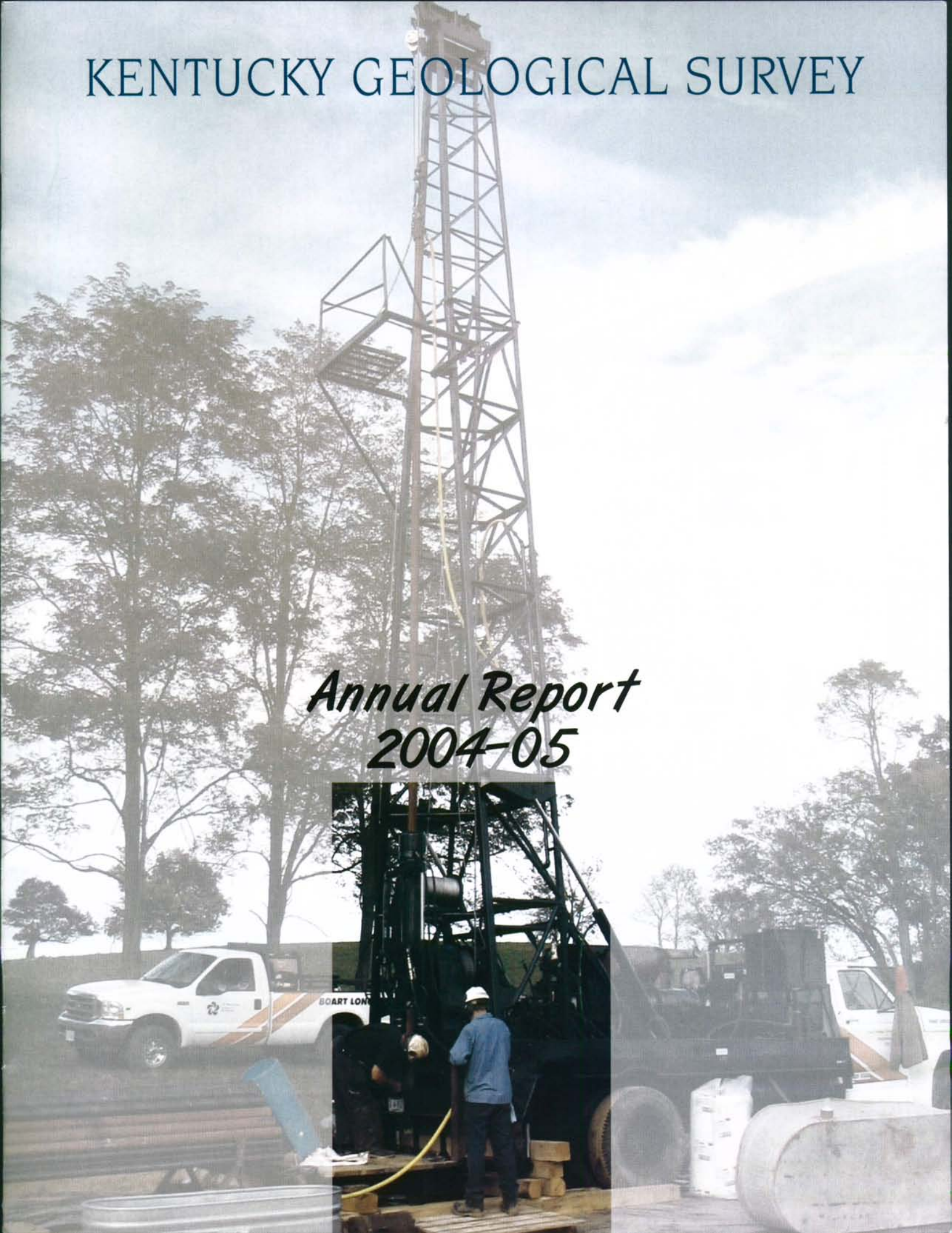
KENTUCKY GEOLOGICAL SURVEY



Annual Report 2004-05

Our Mission

Our mission is to increase knowledge and understanding of the mineral, energy, and water resources, geologic hazards, and geology of Kentucky for the benefit of the Commonwealth and Nation.

Cover photo: taken by Dave Harris, KGS geologist. Core samples being drilled in Clark County. Information gathered from the study of these cores contributes to a better understanding of the formation of natural gas reserves in Kentucky.

Kentucky Geological Survey
UNIVERSITY OF KENTUCKY
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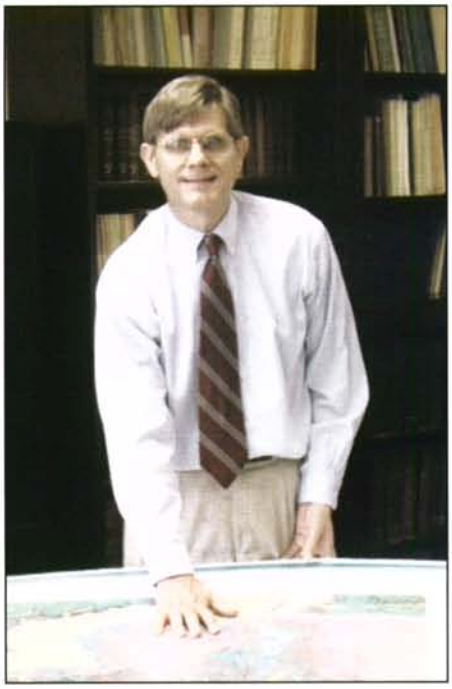


Energy and natural hazards were, without a doubt, the headline-grabbing issues in the earth sciences in 2004-05. Energy is expected to be a big part of our future research agenda on topics such as carbon sequestration and developing criteria that will be useful in selecting sites for future coal-burning power plants. Developing methods to measure and assess the natural outflow of CO_2 from the earth is another important area of research. Finding keys to prospecting for coalbed methane and deep natural gas will also be undertaken in the next year. Work will continue on mapping surficial deposits, and studying karst hydrology, seismology, and groundwater.

Every day the Kentucky Geological Survey's Web site serves hundreds of people who search for and download maps or educational materials on mineral resources, hazards and geology. We are extremely pleased that what began 6 years ago as a vision to better serve the public is now a popular reality. We launched our site in 1996, primarily for outreach and education. By 1999, we began designing and building access to our database. Putting our data on the Web was one of my principal goals as Director and State Geologist, but I often wondered if what we were creating would actually be used. The answer to that question has been a resounding "yes." The information we have is obviously important to citizens and other agencies, and we are now responding to hundreds of times more requests for information than we did in the past.

In April 2005, we released a beta version of a comprehensive geographic information Web site that allows users to view detailed geologic maps along with other maps and data. Specialized tools allow users to make their own highly customized maps using many data sources; they can then print it and take it into the field or use it for a report. Information about the geology, economic resources, hydrology, and hazards for the map area are also available at the click of a mouse. This new Web site, expected to be completed by the end of 2006, realizes the dream of making all KGS data, including maps, available on the Internet at a single user interface.

Two years ago we moved our office in Henderson to a new building. The new office did not have a garage or adequate space to study samples and repair seismic equipment. A 3,200-square-foot garage, completed in September 2005, was constructed next to the office that can accommodate four vehicles, sample and core preparation and analysis, and equipment repair.

Other important work was done at KGS this year on carbon sequestration, groundwater hydrology, karst geology, and hazards. A workshop on landslides attracted a large audience, demonstrating the high level of interest for information about this hazard. The large earthquake and subsequent tsunami in Sumatra in December 2004 generated considerable interest in earthquakes here, and several small earthquakes were in fact recorded in Kentucky.

KGS has an agreement with the Lanzhou Institute of Seismology in Gansu Province, People's Republic of China, to share technical expertise on earthquake hazards. Experts from China visited Kentucky in 2005, and a contingent of four KGS staff members visited China to see first hand their research on earthquakes. This scientific exchange with an international partner may be a first for KGS. Funding from the University of Kentucky and the National Science Foundation helped a great deal to make this partnership a reality. It has been beneficial to both groups and is expected to continue for several years.

James C. Cobb
State Geologist and Director

Camp Nelson, Kentucky

Supplies and prices of energy resources have become critical issues worldwide, and the KGS Energy and Minerals Section has been involved in research on issues relating to energy and the environmental impact of recovering and using energy resources.

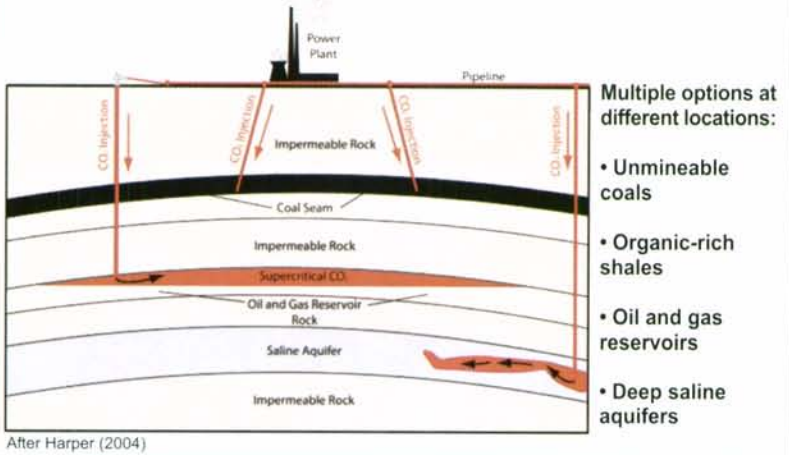
KGS is working closely with the Kentucky Office of Energy Policy to address a number of energy-related issues for Kentucky. Many of these issues are articulated in the Kentucky Comprehensive Energy Stratagy of 2005.

Carbon sequestration research

KGS researchers continued their work on the concept of carbon sequestration, in which carbon dioxide is injected deep into geologic structures. CO_2, produced when coal and other fossil fuels are burned, is considered the major greenhouse gas contributing to global warming.

KGS has been involved in this research for more than 5 years, and federal grants approved near the end of the fiscal year should ensure at least 4 more years of work. During the first phase of the research, the focus of the federally funded work has been on evaluating possible sequestration options and locations in Kentucky and surrounding states. During the next 4 years, test-injecting of CO_2 is expected to begin. Eventually, the injection of CO_2 into existing oil and natural gas fields to enhance recovery of these resources could create an incentive for sequestration.

Geologic carbon sequestration possibilities



After Harper (2004)

KGS researchers are looking into the possible injection of CO_2 gas into shales, where methane gas naturally occurs. Research by **Brandon Nuttall** has shown the concept works for powdered shale samples. He and others have begun looking into forcing CO_2 into solid shale cores. Geologic reservoirs in Kentucky could hold up to 33 billion metric tons of CO_2 gas, or about 370 years of current Kentucky emissions that might otherwise flow into the atmosphere.

Marty Parris has received a 2-year U.S. Department of Energy grant to monitor potential sequestration test sites and determine existing background CO_2 activity. These data would be compared to data gathered after CO_2 has been injected.

Kentucky is a member of three regional carbon sequestration partnerships, which include other state geological surveys, government agencies, universities, industries, and nongovernmental organizations. They are:

- Midwest Geologic Sequestration Consortium
- Midwest Regional Carbon Sequestration Partnership
- Southern States Energy Board Sequestration Project

Research by these partnerships is a component of the federal government's FutureGen initiative, including a zero-emissions power plant design that uses the technology of an Integrated Gas Combined Combustion system.

In June 2005, KGS received notice that DOE had approved its application for a total of $1,042,000 in grants through the sequestration partnerships for 4 more years of research. KGS has applied for a total of $276,000 in state matching funds to secure the federal grants.

Coal research

Kentucky coal research remained very active. Through a USGS grant, KGS continued to evaluate borehole information and make the resulting data available on the Survey's Web site. Currently, information from over 10,000 borehole records are available from both the Eastern and Western Kentucky Coal Fields.

Coalbed methane

Coalbed methane exploration continues to be an active and promising area. In 2005, a 2,000-foot test well was drilled in Union County, from which 23 samples were collected for gas desorption analysis. This is the fourth test drilling for coalbed methane exploration in western Kentucky. Initial results indicate that gas contents are significantly higher than analyses indicated by historical data. In some cases, over 200 standard cubic feet per ton were detected. With the current demand for natural gas, not to mention its increasing price, this is a significant finding.

Currently, coalbed methane accounts for approximately 10 percent of U.S. domestic gas production. A proposal has been submitted to begin a similar exploration project in eastern Kentucky.

Coal technology conference

In June, a coal conference was convened at KGS for the mining and electric utilities industries. A number of topics were discussed, such as what types of resources need to be assessed for new coal utilization technologies, including circulating fluidized bed combustion and integrated gasification combined cycle. Both technologies have the capability of using low-grade coal or preparation-plant refuse waste materials. Such materials were not considered to be a resource a decade ago. As a result of the conference, KGS was invited to send a participant to an industry coal forum panel in Pittsburgh to discuss similar resource issues. ❖

Drilling for coal bed methane in western Kentucky

Water Resources

The importance of Kentucky's water resources to the health and livelihood of the state cannot be overstated. KGS researchers in the Water Resources Section were busy with a variety of projects and investigations through the year.

Karst studies for transportation projects

The Kentucky Transportation Cabinet has contracted with KGS to conduct groundwater investigations in two areas of Kentucky where natural karst systems may affect highway construction. Section personnel began gathering information on the Miller Cave karst groundwater basin in Monroe County in preparation for the relocation of Ky. 163. Similar work began for the karst groundwater basins along the proposed Interstate 66 corridor in Pulaski County. Both studies use dye traces to determine recharge and discharge areas of karst groundwater flow systems.

Randy Paylor collects a dye receptor called a bug.

Evaluating water quality at Kentucky Army National Guard training facilities

The Kentucky Geological Survey concluded work with the Kentucky Department of Military Affairs to assess water quality at the Kentucky Army National Guard training facilities in Muhlenberg, Powell, and Knox Counties. Contract reports were completed that addressed the impact of previous and current activities on surface water and groundwater at the site. A Kentucky Geological Survey publication is being written about the water quality at the Wendell H. Ford site in Muhlenberg County. Water levels in monitoring wells will continue to be measured at this site twice a year. This work was principally funded by the Kentucky Department of Military Affairs, with ancillary support from KGS.

Response to public requests

The Water Resources Section routinely receives requests from individuals or businesses to investigate problems or potential problems relating to sinkholes or groundwater. At least 50 such requests were handled during the fiscal year, as KGS personnel visited homes, business and industrial sites, and construction project locations.

Karst research

Jim Currens and **Randy Paylor** continued a demonstration project to compile maps showing the probability of the occurrence of cover-collapse sinkholes. This ongoing internally funded project is intended to produce such maps for each 7.5-minute quadrangle in the state.

Another internally funded project is developing a methodology to index the degree of karst development in the state. The results of this project will provide an objective method of comparing, during the planning stage of a construction project, the natural karst development at different study sites.

Jackson Purchase groundwater quality studies

Approximately 60 public water utilities provide water from wells or well fields to residents, businesses, schools, and industry in Kentucky's Jackson Purchase Region, and more than 75 percent of residents in that area use groundwater for household needs.

Data collected by the Survey between 1998 and 2004 show that 7 percent of wells sampled in the Purchase yield water with nitrate higher than the U.S. Environmental Protection Agency's maximum contaminant level and 19 percent exceed half of the MCL. This region has the state's highest percentage of wells exceeding the EPA standard.

To determine the possible sources of these elevated nitrate concentrations, detailed land-use and well-construction surveys were completed, samples were collected, and tracer tests were performed on ten 24-inch diameter bored wells to determine their integrity. Five of the wells leaked within the first hour of the tracer test; all were installed after 1985, which is when Kentucky's domestic water-well construction guidelines were enacted. More investigative work is planned in conjunction with the Kentucky Division of Water.

During the fiscal year the Kentucky Geological Survey has worked with county Extension Service agents, county health departments, and Natural Resources and Conservation Service personnel to identify 141 domestic water wells in Ballard, Graves, Marshall, and Calloway Counties that are being sampled for nitrate, chloride, herbicides, total coliform, E. coli, and other parameters. Future plans are to continue sampling bored and drilled wells throughout the Purchase to determine groundwater quality associated with different hydrogeologic settings and to make these data publicly available.

Funding for this project is provided by Kentucky Senate Bill 271, which is administered through the University of Kentucky College of Agriculture. It is a cooperative effort with the UK Department of Agronomy.

Henderson County dairy feedlot remediation

A long-term monitoring and remediation project begun in 1995 in Henderson County continued during 2004–05. A domestic water well apparently was contaminated by a nearby abandoned dairy feedlot. Organic-rich soil was removed from the feedlot area and monitoring wells were installed.

Water-quality samples collected from the wells in 2004–05 indicate that nitrate and chloride concentrations have decreased significantly. Soil cores indicate that soil organic matter and nitrate concentrations are also decreasing.

Groundwater and soil quality will be monitored over time to determine if nitrate concentrations continue to decrease in the aquifer. Additional abandoned feedlots in western Kentucky will also be sought.

This cooperative project between the Kentucky Geological Survey and the University of Kentucky Department of Agronomy is funded by Kentucky Senate Bill 271, administered through the University of Kentucky College of Agriculture.

Agricultural contaminant movement through closed-depression sinkholes

The Kentucky Geological Survey and the University of Kentucky College of Agriculture are in the initial phases of a new program to assess the movement of potential pollutants derived from agricultural activities in closed-depression sinkholes. In some locations, these sinkholes may be several acres in extent and are used to raise row crops, grains, and feed, and to graze livestock. Soil amendments and waste from animals are concentrated in these sinkholes as a result of rainfall, and the resulting temporal ponds drain slowly to the groundwater system. The transport and fate of potential pollutants will be studied under various hydrogeologic conditions.

Kentucky Groundwater Data Repository

The Kentucky Groundwater Data Repository was established in 1990 by KGS to archive and disseminate groundwater data collected by State agencies, other organizations, and independent researchers. In fiscal year 2004–05, **Bart Davidson** and **Steve Fisher** produced three new publications using water-quality data from the repository. These maps, published in the KGS Information Circular series, summarize concentrations of mercury, selenium, and cadmium in water wells and springs throughout Kentucky. The maps may be viewed at the KGS Web site at kgsweb.uky.edu/main.asp. Three additional maps showing concentrations of barium, iron, and atrazine are in the process of completion. Future maps in this series will be produced for nearly 20 other water-quality parameters, including metals, pesticides, herbicides, volatile organic compounds, and inorganic compounds. ❖

Brent Wilhelm gathers water flow rate data in Pulaski County.

Outreach and Education

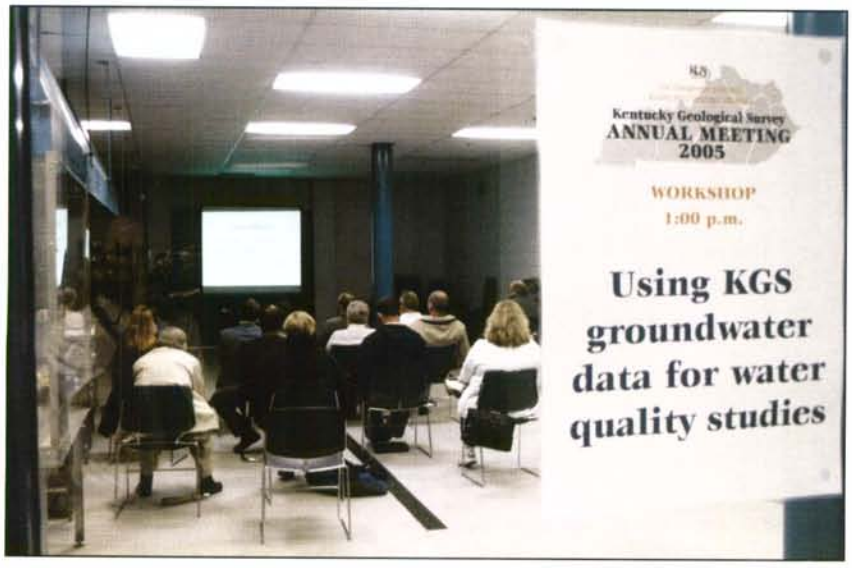
As a full-service geological survey, KGS has been proactive in taking its research to the people we serve and providing opportunities for the public to hear about geologic issues. A number of public events, both at the KGS and in the field, were held during the fiscal year.

Annual seminar

Earthquakes, landslides and rockfalls, sinkholes, flooding, and other hazards were the topic on April 29 at the Survey's 45th Annual Seminar, with the theme of "On Dangerous Ground: Kentucky's Geologic Hazards." More than 90 people from State and local government agencies, engineering and geologic consulting firms, and other organizations attended the seminar, along with KGS staff, at the KGS Well Sample and Core Library.

State Geologist Jim Cobb welcomed the large crowd, and KGS staff gave presentations on a variety of geologic hazards issues. Representatives of the Kentucky Transportation Cabinet discussed the major problem their agency has in dealing with maintenance and repair of landslide and rockfall damages to the state's roads. The effort to develop new flood maps for Kentucky and the development of a hazards mitigation plan for the state were also addressed.

The day-long seminar was capped with afternoon workshops offered by KGS staff. Water Resources Section staff showed participants how to access groundwater data from KGS and use it for water-quality studies, while the Geospatial Analysis Section unveiled a new online geologic mapping service.



Landslide workshop

Taking geologic expertise to an area of the state with a geologic challenge, KGS, four county conservation districts, and the Northern Kentucky Area Planning Commission sponsored a June 14

workshop on the landslide threat to northern Kentucky and the Greater Cincinnati area—an area with one of the largest per capita rates of landslide damages in the country each year. Over 60 local officials filled the NKAPC's conference room for the workshop.

The workshop included a field trip to view a panoramic scene of both sides of the Ohio River and get an overview of the region's geologic setting. Two sites where landslides have had serious effects on a home and on a northern Kentucky industry were also visited during the workshop.

Distinguished lectures

Kentucky historian and author **Ron Bryant** came to the UK campus on February 16 to give the third annual Donald C. Haney Distinguished Lecture. His topic was the prolific life of the youngest man ever appointed Kentucky State Geologist, Willard Rouse Jillson.

Jillson's 12 years as State Geologist resulted in a complete geologic mapping of the state, and

Earth Science Week
Open House
2004

his personal interest in the state's history eventually brought him to the presidency of the Kentucky Historical Society.

Bryant's own publications include *Kentucky History: An Annotated Bibliography*, more than 80 articles in *The Kentucky Encyclopedia*, and many articles on Kentucky history, genealogy, and politics.

After the lecture, current State Geologist **Jim Cobb** presented a plaque to Jillson's daughter, **Anne Jillson Overstreet**, to honor her support for the Survey and its history.

In April, "Global Energy—The Next Decade and Beyond" was the topic for **Arthur R. Green**, retired chief geoscientist for ExxonMobil Exploration Company. Green spoke to another full house at the Mining and Mineral Resources Building in a lecture sponsored locally by KGS and the Kentucky Society of Professional Geologists. He was on a national lecture tour sponsored by the American Association of Petroleum Geologists.

Green discussed the political, environmental, economic, and security implications of the worldwide energy situation and the variety of factors that go into an energy corporation's decision to seek and extract energy resources.

Earth Science Week

During its annual celebration of Earth Science Week, KGS holds an open house, inviting the public to visit the Survey's offices to learn more about its work and to view exhibits on a variety of earth science issues, from groundwater and karst to rocks and minerals and geologic hazards. Several hundred people came to the Survey in October 2004 for this annual open house. ❖

Maps and Publications

The Geological Survey released 70 new publications during the fiscal year. These publications serve a variety of purposes and audiences, from general to technical.

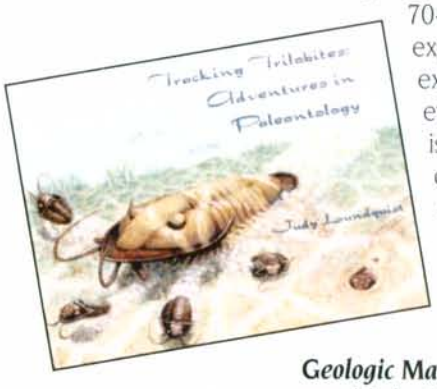
The KGS **Public Information Center** provides access to the Survey's extensive store of publications and geologic information. The professional staff provides personal assistance and information on a variety of geologically-related questions.

Fifteen new ***Generalized Geologic Maps for Land-Use Planning*** were completed and published. In an effort to help local officials, developers and the general public better understand how local geology can help or hinder development, KGS staff and other professionals have been developing these maps on a county-by-county basis.

The geology on the original maps has been 'generalized' into the major rock types affecting development so the non-scientist can understand them. Features like sinkholes, faults, wetlands, and water, oil, and gas wells are depicted on the maps so they can be considered when an area is targeted for development.

Hyrdologist **Dan Carey** and hydrogeologist **Bart Davidson** are leading this program.

Among the Survey's Special Publications was ***Tracking Trilobites: Adventures in Paleontology***, written by Judy Lundquist of Lexington, KY. The 70-page illustrated soft cover book explores the world of these long-extinct creatures and the fossil evidence they left. The publication is intended for general readers from older elementary school-age students through adults, with its straightforward text and more than 150 illustrations and photographs.



Geologic Maps of 30 x 60 Minute Quadrangles were published for the Bowling Green and Murray/Sikeston quadrangles. These maps, compiled from smaller individually digitized maps known as 7.5-minute Digitally Vectorized Geologic Quadrangle (DVGQ) maps, provide a wealth of useful information for anyone needing to know about the geology and geologic resources of this region. (Bowling Green: KGS geologist **Mark F. Thompson,** the map's principal compiler; Murray/Sikeston: **Steve Martin**, a KGS geologist and principle compiler).

The ***Structure and Isopach Maps of the Mississippian Big Lime (Newman Limestone/Slade Formation), Eastern Kentucky*** provides details about the nature of an eastern Kentucky oil- and natural gas-producing geologic formation known as the Big Lime. Two Survey geologists, **David Harris** and **Thomas Sparks**, compiled data from over 6,400 existing oil and gas wells for the publication, which can help energy companies interested in the area improve their chances of finding oil and gas.

KGS is compiling all of its newly completed 1:24,000 scale maps into a ***Geologic Map Series of 1:100,000 scale maps***. The Digital Geologic Mapping Program celebrated the completion of all 1:24,000 scale maps last year. Many of these maps have already been released in central Kentucky and many more are in the process of final compilation and editorial review. The benefits of these maps include preservation of map data, creation of databases and creating regional geologic maps for planning and development purposes. The digital data from these maps are released as Digitally Vectorized Geologic Quadrangles (DVGQ's) so that the user can have easy access to digital information. Some of this digital data is already available via the KGS GeoPortal and others are added annually.

This year **Warren Anderson** and **Drew Andrews** received a 1-year $205,401 grant in the tenth year of renewed funding from the U. S. Geological Survey National Cooperative Geologic Mapping Program (STATEMAP), which supports KGS efforts to convert geologic maps into digital format.

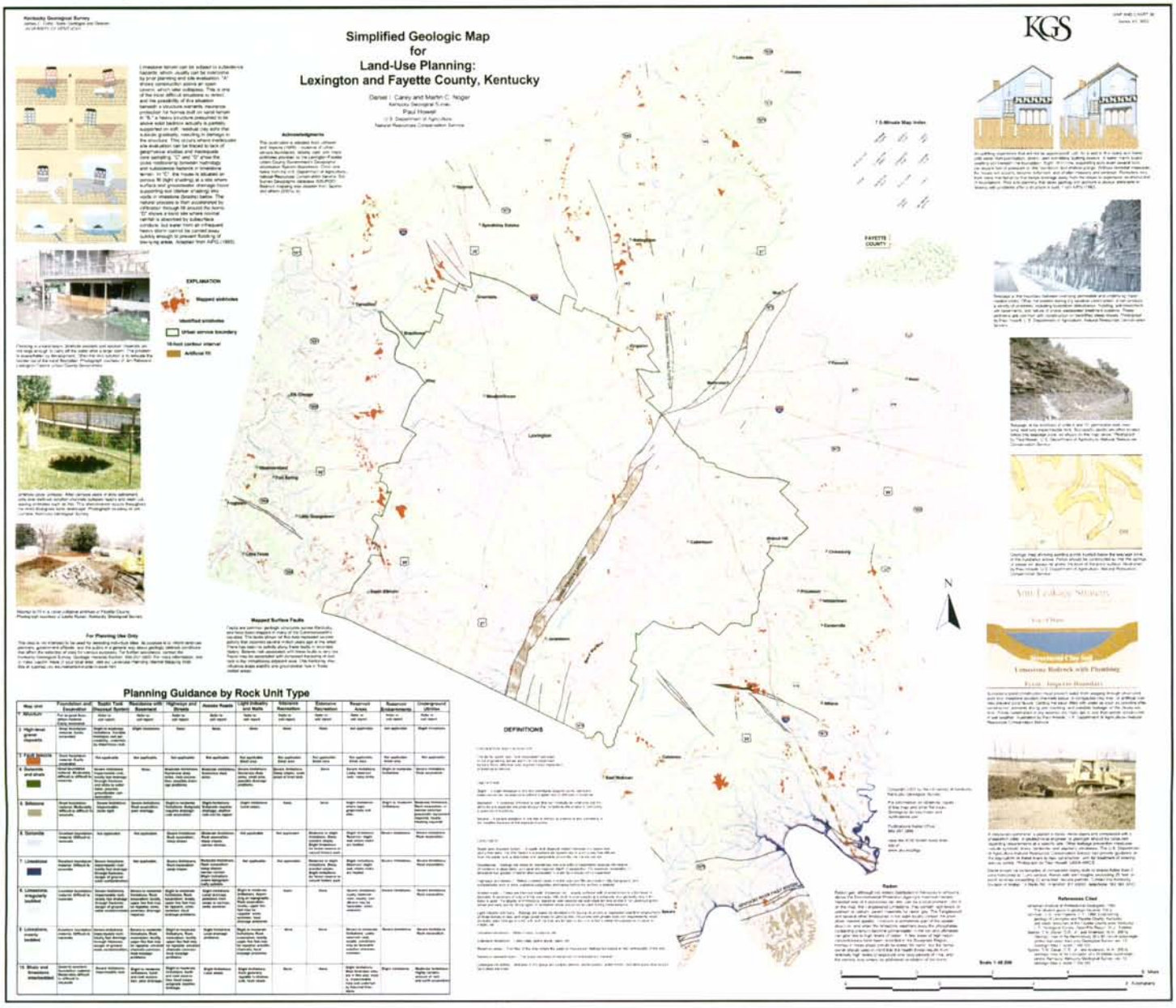
Mapping Quaternary deposits of surficial materials in western Kentucky continued in the Owensboro area. This year six quadrangles were mapped to assist in the hazards assessment and seismic risks along the Ohio River in Daviess and Hancock Counties. KGS geologists also developed information from boreholes, water wells, oil wells, and other geotechnical information. This information will assist in evaluation of hazards in the Ohio River Valley area. This is the third year of new surficial mapping in western Kentucky, and funding from the STATEMAP Program of the U.S. Geological Survey supported this effort. **Drew Andrews** is the Principal Investigator of this project. ❖

AT A GLANCE

KGS *Publications for Fiscal Year* 2004–05:

County Reports	45
Digital Publication	1
Geologic Maps	2
Map & Chart Series	16
Report of Investigation	1
Special Publications	2
Open-File reports	3
Total New Publications	**70**

Land-Use planning map for Fayette County



KGS Partnership with China

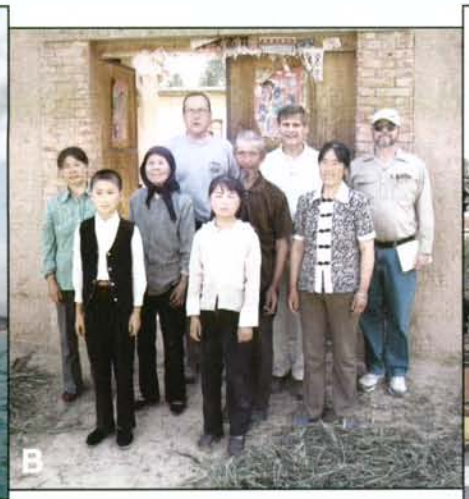
Kentucky earthquake experts and their counterparts in the People's Republic of China began to benefit from each other's research as a result of an exchange agreement involving KGS, UK's Department of Geological Sciences, and the Lanzhou Institute of Seismology in China's Earthquake Administration.

China and Kentucky share a similar earthquake threat: the central United States, including Kentucky, is threatened by earthquakes in the New Madrid and Wabash Valley Seismic Zones, and Gansu Province, where the Lanzhou Institute is located, has been rocked by a number of strong earthquakes in the past century.

A series of exchange visits started in May 2005, to allow the researchers to share their experience. In the first phase of the agreement, three Chinese seismic experts from the Lanzhou Institute visited Kentucky during the first week of May. They gave a series of presentations on their research in China during their visit, and were also escorted to western Kentucky to visit several instrument sites in the Kentucky Seismic and Strong-Motion Network.

Following that visit, four KGS and UK scientists paid a visit to Gansu Province during the last week of June and into the first week of July. KGS Director **Jim Cobb**, Assistant State Geologist **John Kiefer**, **Zhenming Wang** of the KGS Geologic Hazards Section, and **Ed Woolery** of the Geological Sciences Department were guests of the Institute and China's Earthquake Administration.

The huge province is home to sections of the Great Wall as well as the historic Silk Road and is the location of major earthquakes in the 20th century. Both the similarities, such as the earthquake hazard, and the differences between Kentucky and Gansu Province should help Chinese and Kentucky researchers in their cooperative work. One significant difference is that the Chinese faults are exposed at the surface, whereas those in the New Madrid Seismic Zone are concealed, sometimes deep underground. Yet the two regions share a similar surface material covering at least part of the earthquake-threatened areas. Parts of Gansu Province, including developed areas of the city of Lanzhou, are covered with a thick layer of loess, a wind-blown silt deposit whose characteristics and behavior in earthquakes are similar to the liquefaction-prone deposits found in western Kentucky and the rest of the New

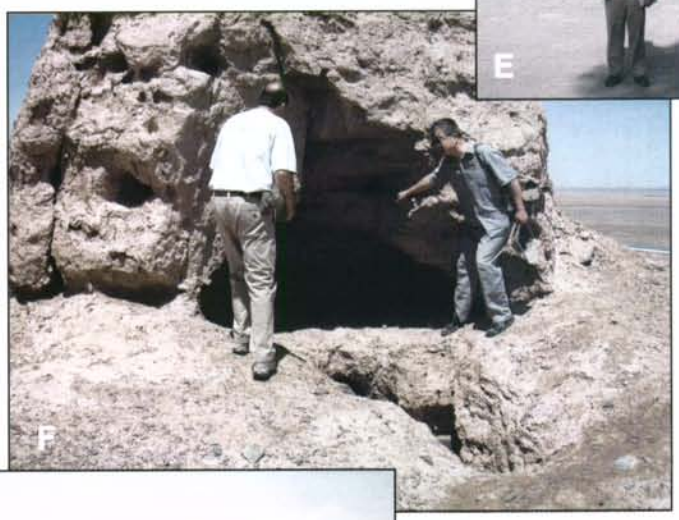


Madrid Seismic Zone. Kentucky's deposits are only a few meters in thickness, while over 400 meters of loess blankets part of Gansu Province.

During the China visit, the KGS and UK scientists visited several active faults, observing surface offsets of up 8 meters. Ed Woolery helped staff members of the Lanzhou Institute acquire their first quality seismic-reflection profiles of active faults, plugging a set of geophones brought from UK into the Chinese hosts' seismic instruments.

Seismic researchers from China plan additional trips to Kentucky, and UK and Chinese graduate students will begin traveling between the two countries to study and conduct research in the next several years as a result of the partnership.

A workshop is being planned for the summer of 2006 either at UK or in China to share information on identifying active geologic faults. ❖

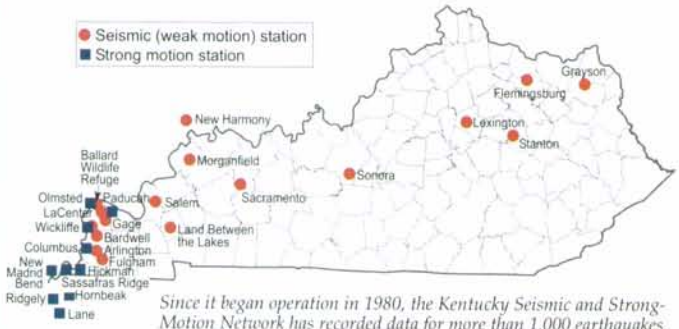


See page 20 for photo descriptions

The Kentucky Seismic and Strong-Motion Network registers earth motions locally and from around the world.

Spread across Kentucky from the New Madrid Bend of the Mississippi River to Grayson in Carter County, a network of 19 seismic instruments operated by the Kentucky Geological Survey monitors earthquake activity in Kentucky and the surrounding region.

Kentucky Seismic and Strong-Motion Network



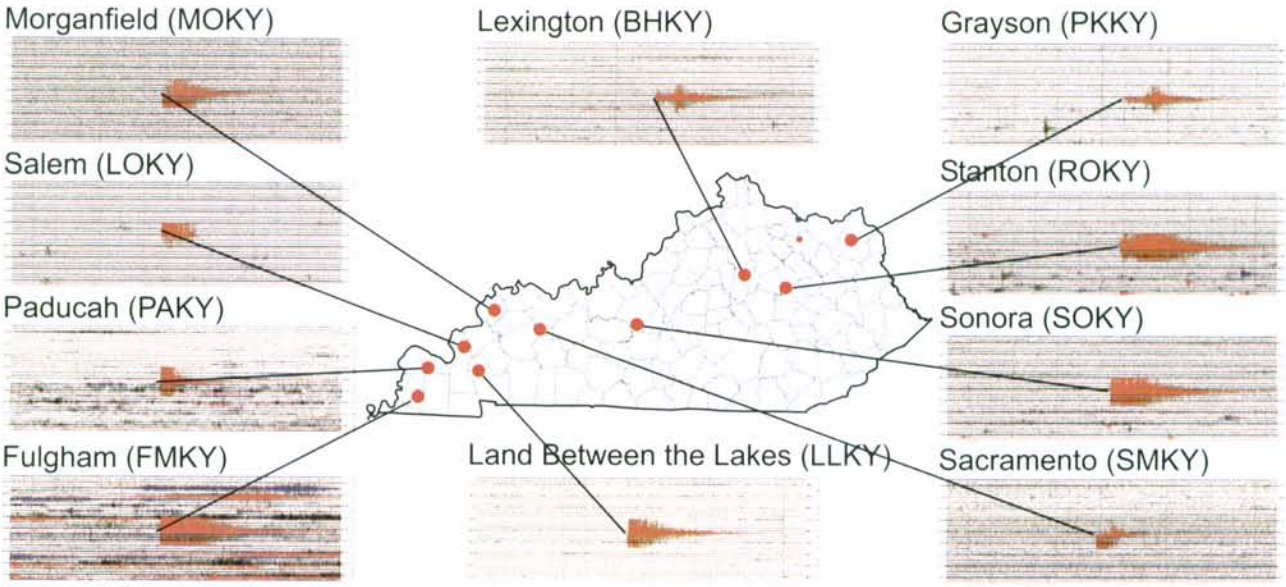
Since it began operation in 1980, the Kentucky Seismic and Strong-Motion Network has recorded data for more than 1,000 earthquakes. The Kentucky Geological Survey and the UK Department of Geological Sciences jointly operate the network.

The recordings from instruments in the Kentucky Seismic and Strong-Motion Network can be viewed in near real time at the KGS web site. But the instruments also record human-caused activity, such as mine and quarry blasting, and the staff in the KGS Geological Hazards Section must filter such activity out of the recordings to be able to analyze the earthquake data.

Nine other instruments, all located in the New Madrid Seismic Zone, record only the stronger earthquakes in that area. These strong-motion instruments accumulate recordings to provide a database for scientists to study the effects on the near-surface soils from the strong ground motion in the New Madrid seismic zone. The amplification of ground motion by near-surface soft soils is a very important issue for seismic hazard assessment in the central U.S. and the potential effects on structures located on soft soils

The instruments in the network can also record seismic waves from very large earthquakes around the world. The December 26, 2004 great Sumatra-Andaman Islands earthquake in the Indian Ocean, registering 9.0 magnitude on the Richter Scale, was recorded on these instruments. That underwater tremor caused catastrophic tsunamis in a number of countries around the Indian Ocean Basin. The seismic waves reached the Kentucky instruments about 20 minutes after the earthquake happened. A magnitude 8.7 earthquake in the same region on March 28, 2005 was also recorded on the network's instruments. ❖

Recordings from the Kentucky Seismic and Strong Motion Network for a Kentucky earthquake on June 20, 2005, magnitude 3.9.



The KGS Web site **(www.uky.edu/kgs)** is one of the University of Kentucky's most frequently visited sites.

The publications and mapping services of the Kentucky Geological Survey have become easily accessible online, and additional capabilities were made available to the general pubic during fiscal year 2005–05.

The KGS web site (http://www.uky.edu/kgs) is one of the most frequently visited sites in the University of Kentucky. For example, in June 2005, there were about 261,482 total web "hits," 150,408 from outside of the campus community.

Hits represent the total number of requests made to the server during the given time period. The requests can be for anything: html pages, graphic images, audio files, CGI scripts, etc. For the fiscal year, there were more than 2.66 million hits on the KGS web site.

Many maps, databases and publications can be viewed and downloaded from the services available through the KGS web site. Resource companies, such as oil and gas drillers and coal companies, can find much valuable information for resource exploration. The public can download maps and publications for professional and educational uses.

Online Geologic Mapping Service

The Kentucky Geological Survey began developing a digital mapping service at its Web site in 2005 to allow users to create a highly customized geologic map for any project area in the state and view a wide variety of related information, including well information, geotechnical and hazards data, related publications, photographs, illustrations, and descriptions about Kentucky geology. A prototype was released to the public in April 2005 to demonstrate its capabilities and to solicit public comment. The online geologic map system is integrated with another KGS Web service—the KGSGeoPortal—to facilitate locating the user's area of interest and linking to other useful data sources.

KGSGeoPortal
Gateway to online Maps, databases, and publications

The objective of this initiative was to make data from existing geologic maps available in an online system. But users also want access to other related data in the context of the geologic maps. For example, land-use planners need to view sinkhole locations or landslide potential in conjunction with the geologic base. Coal companies are interested in viewing mapped coal beds and related site measurements and sample locations. The system needed to be flexible for a diverse audience and easy to use at the same time. The service will allow the user to find a specific area of interest quickly, select the desired map information, determine the map size and scale, and print it or save it for future use. Users can also click a location on any part of a map to receive a report of descriptions for that geologic unit as well as information about other features on the map. A comprehensive search tool provides access to all KGS information that pertains to the user's map area.

By the end of the fiscal year the geologic map site included data for nine 30x60-minute quadrangles in central, eastern, and western Kentucky. The remaining 24 quadrangles are expected to be complete by the end of 2006. ❖

During the 2004–2005 fiscal year, the KGS web site had the following activity:

Total Site Hits: 2,665,608, for an average of 222,134 per month

Internet Map User Visits: KGS hosts 11 online, interactive map services to provide data and maps to the public.

- Total user visits: 245,000
- Average user visits per day: 700
- Most frequently used service: Oil and Gas Gathering Line Map

Online Database Searches: KGS provides online access to seven databases for coal, petroleum, water, and publication information.

- Total searches conducted: 110,000
- Average searches per day: 300
- Most frequently searched database: oil well data (74,000)

Data and File Downloads: KGS allows users to download data, publications, and maps to their local computer.

- Total data files downloaded: 229,000
- Most frequently downloaded files:
  - Oil and gas records (111,000)
  - GIS data (70,000)
  - Publications (68,000)

New Henderson Building Completed

Staff members at the Henderson office conduct a variety of KGS projects and investigations in the western part of the state. They oversee earthquake research, including the Tri-State Earthquake Hazards Mapping Project for portions of Kentucky, Indiana and Illinois. They also conduct water-related projects in conjunction with the KGS Water Resources Section and laboratory. These projects include an ongoing study of groundwater quality in the Jackson Purchase and remediation of groundwater contamination in an abandoned dairy feedlot in Henderson County.

A seismic equipment garage and repair facility at the KGS office in Henderson was completed during the fiscal year. KGS hopes to add additional personnel to be placed at the Henderson office to conduct seismic investigations and maintain equipment.

The new building includes 3200 square feet separated into a large bay area with overhead doors for parking vehicles and trailers, a shop for maintenance of seismic equipment, a seismic monitoring instrument (in a seismic well next to the building) and a sample examination room for studying cores and drill-hole samples.

Dave Williams oversees the office and its four other staff, **Glynn Beck**, **Ron Counts**, **Paul Inkenbrandt** and **Carrie Pulliam**. ❖

Geologic Technician Paul Inkenbrandt doing water sampling at a home in Western Kentucky

Sample analysis lab (left) and exterior view (below) of the new building in Henderson.

Well Sample And Core Library

Increasing prices of crude oil and gasoline on the world market had a direct impact on the activity at the KGS Well Sample and Core Library.

As oil prices rise and exploration becomes more economically feasible, industry and investors are again looking at deeper plays, sparsely drilled areas, tar sand deposits, and the black shales in Kentucky. Exploration geologists are examining cores and cuttings available at the library from wells that were drilled in the '60's, '70's, and '80's, to gather information, interpret geology, and identify potential hydrocarbon prospects. Given the high cost of drilling, examining samples and cores already on file at the library is much more cost-effective than drilling to acquire these data.

In addition, the staff assembled displays promoting the importance of rock materials available at the Well Sample and Core Library for research. A KGS presentation titled "Guidelines in Developing a First Rate Geoscience Data Repository" was presented at the Fifth International Meeting of the National Geoscience Data Repository.

Visitors from Peru, Norway and several states visited the library during the fiscal year to discuss various operational issues, database applications, and research projects and to receive assistance in developing and improving their own facilities.

The facility also serves as a meeting site for a variety of events and activities, including the KGS Annual Seminar. Other entities using the building for meetings during the year were the Kentucky Society of Professional Geologists, the Kentucky Mining Institute, the Petroleum Technology Transfer Council and the Central Kentucky ESRI Group. ❖

An example of a core sampling (above). Such cores are stored on large racks at the Core Library (right, above), which also hosts a variety of meetings and visitors (right, below).

Well Sample & Core Library Activity in fiscal year 2004–05

Telephone requests for information: **756**

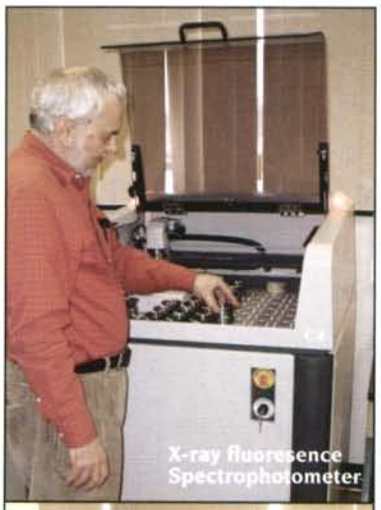
Researchers, students, consultants, and geologists who used the library: **201**

Drill cores and well cuttings examined: **205,000**+ feet

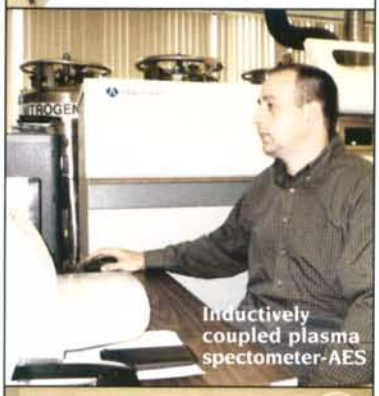
Samples or cores donated to the library: **210,000**+ feet

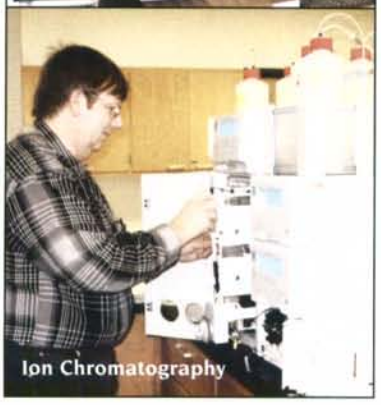
KGS Laboratory

With a wide variety of analysis capabilities in its coal/minerals section and water section, the KGS Laboratory logged in 2,374 samples during the fiscal year.


X-ray fluorescence Spectrophotometer


UV spectrophotometer


Inductively coupled plasma spectometer-AES


Ion Chromatography

While its main function is to serve the needs of the Survey, the lab also helps to meet the needs of other departments of the University of Kentucky, state government agencies and, on occasion, the requests of the private sector when private needs help the Survey achieve its goals. The lab works to add information to the Survey's own database on Kentucky's geology and resources, a database which is publicly available.

Much of the lab work involved analyzing water samples for projects being done by KGS researchers around the state, but one of the largest outside customers has been the Water Watch Program of the Kentucky Division of Water, which does two samplings annually on selected streams.

Several projects being run by KGS staff and other university researchers involve analyzing samples of water from wells around Kentucky to determine levels of chemicals including nitrates, chlorides and herbicides. For instance over the past 7 years, more than 500 water samples from Kentucky's Purchase area have been analyzed by the laboratory in a project to identify contamination sources for rural domestic water well users.

Meanwhile, the coal and minerals section of the lab provides analyses for coal quality and for the mineral content of rock samples. An ongoing project involving the lab is the analysis of coal samples to provide data on potential coal-bed methane for the energy industry.

The lab also serves the needs of other departments of the University by providing analyses for them or making parts of the lab available for their needs.

In an effort to keep its research capabilities modernized, the lab upgraded its X-ray fluorescence instrument and added a water turbidity analysis instrument during the fiscal year.

The facility also maintains a quality control program to assure reliable results for its analyses. Lab staff routinely calibrates the analytical instrumentation, and calibration records are kept on file. ❖

Awards and Recognition

KGS people and publications received recognition during the fiscal year for their quality, not only in the state, but from regional and national organizations as well. A number of KGS staff also served on panels and committees.

◆ State Geologist Emeritus **Don Haney** was presented the John T. Galey Memorial Award by the Eastern Section of the American Association of Petroleum Geologists. The highest award given by the Eastern Section, it recognizes geologists whose accomplishments have been a great benefit to society. Haney served as Kentucky's 11th State Geologist.

◆ KGS Director and State Geologist **Jim Cobb** was elected to the American Geological Institute's Executive Committee as treasurer and elected as historian of the American Association of State Geologists.

◆ Assistant State Geologist **John Kiefer** served as chair for the Southeastern Section of the Geological Society of America, chair of the GSA Southeastern Section's Committee on Geology and Public Policy, representative for the Southeastern Section on the GSA National Committee on Geology and Public Policy, chair of the GSA National Division of Geology and Society (GSA's newest division), chair for the Associates Caucus of the Association of American State Geologists for 2004–05.

◆ **Brandon Nuttall** was selected for the 2005 George V. Cohee Public Service Award from the Eastern Section of AAPG. The award recognizes distinguished service and achievement in public affairs. Nuttall was nominated for work on Kentucky oil and gas records available to the public on the World Wide Web.

◆ **Dave Harris** received the 2005 Honorary Membership Award from the Eastern Section of AAPG, recognizing distinguished service and devotion to the service and profession of geology. He served as lead investigator on the development of a new map of an eastern Kentucky oil- and natural gas-producing geologic formation known as the "Big Lime."

◆ **Drew Andrews** serves as Distinguished Geologic Sites Coordinator for the Kentucky Society of Professional Geologists, and a consultant for the Eastern Kentucky University faculty during their curriculum restructuring effort.

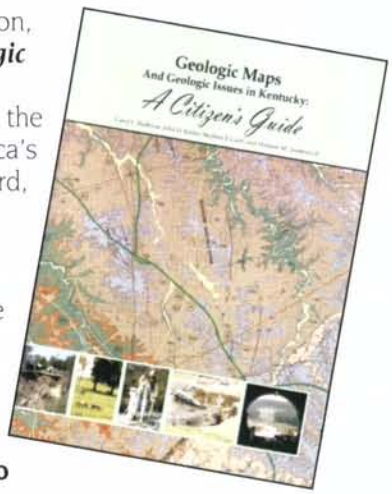
◆ **Steve Martin** received recognitition for the best STATEMAP deliverable for the "Geologic Map of the Murray and Part of the Sikeston 30 x 60 Minute Quadrangles, Western Kentucky."

◆ **Patrick Gooding** chaired the Credentials Committee in the American Association of Petroleum Geologists House of Delegates. He was appointed to a 3-year term as vice chairman of the AAPG Committee on Preservation of Samples and Cores and as a member of AAPG's GeoTour ad hoc Committee. He was also chair of the Membership Committee for the Kentucky Society of Professional Geologists.

◆ **Jim Drahovzal** received a Certificate of Merit for outstanding leadership on behalf of the Division of Professional Affairs, American Association of Petroleum Geologists.

◆ **Steve Fisher** was appointed to the Kentucky Agriculture Water Quality Authority.

◆ The 2003 KGS publication, "***Geologic Maps and Geologic Issues in Kentucky: A Citizen's Guide,***" received the Geological Society of America's John C. Frye Memorial Award, given annually to the best environmental geology publication from GSA or a state geological survey. The award includes a $1,000 prize. **Carol Ruthven, John Kiefer, Steve Greb,** and **Drew Andrews,** authored the publication; **Collie Rulo** did the layout and design.



During fiscal year 2004–05, the Kentucky Geological Survey received funding from federal, state, and private sources for 26 projects for research and other work to meet its mission. The topics of these grants and contracts ranged from monitoring groundwater quality and delineating karst groundwater basins to injecting carbon dioxide gas into deep geologic formations and creating geologic maps.

Grants and Contracts Funded by State and Federal Agencies

1. Computerized Coal Resources Data for the National Coal Resources Data System. Budget period 7/1/04-6/30/05. Award $62,459. Funding agency – U.S. Geological Survey.

2. Chemical Analysis of Groundwater Samples Taken from the Kentucky Groundwater Network. Budget period 7/1/04- 6/30/06. Funding agency – Kentucky Natural Resources and Environmental Protection Cabinet.

3. Generation of 1:100,000 Geologic Maps from Digital 1:24,000 Geologic Quadrangle Maps in the Kentucky River Basin, Kentucky. Award of $245,350 for budget period 4/15/04 – 4/14/05. Award of $205,401 for budget period 4/15/05-4/14/06. This is the 10th year funding of the project. Total award to date $1,819,996. Funding agency – U.S. Geological Survey.

4. Communications Specialist for the Kentucky Board of Registration for Professional Geologists. Budget period 7/1/04- 6/30/05. Award $15,000. Funding agency – Kentucky Board of Registration for Professional Geologists.

5. Expanded Groundwater Monitoring for Nonpoint-Source Pollution Assessment of Watersheds in Kentucky Basin Management Unit Five. Project period 7/1/02-3/31/05. Total award $75,000. Nine month extension with no additional funding. Funding agency - Kentucky Department for Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, and Kentucky Division of Water. Section 319 grant.

6. Mid-Continent Interactive Digital Carbon Atlas and Relational Database. Budget period 1/1/04-6/30/05. Current year award $100,000. Project period 7/1/00-6/30/05 with total award of $576,121. Funding agency – U.S. Department of Energy. Cooperative effort with the Kansas, Illinois, Indiana and Ohio Geological Surveys.

7. Geological Controls on the Origin and Distribution of Fault-Related Dolomites in Central Kentucky: Analogs for Subsurface Trenton-Black River Reservoirs in New York. Budget period 6/1/02-4/30/05. Total award $69,521. Six month extension with no additional funding. Funding agency – Triana Energy.

8. Analysis of Devonian Black Shales in Kentucky for Potential Carbon Dioxide Sequestration and Enhanced Natural Gas Production. Budget period 5/12/02-5/14/05. Current year award $167,051. Total award $364,453. Funding agency – U.S. Department of Energy.

9. Resource Assessment and Production Testing for Coalbed Methane in the Illinois Basin. Budget period 10/1/03-4/30/05. Total award $500,000. Funding agency - U.S. Department of Energy.

10. Groundwater Education, Training, and Technology Transfer. Budget period 7/1/03-6/30/10. Current year pro-rated $64,286. Total award $450,000. Funding agency – Kentucky Natural Resources and Environmental Protection Cabinet.

11. Midwest Geological Sequestration Consortium. Budget period 10/1/03-9/30/05. Current year pro-rated $103,506. Total award $200,840. Funding agency – U.S. Department of Energy through the Illinois State Geological Survey.

12. Creating a Geologic Play Book for Trenton – Black River Appalachian Basin Exploration. Budget period 10/1/03-9/30/05. Current year pro-rated $153,481. Total award $307,780. Funding agency – U.S. Department of Energy through West Virginia University.

13. Mid-America Integrated Seismic Network – UK. Budget period 1/1/04-12/31/06. Current year award $35,000. Total award $109,794. Funding agency – U.S. Geological Survey.

14. Midwest Regional Carbon Partnership. Budget period 11/17/03-9/30/05. Current year award $25,783. Total award $51,566. Funding agency – U.S. Department of Energy.

15. Collect Stream Sediment and Soil Samples in Kentucky. Budget period 6/1/04-5/31/05. Total award $10,000. Funding agency – U.S. Geological Survey.

16. Delineation of Karst Groundwater Basins Along the Proposed I-66 Corridor, Pulaski County. Project period 12/1/04-11/30/05. Total award $130,380. Funding agency – Kentucky Transportation Cabinet.

17. Groundwater Quality Monitoring for Nonpoint Source Chemicals in the Jackson Purchase Region of Kentucky. Budget period 11/1/04-6/30/06. Current year pro-rated $42,500. Total award $85,000. Funding agency – Kentucky Natural Resources Environmental Protection Cabinet.

18. Development of Community Water Supplies. Budget period 1/1/05-6/30/05. Total award $50,000. Funding agency – Kentucky Infrastructure Authority.

19. Delineation of Miller Cave Karst Groundwater Basin for Relocation KY 163, Monroe County, Kentucky. Budget period 1/11/05-6/30/05. Total award $13,230. Funding agency QK4.

20. A Systems Approach to Identifying Exploration and Development Opportunities in the Illinois Basin: Digital Portfolio Plays in Under-Explored Lower Paleozoic Rock. Budget period 9/24/04-9/23/05. Current year award $41,065. Project period 9/24/04-9/27/07 with total award of $197,498. Funding agency – U.S. Department of Energy through University of Illinois.

21. Workshop to Advise the U.S. Geological Survey National Coal Resource Data System Coal Quality Program. Budget period 7/22/04-6/30/05. Total award $20,000. Funding agency – U.S. Geological Survey.

22. Analysis of Washability Data for Eastern Kentucky Coals. Budget period 7/22/04-6/30/05. Total award $42,459. Funding agency – U.S. Geological Survey.

Grants Administered by Other Units of the University of Kentucky

1. Nonpoint-Source Assessment of Groundwater. Funding agency – Commonwealth of Kentucky. Cooperative study with University of Kentucky College of Agriculture.

A.) Animal Research Center – Woodford County. Budget period 7/1/04- 6/30/05. Award $68,262.

B.) High Nitrate Wells. Budget period 7/1/04-6/30/05. Award $62,680.

2. Kentucky Research Consortium for Energy and Environment. Budget period 10/1/03-9/30/05. Current year award $58,072. Total award $117,485. Funding agency – U.S. Department of Energy through University of Kentucky Tracy Farmer Center on the Environment.

3. Characterizing Pollution Impacts to Urban Karst Aquifers from Artificial and Enhanced Recharge. Budget period 3/1/04-2/28/05. Current year pro-rated $19,718. Total award $23,662. Funding agency – U.S. Geological Survey through University of Kentucky Water Resources Research Institute.

Total Amount of Grants and Contracts Awarded - $2,045,982

KGS staff for the fiscal year of July 2004 through June 2005

State Geologist's Office

Cobb, Jim
Director / State Geologist
Kiefer, John
Asst State Geologist
Haney, Don
State Geologist Emeritus
Ruthven, Carol
Geologist IV
Lynch, Mike
Tech Transfer Officer
Hower, Judy
Communications

Administrative Section

Silvers, Jackie
Admin Staff Officer II
Long, Mandy
Admin Support Associate I
Phillips, Gwen
Staff Support Associate II

Energy and Minerals Section

Drahovzal, Jim
Section Head
Barth, Leah
Student worker
Eble, Cortland
Geologist V
Greb, Steve
Geologist V
Harris, Dave
Geologist V
Hickman, John
Geologist III
Lake, Paul
Geologist II
Nuttall, Brandon
Geologist IV
Parris, Marty
Geologist IV
Solis, Mike
Geologist I
Takacs, Kathy
Geological Tech

Geologic Hazards Section

Wang, Zhenming
Geologist V
Shi, Baoping
Geologist III
Woolery, Ed
Seismologist
Vance, Dave
Student worker

Geoscience Information Section

Cordiviola, Steve
Section Head
Alluri, Sandeep
Student worker
Banks, Roger
Account Clerk I
Coleman, Matt
Student worker
Davis, Luanne
Geological Tech
Evans, Theola
Stores Supervisor
Farwell, Mike
Student worker
Hounshell, Terry
Chief Cartographic Illustrator
McElhone, Jim
Info Tech Manager I
Nanduri, Surya
Student worker
Rulo, Collie
Graphic Design Tech Sr
Smath, Meg
Geologist III
Thompson, Mark C.
IS Tech Support Spec IV
Watson, Anna
Geologist II
Williams, Sidney
Student worker

Geospatial Analysis Section

Weisenfluh, Jerry
Section Head
Anderson, Warren
Geologist V
Andrews, Drew
Geologist IV
Carey, Dan
Geologist V
Crawford, Matt
Geologist II
Curl, Doug
Geologist III
Heck, Jason
Student worker
Lambert, Jason
Student worker
Luckett, Brad
Student worker
Martin, Steve
Geologist III
Murphy, Mike
Geologist I
Overfield, Bethany
Geologist II
Petersen, Carl
Geologist II
Poole, William
Student worker
Ramsey, Carolyn
Student worker
Reynolds, Joshua
Student worker
Sergeant, Rick
Geologist IV
Smath, Richard
Geologist II
Sparks, Tom
Geologist III
Strickling, Erica
Student worker
Thompson, Mark F
Geologist II
Wang, Rebecca
IS Tech Support Spec III

Laboratory Services

Francis, Henry
Scientist II / Laboratory Manager
Backus, Jason
Scientist II
Mitchell, Andrea
Scientist I
Mock, Steve
Scientist I

Water Resources Section

Dinger, Jim
Section Head
Cumbie, Dennis
Geologist III
Currens, Jim
Geologist IV
Davidson, Bart
Geologist IV
Fisher, Steve
Geologist V
Fogle, Alex
Geologist III
Gulley, Jason
Temp / Part Time
Paylor, Randy
Geologist II
Webb, Steve
Geologist I
Wilhelm, Brent
Temp / Part Time

Well Sample and Core Library

Gooding, Patrick
Geologist IV / Manager
Daniel, Ray
Research Analyst
Eversole, Mark
Sr Lab Tech

Western Kentucky Office at Henderson

Williams, Dave
Section Head
Beck, Glynn
Geologist III
Counts, Ron
Geologist II
Inkenbrandt, Paul
Geological Tech
Kelley, Amy
Temp / Part Time
Kotter, Dan
Temp / Part Time
McMeans, Megan
Geological Tech
Pulliam, Carrie
Geological Tech Sr
Waninger, Scott
Temp / Part Time

Photo descriptions from page 11

A Reservoir on the Yellow River created in the 1950's by construction of the Liujiaxia hydroelectric dam on the river. John Kiefer and Jim Cobb took a boat trip up the Yellow River with our host Dr. Lanmin Wang.

B A family in Shuixiakou Village in Gansu Province. This village was destroyed in 1927 by a devastating 8.0M earthquake. The elderly gentleman survived the earthquake and related his memories of it.

C The Great Buddha Temple at Zhangye City contains China's largest reclining Buddha at over 110 feet in length. It was built in 1098 A.D. and sustained damage in an earthquake in 2003.

D While waiting to meet the Vice Governor of Gansu Province, John Kiefer took this photo of Chinese art on a rug in the waiting room.

E Mogoa Buddhist Temple and Grottoes near Dunghuang, an oasis town on the Silk Road in Chinese Central Asia. Construction of this site started in the 2nd century B.C. and the Buddhist grottoes were built from the 4th to the 14th centuries. Mogoa has 500 grottoes along the cliff and 2,000 carved and painted statues. One of the largest discoveries of ancient Buddhist manuscripts was at this site. John Kiefer stands in front of the temple.

F A smoke signal tower along the Great Wall in western China, where the Great Wall is made of adobe. Ed Woolery and trip leader, Taiyi Lu, of the Lanzhou Institute of Seismology, inspect the tower. Wooden timbers, straw and abundant pottery pieces could be seen.

G Binglingsi Thousand Buddha Caves on the Yellow River about 100 miles west of Lanzhou City. It is a sandstone cliff in which hundreds of grottoes containing statues of Buddha have been carved. The largest Buddha is more than 100 feet tall. This site was started in the Western Qin Dynasty in 221 B.C.

H The Lanzhou City center from the hotel where the American visitors stayed. Lanzhou City is the capital of Gansu Province with a population of about 3 million people.

I Field work on the outskirts of Lanzhou to locate a fault that moved during a recent earthquake. Ed Woolery with faculty and students from the Lanzhou Institute of seismology ran seismic profiles that successfully imaged the fault.

J A group photo taken after a meeting with Li Ying, Vice Governor of Gansu Province. The Vice Governor is a strong supporter of earthquake studies, seismic safety and education. From left to right—Ed Woolery, Zhenming Wang, John Kiefer, Li Ying, Vice Governor of Gansu Province, Jim Cobb, Zhoa Shenglan, Deputy Director for Foreign Affairs of Gansu Province, and Wang Lamin, Director of the Lanzhou Institute of Seismology.

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