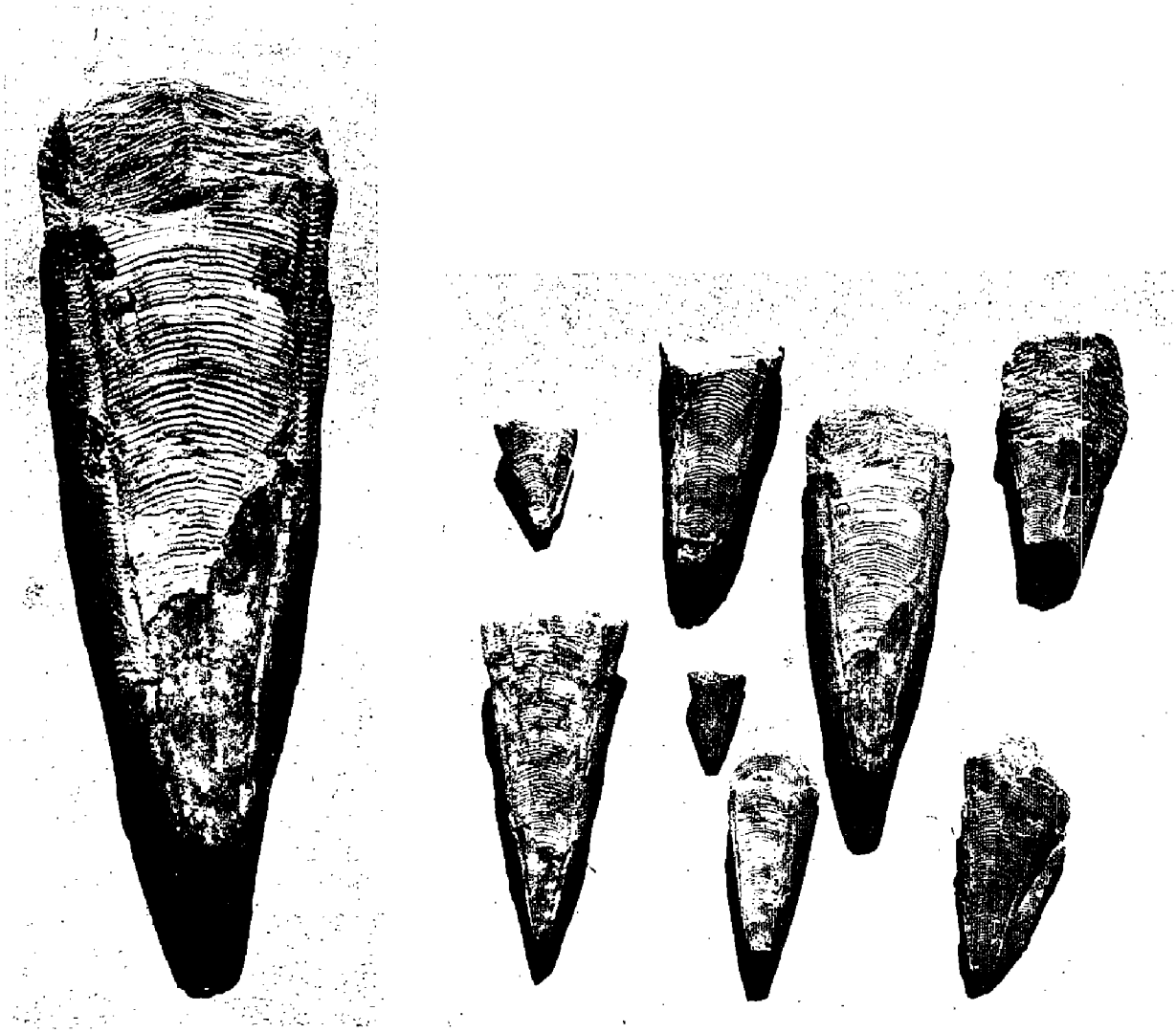
Oklahoma Geology Notes

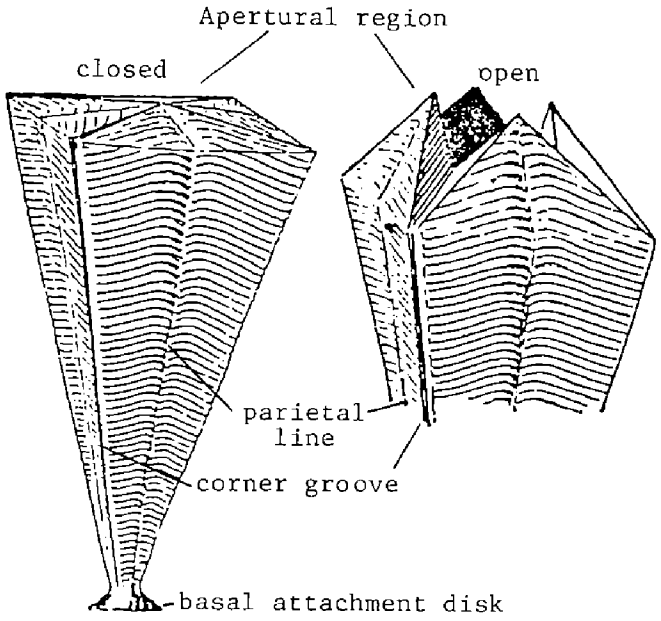
OKLAHOMA GEOLOGICAL SURVEY / VOL. 46, NO. 6 — DECEMBER 1986



On the cover—

Pennsylvanian Conulariids from Okfuskee County, Oklahoma

Eight conulariids were collected recently by the writer from a calcareous shale in the lower part of the Coffeyville Formation (Missourian) in the NW¼ sec. 3, T12N, R10E, Okfuskee County. The largest of the specimens (6.86 cm in length and 2.54 cm in width) is shown at the left on the cover of this issue. The smallest specimen (1.52 cm in length and 7.62 cm in width) is included in the grouping of all eight specimens also shown on the cover.



Morphological features of conulariids.

Although conulariids are found in strata ranging from Middle Cambrian to Lower Triassic, they are relatively rare fossils. Conulariids are an extinct group of chitinophosphatic fossils of typically four-sided pyramidal form, bearing fine transverse markings. A narrow groove runs along each of the four corners where the sides of the pyramid meet. From a basal attachment disk, which is usually broken off at the apex, the four sides diverge toward the aperture, angles between them measuring about 90°. A longitudinal groove (parietal line) in the middle of each side divides it into symmetrical halves. The four-part covering of the apertural region consists of sharply in-bent, flexible extensions of the sides. The morphological features of conulariids are diagrammed above.

Although the species is tentatively identified as *Calloconularia strimplei*, no description or classification of the forms is attempted here. The specimens are available for study at the Oklahoma Geological Survey in Norman.

LeRoy A. Hemish

photos by LeRoy A. Hemish

Oklahoma Geology Notes

Editor: Connie Smith
Editorial Assistant: Christie Cooper
Editorial Clerk: Eileen Hasselwander

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Short articles on aspects of Oklahoma geology are welcome from contributors. A set of guidelines will be forwarded on request.

Oklahoma Geology Notes

OKLAHOMA GEOLOGICAL SURVEY / VOL. 46, NO. 6 — DECEMBER 1986

Contents

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OKLAHOMA GEOLOGICAL SURVEY ANNUAL REPORT

July 1, 1985–June 30, 1986

Introduction

The economy of the State of Oklahoma suffered a precipitous decline during the past 18 months. The demand for, and price of, natural gas fell throughout the period, and crude-oil prices began a dramatic decline at the end of calendar year 1985. Those conditions, together with the continuing problems of agriculture, produced the current, bleak economic conditions facing the State.

The value of mineral and energy production, long a major component of the State's economy, declined by more than $800 million in calendar year 1985 (Fig. 1). Based upon data for the first six months of 1986, the projected value of mineral and energy production for calendar year 1986 will be about $6 billion. This is a decline of more than $3 billion from calendar year 1985, and a decline of almost $5 billion from the peak value attained in 1982. Clearly, such a precipitous change in the major sector of the State's economy has had a dramatic impact on all facets of the State's activity. Furthermore, there is no question about the importance of petroleum and natural gas to the value of mineral and energy production in the State. In calendar year 1985, petroleum and natural gas accounted for more than 96% of the total value of mineral and energy production (Fig. 2). That position of importance of petroleum and natural gas has existed since statehood. However, in the past two decades the relative importance of petroleum and natural gas has changed markedly (Fig. 3). In 1982, for the first time, the value of natural gas exceeded that of petroleum by slightly more than $140 million. In 1985 the value of natural gas exceeded that of petroleum by more than $500 million, and the projection for 1986 is that this difference will exceed $1 billion.

Coal production contributes only a small amount to the State's overall value of mineral and energy production, but is important to the economy in eastern Oklahoma. Production from 11 counties in the eastern Oklahoma coalfields amounted to 4.2 million short tons in 1985. With the passage of Senate Bill 458, requiring coal-burning electric-power generating plants in Oklahoma to use at least 10% Oklahoma-mined coal, production is likely to increase over the next few years by as much as 1 to 2 million short tons per year.

The value of nonfuel minerals also is only a small part of the State's overall value of mineral and energy production. In 1985, these commodities amounted to 2.5% of the total value. However, nonfuel minerals are pro-

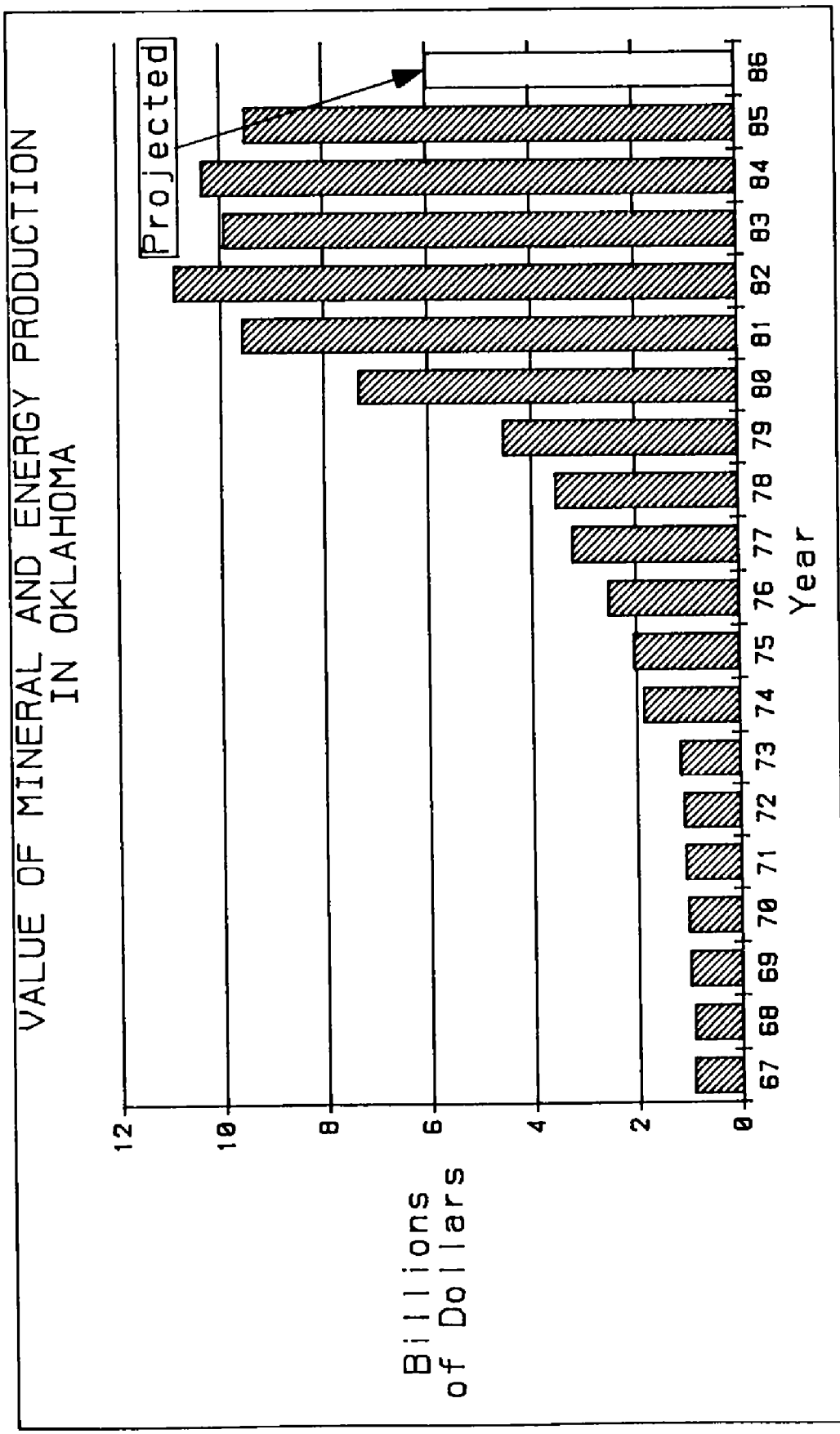

Figure 1. Value of mineral and energy production in Oklahoma, 1967–86.

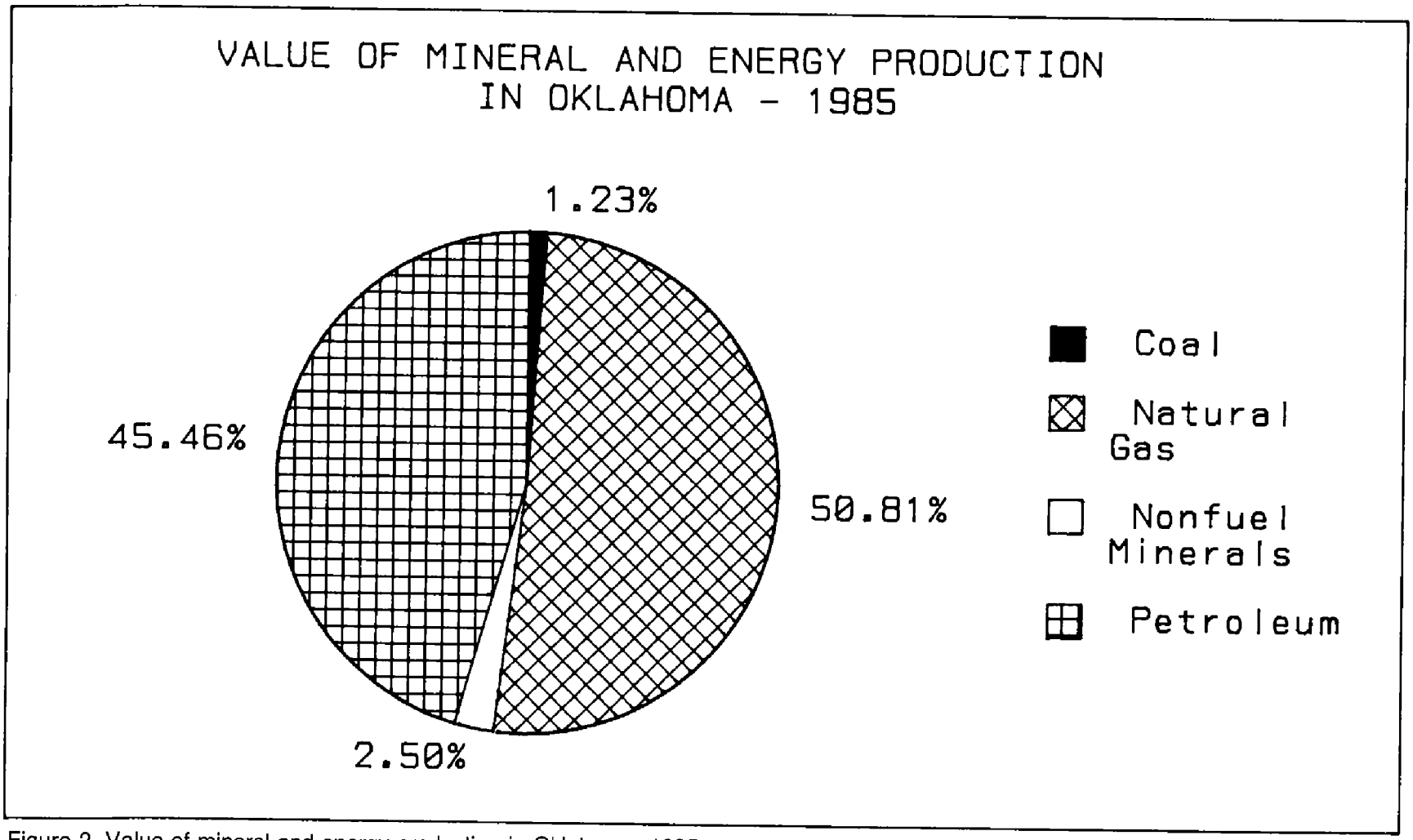

Figure 2. Value of mineral and energy production in Oklahoma, 1985.

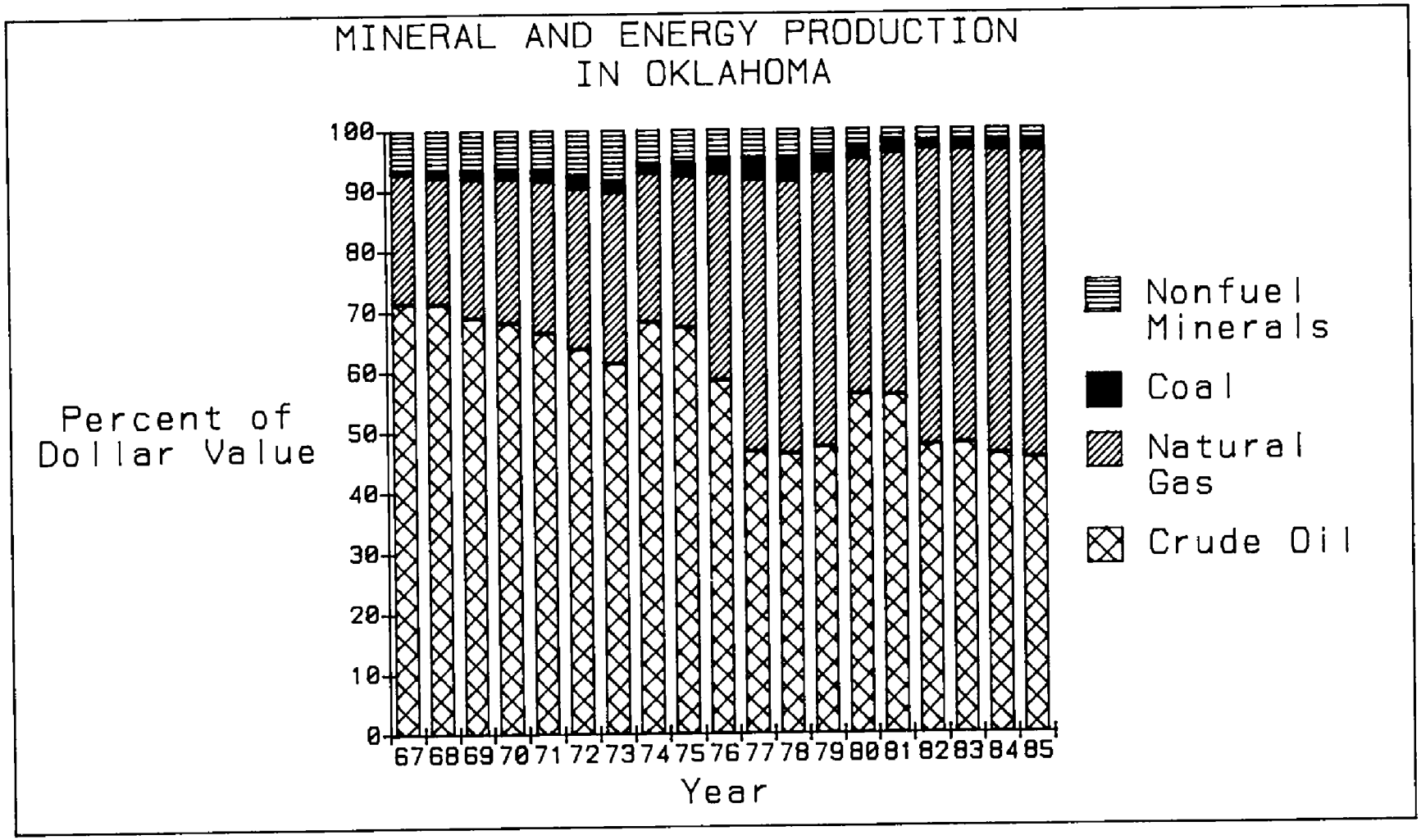

Figure 3. Value of mineral and energy production, shown as percent of dollar value, in Oklahoma, 1967–85.

duced in 58 of the State's 77 counties, and in 1985 a substantial portion of the $246 million generated by nonfuel minerals went into the economy of those counties. Important commodities among the nonfuel minerals produced in Oklahoma are Portland cement, clays and shales, gypsum, sand and gravel, crushed and dimension stone, lime, tripoli, pumice, iodine, feldspar, and salt.

In summary, it should be noted that the economy of the State is heavily dependent upon the production of mineral and energy resources. Furthermore, petroleum and natural gas presently comprise about 96% of that produced value, whereas coal and nonfuel mineral production is, overall, a small ingredient to the economy, but locally important. With the precipitous drop in the price of crude oil and the corresponding decline in both demand for and value of natural gas, it is important to find ways to preserve the future of the State's petroleum industry and to expand the role of coal and nonfuel minerals in the State's overall economy. Many of the programs of the Oklahoma Geological Survey are directed toward these goals.

Programs

The budget of the Oklahoma Geological Survey is divided into 11 separate units. Eight of these units are concerned with research and management of information directed toward a better understanding of the diverse natural resources and related environmental issues of the State. The remaining three units are supporting activities, concerned with overall program management, maintenance of the core and sample library, and public information and assistance. A full-time staff of 47 persons, including 15 geologists and 1 geophysicist, 8 other professional staff members, and 23 classified technical support personnel, is supplemented with several part-time professional investigators and student assistants.

Basic Geologic Investigations

The major effort in the Basic Geologic Investigations program is the geologic mapping of counties and regions of Oklahoma. Surface geology has been mapped at a scale of 1 inch = 1 mile or larger in 21 counties since 1940. Such mapping currently is in progress in 4 additional counties (Fig. 4). Furthermore, three regional studies—of Ouachita Mountains in southeastern Oklahoma, and Hollis Basin and Wichita Mountains in southwestern Oklahoma—are in progress. Geologic maps produced through this program are essential to many types of subsequent studies in the mapped area. Among such studies are mineral-resources investigations, environmental examinations, construction, planning, and other activities that require a knowledge of the types and distribution of rock materials.

The mapping project in the Ouachita Mountains is of special importance because it is a cooperative effort being undertaken by the U.S. Geological

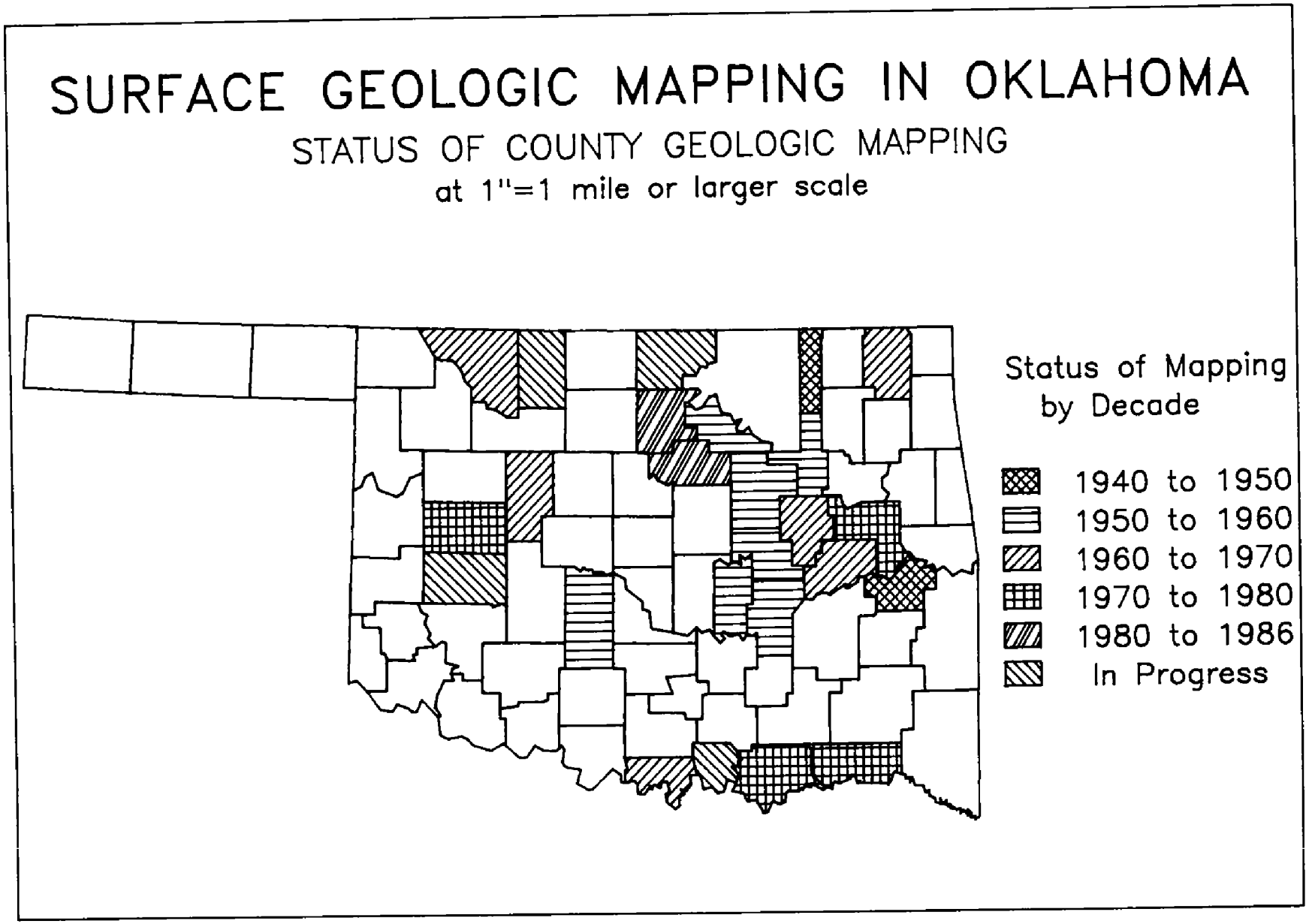

Figure 4. Status of OGS county geologic mapping of Oklahoma.

Survey, the Arkansas Geological Commission, and the Oklahoma Geological Survey. Such multi-state/federal cooperation is rare. The project is expected to produce a comprehensive set of geological and geophysical maps on one of the most enigmatic geologic provinces in the United States. Information derived from this 5-year mapping program will aid in studies of nonfuel minerals, petroleum and natural gas, ground water, and landslide susceptibility, and should aid in the effective development of the region's natural resources.

The Oklahoma Geological Survey also cooperated with the USGS in describing the nature of movement within the last 2,000 years on the Meers fault, which is part of the fault zone that separates the Wichita Mountains from the Anadarko basin.

Petroleum Investigations

Because petroleum and natural gas comprise most of the State's mineral economy, the Survey maintains a large activity in research and management of related information. Major activities include development and maintenance of the Oil- and Gas-Field Production File, the Oil- and Gas-Well Log Library, subsurface mapping in northwestern Oklahoma, and an assessment of the petroleum potential of the Ouachita Mountains of southeastern Oklahoma. In addition, the Survey conducts numerous short-term special investigations on various aspects of the State's petroleum industry.

The Oil- and Gas-Field Production File contains information on location, areal extent, date of discovery, discovery well, producing formation(s), consolidation history, and monthly production for the years 1983–85 for each of the more than 3,000 producing oil and/or gas fields in the State. A companion activity is the Survey's effort to assist the Nomenclature Committee of the Mid-Continent Oil and Gas Association to revise field outlines based upon drilling activities of the past few years. That effort has resulted in completing the revision of field outlines in 16 counties, and 17 counties are under current review (Fig. 5).

A subsurface investigation in northwestern Oklahoma is concerned with the occurrence of oil and gas on the northern shelf of the Anadarko basin. The study involves the mapping of several subsurface horizons, an examination of the history of petroleum exploration and production, and an assessment of the potential for future development in Alfalfa, Major, Woods, and Woodward Counties. Recommendations for exploration concepts that should be successful in discovering additional petroleum reserves will be important contributions of this study.

An assessment of the petroleum potential in the Ouachita Mountains of southeastern Oklahoma is being conducted in connection with the geologic-mapping program. This study involves an examination of all petroleum exploratory and development wells that have been drilled in the mountains, as well as selected wells drilled in a fringe area around the mountains. An assessment of the potential for future petroleum development will be prepared from data found in the well examinations and from

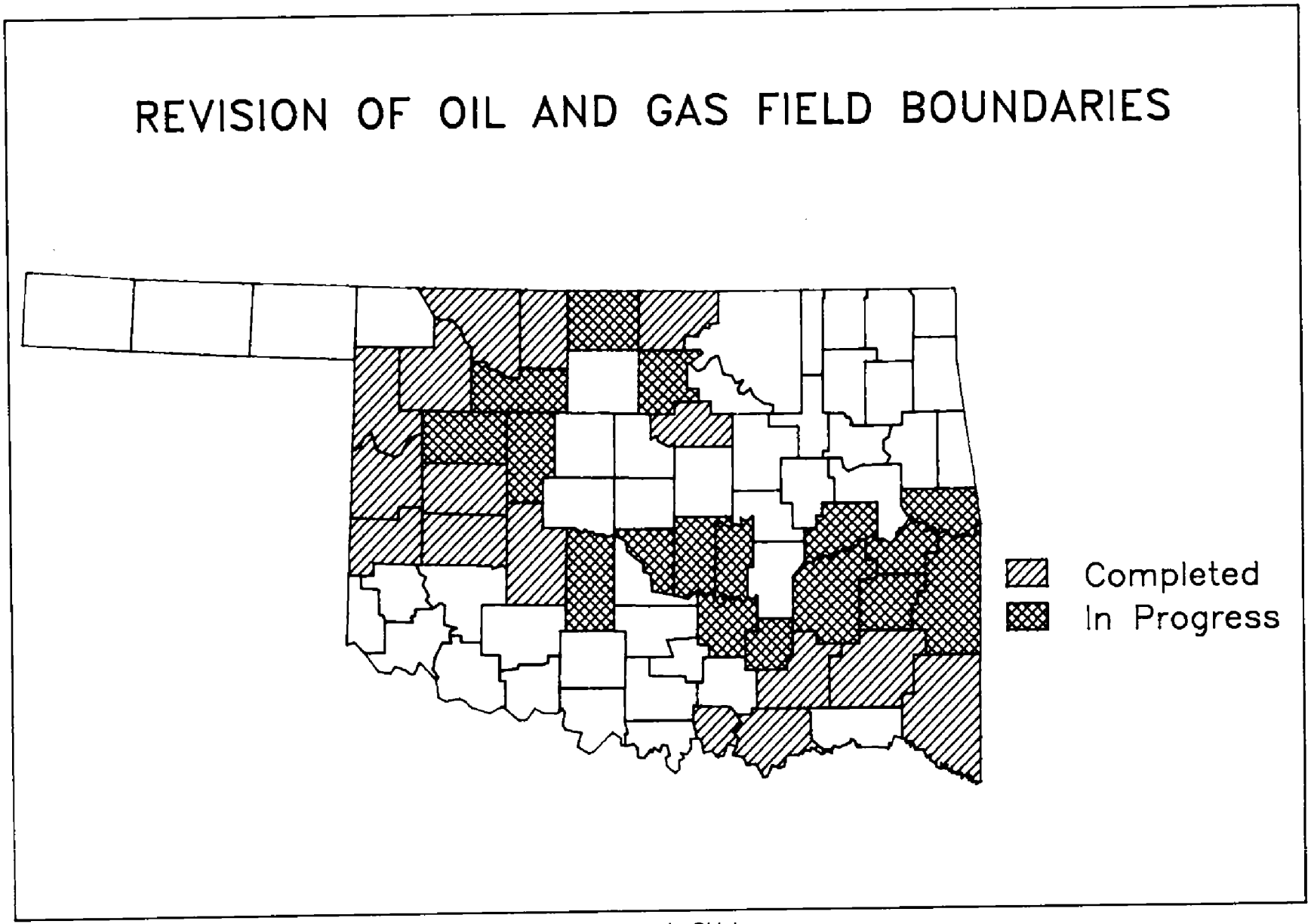

Figure 5. Status of revision of oil- and gas-field boundaries by county in Oklahoma.

an extensive evaluation of the few producing fields in the mountains. A correlative evaluation will be made of the application of side-looking airborne radar imagery (SLAR) and other remote-sensing data to petroleum-resource assessment in this region.

Coal Investigations

Coal production is confined to eastern Oklahoma, where mining began prior to statehood in the late 1800s. All of the early mining activities were in underground operations, whereas present production is predominantly from surface mines. The Survey's coal-investigation program consists of mapping and evaluating individual coal seams on a county basis, developing a computerized coal-information system, maintaining information on current mining activities, and conducting characterization studies on selected coal deposits.

The coal-seam mapping and evaluation program is producing maps and reports on the coal deposits of pairs of counties. Reports have been completed on three pairs of counties, and reports on two additional pairs and one individual county are in advanced stages of completion (Fig. 6). One such report will be published in the coming fiscal year, and two or three reports should be published in the following fiscal year.

The Survey is developing a computerized coal-information system for the State. This effort is in cooperation with the USGS as a part of the National Coal Resources Data System. Data are collected or generated for each coal seam throughout its areal extent. Some of the information is obtained from previous studies, some is from company files, and some is produced as new data from recent sampling of active mines or core drilling by the Survey. At the end of fiscal 1985–86, all elements of the data-entry program were in place, and information on about 1,500 samples was ready for data entry. It is anticipated that these data, plus several hundred additional analyses, will be added to the system in the coming fiscal year.

A program of coal petrography was established to provide information on the organic composition and fabric of individual coal seams, in order to identify the most appropriate use(s) for each of the coal seams in the State. Samples have been collected from most of the coal seams, and results have been obtained from most of these samples. Consequently, the Survey is now able to identify the most beneficial uses for the coal seams of eastern Oklahoma.

Industrial-Mineral Investigations

Studies concerning the State's nonfuel mineral resources have covered a broad spectrum of mineral commodities, including limestone, gypsum, salt, high-purity dolomite, clay and shale, sand and gravel, iodine, copper, lead, and zinc. Much of the current work involves assisting commercial

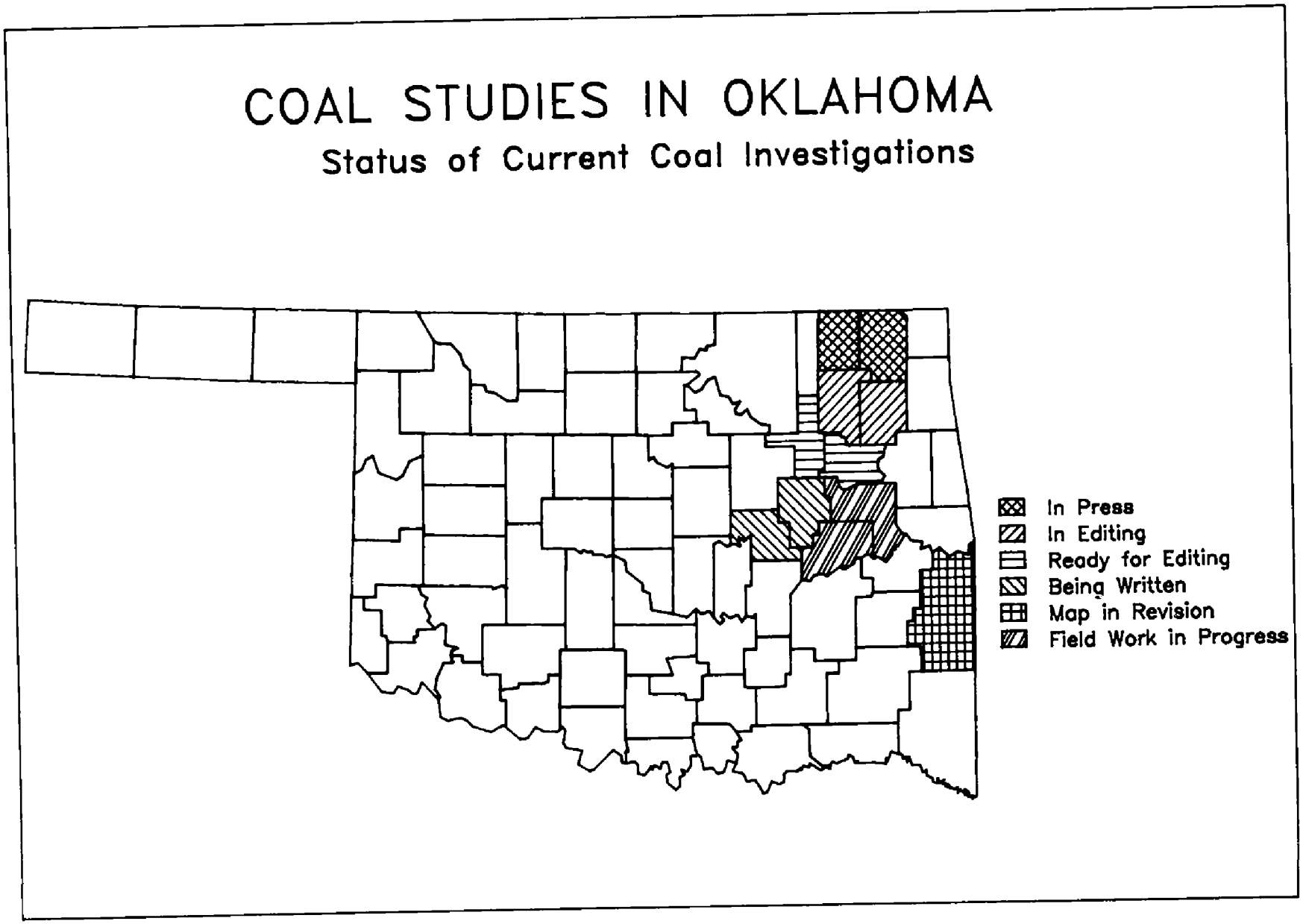

Figure 6. Status of current coal investigations in Oklahoma.

firms and individuals in assessing problems in mineral prospecting, evaluation, and production.

Two companies that have had a long-standing working relationship with the Survey have undertaken major expansions of their mineral operations. Temple-EasTex, Inc. recently opened a new $20 million gypsum wallboard plant at Fletcher to make better use of the extensive gypsum resources that exist in that part of the State. The Survey has been conducting investigations of those resources for the last 30 years and was able to provide the company with substantial information. Cargill Salt Co. also has spent millions of dollars in the last two years to upgrade their facilities for producing as much as 250,000 tons of solar-evaporated salt per year at Freedom in northwestern Oklahoma.

Studies now underway include an inventory and description of all active and abandoned non-coal mines and pits in Oklahoma. These data aid in identifying areas where additional mineral deposits may be found and also in targeting certain lands for future projects of land reclamation. Specific information is being compiled on the location and characteristics of copper, lead, and zinc mines and prospects in the Ouachita Mountains of southeastern Oklahoma. Data indicate that a mining industry existed in this part of the State in the mid-1800s.

Environmental Geologic Studies

The Survey addresses a broad range of issues in environmental and engineering geology. Studies have been undertaken cooperatively with the Oklahoma State Department of Health, various industrial concerns, and with private citizens concerned with issues relating to the safe disposal of hazardous waste materials in the State. Staff members are serving on the Governor's Controlled Industrial Waste Management Council, the Tar Creek Task Force, the Tinker Air Force Technical Review Committee, and a national research program on waste-disposal activities.

Reports recently released on *Disposal of Industrial Wastes in Oklahoma* (Circular 80) and *Maps Showing Principal Groundwater Resources and Recharge Areas in Oklahoma* (open file) have been recognized by the Oklahoma State Department of Health and the Oklahoma Corporation Commission as the authoritative sources of data in identifying lands unsuitable for the disposal of hazardous and oil-field wastes in Oklahoma.

A study completed recently with assistance of funding from the U.S. Bureau of Mines and to be published in the coming fiscal year is the investigation of the potential for land subsidence and collapse associated with the abandoned underground lead and zinc mines in northeastern Oklahoma's Miami–Picher field. Having been once the greatest zinc-producing region in the world, it was abandoned finally in the late 1960s. This study found and described more than 1,000 shafts in the mining district, 481 identified as being open or in some stage of collapse. Suggestions for remedial action are included in the report.

Another recently completed study is on the water quality in the Vamoosa–Ada aquifer of east-central Oklahoma, made cooperatively with the USGS Water Resources Division. The quality of the water is degraded in some parts of the study area. A second study, now nearing completion, will focus on characterizing these areas of water degradation. Both studies are scheduled for publication in the coming fiscal year.

The program of monitoring earthquake activity both throughout the State and around the world is continuing at the Survey's Geophysical Observatory, located near Leonard (15 miles southeast of Tulsa).

Work is continuing on mapping the location and distribution of abandoned underground coal mines and both active and abandoned surface non-coal mines throughout the State.

Water Resources Investigations

A program to investigate the location, distribution, quality, quantity, and use of the State's ground-water resources is being conducted in cooperation with the Water Resources Division of the USGS. This program has produced a series of nine hydrologic atlases, covering all of the State except for the Panhandle, a report on which was completed under a separate cooperative program between the USGS and the Oklahoma Water Resources Board. In the past few years the program has concentrated upon detailed studies of individual aquifers delineated by the regional studies that produced the hydrologic atlases. These aquifers include the Antlers in southeastern Oklahoma, the Vamoosa–Ada in east-central Oklahoma, the Arbuckle–Simpson in south-central Oklahoma, and the Boone and Roubidoux in northeastern Oklahoma. The Vamoosa–Ada aquifer study will be published in the next fiscal year.

In the August issue of the *Oklahoma Geology Notes* (vol. 46, p. 128–134) preliminary results of the assessment of the water quality in the coalfields of eastern Oklahoma were published. This program is a continuing effort to collect information on any changes in water quality that result from coal-mining activities in the region.

The shale-hydrogeology project (described under Basic Research) is a part of the cooperative program with the USGS and is funded in part from the Water Resources Division budget. Because the work is fundamental research and is funded in part from the Basic Research budget, it is described under that section.

Basic Research

Many of the commodity-oriented and other investigation programs and activities are closely interrelated with the Survey's program in basic research. The mapping program, along with some of the environmental, coal, petroleum, and earthquake studies, constitute a mixture of basic as well as applied research. Activities that currently are considered only as

basic research include stratigraphic studies in the Anadarko basin and a shale-hydrogeology study.

The Anadarko-basin studies center on the distribution and characteristics of subsurface rock units that are known to be the source of, or to contain, oil and gas in various parts of western Oklahoma. One objective is to determine the thermal history of the organic matter in several of the black shales, and thereby to evaluate whether these shales could have been the source of the hydrocarbons in major petroleum accumulations in the basin.

Another Anadarko-basin study is concerned with several of the limestone and dolomite formations that are major petroleum reservoirs in the basin. The question to be answered is why the rocks are highly porous and permeable in some areas and thus capable of accumulating oil and gas. This, too, is cooperative with the USGS.

The shale-hydrogeology project, being conducted in cooperation with the Water Resources Division of the USGS, is directed at studying the basic characteristics of shales as they relate to their use as a host rock for containing hazardous wastes. Little is known quantitatively about the permeability, fluid content, fracturing, and weathering characteristics of shales and how these relate to the effectiveness of shales in preventing migration of liquid wastes from a disposal site. Intensive studies are being conducted on four separate shale formations that possess different mineral and physical characteristics, in the hope of developing generic information on the useability of Oklahoma shale formations for these and other, related purposes.

Oklahoma Geophysical Observatory

In 1965 Jersey Production Research Co. (now Exxon) consolidated its petroleum-research activities in Houston. At that time the company gave its geophysical observatory, located near Leonard, Oklahoma, to the University of Oklahoma. In 1978, the University made the decision that it was no longer able to maintain the facility and it was turned over to the Survey. In the ensuing years the Survey has modernized the recording instrumentation and has added equipment and personnel to enhance the facility's operation. Much of this modernization has been accomplished with the cooperative support of grant funds from the U.S. Nuclear Regulatory Commission and equipment from the USGS. Today, the Observatory has a staff of 5 persons and operates 7 seismometers—of which 3 are long-period and 4 are short-period recording instruments—7 field stations located strategically around the State, and 3 radiotelemetry stations located in close proximity to Leonard. In addition, the Observatory contains 1 of 6 geomagnetic stations in the United States that are operated cooperatively with the USGS. The Observatory also maintains a broad array of other geophysical sensing equipment.

With this panoply of instruments, the Observatory continuously monitors and records regional and worldwide earthquakes, phenomena of the

Earth's magnetic and electrical fields, a broad spectrum of atmospheric parameters, and a variety of other geophysical data. Thus, all earthquakes occurring in the State can be located with great accuracy, providing an important time-series of data on the seismicity of Oklahoma (Fig. 7). Geophysical information from the Observatory is included in both the North American and world data repositories.

Core and Sample Library

In the mid-1950s the Survey established a library consisting of rock cuttings and cores from wells drilled in the State. The cores and samples contained in the library have been obtained as donations from companies operating in the State. These materials have been made available to companies and individuals engaged in mineral exploration and research on the subsurface geology of Oklahoma and have served as a valuable resource in their efforts. At present, the library contains nearly 25,000 boxes of cores from about 2,500 wells, and samples from approximately 35,000 wells drilled during the 90-year history of petroleum exploration and development in the State.

Public Information and Assistance

The research and information-collection activities of the Survey are commonly released in the form of published maps, charts, and books. These materials, in conjunction with *Oklahoma Geology Notes*, a bimonthly publication, form the basis of the Survey's information-dissemination program.

For the assistance of persons working in stratigraphy and in exploration for and development of oil and gas resources, the Survey maintains a library of the well-log files received by the Oklahoma Corporation Commission from all oil- and natural-gas-well drilling activity in the State. The records in this library are supplemented with other well-log information contributed by companies and individuals to the Survey. The library also maintains files of drilling and completion records, and other well-history information that may be of value to the petroleum industry. This library is being relocated in Gould Hall on the University of Oklahoma campus, where it is available for public use.

In addition, the Survey staff respond to a continuing flow of requests for information on mineral and energy resources and other geological questions from companies, state and federal agencies, public interest groups, and the general public. Finally, the staff respond to many requests for public presentations on various aspects of the geology and natural resources of the State.

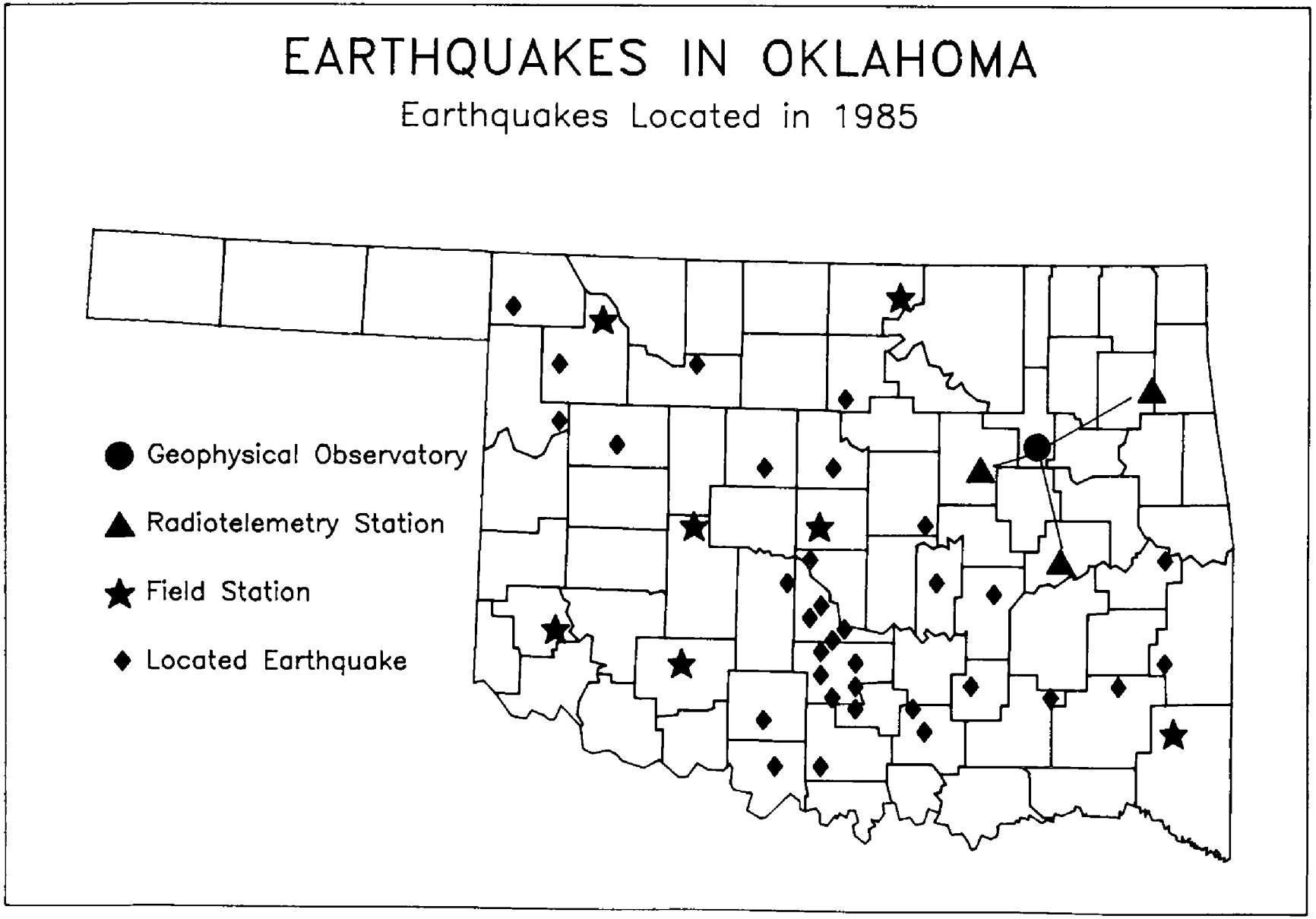

Figure 7. Earthquakes located in Oklahoma, 1985.

Administration

The Survey is a constitutionally created agency placed under the University of Oklahoma Board of Regents for fiscal and administrative control. In addition, the Survey is under the Oklahoma State Board of Regents for Higher Education for program authority and budgetary allocation. The Survey's administrative function provides the basic services to the program areas of the organization and maintains the overall coordination among the various projects.

Summary

The Oklahoma Geological Survey has served the State for 78 years. Throughout its history, the Survey has attempted to maintain a balanced approach among its functions of basic and applied research and collection and management of information. Above all, the staff recognize their responsibilities to provide the citizens of the State with high-quality scientific and technical information and assistance. Those objectives are made easier because of the close cooperation the Survey enjoys with numerous state and federal agencies, colleges and universities in Oklahoma and the surrounding region, scientific and technical organizations, companies, and individuals interested in the wise use of the State's natural resources.

—Charles J. Mankin, *Director*

Appendix A

Survey Staff, 1985–86 Fiscal Year

Professional

Robert H. Arndt
Helen D. Brown
Margaret R. Burchfield
Jock A. Campbell[1]
Brian J. Cardott
Keith A. Catto
James R. Chaplin
Robert O. Fay
Samuel A. Friedman
T. Wayne Furr
L. Joy Hampton
LeRoy A. Hemish
Kenneth S. Johnson
James E. Lawson, Jr.
Kenneth V. Luza
Charles J. Mankin
Connie G. Smith
Larry N. Stout[2]
Michelle J. Summers
Neil H. Suneson[3]
Jane L. Weber
Stephen J. Weber
Laurie A. Wilson

Part-Time Professional

Thomas W. Amsden
Elizabeth A. Ham
Dorothy J. Smith
John H. Webb

Classified

Cartography
D. Randal Burneson[3]
Massoud Safavi
Robert D. Woolley[3]

Chemistry
Jurand W. Janus[2]

Core and Sample Library
Eldon R. Cox
Walter C. Esry

Drilling Technicians
Charles R. Dyer[4]
Danny L. Swink[4]

Editorial
Christie L. Cooper
Eileen M. Hasselwander[5]

Geological Technician
David O. Pennington

Office Manager
Gwen Williamson

Oklahoma Geophysical Observatory Technicians
Barbara J. Garrett
Shirley A. Jackson
James Irwin Jones[1]
Richard L. Watkins

Print-Shop Operators
Paula A. Hewitt
Michael C. Turman

Research Specialist
Charles R. Johnson[6]

Secretarial
Betty D. Bellis
Mitzi G. Blackmon
Margarett K. Civis
Velma L. Cottrell
Judith A. Schmidt[6]

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[1]Appointed July 1985.
[2]Appointed February 1986.
[3]Appointed January 1986.
[4]Appointed August 1985.
[5]Appointed May 1986.
[6]Appointed September 1985.

Appendix B

List of Survey Publications Issued, 1985–86 Fiscal Year

New Publications

Bulletin 137.—*Geology and mineral resources of Payne County, Oklahoma*, by John W. Shelton, John S. Ross, Arthur J. Garden, and James L. Franks. 92 pages, 46 figures, 4 plates, 1 table. Issued August 29, 1985.

Guidebook 22.—*Guide to Robbers Cave*, by Arthur J. Myers, Dearl T. Russell, George J. Goodman, and Cheryl A. Lawson. 48 pages, 29 figures, 1 plate. Issued April 4, 1986.

Map GM-28.—*Map of Oklahoma oil and gas fields*, compiled by Margaret R. Burchfield. Color map showing outlines of 3,083 active fields and 35 abandoned fields. List of names and locations of all fields. Scale 1:500,000. Issued September 4, 1985.

Map GM-29.—*Index to subsurface geologic mapping in Oklahoma, 1940–1966* (second edition), compiled by Louise Jordan and John F. Roberts. 6 color sheets (plates 1–6), scale 1:100,000. Issued January 24, 1986.

Oklahoma Geology Notes.—Six bimonthly issues (August 1985– June 1986), containing 263 pages.

Appendix C

Publications by Survey Staff, 1985–86 Fiscal Year

ROBERT H. ARNDT

Statistics in Oklahoma's petroleum industry, 1984: Oklahoma Geology Notes, v. 46, p. 80–103, 1986.

MARGARET R. BURCHFIELD

Map of Oklahoma oil and gas fields: Oklahoma Geological Survey, Map GM-28, 1985.

Well 24–2 OU now producing [cover-photo description]: Oklahoma Geology Notes, v. 45, p. 229–230, 1985.

BRIAN J. CARDOTT

Thermal maturation by vitrinite reflectance of Woodford Shale, Anadarko basin, Oklahoma: American Association of Petroleum Geologists Bulletin, v. 69, p. 1982–1998, 1985 (with Michael W. Lambert).

JAMES R. CHAPLIN

Early Mississippian deltaic sedimentation in northeastern Kentucky, *in* Haban, S. (ed.), Carboniferous of eastern Kentucky, Guidebook for Field Excursion 6, Sixth Gondwana Symposium: Institute of Polar Studies, The Ohio State University, Miscellaneous Publication 228, p. 26–31, 1986.

Bearea Sandstone (Lower Mississippian) sedimentation in northeastern Kentucky, *in* Haban, S. (ed.), Carboniferous of eastern Kentucky, Guidebook for Field Excursion 6, Sixth Gondwana Symposium: Institute of Polar Studies, The Ohio State University, Miscellaneous Publication 228, p. 36–50, 1986 (with C. E. Mason).

Proposed depositional model for the Cowbell Member of the Borden Formation (Mississippian) in northeastern Kentucky, *in* Haban, S. (ed.), Carboniferous of eastern Kentucky, Guidebook for Field Excursion 6, Sixth Gondwana Symposium: Institute of Polar Studies, The Ohio State University, Miscellaneous Publication 228, p. 52–75, 1986 (with Barbara Lowry-Chaplin).

Stratigraphic relationships of Mississippian delta destructional deposits and transgressive carbonate shelf deposits to overlying Pennsylvanian delta plain deposits in northeastern Kentucky, *in* Haban, S. (ed.), Carboniferous of eastern Kentucky, Guidebook for Field Excursion 6, Sixth Gondwana Symposium: Institute of Polar Studies, The Ohio State University, Miscellaneous Publication 228, p. 115–128, 1986 (with R. T. Lierman and C. E. Mason).

SAMUEL A. FRIEDMAN

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A geochemical study of bituminous coal resources of Middle Pennsylvanian age in eastern Oklahoma: Part I—Maps showing distribution of fixed carbon and sulfur, and lead, zinc, and manganese [abstract], *in* Garbini, Susan; and Schweinfurth, Stanley P. (eds.), Proceedings of a symposium for a national agenda for coal-quality research, April 9–11, 1985: U.S. Geological Survey Circular 979, p. 230–231, 1986.

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MICHELLE J. SUMMERS

Survey compiles databases on State's oil, gas, and coal resources: Oklahoma Geology Notes, v. 45, p. 232–233, 1985.

Appendix D

Papers and Talks Given by Survey Staff at Public Meetings, 1985–86 Fiscal Year

International Symposium on Karst Water Resources, Ankara, Turkey, July 11, 1985.
KENNETH S. JOHNSON: "Hydrogeology and recharge of a gypsum-dolomite karst aquifer in southwestern Oklahoma, USA."

Optimist Club, Ardmore, Oklahoma, August 16, 1985.
CHARLES J. MANKIN: "Mineral and energy resources of Oklahoma."

Group of Muskogee individuals, lecture tour, Leonard, Oklahoma, August 25, 1985.
JAMES E. LAWSON, JR.: A lecture tour of the Oklahoma Geophysical Observatory.

Society of Independent Professional Earth Scientists, Oklahoma City, Oklahoma, September 4, 1985.
KENNETH S. JOHNSON: "Geologic float trip through the Grand Canyon."

Bartlesville Desk and Derrick Club, lecture tour, Leonard, Oklahoma, September 26, 1985.
JAMES E. LAWSON, JR.: A lecture tour of the Oklahoma Geophysical Observatory.

Society of Mining Engineers Fall Meeting, Albuquerque, New Mexico, October 17, 1985.
KENNETH S. JOHNSON: "Cargill is building major solar-salt plant at Big Salt Plain in northwestern Oklahoma."

Holland Hall School, geology student lecture tour, Leonard, Oklahoma, October 20, 1985.
JAMES E. LAWSON, JR.: A lecture tour of the Oklahoma Geophysical Observatory.

Governor's Energy Conference, Oklahoma City, Oklahoma, October 22, 1985.
CHARLES J. MANKIN: "Petroleum potential of the Arkoma basin, Oklahoma."

International Symposium on Evaporite Karst, Bologna-Palermo, Italy, October 24, 1985.
KENNETH S. JOHNSON: "Gypsum karst and salt karst of the United States of America" (with J. F. Quinlin and A. R. Smith).

National Solid Waste Management Association Annual Meeting, Boston, Massachusetts, October 29, 1985.
CHARLES J. MANKIN: "Deep-well disposal of hazardous wastes."

Lion's Club, Norman, Oklahoma, November 12, 1985.
CHARLES J. MANKIN: "Whatever happened to the energy crisis?"

Rotary Club, Muskogee, Oklahoma, November 14, 1985.
CHARLES J. MANKIN: "Mineral and energy resources of Oklahoma."

Rotary Club, Oklahoma City, Oklahoma, November 21, 1985.
CHARLES J. MANKIN: "Natural resources and the State's economy."

Department of Geology, Auburn University, Auburn, Alabama, January 16, 1986.
CHARLES J. MANKIN: "Geopolitics of natural resources."

Lecture to Yukon High School gifted and physics students, Yukon, Oklahoma, January 23, 1986.
KENNETH V. LUZA: "Waste management and environmental protection."

Building Construction Inspectors of Oklahoma Mid-Winter Conference, McAlester, Oklahoma, January 31, 1986.
KENNETH V. LUZA: "Earthquakes: will Oklahoma buildings stand the shake of a quake?"

National Research Council, Board on Earth Sciences, Summit Meeting of Presidents and Executive Directors of Earth Science Societies, Washington, D.C., February 7, 1986.
CHARLES J. MANKIN: "Decline of capabilities, U.S. energy and mineral resources industries."

Department of Geology Colloquium, University of Arkansas, Fayetteville, Arkansas; February 7, 1986.
BRIAN J. CARDOTT: "Organic petrology, vitrinite reflectance, and an example from the Anadarko basin, Oklahoma."

American Institute of Professional Geologists monthly meeting, Oklahoma City, Oklahoma, February 11, 1986.
KENNETH S. JOHNSON: "Geologic float trip through the Grand Canyon."

Department of Geology and Geophysics Colloquium, University of Oklahoma, Norman, Oklahoma, February 12, 1986.
BRIAN J. CARDOTT: "Organic petrology, vitrinite reflectance, and an example from the Anadarko basin, Oklahoma."

Lion's Club, Blanchard, Oklahoma, February 24, 1986.
CHARLES J. MANKIN: "Whatever happened to the energy crisis?"

Blue Cord Society, Oklahoma City, Oklahoma, March 18, 1986.
CHARLES J. MANKIN: "The role of mineral and energy resources in the State's economy."

Geological Society of Kentucky and American Institute of Professional Geologists, Kentucky Section, Lexington, Kentucky, March 21, 1986.
CHARLES J. MANKIN: "The geopolitics of natural resources."

Geological Society of America, Penrose Conference, Southern Oklahoma Aulacogen, Quartz Mountain State Park, Oklahoma, March 24–26, 1986.
THOMAS W. AMSDEN: "Middle Paleozoic strata in the Anadarko basin, Oklahoma and the Texas Panhandle."
BRIAN J. CARDOTT: "Isoreflectance map of Woodford Shale: southern Oklahoma aulacogen region."
KENNETH S. JOHNSON: "Post-Pennsylvanian geologic history of southwestern Oklahoma and the Texas Panhandle" and "Mineral resources of southwestern Oklahoma and the Texas Panhandle."
KENNETH V. LUZA: "Recent geologic studies of the Meers Fault."

21st Annual Shallow Exploration Drillers Clinic, Norman, Oklahoma, March 27, 1986.
CHARLES J. MANKIN: Welcoming address.

School of Geology, Oklahoma State University, Stillwater, Oklahoma, April 2, 1986.
BRIAN J. CARDOTT: "Organic petrology, vitrinite reflectance, and an example from the Anadarko basin, Oklahoma."

Alabama Association for Water Pollution Control, Hazardous Waste Management Symposium, Tuscaloosa, Alabama, April 8–9, 1986.
CHARLES J. MANKIN: "Deep-well injection in the United States: an overview" (with Tola Moffett).

Geoscience Day, University of Oklahoma, Norman, Oklahoma, April 11, 1986.
NEIL H. SUNESON: "Great expectations."

Oklahoma City Geological Society Discussion Group, Oklahoma City, Oklahoma, April 15, 1986.
JOCK A. CAMPBELL: "Deep structure of the Anadarko shelf/basin transition: evidence from southern Canadian and northern Caddo Counties, Oklahoma."

Department of Geology and Geophysics Colloquium, University of Oklahoma, Norman, Oklahoma, April 16, 1986.
NEIL H. SUNESON: "Basin formation, core complex terrane, west-central Arizona."

School of Geology Colloquium, Oklahoma State University, Stillwater, Oklahoma, April 17, 1986.
KENNETH S. JOHNSON: "Post-Pennsylvanian geologic history of the southern Oklahoma aulacogen."

10th Annual Forum of Western Interior Coal Basin Geologists, Tulsa, Oklahoma, April 28–29, 1986.
BRIAN J. CARDOTT: "Effects of weathering on coal."
SAMUEL A. FRIEDMAN: "Coal production and outlook in Oklahoma."
LEROY A. HEMISH: "Coal geology of the northern part of the northeast Oklahoma shelf area."
LAURIE A. WILSON: Poster relating Oklahoma Geological Survey research and microNCRDS capabilities.

Kiwanis Club, Pauls Valley, Oklahoma, April 30, 1986.
CHARLES J. MANKIN: "Whatever happened to the energy crisis?"

Lion's Club, Duncan, Oklahoma, May 1, 1986.
CHARLES J. MANKIN: "Whatever happened to the energy crisis?"

22nd Annual Meeting of the Forum on the Geology of Industrial Minerals, Little Rock, Arkansas, May 6, 1986.
KENNETH S. JOHNSON: "Geologic float trip through the Grand Canyon."

Engineers Club of Bartlesville, Bartlesville, Oklahoma, May 13, 1986.
CHARLES J. MANKIN: "Mineral and energy resources of Oklahoma."

Oklahoma City Geological Society Discussion Group, Edmond, Oklahoma, May 13, 1986.
KENNETH V. LUZA: "Evidence for recent movement on the Meers Fault."

Dolese Quarry Superintendents' Annual Meeting, Oklahoma City, Oklahoma, May 20, 1986.
KENNETH S. JOHNSON: "Recognizing hazardous quarry conditions in mining limestone in Oklahoma."

American Geophysical Union, Baltimore, Maryland, May 22, 1986.
CHARLES J. MANKIN: "Impact of oil prices on earth science education and research funding in the public and private sectors."

Solid Earth Science Panel of the Energy Resources Advisory Board, Albuquerque, New Mexico, June 2, 1986.
CHARLES J. MANKIN: "Summary of congressional testimony" and "Oil, gas, coal."

Wichita Falls Desk and Derrick Club, meeting at the Kimbell Ranch, Meers, Oklahoma, June 14, 1986.
KENNETH V. LUZA: "Geology in the vicinity of the Wichita Mountains."

WICHITA MOUNTAINS AND SLICK HILLS SUBJECTS OF SURVEY'S NEW GUIDEBOOKS

Two new Oklahoma Geological Survey guidebooks are centered around the Wichita Mountains and the Slick Hills of southwestern Oklahoma. Guidebook 23, *Petrology of the Cambrian Wichita Mountains Igneous Suite*, was edited by M. Charles Gilbert; Guidebook 24, *The Slick Hills of Southwestern Oklahoma—Fragments of an Aulacogen?*, was edited by R. Nowell Donovan.

"The Wichita Mountains are a unique geologic window allowing us to look through the Permian into the lower Paleozoic sedimentary sections and into the basement," Gilbert said in his preface to Guidebook 23. "This basement is anomalous for the southern Midcontinent because it is the floor of a Cambrian rift zone called the southern Oklahoma aulacogen."

The 188-page Guidebook 23 contains 13 technical papers and 8 stop descriptions from 20 contributors. Among the technical papers are: "An Interpretation of the Crustal Structure of the Southern Oklahoma Aulacogen Satisfying Gravity Data," "Calculations for Cambrian Extension of the Southern Oklahoma Aulacogen," "Geochemistry and Petrology of the Cold Springs Breccia, Wichita Mountains, Oklahoma," and "Overview of the Wichita Granite Group." Also included are papers discussing isotopic constraints on age and source history, Fe–Ti oxide and sulfide mineralogy, platinum-group-element potential, trace-element geochemistry of mafic igneous rocks, and aeromagnetic studies.

The book's eight stop descriptions cover the Cold Springs Breccia, Quartz Mountain State Park, Little Bow Mountain, Cooperton Rhyolite Dike, Saddle Mountain Granite, Hale Springs Locality, Medicine Bluffs, and a traverse across the Glen Mountains Layered Complex and into the Glen Creek Gabbro.

Guidebook 24 is composed of 11 topical papers and 5 stop descriptions from 25 authors. The Slick Hills, sometimes referred to as the "Limestone Hills," constitute a low range of bald hills north of the igneous Wichitas. As exposed, the Slick Hills are fragments of the frontal zone between the Wichitas and the Anadarko basin.

"The hills are a potpourri of lower Paleozoic igneous and sedimentary rocks, comprehensively deformed by Pennsylvanian tectonism and subsequently overlapped by Permian strata," Donovan stated in the book's preface. "Within the relatively small area, it is possible to illustrate most of the significant facets related to the development of the southern Oklahoma aulacogen."

The technical papers begin with "Geology of the Slick Hills," and include discussions of Paleozoic stratigraphy, Landsat thematic-mapper data for lineament analysis, barite travertine at Zodletone Mountain, and dolomite with evaporitic connections in the Ordovician Cool Creek Formation. Three papers dealing with the Meers Fault are: "The Meers Fault: Quaternary Stratigraphy and Evidence for Late Holocene Movement," "Neotectonic Activity of the Meers Fault," and "Holocene Deformation Associated with the Meers Fault, Southwestern Oklahoma."

Stop descriptions in this 112-page guidebook cover Blue Creek Canyon, Bally Mountain, Zodletone ("Stinking Mountain"), Cook Creek road cut, and the Meers Fault.

These new guidebooks are available from the OGS at the address given inside the front cover of this issue. The price is $12 for Guidebook 23 and $8 for Guidebook 24.

OKLAHOMA LIMESTONE QUARRIES AMONG LARGEST IN NATION

Six of Oklahoma's limestone quarries are among the 150 largest crushed-stone plants in the United States, according to an article in the August 1986 issue of Rock Products (vol. 89, no. 8, p. 44–51). The ranking of these Oklahoma quarries against others in the nation is as follows:

Rank	Company	Quarry Name	County
12	Dolese Bros. Co.	Richards Spur	Comanche
34	Dolese Bros. Co.	Cooperton	Kiowa
87	Material Producers, Inc.	Arbuckle	Murray
112	Tulsa Rock Co.	Tulsa Rock #2	Rogers
125	Standard Industries	East	Tulsa
141	Dolese Bros. Co.	Cyril	Caddo

The list was assembled in descending order of production for the year 1983, according to information compiled by the U.S. Bureau of Mines. No production information was included in the article because the Bureau of Mines considers such data to be proprietary and does not release those figures.

Kenneth S. Johnson

UPCOMING MEETINGS

American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting, February 23, 1987, Denver, Colorado. Information: Meetings Department, Society of Mining Engineers, Caller No. D, Littleton, CO 80127; (303) 973-9550.

Society of Mining Engineers, Annual Meeting and Exhibit, February 24–27, 1987, Denver, Colorado. Information: Meetings Department, Society of Mining Engineers, Caller No. D, Littleton, CO 80127; (303) 973-9550.

AAPG, Southwest Section, Annual Meeting, March 22–24, 1987, Dallas, Texas. Information: James A. Gibbs, 1106 One Energy Square, 4925 Greenville Ave., Dallas, TX 75206; (214) 363–3008.

GSA, South-Central Section, Annual Meeting, March 30–31, 1987, Waco, Texas. Information: Meetings Department, Geological Society of America, P.O. Box 9140, Boulder, CO 80301; (303) 447-2020.

WATER SUMMARY ISSUED FOR 1985

The *1985 National Water Summary*, third in an annual series of comprehensive reports on the status and supply of the nation's vital water resources, provides a state-by-state look at the country's surface-water resources. Each state section contains maps and graphs that illustrate surface-water runoff; precipitation; the location of principal rivers, reservoirs, and hydropower plants; trends in average streamflow discharge; how surface-water resources are managed; and a table on surface-water use.

The volume contains sections for each state plus an overview of hydrologic conditions for the 1985 water year. Also included are articles on record-high levels of the Great Lakes, the disintegration of Columbia Glacier, snow and ice and their effects on climate, and the transfer of water to meet needs.

Single copies of the Oklahoma section of the *1985 National Water Summary* are available from the District Chief, U.S. Geological Survey, 215 Dean A. McGee Ave., Room 621, Oklahoma City, OK 73102.

The 506-page comprehensive report can be ordered from: U.S. Geological Survey, Books and Open-File Reports, Federal Center, Building 41, Box 25425, Denver, CO 80225. The price is $31; add 25% to the price for shipment outside North America.

STATE GYPSUM QUARRIES AMONG LARGEST IN USA

Two of Oklahoma's gypsum mines are among the 10 largest gypsum mines in the United States, according to a recently released Mineral Industry Survey (dated July 14, 1986) by the U.S. Bureau of Mines. In terms of total gypsum output during 1985, the U.S. Gypsum Co. mine at Southard, in Blaine County, ranked 7th in the nation, and the Republic Gypsum Co. mine at Duke, in Jackson County, ranked 10th. Both companies are producing high-purity gypsum from the Permian-age Blaine Formation.

Preliminary figures on the mineral industry of Oklahoma, also released by the U.S. Bureau of Mines, show that the quantity of gypsum produced by the nine companies operating in Oklahoma during 1985 was estimated at 1,554,000 short tons, and its value was estimated at $12,898,000. Production information on individual mines is not available, because these data are proprietary and are not released by the Bureau of Mines.

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