



Kentucky Cross Section

Earth Resources—Our Common Wealth

Spring 2013

Carter County deep well drilled; testing program being prepared

Drilling of a deep well in Carter County was completed in early April, reaching a total depth of 4,835 feet. Eight cores from the well were sent to a laboratory in Houston for a variety of tests.

“Next we’ll do the testing of the rock in the well itself,” says co-principal investigator Rick Bowersox, of the Energy and Minerals Section. “That will involve collecting water samples and conducting tests to determine the rock strength. Once all this is completed, we’ll plug and abandon the well.” The testing program is being designed and equipment scheduled for the testing, which Bowersox says could be finished by mid-

June. Steve Greb, also of the Energy and Minerals Section, is the principal investigator on the project.

KGS partnered with Hanson Aggregates to get access to property at Hanson’s AA Limestone Quarry in northern Carter County. Hanson Aggregates is a subsidiary of Lehigh Hanson Inc., part of the HeidelbergCement Group. Funding for the project came from the Energy Independence and Incentives Act passed by the Kentucky General Assembly in 2007. The legislation also funded part of the cost of a similar research well in western Kentucky, as well as research into enhanced oil and gas recovery in the state.

The research from the deep wells will help KGS and the State learn about reservoir rock properties in the

region and gather data needed to evaluate any potential for future carbon dioxide storage along the Ohio River industrial corridor. In the deep subsurface around both wells there are several geologic formations with properties that may be suitable for CO₂ storage in the future. In addition, overlying impermeable layers will help ensure that any carbon dioxide stored in deeper formations remains deep underground. Industrial-level carbon storage is not planned for the Carter County site or the western Kentucky well site.

While the Carter County project is active, staff in the KGS Water Resources Section are sampling several water wells on private property surrounding the site for independent testing. The sampling was not required, but KGS has provided it to help assure property

owners that the project will have no impact on their water.

Other research at the University of Kentucky may also benefit from the Carter County well. Additional small rock samples were taken from the well at 100-foot intervals and provided to the Center for Pharmaceutical Research and Innovation at UK’s College of Pharmacy. Center Director Jon Thorson says the samples will be analyzed for the presence of novel molecules, which might be useful for developing new drugs.

“We’re interested in how nature makes unique molecules and the activities these molecules provide,” Thorson explains. “A number of natural products have been developed into drugs, and we are looking for unusual environments

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Recent KGS publications highlight Kentucky resources, wells, and Survey data

Several recently released KGS publications showcase the variety of research and information gathered by Survey staff. Among the most recent publications is “Seismic Velocity Database for the New Madrid Seismic Zone and Its Vicinity” (Information Circular 27). The lead author is Qian Li, of the Lanzhou Institute of Seismology. This is the first KGS publication authored by one of the visiting Chinese scholars in our exchange program. Li worked with KGS

staff to create a database of the seismic information collected over 20 years, particularly from the Upper Mississippi Embayment. The new publication describes the process of acquiring the data, compiling it into a database, and its usefulness.

Two other publications describe Kentucky’s geologic resources. “Mines and Minerals of the Western Kentucky Fluorspar District” (Map and Chart 201) shows all the known mines, mineral prospects, and igneous intrusions (dikes or

sills) of the Western Kentucky Fluorspar District. Warren Anderson, of the KGS Energy and Minerals Section, lead author of the publication, compiled the locations from in-house, donated, and loaned maps and files, resulting in an updated comprehensive catalog for the district. Retired KGS geologist Garland Dever Jr. and Associate Director Jerry Weisenfluh co-authored “Limestone and Dolomite Resources of Kentucky” (Map and Chart 203),

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Have I mentioned our efforts at data dissemination lately? A user of the KGS Web services recently spoke with us about how valuable the data accessible from our Web site is to practicing geologists and engineers in Kentucky. KGS began this effort more than 10 years ago, and I'm always pleased to hear anecdotes about the benefits of our efforts. With declining State and federal support and the strain on the KGS budget, there is the temptation to turn this free and accessible resource into a revenue-generating enterprise. I've written before in these pages that our guiding philosophy was to make the data freely accessible in order to fulfill the KGS legislative mandate and to encourage economic development and wise use of natural resources. I believe that doing these things is in everyone's best interest. Adopting this new philosophy required a change in the KGS culture, but resulted in increased pride and energy among the staff to launch new research endeavors and create new computer-based data-distribution methods.

I'm absolutely convinced that we made the right decision, and I'm committed to continuing and improving the services that we provide.

One of the things we've learned over the last decade is not to underestimate the value of historical data. It's tempting to "clean house" by discarding old boxes of records taking up valuable space on shelves. Over and over we have discovered data that have been unused for decades, but have importance for current projects we are working on. Data preservation is an integral aspect of what geological surveys have always been about; now we have tools and programs, such as the National Geological and Geophysical Data Preservation Program, to effectively bring these data into public use.

Over the last decade, we have put a lot of effort into developing our Web site and preparing data for distribution. One of the benefits of making data easily accessible is that the greater use of the information results in improvements in data quality. Another way to increase data



Jerry Weisenfluh

quality is through active research programs. Our focus for the next decade is to conduct new research programs that collect high-quality data, enhancing what is already available, and continuing to make it freely and easily available. We think this is the correct strategy to compete in the new-normal environment of limited resources but continuing dedication to our mission. ♦

Former Advisory Board chairman Zegeer dies at 90

David Zegeer, who chaired the KGS Advisory Board in the 1980's, died on December 10, 2012. During his career, he was a corporate mining executive, head of the U.S. Mine Safety and Health Administration, and community leader in health care, education, and civic involvement in his adopted hometown of Jenkins, Ky. He had a worldwide reputation as a mining engineer and consultant. He served on numerous civic boards in addition to the boards of several mining and equipment companies, the Kentucky Coal Association, KGS, and the Kentucky Mining Institute. He was an adjunct professor in the College of Engineering at the University of Kentucky. Zegeer, who was 90, is survived by his wife of 36 years, Louise Jimm Zegeer, three children, and four grandchildren. ♦



David Zegeer

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to identify new natural products." The center that Thorson heads has been in operation at UK for about a year, and he says a trend in pharmaceutical development is to look for molecules in unusual environments, such as sea beds and thermal vents. The unique biodiversity of the Appalachian Region, as well as the conditions involved in coal mining and deep drilling, also provide such environments for this research, Thorson says.

Many pharmaceutical products have been developed from microbes found in natural environments rather than developed in a laboratory, which can be a major undertaking. "What we do is try to isolate the molecules, characterize them, look at their mechanism and, if it's a unique mechanism of action that has an impact on disease, obviously try to use that as a potential lead structure." The process can involve months of work propagating bacteria found in the samples and identifying those that appear to be producing novel molecules. When those

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Several KGS researchers have initiated seed projects funded from University of Kentucky enrichment funds, hoping to attract external grants to continue the research. Two of these projects are described here.

Matt Crawford monitoring a Boyd County landslide

Matt Crawford, of the Geologic Hazards Section, is monitoring a landslide that caused the evacuation of a home in Boyd County in northeastern Kentucky. The county's emergency management office and the FIVCO Area Development District contacted Crawford to assess the slide. The homeowner and the county are applying for a federal grant to have the home bought out and demolished because of structural damage from the slide.

"When the KGS internal project opportunity came up, I thought it would be a great idea to do a landslide monitoring project," Crawford says. "Monitoring is pretty common among people doing landslide research." He has been gathering information for a database on landslides in Kentucky for several years.

"I needed to choose a landslide wisely for the project. I didn't want a slide that was moving too fast. You don't want your boreholes and instruments to be sheared off in a week, the project to be over, and all that money down the drain! And I didn't want one that was moving too slowly, where I wouldn't get any data."

Crawford visited several landslides and chose the Boyd County site for

several reasons. The homeowner had no objections because he is trying to sell the property through the federal program, and the site's characteristics are representative of much of eastern Kentucky. Crawford wants to determine the depth, magnitude, and rate of movement for the slide. To do this, six boreholes were drilled at the site. Two are cased holes for inclinometers, which can measure displacement within a hundredth of an inch. Crawford takes the inclinometers to the site each time he visits to check for movement.

Two of the holes have standpipe piezometers to measure groundwater levels, and one includes instruments to continuously log water levels. The other two are cased holes drilled through the failure surface to measure electrical resistivity. Junfeng Zhu, of the Water Resources Section, will help with that phase of the work. TERRACON drilled the holes at the site and provided the instruments for the project. The company also analyzed some samples taken during the drilling.

Crawford says he plans to monitor the slide for a year, visiting the site at least every three weeks. He also wants to do a couple of more monitoring projects in locations with different underlying geology, although this site should provide

information applicable to many other landslides in the region.

"All landslides fail for some pretty common reasons. Triggers and other factors can be different, but there are always those common denominators." ❖

Junfeng Zhu identifies sinkholes remotely with LiDAR data

Sinkholes and the damage they can do to structures and infrastructure have been in the news recently in Kentucky and several other states. Karst features, including sinkholes, can also have an impact on water quality by serving as rapid pathways between surface water and groundwater, providing little filtration for contaminants. That situation has led to an internal project developed by Junfeng Zhu of the Water Resources Section.

Zhu proposed a pilot study that uses existing LiDAR (Light Detection and Ranging—optical remote sensing technology) data for Bullitt County to map sinkholes in a karst-prone area of the Floyds Fork watershed. More than 90 percent of the watershed is classified as karst-prone. Zhu's project will explore several remote methods that could automatically identify sinkhole features.

In his proposal, Zhu noted that the Environmental Protection Agency is developing a watershed-flow and water-quality model for determining total maximum daily loads for the watershed. These loads are calculations of the maximum amount of a pollutant the watershed can receive and still safely meet water-quality standards. But the EPA model, which is still being developed, suggests that sinkholes have little impact on stream flow and water quality. Zhu suspects that the inconsistency may be partially caused by insufficient sinkhole data, even though existing sinkhole information from KGS are incorporated in the model.

"LiDAR technology, which provides high-resolution information about the earth's surface, could have great potential for mapping sinkholes in high detail more efficiently," Zhu says. He hopes to test some existing general methods of identifying sinkhole features from LiDAR data and to develop an identification method specifically for sinkholes. "This could help us show that there are more sinkholes in the Floyds Fork watershed than the EPA might suspect."

LiDAR data for the study area were used to identify 1,962 probable sinkholes;

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Junfeng Zhu and Matt Crawford check one of the boreholes drilled at the Boyd County landslide, just downhill from the home damaged by the slide.

Andrews and family receive UK recognition for DanceBlue support

Geologic Mapping Section Head William Andrews and his 10-year-old daughter Elena recently attended the UK Division for Student Affairs Recognition Ceremony on April 26 to receive a Faculty Partner Award, which recognizes UK staff or faculty members who demonstrate significant support for the Division of Student Affairs. The recognition was the result of the Andrews family's work to support DanceBlue, an annual student-run dance marathon that raises money for the pediatric hematology/oncology clinic at UK's Kentucky Children's Hospital.

"DanceBlue benefits the clinic that treats our 7-year-old son Charlie for his blood disorder, and Elena likes to do projects to help the people who help her brother," Andrews explains. "So we as a family run lemonade stands in the summer, and we sell fleece scarves at the holidays to support DanceBlue fundraising activities, help with other fundraisers, and try to support the DanceBlue students at their different events." DanceBlue students invite Elena to run her lemonade

stand as the one source of refreshments for the spectators at the dance marathon.

Andrews family members staffed the entire 12 hours of the 2012 dance marathon and the 24 hours of this year's DanceBlue, which raised \$1.1 million for the recently renamed DanceBlue Clinic. Elena is in her fourth year of fundraising for the event. She recently raised another \$40 at a school function.

"But it's not about the money," Andrews says. "It's about those college kids who are there working so closely with those clinic kids and their families." UK students involved with DanceBlue volunteer in the clinic, adopting young patients and their families to support them throughout the year. They are at the clinic when families visit and interact with the families at the marathon and other activities. Andrews calls the support the students give to the families and patients "phenomenal."



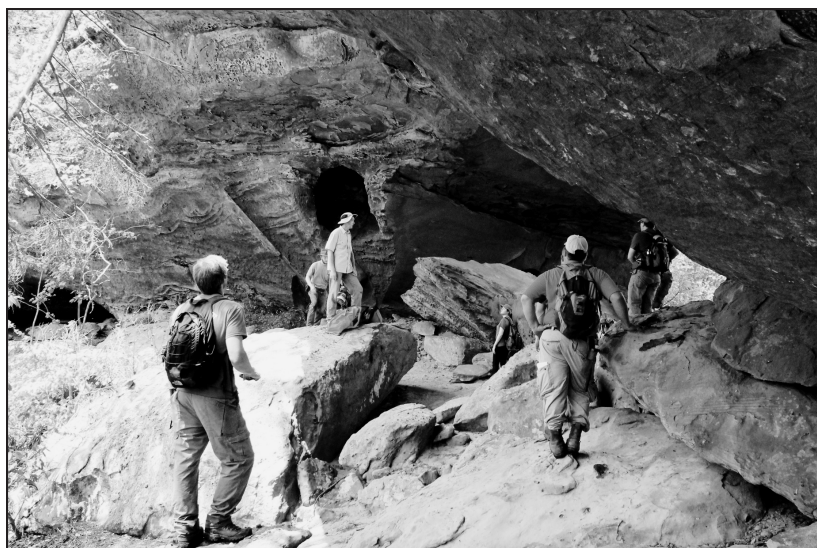
William Andrews and his daughter Elena with UK Vice President for Student Affairs Robert Mock and UK President Eli Capilouto at the Faculty Partner Awards ceremony.

"We don't need that support ourselves so much because we're local," he adds. "We're not at the clinic that much, but we've seen it, and we want to support something so positive."

All funds raised by DanceBlue are matched by the Kentucky Tobacco Settlement to benefit the UK Markey Cancer Center for treatment and research.❖



Geologic Hazards Section Head Zhenming Wang and seismologist Seth Carpenter presented a dedication plaque for the newest instrument in the Kentucky Seismic and Strong-Motion Network to Perry County Public Library Director Elaine Couch on May 23. The seismic station was installed at the library in Hazard last December. The station, with both weak- and strong-motion instruments, was dedicated to the memory of Hazard native Jonathan McIntyre. McIntyre worked at KGS and managed the network until his accidental death on the campus in June 2011. A display about earthquakes and the seismic network was set up in the library after the installation of the instruments.



KGS Geologic Mapping Section staff and others stop at an arch during an April 9 field trip in the Red River Gorge Geological Area. The 15 staff members and students spent the day at the site near Slade in Powell County focused on taking field notes and developing mapping techniques.

Annual seminar focuses on emerging geoscience issues



Water, energy resource, mineral, hazard, and other geoscience topics were the focus of the 53rd annual KGS seminar on May 17. Seven speakers addressed these issues in the morning at the KGS Well Sample and Core Library, to an audience of 120. KGS staff also set up posters and answered questions about their research during a morning break. Participants had a chance to discuss the KGS mission with the Survey's Advisory Board.



During the seminar, the Kentucky Section of the American Institute of Professional Geologists gave out its annual recognitions, including its Geologist of the Year Award. This year, Geologic Mapping Section Head William Andrews received the award, which cited his work to hold refresher courses for geologists preparing for the professional registration exam. KY-AIPG President Trent Garrison presented the award to Andrews.

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which depicts the distribution of the 13 rock units from which limestone and dolomite have been commercially produced in the state. Locations of active and abandoned operations, obtained from State agencies, are also shown, which is useful for the stone quarrying and mining industry, property owners, and others interested in Kentucky's geologic resources.

An updated version of "Geology of Mammoth Cave National Park, Kentucky" (Map and Chart 186), first released in 2008, has been produced and will go on sale at the park's gift shop. Author Matt Crawford, of the KGS Geologic Hazards Section, reduced the size to 42 x 28 inches, to make it easier to handle. He also updated the text and figures and reclassified the geology. Mammoth Cave has initially ordered 40 copies of the new version.

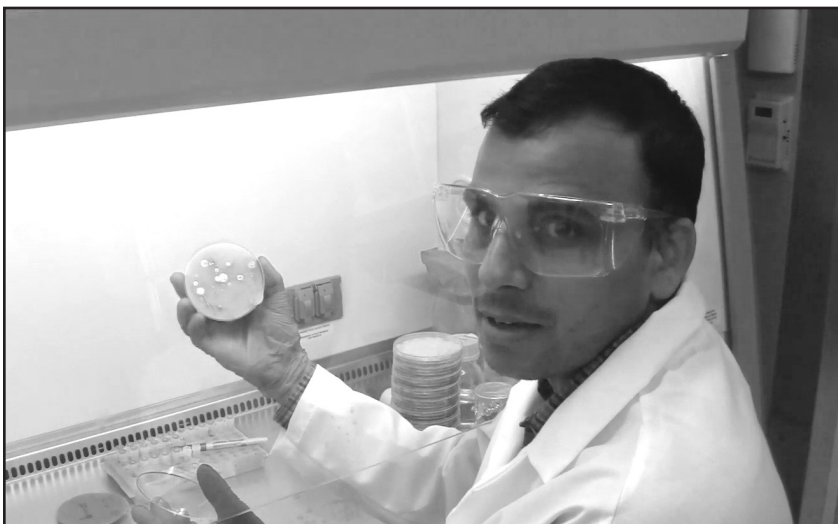
A new map, available for free download from the KGS publications Web site, provides locations and other information on disposal wells for industrial wastewater, hazardous chemicals, and brines. "Class I Waste-Disposal Wells and Class II Brine-Injection Wells in Kentucky" (Map and Chart 204), will be useful for the oil and gas industry as well as people interested in safe underground waste disposal in the state. Principal author Tom Sparks, of the KGS Energy and Minerals Section, says it can help industries determine the best sites for wastes that can be injected underground for disposal. ♦

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molecules can be produced and isolated, their potential value for pharmaceutical research can be investigated.

With only a year of work so far, no new molecules suitable for pharmaceuticals have been found by the center. But Thorson says many novel molecules that don't have pharmaceutical usefulness may be valuable for agricultural, veterinary, or other purposes. He and his colleagues are creating a repository of such discoveries to allow UK researchers in other fields to find potential uses for them in their fields of study.

Why look for such substances in the Carter County well? "Mostly because it's something that others haven't really tapped into as a potential environment for this," Thorson says. "So we're very interested just to see what's there." ♦



Madan Kharel, a researcher in the Center for Pharmaceutical Research and Innovation, processes a sample from the Carter County well.

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KGS student worker Patrick Taylor checks sinkholes initially identified by LiDAR data in Bullitt County.

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418 had been previously mapped in the same area. Sixty-two features identified as sinkholes by LiDAR have been inspected by student worker Patrick Taylor and other KGS staff for the project. Fifty-six of them, or 90 percent, had been correctly identified as sinkholes.

The results from this pilot project will benefit the total maximum daily loads study, but because about 55 percent of Kentucky is underlain by carbonate rocks, the project should also provide insight into the feasibility of using LiDAR to map sinkhole features for karst areas throughout the state.❖