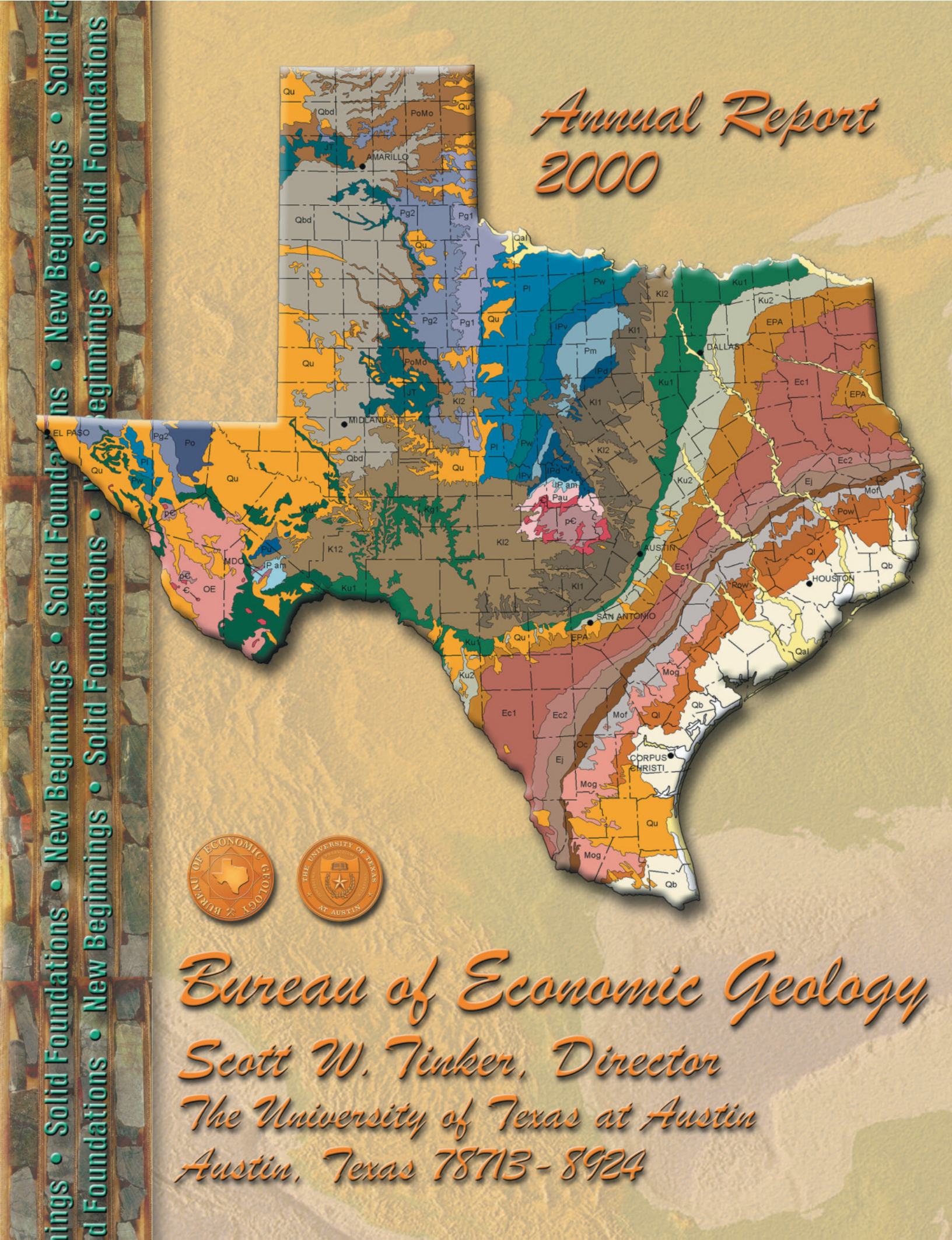
Annual Report
2000
Bureau of Economic Geology
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The University of Texas at Austin
Austin, Texas 78713-8924
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Bureau of Economic Geology

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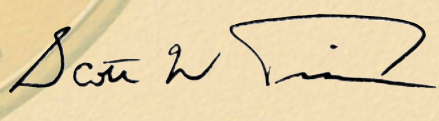
Contents

Director's Message

The Texas Bureau of Economic Geology, established in 1909, is the oldest research unit at The University of Texas. Across nine decades, the Bureau has had only seven Directors; I am the eighth. Each Director left a positive mark, a reflection of himself, on the organization. We are extremely fortunate that former Directors Dr. Peter T. Flawn and Dr. William L. Fisher remain actively involved with the Bureau as friends, mentors, and chairman and member, respectively, of the newly formed Bureau Advisory Committee. It is the dedication and spirit of women and men such as these that provide the "solid foundation" on which the Bureau home is built.

Within the Bureau home for nearly a century has lived a diverse, proud family, rich in a history that tells a story of strong patriarchs, dedicated aunts, quirky uncles, tragedy, triumph, conflict, perseverance, tradition, and loyalty. It is an honor to join the Bureau family, and after nearly a year, I have begun to elucidate our mission. If we maintain ethics in our approach, quality in our results, pride in our science, laughter in our halls, and an eye on "new horizons," then the Bureau family will flourish in the new millennium.



Highlights

A New Annual Report

Along with change in directorship at the Bureau of Economic Geology comes change in our annual reporting. The Bureau will now produce four annual publications, each with a specific purpose and design.

The retooled *Annual Report* is a new, condensed report intended to highlight selected Bureau projects, introduce staff, and disclose basic financial data. Our second publication, titled *Comprehensive Report*, is the familiar in-depth account of projects, people, activities, and services of the Bureau during the previous calendar year. Our third publication, another Bureau standby, is the *List of Publications.* Updated annually, our *List of Publications* contains every type of publication, including books, maps, and CD-ROM's, ever produced by the Bureau, plus pricing and ordering information. And completely new to the Bureau will be our fourth publication, a *Mid-Year Report*. The *Mid-Year Report* will showcase specific areas of Bureau research, as well as update the reader on Bureau activities during the first half of the current year.

In addition to printed publications, the Bureau's Web site is a substantial resource for anyone seeking information about the Bureau, its employees, research programs, public services, or the on-line purchasing of publications. Our Web-site address is http://www.beg.utexas.edu.

Advisory Committee

The Advisory Committee to the Bureau of Economic Geology was created in conjunction with the appointment of the new Bureau Director. Members of this 10-person committee represent a broad range of earth science interests. Meeting twice a year, the committee will receive quarterly reports from the Director, and in turn provide counsel and advice to him. The committee took time out from one of their meetings to pose for a photo. Pictured, front row, from left to right are Dr. Thomas D. Barrow, Chairman, Tobin International; Dr. Peter T. Flawn, Committee Chairman, and former Bureau Director and President Emeritus of the University; Mr. L. Decker Dawson, President, Dawson Geophysical Company; and Mr. Russell G. Slayback, Chairman, Legette, Brashears & Graham, Inc. In the top row, from left to right are

Dr. John R. Hopkins, Vice President, Conoco, Inc.; Mr. James A. Gibbs, Chairman, Five States Energy Company; Dr. Scott W. Tinker, Bureau Director; Dr. Juan M. Sanchez, Vice President for Research at the University (invited guest); and Dr. William L. Fisher, past Bureau Director (ex officio member). Absent when picture was taken are Mr. Don R. Boyd, independent geologist and oil operator; Dr. Charles G. Groat, Director, U.S. Geological Survey, U.S. Department of the Interior; and Mr. Mark S. Leonard, Shell EP International Ventures Inc.

A Growing Family

The Bureau hired 21 new staff members and researchers during 2000. Several of these talented people had been Bureau employees in the past, and we are happy to see them return. Others, including the Director, moved from cities and states spanning the country to be a part of the Bureau as it enters the new millennium.

High Technology

Using matching funds provided by the University's Vice President for Research, the Bureau purchased 15 new dual-monitor, dual-processor Silicon Graphics Octane visual workstations in June. Geoscientists throughout the Bureau use the SGI workstations to enhance geophysical, geologic, petrophysical, coastal, hydrologic, and engineering research.

LIDAR

The Coastal Studies Group took possession of its first LIDAR (Light Detection and Ranging) mapping system in September 2000. This mapping technology has already been used to map damage resulting from Hurricane Mitch in Honduras and to provide a baseline for monitoring change along the Texas

coast. The Optech ALTM 1225 LIDAR instrument combines GPS receivers, scanning optics, a pulsed laser, and an inertial measuring device for acquiring topographic data at 15-cm accuracy and submeter data-point spacing.

PEMEX

In May, the Bureau signed an agreement with PEMEX Exploration and Production that was 5 years in the making. A 12-member team of scientists from the Bureau is working in collaboration with PEMEX to study the Miocene-Pliocene sections of the Macuspana and Veracruz Basins of southern Mexico. Results from these high-profile studies will be used to help Mexico meet its natural gas needs in the coming years. The Bureau looks forward to a long-term, productive relationship with our neighbors to the south.

STARR & ULARI

The mission of the State of Texas Advanced Oil and Gas Resource Recovery (STARR) and University Lands Advanced Recovery Initiative (ULARI) programs is to increase incremental oil and gas recovery on State and University royalty lands. Multidisciplinary teams of experts apply high technology in order to understand the geology of producing oil and gas fields, while working in partnership with operators to increase hydrocarbon production. These programs have been extremely successful.

Permian Basin Core

The Midland Core Research Center (CRC) received 85,000 boxes of Permian Basin core, which was donated by Altura Energy, Ltd. A 13,500-ft^2 warehouse extension was added to the core facility to house this large collection of Permian Basin materials. The Midland CRC will soon store and manage all Permian Basin rock samples kept by the Bureau.

Generous Gifts

The Bureau gratefully accepted many technical and public-domain gifts this year. Cutting-edge software systems were donated to the Bureau by Landmark Graphics Corp.; Schlumberger-GeoQuest; Seismic Micro-Technology, Inc.; Green Mountain Geophysics; Geophysical Development Corporation; Hampson-Russell; Paradigm Geophysical; GeoGraphix; Flagship Geosciences; Geovariances; CMG; Terrasciences; Badleys Earth Sciences, Ltd.; and Dynamic Graphics, Inc. These software packages are essential to many of the Bureau's research activities. Multicomponent seismic research data were donated by 4Sight; Harken International, Ltd.; and Vecta Technology, L.P. Western Geophysical donated 2-D seismic data from offshore Kwanza Basin, Angola.

The Core Research Centers (Austin and Midland) received more than 87,000 boxes of core and cuttings from Altura Energy, Ltd.; Crescendo Resources, L.P.; J. M. Huber; Texland Petroleum; and Cabot Oil & Gas Corporation. The Bureau's Geophysical Log Facility received well log data from both individuals and corporations: the Lower Colorado River Authority, Horizon Resources, James E. Vause, and R. C. Wilshusen and R. D. White. These generous donations of rock material and well logs benefit the citizens of Texas.

Bureau Stars

One of the measures of quality to a scientist is recognition by his or her peers. **Robert Loucks** was awarded the Wallace E. Pratt Memorial Award for the best *American Association of Petroleum Geologists Bulletin* article published in 1999. **Charles Kerans** was granted an Honorary Life Membership by the Permian Basin Section of the SEPM (Society for Sedimentary Geology). **Lesli Wood** received the 2000 Excellence of Poster Presentation award at the American Association of Petroleum Geologists/SEPM (Society for Sedimentary Geology) Annual Meeting in New Orleans, Louisiana. **Jerry Lucia** spent part of the year traveling as an American Association of Petroleum Geologists Distinguished Lecturer. **Shirley Dutton** was awarded the A. I. Levorsen Memorial Award for Best Paper, which she presented at the 2000 Southwest Section, American Association of Petroleum Geologists, meeting in Midland, Texas. And **Milo Backus** accepted the Hollis D. Hedberg Award in Energy from the Institute for the Study of Earth and Man (ISEM) at Southern Methodist University.

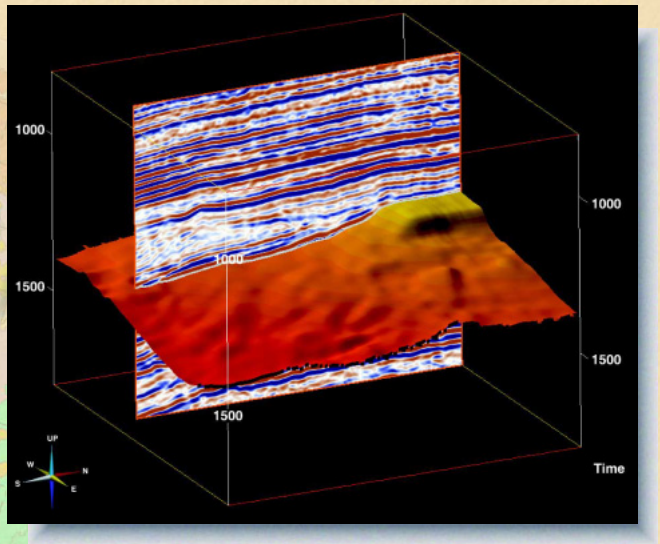
A Busy Place...

The Bureau conducted research on nearly 100 projects for 68 different funding agencies during the year 2000. We also trained nearly 800 teachers and provided classroom-related activities to more than 180 students at Bureau facilities and 1,000 students across the state. All of this activity resulted in the publication of nearly 80 technical papers, 5 books, 5 book chapters, and 8 copyrighted software packages. Bureau researchers also delivered more than 40 presentations at industry and earth science conferences throughout the world.

Energy Research at the Bureau

Industrial Associate Programs

Industrial Associate Programs at the Bureau represent a spectrum of basic and applied research. Industry sponsors provide annual financial gifts, in turn reaping benefits from annual meetings, seminars, and publications.



Reservoir Characterization Research Laboratory

Charles Kerans, F. Jerry Lucia, James W. Jennings, Jr., and William M. Fitchen

The Reservoir Characterization Research Laboratory (RCRL), supported by an industrial consortium since 1989, is a unique, integrated group of full-time researchers dedicated to the development of new techniques for characterizing worldwide carbonate reservoirs. RCRL comprises specialists in carbonate sequence stratigraphy and facies analysis, carbonate-rock-fabric facies analysis and petrophysics, 3-D geological modeling, and geostatistics and reservoir engineering.

The RCRL was founded on rock-oriented studies. Outcrop analogs form the basis of the group's understanding of the subsurface environment, recent examples of which include seismic-scale outcrop analogs of Permian and Pennsylvanian icehouse carbonate systems, where outcrops in the Sierra Diablo Range of West Texas (see panorama in photo below) and the Big Hatchet Mountains of New Mexico have provided a foundation for fundamental reinterpretation of 3-D seismic volumes. CT-scan images of vuggy carbonates are yielding data for evaluating this type of pore space quantitatively and determining how it affects permeability in carbonate systems. A third example of rock-based research is the ongoing effort to link rock fabric to relative permeability in carbonate systems. This link is fundamental to populating 3-D models of carbonate reservoirs with relevant distributions of petrophysical properties.

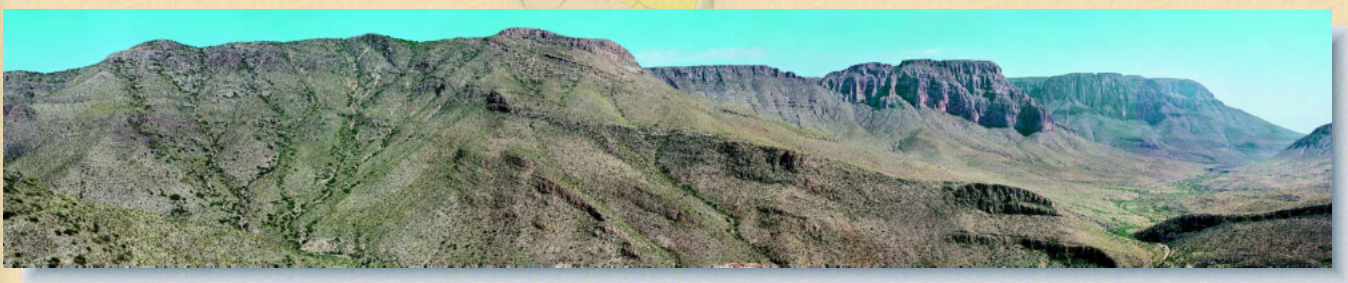
Note 3-D seismic model of the Abo Formation above, showing shelf-margin high in vibrant clarity.

The RCRL focused on six key areas in 2000: (1) construction of a digital database; (2) characterization of Cretaceous reservoirs; (3) a balancing of the ongoing efforts in the Permian Basin; (4) development of improved techniques for interpreting fundamental properties of saturation and permeability from wireline logs by using the rock-fabric approach; (5) construction of a detailed 3-D model of the South Wasson Clear Fork reservoir using rock-fabric-defined layering schemes; and (6) estimating the permeability of vuggy pore space, which represents one of the remaining frontiers in carbonate reservoir characterization.

Applied Geodynamics Laboratory

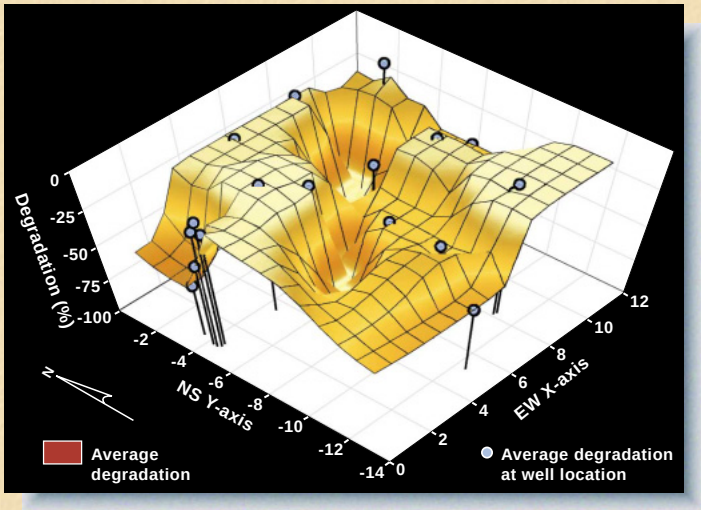
Martin P. A. Jackson, Bruno C. Vendeville, Daniel D. Schultz-Ela, Michael R. Hudec, and Randy L. Remington

The Applied Geodynamics Laboratory (AGL), supported by an industrial consortium since 1988, investigates tectonic processes relevant to the location, origin, mechanics, and evolution of structural hydrocarbon traps.



AGL research has two principal targets: tectonic modeling and seismic-based tectonic analysis. Physical and mathematical modeling embraces a wide range of gravity-driven tectonics involving complex combinations of extension, contraction, or strike slip that involves mobile salt or shale. Physical modeling is performed using computer-controlled rigs to simulate nearly every structural style in 2-D or 3-D; overhead photographs, serial sections, time-lapse videos, and CT scans are also used to reconstruct and analyze structural evolution. Mathematical modeling, using *ABAQUS* and *MARC* programs, enables researchers to perform 3-D forward modeling by simulating combined brittle and ductile deformation, large strains, faulting, fluid flow, and thermal effects.

Seismic-based analysis is being used to investigate salt tectonics and basin evolution along the Angolan Margin (see colorful cross section below). Using 2-D seismic data, well data, and potential-field data, researchers are investigating the clearly imaged, linked structural systems along the margin above salt (red in the cross section). New concepts derived and refined from this analysis are used as a key to understanding the poorly imaged subsalt structures in the Gulf of Mexico. Results are also integrated with those from the AGL modeling program. In addition, AGL scientists are integrating modeling with fieldwork on extensional salt tectonics in The Grabens, Utah.



Fracture Research and Application Consortium

Stephen E. Laubach, Randall A. Marrett (Department of Geological Sciences, The University of Texas at Austin), Jon E. Olson (Department of Petroleum and Geosystems Engineering, The University of Texas at Austin), Julia F. Stowell, Kitty L. Milliken (Department of Geological Sciences, The University of Texas at Austin), and Robert M. Reed

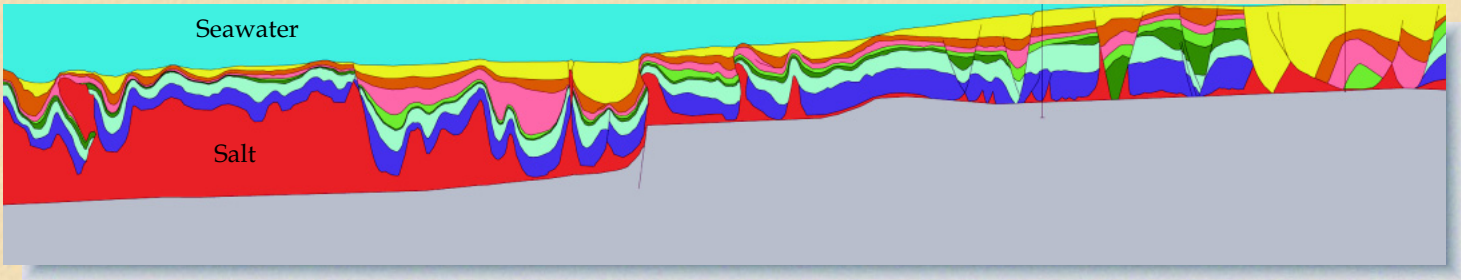
The Fracture Research and Application Consortium (FRAC), an industry-sponsored research association, aims to explain and successfully characterize, predict, and simulate reservoir-scale structures. The focus is on fractures and faults that influence the successful extraction of resources. Many fractures are below the limits of seismic resolution and are difficult or impossible to characterize adequately using currently available technology. Consequently, fractured reservoirs have been intractable to effective description and interpretation, posing serious challenges to successful exploration or development. The methods can be used for evaluating individual wells or, using data from many wells (see illustration), identifying field- or regional-scale fracture patterns and drilling fairways.

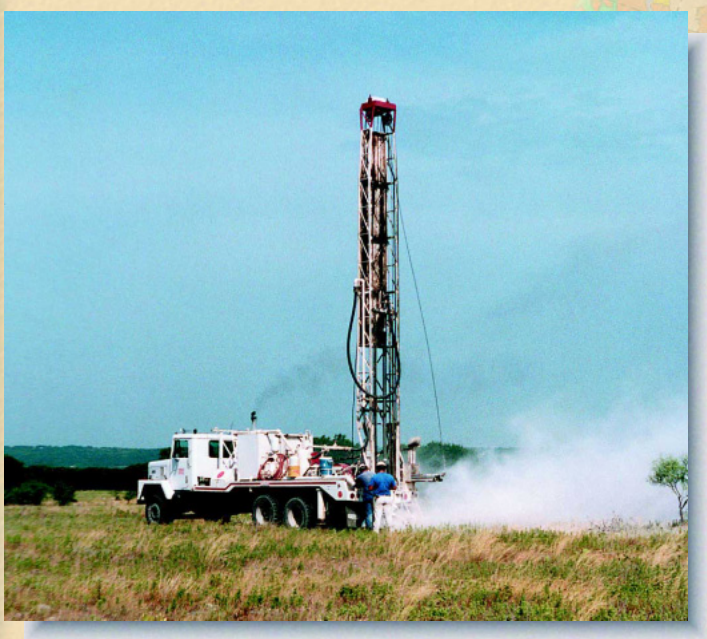
Exploration Geophysics Laboratory

Bob A. Hardage, Milo M. Backus, Robert J. Graebner, James L. Simmons, Jr., and Michael V. DeAngelo

The purpose of the Exploration Geophysics Laboratory (EGL) is to develop technologies that will image reservoirs using all components of the seismic wavefield. Research objectives are to develop seismic field-recording techniques and data-processing and data-interpretation software that will result in independent compressional-wave (P-wave) and shear-wave (S-wave) images of reservoir systems. If researchers combine information from P and S seismic images, more insight can be gained into petrophysical rock properties, pore structure, pore-fluid properties, sequence-stratigraphic relationships, and spatial distributions of lithologies, fractures, and anisotropic properties of complex reservoirs.

Donations by industry sponsors have provided the Bureau with equipment for two 2,000-channel seismic recording systems and access to a fully staffed seismic research crew. These Bureau resources are used to record nine-component,





3-D (9C3D) data over selected test properties. More than 40 mi² of 9C3D research data have been recorded across several onshore prospects. Multicomponent data recorded by ocean-bottom-sensor systems are donated by program sponsors to allow investigations to be extended into marine applications. Research strategy is for scientists to concentrate on the development of multicomponent data-processing and imaging technologies. The photo above shows the shothole drilling team in action preparing a site for dynamite charges.

Clastics

State of Texas Advanced Resource Recovery Project

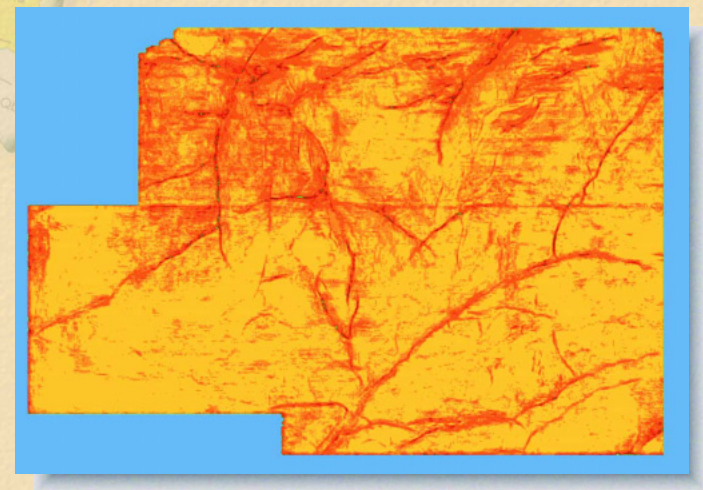
Robert G. Loucks, Bob A. Hardage, L. Frank Brown, Jr., Randy L. Remington, and Ramón H. Treviño III

The State of Texas Advanced Resource Recovery (STARR) project was developed to increase royalty income to the Permanent School Fund by working with operators to drill profitable wells on Texas State Lands. More oil and gas remains in State Lands fields than has been recovered over the decades-long history of State Lands production, and a large volume of this remaining oil and gas is recoverable through the use of advanced recovery technologies. To date, 15 State Lands fields have undergone, or are undergoing, characterization and extended development in collaboration with Texas operators under the auspices of this program. Of the targeted opportunities, 42 infill wells and 29 recompletions have been drilled on State Lands. Texas State Lands operators are invited to participate in project STARR, from which they can obtain, without charge, expert technical advice in developing State Lands oil and gas fields.

Targeting Reserve Growth Opportunities in the Northern Gulf of Mexico Basin: Transferring Secondary Gas Recovery Technology to the Offshore Environment

Lesli J. Wood, Tucker F. Hentz, Hongliu Zeng, Michael V. DeAngelo, and L. Frank Brown, Jr.

The Offshore Secondary Gas Recovery (Offshore SGR) project is a joint venture between the Bureau and the U.S. Department of Energy begun in 1998. It is a continuation of the nearly 9-year Secondary Gas Recovery program that has focused on identifying new technologies and processes to advance recovery of hydrocarbons from known fields. The current Offshore SGR initiative extends the program into the northern, offshore Gulf of Mexico (GOM) Federal Outer Continental Shelf (OCS), where nearly 10,000 gas- and oil-producing reservoirs are found in more than 1,000 fields. The research is more specifically focused on the Miocene-age reservoirs that comprise 42 percent of original proven reserves in the GOM. Because of the stratigraphic and structural complexity of the Tertiary-age section in this region, there is potential for enormous gas resources to have been bypassed even in densely drilled fields. The goals of the current Offshore SGR project are (1) to research processes, technologies, and methods for defining the geologic framework and hydrocarbon-system character of the northern GOM basin; (2) to design and implement the best practices for identifying and producing gas resources from the Miocene; and (3) to utilize knowledge gained in the project to predict bypassed opportunity and regional trends in Miocene hydrocarbon accumulation. In the Federal waters off the coast of Louisiana, scientists involved in the recent seismic study of reserve growth in the Gulf of Mexico Basin created a *coherency time slice* of faults



there (as depicted below left). It is anticipated that the project will ultimately add significantly to the current resource assessments in the region and provide operators and interested companies with a road map to success in the GOM on-shelf Miocene. Opportunities abound for significant publication of these research results.

Study of Evaluation of Tertiary Plays of the Central and Southeastern Mexico Basins

Edgar H. Guevara, David C. Jennette, William A. Ambrose, Dallas B. Dunlap, Shirley P. Dutton, William M. Fitchen, Khaled Fouad, Mark H. Holtz, Michael R. Hudec, Martin P. A. Jackson, Luis A. Sánchez-Barreda, Jianxin Shi, Suhas Talukdar (consultant), Timothy F. Wawrzyniec, and Joseph S. Yeh

A joint PEMEX Exploration and Production–Bureau of Economic Geology study of two basins in southern Mexico started in May. The objective of this 20-month project is definition of gas plays in the Miocene-Pliocene section of the on-land and offshore parts of the 9,100-km^2 Macuspana Basin and the 24,500-km^2 Veracruz Basin. The project's database includes 2-D and 3-D seismic surveys and core, log, engineering, and production data. The studies are being carried out by an interdisciplinary team that includes sequence stratigraphers, structural geologists, petrophysicists, and a petroleum engineer. Results of the study will help PEMEX define and focus its exploration efforts that are aimed at increased gas production and improved ultimate gas recovery from these siliciclastic reservoirs. Significant publication and presentation of results are anticipated. Moving toward that goal, team members in photo above crunch data at "PEMEX Central" here at the Bureau.

Carbonates

Integrated Outcrop and Subsurface Studies of the Interwell Environment of Carbonate Reservoirs: Clear Fork (Leonardian Age) Reservoirs, West Texas and New Mexico

F. Jerry Lucia, Charles Kerans, Stephen C. Ruppel, James W. Jennings, Jr., and Stephen E. Laubach

The U.S. Department of Energy funds this study of carbonate reservoirs, and matching funds are provided by the Reservoir Characterization Research Laboratory for Carbonate Reservoirs. The objective of this project is to investigate and develop improved engineering and geological methods for characterizing carbonate reservoirs for input into fluid-flow simulators to predict reservoir performance. The project is focused on investigations of interwell heterogeneity in Clear Fork reservoirs of the Permian Basin, West Texas and New Mexico. Data are being collected and analyzed from the excellent Clear Fork outcrops in the Sierra Diablo Mountains, West Texas, and from the important South Wasson Clear Fork reservoir in the Permian Basin. The study addresses three fundamental questions: (1) What are the best methods of predicting the distribution of high- and low-permeability rock-fabric facies? (2) What effect does the fine-scale heterogeneity located within rock-fabric flow units have on recovery? (3) What is the impact of natural fractures on reservoir performance in Clear Fork reservoirs?

University Lands Advanced Recovery Initiative

Stephen C. Ruppel and Jianxin Shi

The University Lands Advanced Recovery Initiative (ULARI), funded by The University of Texas System, works to develop new approaches to the characterization and exploitation of University Lands oil reservoirs in West Texas. The mission of ULARI is to increase oil and gas production in fields located on University of Texas System leases in the Permian Basin of West Texas. Funded by the System and in-kind support from oil and gas operators, studies have focused on 16 reservoirs to date, resulting in the production of more than 3 million barrels of incremental oil. In 2000, a new study was initiated in Barnhart field, an essentially abandoned Ellenburger reservoir in Reagan County, Texas. Field operators interested in assistance in characterizing and developing their University Lands oil and gas fields are invited to participate in the ULARI program.

Fractures

Geologic Characterization of Fractured Reservoir Block Size Using Microcrack Data

Stephen E. Laubach and Jon E. Olson
(Department of Petroleum and Geosystems Engineering, The University of Texas at Austin)

The goals of this fracture project, funded by the Advanced Research Program of the Texas Higher Education Coordinating Board, include characterizing fracture arrays in sedimentary rocks, relating fracture characteristics to fluid-flow observations, and relating fracture characteristics to the bedding architecture of the sedimentary rocks. Naturally fractured reservoirs represent a large but poorly understood resource in the State of Texas, as well as in other hydrocarbon-producing provinces throughout the world. Reservoir-scale fracture networks are difficult to characterize because fracture spacing is typically many times the diameter of a conventional borehole, and, consequently, in most cases well bores miss fractures. Because these fractures may nevertheless profoundly influence reservoir behavior, this sampling problem poses a serious challenge to fracture characterization and simulation. This project involves geomechanical modeling and other advanced modeling and characterization methods to improve prediction of fracture attributes in the interwell region. The project has successfully used microstructural fracture proxies to define the location of horizons having conductive fractures on a scale suitable for use in reservoir simulation. These results have been used to specify the vertical dimension of simulator cell blocks. Geomechanical modeling, calibrated according to subsurface fracture observations and new rock-property tests, specifies the spacing of fracture clusters in a way that can be used to define the lateral extent of cell blocks.

Geophysics

Characterizing Marine Gas-Hydrate Reservoirs and Determining Mechanical Properties of Marine Gas-Hydrate Strata Using Four-Component Ocean-Bottom-Sensor Seismic Data

Bob A. Hardage, James L. Simmons, Jr., Michael V. DeAngelo, Milo M. Backus, Robert J. Graebner, and Paul R. Knox

This geophysics research, funded by the U.S. Department of Energy, is based on two concepts: (1) marine gas-hydrate reservoirs can be characterized by using multicomponent seismic data better than by using single-component seismic data and (2) the elastic constants, shear moduli, and mechanical stability of strata that comprise and overlie marine gas-hydrate accumulations can be relatively determined when multicomponent seismic data are recorded across gas-hydrate targets.

The advantage of using multicomponent seismic data for evaluating gas-hydrate systems is that the integration of P and S seismic attributes provides more information about sequence relationships, lithofacies distributions, and pore-filler material than does the use of P-wave attributes alone. In addition, the P-wave velocity (V_p) and S-wave velocity (V_s) associated with a sequence can be used to calculate key elastic constants of the material within that sequence and thereby allow researchers to infer the shear modulus and mechanical strength of the material. A more detailed and informative characterization of marine gas-hydrate systems will thus result if gas-hydrate targets are described in terms of integrated P and S seismic data rather than just P-wave data, as is conventionally done in marine environments.

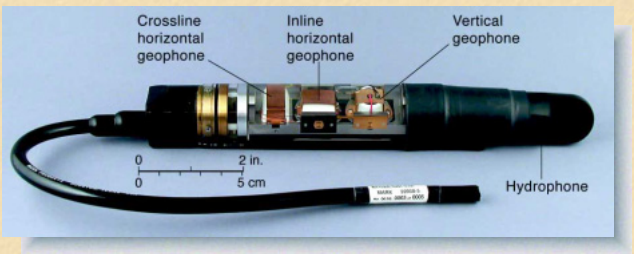
The principal barrier to imaging marine gas-hydrate systems using both P and S wavefields is the inability of S waves to propagate in fluids, and marine gas hydrates are concentrated in sediment that is overlain by rather deep water. This S-wave illumination problem is overcome in this program by our utilizing four-component ocean-bottom sensor (4-C OBS) technology to acquire the seismic data. See photo.

Devine Test Site

Bob A. Hardage, James L. Simmons, Jr., Milo M. Backus, Robert J. Graebner, James A. Doss, Jr., and George T. Bush

The Devine Test Site is a 100-acre property in Medina County, Texas, approximately 15 mi west of Devine, Texas, that the Bureau is upgrading into a world-class geophysical field laboratory. Key assets of the property are three wells, each 3,000 ft deep, that have been constructed for the specific purpose of downhole geophysical experimentation. An appealing feature of these wells is that two of them are cased in fiberglass, which allows downhole electromagnetic instruments to function as they would in an uncased hole without the impediment of steel casing. No fluid-exchange processes are occurring in the interwell spaces because the nearest oil production is several miles away.

The Society of Exploration Geophysicists has provided 3 years of financial support to help the Bureau upgrade facilities at the Devine Test Site. Several commercial firms pay low-cost fees to use the site for testing new geophysical equipment. Key activities of the Bureau's multicomponent seismic research are performed on the property.



Environmental Research at the Bureau

Water Resources

Hydrologic Needs Assessment and Technical Support for the Panhandle Regional Water Planning Area

Alan R. Dutton, Robert E. Mace, and Robert C. Reedy

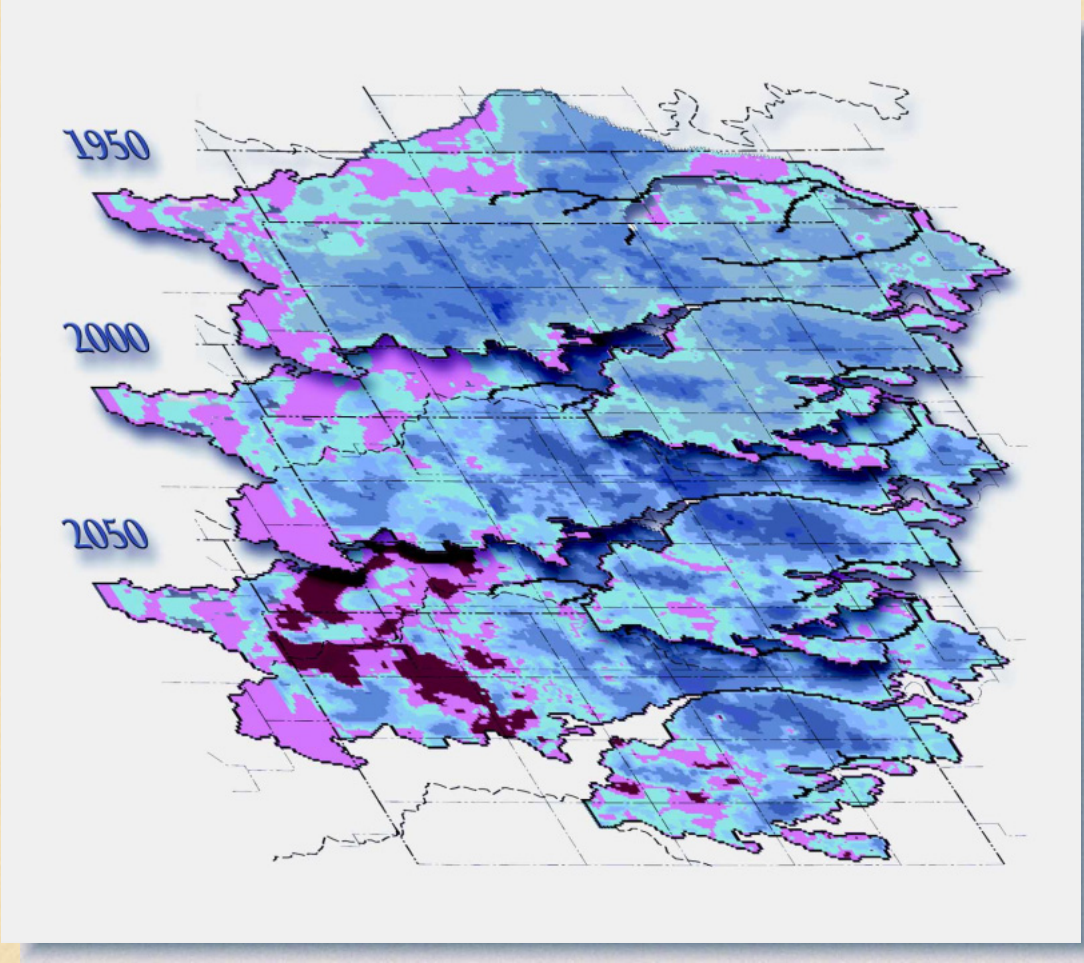
Researchers developed a computer model of the Ogallala aquifer in the north part of the Texas Panhandle to assess surpluses and deficits in aquifer resources in the Panhandle Water Planning Area (PWPA) (see illustration). This model improved on previous models by (1) covering the Ogallala aquifer within the PWPA at a more detailed resolution, (2) using more spatially controlled geologic and hydrologic data, and (3) placing model edges in such a way as to minimize their effects on the area of interest in Texas. Model calibration error was about 74 ft, errors occurring as a result of simplification of recharge, hydraulic conductivity, specific yield, base-flow discharge to rivers and springs, and historical pumping rates. This small error is less than 5 percent of the change in hydraulic head across the model. By means of projected ground-water demands, the model predicts that by 2050 major areas of the aquifer will have less than 50 ft of remaining saturated thickness and that parts of the aquifer in Dallam, Sherman, Hartley, Moore, Potter, and Carson Counties may be dry.

The scope of work also included training ground-water conservation-district staff in running the model to evaluate water-development projects.

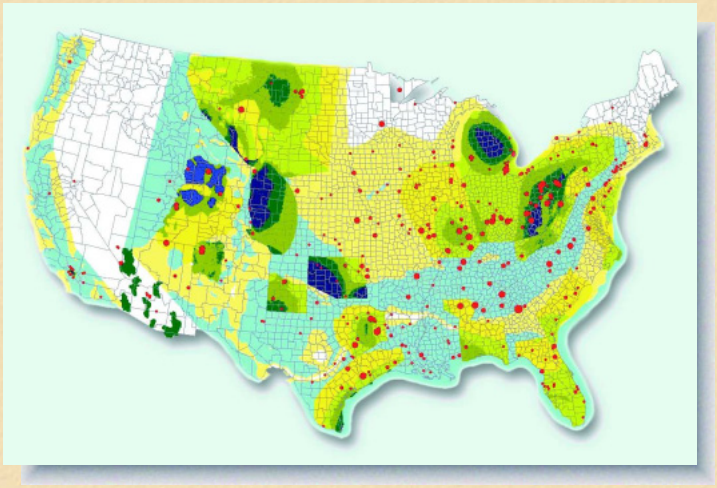
Ground-Water Recharge in Texas

Bridget R. Scanlon and Robert C. Reedy

Water-resource management is a critical issue in Texas because of diminishing supplies and projected rapid increases in population (19 million in 1997 to 36 million in 2050). Recent droughts in Texas have focused attention on recharge issues. To manage future water resources scientists must understand how much water is recharging the ground-water aquifer and how this recharge varies spatially within and between the nine



major aquifers. This project, conducted in collaboration with Dr. Marios Sophocleous (Kansas State Geological Survey), involved (1) development of a database of all existing information on recharge rates on the basis of physical, chemical, isotopic, and modeling techniques of the nine major aquifers in the state; (2) evaluation of the range of recharge rates for each aquifer based on the techniques used and examination of the appropriateness of each technique; (3) development of conceptual models for recharge processes in aquifers; (4) determination of which aquifers require additional recharge studies; and (5) recommendation of appropriate techniques for quantifying recharge in these aquifers. Conceptual models for the different aquifers are being developed, and various techniques for simulating ground-water recharge are being examined.



Environmental Quality

Optimal Geological Environments for Carbon Dioxide Disposal in Brine-Bearing Formations in the United States

Susan D. Hovorka, Martha L. Romero, Andrew G. Warne, William A. Ambrose, Ramón H. Treviño III, and Thomas A. Tremblay

Combustion of fossil fuels releases carbon dioxide into the atmosphere. International concerns about the impact that these anthropogenic changes have on global climate have led to researchers' evaluating options that could be used in the United States to reduce carbon dioxide emissions. The most widely available reservoir for carbon dioxide disposal is unused porous and permeable brine-bearing formations. In this study, funded by U.S. Department of Energy (DOE)/National Energy Technology Laboratory (NETL), researchers inventoried the geologic characteristics of 21 brine-bearing formations in the continental United States (see map) to provide basic data needed to assess the feasibility, costs, and risks of this sequestration method.

The compilation confirms that in many parts of the U.S., unused sedimentary rocks can be found at depths suitable for injection. In many areas, targets having high porosities of 20 to 35 percent, and thicknesses in excess of 100 m were identified, indicating that potentially large volumes of carbon dioxide could be stored. Data from areas that produce hydrocarbons can be used to make inferences about injectivity characteristics of brine formations.

Effectiveness and safety of geologic sequestration depend on the residence time of injected greenhouse gases. Residence time is controlled by (1) geologic properties of potential pathways for vertical escape through top-seal strata and (2) geochemical and hydrologic processes within the target strata. Seal strata that have the potential to isolate the injected gas from potable water or return to the atmosphere were identified in all target basins, as were potential pathways for escape. Detailed information for determining risks of leakage will require additional site-specific data collection and analysis. Residence times of saline brines are thought to be on a geologic time scale, but flow direction is variable. The brine-chemistry and rock-mineralogy data provided can be used to assess the potential for mineral sequestration.

Evaluation of Design, Monitoring, and Modeling of Engineered Covers for Waste Containment

Bridget R. Scanlon and Robert C. Reedy

Engineered covers are required to minimize infiltration into existing and future waste-disposal facilities and to reduce infiltration of water into contaminated sites. This technology is required by municipal and solid-waste landfills, hazardous-waste landfills, and at a variety of disposal and contaminated sites, including Department of Energy and Department of Defense sites. As agencies begin to realize that many of their sites cannot be remediated, containment and stabilization are becoming a viable alternative to remediation.

Engineered covers were installed in the Chihuahuan Desert of Texas. The purpose of our research here was to evaluate the performance of different cover designs through field monitoring and numerical modeling. The designs currently being evaluated include a restrictive barrier consisting of a geosynthetic clay liner on asphalt at 1.3-m depth and a conductive barrier consisting of a capillary barrier at 2-m depth. These covers have been vegetated and may also be considered evapotranspiration covers. Instrumentation systems were designed to monitor the water-balance components of the barriers, including precipitation, runoff, drainage, and changes in water storage. Potential energy is also being monitored to determine the direction of water movement.

Numerical simulations are being conducted by means of a variety of codes, in addition to simulations of data sets developed at other sites to evaluate plant transpiration aspects and the performance of covers in more humid settings. Results of these modeling studies will provide valuable information about which codes are most appropriate for different climates, soils, and vegetation settings. Verification and validation of numerical models are critical because we rely on numerical simulations to predict long-term performance of covers.

Coastal Processes

Evaluation and Validation of EO-1 and Landsat 7 Imagery through an Analysis of Land Cover/Land Use and Rates of Deforestation in Belize, Central America

William A. White, Jay A. Raney, Thomas A. Tremblay, Melba Crawford (Center for Space Research, The University of Texas at Austin), and Solar Smith (Center for Space Research, The University of Texas at Austin)

The Belize project, funded through NASA's Earth Observing-1 (EO-1) program, is a 2-year investigation that is designed to evaluate and validate a new satellite imaging system that was launched successfully on November 21, 2000, at Vandenberg Air Force Base on a Boeing Delta II launch vehicle (photo below taken by U.S. Air Force; see NASA's page, http://eo1.gste.nasa.gov). EO-1 is the first satellite in NASA's New Millennium Program Earth Observing series, whose mission is to develop and validate instruments and technologies for space-based Earth observations using unique spatial, spectral, and temporal characteristics previously unavailable. The Bureau and the Center for Space Research will evaluate the new imaging technology in Belize, Central America, where we have previously conducted remote-sensing studies in

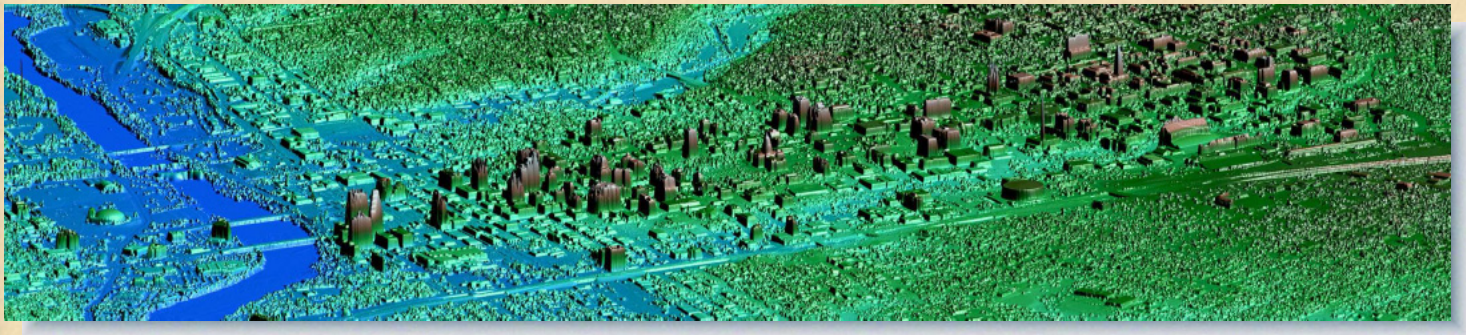
cooperation with the Government of Belize. Managing natural resources in poorly accessible, environmentally sensitive areas impacted by both natural hazards and anthropogenic effects requires remote-sensing data for mapping diverse land cover, such as in Central America. The investigation includes comparing multispectral, panchromatic, and hyperspectral data from EO-1 sensors with Landsat 7 ETM+ data in two areas of Belize where we recently completed studies of land cover/land use and deforestation using Landsat TM data. The proposed work will be conducted in cooperation with the Land Information Centre and Forest Department, Belize Ministry of Natural Resources and the Environment.

Classifying and Mapping Shoreline Types along the Lower Texas Coast: Laguna Madre and Baffin Bay Areas

William A. White, Thomas A. Tremblay, and James C. Gibeaut

Completed in 2000, this mapping project was funded by the Texas General Land Office as part of the Oil Spill Response and Contingency Planning effort by the natural resource trustee agencies in Texas. The purpose of this regional, comprehensive study was to characterize and map different shoreline types that occur along the Gulf of Mexico, in the interior bays, and along the Gulf Intracoastal Waterway. This project focused on the lower coast along Padre Island, Laguna Madre, and Baffin Bay and completed the shoreline mapping of the Texas coast (photo above shows riprap along shoreline at Brazos Santiago Pass, south end of South Padre Island). Results of the study will be used by State and Federal agencies responsible for managing coastal resources.

Shorelines were classified and ranked according to their sensitivity to oil-spill damage. For example, hard, manufactured structures such as seawalls exposed to high-



energy waves generally have low sensitivities to oil-spill cleanup activities, whereas wetlands (mangroves and marshes) have high sensitivities because of their importance as habitats for a variety of flora and fauna and because cleanup activities may be more damaging than the oil itself. The classification scheme also incorporates shore morphologies, slopes, composition, and wave exposure. Shorelines were classified on the basis of physical and biological attributes that had been determined from a variety of sources, including low-altitude color-video surveys taken in 1999 (by Louisiana State University Center for Coastal, Energy, and Environmental Resources), oblique color slides, digital orthophoto quadrangles, and field surveys. The mapped shorelines were digitized and the data formatted in a geographic information system (GIS) (ARC/INFO). Final products of the study include digital files of shoreline classifications, a report that describes shoreline types and presents examples from the study area, and a GIS layer that incorporates photographs of representative shoreline types in the South Texas study area. The final report was completed and submitted to the Texas General Land Office in July 2000.

High-Resolution Elevation Data Capture and Analysis for Honduras

James C. Gibeaut, Roberto Gutierrez, Rebecca C. Smyth, John R. Andrews, Jerome A. Bellian, and Andrew G. Warne

The purpose of the high-resolution data project, funded by the U.S. Geological Survey (USGS), is to conduct airborne Light Detection and Ranging (LIDAR) surveys of 15 selected sites in Honduras for use in flood-hazard assessments. This project is part of an effort by the United States to help Honduras recover from the devastation caused by Hurricane Mitch in 1998. Final results include providing accurate, high-resolution digital elevation models of the sites; developing methodologies for acquiring LIDAR elevation data in steep, vegetated terrain; and especially assisting the USGS and Honduran investigators in the applications of LIDAR and Global Positioning System (GPS) technology for hydrological, ecological, and slope-stability investigations.

A state-of-the-art Optech Airborne Laser Terrain Mapping (ALTM) system, together with a Beechcraft U-21 mapping aircraft, is used to gather and integrate three basic measurement sources: (1) laser ranges and associated scan-angle information; (2) aircraft altitude information from an Inertial Measurement System (IMS); and (3) absolute aircraft trajectory derived from a differential, geodetic GPS network. The digital elevation models derived from millions of laser data points collected during a survey have a horizontal resolution of 1.5 m and vertical accuracy of 15 cm.

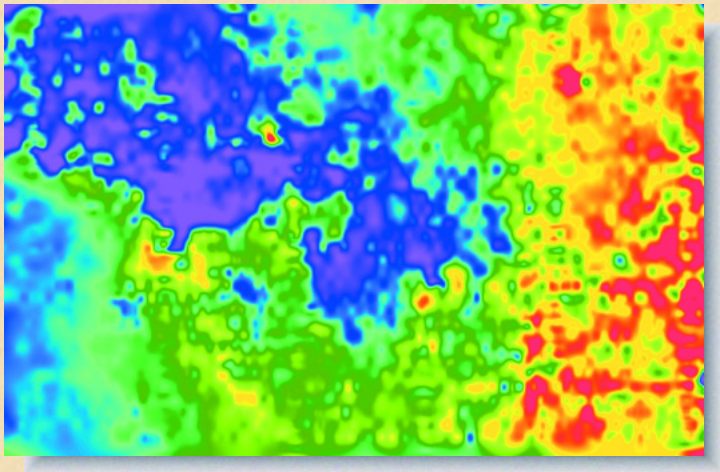
Texas Shoreline Change Project

James C. Gibeaut, William A. White, Tiffany L. Hepner, Thomas A. Tremblay, Roberto Gutierrez, John R. Andrews, Rebecca C. Smyth, and Jerome A. Bellian

In June 1999, Governor George W. Bush signed into law the Coastal Erosion Planning and Response Act (CEPRA). This act provides $15 million over the 1999–2001 biennium for coastal-erosion projects. It authorizes the Texas General Land Office (GLO) to implement a comprehensive coastal-erosion response program that can include designing, funding, building, and maintaining erosion projects. The Bureau, with funding from the Texas Coastal Management Program and CEPRA, is working with the GLO in a series of projects to identify and quantify eroding areas along the Gulf of Mexico and coastal bay shorelines.

The overall goal of the Texas Shoreline Change Project (TSCP) is to establish a state-of-the-art regional shoreline-monitoring and shoreline-change analysis program that will help solve coastal-erosion and storm-hazard problems along the bay and Gulf shorelines of Texas. The TSCP will (1) provide Texas with a comprehensive, up-to-date, digital database of historical shoreline positions and average annual rates of shoreline change and make the data available to the public through the Internet; (2) provide a regional framework for conducting local studies related to specific erosion-control projects; (3) provide data for assessing the susceptibility of the coast to episodic erosion and flooding by storms; and (4) make available observations on the causes of shoreline change and make them understandable to the general public through the Internet and paper reports.

During 2000, the Bureau conducted detailed topographic surveys of the Gulf of Mexico beaches and dunes using airborne Light Detection and Ranging (LIDAR). LIDAR surveys can rapidly provide the detailed, accurate, and continuous topographic models needed for assessing beach erosion. LIDAR instruments combine a scanning laser, a device that records aircraft motion, and high-accuracy Global



Positioning System (GPS) receivers to obtain a vertical accuracy of 8 to 15 cm and data-point spacing of less than 1 m. Researchers developed a method for extracting the shoreline position from the LIDAR data and are currently analyzing the topographic data to map storm-hazard areas. (The topographic map above left depicts the city of Austin.) Comparisons of shorelines mapped from historical vertical aerial photographs and LIDAR will provide average annual shoreline-change rates for the Gulf of Mexico shoreline. For the bay systems, shoreline positions are updated using 1990's digital orthophotos. A Web site showing shoreline-change data collected from various sources and using new ARC/INFO Internet Map Server software was developed (http://www.beg.utexas.edu/coastal/intro.htm).

Near-Surface Geophysics

Rapid Geophysical Identification and Assessment of Ground Water for the Lower Rio Grande Valley

Jeffrey G. Paine

The Lower Rio Grande Valley, subject to severe water shortages during droughts, urgently needs new ground-water resources. In a project funded by the Texas Water Development Board (TWDB) and the U.S. Bureau of Reclamation, Bureau and TWDB staff applied advanced airborne geophysical methods to delineate promising water-bearing subsurface units, estimate depth to water, and assess water quality of potential resources.

The airborne electromagnetic induction (EM) method, long used in mineral exploration, has been adapted successfully to identify salinized soil and water. The EM method detects changes in electrical conductivity of the ground caused by variations in sediment type, water saturation, and water chemistry. Water prospecting in the Lower Rio Grande Valley using EM exploits several known relationships. Sediments consist of interbedded sand, silt, and clay units deposited in the Rio Grande delta. The most abundant water resources are found in the sandy units. These sand bodies and adjacent clay-rich units have differing electrical conductivities. Once the sand bodies are delineated by using EM instruments, their measured electrical conductivities are used to estimate water quality.

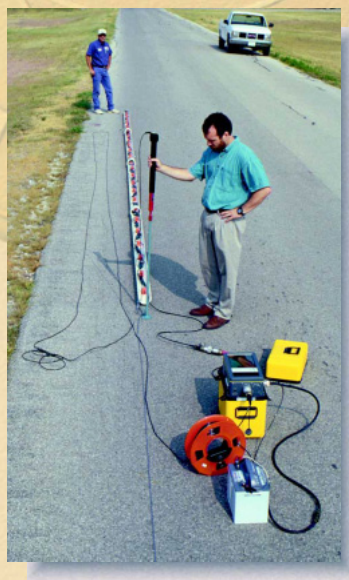
Researchers analyzed electrical-conductivity data from two 260-km^2 airborne geophysical surveys near Raymondville and Edinburg. The psychedelic image at left depicts conductivity at Raymondville. These data demonstrate that airborne EM can image shallow deposits and water quality can be interpreted from conductivity measurements. Principal products are a summary report and a CD-ROM that includes conductivity slices at selected depths, surface geology, water-well data, and maps showing favorable drilling locations.

Estimating Depth to Bedrock

Jeffrey G. Paine

Funded by the Texas Department of Transportation (TxDOT), Depth-to-Bedrock project researchers want to estimate depth to bedrock across the State of Texas by using available soil and geologic data combined with noninvasive geophysical tests. Depth-to-bedrock estimates, which are necessary for assessing pavement condition, are currently made from pavement measurements without benefit of information available on near-surface soils and rocks. Considerable effort has been expended over the last few decades by earth scientists to produce maps, cross sections, and soil profiles that focus on the upper few meters of the subsurface, a critical zone for road design and performance. These data provide a semiquantitative basis for determining regional and local differences in expected bedrock rigidity and depths to bedrock across Texas.

Bureau researchers designed, built, and tested a prototype seismic refraction instrument (the Seismic Refraction Bedrock Analyzer) to rapidly acquire more accurate information on bedrock depth and physical properties beneath pavement. Jeff Paine himself demonstrates in the photo. TxDOT employees will be trained to use this instrument routinely to monitor pavement and substrate condition. Other potential geological uses of the instrument include mapping bedrock in areas of poor exposure, detecting sinkholes, and establishing physical properties of rock types for engineering design and construction.



Geological and Terrain Mapping

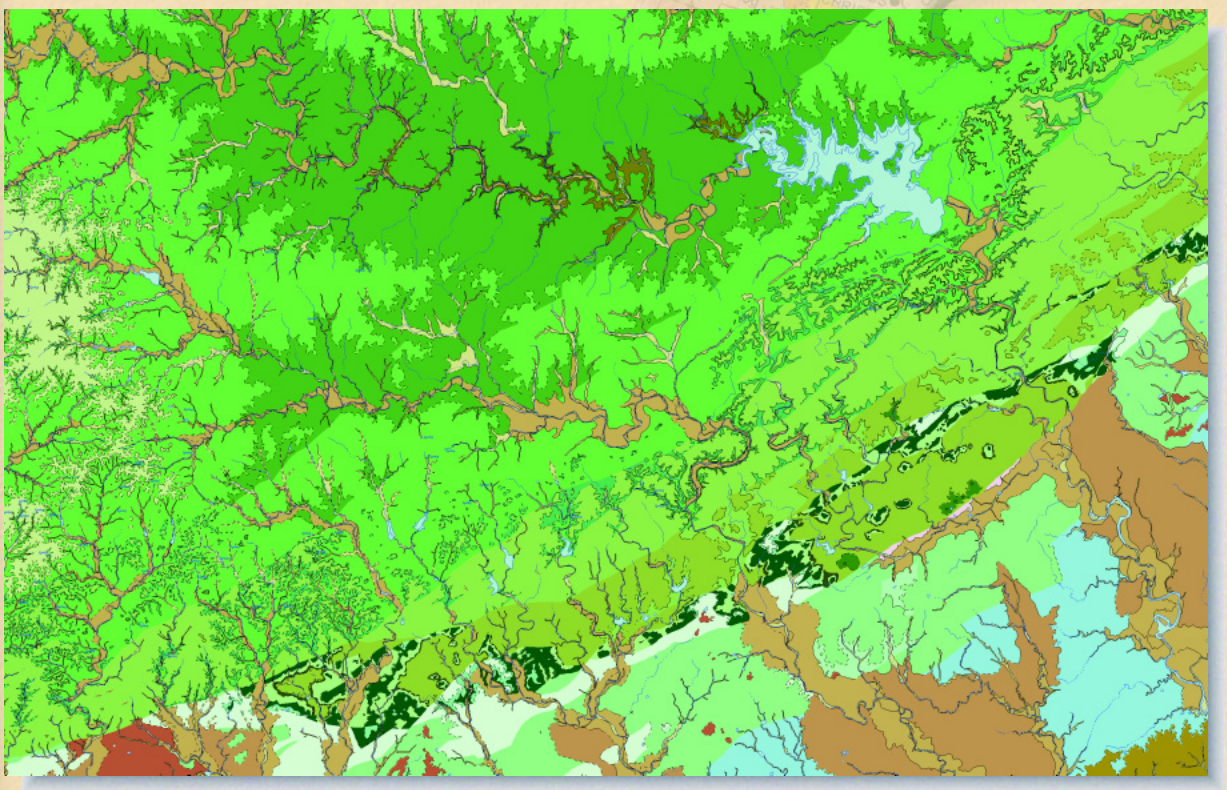
STATEMAP Project: Geologic Mapping to Support Improved Database Development and Understanding of Critical Aquifers of Texas

Jay A. Raney and Edward W. Collins

The objective of the STATEMAP program is to produce geologic maps that augment the Texas and national geologic map database. The project, part of the U.S. Geological Survey's (USGS) STATEMAP program, is funded jointly by the USGS and the Bureau. Work during 2000 was conducted in two Central Texas study areas: the corridor east of Austin and the Edwards aquifer area northeast of Uvalde, Texas. These geologic maps, drawn on a scale of 1:24,000, may be used to address issues related to urban growth, land use and Earth resources, water quality, ground-water management, construction practices, engineering properties of near-surface materials, and public education regarding utilization of Earth resources and sound environmental practices.

The corridor east of Austin, which is undergoing rapid urban growth, lies within a major aquifer of Texas known as the Carrizo-Wilcox aquifer. Geologic units of the area include Upper Cretaceous marine limestone, marl, and calcareous mud units, as well as Paleocene and Eocene sand- and mud-rich units. Lignite intervals exist within the Wilcox Group, and mining and related land reclamation have occurred for a number of years. Gravel and sand deposits (upper Tertiary to Quaternary) and Quaternary terrace deposits of the southeast-flowing Colorado River also occur. The east half of the area contains the northeast-striking Milano Fault Zone, composed of normal faults that form multiple grabens along the zone. The map area also includes two State parks and the Colorado River.

The Edwards aquifer area northeast of Uvalde, Texas, is an important part of the San Antonio segment of the Edwards limestone aquifer and its recharge and contributing zone. Geologic units of the area are dominated by Cretaceous shallow-marine shelf deposits onlapped by chalk and calcareous, clastic-slope sediments. Upper Cretaceous intrusive igneous rocks exist, as well as Upper Cretaceous limestone, marl, and shale. Upper Tertiary and Quaternary gravel and sand deposits locally overlie the older strata. The north part of the study area consists of Lower Cretaceous limestone, dolomitic limestone, dolomite, argillaceous limestone, and marl of the Glen Rose Formation and subdivisions of the Edwards Group. Glen Rose strata make up the upper part of the Trinity aquifer. Normal faults of the Balcones Fault Zone cross the central part of the study area. These faults are the main structural control on the geology of the region and on the Edwards aquifer and recharge zone. The map below is part of the New Braunfels, Texas, 30 × 60 minute quadrangle published this year by the Bureau.



Public Outreach

Education

Web-Based Educational Modules Describing Reservoir Characterization Technology

Bob A. Hardage, Scott D. Rodgers, William A. Ambrose, John R. Andrews, Robert E. Barba (consultant), Shirley P. Dutton, Tucker F. Hentz, Mark H. Holtz, Kerza A. Prewitt, and Lisa E. Remington

The Bureau is working with the American Geological Institute (AGI) to develop Web-based educational modules that cover all aspects of reservoir characterization. The modules are structured around real data sets that illustrate the principles of reservoir characterization for fluvial depositional environments.

The philosophy of this educational program is to create interactive, game-theory-based modules on the Internet that will allow students to interact with geological, geophysical, and engineering data; make data interpretations; and then receive instruction, depending on the correctness of their answers.

The program will be offered by AGI. The Bureau's role is to provide the data required for the instruction, create the text and graphics needed to explain the concepts of reservoir characterization, and format the material into a series of interactive modules that can be accessed by Web users.

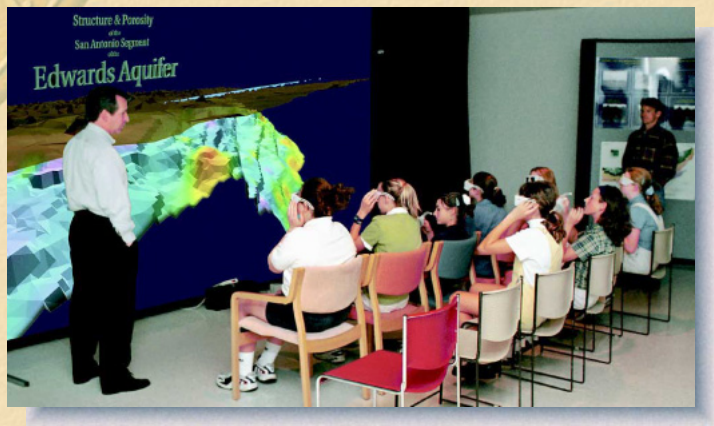
Earth Science Week

Sigrid J. Clift, Scott W. Tinker, and Carol Knepp (Wild Basin Wilderness Preserve)

Earth Science Week was established by the American Geological Institute in 1998 as part of its mission to increase public awareness and understanding of the earth sciences. It is an annual event, celebrated in the United States and around the world, during the first full week of October. Earth Science Week (ESW) gives geoscientists, teachers, youth leaders, and parents opportunities to help students explore and discover connections between their lives and the Earth.

To celebrate ESW 2000, the Bureau, together with members of the Austin area Earth Science Week Consortium, held the first annual ESW Career Fair Day at the Bureau's headquarters on The University of Texas at Austin J. J. Pickle Research Campus. More than 300 Austin middle school students spent the day with geologists, geophysicists, paleontologists, hydrologists, meteorologists, geochemists, museum curators, space scientists, engineers, and educators, who gave 20-minute oral presentations and/or hands-on demonstrations of their work. The students took a virtual-reality 3-D tour of the Edwards aquifer, learned the basics of the Global Positioning Satellite system, watched the sampling of water from a monitoring well, and were thrilled to see onsite faceting and polishing of gemstones.

More than 40 Bureau staff members participated in ESW Career Fair Day, making it a real Bureau team effort. For more information about Earth Science Week, visit the Texas Earth Science Week Web site at http://www.txearthsciweek.org.



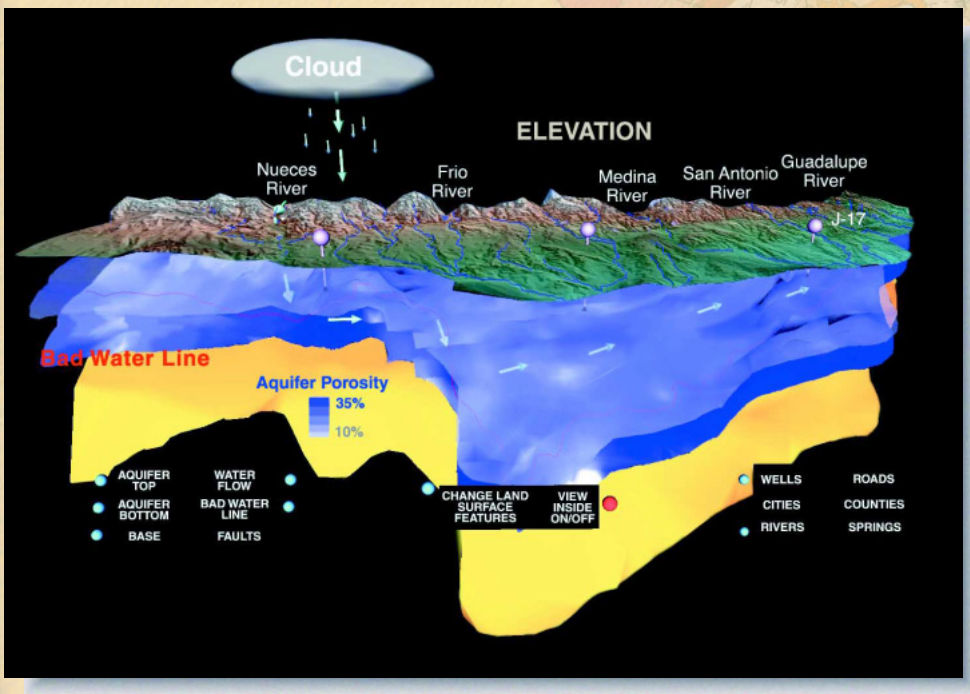
Using GIS Technology to Explore Earth Systems and a Virtual Tour of the Edwards Aquifer

Susan D. Hovorka, John R. Andrews, and Scott D. Rodgers

This Geographic Information System (GIS) project in exploring Earth systems demonstrates a mechanism for bringing geologic research into the classroom to involve students in current geoscience issues. The Bureau participated in a partnership led by ActiveInk Corporation, a start-up at the Austin Technology Incubator, to supply participating public school districts with Web-based interactive projects. This project was funded by a Technology Integrated into Education grant managed by Fabins Independent School District.

Scientists contributed two elements to the Web-based curriculum. One element consisted of newly digitized GIS data of geologic maps from the Border Advanced Technology Program and STATEMAP project to provide students with geologic maps of their local area. Complementing the geologic maps was a wide variety of contextual information, including satellite images; contours and shaded relief maps; soil characteristics; and land use/land cover, vegetation, and cultural features to encourage students to explore for relationships among data sets. ActiveInk then provided the maps to the schools as part of the curriculum.

The second element that scientists provided the project was a VRML model of the Edwards aquifer. This 3-D model can be manipulated by students on the computer screen (see below) to explore the relationships between human activities at the surface and resources in the aquifer. Data are derived from a previously completed Bureau study of the structure, porosity, and permeability of the aquifer so that students are looking at accurate and current data. Just as for the map data, ActiveInk integrated the model with various activities and experiences for the students.



Petroleum Technology Transfer Council (PTTC)

Scott W. Tinker, Sigrid J. Clift, Sylvia J. Jennette, and Amanda R. Masterson

The Bureau is the Texas Regional Lead Organization (RLO) for the Petroleum Technology Transfer Council (PTTC), a national nonprofit organization formed in 1994 to identify the technological needs of domestic independent oil and gas producers and then to transfer upstream technology to them. This program is funded primarily by the U.S. Department of Energy's (DOE) Office of Fossil Energy through the National Petroleum Technology Office and National Energy Technology Laboratory.

Technical information transferred by the PTTC to producers comes from all sectors of the research and development community, as well as from intermediary providers of technology such as the government, universities, DOE, the Gas Technology Institute (formerly Gas Research Institute), professional and trade societies, national laboratories, private companies, and the service industry.

The Texas PTTC Resource Center, which began operation in 1995, includes the Bureau's reading room, map room, geophysical log facility, and core research centers located in Austin and Midland.

In its capacity as the Texas RLO, and in cooperation with the Texas Independent Producers and Royalty Owners Association (TIPRO), the Bureau maintains the Texas PTTC Web site at www.energyconnect.com/pttc/, which has useful information for the independent operators of Texas, such as upcoming events and a quarterly newsletter titled *ProducerNews*.

During 2000, the Texas PTTC sponsored or cosponsored 15 workshops across the state. Topics ranged from low-cost vapor recovery to filing of drilling permits with the Railroad Commission of Texas via its Web site; these workshops provide small operators with proven technologies to assist them as they work to produce more oil and gas.

Information Resources

Core Research Centers

The Core Research Center (CRC) in Austin and the Midland Core Research Center (MCRC) are research and storage facilities managed by the Bureau to house core and rock material donated to The University of Texas. More than 12 industry and academic institutions donated core to the CRC in 2000. The centers are managed by Curator George Bush, who assisted more than 170 visitors during 2000.

The CRC, the Bureau's central core repository, is located adjacent to Bureau headquarters on the University's J. J. Pickle Research Campus. This 95,000-ft^2 facility contains more than 500,000 boxes of core and 750,000 boxes of well cuttings and outcrop samples.

The MCRC became Bureau property in 1994, when Shell Oil Company donated its core lab, containing 450,000 boxes of core, well cuttings, and outcrop samples, to the University. In September 2000, the facility received 85,000 boxes of West Texas Permian Basin core donated by Altura Energy, Ltd. A 13,500-ft^2 warehouse extension was built to store this additional material, which will soon store all Permian Basin rock samples maintained by the Bureau.

Both facilities are open to the public Monday through Friday from 8:00 a.m. to 5:00 p.m. Public facilities include core examination rooms, processing rooms for slabbing core, and office space. For-a-fee services, such as core photography, are available, as are computer printouts and CD-ROM-based CRC inventories. Should visitors conduct any type of sample analysis on the material, the Bureau asks that they provide a copy of the results within 1 year of finishing their research. This information will become part of the CRC's reference material. For information, please call the Austin CRC at 512-471-0402 or visit the Bureau's Web site at http://www.beg.utexas.edu.

The Data Center

The Data Center houses the Bureau's large collection of maps, periodicals, publications, reports, well logs, and open-file materials available for public use. Geologist Sigrid Clift serves as both the Public Information Geologist and manager of the Data Center, which includes the Reading Room and Geophysical Log Facility.

Public Information Geologist

As a public institution, the Bureau receives questions about the geology, energy, and land resources of Texas from people and organizations in Texas and throughout the world. Geologist Sigrid Clift handles the daily appeals for facts and resources. Members of the Bureau's geoscience research staff also provide advisory and technical services. For information, please call the Public Information Geologist at 512-471-0320 or e-mail sigrid.clift@beg.utexas.edu.

Reading Room

The Reading Room is an open-file document storage section containing a large collection of geologic reference materials. These materials include periodicals, maps, well logs, and reports from various governmental and nongovernmental earth science entities. The Reading Room is open to the public Monday through Friday from 8:00 a.m. to 5:00 p.m. and is located on the first floor of Bureau headquarters in Austin. For information, please call the Public Information Geologist at 512-471-0320 or e-mail sigrid.clift@beg.utexas.edu.

Geophysical Log Facility

The Geophysical Log Facility is the repository for geophysical data received from private donations, Bureau research projects, and the Railroad Commission of Texas, which by law receives a copy of geophysical logs from every new, deepened, or plugged well drilled in Texas. The facility is supervised by Daniel Ortuño, who manages both the numerous daily requests for copies of well logs and the flow of new geophysical data into the facility.

Geophysical data available for public research include wireline electric logs, well records, and scout tickets from hundreds of thousands of wells located in Texas. Sample logs from the 1930's through the 1950's are also stored in the facility and are available for public research. Requests for copies of logs can be made in person or by mail, telephone, fax, or e-mail. For information, please call the Geophysical Log Facility manager at 512-471-7139 or e-mail daniel.ortuno@beg.utexas.edu.

Publication Sales

The Bureau publishes and sells maps and reports of research conducted by Bureau staff from 1915 to the present. The office of Publication Sales, under the guidance of Publication Sales Manager Amanda Masterson, receives and processes a daily stream of publication orders. Bureau publications include reports of investigations, guidebooks, handbooks, cross sections, maps, oil and gas atlases, seismic data sets, geologic folios, geologic atlas sheets, page-sized maps of Texas, and classroom teaching aids such as rock kits. Out-of-print publications and most contract reports produced by the Bureau are also available for purchase. Best-sellers for the year 2000 included geologic atlas sheets, guidebooks, page-sized maps, and open-file STATEMAP maps.

The office of Publication Sales is located on the first floor of Bureau headquarters in Austin and is open to the public Monday through Friday from 8:00 a.m. to 4:30 p.m. Orders for publications can be placed in many ways: telephone (512-471-7144), toll-free in the USA (1-888-839-4365), toll-free fax in the USA (1-888-839-6277), e-mail amanda.masterson@beg.utexas.edu), and Internet (http://www.beg.utexas.edu). The Bureau accepts cash, checks, money orders, major credit cards, and international wire transfers.

Free copies of the current year's *List of Publications*, *Annual Report*, and *Comprehensive Report* are available upon request.

Support Staff

Assistant to the Director

Wanda LaPlante serves as assistant to the Director. Her endless talents, combined with 24 years of Bureau experience, have greatly contributed to the Bureau's seamless change of directorship.

Administrative

Senior Administrative Associate Glynis Morse supervises the administrative staff responsible for general management of the Bureau. This dedicated group of people take care of payroll, personnel, accounts payable and receivable, purchasing, travel and reimbursement, and countless other matters for the Bureau's 100+ employees.

Contract Management

Most Bureau research funding comes from Federal, State, and industry sponsors and agencies. Contract management personnel, supervised by Lynda Miller, assist Bureau researchers in preparing the budgets and proposals submitted to potential sponsors. When researchers receive the welcome news that their proposals will be funded, contract management staff serve as liaisons for the various entities involved. Contract management also involves financial reporting, database and records management, and documentation of progress and submission of deliverables, all of which are completed with timely precision.

Editing

Chief Editor Susie Doenges supervises the Bureau's skilled and meticulous editing staff. These editorial and proofreading specialists are responsible for the editing, word processing, desktop publishing, and proofreading of research publications. The Editing staff works closely with the Bureau's Graphics department to produce the outstanding Bureau publications that are available through the office of Publication Sales. Editing staff also assist in preparing contract reports, abstracts, and articles submitted to professional journals, as well as slides and posters.

Graphics

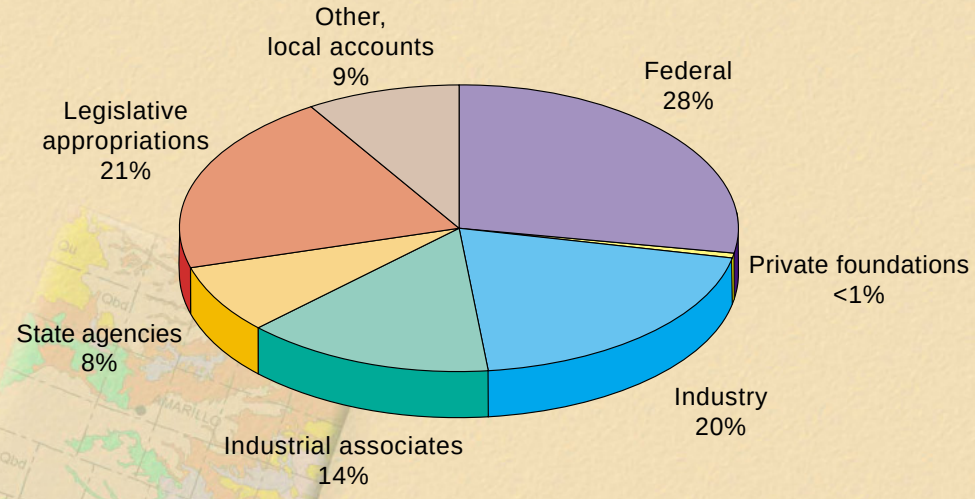
Graphics manager Joel Lardon heads up the talented group of designers, illustrators, and computer wizards responsible for producing the design, artwork, and illustrations for Bureau research and publications. Their award-winning graphics skills include creating text illustrations and presentation materials for Bureau researchers, manual and digital photography, design and layout, and map design and finishing.

Information Technology Services

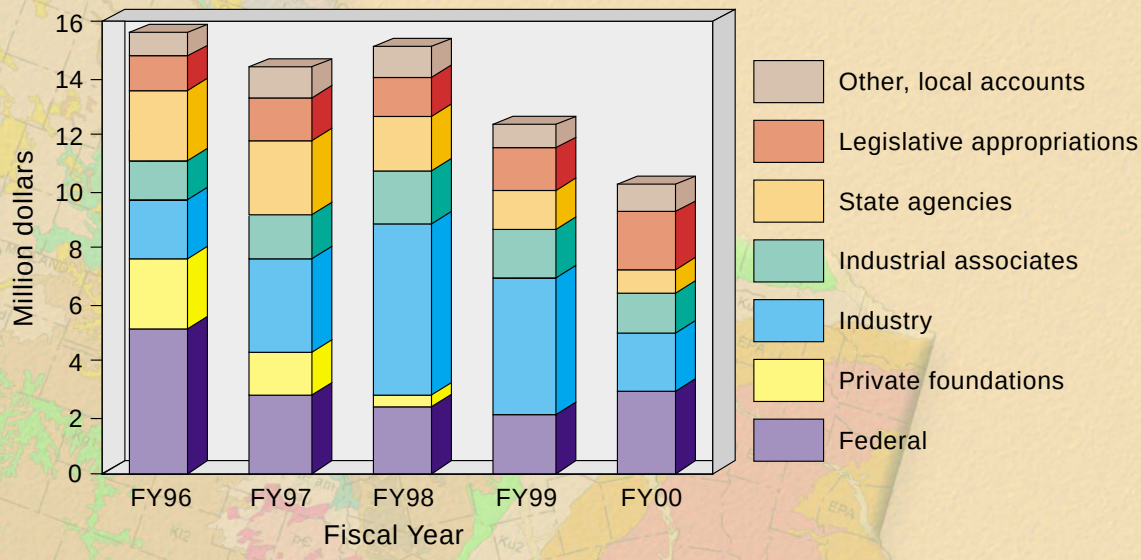
Information Technology Services (ITS), supervised by Ron Russell, provides vital computer technology assistance to the researchers and staff of the Bureau. Computers at the Bureau include PC's, Macs, and Unix workstations. These resources assist researchers in interpretation, 3-D modeling, visualization, characterization, computer mapping, programming, database applications, and statistical and graphic analysis of data. ITS supports these systems and the network design, as well as handling the purchasing, testing, installation, and user training.

Bureau Finances and Staff

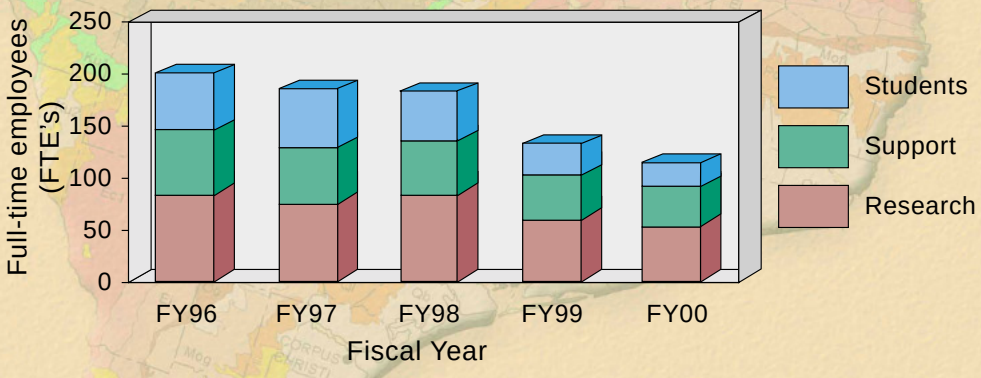
Sources of Funding



Five-Year Budget Trends



Staff Trends



Fiscal year September 1, 1999, through August 31, 2000.

On the Web

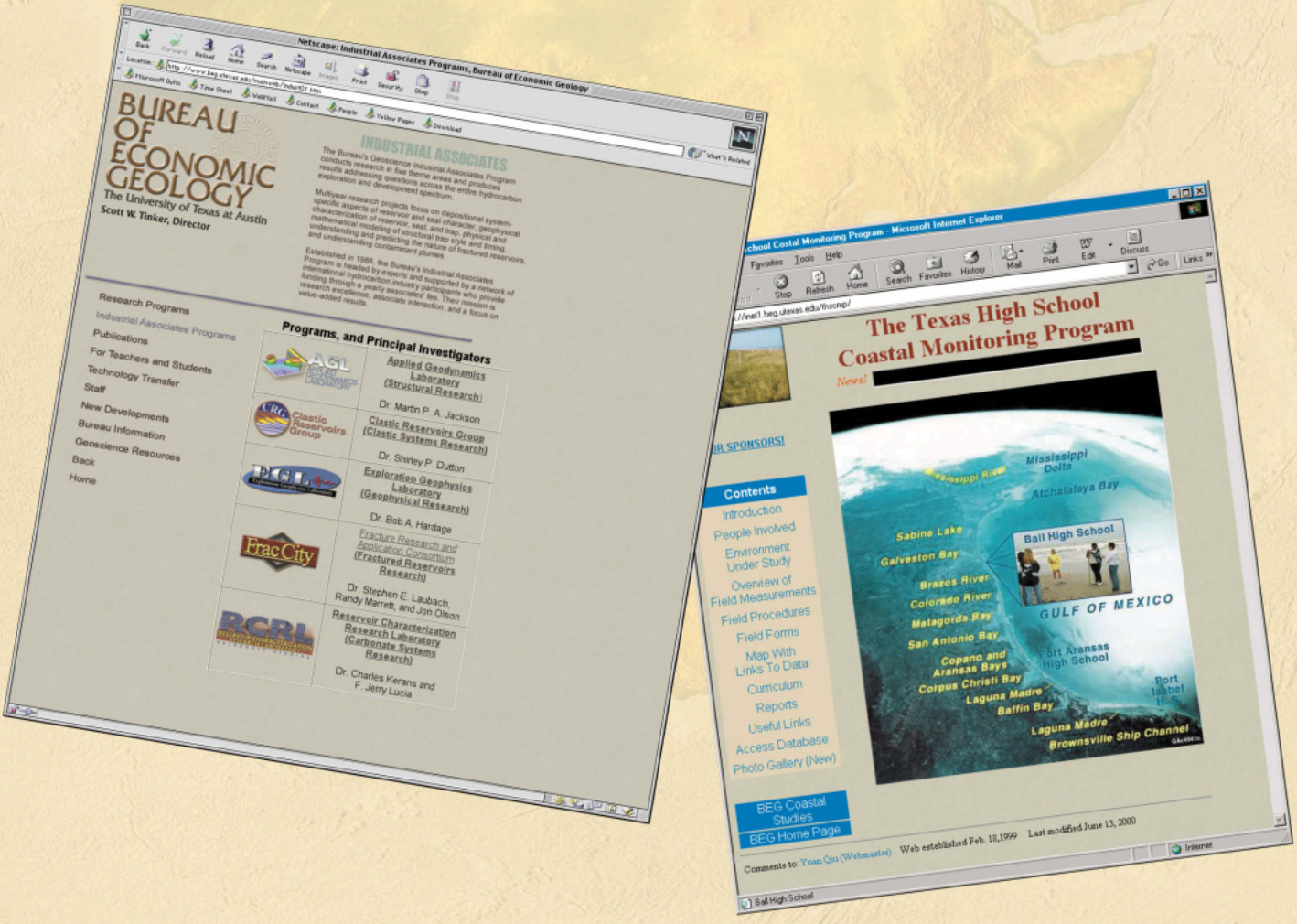
A wealth of information regarding the Bureau of Economic Geology can be found at our Web site, http://www.beg.utexas.edu. Here you can learn about every aspect of the Bureau's mission, its research, public services, and staff. Download what you need.

When you visit our Web site, you can check upcoming events, read about recent research awards and honors, learn about the Bureau's large collection of rock cores and well cuttings, and contact any Bureau researcher or staff member by using his or her office e-mail address or telephone or fax number.

You can review titles and authors of past and present Bureau publications—and then place an order.

Teachers and students can view earth science projects, print directions and then follow them in a Do-It-Yourself Aquifer Demonstration, determine whether Dirt Is Just Dirt, or study the Texas Rock Cycle. The Bureau's Web site also contains links to State, Federal, and industry organizations, as well as geologic and earth science resources.

Our Web site, a vital and integral part of the Bureau, is a work in progress; many more exciting enhancements, databases, and links are planned for 2001.



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