HGS Bulletin

Volume 66, Number 7

Houston Geological Society

MARCH 2024

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The Houston Geological Society Bulletin (ISSN-018-6686) is published monthly except for July and August by the Houston Geological Society, 14811 St. Mary's Lane, Suite 250, Houston, Texas 77079-2916. Phone: 713-463-9476.
Editorial correspondence and material submitted for publication should be addressed to the Editor, Houston Geological Society Bulletin, 14811 St. Mary's Lane, Suite 250, Houston, Texas 77079-2916 or to office@hgs.org.
Subscriptions: Subscription to a digital version of this publication is included in the membership dues ($30.00 annually). The subscription price for non-members is $160.00.

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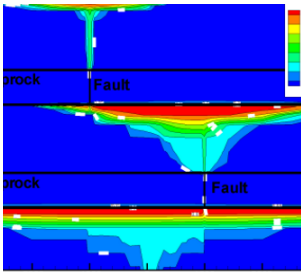

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About the Cover: Mendenhall Glacier medial moraine by Dorene West.
Picture taken from a prop plane (through a scratched Plexiglass window). The glacier is flowing from the Juneau Icefield to Mendenhall Lake. Each flow line represents 1 year. Two arms of the glacier meet with a medial moraine (scraped rock dust/dirt . . .) in between. (Dark rocks at the top; glacier is flowing downhill.) Picture taken September 2010 with a little point and shoot Pentax (before iPhone camera).

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Earn Dividends by Getting Involved in the HGS

FEBRUARY HIGHLIGHT

The Scholarship Night event was held on Monday February 12. It was a fantastic event to honor scholarship recipients and their faculty advisors and provided an opportunity for HGS members to meet students. The dinner set a new record for fundraising for the Calvert memorial Fund and the HGS Undergraduate Foundation, raising $53,500. The net proceeds will be equally divided between the two Foundations, furthering their ability to provide student scholarships well into the future. A special shout out goes to Sponsorship Chair, Jeff Lund, for this accomplishment, and to all the generous sponsors that made this possible. Their names can be seen on the monthly sponsor list, and in the article in this issue on the event.

OFFICE MOVE

Earlier in the year, I discussed the need to reduce the office space. After considering everything from subletting space from member's companies to offsite storage space, a significant savings was gained by moving to smaller space in the same building and just down the hall and from the old office. The suite number should remain the same, but a substantial savings in rent will be realized, and the move will be budget-friendly. Many committees have helped considerably by organizing, sorting and reducing unneeded inventory over the last year, and deserve our thanks for those efforts.

ELECTIONS

Many of you may be wondering about the upcoming election of next year's officers and may have noted the lack of the usual announcement at the January or February General Dinner meeting. This year has not only been an exception, but has proven more difficult than usual.

Each year, the nominations committee (composed of recent past presidents) is tasked to fill a slate of candidates. Some positions are better suited to candidates who have experience with the operations of the Society. However, a growing number of experienced members have already served in the offices needing to be filled. Other positions are well-suited for newer faces, however, many junior members cite job concerns in their reluctance to serve. Furthermore, the membership base is reduced (though stabilized), limiting the number of available candidates. As a result of these factors, this year's slate has been challenging to fill.

This brings me to member involvement. The members of a society are like shareholders, and the dividends come in the form of career benefits. Becoming engaged brings those benefits through peer recognition, network opportunities, exposure to contacts outside of their normal circles, and experience serving in a leadership role. Through my involvement in HGS, and other organizations, I have found those benefits cited above by access to decision-makers when seeking consulting work or selling prospects. I cannot emphasize enough the value of those skills in career advancement within your current company or in moving on to new opportunities. If you wish to become engaged as a shareholder, one way is to attend the general dinners or other events and meet others, another is to reach out to committee chairs or Board representatives to see where you might become involved. Like any journey, it begins with a first step.

the dividends come in the form of career benefits

By the time you are reading this letter, we should have the candidate slate completed. Look for an announcement in the upcoming weekly newsletter, and look for candidate's biographies and photos in the April issue of the *Bulletin*. Ballots will go out in early April. *Please vote!*

UPCOMING EVENTS

There are the usual number of upcoming activities, but I would like to point out just a few. There is a field trip to the Guadalupe Mountains in April lead by the speaker from Scholarship Night, Bob Lindsay, and it promises to be an outstanding trip. GeoGulf 2024, held here in Houston last year, will be held in San Antonio in April. You may recall that GeoGulf 2023 was a leading sponsor for the HGS 100th Anniversary Gala and Special Bulletin. The Shrimp Peel is also planned for April. Check out the calendar on the website and this *Bulletin* for details. I hope to see you there. ■

Caroline Wachtman
editor@hgs.org

Is CCUS Good for Geologists?

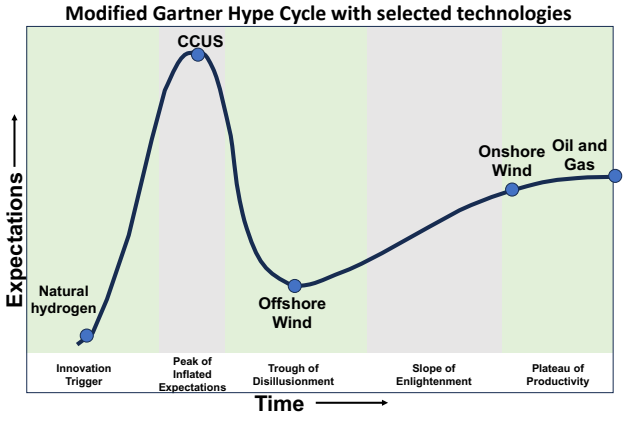
I've listened to many HGS members about their views on Carbon Capture, Utilization and Storage (CCUS). Members' opinions cover a spectrum, but many push back on the idea that CCUS should be getting any attention from geologists or governments. The source of the opposition to CCUS can be grouped into three broad categories: (1) concern that CCUS is a threat to oil and gas, (2) frustration that government funding is supporting CCUS projects and technologies, and (3) skepticism that global temperature rise is an issue for the planet. I hear you! And, I can help address these questions.

CCUS describes the process of capturing CO_2 from anthropogenic sources or the air and utilizing the CO_2 for economically beneficial uses, such as enhanced oil recovery (EOR) or the beverage industry; or CO2 can be sequestered in deep saline formations to remove it from the carbon cycle. CCUS is not a source of energy, so it does not compete with oil and gas. Instead, CCUS can reduce the carbon emissions that result from burning fossil fuels. Using CO_2 for EOR can result in net-zero or net-negative oil, meaning that the carbon footprint associated with generating energy from the oil is less than the amount of carbon retained in the formation through injection. CCUS can work cooperatively with power generation systems, such as the technology developed by NET Power (NET Power), where much of the CO_2 generated from hydrocarbon combustion is recycled in the power generation system as a working fluid and the excess is sequestered underground.

CCUS is a growing source of good jobs for geologists

Some HGS members have expressed frustration that the United States Government is providing grants, loans, and tax incentives to support CCUS technology innovation and commercial-scale projects. Why isn't the government giving similar incentives to oil and gas developers? CCUS projects, particularly those for sequestration are costly to execute, costing 100s of millions to billions of dollars. Furthermore, the regulatory requirements for CCUS projects are costly. For example, applying for a permit to inject CO_2 for sequestration requires months of technical work and years of permit iterations. Permit holders are expected to conduct costly direct measurements and geophysical monitoring of the site during and after injection, unlike typical oil and gas operations. Through repeated commercial-scale deployments, costs are expected to reduce in the future, and government funding is likely to be reduced, too.

The International Energy Agency, and many other governmental agencies around the world have determined that increasing CO_2 in the atmosphere is contributing to global temperature rise. Even Oil and Gas companies such as BP (BP ESG report) and ExxonMobil (ExxonMobil sustainability) aim to reduce their carbon and methane emissions to be net zero by 2050. The impacts of increased temperature include economic and human impacts, such as increased risk of flooding during storms, elimination of communities at low-lying areas due to sea level rise, and others. While there are some benefits to a warmer climate, worldwide organizations propose that the risks don't outweigh the benefits. CCUS is one of many ways to reduce carbon in the atmosphere.



IS CCUS JUST A FAD?

The Gartner Hype Cycle (Gartner) graphically describes common patterns of technology innovation and includes five phases that technologies typically pass through: Technology Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment and Plateau of Productivity. After technology breakthroughs kick off, expectations rise to a peak. Some projects will succeed, and others will fail, leading to disillusionment. Then, examples of how the technology can benefit the industry become more widely understood, leading to more funding and finally to mainstream adoption. While some of the technologies associated with CCUS have been successfully

From the Editor *continued on page 7*

From the Editor continued from page 6

and safely implemented for decades, few commercial-scale projects have been deployed yet. CCUS is commonly placed on the peak of the curve—expectations are high that these projects will be technically and economically successful. The trough of disillusionment is coming. The challenge is to stay the course and come out to enlightenment on the other side.

CCUS IS GOOD FOR GEOLOGISTS

CCUS is a growing source of good jobs for geologists. CCUS roles typically utilize many of the same skills that Oil and Gas geologists have developed: characterizing stratigraphic and structural setting, evaluating reservoir or seal quality, integrating geophysical data to predict rock quality away from well control, and collaborating with engineers to construct predictive models of the subsurface. These are challenging, intellectually stimulating types of roles that require creativity and expertise. Many of the major and mid-size Oil and Gas companies, including ExxonMobil, BP, Chevron, Shell, Oxy, Repsol, Equinor, Talos, have started CCUS teams, because these companies have geoscientists with the right skills.

Additionally, geologists are expected to play an important role in safely developing CO_2 storage projects. The Texas Board of Professional Geologists is evaluating the requirements for Professional Geologists to sign and seal applications for CO_2 storage wells, because CCUS is deemed to be "public practice of geology" that comes with the responsibility to protect public sources of underground drinking water. Geologist should not sit on the sidelines; we have the skills to develop CCUS projects safely and effectively.

To learn more about CCUS and HGS members working in this business

- Read about the basics in the article *What is CCUS?*
- See the profile of Cindy Yeilding, former Senior Vice President of BP and former Board member of Denbury, who is an active advisor and educator on CCUS
- Bill Maloney, former Executive Vice President for Equinor, is an active member of the AAPG-SEG-SPE CCUS conference organizational committee. He shares key lessons from his career in a conversation with the Editor.
- *Pivot Profile* focuses on two HGS members who are applying their geoscience skills to CCUS: Paiden Pruett and Ed Feragen.
- Read about a student and a professor from University of Houston who are applying geology to solving CCUS problems in *We are the HGS.* ■

We Are The HGS

Michael Antonelli, HGS member since 2023

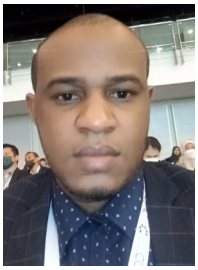
"I teach my first class next week [in January 2024]. Wish me luck," says Michael Antonelli, who recently moved to Houston to start a new position as an Assistant Professor in the Department of Earth and Atmospheric Sciences at the University of Houston. Antonelli comes to Houston after more than 17 years of academic training and experience including the University of Alberta, University of Maryland, UC-Berkeley, Institut de Physique du Globe de Paris, and ETH Zurich. Antonelli says that he is excited to be in Houston and to join the HGS. "I'm hoping to find collaborators, students, and funders," he says.

Antonelli is an isotope geochemist whose work is primarily focused on calcium isotopes. He says there are diverse applications for Ca isotopic analysis that range from higher temperatures, such as volcanic eruption speedometry and formation/evolution of continental crust, to lower temperature settings, such as understanding marine carbonate formation and quantifying the amount of carbon mineralized in CO_2 sequestration projects. Given the growing interest in Carbon Capture and Sequestration (CCS) among Houston-area companies, Antonelli says he is hoping to build industry partnerships on CCS. His first master's student (fall 2024) plans to work on a CCS-related project.

Antonelli is looking forward to building his network of geochemists or geoscientists interested in geochemistry

Antonelli says that while HGS events like the Crawfish Boil and Sporting Clays are not his expertise, he hopes the HGS will consider starting a bowling league, and notes that bowling is a great way to build community. Antonelli is looking forward to building his network of geochemists or geoscientists interested in geochemistry in the Houston area through bowling or other venues.

In addition to teaching and conducting research, Antonelli became Director of the Thermal Ionization Mass Spectrometer (TIMS) Core Facility at UH that specializes in low abundance isotopic measurements. He will be adding new isotopes to the measurement suite in the coming months. ■



Basil Nwafor, HGS member since 2023

Basil Nwafor recently joined the HGS to expand his network and learn more about industry activity in Houston. Nwafor values networking because it has influenced his geology career and led him to new opportunities. He is also interested in sharing his research and knowledge with HGS members.

After earning a bachelor's degree in Geology from Enugu State University in Nigeria, Nwafor worked for Ankor Pointe, a geologic consulting company supporting Oil and Gas operators such as Shell, Chevron, and Petronas. He developed skills in seismic interpretation and reservoir characterization through his work experience. As a geoscientist at Ankor Pointe, he was involved in field development planning, reservoir evaluation, well intervention, prospectivity studies, and other related projects. Then, Petronas offered Nwafor the opportunity to move to Malaysia to work for the company and also earn a master's degree in Petroleum Geoscience from Universiti Teknologi Petronas.

Nwafor earned a scholarship to pursue a PhD at the University of Houston, where he is currently combining geology and geophysics to understand geologic features that control fluid movement during and after CO_2 injection. His research involves observing the effect of CO_2 on geophysical properties and using time-lapse seismic to quantify the changes in a reservoir over time.

Nwafor is looking to build connections to the industry and to potential employers

While Nwafor may ultimately move into consulting roles in the future, he hopes to secure a role with an operating company before he graduates in the fall of 2027. In the meantime, Nwafor says he is looking forward to meeting other HGS members to build connections to the industry and to potential employers. ■

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.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What To Do with CO_2? Carbon Capture, Utilization and Storage for Geoscientists

By Caroline Wachtman

Carbon Capture, Utilization, and Storage (CCUS) describes the process of capturing CO_2 from industrial sources or the air and then utilizing it for purposes such as enhanced oil recovery (EOR), or for permanent geologic sequestration. While the interest in CCUS is relatively recent, the technology has been around for decades. As the portfolio of commercial-scale CCUS projects grows, so too do job opportunities for geologists. Reservoir characterization, modeling and operations skills developed for Oil and Gas are transferrable to solving new subsurface problems in the CCUS industry.

The purpose of this article is to provide a brief overview of CCUS, including how CO_2 is utilized, sequestered, captured and transported (**Figure 1**). For more detailed information and analyses, readers are encouraged to consult the National Energy Technology Laboratory website on Carbon Management (NETL Carbon Management), the Department of Energy's website on Carbon Management (EPA Carbon Management), the Environmental Protection Agency's website (EPA Class VI) and a report by the congressional research service (Congress 2022). Also, readers are encouraged to participate in the discussion at upcoming events such as the 2024 CCUS conference, page 19 (CCUS event).

UTILIZATION AND STORAGE

CO_2 is a valuable commodity (IEA 2019) and can be utilized in a variety of industrial applications such as fertilizer manufacturing, food and beverage production, and in fuels, polymers and building materials. EOR is one of the most common utilizations of CO_2, requiring 70-80 million metric tons per year (MMTA) (IEA 2019), which is roughly 2300 Mscf/day. Companies such as ExxonMobil, Kinder Morgan, Chevron, Oxy and others utilize CO_2 in mature fields as a means of secondary or tertiary oil recovery (e.g. Oxy EOR). While some of the injected CO_2 is produced along with mobilized oil, a portion of the CO_2 is trapped in the reservoir as production declines. Over decades, CO_2 tends to rise to the level of structural and/or stratigraphic containment, where it is prevented from further movement. In addition, some of the CO_2 may be mineralized.

Carbon Capture and Storage (CCS), also called CO_2 sequestration, is similar to EOR. The key difference of CCS is that CO_2 is injected into reservoirs that are not productive of hydrocarbons. Storage reservoirs can be saline aquifers in which the total dissolved solids (TDS) are greater than 10,000 ppm, depleted hydrocarbon fields, un-mineable coal seams, or mafic/ultramafic rocks. The majority of commercial-scale projects currently applying for

What is CCUS? *continued on page 14*

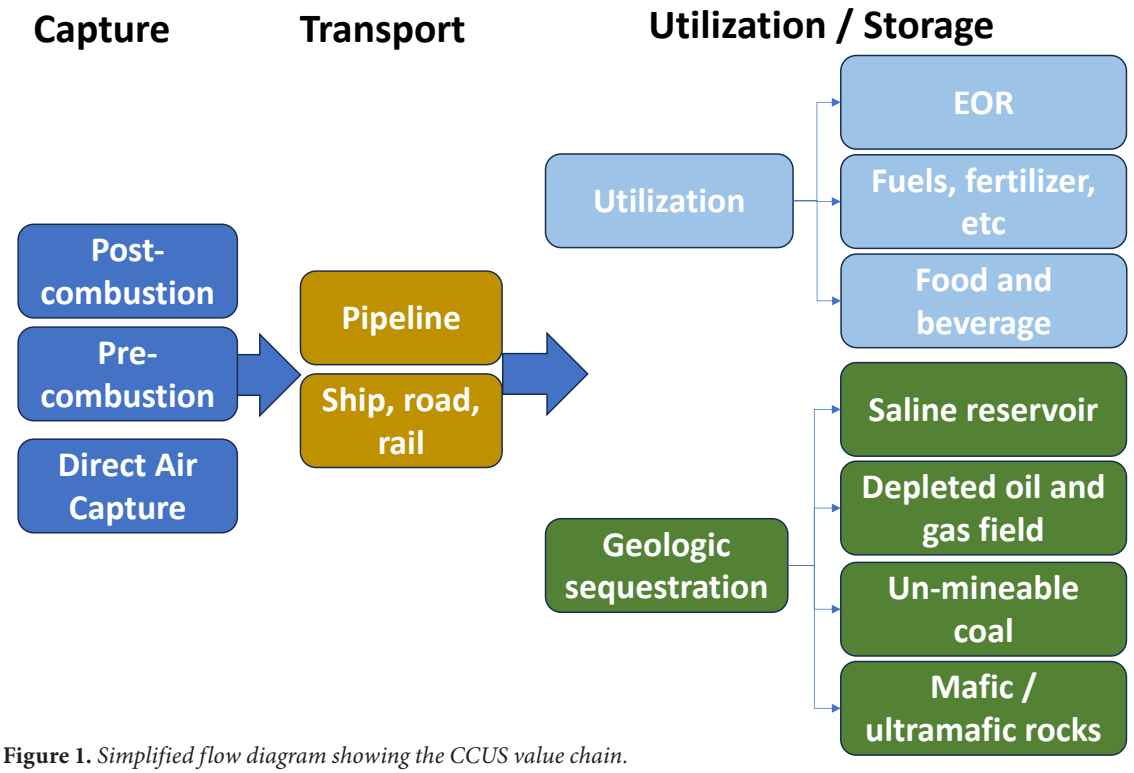

Figure 1. *Simplified flow diagram showing the CCUS value chain.*

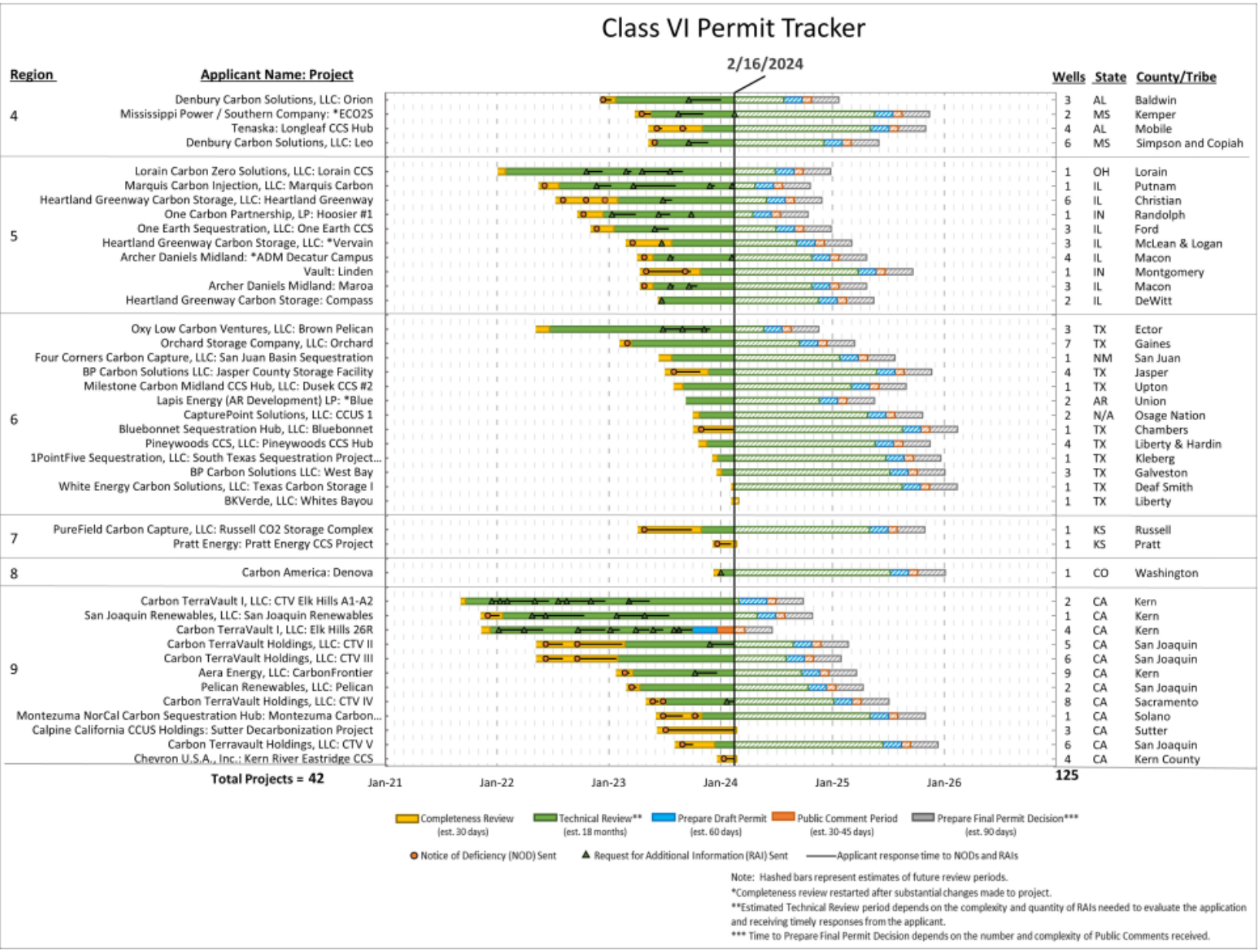

Figure 2. *List of CCS projects currently under review by the EPA. Current Class VI Projects under Review at EPA | US EPA*

What is CCUS? *continued on page 15*

What is CCUS? continued from page 14

Class VI injection permits (the permit required to inject CO_2 for storage) are planned for saline aquifers (**Figure 2**). Climeworks' sequestration facility in Iceland is currently storing CO_2 in volcanic basalt, but none of the current commercial-scale projects plan to store CO_2in this way. Likewise, there are no commercial-scale projects planning to inject CO_2 in coal beds.

CO_2 CAPTURE TECHNOLOGIES AND COSTS

The majority of the CO_2 presently utilized in industrial or chemical applications is sourced from natural deposits, such as Sheep Mountain in Colorado and Jackson Dome in Mississippi. However, an anthropogenic CO_2 source must be utilized to qualify for tax credits associated with CCUS. The CO_2 can be captured post-combustion, e.g., from a flue gas stream, or pre-combustion in certain industrial processes. Additionally, CO_2 can be captured directly from the air in a process commonly referred to as Direct Air Capture (DAC).

POST-COMBUSTION POINT-SOURCE CAPTURE

Mitsubishi Heavy Industries has been a technology leader in post-combustion CO_2 capture technology for decades, and the company says they supply 70% of the capture equipment for chemical and power plants (Mitsubishi). In Mitsubishi's process, exhaust gasses are contacted with a liquid solvent, typically an amine solution, and are pushed through a material that absorbs the CO_2. Then, the solvent is heated to release the CO_2. Historically, only about 90% of CO_2 can be removed with this process, but newly commercialized technology may yield 99.8% recovery of the CO_2 (Forbes). Other mature technologies include chemical adsorption and membrane-based extraction. Cryogenic separation, separating CO_2 at very low temperatures, is in commercial development (Shen et al., 2022).

Ethanol plants are some of the least costly industrial sources for CO_2 capture, because the flue gas composition is nearly 85% pure CO_2, and facilities generally have only a few point sources from which emissions need to be captured. In contrast, power plants may have dozens of point sources throughout a facility and only 4-5% of the flue gas streams are composed of CO_2 (NETL). As a result, it costs more to strip out the CO_2 from power plant emissions. However, the volume of emissions from these facilities is high. More than 50% of the CO_2 emissions in Texas reported to the EPA in 2022 came from power plants (**Figure 3**).

PRE-COMBUSTION CAPTURE

Pre-combustion CO_2 capture is gaining interest, but it typically requires greenfield installation thus it is not applicable to existing CO_2 emissions facilities. To capture CO_2 pre-combustion, an emissions source is partially oxidized under high temperature and pressure. The emissions are converted to synthetic gas, which allows the CO_2 to be efficiently extracted.

DIRECT AIR CAPTURE

DAC is a technology that extracts CO_2 from the air. It does not require a point source of emissions, and therefore can be placed in a wider range of locations. Carbon Engineering, along with Climeworks, and Global Thermostat are leading developers of DAC technology. Climeworks debuted the first commercial-scale DAC facility in 2021 with a capture capacity of up to 4,000 tons of CO_2 per year, which is approximately 0.2 Mcf/day (Climeworks).

Oxy is currently building a facility in Ector County, Texas that aims to capture 500,000 tons of CO_2 per year (Oxy 3Q2023 earnings call), which is approximately 26 Mcf/day. This facility is designed to use Carbon Engineering's technology. In this process, air is drawn into a facility and passed over surfaces containing potassium hydroxide, which binds with the CO_2. The solution is then chemically reacted to precipitate pelletized calcium carbonate, and next heated to separate out the CO_2 from the calcium (https://carbonengineering.com/our-technology/).

CO_2 TRANSPORT

While transport by truck or rail is possible, commercial volumes of CO_2 are typically focused on pipeline transport. Existing,

What is CCUS? continued on page 16

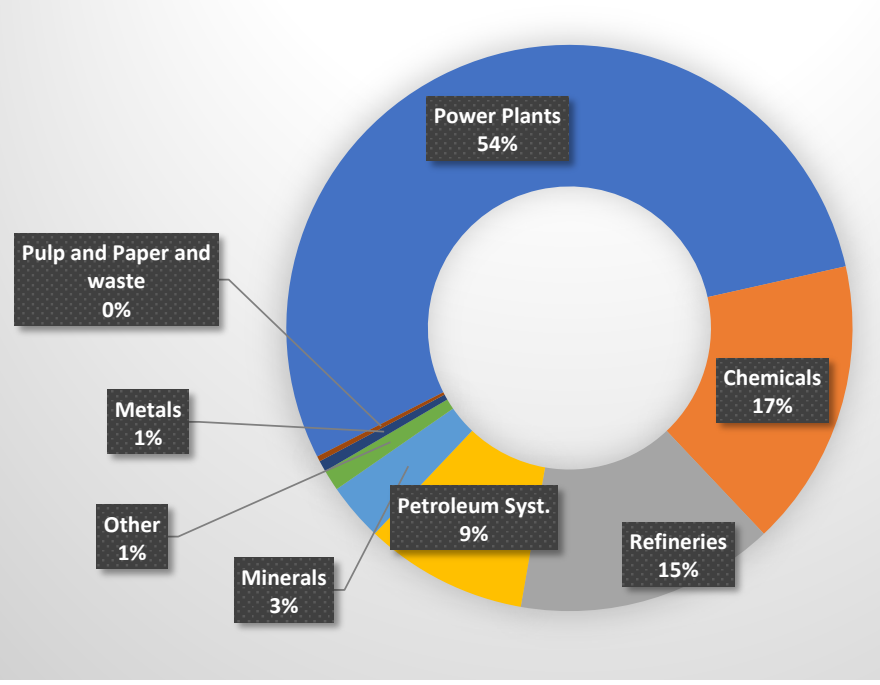

Figure 3. *Source of CO_2 emissions from Texas reported to the EPA in 2022 (most recent data available).*
EPA Facility Level GHG Emissions Data

dedicated CO_2 pipeline infrastructure is dominated by Denbury (recently acquired by ExxonMobil), who owns nearly 800 miles of line connecting Jackson Dome with EOR fields in Texas, Mississippi and Louisiana, and 230 miles in the Rocky Mountain region (Denbury). Kinder Morgan controls 500 miles of pipeline connecting Sheep Mountain to EOR fields in the Permian (Kinder Morgan).

New pipeline construction is typically required for greenfield CO_2 sequestration projects, but can be challenging to win acceptance. For example, Navigator CO_2 planned to build 1,300 miles of dedicated CO_2 pipeline across five states in the Midwest to connect emitters to sequestration sites. However, South Dakota regulators denied the company's permit application in September 2023 and the company subsequently halted their plans after pushback from the public (Navigator CO_2 halts plans). Summit Carbon Solutions is also evaluating a midwest pipeline route (Summit Carbon Solutions).

GEOLOGIC STORAGE OF CO_2

If captured CO_2 is not utilized, it may be geologically sequestered. Saline reservoir storage or storage in depleted oil and gas fields are the most common storage type for current commercial-scale projects. The technology for sequestering CO_2 in reservoirs is based on decades of experience in EOR. Furthermore, many of the same play and prospect elements that result in a hydrocarbon accumulation are also needed for storing an injected CO_2 accumulation.

CO_2 sequestration typically involves injecting CO_2 in a supercritical state, i.e., at a temperature in excess of 31.1°C (88°F) and a pressure in excess of 72.9 atm (about 1,057 psi). These conditions are typically achieved in the subsurface at about 2,600 ft (800 m) below the surface. Therefore, storage reservoirs are typically deeper than about 2,600 ft below ground level.

Ideal reservoirs for saline CO_2 storage have porosity, permeability, and net reservoir thickness suitable for commercial rates of injection (typically 0.5 – 1 million metric tons of CO_2 per year). Similar to oil and gas reservoirs, there is a range of acceptable reservoir quality parameters. Reservoirs proposed for CO_2 storage must be capped by a low permeability sealing facies capable of holding a column of supercritical fluid. Furthermore, storage reservoirs should be free of faults, fractures, or artificial pathways (like improperly plugged wellbores) that pose leakage risks. Additionally, operators must demonstrate low risk of future seismicity at the proposed site.

Unlike hydrocarbon accumulations, saline CO_2 storage does not explicitly require a structural or stratigraphic trap. Capillary trapping, in which the CO_2 is a residual phase and rendered immoveable, is modeled to be the primary trapping mechanism for many saline aquifers. Over longer time scales, some of CO_2-rich brine will be density-segregated to the base of the reservoir and some of the CO_2 will react with the host rock and mineralize (Raza et al., 2016).

In addition to saline aquifers, depleted oil and gas fields may be suitable for sequestration: they have proven seals and generally have lower reservoir pressure to enable efficient injection. However, a key component of obtaining a permit to inject CO_2 is to demonstrate that injected fluid will not migrate to Underground Sources of Drinking Water (USDWs). Depending upon the adequacy of the cement around the casing and the quality of the plugging, existing wellbores may need to be re-plugged. Additionally, although fractures and faults may enable efficient hydrocarbon production, these features add complexity to CO_2 storage projects. Permitting requirements obligate the operator to model and monitor where the CO_2 migrates for 50-100 years post injection, which is a more complex task in a heterogeneous reservoir.

PROVEN CO_2 SEQUESTRATION PROJECTS

Equinor's Sleipner project commenced injection in 1996 and Equinor reports that each year about 1 million tons of CO_2 is stored (Equinor). Equinor has also injected CO_2 into the Snohvit project starting in 2008. Approximately 3.8 million metric tons of CO_2 was sequestered at the In Salah site in Algeria between 2004 and 2011. Shell is sequestering up to 1.2 million tons per year at their Quest facility in Canada. The Archer Daniels Midland project in Decatur, Illinois injected 1 million tons of CO_2 between 2011 – 2014. Two projects recently commenced operations in North Dakota. In July 2022, the Red Trail project in North Dakota commenced operations, and in October 2023, the Blue Flint project in North Dakota commenced CO_2 injection. Each plan to store approximately 4 million metric tons of CO_2.

REGULATORY REQUIREMENTS FOR CO_2 SEQUESTRATION

Regulatory requirements are a key difference between CO_2 injection for EOR and CO_2 injection for sequestration. Both EOR and CCS are regulated by the Underground Injection Control (UIC) program that was established by the EPA to protect Underground Sources of Drinking Water (USDWs). If CO_2 injection is intended to support oil and gas operations, it is regulated by UIC Class II. In Texas, Class II wells are regulated by the Texas Railroad Commission. However, if CO_2 injection is intended for sequestration, it is regulated by UIC Class VI rules. Currently, the EPA administers Class VI permits in most states. Louisiana recently obtained authority to grant Class VI permits in their state (called primacy) and is currently reviewing nearly 20 permit applications. Texas and other states have applied for primacy to award Class VI permits.

The Class VI permitting process is estimated to take more than three years based on the EPA's **What is CCUS?** *continued on page 17*

What is CCUS? continued from page 16

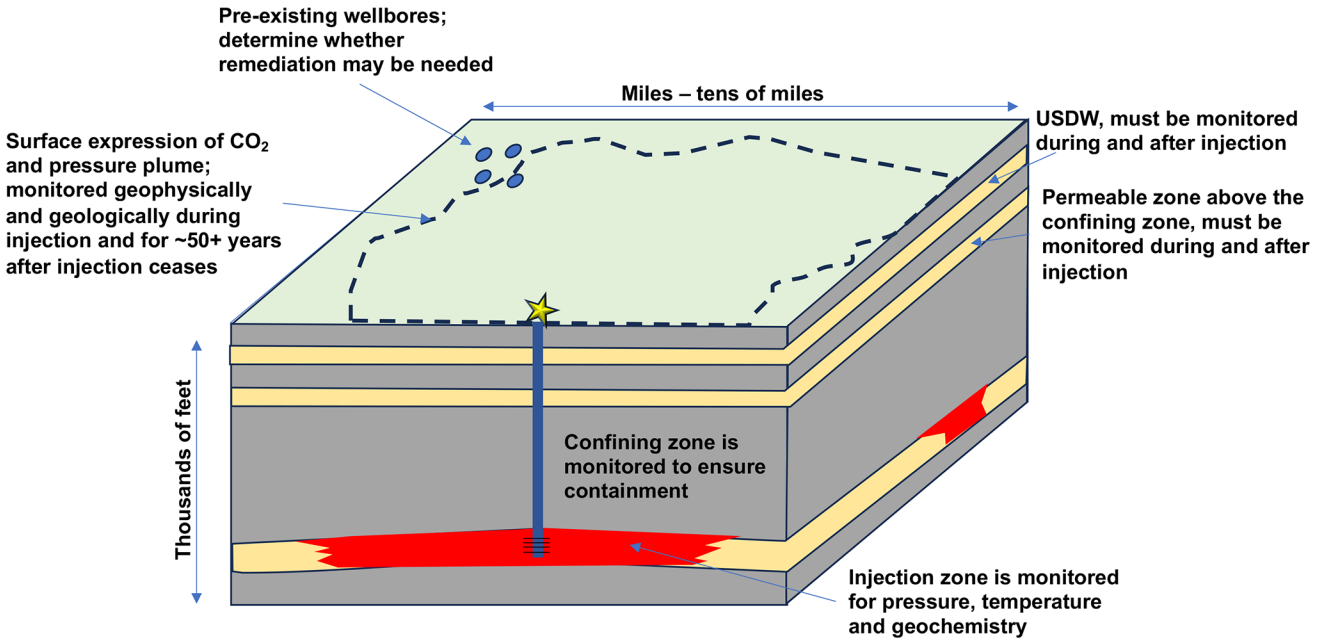

Figure 4. *Cartoon of CO_2 sequestration in a saline aquifer.*

online permit tracking information (https://www.epa.gov/uic/current-class-vi-projects-under-review-epa). The application requires a thorough characterization of the regional and local geologic setting, site specific subsurface data, a plan to test and monitor project operations and financial assurance that the operator can successfully complete the requirements of the project (Final Class VI Guidance Documents | US EPA). See **Figure 4** for an example of the monitoring and testing

Since Class VI rules were established in 2010, the EPA has only permitted two commercial-scale projects: in 2015, the EPA permitted injection for the Archer Daniels Midland ethanol facility in Illinois; and in 2024, the EPA permitted injection for Wabash Carbon Services in Indiana. In late February 2024, there were more than 40 projects in the EPA's Class VI review process.

The regulatory requirements for Class VI wells extend during the injection period and for 50+ years post injection (Final Class VI Guidance Documents | US EPA). Class VI wells are required to be monitored continuously during injection for pressure, temperature and flow rate to confirm wellbore integrity. The first permeable zone above the confining zone and USDWs must be monitored during and after injection to confirm absence of leakage from the injection zone. The resulting pressure and CO_2 plume must also be monitored during and after injection to confirm that CO_2 is not leaking though artificial penetrations or naturally occurring geologic features.

IMPLICATIONS OF CCUS FOR GEOSCIENTISTS?

Geologists trained to characterize reservoirs for oil and gas production are well-suited to evaluate CO_2 storage projects. In both applications, geoscience skills are required to characterize the subsurface, including parameters such as reservoir extent, thickness, and quality; and seal integrity. Geophysical and geologic integration skills are necessary for interpreting subsurface geometry and mapping faults or fractures. Petrophysical skills are needed to evaluate well log and core data. Geomechanical skills are important to understanding fracture pressure, a key component to determine injection rate. Geochemical skills are needed to evaluate reactions between CO_2 injectate stream and mineralogy of the injection zone. In short, geoscience skill sets are critical to CCUS.

The Global CCUS Institute released a report in 2020 that predicts more than 2,000 CCS facilities will need to be deployed by 2050 to reach the International Energy Agency's Sustainable Development target, which translates into 100,000 employees (Global CCUS Institute, 2020). Another report predicts that investing in CCS in Texas could create more than 18,000 project jobs over a 15-year period and more than 9,000 on-going operations jobs (TX_Jobs.pdf (betterenergy.org)). Although these figures represent the total number of jobs, geoscience jobs are also likely to grow with project demand. ■

The Houston Geological Society Continuing Education Committee Presents

Clastic Depositional Systems

Mike Sweet
Thursday, March 28, 2024
Core Lab, Building 2
6323 Windfern, Houston, TX 77040
8:00am – 5:00pm

COURSE OBJECTIVES

1. Understand how sediment is routed through clastic depositional systems from source to sink
2. Learn to identify clastic depositional environments using core, log and seismic data
3. Understand how the spatial organization of facies in each environment of deposition affects the subsurface flow of fluids.

COURSE OUTLINE

This course will cover the following topics:

- Source-to-Sink concepts
- The controls of grain size, sorting and diagenesis on porosity and permeability
- Eolian Depositional Environments
- Fluvial Depositional Environments
- Shoreface Depositional Environments
- Deltaic Depositional Environments
- Marine Shelf Depositional Environments
- Slope and Deep-Water Depositional Environments
- Final Exercise

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$140 Emeritus
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$350 *Non-Members

Registration will close Wednesday, March 27, 2024 at 4 p.m.

Attendees will receive a Certificate of Continuing Education for 8 Professional Development Hours and digital course notes. Lunch is included. *Students should bring pencils, a ruler and their laptops.*

*Non-Members can submit an application and pay their dues before registering to get the member price. Please call the HGS office at 713-463-9476 to be registered only AFTER your application and dues are submitted.

ABOUT THE INSTRUCTOR

Mike Sweet began his role as Co-director of the Gulf of Mexico Basin Depositional Synthesis Project (GBDS) at the University of Texas, Jackson School of Geosciences Institute for Geophysics since 2019. The GBDS is an industry-supported research project that assembles and synthesizes well, seismic, and other data to establish a basin-scale depositional history of the Gulf of Mexico. His work focuses on Cenozoic depositional systems, particularly on quantifying how sediment moves between shallow marine and deep-water environments.

Previously, Sweet spent 18 years working as a stratigrapher for the ExxonMobil Research Company where he described kilometers of core and taught numerous field and classroom courses in clastic stratigraphy. He won the ExxonMobil Excellence in Instruction Award seven times. In addition to his experience in research, Sweet worked as the geoscience led for Angola Production and as a Geologic Advisor to the Caribbean exploration team. Before joining ExxonMobil, Sweet spent 10 years at BP Exploration as a sedimentologist working on clastic reservoir description projects in the North Sea, North Slope, Gulf of Mexico and Colombia. Throughout his career, Sweet has published extensively on deep-water clastic facies and reservoir geology.

Sweet received his PhD in Geology from The University of Texas-Austin in 1989. He is the current President of the Gulf Coast Section of SEPM, has served on the GeoGulf Technical Program Committee (2020-2021), and was Editor of the AAPG Bulletin from 2013-2016

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Registration will close Wednesday, March 27, 2024 at 4 p.m
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For more information about this event, contact Bill DeMis, billdemis@aol.com

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Chris Kendall, *President and CEO, Denbury Inc.*

CCUS – The Opportunity and the Challenges

A growing desire for lower emissions and a sustainable energy future has unleashed record levels of private sector investment and government funding creating an unprecedented concentration of global carbon capture, utilization, and storage projects.

As hosts of Carbon Capture, Utilization, and Storage (CCUS) 2024, from 11–13 March at the George R. Brown Convention Center in Houston, Texas, SPE, AAPG and SEG, have engaged technical experts from all aspects of the carbon capture lifecycle to explore the latest CCUS work and address related challenges and opportunities.

Much like our industry, this event has sparked exponential growth doubling in size year over year since its inception in 2021 establishing one of the fastest growing events in the CCUS arena. CCUS 2024 in Houston looks to build upon this success and will continue to be the industry's leading event for CCUS management and development.

Register Today! Don't miss the best chance you'll have to gain insights into the technical and business aspects surrounding CCUS.

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CCUSevent.org

Pivot Profile
Paiden Pruett and Ed Feragen on Applying Petroleum Geology Skills to CCUS

By Caroline Wachtman

Geologists need jobs and want to make an impact on the world. Carbon Capture, Utilization and Storage (CCUS) that includes applications such as Enhanced Oil Recovery (EOR) and Carbon Capture and Sequestration (CCS) is a growing field for geologists, because it provides jobs and impact. Geologists joining the job market for the first time, and those pivoting at late career stages are interested in the topic, as evidenced by the steadily growing attendance at the annual CCUS conference sponsored by the SPE, AAPG, and SEG societies.

To better understand the skills and capabilities that are transferrable from oil and gas, I interviewed two geologists who recently pivoted to CCS. Paiden Pruett, a geologist with Tallgrass Energy pivoted to CCS immediately after graduate school. Ed Feragen pivoted to CCS after more than 33 years in the Oil and Gas industry. Both Pruett and Feragen find commonalities between Oil and Gas and CCS. Their perspectives represent career bookends that tell the same story: it's an exciting time to be a geologist.

WHY PIVOT: AN EARLY CAREER VIEW

"I expected to go to school and pursue a career in Oil and Gas," says Pruett, who held internships at Hilcorp and EOG. "But then Covid happened, the job market changed, and recruiters went silent," she says. Pruett became interested in the Oil and Gas industry by observing independent wildcatters where she grew up in South Central Texas. She pursued an undergraduate degree in Geophysics at Texas A&M and then a master's degree at Oklahoma State.

Pruett studied with Oklahoma State professor Dr. Camilla Knapp, a leader in geophysical applications to CCS. Confronted with a weak job market for Oil and Gas, and a desire to be a good steward of the planet, Pruett says she looked to apply her academic experience to CCS. In addition, Pruett says she saw many of her classmates taking jobs in CCS with companies such as Batelle, the US Department of Energy, and Denbury.

In 2022, Pruett joined GHD, an energy consulting firm, where she became part of the company's "Future Energy" team conducting site feasibility studies for CCS projects. Pruett says that she was excited to work with mentors such as HGS member Michelle Pittenger, who has decades of experience in EOR projects and Katrina Coterill, who brought a wealth of geophysical knowledge. In late 2023, Pruett followed mentors to Tallgrass Energy, a midstream company that recently expanded to CCS projects. Pruett is excited to be working for an action-oriented operator. "We have done a lot of research, and it's time for field developments," she says.

WHY PIVOT: A MATURE CAREER VIEW

"We are still going to be using hydrocarbons for a long time," says Ed Feragen who retired from ExxonMobil after 33 years of Oil and Gas experience and now works as an independent consultant for CCS. New forms of energy are gaining momentum; but Feragen cautions, "There is no flip of the switch, so CCS is a great bridging tool."

Feragen began his geology career prospecting in East Texas. He then moved to Germany to explore in a mature basin before returning to Houston to work frontier exploration in offshore Brazil. Feragen then transitioned into formal leadership roles where he learned about portfolio management, people management, and the importance of stakeholder engagement, with assignments developing fields in California, Kazakhstan and Russia. Reflecting on key lessons he learned, Feragen says, "Geoscience is fundamental, but an opportunity must make sense economically, and you must be able to get all the stakeholders on board."

In 2020, Feragen retired from ExxonMobil. Although he could have consulted for Oil and Gas, he pivoted to CCS where he became the Executive Vice President of Sequestration for Cozairo, a start-up CCS project developer. In 2023, Feragen set up his own company to provide site screening, subsurface characterization, and other advisory services for CCS clients. "I have the background and the

Pivot Profile *continued on page 21*

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.

 continued from page 20

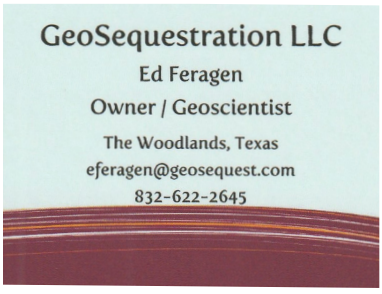
expertise. I can try in a modest way to fight CO_2 emissions and mitigate global warming," he says.

TRANSFERRABLE SKILLS

"I've been pleasantly surprised to see how transferrable the skills are," says Feragen. Both subsurface specialist skills, such as petrophysics and geophysics, and generalist integrator skills are critical to CCS site characterization. Feragen says that the industry needs high-quality reservoir characterization and monitoring, because it is critical to long-term project success. He says, "The characterization work is not easier than Oil and Gas, just different." Pruett echoes the idea that subsurface characterization is essential to CCS projects. "When planning to store large amounts of CO_2, you really must understand the subsurface," she says.

Feragen describes that project management and execution skills are essential to developing CCS opportunities. Integrated projects require coordinated design and implementation of wells and facilities. Furthermore, leadership is important in project development. "Designing a CCS project allows for a fit-for-purpose approach," says Feragen. "You apply leadership skills to design and communicate a plan for a particular site."

Communication is a key transferrable skill for Feragen. CCS project development requires communication with customers, emitters, regulatory agencies and the public. Feragen says he learned the criticality of stakeholder alignment while developing a hydrocarbon project offshore California in the mid-2000s. Although the project had strong technical and economic potential, the community and government stakeholders were not aligned with the goals of the project, and it ultimately did not progress to production. Similarly, Feragen describes that oil and gas operations require routine interfaces with regulators, a skill set he practiced during the start-up of the Arkutun-Dagi field on Sakhalin Island in Russia.



NEW SKILLS FOR CCS

Both Feragen and Pruett find that CCS requires a new perspective. The regulatory regime governing CO_2 injection for sequestration (UIC Class VI) is focused on protecting Underground Sources of Drinking Water (USDWs). "Your license to operate is all about protecting USDW's," says Feragen. "So, you need to be focused on potential leakage pathways, such as improperly abandoned wellbores," he says.

Pruett says the high level of regulatory oversight of CCS projects may feel daunting to seasoned Oil and Gas practitioners. She draws the comparison that regulations lagged development of the hydrocarbon industry, whereas CCS regulations were established at the outset of the industry. Pruett predicts that over time regulations will adjust and monitoring requirements will shorten, as commercial-scale CCS projects are proven to be safe and effective.

A CCS mindset involves thinking longer term. Class VI injection permits require an operator to test and monitor movement of subsurface CO_2 during injection operations and for 50-100+ years after injection ceases. "You have to think about the long game," says Pruett.

While effective communication is a skill common to both CCS and Oil and Gas projects, the type and style of communication is different. CCS stakeholders include CO_2 emitters, such as ethanol plant operators, who are highly experienced in surface operations, but typically lack subsurface experience. Furthermore, CCS geologists may encounter resistance from others in the geoscience community. While the technology is not new, awareness and education are just starting. Some geologists are skeptical that CCS will be impactful. To these geologists, Feragen reminds them that "CO_2 injection is a tool that exists today, is proven, and has been used for decades."

ADVICE ON PIVOTING TO CCS

For geologists who want to learn about CCS, there are many online resources. Pruett and Feragen point to papers, webinars, and podcasts. There are conferences, such as the upcoming 2024 CCUS conference that bring together geologists, geophysicists and engineers to talk about technical challenges and opportunities. Feragen encourages enrollment in short courses. Pruett says that you don't need 20 years of experience in carbon to be successful; just be open to learning from others. ■

FIELD TRIP TO THE GUADALUPE MOUNTAINS NATIONAL PARK

HGS plans a field trip to the Guadalupe Mountains National Park on April 4-7, 2024. Meet Bob Lindsay on the HGS field trip and learn from the master geologist how outcrops can help you understand the subsurface. (See page 12)
Register at HGS.org

A Conversation with Cindy Yeilding: Tenacity, Technical Work, Teamwork, and Transition

By Caroline Wachtman

"I started working in 1985 when I was four years old. That joke never gets old, just like me," laughs Cindy Yeilding. After nearly four decades of being a geologist, she says work doesn't get old either. Yeilding retired from BP in 2021 after a 35-year career and commenced a new phase of serving on corporate, educational, and civic boards.

Yeilding began her career sitting wells and visiting offshore production platforms. She says she then took exploration and technology roles, moving into formal leadership positions after 10 years of experience. "I did everything you could do as a geologist in upstream," she says. While half of her career was focused on the GOM and in technology, she also worked projects in Venezuela, Colombia, and co-led field courses around North America.

In 2016, Yeilding was named Senior Vice President for BP America, a role that involved managing large-scale strategic projects for the company. In addition to managing BP's obligations in the aftermath of the Macondo incident, Yeilding managed BP's relationship with Princeton University, including the Carbon Mitigation Initiative that focused on sustainable carbon and climate change solutions. At the time, her daughter was in high school and her son was in middle school. "My kids motivated me to learn more about Energy Transition," she says. "So when I had an opportunity to chair the National Petroleum Council's (NPC) working group on Carbon Capture, Use, and Storage (CCUS), and I jumped at the opportunity," says Yeilding. The NPC's report, Meeting the Dual Challenge, was published in 2019. "I led the 300+ person working team that delivered that study, and it changed my life," says Yeilding.

"If we aren't attracting new people to geology, our world is missing an opportunity"

Her experience in CCUS positioned Yeilding to join the Board of Denbury in 2021 after retiring from BP. It also led her to join the Board of Center for Houston's Future, a civic organization aimed at bringing together businesses and communities in the nine counties surrounding Houston to innovate on energy, healthcare and immigration reform. Yeilding had been a key supporter of the Center's vision of bringing a hydrogen hub to southeast Texas.

Yeilding explains that the lessons she learned in the early days of her career helped to shape her perspective on being an effective geologist and effective collaborator. Reflecting on her career, Yeilding offers three key lessons to other geologists. She says to stay close to the technical work and be tenacious in pursuing good ideas. In addition, Yeilding emphasizes the importance of being a good collaborator. Woven throughout these lessons is an emphasis on having an explorer's mindset.

STAY CLOSE TO THE TECHNICAL WORK

"I went into leadership roles relatively early in my career, but I kept a workstation and a microscope," says Yeilding. She describes a schedule of ending her leadership day at 5 p.m. and then logging into the workstation for several hours to maintain technical skills and to learn the geology her team was evaluating. Although this schedule became impractical after having children, she emphasizes the importance of building a strong technical basis for decisions.

Yeilding notes that technology is a key enabler supporting geologic evaluations. However, geologists still need to check their work, she advises. In addition, it is important to keep pace with technology and innovation. She recalls an experience of supporting former BP CEO Bob Dudley in responding to a technical question on geothermal energy. She was originally dismissive of the opportunity but was surprised (and delighted!) to learn how much the technology had evolved over the previous few years. "Never underestimate the ability of technology to deliver what the mind can create," says Yeilding.

BE TENACIOUS IN PURSUING GOOD OPPORTUNITIES

Yeilding recalls an experience early in her career of re-mapping a mature field in the GOM. BP had no immediate drilling plans for the producing field, so Yeilding started looking for deeper prospects. Surprisingly, her manager criticized her for focusing too much on "airy-fairy" deeper structures. Those "airy-fairy" ideas later turned out to be Thunder Horse, Blind Faith and other large discoveries. That experience, among others, encouraged Yeilding to trust her instincts and her technical work.

Yeilding says she used creative techniques to build enthusiasm and shared ownership of her ideas. For example, she recalls keeping the workroom doors open and making eye contact with anyone who walked by, inviting them to learn about her work and offer their insights. She notes that asking others for advice is a great way to get help, improve the technical and business case and also build shared ownership in a project's goals. Yeilding recalls one highly creative engagement tactic that involved putting up an annotated seismic line outside of the men's **Cindy Yeilding** *continued on page 23*

Cindy Yeilding continued from page 22

restroom to gather insights and get advice (people had to pass by at least several times a day!). Yeilding says that these tactics, among others, gave her a reputation for being tenacious and for building broad-based support from staff, peers and management.

In addition to understanding the technical potential, Yeilding notes that it is critical to understand whether an opportunity is good from a business perspective. "Be gracious when an opportunity doesn't stack up, or if the timing is just not right," she says. "Don't feel entitled."

BE A GOOD COLLABORATOR

Yeilding started her career sitting wells on offshore rigs. She says she was keenly aware of how much her presence inconvenienced others on the rig. For example, the Company Man always had to give up his bunk so she could have a room to herself. Yeilding says she learned "to be cognizant and gracious" of others on the team, and also learned that it was critical to find something in common with her colleagues and share knowledge of the subsurface to help build trust and open dialogue.

The lesson on building relationships translated into the workroom, where Yeilding says she worked hard to build foundational relationships before launching into technical or business discussions. In the 1980s, she was known as the "geologist who works with engineers," and she recalls that the company's CEO was invited to visit their workroom to see collaboration between geologists and engineers in action.

LEVERAGING EXPERIENCE TO BUILD A FUTURE

"There should be room for all forms of energy, including geothermal and hydrogen, in addition to oil and gas," says Yeilding. She acknowledges that many geologists view the Energy Transition as a threat, but she encourages geologists and the public to become educated about energy topics to recognize the opportunities. Her most recent project is to promote simple, easy to understand information about energy systems. "It's hard to hate something you understand," notes Yeilding. She is collaborating with her son, now a Rice University student, to develop educational materials that describe elements of the current and potential future energy landscape.

Yeilding also encourages geologists to approach CCUS with an explorer's mindset. She recalls that many geologists believed deepwater oil and gas exploration would never work, but creative geoscientists with explorer's mindsets tenaciously pushed those ideas into reality and engineers made production from these environments economic and safe. Similarly, geologists should embrace the role they can play in expanding the energy system to encourage a new generation of geologists. "Geologists are stewards of the Earth. If we aren't attracting new people to geology, our world is missing an opportunity," says Yeilding. ■

NeoGeos at Walking Stick Brewery on January 25

Bill Maloney: Mentoring, Exploring and Living Your Values

By Caroline Wachtman

"Whatever brings you great joy, do it as much as you can as often as you can," advises Bill Maloney, retired Executive Vice President for Equinor (formerly Statoil). Maloney says this philosophy guided him though a 34-year career in the Oil and Gas industry and continues to guide his retirement. "I was rowing on Clear Lake this morning," says Maloney, "And I've got an AAPG meeting this afternoon." Maloney is on the planning committee for the annual CCUS conference event hosted by AAPG, SPE and SEG, along with serving in other AAPG committee roles.

Maloney's career is an example of what can be achieved with the right combination of skills, good mentors, and luck. Maloney attributes key pivot points in his career to mentors who guided and shaped him as a geologist and as a leader. "I wouldn't have done the things I've done without them," he says. Most of Maloney's mentors have been his managers, but one of the earliest and most influential mentors has been his wife of 44 years. These individuals guided Maloney into geology and across more than three decades of exploring and developing oil and gas.

MENTOR LESSON 1: SEEK OUT DIVERSE PERSPECTIVES

As a mathematics major at Hunter College, Maloney took historical geology on a whim. "We called it 'hysterical geology' because the professor, John Boyland, was so funny," says Maloney. Growing up in the Bronx, geology had not been a focus for Maloney, but Boyland inspired Maloney to switch his major to geology. Maloney excelled in the geology program and decided to pursue graduate school. Because of Columbia's proximity, he expected to pursue his graduate work there. "John told me that most of the faculty at Hunter had studied at Columbia, so I would be getting more of the same thinking," says Maloney. Boyland encouraged Maloney to seek out different perspectives in geology and leave the city. This advice propelled Maloney to a master's program at Syracuse University to study hydrodynamics of sediment transport, which made him an attractive candidate for oil company recruiters. After receiving multiple offers, Maloney signed on with Shell and moved to Houston in 1981.

"Whatever brings you great joy, do it as often as you can as"

MENTOR LESSON 2: ASK THE RIGHT QUESTIONS TO BE AN EXPLORER

Maloney joined Shell's Rocky Mountain division, where he worked for Jim Clement. Maloney says, "Jim never told me what to do, but guided me to discover the right answers by asking questions." Clement mentored Maloney to become an exploration geologist through the Socratic method, and Maloney excelled at the task, becoming a team lead after five years.

Maloney then transferred to Pecten, the international division of Shell Oil's operations in the US, where he put to work the lessons he learned in the Rocky Mountain division. Maloney followed previous successful exploration efforts by Shell colleagues to add even more resources in the Pearl River Mouth Basin in China. He later led exploration efforts in offshore Cameroon and elsewhere before becoming Exploration Manager for Latin America.

MENTOR LESSON 3: TAKING RISK V. TAKING UNNECESSARY RISK

While in the Latin America role, Maloney met Marvin Davis, owner of Davis Petroleum Company. Davis wanted to get into Trinidad and decided that Maloney was the right person to lead the effort. So he recruited him to join Davis Petroleum. "Marvin sent his personal jet, which happened to be a 737, for me to fly down to Palm Springs and meet him for an interview," says Maloney. "After talking for about three hours, Marvin asked if I could stay a little longer. In walks former president Gerald Ford, who tells me that I should work for Marvin. It was surreal," says Maloney. After much deliberation, Maloney pivoted his career by leaving Shell and taking the risk of joining the much smaller Davis Petroleum. As the Director of International Exploration and Production, Maloney evaluated farm-ins all over the world.

During a visit to Kazakhstan Maloney says that Davis set up a short meeting with Kazakhstan's president and instructed Maloney to drop all his plans. The short visit turned into a three-week technical evaluation that resulted in Maloney overstaying his visa. "I went to the airport and couldn't get out of the country, because I had come in on a private jet and didn't have the right paperwork," says Maloney. After many stressful hours of working through language barriers and a challenging bureaucratic system, Maloney was finally able to leave the country. Maloney's experience convinced him that the risk of working with Davis wasn't worth the reward, and he resigned shortly thereafter.

MENTOR LESSON 4: MANAGE A PORTFOLIO OF OPPORTUNITIES TO ACHIEVE AN ORGANIZATION'S GOALS

Soon after leaving Davis Petroleum in 1997, Maloney was recruited to join Texaco. He moved to London to manage international exploration in Europe **Bill Maloney** *continued on page 25*

 continued from page 25

and Asia under the guidance of Bruce Appelbaum (a long-time HGS member). Maloney says that Appelbaum taught him how to manage an exploration program by setting goals and building a portfolio of opportunities. "If you want to grow production by a certain number of barrels, you have to have a certain number of opportunities in the portfolio with a certain chance of success," says Maloney. During this time, Maloney also learned from Appelbaum "what gets measured gets done."

MENTOR LESSON 5: WHAT YOU DO IS JUST AS IMPORTANT AS HOW YOU DO IT

In 2002, Maloney joined Statoil as Head of International Exploration, where he says he "found a blank slate" of exploration potential. Statoil was not very active outside of Norway at the time. Maloney needed to motivate the team to compete internationally. He utilized lessons learned at Texaco to build a portfolio of opportunities and says we "found lots of oil and gas" in Tanzania, Brazil, Argentina, the US, and other countries.

Statoil chief executive Helge Lund was "big on values" says Maloney. Lund shaped Maloney's mindset, encouraging him to think about how values drive behavior. "He taught me that it's not only what you do, but how you do it," says Maloney.

The emphasis on values encouraged Maloney to reflect on his behaviors at home. After seven years of weekly commuting between his home in London and Statoil's offices in Stavanger and Oslo, Maloney says he was burned out. He requested a sabbatical, but his managers were reluctant. Maloney was firm in his request, despite the risk that he might not have a job when he returned. During his year away, Maloney and his son volunteered at a school in Nepal, he traveled with his wife, and pursued passions like skiing.

Fortunately, Maloney was offered a role when he returned to Statoil in 2010. He became the Executive Vice President and Head of Development and Production for North America. Maloney says that he and his team grew production from about 70 KOEBD to over 300 KOEBD in five years. He leveraged the portfolio management skills learned from Texaco plus the leadership skills learned at Statoil to enter new basins and expand production in existing acreage in places like Canadian oil sands, Marcellus, Bakken, Eagleford, Gulf of Mexico and others.

MENTOR LESSON 6: FIND A SOUNDING BOARD WHO REMINDS YOU TO BE TRUE TO YOURSELF

Maloney's college girlfriend, now wife of 44 years, has been instrumental in shaping his career. "She's my advisor and my best friend," says Maloney of his wife, Audrey. At key points along his career, Audrey guided Maloney to live his values.

Maloney almost didn't become a geologist. At 19 years old, he dropped out of college to be a drummer playing clubs in New York City. Audrey convinced Maloney that their future together was contingent upon him getting a degree. Taking her good advice, Maloney returned to Hunter College to pursue a degree in mathematics and later geology.

Another key pivot point was the decision to leave Texaco following the Texaco-Chevron merger. Maloney's much-loved International Exploration Manager role had been eliminated, and he was asked to move back to the US. Less than six months of leaving London, Maloney says his wife recognized how unhappy he was, and she encouraged him to resign. Shortly thereafter, he was offered an opportunity to move back to London with Statoil.

GOING FORWARD

"I had a goal to retire before 60, and I formally retired about 30 days before turning 60," laughs Maloney. He subsequently served on the Boards of Trident Energy and ATX Energy. He also worked as a Senior Advisor to Warburg-Pincus. Now, he volunteers his time to AAPG, serves as an Energy Advisor to University of Houston, and volunteers for civic organizations, including being the president of his condominium association.

Reflecting on mentors who shaped his career, Maloney acknowledges he has not told them how influential they were. However, Maloney hopes that he has been able to pay it forward by shaping the careers of those who worked for him. ■

Geology is Beautiful! Results of the HGS Art Contest

Thanks to all participants of the 2023 HGS Bulletin "Geology is Beautiful" art contest. The contest received tremendous positive response and 15 entries. Online voting was available to HGS members through February 15, and now the results are in! Look for the winning photos to be featured on the cover of the HGS Bulletin.

WINNER – DORENE WEST
Category: Geologically Interesting Landscapes
Title: Mendenhall Glacier medial moraine

Mendenhall Glacier near Juneau. Picture taken from a prop plane (through a scratched Plexiglass window). The glacier is flowing from the Juneau Icefield to Mendenhall Lake. Each flow line represents 1 year. Two arms of the glacier meet with a medial moraine (scraped rock dust/dirt . . .) in between. (Dark rocks at the top; glacier is flowing downhill.)Picture taken September 2010 with a little point and shoot Pentax (before iPhone camera).

WINNER – SHARMA DRONAMRAJU
Category: Rocks Up-close and Personal
Title: Red Rocks of Antelope Canyon

Beautiful sunlit Antelope Canyon, reaching about 120ft below the ground. A private land in the Navajo Nation is both a geologist's and photographer's delight. These are Jurassic dunes, carved beautifully by rain and desert streams.

HGS Bulletin Art Contest *continued on page 27*

HS Bulletin Art Contest continued from page 26

WINNER – DAN MOSS
Category Energy
Title: Behind Every Dark Cloud

These two photos were taken by myself (slide film) in 1982 after an afternoon thunderstorm when I was working as a young Petroleum Engineer in the Permian Basin. Located in the Means S. Wolfcamp Field, Andrews County, TX

WELCOME TO NEW MEMBERS, EFFECTIVE JANUARY – FEBRUARY 2024

Mustafa Al-Zehhawi
Graham Brander
Shazane Gazalie
Ben Geaghan
Irene Gebhard
Jarred Hostetler
Joe Koenig
Todd Longbottom
Jonathan Membreno
Fawz Naim
Maksim Nelkin
Ryan Pastor
Fabian Pena
Alexander Mihai Popovici
Jon Primm
Stan Teerman
Norman Wells
Wenping Zhou
Charlie Zhu

Monday, Monday, March 11, 2024

Social Hour 5:30–6:30 pm

Dinner 6:30–7:30 pm, Presentation 7:30- 9:00 pm

HGS Members/Emeritus/Honorary Life $65
Students $65 • 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=2483
Event Contact: Linda Sternbach • linda.sternbach@gmail.com

Mike Sweet
GBDS Research Scientist
The University of Texas at Austin
Institute for Geophysics

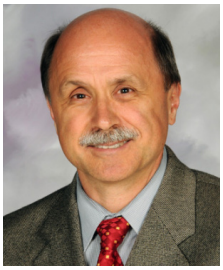
Giant Submarine Fans in a Greenhouse World: The Paleogene of the Gulf of Mexico.

During the Laramide uplift, a warm and humid climate, large rivers, and relatively stable sea level created the most favorable conditions of the Cenozoic for the development of submarine fans. These conditions are recorded in the Paleogene Wilcox Group. A century of outcrop and subsurface mapping and a robust database of subsurface data make the Wilcox Group a unique laboratory to explore the controls on a continent-scale depositional system in a Greenhouse climate.

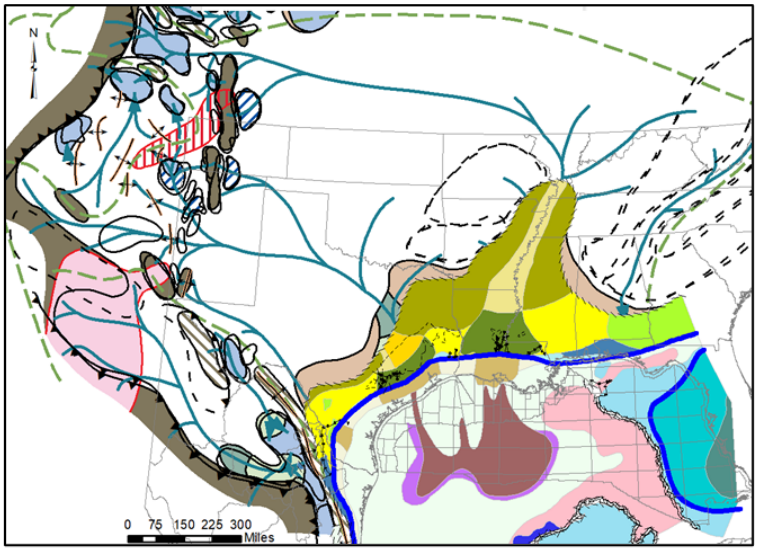
The Wilcox Group spans about 18 million years of the Paleocene and Eocene. During this time, 800,000 km3 of sediment were deposited in the northern Gulf of Mexico Basin. Sixty-four percent of this sediment was deposited in deepwater depositional environments, a significantly higher volume than was deposited in deepwater later in the Cenozoic. Wells drilled into these submarine fans have encountered impressive thicknesses of sandstone. For example, the Leopard well (Alaminos Canyon 691) encountered 2500 m of Wilcox Group deposits, half of which is sandstone.

While growth faulting at the shelf edge acted to conserve sediment in deltas, several other factors favored efficient routing of sediment, especially sand to the deepwater. These factors included: long-live submarine canyons associated with deltaic depocenters and a relatively narrow continental shelf, about 50 km wide. When combined with lower amplitude of sea level fluctuations, these conditions allowed for continuous input of sediment to the deepwater. ■

BIOGRAPHICAL SKETCH



Michael Sweet began his role as Co-director of the Gulf of Mexico Basin Depositional Synthesis Project (GBDS) at The University of Texas at Austin, Jackson School of Geosciences Institute for Geophysics in 2021. The GBDS is an industry-supported research project that synthesizes well, seismic, and other data to establish a basin-scale depositional history of the Gulf of Mexico. His work focuses on Cenozoic depositional systems, particularly on quantifying how sediment moves between shallow marine and deep-water environments.



Lower Wilcox Group (Paleocene) Paleageography

Previously, Sweet spent 18 years working as a stratigrapher for ExxonMobil Research. In addition to his experience in research, Sweet worked as the geoscience lead for Angola Production and as a Geologic Advisor to the Caribbean exploration team. Before joining ExxonMobil, Sweet spent 10 years at BP Exploration as a sedimentologist working on clastic reservoir description projects in the North Sea, North Slope, Gulf of Mexico and Colombia. Throughout his career, Sweet has published extensively on deep-water clastic facies and reservoir geology.

Sweet received his PhD in Geology from The University of Texas at Austin in 1989. He served as President of the Gulf Coast Section of SEPM and served on the GeoGulf Technical Program Committee (2020-2021). Sweet was Editor of the AAPG *Bulletin* from 2013-2016. Contact email: michael.sweet@austin.utexas.edu

Wednesday, March 13, 2024

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

Pre-registered HGS Members $35
Non-Members & ALL Walkups $40
To guarantee a seat, pre-register on the HGS website and pay with a credit card. You may walk up and pay at the door if extra seats are available. Please cancel by phone or email within 24 hours before the event for a refund. Online & pre-registration closes Wednesday, at 5:00 a.m.
Los Tios • 9527 Westheimer Rd • Houston, TX 77063
https://www.hgs.org/civicrm/event/info?id=2548
Event Contact: Matthew Cowan • mrcowan1@hal-pc.org

HGS E&E Dinner Meeting

Brian L. Rader

An Unconventional Approach to Induced Seismicity

This study began by looking into the induced seismicity in the Fort Worth Basin (FWB). The frequency of Magnitude 3 (M3) and larger earthquakes increased in 2014 and 2015. Oil and gas activity has been associated with these earthquakes. In June 2015 the earthquakes stopped. There were nine events of M3 and larger in the first five months of 2015 but it decreased to one per year after June 2015. Industry activity did not have any significant change that could explain this dramatic change in seismicity. As gas production and wastewater injection decreased, the number and magnitude of earthquakes increased. This study took an unconventional approach to seeking an explanation for this observation. When looking at rainfall and drought in the Fort Worth Basin a match was seen between these factors and the seismicity pattern. Rainfall appears to reduce the magnitudes and frequency of the FWB-induced earthquakes. Where the drought increased the earthquake number and magnitudes. Further investigation details where the induced earthquakes occur and why they are absent on other faults within the basin.

The FWB faults that are seismically active, magnitude 3 (M3), and larger, are located near or at the structural low of the injected formation. Recent research suggested that the injected fluid migrates based on the formation pressure. The injected formation has the highest formation pressure where it has the largest overburden, at the formation deepest burial or structural low. Therefore, the injected fluid will migrate updip from high pressure to lower pressure. The proposed fluid factor suggests migrating fluid will lubricate faults in the migration pathway. The fluid reduces the frictional strength of the fault and allow the fault to fail at lower stress levels resulting in small magnitude earthquakes and could explain the absence of seismicity on other faults within the basin. Recently induced seismicity has increased in the Delaware Basin within the Permian Basin of West Texas. Seismicity (M3 and larger) in the Delaware Basin is concentrated in two areas although oil industry activity is spread between 6 counties. Recent Delaware Basin researchers have had difficulty explaining why earthquakes are absent in some counties even though there is not an apparent difference in industry activity. Delaware Basin oil and gas production lately has been steady, however, earthquake magnitudes and frequency have increased. Applying the FWB method, of adding a fluid factor, appears to provide an understanding of earthquake location, frequency, and magnitude of induced seismicity in the unconventional play of the Delaware Basin. ■

BIOGRAPHICAL SKETCH

Brian L Rader has worked in the oil and gas industry for over 38 years. He received a BS in Marine Science from Texas A&M at Galveston and a MS in Geophysics from Texas A&M College Station. Early in his career he worked for several companies helping them move from Gulf of Mexico shelf exploration into the deepwater areas. The last 14 years he has worked on international exploration in the Atlantic Transform Margin. More recently he consulted for AMNI International on their West Africa properties from 2018 to 2020. Brian lived in Dallas while working for Kosmos Energy and felt several of the earthquakes that occurred in the Dallas/Irving area. He noticed when the earthquakes nearly stopped in 2015, although oil and gas activity continued. Upon investigating events around the time of reduced induced seismicity, he found a factor that had a strong correlation when plotted against the earthquake pattern in the Fort Worth Basin. He has presented his results at three conferences and had three articles published covering his results in the Fort Worth Basin and more recently in the Delaware Basin of West Texas.

Wednesday, March 26, 2024

Social 11:15 AM, Luncheon 11:30 AM- 1:00 PM
Cost: $40 pre-registered members
$45 for non-members/ALL walk-ups
$40 for Emeritus/Life/Honorary
Students: $30 if pre-registered
Greenway 5 Conference Center, Houston, TX 77046
https://www.hgs.org/civicrm/event/info?id=2549
Event Contact: Linda Sternbach | linda.sternbach@gmail.com

HGS General Luncheon Meeting

Adam Haecker
Milestone Carbon, Houston

Data Gathering Requirements for Class VI Permit Applications, from a Lone Star Point of View

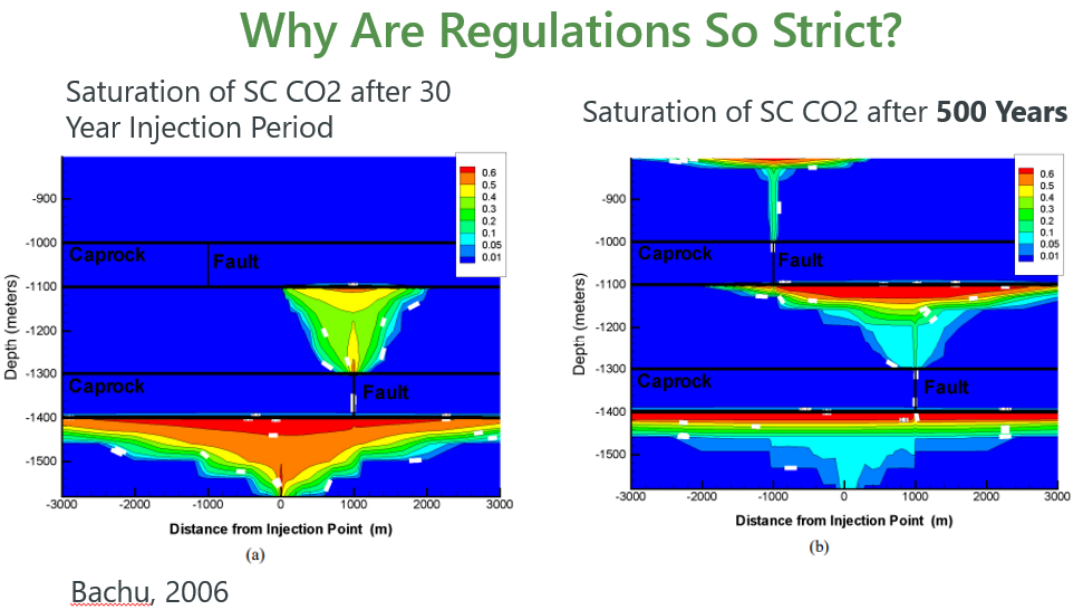
The Environmental Protection Agency (EPA) Class VI data gathering requirements play a pivotal role in the monitoring and regulation of underground injection activities associated with geologic sequestration of carbon dioxide (CO_2). As part of the EPA's comprehensive strategy to address climate change, Class VI regulations focus on the secure storage of CO_2 in deep geological formations to mitigate greenhouse gas emissions. This talk provides a concise overview of the key data gathering requirements essential for compliance with Class VI regulations.

The EPA mandates a robust data collection process to ensure the effective implementation and enforcement of Class VI regulations. Operators involved in geologic sequestration projects must adhere to stringent reporting and monitoring protocols, encompassing geological, geochemical, and hydrological parameters. These parameters include the characterization of injection and confining zone properties, assessment of caprock integrity, and monitoring of underground sources of drinking water (USDW) quality. The talk will give an emphasis on what data to collect, when to collect it, and how it is used.

This talk includes discussion of wireline logging, coring, core testing, surface sampling, and water well sampling; Remote sensing data including geophysical surveys, micro-seismic and VSPs; Mechanical integrity testing such as cased hole bond logs, EM flux tools; and finally continuous data monitoring of temperature, strain, noise and annulus pressures. ■

BIOGRAPHICAL SKETCH

Adam Haecker works in Houston as a Director of Geoscience for Milestone Carbon, a company dedicated to delivering CO_2 sequestration solutions. His research interests include supercritical CO_2 relative permeability, advances in MICP, organic shale petrophysics, and rock mechanics. Prior to Milestone, Adam worked as a petrophysicist for Battelle Memorial Institute, Continental Resources, Chesapeake Energy, and Cabot Oil and Gas (now Coterra), as well as Weatherford Wireline as a field engineer. Adam graduated from Texas A&M in 2007 with a BS in Geology. He served as the Vice President of Finance, Secretary and Administration for the international SPWLA (2021-2023) and as North America Regional Director 1 (2018-2020). Adam speaks English and conversational Japanese.



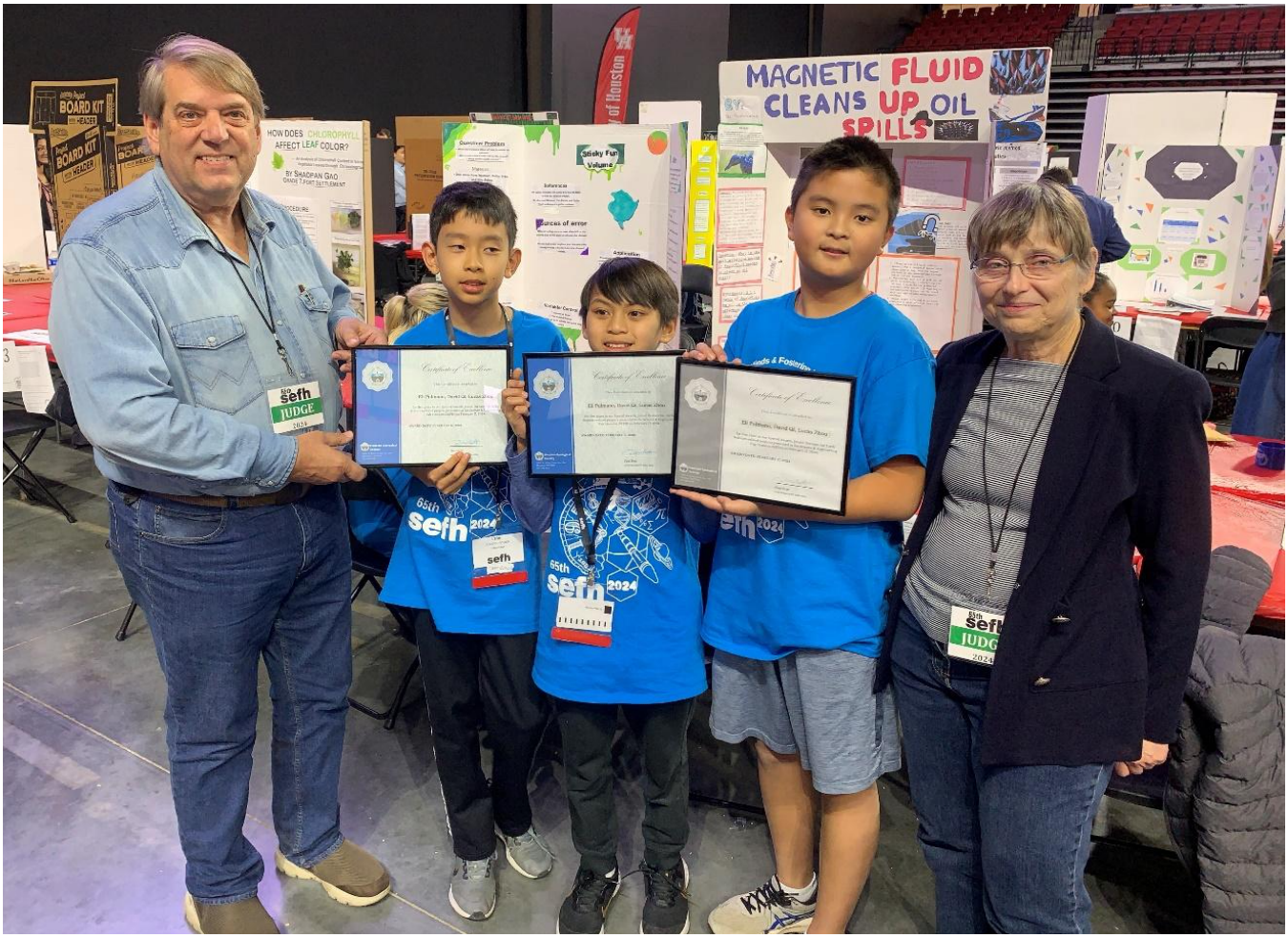
The distribution of saturation values of the CO2-rich phase at the end of the 30-year injection phase (a) and at 500 years (b)

HGS Judges Science and Engineering Fair of Houston

By Dorene West

HGS participated as a Special Awarding Agency judging student projects at the Science and Engineering Fair Houston on Saturday, February 17, 2024. Award certificates were given to the top three Earth science-related projects for the Senior division and top Earth science-related project in the Junior division. Paul Britt and Dorene West presented framed certificates to the students after judging ended. The response from the students (and parents in the case of the Junior Division winners) was priceless!

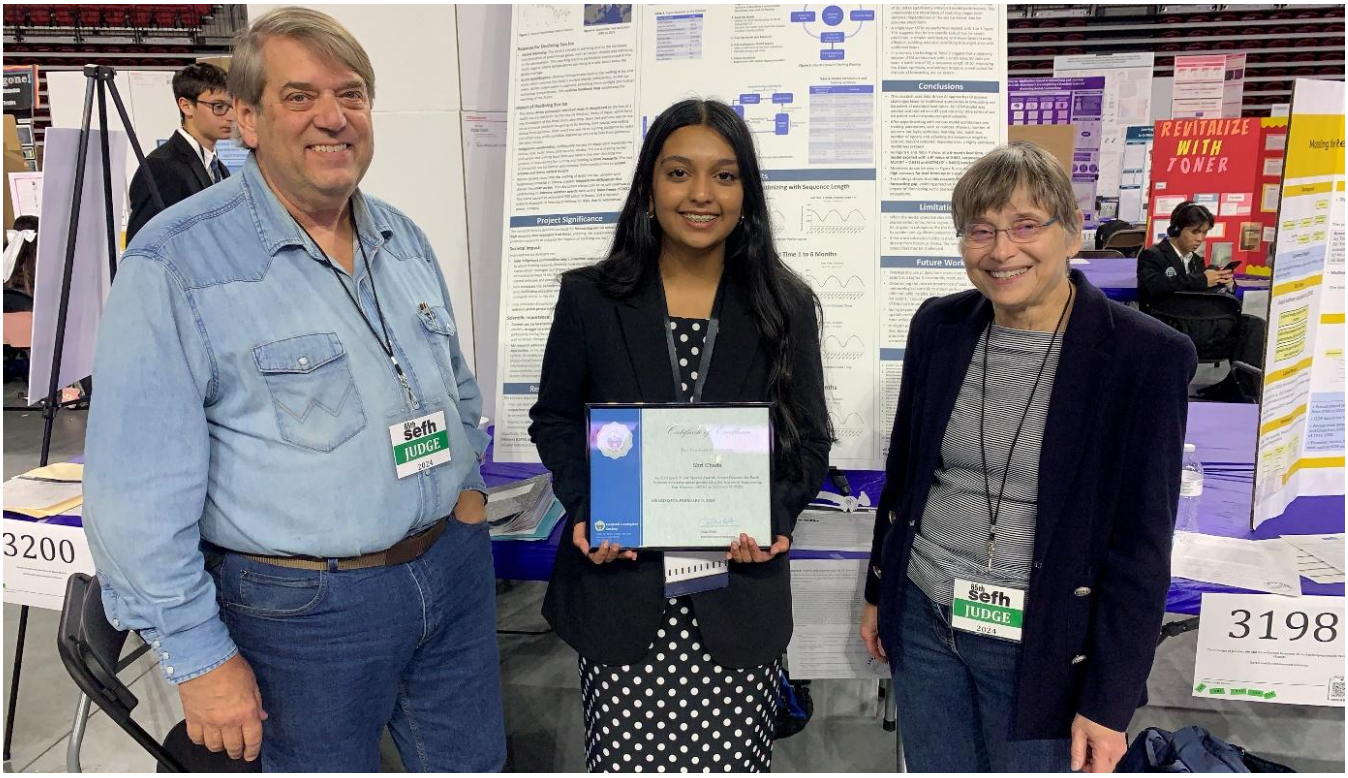
The top ranked Senior projects are nominated to receive HGS-funded summer internships at the Houston Museum of Natural Science. The Junior Division winners will each receive a subscription to a science magazine (donated by HGS Junior Division Special Award Judges and lead Judge). HGS volunteer judges were Paul Britt, Martin Cassidy, Mike Erpenbeck, Barbara Radovich, David Risch, Sandy Rushworth, Jim Tucker, and Dorene West. Paul, Martin, Mike, and Dorene judged Senior Division; David, Sandy, Barbara, and Jim judged Junior Division. Thank you to all our volunteer judges! ■



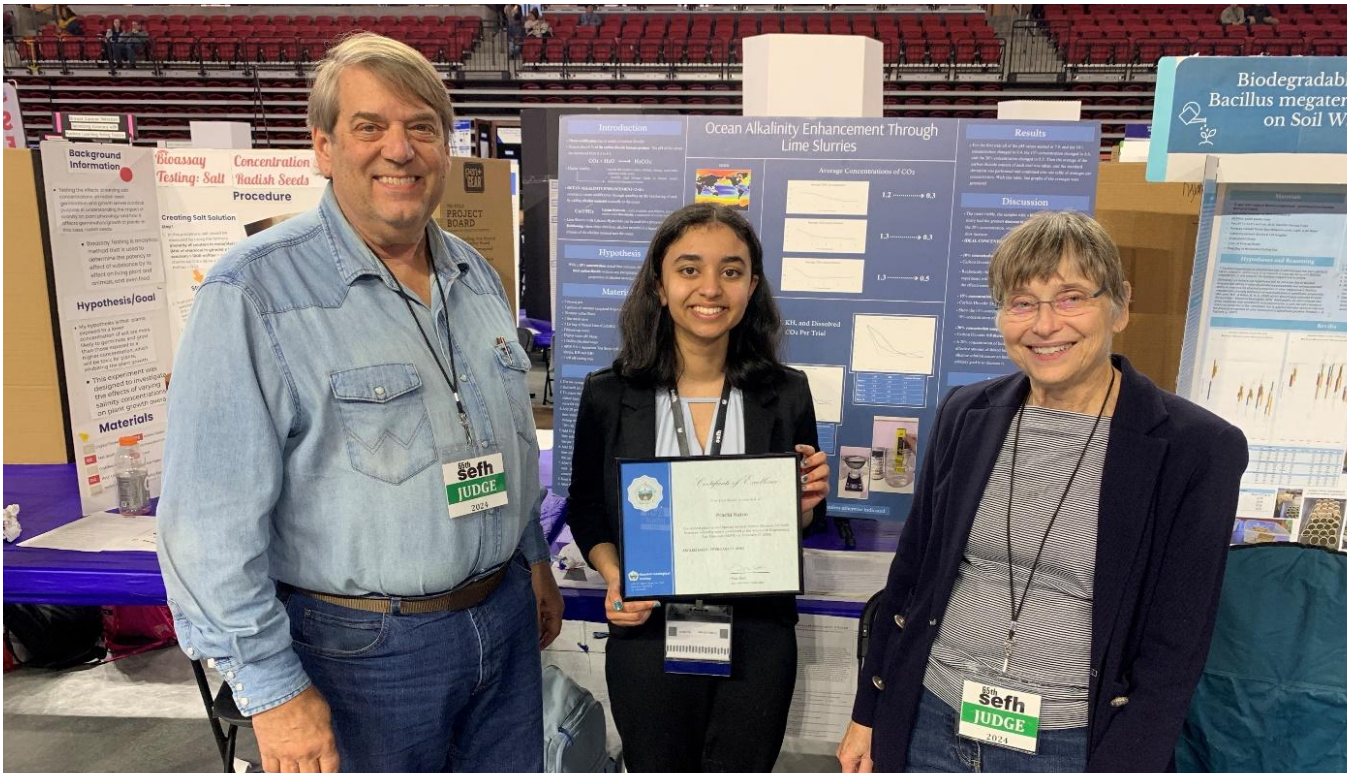
Junior Division First Place, Magnetic Fluid Cleans Up Oil Spills (Fort Settlement Middle School). From left to right, Paul Britt, David Qi, Eli Pulmano, Lucas Zhou, and Dorene West. (Their parents were cheering loudly off camera.)

Science and Engineering Fair *continued on page 32*

Science and Engineering Fair continued from page 35



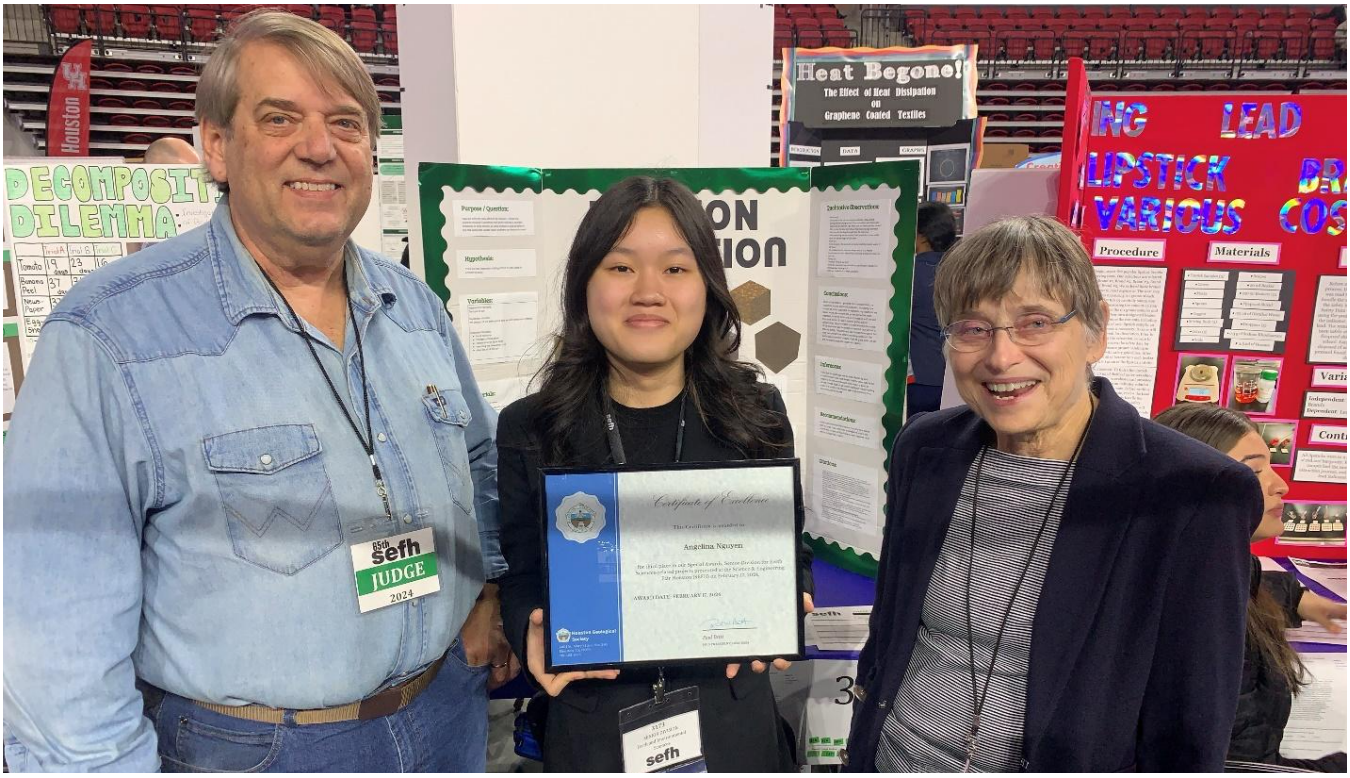
First Place Senior Division was AI-Driven Sea Ice Forecasting: Addressing Challenges and Enhancing Accuracy for Long-Term Predictions in the Changing Arctic Environment by Shiri Chada who is homeschooled. From left to right Paul Britt, Shri Chada, and Dorene West.



Second Place Senior Division: Ocean Alkalinity Enhancement through Lime Slurries by Prachi Natoo from Academy of Science and Technology. From left to right Paul Britt, Prachi Natoo, and Dorene West.

Science and Engineering Fair continued on page 33

Science and Engineering Fair continued from page 35



Third Place Senior Division: Erosion in Motion by Angelina Nguyen from Alief ISD. From left to right Paul Britt, Angelina Nguyen, and Dorene West.

HGS Special Award Judges from left to right, front row Dorene West, Mike Erpenbeck, Martin Cassidy, back row, Barbara Radovich, Jim Tucker, David Risch, Sandy Rushworth, Paul Britt.

HGS Recognizes Scholarship Recipients

By Jeff Lund and Linda Sternbach

The HGS Scholarship Night on February 12 featured graduate and undergraduate students awarded scholarships through the W.L. Calvert Memorial Scholarship Fund (graduates) and HGS Undergraduate Foundation. This year's event celebrated 18 graduate student and nine undergraduate scholarship award recipients from 12 different colleges and universities. Since inception, over $1.3 million has been provided to students across the United States. The HGS scholarship awards are a significant contribution to the professional education of geoscientists and are unparalleled by any other local geological society.

This year, twelve energy companies and individuals supported the Scholarship Night dinner, with direct donations exceeding a record-breaking $53,000 in total. Special thanks to ExxonMobil, Houston Energy, Oxy, Shell, Thunder Exploration and others for supporting scholarships. The Scholarship Night dinner was first introduced by HGS President John Tubb in 2010 to raise additional funds for scholarship programs. Thirteen scholarship award winners and their invited guests attended the dinner that featured guest speaker Bob Lindsay, who presented a talk on Permian basin geology highlighting the Grayburg formation. See the February 2024 HGS *Bulletin* for more details on Lindsay's work.

Fang Lin and Bob Lindsay

The night kicked off with Scholarship Night Chair, Fang Lin, and Paul Britt, HGS President, introducing Calvert Fund Chair, Jeff Lund. Jeff introduced HGS Scholarship Committee representatives, Judy Schulenberg, Nicole Villareal, and Angela Hammond. Penny Patterson was on hand as HGS President-Elect and as the liaison to the Scholarship Committee. Meiying Hu (Chevron) took photos of the event.

The featured speaker for the Scholarship Night was Bob Lindsay of Midland Texas. He encouraged the students in their studies and gave a talk on the Permian Basin and the Guadalupe Mountains and the Grayburg Formation. The talk title was "How Geological Field Work in the Guadalupe Mountains Helped Solve Oil Field Production in the Permian Super Basin: Real Case Studies."

THE 2023-24 RECIPIENTS FOR THE HGS UNDERGRADUATE FOUNDATION SCHOLARSHIP

Nathan Atterberry, Sam Houston State University

Rebecca Beyer, Stephen F Austin State University

Leah Kegerriss, The University of Texas

Valentino Osorio, Rice University

Kyle Nash, Texas A&M; also, Maby Scholarship Winner

Ashton Snyder, Stephen F. Austin State University; also, Paul Basinski Scholarship Winner

Tucker Winkelman, Lamar University

Ashley Whorton, Texas A&M

THE 2023-24 RECIPIENTS FOR THE GRADUATE STUDENT CALVERT FUND SCHOLARSHIP

Alexandra Price, University of Houston

Allison Barbato, Louisiana State University

Edgar Contreras, University of Houston

Emilia Caylor, Arizona State

Jack Butcher, Stephen F Austin State University

Jamie Singer, Stephen F Austin State University

Jared Diehl, University of Missouri

Jenelle Wempner, Texas A&M University

Jordan Walker, Baylor University

Joseph Pelren, University of Tennessee

Leiser Silva, Colorado School of Mines

Marissa Castillo, Ohio State

Mary Campos, Stephen F Austin State University

Melanie Ertons, Stephen F Austin State University

Nicholas Ferry, University of Kansas

Parker Johnson, Texas A&M

Rebecca May, University of Missouri

Tiffany Nordstrom, Louisiana State University

The talk is available on the HGS GeoEducation YouTube channel at the link: https://www.youtube.com/watch?v=vZuvPBfOAZc

The Scholarship Night Awards show is on YouTube at https://www.youtube.com/watch?v=qP7ZOHfJMe0&t=838s

Fang Lin ended the night with a heartfelt closing statement recognizing what HGS contributes to students, and her high hopes for the Scholarship Night next year in 2025.

ABOUT THE HGS UNDERGRADUATE FOUNDATION FUND

The Houston Geological Society Foundation was established in 1984 with the intent of providing scholarships to deserving undergraduate geosciences majors. The Foundation was incorporated in 1985 and achieved tax-exempt status from the IRS later the same year as a nonprofit Section 501c (6) organization for charitable, scientific, or educational purposes. As of November 2022, Foundation trustees are Joe Lynch (Chairman), Angela Hammond (Treasurer), Shannon Lemke (Secretary),

Scholarship Recipients *continued on page 35*

Scholarship Recipients continued from page 34

Kirstin Burns, Paul Hoffman, Scott Krueger, and John Schneider. The Foundation has provided over $300,000 in scholarships since its inception.

The Foundation uses a variety of means to try to raise scholarship funds. Direct donations, HGS membership dues, Vendors Corner proceeds, matching-fund donations, and golf tournaments all produce funds that help support our scholarship program. Since 2011, the HGS has also allowed the Foundation and Calvert Memorial (graduate) scholarship programs to recruit sponsors for Legends/Scholarship Night and has hosted a special dinner meeting to honor the scholarship recipients. Profits from these events are split between the two scholarship funds and are a significant source of funding.

Seven universities participate in the Foundation's scholarship program. These include Rice University, the University of Houston, Texas A&M, the University of Texas, Sam Houston State University, Stephen F. Austin State University, and Lamar. Each fall, the head of the geosciences department at each university is contacted. The university submits two or three nominees and notifies the students of their nomination. Applications for this scholarship are forwarded to the students after nomination. Scholarship winners are notified in December and awards are presented to students in February. Awards range from $1,500 to $5,500. The Foundation is pleased to be supported by both the Maby and Basinski families and awards two special scholarships in their honor every year.

ABOUT THE WARREN L. AND FLORENCE CALVERT MEMORIAL SCHOLARSHIP FOR GRADUATE STUDENTS

The Warren L. and Florence W. Calvert Memorial Scholarship Fund was started in 1974 with a donation from the Calvert family and awarded its first **Scholarship Recipients** continued on page 36

Scholarship recipients with professors

Dick Bishop, Judy Schlenburg and Jeff Lund with scholarship recipients

Scholarship Recipients continued from page 35

scholarship in 1978. The stated purpose of the fund is "to assist worthy and needy geological students to pursue graduate studies in some branch of Economic Geology leading to a master's or doctor's degree at any accredited university of their choice". The scholarship awards are administered by a board of five HGS Members appointed by the HGS leadership.

The growth of the fund's corpus and scholarship awards come from contributions from HGS members and interest earned on fund investments. Several appreciative recipients of Calvert scholarships later donated amounts to the fund that matched or exceeded the awards they received.

Selection of recipients is based primarily on the candidate's past academic record and their potential to complete graduate degree requirements, as attested to by faculty. A recipient may pursue studies at any accredited college or university in the United States that awards graduate degrees in the geosciences. Scholarship applicants must present evidence of their unconditional acceptance for graduate study at the school of their choice. Recipients are expected to be full time students making progress towards their degree and have expressed an interest in pursuing a career in some branch of economic geology. Second and third-year renewals may be granted provided the scholar demonstrates satisfactory progress toward their degree. Individual awards can exceed $6000 per year. ■

WORD BRECCIA – A GEOLOGY WORD JUMBLE

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

NEDARME	_ ○ _ _ _ ○
VILALUF	_ _ _ ○ _ ○ _
LATED	_ ○ _ _ _
WOBOX	_ _ ○ _ _
RAGLEV	○ _ _ ○ _ _

This industry uses captured carbon _ _ _ _ _ _ _ _

HGS Volunteers at North Pointe Elementary School STEM Night

HGS President Paul Britt and HGS member Diane Britt (also Paul's spouse), volunteered for Science, Technology, Engineering and Mathematics (STEM) Night at North Pointe Elementary School on January 30. Returning for the fourth consecutive year, the Britts hosted a booth where they displayed objects to spark interest in paleontology and geology, including a mammoth tooth, model of a dinosaur skull, and rock samples. In addition, they shared information on the Gulf Coast environment during the Pleistocene. The event was attended by 150 – 200 children and parents of the school. ■

Paul and Diane Britt with their grandchildren at North Pointe STEM night

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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
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.**					1 Make your reservations online at hgs.org	2
3	4	5	6	7	8	9
10	11 **HGS General Dinner Meeting** *Giant Submarine Fans of the GOM* *Page 28* *https://www.hgs.org/civicrm/event/info?id=2483*	12 **AAPG CCUS Conference** *George R. Brown* *https://www.hgs.org/civicrm/event/info?id=2520*	13 **HGS E&E Dinner Meeting** *An Unconventional Approach to Induced Seismicity* *Page 29* *https://www.hgs.org/civicrm/event/info?id=2548*	14	15 **Abstract Deadline IMAGE 2024** *https://www.hgs.org/civicrm/event/info?id=2552*	16
17	18	19	20	21	22	23
24 31	25	26 **HGS CCUS Luncheon Meeting** *Data Gathering Requirements for Class VI Permit* *Page 30* *https://www.hgs.org/civicrm/event/info?id=2549*	27	28 **Continuing Ed** *https://www.hgs.org/civicrm/event/info?id=2542* **HGS NeoGeos Happy Hour** *https://www.hgs.org/civicrm/event/info?id=2543*	29	30

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.

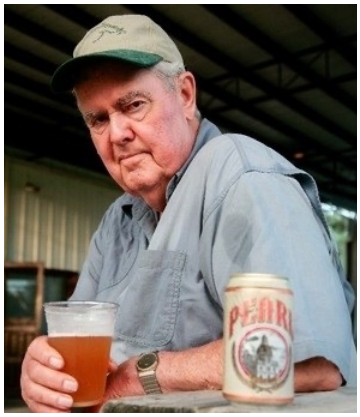
Text should be submitted as a Word file. Figures or photos may be embedded in the document or submitted separately. The following image formats are accepted: tif, .jpg, .png, .psd, .pdf.

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

Remembrance

Brian O'Brien

10/13/1933 - 01/27/2024



Brian Edward O'Brien passed away peacefully on Saturday, the 27th of January 2024, surrounded by his loving family. O'Brien was born on the outskirts of London in Wanstead, England, on the 13th of October 1933, to an Englishman, Wilfred Augustus "Tim" O'Brien, and a native Texan, Catherine Louise Perrenot O'Brien. During World War II, while his father served in the Royal Air Force and his mother volunteered as an ambulance driver, O'Brien attended boarding school and served as an eyewitness to history as the Germans began bombing London. He could recount memories of having to shelter in the basement during air raids and was grateful to have survived the Battle of Britain and the Blitz.

Though O'Brien enjoyed afternoon tea and his British grandmother's cooking, it was during a visit to his mother's hometown of Corpus Christi, Texas, as a young boy that he became captivated by the Texas cowboy, the stark majesty of the landscape, and the unique warmth of the culture. It was then that O'Brien decided he belonged in Texas. In 1946, at the age of 12, O'Brien, his mother and two sisters, Janice and Stephanie, left a war-torn England and sailed to the United States (he would jokingly tell his grandchildren that he came to the U.S. on the Mayflower) to live with family in Corpus Christi. In Texas, he was raised by his maternal grandparents, Edward P. Perrenot and Julia Hunter Perrenot along with his uncles, Robert Loyd Perrenot and Harlan Peter Perrenot, to whom he remained close throughout his life. Surrounded by relatives working in both the cattle and oil and gas businesses in Texas, O'Brien began shaping a dream.

O'Brien graduated high school in Corpus Christi and attended Cameron Agricultural College in Lawton, Oklahoma for two years before being drafted by the U.S. Army in May of 1953, where he served in Korea until 1955. Upon his return to the U.S., O'Brien enrolled at the University of Oklahoma (OU), where he met the love of his life and wife of 62 years, Sandra Ruth Lewallen. He earned a Bachelor of Science in Geology in 1958, married Sandra in 1961, and received his Master of Science in Geology in 1963.

Though O'Brien appeared to never take life too seriously, he had a strong work ethic, a strong faith in God, and an unwavering dedication to achieving his goals. While a student at OU, he made ends meet by working as a mud logger in the oil fields in Oklahoma, Texas, New Mexico, and Louisiana. Upon graduation, he was hired as a geophysicist and later worked as a geologist for Atlantic Richfield Company (ARCO), first in Houston and then in Corpus Christi. During this time O'Brien and Sandra's first three children were born: Timothy Loyd, Mary Catherine, and Robert Edward. In 1969, the family came back to Houston and O'Brien took a job with Mesa Petroleum Corporation. Soon after, O'Brien and Sandra would welcome twin sons, Sean Michael and Stephen Patrick.

While working for Mesa, O'Brien generated an oil and gas prospect south of the city of Laredo. Mesa's management turned down this prospect, and in true entrepreneurial spirit, O'Brien decided to pursue the prospect on his own. He gave up the guarantee of a steady paycheck, turned in the company car, and placed all his chips on the table. Despite the opinions of others, he relied on confidence in his own abilities and geological talents and began drilling. This wildcat prospect turned out to be a major discovery and led to the development of the Lobo play. In 1972, O'Brien, along with A.R. Sanchez, Sr., A.R. Sanchez, Jr., John Blocker, and Joe Thomas, formed the South Texas Exploration Company which was the forerunner of Sanchez-O'Brien Oil & Gas Company (SOBOG). From 1974-1997, SOBOG, under O'Brien's technical leadership, was one of the most successful privately held independent oil and gas companies with numerous notable discoveries. After dissolving SOBOG in 1997, O'Brien continued his career, independently exploring for oil and gas while also partnering with his son, Robert, at Saxet Petroleum, Inc. Together they continued their exploration efforts with successes along the Gulf Coast and throughout South Texas. For many years and up until just two weeks before his passing, O'Brien was at the office daily working on his next prospect.

Remembrance *continued on page 41*

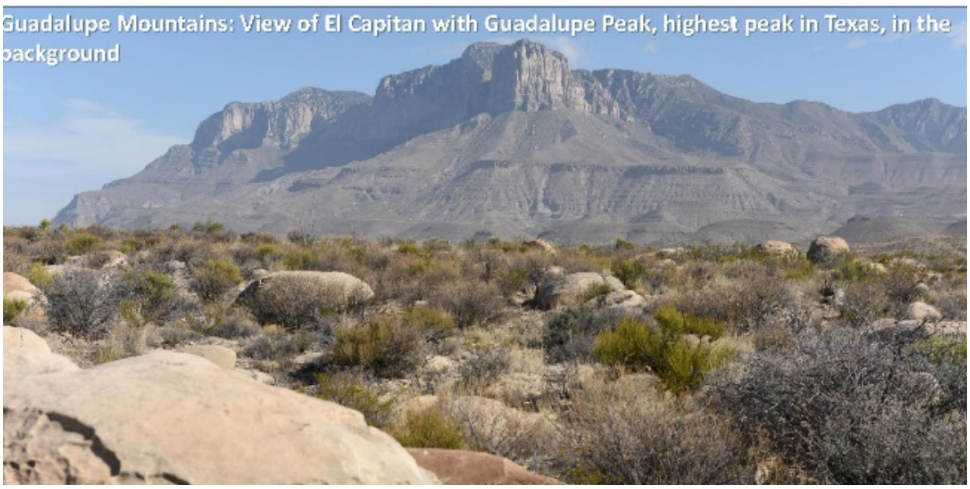
Remembrance continued from page 40

O'Brien was a member of many industry associations, including the American Association of Petroleum Geologists, the Houston Geological Society, the South Texas Geological Society, the Corpus Christi Geological Society, the Texas Independent Producers and Royalty Owners Association, the American Petroleum Institute, the American Association of Petroleum Landmen, and the Institute of Professional Geologists. In 1997, he was inducted into the All-American Wildcatters. O'Brien had a passion for generating and drilling wildcat prospects, and he enjoyed one of the best exploration track records in the oil and gas industry. One of O'Brien's most notable sayings was, "If you ain't drilling, you ain't sh--."

O'Brien was able to fulfill his life-long dream of owning a ranch in South Texas and becoming a cattle rancher. He began acquiring land in 1975 in Maverick County, Texas and continued to increase his land holdings over the next 30 years. Cinco Ranch, named in honor of his five children, has been a place for O'Brien to live out his cowboy dreams: raising cattle, hunting, and experiencing what he called the "mesquite mystique."

O'Brien, in true form, found ways to give to the community in South Texas. In 2000, he and Sandra funded the Brian E. and Sandra O'Brien Endowed Maverick County Scholarship Fund with Texas A&M International University to benefit Maverick County students. He also served on the Board of Directors of the Maverick County Water Control and Improvement District for 16 years and was a member of the Texas Southwest Cattle Raisers Association, Range Management Association, Beefmasters Association, the Texas Wildlife Association, and the Texas Historical Society. O'Brien had a special fondness for South Texas, and it will be his final resting place, as he will be buried amongst the mesquite trees in the beautiful landscape he so loved.

O'Brien was many things, including husband, father, grandfather "Bobo," great-grandfather, geologist, rancher, employer, mentor, colleague, friend, and philanthropist. He was a hard worker, whip-smart, and the understated life of every party. He was beloved by those fortunate enough to work for him and appreciated by those from all walks of life who met him in passing for the kindness he showed them. He adored his grandchildren and attended multiple sporting events, taught them how to hunt and fish, and never missed a graduation, especially if it was at OU! ■



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Active Membership

In order to qualify for Active Membership you must have a degree in geology or an allied geoscience from an accredited college or university or, have a degree in science or engineering from an accredited college or university and have been engaged in the professional study or practice of earth science for at least 5 years. Active Members shall be entitled to vote, stand for election, and serve as an officer in the Society. Active Members pay $36.00 in dues.

Associate Membership

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

Student Membership

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

Membership Benefits

Digital HGS Bulletin

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

Discount prices for meetings and short courses

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

Networking

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

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

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

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

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Preferred Address for HGS mail_____

This is my home address _____ business address _____

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

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

Student **$0.00**_____

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

Total remittance_____

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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