2021

Research Consortia

Bureau of Economic Geology

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Research Consortia

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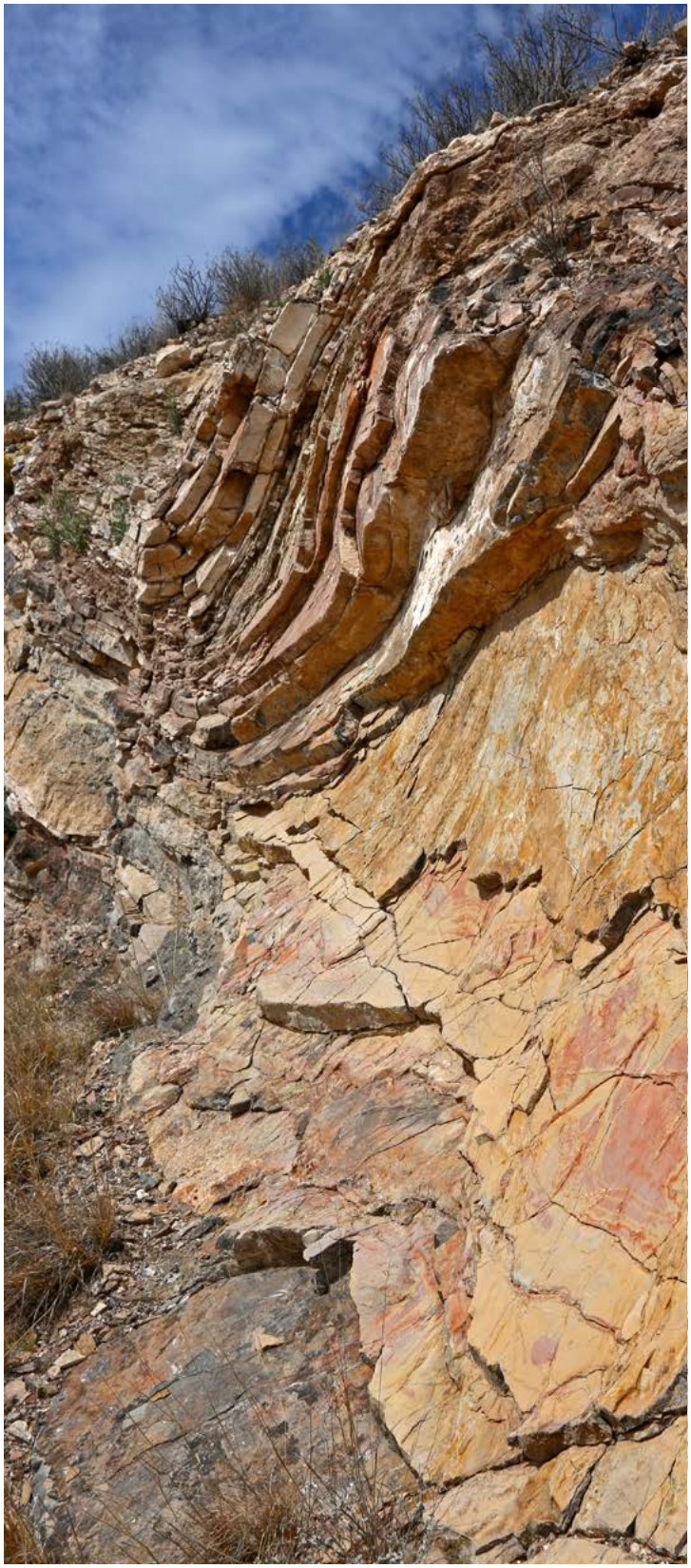
Research Partnerships with the Bureau of Economic Geology



The Bureau of Economic Geology conducts impactful research on subjects of high interest to the energy industry and to environmental firms, and a broad spectrum of companies and other organizations actively participate in its 12 research consortia. These unique partnerships study subjects as diverse as salt tectonics, carbonate reservoir characterization, natural fractures and geophysics, carbon storage, nanotechnology, quantitative clastics, computational seismology, and mudrock reservoirs.

Collectively, these 12 consortia enjoy the support of global partners, with some companies and organizations participating in multiple separate programs. Each research consortium was designed to complement industry 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 office visits by researchers for presentation and interaction. Members also benefit from interactions with counterparts in fellow sponsoring organizations.

Each Bureau research consortium has a dedicated team of full-time researchers, including postdocs. Many of them host talented graduate students, creating combined teams of seasoned experts and early career specialists. A number of researchers have industry backgrounds, and all share a passion for university-based research.

We invite you to review this brochure and to contact the principal investigator of any program of interest to you. If you would like further information about these research consortia, or about the breadth of your organization's engagement with the Bureau, please contact us at mark.blount@beg.utexas.edu, or by phone at 512-471-1534.

UT Bureau of Economic Geology

Who We Are

Established in 1909, the Bureau of Economic Geology is the oldest research unit at The University of Texas. The Bureau is the State Geological Survey of Texas and has been an integral part of the development of the State's oil and gas industry through the years. Our mission is to serve society by conducting objective, impactful, and integrated geoscience research on relevant energy, environmental, and economic issues. Our vision is to be a trusted scientific voice to academia, industry, government, and the public, all of whom we serve. Bureau researchers spearhead basic and applied research projects globally in energy resources and economics, coastal and environmental studies, land resources and use, geologic and mineral mapping, hydrogeology, geochemistry, machine learning, and subsurface nanotechnology. The Bureau provides advisory, educational, technical, and informational services related to the resources and geology of Texas, the nation, and the world.

Bureau Programs

The Bureau is an international leader in a number of research thrusts, working at the intersection of energy, the environment, and the economy, with strengths that include

- Unconventional oil and gas exploration and production
- Salt tectonics
- Natural fractures and structural diagenesis
- Reservoir characterization in carbonates, mudrocks, and sandstones
- Carbon storage in geological reservoirs
- The water-energy nexus
- Energy economics

Talented people are key to the Bureau's success. The research staff includes more than 150 scientists, engineers, and economists, representing 27 countries, working in integrated, multidisciplinary research teams. Together with 40 skilled graduate students and 15 postdocs, they solve the world's greatest challenges in energy and environmental research.

UT Bureau of Economic Geology

Partnerships

Partnerships drive strategy, innovation, and investigation, and the Bureau engages partners, both new and old, on many levels. Investments in Bureau research provide significant returns. Corporate partners participate in and gain vital new insights from the Bureau's many productive research consortia, which are described herein. Government, agency, foundation, and nongovernmental organization partners include the State of Texas, the Alfred P. Sloan Foundation, the U.S. Department of Energy, and the Environmental Defense Fund.

Facilities

Superb facilities and equipment, some cofunded by industry, give researchers the tools they need to find objective, rock-based research solutions. Such facilities and equipment include

- More than 18 individual laboratories hosting research teams investigating everything from nanoparticles to shale porosity and permeability
- Three massive well-core research and storage facilities in Houston, Austin, and Midland that collectively house what may be the largest archive of rock material in the world
- One of the largest collections of well logs in the United States
- An extensive inventory of modern imaging devices and integrated technologies for outcrop and land-surface mapping

Results

More than 100 years of producing research results has earned the Bureau an unparalleled reputation. Successful outcomes can be measured by many yardsticks, and Bureau researchers more than measure up:

- More than 140 peer-reviewed articles and books published annually
- Hundreds of abstracts and articles published each year in *Conference Proceedings* volumes
- More than 50 keynote addresses made annually
- Bureau researchers frequently serve as presidents of international professional societies and editors of major professional journals
- Bureau researchers are continually recognized by their peers with top medals in their fields

Advanced Energy Consortium

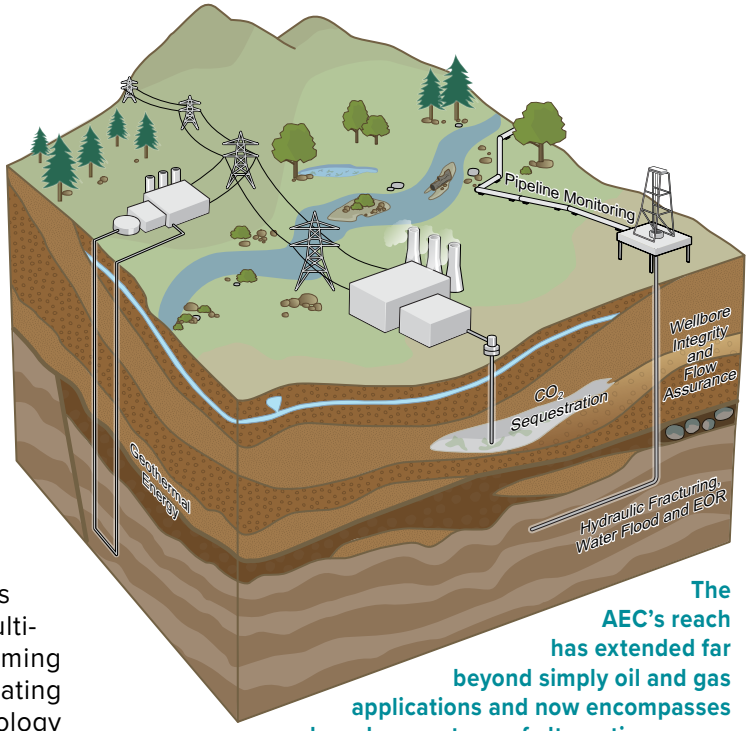
Mission

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 Challenges

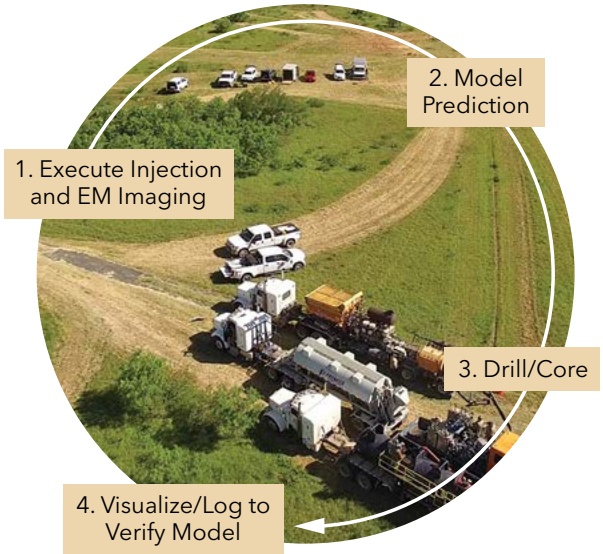
In the decade since its inception, the Advanced Energy Consortium has progressed nanotechnology from fundamental to applied research and is now targeting commercial applications such as precise reservoir imaging of hydraulic-fracture networks using electromagnetic-contrast agents; microsensor-data logging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

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, multicomponent, and multi-institutional applied research programs, transforming the technology of subsurface monitoring and creating exciting field demonstrations to validate our technology in 2021.



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.

Proof-of-concept demonstration and validation workflow



Research Thrusts

Contrast Agents for Mapping Hydraulic-Fracture Networks

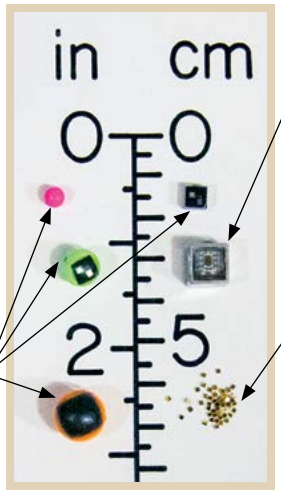
The Use Case 1 (UC1) team is focused on remote characterization of hydraulic-fracture geometries and network permeability using electromagnetic (EM) contrast-agent proppants. Current fracture-imaging technology employs microseismic monitoring, which provides general information about rock mechanics but fails to accurately resolve the extent of connected-fracture geometry and fluid permeability within the fractured network. Accurate mapping of hydraulic fractures is instrumental in enhancing completion strategies and mitigating excessive resource usage.

Advanced Energy Consortium

Research Thrusts *(continued)*

Microelectronic Sensor Systems

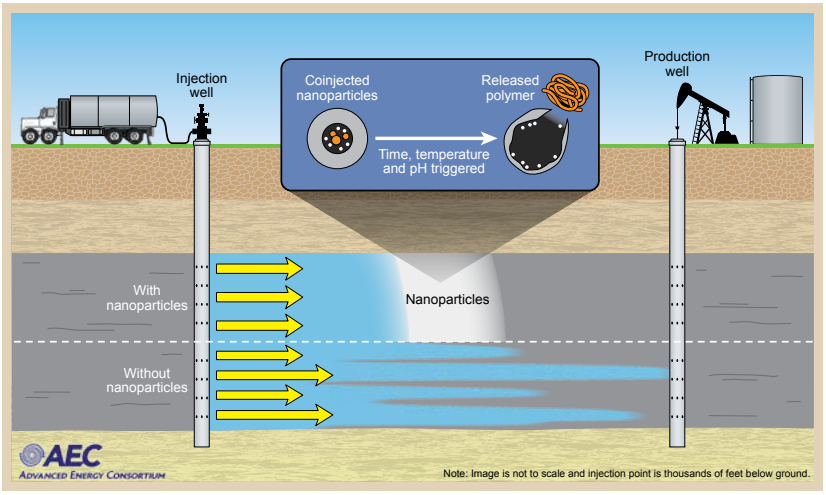
The Use Case 2 (UC2) team designs and fabricates microelectronic sensors capable of acquiring multiple time-stamped measurements in harsh subsurface environments. The AEC has tested three Smart Subsurface Autonomous Nano-sensor Device (Smart-SAND) prototype platforms, as well as continued to develop new sensor, power, microcontroller, and communications components. The three platforms ranged in size from 1 to 12 mm and were hermetically sealed, wirelessly charged and programmed, and suitable for characterization of any combination of temperature, pressure, resistivity, or pH (up to 10 kpsi and 125°C).



Stacked chip system (5–12 mm) Temp./pressure/time combo. Polymer packaging. Battery lifetime of 10–40 hr.

System on a board (8 mm) Temp./pressure/time combo. Steel packaging. Battery lifetime of 10–16 hr.

System on a chip (1 mm) Discrete temp., press., resistivity, pH. Thin film packaging. Radio frequency-powered (batteryless), 30-yr lifetime.



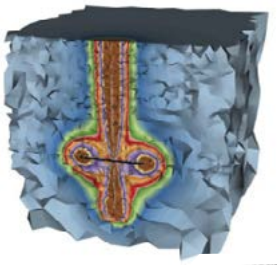
Payload Delivery Systems

The Use Case 4 (UC4) team continues to progress in the development of micro- and nanoscale payload-delivery systems. Timed-payload delivery allows for optimal placement of the cargo in the wellbore or reservoir. Two payload delivery-system mechanisms have been developed: (1) burst release with an inside-out, triggered degradation mechanism and (2) core–shell delivery, in which the payload dissolves at desired temperatures and times.

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. We have also successfully obtained grants from Sandia National Laboratories and the U.S. Department of Energy that promise to offer members more than a 15x increase on their research budget investment over the next two years. Our level of innovation remains unsurpassed, and we are a recognized leader in nanotechnology research, as demonstrated by our numerous filed patents and papers and our team's prestigious 2019 Best Paper Award from the Journal of Environmental & Engineering Geophysics.

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.



Simulations indicate that a combination of steel wellbore casing and electromagnetic (EM) additives could supply continuous electrical power to embedded nanosensors.

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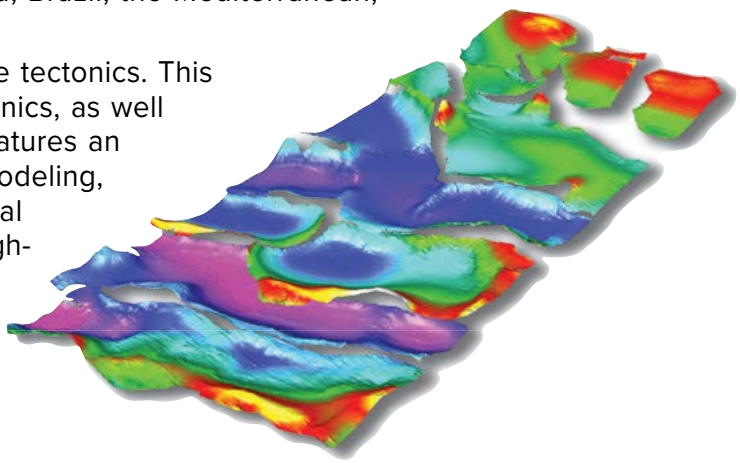
Applied Geodynamics Laboratory
Salt Tectonics

Mission

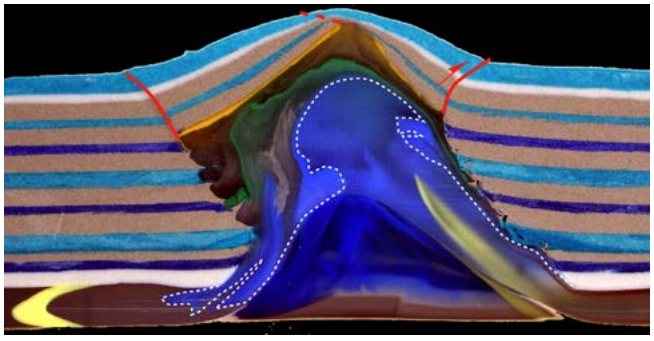
Pure and applied research in salt tectonics has been a strong component of the Bureau's research program since the late 1970's. At the heart of this research is the Applied Geodynamics Laboratory (AGL), an industry-funded consortium dedicated to producing innovative concepts in salt tectonics. Research 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.

In 2017, AGL added a new research effort in shale tectonics. This work builds on our existing expertise in salt tectonics, as well as our experience in soil mechanics. Research features an integration between seismic interpretation and modeling, finite-element modeling, and subaqueous-physical modeling. We are initiating case studies using high-quality 3D seismic data in the Gulf of Mexico and Niger Delta to learn more about the geometry and evolution of shale structures.



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 and shale 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.

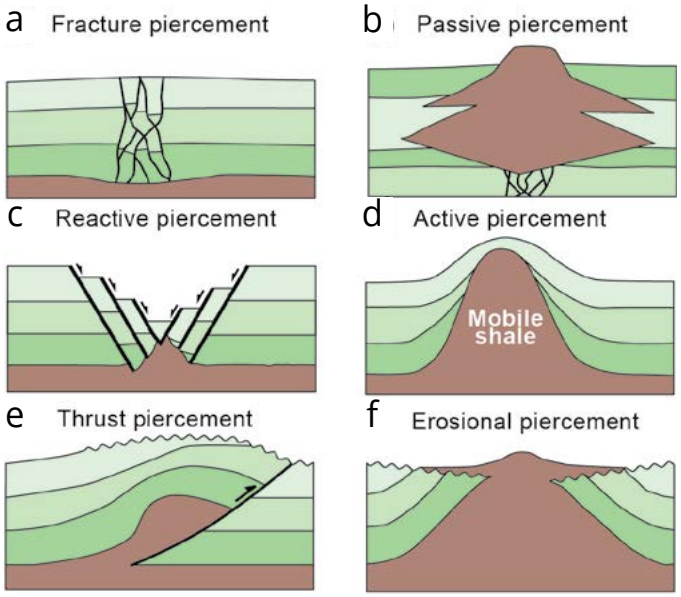
Areas of focus for salt tectonics include salt welds; salt canopies; reactive, falling, and squeezed diapirs; mechanics of salt-sheet advance; the origins and evolution of minibasins; internal salt structures; and salt sutures.

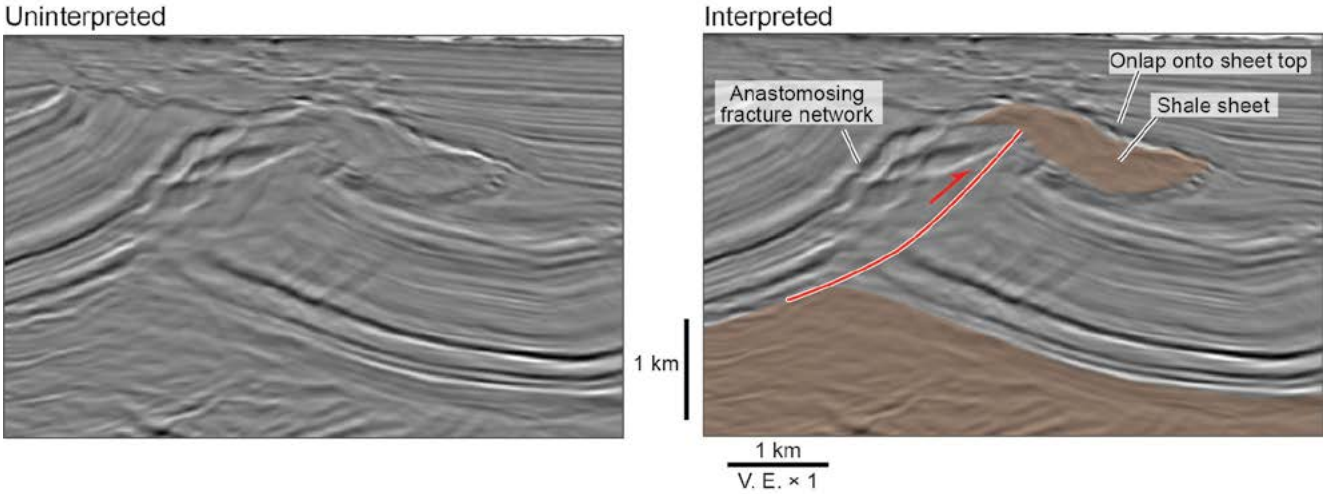
Areas of focus for shale tectonics include mechanical models for mobile shales, mobile-shale piercement mechanisms, and variables affecting the seismic expression of shale diapirs.

Applied Geodynamics Laboratary
Salt Tectonics

Membership

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





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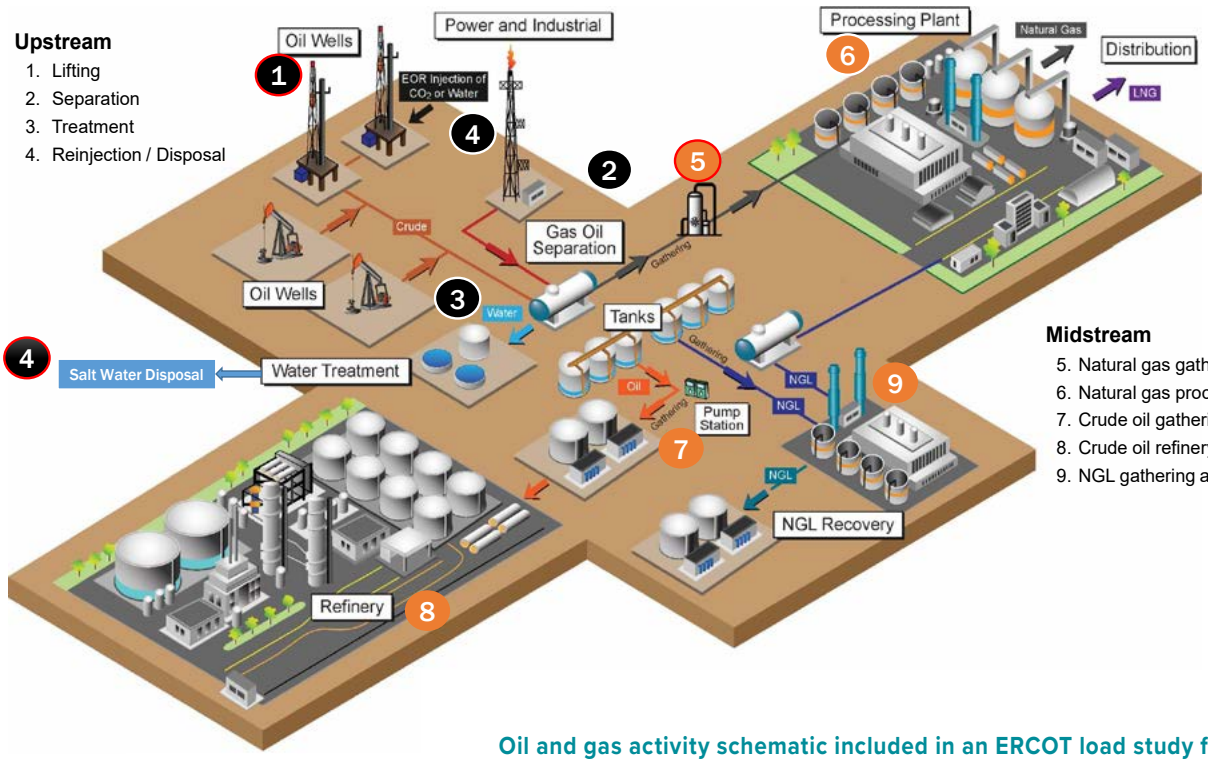
Center for Energy Economics

Mission

Energy-economics research at the Bureau seeks an understanding of relationships among energy resources, economics, and the environment. We aim to establish a solution-based platform to help stakeholders make well-informed decisions at each of these related nexuses. Our research is practical; it improves consensus decision-making and outcome predictability between energy and economics stakeholders. Research is organized around the Center for Energy Economics (CEE) and is conducted collaboratively with member organizations and companies as well as other Bureau research consortia.

Research Challenges

The energy industry is facing incredible challenges: a higher energy demand and an increasing need for lower carbon emissions, and staying profitable through competition and price volatility, all while adapting to disruptive technology and changing climate policy.



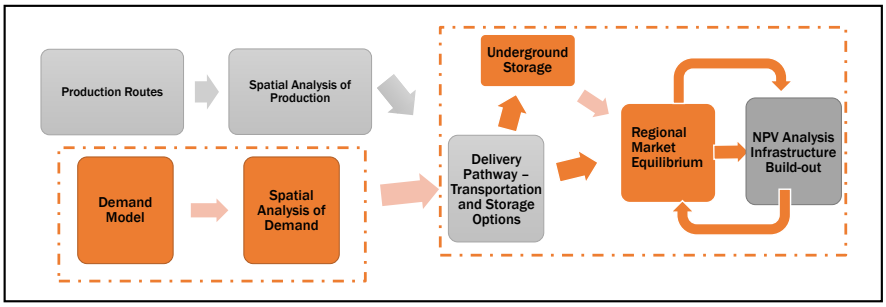
Oil and gas activity schematic included in an ERCOT load study from 2021.

Center for Energy Ecomonics

Research Thrusts

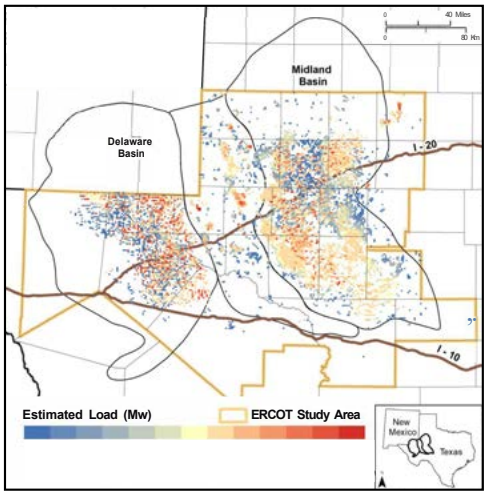
The Center of Energy Economics is working to make an impact by leveraging their expertise in geoscience and enviromental resources combined with economics, and addressing energy and environmental challenges, shared by our industry and communities today in the following main areas:

- Facilitating a plan for power grid expansion with local utilities and market operator by estimating the incremental electric load from oil and gas activities in the Permian Basin. The Permian Basin's fast growth in hydrocarbon production has generated an incremental local electric load that has outgrown the existing grid capacity, and CEE is working with ERCOT to establish a robust and sustainable process to estimate oil and gas related electric-load forecasts for the Texas portion of the Permian Basin. This research fills the gap of knowledge between oil- and gas-resource development and energy requirements of infield operation from upstream to midstream sectors.



Hydrogen infrastructure analysis

- Estimating the value of a natural gas infrastructure in providing energy security for the Texas grid during extreme weather conditions.
  - Collaborating with the Energy Institute of The University of Texas at Austin on the ongoing multidisciplinary research on the Texas winter storm of 2021. Commissioned by PUC Texas and a follow up study, CEE focuses on the natural gas maximum deliverability to market in Texas.
- Defining the role of liquefied natural gas (LNG) and natural gas in the energy transition for West Texas and the global market. CEE actively works with major LNG players to shape the natural gas market strategy for the energy transition.
  - Analyzing the impact of Japanese LNG contract strategies on the Chinese natural gas demand in collaboration with the Institute of Energy Economics in Japan (IEEJ) and RBAC.
  - Developing a systemic approach in identifying a long-term natural gas-upstream-asset-acquisition strategy to ensure long-term energy security for China.
  - Analyzing the global LNG trade-flow impact under a low-carbon economy transition of Europe via a working paper.



Estimated oil and gas load map from June 2020

- Developing an infrastructure analysis for the emerging energy sector:
  - Identifying opportunities for gas and oil infrastructure in the new hydrogen economy and a life cycle-cost analysis for an underground hydrogen storage model.
  - Collaborating with the International Gas Union (IGU) and the Oxford Institute for Energy Studies on a global renewable gas production database.

Membership

Depending on the nature of the projects, CEE offers general membership or private study opportunities.

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Center for Integrated Seismicity Research

Mission

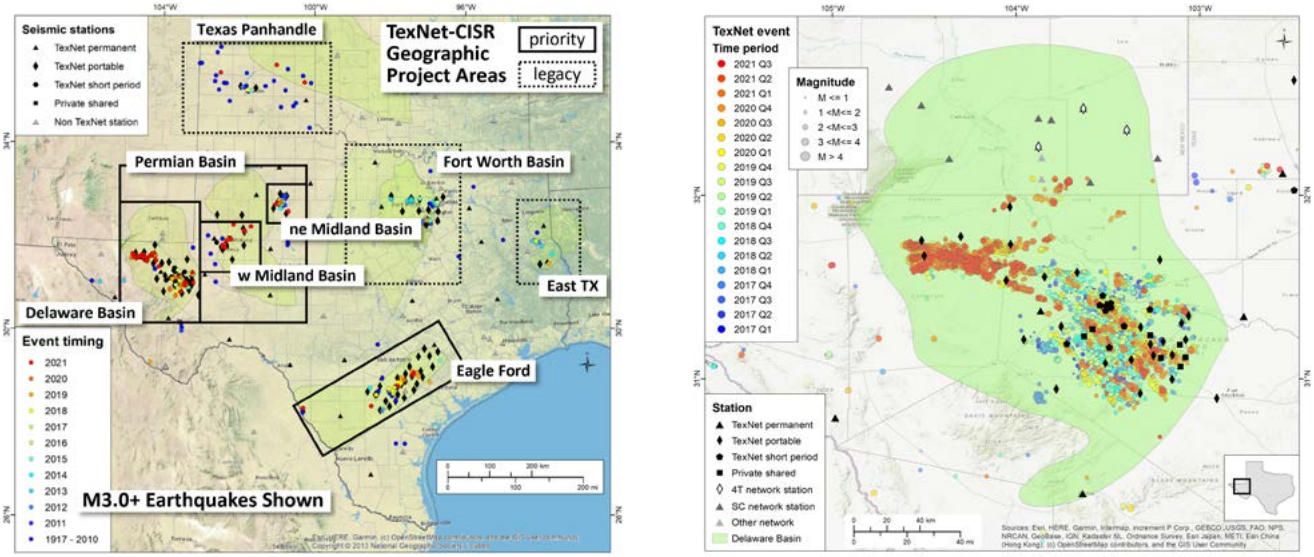
The Center for Integrated Seismicity Research (CISR) is a multidisciplinary, intercollegiate research consortium managed by the Bureau. TexNet and CISR are two parts of a whole; the former is the State-funded network of seismometers across Texas that monitors and catalog earthquakes and conducts research into aspects of causation in key areas. With its upstream and midstream partners, CISR significantly extends and deepens the scope of research into induced seismicity in Texas, New Mexico and beyond and develops an understanding of the processes that influence seismicity, quantifies the evolving hazards, and improves standards of practice for mitigation.

Research Thrusts

CISR conducts fundamental and applied research to better explain seismicity of all causes and its associated hazards. Thorough geologic, geophysical, and reservoir engineering integration underpin all CISR programs. CISR relies on research specialists from from the Bureau, the Department of Geologic Sciences, the Institute for Geophysics, and the Department of Petroleum and Geosystems Engineering at UT. We also partner with Southern Methodist University, UT El Paso, Stanford University, and consulting specialists.

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. In Texas, the impacted areas have evolved rapidly and complexly from quiescence to high earthquake activity. Understanding the interplay between complex operational drivers and interdependent-subsurface physical processes is a daunting challenge that the Bureau is pursuing head-on.

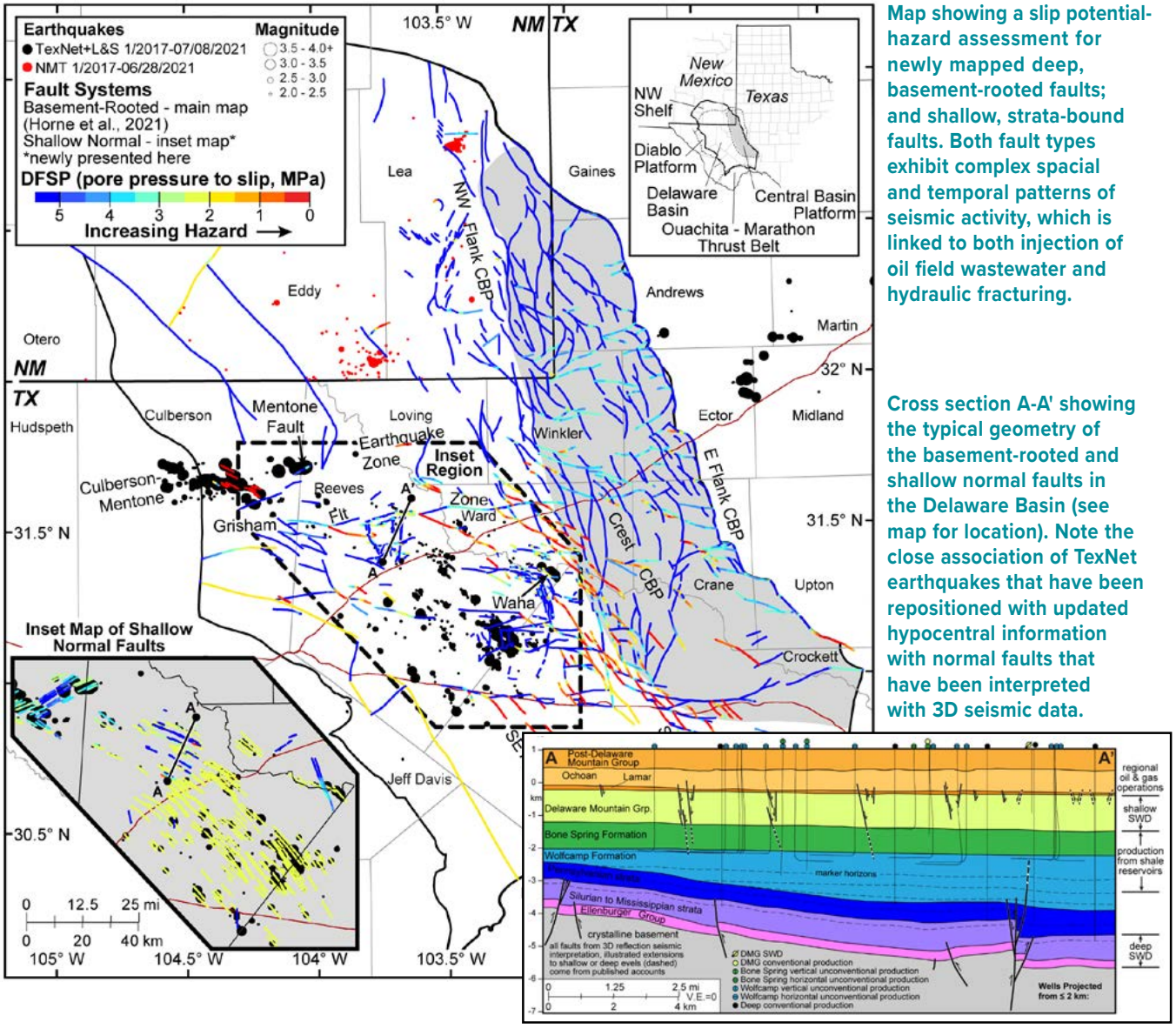


Areas of past and active study by the TexNet-CISR collaborative (left). The Delaware Basin (right), Midland Basin, and Eagle Ford operating region are all under active study by CISR for earthquake-causation analysis and the determination of steps necessary for mitigation. The diagram on the right shows the current synthesis of seismicity catalogued by TexNet in the Delaware Basin.

Center for Integrated Seismicity Research

Membership

Most of the major energy companies that operate in Texas' unconventional plays are CISR members, as are key midstream operators. Each company has one member who serves on the CISR Advisory Committee, which meets quarterly to discuss the design and application of CISR-TexNet research and monitoring projects.. Member companies are encouraged to assist with the 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 is protected by UT Austin's strong intellectual property controls.



Map showing a slip potential-hazard assessment for newly mapped deep, basement-rooted faults; and shallow, strata-bound faults. Both fault types exhibit complex spacial and temporal patterns of seismic activity, which is linked to both injection of oil field wastewater and hydraulic fracturing.

Cross section A-A' showing the typical geometry of the basement-rooted and shallow normal faults in the Delaware Basin (see map for location). Note the close association of TexNet earthquakes that have been repositioned with updated hypocentral information with normal faults that have been interpreted with 3D seismic data.

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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.

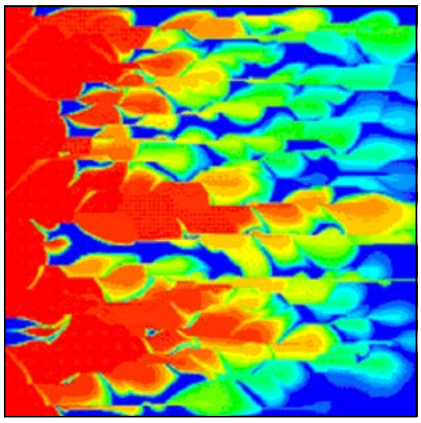
The research is both fundamental and practical, aiming at improving prediction and diagnosis of fracture attributes in hydrocarbon reservoirs and accurately simulating their influence on production. Research is organized around the Fracture Research and Application Consortium (FRAC), conducted together with scientists from member companies. Students are an important part of our program.

Bureau (Bureau of Economic Geology)
PGE (Department of Petroleum and Geosystems Engineering)
DGS (Department of Geological Sciences)

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.

Flow simulation



"Joints" software for fracture modeling and permeability estimation

Research Challenges

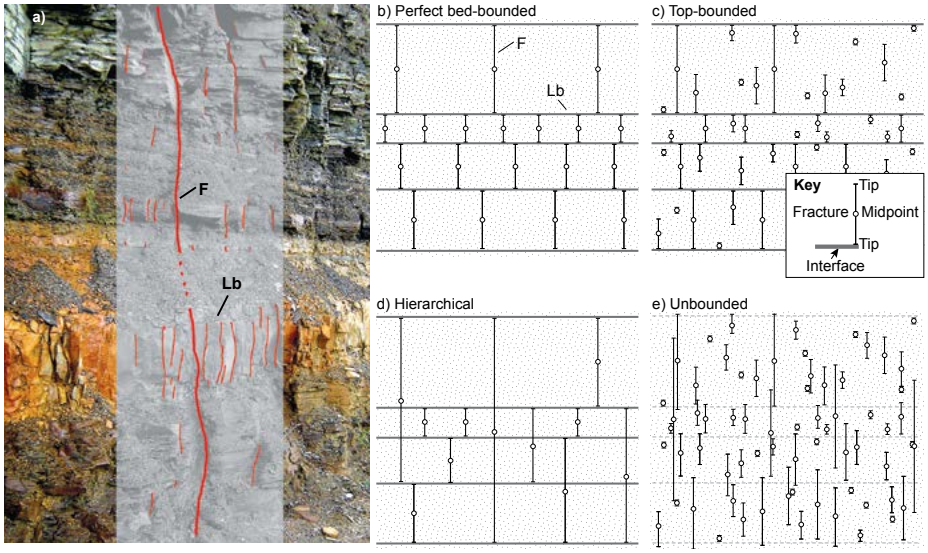
Faults and fractures are difficult or impossible to characterize adequately using currently available technology. Fractures have been challenging to sample and model, posing serious challenges to exploration and development. Our approach is helping to overcome the limitations of current methods.

Fracture Research and Application Consortium

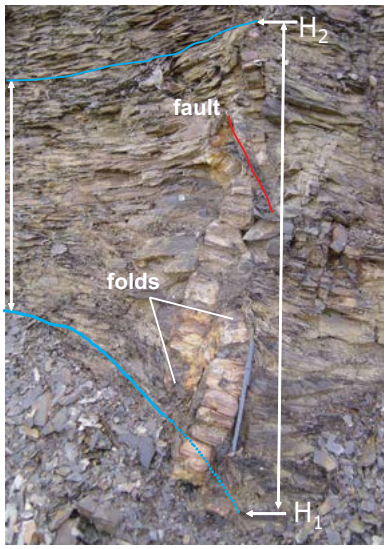
Membership

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.

Participants examine fractures in tight-gas sandstones in the Canadian Foothills; FRAC field trip, fall 2013.



(a) Fracture-height patterns in New Albany Shale roadcut with hierarchical fracture traces, eastern Kentucky. Some fracture traces cut multiple beds (F). Others are bed bounded (Lb = bed boundary). (b-e) Fracture-height classification categories from Hooker and others (2013).



Quartz/dolomite/bitumen-filled fracture compacted by folding and faulting; the H1-H2 compacted fracture height is 70 cm; Blocher Member, New Albany Shale, Kentucky.

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Gulf Coast Carbon Center

Mission

The Gulf Coast Carbon Center (GCCC) works with industry, nongovernmental organizations, and governments to develop and conduct targeted and commercially applicable research to optimize storage of carbon dioxide (CO_2) in geologic formations in the deep subsurface. The GCCC has a mission with a global reach to provide state-of-the-science information to serve diverse stakeholders, from local residents to international industries. The GCCC also educates the next generation of CO_2 storage geoscientists.

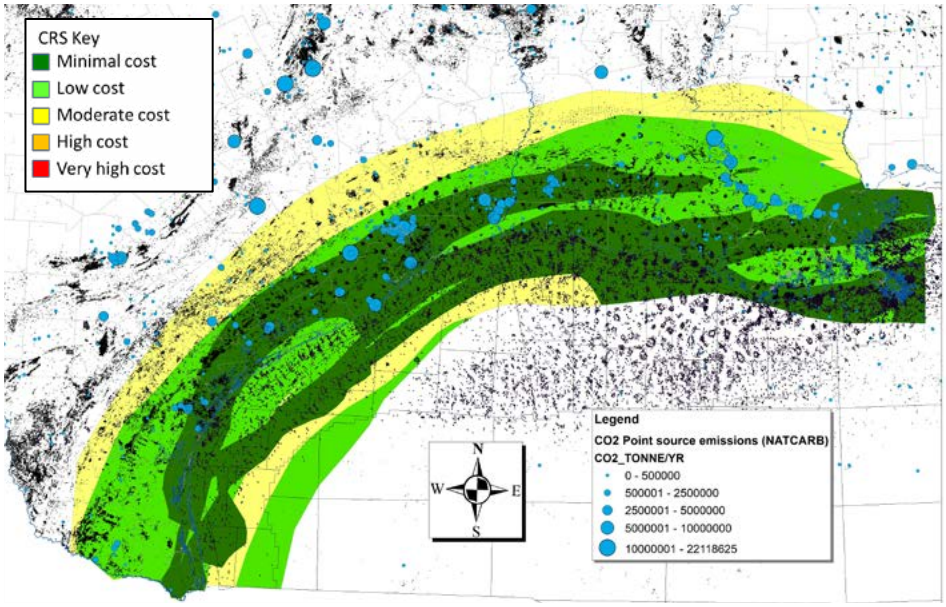
Research Thrusts

GCCC research increases confidence in the large-volume-storage resources that will be viable in the next few years to support the commercialization of carbon capture utilization and storage (CCUS). GCCC collects (1) multiscale laboratory and field-scale fluid-flow data; (2) uses advanced physical and numerical simulation and machine learning techniques to upscale and optimize storage; (3) creates workflows at basin scale that prepare multiple sites to be operated at maximum injection rates over prolonged time periods; (4) improves structural- and stratigraphic-characterization methods and simulation approaches to identify and permit sites; and (5) develops and assesses methods for monitoring in reservoir, over-burden, groundwater, marine and land surface to provide assurance that storage is effective.

Dr. Katherine Romanak collecting soil gas data using an innovative process-based method.

GCCC student Melianna Ulfah presented a recap at the Global Dialog 2021: Solutions for Green Economic Recovery, Climate Justice and Climate Solutions.

Research on CO_2 enhanced oil recovery (EOR) provides information 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.



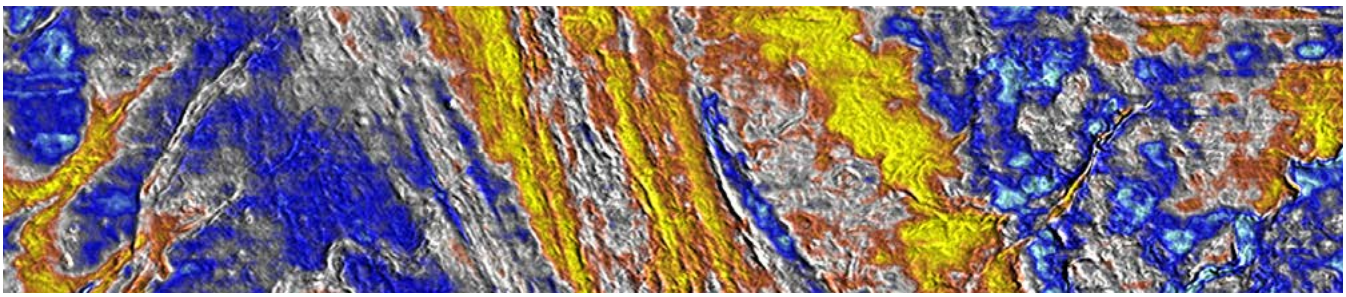
Example of Oligocene- and Miocene-storage fairways (green and yellow) and large CO_2 emission sources (blue dots). Black dots indicates well density. Additional fairways are under assessment.

Gulf Coast Carbon Center

Research Challenges

Industries and governments' interest in the reduction of carbon emissions is on a rapid upswing. However, many stakeholders, from industrial investors to policymakers to journalists, do not have the information needed to evaluate the risks, benefits, and critical role of CCUS in comparison to other mechanisms for attaining climate goals. GCCC addresses information gaps via: (1) providing substantive technical information, (2) translating technical information so that it is accessible by users, and (3) targeting research to reduce uncertainties.

GCCC staff experience leads to a trained CCS workforce.



High-resolution seismic slice collected in shallow water allows improved above-zone monitoring design.

Membership

Members develop aspirational multiyear goals, oversee the incubation of new research thrusts, seek augmentation via increased investment, receive a quarterly newsletter, and meet twice per year for research review.

Contact

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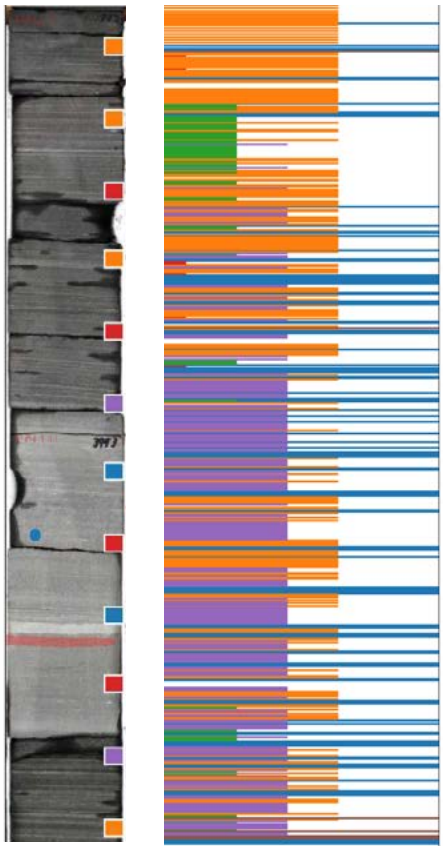
www.beg.utexas.edu/gccc

Mudrock Systems Research Laboratory

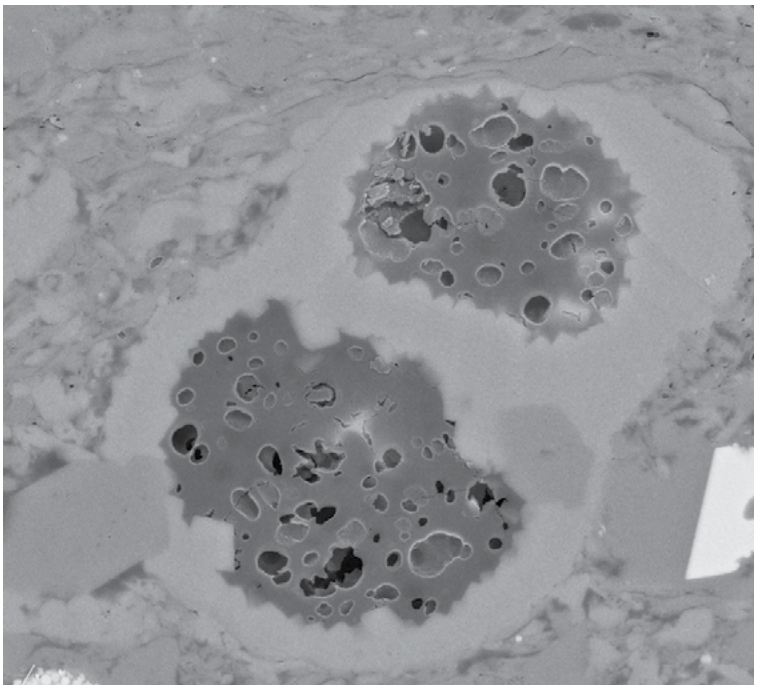
Mission

The primary focus of the Bureau's Mudrock Systems Research Laboratory (MSRL) has been to characterize, model, and integrate core-based measurements to better understand mudrock reservoir systems. MSRL industry sponsors are provided access to annual meetings, core workshops, short courses, MSRL datasets, MSRL laboratories, and access to our team of scientists for specific research issues.

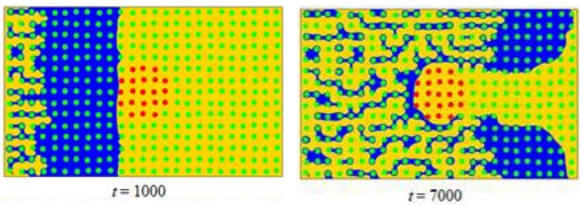


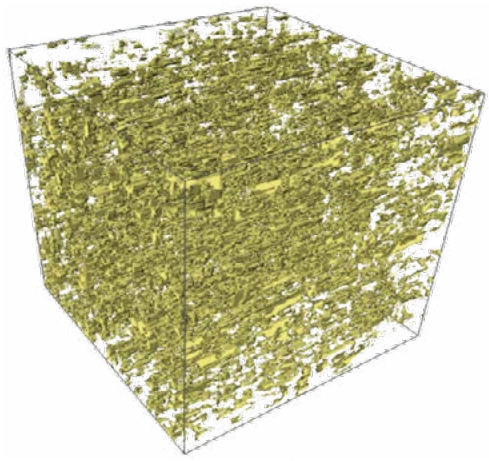
Research Thrusts

MSRL research is multidisciplinary and integrates data generated from the MSRL core-characterization laboratories to build core-validated models. Nano- to micrometer sized pores and their distributions are visualized with scanning electron microscopy. Porosity and permeabilty are measured using helium porosimetry, gas expansion, and pressure decay. Gas and oil geochemistry, organic matter maturity, and biomarkers are measured to understand the fundamental controls to porosity, permeability, and oil saturation. Fluid flow is modeled using 3D object-based permeabilty models. Cores are scanned in our X-ray fluorescence laboratory for chemofacies.



SEM image showing organic-matter pores in bitumen filling the chambers of a foraminifer, Cretaceous Eagle Ford Group, Atascosa Co., Texas.



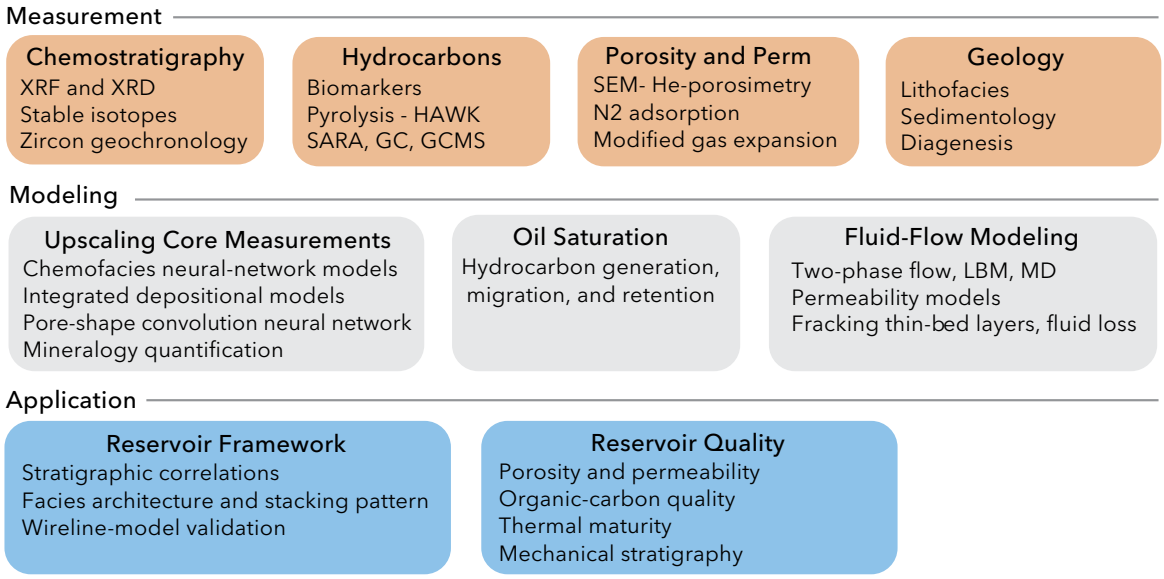


Network of organic matter

Mudrock Systems Research Laboratory

Research Challenges

The MSRL challenge is to develop a better understanding of reservoir framework and reservoir quality through measurement and modeling. MSRL researchers take pride in the integrative multidisciplinary approach to characterize, model, and integrate core-based measurements to better understand mudrock reservoir systems. The MSRL workflow is designed to generate high quality data, validate externally-derived datasets, and understand key processes that control reservoir quality.



Membership

Consortium membership costs $50,000 annually. Members receive priority access to research data, interpretations, reports and the following benefits:

1) Spring annual meeting: four days, including a one day core workshop, two days of technical talks, and a one day mudrocks short course
2) Fall advanced short course: a one day short course covering advanced methods in mudrock science
3) Summer short course: This content varies. In 2021, we hosted a short course on new Python tools we are developing (CorePy) for visualizing core characterization and building neural-network models.
4) Access to data from the MSRL program, starting from 2009: all consortium reports, presentations, posters, extended abstracts, short-course materials, presentation videos, and published papers. Core characterizations include geochemical (high-resolution XRF, Pyrolysis, and biomarkers) and core descriptions.
5) Individualized sponsor-focused core workshops and short courses
6) Potential for sponsors to assist in research directions
7) Characterization/integration of donated/loaned cores
8) Access to MSRL researchers and our analytical facilities

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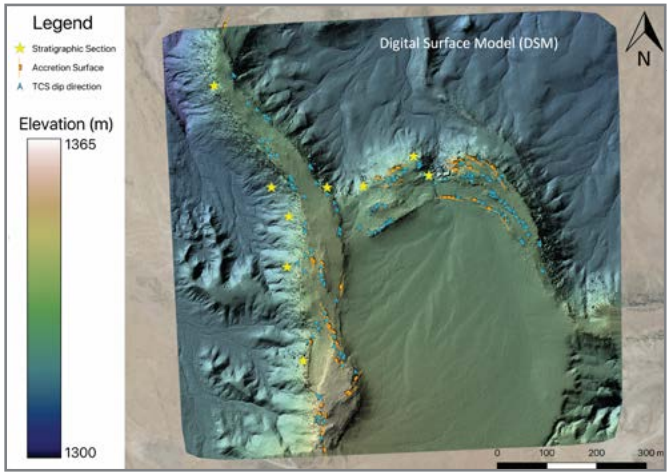
Quantitative Clastics Laboratory

Mission

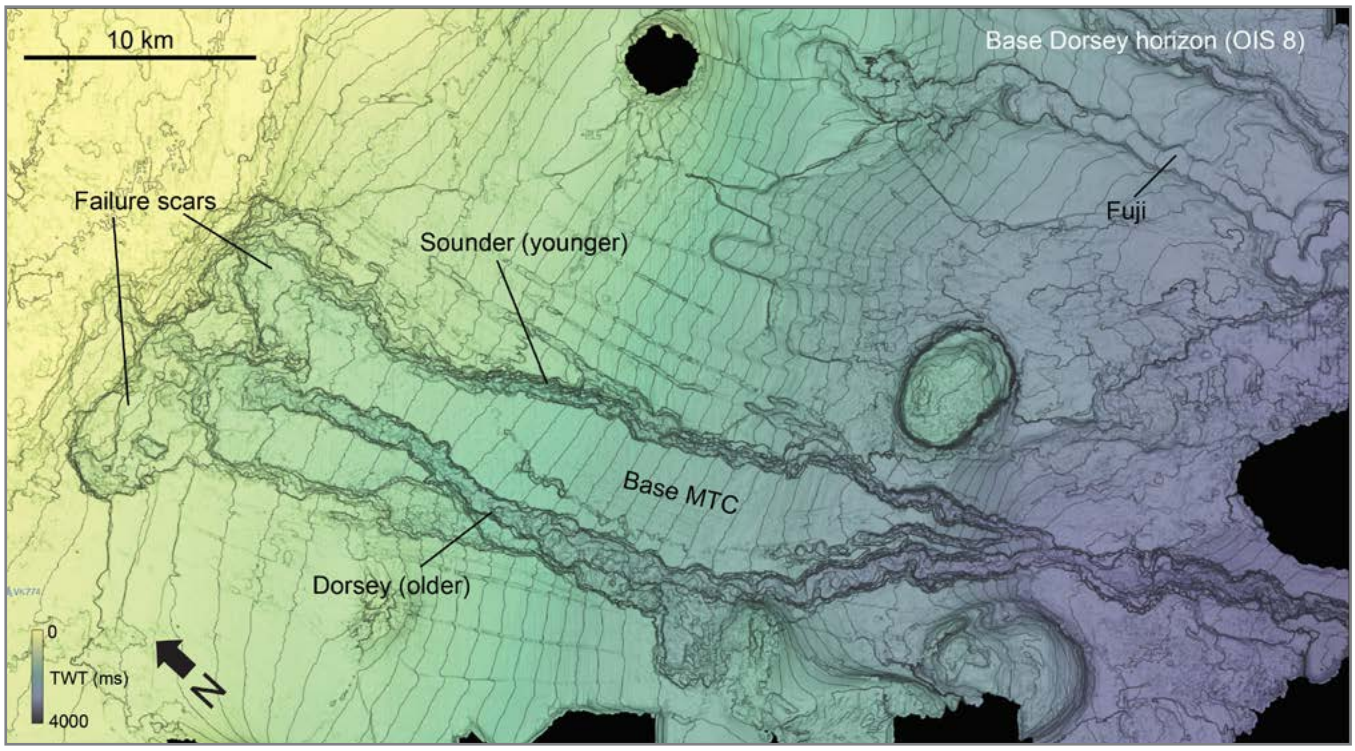
The mission of the Quantitative Clastics Laboratory (QCL) is to develop a predictive understanding of processes and controls on sediment transport and the stratigraphic evolution of depositional systems, with applications in reservoir characterization, modeling, correlation, and source-to-sink predictions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

Research Thrusts

QCL researchers leverage 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 the evaluation of reservoir presence and quality in data-limited frontier basins and the 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.



Digital elevation model of exhumed Cretaceous channel belts in the Cedar Mountain Formation, Utah (Cole Speed).

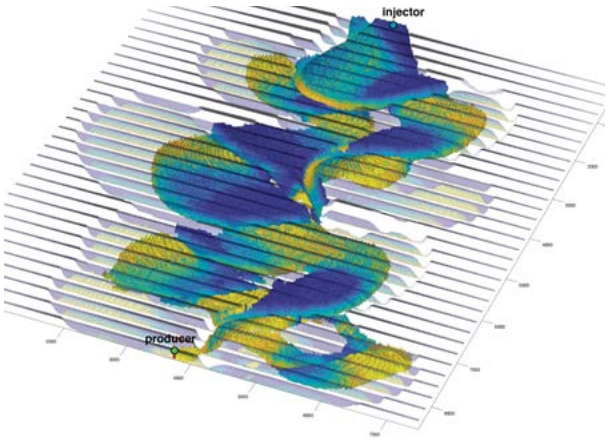


Structure map of a seismic horizon from the eastern Gulf of Mexico, showing the interaction between shelf-edge deltas, failures, and slope channels.

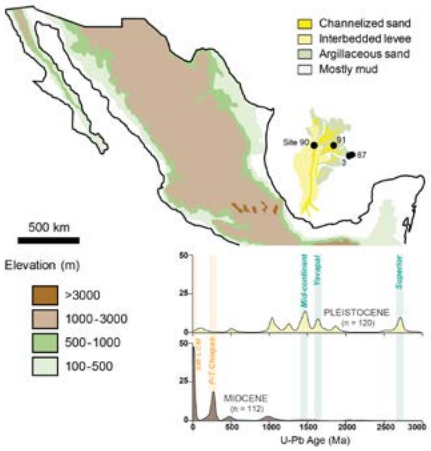
Quantitative Clastics Laboratory

Research Challenges

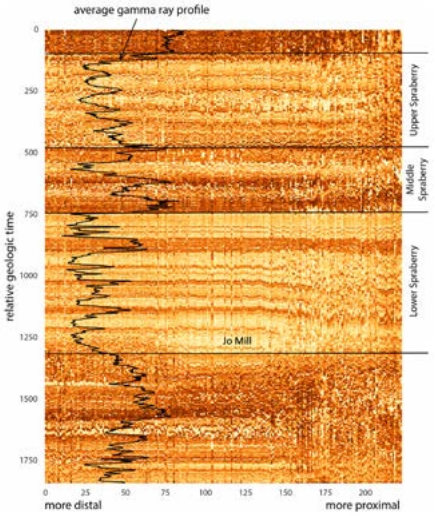
The QCL has two research themes: (1) reservoir-scale depositional system characterization, modeling, and flow simulation for a better understanding of processes that impact connectivity and heterogeneity; and (2) exploration-scale source-to-sink analysis to evaluate correlation, reservoir presence, and 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.



Flow-simulated reservoir model of a fluvial system that includes facies variability due to the presence of counterpoint bars.



Detrital-zircon geochronology to identify source areas for deep-water sands in the Gulf of Mexico.



Map showing well pairs used in correlation (left) and the resulting chronostratigraphic diagram for this part of the basin (right).

Membership

Each year's research calendar begins January 1 and runs through December 31. 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, investigations of multiple scales of depositional environments and their interconnections, and an evolving quantitative database on clastic-depositional systems architecture.

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Carbonate Reservoir Characterization Research Laboratory

Mission

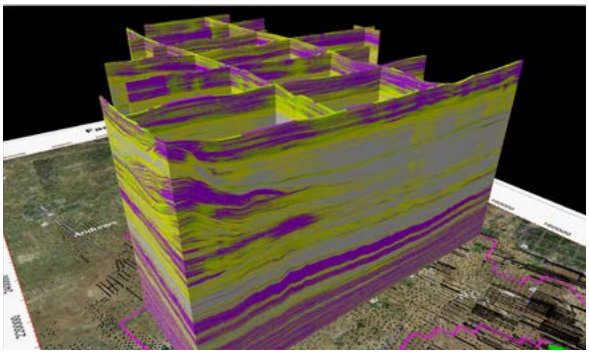
The Carbonate Reservoir Characterization Research Laboratory's (RCRL) mission is to use outcrop and subsurface geologic, geophysical, and petrophysical data from carbonate reservoir strata as the basis for developing new and integrated methodologies and concepts to explain and describe the 3D reservoir 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 nonmatrix 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

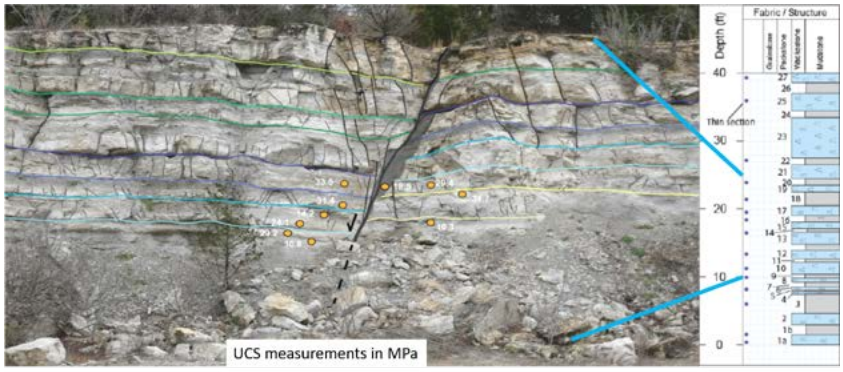
RCRL areas of investigation include Lower Permian shelf-to-basin stratigraphic and structural architecture of the Delaware and Midland Basins; Gulf of Mexico carbonate reservoir settings, pore systems, fracture character, and margin variability; Cenozoic carbonate platform systems, high-resolution stratigraphy, 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.

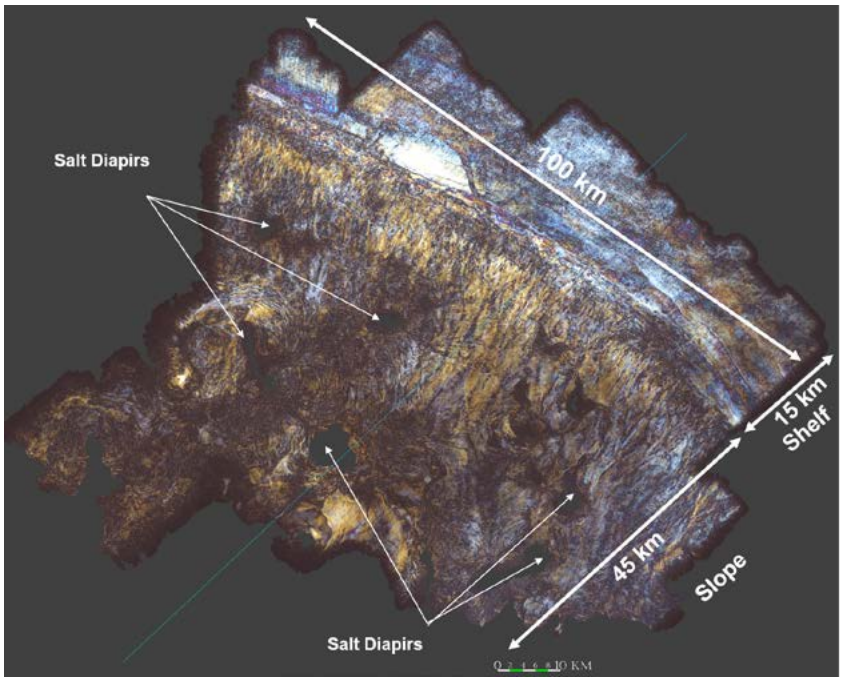


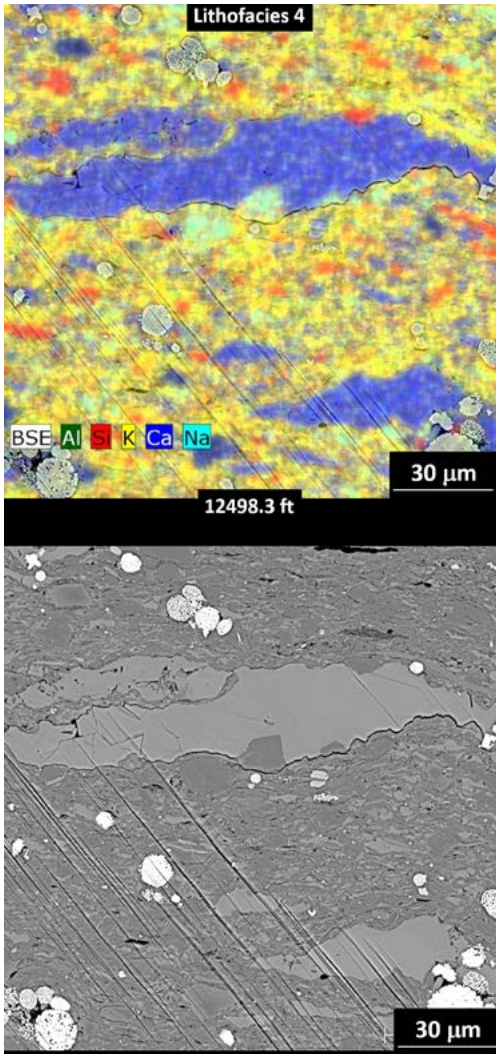
Carbonate Reservoir Characterization Research Laboratory

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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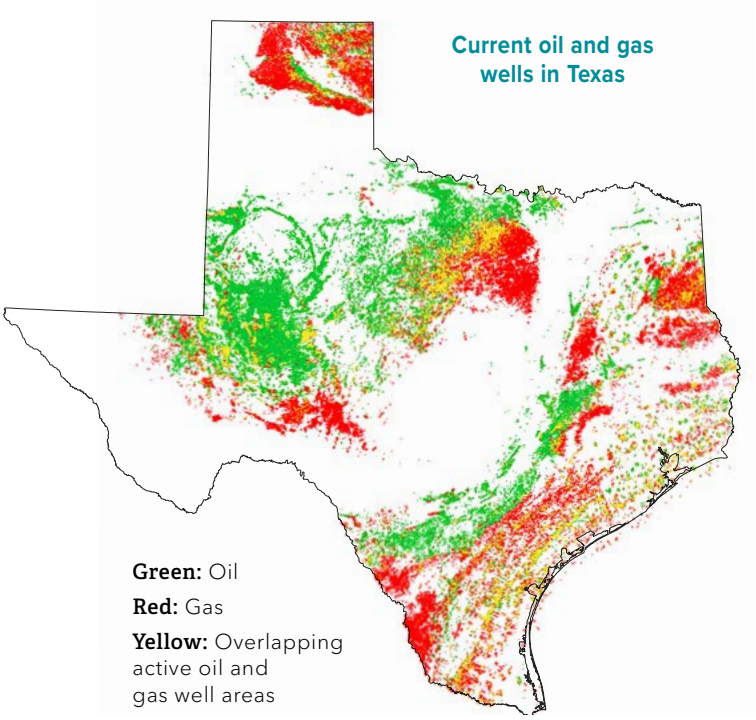
State of Texas Advanced Oil and Gas Resource Recovery

Mission

The mission of the Bureau's State of Texas Advanced Oil and Gas Resource Recovery (STARR) program is to conduct geoscience and engineering research to increase the profitability of earth resources within the State of Texas, including oil, natural gas, hydrogen, geothermal, and minerals, while encouraging responsible economic development and supporting education and environmental stewardship.

STARR carries out this mission by: (1) direct collaboration with operators in Texas who use our wide range of expertise; (2) pursuing detailed geological regional studies to identify factors controlling production; (3) undertaking integrated reservoir studies in collaboration with operators to advise on stranded oil and strategies to increase production from waterfloods and CO_2 floods; and (4) designing and formulating novel research projects associated with the broader gamma of energy resources in Texas.



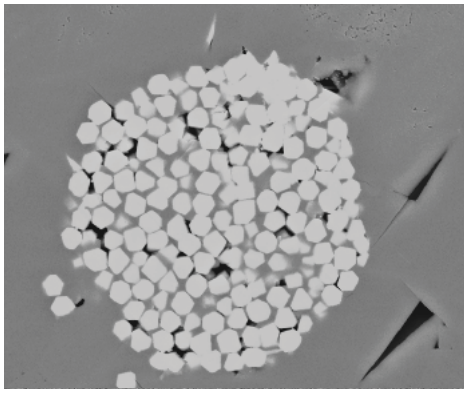
Research Thrusts

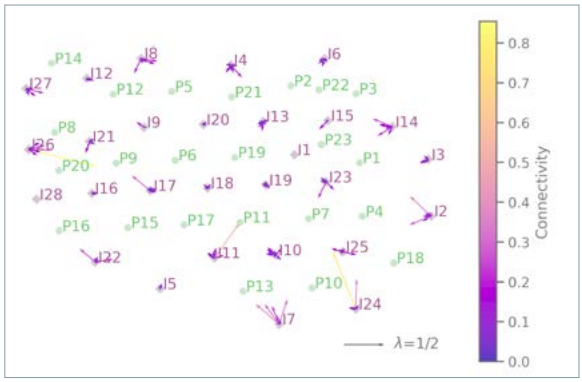
Research thrusts of the STARR program and ongoing technology transfer to operators in the Texas energy industry are focused on: (1) carrying out integrated geoscience characterization studies relevant to the oil and gas industry that span from regional to field scale (for both conventional and unconventional reservoirs); (2) developing improved oil recovery strategies, including optimization of waterfloods and CO_2 Enhanced Oil Recovery (EOR); (3) developing data and analysis to support carbon capture utilization and storage (CCUS) at field scale, including strategies to increase CO_2 storage, assess the effectiveness of caprock seals, and develop monitoring strategies; and (4) conceptualizing and developing geological, geophysical, and engineering projects to support the energy transition in Texas, including hydrogen storage, in situ-hydrogen generation, and geothermal energy.

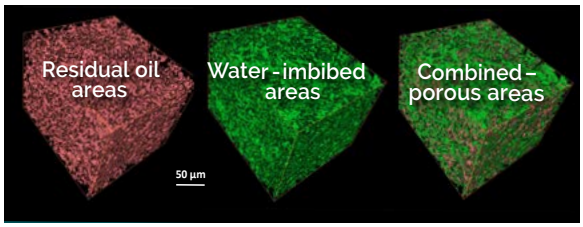
State of Texas Advanced Oil and Gas Resource Recovery

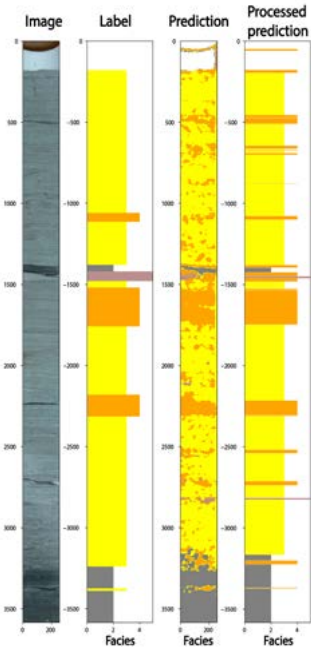
Research Challenges

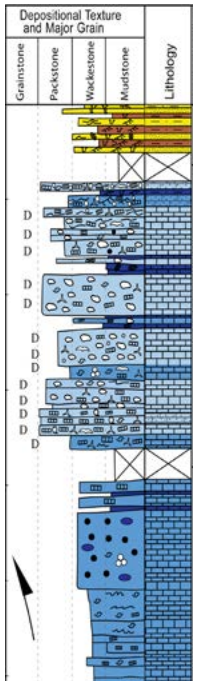
Challenges undertaken by the STARR team are wide and varied, ranging from explaining subsurface characteristics that control oil and gas production in Texas reservoirs to engineering challenges associated with identifying best enhanced recovery (EOR) practices that have the potential for increasing oil and gas production in Texas oil fields. Recently, STARR challenges have expanded into the understanding of how Texas subsurface resources can be positioned to play a role in the ongoing energy transition, aiming at increasing the diversification and resilience of Texas' energy industries and its economy.

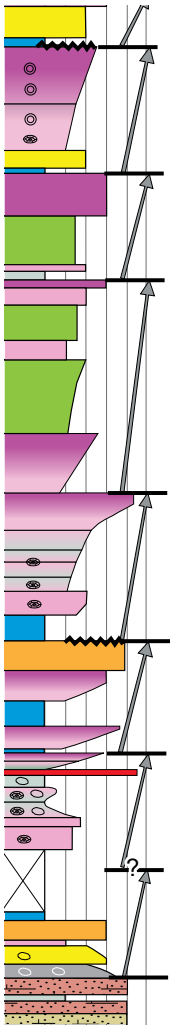












Membership

No costs are associated with participation in the STARR program, which is funded by the State of Texas, although matching support and willingness to facilitate publication of research results is encouraged. STARR partners receive a variety of technical products that include geological and geophysical interpretations that aim at explaining geological controls on reservoir quality and prospectivity, as well as engineering analyses that seek to improve resource recovery.

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Texas Consortium for Computational Seismology

Mission

The Texas Consortium for Computational Seismology (TCCS) is a collaboration between the Bureau and the UT Oden Institute for Computational Engineering and Sciences. The mission of 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.

TCCS develops in automating seismic interpretation, signal-processing, inversion, imaging, and carbon capture and sequestration workflows along with uncertainty estimation, estimating seismic properties using full waveform information, increasing the resolution of seismic reservoir characterization, and seismic acquisition with focus on simultaneous source separation.

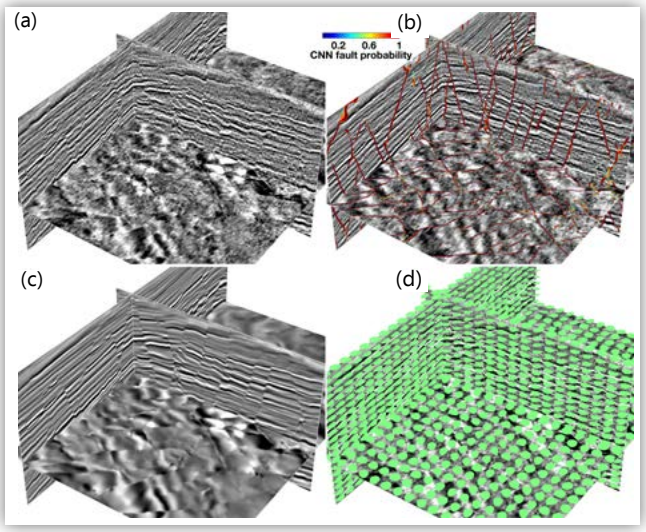
The TCCS group currently consists of people from 7 countries. Our research staff includes 2 principal investigators, 7 Ph.D. students, 1 M.S. student, 2 undergraduate students, and 2 visiting scientists.

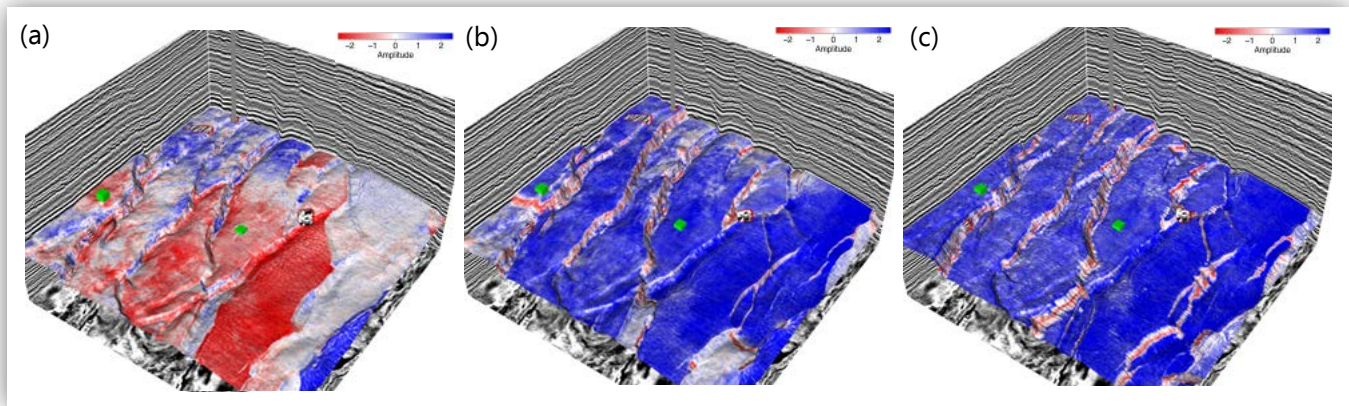
Texas Consortium for Computational Seismology

Research Thrusts

TCCS research areas include the following:

Automating seismic data interpretation, signal-processing, inversion, and seismic imaging workflows using supervised, unsupervised, and semi-supervised frameworks; uncertainty estimation using Bayesian convolutional networks; passive signal denoising using neural networks; deep learning for automatic velocity model building; variational method for picking velocity surfaces from semblance scans; enhancing seismic source separation with an apparition-inversion hybrid method; deep-learning workflows for carbon capture and sequestration; improving time-lapse measurements with simultaneous sourcing; multiazimuth seismic diffraction imaging for fracture characterization in low-permeability gas formations; and seismic-wave focusing for subsurface imaging and enhanced oil recovery.





Membership

The TCCS presents its findings to the sponsors in two research meetings per year and delivers written reports.

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

Contact

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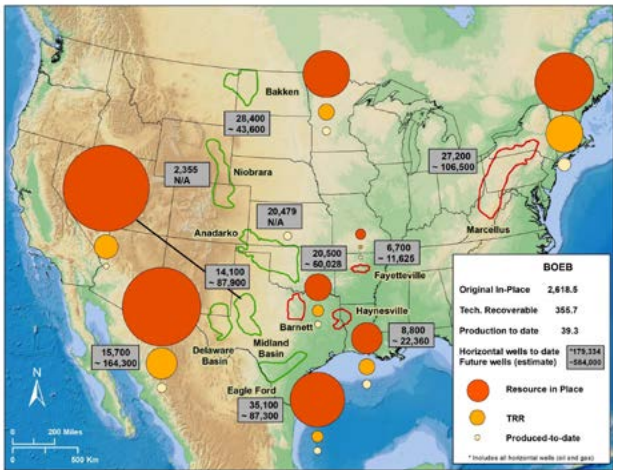
Tight Oil Resource Assessment

Mission

TORA is an industry supported consortium created in 2016 at the Bureau of Economic Geology to fund a multidisciplinary study of oil- and gas-producing horizons in the Permian Basin and other key US tight oil/shale gas plays.

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, and production forecasts with their environmental implications. TORA produces detailed basin maps highlighting areas of highest productivity, in place resources, and technically recoverable volumes based on a robust workflow to characterize the subsurface.

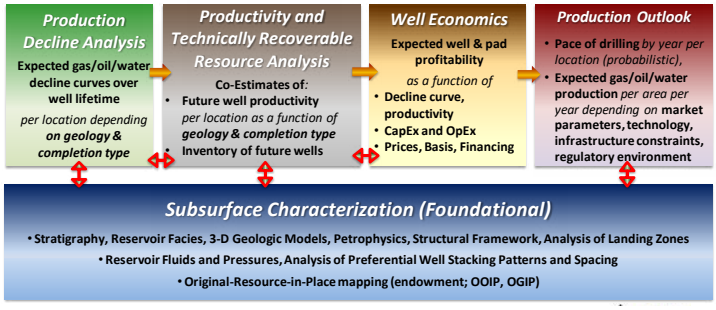


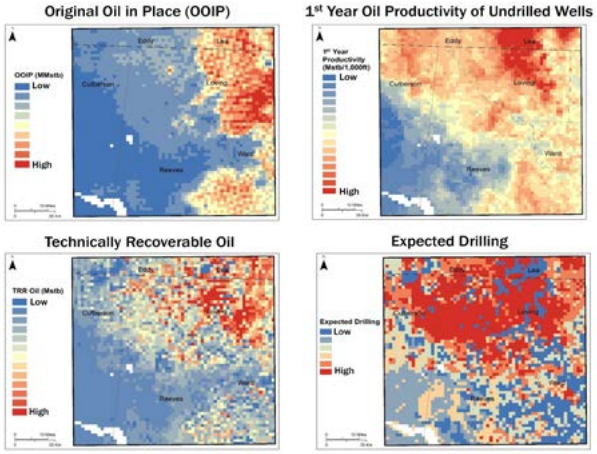
Basin-wide analysis of resources in place and technically recoverable resources for all main US tight oil/shale gas plays.

Research Challenges

TORA aims to build integrated, unbiased, market-independent basin outlooks. Our team employs a novel study workflow utilizing 3D geocellular models. That workflow ultimately defines hydrocarbon recoveries, play sweet spots, economic viability, and play-wide production rates. TORA studies tight oil and gas formations, such as the Spraberry, Wolfcamp, Bone Spring, Avalon, and others, in order to produce unbiased and comprehensive results. What makes TORA unique is the basin-scale scope of investigation, but with in place resource mapping (example below) and predictions of productivity, profitability, and future drilling at a 1 sq. mile scale.

TORA Workflow





Details of play-wide maps at 1 sq. mile resolution.

Tight Oil Resource Assessment

Research Thrusts

TORA employs multidisciplinary research and a highly iterative, resource-evaluation process. The key research disciplines are:

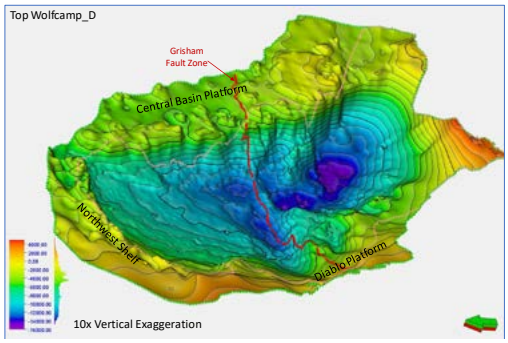
Geology and Petrophysics: We interpret the stratigraphic framework us ing digital-well-log correlations and core descriptions, resulting in a basin-wide 3D facies architecture based on in-house, detailed petrophysics. This framework is also used to calculate resource-in place volumes.

Engineering: We model fluid flow and phase behavior to estimate in place resources and recoverable volumes. We combine physics-based and data-driven modeling to project future production and estimate potential recovery of a well and the entire basin.

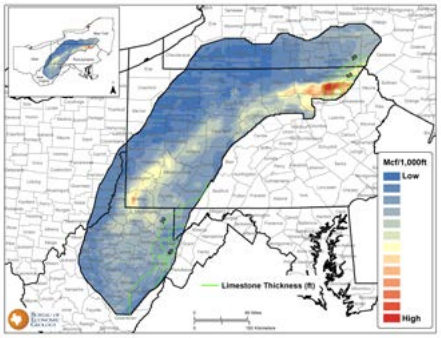
Data Analytics: We relate the productivity (per Hz ft) of existing wells to key subsurface and operational attributes and utilize this information to model the future productivity of all undrilled locations.

Economics: We develop the full range of expected production outcomes per well, technological and cost improvements, commodity prices, basis differentials (logistics), pace of drilling, well attrition, and lease accessibility, etc., in order to develop a view of profitability.

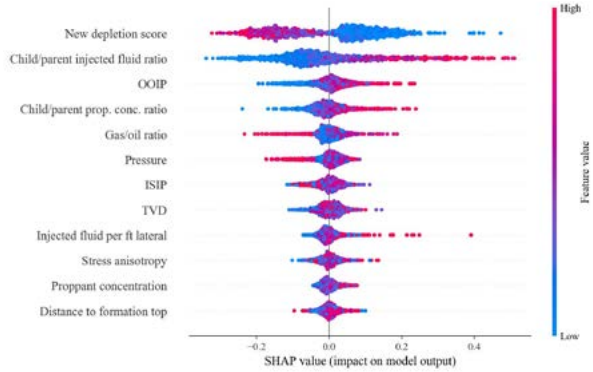
ARC-GIS: We use digital mapping to spatially link key geologic and operational practices to high productivity and resource-dense sweet spots.



Basin-wide 3D structure and facies in a geocellular model.



Productivity map for the Marcellus play, Appalachian Basin.



Feature analysis of the child/parent production ratio model.

Membership

TORA membership is $50,000 annually, with contributions leveraged by State of Texas support and other sponsor funding. Benefits include detailed geologic, petrophysical, engineering, statistical, and economic reports and insights; semiannual meetings and conference volumes; basin-scale 3D geologic models; shapefiles of basin-wide maps for integration with your own mapping; consultations with the TORA team; and consortium-supported data sharing between sponsors and the Bureau to address specific technical questions. Our sponsors include established operators in the basins we study, nonoperating partners, and companies looking to acquire new acreage.

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Notes

Notes

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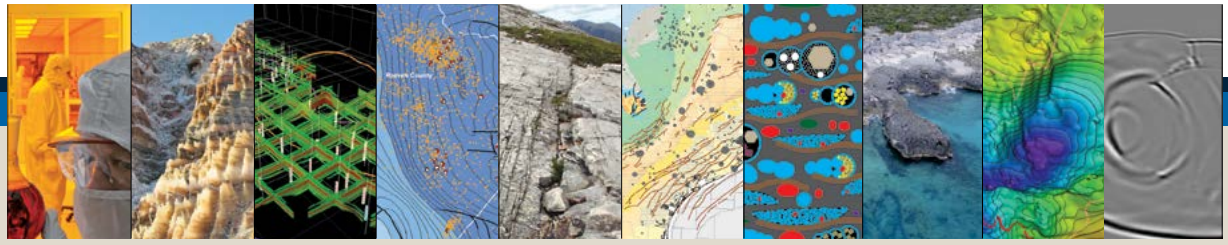
Research Consortia



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