

Kentucky Geological Survey  
228 Mining & Mineral Resources Bldg.  
University of Kentucky  
Lexington, KY  
40506-0107  
(859) 257-5500  
www.uky.edu/KGS

James Cobb, State Geologist and Director  
John Kiefer, Assistant State Geologist  
Carol Ruthven, Editor, *Kentucky Geology*

**Our Mission:**  
To collect, preserve, and distribute information about mineral and water resources and the geology of the Commonwealth.

KGS has conducted research on the geology and mineral resources of Kentucky for more than 160 years, and has developed extensive public databases for oil and natural gas, coal, water, and industrial minerals that are used by thousands of citizens each year. The Survey's efforts have resulted in topographic and geologic map coverage for Kentucky that has not been matched by any other major state in the Nation.

## From the Director

### Vision for the Twelfth Survey

I am happy to announce this newsletter, through which we are making a commitment to improving communication with the public we serve. Understanding the way our land, water, and resources interact with society is vital to us all. Geology in all of its varied aspects gives us the knowledge and insight we need to make good decisions as individuals and as a society about our land and resources. To capture this idea, we are adopting a new motto:

**“Earth Resources—Our Common Wealth.”** achieving this goal, we will be the first state to

This newsletter will be published quarterly and distributed free to all those interested in the results of our research and the many services we provide. It will carry articles about research programs, recent findings, important discoveries, and how to access the many services of KGS. I hope this newsletter is interesting to you; please share it with others who may also be interested. If you have any suggestions or names to add to our mailing list, please contact us at (859) 257-5500 or visit our Web site at [www.uky.edu/KGS](http://www.uky.edu/KGS).

On October 1, 1999, I was appointed State Geologist and Director of the Kentucky Geological Survey. It is a privilege and challenge for me to follow in the footsteps of the 11 previous

State Geologists. As a result of their outstanding vision and leadership, and strong support from the State, our survey has been a national leader in geologic mapping, coal-resource assessment, and applied geology. KGS will maintain its areas of traditional strength and will add new programs in geologic hazards and seismology. My vision for the Twelfth Survey is to have Kentucky be the first state in the country to be completely digitally mapped. In the

process of achieving this goal, we will be the first state to have a statewide geographic information system (GIS) of digital geologic maps and data. This GIS product will be interactive with all KGS databases, which is possible because of advances in computer and Internet technology. I want all users of KGS information to be able to access, manipulate, retrieve, and display for their own purposes this information, 7 days a week, 24 hours a day.

Some background information about me: I began my career in geology 30 years ago working in the mailroom at the Illinois State Geological Survey while an undergraduate. I was captivated from the beginning with how and why surveys did what they did—research and public ser-



vice—and pursued my education in geology with the goal of one day working full time at a survey. I was fascinated that any interested person could contact the survey to find out what resources were on their property, how they could find water, why their foundation might be cracking, or why sinkholes were opening in their yard. I came to the Kentucky Geological Survey 20 years ago, and have seen great advancements in our knowledge and ability to serve the people of Kentucky. Geological surveys are unique in society because they provide information that people and organizations can use to promote economic development, protect public safety, and improve our standard of living. This follows a tradition in Kentucky that goes back more than 160 years. As the Twelfth State Geologist of Kentucky, I am pleased to be following in this tradition, and am committed to making this survey outstanding in the research it conducts and the public service it renders to the people of Kentucky. ❖

## Donation of historic maps



On February 23, the Kentucky Geological Survey donated two rare 18th-century maps to the William T. Young Library of the University of Kentucky. The first, “A Map of the State of Kentucky from Actual Survey,” by Elihu Barker, published in 1793 in Philadelphia, presents the state at the time of its admission to the Union; it provides a sense of the settlement patterns and accurately outlines physiographic features. Barker’s map indicates the location of iron and copper deposits, as well as mineral springs, and may be the first statewide map of Kentucky to show mineral-deposit locations. Only five other copies are known to exist in the United States. The second map, “Map of the State of Kentucky with the Adjoining Territories,” by John Russell, published in London in 1794, is artistic and has remarkably sharp typography. State Geologist Jim Cobb donated the maps to the library to ensure that they are properly archived and made accessible to the public, historians, and researchers. ❖

*Left to right: Jim Cobb, Director, Kentucky Geological Survey; Gloria Martin, Councilwoman, Lexington-Fayette Urban County Government; Thomas Clark, Historian; Charles Wethington Jr., President, University of Kentucky; Paul Willis, Director, W.T. Young Library, University of Kentucky.*

### *Dye-tracing and geologic mapping will help*

## Minimize ground-water pollution

A large percentage of livestock, and many people, in central Kentucky get their drinking water from springs or wells. The ground-water basin, or source, of many springs in Kentucky is unknown. Limestone areas having sinkholes, caves, and springs, such as the Inner Blue Grass, are known as karst terrane. Ground water in karst areas can be rapidly polluted by runoff from highways and industrial operations, and accidental chemical spills. When chemical spills pollute a spring, this can be harmful to livestock and human health. A recent example is the rupture of a pipeline transporting crude oil in Clark County. The spilled oil polluted the ground water and several karst springs, one of which was a drinking-water supply.



*Water holding tank for a karst spring polluted by crude oil spilled from a ruptured pipeline.*

To understand the flow routes of ground water, small quantities of environmentally safe fluorescent dyes can be poured into a sinkhole or sinking stream. Any spring the dye might flow to is monitored with packets of absorbent material. After each test, the absorbent material is taken to a laboratory, where it is checked for dye. Once the spring that the dye traveled to is found, the results show which areas drain to each spring. This research method is referred to as “dye-tracing.”

Jim Currens and Jim Dinger have received a grant of \$288,663 from the Division of Water of the Kentucky Natural Resources and Environmental Protection Cabinet, through the U.S. Environmental Protection Agency, to use dye-tracing to map the pathways of underground water flowing into springs in the Inner Blue Grass region. The maps of ground-water flow paths will be valuable to emergency personnel responding to spills of potentially dangerous contaminants that can damage the quality of ground water and make it unsafe for drinking water and other uses. The study results will also be useful to farmers when they fill out their Kentucky Agriculture Water Quality Authority Producer Workbook.

The area to be mapped includes, but is not limited to, the counties of Harrison, Bourbon, Clark, Jessamine, Woodford, Boyle, Mercer, Anderson, Scott, and Fayette. Fieldwork will begin this spring and continue for the next several years. Property owners who have springs or sinkholes that they would like to have investigated should contact Jim Currens at (859) 257-5500, or by e-mail at [currens@kgs.mm.uky.edu](mailto:currens@kgs.mm.uky.edu). ❖

## Earthquakes in Kentucky?

When you think about earthquakes, do images of California, Turkey, or Japan come to mind? What about Kentucky? Did you know that earthquakes or damage resulting from earthquakes have been experienced in Columbus, Henderson, Hickman, Mayfield, Louisville, Middlesboro, Sharpsburg, Poole, Smith Mills, and Uniontown in the past 200 years? The most significant of these events were the catastrophic earthquakes at the town of New Madrid, Mo., during the winter of 1811–1812. Three of the most powerful earthquakes in U.S. history occurred—magnitude-8 earthquakes—followed by thousands of aftershocks. Witnesses reported seeing cracks open in the earth's surface and the ground literally rolling in waves. The effects of the New Madrid earthquakes and aftershocks were recorded thousands of miles away and damage was reported as far away as Charleston, S.C., and Washington, D.C. Chimneys were knocked down in many places in Kentucky, and one man in Louisville, Jarad Brooks, recorded 1,874 tremors from December 1811 through March 1812 (U.S. Geological Survey, 2000a).

**Should I be concerned?** In Kentucky, moderate earthquakes have shaken houses, cracked plaster, and shaken pictures from walls; bricks have shaken from chimneys; a bluff along the Mississippi River caved in; and landslides have occurred. The strongest earthquake in Kentucky was in 1980 near Sharpsburg, Bath County, in northeastern Kentucky. The effects of this earthquake were felt over all or parts of 15 states and in Ontario, Canada. Property

damage was estimated at \$1 million in Maysville in Mason County, where 27 commercial structures and 269 residences were damaged (USGS, 2000b). This earthquake was particularly interesting because it occurred in a region that had previously not been considered to be seismically active. A second earthquake of magnitude 4.6 occurred in the same area in 1988. This signaled an awareness that the risk of property damage was not limited to western Kentucky, which is adjacent to the New Madrid Seismic Zone, the most active seismic zone east of the Rockies.

**Are geologists studying earthquakes in Kentucky?** After the earthquake near Sharpsburg, the University of Kentucky established the Kentucky Seismic and Strong-Motion Network in late 1980. The network is jointly operated by the UK Department of Geological Sciences and the Kentucky Geological Survey. Since it began operation, the network has recorded data for more than 1,000 earthquakes.

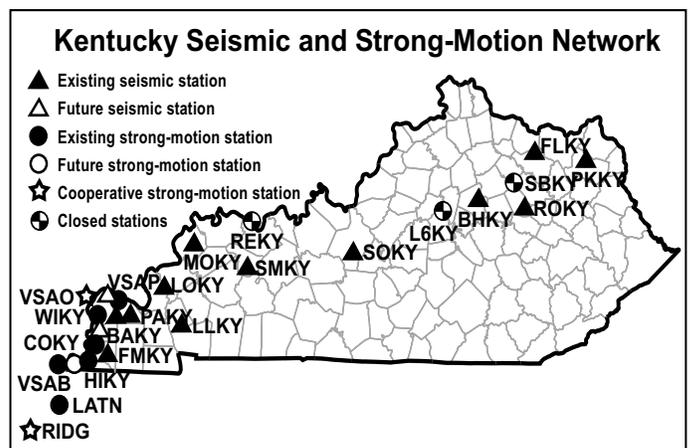
The network has 20 stations—12 weak-motion stations and six strong-motion stations—that monitor seismic activity throughout the state and the surrounding region. Three new stations are planned for the future. Weak-motion stations record the location and magnitude of weak vibrations of the earth that result from small local earthquakes and from moderate to large earthquakes in distant areas. They are well suited for continuous monitoring of seismic activity over time. Strong-motion networks record large earthquakes with a magnitude greater than 4 or 5. Strong-motion networks provide data for designing

buildings, construction projects, and building codes. Strong-motion station VSAO at Olmstead Lock and Dam, on the lower Ohio River, is operated cooperatively with the U.S. Army Corps of Engineers. Data from this station are used to study ground motion at the dam site, as well as for the study of seismic hazards from the Southern Illinois and Wabash Valley Seismic Zones. Strong-motion station RIDG in Ridgley, Tenn., is operated cooperatively with Lamont-Doherty Earth Observatory, a geologic research station affiliated with Columbia University in New York.

**Regional cooperation in earthquake research.** In 1983, Kentucky and six other states (Arkansas, Illinois, Indiana, Mississippi, Missouri, and Tennessee) formed the Central United States Earthquake Consortium (CUSEC). The consortium strives to improve earthquake awareness and education, coordinate multistate planning for earthquake preparedness, and encourage research in efforts to reduce hazards resulting from earthquakes. Assistant State Geologist John Kiefer recently began serving a term as chair of the CUSEC State Geologists, and

*(Continued on page 4)*

*The strongest earthquake in Kentucky was in 1980 near Sharpsburg, Bath County, in north-eastern Kentucky. Property damage was estimated at \$1 million in Maysville in Mason County.*



*The Central United States Earthquake Consortium strives to improve earthquake awareness and education, coordinate multistate planning for earthquake preparedness, and encourage research in efforts to reduce hazards resulting from earthquakes.*

*(Continued from page 3)*

in this capacity he is also an ex-officio member of the Board of Directors of CUSEC. John Kiefer and Steve Cordiviola have been active in the development of seismic-hazard maps for the central United States and the creation of the Central United States Partnership, which is a coalition of national organizations and agencies promoting efforts to reduce damages associated with natural hazards.

**Research on earthquake hazards.** Ed Woolery of KGS and Ron Street of the UK Department of Geological Sciences are conducting research on ways to minimize damage from potential earthquakes in Kentucky. A grant for \$112,816 from the National Earthquake Hazards Reduction Program of the U.S. Geological Survey is supporting research to define the properties of thick soils in the Mississippi Valley in order to identify areas that are vulnerable to earthquake damage. Another grant, \$5,500 from the Kentucky Transportation Center (KTC), at the University of Kentucky is supporting research to study previous earthquake activities over a 250-year period to assess the potential for damage in each county of Kentucky, should an earthquake occur in the future. The latter study is being conducted in cooperation with Issam Harik of the KTC.

State-of-the-art equipment recently purchased through grants received by KGS and the Department of Geological Sciences will enable KGS to study earthquake movements in the deep subsurface and build two-dimensional and three-dimensional models of ground motion on a large regional scale. This equipment is unique in the central and eastern United States, and places the University of Kentucky among the Nation's leaders in the direct measurement of the properties of deep sediment, which is necessary to reduce seismic hazards and design structures that are resistant to earthquake-related damage. As this research at KGS comes to fruition, it will provide an important public service to Kentucky. Geologists at KGS will be able to identify areas that are vulnerable to earthquake damage, and this information in turn can be used by engineers to design new buildings that can withstand the stress of earthquake activities and minimize the loss of life and property damage in the event of future earthquakes.

**How do I get more information?** John Kiefer or Ed Woolery, two geological engineers at KGS, can help you. They can be contacted at (859) 257-5500 or through e-mail at [kiefer@kgs.mm.uky.edu](mailto:kiefer@kgs.mm.uky.edu) and [ewoolery@kgs.mm.uky.edu](mailto:ewoolery@kgs.mm.uky.edu). Additional information is also available at these Web sites:

- [www.uky.edu/KGS/education/earthquakes.html](http://www.uky.edu/KGS/education/earthquakes.html)
- [quake.wr.usgs.gov/](http://quake.wr.usgs.gov/)

#### **References**

- USGS, 2000a, Earthquake history of Kentucky: USGS Web site <[www.neic.cr.usgs.gov/neis/states/kentucky/kentucky\\_history.html](http://www.neic.cr.usgs.gov/neis/states/kentucky/kentucky_history.html)>, abridged from *Earthquake Information Bulletin*, v. 5, no. 1, January–February 1973. Accessed April 18, 2000.
- USGS, 2000b, Largest earthquake in Kentucky: USGS Web site <[www.neic.cr.usgs.gov/neis/eqlists/USA/1980\\_07\\_27.html](http://www.neic.cr.usgs.gov/neis/eqlists/USA/1980_07_27.html)>, abridged from "Seismicity of the United States, 1568–1989 (revised), by Carl W. Stover and Jerry L. Coffman, U.S. Geological Survey Professional Paper 1527, 1993. Accessed April 18, 2000.
- Schweigt, Eugene, Gomberg, Joan, and Hendley, J.W., II, 2000, The Mississippi Valley—"Whole Lotta Shakin' Goin' On": USGS Web site <[quake.wr.usgs.gov/QUAKES/FactSheets/NewMadrid/](http://quake.wr.usgs.gov/QUAKES/FactSheets/NewMadrid/)>. Accessed April 18, 2000.
- Street, Ron, and Nuttli, Otto, 1990, The great Central Mississippi Valley earthquakes of 1811–1812: Kentucky Geological Survey, ser. 11, Special Publication 14, 14 p. ❖

#### **Ground-water quality**

### **New KGS investigations**

Approximately 90 percent of the population in rural Kentucky who supply their own water depend on ground water for domestic water supplies. It is important to study the quality of ground water in order to establish baseline conditions and assess the impact of pollutants. Jim Dinger and Steve Fisher have been awarded two grants to study the quality of ground water in Kentucky. An award of \$95,345, of which \$56,980 is from the U.S. Environmental Protection Agency, will be used to assess the quality of water in wells and springs in drainage basins of the Upper and Lower Cumberland River, Lower Tennessee River, and tributaries of the Ohio and Mississippi Rivers in the Jackson Purchase. An award of \$100,945, of which \$60,000 is from the U.S. Environmental Protection Agency, will be used to map the concentrations of naturally occurring solutes, pesticides, and nutrients in ground water from the Tennessee, Mississippi, Upper and Lower Cumberland, Tradewater, and Green River Basins, and statistically summarize data on the quality of the ground water. Peter Goodmann of the Kentucky Division of Water will be collaborating with Fisher and Dinger on both projects. ❖

## KGS research to aid environmental-impact statement

Jerry Weisenfluh was awarded a \$50,000 grant by the U.S. Office of Surface Mining (OSM) to estimate the extent of potential mountain-top mining areas in the Eastern Kentucky Coal Field. The issue of mountain-top mining and associated valley-fill material has recently become an important public policy issue because of legal proceedings in West Virginia that have limited that kind of mining. As a result of a judicial order,

OSM and the Environmental Protection Agency were charged with preparing an environmental-impact statement for the central Appalachian region, which includes the eastern Kentucky area. Weisenfluh will prepare information for OSM to evaluate the impact that future surface mining may have on Kentucky. Geographic information systems will be used to analyze data pertaining to coal resources and historical mining. ❖

---

## Western Kentucky coal

### Technology-transfer seminar

A 1-day coal-assessment seminar was held on March 8 in Madisonville, Ky., for personnel from coal and natural gas companies and consultants. Each participant was provided information and data on all aspects of coal in the major coal beds of western Kentucky (for example, coal structure, outcrops, mining history, areas that have been mined, coal thickness and quality, and the potential for developing coalbed methane). The

seminar was presented by KGS geologists Don Chesnut, Steve Greb, Cortland Eble, Drew Andrews, and Dave Williams, and geologist Jim Hower of the UK Center for Applied Energy Research. The seminar was part of a series of biannual technology-transfer seminars on coal resources hosted by KGS. If you would like us to add your name to our mailing list for announcements about future seminars, please contact Jim Drahovzal at (859) 257-5500 or by e-mail at [drahovzal@kgs.mm.uky.edu](mailto:drahovzal@kgs.mm.uky.edu). ❖

---

## Natural gas

### KGS geologist identifies natural gas potential

Jim Drahovzal and a team of geologists from several states have discovered the "Hoosier Thrust Belt," a previously unknown ancient eroded mountain belt in the deep subsurface of southern Indiana and northern Kentucky. The presence of the thrust belt was first described by Drahovzal in his article, "Proterozoic Sequences and Their Implications for Precambrian and Cam-

brian Geologic Evolution of Western Kentucky: Evidence from Seismic-Reflection Data," published in 1997 in *Seismological Research Letters*. A more recent discussion of this research is found in the November 1999 issue of the *AAPG Explorer*. The discovery could stimulate natural gas exploration and development in the Illinois Basin, which is one of the oldest oil- and gas-producing areas in the United States. ❖

---

## Global warming

### KGS Distinguished Lecture

Dr. Lee Gerhard, principal geologist of the Kansas Geological Survey, presented the twelfth annual KGS distinguished lecture. In his presentation, "Geologic Constraints on Global Climate Change," Gerhard explained how the earth's climate is constantly changing as a result of natural variability in earth processes. He maintained that natural climate variability over recent geologic time is greater than reasonable estimates of potential changes in greenhouse gases resulting from human activity. Gerhard questioned the reliability of computer models that have been used to predict significant temperature changes during the next century. He pointed out that very general assumptions are made about variables such as solar variability and the interaction between oceans and the atmosphere, which

are understood in principle, but for which there are little data. He argued that the economic impacts of adopting the Kyoto treaty would be immense, and he cautioned against the use of nonscientific rationale for adopting stringent controls on the use of fossil fuels (coal, oil, and natural gas). ❖



Lee Gerhard.

---

## Education outreach

### Earth science for the Kentucky virtual high school

Steve Greb is participating in the design of an earth science high-school course for the Kentucky virtual high-school program. This pilot program, sponsored by the Kentucky Department of Education, is being developed to assist schools that do not have teachers for the core content areas of earth and space science. Greb will be developing the earth-sciences content for the curriculum. ❖



*Want more information?*

---

## **KGS newsletter mailing list**

Would you like to receive the KGS newsletter and announcements of meetings and new publications? If so, we would like to add your name to our electronic mailing list. Please call us at (859) 257-5500 or send an e-mail message to Jennifer Talley at

[jtalley@kgs.mm.uky.edu](mailto:jtalley@kgs.mm.uky.edu) and simply type “Electronic-Mailing List Addition” in the subject line of your message, type your mailing address, and phone and fax number in the message, and we will include your name and address in our mailing list. ❖

*KGS Web site*

---

## **Summer is coming—Interested in hiking, nature, and geology?**

You may want to tour Natural Bridge State Park in Powell County in central-eastern Kentucky by taking the KGS virtual field trip on our Web site at [www.uky.edu/KGS/coal/webgeoky/fieldtrip/naturalbridge.html#trail](http://www.uky.edu/KGS/coal/webgeoky/fieldtrip/naturalbridge.html#trail). On our virtual field trip you can see a natural arch or bridge created by fractures and erosion of rock,

rock shelters and caves, fossils of ancient plants preserved in sandstone, beautiful natural gardens of rhododendrons, and, if you're feeling brave, you can squeeze through “Fat Man's Misery.” ❖

*Calendar of events*

---

- **May 30–June 3:** American Geophysical Union spring meeting, Washington, D.C. <[www.agu.org/meetings](http://www.agu.org/meetings)>
- **September 24–26:** Eastern Section American Association of Petroleum Geologists annual meeting, London, Ontario, Canada <[www.ontpet.com/](http://www.ontpet.com/)>
- **October 15–18, 2000:** American Association of Petroleum Geologists International Conference, Bali, Indonesia <[www.aapg.org/meetings/bali2000/index.html](http://www.aapg.org/meetings/bali2000/index.html)>
- **November 9–18, 2000:** Summit 2000, Geological Society of America annual meeting and exposition, Reno, Nev., <[www.geosociety.org/meetings/2000/index.htm](http://www.geosociety.org/meetings/2000/index.htm)> ❖

Kentucky Geological Survey  
228 Mining & Mineral Resources Bldg.  
University of Kentucky  
Lexington, KY 40506-0107

*Address correction requested*