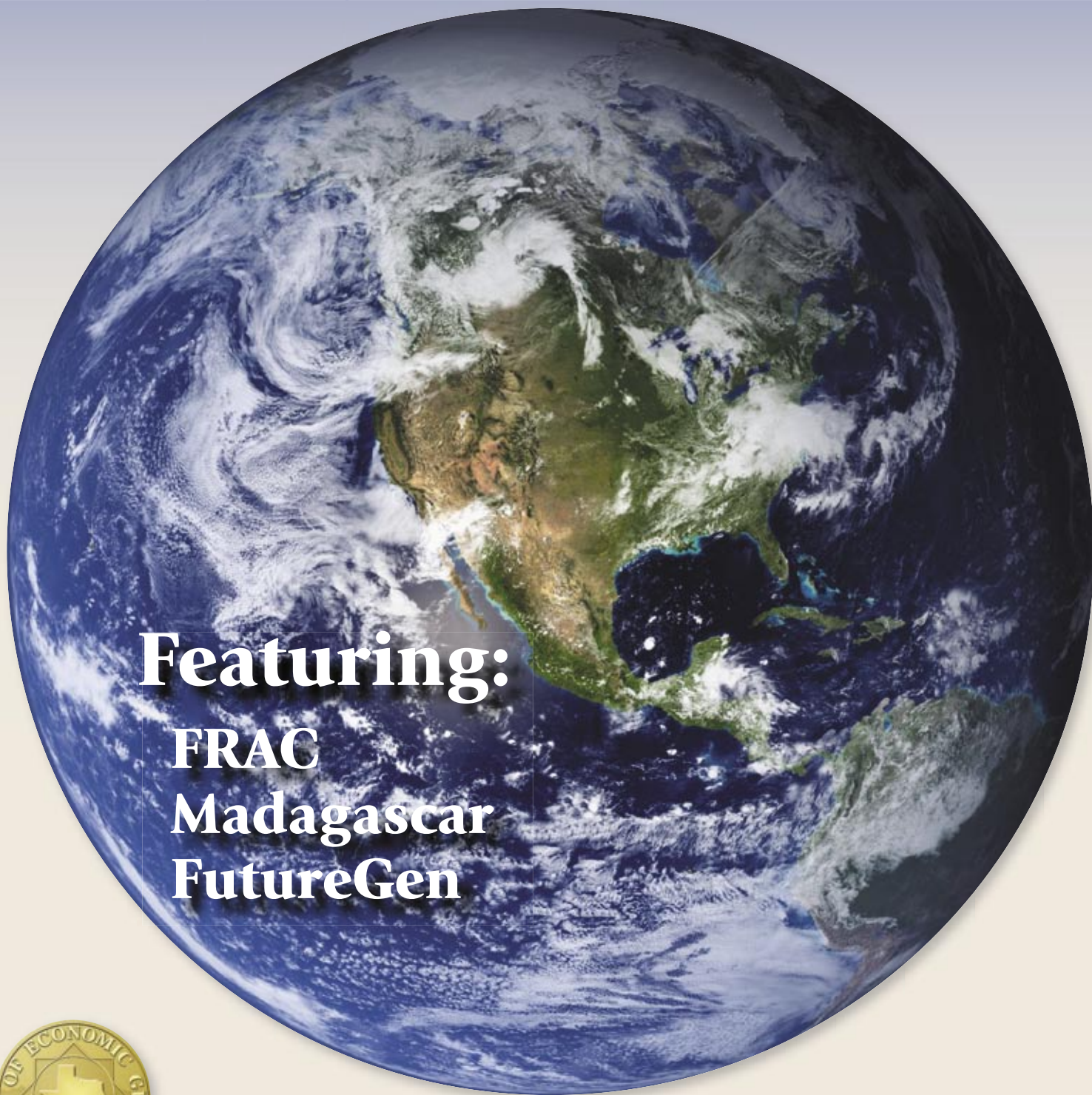


# Annual Report 2006



**Featuring:**  
**FRAC**  
**Madagascar**  
**FutureGen**



***Bureau of Economic Geology***

***Scott W. Tinker, Director ✦ John A. and Katherine G. Jackson School of Geosciences  
The University of Texas at Austin ✦ Austin, Texas 78713-8924***

# Director's Message



I lost a mentor this year. Bob Sneider was a great geologist and my first "boss." I had worked summer jobs in Houston mowing lawns, sacking groceries, building tennis courts, painting houses, working in warehouses and the like, but Bob gave me my first salaried job where what you knew mattered as much as, or more than, what you did. I made \$22,000 a year and felt like a king! Bob shared much with many. He taught me the value of rocks; he showed me impact of work ethic; in later years, he emphasized the balance of family and work. I miss him as a mentor and a friend.

Mentoring underpins the Bureau. The collective wisdom of the Bureau results from handed-down and built-upon knowledge. Colleagues, bosses, friends, parents, educators, new kids, old kids—everyone has something to share, and there is always more to learn. It is a daunting responsibility and awesome opportunity.

As I wrap up my seventh year as director, I wish to thank the many of you who have mentored me. I could not do this job without your counsel, friendship, and wisdom. The insights come at the oddest moments, usually when least expected, but often when most needed. As the years unfold, I will continue to learn and hope to pass along a pearl here and there so that others may benefit in the same way that I have from each of you.

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Scott W. Tinker

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## Cover:

*This spectacular "blue marble" image is the most detailed true-color image of the entire Earth to date. Using a collection of satellite-based observations, scientists and visualizers stitched together months of observations of the land surface, oceans, sea ice, and clouds into a seamless, true-color mosaic of every square kilometer (.386 square mile) of our planet, June through September 2001. NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) ([http://visibleearth.nasa.gov/view\\_rec.php?id=2429](http://visibleearth.nasa.gov/view_rec.php?id=2429)). The globe image on interior pages is from the Earth and Moon Viewer Website (<http://www.journalibeh.earthview.net>). The Living Earth® image is a composite of Earth satellite imagery developed by The Living Earth, Inc., P.O. Box 295, Stevensville, MT 59870, USA. This image is ©Copyright 1996, The Living Earth, Inc./Earth Imaging.*

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# Highlights

## FutureGen Texas Scores

Sites in Odessa and Jewett were named as finalists in a national competition to host FutureGen, the \$1-billion initiative sponsored by the Department of Energy (DOE), to design, build, and operate a 275-megawatt energy facility that produces electricity and hydrogen from coal with near-zero emissions by capturing and sequestering carbon dioxide. "It is a grand slam for both the Odessa and Jewett proposals to be named two of the four on the FutureGen short list," said State Geologist Dr. Scott Tinker, Director of FutureGen Texas. "It is a testimony to Railroad Commissioner



Michael Williams and many others in Texas' leadership, as well as to our outstanding team headed by key players that include Jay Kipper, Steve Walden, Chuck McDonald, Ian Duncan, and Jerry Hill. The FutureGen table was set by Bureau-led research in the Frio Brine Injection Pilot, headed by Dr. Sue Hovorka. It is interesting to note that the two states that were successful in making the FutureGen short list were led by teams from State Geological Surveys—the Bureau of Economic Geology and the Illinois Survey. Our congratulations go out to Illinois."

## New Bureau Hybrid

Our brand-new Toyota Highlander Hybrid gives the Bureau bragging rights for being the first unit at UT to purchase a hybrid gas-electric vehicle. The University is responsible for many initiatives in its quest to preserve our environment, and the Bureau is proud to take the lead in what we hope will be a new phase in this quest.



## AGL Goes Hollywood

On Saturday, June 24th, the Bureau hosted a full day of filming salt-tectonics research for a television series called "Faces of Earth," which the Discovery Channel will broadcast in 2007. The series, which aims to give a face to the geoscience community, is being produced by Evergreen Films, LLC, maker of Emmy-award-winning productions about dinosaurs. The American Geological Institute is sponsoring the series, and the Jackson School of Geosciences Foundation is a contributor. Using two HD digital video cameras, a film crew shot a physical model run in the Applied Geodynamics Laboratory, with commentary, on and off camera, by Tim Dooley and Martin Jackson. The scene then shifted to the AGL work area, where Martin Jackson continued his commentary, on camera, while the crew's own experiment (Fun with Silicone) was captured by time-lapse photography. The film will feature material contributed by Tim, Martin, and Mike Hudec. The film crew later shot Charlie Kerans in the Guadalupe Mountains. Scott Tinker will provide bridge narration.



## Hardage and EGL in the News



Dr. Bob A. Hardage, Senior Research Scientist and head of the Bureau's Exploration Geophysics Laboratory (EGL), had an extra-busy year—in the writing department. In January, Bob agreed to become Editor of the Geophysical Corner section of the monthly *Explorer* publication produced by the American Association of Petroleum Geologists. Judging by reader responses, his monthly one-page articles are explaining seismic technology in ways that seem to appeal to nongeophysicists. Several of his articles illustrate how multicomponent seismic technology expands geologic information, which is the principal research thrust of Hardage and his colleagues at the EGL. Then



this May, *The Leading Edge*, a monthly publication of the Society of Exploration Geophysicists, ran a special issue devoted to gas hydrates. Deep-water gas hydrate research done at the EGL thus became a central focus of this peer-reviewed journal. EGL researchers contributed six papers that demonstrate how multicomponent seismic data can be used to create high-resolution images of near-seafloor geology and to estimate hydrate concentration. Well done, Dr. Bob!

## STARR Barnett Shale Workshops

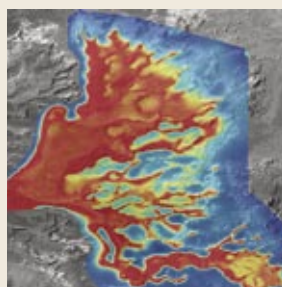
The Bureau's State of Texas Advanced Resource Recovery (STARR) program presented seminars in Midland on November 8 and Houston on November 14. The seminar was titled *The Barnett Shale-Gas Play of the Fort Worth Basin*. This ongoing study



is being conducted to develop and disseminate new geological insights on the Barnett Shale and other current and potential gas-producing mudrock/shale systems. Bureau presenters were Julia Gale, Jeff Kane, Bob Loucks, Angela McDonnell, Eric Potter, Steve Ruppel, Fred Wang, Wayne Wright, and Hongliu Zeng. J. Dan Jarvie of Humble Geochemical Services also presented. A highlight of the workshop was presentation of the largest collection of Barnett cores yet displayed to a public audience. Approximately 200 people attended the events.

## BEG on Mars

Geomorphologic images returned from the Global Surveyor's study of Mars are being interpreted by researchers in the Quantitative Clastics Laboratory IA to explain ancient depositional processes and deposits that formed the planet surface. The 3-D topographic image shown was built by Lesli Wood and John Andrews to illustrate the architectural complexity of Martian deltas and highlight similarities between them and those on Earth. The multilobe architecture, distributive nature of channeling and high sinuosity, chute cutoffs, and lateral accretion seen in many Martian distributary channels are remarkably similar to those identified in modern and ancient Earth deltas. Nearly 100 years' experience by BEG scientists in deltaic-system study uniquely positions



us to contribute to a greater scientific understanding of such processes on other planets. This research was published by Lesli Wood in the May 2006 volume of the *Geological Society of American Bulletin*.





## Service: Presidential Lineup



Bill Ambrose, BEG Research Scientist, was elected President of the Energy and Minerals Division (EMD) of the American Association of Petroleum Geologists (AAPG) on July 1 and will serve through June 2007. EMD is one of three divisions

of AAPG, the largest professional association of geoscientists in the world. Organized in 1977, and consisting of approximately 1,350 members, EMD provides a forum for professional development in energy minerals (coal and uranium), unconventional hydrocarbons (coalbed methane, gas hydrates, gas shales, oil shale, and tar sands), energy economics, geothermal energy, and geospatial information. EMD also sponsors a wide variety of field trips, short courses, luncheons, and technical meetings, as well as providing networking to its members and coal geologist certification. Bill has a long-standing involvement with EMD, co-authoring two Best Papers for the Division in 1991 and 1992. As EMD President in 2006, Bill served as EMD Representative on the Distinguished Lecturer Committee, the Gas Hydrates Committee, the Unconventional Gas Resources Committee, and the Astrogeology Committee.



Scott Tinker will serve as President of the Association of American State Geologists through June 30, 2007. AASG is an organization of the chief executives of the state geological surveys in 50 states and Puerto Rico.

The surveys serve as an information source for their state governments' executive, legislative, and judicial branches, and most are now involved in the regulation and resource management of water, oil and gas, land reclamation, and environmental issues. As president-elect of the association, Scott, with the help of Wanda LaPlante and Kate Kipper, organized liaison meetings March 19–22 in Washington, D.C., for state geologists to visit with key congressional staff, federal agencies, and other Washington organizations. He is also a candidate for President-Elect of AAPG.



Jeffrey G. Paine, Research Scientist at the Bureau, has been elected to serve as President-Elect (2006–07), President (2007–08), and Past

President (2008–09) of the Environmental and Engineering Geophysical Society (EEGS). EEGS is an international professional society devoted to near-surface geophysics that is best known as the sponsor of the annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Jeff began his term as President-Elect at the 2006 SAGEEP held April 2–6 in Seattle, Washington, where he gave a talk titled "Streambed Induction Logs: An Airborne Approach to Identifying Salinity Sources and Quantifying Salinity Loads."



Lesli Wood, Research Scientist, is the current (2006) president of the Gulf Coast Section SEPM (Society for Sedimentary Geology) and secretary-treasurer (2004–2006) of the national organization. Early this year SEPM convened a meeting of its Strategic Planning Committee at the Bureau to develop a strategic plan for the Society for the coming decade. SEPM is an international professional society based in Tulsa, Oklahoma, that disseminates scientific information on sedimentary geology and related disciplines to 4,000 members. Lesli has been influential in the organization for more than a decade, winning the SEPM Student Excellence and Development Award in 1992.



## Awards and Honors



Scott Tinker was appointed by the Secretary of Energy to the National Petroleum Council, which is a self-funded advisory body to the Secretary of Energy, whose members represent all sectors of the oil and gas industries and related interests. In the appointment letter, Secretary Bodman says that the council, created by President Truman in 1946 to continue industry and Government cooperation that began in World War II, provides essential advice, information, and recommendations on matters related to oil and natural gas and the oil and natural gas industries.



Bob Loucks was selected to receive the Levorsen Award for Best Oral Presentation at the 2006 meeting of the Southwest Section of AAPG, which was held in Midland, Texas, in March. The paper (coauthored by Steve Ruppel) is titled "Depositional Setting, Lithofacies, and Pore Networks of the Mississippian Deepwater Barnett Shale Facies in the Fort Worth Basin." The paper is based on early results of an ongoing multidisciplinary analysis of the Barnett and other potential shale reservoir facies currently under study at the Bureau. Bob will receive his award at next year's Southwest AAPG meeting in Wichita Falls, Texas.



Left, Martin Jackson accepts the Jackson School of Geosciences's Joseph C. Walter Excellence Award from Dean Bill Fisher. Shirley Dutton kindly nominated him. The award was provided for in an endowment created by Mr. J. C. Walter Jr. and approved by the Board of Regents in 1977. It was originally titled the Houston Oil and Gas Corporation Excellence Award and was designed to provide annual awards to faculty "in recognition of outstanding service and special contributions to teaching and research programs." With the creation of the Jackson School of Geosciences, and with the thorough endorsement of Mr. J. C. Walter III, the award has been renamed the Joseph C. Walter Jr. Excellence Award and is now extended schoolwide.



Bureau research scientist Bill Ambrose has been appointed to serve as the Vice Chair for the AAPG Astrogeology Committee for a term ending June 30, 2009. Bill will be working with Committee Chairman Harrison H. Schmitt (of Apollo 17 fame) to develop committee objectives, design and implement projects, and balance workloads. Bill is active in planetary geology and recently presented his paper "First-Order Relationships between Lunar Crater Morphology, Degree of Degradation, and Relative Age: the Crater Degradation Index" at the 2006 Annual AAPG Convention in Houston, Texas.



The United States Association for Energy Economics (USAEE) awards committee has chosen Dr. Michelle Michot Foss, head of the Bureau's Center for Energy Economics (CEE), as a recipient of the USAEE Senior Fellow Award for 2006. This award recognizes Dr. Foss's distinguished contributions to the field of energy economics and is given to individuals who have exemplified distinguished service to USAEE and/or the field of energy economics. Thirty awards have been given since the creation of the Association. Dr. Foss received the award at the Annual USAEE meeting in Ann Arbor on Monday, September 25. USAEE was founded in 1994 to provide a forum for the exchange of ideas, experience, and issues among professionals interested in energy economics. USAEE is the largest affiliate of the International Association for Energy Economics. Members of USAEE come from diverse backgrounds—corporate, academic, scientific, and government.



Congratulations to students Nysha Chaderton, Beatriz Garcia-Fresca, Ned Frost, Lorena Moscardelli, Carla Sanchez, Samuel Scott, and Kira Diaz Tushman! Each is a recipient of an American Association of Petroleum Geologists grant. Each is also a Research Assistant working with a Bureau scientist. Bea received the Robert K. Goldhammer Memorial Grant, Ned received the Richard C. Hasson Memorial Grant, Carla received the Harold J. Funkhouser Memorial Grant, Sam received the J. Ben Carsey Sr. Memorial Grant, and Kira received the Raymond D. Woods Memorial Grant.





Claudia Gerardo, an Administrative Associate at the Bureau who handles purchasing, has been chosen to receive one of the University's Staff Excellence Awards. One of only 30 recipients of the award this year throughout the campus, Claudia was honored at the Staff Recognition Program and President's Reception on May 2. She joined the Bureau in November 2003 and quickly learned that geologists can have some unusual purchasing needs for field equipment and modeling supplies. It's a routine day for Claudia to order parts for drilling rigs, or pig gelatin, which stabilizes sand used in models of salt domes. Claudia says she enjoys being a sleuth, assuring Bureau staff that "if it's out there," she'll find it, and at a good price. Claudia also represents the Bureau on the UT Staff Council and serves on The University of Texas Police Department Oversight Committee. Noting Claudia's unique contributions to the Bureau, Director Scott Tinker said, "It takes a sense of humor, a determined nature, and lots of patience to handle purchasing requests for the Bureau. Claudia measures up on all counts and does an excellent job of getting good value for every Bureau dollar spent. Claudia is a great member of the Bureau family, and we are all very proud of this honor."



Susie Doenges, long-time Editor-in-Chief at the Bureau, and recent retiree, received the John A. and Katherine G. Jackson School of Geosciences Staff Excellence Award. Susie graduated with Honors in English from The University of Texas at Austin in 1973 and received her M.A. in English in 1982. Arriving at the Bureau in 1975 as a Senior Secretary, Susie quickly moved through the ranks and was made editor in 1977 and Editor in Chief the following year. Between 1992 and 1995, Susie even served as Assistant Director, eventually returning to her first love, editing, in 1996. Susie is a member of the Association of Earth Science Editors, as well as Phi Beta Kappa and Phi Kappa Phi honor societies. She served as editor of *Blueline*, Newsletter of the Association of Earth Science Editors from 1985 through 1986. For more about Susie and her recent accomplishments, see the rest of her story in "Bureau Transitions."

## Bureau Transitions

In 2006 the Bureau welcomed many new folks into its fold. This year it was hard not to notice the array of talent entering our doors from far and wide. The Bureau family finds strength in its diversity.

### New Research Staff



Aaron R. Averett is a new Research Scientist Associate at the Bureau. He has a B.S. degree in Geography/GIS from Texas A&M. Aaron uses GIS to solve geological problems, and he's familiar with a wide range of GIS packages, databases, scripting and markup languages, platforms, and graphics/media software.



Thomas Jules Browaeys joins the Bureau as a Postdoctoral Fellow to work with Research Scientist Sergey Fomel on developing computational and theoretical methods for seismic imaging. Jules received his M.Sc. and Ph.D. in Geophysics from the Institut de Physique du Globe de Paris in France. His thesis focused on theoretical and numerical forward modeling of seismic anisotropy. His current research projects include seismic migration and angle-domain common image gathers and anisotropy in seismic wave propagation.



Ruarri Day-Stirrat is the most recent addition to the Deep-Shelf study team. A Postdoctoral Fellow, he hails from New Castle, England, where he received his Ph.D. in Geology. Ruarri was granted his Bachelor's of Science degree with honors at Cardiff University, Scotland. His range of interests includes modeling, porosimetry, and pore-size distribution.



Jozina Dirkzwager recently joined Martin Jackson, Mike Hudec, and Tim Dooley in the Applied Geodynamics Laboratory. José's degrees in Earth and Life Sciences were bestowed by the Free University Amsterdam, the Netherlands, although most recently she has been doing postdoctoral research at the Geophysical Institute, Karlsruhe University, Karlsruhe, Germany. Dr. Dirkzwager works with mechanical earth models (MEM) and 3D finite element modeling.







Ray Eastwood is a new member of the STARR team who was hired as a part-time Research Fellow. Ray has M.S. and Ph.D. degrees in Geology from Kansas State University and the University of Arizona, respectively. He has worked extensively in the private sector, notably in the Prudhoe Bay area in Alaska. Ray's research interests include petrophysical log modeling, interpreting full-waveform sonic logs, and teaching physical geology, mineralogy, petrology, geochemistry, geochronology, and volcanology.



Peter Eichhubl, Research Scientist, holds a Ph.D. in geology from the University of California, Santa Barbara, and an M.S. from the University of Vienna, Austria. Having held postdoctoral posts at both Stanford and the Monterey Bay Aquarium, Peter's research is broad. It combines the fields of fault and fracture mechanics and low-temperature geochemistry, addressing deformation mechanisms of the upper crust, structural control of mass and heat transfer in sedimentary basins, effects of chemical mass transfer on the mechanical and hydraulic behavior of fractures and faults, and the chemical interaction between fluids and minerals. As a member of the FRAC research group, Peter will focus on the characterization and prediction of fractured and faulted reservoirs.



Dr. Timothy A. ("Tip") Meckel recently signed on with the Gulf Coast Carbon Center. Tip has an M.S. degree from the University of Montana and received his doctorate from the Institute for Geophysics and Department of Geological Sciences here at UT. A former Mendenhall Postdoctoral Research Fellow at the U.S. Geological Survey, Tip has hit the ground running here at the Bureau by taking on the job of coordinating the weekly Bureau seminars.



Vanessa Nuñez-López, Research Scientist Associate, received an M.S. in petroleum engineering and an M.A. in energy and mineral resources from The University of Texas at Austin and has completed further graduate coursework in petroleum engineering at UT. A native Venezuelan, Vanessa received her B.S. with Honors in Petroleum Engineering at the Universidad

Central de Venezuela. Her expertise lies in developing screening criteria for miscible CO<sub>2</sub> flooding; evaluation of CO<sub>2</sub> EOR/sequestration opportunities, especially in the Gulf Coast; and reservoir characterization of sandstone and carbonate oil and gas reservoirs.



Gil Strassberg, a Postdoctoral Fellow, earned his Ph.D. in civil engineering at The University of Texas at Austin in December. He had previously received his undergraduate degree in civil engineering at the Israel Institute of Technology. As a civil engineer, Gil has been involved in a variety of water resource projects centered on the application of geographic information systems in groundwater studies. As a water resources engineer in Israel, he developed regional water plans, coordinated water management policies and operations, and applied hydrologic and statistical models to support water management decisions.



Wayne Wright, Research Associate, received his Ph.D. in geology at University College Dublin, Ireland. Wayne is currently concentrating his studies on Permian Basin synthesis, focusing on the Pennsylvanian (Carboniferous). He is experienced in integrated reservoir, field, and regional studies combining subdisciplines such as sedimentology, sequence stratigraphy, biostratigraphy, seismic interpretation, geochemistry, and geochemical modeling. He has reservoir experience in the Middle East, India, Pakistan, South America, and North Africa.



Dr. Abhijit Mukherjee joins the Bureau's environmental research group as a geologist with broad, multidisciplinary interests in various fields of environmental geology. He holds B.Sc. with Honors and M.S. degrees in Geology from the University of Calcutta, India, as well as M.S. and Ph.D. degrees from the University of Kentucky in Lexington. Abhijit's current research is a combination of fieldwork, laboratory analyses, and computer applications focused on geogenic groundwater contamination in alluvial basins around the globe. Abhijit's current work also includes analysis of groundwater-surface water interactions and slope stability.





## New Support Staff



Amelia Bridges is an Administrative Associate in the Contracts and Grants section of the Bureau. A May UT graduate, Amelia tells us that she once worked in a museum collection room in the basement, where it was her job to archive photos of survey trips through Big Bend and help restore a skeleton that had been painted with nail polish! Amelia enjoys biking and painting.



Dallas Dunlap returned to the Bureau after a brief tour in the private sector. A Research Scientist Associate III, Dallas's forte is in the world of the computer. He specializes in geologic subsurface mapping, geologic applications research, and work in the Quantitative Clastics lab, and we are thrilled to have him back!



Julie Duiker, newest czarina of the Contracts and Grants section, is a Senior Program Coordinator. Julie, a native Austinite and certified science teacher, has job credits that include ambulance medic, graphic artist, waitress, and mom (three kids), and she is currently finishing her degree in counseling. A true Renaissance woman, she paints, reads, hikes, and builds. Current project: a greenhouse.



Jeannie Farahnak, new Administrative Associate under Jean Abernathy in the Administration area, arrived at the Bureau in October. A 2005 Cum Laude graduate in Architecture from Texas Tech, Jeannie also has an Associate of Science degree from Kilgore College. Jeannie works on payroll, vacation/sick leave, and mileage logs for Bureau vehicles, among other things.



Carlos Garza joined the IT staff as a Computer Equipment Maintenance Technician. He is the first point of contact at the helpdesk, responsible for analyzing and troubleshooting computer, peripheral equipment, and software problems reported by the staff. Carlos also schedules and performs maintenance and updates operating system software on computer desktops and laptops and troubleshoots printer problems. He helps with setup and installation of computer equipment and peripherals and also installs software upon request. He also helps maintain the inventory of equipment as well.



Richard Gutierrez joined the Houston Research Center (HRC) as a Technical Staff Assistant. He is responsible for handling all lawn maintenance at the HRC and assisting

with general maintenance of the facility. Richard pulls core and cuttings for in-house viewing and prepares materials for shipment to other locations. He also helps with the ongoing inventory of materials at the HRC. He gained experience working as a temporary employee at HRC in 2004 and 2005.



Jennifer Logan, Administrative Associate, has taken over administrative responsibilities for the second floor. With a background in Anthropology, Jennifer has recently turned her attention to education and outreach, working for Texas Parks and Wildlife for a number of years before arriving at the Bureau. She joined Sigrid Clift in coordinating the recent Decision Makers' Conference and was a guide for Earth Science Week this fall.



Domingo Morales is the Bureau's new Human Resources person. Domingo takes the place of Carol Zito, who was with us for almost a year before she had to return to her native Canada. So good-bye to Carol and hello to Domingo! Domingo hails from Fort Stockton, but he moved here in 1985 to go to UT, from which he graduated with a BA. Domingo has worked elsewhere in the public sector, such as TX MHMR and Child Protective Services. He's also confessed to be heavily into fitness, having completed three marathons, and works part time as a fitness instructor.



Jana Robinson, recent rehire in the Media Department, has returned to her Bureau roots. A Computer Illustrator, Jana had to spend some time in the private sector to realize that she was happier "back home" with her Bureau friends. In addition to her artistic skills, Jana has a reputation as a cook and is the holder of a coveted "Bureau apron," which she received a few years back at a Bureau holiday cook-off. She also enjoys camping, kayaking, and golf.



Kyla Young, another Administrative Associate, is also new to the Contracts and Grants section. Kyla has a double-major in Political Science and Philosophy—both valuable tools when working with contracts and grants.



## Folks Leaving in 2006



After more than 30 years of service to the Bureau as editor, Susie Doenges retired in May. Susie was responsible for, among many things, coauthoring (with Keene Ferguson) the recent book about the Jackson School's namesake and major donor, Jack Jackson, *The Jack Jackson Story: Reflections of a Geologist*. She was also coeditor of six proceedings volumes on symposia related to continental margins, as well as managing editor of *GCAGS Transactions* volume 44. Susie was Editor in Chief during most of her career at the Bureau. It was on her watch, in fact, that the bulk of our well-respected Reports of Investigations were produced. As Director Scott Tinker said "Susie is a consummate professional. Her service to the Bureau is remarkable, and she is welcome back any time!"



Dr. Jay Raney, Research Scientist, retired in August. Jay served as Environmental Associate Director for many years before the arrival of current Associate Director Ian Duncan. Jay was also responsible for initiating the popular Down to Earth publication series, contributing three books himself—*Down to Earth at McKinney Falls State Park, Texas*, which he wrote on his own, and *Down to Earth at Big Bend Ranch State Park, Texas* *Geologic Map and Trailside Geology*, and *Down to Earth at Mustang Island*, which he coauthored with Chris Henry and Bill White, respectively. Jay was also instrumental in the Bureau's involvement with the Jackson School's GeoForce initiative, a summer program for outstanding South Texas students from grades 8 through 12.



Research Scientist Dr. Edgar Guevara retired after more than 20 years' service to the Bureau. A native of Venezuela, Edgar served as our liaison with LAGOVEN there for many years. BEG's long-standing relationship with the Venezuelan government is largely attributable to Edgar. It was thanks to Edgar that the Bureau did some well-respected work in the Lake Maracaibo area of Venezuela during the 1990's. The last few years, Edgar headed up some of the research teams working in Mexico.

## In Memoriam



On October 17, Dr. Marcus E. Milling, Executive Director of the American Geological Institute, passed away at his home in Reston, Virginia. A graduate of the University of Iowa, Marcus received his Master's of Science in 1964 and his Ph.D. in 1968. Marcus spent his early career in corporate research, first at EPRCO in Houston (now ExxonMobil Upstream Research) and later at the ARCO research lab in Plano. He served as an Associate Director at the Bureau from 1987 through 1992, before leaving to head up the American Geological Institute (AGI). In 1997 Marcus was awarded the Ben H. Parker Medal by AASG, and in 2000, the University of Iowa made him a Liberal Arts Alumni Fellow—the highest award that the College of Liberal Arts can bestow on an alumnus. William L. Fisher, former Bureau Director and former Dean of the Jackson School of Geosciences, remembered Marcus as being "widely regarded and respected for his leadership at AGI and for making the Institute a major force in the earth sciences." Director Scott Tinker recalled some of Marcus's enduring contributions to the geological community: "Marcus had a lasting impact on so many things that he touched—data preservation, geoscience education, Earth Science Week, the health and vision of AGI, and the list goes on. He was a friend to geology and geologists and will be greatly missed."



Dr. Ronit Nativ, Professor in the Department of Soil and Water Sciences and part of the faculty of Agricultural, Food and Environmental Quality Sciences of the Hebrew University in Jerusalem, passed away October 30, 2006. Ronit was hired by the Bureau in 1984 as a Postdoctoral Fellow under Charlie Kreitler. When she left the Bureau in 1987, she had been promoted to Research Associate. Ronit went on to become an Associate Professor at the University of Tennessee at Knoxville and a researcher at the U.S. Department of Energy, Oak Ridge National Laboratory, Tennessee, from 1991 to 1992. But she was destined to return to Israel, where she eventually rose through the ranks of Lecturer, Senior Lecturer, and Associate Professor, to Professor in 2004. Through the years, Ronit served as a member on many committees dealing with the environment and as a consultant on projects concerning her beloved Negev Desert. Bureau Postdoctoral Fellow Daniel Kurtzman carries on Ronit's work at the Bureau in hydrological research. An advisee of Ronit's, Daniel remembers her as "a great hydrologist and a great person. She was an excellent Ph.D. advisor (she never let me refer to her as a supervisor). I owe a great deal of my short academic career to this outstanding woman."





# Research: Energy



## Fracture Research and Application Consortium

Understanding and successfully predicting, characterizing, and simulating reservoir-scale structures are the aims of the Fracture Research and Application Consortium (FRAC). A key aspect of the program is investigation of mechanical and chemical processes and interactions over a range of scales. Our goal is to improve prediction of seismic and subseismic heterogeneities that influence fluid flow.

Fractures and faults have worldwide importance because of their influence on successful extraction of resources. Many faults and fractures are difficult or impossible to characterize adequately using currently available technology. Consequently, reservoirs that contain fractures have been intractable to effective description or interpretation, posing serious challenges in exploration, development, and accurate reservoir simulation and management. More accurate prediction and characterization of fractures can potentially improve production by increasing the success and efficiency of exploration and recovery processes.

The scope of this work includes measurement, interpretation, prediction, and simulation of fractures. The work will

- create and test new methods of measuring attributes of reservoir-scale fractures, particularly as fluid conduits and barriers;
- extrapolate structural attributes to reservoir scale through rigorous mathematical techniques and help build accurate and useful 3-D models for the interwell region;
- develop the capability to accurately predict reservoir-scale deformation using geomechanical, structural, diagenetic, and linked geomechanical/diagenetic models;

- improve the usefulness of seismic response as an indicator of reservoir-scale structure by providing methods of calibrating and verifying seismic fracture detection methods; and
- design new ways to incorporate geological and geophysical information into reservoir simulation and verify the accuracy of the simulation.

Aims of this study are both fundamental and practical—to improve prediction and diagnosis of natural-fracture attributes in hydrocarbon reservoirs and accurately simulate their influence on production. New analytical methods will lead to more realistic characterization of fractured and faulted reservoir rocks. These methods will produce data that can enhance well-test and seismic interpretations and be used readily in reservoir simulators.

Testing diagnostic and predictive approaches is an integral part of the research. Our requirement is that new methods must ultimately be cost effective. Testing of diagnostic and predictive approaches developed from outcrop, core, and well-test studies is generally carried out in areas of interest to member companies. Our results are applicable to fractured hydrocarbon-bearing carbonate and siliciclastic rocks.

Our research team comprises staff of the Bureau of Economic Geology and the Departments of Petroleum & Geosystems Engineering and Geological Sciences, The University of Texas at Austin: Dr. Steve Laubach (structure and diagenesis), Dr. Jon Olson (petroleum engineering and geomechanical modeling), Dr. Randy Marrett (quantitative analysis and structural geology), Dr. Julia Gale (structural geology), Dr. Peter Eichhubl (structural diagenesis), Dr. Jon Holder (rock property testing and rock physics), Dr. Kitty Milliken (diagenesis and geochemistry), Dr. Sergey Fomel (geophysics), Dr. Rob Reed (microstructural imaging and structural geology), and Mr. John Hooker (microfracture interpretation and structural geology).

We have collaborative research arrangements as well with Drs. Rob Lander and Linda Bonnell, (principals of



Geocosm), to study quantitative diagenetic modeling of fracture development. We are also proud of our graduate student staff, which has included several award-winning students, many of whom are now working in industry.

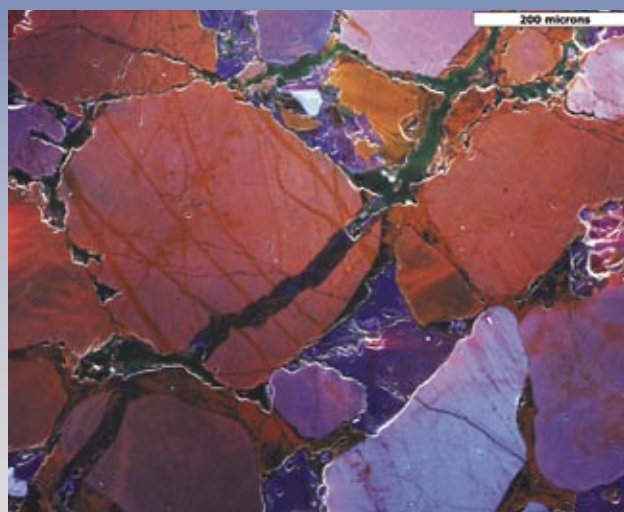
Many staff members have industry experience or have worked closely with industry and are well aware of the challenges and questions facing exploration and development geoscientists and engineers. Our approach may seem fine grained and concerned with fundamental issues, but practical applications are central to our goals.

**Surrogate Methods.** This research aims to provide methods of acquiring site-specific fracture information at user-specified levels of completeness and yielding results without measuring elusive, difficult-to-sample, large fractures.

We are currently investigating new surrogate methods to obtain accurate, site-specific information on fracture intensity, spatial distribution, and fracture porosity preservation. We are studying automated collection of microstructural data used for (1) measuring fracture intensity and fracture orientation and applying the results to documenting variations in fracture patterns within traps and (2) calibrating seismic fracture characterization methods.

The greater volume of data afforded by an automated system will also allow us to apply new insights into fracture spatial scaling.

- Testing quantitative scaling and fracture-quality information for exploration mapping and horizontal well placement, orientation, and length.



- Calibrating seismic response for extracting more information on fracture attributes.
- Constraining and validating fracture-mechanics-based predictive models.
- Improving fractured reservoir simulation.

Fundamental studies of fracture formation and closure help put fracture observations into a rigorous theoretical framework. This study is aimed at matching the wealth of new empirical evidence on fracture attributes with fundamental understanding of the processes that produce these fracture patterns. This match will help us extrapolate observations to unsampled areas and predict fracture attributes.

The goal is to derive predictions of fracture attributes from predrill data such as basin models, diagenetic history modeling, and predictions of rock types on the basis of stratigraphic interpretations. Studies are needed that combine diagenetic and mechanical modeling with rigorous structural and geochemical descriptions of fracture networks. Carefully designed rock-property tests are required and are being carried out in our laboratory to link key parameters in mechanical models (for example, subcritical crack index) with diagenetic parameters that evolve in a systematic way during burial (for example, quartz cement volume and pore pressure, dolomitization, and hydrocarbon maturation).

A key aspect of these studies is creation of predictive structural models that can be tested with the types of observations readily available to industry. These studies explicitly take account of fracture-size scaling.



**Predictive Methods.** Direct characterization of natural fracture network attributes such as length, spacing, aperture, orientation, and intensity in most reservoirs is difficult. The problem stems mostly from the low probability of intersecting vertical fractures with vertical well bores. Even if fractures do intersect the well bore, they are rarely abundant enough to give a good representation of fracture geometry.

One promising alternative is prediction based on core-derived fracture-mechanics parameters. This process-oriented approach can provide a theoretical basis for deciding what types of fracture-attribute distributions are physically reasonable and how attributes such as length, spacing, and aperture are interrelated. The objective of the study is to improve geomechanical fracture network modeling by examining the micro-mechanics of the fracturing process (focused on subcritical crack growth) and by quantifying diagenetic controls on fracture-growth parameters.

The importance of subcritical crack growth is that it exerts fundamental control on fracture-pattern geometry. For a given strain event, subcritical index (and subcritical index evolution) for a particular bed will control amount of clustering of fracture spacing, as well as ultimate fracture intensity.

Key mechanical parameters can thus be used to help accurately predict spatial organization of a fracture pattern. Spatial organization has a primary impact on fluid flow.

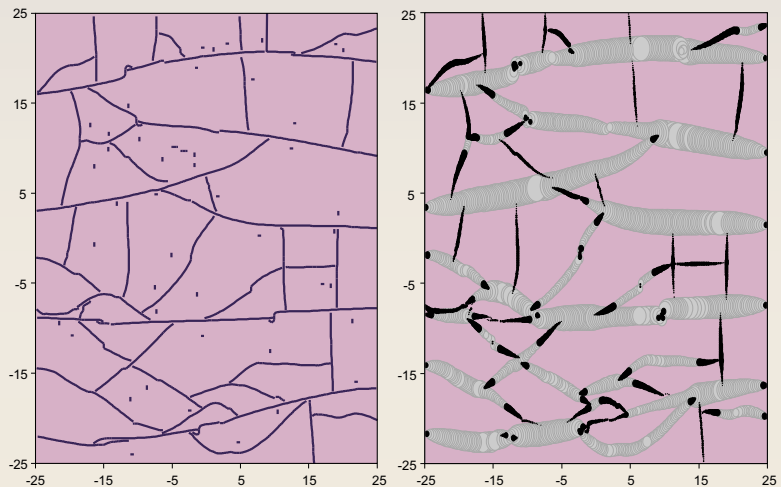
We are addressing this issue in three ways:

- Experimentally, quantifying subcritical index parameters for various rock types;
- Numerically, studying how fracture-pattern geometry varies with different fracture parameters for different beds;
- Observationally, constraining our modeling results with field and core data on fractures and the rocks that contain them.

Ultimately we think that understanding subcritical crack processes and perfecting measurement techniques will enable us to predict which beds

in a particular sequence of stratigraphy are most likely to be fractured and how those fractures are organized throughout the reservoir.

Model results are being compared with our geostatistical work on fracture organization. Rocks currently being tested and modeled include sandstones, carbonates, and shales from a range of geographic and geologic settings. FRAC is compiling subcritical crack index measurements and linking results to rock microstructure observations and diagenesis predictions. We want to determine SCC attributes that existed in the past for use in geomechanical modeling of fracture growth.

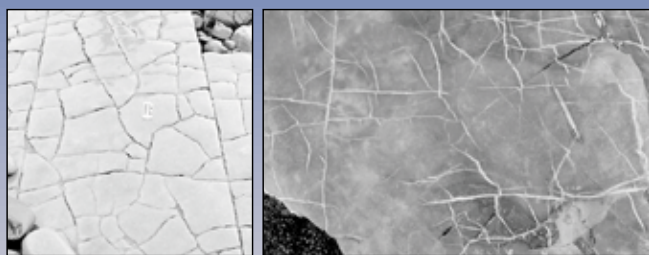


Both of the foregoing research areas involve case studies in formations worldwide.

**Trap-Scale Initiative.** The current phase of the project is multidisciplinary research in analysis of fracture patterns at the trap scale. The study will use outcrop and subsurface data from both siliciclastic and carbonate systems.

Among the issues to be addressed:

- Fracture intensity patterns on and off structure.
- Fracture style, intensity, and porosity preservation variation with structural position and burial history.
- Fracture intensity and fracture spatial arrangements at scales ranging from thin section to trap scale.



Fracture intensity and fracture patterns will be studied in the context of high-resolution data of fold geometry on outcrop analogs and horizontal core data. The aim is to use these data to guide studies of fracture seismic response.

### ***Predicting Fracture Porosity Evolution in Sandstone.***

The goal of this research is to develop an understanding of how fracture growth and diagenetic alteration interact to systematically create and destroy fracture porosity. Our initial objective will be to study a key link between mechanical and chemical processes in opening fractures. Specifically, a new theory of quartz cementation postulates that the rate-limiting step in quartz cementation is precipitation, with supply and transport being of secondary importance. We will test the hypotheses that this cementation process governs evolution of (1) fracture porosity and (2) fracture-growth velocity (subcritical crack index), which, in turn, controls many aspects of fracture-pattern development. Despite the influence of fracture systems on fluid flow, our understanding of the properties of these systems and how they evolve in sedimentary basins is exceedingly meager, owing partly to formidable challenges in collecting meaningful samples of fracture patterns. A practical benefit of our fundamental research is that it will lead to predictions of linked structural and diagenetic attributes, therefore potentially increasing the range of samples that provide meaningful fracture information.

High temperatures and reactive fluids in sedimentary basins dictate that interplay and feedback between mechanical and geochemical processes could significantly influence evolving rock and fracture properties. Moreover, microstructure observations demonstrate that fracturing and diagenesis are linked processes in a wide range of formations,

basins, and tectonic settings. Yet we lack fundamental knowledge of how these processes are linked. Until we understand how they are linked, we cannot hope to develop truly predictive models of fracture systems.

We are studying mechanical and diagenetic feedback loops using new models of cementation, improved measurement methods of key mechanical properties, advanced fracture-mechanics-based fracture-growth modeling, and high-resolution cement and microstructure quantification. This cross-disciplinary research will result in (1) a fundamental advance in our understanding of how the diversity of natural fracture patterns evolves and (2) better predictions of fracture-pattern attributes in the subsurface, where sparse sampling is the rule.

### ***Predicting Reservoir Potential in Deep, Low-Permeability Sandstones.***

A key to unlocking the natural gas resource for the future global energy economy lies in successfully targeting effective reservoir rocks in low-porosity, low-saturation, fractured, and heterogeneous rock systems. This research will create a robust, accurate, and testable procedure for predicting variations in porosity and permeability in deep, tight sandstones. A unique aspect is that rock-mass predictions will explicitly include effects of fractures by combining an innovative numerical model for predicting sandstone porosity and permeability, new models for predicting rock mechanical properties through time and space, and a successful computational model for predicting fracture growth patterns. In deep, nonconventional plays, better predictions are key to locating and producing hydrocarbons economically. Our research will provide new geologic system models and exploration concepts that will help in the discovery of new, overlooked fairways for oil and gas production. Better interwell characterization will also allow for improved reservoir management, leading to maximum economic recovery of hydrocarbon resources.

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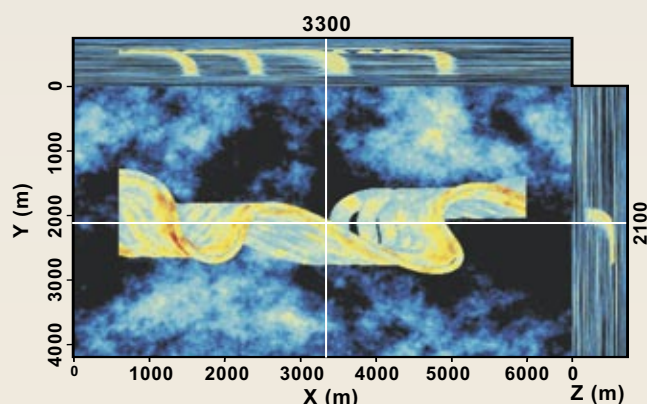




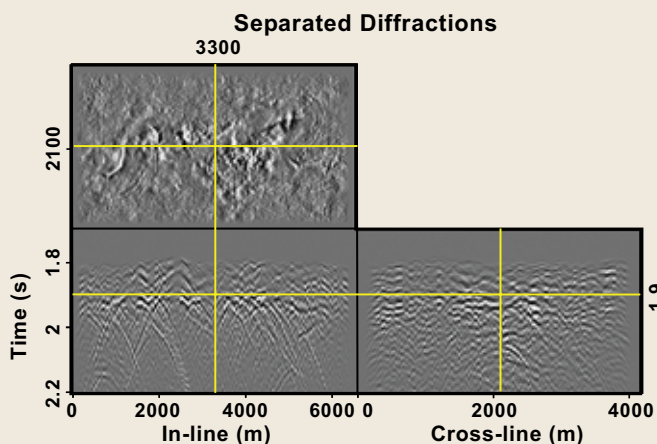


## "Madagascar" Open-Source Project

Researchers doing computational data-processing experiments need software tools that make conducting experiments and exchanging experimental results both convenient and efficient. "Madagascar" is a project that addresses these goals. Started by Bureau Scientist Sergey Fomel in 2003 under the name "RSF" (Regularly Sampled Format), the package was released to the public in June 2006 at the EAGE Workshop, "Open Source E&P Software—Putting the Pieces Together" in Vienna. In August 2006, the Madagascar package was the focus of a School and Workshop in Vancouver titled "Reproducible Research in Computational Geophysics." Fifty participants representing fifteen different companies and fifteen different universities attended the school and received certificates for completing basic Madagascar training. More schools are being planned for next year.



*3-D reservoir model of a channelized system.*

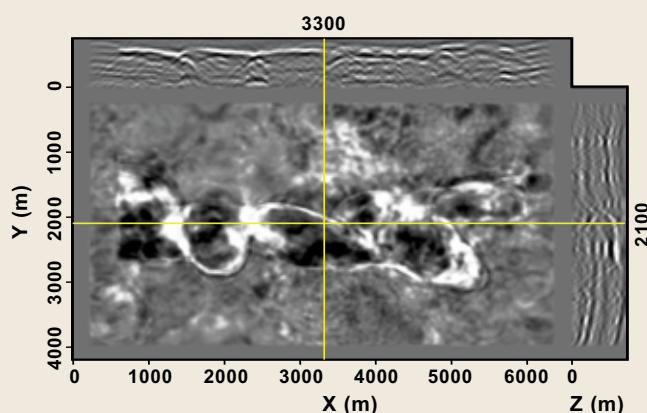


*Seismic diffractions separated from the data.*

Although developed from scratch, Madagascar follows the tradition of geophysical data-processing packages such as SEPlib (developed at Stanford), Seismic Unix (developed at Stanford and Colorado School of Mines), and FreeUSP (developed at Amoco and BP). It reimplements some of the functionality and ideas from these other packages, while updating them to modern software design practices.

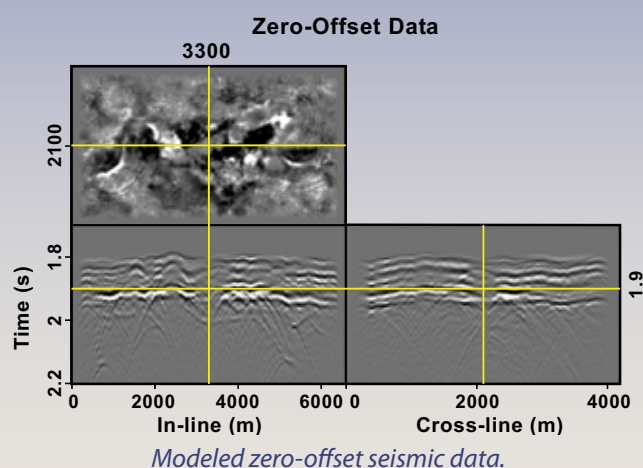
The distinguishing feature of Madagascar is its orientation toward reproducibility of computational experiments. Bringing reproducibility to the field of computational geophysics and enabling fast, convenient technology transfer were the main motivations for the package's development. Madagascar consists of two levels: low-level main programs and high-level processing flows that combine main programs and thoroughly document data-processing histories for testing and reproducibility. Experience shows that high-level programming is easily mastered—even by beginning students that have no previous programming experience.

Madagascar follows the open-source tradition, which is responsible for now-famous products such as the Linux operating system, the Mozilla Firefox Web browser, etc. The main model for the open-source development is an open collaboration among different developers from around the world. Madagascar is hosted by Sourceforge, the main repository of open-source projects. Major contributors include Sergey Fomel and Jim Jennings from BEG; Paul Sava (now at Colorado



*Conventional seismic image of the reservoir model.*

School of Mines); and Gilles Hennenfent, Henryk Modzelewski, and Colin Russell (University of British Columbia). During the first 4 months of public existence, the package was downloaded



from Sourceforge about 400 times and installed by many different organizations.

Madagascar is used primarily for processing and analyzing seismic data. However, its flexible data format makes the package applicable to many other areas that involve computational experiments involving large datasets. An example is the stochastic modeling tools developed by Jim Jennings, which are easily integrated with forward seismic modeling and imaging tools for studying seismic responses of realistic reservoir models.

#### Contact

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<http://www.beg.utexas.edu/mainweb/services/madagascar.htm>

## Updates on 2005 Energy Stories: Where Are They Now?

In the 2005 Annual Report, we reported on seven Bureau energy projects current at the time. We decided to publish an update of five of those stories this year. The projects on High-Resolution Seismic Inversion for Reservoir Modeling and 3-D Characterization of a Sinuous Slope Channel: the Beacon Channel, Brushy Canyon Formation, West Texas, have since been completed.

**Jackson School Royalty Assistance.** In 2006 the Jackson School Royalty Assistance team continued its Barnett Shale studies, in conjunction with the STARR and Permian Basin Geological Synthesis teams, who are conducting regional and rock-based research. On the basis of recent commercial successes of horizontal wells with multiple frac stages, we revised our estimate of Barnett potential upward for the Jackson School royalty lands. Research on the shallower Bend productive interval continued, and we visited companies who operate production in or near the JSG footprint. We showed these companies our new Bend correlation results and suggested infill and recompletion targets. We presented the same information in a poster session at AAPG, and several companies are following up on our recommendations. The research team comprises

*"Madagascar" poster created by Scott Rodgers for the Jackson School booth at the SEG Annual Meeting.*



Eric C. Potter, Tucker F. Hentz, Jeffery A. Kane, William A. Ambrose, Luciano Correa, Joseph S. Yeh, and graduate student Mary Bezara.

***Stratigraphic Architecture and Sandstone Reservoir Quality in Deep Shelf Gas Plays of Texas State Waters.*** Exploration in Tertiary sandstones of the Gulf of Mexico increasingly targets deep to ultradeep reservoirs. Our study focuses on structural setting, stratigraphic architecture, distribution of primary depocenters, and reservoir quality of deep Gulf Coast sandstones below 15,000 ft. Study of the north half of the Texas coast has been completed, and the project is now investigating Texas State Waters, coastal counties, and the Federal OCS along the southern Texas Gulf Coast. The project has 17 corporate sponsors, and additional industrial sponsors are invited to join the project. The Deep-Shelf Gas team comprises Shirley P. Dutton and Robert G. Loucks (coprincipal investigators), Angela McDonnell, Caroline L. Breton, Romulo Briceno, L. Frank Brown, and graduate research assistants Patricia Montoya, Ahmad Ismail, and Carla Sanchez.

***Integrated Geological Synthesis of the Permian Basin.*** Bureau researchers are continuing this integrated analysis of the depositional history and stratigraphic architecture of the Permian Basin. Basic goals of this jointly funded DOE and industry project are to (1) produce a detailed, comprehensive history of the Paleozoic depositional and reservoir systems in the Permian Basin and (2) create spatially integrated databases of depositional, stratigraphic, lithologic, and petrophysical properties for each stratigraphic horizon. Ten industry sponsors have joined the program. More than 30 representatives of these companies gathered at the Bureau for a 2-day workshop in early 2006 to discuss project progress. New objectives have been added to the program including (1) a synthesis of the tectonic and structural history of the basin and (2) a focused analysis of shale-gas reservoir systems across Texas. Project staff are Stephen C. Ruppel, Robert G. Loucks, Wayne Wright, Charles Kerans, Julia F. W. Gale, Edgar H. Guevara, H. Seay Nance, Caroline L. Breton, and graduate research assistants Ted Playton, Mary Bezara, Rosalba Mendoza-Veloza, and David Soto.

### ***3D Modeling of the Mississippian Crinoidal Buildups in the Sacramento Mountains and Comparison with Horseshoe Atoll Reservoirs.***

The Mississippian crinoidal buildups in four canyons located in the Sacramento Mountains, New Mexico, have been captured using ground-based lidar and integrated with the stratigraphy. Three-dimensional images of the buildups have been built using the computer program GOCAD. Results illustrate the systematic change in buildup morphology from landward to seaward. Xavier Janson is the primary researcher on this project. Other team members for this project are Charles Kerans, and Jerome A. Bellian.

***State of Texas Advanced Resource Recovery (STARR) Project.*** Researchers are working with operators to evaluate deeper, higher risk prospects such as reservoirs in the deep-shelf gas play. The deep-shelf gas play comprises offshore Tertiary sandstone reservoirs between the depths of 15,000 and 35,000 ft. The Bureau has strong experience in analysis of 3-D seismic data, including structural and sequence-stratigraphic architectural analyses, stratal slicing, and amplitude anomaly analysis. The STARR group has generated several publications on sequence stratigraphy and gravity tectonics in the Texas Gulf of Mexico area from these studies. The most volumetrically significant State Lands oil and gas resources are in the State Waters of the Gulf Coast and State Leases of the Permian Basin. To date, Project STARR has completed or is currently working on studies of 26 fields on State Lands. Project STARR has contributed to increased royalty payments for the benefit of the Permanent School Fund. Over the last 2 years, the program has helped operators generate approximately \$25 million in royalties to the Permanent School Fund and \$10.8 million in severance tax to the State. Relative to royalty income, Project STARR is revenue positive by a factor of 12.5. Project staff include Robert G. Loucks, Ramón H. Treviño, Ursula Hammes, L. Frank Brown, Hongliu Zeng, Romulo Briceno, Stephen C. Ruppel, Shirley P. Dutton, Fred P. Wang, Julia F. W. Gale, Wayne Wright, and Florence Bonnaffe.



# Research: Environmental and Earth Systems

## Texas Bids for the FutureGen Project

*FutureGen* is a proposed \$1-billion demonstration project sponsored by the U.S. Department of Energy (DOE) to create the world's first near-zero-emissions fossil-fuel energy facility. Envisioned as both a power plant and a research laboratory, *FutureGen* will

- generate electricity,
- produce hydrogen, and
- capture and sequester up to 2.5 million tons of carbon dioxide (CO<sub>2</sub>) a year in deep-subsurface saline brines.

*FutureGen* will also be a large-scale laboratory in which pioneering research into clean coal technology and CO<sub>2</sub> sequestration will do much to create the face of the country's evolving energy future.

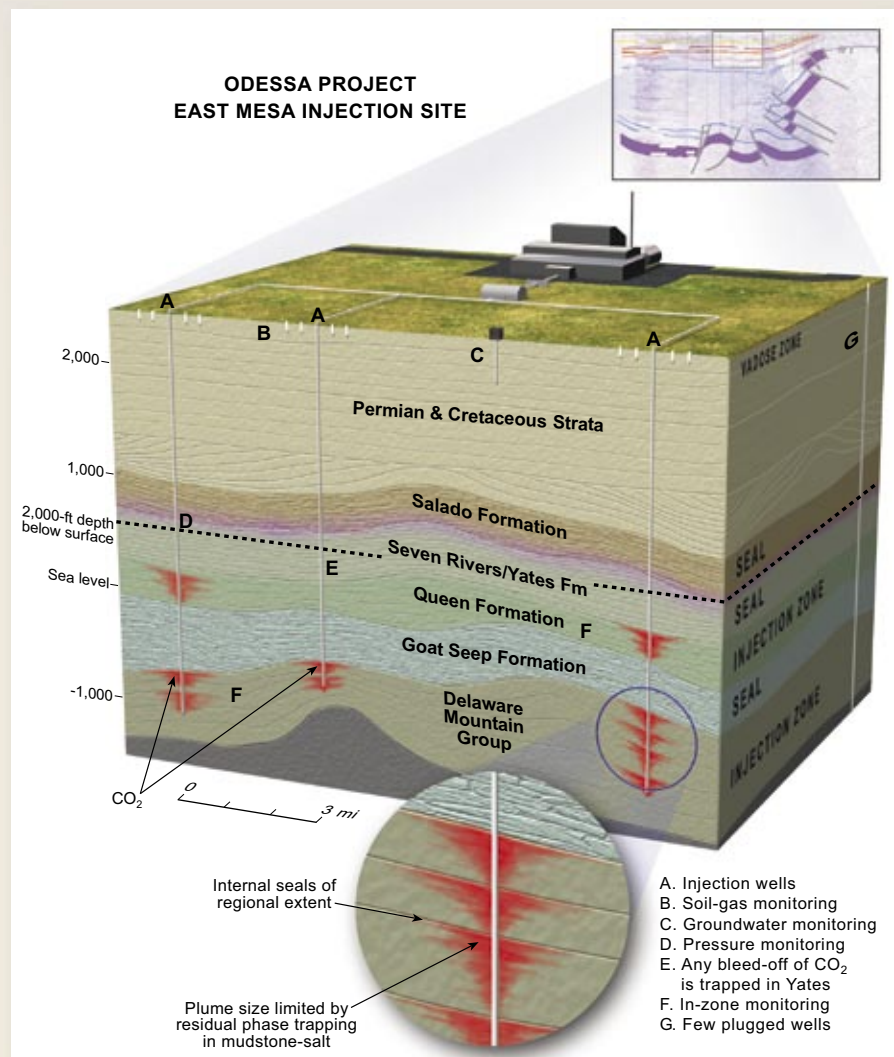
The *FutureGen* project consists of an integrated gasification combined cycle (IGCC) power plant that is in turn combined with CO<sub>2</sub> capture and sequestration, a never-before-tried integration of existing technologies. DOE envisages that the *FutureGen* project will be used to

- improve and refine the technology,
- develop cost-improvement and risk-reduction information, and
- accelerate commercialization by gaining acceptance by industry and financial stakeholders.

To encourage industry investment in improving IGCC technologies,

the *FutureGen* plant is best sited where it can be a commercial success. Such success would enable improvements to the design of key components to increase efficiencies that would ultimately lead to widespread commercial deployment. The Gulf Coast and adjacent southwestern states have

- the largest hydrogen market in the country,
- the largest potential for CO<sub>2</sub>-related enhanced oil recovery (EOR),
- the largest network of CO<sub>2</sub> pipelines, and
- the greatest expertise in CO<sub>2</sub> EOR in the country.





This region also has the most to gain from propagation of "FutureGen-like" plants.

Some key environmental groups support the *FutureGen* initiative. David Hawkins, director of the Natural Resources Defense Council's Climate Center, points out that coal accounts for more than one-third of U.S. CO<sub>2</sub> emissions and nearly 40 percent of global CO<sub>2</sub> emissions. Hawkins notes that "Coal is an inevitable and substantial part of the global energy mix (for the foreseeable future), so to the extent that we are going to use it, we believe coal-based generation should be IGCC with carbon capture and storage."

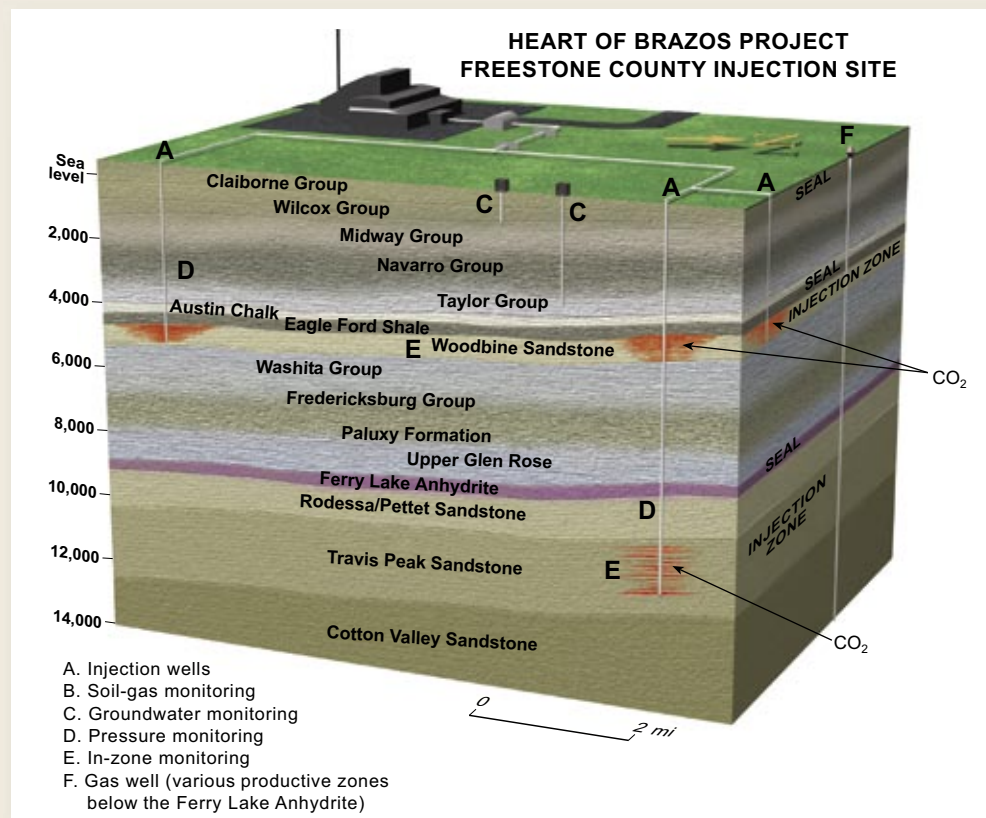
Bringing the *FutureGen* project to Texas would

- put the state at the forefront of developing the next generation of electric power technologies,
- increase the future usage of Texas lignite,
- provide a potential source of CO<sub>2</sub> for EOR and move Texas forward in producing 4 to 5 million barrels of oil that would otherwise remain in the ground, and
- create a model for integrated chemical processing plants that produce electric power and hydrogen-based chemicals such as urea, ammonia, and methanol.

Recognizing the potential importance of the *FutureGen* project to the state, Texas Railroad Commissioner Michael Williams (Texas Governor Rick Perry's designated leader of the Clean Coal Council) asked BEG Director Scott Tinker to create a strategy for bringing the project to Texas. Funded by the Texas Legislature, the *FutureGen* Texas Team was created in 2005. Led by Dr. Tinker, the team consists of Jay Kipper (BEG, business lead), Dr. Jerry Hill (consultant, electric plant and fuel lead), Steve Walden (consultant, environmental lead), Chuck McDonald (consultant, public relations lead), and Dr. Ian Duncan (BEG, subsurface geology lead).

In late 2005, the team created an internal competition among Texas Councils of Governments (COG's) to identify the best potential Texas sites for the *FutureGen* plant. From nine sites submitted, the team selected two sites (one near Odessa in west Texas and one near Jewett in east Texas) to enter into the national competition. In May 2006, 7 states entered a total of 12 proposed sites in response to the *FutureGen* request for proposals. In August, finalists announced

by the *FutureGen* Alliance were two of the sites put forward by Illinois and **both of the sites proposed by Texas**. Since then, the *FutureGen* Texas Team, assisted by numerous environmental consulting organizations, has been working on supplying extensive data sets that will form the basis for Federal NEPA (National Environmental Policy Act) environmental impact assessments of both Texas sites. The team is also assembling "Best Value" packages for each site, outlining economic and other advantages offered by the Texas sites. These will be submitted



to the Alliance before its final site selection decision, which is expected in September of 2007.

## Updates on 2005 Environmental Stories: Where Are They Now?

In the 2005 Annual Report, we reported on five environmental Bureau projects current at the time. We decided to publish an update of three of those stories this year. The Arsenic Contamination in Texas Groundwater project has been completed.

### ***Geologic Mapping for the STATEMAP Program.***

Five 1:24,000 open-file maps of Texas Gulf Coast areas were completed during 2006: three covering Galveston Island and two for Mustang Island. These maps display Holocene geologic units associated with the coastal depositional environments of the barrier islands and are available as color paper copies or GIS digital data sets. Also, six 1:24,000 open-file maps of the Brazos River Valley were completed and are available as black-and-white paper products. Researchers are currently mapping a portion of the Brazos River Valley and the associated aquifers within Burleson, Brazos, Robertson, and Milam Counties. A second project is the geologic mapping of part of the Bolivar Peninsula along the upper Texas Gulf Coast to provide information that will aid in the planning of land use and management of this sensitive coastal area. Bureau staff involved in the STATEMAP projects are Edward W. Collins, Thomas A. Tremblay, and James C. Gibeaut.

### ***Modeling Future Changes in Barrier-Island Wetlands on Galveston Island, Texas.***

The model has been refined and applied to barrier islands at the mouth of the Galveston Bay System, including Galveston and Follets Islands and Bolivar Peninsula. The wetlands model was run 90 years into the future using a repeat of the past record of sea-level change

as recorded by a tide gauge on Galveston Island. The model shows wetlands migrating up the back barriers in a complicated pattern dictated by relict geomorphology but disappearing on the bayward side, owing to inundation and shoreline retreat. At the end of 90 years, upland migration allows for no net change in the combined area of four wetland environments. However, the important low marsh environment decreases by 15 percent, whereas high marsh increases by 35 percent. The space required for upland migration is nonetheless currently under development pressure, especially on Galveston Island, creating the likelihood of greater marsh loss. Results of this study are being used to guide development and conservation on Galveston Island. James C. Gibeaut is the Principal Investigator of the project.

### ***Geological and Petrophysical Characterization for CO<sub>2</sub> Sequestration in Enhanced Oil Recovery Floods, Permian Basin of West Texas.***

The Bureau, along with its industry and academic partners, made significant progress in 2006. An entire 3D seismic shoot was conducted over Claytonville field. In addition to this shoot, a step-out vertical seismic profile (VSP) was acquired. The seismic is currently being interpreted to determine detailed reservoir architectural framework of the Claytonville reservoir through the application of high-resolution seismic inversion. During the year, a new well was drilled from which a long core was taken. The core data are being used to better calibrate wireline-log suites. A groundwater monitoring program has been initiated as well, and the resultant data are being analyzed, along with previously obtained information. All this information is contributing to our understanding of the character of the subsurface into which CO<sub>2</sub> will be injected. Bureau researchers for this project are Mark H. Holtz, Rebecca C. Smyth, Vanessa Nuñez, and Caroline L. Breton.





# Public Outreach and Education



**Beach Monitoring.** The Texas High School Coastal Monitoring Program (THSCMP) is currently in its ninth year. Participating schools are Ball High School on Galveston Island (9 years in the program), Port Isabel High School in South Texas (7 years), Port Aransas High School on Mustang Island (7 years),



Van Vleck Middle and High Schools (2 years), and students participating in the Spanish Science Club at Tidehaven Middle School (2 years). Palacios High School started collecting data this year. BEG researchers and students make at least three field trips to survey sites in their respective coastal regions. BEG envisions a network of coastal schools conducting scientific beach studies and then sharing their observations with other students,

schools, and the public using the Internet. Benefits from this project accrue to those who are directly affected by beach erosion and beach erosion public policy. Data from this project are accessible through the THSCMP Website, CMP project reports, and scientific journal articles. For more information, please visit the Program's Website (<http://coastal.beg.utexas.edu/thscmp/>). Bureau researchers involved in this project are James C. Gibeaut and Tiffany L. Hepner.

**Climate Change Lecture.** On October 5th, the U.T. Environmental Science Institute monthly lecture featured a presentation by Dr. Kerry Emanuel from MIT titled "Is Climate Change Increasing Hurricane Activity?" BEG staffers Dr. Jim Gibeaut, Sigrid Clift, and Reuben Reyes provided prelecture activities



that included topics on coastal erosion along the Texas Gulf Coast and storm surges related to Hurricanes Katrina and Rita.

**Decision Makers' Conference 2006.** In September, the Bureau held its second 2-day Decision Makers' Field Conference, Hazards and Natural Resources of the Texas Gulf Coast: Building the Bridge between Science and Policy. Conference attendees





represented the Texas legislature, State agencies for resource management and protection and included other local, State, Federal, and industry experts. Among Bureau experts were Scott Tinker, Ian Duncan, Jim Gibeaut, Tiffany Hepner, Beverly DeJarnett, and Bob Loucks. Each discussed important environmental and energy issues that Texas is facing, such as carbon-dioxide emissions storage, clean coal technology through the FutureGen initiative, coastal storms and erosion, geological materials preservation, and oil and gas exploration and production. Other activities included visits to various research sites on Galveston Island and a tour of Valero Refinery in Texas City. The conference's goal of informing decision makers on key issues facing the Texas Gulf Coast region was achieved with great success. The conference was coordinated under Jay Kipper by Sigrid Clift and Jennifer Logan. BEG staff photographer David Stephens documented the event, and Dallas Dunlap, Randy McDonald, and Darrell Haynes provided critical logistical support. Jamie Coggin and Lana Dieterich helped produce the field-trip guidebook.

## Earth Science Week 2006

Earth Science Week (ESW), a nationwide program designed to promote interest in and knowledge about earth science and its contributions to society, is observed yearly during the second week in October. In 1998 the American Geological Institute began the ESW observance that is now celebrated annually in every state and in countries around the world. The Austin ESW Consortium, chaired by Bureau scientist

Sigrid Clift, includes members from earth-science-related organizations and companies from the Central Texas area. Of the four very successful events organized for 2006, a book drive for the Austin Public Libraries raised \$2,500 for much-needed earth science books in their collection. Hurricanes and groundwater resources were the themes for the 4th annual summer lecture series, which 200+ people attended, and more than 600 children and their parents attended the Summer Earth Science Festival cosponsored by Austin ESW and Zilker Park. ESW events in Austin culminated in the 7th Annual Earth Science Career Fair for more than 300 middle school students. Financial sponsors for the events were the Jackson School of Geosciences; Texas Space Grant Consortium; the Lower Colorado River Authority; Holt, Rinehart and Winston; D. B. Stephens & Associates; the Subsurface Library; the Austin Geological Society; and the City of Austin Watershed Protection Department. More than 65 dedicated professionals donated their time and resources to provide meaningful earth science educational experiences to students and the general public. Austin ESW owes its success to its sponsors and volunteers. For more information about Austin ESW, visit the Texas ESW Website at [www.beg.utexas.edu/esw](http://www.beg.utexas.edu/esw).



**CAST 2006 in Wichita Falls.** Bureau staffers Jennifer Logan and Sigrid Clift exhibited the Jackson School booth at the Conference for the Advancement of Science Teaching, the annual Texas science teachers' conference that was held this year in Wichita Falls. Science teachers from around the state attended the event to talk to exhibitors and enhance their

science skills, availing themselves of the hundreds of training opportunities that were offered. Jay Kipper, along with Sigrid Clift, gave a presentation titled *Power for Future Generations*, a summary of the basics of environmental issues associated with fossil fuel CO<sub>2</sub> gas emissions and FutureGen's initiative to implement coal gasification and underground storage in order to prevent the release of CO<sub>2</sub> into the atmosphere. CAST 2007 will be held in Austin, November 15–17.

**Museums.** The Fort Worth Museum of Science and History is well known for outstanding hands-on displays and interactive experiences for visitors. The museum is planning a significant renovation and expansion, with a completion target date in 2009. The topic of energy is one of the key themes for the expanded design. The Bureau is part of an advisory team formed to provide expert assistance in the new energy-related design efforts. In October Associate Director Eric Potter represented the Bureau in a planning meeting with museum officials and design consultants.

The Bureau of Economic Geology continued its partnership with the **Petroleum Museum in Midland** in 2006 by again taking part in the American Geological Institute's annual Earth Science Week activities. Elementary and junior high school students from the Midland and Odessa school districts were treated to *EarthView Texas*, a unique virtual reality presentation using the Bureau's state-of-the-art passive stereo visualization system. Presented by Scott Rodgers and coordinated by the Museum's educational staff, the program explores Bureau research into real-world issues such as resource management, energy development, and coastal erosion. Students and teachers are exposed to key geologic concepts and scientific insights. The Petroleum Museum also scheduled special evening sessions that were attended by the general public and museum supporters.

**Rock Curation.** The Bureau's core curation operations continue to thrive. The **Core Research Center in Austin** was the grateful recipient of a sizable number of core samples—including international (33 boxes), frozen (267 boxes), and washed (906 boxes)—as well as a number of boxes of washed cuttings (29 boxes). Cash donations totaled \$468,932. Donors of core,

cuttings, and cash included Shell Exploration, Conoco Phillips, BP America, Terrain Solutions, Tonner Hills SSP, Osburn Heirs Co., Santos USA Corp., Apache Corporation, Kinder Morgan, Burk Royalty, Anadarko Petroleum, and Justiss Oil Co.

The **Houston Research Center** also received more than 30,000 boxes of heritage Unocal rock material from California. Shea Homes of California donated this material and contributed more than \$250,000 toward the UT/BEG endowment.

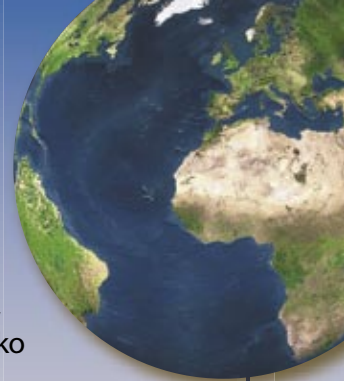
The **Midland Research Center** received 3,775 boxes of core from Oxy and 4,759 boxes from Kinder Morgan.

**IOGCC Visit.** Members of the Interstate Oil and Gas Compact Commission, a multistate agency made up of all oil- and gas-producing states and advocates for environmentally sound ways to increase the supply of U.S. energy, visited BEG for a seminar and tour on Saturday, October 14. Eric Potter, Ian Duncan, Dallas Dunlap, Rob Reed, and Sigrid Clift gave



presentations on BEG energy and outreach programs. The event, part of IOGCC's annual meeting, was held in Austin this year.

**ScienceFest.** The Bureau hosted an Austin Geological Society poster session on March 6. High school students whose earth science projects qualified for the Austin Area ScienceFest displayed the results of their research. Topics included earthquakes,





water quality, water chemistry, and clay properties. The students enjoyed a tour of the Bureau led by Sigrid Clift and also heard talks by scientists Roberto Gutierrez, Sue Hovorka, and Ramón Treviño about their careers and current research projects.



**Explore UT.** More than 30,000 people from all over the state came to campus March 4 to attend 2006 Explore UT, the annual open house organized by The University of Texas at Austin. The Jackson School coordinated six activities that included the Bureau's 3-D Geology virtual reality tour and



a hands-on session called *Not All That Glitters Is Gold*, which were presented by Nedra Bonal, Sigrid Clift, Sue Hovorka, Amanda Masterson, Scott Rodgers, and Carol Zito.

**COOL.** Three students from Cedar Park and Leander High Schools visited the Bureau February 8 and 9 to take part in the Career Opportunities on Location (COOL) job-shadowing program. Susan Hovorka, Gulf Coast Carbon Center (GCCC), Mark Holtz, and



other Bureau staff welcomed Cindy Abbot, Victoria Maynard, and Courtney Snyder to a 2-day career as scientists. The students examined core from an oil reservoir in Fisher County, the site of an enhanced oil recovery effort where CO<sub>2</sub> will be used to get more oil out of the rocks. The CO<sub>2</sub> will then be stored in the reservoir. They also viewed slices of sandstone magnified about 1,000 times under the scanning electron microscope operated by Rob Reed, who helped them identify the minerals making up the rock. The COOL program is designed to give students first-hand experience actually performing jobs that may become their future careers.





# Behind the Scenes

## Support Staff

**Administrative.** Wanda LaPlante is the Assistant to the Director. Sharon Campos supervises the administrative staff, who are responsible for general administration of the Bureau. Sharon and her employees handle payroll, personnel, accounts payable and receivable, purchasing, travel and reimbursement, and countless other tasks for the Bureau's 140+ employees.

**Contract Management.** Contract Manager Julie Duiker and her staff help researchers prepare budgets and proposals and serve as liaisons for funding agencies. Contract management includes financial reporting, database and records management, and the documentation of progress and submission of deliverables.

**Facilities Management.** The day-to-day management of the building is the responsibility of Facilities Manager George Bush. His team provides behind-the-scene support for in-house meetings, conventions, daily mail service, maintenance of Bureau vehicles, office moves, and inventories of basic equipment.

**Media Technology.** The Media Technology (MT) department is led by Joel Lardon. MT comprises the Bureau's Graphics, Editing, Web, and Virtual Reality Laboratory services.

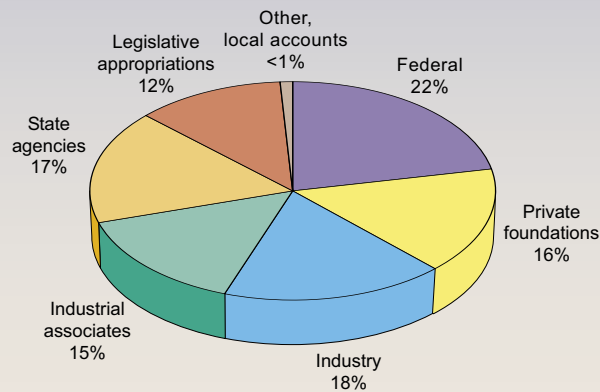
**Information Technology.** The Information Technology (IT) group is led by Ron Russell, who, with his team of IT experts, provides vital computer technology assistance to Bureau researchers and staff. Geoscience software support comes from Landmark Graphics Corporation via the Landmark University Grant Program, Dynamic Graphics, GeoQuest, GMA, Green Mountain Geophysics, GX Technology, Hampson & Russell, Midland Valley, Neuralog, Paradigm, Petra, Seismic MicroTechnology, and Terra Science. Recently IT has added a GeoQuest/Geoframe suite, Petrel Workflow from Schlumberger; Recon from Austin GeoModeling; Attrib3D from Rocksolidimages; ABAQUS from ABAQUS; GOCAD from Earth Decision; Matlab from Mathworks; RMS from Roxar; Polyworks from Innovmetric; ARCGIS from ESRI; and ERMMapper from ERMMapper.



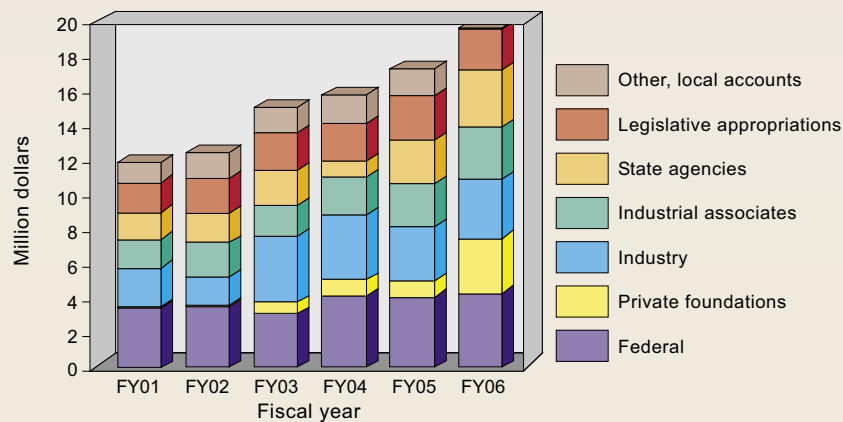
## Bureau Finances

Bureau funding, \$20 million annually, comes from three sources in roughly equal amounts—Federal, State, and private industry. Of that, about one-third is spent on environmental research and the rest on energy. Less than 10 percent is hard money; we end up raising 90 percent of our money on an annual basis. We try to leverage our funding with matching money. In FY 2006 we changed our reporting from “expenditures” to “bookings,” thus eliminating the *local accounts* category.

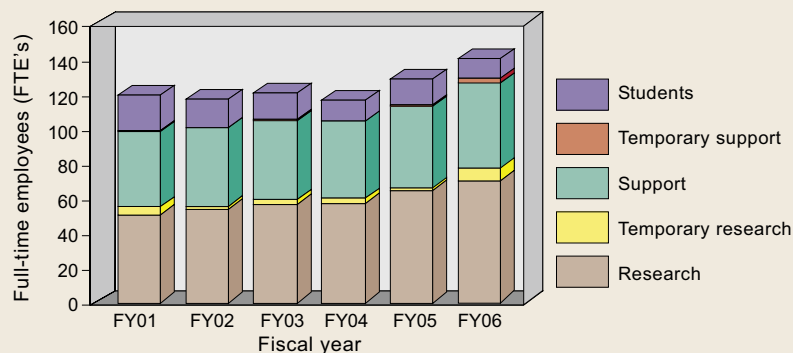
### Sources of Funding



### Six-year Budget Trends



### Staff Trends





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