2020 Annual Report

Bureau of Economic Geology
Scott W. Tinker, Director

Contents

Cover image: Guadalupe Mountains, West Texas. Courtesy of Joshua Malone.

Message from the Director

The word *unprecedented* is used to describe just about anything one feels is different from an expected norm. From weather, to political unrest, to athletic prowess, to artistic talent and beyond. In strict terms, unprecedented means "never done or known before." Like landing on the Moon for the first time. I think what most mean when they say unprecedented is *extraordinary* or *exceptional*. It is fair to say that 2020 will be remembered as both.

The COVID-19 pandemic opened my eyes to both the fragility of support systems and the human psyche. In my six decades, I have not witnessed, nor did I think I would ever witness, an orchestrated suspension of the global economy. The economic shutdown included the mass movement of people from central offices to home offices, from classrooms to kitchens. It resulted in the inevitable implosion of a myriad of jobs that could not be done from home and the shuttering of innumerable businesses that could not weather the storm. The forced pause resulted in the short-term collapse in demand for energy that fuels a healthy economy and the concomitant destruction of a highly-skilled energy workforce. It accentuated often-severe health-care impacts associated with isolation and loneliness, especially in the elderly. It included, and will seemingly continue to include, trillions of dollars of new debt borrowed from our children, who will eventually be forced to deal with it. The list goes on. A few industries and individuals, such as those who provide video streaming software or home delivery services, were strengthened, and a few politicians, actors, activists, and media types used the opportunity to cast blame and doubt. Sadly pathetic. To be sure, 2020 was *extraordinary*.

Yet, from *extraordinary* times rise exceptional deeds and opportunities. The medical community developed viable vaccines in under a year. Health-care professionals, firefighters, peace keepers, farmers, postal workers, truck drivers, and countless other unsung heroes risked exposure every day in order to keep the fragile system intact. Educators moved instruction from the classroom to the home, and parents and guardians added homeschooling to their day jobs. Unemployed workers created new opportunities and businesses and went back to school for reeducation in a new field. In the developed world, the future of office work is being reconsidered and may allow for an evolved office–home balance. Improved planning and preparedness for future pandemics and other global challenges is well underway, and an exceptional sense of community—a realization that we are all in this together, and that no one is immune—is creeping into conversations and attitudes worldwide.

In his 2004 biography of a South African boy born with AIDS, Jim Wooten quotes Nkosi Johnson:

Do all you can
With what you have
In the time you have
In the place you are

At the Bureau of Economic Geology, we know this is our time, and we will do all that we can, with what we have, to come out stronger and continue to serve the public with objective, impactful science that matters.

Weathering the Storm and Coming Out Stronger

Each year holds its own unique set of problems, but 2020 will always be remembered at the Bureau of Economic Geology as the year it battled to weather a "perfect storm" of challenges. The bad luck really began on Friday, March 13th, when The University of Texas at Austin required Bureau staff to evacuate its buildings due to COVID-19 concerns. It would take months of adaptation and sacrifice before operations slowly began ramping up.

At the same time, the global pandemic reduced energy demand, while oil production in producing countries stayed high. That dynamic ultimately led to the collapse of world oil prices and the subsequent devastation of the U.S. oil and gas industry. Energy research funding was drastically reduced, and a huge part of the Bureau's budget was negatively impacted.

Faced with having to deal with all of the ramifications of operating safely within the COVID shutdown while addressing disturbing funding questions, Director Scott Tinker and the associate directors—in concert with senior researchers and administrative staff, and with input from the full staff—tackled the issues and crafted effective strategies to move forward.

Safety protocols were developed within UT Austin guidelines and fully vetted internally before being implemented. These included limited numbers of staff and researchers in Bureau facilities at any one time and, of course, the requirement that everyone wear masks in public spaces. An online "Entrance Log" was developed to track comings and goings and to assist with any necessary contact tracing. Building modifications were made and included plexiglass dividers, hand sanitizing stations, and directional signage.

Within the UT community, Bureau leadership was at the forefront of overcoming obstacles to normal operation. All of the Bureau's labs were soon partially reopened. Exceptions to travel restrictions were approved for a few researchers and technical personnel travelling within Texas to maintain crucial equipment and experiments. Cohorts were established and approved by UT to allow large numbers of researchers and staff to work within Bureau buildings during specified periods of the day, while over half of the staff—with tremendous support from the Bureau IT team—adapted to working from home online. Zoom, WebEx, and Teams became the accepted ways to meet and communicate. In the fall, permission was granted to partially reopen core viewing in all three rock warehouses in the state to industry and the public.

To offset funding reductions, a call went out to Bureau of Economic Geology researchers to consider new external sources for grants and to submit proposal ideas for groundbreaking programs and projects that might interest non-traditional Bureau funders. A huge number of researchers responded, and a flood of proposals was submitted. Many of those proposals were shared with the highest levels of leadership in federal and state agencies, private foundations, corporations, and national laboratories, and a number or potential partnerships began to emerge. Among the proposals pursued were projects in geothermal energy, carbon capture and storage, underground energy storage, hydrogen, access to water and energy, critical minerals, and subsurface nanotechnology.

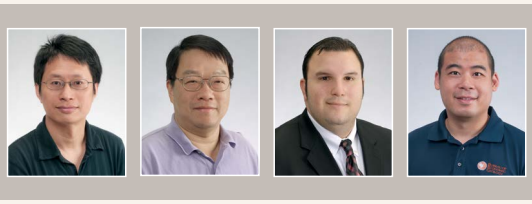
The Bureau of Economic Geology's budget, which relies predominantly on funding from external grants and contracts, was hit hard. To offset losses, painful decisions had to be made, and personnel reductions were implemented. Although every effort was made to retain positions, reductions included a combination of early retirements, voluntary hour reductions and furloughs, and a handful of layoffs. By late fall, all staff had had their hours reduced by some percentage to help meet budget shortfalls.

2020 will indeed be recalled as a troubling year for the Bureau of Economic Geology, but it will also be remembered for the resolve of its leadership and the resilience of its people. No one could have predicted the perfect storm that swept over the organization, but the Bureau will never forget how directors, researchers, and staff fought to hold things together. Although 2020 has come to a close without an end to the fight, the Bureau of Economic Geology emerged from the year leaner, stronger, wiser, and ready to address the greatest energy, environmental, and economic research challenges of the future.

Bureau IT Team Steps Up to Address COVID

Bureau building facilities boast a sophisticated network of computers and other communication technology which has enabled its researchers, students, and staff to connect with colleagues across the campus and around the globe to tackle vital research questions. That all changed when Bureau facilities were shuttered and employees were asked to work remotely as the organization managed the COVID-19 situation.

In the midst of this unexpected and dramatic change, the Bureau's Information Technology team stepped up to ensure a relatively seamless transition to a new IT model utilizing remote connections. For a culture without a history of remote interconnectivity, this rapid transformation by the IT team was remarkable.



(Left to right) Poe Chen, Joseph Yeh, Carlos Garza, and David Chang.

The IT group worked flawlessly as a team to create an effective remote network environment. Led by **Poe Chen** and including team members **Joseph Yeh**, **Chuck Garza**, and **David Chang**, they went to work loading remote connection software onto many individually owned laptops, distributing Bureau laptops, scheduling and holding online training sessions in remote connecting and virtual meeting applications. Throughout the pandemic, they have continued to produce high-quality streams of research presentations and provide excellent tech support.

Reopening the Core Research Centers

The Bureau, under the guidance of The University of Texas at Austin, has gone to great lengths to ensure the safety of its researchers, staff and students during the COVID-19 pandemic. In March, the Bureau's core research centers were closed along with the rest of UT facilities.

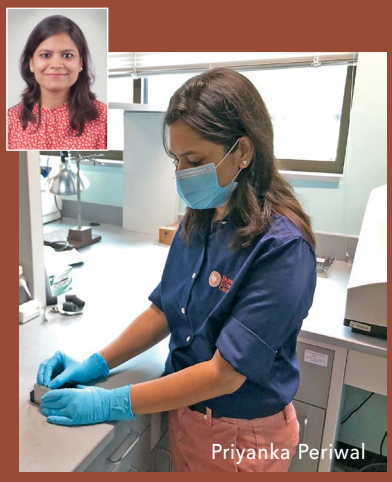
The ability to physically examine core and other rock material is indispensable to geologic research, and reopening the core viewing facilities in Austin, Houston, and Midland was a top priority. After several months of closure, Bureau staff were ready to reopen the Austin Core Research Center with new safety measures in place. Specific core viewing areas were set up, and the core viewing room was limited to single individuals or groups at a time to maintain a safe research environment.

"It is important to be able to lay out and view cores because it is essential to research efforts," said **Nathan Ivicic**, who manages the Bureau's core archives. "I have heard it said many times from geologists that there is no substitute for being able to see the cores in person. I take tremendous pride in the work that we perform at the CRC, and I believe that shows in our efforts to keep research moving during these trying and challenging times."

By December, the Houston, Austin, and Midland facilities were all open to industry and the public.

Nathan Ivicic

Bureau Labs Up and Running



Priyanka Periwal

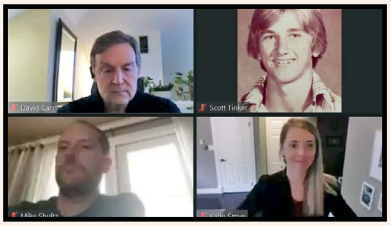
Most of the Bureau's 15 labs are now up and running again. Among them is the Scanning Electron Microscope (SEM) Lab, managed by **Priyanka Periwal**. These days, she is working on understanding the minerological composition of shale samples using some of the lab's sophisticated equipment. "It is very important for the Bureau to have the lab operational. My work involves my presence in the lab; it cannot be done remotely. We practice social distancing and wear face masks at all times in the SEM Lab. I feel pretty safe to come and work in the lab," she says.

The salt tectonics modeling laboratory was one of a handful of the Bureau's research facilities allowed to remain open during the COVID-19 lockdown, thanks to lobbying by the Applied Geodynamics Laboratory (AGL), Bureau leadership, and the Jackson School Dean's office. Most of the AGL's experiments last for weeks or even months, which factored into the lab gaining its exemption from the lockdown. Principal Investigator and Senior Research Scientist **Tim Dooley** is the sole researcher in these facilities and thus an expert on social distancing!

Tim Dooley

Zooming Forward, Together

March 13, 2020—Friday the 13th—made even the least superstitious of the Bureau staff wonder. It was on that day that UT Austin ordered the evacuation of Bureau buildings due to COVID-19 concerns. No longer would staff trade jokes or debate rock science at the coffee machine, or even say "Good morning!" to a co-worker in the hallway. Everyone was isolated and working from home.



But technology prevailed to bring people together. Though only a few were familiar with virtual meeting platforms at first, it wasn't long before everybody was using Zoom, Teams, or WebEx to stay connected. Technical problems abounded at first until the IT team ensured that all staff and researchers had the necessary equipment and training to participate. Virtual meeting apps allowed the geoscience research, business, and relationships of the Bureau to move forward.

As important as Zoom and other video conferencing platforms were to Bureau success, virtual meetings were not without their awkward moments. People learned a lot about each other from peering online into background living spaces. There were suffering hair styles and odd dress code interpretations and ubiquitous screenshots of checkerboards of faces. New microphones were mistakenly active during impromptu snacking, and new cameras frequently captured frozen facial expressions.

It wasn't long before researchers were using Zoom to collaborate on major areas of study, and huge audiences from around the world could join research meetings. Researchers shared their latest findings at distant conferences without travel, and talks were now opened to distant peers.

Zoom facilitated a communication transformation and allowed the Bureau to continue its mission. Of all of its benefits, though, the most important may have been that Zoom ultimately brought the Bureau family back together in unexpected and vitally important ways.

Bureau Social Media Takes Off

As part of last year's Strategic Planning process, the Bureau of Economic Geology committed to greatly enhancing its social media presence in 2020. It developed accounts on Twitter and LinkedIn and began a systematic placement strategy ensuring a stream of posts throughout each week.

Contributions by Bureau researchers were integral to ensuring a steady stream of content week after week. After the COVID-19 situation made it evident that customary research efforts and in-person meetings would be drastically limited—diminishing opportunities to prepare traditional stories for the Bureau's website—researchers were asked to prepare and submit brief summaries of their studies and activities. A flood of interesting information was submitted, and a new web feature—Researchers' Corner—was launched to host it.

Researchers' Corner took the novel approach of featuring the researchers themselves and allowing them to tell their own stories about what they do. Each featured write-up linked to the researcher's personal page in an effort to introduce them directly to curious readers. The topics covered an extremely wide spectrum, everything from the impact of energy development on West Texas to the nuances of geologic modeling in 3D to the preservation of water-dependent ecosystems.

Aside from Researchers' Corner, posts promoting the Bureau's weekly news articles, Bureau Seminar Series, EarthDate radio podcast episodes, featured researchers of the month, and more were featured on the Bureau's social media accounts. A distinctive Bureau social media brand was also developed for these different communications channels, with tailored graphics accompanying each post.

This continual flow of information throughout each week engaged social media followers in new ways as they experienced broad aspects of the Bureau's work. During 2020, the Bureau's social media followers have more than doubled, and that number continued to grow.

If you're not a follower yet, join us on Twitter and LinkedIn, subscribe to our YouTube channel, and stay connected with the Bureau's energy, environmental, and economics research every day.

Keep up with the latest from the Bureau

Twitter: @Bureau3E

LinkedIn: www.linkedin.com/company/bureau-of-economic-geology

YouTube: https://www.youtube.com/c/BureauofEconomicGeology

EarthDate: https://www.earthdate.org/

Researchers' Corner: https://www.beg.utexas.edu/news/researchers-corner

News: www.beg.utexas.edu/news/articles

News and Events

GCCC Hosts Meetings throughout the Year

Biannual Sponsor Meeting

Each year, the Gulf Coast Carbon Center (GCCC) holds two biannual meetings for their industrial affiliates. These meetings cover the latest developments in carbon capture and storage research completed by the center's scientists. The most recent meeting took place on August 25 and was attended by nearly 50 representatives from the GCCC's sponsors.

To give a different look and feel to the poster session this summer, researchers used Prezi, an online presentation software, to create an interactive environment in place of the usual static poster content. During each of three time slots, grouped into three themes, researchers gave a technical brief followed by lengthy discussion. The presentations' major themes included BIGFOOT—GCCC's research into CO_2 storage that has a "big footprint," modeling and monitoring, and the ecosystem.

GoMCarb Joint Meeting

The Gulf Coast Carbon Center joined the Southern States Energy Board (SSEB) for 2 days in March to conduct their annual joint partnership meeting—for the first time via webinar. Participants provided key updates on the research projects they lead on carbon capture and storage (CCS) in the Gulf of Mexico region. In 2018, the GCCC and the SSEB became principal investigators of two different multimillion-dollar projects funded by the Department of Energy (DOE) to explore carbon capture and offshore geological carbon storage in the subsurface under the U.S. Gulf of Mexico. The Gulf of Mexico Partnership for Offshore Carbon Storage (GoMCarb), led by the GCCC, explores the potential in the western Gulf region from western Louisiana to Texas. The second project, led by SSEB and called SECARB Offshore, explores the potential in the eastern Gulf region from eastern Louisiana to Florida.

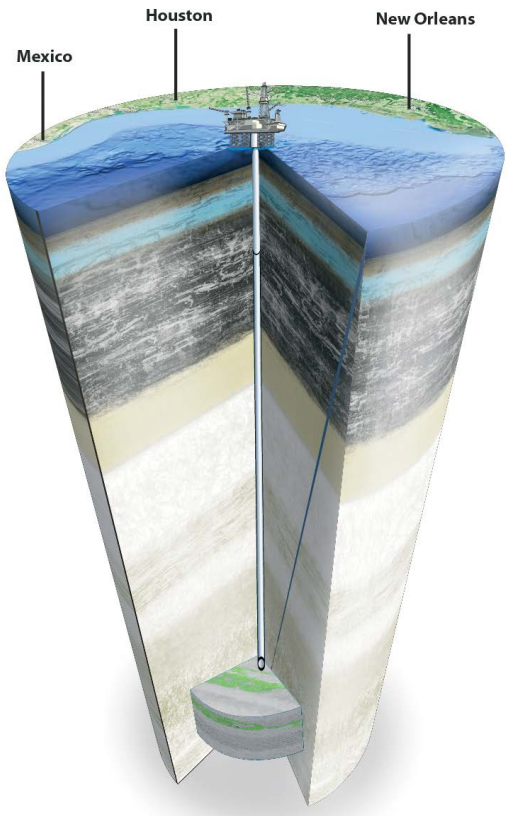
GoMCarb researchers gave updates throughout the first day on topics ranging from characterizing the subsurface geology of potential CO_2 storage sites to transportation and infrastructure needs, risk assessment, subsurface monitoring, and stakeholder engagement in the GoMCarb project.

GCCC members, including **Susan Hovorka, Tip Meckel, Alex Bump, Sahar Bakhshian, Emily Moskal, Dallas Dunlap,** and **Iulia Olariu,** gave presentations.

The SECARB Offshore and the GoMCarb projects advance and mature a series of offshore studies funded by the DOE. At the meeting, researchers presented maps of dozens of structurally defined fetch and trap areas with the potential to be developed as storage complexes. The internal sedimentary architecture of several areas shows favorable stacked traps and seals as well as defines the bounding faults. New work on infrastructure has advanced the potential for pipeline reuse, and, for the first time, risk-assessment work considered the impact and mitigation of offshore well blowouts that intersect stored CO_2 plumes. The researchers are excited about the opportunities ahead for offshore CCS in the Gulf States, matched by the recent uptick in industry interest.

University of Texas Conference on Carbon Capture and Storage

The GCCC cohosted the 5th University of Texas Conference on Carbon Capture and Storage (UTCCS-5) in February along with the Texas Carbon Management Program (TxCMP). More than 100 participants participated in UTCCS-5 to learn about the latest research from UT experts on carbon capture and storage. The University of Texas Conference on Carbon Capture and Storage takes place every other year in conjunction with the biannual GCCC sponsor meeting.



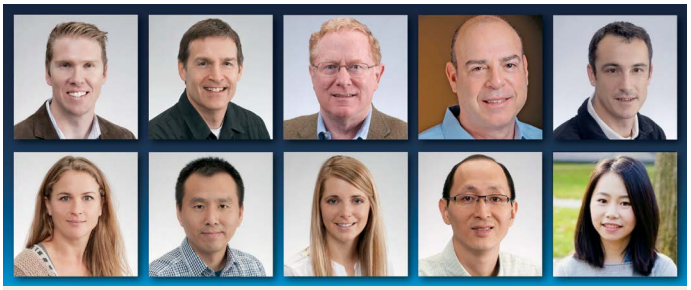
Representatives from CCS groups at Battelle, Baker Hughes, BHP, BP, ExxonMobil, JX Nippon (Petra Nova), Shell, Occidental Petroleum, Total, Trimeric Corporation, the U.S. Geological Survey, the Department of Energy's National Energy Technology Laboratory, the Environmental Defense Fund, Clean Air Task Force, and others attended. This was one of the last in-person Bureau events before the COVID-19 lockdown forced most meetings to follow a virtual format.

The conference's geological storage track was organized by GCCC and focused largely on geological applications, infrastructure, and stakeholder relations within the CCS process. Many storage track presentations were dedicated to presenting project updates on GCCC's 5-year Big Plan, which describes the group's research aspirations and aims at taking CCS to a commercial level by providing solid data to stakeholders.

Bureau Research Showcased at URTeC

For many years, largely due to groundbreaking research in broad aspects of oil and gas exploration and production in unconventional reservoirs, Bureau of Economic Geology researchers have held a commanding presence at the annual Unconventional Resources Technology Conference (URTeC). This year was no different, despite URTeC 2020 taking a virtual format in response to the COVID-19 pandemic.

Bureau researchers made impactful presentations at URTeC in July, presenting new publications and vital research results and conducting a unique online core workshop. **Sheng Peng's** informative talk, "Gas-Water Relative Permeability of Unconventional Reservoir Rocks: Hysteresis and its Influence on Production after Shut-in," was very well received. **Jake Covault, Xavier Janson,** and **David Carr** led discussions, each with a different geological focus, during the virtual core workshop. **Qian Yang** presented "Permian Delaware Basin Wolfcamp A Formation Productivity Analysis and Technically Recoverable Resource Assessment," a paper co-authored by **Emery Goodman, Guin McDaid**, and others. **Alexander Sun** spoke about machine learning in well completions, and Bill Fairhurst made a presentation entitled "The Perfect Unconventional Resource Portfolio." **Katie Smye** and members of the Bureau's Tight Oil Resource Assessment (TORA) team presented papers on geologic variability in U.S. shale plays and on new parent-child approaches in reservoir engineering. Qiqi Wang, a Ph.D. student of the Bureau's Fracture Research and Application Consortium (FRAC) and Principal Investigator **Steve Laubach** presented an intriguing paper on fractures.



URTeC meeting. (Left to right) Jake Covault, David Carr, Bill Fairhurst, Emery Goodman, Xavier Janson, Guin McDaid, Sheng Peng, Katie Smye, Alexander Sun, and Qian Yang.

Steve Laubach

As the industry recovers from the current downturn and drilling in unconventional plays ramps up, Bureau scientists, engineers, and economists will continue breaking new ground in their ongoing research into these tight reservoirs. They are sure to lead key discussions about research that matters during next year's version of the Unconventional Resources Technology Conference.

STARR Generates Over 8 Times the Rate of Return for the State

In the first 17 months of the 2018 to 2020 biennium (September 1, 2018 to January 31, 2020), the State of Texas Advanced Resource Recovery (STARR) program created more than $80 million for the State of Texas in the form of severance taxes. Relative to STARR's total funding of $9.9 million over the biennium, this figure represents a return of 810%. The interim report released in May 2020 summarized STARR's research activities and identified 24 field studies and 13 regional studies in which STARR had been involved during part of the 2018–2020 biennium. Of these studies, 15 were in the Permian Basin.

Texas has produced more oil and natural gas than any other state and was the largest daily producer in 2018 with almost 3.5 MMbbl/d (million barrels per day) of oil and more than 23 Bcf/d (billion cubic feet per day) of gas. No other state or region worldwide has been as heavily explored or drilled for oil and natural gas as Texas. According to the Texas Railroad Commission, approximately 187,400 active oil wells and 98,700 active gas wells were producing oil and natural gas in the state in 2018.

The main objective of the STARR program is to increase severance-tax income for the State of Texas through research projects that promote the drilling of profitable oil and gas wells. The Bureau of Economic Geology receives funds from the State to conduct research that assists oil and gas operators in adding new wells or increasing production from existing wells in Texas. STARR continues to be a tremendous resource for smaller operators, especially in the 2020 low-price environment, in which many operators could not afford research staff.

Since 1995, the STARR program has completed more than 70 field studies. The STARR program provides a variety of research products, including core descriptions and interpretations; subsurface lithology maps from wireline-log data; and interpreted cross sections, inversion analyses, stratal-slice maps, and attribute maps from seismic data. These research products help oil and gas operators to define new exploration and production targets in the form of infill wells, recompletions, field extensions, redesigned waterfloods, and enhanced oil recovery opportunities.

Bureau Awarded $3.7 Million by the U.S. Department of Energy

The Bureau of Economic Geology was recently awarded a 3-year, $3.7-million grant by the U.S. Department of Energy (DOE). The grant, titled "Casing Annulus Monitoring of CO_2 Injection Using Wireless Autonomous Distributed Sensor Networks," aims to address the DOE's interest in obtaining real-time data to better monitor subsurface CO_2 movement.


David Chapman


Mohsen Ahmadian

Co-principal investigators of the project, **David Chapman** and **Mohsen Ahmadian**, will develop and integrate wireless autonomous microsensor technology from the California Institute of Technology, sensor packaging and emplacement technology from the Research Triangle Institute, and smart well-completion technology (wireless active casing collars and wired pipe) from Sandia National Laboratories. The project's goals include successfully conducting a fully integrated field-laboratory validation of an integrated distributed wireless intelligent sensor system at the Bureau's Intermediate Scale Field Test Lab in Devine, Texas.

Microsensors will be deployed within a well-casing annulus without casing perforation, wires, or cables for installation, power supply, or data transmission. The funded project will optimize a wireless solid-state sensor system to continuously measure CO_2, pH, temperature, and methane within the high-pressure, high-temperature environment in the casing annulus. The sensors can improve reservoir and above-zone monitoring for the expected lifetime of the well. The millimeter-scale "sensors on a chip," developed by the Bureau's Advanced Energy Consortium (AEC) over the past 8 years, enable autonomous, transformational near-wellbore reservoir monitoring in the casing annular space. These sensors consist of autonomous microelectronic radio-frequency tag circuits with memory and antenna which have been microfabricated on sensor chips. The sensor chips can be wirelessly addressed and inductively powered with smart casing collars containing routers which communicate to the surface. The collars complete an intelligent, integrated real-time monitoring system.

Sergey Fomel Conducts SEG Lecture


Sergey Fomel

Society of Exploration Geophysicists (SEG) Spring 2020 Distinguished Lecturer **Sergey Fomel** hosted a webinar on May 12 as part of the lecture series. His talk, "Automating seismic data analysis and interpretation," explored recent developments in artificial intelligence and machine learning that can automate different data analysis tasks.

Fomel discussed the quest for automation by tracking the development of automatic picking algorithms—from velocity picking in seismic processing to horizon picking in seismic interpretation.

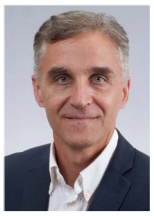
Fomel is the Wallace E. Pratt Professor of Geophysics at The University of Texas at Austin and the director of the Texas Consortium for Computational Seismology (TCCS). At UT Austin, he is affiliated with the Bureau of Economic Geology, the Department of Geological Sciences, and the Oden Institute for Computational Engineering and Sciences.

Artificial Intelligence and Machine Learning at the Bureau

Visualizing Core Data with CorePy


Priyanka Periwal


Evan Sivil


Toti Larson

Upscaling core-based measurements to wireline log responses has been challenging due to the typically low spatial resolution of key rock and fluid attribute measurements relative to the high spatial facies variability that is typical in mudrock systems. The Bureau's Mudrock Systems Research Lab (MSRL) is finding new ways of visualizing the geochemical and geomechanical measurements taken from the core they study: through Python automation. The team of Esben Pedersen, **Priyanka Periwal,** and **Evan Sivil**—led by **Toti Larson**—have created CorePy, an innovative Python tool that uses principal component analysis and K-means clustering to integrate data analytics with graphical visualization. With CorePy, the team can view the statistical distribution of important rock attributes directly and in real time. The core dataset for CorePy spans collections from the Eagle Ford Shale, Permian Basin, Vaca Muerta Formation, Haynesville, Barnett, and other mudrock plays.

"High-resolution X-ray fluorescence (XRF) is a powerful geochemical tool used to characterize geological core, but geologists have struggled to fully utilize the large multivariate datasets that it generates," said Toti Larson. "The application allows researchers to integrate these complex datasets and visualize the results directly on core photographs, and to apply new data analysis tools, quickly visualize the results, and better characterize the core."

Using Artificial Intelligence and Machine Learning for Climate Insights and Carbon Storage


Alexander Sun

Climate extremes are projected to increase in intensity with global climate change. This year, Bureau scientists **Alexander Sun, Bridget Scanlon,** and **Ashraf Rateb** were


Bridget Scanlon


Ashraf Rateb

awarded a 3-year NASA grant to investigate the feasibility of using GRACE (Gravity Recovery and Climate Experiment) satellite data for flood early warning and monitoring. Novel physics-based machine learning (ML) techniques will be developed to perform missing data imputation and forecasting.

Sun is also participating in the ExaSheds Project funded by the Department of Energy's Biological and Environmental Research Program. The multi-year project aims to advance watershed system science by combining multi-scale hydrological modeling, field observations, and AI/ML assisted data analytics.

Seyyed Hosseini and Sun are actively involved in the SMART Initiative (Science-informed Machine Learning to Accelerate Real Time Decisions in the Subsurface) funded by Department of Energy's Fossil Fuel program. SMART is a multi-year, multi-organizational effort with the goal of transforming interactions within the subsurface and significantly improving efficiency and effectiveness of field-scale carbon storage and unconventional oil and gas operations.


Seyyed Hosseini

Automating Geological Feature Interpretation

3D seismic data are paramount for subsurface characterization. However, interpretation of geological features—including faults, channels, stratigraphic horizons, and geologic bodies such as salt or carbonate build-ups—is typically tedious, time-consuming, and often subjective. **Sergey Fomel** and his team of post-docs and students in the Texas Center for Computational Seismology (TCCS) have developed revolutionary approaches for using convolutional neural network (CNN) machine learning and synthetic training datasets to create very rapid computer-based interpretations of these features. This patented approach enables a new automated workflow for seismic interpretation in which these geologic features are identified, and geologists or geophysicists can interrogate the results. This work is a significant step forward in building more robust earth models for resource evaluation and scientific studies.

AAPG Profiles Kitty Milliken

The Bureau's **Kitty Milliken** was featured in June as part of the American Association of Petroleum Geologists (AAPG)'s "Science and Technology Showcase."

Milliken's recent research focus has been in using petrography to document the magnitude of subsurface reactions in sedimentary rocks. Her work has found that cumulative subsurface reaction volumes tend to be very great—that is, the chemistry of a rock is very different from the ancient sediment that makes up that rock. Throughout her career, she has also done important work in pore architecture to understand how the size, shape, and distribution of pores affects the behavior of fluids in rocks. This work can have great impacts in identifying productive areas for drilling in unconventional reservoirs.


BEG scientist Kitty Milliken enjoys the view from the derrick on the drill ship Chikyu, IODP Expedition 316.

Milliken is currently working in Perth, Australia, with a group from the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Together, they are using high-magnification imaging methods—such as field-emission scanning electron microscopy (FE-SEM)—to examine organic-rich Proterozoic mudstones. Milliken is excited to discover how the reactive skeletal material in these rocks has played a role in the development of their pore architecture.

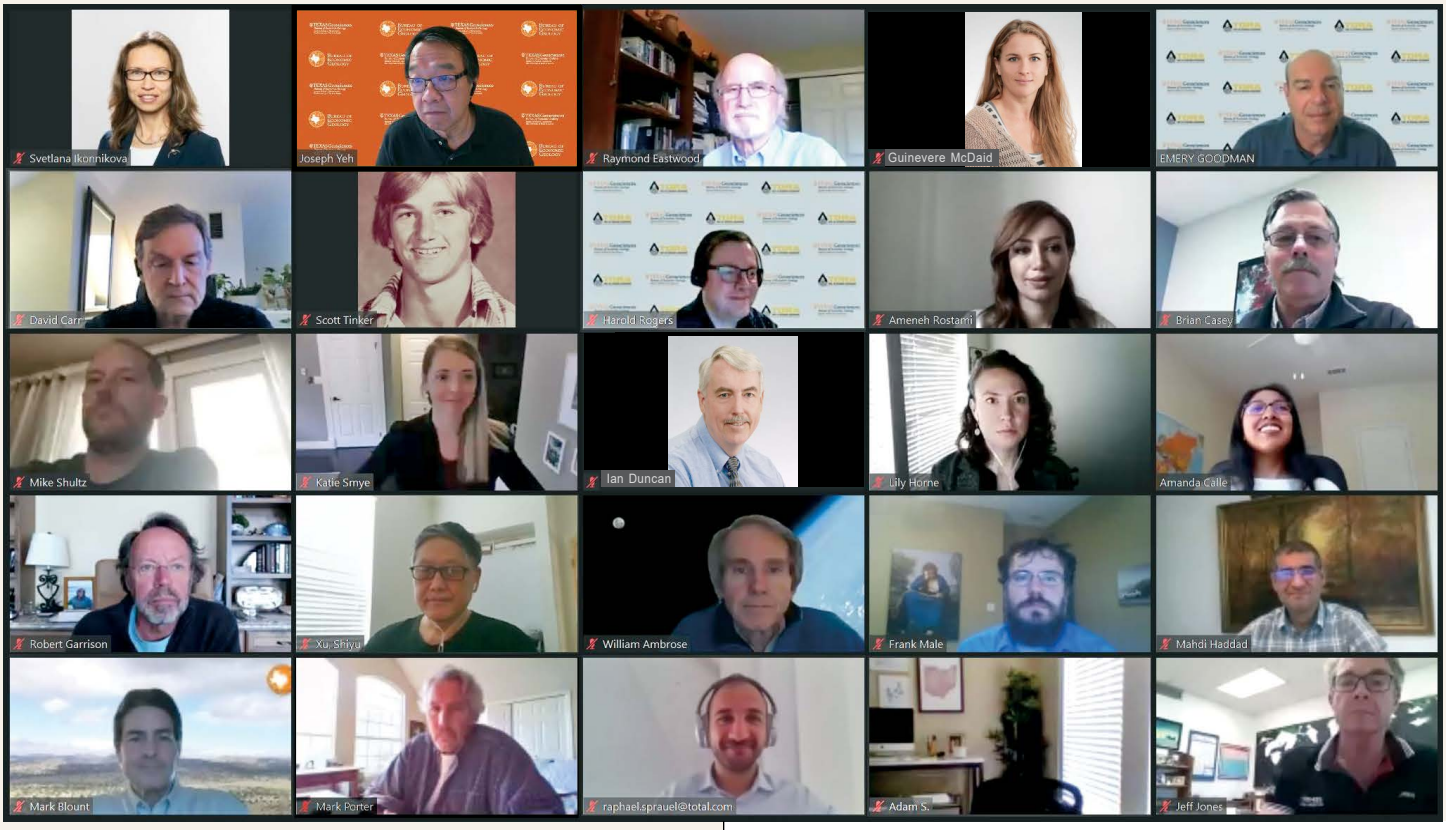
"For understanding the origins of rocks and their basic components, the intersection of new technologies for seeing with previous experience in examining a wide range of rock types provides fertile ground," said Milliken, "Once we have a new way of seeing, then we have a new way of measuring and answering questions, but it's necessary to have experience to know what to measure and which questions to ask."

TORA Zooms through an Impactful Program Overview and Annual Meeting

The Bureau of Economic Geology's Tight Oil Resource Assessment (TORA) program opened its spring Program Overview to over 140 partner representatives who joined the meeting from locations around the world on Zoom in June. Though the COVID-19 situation limited personal contact with representatives from the consortium's many partner companies and organizations, the Zoom platform allowed a broader group to virtually participate in the meeting and learn about the significant research progress TORA had made early in the year.

TORA's vision is to be recognized as the premier organization researching U.S. onshore unconventional resource plays and their production capabilities for the most comprehensive, yet granular, understanding. The detailed reports made by the broad spectrum of TORA researchers at the Program Overview affirmed that the program is achieving its vision.

Among the presentations was a report of a step change in Delaware Basin productivity analysis and a new estimate of its technically recoverable resources (TRR). Researchers have analyzed over 50,000 wells and look forward to examining recently acquired seismic data from across the Permian Basin to improve existing geologic models.



TORA meeting. (Left to right) Svetlana Ikonnikova, Joseph Yeh, Raymond Eastwood, Guinevere McDaid, Emery Goodman, David Carr, Scott Tinker, Harold Rogers, Ameneh Rostami, Brian Casey, Mike Shultz, Katie Smye, Ian Duncan, Lily Horne, Amanda Calle, Robert Garrison, Shiyu Xu, William Ambrose, Frank Male, Mahdi Haddad, Mark Blount, Mark Porter, Raphael Sprauel, Adam S., and Jeff Jones.

In November, 120 representatives of sponsor organizations attended TORA's annual meeting virtually from the U.S., China, Colombia, Germany, and France. The meeting included 24 live presentations and a virtual core description workshop.

Presentations covered geoscience, reservoir engineering, petrophysics, economics, data analytics, and machine learning. The meeting focused on the Permian Basin but included concepts and methods applicable to all unconventional plays, including formation evaluation, geomechanical and spacing controls on well interference, pore pressure analysis, estimated ultimate recovery (EUR) modeling using a two-phase flow model, and the use of seismic inversion to characterize tight oil reservoirs from newly-acquired 3D datasets.

For the first time, TORA expanded its productivity analysis to the entirety of the Delaware Basin, with the highest projected first-year productivity of Wolfcamp A wells in southwestern Lea County, New Mexico, and northern Loving County, Texas.

TORA sponsors find tremendous value in the consortium's work. Valuable aspects of TORA participation include delivery and access to basin-scale maps and models, research impacting field-development business decisions, integration across multiple disciplines, and "fresh" formation data.

MSRL Hosts Annual Meeting

MSRL researchers use a wide range of instruments to characterize core samples, including scanning electron microscopy (SEM), X-ray fluorescence, porosity and permeability tools, Rock-Eval analysis, and gas-liquid chromatography. Integration of core-based characteristics for Wolfcamp A and B in the Delaware Basin allows researchers to develop a deeper understanding of oil-saturation distribution, organic matter source type and preservation (Pr/Ph), and pore distributions. Analytical measurements are compared to petrographic

MSRL meeting. (Left to right) Robert Reed, Toti Larson, Xun Sun, Tongwei Zhang, Lucy Tingwei Ko, Ken Ikeda, Junwen Peng, Xavier Janson, Evan Sivil, Farzam, Javadpour, and Sheng Peng.

observations and gamma-ray core logs for understanding depositional systems and upscaling, respectively.

The Bureau of Economic Geology's Mudrock Systems Research Laboratory (MSRL) hosted its annual meeting late in the year. Due to travel restrictions related to the COVID-19 virus, MSRL researchers adapted to web-based video conferencing and hosted a 2-day technical meeting and 1-day short course online. Over the course of the meeting, more than 140 participants from MSRL member companies across 4 different countries logged on.

Key highlights from this year's technical session included new Permian Basin research integrating lithologic, thermal maturity, oil- and water-saturation studies, and organic matter source typing. Talks were led by MSRL researchers **Toti Larson, Tongwei Zhang, Robert Loucks, Lucy Ko, Farzam Javadpour, Sheng Peng, Robert Reed,** and **Xun Sun**; RCRL collaborators **Charles Kerans** and **Xavier Janson**; and STARR program postdoc **Junwen Peng**. The presentations included new research in the Eagle Ford Shale and Austin Chalk; a technical session on porosity, permeability, and fluid-flow modeling (with MSRL student Hong Zuo); a machine-learning project introducing new methods for identifying pores in SEM images; and a special session on the Vaca Muerta.

The 1-day mudrocks short course, hosted by MSRL researchers, covered the fundamentals necessary to characterize mudrock systems and included a presentation on sediment gravity flow deposits from guest speaker Dr. David Mohrig, professor and Associate Dean for Research at the Jackson School of Geosciences.

Although the online annual meeting format limited the ability for face-to-face networking and interaction, it had the advantage of allowing broader participation from member organizations that do not normally send as many staff to attend in person. By all accounts, the MSRL meeting was a tremendous success.

AGL Holds Highly Successful Annual Review

The Bureau of Economic Geology's Applied Geodynamics Laboratory (AGL) held its 32nd Annual Review Meeting in November, and by all accounts, it was very successful. Like all large Bureau meetings happening during the time of COVID-19, it was held virtually—a format that allowed for 385 interested people from around the world to join in.

Those who logged in were treated to a broad and informative series of sessions. There were 30 presentations by 16 different presenters, and the topics included salt tectonics in the Gulf of Mexico, Pyrenees Mountains, Atlas Mountains, and the North Sea. Participants were able to examine physical models, geomechanical models, and seismic models. A new theme for the AGL is the study of shale tectonics, and the meeting included 10 instructive presentations on the topic.

Membership opportunities are available for organizations hoping to participate in the groundbreaking salt tectonics research of the Applied Geodynamics Laboratory.

TexNet Annual Review

In December, TexNet and the Center for Integrated Seismicity Research (CISR) held a virtual joint Annual Review of activities, research results, and future plans. Over 120 state agency representatives, university partners, and industry scientists participated and heard vital reports about the latest findings in Texas seismic activity.

Although some once-active areas of the state have recently seen a reduction in earthquakes, TexNet-CISR are focused on researching ongoing low-level seismic activity in key areas, including the Midland and Delaware Basins of West Texas and the Eagle Ford play of South Texas. Overarching research questions include understanding earthquake activity, understanding causal factors, understanding impacts, and enabling mitigation.

Annual Review presentations covered a wide range of topics, from poroelastic models for fault reactivation, to integrating seismologic analysis with geological characterizations, to the hydrodynamics of deep saltwater disposal. New capabilities and improved techniques were also discussed.

The Texas State Legislature created and continues to support TexNet and its continuing operation as one of the premier state seismological networks in the U.S. The Center for Integrated Seismicity Research leads teams of expert scientists from the Bureau of Economic Geology and institutions across the state in tackling crucial research challenges as they relate to Texas earthquake activity.

TexNet seismometers placed throughout the state, like this one in Dallas, monitor seismic activity across Texas.

Honors

AEC Team Wins Best Paper Award


Mohsen Ahmadian


David Chapman

Mohsen Ahmadian and **David Chapman** of the Bureau's Advanced Energy Consortium (AEC) coauthored a groundbreaking paper which won the 2019 Best Paper of the Year Award from the Journal of Environmental and Engineering Geophysics in February of this year. The paper, "Power density distribution in subsurface fractures due to an energized steel well-casing source," explores a completely new concept for supplying power to subsurface nanosensors. The study team was created out of a collaboration with Sandia National Laboratories, which also funded the study.

Simulations indicate that a combination of steel wellbore casing and electromagnetic (EM) additives could supply continuous electrical power to embedded nanosensors previously deployed during well completion. These sensors would then be able to communicate measured data back up the wellbore to operators—even decades after deployment. The models also counterintuitively indicate that the electrical charge from the casing could propagate through the EM proppant, with higher energy density at the tips of any filled fractures.

The Journal of Environmental and Engineering Geophysics' Best Paper of the Year Award "acknowledges significant and ongoing contributions to the discipline of environmental and engineering geophysics." This paper is one of a great number of research papers authored by AEC scientists from around the world who have been studying nanotechnology over the last decade.

AAPG Best Paper Award: Peter Hennings


Peter Hennings

In June, **Peter Hennings** was selected by the American Association of Petroleum Geologists (AAPG) Division of Environmental Geosciences (DEG) to receive the DEG Best Paper Award for his oral presentation titled "The Geology of Active Earthquake Sequences in Texas." Hennings' presentation, given at the AAPG Annual Conference and Exhibition in 2019, stood out for the high scores and remarks it received from judges.

The presentation discussed recent earthquake data gathered by the TexNet Earthquake Monitoring Network and provided an overview of TexNet's strides in interpreting the seismicity of local and regional areas with earthquake activity. Each area is unique in its geologic setting, history of industry activity, and history of earthquake sequences. Comparing data from each of these areas provides researchers with insights into the causes of earthquakes and what can be done to mitigate hazards.

In addition to Hennings, the TexNet team behind the presentation included **Alexandros Savvaidis, Jean-Philippe Nicot, Peter Eichhubl,** Casee Lemons, **Katie Smye, Lily Horne, Robin Dommisse,** and **Owen Callahan**.

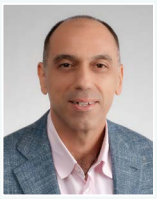
Robert Mitchum Award: Jinyu Zhang


Jinyu Zhang

Bureau researcher **Jinyu Zhang** was awarded the 2020 Robert Mitchum Award for his 2019 paper "Can sediment supply variations create sequences? Insights from stratigraphic forward modelling," which appeared in the journal Basin Research.

The Robert Mitchum Award is presented to the author(s) of the best paper published in Basin Research in the calendar year preceding the award. The paper must meet high scientific standards and should represent a significant contribution to one or more of the disciplines represented by that journal.

TexNet Research Among Top 10% Most Downloaded Papers from JGR Solid Earth


Alexandros Savvaidis

In May, Bureau researcher and TexNet principal investigator **Alexandros Savvaidis** was informed by the Journal of Geophysical Research: Solid Earth (JGR) that his October 2019 paper is among the journal's top 10% most downloaded papers in recent publication history. JGR determines this milestone by reviewing which papers published during a 2-year period receive the most downloads within 12 months of their publication. Savvaidis' work has achieved this distinction despite having been published for only about 7 months at the time of his recognition in May.

Savvaidis' paper, titled "Improving Absolute Earthquake Location in West Texas Using Probabilistic, Proxy Ground-Truth Station Corrections," discusses his work in improving the accuracy of earthquake location monitoring by statistically associating earthquakes with fracturing activity—a cause of human-induced earthquakes. Known locations of fracturing activity are used as proxy ground-truth events to calculate the seismic network. Accurately determining the location and depth of seismic events is critical to monitoring earthquakes and the threat they pose to public safety and infrastructure.

Staff Service Award

Each year, Bureau leadership considers which staff member has had the greatest impact on the organization's operations and success. Throughout all of the disruptions and difficulties of 2020 caused by COVID-19, one vital member of the staff was instrumental in holding things together: **Kim LaValley**.


Kim LaValley

Like the eye of a hurricane, LaValley was calm and collected as a host of problems and new challenges swirled around her. Amidst all the turmoil, LaValley was instrumental in facilitating new safety protocols and building modifications, assuaging the concerns of administrative and other staff, and bringing basic Bureau functions back to a level of normalcy. For her invaluable work, the Bureau is proud to announce Kim LaValley as the winner of the 2020 Staff Service Award.

"Kim is the heart and soul of the Bureau," noted **Jay Kipper**, Associate Director for Operations. "She makes the place run on a daily basis and combines a sense of optimism and professionalism that we all benefit from."

Publication Awards

Although leaders and researchers of the Bureau could not dine together this year to celebrate the annual First Author Publication Awards, they recognized another fruitful year of impactful publications—the Bureau's most vital product. Leadership applauds the 48 Bureau first authors of peer-reviewed papers published in 2019. Last year, Bureau researchers published 135 peer-reviewed papers, first-authoring 63 of these and coauthoring another 22 first-authored by their graduate students.

The highlight of the First Author Publication Awards was the presentation of the Tinker Family BEG Publication Award, "given in recognition of an exemplary publication of demonstrated or expected scientific or economic impact, or that otherwise increases the visibility of the Bureau scientific community."

This year, **Vanessa Nuñez-López**, along with coauthors **Ramón Gil-Egui, Seyyed Hosseini,** and **Emily Moskal**, received the award for "Environmental and operational performance of CO_2-EOR as a CCUS technology: a Cranfield example with dynamic LCA considerations" (coauthored by Gil-Egui and Hosseini) and "Potential of CO_2-EOR for near-term decarbonization" (coauthored by Moskal). These papers represent exemplary publications of societal relevance to carbon management. Runners-up were **Sahar Bakhshian** and **Seyyed Hosseini, Zoltán Sylvester** and **Jacob Covault,** and **Qian Yang** and **Bridget Scanlon**.

Former Bureau Postdoc Awarded the Karcher Award

Xinming Wu, a former Bureau postdoc from 2016 to 2019, was awarded the 2020 J. Clarence Karcher Award by the Society of Exploration Geophysicists. This is a highly prestigious and competitive award given " in recognition of significant contributions to the science and technology of exploration geophysics by a young geophysicist of outstanding abilities who, in the unanimous opinion of the Honors and Awards Committee and the Board of Directors, merits such recognition."


Xinming Wu

Wu worked with **Sergey Fomel** during his time at the Bureau and is the third of Fomel's postdocs to get the Karcher award in the last 3 years. Tieyuan Zhu, now an assistant professor of geophysics at Pennsylvania State University, received one in 2018, and Hejun Zhu, currently an assistant professor at The University of Texas at Dallas, received another in 2019. Wu is now at the University of Science and Technology of China, where he continues to collaborate with Fomel.


Sergey Fomel


(Left to right) Vanessa Nuñez-López, Ramón Gil-Egui, Seyyed Hosseini, Emily Moskal, Sahar Bakhshian, Zoltán Sylvester, Jacob Covault, Qian Yang, and Bridget Scanlon.

Outreach

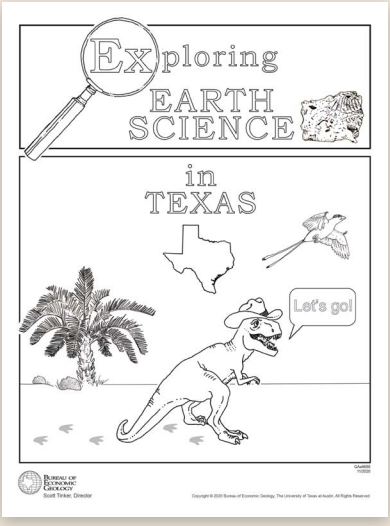
Austin Earth Science *Zoomerama*!

For the past 20 years, professional presenters have provided face-to-face interaction between students and geoscientists during the Bureau of Economic Geology's annual Austin Earth Science Week Career Day. This year's pandemic didn't stop the Bureau from continuing to support students, teachers, and parents. In October, Bureau staff came together to put on Austin Earth Science *Zoomerama*, a series of educational video conferences aimed at middle and high-school students. Led by Bureau Information Geologist **Linda Ruiz McCall** and featuring appearances by Scott Tinker, Mark Blount, Tiffany Caudle, and a team of students from the Gulf Coast Carbon Center, as well as professionals from industry, government agencies, geological societies, non-profits, and the Bureau's academic partners, *Zoomerama* was a great hit.

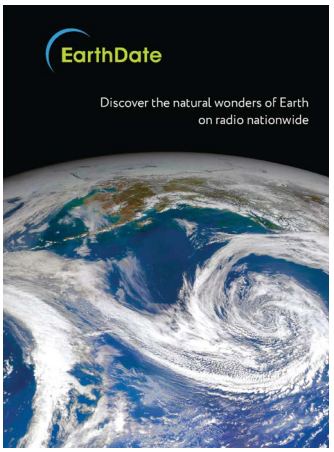
Media Team staff came together to provide resources and support for ***Zoomerama***. **Adam Kirk** and Paula Beard designed and launched the Zoomerama website, and **Francine Mastrangelo** illustrated a coloring book. Emily Harris provided further website support and partnered up with researcher **Aaron Averett** to make the Zoom recordings available on the Bureau's YouTube channel.

New Outreach Publication: *Exploring Earth Science in Texas*

Exploring Earth Science in Texas is a new outreach publication for school children that includes many of the concepts that are required for middle school students and is intended to reinforce classroom lessons in Earth science. This 15-page coloring book, authored by **Linda Ruiz McCall** and illustrated by **Francine Mastrangelo**, is available in The Bureau Store as a free digital download and a low-cost printed publication.



EarthDate Now Reaching Fans on 400 Stations



On April 22, 2017, ***EarthDate***, the Bureau of Economic Geology's weekly Earth science radio program, premiered at that year's Earth Day celebration in Dallas, Texas. After just over 3 years, ***EarthDate*** is aired on 400 radio stations, reaching listeners in every state across the United States and in cities throughout Canada, New Zealand, and the Philippines. Its catalog of 192 episodes explores everything from major geological events of the past to prehistoric life to current weather and natural phenomena. The episodes are accompanied by cost-free background materials that are utilized by thousands of parents, teachers, and students across the country. Each episode and its background materials can be downloaded from *EarthDate.org*.

"To reach 400 radio stations in all 50 states in just a few years is phenomenal," said **Scott W. Tinker**, Bureau director and the creator and host of ***EarthDate***. "It speaks to the public demand for non-partisan, entertaining stories about science and our world."

Dr. Tinker's original concept was to create an easily understandable and accessible series of 2-minute audio vignettes which would open the scientific wonders of our planet to a broad audience of curious listeners. Tinker teamed with award-winning film and media director Harry Lynch, recording specialist Shayna Brown, radio station coordinator Casey Walker, and a crew of Bureau staff including **Juli Hennings**, **Mark Blount**, **Jamie Coggin**, Emily Harris, and **Adam Kirk**. Together, the ***EarthDate*** team has created a high-quality, highly entertaining, and thoroughly informative body of work.

Recently, things came full-circle in a way when *EarthX*, the principal organizer of the annual Earth Day activities in Dallas, generously joined the ***EarthDate*** team as its underwriting sponsor. The mission of ***EarthX*** is to bring people together in building a sustainable future.

(Left to right) Scott Tinker, Juli Hennings, Mark Blount, Jamie Coggin, Emily Harris, and Adam Kirk.

Dallas Dunlap teaches topographic maps using the Bureau's new augmented reality sandbox.

Linda Ruiz McCall teaches the scouts about surface water/groundwater interactions.

Nathan Ivicic shows the scouts core samples.

Allan Standen show the scouts his beautiful collection of minerals and fossils.

Boy Scout Troop Visits the Bureau

Boy Scout Troop 31 paid a visit to the Bureau of Economic Geology in February, where they were hosted by Bureau staff and volunteers. The Bureau's Information Geologist, **Linda Ruiz McCall**, and research scientist and Scout leader, **David Carr**, led the troop through an educational experience designed to help the scouts learn about careers in geoscience and earn their Geology Merit Badges.

The scouts participated in a number of hands-on activities, such as an exploration of fossils and minerals with volunteer Allan Standen, an interactive presentation with the Bureau's new Augmented Reality Sandbox with **Dallas Dunlap**, and a demonstration of groundwater/surface-water interactions.

Vanessa Nuñez-López and **Margaret Murakami** spoke to the scouts about carbon capture and led them through a series of activities developed by the Gulf Coast Carbon Center. Each of the presenters also spoke to the troop about careers in geology.

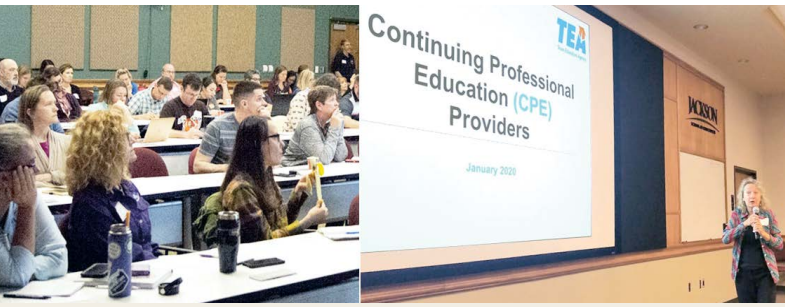
The troop ended their visit to the Bureau with a trip to the newly renovated Austin Core Research Center (CRC), where **Nathan Ivicic** explained the value to science of archiving core samples. Highlights of the troop's visit to the CRC included a walk through the research center entrance which boasts a display of fossil dinosaur casts from the Jackson School of Geoscience's Vertebrate Paleontology Laboratory, followed by an educational and energetic tour through the Stoneburner Family Rock Garden. The scouts left the Bureau with a new understanding of careers in geology and the tools for understanding geological processes important to everyday life.

Vanessa Nuñez-López and Margaret Murakami teach the scouts about carbon capture.

Boy Scout Troup 31 with Linda Ruiz McCall, Nathan Ivicic, David Carr, and Harold Rogers tour the Stoneburner Family Garden.

Bureau Hosts Educational Conference

On January 10, the Bureau of Economic Geology hosted the Texas Environmental Education Advisory Committee (TEEAC) Annual Providers' Meeting. Attendees included approximately 80 representatives from museums, universities, state agencies, zoos, and nature centers across Texas. TEEAC Providers assist the Texas Education Agency (TEA) by offering workshops for teachers and experiences for students that correlate with the Texas Essential Knowledge and Skills standards. These workshops include hands-on laboratory and field experiences. The meeting was organized by TEEAC Chair Kiki Corry of Texas Parks and Wildlife and Statewide Science Coordinator Irene Pickhardt of the TEA Curriculum Division.



Irene Pickhardt, statewide science coordinator of the TEA Curriculum Division (right), addresses TEEAC meeting attendees.

Bureau Information Geologist **Linda Ruiz McCall** welcomed the group and congratulated them on the critical role they play in educating students, teachers, and families about natural resources and good stewardship practices. **Mark Blount**, Bureau External Affairs lead, spoke to the group about the Bureau's newest public outreach publication, *Great Places to View Texas Geology*, which features outdoor locations to view the geologic wonders of Texas. Several TEA members, including Luis Salinas, Monica Brewer, Viviana Lopez, Joe Cisneros, and Kim Brannan, provided updates on the latest TEA initiatives. The attendees left with information and a network of contacts useful for their future work.

CAST and GEOFORCE TEXAS

The Bureau of Economic Geology has a long-standing commitment to supporting Texas educators at the Conference for the Advancement of Science Teaching (CAST) and the Jackson School's GeoForce summer academies for high school students. In 2020, both of these programs were held remotely. **Linda Ruiz McCall** presented to a group of educators attending CAST, and **Tiffany Caudle** lead a virtual field trip for ninth-grade students in June.

Images courtesy of the *Switch* Energy Alliance and Arcos Films.

New Documentary *Switch On*

For much of the past 2 years, Bureau of Economic Geology Director **Scott W. Tinker** has been traveling the world to film a crucial documentary that illustrates the crisis of energy poverty. Some 2.5 billion people live in some form of energy poverty today. Access to secure energy impacts all other major humanitarian issues, including hunger, shelter, clean water, education, healthcare, human migration, empowerment of women, and more. Those who do not have energy access suffer from energy poverty.

With partner and Emmy-winning filmmaker Harry Lynch, Tinker has produced ***Switch On***, a new film which examines the very human story of energy poverty to raise awareness of this global problem. They traveled to rural villages and urban slums in Colombia, Nepal, Kenya, Vietnam, and Ethiopia to discover some of the creative approaches being deployed to bring electricity, water pumps, cook stoves, and irrigation to those with no energy. ***Switch On*** builds on the remarkable popularity of Tinker and Lynch's award-winning global energy film, ***Switch***.

"Energy poverty is pervasive," Tinker said. "Eradicating it will impact the whole world in countless positive ways. It's not just the right thing to do. It's the only thing to do."

For more information about ***Switch On***, visit *SwitchOn.org*, and to help end energy poverty, contact the Switch Energy Alliance at info@switchenergyalliance.org.

Research Consortia

Research Partnerships *with the Bureau of Economic Geology*

The Bureau of Economic Geology conducts objective, impactful, and integrated geoscience research on subjects of high interest to a broad spectrum of stakeholders including energy and environmental firms, government agencies, and the scientific community which actively participate in its 13 research consortia. Each consortium was designed to complement partner efforts to explain a key exploration, production, environmental, and/or economic problem. Participation is on a subscription basis. Member benefits vary, but generally include first-look privileges at research outcomes, access to research teams, invitations to annual review meetings, and individual meetings with researchers for presentation and dialogue. Members also benefit from interactions with counterparts in fellow member organizations. Each Bureau research consortium has a dedicated team of full-time Bureau researchers. Many of them host talented graduate students, with the teams combining seasoned experts and early career specialists. Experienced and effective principal investigators lead each consortium.

Contact the PI of any program of interest to you. For further information about these research consortia, and the breadth of your organization's engagment with the Bureau, please contact us at www.beg.utexas.edu or by phone at 512-471-1534. Download the consortia brochure: http://www.beg.utexas.edu/about/reports-and-information.

Access to Water and Energy

Mission

Our mission is to understand and provide sustainable and economical options to decrease energy and water poverty in geographically specific communities, most of them located in developing countries. The Access to Water and Energy (AWE) consortium will conduct scientific research that identifies potential resources and develops fundamental data and knowledge for modeling and data analytics that meet this mission and maximize positive impact on people's lives.

Research Thrusts

The AWE consortium has a wide-reaching research agenda that will investigate both U.S. and global resources. Research thrusts include: analyzing optimal energy-option scenarios for a defined community, city, country, or continent; investigating how mobile phone technology can be used to capture, monitor, and model energy and water use to ensure sustainable groundwater development; understanding how to build distributed water systems for communities in the U.S. with no water access; examining the role of liquefied petroleum gas (LPG) in reducing energy poverty in specific Southeast Asian countries; assessing how China, India, and other major economies can accelerate away from coal toward other energy options; and determining how AWE can leverage contributions and experience from oil and gas companies to address energy and water poverty.

Research Challenges

Research challenges of the AWE consortium include: improving synergy through cross-disciplinary collaboration and knowledge sharing; empowering local communities with actionable solutions by focusing research on specific case studies; enabling networking and facilitating knowledge-sharing among local governments, technology providers and investors; and promoting user-friendly, open-access educational programs for public engagement, informed decision making, and organized outreach work.

Membership

The membership fee for the consortium is $30,000 per year.

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Advanced Energy Consortium

Mission

Our mission is to illuminate the subsurface reservoir using novel micro- and nanosensing technology developed collaboratively with Advanced Energy Consortium (AEC) members and the global community.

Research Thrusts

Over the past decade, the AEC has played a significant role in enabling nanotechnology solutions for the oil and gas industry. In collaboration with our member companies and researchers, the consortium has evolved from fundamental research at individual university labs into a set of integrated, multi-component, and multi-institutional applied research programs transforming the technology of subsurface monitoring and creating exciting field demonstrations to validate our technology in 2020. The AEC's "reach" has extended far beyond simply oil and gas applications and now encompasses a broader spectrum of alternative energy and environmental applications.

Research Challenges

In the decade since its inception, the Advanced Energy Consortium has progressed nanotechnology from fundamental to applied research and is now targeting commercial applications such as precise reservoir imaging of hydraulic fracture networks using electromagnetic contrast agents; microsensor data logging in wellbores, pipelines, and other infrastructure; and targeted payload deliveries in a host of environments.

Membership

Now is truly an excellent time to be a part of the AEC family. AEC research revenues are increasing as we attract new members. Our level of innovation remains unsurpassed, and we are a recognized leader in nanotechnology research. We invite companies who are ready to transform the future of the energy industry to talk with us about empowering people and protecting the environment using advanced technology.

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Applied Geodynamics Laboratory

Mission

Pure and applied research in salt tectonics has been a strong component of the Bureau's research program since the late 1970's. At the heart of this research is the Applied Geodynamics Laboratory (AGL), an industry-funded consortium dedicated to producing innovative concepts in salt tectonics. Research comprises a mix of physical and mathematical modeling, seismic- and field-based mapping, and structural-stratigraphic analysis of some of the world's most spectacular salt basins—including those of the Gulf of Mexico, West Africa, Brazil, the Mediterranean, and the Canadian High Arctic. AGL research has also been applied extraterrestrially to Mars and Triton.

Research Thrusts

Concepts and terminology pioneered by the AGL over the past quarter-century have profoundly influenced salt tectonics and are now widely disseminated throughout the oil industry. The AGL strives to effectively communicate these results via a variety of media, including Salt Tectonics: Principles and Practice, the leading textbook on the subject in the world.

Research Challenges

The primary goals of the AGL are to develop a conceptual framework for the full range of salt tectonics; to analyze connections among physical models, mathematical models, seismic datasets, and field examples from all over the world; and to disseminate complex technical information to a constantly shifting spectrum of industrial and academic supporters. Areas of focus include salt weld; salt canopy; reactive, falling, and squeezed diapirs; shape of passive diapirs and sheets; fault families (with the University of Colorado); extrusive salt sheets (with BP and ExxonMobil); extensional turtle and mock turtle; mechanics of salt-sheet advance; the origins of minibasins; intrusive salt plumes; and salt sutures.

Membership

The 29 supporting companies of the AGL include a wide range of industry partners from around the world.

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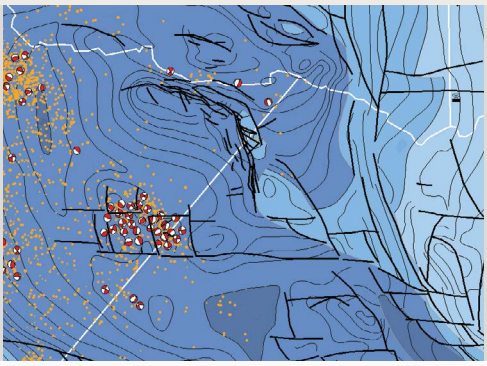
Center for Integrated Seismicity Research



Mission

The Center for Integrated Seismicity Research (CISR) is a multidisciplinary, intercollegiate research consortium managed by the Bureau. TexNet and CISR are two parts of a whole; the former is the State-funded network of seismometers across Texas that conducts research into earthquake causation in key areas. With its industry partnerships, CISR significantly extends and deepens the scope of research and monitoring toward an understanding of the processes that influence seismicity, quantification of hazards, and improvement of standards of practice for mitigation.

Research Thrusts

CISR conducts fundamental and applied research to better explain seismicity of all causes and its associated hazards. CISR brings together UT researchers from the Bureau; the Institute for Geophysics; the Department of Petroleum and Geosystems Engineering; and the Department of Civil, Architectural, and Environmental Engineering. Southern Methodist University, UT El Paso, Texas A&M University, the University of Houston, UT Dallas, and Stanford University are also contributing research partners.

Research Challenges

Over the past decade, the rate of seismicity in the south-central United States has increased markedly, especially in unconventional play areas where water management and sustainable development are increasingly important challenges. Understanding the interplay between complex operational drivers and interdependent subsurface physical processes is a daunting challenge that the Bureau is pursuing head-on.

Membership

Most of the major energy companies that operate in Texas unconventional plays are CISR members. Each company has one member who serves on the CISR Advisory Committee, which meets quarterly to discuss the design and application of TexNet–CISR research. Member companies are encouraged to assist with identification of land parcels that can be used for seismic monitoring and to contribute proprietary data and information that can guide and advance CISR research. Proprietary data are protected by UT Austin's strong intellectual property controls.

Contact:

Dr. Peter Hennings, PI—Subsurface Integration and Ind. Liaison
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http://www.beg.utexas.edu/texnet-cisr

Fracture Research and Application Consortium

Mission

Fracture research at The University of Texas at Austin seeks fundamental understanding of fracture processes with the aim of finding new geological, geophysical, and engineering methods to explain and successfully predict, characterize, and simulate reservoir-scale structures. The research is both fundamental and practical, aiming at improving prediction and diagnosis of fracture attributes in hydrocarbon reservoirs and accurately simulating their influence on production. Research is organized around the Fracture Research and Application Consortium (FRAC), conducted together with scientists from member companies. Students are an important part of our program.

Research Thrusts

Accurate prediction and characterization of fractures hold great potential for improving production by increasing the success and efficiency of exploration and recovery processes. New analytical methods produce data that can enhance well-test and seismic interpretations and can be used in reservoir simulators. We are developing new and more-reliable methods to predict hydraulic fracture propagation in naturally fractured and unconventional reservoirs.

Research Challenges

Faults and fractures are difficult or impossible to characterize adequately using currently available technology. Fractures have been challenging to sample and model, posing serious challenges to exploration and development. Our approach is helping to overcome the limitations of current methods.

Membership

Training in techniques, software, and our workflow is a benefit of membership. Annual meetings cover measurement, interpretation, prediction, and simulation of fractures and mechanical properties in carbonate rocks, mudstones, and sandstones.

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Dr. Julia F. W. Gale
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Dr. Jon E. Olson
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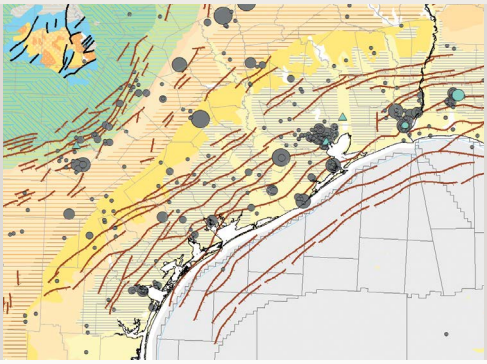
http://www.jsg.utexas.edu/sdi/

Gulf Coast Carbon Center



Mission

The Gulf Coast Carbon Center (GCCC) conducts research and outreach in geologic storage technologies used to reduce emissions of carbon dioxide (CO_2). Carbon dioxide produced by combustion of fossil fuels and by other industrial processes is captured and injected into porous rocks at locations where it is stored.

Research Thrusts

GCCC research into large-volume CO_2 storage (1) improves structural and stratigraphic characterization methods and simulation approaches to identify suitable locations and increase confidence in the technologies; (2) creates workflows for characterization at the basin scale that prepare multiple sites to be operated at maximum injection rates and over prolonged time periods; and (3) assesses storage resources in offshore subsea settings in the Gulf of Mexico and globally. CO_2–enhanced oil recovery (EOR) research helps to assess (1) the best methods and economic usage of CO_2 for EOR in various traditional and novel settings and (2) the intersection of economic value with storage value. Together, this information develops a transparent life cycle that accounts for storage and EOR.

Research Challenges

Carbon capture and storage (CCS) deployment is not happening at the rate and scale needed to achieve emissions reduction goals. Many influential stakeholders, from industrial investors to policymakers to journalists, do not have the information needed to see the critical role of CCS in attaining these goals and the viability of CCS.

Membership

Members meet twice a year, sometimes jointly with other related groups, and receive a quarterly newsletter.

Contact:

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Dr. Tip Meckel
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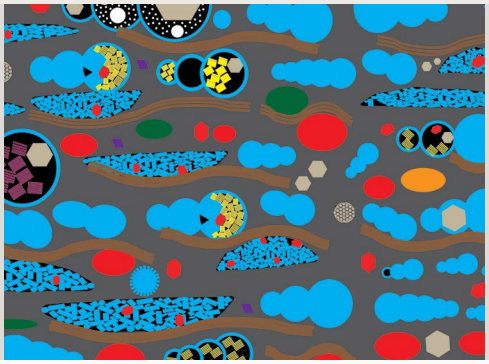
Mudrock Systems Research Laboratory



Mission

The Bureau's Mudrock Systems Research Laboratory (MSRL) program brings together a broad spectrum of research expertise necessary to confront the complicated, multidisciplinary questions key to a better understanding of mudrock systems. The goal of the program is to integrate observations and data from all scales, ranging from nanoscale to basin scale. Only through this kind of integrated analysis can the multiscalar heterogeneities of mudrocks be effectively characterized and models leading to better predictions of reservoir quality be developed.

Research Thrusts

MSRL research activities include the following: field emission scanning electron microscope study of pore architecture, grain types, and diagenesis; analysis of mechanical properties; application of X-ray fluorescence and isotope geochemistry to better define facies and their continuity; delineation and modeling of regional and local trends in depositional and diagenetic facies distribution; development of more-accurate ways to determine porosity, permeability, and flow; critical appraisal of conventional methods of mudrock-analysis techniques; and core-based calibration of borehole geophysical logs for facies mapping.

Research Challenges

Despite their abundance in Earth's crust, mudrocks are not as well understood as other reservoir systems. The current explosion of interest in a better understanding of these rocks stems from the need to devise more-efficient ways of extracting oil and gas from these reservoirs. Our challenge is to develop new methodologies for characterizing these rocks and the fluids they contain. We are meeting this challenge by carrying out integrated studies of rock and fluid attributes on high-precision, high-resolution instruments operated by MSRL researchers.

Membership

Consortium members receive priority access to research data, interpretations, and reports. Results are distributed to members through annual workshops, seminars, field trips, short courses, and the web.

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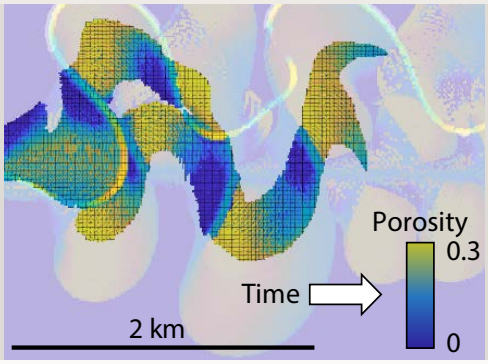
Quantitative Clastics Laboratory



Mission

The mission of the Quantitative Clastics Laboratory (QCL) is to develop a predictive understanding of processes and controls on sediment transport and the stratigraphic evolution of depositional systems, with applications in reservoir characterization, modeling, correlation, and source-to-sink predictions for frontier exploration.

Research Thrusts

The QCL leverages the broad, world-class expertise of the Jackson School of Geosciences (JSG)—including collaborations with groups specializing in structural geology, Texas and Gulf of Mexico depositional syntheses, seismic interpretation, and thermochronology—to address key challenges in the exploration and development of natural resources. These challenges include evaluation of reservoir presence and quality in data-limited frontier basins and characterization of reservoir connectivity and heterogeneity. The QCL has unique clastic research consortia access to industry subsurface data, including global seismic-reflection datasets and Bureau core repositories.

Research Challenges

The QCL has two research themes: (1) reservoir-scale depositional system characterization, modeling, and flow simulation for a better understanding of processes that impact connectivity and heterogeneity and (2) exploration-scale source-to-sink analysis to evaluate correlation, reservoir presence, and quality in the petroliferous Permian Basin and circum–Gulf of Mexico. An exciting update to the QCL program is flow-diagnostics analysis of digital stratigraphic models for evaluating the effect of stratigraphic evolution and facies architecture on fluid flow during production.

Membership

Multiple meetings, workshops, and face-to-face consultations with industry members are held annually. The QCL offers industry members unique access to JSG expertise, industry subsurface data, multiscalar investigations of depositional environments and their interconnections, and an evolving quantitative database on clastic depositional systems architecture.

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Reservoir Characterization Research Laboratory

Mission

The Reservoir Characterization Research Laboratory's (RCRL) mission is to use outcrop and subsurface geologic, geophysical, and petrophysical data from carbonate reservoir strata as the basis for developing new and integrated methodologies and concepts to explain and describe the 3D reservoir environment and to improve hydrocarbon recovery factors. In addition, the RCRL is dedicated to technology transfer and education and consistently offers state-of-the-art training, such as short courses, field seminars, in-company reviews of assets, and extensive student supervision and guided research.

Research Thrusts

The RCRL approaches reservoir characterization through four main scales of investigation: (1) platform-to-basin-scale stratigraphy; (2) reservoir architecture, including both matrix and non-matrix systems (e.g., fractures and paleokarst); (3) structural and geomechanical properties characterization; and (4) pore networks and their reservoir distribution. Research questions are developed using both subsurface data and outcrop analogs. The RCRL emphasizes quantifying observations so that its research is applicable to reservoir models and is valuable in providing predictive relationships and conceptual tools for reservoir characterization and play analysis.

Research Challenges

RCRL areas of investigation include Lower Permian shelf-to-basin stratigraphic and structural architecture of the Delaware and Midland Basins; Gulf of Mexico carbonate reservoir settings, pore systems, fracture character, and margin variability; Cenozoic carbonate platform systems, high-resolution stratigraphy, and structural configuration of shelf margins; fractured carbonate reservoir characterization in outcrop and subsurface analogs; origin and petrophysics of tight limestone and dolomite reservoirs; regional reservoir characterization of the Austin Chalk trend; and carbonate rock mechanics and acoustic-properties research.

Membership

RCRL membership is $55,000 per year. Sponsors are encouraged to commit to a 2-year agreement (at $50,000 per year) to better plan a longer-range research program.

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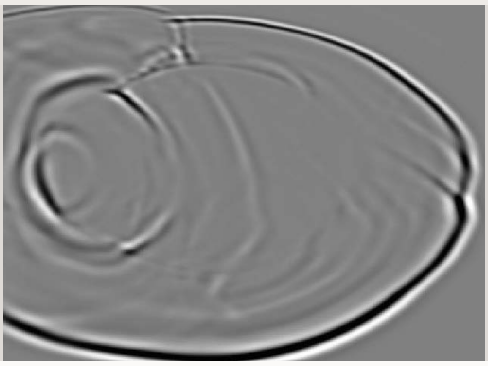
Texas Consortium for Computational Seismology



Mission

The mission of the Texas Consortium for Computational Seismology (TCCS) is to address the most important and challenging research problems in computational geophysics as experienced by the energy industry and to educate the next generation of research geophysicists and computational scientists.

Research Thrusts

TCCS research areas include the following: high-resolution imaging of the Barrolka dataset using diffraction attributes; characterization of fractured shale reservoirs using anelliptic parameters; phase correction of prestack seismic data using local attributes; extraction of seismic events by predictive painting and time warping; low-rank, reverse time migration for subsalt imaging; high-resolution seismic attributes for fracture characterization in the Grosmont Formation; waveform tomography with cost function in the image domain; multiazimuth seismic diffraction imaging for fracture characterization in low-permeability gas formations; and seismic-wave focusing for subsurface imaging and enhanced oil recovery.

Research Challenges

TCCS is a collaboration between the Bureau and the UT Oden Institute for Computational Engineering and Sciences, which is involved in estimating seismic velocities by using full waveform information, identifying the most accurate and efficient seismic imaging algorithms while controlling the trade-off between accuracy and efficiency, increasing the resolution of seismic reservoir characterization, and assisting the seismic interpreter by automating common interpretation and signal-processing tasks.

Membership

TCCS publications follow the discipline of reproducible research: the results of each computational experiment are supplied with the open-source software code required for reproduction and verification.

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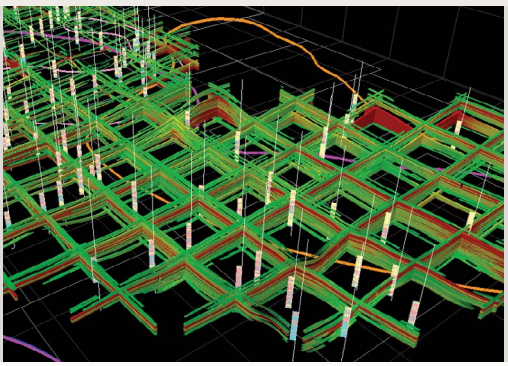
Research Programs

Tight Oil Resource Assessment



Mission

Our mission is to provide our stakeholders with reliable and up-to-date estimates, projections, models, and insights at the basin scale for the major U.S. unconventional plays by conducting innovative, integrated research of in-place resources and recoverable volumes, play/well economics, production forecasts, and environmental implications.

Research Thrusts

TORA employs a multidisciplinary, highly iterative evaluation process. Our approach was developed and refined in a series of Sloan- and DOE-funded studies of several major shale plays: (1) We interpret the stratigraphic framework to create a basin-wide 3D facies architecture of petrophysical-attribute distribution and to calculate in-place resources; (2) we model and match all well-production history before projecting future production, and we perform decline analysis using innovative in-house software; (3) we relate the productivity of existing wells to key subsurface and operational attributes to model the productivity of all undrilled locations; (4) we develop the full range of expected outcomes per well, including technological and cost improvements, pricing, logistics, drilling pace, well attrition, and lease accessibility; and (5) we use digital mapping to spatially link key geologic and operational practices to changes in per-well productivity.

Research Challenges

TORA aims to characterize unconventional reservoirs at the basin scale, building integrated models and market-independent production outlooks. Building on over a century of Bureau Permian research, TORA studies tight oil and gas formations to produce unbiased, comprehensive, publicly available results. Our team employs a newly developed workflow to predict hydrocarbon recoveries, economic viability, and play-wide production rates. Our investigations are basin-scale in scope yet predict productivity, profitability, and future drilling at a 1-mi^2 scale.

Membership

TORA membership is $50,000 annually.

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TexNet Seismic Monitoring Program

Mission

The Bureau's TexNet seismic monitoring program is the State of Texas' earthquake analysis service. Funded by the state, TexNet operates the statewide network of over 150 seismometer stations, capturing vital information on seismic activity across Texas. TexNet hosts a skilled team of scientists and engineers who gather information and research the geologic and seismic data obtained by the network. The team also includes researchers from many public and private universities across the state.

Program Thrusts

TexNet actively monitors earthquake activity across the state of Texas. TexNet members are also working on research in determining the causes of earthquakes and lessening any future impact from these events on people and property. TexNet provides the public with safety information, emergency agencies with earthquake facts important to first responders, public officials with assistance in decision-making regarding earthquake activity, regulatory agencies with solid data to inform policies, industry with information to shape earthquake safety and prevention practices, and researchers with reliable seismic data for answering complex scientific questions.

TexNet Earthquake Catalog

Earthquake data and earthquake monitoring information is now available through the interactive TexNet Earthquake Catalog at www.beg.utexas.edu/texnet-cisr/texnet/earthquake-catalog.

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State of Texas Advanced Oil and Gas Resource Recovery

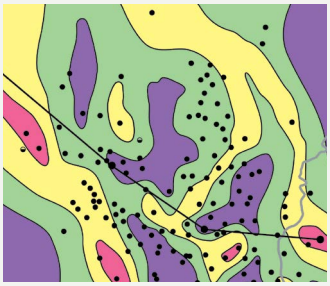
Mission

The mission of the Bureau's State of Texas Advanced Oil and Gas Resource Recovery (STARR) program is to conduct geologic research that increases oil and gas production in the State of Texas. Since its inception in 1996, STARR has helped raise $515.6 million in severance-tax revenues, offsetting Texas' $39.8-million funding investment. In its over 20-year history, STARR has undertaken more than 60 field (reservoir characterization) and 15 regional studies, with over 50 Texas oil and gas operators participating in the program.

Research Thrusts

Research thrusts of the STARR program are applied toward technology transfer to operators in the Texas oil and gas industry in three main areas: (1) integrated geologic characterization studies that employ seismic, core, wireline-log, and petrophysical data for documenting areas with additional oil and gas potential; (2) imaging and characterization of lithology, facies, and micropore systems in unconventional reservoirs; and (3) advanced seismic mapping techniques for imaging potential oil and gas reservoirs.

Research Challenges



The main challenge being undertaken by the STARR group is to explain controls on oil and gas production in Texas reservoirs. Geoscientists at STARR employ a technical approach that emphasizes rock data for better characterizing reservoir quality and continuity—two important factors in determining oil and gas producibility. The STARR group integrates rock-property data in both field and regional-scale projects, drawing upon its extensive core collection at the Bureau.

Membership

No costs are associated with participation in the STARR program, which is funded by the State of Texas, although research matching support is encouraged. STARR partners receive a variety of technical products that include stratigraphic and structural interpretations; facies and depositional-systems analysis from cores, wireline logs, and seismic data; and interpretations of geologic controls on reservoir quality.

Contact:

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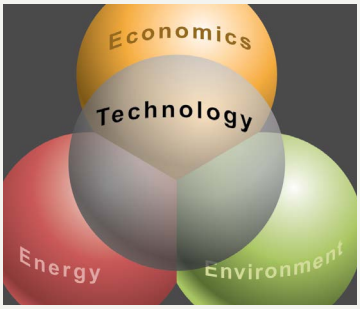
Center for Energy Economics

Mission

Our mission is to provide impactful and data-driven analyses of environmental, economic, and energy issues, applying a sharp focus and a broad perspective. Our goal is to build a solid knowledge system of U.S. and global energy fundamentals to serve as a necessary foundation for collaboration.

Research Thrusts

The Center for Energy Economics (CEE) is working to make an impact by leveraging expertise in geoscience resources, environmental considerations, and economics to address the energy and environmental challenges shared by industry and communities today. Accurate characterization of the relationships between energy production, electricity generation, and economic and environmental impacts holds great potential for improving outcomes for energy producers, local and regional economies, and citizens. The CEE promotes a systems-thinking approach and aims to extend existing expertise to align with market needs.



Research Challenges

Our energy economics research seeks an understanding of the relationships between energy resources and generation, economics, and the environment. Our research aims at establishing a solution-based platform to help stakeholders make well-informed decisions at each of these related nexuses. We are working to investigate the challenges of global unconventional oil and gas, creating a simulator for natural gas markets and infrastructure in North America and globally, determining the risks and opportunities of power integration for oil and gas, creating a Pathfinder Knowledge Framework for sustainable energy transition in Texas, and collaborating with the Access to Water and Energy (AWE) research consortium.

Membership

The CEE is funded by donations from sponsors and welcomes participation from its members in collaboratively developing an impactful research agenda and open, robust partnerships.

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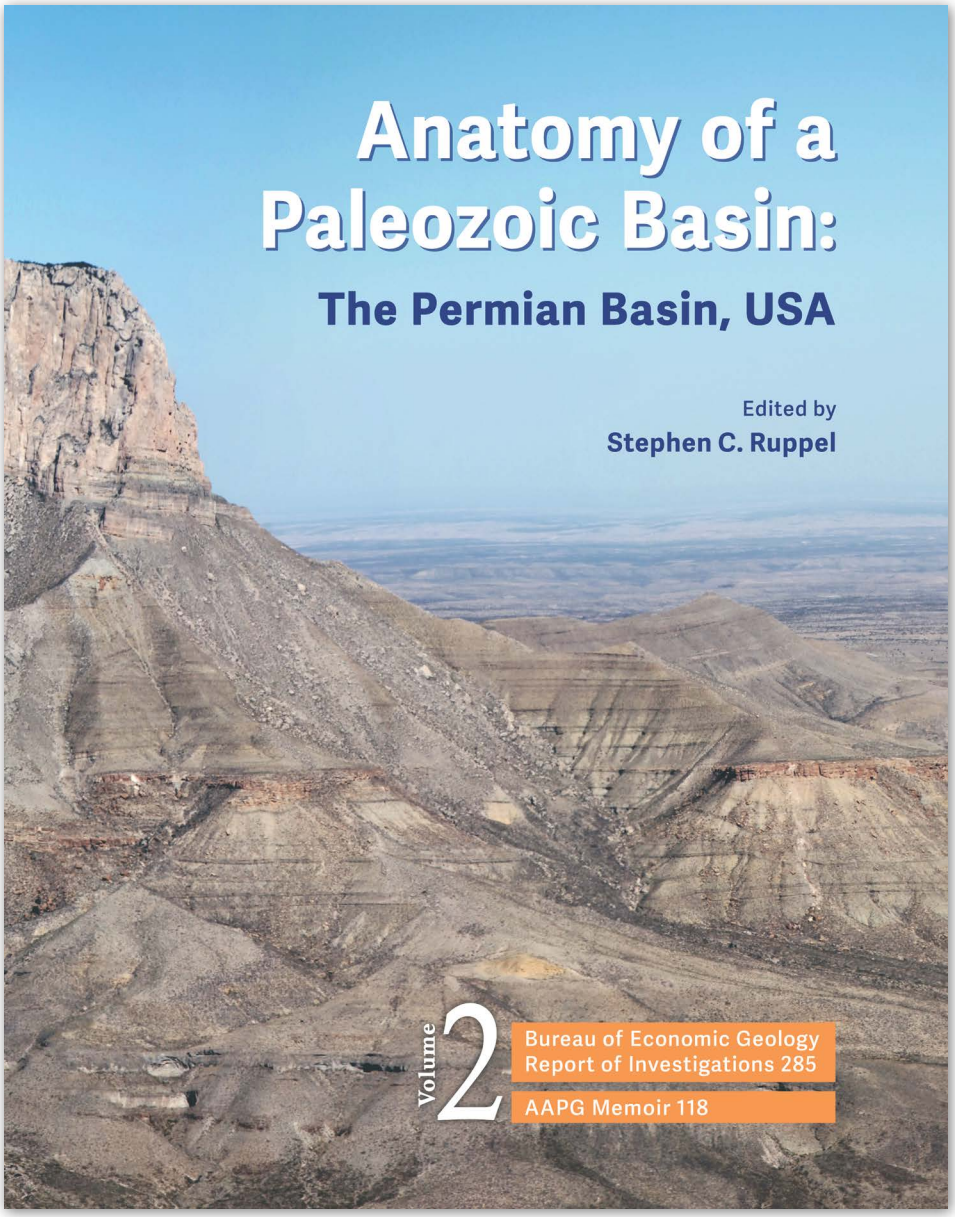
Publications



Anatomy of a Paleozoic Basin: The Permian Basin, USA, Volume 2

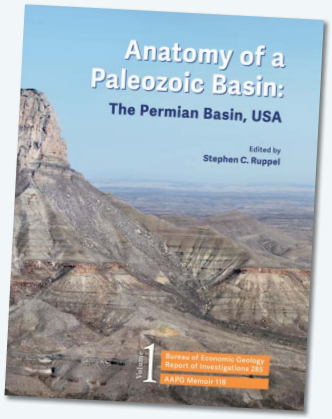
Ruppel, S. C., ed., 2020, Anatomy of a Paleozoic basin: the Permian Basin, USA (vol. 2): The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 285; AAPG Memoir 118, 527 p., doi:10.23867/RI0285-2.

This two-volume set is the first comprehensive analysis of the Permian Basin in more than 60 years. The 26 chapters in the publications cover a breadth of Permian Basin topics, including structural geology, tectonics, and Precambrian geology; paleontology and biostratigraphy; Paleozoic sedimentology and stratigraphy; hydrocarbon production; and a history and synthesis of the major depositional and deformational events that formed the basin during the Paleozoic. Collectively, these chapters provide a spectrum of data and interpretations that characterize one of the largest hydrocarbon-producing basins in the world. This publication will be of interest to all who seek information on the distribution of hydrocarbons in the basin and to those wanting to better understand the evolution of the basin during the Phanerozoic.

Dr. Stephen Ruppel

"The Permian Basin of West Texas is better understood owing to a lifetime of contribution by Dr. Stephen Ruppel. He touched many lives, influenced many people, and will be dearly missed."

—Scott Tinker



Ruppel, S. C., ed., 2019, **Anatomy of a Paleozoic basin: the Permian Basin, USA (vol. 1):** The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 285; AAPG Memoir 118, 412 p., doi:10.23867/RI0285-1.

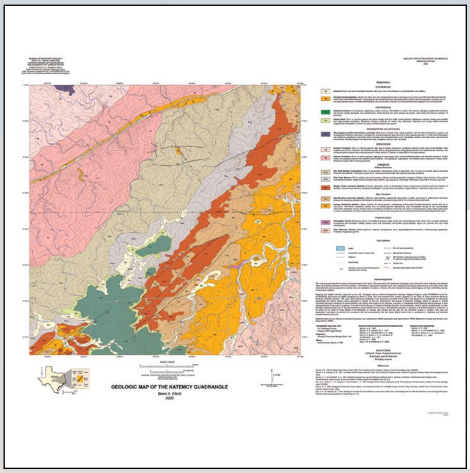
STATEMAP

Bureau of Economic Geology researchers, illustrators, and editors have produced five new geologic maps—the latest in the Bureau's Udden Series—for the most recent installment in the long-running STATEMAP program. STATEMAP is a core element of the National Cooperative Geologic Mapping Program administered by the U.S. Geological Survey. The Bureau's mapping efforts are also supported by the State of Texas Advanced Resource Recovery (STARR) program and the Jackson School of Geosciences, which provide matches that equal the required federal support for the program.

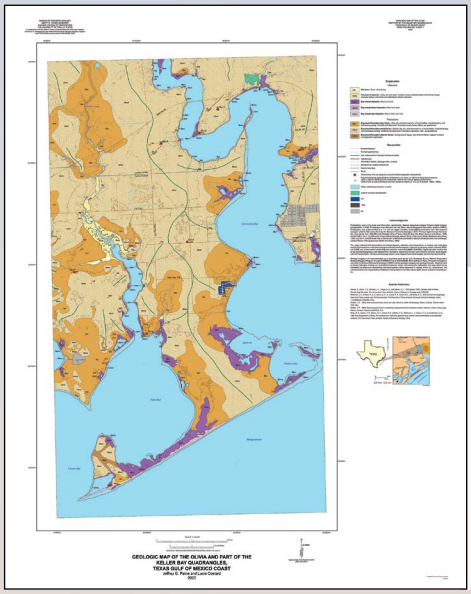
Since STATEMAP began in 1996, geologic maps of 248 quadrangles have been published in the Bureau's Open-File Maps series, along with several peer-reviewed compilation maps in the Miscellaneous Maps series. All maps are available through The Bureau Store.

This year's five new maps include the Lake Stephenson quadrangle in the Galveston Bay area, the Bloomington and Olivia quadrangles in the Matagorda Bay area, and the Taylor and Katemcy quadrangles in central Texas. The coastal quadrangles document the relationships among geologic units deposited and modified during major sea-level changes during repeated glacial and interglacial cycles of the late Pleistocene and Holocene eras. The central Texas quadrangles focus on sand resources for industrial purposes (Katemcy) and on geologic units relevant to rapidly changing land-use patterns in the Central Texas urban growth corridor (Taylor).

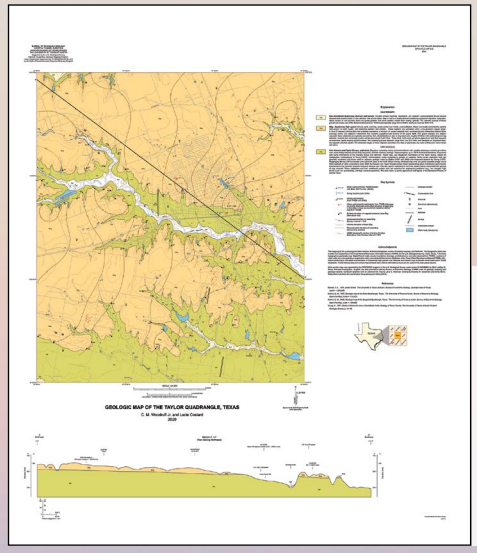
Major contributors to the recent mapping effort include **Tiffany Caudle, Lucie Costard,** Brent Elliott, **Jeff Paine,** and **Chock Woodruff**. Bureau graphics and editing staff **Jana Robinson, Nancy Cottington, Francine Mastrangelo,** Cathy Brown, **Jason Suarez,** and **Amanda Masterson** prepared the maps for publication. No story about the Bureau's STATEMAP program would be complete without mentioning Eddie Collins, whose mapping efforts built the program from its inception to his retirement in 2018. Expanded federal support for the STATEMAP program has also enabled the Bureau to recently hire **Brian Hunt**, an experienced hydrogeologist who will be joining the mapping team to focus on Central Texas mapping projects as well as other hydrogeological studies at the Bureau.



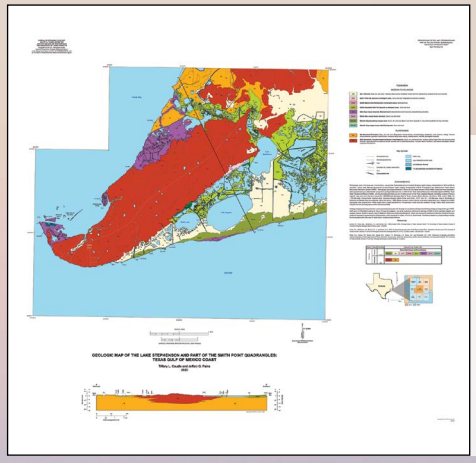
Geologic Map of the Katemcy Quadrangle, Texas
Elliott, B. A., 2020: The University of Texas at Austin, Bureau of Economic Geology Open-File Map No. 244, scale 1:24,000.



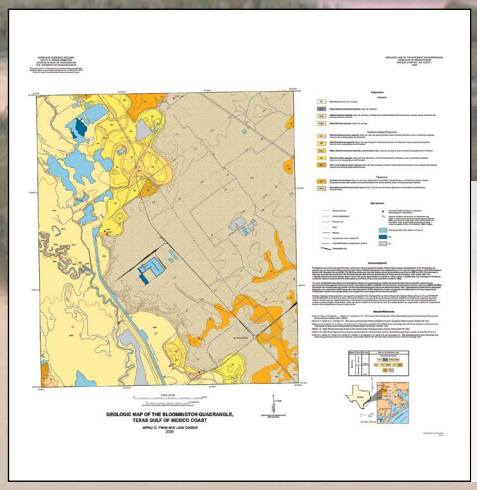
Geologic Map of the Olivia and part of the Keller Bay Quadrangles, Texas Gulf of Mexico Coast
Paine, J. G., and Costard, L., 2020: The University of Texas at Austin, Bureau of Economic Geology Open-File Map No. 247, sheet 1, scale 1:24,000.



Geologic Map of the Taylor Quadrangle, Texas
Woodruff Jr., C. M., and Costard, L., 2020: The University of Texas at Austin, Bureau of Economic Geology Open-File Map No. 245, scale 1:24,000.



Geologic Map of the Lake Stephenson and part of the Smith Point Quadrangles, Texas
Caudle, T. L., and Paine, J. G., 2020: The University of Texas at Austin, Bureau of Economic Geology Open-File Map No. 248, scale 1:24,000.



Geologic Map of the Bloomington Quadrangle, Texas Gulf of Mexico Coast
Paine, J. G., and Costard, L., 2020: The University of Texas at Austin, Bureau of Economic Geology Open-File Map No. 246, sheet 1, scale 1:24,000.

Peer-Reviewed Publications by Bureau Researchers

Abolt, C. J., and Young, M. H., 2020, High-resolution mapping of spatial heterogeneity in ice wedge polygon geomorphology near Prudhoe Bay, Alaska: Scientific Data, v. 7, article no. 87, 7 p., http://doi.org/10.1038/s41597-020-0423-9.

Abolt, C. J., Young, M. H., Atchley, A. L., Harp, D. R., and Coon, E. T., 2020, Feedbacks between surface deformation and permafrost degradation in ice wedge polygons, Arctic Coastal Plain, Alaska: Journal of Geophysical Research: Earth Surface, v. 125, no. 3, article no. e2019JF005349, 17 p., http://doi.org/10.1029/2019JF005349.

Agrawal, D., Lujan, B., Verma, S., Bhattacharya, S., and Mallick, S., 2020, Seismic response to paleo-sand dunes in the Nugget Sandstone Formation, southwestern Wyoming: Interpretation, v. 8, no. 4, p. SR23–SR26, http://doi.org/10.1190/INT-2019-0231.1.

Almansour, A., Laubach, S. E., Bickel, J. E., and Schultz, R. A., 2020, Value-of-information analysis of a fracture prediction method: SPE Reservoir Evaluation & Engineering, v. 23, no. 3, p. 811–823, http://doi.org/10.2118/198906-PA.

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Transitions

New Environmental Associate Director: Dr. Kenneth Wisian

Dr. Kenneth Wisian joined the Bureau as Associate Director of the Environmental Division on May 15. Ken replaces Dr. Michael Young, who decided 2 years ago that he would like to focus again on research. Dr. Young has been an exceptional Associate Director. He joined the Bureau a decade ago, and in this time has led the Environmental Division to grow substantially in quantity of research, breadth of programs, and quality of people.

Before joining the Bureau, Dr. Wisian served as the Executive Director of the Disaster Research Program at The University of Texas at Austin Center for Space Research and as co-investigator of the Department of Energy–funded Geothermal Entrepreneurship Organization, which focuses on accelerating drilling technologies for geothermal energy. After retiring as a Major General from the United States Air Force after 33 years of illustrious service, Dr. Wisian also served as Senior Deputy Director of Coastal Protection & Disaster Recovery at the Texas General Land Office, among other positions. Dr. Wisian holds a Ph.D. in Geophysics from Southern Methodist University, where he studied geothermal systems. He also holds MS degrees in strategic studies and geology and a BS in physics.

Although Dr. Wisian will be replacing Dr. Young, the Bureau is very fortunate to retain Dr. Young in the role of Senior Research Scientist. Consequently, we have not only brought in great new leadership, but also retained a distinguished researcher and administrator, which bodes well for the Bureau as an organization. Please join us in thanking Michael and in welcoming Ken.

New Employees

The Bureau of Economic Geology continues to attract some of the most talented geoscientists in the world to conduct impactful research on a wide range of energy and environmental questions—and equally talented support staff to help them in their efforts. The year 2020 was no exception as the Bureau brought a diverse group of 9 new people on board. Please help us welcome them to the Bureau!

Shuvajit Bhattacharya
Research Associate

Tristan Childress
Research Associate

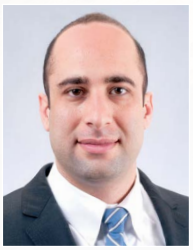
Iason Grigoratos
Postdoctoral Fellow

Emily Harris
Publications Editor

Brian Hunt
Research Scientist Associate IV

Vincent O'Sullivan
Research Scientist Associate II

Juan Soto
Research Scientist



Shayan Tavassoli
Research Associate

Kenneth Wisian
Associate Director

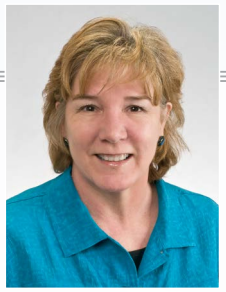
Retirements

The Bureau thanks 2020's retirees for their years of invaluable service and wishes them a happy retirement. They will all be missed!

Paula Beard
Graphic Designer

Scott Hamlin
Research Scientist

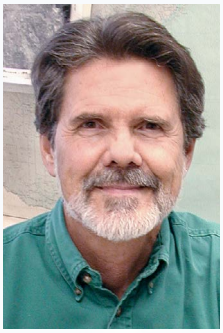
Scott Rodgers
Program Manager



Cathy Brown

If you have ever read one of the Bureau of Economic Geology's Reports of Investigation, enjoyed one of its Annual Reports, searched its comprehensive website, or reviewed one of its beautiful geologic maps, then you have personally experienced the major impact that Cathy Brown had on the Bureau's image and reputation. After 11 years of heading up the Bureau's Media team, Cathy has retired and is looking forward to the next exciting chapter in her life.

Under Cathy's leadership, the Media team produced a vast number of publications and materials—more frequently than not under critical deadlines—that were not only informative but of the very highest quality. She had a keen eye for what was compelling and visually appealing and a unique talent for gleaning necessary information from often-distracted researchers. Her management style and warm sense of humor kept stress levels at a minimum while drawing the very best performance from her accomplished staff. The products of her work have left a legacy of excellence in communication that is admired and respected by Bureau peers and external audiences alike.

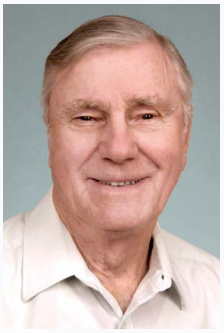


William White

William "Bill" White. It is with great sadness that we report that longtime Bureau of Economic Geology researcher William "Bill" White passed away in September this year at the age of 81. Bill played a huge role in building the Bureau's coastal reputation from the 1970's through the 2000's, particularly in wetlands distribution and change over time, all while being notably modest and unassuming.

"I recall Bill with great fondness from my early years as Bureau Director," said **Scott W. Tinker**. He was a calm and thoughtful presence, and I always enjoyed our conversations." Colleague and Bureau Senior Research Scientist **Jeff Paine** remembers, "Bill was the principal author of all of the Bureau's Submerged Lands atlases and a really wonderful, kind, generous, and soft-spoken person."

Bill was with the Bureau for over 30 years. During his long and productive career, he was best known for his investigations of the status and trends of wetlands in major bay-estuary-lagoon systems, studies of submerged coastal lands of Texas in which benthic sediments were mapped and characterized, studies of faulting and subsidence and their impacts on marshes, and investigations of fluvial-deltaic systems in which wetland sedimentation rates were measured and correlated with rates of relative sea-level rise.



Edmund Gerald Wermund, Jr

Edmund Gerald Wermund Jr. Ph.D, "Jerry" as he was known to his friends and family, passed away on July 15, 2020, at age 94 in Austin, Texas, after a short illness from complications of COVID-19.

In 1971, Jerry accepted a position at the Bureau of Economic Geology at The University of Texas at Austin where he worked for 27 years. He became the Bureau's Associate Director and Director of the Bureau's Land Resource Laboratory. He specialized in remote sensing and surface/subsurface geological mapping to assess petroleum resources both onshore and offshore. Jerry served on many geological panels and commissions for The University of Texas, as well as Texas State agencies and several programs for the U.S. Department of Interior.

During his career, Jerry authored many articles for various geological journals. Since his retirement in 1998, he volunteered as a docent for the Austin Children's Museum where he discovered his love of explaining geology and Earth resources to youthful audiences. Since then, Jerry published four scholastic children's books about geology; "*EarthScapes*" (2003), "*The World According to Rock*" (2005), "*Focus on Minerals*" (2007), "*Soil: More Than Just Dirt*" (2009).

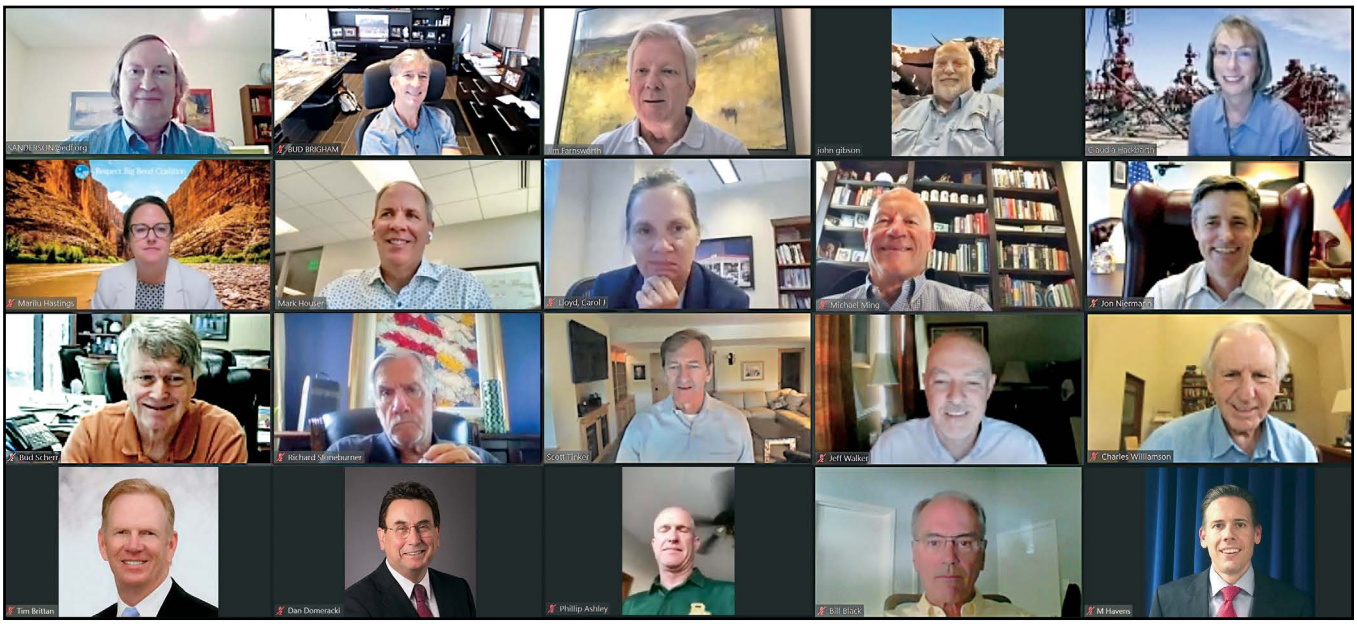
2020 Visiting Committee

The Bureau of Economic Geology's Visiting Committee includes leaders from industry, state agencies, academia, and non-profit organizations, all possessing a deep appreciation for the work of the Bureau and the many ways it serves the public by undertaking the pursuit of energy, environmental, and economics research that matters.

Led by new Chair Claudia Hackbarth, the Visiting Committee came together in August for a virtual annual meeting. The Committee was briefed on how the Bureau has been successfully navigating the impacts of COVID-19 and the downturn in the energy industry while at the same time exploring various new avenues for research and support. The meeting agenda was designed to share potential opportunities for future research and to solicit the Committee members' perspectives on innovative research thrusts and untapped funding resources.

Current challenges for the Bureau of Economic Geology may not be insignificant, but the clear message coming out of this year's Visiting Committee meeting was that the Bureau, with its extensive expertise and broad capacity, is well positioned and ready to capitalize on a variety of new geoscience research opportunities going forward.

For more information about the work of the Bureau or its Visiting Committee, please contact Mark W. Blount, External & Governmental Affairs, mark.blount@beg.utexas.edu.



From top left to right: Mr. Scott Anderson (Environmental Defense Fund), Mr. Bud Brigham (Anthem Ventures, Brigham Minerals, Brigham Exploration, Atlas Sand), Mr. James "Jim" Farnsworth (Beacon Offshore, Azimuth Capital), Mr. John Gibson, Jr. (Flotek), Dr. Claudia Hackbarth (Shell Global Solutions U.S. Inc.), Ms. Marilu Hastings (Cynthia and George Mitchell Foundation), Mr. Mark Houser (University Lands), Ms. Carol Lloyd (Exxon Mobil Corporation), Mr. Michael "Mike" Ming (Ming Energy Partners, LLC), Chairman Jon Niermann (Texas Commission on Environmental Quality), Mr. Bud Scherr (Valence Operating Company), Mr. Richard "Dick" Stoneburner (Pine Brook Partners), Dr. Scott W. Tinker (Bureau of Economic Geology), Mr. Jeff Walker (Texas Water Development Board), Dr. Charles "Chuck" Williamson (Weyerhaeuser Co., Paccar, Greyrock Energy), Mr. Tim Brittan (Infinity Oil & Gas, Inc.), Dr. Dan Domeracki (UNC Kenan-Flagler Business School), Mr. Phillip Ashley (Texas Comptroller of Public Accounts, represented Comptroller Glenn Hegar), Mr. Bill Black (Railroad Commission of Texas, represented Commissioner Christi Craddick), and Mr. Mark Havens (Texas General Land Office, represented Commissioner George P. Bush).

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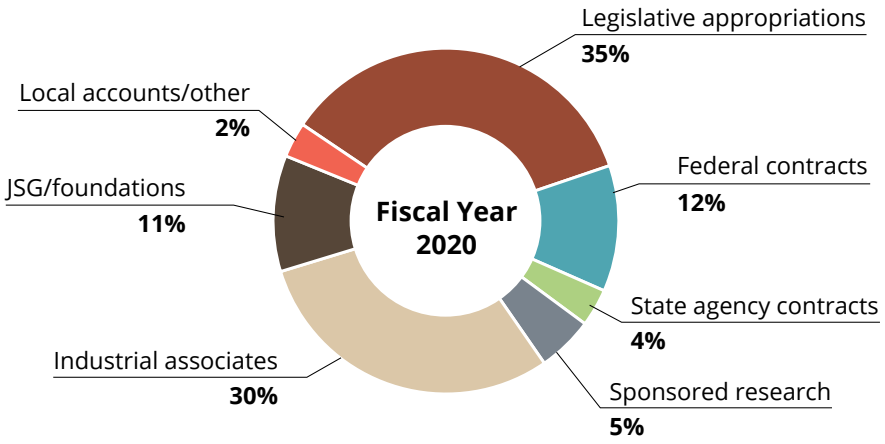

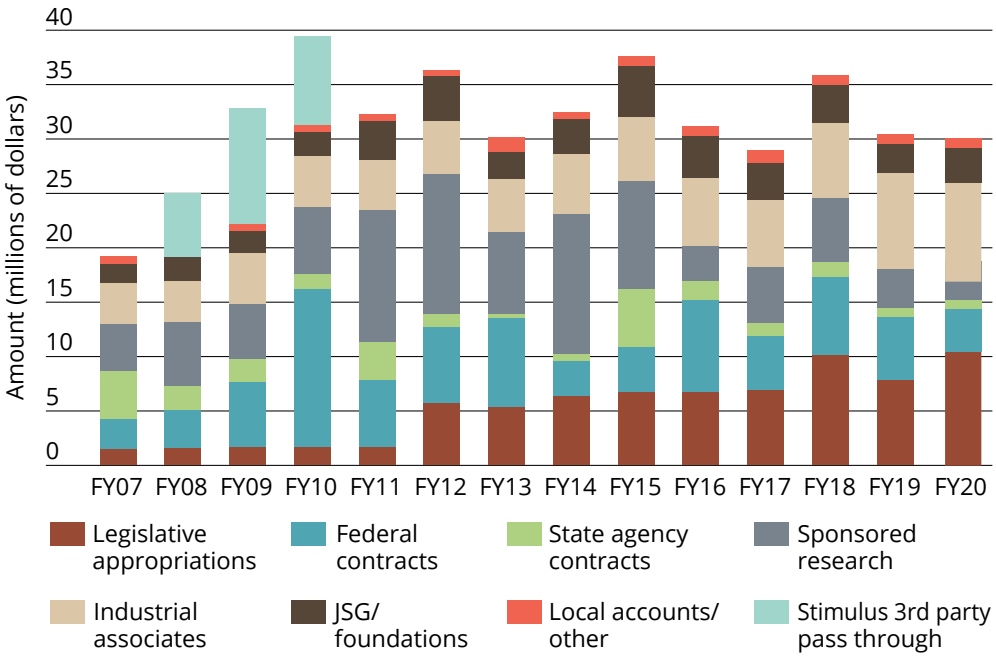

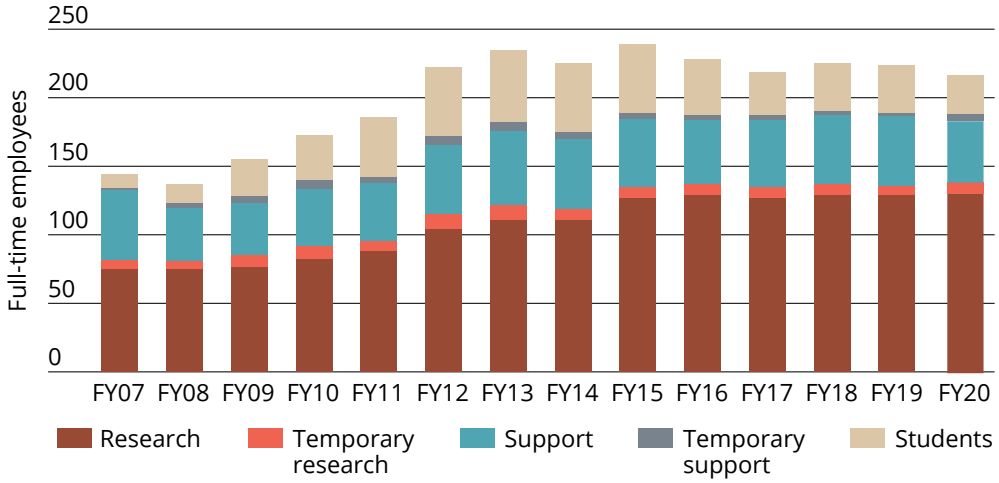

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