HGS Bulletin

Volume 66, Number 2

Houston Geological Society

OCTOBER 2023

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HGS Executive Office Director	Andrea Peoples	713-463-9476	andrea@hgs.org	

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In Every Issue

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About the Cover: Buffalo Bayou leads to innovation. Photo by Rick Wachtman, September 2023.

Technical Meetings

Features

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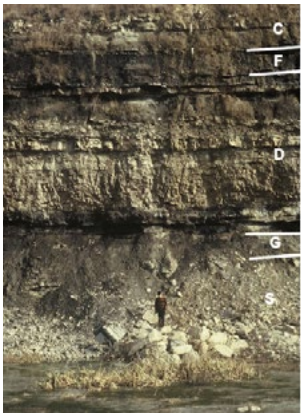

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INSTRUCTIONS TO AUTHORS

Materials are due by the first of the month for consideration to appear in the next month's publication. Submissions should be emailed to editor@hgs.org. The Editor reserves the right to reject submissions or defer submissions for future editions.

Text should be submitted as a Word file. Figures or photos may be embedded in the document or submitted separately. The following image formats are accepted: tif, .jpg, .png, .psd, .pdf.

Feature submissions, e.g., Rock Record, should be approximately 600 words. Technical papers should be approximately 2000 words or less (excluding references).

HGS CELEBRATES 100 YEARS

Houston Petroleum Club

Saturday October 7

Join HGS Past Presidents and Board members to toast the Houston Geological Society's celebration of 100 years of service 1923-2023

The evening will include fine dining created by the chefs of the Petroleum Club, social hour bar service, commemorative items, and showing off the Special 100th Anniversary Bulletin issue (Chief Editor Craig Dingler). The evening hosts will be HGS President Paul Britt, Past Presidents Charles and Linda Sternbach (100th Anniversary Committee co-chairs), Dick Bishop, and Jeff Lund.

Featured HGS speakers will present a historical review over the past 25 years (1998-2023), slideshows, video reels, audience participation, laughter, and fun stories. There will be prizes and audience participation!

We look forward to a beautiful meal, a champagne toast, and a fabulous dessert! As the sun sets over downtown Houston, guests will glimpse the city at dusk out of the Petroleum Club windows and imagine the new chapters in the story of the Houston Geological Society.

Contact Jeff Lund for Sponsorship Oopportunities.

Corporate sponsors at the Gold (10K), Silver (5K), and Bronze (2K) include tickets to the event. Personal sponsorships at the Faithful Friends ($100), Benefactor ($500), and Founder ($1,000) levels include printing the sponsors in an honor roll in the HGS *Bulletin*.

HGS 100th Anniversary Gala Sponsorship Opportunities

All levels receive recognition at the event (verbal, in the program, and signage), on HGS website, and with the recap in the HGS Bulletin.
Please submit company logo (jpg) for recognition

GOLD $10,000
Includes a table for 8 with tickets

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Includes a half table with 4 tickets

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Tickets are not included at this level

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The Year is Off to a Great Start

September marks the start of the HGS event year and also marks the start of a busy season of HGS activity including ChairFest, the Student Expo and dinner meetings for the General section and the Environmental and Engineering group. At the General Dinner, in addition to the usual attendees, there were ten students from Sam Houston State along with their faculty advisor, Dr. Pat Harris. The students were generously sponsored by Star Creek Energy. HGS brought back the General Lunch meeting at the Downtown Petroleum Club for the first time since February 2020. Members have expressed the desire to have in-person meetings, and the numbers are beginning to reflect that success.

I cannot underscore enough the value of in-person social media.

The **Student Expo**, chaired by Amanda Johnston, **was a remarkable two-day event that involved over 250 students** and included 97 recruiters from 24 sponsoring companies. It was an opportunity for students and recent graduates to connect with employers in face-to-face interviews. Read more about this Flagship event later in this edition of the Bulletin.

DON'T DROP FROM THE MEMBERSHIP ROLES

As it is every year around this time, the membership renewals are finalizing, and non-renewing members will be dropped from the membership rolls shortly. As in previous years, that number is a bit disconcerting. Hopefully, the renewals will continue, as they typically do, in the coming months. One thing being considered, and *I would like to hear from members regarding this*, is to shift the dues renewal date from the current fiscal year to the calendar year, beginning with January 2024. Several proposals for its implementation will be reviewed, and it could require a Bylaws change.

CHANGE TO THE HGS OFFICE SPACE

On the horizon this fiscal year is a potential office change. The lease for the present office expires this spring, and an ad hoc committee has been formed to look at alternative office locations and situations. Everything from a virtual office to a much smaller space is being considered, and towards that end, much of the office furniture and items may come up for sale to members. *If any member's company has office space to sublet, please contact me directly.*

JOIN US IN-PERSON

When I moved to Houston in 1978, I knew only a handful of people. I made lasting friendships and business connections through the Houston Geological Society that have persisted throughout my career, and transcended the companies for whom I worked. These connections were made in-person, because there was no internet, no social media, and no virtual meetings when I joined the HGS in the 1980's. All networking was done through in-person activities. I do participate in social media and virtual meetings. I have been meeting with clients via Teams, Zoom and other online meeting services since about 2005 and almost exclusively since 2016, but the lasting associations are still made through in-person contact. All of my consulting business has come through referrals from those friends and associates that I have met along the way. I cannot underscore enough the value of *in-person social media*. I encourage all of you to do the same. See you next month, and in-between, I hope. ■

OCTOBER EVENTS

Registration is open for the **HGS 100th Anniversary Gala,** that will be held on Saturday, October 7th at the Downtown Petroleum Club of Houston. This is a once-in-a-century event, so please consider coming! Guests are welcome and encouraged.

The **Golf Tournament** is being held at the Sterling Country Club in northwest Houston on Monday, October 16th. Space is available for singles, foursomes, and sponsors. Join me there!

Learn more about Carbon Capture, Utilization, and Storage at a **Lunch and Learn** hosted by Premier Corex on October 11.

Friday, October 20th is a virtual half-day **HGS short course** on *Applied Understanding for Geoscientists of How Engineers Calculate Reservoir Oil and Gas Volumes Using PVT*.

And of course, the **General Dinner** will be held on October 16th, the **E&E Dinner** will be held on October 11th, and a virtual **General Luncheon** is scheduled for Wednesday, October 25th. We look forward to your participation.

HGS Bulletin Art Contest
Geology is Beautiful 2023

Geology is beautiful! The Houston Geological Society invites you to submit your original photo or original artwork to the 2023 HGS *Bulletin* Art Contest for an opportunity to have your work featured on the cover of the HGS *Bulletin*, on the HGS website, and at selected HGS meetings.

KEY DETAILS

- Must be original photos or original artwork
- Include a title and a short description of the image (100-500 words)
- Open to HGS members and non-members
- Enter your submission by email to editor@hgs.org; use one of these formats: jpeg, jpg, png, pdf; portrait orientation is preferred
- Submissions accepted September 1, 2023 – December 1, 2023. Contest closes on midnight Central Standard Time.
- Maximum of one entry per person per category

> **Categories**

(1) Geologically interesting landscapes
(2) Rocks up-close and personal
(3) Energy

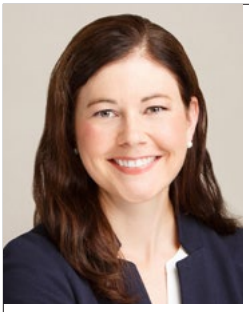
CONTEST RULES

- Submissions should be the original work of the submitter. No third party may own or control any materials the photo/art contains, and the photo/art must not infringe upon the trademark, copyright, moral rights, intellectual rights, or rights of privacy of any entity or person.
- Photos must be in its original state and cannot be altered in any way, including but not limited to removing, adding, reversing, or distorting subjects within the frame.
- No AI generated images.
- The following digital formats are accepted: jpeg, jpg, png, pdf. Digital files will not be returned to the submitter.
- Submissions should exclude images of people, unless the person is being used for scale and the person submits written permission for their image to be included in the contest.
- Entries will not be accepted unless submitted via the official contest channel. Entries not submitted through the proper channel will be deleted.
- By entering the contest, entrants agree that photos/art submitted can be used by the HGS for the *Bulletin*, website, on social media, or at meetings.
- The HGS Board reserves the right to change the category of the submission, if the submission does not appropriately match the category as submitted.
- Entries will be judged by the HGS board. All decisions are final.
- The HGS Board reserves the right to disqualify any entry that is deemed inappropriate or does not conform to stated contest rules.
- Violators will be removed from the contest, stripped of any prize(s), and banned from entering future contests.

Link to submission form: https://forms.gle/3uZ1ZFV1SCr9wirq6

Or Scan the QR Code

MEMBER SUPPLIED PHOTOS FEATURED ON PAST BULLETIN COVERS



Caroline Wachtman
editor@hgs.org

Geology, Startups, and Innovation

Innovation is a key part of the energy industry and geologists are natural innovators. I was reminded of this in the summer of 2021 when I served as an Executive in Residence with the Rice Alliance Clean Energy Accelerator (CEA). The CEA was founded to support startup companies working on innovative solutions to decarbonization and energy efficiency. After more than 15 years in oil and gas, I had strong understanding of the policies and procedures needed to run a company, but I lacked any experience in starting up a company. My role was to mentor, but I approached the opportunity as a student. The experience of working with founders was transformational. It changed my view on the role geologists can and should play in energy innovation.

It changed my view on the role geologists can and should play in energy innovation

One of the first lessons I learned is that startups are not small businesses. While small businesses have a known business model, startup companies need to find or create a business model. It's the difference between producing hydrogen using steam methane reformers v. starting a company that produces hydrogen from biological and geological processes, like Cemvita that you can read about later in this *Bulletin*. The second critical lesson I learned was that a structured scientific method approach to solving technical problems could also be applied to a startup: ask questions of the marketplace, test hypotheses about market needs, and refine or pivot the business model. Geologists are trained in this skill set and are well-positioned to lead startups from concept to established business model.

Perhaps the most transformational part of the Rice CEA was learning about the breadth of innovations in the energy industry. There are dozens of companies working on problems such as transforming waste heat (e.g., from compressor stations) to power, repurposing aging oil and gas wells to generate electricity or store energy, and improving efficiency while reducing emissions from oil and gas infrastructure. I have been trained throughout my career to seek continuous improvement for known processes and procedures, but it was enlightening to envision entirely novel processes and procedures.

I've continued to be an informal mentor to startup founders over the past two years and continue to learn from them. Without exception, the founders I work with are passionate about solving energy challenges. Many have left high-paying corporate jobs to pursue their startups. They have invested their savings, moved long distances, and left behind income stability. Similar to the statistics for economic success of oil and gas exploration wells, only about 10% of these startups will flourish. However, all the ideas and technology development contribute to a more sustainable energy future.

READ MORE ABOUT GEOLOGY AND INNOVATION IN THIS ISSUE

- The article *Geologists at the Forefront of Energy Innovation* provides a perspective on the status of energy innovation in Houston and profiles three sets of geologist innovators whose companies have developed innovative energy technologies grounded in geoscience principles.
- You can read the story of John Jeffers pivot from 30+ years as an oil and gas leader to starting up an energy innovation company in *Pivot Profile*. His experience highlights the skills that geologists need to excel in starting up a company.
- Steve Schutter's history of *Sequence Stratigraphy: From Cyclothems to Seismic Stratigraphy* highlights the innovations of geologists who envisioned new ideas, new methods, and new technologies for interpreting stratigraphic data.
- The profile of Howard Kiatta in *We Are The HGS* highlights lessons learned from innovative geologist George Mitchell and explores how innovation has changed the way geologists work over the past 50 years of oil and gas exploration.
- Finally, a critical component to an effective startup or small business is having the right legal framework in place. You can read tips for starting up an LLC in the article with contributions from Adam Curley, Penny Patterson, and Paul Britt. ■

Please share your thoughts on the HGS by filling out the survey at this link: https://forms.gle/sjZb6HqrkGdyLENY8, or by accessing the QR code

We Are The HGS

Howard Kiatta HGS member since 1967

Howard Kiatta loves being a geologist, and after 60+ years in business, he shows no signs of giving up his love. Now in his late 80's, Kiatta routinely commutes to his downtown Houston office to manage interest positions, serve on the Board of Strand Energy, L.C., and occasionally evaluate prospects. His passion for geology and a realistic view of the risks associated with oil and gas deals has kept Kiatta in business through multiple downturns over the past six decades.

"Keep going and always have something else to turn to," says Kiatta of how he has weathered the cyclic nature of the oil and gas business. Similar to how a geologist might have multiple monitors and workstations today, Kiatta describes how he would always have four different work surfaces in his office: a desk for paperwork, two drafting tables, and a long worktable for laying out data for multiple prospects. "It's such a risky business that you have to work on multiple things. If one doesn't pan out you can turn to the next one," says Kiatta.

Much has panned out for Kiatta over his career that began working for Texaco in New Orleans in 1960. He soon realized that a smaller company would be a better fit for him, and he took the opportunity to work for George Mitchell of Mitchell Energy Corporation in 1967. Over the next 10 years Mitchell was both an employer and mentor to Kiatta, teaching him lessons on how to run an oil business and how to approach life. "George inspired us to do the impossible," says Kiatta, who learned, "Persistence, hard work, and faith in a project will take you a long way."

In 1977, Kiatta set up his own shop as an independent geologist, and he has been "putting deals together" ever since. He has primarily focused on southeast Texas and was mindful to work in areas that would not complete with his former employer, Mitchell. Kiatta's model has been to raise exploration capital from industry investors and build trust with those investors by allowing off-ramps at key exploration milestones.

Kiatta credits the HGS for fostering networking opportunities that allowed him make contacts that led to exchanges of technical information and ideas. In addition to supporting the networking mission of HGS, Kiatta has been instrumental in supporting special publications, including Typical Oil and Gas Fields of Southeast Texas, Volume II, that was produced between 1984 and 1987. He also facilitated creation of 3-D Seismic Case Histories from the Gulf Coast Basin, a collection of 28 papers first published in 1998.

Although geologists joining the oil and gas business today face some of the same challenges he faced over his career, there are new challenges, too. Kiatta notes that technology has allowed companies to do more with fewer employees. Additionally, shale plays require different skills sets than conventional plays, and it can be challenging to convince companies that unconventional assets are not just engineering problems. Furthermore, Kiatta recognizes that many students don't see a long-term future in fossil fuels.

The advice that has shaped his own 60+ year career is still relevant to a new generation of geologists. "Be ready to adapt to change and have an innate love of geology," quips Kiatta. As he reflects on his career, Kiatta says he is proud that he adapted his skill set to include 3D seismic interpretation and also adapted his business model to include unconventional opportunities. ■

Gordon Start HGS member since 2004

Gordon Start is a retired geologist who is passionate about encouraging educational outreach. He volunteers as a geology instructor at Philmont Scout Ranch in New Mexico. "They give me a place to stay, three meals a day, and all I have to do is talk about geology," laughs Start. His interest in volunteering is rooted in own experiences of learning about geology as a young person. He notes that volunteers can have a profound impact on the career trajectory for students, even if the interaction may seem insignificant.

Start got his start as a geologist working for the USGS in 1976, while he was also attending college. He continued to work for the USGS as a graduate student before joining Exxon in 1985. Over the next 35 years, he conducted research on worldwide sedimentary basins, taught training courses, and led field trips for Exxon (later ExxonMobil) Upstream Research Company. Publishing was one the of professional lessons he learned during his career. Start describes that publishing builds professional recognition and is a critical tool for record keeping.

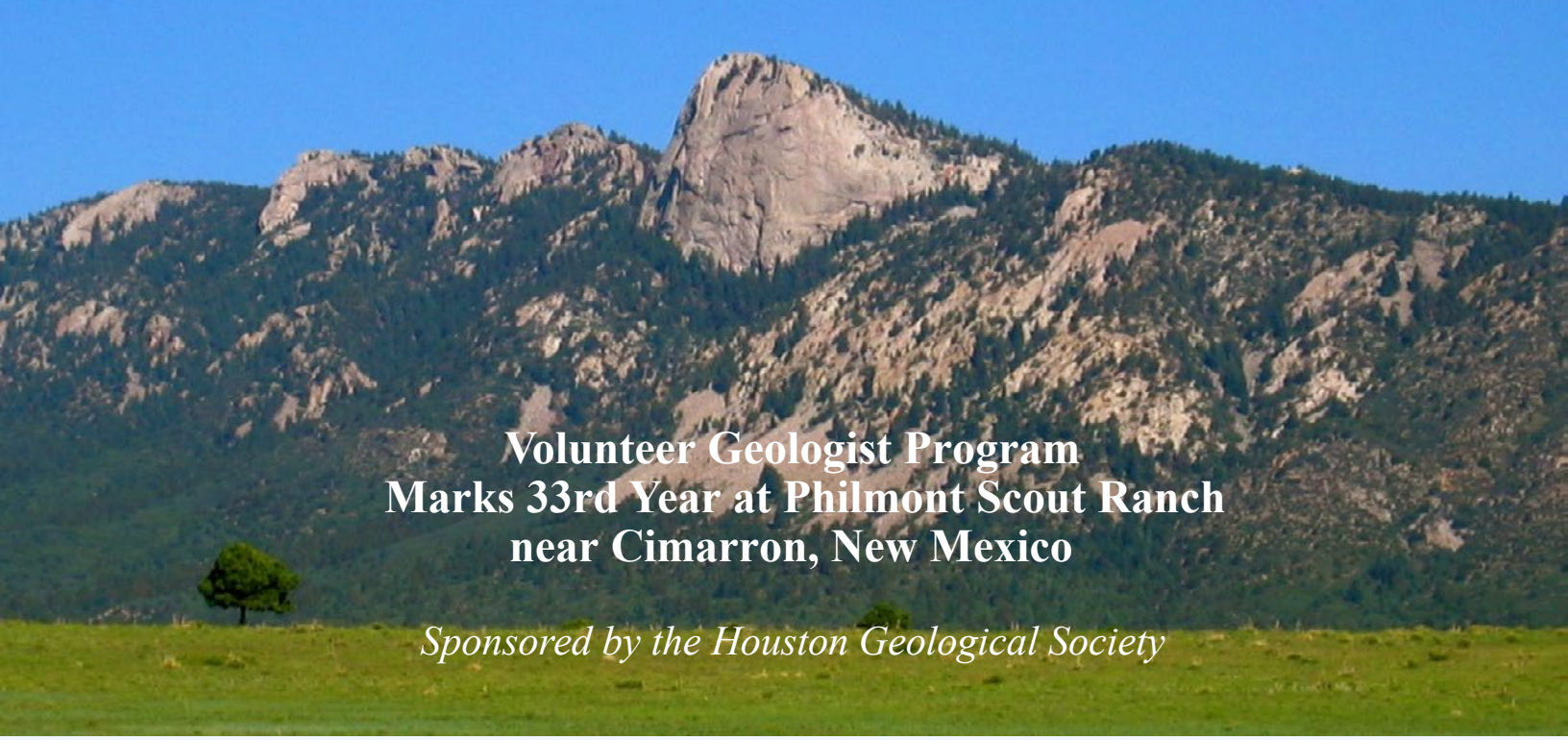
We Are The HGS *continued on page 11*

We Are The HGS continued from page 10

Start initially joined the HGS in 2004, but found that work obligations and the location of meetings limited his participation. He re-instated his membership in 2020 and says he enjoyed attending virtual events during the period of COVID-19 lockdown. Start encourages the HGS to bring back virtual options. He also encourages the HGS to deliver more content on local geology, such as local faulting or fossil occurrences. Additionally, Start encourages geologists to publish their work externally (including in the HGS Bulletin!) as a way to gain professional recognition and keep a record of work.

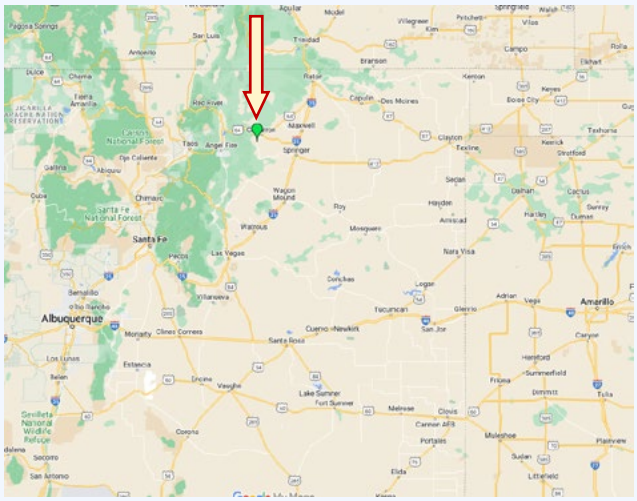
Throughout his professional career, Start says he was "always very interested in field geology," and in volunteering with Boy Scouts. The first item on his bucket list after retirement was to go to Philmont for the summer. Start would love to introduce more Houston-area geologists to volunteering at Philmont Scout Ranch. See page 12 this publication for additional details.

We Are The HGS is a series that highlights the careers and contributions of HGS members with the intention of building community. Would you like to be featured in We Are The HGS? Send a note to editor@hgs.org.



Volunteer Geologist Program Marks 33rd Year at Philmont Scout Ranch near Cimarron, New Mexico

Sponsored by the Houston Geological Society



Map of northeast New Mexico with Philmont Scout Ranch

Philmont Scout Ranch Map in northeast New Mexico

Philmont Scout Ranch is one of three national high-adventure bases owned and operated by the Boy Scouts of America. Located in the southern Sangre de Cristo Mountains of northern New Mexico, Philmont is a 140,000-acre ranch dedicated to outdoor activities. The twelve-, nine-, and seven-day backpacking experience serves more than 27,000 high-school-age boys and girls from all of the USA as well as several foreign countries. Learn more about the geology of the area at: https://pubs.er.usgs.gov/publication/pp505

Fifty-four volunteer positions are open each year, to be filled on a first-come, first-served basis. Volunteers will receive a sign-up packet with scout applications (you have to be register with BSA, at least for the summer!), medical forms, and brochures before summer (usually May). Students who would like to volunteer must show proof of enrollment in a graduate-level program. The 2024 season begins on Saturday, 10 June; the last week of the program begins on Saturday, 5 August.

For more information and to sign up, contact: Gordon Start, 5202 Caversham, Houston, Texas, 77096, USA (713.349.0542, cell: 832.725.8918), ggstart1020@yahoo.com. Alternate contact: David O'Neill, Philmont Scout Ranch, 17 Deer Run Road, Cimarron, New Mexico, 87714, (575.376.2281), david.oneill@scouting.org

Volunteer to Teach and Demonstrate Area Geology in Back-Country New Mexico the Summer!

Pivot Profile
John Jeffers on Geology, Innovation, and Revolution

By Caroline Wachtman

John Jeffers ducks into a conference room on a quiet afternoon at Greentown Labs in Houston's Innovation District. As a co-founder of Revolution Turbines and a mentor to other Energy innovation start-ups, Jeffers is immersed in Houston's innovation scene. Jeffers' pivot to full-time innovator and company founder came after a career spanning 30+ years and including Mobil, Schlumberger, and Southwestern Energy. Jeffers says that he has always been interested in innovation and always looked for opportunities to bring innovative technologies, business processes, and mindsets into his work as a geologist and global subsurface leader.

Mobil hired Jeffers in 1988 at the bottom of the oil price crash as a production geologist in the Gulf of Mexico. Jeffers says he used this experience to "learn the nuts and bolts" of geology and then spent the next 10+ years, learning how his technical work fit into a broader business context. Jeffers chose to move to Schlumberger at the time of Exxon and Mobil merger, and helped the company innovate on their business service model, soon becoming a global subsurface leader. In 2009, Jeffers moved to Southwestern Energy as a subsurface manager and innovation leader, spending much of his time evaluating external technologies. It was during this role that Jeffers says he "recognized how much impact some of these start-up companies can have." In 2020, Jeffers decided to pivot and focus full-time on the innovation side of the energy business.

spend time discovering the people who can give you personal and professional guidance

"Geologists can and should be successful innovators," says Jeffers, and he credits his geoscience background to learning an innovation skill set. Jeffers says, "Geology teaches you to have a systematic approach to managing risky things, and start-ups are an awful lot like frontier exploration and appraisal projects. Only about one in ten succeeds commercially, and the secret is to quickly and inexpensively learn which ones are worth investing development capital." Jeffers explains that a geologist starts with an idea, collects data, learns from the data, and then refines a hypothesis. The same mindset is used for start-ups, but with the added context of testing whether the product works and whether anyone would want to buy it. The start-ups who are most successful, "Begin with the end in mind, and make sure they are solving a problem that needs solving," he adds. "And keep track of what you know and what you don't know."

Jeffers advises geologists and innovators on the importance of building a professional network. He says, "You build a professional network by giving a little bit of yourself, and over time it comes back to you in unexpected ways." Jeffers emphasizes "spend time discovering the people who can give you personal and professional guidance" and the importance of "building trust and respect" with these individuals.

Through his well-developed network, Jeffers can leverage connections to venture capital, manufacturing, technology and other disciplines to support his start-up company, Revolution Turbines. Jeffers is commercializing a technology that captures the energy associated with a pressure drop in an industrial process to generate zero-emission electricity. This energy can be used to power sensors and automation systems. Revolution has recently aligned with a strategic partner who is supporting plans for a field test later this year.

You can learn more about Revolution Turbines at their website here: https://www.revolutionturbines.com. ■

Word Breccia – A Geology Word Jumble

Unscramble the words below and rearrange the circled letters to find the answer to the clue.

VIPTO _ _ O _ _ _

RUBNITE _ _ O _ _ O _

NOYGHERD _ _ _ _ _ O _ O

AOBYU _ O _ O _

HUMTIIL _ OO _ _ _ _

A geologist is a natural _ _ _ _ _ _ _ _ _

Pivot Profile is an occasional series that highlights geoscientists who have utilized their geology skills to interesting career applications. Are you interested to learn more about unique geology-inspired careers or do you have a suggestion of someone to profile? Contact me at editor@hgs.org.

The Rock Record
Owning One's Fallibilities

By Ryan Ruppert

Early in my career as a geologist at ExxonMobil, I had the opportunity to train as a reservoir connectivity specialist under some outstanding mentors. In this capacity, I assisted in deciphering static and dynamic data to describe the controls on the type and distribution of hydrocarbons encountered in well penetrations and employed these insights to improve the prediction of fluids in unpenetrated reservoirs. At the height of my specialization, I was regularly deployed as a consulting expert to company projects around the world. It was a very exciting time in my career, and I was learning a lot about the subsurface, working with people, and myself.

Part of my job was delivering training, and as time went on, I matriculated from assistant instructor to course coordinator—quickly realizing this was a much greater set of responsibilities. One particular class was originally designed by one of my predecessors and featured some really inventive work. While I was a proficient practitioner, I had not authored the content, and thus was worried if I was up to the challenge of teaching. My students were ExxonMobil geologists and engineers, some of them with impressive pedigrees, and many of them were more experienced than myself. In general, they were as brilliant a group of scientists as you could find.

One of the course exercises was complex and required entering several bits of pressure and fluid information into a proprietary spreadsheet template designed to integrate the data and output predictions. The students would then design scenarios of fluid distributions in the subsurface. This was the most difficult part of the instruction, and I was nervous as the room went deathly silent and the students began working. It wasn't long before a hand went up. As I approached, I assured myself I'd be able to help this student keep progressing. But, the situation was worse than I had envisioned. The student complained that "the spreadsheet isn't working." My worst fear was that I had a room full of students trying to complete an elaborate exercise with a corrupt spreadsheet, and I was helpless to remedy the situation.

Keeping my calm, I asked the student to retrace their steps to identify the error. As we did, we found the student had made an input error. Everything was fine—until it happened again. Another hand went up, and the same original fear set in. Again, the student quietly reported the spreadsheet wasn't working. Again, we reviewed this student's work, and again found that the error was with the student's input. Surprisingly, this same scenario happened a half dozen times over the next fifteen minutes. At this point, my confidence in the spreadsheet's competency was solidifying, and I was slowly realizing the fallibility of the students.

Ryan Ruppert teaching at a field school in September 2023

Each subsequent time I taught the class, the same thing occurred: students quickly faulted the spreadsheet without considering their own mistakes. I came to realize the natural human behavior of looking elsewhere to assign blame as a "knee-jerk" reaction. But more importantly, I recognized this behavior in myself. As I took inventory of my own experiences, it was quickly apparent that I was a party to this behavior on a regular basis. Since then, I've made a conscious effort to recognize when I've made mistakes. This has made me a better geologist. ■

The Rock Record is an occasional series that spotlights interesting lessons learned from rocks. Do you have a story to tell about a life lesson you've learned from rocks? Tell us about it at editor@hgs.org.

The Houston Geological Society Continuing Education Committee Presents

Applied Understanding for Geoscientists of How Engineers Calculate Reservoir Oil and Gas Volumes Using PVT

Ronald (Ron) L. Lang, P.E.

Thursday, October 20, 2023
Virtual Event via Zoom • 8:00 am – 1:00 pm
https://www.hgs.org/civicrm/event/info?id=246
Attendees will receive a Certificate of Continuing Education for 4 PDH

COURSE DESCRIPTION

Learn to apply the fundamental principles of PVT beginning at the well site and progressing through the lab to the PVT report and its application in estimating oil and gas volumes.

PRICING

$200 for HGS Members
$100.00 Student/Emeritus
$400 Non-Members or
Non-Members can submit an application and pay their dues before registering to get the member price. Please call the HGS office at 713-463-9476 to be registered only AFTER your application and dues are submitted.

SUMMARY

This practical course will provide students with a working knowledge of Pressure Volume Temperature (PVT) and an understanding of Equation of State (EOS) and its application, following a path from field sampling to the lab and on to the examination of common practices and analyses used in classical and simulated reservoir engineering.

Objectives

- Understand the field separation processes and sampling procedures
- Learn how to select the method of sampling at the well site
- Learn how the PVT lab validates samples and conducts experiments
- Determine which PVT experiments to perform on your samples
- Identify the six reservoir fluid types and their phase behavior
- Learn to read PVT lab reports for DLE, CCE, CVD, and Separator Tests
- Construct black oil PVT tables for volumetrics and simulation models

INTRODUCTION

As a Geoscientist it is useful to understand how your team Reservoir Engineer calculates reserves. You might ask what is Applied Understanding of PVT? It means that you don't need to be an expert in PVT to immediately and effectively apply its fundamental principals in estimating oil and gas volumes at various temperatures and pressures. By the end of this course, you will understand phase behavior in the context of reservoir fluid types and the effect of PVT (pressure-volume-temperature) changes for a characterized fluid (a defined multi-component oil and gas system). You will be equipped to apply your knowledge in the field during sampling and in discussions with the lab, and confidently use the reported results to construct PVT tables. You will also learn how to construct PVT tables using correlations built into Excel. The applied understanding of the fundamental principals is a must for petroleum engineers, especially for reservoir engineers who need to effectively estimate reservoir oil and gas volumes at reservoir temperature and pressure during depletion and enhanced oil recovery (EOR). It is valuable for Reservoir Geoscientists to have an understanding of these principals.

Continuing Education *continued on page 16*

Date: October 20, 2023 • 8:00am – 1:00pm • Virtual Event via Zoom.
Registration will close Wednesday October 19, 2023 at 4 pm. Meeting links will be sent at this time to the "Primary" email listed on your HGS account
Please make your reservations on-line https://www.hgs.org/civicrm/event/info?id=2488
For more information about this event, contact HGS Office 713-463-9476 • office@hgs.org

Continuing Education continued from page 15

COURSE OUTLINE

Volumetrics and Correlations

- Oil and Gas Volumetric Equations
- Oil Correlations for Rs Pb Bo
- Gas Correlations for Z and Bg
- Oil and Gas Behavior Animations
- Oil and Gas Correlation Spreadsheets

Field Separation and Sampling

- Surface Separation of Oil and Gas
- Sampling Separator Oil and Gas

Material Balance of Fluids

- A Day in the Life of a Mole

PVT Lab and Surface Samples

- PVT Lab Surface Sample Workflow
- PVT Lab Sample Validation
- PVT Lab Compositions
- PVT Lab Gas Plant Liquids

PVT Lab Experiments

- Six Reservoir Fluid Types
- Methods and Analyses
- Physical Recombination
- CCE Experiment
- CVD Experiment
- DLE Experiment with Correction to Surface Conditions
- Example PVT Tables

BIOGRAPHICAL SKETCH

Ronald (Ron) L. Lang, P.E. has over 40 years of experience in reservoir engineering, including classical and simulation applications. He is actively involved as a consultant in domestic and international studies requiring application of PVT equation of state (EOS) principles. He participates in association with geoscience teams in field development strategies including primary, secondary, and enhanced oil recovery (EOR) projects. Mr. Lang is a regular guest speaker for the SPE International Continued Education Accelerated Learning Tutorials relating to PVT and EOS.

Mr. Lang received a BSc degree in Petroleum Engineering in 1974 from Texas Tech University. His career began with Amoco Production Company in Houston and transitioned to consulting firms engaged in exploration and development; acquisition and divestment transaction advisory; and petroleum engineering technical evaluations. He is a licensed professional engineer in the state of Texas.

As an experienced simulation engineer, Mr. Lang learned the importance of correctly applying PVT (EOS) to properly characterize reservoir fluids and accurately predict fluid behavior and its impact on reservoir oil and gas volumes and performance. He has studied under the guidance of leading experts in this field in the oil and gas industry. Mr. Lang had a supporting technical role during the litigation of the Deepwater Horizon Macondo oil spill. In the development of conventional and unconventional oil and gas resources, it is crucial for engineers to understand the differences among the various classes of reservoir fluids. In particular, reserves and their value can be lost rapidly if engineers do not properly identify near-critical fluids, and their behavior, such as in the volatile oils and retrograde gases. ■

Sequence Stratigraphy: From Cyclothems to Seismic Stratigraphy

By Stephen R. Schutter

INTRODUCTION

Sequence stratigraphy and the associated concepts have been widespread within the geosciences for many years. Unfortunately, over time the meaning of some of these concepts have drifted, as people have modified and redefined terms to fit their immediate problems, often ignoring the logic behind the original terms. Some concepts are derived or based on other concepts, without a realization of which came first, or why. A brief review of the history of the concepts, therefore, may be helpful.

FOUNDATION OF STRATIGRAPHIC IDEAS

Stratigraphy began in the nineteenth century, with the recognition that packages of sediments, bounded by unconformities and characterized by distinctive fossils, expressed specific depositional episodes and could be correlated with related sediments of the same age over long distances. The original concept of stratigraphic systems was that of discrete depositional episodes, characterized by (but not defined by) the fossils within them.

In the early twentieth century, economic geology became much more important, particularly in relation to coal. In some coal basins, it was recognized that coal occurred in regular stratigraphic cycles; Udden (1912) described such cycles in northern Illinois in one of North America's most important coal basins. He recognized the predictable reoccurrence of the patterns, and that they could be correlated over significant distances.

THE IMPACT OF THE 1930 SYMPOSIUM

Ideas on cyclic deposition fermented for several years, but truly burst forth at a symposium at Urbana, Illinois, in 1930. Many geologists came together and cross-fertilized their thinking; these ideas were published by the Illinois State Geological Survey in 1931 as Bulletin 60. This contained the early works of many geologists who would influence sequence stratigraphy for the next half century.

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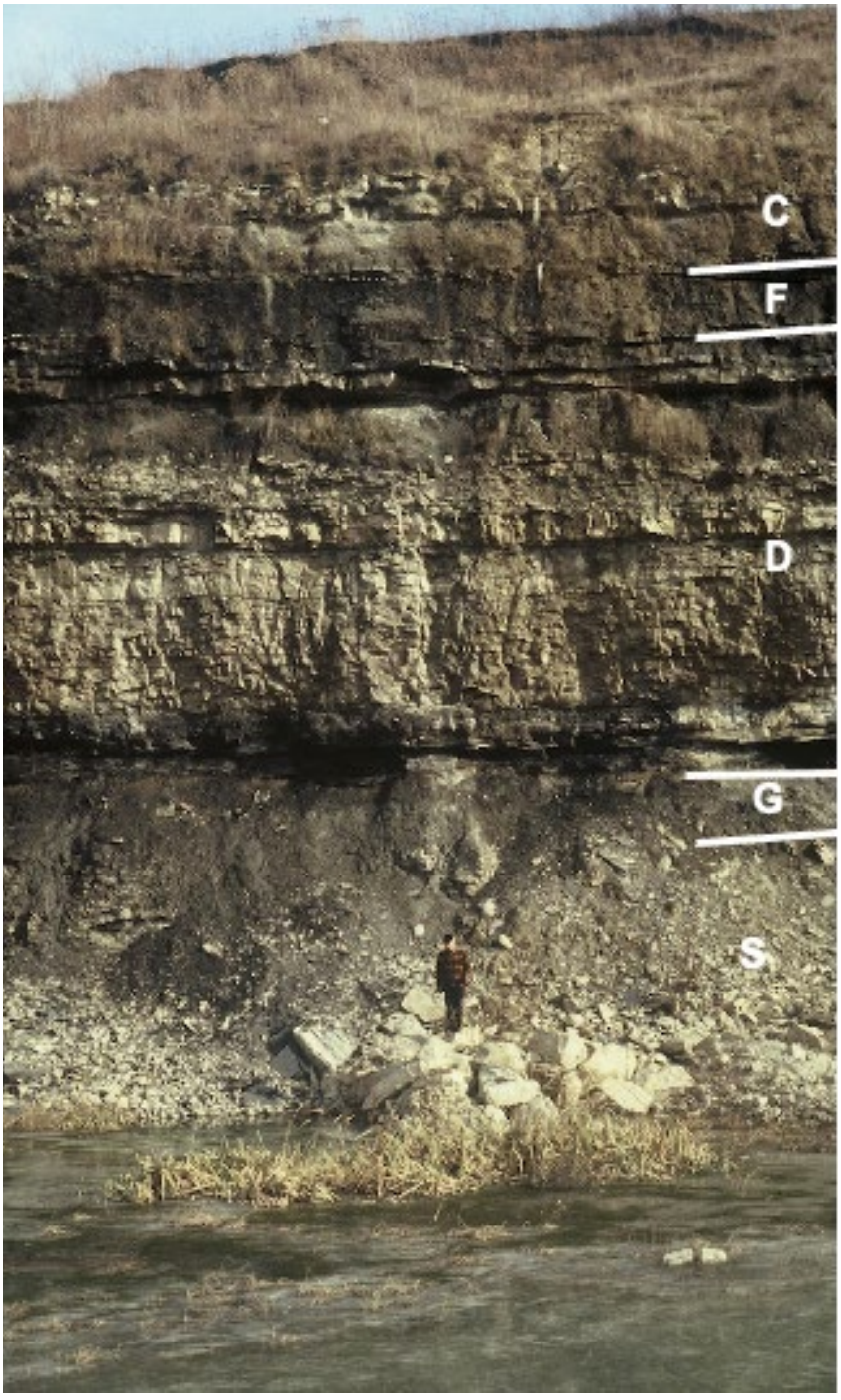

Figure 1. *Upper Pennsylvanian cyclothems, Midcontinent (Thayer, SW IA). Note 6-foot man for scale. He is standing on top of the regressive (upper) limestone of the Swope (S) cyclothem. Behind him is the slope of the Galesburg (G) (nonmarine) Shale that is a dark ledge at the base of the regressive (upper) limestone of the Dennis (D) cyclothem. This is overlain by a thin fossiliferous shale below the Stark Shale. The reddish shale above that is the Fontana (F) (nonmarine) shale, and near the top of the quarry is the Cherryvale (C) cyclothem, which is less developed than the lower two cyclothems. Note that the cyclothems are flat-lying cratonic deposits, unmodified by tectonism; each represents deposition during a 400 Kyr glacio-eustatic cycle.*

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One early idea to come from that meeting was that cycles (especially the Pennsylvanian coal-bearing cycles) occurred in regular patterns, which Wanless and Weller (1932) called cyclothems. These cycles repeated over and over across broad areas of North America and northwestern Europe. While there was considerable discussion about the origin of these cyclothems, the critical recognition of these early studies was that deposition was repetitive, probably controlled by relative sea level change, correlative over large areas, and therefore predictable in terms of lithofacies distribution and characteristics. The idea that they may have been glacio-eustatic in origin was very early (Shepard and Wanless, 1935; Wanless and Shepard, 1936).

These ideas spread rapidly, changing and being modified in many ways, and influencing further ideas. Wanless continued to develop detailed depositional facies maps of individual cyclothems, and for many years his graduate students at Illinois produced a series of theses covering much of the coal-bearing Pennsylvanian cyclothems. In the early 1950s, the U. S. Geological Survey began a Paleotectonic Map program and realized that depositional sequences could form the basis for mapping sedimentation across the United States. Wanless had already done such work and was asked to lead such an effort on the Pennsylvanian, with his work as a nucleus.

EARLY ADOPTERS

Another participant in the 1930 meeting was R. C. Moore, who took the cyclothem idea back to Kansas. Moore was a paleontologist, who realized that the various members of the cyclothems had distinctive faunas that recurred in predictable order in particular lithologies. Cyclothems in the Western Interior (the Midcontinent) are even more regular (Figure 1) than in the Illinois Basin, and Moore (1936) developed what he described as a "megacyclothem," or cyclothem of cyclothems. Principally, however, a Kansas megacyclothem has an Illinois-type cyclothem with additional stratigraphic units, which may be interpreted as incompletely developed cyclothems.

While Moore recognized that specific lithologies within the cyclothems had characteristic fossils reflecting the succession of environments, Israelsky (1949) provided the theoretical basis for recognizing sea level cycles in the fossil distribution in vertical successions, such as wells. This was particularly suited to microfossils, and in the case of Pennsylvanian cyclothems, conodonts were reliably present. Ellison (1941) described how the water depth of various conodont assemblages might be recognized; eventually Heckel and Baesemann (1977) demonstrated that the conodont assemblages showed the changing water depths. In particular, they noted the unique assemblage found in the "core shale" in the middle of the cyclothems, marking the deepest-water biofacies (coincident with what was eventually recognized as the "condensed section" of Loutit and others, 1988).

Another example of an early adapter was Max Littlefield, a geologist working for Gypsy Oil Company (an Oklahoma subsidiary of Gulf Oil Company). In 1931, he identified the Pennsylvanian cyclothems in Oklahoma, citing Weller's (1930) paper published at the time of the Urbana meeting. "This exact cycle sequence as defined by Weller is rare in Oklahoma, but cycle sequences are present and are similar in principle" (from an unpublished Gypsy Oil Company report, 1931, **Figure 2**).

This may seem like an isolated anecdote, but Littlefield successfully applied the stratigraphic concepts of cyclic deposition to exploration for oil in Oklahoma. Later in his career he applied these principles to carbonates and was very successful with Mississippian carbonate-evaporite cycles in Montana. Thus, he recognized the applicability of cyclic deposition principles in a completely different environmental setting.

In Montana, Littlefield mentored a young geologist, Larry Sloss, who was strongly influenced by his thinking and methodology (Dott, 2014). Littlefield and Sloss, like Wanless, were mainly lithostratigraphers. Sloss went on to introduce the concepts of sequence stratigraphy, recognizing depositional packages

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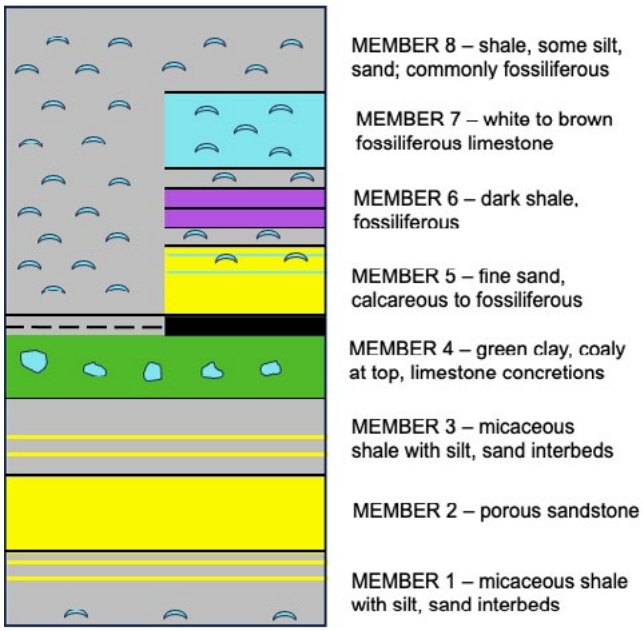

Figure 2. *Pennsylvanian cycle – E Oklahoma. From unpublished report by Max Littlefield for Gypsy Oil, 1931. Member 1 – micaceous shale, silt and sand interbeds, coarsening upward; Member 2 – porous sandstone (reservoir), fluvial or beach; Member 3 – like 1, but fining upward; Member 4 – usually green clay, abundantly carbonaceous to coal at top, may contain dense limestone concretions; Member 5 – thin fine sand, calcareous and/or fossiliferous; Member 6 – dark shale, fossiliferous; Member 7 – white or light brown finely crystalline limestone, fossiliferous; Member 8 – shale, siltstone, sandstone, lacks mica or laminae, commonly calcareous and/or fossiliferous. Members 2-4 are terrestrial, 5-8 are marine, and 1 is transitional from marine to terrestrial. Units 5-7 may shale out, so the marine part of the cyclothem is represented by Member 8.*

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("sequences") bounded by unconformities. The largest of these (in a chronostratigraphic sense) were the first-order sequences identifiable across North America (Sloss, 1963) and the world. While a professor at Northwestern University, Sloss in turn mentored Pete Vail, Bob Mitchum and John Sangree, who all worked on Late Paleozoic cyclic deposits, and went on to develop seismic stratigraphy at Exxon in the 1970s.

FROM CYCLIC DEPOSITION TO SEQUENCE STRATIGRAPHY

The development of thinking about cyclic deposition (eventually to become sequence stratigraphy) was punctuated by meetings and symposia where ideas were exchanged, often followed by a flurry of publications. The 1930 Illinois symposium was the first. A later one was the session on "Rhythm in Sedimentation" at the 18th International Geological Congress, held in London in 1948. Wanless and Moore contributed, as did several European workers. Trümpy (2004) reported that the session did not accept Late Paleozoic glacioeustasy because there were too many cycles.

Possibly the most remarkable symposium was that held by SEPM in Houston in 1963. That produced the two-volume Kansas Geological Survey Bulletin 169 (Merriam, ed., 1964; printed 1966), with a huge number of papers on cyclic sedimentation. (It became known as "The Golden Book of Cyclic Sedimentation" because of its gold covers.)

Sequence stratigraphy developed in the age before plate tectonics. In the 1950s and 1960s, the American oil and gas industry (and therefore geological thought) was still largely focused on onshore basins. The prevailing theory was the geosynclinal model, which postulated stable cratons surrounded by mobile belts providing sediments and tectonics. There was little thought given to what might be happening offshore, let alone in deep basins. Geophysics, particularly reflection seismic exploration, was also maturing. The 1960s and 1970s saw the development of sufficient computer power to generate multifold stackable seismic surveys that would make seismic stratigraphy possible.

Thus, as Sloss's students thought about sequences, they realized that the unconformities between them must mark periods when deposition was shifted to offshore. By extension, those basinward shifts must be predictable, and the succession of depositional facies potentially possible to model. That this could be seen on seismic data thus formed the basis for seismic stratigraphy. Critical observations are that onshore sequences (as defined) are bounded by unconformities when deposition is shifted basinward. (Submarine unconformities do not have such predictable connections, and are not sequence boundaries.). Seismic stratigraphy also permitted the recognition of a range of sequence sizes, determined in part by their onlapping relationships. Because

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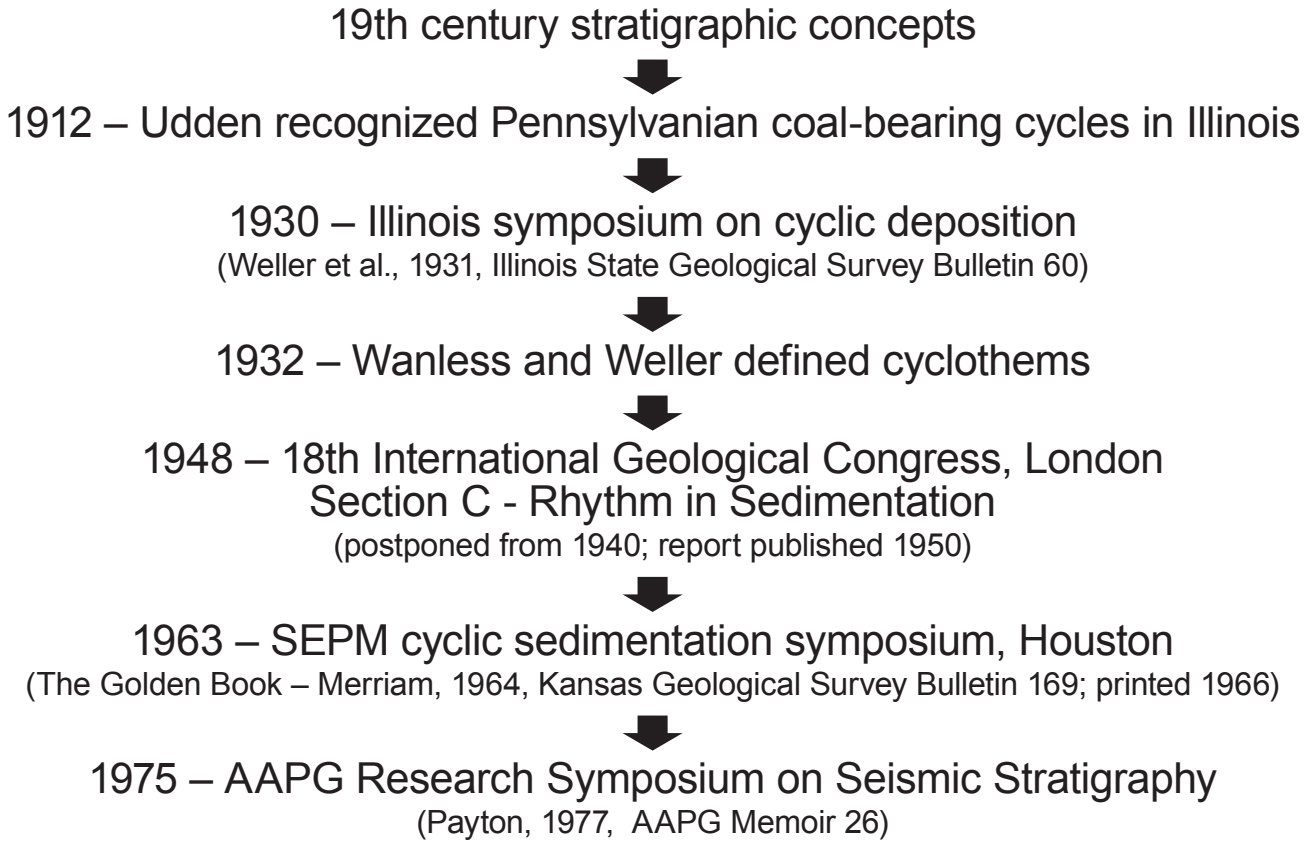

Figure 3. *Development of ideas on cyclothems/stratigraphic sequences.*

Technical Article continued from page 19

it is not always clear what the mechanism for sequence deposition is, the conservative approach is that sequence order is determined by duration of deposition, not by hierarchy. Thus, fourth-order sequences are defined as being between 1.0 and 0.1 Ma in duration; Late Paleozoic cyclothems fall in this range. Minor cycles within the cyclothems are not automatically fifth-order cycles, and bundles of cyclothems are not automatically third-order cycles. (Parasequences, often mentioned in the context of cyclothems, are defined as a sea-level rise without a preceding fall; thus, just an inflection point in a rise. However, in many Late Paleozoic cyclothems, evidence of the lowstand is often removed or subtle, but ultimately present.)

Sloss (1984) in describing these students, wrote: "This group was pre-adapted to recognize unconformity-bounded units on reflection seismic records and they are deeply impressed by the apparent global synchrony of stratigraphic patterns clearly related to the freeboard of continental margins… They find that they sleep well when they place their faith in eustatic sea levels and dream pleasant dreams when glacial controls on eustatics can be invoked" (p. 9-10).

FROM SEQUENCE STRATIGRAPHY TO SEISMIC STRATIGRAPHY

The bridge from sequence stratigraphy to seismic stratigraphy took place at the AAPG's first Research Symposium on Seismic Stratigraphy in 1975, and was summarized in AAPG Mem. 26, where Sloss's students and others (Vail et al., 1977) explained how seismic interpretation showed the expression and predictability of sequence stratigraphy. It is worth noting that Midcontinent cyclothems are generally (but not always) too thin to have recognizable seismic facies, and the development of seismic stratigraphy needed the growth of seismic exploration in thicker and younger rocks (Figure 3).

While beyond the scope of this summary, sequence stratigraphy was not replaced by seismic stratigraphy; both continued to evolve and complement each other. Better understanding of sequence stratigraphy, both in the Late Paleozoic cyclothems and beyond, has helped to solve problems in climate studies, and has enhanced understanding of deep-sea sediments. Both sequence stratigraphy and seismic stratigraphy have continued to evolve synergistically. ■

Acknowledgements

This paper benefitted from helpful comments by Stacy Atchley, Bilal Haq, Phil Heckel, John Mitchell and Rex Price.

BIOGRAPHICAL NOTE

Steve Schutter did his dissertation work on the depositional environments of four Missourian (lower Upper Pennsylvanian) shales of the Midcontinent and Illinois Basin. At Exxon Production Research, he was responsible for the revision of the Paleozoic sea level chart. He also was an instructor for the ExxonMobil Applied Seismic Interpretation School (ASIS).

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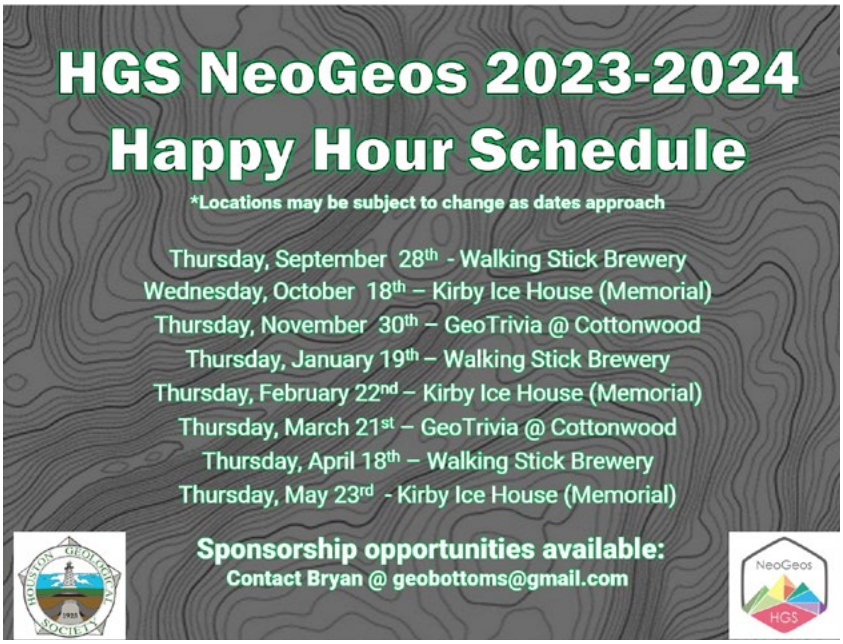
The NeoGeos crowd at a spring 2023 happy hour at Cottonwood.



Geologists at the Forefront of Energy Innovation

By Caroline Wachtman

INNOVATION IS THE HEARTBEAT OF HOUSTON

Innovation is taking something that exists and making it a new way, explains Dawn James, who is the Managing Director of Sustainability Strategy at Deloitte, LLP. James, who is also a geologist and HGS supporter says, "Look at mundane things and think of a new way to do it—that's innovation." James started her geology career at the USGS, where she learned to build large-scale numerical models to understand hydrologically complex systems like the Everglades. She pivoted her modeling skill set to the oil and gas industry and then expanded her knowledge base to include business strategy, tackling energy and sustainability topics. While a strong technical skill set and scientific method-based approach has been the foundation of James' success, innovation has been at the core of each of her roles. "Nobody said I have to be like my professors at school. I can take it and apply it in my own way," says James of how she uses her geology skills to innovate in business strategy.

Key Terms

STARTUPS
Are organizations that have new, scalable ideas; startups have an unknown business model and an uncertain market

SMALL BUSINESSES
Are companies that have a traditional business model and known market

FOUNDERS
Are people who have an idea and transform that idea into a company

ENTREPRENEURS
Typically invest or run known businesses

CLEAN TECH
Focuses on innovation that minimizes impacts to the environment

CLIMATE TECH
Focuses on innovation that reduces greenhouse gas emissions

Geologists in the oil and gas industry are familiar with the idea of doing something in a new way to make it better, cheaper, or faster. For example, innovations that enabled economic production from shale reservoirs are commonly attributed to oil and gas legend George Mitchell, of Mitchell Energy and Development Corp. Oil and gas geologists today continue to innovate better ways to enhance hydrocarbon recovery, improve reservoir performance, and explore for resources.

Houston is seeking to capitalize on the innovation mindset of many of its residents and industries to become a destination for startups and investors. The intent to make Houston a world leader in innovation got a push in 2017 with funding and support from the Greater Houston Partnership and the Houston Mayor's Task Force on Innovation. This support led to developing the Houston Innovation District, a four-mile corridor that stretches from Downtown to the Medical Center.

In 2021, Greentown Labs, an organization focused on supporting startup companies working in Climate and Clean Tech expanded to Houston and now is home to more than 200 startups between their Houston and Boston locations. The ION, a center whose vision is to be the home for Houston's innovation community also opened in 2021. It now boasts corporate energy partners such as Chevron, Aramco, ExxonMobil, Oxy, Woodside and others. Despite the challenges of the COVID19 pandemic, capital is flowing to Houston's startups. Greater Houston Partnership reports that venture capital funding for Houston companies reached over $6 Billion in the past five years (Greater Houston Partnership 2023)

Houston's innovation ecosystem is also supported by organizations such as the Rice Alliance, who launched the Rice Clean Energy Accelerator (CEA) in 2021 to support startups that are advancing decarbonization solutions and advancing energy efficiency strategies by offering training, mentoring, and connections to Houston's business community and investors. Currently in their third year, the CEA has supported 29 emerging ventures that have secured pilots, acquired customers, established partnerships and raised over $75 million (Rice Alliance Clean Energy (ricecleanenergy.org).

Houston is well-positioned to lead innovation, says Juliana Garaizar, Chief Development and Investment Officer at Greentown Labs, for three key reasons. Houston is the energy capital of the world meaning that it has a talented workforce and access to capital. There is a port that encourages the flow of goods and manufacturing. Additionally, Houston has multiple robust industries including energy, medicine, space and art that allow for cross-pollination. "Innovation happens at the intersections," explains Garaizar of why having multiple industries offers Houston a strong innovation advantage. "You need a mixing pot of ideas to get innovation. That is where the magic happens," she says.

GEOLOGISTS ARE NATURAL INNOVATORS

Geologists are natural innovators, says James because they are trained to look at complex earth science problems with lots of unknowns and quickly come up with interpretations. James describes that some geologists have innate problem-solving ability, but for many geologists, learning the scientific method is a critical

Energy Innovation *continued on page 23*

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part of their education. This methodical and rigorous approach to asking questions and testing assumptions is a key part of the innovation process.

Garaizar says that geologists, especially those pivoting from oil and gas, are a good fit for startups. She says that geologists coming from oil and gas are typically older than many founders, but they typically have more resources than younger founders. For example, some geology founders can self-fund their startups, or contribute to the funding by continuing to consult in oil and gas. Geologists have connections to the oil and gas industry that can lead to pilot studies and customers. Additionally, Garaizar explains that geologists from oil and gas are good at establishing partnerships and are accustomed to collaborating with other disciplines.

GEOLOGISTS ARE INNOVATION LEADERS

Liz Dennett, *Chief Technology Officer of Cemvita*

Liz Dennett, Chief Technology Officer of Cemvita and Chief Executive Officer of Endolith, a startup that solves problems at the intersection of geology and biology, says that geologists are interested in Clean Tech and Climate Tech because of a "simultaneous belief that we want to develop oil and gas resources as safely and sustainably as possible and leave legacy of helping to facilitate something greater."

Liz Dennett

Dennett attributes growing up in a small town in Alaska to fostering an innovation mindset because learning on your own was a necessity of the environment. Dennett went on to earn a MS and PhD in geology from the University of Wisconsin-Madison and then began her professional experience at Hess. She later pivoted her skill set to Biota, where she worked on technology that uses the DNA of microbes as tracers in reservoir fluids. Dennett then pivoted to technology innovation at Amazon Web Services and most recently at Wood Mackenzie. She says that innovation requires risk-taking. "If you aren't scared, ask yourself if you are doing it right."

Now at Cemvita, Dennett is focused on leading innovation and technology across three business lines: Endolith, Gold H2 and eCO2 Biomanufacturing. The Endolith business line has developed technology to efficiently mine critical minerals like copper and lithium with the help of microbes. Gold H2 uses biological processes to convert residual hydrocarbons into useable hydrogen and capture carbon. The third business line, eCO2, produces proteins, plastics and fuel feedstocks from waste streams that capture more CO2 than they produce.

Dennett says that Houston geologists are well-positioned to be innovation leaders because they are "scrappy and resilient," partially a result of cyclic nature of the oil and gas industry. Furthermore, the oil gas industry trains geologists to be good communicators, taking a prospect evaluation and distilling it down to one page for a lay audience, explains Dennett. Other skills that benefit geologists working in innovation is the ability to talk about risk and uncertainty.

Janelle Sherman, *Geothermal Project Coordinator*, and
Marybeth Lundquist, *Chief Operations Officer, at Eden*

"Culture shock" is how Janelle Sherman describes her pivot working as an exploration geologist at one of the world's largest oil and gas companies to working on project development at an energy-tech start-up company. Sherman says she has enjoyed seeing the immediate impact of her work since she joined Eden in 2022 after six years as a geologist at ExxonMobil. Sherman says that the mantra of "this is the way we have always done things," does not apply to start-ups. "There is always room for new ideas," says Sherman.

Janelle Sherman

Marybeth Lundquist

Lundquist joined Eden in 2020 after six years as a production and development geologist at ExxonMobil. At Eden, she has helped transform the company from a team of five people and to a company with over 20 people. In addition, her efforts have led to the company acquiring more than $10M in funding.

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Energy Innovation continued from page 23

Eden is developing technology to efficiently extract resources across multiple energy sources such as hydrocarbons, mining and geothermal. The company uses electricity to fracture reservoirs in a controlled way that results in higher accuracy, uses less water, and costs less than traditional fracking methods.

Sherman says that many of her geology skills have directly translated into the energy-tech start-up world. She describes that it is important to be able to characterize risk and uncertainty. Additionally, her operations background is helpful in facilitating conversations with companies who want to know how the technology can be applied to their processes.

Lundquist describes that she leveraged her oil and gas industry experience to help develop structured business practices and processes. However, she is primarily using new skills set that she developed since joining Eden, including investor relations, grant writing and people management.

Working at a start-up has helped Sherman to develop a strong sense for how her work connects to the bottom line and to develop "wholistic business sense." Sherman says that it was sometimes difficult to connect her geologic interpretations to business performance while working for ExxonMobil. At Eden, the connection of her work to the bottom line is clear and immediate.

Joachim Katchinoff, *co-founder of Crew Carbon*

Joachim Katchinoff, co-founder of Crew Carbon, is part of a growing industry in carbon removal technologies. His company, headquartered in Boston, was recently granted $1.3 Million from the Carbon to Sea initiative and has partnered with Pacific Northwest Regional Labs on another DOE-funded grant to accelerate carbon removal technologies. In addition, Crew became part of the Frontier Fund in 2023, which facilitates selling carbon credits to companies like Stripe and Shopify.

Katchinoff explored drivers of global climate starting with a geology degree from College of William & Mary, followed by studying isotope geochemistry at Oxford. He then earned a PhD from Yale investigating weathering reactions in both the geologic past and in modern environments. This led him to the understanding that enhanced weathering could be a successful carbon removal pathway. Crew Carbon's primary market is the wastewater treatment industry, which is already involved in removing carbon at wastewater treatment plants. Katchinoff's technology offers a way to efficiently remove the carbon from the wastewater and trap it in bicarbonate ions. "Soils and rivers do this carbon removal process all the time. Our technology speeds up this process," he says.

Geology is an interdisciplinary subject says Katchinoff. It involves oceanography, biology, physics and chemistry. This multidisciplinary skill set enables geologists to think broadly about technical problems. Katchinoff believes that this multidisciplinary and scientific skill set is in demand amount Venture Capital Investors and Carbon Crediting groups, because there is a low level of scientific knowledge among many investors and customers. In addition to his technical skill set, Katchinoff has broadened his skill set to include investor relations. He says that also had to learn skills about how to take a product to market.

Energy Innovation *continued on page 25*

Get Involved with Innovation

Events - Greentown Labs

Get Involved - Ion District

Mentor or Invest

Rice Alliance

The Cannon

Accenture Innovation Hub

Home - MassChallenge

Halliburton Labs

Capital Factory

Eunike Ventures

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ADVICE FOR GEOLOGIST INNOVATORS

From Dawn James

- Be perpetually curious.
- Leverage your skill set and stretch your mind to do something you haven't done before.

From Liz Dennett

- Find people who push you, both personally and professionally. You need luck, mindfulness and an incredible team.
- Take risks; you will learn a lot even if the risk doesn't pay off.
- Put your hand up to learn something new then work hard.

From Janelle Sherman

- See how you fit into the innovation ecosystem by networking with other founders. Go to happy hours and attend meetings to see what people are talking about.

From Joachim Katchinoff

- Although it can be difficult to reach out to people who are more senior or experienced, most folks are eager to talk and share their experiences and offer insights. Even a 15-minute discussion can be helpful.

From Marybeth Lundquist

- Be more flexible than you thought you could be.
- Be ready to wear lots of different hats.

GET INVOLVED IN HOUSTON'S INNOVATION ECOSYSTEM

You can learn more about energy innovation ecosystem in Houston by visiting Greentown Labs or the ION for information on events such as networking hours, informational talks and conferences. Share your skills with startup founders, or become an investor by learning about companies that are innovating. ■

Doing Business for Yourself: Setting up an LLC

By Caroline Wachtman with contributions from Adam Curley, Penny Patterson, and Paul Britt

Nearly 700 HGS members own or work for Limited Liability Companies (LLCs). Many of these members started LLCs after refining their skills over long careers in the energy industry. In addition, many members have started up LLCs after leaving large companies during industry downturns. The trend of HGS members starting LLCs is likely to continue, as geologists look to continue or expand their professional reach beyond traditional corporate employment.

PART 1: THE LEGAL PERSPECTIVE WITH ADAM CURLEY

Adam Curley, Attorney and Owner of The Curley Law Firm, PLLC, who specializes in legal support for small- to medium-sized businesses in the Houston area virtually sat down with me on a hot, dry Friday afternoon in Houston to discuss the basics of forming a company. Just as many geologists are passionate about rocks or oil-finding, Curley is passionate about the legal framework for Limited Liability Companies (LLCs). After an hour and a half of discussion there was still more to cover. Curley recommends that anyone forming a company should consult four people: a lawyer, an accountant, a banker and an insurance agent, because "it's better to set things up right at the beginning, but it's hard and expensive to fix a problem later." Continuing that guidance, readers are encouraged to treat the information below as an introduction, but not a substitute for professional legal advice.

IS AN LLC RIGHT FOR ME?

Curley says that the United States tax and legal codes encourage people and companies to take risks by allowing vehicles such as LLCs. The primary reason to incorporate is to insulate your personal liability from your professional liability. An LLC is a vehicle that offers protection if you try something that is unsuccessful and avoids loss of personal property if there is a judgement against you. For example, someone cannot sue an LLC owner and take that person's share of the LLC, and the LLC cannot be sued for work done outside the LLC.

Curley lists that they four types of company structures are Sole Proprietorship, Limited Partnerships, Corporations, or LLCs. In the past, it was common for many small entrepreneurial shops to establish a Sole Proprietorship or Limited Partnership structure, but now most small and medium-sized businesses are formed as LLCs, because LLCs allow for more flexibility than Proprietorships or Partnerships. LLCs also allow more flexibility than Corporations, which require processes such as shareholder meetings and documentation of meetings and votes. Curley describes that an LLC is a corporate vehicle that allows owners the maximum flexibility to run a business the way they want to run it.

WHERE TO REGISTER YOUR LLC?

Delaware historically has had favorable terms for setting up businesses, however, many states including Texas have now made company formation a straightforward process. Most new business owners working in Texas choose to form a company in Texas.

Curley suggests that owners who move their business from Texas to another state, should consider whether to set up a new entity in that state, based in part, on where the majority of their business will be conducted. Out-of-state owners who continue to conduct most of their business in Texas may choose to keep their LLC registered in Texas. Owners who do business in multiple states should register as foreign entities (where foreign means out-of-state), as there are penalties for not disclosing an out-of-state relationship.

ONE MEMBER OR MULTI-MEMBER LLC?

If the company consists of only one person, a single member LLC is formed. For multi-member LLCs, owners can choose to be member-managed or manager-managed. Member-managed LLCs disclose who owns the company, whereas multi-member LLCs can choose to list owners or a third party as a manager. If a business founder lacks the capital to pursue an idea, they may choose to form a manager-managed LLC where the founder drives the company direction and the manager supplies the majority of funding.

THE IMPORTANCE OF A COMPANY AGREEMENT

The default governance model for Texas LLCs is the Texas Business Organization Code. This document describes a set of rules for what the LLC can do and the powers of members and managers of the LLC. Curley explains that nearly all of the default provisions can be changed. For example, owners may prefer to include an impartial tie breaker, or coin flip, in case of deadlocked vote. Or, an owner may want to describe what happens to company interest in the case of death or divorce of one of the owners. The changes to the default governance model listed in the Business Organization Code are be described in a Company Agreement. Furthermore, many banking institutions require a Company Agreement to open a business bank account.

WHAT INFORMATION IS NEEDED TO REGISTER AN LLC?

In order to file a Certificate of Formation for an LLC, the company will need to list a registered agent, its members or managers, and also an initial address to receive correspondence. The agent must be a person or business who can physically accept mail and legal actions, therefore PO boxes are not permitted. Curley notes that some owners who work from home are reluctant to make their home addresses discoverable, and therefore may choose to contract a third-party or their lawyer to act as their agent.

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TAXES AND MAINTENANCE OF YOUR LLC

Single member LLCs may choose to use their Social Security number as their tax ID, but Curley advises against this practice to protect against identity theft, and instead recommends that single and multi-member LLCs obtain Employer Identification Numbers. For tax purposes, single member LLCs are treated as pass-through entities, meaning that company earnings are treated a personal income of the owner. Companies that earn in excess of the franchise tax threshold ($1.23 M in 2022) pay franchise tax in addition to personal income tax.

Other than tax documents, the Public Information Report is the only documentation that a LLC registered in Texas needs to submit annually. This document lists the current owners of the LLC. There is no annual fee for maintaining an LLC in Texas, whereas there is an annual fee in other states, such as Delaware.

PART 2: TIPS ON SETTING UP AN LLC FOR CONDUCTING GEOLOGY BUSINESS FROM PENNY PATTERSON

Setting up a Limited Liability Company (LLC) sounds like an easy task and, for the most part, it is fairly easy. The most challenging part is the first step, which is what to name your company. One of the benefits of an LLC is that your company LLC name must be unique, i.e., it may not be used by another business in your State. You can check out www.legalzoom.com to determine if an LLC name is already in use by another company. So, then you must decide what name best represents your proposed company and, in addition, is readily recognizable and characterizes your business expertise. There are many LLC companies that have surnames in their LLC name. For example, if your name is John Doe and you would like to name your company "John Doe's Geology, LLC", then you will need to determine that this name is in not use and therefore, available for you to submit to the State for filing. Other common names for LLC companies include: names with common nature characteristics, for example "Gray Rocks Geology;" names with word abbreviations or contraction of a word, for example, "GrayRks Geology, LLC;" and names that are a modification of a common word "Grey Rocks Geology, LLC." One caution is that if you get too creative with your LLC company name, it may be difficult for your clients to remember it! A website search is helpful to see names that are currently in use.

Once you have selected an LLC company name, the second step is to submit your proposed company LLC name to the State Filing Office to review for name availability. You should act quickly in filing, because there is always a possibility that another company is consider filing the same LLC name, and names are awarded on first-come, first-served basis. The State office will send you a reply as to the name availability. If you receive a response from the State of "see no conflict," then you are free to use that name and move on to the next step of filing a Certificate of Formation, Limited Liability Company form. When you complete the Certificate form, you will come to the third step, which is to decide how your LLC company will be governed. For example, will it be governed by its Member, Members, or Managers? There is a wealth of information online on websites such as legalzoom.com to help you with this aspect of setting up your LLC. The final step is to submit your Certificate of Formation for the Limited Liability Company and filing payment to the State (currently $325). Upon receipt of your Certificate, your LLC has been created and you are ready to conduct business. Well, of course, there is setting up your office, opening up your LLC company bank account(s), etc., and most definitely, having fun!

PART 3: PAUL BRITT'S LESSONS LEARNED FROM MANY YEARS OF OWNING CORPORATIONS AND LLCS

Paul Britt, HGS President, formed a C Corporation in 1991 using a how-to-book from Sam's Club and later converted the entity to an S Corporation for more favorable tax treatment. Britt describes that the primary difference between a C Corp and S Corp is that a C Corp is a separate taxable entity whereas an S Corp is a pass-through entity. Britt also started two LLCs using the online Legal Zoom tool. Some of Britt's key lessons about corporations and LLCs for conducting geologic business are highlighted below.

INSURANCE AND LIABILITY

Some clients will require $1-$5M umbrella liability policies to do business with your LLC. Additionally, commercial office leases require the tenant to have liability insurance. Liability policies can be difficult to obtain for those working in oil and gas. For example, State Farm generally does not write liability policies for oil and gas LLCs.

HOW MANY LLCS DO YOU NEED?

Consider whether you may need multiple LLCs to cover different parts of your business. For example, if you have both working interest and a consulting business, you may want to keep those two income streams separate to make divesture or acquisition of assets more straightforward for accounting and liability purposes.

TAXES

Single member LLCs form Schedule C and multi-member LLCs file form 1065, but it is possible to petition the IRS to file taxes as a Small Business Corporation (S Corp). Filing as an S Corp offers some tax advantages and fewer restrictions, so consult with your tax advisor whether filing as an LLC or S Corp will be a better fit for your business. ■

BIOGRAPHICAL SKETCHES

Adam Curley is attorney and owner of The Curley Law Firm, PLLC, based in Houston, Texas. Curley earned his JD graduating from Texas A&M with a degree in Engineering. His early career focused on insurance litigation, followed by commercial litigation including defending Haliburton **Feature Article** continued on page 28

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in the DW Horizon trial. He started his own law firm specializing in support to small and medium-sized businesses in 2019.

Penny Patterson recently formed Patterson Geoscience Group, LLC, which is a consulting company that focuses on geoscience studies of conventional and unconventional petroleum resources. In 1990, Penny began her 28-year career with ExxonMobil, where she advanced to the position of Senior Technical Advisor for domestic and international exploration and production of hydrocarbon resources. Upon her retirement, she taught Petroleum Geology at the University of Colorado Boulder.

Paul Britt After 14 years working for large independents, Paul became an independent geologist after starting his first corporation, Texplore, 1991 to generate and sell prospects. After accruing working interests in Texplore, he started an LLC in 2011 to separate his consulting income from his oil and gas working interests. He is licensed in three states and certified by three professional societies. He is Past President of AAPG and AAPG-DPA and is currently President of the Houston Geological Society.

Call to Action: Geological Characterization of Buffalo Bayou

BACKGROUND AND JUSTIFICATION:

Buffalo Bayou extends for over 50 miles roughly West to East from Fort Bend County to the Houston Ship Channel. Despite the number of geologists who live in close proximity to the Bayou, little is known about its geologic characterization.

Tom Helm, long-time Houston resident, local geologist, and canoe afficionado, identified the presence of multiple outcrops in the Bayou nearly a decade ago. His work leading canoe trips and as a community activist advising the Harris County Flood Control Projects has been instrumental in helping bring attention to the natural history of Buffalo Bayou.

Helm has identified several key outcrops that display cross-cutting relationships. He interprets that these rocks were deposited and later eroded during glacial and interglacial periods over the last ~250,000 years, although the timing is not well-constrained. Furthermore, Helms interprets that the orientation of the Bayou is likely due to a combination of pre-existing topography, recent faulting, and potential salt tectonics, but the structural and stratigraphic setting has not been comprehensively studied.

WHAT CAN YOU DO?

Let's solve this geologic question together. The characterization of Buffalo Bayou geology will benefit from your help with the following resources and disciplines:

- Well log and/or core data from wells offset to Buffalo Bayou,
- Shallow geophysical data and interpretation,
- Stratigraphic characterization of the deposits, e.g., measured sections to develop sequence stratigraphic framework,
- Structural characterization of timing of faulting and subsidence, salt tectonics and other processes,
- Background research on the regional geologic setting,
- Age dating knowledge,
- GIS mapping,
- Other ideas? Tell us how you think you can contribute!

WHY GET INVOLVED?

The Houston Geological Society has a unique opportunity to leverage the strengths of its members to better characterize the geology beneath our feet. There are three key reasons why HGS can and should tackle the questions of characterizing the geology of Buffalo Bayou. First, HGS members are eager to get involved in the Society, but many members don't know how. Some find it difficult to participate in in-person dinner or lunch meetings. Members are interested in participating in a flexible way that accommodates their careers or families.

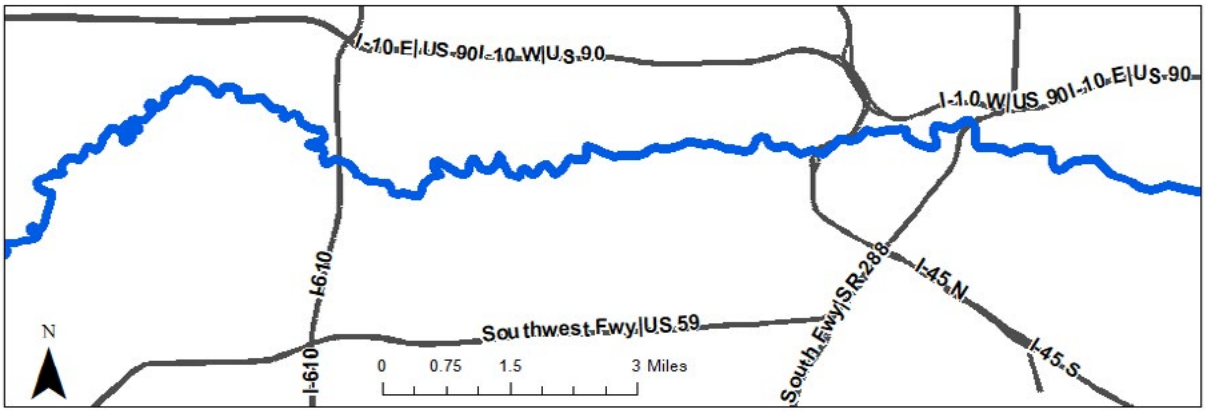
Second, the HGS members have the collective experience and skills to tackle the problem. There is cumulatively 10s of thousands of years of collective wisdom. Many HGS members have explored for hydrocarbons as independent geologists near Houston and have access to well log and seismic data of the area. Additionally, the Society has experienced Engineering and Environmental geologists whose primary business is to characterize the shallow geology around Houston.

Third, doing geology is fun. Many geologists got their start by being interested in the way the natural world works. The Society can leverage that love of learning and exploring, by applying our collective resources to a build a better understanding of the geology that impacts our community.

NEXT STEPS AND EXPECTED OUTCOMES:

Share your interest in joining the Buffalo Bayou Geologic Characterization Project by emailing editor@hgs.org. Please submit your expression of interest by November 15, 2023. We anticipate forming a committee and developing a project plan before year end.

Pending results, we anticipate writing up the results of the study in a dedicated HGS publication that would be available for sale.



Buffalo Bayou (blue line) near downtown Houston

HGS Student Expo

By Amanda Johnston, Cecilia Ramirez, Katie Fry

On September 18th and 19th the HGS Student Expo committee hosted a successful student recruiting event bringing together 20 companies and almost 250 students from across the country. This event is the largest geoscience recruiting event in the United States and gives students the opportunity to network face-to-face with recruiters and future colleagues, learn how to write a resume, and practice interview skills.

Prior to the event, students were encouraged to submit recorded elevator pitches and research presentation videos. Thanks to Chevron for sponsoring pre-Expo videos and for providing 12 students with $1500 awards.

On the first day of the Expo, the Committee led sessions in which students shared their resumes and work interests with recruiters. Dr. Jacek Jaminski, Geology Discipline Manager at BP presented a talk titled: Yet Another Energy Transition – How Do We Respond? This talk highlighted the significance of transitions in life, career, and energy. A fireside chat organized by Daniella Guiterrez Easley explored questions on interview preparation, landing a job, and other related topics. Finally, the Committee hosted geoscience-themed trivia and a happy hour at Lazy Oaks Beer Garden. Thanks to all recruiters that attended, as well as all students for coming out to network after a long day of recruiting and interviews!

Companies conducted interviews on the second day of the Expo. Additionally, Katie Fry, geologist at Oxy and long-time Committee member, led a resume review workshop.

Special thanks to the following sponsors: Ovintiv for sponsoring coffee, Thunder Exploration for sponsoring signage, Coterra Energy for sponsoring lanyards, and Wolf Energy for sponsoring the taco bar. Southwestern Energy and Murphy Oil Company also sponsored the Expo.

This event would not be possible without the tireless dedication, hard work, and resilience of the Student Expo Steering Committee. Amanda Johnston, Committee Chair, successfully coordinated planning of the event, along with the support of Cecilia Ramirez, Andrew Stearns, David Lankford-Bravo, Julian Chenin, Katie Fry, Martha Lou Broussard, Ben Dotson, Joshua Novello, Daniella Gutierrez Easley, Luciana DelaRocha Tinker, Madison Woelfel, Mohamed Abdelfatah, Nahid Hasan, Casey Langdon, and Sushanta Bose. Additionally, extra thanks to Andrea Peoples, HGS Office, for her support. Thank you for all your hard work, countless hours, and commitment to supporting the next generation of geoscientists. ■

See you next year!

Student Expo Committee and HGS President: *Top Row: Paul Britt (HGS President), David Lankford-Bravo, Joshua Novello, Daniella Gutierrez -Easley, Katie Fry, Andrew Stearns (Vice Chair), Cecilia Ramirez, Ben Dotson, Madison Woelfel. Bottom Row: Amanda Johnston (Chair), Mohamed Abdelfatah. Not pictured: Martha Lou Broussard (Founder), Julian Chenin, Luciana Tinker, Nahid Hasan, Sushanta Bose (Past-Chair)*

Student Expo Happy Hour at Lazy Oaks Beer Garden

Wednesday October 11, 2023

11:30 a.m. – 1:00 p.m.

HGS Members/Emeritus/Honorary Life $30
Non-Members & Walkups $30
Premier Corex Conference Room
11335 Clay Rd Ste 180 · Houston, TX 77041 · (281) 783-6130
https://www.hgs.org/civicrm/event/info?id=2500
Event Contact: Bryan Guzman • bryanguzman85@gmail.com

HGS CCUS
Lunch and Learn

Bryan Guzman
Premier Corex

A Brief History of Carbon Sequestration in the U.S. What Does the Future Hold?

Since the 1970's CO_2 has been utilized for enhanced oil recovery (EOR) projects in the US. In the 1980's the first carbon sequestration projects initiated. Since then, waves of government funded projects have been started all over the US with the inclusion of some commercial projects. Today, this pace has increased dramatically bringing with it new opportunities and challenges. These obstacles have placed individuals with subsurface experience front line and center to develop industry best practices for the fulfilment of both technical and regulatory requirements.

WHERE IT BEGAN — ENHANCED OIL RECOVERY (EOR)

The Permian Basin experienced a boom in the early 1970s through the 1980s using CO_2 for EOR. The first commercial flood occurred in Scurry County, TX in 1972 called the Scurry Area Canyon Reef Operators Committee (SACROC). Chevron recovered CO_2 from natural gas processing plants and transported the gas 220 miles for injection. This project combined with high oil prices in the late 70s and early 80s lead to the construction of three major CO_2 pipelines.

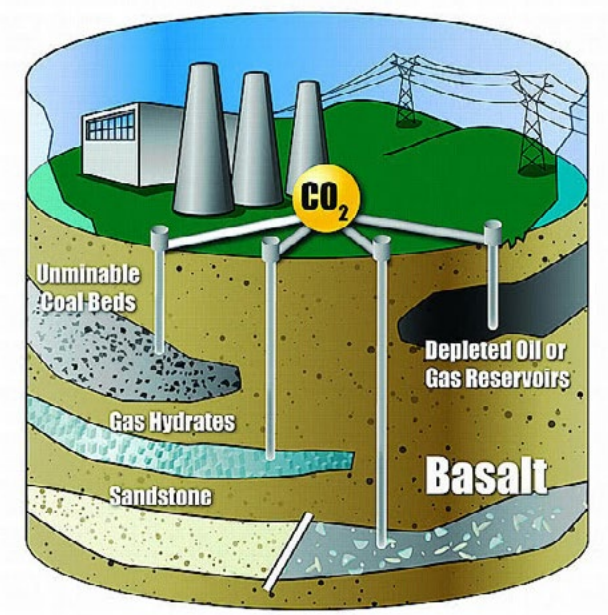


Image credit: https://polarpedia.eu/en/carbon-capture-and-storage/

One of the primary regulations governing EOR applications was the Safe Drinking Water Act of 1974 (managed by the EPA and delegated to the Underground Injection Control Program or UIC). This led to reporting guidelines in the Clean Air Act (CAA) (enacted in 1963), which the EPA upholds. More recently, tax credits based on the 45Q credit enacted by the Energy Improvement and Extension Act of 2008 have provided additional funding for EOR.

INITIAL STEPS — CCS TECHNOLOGIES PROGRAM (MIT)

In 1989, the Carbon Capture and Sequestration Technologies Program at MIT researched various technologies to capture, utilize, and store CO_2 from large stationary sources. It became internationally recognized for it's multi-faceted approach reviewing CCS from a technical, economic, and political perspective.

REGIONAL CARBON SEQUESTRATION PARTNERSHIPS (RCSPS)

In 2003, the US DOE created a nationwide network (7) of regional partnerships to help determine and implement the technology, infrastructure, and regulations to promote carbon storage.

1. **Characterization Phase (2003 – 2005)** data collection on CO_2 sources and geologic formations
2. **Validation Phase (2005 – 2013)** evaluated CO_2 storage opportunities with small scale field tests (< 1 MMT CO_2)
3. **Development Phase (2008 – 2021)** injected 1 MMT or more of CO_2 into the subsurface.

We think the future holds $479 billion dollars of new energy funding through the Infrastructure Investment and Jobs Act (IIJA) Signed into law Fall 2021 and Inflation Reduction Act (IRA) Passed Summer 2022. The US Government has continued to directly fund CCS related initiatives since 2003. This was further enhanced with the 45Q tax credits and recent legislation providing over $479 billion dollars in funding over the next 5 years. Much of the funding has been extended through 2033 with more being discussed. More states are being approved for primacy to expedite class VI permitting. ■ **CCUS Lunch and Learn** *continued on page 33*

Monday, October 16, 2023

5:30 – 9:00 p.m.

HGS Members/Emeritus/Honorary Life $65
Students $25 • Non-Members & Walkups $75
Norris Conference Center, Citycentre
816 Town and Country Blvd #210 • Houston, TX 77024
https://www.hgs.org/civicrm/event/info?id=2476
Event Contact: Linda Sternbach • linda.sternbach@gmail.com

HGS General Dinner Meeting

Dr. Peter Mullin
Werrus Aquamarine

An Emerging Cretaceous Play in the Eastern Gulf of Mexico Shelf: Main Pass and Mississippi Canyon

INTRODUCTION

The Cretaceous is a classical productive play in the onshore Gulf Coast, but while present and proven hydrocarbon-bearing in deepwater clastic facies offshore (Hoorn, 2011), it is generally at great depth, with consequent high costs and limited potential for deliverability. Facies maps previously shown by Moffett (2015), among others, suggest that the principal Cretaceous deepwater clastic fairway is in the Central GOM, where sub-commercial discoveries such as Davy Jones (McMoran) and Tiber Deep (BP) were made (**Figure 1**). By contrast, the Cretaceous in the much shallower eastern GOM was considered to be dominated by shales and marls.

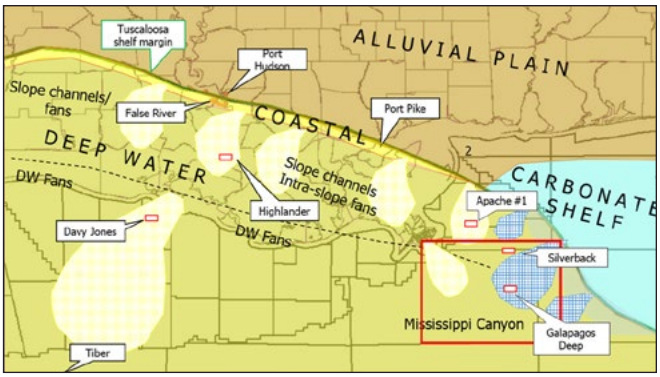


Figure 1. *Tuscaloosa Palaeogeography*

RECENT DRILLING RESULTS

A deep subsalt well recently drilled in shallow water Main Pass, testing a salt flank feature, disproved this facies model: the well had reservoir and pay at multiple levels, including 25 net feet of good porosity clastic pay in the Tuscaloosa, albeit significantly off-structure, overlying a very thick high net-to-gross sand package in underlying Cretaceous clastics (**Table 1**). While the deeper sands have lesser reservoir characteristics, acceptable deliverability is anticipated given the high overpressures and the likelihood of gas charge.

As documented by Snedden (Oral presentation, Geogulf 2021) and Sweet et al (2022) the well lies within a significant Albian to Cenomanian clastic feeder system extending towards the deepwater Mississippi Canyon. In their view, the sands are stacked slope channels and their associated proximal fans.

Two very recent wells drilled by the majors in the eastern Mississippi Canyon have tested the play: Silverback (Chevron) and Galapagos Deep (BP). The Galapagos Deep well encountered primarily carbonates within the Cretaceous. The results of Silverback have not yet been disclosed, but there has been no indication of significant encouragement within what appears to be a large, simple 4-way closure. The nearest deep penetration close to Silverback encountered only carbonates in the package of interest.

LEVEL	GROSS	NET RESERVOIR	NTG	POROSITY	PAY
Tuscaloosa	333	152	43	18	23
Albian	453	237	52	12	3

Table 1. Apache #1 Petrophysical Evaluation Summary, Tuscaloosa to TD

REVISED CONCEPTS

We contend that that the mid-Cretaceous sediment input to the eastern Mississippi Canyon area indeed has low reservoir potential, being dominated by redeposited carbonates derived from the adjacent Florida platform (**Figure 1**). By contrast, the Main Pass area, and probably extending into the western Mississippi Canyon area, has significant clastic input as amply demonstrated by the Main Pass well. This distribution of sediment types is mirrored in the onshore and adjacent platform areas. Clastics provide effective Tuscaloosa reservoir in Louisiana in fields such as False River and Port Hudson, while to the east the dominant, albeit older, Cretaceous reservoirs are carbonate patch reefs of the James Lime and Andrews Formation.

General Dinner *continued on page 33*

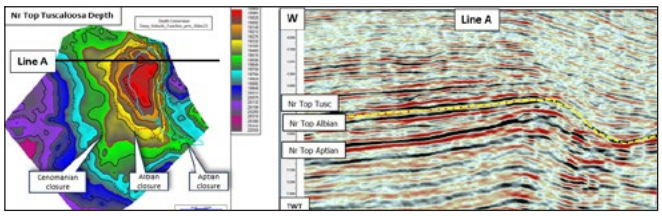


Figure 2. *A Cretaceous 4-Way on the Shelf*

CCUS Lunch and Learn continued from page 31

BIOGRAPHICAL SKETCH

Bryan Guzman received his BS in Geology from the University of Texas at San Antonio in 2008 and his MS in Analytics at Texas A&M University in 2018.

He began his career as a geologist for Ingrain, Inc. in 2008 where he was an integral part of the company's validation period that led to the commercial launch of their product lines and subsequent sale to Halliburton. He is a technical expert in digital rock analysis and deployment of state-of-the-art technologies within the core analysis space. Recently, he has driven Premier's growth into the Carbon Capture and Storage market through participation in Department of Energy (DOE) funded projects, development of training courses that help subsurface teams satisfy federal and state regulations, and consulting with commercial entities on existing projects. Over his career he has held positions in operations, research & development, and sales & marketing.

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PREMIER COREX

General Dinner continued from page 32

Werrus has carried out extensive mapping on 3D data in the Main Pass area demonstrating the presence of large simple untested Cretaceous traps in well-imaged turtle features. **Figure 2** illustrates an example from Main Pass, showing a large well-defined 4-way closure from Lower Miocene to Aptian level, without any overlying salt which would have provided depth conversion uncertainty. The relatively modest drill depth (20,000ft), the shallow water and the nearby infrastructure make this an attractive high volume target area, already substantially derisked by the recent drilling.

CONCLUSIONS

We suggest that future drilling for the Cretaceous plays should be focused on the western portion of Main Pass and Mississippi Canyon, where there is a much better chance of encountering clastic reservoirs throughout this sequence. Within that arena, a test in the shallow water Main Pass would provide a cost-effective test of concept. ■

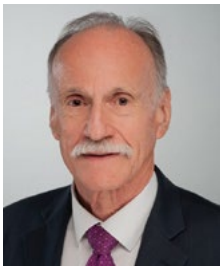
KEY REFERENCES

Hoorn, B.W., 2011. "Identifying new exploration fairways in the Gulf of Mexico: Deepwater Tuscaloosa/Woodbine Play", GCACS Transactions, V 61, p 245-256.

Moffett, J.R., 2015. "Discovering the Missing Piece of the Gulf of Mexico Puzzle" Search and Discovery Article #110198.

Sweet, M.L. et al, 2022 "The Early Cretaceous Transition from Carbonate to Siliclastic Deposition in the Dep Waters of the Northern Gulf of Mexico: New Insights from the Keathley Canyon 102 #1 Well". GCAGS Transactions, V71 (2021), p 58-70.

BIOGRAPHICAL SKETCH



Peter Mullin began his career as a seismic interpreter with Shell International, in later years he was posted to Head Office in The Hague as a Shell advisor and later as Exploration Manager for Angola and then Brazil, in charge of very successful deepwater ventures. He later joined Hess, first as Exploration Manager, Brazil; then in a global new ventures review team, and finally as Americas Regional Geology Manager. Mullin left Hess when it went "unconventional" and joined a small start-up (PanAtlantic) as new ventures manager. After PanAtlantic closed down, he became a consultant geologist and economist in both oil and gas and renewables, working for multiple clients in the Gulf of Mexico, Alaska, Mexico, West Africa, and Malaysia among others. He is currently VP of Exploration for Werrus Aquamarine, a Gulf of Mexico shelf player.

Peter Mullin's 40 years of global experience leads him to conclude that the GOM Super-basin remains under-explored, with undiscovered volume potential on par with the frontier basins but with much lower risk, better terms than most, and relative ease of monetization.

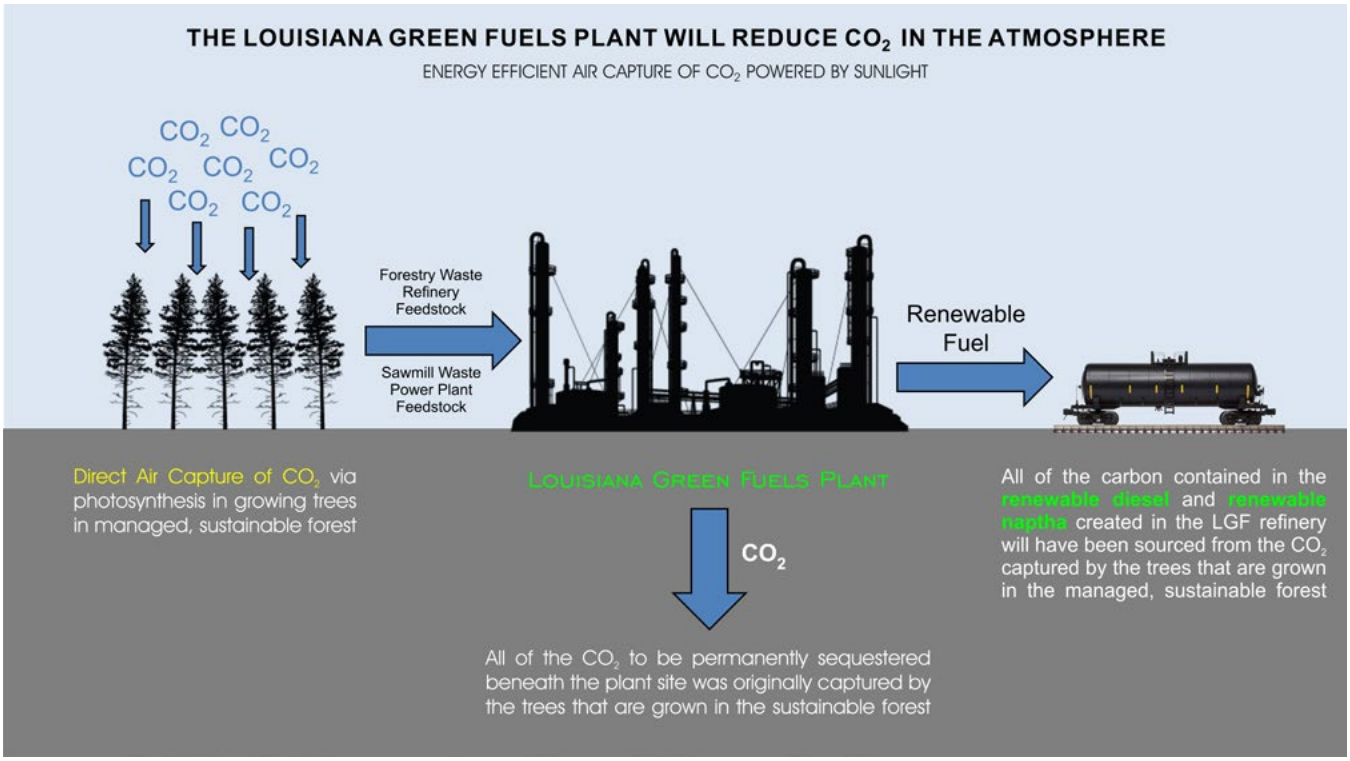
Wednesday, October 25 , 2023

11:30 a.m. – 12:30 p.m.

HGS Members $20 • Students $10 • Non-Members $25
Register using the HGS website calendar.
Zoom link will be emailed to registrants.
https://www.hgs.org/civicrm/event/info?id=2486
Event Contact: Linda Sternbach • linda.sternbach@gmail.com

Steve Walkinshaw
Vision Exploration

The Geology of the Deeply Carbon Negative Louisiana Green Fuels CCS Project: Caldwell Parish, Louisiana



In northeast Louisiana, the world's most deeply carbon negative renewable fuels project is underway. From forest waste products, Strategic Biofuels' planned Louisiana Green Fuels refinery, located just north of Columbia in Caldwell Parish, will annually produce 32 million gallons of renewable fuel comprised of 83% synthetic diesel and 17% naphtha, all of which will be shipped to California via rail. The Louisiana Green Fuels refinery is also capable of producing significant volumes of Sustainable Aviation Fuel (SAF). An on-site biomass power plant will consume sawmill waste and provide all of the power for the refinery, thus enabling the facility to be completely "off the grid." All of the waste gas from the power plant and refinery will be sequestered underground using three purpose-built injection wells.

The underground sequestration of all of the facility's waste gas, 99.5% carbon dioxide, represents a critically important operational objective of the Louisiana Green Fuels facility. To demonstrate the viability of the proposed CCS operation, a 6,200' Class V injection test well was drilled and injection-tested just southeast of the proposed plant site in 2021. Numerous whole cores and rotary cores – along with a comprehensive suite of open-hole logs – were acquired to analyze the rock properties of the primary CO2 sequestration zones and the upper and lower confining layers. Most of these strata had neither been cored nor studied in the northeast Louisiana area for many decades.

Strategic Biofuels submitted its Class VI application to the EPA via its GSDT on March 15, 2023 and its application was deemed Administratively Complete on April 24, 2023. Because it had already drilled, cored, and injection-tested its Class V injection test well in 2021, the comprehensive site-specific data derived from the testing of the proposed sequestration reservoirs was thoroughly integrated into the static and dynamic modeling that formed the cornerstone **General Luncheon Meeting** *continued on page 35*

General Luncheon Meeting continued from page 34

of the Company's Class VI permit application, thus ensuring that its application was more advanced than most other Class VI applications submitted to the EPA to date.

This presentation focuses on this innovative facility, its unique project economics, the subsurface geology of the Caldwell Parish area, and the drilling, evaluation, and testing of the Louisiana Green Fuels injection test well. ■

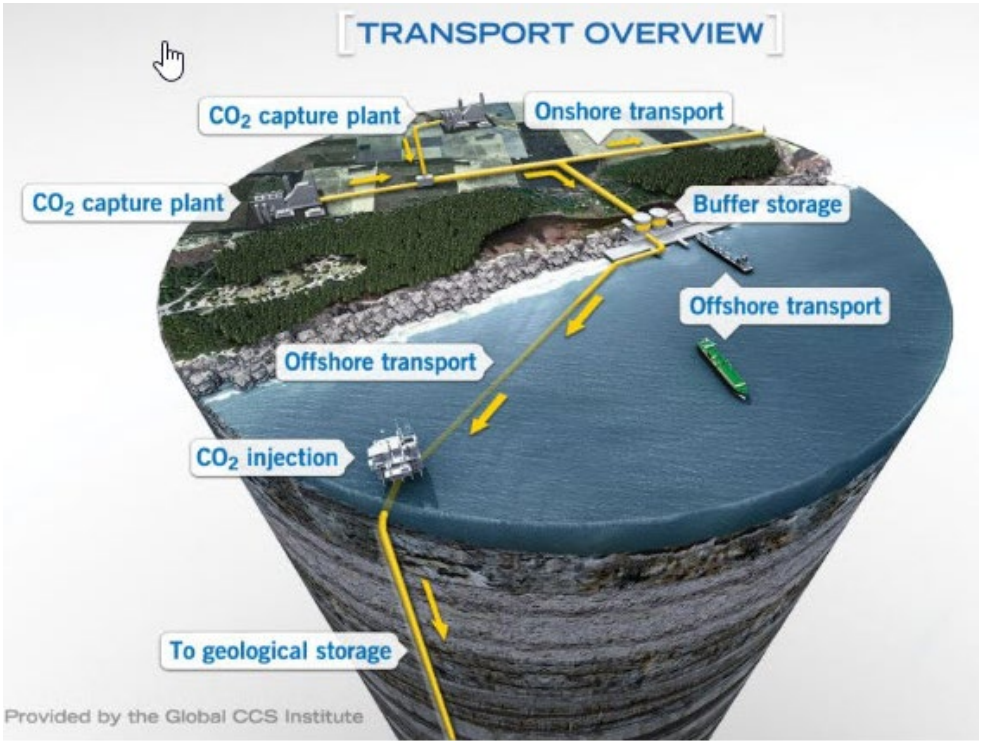
BIOGRAPHIAL SKETCH

Steve Walkinshaw, VP of Geosciences, brings with him 40 years of experience in oil and gas exploration and development. He is responsible for the geology as it relates to carbon sequestration and has been working together with Strategic Biofuels since November 2020. He performed the initial seismic analysis for the project and has worked directly with our COO Bob Meredith and Geostock Sandia in developing and executing the sequestration test well program and the ongoing analysis required for submission of the EPA Class VI well permit.

Walkinshaw is the owner and manager of Vision Exploration, LLC and graduated from Millsaps College in 1981. As an adjunct professor, Steve has also taught Petroleum Geology at Millsaps College. He is a Registered Professional Geologist in the State of Mississippi, a Licensed Professional Geoscientist in the State of Louisiana, and an AAPG/DPA Certified Petroleum Geologist.

Steve Walkinshaw is the chief geoscientist for the Louisiana Green Fuels project and has been responsible for most of the geological mapping and all of the geophysical mapping and wellsite supervision related to the project. He is also the chief liaison for the company in its dealings with CARB, the LDNR, and the EPA, and was responsible for recently filing the company's Class VI Permit application with the EPA via the GSDT. Steve is based in Madison, Mississippi and is also the owner and manager of Vision Exploration, LLC. He graduated from Millsaps College in 1981 and has 42 years of experience in oil & gas exploration and development as well as carbon capture sequestration and geothermal exploration. Steve is a Registered Professional Geologist in the State of Mississippi, a Licensed Professional Geoscientist in the State of Louisiana, and an AAPG/DPA Certified Petroleum Geologist. This PowerPoint was recently presented at the 2023 SPE / AAPG / SEG CCUS Conference in Houston.

Steve was also a contributing author for two other related presentations given at the same Conference: "Rock Strength measurements associated with sCO2 injection into saline aquifers for the Louisiana Green Fuels CCS Project, Caldwell Parish, Louisiana" (Lori Hathon, University of Houston, lead author) and "Reservoir model calibration of sCO2 injection into saline aquifers for the Louisiana Green Fuels CCS Project, Caldwell Parish, Louisiana" (Alessandra Simone, Geostock Sandia, lead author).



October 2023

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2 Make your reservations online at hgs.org	3	4	5	6	7 **HGS 100th Anniversary Gala at the Petroleum Club** *https://www.hgs.org/civicrm/event/info?id=2403*
8 **AAPG Mid-Continent Conference** *https://www.hgs.org/civicrm/event/info?id=2469*	9	10	11 **CCUS Lunch and Learn** *A Brief History of Carbon Sequestration in the U.S.* *Page 31* *https://www.hgs.org/civicrm/event/info?id=2500*	12	13	14
15	16 **HGS Golf Tournament** *https://www.hgs.org/civicrm/event/info?id=2490* **HGS General Dinner Meeting** *https://www.hgs.org/civicrm/event/info?id=2476*	17	18 **HGS E&E Dinner Meeting** *TBA*	19	20 **HGS Short Course** *Applied Understanding for Geoscientists of How Engineers Calculate Reservoir OIl and Gas Volumes Using PVT* *Page 15https://www.hgs.org/civicrm/event/info?id=2488*	21
22	23	24	25 **HGS Luncheon Meeting** *The Geology of the Deeply Carbon Negative Louisiana Green Fuels CCS Project.* *Page 34* *https://www.hgs.org/civicrm/event/info?id=2486*	26	27	28
29	30	31				

RESERVATIONS The HGS prefers that you make your reservations online 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, contact the HGS office at OFFICE@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.**

HGS ANNUAL
GOLF TOURNAMENT
16 OCTOBER 2023 | STERLING COUNTRY CLUB

SPONSORSHIP FORM

Sponsorship deadline: October 9, 2023

Title Sponsorship $2,250
- Sponsor LOGO signs on courses
- Company LOGO prominently displayed on sponsor recognition board at registration and awards banquet
- Company LOGO displayed on driving range and practice putting green signs
- Company LOGO displayed on beverage carts
- Set up on 2 holes (Meet & Greet, Swag and Food)
- Tournament entry for one team (4 people)

Beverage Sponsorship $2,000
- (All beverages must be purchased from the Club)
- Sponsor LOGO on HGS website and social media
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- Set up on 2 holes (Meet & Greet, Swag and Food)
- Tournament entry for one team (4 people)

Lunch Sponsorship $2,000
- Can BBQ onsite, bring in caterer, or have HGS pick the food
- Sponsor LOGO on HGS website and social media
- Company LOGO prominently displayed on sponsor recognition board at registration and awards banquet
- Set up on 2 holes (Meet & Greet, Swag and Food)
- Tournament entry for one team (4 people)

Breakfast Sponsorship $500
- Breakfast Tacos
- Sponsor LOGO on HGS website and social media
- Company LOGO prominently displayed on sponsor recognition board at registration and awards banquet
- Set up on 1 holes (Meet & Greet, Swag and Food)
- 1 complimentary Registration

Nicklaus Sponsorship $1,000
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- Company LOGO prominently displayed on sponsor recognition board at registration and awards banquet
- Company LOGO displayed on driving range and practice putting green signs
- Set up on 1 hole (Meet & Greet, Swag and Food)
- 2 Complimentary Registrations

Hogan Sponsorship $500
- Sponsor LOGO signs on courses
- Company LOGO displayed on sponsor recognition board at registration and awards banquet
- Set up on 1 hole (Meet & Greet, Swag and Food)
- 1 complimentary Registration

Trevino Sponsorship $250
- Sponsor LOGO signs on courses.
- Company NAME displayed on sponsor recognition board at registration and awards banquet
- No Complimentary Registration

Individual Sponsorship $150
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- Company NAME displayed on sponsor recognition board at registration and awards banquet
- No Complimentary Registration

Raffle Swag Prize Sponsorships
- Par Sponsor **$250**
- Birdie Sponsor **$500**
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Please submit company logo with form and payment. Payment by credit card or check.
Please make checks payable to *Houston Geological Society*. Email form to office@hgs.org.

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SPECIALTY SWAG SPONSORSHIP FORM

Sponsorship deadline: October 2, 2023

Gift Bag Tote Sponsor $1,000 - 1 available

- Sponsor logo on white gift bag tote giveaways
- Sponsor logo prominently displayed on sponsor recognition board at registration and awards banquet
- Sponsor logo displayed on HGS website and social media

Divot Tools Sponsor $750 - 1 available

- Sponsor logo on metal divot tool giveaways
- Sponsor logo prominently displayed on sponsor recognition board at registration and awards banquet
- Sponsor logo displayed on HGS website and social media

Golf Ball Sponsor $700

- Sponsor logo on golf ball giveaways
- Sponsor logo prominently displayed on sponsor recognition board at registration and awards banquet
- Sponsor logo displayed on HGS website and social media

Tee Sponsor $500

- Sponsor logo on bamboo tee giveaways
- Sponsor logo prominently displayed on sponsor recognition board at registration and awards banquet
- Sponsor logo displayed on HGS website and social media

Please submit company logo with form and payment. Payment by credit card or check.
Please make checks payable to *Houston Geological Society*. Email form to office@hgs.org.

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Contact Name: _____

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TEAM APPLICATION

Early Bird Deadline: October 9, 2023

Entry Deadline: October 12, 2023

Come join us for golf, food, friends, and fun at the annual HGS Golf Tournament at Sterling Country Club and Houston National Golf Club (www.sccathn.com). There will be prizes awarded for closest to the pin and long drive, putting games before we start, as well as many great door prizes for participants.

Entry Fee: $175.00/Golfer or $700.00/Team.
Early Bird Special (Through October 9th): $150.00/golfer or $600.00/team
Entry Deadline: October 12th.

Individual entries will be grouped with other individual golfers to make a foursome. Entries are limited to and will be accepted on a first-in basis.

Schedule of Events

8:00am - 9:45am Registration, free use of driving range and mini games
10:00am Shotgun start
3:00pm Cash bar, open buffet
3:30pm Door prizes and awards presentation

Companies or individuals interested in sponsoring the event should contact the HGS Office at office@hgs.org or 713-463-9476. If paying by check, please make check payable to HGS or Houston Geological Society. Sponsorship deadline is October 9th.

Team Captain: _____ Phone:_____ Amount Enclosed:_____

Company: _____ Email: _____

Card Number: _____ Exp. Date:_____ CVC:_____

Billing Address: _____

Foursome Members	Company	Phone	Email
1.			
2.			
3.			
4.			

Please print and provide email addresses for ALL team members, as all communications will be done via email.

FIRST ANNUAL HGS SPORTING CLAYS SHOOT

HGS 100TH YEAR ANNIVERSARY

SATURDAY DECEMBER 09, 2023
WESTSIDE SPORTING GROUNDS
10120 PATTISON RD., KATY, TX 77493

$800/4 person Team
$200 / Individual
Includes 4-man cart, 12 & 20ga ammo
Gun Rentals are available from the venue

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Sponsorship Opportunities Available!

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your team now!

Registration & Sponsorship Info: www.hgs.org
or call 713-463-9476

First Annual HGS Sporting Clays SHOOT
HGS 100 YEAR ANNIVERSARY

Saturday, December 9, 2023
Westside Sporting Grounds
10120 Pattison Rd., Katy, TX 77493

Individual and Team Entry Form

This is a 100-target event, a 4-man cart per team and ammo are provided, **participants must provide eye and ear protection.** Westside Sporting Grounds and National Sporting Clay Association safety rules will be in effect. Door prizes and raffle tickets will be awarded by blind drawing after the conclusion of shooting. You must purchase tickets for the drawing, and you must be present at the time of the drawing to win. Lunch will be provided from 11:30 until 1:30. Refreshments will be available throughout the day. **Non-shooting guests are welcome to enjoy lunch and refreshments at a cost of $25 per guest.**

We are limited to 120 shooters on 1 course. Entry fee is $200.00 per shooter for registrations received by MONDAY, DECEMBER 1st. After 12/1/23 REGISTRATION IS CLOSED. Individual shooters will be squadded with a team ***Register early it will fill up fast!!***

For more information, contact: Andrea Peoples at (713) 463-9476 or office@hgs.org
For directions to the club, visit www.wsgclays.com

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ONLINE REGISTRATION INFORMATION AT: https://www.hgs.org/civicrm/event/info?id=2078

To pay by check, mail this form with a check made out to HGS to:
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To pay by credit card, please call the HGS office: (713) 463-9476.

Name: _____ Company: _____

Email: _____ Phone: _____

CC#: _____ Exp:_____ CVC: _____

Ammo: (circle one) 12 gauge 20 gauge

Entry Fees: $ _____ + Guest Fees: $_____ + Sponsor Contribution: $ _____ = Total: $_____

If you wish to register as a squad, please return forms for all squad members together.

ALL SHOOTERS WILL BE REQUIRED TO SIGN A WAIVER OF RESPONSIBILTY BEFORE THEY WILL BE ALLOWED TO SHOOT!

Team Member Name	Email Address	Phone	Ammo Guage
1._____	_____	_____	_____
2._____	_____	_____	_____
3._____	_____	_____	_____
4._____	_____	_____	_____

First Annual HGS Sporting Clays SHOOT

HGS 100 YEAR ANNIVERSARY

Saturday, December 9, 2023
Westside Sporting Grounds
10120 Pattison Rd., Katy, TX 77493

Name: _____ Company: _____

Email: _____ Phone: _____

Sponsorship Level: _____ Amount: _____

Credit card # _____ Exp. Date: _____

Corporate Sponsor - $2,500

This will include one 4-man shooting team with carts and ammo. Your company logo will be recognized as a Corporate sponsor and be displayed on the website, printed banner, sponsor board and promotional items.

Hat Sponsor - $1,500

This will include one 4-man shooting team with carts and ammo. Your company logo will be recognized as the Hat sponsor and be displayed on the hat, website, printed banner, sponsor board.

Lunch Sponsor - $1,500

This will include one 4-man shooting team with ammo. Your company logo will be recognized as a Lunch sponsor and be displayed on the website, printed banner.

First Annual HGS Sporting Clays SHOOT
HGS 100 YEAR ANNIVERSARY

Beverage Sponsor - $750

This will include two team member registration with ammo. Pay for two more team registrations and get the cart with your package. Your company logo will be recognized as a beverage sponsor and will be displayed on the website, printed banner.

Breakfast Sponsor - $750

This will include two team member registrations with ammo. Pay for two more team registrations and get the cart with your package. Your company logo will be recognized as a breakfast sponsor and will be displayed on the website, printed banner.

Station Sponsor - $500

Company Logo will be displayed at assigned station, website and printed banner. You will be allowed to set up a tent at your sponsored station(s). You can either cook or provide snacks and non-alcoholic drinks to the participants.

Door Prize / Raffle Sponsor - $500

Company Logo will be displayed on website and printed banner.

Individual Sponsor - $250

Company Logo will be displayed on website and printed banner.

To pay by credit card, please complete the form and return to office@hgs.org or call 713-463-9476
To pay by check, mail this form with a check made out to HGS to:
Houston Geological Society, 14811 St. Mary's Lane, Ste. 250, Houston, TX 77079

HGS Membership Application

Houston Geological Society
14811 St Mary's Lane Suite 250 Houston
TX 77079
Phone: (713) 463-9476
Email: office@hgs.org

Active Membership

In order to qualify for Active Membership you must have a degree in geology or an allied geoscience from an accredited college or university or, 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 5 years. Active Members shall be entitled to vote, stand for election, and serve as an officer in the Society. Active Members pay $36.00 in dues.

Associate Membership

Associate Members do not have a degree in geology or allied geoscience, but are engaged in the application of the earth sciences. Associate Members are not entitled to vote, stand for elections or serve as an officer in the Society. Associate Members pay $36.00 in dues.

Student Membership

Student membership is for full-time students enrolled in geology or an allied geoscience. Student Members are not entitled to vote, stand for elections or serve as an officer in the Society. Student Member dues are currently waived (free) but applications must be filled out to its entirety. Student applicants must provide University Dean or Advisor Name to be approved for membership.

Membership Benefits

Digital HGS Bulletin

The HGS Bulletin is a high-quality journal digitally published monthly by the HGS (with the exception of July and August). The journal provides feature articles, meeting abstracts, and information about upcoming and past events. As a member of the HGS, you'll receive a digital copy of the journal on the HGS website. Membership also comes with access to the online archives,with records dating back to 1958.

Discount prices for meetings and short courses

Throughout the year, the various committees of the HGS organize lunch/dinner meetings centered around technical topics of interest to the diverse membership of the organization. An average of 6 meetings a month is common for the HGS (with the exception of July and August). Short courses on a variety of topics are also planned throughout the year by the Continuing Education Committee. These meetings and courses are fantastic opportunities to keep up with technology, network, and expand your education beyond your own specialty. Prices for these events fluctuate depending on the venue and type of event; however, with membership in the HGS you ensure you will always have the opportunity to get the lowest registration fee available.

Networking

The HGS is a dynamic organization, with a membership diverse in experience, education, and career specialties. As the largest local geological society, the HGS offers unprecedented opportunities to network and grow within the Gulf Coast geological community.

Please fill out this application in its entirety to expedite the approval process to become an Active/Associate member of Houston Geological Society.

Full Name _____ Type *(Choose one)*: Active Associate Student

Current Email *(for digital Bulletin & email newsletter)*_____

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Preferred Address for HGS mail_____

This is my home address _____ business address _____

Employer *(required)*_____ Job Title *(required)*_____ Will you volunteer? ____ (Y/N) Committee choice: _____

Annual dues Active & Assoc. for the one year *(July 1st-June 30th)* **$36.00**_____

Student **$0.00**_____

OPTIONAL Scholarship Contributions- Calvert/HGS Foundation-Undergraduate **$5.00**_____

Total remittance_____

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Check #_____

Credit card: V MC AE Discover

Credit Card#_____

CVV code (req'd): _____ Expiration: _____ (mm/yy)

Signature: _____ Date: _____

To the Executive Board: I hereby apply for membership in the Houston Geological Society and pledge to abide by its Constitution & Bylaws.

Company*(required, mark 'in transition' if unemployed)*_____

Company Address _____

City *(Work)* _____ **State** *(Work)* _____ **Postal Code** *(Work)* _____

School *(required)*_____

Major *(required)*_____ **Degree** *(required)*_____

Year Graduated _____

School *(optional)*_____

Major *(optional)*_____ **Degree** *(optional)*_____

Year Graduated _____

Years Work Experience *(required)*_____

Please submit a brief statement regarding your work experience in the practice or application of earth science or an allied science.

AAPG Member Number _____ OR

HGS Sponsor's Name _____

Signature: _____ **Date:**_____

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Victor H. Abadie III
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