

# Kentucky Cross Section

Earth Resources—Our Common Wealth

Winter/Spring 2014

## KGS hosting state geologists' national meeting in June

State geologists will converge on Lexington in June for the 106th annual meeting of the Association of American State Geologists. As host of the event, KGS has been planning geologic field trips and tours of sites of historic interest in the Lexington area. The annual meeting brings together state geologists from all 50 states and Puerto Rico and their counterparts from various federal agencies for planning new programs. About 150 people are expected

to participate in the meeting June 8–12.

AASG was founded in 1908 when President Theodore Roosevelt called a White House meeting to launch his conservation movement. State geological surveys were at the forefront of that effort as a result of their mapping and investigations of the nation's mineral, fuel, and water resources. At the time, 42 of the 46 states had geological surveys. The organization ([www.stategeologists.org](http://www.stategeologists.org)) works to promote the study and application of geology and related sciences. AASG has issued

# AASG

ANNUAL MEETING **GEOLOGY:**  
2014 *making an impact*

fact sheets on geologic topics, including hydraulic fracturing, energy, groundwater, and hazards.

The program will include business and technical sessions, field trips to Cumberland Gap and Camp Nelson, a visit to the Kentucky Horse Park, and tours of KGS facilities.

The awards banquet on June 12 will feature remarks by British author Simon Winchester, who now lives in the United States. Winchester's latest book, "The Men Who United the States," tells the stories of "the men who toiled fearlessly to discover, connect,

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## Annual seminar will focus on the application of LiDAR

The KGS seminar is the largest annual gathering of geologists in Kentucky, and

this year's seminar, scheduled for May 16 at the Survey's Well Sample and Core Library,

will examine the applications of LiDAR (light detection and ranging) in the Kentucky geoscience community. LiDAR is a relatively new remote-sensing technology that is transforming geologic and hydrologic mapping and

analysis capabilities. It produces high-resolution elevation data that can "see" through vegetation to produce accurate ground-level elevations.

Several KGS scientists have been using LiDAR data for their research. Matt Crawford, of the Geologic Hazards Section, has used it to identify possible landslide-prone terrain. Junfeng Zhu, of the Water Resources Section, has been confirming and mapping suspected sinkholes in karst areas in the Jefferson/Bullitt County region using LiDAR.

KGS Director Jim Cobb will open the seminar and

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*Poster sessions, field trips, and core workshops like the one held at last year's annual seminar help to attract geologists and other professionals to the event.*

## Director's Desk

Two Kentucky museums made national news and created teaching opportunities for earth science this winter. The National Corvette Museum suffered significant damage caused by sinkhole collapse and the Creation Museum hosted a debate about the origin and age of the earth.

The debate at the Creation Museum featured Bill Nye the Science Guy and Ken Ham, director of the museum. The topic was "Is creation science a viable model of origins in today's scientific era?" Nye has criticized creation science as harmful to children and is of the opinion that it should not be taught in our schools. Ham and the museum's displays portray the age of the earth as 6,000 years and teach that all life forms on Earth are survivors of the Flood and descendants from Noah's Ark. Ham pitted Genesis against science, but many Biblical scholars and theologians do not hold the same literal interpretations that Ham does. Most geologists, paleontologists, cosmologists, physicists, astrophysicists, astronomers, and biologists hold to the many lines of evidence supporting Earth's 4.5-billion-year age.

Organized geologic research has been ongoing in Kentucky since 1838. Hundreds of thousands of wells have been drilled for oil, gas, coal, minerals, water, and foundations, adding to our cogent understanding of the surface and subsurface of Kentucky. Thousands of geologists over these years have mapped, drilled, surveyed, collected, analyzed,

and described rocks, fossils, and minerals from Kentucky. They have compared and correlated their results with geologists in other states and countries. In these 176 years of geology, advancements in science, mapping, technology, and data have contributed to the current sound interpretation of Kentucky geology. The landscape of Kentucky is the product of millions of years of weathering and erosion. Kentucky's bedrock is hundreds of millions of years old. There is overwhelming agreement among geologists for the age, origin, structure, and stratigraphy of Kentucky.

This debate publicized issues that are raised in Kentucky and elsewhere, and can be used to educate about geology and earth science. Society needs information about earth materials, earth processes, resources, and hazards, so geologic studies must go forward unfettered.

By now millions of people have viewed the YouTube video showing the Corvettes falling into a sinkhole. A crack can be seen forming, and then cars disappear into a sinkhole that measured 40 feet across and 30 feet deep. By 8:00 a.m., media had arrived at KGS to interview geologists about what had happened. Previous experiences indicated that this was a sinkhole collapse in an area of classic cave and karst development. The museum is only 25 miles from Mammoth Cave, the most extensively surveyed cave system in the world, with more than 400 miles of passages. Mammoth Cave is formed in thickly bedded soluble lime-



Jim Cobb

stone of the Ste. Genevieve–St. Louis Limestones, of Mississippian age. The St. Louis Limestone occurs at the surface at the site of the museum and is known to have caves and sinkholes. Events such as this can be used to educate the public about hazards such as sinkholes that occur in Kentucky and cause damage and disruption each year.

Information about the geology, fossils, and geologic time scale of Kentucky can be found at [www.uky.edu/kgs](http://www.uky.edu/kgs). KGS's geologic map service, sinkhole map, and sinkhole susceptibility map are online and are valuable resources for alerting the public to the possibility of sinkhole formation. These resources should be consulted by the public, building contractors, and anyone building in cave and karst terrain.

Please contact KGS if you have questions about the rocks and geology of Kentucky. ❖

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### AASG meeting—continued from p. 1

and bond the citizenry and geography of the U.S.A. from its beginnings," according to promotional material at Amazon.com. Winchester's most famous book is "The Map That Changed the World," the story of English mapper William Smith.

KGS has previously hosted the AASG annual meeting in 1958 at Kentucky Dam Village and in 1988 at the Hyatt Regency Hotel in Lexington. ❖

### Annual seminar—continued from p. 1

welcome the participants, and Mike Ritchie of Photo Science Inc. will provide an overview of LiDAR technology. Photo Science is a Lexington, Ky., company that specializes in aerial acquisition of imagery and LiDAR data. Speakers for the rest of the morning will be State and federal officials and KGS researchers. Their topics will cover Kentucky's LiDAR program, floodplain mapping using

the data, sinkhole and landform research, and archaeological inventories of sites of interest.

During the traditional barbecue lunch, the Kentucky Section of the American Institute of Professional Geologists will hand out its annual awards. Afternoon sessions will consist of KGS presentations on existing and proposed networks for seismic and water-level monitoring in Kentucky. ❖

# KGS participating in brine-disposal project for the northern Appalachian Basin

**K**GS, the state geological surveys of Ohio, Pennsylvania, and West Virginia, and Battelle Memorial Institute are cooperating in a project to create a framework for the safe disposal of brine used for the development of unconventional oil and gas resources in the northern Appalachian Basin. The 2-year project, which started in April 2013, is funded by a direct federal budget grant through the nonprofit Research Partnership to Secure Energy for America.

Battelle Memorial Institute is managing the overall project, and Marty Parris, of the Energy and Minerals Section, serves as the principal investigator for the KGS portion. Parris says large volumes of water are injected into geologic formations as part of the hydrofracturing process for oil and gas recovery in unconventional reservoirs (i.e., “fracking”). Following fracturing, some of the water returns to the surface as part of the flowback stage, which cleans the well of drilling and treatment materials and allows oil or gas to flow into the well. “The question then becomes, what do you do with that water?” Parris says. “It has taken on all sorts of dissolved aqueous chemicals, some of which include metals that in high concentrations are toxic.”

Disposal in streams can harm biota, and neither the chemistry or volume of such flowback waters are suitable for wastewater treatment plants. Providing an alternate disposal framework is becoming more important with the rapid expansion of unconventional resource development using hydrofracturing. The project participants have been analyzing deep aquifers and reservoirs to determine which of them might be suitable for safe, economical, and permanent storage of flowback waters. Tom Sparks, of the Energy and Minerals Section, is also involved in the project; he has acquired

data from the Environmental Protection Agency through Freedom of Information requests on existing wastewater disposal wells in Kentucky for the project. These data list injection volumes and pressures for calendar years 2008 through 2012. In addition, he has compiled porosity and permeability data from the KGS oil and gas database.

“There are about 30 active injection disposal wells in eastern Kentucky,” Sparks says. “We received pressure and volume information for 21 of them.” The data from EPA will also help with future updates to the KGS publication by Sparks and others, “Class I Waste-Disposal Wells and Class II Brine-Injection Wells in Kentucky” (KGS Map and Chart 204, 2013). The locations of the active injection disposal wells are displayed on the map.

Each state has also provided cores from formations that are either active injection repositories or prospective for injection. Mechanical testing is being conducted on the cores to determine the injection pressures that would fracture the rock. KGS has provided cores from the Rose Run Sandstone, Copper Ridge Dolomite, and Mount Simon Sandstone.

The project goal is to develop a guidance document for industry operators looking for favorable areas in which to inject the flowback waters in the northern part of the Appalachian Basin, which stretches into Canada’s eastern provinces. In addition, Sparks is analyzing the porosity and permeability relationships in the reservoirs and how they vary spatially. “That’s not required for the project,” Parris says, “but we think it’s a good thing to do, because, independent of the overall report, our intent is to do a separate report specific to the Appalachian Basin in Kentucky.” ❖

## Water resources research award presented to Jim Currens by KWRRRI

**J**im Currens, of the KGS Water Resources Section, was recognized with the Bill Barfield Award for Outstanding Water Resource Research at the March 10 annual symposium of the Kentucky Water Resources Research Institute. The award is named for former KWRRRI Director William Barfield, who also served as the head of the biosystems and agricultural engineering program at UK.

The award cites Currens’s extensive data collection, mapping, and analysis of karst systems in Kentucky, including his investigation of nearly 250 cover-collapse sinkholes and compilation of a database on Kentucky sinkholes. Currens has written or co-authored more than 80 publications on Kentucky karst and coal reserves. He wrote “Model Ordinance for Development on Karst in Kentucky” (KGS Information Circular 25, 2012) to help guide construction on karst terrain for local governments.

Currens is a native of Versailles, Ky., and has worked at the Survey since 1979.

The namesake of the award, William Barfield, continues to serve state and national advisory groups on environmental issues. He is the author or co-author of five books and a developer of water-related software, and served as director of KWRRRI from 1988 to 1992. ❖



*KWRRRI Director Lindell Ormsbee with Jim Currens, recipient of the 2014 Bill Barfield Award, at the institute’s annual symposium.*



## Jim Cobb and Dave Harris report to legislature on CO<sub>2</sub> projects

The Kentucky House of Representatives' Natural Resources and Environment Committee invited KGS to its meeting on January 23 to report on the results of carbon storage research done with the funding and mandate of the Energy Independence and Incentives Act of 2007. Two members of the KGS Advisory Board, Chairman Rusty Ashcraft and Roger Recktenwald, also attended the legislative meeting. KGS Director Jim Cobb summarized the research projects for the committee members, thanked the legislators and project partners, and answered questions.

Energy and Minerals Section Head Dave Harris gave details of the results from the carbon storage and enhanced oil and gas projects completed with the \$5 million State funding plus contributions from partners. The projects studied deep wells in Hancock and Carter Counties to test deep geologic formations for their carbon-storage capability. Other projects on enhanced oil and natural gas recovery using carbon dioxide were also conducted in eastern and western Kentucky.

Partners were property owners, major energy companies, electric utilities, federal and State agencies, consultants, project management companies, and other private businesses. Their contributions ranged from land on which the projects were conducted to grants and contributions to in-kind services. ❖



*Rep Jill York, who lives in Grayson, not far from the Carter County deep carbon storage project, asked questions about the research.*

## KGS staff visit Corvette Museum sinkhole

KGS geologists visited the National Corvette Museum on February 20 to inspect the sinkhole that collapsed part of the museum floor. The collapse of the concrete floor early on the morning of February 12 caused significant damage to the building and eight vintage Corvettes on exhibit at the Bowling Green attraction. Museum officials were alerted to the incident when their security company's motion detectors sounded that morning. The factors that caused or contributed to the formation of the sinkhole are under investigation.

The Corvette Museum began work to recover and restore the vehicles a few days after the collapse and is working with geologists and engineers to determine how to best proceed in repairing damage to the building and reopening the exhibit area.

Sinkholes are the most visible and numerous of the karst features that characterize much of Kentucky's topography. About 55 percent of the state is underlain by soluble limestone rock in which sinkholes and other karst features such as springs, caves, and underground streams can form. Many geologic, topographic, and climatic factors combine to influence the development of sinkholes and karst. Human activities that locally alter natural surface drainage, infiltration, and groundwater flow also may contribute to sinkhole formation. More information about sinkholes and Kentucky's karst areas is available at the KGS website, [www.uky.edu/KGS/water/general/karst](http://www.uky.edu/KGS/water/general/karst).

Jason Polk, a Western Kentucky University geologist, guided the February 20 visit by Chuck Taylor, Junfeng Zhu, Jim Currens, and Matt Crawford. KGS actively compiles data on sinkholes throughout the state to document and better understand the causes and frequency of their occurrence. To report a sinkhole, visit [www.uky.edu/kgs](http://www.uky.edu/kgs) and enter "sinkhole reporting" in the search field. ❖



*Western Kentucky University geologist Jason Polk talks to KGS geologists during their visit to the National Corvette Museum.*

## Stratigraphic tops from KGS research projects now available

**K**GS recently released stratigraphic formation tops as part of the data available from online searches of the Survey's oil and gas records database. Users can view and download this valuable information free of charge for an individual well or for all the wells returned in a search. The most common users of the information are the oil and gas drilling industry, consulting firms, and academic researchers.

To model the geologic structure and thickness of an oil- or gas-producing horizon, the elevation (below sea level) of the top and bottom of the horizon are needed. Stratigraphic tops are the most efficient way to record those data, so they can be extracted and modelled in computer software.

A stratigraphic top is an interpretation, or "pick," by a geologist of the depth to the top or bottom of a stratigraphic horizon in a borehole using

geophysical logs, lithologic cuttings, or other data from well logs. Users will find that some investigators picked only the top of a horizon and not the base. Not all wells for which tops are available have stratigraphic data picked for all formations. Several tops may be recorded for the same formation by different people from different data sources.

"Over the years, any geologist was allowed to make an interpretation of tops for wells in the collection. So our database often contains several interpretations of a specific horizon at any given well site," says Associate Director Jerry Weisenfluh. "The difficulty is how to resolve the best one. And there's no easy answer to that. Our users seem to be quite accustomed to dealing with that." The different interpretations typically vary by only a few feet or less.

Users may also find different levels of information among wells. For ex-

ample, in the data for one well, there may be a pick for the top of the New Albany Shale and also picks for the tops of the Grassy Creek, Sweetland Creek, and Blocher Shales, all of which are members of the New Albany. Other wells may only pick the New Albany. The difference often depends on the nature of the project for which the data were used. The tops data uses a stratigraphic code for each interpreted geologic unit; a complete listing of stratigraphic codes and their use is available by searching for "stratigraphic codes" at the KGS home page, [www.uky.edu/kgs](http://www.uky.edu/kgs).

The information is provided as is, with no assurances as to accuracy or completeness, and users of the data assume all liability for use or misuse of the data. For more information, contact Carrie Pulliam at [carrie.p@uky.edu](mailto:carrie.p@uky.edu) or (859) 323-0543. ❖

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## Meteorite collection donated to KGS by Goshen couple

**A** collection of 10 meteorite specimens found in Kentucky was recently donated to KGS by Goshen, Ky., collector William G. Russell. Russell has collected meteorites found in locations around the world, and he and his wife Mary Ann will donate the remaining items in the collection to the Survey in the spring.

Among the more important specimens donated is a sample of a meteorite that fell through the roof of a house near Burnwell in Pike County on the afternoon of September 4, 1990. The KGS collection had no samples of the Burnwell meteorite until the Russell collection was donated. The largest piece of this stony meteorite is a 3.3-pound portion that went on display in the Smithsonian Institution in 1997.



*Warren Anderson, of the KGS Energy and Minerals Section, looks at one of the meteorites donated to KGS by William Russell, as he adds the collection to a display cabinet.*

One of the larger pieces donated by Russell is from an iron meteorite found in Clark County sometime before 1937. The original piece weighed more than 25 pounds.

All of the meteorites in the Russell collection have been researched to determine their type, chemistry, and relationship to the early solar system. The collection has gone on display in a case at KGS along with a collection of meteorites donated by retired UK chemistry professor William Ehmann in 1999.

Meteorites have been found in at least 25 Kentucky counties. The KGS publication, "Space Visitors in Kentucky: Meteorites and Meteorite Impact Sites in Kentucky," by Ehmann (KGS Special Publication 1, 2000) has information on 27 Kentucky meteorites and the three sites in the state believed to be the eroded remnants of ancient meteorite strikes. ❖

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*Energy and Minerals Section Head Dave Harris spoke to officials of Pioneer Natural Resources and faculty of the UK Department of Earth and Environmental Sciences after the February 14 dedication of the new Natural Resources Stratigraphy and Paleo-environments Laboratory. Harris outlined the cooperation between KGS and the department, including the hiring of students for part-time jobs and geologic experience at the Survey. The laboratory is situated on the renovated ground floor of the Slone Building on the UK campus. The project was undertaken with \$900,000 in support from Pioneer, a large independent oil and natural gas company based in Irving, Texas. The company provided an initial grant of \$600,000 and an additional \$300,000 in operating funds.*