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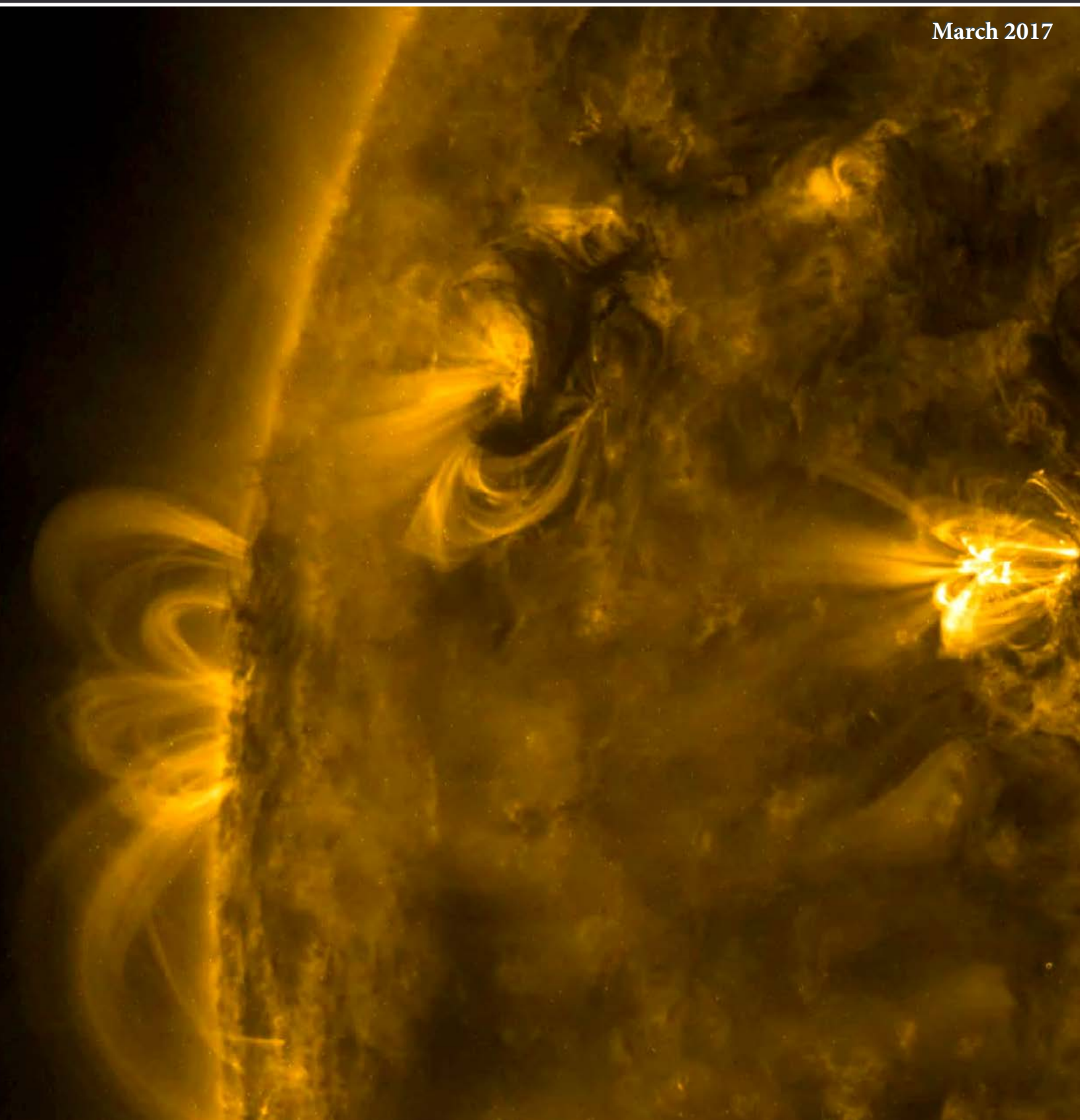
HGS Bulletin

Houston Geological Society

March 2017



The Bulletin
Houston Geological Society

Volume 59, Number 7 March 2017

In Every Issue

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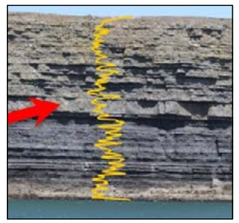
Technical Meetings

Other Features

page 8



page 17

page 25

page 39

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New Growth Opportunities Coming This Spring

New growth opportunities come with the spring at the HGS. This spring we will be running the *Applied Geoscience Mud Rocks Conference* on March 7th and 8th, followed by the *American Association of Petroleum Geologists (AAPG) National Convention* in first week of April. We will wrap up our spring events with our annual *Shrimp Peel and Crawfish Boil* on Friday April 21, 2017 from noon until 6:00pm at Pavilion 6 in Bear Creek Park. The key to success in your career is being prepared for opportunities as they arise where you work. The HGS prides itself in providing low-cost training to its members and the greater geological community. If you look at our member versus non-member pricing you will see that your membership cost is paid for if you attend only one of our technical conferences.

The *Applied Geoscience Mud Rock Conference* was the original shale play conference. Many have tried to usurp it and many have tried to copy it but it is THE premier conference on this subject. **Frank Walles** and his Mudrocks committee have kept this technical conference relevant with cutting-edge topics in this evolving play. This year's two-day conference has talks on Day 1 that focus on understanding reservoir producibility. Day 2 of the conference focuses on new opportunities in the shale play along with case studies highlighting how integrated applied geoscience increases potential profitability. If your company is active in the shale play or is considering joining other companies that are active already, this is a must-attend knowledge and network building event. I want to especially acknowledge Anadarko for providing their excellent facility for our use at no cost which lowers the registration fee for everyone. Thank you!

The big event of this spring is the *AAPG Annual Conference and Exhibit (ACE)* convention. This year's ACE is celebrating the 100th year anniversary of the AAPG. HGS members **Dave Rensink**, General Chair, along with **Craig Shipp**, Technical Chair, and his technical committee have organized a fantastic program. There are 430 oral presentations, 798 posters, 11 field trips and 21 short courses. The depth and scope of this petroleum geoscience conference are not matched anywhere else in the world. If you are an executive, manager, specialist, general technical person (Joe/Jane Geologist) or student, there is something you can learn at this conference. My personal favorites are the Discovery Thinking forum chaired by **Charles Sternbach** and Paul Weimer, and the Future of Energy forum chaired by Peter Carragher and James Courtier. There are technical sessions chaired by the recognized leaders in geoscience covering siliciclastics, carbonates and evaporites, basin modeling, energy and the environment, emerging frontiers and novel technology, geological and geophysical integration, international regional highlights and the SEPM Research Symposium. There also short courses that are being taught by industry recognized leaders in their field. The range and scope of these short courses cover the shale play, prospect risk analysis, basin modeling, quality controlling prospects screening, and much more. In addition, there are field trips you can attend. I am personally looking forward to the Spindletop field trip so I can see where it all started in Texas. There are specially designed programs for guests and K-14 (community college) teachers as well. I am willing to bet that there is nowhere else that your staff can get the magnitude and depth of technical training that is at the fore front of the petroleum geoscience industry at a lower cost than at the AAPG ACE this April in Houston at the George R Brown Convention Center.

Our final HGS event for the spring is our annual *HGS Shrimp Peel and Crawfish Boil* to be held on Friday April 21 at Pavilion 6 in Bear Creek Park. This annual networking social event is running from noon until 6:00pm which should allow everyone in the Energy Corridor to come by for lunch; those of you that work in town and live on the west side can stop in on your way home from the office. Northsiders — get on Texas 99 and join us too! We are considering organizing another event in the fall in your area, but it is not firm. You have the day off? You are welcome to come by any time that afternoon for some fun and food with your buddies and expand your industry network.

I am fond of saying that opportunity favors the prepared. There are opportunities to expand your horizons, grow your career, and meet some new people in Houston this spring. Some of you will get push back from your employer about attending these technical events. If you want to grow in your chosen profession, I would highly recommend that you take some PTO and attend some of these events. Remember, you are in charge of your career, not your employer. The days of working for one company are pretty much history, so if you want to continue forward in the petroleum industry, you need to PREPARE YOURSELF. ■

100TH AAPG ANNIVERSARY

ACE 2017

ANNUAL CONVENTION & EXHIBITION

2-5 April 2017 • Houston, TX • George R. Brown Convention Center

with: SEPM

Interested in bringing advanced technology, new geologic discoveries, and career pathways for your students into the classroom?

Register Now!

The American Association of Petroleum Geologists invites middle-school, high-school, and community college educators to help celebrate its 100th anniversary!

Earth Science Educator Program, April 1-4, 2017

Geologic Field Trips (*Saturday, April 1*)

Spend a day in the field with geoscientists to investigate local geology. Channel your inner scientist: make observations, apply field methods, analyze data, and interpret findings.

Symposium (*Sunday, April 2*)

Join colleagues for a day of interactive sessions exploring emerging fields, advances in technology, and careers. Discussions will highlight data, resources, and ways to bring content into the classroom. Topics include:

- **Roving Robots and Extreme Machines, New Frontiers of Earth Exploration**
- **Careers: A Path for Students to a Geosciences Paycheck**
- **Seeking Oil and Gas in 2017 and Beyond**
- **Why Seismic Matters in Our Hunt for Resources**
- **A Changing World for Petroleum**

Participate in the Convention (*Monday and Tuesday, April 3 and 4*)

Explore exhibits and see the latest in petroleum industry information and technology. Pair up with an industry professional. Interact with representatives from industry, organizations, and universities. View posters and attend technical presentations on cutting-edge industry topics for professional audiences. And more!

Details: http://ace.aapg.org/2017/networking-and-events/aapg-earth-science-educator-program

Registration: https://fs3.formsite.com/AAPGevents/form91/index.html?1481578663623

Participants will receive Gifted and Talented and Professional Development credit hours.

Complimentary event registrations and daily stipend are available for a limited number of participants.

Questions?
Contact stephanie.shipp.1@gmail.com or amanda.guzofski@chevron.com.

I wish to call attention to the need to print a correction to the Feb. issue of the *Bulletin*, as follows:

The poem that Mr. Marks attributes to me is not my own composition at all. It should be deleted and my own substituted, as per Ed's intention. – The two have similar titles, which is perhaps the reason for the wrong selection. My poem, titled *The Pterrible Ptexas Pterodactyl*, was actually published in the *Bulletin* for April 2000, p. 21, and is an item in my unpublished autobiog., *Coal Miner's Son*.

I was surprised – and of course quite pleased – to read the write-up about my tenure as part of the Editorial board of the *Bulletin* for the past two decades – thank you. Having what has been called an "editor's eye", I enjoyed and benefited, as a happy volunteer trooper, from the opportunity to have such an experience.

BTW, my last name is (Revilla (NOT Rivella, as appears a few times in the article and comments).

Charles Revilla,
Mbr. Emeritus, HGS *Bulletin* .

The Pterrible Ptexas Pterodactyl

by C. E. Revilla, with apologies and thanks to R. L. Bates

Once when time was very old,
From imagination bold
Nature had herself a ball,
Making animals and all.

Deep research as a matter of fact'll
Bring to light the pterodactyl -
Yes, the pterrible ptexas dinosaur/fowl,*
Pterodactyl. On the prowl,
There he flies and cries and swoops
Low on yon stoneagedom's troops.*
Wings outspread of warplane size,
The pterodactyl rules the skies.

Pity the poor, slow, earthbound man
Trying to cope; at first he can-
Not even start to commence to begin
To have a chance, much less to win.*
This bird, this flying tank of sorts,
Not only rules the skies, he sports
On landing quite a sizable figure -
Though big is man the pteri's bigger.

Long ages roll and time gets older;
Our modern man gets bold and bolder,
Until one day, the "wright thing" done,
Man leaves the ground. The race is won.

For such is time, anon, anon,
The pterodactyl by then had gone
Long since from the scene, his number up;
Flying man took the loving cup.
For him the blue ribbon as the best,
The creature that learned how to wrest
The dominant role in land- and sea-war,
Last in the sky, from the pterosaur.*

*Pseudo-pscience, perhaps, but poetic license, too!

(Written aboard the R & B semi-submersible drilling rig, the JIM CUNNINGHAM, in the South China Sea, P. R. of China in Mid-1991 on an AMOCO exploratory oil well)

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 2017 Applied Geoscience Conference titled: "Integrated Approaches of Unconventional Reservoir Assessment and Optimization" scheduled to be held on March 7th and 8th, 2017 at the Anadarko Petroleum Conference Center in The Woodlands, Texas. 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 will be a featured speaker, Jeremy Boak, Director of the Oklahoma Geological Survey, who will give a keynote luncheon presentation regarding the Quake Hazards in Oklahoma and their origin. An evening social event will provide opportunities for networking as well as provide time for follow-up discussions with speakers and fellow participants.

Speakers are recognized experts from industry, government, and university who have been specifically selected by our HGS conference organizing committee. The committee-organized technical program will include 20 expert, oral presenters organized within 8 sessions, 15 university research poster presentations, and cores on display from the Wolfcamp and Utica formations (both with presenters).

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

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

- Diagenetic Components of Mudrocks and Their Impact on Production
- Nanoscale Intra-Kerogen Porosity and Hydrocarbon Phase Producibility/Wettability
- Predicting Petrophysical Flow Properties Using Digital Rock Physics
- Geophysical Methods for Producibility, Fracability and GeoHazards
- Hybrid Unconventional Opportunities
- Tight/Complex Reservoirs Opportunities
- Geo-engineered Completions/Geomechanics
- Operator Cases of Integrated Applied Geoscience for Fun and Profit

As a local Houston Geological Society event, it has proven to be highly cost-effective training for both geoscientists and engineers. The multi-member HGS organizing committee has contributed to making this conference happen for the past eleven years, in part because it would be cost and competitor prohibitive for one single company to organize such a diverse 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 event to share knowledge of advancing applied geoscience technologies within mudrock reservoir characterization.

This annual Applied Geoscience Conference (AGC) event is a combined education and scientific advancement service for the HGS member community and 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 AGC technical program committee member, Wayne Camp, was especially important in arranging this venue opportunity.

This AGC on mudrock reservoir characterization and optimization has been highly popular since inception with demand frequently 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 continued industry downturn, and with the help of our venue sponsor, HGS is again offering this conference at a substantially reduced cost to make it as affordable as possible. If you are interested in attending, but are encountering financial hardships such as unemployment, please contact the HGS office for further reduced pricing consideration. See www.hgs.org or contact Andrea Peoples at (713) 463-9476.

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Brand your company with the premier event designed for integrated asset teams.

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93% Rated the overall quality of the technical presentations as good or exceptional compared to other industry conferences

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91% Rated the talks as applicable to their every day work

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Applied Geoscience Conference

March 7 - 8, 2017

Integrated Approaches of Unconventional Reservoir Assessment and Optimization

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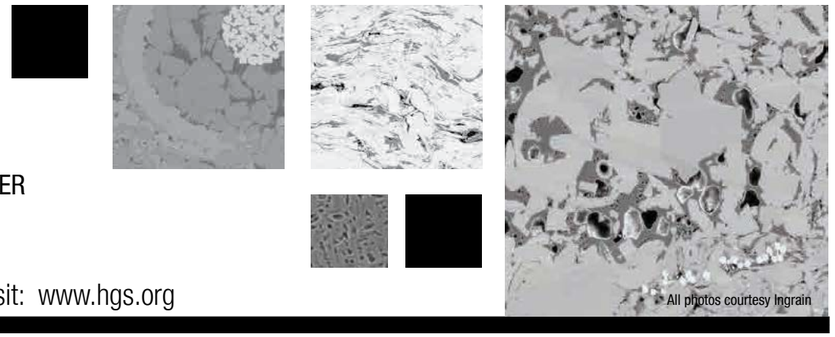

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The Woodlands, TX 77380
For more information please visit: www.hgs.org

Applied Geoscience Conference

March 7 - 8, 2017

Oral Presentations – Tuesday, March 7, 2017

7:00 - 8:00	**Registration and Coffee**	
8:00 - 8:10	Welcome and Opening Remarks: **Frank Walles,** *Conference Chair* **and John Jordan**, *HGS President*	
	Session 1: Diagenetic Components of Mudrocks and Their Impact on Production Session Chairs: Tina Calvin and Neil Fishman	
8:10 - 8:45	Diagenesis in Mudrocks and Its Importance in Unconventional Resource Plays	**Neil Fishman,** *Hess Corporation*
8:45 - 9:20	Diagenesis of Ash Beds in Mudrocks and their Impact on Production	**Christina Calvin,** *Consultant* H. Gamero-Diaz, L. Mosse, R. Malpani, C.K. Miller, J. Xu, and K. Fisher, *Schlumberger*
9:20 - 9:55	DNA Sequencing: A New Subsurface Diagnostic to Maximize Reservoir Production	**Liz Percak-Dennett** and Ajay Kshatriya *Biota Technology, Inc.*
9:55 - 10:20	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 2: Nanoscale Intra-Kerogen Porosity and Hydrocarbon Phase Producibility/Wettability Sesson Chairs: Avrami Grader and James Macquaker	
10:20 - 10:55	What Are We Doing About EOR in Shale and Tight Formations?	**Dr. James Sheng,** *Texas Tech PE Lead of DOE Consortium – Unconventionals*
10:55 - 11:30	The Interaction of Organic and Inorganic Matter: Impact on Composition and Fractionation of Petroleum	**Dan Jarvie,** *TCU Energy Institute*
11:30 - 12:35	**Lunch, Poster, Core Displays and Exhibitor Presentations**	
12:00 - 12:35	**Luncheon Key Note Talk** Earthquakes in Oklahoma: Trends in Injection Induced Seismicity and Regulatory Responses	**Jeremy Boak**, *Director, Oklahoma Geological Survey*
	Session 3: Predicting Petrophysical Flow Properties Using Digital Rock Physics Sesson Chairs: Taras Bryndzia and Timothy Diggs	
12:35 - 1:10	Insights Into Segmentation and Related Problems of Predicting 3D Properties from 2D Images	**Nishank Saxena,** Ronny Hofmann, Seán Dolan, *Shell International Exploration & Production*. Gary Mavko, *Stanford University*
1:10 - 1:45	Upscaling in Numerical Simulation of Shale Transport Properties by Coupling Molecular Dynamics Simulation with Lattice Bolzmann Method	**Yang Ning,** Shuai He, Guan Qin *University of Houston*
1:45 - 2:20	Investigation of New Production Targets in the Springer Shale within the South Central Oklahoma Oil Province (SCOOP) Utilizing the Latest Digital Rock Anaysis Techniques	**Bryan Guzman**, Tiffany Rider, Joel Walls *Ingrain Inc.*
2:20 - 2:45	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 4: Geophysical Methods for Producibility, Fracability and GeoHazards Sesson Chairs: Thomas Reed and Lisa Neelen	
2:45 - 3:20	Examining the Role of Fluid versus Stress in Refractures using Microseismicity	**Adam Baig,** Ted Urbancic, and Mike Preiksaitis, *ESG Canada Inc.*
3:20 - 3:55	Exploiting Microseismic Event Characterization to Optimize Completion Strategies	**Jamie Rich** and Dan Kahn, *Devon*
3:55 - 4:00	Closing Comments, Invitation to Posters and Core Sessions	
4:00 - 6:00	**Core, Exhibitor and Poster Presentations**	

Poster Session – *Invited Presentations*

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Applied Geoscience Conference

March 7 - 8, 2017

Oral Presentations – Wednesday, March 8, 2017

7:00 - 8:00	**Registration and Coffee**	
8:00 - 8:10	Welcome and Opening Remarks: **Frank Walles,** *Conference Chair*	
	Session 5: Hybrid Unconventional Opportunities Sesson Chairs: Obie Djordjevic and Barbara Hill	
8:10 - 8:45	Developing a High-Resolution Understanding of Variations in Sedimentological and Petrophysical Property Space in a Thinly-Bedded Reservoir: Improving Predictions Through Cross-Disciplinary Collaboration and Data Integration	**Stephanie Perry,** Dawn Hayes, *Anadarko*
8:45 - 9:20	Enhancing Performance of a Wolfberry Play via Comprehensive Integrated Petrophysical Analysis	**Tim McGinley**, *Laredo Petroleum*
9:20 - 9:55	Dynamic Flow Behavior Using Shale Rock Model for Recovery Analysis	**Richard MacDonald**, Steve Geetan, *EP Energy;* Denis Klemin, *Schlumberger*
9:55 - 10:25	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 6: Tight/Complex Reservoir Opportunities Sesson Chairs: Mark Andreason and Matt Williams	
10:25 - 11:00	Tight Oil Reservoirs of the Bone Spring Sands – An Example of Low Resistivity Low Contrast Pay	**Randy Miller**, *Core Lab*
11:00 - 11:35	Sweet Spot Identification in the Western Anadarko Basin	**Jacob Shumway**, Brenden Curran, *FourPoint Energy*
11:35 - 1:00	**Lunch, Poster, Core Displays and Exhibitor Presentations**	
1:00 - 1:10	**Poster Awards Presentation**	
	Session 7: Geo-Engineered Completions Sesson Chairs: Luis Baez and Eric Michael	
1:10 - 1:45	Appraising and Developing Your Mudrocks: How to Avoid Squandering Billions of Dollars Next Time	**Cretis Jenkins,** Mark McLane, *Rose & Associates*
1:45 - 2:20	Reducing Subsurface Uncertainties through Formation Evaluation for Improvement of Engineering Solutions of Unconventional Plays	**David Gadzhimirzaev**, Umesh Prasad, *Baker Hughes Inc.*
2:20 - 2:55	Completion Optimization Using Both Vertical and Horizontal Measurements, an Eagle Ford Shale Case Study	**William (Bill) Kreimeier**, *Lonestar Resources;* Maraden Panjaitan, Kevin Fisher, Raj Malpani, Jian Xu, Danny McMillan, *Schlumberger*
2:55 - 3:25	**Coffee, Core Displays and Exhibitor Presentations**	
	Session 8: Operator Cases of Integrated Applied Geoscience for Fun and Profit Sesson Chairs: John Breyer and Raj Malpani	
3:25 - 4:00	Advanced Core Analysis Methodologies Quantify and Characterize Prolific Liquid Hydrocarbon Quantities in the Vaca Muerta Shale	**R. D. Williams**, D. M. Willberg, D. Handwerger, D. Ekart, *Schlumberger*; J. Petriello; R. Suarez-Rivera, *Von Gonten Labs*
4:00 - 4:30	Utilizing Integrated Fracture Characterization Workflows to Optimize Eagle Ford Development Strategies	**Roy Wilty**, A.J. Herrs, Lance Wilson, Adriana Fernandez, Nabiel Eldam, *Marathon*

Core Displays - **Core Display Chairs: Bruce Woodhouse and Taras Bryndzia**

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

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Posters – March 7-8, 2017

Poster Sesson Chairs: Christina Calvin, Mike Effler and Steven Macallelo

University	Student Name	Poster Topic
Colorado State University	**Marisa Boraas-Connors,** Dr. Judith Hannah and Dr. Holly Stein	Using Lithologic and Chemostratigraphic Variation to Interpret Re-Os Isochrons of Organic-rich Shales: The Late Jurassic Agardhfjellet Formation, Svalbard, Norway
Cornell University	**Jonathan Casey Root** and Dr. Teresa Jordan	Diagenetic Evolution of the Cherry Valley Member of the Oatka Creek Formation, Marcellus Subgroup, New York
New Mexico Tech University	**Natasha Trujillo**	Influence of Lithology and Diagenesis on Mechanical and Sealing Properties of the Thirteen Finger Limestone and Upper Morrow Shale, Farnsworth Unit, Texas
Oklahoma State University	**Ibukun Bode,** G. Michael Grammer and Beth Vandenberg	NMR Characterization and Pore-scale Imaging in Mississippian-Aged Carbonate Mudrocks of the Southern Midcontinent
Oklahoma State University	**Justin Steinmann,** G. Michael Grammer and Natascha Riedinger	Assessing Sulfur Isotopes as a Potential Correlation Tool in Carbonate Mudrocks of the Mississippian Limestone
Southern Illinois University	**John Ejembi** and Sally L. Potter-McIntyre	Utilizing Multi-Geochemical Proxies in Paleosols to Investigate the Shift in Middle Jurassic Depositional Environment in Western Colorado
Texas A & M University	**Han Li**	Hydraulic Fracture Height Predictions in Laminated Shale Formations Using Finite-Discrete Element Method
Texas Tech University	**Eric Friedman** and Dustin E Sweet	Preliminary Results: Comparing Siliciclastic Content of Ramp to Rimmed Carbonate Slope Deposits During Relative Sea Level Highstands
University of British Columbia	**Pablo Lacerda Silva**	Contrasting Reservoir Facies of the Doig Formation, Western Canada Sedimentary Basin: Insights from Pore-size Distribution, Mineralogy and Organic Geochemistry
University of Houston	**Anna Krylova** and Gennady Goloshubin	Dispersive Properties of a Fractured Fluid-Saturated Layer
University of Houston	**Ane Slabic**	Uranium, Thorium, and Lead Isotope Geochemistry of Petroleum Source Rocks: An Example from the Eagle Ford Group, Texas
University of Houston	**Zohreh Souri**	TOC Estimation of the Marcellus Shale, Bradford County, Pennsylvania
University of Louisiana at Lafayette	**Logan Adams**	New Plays in an Old Field: Depositional History and Source Rock Characterization at Teapot Dome, Wyoming
University of Oklahoma	**Alex M Vachaparampil** and Ahmad Ghassemi	The Influence of the Intermediate Principal Stress on the Strength of the Mancos Shale
University of Texas of Permian Basin	**Joanna Walker,** Troy Tittlemier, Carlos Saenz, Fatimah Adelekan, Jesse Marinelarena and Mike Camona	The Impact of Post Oil Emplacement Tectonics of the Delaware Mountain Group, with an Emphasis on Residual Oil Zone Potential

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Morgan Sullivan, Bruce Power, Fabien Laugier, Michael Pyrcz, Thomas Dunn, and Larry Zarra
Chevron, Houston, TX
Jacob Covault
Bureau of Economic Geology, Austin, TX

Relationship between Reservoir Quality, Facies and Depositional Environment: Working Towards a Predictive Model for the Deepwater Wilcox

Predictions of reservoir type, extent, heterogeneity, and connectivity are significant subsurface challenges and are essential for accurate production forecasting and optimum field development. This challenge is amplified when seismic data do not have the capability to image the reservoir (e.g. deep, sub-salt) such as in the case of the Paleogene Wilcox in the Gulf of Mexico. As a result of limited well and seismic data, significant uncertainty remains concerning reservoir distribution and the controls on reservoir quality. In response to this important business challenge, a major focus has been on significantly improving the understanding of the linkages between reservoir quality, depositional architecture and lithofacies distribution for the Wilcox and in developing new workflows and models for improved reservoir description, classification, and prediction of reservoir quality and performance.

The first step to understanding the controls of reservoir distribution and quality is a detailed classification of all the reservoir facies and interpretation of the reservoir architecture. The challenge is distinguishing between different architectural styles in the absence of high quality seismic. To address this

HGS General Dinner *continued on page 18*

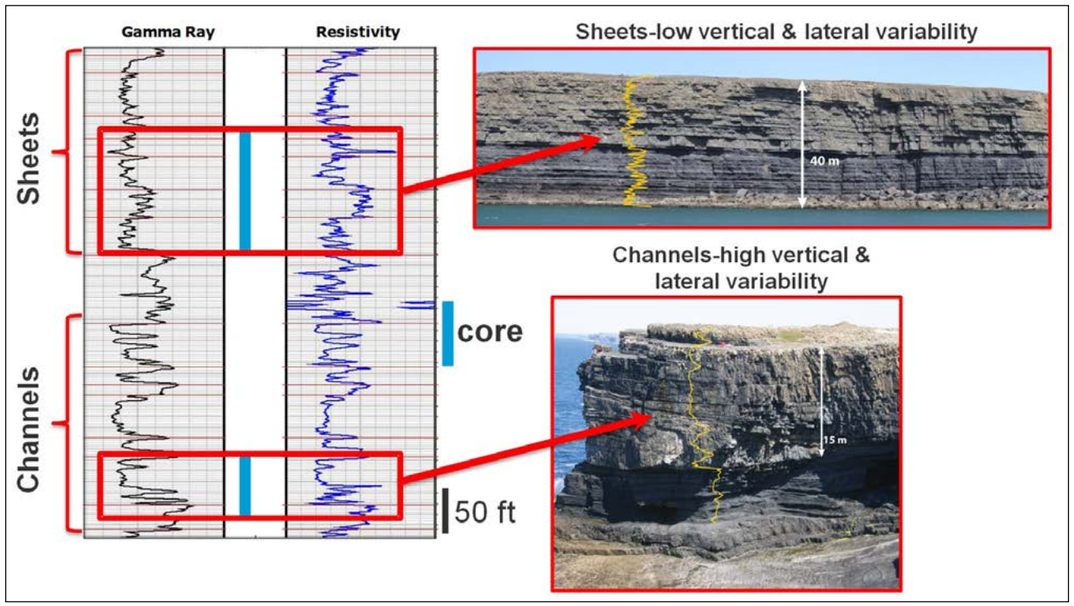

Figure 1: *Example of criteria/workflows for distinguishing reservoir style based on recognition criteria from well and analog data which are not dependent on seismic data.*

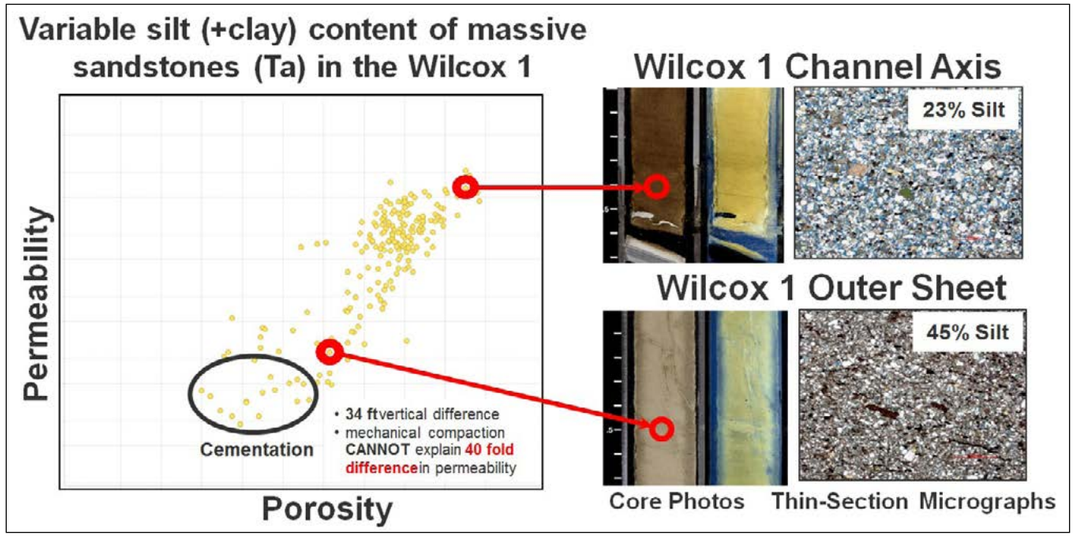

Figure 2: *Porosity-permeability plot for single sandstone lithofacies (Ta/massive sandstones) with examples of core photos, photomicrographs and point counted silt percentages. The two highlighted data points come from the same well and are only 34 ft apart. Mechanical compaction cannot explain the measured 40 fold difference in permeability between these two examples.*

issue, it is necessary to establish common criteria/workflows for distinguishing reservoir style based on recognition criteria from well and analog data which are not dependent on seismic data (**Figure 1**). The recognition criteria applied in these workflows are based on distinct relationships that have been observed relating core facies and well-log character to reservoir type. Individual sheets typically have a blocky to upward fining well-log character, proximal to distal trends in net-to-gross and higher percentages of argillaceous sandstones. Channels have highly variable log character including blocky, upward-fining and upward-coarsening due to axis to margin variations in lithofacies distribution and contain higher proportion of shale rip-ups and cross-bedded sandstones. A key observation is that channels display a very high-degree of vertical variability at the complex scale compared to sheets which tend to be much more homogenous. By integrating observations from analogs with detailed characterization of well-logs and core, predictive 3D models of facies distribution were constructed for the Wilcox. Application of these workflows has greatly aided in reducing uncertainty in predicting reservoir type and distribution.

The next challenge is understanding the controls on reservoir quality. Wilcox reservoir quality is not simply a function of mechanical compaction with depth. Reservoir intervals at similar depths below mud-line in the same well have very different reservoir quality. Furthermore, the range in reservoir quality for the most abundant reservoir facies, the massive sandstones or what are interpreted to be Bouma Ta turbidite divisions, was much greater than had been observed in other deepwater reservoirs (**Figure 2**). From this analysis, it was interpreted that the best reservoir quality was associated with channelized and proximal sheet reservoirs. It was observed, however, that a significant amount of the massive "sandstones" had large amounts of silt, which is unusual for Ta sandstones. These silty massive sandstones were more common in the interpreted sheet deposits and most common in the distal sheet setting. Analysis suggests that massive sandstones with high fine-grained content are not Ta turbidite deposits. Instead, these silty sandstones with poorer reservoir quality represent a transitional facies between turbidites and debrites. These transitional facies need to be treated separately from the cleaner turbidites in forward modeling of reservoir quality. It can now be demonstrated that reservoir quality is strongly controlled by reservoir architecture and in particular proximal to distal changes in depositional sand quality and not solely related to mechanical compaction.

The impact of architectural variability and in particular fine scale heterogeneity on reservoir performance for unconfined deepwater sheets is evaluated to quantify impact on reservoir performance. The impact of architectural variability in channelized deepwater settings on flow performance has been well established. However, the importance of detailed reservoir

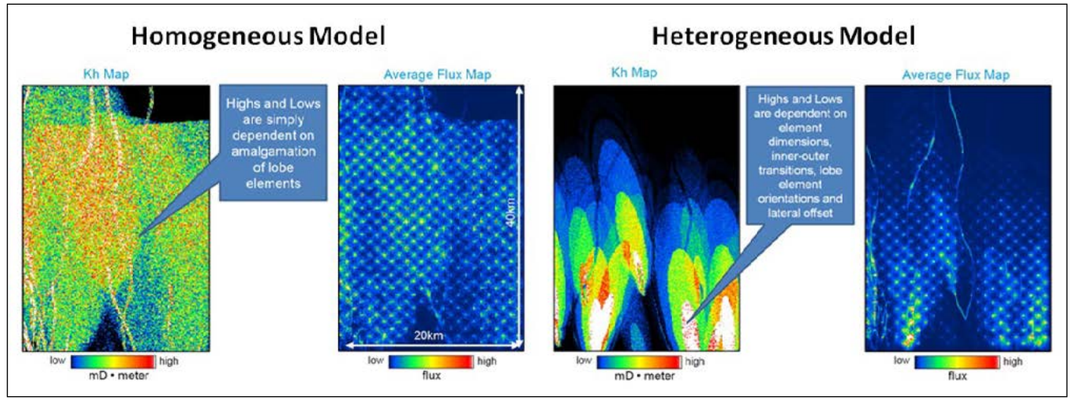

Figure 3: *Comparison of kH distribution and average flux for homogeneous and heterogeneous models. The simple sand-no-sand model displays uniform flux across the entire modeled region whereas the heterogeneous model displays large variation in flux from proximal to distal within sheets and across the entire model.*

heterogeneity in unconfined sheet models had previously not been demonstrated. Current reservoir modeling efforts for unconfined sheets have typically utilized relatively simple sand-no-sand models in evaluating reservoir performance. In order to address this potential uncertainty in the modeling of unconfined deepwater reservoirs comparative models of simple and complex architectural heterogeneity for individual depositional complexes are constructed. The 1st model applies a simple sand-no-sand approach that did not spatially vary rock properties. The 2nd model utilizes all the same parameters (cell dimensions, total kH, well spacing, etc.) but distributes rock properties utilizing the results of detailed stratigraphic characterization of both subsurface, near surface and outcrop analogs. Both models are interrogated utilizing simple flow diagnostic tools to quantify variations in flow performance in the case of primary depletion only. The results suggested significant impact of architecturally controlled heterogeneity on flow behavior. The simple sand-no-sand model displays uniform flux across the entire modeled region whereas the heterogeneous model displays large variation in flux from proximal to distal within sheets and across the entire model (**Figure 3**). These are very much preliminary results and additional modeling and advanced analysis of flow performance must be conducted before definitive conclusions can be drawn.

This study has resulted in more accurate modeling and prediction of Wilcox reservoir quality. This fundamentally new view of the controls on reservoir quality has the potential to significantly impact the reservoir modeling of permeability distribution and impact current Wilcox developments and future exploration wells. It also highlights the need for these stratigraphic features to be properly characterized and then incorporated into reservoir models at their appropriate scales, for accurate production forecasting in the sheet dominated reservoir such as the Wilcox.

Biographical Sketch

Morgan Sullivan is currently the team leader for the clastic stratigraphy team and a senior geological consultant with Chevron Energy Technology Company in Houston. In this role, he is involved in developing and applying new technologies to aid in solving complicated reservoir problems. He received his BS in Geology from the University of California, Santa Barbara in 1986 and his PhD in Geology from the University of Glasgow, Scotland in 1991. Prior to joining Chevron, he spent 3 years on the faculty at California State University, Chico, and 11 years at ExxonMobil Upstream Research Company and ExxonMobil Exploration Company in Houston. He maintains broad technical interests in the sequence stratigraphy and clastic depositional systems, with emphasis on developing new workflows, tools, predictive models and analogs to aid in the prediction of areal reservoir distribution and connectivity when seismic data does not have the capability to detect /image the reservoir (deep, tight, sub-salt).

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Pankaj Khanna, Andre Droxler, Paul M. (Mitch) Harris
Department of Earth Science, Rice University, Houston, TX
Daniel Lehrmann
Department of Geosciences, Trinity University, San Antonio, TX

ETHICS MOMENT

We will dedicate 15 minutes at the beginning of each meeting to ethics to apply towards 0.25 hours of ethics credit.

Upper Cambrian Microbial Reefs, Mason, Texas: The Making of Virtual Outcrops Using Drone Imagery

The discovery of hydrocarbon reservoirs in pre-salt microbial accumulations near offshore Brazil and Angola, in addition to a significant microbial component in some of the world's largest carbonate reservoirs in the Pre-Caspian Basin, has renewed interest in microbial deposits. Spectacular outcrops of Upper Cambrian microbial reefs in Mason County, Texas, offer unique opportunities to assess varying scales of their spatial variation and potentially serve as analogs to improve reservoir correlation and modeling. These outcrops are available on the Shepard and Zesch private Ranches, along the Llano and James rivers and Mill Creek. Recently, these ranches became accessible to carry out geological field work.

An aerial survey was conducted in February 2013 to collect aerial photographs over ten outcrops (three pavements and seven cliffs). Camerawings, an Aerial Photography Company, was hired to conduct the survey with a drone carrying a Sony NEX-7, 24.3 MP camera, a gimble (tool which keeps camera horizontal during flight), and a GPS to locate the position at which the photographs were taken. These aerial photographs were used to build 3D Digital Terrain Models (DTM) using Agisoft software 1.0 version. The workflow followed six steps: first, importing photographs in Agisoft 1.0; second, aligning them according to the location at which the photographs were taken; and third, building a 3D sparse point cloud. The fourth step improved the accuracy of the location of the 3D point cloud model where ground control points (GCPs) were used (before the drone survey, markers were placed in the field and location data was collected using DGPS (Differential GPS) and Trimble Total Station unit. The fifth step was to build a dense point cloud model and the final step is to build a mesh.

Through these 3D models and field studies, three growth phases are observed in the microbial buildups (10-15 m high and tens of meters in width). An initial 'colonization' phase, evolving into a 'vertical aggradation and lateral expansion' phase, and ultimately into a 'capping' phase. 3D analyses of the buildups' colonization phase on a plan view outcrop in the floor of the James River (600m x 200m pavement exposure) offers unique opportunities in scaling the growth at three quantifiable scales: large (few tens of meters), medium (few meters), and small (few decimeters). Different scales were mapped, and their length, width, orientation, and spacing were catalogued. In general, the shape of buildups at all scales is elliptical to circular with large scale ranging in length from 15 to 40 m, medium scale ranging from 1.5 m to 15 m, and smallest scale ranging from 10 cm to 80 cm.

The Rice/Trinity Industry Microbial Research Consortium is funded by Chevron, ConocoPhillips, Shell, and Statoil.

HGS Environmental & Engineering Dinner *continued on page 23*

SAVE THE DATE

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HGS Environmental & Engineering Dinner *continued from page 21*

Biographical Sketch

Pankaj's journey in Geology started from Himalayan foothills in India and brought him to the US in August 2012. As a child he was always interested to learn more about rocks which is why he enrolled at University of Delhi (India) first in Bachelors in Geology (honors) and then in a Master program in Geology. During his education in India he also participated in summer research programs at some major research institutes which include, India Meteorological Department (Delhi), Wadia Institute of Himalayan Geology (Dehradun, Uttarakhand) and Indian Institute of Science and Education (Kolkata). He was also awarded the Summer Research Fellowship by Indian Academy of Sciences. After his arrival at Rice, within a month he started his research by participating at a scientific cruise in September 2012 onboard R/V Falkor funded by Schmidt Ocean Institute during which very high resolution multibeam data over 11 carbonate drowned banks on the south Texas shelf was collected. He is currently working with the data to understand the origin, evolution and demise of these banks. He is also working on a parallel project to understand the evolution of Male Island, Maldives through high resolution multibeam data. Furthermore, in his third project he is utilizing drone imagery to build 3D outcrop models to quantitatively and qualitatively analyze some Upper Cambrian microbial reefs from Mason, Texas. He has also worked with Chevron, Statoil, and TGS as a summer intern over the past summers. Over the past few years Pankaj has also been the TA for sequence stratigraphy and carbonate courses at Rice.

During his stay at Rice he has been awarded with the BP Rice Fellowship 2013 and Departmental service award in 2016. He also won the first prize and second prize in the poster competition at IRESS 2016 and 2014. Additionally he was also invited to give a talk at IRESS 2015. At AAPG Student Expo Houston 2016, he won the first prize in the poster competition. He also won 2nd prize at SEPM Carbonate meeting Photo contest in 2015. Pankaj was also nominated to be a part of the headquarters committee of SEPM and he currently holds the position for the 2016-17 session. He has always been involved with various student groups at Rice which include AAPG Student Chapter President, President of ISAR (Indian Students at Rice), Vice President of the AAPG Student Chapter, Boxing Club and Rice Cricket Club.

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Steven L. Getz
Wavefront Inc.

Oil and Gas Plays in Mesozoic and Tertiary Carbonates Deposited in Southwestern Europe and Northern Africa Near the Mediterranean Sea

On a regional basis, large to world-class giant oil and gas fields have been discovered in Triassic through Miocene-aged carbonates deposited along the ancestral Mesozoic continental margins of southwestern Europe and northern Africa (**Figure 1**). Proceeding in a clockwise manner around the areas proximal to the Mediterranean Sea from southwestern France, these significant fields are represented by:

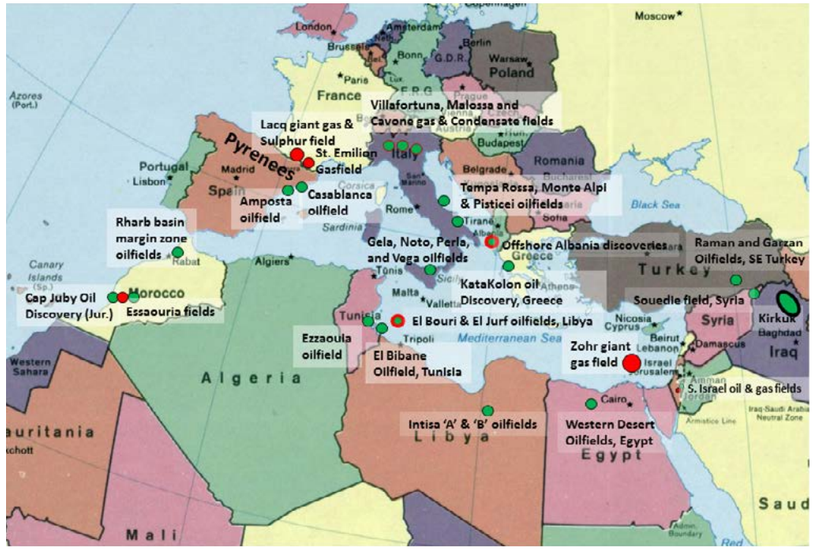


Figure 1. *Some of the key oil and gas fields and recent HC discoveries pooled in Mesozoic and Tertiary carbonates in the vicinity of the Mediterranean Sea.*

1. Lacq world-class giant gas-condensate and sulfur field (EUR 8.9 TCFG, 29 MMBO, and tons of sulfur) and Mellion-Fault gas field (EUR 2.0 TCFG), pooled in Jura-Cretaceous carbonates deposited along the southwestern (stable flank) margin of the Parentis basin foredeep just north of the Pyrenean fold thrust belt that separates France from Spain;
2. Casablanca oilfield (EUR> 170 MMBO of 33-degree API paraffinic, low sulfur crude), pooled in karsted Lower Cretaceous carbonates deposited offshore Spain. This field resides in a tilted fault block proximal to the southeastern flank of the Iberian (Pyrenean) collisional margin;
3. Maloosa >1 TCFG oil gas-condensate field pooled in carbonates of Upper Triassic, Jurassic (Lower, Middle and Upper) and Lower Cretaceous age in Po Valley, northern Italy. Maloosa is one of several large gas-condensate fields pooled in north-verging and south-verging hanging-wall anticlines in opposing fold-thrust belts that border Po valley;
4. Gela, Perla & Vega oilfields of Sicily, also pooled in thrust-faulted hanging-wall blocks;
5. Zohr giant gas field (EUR of 22 to 27 TCFG), which is primarily pooled in salt-sealed Oligo-Miocene (pre-Messinan) carbonates deposited as a reef atoll on a Mesozoic high in Egyptian waters seaward of the Nile delta cone. This reef atoll may have been formed from a Mesozoic fringing reef that grew along the southern flank of the Erosthenes microcontinent upon which the Mediterranean island of Cyprus now rests (**Figure 2**);
6. Intisar 'A' through 'L' oil fields pooled in Eo-Paleocene pinnacle reef carbonates (total EUR of 2,054 MMBO

HGS International Dinner *continued on page 26*

HGS International Dinner continued from page 25

respectively). These pinnacle reefs grew in post-rift sediments deposited in the Agedabia Trough in the prolific Sirte basin aulocogen of Libya.

Although some of the Gulf of Suez oilfields in eastern Egypt contain small to medium-sized oil accumulations (20 to >100 BOE) pooled in Eocene Thebes formation and older carbonates, the primary hydrocarbon pools in this province reside in older sandstone units. Whereas, to the west in Egypt's Western Desert, small to large oil and gas accumulations are pooled in Alamein formation dolomites of Aptian age.

Even further to the west along the Northwest African continental margin, medium to large-sized fields have been discovered in shallow Mediterranean waters just north of Libya and Tunisia (e.g., El Bouri oilfield, offshore Libya, and El Bibane oilfield offshore Tunisia, respectfully). Small to medium oil and gas pools have also been discovered in Mesozoic carbonate reservoirs in Morocco. Specifically, small oil and gas fields have been discovered in Morocco that are pooled in: 1) Jurassic carbonates below the pre-Tertiary basal foreland basin unconformity in the PreRif fold thrust belt bordering the Rharb basin of northern Morocco (e.g., Boudraa and Tselfat small oilfields; 2) Jurassic carbonates in the Essaouira basin, which flanks the Laramide-aged Atlas Mountain inversion area (e.g., Kechoula and Jeer gas fields, as well as the Sidi Rhalem oilfield of Morocco); 3) Cap Juby Jurassic carbonates, wherein medium to high API oil shows were logged in middle Jurassic shelf margin carbonates and low API gravity oil shows were logged in Late Jurassic shelf margin carbonates (**Figure 1**). Recent geochemical analyses of these oils suggest they were sourced by Jurassic sediments with possible contributions from mid-Cretaceous sediments.

Further to the south along the western Atlantic Ocean margin of Africa, recent offshore oil and gas discoveries have been made by the Cairn Group (Senegal) and Kosmos Oil (Mauritania and Senegal) from 2014 through 2016. However, these hydrocarbon discoveries are primarily pooled in Cenomanian and Albian deep water slope sandstones. These hydrocarbons were probably sourced by Turonian, Cenomanian, and Albian shales with possible contributions from Liassic shales and marls. To date, the only large oil pool discovered near the west African Senegalese promontory resides in Oligocene carbonates (tempestites?) deposited over the crests of Dome Flore and Gea salt domes located seventy kilometers offshore near the Senegal and Guinea Bissau boundary. This oilfield complex, which resides in fifty meters of water, contains an estimated 800 MMB barrels of heavy oil in place. Thirteen wells have been drilled into these domal closures, several of which penetrated 10-13 API heavy oil deposits in reservoirs 20-35 meters thick. But, two of these wells found much smaller pools filled with 30-35 API light oil.

Medium gravity oil shows have been logged in eroded Neocomian carbonates drilled near the karsted crests of the Rufisque dome and the SNE anticline south of the Dakar High in offshore Senegal waters. Gas shows were logged in Ndiass-1, which drilled back-reef Jurassic and Cretaceous carbonates deposited over the onshore area of Senegal's Dakar High, which underwent uplift in Laramide time. These oil and gas shows suggest that Mesozoic carbonate reservoirs deposited in platform interior (back-reef shelf) environments along northwest Africa could contain significant hydrocarbon reserves in structural-stratigraphic hydrocarbon traps landward of the West African continental margin, like the large to world-class giant onshore oil and gas pools in Jurassic and Cretaceous shelf carbonates (oolitic and reef debris reservoirs) along the northwestern, northern and northeastern margins of the Gulf of Mexico basin complex.

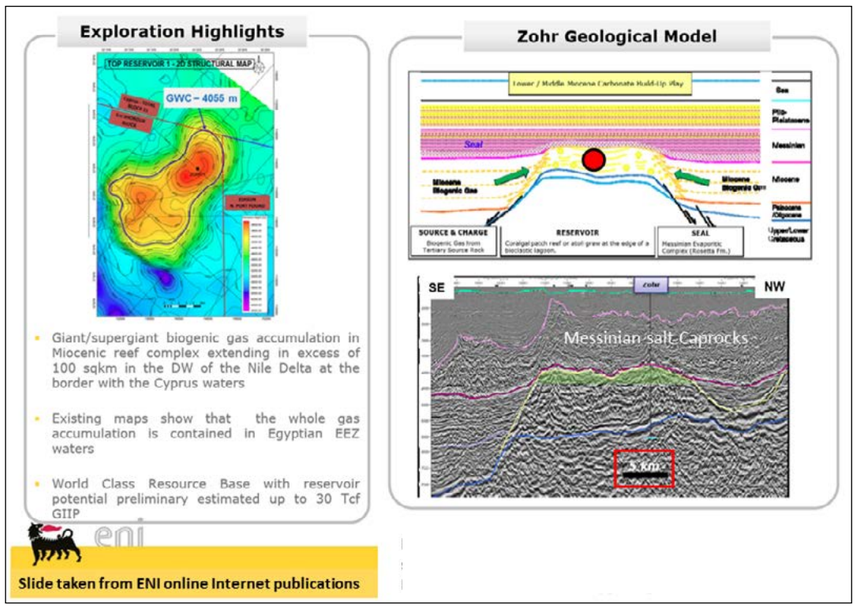


Figure 2. *Zohr gas field (EUR=22 to 27 TCFG), pooled in subsalt paleo-geomorphic trap. Main gas-producing units are Miocene atoll carbonates capped by Messinian salts.*

Rocks that sourced Circum-Mediterranean Mesozoic and Tertiary oil and gas pools include: 1) Paleozoic shales and marls (mainly Silurian) in areas where they have not been overcooked (like the Parentis basin of France); 2) Triassic marls and shales (mainly in Italian carbonate fields, such as the Po Valley gas-condensate fields onshore and nearshore Italy); 3) Jurassic marls and shales (mainly in Po Valley carbonates, Spain's Casablanca field carbonates, Egypt's Western Desert carbonates, and even Morocco's Cap Juby field carbonates); 4) Cretaceous shales (Dome Flore field in Senegal); 5) Lower Paleogene shales (in Libyan and Tunisian onshore and offshore oil and gas fields, e.g., Libya's Intisar reef fields); and, 6) Miocene shales that probably sourced the biogenic gases pooled in the Zohr field's Miocene sub-salt carbonate reservoirs deposited off Egypt's Nile River cone (**Figure 2**); as well as contiguous Miocene sandstone reservoirs in Tamar (8.4 TCFG) and Leviathan (16 TCFG) giant gas fields in the Levantine offshore. ■

Biographical Sketch

Steven L. Getz worked more than nine years as a geophysicist with Cities Service Oil Company before working as an oil and gas consultant for 26 years. From 2005 through 2010, he was the Chief Geologist for Allen Hoffman Exploration. Since 2011, he has worked as an oil and gas consultant to Fortesa International (in their onshore Senegal acreage), Petrotrin (the national oil company of Trinidad and Tobago), and is currently working for a major landowner group in Texas and Louisiana.

Mr. Getz is the current Chairman of the HGS International Group, past chairman of the HGS North American Interests Group, and chairman of the AAPG Geophysical Integration Committee. He has given three previous talks to HGS audiences and he has also served four three terms in the AAPG House of Delegates.

Wednesday, March 22, 2017

Petroleum Club of Houston • 1201 Louisiana (Total Building)
Social 11:15 a.m., Luncheon 11:30 a.m.

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

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.

If you are an Active or Associate Member who is unemployed and would like to attend this meeting, please call the HGS office for a discounted registration cost. We are also seeking members to volunteer at the registration desk for this and other events.

HGS General
Luncheon Meeting

William DeMis
Goldman Sachs

Real Global Price of Oil in the Unconventional Era

The Real Global Price of oil is the price-corrected for inflation and for exchange rate fluctuations in the value of the US dollar on global currency markets. Traditional analyses of oil prices show an inflation-corrected "real price" of oil by correcting the nominal price of oil for inflation using the US consumer price index, or the US GDP deflator. However, since the US abandoned the Bretton Woods Accord in 1971, the value of the US dollar has varied sharply on global currency markets; gaining or losing as much as 50%. OPEC countries obtain 70-90% of their revenue from oil sales that were, until recently, exclusively priced and traded in US dollars. Changes in the US dollar's value can affect OPEC's purchasing power almost as much as changes in nominal prices (DeMis, 2000). Therefore, the Real Global Price of oil is a more accurate measure of oil's value because it measure oil's value relative to the people who set the price – namely OPEC.

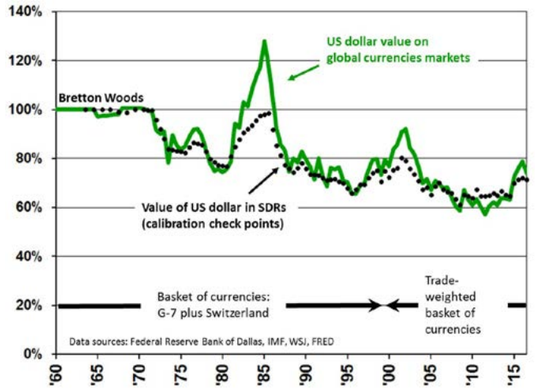


Figure 1. *Percent change in the value of the US dollar on global currency markets from 1970 base. Special Drawing Rights (SDRs), the pseudo currency of the IMF, provide a calibration. The post-Bretton Wood vicissitudes of the US dollar's value have vexed OPEC. Years when OPEC openly considered pricing oil in alternative currencies are noted. Change in data source in 2000 was made because the euro displaced many of the G-7 currencies.*

An historical analysis of the Real Global Price of oil over the OPEC era shows years when OPEC lost purchasing power by drops in the value of US dollar. When the value of the US was low, the Real Global Price of oil was low (e.g., 1973, 1979, and 1995), and OPEC reacted with supply cuts, price increases, and/or calls to abandon the US dollar as the basis for pricing oil. When the Real Global Price is low enough, even non-OPEC countries collaborate with OPEC to push up nominal prices (e.g., Mexico and Norway in 1998; Russia in 2015).

From 1975 to 1985, and 2006 to 2014, oil was manifestly overpriced, as shown in a Real Global Price analysis. These two price spikes in the Real Global Price ultimately led to global over-production and a rapid decline in the nominal price of oil. Relatively lower nominal prices of today are a repeat of the late 1980s price decline. At today's nominal oil price of $52/bbl, the Real Global Price of oil falls into the 2000-2005 Real Global Price trading range. The early 2000s were a halcyon time for OPEC. Nominal oil prices were moderate (avg. $36/bbl), but OPEC had relatively strong purchasing power because the US dollar was strong, the Real Global Price of oil was high.

Gold provides a standard measure of any currency's strength and can be used to corroborate the link between the US dollar's value and oil prices (DeMis, 1996). From 1950 to 1986, gold and oil

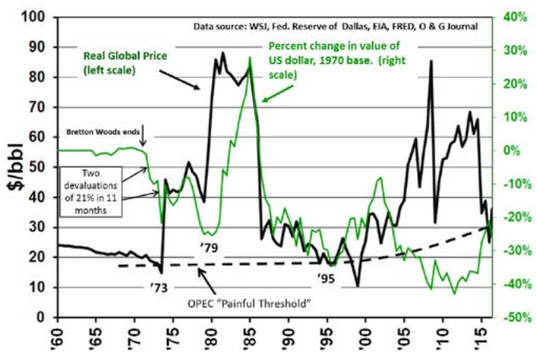


Figure 2. *Real Global Price (RGP) of Oil is corrected for inflation and for changes in the value of the US dollar. RGP floor is set by OPEC's need for purchasing power. The lower limit, the "painful threshold", rises over time because many OPEC countries have expensive social programs that are funded by their one commodity/ industry (DeMis, 2000). When supply and demand are in balance, OPEC can restrict supply to offset an eroding dollar (see, 2005 to 2014).*

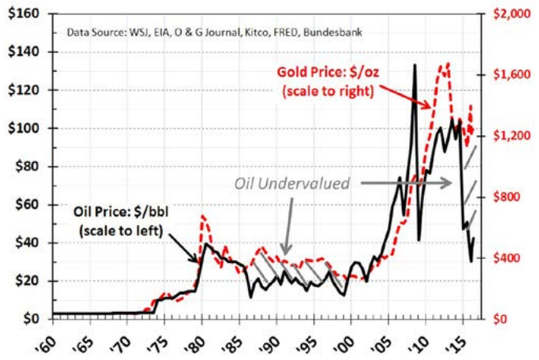


Figure 3. *Commodity analysis. Nominal price of gold and oil (not corrected for anything). Gold and oil prices usually track each other. Notable exceptions are 1986 to 2000, and 2014 to today. During these periods, oil is undervalued because of excess supply. Eventually, the gold-oil parity will return when supply and demand are in balance.*

tracked closely: one ounce of gold bought 11.5 bbls of oil. From 1986 to 1996, oil was undervalued: one ounce of gold bought 21 bbls. From 2000 thru 2005, one ounce of gold only bought 10 bbls. Today, one ounce buys 22 barrels of oil. Oil is undervalued with respect to this key commodity.

Ultimately, the price of oil is driven by market forces of supply and demand: the US dollar does not control price. The probability that in the near term nominal oil prices return to $100 per bbl is low when analyzed in an historical Real Global Price context. The probability that nominal oil prices will drop to $30/bbl is manifestly unsustainable; such low nominal prices would put the Real Global Price below 1973 and 1998 (the previous nadirs of oil's value). This Real Global Price analysis shows that in the absence of a decline in the US dollar's value, and with continued excess supply, nominal oil prices will most likely be in the $40 to $60 range for the near term; a repeat of the 2000-2005 RGP valuations. But nominal oil prices today are weak relative to gold, suggesting upward price pressure to $100 per bbl, when supply and demand come into balance.

Reference

DeMis, W. D., 1996, Historical Changes in U.S. Dollar Exchange Rates and Real Value of Oil: *AAPG Bulletin*, v. 80, issue 13, pgs. A35-A36; AAPG Search and Discovery #90019

DeMis, W.D., 2000, Historical Analysis of Real Global Price of Oil: Implications for Future Prices: *AAPG Bulletin*, v. 84, issue 13; AAPG Search and Discovery #90914

DeMis, W.D., 2007, Historical Analysis of Real Global Price of Oil: Implications for Future Prices: AAPG Search and Discovery #70037

Biographical Sketch

William DeMis is Senior Vice President & Chief Geologist for Goldman Sachs. He has 30 years of industry experience with Pennzoil, Marathon Oil Company and Southwestern Energy. He has worked domestic and international projects, and held a variety of technical and managerial positions. Mr. DeMis received his Master's Degree from The University of Texas at Austin in structural geology. He has written numerous papers on various topics in structural geology, subsurface geology and oil prices. He was awarded AAPG National Awards for his analysis of exchange rates and the Real Global Price of oil in 1996 and 2000. He has won best paper awards from the GCAGS and the PTTC/RMAG, and received the dedicated service award from the West Texas Geological Society. Mr. DeMis is an AAPG Charles Taylor Fellow and he currently serves as AAPG Books Editor and as an Associate Editor of the *AAPG Bulletin*.

Monday, March 27, 2017

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

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.

If you are an Active or Associate Member who is unemployed and would like to attend this meeting, please call the HGS office for a discounted registration cost. We are also seeking members to volunteer at the registration desk for this and other events.

Analysis of New Production Targets in the Springer Shale within the South Central Oklahoma Oil Province (SCOOP) Utilizing the Latest Digital Rock Analysis Techniques

Bryan Guzman, Tiffany Rider, Joel Walls
Ingrain Inc., Houston, TX

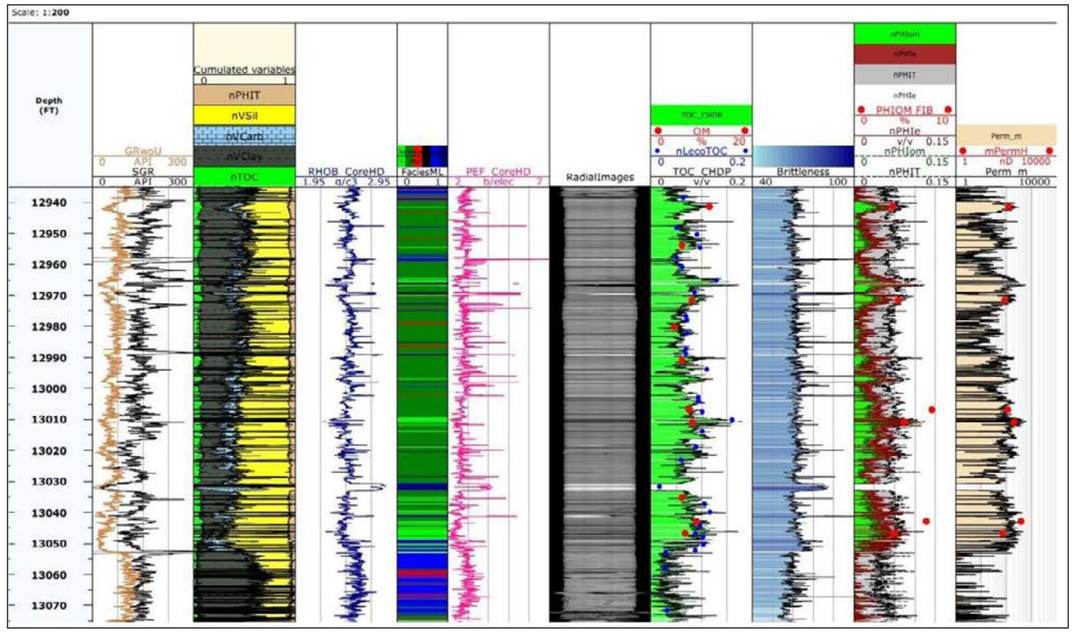


Figure 1. *Dual Energy Whole Core CT Log captured a vertical resolution of 330 microns.*

The South Central Oklahoma Oil Province (SCOOP) has been a main stay of domestic oil for decades. The Woodford shale has been a popular target within this region. Recently, new production within the younger Springer shale has caught the eye of operators. Whole core and rotary side wall core samples were recovered from this formation to undergo both physical and digital rock analysis in order to gain a better understanding of the geologic properties that are contributing to production. Both SEM and FIB-SEM volumes were acquired where porosity, porosity associated with organic matter, and permeability were computed. These data were compiled into distinct clusters based of wireline, whole core CT, and textural information at the pore scale quantified using the latest machine learning algorithms. This comparison sheds addition light on what could be another popular target within the SCOOP. ■

Biographical Sketch

Bryan Guzman received his BS in Geology from the University of Texas at San Antonio in 2008. He joined Ingrain Inc. as a Geologist where he was an integral part of the company's validation period that led to the commercial launch of Ingrain's product line. Since joining Ingrain he has worked on Digital Rock Analysis (DRA) within both complex conventional and unconventional resource plays.

For two years, he coordinated the development and application of DRA for shale drill cuttings where data is being utilized to make near real-time decisions. Presently, he is focused on the development of DRA applications for reserve estimations and production modeling within various unconventional resource plays utilizing the latest data science techniques.

He has over 9 years of experience in the utilization of DRA with patents on rock sample preparation methods involving micro computed tomography (Micro-CT) and drill cuttings methods.

Bryan is also an avid volunteer within the Houston Geological Society where he serves as a committee chairman for Exhibits and sits on the Board as the Treasurer for the 2016-2017 election year.

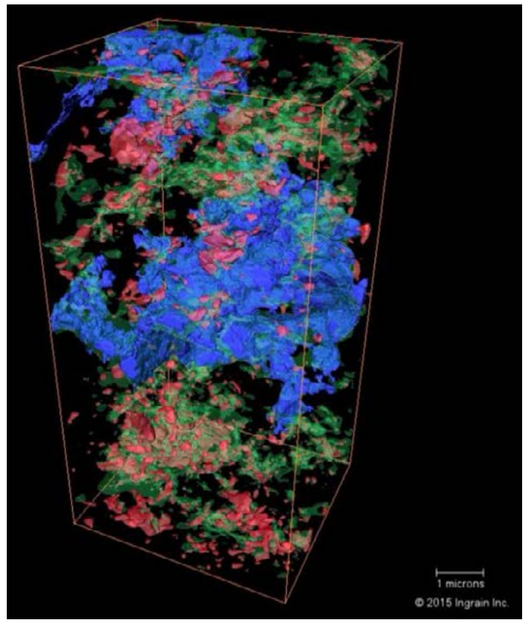


Figure 2. *3D FIB-SEM volume showing connected porosity (blue), disconnected porosity (red), and organic matter (green) at a voxel resolution of 15mm.*

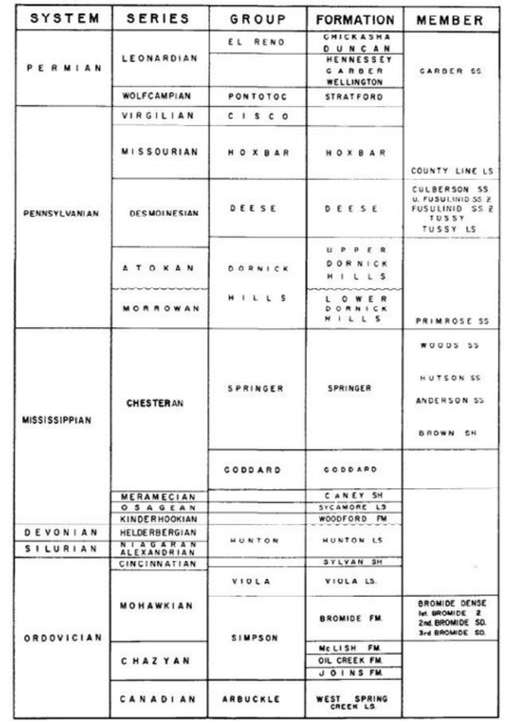


Figure 3. *Geologic Column from CArter Knox Field within the SCOOP (Reedy, J. Harold 1968)*

HGS Tennis Tournament

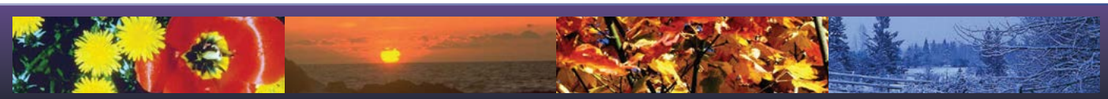
Dear Geoscientist,

Houston Geological Society is organizing a tennis tournament for its members and colleagues in the industry as a fun and active networking event during late Spring 2017. At this time we are looking for volunteers to help set up and run the event: find sponsors and vendors, decide on tennis facility, etc. Knowing the sport of tennis is a helpful but not mandatory for the tasks at hand.

Interested parties should contact Constantin Platon at platonpc@gmail.com **for more details and how to get involved. Thank you!**

HGS North American Dinner Meeting

March 2017 GeoEvents



Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Reservations: The HGS prefers that you make your reservations on-line through the HGS website at www.hgs.org. If you have no Internet access, you can e-mail office@hgs.org, or call the office at 713-463-9476. **Reservations for HGS meetings must be made or cancelled by the date shown on the HGS Website calendar, normally that is 24 hours before hand or on the last business day before the event.** If you make your reservation on the Website or by email, an email confirmation will be sent to you. If you do not receive a confirmation, check with the Webmaster@hgs.org. Once the meals are ordered and name tags and lists are prepared, no more reservations can be added even if they are sent. **No-shows will be billed.**	1	2	3 Don't wait, make your reservations online at hgs.org	4
5	6 **HGS General Dinner Meeting** *"Relationship between Reservoir Quality, Facies and Depositional Environment: Working Towards a Predictive Model for the Deepwater Wilcox," Morgan Sullivan Page 17*	7 **HGS Board Meeting** *6 p.m.* **HGS Applied Geoscience Conference** *The Woodlands, Pages 8-15*	8 **HGS Environmental & Engineering Dinner Meeting** *"Upper Cambrian Microbial Reefs, Mason, Texas: The Making of Virtual Outcrops Using Drone Imagery," Pankaj Khanna, Page 21*	9	10	11
12	13	14	15 **May 2017 Bulletin CONTENT DUE**	16	17	18
19	20 **HGS International Dinner Meeting** *"Oil and Gas Plays in Mesozoic and Tertiary Carbonates Deposited in Southwestern Europe and Northern Africa Near the Mediterranean Sea," Steven L. Getz, Page 25*	21 **HGS Northsiders Luncheon Meeting** *TBD*	22 **HGS General Luncheon Meeting** *"Real Global Price of Oil in the Unconventional Era," William DeMis Page 28*	23	24	25
26	27 **HGS North American Dinner Meeting** *"Analysis of New Production Targets in the Springer Shale within the South Central Oklahoma Oil Province (SCOOP) Utilizing the Latest Digital Rock Analysis Techniques," Bryan Guzman, Page 30*	28	29	30	31	**Members Pre-registered Prices:** Dinner Meetings members..... $45 Emeritus/Honorary members..... $40 Student members ..... $10 Nonmembers & walk-ups ..... $50 Except - Env. & Eng. ..... $30 Nonmembers & walk-ups ..... $35 Emeritus/Honorary members..... $15

March 7-8, 2017
HGS Applied Geoscience Conference

March 28, 2017
SPE Hiring Event
Houston, TX (Page 22)

April 2-5, 2017
AAPG – ACE Annual Convention & Exhibition
Houston, TX

April 21, 2017
HGS Shrimp Peel & Crawfish Boil
Bear Creek Park, Houston, Texas

April 26-28, 2017
Seapex Exploration Conference
Singapore, Asia

April 28-30, 2017
AAPG Hedberg Conference
Beijing, China

Spring 2017
HGS Tennis Tournament

August 18-22, 2017
AAPG Geosciences Technology Workshop
Astrogeology Total Solar Eclipse Field Seminar, Casper, WY

Aug 31- Sept 1, 2017
Africa Conference
London (Page 24)

November 8-9, 2017
HGS Applied Geoscience Conference
Geomechanics in Unconventionals

Getting Your Feet Wet
Earth Science Week Panther Creek Sedimentology Field Trip 2016

By Neal Immega

Setting the scene – Jerry Cobbs and Claudia Ludwig

Scott and volunteers at the junction of Panther and Spring Creeks.

Wow! We really did teach fluvial sedimentation to more than 200 Houston people at the Montgomery County Nature Preserve. We advertised it as a "walk in the park" where you could really get INTO your subject by walking the river. This year's field trip was led by HGS member, **Erik Scott**, who wrote up the great story of a place practically in our back yard. Panther Creek is really an unknown gem of a site, and now the word is out.

Earth Science Week (ESW) is a major outreach project of the Houston Geological Society. Every year, the committee organizes a local field trip so the public can gain firsthand experience in some aspect of geology. We have been to High Island, the Stone City outcrop near Bryan, and the flooded Catahoula rock quarries in Huntsville; we were ready for something new. HGS networking lead us to Erik, who knows the Panther Creek site and has written up a fantastic field guide. The latest versions of are on the HGS web site: http://www.hgs.org/committee?cmtegrp=sci&committee=Earth%20Science%20Outreach%20Committee

Beginners getting their feet wet to learn geology

You will find three versions of the downloadable guide. The full details are in the April 2016 publication called "Morphology and Sedimentology of Panther Creek, Montgomery County Preserve".

The ESW Committee sends out invitations to all the schools in the area, distributes fliers at the Houston Museum of Natural Science activities the previous week, and highlights the upcoming event in the HGS *Bulletin* and web pages. The outing attracts people of all ages – from kids in backpacks to geo-veterans. Experienced geos offer off-the-cuff short courses in fluvial sedimentation to all comers. The largest number of participants are college-level students who come at the suggestion of their professors, as many schools are no longer allowed to run field trips.

Panther Creek is quite unusual because it moves a large amount of sand. The source of much of that sand is construction and fill sites upstream. No matter, the river is usually quite accessible and user friendly. For the water-adverse visitors, there is a dry path so that they can observe from a bank. A number of visitors did ask if the big dog tracks were panthers. Both volunteers and visitors seemed to have a great time.

Many thanks to all the volunteers who made this event a success: Erik and his Rice students, as well as ESW Chair, **Sharon Choens** and the eight HGS volunteers who helped in every capacity. We had such good feedback that we are thinking of repeating this trip next year. ■

Department of Earth and Space Sciences Faculty Position Structural Geology and Neotectonics

The Department of Earth and Space Sciences, Lamar University, Beaumont, Texas is inviting applications for a tenure-track Assistant Professor to Associate position depending on qualifications. Beaumont is a community of approximately 117,000 people, located in Southeast Texas, 90 minutes from Houston and Johnson Space Center and 30 miles from the Louisiana border. Being 20 miles north of the Gulf of Mexico, southeast Texas has a balmy subtropical climate. The Department of Earth and Space Sciences engages in a breadth of research activities including geophysics, GIS, coastal processes, stratigraphy, paleontology, and planetary science. The department homes the Lamar Geospatial Center (LGC), a state-of-the art GIS center running ESRI products. The LGC also runs high-end geophysical software, including Petrel and Kingdom Suite. The Department also has membership in UNAVCO and IRIS.

We seek a person with primary interest in structural geology and neotectonics. Knowledge and experience in GIS is also highly desirable. Responsibilities include teaching structural and physical geology as well as co-teaching of field camp. Minimum qualifications include: Ph.D. degree at time of appointment, demonstrated potential to start and maintain an active research program through securing external grants, demonstrated potential to publish and otherwise disseminate results of research, and demonstrated potential to perform teaching duties. Applicants should submit a vitae or resume, names and addresses of four references who may be contacted for written evaluations, and a letter of application including a statement of the applicant's teaching and research capabilities and plans. Application materials should be sent to Human Resources, P.O. Box 11127, Lamar University, Beaumont, Texas 77710, Position Number 499697, Attn.: Dr. Joseph Kruger, Earth and Space Sciences Search Committee Chair. Review of the material will begin in February and will continue until the position is filled. Lamar University is a member of the Texas State University System and an AA/EEO Employer.

LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM

Nominations Being Accepted for the 2017 HGS Teacher of the Year Award

The Houston Geological Society (HGS) Teacher of the Year has been established to honor individuals whose extraordinary efforts or unique contributions are in earth science education. Nominations for exceptional individuals are now being accepted. The selected teacher is given a $500 cash award, along with a plaque presented at HGS President's Night. The HGS Teacher of the Year will be encouraged to apply to the GCAGS and AAPG Teacher of the Year Programs which offer greater cash bonuses ($1,500 and $5,000, respectfully).

Teacher of the Year Requirements

All applicants must adhere to the following requirements in order to be considered for the Houston Geological Society Teach of the Year Award:

- Minimum of 3 years full-time U.S. teaching experience at any K-12 level.
- Teaching at least one unit per year on natural resources. Natural resources are defined as earth materials used by civilizations past and present such as:
  - Organic materials such as petroleum, natural gas, coal and oil shale.
  - Inorganic substances found in the Earth such as mineral ores, building stone and aggregate.
  - Energy resources from the Earth such as fossil fuels, geothermal energy.
- Teaching should include the scientific study of these resources, their origin, discovery, extraction, and historic and present use. It should also include the preservation of the environment, reclamation, the conservation of resources, and the use of earth science knowledge in decision-making.

The unit will be evaluated on depth and breadth of concepts (resource origin, discovery, processing, usage, and reclamation), creativity of presentation and balanced treatment of information regarding societal need and environmental issues. Please include the length of the unit.

Application Materials

All 4 documents are required for full consideration.

1. Your teaching philosophy and methods of the teaching of natural resources (both content and pedagogy). (1-2 pages)
2. Description of the unit you teach. (1-2 pages)
3. Letter(s) of recommendation from a colleague
4. Letter(s) of recommendation from a administrator.

Submission Deadline: April 1, 2017

All Documents must be submitted to the Houston Geological Society by April 1, 2017 to ensure processing of the selected HGS and publication Teacher of the Year for the June 2017 Issue of the HGS Bulletin. Documents can be submitted as hard copy or electronically to office@hgs.org.

Hardcopies should be mailed to:
Houston Geological Society
Attn: Awards Chairman
14811 St. Mary's Lane, Suite 250
Houston, Texas 77079-2916.

Questions can be sent to Mike Deming, HGS Awards Chairman at mike.deming.HGS@gmail.com.

New HGS Office Staff Member
Jacqueline (Jacky) Jordan

HGS welcomes Jacquelyn Jordan to the staff of the HGS office. Jacky will be Content Manager for the HGS website and assist Office Manager, Andrea Peoples with member support. Her email is jajordan@hgs.org. She is from Houston, and has attended Houston Community College and University of Houston. Jacky is the daughter of HGS members John and Dawne Jordan. Her interests are rock collecting, bicycling, baking, and cooking (she has studied to be a pastry chef). Her favorite companion is "George", a Maltese-Yorkie small dog.

Goose Creek Oil Field, Harris County, Texas
First Offshore Texas Oil Production (1917)

By Jeff Spencer, *GCAGS Historian*
spencerj320@gmail.com, https://petroleumhistoryblog.com/

Goose Creek oil field is located in Harris County, Texas, approximately 25 miles east of downtown Houston. Oil was discovered at Goose Creek in 1908, but in 1916 multi-thousand barrel per day oil gushers brought attention to the area. Drilling progressed from the onshore banks of Goose Creek and the shoreline of Tabbs Bay, to the bay's islands, and then into the shallow waters of Tabbs and Black Duck bays. The field experienced a tremendous jump in oil production from approximately 600 thousand barrels of oil in 1916, to 7.7 million barrels in 1917, and peaked at 8.9 million barrels in 1918. This increased production was partially due to the expansion of the drilling into the offshore.

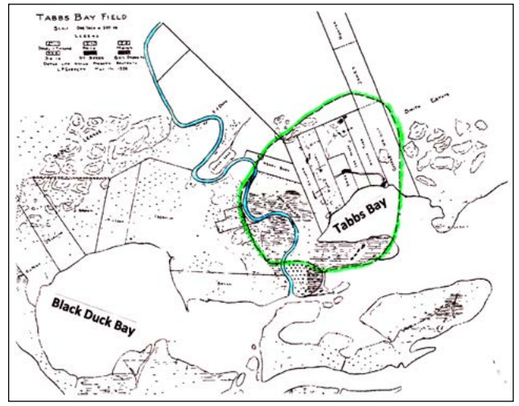


Figure 1

Many "firsts" occurred at Goose Creek, including the first offshore drilling along the Texas coast (1917), the first test of a 2-cone drilling bit (1909), and perhaps the first comprehensive study of land subsidence linked to oil, gas, and water production (1926), (Spencer 2013). Several scenes from the movie Hellfighters (1969) were filmed in and around Goose Creek (Spencer 2014). Over 1500 wells have been drilled in the field and cumulative production exceeds 150 million barrels of oil.

Early United States Over-Water Drilling

Over-water drilling in the United States occurred as early as 1891 in Grand Lake, Ohio (Sneed 2005), also known as Grand Reservoir, Lake Celina, or Grand Lake-St. Marys. In 1896, a pier was constructed 300 feet out into the Pacific Ocean in California and a mounted standard cable-tool rig began drilling. The following year, oil production from the Summerland field began. Fourteen additional piers were constructed and many more wells were drilled and completed. Caddo Lake, Louisiana had that state's first over-water drilling in 1911 with the Gulf Refining No. 1 Ferry Lake, claimed incorrectly on a historical marker as the "world's first over-water oil well." In Gulf Oil Company's 50th anniversary book (Thompson 1951; p. 33), the claim as the "first over-water drilling in the country, and probably the world" is also made for Gulf's Caddo Lake drilling.

Offshore Production at Goose Creek

The *Baytown Sun* (February 28, 1956) with the headline, *Plain old kitchen match found Goose Creek Field*, reported that in 1905, Royal Matthews of LaPorte, Texas and local landowner John Gaillard rowed out into Goose Creek where Matthews lit a match to some bubbles which burst into flames. Fishermen as early as 1906 reported gas bubbling in the waters of Tabbs Bay.

L.P. Garrett (1880-1943) was a geologist from 1903-1908 with the Rio Bravo Oil Company, a subsidiary of Southern Pacific Railroad. In 1908, Garrett became the first geologist hired by the J.M. Guffey Petroleum Company, which had become part of the Gulf Oil Corporation the previous year. In his early years as a geologist, he was involved in the search for salt domes along the Texas-Louisiana Gulf coast.

In 1907 while at Rio Bravo, Garrett published an internal report on Goose Creek (Minor 1925); this report included a map with an outline indicating "probable area of production", encompassing both onshore acreage and part of Tabbs Bay (**Figure 1**). Minor commented that Garrett's outline, based on paraffin beds and gas seeps, "coincides very closely with the field as it exists today."

Drilling progressed from land locations to the banks of Goose Creek (**Figure 2**), across the shoreline of Tabbs Bay to the Bay's

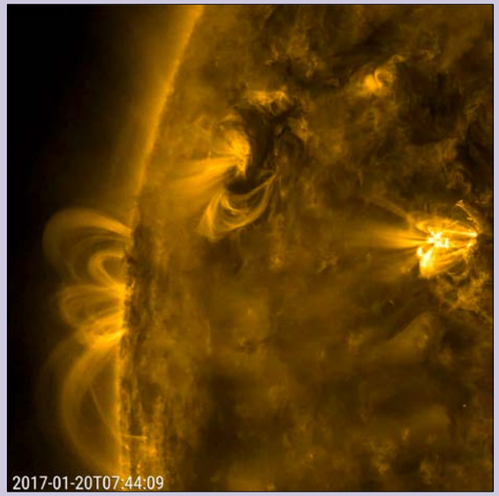
Goose Creek Oil Field *continued on page 41*

Figure 2

About the Cover

About the Cover – PIA11703: Gyrating Active Region

The Solar Dynamics Observatory (SDO) is the first mission to be launched for NASA's Living With a Star (LWS) Program, a program designed to understand the causes of solar variability and its impacts on Earth. SDO is designed to help us understand the Sun's influence on Earth and Near-Earth space by studying the solar atmosphere on small scales of space and time and in many wavelengths simultaneously.



SDO launched on February 11, 2010, 10:23 am EST on an Atlas V from SLC 41 from Cape Canaveral.

A close-up video of a small area of the sun highlighted three active regions, but the one in the center caught our attention the most (Jan. 20, 2017). Over half a day this active region sent dark swirls of plasma and bright magnetic arches twisting and turning above it. All the activity in the three areas was driven by competing magnetic forces. The dynamic action was observed in a wavelength of extreme ultraviolet light.

SDO is managed by NASA's Goddard Space Flight Center, Greenbelt, Maryland, for NASA's Science Mission Directorate, Washington. Its Atmosphere Imaging Assembly was built by the Lockheed Martin Solar Astrophysics Laboratory (LMSAL), Palo Alto, California.

Image Credit: NASA/GSFC/Solar Dynamics Observatory; Image provided Courtesy NASA/JPL-Caltech

Goose Creek Oil Field continued from page 39

islands including Spillman's, Atkinson's, and Hog Island (*Houston Post*, July 22, 1917). The building of wooden piers into the Bay for drill sites was not reported as anything innovative or a "first" for Texas, probably because Gulf had similar operations in Louisiana's Caddo Lake since 1911. Searching through company histories and Texas newspapers, it is not clear which well was the first offshore well in Tabbs or Black Duck bays, or even which company drilled it. The *Houston Post* (April 22, 1917) reported on the Gulf Production Company's No. 4 Beaumont Petroleum coming in as "a gasser with some oil and sand" and that the well was "out in the bay." By mid-1917, wells operated by both Gulf and Humble were drilling in the two bays.

Figure 3

According to *Larson's History* (Larson 1959; p. 433), the company's first offshore Goose Creek drilling in 1917 is mentioned in only one sentence, which places the drilling in Black Duck Bay. Humble Oil acquired a 200 acre lease in Black Duck Bay in February, 1917 as part of a package of acreage the company purchased from the Houston Goose Creek and Houston Deep Well companies for $720,000 (*Houston Post*, February 15, 1917).

Several newspaper articles from the summer of 1917 would suggest that the first oil gusher in Tabbs Bay was the Gulf Production Company No. 4 Stateland, drilled 200 feet out in the bay. The *Houston Post* (July 30, 1917) reported that the well came in with an estimated flow of 8,000 to 12,000 BOPD and "is the third producing well brought in by the Gulf Production Company in Tabbs Bay. No other companies have finished wells in the bay as yet."

The impact on Texas state revenues with the discovery of oil in Tabbs Bay was reported in the *Bakersfield Californian* (August 29, 1917). The state had leased "practically all of the area of the bay to different oil operators on the basis of one-eighth royalty." One producing oil well alone was "bringing to the state daily revenue of $1,600" and there was "room for probably 100 wells." A promotional advertisement by the Gal-Tex Oil Company in the *Houston Post* (August 19, 1917) identified this well as Gulf's No. 4 Stateland and stated that the $1600 per day royalty "has paid for the salaries of the governor, lieutenant governor and several other State officials, and it has been flowing only 10 days."

The Brookshire (TX) Times (October 26, 1917) described another impressive well drilled in Tabbs Bay. With the headline, B*ig gasser in bay now producing oil* the article read, "*After blowing out sixteen joints of drill stem from the hole, the Humble Oil and Refining Company's No. 1 Beaumont Petroleum, out in Tabb's Bay at Goose Creek, changed from a gas well to an oil producer Friday and is now producing at the rate of about 8,000 barrels, according to officials of the company. The well was drilling at about 2,850 feet in sand when it blew out Friday morning. It began making gas, running wild, as such a rate that it could be heard at La Porte (3 miles southwest). One report from Goose Creek was to the effect that the well made considerable sand during Friday afternoon. When it blew out, the drill stem was shot through the crown block and the derrick damaged. No one was injured, however.*"

By 1919, several wells were drilled on wooden piers in Tabbs Bay. **Figure 3** is a portion of a 1919 panoramic photograph taken by well-known Houston photographer, Frank J. Schlueter (1874-1972). Schlueter's photographs, including many of Goose Creek and other Texas Gulf Coast oil fields, can be viewed at http://digital.houstonlibrary.org/cdm/landingpage/collection/schlueter. Other photographs of the Goose Creek oil field can be viewed in Spencer (2013b; p. 40-47).

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HGS Grand Canyon Field Trip

You are invited to join us as the HGS will once again be offering its Grand Canyon field trip in Summer 2018. This very special "Journey Through Time" will weave the impressive geologic story of the Canyon (with other natural sciences on display), the human history, plus the thrills of running many exciting rapids of the Colorado River.

We will float the River on motorized rafts, providing us the opportunity to see and discuss all the classic geology so beautifully portrayed – from some of the earliest Precambrian sediments found in the US, all the way up to modern processes which continue to shape the canyon. Geological concepts are introduced and magnificently illustrated in the Canyon in such a way that the geology comes alive for everyone. In addition to running rapids, we will take a number of short hikes in some of the many side creeks, eat like royalty, and sleep under the stars. Your river guides and gear are supplied by Hatch River Expeditions (Hatch), one of the most experienced outfitters serving the Grand Canyon. Past participants have stated this was the best geologic trip they ever took and many have brought one or more of their family along to share this incredible experience with them.

While this is not an overly strenuous trip, participants must be in good enough physical condition to climb in and out of the rafts. We will enjoy some hiking each day, the longest being six miles, and several hikes require some scrambling. While any of the hikes will be at your pleasure, I encourage you to take as many as you are comfortable doing to fully experience this extraordinary trip.

The trip begins in Las Vegas on June 3, 2018. We provide transportation from there to Marble Canyon by way of Zion National Park for an opportunity to view the geology. Also included are the first night in Cliff Dwellers Lodge, food and drink for our 8 days/7 nights on the river, a helicopter ride to Bar 10 Ranch the last day, and the flight from there back to Las Vegas. Costs not covered include round-trip airfare to Las Vegas, first night's dinner and breakfast in Marble Canyon, tips for our river guides, souvenirs purchased at Phantom Ranch or Bar 10 Ranch, and anything you might spend in Vegas should you decide to extend on either end. Optionally, you may join us in Marble Canyon and Hatch will arrange a return flight to there at the end.

Dates: June 3 – 11, 2018
Cost: $3600 / person
Reserve your spot now on the HGS website with a $500 deposit; the balance due is by December 15, 2017.

Reserve your spot now on the HGS website with a $500 deposit; the balance due is by December 15, 2017. *Please read the HGS's refund policy before booking your trip.* ■

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.*

The Texas Legislature is now in session. To see which bills are of interest to Texas Geologists, go to the Wise Report: https://www.hgs.org/multimedia_WiseReport

AGI Geoscience Policy Monthly Review (November 2016)

International Energy Agency Releases 2016 World Energy Outlook

The International Energy Agency (IEA) released its 2016 World Energy Outlook (http://www.iea.org/bookshop/720-World_Energy_Outlook_2016) on November 18, 2016. This report outlines current world energy usage trends and projections through 2040. In addition to the publication, Dr. Fatih Birol, Executive Director for the IEA, gave a presentation on the potential impacts the Paris Climate Agreement could have on the world's energy outlook over the next 25 years.

Current world energy predictions from the IEA show that natural gas consumption is expected to increase by 50 percent by 2040, eventually overtaking coal as the leading energy source worldwide. In addition, the IEA report attributes the 37 percent increase in global energy production to the renewable energy sector, largely due to China's rapid adoption of renewable energy technologies. For example, in 2015 China installed 32.5 gigawatts of wind power and 18.3 gigawatts of solar power infrastructure nationwide. Conversely, the report projects that global oil consumption will decline in the vehicle sector, while continuing to make gains in the maritime, aviation, petrochemical, and freight industries.

During his presentation, Dr. Birol stated that reaching the Paris Agreement's goal of restricting world temperature increases to fewer than 2 degrees Celsius would require global greenhouse gas emissions to peak in 2020, and for the world to reach net zero emissions by 2100. The more ambitious goal set by the Paris Agreement to keep temperature increases below 1.5 degrees Celsius would require even more regulation. In order to achieve this, Dr. Birol stated that all global power systems would have to produce zero emissions, and all transportation systems would have to run on electric energy, by 2040.

Dr. Birol expressed that while the Paris Agreement is an important move toward a cleaner global energy portfolio, it does not contain any legally binding incentives to carry out its specified actions. Dr. Birol stated that the next steps for the global energy sector "depend entirely on the coming policy actions."

BOEM Mid-Atlantic Regional Planning Body Submits Ocean Action Plan

The Bureau of Ocean Energy Management's (BOEM) Mid-Atlantic Regional Planning Body (MidA RPB) submitted its Mid-Atlantic Regional Ocean Action Plan to the National Ocean Council for certification on November 3. The MidA RPB Action Plan is part of an ongoing effort to fulfill the National Ocean Policy Implementation Plan established by the Obama Administration in 2010.

The plan addresses key ocean challenges and establishes nine regional planning bodies, including the MidA RPB. Objectives set forth by the MidA RPB Action Plan include continued protection of ocean ecosystems off the coasts of Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia. The plan includes engagement with stakeholders for undersea critical infrastructure interests, such as submarine cables and pipelines, and acts to enhance support for ocean research and monitoring. The plan promotes sustainable fishing practices through enhanced collaboration between federal, state, and tribal entities as well as various fishery management councils.

The Mid-Atlantic Regional Planning Body (MidA RPB) submitted the Mid-Atlantic Regional Ocean Action Plan to the National Ocean Council for certification, as stated in the November 2016 Federal Register notice. On December 7, 2016, the NOC announced through the White House blog that the Plan has been certified and the MidA RPB will begin implementation.

USGS Announces Grant Program to Support National Groundwater Monitoring Network

The U.S. Geological Survey (USGS) has announced a new grant program that will award up to $2 million in cooperative agreements for new state and local water resource agencies participating in the National Groundwater Monitoring Network (NGWMN). The funds will be used to provide groundwater data to the NGWMN, a cooperative network between the USGS and the Federal Advisory Committee on Water Information's (ACWI) Subcommittee on Ground Water (SOGW) that helps manage and monitor national groundwater.

Government Update *continued on page 44*

Government Update continued from page 43

Under the agreements, new data providers are required to identify and classify groundwater sites that are currently being monitored, and to establish web services that will connect these new data sources to the existing NGWMN portal. The awardees are then required to draft a summary of how they implemented the connection process.

EESI Holds Briefing on future Environmental Actions to be Taken in China

The Environmental and Energy Study Institute (EESI) held a briefing to address the actions China plans to be taken to achieve its goals under the Paris Climate Agreement.

The speakers highlighted external pressures, such as the high carbon cap expectations of other ratifying nations, and internal pressures, such as China's increasing air pollution, as reasons the Chinese government ultimately decided to enact new climate change policies.

Jiansheng Qu, Director of the Scientific Information Center for Resources and Environment at the Chinese Academy of Sciences, provided a comprehensive overview of China's Household Carbon Emissions (HCEs) and outlined China's primary environmental targets for the next five years. China aims to reduce its emissions per its gross domestic product (GDP) to 40-45 percent of the 2015 value by 2020 and to 60-65 percent of the 2005 value by 2030. China plans to increase the ratio of non-fossil fuel energy to other energy sources by 15 percent by 2020 and 20 percent by 2030 and to commence the operation of a national carbon trading system by 2017.

Linling Mu, Secretary General at the Tianjin Green Supply Chain Association, discussed the complexities of a national emissions trading system. Mu outlined China's Green Supply Chain policy pilot program. This pilot program led to the establishment of governmental regulations to promote environmentally friendly carbon trading activities within Tianjin. Mu detailed the Tianjin Province's Climate Exchange, a domestic carbon cap-and-trade program, which encourages companies to reduce their carbon footprint for financial gain by pricing carbon and placing limits on carbon emissions.

Department of the Interior Passes Methane Emission Reduction Rule, Faces Lawsuit

November 15, 2016 – The Department of the Interior (DOI) released a final rule to cut methane emissions from oil and gas operations on federal and tribal lands. According to Secretary of the Interior Sally Jewel, the goal of the Methane and Waste Prevention Rule is to reduce "harmful methane emissions that contribute to climate change" through economically viable actions.

The rule requires oil and gas companies to incorporate modern technologies into infrastructure planning that will reduce methane flaring events. The rule also requires companies to carry out periodic inspections of equipment for leaks and establishes limits to oil and gas storage tank venting. The rule lists guidelines on royalty amounts to be paid by operators exhibiting excessive methane gas flaring. These rates vary and can total up to, and in excess of, 12.5 percent of the production value of oil and gas at that particular site.

The Western Energy Alliance (WEA) and the Independent Petroleum Association of America have responded negatively to the new rule: the two organizations filed a lawsuit against the Bureau of Land Management in the U.S. District Court for Wyoming. The lawsuit claims that the rule is an "unlawful and unconstitutional agency action," on the basis that Congress previously delegated the authority to regulate air quality to the Environmental Protection Agency. The states of Wyoming and Montana have also leveled a lawsuit against DOI for the same reason.

While a hearing date has yet to be announced, WEA has submitted a preliminary injunction to stop the rule from being implemented in the meantime.

Sources: Department of the Interior, Montana Department of Justice, Western Energy Alliance

White House Releases Mid-Century Deep Decarbonization Strategy

November 16, 2016 – The White House released its Mid-Century Strategy for Deep Decarbonization, which identifies key actions the United States must take to reduce its carbon footprint by 2050.

The impetus for the report came last March when the White House released at joint press release detailing its commitment with Canada to fulfill the climate goals set forth by the Paris Agreement.

Actions proposed within the report include, investing in energy-efficient technologies, altering the electricity system by improving transmission systems and electricity storage, and adopting clean energy and low carbon fuels for transportation infrastructure, buildings, and the industrial sector. To facilitate these goals, the federal government will expand state and local carbon emission policies and provide incentives for carbon dioxide removal technologies.

The report also notes the importance of sequestering carbon through proper forest and soil management. A balance between biomass storage and critical land use priorities suggested in the report could support those practices. Artificial carbon dioxide removal technologies such as Bioenergy Plus Carbon Capture and Storage (BECCS) are also noted as worthwhile investments to reduce our country's carbon footprint.

Non-CO_2 emissions, such as methane and nitrous oxide, are targeted in the proposed strategy through regulatory policies, technological advances, and updated agricultural practice guidelines.

The Mid-Century Strategy for Deep Decarbonization is set to be implemented over the next 34 years.

NASA and FEMA Hold Asteroid Emergency Planning Exercise in El Segundo, California

NASA and the Federal Emergency Management Agency (FEMA) hosted an asteroid emergency planning exercise on October 25 in El Segundo, California. The exercise centered on a hypothetical event, in which an asteroid discovered in 2016 would hit southern California in 2020.

Government Update *continued on page 46*

Government Update continued from page 45

The scenario presented a unique challenge for emergency managers, who typically plan for higher-probability events, such as wildfires and floods, with much less lead time. Because the public knew four years ahead that an asteroid was going to strike, emergency managers faced many challenges fielding public responses and media reports as communities awaited their doom. NASA researchers also faced challenges during the exercise, as they attempted to calculate the location and radius of the asteroid, as well as the damage it would cause.

The exercise was the third in a series of asteroid hazard workshops that were developed to foster collaboration between NASA and FEMA under the NASA's recently established Planetary Defense Coordination Office. A previous exercise held in Houston in 2013 focused on a scenario in which NASA attempted to stop an asteroid impact by deflecting it using spacecraft designed to change the object's course via direct impact.

National Academy of Sciences Hosts Cascadia Subduction Zone Panel

On November 10, 2016, the National Academy of Sciences (NAS) hosted a panel discussion on the Cascadia Subduction Zone (CSZ) and its potential for large scale fault rupture. Research from a number of academic institutions has suggested that such a rupture is capable of producing a magnitude-9.0 earthquake and subsequent tsunami, which could devastate coastal regions of Washington, Oregon, northern California, and British Columbia. The NAS event was separated into three panels and ended with a discussion on preparedness, response, and mitigation techniques for a potential earthquake.

Panelists from the Geological Survey of Canada (GSC), the U.S. Geological Survey (USGS), and the Federal Emergency Management Agency (FEMA) discussed the need for better monitoring and risk assessment tools in case of a CSZ earthquake. Dr. Kelin Wang, a research scientist with GSC, outlined the benefits of installing geodetic and seismic sensors on the seafloor along the coast from British Columbia to northern California to help determine the possibility of a CSZ earthquake. Dr. Joan Gomberg, a research geophysicist with the USGS, outlined methods that more accurately quantify risk from natural hazards. She also mentioned the importance of agency partnerships that disseminate information and warning messages ahead of these risks. The final panel highlighted the progress of FEMA's risk assessment mapping in Oregon, which now covers eleven coastal counties.

The NAS event ended with a discussion of the Tsunami Warning, Education, and Research Act (H.R.34), and the National Earthquake Hazards Reduction Program (NEHRP), which both provide research and funding for natural hazard mitigation.

Secretary of the Interior Presents Plan to Block Future Mining Outside Yellowstone

Secretary of the Interior, Sally Jewell, announced a plan to block mining development outside of Yellowstone National Park. Under this plan, 30,000 acres of public land north of Yellowstone is subject to a two-year restriction on mining claims while a permanent ban is considered.

Secretary Jewell has voiced her support for the rule as an effort to analyze the environmental impacts of mining to the area's natural resources and ecosystems. The plan aims to limit the negative impacts that mineral resource extraction and development may have on local watershed, wildlife, and tourism economies. Secretary Jewell stated that although mining is important in many areas, "the doorstep of Yellowstone National Park [should] not be one of them."

The mining industry has greeted the plan with criticism. A spokesman from Canadian mining firm, Lucky Minerals, states that these regulations can lead to investors reconsidering local mineral exploration opportunities, which will in turn negatively affect local economies.

The protection will not limit current or future mining efforts based on pre-existing contracts. Any contracts approved before the plan's implementation will continue to mine local gold and other minerals. The decision is subject to a 90-day public comment period that ends on February 21, 2017. ■

HGS Welcomes New Members

New Members Effective January 2017

ACTIVE MEMBERS

Anisa Ahmadzai
Rodrigo Bastidas
Roxanna Bush
Hunter Carr
Paul Credo
Hisataka Inoue
Kimberley Kuijper
Shira Paulson
Lance Pawlik
Aaron Salin
Jiang Zhang
Jeffrey Fulco

EMERITUS MEMBER

Carol Lucas

STUDENT MEMBERS

Chia-Jui Chang
Shenelle Gomez
Shawntell Graham
Toluwani Soares
Jonathan Tipton
Daniel Villanueva
Yuxiang Zhang

Welcome New Members

Remembrance

Gail Bloomer
1934-2017

Dr. Gail Bloomer (1934-2017) passed away January 12, 2017 due to pneumonia contracted while undergoing cancer treatments. Gail was born in Kingston, NY and grew up primarily in New Paltz, NY. Gail earned his Bachelor's degree in Geology from the University of Arizona, and his Masters and PhD in Geology from Harvard University. From 1956-60, he served in the US Air Force as a Russian interpreter. His career researching, developing, managing, and executing technical projects and studies in the oil and gas industry spanned over 50 years, including positions at Oasis Oil (Libya), College of the Virgin Islands, Gulf Oil, Kerr-McGee, and various independent consulting and advisory posts. He was a member of Sigma Xi, AAPG, SPE, and HGS.

Gail is survived by his wife of 54 years, Lyne Hanania Bloomer, and daughters Dina and Carolyn.

Published in *Houston Chronicle* on Jan. 15, 2017

Remembrance

Calvin Chimene
1927-2016

Calvin Alphonse Chimene, 89, passed away on Friday, December 23, 2016. He leaves behind his three sons, J.B., Andre, and Beau, and eight grandchildren, Daniel, Gabrielle, David, Zachary, Beverly, Cooper, Coby, and Daisy. His first wife, Katie Allen Chimene, and his second wife, Ann Carol, both preceded him in death.

The son of Julius and Fannie Chimene, Calvin grew up in Houston's Third Ward and later in West University, where he went to Lamar High School. He attended the University of Texas at age 17, then left to join the US Army for World War II. After serving in the occupation of Japan, he returned to the University of Texas where he graduated with a Bachelor of Science degree in Geology. He then attended the University of Houston, where he acquired a Master of Science degree in Geology with a minor in Physics. He was selected as a member of the SGE, the national geology honors fraternity.

Some of Calvin's papers on exploration have been published in articles by *The Oil & Gas Journal*, other Exploration periodicals, the *Journal of Sedimentary Petrology and Paleontology*, and two separate Memoirs of the American Association of Petroleum Geologists. He has lectured extensively at AAPG conventions, Houston Geological Society, and meetings of the Houston Mesozoic Geologists Group. He was selected to present one of his papers during the World Geological Congress in Washington DC, 1989. His Master's Thesis in 1952 was the first one published from the University of Houston by any outside publishing company. He worked in the corporate world for 33 years, rising to the position of VP in charge of domestic exploration for hydrocarbons of a large American corporation, heading a staff of roughly 100. Retired in 1985, he formed a family corporation to carry on his interests in oil and gas exploration and raising pecans. He began writing fiction in 1988 and has published three volumes of short stories and one novel. He was also an artist, creating charcoal drawings of fossils. Calvin played handball and table tennis into his eighties, and won several medals in competition at the local Senior Olympics.

Revised publication from *Houston Chronicle* on Jan. 1, 2017

Remembrance

Remembrance

Douglas Burton Dunn
March 22, 1930 - December 13, 2016

Douglas Burton "Burt" Dunn, 86, died December 13, 2016, in Houston, Texas. He was born March 22, 1930, in Montreal, Quebec, Canada, to Howard Sidney and Audrey Pearl Dunn. Early in life he played hockey and football. He studied geology on a hockey scholarship at the University of Michigan and played on two NCAA national championship teams. He began his career as an exploration geologist with Gulf Oil in Western Canada. His career progressed with Huber Oil, then Cayuga Oil, which brought him to Houston, Texas from Calgary in 1975. He later worked for Coral Petroleum before becoming an independent geologist, advising on exploration prospects into his early 80s. He was an active member of the American Association of Petroleum Geologist, Houston Geological Society and the Petroleum Club of Houston. He is survived by his wife, Marjorie Louise Whitten Dunn, whom he married June 4, 1960; one son, Douglas "Brad" Dunn of Houston, Texas; two daughters, Catherine Louise "Cathy" Williams of Austin, Texas and Patti JoAnne Grote of Madison; one brother, Donald Dunn; one sister, Jean Elliot; and eight grandchildren. He was preceded in death by his parents; and one sister, Elaine Dunn Hanna.

Revised publication from AP news https://www.apnews.com/2a2a334baa334484aed7d63c487132d2

Remembrance

Remembrance

Ronald Wade Harlan
August 24,1938 – December 22, 2016

Ronald (Ron) Wade Harlan left this world December 22, 2016 to be with his parents Ada and William Harlan; his sister, Patricia; and brother, William. He is survived by his wife, the love of his life, Dorothy, of 56 years, his children: Angela, Heather and Tearle and his seven grandchildren of whom he was most proud. He will be remembered as a loving husband, father and grandfather.

Ron was also very proud of his accomplishments as an Exploration Geologist in the Oil and Gas Industry starting with Texaco in 1968 to his retirement from Western Atlas E&P in 2003, and as president of Exron Independent Oil Co. until is death.

Ron graduated from Baytown Lee High School in 1956 where he was Captain of the football team. He played football for the University of Houston where he completed his BS and MS in Geology and was honored as the Outstanding Student of the Year. He earned his PhD in Geology from Texas A&M in 1966. He then proceeded to fulfill his military obligations, attaining the rank of Captain in the Army Corp of Engineers where he studied the feasibility of the nuclear construction of shipping canals in Panama and Columbia.

After serving his country, Ron returned to the Texas Oil Patch where he worked as a Texaco Research Geologist in Bellaire, using geochemical exploration in the GOM. At Exxon, as frontier Geophysicist, exploring the Gulf of Alaska and Nova Scotia. As an Explorationist at Oxy, Ron generated the Arenosa Prospect resulting in the discovery of 200BCFG at El Toro Grande Field, Jackson Co., Texas. As an Exploration Manager at BHP Petroleum, Ron's team led in several significant discoveries, such as: Bonne Terre Field (220 BCFG), McMullen Co., Tx. and Ewing Bank Blk 988 Field (28MMBO) GOM. At Western Atlas, Ron participated in the formation of a JV with Marathon Oil and Apache Oil companies leading to several discoveries, including Camden Hills, MC 348. Ron was also involved with HGS, serving as VP and President from 1985-1990.

Ron Harlan had a long-term relationship with the Gulf of Mexico, as a scientist, a well-respected Manager and a record of significant oil and gas discoveries. Your leadership, kindness and friendship will be sorely missed, Ron, but most of all that winning smile of yours!

Written by Bill Lefler

Remembrance

Marvin Lyle Smith
1925-2016

Marvin Lyle Smith (91), dedicated HGS and AAPG House of Delegates member, passed away December 31, 2016. Marvin volunteered at the HGS Booth at many AAPG and GCAGS conventions promoting HGS membership. Geologists recognized Marvin for his long service in the oil and gas business starting at Shell Oil, and later at Hamill Resources.

Marvin Smith graduated from the University of Rochester with a BS and MS in Geology and Civil Engineering. He began his career as a petroleum geologist with Shell Oil Company. His first assignment was surface mapping in Colorado followed by relocations to San Antonio, Corpus Christi and Houston where he worked as a subsurface geologist for the exploration department. In 1965 he resigned from Shell, where he had served as District Manager and Offshore Manager, to become an independent consultant. Marvin spent the majority of his consulting time with Hamill Resources (an independent oil and gas company) where he served the company as it grew to more than 500 productive wells. Marvin was a member of the American Association of Petroleum Geologists, American Institute of Professional Geologists, Society of Independent Earth Scientists, Paleontological Society, Houston Geological Society, Gulf Coast Association of Geological Societies and the Society of Sigma Xi.

Smith was born in Tampa, Florida, to Lee Smith and Gladis Roland on July 24, 1925. He graduated high school from Florida Military Academy, in St. Petersburg, Florida, in 1943, where he was on a full sports scholarship playing: football, basketball, baseball and riflery. He joined the United States Navy after high school. His naval training began in Bainbridge, MD, followed by communications training in Sampson, NY. In 1944, he was transferred to the Pacific Theater where he served from Australia to Alaska. While touring the Pacific Ocean his main duty was communications trouble shooting on a variety of naval vessels. As with any war, communications during WWII was extremely vital between U.S. ships as well as of upmost importance in intercepting enemy messages.

Marvin Smith served on the National Boy Scout Board and was a Life Member of the Sam Houston Area Council Executive Board. He served on the National Catholic Committee on Scouting and was National Chair from 1986-1989. Marvin was humbled to receive the Silver Buffalo award, which is the highest national honor bestowed on a member of the Boy Scouts of America. He credits the scouts for his love of God, country, and family. Marvin loved God, family and country and was proceeded in death by his precious wife, Geraldine Gilligan Smith. After losing his sweetheart of many years, Marvin married Winona LaBrant in 1998.

Please make donations in Marvin Smith's name to NCCS Boy Scouts of America.
Attn: NCCS-Emmett J. Doerr Memorial Scout Scholarship, P.O. Box 152079, Irving, TX 75015-2079 or Sam Houston Area Council, BOY SCOUTS OF AMERICA, 2225 North Loop West, P.O. Box 924528 Houston, Texas 77008. Condolences may be offered at www.earthmanbellaire.com.

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http://www.legacy.com/obituaries/houstonchronicle/obituary.aspx?pid=183276816

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 hard copy 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.

HGS *Bulletin* Advertising

The *Bulletin* is printed digitally using InDesign. Call the HGS office for availability of ad space and for digital guidelines and necessary forms or email ads@hgs.org. Advertising is accepted on a space-available basis. **Deadline for submitting material is 6 weeks prior to the first of the month in which the ad appears.**

Random Inside Ad Placement Black & White Prices Shown – Color add 30% to prices below					**Specific Page Color Ad Placement**					
No. of Issues	Random Eighth Page	Random Quarter Page	Random Half Page	Random Full Page	Inside Front Cover Full Page	Inside Back Cover Full Page	Page 2 Full Page	Outside Back Cover Half Page	Back of Calendar Full Page	Calendar Quarter Page
10	$950	$1,350	$2,550	$4,750	$8,000	$7,500	$7,050	$6,850	$6,650	$3,000
9	$800	$1,300	$2,500	$4,700						
8	$750	$1,250	$2,250	$4,300						
7	$600	$1,100	$2,200	$3,850						
6	$550	$950	$1,800	$3,500						$2,000
5	$500	$800	$1,600	$3,000	$4,700	$4,500	$4,350	$4,000		
4	$450	$650	$1,300	$2,500						
3	$300	$550	$950	$2,000						$1,000
2	$250	$400	$700	$1,500						
1	$150	$250	$450	$1,000	$1,500	$1,400	$1,250	$1,000	$1,250	$850
Professional Directory Section Business Card Ad: 10 Issues – $160 ($30 for each additional name on same card)										

Website Advertising Opportunities

There are currently 5 opportunities to help spread the word about your business or event and generate traffic to your website or campaign. Please submit all ad materials five (5) days prior to the go-live date for testing.

Placement	Rate	Specifications/Description
HGS Website Home Page Banner Ad	$800 – Monthly $1600 – 3 Months $2000 – 6 Months $3000 – 12 Months	275 x 875 pixels; home page top banner ad. All Home Page Banner Ads rotate every 10 seconds.
HGS Website Home Page Column Ad	$700 – Monthly $1400 – 3 Months $1800 – 6 Months $2800 – 12 Months	200 x 400 pixels; home page right column ad
HGS Website Event Page Ad	$600 – Monthly $1200 – 3 Months $1600 – 6 Months $2600 – 12 Months	200 x 400 pixels; calendar page left column ad. All Event Page Ads rotate every 10 seconds.
Geo-Jobs	$50 – 14 days $100 – 30 days $350 – 3 Months $650 – 6 Months $1300 – 12 Months	Posting of job opportunities on HGS website. Click the Geo-Jobs tab to get started. Must be filled out completed and the dates set appropriately.
Vendor Corner	$250 *4 Pack option available. Send request to vendorcorner@hgs.org.	Company logo, company website, and company description will be highlighted on HGS Calendar website event. This is an opportunity to display company wares, gain personnel exposure and hand out product information at HGS dinner meetings.
Bundle & Save!	• 30% off website ads when combined with print ads in all 10 HGS *Bulletin* issues. • 20% off website ads when combined with print ads in 5 HGS *Bulletin* issues. • 10% off website ads when combined with print ads in 3 *Bulletin* issues.	

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 q Active or q Associate membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws. q 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 ❑ North American E&P (other than Gulf Coast)

❑ International E&P ❑ 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

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