HGS Bulletin
Houston Geological Society
Volume 58, Number 6
February 2016

Oligocene-Miocene Rifting and its Influence on Siliciclastic Reservoir Distribution and Exploration in the Gulf of Suez, Egypt

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New Evidence for a Paleocene/Eocene Extreme Evaporative Drawdown of the Gulf of Mexico

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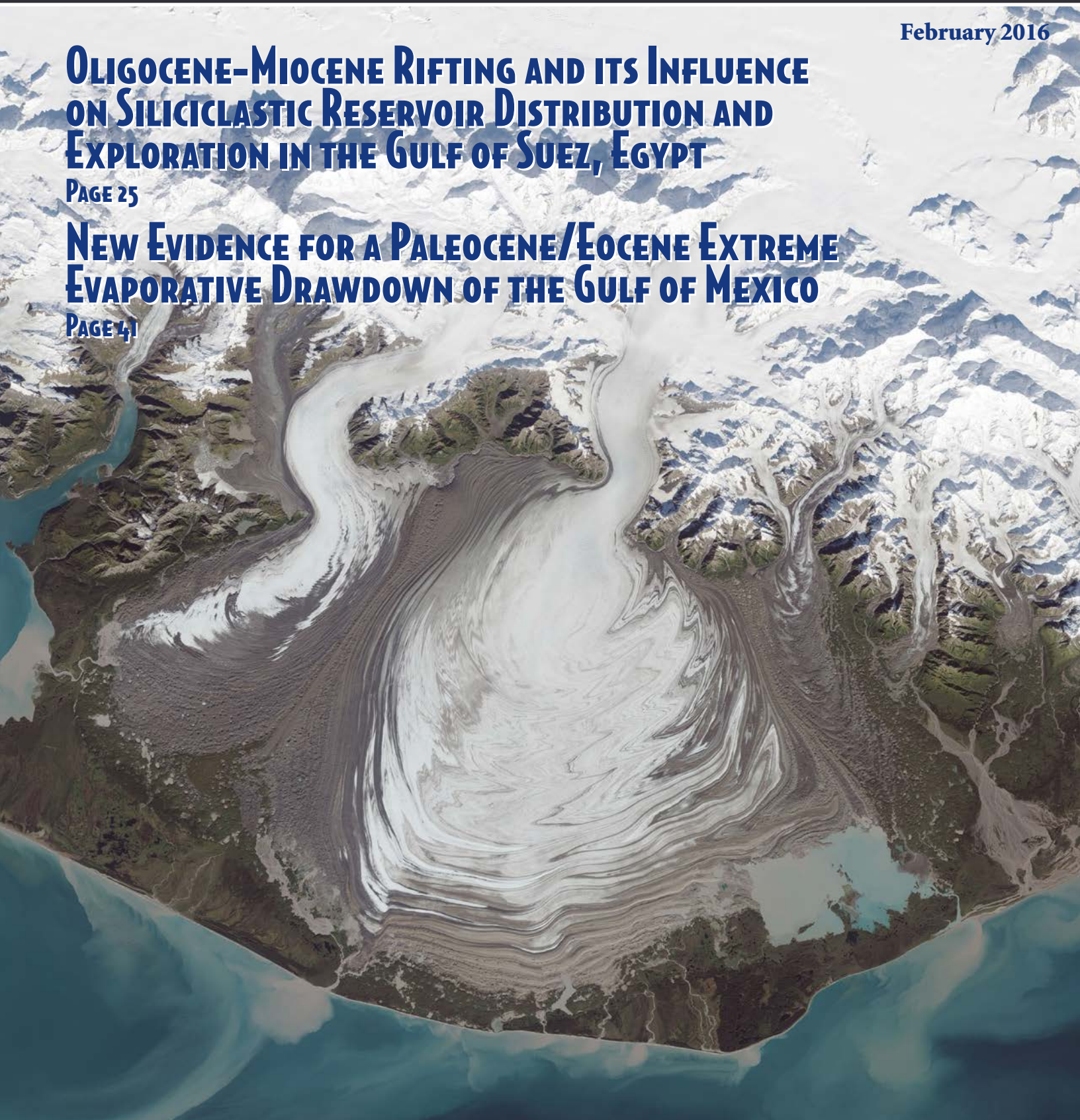

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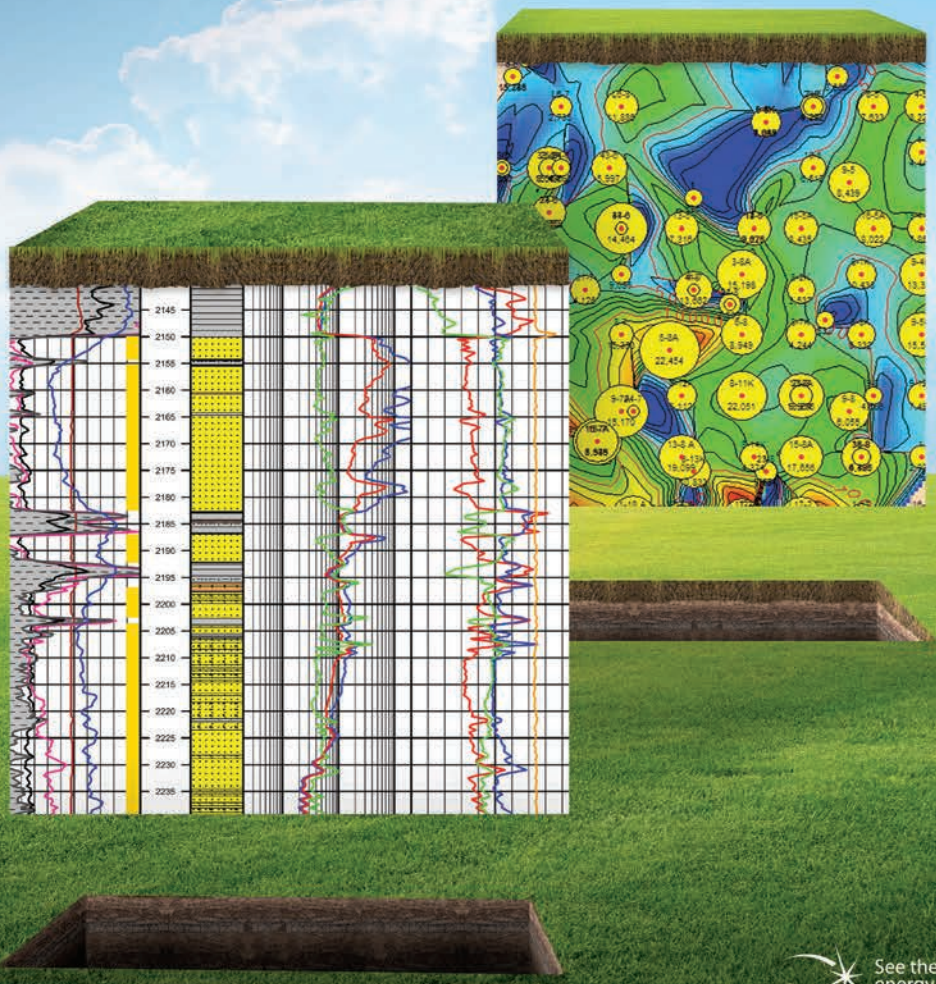

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The Bulletin
Houston Geological Society

Volume 58, Number 6 February 2016

In Every Issue

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Technical Meetings

Other Features

About the Cover: On 24 September 2014, the Operational Land Imager (OLI) on Landsat 8 acquired this image of Malaspina Glacier in southeastern Alaska, one of the largest piedmont glaciers in the world. The main source of ice comes from Seward Glacier, located at the top-center of this image. The Agassiz and Libbey glaciers are visible on the left side, and the Hayden and Marvine glaciers are on the right. The brown lines on the ice are moraines—areas where soil, rock, and other debris have been scraped up by the glacier and deposited at its sides. Where two glaciers flow together, the moraines merge to form a medial moraine. Glaciers that flow at a steady speed tend to have moraines that are relatively straight.

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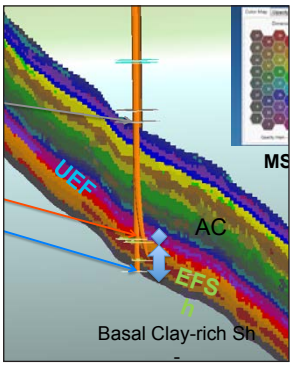

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HGS Shrimp Peel

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(plus 1 guest at the same price)

$45 – non-members/walk-ins

• Deadline to purchase tickets online is February 19, 2016 *(No Refund)* •

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Deborah Sacrey
dsacrey@auburnenergy.com

Peel Some Shrimp With Your Friends!

Can't believe it's already 2016 as I am writing this. I don't know where 2015 went, but I am pretty glad it's history, as I know many of you are too.

Let us all hope and pray that 2016 is a MUCH better year…that prices of commodities will recover, and exploration companies will get back to doing what they do best — drill, baby, drill.

Your HGS Board is always trying to think of things to help the membership during these hard times, and one of the ideas is to organize events to assist in networking. We have decided to bring back the Shrimp Peel this month, and I hope everyone takes advantage of the networking opportunities this event will offer. Come and join 300 or 400 of your friends (and hopefully MORE!), and see who is doing what, or who may need help with a consulting project.

Another way the Board is trying to help the membership is to offer discounts for Continuing Education events, all of our conferences, and our lunch and dinner meetings.

We are keeping the costs to break-even (even a little bit of a loss for HGS — but we feel the money is worth it to help the membership), so the costs are extremely reasonable considering renting the Race Park and the cost of food and drink. We are even keeping the cost of sponsorship at very modest levels to encourage even small companies to contribute — every little bit helps!

The date is February 27th — and yes, we know that is the same weekend as the Houston Rodeo BBQ Contest — but it was the only date we could reserve, make the press deadlines, and have really good, fresh shrimp at the same time. Would you rather fight the crowds and have to walk a mile to get BBQ, or come network at the Sam Houston Race Park, drink a couple of good brews, eat shrimp and hot dogs, and network with your friends? Oh — and it is my understanding that there is a Wine Tasting at the Race Park that day as well…you will need to call them to get information — but it is only $20! And who knows…you might get lucky betting on the horses too.

I will be going for sure, as the 28th is my birthday — and I can't think of a better way to celebrate!

Another way the Board is trying to help the membership is to offer discounts for Continuing Education events, all of our conferences (Mudrocks, Africa, etc), and our lunch and dinner meetings. For the lunch and dinner meetings, one must call the HGS office to let them know you are an unemployed member who would like to register at the special rate. This rate is below cost for us — so members are operating on the honor system when calling the office!

Hope to see everyone at the Shrimp Peel.

Best,
Deborah

Third Announcement and Final Call for Papers

Africa: What's Next?

The 15th HGS-PESGB Conference on African E&P

September 12-14, 2016

The Westin Houston, Memorial City, Houston Texas

This annual conference, alternating between Houston and London, has established itself as the primary technical E & P conference on Africa with attendances in recent years exceeding 600, including industry operators, consultants, governments, and academia. There will be a large poster program in addition to the oral program of about 25 high quality talks covering aspects of E & P in all regions of Africa.

Theme 1: African Exploration in a Global Context
Session Chair: Joan Flinch (Repsol)

Theme 2: Knowledge Transfer: Emerging Exploration Concepts, Conjugate Margins and Analogues
Session Chair: Bill Dickson (DIGS)

Theme 3: Hydrocarbon Generation Through Time and Space
Session Chair: Carol Law (Soaring Eagle Energy)

Theme 4: Storage and Containment: New Insights into Reservoirs, Seals and Traps
Session Chair: Katrina Coterill (BHP)

Interactive Seismic Showcase and Geology Workshop
Session Chair: John Moran (Anadarko)
Ongoing throughout the conference – see website for announcement of details.

Abstracts Abstracts (up to 2 pages long and can include diagrams) should be sent as soon as possible and no later than **March 1, 2016** to Africa2016@hgs.org. Extended abstracts are normally written once your paper is accepted and are issued on a conference CD.

Invited Keynote and Other Speakers A number of respected industry leaders have accepted invitations to deliver keynote presentations: Presenters include: opening keynote address by Bob Fryklund (Chief Upstream Strategist-IHS Energy) on *Africa Exploration – Dealing with the New Reality?*, plus Peter Elliott (PVE Consulting Ltd) on *Exploration Strategy and Performance in Sub Saharan Africa*, GlobalData on *Commercial Aspects of Exploration in Africa*, Cynthia Ebinger (Univ. of Rochester) on *Fluid Flow in East African Rift Systems* and Anadarko on *Reservoirs and Seals of the Deep Ivorian Basin*. Further announcements to be revealed in due course; please consult the HGS website.

Short Courses 2 short courses will be held in conjunction with the conference
Duncan Macgregor – *Petroleum Basins and Recent Discoveries in North and East Africa*
Ian Davison – *South Atlantic Margins: Geology and Hydrocarbon Potential*

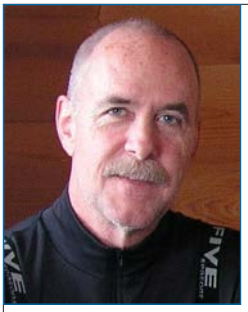
Conference Opening Evening Lecture Prof. Andy Nyblade (Penn State University) will present the Conference Opening lecture on *Imaging First-Order Structure of Large Karoo and Younger Basins in Central, Eastern and Southern Africa Using Passive Source Seismic Data*. The lecture will be held on the evening of Monday September 12th. Details to be announced shortly.

Details of sponsorship opportunities and exhibition booths are available at office@hgs.org or on the HGS website.

Registration will open in April, 2016.

Early bird rates will be available: check the HGS website for details.

Abstract submission: Africa2016@hgs.org • Information: office@hgs.org



Jon Blickwede
jonblickwede.hgs@gmail.com

The Resistance to Extreme Geology

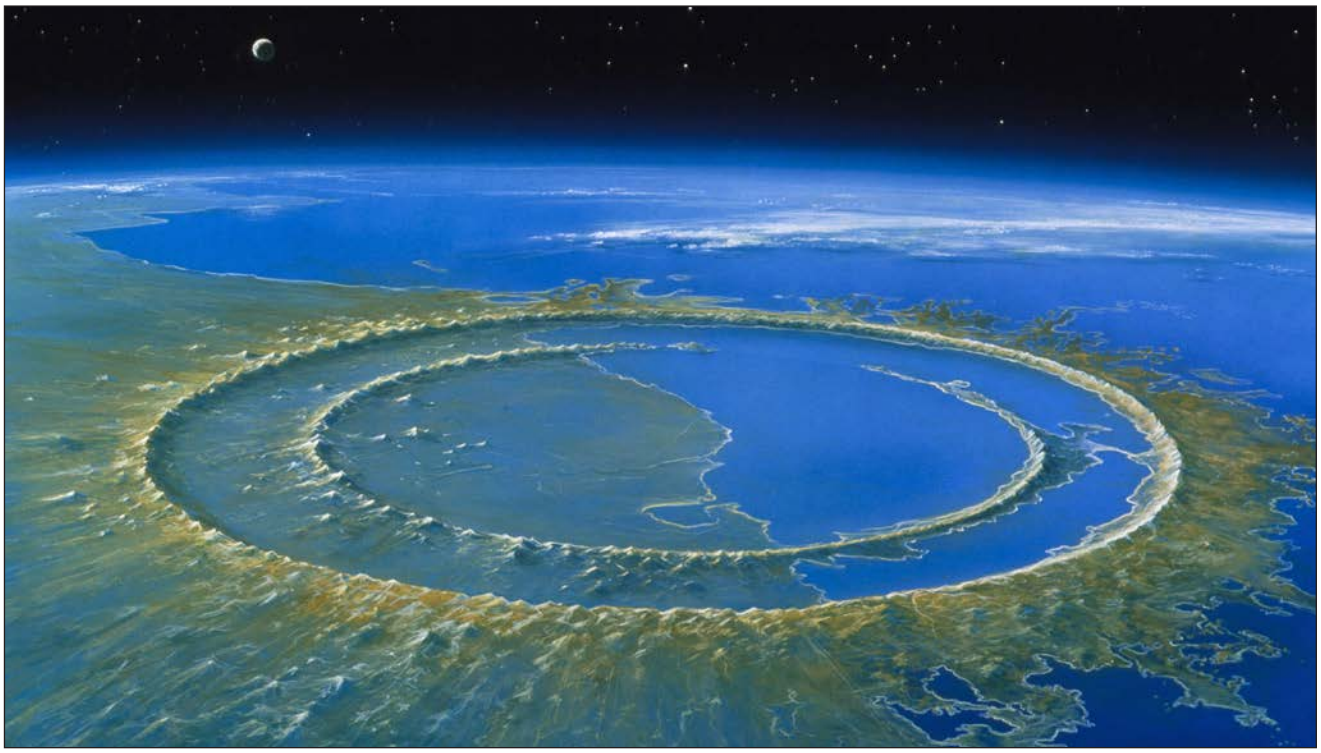
One of the main concepts to which all Geology 101 students are introduced is uniformitarianism, which is simply stated as "the present is the key to the past." As we geologists all know, the fundamental concept was introduced by James Hutton in the late 18th century, and institutionalized by geologist and lawyer Charles Lyell via his landmark *The Principles of Geology* first published during the 1830's.

Uniformitarianism was proposed as an alternative to catastrophism, the latter having been popularized by French paleontologist Georges Cuvier as a theory to explain the patterns of extinction and faunal succession observed in the rock record, but later used by others to support extreme events described in the Bible, such as the Noachian Flood.

Lyell attacked the catastrophists with dramatic flair: "We hear of sudden and violent revolutions of the globe… of general catastrophes and a succession of deluges, of the alternation of periods of repose and disorder, of the refrigeration of the globe, of the sudden annihilation of whole races of animals and plants, and other hypotheses, in which we see the ancient spirit of speculation revived, and a desire manifested to cut, rather than patiently to untie, the Gordian knot. In our attempt to unravel these difficult questions [of geologic history], we shall adopt a different course, restricting ourselves to the known or possible operations of existing causes; feeling assured that we have not yet exhausted the resources which the study of the present course of nature may provide, and therefore that we are not authorized… to recur to extraordinary agents." (Lyell, 1833)

During the following century, Stephen J. Gould and others challenged strict, substantive uniformitarianism. Instead of an either/or situation, they argued that both uniformitarian and catastrophic processes and events have been and will continue to be important elements shaping Earth's history. As someone stated (it may have been Gould himself), geologic history, like war, is characterized by "long periods of boredom punctuated by moments of sheer terror."

From the Editor *continued on page 9*



Artist's rendering of Chicxulub Crater (after the dust settled in the Danian) by D. van Ravenswaay, Science Source

The 15th HGS-PESGB Conference on African E&P

September 12-14, 2016 • Houston Texas

Exhibitor/Sponsorship Form

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Do you require internet access at your booth? ☐ Yes ☐ No

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From the Editor continued from page 7

By today, some catastrophic/extreme geological events and processes have gained wide acceptance, such as the Chicxulub bolide impact on the Yucatan Platform that caused the mass extinction which defines the Mesozoic/Cenozoic boundary. Another example is the recent body of research focused on extreme depositional systems (e.g. Chan and Archer, 2003).

Nevertheless, despite the reconciliation of the formerly competing concepts, there seems to be a persistent prejudice against hypotheses that contain elements of catastrophism. I'm not exactly sure why this is, but I'd suggest it's related to a number of factors, among them a persistent view that "real" earth science must be based on direct observation of natural processes operating today, aversion to any ideas that could be viewed as sensationalistic, the fact that the creationist movement (seen by many as anti-science) has often used catastrophist hypotheses as a tool for promoting their cause, and perhaps just the natural human tendency to wish for a predictable/comfortable world. A recent example of this prejudice is the slowness of the geological community to give serious consideration to the Gulf of Mexico evaporative drawdown hypothesis, new evidence for which is described in the feature article by Rosenfeld starting on page 41 of this issue. ■

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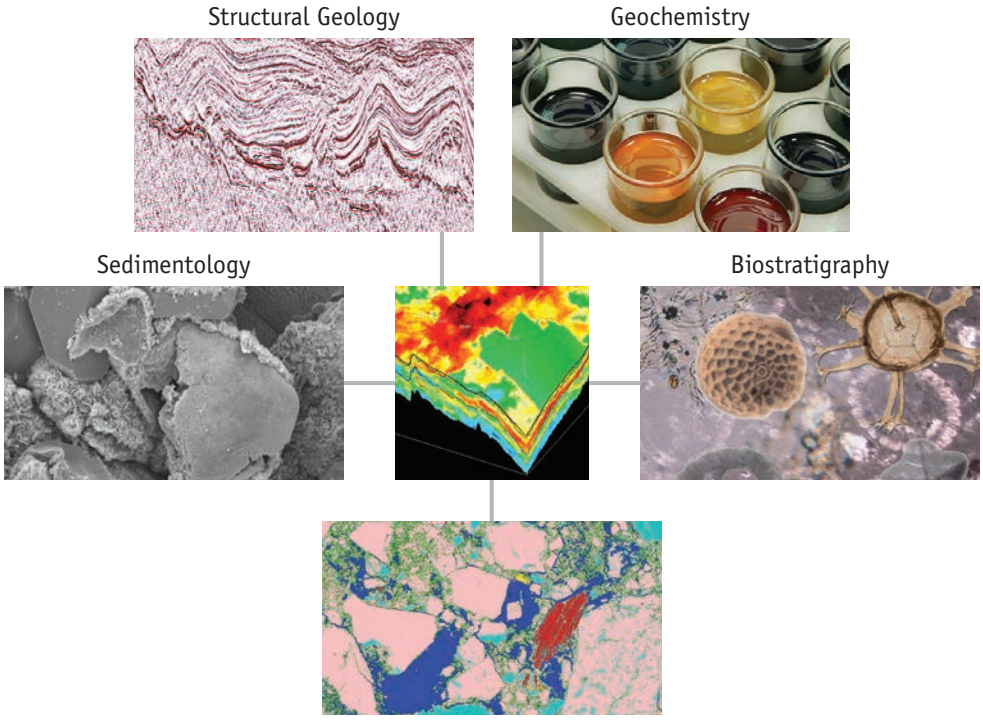
Core Strengths

Geological solutions to geophysical challenges



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HGS Applied Geoscience Mudrocks Conference Provides a Low Cost, High Quality Training and Networking Opportunity

by Mike Effler and Frank Walles

Please consider attending the upcoming Houston Geological Society 2016 Applied Geoscience Conference entitled: "Integrated Approaches to Unconventional Reservoir Assessment and Optimization," scheduled to be held on March 8th and 9th, 2016 at the Anadarko Petroleum Conference Center in The Woodlands. As a service to advance your personal knowledge in this very important field, this two day local event will feature the latest on reservoir characterization and optimization of recovery for unconventional reservoirs. A special addition to the event will include a leading industry speaker, Dr. Michelle Michot-Foss, Chief Energy Economist with the University of Texas/BEG, who will give a keynote luncheon presentation regarding the latest economic trend assessment of our industry.

Oral speakers are recognized experts from industry, government, and university who are specifically selected by our 45+ member conference organizing committee. The committee-invited technical program will include 20 top expert oral presenters organized within 8 sessions, 10 advanced university research poster presentations, and 5 operator and university research industry cores on display all with presenters (including cores from the Eagleford, Niobrara, Utica, others).

This is an annual HGS event that was first developed in 2006, began at the advent of the combined industry, government and university early mudrock reservoir characterization research. This technical conference has established itself as the premier Houston Mudrocks Technical Reservoir Characterization Conference that spans the research and applied geology spectrum from the outcrop to the nanoscale. Invited presenters have included the top researchers and applied experts from the early applied research in the 50's through the present.

This year's technical oral program event includes 16 session Co-Chairs that have developed invited presenter sessions on:

- Nanoscale reservoir behavior and observations
- Petroleum systems attribute integration
- Petrophysical integration to optimize completions
- Hybrid unconventional opportunities
- Unconventional technology for tight reservoirs
- Geophysical advances for reservoir characterization
- Recompletion and refracturing
- Integrated reservoir characterization for fun and profit.

Please see the technical program flyer within this issue of the HGS *Bulletin*.

As a local Houston Geological Society event it has proven to be cost and highly effective training for both geoscientists and engineers. The multi-member HGS organizing committee has contributed in making this conference happen for the past ten years, in part because it would be cost and competitor prohibitive for one single company to organize such a diverse (integrated industry, government & university) event.

Conference attendees will receive the committee and author developed expanded abstract / paper technical brochure of the oral and poster presentations to assist in the communication and sharing of the learnings. The HGS provides this industry developed event to fulfill a need for a focused sharing of advancing applied geoscience technologies within mudrock reservoir characterization.

This annual applied geoscience conference (AGC) event, as a combined education and scientific advancement service for the HGS member community, continues to be generously supported by many industry sponsors. The event location within conference facilities of Anadarko Petroleum is a very special tribute from our sponsors and we are especially grateful for the generosity of Anadarko to host this event. Houston Geological Society President Elect – **John Jordan**, and HGS AGC technical program committee member, **Wayne Camp** were especially critical in arranging this venue opportunity.

This Applied Geoscience Conference on mudrock reservoir characterization and optimization has been highly popular since inception with demand typically exceeding venue capacity. Attendee disciplines include the full range of management through geological, geophysical, petrophysical, production, reservoir and completion engineering. This year, in response to the industry downturn, and by the help of our venue sponsor, the **HGS has substantially reduced the cost to make it more affordable than ever.** *If you are interested in attending, but are encountering financial hardships such as unemployment, please contact the HGS front office for reduced pricing consideration.*
See www.hgs.org or contact Andrea Peoples at (713) 463-9476. ■

Applied Geoscience Conference

March 8 - 9, 2016

Integrated Approaches of Unconventional Reservoir Assessment and Optimization

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Day 1
- Nano-scale Reservoir Behavior and Observations
- Petroleum System Attribute Integration
- Petrophysical Integration to Optimize Completions
- Hybrid Unconventional Opportunities

Day 2
- Unconventional Technology for Tight Reservoirs
- Geophysical Advances for Reservoir Characterization
- Recompletions and Refracturing
- Integrated Reservoir Characterization for Fun and Profit

We will also feature posters highlighting university research, a multi core program supporting the oral technical program and a luncheon keynote address.

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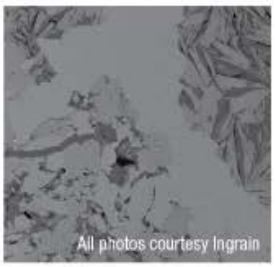

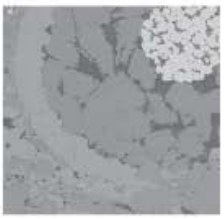

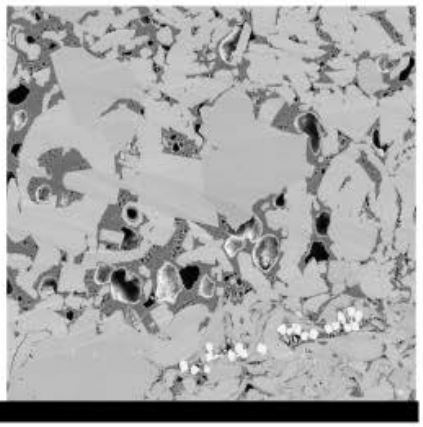

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Applied Geoscience Conference

March 8 - 9, 2016

Oral Presentations – Tuesday, March 8, 2016

7:00	**Registration and Coffee**	
8:00 - 8:10	Welcome and Opening Remarks: **Deborah Sacrey**, *HGS President*	
	Session 1: Nanoscale Reservoir Behavior and Observations **Session Chairs: Joe Macquaker and Avrami Grader**	
8:10 - 8:45	Connectivity in Nanoscale Cores	**Jap Claver,** Guillaume Desbois, *RWTH Aachen University, Germany*
8:45 - 9:20	Making Geologic Sense of Pore-System Characterizations in Carbonate-Rich Mudrocks: Examples from the Niobrara Formation	**David Budd,** *University of Colorado*
9:20 - 9:55	Linking the Nanoscale with the Macroscale using Infrared Microscopy and Laser-Induced Breakdown Spectroscopy	**Kate Washburn,** *INGRAIN*
9:55 - 10:20	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 2: Petroleum Systems Attribute Integration **Sesson Chairs: Neil Fishman and Taras Bryndzia**	
10:20 - 10:55	Variations of the Standard Measurement of Maturity (Vro%) in Unconventional Targets	**Paul Hackley,** *USGS*
10:55 - 11:30	Improved Assessment of Kerogen Density from Organic-Rich Shales—Impacts on Maturity Estimation and Petrophysical Interpretations	**Andrew E. Pomerantz,** *Schlumberger-Doll Research*
11:30 - 12:30	**Lunch, Poster, Core Displays and Exhibitor Presentations**	
12:00 - 12:30	**Luncheon Key Note Talk** Forward, Backward, Sideways – Market Redux	**Dr. Michelle Michot-Foss**, *University of Texas / BEG - Chief Energy Economist, Bureau of Economic Geology's Center for Energy Economics*
	Session 3: Petrophysical Integration to Optimize Completions **Sesson Chairs: Matt Williams and Barbara Hill**	
12:35 - 1:10	Electrical Properties of Kerogen and Its Impact on Electrical Properties of Organic-Rich Mudrocks	**Zoya Heidari,** *University of Texas*
1:10 - 1:45	High Resolution In-situ Elastic Property Characterization of Thin Laminates in Shale Formations	**Smaine Zeroug,** *Schlumberger-Doll Cambridge, MA*
1:45 - 2:20	Using Petrophysical Characteristics to Highgrade Prospectivity and Optimize Completions	**Lisa Marlow,** Scotty Tuttle, Keith Owen, Herman Vacca, *Halcon Resources*
2:20 - 2:45	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 4: Hybrid Unconventional Opportunities **Sesson Chairs: Gretchen Gillis and Obie Djordjevic**	
2:45 - 3:20	Using Advanced Logging Measurements to Develop a Robust Petrophysical Model for the Bakken Petroleum System	**Gary Simpson,** John Hohman, *Hess Corporation*; Iain Pirie, Jack Horkowitz, *Schlumberger*
3:20 - 3:55	A Tale of Two Three Forks: Unravelling the Intricacies of the Three Forks Using a Hybrid Conventional/Unconventional Toolset	**Mark Millard,** *SM Energy*, Riley Brinkerhoff, Sam Fluckiger
3:55 - 4:00	Closing Comments, Invitation to Posters and Core Sessions at Hotel Venue	
4:00 - 6:00	**Core, Exhibitor and Poster Presentations**	

Poster Session – ***Invited Presentations***

Open during All Coffee and Lunch Breaks • Allison Hall, Main Conference Room

Applied Geoscience Conference

March 8 - 9, 2016

Oral Presentations – Wednesday, March 9, 2016

7:00	**Registration and Coffee**	
	Session 5: Unconventional Technology for Tight Reservoirs **Sesson Chairs: Mike Cameron and Mark Andreason**	
8:10 - 8:45	A Regional Assessment of the Emerging Marble Falls Play in the Fort Worth Basin: The Effects of a Complex Sequence Stratigraphic Framework on Reservoir Lithofacies Distribution	**Beau Berend**, Ulysses Hargrove, Craig Adams, *Newark E&P Operating, LLC*; Mike Grace, *Independent Consultant*; Mike Mullen, *Stimulation Petrophysics Consulting*
8:45 - 9:20	Comparing Gas Shales and Tight Oil Reservoirs	**Alton Brown**, *Independent*
9:20 - 9:55	Accurate Time and Lithologic Relationships Of "Woodbine Complex" East Texas Using Cores, Cutting, High Resolution Biostratigraphy and Maximum Flooding Surface Sequence Stratigraphy	**Walter W. Wornardt Ph.D.**, *MICRO-STRAT INC.*
9:55 - 10:25	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 6: Geophysical Advances for Reservoir Characterization **Sesson Chairs: Lisa Neelan and Paul Collins**	
10:25 - 11:00	Drilling and Completions Engineers Want More From Seismic	**David Paddock**, Colin Sayers, Don Lee, Chuck Wagner, *WesternGeco Schlumberger*
11:00 - 11:35	Evaluating Productivity of Unconventional Fields Through Multivariate Analysis	**Damian Lynch**, Paul Collins, *Statoil*
11:35 - 1:00	**Lunch, Poster, Core Displays and Exhibitor Presentations**	
1:00 - 1:10	**Poster Awards Presentation**	
	Session 7: Recompletions and Refracturing **Sesson Chairs: Casee Lemons and Arlin Howles**	
1:10 - 1:45	Faulty Fracs — Can We Avoid the Need to Refrac with Better Input From Geoscientists?	**Mike Vincent**, *Fracwell*
1:45 - 2:20	Insight into Geomechanics of Re-Fracking — A Geomechanically Optimized Treatment Design	**Sudhendu Kashikar**, *MicroSeismic, Inc.*
2:20 - 2:55	Well Integrity and Candidate Requirements for Refracturing in Multiple Fractured Horizontal Wells	**George King**, *Apache*
2:55 - 3:25	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 8: Integrated Reservoir Characterization for Fun and Profit **Sesson Chairs: John Breyer and Andy Benson**	
3:25 - 4:00	Eagle Ford Reservoir Characterization Integration for Economic Success	**Falene Petrik**, *Marathon Oil*
3:50 - 4:20	Advanced Petrophysical, Geological, Geophysical and Geomechanical Reservoir Characterization — Key to the Successful Implementation of a Geo-Engineered Completion Optimization Program in the Eagle Ford Shale	**Tie Sun**, Chrystianto Mardi, German Merletti, Hemali Patel, Stephan Cadwallader, Mitchell Graff, Jeff Wampler, Ivan Gil, Herb Sebastian, David Spain, Omar Aguirre, *BP America*

Core Display Chairs: Bruce Woodhouse and Taras Bryndzia

Core Displays

Selected Core from Emerging and Established Unconventional Reservoirs Supporting the Oral Technical Presentations

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Bureau of Economic Geology, University of Texas

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Applied Geoscience Conference

March 8 - 9, 2016

Student Posters – March 8-9, 2016

Poster Sesson Chairs: Mike Effler and Steven Macallelo

University	StudentName	Poster Topic
Gdansk University of Technology	**Aleksandra Ptaszynska**	The Role of Mineral and Organic Matter Constituents in Kerogen Transformation and Hydrocarbons Mobility
University of Alberta	**Korhan Ayranci**, Tian Dong, Nicholas Harris	Detailed Lithofacies Analysis and Sequence Stratigraphy of the Horn River Group, British Columbia, Canada
University of Calgary	**Emma L. Percy**, Dr. Per Kent Pedersen	Identifying "Sweet Spots" in Mudstones: Applying Conventional Exploration Methods to Unconventional Reservoirs
University of Houston/ GFZ-German Research Center for Geosciences	**Jingqiang Tan**, Brian Horsfield	Geological Characterization for the Lower Silurian and Lower Cambrian Shale Gas Systems in South China
University of Oklahoma	**Sayantan Ghosh**, Caleb P. Bontempi, Roger M. Slatt	Woodford Shale Fracture Distribution from Arbuckle Wilderness and US-77D Outcrops
University of Oklahoma	**Jing Zhang**, Bryan Turner, Roger Slatt	XRF Chemostratigraphy for Characterizing a Shale Reservoir Along a Horizontal Well Track
University of Oklahoma	**Tengfei Wu**, Jeremy Boak	Chemostratigraphy and Mineral Evolution of the Green River Formation
University of Texas	**Christopher Hendrix**, Harry Rowe, Robert G. Loucks	Calcareous Mudrock Chemolithostratigraphy of the Late Cretaceous South Texas Shelf
University of Texas	**Lauren Redmond**, Robert Loucks, Harry Rowe	Tying Core Descriptions and Optical Petrography with XRF Geochemical Data for a Detailed Characterization of the Mississippian Barnett Formation in the Southern Fort Worth Basin of North-Central Texas
Virginia Polytechnic Institute	**T.R. Them II**, B.C. Gill	Paleoenvironmental Changes Recorded in an Early Jurassic Mudrock Succession from Western North America

Participating Schools

Gdansk University of Technology

University of Alberta

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University of Houston

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University of Texas

Virginia Polytechnic Institute

Open during Coffee and Lunch Breaks, Tuesday Social Hour
Allison Hall Main Conference Room

Monday, February 8, 2016

Westchase Hilton • 9999 Westheimer
Social Hour 5:30–6:30 p.m.
Dinner 6:30–7:30 p.m.

Cost: $45 Preregistered members; $50 non-members/walk-ups

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Owen Stephens
Noble Energy, Houston

Big Bend Field: Gulf of Mexico Success, from Prospect to Production through Geoscience Integration

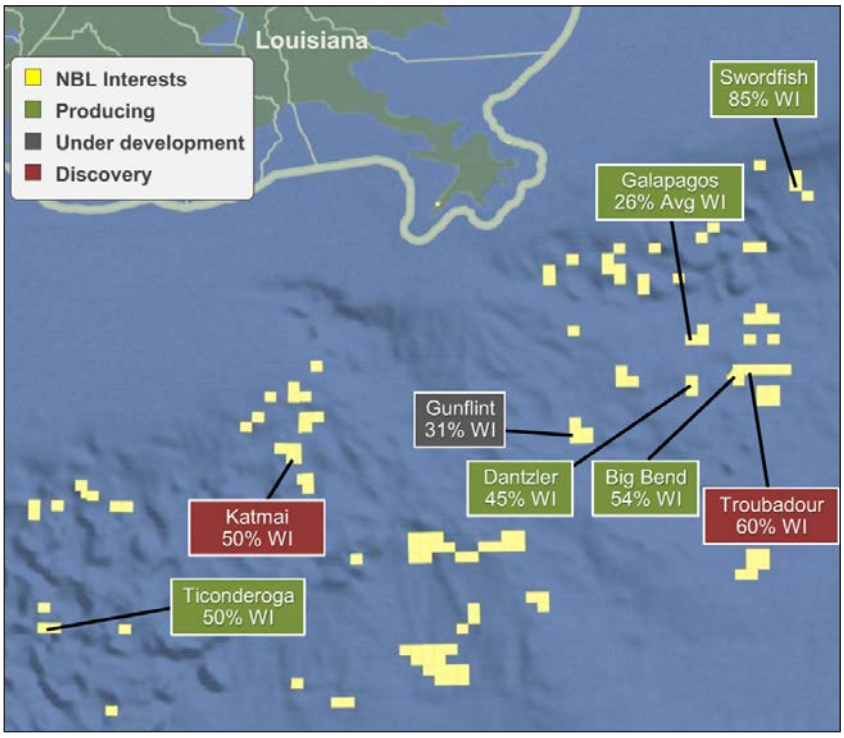

Figure 1. *Location of the Big Bend Field in the Gulf of Mexico.*

Big Bend is one of several recent discoveries made in Mississippi Canyon by Noble Energy and partners. Oil is contained in lower Middle Miocene deepwater sandstones within a very high-relief combination structural/stratigraphic trap. This presentation will recount the subsurface analysis that drove the successful discovery and subsequent rapid development of the Big Bend Field.

Several techniques were used to de-risk the Big Bend prospect prior to drilling. 3D wide azimuth seismic data was processed using proprietary methods, which provided meaningful uplift to the imaging adjacent to and underneath salt bodies, DHI interpretation, and migration velocities. This uplift increased the confidence in reservoir presence and quality. An improved velocity volume was used in the pore pressure analysis to assess column height and top seal potential, which helped mitigate containment risk. Chimney cube technology results confirmed migration pathway and thermogenic charge assumptions, as well as the leaky trap prediction from pore pressure analysis. Seismic inversion reduced concerns about reservoir and hydrocarbon presence. With the resulting increased confidence, the initial well was drilled in late 2012, discovering 130 feet of high quality net oil pay.

After discovery, actively addressing the remaining field uncertainties allowed acceleration of both project sanction and first oil. Risk of the interpreted oil/water contact being a paleo-contact was reduced through fluid substitution modeling and geostatistical seismic inversion. An updated depositional model

HGS General Dinner *continued on page 19*

HGS General Dinner continued from page 17

was created using sidewall core, conventional core from nearby analogs, image log analysis and seismic interpretation, reducing reservoir uncertainties and feeding into the reservoir model. This then guided a multi-phased reservoir modeling approach. First, a simple model provided production profiles for early project planning. Multiple deterministic cases were then used to assess volumetric and compartmentalization uncertainties. With those uncertainties understood, the development could be sanctioned as a single-well subsea tie-back, maximizing value by minimizing both appraisal costs and project costs, and accelerating first oil. The resulting early production history will allow further appraisal of field volumes and compartmentalization, in the upside case potentially justifying an additional producer and water injection.

Big Bend commenced production on October 26, 2015, less than three years from discovery and within the sanctioned budget, with production reaching over 20 Mboe/d. ■

Biographical Sketch

Owen Stephens is a Senior Geologist with Noble Energy in Houston. In his current role as reservoir geology specialist and reservoir modeler for the deepwater Gulf of Mexico, he has helped successfully bring many of Noble's assets from appraisal to development, first production and beyond, addressing issues of reservoir presence, thickness, quality and connectivity. Previously, he worked on the North Sea, Irish Sea and Eastern Mediterranean, including the discovery, appraisal and development of Noble's giant gas field, Tamar. Owen earned a BA in Natural Sciences (Geology) from the University of Cambridge, U.K. in 1996 and an MSc in Basin Evolution and Dynamics from Royal Holloway, University of London, U.K. in 1997.

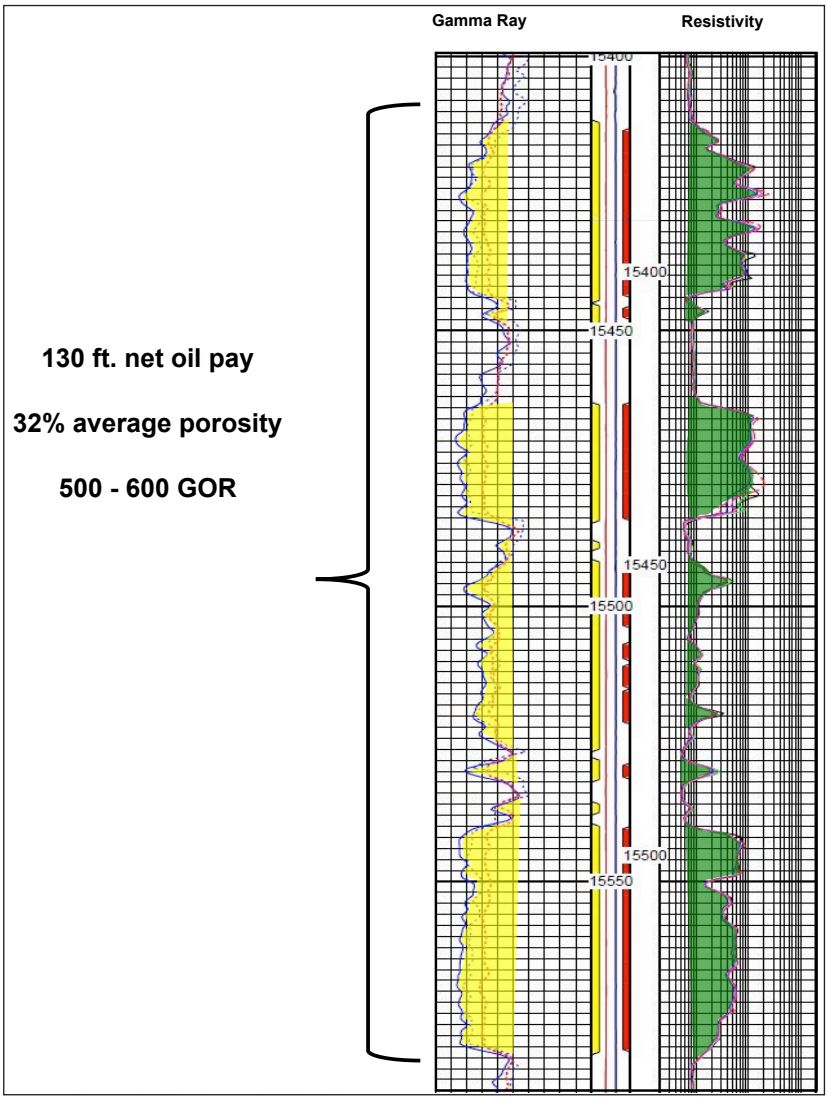

Figure 2: *The lower Middle Miocene reservoir in the Big Bend discovery well, MC698#1.*

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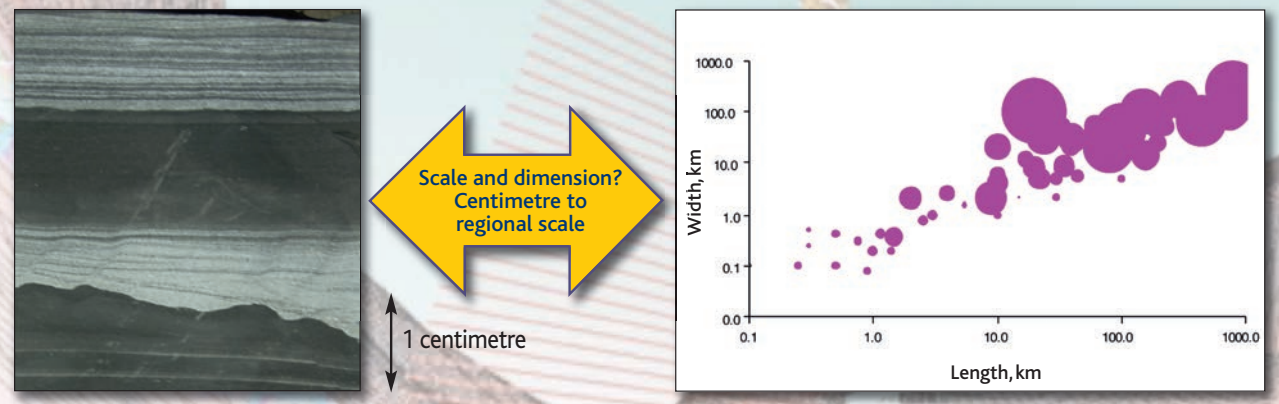
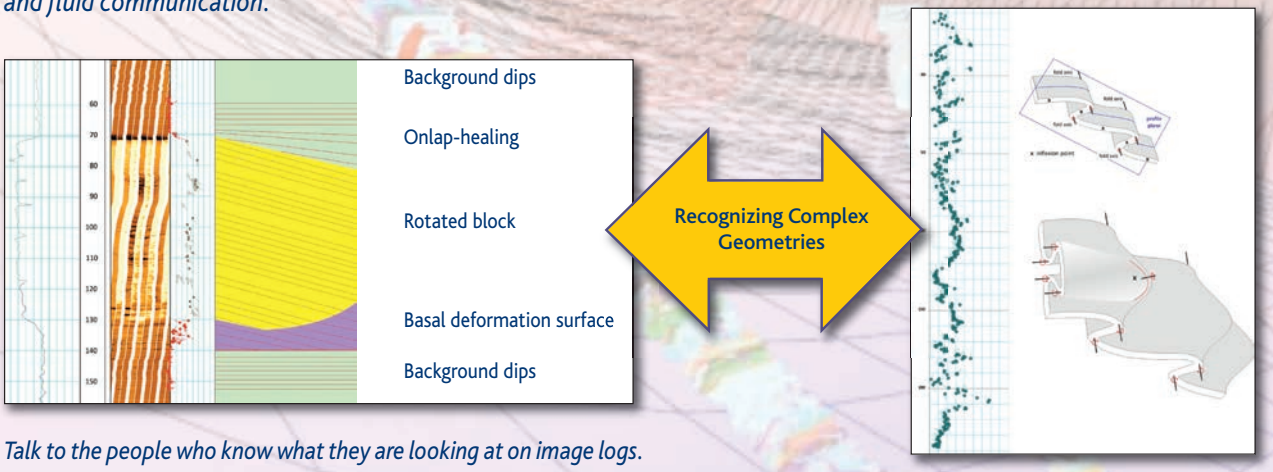
RECOGNISING MASS TRANSPORT COMPLEXES (MTC) are part and parcel of any exploration or development in continental margin, abrupt margin and submarine canyon plays. Based on hundreds of kilometres of image and cores studies, **TASK FRONTERRA** has determined that at least 12% of deep marine deposits are deformed by creep, failure or rotational slumping. We have conducted numerous studies in the Gulf of Mexico, West Africa, Brazil, West of Shetlands, Nile Delta, Australia: North West Shelf and Malaysia.



Whether you are looking to sequester CO_2 in compartmentalized sediments, or looking at field development strategies – you want to be using the people who can measure and characterize these sediments in terms of geometry, scale, contacts and fluid communication.



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Wednesday, February 10, 2016

Black Lab Pub, Churchill Room • 4100 Montrose Blvd.
Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $30 Preregistered members; $35 non-members/walk-ups

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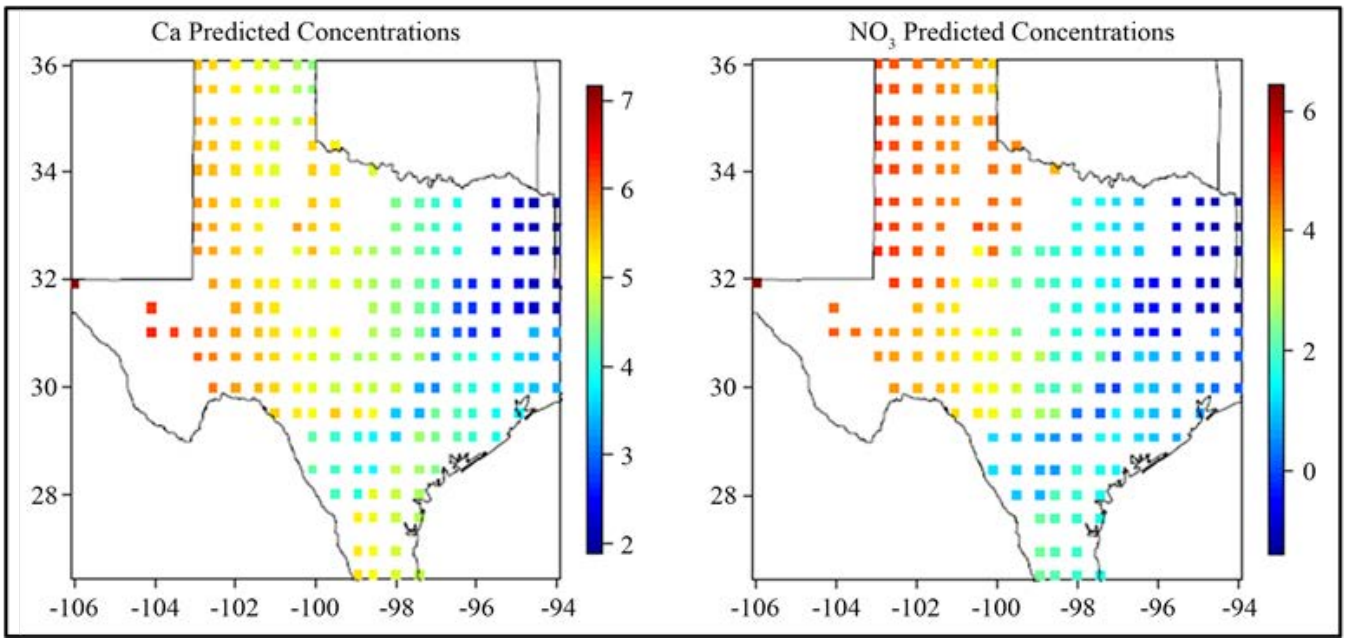
Dr. Faye Anderson
Research Scientist, Center for Advances in Water and Air Quality
Lamar University, Beaumont, TX
faye.anderson@lamar.edu

Multivariate Geostatistical Model for Groundwater Constituents in Texas



Although many studies have explored the quality of Texas groundwater, very few have investigated the concurrent distributions of more than one pollutant, which provides insight on the temporal and spatial behavior of constituents within and between aquifers. The purpose of this research is to study the multivariate spatial patterns of seven health-related Texas groundwater constituents, which are calcium (Ca), chloride (Cl), nitrate (NO3), sodium (Na), magnesium (Mg), sulfate (SO4), and potassium (K). Data is extracted from Texas Water Development Board's database including nine years, 2000 through 2008. A multivariate geostatistical model was developed to examine the interactions between the constituents. The model had seven dependent variables—one for each of the constituents, and five independent variables: altitude, latitude, longitude, major aquifer and water level. Exploratory analyses show that the data has no temporal patterns, but hold spatial patterns as well as intrinsic correlation. The intrinsic correlation allowed for the use of a covariance matrix. The model was validated with a split-sample. Estimates of iteratively re-weighted generalized least squares converged after four iterations. Matérn covariance function estimates are zero nugget, practical range is 44 miles, 0.8340 variance and kappa was fixed at 2. Prediction maps for the seven constituents are estimated from new locations data. The results point to an alarmingly increasing levels of these constituents' concentrations, which calls for more intensive monitoring and groundwater management. ■

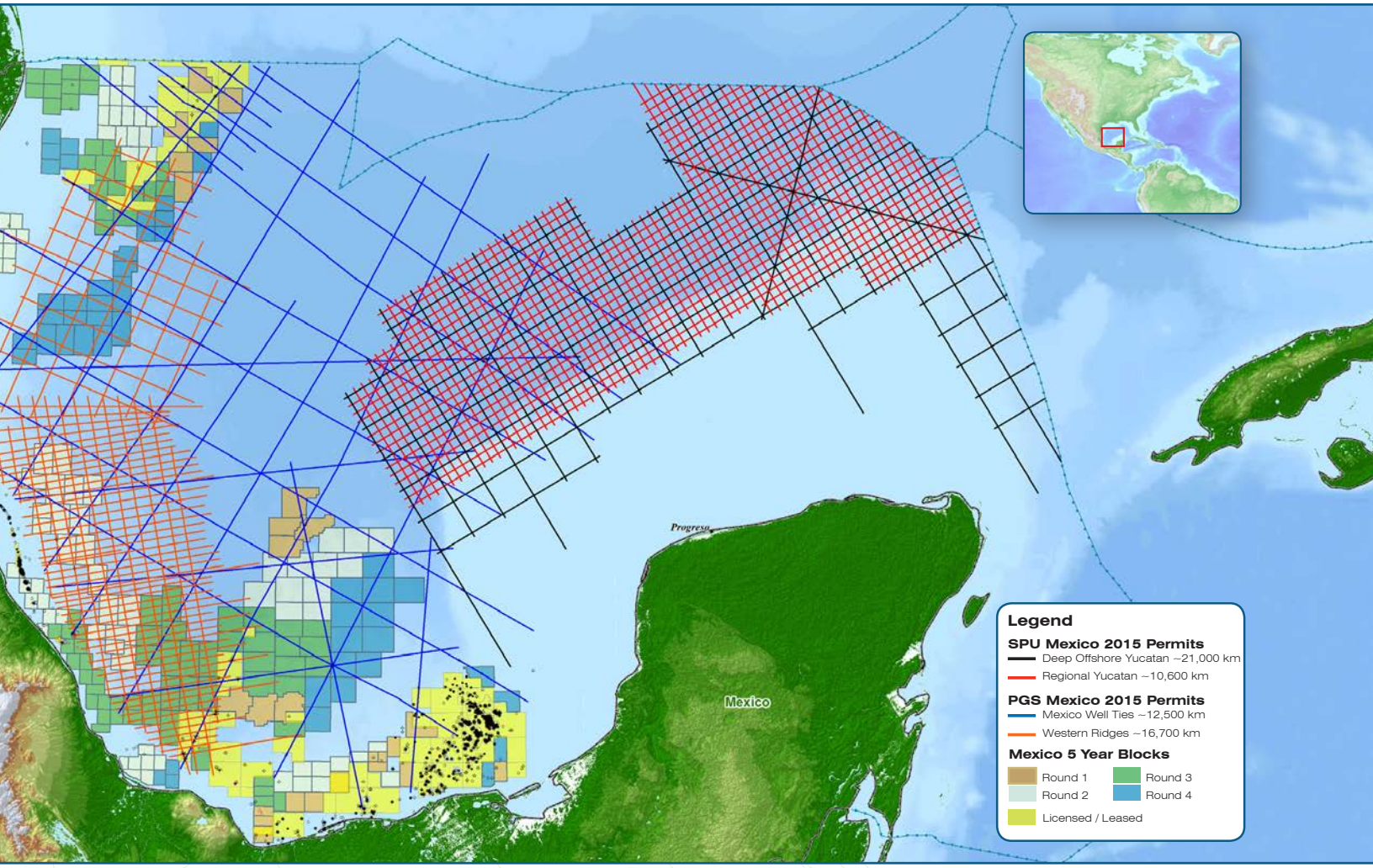
Biographical Sketch

Dr. Faye Anderson is a research scientist in the Center for Advances in Water and Air Quality at Lamar University in Beaumont, Texas. Her research interests include environmental and occupational monitoring and assessment, environmental toxicology, geographical information systems (GIS), geostatistical modeling, health disparities, global

HGS Environmental & Engineering Dinner *continued on page 23*

Mexico GoM

Newly Acquired Multi-Client 2D Seismic



Spectrum's latest long-offset 2D seismic survey offshore Mexico is a collaborative effort with PGS and Schlumberger, spanning approximately 60,000 km. The survey provides seamless broadband seismic coverage across the Gulf of Mexico from the Yucatan Platform in the southeast, to the Perdido Fold Belt in the northwest, tying key wells in producing hydrocarbon basins and sampling emerging pre-salt plays. These strategically placed surveys will help provide greater insight to clients preparing for subsequent licensing rounds.

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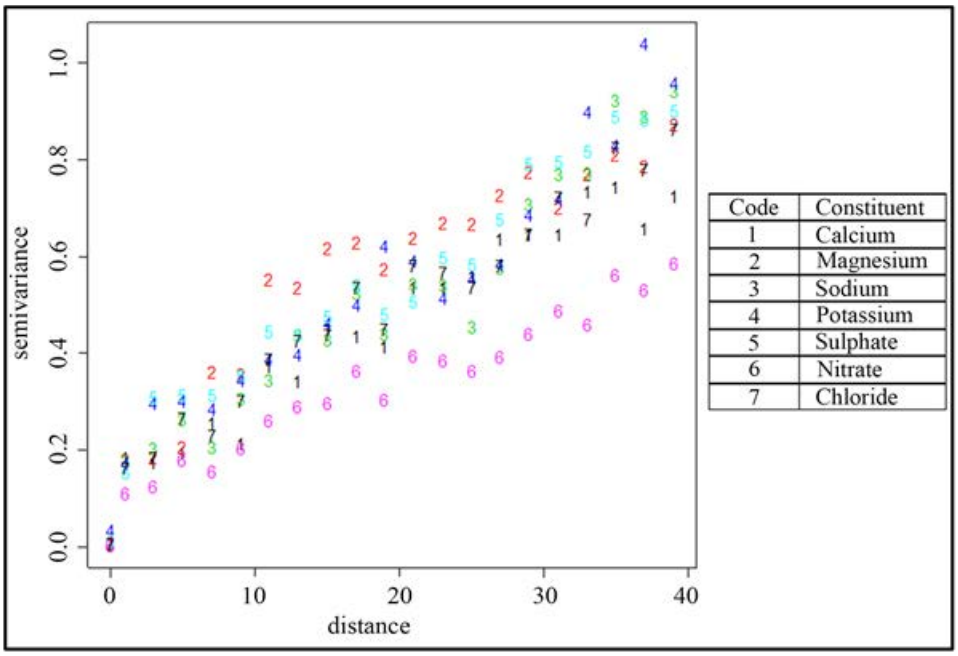
Spectrum

HGS Environmental & Engineering Dinner continued from page 21

health, large data management and analyses, quantitative and qualitative research, spatiotemporal analysis, sustainability studies, and action research. Dr. Anderson has peer-reviewed publications reflecting her research, especially regional air and groundwater quality issues. She also worked as an analyst for the International Space Station in Houston, Texas.

Dr. Anderson received an MS in Statistics from Colorado State University in Fort Collins, and a PhD in Public Health in Environmental and Occupational Health Science from the University of Texas School of Public Health, Houston.



Code	Constituent
1	Calcium
2	Magnesium
3	Sodium
4	Potassium
5	Sulphate
6	Nitrate
7	Chloride

Monday, February 15, 2016

HGS International Explorationists Dinner Meeting

Westchase Hilton • 9999 Westheimer
Social Hour 5:30–6:30 p.m.
Dinner 6:30–7:30 p.m.

Cost: $45 Preregistered members; $50 non-members/walk-ups

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Sharma Dronamraju
AKD Professional Solutions

Oligocene-Miocene Rifting and its Influence on Siliciclastic Reservoir Distribution and Exploration in the Gulf of Suez, Clues from Recent Sub-surface Analysis, Eastern Desert, Egypt

Gulf of Suez is a prolific petroleum province and probably has the most unique geological setting to study sedimentary responses to tectonics. The short source-to-sink distance (less than 30km) and active rifting provides ample opportunity to study the rapid sedimentary response to the interaction between rifting, accommodation space and rate of sediment supply. The earliest evidence of rifting in the Gulf of Suez is documented to be the Oligocene-Miocene, which is responsible for the present-day shape of the Gulf. Much of the rifting was influenced by the structural grain established during the Late Proterozoic to Cambrian.

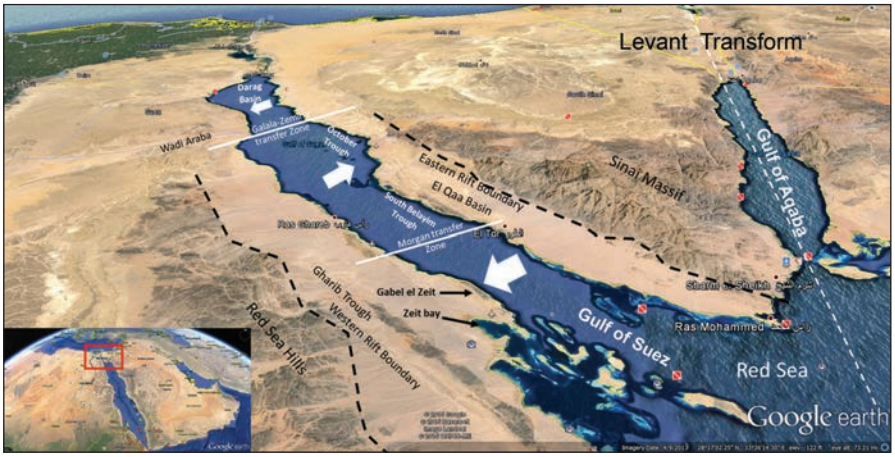

Figure 1: *Gulf of Suez, regional tectonic picture.*

Late Cretaceous Limestone member (Brown Limestone) is considered to be the predominant source of hydrocarbons, with millions of barrels in recovered in classical fields such as Gemsa, Ramadan, and few other well-known fields. Other factors include rapid burial of high quality sands from arid provenance, formation of several horst-graben structures, sediment drapes due to differential subsidence, effective entrapment by shallower evaporite sequence, etc. These fields produced predominantly from the pre-rift clastics and carbonate sequences, in well-defined faulted-block structures. However, much of the future exploration in the Gulf of Suez will depend on understanding the sedimentation trends in syn-rift and post-rift sag periods (Oligocene-Miocene), in highly complex fault systems in the regionally extensive *Nukhul, Rudeis*, and *Kareem* formations. These reservoirs are poorly imaged due to a thick overburden of evaporites, and the sparse well coverage adds to subsurface uncertainty.

Recent work on the Yusr Field, Eastern Desert for an EOR project provides new exploration ideas. This study suggests that locating field-scale transfer or accommodation zones by applying the knowledge gained in East African Rift System and other similar intra-cratonic rifts, could help exploration. Experimental deformation on scaled, physical models could supplement and possibly compensate for the poorly imaged 3D seismic and help delineate exploration targets. This study focuses on the *Rudeis fm.* and its hydrocarbon potential. Carefully extracted seismic attributes (Ant Tracking* and Coherence attributes) illuminates fault patterns that are previously not recognized. Preliminary observations indicate that depocenters are created between the transfer zones, with high chance of up-dip stratigraphic terminations and lateral seals. While better imaged 3D seismic is imperative, intuitive application of analogue knowledge is essential in these challenging areas. ■

HGS International Dinner *continued on page 26*

HGS International Dinner continued from page 25

Biographical Sketch

Sharma Dronamraju is a Geoscientist and Director, AKD Professional Solutions in Houston. He worked for Petrobras USA, Marathon Oil, Halliburton, Landmark Graphics, Fugro and ONGC over 25 years of upstream oil and gas. His expertise lies in Reservoir Modeling and rejuvenating mature fields. He was associated with several deep-water developments and exploration appraisals in GoM, deep-water Nigeria, Equatorial Guinea, and South China Sea. Sharma's recent work includes Geomodeling for EOR in mature oil fields in Miocene Syn-rift clastics and carbonates and regional prospectively of Gulf of Suez, Egypt, heavy oil development in Powder River Basin in Lower Cretaceous incised valley fills (Newcastle Fm.), reservoir modeling of HPHT fields offshore East Malaysia and Borneo, and sub-salt interpretation, appraisal, and reservoir delineation of Lucius Field, GoM. Sharma earned his Masters degrees from Indian Institute of Technology, Texas A&M University, and MBA from Rice University. He works with several non-profit associations in Houston, Houston Geological Society International Committee, a KEYS Mentor with Katy ISD, and a Coach for Science Olympiad.

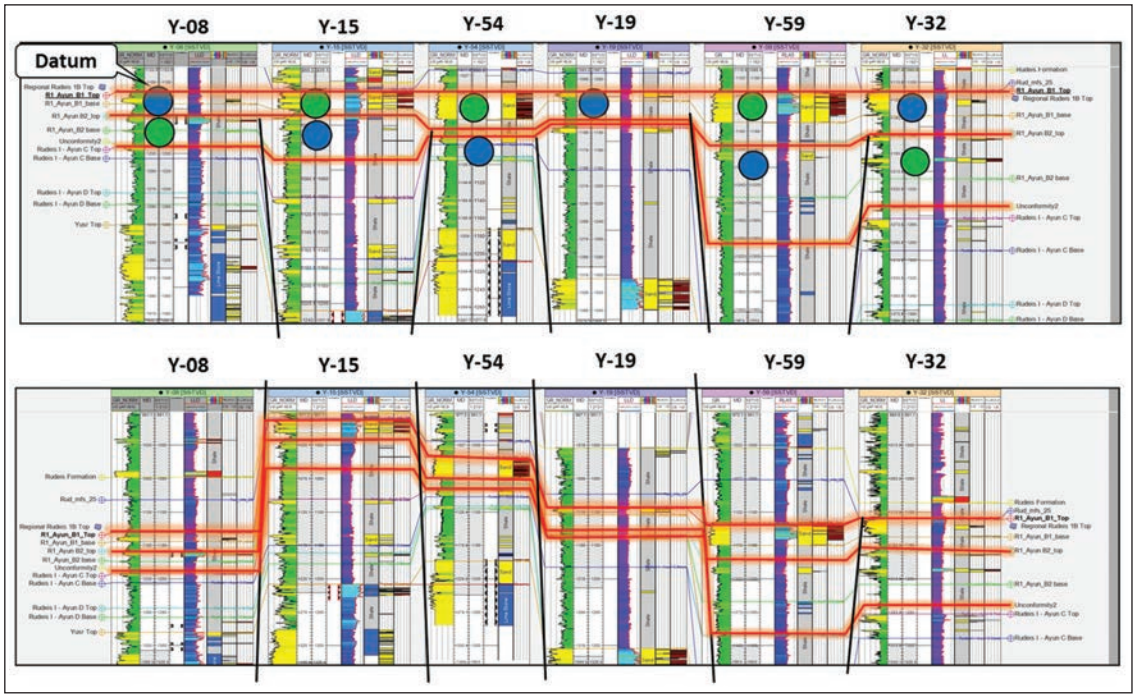

Figure 2: *Stratigraphic and structural cross sections.*

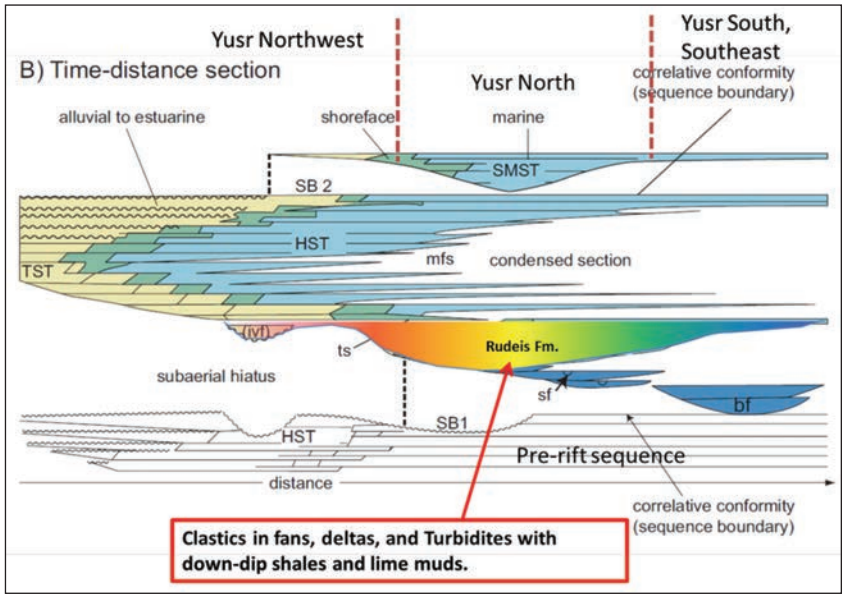

Figure 3: *Tentative sequence stratigraphy identity of Rudeis Formation.*

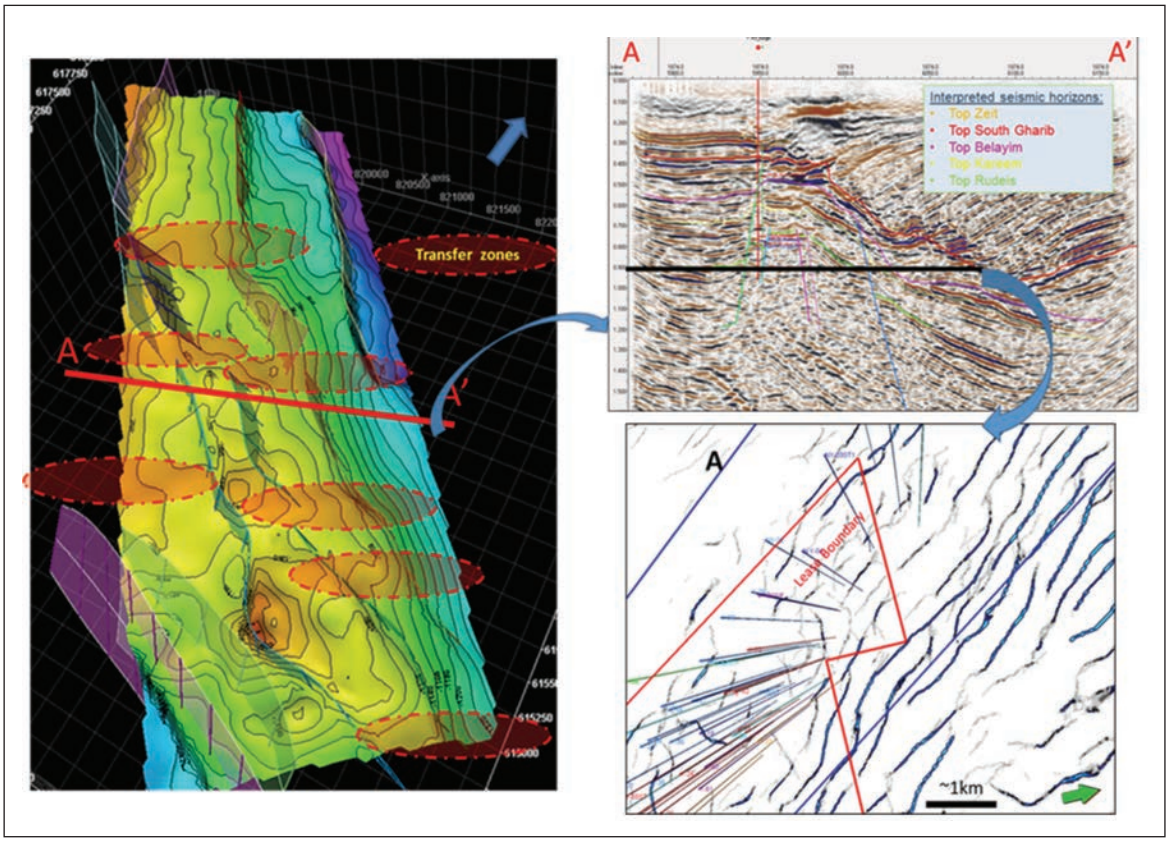

Figure 4: *Field-scale transfer zone interpretation.*

Thursday, February 18, 2016

Southwestern Energy Conference Center, 10000 Energy Drive, Spring, TX 77389
Social 11:15 a.m., Luncheon 11:30 a.m.

Cost: Active/Associate Members - $30, Emeritus/Life/Honorary - $25

Students who are members of HGS - $10, Non-members - $40

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
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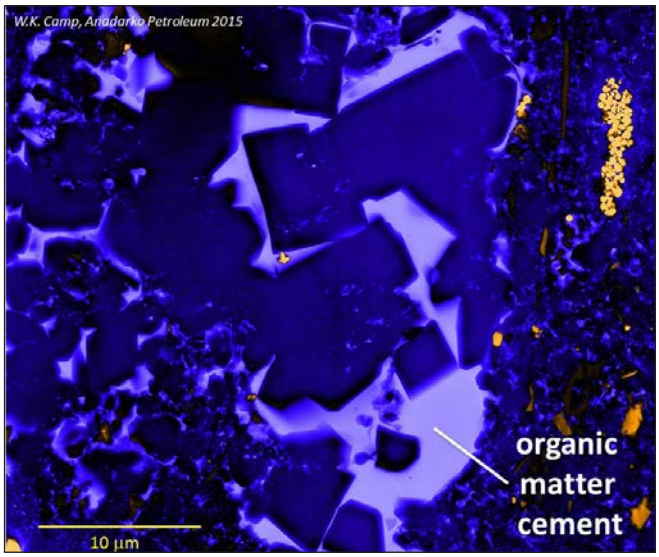
Wayne K. Camp
Anadarko Petroleum Corporation
The Woodlands, Texas

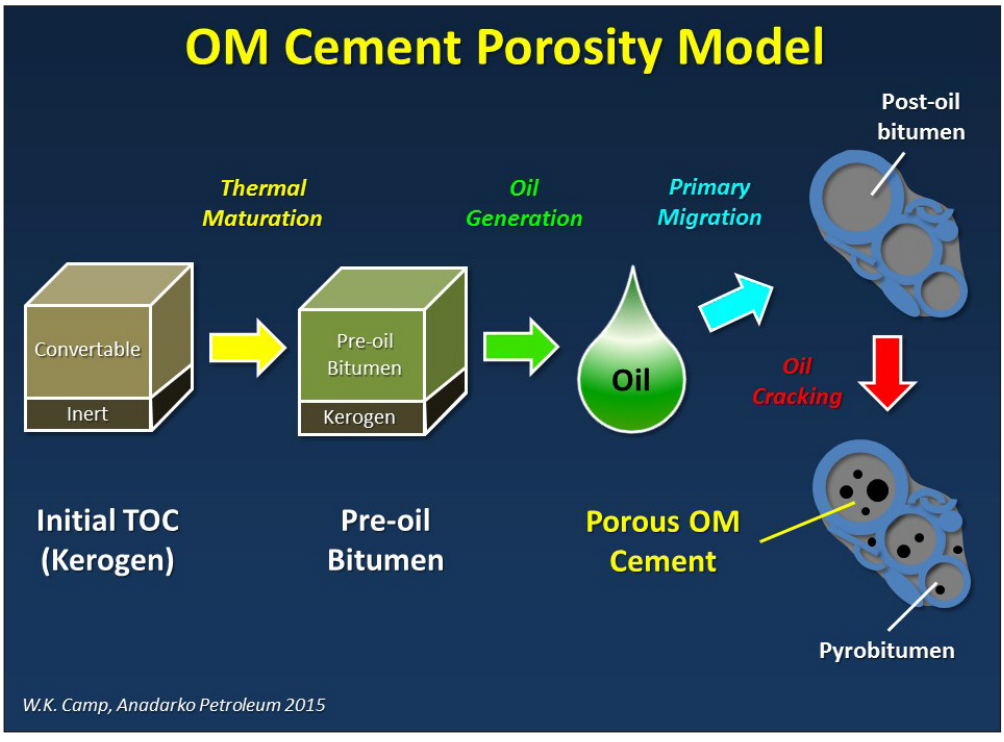
Diagenetic Evolution of Organic Matter Cements in Unconventional Shale Reservoirs

Organic matter cements in the form of bitumen and pyrobitumen are commonly observed in scanning electron microscopic images in many U.S. unconventional shale reservoirs that range in age from Ordovician to Cretaceous. Organic matter cements are distinguished from kerogen based on petrographic identification of cement as a void-filling material within matrix pores, microfossil internal voids, and microfractures. The character of organic matter cements and their impact on reservoir quality changes with increasing thermal maturity as illustrated by the organic-rich interval of the lower Eagle Ford Formation in south Texas.

In thermally immature (<0.50%Ro) outcrops of the Boquillas (Eagle Ford) Formation, meniscus-type organic matter cements partially fill interparticle pores within coccolith-rich lamina.

HGS Northsiders Luncheon *continued on page 31*





HGS Northsiders Luncheon continued from page 29

The origin of this organic matter cement is interpreted as pre-oil generation bitumen created at the initial stage during the conversion of kerogen to oil.

In the subsurface, migrated residual oil (migra-bitumen) fills matrix pores and foraminifera chambers forming solid organic matter plugs that may serve to form updip lateral seals along the updip edge of the oil window. This soluble bitumen may be partially removed by hot solvent (toluene) during Dean Stark extraction on crushed rock samples (GRI method), that could result in overly optimistic porosity measurements.

Down dip at higher thermal maturity (>1.0%Ro), organic matter cements in the form of pyrobitumen develop a well-connected secondary porosity network, often mistakenly described as "kerogen" porosity. The organic matter pores are interpreted to form as a result of gas generation during the thermal cracking of oil retained within primary matrix pores preserved prior to oil generation and migration.

Mineral cements observed within foraminifera chambers (e.g. calcite, quartz, kaolinite) predate the surrounding organic matter cement. This relationship suggests that mineral cementation may be terminated during primary oil migration as oil replaces water expelled from primary pores within the source rock.

Biographical Sketch

Wayne K. Camp is a Distinguished Geological Advisor with Anadarko Petroleum Corporation, where he has been employed since 1980, working various domestic and international exploration and development projects. Camp's expertise includes identifying and evaluating new exploration play opportunities, and unconventional play risk assessment. Camp supervised a number of geological and geophysical exploration and development teams at Anadarko from 1986 to 2004. His experience includes conventional and unconventional plays onshore U.S., subsalt and deepwater plays in the Gulf of Mexico, and offshore plays in Indonesia.

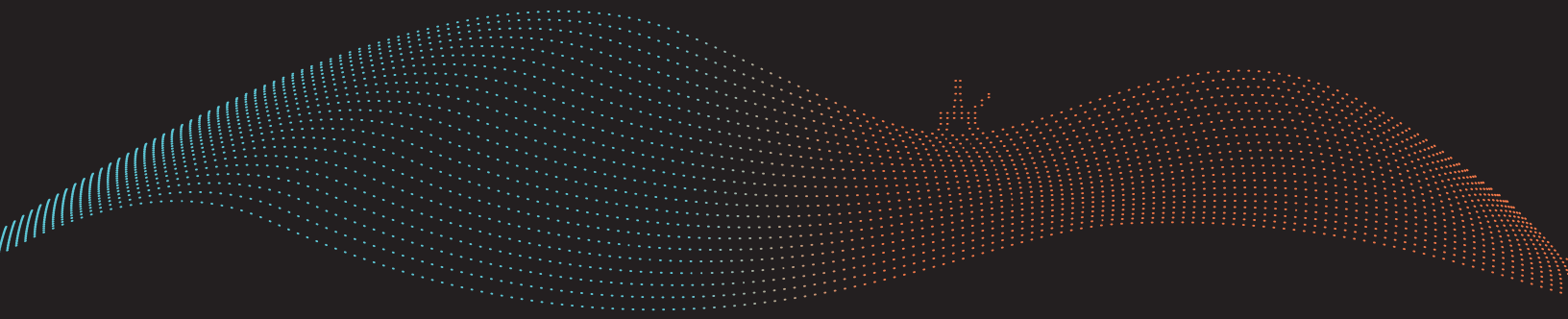
Prior to working with Anadarko, Camp was employed for two years by Phillips Petroleum Company. He received a BA degree in geology with honors from the State University College at Oneonta, New York, and a MS degree in geology from Colorado State University, Fort Collins, Colorado.

Camp is an active member of AAPG, the Geological Society of America, and the Houston Geological Society. He served as chairman for the AAPG Unconventional Reservoirs Research Group in 2004, and was co-chairman for the 2005 Hedberg Conference on tight-gas sands. Camp also served as an advisor for the U.S. Department of Energy Unconventional Resources Technology Advisory Committee from 2010 to 2013.

Camp was co-editor and contributor to AAPG Hedberg Series No. 3, "Understanding, Exploring and Developing Tight-gas Sands", which was awarded the Robert H. Dott Sr. Memorial Award for best AAPG Special Publication in 2010. He was also senior editor for AAPG Memoir 102, "Electron Microscopy of Shale Hydrocarbon Reservoirs" that was published in 2013, now in its second printing.

Camp lives in Montgomery, Texas with his wife Joanne, and has two daughters and two granddaughters.

blueback reservoir
GeoScience Solutions Partner



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Dinner 6:30–7:30 p.m.

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HGS North American Dinner Meeting

Patricia A. Santogrossi
Geophysical Insights, Houston

Sub-seismic Resolution in the Eagle Ford Enabled by Multi-Attribute Analysis Using Instantaneous, Geometric, and Spectral Decomposition Self Organizing Maps

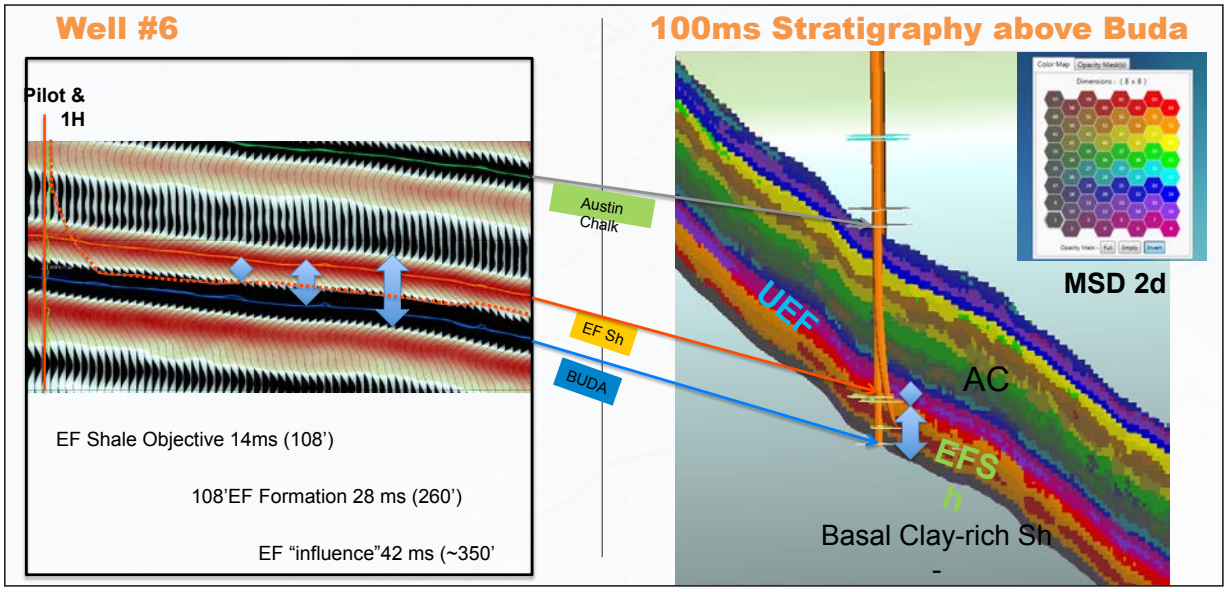

Figure 1: *Multi-Attribute Analysis' Sub-seismic Resolution*
NW-SE seismic sections across Well #6 location. All Seismic data owned and provided courtesy of Seitel, Inc.
Conventional amplitude seismic with red/white/black 1d color scheme that shows the Austin Chalk – Eagle Ford Group – Buda stratigraphic interval resolved in 2.5 peak /trough cycles. Sample was provided by client; amplitudes appear "boosted". Formations appear "continuous" but little or no detail is resolved.
(b) Results of SOM of multiple Instantaneous attributes colored by neuron of up to 64 clusters show non-layer cake facies bands that reveal details in the Eagle Ford's (EF) basal clay rich shale, high resistivity and low resistivity EF Shale objectives, the EF Ash, and the Upper EF marl which are overlain disconformably by the Austin Chalk.

These days many unconventional plays are being challenged by the low commodity price. During market downturns, many operators look for ways to "squeeze" more information out of their seismic and well control data to reduce risk of a dry hole or a poorly performing well.

The Paradise® geoscience analysis platform is a triple threat. First, we employ Principal Component Analysis (PCA) to identify and quantify the key attributes of any given class that are the most independent and characteristic in the data set. Usually a dozen or fewer attributes rise to the top and can be included in a Self-Organizing Map (SOM) wherein the learning machine classifies the data by neurons which may reveal natural clusters, form discernible geobodies, and enable specific calibrations or correlations. The third weapon in the arsenal is an interactive 2D ColorMap that can be queried and inverted to "extract" the natural clusters or geobodies from the "forest."

HGS North American Dinner *continued on page 34*

HGS North American Dinner continued from page 33

- Ten Geometric attributes were used to make this SOM image "ghosted" onto a horizon:
  - Chaotic reflection
  - Curvature
    - In Dip Direction
    - In Strike Direction
    - Maximum
    - Mean
    - Shape Index
  - Dip of Maximum Similarity
  - Similarity
  - Smoothed dip of Maximum Similarity
  - Smoothed Similarity

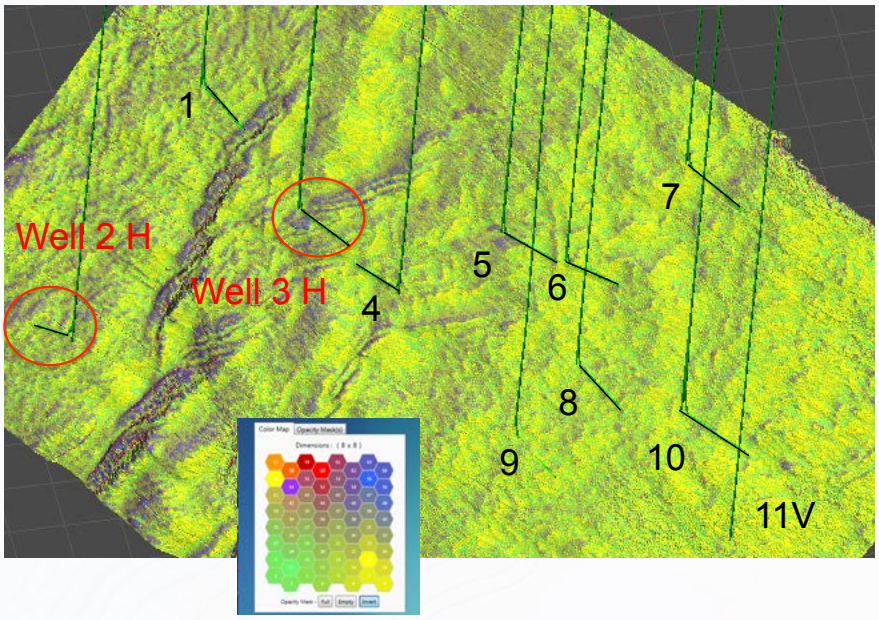

Figure 2: *Geometric Classification in High Res Eagle Ford*
Principal Component Analysis suggested reduction of 25 geometric attributes to 10 from the first two eigen vectors. When run in a Geometric SOM and then visualized on this "ghost" on the Top Eagle Ford horizon pushed 16ms or 8 samples down into the High resistivity EF Shale objective, the multiplicity of faults that can now be seen defied expectations. Well 3H's borehole encountered 6 faults seen here largely unexpectedly; Well 2H encountered 2, one of which is imaged uniquely in Figure 4 at a higher stratigraphic level using an Instantaneous Spectral Decomp SOM.

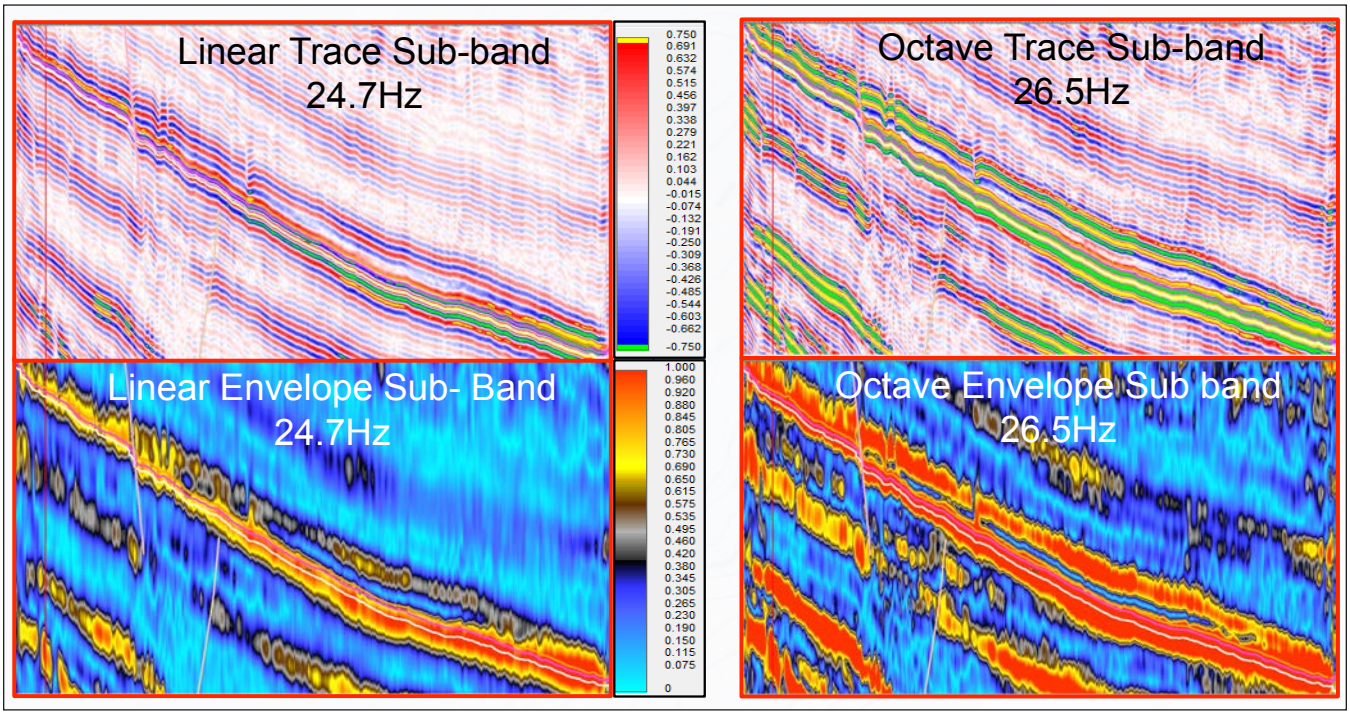

Figure 3: *Spectral Decomposition selections from range of 12 to 50Hz tests wherein the goal was to get the best stratigraphic imaging as opposed to amplitude. Each view resolves the disconformable Austin Chalk overlying the Upper EF marl (gold pick), EF Shale facies (magenta pick) and the Buda (white pick). The Trace sub-bands were used as base surveys for SOMs made from Instantaneous attributes that revealed, primarily, structural and stratigraphic details such as scours and karsts in the Austin Chalk and facies changes in the Buda.*

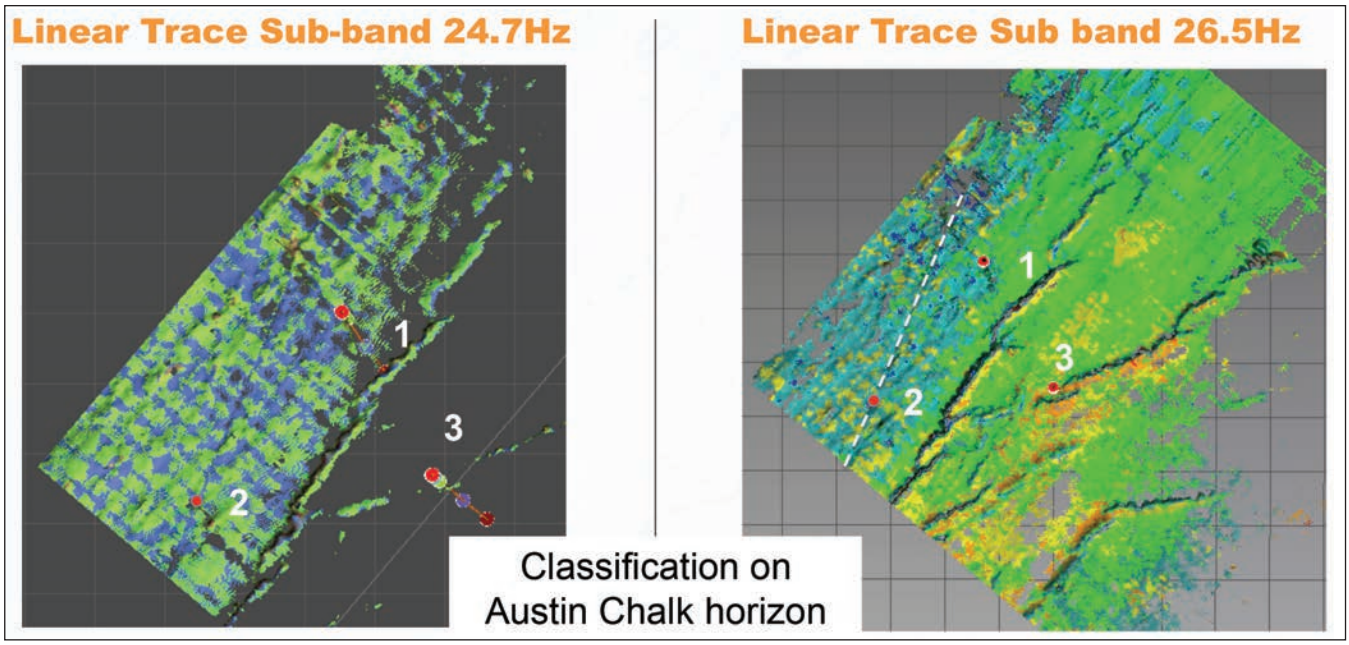

Figure 4: *Instantaneous Spectral Decomp SOMs 24.7Hz vs 26.5Hz*
SOMs run on the separate singular sub-bands as the base surveys for Instantaneous attributes yield these results at the top Austin Chalk that include a fault heretofore not seen in map or seismic section, yet are recognized in the #2 lateral wellbore. These views also demonstrate the gridding footprint of data picked on every fifth inline. Data picked on every line as in the geometric example in Figure 2 give much smoother results in volumes and on horizon slices.

The conclusions to date in this study allow simple distinction of all of the members of the Eagle Ford (EF): Upper EF (marl), Top EF Ash beds, and Basal Clay-rich shale. The Eagle Ford Shale target facies previously characterized as High Resistivity and Low Resistivity can now be shown to comprise four or more non layer-cake zones, to include one or more previously unrecognized and possibly underdeveloped (?) sweet spots, and to be offset by numerous faults, some of which are compressional. Spectral Decomposition appears to reveal more in the overlying Austin Chalk and the underlying Buda than in the Eagle Ford.

These methods can be shown to enable an interpreter to prognose and calibrate wells better, to enhance an engineer's precision in geo-steering, and to improve one's confidence in leasehold evaluation. ■

Biographical Sketch

Patricia Santogrossi is geoscientist who has enjoyed 40 years in the oil business. She is currently a Consultant to Geophysical Insights, a Tom Smith company that develops and implements their Paradise® software. Formerly she was a Leading Reservoir Geoscientist and Non-operated Projects Manager with Statoil USA E & P and was engaged for nearly nine years in Gulf of Mexico business development, corporate integration, prospect maturation, and multiple appraisal projects.

Patricia has previously worked with domestic and international Shell Companies, Marathon Oil Company, and Arco/Vastar Resources in research, exploration, leasehold and field appraisal as well as staff development. Subsequently, Patricia became Chief Geologist for Chroma Energy, who possessed proprietary 3D voxel visualization technology, and for Knowledge Reservoir, a reservoir characterization and simulation firm that specialized in deepwater project evaluations.

A longtime member of SEPM, AAPG, GCSSEPM, HGS and SEG, Patricia has assumed various elective and appointed positions. She is currently in service to AAPG as the Chair of the House of Delegates' Nominations and Elections Committee and is near the end of her third term as a representative to the AAPG House of Delegates from HGS.

Patricia was born, raised, and educated in Illinois before she headed to Texas to work for Shell after she received her MS in Geology from the University of Illinois, Champaign-Urbana. Her other 'foreign assignments' have included New Orleans and London. She resides in Houston with her husband of twenty-four years, Joe Delasko.

Wednesday, February 24, 2016

Petroleum Club of Houston • 1201 Louisiana (Total Building)
Social Hour 11:15 a.m.
Luncheon 11:45 a.m.

Cost: $45 Preregistered members; $50 non-members/walk-ups

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John Jordan
HGS President-Elect
John.Jordan@anadarko.com

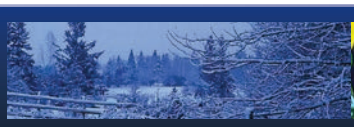
Understanding Ethics, Moral Compass and Business Ethics

Most large oil companies require their employees to have some ethics training every year, which is usually quite broad and often dry. Texas Board of Professional Geoscientists (TBPG) licensees are also required to have one hour of ethics training every year. This talk will fulfill that requirement for the year. Although I do not have a degree in philosophy or jurisprudence, I have been an international explorationist for over 34 years and witnessed/heard many situations where individual or business ethics are tested. Please join me as I review my findings and understandings of ethics as taught though Google University and then applied to our industry. I will explore the difference between moral compass and ethics and how this relates to business ethics. Come and hear how Machiavelli, Hunter S. Thompson and ethics are related, and join in a spirited discussion about the "grey areas." ■

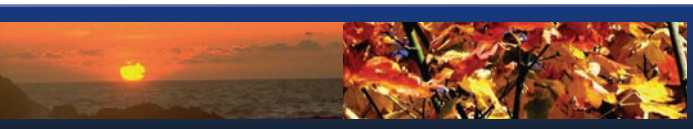
Biographical Sketch

John E Jordan, Jr. is President-Elect of the HGS. He is a Project Geophysical Advisor at Anadarko Petroleum in The Woodlands, Texas. Spanning 30+ years in the oil industry, he has worked projects worldwide from Alaska and the Gulf of Mexico to the Middle East, Asia, Africa and South America. Prior to joining Anadarko in 2007, he worked at Kerr McGee, Noble Energy, Arco and Chevron. John is a graduate of Wright State University where he received both a BSc and an MSc from the College of Science and Mathematics, majoring in geology and geophysics. He does not hold degrees in either philosophy or jurisprudence.

February 2016



Sunday	Monday	Tuesday	Wednesday
	1 **Don't wait, make your reservations online at hgs.org**	2 **HGS Board Meeting** *6 p.m.*	3
7	8 **HGS General Dinner Meeting** *"Big Bend Field: Gulf of Mexico Success, from Prospect to Production through Geoscience Integration," Owen Stephens Page 17*	9	10 **HGS Environmental & Engineering Dinner Meeting** *"Multivariate Geostatistical Model for Groundwater Constituents in Texas," Dr. Faye Anderson, Page 21* **NAPE Summit**
14	15 **HGS International Dinner Meeting** *"Oligocene-Miocene Rifting and its Influence on Siliciclastic Reservoir Distribution and Exploration in the Gulf of Suez, Clues from Recent Sub-surface Analysis, Eastern Desert, Egypt," Sharma Dronamraju, Page 25*	16	17
21	22 **HGS North American Dinner Meeting** *"Sub-seismic Resolution in the Eagle Ford Enabled by Multi-Attribute Analysis Using Instantaneous, Geometric, and Spectral Decomposition Self Organizing Maps," Patricia A. Santogrossi, Page 33*	23	24 **HGS General Luncheon Meeting** *"Understanding Ethics, Moral Compass and Business Ethics," John Jordan, Page 37*
28	29		



GeoEvents

Thursday Friday Saturday

4	5	6
11	12	13
18 **HGS Northsiders Luncheon Meeting** *"Diagenetic Evolution of Organic Matter Cements in Unconventional Shale Reservoirs," Wayne K. Camp, Page 29*	19	20
25	26	27 **HGS Shrimp Peel** *Sam Houston Race Track Page 4*

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February 10-12, 2016
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London, UK

March 2-3, 2016
SPE/AAPG Colombia Offshore Workshop
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March 7-11, 2016
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AAPG/SEG ICE
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May 2-5, 2016
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HGS Grand Canyon Field Trip
Grand Canyon

June 19-22, 2016
AAPG ACE
Calgary, Alberta

September 6-9, 2016
AAPG/SEG ICE
Cancun, Mexico

September 12-14, 2016
HGS-PESGB Africa Conference
Houston, TX

September 18-20, 2016
GCAGS Annual Convention
Corpus Christi, TX

Subaerial Erosion in the Deep Gulf of Mexico Basin Indicates Extreme Sea Level Drawdown

by Joshua H. Rosenfeld, Independent Geologist, Granbury, Texas
jhrosenfeld@gmail.com

Detailed bathymetry of the continental slopes of eastern Florida and northern Yucatan reveals the presence of steep-walled canyons and sinkholes far deeper than the Pleistocene sea level minimum. This article proposes that these features formed during subaerial erosion upon evaporative drawdown of the Gulf of Mexico when Paleocene-Eocene collision of the Cuban Arc and Florida-Bahamas block isolated the Gulf of Mexico from the Atlantic Ocean.

Open-file bathymetry from Columbia University's EarthObserver app (http://www.earth-observer.org/) and Google Earth make it possible to view the physiography along most of the world's oceanic shelves, slopes and basins, including detailed bathymetry for the lower continental slopes of southwestern Florida (EarthObserver) and northern Yucatan (Google Earth). These two areas are unique when compared to their global counterparts, and their marked similarity to one another indicates a co-genetic relationship. Three areas outlined in Figure 1 are discussed below.

The most striking bathymetric elements on both the Florida and Yucatan continental slopes are the numerous, closely spaced, steep-walled canyons that separate the slopes from the abyssal plain (**Figure 2**). These canyons differ from those that commonly link shelves and deep water in that the latter generally occur where rivers have fed terrigenous sediment into the basin. This contrasts with the Florida and Yucatan slopes, which are seaward of wide, passive carbonate platforms with minimal topographic relief and no major rivers. DSDP Legs 10 (Worzel et al., 1973) and 77 (Buffler et al., 1984) found that these slopes consist of lithified Cretaceous to Early Paleocene carbonates covered by thin younger pelagic sediments. Canyons cutting these slopes differ from "normal" slope canyons by having their maximum wall-to-thalweg relief at the base of the slope rather than near the shelf break. They also display abundant tributary channels of all sizes not attributable to excavation by submarine density currents descending from the shelf, nor to slumping of the indurated bedrock.

The conclusion to be drawn from this morphology, therefore, is that these canyons formed by subaerial erosion. For comparison, canyons in the arid Funeral Mountains northeast of Death Valley are topographically similar to the lower slopes of Florida and Yucatan (**Figure 3A**). A submersible traverse of these slope canyons may reveal escarpments resembling the one shown in

Subaerial Erosion in the Deep Gulf of Mexico Basin *continued on page 43*

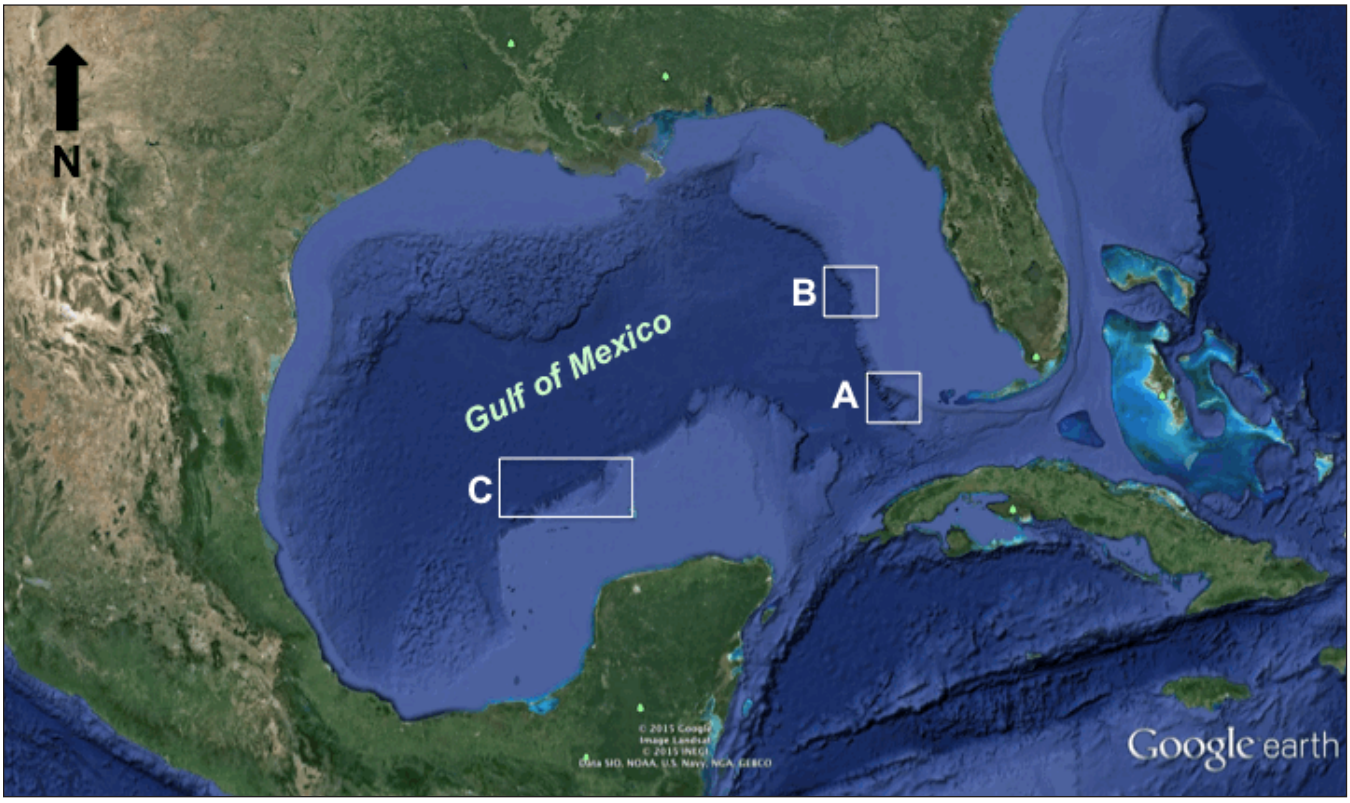

Figure 1: *Index map showing the areas illustrated in Figure 2.*

Subaerial Erosion in the Deep Gulf of Mexico Basin continued from page 41

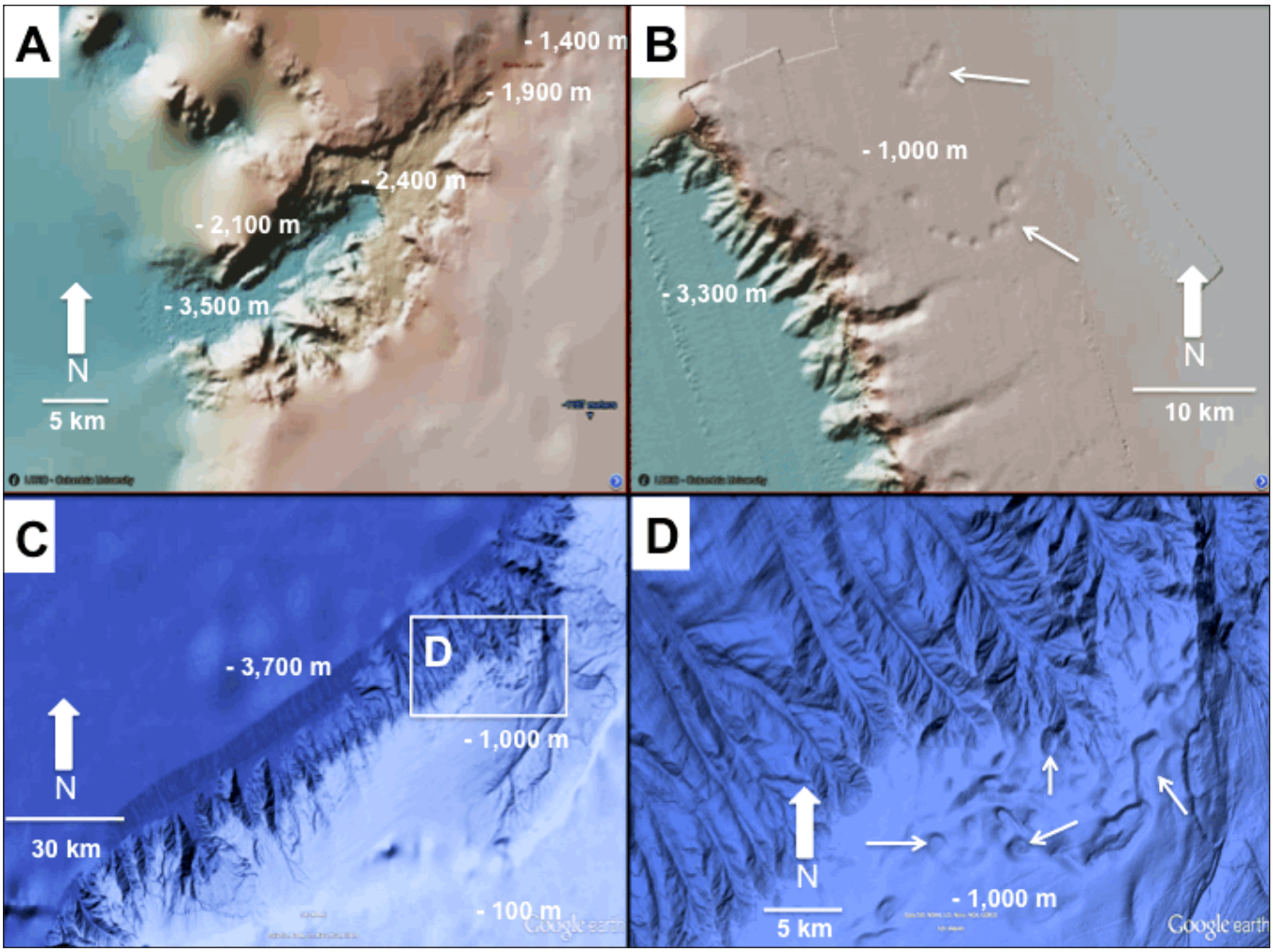

Figure 2: *(water depths in meters): A - Florida Canyon, the largest erosional canyon on the lower continental slope of western Florida. Steep canyon walls testify to the lithified carbonate country rock. Post-Early Paleocene sedimentation has been minimal. B - Typical lower slope segment of the eastern Florida margin with abundant steep-walled canyons. Sinkholes on the 1,000 m deep terrace are indicated by the small white arrows. C - Concave-to-the-basin headwall of this terrace suggests that this is a coherent slide block from the K/Pg Chicxulub bolide impact. The base of the slope is cut by many steep-walled canyons. The rectangle is the area enlarged in 4D. D - Detail of the lower Yucatan slope showing numerous canyons with tributary channels. Small white arrows indicate sinkholes.*

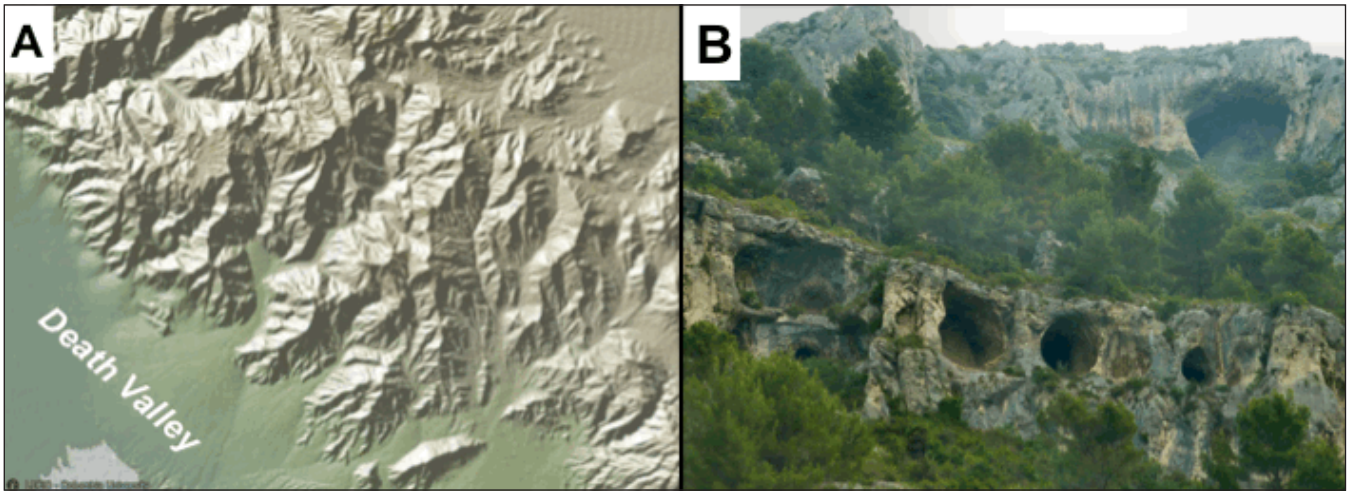

Figure 3: *A - EarthObserver app image of the Funeral Mts. northeast of Death Valley showing typical arid mountainous erosion similar to the lower continental slopes of northern Yucatan and western Florida. B – Karsted carbonate escarpment above Fontaine-de-Vaucluse in Provence, France proposed as an analogue to morphology of the lower slope canyons in the eastern and southern Gulf of Mexico, such as Florida Canyon.*

Subaerial Erosion in the Deep Gulf of Mexico Basin *continued on page 45*

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Petroleum Geology for Engineers (with OTC meeting)	**May 6, 2016** Houston, TX
Basic Seismic Interpretation	**May 17-18, 2016** Tulsa, OK
"Old" (pre 1958) Electric Logs: A Quick Review	**May 19, 2016** Tulsa, OK
Quick Guide to Carbonate Well Log Analysis	**May 20, 2016** Tulsa, OK

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Modern Terrigenous Clastic Depositional Systems	**May 31 - June 7, 2016** South Carolina
Field Safety Course for Field Trip Leaders	**April 6-7, 2016** Houston, TX
Carbonate Reservoir Analogues: Play Concepts & Controls on Porosity (with Barcelona ICE mtg.)	**April 7-12, 2016** Almeria, Spain
Reservoir Analogues from Modern & Ancient Turbidite Systems, Tabernas Basin (with Barcelona ICE mtg.)	**April 7-10, 2016** Spain
Interp. of Thrust Belts & Foreland Basins: Models from the Spanish Pyrenees (with Barcelona ICE mtg.)	**April 7-10, 2016** Spain
Fractured Carbonate Reservoirs Outcrops (with Barcelona ICE mtg.)	**April 7-9, 2016** Italy
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AAPG Education

Subaerial Erosion in the Deep Gulf of Mexico Basin continued from page 43

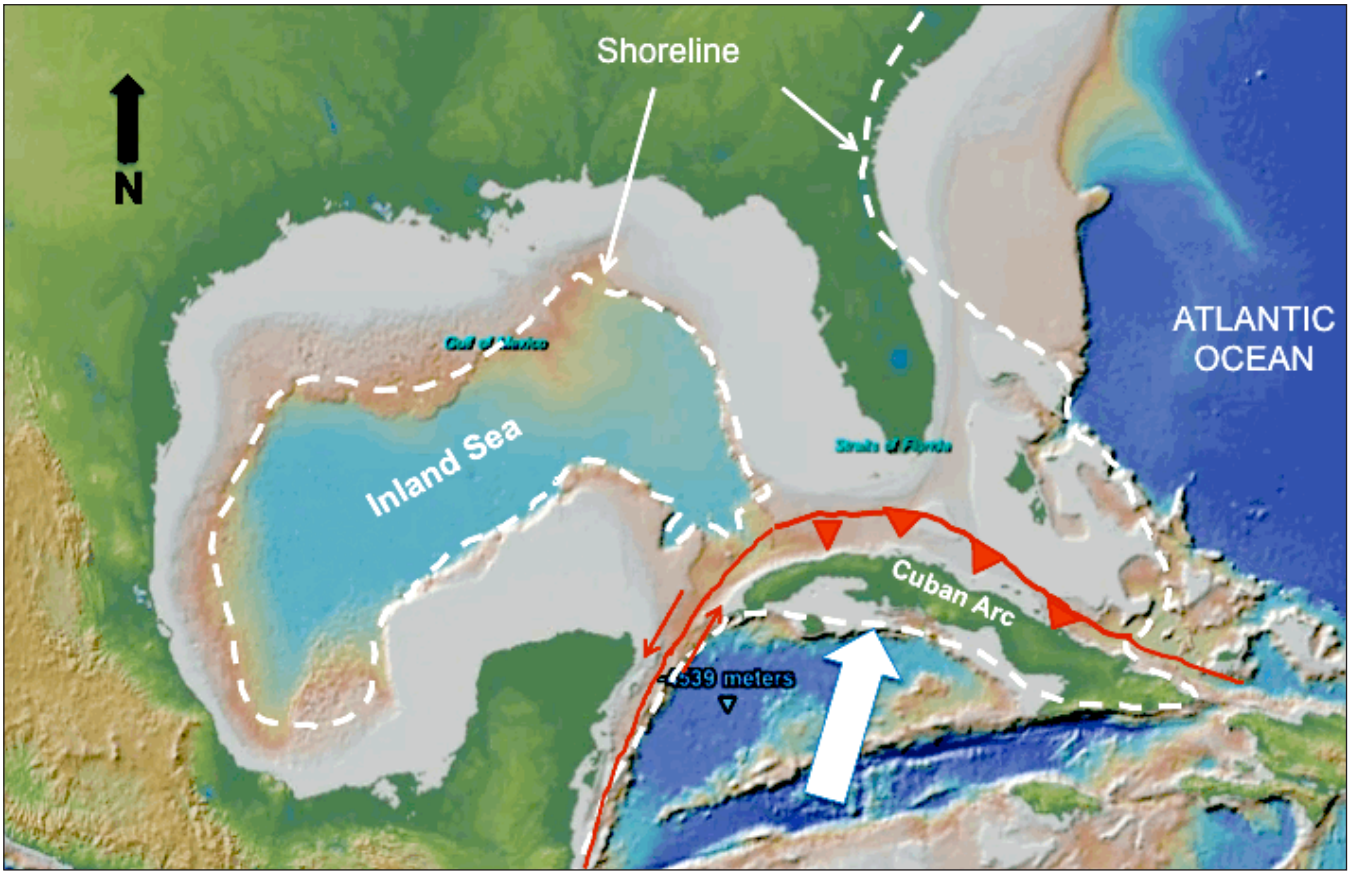

Figure 4: *Paleogeography of the drawn-down Gulf of Mexico at the Paleocene-Eocene boundary. Note the collisional suture zone and land bridge connecting Florida-Bahamas across Cuba to Yucatan. The proposed Gulf water level, indicated by the subaerial erosion features described in this article, is near the base of the continental slope.*

Figure 3B. The sharply defined bathymetric break separating the scarps from the abyssal plain, in this interpretation, would have been a wave cut shoreline with fan deltas and talus aprons mantled by post-drawdown pelagic sediments, respectively, at the mouths of the canyons and along the slopes.

The proposition that drawdown and exposure were widespread is further reinforced by sinkholes in today's deep water, which indicate that the slope terraces were subaerially exposed and underwent extensive cavern development. **Figure 2** shows sinkholes on the Florida and Yucatan slopes in water depths of about 1,000 m. Large sinkholes were also found southwest of Key West, Florida (Jordan, 1954) in water depths ranging from 270 m (rims) to 420 m (bottoms).

With the present deepwater connection to the world ocean (400 m in the Strait of Florida and 1,100 m in the Yucatan Channel), it is understandably difficult to accept that the lower continental slopes, and perhaps even the floor of the Gulf of Mexico were exposed during a basin-wide eustatic minimum at the Paleocene-Eocene boundary (**Figure 4**). Readers are encouraged to examine the readily observable bathymetric evidence discussed above, and draw their own conclusions.

For more complete treatment of the theory, the reader is referred to Rosenfeld and Pindell (2003), Rosenfeld et al. (2008) and Rosenfeld (2014). This theory, if confirmed, would certainly generate exciting new academic and commercial opportunities, and could lead to better understanding of the Suwanee Channel-DeSoto Canyon system across northern Florida, the Vicksburg Embayment along the Texas-Mexico border, and the Comalcalco Basin in the Sureste Basin of Mexico. ■

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Subaerial Erosion in the Deep Gulf of Mexico Basin continued on page 47

HGS Welcomes New Members

New Members Effective December 2015

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Smaine Zeroug

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David Phillips

STUDENT MEMBERS

Natasha Hansen

Bianca Broman

Michelle Rimmel

Welcome New Members

Subaerial Erosion in the Deep Gulf of Mexico Basin continued from page 45

world oceans; drawdown and refill: HGS *Bulletin*, v. 51, n. 2, p. 13

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Worzel, J.L. et al., 1973: Initial Reports of the Deep Sea Drilling Project, v. 10, US Government Printing Office, Washington, DC

Biographical Sketch

Josh Rosenfeld received his Bachelor's degree in Geology from the City University of New York in 1960. He taught high school Earth Science for two years before being drafted by the US Army, and was stationed in Guatemala from 1964 to 1966 as a Terrain Reconnaissance Specialist. After discharge, he remained in Guatemala for another 10 years as a mining geologist, and eventually became Chief Geologist for the Guatemalan Ministry of Economy. During this time, he earned his Master's degree from the University of Miami with thesis work on the 1976 Guatemala earthquake.

Josh returned to the US in 1977 to resume his geological studies at the State University of N.Y. at Binghamton, and earned his doctorate in 1980 on the *Origin and Emplacement of the Santa Cruz Ophiolite in Eastern Guatemala*. He worked for Amoco (now BP) from 1980 to 1999, primarily on projects around the Gulf of Mexico and New Ventures in Latin America. He retired after serving as the company's Exploration Manager in Colombia. He then joined Veritas DGC (now CGG) working on business development and technical projects in Mexico until 2001 when he relocated to Granbury, Texas where he now ponders geological matters and occasionally consults on international mining and petroleum projects.

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Remembrance

Bill St. John

Bill St. John, 83, died in Kerrville, Texas on October 26, 2015. He was an extraordinary geologist, widely respected within the petroleum industry where he spent most of his career. His personal pursuit of a greater understanding of what makes the world tick was equally important and respected in academia.

He is survived by his wife of 30 years, Nancy; sons Michael, Tad, Kevin and Doyle; and stepsons Tim and Christopher Rivali.

Billy Eugene St. John was born in Wink, Texas in 1932. He graduated from high school in Wichita Falls and attended Hardin College there but dropped out in the middle of his sophomore year to enlist in the Marines in January 1951. He had stateside training and duties until he got bored and requested a transfer to Korea where he served as a Forward Observer until the truce of July 27, 1953 (his 21st birthday present).

Two famous Bills, friends with shared UT Austin roots – St. John and Muehlberger

Bill returned to his studies in 1954 when he enrolled at The University of Texas at Austin. He graduated with a BS in Geology in June 1958. With the encouragement of Dr. Bill Muehlberger, Bill remained in school and received an MA in Geology in June 1960.

He worked briefly for the Bureau of Economic Geology in Austin before accepting an offer from Amoseas to work in Libya where his geological acumen and willingness to stand up to whatever came along was typified. One of his first assignments was to do field work alongside a seismograph crew. They had set up camp in a valley which Bill immediately recognized as a breached anticline. Bill requested aerial photos, mapped it, measured sections and prepared a report. The General Manager doubted that a fresh-faced new kid could have done that by himself and asked Bill whose work he had copied. Bill got angry, told the Manager what he thought, what the Manager could do and walked out. Maybe that's why a few years later he quit and went back to UT to pursue a PhD. His dissertation work was in the Black Gap area of the eastern Big Bend, West Texas; again under the guidance of Dr. Muehlberger.

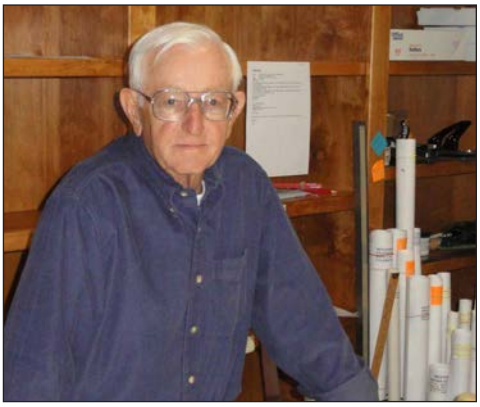
Upon receipt of his PhD in 1965 Bill took a job with Esso Exploration. He was with them for eight years, mostly in Stavanger, Norway and at Esso Production Research in Houston. He then had an opportunity to work for a very small independent, LVO. While there from 1973-81 his interest in exotic places led him to generate or support proposals in Africa, the Middle East and Southeast Asia. That was followed by an opportunity to lead another small company, Primary Fuels. Under his leadership it grew from virtually nothing to an attractive, successful, takeover target in 1989.

Bill then hung out his consulting shingle. In 1990 he accepted a request by the World Bank to oversee a project intended to promote the petroleum potential of Ethiopia. He prepared a well-documented report demonstrating that potential, particularly within the Ogaden Basin bordering Somalia. His report was quite successful as it led to interest by several companies and large concessions were subsequently taken by Maxus Energy and Hunt Oil. Early on, Bill accompanied Maxus personnel on a helicopter overflight of their concession area. The pilot inadvertently landed in a small town in Somalia. All personnel were taken into custody as possible CIA, or Israeli, spies. They were flown to Mogadishu and placed under house arrest before being released eight days later. Meanwhile Bill had signed on as Resident Manager for Hunt Oil's concession. Life in Ethiopia included a fair share of interesting experiences such as running through a barricade set up by armed bandits, an evacuation due to a rebel insurgency and constant personal and company logistical problems.

Bill St. John *continued on page 50*

Remembrance continued from page 49

In 1994 Bill took Nancy's advice, resigned from Hunt Oil and returned to the USA. Shortly thereafter, Hunt Oil requested that Bill return to restore government relations that had seriously deteriorated under his successor. By 1995 that had been accomplished and thus ended the Ethiopian saga.



Bill St. John in his office in Kerrville, Texas, where he had been working on creating a new Tectonic Map of the World.

By then Bill had a well-deserved reputation as one of the very best analysts of the prospectivity of relatively untested basins. He was called upon to work on basins in India, Azerbaijan and a wide range of African countries. He accepted one long-term assignment with Vanco Energy to study the West African offshore; no small feat in itself. In fact, large scale projects were right down his alley as he was, quite literally, always ready to take on the world. In his 'spare' time in 1984 he created the still popular map *Sedimentary Provinces of the World* which is also now available in digital format from the AAPG. Also in 1984 he was program chair for the Wallace E. Pratt Memorial Conference, *Future Petroleum Provinces of the World,* the proceedings of which were published in 1986 as AAPG Memoir 40. Bill authored/co-authored two contributions to that volume, on Antarctica and on giant oil and gas fields. In 1990 Bill was editor of AAPG Studies in Geology No. 40, *Antarctica as an Exploration Frontier: Hydrocarbon Potential, Geology and Hazards.* By mid-2010 he had authored and self-published the well-received *Hydrocarbon Potential of the Eastern Africa Offshore.* At the time of his death he was working on a Tectonic Map of the World — no small undertaking for one person.

George Bernard Shaw wrote it: "Some men see things as they are and ask 'why?'. Others dream things that never were and ask 'why not?'". Teddy Kennedy popularized it in a memorial service for his brother Bobby in 1968. Bill lived it. He will be greatly missed.

Contributed by Patricia Wood Dickerson and Ted Schulenberg

Government Update

by ***Henry M. Wise, P.G.*** *and* ***Arlin Howles, P.G.***

If you'd like the most up-to-date Texas rules, regulations, and governmental meeting information we direct you to the HGS website to review The Wise Report. This report, which comes out as needed but not more often than once a week, offers the most up-to-date information that may be of interest to Texas geologists.

USGS Estimates of Potential Uranium in South Texas Could Equal Five Years of U.S. Needs

The potential for almost five years of annual domestic U.S. nuclear fuel requirements may exist in south Texas, according to a new USGS assessment of both identified and undiscovered uranium oxide resources. This assessment estimates 60 million pounds of identified, but unmined, uranium resources, and more than 200 million pounds of newly estimated undiscovered resources.

The uranium oxide is located in sandstone formations throughout the South Texas Coastal Plain, which borders the Gulf of Mexico. The area has long been known to contain uranium, and two mines are currently in operation, with a number of companies actively exploring for uranium.

"As the world's leader in nuclear power, uranium is both a critically and strategically important resource," said Larry Meinert, program coordinator of the USGS Mineral Resources Program. "Identifying and understanding our domestic mineral wealth is a vital part of ensuring the security of our supply chain for these resources."

The 60 million pounds of identified uranium resources could, if mined, provide up to one year's worth of domestic nuclear fuel requirements, based on 2014 requirements. The 200 million pounds of undiscovered resources could, if proven and produced, add another four years of nuclear fuel for the United States, bringing the total potential to about five years of domestic supply.

U.S. nuclear power plants generate about 19 percent of the Nation's electricity. In 2014 alone, these plants purchased 53 million pounds of uranium oxide to meet their needs, and U.S. nuclear capacity is expected to increase.

The United States has more nuclear plants than any other country, but imports more than 90 percent of the uranium used in those plants.

"This study highlights the breadth of USGS science related to complex issues associated with the mineral and energy resources lifecycle," said Jon Kolak, acting program coordinator for the USGS Energy Resources Program. "The USGS provides impartial information to help resource managers, policymakers, the public, and others balance the need for adequate and reliable mineral and energy supplies against the potential effects of resource development and use on the landscape."

This new study is part of a larger USGS effort to update knowledge of the geologic setting, occurrence, and amount of the Nation's uranium resources.

The USGS collaborated with the Texas Bureau of Economic Geology on the South Texas assessment. Nuclear power requirements and electricity production are tabulated by the U.S. Energy Information Administration. A fact sheet describing this assessment can be found at: http://dx.doi.org/10.3133/fs20153069.

AGI Geoscience Policy Monthly Review (October 2015)

House Passes Bill That Allows for Faster Acquisition of Mining Permits

The House passed the National Strategic and Critical Minerals Production Act of 2015 (H.R. 1937) on October 22, 2015. The bill calls for faster permitting timelines for mines located on federal lands and for the development of domestic sources of strategic and critical minerals.

The bill endorses judicial review of mining permits, but would bar civil action against mineral exploration or mining permits filed more than 60 days after the federal agency request. It also requires courts to hear civil actions as promptly as possible.

H.R. 1937 will now be referred to the Senate so that the two chambers can agree a final version of the legislation. S. 883, The American Mineral Security Act of 2015, was introduced by Senator Lisa Murkowski (R-AK) on May 12, 2015. Sen. Murkowski's bill also calls for the acquisition of faster permitting with respect to the mining of critical minerals, but has a much narrower definition of which minerals qualify as critical.

House Subcommittee Addresses Issues of Abandoned Mine Cleanups by Good Samaritans

The House Subcommittee on Water Resources and the Environment held a hearing to gather information on abandoned mine sites in the United States and the opportunities for Good Samaritan cleanups. The hearing addressed the liability issues faced by Good Samaritans when cleaning up abandoned mines, which often causes the sites to sit untouched. It is estimated that there are about 500,000 abandoned hard rock mines throughout the United States, a large percentage of which present pollution threats to surface- and groundwater.

A Good Samaritan is defined as any person or entity that has no history with a specific abandoned mine site, including government agencies, nongovernmental organizations, or other

Government Update *continued on page 52*

Government Update continued from page 51

private parties. Under the Clean Water Act (CWA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or SUPERFUND), any Good Samaritan responsible for the cleanup of an abandoned mine is also accountable for any new or continuing point-source discharge. The Environmental Protection Agency (EPA) released a guidance document to the permitting process in 2012.

During the hearing, witnesses called for federally supported liability protection for Good Samaritan groups involved in cleanups. Witnesses were either in support of amending the CWA to create new "Good Samaritan Permits," or expanding CERCLA's "Good Samaritan Program," which currently does not take into account ongoing water discharge after a mine has been cleaned. Most of the witnesses called for a strong bipartisan bill to protect Good Samaritan efforts, and the idea that mining companies should be able to qualify as Good Samaritans to help with the cleanup processes.

The Native American Energy Act passed House of Representatives
The Native American Energy Act (H.R. 538) passed the House of Representatives on October 8, 2015. Introduced by Rep. Don Young (R-AK), the bill seeks to reduce the federal regulations limiting tribal development of natural resources on Indian land.

The bill calls on the Department of the Interior to work with tribal nations to develop energy resources, such oil and gas, solar, and wind, and limits comments on proposed developments on Indian lands to members of the tribe, people living in the affected area, and governments. The bill exempts Indian lands from any Department of the Interior rules on hydraulic fracturing for oil or gas development unless the beneficiary of the land agrees to the rules, and would allow the Navajo Nation to enter into mineral lease without Interior's approval.

New NPS Rule Proposes Updating Regulations Governing Non-Federal Oil and Gas Production
The National Park Service (NPS) has proposed a rule giving the agency greater oversight over the exercise of non-federal oil and gas rights on NPS land. Currently, private oil and gas production is allowed on NPS land in cases where the previous private land owner still owns the subsurface mineral rights. The new rule would give NPS more oversight over those operations.

The rule would allow the NPS to set higher financial assurance levels for oil and gas operators to fund reclamation efforts if an operator becomes insolvent or defaults, and would implement a permitting process for entities that extract resources from locations adjacent to, but not within, a national park. The NPS has performed a cost-benefit analysis and released a Draft Environmental Impact Statement pertaining to the rule.

Addressing the Drought in the Western United States: What is Congress Doing About It?
The western United States is experiencing a historically persistent drought. In California, the lack of water has had a devastating impact on the state's environmental health and economic growth, leading California Governor Jerry Brown to issue a State of Emergency for the fourth consecutive year. Record-low levels of reservoir and aquifer recharge have forced farmers across the state to fallow their fields, and the dry conditions have only increased the risk for catastrophic wildfires. California has also reported that the number of dry wells throughout the state is growing, with more than 1,988 in the Central Valley alone.

Given these conditions, how are legislators responding to this historic drought? Two bills are currently being considered at the federal level to tackle drought conditions across the West: the Western Water and American Food Security Act (H.R. 2898) and the California Emergency Drought Relief Act (S. 1894). Both bills address drought-stricken regions in California: the Central Valley Project (CVP), a water management project in northern California, and the Sacramento-San Joaquin Delta.

H.R. 2898 introduced by Rep. David Valadao (R-CA) advocates for water management strategies that favor agricultural and civic water rights across California while limiting negative impacts on native fish species. The bill allows for agricultural water allocations to remain within previously designated levels and provides funds for the construction and enhancement of surface water storage facilities. The bill also requires the U.S. Departments of Agriculture, Commerce, and the Interior to

expedite approval of mitigation and water-use projects requested by California state and local governments.

S. 1894 introduced by Sen. Dianne Feinstein (D-CA) supports projects for emergency drought relief, long-term water supply, and local drought resiliency. In addition to ensuring federal support for water recycling and desalination projects in the state, the bill authorizes funding for multiple water storage projects such as enlarging dams and reservoirs and requires the Environmental Protection Agency (EPA) to set aside funds for future emergency drought declarations. Feinstein's bill would also support research and monitoring efforts. The bill requires the Secretaries of the Interior and Commerce to implement strategies to monitor turbidity and flow of local rivers and establishes a WaterSense Program within EPA to identify and promote water efficient products, building, landscapes, facilities, processes and services via a "WaterSense" label. It also establishes an "Open Water Data System" within the U.S. Geological Survey to provide an open exchange of water data for management purposes.

The proposed bills, however, still have a long way to go before they can become law. Although H.R. 2898 has been approved by the House, it still needs to be considered in the Senate; its likely companion bill, S. 1894, still has to be approved by the Senate before it can be considered in the House or go to conference. In addition, many other water legislation bills have been introduced throughout the this Congress to address the drought, including the New Mexico Preparedness Act of 2015 (S. 1936) and the Land and Water Conservation Authorization and Funding Act of 2015 (S. 890) among others.

In the meantime, California state and local governments have pushed for their own regulatory changes at the state level to mitigate the drought's devastating impacts. For example, the California Department of Food and Agriculture has put forth a plan to help farmers implement on-farm irrigation systems, and the Department of Water Resources has established draft regulations to provide a process for local agencies to modify the boundaries of groundwater basins. In addition, Gov. Brown has approved legislation that prohibits and fines cities and counties for using water resources in unbeneficial ways, such as watering private lawns. California citizens are also trying to help by decreasing the number of private swimming pools throughout the state.

As the drought persists throughout the western United States, geoscientists are providing federal, state, and local communities with the information they need to assess water quality and quantity now and in the future. There are many efforts at the federal and local level to help alleviate the impacts from drought; for more information please visit the U.S. Geological Survey website at http://www.usgs.gov/water/. ■

A Simple Hello Can Lead to a Million Things

by Bonnie Milne

The Houston Geological Society has an astonishing 279 Emeritus, 3,296 Active and 165 Associate Members. Our HGS organization consists of geoscience professionals, educators, students, and interested industry parties throughout the Houston area and beyond. Members of HGS include a cross-section of many disciplines of geology, geophysics, and engineering, with members of all ages and all levels of experience.

An important function of The Houston Geological Society is to enable members to network and interact. Towards this objective, the HGS Membership Directory can be a powerful tool allowing members to find each other and connect. However, the Membership Directory requires updating and improvements to provide the best possible vehicle for networking.

The Directory Committee 2015-2016 is anchored by the following individuals: **John Tubb Jr., Brittany Davis-Morris** and **Bonnie Milne**. Together with cooperation from website chair **Linda Sternbach** and Membership Chair **Sharie Sartain**, the group will spearhead all aspects of the online **Directory Update Initiative** (otherwise known as DUI). The goal of the committee is to prepare a robust and searchable Membership Directory available as a link on the HGS Website as well as a downloadable PDF for those who prefer to do their networking with a printed medium.

Please be aware that members will receive an email blast in the near future with instructions to log on to the hgs.org website for the purpose of updating and augmenting your personal data.

Although the submission of personal data and information will be the personal choice of the Member, the Directory Committee will format the request to add the following updated information to your profile:

- Name and Title
- Company
- Address
- Phone Number
- Email address
- Status of Membership (Active, Associate, Emeritus) and date of joining HGS
- Degree- School- Year Degree Received
- Spouse/Partner Name
- Photo
- Resume (available only if submitted by member and available as a 'drop down' on the Website Directory. The resume will be available for review only online and will not be included in the printable version.

Again, **all personal information submitted will be at the discretion and choice of the member!** ■

HGS *Bulletin* Instructions to Authors

All materials are due by the 15th of the month, 6 weeks before issue publication. Abstracts should be 500 words or less; extended abstracts up to 1000 words; articles can be any length but brevity is preferred as we have a physical page limit within our current publishing contract. All submissions are subject to editorial review and revision.

Text should be submitted by email as an attached text or Word file or on a clearly labeled CD in Word format with a hardcopy printout to the Editor.

Figures, maps, diagrams, etc., should be digital files using Adobe Illustrator or Adobe Photoshop. Files should be saved and submitted in .ai, .eps, .tif or .jpg format. Send them as separate attachments via email or CD if they are larger than 5 MEGs each, accompanied by figure captions that include the file name of the desired image. DO NOT EMBED them into your text document; they must be sent as separate files from the text. DO NOT USE POWERPOINT, CLIP ART or Internet images (72-DPI resolution) as these do not have adequate resolution for the printed page and cannot be accepted. All digital files must have 300-DPI resolution or greater at the approximate size the figure will be printed.

Photographs may be digital or hard copy. Hard copies must be printed on glossy paper with the author's name, photo or figure number and caption on the back. Digital files must be submitted in .tif, .jpg or .eps format with 300-DPI or greater resolution at the printing size and be accompanied by figure captions that are linked by the file name of the image. The images should be submitted as individual email attachments (if less than 5 MB) or on CD or DVD.

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8	$750	$1,260	$2,242	$4,307						
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6	$590	$990	$1,782	$3,392						$1,890
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4	$405	$683	$1,223	$2,326						
3	$327	$550	$990	$1,886						$1,080
2	$232	$392	$704	$1,339						
1	$146	$246	$443	$842	$1,404	$1,296	$1,313	$1,080	$1,296	$810
Professional Directory Section Business Card Ad 10 Issues – $160 ($30 for each additional name on same card)										

Website Advertising Opportunities

HGS has multiple website advertising opportunities for your company! We've expanded our offerings to include a 275 x 800 pixel, rotating banner ad on the front page of the website. We have kept the popular Event Calendar and Geo-Job Postings advertisement locations!

	Home page Banner	Home Page (200 x 400 pixels)	Event Calendar (200 x 400 pixels)	Geo-Jobs (120 x 90 pixels)	Website Business Card (Members Only)	Personal Resumes (Members Only)
One year	$3,000.00	$2,800.00	$2,500.00	$1,400.00	Free	Free
6 months	$2,000.00	$1,800.00	$1,500.00	$750.00	Free	Free
3 months	$1,500.00	$1,300.00	$1,000.00	$450.00	Free	Free
Monthly	$ 700.00	$500.00	$ 400.00	$200.00	Free	Free

We still offer Geo-Jobs - where your company can post job openings for 14 days at $50.00 or 30 days at $100.00.

For more information regarding website advertising visit HGS.org or email jill@hgs.org.

Application to Become a Member of the Houston Geological Society

Qualifications for Active Membership

1) Have a degree in geology or an allied geoscience from an accredited college or university; or
2) Have a degree in science or engineering from an accredited college or university and have been engaged in the professional study or practice of earth science for at least five (5) years.

Qualifications for Associate Membership (including students)

1) Be involved in the application of the earth or allied sciences.
2) Be a full-time student enrolled in geology or in the related sciences.

Apply online at www.hgs.org and click on Join HGS

Annual Dues Expire Each June 30. (Late renewals – $5 re-instatement fee)
Annual dues are $28.00; emeritus members pay $14.00; students are free.

Mail this application and payment to:
Houston Geological Society
14811 St. Mary's Lane, Suite 250 • Houston, TX 77079-2916
Telephone: 713-463-9476 Fax: 281-679-5504

Payment method:

☐ Check, ☐ VISA, ☐ MasterCard, ☐ American Express, ☐ Discover

Card # _____

Expiration Date: _____ Card I.D. _____

(Card I.D. – 3 or 4 digit number on front or back of card)

To the Executive Board: I hereby apply for ❑ Active or ❑ Associate membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws. ❑ Check here if a full-time student.

Name: _____

Address: _____

_____

Home Phone: _____ *Spouse's Name:* _____

Email: _____

Job Title: _____

Company: _____

Company Address: _____

_____

Work Phone: _____ *Fax Number:* _____

Circle Preferred Mailing Address: Home Office

Professional Affiliations: _____

❑ AAPG member No.: _____

Professional Interest:

❑ Environmental Geology
❑ International E&P
❑ North American E&P (other than Gulf Coast)
❑ Gulf Coast E&P (onshore & offshore)

School _____

Degree _____ *Major* _____ *Year* _____

_____

School _____

Degree _____ *Major* _____ *Year* _____

Earth Science Work Experience _____

_____

_____

_____

Applicant's Signature _____ *Date* _____

Endorsement by HGS member (not required if active AAPG member)

Name: _____

Signature _____ *Date* _____

Membership Chairman _____ *HGS Secretary* _____

revised 7/30/14

Houston Petroleum Auxiliary Council News

by Shirley Gordon, HPAC-HGS Liaison

Members of the Houston Geological Society, please show this article to your spouse. Spouses of geologists, geophysicists, engineers, and landmen who are current members of their respective professional organizations are eligible for membership in the Houston Petroleum Auxiliary Council, better known as HPAC. HPAC is an organization designed to further friendships and common interests among spouses of HAPL, GSH, SPE and HGS. Lady scientists and engineers, if you have time to get away from your primary professional responsibilities, we would welcome you to our meetings. And we do not limit our membership only to women, so some of you gentlemen might find some of our programs of interest, and of course are more than welcome too.

Now that the busy holiday season is well behind us, it's time to look forward to our next two programs. The first will be at 10:30 am – 2:45 pm on February 23rd, which is our "Game Day," to held at the lovely Braeburn Country Club at 8101 Bissonnet. There will be all sorts of games to play, including "classic" dominoes, chicken foot dominoes, bridge, and scrabble. Bring a table of friends and enjoy the day. A lunch will be provided about noon, after which play will resume. Of course, there are lots of door prizes, so if you don't get lucky at the game tables, you might have better luck winning a door prize! **Daisy Wood** is chairman for the event, and **Norma Roady** is co-chairman. Committee members are **Linnie Edwards, Lois Matuszak, Gwends Scott, Millie Tonn** and **Suzanne Womack**. When making your reservation (call Daisy at 832-581-3231 or 713-826-7952; or Norma at 713-669-1200), please indicate your game of choice so that the committee can have all the necessary items and number of people to play. The last meeting of the fiscal year will be during May—more to come on that in the March *Bulletin*.

By the time you read this column, the Book Club will have met and discussed *Isabella, the Warrior Queen*. Reports are that it was a very good discussion. The next Book Club meeting will be on May 2nd, with a discussion of *Dead Wake: The Last Crossing of the Lusitania* by Erik Larson. Discussion leader will be **Mickey Murrell**, with **Barbara Peck** as hostess.

ATTENTION BRIDGE PLAYERS! There are two bridge groups associated with HPAC. One meets the third Wednesday of each month at The Petroleum Club, now at 201 Louisiana Street; parking is $15, bridge is $15, and lunch is $30. Please call **Daisy Wood** at (832) 581-3231 for (713) 826-7952. The second group, "Cinco Mas," meets the second Thursday at the Westchase Marriott, 2900 Briarpark. **Audrey Tompkins** coordinates that group and can be reached at (713) 686-0005. Really good bridge played in both groups!

I hope you enjoy these pictures from our December meeting at the Racquet Club. You can see a great time was enjoyed by all. ■

Judy Johnson, Shelby Daniels, and Shirley Gordon

Sally Blackhall and President Norma Jean Jones

Mary Harle and Margery Ambrose

Ballet dancers from Uptown Dance Centre

Phyllis Carter, Event Chair

Norma Jean and Larry Jones

You are invited to become a member of

HPAC

2015–2016 dues are $20.00 Mail dues payment along with the completed information

to **Wanda Shaw** • 1506 Haven Lock Drive • Houston, Texas 77077

YEARBOOK INFORMATION

Last Name	First Name	Name Tag
Spouse Name	Company	
Street Address	City State	Zip
Email Address	Home Fax	
Home Phone	Cell Phone (Optional)	Home Email Address

Please choose a committee assignment if you are interested.

☐ Fall Event ☐ Yearbook ☐ Bridge ☐ Membership

☐ Christmas Event ☐ Spring Event ☐ Notification ☐ Book Club

☐ Exploring Houston ☐ Courtesy

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