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

ANNUAL REPORT 1980-1981

1980-1981
ANNUAL REPORT

KENTUCKY GEOLOGICAL SURVEY

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

RESEARCH AND ADMINISTRATIVE OFFICES
311 Breckinridge Hall
University of Kentucky
Lexington, Kentucky 40506
Phone (606) 258-5863

UNIVERSITY OF KENTUCKY

Otis A. Singletary, President
Art Gallaher, Jr., Vice President for Academic Affairs
Wimberly C. Royster, Dean of Graduate School and Coordinator of Research
James Y. McDonald, Executive Director, University of Kentucky Research Foundation

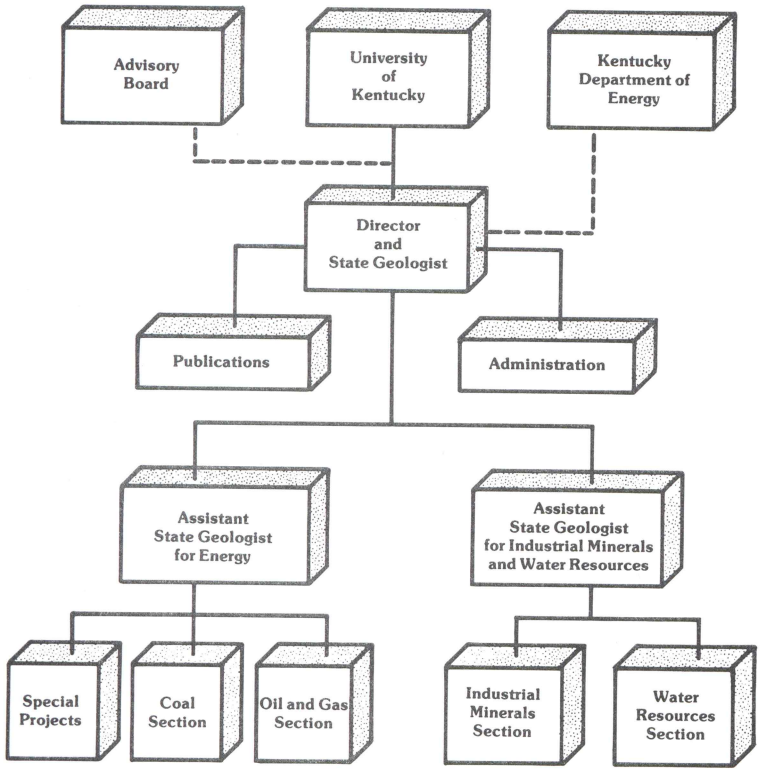
KENTUCKY GEOLOGICAL SURVEY ADVISORY BOARD

David A. Zegeer, Chairman, Lexington
Phil M. Miles, Vice Chairman, Lexington
David E. Bayer, Lexington
John G. Donan, Sr., Madisonville
Wallace W. Hagan, Lexington
Nicholas C. Kieffer, Jr., Louisville
Harold G. Mays, Frankfort
J. Edward Parker, Lexington
W. J. Reynolds, Allen
Henry A. Spalding, Hazard
Ralph N. Thomas, Owensboro
George H. Warren, Jr., Owensboro

CONTENTS

Page

Foreword 1
Research 2
Coal 2
Industrial and metallic minerals 15
Oil and gas 19
Water 24
Other research 28
Cooperative programs 28
Geologic mapping 28
Topographic mapping 29
National Cartographic Information Center 30
Water resources 31
Publications 34
Information Circular 34
Special Publications 34
Reprints 35
Guidebook 36
Maps 37
In press or editing complete 37
Open-file material 38
Papers by staff members in outside publications 38
Talks by staff members to professional groups 40
Services 41
Well record library 41
Sample library 42
Public information services 42
Personnel 43
Professional staff 43
Clerical and technical staff 47



Organization of the Kentucky Geological Survey

FOREWORD

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

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 hydrogeology study to collect baseline ground-water quantity and quality data in the Eastern Kentucky Coal Field; a study of the hydrogeology of the oil shale regions of Kentucky; various mineral resources investigations including a major study of limestone resources in eastern Kentucky; subsurface investigations of structure and stratigraphy related to the occurrence of oil and gas including special projects on tar sand and oil shale; 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 Department of Energy, the Survey serves in an advisory capacity to local, regional, and various State and Federal agencies. Additionally, the Survey places great emphasis on maintaining a dialogue with the general public through multifaceted public service activities. Close cooperation with industry and public awareness and participation are essential to the Kentucky Geological Survey in attaining its goal of defining, understanding, and properly 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. 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 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

Kentucky leads the Nation in the production of bituminous coal and, when compared to all coal-producing countries in the world, ranks fifth behind China,the United States, the Soviet Union, and Poland. In 1980 Kentucky produced about 150 million tons of coal, and almost half of this production was low-sulfur coal. Kentucky's coal will become increasingly important in the future as National policies to utilize domestic energy resources are implemented, sales to foreign markets are increased, advances are made in the technology for air-pollution control, and coal-conversion industries are created. Present and future demands for Kentucky's coal require a thorough understanding of this valuable resource to insure its most efficient utilization.

Kentucky is unique in having coal resources in three different geographic areas: the Eastern Kentucky Coal Field of the Appalachian Basin,the Western Kentucky Coal Field of the Eastern Interior Basin, and the lignite deposits of unknown potential in the Jackson Purchase region. Early in this century lignite was mined in the Jackson Purchase region, where it was converted into kerosene. The coals in these areas differ considerably in geologic occurrence, quality, manner of extraction, and potential impact on the environment.

The Kentucky Geological Survey is engaged in a wide variety of research projects directed at gaining a better understanding of Kentucky's diverse coal resources. The current areas of active research are coal-resource estimation, coal-mining geology, coal characterization, coal-field hydrology, lignite, stratigraphy, and geophysical well logging. Many of these research efforts by the Kentucky Geological Survey receive funding from State and Federal agencies. The U. S. Geological Survey sponsors a large portion of the active research. Other major support for current programs comes from the Kentucky Institute for Mining and Minerals Research, the Office of Surface Mining and Reclamation, the Nuclear Regulatory Commission, and the University of Kentucky.

COAL RESOURCES OF EASTERN KENTUCKY

BRANT, Russell A., HAMILTON, Joseph P., GILL, Kenneth L., and CHESNUT, Donald R., Jr.

The increasing need of Kentucky's citizens, industry, and government agencies for reliable, current, and up-to-date coal resource information has led to this major coal resources study. The Kentucky Geological Survey has mounted a major effort to collect data that accurately define coal resources in eastern Kentucky. These data are collected for each mineable coal bed and are used to produce maps showing the extent and thickness variation of each bed. The data are placed into computer files for coal resource determinations and permanent storage. A total of 15,000 coal thickness measurements in 184 quadrangles of eastern Kentucky have been collected to date in this project. Approximately seven quadrangles remain for field mapping of the coal. It is expected that this work will be completed in early 1982.

During the year the estimate of coal resources in the Princess Reserve District was completed. The coal resource report, soon to be published, shows the original coal resources in the ground to be 3.36 billion tons, which is 77 percent greater than the previous estimate for the district. This estimate is based on coal in 22 beds, but 11 of the beds contain 95 percent of the estimated coal. A total of 1,107 measurements were collected in about 20 quadrangles to support this coal resource estimate.

Coal resource maps and calculations of tonnages are being made for the Southwest Reserve District. A total of 3,500 new field measurements were collected in approximately 78 quadrangles in the district. A report summarizing thse coal resources is in preparation.

The Upper Cumberland and Licking River Districts are also in progress for coal resource determinations. The field work is mostly completed for these areas and approximately 3,300 new coal thickness measurements have been made. Coal mapping and resource tonnage calculations are progressing for the Licking River Reserve District and completion is scheduled for late 1982. Completion of the Upper Cumberland Reserve District is expected in mid 1983.

Field work in the Hazard and Big Sandy Reserve Districts is on schedule and will be completed in late 1981 and mid 1982, respectively. Analysis of data, coal mapping, and resource tonnage calculations will be completed by mid 1982 for the Hazard Reserve District. The Big Sandy Reserve District will be completed by mid 1983.

All coal resource mapping and tonnage calculations will be completed by mid 1983. The products of this project will provide a detailed delineation of the mineable coal beds of eastern Kentucky; appropriate maps will show thickness variations, and tables will show coal resources by coal bed, quadrangle, county, and reserve district. Detailed estimation of coal below drainage is limited by a lack of cores that penetrate to the base of the Pennsylvanian. The coal thickness data will be placed into files retrievable by computer. A microfilm file is also planned. These data will become the guide to future coal development in eastern Kentucky and a permanent reference for science, industry, government, and private citizens.

This project is funded in part by the Kentucky Institute for Mining and Minerals Research and the U. S. Geological Survey.

COLLECTION OF DATA FOR THE NATIONAL COAL RESOURCES DATA SYSTEM

BRANT, Russell A., and PORTIG, Elisabeth R.

Access to Statewide coal information requires a data system that is capable of accommodating the tremendous interest that exists in both the public and private sectors of Kentucky. The objective of this project is to collect and organize coal data for the National Coal Resources Data System (NCRDS), a Federal program designed to disseminate coal information using computer technology and access terminals Nationwide. This project is funded in part by the U. S. Geological Survey.

Coal information is being collected from roadcuts, drill holes, and mine exposures in eastern Kentucky. The data are organized

into a coal resource data base that includes coal thickness, geographic location, character of the coal, character of partings, and nature of the enclosing strata. These data are stored in a computer for rapid and easy retrieval of data by coal bed, county, or reserve district. At this time, nearly 15,000 data points are in the data base. The computer data base for the Princess Reserve District is nearing completion and data bases for all of eastern Kentucky's reserve districts will be available by 1983.

This project provides a central, easily accessed file for coal measurements of use in resource mapping, coal resource estimations, and othr coal research. It is easily updated as additional information becomes available. As coal deposits are depleted through mining and new mineable deposits are sought, this data file will be a valuable asset.

GEOLOGY AND COAL RESOURCES OF THE PRINCESS RESERVE DISTRICT, EASTERN KENTUCKY

BRANT, Russell A., and SERGEANT, Richard E.

This report will be the first in a series of six reserve district reports with an emphasis on the geology of the coal resources of eastern Kentucky. It will discuss the geology, stratigraphy, and coal beds of the Princess Reserve District (Boyd, Carter, Greenup, and Lawrence Counties) and will characterize the nature and occurrence of the mineable coal beds. Coal bed maps for the more important coals will be included in order to show their extent and thickness variations.

In addition to the geology of the coal resources of the Princess Reserve District, this report will describe methods, criteria, and definitions that were used in calculating and summarizing the coal resources. It is expected that this will be an Information Circular or Report of Investigations published by the Survey.

GUIDEBOOK TO PENNSYLVANIAN ROCKS OF THE EASTERN KENTUCKY COAL FIELD

COBB, James C., CHESNUT, Donald R., Jr., HESTER, Norman C., and HOWER, James C.

There has been growing interest in the high-Btu , low-sulfur coals of eastern Kentucky. A guidebook which includes a roadlog and stratigraphic description of the rocks in the Eastern Kentucky Coal Field will provide a stratigraphic framework and present some of the recent research from the area. Accompanying the roadlog are 18 invited papers covering such topics as coal

resources, coal quality, mining hazards, stratigraphy, sedimentology, paleobotany, paleontology, palynology, coal hydrology, and geophysics. This guidebook will be extremely useful in answering the many inquiries that are received concerning coal in eastern Kentucky and will stimulate future research.

This guidebook will provide a detailed roadlog through the central part of the Eastern Kentucky Coal Field and include stratigraphic descriptions of the coal-bearing rocks of Pennsylvanian age. The invited papers presented in the guidebook will demonstrate the variety of ongoing research and include new data on coal chemistry, coal quality, stratigraphy, paleobotany, and geophysics.

The guidebook will be published by the Kentucky Geological Survey for the 1981 Geological Society of America Field Trip sponsored by the Coal Division.

COAL RESOURCES OF THE DANIEL BOONE NATIONAL FOREST

COBB, James C., and SLUCHER, Ernie R.

The Bureau of Land Management and the U. S. Geological Survey Conservation Division have determined that an assessment of Federally owned coal within the Daniel Boone National Forest is necessary for proper forest-land management. The Kentucky Geological Survey is cooperating with this effort by supplying data on coal thickness in the Daniel Boone National Forest and acquiring new data from various sources, both public and private. The Kentucky Geological Survey is also supplying a well-site geologist to assist in core description and coal sampling. A total of 21 drill holes has been planned. The cores obtained from the drilling will be permanently housed at the Core Library of the Kentucky Geological Survey. The drilling of this project will be completed by March 1982.

GEOPHYSICAL WELL LOGGING

COBB, James C., SMATH, Richard A., and HAMILTON, Joseph P.

Geophysical well logging is an important data-collection tool used in geological research. It is particularly valuable for studies related to coal, oil shale, tar sands, oil and gas, ground water, and engineering problems. Well logging involves the lowering of wireline devices into boreholes in order to record properties of the rocks. Properties such as electrical potential and resistivity, radioactivity, rock density, and borehole diameter are measured.

These measurements provide information such as depth to and thickness of coal beds, hydrocarbon reservoirs, aquifers, and aquicludes. Geophysical logs are useful for determining rock types and making stratigraphic studies and coal bed correlations. They provide data for determination of coal quality and ground-water quality, as well as estimation of coal resources.

The wide capabilities of well logging provide a significant data-gathering function for many Survey research programs. Well logs constitute a permanent record of subsurface information and are placed on open file for use by industry and the public. They contain extensive information not available from any other source. Logs are obtained from boreholes drilled by the Survey and from those volunteered by private industry. Providing support to industry through well logging has become a very useful and constructive contact with the coal industry of Kentucky.

An open-file archive of all Kentucky Geological Survey geophysical logs indexed by county, 7.5-minute quadrangle, and Carter coordinate location has been developed. Geophysical logging is a continuing program in support of a broad spectrum of Kentucky Geological Survey activities.

ACQUISITION, STORAGE, AND CLASSIFICATION OF ENGINEERING AND GEOLOGICAL DATA FOR SURFACE-MINING DESIGN AND RECLAMATION

COBB, James C., UNRUG, K., TURNER, J., BOLTON, James C., and SMATH, Richard A.

This project is a cooperative effort of the Kentucky Geological Survey and the Mining Engineering Department of the University of Kentucky. It is supported by the Federal Title 3 program (Public Law 95-87), administered through the Kentucky Institute for Mining and Minerals Research. The Kentucky Geological Survey has collected geological data on cores from eastern Kentucky on which the Mining Engineering Department has performed numerous engineering tests. Over 1,000 engineering tests have been performed and the results of the tests and geologic data are stored in the University's IBM 370 computer. A program to allow user interaction with the data base is being developed.

A report on this testing program and a description of the use of the data base are being assembled. A final report including all results and methods, and the significant findings, will be published by the Kentucky Geological Survey.

STRUCTURAL AND STRATIGRAPHIC STUDIES OF LIGNITE IN THE JACKSON PURCHASE AREA OF KENTUCKY

COBB, James C., and WILLIAMS, David A.

Studies of lignite (low-rank coal) in the Jackson Purchase area of Kentucky were conducted during the 1950's by the Kentucky Geological Survey. Working from surface exposures, surface clay mines, and shallow wells, lignites 3 to 6 feet thick and locally up to 15 feet thick were reported. The purpose of the current project is to investigate the structure and stratigraphy of lignite-bearing strata in a limited area of Carlisle County, Kentucky. This area is within the New Madrid seismotectonic area and is of interest because of the possible faulting. This project is supported by the Nuclear Regulatory Commission.

Four boreholes, a total of 700 feet deep, were drilled, sampled, and logged by down-hole geophysical techniques which include spontaneous potential, resistivity, gamma ray, and density. The boreholes were spaced about 1/2 mile apart across a suspected fault. The data are being assessed and will be compiled into a final report for the Nuclear Regulatory Commission.

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 for three years by the U. S. Geological Survey in May 1979. This project has a two-fold purpose. First, 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 that can be used for liquefaction, gasification, and as non-polluting sources of steam coal. Second,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 coal beds with as wide a geographic distribution as possible. Each sample is intended to represent the quality of the full-seam thickness at the sample site. A detailed set of records is kept to accurately delineate the pattern of sample sites and the geologic conditions at each site.

During the second year of the project 182 full-thickness channel samples were collected. During fiscal year 1980-1981, 156 samples were collected. Of thse samples, 10 were contributed by other Kentucky Geological Survey programs and three by the Kentucky Institute for Mining and Minerals Research. The coal strike during the spring of 1981 adversely affected sample collection. Collection of the proposed 600 samples by the end of the study should be possible.

Samples have been collected from nearly all coal-producing eastern Kentucky counties, except for a few along the western limit of the coal field where there is little, if any, active mining. Concentrated effort for the fall and winter of 1981-1982 will be in Bell, Harlan, and Pike Counties. Sampling during the spring will concentrate on areas where gaps exist and on preparation of reports. Sample site density in many areas is now reaching the point that new samples cannot be collected without violating the desired 5-mile separation. Opportunities for all sample sites are controlled by mine locations.

The preparation of regional coal quality maps has been temporarily set aside while the data base was put in order. This work is nearly complete and work on the maps should be resumed in the fall of 1981. Two maps, the Upper Elkhorn No. 3 and Fire Clay coals, are complete. Maps for the Amburgy coal are also nearing completion.

Analytical results will be published upon completion of the project. Draft copies of the regional coal quality maps will be placed on open file when a satisfactory data point density is attained. A final report will be published.

COMPUTERIZATION OF COAL-RELATED DRILLING RECORDS OF KENTUCKY

SERGEANT, Richard E.

The Kentucky Department for Natural Resources and Environmental Protection is compiling an index of information pertinent to the Federal Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87). This index will be used by coal operators who are seeking data necessary to prepare mine permit applications and by the Department for evaluating these applications. An important component of this index is a listing of coal-related drilling records available to the public for the Eastern and Western Kentucky Coal Fields.

With the support of the Department for Natural Resources and Environmental Protection the Kentucky Geological Survey is compiling and computerizing such a list. Existing drill record files at the Kentucky Geological Survey are being encoded into a standardized format. These sheets contain information on drill-hole location, elevation, total depth, and operator's name. Additionally, if there is a core available and if geophysical logs have been run it is noted. These data are then entered into Survey computer files, and copies of the computer files are transferred to the Department for Natural Resources and Environmental Protection. Most of the western Kentucky records have been computerized and are being checked. Eastern Kentucky records will be completed by early 1982. This system allows new records to be added as they become available.

FACTORS AFFECTING COAL DEVELOPMENT IN THE WESTERN KENTUCKY COAL FIELD

SERGEANT, Richard E., and BINGEMER, Roxanne

During the decade of the 70's the world energy picture was changed drastically by the Organization of Petroleum Exporting Countries (OPEC). This resulted in the United States establishing the goal of energy independence by the year 2000. To accomplish this independence it is necessary to accelerate the development of coal resources such as are found in eastern and western Kentucky. Increased coal production and development of synfuel alternatives require heavy concentrations of people from the mining and construction industries and capital investment for equipment and construction.

Development of this nature will have a severe impact on rural settings such as western Kentucky, where there is presently only one large urban center (Owensboro). It is essential that this impact be mitigated wherever possible by comprehensive regional and local planning. To this end,the U. S. Geological Survey has funded the Geological Surveys of Kentucky, Illinois, and Indiana to compile coal and coal-mining-related data for their respective portions of the Illinois Basin. These data, which include information concerning reserves and resources, coal quality, mined-out areas, hydrology, reclamation, hydrocarbon exploration and production, and limestone, will be organized and explained in manuals written for the non-scientist. The manuals will direct the user to sources of specific information. Data compilation was initiated in January 1980 and was completed in June 1981.

Workshops to acquaint the public with the results of this project are planned for early 1982.

MINE MAP INVENTORY OF WESTERN KENTUCKY

SERGEANT, Richard E., and BINGEMER, Roxanne

The Western Kentucky Coal Field includes all or portions of 17 counties in western Kentucky. It is the southrnmost extension of the Eastern Interior Basin, which is contiguous with coal-producing regions in Indiana and Illinois.

Coal has been mined in western Kentucky since 1820, and in 1978 production totaled 39,000,000 short tons (which would have placed western Kentucky sixth in United States coal production). Despite this long history of mining activity, estimated remaining coal resources indicate continued production well into the twenty-first century. A recently completed study estimated that original resources in the Western Kentucky Coal Field exceeded 40 billion short tons, and coal remaining is estimated to exceed 38 billion short tons.

Because of its extensive coal resources, plentiful water supply, and central geographic location, western Kentucky will likely be the site of several synfuel plants and new electric power plants by the year 2000. These facilities as well as increased mining activity will accelerate urban and industrial development. To properly plan for this accelerated growth, it is imperative to have precise knowledge about areas where coal has been mined both on the surface and underground. Although a considerable amount of data on mined-out areas exists, it will require compiling and synthsizing records from public and private sources to create a comprehensive file on mined-out data.

This project will undertake an extensive inventory of selected areas in the Western Kentucky Coal Field where coal resources have, for all practical purposes, been mined out. A comprehensive index of the geographic location and magnitude of such mined-out areas is essential for the development of western Kentucky's coal resource. Scheduled completion of this project is the summer of 1983.

STRATIGRAPHY OF THE AMOS AND FOSTER COALS OF THE WESTERN KENTUCKY COAL FIELD

WILLIAMS, David A.

This project will determine the stratigraphic positions of the Amos and Foster coal beds of western Kentucky, and will

delineate their areal extent. A study of the macerals in these coals is also underway in conjunction with their stratigraphic analysis. The petrographic research is being done in cooperation with the Kentucky Institute for Mining and Minerals Research. The objective of this investigation is to access characteristics and resource potentials of these coals.

Bed maps and cross sections are being compiled from drilling records and field investigations. Twenty-six samples have been collected from these coals. Eighteen samples have been analyzed for petrographic and chemical composition. The project is scheduled for completion in 1984, and the results will be published by the Kentucky Geological Survey.

STRATIGRAPHIC CORRELATIONS FOR WESTERN KENTUCKY

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

During the Western Kentucky coal resources study, the results of which were recently published, 32 core holes were drilled within the coal field to resolve stratigraphic problems. A report was prepared in which the important coal beds and stratigraphic marker beds penetrated by the cores were identified and correlated. This report is in the form of an information circular and is in the final stages of publication. The circular contains a brief text explaining the stratigraphic interpretations, presents cross sections and core descriptions, and gives an index to key horizons in each core.

RECLASSIFICATION OF PENNSYLVANIAN STRATIGRAPHIC SECTION IN WESTERN KENTUCKY

WILLIAMSON, Allen D.

Although the Western Kentucky Coal Field contains approximately one-half of the coal resources in Kentucky, and although a significant fraction of Kentucky's coal production is derived from this coal field, no comprehensive classification has been prepared of the coal-bearing strata of this region. Over the past 20 years detailed studies have been made of small parts of the Western Kentucky Coal Field; however, the lack of such a classification has resulted in some invalid regional correlations and confused estimates of coal reserves, quality, and stratigraphic position. This study will enable coal industry personnel to make more accurate estimates of the extent, quality, and mineability of coal in western Kentucky, and will provide a necessary basis for

future coal development.

The objective of this study is to establish a comprehensive rock-stratigraphic classification for the coal-bearing rocks of western Kentucky. Secondary objectives are to designate and describe type and reference sections for the Pennsylvanian System, to correct various miscorrelations, and to develop an informal coal bed nomenclature.

A tentative biostratigraphic framework has been constructed and criteria for defining rock-stratigraphic units have been developed. Construction of thickness maps for each major rock unit is in progress. Surface data are being utilized where available; however, a major task of this project is the interpretation of subsurface data, most of which consist of oil-test records.

Subsequent work will involve a compilation of western Kentucky coal bed names and their positions in the stratigraphic section. Redundant, archaic, and miscorrelated coal bed names will be rejected and new names will be selected as necessary. Insofar as is possible each retained or named coal bed will be assigned a reference locality or core.

The final phase will involve the construction of a standard stratigraphic section for the Pennsylvanian System of western Kentucky.

Upon completion of this five-year project, a report outlining the Pennsylvanian rock-stratigraphic classification for western Kentucky will be prepared and a bulletin of stratigraphic names, their correlation type sections, lithologic characteristics, and stratigraphic position will be published.

STUDY OF THE PENNSYLVANIAN-AGE CASEYVILLE FORMATION

WILLIAMSON, Allen D., and BEARD, John G.

Most of the coal currently mined in the Western Kentucky Coal Field contains a sulfur content that renders it unacceptable under current Federal regulations. This high-sulfur coal can be blended, however, with low-sulfur coals to produce an acceptable feedstock which complies with current Federal Environmental Protection Agency standards.

The Caseyville Formation contains significant resources of high-Btu , low-sulfur coal; however, the Caseyville Formation and its coal beds have received little attention and are poorly understood. In order to aid exploration for low-sulfur coal beds in the Caseyville Formation, a study was initiated in 1979. The purpose of the study is to define the boundaries of the Caseyville, describe

the lithology and internal sedimentary features of the formation, and to describe and delineate the known coal beds.

The Caseyville Formation also contains significant amounts of petroleum. This formation contains the "pay zone" in several of the more prolific oil pools in western Kentucky. In this study the oil-bearing localities will be summarized, and examples of typical Caseyville oil pools will be characterized.

Investigative methods utilized in this study include a review of pertinent literature, analysis of published geologic maps and cross sections, microscopic examination of oil well cuttings, measurement and analysis of surface exposures, and analysis of various types of subsurface records.

Significant coal beds and other units have been identified, lithologic and thickness maps are being prepared, and appropriate cross sections are being constructed. This study is expected to be completed by January 1, 1982.

WESTERN KENTUCKY COAL BED INDEX

WILLIAMSON, Allen D., BINGEMER, Roxanne, and BRANT, Russell A.

The purpose of this project is to catalog the important coal beds of the Western Kentucky Coal Field and to summarize their distribution, thickness, stratigraphic relationships, and quality. This index is expected to be used by coal industry personnel who wish to identify and correlate coal beds in their locality, private citizens who wish to obtain information about the coal on their property, and others interested in obtaining information for a variety of reasons on western Kentucky coal beds.

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) of the Carbondale Formation. These beds are restricted to the central part of the 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 in western Kentucky. Other less extensive coal beds are found throughout the Western Kentucky Coal Field.

This index of coal beds of the Western Kentucky Coal Field is planned for publication.

INDUSTRIAL AND METALLIC MINERALS

Geologic studies of Kentucky's industrial and metallic minerals are aimed at delineating areas of favorable rocks that could contain significant concentrations of economic minerals. Investigations and report-writing during the 1980-1981 fiscal year have concentrated on barite, carbonate rocks, fluorite, sand and gravel, and zinc. These resources are not evenly distributed and represent wide variations in character and composition. The resulting reports are designed for industry-oriented people involved in exploring and developing mineral deposits and those concerned with environmental and land-use decisions. Commodity reports are popular publications. They enable geologists and engineers to focus attention quickly on likely mineral targets without costly and time-consuming searches for background data, thus stimulating development activities.

ZINC DEPOSITS OF SOUTH-CENTRAL KENTUCKY

ANDERSON, Warren H.

This investigation examines the subsurface stratigraphic relationships in the Cambro-Ordovician Knox Dolomite in southern Kentucky. For several years carbonate rocks of the Knox Dolomite have been mined for zinc in central and eastern Tennessee. This investigation will describe the lithostratigraphy of the Knox Dolomite from cores and well cuttings in Cumberland County, Kentucky, and adjacent areas.

The identification and correlation of lithologic marker beds is one aspect of understanding the ore controls of zinc mineralization. This information provides a geologic framework to investigate the relationship between lithology and zinc mineralization.

Descriptions of two cores have been completed and released as open-file reports. Well cuttings from the Murley No. 1 oil and gas test are being described and the description will be released as an open-file report about January 1, 1982. Additional core and well-sample descriptions will provide further coverage in southern Kentucky.

BARITE DEPOSITS OF KENTUCKY

ANDERSON, Warren H., TRACE, Robert D., and McGRAIN, Preston

A recently completed investigation indicates that barite is a potentially important mineral resource in Kentucky. Barite has been recognized at more than 170 mines, prospects, and outcrops in 23 counties in central, south-central, and western Kentucky. No mines were active at the time of this investigation.

Most of the Kentucky barite deposits are classified as vein or residual deposits that range in thickness from a fraction of an inch to a few feet and in length from tens to hundreds of feet. Bedded deposits of barite have not been mined in Kentucky.

The vein deposits are generally mixed ores. Most common co-products are fluorite (fluorspar), galena, and sphalerite. Because mixed ores, particularly barite and fluorite, were once considered difficult to separate economically, many deposits were bypassed in mining activities.

A report describing the known occurrences of barite in Kentucky is being processed for publication by the Kentucky Geological Survey.

CHEMICAL CHARACTERISTICS OF CARBONATE ROCKS IN THE HIGH BRIDGE GROUP (MIDDLE ORDOVICIAN) OF CENTRAL AND NORTH-CENTRAL KENTUCKY

DEVER, Garland R., Jr.

The High Bridge Group (Middle Ordovician) is a thick (430 to 570 feet), widespread body of limestone and dolomite which is at a mineable depth beneath central and north-central Kentucky. It is a major source of construction and agricultural stone in the region and is used in the production of lime for flue-gas desulfurization, flux, chemical industries, and water treatment. Objectives of this project are to determine the chemical characteristics of High Bridge rocks across the region and to define the occurrence of deposits suitable for industrial uses requiring carbonate rocks of high chemical purity. Chemical quality of the High Bridge rocks is being determined by the analysis of foot-by-foot samples taken from cores donated to the Survey by private companies.

Analysis of cores taken in Boone and Fayette Counties shows that the High Bridge in both central and north-central Kentucky contains thick deposits of chemically pure carbonate rocks. Correlation between the stratigraphic position of high-carbonate zones in the two cores, taken 70 miles apart, suggests that the

deposits are widespread. Analyses of the Boone County core were published by the Survey in 1974 (ser. 10, Information Circular 22). The report on the Fayette County core was completed and published during this year (1980, ser. 11, Information Circular 4). Chemical analyses (excepting phosphorus and sulfur determinations) for a Grant County core were completed and a report is being prepared. Project duration is dependent upon the availability of cores to define the regional chemical characteristics of the High Bridge.

LIMESTONE RESOURCES IN EASTERN KENTUCKY FOR ENVIRONMENTAL-CONTROL MEASURES BY COAL-RELATED INDUSTRIES

DEVER, Garland R., Jr., and MOODY, Jack R.

Carbonate rocks, principally limestone, are employed by coal producers and coal-consuming industries in environmental-control measures to meet Federal and State standards for mine safety and reclamation, water quality, and air quality. The objective of the project is to determine the availability of limestone and dolomite resources in eastern Kentucky with chemical characteristics suitable for use in the environmental-control measures. During the first five years of the project, 2,605 foot-by-foot samples have been taken for chemical analysis from deposits exposed in quarries, mines, and roadcuts along the western border of the Eastern Kentucky Coal Field and along Pine Mountain in the southeastern part of the coal field. Samples are being analyzed at the Kentucky Center for Energy Research Laboratory (KCERL). Chemical analyses (excepting phosphorus and sulfur determinations) have been completed for eight sections bordering the coal field and for one section on Pine Mountain. The analyzed section on Pine Mountain contains thick deposits of low-silica stone, potentially suitable for use as rock dust for underground coal mines.

The principal carbonate lithotypes of the sampled sections in eastern Kentucky are being tested at KCERL to evaluate their suitability for fluidized-bed combustion systems. Selected dolomite and limestone deposits in western and central Kentucky also are being sampled for testing. A procedure using dyed epoxy was developed to increase accuracy of porosity determinations used in evaluating carbonate rocks for reactive processes.

The project is funded by the Institute for Mining and Minerals Research. Its proposed duration is 1976-1982.

NONFUEL MINERAL STATISTICS

McGRAIN, Preston

Through a formal agreement, the Kentucky Geological Survey cooperates with the U. S. Bureau of Mines in the collection and compilation of nonfuel mineral statistics and activities. Joint efforts with Kentucky and other states provide a basic source of data for the Bureau's "Minerals Yearbook," an accepted reference for anyone seeking information on the mining industry.

The Kentucky chapters for the 1977 and 1978-1979 "Minerals Yearbooks" were published during the 1980-1981 fiscal year. The value of nonfuel mineral production in Kentucky was $156 million in 1977, $191 million in 1978, and $207 in 1979.

SAND AND GRAVEL RESOURCES OF KENTUCKY

McGRAIN, Preston

This project is designed to provide an overview of the sand and gravel resources of Kentucky. It will serve as a guide for those concerned with exploring and developing mineral aggregates and a base for future detailed studies characterizing specific deposits.

In terms of both value and volume, sand and gravel constitutes the second-most important source of mineral construction raw material in Kentucky, being exceeded only by limestone. Production has increased markedly in recent years, reflecting substantial growth in Kentucky's construction industry. However, deposits which meet most requirements and specifications for aggregates are not evenly distributed.

Principal production of sand and gravel in Kentucky is concentrated in the channels and valleys of the Ohio and Mississippi Rivers. Approximately two-thirds of Kentucky's current production is derived from floating dredge operations in the Ohio River itself and glacial outwash deposits of Wisconsin age along its valley.

On the basis of current use, most Kentucky deposits are classified as construction sands and gravels. Some deposits, however, contain sufficiently high silica content to classify them as industrial sands and gravels.

A manuscript describing the principal deposits in the State is approaching completion and will be submitted for publication early in the 1981-1982 fiscal year.

GEOLOGY AND ORE DEPOSITS OF PART OF THE TABB FAULT SYSTEM, CRITTENDEN COUNTY, KENTUCKY

TRACE, Robert D.

More than three-fourths of the fluorspar produced in the United States has come from the Illinois-Kentucky Fluorspar District; about 30 percent or 3 1/4 million short tons have been produced from Kentucky. Over 1 million short tons, about 30 percent of the Kentucky production, has been mined from the 4-mile-long segment of the Tabb Fault System near Mexico, Kentucky, that is being investigated.

Although the Tabb area has been the largest producing area in the Kentucky district, only few geologic data have been published on this area since the early 1920's.

The objective of the current investigation is to compile all available geologic data into a report that will include detailed surface and underground maps gathered from public and private sources since 1942. The investigation should contribute to a better understanding of the origin and geologic controls of the mineral deposits in the district.

A first draft of the report on the geology and ore deposits of the Tabb area will be completed about October 31, 1981.

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.

A new oil and gas information file has been developed for county and regional areas that will enhance the efficiency of dealing with general information inquiries. This file contains such information as cumulative annual oil production, oil and gas pool maps at a scale of 1:250,000, pool indexes, geologic quadrangle indexes, and county and regional bibliographies.

The Survey is the official repository for oil and gas well records; a well record library is maintained for public use. Presently, there are approximately 125,000 well records 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.

RESOURCE ASSESSMENT OF OIL-BEARING SHALE IN CENTRAL KENTUCKY

BEARD, John G.

The New Albany-Chattanooga-Ohio black shale of Devonian age and the Sunbury black shale of Mississippian age are un-

dergoing an intense investigation as to their potential as a source of synthetic crude oil. A resource assessment is being conducted in cooperation with the Kentucky Institute for Mining and Minerals Research and is supported by the U. S. and Kentucky Departments of Energy and private sources. This evaluation will cover the outcrop belt within strippable limits around the Lexington Dome and in the Cumberland Saddle.

In early 1981 the Kentucky Institute for Mining and Minerals Research published a technical report, "Resource Assessment of the Oil-Bearing Shales in Lewis and Fleming Counties, Kentucky." Eleven borings were made for this phase of the project. Within this two-county area it was determined that a resource potential existed in the amount of 1.3 billion barrels of synthetic crude oil at a stripping ratio of 2.5:1. This report covers the stratigraphy, organic and inorganic chemistry, and physical properties, as well as the resource assessment. Since the report was published, 11 additional core holes were drilled through Bath, Rowan, Montgomery, Powell, and Estill Counties, and a resource assessment is being prepared similar to that for Lewis and Fleming Counties.

An additional 38 drilling sites in 17 counties have been located and permitted and will be cored in summer 1981. These cores will be described, analyzed, and combined with Kentucky Geological Survey file data to produce a resource assessment of the entire outcrop area in Kentucky.

SUBSURFACE STUDY OF KNOX GROUP IN KENTUCKY

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 complement a similar map published by the State of Tennessee. It will be compiled from subsurface information derived from the examination of well samples, cores, geophysical logs, and drillers' logs in locations where other information is lacking. The scale will be 1:250,000 with a contour interval of 100 feet. Over 600 cores, samples, and drillers' logs have been examined, and a literature search has been completed.

Structure data will be computerized, and maps will be derived from this information. Columnar and lithologic cross sections will be prepared of rock types directly above and below the top of the Knox. The deadline for this project was extended and the completion date is now December 1, 1981.

CORRELATION OF STRATIGRAPHIC UNITS OF NORTH AMERICA (COSUNA)

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

This project is addressed to the long-term need to update the series of North American correlation charts of geologic units 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 American Association of Petroleum Geologists (AAPG) 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 compiled 10 columns for the Kentucky portion of provinces 300, 135, and 160. The seven columns for provinces 300 and 315 have been reviewed and incorporated into the Lowland Basins and Arches Region (LOBAR) chart which consists of 29 columns covering all or portions of Wisconsin, Michigan, Ohio, Indiana, Illinois, Kentucky, Tennessee, and Alabama. The LOBAR sheet will be the first COSUNA chart published and has been submitted to Gulf Oil Company, which will prepare all charts for publication. Stratigraphic data sheets have been compiled for each unit on the seven Kentucky columns and submitted to the Regional Coordinator.

The three columns for province 160 have been compiled, reviewed locally, and submitted to the Regional Coordinator for incorporation into the Appalachian Basin chart which will consist of 53 columns covering all or portions of New York, New Jersey, Pennsylvania, Ohio, Maryland, West Virginia, Virginia, Kentucky, Tennessee, Georgia, and Alabama. Stratigraphic data sheets are being compiled for the Kentucky columns.

COMPUTERIZATION OF OIL AND GAS WELL RECORDS

NUTTALL, Brandon C.

The purpose of this project is to provide a unified storage and retrieval system for oil and gas records on file at the Kentucky Geological Survey. The computerization of the well record library is expected to considerably enhance the speed and efficiency of

data retrieval. Programs have been developed to provide proofreading and error checking aids, well lists, and to manipulate computer data sets.

Approximately 1,500 well completions have been encoded, keypunched, and proofread for 1981. These data are being reported on magnetic tape to the American Petroleum Institute.

In conjunction with the county oil and gas base map project, well record data sets have been computerized and are now available for Anderson, Bell, Boyle, Bourbon, Caldwell, Carter, Clark, Fayette, Garrard, Grant, Greenup, Harlan, Jessamine, Larue, Letcher, Lewis, Logan, Madison, Mercer, Montgomery, Nicholas, Todd, Washington, and Woodford Counties and the Horton Quadrangle.

An index of deep test wells has been computerized as part of the subsurface study of the Cambrian of Kentucky.

In cooperation with private industry, well records data are being collected and encoded for computerization for heavily drilled areas of eastern Kentucky. This project is designed to collect information needed to help industry support their efforts to qualify natural gas produced from formations with low permeability under pricing guidelines set forth by the Federal Energy Regulatory Commission.

COUNTY OIL AND GAS BASE MAPS

PONSETTO, Louis R.

The purpose of this project is to build a file of current oil and gas base maps that give location, identification, and well status for each county in Kentucky. Individual county maps are being 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. The original program has been modified to include 7.5-minute quadrangle oil and gas maps on a planimetric base at a scale of 1:24,000. These maps and columnar sections are prepared on mylar to facilitate updating and reproduction. As the individual counties and quadrangles 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, Anderson, Barren, Boyle, Carter, Clark, Garrard, Grayson, Greenup, Jessamine, Letcher, Lewis, Madison, Mercer, Rowan, Todd, Washington, and Woodford Counties have been completed and placed on open file; Bell, Caldwell, Harlan, and Montgomery Counties are also on open file, although they need

generalized stratigraphic columns to be complete. Counties in progress are Adair, Casey, Fayette, Fleming, Grant, Larue, Lawrence, Logan, McCreary, Menifee, Oldham, Pulaski, and Simpson.

FEASIBILITY ASSESSMENT OF UNCONVENTIONAL GAS IN KENTUCKY

PONSETTO, Louis R.

Unconventional gas in Kentucky is defined as methane gas produced from coal beds and gas produced from Devonian Shales. The Kentucky Department of Energy has received a grant from the U. S. Department of Energy to investigate the feasibility of developing this resource as a supplement to conventional natural gas for rural areas, municipal public utilities, and local industries.

Three test sites, two in eastern Kentucky at Prestonsburg and Hazard, and one in western Kentucky at Henderson, have been selected for coring and testing. All sites will test the potential for coal-bed methane, but Prestonsburg will be the only site to test the Devonian shale gas.

The Kentucky Geological Survey will provide the technical assistance necessary to evaluate this resource as a potential supplement to conventional supplies.

THE CAMBRIAN SYSTEM OF KENTUCKY

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. Each year a few additional wells are drilled that penetrate all or part of this unit, adding further to our knowledge. To date, all of the wells on which the Kentucky Geological Survey has any record have been identified and entered into our developing computer system. There is now available an open-file map at a scale of 1:500,000 showing the location and total depth formation of each well. A computer printout accompanying the map gives details concerning the wells.

As completion reports are received on all new wells that reach the Cambrian, the data from these wells have been added to the map and to the computer printout.

WATER

The Kentucky Geological Survey plays a vital role in the development and management of water resources in Kentucky. The role of the Water 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. In 1981, as in the past, many of our programs have been carried out in cooperation with the U. S. Geological Survey.

Since the U. S. Geological Survey has been traditionally strong in the area of surface water, it is felt that our greatest contribution can be in the field of ground water; therefore, most of our programs reflect that emphasis.

Over the past several decades, a new awareness of the tremendous potential and the overall critical importance of the Nation's ground-water resource has been generated. With that awareness has come the realization of the difficult problems associated with the management and the protection of that resource. If one considers the basic needs of modern civilization—food, clothing, shelter, and energy—there is virtually nothing that can be produced without large quantities of water. There is also a need to dispose of the large quantities of waste water our system generates.

Nationwide, more than 80 percent of our total water use presently comes from surface-water sources. Yet our lakes and rivers make only a small percentage of our total reserves of fresh water. Ground water comprises a large and extremely important percentage of our total water reserve and holds our hope for the future in many areas of the Commonwealth. The efficient development, utilization, and protection of the ground-water resource is a major challenge of the 80's. It is our goal to meet that challenge.

HYDROGEOLOGY OF THE EASTERN KENTUCKY COAL FIELD

CORDIVIOLA, Steven, and KIEFER, John D.

The objectives of this program are to provide baseline geologic and hydrogeologic information about ground water in the Eastern Kentucky Coal Field and to assess the effects of surface mining on ground-water quality and quantity. Information gained from this project will add to the understanding of the ground-water system throughout the Eastern Kentucky Coal Field and aid regulatory agencies and the mining industry in developing reliable ground-water monitoring programs. The study is funded by the Water

Resources Division of the U. S. Geological Survey. The project began in January 1980 and is scheduled for completion in January 1985.

A network of approximately 10 permanent ground-water observation sites will be established in the 1,100-square-mile drainage basin of the North Fork of the Kentucky River, upstream of Jackson, Kentucky. Rather than individual wells, each site will consist of a series of observation wells drilled to various depths. These observation wells will provide long-term information necessary to assess the existence of a regional aquifer system and define its hydrologic response.

Within the larger watershed, several first- or second-order watersheds will be selected for detailed study. Criteria for selection of these smaller drainages include a pristine watershed in which no mining will occur during the term of the project, a watershed in which some portion will be mined and reclaimed during the project, a watershed on which mining and reclamation have occurred, and a watershed on which mining has occurred but on which there has been no reclamation. Approximately 40 borings will be drilled for the detailed studies. Hydrogeologic, stratigraphic, and water-quality information will be collected and compiled.

A conceptual model of the hydrogeology of the coal field will be developed. Products of this project will include reports and maps which will be useful in preparing pre-mining, mining, and post-mining plans and in assessing environmental impacts to both surface and deep mining of coal.

Observation borings have been drilled at Jackson and at two sites in the vicinity of Hazard. The cores were utilized for hydrogeologic and stratigraphic information. In addition, the borings were geophysically logged. Several ground water monitoring wells have also been drilled at these sites. Selection of the pristine and the pre-mined watersheds should be concluded in fall 1981, and drilling for stratigraphic and hydrologic information will begin shortly thereafter, in conjunction with the completion of the regional well sites.

IDENTIFICATION OF SELECTED FRESH-WATER AQUIFERS

CORDIVIOLA, Steven, and TOWNSEND, Margaret A.

The purpose of this study is to identify and delineate ground-water aquifers in Kentucky presently supplying or having the potential to supply potable water. The Federal or State Un-

derground Injection Control Program will protect these aquifers from possible contamination resulting from injection of liquid wastes underground.

The portion of the project funded by the Kentucky Department for Natural Resources and Environmental Protection, Division of Water, is completed. The final report was presented to the Agency in August 1981. The U. S. Environmental Protection Agency has provided the additional funding necessary to complete the project by October 1981. The final report should be presented to the Environmental Protection Agency by December 1981.

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

Drillers' logs, brine analyses, and various indirect techniques, which include the use of geophysical logs, are being utilized to delineate salt-water zones on a county-by-county basis.

To date, preliminary evaluation for the occurrence of salt-water zones has been completed in the Mississippian Plateau region, the Western Kentucky Coal Field, and in the southwestern and northeastern sections of the Eastern Kentucky Coal Field. Work is progressing to complete the evaluation of all of the counties in the State. The county and multicounty maps, cross sections, and reports are in various stages of completion.

Final products of the study will include maps, charts, and tables which will enable the Federal or State agency in charge of the program to make sound judgments on any requests for permits to inject liquid wastes underground.

Additional money was granted from the U. S. Environmental Protection Agency to inventory disposal injection wells in Kentucky. Records on file at various State and local agencies were searched for data on oil and gas injection and disposal wells, industrial waste disposal wells, and other wells used for the disposal of nonhazardous liquids. To date, approximately 4,500 records have been located and inventoried. This portion of the study will be completed by early fall 1981.

GEOHYDROLOGY OF THE OIL SHALE AREAS OF KENTUCKY

KIEFER, John D., and CORDIVIOLA, Steven

The purpose of this Kentucky Geological Survey-U. S. Geological Survey cooperative study is to describe the general hydrology of the oil shale areas of Kentucky, including an inventory of ground-water yields from the shale and adjacent units, methods and directions of ground-water flow through the shale, and ground-water quality studies. The study is to include the entire area along and adjacent to the outcrops of the shale, but will focus on areas in which initial development of the oil shale is most likely to occur. Three areas along the oil shale outcrop belt—Carters Quadrangle in Lewis County, Palmer Quadrangle in Clark and Estill Counties, and Loretto Quadrangle in Nelson and Marion Counties—have been selected for more detailed study, and other areas may be selected as the project progresses.

The study will add to the hydrologic knowledge of a region of Kentucky that has been generally ignored in previous studies, and it will assist regulatory agencies and industry in the proper development of the oil shale resource.

A preliminary study has been completed and a report which will serve as the basis for continued study is being written. The project will last approximately three years, and a summary report will be published at the completion of the project.

MISSISSIPPIAN PLATEAU WATER RESOURCES

KIEFER, John D., and TOWNSEND, Margaret A.

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 was recently redesigned to place more emphasis on water-quality aspects, particularly in the area of trace elements.

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, U. S. Geological Survey 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. A report covering Meade and parts of Breckinridge and Hardin Counties and a report covering part of Hardin, Larue, Hart, Grayson, and Green Counties are nearing completion.

OTHER RESEARCH

ECONOMIC GEOLOGY OF ROWAN COUNTY, KENTUCKY

McGRAIN, Preston, and NOGER, Martin C.

Geologic resources, broadly interpreted as land, minerals, and water, are important in the economic growth and development of Rowan County. Building stones, ceramic raw materials, coal, limestone, oil and gas, oil shale, sand and gravel, and water are potential resources. Geologic and mineral resource maps, compiled from previous investigations and original field work, are included in a recently completed report and provide an overview of the economic geology of the county.

Geologic conditions and processes are present in Rowan County that have environmental implications which may affect humanity and the management of geological resources. The competition for land for housing and plant-site development, highway networks, and recreational areas might encourage expansion into areas with potentially unstable ground conditions or the elimination of potential resource sites. Data included in this report should assist those responsible for such land-use decisions.

The rugged, rock-capped hills and the picturesque knobs are also important geological resources of the region. The combination of these natural scenic features and the recently man-made Cave Run Lake on Licking River offer many opportunities for the growth of the tourist-trade industry in Rowan County.

A well illustrated text with accompanying geologic and mineral-resource maps is being processed for publication.

COOPERATIVE PROGRAMS

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 of 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.

The map is in the final stages of cartographic preparation.

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 1980-1981, 12 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, 8 maps were standard revisions, which involve recontouring in areas where there have been changes in the topography; changes of 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, are available for portions of eastern and south-central Kentucky.

In fiscal year 1980-1981, Kentucky began revising topographic maps under the sector revision program. This program allows photoinspection and revision of areas where change has taken place on a recurring, five-year cycle. Currently, photography has been acquired for most of western and southern Kentucky, and photoinspection of these areas is taking place. Most of eastern Kentucky is scheduled to be covered by aerial photography in fiscal year 1981-1982.

During fiscal year 1980-1981, 55 landslide hazard maps were produced for a part of southeastern Kentucky. These were done in the 7.5-minute format by the U. S. Geological Survey, and are available through the Kentucky Geological Survey.

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

National Cartographic Information Center

In March 1980 the Kentucky Geological Survey became the state affiliate of the National Cartographic Information Center (NCIC). NCIC was established by the U. S. Geological Survey in 1974 as the national repository for information regarding maps, charts, aerial photography, space imagery, digital map data, and geodetic control. Its mission is to organize cartographic data of national significance into a usable information system while the data themselves remain with the original holder.

During fiscal year 1980-1981, the National Cartographic Information Center of the Kentucky Geological Survey saw a steady increase in use. KGS-NCIC processed 841 separate requests for information. Work continued on the Kentucky Cartographic Inventory, and the possibility of cooperative funding of this project by the U. S. Geological Survey continued to improve. A small grant from the Shongum Oil and Gas Company was used to purchase computer-enhanced satellite imagery to be used in the compilation of linear features maps. Maps and illustrations from Kentucky Geological Survey publications, series 2 through series 6, were catalogued, and a storage and retrieval system for this information was developed, utilizing the University of Kentucky Computing Center.

In the next year KGS-NCIC will continue its data acquisition program and work to improve the service provided to Kentucky map users.

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 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, "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. A 963-page cooperative publication, "A Compilation of Ground Water Quality Data for Kentucky," was released in 1980; it lists all ground-water data for Kentucky, including chemical analyses, in the files of the U. S. Geological Survey through 1979. 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 nearly $1,000,000. Following are brief descriptions of the projects.

1. Surface-Water Stations—A State-wide 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." 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 State-wide 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 continuous 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 year 1964-1974, 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 State-wide network is to collect water-level data for a long-term 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 five-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 U. S. Geological Survey 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 the U. S. Geological Survey publication, "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. This project has been redesigned recently to place more emphasis on the aspect of water quality, particularly in the area of trace elements. 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, U. S. Geological Survey Water Resources Investigation 78-25, by R. O. Plebuch, was published in summer 1981 and encompasses most of Trigg County and portions of Lyon, Caldwell, and Christian Counties. Similar reports covering Meade and parts of Breckinridge and Hardin Counties and a report covering parts of Hardin, Larue, Hart, Grayson, and Green Counties are nearing completion.

6. *Water from Coal Mines in Johnson and Martin Counties.*—The purpose of this project is to provide some preliminary data on the quantity and quality of water which may be available from abandoned coal mines. This information may be useful in planning for future public and industrial water supplies. It is hoped that water in these abandoned mines can, at a minimum, provide reliable auxiliary water supplies in times of drought or other water emergencies. A summary report for this project is scheduled for publication in late 1981. While this initial report may be rather limited in scope, it is hoped that it will serve as a basis for an expanded study of water from coal mines in the near future.

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. A summary report for this study is nearing completion.

8. *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.

9. *Geohydrology of the Oil Shale Areas of Kentucky*—This project to describe the general hydrology of Kentucky's oil shale areas includes an inventory of ground-water yields from the shale and adjacent units, methods and directions of ground-water flow through the shale, and ground-water quality studies. The study will concentrate on areas in which initial development of the oil shale is most likely to occur.

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 the Small Animal Building on the University of Kentucky campus. Total sales for fiscal year 1980-1981 amounted to about $134,000.

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

Information Circular

Information Circular 4. High-Carbonate and Low-Silica Stone in the High Bridge Group (Middle Ordovician), Fayette County, Central Kentucky, by Garland R. Dever, Jr., 45 p. 4 figs., 2 tables.

The High Bridge Group (Middle Ordovician) of central Kentucky, a major source of limestone and dolomite for construction and agricultural stone, is also a potential source of stone for industrial uses requiring carbonate rocks of high chemical purity. Chemical analyses of foot-by-foot samples from a Fayette County core show that several thick zones of high-carbonate and low-silica stone are present in the High Bridge at a mineable depth.

Special Publications

Special Publication 2. Proceedings of the Technical Sessions, Kentucky Oil and Gas Association Thirty-Sixth and Thirty-Seventh Annual Meetings, 1972 and 1973, edited by Margaret K. Luther, 71 p., 42 figs., 7 plates.

Contains "Reconnaissance Report, Lamar County, Alabama, Black Warrior Basin," by William Duchscherer, Jr.; "Polymer Treatments in Producing Wells to Reduce the Water-Oil Ratio," by

D. R. Wieland; "Role of Geophysics in Exploration of Stratigraphic Traps," by V. J. Satoskar; "Oil and Gas Possibilities of the Big Lime Formation in Southeastern Kentucky," by J. H. Murphy; "Structures of the Appalachian Plateau—What Role for Basement?," by E. J. Webb; "Hydrocarbon Entrapment Along a Middle Ordovician Disconformity," by Howard Schwalb; "The Newman Limestone (Mississippian): An Indicator of Tectonic Activity in Northeastern Kentucky," by Garland R. Dever, Jr.; and "Sub-Pennsylvanian Valleys in the Chesterian Surface of the Illinois Basin," by Hubert M. Bristol and Richard H. Howard.

Special Publication 3. Proceedings of the Technical Sessions, Kentucky Oil and Gas Association Thirty-Eighth Annual Meeting, June 6-7, 1974, edited by Margaret K. Luther, 54 p., 44 figs., 2 tables.

Contains "A Regional Study of the St. Peter Sandstone in Eastern Kentucky," by Michael L Price; "Exploration Along the Northwestern Margin of the Rome Trough," by J. Donald Silberman; "Deep Exploration in Eastern Kentucky by the SCLAW Group During the Early Seventies," by E. M. Sutton; "Geology and Petroleum Occurrences in the Rough Creek Fault Zone: Some New Ideas," by Avery E. Smith and James E. Palmer; "Regional Setting of the Cambro-Ordovician in the Illinois Basin," by John Avila.

Special Publication 4. Proceedings of the Technical Sessions, Kentucky Oil and Gas Association, Thirty-Ninth and Fortieth Annual Meetings, 1975 and 1976, edited by Margaret K. Luther, 54 p., 44 figs., 2 tables.

Contains "Oil Shale Development, When?," by Paul Wellman; "Tertiary Recovery and the Maraflood™ Oil Recovery Process," by Fred H. Poettman; "Coal Liquefaction—A Source of Hydrocarbons," by J. V. Fox; "Radioactive-Logging Survey of the Pickett Chapel-Exie South Field, Adair and Green Counties, Kentucky," by Sam Norris; "Massive Hydraulic Fracturing—From Planning to Performance," by W. T. Malone, E. J. Stahl, Jr., and G. R. Coulter; "A Geophysical and Tectonic Study of East-Central Kentucky with Emphasis on the Rome Trough," by G. R. Keller, M. L. Ammerman, and A. E. Bland; and "Silurian Reefs in Southwestern Indiana and Their Relation to Petroleum Accumulation," by Leroy E. Becker and Stanley J. Keller.

Reprints

Reprint 7. Coal in Kentucky, by Russell A. Brant and Norman C.

Hester. Reprinted from 1980 Keystone Coal Industry Manual, (11) p., 4 figs., 20 tables.

Kentucky contains significant coal resources in two fields. In western Kentucky coal measures of Pennsylvanian age underlie 6,400 square miles of the eastern region of the Interior Coal Province and represent the southernmost extent of the Illinois Basin. This coal field is contained in the Moorman Syncline and is transected by a complex of faults associated with the Rough Creek Fault System. The coal field of eastern Kentucky contains approximately 11,000 square miles of the Appalachian region of the Eastern Coal Province and fringes on the folded Appalachians. The Pine Mountain thrust block in southeastern Kentucky contains the important Upper Cumberland Coal Reserve District.

Reprint 8. Oil and Gas Developments in East-Central States in 1979, by Edmund Nosow, Robert D. Lindau, Jacob Van Den Berg, and G. L. Carpenter. Reprinted from the American Association of Petroleum Geologists *Bulletin*, v. 64, no. 9, p. 1462-1475, 4 figs., 10 tables.

In Kentucky 877 oil and gas tests were drilled in 1979, down 5.1 percent from 1978. The 322 exploratory tests, down from 351 in 1978, resulted in 42 oil wells and 38 gas wells, a success rate of 24.1 percent. Development wells were 60.7 percent successful and resulted in 234 oil wells and 97 gas wells. Among the exploratory successes in western Kentucky was a new-field discovery in Webster County that flowed 221 barrels of oil per day from the McClosky. Clear Creek production (Devonian) was discovered in Deanefield Field, Ohio County. Leasing and drilling in Muhlenberg County have increased appreciably. In central Kentucky, drilling increased greatly in Clinton and Cumberland Counties; several new areas of Ordovician production were discovered. In eastern Kentucky, the main interest has been in exploration of Big Lime production. Seismic exploration has increased in eastern Kentucky, and at least two deep tests are scheduled in the Rome Trough. Prospects for 1980 are for a banner year for all areas of the State. Crude oil production in Kentucky in 1979 was 5,513,688 bbl, down 3.4 percent from 1978. Gas production was 59,519,590 Mcf, down 14.2 percent.

Guidebook for Geology Field Trip

Stratigraphy, Trace Fossil Associations, and Depositional Environments in the Borden Formation (Mississippian), Northeastern Kentucky, by James R. Chaplin (Annual Field Conference of the Geological Society of Kentucky, 1980), 114 p., 53 figs., 9 tables, 7 plates.

Environments of deposition of the Borden Formation (Lower to Middle Mississippian) will be examined. Lithostratigraphy, sedimentary structures, and trace fossil associations will be particularly emphasized. Samples of several diverse trace fossil associations can be collected.

Maps

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

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

In Press or Editing Completed

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

Bulletin 1. *Barite Deposits of Kentucky,* by Warren H. Anderson, Robert D. Trace, and Preston McGrain.

County Report 2. *Economic Geology of Rowan County, Kentucky,* by Preston McGrain and Martin C. Noger.

Information Circular 5. *Quality of Surface Water in Bell County, Kentucky,* by Robert B. Cook, Jr., and Reese E. Mallette.

Report of Investigations 1. *Sand and Gravel Resources of Kentucky,* by Preston McGrain.

Reprint 9. *The Mineral Industry of Kentucky, 1977,* by William T. Boyd and Preston McGrain.

Reprint 10. *The Mineral Industry of Kentucky, 1978-1979,* by Donald K. Harrison and Preston McGrain.

Special Publication 5. *Proceedings of the Technical Sessions of the Kentucky Oil and Gas Association, 1977,* edited by Margaret K. Luther.

Special Publication 6. *Proceedings of the Technical Sessions of the Kentucky Oil and Gas Association, 1978-1979,* edited by Margaret K. Luther.

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

Guidebook. *Energy Resources of Devonian-Mississippian Shales of Eastern Kentucky,* by Wayne A. Pryor and others.

Miscellaneous Publication. *Middle Chesterian Rocks in the Stevens Hill Cut, Caldwell County, Kentucky,* by Robert D. Trace.

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.

The Survey's Oil and Gas Section maintains an open file of oil and gas county base maps. These maps show the locations of all known wells drilled for oil and 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 17 counties are presently available, and work is in progress for 17 counties.

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

Beard, J. G. (with Robl, T. L., Kepferle, R. C., Pollock, J. D., Koppenaal, D. W., Thomas, G. A., Bland, A. E., Cisler, K. E.,

Barron, L. S., and Kung, Jerry), 1980, Resource assessment of oil-bearing shales in Lewis and Fleming Counties, Kentucky: Kentucky Institute for Mining and Minerals Research Technical Report, 2 v., unnumbered.

Beard, J. G. (with Whaley, P. W., Duffy, J. E., and Nelson, W. J.), 1980, Structure and depositional environments of some Carboniferous rocks of western Kentucky: American Association of Petroleum Geologists Eastern Section Field Trip Guidebook: Murray, Kentucky, Murray State University, 38 p.

Chesnut, D. R., Jr., 1981, A preliminary survey of marine zones in the Pennsylvanian sediments of eastern Kentucky [Abst.]: Geological Society of America Southeastern Section Abstracts with Programs, v. 13, no. 1.

Dever, G. R., Jr. (with Hasler, J. R.), 1980, Progress report on limestones being tested for possible use in TVA's pilot fluidized bed coal combustion unit: Kentucky Institute for Mining and Minerals Research Technical Report IMMR 80/c-31/1, 55 p.

McGrain, Preston (with Boyd, W. T.), 1981, The mineral industry of Kentucky, 1977: U. S. Bureau of Mines Minerals Yearbook 1977, v. 2, p. 243-251.

McGrain, Preston (with Harrison, D. K.), 1981, The Mineral industry of Kentucky, 1978-79: U. S. Bureau of Mines Minerals Yearbook 1978-79, v. 2, p. 225-231.

Ponsetto, L. R., 1981, Review of eastern Kentucky drilling and development, 1980 [Abst.]: Proceedings, 12th Appalachian Petroleum Geology Symposium, Morgantown, West Virginia, March 20, 1981.

Portig, E. R. (with Blackburn, W. H.), 1981, Chemical variance in the Ordovician bentonites of central Kentucky [Abst.]: Geological Society of America Southeastern Section Abstracts with Programs, v. 13, no. 1.

Trace, R. D., 1981, *Chaetetella:* A guide fossil for the Lower Member of the Kinkaid Limestone (Chester-Mississippian) in the fluorspar district of western Kentucky [Abst.]: Geological

Society of America Southeastern Section Abstracts with Programs, v. 13, no. 1, p. 36-37.

Williams, D. A. (with Hower, J. C., Fiene, F. L., Pollock, J. D., and Rich, F. J.), 1981, Geology of lignites from Jackson Purchase region of western Kentucky [Abst.]: Geological Society of America Southeastern Section Abstracts with Programs, v. 13, no. 1.

TALKS BY STAFF MEMBERS TO PROFESSIONAL GROUPS

Beard, J. G., 1980, The Devonian and Mississippian oil shales of Lewis and Fleming Counties, Kentucky: Buffalo Trace Area Development Seminar, July 23, 1980.

Chesnut, D. R., Jr., 1981, A preliminary survey of marine zones in the Pennsylvanian sediments of eastern Kentucky: Geological Society of America Southeastern Section, Hattiesburg, Mississippi, March 19, 1981.

Dever, G. R., Jr., 1980, Stratigraphic and economic significance of the *Lithostrotian (Siphonodendron) genevievensis* zone in the Ste. Genevieve Limestone (Mississippian) of western Kentucky: Kentucky Academy of Science Geology Section, Lexington, November 8, 1980.

McGrain, Preston, 1980, Trends in the industrial minerals industry in Kentucky: Kentucky Academy of Science Geology Section, Lexington, November 8, 1980.

Nuttall, B. C., 1980, The KGS well ticket system for encoding drill hole information and the "Tight Formation" card—card 7: Kentucky Oil and Gas Association Tight Formation Committee, Ashland, December 17, 1980.

Ponsetto, L. R., 1980, Recent tar sands activity in Kentucky: Interstate Oil Compact Commission Annual Meeting, Tar Sands Subcommittee, Dallas, Texas, December 3, 1980.

Ponsetto, L. R., 1981, Kentucky's unconventional gas resource potential: Kentucky Department of Energy-U. S. Department of Energy Unconventional Gas Workshop, Lexington, March 10, 1981.

Ponsetto, L. R., 1981, Review of eastern Kentucky drilling and development, 1980: 12th Appalachian Petroleum Geology Symposium, Morgantown, West Virginia, March 20, 1981.

Portig, E. R. (with Blackburn, W. H.), 1981, Chemical variance in the Ordovician bentonites of central Kentucky: Geological Society of America Southeastern Section, Hattiesburg, Mississippi, March 20, 1981.

Trace, R. D., 1981, *Chaetetella:* A guide fossil for the Lower Member of the Kinkaid Limestone (Chester-Mississippian) in the fluorspar district of western Kentucky: Geological Society of America Southeastern Section, Hattiesburg, Mississippi, March 20, 1981.

Walker, F. H., 1981, Oil and gas research activities of the Kentucky Geological Survey: Kentucky Oil and Gas Association, Lexington, June 11, 1981.

Walker, F. H., 1981, Recent oil and gas developments in Clinton and Cumberland Counties, Kentucky: Independent Oil Producers Association, Incorporated, Evansville, Indiana, April 3, 1981.

Williams, D. A. (with Hower, J. C., Fiene, F. L., Pollock, J. D., and Rich, F. J.), 1981, Geology of lignites from Jackson Purchase region of western Kentucky: Geological Society of America Southeastern Section, Hattiesburg, Mississippi, March 19, 1981.

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 125,000 wells. Records for approximatly 4,000 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 examination of records are used daily by representatives of industry, government, academic institutions, and the general public. An estimated 60,000 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 approximatley 600 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 (approximatley 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, students, spelunkers, rock and mineral collectors, persons planning vacations in Kentucky, and many others residing within the Commonwealth 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 students. 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.

PERSONNEL
Professional Staff

Warren H. Anderson
Geologist II, Industrial and Metallic Minerals Section
B.S. South Dakota School of Mines and Technology, 1977

John G. Beard
Geologist IV, Oil and Gas Section (Henderson Office)
B.S. University of Kentucky, 1951

Roxanne Bingemer
Geologist I, Coal Section (Henderson Office)
B.S. Murray State University, 1979

Russell A. Brant
Geologist V, Coal Section
B.S. University of Michigan, 1948
M.S. University of Michigan, 1949

Donald R. Chesnut, Jr.
Geologist III, Coal Section
B.S. University of Kentucky, 1974
M.S. University of Kentucky, 1980

James C. Cobb
Head, Coal Section
B.S. University of Illinois, 1971
M.S. Eastern Kentucky University, 1974
Ph.D. University of Illinois, 1980

Steven Cordiviola
Geologist III, Water Section
B.A. Rutgers State University, 1972
M.S. University of Cincinnati, 1974

James C. Currens
Geologist III, Coal Section
B.S. University of Kentucky, 1973
M.S. Eastern Kentucky University, 1978

Garland R. Dever, Jr.
Geologist IV, Industrial and Metallic Minerals Section

B.S. University of Notre Dame, 1957
M.S. University of Kentucky, 1973

James S. Dinger
Geologist IV, Water Section
B.S. Juniata College, 1967
M.S. University of Vermont, 1970
Ph.D. University of Nevada-Reno, 1977

Thomas E. Dugan
Geologist I, Water Section
B.S. Southern Illinois University, 1977

Blaine L. Fennell, Jr.
Geologist I, Coal Section
B.S. Indiana University of Pennsylvania, 1972
B.S. Eastern Kentucky University, 1978

Wayne T. Frankie
Geologist I, Coal Section
B.S. Southern Illinois University, 1980

Kenneth L. Gill
Geologist II, Coal Section (Morehead Office)
B.A. Indiana University, 1977

Mary K. Gilmore
Geologist I, Water Section
B.A. Albion College, 1978

Patrick J. Gooding
Geologist II, Oil and Gas Section
B.A. Eastern Kentucky University, 1975
B.S. Eastern Kentucky University, 1976

James Hamilton
Administrative Staff Officer II
B.A. Berea College, 1967
M.P.A. Eastern Kentucky University, 1971

Joseph P. Hamilton
Geologist I, Coal Section (Morehead Office)
B.S. Eastern Kentucky University, 1978

Donald C. Haney
Director and State Geologist
B.S. University of Kentucky, 1959
M.S. University of Kentucky, 1960
Ph.D. University of Tennessee, 1966

Donald W. Hutcheson
Head, Publications Section
B.A. Berea College, 1955
M.S. University of Illinois, 1957

John D. Kiefer
Assistant State Geologist, Energy, and Head, Water Section
B.A. St. Joseph College, 1961
M.S. University of Illinois, 1968
Ph.D. University of Illinois, 1970

James Kipp
Geologist II, Water Section
B.S. Illinois State University, 1975

Fred Lawrence
Geologist III, Water Section
B.S. Wright State University, 1974
M.S. University of South Florida, 1976

Margaret K. Luther
Assistant Editor, Publications Section
B.A. Vanderbilt University, 1978

Preston McGrain
Assistant State Geologist, Water, Minerals, and Maps, and Head,
Industrial and Metallic Minerals Section
B.A. Indiana University, 1940
M.A. Indiana University, 1942

Patrick H. McHaffie
Geologist/Geographer II
B.A. Eastern Kentucky University, 1978
M.A. Eastern Kentucky University, 1980

Jack R. Moody

Geologist II, Industrial and Metallic Minerals Section
B.S. East Tennessee State University, 1977

Martin C. Noger
Geologist IV, Oil and Gas Section
B.S. University of Kentucky, 1952

Brandon C. Nuttall
Geologist I, Oil and Gas Section
B.S. Eastern Kentucky University, 1975

Louis R. Ponsetto
Head, Oil and Gas Section
B.S. University of Kentucky, 1956
M.S. University of Kentucky, 1958

Elisabeth R. Portig
Geologist I, Coal Section
B.A. University of Texas, 1970

Roger B Potts
Chief Cartographic Illustrator
Lafayette Vocational Institute, 1950

Richard E. Sergeant
Geologist III, Coal Section
B.S. Eastern Kentucky University, 1974
M.S. Eastern Kentucky University, 1979

Ernie R. Slucher
Geologist I, Coal Section
B.A. Eastern Kentucky University, 1979

J. Hiram Smith
Geologist III, Coal Section
B.S. Washington and Lee University, 1938

Margaret A. Townsend
Geologist II, Water Section
B.S. Beloit College, 1976
M.S. University of Texas at Austin, 1981

Robert D. Trace
Geologist III, Industrial and Metallic Minerals Section (Princeton Office)
B.S. Southern Methodist University, 1940
M.A. University of California at Los Angeles, 1947

Frank H. Walker
Geologist IV, Oil and Gas Section
B.A. Berea College, 1947

David A. Williams
Geologist III, Coal Section (Henderson Office)
B.S. Western Carolina University, 1973
M.S. Eastern Kentucky University, 1979

Allen D. Williamson
Geologist IV, Coal Section (Henderson Office)
B.S. University of North Carolina, 1949

Clerical and Technical Staff

Mary E. Barron
Senior Laboratory Assistant

William A. Briscoe, III
Publications Sales Supervisor

Robert R. Daniel
Laboratory Assistant

Margaret Fernandez
Administrative Accounts Clerk

Lynn D. Guindon
Principal Drafting Technician

Freda M. Harris
Drafting Technician

Brenda L. Hayden
Administrative Secretary

Robert C. Holladay
Drafting Technician

Anna L. Hopkins
Administrative Secretary

Jean Kelly
Secretary

Sherry A. McKune
Administrative Secretary

Edwin A. Morford
Core Driller III

Norma J. Reynolds
Administrative Secretary

Helen P. Sensabaugh
Administrative Secretary

Juanita G. Smith
Secretary (Henderson Office)

Richard W. Taulbee
Senior Laboratory Assistant

Lemuel W. Waite
Stores Worker

Douglas Watts
Core Driller I