

KENTUCKY GEOLOGICAL SURVEY

Donald C. Haney, Director and State Geologist
UNIVERSITY OF KENTUCKY, LEXINGTON

ANNUAL REPORT 1978-1979

KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY, LEXINGTON, SERIES N, 1978
Wayne W. Hagan, Director and State Geologist



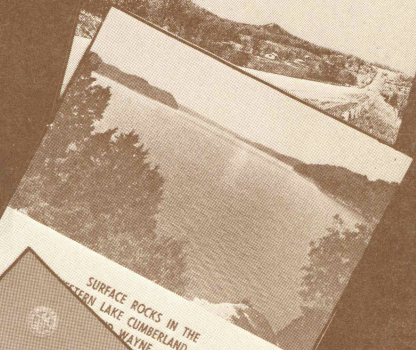
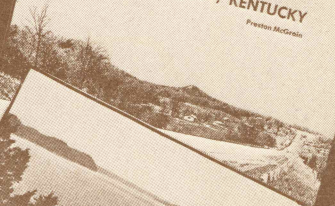
SEDIMENTOLOGY OF THE KYROCK SANDSTONE
(PENNSYLVANIAN) IN THE
BROWNVILLE PALEOVALLEY,
EDMONSON AND HART COUNTIES, KENTUCKY

By
Sedimentology Seminar
H. C. Folk Laboratory of Sedimentology
University of Kentucky



KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY, LEXINGTON, SERIES M, 1979
Donald C. Haney, Director and State Geologist

ECONOMIC GEOLOGY
OF LINCOLN COUNTY, KENTUCKY
Frederic McGee

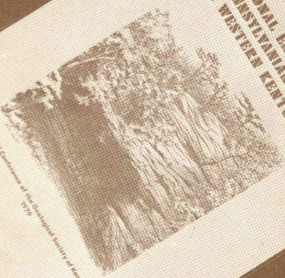


SURFACE ROCKS IN THE
EASTERN LAKE CUMBERLAND AREA,
AND WAYNE COUNTIES, KENTUCKY
Robert C. Beeson



John G. Beeson
and
Robert C. Beeson

DEPOSITIONAL ENVIRONMENTS OF
PENNSYLVANIAN COALS
IN WESTERN KENTUCKY



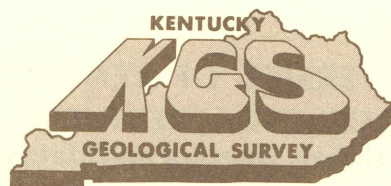
1978-1979 ANNUAL REPORT

KENTUCKY GEOLOGICAL SURVEY

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FOREWORD

The Kentucky Geological Survey was established in 1854 as the official geologic research organization in the Commonwealth of Kentucky. Since that time the Survey, which is part of the University of Kentucky, has continued to perform basic research in a number of geologic areas such as energy (coal, petroleum, and natural gas), applied geology, mineral resources, geologic mapping, topographic mapping, and hydrology.

Some of the Survey's ongoing and future research objectives include: studies of coal bed continuity, quality, and characteristics in the Eastern and Western Kentucky coal fields; a coal hydrology study in eastern Kentucky; a study of limestone resources in eastern Kentucky for environmental-control measures; various mineral resources investigations; stratigraphic and structural subsurface investigations related to the occurrence of oil and gas; initiation of geologic-hazards research throughout the Commonwealth; and a study to characterize specific aquifers in Kentucky that have the potential to supply potable water.

As an ex-officio member of the Kentucky Development Cabinet, the Survey serves in an advisory capacity to various State and Federal agencies. Additionally, the Survey places great emphasis on maintaining a dialogue with the general public through multifaceted public service activities. Public awareness and participation are essential to the Kentucky Geological Survey in attaining its goal of defining, understanding, and utilizing the natural resources of the Commonwealth of Kentucky.

RESEARCH

Basic research in geology and hydrology has formed the cornerstone of the Kentucky Geological Survey since its inception in 1854. This dedication to the identification and characterization of the Commonwealth's vast natural resources has continued throughout the Survey's 125 years of service to the people of Kentucky.

The Kentucky Geological Survey still maintains a diversified and comprehensive research program which includes the fields of coal geology, industrial and metallic minerals, oil and gas, and hydrology. In addition, there are a number of energy-related special projects which are funded by grants or contracts. Projects in all of these areas of research are described in greater detail in the following sections.

Although research at the Kentucky Geological Survey covers a wide variety of subjects, it has a unified goal: a better understanding of the geology of the Commonwealth and utilization of the State's resources for the greatest benefit to the citizens of Kentucky and the Nation.

Coal

Coal is one of the most important commodities in our present society. It provides 78 percent of the electrical power for our Nation, is fundamental in the production of iron and steel, and is the source of myriad chemicals which are used in industry and are part of our everyday life. Attention is now being focused on the conversion of coal to gas and petroleum (gasification and liquefaction) in order to supplement our present and future needs.

Coal has been produced commercially in the Commonwealth since 1790. In 1978 Kentucky led the nation in coal production with a total of approximately 136,000,000 tons. Large reserves still remain in both the Eastern and Western Kentucky coal fields for future production.

The Kentucky Geological Survey is presently involved in research programs which address issues such as coal resource assessment, coal quality and mineability, and geologic control of mining hazards.

MINING POTENTIAL OF ORPHAN LANDS

AKIN, George B., Jr., and WILLIAMS, David A.

This project is funded by the Kentucky Department for Natural Resources and Environmental Protection for the purpose of assessing the potential for renewed coal mining on abandoned mine lands in Kentucky.

The project has two principal objectives. The first is to develop a methodology which will enable Kentucky Division of Orphan Land personnel to quickly categorize orphan-land areas according to economic potential. To this end, the usefulness and accuracy of existing data that pertain to coal geology and coal resources are being evaluated and a format for the systematic use of this information is being developed. The second objective is to conduct detailed field investigations of six or more areas in the Eastern and Western Kentucky coal fields in order to demonstrate the type of work required for an accurate assessment of re-mining potential and to evaluate the effectiveness of methods developed during the general investigation. The quadrangles studied are London, Hazard South, and Argillite in eastern Kentucky, and Providence, Drakesboro, Dawson Springs Southeast, and St. Charles in western Kentucky. These areas were selected to reflect topographic diversity, coal seams, and geographic location.

The field work was completed in 1979, and a preliminary report was submitted. A final report will be available by April 1980.

COAL RESOURCES OF KENTUCKY

BRANT, Russell A.

The coal resources of Kentucky have never been adequately defined. Because no definitive work has been published on the Western Kentucky coal field and the most recent coal-resource report of broad scope for eastern Kentucky was published in 1963, the Kentucky Geological Survey initiated a program in 1974 in conjunction with the Institute for Mining and Minerals Research to develop a detailed analysis of the coal resources of Kentucky.

Initial work which began in western Kentucky included measuring coal thickness in outcrops, mine exposures, and drill holes. Additionally, coal thicknesses were determined from resistivity logs of oil and gas drill holes. Information from these sources

was developed into resource maps using the geologic quadrangle maps as bases. Data were analyzed, plotted, and maps were developed coal bed by coal bed. Final resource tabulations for western Kentucky were released in September 1978, and coal-bed summary maps were completed early in 1979. The result was the first definitive coal-resources estimate for the Western Kentucky coal field. The total effort produced maps of the major coal beds, estimates of coal resources by bed, county, and overburden category, and estimates of remaining coal by county. These data maps and summaries have been of considerable use since they were developed.

In 1976, the coal-resources effort was transferred to the Eastern Kentucky coal field, where a similar but more intensive effort is being expended because of more complex coal occurrences. The project utilizes 14 geologists and support personnel. Two field offices are maintained with headquarters in Lexington. Four geologists are deployed from each field office to measure coal thicknesses in outcrops and coal mines and to collect core-log information from industry. A limited drilling program has been conducted in the Princess district and small areas in southern Kentucky by the Kentucky Geological Survey and the Institute for Mining and Minerals Research. Geophysical logging of the coal and associated rock strata complete the preliminary exploration. The data are accumulated and reports and thickness data are submitted to Lexington for review, processing, and electronic filing. The ultimate product will be a series of coal-resource maps, quantity estimates, and classification of coal resources.

The data and maps developed for this program are proving valuable to the public, State and Federal agencies, and private enterprises, and are being applied to coal prospecting, mining, processing, and synfuel conversion. The results of the work provide answers to many questions about coal resources and occurrences. Moreover, the State is presented with management and decision-making tools for the maximum utilization of coal to benefit the State and Nation. It is necessary that these data be made available to government officials, particularly those in energy-related fields at State legislative and administrative levels, in order for them to make wise use of the resource and make decisions which facilitate that use. The information is also vital at the Federal level, particularly for researchers and advisors who direct efforts to utilize and convert this extremely important energy resource.

Field work has been finished for about 60 percent of the Eastern Kentucky coal field. The target date for completion of maps and resource estimates is January 1, 1982.

SAMPLING AND ANALYSIS OF EASTERN KENTUCKY COALS

CURRENS, James C.

An extensive coal sampling and analysis program for the Eastern Kentucky coal field was funded in May 1979 by the U.S. Geological Survey. This 3-year project has a two-fold purpose. The Kentucky Geological Survey will describe the coal and enclosing rocks and sample the coal, and the U.S. Geological Survey will analyze the samples for basic coal-quality parameters and trace-element content. Trace element data will be used to delineate coal resources which can be used for liquefaction, gasification, and as nonpolluting sources of steam coal. In addition, the Kentucky Geological Survey has a long-standing need for basic coal-quality data. The coal-sampling program will provide essential data which will be used to evaluate the State's coal resources and provide regional data to potential resource developers.

The coal sampling follows procedures established by the U.S. Geological Survey. The objective is to collect as many samples as possible from given beds with as wide a geographic distribution as possible. Each sample is intended to represent the quality of the entire thickness of the coal bed at the site, as it is being produced. A detailed set of records is kept to accurately delineate the pattern of sample sites and the geologic conditions at each site.

The sampling, which is ahead of schedule, requires the collection of 200 high-quality samples per year from active mining operations. A total of 169 samples has been collected since June 8, 1979. Many analyses results have already been received from the laboratories.

Regional coal-quality maps for individual coal beds and coal zones are now being prepared using new data, in conjunction with available information. The field notes and analyses results will be made available to the public when completed. Draft copies of the regional coal-quality maps will be open filed when a satisfactory data-point density has been attained. A final report will be open filed in July 1982.

GEOLOGY OF THE PRINCESS COAL DISTRICT, EASTERN KENTUCKY

SERGEANT, Richard E.

Work on the Princess district was initiated as a four-phase project in December 1978. The Princess district report will be the first in a series of reserve district reports for the Eastern Kentucky coal field.

Phase I is an examination of Pennsylvanian Upper Breathitt Formation (Princess No. 5-Richardson coal bed to Princess No. 9 coal bed).

Phase II deals with the Pennsylvanian Conemaugh Formation, and, more specifically, with the Ames and Bush Creek Limestones.

Phase III is an examination of the Pennsylvanian Breathitt Formation from the top of the Mississippian to the Princess No. 5-Richardson coal.

Phase IV will coordinate data from the first three phases with calculated reserve and coal-quality data in a comprehensive report for the entire reserve district. This report will include information on coal correlations and continuity, coal quality, estimated reserves, coal bed thickness maps, district-wide structural implications, stratigraphy, and flint and plastic clays.

Phase I was completed in August 1979, and Phases II, III, and IV will be completed by July 1980.

WESTERN KENTUCKY COAL BED INDEX

**WILLIAMSON, Allen D., BINGAMER, Roxanne, and
BRANT, Russell A.**

This project was initiated to provide brief descriptions of the significant coal beds in western Kentucky. Only coal beds of major economic importance for the 16 western Kentucky coal-producing counties are considered.

The most extensive and economically important coal beds in the Western Kentucky coal field are the Mulford (Western Kentucky No. 9) and the Herrin (Western Kentucky No. 11) coal beds of the Carbondale Formation. These beds are restricted to the central part of the Western Kentucky coal field, where they have been mined extensively. Of secondary importance are the

Paradise (Western Kentucky No. 12), Wheatcroft (Western Kentucky No. 13), and Coiltown (Western Kentucky No. 14) coal beds, which are mined near the center of the Western Kentucky coal field, and the Davis (Western Kentucky No. 6) and Mannington (Western Kentucky No. 4) coal beds, which have been mined near the southern rim of the coal field; all of these coal beds have been mined extensively in western Kentucky. Other less extensive coal beds are found throughout the Western Kentucky coal field.

An open-file report is expected to be completed by February 1980. It will summarize by county and bed the known areas of mineable coal, coal-bed thickness, stratigraphic relationships, and coal-bed quality. Areas of past and current mining activities are outlined and known geologic obstructions to mining are summarized. Pertinent tables and charts are included.

STUDY OF THE PENNSYLVANIAN-AGE CASEYVILLE FORMATION

**WILLIAMSON, Allen D., BEARD, John G., Sr., and
HESTER, Norman C.**

Most of the high-BTU (British Thermal Unit), low-sulfur coal in western Kentucky is contained in the Lower Pennsylvanian strata, particularly the Caseyville Formation. In order to aid industry in exploration for these coal beds which comply with Environmental Protection Agency Standards, a study of the Caseyville Formation was initiated in 1979. This formation contains several high-quality coal beds; however, the lenticular occurrence and quality variation of these coal beds is at present poorly understood. This project will define the boundaries of the Caseyville, describe the internal sedimentary features of the formation, and interpret the depositional history and sedimentary environments of the Caseyville with particular emphasis on the coal beds.

To date a literature search has been completed, a file of published and open-file data related to the Caseyville has been assembled, and selected surface exposures have been examined and measured. A series of subsurface cross sections and sand-shale ratio maps are in preparation. The target date for completion of this project is January 1, 1981.

RECLASSIFICATION OF THE PENNSYLVANIAN STRATIGRAPHIC SECTION IN WESTERN KENTUCKY

WILLIAMSON, Allen D., BEARD, John G., Sr., and WILLIAMS, David A.

A comprehensive rock stratigraphic classification does not exist for the coal-bearing Pennsylvanian System of western Kentucky. As a result there are a number of bewildering stratigraphic terms in use, most of which are local coal bed names. This has led to invalid regional correlations and confusion as to coal-bed thickness, continuity, quality variation, and stratigraphic position. In some cases beds thought to be singular have been shown to consist of two or more discontinuous beds, and beds with numerous local names have been demonstrated to be a single correlative bed.

The objective of this study is to establish a comprehensive rock stratigraphic system for the Pennsylvanian of western Kentucky, to effect intra- and interregional stratigraphic correlations, and to consolidate and condense coal bed names. The study is separated into four phases: (1) review and synthesis of available stratigraphic and paleontologic data, and establishment of major rock units; (2) construction of thickness maps for each major rock unit; (3) completion, correlation, and consolidation of coal-bed terms; and (4) construction of a standard stratigraphic section and report for the Pennsylvanian of western Kentucky.

Phase 1 is essentially complete; phases 2 and 3 will be completed sequentially in 1982 and 1983. The target date for project completion is December 31, 1984.

Industrial and Metallic Minerals

Kentucky has had a long history of industrial and metallic mineral production. Mineral commodities used in ceramic, chemical, construction, metallurgical, and related industries have played significant roles in the economy and development of the Commonwealth.

Industrial minerals, also called nonmetallic minerals, include such important Kentucky minerals as barite, clay, dolomite, fluorite, gravel, limestone, sand, sandstone, and shale. For many years Kentucky ranked second nationally in the production of ball clay and fluorspar. From the standpoint of dollar value, stone is currently Kentucky's second most important mineral commodity, being exceeded only by coal.

Metallic minerals include galena and sphalerite, ores of lead and zinc. In addition, there is evidence in both the eastern and western parts of the State of a once-active iron industry.

ZINC DEPOSITS OF SOUTH-CENTRAL KENTUCKY ANDERSON, Warren H.

This subsurface investigation of the Cambro-Ordovician Knox Dolomite in south-central Kentucky will provide a basic stratigraphic framework in which to evaluate the relationship of lithologic changes to mineralization and ore deposition.

The study will concentrate on lithostratigraphic descriptions and correlation of selected core holes in Cumberland, Monroe, Clinton, Wayne, Russell, and Adair Counties. A literature search reviews previous work from the last 50 years and covers Mississippi Valley-type ore deposits in the central United States.

Approximately 40 core holes were briefly examined to determine if their stratigraphic position included the top and a complete upper section of the Knox Dolomite, which is essential for control purposes. A detailed lithostratigraphic description of core hole C-284, Cumberland County, Kentucky, has been placed on open file, and core hole C-285, Cumberland County, Kentucky, is currently being described. This is a long-term project and subsequent information will be presented as it is generated.

BARITE DEPOSITS OF CENTRAL AND WESTERN KENTUCKY ANDERSON, Warren H., and TRACE, Robert D.

This investigation evaluates barite deposits in Kentucky by locating, describing, and mapping the distribution of these deposits. This study provides a preliminary data base of known and reported occurrences of barite for future detailed investigations and exploration.

A literature review utilizes previous investigations, geologic quadrangle maps, and information from local residents, and field studies examine old mines, adits, prospects, and other occurrences to determine locations, size, production data, age, and geologic environment. The data are compiled alphabetically by county, by prospect, and numerically.

Literature review and field work have been completed, and a preliminary draft of the text of a report and a map are being compiled and will be completed by January 1, 1980.

CHARACTERIZATION OF CARBONATES OF THE HIGH BRIDGE GROUP, CENTRAL KENTUCKY

DEVER, Garland R., Jr.

The objective of this project is to evaluate the carbonate-rock resources in the High Bridge Group (Ordovician) of central Kentucky to determine the availability of high-calcium and high-carbonate stone for special industrial uses which employ stone of high chemical purity. The High Bridge is a thick (430 to 570 feet), widespread body of carbonate rock (limestone and dolomite) which is present at a mineable depth in central and north-central Kentucky, and crops out along the Kentucky River from Frankfort upstream to Boonesboro. The High Bridge is mined for construction stone in central Kentucky; two deep mines in north central Kentucky recover high-purity stone for producing lime for steel manufacture and stack-gas scrubbing.

Characterization of the chemical quality of the carbonate rocks is being determined by the analysis of foot-by-foot samples from cores donated to the Survey by private companies. Analyses of foot-by-foot samples from a Boone County core have been published by the Survey (1974, Inf. Circ. 22). The core contains two zones of high-carbonate stone (32 and 67 feet thick). Mineable deposits of High Bridge stone along the Ohio River valley have been outlined in *Mining Engineering* (1978, v. 30, no. 4). A report on analyses of samples from a Fayette County core is in preparation. Chemical analysis of a Grant County core is being completed. Project duration is dependent upon the availability of cores to define the regional chemical characteristics of the High Bridge Group.

LIMESTONE RESOURCES IN EASTERN KENTUCKY FOR ENVIRONMENTAL-CONTROL MEASURES USED BY COAL-PRODUCING AND COAL-CONSUMING INDUSTRIES **DEVER, Garland R., Jr., and MOODY, Jack R.**

The objective of this project, is to evaluate the carbonate-rock resources of eastern Kentucky to determine the availability of stone which is suitable for use in environmental-control measures employed by coal-producing and coal-consuming industries to meet federal and state standards for mine safety and reclamation, water quality, and air quality. Suitability of stone for the control measures is determined mainly by its chemical composition. Characterization of the chemical quality of the carbonate rocks is being accomplished by (1) analysis of foot-by-foot samples taken from limestone deposits exposed in quarries, mines, and roadcuts in outcrop belts along the western border of the Eastern Kentucky coal field and along Pine Mountain in southeastern Kentucky, and (2) utilization of the body of chemical data on limestones in the region developed during earlier Survey work. Dolomite deposits in the western outcrop belt are being sampled to evaluate their potential use in fluidized-bed combustion systems. Deposits of high-calcium and high-carbonate stone are further evaluated through petrographic analysis and porosity determinations, since reactivity of carbonate rocks is related to their porosity and grain size.

During the first three years, 1,566 samples were taken from sections in the southern part of the western outcrop belt and on Pine Mountain for chemical analysis at the Kentucky Center for Energy Research Laboratory (KCERL). Selected samples are tested at KCERL to determine sulfur-sorption capacity.

The study is funded by the Institute for Mining and Minerals Research, University of Kentucky. Its proposed duration is 1976-1982.

MIDDLE CHESTERIAN ROCKS IN THE STEVENS HILL CUT AREA NEAR PRINCETON, KENTUCKY

TRACE, Robert D.

In order to solve problems with formational boundaries and stratigraphic nomenclature, a study of changing Middle Chesterian lithologic facies in a roadcut near the Stevens Hill area was undertaken. The roadcut, which is as deep as 100 feet, is

located about 4 miles east of Princeton, Kentucky, along the Western Kentucky Parkway. The roadcut was originally geologically mapped on the Olney geologic quadrangle during the U.S. Geological Survey-Kentucky Geological Survey cooperative mapping program.

A mile-long longitudinal section of the rock column along the Parkway was constructed. The Cypress, Golconda, Hardinsburg, Glen Dean, and Tar Springs formations were measured and described in detail.

A report on the Middle Chesterian rocks has been completed and has been recommended for publication to the Kentucky Geological Survey.

STRATIGRAPHY AND STRUCTURE OF THE WESTERN KENTUCKY FLUORSPAR DISTRICT

TRACE, Robert D., and AMOS, D. H.

The Western Kentucky fluorspar district is a part of the Kentucky-Illinois fluorspar district, which is the largest producer of fluorspar in the United States. Because of the economic importance of the district, "The Stratigraphy and Structure of the Western Kentucky Fluorspar District" was written, utilizing the abundant new data gathered during the recently completed U. S. Geological Survey-Kentucky Geological Survey geologic mapping program. The report and accompanying district map are intended primarily to help those working with the stratigraphy and structure of the district. A short summary of the fluorspar, zinc, lead, and barite deposits is also included in the report.

Geologic rock units in this district, including the Osagian, Meramecian, and Chesterian of Mississippian age, the Morrowan and Atokan of Pennsylvanian age, the Gulfian of Cretaceous age, the Pliocene of Tertiary age, and the Pleistocene and Holocene of Quaternary age, are described in detail. Mafic dikes and sills and complex fault systems are described in the report and located on a geologic map with structural contours derived from the 13 U. S. Geological Survey geologic quadrangle maps which cover the district. Some new structural data are introduced and some new interpretations of the origin of the complex faulting are made.

The report and accompanying map, which are coauthored by D. H. Amos of the U. S. Geological Survey, are being processed for publication as a U. S. Geological Survey Professional Paper.

Oil and Gas

One of the basic responsibilities of the Kentucky Geological Survey is to provide industry, government agencies, academic institutions, and the general public with information pertinent to the exploration for and development of oil and gas in Kentucky.

The Survey is the official repository for oil and gas well records and samples; a well record library and well sample library are maintained for public use. Presently, there are approximately 150,000 well records and 14,000 sets of well cuttings on file. In addition to providing public service, the Survey's Oil and Gas Section is also involved in basic geologic research which includes both regional and local subsurface studies of structure and stratigraphy.

THE NEW ALBANY BLACK SHALE OF WESTERN KENTUCKY

BEARD, John G., Sr.

The New Albany black shale of Devonian age has long been a major source of natural gas in Kentucky. Recently, interest has been shown in this shale as a source of crude oil. Analyses indicate that 5 to 25 gallons of crude oil can be obtained per ton of New Albany black shale; the remaining ash contains 10 to 50 parts per million of uranium. In 1977 the Kentucky Geological Survey obtained a contract with the U. S. Department of Energy, Morgantown Energy Technology Center, contract number EW-78-S-21-8215, to characterize the New Albany black shale of western Kentucky.

A structural map has been drawn on the base of this shale using 255 subsurface control points. The shale has been subdivided into three units: the Blocher, Sweetland Creek, and Grassy Creek members. Isopachous maps were produced for each of these members and four geologic cross sections were drawn using geophysical logs. Additionally, a map was made indicating all known gas shows in the New Albany black shale in western Kentucky.

In 1979, the contract for this subsurface study was amended to include the area of the outcrop belt on the western side of the Cincinnati Arch. The Kentucky Geological Survey cut five diamond core holes; ten additional cores were already on file at

the Survey's Core Library. These cores were described in detail and analyzed for uranium, thorium, and kerogen contents. These core hole descriptions accompanied by sample studies and other shallow oil field data were assembled, and a final report is being written. The report will allow identification of subsurface zones which are most likely to produce gas, and outcrops which are richest in organic material and will yield a large quantity of oil and uranium. The final report will be open filed in January 1980.

STRUCTURE OF KNOX DOLOMITE

GOODING, Patrick J.

A state-wide structural map on top of the Knox Dolomite is being prepared to aid in the exploration and development of oil and gas and other mineral resources such as lead and zinc. This map will compliment a similar map published by the State of Tennessee. It will be compiled primarily from subsurface information derived from geophysical logs, drillers' logs, and the examination of well samples and cores. The scale will be 1:250,000 with a contour interval of 100 feet. Completion date is July 1, 1981. Presently a literature search has been completed and 15 sets of well cuttings from Adair and Cumberland Counties have been examined.

SUBSURFACE STUDY OF THE MISSISSIPPIAN SYSTEM OF EASTERN KENTUCKY

NOGER, Martin C.

The purpose of this project is to investigate the roles played by stratigraphy and structure in the entrapment of hydrocarbons in rocks of Mississippian age in eastern Kentucky.

Mississippian sediments will be divided into three study units—the Pennington Formation, the Newman Limestone, and the Borden Formation. Cross sections and structure, isopachous, lithofacies, and production maps will be compiled from studies of well cuttings, mechanical logs, and measured sections for each study unit. To facilitate the distribution of information, results will be published or open filed on 1:250,000-scale maps with an appropriate text after the completion of each study unit. A comprehensive report will be published after studies of the three units are completed.

A base map showing location of well cuttings, mechanical logs, measured sections, and outcrop areas of rocks of Mississippian age has been completed. It is estimated that the project will be completed in five years.

CORRELATION OF STRATIGRAPHIC UNITS OF NORTH AMERICA (COSUNA)

NOGER, Martin C., DEVER, Garland R., PONSETTO, Louis R., SMITH, J. Hiram, SCHWALB, Howard R., and WILLIAMSON, Allen D.

This project, which is managed by the American Association of Petroleum Geologists under a contract from the U. S. Geological Survey, is addressed to the long-term need to update the series of North American correlation charts published by the Geological Society of America. The new charts will be enhanced by the large amount of subsurface data that has accumulated in recent decades. An adjunct effort is the creation of a central stratigraphic data bank.

Working areas designated for the United States are based on the provinces set up by the Committee on Statistics on Drilling (CSD). Kentucky encompasses parts of the following CSD provinces: 250 (Mississippi Embayment), 300 (Cincinnati Arch), 315 (Illinois Basin), and 160 (Appalachian Basin).

The Kentucky Geological Survey COSUNA Committee has outlined areas for compilation of 11 work columns for the Kentucky portion of CSD provinces 160, 300, and 315.

The regional charts and stratigraphic data sheets are to be submitted to the AAPG Committee on Stratigraphic Correlations by August 1980. The Kentucky charts are about 40 percent compiled.

OIL AND GAS COUNTY BASE MAPS

PONSETTO, Louis R.

The purpose of this project is to build a file of current oil and gas base maps giving location, identification, and well status for each county in Kentucky.

Individual county maps will be compiled on a planimetric base at a scale of 1:48,000 and will be accompanied by an index of wells and a generalized columnar section. These maps and columnar sections will be prepared on mylar to facilitate updat-

ing and reproduction. Using the Oil and Gas Section's professional staff of six geologists, an estimated five years will be required to complete the approximately 70 counties which presently have production. As the individual counties are completed, the data will be placed on open file and maintained for the use of industry, government, educational institutions, and the general public.

To date, Grayson and Greenup Counties have been completed and placed on open file; Barren, Letcher, and Todd Counties are complete and awaiting final drafting; Adair, Bell, Lewis, Logan, Martin, and Pulaski Counties are in various stages of development. An estimated seven counties should be complete and on open file by January 1, 1980.

STUDY OF PALEOZOIC STRATIGRAPHY IN THE NEW MADRID AREA OF THE MISSISSIPPI EMBAYMENT **SCHWALB, Howard R.**

The purpose of this study funded by the U.S. Nuclear Regulatory Commission is to expand comprehension of the subsurface stratigraphic units in an area that would be affected by a New Madrid seismic event.

To this end, records from oil and gas drill holes are being evaluated as to lithotype and correlatability. This information is used to construct a variety of geologically pertinent maps and cross sections for the study area. Examples include the recently completed isopachous map and associated structure contour map of the Everton-Knox carbonate group. Additionally, well cuttings from selected drill holes are being described in detail and preferentially analyzed to obtain more specific lithologic data. This includes stable isotope analyses of igneous intrusives by the University of Pennsylvania, and analyses of basement samples to determine their geochronology.

CAMBRIAN OF KENTUCKY, OIL AND GAS STUDY **WALKER, Frank H.**

This is a subsurface study of a little understood section of the rock column. Few wells have topped this unit and even fewer have penetrated the entire section. All wells of sufficient stratigraphic depth are being catalogued along with an inventory of the information available on each well. A 1:500,000-scale map is

being prepared which shows the locations and total depth formation of the wells. When the catalog is complete, a study will be undertaken which will determine the stratigraphic nomenclature to be used in the subsurface; structure, isopachous, and lithofacies maps will be prepared as necessary.

EASTERN KENTUCKY GAS SHALES PROJECT **WILSON, Edward N.**

The Eastern Kentucky Gas Shales Project studies the distribution of the Devonian shales of eastern Kentucky and the occurrence of gas in them in order to improve marginal production rates, increase total gas yields, and identify additional productive areas. Geologic base maps, regional stratigraphic cross sections, and structural and isopachous maps are constructed to guide research. Well and outcrop data and research interpretations are recorded to computer-processable form for reports and additional analysis.

Seven geologic base maps and two regional cross sections are being drafted or revised for publication. A third more complex cross section is being compiled. The first draft of an integrated report on the Middlesboro Syncline, which covers approximately the southeastern third of the project area, is nearly complete. Papers on the stratigraphy and gas occurrences of the formation and the Devonian-Mississippian boundary were delivered to the Second Eastern Gas Shales Symposium and the Ninth International Congress of Carboniferous Stratigraphy and Geology and will be published in their proceedings.

More than 800 data sets were sent to the Eastern Gas Shales Project data bank, and a tape of 12,000 well histories was received from them. The Project reported 581 wells that logged coal to the Kentucky Geological Survey Coal Section and the Institute for Mining and Minerals Research. A remote computer terminal has been ordered, and a program to encode 1,500 to 1,800 well histories has begun.

The project is funded by contract between the University of Kentucky Research Foundation and the U. S. Department of Energy's Eastern Gas Shales Project. It receives an annual grant from the Institute for Mining and Minerals Research to record coals in its data bank. The project will be terminated May 31, 1980.

Water

Since its establishment in 1854, the Kentucky Geological Survey has played a vital role in the development and management of water resources in Kentucky. The current role of the Water Resources Section at the Survey is to collect data and to conduct research in hydrology in order to provide for the optimum development, utilization, and management of the State's water resources. Many of the studies are conducted in cooperation with the U. S. Geological Survey.

Although much of the Nation's attention has recently been focused on the energy crisis (especially on the problems related to the extraction and utilization of fossil fuels), there has also been an increasing awareness of the critical impact of the quantity and quality of water on all aspects of our daily life, including energy. Nowhere has this been more evident than in the field of ground water. In response to this increased concern, the Kentucky Geological Survey has incorporated major new projects into its water resources program. These include an investigation of underground-waste-injection control and a five-year study (scheduled to begin in early 1980) of the geohydrology of the Eastern Kentucky coal field.

AQUIFER CHARACTERIZATION, KENTUCKY **CORDIVIOLA, Steven**

The Aquifer Characterization study will identify and characterize ground-water aquifers in Kentucky presently supplying or having the potential to supply potable water. The Federal or State Underground Injection Control Program will protect these aquifers from possible contamination by liquid wastes injected underground. The study is funded by the Kentucky Department for Natural Resources and Environmental Protection, Division of Water Quality.

Guidelines set forth by the U. S. Environmental Protection Agency set a minimum of 10,000 parts per million total dissolved solid concentration in ground water as the criteria for protecting aquifers. In Kentucky, very little is known about ground water having total dissolved solid concentrations within the indicated range, as most of the potable water presently being used is below this figure.

The initial phase of this study, which has been completed, involved the collection and organization of available, relevant data. Various indirect techniques which include the use of bore-hole geophysical logs have been researched and evaluated. The second phase will involve studying aquifers on a county by county basis. The Division of Water Quality will list by priority counties with immediate needs and available information.

Final products of the study will include maps, charts, and tables which will enable the Division of Water Quality of the U.S. Environmental Protection Agency to make sound judgments on any requests for permits to inject liquid wastes underground.

MISSISSIPPIAN PLATEAU WATER RESOURCES **KIEFER, John D., and BAYHA, David C.**

The purpose of this Kentucky Geological Survey-U. S. Geological Survey cooperative investigation is to provide information on water levels, directions of ground-water movement, and ground-water quality to aid in locating additional ground-water supplies and to guide planning agencies in making decisions regarding the conflicting uses of karst regions.

Major objectives are: (1) to construct maps of the potentiometric surface to show the general direction of ground-water movement, (2) to provide drillers, planners, and users with information on the Mississippian aquifers, (3) to gain a better understanding of the areas of recharge and discharge, and (4) to provide a data base for future studies.

The project area coincides with the area of outcrop of Mississippian-age rocks in central and western Kentucky. The first report resulting from this project, Water Resources Investigation 78-25, "Potentiometric Surface of the Mississippian Aquifer in Parts of Trigg, Lyon, Caldwell, and Christian Counties, Mississippian Plateau Region, Kentucky," by R. O. Plebuch, has been published and a second report which includes Meade County and parts of Breckinridge, Hardin, and Larue Counties is currently in review.

ALLUVIAL AQUIFER STUDY, RED RIVER WATERSHED **McALLISTER, Scott, and CORDIVIOLA, Steven**

The 65.8-square-mile alluviated portion of the upper Red River watershed near Hazel Green, Kentucky, is being studied to estab-

lish various hydrologic parameters of the alluvial aquifer. The alluvium in the valley is the major aquifer and covers approximately 8 square miles.

Initially, stream gage discharge data are being utilized to estimate various aquifer values for transmissivity, storage coefficient, and rates of aquifer recharge. In addition, rates for discharge and evapotranspiration of the ground water can be estimated. The second phase of the project will involve the field verification of these estimated values.

It is anticipated that the analytical methods evaluated in the project will offer a quick, relatively inexpensive means of estimating selected aquifer parameters. Such techniques will enable mine operators and various State and Federal agencies to obtain a preliminary assessment of the potential impact of coal mining on parts of the ground-water system without lengthy field reconnaissance and testing. In addition, these methods will aid in the development of water resources management where long-term ground-water data are not available.

Other Research

ECONOMIC GEOLOGY, COUNTY REPORT

McGRAIN, Preston

Kentucky's recent statewide areal geologic mapping project, conducted jointly by the Kentucky and United States geological surveys, produced a series of modern geologic maps which provide the framework for a series of county economic geology reports.

A report on the economic geology of Lincoln County, Kentucky, the latest in the series, has just been published as County Report 1. Previously published reports cover economic geology studies of Allen, Calloway, Hancock, Marshall, McCracken, Simpson, and Warren Counties.

These economic geology reports summarize and synthesize information relative to the geologic resources of one of Kentucky's counties, drawing on data of earlier programs as well as original field work. These studies are useful not only to those interested in the exploration for and development of geologic resources but also those concerned with various aspects of land use.

COOPERATIVE PROGRAMS

Topographic Mapping

The Kentucky Geological Survey has an ongoing cooperative program with the U. S. Geological Survey for topographic map revision in Kentucky. This program, which is designed to maintain revised and up-to-date maps for all areas of the Commonwealth, has been active since Kentucky became the first major state to be entirely mapped topographically at a scale of 1:24,000, more than 20 years ago.

During fiscal year 1978-79, 125 quadrangles were revised; each quadrangle encompasses 7.5 minutes of latitude and 7.5 minutes of longitude and covers an area of approximately 59 square miles. Of this total, 25 maps were standard revisions which involve recontouring in areas where there have been changes in the topography; changes on these maps are field checked. The remaining maps were photorevisions on which changes are compiled from aerial photographs but are not field checked. Orthophotoquads, which are corrected aerial photographs overprinted with minimum geographic information in standard 7.5-minute quadrangle format, were made available for portions of eastern and south-central Kentucky.

In addition, work has been progressing on the preparation of new intermediate-scale (1:100,000) maps for portions of the State. Progress was made on planimetric maps at this scale in a 1-degree by 30-minute format for areas in western and southeastern Kentucky; a few published maps are already available in this series. Intermediate-scale planimetric maps are also available in a county format for a number of Kentucky counties. Work is continuing on county topographic maps at a scale of 1:50,000 for Kentucky's urban areas.

A map showing status of the topographic mapping revision program is available free upon request to the Kentucky Geological Survey.

Geologic Mapping

In 1960, the Commonwealth of Kentucky, University of Kentucky, and the Kentucky Geological Survey in cooperation with

the U. S. Geological Survey began a project to map the Commonwealth geologically at a scale of 1:24,000 (1 inch on the map equals 2,000 feet on the ground); the maps were to be published as U. S. Geological Survey geologic quadrangle maps. The last of 707 geologic maps was printed on October 30, 1978.

Benefits of the mapping project appear to be exceeding the most optimistic expectations. Reports of discoveries of coal, fluorspar, petroleum, stone, and other minerals resulting directly or indirectly from the project indicate a benefit-cost ratio in excess of 50:1. Savings from proper design and location of highways, factories, waste-disposal sites and other facilities could enhance this figure. Total cost of the program was \$20,927,500; this cost was shared equally by State and Federal governments.

Users of the new geologic maps represent a broad spectrum of Kentucky activities—agriculture, business, education, government, and industry. More than 100,000 copies have already been sold by the Kentucky Geological Survey to geologists, engineers, landowners, planners, realtors, researchers, soil scientists, students, teachers, and many others. Approximately 150 scientific articles resulting from the project have been published or are currently in progress.

NEW GEOLOGIC MAP OF KENTUCKY

A major bonus from the geologic mapping program will be a new Geologic Map of Kentucky at a scale of 1:250,000 (1 inch on the map equals 4 miles on the ground). The new map has been compiled on three sheets by synthesizing and generalizing the 707 geologic quadrangle maps resulting from the Kentucky Geological Survey-U. S. Geological Survey cooperative mapping project. This synthesis will make it possible to delineate large-scale trends and distribution of geologic units and structures that are difficult to comprehend on the larger scale individual quadrangle maps. In addition to depicting geologic relationships for the entire State, the new geologic map will also be useful in preparation of illustrations for reports dealing with major geologic provinces within Kentucky.

Technical reviews by State and Federal agencies have been completed, and the map is being prepared for publication by the U. S. Geological Survey. Estimated publication date is November 1980.

Water Resources

The Kentucky Geological Survey has maintained an excellent working relationship with the U. S. Geological Survey throughout the years. Water-related cooperative programs with the U. S. Geological Survey date back to as early as 1920. The cooperative programs have covered a wide range of water-information needs on both Federal and State levels and have provided data for more than 200 maps, publications, and open-file reports, many of which are currently available from the Kentucky Geological Survey. These data provide the basis for answering several hundred requests annually from individuals, industry, and State and Federal agencies. Most of the information is summarized in an annual report entitled "Water Resources Data for Kentucky," published by the U. S. Geological Survey. This report combines streamflow data, water-quality data for surface and ground water, and ground-water level data from the basic network of observation wells. Additional information on ground water can be found in the Hydrologic Atlases which are available for all areas of Kentucky. Both the "Water Resources Data for Kentucky" and the Hydrologic Atlases are available from the Kentucky Geological Survey.

The present cooperative program for water resources calls for a total funding of over \$900,000. Following are brief descriptions of the projects.

1. *Surface-Water Stations*—A Statewide network to collect surface-water data for a variety of uses such as research and special studies, assessment of water resources, waste disposal, pollution control, planning and design of facilities, and forecasting of water levels has been in continuous operation since 1938. Prior to 1960, information from this program was published annually in the U. S. Geological Survey Water Supply Paper series, "Surface Water Supply of the United States." From 1961 to 1970, 5-year compilations were published. Daily streamflow records for Kentucky from 1961 to 1974 were also published in annual U. S. Geological Survey open-file reports. Records since 1975 are found in the annual publication, "Water Resources Data for Kentucky."

2. *Water-Quality Stations*—This Statewide network of approximately 60 sites where water quality is monitored on a regular basis provides data for broad Federal and State planning and for the management of waterways. This program has been con-

tinuous since 1949. Prior to 1971, these data were published annually in the Water Supply Paper series, "Quality of Surface Waters of the United States." For the years 1964 to 1974, these data for Kentucky were also released annually in open-file U. S. Geological Survey reports. Records since 1975 are found in the annual report, "Water Resources Data for Kentucky."

3. *Ground-Water Stations*—The purpose of this Statewide network is to collect water-level data for a long-term data base which will allow data collected during hydrologic investigations to be compared against the baseline data. This information can also be used to predict future conditions, to detect and define pollution and supply problems, and to manage ground-water resources. The program has been continuous since 1943. Prior to 1975, ground-water levels and artesian pressures in observation wells in Kentucky were reported in the 5-year U. S. Geological Survey Water Supply Paper series, "Ground-Water Levels in the United States, Southeastern States." Records since 1975 are found in the annual publication, "Water Resources Data for Kentucky."

4. *Sediment Stations*—A network of stations for sampling stream sediment provides data for State and Federal planning and for management of interstate waters. Six stations are sampled on a daily basis, and 43 stations are sampled once a week or more frequently during periods of abnormally high or low streamflow. Information can be found in "Water Resources Data for Kentucky."

5. *Mississippian Plateau Potentiometric Map*—This project is designed to provide detailed information on water levels, directions of ground-water movement, and ground-water quality in order to aid in locating additional ground-water supplies and to guide planning decisions regarding the conflicting uses of karst regions. The project area coincides with the area of outcrop of Mississippian-age rocks in central and western Kentucky. The first report resulting from this project, Water Resources Investigation 78-25, by R. O. Plebuch, was published this summer and encompasses most of Trigg County and portions of Lyon, Caldwell, and Christian Counties.

6. *Water from Coal Mines in Johnson and Martin Counties*—The purpose of this project is to provide geologic and hydrogeologic information on quantity and quality of potential water supplies available from abandoned coal mines. This information can then be used by communities and industries in planning for fu-

ture water supplies.

7. *Sediment Characteristics of Kentucky Streams*—The objective of this project is to define sediment yields and particle-size distribution of suspended and bed material transported by streams draining the major physiographic and land-use areas of the State. Sediment stations are also installed for selected problem drainage areas.

8. *Water Resources of Levisa Fork and the Big Sandy River Basin*—This project, which is just getting underway, is planned as a 4-year reconnaissance of the Levisa Fork of the Big Sandy River and the Big Sandy River basin from the confluence of the Levisa and Tug Forks to the mouth. Major objectives are to study the water quantity, runoff characteristics, magnitude and frequency of flooding, and quality of surface water throughout the basin. The general features of occurrence of ground water in the basin, yields, water-level fluctuations, water-bearing characteristics of rocks, gains or losses to streams, and ground-water quality will be determined.

9. *Ground Water in the Ohio River Valley in Kentucky*—The main purpose of this project is to study the quantity and quality of ground water in the alluvium and its relationship to the Ohio River. Alternatives will be proposed to guide future planning and development. This project includes a research program and pumping tests on the alluvial aquifer near the Louisville Water Plant; objectives are to determine the potential yield of the aquifer and filtering capabilities of the alluvium of both organic and inorganic constituents.

10. *Water Use and Availability*—This Statewide program is designed to evaluate the use of water throughout the Commonwealth and to evaluate the limitations on water availability.

11. *Hydraulics of Bridge Sites*—This project, continuous since 1939, provides hydraulic factors at proposed bridge sites to assure that adequate information is available for proper design.

Aeromagnetic Survey of Kentucky

The cooperative program between the Kentucky Geological Survey and the Tennessee Valley Authority to provide an aeromagnetic survey for the entire Commonwealth of Kentucky has been completed. Data resulting from this survey will be utilized by industry in the exploration for mineral deposits and

accumulations of oil and gas, and by scientific researchers in studying compositional and structural variations in the earth's crust.

Flying of remaining areas of the State was completed during the past year, and data were made available to the Kentucky Geological Survey in the form of contour maps showing aeromagnetic intensity. Two of these maps, the central and eastern sheets, are currently being readied for publication at a scale of 1:250,000. The Western sheet was published by the Survey in 1978.

PUBLICATIONS

Publications are the means by which the results of research projects and field investigations of the Kentucky Geological Survey are made available to the public. Making this information readily available is one of the major functions of the Survey as a public geologic research organization. These publications serve as a vehicle for the dissemination of geologic data generated by Survey staff members, by members of cooperating agencies, and by other earth scientists doing research on Kentucky's geology and mineral resources. The Survey also publishes the proceedings of technical sessions and symposia, and guidebooks for geologic field conferences.

Publications of the Kentucky Geological Survey are made available at a nominal cost and have received widespread distribution. Distribution of maps and publications is handled through the sales office which is located in Breckinridge Hall on the University of Kentucky campus. Total sales for fiscal year 1978-79 amounted to about \$84,000.

During the past fiscal year, the Kentucky Geological Survey issued the following publications:

Report of Investigation

Report of Investigations 21. Sedimentology of the Kyrock Sandstone (Pennsylvanian) in the Brownsville Paleovalley, Edmonson and Hart Counties, Kentucky, by Sedimentation Seminar. 24 p., 22 figs., 5 tables.

The sedimentary fill of the Brownsville paleovalley in west-central Kentucky was studied to determine its characteristics, depositional environment, and relationship to both the Appalachian Basin and Ouachita Trough.

The Brownsville paleovalley is about 200 feet (61 m) deep, about 3 miles (5 km) wide, and has several sharply defined benches along its sides. The valley fill, which is almost entirely sandstone, consists of two major sandstone bodies: a lower, medium- to coarse-grained, crossbedded body and an upper, fine- to medium-grained crossbedded, but less homogenous body that contains some shale. The lower sandstone may have been deposited by a low-sinuosity braided stream; the upper unit was deposited by a series of small high-sinuosity meandering streams 20 to 30 feet (6 to 9 m) deep. The upper unit was deposited by more variable paleocurrents and extends somewhat beyond the limits of the erosional valley.

The internal facies of the valley fill suggest deposition by a stream about the size of the Wabash River (in southwestern Indiana) on an alluvial plain in a tropical climate. The change from possibly braided to meandering pattern is probably related to lower gradients as alluviation encroached into the Illinois Basin from the Ouachita Trough to the southwest in Early Pennsylvanian time. There are several possible ways to connect this paleovalley to the Appalachian Basin, none of which can be well established. East of the study area the sandstone becomes totally decemented, and only scattered quartz pebbles and cobbles mark its former presence.

Information Circular

Information Circular 1. A Pennsylvanian Channel in Henderson and Webster Counties, Kentucky, by John G. Beard and Allen D. Williamson. 12 p., 6 figs.

A local absence of Mulford coal (Western Kentucky No. 9) in Henderson and Webster Counties in northwestern Kentucky has long been recognized. This absence has been attributed variously to faulting or local coal washout. An examination of electric logs from oil-well tests demonstrates that the feature is a Middle Pennsylvanian channel from which the Mulford coal was eroded.

The channel is generally sandstone filled, and is more than 20 miles long. It extends northward from the Ohio River into Indiana, and southward across the Rough Creek fault system where the direction of the axis apparently changes to east-west. The Henderson channel may be part of a larger distributary network which, in other places, may have also eroded the Mulford and other coal beds of economic importance. Channels, where they cut down to or through a mineable coal seam, constitute a significant mining hazard.

County Report

County Report 1. Economic Geology of Lincoln County, Kentucky, by Preston McGrain. 25 p., 22 figs., 2 plates, 4 tables.

Lincoln County has a long history of mineral exploration and exploitation, but mineral production has not dominated the local scene. Barite, clay, gravel, mineral waters, petroleum, salts, and stone have been prospected or produced at one time or another. Because of its geologic setting with respect to the Cincinnati Arch and the Kentucky River and Irvine-Paint Creek fault systems, the area should continue to offer sites for prospecting for needed fuel and mineral raw materials. Geologic and mineral resource maps included in this report show the distribution of rock formations, location of structural features, and areas of occurrence of principal mineral resources; they should aid future prospecting.

The geological data for Lincoln County should also be helpful to those concerned with engineering and environmental projects, land-use planning, and water-resources development. As industry and population continue to expand into suburban areas, there will be a growing need for quantitative and qualitative inventories of mineral resources, sources of construction materials, geological data on the sources and quality of water supplies, evaluation of the ability of the land to support bridges, buildings, dams, highways, and railroads, and determination of the suitability for and the capacity of the earth to receive liquid and solid wastes.

Muldraugh Hill is the most prominent topographic feature in the county, rising 300 to 500 feet above the adjacent rolling Outer Blue Grass region. This escarpment, together with the as-

sociated isolated knobs and hills, constitutes a striking and beautiful portion of Kentucky's landscape. This part of Lincoln County appears to contain some potential for recreational and tourism development.

Reprints

Reprint 1. The Mineral Industry of Kentucky, 1975, by William T. Boyd and Preston McGrain. Reprinted from U.S. Bureau of Mines Minerals Yearbook, 1975, 13 p., 2 figs., 8 tables.

Reprint 2. Oil and Gas Developments in East-Central States in 1977, by Jacob Van Den Berg, G. L. Carpenter, Edmund Nosow, and Anthony Statler. Reprinted from the American Association of Petroleum Geologists *Bulletin*, v. 62, no. 8 (August 1978), p. 1340-1354, 3 figs., 10 tables.

In Kentucky 1,005 oil and gas tests were drilled in 1977, down from 1,073 in 1976. The 365 exploratory tests, down from 373 in 1976, resulted in 51 oil wells and 22 gas wells, a success of 20.0%. Development wells were 60.6% successful, resulting in 262 oil wells and 126 gas wells. Discoveries consisted of 6 fields, 10 new-pool wildcat successes, 10 deeper pools, 20 shallower pools, and 27 extensions. A discovery in western Kentucky, an extension to Cadiz field in Trigg County, had an initial production of 100 Mcf from New Albany Shale; apparently the Devonian shale in this area, although thin compared with that in the Big Sandy gas field in eastern Kentucky, can be commercially productive. In Webster County, a deep test was dry in the Cambrian at 15,200 ft TD. Crude oil production in Kentucky in 1977 was 6,571,000 bbl, down 12.2% from 1976.

Reprint 3. Recognition of Lapies-Type Features in the Kentucky Karst—an Example of Applied Geomorphology, by Preston McGrain. Reprinted from *Transactions of the Kentucky Academy of Science*, v. 40, no. 1-2, p. 21-26, 4 figs.

Lapies-type features are thought to represent a common, but little known and rarely exposed, geomorphic development in the karst region of Kentucky. An understanding of the occurrence and distribution of irregularly dissolved upper surfaces of limestone strata should be of interest not only to the student of un-

derground drainage phenomena but also to those involved in construction activities and the removal of earth materials in limestone terranes. Failure to recognize the existence and distribution of lapies-type surfaces could result in unexpected and unplanned excavation costs or inadequate foundation conditions for anticipated structures.

Guidebooks for Geology Field Trips

Surface Rocks in the Western Lake Cumberland Area, Clinton, Russell, and Wayne Counties, Kentucky, by Richard Q. Lewis, Sr., and Paul Edwin Potter (Annual Field Conference of the Geological Society of Kentucky, 1978). 41 p., 31 figs., 3 tables.

Rocky shorelines and mature dissection provide excellent exposure of the Mississippian, Devonian, and Ordovician rocks in the western part of the Lake Cumberland area. Here many diverse, interesting, and perplexing lithologies can be observed, fossils can be collected, and a much better understanding of subsurface facies relations can be obtained.

Depositional Environments of Pennsylvanian Rocks in Western Kentucky, by Peter W. Whaley, Norman C. Hester, Allen D. Williamson, John G. Beard, Wayne A. Pryor, and Paul E. Potter (Annual Field Conference of the Geological Society of Kentucky, 1979). 48 p., 47 figs., 1 plate, 1 table.

Environments of deposition of Pennsylvanian rocks in western Kentucky are examined. The stratigraphy and depositional environments of coal and related rocks are particularly emphasized. Samples of several important coals of the Western Kentucky coal field can be collected.

Other Kentucky Reports

Abstracts and Program: Symposium—Kentucky Geologic Mapping Project, 1960-1978. Abstracts of 29 papers presented in Lexington, Kentucky, on February 1-2, 1979, 33 p.

An Economic Evaluation of the Kentucky Geologic Mapping Program, by Preston McGrain. 12 p., 4 figs.

Maps

Generalized Geologic Map of Kentucky. Scale 1:1,000,000.

Generalized Geologic Map of Kentucky. Page Size.

In Press or Editing Completed

The following publications are either at the printer or have undergone final editing and are being processed for printing:

Special Publication 1. *Bibliography of Karst Geology in Kentucky*, by James C. Currens and Preston McGrain.

Special Publication 2. *Proceedings of Technical Sessions of the Kentucky Oil and Gas Association, 1972-1976.*

Thesis Series 1. *Stratigraphic Relationships in the Lower and Middle Newman Limestone (Mississippian), East-Central and Northeastern Kentucky*, by Garland R. Dever, Jr.

Thesis Series 2. *Kimberlite of Elliott County, Kentucky*, by Stephen L. Bolivar.

Information Circular 2. *Bibliography of the Kentucky Geological Survey, 1839 through 1978*, by Howard R. Schwalb, Vivian S. Hall, and Juanita G. Smith.

Reprint 4. *Oil and Gas Developments in East-Central States in 1978*, by G. L. Carpenter and others.

Map. *Structure and Isopach Map of the New Albany-Chattanooga-Ohio Shale (Devonian and Mississippian) in Kentucky: Eastern Sheet*, by Linda P. Fulton. Scale 1:250,000.

Map. *Residual Total Intensity Aeromagnetic Map of Kentucky: Central Sheet*, by R. W. Johnson, Jr., C. Haygood, and P. M. Kunselman. Scale 1:250,000.

Map. *Residual Total Intensity Aeromagnetic Map of Kentucky: Eastern Sheet*, by R. W. Johnson, Jr., C. Haygood, and P. M. Kunselman. Scale 1:250,000.

Open-File Material

The Kentucky Geological Survey maintains an open file of reports, maps, manuscripts, theses, and other material including logs of core holes, sample descriptions, and gravity base station

networks. Some of this material will eventually be published but has been placed on open file in order to make the data available prior to publication.

During the past year, the Survey began preparation of a series of open-file oil and gas county base maps. These maps show the locations of all known wells drilled for oil or gas in a county. They are prepared at a scale of 1:48,000 and indicate whether the wells produced oil or gas, have been abandoned, or were completed as dry holes. A well index and columnar stratigraphic section accompany the maps. Base maps for two counties, Grayson and Greenup, are presently available.

Open-file reports are available for inspection at Survey offices in Breckinridge Hall on the University of Kentucky campus during regular office hours. Copies of reports which consist of page-size material or for which the Survey has reproducible copy are available for purchase. The Kentucky Geological Survey also maintains copies of most open-file reports dealing with Kentucky geology which are prepared by the U. S. Geological Survey.

Papers by Staff Members in Outside Publications

Brant, R.A., and Hester, N.C., 1979, See Hester, N.C., and Brant, R.A., 1979.

Dever, G.R., Jr. (with Ellsworth, G.W., Jr., and Sumartojo, J.), 1978, Evidence for deposition of evaporites in the St. Louis Limestone (Mississippian) of eastern Kentucky: Geological Society of America Abstracts with Programs, v. 10, p. 167.

Dever, G.R., Jr., 1979, Lithic resources for tool manufacture in the area of Floyd County, Kentucky, in Sanders, T.N., and Gatus, T.W., A reconnaissance and evaluation of archaeological sites in Floyd County, Kentucky: Kentucky Heritage Commission, Archaeological Survey Report 7, p. 143-148.

Dever, G.R., Jr. (with Ettensohn, F.R.), eds., 1979, Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, 293 p.

Dever, G.R., Jr. (with Ettensohn, F.R.), 1979a, The Newman Lime-

stone on the east side of the Waverly Arch, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, p. 96-107.

Dever, G.R., Jr. (with Ettensohn, F.R.), 1979b, The Newman Limestone west of the Waverly Arch, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, p. 119-124.

Dever, G.R., Jr. (with Ettensohn, F.R.), 1979c, The Waverly Arch apical island, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, p. 108-112.

Dever, G.R., Jr., Hester, N.C., and Moody, J.R. (with Ettensohn, F.R.), 1979, Newman Limestone (Mississippian) of east-central Kentucky and Lower Pennsylvanian slump structures, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, p. 175-181.

Dever, G.R., Jr., and McGrain, Preston, 1979, General relationships between the Mississippian sections of west-central and east-central Kentucky, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, University of Kentucky, p. 211-213.

Dever, G.R., Jr., and McGrain, Preston (with Ellsworth, G.W., Jr.), 1979, A representative depositional sequence of the Chesterian Series in northwest-central Kentucky, in Ettensohn, F.R., and Dever, G.R., Jr., eds., Carboniferous geology from the Appalachian Basin to the Illinois Basin through eastern Ohio and Kentucky. Field trip no. 4, Ninth International Congress of Carboniferous Stratigraphy and Geology: Lexington, Univer-

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SERVICES

Well Record Library

The Oil and Gas Section of the Kentucky Geological Survey is the official repository for records of all wells drilled in the State. A variety of records such as drillers' logs, wireline logs, well-location survey plats, plugging affidavits, and completion reports are on file for an estimated 150,000 wells. Records for approximately 2,500 wells are processed and recorded annually by the Survey.

The Survey is obligated to make all such data and records available and open to the public. Facilities in the Well Record Library for public examination of records are used daily by representatives of industry, government, academic institutions, and the general public. An estimated 45,000 records are duplicated annually in reply to mail orders, telephone requests, and walk-in requests.

Sample Library

The Kentucky Geological Survey Well Sample and Core Library is the official repository for well cuttings and core samples of wells drilled in Kentucky. Approximately 400,000 feet of well cuttings are processed, catalogued, and filed annually. At the present time there are cuttings from over 14,000 wells and approximately 400 cores on file in the library.

The objective of the Survey is to selectively provide, wherever possible, a representative set of well cuttings or core samples for every Carter coordinate section (approximately 1 square mile) in the State. Also, the Survey strives to make these samples available to industry, government, academic institutions, and the general professional community by providing adequate space and facilities in the library for sample examination.

Public Information Services

Questions concerning various aspects of Kentucky geology come in to the Survey almost daily. These questions come from landowners, teachers, businessmen, farmers, schoolchildren, spelunkers, rock and mineral collectors, persons planning vacations in Kentucky, and many others, residing within the Common-

wealth and outside the State. Most inquiries are answered by providing leaflets, maps and pamphlets designed for this purpose, or by recommending available publications and maps that deal with the topic of interest.

Services include identification of rock, mineral, and fossil specimens and the distribution of rock and mineral sample sets to schoolchildren. Displays are prepared for conferences, fairs, rock and mineral shows, and other public functions. These exhibits are designed to inform people about the many interrelationships of geology to everyday life and educate them in the use of maps and other geologic publications.

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