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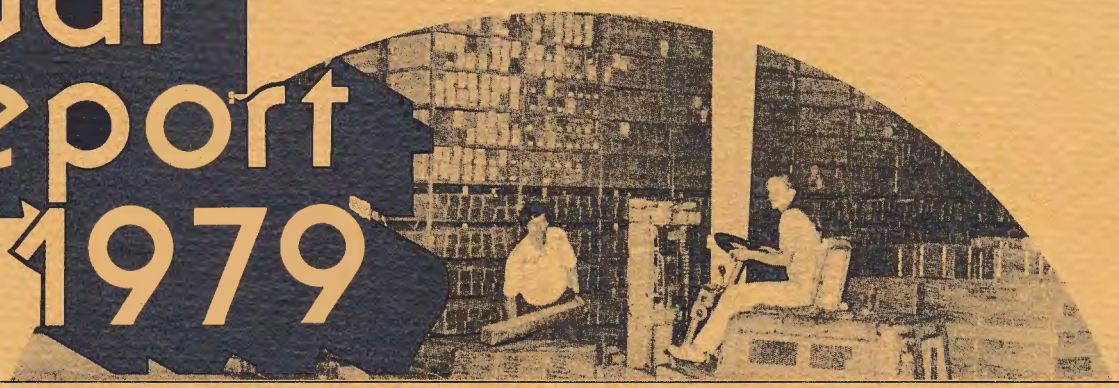
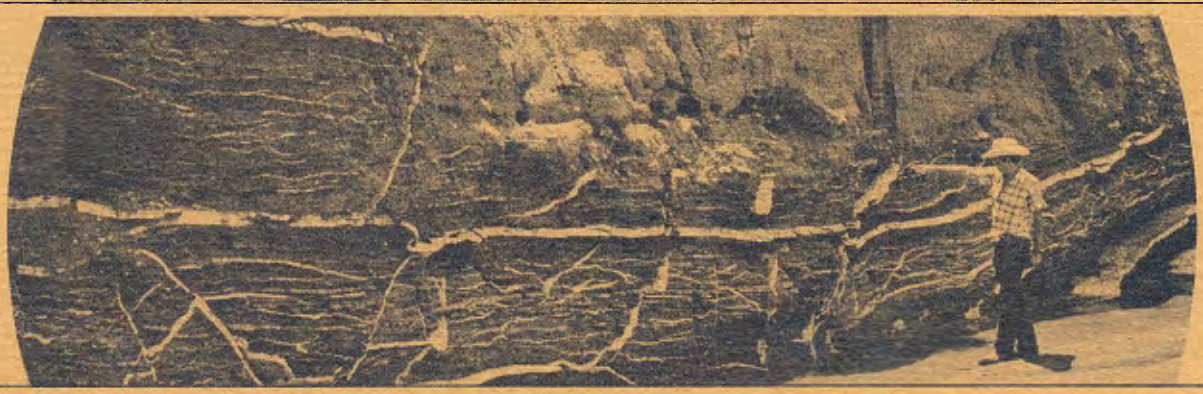
Bureau of Economic Geology

Annual Report 1979





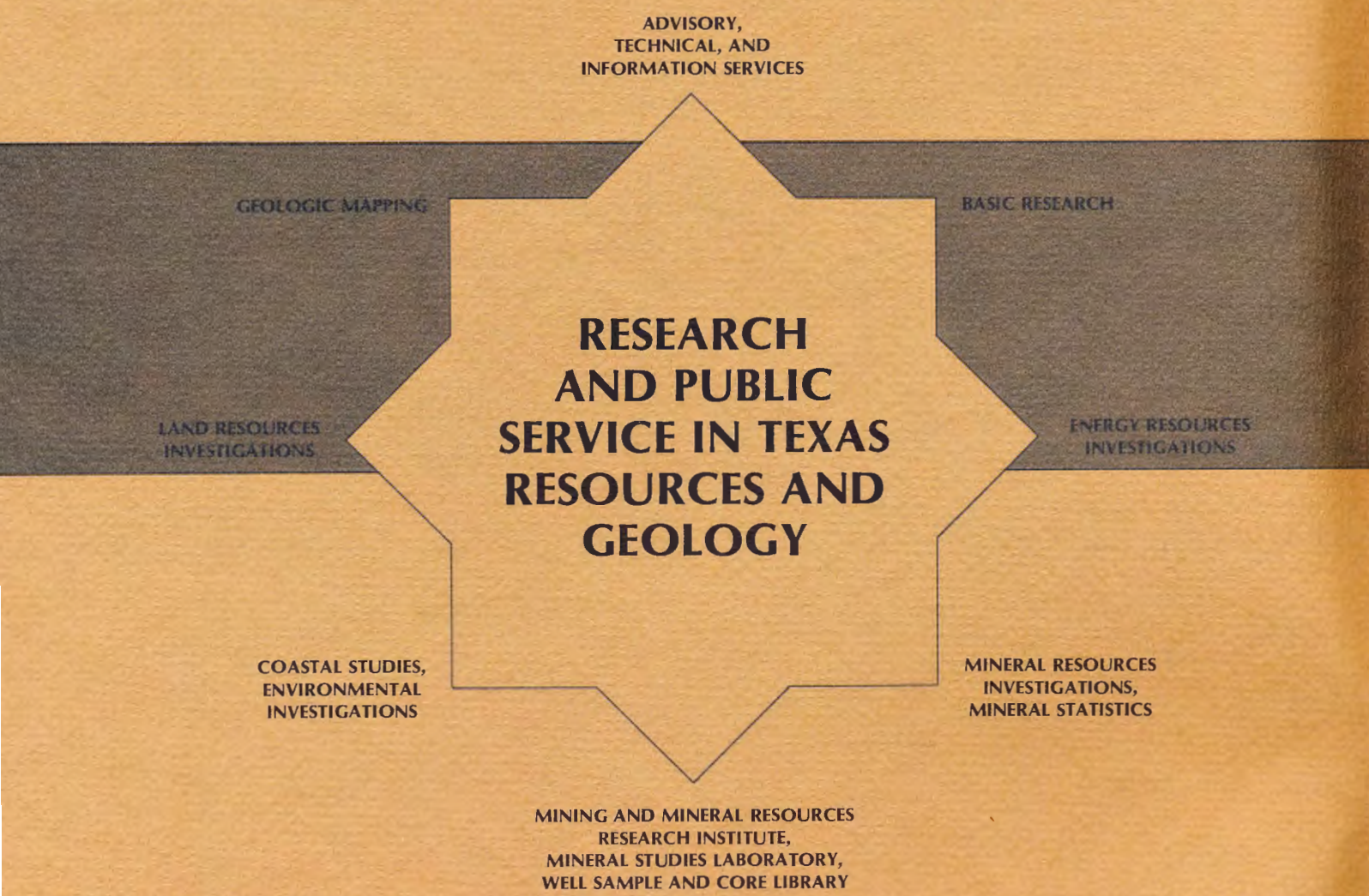
Foreword

The Bureau of Economic Geology, established in 1909 as the successor to the Texas Geological Survey and the Texas Mineral Survey, is a research entity of The University of Texas at Austin. It also functions as the State Geological Survey — a quasi-state agency. The Bureau Director is a member of the Texas Energy and Natural Resources Advisory Council, as well as several interagency committees. The Director serves as State Geologist and represents Texas in the Association of American State Geologists.

The Bureau provides extensive advisory, technical, and informational services relating to the geology and resources of Texas. In addition, it conducts a large number of basic and applied research projects in energy resources, mineral resources and statistics, land resources, systematic geologic mapping, and a variety of other research programs in such areas as hydrogeology, basin analysis, geochemistry, and coastal studies. Certain projects are conducted jointly with other units of the University as well as with State, Federal, and local governmental agencies. The Texas Mining and Mineral Resources Research Institute functions as an administrative unit of the Bureau.

The Bureau of Economic Geology publishes major reports in The University of Texas Publication series; it also has its own series of Reports of Investigations, Geologic Quadrangle Maps, Geologic Atlas Sheets, Environmental Geologic Atlases, Guidebooks, Handbooks, Geological Circulars, Mineral Resource Circulars, and several Special Publications. Publications are sold for a nominal price designed to recover printing costs. A complete list of publications is available on request.

The Annual Report of the Bureau of Economic Geology outlines the scope and status of current research programs and projects, publications, professional personnel activities, and special services in the area of Texas geology and resources available to agencies, industry, and all citizens of Texas. The Annual Report is available on request at no charge.



Cover photos (top to bottom): Well Sample and Core Library, Balcones Research Center; gypsum-filled fractures in Permian red mudstones, overlain by Holocene alluvium, Briscoe County, Texas; sunrise over Padre Island; by David M. Stephens, Thomas C. Gustavson, and William A. White.

Bureau of Economic Geology

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Research

Bureau research programs and projects are designed to address many of the State's major concerns in the areas of geologic, energy, mineral, land, and environmental resources. Through the years, an extensive research program in energy and mineral resources has been maintained. This substantial research emphasis is broadened by comprehensive investigations of land and water resources. The Bureau's projects are directed toward solving existing problems of resource utilization; they are aimed at research programs incorporating geologic concepts that will build toward an understanding of a specific resource and its impact on human activities.

The diverse range of Bureau research is typified by the programs dealing with the evaluation of bedded salt deposits in the Panhandle and interior salt domes in East Texas as potential sites for isolation of nuclear wastes. These projects require in-depth, comprehensive evaluations of subsurface hydrology, resource distribution, depositional systems, and land-surface configurations and denudation rates. Such programs call for expertise in areas such as geomorphology, hydrology, basin analysis, tectonics, environmental geology, geochemistry, and rock physics. This research integrates complex geologic subdisciplines into a coordinated assessment of a critical problem needing scientific, objective review.

The newly established Texas Mining and Mineral Resources Research Institute, embracing both research and training, operates as an administrative unit of the Bureau of Economic Geology. The Land Resources Laboratory coordinates the numerous land resources programs within the Bureau of Economic Geology. Bureau research in 1979 focused on the assessment and analysis of environmental problems concerning geopressured geothermal energy production and uranium utilization, in addition to continuing work on such long-standing projects as the *Environmental Geologic Atlas of the Texas Coastal Zone* and the Guadalupe - San Antonio - Nueces river basins regional study.

Minerals and energy resources programs continued to be a major part of Bureau research. In addition to resource assessments in uranium, lignite, and geopressured geothermal energy, the Bureau continued research into analysis of governmental policy related to the availability of energy raw materials or resources. A comprehensive survey of mineral localities in the State was also in progress; this survey proposes to develop detailed information on hundreds of mineral sites across Texas.

Systematic geologic mapping, coastal studies, basin analyses, and investigations in other areas of economic geology further indicate the range of research programs carried forward in 1979.

ENERGY RESOURCES INVESTIGATIONS

RESOURCE ASSESSMENT AND TEST-WELL SITE SELECTION—GEOPRESSURED GEOTHERMAL ENERGY, TEXAS GULF COAST

Don Bebout, project director, A. R. Gregory, Bonnie R. Weise, and Marc B. Edwards, assisted by Jan S. Posey, Victor J. Gavenda, Jung H. Seo, David A. Budd, Steven D. Mann, Jeffrey D. Potter, Teddy J. Bond, John B. Swanson, Jong H. Han, Jon Herring, Douglas H. Wilson, H. Scott Hamlin, James L. Lockley, Adrienne D. Allie, Charles D. Winker, and Jonathan C. Herwig.

Assessment of the geopressured geothermal resource began in 1974 with funding from the U. S. Atomic Energy Commission and The University of Texas at Austin, Center for Energy Studies. Initially, the project involved only an evaluation of the Frio Formation of South Texas. Later the geothermal project was expanded significantly to include studies of the Frio Formation and the Vicksburg and Wilcox Groups of the entire Texas Gulf Coast and was subsequently funded for more than $1.5 million by the U. S. Department of Energy, Division of Geothermal Energy.

The project consisted of two major phases: (1) a regional evaluation of the geothermal energy potential of the Tertiary depositional systems of the Texas Gulf Coast and the identification of potentially productive areas, and (2) a study of the prospective areas in order to develop sites for test wells. Extensive geological and petroleum engineering studies were required to meet these objectives. Geological research included regional correlation, regional mapping of sandstones, regional studies of sandstone diagenesis, analysis of seismic data, and the recognition of growth fault models and their relationship to depositional patterns. Engineering research included a study of reservoir pressure and temperature gradients, interpretation of subsurface porosity and permeability, determination of reservoir performance (deducted from reservoir pressure decline and hydrocarbon production histories), and calculation of fluid salinity and methane content of the reservoirs.

The regional resource assessment of the Frio, Vicksburg, and Wilcox has been completed. Several geothermal fairways were identified in the Frio, but all except one, the Brazoria Fairway, failed to meet minimum requirements considered necessary for a geothermal test. The Austin Bayou Prospect was developed in the Brazoria Fairway, and the geopressured geothermal test well General Crude Oil Company and U.S. Department of Energy No. 2 Pleasant Bayou was completed in 1979. This well will make possible the testing of fluids from lower Frio reservoirs (at depths of 14,000 to 16,500 feet) to determine water chemistry, amount of methane in solution, and flow rate deliverability over an extended period of time.

Geophysical studies of existing seismic lines are continuing in the Austin Bayou Prospect (Frio Formation) and Cuero Prospect (Wilcox Group). It is anticipated that new lines will be shot across these prospects in 1980.

VOLUME AND ACCESSIBILITY OF ENTRAINED METHANE IN DEEP GEOPRESSURED RESERVOIRS—TERTIARY FORMATIONS OF THE TEXAS GULF COAST

A. R. Gregory, M. M. Dodge, and J. S. Posey, assisted by Bryant W. Hainey, M. Scott Ritchie, and John B. Swanson, Akanni Segun Lawal, Anil Hulkarni, Sharad Kelkar, Randall McCloskey, Michael L. Lunceford, Victor Lombeida, Lynette S. Schillo, Koso I. Idigbe, Izielen Abgon, Charles Sponberg, Kingston C. W. Yong, Laura Huebner, Evans V. Jegbefume, Valerie A. Hunter, Gregory Shoemaker, Rosemary Capo Shoemaker, and Stephen Weiner.

In recent years, higher natural gas prices have stimulated interest in the methane-saturated geothermal waters of the Texas Gulf Coast as a potential source of natural gas. Widely varying estimates by different researchers concerning the amount of energy in place in the Texas Gulf Coast have indicated the need for a more definitive study.

The objectives of this project are (1) to appraise the total resource of entrained methane in the onshore Texas Gulf Coast sandstone reservoirs within the stratigraphic section extending from the base of significant hydrocarbon production to the deepest significant sandstone occurrence, and (2) to assess the economics of producing methane from this zone. During 1979 a series of structural cross sections (24 dip sections and 4 strike sections with sea level as the datum plane) was completed showing sand distribution and the location of major growth faults. Parameter plots corresponding to these cross sections are being made to show how formation pressure, salinity, temperature, and porosity vary with depth in each well. The volume of in-place methane resource is directly related to these parameters. Structural and stratigraphic boundaries are being used to subdivide the Texas Gulf Coast into units for which total methane content will be calculated. Each unit, or reservoir, of sandstone will be uniquely identified by its volume of sandstone, by its representative porosity and permeability, and by the temperature, pressure, and salinity of its fluids. Conceptual models based on this information will be developed to describe the distribution of methane in the Gulf Coast.

EFFECTS OF A GEOPRESSURED GEOTHERMAL SUBSURFACE ENVIRONMENT ON ELASTIC PROPERTIES OF TEXAS GULF COAST SANDSTONES AND SHALES

A. R. Gregory (Bureau of Economic Geology) and Milo Backus (Department of Geological Sciences).

The objective of this project is to evaluate the elastic properties and attenuation of the geopressured geothermal sediments that are penetrated by the General Crude Oil Company and U. S. Department of Energy No. 1 and No. 2 Pleasant Bayou wells in Brazoria County, Texas. The project involves the use of elastic wave velocity and amplitude data obtained from conventional acoustic logs, long-spaced sonic logs, velocity surveys, and laboratory measurements on cores, as well as density data obtained from density logs to determine the effect of high formation pressures and temperatures on the physical properties of deep sediments. Similar data are obtained in shallow hydropressured formations and in the transitional zone that extends above and below the top of geopressured sediments.

Long-spaced sonic digital transit time and wave form logs were run in the No. 2 Pleasant Bayou well at different spaces between receiver and transmitter sondes and provide an opportunity to study borehole effects on sonic velocity and attenuation data. Vertical seismic profile data were obtained in the cased hole at 63 depth levels using a lock-in geophone and two 5-tone vibroseis source units. Direct interpretation of the sonic waveforms provides a basis for obtaining improved velocity logs in those zones of the borehole where conventional sonic logs are in error due to cycle skipping caused by waveform amplitude variations. The expected reflecting properties of sandstones in the deep geopressured environment, and in shallower normal pressure environment, will be determined in this study.

The project, which began in 1978, is sponsored by the Center for Energy Studies of The University of Texas at Austin and funded by the U. S. Department of Energy.

GEOLOGICAL STUDIES OF GEOPRESSURED ZONES

Robert A. Morton, Don Bebout, A. R. Gregory, Bonnie R. Weise, Marc B. Edwards, and R. G. Loucks, assisted by James L. Lockley, H. S. Hamlin, Adrienne D. Allie, Steven D. Mann, Victor J. Gavenda, Jong H. Han, Nathaniel Smith, Jonathan C. Herwig, Katie J. McDonough, Douglas H. Wilson, Izielen Abgon, Lynette S. Schillo, Lee A. Jirik, William K. Rack, Donald W. Downey, and Richard A. Schatzinger.

This project, sponsored by the Gas Research Institute, was initiated in January 1979. The objective of the study is to delineate prospect areas and sites for test wells capable of long-term production of water from the shallow geopressured zone. The study concentrates on Tertiary geopressured sandstone reservoirs of the Texas Gulf Coast that have fluid temperatures of less than 300°F (149°C).

During 1979, geopressured corridors, primarily in the Wilcox Group and Frio Formation, were delineated along the Texas Gulf Coast. Within those corridors, five fairways were selected for detailed study as the areas most favorable for shallow geopressured water reservoirs. For each fairway, electrical logs were correlated in detail, cross sections, structure maps, and net-sand maps constructed, and permeability, porosity, temperature, pressure, and salinity data studied. On the basis of the cross sections, maps, and well data, prospect areas for test sites were outlined within the fairways. Project completion is scheduled for May 1980.

ESTIMATION OF UNCERTAINTY IN COAL RESOURCE AND COST ASSESSMENTS

W. C. J. van Rensburg and W. R. Kaiser.

The aim of this project is to develop a conceptual model for characterizing uncertainty in coal resource estimates based on geological, chemical, and statistical analyses of available data. This model has been previously applied and tested in the Gulf Coast coal basin. Central to this approach is the integration of ancient coal depositional systems in the estimation of coal resources.

A carefully selected team of investigators, each with expertise specific to the task defined, has been brought together for the study. Coordinated by the Texas Energy Advisory Council, the program includes data and personnel from the Bureau of Economic Geology and the Operations Research Group in The University of Texas College of Engineering. Funded as of June 1, 1979, the project is scheduled for completion in December 1980.

GEOTHERMAL RESOURCE ASSESSMENT FOR THE STATE OF TEXAS

C. M. Woodruff, Jr., project director, S. Christopher Caran, Christine R. Gever, and Mary McBride; assisted by Elizabeth M. Andrews, Cecilia M. Binig, Jeff L. Blass, Gwendolyn L. Macpherson, Rhonda D. Rasco, Eric J. Thompson, Lia J. Tomlinson, and David Robert Wuerch.

This two-year study, funded by the U. S. Department of Energy (DOE), was initiated in July 1979. The study comprises several tasks, the purposes of which are to produce baseline information on the quality and extent of hydrothermal resources in Texas. These tasks are partly regional and partly statewide in scope. The regional investigations focus on areas of documented geothermal potential—for example, the Balcones and Luling-Mexia-Talco fault systems in Central Texas. The statewide surveys are intended to locate any new areas that warrant attention because of geothermal attributes.

The regional study of Cretaceous aquifers in Central Texas is a continuation of a previous DOE-funded survey. This is the area in which projects are underway to use low-temperature geothermal waters as energy resources; wells are already completed at Marlin and Corsicana, Texas, and others are proposed. However, currently there is little detailed information on the quantitative hydrologic attributes of the aquifers along this trend, so that judgments cannot easily be made regarding density of wells and safe rates of pumpage. We propose to supply this information so that these geothermal resources can be properly managed. We also intend to refine further the subsurface geologic picture developed during the previous one-year study, in order to delineate better the optimal areas for geothermal production in Central Texas.

Projected products of the statewide surveys include a map showing geothermal gradients across Texas, a map depicting temperatures of various deep aquifers across the state, a map showing large-scale lineaments, and a state-of-knowledge, composite map for the general public showing generalized geothermal resources of Texas. Parts of these statewide surveys entail extensive field work, and other staff efforts will be required to reduce and encode the various kinds of data obtained. The products slated for completion during the first calendar year are the statewide lineament map and the generalized "public" overview map. As part of the DOE contract, our data will be provided to the national GEOTHERM file, which is managed by the U. S. Geological Survey for the purpose of maintaining a continuing inventory of geothermal data.

REGIONAL ASSESSMENT AND PROSPECTIVE SITE ANALYSIS OF GEOTHERMAL POTENTIAL ALONG THE BALCONES AND LULING-MEXIA-TALCO SYSTEMS, CENTRAL TEXAS

C. M. Woodruff, Jr., and Mary W. McBride; assisted by Lisa E. Craig, Rebecca Russo, James P. Immitt and David Robert Wuerch; consulting services provided by O. T. Hayward, Robert G. Font, M. S. Brigham, W. A. Charyvat, R. V. Corwin, R. H. Hazelwood, R. M. Knapp, and C. S. McKnight of Baylor University, Waco, Texas.

This project, funded by the U. S. Department of Energy (DOE), entailed evaluating the Cretaceous aquifers that locally yield warm ground water (greater than 90°F) in Central Texas. The aquifers investigated for their geothermal attributes were the Hosston/Trinity Sands, the Hensel Sand, the Paluxy Sand, the Edwards Limestone, and the Woodbine Sand. Of these, the Hosston/Trinity aquifer system has the greatest potential as a low-temperature geothermal resource. It has thicker and more extensive sand trends that lie at a greater depth than the other aquifers. The Paluxy and Woodbine Sands also have geothermal potential, but geothermal attributes of the Hensel Sand and the Edwards Limestone were severely constrained by adverse water quality or inadequate hydrologic properties.

The areas of greatest immediate promise for tapping low-temperature geothermal resources are those towns that already use the warm waters as a potable supply. In most instances, the heat has heretofore been considered a nuisance and thus has been wasted, but simple and inexpensive procedures (such as plumbing modifications) might allow use of the energy. The potential value of this warm water is illustrated by ground-water production from a single municipal well at Taylor, Texas. During an "average" January, more than 31 million gallons of 116°F water is pumped from a depth of approximately 90 feet (the water rises under artesian pressure to this level). The heat value of this water is in excess of 20 billion Btu's, with a monetary value of more than $51,000. Of course, inefficiencies of heat exchange systems result in energy losses, so the realizable dollar value is somewhat less than the above sum. Nonetheless, potential savings are considerable since the water is now being consumed without regard for its energy content.

Part of the one-year regional study involved providing technical consultation to a DOE-funded geothermal test-well project at Marlin, Texas. There, a 3,885-foot well was completed in the Hosston Sand for the pupose of providing space heat and hot water to the Torbett-Hutchings-Smith Memorial Hospital. Well tests produced 300 gallons of water per minute at 153°F with approximately 4,000 ppm dissolved solids. A heat exchange system will be employed that will reduce the hospital's consumption of natural gas by 85 percent—a savings of 10.5 million cubic feet of natural gas per year.

A final report on the regional geothermal resource assessment was submitted during mid-1979. A Bureau of Economic Geology publication that will present the findings of this project is in progress.

LIGNITE RESOURCES IN TEXAS

W. R. Kaiser, L. W. LaBrie, and W. B. Ayers, Jr.

This project, initiated in May 1978, is funded by the Texas Energy Advisory Council and the Bureau of Economic Geology. The goal of the study is to calculate near-surface lignite resources — those that are under less than 200 feet of cover and in seams greater than 3 feet thick. The method of estimation is based on proprietary industry data and a firm understanding of regional geology. In areas where data are numerous, critical parameters such as number of seams, thickness, and lateral extent can be established and tonnage per acre calculated. With the use of tested exploration models, tonnage values can then be applied along the lignite trend in areas of limited control and similar geologic settings. Resources will be reported by geologic units and region, such as the Wilcox unit in the region between the Colorado and Trinity Rivers. Eight regions, composed of 5 to 12 counties, have been delineated statewide. Available data on composition of the lignite are being tabulated and reported by geologic unit and by county. The study was nearing completion at the end of 1979.

NATIONAL URANIUM RESOURCE EVALUATION

L. F. Brown, Jr., coordinator, W. L. Fisher, Marc B. Edwards, Christopher D. Henry, David K. Hobday, Clara L. Ho, J. H. McGowen, and Mary K. McGowen, principal investigators; Richard L. Andersen, Joyce M. Basciano, Josefina M. Calvo, Timothy W. Duex, Dawn G. McKalips, Steven J. Seni, and Steven W. Tweedy; assisted by Brian Dupre, Linda C. Seekins, Jeffrey E. Thurwachter, Floyd G. Rose, Jr., Ray S. Risner, Charles D. Smith, Keith S. Pullman, and Michael S. Bumpass.

This major project was initiated in the spring of 1978 after the Bureau of Economic Geology entered into a subcontract with Bendix Field Engineering Corporation (under contract with the U. S. Department of Energy) to take part in the National Uranium Resource Evaluation program — NURE. The Bureau's part of the program is to determine the uranium potential of all geologic rock units from the surface to a depth of 5,000 feet within all or parts of eight quadrangle areas in Texas. These areas correspond to the Amarillo, Emory Peak, Lubbock, Marfa, Palestine, Presidio, Sherman, and Wichita Falls sheets of the National Topographic Map Series (scale 1:250,000). The Emory Peak, Marfa, and Presidio sheets extend into Mexico, and the Sherman sheet extends into Oklahoma. Each of the quadrangles is bounded by 1 degree of latitude and 2 degrees of longitude. A geologic map of each quadrangle either has been or will be published in the Bureau's Geologic Atlas of Texas series.

Bureau chemists are making a geochemical analysis of 30 trace elements in the samples from each of the quadrangles. Well cuttings on file at the Bureau's Well Sample and Core Library and samples collected from the surface are being utilized in the analysis. Progress in 1979 is shown in the following table.

NURE Quadrangle	Samples collected	Samples analyzed
Amarillo	1,120	1,118
Lubbock	1,529	1,504
Palestine	1,545	1,224
Sherman	1,530	1,237
Wichita Falls	1,549	1,516
Emory Peak, Marfa, Presidio	1,238	1,231
TOTAL	8,511	7,830

As part of the uranium evaluation, Bureau geologists are developing information pertaining to various rock units in the eight study areas. For example, they are making systematic studies of the stratigraphy of the Antlers Formation, which occurs in the Sherman quadrangle area, and of the Ogallala Formation and Dockum Group, among others, which are present in the areas covered by the quadrangle studies. The NURE investigations are also being coordinated with the Bureau's two nuclear waste isolation projects.

Some 1979 results were accepted for presentation at scientific meetings. The subjects and the societies include the following: (1) Ogallala depositional systems (Amarillo and Lubbock Quadrangles) for a national GSA meeting, (2) Antlers facies (Sherman Quadrangle) for a Rocky Mountain section AAPG meeting, (3) Woodbine outcrops (Sherman and Palestine Quadrangles) for an AAPG-SEPM field trip, and (4) uranium mobility in tuffaceous sediments (Marfa and Emory Peak-Presidio Quadrangles) for a Southwestern section AAPG meeting.

POTENTIAL FOR GEOPRESSURED GEOTHERMAL ENERGY, WILCOX GROUP, TEXAS GULF COAST

Don Bebout, Marc B. Edwards, Jim L. Lockley, A. Ray Gregory, Jonathan C. Herwig, Bonnie R. Weise, Steven D. Mann, Victor J. Gavenda, and H. Scott Hamlin.

This project was concluded in mid-1979, at which time a contract report was prepared. The purpose of the project was to locate sites of test wells to determine the potential for producing geopressured geothermal energy from the Wilcox Group. This resource consists of hot, methane-saturated brines forced to the surface under great pressure (geopressure). The study proceeded by delineating six fairway areas, of which two were suited for detailed site selection. The De Witt Fairway contains the prime prospect — the Cuero Prospect; the Colorado Fairway contains the less attractive Eagle Lake Prospect.

RESOURCE EVALUATION OF THE FRIO FORMATION (FRIO MAJOR STRATIGRAPHIC UNIT — TEXAS GULF COAST PROVINCE)

William E. Galloway and Kinji Magara, assisted by Mark A. Helper and Diana Morton.

The Frio Formation is one of the most productive petroleum reservoirs in the Gulf Coast Basin. More than 15 billion barrels of oil and gas equivalent have been produced from the Frio to date. Extent of probable migration pathways and the number and variety of known and potential traps available indicate that the Frio retains significant volumes of undiscovered hydrocarbons.

This project, funded by a contract with the U. S. Geological Survey, is a cooperative effort to develop and apply geologically based methodologies for estimating undiscovered oil and gas as an alternative to traditional approaches to resource evaluation. The Frio major stratigraphic unit (MSU) includes the subsurface Frio, Anahuac, and shallow Catahoula Formations.

Specific objectives of the study include (1) compilation of the existing geologic data base for the Frio (depositional systems, lithofacies reservoir quality, structure, fluid composition, temperature, pressure, and known distribution of hydrocarbons); (2) development of methodologies for resource evaluation incorporating, as appropriate, the geologic framework, historical indices of finding rate, and reservoir/source rock volumetrics and trapping efficiency; and (3) assessment of the potential undiscovered hydrocarbons within the Frio Sandstone.

A report will be provided to the U.S. Geological Survey near the end of 1980.

SAN ANDRES OIL AND GAS STUDIES

Mark W. Presley, Paul J. Ramondetta, and Kathy A. McGillis, assisted by A. John Garza, Robert W. Merritt, and Vickey I. Price.

The purpose of this project is to determine the potential for oil and gas generation in the San Andres Formation in the Palo Duro Basin.

An extensive data base has been established over areas of San Andres production. The distribution of data points is specially designed for the field studies. The entire data base is catalogued in a card file system and is now being

computerized. A coordinate system based on latitude and longitude is also applied to the data base.

Facies variations are being studied as possible controls. Correlations of lithology, marker beds, porosity zones, and depositional cycles over known fields to the south are shown on cross sections. These parameters will also be mapped. What is learned in the producing areas will be applied to the area in question.

Study of the kerogen and its relationship to the facies is aiding our understanding of in situ generation of hydrocarbons; additional organic geochemical analyses may indicate whether long-range migration of hydrocarbons has occurred.

COMPUTERIZED CALCULATION OF LIGNITE RESOURCES IN TEXAS

W. R. Kaiser, L. E. Garner, and Susan J. Tewalt, assisted by Suzanne M. Montano, Paul Anaejionu, Larry F. Champagne, Guy G. Cleveland, Richard A. Kolb, and Clayton H. Wilson.

This project, funded by the U.S. Geological Survey, uses a data base of proprietary geophysical logs to record near-surface lignites of the Wilcox Group (in the area between the Colorado and Trinity Rivers) for entry into the National Coal Resources Data System (NCRDS). Data are encoded in NCRDS format using the U.S. Geological Survey stratigraphic sequence form. U.S. Geological Survey personnel will enter the data into the system and calculate resources according to the criteria of U.S. Geological Survey Bulletin 1450-B. Proprietary data remain confidential as to point source and are maintained at the highest level of confidentiality. Resources will be reported on an aggregated basis by stratigraphic unit and regions consisting of 5 to 10 counties.

LAND RESOURCES INVESTIGATIONS

ENVIRONMENTAL GEOLOGIC ATLAS OF THE TEXAS COASTAL ZONE

L. F. Brown, Jr., project director.

Essentially completed, this atlas series comprises seven publications covering seven areas of the Coastal Zone: Galveston - Houston (1972), Beaumont - Port Arthur (1973), Bay City - Freeport (1976), Port Lavaca (1976), Corpus Christi (1976), Kingsville (1977), and Brownsville - Harlingen. At yearend, the final text for Brownsville - Harlingen was in preparation; maps for this area have been printed and are available. Each atlas of the series consists of a descriptive text, an environmental geologic map (scale 1:125,000), and eight special-use maps (scale 1:250,000). All maps are printed in full color on a specially constructed base.

The *Environmental Geologic Atlas of the Texas Coastal Zone* is the product of an extensive study conducted by the Bureau of Economic Geology during the past 13 years. The entire *Atlas* depicts approximately 20,000 square miles of the Texas Coastal Zone within an area extending from about the 5-fathom line offshore to 50 miles inland. Mapping was accomplished with the use of detailed photographic mosaics, topographic maps, and other existing maps of many types. Photomapping was supplemented by many hours of low-level aerial reconnaissance and selected field studies. The special-use maps were derived from basic mapping and from compilation of a variety of existing data. The *Environmental Geologic Atlas of the Texas Coastal Zone* was designed to provide a thorough inventory of natural and man-made resources and to serve as a basic document in planning, development, and conservation of the Texas Coastal Zone. Much of the basic data for the Coastal Management Program of the Texas General Land Office was provided by the *Atlas*, and it continues to be a principal source of information for citizens, firms, and government agencies involved in Coastal Zone problems and programs. The investigation of State-owned submerged lands by the Bureau of Economic Geology will complete the assessment of coastal environments and land resources out to the offshore 3-league (10.36 statute miles) line on the continental shelf. Other, more specialized Bureau programs derived in part from the *Environmental Geologic Atlas of the Texas Coastal Zone* include studies of shoreline changes, faulting and subsidence, land and water resources, and coastal hazards.

THE GUADALUPE - SAN ANTONIO - NUECES RIVER BASINS REGIONAL STUDY

E. G. Wermund and Thomas C. Gustavson, project directors; Robert A. Morton, Richard L. Andersen, Joyce M. Basciano, L. E. Garner, and C. M. Woodruff, Jr.; assisted by Maryann M. McGraw, Debra M. DeLong, David M. Brown, and Charles D. Smith. Cartography by Richard L. Dillon.

This long-term project is a comprehensive environmental geologic analysis of 30,558 square miles of the Nueces, San Antonio, Guadalupe, and Lavaca river basins of South Texas. The project was initiated in June 1972 under contract with the Texas Water Development Board. That contract continued through August 1975; thereafter, the Bureau of Economic Geology supported completion of all remaining work.

Products of this program are included in a series of maps, which were hand-colored onto scribed plastic base maps. The bases are reproductions of the standard Army Map Service topographic maps (1:250,000). The hand-colored series includes maps of (1) environmental geology, (2) physical properties, (3) active processes, (4) biologic assemblages, (5) economic resources, (6) land use, and (7) slopes. Environmental geologic maps and slope maps are compiled at a scale of 1:125,000; all other map types are presented at a scale of 1:250,000. Maps of the environmental geology and land use represent original mapping. The biologic assemblage map is essentially original mapping, as the biologic assemblages were identified in the field and their boundaries were located in general conformity to environmental geologic boundaries. Maps of active processes and physical properties were directly derived from the environmental geologic map. The economic geology was synthesized from previous Bureau publications. The slope maps were made only for the northern third of the regions in terrain where Edwards (Lower Cretaceous) through Carrizo (Tertiary) stratigraphic units crop out.

Environmental geologic units were mapped initially on standard topographic sheets (scale 1:24,000) or on black-and-white, aerial photographic, controlled mosaics. Land use was interpreted from 1973 color-infrared aerial photographs (scale 1:120,000). Slope maps were interpreted on topographic maps (scale 1:24,000).

All of the hand-colored maps prepared during the project are currently available for study by interested persons. Topographic maps (scale 1:24,000) and controlled photographic mosaics with original compilation, which will remain at the Bureau of Economic Geology, are also available for study.

In 1978, an up-to-date topographic base map was compiled by transcribing data from topographic quadrangle maps (scale 1:24,000) to facilitate the eventual color separation and publication of all mapping. Published reports and maps resulting from this regional project will deal with separate basins or parts of basins within the region. At yearend, maps for the Lavaca and lower Guadalupe river basins were being prepared for color separation and publication. A descriptive text for these two areas has been completed.

During 1979, it was decided to complete final scribing, labeling, and color separation for only the environmental geology map. All other maps will be scribed and labeled only; they will be placed on open file for blueline copying for interested persons.

GEOPRESSURED GEOTHERMAL ENERGY DEVELOPMENT—PROGRAM PLAN FOR ENVIRONMENTAL BASELINE STUDIES

Thomas C. Gustavson and Charles W. Kreitler.

This project, initiated in September 1977 under contract to Lawrence Livermore Laboratory of the University of California, has defined research programs that will address environmental problems posed by geopressured geothermal energy development. Major tasks of this project included (1) identification of key environmental issues, (2) inventory of available environmental data, (3) assessment of the available data, (4) identification of data gaps, (5) identification of key agencies and resources, and (6) preparation of a program plan for baseline environmental studies of the Texas Gulf Coast area. A final report was submitted to Lawrence Livermore Laboratory.

ENVIRONMENTAL ANALYSIS OF GEOPRESSURED GEOTHERMAL PROSPECT AREAS, TEXAS GULF COAST

Thomas C. Gustavson, principal investigator, Elizabeth Badger, and Florette Reeder.

Information was collected and analyzed for this project as part of a preliminary environmental analysis of potential geopressured geothermal resource areas in Colorado and De Witt Counties, Texas. Approximately 150 km² (60 mi²) were analyzed within each of the Colorado and De Witt County prospect zones, with the objectives of (1) conducting comparative environmental analysis of prospective sites for geopressured geothermal test wells, and (2) providing an environmental data base for future well development with the possibility of full-scale energy production.

Preliminary environmental data, including current land use, surface lithology, soils, natural hazards, water resources, biological assemblages, meteorological conditions, and regulatory considerations have been collected and analyzed for both areas. The study determined environmentally suitable sites for the prospect well within spatial constraints set by subsurface reservoir conditions. Analyses of data revealed the need for focusing on the following areas: potential for subsidence and fault activation, possible effects of produced saline waters on biological assemblages and ground-water resources, distribution of expansive soils, and effect of drilling and associated activities on known archeological-cultural resources.

The project was supported by the U.S. Department of Energy. The final project report will be submitted in early 1980.

ENVIRONMENTAL MONITORING—GEOPRESSURED GEOTHERMAL TEST WELL, BRAZORIA COUNTY

Thomas C. Gustavson, assisted by Rory Howard and Douglas A. McGookey.

The Bureau of Economic Geology, under a contract with the U.S. Department of Energy, has undertaken management and coordination of environmental monitoring at the Brazoria County, Texas, geopressured geothermal test-well site. Effects on local ecosystem quality from the accidental release of geothermal brines and from the possible initiation of land-surface subsidence as a result of withdrawal of large volumes of geothermal fluids are the primary concerns of this project.

Baseline environmental studies include repeated analysis of air and water quality, a microseismicity survey, repeated first-order leveling surveys, a liquid tilt-meter survey, an archeological resources survey, and a noise survey. These studies were underway both preceding and during the test-well drilling. The air- and water-quality analysis, microseismicity survey, first-order leveling survey, and liquid tilt-meter survey will be continued during the production phase of the test-well operation. Production testing of more critical zones began in late 1979.

SUPPORT OF NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA) APPLICATIONS SYSTEM VERIFICATION AND TRANSFER IN TEXAS

Robert J. Finley, Robert W. Baumgardner, Jr., and Thomas R. Calnan, assisted by C. Elmo Brown, William P. Jenkins, Douglas A. McGookey, and Alan B. Alhades.

The Bureau of Economic Geology is cooperating with the Texas Natural Resources Information System in evaluating the further application of remote sensing technology to State agency needs. These needs are related to agency responsibilities in the areas of natural resources and the environment. The National Aeronautics and Space Administration supports funding for this project.

Initial evaluation of a Remote Sensing Information Subsystem for use by State agencies includes examination of Landsat images and aerial photographs of the Texas Coastal Zone. Extensive ground data are being collected simultaneously with data obtained from satellite overpasses and aircraft operations at four different altitudes. These data are being evaluated for application in monitoring land cover/land use, surface-water circulation, bay-water chemistry and temperature distribution, and coastal vegetation. Black-and-white infrared film and aircraft-mounted multispectral scanner imagery have been used in conjunction with the more typical color and color-infrared films. Test sites in the Texas Panhandle, East Texas, Trans-Pecos Texas, and an urban area of Central Texas are being studied. The project will be completed in fiscal year 1981.

ENVIRONMENTAL EFFECTS OF IN SITU GASIFICATION OF TEXAS LIGNITE

T. F. Edgar (Department of Chemical Engineering), project manager, W. R. Kaiser (Bureau of Economic Geology), and M. J. Humenick (Department of Civil Engineering), assisted by Elliott Pew.

This project, funded by the U.S. Environmental Protection Agency and initiated in October 1978, is a joint study with the Bureau of Economic Geology and the Departments of Chemical Engineering and Civil Engineering of The University of Texas at Austin. It is a general survey of environmental effects of in situ gasification of lignite in Texas.

The portion of the study conducted by the Bureau of Economic Geology involves the evaluation of deep-basin lignite resources in 5-foot seams that are under less than 2,000 feet of cover. Resources will be calculated on the basis of exploration models developed in earlier studies by Kaiser and associates. As part of the current project, Pew and Kaiser have done extensive lithofacies mapping of the South Texas lower Jackson geologic unit. The Wilcox, Yegua, and Jackson geologic units will be tested against an ideal gasifier to identify potential gasifier sites; among the criteria are resources, seam thickness and geometry, host lithology, aquifer development and orientation, and location relative to potential users. On this basis, predictions will be made concerning areas of the Texas environment that are likely to be affected by in situ gasification. The study was nearing completion by the end of 1979.

ENVIRONMENTAL GEOLOGY OF THE EAST TEXAS LIGNITE BELT — JACKSON AND YEGUA UNITS

Roger D. Sharpe and John C. Wilson, assisted by Robert A. Rountree.

Work was initiated in late 1979 toward understanding the environmental impact of future mining of lignite in the Jackson and Yegua units of the East Texas lignite belt. This is a two-year program funded by the Energy Lands Division of the U.S. Geological Survey. Aerial photographs and topographic quadrangles have been collected for the region lying between the Colorado River and the Louisiana-Texas state line. Preliminary field work commenced from which appropriate mapping units are being derived.

A FEASIBILITY STUDY FOR MAPPING ABANDONED COAL MINING AREAS IN YOUNG COUNTY, TEXAS

Robert J. Finley and W. H. Hupp, assisted by Robert W. Baumgardner, Jr.

The objective of this one-month feasibility study was to evaluate the use of aerial photography to locate and determine the condition of abandoned coal mining areas in Young County, Texas. The project was conducted for the Surface Mining and Reclamation Division of the Texas Railroad Commission. Pennsylvanian-age bituminous coal was mined in Young County primarily from 1910 into the 1920's.

It was found that barren, high-reflectance areas, possibly representing abandoned mine sites, were best delineated on 1:20,000-scale black-and-white photographs. The 1:20,000-scale data were adequate for screening of sites on the basis of size, amount of vegetative cover, presence of waste material, type of land disturbance, and evidence of erosion. Data at smaller scales, even though on color or color-infrared film types, were not as useful owing to lower resolution. Known mines, such as the Belknap Mines near Newcastle, Texas, were easily located on 1:20,000-scale photographs.

DELINEATION AND ENVIRONMENTAL GEOLOGIC EVALUATION OF ABANDONED COAL MINES IN NORTH-CENTRAL TEXAS

Robert J. Finley, S. C. Caran, and W. H. Hupp.

An environmental geologic survey of abandoned bituminous coal mines in North-Central Texas located 139 confirmed and probable mines in 12 counties. Present surface conditions at the mine sites have been evaluated relative to the need for possible reclamation. Based on the oldest available, and more recent, 1:20,000- to 1:40,000-scale aerial photographs, low-altitude aerial observation, and ground confirmation, mining and subsequent mine abandonment has resulted in five major effects. These are (1) devegetation, in part due to leachates from mine spoil; (2) erosion by gullying, sheetwash, and mass wasting; (3) increased sedimentation in tanks and streams; (4) ground surface subsidence, and (5) accumulation of mine spoil, deteriorated equipment, and other refuse.

The coals, mined from the 1850's to the 1940's, are in the Middle and Late Pennsylvanian Strawn, Canyon, and Cisco Groups. Mining was primarily underground by a modified longwall advancing method. A total of 585 acres has been affected by mining, with 142 acres in Young County (13 confirmed mines), 94 acres in Palo Pinto County (16 confirmed mines), and 45 acres in Wise County (15 confirmed mines). The greatest surface effects are evident near Thurber in Erath County and at Strawn in Palo Pinto County, where extensive spoil piles are present. Near Bridgeport in Wise County, shale in the spoil piles has been used in brickmaking. Renewed interest in these bituminous coal resources has led to active exploration. This project, conducted for the Surface Mining and Reclamation Division of the Texas Railroad Commission, was completed in October 1979.

MINERAL RESOURCES INVESTIGATIONS

MINERAL AND ENERGY RESOURCES OF TEXAS ATLAS

L. E. Garner, Roger Sharpe.

At yearend, the second phase of this atlas project, the *Mineral Resources of Texas* map, was printed. Compilation of information for the *Handbook of Texas Mineral Resources* was in progress. These two parts of the atlas series have been preceded by the *Energy Resources of Texas* map, published in 1976.

The *Mineral Resources of Texas* map is a companion to the map of Texas energy resources, printed at the same

scale (1:1,000,000) and in full color. The mineral resources map shows current and historical production sites and mineral occurrences. Distributions of major rock types used in the mineral industry are also shown, including limestone, dolomite, ceramic clay, nonceramic clay, iron, sand and gravel, trap rock, granite, industrial sand, extrusive igneous rocks, talc, salt, and sulfur. This map was published in 1979.

MINERAL INDUSTRY LOCATION SYSTEM (MILS) FOR TEXAS

L. E. Garner, Becky S. Wiggins, and Roger D. Sharpe, assisted by Eric K. Hass, Mark E. McClelland, Rosie Somohano, Gregg Downs, and Theresa Brown.

The goal of the MILS project is to acquire information about the location of every mineral industry in the State of Texas. Data on mineral occurrences, prospects, pits, mines, and all immediate processors of mineral industry products are collected and stored in a computer filing system for easy access. Emphasis is on mineral production areas, including both major mineral districts with known mineralization and urban centers. Information obtained during the course of this project will complement the *Energy Resources of Texas* map, the *Mineral Resources of Texas* map, and the *Handbook of Texas Mineral Resources*. Funded by the U.S. Bureau of Mines, the project was completed in the final quarter of 1979.

HANDBOOK OF TEXAS MINERAL RESOURCES

L. E. Garner, Roger D. Sharpe, Gary E. Smith, W. C. J. van Rensburg, and Richard Kyle (Department of Geological Sciences), assisted by Terry J. Barron.

The purpose of the *Handbook of Texas Mineral Resources* is to provide geologists, engineers, and the general public with a comprehensive survey of Texas mineral resources. Topics covered include metallic minerals, nonmetallic minerals with emphasis on end-use relationships, and nonpetroleum fossil and nuclear fuels. Introductory material includes Federal and State mining and reclamation laws, mineral taxation, economic analysis, and infrastructure of the mineral industry in Texas.

Areas of investigation include (1) description of known deposits and favorable areas for exploration, (2) physical and chemical properties, (3) geologic setting, (4) production and uses, (5) exploration, evaluation, and development of new deposits, (6) economic factors of production and marketing, (7) production/demand trends and projections, (8) environmental factors, and (9) potential resources in Texas.

The handbook is a vital addition to the mineral resource knowledge of Texas. It provides current information on the distribution of Texas strategic mineral resources. Deposits that were marginal or uneconomical in the past need to be re-evaluated in light of new developments in mining and beneficiation techniques.

Potential benefits of the handbook include (1) providing a reference for college courses in mineral resources, (2) answering many of the questions received by the Bureau of Economic Geology concerning the geology and economics of Texas mineral resources, (3) disseminating information in a form that the nongeologist as well as the professional can use, and (4) providing current information on exploration and evaluation techniques related to special problems in the analysis of Texas mineral resources.

Two circulars by Roger Sharpe, "Development of the Mercury Mining Industry: Trans-Pecos Texas" (in press) and "The Portland Cement Industry and Cement Raw Material Resources in Texas" (in preparation) are the initial articles being prepared for this ongoing program.

REGIONAL RECOGNITION OF SUBSURFACE BASE-METAL RESOURCES IN THE LLANO REGION OF CENTRAL TEXAS

Gary E. Smith, assisted by Mary Jackson.

The Llano region and associated base-metal occurrences in Cambrian host rocks bear a stratigraphic, mineralogic, and structural similarity to the southeast Missouri mineral district that supplies a major portion of the U. S. supply of lead and zinc, along with minor silver, copper, and cadmium. Historically, the southeast Missouri district has also produced significant amounts of strategically important cobalt. The regional recognition of lead, zinc, and possible cobalt resources in the Central Texas mineral district, using an integrated geochemical-geophysical-stratigraphic approach, comprises the primary objective of a project that was begun on October 1. The delineation of subsurface geochemical anomalies and stratigraphically defined exploration trends in the Llano region would be a positive step toward reducing the U. S. import requirements for these metals.

Research will involve collecting available surface and subsurface lithostratigraphic data so that trace element analyses can be correlated with the local stratigraphic framework, interpretation of gravity and aeromagnetic data to determine sub-Cambrian, basement topography, and multi-element spectrographic analysis of insoluble residues for the identification of metallogenetically significant trace elements. The analytical, field, and interpretive (geophysical) data acquired in this study will provide interdependent data sets for determining the viability of subsurface metal potential in the Llano region.

The search for mineral resources is becoming increasingly dependent on indirect methods for establishing favorable exploration targets. Research conducted as part of this project will also provide an opportunity to test and evaluate recently developed exploration techniques that may be used in the search for buried, "blind" ore bodies.

URANIFEROUS ASPHALTITE

C. Robertson Handford and George E. Granata, assisted by Frances D. Bockoven.

This short-term project was funded through Bendix Field Engineering Corporation to evaluate the distribution and concentration of uraniferous asphaltite in the Red Cave-Panhandle lime formations in the Texas Panhandle. All available drill cuttings and several cores were examined, resulting in characterization of the occurrence of asphaltite with respect to facies and structure. An open-file report was prepared in September 1979.

BASIN STUDIES

DEEP WATER FACIES OF THE SPRABERRY SANDSTONE, MIDLAND BASIN

C. Robertson Handford, assisted by Holly Fanan and Penny Bockoven.

For several decades, the Spraberry Sandstone of Early Permian age has been an important exploration target and oil-producing reservoir in the Midland Basin. To date, no comprehensive studies of the Spraberry have been published. The objective of this project is to describe available well cores from the Spraberry, delineate facies sequences and distribution, interpret depositional environments, determine diagenetic processes, and correlate the relationship between oil production and depositional-diagenetic facies.

This project began in late 1978 and continued through 1979. The initial phases of the project dealt with core descriptions, facies determinations, and determination of sandstone geometry through well log correlations.

FLUID FLOW SYSTEMS OF AN ACTIVELY SUBSIDING BASIN — IMPLICATIONS FOR NATURE AND LOCATION OF EPIGENETIC URANIUM DEPOSITS

William E. Galloway, assisted by Allen R. Standen.

The South Texas Coastal Plain is an increasingly important producer of and exploration target for epigenetic uranium resources. In the Gulf Basin, downdip stratigraphic equivalents of the principal uranium hosts, the Catahoula and Oakville Formations, have been buried to depths in excess of 15,000 feet, and burial continued throughout the Tertiary. In addition, host sands overlie thick sections of early Tertiary undercompacted sediments, which have not attained hydrostatic equilibrium with the surface. The result is a hydrologically active basin where counter-flow of geochemically different water masses within aquifiers has persisted since their deposition. This complexity of hydrochemical systems and diversity of fluid fluxes has produced complex distributions and styles of mineralization.

Objectives of this study, funded by a contract with the Uranium-Thorium Branch of the U. S. Geological Survey, include (1) recognition and description of the full range of geochemical and diagenetic zones associated with the counter-flux of waters in shallow, uraniferous aquifers; (2) interpretation of the origins of reactive waters on the basis of their preserved record in deposit mineralogy and geochemistry; (3) determination of the historical evolutions of flow dynamics and geochemistry of mineralized aquifers; and (4) qualification of geochemical gradients or zonations indicative of principal epigenetic processes.

LOCATING FIELD CONFIRMATION STUDY AREAS FOR ISOLATION OF NUCLEAR WASTE IN THE TEXAS PANHANDLE

William E. Galloway, Thomas C. Gustavson, C. Robertson Handford, Mark W. Presley, Robert J. Finley, Shirley P. Dutton, James R. Morabito, Douglas A. McGookey, William P. Jenkins, Maryann M. McGraw, and Mary A. Bauer, assisted by Kathy A. McGillis, Paul E. Fredericks, Francis M. Mikan, Sunshine C. Sherrell, Carol A. Gray, Stanley M. Sutton, Melissa A. Sandstrom, Steven W. Tweedy, Josefina M. Calvo, and Gary A. LaMotte.

The goal of this Bureau research project, which is funded by the U. S. Department of Energy, is to produce a comprehensive evaluation of the Palo Duro and Dalhart Basins of the Texas Panhandle to determine if the bedded Permian salt strata in those basins meet fundamental geologic criteria for safe isolation and long-time storage of nuclear waste. One team of Bureau researchers is currently conducting a basin analysis of the Palo Duro Basin; a second research team is investigating the surface landforms and the shallow subsurface stratigraphy of all the Texas Panhandle region.

As an integral part of the study, the U. S. Department of Energy arranged for the drilling of several stratigraphic core tests. The first two test holes, completed in the Palo Duro Basin in late 1978, produced more than 7,500 feet of core from Triassic and Upper Permian rock units.

During 1979 significant sources of data were acquired for direct analysis by each research task group (remote sensing/surficial studies, hydrogeology, host-rock, and basin analysis). Among these new sources of data were (1) petroleum source rock quality and thermal maturity data for resource assessment studies, (2) drill stem test data for regional hydrogeologic studies, and (3) quantitative climatic, erosional, and shallow subsurface salt dissolution data needed to predict the long-term geomorphic integrity of the Texas Panhandle.

Acquisition of two salt-bearing cores from the Palo Duro Basin in late 1978 provided the first opportunity to determine salt character and quality, and to conceptualize salt depositional models based upon sedimentological features of the cores and modern salt depositional settings. Banded to massive salt (greater than 85% halite) and chaotic mudstone-salt (less than 85% halite) are the dominant salt facies. Each facies is stratigraphically and geographically associated with dolomite, anhydrite, and red-bed strata to form numerous large-scale and small-scale genetic stratigraphic units, all of which suggest deposition in environments ranging from continental and coastal sabkha to shallow marine shelf. Carbonate-evaporite and siliciclastic or mud-rich sabkha deposits are recognized, exhibiting cyclicity and basinward migration through time. Analysis of cores permitted improved calibration of geophysical well logs with lithic composition of the salt-bearing sequences. Consequently, salt quality can now be predicted with greater accuracy using well logs. Furthermore, core data enabled research-staff geologists to refine further the depositional models developed during 1978 that were based principally upon geophysical well logs. Hence, by the end of 1979, interpretation of the various cyclic salt sequences reached a high level of sophistication and accuracy. Generalized salt depth/thickness maps were prepared for each of seven salt-bearing sequences, illustrating regions where further evaluation should be undertaken.

Drill cuttings from numerous wells across the Palo Duro Basin were submitted for organic geochemical analyses. These analyses indicated that petroleum source rocks are present and that they reached the early stages of oil generation. Since the basin also contains potential

hydrocarbon reservoirs and traps, it will probably be the focus of increasing oil and gas exploration activity.

Preliminary hydrogeologic mapping of deep-basin aquifers is based entirely upon pressure data derived from drill stem tests of oil and gas exploratory ventures. Results show that deep-basin ground water flows from west to east, recharging in the northwestern Panhandle and discharging both in the southeastern Palo Duro Basin and near the Amarillo Uplift. Facies control over ground-water flow is also recognized.

An understanding of processes and rates of sediment removal, stream propagation, slope retreat, and salt dissolution is required to ensure the long-term integrity of any potential nuclear waste management site. An integrated program of geomorphic, hydrologic, and shallow stratigraphic studies has provided preliminary results on rates of surface erosion, stream incision and development, and rates and direction of movement of salt dissolution fronts. Estimates of slope retreat rates along the eastern Caprock Escarpment of the Southern High Plains were developed from three different data sets, yet the rates differ by less than a factor of 1.8. Preliminary slope retreat rates are approximately 0.6 mi (1 km) per 9,000 years. Minimum horizontal salt dissolution rates for the same area may exceed 0.21 mi (0.34 km) in 10,000 years.

ELLENBURGER CARBONATE FACIES, DEPOSITIONAL ENVIRONMENTS, AND DIAGENESIS—WEST TEXAS

Robert G. Loucks, assisted by James H. Anderson.

This project involves an investigation of the Ellenburger carbonate rocks west of the Llano Uplift. The major objective of the study is to delineate the relationship among high-quality oil and gas reservoirs, depositional facies, and diagenesis. The Delaware and Val Verde Basins in West Texas are active areas of deep subsurface hydrocarbon exploration. The Ellenburger Group, the oldest potential productive unit in the basins, is being investigated as part of a larger basinal study. Through the use of cores, the Ellenburger project is concentrating on reservoir development as controlled by depositional facies and diagenesis. The rocks are highly dolomitized and brecciated. The origins of the dolomitizing process and of the brecciation are major concerns, as these control the reservoir quality. The study has concentrated on the area of the Puckett field in Pecos County, Texas, but additional cores east to the Llano Uplift in Central Texas have been logged.

ANALYSIS OF THE CONSOLIDATION OF TERTIARY SANDSTONES, TEXAS GULF COAST

Robert G. Loucks, Debra L. Richmann, Kitty L. Milliken, Clara L. Ho, L. Scott Underwood, and Lee A. Jirik.

For several years the Bureau of Economic Geology has been conducting an assessment of geopressured geothermal resources in the Texas Gulf Coast area. This has resulted in delineation of geothermal fairways in the Frio, Vicksburg, and Wilcox Formations. By defining the consolidation history of the sandstones (compaction, cementation, and leaching) an understanding of the development, preservation, and distribution of porosity and permeability is possible.

The Sandstone Consolidation II Project is concerned with comparing two areas of contrasting sandstone reservoir quality to determine the chemical and physical controls on porosity and permeability. Areas of study are the geothermal test-well site in Brazoria County and the McAllen Ranch Field in Hidalgo County. Brazoria County sandstones can have high permeabilities (greater than 1,000 md) at depths of 13,000 feet and greater, whereas sandstones at similar depths in Hidalgo County have average permeabilities less than 1 md. To understand the differences in reservoir quality between the two areas, Bureau researchers are studying detailed mineralogy, geochemistry, and diagenesis for both the sandstones and shales in each area.

CARBONATE FACIES, DEPOSITIONAL ENVIRONMENTS, AND DIAGENESIS—SOUTH TEXAS

Don Bebout, assisted by Richard A. Schatzinger and David A. Budd.

The final report on Sligo/Hosston facies, depositional environments, and diagenesis from core studies is complete and is being readied for publication. The resulting Report of Investigations is scheduled for release in 1980.

Emphasis is on a regional study of Jurassic carbonates, evaporites, and terrigenous clastics of South Texas. Because of the sparsity of cores from the Jurassic, it is anticipated that this study will entail dominantly the study of well samples and logs. All data of this type from wells in South Texas are being solicited.

EVALUATING THE POTENTIAL OF EAST TEXAS INTERIOR SALT DOMES FOR ISOLATION OF NUCLEAR WASTES

Charles W. Kreitler, project director; D. K. Hobday, Edgar H. Guevara, Olusegun Agagu, Graham E. Fogg, Alice B. Giles, Edward W. Collins, Shirley P. Dutton, Mary K. McGowen, Joyce M. Basciano, George E. Granata, and Owen R. Dix; assisted by Edward A. Duncan, Debra H. Wood, Stephen P. Cumella, David A. Pass, Robert C. Cobb, H. Victor Wuerch, Edwin D. Lindgren, James L. Gregory, Kathleen Rader, Cynthia M. Lopez, Rick Davis, Julie P. Rogers, Jacqueline D. Smith, Geoffrey Meyer, Alan M. Berarducci, John F. McIntyre, Eugene T. Pisasale, Sarah M. Sharlot, Robert L. Sherrill, Samir A. Ghazi, Robert D. Conti, Patrick Talamas, Linda M. Ruiz, and David W. Harris.

The goal of this comprehensive investigation is to evaluate the suitability of underground salt domes in the East Texas Basin as possible sites for long-term isolation of nuclear wastes. The project is funded by the U. S. Department of Energy. Major considerations in this evaluation are the hydrologic and tectonic stability of the domes and the potential natural resources in the basin. To develop information related to these concerns, a Bureau research team is making geologic, hydrologic, geomorphic, and remote-sensing investigations of specific salt domes and also of the entire region.

Hydrologic investigations include studies of the ground-water systems of the basin and also of the ground-water flow around the salt domes to determine amount and rate of salt dome dissolution and location of the saline-water plumes (resulting from the dissolution of the salt) in the fresh ground-water supplies. Hydrologic studies have resulted in the following conclusions: (1) Ground-water flow in the Carrizo-Wilcox aquifer is controlled by

topography and structure. Ground-water chemistry in the aquifer evolves from an oxidizing, low-pH water in the outcrop into a reducing, high-sodium-bicarbonate, high-pH water in the deeper subsurface; (2) Preliminary field studies and hydrologic computer modeling of ground-water flow around salt domes are extremely complex; (3) Anhydrite caprock results from the dissolution of the salt dome and subsequent accumulation of an insoluble residuum; and (4) Salt brining on Palestine salt dome in the early 1900's has resulted in several sink holes. Man's impact on this dome has made it unsuitable for a nuclear waste repository.

Regional subsurface studies are in progress to determine the size and shape of specific salt domes, the geology of the strata immediately surrounding the domes, and the regional geology of the East Texas Basin. Such information will enable the research team to interpret the geologic history of the development and growth of the domes and of the filling of the basin with sedimentary rocks. In addition, the research team will use the information to evaluate potential natural resources of the basin. The subsurface team has reached the following conclusions: (1) Salt domes can be identified with different stages within Trusheim's dome growth cycle (pillow structures, immature diapirs, mature diapirs); (2) The structural relationships of the dome and flanking strata are dependent on the history of sedimentary infilling in that section of the East Texas Basin. Domes in areas of significant sedimentation have matured further in the growth cycle than those domes in areas of minimal sedimentation; and (3) Occurrences of oil and gas are strongly influenced by the salt-tectonic control of the sedimentary infilling of the basin.

Studies of the surface geology, including geomorphology, are also in progress. The objective of these studies is to determine if any dome growth or any tectonic movement such as tilting and faulting has occurred in the region during the Quaternary Period (within the past 2 million years). Two important conclusions were reached in studies of the surface geology: (1) Quaternary terrace deposits over domes do not appear to be uplifted; and (2) A fault in the Mt. Enterprise-Elkhart Graben fault system appears to have been active during the Quaternary.

PENNSYLVANIAN/PERMIAN FACIES, EASTERN SHELF, NORTH-CENTRAL TEXAS

L. F. Brown, Jr., and Raul F. Solis, assisted by Stephen C. Van Dalen.

Approximately 6,000 well logs have been examined in this regional study of the surface and subsurface Pennsylvanian and Early Permian strata in a 30-county area of North-Central Texas. Extensive investigation of Pennsylvanian/Permian depositional features involves the mapping and recognition of fluvial, deltaic, and related marine depositional systems and their component facies. The resulting regional description will serve as a guide in the search for oil, water, clay, coal, and other resources in the North-Central Texas area, as well as in similar depositional systems elsewhere. Final data were being compiled in late 1979.

COASTAL STUDIES

GEOLOGY OF STATE-OWNED SUBMERGED LANDS

J. H. McGowen and Robert A. Morton, project coordinators, Thomas R. Calnan, Russell S. Kimble, Thomas G. Littleton, and H. Seay Nance, assisted by Ricky J. Dauzat, James A. DiGiulio, Jon P. Herber, Stephen M. Robertson, Janice Schoepfle, Gary J. Steck, Joseph E. Sullivan, Lisa R. Wilk, and Stephen S. Wright.

This comprehensive investigation was designed to provide a detailed baseline inventory of State-owned submerged lands prior to the anticipated increase in offshore activities and multipurpose use of these lands. State-owned submerged lands include the inner continental shelf, extending from the Texas Gulf shoreline seaward for 10.36 statute miles (3 marine leagues), and the bays, estuaries, and lagoons of the Coastal Zone from the Rio Grande to Sabine Lake. More than 6,700 grab samples have been collected on 1-mile centers from these submerged lands. Research has been conducted in cooperation with the Marine Geology Branch of the U.S. Geological Survey and has been funded in part by the General Land Office of the State of Texas.

In 1979 (1) trace metal data were mapped for the Houston-Galveston sheet, and trace metal work was in progress for Brownsville-Harlingen and Kingsville sheets; (2) surface sediment distribution was mapped for the Houston-Galveston sheet, and sediment work was in progress for the Brownsville-Harlingen sheet; (3) configuration of the Pleistocene erosional surface and thickness of Holocene bayfill had been determined from geophysical records for the Houston-Galveston sheet system and part of the Corpus Christi sheet, and analysis of geophysical data was in progress for all the bay-estuarine systems; and (4) a report was in progress for the Houston-Galveston sheet.

The gravel fraction for the inner continental shelf is principally shell material with subordinate amounts of lithic clasts. Areal variations of the gravel fraction can be a transgressive lag derived from erosion of late Pleistocene deltas or can form compound strandline features associated with the retreat of Holocene deltas. On the shelf in the Houston-Galveston sheet, the concentrations of total organic carbon bear a reciprocal relation to the coarse fraction, and highest values correspond to mud sinks.

All benthic macro-invertebrates from the samples of the Houston-Galveston sheet were counted and identified to species level when possible. The dominant invertebrate groups found in the samples include the polychaetes, mollusks (live and dead molluscan species are being identified and counted), crustaceans, and echinoderms. Tables, graphs, and maps representing the distribution and diversity of benthic fauna were constructed. The final report will be the basis for the implementation of multiple resource management by State and local governmental agencies.

HIGH-RESOLUTION SEISMIC INTERPRETATION OF LATE QUATERNARY HISTORY, TEXAS CONTINENTAL SHELF

Charles D. Winker and Robert A. Morton.

High-resolution seismic profiles of the Texas inner continental shelf and central Outer Continental Shelf are being studied as part of a broader investigation of the late

Quaternary history of the Texas shelf and Coastal Plain. Spaced at 1-mile intervals, the profiles, obtained with an 800-joule minisparker, cover the inner continental shelf. Fifteen long dip lines provide additional coverage on the central Outer Continental Shelf. Major objectives of this study are to determine (1) thickness of Holocene sediments; (2) thickness and internal stratification of the last, or top, Pleistocene depositional unit; (3) regional structure of the deeper, or lower, Pleistocene sediments; and (4) relationship of lithology and geotechnical properties to strong reflectors. Results are being compared and integrated with a similar study of the south and central Outer Continental Shelf of Texas conducted by the U. S. Geological Survey. Preliminary results indicate that late Pleistocene centers of deposition (depocenters) occur offshore from the mouths of the present Rio Grande and Colorado and Brazos Rivers, where the sediments increase in thickness from the coast to the Shelf edge.

The final report will consist of a series of structural and isopachous maps, cross sections, and a paleotopographic reconstruction of the Texas shelf prior to Holocene transgression. Emphasis will be on the inner continental shelf, but some interpretation of the Outer Continental Shelf will also be included. This report will document the shifting of depocenters and the activity of growth faults and salt domes during the late Quaternary Period of geologic time.

SURFICIAL BIOLOGY OF MARINE AND ESTUARINE DEPOSITS IN CORPUS CHRISTI VICINITY FOR INTEGRATED ENVIRONMENTAL PLANNING

Thomas R. Calnan, Russell S. Kimble, Thomas G. Littleton, Joseph E. Sullivan, Gary Steck, James A. DiGiulio, and Lisa R. Wilk.

This investigation is related to another Bureau project, "Geology of State-Owned Submerged Lands." The investigation involved biological analyses of approximately 375 benthic samples taken from the State-owned submerged lands in the Corpus Christi area. Such lands in that area include the inner continental shelf, extending from the Gulf of Mexico shoreline seaward for 10.36 statute miles, and all the bays, estuaries, and lagoons from northern Laguna Madre to northern Aransas Bay.

All benthic invertebrates from the samples are being counted and identified to species level when possible. The dominant invertebrate groups found in the samples include the polychaetes, mollusks (live and dead molluscan species are being identified and counted), crustaceans, and echinoderms. Species diversity maps, invertebrate assemblage maps, and graphs showing faunal-sediment relationships are being constructed. The final report will be the basis for the implementation of multiple resource management by State and local governmental agencies.

PADRE ISLAND NATIONAL SEASHORE— A GUIDE TO THE GEOLOGY, NATURAL ENVIRONMENTS, AND HISTORY OF A TEXAS BARRIER ISLAND

Bonnie R. Weise and William A. White.

To be published in 1980 as Guidebook 17, this nontechnical guide to Padre Island discusses the origin, active processes, and present environments of Padre Island and Laguna Madre in the area of the National Seashore. The guidebook also includes historical information provided by Keene Ferguson, a former Bureau staff member. More than 100 photographs and figures are included in the guidebook to illustrate the dynamic character of the island and the importance of maintaining balances among the sensitive natural environments. The project involved mapping of island environments on large-scale, color-infrared photographs taken in 1975 and constructing a cartographically precise full-color environmental geologic map. Cartographic work was accomplished by Dan F. Scranton. Color photographs of each mapped environment are included in the map legend to provide visual reference for the intended popular audience composed of National Seashore visitors. Initiated and directed by L. F. Brown, Jr., the project was conducted in cooperation with the National Park Service.

WETLANDS DELINEATION AND CLASSIFICATION OF THE COASTAL AND PANHANDLE REGIONS OF TEXAS

William A. White, project director, Katherine E. Fonken, Linda S. Adair, and Jeffrey A. Songer.

Initiated on November 1, 1978, and funded by the U. S. Fish and Wildlife Service, this project is part of a national effort to classify and map wetlands and deep-water habitats in accordance with a standardized classification system. This system is composed of five categories (Marine, Estuarine, Riverine, Lacustrine, and Palustrine) which are in turn subdivided into subgroups and classes. Wetlands in the coastal and Panhandle regions of Texas are mapped on available black-and-white and color-infrared aerial photo transparencies (scales of 1:80,000 and 1:120,000) with the aid of six-power folding mirror stereoscopes and light tables. Mapped areas are transferred by the U. S. Fish and Wildlife Service to the U. S. Geological Survey for review and evaluation. The final published maps (scale of 1:100,000) will be available through the U. S. Fish and Wildlife Service.

LAND AREA CHANGE AT BUFFALO POINT: WEST END OF BOLIVAR PENINSULA

J. H. McGowen.

The project was conducted for the General Land Office of Texas and the Attorney General's Office to determine the cause (or causes) of erosion along the bay shoreline at Buffalo Point. The project was initiated in March 1979 and was completed in May 1979, at which time a 73-page deposition was given.

HISTORY AND PROCESSES INVOLVED IN DEVELOPMENT OF SOUTH PADRE ISLAND, LAGUNA MADRE, AND LOS BANCOS DE EN MEDIO

J. H. McGowen, assisted by J. P. Herber, and S. A. Wright.

This project has been conducted in two phases. Phase I was initiated in March 1977 and completed in August 1977. Phase I included analysis of grab samples on ½-mile spacing, selected washdown borings, and trenching of sedimentary structures. Phase II was initiated December 1, 1979, and will be completed January 31, 1980. Phase II involves mapping of the position of wind tides on controlled aerial photographs, and analysis of weather data. On October 5, 1979, a 178-page description was given relative to the work performed for Phase I. This project is funded by the General Land Office of Texas.

HYDROGEOLOGY INVESTIGATIONS

PREDICTING RESPONSE OF A NATURAL SYSTEM TO URANIUM EXTRACTION: OAKVILLE AQUIFER SYSTEM, TEXAS

William E. Galloway, project director; Gary E. Smith, Clara L. Ho, Christopher D. Henry, and James K. Gluck; assisted by Constance S. Childs, Scott Spradlin, Eugene T. Pisasale, and John F. McIntyre.

Current exploration and mining activity indicates an expanding role for uranium extraction in the economy of South Texas. Deeper exploration dictates that the use of in situ leach mining will continue to increase as a preferred method of extraction.

Funded by the U. S. Environmental Protection Agency, this project resulted in a description of the physical, stratigraphic, and structural framework of the Oakville aquifer. Also completed was a compilation of existing hydrologic and hydrochemical data necessary for a detailed, quantitative description of natural and mining-induced interactions between water and rock in representative parts of this important aquifer system. Results of the study will provide information on the nature and distribution of uranium deposits and, consequently, will improve the technical basis for monitoring and clean-up procedures required by the Texas regulatory agencies that are responsible for granting mining permits.

GROUND-WATER HEAT PUMP DEMONSTRATION

Jerold W. Jones (Department of Mechanical Engineering), project director; Charles W. Kreitler (Bureau of Economic Geology), and Philip S. Schmidt (Department of Mechanical Engineering).

This cooperative project of the Bureau of Economic Geology and the Department of Mechanical Engineering of The University of Texas at Austin was begun in 1978 with funding from the Texas Energy Advisory Council and the Center for Energy Studies of The University of Texas at Austin. The aim of the Bureau's portion of the project was to evaluate the ground-water resources of Texas in terms of their suitability for use in ground-water heat pump systems.

The prospects for large-scale usage of ground-water heat pumps within the State are not encouraging. The major limiting factor is the lack of laterally extensive, shallow, cool ground water in the major metropolitan areas of the State. In the western half of the State, where water supplies are scarce, alternate needs (industrial, public water supply, or irrigation) for ground water are more important. A final report is in preparation.

GROUND-WATER QUALITY IN THE EDWARDS AQUIFER SOUTHWEST OF AUSTIN, TRAVIS COUNTY

Ann E. St. Clair.

The Rollingwood area, southwest of Austin, lies in the Balcones Fault Zone, which is the recharge zone of the Edwards aquifer in this area. Rapid suburban development and increased use of septic tanks have characterized the growth in the area for the past 25 to 30 years. To determine the effects of this development on water quality in the Edwards, water wells in the area were sampled during January through August 1978. Chemical and bacteriological analysis was performed on the samples to evaluate the presence or absence of several parameters that would indicate contamination by septic tanks. In addition, water-quality data were used to evaluate the hydrogeologic relationships among Barton Creek, Barton Springs, the Edwards aquifer, and the Colorado River. A geological circular summarizing this work will appear in 1980.

OTHER RESEARCH

COMPOSITION AND ORIGINS OF TEKTITES

Virgil E. Barnes and Stanley V. Margolis (University of Hawaii).

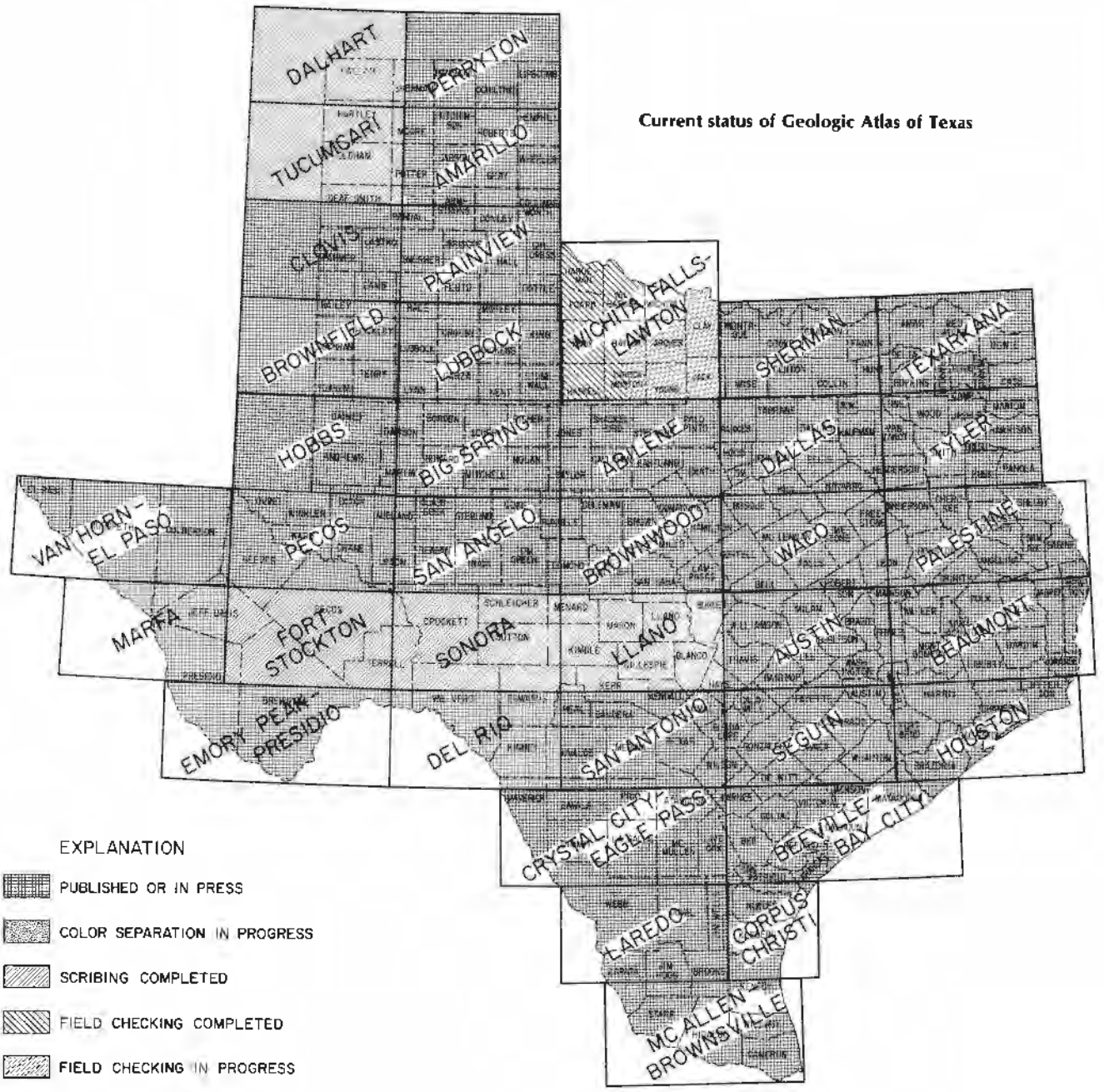
This long-term study of tektites (the small glass objects found in many places throughout the world) and meteorites began in 1935 and has resulted in 66 publications. During 1979, a paper entitled "Cathode Luminescence and X-ray Fluorescence Studies of Libyan Desert Glass" was prepared for publication.

GEOLOGIC MAPPING

GEOLOGIC ATLAS OF TEXAS

Virgil E. Barnes, project director; R. S. Kier and Dawn G. McKalips. Cartography by James W. Macon, Richard L. Dillon, Dan F. Scranton, and Margaret R. McKinney.

A new geologic map of Texas showing the distribution of outcropping rock units is being published as a series of separate map sheets. Each sheet is printed in full color on a topographic base at a scale of 1:250,000 (1 inch equals approximately 4 miles). Map sheets are confined primarily to areas within 1 degree of latitude and 2 degrees of longitude, but some sheets include larger or smaller areas owing to cartographic presentation. When completed, the *Geologic Atlas of Texas* will consist of 38 map sheets depicting all of Texas and parts of New Mexico and Oklahoma.



Thirty-two map sheets in the series have been published, including the Marfa and Emory Peak - Presidio Sheets, which were issued in 1979. At yearend, scribing was completed for the Sonora, Dalhart, and Tucumcari Sheets. All field work and scribing is now complete except for the Wichita Falls Sheet. The *Geologic Atlas of Texas* will probably be completed in 1981.

GEOLOGIC MAP OF TEXAS

Virgil E. Barnes.

The preparation of a new geologic wall map of Texas began in May 1978. To be published in four quadrants at a scale of 1:500,000, the new map will replace the 1937 U. S. Geological Survey Geological Map of Texas, which has been out of print for many years.

The new map is being derived from the *Geologic Atlas of Texas* map sheets (scale 1:250,000). A set of all completed sheets of the *Geologic Atlas of Texas* in the northeastern quadrant of the State has been marked for use in drafting the new map. The completion date of the new map will depend on completion of the final sheets of the *Geologic Atlas of Texas*.

GEOLOGIC QUADRANGLE MAPPING IN CENTRAL TEXAS

Virgil E. Barnes.

Geologic mapping of 7.5-minute quadrangles in Central Texas was initiated in 1939 to provide basic geologic maps

for use in economic, stratigraphic, structural, and geophysical investigation. Thirty-three of the geologic quadrangle maps have been published. The final four maps of this series, which depict the geology of the Marble Falls, Pedernales Falls, Spicewood, and Hammetts Crossing Quadrangles, are expected to be published in 1980.

QUATERNARY MAPS OF TEXAS

E. G. Wermund and James W. Macon, project coordinators; Barbara Hartmann, cartographer.

This project, initiated in 1978 with funds from the U.S. Geological Survey, involves the preparation of geologic maps of Texas Quaternary rock units as this State's contribution to the U.S. Geological Survey map series, "Quaternary Geology of the United States" (scale 1:1,000,000). The Bureau's role in this nationwide program includes the compiling and scribing of the Texas Quaternary maps at a scale of 1:1,000,000 by using previously published Bureau of Economic Geology maps as the basic source material.

At yearend, Bureau cartographers were working on the first scheduled map of the project, the White Lake quadrangle, which includes all or part of the Beeville-Bay City, Houston, Beaumont, and Palestine Sheets of the *Geologic Atlas of Texas* (scale 1:250,000). In addition to the *Geologic Atlas of Texas*, sources to be utilized in the compilation of the White Lake quadrangle are the (1) *Land Resources of Texas* map, (2) *Environmental Geologic Atlas of the Texas Coastal Zone*, and (3) *Land and Water Resources of the Houston-Galveston Area Council*.

During 1979, work proceeded on a Quaternary Map of Texas; draft copies of the eastern half of Texas were completed. In addition to the mapping of Quaternary units, the U.S. Geological Survey requested the recognition and delineation of surficial cover of the entire map area.

CONTRACTS AND GRANT SUPPORT

Contract obligations at the Bureau have expanded greatly in recent years, resulting in a total of 44 Bureau contracts in effect during all or part of 1979. Contract management has, correspondingly, become an increasingly complex function.

The Bureau of Economic Geology maintains formal and informal cooperative arrangements with several governmental entities. Parts of the Bureau's research program are supported by contracts and grants with State agencies, local units of governments, Federal agencies, and other organizations.

Contracts and grants in effect during all or part of 1979 included the following:

Federal

Assessment of Geothermal (Geopressured) Resources in the Texas Gulf Coast — Test Site: supported by U.S. Department of Energy.

Computerized Calculation of Lignite Resources in Texas: supported by U.S. Geological Survey.

Environmental Effects of In Situ Gasification of Texas Lignite: supported by U.S. Environmental Protection Agency through the Department of Chemical Engineering of The University of Texas at Austin.

Evaluating the Potential of East Texas Salt Domes for Isolation of Nuclear Wastes: supported by U.S. Department of Energy.

Factors Controlling Reservoir Quality in Tertiary Sandstones and Their Significance to Geopressured Geothermal Production: supported by U.S. Department of Energy.

Fluid Flow Systems of an Actively Subsiding Basin — Implications for Nature and Location of Epigenetic Uranium Deposits: supported by U.S. Geological Survey.

Fourth United States Gulf Coast Geopressured Geothermal Energy Conference: supported by U.S. Department of Energy through the Center for Energy Studies of The University of Texas at Austin.

Geothermal Resource Assessment for Texas: supported by U.S. Department of Energy.

Land Resources and Environmental Impact for East Texas Lignite Belt, Jackson-Yegua Trend: supported by U.S. Geological Survey.

Locating Field Confirmation Study Areas for Isolation of Nuclear Waste in the Texas Panhandle: supported by U.S. Department of Energy.

Mineral Industry Location System (MILS) for Texas: supported by U.S. Department of the Interior, Bureau of Mines.

Predicting Response of a Natural System to Uranium Extraction — Oakville Aquifer, Texas; Phase II: supported by U.S. Environmental Protection Agency.

Preliminary Environmental Analysis of Wilcox Formation Geopressured Geothermal Prospect Areas, Texas Gulf Coast: supported by U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Amarillo Quadrangle: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Emory Peak, Marfa, and Presidio Quadrangles: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Lubbock Quadrangle: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Palestine Quadrangle: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Sherman Quadrangle: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Quadrangle Evaluation of Uranium Favorability of the Wichita Falls Quadrangle: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Regional Assessment and Prospective Site Analysis of Geothermal Potential Along the Balcones, Luling-Mexia-Talco Systems, Central Texas: supported by U.S. Department of Energy.

Resource Evaluation of the Frio Formation (Frio MSU-Texas Gulf Coast Province): supported by U.S. Geological Survey.

Sandstone Consolidation Analysis to Delineate Areas of High-Quality Reservoirs Suitable for Production of Geopressured Geothermal Energy: supported by U.S. Department of Energy.

Study Effects of Geopressured Geothermal Subsurface Environment on Elastic Properties of Texas Gulf Coast Sandstones and Shales, Using Well Logs, Core Data, and Velocity Surveys: supported by U.S. Department of Energy through the Center for Energy Studies of The University of Texas at Austin.

Texas Mining and Mineral Resources Research Institute, Administration and Research Grants: supported by U.S. Department of the Interior, Office of Surface Mining.

Trace and Potentially Toxic Elements Associated with Uranium Deposits in South Texas: supported by U.S. Environmental Protection Agency.

United States Gulf Coast Geopressured Geothermal Program — Special Projects Research and Coordination Assistance: supported by U.S. Department of Energy through the Center for Energy Studies of The University of Texas at Austin.

United States Gulf Coast Geopressured Geothermal Resource: Preliminary Environmental Analysis of Geopressured Geothermal Prospect Areas, Texas Gulf Coast: supported by U.S. Department of Energy.

Uranium Potential of the Catahoula Formation, Texas — A Stratigraphic, Depositional, and Geothermal Evaluation; Phase II: supported by Bendix Field Engineering Corporation, a prime contractor for the U.S. Department of Energy.

Volume and Accessibility of Entrained Methane in Deep Geopressured Reservoirs—Tertiary Formations of the Texas Gulf Coast: supported by U.S. Department of Energy.

Wetland Delineation and Classification Study of the Coastal and Panhandle Regions of Texas: supported by U.S. Department of the Interior, Fish and Wildlife Service.

State

An Investigation of the Sediment Contribution from the Brazos River to the Nearshore Marine Environment: A Pilot Study: supported by Texas A & M Sea Grant Program.

Development of Operational Capabilities for Analyzing Landsat Satellite Data: supported by Texas Department of Water Resources.

Estimation of Uncertainty in Coal Resources and Cost Assessments Tasks 2 and 3: supported by Texas Energy and Natural Resources Advisory Council.

Ground-water/Heat Pump HVAC Demonstration Phase I: Design Development SPI 78-C-6: supported by Texas Energy Advisory Council through the Center for Energy Studies of The University of Texas at Austin.

Lignite Resources in Texas — Texas Energy Advisory Council Category L-1 (Reserve Estimation): supported in part by Texas Energy Advisory Council.

Locating Abandoned Mines in North-Central Texas: supported by Texas Railroad Commission.

Methodology of Economic Reserve Estimation (PIES Models): supported by Texas Energy Advisory Council.

Natural Hazards of the Texas Coast: supported by Texas Coastal and Marine Council.

Surficial Biology of Marine and Estuarine Deposits in Corpus Christi Vicinity for Integrated Environmental Planning: supported by U.S. Department of Commerce through the Governor's Budget and Planning Office.

Textural, Geochemical, Geophysical, and Biological Analysis of Bottom Samples — Texas Submerged Lands: supported by General Land Office of the State of Texas.

University Coal Lab Proposal Preparation: supported by Texas Energy and Natural Resources Advisory Council.

Other

Analyze the Organic Geochemistry of Samples from the Geopressured Geothermal Test Well, U.S. Department of Energy and General Crude Oil Company No. 1 Pleasant Bayou: supported by Gas Research Institute.

Geological Studies of Geopressured Zones: supported by the Gas Research Institute.

CONTRACT REPORTS

During 1979, Bureau staff members prepared the following reports on research conducted under contract with various governmental agencies and other organizations. (Some of the reports were issued by those agencies in 1979; some will be published by the Bureau of Economic Geology.)

Bebout, D. G., Weise, B. R., Gregory, A. R., Edwards, M. B., 1979, Wilcox sandstone reservoirs in the deep subsurface along the Texas Gulf Coast, their potential for production of geopressured geothermal energy: prepared for the U.S. Department of Energy, Division of Geothermal Energy, under Contract No. DE-AS05-76ET28461 (formerly EY-76-S-05-4891), 219 p.

Calnan, Thomas R., Kimble, Russell S., Littleton, Thomas G., and Sullivan, Joseph E., 1979, Part I: Biological analyses of bottom samples — Texas submerged lands: prepared for the General Land Office of Texas under Interagency Contract No. (78-79)-1910, 199 p.

Finley, Robert J., 1979, Test plan for remote sensing information subsystem products, coastal applications test site: prepared for the Texas Natural Resources Information System and the National Aeronautics and Space Administration, under Interagency Contract No. (78-79)-2405, 46 p.

Finley, Robert J., and Baumgardner, Robert W., Jr., 1979, Annotated bibliography of techniques for image

enhancement and interpretation in remote sensing: prepared for the Texas Natural Resources Information System and the National Aeronautics and Space Administration, under Interagency Contract No. (78-79)-2405, 45 p.

Finley, Robert J., Caran, S. Christopher, and Hupp, William H., 1979, Delineation and environmental geologic evaluation of abandoned coal mines in North-Central Texas: prepared for the Texas Railroad Commission, Surface Mining and Reclamation Division.

Finley, Robert J., and Hupp, William H., 1979, A feasibility study for mapping abandoned coal mining areas in Young County, Texas: prepared for the Texas Railroad Commission, Surface Mining and Reclamation Division, 73 p.

Galloway, William E., Gustavson, Thomas C., Dutton, Shirley P., Finley, Robert J., Handford, C. Robertson, and Presley, Mark W., 1979, Locating field confirmation study areas for isolation of nuclear waste in the Texas Panhandle: prepared for the U.S. Department of Energy, Office of Nuclear Waste Isolation, under Contract No. DE-AC97-79ET-44614.

Galloway, William E., and Kaiser, W. R., 1979, Catahoula Formation of the Texas Coastal Plain: origin, geochemical evolution, and characteristics of uranium deposits: prepared for Bendix Field Engineering Corporation under Contract No. 77-063-E, 139 p.

Gustavson, Thomas C., 1979, Environmental baseline monitoring in the area of General Crude Oil — Department of Energy Pleasant Bayou No. 1 — a geopressured geothermal test well — 1978: prepared for the U.S. Department of Energy, Division of Geothermal Energy, under Contract No. DE-AS05-77ET27031 (formerly EG-77-S-05-5401), 33 p.

Gustavson, Thomas C., and Kreitler, Charles W., 1979, An environmental overview of geopressured geothermal development: Texas Gulf Coast: prepared for Environmental Sciences Division, Lawrence Livermore Laboratory, University of California, and Assistant Secretary for the Environment, U.S. Department of Energy, under Purchase Order No. 7949703, 184 p.

Gustavson, Thomas C., Reeder, Florette, and Badger, Elizabeth, 1979, Environmental analysis of geopressured geothermal prospect areas, DeWitt and Colorado Counties, Texas: prepared for the U.S. Department of Energy, under Contract No. DE-AS05-79ET-27127.

Handford, C. Robertson, and Granata, George E., 1979, Uraniferous asphaltite in Moore and Potter Counties, Texas: prepared for Bendix Field Engineering Corporation (a prime contractor for the U.S. Department of Energy), under Subcontract No. 78-158-E, 7 p.

Henry, Christopher D., and Basciano, Joyce M., Environmental geology of the Wilcox Group lignite belt, East Texas: prepared for the U.S. Geological Survey, under Grant Numbers 14-08-0001 and G158/316/412, 61 p.

Henry, Christopher D., and Kapadia, Rajesh R., 1979, Trace and potentially toxic elements associated with uranium deposits in South Texas: prepared for U.S. Environmental Protection Agency under EPA Grant/Project No. 80514701, 110 p.

Kreitler, Charles W., Collins, E. W., Dix, Owen R., Fogg, Graham E., Giles, Alice B., Agagu, O., Hobday, David K., and Wermund, E. G., 1979, Evaluating the potential of East Texas salt domes for isolation of nuclear waste: prepared for U.S. Department of Energy, Office of Nuclear Waste Isolation, under Contract No. DE-AC97-79ET44605.

Loucks, R. G., Dodge, M. M., and Galloway, W. E., 1979, Sandstone consolidation analysis to delineate areas of high-quality reservoirs suitable for production of geopressured geothermal energy along the Texas Gulf Coast: prepared for the Division of Geothermal Energy, U.S. Department of Energy, in partial fulfillment of Contract No. DE-AS05-77ET28472 (formerly EG-77-S-05-5554).

Woodruff, C. M., Jr., and McBride, Mary W., 1979, Regional assessment of geothermal potential along the Balcones and Luling-Mexia-Talco fault zones, Central Texas: prepared for the U.S. Department of Energy, Division of Geothermal Energy, under Contract No. DE-AS05-78ET-28375 (formerly ET-78-S-05-5864), 145 p.

Publications

In its role as a public geologic research unit, the Bureau of Economic Geology disseminates the results of research projects and programs primarily through its own publication series. During the 70-year history of the Bureau, more than 700 reports, bulletins, circulars, special publications, and maps have been published covering major aspects of the geology and natural resources of Texas. In addition, more than 400 reports and maps are available to the public through open-file holdings at the Bureau. Publications are sold to interested persons at nominal prices designed to recover printing or duplication costs. To date, approximately 1 million publications have been distributed on a world-wide basis, principally through direct sales. During 1979, the Bureau issued the following publications:

REPORTS OF INVESTIGATIONS

Report of Investigations No. 93. Landsat Analysis of the Texas Coastal Zone, *by R. J. Finley. 71 p., 29 figs., 12 tables, 1 color pl., 5 maps (scale 1:125,000) ($4.00).*

Part 1 of this report presents results of the manual interpretation of Landsat imagery covering four test sites along the Texas coast. Twenty-three land cover/land use categories were mapped at a scale of 1:125,000, including five wetland classes: topographically low marshes, topographically high marshes, tidal flats, sea-grass beds and algal flats, and vegetated dredge spoil. Test sites were field checked, and aerial photographs were used in an accuracy analysis of each category.

Part 2 of this report is a guide to visual interpretation of Landsat imagery emphasizing the use of color, shape, texture, and position of features seen on standard image products. Six segments of Landsat false-color composite images are reproduced in full color as examples keyed to the classification system used in Part 1. The methods described are relatively simple, yet allow the user to take full advantage of the repetitive coverage, synoptic view, and relatively low direct-purchase cost of Landsat imagery.

Report of Investigations No. 95. Land and Water Resources of the Corpus Christi area, Texas, *by R. S. Kier and William A. White. 22 p., 11 figs., 17 tables, 1 plate ($2.50).*

Development and use of land and water resources consistent with their natural capabilities will minimize or prevent many environmental problems. This report provides the basis for formulating general management policy in the Corpus Christi area through presentation of the characteristics of natural environments in a variety of formats — map, text, tables, and illustrations.

The types, extent, and distribution of land and water resources in the Corpus Christi area (Aransas, Nueces, Refugio, and San Patricio Counties) are analyzed. The report also provides a description of the Corpus Christi area including geology, physical properties, ground water, mineral and energy resources, and natural hazards.

Forty land and water resource units, defined and mapped in the Corpus Christi area, are classified into the following systems: Coastal Plain; active floodplains; barrier islands; wetlands; man-made features; and bays, lagoons, estuaries, and open Gulf. Fundamental definition and delineation of the units were based on characteristics such as natural processes and hazards and physical, chemical, and biological properties.

The text is accompanied by a Land and Water Resources map at a scale of 1:125,000. Use of the map, text, and tabular information, and construction of special-purpose derivative maps can contribute to planning for future development of the Corpus Christi area.

Report of Investigations No. 96. Geologic Setting and Geochemistry of Thermal Water and Geothermal Assessment, Trans-Pecos Texas, with Tectonic Map of the Rio Grande Area, Trans-Pecos Texas and Adjacent Mexico, *by Christopher D. Henry. 48 p., 24 figs., 5 tables, 1 plate ($2.25).*

The Trans-Pecos area of Texas is part of the Basin-and-Range Province, a highly favorable region for the discovery and development of geothermal energy. This geologic setting and the presence of numerous hot springs and wells with temperatures up to 90°C along the Rio Grande in Texas and Mexico suggest that the Trans-Pecos region is also favorable for geothermal energy.

This report catalogs individual hot springs and wells, including their location, temperature, flow rate, and geologic setting. It provides chemical analyses of both thermal and nonthermal water and discusses the origin of their chemical compositions. It also provides chemical and isotopic geothermometers to estimate possible maximum temperatures in the subsurface. The report concludes with an assessment of the favorability of geothermal energy development throughout Trans-Pecos Texas.

The text is accompanied by a tectonic map of the Rio Grande area of Trans-Pecos Texas and adjacent Mexico, which shows major structural and geologic elements of the region, emphasizing those that control the location of hot water.

Report of Investigations No. 97. Depositional Framework of the Lower Dockum Group (Triassic), Texas Panhandle, *by J. H. McGowen, G. E. Granata, and S. J. Seni. 60 p., 43 figs., 2 tables ($2.00).*

The Dockum Group in West Texas and eastern New Mexico was investigated in cooperation with the U.S. Geological Survey for the purposes of (1) determining geological conditions that influenced sedimentation, (2) establishing relationships between uranium occurrence and depositional facies, and (3) developing a depositional model that possibly could be applied to uranium occurrence.

This report addresses the first objective and is primarily concerned with the depositional environments operative during accumulation of the lower part of the Dockum Group and the structural and climatic conditions that

dictated depositional style. The Dockum Group is a product of alternating humid and arid climatic conditions; an increase in rainfall from the arid "Permian" into the Triassic is postulated to have been related to the opening-up of the Gulf of Mexico.

Sediment derived principally from older sedimentary rocks was transported to a fluvial-deltaic-lacustrine basin from parts of Texas, Oklahoma, and New Mexico. A small amount of granitic material contained in the Dockum Group, Texas, north of the Matador Arch, had its source in Oklahoma.

Preliminary results indicate that uranium in the Dockum Group of Texas occurs chiefly in depositional units that accumulated during the more humid climatic conditions.

Report of Investigations No. 98. Environmental Geology of the Wilcox Group Lignite Belt, East Texas, *by Christopher D. Henry and Joyce M. Basciano. 28 p., 9 figs., 3 tables, 7 maps (scale 1:125,000) ($6.00).*

The Wilcox Group of East Texas contains an estimated 12.2 billion short tons of surface mineable lignite. Lignite production has grown from 2 million short tons in 1970 to an estimated 25 million short tons in 1979. Estimates of lignite demand indicate that all economically recoverable strippable reserves will be committed to use by 2000. However, lignite mining and related activities could have considerable impact on other natural resources, especially land and water. To avoid any deleterious impact, developers of lignite must consider potential impact and use proper baseline information and planning.

This report includes a set of seven full-color environmental geologic maps and an explanatory text. The maps cover 18,000 km^2 of the outcrop of the Wilcox Group and adjacent formations from Bastrop County to Texarkana. The text (1) describes the physical setting of the lignite belt, including geology, hydrology, soils, vegetation, and land use, (2) discusses criteria for selecting environmental geologic units, (3) provides a thorough description of the units, and (4) illustrates application of the environmental geology maps. Application includes identifying land capability, providing an inventory of land and water resources, especially prime farmland and ground-water aquifer and recharge areas, and identifying areas of significant natural hazards such as floodplains. Use of the maps and text should allow development of lignite as well as protection of other resources essential to mankind.

Report of Investigations No. 99. Depositional Patterns of Miocene Facies, Middle Texas Coastal Plain, *by James David Doyle. 28 p., 30 figs., 1 table ($1.75).*

This report describes Miocene strata along the Middle Texas Coast that comprise an offlapping sequence of fluvial and deltaic sandstones and shales overlying shelf shales of the Oligocene (?) Anahuac Formation. The study area includes all or part of Aransas, Bee, Brazoria, Calhoun, Goliad, Jackson, Matagorda, Nueces, San Patricio, Victoria, and Wharton Counties.

The Miocene strata were subdivided into nine thin time-contemporaneous units. Sandstone distribution maps and electrical logs show three depositional systems within each unit: fluvial, deltaic, and distal deltaic/shelf systems. Structural features controlling the deposition are growth faults and areas of unusual basin subsidence.

By determining the distribution of Miocene sandstones and by inferring their paleoenvironments, this study is designed to aid in evaluating the potential of Miocene sandstones as disposal reservoirs for geothermal, as well as oil field, fluids that may be produced from the Frio Formation.

GEOLOGICAL CIRCULARS

Geological Circular 79-1. Geology and Geohydrology of the Palo Duro Basin, Texas Panhandle, A Report on the Progress of Nuclear Waste Isolation Feasibility Studies (1978), *by S. P. Dutton, Robert J. Finley, W. E. Galloway, Thomas C. Gustavson, C. Robertson Handford, and Mark W. Presley. 99 p., 62 figs, 6 tables ($2.50).*

The Bureau of Economic Geology is conducting a study of salt-bearing strata in the Palo Duro Basin as part of the national nuclear repository program. This report covers initial subsurface basin analysis and surface geomorphic studies, which were the focus of the first year of the project.

Subsurface studies have delineated the structural and stratigraphic framework of the basin. Representative cross sections and isopach maps illustrating depositional models of Upper Permian salt-bearing units and subjacent Lower Permian and Pennsylvanian strata are presented. Seven salt units of interest as potential hosts for nuclear waste isolation are discussed in detail. The stratigraphic work forms the basis for a preliminary assessment of petroleum, uranium, copper, and potash resources.

Surface studies utilized ground and remotely sensed data to describe surficial processes. This circular gives initial results of geomorphic mapping, linear element analysis, climate and erosion monitoring, and studies of salt dissolution, and describes a major flood event on the Llano Estacado.

Geological Circular 79-2. Geochemistry of Bottom Sediments, Matagorda Bay System, Texas, *by J. H. McGowen, J. R. Byrne, and B. H. Wilkinson. 64 p., 7 tables, and 27 figs. ($1.50).*

A pilot study of the Matagorda Bay system was initiated in October 1971 to collect baseline data with which future data can be compared. Initial study of the Matagorda Bay area documented historical shoreline and marsh-area changes; the first report, "Historical changes and related coastal processes, Gulf and mainland shorelines, Matagorda Bay area, Texas," was published in 1975. "Geochemistry of bottom sediments" is the second report on the Matagorda Bay system.

This report covers the distribution of sediment types, total organic carbon, and 20 trace metals that were detected in the bay and fluvial sediment. More than 800 sediment samples were collected on 1-mile centers both in the bays and up to 20 miles inland along navigable streams. Shell-sand-mud ratios were determined in the laboratory and mapped on a base of 1:62,500. Total organic carbon content of the sediment was determined by wet combustion. All trace metals, except mercury, were analyzed with a Direct-Current Arc 5park Emission Spectrograph. Mercury content was determined by the mercury vapor detector method.

Sediment, total organic carbon, and trace metal distribution are determined largely by physical processes

operating within the bay system. A close correlation exists among water depth, sediment texture, total organic carbon, and distribution of most trace elements.

This report was published in cooperation with the General Land Office of Texas.

Geological Circular 79-3. Precambrian Rocks of the Southeastern Llano Region, Texas, *by Richard V. McGehee. 36 p., 5 pl. ($1.50).*

Precambrian sedimentary rocks and associated mafic and silicic igneous rocks in Central Texas underwent a single episode of regional metamorphism about 1,050 million years ago. In the final stages of metamorphism great masses of granite and innumerable small pegmatite bodies intruded the older sedimentary and igneous rocks. This report discusses the stratigraphy, structure, petrography, metamorphism, and geologic history of Precambrian rocks in the southeastern Llano region of Texas.

The Llano Supergroup, stratiform metamorphic rock, includes two groups, the Valley Spring Gneiss and the overlying Packsaddle Schist. Four new formations—Honey, Sandy, Rough Ridge, and Click — are proposed as subdivisions of the Packsaddle Schist. Metamorphosed intrusive igneous rocks include Coal Creek Serpentine, Big Branch Gneiss, Red Mountain Gneiss, and many small bodies of metagabbro and metagranite.

Geological Circular 79-4. Sandstone Distribution and Potential for Geopressured Geothermal Energy Production in the Vicksburg Formation Along the Texas Gulf Coast, *by R. G. Loucks. 33 p., 35 figs., 1 table ($ .75).*

The major objective of this study was to define the potential geopressured geothermal reservoirs in the Vicksburg Formation which are limited to Hidalgo County along the Lower Texas Gulf Coast. In Hidalgo County, an area of approximately 385 mi² (designated the Vicksburg Fairway) contains up to 1,300 ft of geopressured sandstones with fluid temperatures greater than 300°F. In-place effective permeability, however, averaged less than 1 millidarcy in the Vicksburg sandstones because of the fine grain size and extensive late carbonate cementation. Also, areal extent of individual reservoirs is limited in a dip direction by growth faults and in a strike direction by the lenticular geometry of the sandstone bodies. Under present criteria for geothermal fairways, the Vicksburg has minimal potential because of inferred low reservoir deliverability, which is constrained by low permeability and limited reservoir continuity. If future tests indicate that lower permeabilities are acceptable, the Vicksburg Fairway should be reconsidered because of the presence of extremely thick sandstone bodies.

GUIDEBOOKS

Guidebook 18. South Texas Uranium Province—Geological Perspective, *by William E. Galloway, Robert J. Finley, and Christopher D. Henry. 81 p., 54 figs., 2 tables ($3.00).*

This guidebook was published for the field trip sponsored by the Energy Minerals Division, American Association of Petroleum Geologists, for the 1979 national convention in Houston, Texas. The guidebook reviews general aspects of South Texas uranium deposits; host geology of the Jackson Group, Catahoula Formation, and Oakville Formation; structural setting; ground-water and mineralization history; and reclamation practices. The chapter on the Oakville includes much material published for the first time. Five field localities, illustrating important geologic attributes of South Texas uranium deposits and their hosts, provide the focus for discussions of host depositional environments, uranium sources and mobilization, hydrogeology of coastal plain aquifers, and exploration potential of the younger stratigraphic section. Localities described include the Panna Maria pits (Jackson) and the Felder-McLean pits (Oakville).

Guidebook 19. Cenozoic Geology of the Trans-Pecos Volcanic Field of Texas, *Anthony W. Walton and Christopher D. Henry, editors. 202 p. ($4.00).*

This guidebook is expanded and revised from one first published for a conference on the *Cenozoic Geology of the Trans-Pecos Volcanic Field of Texas* held May 21-23, 1978, in Alpine, Texas.

The Trans-Pecos area of Texas has been mapped as thoroughly as any volcanic region in the United States, but much of the work is in unpublished theses and dissertations. Recently, specialized studies based on existing maps have been initiated to cover a broad range of problems of volcanic rocks. This guidebook is evidence of the current status of such studies, most of which are also unpublished. The conference and guidebook were designed to promote an interchange of ideas and to present results of research among geologists actively involved in Trans-Pecos Texas and other geologists interested in volcanic processes and deposits.

The guidebook emphasizes results of research on volcanic and volcaniclastic rocks of the Trans-Pecos field. Topics include magma generation and evolution, petrology, sedimentation, stratigraphy, and timing of events; studies of both the region and individual volcanic centers are presented. Other subjects are geophysical studies, such as seismicity, faulting, gravity surveys, and paleomagnetism; geomorphology; economic geology; and geothermal studies.

GEOLOGIC ATLAS OF TEXAS

Geologic Atlas of Texas, Emory Peak-Presidio Sheet, Joshua William Beede Memorial Edition, *Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($4.00).*

The Emory Peak-Presidio Sheet includes part of Presidio, Brewster, and Terrell Counties. Mapping is mostly from published and unpublished sources and by J. B. Brown, N. J. Cepeda, and F. W. Daugherty. The map was reviewed by the Geologic Atlas Committee of the West Texas Geological Society and by R. K. DeFord, J. A. Wilson, S. E. Clabaugh, D. S. Barker, and F. W. McDowell, Department of Geological Sciences, The University of Texas at Austin. The Emory Peak-Presidio Sheet is a memorial edition honoring Joshua William Beede. Dr. Beede, a distinguished paleontologist,

made a life work of studying the Pennsylvanian and Permian rocks of Kansas, Oklahoma, and Texas. He was one of a small group that demonstrated the presence of the Permian System in America and was chiefly responsible for fixing its lower boundary. While with the Bureau of Economic Geology, in addition to his paleontologic and stratigraphic work, Dr. Beede did geological mapping and reported on oil possibilities.

Geologic Atlas of Texas, Marfa Sheet, W. H. von Streeruwitz Memorial Edition, *Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($4.00).*

The Marfa Sheet includes part of Hudspeth, Culberson, Jeff Davis, and Presidio Counties. Mapping was compiled by P. C. Twiss. The map was reviewed by the Geologic Atlas Committee of the West Texas Geological Society and by R. K. DeFord, J. A. Wilson, S. E. Clabaugh, D. S. Barker, and F. W. McDowell, Department of Geological Sciences, The University of Texas at Austin. The Marfa Sheet is a memorial edition honoring W. H. von Streeruwitz (1833-1916). Von Streeruwitz, a member of the 1888-1894 Texas Geological Survey, was a pioneer in mineral deposit studies in Trans-Pecos Texas and made significant contributions to knowledge concerning coal and lignite elsewhere in Texas.

MINERAL RESOURCE CIRCULARS

Mineral Resource Circular No. 60. The Mineral Industry of Texas in 1975, *by Murphy E. Hawkins and Thomas J. Evans. 40 p., 1 fig., 28 tables (free on request).*

A cooperative agreement between the U.S. Bureau of Mines and the Bureau of Economic Geology produces this annual summary of the mineral industry of Texas. This circular is a preprint of the U.S. Bureau of Mines "Minerals Yearbook 1975" chapter on Texas. Each year the chapter preprint is distributed by the Bureau free on request.

Mineral Resource Circular No. 61. Coal Problems and Prospects, *by W. C. J. van Rensburg, H. B. H. Cooper, Jr., W. R. Kaiser, and S. H. Spurr. 20 p., 5 tables ($1.00).*

This circular outlines the National Energy Plan as it pertains to coal as a potential major energy source and describes how constraints on coal production may make the NEP's 1985 goal of 1,265 million tons of coal production unobtainable. Maintaining that the coal industry is not "resource constrained," but "demand and regulation constrained," the authors review such industry constraints as regulations on mining and surface mining, health and safety and air quality control requirements, solid waste disposal problems, and needs regarding labor, transportation, and capital. The circular also points up the need for new coal conversion processes and the necessity of continued research and developments in such technological areas as air pollution control, gasification, liquefaction, and deep surface mining.

This timely circular also reviews the impact of President Carter's latest energy program and the benefits to coal production from his proposed excess profits tax on the oil industry.

Tabular material covers such topics as the additional mines, equipment, and transportation needed to reach the NEP goal, estimated coal consumption in Texas and the nation, capital required for such consumption, and capital and operating costs of environmental controls on new coal-fired power plants.

The authors make specific recommendations for realizing the potential of coal as a major energy source, recommending such steps as the formulation of a consistent environmental policy, immediate construction of coal gasification and liquefaction plants, and a thorough review of all regulations that are impeding the development of coal mines and utilization plants.

Mineral Resource Circular No. 62. Coal Gasification and Liquefaction, *by W. C. J. van Rensburg. 42 p., 8 figs., 5 tables ($1.50).*

Coal gasification is a generic term for processes that convert coal or lignite to gaseous fuels. This circular outlines and compares the commercially available processes for the production of medium- or high-Btu gas from coal, such as the Lurgi, Koppers-Totzek, and Winkler processes. Also described are the so-called second-generation gasification processes, which are currently being developed.

Selection of a gasification process and the various advantages and disadvantages of fixed-bed, fluidized-bed, and entrained-bed gasifiers, are outlined, as is subclassification of processes based on pressure (atmospheric or elevated) and temperature (slagging or non-slagging). The author reviews coal properties and their effect on the operational efficiency of various types of gasifiers.

The second half of the circular explains liquefaction of coal and how it can be accomplished by three fundamentally different methods, namely indirect conversion (gasification followed by hydrocarbon synthesis), hydroliquefaction, and pyrolysis. Among topics covered in this section are the H-coal process, Donor Solvent process and Solvent-refined Coal process, as well as current techniques for upgrading of primary coal liquids, a relatively new field. Throughout this section, the author presents information on successful liquefaction of coal at the Sasol I plant in South Africa, currently the only commercial coal liquefaction plant in the world.

The circular's final section concerns the economies of coal gasification and liquefaction, and charts give the relative costs of synthetic fuels in dollars per million Btu and dollars per barrel equivalent utilizing oil shale, tar sands, coal gasification, and coal liquefaction.

Mineral Resource Circular No. 63. The Future Utilization of Texas Lignites: A Review, *by W. C. J. van Rensburg. 57 p., 10 figs., 1 table ($2.00).*

This circular evaluates the potential of Texas lignite as a source of energy, particularly as a "bridging fuel" to ease already occurring, sporadic fuel shortages in Texas and to counter the effects of increased costs and possible curtailments of imported oil. In addition to the use of lignite for electric power generation, other applications of lignite cited by the author include the production of synthetic liquid and gaseous fuels, fertilizers, plastics, and reductants, and the need to substitute lignite for natural gas in industrial boilers.

Various mining methods applicable to Texas lignite are outlined, including surface mining, in situ conversion of lignite, and underground mining. A number of coal gasification processes are discussed with reference to Texas lignite, among them such commercial gasification processes as the Lurgi gasifier, the Koppers-Totzek gasifier, and the Winkler gasifier, and such second-generation

gasifiers as the Texaco coal gasifier, the Slagging Lurgi gasifier, the Hygas process, the Synthane process, and the CO_2-Acceptor process. Figures detailing each gasifier or process accompany the text.

Other topics include sections on chemistry and characterization of Texas lignite and the important difference between Texas lignite "resources" and "reserves."

The author, director of the Mining and Mineral Resources Research Institute, makes specific recommendations for the conversion of a part of the Texas energy economy to lignite. The recommendations detail the need for further research into geology and depositional environments of lignite, coal characterization, and resource assessment, as well as the need for improved mining technology, improved combustion of lignite, and the need to develop effective reclamation methods state-wide, among other suggestions.

SPECIAL PUBLICATIONS

Depositional and Ground-Water Flow Systems in the Exploration for Uranium, *by William E. Galloway, Charles W. Kreitler, and J. H. McGowen. 267 p., 12 papers with figs. and tables ($6.00).*

During the past 4 years, the Bureau of Economic Geology has conducted, in cooperation with several State and Federal agencies, a number of projects on the geology, origin, and extent of uranium resources in Texas. This volume, which was prepared in conjunction with a research colloquium sponsored by the Bureau, reviews and synthesizes the results of this research and demonstrates their applicability to the interpretation of uranium deposits. Chapters include discussions of fluvial, alluvial-fan, and coastal plain depositional systems, ground-water hydrology of depositional systems, Jackson and Catahoula systems of the Gulf Coastal Plain, Triassic systems of north Texas, Jurassic systems of the Colorado Plateau, and early Tertiary systems of Wyoming intermontane basins. A topical bibliography is also included.

Sediment Distribution, Bathymetry, Faults, and Salt Diapirs, Submerged Lands of Texas, *by J. H. McGowen and R. A. Morton. 31 p., 6 figs., 2 tables, and 7 maps (scale 1:125,000) ($8.00).*

This report is the first in a series of several reports as part of a comprehensive sedimentological, geochemical, geophysical, and biological study of State-owned submerged lands which began in 1976. Field work was conducted through 1976 and 1977. Research was conducted in cooperation with the Marine Branch of the U.S. Geological Survey and was funded by the General Land Office of the State of Texas.

This project will provide a detailed baseline inventory of State-owned submerged lands prior to the anticipated increase in offshore activities and multipurpose use of these lands. Field data gathered for this study include (1) bottom sediment samples, (2) geochemical samples, (3) samples of benthic organisms, and (4) sub-bottom profiles generated by a higher-resolution sparker system. Analyses of the sediment, biological, and geochemical samples, and of the geophysical profiles will result in detailed reports on sediment distribution, trace metal distribution, distribution of benthic organisms, and seismic stratigraphy of Holocene and Pleistocene deposits.

State-owned submerged lands include the inner continental shelf, extending from the Texas Gulf shoreline seaward for 10.36 statute miles (3 marine leagues), and the coastal lagoons from the Texas-Louisiana border to the Texas-Mexico border. "Sediment Distribution Bathymetry, Faults, and Salt Diapirs, Submerged Lands of Texas" is a preliminary report including all of the State-owned submerged lands. The sediment distribution maps were generated from field descriptions of approximately 6,000 shelf and lagoon samples. Bathymetric maps for lagoons were prepared from soundings made at each sample station. Faults and salt diapirs were mapped on the inner continental shelf through the use of high-resolution sparker profiles.

The report is published in cooperation with the General Land Office of Texas.

Land Resource Overview of the Capital Area Planning Council Region, Texas — A Nontechnical Guide, *by C. M. Woodruff, Jr. 29 p., 25 figs., 1 table, 3 plates, 1 map ($3.00).*

The Capital Area Planning Council (CAPCO) Region comprises 10 counties in Central Texas: Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, Lee, Llano, Travis, and Williamson. It is a region of great physical diversity, and it also contains areas that are experiencing rapid socio-economic growth. This report was prepared to (1) present a generalized inventory of the various types of land in the region, and (2) tabulate expected responses of the land to selected human activities at different places. The main tool for accomplishing these objectives is a *Land Resources Map* of the region at a scale of (approximately) 1 inch equals 4 miles. This map contains 24 land resource units defined mainly on the basis of substrate materials, landforms, and processes that affect or are affected by human endeavors.

Besides the map and its applications to generalized land resource evaluations, this report addresses the CAPCO region from two other perspectives. One entails a region-wide summary of various natural resources — such as soil, water, minerals, vegetation, physiography — that are presented in a series of schematic maps. These maps demonstrate the existence of *five natural resource* areas on the basis of the convergence of the various resource themes. The natural resource areas provide the second perspective for assessing the region. They allow one to focus on the potentials and problems of intensive human demands in an area-by-area recapitulation.

Mineral Resources of Texas. *Mapping compiled by L. E. Garner, A. E. St. Clair, and T. J. Evans. Scale 1:1,000,000, in full color ($2.50).*

The *Mineral Resources of Texas* map is the second part of the Bureau of Economic Geology's Mineral Atlas Series and is designed to illustrate the historical and current distribution of industrial mineral occurrences and production sites in Texas. Distributions of major rock types used in the mineral industry are also shown, including limestone, dolomite, ceramic clay, nonceramic clay, iron, sand and gravel, trap rock, granite, industrial sand, extrusive igneous rocks, talc, salt, and sulfur.

The Mineral Atlas emphasizes the contribution that Texas makes to the National economy. The *Energy Resources of Texas* map, completed in 1976, reflected the ranking of Texas as the largest energy producer in the U.S. Now, the *Mineral Resources of Texas* map reflects Texas' position as one of the Nation's leading mineral producers.

REPRINTED PUBLICATIONS

Report of Investigations No. 79. Texas Lignite: Near-Surface and Deep-Basin Resources, *by W. R. Kaiser. 70 p., 22 figs., 7 tables, 1 appendix, 1974 (third printing; $3.00).*

Geological Circular 67-4. Depositional Systems in the Wilcox Group of Texas and Their Relationship to Occurrence of Oil and Gas, *by W. L. Fisher and J. H. McGowen. Reprinted from TRANSACTIONS of the Gulf Coast Association of Geological Societies, Vol. XVII, p. 105-125, 1967 (fourth printing; $1.00).*

Geological Circular 72-4. Depositional Systems and Oil-Gas Reservoirs in the Queen City Formation of Texas, *by E. H. Guevara and R. Garcia. Reprinted from TRANSACTIONS of the Gulf Coast Association of Geological Societies, Vol. XXII, p. 1-22, 18 figs., 2 tables, 1972 (second printing; $1.00).*

Geological Circular 73-1. Asbestos in the Allamoore Talc District, Hudspeth and Culberson Counties, *by R. G. Rohrbacher. 17 p., 2 figs., 1 table, 1973 (second printing; $ .75).*

Geological Circular 75-3. Upper Pennsylvanian Limestone Banks, North-Central Texas, *by E. G. Wermund. 34 p., 14 figs., 2 tables, 1975 (second printing; $1.50).*

Geological Circular 75-8. Geothermal Resources, Frio Formation, Middle Texas Gulf Coast, *by D. G. Bebout, O. K. Agagu, and M. H. Dorfman. 43 p., 38 figs., 1975 (second printing; $1.00).*

Guidebook 6. Texas Rocks and Minerals: An Amateur's Guide, *by R. M. Girard. 109 p., 76 illustrations, 1964 (fourth printing; $2.00).*

Guidebook 7. The Big Bend of the Rio Grande, A Guide to the Rocks, Landscape, Geologic History, and Settlers of the Area of Big Bend National Park, *by R. A. Maxwell. 138 p., 117 figs., geologic map in color, 1968 (fourth printing; $3.00).*

Guidebook 14. Pennsylvanian Depositional Systems in North-Central Texas, A Guide for Interpreting Terrigenous Clastic Facies in a Cratonic Basin, *by L. F. Brown, Jr., A. W. Cleaves II, and A. W. Erxleben. 122 p., 79 figs., 1 pl., 1 table, 1973 (third printing; $3.50).*

Index Series. Bibliography and Index of Texas Geology, 1951-1960, *by E. T. Moore and M. D. Brown. 575 p., 1972 (second printing; $11.00).*

Mineral Resource Circular 56. Gold and Silver in Texas, *by T. J. Evans. 36 p., 14 figs., 5 tables, 1 appendix, 1975 (second printing; $1.00).*

Geologic Atlas of Texas: Seguin (1974), Texarkana (1966), and Waco (1970) Sheets *(second printing for all; $4.00 each).*

Geologic Quadrangle Map 38. Austin West, Travis County, Texas, *by P. U. Rodda, L. E. Garner, and G. L. Dawe. Scale 1:24,000; 11-p. text, 1970 (second printing; $2.50).*

OPEN-FILE MATERIAL

The Bureau of Economic Geology maintains an open file of reports, maps, manuscripts, and other materials obtained from various private and governmental sources. Most are unpublished, although a few are progress reports of research that will eventually be published. Work maps and data developed in connection with Bureau of Economic Geology projects currently underway may be examined and studied at the Bureau offices.

Some of the open-file reports of the U.S. Department of Energy (DOE) and of the former U.S. Energy Research and Development Administration (ERDA) have been placed on file at the Bureau of Economic Geology, and some have been transferred to the Geology Library of The University of Texas at Austin. Information concerning DOE and ERDA open-file reports may be obtained from the Technical Library, Grand Junction Office, U.S. Department of Energy, Grand Junction, Colorado 81502 (telephone: 303-242-8621, ext. 278), and also from the Bureau of Economic Geology.

A limited number of open-file reports of the U.S. Geological Survey are on file at the Bureau of Economic Geology. Information concerning additional reports of that organization may be obtained from Open-File Services Section, Branch of Distribution, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225 (telephone: 303-234-5888).

Services

BUREAU OFFICES

In November 1979, the Bureau opened a new facility in the Tri-Towers Building, 800 West 24th Street. The Tri-Towers Building provides an additional 12,600 square feet of office space to accommodate the Bureau's geothermal programs, which are coordinated by Dr. Robert A. Morton. In addition to geothermal research, two U.S. Geological Survey projects, under the direction of Dr. W. E. Galloway, are also located in the Tri-Towers Building.

This additional space brings the total Bureau operating space to 46,000 square feet (not counting laboratory space at Balcones Research Center). Other facilities are located in the Geology Building on the University Campus (13,500 square feet) and in the Oetting Building at 302 West Thirteenth Street (19,900 square feet).

A new telephone system will be installed in mid-January linking all Bureau facilities via a central switchboard located in the campus office. This system will include a microwave link with the Balcones Research Center that will facilitate communication with the Bureau's laboratories there. The number of incoming lines will be doubled, thereby alleviating problems now caused by the overloaded system.

COMPUTER SERVICES

During 1979, the Bureau expanded its use of computer services under the direction of Mark McClelland, computer programmer-in-charge. Mr. McClelland, formerly employed by the UT Department of Linguistics, supervises seven part-time workers.

Through the use of the University's DUAL CDC Cyber 170/750 computer system, the computer services staff performs most of the computational requirements of the Bureau. Staff duties are (1) to develop encoded data bases for mineral resources, geochemical analyses, hydrologic models, geopressured geothermal phenomena, as well as biology and geology of samples collected from Texas submerged lands and (2) to program software for statistical analyses, modeling, and display. Additional work initiated in 1979 includes the development of files of statewide geophysical logs and, in the business area, files of contracts, grants, and publication sales. Work completed in 1979 included the Mineral Industry Location System (MILS) for Texas.

PUBLIC INFORMATION SERVICES

In addition to conducting basic and applied research programs, the Bureau of Economic Geology provides a variety of advisory, technical, and information services related to the geological, mineral, and land resources of the State. These services are available to individuals, companies, and governmental bodies and agencies. Staff members respond to individual requests for information received daily by letter and phone, and from visitors. In particular, two members of the Bureau's research staff respond to the many requests for information from the general public.

Roselle Girard handles many of the written requests for information on Bureau programs, publications, and general Texas geology, and responds to a steady flow of visitors seeking available information. She is in charge of the Reading Room, which is located in the Bureau's offices on the fifth floor of the Geology Building on the main campus of The University of Texas at Austin. This facility is open to the public and houses a variety of publications pertinent to Texas geology and natural resources.

L. E. Garner responds to requests for rock and mineral identification and handles all public-sample testing in cooperation with the Mineral Studies Laboratory. He also coordinates the Bureau's participation in the review of environmental impact statements and similar preliminary project reports as part of the interagency cooperation necessary for complete and adequate review of proposed State projects.

MINERAL STUDIES LABORATORY

The Mineral Studies Laboratory at Balcones Research Center provides measurement and evaluation of geological and biological materials and water samples for Bureau of Economic Geology research projects.

This past year, the Mineral Studies Laboratory greatly increased its capability and efficiency in the area of multiple element and trace inorganic analysis. Among reasons for the increased accuracy and output are (1) installation and operation of the inductively coupled plasma emission spectrometer (ARL), which is equipped with PDP-11 computer with floppy disc memory system for data storage and processing; (2) installation of the Farrand Mark I

spectrofluorometer; (3) improvement and development by MSL of other analytical techniques; and (4) increased experience and competence gained by laboratory personnel.

Inductively coupled plasma emission spectrometry has become one of the most powerful tools in geochemical analysis and environmental monitoring during the last few years. Once a sample is dissolved in solution, optimum condition of the instrument is determined, and calibration of the instrument, using a series of standards for each element with proper corrections for background and spectral interferences, is established, simultaneous measurement of 30 elements can be obtained in less than 3 minutes per sample. The spectral lines on the lab's ICP are Na, K, Li, Be, Mg, Ca, Sr, Co, Cu, Cr, Ni, Mn, Sn, Sb, As, Se, Mo, Ba, Cd, Fe, Pb, Zn, Al, B, P, Ti, V, Zr, Th, U. Additional spectral lines for other elements may be installed when needed.

The new Farrand Mark I double beam spectrofluorometer has greatly increased the sensitivity and precision for Se and U analysis. Installation of the new IL254 autosampler for the graphite furnace on the IL651 atomic absorption spectrophotometer has increased precision and efficiency in micro-sample injection for ultra-grace analysis utilizing flameless atomic absorption spectrophotometry. Development of simple, rapid methods for sample dissolution and subsequent U_3O_8 analysis has greatly improved analytical efficiency by more than five times, as well as achieving cost reduction compared with methods used previously.

Many elements cannot be measured by any of the instruments mentioned above. The MSL has developed other techniques, such as titration, spectrophotometry in conjunction with organic extraction, steam distillation separation, selective ion electrode, and nephelometry to be used in such cases.

The MSL estimates the total number of analyses completed during 1979 to be more than 18,000 for the National Uranium Resource Evaluation (NURE) project, and approximately 16,000 for other projects (an average of 15 parameters per sample).

Sedimentological analysis, another function of the Mineral Studies Laboratory, has been expanded with the addition of a Coulter TAII Counter, which became operational for mud analysis in March 1979. Total sediment spectrum analyses using the Coulter Counter and the Rapid Sediment Analyzer were completed on 800 samples from the Galveston-Houston, Corpus Christi, and Bay City-Freeport areas. Since January 1, 1979, the lab has also completed basic gravel/sand/mud analysis for 1,160 samples ordered for sheets being prepared for the same area.

The Sedimentology Laboratory employs a computer program that accepts raw data from the various analytical procedures used in the lab and generates a total picture of a sample, as well as basic statistics of interest to sedimentary research. The lab is also carrying out an on-going investigation of traditional analytical methods, comparing them with results obtained by the newest, "state-of-the-art" methods currently employed by the Sedimentology Laboratory.

WELL SAMPLE AND CORE LIBRARY

Authorized by the Texas Legislature in 1937, the Bureau's Well Sample and Core Library has been located at Balcones Research Center since 1945. Housing one of the largest public collections of subsurface geological materials in the nation, the library to date lists cores from 2,376 wells and drill cuttings from more than 90,000 wells.

During 1979, the library received subsurface materials from Bradley Peek, Houston Oil & Minerals; U.S. Geological Survey; M. M. Lopez; Getty Oil, E. Stout; Core Lab; Amoco, A. C. Milam, Jr.; Ligen Exploration; Wainoco; Sante Fe Minerals, Inc.; Mr. James Kunupki; Texas International Petroleum; Pioneer Nuclear Corp.; Texas Department of Water Resources; Montgomery Stratigraphic Service, Porter Montgomery; Colorado Interstate Gas; Hamilton Drilling & Engineering, Inc.; and Ashland Exploration, Inc. Mr. George C. Hardin, Jr., president of Ashland Exploration, Inc., donated 14 cores and 50 cuttings from 64 wells, the largest and most significant donation for 1979. Total donations to the library included cores from 33 wells and cuttings from 183 wells.

Increased growth of the collections and increased need for ready access to the rock materials have led to the computerization of all available well core records. In addition, the staff is preparing a print-out of all cuttings, resulting in a corrected print-out now listed alphabetically by county through Guadalupe County. Another project involved cores C-1 through C-1,000, which were physically inventoried and corrected, resulting in a print-out with more reliable data.

The Well Sample and Core Library is now serving as headquarters for the Bureau's core drilling operations. Equipment used for this work includes a portable 6,000-pound drilling rig from Mobile Drilling Company. A hydraulic-powered rotary core drill is utilized with the rig, which has the capacity to take cores, as well as shallow soil samples.

Work performed by the library this past year included the processing of more than 7,000 feet of cores from the Randall County Rex White #1 and Swisher County Grabbe #1 wells. Because these were West Texas Waste Isolation project cores containing large percentages of salt, the staff had to develop a unique core processing project. Staffers also continued the consolidation project, splitting and reboxing 26 cores to double storage space and reboxing 83 wells represented by cuttings.

A new addition to the library this year is the thin section laboratory, which was paid for out of thin section fee receipts. The thin section laboratory is specifically designed for high volume petrographic thin section production and features soundproofing, heating and air conditioning, a ventilation system, and efficient counter space within its 88 square feet.

The library is open from 8 a.m. to 5 p.m. Monday through Friday. Visitors may examine and study the subsurface materials at that facility, where microscopes and other equipment are provided and library staff members are available to assist interested persons. Last year a total of 76 non-Bureau visitors toured the library, including 10 oil company representatives, 8 uranium researchers, 12 consultants, 6 mineral specialists, and 40 University/Geological Survey staffers.

Cores and cuttings may be checked out of the library, with the borrower paying shipping costs. Last year, 96 cores and 98 cuttings were checked out by Bureau personnel, and an additional 40 cores and 101 cuttings were checked out by non-Bureau personnel.

Personnel

RESEARCH STAFF

FORMER DIRECTOR BECOMES PRESIDENT OF THE UNIVERSITY

Dr. Peter T. Flawn, 21 years with the Bureau of Economic Geology and its fifth director from 1960 to 1970, assumed the Presidency of The University of Texas at Austin in September 1979. He was appointed to the post by the Board of Regents in February.

Flawn's research at the Bureau of Economic Geology emphasized economic, structural, and environmental geology, areas on which he published extensively. In 1970, Dr. Flawn left the Bureau of Economic Geology to become Vice President for Academic Affairs for the University; in 1972 he was named Executive Vice President at The University of Texas at Austin, and later that year was appointed President of The University of Texas at San Antonio, a post he held for five years.

In 1978 Dr. Flawn was named Leonidas T. Barrow Professor of Mineral Resources; he also serves as Professor of Public Affairs in the LBJ School of Public Affairs.

In addition to a distinguished career in research, teaching, and administration, Flawn has long been active in professional affairs and national issues of public policy.

The Bureau of Economic Geology salutes its former member and director, Peter Flawn, in his assumption of the Presidency of The University of Texas at Austin.

SPECIAL RECOGNITION FOR BUREAU SCIENTISTS

Four research scientists of the Bureau of Economic Geology were cited for excellent presentation of a scientific paper at several 1979 professional meetings.

Two scientists won awards at the joint annual meeting of the Society of Economic Paleontologists and Mineralogists and the American Association of Petroleum Geologists held in Houston, Texas. C. Robertson Handford received the SEPM "Excellence of Presentation Award" for his paper entitled "Lower Permian facies tracts and evolution of carbonate shelf margins, Palo Duro Basin, Texas Panhandle." Handford's paper was chosen from the 310 papers accepted for presentation by SEPM. William E. Galloway won the "Energy Minerals Division Best Paper Award" within AAPG presentations. Galloway's paper, "Oakville Formation of Texas Coastal Plain — depositional systems, composition, structure, geohydrology, and uranium mineralization," was among 24 papers accepted in 1979 by this newly created division of AAPG.

Mark W. Presley won the "A. I. Levorsen Memorial Award" for presenting "Lower Pennsylvanian alluvial to delta plain facies in northern West Virginia and their relationship to the occurrence of coal" at the annual meeting of the Eastern Section of the American Association of Petroleum Geologists in Cleveland, Ohio.

Charles D. Winker received the "First Best Paper Award" for the 29th annual meeting of the Gulf Coast Association of Geological Societies in San Antonio. The paper was titled, "Late Pleistocene fluvial-deltaic deposition, Texas Coastal Plain and shelf." There were 28 papers given at the GCAGS meeting.

OCS ADVISORY BOARD

Upon the recommendation of Governor William P. Clements, Jr., W. L. Fisher and E. G. Wermund were appointed by Secretary of Interior Cecil D. Andrus to serve on that department's Outer Continental Shelf Advisory Board. Dr. Fisher represents Texas on the Policy Committee, which examines national issues resulting from leasing oil and gas exploration tracts on the Outer Continental Shelf. Voting representatives come from all those states having a boundary contiguous with United States submerged lands.

Dr. Wermund serves Texas on the Gulf Coast Outer Continental Shelf Technical Working Group Committee, which studies leasing impacts on private and public properties of Texas, Louisiana, Mississippi, Alabama, and Florida. This group will recommend exploration leasing schedules in the Gulf to the Bureau of Land Management.

NATIONAL ENERGY POLICY ISSUES

On April 25, 1979, Governor William P. Clements, Jr., requested of The University of Texas at Austin President Lorene L. Rogers that the University's Council on Energy Resources conduct an objective analysis of current national energy policy issues, with particular regard to the President's energy proposals of April 1979.

A summary document, prepared by W. L. Fisher, Director of the Bureau of Economic Geology, and Walt W. Rostow, professor of economics and history, was transmitted to the Governor in early May. A comprehensive report, containing 10 individual reports plus an overview, was presented to the Governor and made available to the public in June.

The Council on Energy Resources is a University-wide coordinating body consisting of the Director of the Bureau of Economic Geology, as Chairman, Dean of the School of Business, Dean of the LBJ School of Public Affairs, Dean of the Law School, Director of the Center for Energy Studies, and Chairman of the Department of Economics.

The Council's June report was third in a series of reports, also requested by the Governor and dealing with national energy policy issues.

TEXAS MINING AND MINERAL RESOURCES RESEARCH INSTITUTE

On September 15, 1978, a new Mining and Mineral Resources Research Institute was established as an administrative unit of the Bureau of Economic Geology. This Institute and similar institutes in a number of other states were provided for in Title III of the Federal Surface Mining Control and Reclamation Act of 1977.

The Institute functions both in research and in training. Funding, authorized through 1983 by the Act, is provided by the U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. Federal funds for research grants and for fellowships and scholarships are provided; funds for operation of the Institute are matched by The University of Texas at Austin. Creation and funding of the Institute have permitted new research directions and have facilitated the integration, enlargement, and more direct focus of existing mining and research and training programs.

The first Director of the Institute, Dr. W. C. J. van Rensburg, assumed duties on February 1, 1979. He also serves as an Associate Director of the Bureau of Economic Geology, and as a professor in the Department of Geological Sciences. Dr. van Rensburg, a native of Bloemfontein, South Africa, holds B.Sc., B.Sc. (Honors), and M.Sc. degrees in geology from Pretoria University and a Ph.D. degree in geology from the University of Wisconsin. He was formerly Head of the Department of Geosciences at West Texas State University. His professional background includes experience as British Petroleum Professor of Energy Economics at Rand Afrikaans University and Director of the Institute for Energy Studies at that University; Technical Director of the South African Minerals Bureau, Department of Mines; Head of the Economics and Costing Division of the South African National Institute for Metallurgy; Deputy Director of the South African Department of Planning and the Environment; and Senior Geologist with the South African Geological Survey. He is the author and co-author of numerous articles, reports, and books on mineral resources and mineral economics.

A Mining and Mineral Resources Research Committee has been established, consisting of the President of The University of Texas at Austin, the Executive Vice-Chancellor for Programs of Texas A&M University, and a Member of the Railroad Commission of Texas. The committee solicits research proposals and nominations for student fellowships and scholarships, and makes recommendations to the Institute Director for fund allocations. On the basis of the recommendations of the committee, the Institute has decided to give priority to research aimed at the optimum utilization of Texas near-surface and deep-basin lignites, the State's uranium resources, and the development of the base metals and minerals industry. The Institute has also initiated research into global resources and reserves of strategic metals and minerals, with particular reference to the growing dependence of the United States on imported sources of these materials. In its graduate training, the Institute has emphasized the development of a multi-disciplinary program in resource economics.

The Institute published three reports during 1979 in the Bureau of Economic Geology Publication Series, and a number of additional papers are in press. Additional funding has been secured through the Texas Energy and Natural Resources Advisory Council and the U.S. Geological Survey.

NEW RESEARCH STAFF MEMBERS

The Bureau research staff increased in 1979 with the addition of 1 research scientist and 24 research scientist associates. The diverse educational and professional backgrounds of these new staff members have measurably strengthened the Bureau's overall research capabilities.

Kinji Magara

Dr. Kinji Magara joined the Bureau as a Research Scientist in October 1979. He is currently assisting with the evaluation of hydrocarbon resources of the Frio Formation. Dr. Magara received a B.S. degree in geology in 1959 and a Ph.D. in geology in 1967, both from Kyoto University, Japan. He has more than 17 years' experience in the petroleum industry and several years in academic research. Dr. Magara holds professional membership in the American Association of Petroleum Geologists, Canadian Society of Petroleum Geologists, Canadian Well Logging Society, and Japanese Association of Petroleum Technologists, and is a Registered Professional Geologist in Alberta, Canada.

Dr. Magara has published more than 45 papers, abstracts, and reports and over the years has given more than 35 invited talks. He has published a well-received book entitled *Compaction and Fluid Migration — Practical Petroleum Geology*. A second book, *Petroleum Migration and Accumulation*, is nearly complete.

Olusegun K. Agagu

Dr. Olusegun K. Agagu joined the Bureau staff as a Research Scientist Associate in July 1979. He previously served in that capacity from 1974-1975. He is currently working on subsurface stratigraphy and structural reconstruction of the East Texas Basin as part of an evaluation of salt domes for nuclear waste disposal.

Dr. Agagu received a B.S. degree in geology from the University of Ibadan (Nigeria), an M.A. degree in geology from The University of Texas at Austin, and a Ph.D. in geology from the University of Ibadan. Before returning to the Bureau of Economic Geology this last time, Dr. Agagu was a Lecturer at the University of Ibadan, where he taught petroleum geology, stratigraphic principles, stratigraphy of Nigeria, sedimentology, and depositional processes.

Alan B. Alhades

Mr. Alan B. Alhades joined the Bureau as a Research Scientist Associate in January 1979. Since that time he has been involved in analyzing well data for salt dissolution in the Texas and New Mexico High Plains toward production of maps and cross sections. He also maintains a system of collecting and processing data related to modern erosion of the Texas High Plains. Mr. Alhades received a B.S. in geology from the State University of New York at Binghamton in 1978.

Randy L. Bassett

Dr. Randy L. Bassett joined the Bureau as a Research Scientist Associate in September 1979. Dr. Bassett currently works on the West Texas Waste Isolation project and heads a team of investigators responsible for analyzing the regional and site-specific hydrology and geochemistry of the Palo Duro and Dalhart Basins. Before coming to the Bureau, Dr. Bassett worked for the U.S. Geological Survey.

Dr. Bassett received a B.S. in geology with a minor in chemistry from Baylor University in 1971, an M.S. in geochemistry from Texas Tech University in 1973, and a Ph.D. in environmental geochemistry in 1976 from Stanford University.

Dr. Bassett is a member of the American Chemical Society, the American Geophysical Union, the Baylor Geological Society, the Clay Mineral Society, the Geochemical Society, and the Society for Environmental Geochemistry and Health.

Mary A. Bauer

Ms. Mary A. Bauer started with the Bureau in September 1977 as a Research Scientist Associate and remained until February 1978, when she left to work for private industry. In September 1979, she returned to the Bureau. Ms. Bauer's current project is evaluating uncertainties associated with coal resource-reserve estimations. She received a B.A. in 1975 and an M.A. in 1976, both in geology, from Rice University.

Robert W. Baumgardner

Mr. Robert W. Baumgardner, Jr., was promoted to Research Scientist Associate in May 1979 after previously working at the Bureau as a Research Scientist Assistant on two occasions. Mr. Baumgardner received a B.A. from The University of Texas at Austin in August 1974, with special honors in zoology. In May 1979, he received an M.A. in geology with a thesis emphasizing geomorphology and hydrogeology.

Mr. Baumgardner currently assists on a Landsat project using satellite imagery of the Texas surface and on the West Texas Waste Isolation project, which investigates the potential of the Palo Duro Basin as a repository for nuclear waste.

Michael S. Bumpass

Mr. Michael S. Bumpass is currently assigned as a Research Scientist Associate to the National Uranium Resource Evaluation Project (NURE), serving as a field geologist for the Wichita Falls, Texas, Quadrangle. His previous Bureau experience includes serving as a rock processor for chemical analysis at Balcones Research Center. Mr. Bumpass received a B.S. degree in geology from The University of Texas in July 1978 and joined the Bureau staff in April 1979.

Owen R. Dix

Mr. Owen R. Dix, who is currently working on detailed analysis of stream drainage over dome and non-dome areas and the study of lineaments in East Texas, joined the Bureau staff in January 1979 as a Research Scientist Associate. Mr. Dix received a B.Sc. in geology in 1976, and an M.Sc. in geology in 1979 from the University of Natal, Pietermaritzburg, South Africa. He is a member of the Society of Economic Paleontologists and Mineralogists, and the Geological Society of South Africa.

Deborrah A. Garcia

Ms. Deborrah A. Garcia worked for the Bureau in July 1977 as a Laboratory Research Assistant. She was promoted to Research Scientist Associate after receiving her B.S. in geophysics from The University of Texas at Austin in July 1979. Her work involves geophysical processing and interpretation of seismic and sonic log data for study of geophysical aspects of geothermal geopressured site selection in the Gulf Coast.

Abato John Garza

Mr. Abato John Garza joined the Bureau as a Research Scientist Assistant in May 1979. In September, he was reclassified as a Research Scientist Associate. Mr. Garza worked for the Bureau as a Laboratory Research Assistant in 1976. He received a B.S. in geology from The University of Texas at Austin in August 1978 and is currently working on the West Texas Waste Isolation project.

David W. Harris

Mr. David W. Harris joined the Bureau Staff as a Research Scientist Associate in May 1979. His current work involves the interpretation of seismic, gravity, and well data for the East Texas Waste Isolation project. Mr. Harris received a B.S. in geology from The University of Texas at Austin in May 1979. He is a member of the American Association of Petroleum Geologists, Society of Economic Geologists, and the American Institute of Mining, Metallurgical and Petroleum Engineers.

Ann D. Hoadley

Ms. Ann D. Hoadley began at the Bureau in January 1979 as a Laboratory Research Assistant. In July 1979 she was promoted to Research Scientist Associate after receiving a B.S. in geology from The University of Texas at Austin. Ms. Hoadley is currently participating in the study of salt dissolution in the Palo Duro Basin of the Panhandle of Texas, using electric logs to identify such zones, to construct cross sections, and to project rates of salt dissolution. She is a member of the Austin Geological Society.

Rory C. Howard

Mr. Rory C. Howard is currently working on the West Texas Waste Isolation project and is responsible for the collection of weather and geomorphic data in the Texas Panhandle. Mr. Howard joined the Bureau in July 1979 as a Research Scientist Associate. He received a B.S. in geology from Eastern New Mexico University in 1974.

David Mathew

Dr. David Mathew received a B.S. degree in April 1973 and an M.S. degree in May 1975 from the University of Natal in South Africa. In December 1977, he received a Ph.D. from the University of South Carolina. Dr. Mathew has been with the Bureau since September 1979 as a Research Scientist Associate. He works on a project, sponsored by Electric Power Research Institute (EPRI), estimating uncertainty in coal resource and cost estimates. This entails the development of a conceptual model for characterizing uncertainty in coal resource estimates based on geological, chemical, and statistical analysis of bore-hole data from the Texas Gulf Coast Tertiary Basin.

Dr. Mathew was formerly associated with Westmoreland Coal Company in Crab Orchard, West Virginia, as Director of Coal Geology. He is the author of numerous publications and is a member of the Geological Society of South Africa.

Kathy McGillis

Ms. Kathy McGillis, who became a Research Scientist Associate for the Bureau of Economic Geology in January, worked for the Bureau previously on two occasions as a Research Scientist Assistant. Ms. McGillis' current responsibility with the Bureau is with the West Texas Waste Isolation project. She attended Georgia State University in Atlanta and The University of Texas at Austin, where she obtained a B.S. in geology in 1977.

Kitty L. Milliken

Ms. Kitty L. Milliken rejoined the Bureau as a Research Scientist Associate in June 1979. She had previously worked for the Bureau in the summer of 1977 as a Research Scientist Assistant. Ms. Milliken received a B.A. degree in geology from Vanderbilt University in spring 1975. In December 1977, she received an M.A. in geology from The University of Texas at Austin.

Ms. Milliken is currently involved in the Sandstone Consolidation project related to the search for porosity in the geopressured geothermal zone. She is a member of the Society of Economic Paleontologists and Mineralogists, the Kentucky Academy of Science, and the Austin Geological Society.

Suzanne M. Montano

Ms. Suzanne M. Montano joined the Bureau of Economic Geology in July 1977 as a Laboratory Research Assistant. In September 1979, she was promoted to Research Scientist Associate on receipt of a B.S. in geology from The University of Texas at Austin. Ms. Montano is now working on a project to computerize lignite resource data and has contributed to the U.S. Bureau of Mines Mineral Industry Location System.

Paul J. Ramondetta

Mr. Paul J. Ramondetta received a B.S. in 1971 and an M.A. in geology in 1975, both from Brooklyn College. He joined the Bureau as a Research Scientist Associate in May 1979. Mr. Ramondetta holds professional membership in the Houston Geological Society and the Petroleum Information - Geological Information Centers. His current project is to determine the potential for oil and gas generation in the San Andres Formation in the Palo Duro Basin.

Debra L. Richmann

Ms. Debra L. Richmann, who is currently working on a DOE-funded project assessing the effects of diagenetic alteration on reservoir quality in connection with the Bureau's geothermal research, began work at the Bureau in March 1979 as a Research Scientist Associate. She came to the Bureau from the American Petroleum Institute, Washington, D.C. She previously worked as a Research Assistant at the Bureau from June to August 1976.

Ms. Richmann received a B.A. in geology from the University of Minnesota in 1974 and in 1977 received an M.A. in geology from The University of Texas at Austin. She is a member of the Geological Society of America, and American Association of Petroleum Geologists, and is chairwoman of the Publications Committee of the Austin Geological Society.

William W. Simpkins

Mr. William W. Simpkins joined the Bureau as a Research Scientist Associate in July 1979. He received a B.A. in geology in 1976 from Augustana College in Illinois. In May 1979, he received a double M.S. degree in geology and water resources management from the University of Wisconsin at Madison. Since coming to the Bureau, Mr. Simpkins has been working on the West Texas Waste Isolation project. Mr. Simpkins is a member of the Geological Society of America, the American Water Resources Association, and the National Well Water Association.

Gary E. Smith

Mr. Gary E. Smith is currently beginning a study of the potential of lead, zinc, and cobalt resources in the Llano area of Central Texas, using an integrated geochemical, geophysical, and stratigraphic approach. He has just completed part of a study of the effects of *in situ* uranium extraction on the Oakville aquifer of South Texas.

Mr. Smith began with the Bureau as a Research Scientist Assistant in January 1972. In July 1972 he left to work in the mining industry, where he gained varied experience in Texas, Colorado, and the West. In March 1979, Mr. Smith returned to the Bureau as a Research Scientist Associate. He received a B.S. from the University of Utah in 1968 and an M.A. in geology from The Universtiy of Texas at Austin in 1973. The Bureau published Mr. Smith's M.S. thesis as Report of Investigations No. 80.

Susan J. Tewalt

Ms. Susan J. Tewalt joined the Bureau as a Research Scientist Associate in June 1979. She previously worked several years as a geologist for the West Virginia Geological and Economic Survey.

Ms. Tewalt received a B.S. and an M.S. in geology from West Virginia University in Morgantown, West Virginia. Since coming to the Bureau, she has been working on a coal project in the Mining and Mineral Resources Research Institute.

Michael P. Roberts

Mr. Michael P. Roberts came to the Bureau in October 1979 as a Research Scientist Associate. In 1962 he received a B.S. with distinction in pure mathematics from the University of Cape Town with emphasis on applied mathematics and physics. He received an M.S. in 1965 from the same university. Before joining the Bureau, Mr. Roberts worked for several years with the Chamber of Mines Research Laboratories in South Africa. As chief of the coal computer applications division, he specialized in coal mining computer applications with emphasis on reserve estimation and production planning and control. Mr. Roberts' first Bureau project is the coal resources uncertainty project. Mr. Roberts is a founder member of the South African Operations Research Society and a member of the South African Computer Society.

Charles D. Winker

Mr. Charles D. Winker was promoted to Research Scientist Associate with the Bureau in October 1979. His responsibilities include the application of seismic data both to predict geothermal geopressured reservoir volumes in the Tertiary of the Gulf Coast and to optimize locations of test wells.

Mr. Winker received a B.S. from the University of Georgia in 1977 and an M.A. degree from The University of Texas at Austin in December 1979. Mr. Winker presented award-winning papers to the 1977 and 1979 annual meetings of the Gulf Coast Association of Geological Societies.

H. Victor Wuerch III

Mr. H. Victor Wuerch III started at the Bureau as a Laboratory Research Assistant in June 1978. In September 1979, he was promoted to Research Scientist Associate on receipt of a B.S. in geology from The University of Texas at Austin. He is currently working on the East Texas Waste Isolation project and is involved in the sampling of ground waters from aquifers.

PAPERS BY BUREAU OF ECONOMIC GEOLOGY STAFF IN OUTSIDE (NON-BUREAU) PUBLICATIONS

In addition to reports published by the Bureau of Economic Geology, staff members also write papers that are issued by other organizations in journals, proceedings, and other professional publications. During 1979, the following papers by Bureau staff members were published outside of the Bureau:

PAPERS

Barnes, Virgil E., 1979, Memorial for William Charles Bell: The University of Texas at Austin, Department of Geological Sciences Newsletter, v. 28, p. 45-46.

Bassett, R. L., 1979, A computer model for aqueous organic complexes in natural systems and physiologic fluids: Trace Substances in Environmental Health Symposium, v. 13, p. 189-197.

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Bebout, Don, Moore, Clyde, Davies, Grahm, Scholle, Peter, and *Wardlow, Norman C.*, 1979, Geology of carbonate porosity: American Association of Petroleum Geologists Continuing Education Course Notes, Series II, 247 p.

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Brown, L. F., Jr., 1979, Deltaic sandstone facies of the Mid-Continent, *in* Pennsylvanian sandstones of the Mid-Continent: Tulsa Geological Society, Special Publication No. 1, p. 35-63.

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Dutton, S. P., (with *Land, L. S.*), 1979, Cementation of sandstones — a response: Journal of Sedimentary Petrology, v. 49, no. 4, p.1359-1361.

Edwards, Marc B., 1979, Late Precambrian glacial loessites from north Norway and Svalbard: Journal of Sedimentary Petrology, v. 49, no. 1, p. 85-92.

Edwards, Marc B., 1979, Sandstone in Lower Cretaceous Helvetiafjellet Formation, Svalbard: bearing on reservoir potential of Barents Shelf: American Association of Petroleum Geologists Bulletin, v. 63, no. 12, p. 2193-2203.

Edwards, M. B., Bjaerke, T., Nagy, J., Winsnes, T. S., and *Worsley, D.*, 1979, Mesozoic stratigraphy of Svalbard: A discussion: Geological Magazine, v. 116, no. 1, p. 49-54.

Fisher, W. L., 1979, Energy potential in Texas, *in* Presession 66th Legislative Conference, Proceedings: Austin, Texas, The University of Texas at Austin, Lyndon B. Johnson School of Public Affairs, p. 30-34.

Fisher, W. L., 1979, Oil and gas in Mexico, *in* Texas Business Review: Austin, Texas, The University of Texas at Austin, Bureau of Business Research, v. 53, no. 2, p. 29-34.

Fisher, W. L., 1979, Outlook for energy in the eighties: Gas Processors Association, Annual Meeting, Denver, Colorado, 1979, Proceedings, p. 41-43.

Fisher, W. L. (with *Morton, R. A.*), 1979, Anticipated revenues and production responses from decontrol of oil prices, *in* National Energy Policy Issues, June 1979: Austin, Texas, The University of Texas at Austin, Council on Energy Resources, p. 97-106.

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LECTURES AND PUBLIC ADDRESSES

A measure of the interest in Bureau of Economic Geology research programs and their results is shown by the number of public lectures presented each year. Lectures are given to a wide audience, including professional societies, universities, and Federal, State, and local units of government.

Although the primary method of disseminating the results of Bureau research is through publication, formal and informal lectures are important means of presenting information before final publication.

Following are lectures given by Bureau staff members during 1979.

Richard Andersen

The geology of Texas: presented at two third-grade classes, Doss Elementary School, Austin, Texas.

Mountain building: presented at five third-grade classes, Cunningham Elementary School, Austin, Texas.

Joyce M. Basciano

Hydrology and water quality of the Eocene Wilcox Group: significance for lignite development in East Texas:

presented at the Gulf Coast Association of Geological Societies Annual Meeting (sponsored by the Gulf Coast Association of Geological Societies), San Antonio, Texas.

Don Bebout

Bureau of Economic Geology program on geopressured geothermal research: presented at the Geopressured Geothermal Conference and Program Review (sponsored by the U.S. Department of Energy, Preproposal Conference), Houston, Texas.

Energy resources of water-bearing geopressured reservoirs: presented at various universities and geological societies nationwide (American Association of Petroleum Geologists Distinguished Lecture series).

Geothermal resources — Texas Gulf Coast: presented at Lakeway Men's Club, Lakeway, Texas.

Geothermal resources, Wilcox trend, and evaluation of reservoir properties from Pleasant Bayou No. 1 Well: presented at the Industry Geopressured Geothermal Resource Development Program (sponsored by the U.S. Department of Energy), Houston, Texas.

Lower Cretaceous carbonates — South Texas: presented at the South Texas Geological Society, San Antonio, Texas.

Lower Cretaceous — South Texas; presented at the Mesozoic Geology Group, Houston, Texas.

Secondary carbonate porosity: presented at the American Association of Petroleum Geologists "Geology of Carbonate Porosity" short course, Houston, Texas.

L. F. Brown, Jr.

The role of lithofacies in sedimentary minerals exploration: presented before the Argentina Geological Association, Buenos Aires, Argentina.

Seismic stratigraphic interpretation: presented before the Oklahoma City Geophysical Society, Oklahoma City, Oklahoma.

Seismic stratigraphy: presented before class in Geophysics, The University of Texas at Austin.

Thomas Calnan

Molluscan distribution in Copano Bay, Texas: presented at the American Malacological Union, Corpus Christi, Texas.

Marianne M. Dodge

Geothermal energy: presented to an ecology field class, Richardson (Texas) High School, visiting the Bureau of Economic Geology, Austin, Texas.

Progress report on evaluation of entrained methane in deep reservoirs, Texas Gulf Coast, presented at the 4th Geopressured Geothermal Conference, Austin, Texas.

Review of consolidation history and reservoir quality of sandstones of the Texas Gulf Coast: presented at the meeting of Unconventional Natural Gas Project Advisors, Gas Research Institute, Houston, Texas, September 1979.

Review of entrained methane assessment in the Texas Gulf Coast: presented at the meeting of Unconventional Natural Gas Project Advisors, Gas Research Institute (sponsored by the Bureau of Economic Geology), Austin, Texas, May 1979.

Review of entrained methane assessment in the Texas Gulf Coast: presented at the meeting of Unconventional Natural Gas Project Advisors, Gas Research Institute, Houston, Texas, September 1979.

Shirley Dutton

Depositional systems and hydrocarbon resource potential of the Pennsylvanian System, Palo Duro Basin, Texas Panhandle: presented at Abilene Geological Society, Abilene, Texas, *and* at West Texas Geological Society, Midland, Texas.

Exploration potential of Pennsylvanian-Permian carbonate shelf margins and deltaic sandstones, Palo Duro Basin, Texas: presented at the American Association of Petroleum Geologists, Annual Meeting, Houston, Texas.

Marc B. Edwards

Glacial environments and facies, application to ancient glacial sequences: presented at Technical Sessions, The University of Texas at Dallas, Department of Geology, Richardson, Texas.

Growth faults in Triassic deltas, Spitzbergen: presented at Technical Sessions (sponsored by The University of Texas at Austin Department of Geological Sciences), Austin, Texas.

Robert J. Finley

Landsat classification of coastal wetlands in Texas: presented at the Fifth Annual William T. Pecora Symposium (sponsored by the American Water Resources Association), Sioux Falls, South Dakota.

Palo Duro Basin Analysis: presented at the American Association of Petroleum Geologists Annual Meeting, Houston, Texas.

W. L. Fisher

Coal and lignite in America's energy future: presented at U.S. Department of Energy *and* University of North Dakota, 10th Biennial Lignite Symposium, Grand Forks, North Dakota.

Domestic energy sources—outlook for next decade: presented at Gas Processors Association, Annual Meeting, Denver, Colorado.

Energy and government—in conflict?: presented at Houston Geophysical Society, Meeting, Houston, Texas.

Energy development and government regulations: presented at Society of Independent Professional Earth Scientists, Meeting, Dallas, Texas; South Texas Geological Society, San Antonio; and Southeastern Geophysical Society, New Orleans.

Energy futures: presented at Texas Association of Life Insurance Officials, Annual Meeting, San Antonio, Texas.

Energy in Texas—future of a petro-state: presented at Dallas Chamber of Commerce, Leadership Seminar, Dallas, Texas.

Energy sources—conventional and alternative: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Symposium on Alternate Energy Resources, San Antonio, Texas.

Exploration and public lands policy — growing conflicts: presented at American Association of Petroleum Geologists, Pacific Section, Annual Meeting, Anaheim, California.

Exploration, science, and public policy — conflicts in the making: presented as an American Association of Petroleum Geologists Distinguished Lecture before the Dallas Geological Society, Dallas, Texas; the Lafayette Geological Society, Lafayette, Louisiana; the New Orleans Geological Society, New Orleans, Louisiana; the Rocky Mountain Association of Geologists, Denver, Colorado; the Roswell Geological Society, Roswell, New Mexico; the South Texas Geological Society, San Antonio, Texas; *and* the Tulsa Geological Society, Tulsa, Oklahoma.

Geology and energy in the public arena: presented at Southern Illinois University, Geology Building Dedication, Carbondale, Illinois.

Is registration necessary or desirable?: presented at

American Association of Petroleum Geologists, Division of Professional Affairs, Annual Meeting, Houston, Texas.

Mexican oil and gas: presented at Austin Kiwanis Club, Meeting, Austin, Texas: Austin Rotary Club, Meeting, Austin, Texas; *and* Lakeway Club, Meeting, Lakeway, Texas.

Oil as a continuing energy resource: presented at Southwest Texas State University, Symposium on Energy and the Environment, San Marcos, Texas.

Perspectives on energy—the world dilemma: presented at American College of Dentists, Texas Section, Annual Meeting, Austin, Texas.

Role of federal estate in energy and mineral production: presented at the Society of the Sigma Xi, Stephen F. Austin State University, Banquet, Nacogdoches, Texas.

Science and energy—getting from here to there: presented at The University of Texas at Arlington, College of Science, Commencement, Arlington, Texas.

Uranium and the U.S. energy future: presented at American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), South Texas Section, Banquet, Corpus Christi, Texas.

Graham E. Fogg

Regional aquifer analysis for nuclear waste isolation: hydrogeology of the East Texas Basin: presented at the Austin Geological Society, December meeting, Austin, Texas.

William E. Galloway

Diagenetic destruction of sandstone reservoirs—Gulf of Alaska and Gulf Coast, Texas: presented at the Sedimentology Seminar (sponsored by the Department of Geology, Texas A & M University), College Station, Texas.

Geology of the Western Gulf Coast Basin: presented before a special graduate short course (sponsored by the Louisiana State University, New Orleans, Department of Geology), New Orleans, Louisiana.

Hydrogeology of a leaky confined coastal-plain aquifer—Catahoula Formation, Texas: presented at the Geological Society of America, South-Central Section, Annual Meeting, Mountain View, Arkansas.

Relationships between depositional system, groundwater flow history, origin, migration, and concentration of uranium, Catahoula Formation of Texas Coastal Plain: presented at the Dallas Geological Society, Dallas, Texas.

Uranium geology of the Texas Coastal Plain: presented at The University of Texas at El Paso, Department of Geological Sciences, El Paso, Texas.

L. E. Garner

Aggregate sources in Texas: presented before the Texas Aggregate and Concrete Association, the 21st Annual Short Course, Austin, Texas.

Lignite resources in the national forests of Texas: presented at the U.S. Forest Service Planning Workshop, Lufkin, Texas.

Mechanisms of slope failure: presented before an environmental geology class, The University of Texas Department of Geological Sciences, Austin, Texas.

Mineral resources of Texas: presented before an economic geology class, The University of Texas Department of Geological Sciences, Austin, Texas.

Thomas C. Gustavson

Deposition in glaciofluvial and glaciolacustrine environments: presented before Mobil Oil Company representatives, Dallas, Texas.

Environmental analyses of two geopressured geothermal prospect areas, Colorado and De Witt Counties, Texas: presented at the 4th Geopressured Geothermal Conference, Austin, Texas.

Environmental monitoring, Pleasant Bayou #1, 2, a geopressured geothermal test well: presented at the 4th Geopressured Geothermal Conference, Austin, Texas.

C. Robertson Handford

Depositional system of lower Clear Fork salt and associated facies, Palo Duro Basin, Texas: presented at the Society of Economic Paleontologists and Mineralogists research colloquium on evaporites (sponsored by the Society for Economic Paleontologists and Mineralogists), American Association of Petroleum Geologists Meeting, Houston, Texas.

Evolution of Lower Permian shelf margins, Palo Duro Basin, Texas: presented at the Society of Economic Paleontologists and Mineralogists research colloquium on carbonates (sponsored by the Society of Economic Paleontologists and Mineralogists), American Association of Petroleum Geologists Meeting, Houston, Texas.

Lower Permian depositional systems and petroleum potential in Palo Duro Basin, Texas: presented at the Union Oil Company Research Center, Brea, California.

Christopher D. Henry

Geology and formation of sandstone uranium deposits: presented at the In-situ Uranium Mining Seminar for Regulatory Personnel (sponsored by the Nuclear Regulatory Commission), Corpus Christi, Texas.

Trace elements in soils—South Texas Uranium Mining District: presented at the Soil Survey Work Planning Conference (sponsored by Texas A & M University), College Station, Texas.

William T. Hupp

Computer analysis of Landsat multispectral data for land use mapping: presented at the Joe C. Thompson Conference Center before the local chapter of the American Society of Photogrammetry (sponsored by the local chapter of the American Society of Photogrammetry), Austin, Texas.

Detection and mapping of water using satellite multispectral data and DAM software package: presented at the American Society of Photogrammetry and Remote Sensing Conference, Phoenix, Arizona.

The use of remote sensing data for identifying archeological sites: presented at the Incarnate Word College, San Antonio Archeological Society (sponsored by The University of Texas at San Antonio, Center for Archaeological Research), San Antonio, Texas.

Charles W. Kreitler

Geochemical evolution of an aquifer: presented before Department of Hydrology, University of Arizona, Tucson, Arizona.

Interpretation of sandstone aquifer heterogeneities by depositional models: presented at the 9th Annual Rocky Mountain Ground Water Conference (sponsored by the Desert Research Institute), Reno, Nevada.

Nitrogen isotope chemistry of nitrogen in natural waters: presented at the School of Natural Sciences Monthly Seminar, The University of Texas at San Antonio, San Antonio, Texas.

Nuclear waste isolation studies of salt domes in the East Texas Basin, Texas: presented at a Public Information Meeting of the Office of Nuclear Waste Isolation (sponsored by Battelle Memorial Institute), Columbus, Ohio.

Paleohydrology and geologic controls on ground-water

flow: presented before Department of Hydrology, University of Arizona, Tucson, Arizona.

Problems of nuclear waste isolation in the salt dome of the East Texas Basin: presented before Department of Hydrology, University of Arizona, Tucson, Arizona.

Regional aquifer analysis for nuclear waste isolation: hydrogeochemistry of East Texas Basin: presented at Austin Geological Society, Meeting, Austin, Texas.

Thomas G. Littleton

The fresh-water mussels of the Navasota River, Texas: presented at the American Malacological Union (sponsored by the American Malacological Union), Corpus Christi, Texas.

R. G. Loucks

Factors controlling reservoir quality in geopressured sandstone: presented at the International Institute of Applied Systems Analysis, Vienna, Austria.

Geology of a giant gas field, Ellenburger Puckett Field, Pecos County, Texas: presented before Fort Worth Geological Society, Fort Worth, Texas.

Mineralogy, diagenesis, and porosity in Texas Gulf Coast Tertiary Sandstone—implications for hydrocarbon and geothermal reservoirs: presented before Department of Earth Sciences, University of New Orleans, as part of the Distinguished Lecturer Series, New Orleans, Louisiana.

Mineralogy, diagenesis, and secondary porosity in Texas Gulf Coast Tertiary sandstone — implications for hydrocarbon exploration: presented before Corpus Christi Geological Society, Corpus Christi, Texas.

Precipitation of carbonate minerals in geopressured aquifers: presented before American Chemical Society, Austin, Texas.

Mary W. McBride

Rocks and minerals tell a story: presented at Wooten Elementary School, Austin, Texas.

Texas mineral resources and our environment: presented before an education workshop (sponsored by Abilene Christian College), Abilene, Texas.

J. H. McGowen

Shoreline changes of the Matagorda Bay System from 1856-1972: presented before Texas Coastal and Marine Council, Special Meeting, Lake Jackson, Texas.

Kinji Magara

Compaction and fluid migration: presented at Japan National Oil Corporation, Tokyo, Japan.

Geological models for predicting optimum sandstone percentage for oil accumulation: presented at Canadian Society of Petroleum Geologists Luncheon Meeting, Calgary, Alberta, Canada.

Robert A. Morton

Map identification and physical processes of natural hazards along the Texas Coast: presented at the Houston Audubon Society Annual Meeting, Houston, Texas.

Mark W. Presley

A multidisciplinary geologic approach to basin evaluation for nuclear waste: presented at National Waste Terminal Storage Program Information Meeting, U.S. Department of Energy, Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, Ohio.

Identification of evaporite facies in geophysical logs in the Texas Panhandle: presented before Society of Economic Paleontologists and Mineralogists Evaporite Research Group at the American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston, Texas.

Shelf and supratidal facies in Upper Permian strata, Palo Duro and Dalhart Basins, Texas: presented before West Texas Geological Society, Midland, Texas.

Upper Permian carbonate and evaporite facies of the Texas Panhandle: presented before Roswell Geological Society, Roswell, New Mexico.

Debra L. Richmann

An introduction to rocks and minerals: presented at Bedichek Junior High School, 8th grade earth science classes, Austin, Texas.

William W. Simpkins

Glacial geology and hydrogeology in northeastern Wisconsin: presented at the Minnesota Geological Survey Research Colloquium, Minneapolis, Minnesota.

The importance of glaciers in our lives: presented at Holden Village Retreat Community, Holden, Washington.

W. C. J. van Rensburg

A comment on the U.S. synfuel program: presented before Center for Energy Studies, The University of Texas at Austin, Austin, Texas.

Legal and political aspects of ocean mining: presented at the Texas Association of Earth Science Teachers, Austin, Texas.

The philosophy of mineral resource appraisal: presented before U.S. Geological Survey, Denver, Colorado.

The strategic importance of natural resources in the Indian Ocean region: presented at the Defense Technology 1979 Conference (sponsored by Defense and Foreign Affairs Magazine), Chicago, Illinois.

Synthetic fuels as an energy resource: presented at Southwest Texas State University, San Marcos, Texas.

U.S. dependence on imported sources of non-fuel minerals: presented before Austin Geological Society, Austin, Texas.

The U.S. energy position: presented before Texas Railroad Commission, Austin, Texas.

Bonnie R. Weise

Barrier island and lagoon environments, Padre Island National Seashore: presented before an ecology field class, Richardson (Texas) High School, visiting the Bureau of Economic Geology, Austin, Texas.

Review of geological studies of geopressured zones: presented at a meeting of the Unconventional Natural Gas Project Advisors, Gas Research Institute (sponsored by the Bureau of Economic Geology), Austin, Texas.

E. G. Wermund

Bureau of Economic Geology studies of Oakwood salt dome for deep geological burial of nuclear waste: presented at public meeting, Freestone County Courthouse, Fairfield, Texas.

Deep geological burial of commercial nuclear wastes—the relation of Texas and federal programs: presented before the West Texas State University chapter of Sigma Gamma Epsilon, Canyon, Texas.

Potential for Bureau of Economic Geology/U.S. Geological Survey cooperative studies: presented before Central Region cluster of U.S. Geological Survey and State Geologists, Estes Park, Colorado.

Status of studies of deep geological burial of nuclear

waste in East Texas salt domes: presented before Rotary Club, Palestine, Texas.

William A. White

Application of Landsat data in the Texas Panhandle and the Texas Coastal Zone: presented before representatives of the People's Republic of China during their visit to the Texas Natural Resources Information System.

Delineation of wetlands along the Texas Coastal Zone: presented at a meeting of the Texas State agencies concerning Texas guidelines for the National Wetlands Inventory (sponsored by the Bureau of Economic Geology), Austin, Texas.

The role of land and water resource investigations in land use planning in the Texas Coastal Zone: presented before Coastal Zone management class, School of Architecture, The University of Texas at Austin, Austin, Texas.

C. M. Woodruff, Jr.

Beyond the Marlin Well—regional aspects of low-temperature geothermal resources in Texas: presented at the Rotary Club, Marlin, Texas.

Geothermal energy from ground water—a potential low-temperature resource along the margins of the Gulf Coast Plain and the Mississippi Embayment: presented at "Rural America: Energy Needs and Alternatives," American Association for the Advancement of Science (sponsored by the American Association for the Advancement of Science; Sigma Xi; the Scientific Research Society; the Joint Educational Consortium of Henderson State University and Ouachita Baptist University; the Arkansas Academy of Sciences; the State of Arkansas; the State of Louisiana; the State of Oklahoma; the State of Texas), Arkadelphia, Arkansas.

Projects and progress of the Bureau of Economic Geology: presented at the Soil Survey Work—Planning Conference (sponsored by the U.S. Soil Conservation Service, Texas Agricultural Experiment Station, and Texas Agricultural Extension Service of Texas A & M University), College Station, Texas.

Stream piracy near the Edwards Plateau: presented at Baylor University (sponsored by the Department of Geology), Waco, Texas.

CONGRESSIONAL, LEGISLATIVE, AND SPECIAL TESTIMONY

Bureau of Economic Geology staff members are invited to testify as expert witnesses by Federal and State legislative committees and agencies when resource and environmental matters are under consideration. During 1979, Bureau geologists appeared before the following:

Texas Energy Advisory Council — W. L. Fisher (testimony given: "Lignite Development in Texas").

Texas Energy Advisory Council — W. L. Fisher, with W. W. Rostow (testimony given: "The Energy Situation in Light of the Iranian Crises").

Texas House of Representatives, Committee on Energy Resources — W. L. Fisher (testimony given: "Texas Oil and Gas Reserves and Resources").

Texas House of Representatives, Committee on Natural Resources — E. G. Wermund (testimony given: "The Relation of Texas and National Nuclear Waste Programs").

Texas House of Representatives, Committee on Ways and Means — W. L. Fisher (testimony given: "Uranium Reserves in Texas").

Texas Senate, Subcommittee on Energy — W. L. Fisher (testimony given: "Energy and Regulation").

Texas House of Representatives, Subcommittee on Energy Resources — E. G. Wermund (testimony given: "The Significance of Texas and National Nuclear Waste Isolation Programs").

Texas Senate, Committee on Natural Resources — E. G. Wermund (testimony given: "A Brief Summary of Texas and National Nuclear Waste Isolation Programs").

U.S. Department of Transportation — W. L. Fisher (testimony given: "Projected Terminal Volumes Through the Texas Deep-Water Port Facility").

U.S. House of Representatives, Subcommittee on Energy and Power, Committee on Interstate and Foreign Commerce — W. L. Fisher, with William P. Hobby, Mack Wallace, and W. W. Rostow (testimony given: "Oil Decontrol").

U.S. Senate, Committee on Energy and Natural Resources — W. L. Fisher, with William P. Hobby, Mack Wallace, and W. W. Rostow (testimony given: "National Energy Policy").

U.S. Senate, Committee on Governmental Affairs — W. L. Fisher, with Mack Wallace (testimony given: "Natural Gas Policy Act").

COMMITTEE SERVICES, OFFICES, AND OTHER PROFESSIONAL RESPONSIBILITIES

Virgil E. Barnes

Co-leader of a field trip prepared on the economic geology of south-central Texas, Gulf Coast Association of Geological Societies Annual Meeting, San Antonio.

Don Bebout

Member of the Membership Committee, American Association of Petroleum Geologists.

Member of the Publication Committee, Society of Economic Paleontologists and Mineralogists.

Vice President of the Austin Geological Society.

L. F. Brown, Jr.

Associate editor, American Association of Petroleum Geologists Bulletin.

Co-chairman, Seismic Stratigraphy Session, Offshore Technology Conference, Houston.

Member of Continuing Education Program, American Association of Petroleum Geologists.

Marianne M. Dodge

Member of the Public Relations Committee, Austin Geological Society.

Shirley P. Dutton

Judge of presentations, American Association of Petroleum Geologists/Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston.

Member of the Entertainment Committee, Austin Geological Society.

Marc B. Edwards

Judge of presentations, American Association of Petroleum Geologists/Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston.

Judge of presentations, Gulf Coast Association of Geological Societies, 29th Annual Meeting, San Antonio.

Robert J. Finley

Alternate member of the Texas Mapping Advisory Committee.

Member of the Remote Sensing and Cartographic Committee of the Texas Natural Resources Information System Task Force.

Vice-chairman and member (through June 1979) of the Citizens Board of Natural Resources and Environmental Quality of Austin, Texas.

W. L. Fisher

Chairman of Executive Committee, Council on Energy Resources, The University of Texas at Austin.

Chairman of Governmental Liaison Committee, Association of American State Geologists.

Distinguished Lecturer, American Association of Petroleum Geologists.

Lecturer for Continuing Education Program, American Association of Petroleum Geologists.

Member of Academic Liaison Committee, American Association of Petroleum Geologists.

Member of Advisory Board, Center for Energy Studies, The University of Texas at Austin.

Member of Advisory Committee on Energy Research, Association of American Universities.

Member of Advisory Committee, Institute for Latin American Studies, The University of Texas at Austin.

Member of Advisory Council for Marine Science and Technology, Texas A & M University.

Member of Advisory Group, Southern Illinois University.

Member of Advisory Panel on Stockpile Disposal Policies, U.S. General Services Administration.

Member of Environmental Geology Committee, American Institute of Professional Geologists.

Member of Executive Board, American Institute of Professional Geologists.

Member of Executive Committee, Geology Foundation, The University of Texas at Austin.

Member of General Exploration Affairs Committee, American Petroleum Institute.

Member of Geothermal Industrial Advisory Committee, the Railroad Commission of Texas and U.S. Department of Energy.

Member of Government, Energy, and Mineral Affairs Committee, American Institute of Mining, Metallurgical, and Petroleum Engineers.

Member of Lignite Research, Development, and Demonstration Committee, Texas Energy Advisory Council.

Member of Marine Geology Committee, American Association of Petroleum Geologists.

Member of Mineral Resources Committee, National Association of State Universities and Land Grant Colleges.

Member of National Executive Committee, American Institute of Professional Geologists.

Member *(ex officio)* of Natural Resources Council, State of Texas.

Member of Nominating Committee, Geological Society of America.

Member of Nuclear Energy Committee, Texas Energy Advisory Council.

Member of Nuclear Waste Committee, Association of American State Geologists.

Member of Policy Advisory Board, Outer Continental Shelf, U.S. Department of the Interior.

Member of Public Affairs Committee, Association of American State Geologists.

Member of Publications Committee, Society of Economic Geologists, Inc.

Member of Publications Policy Committee, The University of Texas at Austin.

Member of Renewable Resources Committee, Southern States Energy Board.

Member of Research Committee, Interstate Mining Compact Commission.

Member of Research Committee, Interstate Oil Compact Commission.

Member of Task Force, National Plan of Action to Combat Desertification, U.S. Department of the Interior.

Member of Technical Program Committee (AAPG/OTC), American Association of Petroleum Geologists.

Member of Texas Energy Advisory Committee, Texas Energy Advisory Council.

Member of Texas Energy and Natural Resources Advisory Council.

Member of Texas Mapping Advisory Committee.

Member of University Coordinating Committee, Texas Energy Advisory Council.

President of Texas Section, American Institute of Professional Geologists.

Vice President, Association of American State Geologists.

William E. Galloway

Elective member, Advisory Council, Department of Geological Sciences, The University of Texas at Austin.

Leader/organizer of a field trip to South Texas Uranium Province, American Association of Petroleum Geologists National Meeting, Energy Minerals Division, Houston.

Lecturer for the American Association of Petroleum Geologists Seismic Stratigraphy School, Jackson Hole, Wyoming, and London, England.

Member of the Academic Advisory Committee, Texas Mining and Minerals Resource Research Institute.

Member of the Liaison Committee, American Association of Petroleum Geologists, Offshore Technology Conference, Houston, Texas.

L. Edwin Garner

Co-leader of field trip, "Urban Hydrology and Other Environmental Aspects of the Austin Area," Austin Geological Society.

Field trip leader, Pleistocene Tertiary field trip in the Beaumont Sheet area for Union Carbide Field Geologists.

Member, National Steering Committee, Highway Geology Symposium.

Edgar H. Guevara

Delegate (representing Venezuela), House of Delegates, American Association of Petroleum Geologists.

Judge of presentations, American Association of Petroleum Geologists/Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston.

Thomas C. Gustavson

Member of the Resource Group for the Texas Advisory Committee on Conservation and Environmental Education, Texas Education Agency.

Christopher D. Henry

Co-leader of a field trip to South Texas Uranium Province, American Association of Petroleum Geologists National Meeting, Energy Minerals Division, Houston.

David K. Hobday

Chairman of Technical Program Committee, Austin Geological Society.

Co-leader of a field trip, "Paleoenvironmental Analysis and Trace Fossils," Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston.

Corresponding member, International Quaternary (INQUA) Shoreline Commission, Subcommission for Africa.

W. R. Kaiser

Member of the Editorial Board for "In Situ Oil-Coal-Shale Minerals."

Member of the Lignite Subcommittee of the Fossil Energy Advisory Committee of the United States Department of Energy.

Charles W. Kreitler

Member of the Editorial Board, Ground Water.

R. G. Loucks

Business Representative of the Gulf Coast Section of the Society of Economic Paleontologists and Mineralogists.

Discussion leader for a workshop on Subsurface Disposal of Geopressured Fluids, Gulf Coast, sponsored by the Louisiana Department of Natural Resources and Louisiana State University.

Judge of presentations, American Association of Petroleum Geologists/Society of Economic Paleontologists and Mineralogists Annual Meeting, Houston.

Member of the Geopressured Geothermal Site Selection Subcommittee, U.S. Department of Energy.

Vice Chairman of the Carbonate Rock Subcommittee, American Association of Petroleum Geologists.

Vice President/Treasurer (1979-1980) and Secretary (1978-1979), Austin Geological Society.

Kinji Magara

Associate editor, Canadian Society of Petroleum Geologists Bulletin.

J. H. McGowen

Co-leader of field trip, "Modern Depositional Environments of the Texas Coast," sponsored by the Gulf Coast Association of Geological Societies, and co-author of 175-p. field guide to be formally published in 1980.

Leader of field trip, "Field Conference on Clastic Sedimentary Environments, Bay City and Corpus Christi Areas," sponsored by the U.S. Geological Survey Office of Energy Resources.

Member of Committee on Continuing Education, Society of Economic Paleontologists and Mineralogists.

Mary McGowen

Member of House of Delegates, American Association of Petroleum Geologists, representing Austin Geological Society.

Robert A. Morton

Co-leader of field trip, "Modern Depositional Environments of the Texas Coast," sponsored by the Gulf Coast Association of Geological Societies, and co-author of 175-p. field guide to be formally published in 1980.

Expert witness on behalf of the State of Texas (at the request of the Texas Attorney General's Office) at hearings concerning the Open Beaches Act and coextensive geological and legal boundaries.

Member of User Advisory Group of the Texas Natural Resources Information System and National Aeronautics and Space Administration Joint Project, conducted by the Texas Natural Resources Information System.

Technical session co-chairman, American Association of Petroleum Geologists Annual Meeting, Houston.

Mark W. Presley

Business representative of the Gulf Coast Section of the Society of Economic Paleontologists and Mineralogists.

Co-editor of field guidebook and co-leader of field trip, "Carboniferous Coal" (short course and field trip), sponsored by the Eastern Section of the American Association of Petroleum Geologists.

Co-editor of field guidebook and co-leader of field trip, "Depositional Systems of Coal Deposits in Central Appalachian Coal Basins," sponsored by the Eastern Section of the American Association of Petroleum Geologists.

Vice Chairman of the Evaporite Research Group, Society of Economic Paleontologists and Mineralogists.

Debra L. Richmann

Chairwoman, Publications Committee, Austin Geological Society.

Gary E. Smith

Co-chairman of the Brines and Lead-Zinc Symposium, American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New Orleans.

Bonnie R. Weise

Chairwoman, Membership Committee, Austin Geological Society.

Judge for Best Paper Award, Gulf Coast Association of Geological Societies Annual Meeting, San Antonio.

Member of the Entertainment Committee, Austin Geological Society.

E. G. Wermund

Chairman of the Long-Range Planning Committee, Gulf Coast Association of Geological Societies.

Delegate from Austin Geological Society, Executive Committee, Gulf Coast Association of Geological Societies.

Member of the Awards Committee, Department of Geological Sciences, The University of Texas at Austin.

Member of the Environmental Geology Committee, American Association of Petroleum Geologists.

Member of the Executive Committee, Austin Geological Society.

Member of the Publications Committee, American Association of Petroleum Geologists.

Vice Chairman of Interagency Task Force and Chairman of Operations Review Committee, Texas Natural Resources Information System.

C. M. Woodruff, Jr.

Co-leader of field trip, "Urban Hydrology and Other Environmental Aspects of the Austin Area," Austin Geological Society.

Member of the Geothermal Task Force, Texas Energy Advisory Council.

UNIVERSITY TEACHING/ CONTINUING EDUCATION

TEACHING ACTIVITIES

Several members of the Bureau of Economic Geology research staff participate in teaching, either through courses offered in University departments or in continuing education or special short courses sponsored by the Bureau, the Department of Geological Sciences, or professional societies. These activities for 1979 included the following:

ACADEMIC COURSES

Department of Geological Sciences, The University of Texas at Austin

L. F. Brown, Jr. and *Milo Backus* — Seismic Stratigraphy (Geology 391).

William E. Galloway and *W. R. Kaiser* — Sedimentary Economic Geology (Geology 391).

Charles W. Kreitler — Hydrogeology (Geology 391c).

W. C. J. van Rensburg — Geology of Energy Resources (Geology 368).

Department of Mineral Development Engineering, University of Tokyo, Tokyo, Japan

Kinji Magara — Petroleum Migration.

Department of Marine Science and Technology, Tokai University, Shimizu, Japan

Kinji Magara — Primary Oil Migration.

SHORT COURSES

American Association of Petroleum Geologists

Don Bebout — Carbonate Core-Logging Exercise — Recognition of Carbonate Facies and Depositional Environments (presented at Austin, Houston, and Salado, Texas).

Don Bebout (with G. H. Moore, G. Davies, P. Scholle, and H. Wardlow) — Geology of Carbonate Porosity (presented at the Annual Meeting, American Association of Petroleum Geologists/Society of Economic Paleontologists and Mineralogists, Houston).

L. F. Brown, Jr. — "Seismic Stratigraphy and Depositional Systems," Continuing Education Schools on "Stratigraphic Interpretation of Seismic Data," sponsored by American Association of Petroleum Geologists, presented in London, September 1979, and Jackson Hole, August 1979.

William E. Galloway — Depositional Systems in Exploration for Sandstone Stratigraphic Traps (presented in Midland and Houston, Texas, and at Kansas Geological Society, Wichita, Kansas).

R. G. Loucks — American Association of Petroleum Geologists Exploration School (presented in San Antonio).

Other societies and associations

L. F. Brown, Jr. — "Depositional Systems and Seismic-Stratigraphic Interpretation," (presented before University of Houston School on Geophysics for Geologists, May 1979; Australian Minerals Foundation, Adelaide, July 1979; Edinburgh Geologic Institute (Geological Survey of Great Britain), Edinburgh, October 1979; and Yacimientos Petroliferos Fiscales, Buenos Aires, November 1979).

David K. Hobday — Depositional Systems and Mineral Exploration (presented before Geological Society of South Africa, Cape Town and Stellenbosch, South Africa).

Kinji Magara — Petroleum geology (presented at Kyoto University, Department of Geology and Mineralogy, Kyoto, Japan).

CONTINUING EDUCATION

College of Engineering, The University of Texas at Austin; The University of Texas, Permian Basin

William E. Galloway — Reservoir Heterogeneity and Hydrocarbon Recovery.

WORKSHOPS

Bureau of Economic Geology, Department of Geological Sciences, and Geology Foundation, The University of Texas at Austin

Don Bebout — Carbonate Workshop—Recent and Ancient Environments for Explorationists and Engineers.

A. R. Gregory — Guest Lecture on "Rock Physics in Seismic Interpretation" by invitation of Professor Backus, Geology 365M.

SUPPORT STAFF

ADMINISTRATIVE/SECRETARIAL

The administrative/secretarial staff fulfills an important role in achieving the goals of the Bureau. These staff members are, in many respects, the Bureau's closest contact with a majority of the public. As Bureau research programs grow in numbers and complexity, staff members help with aspects of program administration and complete an ever-increasing volume of secretarial tasks for the day-to-day operation of the Bureau. Mrs. Eloise Hill, Executive Assistant, coordinates the work of the administrative/secretarial staff.

CARTOGRAPHY

James W. Macon, Chief Cartographer, directs the work of the Cartography Section for the Bureau. Much of the Bureau's reputation in the areas of geologic and land resource mapping is a reflection of the excellent cartographic support provided by these staff members. Besides the high-quality full-color map products which are the hallmark of the Cartography Section, the present staff also produces a full range of other maps, illustrations, slide copy, and display materials.

PHOTOGRAPHY

David Stephens provides technical photographic support for the Bureau's publications, lectures and public addresses, and research projects. Most of the photographic work consists of slides, cover photos, and text photos.

PUBLICATIONS PREPARATION

A central part of the Bureau's function as a public geological research organization is to make available the results of its research programs. This is accomplished chiefly by means of its publications. Preparing Bureau reports for publication involves manuscript typing and composing, editing, graphics design, and layout.

Lucille Harrell coordinates the work of the manuscript typing and composing section. Susann Doenges directs the editorial staff. Judy Culwell, under the direction of Chief Cartographer James W. Macon, designs the publications and prepares final camera-ready copy.

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The Bureau of Economic Geology augments its research staff through the employment of students as part-time research assistants. These students not only contribute to the research effort but also gain experience in organized research as part of their academic training. During 1979, more than 150 students, predominantly graduate students in geology, chemistry, biology, and engineering, were so employed.