

# Oklahoma Geology Notes

OKLAHOMA GEOLOGICAL SURVEY/VOL. 44, NO. 5—OCTOBER 1984

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*On the cover—*

## Survey Updates Core Catalog

Walter C. Esry, of the Oklahoma Geological Survey Core and Sample library, is shown on this month's cover operating a fork lift that is used to move the heavy pallets of samples stored at the library. The collection, the best such repository in Oklahoma, has been growing steadily since 1937, providing ample opportunity for OGS employees to sharpen their skills with the fork lift.

A new revised and updated catalog of this ever-increasing collection of well cores has just been issued by the Survey as OGS Special Publication 84-2. The volume contains 2,306 records in which cores are identified by locality (section, township, and range), by operator, by fee (owner of mineral rights on the lease), by depth, and by geological formation as identified by the operator.

Material for the C&S Library is obtained by donation and is stored and offered by OGS as a service to the public. Cores may be examined at the library for \$5.00 per box or borrowed from the library for \$7.50 per box, with the borrower paying shipping charges. The C&S Library offers samples (well cuttings) that are not available from commercial libraries for similar charges. The library also has an extensive collection of cores taken from coal-bearing rocks and other economic-mineral deposits that are accessible for inspection.

It should be noted that the library does not offer analytical information nor perform tests of materials.

The OGS Core and Sample Library is located at 2725 Jenkins Avenue in Building 193 on the South Campus of The University of Oklahoma. The phone number is (405) 325-4386.

The new core-collection catalog can be obtained from the Survey at the address below. The price is \$4.

## Molybdenite Location Corrected

The site location of the Willis Quarry, from which the molybdenite sample on the August 1984 *Oklahoma Geology Notes* cover was taken, was incorrectly listed in that issue. The correct location is sec. 26, T6N-R21W, Greer County, Oklahoma. The *Notes* regrets the error in the previous listing. An article on that molybdenite occurrence can be found on page 160 of this issue.

### **Oklahoma Geology Notes**

**Editor:** Connie Smith

**Editorial Staff:** Elizabeth A. Ham, William D. Rose

**Oklahoma Geology Notes** ISSN 0030-1736, is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, reviews, and announcements of general pertinence to Oklahoma geology. Single copies, \$1.50; yearly subscription, \$6. All subscription orders should be sent to the Survey at 830 Van Vleet Oval, Room 163, Norman, Oklahoma 73019.

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

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# MOLYBDENITE IN THE WICHITA MOUNTAINS SOUTHWESTERN OKLAHOMA

Zuhair Al-Shaieb<sup>1</sup>

## Introduction

The purpose of this article is to report the finding of the mineral molybdenite ( $\text{MoS}_2$ ) in the Wichita Mountains province of southwestern Oklahoma.

In April 1984 a metallic sample that was collected from the Willis Quarry (sec. 26, T6N-R21W), Greer County, Oklahoma, was brought to my attention by Ms. Brenda Willis-Hickerson. Detailed mineralogical and chemical analyses of this sample indicate it to be molybdenite. In May I inspected the site (fig. 1A) and verified the occurrence of molybdenite mineralization.

## Mineralization

The molybdenite mineralization occurs as fracture fillings (fig. 1C) and as disseminations in a 10-ft-wide zone (fig. 1B). The mineralized zone was examined on a recently cut surface in the quarry. The host rock is typical Reformatory Granite. This granite, described by Merritt (1958), and Al-Shaieb and Shelton, (1978), is the coarsest granite in the Wichita Granite Group of Cambrian age. The texture is hypidiomorphic granular with feldspar crystals normally ranging in length from 15 to 20 mm, and quartz averaging 5 to 10 mm. Microperthite and orthoclase are the dominant constituents, followed by quartz. Albite-oligoclase occur in small amounts, and a trace of microcline is also present. Hornblende, which averages approximately 4 percent of the total rock volume, is the dominant femic mineral, whereas biotite is less common. The color of hand specimens is flesh red on fresh surfaces, and light pink, deep red, or reddish brown on weathered surfaces.

The mineralized zone is unusually enriched in hornblende, opaque minerals, and biotite to a lesser extent. Merritt (1958) reported a high hornblende content from the abandoned B. L. Smith Quarry in the Reformatory Granite. He suggested a late hydrothermal origin for the hornblende. Figure 2 is a pho-

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<sup>1</sup>T. Boone Pickens, Jr., School of Geology, Oklahoma State University, Stillwater, OK 74078.

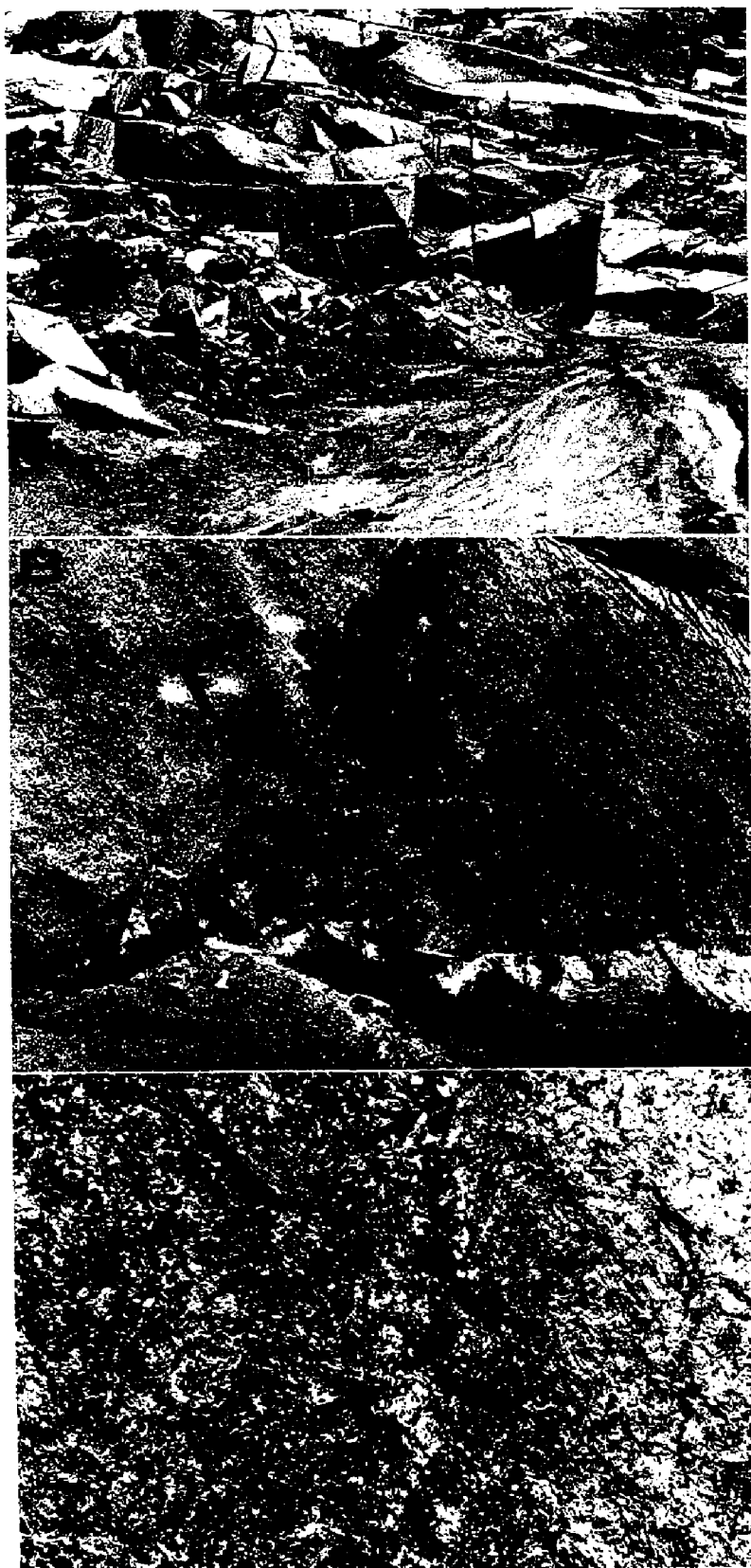


Figure 1. *A*, Overview of Willis Quarry (sec. 26, T6N-R21W). *B*, Hornblende-rich zone with abundant sulfide mineralization (arrows). *C*, Molybdenite (arrows) filling fracture.

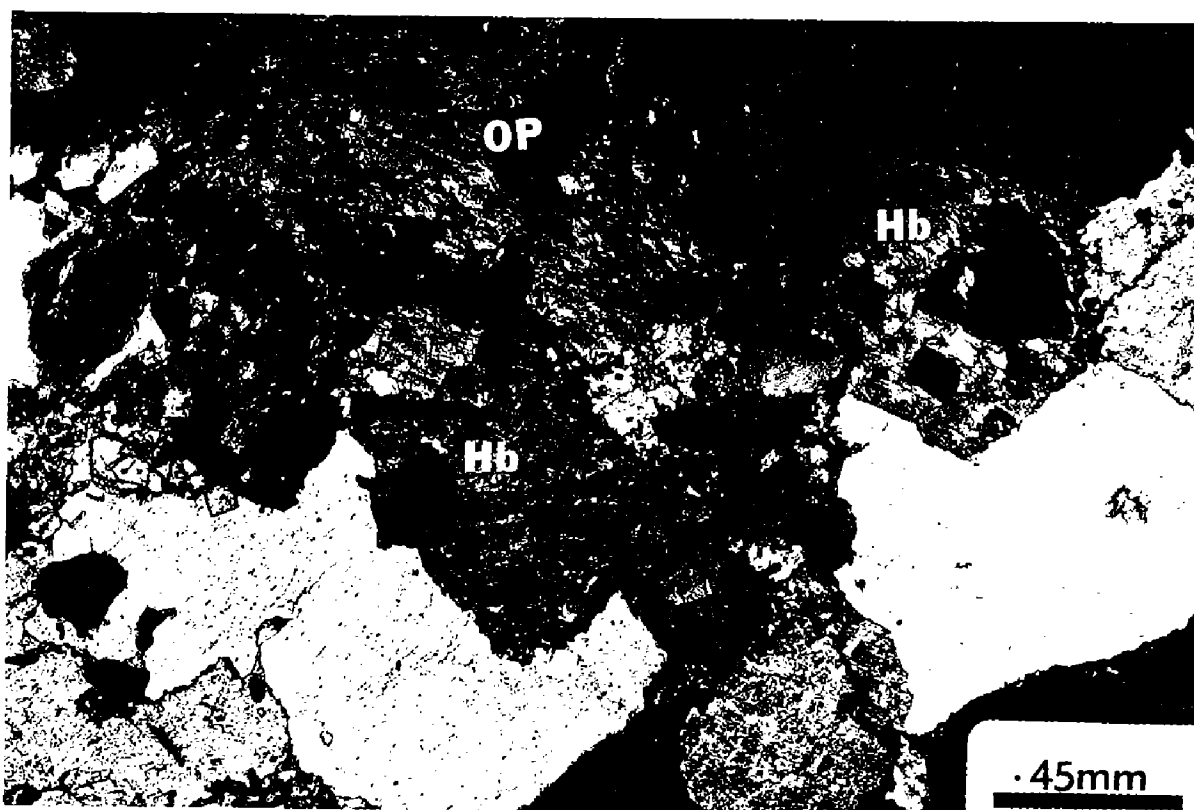


Figure 2. Opaque minerals (*OP*) in hornblende (*Hb*)-rich zone of Reformatory Granite. Crossed nicols.

tomicrograph of a polished thin section of the mineralized zone. The hornblende crystals exhibit subhedral to euhedral outlines. It is important to observe the intimate relationship between the opaque minerals and the hornblende crystals.

X-ray-diffraction analysis (fig. 3) shows a typical diffraction pattern of hexagonal  $\text{MoS}_2$ . Both scanning-electron microscopy and energy-dispersive x-ray analysis show the morphology and chemical analysis of the sample collected (figs. 4a, 4b).

Although this note is intended to report only the occurrence of molybdenite in the Wichita Mountains area, a more comprehensive program is under way to examine the extent and genesis of this mineralization.

## References Cited

- Al-Shaieb, Zuhair, and Shelton, J. W., 1977, Evaluation of uranium potential in skeletal Pennsylvanian and Permian units and igneous rocks in southwestern and southern Oklahoma: U.S. Department of Energy, Grand Junction Office, Open-File Report GJ BX-35 (78), 248 p.
- Merritt, C. A., 1958, Igneous geology of the Lake Altus area, Oklahoma: Oklahoma Geological Survey Bulletin 76, 70 p.

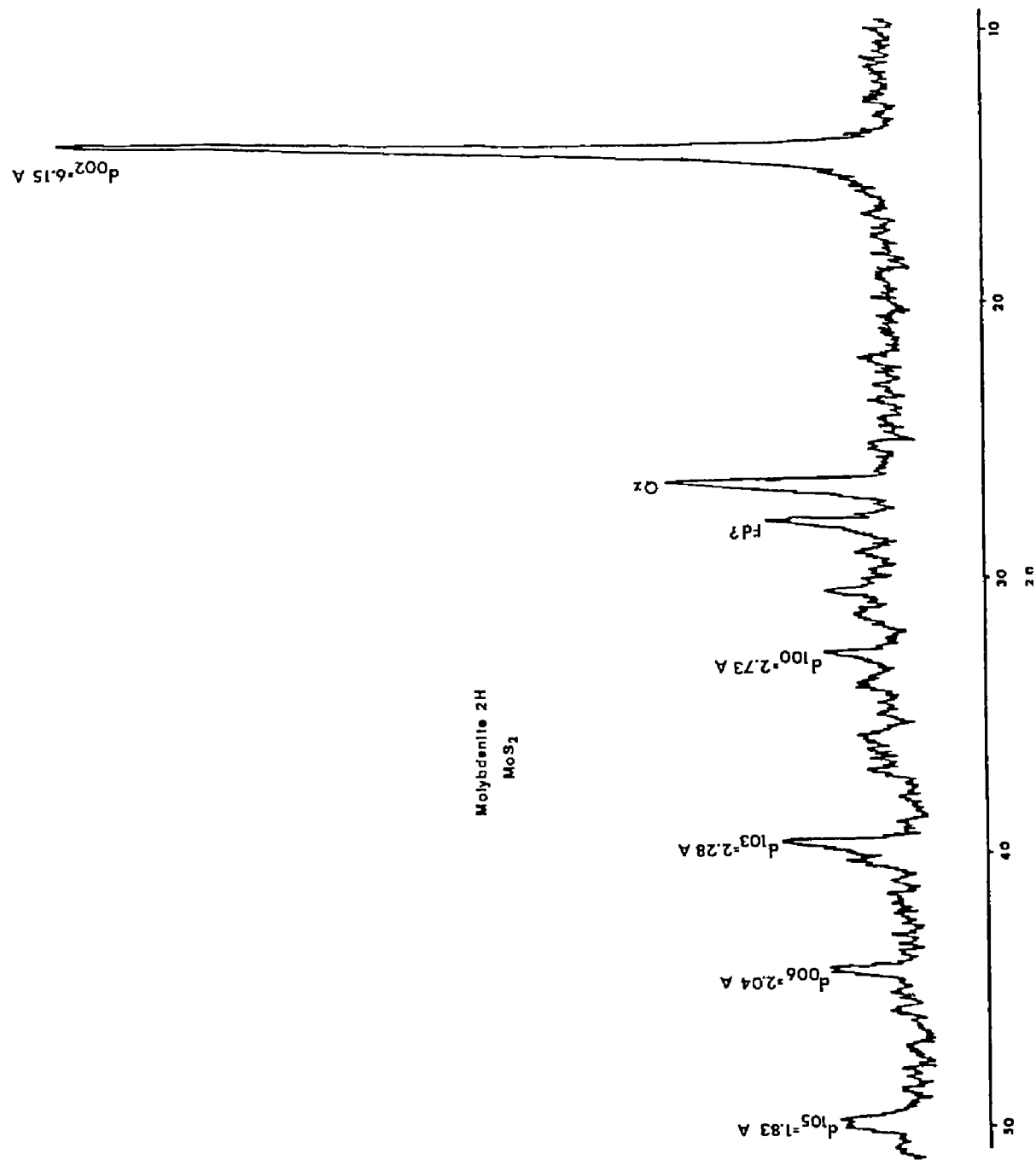


Figure 3. X-ray-diffraction pattern of molybdenite, showing the three strongest diffraction lines. Other lines represent other minerals associated with molybdenite.

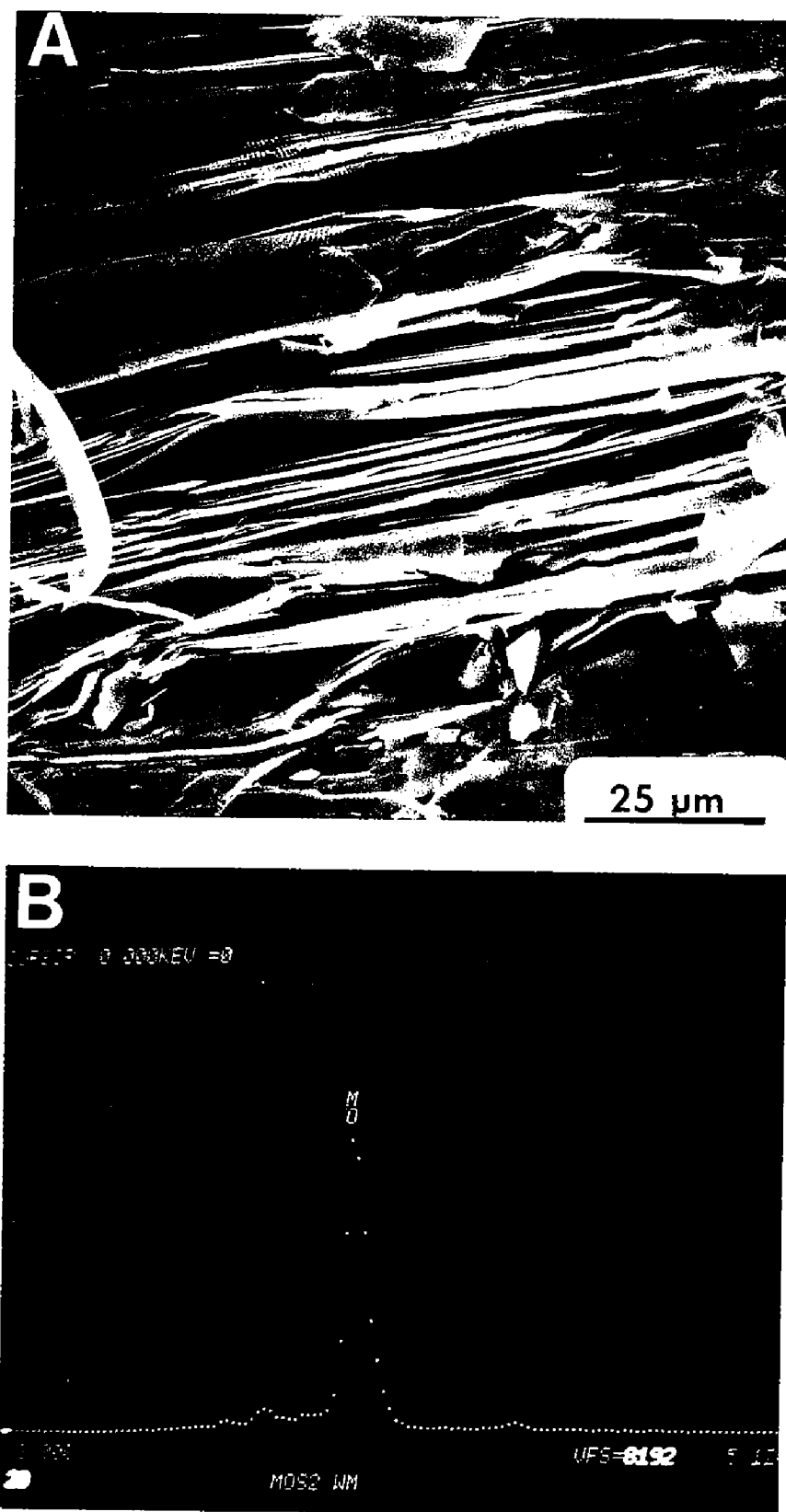


Figure 4. *A*, scanning-electron micrograph of molybdenite sample perpendicular to C axis (0001). *B*, energy-dispersive x-ray analysis of molybdenite sample shows intensity of L-series of molybdenite.



## WASTE-MANAGEMENT-STUDIES GROUP NAMES MANKIN CHARTER MEMBER

Oklahoma Geological Survey director Charles J. Mankin and eight other distinguished scientists have been invited by the University of Alabama to study environmental issues related to disposal of hazardous and non-hazardous wastes.

The scientists are charter members of the recently formed University of Alabama Institute for Waste Management Studies. The institute members, professors at major research universities, specialize in such fields as geology, toxicology, chemistry, socioeconomics, and engineering.

Alabama President Joab Thomas announced the formation of the institute recently during news conferences in Washington, DC, and New York City. He said the institute's purpose is to study the technical, social, and economic issues related to safe management of the nation's wastes, and to make its findings available to Congress, state legislatures, governmental agencies, and the public. The institute will emphasize the study of storage, treatment, and disposal methods as well as "state-of-the-art" technologies essential to the development of a national waste-management policy.

One institute project, due for completion in January 1985, involves developing a strategy for the management of spent solvents and solvent-contaminated wastes.

Formation of the institute was proposed by Philip E. LaMoreaux, a former Alabama state geologist and U.S. Geological Survey administrator who is president of P. E. LaMoreaux and Associates, Inc., an international consulting firm based in Tuscaloosa, Alabama. LaMoreaux will serve as director of the institute, and Robert L. Wells, Alabama's assistant vice president of research, will be assistant director.

Besides Mankin, the institute's charter members are Gary F. Bennett, professor of biochemical engineering at the University of Toledo; William J. George, professor of pharmacology and director of toxicology at Tulane University; Robert A. Griffin, head of the Illinois State Geological Survey's geochemistry section at the University of Illinois; James Mitchell, professor of civil engineering at the University of California at Berkeley; Carl Silver, professor of statistics and human engineering at Drexel University; Yaron M. Sternberg, professor of civil engineering and director of the University of Maryland's International Rural Water Resources Development Laboratory; and James V. Walters, Alabama professor of civil engineering.

The institute is supported by the University of Alabama and a \$390,000 grant from Waste Management, Inc., of Oak Brook, Illinois. Alabama officials hope for more funding from other public and private sources.

## **GARBER-WELLINGTON PROJECT GIVEN "GO-AHEAD" BY EPA**

The U.S. Environmental Protection Agency has recently given the Association of Central Oklahoma Governments (ACOG) and the Garber-Wellington Association the go-ahead to begin work on the second phase of a research project on central Oklahoma's Garber-Wellington aquifer.

Major tasks to be accomplished during the next 3 years include continued data accumulation, testing of microcomputers as management tools for aquifer protection, research of possible man-made and natural contamination, and development of a methodology for determining future aquifer potential.

Some of the specific products of the work will be an accelerated records-keeping system, test wells to monitor the condition of the aquifer, microcomputer modeling and graphics software, an inventory of subsurface impoundments, detailed soils information, recommended land-use zoning, chemical analyses of water quality, and methods for detecting zones of naturally occurring pollutants.

The Garber-Wellington Research Project was begun nearly 5 years ago by the local governments of ACOG, which formed the Garber-Wellington Association to conduct the research. The project has been supported with federal, State, and local funds. In addition to providing much-needed information to local governments for protection of the aquifer, the project has already begun to reduce water-protection costs for those using the research results.

Anyone wanting more information about the progress of the project can contact Odell Morgan or Greg Wallace at the ACOG office in Oklahoma City.

## **HARRISON APPOINTED TO POST ON SEPM RESEARCH COMMITTEE**

William E. Harrison, Oklahoma Geological Survey petroleum geologist and geochemist, has been appointed vice-chairman of the SEPM (Society of Economic Paleontologists and Mineralogists) National Research Committee for 1984-85. He will assume the chairmanship of the committee for the 1985-86 term. The appointment was made by SEPM president M. Dane Picard.

The purpose of the committee is to foster and encourage research, to advise the SEPM council on research activities that affect the society, and to develop topics for research conferences and the annual symposium of the Research Committee.

Harrison recently completed a 2-year term as chairman of the SEPM research group on Organic Geochemistry of Sediments.

## MACHINE GUN HELPS REVEAL UNDERGROUND GEOLOGY

During World War II, 50-caliber guns were mounted on tanks, and tailgunners fired them from airplanes.

Today the gun—aimed at the ground, not an enemy—might play a role in oil and gas exploration. At least that's the hunch of Don Steeples, a geophysicist at the Kansas Geological Survey, based at the University of Kansas, Lawrence.

Steeple and his colleagues are experimenting with a standard military 50-caliber machine gun that is mounted on the rear of a pickup truck and fired straight into the ground. The gun, says Steeples, may help produce clearer images of underground geology by improving seismic reflection.

Seismic reflection begins with a vibration at the earth's surface—a dynamite blast, for instance. Sound waves from the blast travel underground, where they echo off underground rock layers. The vibrations then bounce back to the surface and are recorded on microphone-like devices called geophones. The result is an image of the subsurface that shows layers of rock, one on top of the other.

"Using this method [the 50-caliber gun], the resolution is improved noticeably," he said. "We can detect rock layers that are too thin to have been detected before."

For 4 years Steeples has experimented with different vibration sources for seismic reflection. Under a grant from the National Science Foundation, he has experimented with different projectiles and their effect on the electronic signal received at the surface. The 50-caliber gun, he found, produces a clear image of the geology from 300 to 4,000 ft deep, depending on the local variations.

The gun is effective, he says, because it packs a wallop. Bullets 2 in. long weighing almost 2 oz can be fired through 6 in. of solid steel. Shot into the air, the bullet has a range of up to 7 mi.

Steeple uses the machine gun because of its particular firepower. Shots are fired into the ground a few seconds apart rather than at the rat-a-tat rate usually associated with machine guns. The bullets penetrate the ground to a depth of about 5 ft, producing a hole about three-quarters of an inch in diameter.

"To use dynamite in seismic reflection, you have to drill a hole and put the dynamite into that," he said. "The machine gun avoids the cost of drilling the hole and causes less environmental damage."

But isn't a machine gun dangerous?

"With proper precautions, it's safer than dynamite," Steeples said. "The gun doesn't scare me, but then we use a number of safety procedures. We built a heavy steel containment device to muffle much of the blast and to con-

tain the dirt, gravel, and shrapnel that fly up. I don't have any trouble with the safety of the technique."

Using the gun, Steeples and a crew of KU graduate students studied a site in Doniphan County, Kansas, and a sinkhole in central Kansas. This fall they plan to use it to construct a seismic profile of a heavily explored oil field in Butler County, Kansas.

Because it is less expensive than other methods, Steeples believes the machine-gun technique may be economically practical in some parts of Kansas. In other areas, such as southwestern Kansas, the technique needs to be improved so that it can detect formations that are 7,000 to 10,000 ft deep. A larger version, firing three guns at the same time, might do that.

"If oil prices go up and the electronics continue to improve and decrease in price, this could be a common technique throughout the state," Steeples said.

## **MANKIN SERVES AS OFFICER IN TWO PROFESSIONAL GROUPS**

Charles J. Mankin, Oklahoma Geological Survey director and executive director of The University of Oklahoma's Energy Resources Institute, is serving a 1984-86 term as councilor for the Geological Society of America.

Mankin has also served this year as vice president of the American Institute of Professional Geologists (AIPG). With Mankin on the AIPG executive committee are president Dean Grafton, a corporate geologist from Houston; president-elect Ernest K. Lehmann, president of Ernest K. Lehmann and Associates, Inc., Minneapolis, Minnesota; and secretary-treasurer Richard J. Anderson, an independent consulting geologist in Columbus, Ohio.

## **SECRETARY OF ENERGY APPOINTS STEHLI TO ENERGY RESEARCH ADVISORY BOARD**

Francis G. Stehli, dean of The University of Oklahoma's College of Geosciences, has been appointed by U.S. Secretary of Energy Donald Paul Hodel to the Energy Research Advisory Board. The board, established in 1978, advises the secretary and principal officials of the Department of Energy (DOE) on energy research and development programs and policies.

"In this capacity," Hodel wrote, "the board plays an important role in providing outside technical advice to the DOE. The findings and recommendations of the board have provided, and should continue to provide, valuable input to the decision-making process that shapes our nation's energy future."

Stehli, a nationally respected educator and scientist, has been dean of OU's College of Geosciences since 1981. The college, a pivotal part of the OU Energy Center, consists of the School of Meteorology, School of Geology and Geophysics, and Department of Geography.

## WATER CONCERNS SUMMARIZED IN REPORT

U.S. Interior Secretary William Clark has announced publication of the *National Water Summary 1983*, the first of an annual series of U.S. Geological Survey reports to provide state-by-state assessment of the nation's water resources.

The Oklahoma section of the report notes that the State uses an average of 1.7 billion gallons of water a day (bgd), with about 0.8 bgd coming from surface-water supplies. The section also describes a variety of water problems of concern to the State and includes a map showing the location and extent of these problems.

The report provides an assessment of hydrologic conditions and issues facing the country, based on the extensive information-gathering and research programs of the USGS. Working in cooperation with about 800 state and local agencies, the USGS gathers data on the quantity and quality of the nation's surface- and ground-water resources at more than 45,000 sites. The USGS report makes no specific policy appraisals or recommendations but highlights water issues and related activities in all 50 states as well as the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the western Pacific islands under U.S. jurisdiction.

Highlights of the water issues presented in the Oklahoma section of the report include:

- In northwestern Oklahoma, water is supplied almost exclusively from the High Plains aquifer. Withdrawals exceed recharge to the aquifer, and water levels have declined more than 50 ft between 1940 and 1980.
- There is concern that increasing urbanization in Oklahoma has exceeded the capacity of many sewage-treatment plants and that the North Canadian River is polluted from Oklahoma City to Lake Eufaula.
- Natural brine seeps and springs along the Salt Fork of the Arkansas, the Cimarron, and the Red Rivers increase the chloride concentrations so that water from these streams is unusable for many purposes.
- Acid mine-water from the abandoned lead-zinc mines in northeastern Oklahoma contains high concentrations of iron, zinc, and cadmium and is polluting Tar Creek, a tributary of Grand Lake (Lake O' the Cherokees). Concern is being expressed that the acid mine-water also could pollute local ground-water supplies.
- Bituminous coal beds underlie 1.5 million acres in 19 eastern Oklahoma counties. The principal hydrologic issues of concern regarding surface mining of coal in Oklahoma are possibilities of increased sediment concentrations and degradation of the chemical quality of streams.

The *National Water Summary 1983* is divided into four major sections: a 20-month chronology of significant hydrologic events in the nation, hydrologic discussions of major water issues, a multi-page summary with maps of

the major water issues for each state, and a basic discussion of the hydrologic cycle and how man influences the cycle.

Copies of the 243-page report, fully titled *National Water Summary 1983—Hydrologic Events and Issues*, and published as USGS Water-Supply Paper 2250, are available for \$9 apiece from: Branch of Distribution, Text Products Section, USGS, 604 South Pickett St., Alexandria, VA 22304. Orders must specify Water Supply Paper 2250 and include check or money order payable to the Department of the Interior—USGS.

## NEW THESES ADDED TO LIBRARY

The following M.S. theses and Ph.D. dissertation have been added to The University of Oklahoma Geology and Geophysics Library:

*Areal Geology of Cement-Cyril Area, Southeastern Caddo County, Oklahoma*, by Michael R. Nelson. 64 p., 26 figs., 1 pl., 1983.

*A Statistical Study of Fracture Orientation and Spacing on the East Kaibab Monocline, Arizona*, by Michael E. Quillin. 87 p., 5 pls., 1983.

*A Structural Interpretation of a Portion of the Eastern Laramie Mountain Flank, Albany, Platte, and Laramie Counties, Wyoming*, by Thomas H. Butler. 69 p., 15 figs., 4 pls., 1982.

*Carbonate Petrography, Microfacies, and Depositional History of the Marble Falls Formation (Pennsylvanian), Llano Region, Central Texas*, by Douglas Wade Johnson. 258 p., 31 figs., 11 pls., 1983.

*Depositional Facies and Diagenetic Fabrics in the Late Pleistocene Falmouth Formation of Jamaica*, by Dana Christine Larson. 228 p., 64 figs., 1983.

*Intrabasinal and Eustatic Controls on the Deposition of the Watton Canyon Member, Twin Creek Limestone, Lincoln County, Wyoming*, by Dennis Joseph McCormick. 71 p., 7 figs., 1983.

*Lithostratigraphy and Depositional Environments of the Mayes Formation (Mississippian) in Adair County, Oklahoma*, by Thomas J. Turmelle. 144 p., 9 figs., 10 pls., 1982.

*Organic Facies Variations of the Woodford Shale, in Western Oklahoma*, by Karen L. Sullivan. 101 p., 33 figs., 3 tables, 1983.

*Regressive Shelf Deposits in the Pennsylvanian Arkoma Basin, Oklahoma and Arkansas*, by Michael Raymond O'Donnell. 73 p., 9 figs., 3 pls., 1983.

*Statistical Analysis of Dolomite Outcrop Fracture Distributions to Evaluate Well Core Sized Samples (Sawtooth Mountains, Montana)*, by William Edward Todd-Brown, Jr. 165 p., 11 figs., 1983.

*Structural and Geochemical Study of the South Sulphur Asphalt Deposits, Murray County, Oklahoma*, by Daniel B. Williams. 163 p., 30 figs., 7 pls., 1983.

*Structural Mechanisms and Oil Accumulation Along the Mountain View-Wayne Fault, South-Central Oklahoma*, by Tyrrell C. Axtmann. 70 p., 17 figs., 8 pls., 1983.

*Structural Style of the Wichita Mountains of Southern Oklahoma*, by Thomas R. McLean. 94 p., 28 figs., 3 maps, 1983.

*The Lithostratigraphy and Depositional Environments of the Springer and Lower Golf Course Formations (Mississippian–Pennsylvanian) in the Ardmore Basin, Oklahoma*, by Frederick Barber Meek. 212 p., 14 figs., 12 pls., 4 maps, 1983.

*The Lithostratigraphy and Depositional History of the Marble Falls Formation (Pennsylvanian) in the Subsurface Immediately North of the Llano Uplift, Central Texas*, by Charles Michael Brown. 215 p., 1983.

*The Tertiary Bathymetry of the Norwegian–Greenland Sea and Eurasia Basin and the Cenozoic Environment*, by Clare Ann Bernero. 193 p., 27 figs., 2 tables, 3 appendixes, 1983.

*The Mechanical and Thermal Subsidence History of the Williston Basin*, by Steven Robert Mrkvicka. 131 p., 33 figs., 1 table, 2 appendixes, 1982.

*The Wagwater Belt, Jamaica: The Tectonic–Geologic Development of an Aulacogen*, by Christopher L. Perry. 152 p., 16 figs., 9 pls., appendix, 1984.

*Relationships of Rock Cleavage Fabrics to Incremental and Accumulated Strain in a Portion of the Blue Ridge, Virginia*, by James Bryan Tapp. 296 p., 40 figs., 7 tables, 3 appendixes, 1983 (Ph.D. dissertation).

## GOVERNOR'S WATER CONFERENCE SCHEDULED

On December 12 the Oklahoma Water Resources Board will host the Fifth Annual Governor's Water Conference at the Hilton Inn West in Oklahoma City. In addition to Oklahoma Governor George Nigh, speakers featured at the day-long seminar on water will include members of the Oklahoma congressional delegation.

Discussions will focus on water for agriculture, water for commerce and industry, public water supply, rural water, and water etcetera (a category that will include discussions of conservation, navigation, recreational water, and water for fish and wildlife. Sharing sponsorship with the governor's office and the Oklahoma Water Resources Board are some 30 other organizations and agencies with an interest in water.

The theme of the conference will be "Paying for Water—It's Up to Us," reflecting the shrinking federal role and the State's increasingly important role in planning and financing water development.

Immediately following the last afternoon session, delegates will be invited to an informal "Cracker Barrel Session," at which time speakers will be available to answer individual questions.

More information on the conference is available by calling Mary Whitlow, Conference Coordinator, Oklahoma Water Resources Board, 405-271-2581.

## STATE FINISHES NEAR TOP IN 1983 IN WELL COMPLETIONS

Victor E. Bartlett<sup>1</sup>

Oklahoma continues to rank second among all states in drilling activity and led the nation again in 1983 in the completion of deep wells.

Only Texas topped Oklahoma in total wells completed last year, with Kansas in third place, according to figures released by Petroleum Information Corp., Denver. An American Petroleum Institute report on well completions for January 1984 shows the same ranking.

Despite wide concern over the much-publicized drilling slump, 1983 proved to be the third best year in Oklahoma drilling history, and it was second best for the nation overall.

Oklahoma's well completions were down last year by 2,080 wells to 9,950 from the record high of 12,030 in 1982. The second-best year was 1981, with 11,699 completions in the State. In deep drilling, Oklahoma was in first place with 375 "superdeep" wells at depths of 15,000 ft or more, Petroleum Information (PI) reported. Although this was a 13-percent drop from the 430 wells in that category completed in the previous year, it accounted for 37 percent of all U.S. "superdeep" well completions in 1983.

The decline last year in recorded well completions was the first since the 1973 Arab oil embargo. In the past decade, stepped-up drilling activity brought a turnaround in the declining oil-production rate. Natural gas was a different story, with a substantial drop in U.S. gas production again last year, continuing a 5-year trend.

Oklahoma's estimated production of crude oil last year was up by 1.9 percent over the 1982 figure, PI reported, but natural-gas production fell by 17.7 percent.

Many wells listed as completed in 1983 were begun a year or two earlier, especially among the deep wells of the Anadarko Basin of western Oklahoma and Texas, which ranked second among all geologic provinces in the nation in estimated expenditures and second when ranked by new-field wildcats. On the completion scoreboard, the province ranked sixth.

The southern Oklahoma folded belt climbed to 10th place in the ranking of geologic provinces by estimated expenditures, nosing out the Arkoma Basin.

Wells of all types completed in Oklahoma last year included 5,003 oil wells, 1,891 gas wells, and 3,056 dry holes. The success rate was 69.3 percent, dropping from a 72.2 percent rate during the previous year.

The average well completed in Oklahoma was 4,834 ft deep in 1983—more

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<sup>1</sup>President, Oklahoma-Kansas Oil and Gas Association.



than 600 ft deeper than the national average but much less than the 5,211 ft reported in Oklahoma a year earlier.

PI predicted that the final figures for 1983 will show a drop in Oklahoma drilling and completion expenditures to \$4.39 billion from the record \$7.6 billion of 1982, reflecting lower per-foot costs of drilling as well as the fewer number of wells drilled.

Most observers continue to be cautiously optimistic about the industry's prospects. As PI expressed it, "A strong finish to 1983 points to firm U.S. activity in 1984."

## **PROJECT HELPS MAKE PHOTOGRAPHS EASILY AVAILABLE TO THE PUBLIC**

The National High Altitude Photography program (NHAP), a federal multi-agency activity coordinated by the U.S. Geological Survey, is making the most recent aerial photographs more easily accessible to the public.

Film transparencies or photographic reproductions of black and white and color infrared photographs are available in a 9- x 9-in. contact-print size as well as in standard enlargement sizes of 2X (18 x 18 in.), 3X (27 x 27 in.), and 4X (36 x 36 in.). Special print sizes also can be ordered.

To aid in selecting and ordering imagery, a comprehensive set of micrographic indexes to the NHAP coverage is available. The microfiche are keyed to the 1:1,000,000-scale International Map of the World series index and contain roll, project year, frame, and photographic-identification information needed to order prints.

The black and white photography is of cartographic quality, and the color infrared is valuable for resource evaluation, interpretation, monitoring, and management.

Acquisition of the database began in 1978. Coverage of the conterminous United States is scheduled to be complete within the next year or year and a half. Work in all but the extreme westernmost part of Oklahoma has been completed.

For more information, contact: U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198 (telephone, 605-594-6151).

## A Review

### KANSAS GEOLOGY

*Kansas Geology*, edited by Rex Buchanan, 1984, 208 p. Published for the Kansas Geological Survey by the University Press of Kansas, 303 Carruth, University of Kansas, Lawrence, KS 66045. \$12.95 in paperback, \$19.94 in hardback.

Elizabeth A. Ham<sup>1</sup>

Every state should have one, and several states do, but Kansas has the most recent.

Rex Buchanan, assistant director for publications and public affairs for the Kansas Geological Survey, has come out with a book on the geology of his state for (in his words in the preface) "those who have little or no background in earth science but want to know more about the geology of Kansas." His stated aim is to avoid both "distorting oversimplification" and "mistifying complexity." He has done a good job in avoiding these pitfalls and on the book as a whole.

The volume opens with an introduction by Buchanan himself in which he summarizes briefly not merely the general geology of Kansas but geology itself, describing basic geologic concepts—geologic time, deposition, erosion, stratigraphy, etc.—and applying them to the geology of the state.

Four subsequent chapters by other authors include: "Landscapes: A Geologic Diary," by Frank Wilson; "Rocks," by Laura Tolsted and Ada Swineford; "Minerals and Sedimentary Structures," also by Tolsted and Swineford; and "Fossils," by Debra K. Bennett. The concluding chapter, by Buchanan and James McCauley, is a west-east road log of the 424 mi of Interstate Highway 70 from the Colorado border to Kansas City.

There is also a comprehensive, helpful glossary to explain some of the terms used in the text. It is so comprehensive, in fact, that it includes such words as "coal," "petroleum," and "earthquake." And toward the center of the volume there is an insertion of page after page of excellent color photos and plates.

This would be a good book for anyone going into Kansas, whether for the first or the hundredth time. The road log covers only the features seen along I-70, but it expands upon those features and even includes some interesting historical notes. The chapter on landscapes covers topographic features and

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<sup>1</sup>Associate editor, Oklahoma Geological Survey, Norman.

how they got that way, plus general and some economic geology, but it also goes further. The chapter on rocks is an elementary course in petrology, applied to the purpose of the book. The following chapter is the same for mineralogy, with some sedimentology added. The chapter offers two tables for identifying Kansas minerals. The chapter on fossils, which is strikingly illustrated, offers a general view of the science of paleontology and some of its past proponents, plus a geologic history of the area, replete with life forms of the past; it becomes more specific about Kansas' former inhabitants, some of which were rather amazing.

This book is well illustrated, with most of the photos having been taken especially for the publication. As I said, the whole thing represents a job well done. I think even those not going into Kansas would find it interesting.

There are a couple of things I wish had been included, however. One is a sketch map to accompany the road log, another is at least a generalized composite columnar section. I would like also to find a list of the illustrations: only the color illustrations are listed in the front of the book. There are 121 figures, and it would be quite a list, but it would also be helpful.

What I would like most is to see more than one road log, especially one north from the Oklahoma border along I-35, and Rex Buchanan has informed us that he and others currently are in the process of preparing more of these logs.

We would like to congratulate our neighboring Survey on this new publication.

Now if someone will please tell us who drew the crazy sunflower on the dead tree stump in the photo of Kansas' highest point, Mount Sunflower—

## NEW BOOK FROM OU PRESS TELLS STORIES FROM THE OIL PATCH

*Voices from the Oil Fields* is a new University of Oklahoma Press publication, the rather bland cover of which belies the colorful personal accounts of early-day oil-patch workers whose stories fill the 259 pages.

The book, edited by Paul F. Lambert and Kenny A. Franks, is taken from recordings made in the late 1930's by employees of the Federal Writers Project, a branch of the New Deal Works Progress Administration. Told in the words of the actual workers, these stories are based on the oil-boom days of the early 20th century. Some of these tales are so gripping, however, that the historical facts pale beside the human suffering and endurance found in the lives of these people.

The men and women in this book were caught between the boom and bust cycles of both the oil industry and the United States. The hard times of the depression became even more paralyzing when boom towns died and drilling

decreased. Without government programs to fall back on, babies died from malnutrition and injured employees were often without any means of support.

Readers will learn how cable-tool rigs worked, find out about the construction of wooden derricks, and cringe through accounts of trips made in the "soup wagon," or nitroglycerin truck, to remote well sites.

The book is divided into 20 chapters, each containing an account by a different worker. While most narrations are by males, "The Old Lady with a Crutch" and "The Prostitute" deal with the difficult lives of women in these early boom-towns. "The Old Lady with a Crutch" tells the story of Manila Kate, who took over her husband's drilling outfit after he was killed in an accident. The account tells of Kate's success as a driller and her later inability to cope with life without her work.

Among the others heard from are "The Spudder Man," "The Roughneck," "The Tankie," and "The Pipeliner." Along with often detailed technical information, the narrators tell of their friends, their streaks of both bad and good luck, and the atmosphere of the oil patch. Pride in the work they did is a theme heard again and again throughout the book.

Those interested in the oil patch or the early days of the State will find this book fascinating reading. The book contains 41 photographs that are a treat in themselves. But on another level, the book will appeal to almost anyone who enjoys true-life drama, and in this context it might be just the gift for some of those hard-to-please people on your Christmas list.

For ordering information, contact The University of Oklahoma Press, 1005 Asp Ave., Norman, OK 73019. The price is \$19.95.

*Connie Smith*

## NOTES ON NEW PUBLICATIONS

### *Wilderness Mineral Potential: Assessment of Mineral-Resource Potential in U.S. Forest Service Lands Studied in 1964–1984*

Edited by S. P. Marsh, S. J. Kropschot, and R. G. Dickinson, the 1,183-page, 2-volume Professional Paper contains 332 articles that summarize the mineral resources and mineral-resource potential of an area studied as part of an evaluation of U.S. Forest Service lands from 1964 to 1984. Each article describes the location, geography, and geology of a particular area and details any resources and their relationship to known mining activity. Also given is the resource potential as determined by investigators. A generalized geologic map of the area showing the mineral-resource potential (if any) is included in each report.

Order from: Eastern Distribution Branch, Text Products Section, U.S. Geological Survey, 604 South Pickett St., Alexandria, VA 22304. Order number: P1300. The price for both volumes is \$38.

### *Federal Coal Resource Occurrence and Federal Coal Development Potential Maps of the Stigler West 7.5-Minute Quadrangle, Muskogee and Haskell Counties, Oklahoma*

Open-file report OF 79-0306, by Geologic Services of Tulsa, Inc., and B. T. Brady of the U.S. Geological Survey, consists of 37 pages and 6 oversized map sheets, scale 1:24,000 (1 in. = 2,000 ft).

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$9 for microfiche and \$23.50 for paper copy.

### *Ground-Water Levels in Observation Wells in Oklahoma, 1980–82*

Open-file report OF 83-0760, by R. L. Goemaat, L. D. Mize, and D. E. Spiser, consists of 612 pages of well-data tabulations.

Order from: United States Geological Survey, Water Resources Division, 215 Dean A. McGee St., Room 621, Oklahoma City, OK 73102. The price is \$3.50 for microfiche and \$79.75 for paper copy.

### *Oklahoma: Water-Level Changes in the High Plains Regional Aquifer, Northwestern Oklahoma, Predevelopment to 1980*

Water-Resources Investigations report WRI 83-4073, by J. S. Havens, consists of 1 oversized sheet, scale 1:500,000 (1 in. = about 8 mi).

Order from: United States Geological Survey, Water Resources Division,

215 Dean A. McGee St., Room 621, Oklahoma City, OK 73102. The price is \$1 for microfiche and \$2 for paper copy.

*Location and Names of Basins in the Conterminous United States*

Open-file report OF 83-0919, compiled by S. E. Frezon and T. M. Finn, consists of 1 oversized sheet.

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$1 for microfiche and \$3.75 for paper copy.

*Total Thickness of Sedimentary Rocks in the Conterminous United States*

Open-file report OF 83-0920, compiled by S. E. Frezon, T. M. Finn, and J. M. Lister, is made up of 1 oversized sheet.

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$1 for microfiche and \$3.75 for paper copy.

*Wells Drilled for Oil and Gas Deeper than 15,000 Feet in the Conterminous United States and Offshore*

Open-file report OF 83-0921, compiled by K. I. Takahashi and K. I. Cunningham, comprises 1 oversized sheet, scale 1:7,500,000 (1 in. = about 118 mi).

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$1 for microfiche and \$2 for paper copy.

*Wells Drilled for Oil and Gas Deeper than 20,000 Feet in the Conterminous United States and Offshore*

Open-file report OF 83-0922, compiled by K. I. Takahashi and K. I. Cunningham, consists of 1 oversized sheet, scale 1:7,500,000 (1 in. = about 118 mi).

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$1 for microfiche and \$2 for paper copy.

*Principal Structural Features of Kansas*

A map showing the principal structural features of Kansas displays sedimentary basins, arches, faults, anticlines, synclines, principal towns, cities and county seats. Large regional features, such as buried erosional limits of

Mississippian rock, are also included. Map insets give Precambrian rock type and fault distribution, a Kansas physiographic map, a cross section of stratigraphic sequences, major pre-Mississippian structural provinces with some minor structures, and a generalized geologic cross section of Kansas. Map size, 40 X 58 in., scale, 1:500,000 (1 in. = 8 mi).

Order P5270 from: PennWell Books, P.O. Box 21288, Tulsa, OK 74121. The price is \$40 U.S. and Canada, \$58 export.

*Oklahoma: Preliminary Appraisal of the Hydrology of the Rock Island Area, Le Flore County, Oklahoma*

Water-Resources Investigations report WRI 83-4013, by M. V. Marcher and others, consists of 39 pages and 3 oversized sheets at a scale 1:24,000 (1 in. = 2,000 ft).

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. The price is \$12.50 for paper copy and \$5 for microfiche.

*U.S.A. Oil Industry Directory—23rd Edition*

The 550-page 23d edition of the *U.S.A. Oil Industry Directory* lists 27,500 personnel from more than 4,000 companies in more than 8,500 locations. A statistical survey that summarizes profitability and productivity data for 400 U.S. oil-and-gas-producing companies is also included.

Order P1014 from: PennWell Directories, P.O. Box 21278, Tulsa, OK 74121. The price: \$75 for U.S. and Canada, \$87.50 export.

*Oil Industry Outlook for the United States*

This 1st edition examines the state of the oil industry and illustrates market indicators that may be used to analyze the industry. It includes worldwide outlook—demand and supply; U.S. outlook—demand and supply; capital expenditures; and exploration and production.

Order P1400 from: PennWell Directories, P.O. Box 21278, Tulsa, OK 74121. The price is \$125 for U.S. and Canada, \$156 export.

*The Computer Graphics Directory*

This 125-page 1st edition lists services, industry data, software, hardware, and key industry personnel.

The book lists hardware from micros to mainframes, as well as software. Topics covered include scientific modeling, business graphics, cartography, turnkey systems, work stations, digitizers and input devices.

Order P1600 from: PennWell Directories, P.O. Box 21278, Tulsa, OK 74121. The price is \$80 U.S. and Canada, \$90 export.

### *Directory of Online Databases*

The *Directory of Online Databases*, published by Cuadra Associates, Inc., and distributed by PennWell, is designed to keep readers abreast of information contained in online databases available for interactive access from remote computer terminals. It contains more than 1,300 entries for 1,600 databases containing numeric and textual information.

Order from: PennWell Directories, P.O. Box 21278, Tulsa, OK 74121. The price is \$45 U.S. and Canada, \$56.50 export.

### *A Writer's Guide to Periodicals in Earth Science*

This guide, edited by Wendell Cochran and Mimi Braverman, lists pertinent information from 50 earth-science publications so that authors may submit manuscripts to the most appropriate journals. Included is a supplemental list that gives the names and addresses of 70 international earth-science periodicals.

Order from: American Geological Institute, 4220 King St., Alexandria, VA 22302. The price is \$3.50 postpaid.

### *Digital Filtering: Applications in Geophysical Exploration for Oil*

Author Attila Mesko's 512-page book covers techniques of digital filtering as well as several applications in seismic-, gravity-, and magnetic-prospecting methods. The book includes introductory material on linear integral transforms and other topics.

Order from: Wiley Professional Books-by-Mail, John Wiley & Sons, Inc., Dept. 0658, Somerset, NJ 08873. The price is \$69.95.

### *Prehistory of Oklahoma*

Editor Robert E. Bell summarizes the archaeology of the Southern Plains and Caddoan areas of Oklahoma in this 456-page book. Chapters include information on the Oklahoma environment, past and present, with lists of faunal, floral, and lithic resources that provide a background for understanding the ecology of prehistoric inhabitants.

Order from: Academic Press, Inc., Promotion Dept., 6277 Sea Harbor Dr., Orlando, FL 32821. The price is \$48.50.

### *Role of Rock-Fluid Reactions in the Enhanced Recovery of Petroleum*

Open-file report OFR 61-84, by W. H. Somerton and C. J. Radke, evaluates the effects that rock-fluid reactions in typical oil-producing formations



may have on the success or failure of enhanced-oil-recovery (EOR) operations. Core samples were collected from a number of oil-producing zones that either are undergoing or are potential candidates for EOR operations; then these samples were evaluated for mineralogical-petrographic characteristics. Copies of this report are not available for purchase, but the report is available for reference at the U.S. Department of Energy office in Bartlesville, OK.

*Chemical Data for Soils over and Around the Velma Oil Field, Stephens County, Oklahoma*

Open-file report OFR 84-262, by Susan S. Roeming and Terrence J. Donovan, contains 7 illustrations and 23 pages. The report may be inspected at the Oklahoma Geological Survey, at the address inside the front cover of this issue.

*Measured Stratigraphic Sections of Uranium-Bearing Upper Triassic Rocks of the Dockum Basin, Eastern New Mexico, West Texas, and the Oklahoma Panhandle, with Brief Discussion of Stratigraphic Problems*

Open-file report OPR 83-701, by Warren I. Finch and James C. Wright, contains 29 illustrations and 123 pages. The report may be inspected at the Oklahoma Geological Survey, at the address inside the front cover of this issue.

*Organic Geochemical Analyses for 247 Organic-Rich Rock and 11 Oil Samples from the Middle Pennsylvanian Cherokee and Marmaton Groups, Southeastern Iowa, Missouri, Southeastern Kansas, and Northeastern Oklahoma*

Open-file report OFR 84-160, by Joseph R. Hatch, Ted A. Daws, Sister Carlos M. Lubeck, Mark J. Pawlewicz, Charles N. Threlkeld, and April K. Vuletich, consists of 1 illustration, 7 tables, and 41 pages. The report may be inspected at the Oklahoma Geological Survey, at the address inside the front cover of this issue.

*Vertical Seismic Profiling: Techniques, Applications and Case Histories*

This 448-page reference book, edited by A. H. Balch and Myung W. Lee, discusses vertical-seismic-profiling (VSP) applications. A bibliography is included. The reference was designed for persons working in applied exploration seismology.

Order from: IHRDC Publications, 137 Newbury St., Boston, MA 02116. The price is \$58.

### *1984 International Petroleum Encyclopedia*

The *1984 International Petroleum Encyclopedia* contains more than 400 pages, including a 160-page atlas. Topics cover third-world oil exploration and development, a profile of OPEC, offshore oil exploration, the U.S. Strategic Petroleum Reserve, and a seismic-exploration update.

Order from: PennWell Publishing Co., P.O. Box 21278, Tulsa, OK 74121. The price is \$65.

### *McGraw-Hill Dictionary of Earth Sciences*

The earth-science information in this dictionary was taken largely from the *McGraw-Hill Dictionary of Scientific and Technical Terms*. The 850-page book covers 18 fields, including geology, geodesy, climatology, hydrology, and petroleum engineering and includes more than 15,000 terms with synonyms, acronyms, abbreviations, cross references, and discipline identification for every definition.

Order from: McGraw-Hill Book Co., P.O. Box 400, Hightstown, NJ 08520. The price is \$32.50.

### *Dictionary of Petrology*

The *Dictionary of Petrology* by Sergi I. Tomkeieff, edited by E. K. Walton and others, covers the terminology of sedimentary, metamorphic, and igneous petrology. It includes synoptic tables that allow the user to correlate similar and synonymous terms and understand their different connotations. An alphabetical listing gives word background and changes in definition with time. The 692-page book was designed for teachers and researchers in geology.

Order from: John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158. The price is \$100.

### *The Techniques of Modern Structural Geology, Volume 1: Strain Analysis*

John G. Ramsay and Martin I. Huber present an introduction to fundamental techniques of structural geology for students in the earth sciences in their new book. The 328-page publication is divided into 14 work sessions, each giving practical work on a specific topic, of approximately 3 hours each. All sessions are taken from real geological examples and illustrated by field photographs and micrographs, and are followed by a set of graded problems.

Order from: Academic Press, Inc., Promotion Dept., 6277 Sea Harbor Dr., Orlando, FL 32821. The price is \$50 for clothbound copies and \$25 for paper-bound copies.

### *Advances in Petroleum Geochemistry, Volume 1*

Reviews of recent advances in petroleum geochemistry are contained in this 360-page volume, edited by Jim Brooks and Dietrich H. Welte. The book was designed to cover, in a topical way, important aspects of petroleum geochemistry.

Order from: Academic Press, Inc., Promotion Dept., 6277 Sea Harbor Dr., Orlando, FL 32821. The price is \$49.50.

### *Contributions to the Tectonics and Geophysics of Mountain Chains*

The 15 papers included in Memoir 158 discuss regional geology and tectonics of the Appalachian orogen; comparisons with the Caledonides, the Mauritanides, the Alps, and the North American Cordillera; the application of mechanical principles to the solution of structural problems; and the use of reflection seismology and data from aeromagnetic and gravity studies to interpret large-scale problems in the tectonics of mountain chains. This 224-page book also includes 15 oversized figures in a pocket.

Order Memoir 158 from: GSA Publication Sales, P.O. Box 9140, Boulder, CO 80301. The price is \$42.50.

### *Geowriting*

*Geowriting's* 4th edition, edited by Wendell Cochran, Peter Fenner, and Mary Hill, has been revised and contains information on word processing, along with chapters on style, type design, getting started, drawings and photos, rules for names, and a number of other topics. The book has examples of copyediting and proofreading marks, and has important facts highlighted at the beginning of each chapter.

Order from: American Geological Institute, 4220 King St., Alexandria, VA 22302. The price is \$5.

### *Dictionary of Geological Terms*

The 3d edition of *Dictionary of Geological Terms*, edited by Robert L. Bates and Julia A. Jackson, contains more than 1,000 new terms and definitions, a hyphenation and pronunciation guide, commonly used abbreviations, and a geologic time and life chart.

Order from: American Geological Institute, 4220 King St., Alexandria, VA 22302. The price is \$19.95 hardbound, \$7.95 softbound.