

1977 ANNUAL REPORT BUREAU OF ECONOMIC GEOLOGY

THE UNIVERSITY OF TEXAS AT AUSTIN

AUSTIN, TEXAS

W. L. FISHER, DIRECTOR

Cover photograph:

Sierra del Carmen, Big Bend National Park,
Brewster County, Texas. Moonrise over these
Lower Cretaceous limestone units raised along a series
of faults and filled to the east
forming fault block ridges.
Photo courtesy France P. Davis

FOREWORD

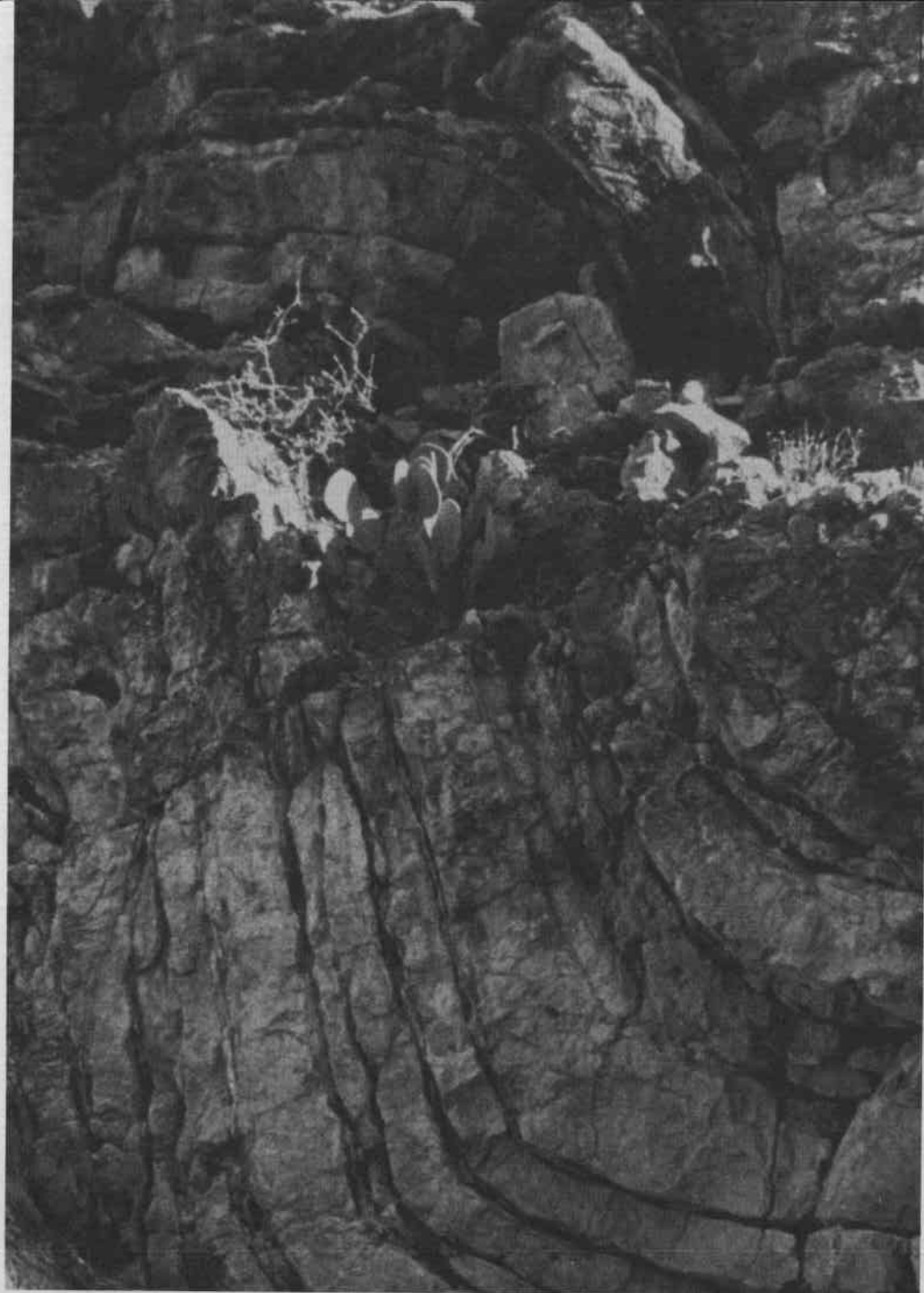
The Bureau of Economic Geology, established in 1909 as the successor to the Texas Geological Survey and the Texas Mineral Survey, is a research entity of The University of Texas at Austin. It also functions as the State Geological Survey—a quasi-state agency—with membership in the Natural Resources Council of the State of Texas. The Bureau 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 Bureau of Economic Geology publishes results of its research in Reports of Investigations, Environmental Geologic Atlases, Geological Circulars, Handbooks, Land Resources Laboratory Series, Research Notes, Mineral Resource Circulars, Geologic Quadrangle Maps, Geologic Atlas of Texas Maps, and Guidebooks. 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.

Folded Boquillas Formation limestone
along Marufo Vega Trail, Big Bend
National Park, Brewster County



1977 ANNUAL REPORT BUREAU OF ECONOMIC GEOLOGY

THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS
W.L. FISHER, DIRECTOR

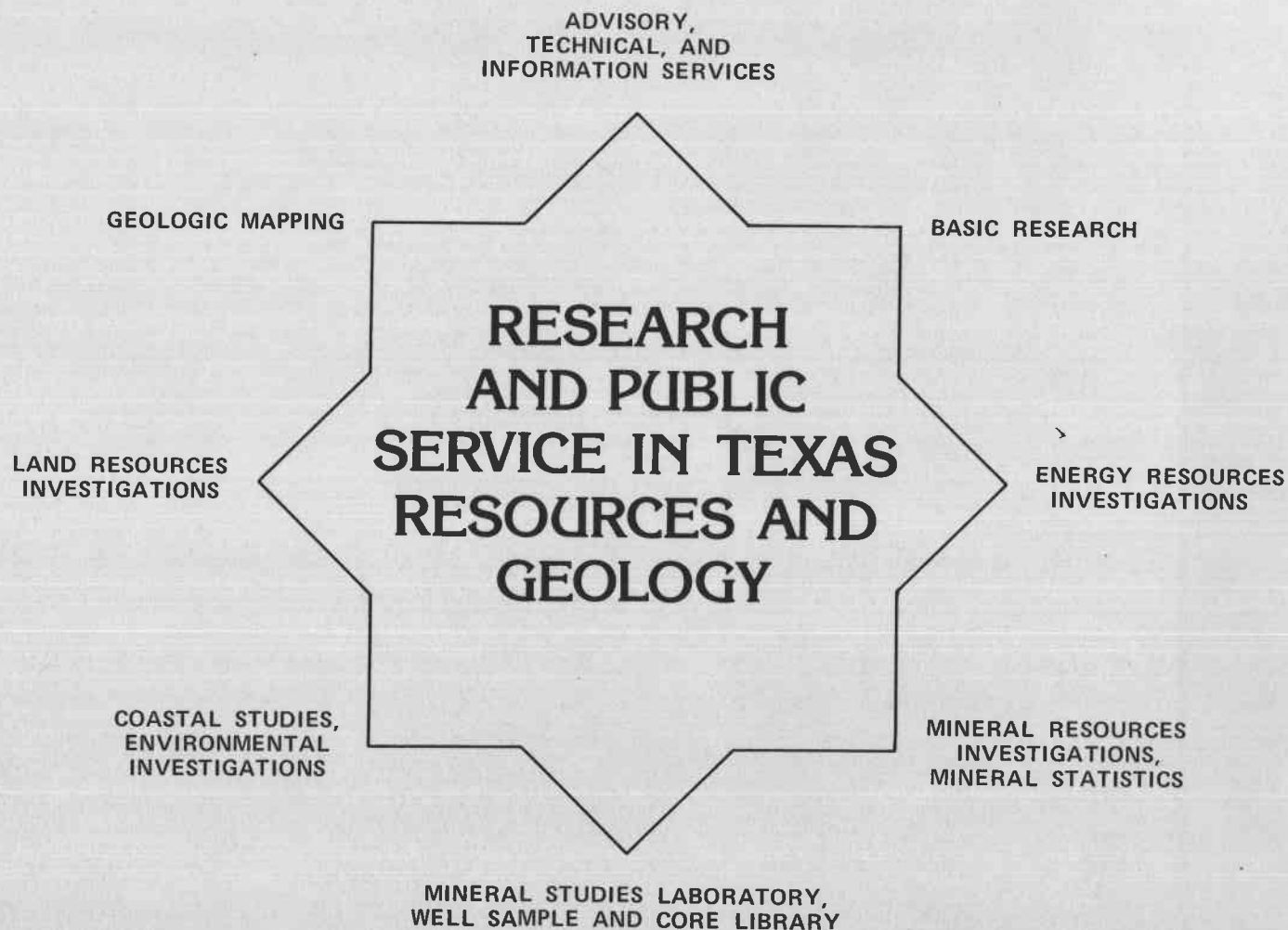
RESEARCH AND ADMINISTRATIVE OFFICES

Geology Building, Main Campus
University Station, Box X
Austin, Texas 78712
(512) 471-1534



SPECIAL SERVICES LABORATORIES

Balcones Research Center
10100 Burnet Road
Austin, Texas 78758
(512) 836-0440



Except where otherwise noted, photos in this Report were prepared by David M. Stephens. Design, production, and logo by Claudia Farmer.



CONTENTS

RESEARCH

ENERGY RESOURCES INVESTIGATIONS	5
MINERAL RESOURCES INVESTIGATIONS	8
LAND RESOURCES INVESTIGATIONS	10
COASTAL STUDIES	15
HYDROGEOLOGY INVESTIGATIONS	17
BASIN STUDIES	18
SPECIAL RESEARCH PROGRAMS	19
OTHER RESEARCH	20
GEOLOGIC MAPPING	21
CONTRACTS AND GRANT SUPPORT	22

PUBLICATIONS

ENVIRONMENTAL GEOLOGIC ATLAS	23
REPORTS OF INVESTIGATIONS	23
GEOLOGICAL CIRCULARS	25
MINERAL RESOURCE CIRCULAR	26
SPECIAL PUBLICATIONS	26
MAPS AND CHARTS	27
FINAL EDITING/IN PRESS	28
REPRINTED PUBLICATIONS	28

SERVICES

MINERAL STUDIES LABORATORY	29
WELL SAMPLE AND CORE LIBRARY	29
PUBLIC INFORMATION SERVICES	30
EDUCATION SERVICES	30
OPEN-FILE MATERIAL	30

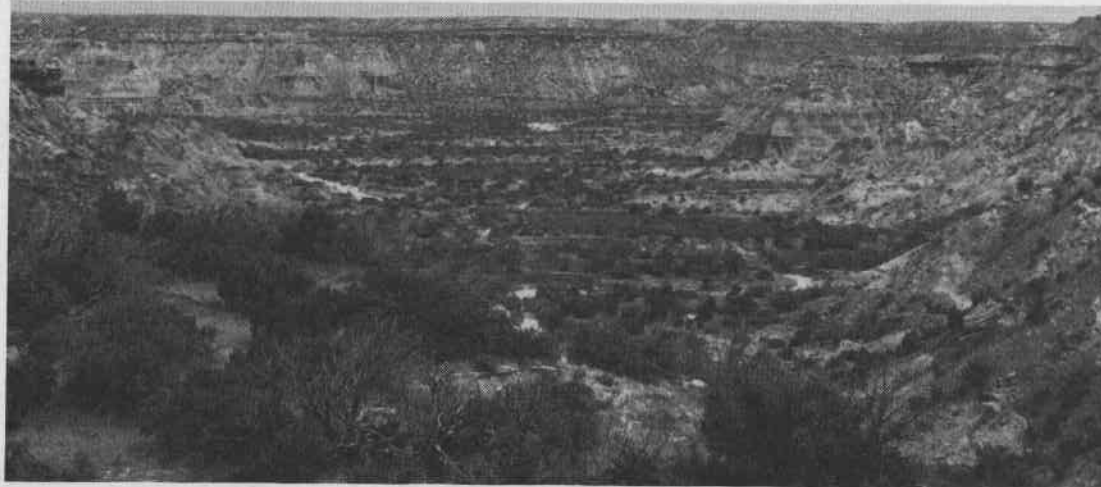
PERSONNEL

RESEARCH STAFF	33
PAPERS IN OUTSIDE PUBLICATIONS	41
LECTURES AND PUBLIC ADDRESSES	44
MEETINGS ATTENDED	47
LEGISLATIVE COMMITTEE HEARINGS	49
COMMITTEE SERVICE, OFFICES, AND OTHER PROFESSIONAL RESPONSIBILITIES	49
TEACHING ACTIVITIES	51
SUPPORT STAFF	52



RESEARCH

View looking east from Sunday Canyon
towards Palo Duro Canyon, Randall
County, Panhandle region of Texas



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 which 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 like 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 Land Resources Laboratory coordinates the numerous land resources programs within the Bureau of Economic Geology. Bureau research in 1977 focused on the assessment and analysis of environmental problems concerning geopressed 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 geopressed geothermal energy, the Bureau began research into analysis of governmental policy related to energy. Initiation of a comprehensive survey of mineral localities in the State began in late 1977. This survey proposes to develop detailed information on hundreds of mineral sites across Texas.

Systematic geologic mapping, coastal studies, basin analysis projects, and investigations in other areas of economic geology further indicate the range of research programs carried forward in 1977.

ENERGY RESOURCES INVESTIGATIONS

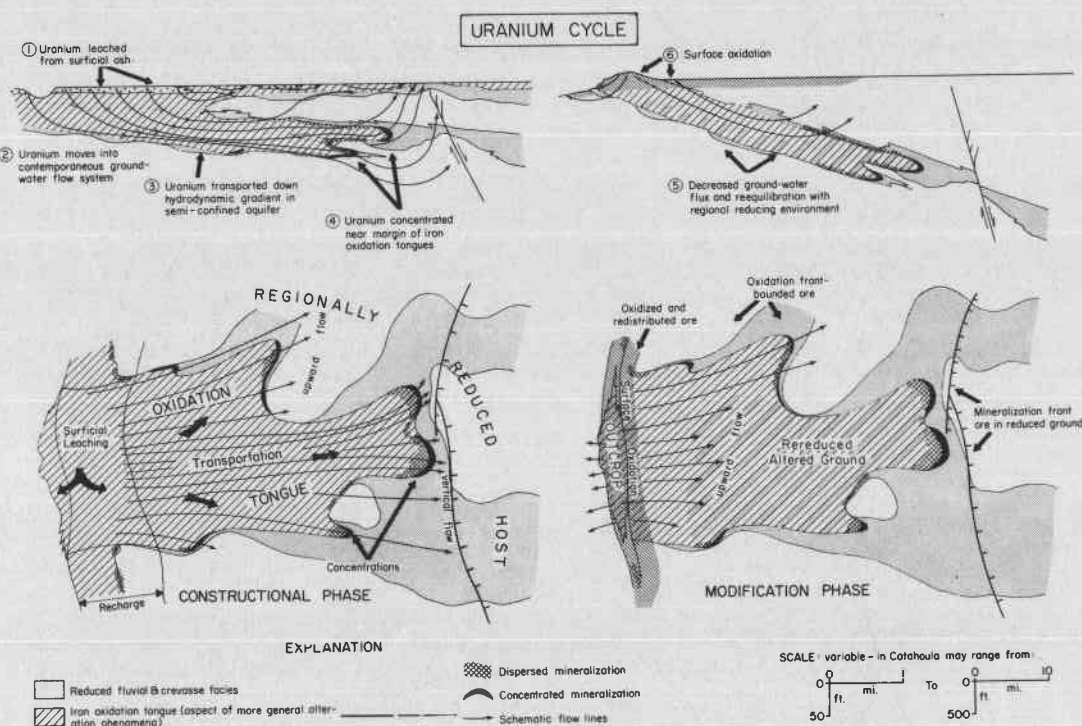
URANIUM POTENTIAL OF THE CATAHOULA FORMATION—PHASE II

William E. Galloway and William R. Kaiser, assisted by R. Stephen Fisher, Constance S. Childs, and Stanley M. Sutton.

Continuing investigation of the uranium-bearing Catahoula Formation (see Report of Investigations No. 87) will emphasize reconstruction of the hydrologic and geochemical history of this major uranium-host formation. The structural and stratigraphic framework delineated in Phase I will be combined with detailed mineralogic and geochemical studies and reconstructions of modern ground-water

flow patterns and hydrochemical trends to identify the factors and processes controlling the solution, migration, and concentration of uranium.

Characterizing the geochemical environment most favorable to uranium concentration in the Catahoula will require detailed mineralogic study of uranium ores, barren ground, and altered ground. Stability diagrams for identified mineral phases will be constructed and evaluated with respect to a suite of hydrochemical parameters known to exist in Catahoula waters. The project is funded by the U.S. Department of Energy.



Diagrammatic representation of the two principal phases of the uranium cycle interpreted for Catahoula Formation fluvial systems

URANIUM POTENTIAL AND GENETIC STRATIGRAPHY OF THE TRIASSIC DOCKUM GROUP OF THE TEXAS PANHANDLE

J.H. McGowen, assisted by George E. Granata and Steven J. Seni.

This study of fundamental facies distribution and mineralization within the Dockum Group began in December 1974 as a joint project funded in part (for 2 years) by the U.S. Geological Survey, Uranium/Thorium Branch. The project involves investigations of the surface and subsurface continental Triassic facies in Texas.

The project is concerned chiefly with the development of a stratigraphic framework model and a depositional model, as well as with the accurate delineation of uranium mineralization and the determination of probable controlling or localizing factors. Both surface and subsurface trends are being considered. The entire sequence of terrigenous clastic facies in the Texas Panhandle will be evaluated.

At the end of the first year of the project, field reconnaissance was completed within an area extending from Santa Rosa, New Mexico, to Scurry and Borden Counties, Texas; detailed field work was conducted in Crosby, Dickens, Garza, and Kent Counties, Texas; subsurface reconnaissance was completed over most of the Triassic sedimentary basin; and detailed subsurface work was completed downdip from Garza and Crosby Counties. In 1976, during the second year of the investigation, outcrop work was conducted in Palo Duro Canyon, and detailed subsurface work throughout the basin was almost completed.

In 1977, field work was completed in Guadalupe County, New Mexico, and Palo Duro Canyon, Texas; collection of subsurface data was completed for Texas and New Mexico. Also during the year, a report covering the first half of the project was written. The report described the depositional framework of the lower half of the Dockum in the area south of the Amarillo uplift. A second report on the final half of the project is in preparation.

FORMATION OF URANIUM ORES BY DIAGENESIS OF VOLCANIC SEDIMENTS

Christopher D. Henry, Anthony W. Walton (University of Kansas), and Charles G. Groat (The University of Texas at El Paso), assisted by Grace Nell Tyner.

The basic objective of this study is to understand the process by which uranium ore bodies might form in areas of thick accumulation of volcanic tuffs and volcanoclastic sediments. During the summer of 1977, A.W. Walton and C.D. Henry mapped and analyzed the lithologic and diagenetic facies in a sedimentary basin surrounded by volcanic centers south and west of Marfa in Trans-Pecos Texas. They also identified source-vent areas and examined flow rocks and tuffs for relationship to basin sequences. Additional field work in Nevada and Utah allowed comparison with areas of similar volcanic and sedimentary sequences.

Work under way during the fourth quarter of 1977 included petrographic and X-ray analysis of alteration within the volcanic and sedimentary rocks, and correlation with chemical concentrations of uranium and other elements. Final outcome of the study will be a model of deposition, diagenesis, and uranium migration and concentration around volcanic centers which should be used in prospecting in volcanic terranes.

This project is funded by the U.S. Department of Energy.

REGIONAL ASSESSMENT AND SITE SELECTION OF THE GEOPRESSURED GEOTHERMAL RESOURCE, TEXAS GULF COAST

Don G. Bebout, Robert G. Loucks, and A.R. Gregory, assisted by Victor J. Gavenda, Jong H. Han, Jeffrey D. Potter, Jung H. Seo, Stephen C. Claypool, Kitty L. Milliken, and Mark E. Rusk.

A geothermal reservoir should have a sandstone volume of at least 3 cubic miles, fluid temperature of 300°F or greater, and at least 20 millidarcys permeability. Regional studies of the Frio Formation resulted in the identification of several fairways—Hidalgo, Kenedy, Nueces, Matagorda, and Brazoria—that meet some of these specifications. More detailed studies completed in 1977, however, disclosed serious

limitations of all of these fairways with the exception of Brazoria Fairway. Within that fairway, the Austin Bayou Prospect has been identified. A final report (Report of Investigations No. 91) that described the geologic and engineering conditions expected at a test-well site in the Austin Bayou Prospect was completed in 1977. Drilling of a test well was scheduled to begin in early 1978 with funds from the U.S. Department of Energy; General Crude Oil Company is the operator of the drilling program.

Regional resource assessment of the Wilcox and Vicksburg Formations is also now complete; several additional fairways have been identified along these trends. Regional distribution of sandstone reservoirs in the geopressed Wilcox and



Volcanic ash, a potential source for uranium mineralization, exposed in wall of inactive uranium mine, Karnes County

Vicksburg units will be described in a report planned for publication in early 1978. Additional funding is anticipated to continue study of these fairway areas in order to delineate several geopressed geothermal prospects in the Wilcox and Vicksburg trends.

TEXAS' FIRST GEOTHERMAL WELL SITE SELECTED

More than 3 years of research into the feasibility of producing geothermal energy from the geopressed zone along the Texas Gulf Coast was conducted by a team of Bureau scientists. The study resulted in the selection of a test-well site in Brazoria County. Located along Chocolate Bayou, the test well, named the ERDA and General Crude No. 1 Martin's Ranch, was scheduled to be drilled by General Crude Oil Company starting in early 1978. The University of Texas at Austin was granted funds from the U.S. Department of Energy to coordinate drilling and completion of the test well and to proceed with subsequent research on data obtained during drilling. This program is co-directed by Don G. Bebout (Bureau of Economic Geology) and Myron L. Dorfman (Department of Petroleum Engineering; Center for Energy Studies).

The prospective reservoir is in the lower Frio Formation (*Anomalina bilateralis* zone) between 13,500 and 16,500 feet deep. The test well is expected to penetrate more than 800 feet of sandstone with fluid temperatures in excess of 300°F. At least 250 feet of this sandstone should have permeabilities greater than 20 millidarcys. Assuming a drainage area of 4 square miles, the reservoirs penetrated by the test well should contain at least 10 billion barrels of water. If the water contains 40 cubic feet of methane per barrel, then the total natural gas resource should be 426 billion cubic feet in place. A complete description of the conditions expected in the test-well area is included in the Bureau of Economic Geology Report of Investigations No. 91, "Frio Sandstone Reservoirs in the Deep Subsurface Along the Texas Gulf Coast."

ANALYSIS OF THE CONSOLIDATION OF TERTIARY SANDSTONES, TEXAS GULF COAST

Robert G. Loucks, Don G. Bebout, and William E. Galloway, assisted by Marianne G. Moseley and Turner F. Williamson.

This project involves a detailed study of the sandstone consolidation history of the Texas Gulf Coast Tertiary section with emphasis on the formation, preservation, and vertical and lateral distribution of porosity and permeability. The study concentrates mainly on the Tertiary section that contains the Frio, Vicksburg, and Wilcox geothermal corridors.

During the initial stage of the project, approximately 300 well cores from the Gulf Coast area were collected. Samples were cut from the cores, and thin sections of the samples were prepared. The point counter method was then employed to determine the mineral composition, diagenetic features, and porosity types which are present in the sandstones. These data are being used to help determine the location of deep reservoirs of the quality needed for geothermal fluid production. Such reservoirs must extend over an area large enough to make sustained production possible, and they must occur at depths great enough to contain the necessary pressures and temperatures.

The results of this study will be used in conjunction with the Bureau of Economic Geology regional assessment studies to indicate the most favorable areas in which to search for geopressed geothermal prospects. This one-year project, which began in September 1977, is funded by the U.S. Department of Energy.

REGIONAL LIGNITE EVALUATION OF NATIONAL FOREST LAND IN TEXAS

L.E. Garner, assisted by David A. Pass.

Study of the regional distribution of lignite reserves and other minerals on National Forest lands in Texas began in October 1977. Funded by the Forest Service of the U.S. Department of Agriculture, the project involves the investigation of surface and subsurface occurrence of

lignite and other minerals in Sabine, Angeline, Davy Crockett, and Sam Houston National Forests.

Limited evaluation of lignite reserves will include (1) reserve estimates, (2) economic trends in lignite production, (3) environmental factors related to production, and (4) recommendations for further studies. This project is scheduled for completion in fall 1978.

IN SITU GASIFICATION OF TEXAS LIGNITE

William R. Kaiser, assisted by John E. Johnston, III.

This is a joint study, with Thomas F. Edgar (Department of Chemical Engineering) and Thomas W. Thompson (Department of Petroleum Engineering), funded in part by the National Science Foundation, Research Applied to National Needs Program (NSF-RANN). The project, initiated in November 1974, is a study of the deep-basin lignite in the Texas Gulf Coastal Plain north of the Colorado River. Emphasis is on lignite occurrence, physical stratigraphy, sand body geometry, and depositional environments. The NSF funding of Bureau of Economic Geology participation ended August 31, 1977.

Exploration models have been developed for three Eocene stratigraphic units—the Wilcox Group, Yegua Formation, and Jackson Group. The Wilcox and Jackson have the highest potential for in situ gasification. From hydrologic and environmental standpoints, the Jackson is superior to the Wilcox.

A report presenting the geology and lignite occurrence in the Wilcox and Jackson will be published in 1978. In preparation is a report on the geologic and hydrologic factors of in situ gasification for Texas lignite.

PLAN FOR THE MULTIPLE LAND USE OF CAMP SWIFT, BASTROP COUNTY, TEXAS E.G. Wermund.

The Camp Swift area of Bastrop County is regularly used by the Texas National Guard for

the training of military personnel. It is underlain by a valuable energy resource—low-rank coal (lignite) which can be mined from the surface. The purpose of this study was to evaluate the possibility of both exploiting the lignite resource and using the Camp Swift area for military training. The project was initiated and completed under a contract with the Governor's Office of Budget and Planning.

The study inventoried the land uses, land resources, biologic assemblages, air quality, surface and ground water, energy, and historical-archaeological data in the vicinity of Camp Swift. Potential developments in the area were studied and evaluated in light of the inventory. The investigation determined that simultaneous military training and surface mining of lignite are compatible, and a plan of multiple use was recommended.

TEXAS PUBLIC LANDS—ESTIMATE OF FUTURE OIL AND GAS PRODUCTION FROM ESTABLISHED FIELDS OF TEXAS GULF COAST, BAYS, ESTUARIES, AND OFFSHORE

Willard R. Stearns.

The first phase of this project, involving an investigation of oil and gas reserves of State-owned lands in the Gulf coast and offshore areas, is continuing. Production history and reservoir data—such as porosity, permeability, sand thickness, and pressure-volume-temperature relationships—of approximately 800 reservoirs are being compiled. The ultimate aim of this project is to survey and evaluate the mineral resources of all lands owned by the State of Texas.

Headframe at now-inactive Hazel copper mine (left); cement manufacturing plant in Central Texas (middle); limestone quarry along Balcones Fault Zone between San Antonio and Austin (right)

MINERAL RESOURCES INVESTIGATIONS

MINERAL AND ENERGY RESOURCES OF TEXAS ATLAS

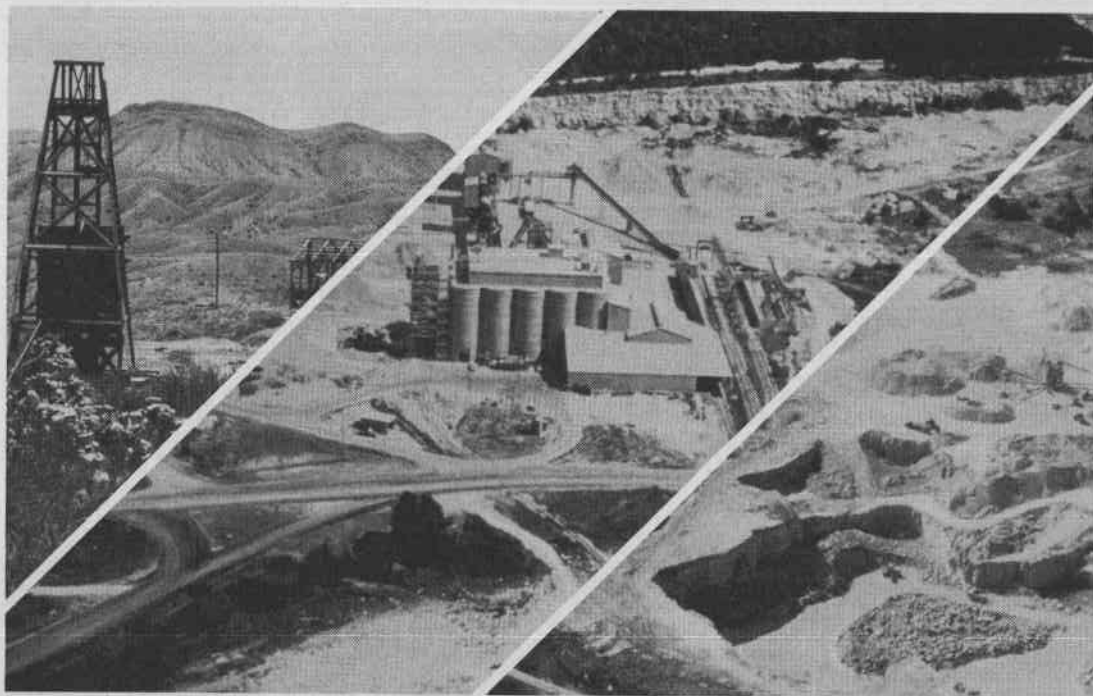
Thomas J. Evans, L.E. Garner, Ann E. St. Clair, assisted by Patricia K. Bettis and Paul Anaejionu.

This atlas project is now entering a new phase with the completion of cartographic preparation of the "Mineral Resources of Texas" map and the initiation of mineral commodity data sheets. 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. Distribution of major rock

types utilized in the mineral industry is also shown, including limestone, dolomite, ceramic clay, non-ceramic clay, iron, sand and gravel, trap rock, granite, industrial sand, extrusive igneous rocks, talc, salt, and sulfur. At yearend, the map was ready for printing.

Mineral commodity data sheets were initiated in late 1977. These sheets summarize the nature and importance of more than 60 minerals and commodities in the State. Sheets will include information on occurrences, production, uses, geologic setting, and critical references. Cross-indexing of data sheets will permit easy reference to related commodities. Data sheets are designed for individual distribution, as related packages, or as a complete set. The first mineral commodity data sheets are now scheduled for publication in 1978.





MINERAL LANDS IN THE CITY OF DALLAS

Ann E. St. Clair.

The City of Dallas, recognizing the need to use its mineral resources and mined lands properly, requested the Bureau of Economic Geology to make a 12-month study of mined lands and mineral resources within that city. The project, which began in August 1976, involved identification of all active and inactive mineral production localities and areas of potential mineral production. Resources in Dallas are principally sand and gravel, limestone, and clay. A map of mineral resources and mined lands was prepared, and the reclamation of the mined lands was analyzed. A report on the

results of the study will be published by the Bureau in early 1978.

SAND AND GRAVEL RESOURCES OF TEXAS

Thomas C. Gustavson, assisted by John P. Ferguson.

Potential and existing sand and gravel resources and active and inactive mining operations are shown on the "Sand and Gravel Resources of Texas" map. This map, at a scale of 1:1,000,000, consists of four sheets, all in full color. The map was completed in early 1977, and the text was in editorial review at yearend. Publication of both map and text is expected in early 1978.

*Inactive sand and gravel operation along
the Trinity River in Dallas County*

MINERAL PRODUCTION IN TEXAS

Thomas J. Evans, in cooperation with staff of the U.S. Bureau of Mines.

Mineral production data and other mineral industry information are compiled annually as part of a continuing cooperative program between the Bureau of Economic Geology and the U.S. Bureau of Mines.

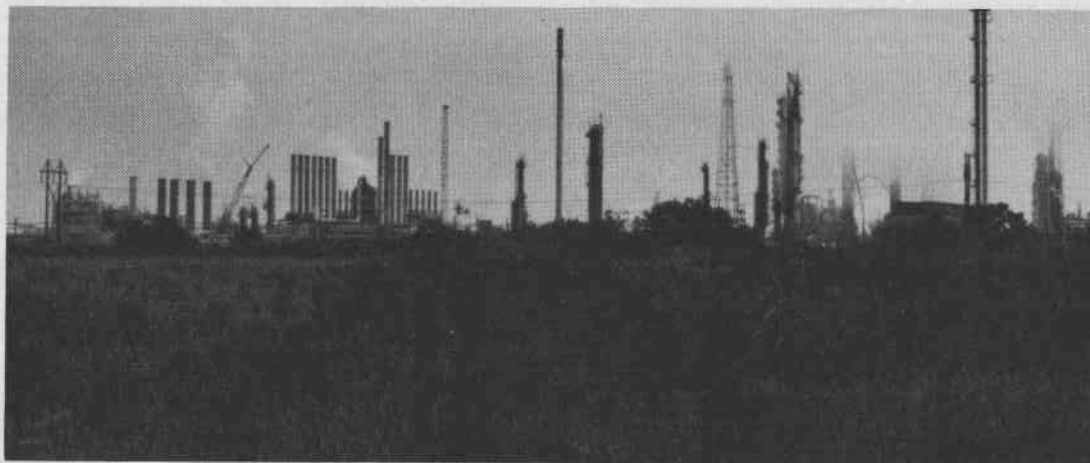
During 1977, a report on 1976 production of industrial minerals in Texas was prepared for publication in the Texas chapter of the U.S. Bureau of Mines "Minerals Yearbook 1976." A preprint of the chapter will be issued as a Mineral Resource Circular, "The Mineral Industry of Texas in 1976," by the Bureau of Economic Geology.

LAND RESOURCES INVESTIGATIONS

Land resources investigations at the Bureau of Economic Geology are coordinated by the Land Resources Laboratory. Created in 1974, the Land Resources Laboratory assures a continuing program of land resources and environmental research at The University of Texas at Austin.

Since its inception the Laboratory has had responsibility for a significant portion of the Bureau's research program. Major research efforts have been made in (1) land resource inventories, (2) current land use inventories, (3) urban environmental geologic mapping, (4) inventories of land prone to natural hazards, (5) inventories of unique mineral lands, and (6) geologic criteria affecting coastal zone management.

A more detailed explanation of programs of the Land Resources Laboratory underway during 1977 is presented in the following pages.



Environmental considerations of geopressured geothermal energy production in Brazoria County prospect area include, among others, potential for subsidence and fault activation affecting nearby industrial complexes (above) and recreational/community development (far right) and possible effects of produced brines on biologic assemblages and associated estuaries (near right)



LAND RESOURCES OF TEXAS: MAPPING AND CLASSIFICATION

Robert S. Kier, L.E. Garner, and L.F. Brown, Jr., assisted by Janet E. Nilsson.

This project, initiated in April 1972 with partial support from the Texas Water Development Board and the Division of Planning Coordination, Office of the Governor, and completed in 1977, provides a statewide classification of Texas lands. A wall map (scale 1:500,000) shows the distribution of the various land types. This statewide analysis supplements detailed environmental mapping programs of the Bureau of Economic Geology and provides a regional technical base for land and natural resource conservation and development.

Cartographic preparation and printing of the map and text were partly financed in 1976 and 1977 by an integrated grant from the U.S. Department of Housing and Urban Development through the Governor's Office of Budget and Planning, with matching funds from the General Land Office of Texas, Texas Coastal and Marine Council, Texas Department of Health Resources, Texas Forest Service, and Texas Water Quality Board.

ENVIRONMENTAL CONCERNS ARISING FROM THE PRODUCTION OF GEOPRESSURED GEOTHERMAL ENERGY ON THE GULF COAST

Thomas C. Gustavson, project director; Maryann M. McGraw, R. Mills Tandy; Faust Parker, Donald E. Wohlschlag (The University of Texas Marine Science Institute).

This study is an interdisciplinary approach to identify and evaluate the ecological implications resulting from development of the geothermal resource along the Texas and Louisiana Gulf Coast. The Bureau has assessed terrestrial impacts, providing an overview of facilities and ancillary systems associated with geothermal energy production. The Marine Science Institute has assessed potential intrusions into marine and coastal bay environments.

Initiated in fall 1976, this project was completed in fall 1977 with the submission of a final report that included over 600 annotated references pertinent to evaluation of potential environmental impacts related to production of the geothermal resource. This project was supported by the Fish and Wildlife Service, U.S. Department of Interior.

GEOPRESSURED GEOTHERMAL ENERGY DEVELOPMENT—PROGRAM PLAN FOR ENVIRONMENTAL BASELINE STUDIES

Thomas C. Gustavson and Charles W. Kreidler.

This project, initiated in September 1977 under contract to Lawrence Livermore Laboratory of the University of California, is intended to define research programs which will address environmental problems posed by geopressured geothermal energy development. Major tasks of this project include (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 from this project is expected by late 1978.

ENVIRONMENTAL ANALYSIS OF GEOPRESSURED GEOTHERMAL PROSPECT AREAS, TEXAS GULF COAST William A. White, Maryann M. McGraw, Thomas C. Gustavson (principal investigator).

Information was collected and analyzed for this project as part of a preliminary environmental analysis of potential geopressured geothermal resource areas in Brazoria and Kenedy Counties, Texas. Approximately 150 km² (60 mi²) were analyzed within each of the Brazoria and Kenedy 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 in the Austin Bayou Prospect area near Chocolate Bayou, Brazoria County, Texas. A geopressured geothermal test well was scheduled to be drilled at this site in early 1978. 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, susceptibility of test well and support facilities to fresh- and salt-water flooding, 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 was submitted in late 1977.

ENVIRONMENTAL MONITORING—GEOPRESSURED GEOTHERMAL TEST WELL, BRAZORIA COUNTY

Thomas C. Gustavson, assisted by Maryann M. McGraw.

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. Primary environmental concerns center on local effects on air and water quality due to accidental release of geothermal fluids, and the possible initiation of land-surface subsidence as a result of withdrawal of large volumes of geothermal fluids.

Baseline environmental studies include air and water quality, microseismicity survey, and first-order ground leveling survey. These studies

are scheduled for completion prior to test-well drilling. Similar analyses will be completed during the drilling, producing, and well-testing phases to determine potential impacts, if any, of the test well on the Brazoria County environment.



Open pit mining for uranium, Karnes County

TRACE AND POTENTIALLY TOXIC ELEMENTS ASSOCIATED WITH URANIUM DEPOSITS IN SOUTH TEXAS

Christopher D. Henry, assisted by Janet E. Nilsson.

Several environmentally sensitive trace elements (molybdenum, arsenic, and selenium) are known to be associated with South Texas uranium deposits. This project, supported by the U.S. Environmental Protection Agency, will ascertain whether or not significantly high concentrations of these elements actually do exist. It will also determine the natural range of concentrations of these elements in various soils and geologic units in the uranium mining area. The source of any high concentrations will be determined, whether natural because of location within a mined area or man-made as a result of mining operations.

Work during the summer of 1977 consisted of compilation of existing geologic and soils

mapping, collection of approximately 200 samples from the major geologic and soil units in the mining area, and preparation of laboratory analytical procedures. The project, which began in 1977, is scheduled for completion in 1978.

PREDICTING RESPONSE OF A NATURAL SYSTEM TO URANIUM EXTRACTION:

OAKVILLE AQUIFER SYSTEM, TEXAS

William E. Galloway and Charles W. Kreitler, assisted by Paul E. Devine and Margaret A. Townsend.

Delineation of the major depositional systems that comprise the Oakville aquifer (a major uranium host-rock of the Texas Coastal Plain) will be combined with mineralogical, geochemical, and hydrologic data. The purpose of this study is to provide a geologic background for efficient mine-site monitoring, anticipation of possible problems arising from surface or in situ mining, and evaluation of the potential for natural buffering of mine effluents.

This 2-year project is funded by the U.S. Environmental Protection Agency. Techniques and concepts developed in the course of this investigation will be applicable to other uranium-bearing units in the Coastal Plain.

ENVIRONMENTAL GEOLOGIC ATLAS OF THE TEXAS COASTAL ZONE

L.F. Brown, Jr., project director; Thomas J. Evans, J.H. McGowen, and W.L. Fisher.

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 8 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 (10.2 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 on 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 Robert C. Cobb, Scott A. Holden, Kathy A. McGillis, Maryann M. McGraw, Lloyd B. McKinney, and Janet E. Nilsson. 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. It was initiated in June 1972 under contract with the Texas Water Development Board.

The first phase of the project concerned an area that includes the southern Edwards Plateau and Cretaceous coastal plain. The region is of prime environmental significance because it includes the recharge and productive areas for the subsurface Edwards Limestone aquifer, which supplies water to nearly one million people in metropolitan San Antonio, San Marcos, New Braunfels, Hondo, and Uvalde. The aquifer also supplies irrigation water for about 2,000 square miles of croplands.

In the second phase, maps showing environmental geology, biologic assemblages, slope, and mineral and energy resources (except sand and gravel resources) were completed for the area of Cretaceous substrate. The map data were compiled on topographic sheets (scale 1:24,000) and controlled aerial photographic prints of the same scale, augmented by stereoscopic pairs of black-and-white photographs (scale 1:40,000). Interpretations were checked both on the ground and by means of low-level flights.

In 1974, environmental geologic mapping included areas having Tertiary and Pleistocene substrates. Those areas include several major and numerous minor sand aquifers. Therefore, many recharge (or infiltration) zones are critical elements in the environmental mapping. The most important sandstone aquifer is the Carrizo-Wilcox aquifer, which extends over 10,000 square miles (including both the infiltration and productive zones). The aquifer yields potable water to eight or more prominent communities in South Texas. In recent years, there also has been an increasing demand for irrigation water from the Carrizo-Wilcox aquifer.



Flooding along the Nueces River, low-water crossing on Highway 55, near Laguna in Uvalde County

In 1975, mapping and initial cartography were completed for the southernmost region of Tertiary and Pleistocene substrates. The environmental geologic and slope maps are portrayed at a scale of 1:125,000. The derivative maps of active processes and physical materials, and also the maps of biologic assemblages, economic resources, and land use are shown at a scale of 1:250,000. The base (showing culture and drainage) used for these maps was prepared from U.S. Army Map Service maps.

In 1976, final hand coloring was completed for maps of the environmental geology, physical materials, active processes, slopes, and economic geology. Available maps are hand colored on stable plastic sheets. Each map category consists of 16 sheets. Individual sheets are bounded by 1° of longitude and 1° of latitude unless such a quadrangle would contain only a small portion of a river basin. Sheets showing smaller areas are used to depict these

portions. On the southeast margin of the region areas included in another of the Bureau's mapping projects, the Environmental Geologic Atlas of the Texas Coastal Zone, were not remapped.

In 1977, final mapping of biologic assemblages and land use was completed, and hand-colored maps were prepared. The land use map was compiled from the interpretation of 1974-1975 color infrared photography, scale 1:120,000. It shows 20 land use units, which are modified after the classification of Anderson and others, 1972 (U.S. Geological Survey Circular 671).

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 order to expedite eventual color separation and publication of all mapping, an up-to-date base map has been scribed by means of transferring base data from topographic maps (scale 1:24,000). Published reports and maps resulting from this regional project will deal with separate portions of the region, each including all or part of a drainage basin. Writing of the reports has been initiated.

LAND RESOURCES AND ENVIRONMENTAL IMPACT, EAST TEXAS LIGNITE BELT

Christopher D. Henry and Joyce M. Basciano, assisted by Janet E. Nilsson and Sara L. Ulerick.

This continuing project is concerned with providing a geologic mining inventory of the extensive lignite belt in East Texas and evaluating environmental and economic aspects of exploitation of these lignite deposits. Objectives of the project are (1) preparation of a suite of environmental geologic maps for the lignite belt, (2) location of historical, operating, and planned lignite strip mines, and (3) measurements of the physical and chemical properties of overburden and evaluation of its reclamation potential. Funding for this project is provided by the Geological Survey, U.S. Department of Interior.

During 1975 and 1976, environmental geologic maps (scale 1:24,000) were compiled from air-photo interpretation for an area extending from the Colorado River to the eastern edge of Franklin County and containing outcrops of the Wilcox Group and the Carrizo Sand. Mappable units were derived from studies of the substrate, soil, geologic processes, geomorphology, and biologic assemblages. Interpretations were checked in the field and compared with existing data such as geologic, soil, and flood-prone area maps. Supplemental work included (1) descriptions of the biologic assemblages in the southern half of the study region, (2) analysis of water quality of streams in mining areas, and (3) descriptions of algae occurring in streams which drain the actively



"Orphaned" lands resulting from lignite mining, now inactive, and simultaneous reclamation of lands disturbed by lignite extraction.



mined areas. To date, four reports have been published.

During 1977, environmental geologic maps (scale 1:24,000) were compiled for an area containing the same stratigraphic intervals and extending from the eastern edge of Franklin

County to the Texas-Arkansas border. Mapping procedures established earlier during the project were used. Editing and initial scribing of the maps were begun in late 1977. Supplemental work included the continuation of sample collection and chemical analysis—begun in 1974—of representative waters from streams adjacent to mined areas.

Project plans for 1978 are (1) to complete a regional base map and the scribing and color separation of the environmental geologic maps for the entire study area, (2) to complete the measurement and evaluation of representative streams adjacent to mined areas, and (3) to complete a text for the environmental geologic maps and the chemical analysis of stream water.

LANDSAT INVESTIGATION FOR THE TEXAS COASTAL ZONE

Robert J. Finley, assisted by Robert W. Baumgardner.

Extended funding for 2 months was provided for this project by NASA, through the Texas General Land Office, following completion of the initial project in 1976. This funding was used to prepare supplementary reports on Landsat image interpretation and an evaluation of environmental geologic mapping of the Texas Coastal Zone.

One of the reports, "A Guide to Visual Interpretation of Texas Coastal Features from Landsat Imagery," details the characteristics of 23 land cover/land use categories as seen on Landsat false-color composite transparencies. Examples of each category are given from test sites mapped during the project, along with a brief glossary of terms and an annotated bibliography of remote sensing literature dealing with coastal regions. Another report, "Evaluating the Environmental Geology Sheet, Environmental Geologic Atlas of the Texas Coastal Zone," provides information on map evaluation using 1975 NASA high-altitude photography. Over 1,000 alterations of the coastal environment were detected, but these represent only 0.9 percent of the 30,600-km² area checked. Most changes resulted from man's activities.

LAND AND WATER RESOURCES OF THE CORPUS CHRISTI AREA

Robert S. Kier and William A. White.

This project was initiated in 1972 as part of the Bureau's work with a university-based multidisciplinary research effort, "Criteria for Coastal Zone Management," funded by National Science Foundation—RANN and the Governor's Office of Budget and Planning. The project was completed, and three reports were prepared for publication as part of the Bureau's Land Resources Laboratory series and Research Note series.

Thirty-nine natural land and water resource units were delineated in the Corpus Christi area, which encompasses Nueces, San Patricio, Aransas, and Refugio Counties. The units are depicted on a full-color map at a scale of 1:125,000. Also indicated on the map are topography, culture, urban areas, and lineations (noted on aerial photographs) which may represent fracture zones or potentially active faults. Text and tabular descriptions accompanying the map present geological and biological origins, distribution, and relationship of the units to adjacent land and water areas. Natural suitability for use and potential hazards (to people and to the environment) associated with the use of the land and water areas are detailed.

Two aspects of natural environmental carrying capacity are emphasized: (1) quantification of physical properties of land resource units, and (2) the hydrogeologic character of the units. Soils test data obtained from various public agencies and private firms provided a means to determine representative values for important physical parameters such as those used to assess foundation strength and permeability. Water-well data collected by the U.S. Geological Survey and Texas Water Development Board formed the basis for determining the distribution and quality of ground water in the Corpus Christi area (data derived in part from Master of Science thesis work by Dennis L. Bell and James T. Woodman). The map has been printed, and the texts were in the final stages of editing at the end of 1977.

COASTAL STUDIES

GEOLOGY OF STATE-OWNED SUBMERGED LANDS

J.H. McGowen and Robert A. Morton, project coordinators; Richard L. Andersen, L. Chester Safe, Thomas R. Calnan, Mary K. Pieper, William A. White, John L. Chin, Jon P. Herber, John A. Kieschnick, C. Russell Lewis, and Dale E. Solomon.

This comprehensive 2-year geological investigation, funded through May 1977, 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 10.2 miles (3 leagues), and the bays, estuaries, and lagoons of the Coastal Zone from the Rio Grande to Sabine Lake. Research was conducted in cooperation with the Marine Geology Branch of the U.S. Geological Survey and was funded through the Coastal Management Program of the General Land Office of the State of Texas.

During 1977, sampling of surficial sediment on the inner continental shelf was completed, bringing the total number of shelf samples to nearly 4,000. Of these samples, 2,300 were processed for determination of total organic carbon, and 750 were analyzed for selected trace elements. Sediment analysis of samples resulted in the preparation of preliminary maps of surface sediment distribution. Biologic analysis continues and is currently keyed, with physical parameters, to determining the degree of mixing between relict and Modern shelf sediments. Approximately 3,500 nautical miles of high-resolution seismic data were obtained. Preliminary maps of faulting and diapiric structures were prepared.

Over 3,200 samples were collected from Texas bays, estuaries, and lagoons. Determination of total organic carbon content of nearly 800 samples and trace element analysis of about 360 samples have been completed. Preliminary maps of the bottom sediment and the areal distribution of other geologic and chemical parameters are being completed. Nearly 300 biologic samples have been processed to date; distinct, preliminary biologic

assemblages have been identified, and faunal lists have been prepared. Approximately 600 nautical miles of seismic data were collected.

In August 1977, a preliminary report was prepared for the General Land Office of the State of Texas. Maps of surface sediment distribution and the areal distribution of various geologic, biologic, and chemical parameters for parts of the Texas shelf and bay systems were included in the report.



Nearshore changes at Mansfield Channel: shoreline accretion to the south (right) and erosion to the north (left). Longshore drift is from south to north.

NEARSHORE CHANGES AT JETTIED INLETS, TEXAS COAST Robert A. Morton.

This project, initiated in 1975, was designed to use and augment the data gathered for the recently completed historical monitoring project in order to understand the shoreline and shore-face response to jetty construction at former natural tidal inlets, at artificial channels, and at the former mouth of the Brazos River.

Distinct patterns of deposition and erosion developed after jetty construction at each of the navigation channels. The study confirms that shorelines accrete updrift and erode down-drift from jetties constructed across straight shorelines with shore-parallel depth contours, but paired jetties which permanently disrupt



Shallow subsurface sampling along Laguna Madre tidal flats, State-owned submerged lands project.

sediment bypassing at ebb-tidal deltas and river-mouth bars may cause updrift and down-drift shoreline accretion related to adjustment of offshore profiles and landward transport of sediment.

Results of the study were published in the Proceedings of the Coastal Sediments '77 Symposium sponsored by the American Society of Civil Engineers.

INVESTIGATION OF WIND-DRIVEN CURRENTS AND COASTAL STORM DEPOSITS

Robert A. Morton.

Observation of unusual physiographic features on post-storm aerial photographs of Texas barriers has led to a study of wind stress and



Wind stress features on Padre Island following hurricane-driven shallow-water surge across the barrier island.

the generation of unidirectional flow in shallow water by hurricane-velocity winds. The wind stress features include: (1) counterclockwise curvature of washover channels, (2) flame-shaped fans emerging from deeply incised channels, (3) closely spaced, slightly curved striations, (4) transverse bars along bay shorelines, and in some instances, (5) rhomboid bed forms. Ongoing research related to this study includes interpreting the bed forms and sedimentary structures preserved from the wind stress features and estimating current velocities using various techniques.

COASTAL NATURAL HAZARDS SUMMARY MAP, GALVESTON, BRAZORIA, AND SOUTHERN HARRIS COUNTIES

Robert J. Finley.

The Texas Coastal and Marine Council contracted the Bureau of Economic Geology in late 1977 to prepare a map depicting natural hazards along a portion of the Texas coast. The map will show historical data on hurricane effects, flooding, shoreline erosion, land subsidence, and surface faulting. Included with the map will be a brief text describing these natural processes and their potential impact on coastal environments.

Data are derived from "Natural Hazards of the Texas Coastal Zone," a special atlas published by the Bureau in 1974. The Bureau will supply final composite negatives to the Texas Coastal and Marine Council in early 1978. The final full-color map will be available from the Texas Coastal and Marine Council.

GEOLOGY OF PADRE ISLAND NATIONAL SEASHORE

Bonnie R. Weise and William A. White.

Initiated in September 1975 under the direction of L.F. Brown, Jr., this project of mapping from recent color-infrared aerial photographs will serve to update the Padre Island National Seashore portion of the Bureau's Environmental Geologic Atlas of the Texas Coastal Zone. One final product will be a



Portion of Padre Island National Seashore including, inland from surf zone, beach and coppice dunes (a), washover channel and vegetated barrier flat (b), and active dunes and wind-tidal flats (c).

full-color environmental geologic map to accompany a nontechnical guidebook containing descriptions of the origin, present morphology, environments, and active processes of Padre Island, plus historical information provided by Keene Ferguson, a former Bureau staff member. To be produced in cooperation with the National Park Service, the guidebook will stress the dynamic character of the island and the importance of maintaining balances among the sensitive natural environments.

During 1977, the environmental geologic map was completed, and the guidebook text was in preparation at yearend. The guidebook is expected to be completed by the summer of 1978.

HYDROGEOLOGY INVESTIGATIONS

HYDROGEOLOGY OF THE EDWARDS AQUIFER IN TRAVIS COUNTY

Ann E. St. Clair.

The Edwards underground aquifer, as legally defined, extends from Val Verde County to northern Hays County. The Edwards does, however, continue northeastward through Travis, Williamson, and Bell Counties, although few studies of the aquifer include this area. This study is part of an evaluation of the Edwards aquifer northeast of the prolific Edwards underground aquifer which provides water for the City of San Antonio and many other communities in South and southwest Texas.

The project includes a general evaluation of the hydrogeology of the Edwards Formation in Travis County, particularly in the Balcones fault zone. An investigation to determine the potentiometric surface, ground-water flow directions, recharge-discharge relationships, and

water chemistry of the Edwards is in progress. The effects of septic tank development on water quality of the aquifer are being examined in an area southwest of the City of Austin.

Though it is not extensively used in Travis County at this time, the Edwards aquifer represents a significant potential water resource for the area. Information gained in this study will be useful for assessing the impact of urban and suburban development on this potential resource. The study is expected to be completed in late 1978.

GULF COAST HYDROLOGY

Charles W. Kreitler, assisted by Bryan L. McCulley.

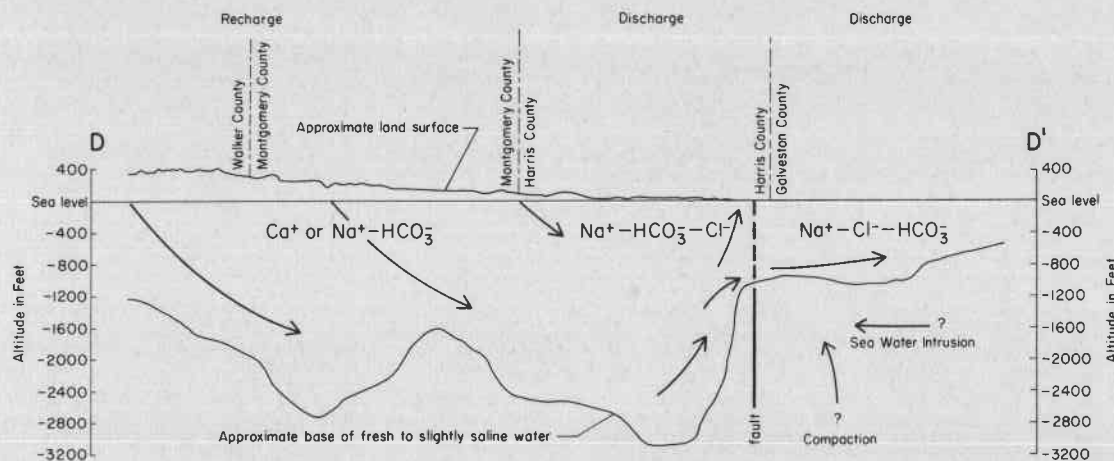
The aim of this study is to determine the interrelationships of ground-water flow and ground-water chemistry to facies distribution and faults in the Pleistocene and Pliocene

sediments. The project is a continuation of earlier work on subsidence and faulting in Harris and Galveston Counties. Although the initial area of this study has been Harris and Galveston Counties, plans call for studies of additional sections of the Texas Coastal Zone. A primary benefit of this program will be to permit a better evaluation of available ground-water resources in the Texas Coastal Zone.

NITROGEN ISOTOPES OF NITROGEN IN NATURAL WATERS, CENTRAL TEXAS

Charles W. Kreitler and Lynton S. Land (Department of Geological Sciences).

This project, which began in November 1974, has evaluated the nitrogen isotopes of nitrates in several different aquifers in Texas in an attempt to determine sources of nitrate. Aquifers that have been studied are the Lockhart and Taylor gravels, the Seymour aquifer, and the Edwards aquifer. Studies of surface water, nitrate, organic nitrogen, and dissolved nitrogen gas from the Colorado River system have been completed. Several papers were in preparation at yearend. Funding was provided by the National Science Foundation.



Hydrochemical facies of Gulf Coast aquifer and depth of fresh water, Liberty, Hams, and Galveston Counties (after Wood, Gabrysch, and Marvin, 1963).

BASIN STUDIES

DEPOSITIONAL SYSTEMS OF THE UPPER CRETACEOUS SAN MIGUEL AND OLMOS FORMATIONS, SOUTHWEST TEXAS

Bonnie R. Weise.

Oil and gas have been produced in a number of fields in the Upper Cretaceous San Miguel and Olmos Formations in southwest Texas. In addition, coal has been produced from the Olmos near the Rio Grande in Maverick County. The primary goals of this project, initiated in June 1977, are to identify the characteristics, distribution, and relationships of the sedimentary facies of the San Miguel and Olmos on the basis of core and well log data, to delineate the depositional systems, and to construct a depositional model for these Upper Cretaceous sands.

During 1977, well logs and cores were studied, and regional cross sections and various sand maps were constructed. In 1978, facies control on diagenesis will be investigated, and final interpretations will be made. Project completion is scheduled for August 1978.

ELLENBURGER CARBONATE FACIES, DEPOSITIONAL ENVIRONMENTS, DIAGENESIS—WEST TEXAS

Robert G. Loucks, assisted by Patricia A. Mench.

The Ellenburger project, a long-term study of subsurface rocks, will deal with all of that portion of Texas lying west of the Llano uplift. In the initial phase of the study, now in progress, emphasis is on southwest Texas in the area of Pecos County. Since the start of the study in October 1976, approximately 2,700 feet of core have been analyzed for the determination of depositional facies, diagenetic history, and occurrence of porosity.

The Ellenburger rocks are composed of facies which were deposited in several major environmental settings—subtidal, intertidal, channeled belt, and supratidal. The basic facies sequence is an upward-shallowing cycle capped by a soil breccia. A depositional model similar to that of the Bahama Bank is postulated.

Some facies of the Ellenburger have been changed during several episodes of dolomitization. These episodes are also being studied, along with other aspects of Ellenburger diagenesis.

There appears to be some correlation between porosity and facies of the Ellenburger. The porosity is chiefly in the form of tectonic and karst fractures and karst vugs. It is generally low but is locally enhanced by intercrystalline, moldic, and interparticle openings.

The highest porosity and permeability in the Ellenburger are commonly present in those thin-bedded supratidal rocks which are most affected by karst development and tectonic fracturing. Because oil and gas reservoirs are characterized by good porosity and permeability, facies analysis helps locate the most favorable reservoirs in the Ellenburger.

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

L.F. Brown, Jr. and Raul F. Solis.

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 picture 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 still being compiled in late 1977; maps are expected to be completed in the coming year.

LOWER CRETACEOUS CARBONATE FACIES AND DEPOSITIONAL ENVIRONMENTS—SOUTH TEXAS

Don G. Bebout, assisted by Richard A. Schatzinger.

The objective of the Lower Cretaceous carbonate research program is to describe in detail cores from all of the formations, delineate facies distribution, identify diagenetic processes, and interpret depositional environments. Ultimately, regional patterns of porosity and permeability will be related to the depositional environments and facies distribution recognized in the Lower Cretaceous carbonates.

Regional dip and strike cross sections along the Texas Gulf Coast, which include Lower Cretaceous units, have been published in Report of Investigations No. 89.



R. Solis using detailed regional cross sections of Pennsylvanian-Permian rock units to define major depositional systems in north-central Texas.

SPECIAL RESEARCH PROGRAMS



East Texas salt domes reviewed for waste-isolation feasibility study.

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

L.F. Brown, Jr., E.G. Wermund, Thomas C. Gustavson, William E. Galloway, C.M. Woodruff, Jr., Robert J. Finley, Mark W. Presley, C. Robertson, Shirley P. Dutton, Mary A. Bauer, and James R. Morabito; assisted by William W. Bath, Stanley M. Sutton, John C. McBryde, Bahman Sepassi, George E. Granata, Robert I. Chapin, and Barbara B. Gagnier.

Locating safe repositories for isolation of nuclear waste is an important goal of the U.S. Department of Energy. Current technology indicates bedded salt basins are potential areas for safe, long-term isolation of nuclear waste. The Palo Duro and Dalhart Basins of the Texas Panhandle are two such basins that warrant detailed evaluation. The Bureau initiated studies in 1977 to provide a comprehensive evaluation of these two basins to determine whether or not field confirmation areas for isolation of nuclear waste do exist and, if so, the nature and location of these areas.

Five principal research tasks have been identified as critical to comprehensive evaluation of the Palo Duro and Dalhart Basins: basin analysis, remote sensing/surficial studies, geohydrology, host rock analysis, and site delineation and classification. These tasks are composed of nine sometimes-overlapping research elements: structure/seismicity, resource assessment, depositional systems, geochemistry/petrology/rock physics, basin hydrology/solution studies, ground water/hydrology, fracture systems, erosion/degradation, and land resources. In 1977, two research groups began the basin analysis and remote sensing/surficial studies.

The basin analysis task force is evaluating the physical stratigraphy and structure of the Palo Duro and Dalhart Basins. Objectives for this phase of the field confirmation areas project are (1) evaluation of suitability of the salt section for waste isolation, (2) evaluation of potential resources in the basins, including

oil, gas, uranium, sedimentary metals, evaporite salts, and ground water, and (3) determination of shallow and deep basin fluid circulation regimes possibly affecting waste isolation sites. As a part of this program, several deep continuous core holes will be sited (two sites have already been selected), and core material will be analyzed by this group.

The remote sensing and shallow stratigraphy task force has completed an initial manual and computerized search for reference material, locating over 500 references pertinent to their research tasks. Analysis of topographic and geologic maps suggested 23 potential areas which appear suitable for monitoring erosional processes. Seven monitoring stations have been selected, and detailed instrumental installations have been completed following initial field work consisting mainly of observing topography, soils, outcrops, stream processes, eolian processes, and surficial structures, and of recording several hundred fracture measurements. In addition to establishing the seven monitoring stations, work has begun on preparing an environmental geologic map, interpreting past geomorphological processes, mapping surficial fractures, and studying near-surface geohydrology.

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

Charles W. Kreidler, principal investigator, Edgar H. Guevara and Alice B. Giles, assisted by Russell C. Bunker and Vicki A. Verross.

Initiated in fall 1977, this project is designed to evaluate the suitability for potential nuclear waste isolation of interior salt domes within the East Texas basin. A comprehensive analysis of the East Texas interior salt dome basin is proposed in order to (1) review, verify, and select priority salt domes, (2) undertake intensive site-specific analyses (geophysical, stratigraphic, geometric, hydrologic) of selected domes, and (3) undertake and integrate regional evaluation with site-specific studies to ensure structural stability and hydrologic integrity for the prescribed nuclear-waste residence time. Results of



EXPLANATION

- Shallow salt domes (salt at depths less than 2000 feet)
- Intermediate salt domes (salt at depths of 2000-6000 feet)

this project, upon completion of all research phases, will provide the basis for final evaluation of Texas interior salt domes for nuclear waste isolation. This project is funded by the Office of Waste Isolation of the U.S. Department of Energy.

The research program consists of five principal research tasks: (1) hydrology/hydrologic integrity, (2) dome geometry and stratigraphic/tectonic framework, (3) tectonic stability, (4) review of previous priority selections, and (5) investigations and continual review of selected domes. Nine critical research elements will be addressed: regional aquifer variations; local hydrologic integrity of domes; geochemistry, petrography and rock physics; regional/local stratigraphy and tectonics; dome geometry; geophysics; remote sensing; areal geology and geomorphology, and land/human resources.

During the first few months of the program research will focus on an intensive review of previous studies and readily available data to

confirm, reject, or question previous priority selections of host domes. Following this initial review, researchers will develop a list of domes ranked according to potential suitability for waste isolation and will initiate more intensive specific studies. Integrated with these specific dome studies will be comprehensive analyses of hydrologic systems and tectonic elements within the interior salt dome basin. Continual review and assessment of candidate domes will involve specific studies, including initiation of drilling, geophysical monitoring, and seismic/gravity analyses. Regional analyses of hydrologic factors, aquifer variations, and dome piercement histories will supply framework data within which to interpret properly data derived from specific dome studies.

OTHER RESEARCH

CARBONIFEROUS GEOLOGY OF TEXAS
Robert S. Kier, L.F. Brown, Jr., and Earle F. McBride (Department of Geological Sciences).

The object of this project is to prepare a summary of the geology of Mississippian and Pennsylvanian rocks in Texas. The summary will be combined with similar material contributed by other states; it will be published by the U.S. Geological Survey as a professional paper in conjunction with the Ninth International Congress of Carboniferous Stratigraphy and Geology to be held at the University of Illinois, Urbana, Illinois, in May 1979. Emphasis in the paper is on surface stratigraphy, biostratigraphy, and economic products. The project is expected to be completed in early 1978.

COMPOSITION AND ORIGIN OF TEKTITES

Virgil E. Barnes, director of tektite research, The University of Texas at Austin, and Stanley V. Margolis, University of Hawaii, Honolulu.

Although tektite research continues, it has had a low priority during 1977 because of more pressing work. Correspondence on tektites, however, continues to be fairly brisk.

A spinoff from the tektite project was the discovery of a new lithium aluminum silicate

mineral. This mineral has been named "virgilite" in honor of Dr. Barnes. The name was submitted by Dr. Bevan M. French, National Aeronautics and Space Administration, in recognition of Dr. Barnes' contributions to the study of tektites, impactites, and other natural glasses. The new mineral, virgilite, was discovered in a clear, greenish volcanic glass found in the Peruvian Andes.

CAVE RESOURCES OF TEXAS—GEOLOGIC ASPECTS

Ernst H. Kastning, Jr.

This project, initiated when the researcher was a member of the Bureau staff, was completed in August 1977 with the submission of a manuscript to the Texas Natural Areas Survey of The University of Texas at Austin. The Survey undertook this inventory of the caves of Texas in order to outline the variety and distribution of Texas caves and to describe their value as geologic, biologic, paleontologic, archeologic, and historic resources. The Bureau of Economic Geology provided interpretation of the geologic setting and the processes involved in cave evolution.

GEOLOGIC MAPPING

GEOLOGIC ATLAS OF TEXAS

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

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 about 4 miles). Map sheets are confined primarily to areas within 1° of latitude and 2° of longitude, but some sheets include larger or smaller areas owing to cartographic presentation. Current plans call for the publication of 38 separate map sheets covering all of Texas and parts of New Mexico and Oklahoma.

To date, 30 map sheets in the Geologic Atlas of Texas series have been published. The Crystal City - Eagle Pass, Del Rio, and Clovis sheets were published in 1977. At yearend, the Marfa and Emory Peak - Presidio sheets were in color separation, and the Fort Stockton sheet was being scribed. Field checking of mapping is complete for the Dalhart sheet. The Llano sheet is mostly scribed, but a few areas remain to be field checked. Field checking is nearing completion for the Sonora, Tucumcari, and Wichita Falls - Lawton sheets. In 1978, all field checking will be completed, and several additional sheets will be published. The Geologic Atlas of Texas project will probably be completed in 1979.

GEOLOGIC QUADRANGLE MAPPING IN CENTRAL TEXAS






Virgil E. Barnes and cartographic section (R.V. McGehee is co-author for Click, Cap, and Dunman Mountain quadrangles).

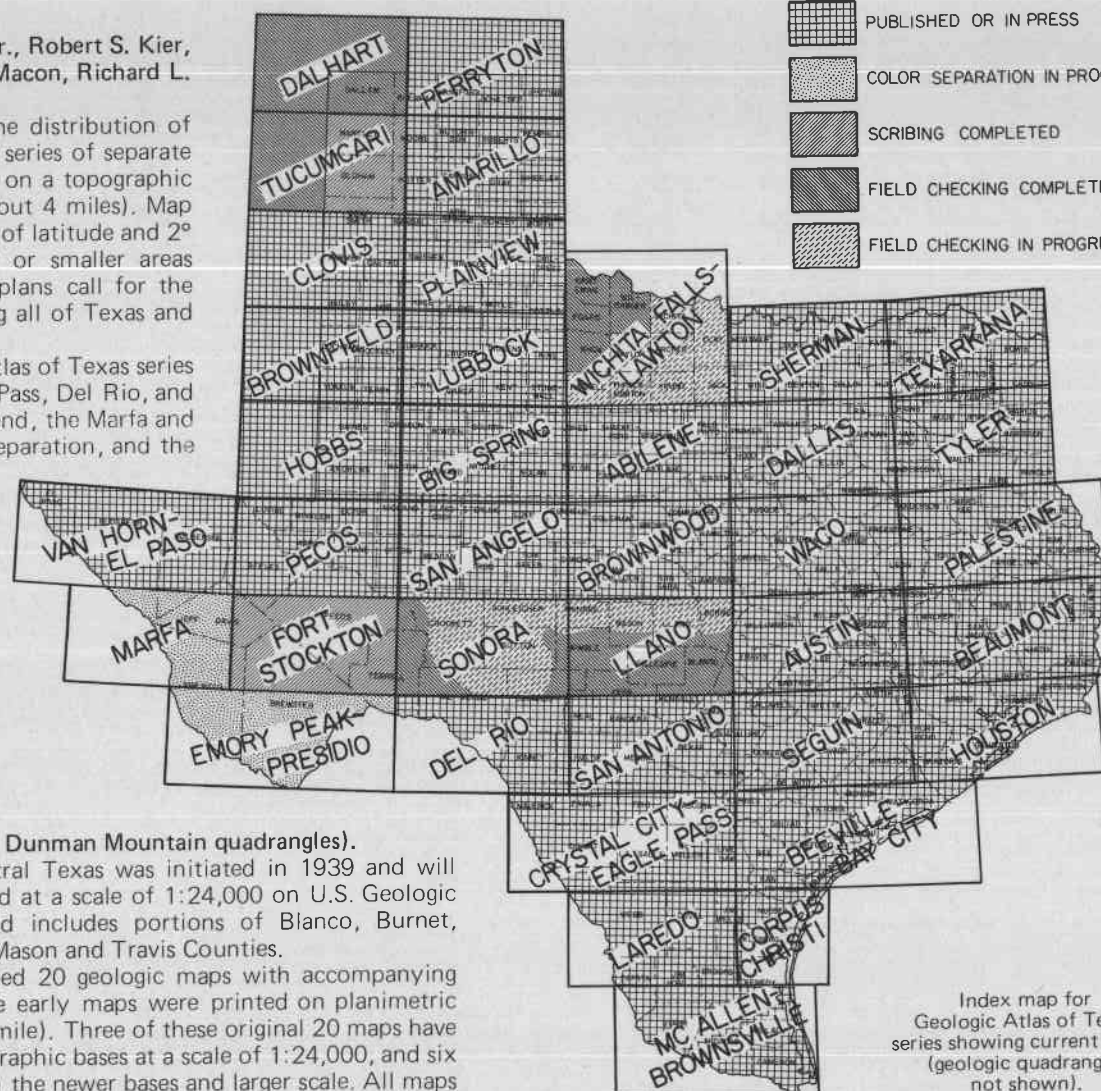
Geologic mapping of quadrangles in Central Texas was initiated in 1939 and will continue until all remaining maps are published at a scale of 1:24,000 on U.S. Geologic Survey topographic bases. The area mapped includes portions of Blanco, Burnet, Gillespie, Hays, Kendall, Kerr, Kimble, Llano, Mason and Travis Counties.

From 1952 to 1956, the Bureau published 20 geologic maps with accompanying texts for 20 quadrangles in this region. These early maps were printed on planimetric bases at a scale of 1:31,680 (1 inch equals 1 mile). Three of these original 20 maps have been reissued on U.S. Geological Survey topographic bases at a scale of 1:24,000, and six additional quadrangles have been published on the newer bases and larger scale. All maps are printed in full color.

Cap, Click, and Dunman Mountain quadrangles were published in 1977. At yearend, color separation was essentially complete for Howell Mountain, Pedernales Falls, Round Mountain, Hammets Crossing, Marble Falls, and Spicewood Quadrangles.

EXPLANATION

-  PUBLISHED OR IN PRESS
-  COLOR SEPARATION IN PROGRESS
-  SCRIBING COMPLETED
-  FIELD CHECKING COMPLETED
-  FIELD CHECKING IN PROGRESS



Index map for
Geologic Atlas of Texas
series showing current status
(geologic quadrangles
not shown).

CONTRACTS AND GRANT SUPPORT

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, and federal agencies. Contracts and grants in effect during all or part of 1977 include:

Analysis of Current Energy Issues of State, National, and International Concern: project supported by Office of the Governor, State of Texas.

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

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

Completion of Bottom-Sampling Program, Submerged Lands, Texas Continental Shelf: project supported by Texas General Land Office, Coastal Management Program.

Environmental Assessment of Geopressured Geothermal Production in Texas: project supported by Lawrence Livermore Laboratory.

Evaluating the Suitability of East Texas Salt Domes for Nuclear Waste Isolation: project supported by U.S. Department of Energy.

Formation of Uranium Ores by Diagenesis of Volcanic Sediments: project supported by Bendix Field Engineering Corporation.

Geologic Atlas of Texas: project supported, in part, by Texas Department of Water Resources.

Identification of the Ecological Implications of Development of Geothermal Energy from Texas Gulf Coast: project supported by Fish and Wildlife Service, U.S. Department of Interior.

Land Resources and Environmental Impact, East Texas Lignite Belt: project supported, in

part, by Geological Survey, U.S. Department of Interior.

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

Mineral Resources and Mined Land Reclamation, City of Dallas: project supported by City of Dallas, Texas.

Natural Hazards Disclosure Statement: project supported by Texas Coastal and Marine Council.

Nitrogen Isotopes in Surface Waters and Ground Waters of Central Texas: project supported by National Science Foundation.

Optical Interpretation of Landsat Imagery: project supported by Texas General Land Office.

Planning Assistance for Lignite Mining Operations at Camp Swift: project supported by Budget and Planning Office, Office of the Governor, State of Texas.

Predicting Response of a Natural System to Uranium Extraction: Oakville Aquifer, Texas: project supported, in part, by U.S. Environmental Protection Agency.

Reconnaissance Geothermal Assessment of the Rio Grande Valley, Trans-Pecos Texas: project supported by U.S. Energy Research and Development Administration (Department of Energy).

Reconnaissance Geothermal Assessment of the Rio Grande Valley, Trans-Pecos Texas—Geothermal Workshop: project supported by U.S. Energy Research and Development Administration (Department of Energy).

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

Study of the Uranium Potential and Genetic Stratigraphy of the Triassic Dockum Group of the Texas Panhandle: project supported by Geological Survey, U.S. Department of Interior.

Study to Determine Feasibility of Developing Lignite Coal Deposits in the National Forests in Texas: project supported by Forest Service, U.S. Department of Agriculture.

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

A 2-Year Study of Sediment Distribution and Bottom Conditions in the Bays and State-Owned Portion of the Gulf of Mexico Continental Shelf—Phase II: project supported by Texas General Land Office, Coastal Management Program.

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

Uranium Potential of the Catahoula Formation, Texas—A Stratigraphic, Depositional, and Geochemical Evaluation—Phase II: project supported by Bendix Field Engineering Corporation.

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 68-year history of the Bureau, over 700 reports, bulletins, circulars, special publications, and maps have been published covering all major aspects of the geology and natural resources of Texas. In addition, over 300 reports and maps are available to the public through open-file holdings at the Bureau. Publications are made available to interested persons at prices designed to recover printing or duplication costs. To date, approximately one million publications have been distributed on a world-wide basis, principally through direct sales. During 1977, the Bureau issued the following publications:

ENVIRONMENTAL GEOLOGIC ATLASES

The Environmental Geologic Atlas of the Texas Coastal Zone is an innovative series of seven atlases which provides an urgently needed, comprehensive inventory of environments and resources within the sensitive lands along the Gulf coastal region of Texas. Each atlas includes an environmental geology map and eight special-use maps, all in full color. The maps delineate over 150 units defined on the basis of substrate characteristics, active processes, biologic activity, and man-made alteration. Besides providing much of the natural resource inventory base for Texas coastal management programs, the Environmental Geologic Atlas has also provided the basis for other, more specialized studies on subsidence and faulting, shoreline erosion, coastal hazards, and land and water resources.

Environmental Geologic Atlas of the Texas Coastal Zone—Kingsville Area, by L.F. Brown, Jr., J.H. McGowen, T.J. Evans, C.G. Groat, and W.L. Fisher. 131 p., 30 figs., 15 tables, 9 full-color maps (\$8.75).

The Kingsville area comprises a unique portion of the Texas Gulf Coast—the South

Texas Eolian System. The mapped area includes a diverse suite of wind-dominated environments stretching from Kleberg County south to southern Kenedy County, and inland from Padre Island across extensive wind-tidal flats and onto the predominantly sandy region as far west as Kingsville.

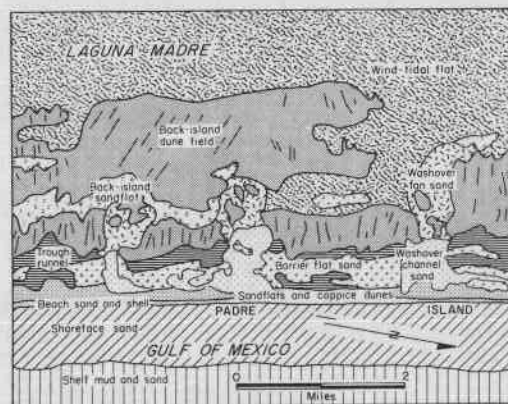
Land use in the Kingsville area is dominated by ranching interest. Urban development is concentrated around the City of Kingsville and a few small sites along U.S. Highway 77. Padre Island, a thin barrier island east of Laguna Madre, is a federally protected National Seashore. Bay-estuarine areas are characterized by hypersalinity in Laguna Madre and Baffin Bay, presence of now-dead serpulid reefs, and an array of wind-tidal flat and transitional eolian environments.

REPORTS OF INVESTIGATIONS

Report of Investigations No. 87. Catahoula Formation of the Texas Coastal Plain: Depositional Systems, Composition, Structural Development, Ground-Water Flow History, and Uranium Distribution, by William E. Galloway. 59 p., 31 figs., 2 tables, 4 plates (\$3.00).

This report describes the physical geology of the Catahoula Formation—its genetic stratigraphy, structure, mineralogical composition, and post-depositional history—and discusses the known distribution of uranium within the context of these geological parameters. Emphasis is on definition of primary physical and historical factors affecting the mobilization, transport, and concentration of uranium in the Catahoula Formation.

Diagenetic features, distribution of trace uranium in fine-grained tuffaceous facies, and reconstructed ground-water flow history in the Catahoula provide the basis for interpretation of a terrigenous coastal-plain uranium cycle. The inferred cycle provides criteria which can be used to compare the uranium potential within the two component fluvial systems of



MAP VIEW
Near-shore and barrier-island environments, Padre Island, Kingsville map area

the Catahoula Formation, and to determine the possible nature and distribution of uranium mineralization. These criteria also apply to other potential host systems in the Texas Coastal Plain.

Report of Investigations No. 88. The Moore Hollow Group of Central Texas, by Virgil E. Barnes and W. Charles Bell. 169 p., 13 figs., 24 tables, 18 plates (price to be determined).

Middle and Upper Cambrian rocks (and locally up to 90 feet of Lower Ordovician strata) comprise the Moore Hollow Group in Central Texas. This major stratigraphic monograph summarizes the lithologic and biostratigraphic relationships among rocks of the Moore Hollow Group on the basis of detailed local observations in various parts of the Llano region. Discussions of petrology, heavy-mineral suites, sedimentary structures, biostratigraphy and paleontology, and geologic structure are presented along with extensive descriptions of measured sections and local geology.

Report of Investigations No. 88 represents Part I (General Discussion and Local Stratigraphy) of a three-part investigation of these lower Paleozoic units. Parts II and III, Surface Stratigraphic Data and Subsurface Stratigraphic Data, respectively, are on open file at the Bureau of Economic Geology.

Report of Investigations No. 89. Cretaceous Carbonates of Texas and Mexico—Applications to Subsurface Exploration, D.G. Bebout and R.G. Loucks (editors). 25 papers, 332 p. (\$8.50).

Thirty-one authors prepared the 25 papers in this volume on Cretaceous carbonates of Texas and Mexico for a major symposium held in conjunction with the 27th Annual Meeting of the Gulf Coast Association of Geological Societies in Austin in October 1977.

The papers and abstracts included in this volume cover studies of regional stratigraphy, facies and depositional environments, diagenesis, geochemistry, paleontology, seismic stratigraphy, porosity, and hydrocarbon production and economics. Ten papers deal exclusively with subsurface investigations, nine focus on outcrop

studies, and six papers treat both subsurface and outcrop relationships.

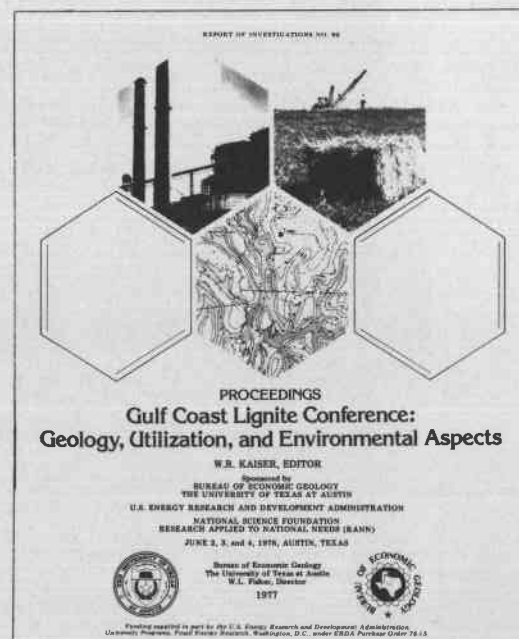
The primary focus is on Cretaceous carbonates of South and Central Texas; however, some attention is given to the extensive but less well-known Cretaceous carbonates of West Texas, as well as to Mexican Cretaceous strata, particularly the outcropping facies which are similar to subsurface facies in Texas.

Papers by Bureau research staff include (1) "Sligo and Hosston Depositional Patterns, Subsurface of South Texas," by D.G. Bebout, (2) "Regional Cretaceous Cross Sections—South Texas," by D.G. Bebout and R.A. Schatzinger, (3) "Porosity Distribution in the Stuart City Trend, Lower Cretaceous, South Texas," by D.G. Bebout, R.A. Schatzinger, and R.G. Loucks, and (4) "Porosity Development and Distribution in Shoal-Water Carbonate Complexes—Subsurface Pearsall Formation (Lower Cretaceous) South Texas," by R.G. Loucks.

Report of Investigations No. 90. Proceedings, Gulf Coast Lignite Conference: Geology, Utilization, and Environmental Aspects, W.R. Kaiser (editor). 28 papers, plus summary of workshops presented in Austin, Texas, on June 2-4, 1976 (price to be determined).

The Conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, was held in June 1976 in Austin. Presentations by representatives of public and private research groups, state and federal government, energy exploration and mining companies, industrial users, and energy consulting firms reflect the broad, diversified front on which research, exploration, and development of Gulf Coast lignite is currently progressing.

Geologic topics included discussions of modern analogs of lignite beds, such as the Mississippi delta peats and swamps, and regional framework of lignite-bearing strata in Texas, Louisiana, Mississippi, and Alabama. Utilization topics ranged from specific mine sites and mining techniques to combustion characteristics and conversion potential. Environmental aspects of lignite use were examined in presentations



Proceedings of 1976 Gulf Coast Lignite Conference being readied for 1978 publication.

on applying environmental geologic mapping to lignite lands, flue-gas desulfurization technology to air-quality control, and several other topics.

Report of Investigations No. 91. Frio Sandstone Reservoirs in the Deep Subsurface Along the Texas Gulf Coast—Their Potential for the Production of Geopressured Geothermal Energy, by D.G. Bebout, R.G. Loucks, and A.R. Gregory (price to be determined).

The Frio Formation of the subsurface Tertiary section in the Gulf Coast basin has been the focus of extensive evaluation for potential resources of geopressured geothermal energy. This report represents a comprehensive summary of the Bureau's geothermal programs in the Frio, which have culminated in the selection of Texas' first test-well site for geothermal production. A portion of this investigation was published previously by the Bureau as Geological Circulars 75-1, 75-8, and 76-3.

The Hidalgo, Armstrong, Corpus Christi, Matagorda, and Brazoria Fairways are delineated. The Austin Bayou Prospect in the Brazoria Fairway of Galveston and Brazoria Counties is pinpointed as the most suitable site for Frio geothermal production. At this site, 250 to

350 feet of reservoir sandstone occur with core permeabilities between 40 and 60 millidarcys and fluid temperatures from 300° to 350°F. Detailed geological, geophysical, and engineering studies have been applied to delineate the Austin Bayou test-well site.

GEOLOGICAL CIRCULARS

Geological Circular 77-2. Shoreline Changes in Central Padre Island (Yarborough Pass to Mansfield Channel)—An Analysis of Historical Changes of the Texas Gulf Shoreline, by Robert A. Morton and Mary J. Pieper. 35 p., 9 figs., table, 3 appendices (\$1.25).

These circulars are the final two sections of the eight-part report on historical changes of the Texas Gulf shoreline. Monitoring of historical changes, based on aerial photography and detailed topographic maps, covers the period from the mid-1800's to 1975. Descriptions of the methods and procedures used in shoreline monitoring are discussed in each report, as are the factors affecting the accuracy of data. The position of the vegetation line—a legal boundary which is dynamic and subject to natural, active processes—is also documented over the period of the last 40 years.

Impact of human alterations such as dredged channels and artificial jetties is evaluated along with the natural processes affecting shoreline conditions. Significance of historical monitoring data and an evaluation of other factors for prediction of future changes are included in each report.

Geological Circular 77-3. The Gulf Shoreline of Texas: Processes, Characteristics, and Factors in Use, by J.H. McGowen, L.E. Garner, and B.H. Wilkinson. 27 p., 19 figs. (\$1.25).

During approximately the past 10 years, the Texas Gulf shoreline has experienced unprecedented urban-recreational-industrial development. Much of this recent development proceeded without proper consideration of the geomorphological features constituting the Gulf

shoreline. The variety of Gulf shoreline features results from a complex of active processes and natural conditions. Superimposed upon this natural setting are man's activities, which tend to disrupt the natural balance among those processes active along the coast. This circular includes a review of the processes actively molding the Gulf shoreline, a description of shoreline features, and a discussion of man's role in altering the natural condition of the Texas Gulf shoreline.

Geological Circular 77-4. Hydrogeology of Gulf Coast Aquifers, Houston-Galveston Area, Texas, by C.W. Kreidler, E. Guevara, G. Granata, and D. McKalips. 18 p., 16 figs., table (price to be determined).

Gulf Coast aquifers represent some of the most prolific sources of fresh ground water in the United States. Severe land subsidence and fault activation, however, have resulted from the intensive ground-water production from the fresh-water section of Plio-Pleistocene fluvial-deltaic sediments.

The objectives of the research reported in this circular were (1) to delineate the distribution of sands, clay, and structural elements in the Plio-Pleistocene aquifers beneath the Greater Houston area, (2) to identify genetic stratigraphic units, (3) to synthesize data on ground-water chemistry for the study of hydrochemical facies trends, and (4) to establish the effects of sediment distribution, growth faults, and Quaternary sea-level changes on long-term and short-term hydrology of Gulf Coast aquifers.

Geological Circular 77-5. Relationship of Porosity Formation and Preservation to Sandstone Consolidation History—Gulf Coast Lower Tertiary Frio Formation, by R.G. Loucks, D.G. Bebout, and W.E. Galloway. 12 p., 21 figs., 2 tables (price to be determined).

The quality of sandstone reservoirs in the Gulf Coast lower Tertiary Frio section varies from a few percent porosity in well-cemented sandstones to as high as 40 percent in uncemented sands, and corresponding permeabilities

vary from less than 0.01 millidarcy to as high as several thousands millidarcys. Reservoir quality depends on a complex relationship between the sandstone depositional environment, mineralogical composition, and consolidation history (compaction, cementation, and leaching). This circular presents the results of a preliminary study of Frio sandstone consolidation history which exerts a major control on reservoir development and preservation at increasing depths of burial.

Geological Circular 77-6. Historical Shoreline Changes and Their Causes, Texas Gulf Coast, by Robert A. Morton. 13 p., 5 figs., 2 tables (price to be determined).

This circular summarizes the results of the Bureau's historical monitoring program of the 367 miles of the Texas Gulf shoreline. This extensive program generated concrete data on linear shoreline changes (as reported in previous geological circulars) and documents areal shoreline changes along the coast (as reported for the first time in this circular). Estimates of areal changes provide another means of quantifying shoreline stability and determining areas of critical erosion. Such estimates provide a basis for calculating volumetric sediment changes, and they can be translated into gains and losses in real property.

Causes of shoreline changes over a period of time include the complex interactions of climate, sediment, budget, coastal processes, relative sea-level changes, and human activities. Historical records over the past 125 years have been used to delineate the impact of these factors on Gulf shoreline conditions.

An extensive list of references dealing with shoreline changes is included.

Geological Circular 77-7. Depositional Systems in the Sparta Formation (Eocene), Gulf Coast Basin of Texas, by Jose Ulises Ricoy and L.F. Brown, Jr. 16 p., 11 figs. (price to be determined).

This investigation covers the outcrop and subsurface extent of the Sparta Formation in Texas, an area of approximately 3,000 square

miles. Sparta Formation units were studied in order to recognize and map depositional systems and genetically related constituent facies.

The Sparta Formation is one of the many Tertiary, offlapping, terrigenous, clastic-wedge sequences which filled the Gulf Coast basin. It is composed of sand and mudstone deposits representing three principal depositional systems: high-constructive delta system (East Texas), strandplain/barrier bar system (Central Texas), and high-destructive, wave-dominated delta system (South Texas).

Geological Circular 77-8. Depositional Systems in the Paluxy Formation (Lower Cretaceous), Northeast Texas—Oil, Gas, and Ground-Water Resources, by Charles A. Caughey. 59 p., 27 figs., 4 tables, appendix (price to be determined).

The Lower Cretaceous Paluxy Formation is a relatively thin and continuous stratigraphic unit composed of sandstone and shale which occurs throughout the northern part of the East Texas embayment. Paluxy aquifers furnish water for domestic, public supply, farm, and industrial uses in areas alongside of and adjacent to the outcrop belt. Significant oil and gas accumulations occur farther downdip to the south and east. This circular describes regional aspects of Paluxy sedimentation in northeast Texas and relates this depositional framework to the nature and distribution of associated ground-water and petroleum resources.

MINERAL RESOURCE CIRCULAR

Mineral Resource Circular No. 59. The Mineral Industry of Texas in 1974, by Murphy E. Hawkins and Roselle Girard. 37 p., fig., 29 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 1974" chapter on Texas. Each year

the chapter preprint is distributed by the Bureau free on request.

SPECIAL PUBLICATIONS

LAND RESOURCES LABORATORY SERIES

Land Resources Laboratory Series No. 2. Land Resources of Texas, by R.S. Kier, L.E. Garner, and L.F. Brown Jr. 42 p., 4 figs., 18 tables; map, full-color, topographic base, 4 sheets, scale 1:500,000 (\$7.50).

The map and accompanying text provide a comprehensive inventory of land resource units recognized in the State of Texas. Land resource units are mappable areas encompassing similar characteristics defined by a limited and predictable range of properties which determine their suitability for various uses. Fundamental properties of Texas lands are used to define several basic land categories, including (1) areas of ground-water recharge, (2) lands with various mineral resources, (3) substrates with significant physical properties, (4) land forms with unusual or critical configurations, (5) areas influenced by active physical processes, (6) areas dominated by biologic activity, (7) submerged lands, and (8) lands altered or created by man. Within these eight basic land categories, 70 land-resource units are defined and described on the map explanation. Each of the 70 land resource units is indicated by a unique color and symbol on a U.S. Geological Survey topographic, physical, and cultural base map (scale 1:500,000). A legend—including 11 color inset maps depicting such features as regional physiography, generalized soils distribution, climate, and major drainage basins—and a table delineating natural suitability, economic potential, and recommended use considerations are included on the map.

The text includes discussions of the concept of land-resource mapping, its utility in inventory and planning, and the purpose of the "Land Resources of Texas" map. A complete review of the "Land Resources of Texas" map



W. L. Fisher, Director
Bureau of Economic Geology
The University of Texas at Austin

1977

LAND RESOURCES OF TEXAS

by
R. S. Kier, L. E. Garner, and L. F. Brown, Jr.

Cartography by
James W. Macon, Chief Cartographer, Dan F. Scranton,
Barbara M. Hartmann and David M. Ridner

Cover for Land Resources of Texas map
Laboratory Series, Bureau of Economic Geology

construction and use is included, as well as guidelines for the creation by users of derivative maps to meet special needs or objectives. A glossary is included to help the reader understand relevant terms used for the map and text.

RESEARCH NOTES

This is a series of informal, limited-distribution reports based on research of the Bureau staff. Information included in these reports covers a wide range of topics, but the scope of the research or its availability in other sources precludes issuing these reports in the formal Bureau publications series.

In 1975 and 1976, six research notes were published. The following research note was published in 1977:

Research Note 7. Guide to Modern Barrier Environments of Mustang and North Padre Islands and Jackson (Eocene) Barrier/Lagoon Facies of the South Texas Uranium District, by W.A. White and W.E. Galloway. 51 p., 19 figs., 2 tables, map (\$2.00).

This is a field guide to the Modern depositional environments in the Corpus Christi area and the Jackson Group strata of the Texas Coastal Plain. The similarity between these two areas provides the information for detailed facies interpretation and paleoenvironmental reconstruction—the basis for understanding the nature and distribution of uranium mineralization in the Jackson Group.

MAPS AND CHARTS

GEOLOGIC ATLAS OF TEXAS

Geologic Atlas of Texas. Clovis Sheet, Edwin Theodore Dumble Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base (\$3.00).

The Clovis Sheet incorporates all or part of Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, and Randall Counties in Texas, and Chaves,

Curry, De Baca, Quay, and Roosevelt Counties in New Mexico. Mapping was compiled by G.K. Eifler, Jr. (Texas) and C.C. Reeves, Jr. (New Mexico). Mapping was reviewed by the Geologic Atlas Committee of the Panhandle Geological Society.

The Clovis Sheet is a memorial edition honoring Edwin Theodore Dumble (1852-1927). Dr. Dumble was the State Geologist of Texas from 1887 to 1896. He was instrumental in establishing the value of a scientific geological survey in Texas. His pioneer efforts in surveying mineral resources remain today as early primers of Texas geology. Dumble's research work focused on East Texas and deposits of Texas lignite. Dr. Dumble continued to contribute to Texas geology after 1896 by serving as consulting geologist to the Southern Pacific Company. He is also remembered for his contributions to the introduction of the use of paleontology in the oil industry.

Geologic Atlas of Texas. Crystal City - Eagle Pass Sheet, Dolan Hoyer Eargle Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base (\$3.00).

The Crystal City - Eagle Pass Sheet includes all or part of Atascosa, Bee, Dimmit, Duval, Frio, Jim Wells, Karnes, La Salle, Live Oak, Maverick, Webb, Wilson, and Zavala Counties. Mapping was compiled by T.E. Brown and N.B. Waechter. Geologic mapping was reviewed by the Geologic Atlas Committee of the Corpus Christi Geological Society.

The Crystal City - Eagle Pass Sheet is a memorial edition honoring Dolan Hoyer Eargle (1905-1973). D. Hoyer Eargle made significant contributions to present-day understanding of South Texas uranium deposits and their mode of emplacement. He and his U.S. Geological Survey colleagues proposed the concept that uranium-bearing ground water came in contact with hydrogen sulfide gas escaping from deeper hydrocarbon accumulations, which precipitated the uranium minerals. In addition, Mr. Eargle



studied the Pennsylvanian section in Brown County, Texas, and Gulf Coast salt domes.

Geologic Atlas of Texas. Del Rio Sheet, Robert Thomas Hill Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base (\$3.00).

The Del Rio Sheet covers all or part of Edwards, Kinney, Maverick, Real, Terrell, Uvalde, Val Verde, and Zavala Counties. Geology was compiled by Noel Waechter and V.E. Barnes. Mapping was reviewed by the Geologic Atlas Committees of Corpus Christi Geological Society and South Texas Geological Society.

The Del Rio Sheet is a memorial edition honoring Robert Thomas Hill (1859-1941). Robert T. Hill was one of the foremost Texas geologists in the late 19th and early 20th centuries. His pioneer work on the Texas Cretaceous section stands today as the primary early resource on this subject. His prolific writings on Texas geology are unmatched in their impact on early geologists interested in Texas stratigraphy and paleontology.

FINAL EDITING/IN PRESS

Report of Investigations 92. Interpretation of Unenhanced Landsat Imagery for Land Cover and Land Use Delineation on the Texas Coast, by Robert J. Finley.

Geological Circular 78-1. Mineral Lands in the City of Dallas, by Ann E. St. Clair.

Geological Circular 78-2. Fracture Zones of the Southern Edwards Plateau: Part I—Regional Distribution of Fractures and Their Relation to Tectonics and Caves, by E.G. Wermund, Joseph C. Cepeda, and P.E. Luttrell.

Geological Circular 78-3. Electric Power Generation from Texas Lignite, by W.R. Kaiser.

Geological Circular 78-4. A guide to Visual Interpretation of Texas Coastal Features from Landsat Imagery, by Robert J. Finley.

Geological Circular 78-5. Sand Body Geometry and the Occurrence of Lignite in the

Eocene of Texas, by W.R. Kaiser, J.E. Johnston III, and W.N. Bach.

Land Resources Laboratory Series No. 4. Land Resource Overview of the Capital Area Planning Council Region, Texas: A Non-Technical Guide, by C.M. Woodruff, Jr.

Land Resources Laboratory Series No. 3. Land and Water Resources, Historical Changes, and Dune Criticality, Mustang and North Padre Islands, Texas, by W.A. White, R.A. Morton, R.S. Kerr, W.D. Kuenzi, and W.B. Brogden.

Research Note 8. Engineering Properties of Land Resource Units in the Corpus Christi Area, by R.S. Kier, D.L. Bell, and P.C. Patton.

Research Note 9. Evaluating the Environmental Geology Map, Environmental Geologic Atlas of the Texas Coastal Zone, by Robert J. Finley.



Sunset along Texas Gulf Coast. High energy surf or breaker zone along coastal beach in foreground.

Geologic Quadrangle Map No. 43. Geologic Map of the Click Quadrangle, Llano and Blanco Counties, Texas, by Virgil E. Barnes and R.V. McGehee. Scale 1:24,000.

Geologic Quadrangle Map No. 44. Geologic Map of the Dunman Mountain Quadrangle, Llano, Burnet, and Blanco Counties, Texas, by Virgil E. Barnes and R.V. McGehee. Scale 1:24,000.

Geologic Quadrangle Map No. 45. Geologic Map of the Cap Mountain Quadrangle, Llano County, Texas, by Virgil E. Barnes and R.V. McGehee.

Mineral Resource Circular 60. The Mineral Industry of Texas in 1975, by Murphy E. Hawkins and Thomas J. Evans.

REPRINTED PUBLICATIONS

Geological Circular 69-4. Geometry and Distribution of Fluvial and Deltaic Sandstones (Pennsylvanian and Permian), North-Central Texas, by L.F. Brown, Jr. Reprinted from *TRANSACTIONS of the Gulf Coast Association of Geological Societies*, v. XIX, p. 23-47, 22 figs., 1969 (2nd printing; \$1.00).

Geological Circular 74-3. A Numeric Code for Describing Rocks in Sedimentary Basins, by E.G. Wermund and C.A. Caughey. 28 p., 4 figs., 3 tables, 2 appendices, 1974 (2nd printing; \$1.00).

Guidebook 3. Field Excursion, Central Texas: Tertiary Bentonites of Central Texas, by R.L. Folk, M.O. Hayes, and T.E. Brown; **Uranium-Bearing Clays and Tuffs of South-Central Texas,** by D.H. Eargle and A.D. Weeks; **Vermiculite Deposits Near Llano,** by V.E. Barnes and S.E. Clabaugh. 53 p., 8 figs., 1961 (3rd printing; \$1.25).

SERVICES

SCHOFIELD RETIRES FROM MINERAL STUDIES LAB



D. A. Schofield received recognition for his years of service with the Mineral Studies Laboratory from Dr. W. L. Fisher

Pasco Copper Corporation (1937-1941). Schofield came to Texas in 1942 as a research fellow in the Bureau of Industrial Chemistry. He later joined the Research Laboratory in Ceramics, where he worked on ceramics analysis and other aspects of clay mineral research.

Schofield has been a major contributor to several Bureau publications, including regional resource inventories, evaluation of Cambrian sandstones for low-grade iron ore, and beneficiation of silica sands for industrial use. His varied and significant contributions are best exemplified in the Mineral Studies Laboratory. Under his leadership, the Laboratory grew both in the volume of samples processed and in the diversity and complexity of testing procedures available for evaluating samples.

MINERAL STUDIES LABORATORY

The Mineral Studies Laboratory supports many Bureau projects as an analytical laboratory wherein chemical analysis as well as physical testing of natural materials is performed. Occasionally, the Laboratory performs similar work for various departments of The University of Texas at Austin, for Texas State agencies, and, under certain conditions, for Texas residents. The Laboratory is located at Balcones Research Center in Austin.

Staff changes at the Laboratory during 1977 included the retirement of the Chemist-in-

Daniel A. Schofield, Chemist-in-Charge of the Mineral Studies Laboratory of the Bureau of Economic Geology, retired on August 31, 1977. Mr. Schofield served as head of the Mineral Studies Laboratory for 32 years, directing its growth and development into a major rock and mineral testing support facility for numerous teaching and research departments of The University of Texas at Austin, in addition to the Bureau of Economic Geology.

Mr. Schofield received his B.S. degree in chemistry from the University of Southern California in 1932. He earned an M.S. degree in industrial chemistry (Cornell University, 1934) and an M.S. degree in chemical engineering (University of Texas, 1947). Prior to coming to Texas, he worked as an industrial research chemist for the Government of Peru (1934-1937), and he was the chief chemist of the Casapalca Department of the Cerro de

Charge, Daniel Schofield, and the move of a senior chemist, Lawrence C. McGonagle, into industry. Two full-time chemists, Stephen W. Tweedy and Josephina R. Calvo, joined the Laboratory staff during the second half of the year. They share responsibility for analysis and, at yearend, were assisted by five students, Yet-Ming L. Hung, David M. Johnson, Anna L. McKee, Mary B. Purvis, and David L. Woodrum, who were working on a part-time basis. A new Chemist-in-Charge, Dr. Clara Ho, joined the Laboratory staff in January 1978.

Several important Bureau of Economic Geology projects were strongly supported by work performed during the year by the Mineral

Studies Laboratory. Such work included (1) water analysis related to lignite strip mines in East Texas, (2) instrumental analysis of trace elements in uraniferous Oakville sediments, (3) measurement of total organic carbon in sediments of the State-owned submerged lands, and (4) determination of acid-soluble uranium in Panhandle and South Texas strata.

Public samples are submitted to the Mineral Studies Laboratory through L.E. Garner of the Bureau's research staff.

WELL SAMPLE AND CORE LIBRARY

The Bureau's Well Sample and Core Library was authorized by the Texas Legislature in 1937, and it has been located at Balcones Research Center since 1945. The Library is one of the Nation's largest public collections of subsurface geological materials. To date, it lists cores from 2,018 wells and drill cuttings from 69,548 wells. (The number of wells represented by drill cuttings will be increased by 33 percent when recent acquisitions from Superior Oil Company are catalogued.)

Included in the Library's collections are subsurface materials from all regions of Texas, and from wells in Arkansas, Florida, Lesser Antilles, Louisiana, Mexico, Mississippi, Montana, New Mexico, and Oklahoma. The Library also contains electric, driller's, sample, and strip logs; scout tickets; and assorted maps. All of the Library's holdings have been donated by companies, governmental agencies, and individuals. During 1977, the Library received contributions of subsurface materials from Core Laboratories; Core Services, Inc.; Bill Ellis; Getty Oil Company; Hunt Oil Company; Porter Montgomery; Shell Oil Company; Superior Oil Company; and the Texas Water Development Board.

Library use in 1977 was 30 percent greater than in 1976. Increased growth of the collections and increased need for ready access to the rock materials have led to the computerization

of records of all available well cores; the computerization of records of drill cuttings also continued during the year. In 1977, the cores, well logs, and other materials received from Shell Development Company during the past several years were designated as the Library's Dr. F.E. Lozo Collection in honor of a geologist from that company who has made valuable contributions to the knowledge of Texas geology.

The production of thin sections of rocks at the Well Sample and Core Library increased from a total of 759 thin sections in 1975 to over 2,300 thin sections in 1977. Both simple and impregnated sections are produced. Harry J. Madsen heads the production operation, assisted by Robert L. Sherrill. Although thin sections are prepared primarily for Bureau of Economic Geology projects, they also can be produced, on a fee basis, for persons outside the Bureau.

The Well Sample and Core Library is supervised by Guy L. Tidmore; other members of the Library staff include H. Scott Hamlin, James L. Lockley, Harry J. Madsen, Suzanne M. Montano, Hardie Seay Nance, Jon A. Robin, and Robert L. Sherrill. The Library is open from 8:00 a.m. until 5:00 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. Cores and cuttings may also be checked out of the Library; the borrower must pay shipping costs.

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. Two members of the Bureau's research staff, in particular, respond

to the many requests for information from the general public.

Roselle Girard handles most 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.

EDUCATION SERVICES

The Bureau of Economic Geology continued in 1977 to expand its participation in a public school education program through workshops and numerous public addresses. L.E. Garner, Thomas J. Evans, Mary J. Pieper, Dawn McKalips, Ann St. Clair, and Bonnie R. Weise of the Bureau of Economic Geology staff participated in the program during the year.

A set of curriculum materials to accompany the Bureau's new "Energy Resources of Texas" map is being produced. To date, "Unit I: Energy from Start to Finish," is published; "Unit II: Energy, Economics, and the Environment," and "Unit III: Energy in the Future," are scheduled for publication in 1978. Dawn McKalips is coordinator of the project; J.E. Anderson of Austin and Anita R. Trippett of Corpus Christi are consultants.

Requests for information, resource materials, and references are welcome; suggestions and comments from Texas earth science teachers are also needed and welcomed.

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 which 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 open-file reports of the U.S. Energy Research and Development Administration (ERDA), which on October 1, 1977, was included in the new U.S. Department of Energy (DOE), have been placed on file at the Bureau of Economic Geology; this material is listed below. Other reports have been transferred to the Geology Library of The University of Texas at Austin. Information concerning reproductions of ERDA and DOE open-file reports may be obtained from the Technical Library, Grand Junction Office, U.S. Department of Energy, Grand Junction, Colorado 81501 (telephone: 303-242-8621, ext. 278).

Copies of open-file reports of the U.S. Geological Survey may be ordered from the Open-File Services Section, Branch of Distribution, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225 (telephone: 303-234-5888).

Materials placed on open file at the Bureau of Economic Geology during 1977 include the following:

Advanced Geostatistics in Ore Reserve Estimation and Mine Planning (Practitioners Guide), by Young C. Kim, Donald E. Myers, and Harvey P. Knudson: U.S. Department of Energy (ERDA) Open-File Report GJBX-65(77), 242 p., 1977.

Aerial Gamma-Ray and Magnetic Survey of the Red River Area—Block C, Texas and Oklahoma, Final Report: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-17(77), v. 1, consisting of

text with 16 figs., 20 tables, and appendices, including 24 microfiche cards; v. 2, consisting of 4 sections of bound maps (scale 1:500,000), profiles, and histograms of Abilene, Ardmore, Dallas, and Sherman National Topographic Map Series (quadrangles), 1977.

Aerial Radiometric and Magnetic Survey [of Red River Block B, Oklahoma and Texas]—Clinton National Topographic Map, Oklahoma; Lawton National Topographic Map, Texas and Oklahoma; Oklahoma City National Topographic Map, Oklahoma; Wichita Falls National Topographic Map, Texas: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-34(76), Clinton [quadrangle], v. 1, 78 p. and 56 microfiche cards, v. 2, 65 p.; Lawton [quadrangle], v. 1, 100 p. and 56 microfiche cards, v. 2, 65 p.; Oklahoma City [quadrangle], v. 1, 94 p. and 56 microfiche cards, v. 2, 65 p.; Wichita Falls [quadrangle], v. 1, 65 p. and 56 microfiche cards, v. 2, 65 p., 1976.

Aeromagnetic Map of the Salt Basin Area, Texas: U.S. Geological Survey Open-File Report 77-231, 1 pl., 1977.

Alternatives for Managing Wastes from Reactors and Post-Fission Operations in the LWR Fuel Cycle, John W. Bartlett, John R. Carrell, Max Kreiter, Allison M. Platt, and Judith A. Powell, report coordinators: U.S. Energy Research and Development Administration Open-File Report ERDA-76-43, v. 1, Summary; v. 2, Alternatives for Waste Treatment; v. 3, Alternatives for Interim Storage and Transportation; v. 4, Alternatives for Waste Isolation and Disposal; v. 5, Appendices, 1976. (A copy of this report may be purchased from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.)

Annual NURE Report, 1976: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-11(77), 75 p., 1977.

Catahoula Formation of the Texas Coastal Plain—Depositional Systems, Composition, Structural Development, Ground-Water Flow History, and Uranium Distribution, by W.E. Galloway, assisted by T.D. Murphy, R.C. Belcher, B.D. Johnson, and Stanley Sutton: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-41(77), 59 p., 31 figs., 4 pls., 1977 (published as Bureau of Economic Geology Report of Investigations No. 87).

Chemical Analysis of Ground and Surface Samples from Parts of the United States 1956-1975, by D.W. McCarn and R.W. Freeman: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-51(76), 541 p., 1976.

Energy Use Patterns in Metallurgical and Nonmetallic Mineral Processing, prepared by Battelle Columbus Laboratories, Ohio: U.S. Bureau of Mines Open-File Report 117(2)-76, Final Report, Phase 7, Summary of the Results of Phases 4, 5, and 6, 24 p., 1 fig., 5 tables, 1976; Open-File Report 80-75, Phase 4, 3 microfiche cards, 1975; Open-File Report 96-75, Phase 5, 3 microfiche cards, 1975; Open-File Report 117-76, v. 1, Phase 6, 3 microfiche cards, 1976. (Copies of these reports may be purchased from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.)

Evaluation of Lignite Resources at Proposed Carl L. Estes Lake Site, Rains, Van Zandt, and Wood Counties, Texas, by Albert E. Ward: U.S. Bureau of Mines, coal-analysis report sheets, locality map, and 36 geophysical logs, 1977. (Information concerning reproductions of this material may be obtained from the U.S. Department of the Interior, Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, Colorado 80225.)

Evaluation of Lignite Resources at Proposed Millican Lake Site, Brazos, Grimes, and

Madison Counties, Texas, by Albert E. Ward: U.S. Bureau of Mines Report, 19-p. text, appendix and coal-analysis report sheets, and 52 geophysical logs, 1976. (Information concerning reproductions of this report may be obtained from the U.S. Department of the Interior, Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, Colorado 80225.)

Geostatistics Project of the National Uranium Resource Evaluation Program, January-March 1977, by T.R. Bement, D.V. Susco, D.E. Whiteman, and R.K. Zeigler: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-50(77), 32 p., 1977.

Hydrologic Interpretation of Geophysical Data from the Southeastern Hueco Bolson, El Paso and Hudspeth Counties, Texas, by Joseph S. Gates and W.D. Stanley: U.S. Geological Survey Open-File Report 76-650, 37 p., 6 figs., 1 table, 1976.

Interpretation of an Aeromagnetic Anomaly in McMullen and Live Oak Counties, Texas, by J.S. Duval and R.A. Martin: U.S. Geological Survey Open-File Report 77-768, 8 p., 3 figs., 1977.

Land Resources of Fayette County, Texas, by C.M. Woodruff, Jr., and Thomas C. Gustavson: Bureau of Economic Geology Open-File Map (scale 1:125,000) and 3 descriptive sheets, including small, page-size map of Fayette County, 1976.

Land Resources of Kendall County, Texas, by C.M. Woodruff, Jr., Robert A. Morton, and E.G. Wermund: Bureau of Economic Geology Open-File Map (scale 1:125,000) and 2 descriptive sheets, 1976.

Multivariate Analysis of Geophysical and Mineralogical Data from Uranium-Bearing Sandstones, by E.L. Maxwell, M.J. Kluth, and Mitchell Weiner: U.S. Geological Survey Open-File Report 76-861, 45 p., 1976.

National Uranium Resource Evaluation Program—Hydrogeochemical and Stream-Sediment Reconnaissance Program in Central United States, by J.W. Arendt: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-64(76), July 1, 1976, through September 30, 1976, 55 p.; GJBX-42(77), October 1, 1976, through December 31, 1976, 24 p.; GJBX-70(77), January 1, 1977, through June 30, 1977, 35 p., 1977.

Rapid Determination of Uranium in Natural Waters by Thermal Emission Mass Spectrometry, by J.R. Ferguson, J.D. Caylor, E.R. Rogers, and S.H. Cole: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-36(77), 14 p., 1977.

Rapid, Low-Cost Image Analysis through Video Processing, by R.W. Marrs, R.A. Levinson, and D.G. Grantham: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-37(76), 54 p., 1976.

Reconnaissance Report on the Rossman SOM Project, Hudspeth County, Texas, by B.N. Webber: U.S. Energy Research and Development Administration (ERDA) Open-File Report RMOO-148, 1 microfiche card, 1946.

Reconnaissance Report on the Trans-Pecos Region, Texas, by J.M. Hill: U.S. Energy Research and Development Administration (ERDA) Open-File Report RMOO-138, 1 microfiche card, 1945.

Regional Appraisal of the Wilcox Group in Texas for Subsurface Storage of Fluid Wastes; Part I, Geology, by P.H. Jones, P.R. Stevens, J.B. Wesselman, and R.H. Wallace, Jr.: U.S. Geological Survey Open-File Report 76-394, 107 p., 34 figs., 8 pls., 1976.

Status Report on the Development of a Prompt Fission Neutron Uranium Borehole Logging Technique, by Gerald W. Smith: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-47(77), 55 p., 1977.

Summary of the Tertiary Geology in Trans-Pecos Texas and Its Relation to Rocks and Mineral Deposits in the Gulf Coastal Plain, A, by J. Frank Woodward, Jr.; edited by C.C. Reeves, Jr.: Report prepared for Meeker and Company, Fort Worth, v. 1, 39 p., v. 2, cross sections and acreage contracts, 1970.

Survey of Lands Held for Uranium Exploration, Development and Production in Fourteen Western States: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-2(77), report for six-month period ending June 30, 1976, 20 p.; GJBX-33(77), report for six-month period ending December 31, 1976, 20 p., 1977.

Test Drilling for Ground Water in Hudspeth, Culberson, and Presidio Counties in Westernmost Texas, by Joseph S. Gates and Donald E. White: U.S. Geological Survey Open-File Report 76-338, 76 p., 6 figs., 8 tables, 1976.

Thermoluminescence of Sand Grains Around a South Texas Roll-Type Deposit, by C.S. Spirakis, M.B. Goldhaber, and R.L. Reynolds: U.S. Geological Survey Open-File Report 77-640, 31 p., 5 figs., 1 table, 1977.

Uranium and Thorium Distribution in Soils and Weathered Bedrock in South Texas, by Kendell A. Dickinson: U.S. Geological Survey Open-File Report 77-764, 18 p., 8 figs., 1977.

Uranium Exploration Expenditures in 1976 and Plans for 1977-78: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJO-103(77), 12 p.

Uranium Geochemical Survey in the Crystal City and Beeville Quadrangles, Texas, by C.E. Nichols, T.R. Butz, G.W. Cagle, and V.E. Kane: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-19(77), 132-p. text, appendices, and 2 microfiche cards, 1977.

Uranium in West Texas—Paper delivered June 3, 1975, AAPG-SEPM Rocky Mountain Section Meeting, Albuquerque, New Mexico, by

Warren I. Finch: U.S. Geological Survey Open-File Report 75-356, 20 p., 8 figs., 1975.

Uranium Potential of the Texas Coastal Plain, by Kendell A. Dickinson: U.S. Geological Survey Open-File Report 76-879, 9 p., 2 figs., 1 pl., 1976.

U.S. Geological Survey Programs of Resource Assessment, Geologic Environmental Studies, and Marine Geology Investigations of the Continental Margin Adjacent to Deep Sea Areas in the Atlantic and Gulf of Mexico, by John C. Behrendt: U.S. Geological Survey Open-File Report 77-320, 44 p., 5 figs., 2 tables, 1977.

Uranium Favorability of Late Eocene Through Pliocene Rocks of the South Texas Coastal Plain, by J.V. Quick, N.G. Thomas, L.D. Brogdon, C.A. Jones, and T.S. Martin: U.S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-7(77), 49 p., appendix, and 62 plates on 6 microfiche cards in pocket, 1977; GJBX-7(77)a, pls. 1-62 (printed copies), 1977.

PERSONNEL

RESEARCH STAFF



FISHER RETURNS TO DIRECT BUREAU

Dr. William L. Fisher returned to his position as Director of the Bureau of Economic Geology on January 26, 1977. He resigned on January 20 as Assistant Secretary for Energy and Minerals in the U.S. Department of Interior.

Dr. Fisher took a leave of absence from his position as Bureau Director to go to Washington in May 1975 as Deputy Assistant Secretary for Energy. President Gerald R. Ford nominated Dr. Fisher for Assistant Secretary for Energy and Minerals in February 1976. At the Interior Department, Dr. Fisher had line supervision and management responsibility for numerous agencies and sub-agencies employing more than 22,500 persons. He had direct responsibility in the areas of policy and technical aspects of the availability, development, and management of energy and mineral resources on Federal lands, particularly the western U.S. coal deposits and the leasing of the Outer Continental Shelf for oil and gas exploration.

Dr. Fisher returned to the Bureau after 21 months of Federal service and reassumed the position of Director, to which he was appointed in 1970.

FISHER CHAIRS NEW COUNCIL ON ENERGY RESOURCES

Dr. William L. Fisher, Director of the Bureau of Economic Geology, has been named chairman of the Council on Energy Resources by Dr. Lorene Rogers, President of The University of Texas at Austin. Dr. Fisher heads the Executive Committee, which will administer the programs of the Council.

The Council on Energy Resources was created at UT Austin to promote and coordinate research on energy resources and issues critical to the State of Texas and to the Nation. Several existing research institutes, including the Bureau of Economic Geology, comprise the membership of the Council.

The initial research effort directed by the Council has been a comprehensive, interdisciplinary review and analysis of the National Energy Plan proposed by President Carter, and its subsequent Congressional formulations. For this massive effort, the Council has coordinated the research of over 25 University of Texas at Austin scientists and teachers working in 10 departments or research institutes. At yearend, "National Energy Plan: A Continuing Assessment" was in final editing and scheduled for publication by the end of January, 1978.

The Council on Energy Resources is an outgrowth of The University of Texas at Austin's response to the Governor of Texas' request for a thorough analysis of the social, economic, and technical implications of the National Energy Plan for Texas. With the completion of this first phase of the Council's work, the Council plans to continue a long-run, sustained effort to combine information on energy research from several disciplines and focus this material on national energy policy issues in the future.

GALLOWAY RECEIVES LEVORSEN AWARD

Dr. William E. Galloway has been awarded the A.I. Levorsen Memorial Award, which is presented annually for the best technical paper by a professional geologist at a regional meeting of the American Association of Petroleum Geologists. The paper, entitled "Relationships Between Depositional System, Ground-Water Flow History, and Origin, Migration, and Concentration of Uranium—Catahoula Formation of the Texas Coastal Plain," was based on research carried out at the Bureau of Economic Geology concerning the nature and origin of South Texas uranium deposits. Dr. Galloway presented the paper at the 26th Annual Meeting of the Rocky Mountain Section, AAPG-SEPM, in Denver, Colorado, on April 6. The Levorsen Award is one of the most prestigious recognitions of geological research in the profession.

FISHER ON ADVISORY COMMITTEE OF T.E.A.C.

Dr. William L. Fisher, Director of the Bureau of Economic Geology, was appointed by Lt. Governor William P. Hobby to serve on the statute-created Advisory Committee of the Texas Energy Advisory Council. Dr. Fisher will provide advice and counsel on energy matters pending before the Council, and State and Federal governments.

The Texas Energy Advisory Council, created by the Energy Policy Planning Act of 1977, is chaired by Lt. Governor Hobby. The Council's purpose is to articulate a State energy policy, to coordinate energy planning and research activities among State agencies, and to stimulate research and development in energy resources vital to the State of Texas.

BUREAU REORGANIZATION REFLECTS GROWTH AND CHANGE

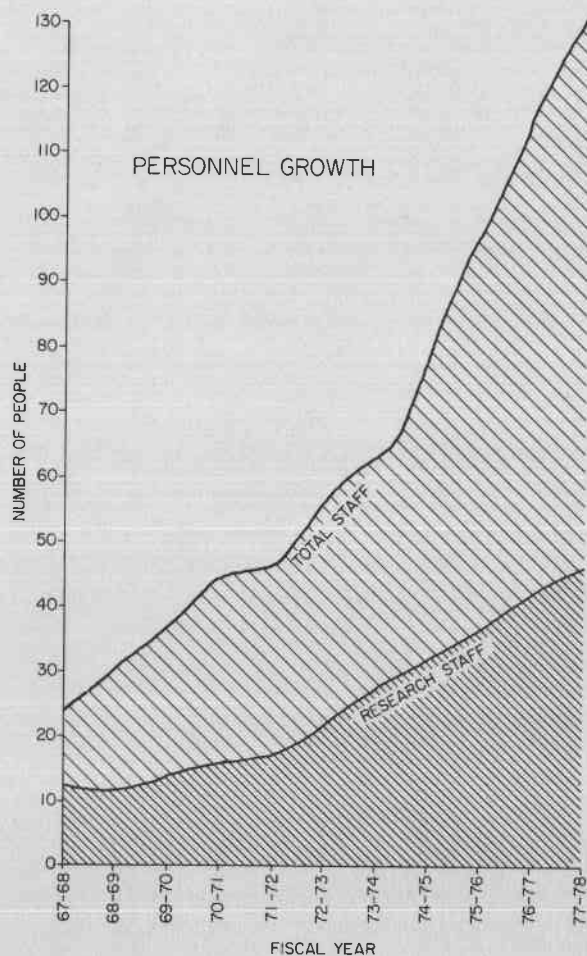
The Bureau of Economic Geology restructured its top-level directoral positions in 1977. The reorganization included redefining two positions and creating two new positions in order to streamline program and policy responsibilities for this rapidly expanding research organization.

Dr. W.L. Fisher returned to the Bureau as Director in January 1977, following a leave of absence during which he served as Assistant Secretary of the Interior for Energy and Minerals in Washington, D.C. The two Associate Director positions have been redefined and include (1) Dr. L.F. Brown, Jr., as Associate Director with responsibilities for Bureau research programs in energy and mineral resources,

and (2) Dr. E.G. Wermund, as Associate Director with responsibilities for direction of land and water resources research. Mary J. Pieper was named to the new position of Assistant Director in October 1977. Ms. Pieper is responsible for planning analysis of Bureau programs and budgets, hiring research assistants, and handling public relations with local and regional governmental groups and State agencies. Douglas Ratcliff manages administrative aspects of contracts and grants as well as the Well Sample and Core Library.

This new directoral structure is necessitated by growth in Bureau programs and size and the expanding directions of Bureau research, including land, energy, mineral resources, coastal studies, and special research programs. Over the past decade, the total Bureau staff increased from 26 to 130, with full-time research staff increasing from 12 in the late 1960's to 46 in 1977. During 1977, the total Bureau staff increased 25 percent. Two scientists were scheduled to join the staff in early 1978, and three more positions were being recruited.

Commensurate with this growth in size and diversity, the budget has increased over 28 percent per year over the past 10 years. The budgetary increases reflect increased funding by local, State, and Federal agencies. This support has advanced the Bureau's continuing role in public-sector research in Texas geology and resources.



FISHER APPOINTED TO I.O.C.C. AND I.M.C.C.

Governor Dolph Briscoe recently appointed Dr. William L. Fisher to represent Texas on the Research Committees of the Interstate Oil Compact Commission and the Interstate Mining Compact Commission.

The Interstate Oil Compact Commission is composed of a cooperative advisory group of states organized to enhance interstate cooperation for the prevention of avoidable waste of oil and gas. Further, the I.O.C.C. seeks to promote efficient oil and gas production practices.

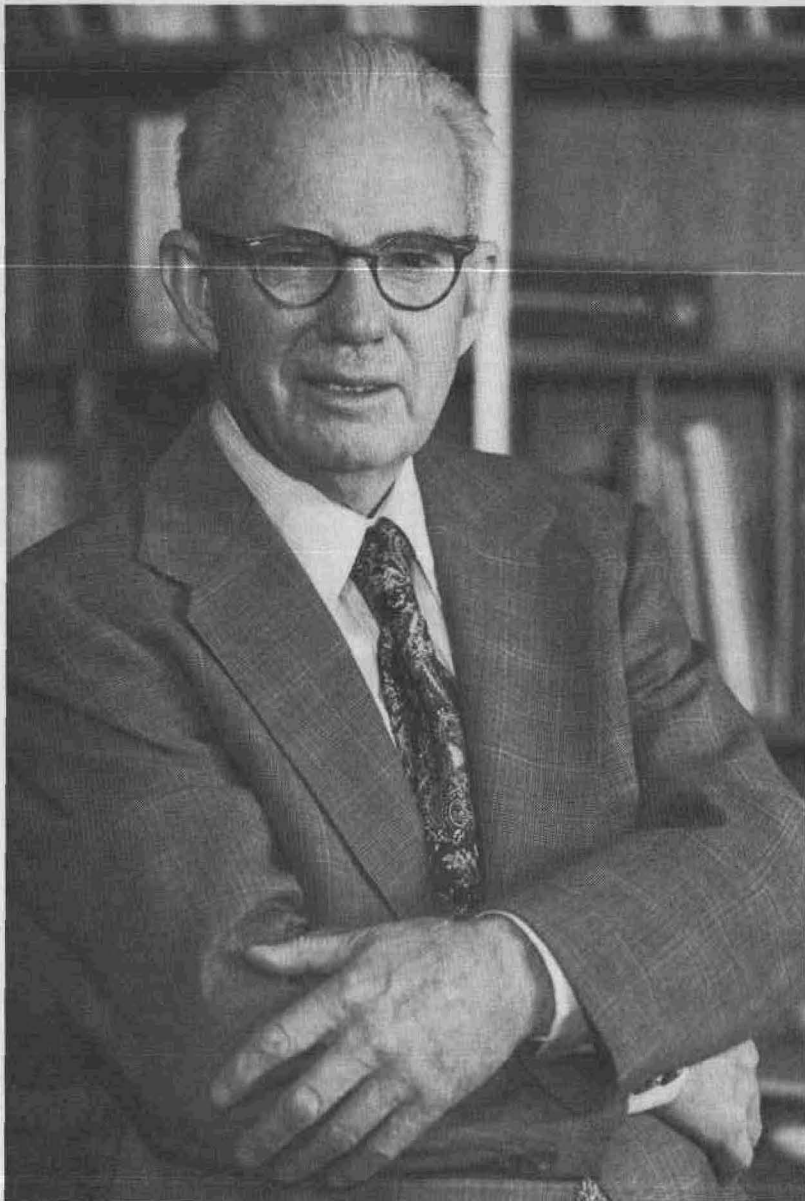
The Interstate Mining Compact Commission is also composed of a cooperative advisory group of states dedicated to interstate cooperation concerning mining and reclamation activities within the respective member states. In addition, the Compact serves to enhance the exchange of information of resource development and reclamation techniques.

FISHER HONORED BY SOUTHERN ILLINOIS UNIVERSITY

Dr. William L. Fisher was honored by the Southern Illinois University Alumni Association when he was named the recipient of their Achievement Award. The Achievement Award recognizes an alumnus who has made substantial professional contributions in his chosen field.

Dr. Fisher graduated from Southern Illinois in 1954, receiving a B.S. degree in geology. He received the M.S. and Ph.D. degrees in geology from the University of Kansas and joined the Bureau of Economic Geology as Research Scientist in 1960.

Dr. Fisher has served as Director of the Bureau of Economic Geology since 1970, except for a 21-month term of service in Washington, D.C., where he served as Assistant Secretary for Energy and Minerals in the U.S. Department of Interior. Fisher also serves as chairman of the Council on Energy Resources at The University of Texas at Austin.



VIRGIL BARNES RETIRES AFTER 42 YEARS OF SERVICE

Dr. Virgil E. Barnes retired from active service with the Bureau of Economic Geology on August 31, 1977. Dr. Barnes' retirement follows 42 years of distinguished professional contributions to the field of geology, the Bureau of Economic Geology, and The University of Texas at Austin. Dr. Barnes continues his professional involvement in geology as Professor Emeritus with the Department of Geological Sciences, The University of Texas at Austin, and as consultant to the Bureau for the Geologic Atlas of Texas and for the geologic Quadrangle mapping in Central Texas.

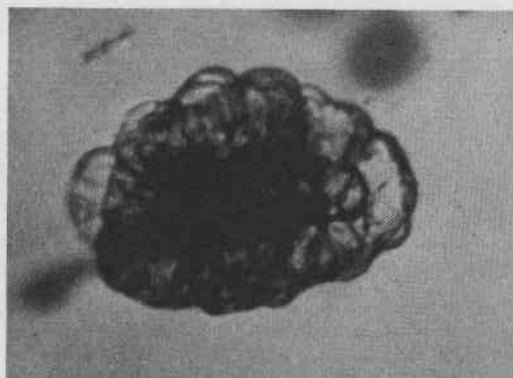
Dr. Barnes received his formal training at the State College of Washington (now Washington State University) where he was awarded the B.S. and M.S. degrees in 1925 and 1927, respectively. He pursued his education in geology at the University of Wisconsin, receiving the Ph.D. degree in geology in 1930. His professional experience prior to coming to the Bureau included work in earth temperatures and oil-field waters in north-central Texas for the American Petroleum Institute (1930-1931), and topographic mapping in Texas and Minnesota for the U.S. Geological Survey, Topographic Branch (1933-1935). Dr. Barnes has been a geologist and research scientist at the Bureau of Economic Geology since 1935, serving as Associate Director from 1962 to 1968. In 1961, he was named a Professor of Geology in the Department of Geological Sciences, The University of Texas at Austin; he has served as a Professor and a member of the graduate faculty since that time.

Dr. Barnes' professional interests have focused on the geology of Central Texas and the origin and composition of tektites. Barnes has published over 100 articles, maps, guidebooks, and major monographs on the geology of Central Texas. He has also published extensively on tektite research; his work includes over 60 abstracts, articles, and books. In addition, Barnes has published approximately 10 major articles on lunar geology and meteorites. He also served as project director for the Geologic Atlas of Texas, for which 38 geologic maps (scale 1:250,000) have been prepared; to date, 30 have been published. A complete listing of Dr. Barnes' publications follows at the end of this article.

Dr. Barnes' contributions to both Texas geology and the science of tektites cannot be measured in numbers alone. The significance and quality of his research in these and other fields speaks even more eloquently of the impact of Virgil E. Barnes on the geological sciences. Dr. Barnes has contributed fundamentally to our understanding of geologic relationships among the diverse assemblages of rocks and minerals present in the Central Mineral Region. His research scope in this area embraces geologic mapping, petrography, biostratigraphy, paleontology, stratigraphy, and economic geology.

In the area of tektites, Dr. Barnes was an early proponent of the terrestrial origin of these small, glassy objects found in so many places throughout the world. His extensive publishing history is indicative of the breadth and depth of his research on this topic, as it includes articles on distribution, origin, age relationships, chemistry, and petrology of tektites of world-wide distribution. Though the origin of tektites—terrestrial or extraterrestrial—is still a question of debate, the role of Dr. Barnes in tektite research is without question one of substantial accomplishment.

Symbolic of the esteem in which Dr. Barnes is held by his colleagues is the naming of a new mineral, "virgilite," in his honor. This mineral, a lithium aluminum silicate, was discovered in an unusual clear greenish volcanic glass originally collected and studied by Barnes. The glass, macusanite, was



Photomicrograph of virgilite, lithium aluminum silicate, under transmitted light at about $\times 10$

found in the Peruvian Andes. The name for this mineral was suggested to the Commission of New Minerals and Mineral Names of the International Mineralogical Association by Dr. Bevan M. French.

Dr. Barnes married Mildred Adlof in 1932. Their three children, Virgil II, Louise, and Elizabeth, all have received Ph.D. degrees in their chosen fields. Mildred Barnes served with Dr. Barnes as co-editor of "Tektites," a major publication in that field. Additional details on the career of Dr. Barnes are included in an article in the 1974 Annual Report of the Bureau of Economic Geology.

Virgil E. Barnes, 74, stands today as one of the foremost scientists involved in geologic research in the State of Texas. His outstanding professional reputation is of international scope and has brought favorable attention to the Bureau of Economic Geology and The University of Texas at Austin. The Bureau of Economic Geology is proud to express its deep gratitude for the contributions of the past and those of the future to one of our most distinguished members, Dr. Virgil E. Barnes.

PUBLICATIONS—VIRGIL E. BARNES

- 1930** Changes in hornblende at about 800°C: *American Mineralogist*, v. 15, p. 393-417.
- 1932** Earth temperatures of north-central Texas: *American Assoc. Petroleum Geologists Bull.*, v. 16, p. 413-416.
Geology, development of Washington's nonmetallic mineral resources: *Pit and Quarry*, v. 23, no. 9, p. 43-47, Jan. 27, 1932.
Oil-field waters of north-central Texas: *American Assoc. Petroleum Geologists Bull.*, v. 16, p. 409-411.
- 1933** Metallic minerals in anhydrite cap rock, Winnfield salt dome, Louisiana: *American Mineralogist*, v. 18, p. 335-340.
- 1936** Asphalt deposits of Burnet County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Survey Circ.* 11, 4 p.
Building stone deposits of Burnet County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Survey Circ.* 10, 5 p.
Pavite silver-copper prospect, Burnet County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Survey Circ.* 5, 4 p.
- Sheridan copper prospect, Burnet County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Survey Circ.* 9, 2 p.
- 1937** Review: The geology of Texas, Vol. III, Upper Paleozoic ammonites in Texas, F.B. Plummer and Gayle Scott; (and) Permian Fusulinidae of Texas, Carl O. Dunbar and John W. Skinner: *American Assoc. Petroleum Geologists*, v. 21, p. 1359-1360.
- 1938** (with E.P. Schoch and G.A. Parkinson) High magnesia marble from Sharp Mountain area of Llano County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ.* 10, 5 p.
- 1939** Additional notes on barite: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ.* 11, 4 p.
Catalogue of Texas meteorites: Univ. Texas Pub. 3945, p. 583-612 [1940]. Abstracts: *Mineralog. Abs.* 8, p. 59 [1941]. *Pop. Astron.* 49, p. 49-50 [1941].
North American tektites: *Univ. Texas Pub.* 3945, p. 477-582 [1940]. Abstracts: *American Mineralogist*, p. 4 (Dec. 1940). *Mineralog. Abs.* 8, p. 62 [1941]. *Chem. Abs.* 35, 4317² [1941].
- Pseudotachylite in meteorites: *Univ. Texas Pub.* 3945, p. 645-657 [1940]. Abstracts: *Mineralog. Abs.* 8, p. 56 [1941].
- The iron meteorite from Nordheim, Texas: *Univ. Texas Pub.* 3945, p. 633-644 [1940]. Abstracts: *Mineralog. Abs.* 8, p. 60 [1941]. *Chem. Abs.* 35, 4310⁹ [1941].
- The stony meteorite from Cuero, Texas: *Univ. Texas Pub.* 3945, p. 613-622 [1940]. Abstracts: *Mineralog. Abs.* 8, p. 59 [1941]. *Chem. Abs.* 35, 4316⁹ [1941].
- The stony meteorite from Kimble County, Texas: *Univ. Texas Pub.* 3945, p. 623-632 [1940]. Abstracts: *Mineralog. Abs.* 8, p. 59 [1941]. *Chem. Abs.* 35, 4317² [1941].
(with G.A. Parkinson) Dreikanter from the basal Hickory sandstone of Central Texas: *Univ. Texas Pub.* 3945, p. 665-670 [1940].
(with G.A. Parkinson and R.F. Dawson) Preliminary report on gray granites from Central Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ.* 12, 4 p.
(with H.B. Stenzel) A bismuth-molybdenum prospect (Kiam prospect) of Llano County, Texas: *Univ. Texas Pub.* 3945, p. 911-922 [1940].
- 1940** Additional notes on graphite in Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ.* 15, 11 p.
Distribution and origin of tektites (abs.): *Geol. Soc. America Bull.*, v. 51, p. 1919-1920.
Pre-Cambrian of Llano region with emphasis on tectonics and intrusives: Guidebook to excursions offered in connection with 53d annual meeting: *Geol. Soc. America, p.* 44-55, Austin, Texas, Dec. 1940.
Serpentine and associated minerals of Gillespie and Blanco counties, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ.* 14, 5 p.
(with E.H. Sellards) Meteor crater of Ector County: Guidebook to excursions offered in connection with 53d annual meeting: *Geol. Soc. America, p.* 129-130, Austin, Texas, Dec. 1940.
(with E.H. Sellards) Minerals of Texas: *Manufacturers Record*, v. 109, no. 6, p. 33-35, 52.
- 1941** Cretaceous overlap on Llano uplift of Central Texas (abs.): *Geol. Soc. America Bull.*, v. 52, p. 1994.
Tektites: *American Mineralogist*, v. 26, p. 194. Abstract: *Abs. NJI* 348 [1941].
(with Josiah Bridge) Stratigraphy of Upper Cambrian, Llano uplift, Texas (abs.): *Geol. Soc. America Bull.*, v. 52, p. 1996.
- 1942** Gypsum in Gillespie County, Texas: *Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Survey Circ.* 54, 7 p.
(with Josiah Bridge) Report of facies changes in the Cambrian of Central Texas, in Report of the Committee on Marine Ecology as Related to Paleontology, 1941-1942: *Natl. Research Council, p.* 11-12, Dec. 1942.

- (with R.F. Dawson and G.A. Parkinson) Building stones of Central Texas: Univ. Texas Pub. 4246, 198 p.
- (with R.W. Mathis) Soapstone of northeastern Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ. 55, 10 p.
- (with G.A. Parkinson and L.E. Warren) Scheelite in Llano County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ. 20, 2 p.
- 1943** Analyses of dolomites and serpentine from Blanco and Gillespie Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ. 25, 3 p.
- Earth temperatures and oil field waters of north-central Texas: Univ. Texas Pub. 4301, p. 313-357 [1946].
- Feldspar in the Central Mineral Region of Texas: Univ. Texas Pub. 4301, p. 93-104 [1945].
- Gypsum in the Edwards limestone of Central Texas: Univ. Texas Pub. 4301, p. 35-46 [1944].
- Preliminary report on fluorite in the Spring Creek area of Burnet County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Mineral Res. Circ. 27, 6 p.
- Progress in excavating the Odessa, Texas, meteorite crater: Pop. Astron., v. 51, p. 224-225. Abstract: Mineralog. Abs. v. 8, p. 378 [1943].
- Soapstone and serpentine in the Central Mineral Region of Texas: Univ. Texas Pub. 4301, p. 55-92 [1945].
- (with P.E. Cloud, Jr., and Josiah Bridge) Stratigraphy of the Ellenburger group in Central Texas—a progress report: Univ. Texas Pub. 4301, p. 133-161 [1945].
- (with P.E. Cloud, Jr., and L.E. Warren) The Devonian of Central Texas: Univ. Pub. 4301, p. 163-177 [1945].
- (with G.A. Parkinson) Grinding pebble deposits of western Gulf Coastal Plain of Texas: Univ. Texas Pub. 4301, p. 47-54 [1944].
- (with Frederick Romberg) Gravity and magnetic observations on Iron Mountain magnetite deposit, Llano County, Texas: Geophysics, v. 8, p. 32-45 [revised and reprinted in Geophysical Case Histories, p. 400-414, George Banta Publishing Co., Menasha, Wis., 1948].
- 1944** (with Frederick Romberg) Correlation of gravity observations with the geology of the Smoothingiron granite mass, Llano County, Texas: Geophysics, v. 9, p. 79-93 [reprinted in Geophysical Case Histories, p. 415-428, George Banta Publishing Co., Menasha, Wis., 1948].
- 1945** (with P.E. Cloud, Jr.) Representative sections of the Ellenburger group in Central Texas: Univ. Texas, Bur. Econ. Geology, Mineral Res. Circ. 34, 41 p.
- 1946** (with P.E. Cloud, Jr.) The Ellenburger group of Central Texas: Univ. Texas Pub. 4621, 473 p. [1948].
- (with P.E. Cloud, Jr.) The life and environment of the early Ordovician sea in Central Texas, in Report No. 6 of the Committee on Marine Ecology as Related to Paleontology: Natl. Research Council, p. 87-101, Dec. 1946.
- 1947** Road log for Blanco County field trip: Houston Geol. Soc. Field Trip, February 14-15, 1947, 5 p.
- (with Josiah Bridge and P.E. Cloud, Jr.) Stratigraphy of the Upper Cambrian, Llano uplift, Texas: Geol. Soc. America Bull., v. 58, p. 109-124.
- (with P.E. Cloud, Jr., and L.E. Warren) Devonian rocks in Central Texas: Geol. Soc. America Bull., v. 58, p. 125-140.
- 1948** Road log and instructions for lower Paleozoic field trip, Llano uplift, Texas: Abilene Geol. Soc., Jan. 17-18, 1948.
- Road log for Blanco County field trip: Corpus Christi Geol. Soc. Field Trip, May 22-23, 1948, 5 p.
- Ouachita facies in Central Texas (abs.): Geol. Soc. America, Program 1948 Annual Meetings, p. 16, 1948 [reprinted in Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 2, 12 p.].
- (with P.E. Cloud, Jr.) Paleogeology of the early Ordovician sea in Central Texas, in Report of Committee, Treatise on Marine Ecology and Paleogeology, No. 8, 1947-1948: Natl. Research Council, Div. Geol. Geog., p. 29-83.
- (with R.W. Mathis and Frederick Romberg) Gravity prospecting for lead and zinc, New Mexico (abs.): Internat. Geol. Cong. 18th Sess., Great Britain, Vol. of abstracts, p. 24, 1948 [printed in full in Report of 18th session, Great Britain 1950, Part V, p. 5-15].
- (with Frederick Romberg) Observations of relative gravity at Paricutin volcano: Geol. Soc. America Bull., v. 59, p. 1019-1026.
- 1949** Geologic map of the Cypress Mill area, Blanco County, Texas; and Geologic map of the Turkey Bend area, Burnet and Travis Counties, Texas, in Cretaceous of Austin, Texas, area: Shreveport Geol. Soc. 17th annual field trip guidebook, plates 3 and 4, Sept. 1949.
- (with S.S. Goldich and Frederick Romberg) Iron ore in the Llano region, Central Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 5, 50 p.
- (with Frederick Romberg) Correlation of gravity observations with geology of the Coal Creek serpentine mass, Blanco and Gillespie Counties, Texas: Geophysics, v. 14, p. 151-161 [reprinted in Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 4, 11 p.].
- 1950** (with D.A. Shock and W.A. Cunningham) Utilization of Texas serpentine: Univ. Texas Pub. 5020, 52 p.
- 1951** New tektite areas in Texas (abs.): Geol. Soc. America, Program 1951 Annual Meeting, Detroit, p. 14, Nov. 1951.
- Paleozoic and Cretaceous rocks of eastern Llano uplift: Field trip guidebook for regional meeting of American Assoc. Petroleum Geologists and 18th annual meeting and field trip of South Texas Geol. Soc., Oct. 20, 1951.
- 1952** Geology of the Bear Creek Quadrangle, Gillespie, Kerr, and Kendall Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 12.
- Geology of the Blowout Quadrangle, Gillespie and Llano Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 5.
- Geology of the Cain City Quadrangle, Gillespie and Kendall Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 13.
- Geology of the Crabapple Creek Quadrangle, Gillespie and Llano Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 3.
- Geology of the Gold Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 9.
- Geology of the Hilltop Quadrangle, Gillespie, Llano, and Mason Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 2.
- Geology of the Live Oak Creek Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 7.
- Geology of the Morris Ranch Quadrangle, Gillespie and Kerr Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 11.
- Geology of the North Grape Creek Quadrangle, Blanco and Gillespie Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 10.
- Geology of the Palo Alto Creek Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 8.
- Geology of the Spring Creek Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 6.
- Geology of Squaw Creek Quadrangle, Gillespie and Mason Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 1.
- Geology of the Stonewall Quadrangle, Gillespie and Kendall Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 14.
- Geology of the Willow City Quadrangle, Gillespie and Llano Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 4.
- High purity Marble Falls limestone, Burnet County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 17, 27 p.
- Meteorites in Texas, in Handbook of Texas, v. II: Texas State Historical Association, p. 180-181.
- Tektites in Texas, in Handbook of Texas, v. II: Texas State Historical Association, p. 180-181.
- (with P.T. Flawn) Gravimetric data, in Flawn, P.T., The Hazel copper-silver mine, Culberson County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 15, p. 16-19.
- 1953** American Assoc. Petroleum Geologists Field Trip No. 5 from Austin to Central Mineral Region (Llano uplift): Guidebook (American Assoc. Petroleum Geologists), (Soc. Econ. Paleontologists and Mineralogists), and Soc. Econ. Geologists Joint Annual Meeting, Houston, Texas, March 1953, p. 61-74, 6 figs.
- Can Ellenburger be subdivided? Petroleum Engineer, v. 25, p. B-104 and B-107, May, 1953.
- Magnetic susceptibility measurements on Llano uplift rocks: Geophys. Soc. Tulsa, Proceedings, v. 1, p. 45-49.
- Magnetic susceptibility measurements of well cores from pre-Simpson Paleozoic rocks: Geophys. Soc. Tulsa, Proceedings, v. 1, p. 50-55.
- (with W.A. Anderson and Frederick Romberg) Correlation of gravity and magnetic observations with geology of Blanco and Gillespie Counties, Texas: XIX^e Congress Geologique International, Comptes Rendus, section IX, Contribution de la Géophysique à la Géologie, p. 151-162, 1954 [also, abstract (Resumes des communications) p. 56, Alger, 1952].
- (with P.E. Cloud, Jr., and Helen Duncan) Upper Ordovician of Central Texas: American Assoc. Petroleum Geologists Bull., v. 37, p. 1030-1043.
- 1954** Geology of the Dry Branch Quadrangle, Kerr and Gillespie Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 17.
- Geology of the Harper Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 16.
- Geology of the Klein Branch Quadrangle, Gillespie and Kerr Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 18.
- Geology of the Wendel Quadrangle, Gillespie, Kimble, and Kerr Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 15.
- Phosphorite in Eastern Llano uplift of Central Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 23, 9 p.
- (with W.C. Bell) Cambrian rocks of Central Texas: Guidebook, San Angelo Geol. Soc. Field Conference, March 19-20, 1954, p. 35-69.
- (with W.C. Bell) Road log: Guidebook, San Angelo Geol. Soc. Field

- Conference, March 19-20, 1954, p. 14-34.
- (with Frederick Romberg) A geological and geophysical study of Pilot Knob (south), Travis County, Texas: *Geophysics*, v. 19, p. 438-454.
- (with Frederick Romberg and W.A. Anderson) Geology and geophysics of Blanco and Gillespie Counties, Texas: Cambrian field trip—Llano area guidebook, San Angelo Geol. Soc. Field Conference, March 19-20, 1954, p. 78-90.
- 1956** Geology of the Fall Prong Quadrangle, Kimble, Gillespie, and Mason Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 19.
- Geology of the Threadgill Creek Quadrangle, Gillespie and Mason Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 20.
- Lead deposits in the Upper Cambrian of Central Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 26, 68 p.
- Resume of geology of eastern Llano uplift and road logs: Guidebook, San Angelo Geol. Soc., Four Provinces Field Trip, March 16-17, 1956, p. 1-32, 132-147.
- Tektite localities in southern United States: Resúmenes de los Trabajos Presentados, XX Internat. Geol. Cong., Mexico, p. 274, 1956.
- (with W.C. Bell) Cambrian of Central Texas, in *Cambrian Symposium*, v. 3, 20th Internat. Geol. Cong., Mexico, 1956, p. 484-503 [Moscow, 1961].
- (with Frederick Romberg and W.A. Anderson) Map showing correlation of geologic, gravity, and magnetic observations, Blanco and Gillespie Counties: Univ. Texas, Austin, Bur. Econ. Geology.
- 1957** Tektites: *Geotimes*, v. 1, no. 12, p. 6-7, 16-17.
- (with S.E. Clabaugh) Origin of Central Texas vermiculite deposits (abs.): *Geol. Soc. America Bull.*, v. 68, p. 1709.
- (with P.E. Cloud, Jr.) Early Ordovician sea in Central Texas: *Geol. Soc. America, Memoir* 67, p. 163-214.
- (with P.E. Cloud, Jr., and W.H. Hass) Devonian-Mississippian transition in Central Texas: *Geol. Soc. America Bull.*, v. 68, p. 807-816.
- 1958** Field excursion eastern Llano region: Guidebook no. 1, Univ. Texas, Austin, Bur. Econ. Geol., 36 p.
- Properties of tektites pertinent to their origin: *Geochimica et Cosmochimica Acta*, v. 14, p. 267-278.
- (with Zdenek Kopal and Harold C. Urey) Origin of tektites: *Nature*, v. 181, p. 1457-1458.
- 1959** Chemical examination of pre-Simpson Paleozoic rocks, in *Stratigraphy of the pre-Simpson Paleozoic subsurface rocks of Texas and southeast New Mexico*: Univ. Texas, Pub. 5924, v. 1, p. 145-163 [4 plates in pocket].
- Thermoluminescence of pre-Simpson Paleozoic rocks, in *Stratigraphy of the pre-Simpson Paleozoic subsurface rocks of Texas and southeast New Mexico*: Univ. Texas, Pub. 5924, v. 1, p. 165-183 [6 plates in pocket].
- Use of color for correlating pre-Simpson Paleozoic rocks, in *Stratigraphy of the pre-Simpson Paleozoic subsurface rocks of Texas and southeast New Mexico*: Univ. Texas, Pub. 5924, v. 1, p. 185-189, 294.
- (and others) Stratigraphy of the pre-Simpson Paleozoic subsurface rocks of Texas and southeast New Mexico: Univ. Texas, Pub. 5924, v. 1, p. 185-189, 294.
- (with George A. Bruce) Tektites in Georgia: *Geotimes*, v. 3, no. 7, p. 18.
- (with S.E. Clabaugh) Vermiculite in Central Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 40, 32 p.
- (with L.F. Dixon) Insoluble residues of Ellenburger subsurface rocks, in *Stratigraphy of the pre-Simpson Paleozoic subsurface rocks of Texas and southeast New Mexico*: Univ. Texas, Pub. 5924, v. 1, p. 191-198 [plate in pocket].
- 1960** Significance of inhomogeneity in tektites: XXI Internat. Geol. Cong., Proceedings, Part XIII, p. 328-332, Copenhagen, 1960.
- Tektites: *Encyclopedia Britannica*, p. 881-882.
- 1961** A world-wide geological investigation of tektites: *Geotimes*, v. 6, no. 2, p. 8-12, 38.
- Letters: *Geotimes*, v. 6, no. 4, p. 37.
- Survey of tektite localities, 1960-1961: Univ. Texas, mimeographed circular, 4 p., Mar. 24, 1961.
- Tektites: *Sci. American*, v. 205, no. 5, p. 58-65.
- Temperature of tektite formation: CERN Conference on Fission and Spallation Phenomena and Their Application to Cosmic Rays, abs. 37, Sept. 26-29, 1961.
- 1962** A world-wide geological investigation of tektites (reprint of 1961 *Geotimes* article with addition of two pages of tektite and impactite photographs): *Lapidary Journal*, v. 16, no. 1, p. 132-138.
- Letters: *Sci. American*, v. 206, no. 2, p. 12.
- On the origin of tektites (reprint of 1961 *Scientific American* article with additional tektite photographs): *Gems & Minerals*, no. 299, p. 16-21.
- Tektites: Internat. Council of Sci. Unions (ICSU) Review, v. 4, p. 75-81.
- Tektites—Original surfaces preserved beneath flanges, rayed bubbles and reoriented strain (abs.): *Trans., American Geophysics Union*, v. 43, no. 4, p. 466.
- Temperature of tektite formation: *Jour. American Geophysics Union*, v. 67, no. 9, p. 3540.
- (with W.C. Bell) Cambrian history, Llano region, in *Geology of the Gulf Coast and Central Texas*: Houston Geol. Soc., Houston, Texas, p. 79-85, 1962 [reprinted as Univ. Texas, Austin, Bur. Econ. Geology, Guidebook no. 5, p. 79-85, 1963].
- (with W.C. Bell, S.E. Clabaugh, P.E. Cloud, Jr., Keith Young, and R.V. McGehee) Field Excursion No. 1, November 10-11, 1962, geology of Llano region and Austin area, in *Geology of the Gulf Coast and Central Texas*: Houston Geol. Soc., Houston, Texas, p. 58-131, 1962 [reprinted as Univ. Texas, Austin, Bur. Econ. Geology, Guidebook no. 5, 74 p., 1963].
- (with W.C. Bell and P.E. Cloud, Jr.) Field trip road log, stops 3 to 5, in *Geology of the Gulf Coast and Central Texas*: Houston Geol. Soc., Houston, Texas, p. 113-124, 1962 [reprinted as Univ. Texas, Austin, Bur. Econ. Geology, Guidebook no. 5, p. 113-124, 1963].
- (with P.E. Cloud, Jr.) Ordovician to earliest Mississippian rocks, Llano region, in *Geology of the Gulf Coast and Central Texas*: Houston Geol. Soc., Houston, Texas, p. 86-93, 1962 [reprinted as Univ. Texas, Austin, Bur. Econ. Geology, Guidebook no. 5, p. 86-93, 1963].
- (with Kaset Pitakpaivan) Origin of indochinite tektites: *Proc., Natl. Acad. Sci.*, v. 48, no. 6, p. 947-955.
- (with Kaset Pitakpaivan) Origin of tektites of Muong Nong - type: *Jour. American Geophysics Union*, v. 67, no. 9, p. 3587.
- 1963** Crystalline minerals in Muong Nong - type indochinites from Nong Sapong, Thailand (abs.): Second International Symposium on Tektites, Univ. Pittsburgh, p. 26, 1963.
- Detrital mineral grains in tektites: *Science*, v. 142, no. 3600, p. 1651-1652.
- Geology of the Johnson City Quadrangle, Blanco County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 25.
- Tektite strewn-fields, in John A. O'Keefe (ed.), *Tektites*, chapter 2, p. 25-50, University of Chicago Press.
- Terrestrial implications of layering, faulting, and crystalline minerals in tektites (abs.): *Trans., American Geophysics Union*, v. 44, p. 93.
- Variations in properties of indochinites within their strewn-field (abs.): Second Internat. Symposium on Tektites, Univ. Pittsburgh, p. 19-20, 1963.
- 1964** Petrography of tektites from near Muong Nong, Laos (abs.): *Trans., American Geophysics Union*, v. 45, no. 1, p. 82.
- Rayed bubbles in tektites: *Geochimica et Cosmochimica Acta*, v. 28, p. 1373-1375.
- Terrestrial implication of layering, bubble shape and minerals along faults in tektite origin: *Geochimica et Cosmochimica Acta*, v. 28, p. 1267-1271.
- Variation of petrographic and chemical characteristics of indochinite tektites within their strewn-field: *Geochimica et Cosmochimica Acta*, v. 28, p. 893-913.
- (with D.A. Schofield) Potential low-grade iron ore and hydraulic fracturing sand in Cambrian sandstones, northwestern Llano region, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Rept. Inv. 53, 58 p.
- (with G.E. Willford) Brunei Tektites (abs.): *Trans., American Geophysics Union*, v. 45, no. 1, p. 82.
- 1965** Geology of the Hye Quadrangle, Blanco, Gillespie, and Kendall Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 27.
- Geology of the Rocky Creek Quadrangle, Blanco and Gillespie Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 29.
- Original tektite crust (abs.): XX Internat. Cong. of Pure and Applied Chemistry, Division C: Cosmic Chemistry, Moscow, p. 20, 1965.
- (and others) Geologic Atlas of Texas—Tyler sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with Carl E. Hedge and Zell E. Peterman) Soil: Source material for tektites (abs.): *Trans., American Geophysics Union*, Fifth Western Natl. Meeting, v. 46, no. 3, p. 545.
- (with Richard V. Russell) Devitrification of glass around bubbles in tektites (abs.): *Trans., American Geophysics Union*, Fifth Western Natl. Meeting, v. 46, no. 3, p. 545.
- 1966** Geology of the Stonewall Quadrangle, Gillespie and Kendall Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 31.
- Memorial to Frank A. Herald (1887-1965): *American Assoc. Petroleum Geologists Bull.*, v. 50, p. 1064-1066.
- Tektite research, in 1965 Annual Report: Univ. Texas, Austin, Bur. Econ. Geology, p. 13-15.
- (and others) Geologic Atlas of Texas—Texarkana sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with A.J. Boucot, P.E. Cloud, Jr., R.H. Miller, and A.R. Palmer) Silurian of Central Texas: A first record for the region: *Science*, v. 154, p. 1007-1008.
- (with Richard V. Russell) Devitrification of glass around collapsed bubbles in tektites: *Geochimica et Cosmochimica Acta*, v. 30, p. 143-152.
- 1967** Geology of the Cave Creek School Quadrangle, Gillespie County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 32.
- Geology of the Monument Hill Quadrangle, Blanco County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 33.
- Geology of the Yeager Creek Quadrangle, Blanco and Hays Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 34.

- Petrography of moldavites (abs.): Meteoritical Society, 30th Annual Meeting, Oct. 25-27, 1967, Ames Research Center, Moffett Field, California.
- Tektites: Encyclopedia Britannica, v. 21, p. 763.
- Tektites, in International Dictionary of Geophysics, S.K. Runcorn (ed.), Pergamon Press, v. 2, p. 1507-1518.
- (and others) Geologic Atlas of Texas—Lubbock sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Sheridan sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- 1968** Mineral Resources, in Eastern Hill Country Resource Conservation and Development Project of Texas: U.S. Dept. Agr., Soil Conserv. Service, Fort Worth, Texas 4-26613, 6-68, p. 73-83.
- Petrography of new tektite localities in Thailand and the Philippines (abs.): 23d Internat. Geol. Cong., Prague, Report (Abstracts), p. 328, 1968.
- Petrography of new tektite localities in Thailand and the Philippines: 23d Internat. Geol. Cong., Prague, Proc., v. 13, p. 27-36.
- (and others) Geologic Atlas of Texas—Beaumont sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Houston sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Palestine sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Plainview sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Van Horn - El Paso sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with S.B. Hyder) Electron microprobe analysis of inhomogeneities in tektites (abs.): Trans. American Geophysics Union, v. 49, p. 243.
- 1969** Petrology of moldavites (abs.): Internat. Tektite Symposium, Third, Corning Museum of Glass and Smithsonian Institution, Corning, New York, p. 42.
- Petrology of moldavites: Geochimica et Cosmochimica Acta, v. 33, p. 1121-1134.
- Progress of tektite studies in China: Trans., American Geophysics Union, p. 704-709.
- (and others) Geologic Atlas of Texas—Amarillo sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with G.K. Eifler, Jr.) Cartography of Quaternary deposits of Texas (abs.): Internat. Union for Quaternary Research (INGUA), Eighth Internat. Cong., Paris, Abstracts, p. 325, 1969.
- (with E.P. Henderson) Restudy of Nordheim staurolite, De Witt County, Texas (abs.): Trans., American Geophysics Union, v. 50, p. 222.
- (with L.A. Smith) Age of South China Sea tektites (abs.): Internat. Tektite Symposium, Third, Corning Museum of Glass and Smithsonian Institution, Corning, New York, p. 34.
- 1970** (and others) Geologic Atlas of Texas—Perryton sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Waco sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with Preston Cloud, S.V. Margolis, Mary Moorman, J.M. Barker, G.R. Licari, and David Krinsley) Micromorphology and surface characteristics of lunar dust and breccia: Geochimica et Cosmochimica Acta, v. 34 (Proc. Apollo 11 Lunar Science Conference, supplement 1, v. 2, p. 1793-1798).
- (with Preston Cloud, S.V. Margolis, Mary Moorman, J.M. Barker, G.R. Licari, and David Krinsley) Micromorphology and surface characteristics of lunar dust and breccia: Science, v. 167, p. 776-778.
- (with George Edwards, W.A. McLaughlin, Irving Friedman, and Oiva Joensuu) Macusanite occurrence, age, and composition, Macusani, Peru: Geol. Soc. America Bull., v. 81, p. 1539-1546.
- 1971** Age of Asian tektites: Geol. Soc. America Bull., v. 82, p. 1995-1996.
- Description and origin of large tektite from Thailand: Chemie der Erde, v. 30, p. 13-19.
- Description and origin of 12.8-kg layered tektite from Thailand (abs.): Meteoritics, v. 6, p. 249.
- (with W.C. Bell) Cambrian history, Llano region, in Shreveport Geol. Soc., 1971 Guidebook, p. 27-34.
- (with S.E. Clabaugh) Geology of the Llano region and Austin area, road log, first day, in Shreveport Geol. Soc., 1971 Guidebook, p. 49-67, 87-88.
- (with S.E. Clabaugh, P.U. Rodda, and Keith Young) Geology of the Llano region and Austin area, second day, in Shreveport Geol. Soc., 1971 Guidebook, p. 35-44.
- (with P.E. Cloud, Jr.) Ordovician to earliest Mississippian rocks, Llano region, in Shreveport Geol. Soc., 1971 Guidebook, p. 68-88.
- (with S.V. Margolis, Preston Cloud, and R.V. Fisher) Surface micromorphology of lunar fines compared with tektites and terrestrial volcanic analogs: Proceedings of the Second Lunar Science Conference, v. 1, p. 909-921, 1971.
- (with S.V. Margolis, Preston Cloud, and R.V. Fisher) Surface micromorphology of lunar and terrestrial glasses, in Lunar Science Conference Abstracts: Natl. Aeronautics and Space Adm., p. 236237, Houston, 1971.
- 1972** (and others) Geologic Atlas of Texas—Abilene sheet: Univ. Texas, Austin, Bur. Econ. Geology [1973].
- (and others) Geologic Atlas of Texas—Dallas sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with M.A. Barnes) Tektites: Dowden, Hutchinson & Ross, Inc., Stroudsburg, Pennsylvania, 445 p.
- (with M.A. Barnes) World-wide investigation of tektites continued: Lapidary Journal, v. 26, p. 18-48.
- (with W.C. Bell) Cambrian history, Llano region, in Univ. Texas, Austin, Bur. Econ. Geology Guidebook 13, p. 24-29.
- (with W.C. Bell, S.E. Clabaugh, P.E. Cloud, Jr., R.V. McGehee, P.U. Rodda, and Keith Young) Geology of the Llano region and Austin area: Univ. Texas, Austin, Bur. Econ. Geology, Guidebook 13, 77 p.
- (with S.E. Clabaugh) Geology of the Llano region and Austin area, road log, stops 1-7, in Univ. Texas, Austin, Bur. Econ. Geology, Guidebook 13, p. 47-59, 77.
- (with P.E. Cloud, Jr.) Ordovician to earliest Mississippian rocks, Llano region, in Univ. Texas, Austin, Bur. Econ. Geology, Guidebook 13, p. 30-37.
- (and G.K. Eifler, Jr.) Cartography of Quaternary deposits of Texas, in Etudes sur le Quaternaire dans le Monde, Mireille Ters, (ed.), Eighth INQUA Congress, Paris, 1969, p. 861-864.
- (with P.U. Rodda and Keith Young) Geology of the Llano region and Austin area, road log, stops 8-14, in Univ. Texas, Austin, Bur. Econ. Geology Guidebook 13, p. 60-77.
- 1974** (and others) Geologic Atlas of Texas—Austin sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Big Spring sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Brownfield sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—San Antonio sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Seguin sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with S.V. Margolis) Electron microprobe examination of inhomogeneities in tektites (abs.): West Berlin and Regensburg, Internat. Mineralog. Assoc., Collected Abstract, IMA, Ninth General Meeting, p. 149, 1974.
- 1975** (and others) Geologic Atlas of Texas—Beaumont-Bay City sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—San Angelo sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with S.S. Oriel) Stratigraphic Commission Note 43—Records of Stratigraphic Commission for 1972-1974: American Assoc. of Petroleum Geologists Bull., v. 59, p. 2031-2036.
- 1976** Geology of the Kingsland Quadrangle, Llano and Burnet Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geol. Quad. Map no. 41.
- (and others) Geologic Atlas of Texas—Brownwood sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Hobbs sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Laredo sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—McAllen-Brownsville sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Pecos sheet: Univ. Texas, Austin, Bur. Econ. Geology.
- (with Robert W. MacIay) Field trip road log, first day, October 30, 1976, stops 1-5, in Economic geology of south central Texas, a guidebook for the 1976 South Texas Geol. Soc. field trip, October 30-31: San Antonio, Texas, South Texas Geol. Soc., p. 6-35.
- (and S.V. Margolis) Cathode luminescence and microprobe studies of Libyan Desert glass and australites (abs.): Sydney, Australia, 25th Internat. Geol. Cong., Abstracts, p. 611, 1976.
- (and James R. Underwood, Jr.) New investigation of the strewn field of Libyan Desert glass and its petrography: Earth and Planetary Science Letters, v. 30, p. 117-122.
- (with Keith Young and W.R. Kaiser) Field trip road log, second day, October 31, 1976, stops 6-9, in Economic geology of south central Texas, a guidebook for the 1976 South Texas Geol. Soc. field trip, October 30-31: San Antonio, Texas, South Texas Geol. Soc., p. 36-57.
- 1977** Geology of the Cap Mountain Quadrangle, Llano County, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 45.
- Geology of the Click Quadrangle, Llano and Blanco Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geology, Geol. Quad. Map no. 43.
- Geology of Dunman Mountain Quadrangle, Llano, Burnet, and Blanco Counties, Texas: Univ. Texas, Austin, Bur. Econ. Geol. Quad. Map no. 44.
- (and others) Geologic Atlas of Texas—Clovis sheet, Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Crystal City - Eagle Pass sheet, Univ. Texas, Austin, Bur. Econ. Geology.
- (and others) Geologic Atlas of Texas—Del Rio sheet, Univ. Texas, Austin, Bur. Econ. Geology.
- (with W.C. Bell) The Moore Hollow Group of Central Texas: Univ. Texas, Austin, Bur. Econ. Geol. Rept. Inv. 88, 169 p.
- (with W.C. Bell) The Moore Hollow Group of Central Texas, Parts II and III: Univ. Texas, Austin, Bur. Econ. Geology (to be placed on open file).



L to R (seated): Marianne Moseley, Mark Presley. L to R (standing): Robert Handford, Shirley Dutton, Tom Calnan (back), Edgar Guevara, James Morabito

NEW RESEARCH STAFF MEMBERS

The Bureau research staff increased in 1976 with the addition of four persons and in 1977 with the addition of 10 persons. Their employment with the Bureau brings the total number of research scientists to 46. The diverse educational and professional backgrounds of these new staff members have measurably strengthened the Bureau's overall research efforts.

Mary A. Bauer

Mary A. Bauer joined the research staff of the Bureau in September 1977. Since that time, she has been working on basin and analysis projects in the Palo Duro Basin for the waste isolation project in the Texas Panhandle. Her research interests include carbonate environments, marine geology and micropaleontology, and computer analysis of geologic data.

Bauer received the B.A. (1975) and M.A. (1976) degrees in geology from Rice University. Her graduate research focused on computer analysis of living planktonic foraminiferal assemblages of the South Texas outer continental shelf. She has previously worked as geologist in subsurface exploration for the National Oil Corporation of Libya.

Thomas R. Calnan

Since joining the Bureau in March 1976, Thomas R. Calnan has been working as biologist for the State-owned submerged lands project. He received B.S. and M.S. degrees in biology from Texas A&M University. His main research interest is invertebrate ecology and taxonomy. He is a member of Phi Sigma.

Shirley P. Dutton

Shirley P. Dutton joined the Bureau in June 1977. Her initial research responsibilities have been with the Panhandle waste isolation project, for which she is doing subsurface basin analysis, genetic stratigraphy, and resource evaluation.

Dutton received a B.A. degree in geology from the University of Rochester in 1975 and an M.A. degree in geology from The University of Texas at Austin in 1977. Her graduate thesis focused on sandstone diagenesis and the relationship of porosity and cementation to depositional environments in sandstones of the Strawn Group in north-central Texas. Dutton is a member of the Geological Society of America, American Association of Petroleum Geologists, and the Society of Economic Paleontologists and Mineralogists.

Victor J. Gavenda

Victor J. Gavenda joined the Bureau staff in January 1977. He has been involved with the geopressured geothermal resource assessment project since that time. Specifically, Gavenda has worked on geothermal fairway delineation in the Wilcox Group and on the Frio Formation Austin Bayou Prospect in Brazoria County.

Gavenda received his B.A. degree in 1976 from Harvard University. His other research interests include sedimentary geology.

Alice B. Giles

Alice Giles joined the staff of the Bureau in September 1977. She is presently involved with the assessment of the suitability of East Texas salt domes for nuclear waste isolation. Her previous professional experience includes service as an environmental/engineering geologist with the U.S. Environmental Protection Agency and as consultant for oil and gas exploration efforts in southwest Kentucky.

Giles received her B.S. and B.A. degrees from Appalachian State University in North Carolina in 1974. She received her M.S. degree in geology in 1977 from George Washington University, where she was involved in research concerning the geology of an area in Jamaica. Giles is a member of the Geological Society of America.

A.R. Gregory

A.R. Gregory joined the Bureau in August 1976. His research activities since that time have been focused on engineering assessments of the production of geopressured geothermal energy from the Texas Gulf Coast. Additional research interests include reservoir engineering, well-log analysis, rock mechanics, and geophysics.

Gregory previously worked for Phillips Petroleum Company and Gulf Research and Development Company. He has extensive experience in laboratory wave propagation studies of subsurface cores under simulated subsurface environmental conditions. He received his B.S. degree in chemical engineering in 1938 from The University of Texas. He completed additional graduate work at the University of Pittsburgh and Gulf Research and Development Company.

Gregory is a member of the Society of Petroleum Engineers (AIME) and the Society of Exploration Geophysicists.

Edgar H. Guevara

Edgar Guevara was formerly associated with the Bureau of Economic Geology in 1974 and 1975. He rejoined the Bureau staff in September 1977. Guevara completed his bachelor's work in 1965 in Venezuela and received his M.A. and Ph.D. degrees in geology from The University of Texas at Austin in 1972 and 1974, respectively. His previous experience includes extensive work in subsurface oil and gas exploration in Venezuela, where he served as Head of Stratigraphic Section at Shell Venezuela (Now, Maraven, S.A.).

Guevara's research interests include basin analysis and the study of depositional systems as they relate to ground water and energy resources. His previous work at the Bureau included basin analysis of the late Tertiary and Quaternary sediments in the subsurface in the Galveston-Houston area. Currently, Guevara is a research scientist with the East Texas waste isolation project for which he is working on the geometry of interior salt domes of East Texas and their regional stratigraphic and tectonic framework.

C. Robertson Handford

Dr. Handford is currently involved in basin analysis of the Lower Permian in the Texas Panhandle waste isolation project. He joined

the Bureau in November 1977. Handford was previously employed as a research geologist with Union Oil Company in Brea, California.

Handford received his B.S. degree in 1967 from Northeast Louisiana State College, his M.S. degree in 1969 from the University of Arkansas, and the Ph.D. degree from Louisiana State University in 1976. Graduate research for his Ph.D. degree concerned the sedimentology and diagenesis of Mississippian oolitic limestones in the southern Appalachian Mountains.

Jon P. Herber

Jon Herber joined the Bureau research staff in September 1976. Since that time, he has been involved in the Bureau's State-owned submerged lands program, both bay and shelf phases. He was previously employed with AMAX as geologist investigating the feasibility for uranium deposits in the Triassic Dockum Group.

Herber received a B.S. degree from Monmouth College in Illinois in 1973. He has also taken advanced graduate courses in geology at The University of Texas at Austin. He is a member of the Society of Economic Paleontologists and Mineralogists.

C. Russell Lewis

C. Russell Lewis rejoined the Bureau staff in 1975; his former service was from September 1972 to September 1973. Lewis has been involved with several programs including, among others, the Matagorda Bay Project, faulting and subsidence in the Houston-Galveston area, and, most recently, the State-owned submerged lands project.

Lewis received his B.A. degree in geology in 1972 from The University of Texas at Austin. His general research interests include coastal processes and environmental geology.

James R. Morabito

James R. Morabito joined the Bureau in October 1977. He has since been investigating geomorphic processes for the surface and shallow stratigraphy group on the waste isolation project, in the Texas Panhandle. He was previously employed by the New Zealand Soil Bureau, D.S.I.R. (1975), where he worked on a micro-earthquake study of urban areas north of Wellington, New Zealand.

Morabito received his B.S. degree in geology from Wayne State University in 1974. Currently, he is finishing his M.S. thesis concerning a nearshore, marine clastic sequence of Middle Cambrian age in central Nevada. He is a member of the Michigan Basin Geological Society.

Marianne G. Moseley

Marianne G. Moseley has been working on sandstone diagenesis and its relationship to reservoir porosity since joining the Bureau in September 1977. Her other research interests center on geochemistry.

Moseley received her B.S. degree from the College of William and Mary in 1975 and her M.S. degree from The University of Texas at Austin in 1977. She is a member of the American Association of Petroleum Geologists.

Mark W. Presley

Mark W. Presley joined the Bureau staff in August 1977, and is involved in basin analysis of the Palo Duro and Dalhart basins of the Texas Panhandle. He previously was employed at West Virginia University, where he was a Research Associate with the coal exploration program of the Department of Geology.

Presley received a B.A. degree (1968) in geology from Franklin and Marshall College, and an M.S. (1971) from the University of Montana. He received his Ph.D. (1977) from West Virginia University, where he conducted research on a depositional systems analysis of Upper Mississippian (Mauch Chunk Group) and Lower Pennsylvanian (Pottsville Group and Allegheny Formation) sediments of northern West Virginia.

Presley's research interests include genetic stratigraphy and the analysis of depositional systems both in the subsurface and in outcrop. He is a member of the Society of Economic Paleontologists and Mineralogists and the Geological Society of America.

Vicki A. Verros

Vicki A. Verros joined the Bureau in November 1977, and has been investigating structural stability of East Texas interior salt domes for the East Texas waste isolation

project. Her other research interests include coastal geology, barrier island development, and sedimentation. Verros graduated from the University of Georgia in 1977 with a B.S. degree in geology.

PAPERS BY BUREAU OF ECONOMIC GEOLOGY STAFF IN OUTSIDE PUBLICATIONS

Bebout, D.G., 1977, Geological parameters used in geopressed geothermal fairway evaluation and test-well site location, Frio Formation, Texas Gulf Coast: The University of Southwestern Louisiana, Center for Energy Studies, Third Geopressed Geothermal Energy Conference, Proceedings.

Bebout, D.G., 1977, Geothermal resources, Texas Gulf Coast (abstract): Ninth Petrochemical and Refining Exposition, Program, 83d National Meeting, p. 66-67.

Bebout, D.G., 1977, Sligo and Hosston depositional patterns, subsurface of South Texas (abstracts): American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1551; Gulf Coast Association of Geological Societies, Transactions, v. 27, p. 435.

Bebout, D.G., 1977, Subsurface techniques for locating and evaluating geopressed geothermal reservoirs along the Texas Gulf Coast, in Campbell, Michael D., ed., Geology of alternate energy resources in the south-central United States: Houston, Texas, Houston Geological Society, chapter 12, p. 251-273.

Bebout, D.G., and **Loucks, R.G.**, 1977, Geopressed geothermal energy from the Frio Formation, Texas Gulf Coast—Review of ideal and actual prospects (abstract): Geological Society of America, Abstracts with Programs, v. 9, no. 1, p. 4.

Bebout, D.G., **Loucks, R.G.**, and **Gregory, A.R.**, 1977, Study looks at Gulf Coast geothermal potential: Oil and Gas Journal, v. 75, no. 40, p. 96-99.

Bebout, D.G., **Loucks, R.G.**, and **Gregory, A.R.**, 1977, Test site for geopressed geothermal well—Frio sandstone, Texas Gulf Coast (abstracts): American Association of Petroleum Geologists Bulletin, v. 61, no. 5, p. 765; AAPG/SEPM Program and Abstracts, 1977 Annual Meeting, p. 60.

Bebout, D.G., Loucks, R.G., and Gregory, A.R., 1977, Texas geothermal prospect slated to begin operations at Martin Ranch: *Oil and Gas Journal*, v. 75, no. 41, p. 184-187.

Bebout, D.G., Schatzinger, R.A., and Loucks, R.G., 1977, Porosity distribution in the Stuart City Trend, Lower Cretaceous, South Texas (abstract): *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 436.

Bebout, D.G., and Schatzinger, R.A., 1977, Regional Cretaceous cross sections—South Texas (abstract): *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 435.

Bebout, D.G., and Loucks, R.G. (with Dorfman, M.H., Deller, R., Howard, J., and House, P.), 1977, Evaluation of the geopressed geothermal resources of the Texas Gulf Coast: *American Nuclear Society, Energy and Mineral Recovery Conference, Proceedings*.

Brown, L.F., Jr., Bailey, S.W., Cline, L.M., and Lister, J.S., 1977, Clay mineralogy in relation to deltaic sedimentation patterns of Des Moinesian cyclothems in Iowa-Missouri: *Clays and Clay Mineralogy*, v. 25, p. 171-186.

Brown, L.F., Jr., and Fisher, W.L., 1977, Seismic-stratigraphic interpretation of depositional systems—examples from Brazilian rift and pull-apart basins, *in* *Seismic stratigraphy*: Tulsa, Oklahoma, American Association of Petroleum Geologists, *Memoir* 26, p. 00.

Brown, L.F., Jr. (with Ricoy, J.U.), 1977, Depositional systems in the Sparta Formation (Eocene) Gulf Coast of Texas: *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 139-154.

Dutton, S.P., 1977, Diagenesis and porosity distribution in deltaic sandstone, Strawn Series (Pennsylvanian), north-central Texas: *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 272-277.

Evans, T.J., 1977, Principal bituminous coal deposits in Texas (abstract): *Geological Society of America, Abstracts with Programs*, v. 9, no. 1, p. 17-18.

Finley, R.J., 1977, Impacts of urban developments in coastal areas—an evaluation of ongoing change affecting environmental geologic

mapping in the Texas Coastal Zone (abstract): *Estuarine Research Foundation, Fourth Biennial Estuarine Research Conference, Abstracts*, p. 9-10 (Unnum.).

Finley, R.J., and Baumgardner, R., Jr., 1977, Landsat study of nearshore circulation off Aransas Pass, Texas (abstract): *American Association of Petroleum Geologists Bulletin*, v. 61, no. 5, p. 783.

Finley, R.J., and Humphries, S.M., 1977, Morphologic development of North Inlet, South Carolina, *in* Hayes, M.O., and Kana, T.W., eds., *Terrigenous clastic depositional environments*: Columbia, South Carolina, University of South Carolina, Department of Geology, Technical Report 11-CRD, p. II 172-184.

Fisher, W.L., coordinator, 1977, Mining and minerals policy—1977 annual report of the Secretary of Interior under the Mining and Minerals Policy Act of 1970: U.S. Department of the Interior, Washington, D.C., U.S. Government Printing Office, 154 p.

Fisher, W.L., 1977, Issues in mining policy—what to expect from Washington: *National Western Mining Conference, Mining Yearbook*, p. 68-70.

Fisher, W.L., 1977, Ocean mining: testimony before U.S. House of Representatives, 95th Congress, *in* *Deep seabed mining, hearings before the Subcommittee on Oceanography and the Committee on Merchant Marine and Fisheries*, House of Representatives, Serial No 95-4: Washington, D.C., U.S. Government Printing Office, p. 110-129.

Fisher, W.L., 1977, Our unprecedented task in energy—avoiding a decade of decline: *Interstate Oil Compact Commission Bulletin*, v. 19, no. 1, p. 48-52.

Fisher, W.L., Galloway, W.E., Kaiser, W.R., and Morton, R.A., 1977, The National Energy Plan—projected impacts on future Texas oil and gas production and value, *in* *Preliminary assessment of the President's National Energy Plan*, May 11, 1977: Austin, Texas, The University of Texas at Austin, p. 137-161.

Fisher, W.L., (with Rostow, W.W., and Kosmetsky, G.), 1977, Energy for the future: *Discovery*, v. 2, no. 1, p. 4-9.

Fisher, W.L. (with Rostow, W.W., and Kosmetsky, G.), 1977, The National Energy Plan—an overview, *in* *Preliminary assessment of the President's National Energy Plan*, May 11, 1977: Austin, Texas, The University of Texas at Austin, p. 1-35.

Fisher, W.L. (with Rostow, W.W., and Woodson, H.H.), 1977, National energy policy—an interim overview: *Council on Energy Resources*, The University of Texas at Austin, 72 p.

Galloway, W.E., 1977, Uranium host depositional systems of Texas Gulf Coastal Plain—influence of genetic factors on mineralization pattern (abstracts): *American Association of Petroleum Geologists Bulletin*, v. 61, no. 9, p. 1536-1537; *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 245.

Galloway, W.E., Yancey, M.S., and Whipple, A.P., 1977, Seismic stratigraphic model of depositional platform margin, eastern Anadarko basin: *American Association of Petroleum Geologists Bulletin*, v. 61, no. 9, p. 1437-1447; and *in* *Seismic stratigraphy*: Tulsa, Oklahoma, American Association of Petroleum Geologists, *Memoir* 26, p. 00.

Galloway, W.E. (with Belcher, R.C.), 1977, Evidence for early Tertiary Rio Grande drainage (abstract): *Geological Society of America, Abstracts with Programs*, v. 9, no. 1, p. 5.

Girard, R. (with Hawkins, M.E.), 1977, The mineral industry of Texas, *in* *Minerals Yearbook*, 1974, v. II: United States Department of the Interior, Bureau of Mines (preprint, November 1977), 37 p.

Gregory, A.R., 1977, Aspects of rock physics from laboratory and log data that are important to seismic interpretation, *in* *Seismic stratigraphy*: Tulsa, Oklahoma, American Association of Petroleum Geologists, *Memoir* 26, p. 00.

Gregory, A.R., 1977 Engineering parameters used in geopressed geothermal fairway evaluation and test-well site location, Frio Formation, Texas Gulf Coast: The University of Southwestern Louisiana, Center for Energy Studies, Third Geopressed Geothermal Energy Conference, *Proceedings*.

Gustavson, T.C., 1977, Bedforms and stratification types of modern gravel meander lobes, Nueces River, Texas (abstract): Canadian Society of Petroleum Geologists and the University of Calgary, First International Symposium on Fluvial Sedimentology, Programs and Abstracts, p. 11-12.

Gustavson, T.C., 1977, Paleotemperature analysis of the marine Pleistocene of Long Island, New York, and Nantucket Island, Massachusetts—reply to discussion: Geological Society of America Bulletin, v. 89, p. 159-160.

Gustavson, T.C., and Kreitler, C.W., 1977, Geothermal resources of the Texas Gulf Coast—environmental concerns arising from the production and disposal of geothermal waters, in Campbell, Michael D., ed., Geology of alternate energy resources in south-central United States: Houston, Texas, Houston Geological Society, Chapter 14, p. 297-335.

Gustavson, T.C., McGraw, M.M., Tandy, R.M., Parker, Faust, and Wohlschlag, D.E., 1977, Potential environmental effects arising from the development of geopressed geothermal energy along the Texas-Louisiana Gulf Coast: The University of Southwestern Louisiana, Center for Energy Studies, Third Geopressed Geothermal Energy Conference, Proceedings.

Henry, C.D., 1977, Geologic setting of hot springs, Trans-Pecos Texas and adjacent Mexico (abstract): Geological Society of America, Abstracts with Programs, v. 9, no. 1, p. 25.

Kaiser, W.R., and Groat, C.G., 1977, Texas lignite (abstract): American Association of Petroleum Geologists Bulletin, v. 61, no. 5, p. 801-802.

Kaiser, W.R. (with Edgar, T.F., Thompson, T.W., Gray, K.E., and Humenick, M.J.), 1977, In situ conversion of Texas lignite to synthetic fuels, semi-annual report no. 4 to the National Science Foundation, RANN Division: Austin, Texas, The University of Texas at Austin, Department of Chemical Engineering, 148 p.

Kaiser, W.R. (with Edgar, T.F., Thompson, T.W., Gray, K.E., and Humenick, M.J.), 1977, In situ conversion of Texas lignite to synthetic fuels, semi-annual report no. 5 to the National Science Foundation, RANN Division: Austin,

Texas, The University of Texas at Austin, Department of Chemical Engineering, 120 p.

Kaiser, W.R. (with Edgar, T.F., and Thompson, T.W.), 1977, Research on in situ gasification of Texas lignite at The University of Texas, in Shuck, L.Z., ed., Second Annual Underground Coal Gasification Symposium, Proceedings: Morgantown, West Virginia, U.S. Energy Research and Development Administration, Energy Research Center, MERC/SP-76/3, p. 90-95.

Kaiser, W.R. (with Groat, C.G.), 1977, Texas lignite: utilization and geology (abstract): Geological Society of America, Abstracts with Programs, v. 9, no. 1, p. 24.

Kaiser, W.R. (with Edgar, T.F.), 1977, The potential of in situ lignite gasification in Texas, in Campbell, Michael D., ed., Geology of alternate energy resources in south-central United States: Houston, Texas, Houston Geological Society, p. 179-192.

Kier, R.S., Garner, L.E., and Brown, L.F., Jr., 1977, Application of the Texas land resources map: Gulf Coast Association of Geological Societies, Transactions, v. 27, p. 69-71. Abstract, with title, Land resources of Texas, in American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1539.

Kreitler, C.W., 1977, Fault control of land subsidence, Houston-Galveston, Texas: Ground Water, v. 15, no. 3, p. 203-214.

Kreitler, C.W., 1977, Faulting and land subsidence from ground water and hydrocarbon production, Houston-Galveston, Texas: Anaheim, California, Second International Symposium of Land Subsidence, Proceedings, IAHS-AISH Pub. no. 121, p. 435.

Kreitler, C.W., 1977, Nitrogen isotopes of soil and ground-water nitrate, Lockhart and Taylor alluvial fans, Central Texas (abstract): Geological Society of America, Abstracts with Programs, v. 9, no. 7, p. 1058.

Kreitler, C.W., Guevara, E., Granata, G., and McKalips, D., 1977, Hydrology of Gulf Coast aquifers, Houston-Galveston Area, Texas: Gulf Coast Association of Geological Societies, Transactions, v. 27, p. 72-89. Abstract, with

title, Geometry of Gulf Coast aquifers, Houston-Galveston, Texas, in American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1539.

Kreitler, C.W., Ragone, S.E., and Katz, B., 1977, Nitrogen isotope ratios of ground-water nitrate, Long Island, New York (abstract): Ground Water, v. 15, no. 4, p. 322.

Loucks, R.G., 1977, Incomplete carbonate cementation—principal factor in development of porosity (abstract): American Association of Petroleum Geologists Bulletin, v. 61, no. 5, p. 809-810.

Loucks, R.G., 1977, Porosity development and distribution in shoal-water carbonate complexes—subsurface Pearsall Formation (lower Cretaceous), South Texas (abstracts): American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1554; Gulf Coast Association of Geological Societies, Transactions, v. 27, p. 441.

Loucks, R.G., Bebout, D.G., and Galloway, W.E., 1977, Relation of porosity formation and preservation to sandstone consolidation history—Gulf Coast lower Tertiary Frio Formation: Gulf Coast Association of Geological Societies, Transactions, v. 27, p. 109-120. Abstract, with title, Consolidation history of Gulf Coast lower Tertiary sandstone reservoirs, in American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1541.

Loucks, R.G., and Mosely, M.G., 1977, Factors controlling geopressed geothermal reservoir quality—Frio sandstone facies, Texas Gulf Coast: The University of Southwestern Louisiana, Center for Energy Studies, Third Geopressed Geothermal Energy Conference, Proceedings.

Loucks, R.G. (with Scott, A.J., Bebout, D.G., and Mench, P.A.), 1977, Lower Cretaceous carbonate tidal facies, Austin, Texas, area: Gulf Coast Association of Geological Societies, Field Trip Guidebook, 45 p.

McGowen, J.H., Granata, G.E., and Seni, S.J., 1977, Depositional framework of the lower Dockum Group (Triassic), Texas Panhandle (abstracts): American Association of Petroleum Geologists Bulletin, v. 61, no. 9, p. 1542; Gulf

Coast Association of Geological Societies, Transactions, v. 27, p. 246.

McGowen, J.H. (with **Wilkinson, B.H.**), 1977, Geologic approaches to the determination of long-term coastal recession rates, Matagorda Peninsula, Texas: *Environmental Geology*, v. 1, p. 359-365.

McKalips, D.G., Kreidler, C.W., and Muller, D.A., 1977, Horizontal resistivity profiles across surface faults, Texas Coastal Zone (abstract): *Geological Society of America, Abstracts with Programs*, v. 9, no. 1, p. 64.

Morton, Robert A., 1977, Aerial photograph interpretation of high-velocity wind-driven currents (abstract): *American Association of Petroleum Geologists Bulletin*, v. 61, no. 5, p. 816.

Morton, Robert A., 1977, Effects of Hurricane Eloise on beach and coastal structures, Florida Panhandle: *Geology*, comment and reply, v. 4, p. 633-635; *idem*, comment and reply, v. 5, p. 61-63.

Morton, Robert A., 1977, Historical shoreline changes and their causes, Texas Gulf Coast: *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 352-364. Abstract, *American Association of Petroleum Geologists Bulletin*, v. 61, no. 9, p. 1543.

Morton, Robert A., 1977, Large-scale rhomboid bedforms and sedimentary structures associated with hurricane washover: *Sedimentology*, v. 24, no. 6.

Morton, Robert A., 1977, Nearshore changes at jettied inlets, Texas Coast: *American Society of Civil Engineers, Coastal Sediments '77 Symposium, Proceedings*, p. 267-286.

Morton, Robert A., 1977, Paleohydrology of a Pennsylvanian fluvial channel compared with a Modern analogue (abstract): *Canadian Society of Petroleum Geologists and the University of Calgary, First International Symposium on Fluvial Sedimentology, Program and Abstracts*, p. 22.

Wermund, E.G., and Woodruff, C.M., Jr., 1977, Land resource units for planning in carbonate terranes, *in* Tolson, J.S., and Doyle, F.L., eds., *Karst hydrogeology*: Huntsville, Alabama, *International Association of Hydro-*

geologists, Proceedings of 12th International Congress, Memoirs v. 12, p. 339-353.

White, William A., McGraw, Maryann, and Gustavson, Thomas C., 1977, Preliminary environmental analysis of a geopressed geothermal test well in Brazoria County, Texas: *The University of Southwestern Louisiana, Center for Energy Studies, Third Geopressed Geothermal Energy Conference, Proceedings*.

Woodruff, C.M., Jr., 1977, Stream piracy near the Balcones fault zone, Central Texas: *Journal of Geology*, v. 85, no. 4, p. 483-490.

Woodruff, C.M., Jr., and Longley, William L., 1977, Statics and dynamics of natural systems—a genetic basis for assessing environmental impacts (abstracts): *American Association of Petroleum Geologists Bulletin*, v. 61, no. 9, p. 1550; *Gulf Coast Association of Geological Societies, Transactions*, v. 27, p. 250.

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 prime method of disseminating the results of Bureau research is through publication, formal and informal lectures are important means of presenting information prior to final publication.

Following are lectures given by Bureau staff members during 1977.

D.G. Bebout

Evaluation of the geopressed geothermal resource along the Texas Gulf Coast—regional assessment to site selection: presented at Geopressed Geothermal Industrial Workshop (sponsored by U.S. Energy Research and Development Administration and C.K. Geopressure Corporation), Dallas, Texas.

Exploration for a geothermal reservoir in the geopressed zone, Texas Gulf Coast: presented at Dallas Geological Society, Meeting,

Dallas, Texas; North Texas Geological Society, Meeting, Wichita Falls, Texas; and Society of Economic Paleontologists and Mineralogists, Permian Basin Section, Meeting, Midland, Texas.

Geological parameters used in geopressed geothermal fairway evaluation and test-well site location, Frio Formation, Texas Gulf Coast: presented at Third Geopressed Geothermal Energy Conference, held at the Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana.

Geopressed geothermal energy from the Frio Formation, Texas Gulf Coast—review of ideal and actual prospects: presented at Geological Society of America, South-Central Section, Annual Meeting, El Paso, Texas.

Geothermal resources—Texas Gulf Coast: presented at American Institute of Chemical Engineers, 83d National Meeting, Houston, Texas.

Natural gas in the geopressed zone: presented at Fall Conference of the National Association of Petroleum Investment Analysts, Tampa, Florida.

Sligo and Hosston depositional patterns, subsurface of South Texas: presented at Gulf Coast Association of Geological Societies, Cretaceous Carbonate Symposium, Austin, Texas.

Test site for geopressed geothermal well—Frio Formation, Texas Gulf Coast: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.

L.F. Brown, Jr.,

Depositional systems of Pennsylvanian age on the Eastern Shelf of the West Texas Basin: presented before Department of Geology, Texas Christian University, Fort Worth, Texas.

Environmental geologic programs of the Bureau of Economic Geology: presented before Geology Club at Texas Christian University, Fort Worth, Texas.

Principles of seismic stratigraphy: presented before classes (Geology 365K and 265M) at the Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

Shirley P. Dutton

Diagenesis and porosity distribution in deltaic sandstone, Strawn Series (Pennsylvanian) north-central Texas: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Thomas J. Evans

Geology of McKinney Falls State Park and the Pilot Knob area: presented (twice) at McKinney Falls State Park (sponsored by McKinney Falls State Park and Bureau of Economic Geology), Austin, Texas.

Principal bituminous coal deposits in Texas: presented at Geological Society of America, South-Central Section, Annual Meeting, El Paso, Texas.

Texas mineral and energy resources—their nature, use, and impact on the environment: presented at Environmental Education Workshop (Abilene Christian University), Abilene, Texas.

Robert J. Finley

Impacts of urban developments in coastal areas—an evaluation of ongoing change affecting environmental geologic mapping in the Texas Coastal Zone: presented at Fourth Biennial Estuarine Research Conference (sponsored by Estuarine Research Foundation), Mt. Pocono, Pennsylvania.

A Landsat study of nearshore circulation off Aransas Pass, Texas: presented at American Association of Petroleum Geologists, Annual Meeting, Washington, D.C.

Wind-generated longshore currents: presented at Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.

W.L. Fisher

Alternatives in energy policy: presented to Association of Physics Students, The University of Texas at Austin.

America's energy future: presented at Texas Academy of Science, Annual Meeting Banquet, Waco, Texas.

The challenge of domestic energy sufficiency: presented at Southern Illinois, Inc., Banquet, Southern Illinois University, Carbondale, Illinois.

Coal and hard minerals in Texas: presented at Austin Kiwanis Club, Meeting, Austin, Texas.

The dilemma in energy: presented at Northwest Republican Women, Meeting, Austin, Texas.

Elements of National Energy Policy: presented at Association of Public Administrators, Austin Chapter, Meeting, Austin, Texas.

The energy agenda for Texas: presented at Second Annual Texas Energy Policy Conference, Austin, Texas.

Energy and growth: presented at Lyndon B. Johnson Library and Lyndon B. Johnson School of Public Affairs, Symposium on Alternatives to Confrontation, Austin, Texas.

Energy and the future of geology: presented at University of Oklahoma, Norman, Oklahoma.

Energy availability and supply: presented at Southern Seedsmen's Association, Annual Meeting, Houston, Texas.

Energy from the Rockies: presented at American Association for the Advancement of Science, Symposium on Energy from the Rockies, Denver, Colorado.

Energy in Texas—dimensions of the future: presented at Industrial Research Council, Area/Industry Conference, San Antonio, Texas.

Energy in Texas—what lies ahead: presented at Town and Gown Meeting, Austin, Texas.

Energy position of the South in the National picture: presented at Southern Legislative Conference, Annual Meeting, Charleston, South Carolina.

Energy—the role of Texas in the National program: presented at Third Annual West Texas Conference on State Affairs, San Angelo, Texas.

Energy, water, and politics: presented at 22d Midwest Ground-Water Conference, Little Rock, Arkansas.

The hard road back to coal: presented at Energy Sound-Off, Americans for Energy Independence, Houston, Texas.

Issues in National minerals policy: presented at Asilomar Conference on Contingency Planning for Materials Resources, Pacific Grove, California.

A look at the President's National Energy Plan: presented at International Association of Geophysical Contractors, Annual Meeting, Houston, Texas.

The main issues in the current energy debate: presented at West Austin Rotary Club, Meeting, Austin, Texas.

Midway in the National Energy Plan: presented at Texas Independent Producers and Royalty Owners Association, Meeting, El Paso, Texas.

The National Energy Plan—an imbalance in supply and demand: presented at Americans for Energy Independence, Meeting, Austin, Texas.

The National Energy Plan at a glance: presented at Austin Geological Society, Meeting, Austin, Texas.

National energy policy: presented at American Association of Petroleum Geologists, Southwest Section, Annual Meeting, Abilene, Texas.

National energy production issues: presented at National Savings and Loan League, Business Development Meeting, April Sound, Texas.

National policy issues impacting mining: presented at National Western Mining Conference, Denver, Colorado.

Natural hazards in coastal regions: presented at Cousteau Involvement Day, Conference, Houston, Texas.

Our challenge in resources—avoiding a decade of decline: presented at American Society of Engineering Education, Symposium, Grand Forks, North Dakota.

Our continuing crises in energy: presented at University of Texas Alumni College 77, Austin, Texas.

Production requirements under the National Energy Plan: presented at Association of American State Geologists, Annual Meeting, University of Delaware, Newark, Delaware.

Seismic stratigraphy in oil and gas exploration: American Association of Petroleum Geologists Short Course, Permian Basin Graduate Center, Midland, Texas.

Texas and energy—a concern of the public sector: presented at Geology Building Dedication, West Texas State University, Canyon, Texas.

Texas and lignite—projections and uncertainties: presented at Pioneer Oil Producers Society, Meeting, Houston, Texas.

U.S. and Texas energy problems: presented at Texas State Historical Association, Institute, Austin, Texas.

William E. Galloway

Depositional systems and shelf-slope transition, Cisco Group, Eastern Shelf of Midland Basin: presented at Abilene Geological Society, Meeting, Abilene, Texas.

Relationships between depositional system, ground-water flow history, and origin migration and concentration of uranium—Catahoula Formation of Texas Coastal Plain: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Rocky Mountain Section, Annual Meeting, Denver, Colorado; and by invitation at the Geological Society of America and Society of Economic Geologists, Annual Meeting, Seattle, Washington.

Sandstone diagenesis in arc-related basins—significance for exploration potential: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Rocky Mountain Section, Annual Meeting, Denver, Colorado.

Uranium host depositional systems of Texas Gulf Coastal Plain—influence of genetic facies on mineralization pattern: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

L.E. Garner

Geologic history of the Balcones fault zone: presented at dedication of Balcones fault zone historical marker (sponsored by Daughters of the American Colonists), Austin, Texas.

Land resource mapping and map compilation: presented before graduate class in Urban Planning at the School of Architecture, The University of Texas at Austin, Austin, Texas.

Projects and progress of the Bureau of Economic Geology: presented at Soil Survey Technical Work-Planning Conference (sponsored by Texas A&M University), College Station, Texas.

Relationships of soils and geologic formations, Texas: presented at Soil Survey Technical Work-Planning Conference (sponsored by Texas A&M University), College Station, Texas.

A.R. Gregory

Engineering parameters used in geopressed geothermal fairway evaluation and test-well site location, Frio Formation, Texas Gulf Coast: presented at Third Geopressed Geothermal Energy Conference, held at the Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana.

Relationship between physical and elastic properties of rocks and effect of subsurface environment: presented before class in geology (Geology 365K), at the Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

Thomas C. Gustavson

Environmental implications of geopressed geothermal energy development, Texas-Louisiana Gulf Coast: presented at Third Geopressed Geothermal Energy Conference held at the Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana.

Nueces River hydrology and bedforms: presented at First International Symposium on Fluvial Sedimentology (sponsored by the Canadian Society of Petroleum Geologists and the University of Calgary), Calgary, Alberta, Canada.

Preliminary environmental analysis of a geopressed geothermal test well in Brazoria County, Texas: presented at Third Geopressed Geothermal Conference held at the Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana.

W.R. Kaiser

Electric power generation from Texas lignite: presented at the 1977 Lignite Symposium (sponsored by Grand Forks Energy Research Center of U.S. Energy Research and Development Administration and the University of North Dakota), Grand Forks, North Dakota.

Geology and utilization of Texas lignite: presented at Society of Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Texas Gulf Coast Section, 137th Meeting, Houston, Texas.

Sand body geometry and the occurrence of lignite in the Eocene of Texas: presented at

1977 Symposium on the Geology of Rocky Mountain Coal (sponsored by Colorado Geological Survey and U.S. Geological Survey), Golden, Colorado.

Texas lignite: presented at American Association of Petroleum Geologists, Annual Meeting, Washington, D.C.

Robert S. Kier

Application of the Texas land resources map: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Land resources of Texas: presented at Fort Worth Geological Society, Meeting, Fort Worth, Texas.

Charles W. Kreidler

Hydrogeology of Gulf Coast aquifers, Houston-Galveston, Texas: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Nitrogen isotope ratios of ground-water nitrate, Long Island, New York: presented at National Water Well Association, Annual Technical Division Meeting, Boston, Massachusetts.

Nitrogen isotopes of soil and ground-water nitrate, Lockhart and Taylor alluvial fans, Central Texas: presented at Geological Society of America, Annual Meeting, Austin, Texas.

Robert G. Loucks

Deep subsurface dolomitization in carbonates by mixing of brines and low-salinity fluids from diagenetic dewatering of laterally equivalent shales: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.

Evaluation of geopressed geothermal fairways along the Texas Gulf Coast: presented at Conference on Request for Proposals from Industry to Investigate and Evaluate Geothermal Geopressed Wells (sponsored by U.S. Energy Research and Development Administration), Houston, Texas.

Factors controlling geopressed geothermal reservoir quality—Frio Sandstone facies, Texas Gulf Coast: presented at Third Geopressed Geothermal Energy Conference, held at the

Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana.

Geology of the Austin Bayou geopressed geothermal prospect, Brazoria County, Texas: presented at Geopressed Geothermal Industrial Workshop (sponsored by U.S. Energy Research and Development Administration and C.K. Geoenergy Corporation), Dallas, Texas.

Incomplete carbonate cementation—a principal factor in development of porosity: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.

Porosity development and distribution in shoal-water carbonate complexes—subsurface Pearsall Formation (Lower Cretaceous), South Texas: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Relationship of porosity formation and preservation to sandstone consolidation history—Gulf Coast Tertiary Frio Formation: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

J.H. McGowen

Depositional framework of the lower Dockum Group (Triassic), Texas Panhandle: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Triassic lacustrine deltas: presented at the Department of Geology of the University of Houston, Houston, Texas.

Dawn G. McKalips

Horizontal resistivity profiles across surface faults, Texas Coastal Zone: presented at Geological Society of America, South Central Section, Annual Meeting, El Paso, Texas.

Robert A. Morton

Aerial photograph interpretation of high velocity wind-driven currents: presented at American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.

Historical shoreline changes and their causes, Texas Gulf Coast: presented at Gulf Coast Association of Geological Societies, Annual

Meeting, Austin, Texas; and at Austin Geological Society, October Meeting, Austin, Texas.

Paleohydrology of a Pennsylvanian fluvial channel compared with a Modern analogue: presented at First International Symposium on Fluvial Sedimentology (sponsored by the Canadian Society of Petroleum Geologists and the University of Calgary), Calgary, Alberta, Canada.

Patterns of sedimentation and erosion and associated shoreline changes at major jettied inlets, Texas Gulf Coast: presented at Coastal Sediments '77 Symposium (sponsored by the American Society of Civil Engineers), Charleston, South Carolina.

Surface and shallow subsurface geology of the Texas Inner Continental Shelf: presented at Society of Economic Paleontologists and Mineralogists, Permian Basin Section, Monthly Meeting, Midland, Texas.

Ann E. St. Clair

Bureau of Economic Geology research and job opportunities for women in geology: presented at meeting of geology majors, Department of Geology, Trinity University, San Antonio, Texas.

Hydrogeology of the Barton Creek watershed: presented to class in Urban Planning at the School of Architecture, The University of Texas at Austin, Austin, Texas.

Texas energy resources and environmental geology: presented to Travis High School Science Club, Austin, Texas.

E.G. Wermund

Bureau of Economic Geology program to examine Texas Panhandle for potential isolation of nuclear waste: presented at Panhandle Geological Society, Meeting, Amarillo, Texas.

Missourian limestones in north-central Texas: presented at Abilene Geological Society, Meeting, Abilene, Texas.

C.M. Woodruff, Jr.

Convergence of disciplines—questions posed in studying natural systems: presented to Analytical/Inorganic Research Group Seminar, Department of Chemistry, The University of Texas at Austin, Austin, Texas.

Geomorphic factors affecting archaeological surveys: presented at Field Course in Archaeology at Saint Mary's Hall (sponsored by The University of Texas at San Antonio), San Antonio, Texas.

Land resources of Kendall County: presented at public meeting convened by the County Judge of Kendall County, Boerne, Texas.

Significant geologic resources of Fayette County: presented at the Fayette County Arts Forum (sponsored by the Capital Area Planning Council), La Grange, Texas.

Statics and dynamics of natural systems—a genetic basis for assessing environmental impacts: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas.

Uncertainty and environmental impacts—information needs for coastal management: presented at Offshore Oil—Dialogues Toward Understanding, Conference (sponsored by General Land Office of Texas, Environmental Policy Center, Inc., American Petroleum Institute, and League of Women Voters of Texas), Galveston, Texas.

MEETINGS ATTENDED

Staff members represented the Bureau of Economic Geology or The University of Texas at numerous scientific and professional meetings in 1977. Principal meetings attended during the year included:

American Association for the Advancement of Science, Symposium on Energy from the Rockies, Denver, Colorado—W.L. Fisher.

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Washington, D.C.—Don G. Bebout, Robert J. Finley, William R. Kaiser, Robert G. Loucks, Robert A. Morton, Mark W. Presley.

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Rocky Mountain Sections, Annual Meeting, Denver, Colorado—Don G. Bebout, William E. Galloway, Robert G. Loucks.

American Association of Petroleum Geologists, Southwest Section, Annual Meeting, Abilene, Texas—W.L. Fisher.

American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, Atlanta, Georgia—Thomas J. Evans.

American Society of Engineering Education, Annual Meeting, Grand Forks, North Dakota—W.L. Fisher.

Association of American State Geologists, Annual Meeting, Newark, Delaware—W.L. Fisher, E.G. Wermund.

Coastal Sediments, '77 Symposium (sponsored by the American Society of Civil Engineers), Charleston, South Carolina—Robert A. Morton.

Consortium of Universities and Departments Interested in an Integrated Proposal to ERDA for Shelf Research, Conference, College Station, Texas—L.F. Brown, Jr.

Contingency Planning for Material Resources, Conference, Pacific Grove, California—W.L. Fisher.

Estuarine Research Foundation, Fourth Biennial Estuarine Research Conference, Mt. Pocono, Pennsylvania—Robert J. Finley.

Fluvial Sedimentology, First International Symposium (sponsored by the Canadian Society of Petroleum Geologists and the University of Calgary), Calgary, Alberta, Canada—Thomas C. Gustavson, Robert A. Morton.

Geological Society of America Annual Meeting, Seattle, Washington—William E. Galloway, Charles W. Kreitler, E.G. Wermund.

Geological Society of America, South-Central Section, Annual Meeting, El Paso, Texas—Don G. Bebout, Thomas J. Evans, Christopher D. Henry, Robert G. Loucks, J.H. McGowen, Dawn G. McKalips.

Geology of Rocky Mountain Coal, 1977 Symposium (sponsored by Colorado Geological Survey and U.S. Geological Survey), Golden, Colorado—William R. Kaiser.

Geomorphology of the High Plains in Eastern New Mexico, Field Conference (sponsored by New Mexico Bureau of Mines and Mineral Resources), Clayton, New Mexico—

Robert J. Finley, Thomas C. Gustavson, C.M. Woodruff, Jr.

Geopressed Geothermal Energy Conference, Third, held at Center for Energy Studies of The University of Southwestern Louisiana, Lafayette, Louisiana—Don G. Bebout, A.R. Gregory, Thomas C. Gustavson, Robert G. Loucks.

Geopressed Geothermal Industrial Workshop (sponsored by U.S. Energy Research and Development Administration and C.K. Geopressure Corporation), Dallas, Texas—Don G. Bebout, Robert G. Loucks.

Gulf Coast Association of Geological Societies, Annual Meeting, Austin, Texas—Don G. Bebout, L.F. Brown, Jr., Shirley P. Dutton, Robert J. Finley, W.L. Fisher, William E. Galloway, L.E. Garner, Alice B. Giles, Roselle M. Girard, Edgar H. Guevara, Thomas C. Gustavson, Robert S. Kier, Charles W. Kreitler, Robert G. Loucks, J.H. McGowen, Dawn G. McKalips, Robert A. Morton, Janet E. Nilsson, Mary J. Pieper, Mark W. Presley, Ann E. St. Clair, Bonnie R. Weise, E.G. Wermund, C.M. Woodruff, Jr.

Highway Geology Symposium, 28th Annual Meeting, Rapid City, South Dakota—L.E. Garner.

Industrial Research Council Area/Industry Conference, Annual Meeting, San Antonio, Texas—W.L. Fisher.

International Association of Geophysical Contractors, Annual Meeting, Houston, Texas—W.L. Fisher.

Interstate Mining Compact Commission, Annual Meeting, Birmingham, Alabama—W.L. Fisher.

Interstate Oil Compact Commission, Annual Meeting, Nashville, Tennessee—W.L. Fisher.

Interstate Oil Compact Commission, Mid-year Meeting, Santa Fe, New Mexico—W.L. Fisher.

Lignite Symposium, 1977 (sponsored by Grand Forks Energy Research Center for U.S. Energy Research and Development Administration and the University of North Dakota), Grand Forks, North Dakota—W.R. Kaiser.

Midwest Ground Water Conference, Annual Meeting, Little Rock, Arkansas—W.L. Fisher.

National Water Well Association, Annual Meeting, Boston, Massachusetts—Charles W. Kreitler.

National Western Mining Conference, Denver, Colorado—W.L. Fisher.

Offshore Oil—Dialogues Toward Understanding, A National Conference on the Effects of OCS Oil and Gas Development on Coastal States (sponsored by the General Land Office of Texas, the Environmental Policy Center, Inc., the American Petroleum Institute, and the League of Women Voters of Texas), Galveston, Texas—C.M. Woodruff, Jr.

Request for Proposals from Industry to Investigate and Evaluate Geothermal Geopressed Wells, Conference (sponsored by U.S. Energy Research and Development Administration) Houston, Texas—A.R. Gregory, Robert G. Loucks.

Review of Research Proposals, Conference (sponsored by U.S. Energy Research and Development Administration and Union Carbide Corporation), Oak Ridge, Tennessee—L.F. Brown, Jr.

Review of Research Proposals, Conference (sponsored by U.S. Environmental Protection Agency, Dallas Regional Office), Dallas, Texas—L.F. Brown, Jr., William E. Galloway, Christopher D. Henry.

Rock Mechanics, 18th U.S. Symposium (sponsored by Colorado School of Mines), Keystone, Colorado—A.R. Gregory.

Society of Professional Well Log Analysts, 18th Annual Meeting and Logging Symposium, Houston, Texas—A.R. Gregory.

Soil Survey Technical Work-Planning Conference (sponsored by Texas A&M University and the U.S. Soil Conservation Service), College Station, Texas—L.E. Garner.

Southern Legislative Conference, Annual Meeting, Charleston, South Carolina—W.L. Fisher.

Texas Academy of Science, Annual Meeting, Waco, Texas—W.L. Fisher.

U.S. Geological Survey and State Geological Survey's Fourth Annual Seminar, Vail, Colorado—L.F. Brown, Jr.

Uranium In Situ Symposium (sponsored by South Texas Minerals Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers), Corpus Christi, Texas—William E. Galloway, William R. Kaiser, William A. White.

West Texas Conference on State Affairs, Annual Meeting, San Angelo, Texas—W.L. Fisher.

LEGISLATIVE COMMITTEE HEARINGS

Bureau of Economic Geology staff members are invited to testify as expert witnesses by Federal and State legislative committees when bills on resource and environmental matters are under consideration. During 1977, Bureau geologists appeared before the following committees:

Texas House of Representatives, Committee on Economic Development, Austin, Texas—W.L. Fisher (testimony given).

Texas House of Representatives, Committee on Natural Resources, Austin, Texas—C.M. Woodruff, Jr.

Texas House of Representatives, Committee on State Affairs, Austin, Texas—W.L. Fisher (testimony given); C.M. Woodruff, Jr.

U.S. House of Representatives, Subcommittee on Oceanography and Committee on Merchant Marine and Fisheries—W.L. Fisher (testimony given).

COMMITTEE SERVICES, OFFICES AND OTHER PROFESSIONAL RESPONSIBILITIES

Joyce M. Basciano

Member of Editorial Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Don G. Bebout

Chairman of Technical Program Committee, 1976-1977, Austin Geological Society.

Co-leader of field trip, "Lower Cretaceous Carbonate Tidal Facies, Austin, Texas, Area," for the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Co-organizer, co-editor, and co-convenor of Cretaceous Carbonate Symposium held in con-

junction with the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Delegate (representing Austin Geological Society), House of Delegates, American Association of Petroleum Geologists.

Member of the Committee for the Preservation of Samples and Cores, American Association of Petroleum Geologists.

Member of the Geopressed Geothermal Site Selection Subcommittee, U.S. Energy Research and Development Administration (U.S. Department of Energy).

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

Member of Technical Advisory Committee, ERDA Well-of-Opportunity Program, U.S. Energy Research and Development Administration (Department of Energy) and Gruy Federal, Inc.

Representative (of the Society of Economic Paleontologists and Mineralogists) at the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Vice chairman of the Publications Subcommittee of the Geothermal Committee of the Energy Minerals Division, American Association of Petroleum Geologists.

L.F. Brown, Jr.

Associate editor, American Association of Petroleum Geologists Bulletin.

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

Thomas J. Evans

Chairman of Publications Committee, 1976-1977, Austin Geological Society.

Member of Arrangements Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Robert J. Finley

Member of Citizens Board of Natural Resources and Environmental Quality of Austin, Texas.

Member of Conventional Theatre Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Member of Remote Sensing and Cartographic Committee of the Task Force for the Texas

Natural Resources Information System, Natural Resources Council of the State of Texas.

Member of Texas Mapping Advisory Committee.

W.L. Fisher

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

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

Member of Advisory Committee, Texas Energy Advisory Council.

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

Member of Governmental Liaison Committee and of Public Affairs Committee, Association of American State Geologists.

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

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

Member of Natural Resources Council, State of Texas.

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

Member of Research Committee, Interstate Mining Compact Commission.

Member of Research Committee, Interstate Oil Compact Commission.

Member of Texas Advisory Committee on Conservation and Environmental Education, Texas Education Agency.

Member of Texas Mapping Advisory Committee.

Member of University Coordination Committee, Texas Energy Advisory Council.

President-elect of Texas Section, Association of Professional Geological Scientists.

William E. Galloway

Chairman of Field Trip Committee of the South Texas Minerals Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Co-leader of field trip, "Modern Barrier Environments of Mustang and North Padre Islands," for the Uranium In Situ Symposium of the South Texas Minerals Section of the

American Institute of Mining, Metallurgical, and Petroleum Engineers.

Panelist at session, "Exploration," during the Uranium In Situ Symposium of the South Texas Minerals Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Technical consultant for Panel Report on the National Energy Plan, for Office of Technology Assessment, Congress of the United States, Washington, D.C.

L.E. Garner

Author of an unpublished report, "Geology of the Wild Basin Area," prepared for the Committee for Wild Basin Wilderness Park, Travis County, Texas.

Chairman of Publications Committee, 1977-1978, Austin Geological Society.

Co-leader of field trip, "Environmental Geology of the Austin Area," for the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Member of Board of Directors, Austin Natural Science Association.

Member of Publicity Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Edgar H. Guevara

Counselor of Asociacion Venezolana de Geología, Minería y Petróleo (Caracas, Venezuela).

Member of Energy Resources Committee of the V Venezuelan Geological Congress - Caracas (November 1977).

Member of Petroleum Geology Committee of the Sociedad Venezolana de Geólogos (Caracas, Venezuela).

Thomas C. Gustavson

Member of Texas Advisory Committee on Conservation and Environmental Education, Texas Education Agency.

William R. Kaiser

Co-leader of field trip, "Modern Barrier Environments of Mustang and North Padre Islands," for the Uranium In Situ Symposium of the South Texas Minerals Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

Member of Texas Energy Development Fund Lignite Task Force, Texas Energy Advisory Council.

Robert S. Kier

Member of Editorial Committee of the 1977 Annual Meeting, Gulf Coast Association of Geological Societies.

Member of Field Trip Committee of the 1977 Annual Meeting, Gulf Coast Association of Geological Societies.

Charles W. Kreidler

Chairman of Technical Program Committee, 1977-1978, Austin Geological Society.

Consultant for the Texas Coastal and Marine Council concerning environmental effects resulting from development of geopressed geothermal energy resources.

Member of Field Trip Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Robert G. Loucks

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

Co-leader of field trip, "Lower Cretaceous Carbonate Tidal Facies, Austin, Texas, Area," for the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Co-organizer, co-editor, and co-convenor of Cretaceous Carbonate Symposium held in conjunction with the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Member of the Carbonate Rock Subcommittee, American Association of Petroleum Geologists.

Member of the Geopressed Geothermal Site Selection Subcommittee, U.S. Energy Research and Development Administration (Department of Energy).

Robert A. Morton

Consultant on delineation of flood-prone areas of Harris County and evaluation of storm-related damage for the Texas Coastal and Marine Council.

Member of Editorial Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Mary J. Pieper

Editor of the Transactions of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Ann E. St. Clair

Chairman of Arrangements Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Consultant (with Education Committee of the South Texas Geological Society) to assist in planning field trip guidebook of San Antonio area for teachers.

Co-presenter of workshop on use of land and water resources map of Fayette County at public meeting in La Grange, Texas.

Co-presenter of workshop on use of land and water resources map of Kendall County at public meeting in Boerne, Texas.

Member, representing Bureau of Economic Geology, of the Technical Advisory Committee, Sam Houston Resource Conservation and Development Project.

Bonnie R. Weise

Member of Editorial Committee of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

Member of Entertainment Committee, Austin Geological Society.

E.G. Wermund

General Chairman of the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies.

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

Member of the Task Force of the Texas Natural Resources Information System, Natural Resources Council of the State of Texas.

President, 1977-1978, Austin Geological Society.

William A. White

Co-leader of field trip, "Modern Barrier Environments of Mustang and North Padre Islands," for the Uranium In Situ Symposium of the South Texas Minerals Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

C.M. Woodruff, Jr.

Co-chairman of Natural Areas Technical Advisory Group, Resource Preservation Committee, Capital Area Planning Council.

Consultant for the Texas Coastal Management Program, General Land Office of Texas (accompanied representatives of Texas General Land Office, and of the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration on a 2-day field trip along the Texas Coast, Beaumont to Corpus Christi, Texas).

Consultant on a geologic field assessment of archaeological survey sites on Camp Bullis Military Reservation, Bexar County, Texas, for the Center for Archaeological Research, The University of Texas at San Antonio.

Panelist at Blanco County Forum at Johnson City, Texas, sponsored by Capital Area Planning Council and the County Judge of Blanco County.

Panelist at Caldwell County Forum at Lockhart, Texas, sponsored by Capital Area Planning Council and the County Judge of Caldwell County.

Panelist at Fayette County Forum at La Grange, Texas, sponsored by Capital Area Planning Council and the County Judge of Fayette County.

Panelist at Travis County Forum at Austin, Texas, sponsored by Capital Area Planning Council and the County Judge of Travis County.

Panel moderator at conference "Offshore Oil—Dialogues Toward Understanding: A National Conference on the Effects of OCS Oil and Gas Development on Coastal States," in Galveston, Texas, sponsored by the General Land Office of Texas.

TEACHING ACTIVITIES

Information developed in various research projects at the Bureau of Economic Geology is included in continuing education short courses and in regularly scheduled university courses taught each year by members of the Bureau staff. During 1977, six staff members were involved in such activities.

Don G. Bebout taught a regularly scheduled course, Geology 383N, "Biogenic and Evaporite Depositional Systems," at the Department of Geological Sciences, The University of Texas at Austin. He also taught three short courses. One of these, "Carbonate Workshop for Explorationists and Engineers," sponsored by the Geology Foundation, the Bureau of Economic Geology, and the Department of Geological Sciences of The University of Texas at Austin, was taught with Robert L. Folk, Robert G. Loucks, and Alan J. Scott in Austin, Texas. Another short course, "Identification of Carbonate Facies and Interpretation of Depositional Environments Through Studies of Subsurface Cores," was taught at the Department of Geological Sciences of The University of Texas at El Paso. It also was taught in Houston, Texas, under the sponsorship of Exxon Company, U.S.A., and in Dallas, Texas, under the sponsorship of Mobil Oil Corporation. The third short course, "Recent Carbonate Environments of Florida Bay and Bahamas," was taught at the Rosenstiel School of Marine and Atmospheric Sciences of the University of Miami in Miami, Florida.

L.F. Brown, Jr., taught three short courses, which were repeated a number of times in several cities. One of the courses, "Clastic Depositional Systems," was taught at Mineral Wells, Texas, under the sponsorship of Amoco Production Company. It was also taught at Mineral Wells, Texas, and at Santa Barbara, California, under the sponsorship of Chevron Oil Company; at Lagos, Nigeria, under the sponsorship of Mobil Producing Company; and at Dallas, Texas, under the sponsorship of Mobil Oil Corporation. Another course, "Seismic Stratigraphy," was taught in Houston, Texas, under the sponsorship of Shell Oil Company; in Dallas, Texas, under the sponsorship of Mobil Oil Corporation; and in Lagos, Nigeria, under the joint sponsorship of Mobil Producing Company and the Nigerian Geological Society. A continuing education short course in seismic stratigraphy, sponsored by the American Association of Petroleum Geologists, was taught in

Calgary, Alberta, Canada, and in Monterey, California. Brown also taught part of a short course, "Geophysics for Geologists," sponsored by the University of Houston. In addition, he continued to supervise the research of several graduate students at The University of Texas at Austin.

W.L. Fisher taught a short course, "Seismic Stratigraphy in Oil and Gas Exploration," sponsored by the American Association of Petroleum Geologists, at the Permian Basin Graduate Center, Midland, Texas. He also taught, with Stephen H. Spurr and Marla Blissett, a regularly scheduled course, "Policy Issues Affecting Texas' Role in U.S. National Energy Policy," at the Lyndon B. Johnson School of Public Affairs of The University of Texas at Austin.

William E. Galloway was the leader of a Clastic Sedimentation School sponsored by Continental Oil Company in Houston, Texas, and he taught at the Seismic Stratigraphy School sponsored by the American Association of Petroleum Geologists in Monterey, California. He also presented a short course, "Depositional Systems and Uranium Exploration," which was sponsored by Urangesellschaft, U.S.A., in Denver, Colorado.

A.R. Gregory prepared a section of the written text for a short course, "Seismic Estimation of Earth Parameters—Velocity, Density, and Specific Attenuation," which was presented under the sponsorship of the Society of Exploration Geophysicists in Houston, Texas, and in other cities.

Robert G. Loucks along with Don G. Bebout of the Bureau of Economic Geology and R.L. Folk and A.J. Scott of the Department of Geological Sciences, taught a short course, "Carbonate Workshop for Explorationists and Engineers," in Austin, Texas. The course was sponsored by the Geology Foundation, the Bureau of Economic Geology, and the Department of Geological Sciences of The University of Texas at Austin. Loucks also taught at a Clastic Sedimentation School sponsored by Continental Oil Company in Houston, Texas.

SUPPORT STAFF



ADMINISTRATIVE/SECRETARIAL

The administrative/secretarial staff fulfill 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 necessary 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.

GAINES HEADS PUBLICATIONS

Dr. Margaret Scott Gaines joined the Bureau staff in August 1977. As Publications Manager, Dr. Gaines is responsible for the continuing operations of the Publications Section at the Bureau. She has line supervision and management responsibility for all aspects of technical report publication and coordination through final printing.

Dr. Gaines received her B.A. and M.A. degrees in English from the University of Kentucky in 1965 and 1967. She received her Ph.D. degree in English from Tufts University in 1973. Her research interests include Shakespearean comedy, the role of women in literature, technical writing, and techniques of teaching composition. She served as technical writer and editor in Civil Engineering at the Massachusetts Institute of Technology from 1973 to 1975, and as Assistant Professor of English at Texas Tech University from 1975 to 1977.

PUBLICATIONS

Making available the results and implications of its research programs in a central part of the Bureau's role as a public geologic research organization, Bureau publications are the major vehicles through which such information is disseminated. Manuscript preparation, editorial production, composing, and graphics design and layout comprise the Publications Section, which is under the direction of Dr. Margaret Scott Gaines.



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 preparation of slides, cover photos, and text photos.

*Research Assistants

Paul Anaejionu
William W. Bath
Robert W. Baumgardner
Patricia K. Bettis
Neil T. Bockoven
Russell C. Bunker
Robert I. Chapin
Constance S. Childs
Stephen C. Claypool
Robert C. Cobb
Paul E. Devine
Marvin J. Drodgy

R. Stephen Fisher
Barbara B. Gagnier
Ward M. Haggard
Jong H. Han
Laura Hill
Scott A. Holden
Bruce D. Johnson
John E. Johnson III
Ernst H. Kastning, Jr.
John A. Kieschnick
Carolyn E. Kirschner
Janet M. Lindley
Jack E. Loocke

John C. McBryde
Lon A. McCarley
Bryan L. McCulley
Maryann M. McGraw
Kathy A. McGillis
Lloyd B. McKinney
Patricia A. Mench
Linda C. Merritt
Kitty L. Milliken
Janet E. Nilsson
Elizabeth D. Orr
David A. Pass
Jeffrey D. Potter

Mark E. Rusk
Richard A. Schatzinger
Steven J. Seni
Jung H. Seo
Bahman Sepassi
Dale E. Solomon
Stanley M. Sutton
Margaret A. Townsend
Grace N. Tyner
Sarah L. Ulerick
Bruce R. Van Allen
Turner F. Williamson
Charles D. Winker
Stephen S. Wright

*Research assistants are generally half-time staff.

BUREAU OF ECONOMIC GEOLOGY

Dr. William L. Fisher, Director
Dr. L.F. Brown, Jr., Associate Director
Dr. E.G. Wermund, Associate Director
Mary J. Pieper, Assistant Director

Dr. Thomas C. Gustavson, Coordinator, Land Resources Laboratory
Eloise Hill, Executive Assistant

Research Scientists

Dr. Virgil E. Barnes
Dr. Don G. Bebout
Dr. William E. Galloway
Dr. Edgar H. Guevara*
Dr. William R. Kaiser
Dr. Robert S. Kier
Dr. Charles W. Kreidler
Dr. Joseph H. McGowen
Dr. Robert A. Morton
Dr. Charles M. Woodruff, Jr.

Research Staff

Richard L. Andersen
Joyce M. Basciano
Mary A. Bauer*
Thomas R. Calnan
John L. Chin
Shirley P. Dutton
Thomas J. Evans
Dr. Robert J. Finley
L. Edwin Garner
Victor J. Gavenda
Alice B. Giles*
Roselle M. Girard
A.R. Gregory
George E. Granata
Dr. C. Robertson Handford*
Dr. Christopher D. Henry
Jon P. Herber
C. Russell Lewis

Dr. Robert G. Loucks
Dawn G. McKalips
James R. Morabito*
Marianne G. Moseley
Dr. Mark W. Presley*
L. Chester Safe*
Ann E. St. Clair
Raul F. Solis
Willard R. Stearns
R. Mills Tandy*
Vicki A. Verross*
Bonnie R. Weise
William A. White

Cartographic Staff

James W. Macon,
Chief Cartographer
France P. Davis
Richard L. Dillon
Barbara M. Hartmann
Gail C. Larimer
Margaret R. McKinney
Gregg J. Miller
David M. Ridner
Dan F. Scranton
Bobbie S. Couch*
Margaret L. Rhodes*

Administrative/Secretarial Staff

Bettye A. Blitch
Thomas M. Glimp
Lucille C. Harrell

Nancy J. Kier
Wanda L. LaPlante
Douglas C. Ratcliff
Cheryl S. Dodd*
Deborah A. Garcia*
James T. Goodwin*
M. Karen King*
Jennifer Lundelius*
David B. Story*

Publications Staff

Dr. Margaret Scott Gaines,
Publications Manager*
Susann V. Doenges
Claudia J. Farmer
Susi Hall
Cecille Haynie
Fannie M. Sellingsloh
David M. Stephens
Dawn M. Weiler
Karen M. White
Scott E. Fishman*
Kelley E. Kennedy*
Amanda R. Masterson*
Maria I. Mendoza*
Kathleen A. O'Neill*
Laurel L. Scott*
Martine K. Stemerick*

Mineral Studies Laboratory

Daniel A. Schofield,
Chemist-in-Charge (retired)

Laurence C. McGonagle
Kelly C. Street
Debra K. Atteberry*
Josefina R. Calvo*
Yet-Ming L. Hung*
David M. Johnson*
Mrudula Kapadia*
Anha L. McKee*
Ronald M. Payne*
Mary B. Purvis*
Gregory L. Richards*
Sarah A. Rowe*
Steven W. Tweedy*
David L. Woodrum*

Well Sample and Core Library

Guy L. Tidmore
H. Scott Hamlin
Harry J. Madsen
Michael R. Amini*
Stephen P. Cunella*
Douglas J. Day*
Steven J. Jacoby*
James A. Leonard*
James L. Lockley*
Molly A. McGannon*
Suzanne M. Montano*
Hardie S. Nance*
Jon A. Robin*
Robert L. Sherrill*
Daniel E. Wilkins*

*Indicates part-time staff or full-time staff for less than six months in 1977.

BUREAU OF ECONOMIC GEOLOGY

The University of Texas at Austin
University Station, Box X
Austin, Texas 78712

Return Requested

**SPECIAL FOURTH CLASS
RATE - BOOKS**

**SPECIAL FOURTH CLASS
RATE - BOOKS**