HGS Bulletin
Houston Geological Society
Volume 66, Number 3
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In Every Issue

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About the Cover: View of Litli Geysir (Little Geyser) captured August 2008 in southwestern Iceland. Surface expressions of geothermal features have historically been used to identify deep geothermal deposits.

Technical Meetings

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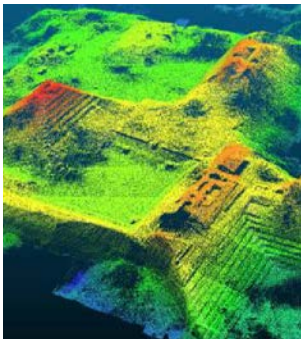
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Houston Celebrates the HGS

Last month, the Society's 100th year Gala was held at the Petroleum Club of Houston. The Gala focused on the 25 years since the 75th year Gala that was held in 1998, also at the Petroleum Club. After dinner, presentations were made by me, Charles Sternbach, and Jeff Lund. Then, we held an "open mic" session where attendees were given the opportunity to share their experiences with the HGS. Speakers ranged from well-seasoned professionals to newer members, including two HGS scholarship recipients. The event was a truly momentous occasion that was made even more special by chocolate oil derrick desserts. A recap and photos from the Gala is included in this *Bulletin*.

to stimulate interest and promote advancement in geology for the Houston area

To commemorate the 100th year anniversary, October 7th was proclaimed by Mayor Sylvester Turner as the Houston Geological Society Day. The proclamation states, "The objectives of the Houston Geological Society are: to stimulate interest and promote advancement in geology for the Houston area; to disseminate and facilitate discussion of geological information, relationships among geologists in the area; and to aid and encourage academic training in the science of geology." Turner recognizes the HGS' contributions through events, activities and publications, and writes that "the Society has rendered a service to its members, the geological profession, and … to the entire community." Thanks to HGS member Mark Hamzat for his initiative in getting this proclamation from the Mayor's office.

RENEW YOUR MEMBERSHIP!

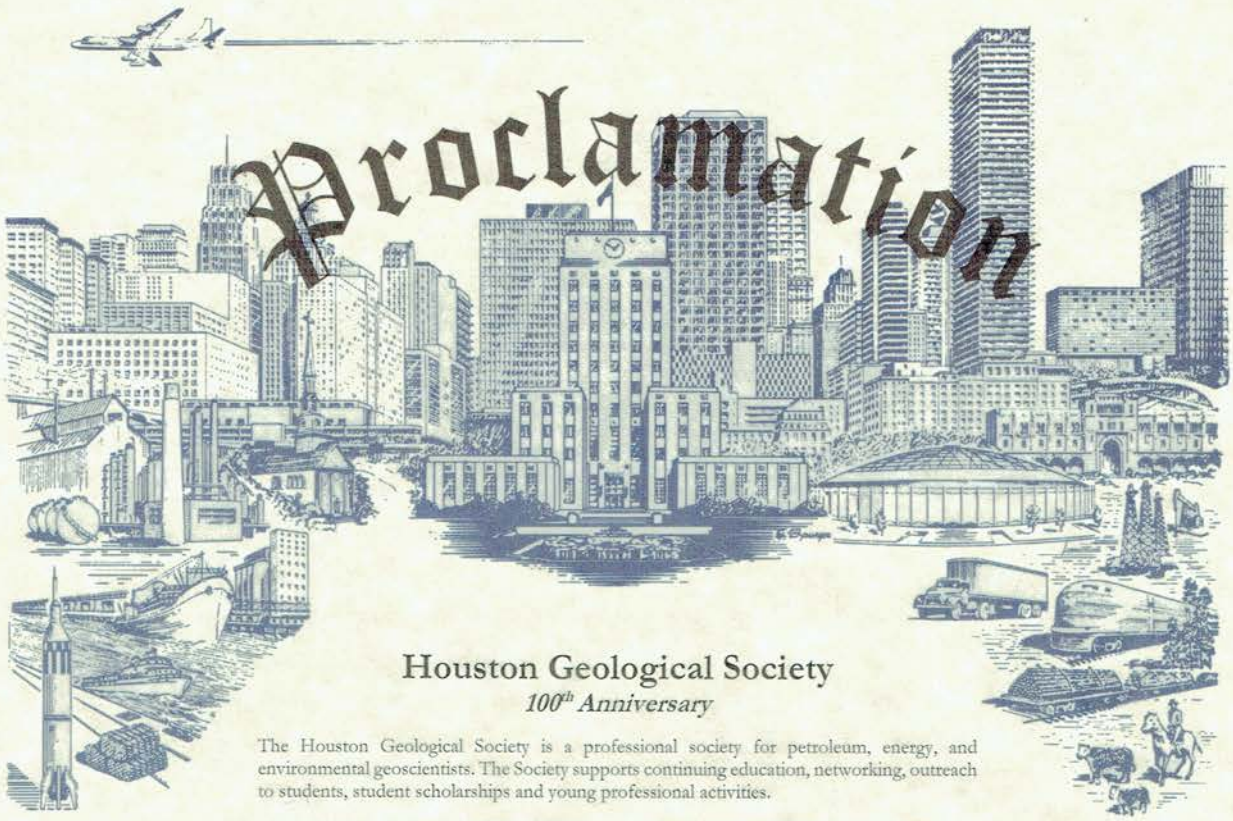
Many members have not yet renewed their membership that was due on June 30. You may not have realized that your membership has lapsed, but there is still time to renew! Historically, members were removed from Society roles after September, but this year we are extending the renewal offer through November. Please check your membership account online, or you can email the office at office@hgs.org to check your membership status.

OCTOBER EVENTS

October saw very successful in-person events including the the annual Golf Tournament, General Dinner, the Environmental & Engineering Dinner, and a NeoGeos Happy Hour. Additionally, we held for the first time a lunch and learn about Carbon Capture, Utilization, and Storage (CCUS). Thanks to the committees and members who organized these in-person events. We increased our virtual offerings with a General Luncheon and a Continuing Education class that were also well-attended.

UPCOMING EVENTS

- The E&E Group is hosting an ethics talk Wedesday November 8 that will be especially of interest to those of us who require professional development hours to maintain a P.G. license.
- The 25th Annual Sheriff Lecture will be held on Monday, November 13.
- A one-day field trip on Saturday, November 18 that covers geology of the Brazos Delta to Galveston promises to be a fantastic opportunity to see modern depositional processes in action.
- The Sporting Clays Tournament is returning this year and will be held on Saturday December 9.



Proclamation

Houston Geological Society

100th Anniversary

The Houston Geological Society is a professional society for petroleum, energy, and environmental geoscientists. The Society supports continuing education, networking, outreach to students, student scholarships and young professional activities.

The objectives of the Houston Geological Society are: to stimulate interest and promote advancement in geology for the Houston area; to disseminate and facilitate discussion of geological information, relationships among geologists in the area; and to aid and encourage academic training in the science of geology.

The Society strives to achieve these goals through regularly scheduled technical meetings, publication of a monthly Bulletin, a continuing education program, field trips, the publication of timely books, and two student scholarship funds.

Through its publication efforts, the Society has rendered a service to its members, the geological profession, and occasionally to the entire community with books of general interest. The publication, "Houston Area Environmental Geology: Surface Faulting, Ground Subsidence, Hazard Liability," is a significant contribution to both the geological and lay communities.

The Society encourages and aids students through the Calvert Memorial Scholarship Fund for graduate students, and the Undergraduate Scholarship Fund for undergraduates. The Society also gives Outstanding Geology Student Awards to Stephen F. Austin University, Lamar University, Texas A&M University, the University of Texas at Austin, Rice University, the University of Houston, and Sam Houston State University; and promotes participation in the Houston Engineering and Science Fair.

On October 7, 2023, the Houston Geological Society will celebrate their 100th anniversary. The City of Houston commends the Houston Geological Society for their significant contributions to the geological community.

THEREFORE, I, Sylvester Turner, Mayor of the City of Houston, hereby proclaim October 7, 2023, as

Houston Geological Society Day

100th Anniversary

in Houston, Texas.

In Witness Whereof, I have hereunto set my hand and have caused the Official Seal of the City of Houston to be affixed this 4th day of October, 2023.

Sylvester Turner
Mayor of the City of Houston

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

Why Pivot?

Pivoting is a common theme among the 10+ geologists I interviewed for this month's *Bulletin*. Many of the geologists working in the Geothermal Industry started their professional careers in Oil and Gas. For some, the pivot to Geothermal was facilitated by the need for a job transition after Oil and Gas Industry downturns in ~2015 and ~2020. Others pivoted to Geothermal because they wanted to find a slower pace of life, live in a location where Oil and Gas employment is not common, or to align their professional contributions with decarbonization of the energy economy. In all cases, the geologists I interviewed were enthusiastic about their decisions to pivot and welcome other pivoters.

pivoting is a natural part of a geologist's career

PIVOTING IS A NATURAL PART OF A GEOLOGIST'S CAREER

I began my college career with an intention of becoming an paleoanthropologist. That intention changed during the summer after my freshman year, when I studied abroad in Kenya on paleoanthropology field school. The summer was spent listening to a few prominent scientists debate whose hominid fossil was better. As I looked out on the vast savannah, I realized that rocks were plentiful where fossils were scarce. I decided to let the paleoanthropologists continue to fight about their hominids and I pivoted to learning about Earth's processes.

The idea of pivoting from a crowded, cutthroat market to an emerging market is called a "Red Ocean v. Blue Ocean" approach, which was explained by Chan Kim and Renee Mauborgne in their 2005 book *Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant*. Although I didn't know it at the time, I made a decision to pivot into a blue ocean.

Like many geologists, I've made a blue ocean pivot multiple times throughout my career. The decision to join the Oil and Gas Industry was a highly attractive option in 2005, as companies were hiring in response to rising commodity prices. At that time, the Oil and Gas industry looked like a blue ocean opportunity. I made a similar blue ocean choice in 2021 to pivot from Oil and Gas Exploration to Carbon Capture, Utilization, and Storage. Some of the geologists who have pivoted to geothermal are making blue ocean choices.

TAKE A CHANCE ON YOURSELF OR SOMEONE ELSE

Another reoccurring theme of the interviews in this month's *Bulletin* is the acknowledgement that making a pivot requires taking risk. The geologists who left behind Oil and Gas careers are taking a risk to move into an emerging market. In this *Bulletin*, you can read about Mike Eros, Chief Geoscientist of Sage Geosystems, who took a risk to leave a corporate Oil and Gas role to join a start-up company, and Nicole Wagoner, PhD student, who took the risk to leave Oil and Gas and return to school for a different career path.

In order for these geologists to pivot into Geothermal, it required employers, co-founders, and family members to take a risk, too. I talked with Derek Adams in *Pivot Profile* about the risk he took to start his own geothermal energy storage company and some of the lessons he has learned along the way. He emphasized that having a strong professional and personal support system is a critical component to enable risk-taking. In my personal experience, I've been amazed by the willingness of some employers to take a risk on me. I look for ways to support others who are looking to take a risk and make a blue ocean pivot.

READ MORE ABOUT THE GEOTHERMAL INDUSTRY, PIVOTING AND RISK-TAKING IN THIS BULLETIN:

- Learn about geologists who pivoted to the Geothermal Industry in the article *Hot Rock and Hot Fluids are Hot Topics.*
- See Derek Adams' pivot from Oil and Gas Geologist to Geothermal Innovator in *Pivot Profile*.
- Learn about mining for lithium in geothermal brines to reduce risk of critical mineral supply shortages in *Lithium Mining from Geothermal Brines: A Team from Rice University and Chevron Leads the Way*.
- In *We are the HGS,* hear from Carolyn Miracle Ross who took a risk to be one of the first female geologists working in Oil and Gas, and the manager who finally took a risk to give her a job. Also, read Rogers Beall's story about making a risky pivot from business management to seismic entrepreneur. Beall believes companies and the HGS should be taking more risk today.
- Charles Sternbach and Dick Bishop discuss characteristics of high-risk, but high-reward super major oil fields in their article *Gulf Coast Giant and Super-Giant Fields Compared to Global Super-Giants: Analogs to Help us Find More*.

We Are The HGS

Carolyn Miracle Ross HGS member since 1968

As a woman geologist who started her professional career in the late 1950's, Carolyn Ross laughs that she was always a "party of one." Being the only one has not kept Ross from pursuing an impactful geology and earth science career for more than seven decades. She says she had to prove herself over and over again, and has had to develop a tough skin, but those challenges did not dissuade her from working international projects.

Ross says that her passion for international work started as a young girl growing up on a farm in rural Arkansas where her exposure to the world was though pen pals. Although she was valedictorian of her graduating class, she knew that her family could not afford to send her to college. By chance, her father saw a magazine article about an academic competition, and that article set her life on a different course. She won the competition and earned the interest of University of Arkansas, where she was encouraged to apply for a scholarship. Although she wasn't very interested in geology, she laughs that it was better than the other options, which included football, music, or chemical engineering. Ross graduated with honors in 1958 and found a professional work environment that was openly hostile to women geologists.

"We can't hire you as a geologist, but we really need a good geology secretary," was the message Ross repeatedly heard from potential employers. After nearly nine years of working in supporting roles such as geology librarian and draftsman, she was finally offered a role by an open-minded manager at Phillips Petroleum. She says the manager told her, "I can't hire you as a geologist, but I can create a job as an assistant geologist for you." She took the offer and later went on to hold geologist positions at multiple companies including Shell, Monsanto and others before becoming an independent consultant.

By the early 1980s women were more accepted in geology workplaces, but old attitudes persisted among some managers. She recalls one manager who routinely introduced her as a "woman geologist" to counterparties and "apologized for bringing a woman geologist" to technical meetings.

Ross found acceptance among the HGS and realized that she could be a leader in the society, even if professional workplaces were restrictive. Tired of the emphasis on Gulf Coast geology, Ross had the idea to create the International Explorationists section of the HGS. They held their first meeting in March 1983, and the interest in their events helped propel HGS to be one of the largest professional geology societies in the world in the 1980s and 1990s. Ross says that she wanted the International Explorationists meetings to feature discussion and debate, so she held the meetings in the evening following cocktail hour and dinner. She soon realized that she did not have to worry about engaging the audience, as the International Explorationist attendees did not hold back on their commentary.

Ross recalls one the most impactful pieces of advice she received in her career was from a manager who told her, "It's up to you to make sure we know you are doing a good job." Ross realized that she needed to highlight her accomplishments rather than expecting management to figure it out on their own. In addition to this advice, Ross advises junior geologists is to keep up to date with new technologies and interpretations. Furthermore, she offers the importance of finding a spouse who supports your dreams and goals.

Ross was honored with the Distinguished Service Award in 1990 for her service to HGS. She has also been featured in the book *Anomalies: Pioneering Women in Petroleum Geology 1917-2017.* ■

Rogers Beall HGS member since 2003

"How can we reinvigorate geologists to be true to ourselves?" asks Rogers Beall, an HGS member who has been working for nearly 50 years. To Beall, "being true" means focusing on oil and gas industry, instead of expanding into hydrogen, renewables, or other industries that he says "geologist weren't set up for." After working in Africa for decades, Beall has seen the tremendous impact that oil and gas can have on lifting people out of poverty. Furthermore, he believes that geologists have an important role to play in increasing the standard of living and reducing poverty in the United States and elsewhere.

Beall started his career in business and engineering by going to work for Arthur Anderson in 1969 and then NASA a few years later. In 1974, he pivoted his skill set to work for a seismic acquisition and brokerage company, Richardson Seismic Services, where he became President of Northern Operations. Beall then founded Africa Fortesa Corporation in the late 1990s to specialize in offering data packages for exploration in the offshore and onshore West Africa. He currently spends much of his time at Fortesa's headquarters in Senegal.

We Are The HGS *continued on page 10*

We Are The HGS continued from page 9

Beall says that he has seen significant changes in the Houston oil and gas industry since the 1970s. For example, most of the mid-sized independent companies like Anadarko and Noble have merged with larger companies and those larger companies are less inclined to participate in external technical sharing. Most significantly, Beall say he has seen a sharp decline in oil and gas exploration activity as companies have shifted their focus to paying down debt through optimizing producing assets to increase cash flow. "Exploration is not of interest. It's hard to run a [data] promotion when no one wants to take risk," says Beall.

The HGS could do more to help invigorate the exploration business, explains Beall. "Maybe the Society should be talking about risk management," he says of how to encourage exploration. He notes that the largest discoveries, such as Guyana, happened because companies took risk. Beall also offers that the HGS should look to the pioneers of the past such as Michael Halbouty and George Lindahl for inspiration on risk-taking.

"We will get stronger by more people doing more community service, more leadership," suggests Beall. "The world is going in strange ways, but the HGS can remain a strong and impactful organization for the future," he says. ■

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.

WELCOME TO NEW MEMBERS, EFFECTIVE SEPTEMBER 2023

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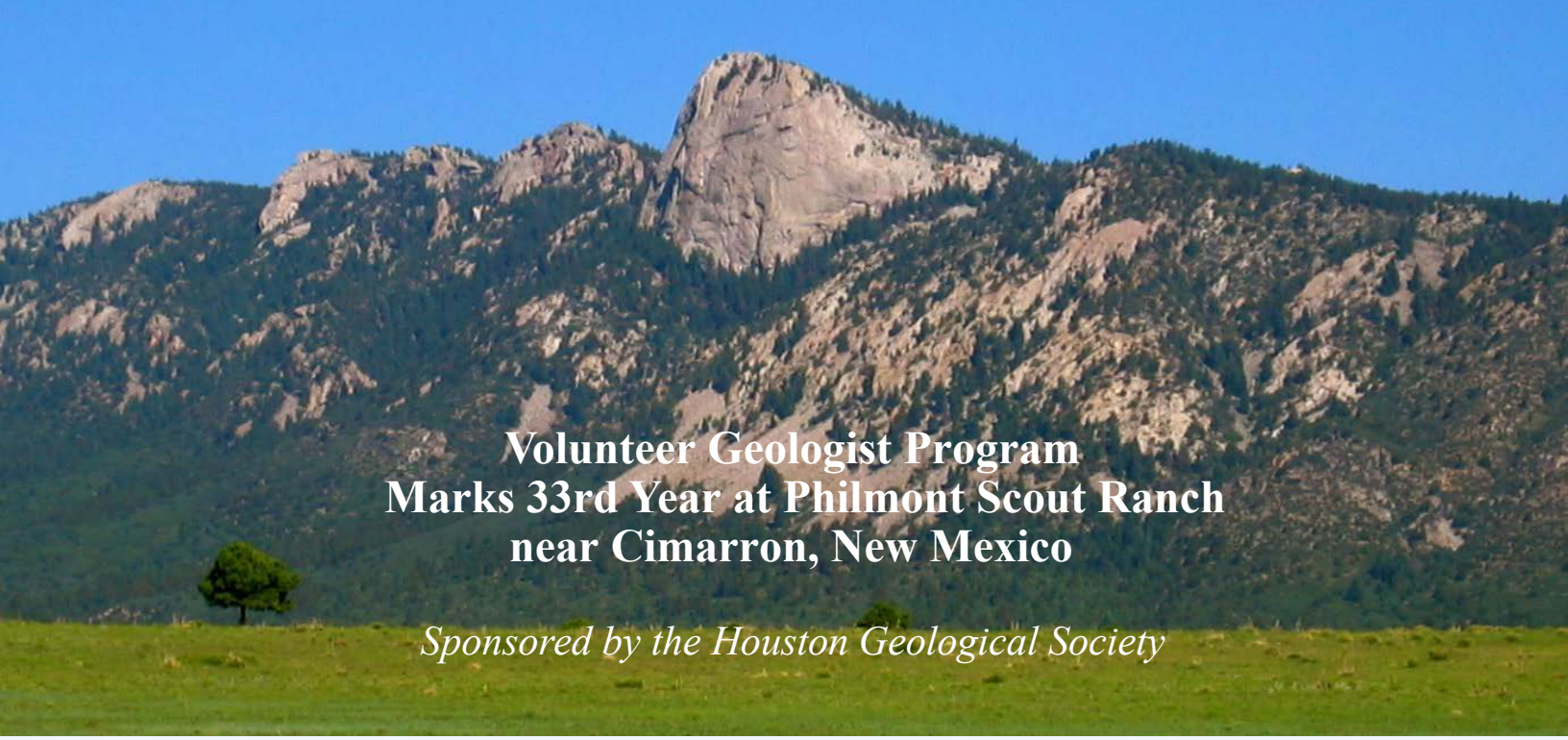

Volunteer Geologist Program Marks 33rd Year at Philmont Scout Ranch near Cimarron, New Mexico

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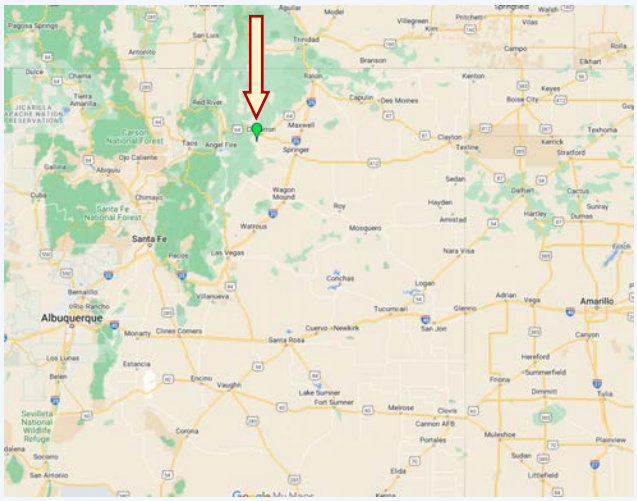
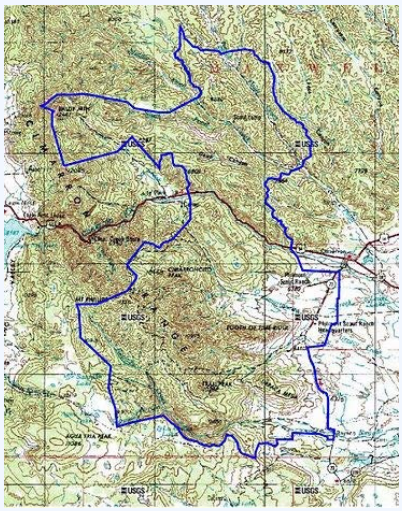


Map of northeast New Mexico with Philmont Scout Ranch



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

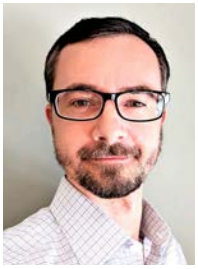
Fifty-four volunteer positions are open each year, to be filled on a first-come, first-served basis. Volunteers will receive a sign-up packet with scout applications (you have to be register with BSA, at least for the summer!), medical forms, and brochures before summer (usually May). Students who would 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
Derek Adams is Bridging the Gap Between Electricity Supply and Demand

By Caroline Wachtman



"Every morning when I wake up, I know how impactful my work will be. I know it matters," says Derek Adams, co-founder of EarthBridge Energy. Adams says his journey to becoming an innovator and founder began with the realization that much of the renewable energy created from wind and solar is wasted. Due to a timing mismatch between when variable renewable power is available and when there is demand for power, more robust and flexible grid transmission and/or better energy storage is required. EarthBridge's technology aims to improve energy storage by a process that combines geothermal concepts with reservoir management principles.

Adams co-founded EarthBridge in 2021 after a decade working as a geoscientist in the oil and gas industry for ExxonMobil. During his tenure, he primarily focused on hydrocarbon exploration and development in the Gulf of Mexico, integrating log and seismic data to identify prospects and drill development wells. He says that years of experience integrating data to solve reservoir-scale questions plus his PhD experience in paleoclimate research led him to think about using his skill set in an innovative way.

EarthBridge is developing a long-duration thermal energy storage technology that heats or cools water with excess electricity, injects the water into shallow brine or saline aquifers for storage, and finally produces water when demand is needed for electricity production or decarbonized heating and cooling. Adams explains reservoirs provide optimal size and thermal insulation to preserve the hot or cold water and store vast quantities of energy for weeks to months. When electricity generation is needed, hot water produced from the reservoir is used to drive a novel turbine-based heat engine for electricity generation. The cool water can also be used to increase the efficiency of the electricity generation process, or used for other applications, such as cooling data centers.

"I thrive on learning new things and having to solve new problems," says Adams. This growth-based mindset has been necessary, as Adams has needed to learn new skills such as grant writing, marketing, economic modeling, and making pitch presentations to prospective investors. In addition to those business skills, Adams is expanding his skill set in thermodynamics, mechanical engineering and drilling. Adams explains that learning about power markets has been one of the most critical parts of his pivot to geothermal energy storage. He says that power markets "are not as easy as oil and gas; there are more layers, more players involved, and each market is different."

learning about power markets has been one of the most critical parts of his pivot to geothermal energy storage.

Adams and his colleagues recently acquired acreage near El Paso, TX for a technology demonstration project. They believe that this location is ideal, due to both an opportunity for energy storage deployment and the potential to harvest known geothermal resources. Following a technology demonstration and EarthBridge's first full-scale projects planned in Texas, Adams is eyeing expansion into California, the East Coast and "markets where renewable energy curtailment is high and there are shallow brine reservoirs."

Adams advises other geoscientists interested in pivoting to an innovation start-up to focus on learning through networking. "Ask for help, but also see how you can help other people—be a connector," says Adams. From a practical perspective, Adams advises others to "save your money" and learn as much as possible about a new industry or business prior to making a pivot. He also strongly recommends having a good operating agreement in place for your business. "A company is like a marriage," laughs Adams, "it is important to get alignment on expectations." Additionally, he emphasizes the importance of having both professional and personal support systems in place. He says that founding a start-up "isn't a 9-5" type of job. Despite the significant effort required, Adams says, "I wouldn't change it for the world." ■

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.

Gulf Coast Giant and Super-Giant Fields Compared to Global Super-Giants: Analogs to Help us Find More

Reprinted and revised from Gulf Coast Association of Geological Societies Transactions Vol. 72 (2023), Pages 207-213

By Charles A. Sternbach, PhD, Star Creek Energy and Richard S. Bishop, PhD, Retired

ABSTRACT

Analog traps are an important part of any geoscientist's 'toolkit." There is no better source than understanding how giant fields (>500 MMBOE) and super-giant fields (>2,000 MMBOE) form and have been found by past and current generations of explorers. Analog studies are useful for understanding prospects' geologic risk factors and data quality. While every field is different, studying common play elements and motifs is always enlightening. Giants are also common proving grounds for new techniques and technologies that benefit all field developments.

The US and Mexico's Onshore and Offshore Gulf Coast basins have long been fertile grounds for giant oil and gas fields. The Gulf Coast boasts prolific Cenozoic and Mesozoic petroleum systems and an extensive infrastructure, making it an advantaged province. The discovery and development of 79 giant fields and eight super-giants have brought prosperity to the Gulf Coast and beyond. Studying these giants can add value, because they have an estimated ultimate recovery (EUR) of 106 BBOE, 51% of the 210 BBOE EUR for the Gulf Coast (Dolson, 2021).

This manuscript illustrates giant and super-giant fields with greatly differing habitats and discusses the technology and insights that enable us to find more. The key to understanding the size of giants and super-giants is that trap size limits field size, and trap size is commonly limited by leaks.

INTRODUCTION

Giant fields are significant to oil and gas supply because they comprise a large percentage of the 145-billion-barrel oil equivalent (BBOE) produced in the US and Mexico (S&P Global Commodity Insights). Thus, it is appropriate for all explorers and developers to know what makes them giants.

Analog fields are important to any geoscientist's "toolkit" (Sternbach 2020). Because trap size limits field sizes (Bishop, 2015, 2023), it is essential to recognize how structural style and seal limit trap size. Enhanced seismic imaging and technology greatly aid trap definition.

We refer to the Gulf Coast, onshore and offshore, US and Mexico, as the GoM. The GoM has 79 conventional giant oil and gas fields, and eight of these are super-giants (**Figure 1**). They are widely distributed in the

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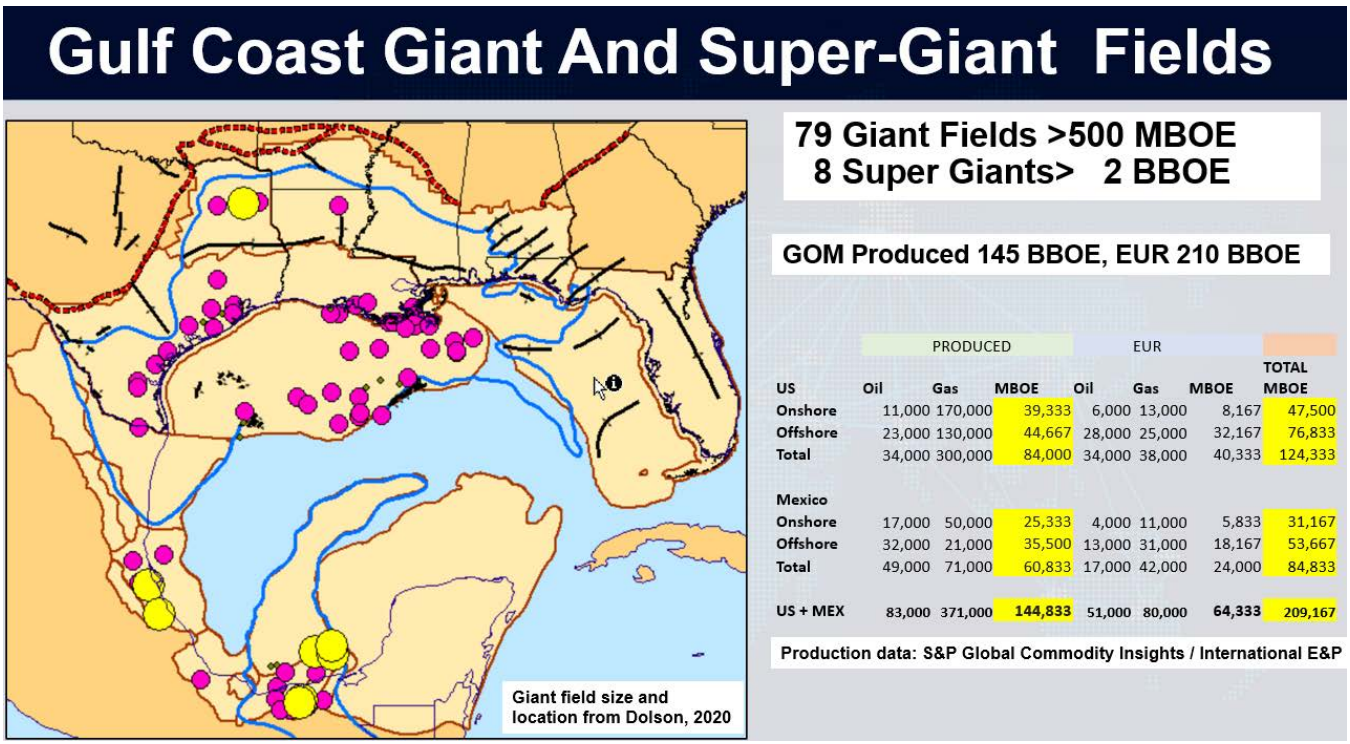

	PRODUCED			EUR			TOTAL
US	Oil	Gas	MBOE	Oil	Gas	MBOE	MBOE
Onshore	11,000	170,000	39,333	6,000	13,000	8,167	47,500
Offshore	23,000	130,000	44,667	28,000	25,000	32,167	76,833
Total	34,000	300,000	84,000	34,000	38,000	40,333	124,333
Mexico							
Onshore	17,000	50,000	25,333	4,000	11,000	5,833	31,167
Offshore	32,000	21,000	35,500	13,000	31,000	18,167	53,667
Total	49,000	71,000	60,833	17,000	42,000	24,000	84,833
US + MEX	83,000	371,000	144,833	51,000	80,000	64,333	209,167

Figure 1. *Location of 71 giant (purple circles) and 8 super-giant (yellow circles) fields in the GoM. Cumulative production is 145 BBOE in the US and Mexico with 210 BBOE EUR.*

Technical Article continued from page 13

US and Mexico onshore and offshore. This paper examines the limiting factors of giant fields and describes their habitats — such discussions are rare to non-existent in the literature.

DISCUSSION

Explorers have been discovering Gulf Coast giant fields for more than 100 years (**Figure 2**, black circles). The main branches of technology include drilling and completion, petrophysical, geophysical, surface and subsurface mapping, geological methods, and ever-evolving concepts of hydrocarbon accumulation. The interplay of technology, access, and economic factors, like the price of oil shown in green in Figure 2, impact the discovery of giant fields, ranging from 500 MMBOE to 18.7 BBOE.

Integration of geology and geophysics is particularly important in the GoM. The trap definition is the limiting factor, which we will discuss shortly. New giants are found when favorable economic conditions and access permits. We identify seven time periods characterized by significant geoscience technology, which flourishes in many new giant field discoveries in times of favorable access and oil price. Engineering breakthroughs in drilling and completions open new realms of access to ever-greater water depths. The GoM continues to reinvent itself every few years, and technology plays an important role.

The GoM giant fields overlie prolific petroleum source rocks that are Jurassic (blue), Cretaceous (green), and Cenozoic (tan) in age (**Figure 3**). Source rock calculations show that the Campeche area of GoM has an overabundance of hydrocarbon charge (Magoon, 2003), so the charge does not limit field size. The Jurassic is a dominant source rock in both North and South GoM. Many Cretaceous Oceanic Anoxic Events (OAE) and sources have been recognized (Hood et al. 2002). The GoM generates abundant hydrocarbon charge with high potential Ultimate Expellable Petroleum (UEP). Pressures across faults, geopressure, and temperature gradients provide valuable insights into hydrocarbon migration (Pepper, 2023).

Traps and seals limit the size and area of Giant Fields in the GoM (Bishop et al., 1983; Bishop, 2015; Bishop, 2023). Traps are filled to a leak point or synclinal spill point, and much work has been done on cross-fault leaks (pioneered by Urban Allan and Shell) and fault gouges. Most GoM giants and super-giants are oil or oil and gas fields that preferentially retain oil due to preferential gas leakage. (**Figure 4**).

The structural style of super-giants (except for Zagros foldbelt) shows them to involve the basement, including combination traps (Bishop, 2023). Many giant fields have detached structural styles,

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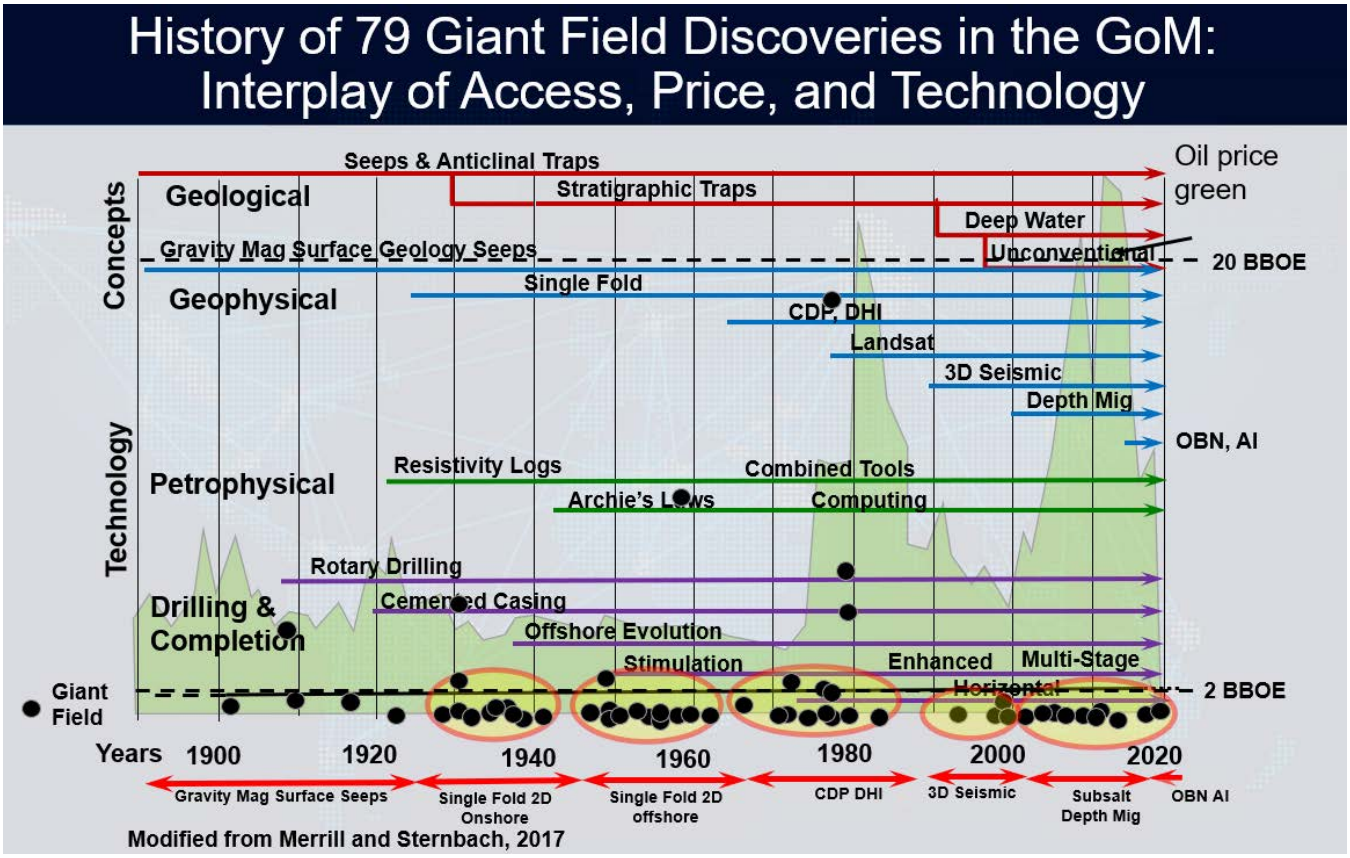

Figure 2. *Branches of technology and evolving geologic concepts create waves of giant discoveries (black dots) moderated by economics (price), global events, and access.*

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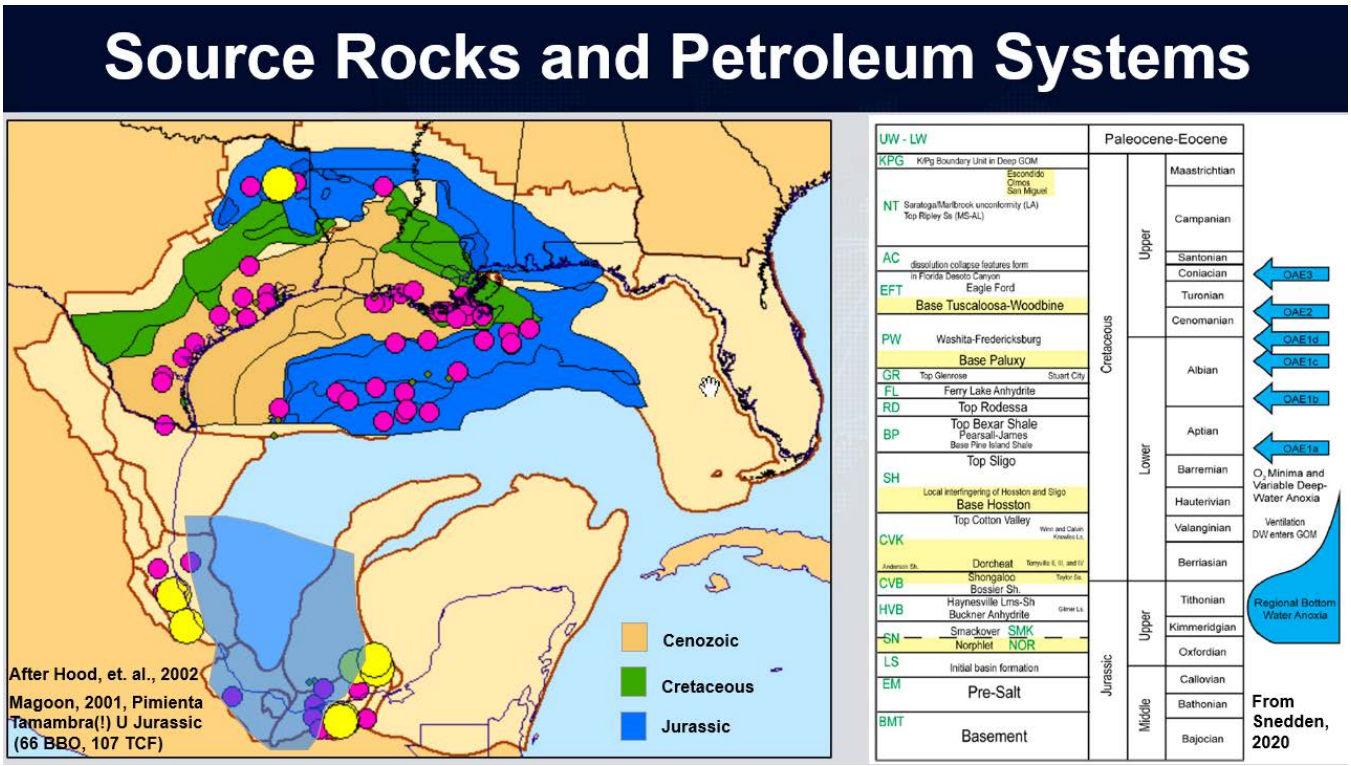

Figure 3. *The GoM giants (purple dots) and super-giants (yellow dots) occur above abundant source rocks of the Jurassic, Cretaceous, and Cenozoic ages. Source rock calculations show that the GoM has an abundant hydrocarbon charge that does not limit field size or accumulations. (Information for the northern GoM derives from Hood et al., 2002; southern GoM Magoon, 2001; Snedden, 2019; and Pepper, 2023; field data from Dolson, 2023).*

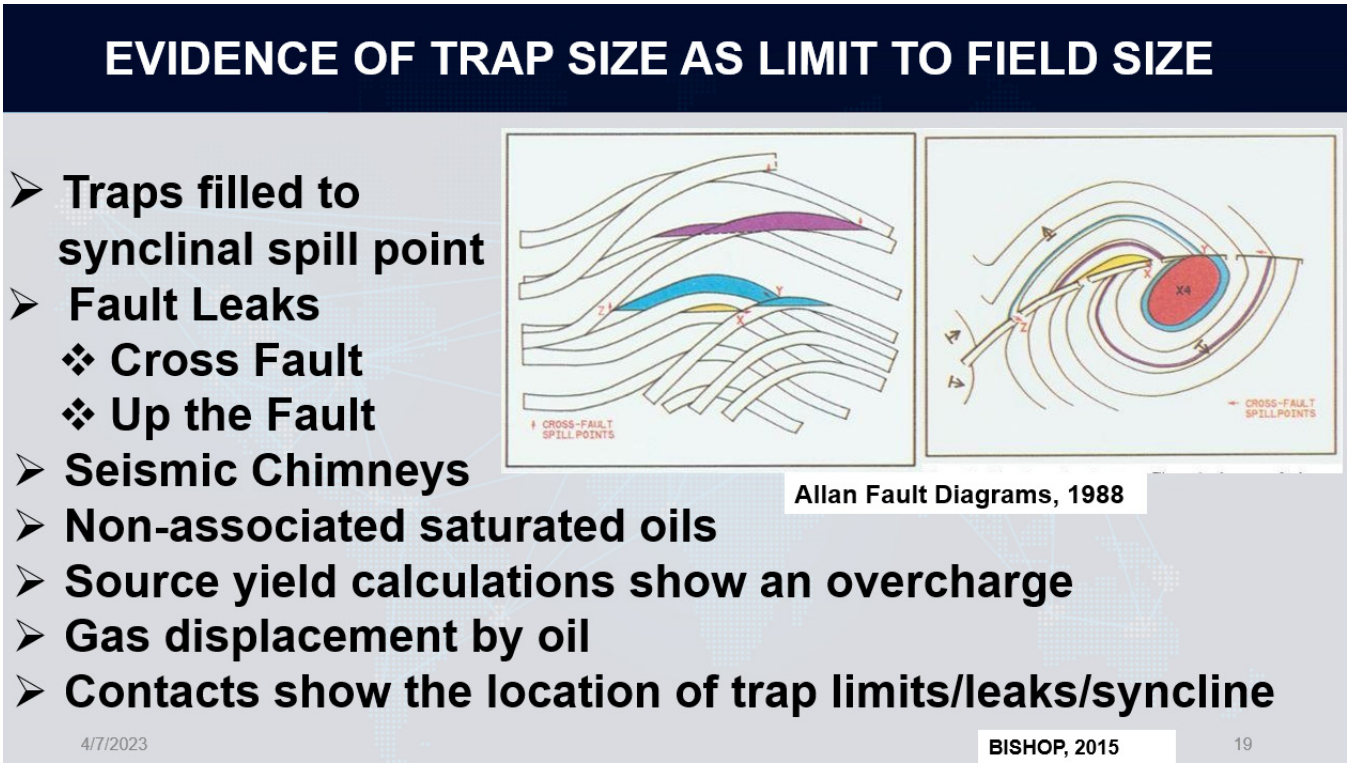

Figure 4. *Abundant cross-fault leakage, seismic chimneys, non-associated saturated oils, and preferential oil preservation by gas leakage limit the size of many GoM giants.*

Technical Article *continued on page 16*

including growth faults, but this structural style seems to have an upper limit of less than 1.5 BBOE. This upper size limitation is consistent with giant fields in detached settings in other basins such as the Campos basin in Brazil, in Angola, and in Nigeria, where detached traps do not exceed 1.5 BBOE, except when several detached traps form complexes.

All eight super giants in the GoM produce from Cretaceous reservoirs and have a basement-involved structural style. In addition to large traps created by this basement linkage, the super giants benefit from migration paths proximal to prolific source rocks.

Long ultra-regional seismic profiles across the Gulf of Mexico show a deep basement reflector on which Jurassic and Cretaceous source rocks may have been deposited. (**Figure 5**). Thick sedimentary sections containing Paleogene and Neogene reservoirs (and some source rock) overlie these potential sources. Where salt is present (absent in **Figure 5**), it affects trap geometries, is mobile, and can conduct thermal energy, enabling the oil window to migrate to greater depths.

The GoM covers a large area of many basins and does not have a single, basin-wide seal but has multiple petroleum systems, each with its own seal. These regional seals above giants are commonly thick transgressive shales where faults from below die out (for example, the Anahuac shale). They produce giant fields when shales with extremely low vertical permeability associated with eustatic and tectonic sags combine to overlie thick reservoir packages. The same seals over thin reservoir packages can produce fields but not giants.

As seismic imaging improves, more giant stratigraphic traps are being discovered globally. In West Africa, Industry is discovering giant oil and gas fields in Cretaceous reservoirs above oceanic basement rocks, such as Bonga North (2004), Bonga SW (2001), Ikija (2000), Agbami (1998), and Bonga (1996). We wonder if similar play elements in the GoM suggest that future giants await us in the GoM (Sweet et al., 2022).

GOM GIANT FIELDS AND GLOBAL ANALOGS

AAPG Memoir 125, and analysis of the Global Giant field database of 1057 fields provide a global context of new paradigms applicable to the Gulf of Mexico (Dolson, 2021; Sternbach et al., 2021). Stratigraphic and combination traps comprise 50% of giant field discoveries in the last two decades, vs. historical 10%. This astounding result largely arises from enhanced 3D seismic reservoir imaging and discipline integration.

The industry is discovering Giant fields with oil and liquids at great depths, 7-10 km below mudline, with good reservoirs and high pressure. Operators commonly find hydrodynamic upward flow in over-pressured basins and many previously unrecognized tilted contacts. New giants, like Liza, Venus, Orca and Coral occur over thin transitional crust or oceanic crust, which once was taboo.

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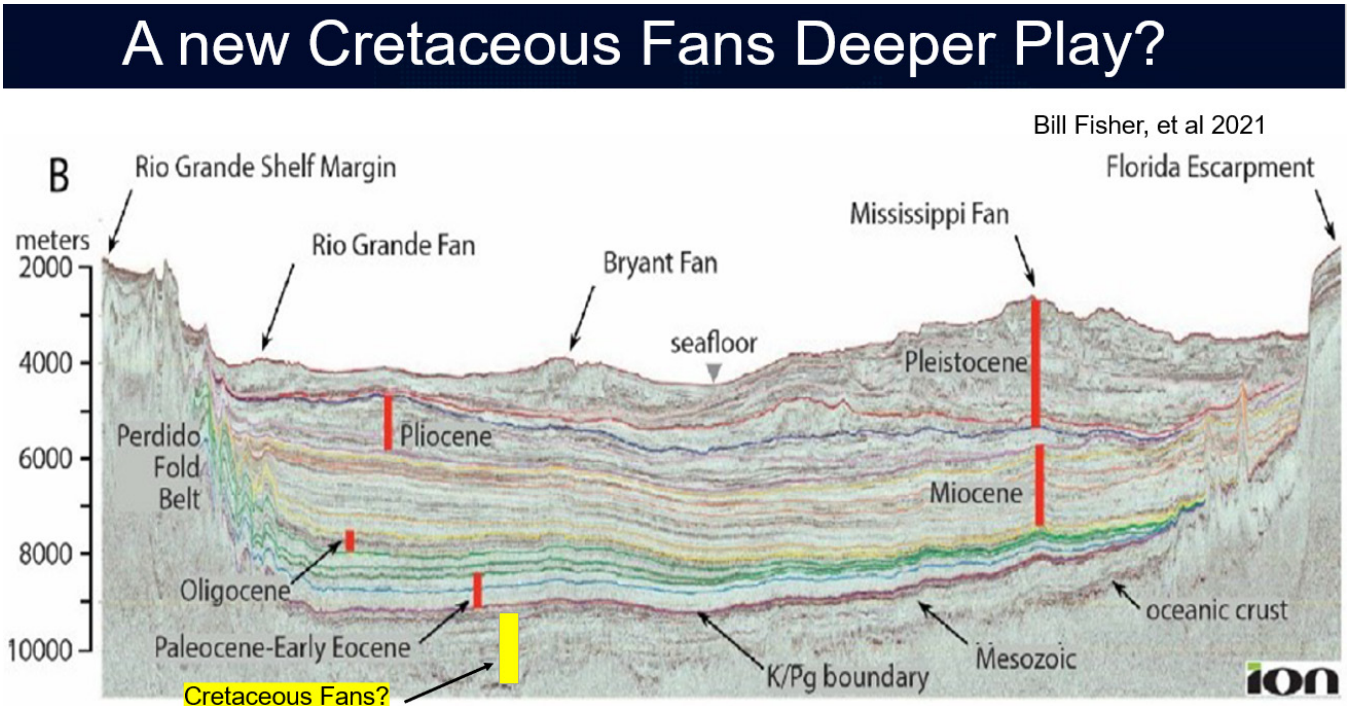

Figure 5. *Basement involvement and combination traps influence the size and area of giant fields in the GoM. Recent giant discoveries of Cretaceous reservoirs on oceanic crust in global basins suggest that the same play elements may be present in the GoM and that future GoM giants may await in the deep ocean. (Figure from Fisher et al., 2021).*

SUMMARY AND CONCLUSIONS

Super Giants are associated with Cretaceous sag over basement highs rimming the GoM Basin, including Tampico and Campeche. Most Giants are Cretaceous and Miocene-aged reservoirs. All Super-Giants are Cretaceous-aged reservoirs associated with a basement uplift, proximity to source rocks, and capped by sag and eustatic-related regional seals.

Seals and traps limit the area and extent of giant and super-giant fields. Giant fields with a detached structural style are limited to about 1.5 BBOE. Basement-involved structures create Super Giants. Trap limitations are evidenced by "a leaky" basin with escaping gas. Hydrocarbon source rocks are several and abundant. Traps and seals are the primary factors limiting field size.

For more than 100 years, the GoM has repeatedly reinvented itself. The interplay of economics (oil price), access, engineering enablers, technology, and the integration of geology and geophysics have historically driven the discovery of many giants and super giant fields. New technologies contribute to all fields.

The industry will discover giant oil and gas fields with increased access and new seismic acquisition and processing methods that improve imaging. The result will be the discovery of more stratigraphic traps, deeper oil pays, giant fields over the oceanic basement, and hydrodynamic surprises. The foundation for the future is with the giants. ■

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Hot Rocks and Hot Fluids are Hot Topics for Geologists

By Caroline Wachtman

EXPLOSIVE INTEREST IN GEOTHERMAL

"In 2019, everyone tried to convince me not to do geothermal, and now everyone is looking at geothermal," says Philip Ball, a geologist and Chief of Geothermal Innovation at Clean Air Task Force. Ball pivoted to the Geothermal Industry after spending more than 20 years exploring for hydrocarbons in deepwater basins. While investigating the cost competitiveness of different geothermal technologies for an MBA thesis project, Ball became interested in utilizing his geoscience skills for geothermal exploration. He realized that the same skills used to understand hydrocarbon potential in rifted margins could be applied to geothermal exploration.

Most of the geologists interviewed for this feature article share a similar story. For example, Tina Riley, Geothermal Development Coordinator for the City of Boise, pivoted to the Geothermal Industry after 20 years as a geologist and Exploration Manager at ExxonMobil. The capabilities she developed in negotiating oil and gas exploration contracts, along with her foundational geology skills, are well-suited for the burgeoning Geothermal Industry that is gaining momentum across the country.

Recently graduated geologists have also pivoted to the Geothermal Industry. After gaining initial work experience in hydrocarbon exploration, Gabby Ramirez joined Ormat in 2021. Ramirez is now a Project Geologist responsible for the exploration, development, and production of conventional geothermal resources. Ramirez says that the seismic interpretation skills she developed while exploring for resources in West Africa have been unexpectedly important for work in Geothermal exploration. Although most conventional geothermal reservoirs are hard-rock igneous systems, Ormat is developing clastic reservoirs in the Imperial Valley of California.

In addition to having transferrable skills, geologists are pivoting for other reasons, too. Ball, Riley, and Ramirez all say that their pivot to Geothermal was influenced by an interest in decarbonization. Additionally, Geothermal jobs are more distributed across the country, which appeals to those geologists looking to leave Houston. "Conventional geothermal tends to happen at plate boundaries in really gorgeous locations," says Ramirez. Finally, the Geothermal Industry may be more stable than Oil and Gas. Because of the tie to baseload power generation, geothermal is not commodity-price driven and thus is not subject to the cyclic nature of industry booms and busts.

Customer demand for geothermal power is growing. Riley says her current role was specifically created to address the growing interest in geothermal power among businesses and residential customers. She is seeing customer demand for expansion beyond traditional geothermal hotspots in the West. While some cities like Boise have been using geothermal power for heating since the 1980s, "We can be doing this in a lot more cities," says Riley.

Aligned with the growing number of geologists pivoting to Geothermal and customers asking for Geothermal, the Industry has seen an influx of geothermal start-up companies since 2020. Recent startups in Houston include Criterion Energy Partners, Sage Geosystems, Fervo Energy, EarthBridge Energy and others. These companies are taking advantage of Houston's robust innovation ecosystem (see articles in the October Bulletin), as well as proximity to drilling and other service companies, as well as prospective investors.

FUNDING IS NOT KEEPING PACE WITH INTEREST

Despite the strong interest in Geothermal, funding is not keeping pace. "Lack of success, or perceived lack of success" is one of the critical barriers to geothermal funding, says Malcolm Ross, self-proclaimed geothermal evangelist, industry advocate and innovator. Geothermal demonstrations take years to prove success and are not well-aligned with investor funding cycles. Companies such as Fervo Energy and Eavor Technologies (see below), as well as the Department of Energy's (DOE) FORGE project, are making significant advances in demonstrating the potential of new geothermal technologies, but it could be a couple of years before these projects produce results that reduce investment risk.

Ross advocates on the state and federal level for geothermal funding. He says that the DOE's Geothermal Technology Office is under-funded relative to the resources available to renewables. Government investments on the order of at least $500 Million are necessary to propel the industry along the experience curve needed to achieve cost parity with alternatives. Additionally, companies need early development loans, but many are not eligible for DOE Loan Office programs, which set the minimum loan amount much higher than early development projects require.

Baseload Capital has taken a unique approach progressing geothermal projects. Bridget Silva, Head of Commercial Strategy for Americas at Baseload, says the company supports resilient, always-on baseload power by investing in existing geothermal power plants. Baseload currently has two plants in their portfolio that are operating at high efficiency, and they are investing to optimize efficiency and effectiveness in six additional plants. Silva says that the company plans to grow and develop partnerships to bring synergies on an Industry-wide scale. "We have a lot of friends who want us to win," says Silva.

Another innovative funding model is being piloted by Project InnerSpace. They are an **Hot Rocks** *continued on page 19*

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independent organization working to facilitate the rapid global deployment of geothermal energy and are trying to solve the funding problem through philanthropy. The first phase of their project was kicked off in the Fall of 2022 and is designed to develop an interactive global resource map to identify high-geothermal-impact locations. The second phase aims to fund startups with high-impact potential. The goal is to reduce project risk so that private investment capital will follow.

WHAT IS HOLDING GEOTHERMAL BACK?

Drilling and completions costs and drilling risks are the most significant concerns for potential investors, says Tony Pink, Vice President of Subsurface Energy Technology at NOV. Drilling is one of the most significant costs in a geothermal development, where a well can cost as high as $20-$40M, might take 70-80 days to drill, and could be a "dry" hole. Driving efficiency in drilling costs can have a substantial impact on project economics. Pink lists five key drilling-related barriers that NOV and other companies are working to solve.

First, slow rates of penetration through hard rocks result in high-cost wells. While industry was drilling 30 ft per hour several years ago, recent projects have experienced rates of 125-130 ft per hour, says Pink. Second, downhole tools are unreliable or inoperable at ideal temperatures for geothermal at or above ~350 F (~180C). Pinks says that NOV has helped solve this problem by designing a double-wall pipe string to insulate tools from the rock, similar to the concept employed by a popular cooler brand. Third, low-temperature drilling fluid can damage the high-temperature rock by cooling the vicinity of the wellbore. Even a couple weeks of delay in returning to normal heat levels at the wellbore can result in a sub-economic well. Fourth, cement and casing are weakened at geothermal temperatures. While this may not be a problem for crystalline basement, it may be a problem for poorly consolidated or highly fractured rocks. Finally, hot and salty fluids are generally corrosive to wellbore construction materials. Pink says that NOV has pioneered much of the new drilling technology for geothermal, but engineering problems persist.

FUTURE OF GEOTHERMAL: RESEARCH AND INNOVATION

The conventional Geothermal Industry, i.e., producing hot fluids for heat or electricity production, is still young, and much work remains on better understanding conventional geothermal systems. The University of Nevada at Reno (UNR) is leading research on conventional fault-controlled convection geothermal system. Nicole Wagoner, who started her geology career in Oil and Gas, pivoted to a Geothermal PhD program at UNR in 2020. Wagoner says that her research utilizes play fairway analysis adapted from Oil and Gas to determine statistical relationships of what leads to success in geothermal systems. Wagoner explains that while much of the geothermal ecosystem is focused on non-traditional styles of geothermal production, there is significant unexplored potential in traditional conventional systems.

Ramirez echoes the sentiment that abundant conventional geothermal resources remain to be discovered. Most of the resources with surface expressions have been discovered and are in development. "We need to get more clever," says Ramirez, "and look for geothermal systems with innovative geophysical methods, such as magnetotellurics, gravity, and magnetics." Ramirez also explains a need for research into optimal development models to sustain production in operating fields.

What is old is new again, for geopressured geothermal, a style of geothermal energy production that relies on producing moderately hot fluids from overpressured Gulf of Mexico reservoirs such as the Wilcox and Frio formations. Geopressured geothermal production was studied in 1989-1991 through DOE-funded grants at Pleasant Bayou (Texas Fact Sheet). The method involves producing methane-enriched brine to the surface, selling or producing energy from the methane and using the brine for additional geothermal electricity generation or heat. The idea was not pursued due to the rebound of oil and gas prices in the 1990s but is again gaining interest today. Two long-time HGS, Steve Getz and Bob Wiener, formed Geothermal Resources LLC to develop geopressured geothermal sites along the Gulf Coast and conventional geothermal plays in Nevada. In 2022, Houston-based start-up Criterion Energy acquired a 10,000-acre lease to explore geopressured geothermal (Criterion Energy).

Several other startups in the Houston area are also exploring and intending to utilize geothermal resources in innovative ways. Mei-Mei Pickering is the co-founder of Viridly, a geothermal startup that participated in the 2022 cohort of the Rice Clean Energy Alliance. Viridly aims to use conventional geothermal resources with innovative surface geology to heat greenhouses. Derek Adams (see Pivot Profile in this *Bulletin*) co-founder of EarthBridge Energy is seeking to use Earth's insulating properties for long-term energy storage. Geothermal Evangelist Malcolm Ross is working to promote the idea that salt domes, such as Spindletop, could be excellent sources of geothermal energy while simultaneously allowing for H_2 or CO_2 storage.

Sage Geosystems™, Fervo Energy and Eavor Technologies are three startups that stand out from competitors. They have raised funding and are pursuing innovative geothermal drilling technologies that allow unconventional geothermal production across a wide range of geothermal heat sources. Mike Eros, Chief Geoscientist at Sage Geosystems, says his company developed industry partnerships and raised philanthropy seed-round funding. Sage aims to pilot the application of traditional Oil and Gas drilling technology to "hot, dry rock" in a method called Enhanced Geothermal Systems (ESG). The method involves pumping cold water into deep, stimulated rock fractures **Hot Rocks** continued on page 20

Hot Rocks continued from page 19

in low-permeability formations. The water is heated through conduction and convection and then produced back to the surface to be used in electricity generation. Sage has also piloted storing and recovering electricity as pressured water (mechanical energy) in fractures at their Texas demonstration site (Sage Canary Media).

Emma McConville, Development Geoscience Lead at Fervo, says that the company has been successful in gaining investors by taking a phased approach. Fervo initially demonstrated the viability of their technology by recompleting non-productive geothermal wells drilled by other operators. The technology demonstration convinced investors to fund a pilot project that recently realized significant improvements in drilling speed on three ESG-completed wells. Following drilling results, Fervo recently announced plans for 400-megawatt power generation facility in Utah (Fervo Energy Canary Media).

Eavor is piloting a slightly different completion technology called Advanced Geothermal Systems (AGS) or "closed loop" systems in which multiple laterals are drilled. The toes of the laterals are connected and a working fluid is circulated through the laterals, similar to a radiator concept. The hot fluid is returned to the surface and can be used for electricity generation or residential heating. The process works through heat convention and can be used in lower-heat geothermal environments. Eavor was recently awarded a Department of Defense contract to power the U.S. Air Force base in San Antonio, Texas (Eavor globenewswire.com).

BUILD IT AND THE JOBS WILL FOLLOW

Despite the enthusiasm among the Geothermal community, there are currently very few geologist jobs in Geothermal. For example, although Ormat is one of the largest geothermal energy producers, Ramirez is one of less than a dozen geologists exploring and developing worldwide resources. Riley says there are currently no geologist roles with the City of Boise to manage their geothermal production. As Chief Geoscientist, Eros is currently the only full-time geologist at Sage. Wagoner, who plans to graduate with a PhD in a few years, believes jobs will follow more funding and more demonstrated geothermal successes.

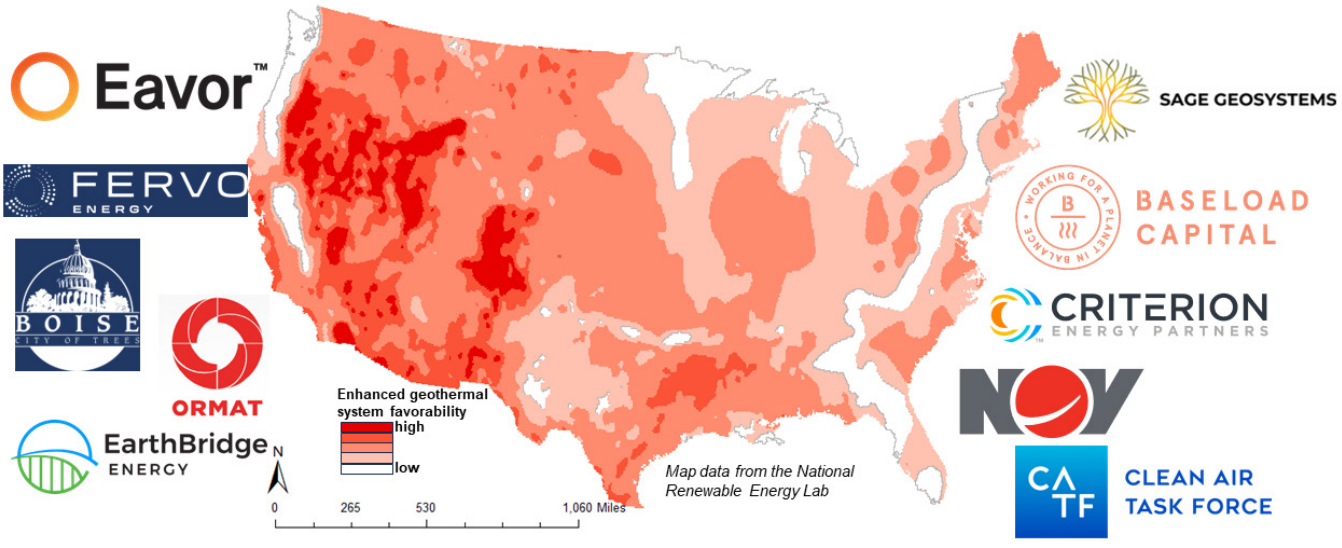
McConville notes that Fervo has recently increased the size of their geothermal team to five geologists. They also offer two summer geology internships. She sees a strong future ahead for geothermal geologists. To scale-up the Geothermal Industry "it will take a huge number of wells and a fast timeline," which will require technical support, says McConville. When jobs open, geologists will be ready. "Geothermal is small; but vibrating with energy. Everyone is ready to see geothermal soar," says Ramirez. ■

WORD BRECCIA – A GEOLOGY WORD JUMBLE

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

RESUPERS	O _ _ O _ _ _ _
MERHALT	_ _ O _ _ O _
GREYNE	_ O _ _ _ _
RENIB	_ _ O O _
REXPOLE	_ O _ _ O _ _

Energy Transition is more appropriately called an Energy _ _ _ _ _ _ _ _ _



Map showing prospective areas for Enhanced Geothermal System technology. Data was last published by the NREL in 2018. Logos of companies interviewed for this story are also shown.

Lithium Mining from Geothermal Brines: A Team from Rice University and Chevron Leads the Way

By Caroline Wachtman

In 2021, the US Department of Energy (DOE) announced that "A reliable, diversified lithium supply is a top priority[1]." Researchers from Rice, in partnership with Chevron, are leading the way to help make the DOE's priority a reality. The team, led by Dr. Haotian Wang and Dr. Lisa Biswal, was recently awarded $500,000 for their project: Direct and Continuous Electrochemical Manufacturing of High-purity Lithium Hydroxide from Geothermal Brines in a Solid Electrolyte Reactor.

"The field is in very early stages of fundamental research, and there is no roadmap," explains Wang of the challenges with geothermal brine mining. The problem is very challenging because the ratio of Sodium to Lithium in typical geothermal brines is 100:1. Wang and his colleagues are embracing the challenge. His research group, along with Biswal's team are developing an electro-chemical device to more efficiently separate Lithium from Sodium. Wang says, "As long as electrons can help, we are very interested."

The DOE and others are interested in new sources of lithium mining technologies because the global demand for lithium is expected to increase 500% by 2050[1]. Currently, nearly 75% of mined lithium is used in batteries[2], and the need for batteries in portable electronics and electric vehicles is expected to increase in the coming decades.

Lithium is found in two different types of deposits: ores and brines. Brines containing lithium can be widespread in some sedimentary basins, such as the Permian. Geothermal brines are a subset of brines that can be found in geothermal environments such as California's Salton Sea. These brines have the potential to be sources of both geothermal energy and lithium production.

Current technology for extracting lithium from geothermal brines is costly and difficult to scale. Of the eight commercial-scale lithium brine mines that were in operation in 2022, seven of them relied on evaporation and precipitation to separate out lithium from other constituents[3]. Evaporation requires large acreage positions, uses large amounts of freshwater, and can take years to produce lithium[3].

To improve the efficiency and effectiveness of brine mining, the DOE is funding research into new technologies. A $12M funding opportunity was announced in 2022[4], and $10.9M was awarded in July 2023[5]. Wang and Biswal's team was one of those awarded grants for geothermal brine mining.

Wang and Biswal's technology may one day be used to fuel the energy circular economy, which describes a model of production and consumption where materials are reused or recycled as much as possible. The DOE envisions a future where geothermal energy could be generated with mineral-rich brine and then lithium and other critical minerals extracted from the brine before the brine is recycled, utilized or disposed. A press release from the DOE states: "In repurposing the extracted fluids already used for electricity production as a lithium source, we can put domestic lithium onto the market while producing electricity.[1]"

Mining lithium from geothermal brines also has the potential to increase the domestic supply of lithium, which is primarily imported from international operations. Only one commercial lithium mine was operational in the US in 2022 and it produced less than 1% of the supply needed that year. Over 90% of lithium used in the US is imported from Argentina and Chile, and nearly 10% is imported from China, Russia and other countries[2].

Wang says that he expects the project to extend for three years and results are expected to be published in peer-reviewed journals. ■

ABOUT THE PRINCIPAL RESEARCHERS

Dr. Haotian Wang is a tenured professor of Chemical Engineering who joined Rice University in 2019 following completion of his PhD at Stanford in 2016 and post-doctoral research at Harvard.

Dr. Lisa Biswal joined Rice in 2006 following a PhD at Stanford and post-doctoral research at the University of California at Berkely. She is a professor of Chemical and Biomolecular Engineering and the Senior Associate Dean of Engineering.

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[1] Can Geothermal Energy Solve the Lithium Shortfall? | Department of Energy

[2] Mineral Commodity Summaries 2022 - Lithium (usgs.gov)

[4] DOE Invests Millions in America's Massive Lithium-Production Potential | Department of Energy

[3] Environmental impact of direct lithium extraction from brines | Nature Reviews Earth & Environment

[5] Funding Selections: FY22 AMMTO-GTO Lithium Extraction and Conversion from Geothermal Brines | Department of Energy

Blast from the Past: What About Geothermal in the U.S. Energy Mix?

A reprint from November 2011, Volume 54, Number 3

By Ron Waszczak

Production of unconventional oil and gas from shales and sands has afforded North America a mega change in regard to the source and the reliability of supply of hydrocarbons. I often wonder if the latest technologies established to economically produce unconventional gas and liquid from the subsurface — principally hydraulic fracturing and steam-assisted drainage —could transfer to new applications in the geothermal industry. Leveraged by the hydrocarbon industry's unconventional technologies, could geothermal break through as North America's next energy resource for large-scale exploration and development? Can and will geothermal energy contribute to North American energy supply with significant impact in the near future and for decades to come?

It is apparent that the oil and gas industry currently employs a workforce with the subsurface skills and access to technologies that will prove vital to moving the hydrothermal industry forward. It is easy to project which petroleum geology and engineering skills and tools are transferable to hydrothermal. The technical specialties are many: stratigraphy and sedimentary petrology; seismic imaging, specifically in hard rocks with faults and fractures; rock mechanics, fracture generation and confined fracture systems; basin modeling, fluid flow, connectivity and pore pressure analysis; high-temperature wellbore geophysics; high-temperature material and fluid engineering; and high-temperature drilling, directional drilling, logging, casing and stimulating. ■

CALL TO ACTION
Geology of Buffalo Bayou

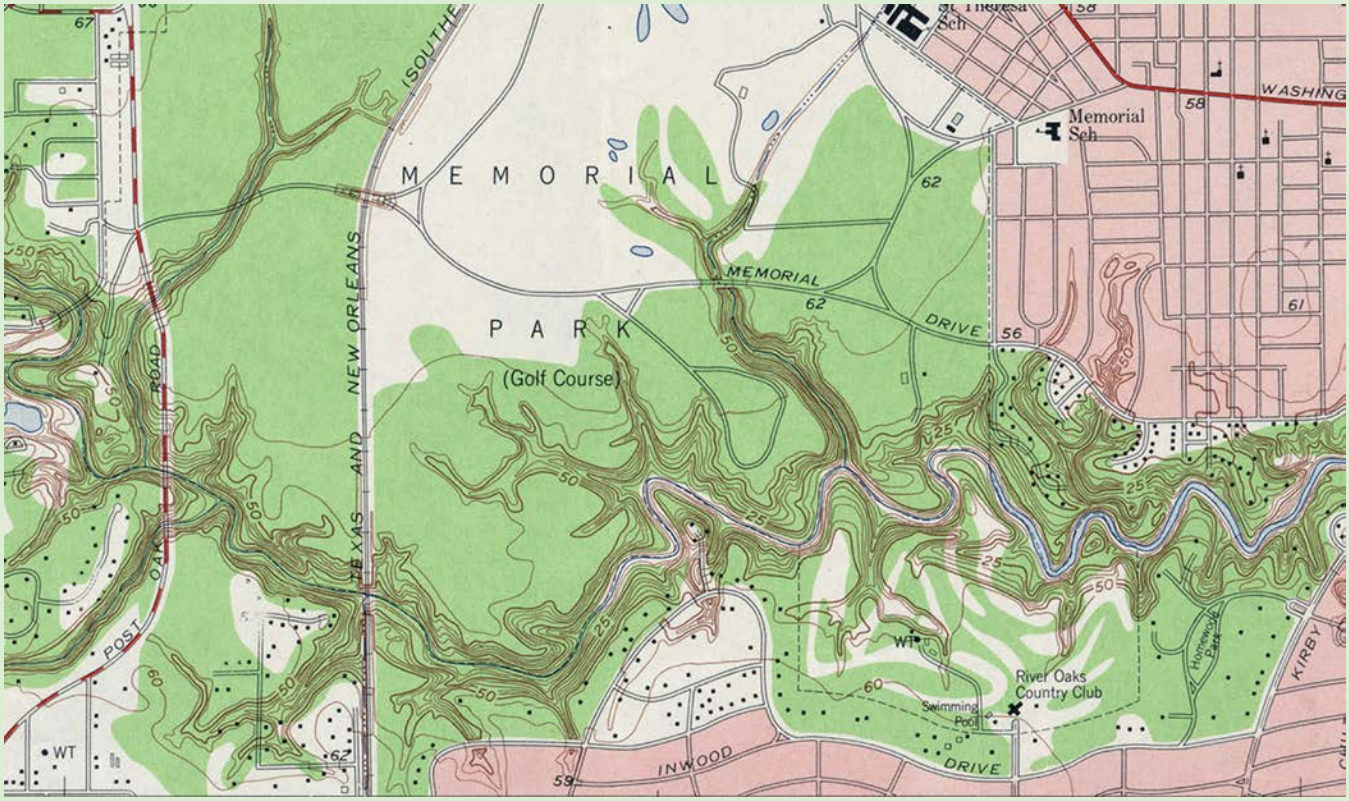
WHAT?
Community-based geologic investigation of Buffalo Bayou

WHY?
Despite the Bayou's prominence in Houston's landscape, little is known about its geologic characterization.

WHY THIS WAY?
Our community is rich with geoscience knowledge—let's harness those skills and energy to collaborate on a fun project!

HOW CAN YOU HELP?
- Share your skills: well log correlation, geophysical interpretation, stratigraphic and structural characterization, research, age dating, or GIS mapping.
- Share your near-surface or surficial data from the Texas Gulf Coast.
- Other ideas? Tell us how you think you can contribute!

NEXT STEPS
Let us know you are interested by sending a note to editor@hgs.org.
Then, join us for the kickoff session to be scheduled in mid-November.



1955 Topographic map of a portion of Buffalo Bayou. (From the savebuffalobayou.org website)

Saturday, November 18, 2023

8:00 a.m. – 6:00 p.m.

$175 for HGS Members, $195 for Nonmembers
Several student tickets available, they will need to contact Erik Scott directly
Limit: 25 people including trip leader.
Meeting Place: Rice University Wildcat Stadium Parking Lot
https://www.hgs.org/civicrm/event/info?id=2502
Event Contact: Erik Scott • erikscott.geo@gmail.com

Dr. Erik Scott
Rice University

Texas Coastal Processes: Brazos River Delta to Galveston Island

WHO SHOULD ATTEND

Geologists, geophysicists, and engineers working on reservoirs from coastal settings.

YOU WILL LEARN

- The sedimentological processes that transport sediment in the coastal environment
- Characteristics of the deposits found along the coast dominated by barrier islands

OVERVIEW

Sites located along the SE Texas coastline from the Brazos River Delta to the barrier islands of Follets and Galveston provide locations to observe coastal sedimentological processes and their resultant deposits. The trip will look at the various processes that shape the coastline and the characteristics of the sediments that are deposited. Participants will observe processes on the beach, recent erosion, various styles of washover deposits, different types of delta systems, and sand ridges that are active on the Texas Gulf Coast.

TRIP ITINERARY

Meet the trip at Rice University Stadium Parking lot 7:45 am Saturday November 18, ready to leave at 8:00 am. Meeting place map will be sent to attendees ahead of time. The group will travel using 12-passenger vans. Lunch, including a sandwich and soda/water, are included in the field trip price. For more information, contact Erik Scott at erikscott.geo@gmail.com

Drive to Freeport (~ 1 hour)

Stops 1 through 4 extend from Bryan Beach Park to the Brazos River Delta.
Stop 1 – Overview of beach environments and processes
Stop 2 – Recent erosion of back barrier deposits
Stop 3 – Washover apron
Stop 4 – Brazos River Delta
Lunch will be at the Brazos River Delta

Drive to Follets Island

Stops 5 and 6 are on Follets Island northeast of Surfside Beach
Stop 5 – Back barrier
Stop 6 – Washover fan

Drive to Galveston Island

Stops 7 to 9 are on Galveston Island from the San Luis Pass to the Galveston seawall
Stop 7 – Tidal inlet and coastal dunes
Stop 8 – Sand ridges
Stop 9 (optional) – Recent foreshore erosion/deposition

Wednesday, November 8, 2023

Social 5:30 p.m., Dinner 6:30 p.m., Presentation 7:30- 9:00 p.m.

Pre-registered HGS Members $35
Emeritus/Honorary Life $15
HGS Students Members $5.00
Non-Members & ALL Walkups $40
Craft Republic Houston • 11470 Westheimer Rd.
https://www.hgs.org/civicrm/event/info?id=2510
Event Contact: Matthew Cowan • mrcowan1@hal-pc.org

HGS E&E Dinner Meeting

Danny Kingham, PG
GSI Environmental Inc.

TBPG Professional Ethics Training

Geoscience work performed for the public must be performed competently and ethically as it may affect publicly shared natural resources and put public, assets, and property at risk. A minimum of one hour of Professional Ethics per year is required for renewal of a Texas Professional Geoscientist (PG) license or a Geoscientist-In-Training (GIT) certification. This fun-filled, action-packed Ethics Training Seminar will provide an overview of the ethical standards set by the Texas Board of Professional Geoscientist (TBPG) and will satisfy the ethics credit requirements for your C&E records. ■

BIOGRAPHICAL SKETCH

Ms. Danny Kingham is a Senior Hydrogeologist and the Corporate Health and Safety Administrator at GSI Environmental Inc. Ms. Kingham is an Appointed Member to TBPG and a registered PG in Texas, Louisiana, and New York, with over 18 years of professional experience. Ms. Kingham is actively involved in environmental issues related to carbon capture and sequestration, including the development of USEPA UIC Class VI permit applications and the application of federal and state guidelines on environmental monitoring and verification programs. She has managed large litigation projects regarding environmental impacts related to oil and gas operations, emerging contaminants, chemical and manufacturing facilities, landfills, pipelines, and air emissions throughout the US and abroad. Ms. Kingham is an expert in site investigations at residential and commercial/industrial properties, including chemical manufacturing plants and oil and gas facilities, under various state and federal regulatory programs.

GOT SOMETHING TO SHARE?

The HGS Bulletin is looking for short (2-6 pages) technical papers.

- **Example topics:**
  - **Geology and geophysics**
  - **Engineering and environmental geology**
  - **Planetary geology**
  - **History of geologic concepts**
  - **Biographies of geology pioneers**

Papers will be citable publications. They can be research summaries, study reviews, or topics of interest.

- **Send submissions, ideas, or questions to: editor@hgs.org**
- **Documents should be word files; Figures should be individual .tif, .jpg, .png, .psd, .pdf**
- **Due by first of the month for potential inclusion in following month's bulletin**
- **Please include a biographical note and a headshot**

Monday, November 13, 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=2477
Event Contact: Linda Sternbach • linda.sternbach@gmail.com

HGS General and North American Dinner Meeting

Dr. Juan Carlos Fernandez-Diaz
University of Houston
Dr. Charles Sternbach
Star Creek Energy and University of Houston
Richard S. Bishop

The 25th Anniversary Lecture

The Robert E. Sheriff Lecture Series

Sponsored by the Department of Earth and Atmospheric Sciences at University of Houston and the U.H. Geoscience Alumni Association

Learn about University of Houston geoscience program with Dr. Tom Lapen, Department Chair, Dr. Robert Stewart and Dr. Paul Mann. As well as the departmental Outstanding Alumni Award. There will be a poster session early in the evening on current thesis and dissertation research of the U.H. students.

Join the meeting early to meet the next generation of geoscientists from the University of Houston!

The Robert E. Sheriff Lecture Series was initiated in 1999 by the University of Houston Geoscience Alumni Association to honor Dr. Sheriff as an educator, scholar, and proponent for the geosciences. The series has recently been co-sponsored by the Houston Geological Society.

The Sheriff Lecture mission is to

bring some of the best known geologists and geophysicists in the world to the Houston community to share ideas relevant to exploration geology and geophysics, and to showcase geoscience activity at the University of Houston.

A full list of the Student Posters will be available on the HGS Website.

R.E. Sheriff Lecture 1

Twenty Years of Exploration and Discoveries Using Airborne Laser Mapping: Contributions to the Archaeology of North and Central America

The National Center for Airborne Laser Mapping (NCALM), the University of Houston (UH), and collaborators are making exciting discoveries of hidden surface features using drones and airborne light detection and ranging (LIDAR) methods. LIDAR can map 3-dimensional forms of the ground and archaeological sites by penetrating vegetation. Our first speaker is Dr. Juan Carlos Fernandez-Diaz, Research Assistant Professor at UH, and Co-Investigator for NCALM. He and partners have discovered a lost Maya city deep in the jungles of Campeche, on the Yucatan Peninsula, in Mexico. Among the findings were several 50-foot-tall pyramid-like structures that date the city to the Late Classic period, between the years 600 and 800 AD. Through the analysis of airborne LIDAR, an international team of researchers identified

HGS Joint General and North American Dinner *continued on page 27*

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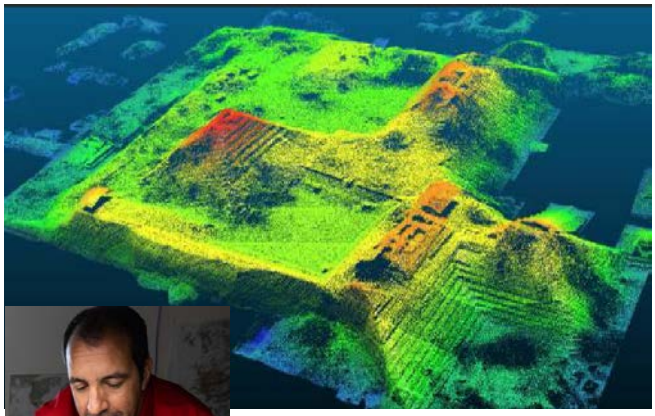
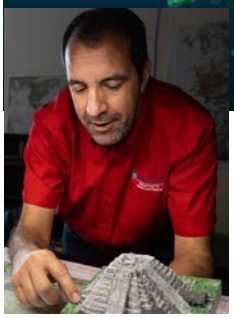




478 ceremonial centers in the Mexican states of Tabasco and Veracruz. A new buried city was discovered, now dubbed Ocomtún, or stone column in Maya. These discoveries are transforming scholars' understanding of the origins of Mesoamerican civilizations, particularly the relation between Olmec and Maya cultures. NCALM has been based at UH since 2010, and operates jointly with the University of California at Berkeley. ■

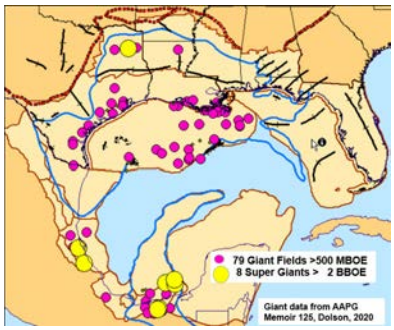
BIOGRAPHICAL SKETCH

Dr. Juan Carlos Fernandez-Diaz is a Research Assistant Professor in the University of Houston's Civil and Environmental Engineering Department, a co-investigator for the National Center for Airborne Laser Mapping (NCALM), and is part of the 2023-25 cohort for the American Geophysical Union (AGU) LANDInG Academy Fellows. Fernandez-Diaz joined UH in 2010 as a senior researcher after earning his doctorate in Geosensing Systems Engineering from the University of Florida. He became a Research Assistant professor in 2019.

R.E. Sheriff Lecture 2

The Habitat of Giant Fields in the Gulf of Mexico: Geology, Geophysics, Digital Technology: Are There More Giants to be Found?

The US and Mexico's Onshore and Offshore Gulf Coast basins have long been proving grounds for discovering giant oil and gas fields. This province boasts prolific Cenozoic and Mesozoic petroleum systems and an extensive infrastructure that makes this collection of Super Basins also an economically "Advantaged Basin." This talk will explore examples of widely differing giant fields and discuss the technology and insights that might enable us to find more oil resources. Questions to be addressed in this presentation:



1. The Super Basin Thinking Toolkit
2. "Seven Habits of Highly Creative Energy Geoscientists"
3. What can we learn from studying the global Giant Fields database?
4. Why are Cretaceous (and Miocene) Giant Fields larger than everything else?
5. Why are Gulf Coast Giant and Super Giant Fields liquid-rich?
6. What are Gulf Coast Giant Fields' structural styles, limiting factors, and habitats?
7. How is the Discovery of Giant Fields linked to Technology and G&G Integration, and what do their trends suggest for the future? ■

BIOGRAPHICAL SKETCH

Charles Sternbach earned an MS and PhD in geology from Rensselaer Polytechnic Institute and a BA in geology from Columbia University. Sternbach started as a geologist for Shell Oil Company, and then became an Exploration Manager for Tom Jordan (Jordan Oil and Gas), and President of First Place Energy (International Frontier Exploration). He is currently President of Star Creek Energy (since 2004). Charles has created and organized AAPG and HGS programs on exploration for 25 years. Sternbach was recently awarded the AAPG Halbouty Award for 2024 and is a past president of both AAPG and HGS.

Looking Ahead to A New Century — The Houston Geological Society Celebrates its 100th Anniversary

By Charles and Linda Sternbach, co-chairs of the HGS 100th Anniversary Committee

The Houston Geological Society held a 100th Anniversary Gala Celebration on October 7, 2023, at the Petroleum Club of Houston. The mood was inspiring, grateful, forward-looking, and humbling. HGS is a volunteer-led organization run by geoscientists. More than 130 celebrants gathered to mark the historic milestone and to remember those who have gone before and others unable to attend.

The HGS 100th Anniversary Committee thanks committee members, especially Jeff Lund (sponsorship chair and wine auction organizer), Craig Dingler (historian and co-editor of the 100th anniversary edition of the Bulletin), Alexandra Price and husband Leonardo Gutierrez (conducting check-in), Mark Hamzat Erogbogbo (HGS Day Proclamation), 100th HGS President Paul Britt (leading the champagne toast), and generous sponsors and wine auction participants.

We recap a few highlights from the Gala and the HGS 100th Anniversary Special Issue—summarizing mission-fulfilling programs, particularly of the last quarter century.

WE HOPE YOU ENJOY THESE VIDEO LINKS ON THE HGSGEO EDUCATION YOUTUBE CHANNEL

Charles Sternbach the Past 25 Years
https://youtu.be/sjf99TCbsk4

HGS Logo
https://youtu.be/NGNpF6lte1E

Paul Britt Toast to the Future
https://youtu.be/TXwuzTOV69I

Penny Patterson
https://youtu.be/sLPFicLOp_M

Attendees at the 100th Anniversary Gala at the Petroleum Club of Houston

A FEW QOTES

"Charles and Linda, thank you and all the HGS staff and members for their continuous outstanding service to the Houston Geological Society over the last 50 years I have been a member. You all have been and continue to be a tremendous inspiration for all members and the up-and-coming future geoscientists! My sincere best regards." *Andy Hampf, HGS Member since 1973*

"Thank you for coordinating this once in a 100 year's landmark event. Organizations and people like you make our profession and our great Society, HGS, thrive. Thank you again, and I will see you later. Lidia and I had a great time!" *Hector F. San-Martin*

HGS 100th Anniversary Gala *continued on page 29*

HGS 100th Anniversary Gala Celebration continued from page 28

We salute many wonderful women leaders of HGS

"Very cool. Great job – even significant others had a good time." *Glenn R. Lowenstein, PG (TX #28)*

"Y'all did an awesome job!!! CONGRATULATIONS!!!" Penny Patterson, HGS President-Elect, #101

"Thank you so much! Gala of the century. I am looking forward to sharing that Armstrong wine with you to celebrate." *Jon R. Rotzien, Ph.D. Basin Dynamics*

Allison Barbato, HGS Scholarship Night Recipient, chats with Jeff Lund, Marti Lund, and Mary Kae Dingler.

President Paul Britt reads the Proclamation from the Mayor of Houston declaring October 7, 2023 to be HGS Day, followed by a champagne toast to the century past and the future.

HGS 100th Anniversary Gala *continued on page 30*

HGS 100th Anniversary Gala Celebration

continued from page 29

Stephanie Taylor (granddaughter of HGS First President John Suman with past presidents Charles Sternbach (#76) and Walter Light (#99).

"I've been President of the Houston Geological Society, the GCAGS (Gulf Coast Section of AAPG), and AAPG. Each society contributes to our geoscience community working best when they reinforce each other. Many young professionals make their first contact with professional organizations through local societies. HGS is a valuable partner in this effort with a coordinated series of outreach and professional committees guiding young professionals into our Industry." *Charles Sternbach*

"It's official! October 7, 2023, is the Houston Geological Society 100th Anniversary Day by the Mayor of the City of Houston. The Proclamation was presented at last night's HGS' 100th Year Gala. Thanks to the Gala committee Co-Chaired by Charles and Linda Sternbach and Mark Hamzat, who arranged for the Proclamation from the Mayor's office posted here." *Paul Britt, HGS President #100*

"My hat's off to all who planned this stellar event — especially to the esteemed co-chairs, Linda & Charles Sternbach!!" *Sara B. Davis*

"Charles, you and Linda truly knocked it out of the park!!! What a fabulous gala!!! I have never had so much fun, and I was/ am sincerely honored to have helped out. I hope I made you proud with my impromptu open-mic speech!! Let's plan on a fabulous 125-year gala!!!" *Alexandra Price*

Alexandra Price holds a copy of the "Rockhounds of Houston" by HGS pioneer Alva Ellisor.

Joseph Ebrom, offers comments on the HGS. Note the mural "100 Years, 100 Presidents" in the background.

Mark Hamzat Erogbogbo comments about HGS and its impact on the community

NeoGeos

NeoGeos Happy Hour at Walking Stick Brewery was held on September 28. Over 20 attendees joined the fun.

HGS NeoGeos 2023-2024 Happy Hour Schedule

***Locations may be subject to change as dates approach**

~~Thursday, September 28th – Walking Stick Brewery~~

Wednesday, October 25th – Kirby Ice House (Memorial)**
Change of date due to Astros Game**

Thursday, November 30th – GeoTrivia @ Cottonwood

Thursday, January 19th – Walking Stick Brewery

Thursday, February 22nd – Kirby Ice House (Memorial)

Thursday, March 21st – GeoTrivia @ Cottonwood

Thursday, April 18th – Walking Stick Brewery

Thursday, May 23rd - Kirby Ice House (Memorial)

Sponsorship opportunities available:
Contact Bryan @ geobottoms@gmail.com

HGS Golf Tournament 2023

By Jimmy Bagley

The HGS hosted the annual golf tournament at Sterling Country Club on Monday, October 16. The even had record-breaking attendance with over 134 teams! Every year, we try to make this event better, and we couldn't do it without all the amazing volunteers and sponsors. Thank you all for the time and dedication to our organization.

Nearly 15 sponsors and vendors set up booths around the course where they hosted activities such as card games and long drive games featuring hula hoops. Larry Adamson of Navitas, who was playing on the CGG Team, won the "closest to the pin" contest. Continental Laboratories cooked tasty treats at the first hole for all the players to enjoy.

Following the tournament, attendees enjoyed a great BBQ lunch, followed by an awards ceremony and raffle giveaway. A few teams "understood the rules" and increased their scores after the golf concluded.

Thank you to all the volunteers, members, and sponsors who made this year's tournament a huge success. We are already planning for 2024, so be on the lookout for information coming soon including new/updated scoring rules and maybe even a venue change!

THE WINNERS WERE AS FOLLOWS:

1st Place Team

Edge Systems: Daniel Baker, Stephen Frazier, Kenny Baucum, and Jake Lacy

2nd Place Team

Edge Systems: Seth Johnson, Benjamin Gutierrez, Stanley Stackhouse, and Dan Sheehan

3rd Place Team

Quantum Energy Technologies: Adam Erwin, Logan Chatterton, Jason Hanzel, and Mark McCollum

1st Place Team – Edge Systems: (L to R) Kenny Baucum, Daniel Baker, Stephen Frazier, Jake Lacy

Above photo: (not in order) Shannon Lemke (Eplison Energy), Kathy Bair, Jennifer Wilson, Lindsey Bateman

Left photo: (not in order) Bryan Guzman (up on the backs), Daniel Sutton, Evan Jones, Mike Sheahan

HGS Outreach
Reach for the Stars! STEM Festival

By Aubrey Waddail and Janet Combes

Eight volunteers from HGS participated in the 15th semi-annual Reach for the Stars! STEM Festival held at Rice University on September 30. Hundreds of students attended the event that included a street fair, workshops, guest speakers and exhibits on Science, Technology, Engineering and Mathematics (STEM). The HGS volunteer team included Barbara Hill, Lauren Robinson, Elizabeth Baker, Michelle Pittenger, Geraldine Tijerina, Aubrey Waddail, and Aubrey's daughters Ava and Kendall.

(L-R) Lauren Robinson, Kendall Waddail (Geologist in Training), and Barbara Hill engage students in Geology.

HGS volunteers helped students to view rock samples using a hand lens, and taught students to make geological observations. The geophone and pumice garnered much attention. Students kept the volunteers on their toes with questions about renewable energy, geothermal, and carbon capture and storage. Volunteers also shared information about diverse geology careers. Barbara Hill participated on a Physical Sciences panel and answered many questions about being a geologist, in particular a female geologist

Thanks to the efforts of Janet Combes and Chuck Caughey, United Salt donated samples from their mine in Hockley. These samples were distributed to students and teachers. The HGS also provided teachers with a 12-page salt information sheet that was assembled by Debbie Caperton.

The Reach for the Stars Festival was started in 2006 through a collaboration between astronaut Sally Ride and Rice University. The HGS has participated in 14 of the 15 Festivals, only missing one event that was held during the pandemic. ■

November 2023

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8 **HGS E&E Dinner Meeting** *TBPG Professional Ethics Training* *Page 25* *https://www.hgs.org/civicrm/event/info?id=2510*	9	10	11
12	13 **Sheriff Lecture 25th Anniversary** *Page 26* *https://www.hgs.org/civicrm/event/info?id=2477*	14	15	16	17	18 **HGS Field Trip** *Galveston Brazos River Field Trip* *Page 24* *https://www.hgs.org/civicrm/event/info?id=2502*
19	20	21	22	23 **HGS Office Closed for Thanksgiving**	24	25
26	27	28	29	30		

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.**

Make your reservations online at hgs.org

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.

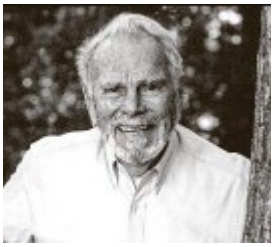
Text should be submitted as a Word file. Figures or photos may be embedded in the document or submitted separately. The following image formats are accepted: tif, .jpg, .png, .psd, .pdf.

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

Remembrance

Robert Joseph Schorp Smith

October 18,1926 – September 28, 2023



Robert Joseph Schorp Smith, 96, of Houston, Texas went home to be with The Lord on September 28, 2023. Bob, as he was known by his friends and family, was born October 18, 1926 in Pearsall, Texas to Walter Frank Smith and Ida Helen Schorp Smith. Upon graduation at the age of 16 from Pearsall High School, where he played football and was president of his senior class, he moved to Port Arthur, Texas, where he worked for a contractor developing aviation materials for the war effort. He then moved to Washington, DC and clerked for the US War Department until December of 1944, when he volunteered for the Air Force and began basic training at Shepherd Air Force Base in Wichita Falls, Texas. Upon completion, he was transferred to Lowry Field in Denver for additional training and then on to Germany. In Germany, he was based at Furstenfeldbruck, formerly the largest Luftwaffe facility in the country.

Bob left the service in May of 1946 and moved to Laredo, Texas to work as a roughneck. In May of the following year, he enrolled at University of Oklahoma and went on to receive his BS in Geology with a double minor in physics and chemistry. After graduation, he returned to Laredo, this time to work as a geologist for Chevron. They later sent him to Tulia, Texas where he was head of a geophysical crew and then on to Amarillo to do the same. He moved to San Angelo after being promoted to Exploration and then on to Galveston where he did offshore work. He later was transferred to Houston and then to Corpus Christi in 1960.

In 1962 he married the love of his life, Cynthia Bingman Smith. They lived in Corpus until 1965 and were then transferred to Midland, Texas, where Bob was put in charge of acquisitions for Chevron's western division. His final transfer with Chevron was back to Houston in 1968, working in acquisitions on the Vice President's staff.

In 1971, he traveled to the USSR for the International Association of Petroleum Geologists convention, while there he suffered a heart attack at the age of 45. Upon recovery he made the decision to resign from Chevron and form his own company named after his family's ranch and childhood home in South Texas. Santa Maria International was formed in 1972. Bob ran the company for over 45 years and traveled extensively for his new endeavor to places such as Kazakhstan, Egypt, Turkey, Malaysia, China, Australia, New Zealand, Romania, Yemen, and beyond. This all led to his amazing love of traveling the world.

In his later years, Bob enjoyed spending time on his beautiful Texas Hill Country ranch with his wife, riding his favorite horse Bonita, working cattle and enjoying the peace that came to him from the heritage of the land.

He was a member of the American Association of Petroleum Geologists in the Division of Professional Affairs, The Houston Geological Society, past member of the Houston Producers Forum and a member of The World Affairs Council. Bob was also a member of The Sons of the Republic Of Texas, a life member of the 100 Club of Houston and the Houstonian Club where he made many lifelong friends. He was on the Board of Directors of Tradition Bank and the Board of Directors of Transglobe Energy in an Advisory position.

Our precious husband, father, and grandfather is proceeded in death by his parents Frank and Ida and his sister Helen Smith Carroll. He is survived by his loving wife of 61 years, Cynthia, and their three children and nine grandchildren who adored him. His children and grandchildren include: his son, Robert Smith, and Robert's wife Alice of Houston, Texas and their two children Robert Louis and Michelle; his daughter, Harriet Smith Essman, and Harriet's husband, Jim, of Midland, Texas and their three children, Jimmy, Macy, and Smith; and Helen Smith Todora and her husband, Michael, of Fort Worth, Texas and their four children, Robert Thomas, Harrison, Vivian, and John. Bob is also survived by his sister, Mary Jo Phillips, of Pearsall, Texas. Bob will be buried on his beloved Texas Hill Country ranch in the family cemetery following a private service there.

Published by Houston Chronicle *Sunday, 8 Oct 2023.*

Remembrance

John A Breyer

February 26th, 1947 – October 21, 2023

Dr. John A Breyer, 76, passed away October 21, 2023. He was born on February 26th, 1947 in Cincinnati, Ohio to his parents Frederick A and Catherine Crowley Breyer.

He was preceded in death by his parents Frederick A and Catherine Crowley Breyer, brother Eric and sisters Frances and Julie. He is survived by his college sweetheart and wife, Mary Ann, brothers Bill, Jimmy, and Woody, sister Mimi, niece Emma, nephew Daniel, twelve other nieces and nephews, and four decades of undergraduate and graduate students who he loved and mentored as his own children.

John was a lifelong learner who attended St. James School, Roger Bacon High School, University of Cincinnati (B.S.) and the University of Nebraska (Ph.D – Geology, 1975).

In August 1975, he began his teaching career at Texas Christian University where he won numerous awards for teaching, research and service to the students and University. From 1981 to 1984, John took a leave from TCU to conduct research at Exxon Production Research Company where he studied sedimentary stratigraphy and Texas coal deposits across south and east Texas. After returning to TCU in 1984, John continued his long service at TCU as a professor and mentor to undergraduate and graduate students who then went on to work in the oil and gas industry. Based on his research contributions he was elected a Fellow of the Geological Society of America in 1991. John received the GCAGS Outstanding Educator Award in 2005. While at TCU and as Emeritus Professor after retirement, John authored or co-authored more than seventy articles in international and national scientific journals. He is a documented author on research subjects ranging from the biostratigraphy of camel metapodials, conventional Gulf Coast subsurface geology, mudrock sedimentology, and unconventional resource oil and gas plays including the Barnett, Eagle Ford, Bakken, Delaware, and central Oklahoma resource basins.

John joined Marathon in 2011 after teaching for thirty-three years at Texas Christian University. While at Marathon, John was recognized for his technical skillset, ability to bring teams together, and for his mentorship ability to young and mid-career professionals. After seven successful years at Marathon, John retired from Marathon Oil Company in 2018 as a Senior Technical Consultant working in unconventional resources.

His presentations at national meetings have twice been recognized for excellence by his peers. John is an expert in the geology of shale resource systems. He edited and contributed to AAPG Memoir 97 Shale Reservoirs—Giant Resources for the 21st Century, which won the Robert H. Dott Sr. Memorial award from AAPG as the Association's best technical publication in 2012. A second AAPG Memoir with the title: The Eagle Ford Shale—A Renaissance in U.S. Oil Production was published in 2016.

In his personal life, John was a frequent global traveler. During his time at TCU, John spent numerous summers in Scotland teaching geology and the history of the Enlightenment Period to students who participated in the TCU-in-Scotland program. In October 2013, John spent two weeks hiking in the Himalayas as a participant in the National Geographic Society trip, Bhutan: The Sacred Valley Trek. In 2014 he spent three weeks in Russia and a week in Japan. In 2015, much to his younger colleagues' surprise, John survived a hike to the Mt. Everest base camp. He had also been to England, France, Spain, Switzerland, Argentina, and Chile to take in the scenery, and to Abu Dhabi, Poland, Norway and Germany on business. In 2016, John crossed the Andes on the Inca trail into Machu Picchu, hiked to the top of Mount Kilimanjaro, and visited Ngorongoro Crater and the Serengeti. He hiked along the Great Wall in China, rode a camel, and milked a yak in Mongolia.

John will be greatly missed by all who loved, supported, admired, and respected him. The TCU, professional, and AAPG communities all express condolences for his loss and gratitude for the time we were able to spend with him when he forever changed them.

Dr. John A Breyer was a great man, a powerful mentor, left a legacy of students and contributions to science, and made a difference in the lives of many across the world. A Memorial service will be held on December 2, 2023 at TCU.

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

Gun Raffels, Door Prizes, Lunch,
Drinks & MULLIGANS for purchase

Sponsorship Opportunities Available!

Register
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

****

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:
Houston Geological Society, 14811 St. Mary's Lane, Ste. 250, Houston, TX 77079

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)*_____

Phone _____

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_____

Payment:

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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Consulting Geologist

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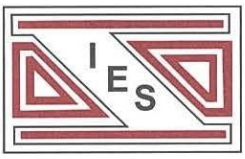

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