforce:

- The operations focus of unconventional plays, for example, requires drilling large numbers of wells. Over the past decade freshly minted geoscience graduates were geo-steering those wells, finishing one and immediately moving to the next.

They got better with time and experience, of course, but fluid intelligence is what made them good.

- Developing a play concept or prospect, in contrast, is a process of collecting and sifting data, searching for the elements of a working petroleum system.

These geoscientists need to develop a story about the play or prospect, teasing out the thread holding the story together. Then they need to convince someone to spend money and test the idea.

Both types of intelligence – fluid and crystallizing – are necessary in our business, but we have to actively cultivate them.

Everything in our digital world is streamlined to facilitate our fluid intelligence.

But if you want to be an explorer – to find oil and natural gas – I'd encourage you to cultivate the skills of reading and thinking –including offline – to enhance your crystallizing intelligence.

It's not difficult, but you have to make mental space available for it. And that takes determination and will power.

Hey, is that your phone buzzing, or mine?

DIVISIONSREPORT: EMD

What You Can Do For EMD

By ROBERT TREVAIL, EMD President


TREVAIL

As I sat down to write this column I contemplated what new and informative message I could put forth that hadn't been conveyed previously by my predecessors in their inaugural president's message.

> **As a volunteer, you will find yourself working with an extremely dedicated group of individuals.**

It turns out there is not a lot I personally can add to the conversation – other than to stress the importance of the benefits that AAPG's Energy Minerals Division brings not only to its own membership but also to the AAPG membership in general and public at large.

As pointed out earlier this year at one of our EMD leadership meetings by Brian Cardott, chair of EMD's Coalbed Methane Committee, EMD provides benefits to all AAPG members through publications such as Sequence Stratigraphy, Paleoclimate and Tectonics of Coal-Bearing Strata (AAPG Studies in Geology No. 51), Heavy-Oil and Oil-Sand Petroleum Systems in Alberta and Beyond (AAPG Studies in Geology No. 64), Atlas of Coal Geology, 2nd Edition (AAPG Datapages Discovery Series No. 17) and the Unconventional Energy Resources of North America: EMD poster as well as sponsorship at professional meetings.

Basic information on each of EMD's nine commodity and two supporting committees can be found in the public area of the EMD website (emd.aapg.org).

EMD's Success at ACE

This year's AAPG Annual Convention and Exhibition gathering in Denver proved to be a success for EMD with the meeting's EMD vice chair Jeff Aldrich and his team organizing nine oral sessions (64 talks), six poster sessions (66 posters), one field trip, two short courses and, of course, the annual EMD luncheon.

During the luncheon EMD service awards were presented to a number of deserving recipients:

- **Neil Fishman**, **Paul Basinski** and **Joan Spaw** each received a Certificate of Merit for their service at the 2014 ACE meeting in Houston.
- Distinguished Service Awards were given to **Frank Walles** and **Peter Warwick** for their many years of dedicated service to EMD.
- Honorary membership was bestowed upon **Brian Cardott** for his past and ongoing service to the Energy Minerals Division.

Speaking of Neil Fishman, he has stepped down as chair of the Shale Gas and Liquids Commodity Committee after five years of commendable leadership and service. Neil and his committee compiled mid-year and annual reports providing a concise overview of not only the major shale plays but also of many of the lesser known ones as well.

The most recent reports often exceeded 150 pages, and are a valuable resource to those involved in unconventional resource exploration and development.

Ursula Hammes agreed to take over as chair of the committee effective July 1.

Also during EMD's annual meeting in Denver, it was pointed out repeatedly by the commodity committee chairs that the current low natural gas and oil prices were having a negative impact on activities related to not only shale gas and liquids, but also to coalbed methane, bitumen/heavy oil, geothermal resources and coal.

On the bright side however, there is renewed interest being shown in natural gas hydrates and nuclear power.

EMD Membership

According to the most recent numbers available, EMD membership stands at more than 4,300, which is down almost 17 percent from the previous year – a loss attributed to the decline in the price of oil.

If you are not one already, I would urge you to seriously consider becoming a member of the Energy Minerals Division.

And it's a good deal – it's free to join.

To become a member of EMD, just log onto the AAPG website, click on "My Profile," find the Involvement tab to view your Division status and finally locate and click the "Join EMD" button.

In addition to the publications mentioned above you will gain access to the Members Only section of the EMD website, which contains an archive of past commodity and supporting committee reports and other valuable information resources.

See **Join**, page 49

still jamming

We are rocking and rolling with new additions to our library.

call Seitel. drill Smart.

For over 30 years, Seitel has been drumming up seismic surveys to compile the largest onshore data library in North America. We roll out a dynamic band of services to accent your drilling projects with permitting, acquisition, and processing. Working together, we can create a sound plan to ensure precise execution and production delivery.
Seismic is the key to your success!

- Quality 2D and 3D seismic
- Acquisition management
- Fast-track processing
- Pre-stack depth migration
- Azimuthal analysis
- EarthStudy 360
- Multi-Component Processing
- 5D Interpolation

seitel.com

Visit seitel.com often to see our acquisitions in progress, and seize the competitive edge by being the first to license our latest data.

SEITEL