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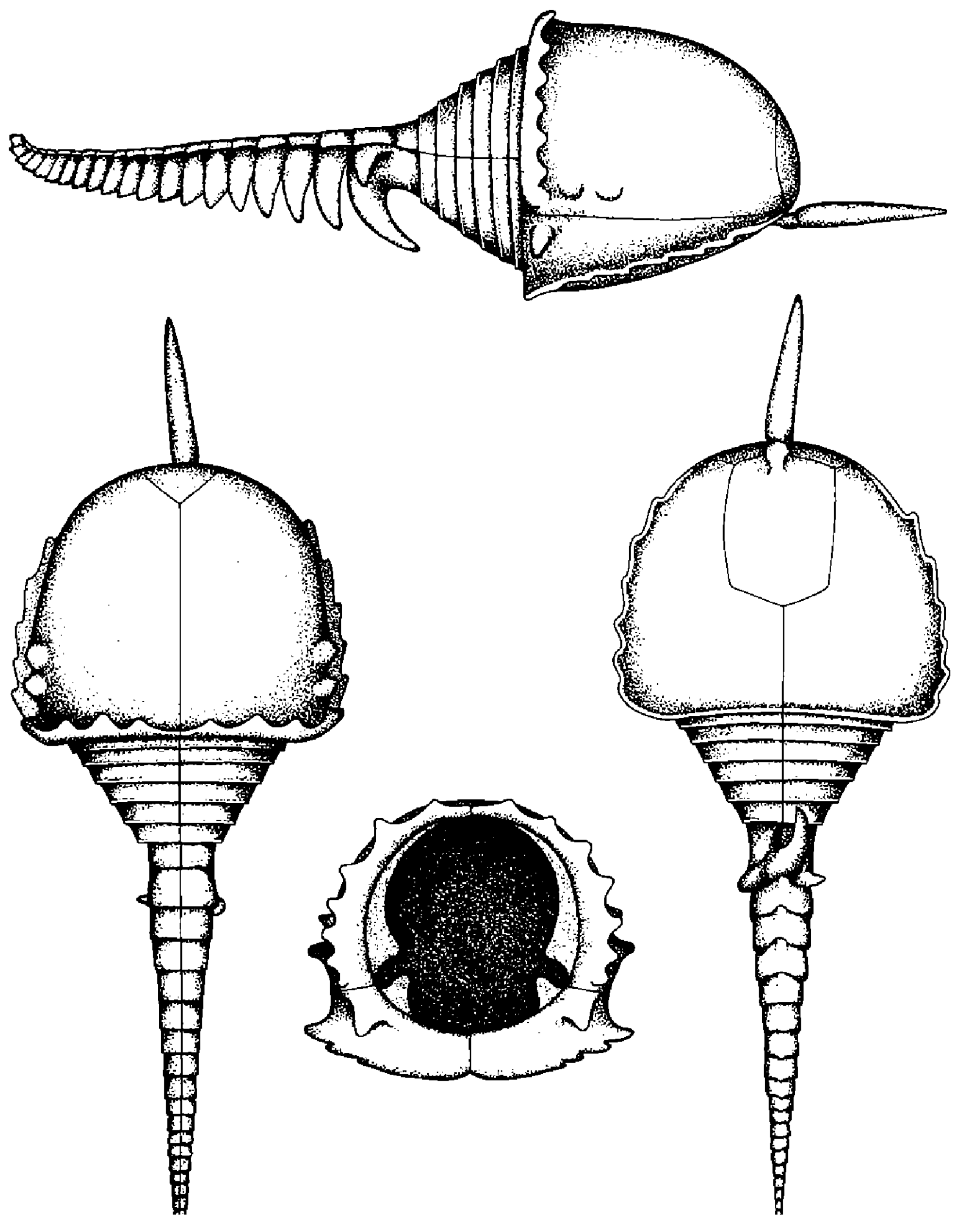

On the cover—

Newly Discovered Carpoid from Pennsylvanian Rocks of Oklahoma

Reconstruction of a new mitrate carpoid from the Pennsylvanian (Morrowan) Gene Autry Shale Member of the Golf Course Formation of southern Oklahoma. Carpoids, an extinct subphylum of echinoderms, are one of the most enigmatic groups of organisms in the fossil record. Their anatomy, life modes, and phylogeny are perplexing and controversial.

The new Oklahoma carpoid is unusual because it postdates the youngest previously known carpoids (Early Devonian) by ~70 m.y. The reconstruction is based on examination of several hundred incomplete specimens and fragments that were sieved from shale. This is an unusually small species, with a body that was no longer than 4 mm. A manuscript describing the new species is being prepared by D. R. Kolata, T. J. Frest, and R. H. Mapes.

My anatomical interpretations are that the lateral view of the right side of the animal is shown in the top illustration; the drawing on the left is the view of the top of the animal (dorsal); the drawing on the right is the view of the lower surface (ventral); and the bottom illustration shows the view of the posterior part of the body with the appendage removed, looking into the body cavity.

Dennis R. Kolata
Illinois State Geological Survey

OKLAHOMA GEOLOGICAL SURVEY

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OKLAHOMA GEOLOGY NOTES

C O N T E N T S

OKLAHOMA
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VOL. 49, NO. 1

FEBRUARY 1989

GEOLOGIC MAP REVISION OF THE BLACK MESA REGION, CIMARRON COUNTY, OKLAHOMA

Patrick S. Mulvany[1] and Judith O. Mulvany[1]

Abstract

A geologic map has been made for secs. 20, 21, 28, and 29, T. 6 N., R. 1 ECM, Kenton Quadrangle, Black Mesa region, northwestern Cimarron County, Oklahoma, where Cenozoic and Mesozoic rocks outcrop. This map revises corresponding areas of previously published geologic maps and demonstrates the need for additional remapping in the Black Mesa region. The most notable conclusion is that Triassic Sheep Pen Sandstone does not form a continuous outcrop (as shown on a prior map); rather, in places, Sheep Pen wedges out between Triassic Sloan Canyon Formation and Jurassic Exeter Sandstone.

Introduction

In extreme northwestern Cimarron County, Oklahoma, the Cimarron River and its tributaries have carved into Cenozoic and Mesozoic strata a terrain characterized by valleys, canyons, mesas, and buttes. Black Mesa, with its cap of basalt, is a conspicuous topographic feature in this semiarid region.

There are three published geologic maps of the Black Mesa region of Cimarron County that can be regarded as original works based on firsthand field observations; they are Rothrock (1925, fig. 3), Stovall (Schoff, 1943, pl. II), and Fay (1983, pl. 1). Rothrock mapped the entirety of Cimarron County. DeFord (1927) claimed that Rothrock's map "needs considerable revision." Six (1930, pl. I) published a modified version of Rothrock's map; Rothrock's geologic boundaries were preserved with few exceptions, but different names were given to the geologic formations. Stovall mapped the northwestern part of Cimarron County; he extensively revised Rothrock's geologic interpretation of the area. Fay mapped Triassic strata in the Black Mesa region of Cimarron County and adjacent parts of Colorado and New Mexico; he revised Stovall's interpretation of Triassic strata.

For the past five years we have studied the Black Mesa region of Cimarron County. We have come to the conclusion that the aforementioned maps require further revision in the vicinity of Black Mesa. The purpose of this paper is to demontrate this point. Toward this end we have prepared a geologic map of secs. 20, 21, 28, and 29, T. 6 N., R. 1 ECM, Kenton Quadrangle. This map includes the east

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tip of Black Mesa. We chose this particular study area for three reasons: first, it is the best place for showing how our interpretation differs from the interpretations of previous mappers; second, the geology in this area is typical of the region and includes most of the formally recognized stratigraphic units; third, when afoot in the field, we have noticed that this area—the dinosaur tracks locality, in particular—is a popular stop for sightseers and groups of students on field trips.

Methods

Detailed field work was done during a few visits in 1986 and 1987. The base for the field map was an aerial photograph (GS-VBKR, 4-131). Adjacent photographs (4-130, 4-132) were used to achieve stereoscopic viewing, which facilitated geologic interpretation both in the field and later in the office. We did not map surficial deposits, because our single goal was to show bedrock geology. We walked out most of the outcrops. Where needed—and where we could—we dug through surficial deposits to reveal underlying bedrock. A final map (Fig. 1) was made by transferring geologic information from the field map to a base map patterned from the Kenton Quadrangle 7.5′ topographic map. Corrections for photographic relief displacement were made visually.

Detailed descriptions of the formations and criteria for their delineation, written by Stovall, can be found in Schoff (1943). When using Stovall's descriptions in conjunction with our map, the reader must bear in mind some important points. Stovall (Schoff, 1943, p. 45,47) chose not to recognize the occurrence of Sheep Pen Sandstone in northwestern Cimarron County. But as Baldwin and Muehlberger (1959, p. 40) speculated, and as Fay (1983) later confirmed, Sheep Pen does occur—Stovall included it in Exeter Sandstone. Stovall (Schoff, 1943, p. 49) acknowledged that strata he called Dockum Group are equivalent to Sloan Canyon Formation.

Discussion

Comparing our map to corresponding areas on the maps by Stovall (Schoff, 1943, pl. II) and Fay (1983, pl. 1), one readily discerns some differences. We found no evidence in the field indicating that Sloan Canyon or Sheep Pen outcrop in the E½ sec. 28. Exposures of dinosaur-track-bearing sandstone in Coopers Arroyo in the NE¼ sec. 28 are in lower Morrison Formation; we recently learned indirectly from Conrad and others (1987, p. 134) that Lockley (1986) independently made this same conclusion. Moreover, the contact between Morrison and Exeter is exposed in the N½ sec. 28. Morrison—not Sloan Canyon—outcrops over much of the NE¼ sec. 28.

Fay's map depicts Sheep Pen as forming a continuous outcrop. In places, however, Sheep Pen is absent, being totally truncated by Exeter. On the southeast side of the Dakota-capped butte (Labrier Butte) that is common to secs. 20 and 29 (and alongside the paved road), Sheep Pen is clearly visible, being sandwiched between Exeter and Sloan Canyon. A photograph of this exposure appears in Baldwin and

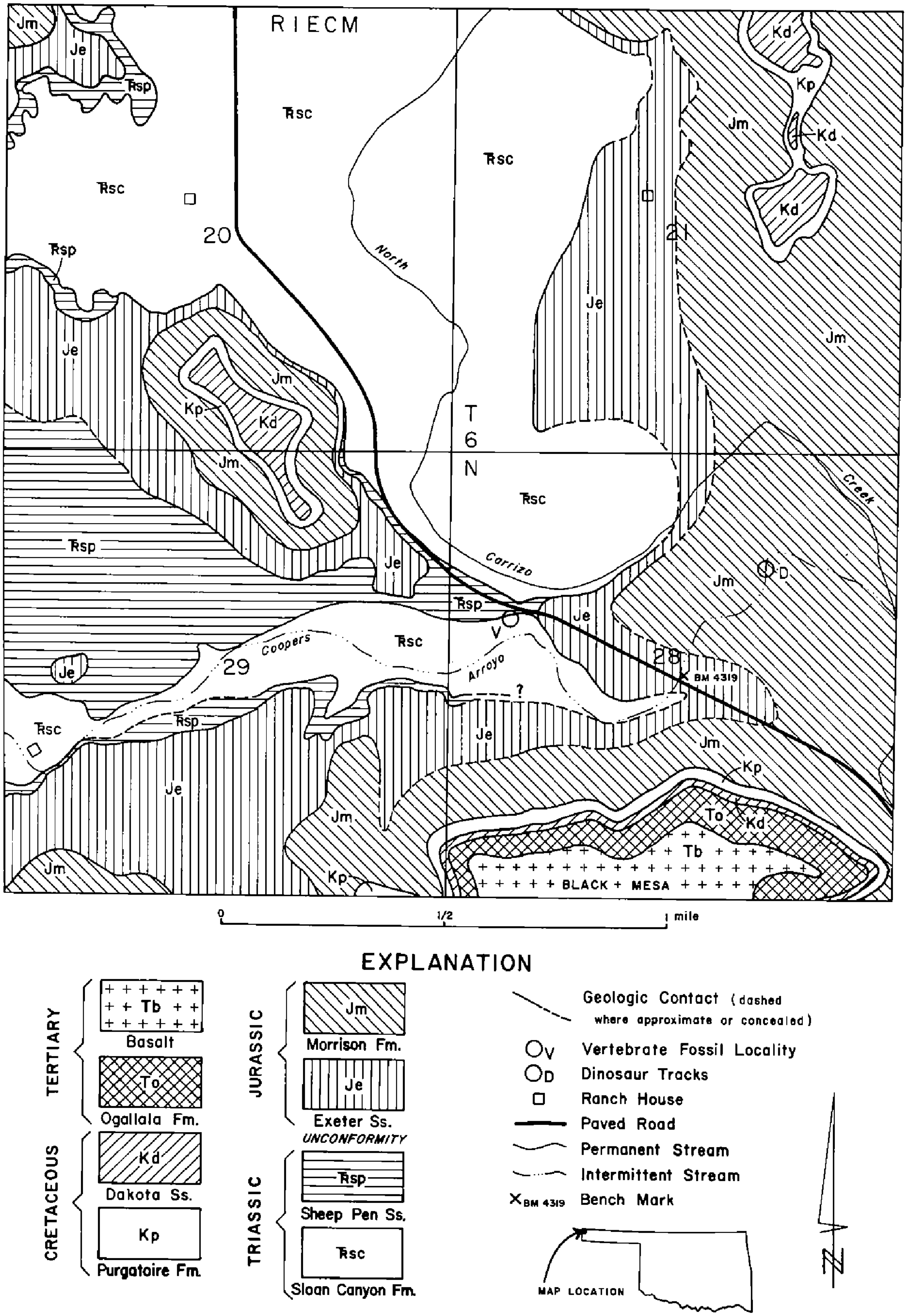

Figure 1. Geologic map of secs. 20, 21, 28, and 29, T. 6 N., R. 1 ECM, Cimarron County, Oklahoma.

Muehlberger (1959, p. 20, pl. 5A). From this point northwest, Exeter is easily traced along the northeast side of the butte; Sheep Pen and Sloan Canyon, however, disappear under colluvium. On the north side of this butte an excellent exposure shows Exeter resting on Sloan Canyon—Sheep Pen is absent. The location of the Sheep Pen wedge-out along the northeast side of the butte was determined by digging through colluvium. Northwest of the butte this wedge-out is visible in a natural exposure. In the N½SW¼ sec. 28, the Sheep Pen wedge-out is concealed by surficial deposits.

In the W½ sec. 21, Exeter outcrops in a long, continuous, west-facing ledge. Thick surficial deposits abut this ledge. At the south end we found a place where we could dig through surficial deposits and expose the underlying formation—Sloan Canyon. About 1,000 ft to the north we found a small pile of fragmented green shale at the mouth of an animal burrow that went down into surficial deposits and presumably back under the ledge. This shale is typical of Sloan Canyon. Sheep Pen probably does not outcrop in the W½ sec. 21.

In the NW¼ sec. 28, North Carrizo Creek makes a broad turn and flows northeast for about one-half mile. Where the creek has cut into its right bank is a fine exposure—though obscured by trees—of Exeter directly overlying Sloan Canyon. Along this exposure, from southwest to northeast, Exeter progressively truncates older and older Sloan Canyon strata. In the SE¼SW¼NW¼ sec. 28, east-flowing Coopers Arroyo has cut into its left bank, producing a similar and equally interesting exposure. At the north end, Exeter truncates a thin bed of sandstone, which we think is close to the base of Sheep Pen. The Exeter then thickens southeastward as it progressively truncates Sloan Canyon strata.

In our study area, Exeter is unconformable with Sheep Pen and Sloan Canyon. Regionally (northwestern Cimarron County and adjacent parts of New Mexico and Colorado) this pre-Exeter unconformity has been variously recognized by Lee (1902), Stanton (1905, p. 665), Gould (1905, p. 82, fig. 28), Rothrock (1925, p. 48), DeFord (1927), Darton (1928, p. 306), Six (1930, p. 27,28), Parker (1930, 1933, 1934), Sanders (1934, p. 866), Ver Wiebe (1934, p. 12), Stovall (1938), Stovall and Savage (1939), Schoff (1943), McLaughlin (1954, p. 88), Baldwin and Muehlberger (1959), Fay (1983, pl. 1), and Lucas and others (1987, p. 97). We decline to comment definitely whether this unconformity in our study area is an angular unconformity or a disconformity, for pertinent exposures are small and disparate and true bedding in Exeter is difficult to discern.

Differences between our map and Fay's map suggest differences in opinion on how Sheep Pen and Exeter should be distinguished. We found the following criteria useful in our study area:

Sheep Pen typically is a light- to medium-tan, thin- to thick-bedded, moderately hard, dense, clean to dirty sandstone. The basal portion is often intercalated with green shale; in such cases the sandstone itself has a green tinge. Bedding surfaces sometimes bear ripple marks and fucoids (as in the NW¼ sec. 20). Sheep Pen is conformable and gradational with Sloan Canyon. We consider the first appearance of predominantly sandstone strata as representing the base of Sheep Pen.

Exeter typically is a white to orange-brown, massive, cross-bedded, clean, friable sandstone. It is sometimes thin- or thick-bedded at the bottom or at the top. There are no ripple marks or fucoids. It often outcrops in continuous, light-colored, prominent, massive ledges that are sometimes castellated. Weathering is sometimes cavernous (as in the SW¼ sec. 21). Exeter is unconformable (or deceptively conformable) with Sheep Pen and Sloan Canyon. Morrison is conformable with Exeter.

Visual descriptions aside, one simple mechanical field test is useful for distinguishing Sheep Pen and Exeter in our study area. A two-pound hammer tends to recoil ("rings") upon impact with Sheep Pen. Usually more than one blow is required to induce failure of the rock. The rock breaks cleanly, and the resulting fragments have sharp edges; the rock resists mechanical disaggregation. The hammer does not recoil (instead "thuds") upon impact with Exeter. The rock does not break cleanly; it tends to disintegrate into individual grains and small aggregates. Some beds of Sheep Pen do react to hammer blows as Exeter does, but these are overlain by typical Sheep Pen beds that make the hammer "ring."

Vertebrate-Fossil Locality

In September 1982, at the vertebrate-fossil locality (SW¼NW¼ sec. 28), which is the floor of a small quarry, we collected several teeth and an incomplete but fairly well-preserved labyrinthodont skull from Sloan Canyon, 16 ft below the base of Sheep Pen. The skull is currently at the Museum of Northern Arizona, Flagstaff, undergoing preparation for further identification. Lucas and Hunt (1987) and Lucas and others (1987, p. 109, fig. 11F) reported and pictured an alleged Metoposauridae skull fragment collected from Sloan Canyon at this locality, for which Lucas and others (1987, p. 114, control point 38) gave incorrect coordinates.

Summary and Conclusions

1. Our geologic map of secs. 20, 21, 28, and 29, T. 6 N., R. 1 ECM, Kenton Quadrangle, Black Mesa region, northwestern Cimarron County, Oklahoma, revises corresponding areas of geologic maps published by Stovall (Schoff, 1943, pl. II) and Fay (1983, pl. 1).
2. The dinosaur tracks exposed in Coopers Arroyo in the NE¼ sec. 28 are in lower Morrison Formation—not in Sloan Canyon Formation, as indicated by the maps of Stovall and Fay.
3. Sheep Pen Sandstone and Sloan Canyon do not outcrop in the E½ sec. 28.
4. Fay's map shows Sheep Pen as forming a continuous outcrop. We have shown that Sheep Pen wedges out in places.
5. Sheep Pen probably does not outcrop in the W½ sec. 21.
6. In the NW¼ sec. 28, Exeter Sandstone overlies and truncates some Sloan Canyon strata.
7. There is a marked pre-Exeter unconformity, but we are unable to determine the nature of this unconformity, because pertinent exposures are small and disparate and true bedding in Exeter is difficult to discern.
8. Differences between our map and Fay's map suggest differences in opinion on how Sheep Pen and Exeter should be distinguished. We state how we distinguish these two units.
9. The vertebrate-fossil locality of Lucas and others (1987) is located in the

SW¼NW¼ sec. 28. Lucas and others (1987) gave incorrect coordinates for this locality.

10. There is a need for additional remapping in the Black Mesa region of Cimarron County, Oklahoma.

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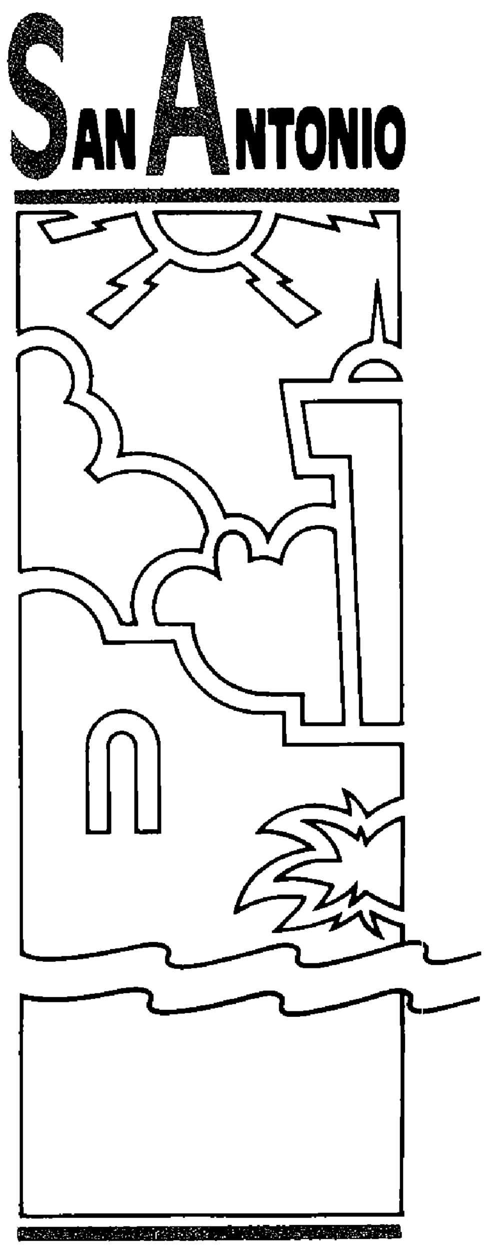
AAPG ANNUAL CONVENTION
San Antonio, Texas, April 23–26, 1989

Welcome home to San Antonio! Most of us in AAPG and SEPM have been here many times before—in the service, on vacation, working in our industry, attending conventions like this one—so you know the place pretty well—the fun of the cosmopolitan atmosphere combined with small-town friendliness and the ease of getting around historic downtown, where all principal convention activities are within easy walking distance of each other.

The excitement is already rising as we approach the time for another AAPG convention. This is the city everyone wants to visit, with its great history, its missions, its winding river, and its tradition of great fiestas. Added to all this since your last convention visit here are the new IMAX Theatre with its six-story-high screen, Sea World and Shamu, and a glamorous new Rivercenter Mall one block from the convention center and adjoining the just-opened 1,000-room Marriott Hotel, which will serve as our convention headquarters. The South Texas Geological Society welcomes you and is pleased to be your host at this convention. Its three hundred and fifty dedicated members have worked diligently over the past two years to bring you an outstanding technical program in addition to all of the fun and frolic which are traditional in the River City.

We extend our warmest invitation to all of you to attend what we know will be a great convention.

—Don F. Tobin
General Chairman



AAPG Annual Convention Agenda

Technical Program

April 24

EMD Minerals Management—Issues for the 1990s
AAPG Development Geology, U.S. Gulf Coast and Permian Basin
AAPG Research Symposium I: Application of Chemical Modeling to the Prediction of Reservoir Quality
SEPM Expert Systems and Computer Modeling—Approaches to Basin Analysis and Basin Modeling
AAPG Petroleum Potential of the Basin and Range Province
SEPM Lacustrine Organic Geochemistry
SEPM Burial Diagenesis of Carbonates
New Computing Technology Concepts, Directions, and Applications in Petroleum Geology

April 25

AAPG Petroleum Potential of Sedimentary Basins—Methods, Techniques, and Approaches
AAPG Development Geology, Rockies, Canada, California, and North Sea
AAPG Exploration in South America
SEPM Siliciclastic Diagenesis I: Controls on Reservoir Heterogeneity
EMD General Session
SEPM Geochemistry, Diagenesis, and Source Rocks
SEPM Three-Dimensional Architecture of Clastic Sediments I and II
AAPG Emerging New Plays and Regional Trends
AAPG Petroleum Geology of Columbia
SEPM Geochronology and Biostratigraphy
SEPM Siliciclastic Diagenesis II: Influence of Depositional Environments

April 26

AAPG U.S. Gulf Coast Stratigraphy and Diagenesis
SEPM Siliciclastic Depositional Systems I and II
AAPG Application of Seismic Data to Stratigraphic Interpretation
SEPM Carbonate Facies and Depositional Systems
AAPG Ocean Drilling, Northwestern Australia Offshore: Mesozoic Sedimentary History
AAPG Exploration Potential—Mid-Continent Rift System U.S.A.
AAPG U.S. Gulf Coast—Structure and Salt Tectonics
AAPG Geology of China
AAPG Natural Gas Resources
SEPM Carbonate Diagenesis
AAPG Petroleum Geochemistry in Exploration
SEPM Siliciclastic Sedimentology and Tectonics

Short Courses

AAPG Exploration and Development Advanced Technology, *April 21–23*
SEPM Recognition of Fluvial Depositional Systems and Their Resource Potential, *April 22–23*
SEPM Integrated Stratigraphic Analysis (students only), *April 22 or 23*
STGS Sequence Stratigraphic Interpretation of Seismic, Well, and Outcrop Data, *April 22–23*
STGS Introduction to Hands-On Computer Operation for the Explorationist, *April 22 or 23*
STGS Lower Wilcox Core Workshop, Hallettsville Field "Shoestring Sands," *April 22 or 23*
AAPG Development Geology: Strategies for Recovery of Oil Remaining in Existing Reservoirs (students and faculty only), *April 23*
SEPM Subsurface and Outcrop Examination of the Capitan Shelf Margin, Northern Delaware Basin, *April 23*
STGS/SIPES How to be a Petroleum Independent, *April 23*
SEG Carbonate Seismology, *April 27–28*

Field Trips

GCS/SEPM Classic Exposures of the Cretaceous and Jurassic of Northern Mexico, *April 18–22*
STGS Upper Cretaceous of Southwest Texas—Shoal-Water Carbonates, Volcanism, and Clastic Progradation, *April 21–22*
STGS Clastic/Carbonate Depositional Models in a Cratonic Basin Setting—Pennsylvanian of North-Central Texas, *April 21–22*
AAPG Lower Cretaceous Sedimentary Geology of the Edwards Plateau, San Antonio Area (students and faculty only), *April 22*
GCS/SEPM Recent Sediments of Southeast Texas, *April 22*
STGS The Balcones Escarpment, *April 23*
PBS/SEPM A Field Trip Seminar—The Capitan Reef Complex, West Texas and New Mexico, *April 26–30*
STGS Geology of the Big Bend and Trans-Pecos Region, *April 26–30*
EMD Energy Programs at the Southwest Research Institute, *April 27*
EMD South Texas Lignite, *April 27*
GCS/SEPM Lower Cretaceous Carbonate Facies of the Moffatt Mound (Edwards Fm.), Lake Belton Area, Bell County, Texas, *April 27*
STGS Geology of the San Antonio Area, *April 27*
STGS Lower Cretaceous Carbonates of the Edwards Plateau, Texas, *April 27–29*

For further information about the annual meeting, contact AAPG, Convention Dept., P.O. Box 979, Tulsa, OK 74101; (918) 584-2555. The preregistration deadline is March 20.

NEW OGS PUBLICATION

SPECIAL PUBLICATION 88-4. *Petroleum Core Catalog, Oklahoma Geological Survey—October 1988,* compiled by Eldon R. Cox and Michelle J. Summers. 143 oversized pages, spiral bound. Price: $5.

Listed in this catalog are the petroleum cores, the largest and most-used group of materials contained in the OGS Core and Sample Library. The petroleum group consists of cores taken from more than 2,500 wells drilled in Oklahoma, contained in more than 55,000 boxes. This information has been developed and computerized by the OGS and OU's Geological Information Systems and is now under the Natural Resources Information System (NRIS) of Oklahoma, which is a group of interrelated data bases that together provide a wide range of detailed information on the State's oil, gas, and coal resources.

The petroleum core data base presented in this catalog consists of information on section, township, range, quarter section, county, operator name, well name and number, stratigraphic unit, depth interval, cored interval number, number of boxes per interval, diameter, condition, representation, total feet cored, average feet per box, and the library file number.

Although not included in the Petroleum Core Catalog, the Library also contains samples (well cuttings) and non-petroleum cores related to coal, minerals, and special stratigraphic studies. These items are listed in a separate card file at the Library.

SP 88-4 can be purchased over the counter or postpaid from the Survey at 830 Van Vleet Oval, Room 163, Norman, OK 73019; phone (405) 325-3031.

OGS TO HOST ASSOCIATION OF AMERICAN STATE GEOLOGISTS ANNUAL MEETING

The annual meeting of the Association of American State Geologists (AASG) will be held in Norman, Oklahoma, on May 13–17, 1989. The Oklahoma Geological Survey will be the host to this major meeting that brings together representatives of state geological surveys from all 50 states and Puerto Rico, as well as invited guests from federal agencies. About 150 persons are expected to attend the meeting, which will be held at the Oklahoma Center for Continuing Education on the campus of the University of Oklahoma.

Business meetings are being planned to discuss common problems and solutions that are peculiar to state geological surveys. Also, discussions about programs and grants or contracts between state surveys and the various federal agencies will be of particular interest. A geologic field trip to the Arbuckle Mountains is planned for the last day of the AASG meeting.

INDUSTRY GIVES SUPPORT TO OU

- **Conoco/Du Pont** has given $165,000 to the University of Oklahoma to benefit several academic disciplines and the Energy Center. The gift provides $100,000 for the Energy Center tower, currently under construction. The donation also includes $10,000 each for chemical engineering and University Libraries, $9,000 to business administration, $8,000 each for the general engineering program and minority engineering, $7,000 for geology and geophysics, $4,000 each for chemistry and petroleum engineering, $3,000 for petroleum land management, and $2,500 to mechanical engineering.

- **Phillips Petroleum Foundation** has contributed $126,000 for OU's Energy Center, student and faculty development support, and scholarships. The gift included the final $100,000 of Phillips's five-year $500,000 commitment to the Energy Center. A $14,300 Professional Development Fund grant marks the 21st consecutive year that Phillips has supported the stimulation of student and faculty interest in the area of professional development. The grant provides $6,400 to the College of Engineering, $3,000 to the College of Business Administration, $2,700 to the College of Arts and Sciences, $1,200 to the College of Law, and $1,000 to Career Planning and Placement Services.

  Additional support provided by the foundation included $4,000 for a scholarship in petroleum engineering and chemical engineering, $2,500 for undergraduate scholarships in petroleum land management, $2,250 to support three W. W. Keeler scholarships for minority students, $1,500 for geology scholarships, and $1,500 for the undergraduate scholarship program in chemistry.

- **Halliburton Foundation** has continued its support of the University of Oklahoma with a $100,000 payment toward a $575,000 commitment to the rock mechanics laboratory, a joint project of the colleges of engineering and geosciences. The Halliburton Foundation initiated funding of the laboratory in 1985. Located in the Energy Center, the laboratory's purpose is to improve drilling technology and hydrocarbon production through a more fundamental understanding of the mechanics of rock behavior as it applies to reservoir conditions. The lab serves all energy-related disciplines at OU with primary applications in petroleum and geological engineering, geology, geophysics, and civil and mechanical engineering.

- **Mobil Foundation** contributed funds totaling $36,000 to benefit areas in the OU colleges of business administration, engineering, and geosciences. In the College of Business Administration, $5,000 will fund five $1,000 scholarships for qualified minority students in the Margin of Quality Scholarships Program, and another $1,600 grant will go toward general support of the petroleum land management program. To benefit the College of Engineering, the foundation presented $7,000 in general support of the School of Petroleum and Geological Engineering and another $3,000 to fund an undergraduate tuition scholarship; $5,000 in general support of the Engineering Minority Programs; and $3,400 in general support of the School of Chemical Engineering and Materials Science. In the College of Geosciences, $10,000 was provided for support of the Organic Geochemistry Research Program in the School of Geology and Geophysics, and another $1,000 in general support to geology and geophysics.

- **Union Pacific Foundation** has awarded grants totaling $17,500 for the OU Energy Center and three other University areas. A $10,000 grant will assist with the Energy Center contruction, and the remainder will fund two $3,000 graduate fellowships in petroleum engineering and geology and a $1,500 scholarship in the College of Business Administration.

- **Sun Exploration and Production Co.** has donated $5,000 to the School of Geology and Geophysics. A total of $4,000 will be used for salary, awards, assistance to professors or students, and endowments. The other $1,000 will be used to provide a scholarship.

- **Amoco Foundation, Inc.** has made an unrestricted grant of $4,000 to the School of Petroleum and Geological Engineering.

NOTES ON NEW PUBLICATIONS

Minerals Yearbook, 1986
Volume II. Area Reports: Domestic

Prepared by the staff of the Bureau of Mines, this 546-page volume of the 1986 Minerals Yearbook contains chapters on the mineral industry of each of the 50 states, Puerto Rico, and the U.S. island possessions in the Pacific and the Caribbean. A statistical summary is also included.

Order GPO Stock No. 024-004-02202-7 from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; phone (202) 783-3238. This price is $22.

Annual Yield and Selected Hydrologic Data for the Arkansas River Basin Compact, Arkansas–Oklahoma, 1987 Water Year

M. A. Moore, T. E. Lamb, and L. D. Hauth wrote this 33-page USGS open-file report.

Order OF 88-0301 from: U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225; phone (303) 236-7476. The price is $4 for microfiche and $5.75 for a paper copy; add 25% to the price for foreign shipment.

Geologic Logs for Selected Deep Wells in Parts of Oklahoma, Texas, and New Mexico

A computerized data base of geologic logs for selected deep wells in parts of Oklahoma, Texas, and New Mexico was prepared by the USGS as part of the Central Midwest Regional Aquifer-System Analysis. At least one well per county in the study area was selected, and the geologic logs for the wells were entered into the data base. Summaries of the geologic logs are presented in this 161-page open-file report by Scott C. Christenson, Robert B. Morton, John S. Haven, and Roy W. Fairchild. Geophysical logs were used for interpretation of the geologic logs, and a list of these geophysical logs is also presented.

Order OF 86-541 from: U.S. Geological Survey, Water Resources Division, 215 Dean A. McGee Ave., Room 621, Oklahoma City, OK 73102; (405) 231-4256. A limited number of copies are available for distribution free of charge.

Summary of the High Plains Regional Aquifer-System Analysis in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming

The Ogallala Formation is the principal geologic unit in the High Plains Aquifer, which underlies 174,000 mi^2. In this 30-page USGS professional paper, authors J. B. Weeks, E. D. Gutentag, F. J. Heimes, and R. R. Luckey report that the water-table aquifer has a maximum saturated thickness of ~1,000 ft, an average thickness of 200 ft, and contains ~3.25 billion acre-ft of drainable water. Landsat data were used to map 1980 irrigated cropland and to estimate irrigation water use. In 1980, ~18 million acre-ft were pumped to irrigate 13 million acres. The volume of water in storage decreased ~166 million acre-ft from predevelopment to 1980. Using computer models, water levels were projected to decline >100 ft in areas totaling ~15,500 mi^2 from 1980 to 2020.

Order P 1400-A from: U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225; phone (303) 236-7476. The price is $2; add 25% to the price for shipment outside North America.

Land Use and Land Cover and Associated Maps for Fort Smith, Arkansas; Oklahoma

This data set consists of one map keyed to USGS topographic map Fort Smith at 1:250,000 (1 in. = about 4 mi). This map is coded for statistical data development. The map shows land use and land cover, political unit, hydrological units, and census county subdivision. Also included is one positive of the cultural base for Fort Smith.

Order OF 86-0011 from: U.S. Geological Survey, Mid-Continent Mapping Center, 1400 Independence Road, MS–231, Rolla, MO 65401; phone (314) 341-0851. The price is $4 for a paper diazo reproduction; add 25% to the price for foreign shipment. (A $1 postage and handling charge is applicable on orders of less than $10.)

Statistical Summaries of Streamflow Records in Oklahoma and Parts of Arkansas, Kansas, Missouri, and Texas through 1984

Statistical summaries of streamflow records through 1984 for gaging stations in Oklahoma and parts of adjacent states are presented in this 387-page USGS water-resources investigations report. David C. Heimann and Robert L. Tortorelli present records for 148 stations with at least 10 years of unregulated or regulated streamflow. For each gaging station, a brief description of the location, drainage area, and period of record is given. For those stations with a regulated streamflow record, a brief regulation history is given also. This information is followed by tables of monthly and annual discharge statistics, low- and high-flow frequency statistics, peak-flow frequency statistics, and flow-duration statistics. Daily flow-duration hydrographs are included for most stations.

Order WRI 87-4205 from: U.S. Geological Survey, Water Resources Division, 215 Dean A. McGee Ave., Room 621, Oklahoma City, OK 73102; phone (405) 231-4256. A limited number of copies are available free of charge.

Cross Sections Based on Gamma-Ray, Density, and Resistivity Logs Showing Stratigraphic Units of the Woodford Shale, Anadarko Basin, Oklahoma

Compiled by T. C. Hester, H. L. Sahl, and J. W. Schmoker, this USGS miscellaneous field studies map consists of two sheets. Sheet 1 is 38 × 54 in.; sheet 2 is 33 × 53 in.

Order MF-2054 from: U.S. Geological Survey, Map Distribution, Federal Center, Box 25286, Denver, CO 80225. The price is $3; add 25% to the price for shipment outside North America.

National Water Summary, 1986 Hydrologic Events and Ground-Water Quality

The fourth of an annual series describing the nation's water resources, this 560-page report focuses on ground-water quality and summarizes the ambient quality of ground water in the principal water-supply aquifers and describes the nature and extent of ground-water contamination in each state, the District of Columbia, and the territories.

Compiled by D. W. Moody, Jerry Carr, E. B. Chase, and R. W. Paulson, each summary contains the location of principal aquifers and presentations of data related to water quality in those principal aquifers, as well as the location of selected waste sites, areas of naturally impaired ground-water quality, and areas reflecting human-induced contamination. Also summarized are the state agencies, laws, and regulations involved in ground-water-quality management. Other parts of the report provide a review of significant hydrologic events in the 1986 water year. The role of the EPA and the federal government in ground-water protection is discussed, as are the results of a study of state and local ground-water-protection strategies conducted by the National Research Council.

The seven-page summary of data on ground-water quality in Oklahoma was prepared by W. F. Horak and J. D. Stoner.

Order W 2325 from: U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225; phone (303) 236-7476. The price is $36; add 25% to the price for shipment outside North America. Reprint copies of the Oklahoma summary are available free of charge from the U.S. Geological Survey, Water Resources Division, 215 Dean A. McGee Ave., Room 621, Oklahoma City, OK 73102; phone (405) 231-4256.

Effects of Future Ground-Water Pumpage on the High Plains Aquifer in Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming

In this 44-page USGS professional paper water levels, saturated thickness, and well yields are projected to the year 2020 assuming current trends, voluntary reduction in water use, and mandatory reduction in water use. Authors R. R. Luckey, E. D. Gutentag, F. J. Heimes, and J. B. Weeks project water levels to decline >100 ft in 15,500 mi^2. By 2020, well yields >750 gal/min will still be probable in much of the northern High Plains, but well yields >250 gal/min will be the norm in the southern High Plains.

Order P 1400-E from: U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225; phone (303) 236-7476. The price is $2.75; add 25% to the price for shipment outside North America.

UPCOMING MEETINGS

South-Central Friends of the Pleistocene, April 7–9, 1989, Central Texas. Information: Stephen A. Hall, Dept. of Geography, University of Texas, Austin, TX 78712; (512) 471-5116.

National Fossil Exposition XI, April 14–16, 1989, Macomb, Illinois. Information: Karl A. Stuekerjuergen, Route 1, Box 28A, West Point, IA 52656; (319) 837-6690.

American Geophysical Union, Spring Meeting, May 8–12, 1989, Baltimore, Maryland. Information: Convention Director, AGU, 2000 Florida Ave., N.W., Washington, DC 20009; (202) 462-6903.

40th Annual Highway Geology Symposium, May 17–19, 1989, Birmingham, Alabama. Information: Kathy Keller, Alabama Highway Dept., Bureau of Materials and Tests, 1409 Coliseum Blvd., Montgomery, AL 36130; (205) 261-5788.

28th International Geological Congress, July 9–19, 1989, Washington, D.C. Information: 28th International Geological Congress, P.O. Box 1001, Herndon, VA 22070-1001; (703) 648-6053.

OKLAHOMA ABSTRACTS

The following are abstracts from University of Oklahoma M.S. theses. Permission of the authors to reproduce the abstracts is gratefully acknowledged.

Paleomagnetic Dating of Calcite Speleothems in Arbuckle Group Limestones, Southern Oklahoma: A Possible Relationship Between Hydrocarbons and Authigenic Magnetite

LISA DORIS CRAWFORD, University of Oklahoma,
Norman, OK, M.S. thesis, 1987

Rock magnetic, paleomagnetic, petrographic, and geochemical studies were undertaken to study the origin and date the formation of calcite speleothem deposits within the Lower Ordovician Kindblade Formation. The speleothems are predominantly composed of clear to dark and red columnar calcite bands. Most of the dark bands contain abundant hydrocarbon inclusions defining growth layers and possess up to an order of magnitude stronger magnetization than lighter bands which do not contain hydrocarbon inclusions. Red calcite bands are stained with hematite, but also contain abundant hydrocarbon inclusions. Fossils interbedded with the speleothems indicate a Permian age of formation for the calcites. The dark calcites contain a chemical remanent magnetization (CRM) with a southeasterly and shallow "Kiaman" or Permian direction of magnetization (decl = 160°, incl = 3°, k = 17, α 95 = 5). Rock magnetic experiments suggest that the magnetization resides in magnetite. The red calcites contain a similar direction to that for the dark calcites; demagnetization evidence suggests that the magnetization resides primarily in magnetite with a minor contribution from hematite.

At one location a speleothem which fills a vertical fracture contains an anomalous direction of magnetization (decl = 122°, incl = −4°). The magnetization for this site is interpreted as a CRM residing in magnetite. The host rock, the Kindblade limestone, also contains a CRM residing in magnetite and has approximately the same direction as the speleothem in the vertical fracture fill. These anomalous directions are interpreted to be the result of structural rotations that have occurred in the area due to left lateral wrench faulting.

The dark color of the calcite bands is caused by hydrocarbon inclusions. Organic geochemical studies indicate these hydrocarbons are apparently not severely degraded. Magnetic extracts from the dark calcites contain botryoidal, spherical, and other authigenic forms which, based on energy dispersive analysis, contain iron as the only detectable element. X-ray diffraction analysis revealed the presence of magnetite and hematite in the magnetic extracts. The botryoidal and spherical forms are interpreted to be authigenic magnetite.

Hydrocarbons apparently seeped into the caves during precipitation of the speleothems, and were trapped in the calcite crystals. The results from the light and dark calcites suggest that the chemical conditions created by the hydrocarbons may have caused the precipitation of the authigenic magnetite and acquisition of

the associated CRM. The red calcites may have had a similar diagenetic history with chemical conditions favoring the formation of hematite, and causing the slightly red coloration.

Deposition of a Late Permian Mud–Rich Sabkha in Northern Caddo County, Oklahoma

BARRY CHRISTMAN CASPAR, University of Oklahoma, Norman, OK, M.S. thesis, 1987

In the Mound Valley region of northern Caddo County, Oklahoma, upper Rush Springs strata record a single marine regression from a marine shelf bar through mud rich sabkha. The five facies encountered: (1) sandstone, (2) gypsiferous siltstone, (3) dolomitized evaporite, (4) layered dolomite, and (5) breccia/red silt were deposited on the inland portion of a shallow restricted basin. Marine sabkhas formed in patches in the region revealing local variations in salinity and bathymetry.

Large conspicuous dolomite domes are coincident with evaporitic lenses and formed as a result of displacive, interstitial and diagenetic growth of anhydrite and gypsum. Other penecontemporaneous and diagenetic features include degassification holes, false ripples, false bedding, sand clasts, differential weathering pipes, peritidal teepee structures, dolomitization and dolomite replacement of evaporites. The evaporitic minerals in these rocks have been replaced by dolomite, preserving original textures and bedding.

All dolomite mineralogies are of the same grain size range and XRD scans indicate all dolomite mineralogies to be identical. This implies the present day dolomite mineralogy is secondary. The original layered dolomite mineralogy may have been supratidal in origin.

Brachiopod Biostratigraphy and Paleoecology of the Upper Dornick Hills Group, Middle Pennsylvanian, Ardmore Basin, Southern Oklahoma

MARK M. DENNEN, University of Oklahoma, Norman, OK, M.S. thesis, 1987

The Upper Dornick Hills Group (Atokan–Desmoinesian) of the Ardmore Basin is a thick (up to 500 meters) sequence of marine shales interbedded with thin limestone, sandstone and conglomerate intervals. Although poorly exposed, many of these units contain prolific brachiopod faunas. Thirty-seven species of brachiopods have been found in the study interval.

Rapid evolution of several brachiopod lineages makes biostratigraphic zonations possible in the Atokan. Using these zonations, it has been concluded that the "Davis Sand" pinches out stratigraphically in the northern part of the basin. In the Desmoinesian, evolutionary changes are comparatively slow.

Brachiopod biofacies can be related to lithofacies. Chonetid brachiopods are very abundant in calcareous shales. Productid brachiopods and *Neospirifer* are dominate in the low energy carbonate facies. *Anthracospirifer* and *Spirifer* were more tolerant of clastic influxes and are found predominantly in quartz-sandy carbonates and less commonly in sandstones.

Depositional and Diagenetic Framework of the Lower Permian Chase Group, Southern Hugoton Embayment

RICHARD CLAY STEVER, University of Oklahoma,
Norman, OK, M.S. thesis, 1987

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The Chase Group of southwestern Kansas and the Oklahoma Panhandle consists of interbedded shallow marine carbonates and intertidal to supratidal clastic-dominated sediments. These rocks were deposited on, and adjacent to, a broad shelf in a shallow Wolfcampian epeiric sea. Nine depositional facies of the Chase are delineated, including: (1) bedded anhydrite; (2) red-brown dolomitic siltstone and silty dolomudstone; (3) green to grey dolomitic siltstone and silty dolomudstone; (4) light brown to grey-brown silty dolomudstone; (5) brown-grey pseudonodular dolomudstone; (6) light brown spiculite; (7) calcareous to dolomitic skeletal carbonate; (8) oolitic grainstone; and (9) dark grey silty wackestone. These facies represent the seaward succession of linear facies belts.

The nine facies reflect deposition on a variation of a classic carbonate ramp, here characterized by a marginal barrier bank complex and a low angle slope. An arid climate is also indicated. The vertical succession of facies reflects distinct upward-shallowing cycles (CABCD). Six such cycles occur in the Chase, which in itself represents a mega-cycle.

Chase Group carbonates have undergone extensive and complex diagenesis, each phase partially obscuring those preceding it. This paper establishes the fabrics and relative timing of diagenetic events, the most important of which include: (1) several forms of calcite cementation, (2) at least two stages of dolomitization, (3) pervasive anhydrite emplacement, (4) two phases of silicification, (5) clay alteration and authigenesis, and (6) at least two major dissolution events. Most phases of diagenesis were probably related to sedimentary cycles. Lateral facies distribution, cyclic deposition, and diagenetic alteration have jointly served to selectively enhance and degrade reservoir quality in Chase rocks.

The Stratigraphy and Petrography of the Wapanucka Formation Along the Northeastern Flank of the Arbuckle Mountains in Southern Oklahoma

DARREN LEO BROWN, University of Oklahoma,
Norman, OK, M.S. thesis, 1987

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The Wapanucka Formation (Early Pennsylvanian) outcrops as a sinuous ridge along the northeastern flank of the Arbuckle Mountains in Atoka, Coal, Johnston, and Pontotoc Counties, Oklahoma. The topographic relief of the ridges may be as great as 150 ft (46 m). A detailed stratigraphic and petrographic study was conducted on the formation in this area in order to fill a gap left by previous studies.

The contact between the Wapanucka and Springer Formations has not been observed in the field, but is suspected to be conformable. Three localities have been described in which detailed sampling conducted during low water stands might reveal the contact. The contact between the Wapanucka and Atoka Formations is unconformable but poorly exposed. The best evidence of the contact is the basal Atokan conglomerate. However, this conglomerate is generally confined to the vicinity of the Clarita Anticline. Other evidence of the unconformity are solution collapse breccias, missing formation, and the truncation of the Wapanucka by the Atoka in sec. 6, T. 1 N., R. 7 E.

Detailed surface mapping, detailed measured stratigraphic sections, and extensive petrographic examination of the formation reveal that the Wapanucka is a heterogeneous unit of shale and limestone with minor quartz arenite and chert members. Six facies are recognized: (1) oolite, (2) bioclast, (3) shale, (4) spiculite, (5) phylloid algae, and (6) a sandstone/siltstone facies.

Using the data from the field investigations and petrographic examinations, a depositional model is proposed. Three stages of deposition have been recognized. A structurally uncomplicated carbonate shelf developed in Stage I. The compartmentalization of depositional environments as a result of tectonic activity along with the development of prominent ooid shoals and phylloid algal mounds occurred during Stage II. The maximum regression of the Wapanucka seas resulting in subaerial exposure and erosion occurred during Stage III. This was followed by the transgression of the Atokan seas and clastic deposition. The Clarita Anticline and the topographic high south of the Sulphur Fault were the most prominent positive tectonic features that developed during the deposition of the Wapanucka.

Effect of Biodegradation on Tar-Sand Bitumen of South Woodford Area, Carter County, Oklahoma

LI-HUA LIN, University of Oklahoma, Norman, OK,
M.S. thesis, 1987

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Tar-sand bitumens from the South Woodford Area have been analyzed to study effects of biodegradation on oils and to determine their possible sources. The tar-sand deposits, located approximately 1.5 miles south of Woodford, Carter County, Oklahoma, are distributed along the crest of the South Woodford Anticline. Sixteen bitumens from the Rod Club Sandstone (Mississippian) were chosen from a single well (Fitzgerald #5) which was cored near the axis of the anticline.

This study shows that the tar-sand bitumens have been so severely biodegraded that most of the *n*-alkanes, low molecular weight cycloalkanes, isoprenoid alkanes, C_{27}–C_{29} steranes, and light aromatics and sulfur compounds have been removed. In addition, the hopane distributions have been altered to differing degrees with those above C_{30} decreasing prior to the C_{27-29} hopanes. The triaromatic steroid hydrocarbons are also altered with the preferential removal of C_{20-21} and C_{27-28} 20R species. Diasterane and C_{30}-sterane distributions appear to be unaffected by biodegradation. The high resistance of tricyclic terpanes, C_{24}-tetracyclic terpane and monoaromatic steroid hydrocarbons to biodegradation indicate that the distribution of these compounds are well suited to serve as bitumen–oil correlation parameters.

Geochemical correlation between the tar-sand bitumen and oils produced in the Pauls Valley area was attempted to determine which of these oils was the source for the tar-sand bitumen. The age of the reservoir of these oils range from Ordovician to Pennsylvanian. These oils were divided into two major groups based on biomarker distribution (Jones, 1986). One group appears to be sourced by the Woodford Shale whereas the other appears to be sourced by the Viola Limestone. The tar-sand bitumen–oil correlation study, based on biomarker distributions and pyrolysis–gas chromatography of asphaltenes, shows that the tar-sand bitumen is genetically related to the group of oils derived from the Woodford Shale.

Effect of Biodegradation Upon Porphyrin Biomarkers in Upper Mississippian Tar Sands and Related Oils, Southern Oklahoma

GERALD ERIC MICHAEL, University of Oklahoma,
Norman, OK, M.S. thesis, 1987

An axiom in organic geochemistry is that the more complex the structure of a fossil molecule, or biomarker, the more information which can be deemed from its study. The present study is an attempt to determine the effect of biodegradation upon total porphyrin distributions and advance the use of this complex biomarker for petroleum exploration.

A suite of nineteen tar sand sample extracts from core which show different levels of biodegradation, based upon other biomarker distributions (Lin, 1987), were used to study possible effects of biodegradation on porphyrins. Hypothesized changes in porphyrin structure due to biodegradation were *n*-alkyl side chain cleavages and possible conversion from DPEP type to ETIO type porphyrins. The main ring structure of the porphyrin molecule did not appear to be effected by biodegradation in this study. Changes due to biodegradation were monitored by observing peak ratios of porphyrins in normal phase high performance liquid chromatography chromatograms. The present study shows that there are no observable effects in total porphyrin distributions even at high levels of biodegradation in these particular tar sand samples.

The second part of the study is designed to evaluate the usefulness of porphyrin biomarkers in correlation work. The oils used in the study were from the Pauls Valley–Hunton Uplift Area of Southern Oklahoma which have been previously classified and correlated to possible source rocks in the same area (Jones, 1986). The oils could be divided into two basic groups, those sourced by the Woodford Shale (80% of the oils) and those sourced by the Viola Limestone.

Based upon porphyrin distributions many of the oils could be correlated to one another indicating a common source. The Woodford Shale was shown to be the probable source rock for many of the oils and the tar sand extract. A secondary source such as the Viola Limestone could not be confirmed by the use of porphyrin biomarkers. This lack of ability to confirm a second source may have resulted from the alteration of the porphyrin distributions at high levels of maturity. A second possibility is that Jones (1986) is not entirely correct about the proposed Viola Limestone source.

A Geochemical and Isotopic Study of the Garber–Wellington Aquifer, Cleveland County, Oklahoma

THOMAS DWAYNE SCOTT, JR., University of Oklahoma, Norman, OK, M.S. thesis, 1988

The Garber–Wellington aquifer consists of Permian age sandstone, siltstone, and shale. The aquifer provides a backup source of ground water for Cleveland County, Oklahoma. Ground water flow in the aquifer near Norman has been difficult to evaluate due to the heterogeneous, anisotropic, and complex stratigraphic nature of the aquifer. Previous hydrochemical data has been presented in a descriptive framework only. The study has utilized inorganic and stable isotopic geochemistry to identify the dominant hydrogeochemical processes in the aquifer, and moreover has qualitatively elucidated Lake Thunderbird as a source of recharge for deep wells. Four distinct hydrochemical ground-water facies have also been delineated. Thermodynamic evaluation of the ground water has evinced seasonal variations in saturation states of various carbonate phases.

Seismic Stratigraphy of the Upper Pennsylvanian Swope Limestone, Comanche County, Kansas, and Woods County, Oklahoma

MICHAEL NEAL AUSTIN, University of Oklahoma, Norman, OK, M.S. thesis, 1988

The oolitic facies of the Upper Pennsylvanian Swope Limestone is a prolific oil and gas producing reservoir in central and western Kansas. However, reservoir predictability from available well control is difficult owing to rapid lateral variations in lithofacies. Seismic stratigraphy aids the interpretation of the facies heterogeneity.

A detailed investigation of the Swope Limestone in Comanche County, Kansas, and Woods County, Oklahoma, reveals seven principal lithofacies per cyclothem. These may in turn be combined into three mappable seismic facies. From petrophysical constraints, a synthetic seismogram was generated from a detailed geologic model. The real polarity attribute of the model detects moldic Swope porosity down to a 1.5 m (5 ft) thickness ($1/55$ wavelength) and delineates three ranges of porosity thickness: less than 1.5 m (5 ft), 1.5 to 3.0 m (5 to 10 ft), and greater than 3.0 m (10 ft).

Detection below the classic $1/30$ wavelength threshold (i.e., $1/55$ wavelength) is possible in this setting owing to wavelet tuning from multiple acoustic interfaces.

An effective application of this attribute modeling method to oil and gas exploration is controlled by the accuracy of the inputted geologic model and the quality of the acquired and processed seismic data. The incorporation of the synthetic seismic response with available well control confirms the physical realizability of the 1986 Vibroseis® seismic in the study area and allows prediction of oolitic reservoir porosity prior to the drillbit.

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Geochemistry of the Sandy Creek Gabbro, Wichita Mountains, Oklahoma

DIANA MAGDALENA DIEZ DE MEDINA, University of Oklahoma, Norman, OK, M.S. thesis, 1988

Major, trace and rare earth element and mineral chemistry data have been determined for 26 Sandy Creek gabbros samples. These gabbros were divided into four groups: high-MgO (10–15 wt.% MgO), moderate-MgO (5–10 wt.% MgO), low-MgO (1–5 wt.% MgO), and high Fe–Ti gabbros (>18 wt.% FeO and >5 wt.% TiO_2). Further division of the moderate-MgO gabbros was done on the basis of Nb and Y contents.

Trace element fractional crystallization modeling determined the following petrogenetic sequence: high-MgO gabbros —> moderate-MgO group A gabbros —> moderate-MgO group B gabbros —> low-MgO gabbros —> high Fe–Ti gabbros. Strontium, Ba and Rb contents suggest that the petrogenesis of the Sandy Creek gabbro involved open system crystal fractionation with contamination from the crust. The greatest sources of error in the modeling are the determination of cumulus phases in the gabbro and the selection of distribution coefficients used in the modeling.

Finally, the Sandy Creek gabbros were compared to mafic rocks in similar rift environments: the Mesozoic dikes of North America, the Portage Lake lavas of Upper Michigan and the Serra Geral flood basalts of central Brazil. It was determined that these mafic rocks all have high Ti and P components and are LREE enriched. These geochemical characteristics suggest mantle sources of similar chemical composition that have undergone differing degrees of partial melting and crustal contamination.

Seismic Analysis of a Complex Structure in Stephens County, Oklahoma

JOHN HENRY SHINOL, University of Oklahoma, Norman, OK, M.S. thesis, 1988

A seismic investigation was perfomed for a structurally complex area in the West Velma oil field of Stephens County, Oklahoma. Nonclassical approaches to processing and interpretation were applied to the seismic data. These included dip

moveout and radius-of-wavefront-curvature interval-velocity analysis.

A seismic line, originally shot for TXO Production, has field parameters designed for acquisition of data from dipping reflectors. These parameters included short shot-geophone offsets and small common-depth-point (CDP) group intervals.

The data were processed on a VAX 11/785. The core processing scheme included: demultiplexing, automatic gain control (AGC) scaling, CDP sorting, datum statics, velocity analysis, muting, normal-moveout corrections, surface-consistent residual statics, CDP stacking, spiking deconvolution, migration, and bandpass filtering. Short-window AGC was applied to equalize amplitudes of steeply dipping reflectors with those from the more gently dipping reflectors.

Due to the poor quality of steeply dipping reflections on the stacked section, a parallel processing scheme incorporating dip moveout was performed. The dip moveout diminished CDP smear and thus produced a better stacked section. The combination of dip moveout and short-window AGC enhanced the image of the dipping reflectors.

The interpretation incorporated local well control with the seismic section. With the well control, a structural cross section, which closely paralleled the seismic line, was made. Also, a composite sonic log was created for subsequent construction of a one-dimensional synthetic seismogram. The synthetic seismogram permitted the identification of key horizons on the seismic section.

Interval velocities were calculated using a radius-of-wavefront-curvature method to account for the dip of reflectors. These interval velocities were used as input to two-dimensional seismic modeling. The interpretations were refined by comparing the recorded data to the two-dimensional synthetic data. The final interpretation was the result of several iterations of the modeling.

A Surface-to-Subsurface Study of the Sycamore Limestone (Mississippian) Along the North Flank of the Arbuckle Anticline

TONY COLE, University of Oklahoma, Norman, OK, M.S. thesis, 1988

The study area is located along the northern flank of the Arbuckle Anticline and to the subsurface to the west and northwest, in the area of the Sho-Vel-Tum, Shalom Alechem, and Golden Trend oil fields. The Sycamore Formation unconformably overlies the Woodford Shale and is in turn conformably overlain by the Caney Shale.

The Sycamore Formation can be divided into six facies based upon lithology. These facies are: Glauconitic Shale, Bioturbated Shale, Fossiliferous Mudstones and Wackestones, Organic Shale, Silty Pelletal Packstone, and Pellet Rich Siltstone.

Five stratigraphic sections were measured and three partial cores described for this study. Hand samples were collected and slabs and thin sections were prepared and described. Approximately 470 well logs from throughout the study area were also examined. This data was used in the construction of structural, isopach, and carbonate lithofacies maps and stratigraphic cross sections.

Finally, the depositional environments of the lithofacies and the factors controlling their distribution were determined. The glauconitic shale was deposited in a shallow marine environment following transgression of the sea over the exposed Woodford Shale. The bioturbated shales and fossiliferous mudstones and wackestones were also deposited in a shallow marine environment. The silty pelletal packstone and pellet rich siltstones were deposited in the deeper, basinal environment of the Southern Oklahoma Aulacogen. These sediments show evidence of storm dominated deposits, indicating that they were deposited below normal wave base but above storm wave base. The organic shales were deposited in quiet, deep water environment.

Present day facies distribution is strongly influenced by post depositional tectonic activity along the Washita Valley Fault system.