AAPG EXPLORER

MAY 2015

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See page 10

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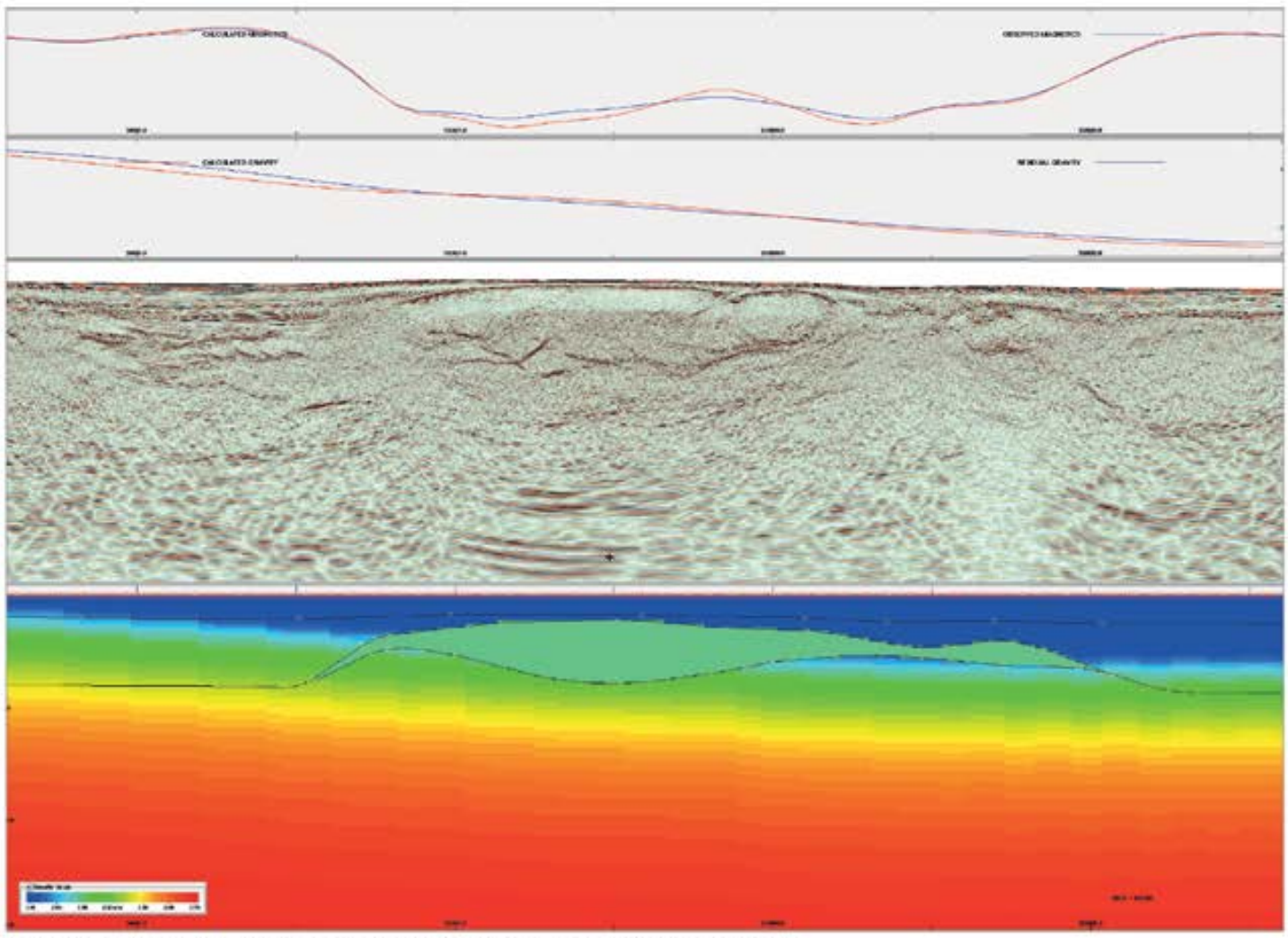

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Vol. 36, No. 5
May 2015

PRESIDENT'S COLUMN

How to Fall Back in Love With Geology

By RANDI MARTINSEN

I was born and raised in New York City, but I spent my summers in the mountainous wilds of New Jersey where I was free to wander the wilderness of the Ramapo Mountains. I spent most of my time along the brooks (small rivers) constructing small boats of twigs and watching them navigate the currents and eddies of the flowing waters, up-turning rocks to see what creatures lay underneath and then smashing the rocks to see the molds of creatures that once existed.

When I was eight my mother took me with her to spend the summer in Norway with my grandmother. There I discovered another world, the world of the rocky intertidal and cold, shallow, crystal-clear marine waters of the Norwegian coast. Pity is given to all the creatures that, because of my curiosity, gave their lives to become part of my collection of marine life.

The spark first generated in the wilds of New Jersey burst into flames – a flame that still burns to this day: I knew I wanted to be a scientist and explore the wonders of our earth.

What are some of my other life-inspiring experiences?

A big one is seeing the Grand Canyon for the first time and then hiking down it – and right then and there truly contemplating the enormity of time and the amazing evolution of life.

Another biggie was sitting wells (in the wilds of Wyoming) and listening to the singing of the drill string as it encountered and cut through porous and permeable hydrocarbon-filled pay: such sweet music.

It seemed it always was in the middle of the night – but that never diminished the excitement of the experience.

A younger but just as in-love-with-geology Randi Martinsen.

I'm sure most of you could tell similar stories about how you first fell in love with geology and the geosciences when you were young. Maybe it was hiking in the mountains, or perhaps finding unusual rocks scattered along a shoreline.

It mattered, to all of us. It's who we are. And it's what still fuels our professional passion.

* * *

During the several downturns that have occurred since I first went to work – and also sometimes during the upturns when things weren't going so well for me work-wise – I have thought back to how and why I became a geologist.

These memories always have helped me through the hard times.

I use my memories to reconnect with my "inner child" and all the "childish joys" I have been fortunate enough to experience in my life. Doing this helps get me out of the doldrums, which in turn helps me find the energy and motivation I need to get through my difficult times and move forward.

Yes, times are hard now – especially for those who have been laid off or for those young people about to graduate and need a job. And I don't want to imply that getting in touch with your "inner child" will solve the problem of having lost your job. Not at all.

Perhaps, however, being reminded of the positive awe that we felt when we were young can still have an impact. Perhaps reconnecting with your "inner child" may help you remember just why you chose geoscience for your professional life.

It may reinvigorate your passions.

And perhaps it may help just a little to get you through this roller coaster ride.

* * *

Another thing I keep telling myself is "this too will pass," and the boom times will be back. History tells us this is true.

In the meantime, we all have friends, colleagues and a great networking community within AAPG that we can reach out to for help and information about job opportunities.

Your AAPG staff and leadership are working hard to find ways and develop programs to help us through – until, during and after the next boom.

So stay connected – to AAPG, because that's where your professional career can remain fresh and be revitalized, and to your inner child, because that's the source of your inner strength.

Believe me, the adult inside of you will be grateful.

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REGULAR DEPARTMENTS

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

ON THE COVER:

Black Lake in Summit County, Colorado is just one example of the world-renowned geology surrounding this year's venue for ACE, which will be explored in detail in each of the 12 field trips on offer.

Left: The Roan Cliffs oil shale rocks in the Piceance Basin of western Colorado are another example of the spectacular geology available to see up close at this year's Annual Convention field trips. Photo by David Hiser, courtesy the U.S. National Archives and Records Administration.

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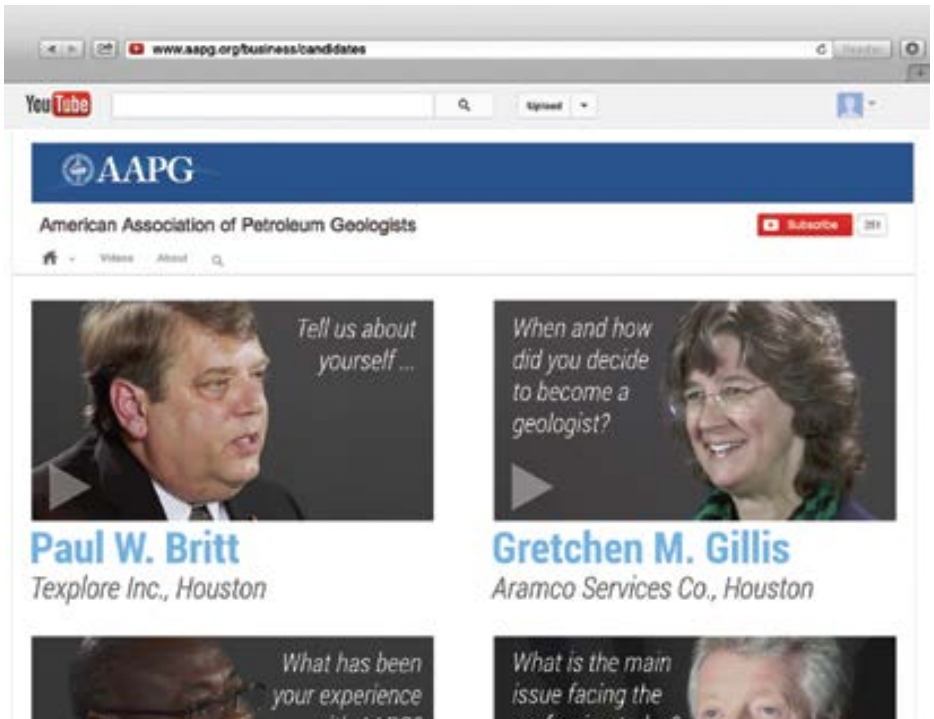


EC candidates

Q&A Videos Online

New Q&A videos featuring all six officer candidates for the 2015-16 AAPG Executive Committee are now available online, where they will remain through the rest of the election season.

Also continuing to be available on the AAPG website are the "bio videos," introduced last month as a way to allow members around the world to meet the candidates on a virtual basis, plus their printed biographies and other individual information.

Release of the videos comes with a reminder: The voting deadline arrives this month, on May 15.

The newest candidate videos show all six responding to six specific questions, intended to allow members around the world to have a better idea into the thoughts, priorities and visions of those running for office.

Those questions include:

- When and how did you decide to become a geologist – and why?
- What has been your experience with AAPG?
- What is the main issue facing the profession today?
- How could you help AAPG be a better association?
- Why did you agree to stand for office?

Printed information on the candidates also was included in the February 2015 EXPLORER.

Members can vote one of two ways: You can use the printed ballots that were mailed, or you can vote online.

If both options are used, however, the mailed printed ballot will be used as the official vote cast by members.

The person voted president-elect will serve in that capacity for one year and will be AAPG president for 2016-17. The terms for vice president and secretary are two years.

To view the videos, go online to the AAPG candidate page at aapg.to/2015canvid.

The slate is:

President-Elect

❒ **Paul W. Britt**, Texplore Inc., Houston.

❒ **Gretchen M. Gillis**, Aramco Services Co., Houston.

Vice President-Regions

❒ **Adebayo O. Akinpelu**, Fixital Ltd., Lagos, Nigeria.

❒ **Peter M. Lloyd**, Asia Pacific Training Ltd., Falicon, France.

Secretary

❒ **Heather L. LaReau**, Noble Energy Inc., Denver.

❒ **Nicole S. Morris**, FireWheel Energy LLC, Fort Worth.

Associate and Student members are not eligible to vote. If you would like to upgrade your membership status so you can vote in future elections, contact your delegate or an AAPG Member Services representative.

Some Salaries Drop, But Some Hold Steady

By VERN STEFANIC, EXPLORER Managing Editor

It's no surprise to officially know the always-cyclical oil and gas industry currently is down – and for some companies, very down.

It may be surprising to know, however, that even in this season that is best described by one word – "gloomy" – there are some areas of the industry that are not only holding steady, but actually shows signs of being robust.

That's one of the findings of this year's annual AAPG salary survey, which showed that average salaries are down slightly this year for most – but not all – age groups.


AYLING

The survey is one snapshot of the industry that started the year strong and then saw oil prices – and activity, and hiring, and in some cases, job security – drop dramatically.

Taken in total, though, the 2014 survey "shows very little change in salaries" from the previous year, according to Mike Ayling, of MLA Resources in Tulsa, who has conducted the annual salary survey for AAPG since 1981.

"While these (age) groups remain in strong demand, perhaps lethargic overall hiring has taken a toll on average salaries," Ayling said.

For example, "beginning geologists saw an almost inappreciable drop in starting salaries," Ayling said. Indeed, the average salary for those with two years experience or less was $102,900 in 2014, down from the previous year's $103,400.

"Geoscientists with 10-14 years experience had the largest gains – about 12 percent, perhaps reflecting an adjustment from last year when they saw little change," he said.

But that wasn't the case for those with 25-plus years of experience, a group that saw "a major drop" of 9 percent, Ayling said, "perhaps reflecting industry retirements.

"Geologists who have some experience – those in the 10- to-19-year category, are making pretty good salaries," he said, "probably because there are so few of them."

The AAPG annual survey is based on U.S. salaries only, which are still considered the industry's "gold standard." The measurement for international salaries for explorationists is virtually on a country-by-country, case-by-case basis, Ayling said, which makes statistical averaging non-productive beyond the boundaries of any specific country.

Also, many ex-pats are paid U.S.-based salaries, while the national oil companies opt to pay compatriots on a different, lower scale.

Ayling said his survey is based on employed, salaried geoscientists and cannot account for unemployed or underemployed individuals. Nor can these numbers take into account the compensation of individuals who are primarily paid in the form of consulting fees, retainers or overrides.

No attempt has been made to include any additional sums to account for employee benefits, bonuses, automobiles or other perquisites. The purpose of this survey is merely to provide a yardstick for those interested in accessing their compensation.

Ayling feels strongly that "compensation is often a secondary consideration when evaluating overall job satisfaction."

2014 Geological Salary Survey

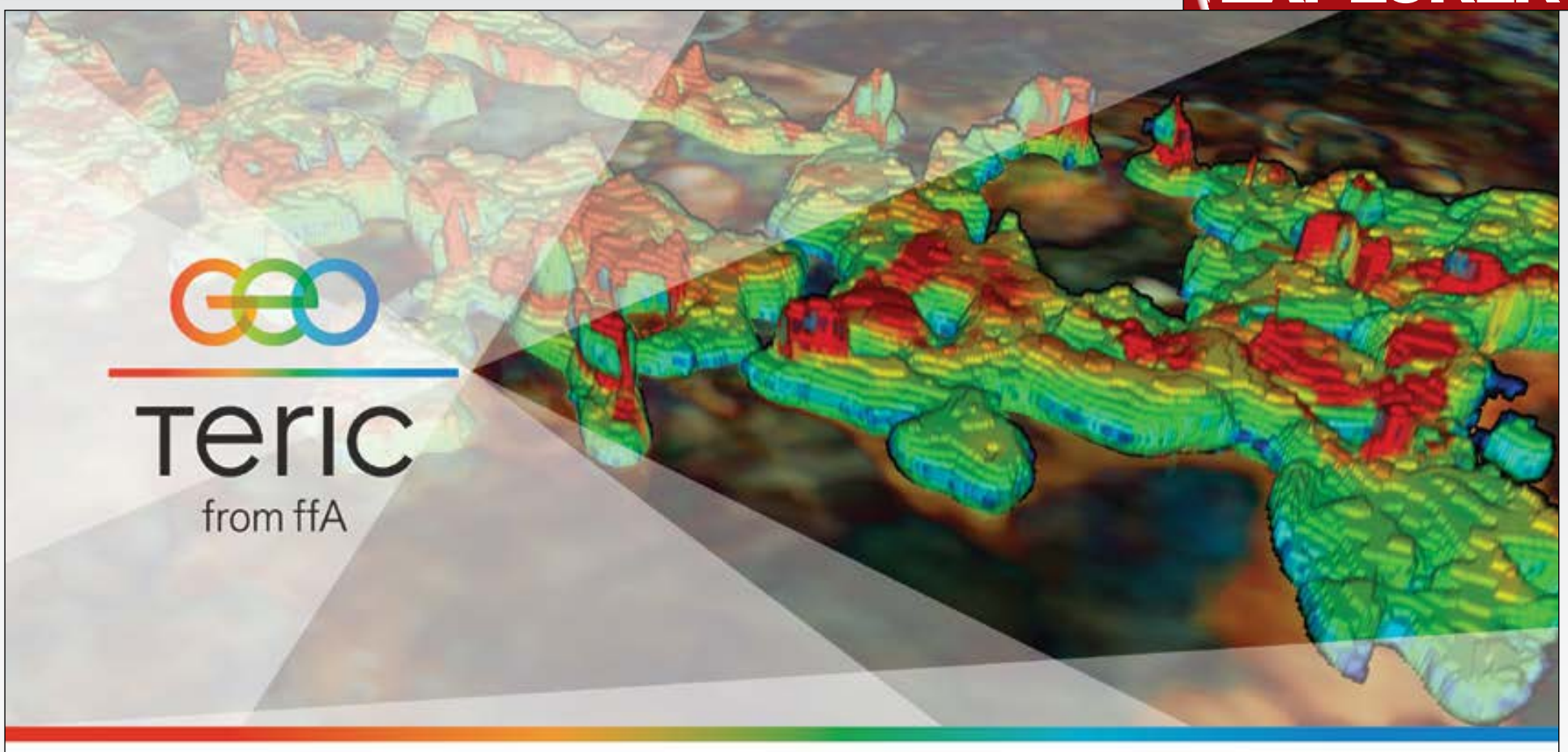
YEARS EXPER	HIGH	AVERAGE	LOW
0-2	$ 117,300	$ 102,900	$ 87,000
3-5	140,000	114,900	98,000
6-9	163,200	148,300	135,000
10-14	207,000	165,600	132,000
15-19	206,000	189,000	155,000
20-24	315,000	234,300	185,400
25+	425,000	229,900	185,000

Average Salary By Degree

YEARS EXPER	B.S.	M.S.	Ph.D.
0-2	$ 92,000	$ 104,400	$ 117,300
3-5	89,000	109,100	140,000
6-9	n/a	143,000	155,300
10-14	160,000	150,000	178,900
15-19	n/a	200,300	155,000
20-24	198,900	250,200	238,000
25+	209,000	221,600	248,000

Historical Averages Salary

YEARS EXPER	2006	2007	2008	2009	2010	2011	2012	2013	2014
0-2	$ 82,200	$ 82,800	$ 83,600	$ 87,600	$ 93,000	$ 98,700	100,500	$ 103,400	$ 102,900
3-5	89,600	107,800	108,000	105,600	102,300	109,400	101,000	114,500	114,900
6- 9	98,500	121,100	118,400	121,700	127,800	137,300	127,800	145,400	148,300
10-14	111,500	119,800	121,900	123,500	139,100	153,400	147,000	147,500	165,600
15-19	141,000	151,600	139,400	150,800	151,000	193,600	190,300	179,200	189,000
20-24	155,000	167,400	176,800	180,300	191,000	199,200	211,600	219,500	234,300
25+	149,900	162,800	171,700	186,800	206,300	199,600	212,000	252,600	229,900



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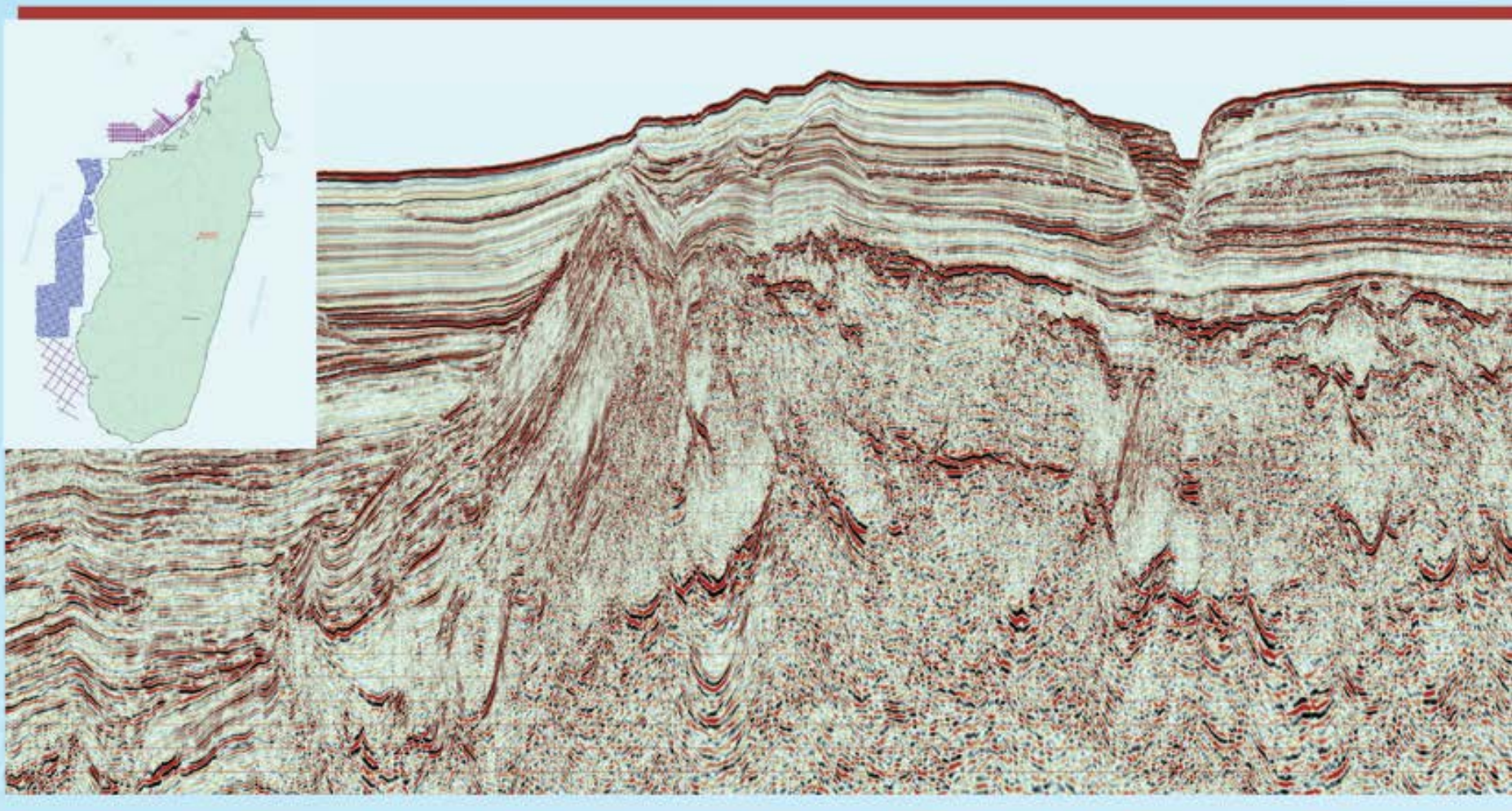
- Namibia SPAN 2D, in association with ION, ~10288 km, final deliverables: Q2, 2015
- West Australia Bilby 2D, in association with Searcher Seismic, adjacent to Phoenix Sourh-1, final deliverables will be ready in Q3, 2015
- West Australia Group Seis 2D & 3D, cooperate with Searcher Seismic, Final data set: Q3, 2015



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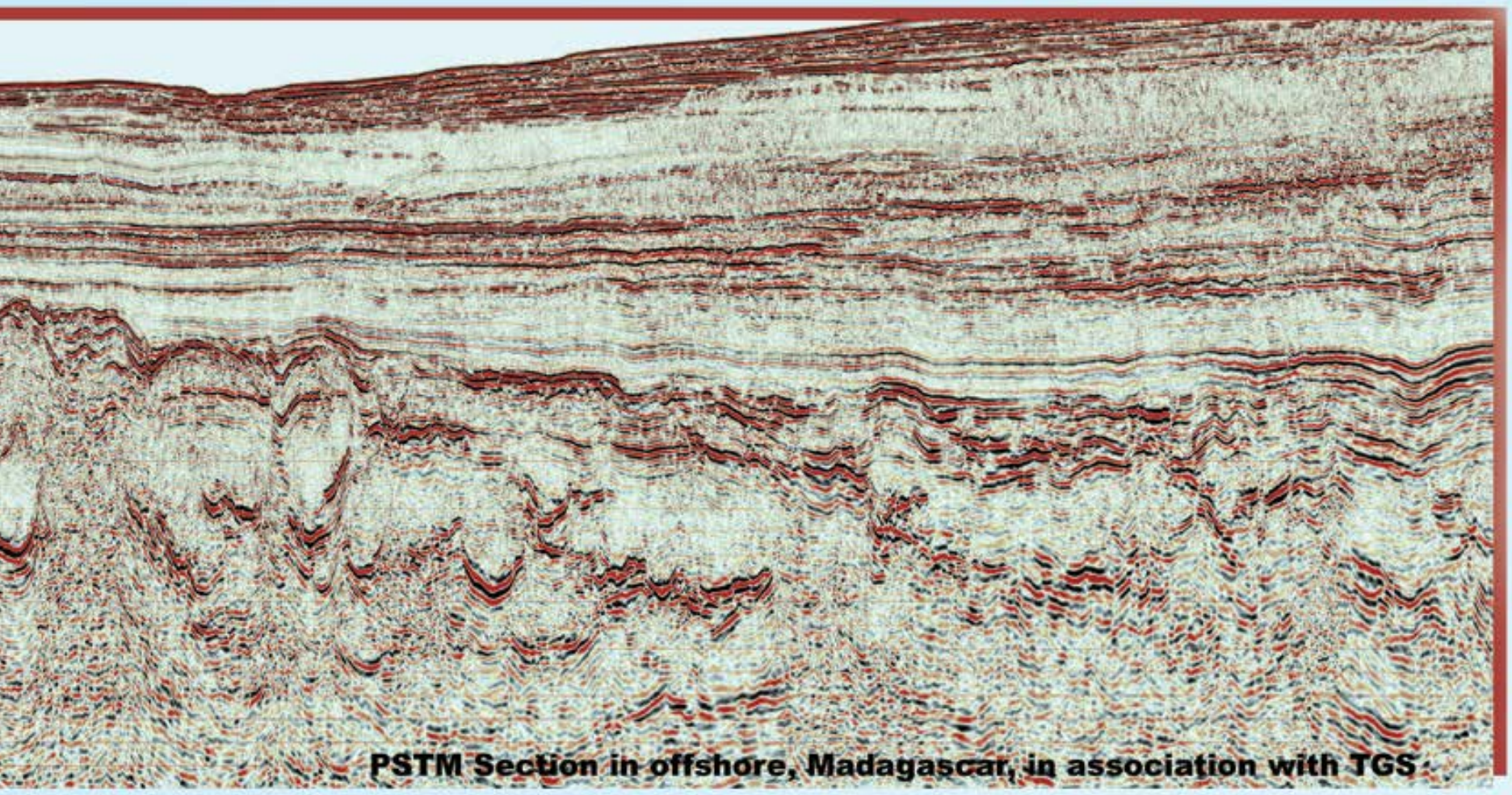

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Paradigms change, passion for science remains

ACE Returns to Denver with Vast Program, New Features

By CHRISTOPHER STONE, EXPLORER Correspondent

A huge and diverse technical program plus easy and close accessibility to some of the earth's most spectacular displays of geology provide the setting for this year's AAPG Annual Convention and Exhibition.

The 2015 ACE will be held May 31-June 3 at the Colorado Convention Center in Denver.

It is the ninth time AAPG has traveled to Denver for an annual convention – ACE was last held there in 2009 – but organizers say this may be the best time ever to head for the mountains.

"The changing global economy, new technologies, recent discoveries and international events are constantly changing the energy landscape, but for most of us the driving force is a passion for the science," said ACE general chair John Robinson.

"Exploration and production activity in the greater Rocky Mountain region is emblematic of these new paradigms in our science, making Denver the ideal city to host this meeting," he said.

"There's no better time to invest in your professional future than now."

This year's technical program will feature more than 800 presentations that address a broad range of topics, including Petroleum Systems and Geochemistry; Unconventional Resources; Carbonates and Evaporites; Siliciclastics; Geophysics; Energy Minerals; and Structure and Geomechanics.

Just down the road: Denver, site of the 2015 AAPG Annual Convention and Exhibition, provides easy access to spectacular displays of geologic splendor in the Rocky Mountains.

There also will be several special sessions, including two Discovery Thinking sessions (see pages 50 and 52), a "celebration" of Sidney Powers medalist Paul "Mitch" Harris; and an important "town hall" style meeting on "The Department of Energy Crosscutting Subsurface Initiative: Adaptive Control of Subsurface Fractures and Flow."

Another new feature in Denver will be the "GeoLegends Theater," a three-day program that offers the premiere showing of 13 videos that celebrate some of the greatest discoveries in the profession's history, told by the geologists who helped make it happen.

The videos, produced by AAPG and the 100th Anniversary Committee, have been created to celebrate and promote AAPG's centennial in 2017 and feature committee chairs Ed Dolly and Paul Weimer talking to top explorers, research geologists and professors who pioneered geology and exploration during the past 60 years.

Those featured include Sidney Powers Memorial Award medalists Bob Weimer, Ken Glennie and Fred Meissner, plus legendary explorers Dan Steward, John Masters, Richard Stoneburner, Mike Johnson and Harry Jamison.

Other ACE highlights include:

- Hundreds of feet of core from major petroleum plays will be on display at the core poster sessions.
- The opening session and awards ceremony, where the best of AAPG will be honored. Among the honorees will be veteran geologist Paul "Mitch" Harris, who will receive the AAPG Sidney Powers Award, AAPG's highest honor, and Alfredo Guzman, winner of this year's Michel T. Halbouty Leadership Award.
- An exhibit hall featuring more than 250 companies who will display the latest in technology, science and services.

To register or for more information, go to ace.aapg.org/2015.


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MINCH


REILLY


TARI

Spotlight Readied for ACE Opening Session

By VERN STEFANIC, EXPLORER Managing Editor

Paul M. "Mitch" Harris, a much-celebrated and award-winning geoscience researcher, author, editor, lecturer and professor, will receive the Sidney Powers Memorial Award – AAPG's highest honor – during the opening session of the AAPG Annual Convention and Exhibition in Denver.

Harris, an AAPG Honorary member, is senior research consultant-Earth Science R&D for Chevron Energy Technology Co. in San Ramon, Calif.

Joining Harris at the top of this year's awardees list and receiving his award in Denver is **Alfredo E. Guzmán**, a past AAPG vice president-Regions and past president of AAPG's Latin America Region, who has been named recipient of the Michel T. Halbouty Outstanding Leadership Award.

Guzmán, a longtime executive with Pemex, the Mexican national oil company, is now with Altamira Petroleum Co., in Veracruz, Mexico.

And honored at the opening session will be **David Worthington**, this year's winner of the L. Austin Weeks Memorial Award, the AAPG Foundation's highest honor.

They and 50 others will be honored during the ACE opening session, set at 4 p.m. Sunday, May 31, at the Colorado Convention Center.

The program is preceded in the same room at 3 p.m. by the AAPG Imperial Barrel Award ceremony, and the premiere of a dazzling new movie "A Brief History of Colorado Through Time," produced by the Interactive Geology Project at the University of Colorado, the Denver Museum of Nature and Science, and Colorado Plateau Geosystems (see related story, page 14).

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

This year's list of awardees features a new technical publication award – the first SEG/AAPG Best Paper in Interpretation Award, created specifically for contributions to the jointly produced journal, Interpretation; one member who will be receiving two awards (Kitty Milliken); and a posthumous honor for a pioneer woman geologist.

Harris, the 68th person to win the Powers Award, has been an influential and dynamic leader in geoscience research, technical programming and scientific knowledge for more than 35 years – and as a two-time AAPG Distinguished Lecturer was instrumental in personally sharing the latest in geologic thought and concepts with thousands of professionals around the world.

He also has been published in more than 200 books, journals and guidebooks; served as an editor on 30 volumes; and with AAPG has won the John W. Shelton Search and Discovery Award, the Wallace E. Pratt Memorial Award and twice won the Robert H. Dott Sr. Memorial Award (see related story, page 16).

Guzmán is the ninth recipient of the Halbouty Outstanding Leadership Award, given in recognition of outstanding and exceptional leadership in the petroleum geosciences.

He has a long record of achievements, both as a petroleum geologist and in leadership positions, particularly in the Mexican and Latin American petroleum industry.

A three-time past AAPG Distinguished Lecturer, Guzmán was president of the AAPG Latin America Region in 2005, and served on the AAPG Executive Committee as vice president-Regions in 2009-11 (see related story, page 22).

Worthington, a significant contributor to the AAPG Foundation and an officer and leader of both the Foundation and the Trustee Associates, will receive the Weeks Memorial Medal in recognition of "extraordinary philanthropy and service in advancing the mission of the AAPG Foundation."

He is the award's eighth recipient.

Worthington, the former CEO of TGS-Calibre and chairman of TGS-NOPEC, now resides in Naples, Fla.

Award winners announced by AAPG and who will be honored along with Harris, Guzmán and Worthington in Denver are:

Honorary Member Award

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

❒ **Abdulrahman S. Al-Sharhan**, Middle East Geological Establishment, Al Ain, U.A.E.

❒ **William J. "Bill" Barrett**, retired, Denver.

❒ **Wallace G. Dow**, Cimarex, Tulsa.

❒ **David H. Hawk**, Energy Analysis and Answers, Boise, Idaho.

❒ **John C. Lorenz**, FractureStudies LLC, Edgewood, N.M.

❒ **Kay L. Pitts**, consultant, Bakersfield, Calif.

❒ **Scott W. Tinker**, Bureau of Economic Geology, Austin, Texas.

Norman H. Foster
Outstanding Explorer Award

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

❒ **Hans Christian Ronnevik**, Lundin Petroleum Norway, Baerum, Norway.

Ronnevik has had a remarkable career as an explorationist, particularly in the North Sea, where his discoveries have included the giant Snorre Field, the Alvheim Field, the Volund Field and the giant John Sverdrup Field,

Robert R. Berg
Outstanding Research Award

Presented to honor a singular achievement in petroleum geoscience research.

❒ **Kitty L. Milliken**, senior research scientist at the Bureau of Economic Geology, Austin, Texas – and a global authority in sedimentary petrography.

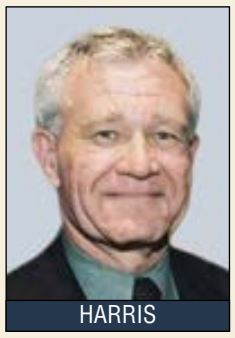
She also is a co-recipient of this year's Wallace E. Pratt Memorial Award; see below (see related story, page 28).

❒ **Mark D. Zoback**, Benjamin M. Page Professor, Stanford University, Stanford, Calif. – a principal investigator of the SAFOD project and a global expert on Earth stress and its impact on drilling (see related story, page 32).

Distinguished Service Award

Presented to those who have distinguished themselves in singular and

Continued on next page


HARRIS

Paul M. "Mitch" Harris, when he receives his award in Denver, will become the 68th Powers medalist in AAPG history, first awarded in 1945 to legendary geologist Wallace E. Pratt.

The Powers Award is given annually in recognition of distinguished and outstanding contributions to, or achievements in, petroleum geology.

Sidney Powers himself was a founding member and 14th president of the Association. He died in 1932 at the age of 42.

Frank R. Clark, in his memorial to Sidney Powers, said, "Sidney Powers will be known by future generations for his able contributions to pure and applied geology, but, important as are his scientific achievements, his character was greater, because it typified service to others."

AAPG Sidney Powers Winners

2014 – Ernest A. Mancini
2013 – Dietrich H. Welte
2012 – Koenraad Johan Weber
2011 – John W. Shelton
2010 – Leonard Franklin Brown Jr.
2009 – Marlan Wayne Downey
2008 – Fred Franke Meissner
2007 – Arnold Heiko Bouma
2006 – Robert Mitchell Mitchum Jr.
2005 – Kenneth William Glennie
2004 – Lawrence W. Funkhouser
2003 – Peter Robbins Vail
2002 – James Lee Wilson
2001 – Robert M. Sneider
2000 – Gerald Manfred Friedman
1999 – Norman H. Foster
1998 – Albert Walter Bally
1997 – Robert D. Gunn
1996 – Bernold M. Hanson
1995 – John D. Haun
1994 – William L. Fisher
1993 – Robert Raymond Berg
1992 – Sherman A. Wengerd
1991 – John E. Kilkenny
1990 – John E. Galey
1989 – Hugh N. Frenzel
1988 – Rufus Joseph Leblanc
1987 – James E. Wilson Jr.
1986 – Merrill W. Haas
1985 – J. Ben Carsey
1984 – Robert J. Weimer
1983 – Grover E. Murray
1982 – Daniel A. Busch
1981 – Mason L. Hill
1980 – Kenneth K. Landes
1979 – William H. Curry Jr.
1978 – Kenneth H. Crandall Jr.
1977 – Michel Thomas Halbouty
1976 – W. Dow Hamm Jr.
1975 – Dean A. McGee
1974 – G. Moses Knebel
1973 – Gordon I. Atwater
1972 – Morgan J. Davis Sr.
1971 – Frank A. Morgan
1970 – Frank R. Clark
1969 – Ira H. Cram, Sr.
1968 – Maurice Ewing
1967 – Carey Croneis
1966 – William B. Heroy Sr.
1965 – V. E. Monnett
1964 – Edgar W. Owen
1963 – Hollis D. Hedberg
1962 – Lewis G. Weeks
1961 – Clarence L. Moody
1960 – Henry V. Howe
1959 – Raymond C. Moore
1958 – Paul Weaver
1957 – Joseph P. D. Hull
1956 – W. E. Wrather
1954 – George Martin Lees
1953 – Frederic H. Lahee
1952 – Kenneth C. Heald
1951 – Max Steinke
1950 – Everette L. DeGolyer
1948 – A. I. Levorsen
1947 – Alexander Deussen
1945 – Wallace E. Pratt


WIGLEY


AKANDE


BOYD

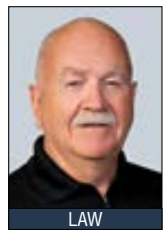

PUCKETTE


WRIGHT


HARRIS


MacMILLAN


RYAN


LAW


STEWART


RUDNICKI


AWWILLER


ZHANG


GAO


TINGAY


HART


SOBORNOV


HENNINGS


McKERNAN


MECKLENBURGH


RUTTER


TAYLOR

Continued from previous page

beneficial long-term service to AAPG.

❒ **Ronald F. Broadhead**, New Mexico Bueau of Geology, Socorro, N.M.

❒ **Ross A. Clark**, Kallisto Energy Corp., Calgary, Canada.

❒ **Denise M. Cox**, Storm Energy, Panama City, Fla.

❒ **John C. Dolson**, DSP Geosciences and Associates, Coconut Grove, Fla.

❒ **Meredith Faber**, Noble Energy, Houston.

❒ **William S. Houston**, New Zealand Oil and Gas, Willington, New Zealand.

❒ **Mark W. Longman**, QEP Resources, Denver.

❒ **John A. Minch**, John Minch and Associates, Mission Viejo, Calif.

❒ **James F. Reilly**, American Public University System, Colorado Springs, Colo.

❒ **Gabor Tari**, OMV, Vienna, Austria.

❒ **Peter Wigley**, Lynx Information Systems, London, England.

Grover E. Murray Distinguished Educator Award

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

❒ **Samuel O. Akande**, University of Ilorin, Ilorin, Nigeria.

❒ **Donald W. Boyd**, University of Wyoming, Laramie, Wyo.

❒ **James O. Puckette**, Oklahoma State University, Stillwater, Okla.

❒ **V. Paul Wright**, director of PW Carbonate Geoscience and honorary research fellow at the National Museum of Wales, Cardiff.

Harrison Schmitt Award

Presented to recognize individuals who, for a variety of reasons, do not qualify for other Association honors or awards.

❒ **Anita Harris**, honored posthumously for her long career with the U.S. Geological Survey, best known for her work with conodonts, which resulted in a significant new method for locating petroleum plays (see related story, page 38).

Public Service Award

Presented to recognize contributions of AAPG members to public affairs.

❒ **Logan MacMillan**, Littleton, Colo., honored for his work with a variety of governmental and policy groups, including service on the RMAG Public Issues Committee.

❒ **Timothy M. Ryan**, Ryan Exploration, Englewood, Colo., honored for "promoting earth science to the general public," especially in his work with the Denver Museum of Nature and Science.

Pioneer Award

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

❒ **Ben E. Law**, Pangea Hydrocarbon Exploration, Lakewood, Colo.

Geosciences in the Media Award

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

❒ **Iain S. Stewart**, professor of geoscience communication at the University of Plymouth and the host/producer of several earth science documentaries that have been presented on the BBC, PBS, Discovery Channel and YouTube, including "Earth: The Power of the Planet," "Hot Rocks: Geology of Civilization" and "How Earth Changed History." (See August 2014 EXPLORER.)

Wallace E. Pratt Memorial Award

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

❒ **Kitty L. Milliken**, **Mark D. Rudnicki**, **David N. Awwiller** and **Tongwei Zhang**, for "Organic Matter-Hosted Pore System, Marcellus Formation (Devonian), Pennsylvania," which appeared in the February 2013 AAPG BULLETIN.

Milliken and Zhang are with the Bureau of Economic Geology, Austin, Texas; Rudnicki and Awwiller are with ExxonMobil, Houston.

Robert H. Dott Sr. Memorial Award

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

❒ **Dengliang Gao**, for AAPG Memoir 100 – Tectonics and Sedimentation: Implications for Petroleum Systems.

Gao is with the Department of Geology and Geography, West Virginia University, Morgantown, W.Va.

J.C. "Cam" Sproule Memorial Award

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

❒ **Mark R.P. Tingay**, for the paper "Evidence of Overpressure Generation by Kerogen-to-Gas maturation in the Northern Malay Basin," which appeared in the April 2013 AAPG BULLETIN.

Tingay is with Chevron Australia, Manning, Australia.

SEG/AAPG Best Paper In *Interpretation* Award

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

❒ **Bruce Hart**, for the paper "Whither Seismic Stratigraphy," which appeared in August 2013 issue.

Hart is a geologist in Statoil's shale oil and gas research group, Houston.

John W. Shelton Search and Discovery Award

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

❒ **Konstantin Sobornov**, for the paper "Structure and Petroleum Habitat of the Pay Khoy-Novaya Zemlya Foreland Fold Belt, Timan Pechora, Russia."

Sobornov is with Nord West Ltd., Moscow, Russian Federation.

George C. Matson Award

Presented to honor and reward the best oral presentation at the 2014 AAPG Annual Convention and Exhibition in Houston.

❒ **Peter Hennings**, for the paper "Relationship Between Reservoir Quality and the Deformation Associated With Anticlinal Folding in the Tensleep Sandstone at Alcova Reservoir, Central Wyoming."

Hennings is with ConocoPhillips, Houston.

Jules Braunstein Memorial Award

Presented to honor and reward the best poster presentation at the 2014 AAPG Annual Convention and Exhibition in Houston.

❒ **Rosanne McKernan**, **Julian Mecklenburgh**, **Ernest Rutter**, **Kevin Taylor** and **Stephen J. Covey-Crump**, for the poster "Influence of Effective Pressure on Shale Matrix Permeability."

All are with the University of Manchester, Manchester, England.


BEGA


ELLIS


CLARKE


BOLE


RAY


SACREY

Gabriel Dengo Memorial Award

Presented to honor and reward the best oral presentation at the 2014 AAPG International Conference and Exhibition in Istanbul, Turkey.

❒ **Zamir Bega**, for "Deep Oligocene Reservoirs as Potential Oil Play in Deep Waters of Western Black Sea Basin."

Bega is with OMV Petrom, Bucharest, Romania.

Ziad Beydoun Memorial Award

Presented to honor and reward the best poster presentation at the 2014 AAPG International Conference and Exhibition in Istanbul, Turkey.

❒ **Grant Ellis**, for "Late Authigenic Pyrite – An Indicator of Oil Migration and Entrapment in the Bonaparte Basin, Timor Sea, Australia."

Ellis is with Eni Australia Ltd., Dalkeith, Australia.

House of Delegates Honorary Member

❒ **Donald D. Clarke**, geological consultant, Lakewood, Calif.

❒ **George Bole**, consultant, Houston.

House of Delegates Distinguished Member

❒ **Robert R. "Randy" Ray**, R3 Exploration Corp., Lakewood, Colo.

❒ **Deborah K. Sacrey**, Auburn Energy, Houston.

Finalists Announced for 2015 IBA Competition

The semi-finals rounds have been completed, and now 12 teams from around the world are bound for Denver to participate in the finals of the 2015 AAPG/AAPG Foundation Imperial Barrel Award competition.

The finals competition will take place May 29-30, with the winning team announced at 3 p.m. at the IBA ceremony in the Mile High Ballroom of the Colorado Convention Center – the same location as the opening session, which will begin at 4 p.m. All are invited to attend.

The finalists, all winners of their respective Region and Section competitions, are:

- Africa Region – University of the Western Cape
- Asia Pacific Region – Curtin University, Perth, Australia
- Canada Region – Queen's University
- European Region – Royal Holloway University
- Latin American Region – Simon Bolivar University
- Middle East Region – King Fahd University of Petroleum & Minerals
- Eastern Section – To be determined (semi-finals were held April 24, after EXPLORER deadlines)
- Gulf Coast Section – University of New Orleans
- Mid-Continent Section – University of Oklahoma
- Pacific Section – University of Alaska Fairbanks
- Rocky Mountain Section – University of Montana
- Southwest Section – University of Texas, El Paso

That was then, this is now: The new video, "A Brief History of Colorado Through Time" uses actual footage and computer animation to tell the geologic story of Colorado's spectacular setting.

New Video On Colorado Geology Set For ACE Opening

A dazzling, compelling movie that depicts the creation and evolution of Colorado's impressive geologic origins will premiere at the AAPG Convention and Exhibition in Denver as part of the opening session festivities.


WEIMER

"A Brief History of Colorado Through Time," which dramatically and creatively shows how the state's famous landscapes evolved through geologic time, will be shown at 3:30 p.m. Sunday, May 31, immediately after the Imperial Barrel Awards program and immediately before the opening session.

All of the activities are free of charge and will be in the Four Seasons Ballroom at the Colorado Convention Center.

The movie, intended for geologists such as RMAG members but good for the general public as well, is designed to set the scientific scene for many of the AAPG convention's talks and field trips.

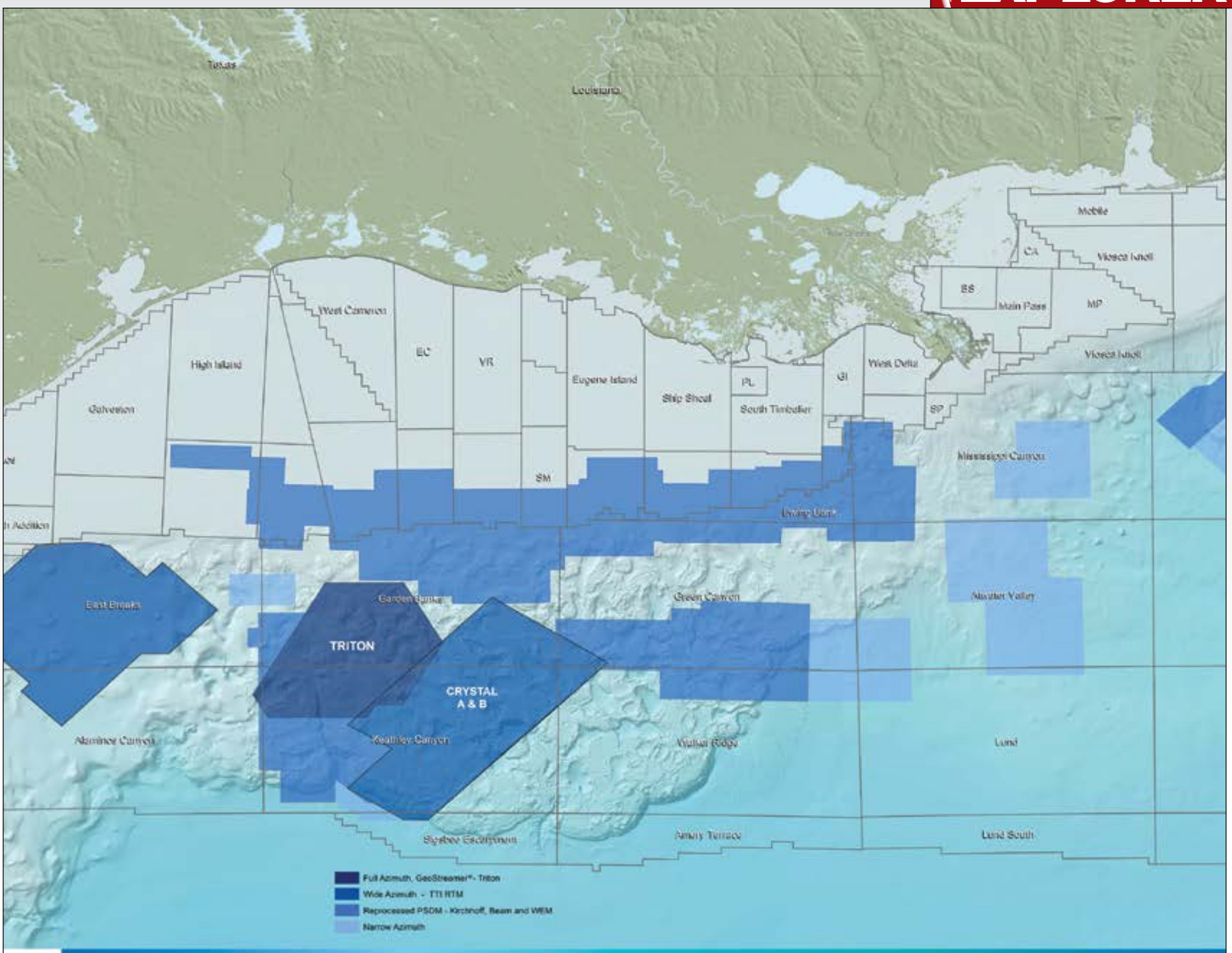
It features video and computer animations highlighting:

- The geologic origin of the state's national parks and monuments.
- Stegosaurus – the state fossil of Colorado – munching Late Jurassic vegetation.
- The Yule Marble – Colorado's state rock, used to build the Lincoln Memorial.
- The Late Cretaceous Coastal Plain sediments of the Book Cliffs – complete with Triceratops.
- The state's Cenozoic igneous history, including mineral and ore deposits.
- Neogene evolution of the Rio Grande Rift and regional uplift of Colorado.
- Glaciations during the past million years.

"The movie includes many surprising facts," said Paul Weimer, a past AAPG president and one of the film's producers, "even for the most experienced geologist."

The movie was produced by the Interactive Geology Project at the University of Colorado, the Denver Museum of Nature and Science, and Colorado Plateau Geosystems.

Various versions of this movie are and will be part of a larger outreach program.



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  - Acquisition completed in August 2014
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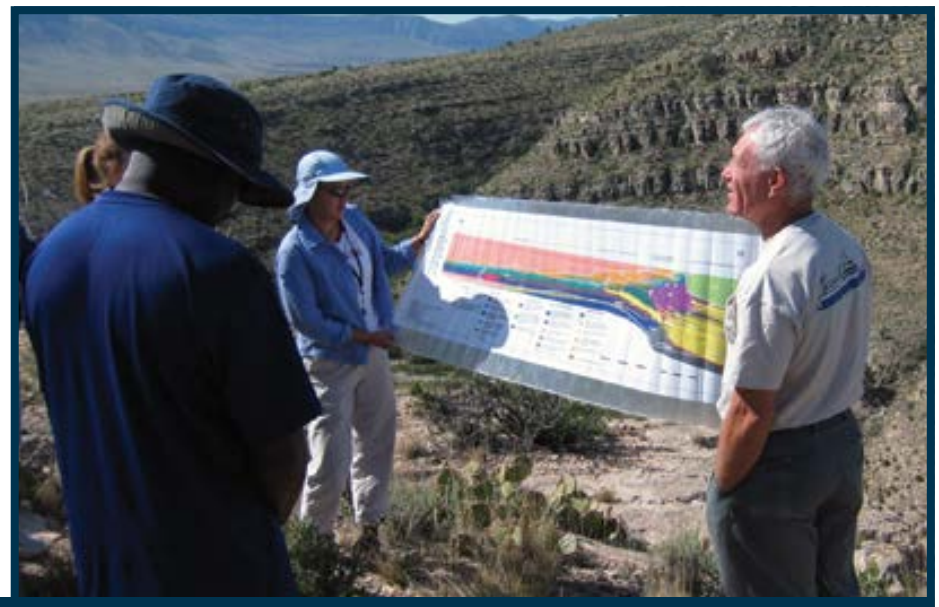

Many of Mitch Harris' best moments come in the field (left, 2008, during a Morocco field seminar), where students and experts alike gather to learn more about carbonates.

Sidney Powers Memorial Award

Mitch Harris is 'The Godfather of Carbonates'

By HEATHER SAUCIER, EXPLORER Correspondent

On a field trip to the Bahamas in 1974, Paul M. "Mitch" Harris sat alongside his thesis adviser on a beach of the Joulters Cays, gazing at the white sand – the landscape lush with colors "not unlike an impressionist painting," Harris recalled.

In that moment, his adviser, the world-class carbonate geologist Robert Ginsburg, changed the course of Harris' career when he suggested Harris scrap his plans for a doctorate on the recent geologic history of Florida Bay.

"Florida Bay has been looked at already," Ginsburg said. "Look at this place. It's beautiful. Nobody has ever worked here, and it's a reservoir in the making."

And so began a research career in carbonate rocks, which contain roughly half of the world's oil in limestone and dolomite.

Harris' research – which started with the study of the sedimentology of the Joulters Cays ooid sand shoal on the Great Bahama Bank – has taken him to other exotic places like Kazakhstan, Russia, India, China and Brazil, as well as the Middle East and Europe, to sharpen the industry's understanding of carbonates.

His extensive research on carbonates coupled with his globally renowned carbonate training programs for scientists of all ages and skill sets, have earned Harris this year's AAPG Sidney Powers Memorial Award.

The award is given to those who make notable contributions to science while serving others in the industry. The fact that Harris' colleagues and students have often called him the "Godfather of Carbonates" as well as "Uncle" no doubt serves as a testament to Harris being an obvious choice for AAPG's highest honor.

"Mitch is a man of the rocks, and he has been so for more than three decades. If we can borrow a quote from (British geologist) H.H. Read, '…the best geologist is the one who has seen the most rocks,'" wrote AAPG member Paul Siegele, president of the Chevron Energy Technology Company (ETC), Harris' former employer.

"This certainly applied to Mitch," he added, "and his lifelong history with carbonate sediments and rocks."

Choosing a Career

The Godfather of Carbonates did not start out with a love of rocks.

As an undergraduate at West Virginia University in Morgantown in the late 1960s, Harris majored in aerospace engineering and then biology before discovering geology. A week-long field trip to south Florida clinched the deal, opening up to Harris the world of carbonates, particularly how they relate to sedimentology and stratigraphy.

After earning his master's in geology in 1973 from his alma mater, Harris set his eyes on the University of Miami's Rosenstiel School of Marine and Atmospheric Studies, where the renowned Ginsburg, who worked for Shell before moving into academia, studied carbonates on Fisher Island.

Harris eventually worked with Ginsburg, who had just opened the Comparative Sedimentology Laboratory (CSL), which later became the Center for Carbonate Research (CSL-CCR), to fine-tune his research project.

"The CSL was an ideal laboratory, not just for studying carbonates, but for understanding the industry interests and viewpoints and for building industry relationships," Harris said. "There were endless opportunities to meet with industry visitors, take short courses with them, and go on field trips with them.

"All of this allowed me to develop my own 'industry view' while I was still a student," he said, "and it definitely influenced me in my own research direction and findings."

In this "carbonate paradise," Harris solidified his commitment to researching sedimentary rocks, intrigued by their complexity and the major part they play in forming reservoirs.

"What I learned at the Joulters Cays resonated throughout my career and provided themes that I carried through further research," Harris said.

"One of my passions, which probably more than anything has led to this award, was to organize and actively participate in publications, core workshops, short courses, conferences and fieldtrips that created opportunities for earth scientists from industry and academia to focus on the varied aspects of carbonates."

In the Bahamas, 2005.

Harris at Caicos Platform, British West Indies.

Three Influencing Factors

The list of Harris' accomplishments and accolades carries on for miles. During a 36-year career at Chevron, from which he retired in 2014, Harris worked his way from a project geologist to senior research consultant and a Chevron fellow.

He has performed carbonate core, petrographic, stratigraphic and seismic studies that have aided development and exploration programs around the world. He has conducted research in carbonate stratigraphy, facies, diagenesis, play types and reservoir modeling. And, he headed up Chevron's Internal Technical Group on Carbonate Geology.

Harris has been published in more than 200 books, journals and guidebooks.

For all of his accomplishments, Harris can narrow his top achievements to three influential factors:

- A long-standing relationship with his company.
- An opportunity to interact with academia.
- Regular involvement with the AAPG and its affiliate, the Society for Sedimentary

See **Career**, page 18

Caicos, 2006.

South Florida seminar, 2007.

Career

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Geology (SEPM).

Harris is an AAPG Distinguished Lecturer and International Distinguished Lecturer, and past recipient of the Wallace E. Pratt Memorial Award, the Robert H. Dott Sr. Memorial Award (twice), the John W. Shelton Search and Discovery Award, and an Honorary member of AAPG and SEPM.

He also served as president of SEPM, and has served on numerous committees for both associations.

"I was blessed to be able to stay and thrive with the same company for such a long period of time," Harris said. "I liked the technical challenges that were always there, and I loved the people to work with and interact with."

Chevron proved to be highly receptive to Harris' desire to venture into academia and build strong relationships with several carbonate-oriented schools, such as the CSL-CCR; the Reservoir Characterization Research Laboratory at the University of Texas' Bureau of Economic Geology; the Kansas Interdisciplinary Carbonates Consortium at the University of Kansas; and the Earth Science Department at Rice University.

In fact, even after retiring, Harris continues on as an adjunct professor at the University of Miami and at Rice.

In devoting much of his time to AAPG and SEPM, Harris gave talks, poster presentations, organized sessions, presented short courses and core workshops and ran field trips at national and international meetings.

"There are very few people in the world like Mitch with this combination of top-tier technical understanding and a social element that brings everyone together into synergy," said AAPG member Ted Playton, a development geologist at Tengizchevroil in Kazakhstan. "He is an excellent communicator, networker, integrator, mentor and teacher, and adviser, which furthers the science by promoting relationships and teamwork across a variety of spectrums."

Hallmark of His Career

Some of Harris' most noteworthy accomplishments are the carbonate training programs – which Siegele calls "the hallmark of his career" – that Harris developed and offered to Chevron employees and its overseas affiliates.

Traveling around the globe, he explained with great exuberance – and sometimes in a body of water up to his

See **Carbonates**, page 20

Morocco field seminar, 2008.

Carbonates
from page 18

chest – why carbonates are challenging exploration targets and heterogeneous in reservoirs.

Different from an academic course, Harris' training offered a fresh perspective on carbonates in places such as the giant Tengiz Field in Kazakhstan on the shore of the Caspian Sea, to outcrops in the Guadalupe Mountains, and to the Bahamas countless times – initially through AAPG's former field seminars in Sequence Stratigraphy and Reservoir Distribution in Modern Carbonates, followed by similar programs of the CSL.

"I have emphasized the relevance of the subject to understanding a reservoir," Harris said. "Even when taking people on a modern carbonate field trip and showing them different depositional environments, I try to emphasize the 'analog' aspect of the field stop and focus the information and discussions on the subsurface."

Harris wanted his fellow geologists and engineers to perfect their interpretations of seismic facies and stratigraphy, to more accurately describe a core or "thin sections," to improve their interpretations of logs and build better geologic and reservoir models.

"I was always taught that the more a geologist sees, the more he learns, and the better his interpretations will be," he said. "I believe this is certainly true as far as seeing different modern areas of deposition, different outcrops, different subsurface datasets, and even hearing different points of view.

"Studying carbonates worldwide, and traveling to see them, broadens your understanding and perspective," he added.

No doubt Harris' groups left his courses richer in knowledge than they ever thought. Having held thousands of rocks in his hands throughout his career, Harris developed an "encyclopedic knowledge" of 30-plus years of studies of his company's carbonate assets, said AAPG member and former colleague James W. Bishop, a research geologist for Chevron's ETC.

In fact, to some, Harris' retirement means the end of an era for many geologists learning about rocks the old-fashioned way, said AAPG member Jeroen Kenter, a lead research geologist at ConocoPhillips.

Harris' leaving the carbonate geosciences community marks an "industry-wide transformation from a generation with a passion for finding truth in rocks 'old style' through observations on modern carbonate sediments and the rock record and asking fundamental questions, to one that is more driven by digital data and less exposure to those rocks," Kenter said.

Marvelous Mentor

Of all of Harris' contributions to the industry, he looks back on mentoring as the most meaningful.

With his love for people as strong as his dedication to science, Harris shared the knowledge he gained in every opportunity that came his way.

"Mentoring and teaching are the most important things we can do, whether it's part of your job description or not," Harris said. "Companies all have some form of formal training, but the informal learning from your peers and on-the-job training is perhaps the most valuable way to learn.

"Seek to learn, regardless of your age and level of experience," he added. "There is always more to learn and there are always people to help you along the way."

And while he is officially retired, he continues to offer advice, especially for those in the industry who are experiencing the fallout from the recent economic downturn:

"Appreciate that a long career in the industry will cause one to experience downturns several times. As budgets shrink, activities decrease, and opportunities become fewer. It's only natural to feel frustrated," he said.

"I always tried to stay focused on the technical challenges – the science – and minimize the bad aspects of a downturn," he said. "They don't last forever, so don't give up."

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Michel T. Halbouty Outstanding Leadership Award

Guzmán: Leading the Way to Success

By HEATHER SAUCIER, EXPLORER Correspondent

The unprecedented energy reforms taking place in Mexico – which are allowing foreign investors into the country for the first time in 77 years – have been the talk of the petroleum geology community.

AAPG Honorary member Alfredo E. Guzmán, this year's recipient of the Michel T. Halbouty Outstanding Leadership Award, had a small hand in the changes many are calling "Mexico's Moment."

A former executive of Petróleos Mexicanos (Pemex) who also served on the country's National Hydrocarbon Commission, Guzmán's honors are two-fold: Not only is he receiving AAPG's second highest award, he is experiencing a rush of pride watching his country transform on a host of levels.

"I would like to think that I had some influence on the changes that Mexico is undergoing, as I always felt and expressed that the country needed more enterprises looking for oil and gas resources rather that just one company – no matter how good and efficient it could be," said Guzmán, who has been an active member of the AAPG for 46 years and a notable leader in Mexico.

Alfredo Guzmán, standing on a production platform in the Gulf of Mexico.

Pushing PEMEX to Its Max

Although Pemex sometimes has been criticized by outsiders for inefficiency and corruption, Guzmán said the company has performed exceptionally well given its relatively small workforce that has been tasked with exploring and producing some of the world's largest oil fields.

Throughout his career at Pemex, holding multiple executive titles, Guzmán led Mexico to some of its most historical achievements including:

- Increasing gas production in the Burgos Basin from 183 million cubic feet per day to 1.65 billion cubic feet through the discovery of more than 90 new fields – boosting the basin's estimated ultimate recovery from 10 to 26.5 trillion cubic feet.

- Implementing the rejuvenation of the Veracruz Basin from 150 million cubic feet per day to 1 billion cubic feet after the discovery of nine new fields, leaving an additional 250 million cubic feet per day at the wellhead in 2007 waiting for facilities to come on line.

- Leading the discovery of the Lankahuasa Field, which contains almost 500 billion cubic feet of 3P reserves that came on-stream at 100 million cubic feet per day. It is the first offshore gas province in Mexico, located off central Veracruz State.

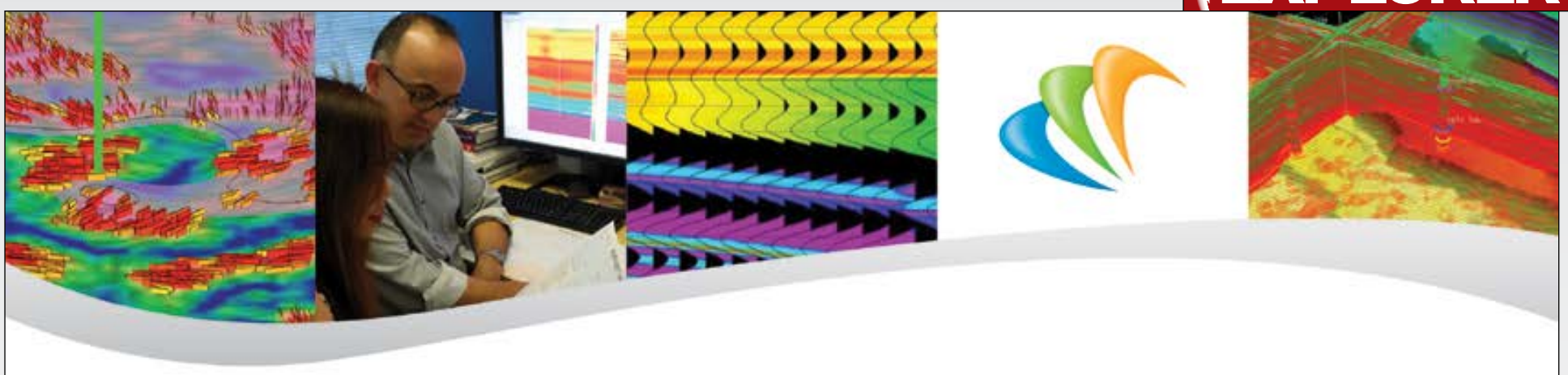
- Leading the discovery of six new offshore pools in the Tampico and Poza Rica shelf areas, with 300 million barrels of new light oil reserves, turning around a 50-year decline in the output of oil in the region.

- Implementing a new process for the evaluation of the exploration function at Pemex and the development of an exploration portfolio with more than 2,500 opportunities – up from a previous count of 40.

- Initiating a development project for the Chicontepec Paleochannel, a resource play located in northern Veracruz that has more than 100 billion barrels of original oil-in-place and 50 trillion cubic feet of original gas-in-place.

While at Pemex, Guzmán expressed

See **Vision**, page 24



Nothing Left Behind

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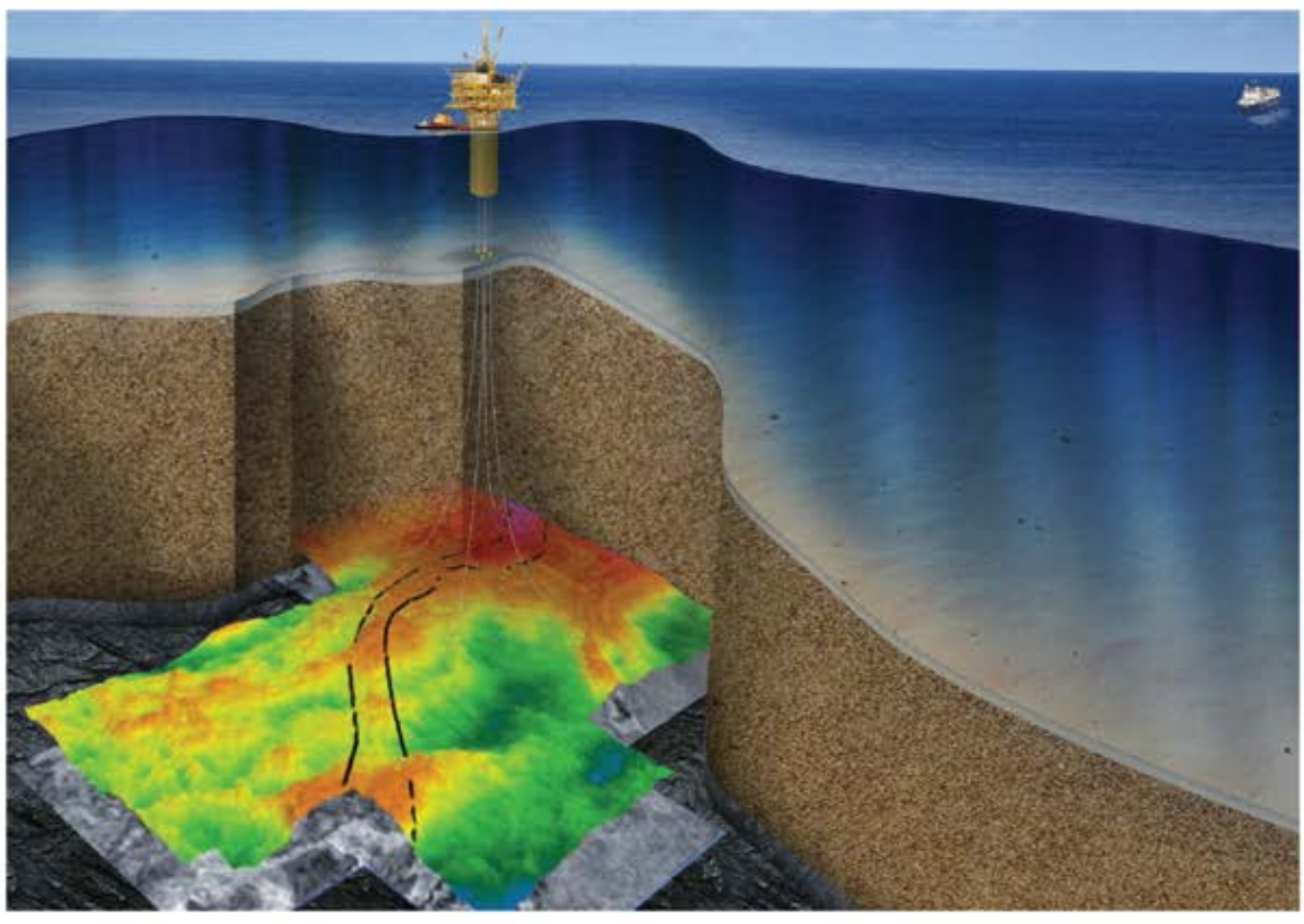

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Guzmán (second from the right) with Mexico's President Fox (blue shirt).

Vision

from page 22

the need for Mexico to open its doors to third-party investors when the country began to experience a decline in production of its largest oil field, the offshore Cantarell, in 2004. The idea was highly controversial at the time, but it was the only obvious path to enabling the world's 10th largest producer to reach its full potential.

"He guided Pemex into offshore areas of exploration and pressed for innovation at a time when such was not popular," said Scott Tinker, a past AAPG president and the director of the Bureau of Economic Geology, State Geologist of Texas. "Alfredo's vision is now being borne out by the actions of the Mexican government."

A New Mexico

As a result of Mexico's energy reforms, which were signed into law in December 2013, operators north of the border and beyond are jumping at opportunities to explore and exploit the country's hydrocarbon-rich fields.

Mexico has discovered in its subsurface 263 billion barrels of oil and 279 trillion cubic feet of gas, Guzmán said – and those numbers do not include the "yet-to-be-found" conventional and unconventional resources.

If Pemex's estimate of 435 billion barrels of oil equivalent for the country's total endowment is correct, there are at least 159 billion barrels of oil equivalent to be produced, Guzmán explained.

To date, just six of its 12 basins with petroleum systems are currently producing.

Guzmán grew up in a county that relied on its national oil company to provide 30 to 40 percent of its income in revenues. Although his father was a petroleum geologist at Pemex and former vice president of the AAPG, Guzmán initially felt a different pull in college.

"Actually I liked chemistry, but during my first semester at Texas Tech University I had to take a course in an additional science, and a professor I had, Vestal L. Yeats, showed me how fulfilling and rewarding geology could be," Guzmán said. "Once I chose my career, my father was highly influential in my choosing petroleum geology and in exposing me to the AAPG."

Guzmán entered the field of petroleum geology in 1970 as a field assistant for the Minerals Exploration Company, a subsidiary of Unocal, in northwestern Mexico. He joined Pemex four years later as a field geologist and went on to become:

- Burgos Basin Integral Project team leader.
- Exploration manager of the North Region Strategic Business Unit in northern Mexico.
- Planning manager of the North Region Strategic Business Unit.
- Vice president of exploration for all of Mexico.
- Vice president of the North Region.

Mexico's Moment

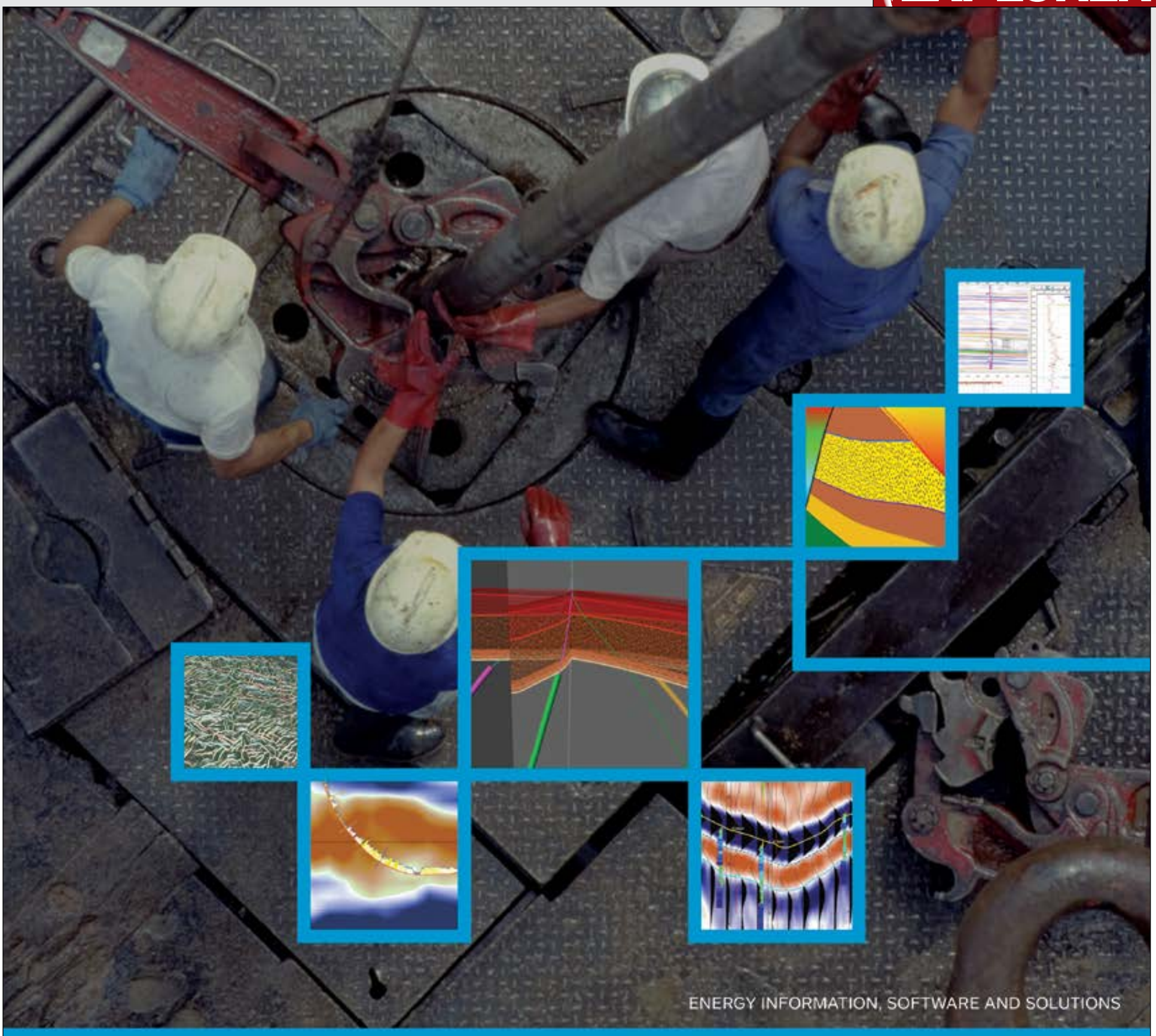
A career at Pemex spanning 33 years paired with a year as a commissioner for the National Hydrocarbons Commission in 2009-10, Guzmán – if anyone – knew what Mexico needed to up its game for its citizens and in the international playing field. Currently, people in Mexico pay six times more for electricity than those in the United States, Guzmán explained.

"It was impossible for just one company to explore the whole country and produce all that was needed, especially after Cantarell started declining," he said, explaining that Cantarell and just a handful of Mexico's 600 oil fields were producing more than 90 percent of the country's total.

As a commissioner for the National Hydrocarbons Commission, Guzmán lobbied for the creation of a "development area" to connect exploration and production at Pemex, as many of the fields Pemex discovered could not be produced because of a lack of people with subsurface skills.

"It is expected that third party

See **Interaction**, page 26



Not just an office guy: Guzmán at the site of a gas well blow out.

Interaction

from page 24

participation will increase the investment in the oil and gas sector from approximately $23 billion a year to more than three times that amount," Guzmán said.

"Oil production, which has been declining since 2004, will increase to an estimated 3.5 to four million barrels of oil per day by 2018," he continued. "Gas output should increase from its current six billion cubic feet per day to more than eight billion cubic feet."

Working Together

To help push Mexico forward, Guzmán recognized the need for interdisciplinary teams early on and created them within Pemex.

"It is important for geoscientists to interact on multidisciplinary fronts," he said, "in order to promote their ideas and concepts."

On a macrocosmic level, Guzmán has done the same in his involvement with AAPG – working to connect countries and cultures to enhance working relationships and, ultimately, productivity.

A member since 1969, Guzmán has participated in or served as the following:

- International Distinguished Lecture Committee in 1991, 1997 and 1999.
- Visiting Geologist Committee since 1999.
- Annual convention session chair.
- General chair for the 2004 AAPG International Conference and Exhibition in Cancun, Mexico.
- President of the Latin America Region in 2003-04.
- Vice president-Regions 2010-11.

"When I think of Alfredo, I always recall him talking to me once, giving credit to the AAPG for the short courses he took and lectures at conventions he attended that inspired him to go back to his drawing board in Mexico and apply what he learned to finding more oil and gas," said Robbie Gries, president of Priority Oil and Gas and an AAPG past president, Honorary member and previous winner of the Halbouty Leadership Award.

"He credits the AAPG for the valued enhancement of his own professional life."

Guzmán was recognized by AAPG in 2002 at the luncheon of the Heritage of the Petroleum Geologist, given by the Division of Professional Affairs/ Society of Independent Professional Earth Scientists. That recognition was followed by his receiving the AAPG Distinguished Service Award in 2007 and the Statesmanship Award from the Gulf Coast Association of Geological Societies in Corpus Christi, Texas in 2007.

He has published more than 100 papers and made more than 200 presentations for AAPG and its affiliates throughout his career.

"We have to continue the globalization process of the AAPG if we are going to go into our second 100 years as a truly international organization," Guzmán said. "We have to work hard to increase our membership, to include more young professionals and to be a more diverse group. We have to have more women entering our profession as well as in our organization."

A Change of Direction

After retiring from Pemex in 2007, Guzmán worked as a consultant for several oil and gas companies before joining Casa Exploration as its director of exploration and new ventures in 2014.

Initially focused on South America, the company quickly changed directions when Mexico announced its plans to reform its energy sector.

With the backing of savvy and professional investors, Casa Exploration expects to have a significant short-term impact on Mexico's efforts to increase its production and reserves, Guzmán said.

"The possibility for private third parties to invest in the exploration, development and production of Mexico's oil and gas resources will have only positive results," he said.

"It means more income for the government," he added, "more energy for the people at lower costs, jobs and an increased GDP for the country."

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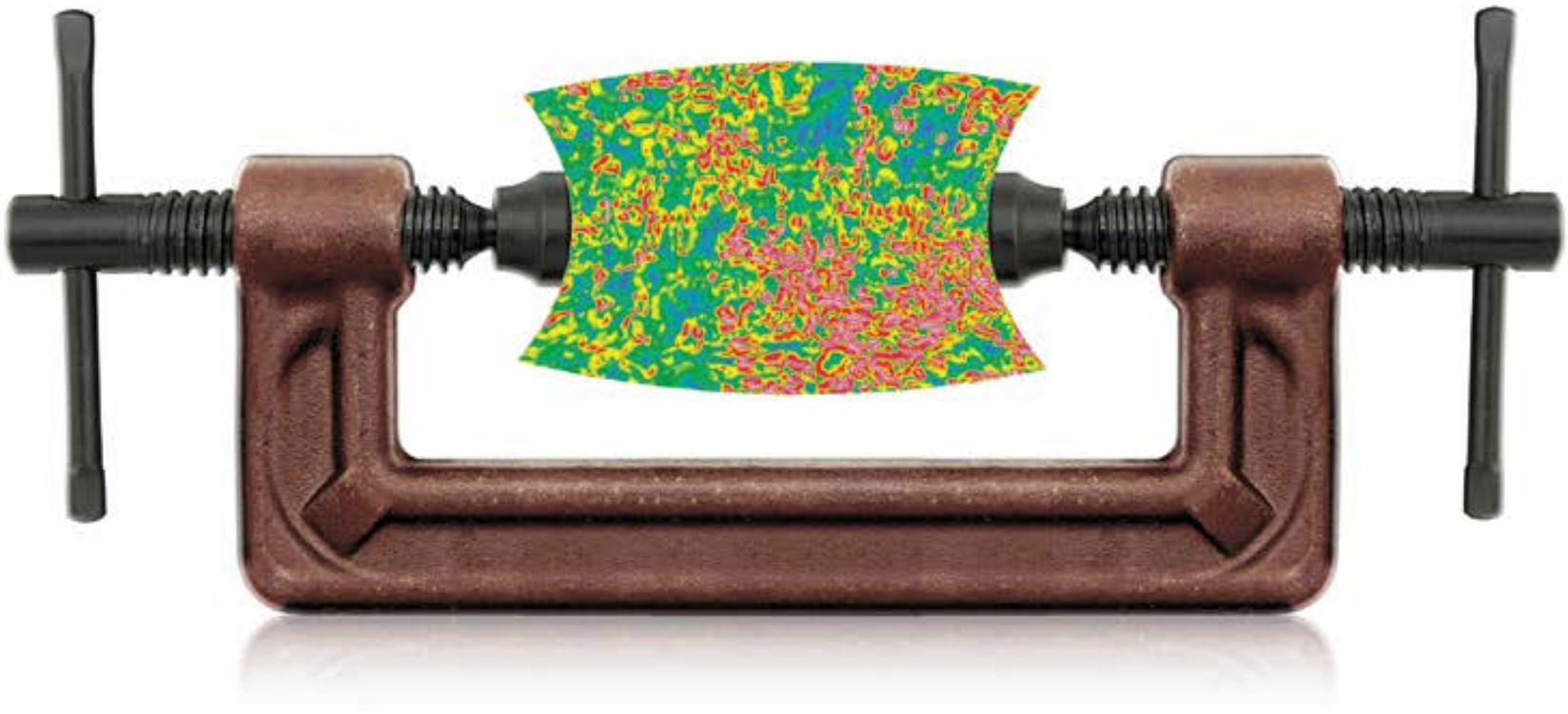

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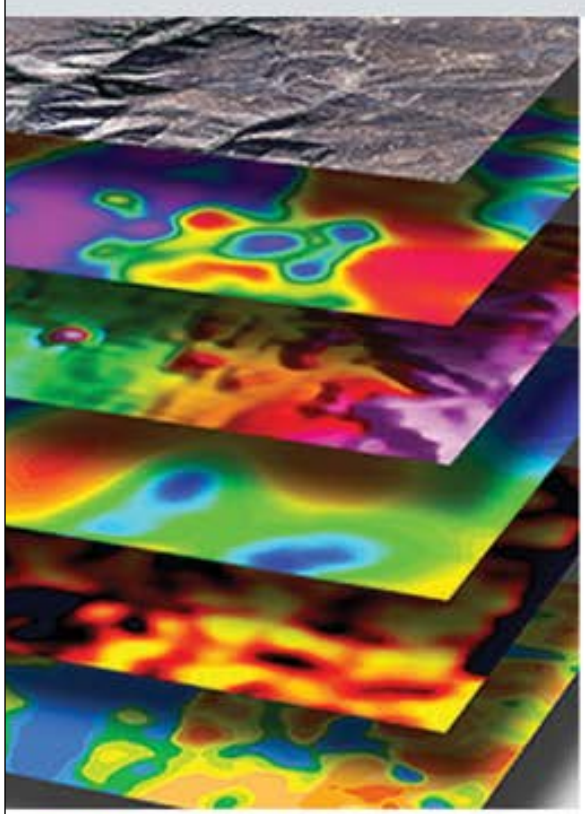

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Robert R. Berg/Wallace E. Pratt Awards

Milliken: Finding the Upside of a Downturn

By HEATHER SAUCIER, EXPLORER Correspondent

While not wanting to be dismissive of the current downturn in the oil and gas industry, Kitty L. Milliken – winner of AAPG's Robert R. Berg Outstanding Research Award and co-recipient of the Wallace E. Pratt Memorial Award for best AAPG Bulletin article – points out that had she not been laid off during the 1980s' oil glut, she might be applauding others for groundbreaking research benefitting the nation's shale energy boom.

Today, Milliken works as a senior research scientist at the Bureau of Economic Geology (BEG) in Austin, Texas, and is a global authority on sedimentary petrography, the microscopic description and classification of sedimentary rocks.

However, in 1986 – less than a year after she earned her doctorate degree in geology – she became a target of the Exxon Production Research Company's budget cuts, which prompted her to contact her former thesis adviser, Lynton S. Land, at the University of Texas at Austin for help.

"He said, 'Come back and we'll figure something out,'" she recalled. "I was given a table in the corner of a lab, and that was my desk for the next 20 years."

As a sedimentary petrologist, Milliken's initial interests focused on the microscopic makeup of carbonates and sandstones. Yet when the trying times of the 1980s took her back to her alma mater's research laboratory – where she initially was paid a salary equivalent to that of an undergraduate research assistant – she turned her attention toward mudrocks, known in the industry as shales.

Room with a view: Milliken drilling Nankai mud on the Chikyu (with Arito Sakaguchi).

As a result of her creative thinking, integrative research, and willingness to spend hours in a darkened room watching the raster of a scanning electron microscope screen, Milliken today is performing invaluable research and posing testable hypotheses about crystals smaller than 0.0625 millimeters that dominate in mudrocks.

"My research has applicability in helping people in the industry make more informed decisions about which rocks are going to be favorable for hydraulic fracturing," said Milliken, who also serves as president of the Society for Sedimentary Geology. "My work is aimed at improving our ability to make predictions about porosity and mechanical rock properties – things that matter in production."

When discussing the rarity of a geologist winning two AAPG awards in one year, Milliken said the only word that comes to mind is "flabbergasted."

And to think it all began with a childhood affinity for small things.

Let's Get Small

As a child in Franklin, Ky., Milliken played in the streambeds and fields near her home, examining chert nodules and other bits of silicified limestone with fossils and quartz crystals that she remembers as "treasures."

"I loved looking at their detailed features and soon had boxes and boxes filled with rocks," she recalled.

Even today, she has a marble and stone sphere collection that continues to grow.

"There are all kinds of variations and they are beautiful. It's the same thing with sand grains," she said. "You can't come to an understanding about mudrocks and not focus on the tiny details."

The small details that catch Milliken's eye are the tiny pores and crystals in mudrocks. Her work is to decipher their implications for a lucrative hydraulic fracturing operation.

In her award-winning 2013 paper titled, "Organic Matter-Hosted Pore System, Marcellus Formation (Devonian), Pennsylvania," which she co-authored with colleagues from ExxonMobil and the BEG, she reports observations that were intended to link porosity with a mudrock's thermal maturity.

Her findings – which were not at all what she had predicted – revealed that a rock's porosity may be more closely linked to its organic content than its thermal maturity (although she admits she would

See **Uncertainties**, page 30

Looking at shales on Svalbard.

Uncertainties

from page 28

like to conduct further testing in additional localities).

"I like research because I like uncertainties," she said. "You don't know what the answer is, so you go and find out. My hope is that people will take the observations I've made, and the conclusions that come out of my research, into the real world and test them.

"I'm not in the practice of exploring for oil or gas," she said, "but for the people who do, perhaps they can take my results and have better success."

Also noteworthy is Milliken's large repertoire of highly cited journal articles and book chapters, said her colleague Kathleen Marsaglia, an AAPG member and professor in the geosciences department at California State University Northridge. Milliken also has developed several educational products, including the AAPG sandstone and carbonate digital tutorial sets and a recent compendium focused on the identification of the components of marine mud, which is available to the public at: iodp.tamu.edu/publications/TN.

Trying Something New

After completing her master's thesis in 1977 on the stable isotopic geochemistry of silicification features in the Mississippian limestones of southern Kentucky and northern Tennessee, Milliken ventured into what was at the time uncharted waters and applied stable isotopes to sandstones – integrating microscopy and chemistry in an effort to understand chemical history.

"Integration of imaging and analysis has been the theme of my research throughout my whole career," Milliken said.

As she worked to understand diagenesis – the process of chemical and mechanical changes that occur in rocks in the subsurface – in sandstones, she realized that sandstones could not be fully understood without understanding mudrocks, as mudrocks comprise more than two-thirds of sedimentary rocks.

At first, she worked on the thick mudrocks of the Gulf of Mexico but eventually expanded her work into different basins, in Italy, the Appalachians and the Iberian margin. After joining the BEG in 2008, Milliken continued her mudrock focus, but with a much broader community taking an interest.

Mudrock components are so small they require a scanning electron microscope to be examined. So, Milliken's affinity for small things became larger, in a way, expanding into additional groups of rocks and the use of more expensive equipment.

With an electron microscope, Milliken found that the architecture and chemistry of mudrocks have a particulate structure that is completely analogous to sandstones, and that mudrocks are subject to a similar range of processes that contribute to lithification and loss of porosity as they are buried.

Her work and her modesty have caught the attention of many over the years.

"Kitty – I don't think anyone calls her 'Dr. Milliken' – has done groundbreaking work on diagenesis and sedimentology, most recently on the fine-grained sedimentary rocks," said geologist and petrophysicist Terri Olson, an AAPG member and colleague of Milliken. "She is fun to work with and a popular speaker."

Marsaglia describes her peer as "a meticulous and insightful scientist of the highest caliber who literally probes diagenetic processes and sediment provenance from the basin level down to the atomic scale."

The Value of Research

While braving the roller coaster of the '80s – her paycheck varying with the success of grant proposals – Milliken used that desk in the corner of the lab to carve out a niche for herself.

"It was an outstanding research situation because I had unfettered access to equipment and a creative bunch of colleagues," she said. As a result, Milliken has made herself practically irreplaceable.

"Maybe I was stubborn to the point of absurdity, but at the time I knew that microscopy and diagenesis were important and I just couldn't abandon these topics," she said.

Understanding that research is often the

See **Research**, page 34

Robert R. Berg Outstanding Research Award

Zoback: Bridging the Gap Between Lab and Industry

By DAVID BROWN, EXPLORER Correspondent

Did seismology suddenly become sexy?

AAPG member Mark Zoback started his career with an interest in obscure areas of geoscience, trying to figure out how research could help solve practical, real-world problems.

And they truly were obscure areas – things like geomechanics, in-situ stress, natural and generated seismicity and the effects of hydraulic fracturing.

At that time, "I had no idea hydraulic fracturing and induced seismicity would be important 30 years later," he said.

Not only did his areas of research become important, they went straight to the forefront of what the oil and gas industry is doing today.

Zoback, professor of geophysics in Stanford University's School of Earth, Energy and Environmental Science, has been named a 2015 recipient of AAPG's Robert R. Berg Outstanding Research Award.

"What I feel like I've tried to do in my career, and what I'm most proud of," Zoback said, "is bridging the gap between the concepts in the laboratory and in academia with real-world problems faced in the petroleum industry and related industry."

(Can Get) Satisfaction

AAPG bestows the Robert R. Berg Award in recognition of a singular achievement in petroleum geoscience research.


ZOBACK

> "Twenty years ago we had to explain what 'geomechanics' was. Now hundreds or thousands of times the industry uses our work as routine models."

Zoback's research has advanced the industry's understanding and application of geomechanics, but he's also done important work in other areas.

His colleagues and other experts cite him:

- As a pioneer in the science of modeling geomechanics using well data, pore pressure, rock properties and other information.
- As a researcher whose work has helped to mitigate the risks of wellbore stability.
- As a developer of proven, and now industry-standard, techniques for determining in-situ stress.
- As a leader of research into the characteristics and geomechanics of shale reservoirs and unconventional reservoir stimulation.
- As conceptual developer of the critically-stressed-fault hypothesis.
- As co-founder of GeoMechanics International.
- As principal investigator for the San Andreas Fault Observatory at Depth Project.
- As an outstanding teacher for dozens and dozens of students who later established careers in the oil and gas industry.
- As author of the textbook "Reservoir Geomechanics."

Add to that Zoback's contributions to public policy and social awareness, notably his service on a National Academies committee investigating the Deepwater Horizon accident, on a U.S. Secretary of Energy's committee on shale gas development and environmental protection, and on a Canadian Council of Academies panel on the same subject.

"Twenty years ago we had to explain what 'geomechanics' was. Now hundreds or thousands of times the industry uses our work as routine models," he said. "That gives me tremendous satisfaction."

Testing, Testing …

After growing up in Tucson, Ariz., Zoback became the first member of his family to attend college. He received a degree in geophysics from the University of Arizona, then earned his master's degree, then doctorate in geophysics at Stanford University.

He felt an early attraction to geology but wanted "something less descriptive and more quantitative," switched to seismic and Earth-stress studies, and in the end "did my Ph.D. studying rock deformation in earthquakes – rock deformation and fluid flow in the Earth," he said.

That started him on the path to post-doctoral work with the U.S. Geological Survey, where he served as chief of the In-Situ Stress Measurement Project from 1976-80 and of the Branch of Tectonophysics from 1981-84.

His formative experiences as a researcher included work with the oil and gas industry and an early attempt to understand the process and effects of hydraulic fracturing.

"I first did some work on hydraulic fracturing as a researcher. Then I went into the field and probably did a hundred small hydraulic fracturing projects myself," Zoback recalled.

"We actually built a logging truck to house the instruments," he said, "and ran

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Experiment
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the instruments ourselves."

Work in the oilfield appealed to him, and he called that experience the most fun he's had as a researcher.

"Early in my career I had to work around drilling rigs, a lot. I spent a lot of time in the field. That has had just tremendous benefit to my career," Zoback noted.

"A drilling project is a giant experiment, right?" he said.

Needed: Solutions

He served as chairman of Stanford's Department of Geophysics from 1991-97, and since then has become involved in numerous research projects, many directly related to oil and gas. In 2014 he became director of the Stanford Natural Gas Initiative, which examines the implications of tremendous growth in natural gas production.

Zoback called himself "a very strong proponent of responsible oil and gas development" and of environmental quality, and said "the enhanced use of natural gas is a big part of what we can do."

Much of his research in recent years has been devoted to unconventional resources, including the development of production from shale reservoirs.

"For the last seven or eight years I've been focused on understanding the geomechanics of these unconventionals, for all the obvious reasons," Zoback said.

In March, the U.S. Department of the Interior released new regulations for the use of hydraulic fracturing on federal and tribal lands. Zoback served on the panel that advised the government on hydrofracturing and that helped devise the regulations.

The new rules drew criticism from some parts of the oil and gas industry, and Wyoming and North Dakota have challenged the regulations in court – but in comments Zoback has defended the government's position.

"In general I thought it was all steps in the right direction. The devil is in the details, of course," he said. "Like-minded people might disagree on the details, but there are real problems out there that need solutions – meaningful, impactful, but not burdensome."

Something Big

Another high-profile issue attracting Zoback's attention is the recent increase in earthquake activity in the middle of the United States, especially the question of induced seismicity in Oklahoma.

He noted that Stanford has nine professors working on the subject of induced seismicity, and said he has co-authored a soon-to-be-published paper that directly addresses the Oklahoma earthquake situation.

Zoback sees environmental concerns having an ever-larger effect on the oil and gas industry, as it is pressed to meet the world's growing energy needs.

"I think the big challenge is the coming challenge of providing energy for society while protecting the environment," he explained.

"When I talk to my students today, I tell them it's not just a case of switching from dirty fuel to clean fuel. It's a long-term process, to decarbonize the energy system while doubling it in size, and allowing for economic growth while protecting the environment and meeting societal norms," he said.

And Zoback said his students are responding to that challenge, as they see the energy-environment story playing out on a global scale.

"I think it's compelling to students because they feel like they're part of something big," he said.

Zoback plans to continue "doing research in fundamental science that has applications to real-world situations. The most important part comes down to being able to quantify and measure forces in the Earth to solve practical problems.

"I don't want to pretend I'm sitting in a rocking chair in a self-satisfied way," he said. "Good researchers are never satisfied."

Research
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first expenditure cut during challenging times, Milliken offers a fresh perspective for those in an oil-saturated market.

"The value of research has gone up a lot. The need to make better predictions has become greater," she said. "Although research does cost money, it is still cheap compared to one bad well. You can lose millions with one bad well, but less than that can keep me and several colleagues going for quite a while."

Milliken makes sure to emphasize the value of research in the many talks she gives to audiences that range from junior high students to esteemed colleagues. As she expresses utter delight of the fine details of a rock, she wants all to know why something so small is so important.

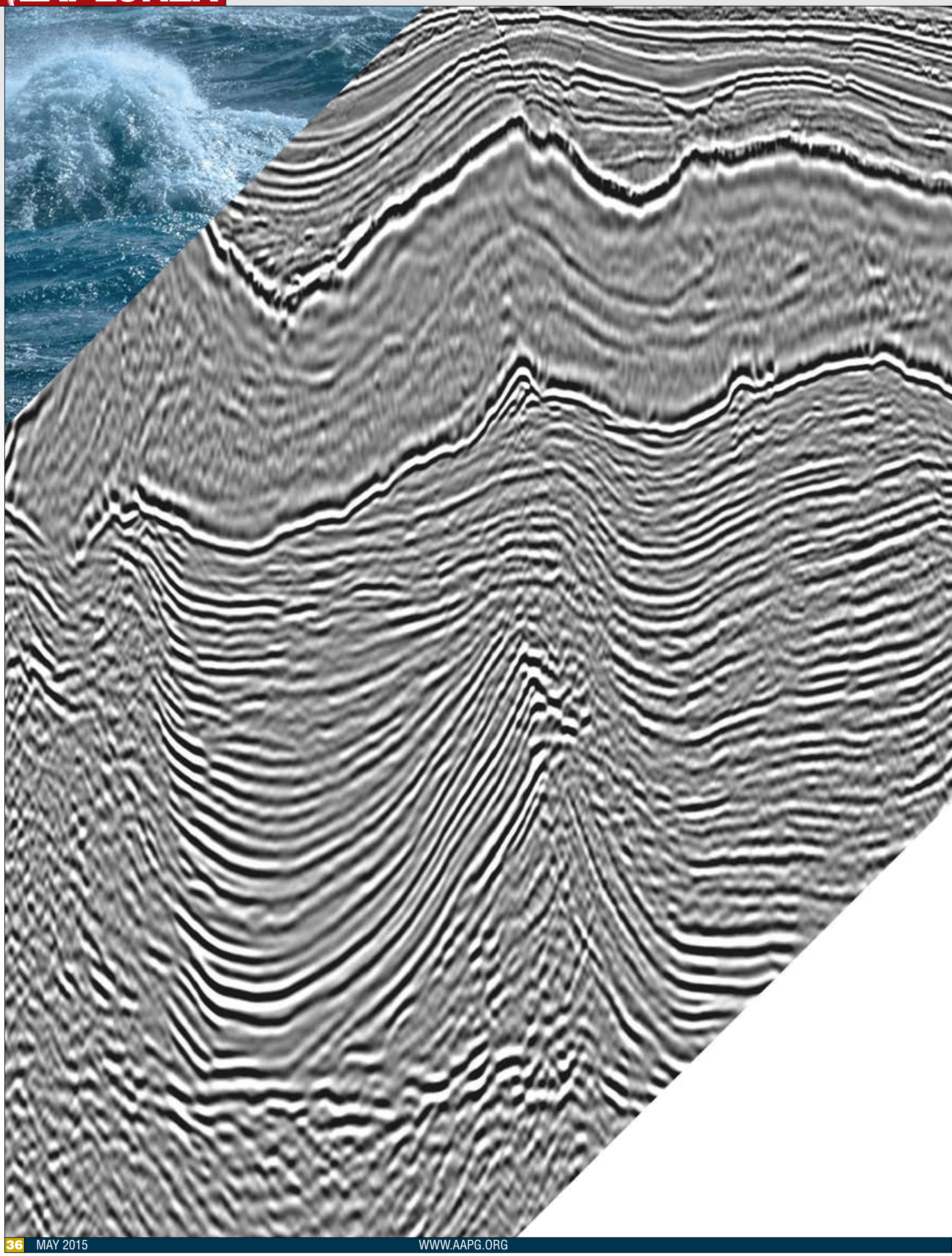
Why should people care that tiny quartz crystals precipitate?

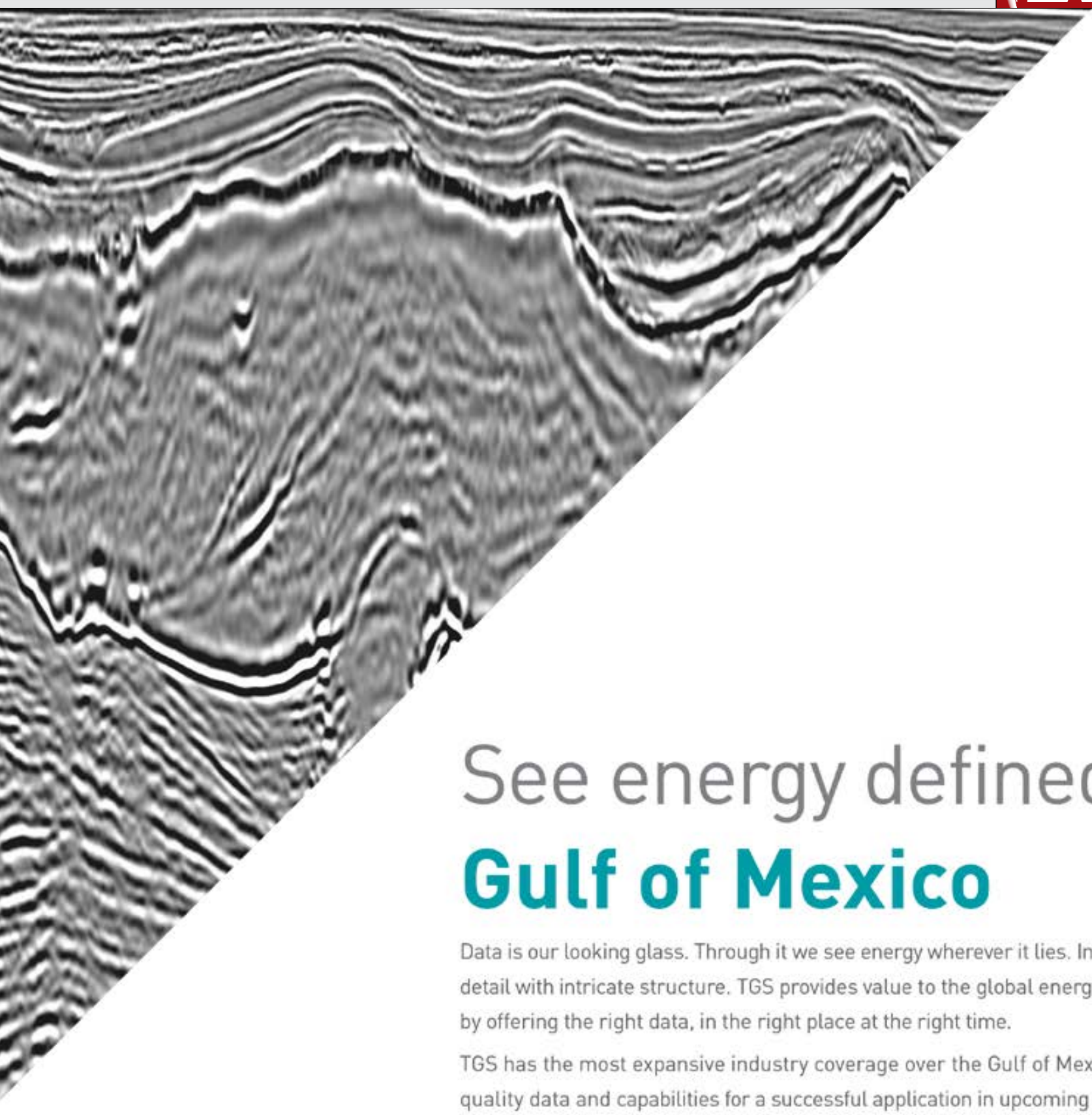
"That's a big issue in the mechanical behavior in some shales," Milliken said. "Some are brittle because they have a mass of tiny micro-crystalline quartz that binds the rocks together and makes them hard. If you understand why these crystals form and when they formed and what controlled how abundant they are, that ties directly back to our ability to make predictions of fracturing behavior."

It is Milliken's hope that her and others' research will help to build more accurate models for exploration and development.

"Because mudrocks are fundamentally like sandstones, we can reasonably expect there is the same potential for predictive models to be developed at a variety of scales," she said. "The models might be different because mudrocks differ from sandstones in detail, but the broad characteristics are the same.

"We are still learning about this," she added. "It will be interesting to see what happens."





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Harrison Schmitt Award

Anita Harris: Color Her World, With Love

By HEATHER SAUCIER, EXPLORER Correspondent

In 1977, an editorial threw the spotlight on AAPG member Anita G. Harris – an obscure paleontologist with the U.S. Geological Survey (USGS) who had developed a groundbreaking technique for exploring for hydrocarbons.

The piece specifically praised Harris' Color Alteration Index (CAI), which burst onto the geological scene in the 1970s after Harris demonstrated that the color of tiny fossils embedded in a variety of sedimentary rocks could determine the rocks' thermal maturity and whether or not the rocks were present within the "oil window."

Published by the Newspaper Enterprise Association, the editorial noted the many requests Harris received from oil companies all over the United States, Great Britain and the Soviet Union, and that she could have been rich had she performed her research privately.

Harris didn't seem to care.

"I like it in government," she was quoted as saying. "I like it more than money."

Anita Harris, at work in the Franklin Mountains of Texas, will be honored posthumously at ACE.

One of a Kind

Feisty. Funny. Determined. Competitive. Brilliant. Generous.

The words used to describe Harris, who died last July at age 77 after suffering from dementia, remain free-flowing as former colleagues and relatives remember Harris in advance of her posthumously receiving the AAPG Harrison Schmitt Award at the upcoming AAPG Annual Convention and Exhibition in Denver.

Meant for those who have made outstanding contributions to science, yet whose work falls outside the more defined categories of other AAPG awards, the Schmitt Award seems the perfect fit for Harris. For she, herself, made sure that if ever put into a box, she would bust out of it with one punch.

Growing up poor in Brooklyn, N.Y., with not much to look at except ships being built in the U.S. Navy Yard, Harris saw science as a way out of a dismal situation.

"She saw geology as a way to see the world," said David Fey, a geochemist with the USGS and former colleague who sometimes provided housing for Harris when she worked in Denver during the summers.

Bustling her way through a man's world, Harris enrolled in Brooklyn College at age 16 and graduated with degrees in geology and physics in 1957. She then made a beeline to Indiana University where she worked on her master's degree and studied geophysics in the late 1950s, after which she married USGS geologist emeritus Jack Epstein. (She married the late Leonard Harris, a structural geologist with the USGS, in 1977.)

After a brief stint teaching high school in Louisiana – a job she was forced to take because the USGS would not allow her to work alongside her spouse – she earned a doctorate degree in geology from Ohio State University in 1969. As controversial as her place might have been among her male peers, Harris outperformed most, topping her success with a graduate fellowship from the National Science Foundation.

When urged by professors and employers to abandon her theories that linked the colors of conodonts – tooth-like fossils found in the late Cambrian through the Triassic period – with a rock's thermal history, Harris studied them at home. She baked them in her oven and watched their colors change with varying temperatures.

"We would tease her from time to time about her Betty Crocker oven," said Nancy Stamm, a USGS geologist and former long-time assistant of Harris.

When Harris proved that the different colors of conodonts were directly linked to the peak temperatures of rocks, hundreds in the geological community and in the industry began knocking on her door.

She gladly accepted requests to analyze rock samples shipped to her from all over the world. She also traveled with her library and micro-slides to help

See **Harris**, page 40

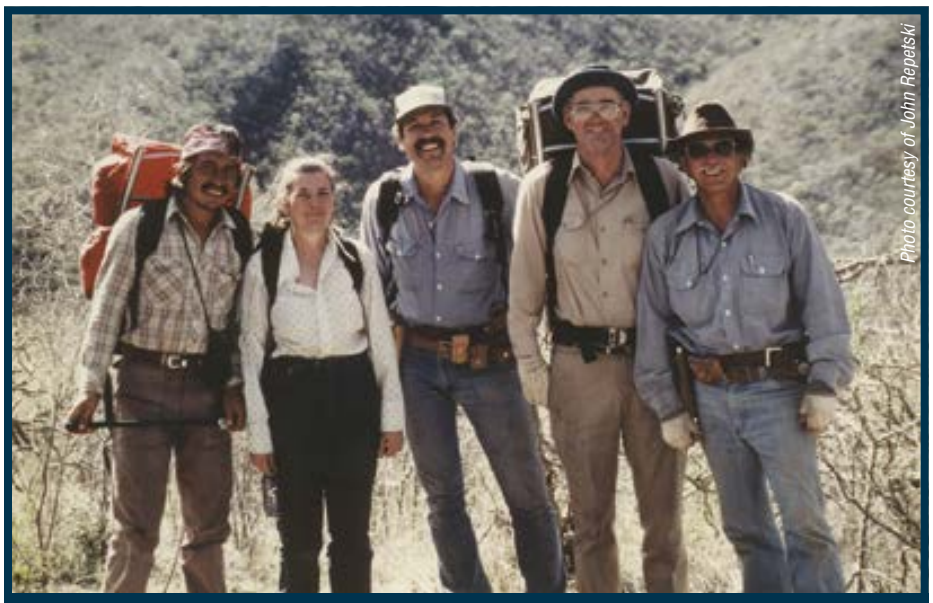

Photo courtesy of John Repetski

Outstanding in her field: Anita Harris with fellow geologists in Sierra Agua Verde, Sonora, Mexico.

Harris

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geologists better understand their rocks. She especially welcomed students from other countries who wanted to learn how to the use the CAI – often letting them stay in her home and drive her car.

"She made them pay attention to what they were walking on," Stamm recalled. "She took the time to get young minds to think for themselves. Her favorite saying was 'You only know what you see.' That's so true, especially in geology."

Her work drew accolades by the dozens. Yet, the one she coveted most was the Pander Society Medal – given selectively to conodont paleontologists who advance science – and up until Harris' time, given only to men.

Curious About Conodonts

While conducting research for her doctoral dissertation on ostracods in the Appalachians, Harris stumbled upon conodonts of varying colors – ranging from pale yellow to black – as she chipped her way from Ohio to New York. Intrigued by the differences, she mentioned her findings to her adviser, who promptly told her that the change in coloration was an anomaly with which she shouldn't concern herself.

Too curious to let it go, Harris began experimenting with conodonts on her own, believing their colors varied according to how deeply they were buried and consequently how hot they became.

Insulted that the USGS wanted to hire her as a physical science technician after completing her doctorate courses rather than as a junior geologist, Harris snubbed her nose at the agency until she was offered an assistant geologic map editor position in 1967, said AAPG member John Repetski, a USGS geologist and former colleague of Harris.

She accepted the job in Washington, D.C., to get her foot in the door.

While working at the USGS, Harris continued to cook conodonts at her home until she found a calibrated oven that could bake them at higher temperatures. She watched the fossils no larger than one-twentieth of an inch turn from pale yellow – their original color if never heated – to amber, to light brown, to darker brown to black, to grey and then to a crystalline white – all directly proportionate to the temperatures to which they were exposed.

She learned it was the organic content in the conodonts that actually changed color.

Comments from her peers that she might not excel as a geologist became fuel for Harris, who stood a mere five feet, two inches tall.

"She would do everything she could to prove otherwise," said Laura Neustater, Harris' only child. "When she had a hard time proving herself, she used strong, vulgar language. She was very competitive and whatever she did, it had to be the best or she was not happy."

"She was just filled with character," Stamm added. "She is sorely missed."

After a few years of processing countless rock samples with consistent results, Harris caught the attention of the chief of the Oil & Gas Branch of the USGS who began paying her one day a week to continue her research, Repetski said.

Color Alteration Index (CAI)

Harris' findings were published as a USGS Professional Paper in 1977 – three years after she was promoted to research geologist in the Paleontology and Stratigraphy Branch. (She co-authored the paper with Epstein and Leonard Harris.)

From her oven experiments, she initially indexed conodonts on a scale from 1 to 5, with "1" indicating a temperature of no greater than 50-80 degrees Celsius and "5" indicating a temperature range from 300 to 480 degrees Celsius.

In 1987, Harris published the second half the CAI (as a second author) with a scale that reached an "8," indicating temperatures of 600 degrees Celsius and higher.

She literally rocked the geological community with a new means to determine the thermal maturation of rocks. Although the technique could be used in the minerals industry to help locate potential gold deposits, it was more largely embraced by the oil and gas industry, Stamm said.

Using an acidic solution, "We probably

See **Color Alteration**, page 42

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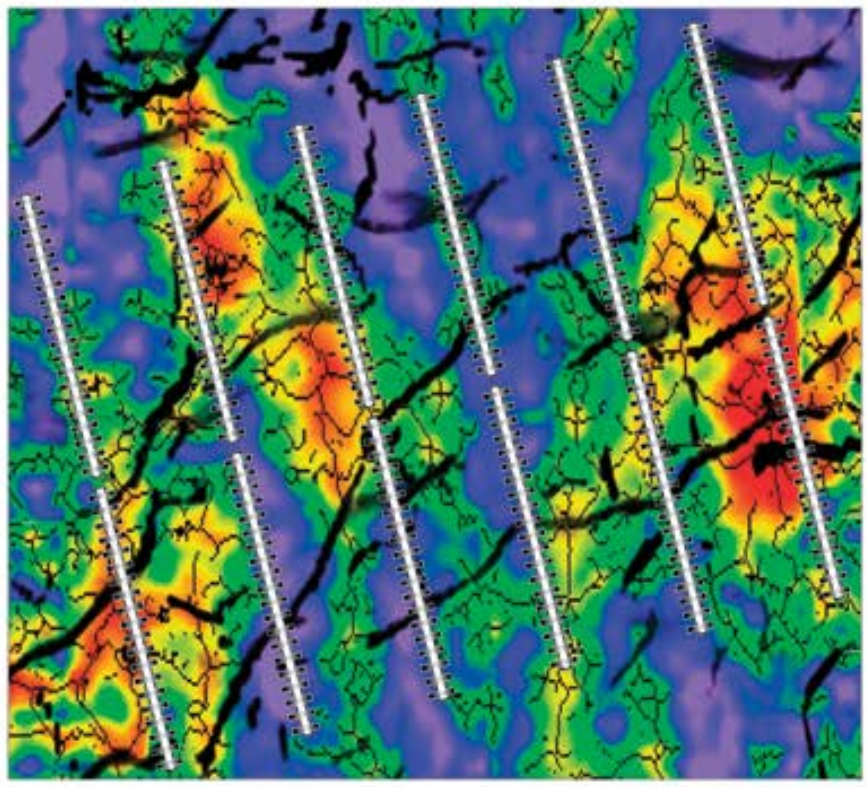

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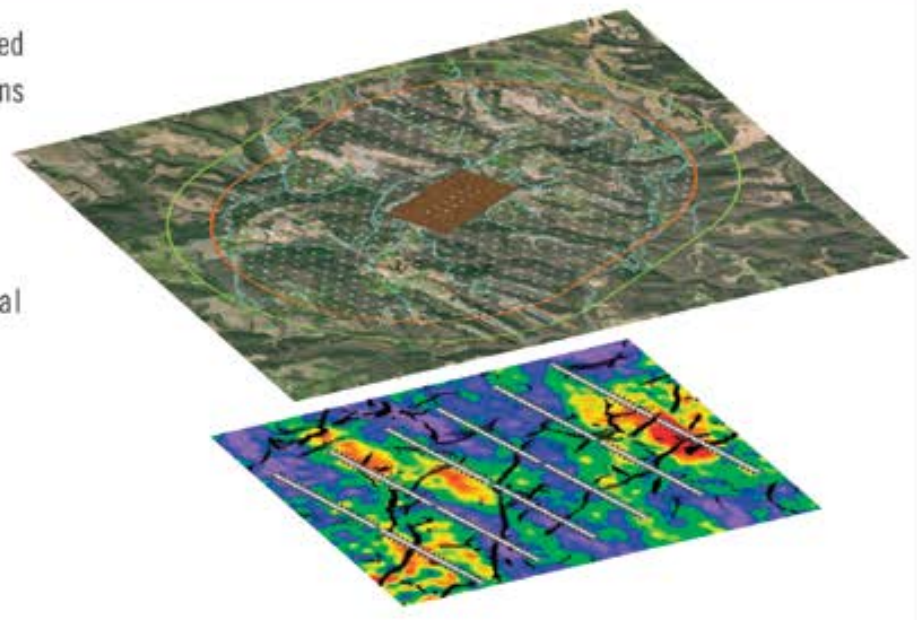

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Photo courtesy of Julie Dumoulin

Harris, a geologist praised by John McPhee.

Color Alteration

from page 40

dissolved a ton of rocks each year from all over looking for conodonts," Stamm said.

Rocks from the Appalachians, Alaska, Indiana, Ohio, China, Tibet and the Basin and Range provinces – including Nevada, southeast California, Idaho, Utah, Arizona and Sonora, Mexico – made their way into Harris' hands and eventually to others who trained to process and analyze them.

"It made a lot of careers for a lot of people," Repetski said of the CAI.

Part of Harris' collection of 18,000 microslides, as applied to the CAI, eventually became the base for regional oil and gas potential maps.

With Harris as her supervisor, Stamm threw all desires to attend graduate school out the window.

"I couldn't have learned more had I gone on and gotten my master's and Ph.D.," she said. "I wasn't going to miss anything."

That included many nights when Harris and Stamm searched for rock samples in the dark.

"We had the car lights shining on the outcrops and it was like go, go, go. She was a pistol," Stamm said. "She worked harder and longer hours than anyone I knew. Being a civil servant was very important to her."

Harris' work eventually took her to the Red Dog Mine and the Brooks Range in Alaska, where metamorphic rocks of previously unknown age could be dated using conodonts, said AAPG member Julie Dumoulin, a research geologist with the USGS.

"I feel incredibly lucky to have met her at the point in my career that I did," she said. "Her work allowed us to look at carbonate rocks in ways they had never been looked at before in Alaska and showed that you can unravel complex histories using conodonts as a tool."

Harris and Dumoulin often were transported by helicopter into the bush to collect sacks of rock samples weighing 10 kilograms each. To avoid numerous trips walking the sacks down the mountainsides, Harris sent them rolling like heavy tumbleweeds with a swift kick.

"Some would hit a large rock and explode, but most survived the trip," Dumoulin recalled. Then, Harris would mail the bags back to her office, where they would be lined up outside the door waiting for processing.

When emptied, Harris charged her young daughter with washing and ironing the bags alongside the family's linens to save the government money, Neustater recalled.

Unlike many conodont paleontologists who focus on one specific time interval, Harris worked the entire span of conodont history.

So dedicated to her science, Harris' official retirement from the USGS in 1999 carried no significance nor prompted any tears, for everyone knew she could never really leave.

"We didn't even bother having a retirement party for her," Stamm said, "because she was back in her office the next day."

Harris continued working for the USGS as an emeritus geologist, shuffling back and forth between the USGS offices in Reston, Va., and Denver and her home in Fort Lauderdale, Fla., near her daughter until 2008.

Rich In Spirit

While Harris told many she became a geologist to escape being poor, her dedication to the government and to science show that she sought greater things than money.

Throughout her career, Harris gave more than 80 lectures, authored or co-authored an estimated 150-200 journals and reports, and served as adviser or co-adviser for 14 theses and dissertations. She even managed two rare (for a USGS employee) teaching sabbaticals at Duke and Case Western Reserve universities, where she taught Appalachian geology to upper level undergraduate and graduate students.

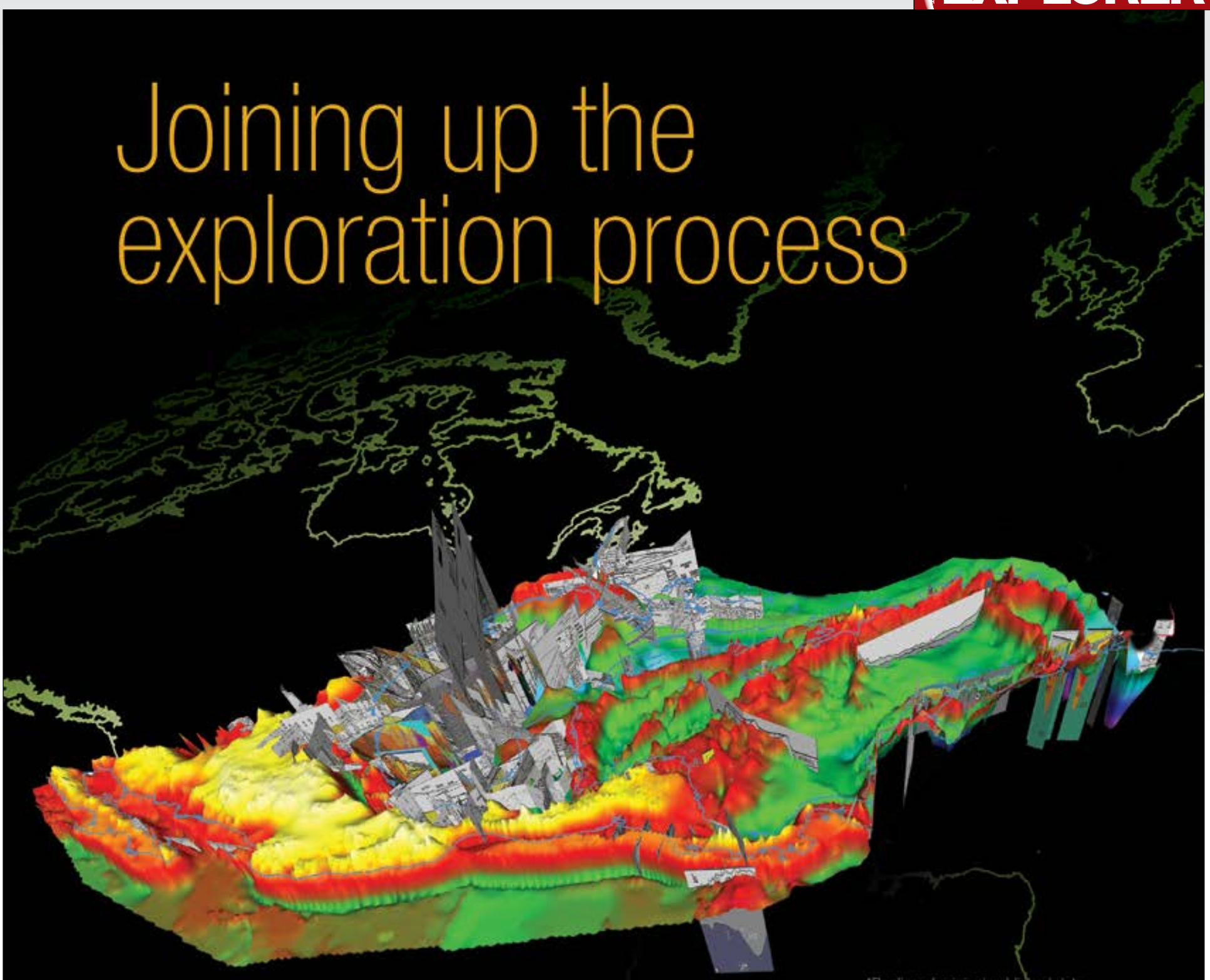
She also was given the Meritorious Service Award and the Distinguished Service Award from the U.S. Department of the Interior – the two highest awards for civilian government work.

Harris appeared on the PBS children's science television show 3-2-1 CONTACT – during which she unleashed a few curse words when an experiment went awry. And she also was the subject of an obscure film for IBM with former professional football quarterback Joe Montana in which footballs and fossils were somehow linked, as humorously pointed out in her curriculum vitae.

She eventually caught the attention of American writer John McPhee, who raised her status in the geologic community even higher when he wrote about her life and her work in a 1983 book titled "In Suspect Terrain," later published in 1999 in "Annals of the Former World," a geological history of North America.

Forever memorialized, Harris remains highly regarded. Although her last years were darkened with dementia, stealing away those parts of her mind and personality that endeared her to so many, the no-nonsense yet hilarious Harris seems to have left a permanent mark on countless people and on geology itself.

Joining up the exploration process



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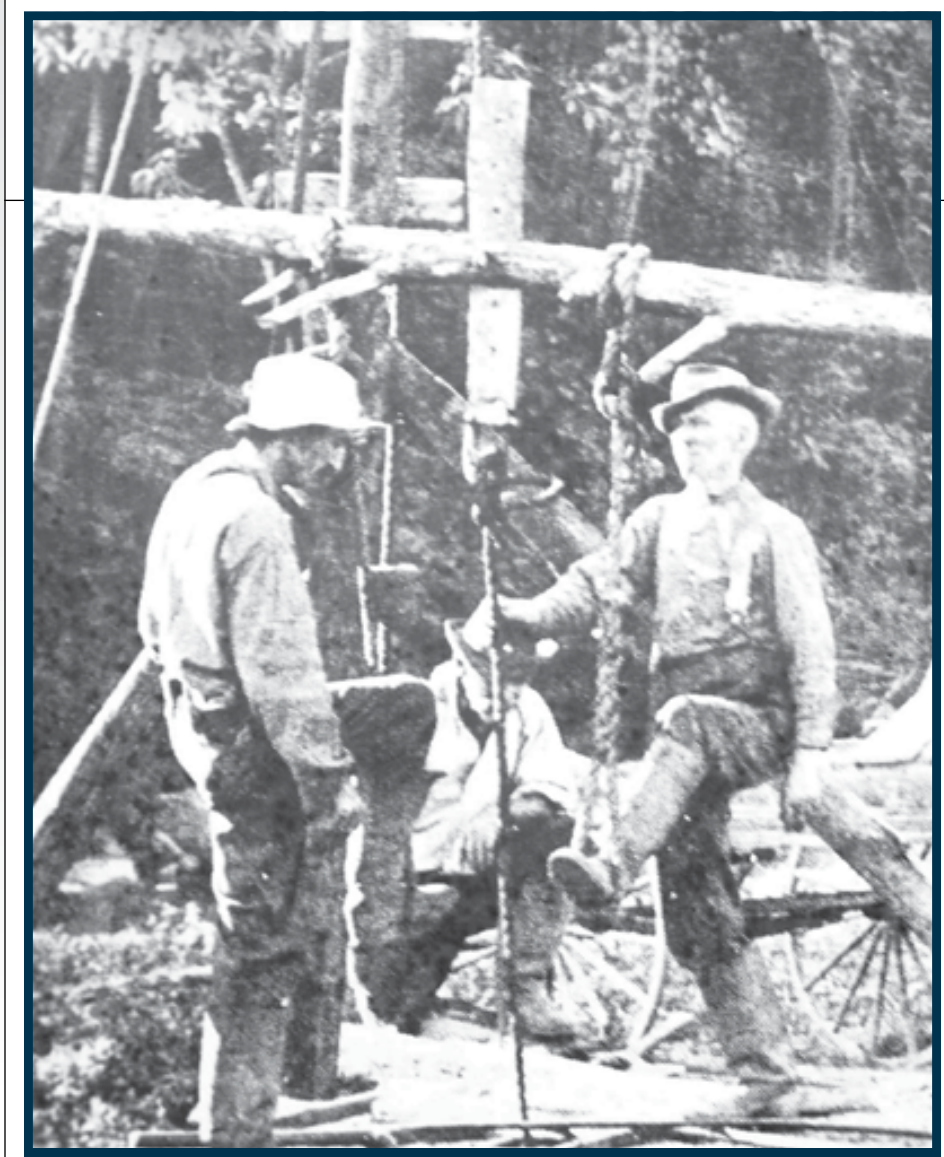

This is believed to be a picture (taken in the late 1800s) showing a re-enactment of the kicking-down of Barmore's well. Barmore is portrayed by the person on the left.

The Unsung 'Father of the Natural Gas Industry'

By GARY G. LASH and EILEEN P. LASH

In the numerous histories written of the development of natural gas and oil in the United States, one name rarely encountered is that of Preston Barmore.

This oversight likely is more a reflection of the sadly short life of this unassuming young man rather than any lack of contribution on his part to the burgeoning hydrocarbon industry of the late 19th century.

BARMORE

Indeed, there is little doubt that Barmore's advanced level of scientific and engineering thinking contributed much to our understanding of natural gas production from modern gas shale plays, including the Marcellus Shale and Utica Shale.

Preston Barmore was born in 1831 in Forrestville, N.Y., eight miles east of the somewhat larger village of Fredonia, N.Y., where only six years earlier, in 1825, William Hart had drilled what is generally recognized to be the first commercial natural gas well in the United States along the banks of Canadaway Creek.

Barmore received his formal education at the prestigious Fredonia Academy – the first institution of higher education in Chautauqua County and the forerunner of the State University of New York, Fredonia. He attended the Academy from August 1847 through spring 1851, taking the typical range of required courses for the time, which included a course on geology using Edward Hitchcock's "Elementary Geology," published in 1840.

Following graduation, Barmore eschewed the family cabinetry and coffin-making business, instead finding employment as a census marshal. In 1856, Barmore entered politics as a Republican and a speaker at the "Fremont Club."

Barmore's Niche

Political pursuits appear not to have been enough to keep Barmore occupied, for he soon directed his energies to the production of natural gas. Certainly he was aware of what Hart – by this time a relative through marriage – had accomplished two decades earlier in the illumination of a modest number of lights along Fredonia's Canadaway Creek.

Perhaps Barmore also was familiar with Lewis Caleb Beck's elaborate report on New York's mineralogy.

Beck, who had been appointed mineralogist of the New York State Geological Survey of 1835-41, was especially interested in the occurrence of natural gas near Fredonia, writing that:

See **Fracturing**, page 46

Gasometer pre-1964.

Fracturing
from page 44

"… There is at some distance below the surface a vast reservoir of gas, the evolution of which is prevented by the pressure upon it. The fact to which I refer is that when the water in the creek is low, bubbles of gas are often observed, which disappear entirely when the water has risen, after a rain."

He went on to declare:

"Gas may be obtained at almost any part of the bank by boring to a depth of 20 or 30 feet. So common, indeed, is this occurrence that many of the (water) wells in the village of Fredonia are strongly charged with the gas."

Finally, Beck observed that gas flowed from "disruptions in the strata of slate (shale), which have probably been caused by some expansive force exerted from beneath."

In other words, gas issued from fractures or joints hosted by the shale.

This last point would not be lost on Barmore.

Finally, Barmore must have had knowledge of Sir Charles Lyell's June 1841 visit to Fredonia on his way to Buffalo, N.Y. Of that brief stopover, Lyell wrote, "The streets (of Fredonia) are lighted up with natural gas, which bubbles up out of the ground, and is received into a gasometer, which I visited."

Lyell concluded that the "gas consists of carburetted hydrogen, and issues from a black bituminous slate."

Armed with this knowledge, in 1856 Barmore entered into a financial agreement with a man named Elias Forbes that resulted in the purchase of a small plot of land on the Risley farm along Canadaway Creek where Lewis Beck had described a robust flow of gas from fractured shale in the creek bottom. Further, the newly purchased land was located about three-quarters of a mile downstream from where Hart had drilled his 1825 well.

On April 14, 1857, the Fredonia Gas Light and Water Works Company was incorporated as the country's first natural gas company. Soon after this, Barmore began his operations on the Risley property. His initial foray involved the drilling of two wells, neither of which was very productive.

Undeterred, Barmore, who appears to have understood the importance of fractures as conduits of gas through the otherwise impermeable shale, decided to:

- Assess the possibility of inducing artificial fractures as a means of enhancing the flow of gas from his wells.
- Define the depth of the stratigraphic position in the subsurface from which the gas issued.

Experiments in Fracturing

The Dec. 16, 1857, issue of the Fredonia Censor described Barmore's attempt to increase the flow of gas from one of his wells:

"In (the) Risley seed garden, adjoining the creek, a boring has been made by laborious drilling in the solid rock, four inches in diameter, and to the depth of 122 feet. No gas having made its appearance at this depth, the experiment was tried of blowing out the crevices of the rock with gunpowder.

"A canister of eight pounds was accordingly sunk to the bottom of the boring, connected with the surface by a hollow tin tube. Through this a red hot iron was dropped, and the explosion which expelled the water in the shaft, was followed by a plentiful supply of gas."

In essence, Barmore, in the fall of 1857, had successfully artificially fractured a shale well with the sole intention of increasing gas production. Following this, Barmore set out to assess the depth of the gas reservoir by fracturing the well at a shallower level. Perhaps he would find that he could sink wells to shallower depths.

Again, the Fredonia Censor was on hand to describe the results of Barmore's experiment, observing:

"(An) explosion of powder at a depth of 85 feet, which obstructed the shaft below it,

See **Industry**, page 48

Gary Lash is a member of the geology faculty at SUNY Fredonia; Eileen Lash, former CEO of an assisted living facility, is an amateur geologist who became interested in the history of Chautauqua County as she walked the streams and collected geological data.

Gasometer post-1964.

Industry
from page 46

was followed by an evolution of sulphurated hydrogen, but of none of the inflammable gas, or carburatted hydrogen, which fact tends to establish that the source of the latter is much deeper."

Thus, Barmore had demonstrated that the sought-after gas was sourced at "great" depth.

The Censor added:

"Mr. Barmore is still prosecuting his experiments with energy, and we trust they may meet with a more substantial recompense than the establishment of certain geological theories, as they have thus far been conducted at his individual expense."

Birth of An Industry

Barmore continued to improve his wells throughout 1858. In November of that year, the Fredonia Gas Light and Water Works Company was renamed the Fredonia Natural Gas Company, and Barmore was named the company's secretary and superintendent.

Earlier that fall, Barmore had started pumping water from the Risley wells as a means of improving gas extraction. His efforts were a smashing success, yielding 9,600 cubic feet – enough gas to supply 1,200 lights or burners.

He needed to devise a means of storing the gas he was producing. To this end, Barmore purchased a lot on Fredonia's Center Street, about three-quarters of a mile from the Risley well, for the purpose of housing a gasometer within which to store produced gas.

A network of four-inch-diameter lead pipes was laid at a depth of three-and-one-half feet from the wells on the Risley property to the newly constructed octagonal brick gasometer on Center Street.

It is noteworthy that Barmore's gasometer stood in the village in various capacities until collapsing during a heavy snowstorm in January 1964.

By December 1858, the first of many gas burners had been placed in downtown Fredonia, located at the Barmore and Brothers grocery store. The Fredonia Natural Gas Company was contracted by the village to have at least four street lamps illuminated by natural gas by Christmas Eve.

Further:

- Gas usage for illumination of the Fredonia Trinity Episcopal Church was now being metered at a cost of $4 per 1,000 cubic feet.
- By June of the following year, 150 lights were being illuminated by gas supplied by the Fredonia Natural Gas Company and more pipe was being laid to illuminate more and more of the village.
- By the middle of 1858, many stores and businesses in the village as well as many street corners were illuminated by gas emanating from Barmore's wells on the Risley property.

It was hoped that the planned upgrading of the Center Street gasometer and the laying of additional lead pipe throughout the village would bring private residences "on line."

It was believed that supplying gas to noncommercial customers would help to reduce the alarming number of private wells that were springing up throughout the village.

Expanding Empire

Soon after getting his Fredonia business in order, Barmore and William Hart traveled to the newly opened oil play of northwestern Pennsylvania along Oil Creek, where he formed the Empire Shale Rock Oil Works and began drilling oil wells.

Barmore again displayed his scientific and engineering acumen by using natural gas recovered as a by-product of the production of oil to heat boilers that ran the steam engines used to power his drilling operations.

Sadly, Preston Barmore passed away in 1861 at the young age of 30, suffering the effects of alcoholism.

Perhaps as a response to the nature of her son's death, Barmore's mother as well as his sister-in-law helped to found the Women's Temperance Crusade of 1873-74.

It is impossible to gauge what impact Preston Barmore would have had on the search for gas and oil if he lived another 30 or 40 years.

Still, it is not exaggeration to state that Barmore left a meaningful impact on the successful production of natural gas from shale. Indeed, his approach to producing from impermeable shale is essentially what is used to realize the full potential of gas shale plays of today.

More than this, Barmore's interests extended beyond the production of natural gas to considerations of the transportation, storage and marketing of gas. That is, Barmore was interested in developing an industry – the natural gas industry.

While Barmore arguably can be thought of as the first reservoir or petroleum engineer, he may better be accorded recognition as the father of the natural gas industry.

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Discovery Thinking Forum

Standing on the Shoulders of Giants

By LOUISE S. DURHAM, EXPLORER Correspondent

When the initial Discovery Thinking forum debuted in San Antonio at the 2008 AAPG Annual Convention and Exhibition, it garnered high marks from attendees.

Still, who could have known that this initial forum would be the harbinger of such an amazingly successful and long-running program?

The upcoming AAPG ACE in Denver will be the setting for forums number 12 and 13. The morning session will focus on field discoveries in global settings, followed by an afternoon gathering dedicated to major and significant discoveries in North America.

"This will be a day of discovery," said AAPG Honorary member Charles Sternbach, who helped conceive, organize and frequently operate (as a co-chair) the Discovery Thinking initiative as part of AAPG's 100th anniversary celebration.

Typically planned as a half-day event, this is the third time for a doubleheader.

Daylong sessions were held in Houston in 2014 and Denver 2009, according to Sternbach, who has been a major force in planning each forum.

For the 2015 event in Denver, he will be joined by co-chairs Paul Weimer (AAPG past president) and AAPG Honorary member Ed Dolly.

"Discovery Thinking originally started as an anniversary initiative recognizing 'one hundred who have made a difference,'" Sternbach said. "As the forums progressed, we included the personal issues and expanded the time slots to let people bring in a lot of technical information."


STERNBACH

> **"Discovery Thinking originally started as (an) anniversary initiative recognizing 'one hundred who have made a difference.'"**

He attributes the success of DT in large part to filling the gap in exploration experience – in other words, how the technical and professional skills combine to turn prospects into discoveries.

For the most part, the uniqueness of DT forums stems from the fact that all of the talks are focused on heavyweight, notable discoveries.

"Some are actual game changers for their regions," Sternbach said.

He noted, for example, the Levant Basin, eastern Canada and the Utica Play extension on the roster for the upcoming Denver ACE.

"The Utica was a major step-out," he noted. "Shell announced two wells in the fall that basically proved the concept.

"They were drilling 100 miles to the northeast of the nearest horizontal Utica producer," he said. "So, going into Tioga County (Pennsylvania) for Shell was a major play extender."

The planned talk on Big Bend Gulf of Mexico exploration success also is certain to be a unique story.

"It's in the class of discovery talks that show how integrated G&G technology is changing the game," Sternbach explained. "(The project) is a game changer of the latest integrated technology."

Critical thinking fed and nourished by specific knowledge is basic to the art/science of discoveries. Innumerable factors play a role.

"Many successes build on acquiring strategic knowledge that later provides key insights for discovery, such as petroleum systems, reservoirs, seals and biostratigraphy," Sternbach said.

"Many discoveries happen by critical efforts at key pivot points," he emphasized. "For example, when corporate decisions are made whether to continue or not in an exploration project.

"Receptive management and a culture of support for exploration can be crucial in the chain of events along the path to success," he added.

Regarding the array of discoveries presented in the DT talks, Sternbach noted that the best teams are often those in which you can't tell who is the geologist, geophysicist or engineer.

He has a meaningful take on the potential impact of these forums for all explorers: "Standing on the shoulders of giants helps us all see farther."

DT Forums to Come

If you haven't yet attended a DT event or simply missed out on a few, don't despair.

First, the presentation archives can be accessed on Search and Discovery (searchanddiscovery.com/specialcollections/discoverythinking), allowing you to not just view what you missed, but to do so at your leisure.

The total number of viewers of these archives thus far has reached 30,000, with 10,000 of these in the past year.

Second, future events are beginning to take shape.

A DT forum on southeast Asia discoveries is on track for the September 2015 ICE in Melbourne, while talks already are being sought for the June 2016 AAPG ACE in Calgary.

"We're going all the way through to AAPG's 100th anniversary in 2017 in Houston," Sternbach said.

"Then we'll see what happens after that."

The paper "Unlocking the Deep Utica Play in Northeast Pennsylvania" will be presented as part of this year's Discovery Thinking programs at the upcoming AAPG Annual Convention and Exhibition in Denver. The paper will be part of the afternoon session, focusing specifically on North American discoveries, and is scheduled at 3:25 p.m. in the Four Seasons Ballroom of the Colorado Convention Center.

A large dry gas discovery in the Utica Play, which extends from Ohio to northeast Pennsylvania. Circle on map is Shell Utica focus area.

Unlocking the Utica

By LOUISE S. DURHAM, EXPLORER Correspondent

Action is ongoing in the late Ordovician-age Utica shale play in the northeastern United States, despite the drilling pullback in shale plays overall owing to the global downturn in crude oil prices.

The Utica sits beneath the geologically younger, highly productive Marcellus shale of Devonian age. It is the primary source rock for many conventional hydrocarbon-bearing reservoirs throughout the Appalachian Basin.

The source rock component of the geographically extensive Utica underlies parts of Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennessee, West Virginia and Virginia – and trends northward into Canada.

Areas of dry gas, natural gas liquids and oil windows occur in the widespread formation.

Take your pick.

Shell opted for dry gas not long ago when it stepped out of the main drilling area into Tioga County, Pa., where it drilled a couple of successful wells more than 100 miles northeast of the closest horizontal Utica producer.

The Gee and Neal discovery wells were drilled to the deep Utica-Point Pleasant formation, tallying initial flowback rates between 11 and 26 MMscf of natural gas per day.

This heralded a significant new field discovery in the deep formation, which Shell announced in September 2014.

Today, the company has seven wells online in this play extension, with two more set to come on soon. Vertical depths range between 10,000 and 12,000 feet.

"Reservoir quality is exceptional over a net pay range of 250 to 500 feet, exhibiting well-connected kerogen porosity-permeability networks and high reservoir pressures," said Christopher Gonsalves, Tioga area manager at Shell Appalachia.

The Utica-Point Pleasant relationship is tricky to nail down, presenting a challenge to geoscientists who want a more refined definition – it can be highly interpretive as to what is Point Pleasant and what is Utica.

The Point Pleasant, composed of interbedded organic-rich limestones and black shales, is more distinct to the west, where it sources the bulk of the liquids-rich play in Ohio.

Whatever the case, the new play extension is economically productive. Gonsalves commented that appraisal results to date have been in line with the initial discovery wells, and breakeven gas prices for development are expected to be less than $3/MMcf.

Existing pipeline infrastructure plays an important role in the economics.

The discovery was the result of considerable study and evaluation on the part of the Shell team's members.

"Regional play-based exploration led to the Utica-Point Pleasant discovery in Tioga County, with the integration of detailed well synthetics from Shell's southwest Pennsylvania exploratory well and new regional 2-D seismic in 2011," Gonsalves said.

"Reinterpretation of legacy well logs revealed inconsistencies with published basin architecture and evolution concepts that suggested the Utica depositional sweetspot was limited to southeast Ohio," he noted.

"Integration of seismic interpretation, consistent log analyses and detailed core and outcrop descriptions confirmed a subtle, fault-bounded Utica age depocenter coincident with basement structures in Tioga that were reactivated during the Middle Ordovician Taconic Orogeny," he continued.

Utimately the Shell team arrived at an interpretation that suggested the Utica Basin extended from southeast Ohio into northeast Pennsylvania, and rock properties converge in a sweetspot – where Shell commands an impressive leasehold position of more than 350,000 net acres.

"Additional appraisal will continue to delineate the extent of commercial hydrocarbons," he said.

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 is part 1 in a series dealing with how impedance inversion can be a crucial aid to seismic interpretation.

The Transformers: A Big Aid in Interpretation

By SATINDER CHOPRA and RITESH KUMAR SHARMA


CHOPRA


SHARMA

Seismic inversion for acoustic impedance is widely used in our industry today, mainly due to the ease and accuracy of interpretation of impedance data, but also because it allows an integrated approach to geological interpretation.

This month's column refers to "inversion" as the transformation of seismic amplitude data into acoustic impedance data.

Seismic data represent an interface property wherein reflection events are seen due to relative changes in acoustic impedance of adjacent rock layers.

Such observed amplitude changes may not indicate if the amplitude changes relate to lithology variations above or below an interface. Acoustic impedance is a physical rock property, given as the product of density and velocity. Well logs measure both these entities directly, so that by dividing the density log with the sonic log, acoustic impedance log is obtained. Thus while acoustic impedance is a layer property, seismic amplitudes are attributes of layer boundaries.

Now, if quantitative interpretation of seismic data in terms of thin stratal interval properties (impedance) is to be attempted, then instead of the interface reflection properties, we resort to inversion. Acoustic impedance, being a layer property, simplifies lithologic and stratigraphic identification and may be directly converted to lithologic or reservoir properties such as porosity, fluid fill and net pay.

In such cases then, inversion allows direct interpretation of three-dimensional geobodies.

Inversion plays an important role in seismic interpretation, reservoir characterization, time lapse seismic, pressure prediction and other geophysical applications.

* * *

Since the inversion process transforms seismic amplitudes directly into impedance values, special attention needs to be paid to their preservation, which ensures that the observed amplitude variations are related to geological effects.

Clearly, the seismic data should be free of multiples, acquisition footprint, have high signal-to-noise ratio, zero-offset migrated and without any numerical artifacts.

Due to the band-limited nature of the seismic data, the lack of low frequencies will prevent the transformed impedance traces from having the basic impedance or velocity structure (low frequency trend) crucial to making a geologic interpretation. Also, the weak high frequency signal components or their absence thereof from the seismic data will find the impedance sections wanting in terms of resolution of thin layers.

The low frequency trend of acoustic impedance is usually derived from well logs or stacking velocities, and used as a priori information during the inversion process. This helps enhance the lateral consistency of the impedance data so produced.

The weak high frequency signal components indicate notches or roll-offs on the higher end of the amplitude spectra of seismic traces.

Processing steps that tend to broaden the spectral band in an amplitude friendly way are usually adopted so that the data that is input to inversion has an enhanced effective frequency bandwidth.

* * *

Several different techniques methodologies are commonly used to perform impedance inversion.

Whatever inversion approach is adopted, impedance volumes so generated have significant advantages. These include:

✓ Increased frequency bandwidth.

✓ Enhanced resolution and reliability of amplitude interpretation through detuning of seismic data.

✓ Obtaining layer property that affords convenience in understanding and interpretation.

These different impedance inversion techniques are:

(All the methods described below are post-stack inversion methods.)

Recursive inversion – This is the most basic type of inversion and assumes that the seismic amplitudes are proportional to reflection coefficients and transforms the input seismic traces to acoustic impedance traces.

As it does not remove the effects of the seismic wavelet, the method produces results that are within the seismic bandwidth – and so does not offer a significant advantage relative to interpreting seismic data.

Model-based inversion – This method models the subsurface as layers in terms of acoustic impedance and time.

The starting model is defined by a few 3-D main time horizons. Well log data are used to tie the main time horizons to the seismic data and define the impedance bounds for each layer. The impedance within each layer may vary laterally or vertically.

The starting model is compared to the input seismic data and iteratively the model is updated to better match the seismic data.

Sparse-spike inversion – This method gives an estimate of the reflectivity series that would approximate the seismic data with a minimum (sparse) number of spikes.

As this method tends to remove the embedded wavelet from the data, the inversion results are broadband for the higher frequencies, maximizing vertical resolution and minimizing the tuning effects.

Stratigraphic inversion – In an attempt to construct a stratigraphic model from seismic data, some inversion techniques introduce complex spatial stratigraphic relationships such as conformity, angular unconformity and baselap, for example, between layers.

Geostatistical inversion – This method combines geostatistical data analysis and modeling with seismic inversion.

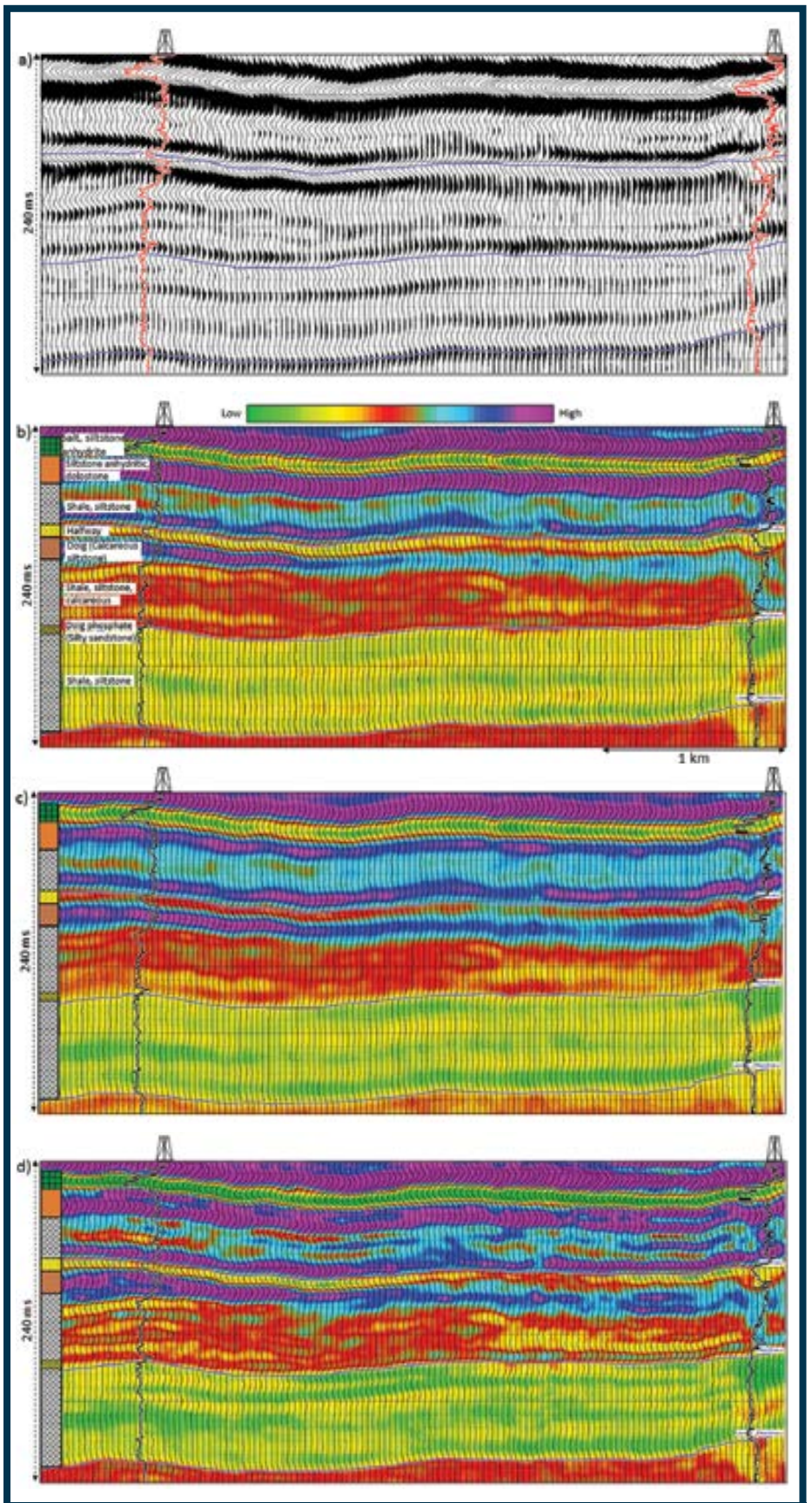

Figure 1 – Segment (a) of a seismic section from the Montney-Dawson area in British Columbia, Canada. Equivalent impedance sections from (b) band-limited, (c) colored inversion and (d) model-based techniques are shown correlated with two impedance logs. The log curve on the left was used in the inversion process, while the curve on the right serves as a blind well test. A litho-column is inserted alongside the log curve to the left as shown in figure 1b. Notice the low impedance zones on the log curves corresponding to the salt and the sand intervals correlate well with the low impedance seen on the impedance sections.

Geostatistical analysis generates spatial statistics – vertical variograms are generated from well bore measurements and horizontal variograms are estimated from the acoustic impedance values afforded by starting impedance model generated from seismic data – for example, recursive inversion or colored inversion. Starting from the well log control points, geostatistical modeling simulates data at grid points.

While carrying out the inversion, the simulated pointes are modified so as to concur both the well and seismic data.

Seismic inversion is a non-unique process – meaning that there are a large number of possible impedance outcomes on inversion. In other words, if the reflectivity derived from these impedance outcomes were convolved with a wavelet, the results would be very similar.

Continued on next page

Editor's note: Ritesh Kumar Sharma is with Arcis Seismic Solutions, TGS, Calgary, Canada.

Continued from previous page

In simple terms we also can say that there is a certain level of uncertainty in the reservoir models that are built from different impedance outcomes. Of course, we try and lower the uncertainty by introducing some constraints in the inversion process.

In geostatistical inversion we try and describe these possible outcomes, and by examining them we get an idea of the uncertainty inherent in the inversion process for the dataset under process.

Colored inversion: It has been observed that the amplitude spectra of the acoustic impedance log can be described as f^{α}, where f is the frequency and α is a constant. Given the acoustic impedance logs in the area of interest, the value of α can be calculated so as to determine the spectral function.

A colored inversion operator is determined by mapping the mean log amplitude spectra to the mean amplitude spectra of seismic traces that have a phase change of minus 90 degrees.

Once the operator is determined, it is run on the input seismic data so as to obtain impedance data – colored inversion is fast and easy to implement.

* * *

In figure 1, we show a segment of a seismic section from the Montney-Dawson area of British Columbia, Canada, where the Lower Triassic Montney and Doig play has garnered attention in the last decade or so.

The Montney Formation consists of interbedded shale, siltstone and sandstone in variable amounts. It is sub-divided into an Upper interval that is predominantly shale and the Lower interval that has siltstone-sandstone dominance.

The two intervals are separated by an unconformity that resulted from the tectonic uplift of the area.

The Upper Montney interval can be seen at the lower level of lithostrip to the left of the impedance section shown in figure 1b.

Overlying the Upper Montney interval is the Doig Formation, which is divided into three litho units, namely, the lower phosphate zone, middle siltstone shale zone and the upper calcareous siltstone.

Overlying the Doig Formation is the Halfway clean sandstone unit. The Halfway and the Doig interval comprise the Middle Triassic zone. A siltstone and shale interval overlies the Halfway, which in turn has a thin layer (20 meters) of salt above it. This salt is interbedded with anhydrites and siltstone and shows a slight lowering in velocity on the sonic curve, but has an appreciable lowering of density in the same zone.

As a result, the impedance curves log curves overlain on figure 1a exhibit a lowering of impedance in the salt interval.

A close examination of the reflection events in the Montney, Doig and Halfway zones shows some lateral amplitude variation – however, it is difficult to interpret this in terms of impedance variation corresponding to lithology, porosity or fluid changes in those intervals.

A quick run of three different types of inversion was carried out, and the equivalent displays shown in figures 1b, c and d. The recursive inversion display shown here exhibits the lateral impedance variation within the Montney, Doig and Halfway intervals, as well as the salt zone.

Their corresponding correlation with the overlaid impedance log curves on the sections is encouraging.

Figure 1c shows the colored inversion display, wherein we notice that while the blue siltstone zone above the Halfway is somewhat better defined, variation in the Montney zone may not be very convincing.

Finally in figure 1d, we show the model-based impedance inversion display. We notice that the impedance variation in the Montney interval appears more detailed than the recursive or colored displays.

* * *

The transformation of seismic amplitudes into impedance comes in as a big aid to their interpretation. Such inversion results, when correlated/calibrated with the available well control, lend confidence in the interpretation that is carried out on them.

We would like to thank AAPG members James Keay and Hossein Nemati for helpful discussions that led to the making of the lithology strip show in figure 1b.

Winchester and the Book That Changed His World

By BARRY FRIEDMAN, EXPLORER Correspondent

Simon Winchester, Oxford graduate in geology and a multiple best-selling author – including one of the most successful books on geology in recent memory, "The Map That Changed the World" – was, by his own appraisal, not a great practitioner in the field.

"I was living in Uganda, looking for copper, working for a Canadian mining company, and I wasn't very good at it," he told the EXPLORER. "In fact, I wasn't a particularly stellar geologist, either, but I had plenty of spare time to read."

He was 20.

And one of the books he read was James Morris's "Coronation Everest," which recounted the author's work as the London Times' correspondent on the 1953 expedition to Mt. Everest and the serendipity of the reporting that coincided with Queen Elizabeth's coronation; hence the title.

The writing fascinated Winchester, as did the life, so he wrote Morris and, in Winchester's own words, essentially said, "I want to be you."

Morris wrote back and told him that if he was serious about writing, he needed to quit his job that day – not next week, not next month, but that day, which Winchester did – and to return to London and get a job as a reporter, which Winchester thought would be easy.

"I have an Oxford degree," he thought to himself, "I'll get into any place I want."

Here Winchester laughs.

If, however, you don't count the almost year it took him and the countless rejections and humiliations, it was.

So, what was the motivation?

Many people do work at which they're not particularly stellar, so why wasn't being just an OK geologist with an Oxford seal of approval enough for him?

"I wanted to wander around the world," he said, "and tell stories."


WINCHESTER

> **"A lot of geologists think they labor away with their hammers and magnifying glasses as sort of unsung heroes, but I think they are quite heroic."**

Portrait of a Hero

And eventually he did.

He went to San Francisco to write about its famous earthquake; to Indonesia to write about Krakatoa; to Washington to write about Watergate; and then he came home (twice) to write about the low-born, self-taught, determined and intellectually iconoclastic map maker named William Smith, a man whose story is part Dickens, part Mozart, part Horatio Alger.

His second book on Smith, "The Man, His Map and the Democratization of Geology," is his topic at this All-Convention Luncheon at the upcoming AAPG Annual Convention and Exhibition in Denver.

"He was burdened by a very rigid class structure," said Winchester of Smith. "Working class, an orphan, but he had a fascination with fossils early on."

Smith worked on his aunt and uncle's farm and used pound stones to help her sell butter – the weight used against a pound of butter.

See **Winchester**, page 58

Compelling Luncheons Set for ACE

Best-selling author Simon Winchester will be the featured speaker at the All-Convention Luncheon in Denver, but that's not the only special luncheon that's planned for the upcoming AAPG Annual Convention and Exhibition.

Other luncheons, all slated for the Colorado Convention Center, are:

- The DPA Luncheon, at 11:30 a.m. on Tuesday, June 2, featuring **Mark R. Williams**, senior vice president of exploration and development for Whiting Petroleum Corp., who will be talking on "Evolution of Unconventional Oil Plays from early Innovations to Future Challenges."

- The DEG Luncheon, at 11:30 a.m. on Wednesday, June 3, featuring **Larry Wickstrom**, president of Wickstrom Geoscience LLC, who will be talking on "Brine Injection, Hydraulic Fracturing and Induced Seismicity – Can Unbiased Science Prevail in an Overtly Political Society?"

- The EMD Luncheon, at 11:30 a.m. on Wednesday, June 3, featuring **Frances Hein**, EMD president and chief geologist for Alberta Energy Regulator, who will be talking about "Alberta's Oil Sands: Big Challenges, Big Rewards."

- The SEPM Luncheon, at noon on Wednesday, June 3, featuring **Joe Macquaker**, senior researcher for ExxonMobil Upstream Research Co., talking on "Diagenesis: The Underappreciated Factor Controlling Mudstone Variability and the Role It Plays on Hydrocarbon Systems and Our Record of Long-Term Stratigraphic Variability."

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Author Signing:
AAPG Memoir 109: A Color Guide to the Petrography of Sandstones, Siltstones, Shales and Associated Rocks

Please join **Dr. Dana S. Ulmer-Scholle**, Associate Research Professor at the New Mexico Institute of Mining and Technology and co-owner of Scholle Petrographic, LLC, for a book signing on **Monday, June 1 from 4:30-5:30 in the AAPG Center located in the Exhibit Hall.**

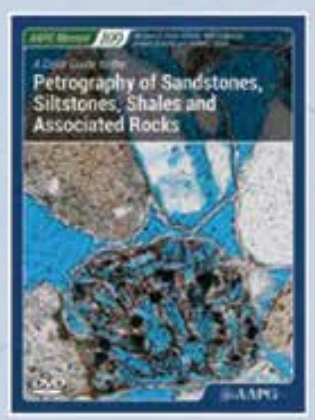
Memoir 109

A Color Guide to the Petrography of Sandstones, Siltstones, Shales and Associated Rocks

This memoir is designed as a practical guide for students and professionals to learn the fundamentals of microscopic examination of sandstones, mudrocks, and associated rocks. With more than 1,100 color illustrations, it covers the identification of grains, textures, and structures of clastic terrigenous rocks as well as their diagenetic alteration (compaction, cementation, dissolution, and replacement) and porosity reduction or enhancement. It also provides classification diagrams for formal description of those rocks and their porosity.

Although the majority of the outcrop and subsurface examples come from the United States (35 states and Puerto Rico), there are representative photographs from 32 other countries, including many from the offshore areas. The foldout birefringence chart and an included DVD with Powerpoint files of all the petrographic images provide additional aids for instructors and students.

Authors: Dana S. Ulmer-Scholle, Peter A. Scholle, Juergen Schieber and Robert J. Raine
Product Code: #1250
ISBN: 0891813896
Member Price: $139 USD
Non-member Price: $279 USD



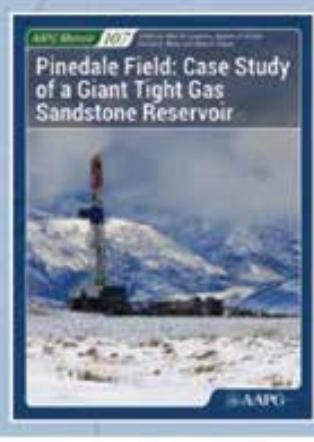
Memoir 107

Pinedale Field: Case Study of a Giant Tight Gas Sandstone Reservoir

Improved geologic insights combined with advances in technology and innovative thinking, mainly since the late 1990s, have driven Pinedale field's development and unlocked a giant natural gas resource in stacked low-permeability fluvial sandstones. Understanding this field can provide a model for developing similar tight sandstone reservoirs around the world.

This memoir contains 15 well-illustrated, peer-reviewed chapters that describe the history of field development, the deposition and diagenesis of the reservoir rocks, geophysical characteristics of the field, special core analysis techniques used to better quantify the reservoir, petrophysical characteristics and interpretations of the reservoir, the types and abundance of natural fractures, and fluid production characteristics in the field. Finally, static and dynamic models for the field are presented in an attempt to integrate all the pieces of this giant geologic puzzle.

Edited by: Mark W. Longman, Stephen R. Kneller, Thomas S. Meyer and Mark A. Chapin
Product code: 1252
Member price: $144 USD
Non-member Price: $289 USD



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Registration Open for ICE in Melbourne

Registration is now open for AAPG's 2015 International Conference and Exhibition (ICE) – and those who register before June 23 can save up to $305 on registration fees.

ICE 2015 will be held Sept. 13-16 in Melbourne, Australia, and will be an historic event for being the first-ever ICE co-hosted by AAPG and the Society of Exploration Geophysicists (SEG).

The last time Australia provided the venue for ICE was in 2006 in Perth, which saw attendance of more than 2,600 geoscientists, and this year's ICE is on track to exceed that turnout with industry professionals from more than 60 countries.

Themed "A Powerhouse Emerges: Energy for the Next Fifty Years" in recognition of the 50th anniversary of the Gippsland Basin oil discovery that unlocked the Australasian market, ICE will be hosted by the Petroleum Exploration Society of Australia (PESA) and will include PESA's Eastern Australasian Basins Symposium.

The ICE announcement is available online, and was included with this month's Explorer.

ICE is known for delivering strong technical programs, diverse short-courses and field trips, state-of-the-art displays and networking activities designed to facilitate new business development.

To register, visit ICE.AAPG.org.

Winchester
from page 56

"He then became an apprentice to a surveyor, a good one," Winchester said. "On a survey of a canal, he noticed layers of rock of different types with different fossils and realized he had seen similar layers in the same sort of order with similar fossils and they would be the same layers, only dipping and rising underneath the earth.

"He realized – an amazing epiphany for him," Winchester opined, "he could draw a map that would show the invisible underneath of the country."

For 15 years Smith, entirely on his own, trekked the length and breadth of England and Wales measuring strikes and slopes and all basic elements of geology, and eventually drew his map in 1815, which was the "first-ever geologic map of anywhere."

It bears repeating: the first-ever geologic map of anywhere.

"It was a remarkable, heroic story."

But it was 19th century England, and remarkable heroic, rags-to-riches were not in fashion.

"Because he was lower class, his work was dismissed, it was copied, plagiarized, undersold, published under others' names," Winchester said. "This bankrupted him, sent him to debtor's prison."

When he got out he took work as a journeyman surveyor, only to be rediscovered by a wealthy landowner who asked about his early work. It was only then that Smith's success, good name and connection to his work among the profession's elite was reestablished.

"And he died," Winchester said of this most seminal figure in the profession, "a respected, contentment man."

Changed Lives

Winchester, who has been a foreign correspondent and a frequent guest on The New York Times best seller list and who has written about the Oxford English Dictionary as well as Alice from "Alice in Wonderland," knows this is the kind of tale that doesn't always end happily – for Smith or himself.

He never expected the first book on Smith to sell more than 100 copies. But the story of Smith, Winchester believes, on some level, speaks to modern-day geology and the people who practice it.

"A lot of geologists think they labor away with their hammers and magnifying glasses as sort of unsung heroes," Winchester said, "but I think they are quite heroic."

To talk to Winchester is to hope he keeps talking.

Funny, irreverent, self-deprecating, this best-selling author, this man who became a naturalized American citizen aboard the USS Constitution, talks about his career, including his current gig, with the lightest of touches, complete with tales of luck and wonder and transsexualism.

Yes, you read right.

"As you probably know, James Morris became Jan Morris," a Welsh historian, author and travel writer with whom he has kept a lifelong friendship.

"When I got the job at The Guardian in London, I got a letter asking how, in fact, you get a job at The Guardian. 'Very easy, I said, 'all you do is go to Oxford, get a job in geology, be not very good at it, and then become great friends with a transsexual.'"

He says, unabashedly, coming back to the upcoming convention, that geology is a "noble profession" with committed practitioners and a wonderful, albeit imperfect, history.

And one that – the irony doesn't escape him – can change careers and lives.

"A woman came up to me at a conference years ago and said she was an English major," he said, "but after reading the first Smith book, she changed her major to geology and has never been happier.

She now works for the U.S. Geological Survey.

So on Monday, June 1, when Simon Winchester speaks in Denver about his new book and the beauty of geology, he won't just be talking about William Smith.

"I've always maintained that geology, literally, quite literally, underpins everything," he said, "so is the most important of all the sciences."

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Practical Aspects of Petrol. Geochemistry Short Course (with AAPG Annual Mtg.)	May 31, 2015 Denver, CO

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Lacustrine Basin Exploration	September 20-27, 2015 Utah
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Complex Carbonate Reservoirs	Sept. 26-Oct. 2, 2015 Italy

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AAPG Education

Editor's note: Regions and Sections is a regular column in the EXPLORER offering news for and about AAPG's six international Regions and six domestic Sections. Contact: Delia Kuye, director of AAPG's Africa Region office, at dkuye@aapg.org; and David Blanchard, president of the AAPG Africa Region, at energydcb@aol.com.

West Africa: Land of Opportunity

By DELIA KUYE and DAVID BLANCHARD

Quiz time: When was the Nene Field, a 1.2 billion barrel field on the shelf in 90 feet of water, discovered?

A) 1958
B) 1977
C) 2014
D) 1995

Answer: 2014.

That's correct, just last year the Nene Field – a 1.2 Bbbl field discovered by ENI in 28 meters of water in Congo, proved that, deep water aside, West Africa still holds ample exploration and exploitation opportunities.

Africa is rich in both basin frontier and exploitation opportunities, and has been a key player in global oil production for decades.

From its start in the early 1960s, offshore West Africa exploration was crowned with success in the shallow offshore Niger Delta, off the Port Gentil region of Gabon in 1963 when the Gamba field was discovered by Shell; and offshore Congo with the discovery of the Emeraude field.

Following these initial discoveries, the West African region saw a flurry of exploration activity that resulted in numerous finds, including the Etame and Rabi-Kounga fields offshore Gabon and several others in the Niger Delta.

Between 1965-99, 233 fields have come into production in the West Africa region between Angola and the Ivory Coast – utilizing the services of several hundred platforms to produce at a peak rate of 3.1 MMbopd of liquids from 24.63 Billion BOE of accessible reserves.


KUYE


BLANCHARD

Since the mid-1990s, the West African region saw significant expansion in exploration and development activity with the advent of giant deepwater fields discoveries.

The first giant deepwater fields of economic importance to be found in were Bonga in Nigerian Block OPL 212 and Girassol in Block 17 off Angola in the spring of 1996. Since then a total of 43 more fields have been discovered in water depths ranging from 300 to 1,458 meters, making the region a world hot spot for new reserves and finds.

The discovery of commercial petroleum off the coast of Ghana and Cote D'Ivoire also resulted in greater international attention on western Africa and kindled interest in West Africa's transform margin.

Recently there has been increased focus on deepwater and pre-salt drilling, with over nine deepwater wells targeting pre-salt plays offshore West Africa since 2012, most having been drilled in the Kwanza basin offshore Angola, and West African exploration has been driven largely by deepwater finds.

Recently pre-salt exploration in West Africa has been marked with many failures as well as some major successes, and the pre-salt campaigns in the last few years have not delivered as expected, the reasons being mainly related to difficulties in seismic imaging.

In 2014, many of Africa's frontier wells delivered dismal results and 2014 saw lackluster performance, but despite poorer performance across the continent, several new discoveries have been made and development plans are under way for a number of fields.

Recent discoveries and activity include:

- ENI made a discovery from the Sankofa East-1X well in Ghana's offshore Cape three points block with estimated discovered volumes being 490 Mbbls and 1.2 TSCF gas in place. The company envisages first oil by 2017 and first gas by 2018.

- Gabon – Tullow discovered a new oil accumulation with the Igondo-1 well in July 2014. The well encountered 90 meters of net oil and gas pay.

- In Senegal, Scottish operator Cairn Energy made a commercial discovery by drilling the FAN-1 well in the North Fan prospect in the Sangomar deep block, targeting multiple stacked deep-water fans. The well encountered 29 meters of net oil bearing sands.

- In 2014, some successes in pre-salt included Cameia (Angola), Diaman (Gabon) and Nene Marine (Congo). The Nene Marine wells discovered light oil and wet gas in the marine XII block offshore Congo, in a pre-salt clastic sequence.

- Total made a second commercial discovery in deepwater Cote D'Ivoire by drilling wildcat well Saphir-1XB well in block CI-514, confirming the extension of an already proven active petroleum system in the prolific Tano basin offshore Ghana.

- Nine deepwater project developments have been slated to come on line between 2014 and 2018 in Angola. Projects include Total's CLOV, ENI's west hub and Chevron's Lianzi, to mention a few. These new projects are targeted at delivering 1,060,000 bbls at peak sometime in 2020.

- Nigeria has five deepwater projects expected to come on stream between 2014-20:
  - ✓ Shell's Bonga Northwest- 50 kbbls/day (OML118).
  - ✓ ExxonMobil's Erha North (OML113) – 50,000 bopd.
  - ✓ Total's Egina (OML130) – 200,000 bopd.
  - ✓ ENI's Etan/Zabazaba (OPL245) – 80,000 bopd.
  - ✓ Shell's Bonga South/Aparo (OML118/132) – 225,000 bopd.

Continued on next page

Editor's note: This month's Policy Watch is written by AAPG Student-YP member Steve Brennan, a graduate student at the Colorado School of Mines who not only participated in the recent AAPG Congressional Days, he "wowed" everyone with his excitement and passion for the event.

POLICYWATCH

Congressional Visit Days Bridge Policy and Science

By STEVE BRENNAN


BRENNAN

AAPG Congressional Visit Days (CVD) are held annually in the spring in Washington, D.C. – and I was fortunate to participate this past March, adding the perspective of a graduate student to the event.

As the lone student in the group I came without expectations and plenty of questions.

Over the course of two days our group of 16 visited various government agencies to better understand their legislative and budgetary priorities related to energy policy and to introduce them to AAPG as a technical resource.

Our visits included conversations with:

- The Congressional Research Service.
- The Department of Energy (Subsurface Technology and Engineering, and Oil and Gas Research).
- The Bureau of Ocean Energy Management.
- The U.S. Geological Survey Energy Resources Program.

In addition, we met with specific House committees on Science, Space and Technology as well as Natural Resources.

These meetings were particularly exciting as they introduced us to specific policies of interest to the current 114th United States Congress.

* * *

There were multiple hot-button issues that repeated themselves throughout the two days. These included:

- Induced seismicity.
- Restrictions on oil and gas leasing of federal lands.
- The status of developing natural gas hydrates.
- The opening of the Atlantic Outer Continental Shelf (OCS).

It was clear the government employees with whom we spoke valued our input as both engaged constituents and as a scientific resource that actively researches these issues.

For me, personally, the CVD established the precedent that the obligations of geoscientists are no longer limited to the offices in downtown Denver, Oklahoma City, Houston, or any other oil center. Colorado in particular has experienced a recent onslaught of political and social backlash toward oil and gas development.

We must learn to effectively communicate with our neighbors and communities to maintain our social license to operate. There are a number of government bodies in Washington willing and able to support us, and it's crucial that we recognize how and where they can do so.

At the culmination of my CVD visit I was provided the opportunity to speak one-on-one with the senior legislative assistant to my district's congressman, Rep. Ed Perlmutter (Colorado's 7th district), and during our conversation I introduced him to the AAPG Colorado School of Mines Student Chapter as a resource within the district. I'm the current president of the chapter, and we have worked hard this school year to establish ourselves as a campus and community-based organization.

I left the meeting with an open-ended invitation to continue our discussion at their district office in Colorado.

* * *

My sincere thanks to the AAPG colleagues I met in Washington, D.C. They were incredibly generous in their support and patience with my questions.

Also, I certainly recommend the experience to students in the future, whether you're currently interested in policy or not. The CVD will open your eyes to the inner workings of Washington and further educate you on the opportunities within the AAPG itself.

Please feel free to contact me with any questions regarding my AAPG CVD student experience at stbrenna@mines.edu.

Continued from previous page

Their combined output is expected to be 680,000 bopd.

New opportunities abound still and there is abundant low-hanging fruit.

Ranking among deepwater producers, the West African aquatory remains at the top of its game. Nigeria holds an estimated 37.1 billion barrels and 181 TCF gas, and production has averaged around 2.2 mbbls/day between 2005 and 2014.

According to Wood Mackenzie, most of the undeveloped marginal fields in Nigeria contain recoverable reserves between 50-500 Mbbls, most having been either awarded to indigenous operators or are peripheral within the major international companies' portfolios.

In Angola, Sonangol – Angola's state-owned hydrocarbon company – stated that the country has 13 Bbbls in reserves. Deepwater fields on-stream in West Africa between 2000 and 2010 had total reserves of 13,330 MMbbls of liquid and 17,870 BCF gas, while shallow water finds had 4,152 MMbbls of liquid and 13,891 BCF gas in reserves during the same period, according to Chatham House and KPMG sources.

These point to ample opportunities still existing in the region.

And there is low hanging fruit!

On the transform margin in Ghana, the TEN Project – from which Tullow is farming down – is on course for delivery. The deepwater cluster is expected to build production toward 80,000 bopd by 2017.

Any farm-in project will take less than two years to reach payday, as Tullow Oil farms down half of its 49.5 percent interest. Similar farm-in opportunities

See **Africa**, page 63

"ProTracks" is an ongoing feature of the EXPLORER, offering news and information pertinent to getting started or getting better in your career.

YPs Enjoy Networking at NERC CDT Opening

By MAXIM KOTENEV, Europe Region Young Professional

Mentoring, training and learning are vital parts of young professionals' development and form a critical skill set for their future careers.


KOTENEV

The historical city of Edinburgh, Scotland, was the site of a networking day where representatives of the YP groupings within AAPG and the Petroleum Exploration Society of Great Britain (PESGB) developed those skill sets by volunteering to become mentors to the first cohort of doctoral students from the Natural Environment Research Council (NERC)'s Centre for Doctoral Training (CDT).


Edinburgh's NERC Centre for Doctoral Training provided a valuable setting for networking and learning for YP members of AAPG.

The new NERC Centre for Doctoral Training consists of seven core partners led by Heriot-Watt University and 12 associate academic partners who bring diversity and expertise in additional disciplines.

The CDT provides a unique opportunity to train the next generation of geoscientific and environmental researchers in oil and gas. Its aim is to create a highly skilled workforce with expertise that can be used across the energy and environmental sectors.

It also aspires to fill skills gaps in the oil and gas industry and in academia, both of which reliably inform government policy. The CDT equips the industry with the skills needed to explore, sustain and reduce the environmental impact of oil and gas exploration and extraction at a time of economic challenge and responsible environmental management.

The annual conference in October, where the postgraduate students will present their results, will not only provide a great opportunity for interaction with individual students and their supervisors, but also a chance to identify research links, new projects and possible recruitment opportunities.

All of the postgraduate students benefit from being embedded alongside world-class researchers while also having access to industry partners in the form of placements, mentoring, specialist facilities and equipment.

'Game-Changing Initiative'

During the opening of the CDT in 2014, the president of AAPG Europe, Keith Gerdes of Shell, commented, "This is a truly game-changing initiative and represents the most exciting development in the provision of training for the energy industry in the UK that has occurred during my career."

In attendance were 17 YP mentors and 26 CDT students.

A selection of presentations and discussions were arranged at one of the tapestry studios in Scotland's capital city as an opportunity to meet and network.

The day started off with the motivational welcome speech by AAPG member and Grover E. Murray Memorial Distinguished Educator Award winner John Underhill, academic director of the NERC CDT in oil and gas and the Shell Professor of Exploration Geoscience at Heriot-Watt University.

The day continued with a passionate presentation by Alison Goligher, EVP of unconventionals at Shell, with a refreshing overview of unconventionals worldwide, including some of the challenges related to costs and existing technologies.

AAPG member Graham Blair, technical lead for unconventional exploration at Shell, then gave a technical and truly absorbing talk on the successes and failures of unconventionals and what contributed to

Continued on next page

SPOTLIGHTON ...

SMU Educator James Brooks Receives AAPG Presidential Award

AAPG member James E. Brooks, professor emeritus at Southern Methodist University, has received the 2015 AAPG Presidential Award for Exemplary Service.

AAPG President Randi Martinsen bestowed the honor upon Brooks "for a lifetime of inspired and dedicated service to his profession and community, and for the education of hundreds of students for whom he has served as an outstanding teacher, wise mentor and genuine friend."


BROOKS

Brooks, who also received the AAPG Public Service Award in 1994, taught courses there for more than 60 years at SMU, serving in a range of capacities: professor, department chair, dean of the College of Arts and Sciences, university provost, interim university president and as chairman of the Institute for the Study of Earth and Man (ISEM).

Although now officially retired, he remains on the department staff in various roles, most recently with ISEM.

"He is a beloved teacher, mentor, role model, counselor and principal professor of dozens of M.S. theses and Ph.D. dissertations," said AAPG Honorary member and former AAPG President James Gibbs, who was among several AAPG members who nominated Brooks for the award.

"He has been very supportive of petroleum geology science and business," Gibbs added.

"I've known Jim for 40 years, and he is a man whose character, accomplishments and modesty I greatly admire," said past AAPG president, Sidney Powers award winner and Honorary member Marlan W. Downey.

"An extraordinary number of distinguished people have passed under Jim's wings at SMU and (ISEM) in Dallas and have been influenced by him," Downey said.

That group included such renowned geologists and geoscientists as Ray Hunt, Leighton Steward, Mike Forrest, Roy Huffington and Susan Morrice, "to name just a few," Downey said. "Jim is one of the 'good guys.'"

Continued from previous page

these outcomes.

After the tea break, both speakers drew upon experiences from their careers in engineering and geoscience, respectively, relating technical, commercial and personal challenges.

The discussion concluded with a wide range of insightful questions from the audience.

Another highlight was the roundtable session for students and YP mentors to describe their projects and career backgrounds. A lighter side to this activity was the request that all mentors and mentees give away one unusual and extraordinary fact about themselves to help break the ice and reveal a little more about each other.

In fact, from speaking to YP mentors, students and organizers alike, Edinburgh was an ideal location to hold such an event, not least for access to Heriot-Watt University, which sits between London and Aberdeen and is a place of cultural richness and significance in scientific and social history.

"It was a great chance to meet face-to-face instead of just emailing to get to know your own mentors as well as others that may be able to assist with the Ph.D. projects later in the course," said AAPG member Ginny-Marie Bradley, one of the doctoral students from the University of Manchester. "It was nice to get an insight from each company … see what they are like (and discuss) the different paths YPs had taken and finally to learn what it's like to be a graduate in the petroleum industry."

The day concluded with an evening meal and an Edinburgh ghost bus tour, which "took a ride to the dark side of the city."

Thanks goes out to all those involved, especially John Underhill, Lorna Morrow, Anna Clark and the Heriot-Watt-based CDT team, which put in much work behind the scenes. Virtually everyone present was interested in shaping and developing the initiative. A collaborative vision linking academic, industry and environmental interests in the oil and gas sector is vital.

This successful mentee/mentor networking event exceeded all expectations, and the CDT's progressive training program surely has a very long and bright future.

(Editor's note: Maxim Kotenev is a Europe Region YP residing in London, England.)

Africa

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exist across West Africa.

The drilling of the Padouck Deep, Affanga and Okala wells in Gabon in the pre-salt play have helped to further de-risk the play elements offshore Gabon. Many smaller oil companies are on the lookout for such opportunities that have been de-risked and only waiting to be worked up to production.

There also are opportunities in the areas of field reactivation and redevelopment. For example, the redevelopment of the Seme Field in the Benin Basin, which was under production by PanOcean and Ashland Oil, producing 7,627 bopd at its peak in 1984.

At its lowest in 1997, it was producing only 1,207 bopd – and more of water than oil – and was abandoned in 1997.

Sapetro took over the field, acquired extensive seismic data and conducted extensive interpretation, reservoir characterization and modeling.

With field redevelopment, the company sees peak production at around 9,000 bbls liquid/day and expects that the field can be drained optimally for the next 16 years.

As the saying goes: The best place to find oil is where oil has been found, and West Africa remains one of the most prolific areas in the world to explore and exploit hydrocarbons.

Teacher of the Year

Industry Background Makes Teaching Relevant

By KRISTI EATON, EXPLORER Correspondent

For Jacqueline Bath, teaching geology is no mere academic exercise.

Much of her learning about and experience with geology didn't come only through textbooks and lectures, but firsthand via her 18 years' field experience, completing subsurface studies and evaluating petroleum prospects.

In other words, she's well acquainted with how vital and integral petroleum geology is to our way of life.

Later, after voluntarily leaving her position to care for her young children, Bath decided to become a secondary science teacher, using her knowledge and work experience to help teach and shape her students.

That previous experience working in the field helped her create meaningful hands-on activities and tasks, especially in geology, where there is little curriculum available at the high school level, she said.

"I feel that now that I am teaching geology and earth science, I can bring in my knowledge to support learning," she said. "I am able to take an idea from a professional development class or a lab from a college manual and actually use some parts to put together a unit that has students engaged in many of the activities that I engaged in as a geologist."

And clearly, she does it well.

Bath, a geosciences teacher at ThunderRidge High School in Highlands Ranch, Colo., has been named the AAPG Foundation's 2015 Teacher of the Year.

BATH

The honor comes with a $6,000 prize from the AAPG Foundation to be evenly split between Bath and ThunderRidge High School.

She also will receive an expense-paid trip to the AAPG Annual Convention and Exhibition in Denver May 31-June 3, where Foundation Chairman Jim Gibbs will present her with her award at the All-Convention Luncheon.

Jacqueline Bath relies on her knowledge and experience as a geologist when she teaches – an award-winning approach.

Using Real-World Concepts

Keeping students engaged and interested in real-world concepts and science ideas is important to Bath, an educator for the past 18 years who currently teaches earth environmental science, astronomy and geology to students in grades 9 through 12.

She regularly invites friends who are in the industry to speak to her classes, which, she said, not only helps her keep up to date with industry trends and opportunities, but also provides the students an opportunity to see how a task is related to the real world.

"Students have an opportunity to ask questions about what it is like to be a geologist, engineer or landman in case they are considering a career in one of those areas," Bath said.

Using local, regional or global geology as a hook also piques student interest. For example, her students learn about Colorado's minerals and why they are important to the community, as well as making and interpreting a cross-section of Alaska's Prudhoe Bay Oil Field.

"Using real-world scenarios makes learning relevant," she said.

Students in her geology class also learn about petroleum in a unit called "Petroleum Products and You." Various products such as a basketball, credit card, suntan lotion and sneakers are passed out, and students must decide if it's made from petroleum or not and then create a two-column list on the whiteboard.

Afterward, Bath and the class go over the list and what other items are made using petroleum.

"Students reflect on what petroleum products they used on that day as well as what products they think they could do without," she said. "In this way they understand that petroleum products are a key part of their lives."

Collaborative learning is another

Continued on next page

Jacqueline Bath will receive her award as the AAPG Earth Science Teacher of the Year (TOTY) in Denver at the All-Convention Luncheon Monday, June 1.

In receiving the honor Bath becomes the 18th TOTY, an award funded by the AAPG Foundation.

Past TOTY winners are:

2014 – Heather McArdle (Mahopac High School, Mahopac, N.Y.)
2013 – Chris Bolhuis (Hudsonville Freshman Campus, Hudsonville, Mich.)
2012 – Jonna Gentry (Green Mountain High School, Lakewood, Colo.)
2011 – Sharon Milito (Patrick Henry Elementary School, Colorado Springs, Colo.)
2010 – L. Stef Paramoure (Oak Run Middle School, New Braunfels, Texas)
2009 – Ty Robinson (Provo High School, Provo, Utah)
2008 – Mary Fitts (Sierra Middle School, Parker, Colo.)
2007 – Ryan Henry (Street School, Tulsa)
2006 – James G. Schulz (Helena High School, Helena, Mt.)
2005 – Marilyn Bachman (Montecito Union School, Santa Barbara, Calif.)
2004 – Michael Fillipow (Polytechnic High School, Long Beach, Calif.)
2003 – Amy John (TseBitAi Middle School, Shiprock, N.M.)
2002 – Kevin Leineweber (McCutcheon High School, Lafayette, Ind.)
2001 – John McKinney (Castle Rock Middle School, Castle Rock, Colo.)
2000 – Peggy Lubchenco (La Colina Junior High School, Santa Barbara, Calif.)
1999 – Herbert L. Turner (Waynesville Middle School, Waynesville, Mo.)
1998 – No recipient
1997 – No recipient
1996 – Jane Justus Frazier (Natomas High School, Sacramento, Calif.)

Continued from previous page

feature of Bath's classroom. Students are arranged in groups of four for group discussions while Bath circulates around the room.

"I feel that collaboration is important for learning so that students develop skills needed for life and the workplace," Bath said, adding that skills developed through collaboration include generation of ideas, effective problem solving and completing complex tasks.

But variety and personalization also are key to better learning, Bath believes, so she makes sure her students have choices in their learning environment. This can mean using technology to create a digital product for some students, while others may prefer an illustration or model.

Students also can learn new content via a one-on-one video-audio lecture, by reading a textbook or using interactive Web animations.

The Perks of Teaching

Bath, who received her bachelor's degree in geology from the University of Texas and her master's degree in education from the University of Denver, said her favorite part of being a teacher is witnessing her students' growth and developing and creating activities and tasks that challenge and engage the students.

Her least favorite part of the job? Something many teachers struggle with – keeping up with grading and documenting so many students.

As a former geologist, it's little wonder that Bath's favorite unit to teach is mineral resources to her freshman class.

"I love minerals," she said. "I regularly attend the Denver gem, mineral, and jewelry shows, and I make jewelry with natural stone beads."

Another favorite is the mining performance task, where students pretend they are drillers, miners and millers. That's when, Bath said, she gets to wear her hard hat all day.

"I also love the futures in energy unit in my geologist class since this is when they participate in the gushers and dusters simulation, and industry professionals are here," she said. "This is also a favorite because it relates to my background in petroleum energy."

Sean Patterson, ThunderRidge High School's assistant principal, said Bath has been able to take her high-level knowledge and teach it to her students, which is not always an easy task. Her gentle demeanor combined with her expertise makes for an exciting and enlightening classroom atmosphere, he said.

"She is very creative in her lessons and is very compassionate to her students," Patterson said. "She makes learning fun and incorporates many hands-on activities that students can carry on with them throughout their lives."

Bill Fisher to Receive Chairman's Award at ACE

BY APRIL STUART, AAPG FOUNDATION PROGRAMS COORDINATOR

William L. Fisher, a past chairman of the AAPG Foundation's Board of Trustees, past president of the Association and an award-winning leader of both entities for nearly 40 years is the winner of this year's AAPG Foundation Chairman's Award.

The award, presented to recognize those who have made "extraordinary contributions (monetary or service) to the AAPG Foundation," will be presented to Fisher in Denver June 2 during the Chairman's Reception at the AAPG Annual Convention and Exhibition.

Fisher, a dedicated contributor to the AAPG Foundation, is an Honorary AAPG member and a winner of the Sidney Powers Memorial Award, AAPG's highest honor.

For the Foundation he has been a Trustee Associate since 1993, a Member of the Corporation since 1996 and a Trustee Emeriti since 2013. He was a Foundation Trustee in 2001-06, and served as chair from 2006-13.

Apart from AAPG, Fisher is the Leonidas T. Barrow Chair and Professor in the Department of Geological Sciences of the Jackson School of Geosciences at the University of Texas at Austin. Previously, he served as the inaugural dean and the first director of the John A. and Katherine G. Jackson School of Geosciences, a school he was instrumental in founding as well as securing its substantial endowment.

He is a former long-time director of the Bureau of Economic Geology, former chairman of the Department of Geological Sciences and former director of the Geology Foundation.


FISHER

For the national scene, Fisher has been an adviser to two presidents, several governors, members of the U.S. Congress and Texas legislature and numerous federal and state agencies.

He was Assistant Secretary of Energy and Minerals in the U.S. Department of Interior under President Gerald Ford and as a member of the White House Science Council under President Ronald Reagan.

He also is an elected member of the National Academy of Engineering and has long been active in the Nation Research Council of the National Academies.

Fisher's research has focused in the areas of stratigraphy, sedimentology, and oil and gas assessment. In 1967 he introduced the concept of depositional systems – now a fundamental part of modern stratigraphy and sedimentology.

In 1987 he led an assessment team for DOE that turned around the then-prevalent view of natural gas scarcity.

He has championed the importance of technology in resource availability and has been a leader in the rethinking of the significance of reserve growth from existing, geologically complex oil and gas fields.

Satterfield Named Foundation Professor of the Year

BY APRIL STUART, AAPG FOUNDATION PROGRAMS COORDINATOR

Joseph Satterfield, a geology professor at Angelo State University in San Angelo, Texas, has been chosen the winner of the AAPG Foundation's 2015 Professorial Award.

The honor, determined by the AAPG Academic Liaison Committee and presented annually to a professor for "Excellence in the Teaching of Natural Resources in the Earth Sciences," comes with a $1,000 prize from the AAPG Foundation.

Satterfield, an AAPG member, will receive his award (including a commemorative plaque) at the Foundation Chairman's Reception during the AAPG Annual Convention and Exhibition in Denver.

Satterfield is known at ASU for leading the department to offer value-added geology field projects, providing outstanding mentorship to his students, and designing and teaching seven new upper-level geology courses for the BS in Geoscience and Earth Science Minor.


SATTERFIELD

Acclaimed by his colleagues and students for his unique teaching style, Satterfield was called "an excellent teacher and mentor" by David Bixler, chair of the Department of Physics and Geosciences, who added he has been "one of the 'go-to' faculty on campus for advice on teaching and pedagogy."

Bixler said Satterfield not only imparts his knowledge on his students, he also has "taught his colleagues many concepts in geology that are now used in making interdisciplinary connections in the university's physics and physical science classes."

The Foundation's Professorial Award was created to encourage geoscience professors to stay current on industry trends and cutting edge technology to share with their undergraduate and graduate students, further enhancing the field of geoscience research.

Satterfield is the third recipient of the Foundation's honor. Previous honorees have been:

- Grant Wach, Dalhousie University, Nova Scotia, Canada (2013).
- Robert Goldstein, University of Kansas, Lawrence, Kan. (2014).

An interview with Satterfield will appear in a future EXPLORER.

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In Denver? Pay Dues, Buy a Book And Help Students at the AAPG Center

By VICKI BEIGHLE, AAPG Member Services Manager

It's time to pay your annual AAPG membership dues – and those attending the AAPG Annual Convention and Exhibition in Denver can do so quickly and easily at the AAPG Center.

Member Services representatives will be available throughout the meeting to provide assistance in paying dues for 2015-16 fiscal year.

In addition to taking care of dues, members who visit either the AAPG Center or go online also can update their member profile and learn more about member benefits.

In fact, the AAPG Center is the place to find "everything AAPG," in one convenient location – representatives from the education department, future meetings, Divisions, group insurance, website and communications teams, Datapages, the AAPG Foundation and more will be on hand to help you get the most out of your membership, organization and opportunities provided at the annual meeting and beyond.

And students and faculty members, be sure to visit the Chevron-sponsored lounge, also located within the Center and provided just for you.

Anchoring the Center will be the AAPG Store, where attendees have the option to review the latest in publications and digital products. Be sure to check out our discounted book section – and don't miss the author signing. This is also the place to purchase AAPG apparel and souvenirs – a large selection of newly designed dress shirts, golf shirts, t-shirts, hats and a variety of merchandise for children will be available.

Proceeds from these sales benefit the AAPG Student Chapters working in the store.

Those NOT attending the convention can easily pay their dues by going to our website, logging on to their profile page and click on the "Pay Dues" icon.

Those paying by credit card also can contact Member Services at (918) 584-2555 or members@aapg.org.

New Site, New Savings for URTeC 2015

The technical program is in place for the third annual Unconventional Resources Technology Conference (URTeC), which will be held July 20-22 at the Henry B. Gonzalez Convention Center in San Antonio, and there's still time to save $100 by registering before June 8.

URTeC is the industry's leading multidisciplinary conference on unconventional resources and is hosted jointly by AAPG, the Society of Petroleum Engineers (SPE) and the Society of Exploration Geophysicists (SEG).

This year's meeting will be the first time URTeC is being held in San Antonio.

Last year, SPE, AAPG and SEG announced record attendance of more than 5,200 oil and gas professionals at the second annual URTeC held in August in Denver – growth of some 20 percent over the inaugural event in 2013, also in Denver.

More than 230 companies exhibited at the event, showcasing the latest products, technologies and services for successful unconventional play development.

"With a record number of abstracts submitted, URTeC is becoming widely recognized as the premier sharing venue for the cross-disciplinary best practices that define success in unconventional plays," said AAPG program co-chair Skip Rhodes, who is director of unconventional resources for Pioneer Natural Resources.

The highly-rated science and technology exchanges in the first two URTeC events have set a precedent for the URTeC 2015 Technical Program, which boasts more than 300 papers from geologists, geophysicists, petroleum engineers and other energy professionals presenting on innovations, best practices and experiences in integrated approaches for North American unconventional resource plays.

There also are five field trips, nine short courses and at this date more than 180 exhibitors expected.

The event has been designed to fill the unique need for a peer-reviewed, science-based unconventional resources conference that will take an asset team approach to development of unconventional resource plays – similar to how oil and gas professionals work in today's market.

For more information go to the URTeC.org website.

CLASSIFIEDADS

POSITIONS WANTED

Director, Energy Resources Institute
Professor, Geology and Geological Engineering

The Department of Geology and Geological Engineering (GGE) at the South Dakota School of Mines & Technology (SD Mines) invites applications for a nine-month academic tenured/tenure-track position in Geology and Geological Engineering. Possibility of summer support dependent upon ability to obtain funding The successful candidate will become the inaugural Director of the newly established Energy Resources Institute (ERI) within the GGE Department at SD Mines, with an academic rank of Professor. ERI's vision is to develop a nationally recognized program of basic and applied research and education that covers both upstream and downstream components of the petroleum industry.

An earned doctorate in a science, technology, engineering, or mathematics discipline with an expertise that includes petrophysics, geomechanics, or a closely related field is required. This is a senior-level position for a scientist or engineer whose research program is well regarded by the petroleum industry, and who has either a record of significant funding and publication or significant leadership experience in a petroleum firm's research lab. Previous experience working with joint academic/industry consortia or NSF I/UCRC center development is highly desirable.

The ERI Director's primary duties will be building and directing an interdisciplinary research institute comprised of affiliated SD Mines faculty, as well as externally-supported researchers, technicians, postdocs, and graduate students. The Director, with the aid of the ERI advisory board and faculty affiliated with the institute, will define scientific projects, form industry/academic alliances, seek funding for individual and collaborative projects from agencies and industry, and successfully execute funded research. The ERI Director will also be expected to work closely with the SD Mines Foundation to engage prospective philanthropic supporters of the energy program. Candidates should demonstrate previous experience in supervising research staff and building effective teams. The Director also will be expected to generate interest and support for the newly established minor in Petroleum Systems and the graduate certificate in Petroleum Systems, with teaching duties focused on supporting these programs.

Review of applications will begin July 6, 2015, and will continue until the position is filled. Employment is contingent upon completion of a satisfactory background investigation. For questions about this position, contact Laurie Anderson, Search Chair, at Laurie.Anderson@sdsmt.edu. For more information about the School of Mines and Rapid City, visit: www.sdsmt.edu and www.visitrapidcity.com.

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MISCELLANEOUS

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EMD
from page 70

▸ In-capsule heating.

This is a new type of process invented by Red Leaf Resources, in which shallow oil shale is mined and used to create stadium-sized rubble beds surrounded by engineered earthen walls. The oil shale is heated indirectly to retorting temperatures by flowing hot gas through embedded tubes, with heat distributed by conduction and convection and the spent shale abandoned in place.

▸ In-situ heating.

This was resurrected from Swedish technology of the mid-20th century by Shell using more modern drilling technology and heating cables, and several companies are researching variations of in-situ heating in the United States and Israel.

Shell recently abandoned its U.S. BLM RD&D leases in preference for a demonstration of its in-situ conversion process (ICP) in Jordan. Israel Energy Initiatives was recently denied a permit in Israel to conduct a pilot test of a similar process and is considering its options.

The first commercial shale oil production in the United States will likely use Red Leaf's EcoShale in-capsule heating technology in a joint Utah project with Total S.A. Red Leaf obtained the necessary permits from the state of Utah and started construction on a 5/8th commercial-scale demonstration that would produce more than 300,000 barrels of oil over 400 days.

However, the drop in oil prices has caused them to re-optimize the project and begin in 2016, or possibly later.

TomCo Energy recently received temporary approval from the state of Utah for its development using the Red Leaf EcoShale process after the demonstration is completed.

Agreements were reached with one environmental group to proceed, but other environmental groups recently filed another suit to stop the projects.

DIRECTOR'S CORNER

A Jedi Master's Path to Success

By DAVID CURTISS

Luke and Leia, Han Solo and Chewbacca, R2-D2 and C-3PO – you know the names, you know the characters and, unless you're completely insulated from popular culture, you know that at the end of 2015 they're coming back to the big screen.

This reboot of the Star Wars franchise already is creating a stir, powered by a marketing engine that is drawing thousands to events in anticipation of the release. And in living rooms everywhere, those of us who were children when the initial film was released in 1977 are introducing our children to a world, "A long time ago, in a galaxy far, far away …"

That is a striking fact: Nearly 40 years after its initial release, Star Wars still evokes passion and emotion in many of us who were spellbound by its story.

While reading Ed Catmull's recent book, "Creativity, Inc.," I was reminded of the story of George Lucas, the creator of Star Wars.

Catmull is the president and co-founder of Pixar Animation Studios, a juggernaut in its own right with movie favorites ranging from "Toy Story" to "Monsters, Inc." But as a young man he worked for Lucas at Lucasfilm, pioneering the use of computer technology in cinematic storytelling.

And based on his experience at Lucasfilm he credits three traits for much of Lucas's success:


CURTISS

> **Building your future takes vision – you have to know where you're headed.**

▸ First, Lucas **possesses confidence**.

The often-told story is how after his early commercial success with the film "American Graffiti," Lucas was urged by his colleagues to ask for a much-higher salary for "Star Wars." That's the conventional approach: direct a successful film, demand more money for the next one.

Instead, Lucas asked for the ownership rights to licensing and merchandising for the film. He believed in the project and his ability to deliver a great film.

The movie studio, 20th Century Fox, in contrast, was simply looking for the next blockbuster among a portfolio of films it was backing, so giving up a potential revenue stream on an unproven film hardly seemed risky. The studio agreed to the terms.

Today, Forbes lists George Lucas as having a net worth over $5 billion.

▸ Second, Lucas sees **value in the journey**, the struggle to achieve a goal.

This is a recurring theme in his movies ("Do, or do not – there is no try") – and also in his life.

Catmull recounts how Lucas would motivate the team – these projects were not accomplished alone, but together – with gallows humor that was disturbingly on point. Developing Skywalker Ranch, where Lucas built his own film facilities, was like "a ship going down river … that had been cut in half … and whose captain had been thrown overboard.

"'We're still going to get there,' he (Lucas) would say. 'Grab the paddles and let's keep going!'"

▸ Third, Catmull writes, Lucas takes a **long-term perspective**. He has a big picture in mind, a picture of his future. And this vision, fueled by his self-confidence and willingness to work hard and struggle, is what has propelled him forward.

This isn't the formula for a comfortable life. But for Lucas, at least, it has proven the formula for an artistically and commercially productive life.

* * *

Each of us has the opportunity, perhaps even an obligation, to develop our own formula for success. And as I read these passages in Catmull's book, I saw applications for you and for me as professionals in the oil and natural gas industry.

We've chosen to work in a cyclical, commodity business. Job security as historically defined is an increasing rarity in the global economy. But in our industry it's vanished.

What does that mean for your big picture, your future?

You may not be our industry's next George Lucas. But remember, he didn't do it alone – and the people on his teams, like Ed Catmull, have gone on to have their own remarkable careers.

There are nearly 40,000 AAPG members spanning the eastern and western hemispheres, geoscientists like you and me. Helping you make connections and build professional relationships is why AAPG exists. It's why we're gathering in Denver later this month for our Annual Convention and Exhibition.

We're all in this together, striving to create our individual and collective futures.

Surround yourself with people like that, and who knows what could happen?

Building your future takes vision – you have to know where you're headed. It takes confidence and skill to achieve your goals. And it will likely take struggle. The kind of struggle where if you knew going in how hard it would be, you wouldn't start.

But that's why we need each other – to build our futures together.

DIVISIONS REPORT: EMD

Then and Now: An EMD Perspective on Oil Shale

By ALAN BURNHAM

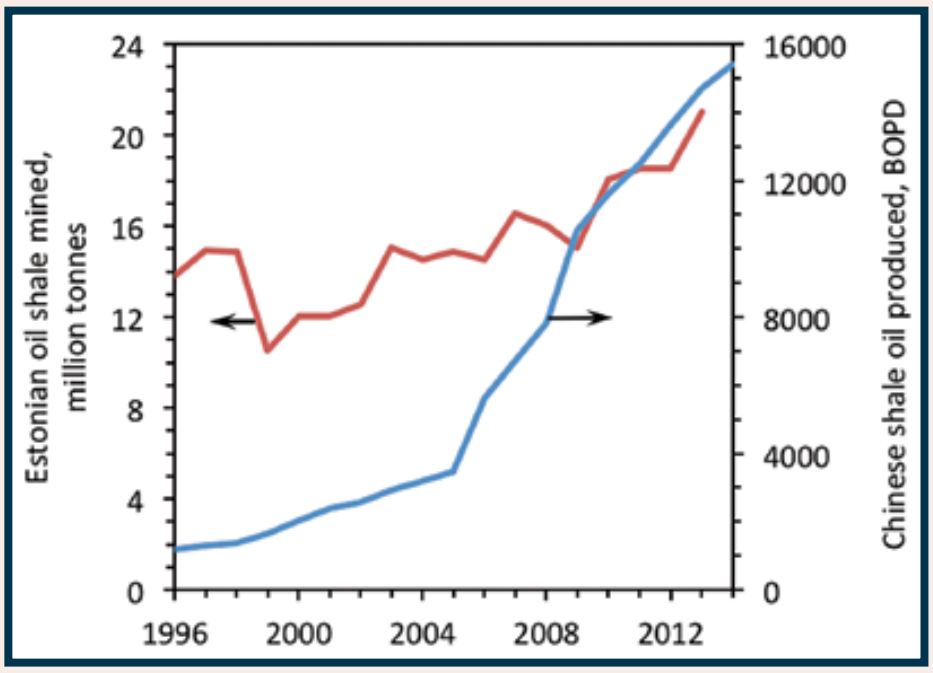
Oil shale is a rich petroleum source rock that never got buried deep enough to generate oil and gas. Worldwide, oil shale is a massive resource that potentially could yield a trillion barrels of oil and gas equivalent.

Prior to the discovery of commercial natural petroleum deposits, oil shale was a significant source of heating and lighting oil, particularly in Scotland in the 19th century. In the United States, interest in oil shale awakens every 30 years or so with concerns about conventional petroleum supplies, then wanes with new oil discoveries.

Oil shale activities in other parts of the world are less variable. Prior to the recent drop in oil prices, the future of oil shale looked bright, at least in certain parts of the world. The current status is in flux, but it is too early to know whether we are seeing a repeat of the 1980s.

The United States has the largest deposit of oil shale (Green River Formation), but Estonia and China currently are the largest producers, using it for making both electric power by burning and shale oil by retorting (destructive distillation).

The unfortunate recent use of the term "shale oil" for oil produced by hydraulically fracturing mature source rocks is a source of major confusion in both public and scientific circles, as the resources and production means are completely different.



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Oil shale mining peaked in 1980 at about 43 million tons per year; declined to about 16 million tons a year in 2000; but has grown steadily since to about 33 million tons in 2014, of which 90 percent was split between China and Estonia (see figure above).

Brazil produced most of the rest.

From the portion retorted, China averaged about 16,000 BOPD, Estonia 14,000 BOPD, and Brazil nearly 4,000 BOPD. The Chinese and Estonian numbers include new capacity added during the year, so those totals will rise in 2015.

New oil shale development is proposed in the three currently producing countries and in Jordan, the United States, Australia, Morocco, Mongolia, Israel, Canada and Uzbekistan.

How fast this expansion proceeds depends strongly on the price of oil – but it is likely that some R&D and incipient commercial production will occur in order to refine processing technology and economics, under the presumption that oil prices will go up during the years before significant commercial production.

Projections prior to the recent oil-price collapse were about 400 million tons of oil shale mined per year and 500,000 BOPD by 2030.

* * *

The two primary processes for producing shale oil are hot-gas retorts and hot-solids retorts.

Many variations of each exist, with the Fushun, Kiviter, Petrosix and Paraho processes being the dominant hot-gas types used in China, Estonia, Brazil, Australia and the United States; and the Galoter, Petroter, Enefit and ATP processes being the hot-solids types used in Estonia and China, and potentially in the United States, Jordan and Morocco.

Enefit is pursuing a commercial development in Utah on both private and U.S. land (via its BLM RD&D lease) using its hot-solids technology. They have been actively seeking a permit for a utility corridor across federal land to their property, with a draft decision expected this year.

The two new types of processes being researched are:

See **EMD**, page 69

still jamming

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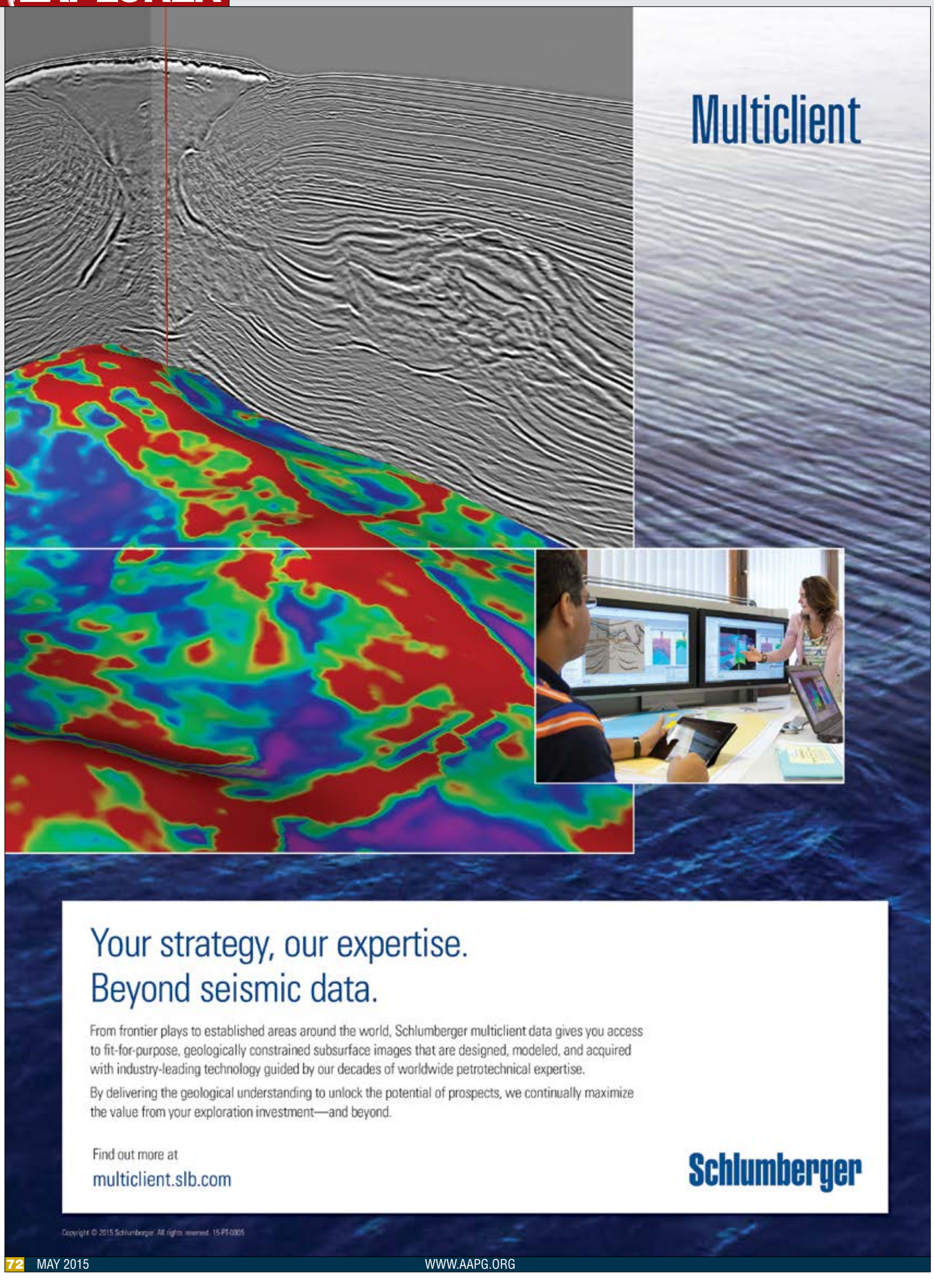
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