

# Kentucky Cross Section

Earth Resources—Our Common Wealth

Fall 2014

## Outstanding unconventional oil and gas symposium held in Lexington

The first Eastern Unconventional Oil and Gas Symposium, held in Lexington November 5–7, attracted about 120 participants. The event was organized and sponsored by KGS and the UK Center for Applied Energy Research. It focused on issues and challenges related to energy production from unconventional resources, including

exploration, regulatory, environmental, and utility viewpoints. The organizers attracted participants from the oil- and gas-producing areas of the Appalachian, Illinois, and Michigan Basins of the eastern United States. KGS and CAER plan to make the symposium an annual event.

The opening plenary session began with a talk by Kentucky Energy and Environment Cabinet Secretary Len Peters,

“Planning Amid Uncertainty.” Peters addressed regulatory, environmental, price-volatility, and political aspects of the state’s energy policy. He acknowledged that some key assumptions of Kentucky’s 2008 Energy Policy turned out to be wrong, but concluded that the state and country must plan *because* of uncertainty, not *despite* it.

Joe Morris, vice president for geology with energy company

EQT, spoke during the opening session on energy resource development opportunities in the Appalachian Basin and public perceptions about energy resource companies. Rich Haut, a researcher with the Houston Advanced Research Center, discussed gas flaring from unconventional oil production and emerging technologies for using gas currently being burned off

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## Gooding testifies at congressional hearing on data preservation act

(Information for this story was originally printed in the American Geophysical Union’s publication, *Eos*: Showstack, R., 2014, Geological data preservation program receives bipartisan support: *Eos*, Transactions of the American Geophysical Union, v. 95, no. 39, p. 350.)

**K**GS Well Sample and Core Library Manager Patrick Gooding was one of six people who testified Sept. 17 on reauthorization of the National Geological and Geophysical Data Preservation Program Act of 2005.

“Each year, millions of feet of cores and well cuttings—along with the water data, geologic records, maps, seismic data, and mineral and fossil collections—are discarded and destroyed all over the United States. The loss of this resource, which costs millions of dollars to obtain,



Patrick Gooding (second from left) was among six people who testified in support of the National Geological and Geophysical Data Preservation Program Act of 2005 in Washington, D.C., in September.

is a tragedy for our nation,” Gooding testified.

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## Director's Desk

I recently received a request for information from an international company looking for ultra-low-magnesium limestone resources in Kentucky. This company specializes in precipitated calcium carbonate products used in a variety of specialty industrial applications. If they can find a source of stone that meets their specifications, they would hope to build a processing facility near the mines to supply product to the U.S. domestic market.

Requests like this would normally be forwarded to the KGS staff member with expertise in the field. In this case, our industrial limestone expert, Garland Dever, retired a number of years ago, and the program became inactive—an increasing problem in geological surveys with shrinking budgets and staff. Fortunately, geologists at KGS had spent the past several years digitizing all the field and laboratory data obtained by Dever

and his predecessors since 1949. These data include a tremendous collection of foot-by-foot chemical analyses and descriptions of carbonate rock from quarries across Kentucky. Field notes describing the geologic context of the samples have also been digitized for easy access. The availability of these electronic data allowed me to quickly focus on a single geologic horizon with high potential for stone with the right chemical composition, and a number of active quarries that produce it. This was just in time for a meeting with managers of the company, who happened to schedule a visit to the United States. Since then, we've visited a quarry and facilitated sample collection for further testing. The ability to respond quickly to this request has positioned Kentucky as a strong candidate for this new development.

This scenario reminds us of the important economic develop-



*Jerry Weisenfluh*

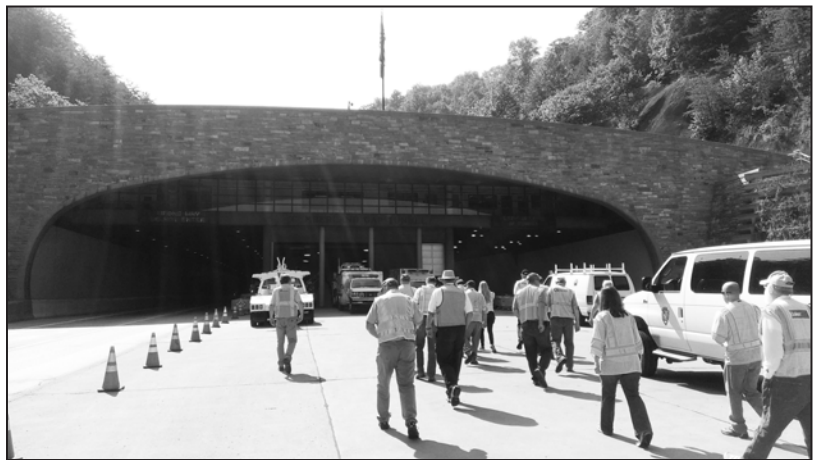
ment role that geological surveys can play across the nation. It also reinforces the critical need to preserve geoscience data of all kinds to facilitate geologic investigations for resource development and environmental stewardship. KGS participates in a national program administrated by the U.S. Geological Survey called the National Geological and Geophysical Data Preservation Program. Established in the 2005 Energy Policy Act, this program provides funds to geological surveys to catalog, curate,

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### *Oil and gas—continued from p. 1*

at oil drilling sites, both at the sites and at other locations.

Break-out sessions on the remaining two days covered a broad range of topics, including carbon storage in shales, heavy oil sands, shale gas reservoirs, water waste disposal and treatment, and regulatory updates. KGS presenters included Rick Bowersox, Dave Harris, Bart Davidson, Brandon Nuttall, and Cortland Eble. Extended abstracts for all of the papers presented are available at the meeting website: [www.euogs.org](http://www.euogs.org). ❖



*About 100 people attended the 14th Geohazards Impacting Transportation in Appalachia forum, Aug. 5–7, hosted by KGS. The annual event is sponsored by Marshall University's Center for Environmental, Geotechnical and Applied Sciences. Major topics discussed included rockfall and landslide mitigation, bridge scour and foundations, and tunneling. Participants also took a field trip to southeastern Kentucky, where they visited the 4,600-foot-long Cumberland Gap Tunnel along U.S. 25 where Kentucky, Tennessee, and Virginia meet.*

## New project investigates rare earth elements in coal ash

KGS staff began working in July with other UK departments, including the Center for Applied Energy Research, on preliminary assessments of rare earth elements in coal. The work is part of a broader effort to develop methods for recovering the elements from coal processing and combustion byproducts. Rick Honaker, chair of the UK Mining Engineering Department, is leading the effort, funded by the U.S. Department of Energy's National Energy Technology Laboratory. Rare earth elements are critical to hundreds of technology applications, including LCD displays, polished glass products, and new types of batteries.

Global production of rare earth elements has shifted to China

in recent decades, but China has limited its exports, creating a critical shortage in the United States for both consumer and strategic needs. Coal beds contain naturally occurring concentrations of rare earth elements, and some Kentucky coal beds have higher levels compared to coals from other parts of the country. Rare earth elements primarily occur in association with the inorganic (mineral matter) fraction of the coal. The rare earth-bearing minerals are associated with ash in the coal and can be concentrated during coal preparation processing or as byproducts of combustion.

The first step was collection of coal and refuse samples from historic sample archives, active mines, preparation plants, and

power plants. Samples are being analyzed by KGS staff and graduate students of the Mining Engineering Department in the KGS laboratory. The samples were preprocessed, ashing them for 6 hours, digesting them with several chemicals, and analyzing them with instruments in the KGS laboratory. Some of the sample processing is being conducted by engineers at Virginia Tech.

The results being compiled by UK Mining Engineering and Virginia Tech Mining Engineering will help the National Energy Technology Laboratory develop a report for Congress to determine if coal combustion and preparation processes are possible sources of economically recoverable rare

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## Evaluation of western Kentucky heavy oil and bitumen resources completed

A new study of sandstones in western Kentucky has resulted in an updated preliminary estimate of the heavy oil and bitumen resources of the area. The evaluation, done by Rick Bowersox of the KGS Energy and Minerals Section, indicates that tar sands contain at least 3.87 billion barrels of heavy oil and bitumen resources, with the largest resource in the Big Clifty Sandstone (2.46 billion barrels), followed by the Caseyville (1.04 billion barrels) and Hardinsburg (366 million barrels). Heavy oil- and bitumen-bearing sandstones—historically, asphalt rock, black rock, and tar sands—are found on the southern margin of the Illinois Basin in a belt extending 60 miles north

from Logan County to southern Hardin and eastern Breckinridge Counties. Unconventional surface to shallow-subsurface tar-sand resources are found in several sandstone formations in the region.

Bowersox reviewed records from 3,930 oil and gas wells, core-holes, and mines in the tar-sand belt for the project.

Previous estimates of the resources have ranged widely, from 73 million barrels to 3.1 billion barrels. Volumes of heavy oil and bitumen produced from the region by all methods have been, up to now, about 2.8 million barrels from all historical quarry production. Surface deposits were quarried for road surfacing from 1889 to 1957. There has been no com-

mercial oil production from the tar sands using an enhanced oil recovery process to date. Extraction of bitumen from the tar sands using a solvent, surfactant, or other industrial-plant process may be the key to developing this resource.

The only active tar-sands development project currently operating in Kentucky uses a water-based chemical to clean oil from the Big Clifty tar sand at a 121-acre site in northern Logan County. The surface-mining and pilot bitumen extraction operation began in the fall of 2013. No information is available about the volumes of bitumen that may have been recovered.❖

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## Kentucky minerals database available from KGS website

Thousands of records on minerals and mining in Kentucky are now available online through a KGS service providing information and location data on the state's ore mineral resources and their associated commodities. They include fluorite (fluorspar), galena (lead), sphalerite (zinc), barite, iron, nitrates, and phosphates. During the past decade, KGS staff Warren Anderson, Tom Sparks, and Richard Smath developed a database of scanned documents, including core logs, cross sections, maps, chemical analyses, and unpublished reports.

Sparks built the original version of the spatial database, and Doug Curl, who heads the Survey's Geologic Information Man-

agement Section, developed the online map service that displays the locations from which the data were drawn. The database provides access to more than 20,000 files containing information about the state's ore-bearing mines and their associated minerals, particularly in the three major mineral districts in central, southern, and western Kentucky. Any core data with significant mineral information were also included in this database, especially if they came from the mineral districts.

"With the recent opening of a new fluorite mine and additional fluorite exploration drilling in western Kentucky, this information should be very valuable to the mining community," says An-

derson. The database is available online at [kgs.uky.edu/kgsmap/KGSMineral](http://kgs.uky.edu/kgsmap/KGSMineral). The files are organized by links to mine names for western Kentucky, and by county names for central and southern Kentucky. Spatial and tabular information about a mine or mineral site is available, along with scanned document images.

A link called "About This Service" provides instructions on how to use it. Panels on the left side of the page include a legend describing icons on the map, layers that can be turned on and off, and search and print utilities. Information can be searched by name (general to specific),

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## KGS and consortium partners begin research on the Berea Sandstone

The KGS Energy and Minerals Section has organized an industry-funded consortium to study the Devonian Berea Sandstone oil play of northeastern Kentucky. It is funded by eight energy companies, and research is performed by KGS, the U.S. Geological Survey, the R.J. Lee Group, and the Ohio Geological Survey. The Berea oil play is notable for two reasons. First, for decades the Berea has been a major producer of natural gas. Second, the current geographic focus of the play in Lawrence and Greenup Counties now accounts for more than 10 percent of Kentucky's oil production. Development of the oil play is attributable to horizontal drilling and hydraulic fracturing technology.

Energy and Minerals Section Head Dave Harris calls it an ideal research topic. "The presence of oil in the Berea Sandstone brought up a lot of questions," he says. "It's an enigmatic oil play because it's in an area where source rocks are thought to be immature and shouldn't be generating oil." One of the questions the consortium hopes to answer is whether thermal maturity maps of the Devonian Ohio and Mississippian Sunbury Shales (possible source rocks) are inaccurate. Thermal maturity of a source rock is a measure of its stage of hydrocarbon (oil and gas) generation.

Steve Greb and Marty Parris of the Energy and Minerals Section are principal investigators on the project, which began in the

summer and will take 18 months. In addition to the source rock work, the consortium will use numerous cores, logs, and outcrops to characterize the detailed stratigraphy and structure of the Berea in the oil-producing area. This work will provide the stratigraphic and structural framework needed to successfully plan and drill horizontal wells in the Berea interval.

Harris says the consortium hopes to develop new, more accurate methods to assess the thermal maturity of organic-rich shales. Other issues to be addressed include the porosity and permeability of the sandstone as well as the actual source of the oil. The main question about the source is whether oil migrated from deeper,

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*Gooding testifies—continued from p. 1*

The preservation program received bipartisan support from members of the House subcommittee that held the hearing. The annual authorization for the program has been \$30 million, but Congress has only been able to allocate a total of \$8 million since 2007.

Florida Geological Survey Director Jonathan Arthur, president of the Association of American State Geologists, said AASG supports the program. Although Congress's modest appropriation levels in recent years have not been sufficient for intended capital improvements to geologic collection facilities, he added, the

program has helped with some important data preservation.

Kevin Gallagher, USGS associate director of core science systems, also testified. "The need is most urgent in just increasing the scale of the facilities," Gallagher said. "We've done a great job here in the first 8 years of the program in rescuing some collections, inventorying collections, cataloging." Gallagher urged that facilities be provided the resources to expand and preserve more collections, allowing work to continue with the National Digital Catalog to make the collections accessible. ❖

*Director's desk—continued from p. 2*

and store geoscience holdings of all kinds for the benefit of the nation. The vision of this program is to build and expand facilities to house rock and mineral specimens and associated data collected by surveys. The low level of appropriated funds has limited the work to inventories and data management, but nevertheless has resulted in many success stories like this one. Patrick Gooding, manager of the KGS Well Sample and Core Library, was invited by Congress to testify at a hearing in September related to reauthorization of the NGGDPP act. (See the story on page 1.) It's important that our representatives in Congress understand the importance of this work and advocate for increased funding. If you're in a position to do so, please reinforce that message with your representative. It just might facilitate the very kind of economic development we hope we have attracted by preserving our industrial limestone data. ❖



*About 200 people came to KGS Wednesday evening, Oct. 15, for the Earth Science Week open house. KGS staff, UK geology students and professors, the Bluegrass Gem and Mineral Club, and other organizations set up displays and demonstrations for the annual event. (Above) Susan Miller and Judy Lundquist made trilobite molds for children who attended the open house.*

*Berea Sandstone—continued from p. 4*

more mature areas into the shallow, less mature area of the present play or whether the oil was generated locally. The Berea Sandstone study may have a broader application to other low-maturity areas, Harris says, and it could expand the potential productive area for unconventional reservoirs. One potential area is parts of the New Albany Shale in western Kentucky. ❖



*KGS editor Meg Smath hosted the 48th meeting of the Association of Earth Science Editors Oct. 8–10 at KGS. Topics discussed included writing good abstracts and editing manuscripts to meet reader expectations. Participants took field trips, including a visit to Camp Nelson to examine the area's stratigraphy and its effects on the Civil War battle there and a trip to Shaker Village at Pleasant Hill in Mercer County (above).*

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*In August, Steve Greb, Richard Smath, and Bart Davidson helped judge rock, mineral, and fossil displays prepared by elementary and high-school 4-H students from across Kentucky. These displays are part of the 4-H exhibition at the Kentucky State Fair each year, set up at a 4-H youth village called Cloverville.*

*Minerals database—continued from p. 4*

commodity, mineral, or location (county or quadrangle).

This database was made possible by the contribution of records from geologists, mining and exploration companies, and researchers, as well as students and staff who scanned and organized these records over the years of the database's development.❖

*Rare earth—continued from p. 3*

earth elements. Interim Director Jerry Weisenfluh and Cortland Eble of the Energy and Minerals Section are leading the KGS portion of the work. Jason Backus and Andrea Connor are conducting the analysis in the KGS laboratory.❖