Kentucky Geological Survey

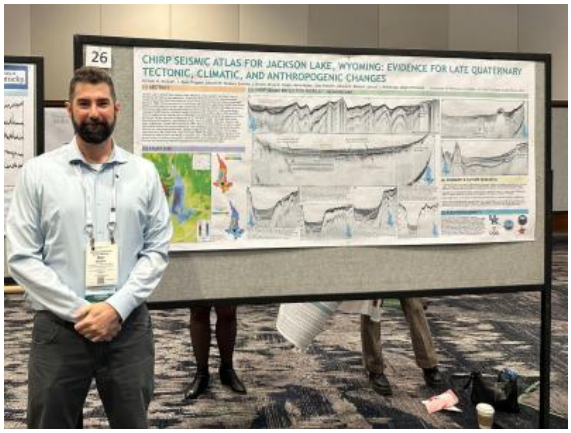
2024–2025 Annual Report

Director's Letter

“Every new beginning… comes from some other beginning’s end.”

Dear friends,

2025 marked my first full year as the state geologist and director of the Kentucky Geological Survey (KGS). KGS tradition dictates that with the onboarding of a new director, a new survey begins. We are mindful of the past at KGS—our history is long and remarkable, and our service mission to the Commonwealth and its people remains the foundation of our



State Geologist and KGS Director **Mike McGlue** presenting his poster at the Rocky Mountain Section meeting.

culture. That said, a famous late 20th century philosopher once said that “Every new beginning… comes from some other beginning’s end.” It is in that spirit that we work to honor our past and embrace the future. Our goal is to intentionally seek opportunities to make the 14th Kentucky Geological Survey one of the very best state geological surveys in the nation and the premier center for geoscience research and engagement in the Commonwealth. We center credibility and integrity, and these principles were used to guide the development of a new strategic plan, which emphasizes five key tenets and directly aligns us with the strategic, land grant mission of the University of Kentucky:

1. Science as service, including promoting geology across the Commonwealth
2. Building resilience for Kentucky through convergence research
3. Our evolving relationship with geology in the age of artificial intelligence
4. New and emerging energy, low carbon solutions, and energy infrastructure
5. Taking care of our KGS people

The 14th Kentucky Geological Survey evolved considerably in 2025 to meet the high expectations of this new strategy, and I am enormously proud of our people for their exceptional efforts. In the pages of this annual report, you will find details on many of the successful KGS operations around Kentucky in 2025. A few highlights that I consider particularly noteworthy:

- A new leadership structure that focuses on supporting a tranche of nimble science teams with both research and engagement missions. The teams of the 14th KGS are Landscape Evolution and Mapping, Landslides and Engineering Geology, Earthquakes and Geophysics, Critical Minerals and Geochemistry, Fossil Energy and Subsurface Geology, Hydrogeology and Karst, Geohealth, Environmental Geology, and Analytical Chemistry Laboratory. These teams will be intentional about cross-disciplinary collaboration, open and transparent communication, and internal talent development.

- Six new KGS laboratories were built in 2025 using funds from the Office of the Vice President for Research (VPR) as well as sponsored projects like the NSF-UK CLIMBS collaboration. These facilities mark a major step in our evolution as a research center and provide region-leading capacity in the geology of critical minerals (GEMS), flood modeling (SP&M), landslide monitoring (LAZR), water availability forecasting (HydroLab), geohealth (CHAOS), and environmental sedimentary geology (SQRL).

- A new KGS website was launched, providing unlimited free access to a wealth of geological, hydrological, and environmental data to our stakeholders. The website also highlights our people and their remarkable work.

- Significant moves were made to strengthen our staff through promotions and position reclassifications. These steps were taken to maximize career growth and address some historical practices that undermined employee satisfaction and retention. We have also added to our staff at the Henderson office, acknowledging the large and growing need for hydrogeological research in western Kentucky.

- A broad effort to engage more effectively with the public is well underway through new outreach products (e.g., a wonderful arches pamphlet), professional development opportunities (e.g., workshops at our annual meeting), and educational programs (e.g., the Geoscience Education Working Group to support institutions of higher education offering geology programs in the state). These efforts complement our Paul Edwin Potter Internship Program and other initiatives to serve the state.

Despite the progress, 2025 also brought challenges, as is to be expected with all transitions. Inarguably the most significant challenge will be to move forward following the departure of five senior staff **(Steve Greb**, **Marty Parris**, **Tom Sparks**, **Drew Andrews**, and **Rick Bowersox**); we wish our colleagues all the best in their retirements. Replacing the skills and institutional knowledge of these fine scientists will be a focal point of our recruiting for the next several years. All of this coincides with shifting priorities amongst our federal sponsors, new state legislation, an evolving relationship with our work owing to AI, and geology programs across the state facing obstacles with student enrollments and retention. How we traverse these shifting sands is likely to define the future of KGS for several decades. I remain grateful to the KGS advisory board, the UK VPR, and our collaborators and stakeholders across the Commonwealth for their support and encouragement.

With warm wishes for a prosperous 2026,

M.M. (Mike) McGlue, Kentucky State Geologist and KGS Director

Engagement

Engaging with the people of Kentucky is a privilege that KGS values. We serve the Commonwealth by providing research-ready samples, data, high-quality publications, and informative experiences. Whether people explore our archives online or at the Earth Analysis Research Library (EARL), interact with our social media posts, or participate in one of our outreach or educational events, we hope they leave with a better understanding of geology's role in their lives.

Archives

This past year brought us new employees and new projects. **Sierra Ison** joined our team to initiate the Oil and Gas Wellbore Cuttings Collection Assessment, Rehousing, and Research Contributions project, funded by the U.S. Geological Survey (USGS) National Geological and Geophysical Data Preservation Program (NGGDPP). **Angela Torres-Zamora** came to KGS to describe mineral cores and create relevant educational materials for the ongoing Save America's Treasures (SAT) project funded by the Institute of Museum and Library Services (IMLS). **Charlie Hall** brought the USGS NGGDPP-funded Norris Well Elogs Collection Identification, Scanning, and Online Dissemination project to an early conclusion before assisting **Olivia Teleky** in scanning and organizing essential research documents for the KGS Publication and Returned Data Identification, Cataloging, and Salvage project. **Natalie Fields** and **Kurstin Williams** continued to contribute to the SAT project before transitioning to the new USGS-funded Rock Core Photography, Description, and Geochemical Analysis project. **Monte Rivers** and **Bailee Hodelka** worked with **Kurstin Williams** to develop protocols, standard operating procedures, and training material for analyzing geophysical properties of rock, soil, and sediment cores using our Geotek Multi-Sensor Core Logger.

Cheyenne Hohman hired **Percy Devereaux** to scan archived KGS publications and enter item-level metadata under the IMLS-funded project Connecting Geoscience Collections: Expanding Research Potential through Metadata at the Kentucky Geological Survey. This year, our publications archive staff added 5,163 items (including 2,965 KGS publications) to our new database, scanned 364 KGS publications and 707 Geologic Quadrangles, added 134 scans to the Internet Archive, and rebound 5 heavily worn and damaged KGS publications.

Education

KGS closed out another successful year of the Paul Edwin Potter Internship Program with an intern showcase for the 2024 cohort. Our interns, **Madison High**, **Sierra Ison**, **JT Gribbins**, **Darryl Woods**, **Abbie Grzykowicz**, and **Emelia Harris**, presented their work in Red River Gorge, which covered topics ranging from cave mapping and geochemical analysis to bio inventories.

Figure 1. The 2025 interns enjoying a wet field day at Mundys Landing.

The 2025 cohort focused on the hydrogeology, karst, and biodiversity features of Mundys Landing in Woodford County, Kentucky.

- **Finley Gardner**, “Understanding the Effects of Agricultural Cultivation on Soil Infiltration Rates at Mundy’s Landing, KY.”
- **Emmerson Willhoite**, “Investigating Factors that Influence Bird Abundance and Distribution.”
- **Maysn Hughes**, “Using Electrical Resistivity Tomography to Investigate Subsurface Faulting.”
- **June Lennex-Stone**, “Exploring Depth to Bedrock Estimation.”
- **Hala Ison**, “Effects of Different Vegetation Density and Type on Flooding in the Mundy’s Landing Area.”
- **Victoria Apostolides**, “Examining the Effects of Precipitation on Flood Severity.”

Figure 2. [Left to Right] **Maysn Hughes**, **Victoria Apostolides**, **Emmerson Willhoite**, **Hala Ison**, **June Lennex-Stone**, and **Finley Gardner** on their final day of their 2025 internship.

This year's mentors included **Meredith Swallom** (primary), **Hudson Koch**, **Donna Robinson**, **Doug Curl**, and **John Hickman**. The mentors led multiple field days, which included teaching the interns various field methods, providing equipment training, and demonstrating sample collection techniques.

Outreach

This year's KGS Annual Seminar, "Geology in the Modern World," hosted over 170 attendees representing industry, state government, students, and faculty from across the Commonwealth. The event emphasized professional development and highlighted recent advances in geoscience research across Kentucky, with a focus on karst landscapes, groundwater systems, and natural hazard assessment.

Our keynote speaker was Sarah Gaddis of the Kentucky Division of Water (DOW), who discussed the role of DOW scientists, engineers, and regulators working in the state. **Desireé Cunningham** provided a compelling update on efforts to integrate lidar and machine learning to map and monitor sinkholes in the Barren River Area Development District (BRADD), significantly enhancing hazard evaluation. **Glynn Beck** shared updates on work using drone-based thermal imaging and subsurface sensors to study groundwater flow and elevation changes in western Kentucky. A panel of KGS researchers gave updates on the CLIMBS initiative and new EPSCoR-supported labs, emphasizing interdisciplinary approaches to environmental monitoring and infrastructure resilience.

The morning presentations were followed by two concurrent hands-on workshops on the practical applications of KGS data and rock cores for mitigation planning and limestone aquifer characterization.

Figure 3. Participants enjoying the Landslide Hazards and Karst Aquifer and Core Workshops.

Matt Crawford, with colleagues from the Landslides and Engineering Geology Team, provided a comprehensive overview of how to apply KGS landslide data in the planning, development, response, and outreach stages of mitigation projects. Participants completed exercises on accessing, downloading, and exploring practical use cases for the data.

Chuck Taylor, **Angela Torres-Zamora**, **Glynn Beck**, and **Junfeng Zhu** led a workshop demonstrating the benefits of rock core testing versus field borehole assessments in limestone aquifer hydrogeology. Beginning at EARL, participants studied core features such as grain properties, depositional facies, visible porosity and permeability zones, and the potential for karstification, along with how these features influence groundwater flow and contaminant movement. Participants then traveled to the Kentucky Horse Park, where they learned about the findings of the NSF karst data fusion project and watched a demonstration of the new KGS borehole logging tool.

Figure 4. At left, **Angela Torres-Zamora** at EARL leading a presentation about rock core characteristisc to workshop attendees. At right, seminar workshop attendees at a demonstration of the new KGS borehole logging tool.

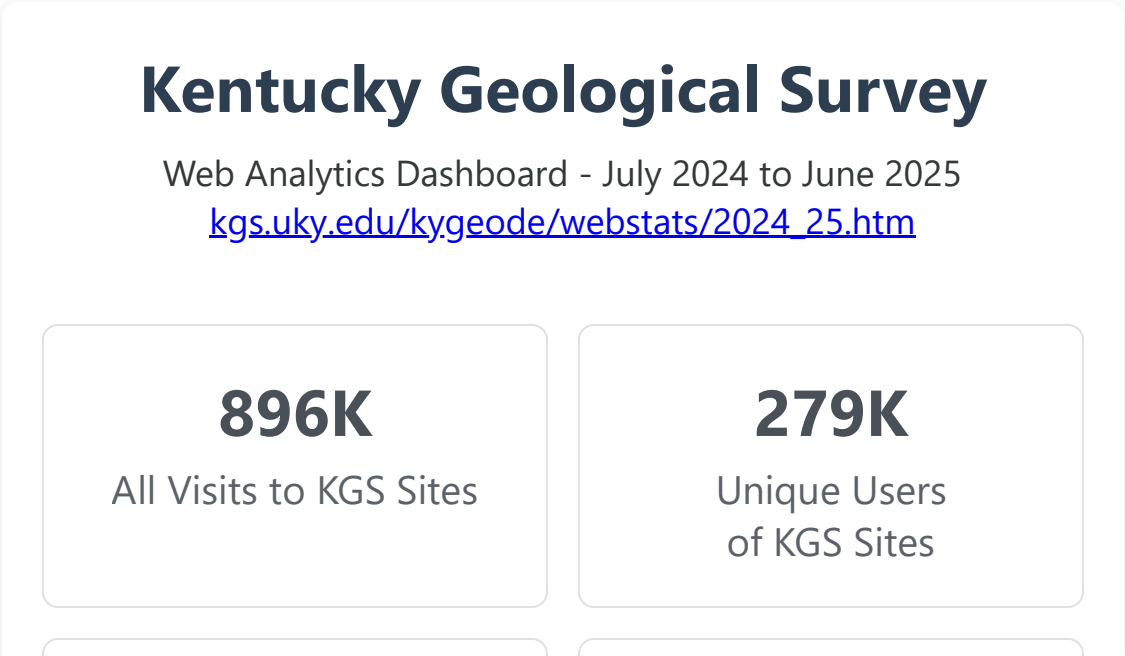
Information Management

The Information Management Division, led by **Doug Curl**, maintains and manages KGS data and web services, along with developing, maintaining, and securing the KGS IT infrastructure. In February, we welcomed **Ralph DeJesus** to the Division, where he manages server infrastructure and collaborates with Division staff to advance our data and IT mission.

KGS website

KGS research data, maps, publications, databases, and other geologic information are publicly available on our websites. In FY24–25, KGS websites had over 896K visits from 279K unique visitors from 214 countries. The main KGS website (which hosts content about KGS research and general geology information) had over 567K visits from 238K unique visitors. Most visits to the main website were from the United States, and 14% of visits were from Kentucky. The most popular

pages were those providing information about rocks and minerals, fossils, coal, karst, and earthquakes.



KGS Web Analytics Dashboard

KY Geode, KGS's hub for finding and exploring data, provides access to a vast array of Kentucky geologic data via 16 tabular data search sites, 24 interactive map services, and 14 story maps. Now numbering more than 25 million records, the available data include oil and gas records and data, water well and spring data and documents (via the Kentucky Groundwater Data Repository), coal information, minerals and limestone resource data, the statewide geologic map coverage and associated data, geotechnical data, publications, and photos. During the past fiscal year, KY Geode services received more than 328K visits originating from 128 countries, with an average engagement rate (percentage of visits that included interaction with a page) of 84% and an average of over three minutes spent on interacting with pages per user. Most visitors using KY Geode originated from the United States, and the top five states were Kentucky (36%), Virginia, Illinois, Indiana, and Georgia. Nearly 23K unique visitors conducted approximately 112K database searches; oil and gas

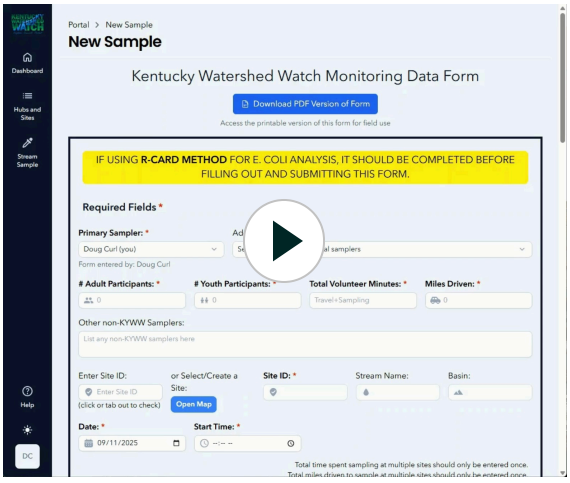
data were the most accessed data service, followed by water well and spring data.

Users downloaded over 3.1 million files from the website, including data text files, well and elog documents, photos, and KGS publications and presentations. Oil and gas records, water well and spring data, online publications, coordinate files generated by KGS's coordinate conversion tools, and data from the geologic map server continue to be the most frequently downloaded data. Over 27K unique KGS website users accessed the online map services nearly 118K times. The most popular map service continued to be the Kentucky Geologic Map Information Service, accessed more than 56K times. The next most popular map services were the water services, hazard-related services, and KGS story maps.

In FY24–25, KGS introduced several new web and data services, including the Kentucky Microbiome Map. Produced by **Doug Curl** and **Rachel Washburn**, the map is an interactive, dynamic platform designed to visualize the distribution and diversity of microorganisms across the Commonwealth of Kentucky. **Glynn Beck** and **Riley Summers** also released a story map about the Kentucky Groundwater Observation Network Well 3, located at the KGS Western Kentucky Office in Henderson.

Kentucky Watershed Watch Data Portal

KGS has supported Kentucky Watershed Watch (KWW) since 2014 by housing volunteer sampling data in a KGS-hosted database and providing a website for exploring sampling results. KWW awarded KGS one year of funding to develop a new data portal for handling volunteer onboarding, volunteer data entry, supply



management, and data access and visualization. Staff from the Division, including **Doug Curl** and **Ralph DeJesus**, built the open-source application and database architecture on a KGS server and developed the front-end website for this new data portal. The site went live to volunteers in January 2025 and to date, nearly 200 volunteers have signed up and entered data for nearly 300 samples into the new portal (Figure 4). A public view of the data portal is available at kyww.uky.edu, with more visualization tools and an API for public data access coming soon.

Figure 4.

New Server for KGS Imagery Collections

The USGS NGGDPP awarded funding to KGS to purchase and set up a new server for disseminating products (including images and metadata) from KGS rock core photography projects. **Ralph DeJesus** ensured that the server was properly configured, installed, and incorporated into the KGS server architecture. **DeJesus** also improved the front-end website used for the KGS Digital Collections, a database-driven application housed on the server and used by KGS for web delivery of rock core photos and associated metadata. This application allows users to browse the collections and download photos in different formats and at different resolutions based on their needs. Users can also search some of these collections using the KGS Rock Core Inventory Search.

Other Activities

In FY24–25, the Division brought several research labs online. **Mike Ellis** and **Ralph DeJesus** worked with **Jason Dortch**, **Gina Lukoczki**, and **Junfeng Zhu** to set up workstations and servers for the Surface Processing and Modeling (SP&M) Lab, the Geochemical Exploration of Mineral Systems (GEMS) Lab, and the Hydrologic Modeling Laboratory (HydroLab), respectively.

An increasingly important activity for the Division is maintaining the KGS monitoring networks and disseminating data from network receivers. **Ralph DeJesus** worked with **Seth Carpenter** and **Jon Schmidt** to maintain the seismic server infrastructure for receiving data from the KGS Seismic Network. **Doug Curl** worked with the Hydrogeology and Karst Team to build a website for disseminating real-time data from the Kentucky Groundwater Observation Network. So far, one well at the Kentucky Horse Park is online for public viewing at https://kgs.uky.edu/kygeode/services/water/gwmn/hp/. Look for other wells to be brought online in the coming year.

Kentucky Horse Park Water Well (KGON-1)

ESRI Conference and Housing Suitability Interactive Map

Doug Curl attended the Esri User Conference in July 2024 and presented a poster (Figure 5) titled “Housing Suitability Maps for Flood Survivors in Eastern KY,” which he coauthored with Key Douthitt, MD (University of Kentucky Healthcare) and Ryland Gross (Harvard University). The poster highlighted their work using Esri GIS tools (ArcPro and ArcGIS Online) to

develop an interactive suitability map for home building in Breathitt County, KY, following a historic flooding event in spring 2022. By combining this interactive map with on-the-ground surveys, local officials identified 10 potential sites suitable for post-flood rebuilding and referred these sites to the Housing Development Alliance for new home construction. The first such property was purchased by the City of Jackson and announced by Governor Andy Beshear on March 28, 2024.

Figure 5. **Doug Curl** in front of his ESRI poster.

Landscape Evolution and Mapping Team

The Landscape Evolution and Mapping (LEM) Team integrates workflows and datasets to investigate surface processes. Surface processes and resulting landscape evolution fundamentally control critical mineral distributions and susceptibility to debris flows and floods.

STATEMAP

This year, supported by the STATEMAP component of the USGS's National Cooperative Geologic Mapping Program, LEM Team members continued surficial mapping in Warren County. **Meredith Swallom**, **Matt Massey**, **Steve Martin**, **Bailee Hodelka**, and **Emily Morris** completed new surficial maps of the Bristow, Smiths Grove, and Bowling Green South quadrangles, which can inform geotechnical and urban planning initiatives along the developing I-65 corridor. **Meredith Swallom**, **Donna Robinson**, and **Bailee Hodelka** completed field work for five new quadrangles (Figure 6), and **Angela Torres-Zamora** began digitizing surface materials. **Matt Massey** and **Meredith**

Swallom were awarded $137,067 to continue these efforts and complete surficial mapping of Warren County in 2025 and 2026. STATEMAP funding also allowed **Jason Dortch** to purchase a new Shaw drill, which will be used to collect sediment cores and determine depth to bedrock—information critical for slope stability assessments and understanding paleofloods.

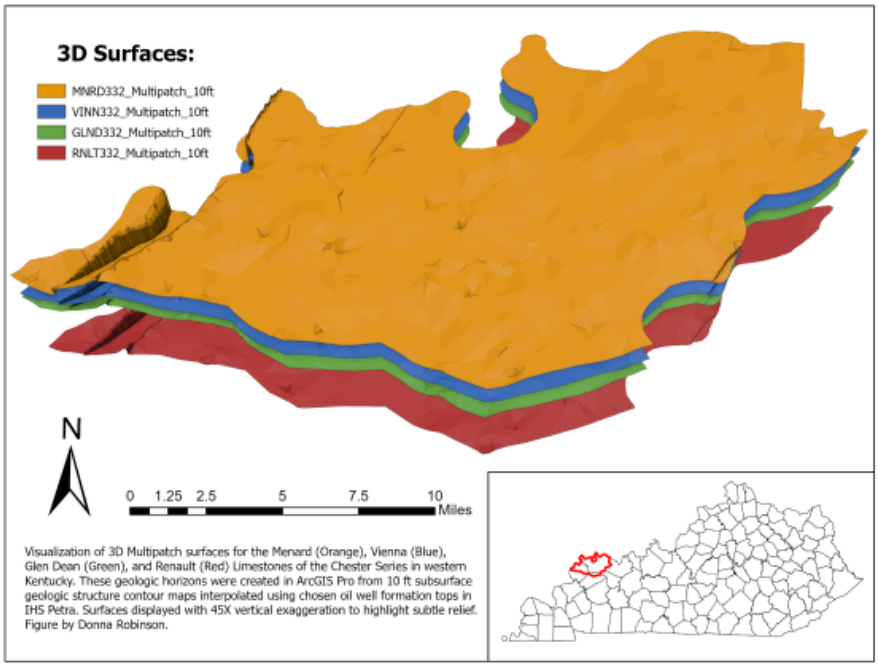


Figure 6. Visualization of 3D Multipatch surfaces for the Menard (orange), Vienna (blue), Glen Dean (green), and Renault (red) Limestones of the Chester Series in western Kentucky.

NSF

As part of EPSCoR CLIMBS Project 2, **Meredith Swallom** and **Jason Dortch** completed a pilot study in Letcher County quantifying the effects of land use change on surficial flooding (Figure 7). Results of this work have been presented and well-received at a variety of stakeholder meetings, such as the Kentucky Association of Mitigation Managers' annual conference and the Kentucky Water Research Institute's Kentucky Water Resources Annual Symposium. In support of future Project 2 efforts, KGS funded

a stream monitoring station so the Team can begin developing new flood warning protocols and procedures.

Jason Dortch, **Matt Crawford**, **Meredith Swallom**, and **Hudson Koch** were also awarded funding as part of the NSF CLaSH initiative ($150,000), which the LEM Team will leverage to model and assess debris flow hazards in eastern Kentucky and the broader Appalachian region.

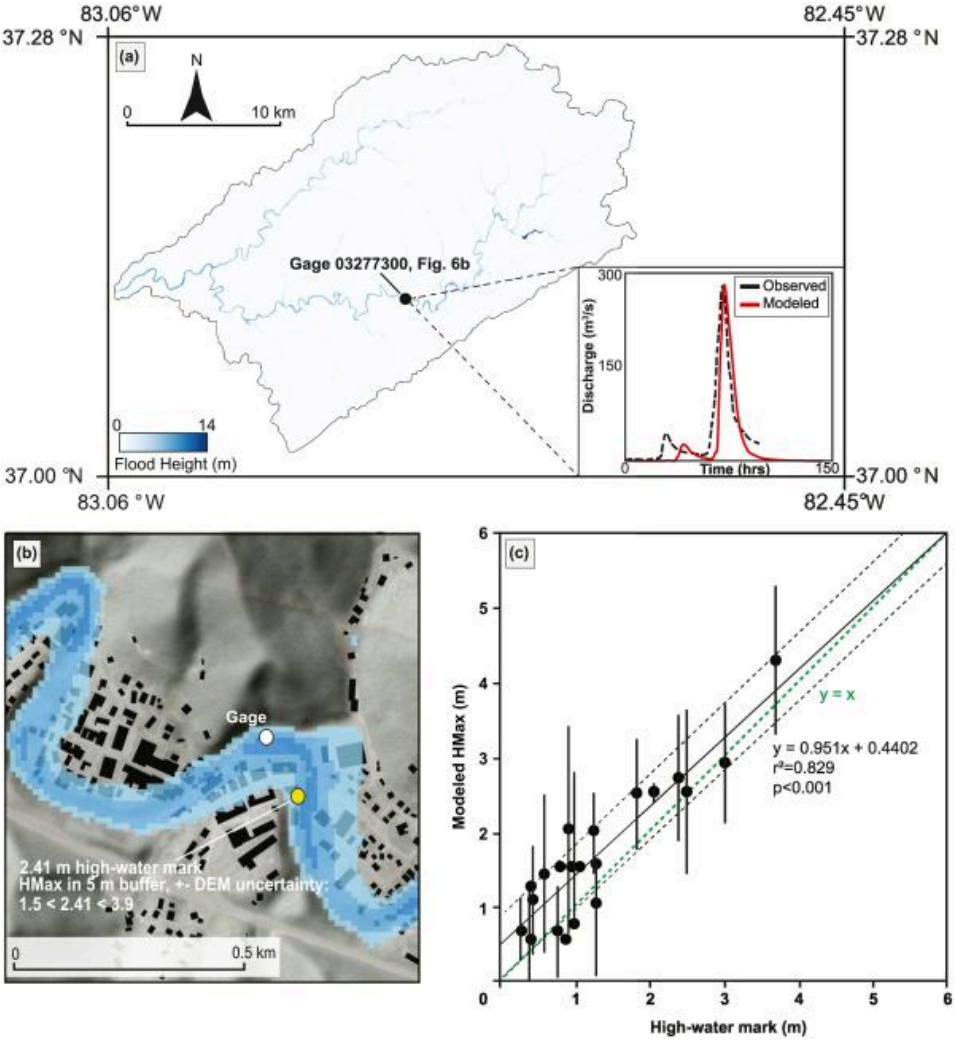


Figure 7. Results and validation of a flood model replicating the July 2022 flood in eastern Kentucky. (a) Map output displaying spatial patterns of flood height. Time series data extracted from the model at the location of the Whitesburg USGS stream gage (red curve) and the observed data from the same location (black dashed curve) show that the model yields a temporal discharge response that compares favorably with observed discharge peak (accuracy = 98.6%). (b) Zoomed-in view of the flood height map atop topography and buildings near the USGS gage and an example of the process for spatially validating the model. Yellow circle indicates a high-water mark of 2.41 m. (c) 1:1 plot between modeled flood heights from the default model and flood heights recorded in the field following the July 2022 storm. The green line is a reference line with slope = 1, while the solid black line is the linear regression line between observed high water marks and modeled flood heights. The reference line staying within the dashed black lines that denote 1-sigma uncertainties indicates that model performs well to maximum flood height of 17.7 m. After this, the model will underestimate flood height by more than one sigma.

Mapping

Emily Morris created a hurricane landfall map to help KGS researchers understand the distribution of remnant tropical storms, which have fueled weather-related hazards in Kentucky in recent years. **Morris** also worked with **Paul Puckett** and **Gina Lukoczki** on a map of the mines of the Illinois-Kentucky Fluorspar District and with **Steve Martin** on upcoming joint maps. **Martin** presented his work on the natural arches of Kentucky at the Geological Society of America Southeastern Section Meeting and created a pamphlet.

Other Work

Matt Massey is collaborating with UK Department of Earth and Environmental Sciences (EES) colleagues and KGS faculty affiliate **Ryan Thigpen** (associate professor) on a critical minerals project in the southern Appalachians. **Donna Robinson** published a KGS dataset with **John Hickman** and **Gina Lukoczki** to showcase subsurface geological and geochemical data from the Illinois-Kentucky Fluorspar District for the Earth MRI Western Kentucky Fluorspar District 3D Modeling Project.

Outreach

Jason Dortch, **Steve Martin**, and **Meredith Swallom** have spearheaded efforts to provide geoscience training to the rock-climbing community in the Red River Gorge. **Swallom** and **Martin** also worked with UK EES alumni, Powell County Tourism, **Hudson Koch**, and KGS faculty affiliate **Sarah Johnson** (research assistant professor) to facilitate a second year of presence and guided geology hikes at Rocktoberfest.

Hydrogeology and Karst Team

The Hydrogeology and Karst Team, led by **Junfeng Zhu**, investigates surface water and groundwater resources in Kentucky to support sustainable water resource management and to help the Commonwealth build resilience in the face of flooding, karst, and sinkhole hazards. The Team seeks to advance hydrologic science in Kentucky through collaborative research, unbiased public data sharing, and vigorous engagement with stakeholders. **Chuck Taylor**, **Glynn Beck**, and **Junfeng Zhu** operate and maintain the Kentucky Groundwater Observation Network, and in fulfillment of state legislative mandates, **Sarah Arpin** maintains the Kentucky Groundwater Data Repository. In FY24–25, the Team conducted a wide range of projects in Kentucky's groundwater, surface water, and karst.

CLIMBS

The CLIMBS project, a five-year, $24 million research partnership across eight institutions, will advance Kentucky's climate resiliency, protect communities, and bolster economic growth for years to come. **Sarah Arpin** participated in Project 2, and **Junfeng Zhu** participated in Project 3, Project 7, and the Learning Hub Scholars program. In Project 3, **Zhu** led the effort to develop water budget models for Kentucky's major watersheds. In Project 7, **Zhu** participated in developing a multimodal disaster dataset with researchers from the University of Kentucky, the University of Louisville, and Western Kentucky University. In the Learning Hub, **Zhu** served as an academic advisor for a group of approximately 30 student scholars from eight universities in Kentucky.

Developing a Karst/Sinkhole Hazard Mitigation Plan-Related Activity for the Barren River Area Development District

Karst-related subsidence and sinkhole collapses are common occurrences in Kentucky. Damage from sinkholes and other karst-related hazards costs the Commonwealth tens of millions of dollars annually. KGS is a leader in karst sinkhole mapping and karst hazard assessment. With a new grant from the Federal Emergency Management Agency (FEMA), **Junfeng Zhu**, **Desireé Cunningham**, and **Hudson Koch** are using lidar, spatial analysis, machine learning, and deep learning to enhance karst and sinkhole hazard evaluation for BRADD, which includes communities in Allen, Barren, Butler, Edmonson, Hart, Logan, Metcalfe, Monroe, Simpson, and Warren Counties. Figure 8 shows the new sinkhole maps for Hart and Barren Counties. These improved sinkhole maps are essential for better assessment of these communities' susceptibility and vulnerability to karst hazards. These maps will also be incorporated into the statewide lidar-derived sinkhole coverage, which is freely available to the public via KGS Geological Map Service.

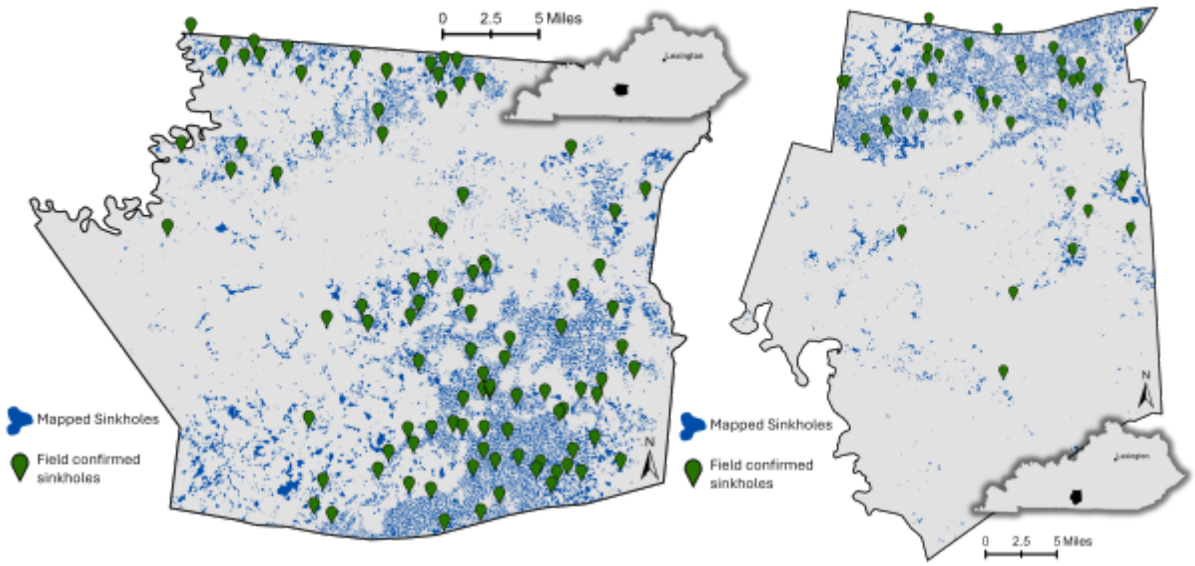


Figure 8. Lidar-derived sinkhole maps for Hart (left) and Barren (right) Counties. In Hart County, 15,876 sinkholes were mapped, and 97 were confirmed in the field. In Barren County, 8,900 sinkholes were mapped, and 41 were confirmed in the field.

Karst Sinkhole and Groundwater Flooding

Figure 9. Aerial drone photograph showing flooding impacts in the karst sinkhole valley in Burgin, Kentucky, February 7, 2025 (courtesy of the City of Burgin).

Karst sinkhole and groundwater-related flooding are challenging and under-recognized geohazards in much of Kentucky. **Chuck Taylor** is currently leading two projects investigating karst sinkhole and groundwater flooding and developing new approaches to assess potential vulnerability to karst flooding and help mitigate its effects. The first project is a karst flooding vulnerability assessment for the Inner Bluegrass region. Funded by FEMA through Kentucky Emergency Management, this project involves the development and use of GIS terrain processing and hydrogeologic mapping techniques to help delineate sinkhole and sinking stream catchments and identify areas of higher potential vulnerability to karst sinkhole and groundwater-related flooding in the Inner Bluegrass region.

The second project provides technical assistance to the City of Burgin in Mercer County. Burgin, located within a karst sinkhole valley underlain by karst conduits, experiences frequent and severe flooding. KGS is conducting research and providing information and expertise to help the city understand the causes of the flooding and to help them identify and implement a successful, cost-effective solution to minimize or mitigate the flooding impacts (Figures 9 and 10).

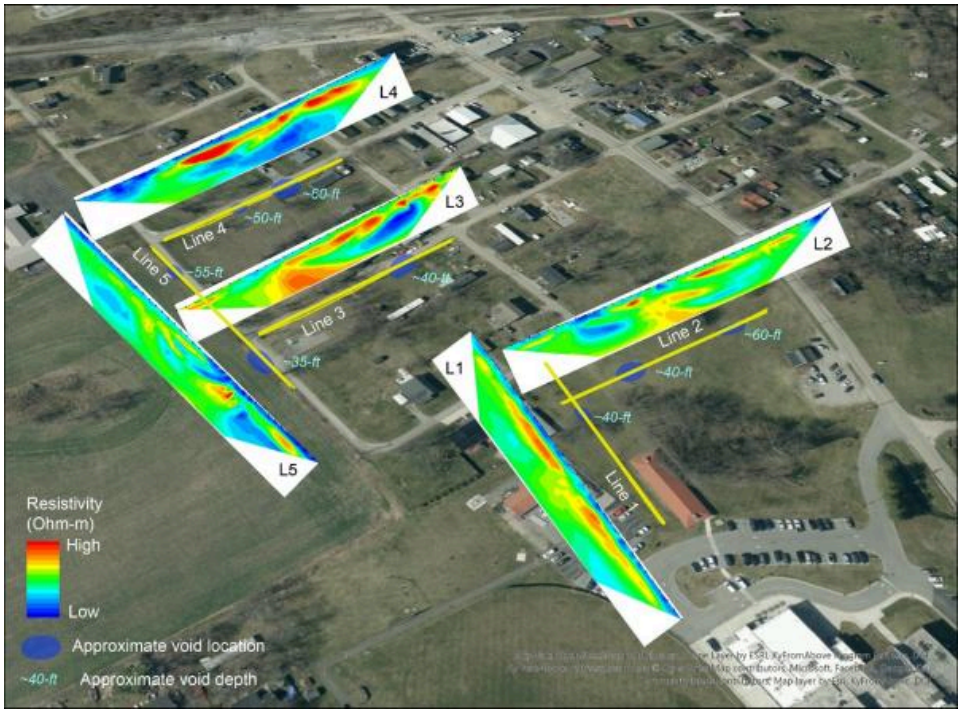


Figure 10. Image showing interpreted preliminary results of high-resolution electrical resistivity geophysical surveys conducted in Burgin, Kentucky, April 2025, to help identify the possible locations and depths of underground karst conduits that contribute to the karst flooding problem. The locations and depths of surveyed low-resistivity geophysical anomalies identified as water-bearing underground karst conduits are shown as blue ovals.

Edge-of-field surface water-quality monitoring of nutrient and sediment loss from no-till row-crop fields in western Kentucky

Glynn Beck collaborated with researchers Brad Lee, Zach Creech, Taylor Valastek, Leighia Eggett, Jason Unrine, Erin Haramoto and John Grove from the UK Martin-Gatton College of Agriculture, Food and Environment to continue year-round edge-of-field water quality monitoring of 19 watersheds in the lower Green River and lower Cumberland River watersheds. These monitoring efforts will improve our understanding of nitrogen, phosphorus, and sediment loads from row-crop fields in western Kentucky. This work is funded by the U.S. Department of Agriculture Natural Resources Conservation Service, Kentucky Soybean Promotion

Board, Kentucky Agricultural Development Board, and five western Kentucky agricultural producers (Figure 11).

Figure 11. Edge-of-field discharge during (A) and after (B) the April 2024 heavy precipitation event in western Kentucky, along with the associated hydrograph (C). Some soil erosion is evident in the row-crop field (B). Photographs taken by Zach Creech.

Midcontinent stratigraphy of the gulf coastal plain northern Mississippi Embayment

Glynn Beck and **Steve Greb** collaborated with researchers from the Illinois State Geological Survey and Morehead State University to better define stratigraphic boundaries of the northern Mississippi Embayment (NME). More than 100 biostratigraphic samples were collected from various geologic units in Trigg, Marshall, Calloway, and Graves Counties, Kentucky. Researchers plan to collect continuous cores in the summer of 2026. Data from the biostratigraphy and core samples will be used todevelop biostratigraphic and hy drostratigraphic cross-sections of the NME. Funding for this project is provided through USGS (Figure 12).

Figure 12. **Steve Greb** and **Jen O'Keefe**, Morehead State University, collecting biostratigraphic samples for analysis.

Using drone-based thermal cameras to map surface water and groundwater interaction along Little Bayou Creek, McCracken County

Glynn Beck used drone-based thermal cameras to map groundwater seeps along Little Bayou Creek (LBC). Above-canopy and in-stream flights were flown in August 2024 (full leaf-on conditions) and January 2025 (full leaf-off conditions). All previously identified seeps and several previously unidentified seeps were mapped. The goal of the project is to identify groundwater discharging into LBC, which will assist efforts in monitoring potential contamination associated with the Paducah Gaseous Diffusion Plant (PGDP). Funding for this project is provided by the U.S. Department of Energy Portsmouth Paducah Project Office through the Kentucky Research Consortium for Energy and Environment (KRCEE) to support PGDP groundwater monitoring and modeling efforts (Figure 13).

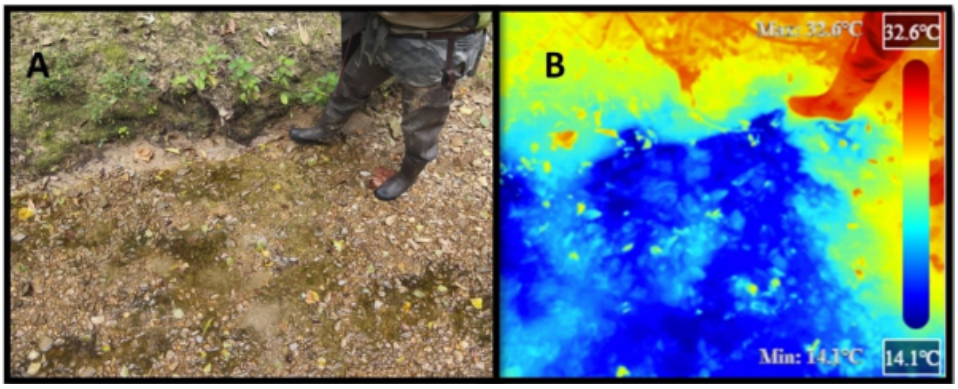


Figure 13. A color aerial photograph (A) and thermal image (B) of a groundwater seep taken in August 2025 during the in-stream flight. The discharging groundwater is much cooler (approximately 14.1°C) compared to the surrounding area (B).

Assessing the influence of center-pivot irrigation on local groundwater resources in a shallow limestone aquifer in southern Christian County

Glynn Beck is working with a row-crop farm in southern Christian County to collect continuous groundwater level data

from five water wells completed in fractured and karstic limestone bedrock. Data from this project will be used to evaluate the influence of center-pivot irrigation (CPI) on a local limestone aquifer in the Western Pennyroyal and to educate the agricultural sector on the importance of understanding the local hydrogeology before investing in CPI. Funding for this project is provided by KGS (Figure 14).

Figure 14. **Glynn Beck** downloading a groundwater level transducer removed from one of the monitored wells in southern Christian County.

National Cave and Karst Research Institute

Sarah Arpin and **Bailee Hodelka** were awarded $24,997 from the National Cave and Karst Research Institute. They, along with **Jason Dortch**, have installed new bedload and water monitoring equipment in Stillhouse Hollow catchment, Mammoth Cave, to better understand the effects of sediment transportation in surface and karst streams during flood events like those that impacted western portions of the state in 2023 and 2025.

Earthquakes and Geophysics Team

The Earthquakes and Geophysics (E&G) Team conducts research on and disseminates information about issues related to earthquakes and subsurface characterizations to the benefit of Kentucky. The E&G Team supports KGS's mission to build Kentucky's resilience through relevant, innovative, and high-impact research that assists with mitigating natural hazards that the Commonwealth faces, focusing on hazards related to earthquakes. The team also provides earthquake

information and research products to the research community, the public, the media, and stakeholders.

Figure 15. KGS Associate Director **Zhenming Wang** (left), the Earthquakes and Geophysics Team (left to right: **Jon Schmidt**, **Seth Carpenter**, and **Greg Steiner**), and the completed installation of the infrasound (foreground), seismic, and strong-motion instruments at KSSMN station WIKY, Ballard County Detention Center, Wickliffe. Funding to purchase these instruments was provided by KRCEE.

The E&G Team operates the Kentucky Seismic and Strong Motion Network (KSSMN), which provides critical data and information on earthquakes in Kentucky and around the world and is the cornerstone facility for earthquake- and seismology-research at KGS. KGS computers acquire data from 20 of the 24 stations in near-real-time. KGS seismologists and other researchers use these data to locate and estimate the magnitudes of earthquakes that occur in and around Kentucky, as well as globally. This year, E&G Team members **Jon Schmidt**, **Greg Steiner**, and **Seth Carpenter**, with the help of Associate Director **Zhenming Wang**, upgraded KSSMN stations CUSSO (Fulton County), FMKY (Hickman County), LLKY (Lyon County), SMKY (McLean County), WIKY (Ballard County), and VSAP (McCracken County). With funding support from FEMA and KRCEE, the team installed new infrasound sensors designed by **Greg Steiner** at these stations, as well as new dataloggers and power and communications systems at all stations except CUSSO (Figure 15). In combination with the very sensitive broadband seismometers also installed at CUSSO, FMKY, LLKY, and FMKY, this year's KSSMN upgrades greatly enhance the network's ability to record earthquakes in western Kentucky and the Jackson Purchase region and provide new capabilities to record seismic and sound waves produced by on-the-ground tornadoes and other phenomena, such as infrasound waves (i.e., sound waves at frequencies below the audible range) from the 2025 bolide explosion over Georgia. Data from

these sensors support ongoing seismic and tornado research. The team also installed new strong-motion accelerometers at FMKY, SMKY, VSAP, and WIKY to record on-scale ground motions during large earthquakes; these recordings will facilitate improving earthquake mitigation measures, particularly in the Jackson Purchase region and the vicinity of the PGDP.

As part of the E&G Team's continued involvement with and support from KRCEE to improve seismic hazard assessment in the Jackson Purchase region and at the PGDP, the E&G Team installed seismic nodes at six sites around the Plant. The team then used data from these nodes to evaluate other temporary instruments deployed in the region and to characterize earthquake wave resonances and variations in depth to bedrock in the area. UK EES MS student **Seth Thompson** joined the E&G Team to investigate seismic signals uniquely produced by touched-down tornadoes. **Thompson**'s work supports a three-year FEMA-funded project evaluating whether real-time KSSMN data streams can be used to improve tornado warning systems. Preliminary analyses of broadband data recorded during the December 2021 outbreak and the 2025 Somerset-London tornado reveal that detectable changes in the seismic wavefield occurred while these tornadoes were on the ground. As part of Project 3 of the NSF EPSCoR-funded CLIMBS project, the E&G Team is planning a dense array of broadband seismic stations to characterize groundwater resources and their fluctuations in Jackson Purchase region aquifers using passive seismic techniques. This fiscal year, the Team collaborated with Murray State University to complete extensive assessments of potential project instruments. The Team also collaborated with seismologists at the University of South Florida to conduct the first analyses of passive seismic data in the project area using algorithms that detect extremely small changes in the ambient seismic

wavefield, some of which correspond to groundwater level fluctuations.

Landslides and Engineering Geology Team

The Landslides and Engineering Geology Team, led by **Matt Crawford**, works to further understand landslide hazards, collect and disseminate landsl ide data, and foster collaboration with regional hazards groups, government, industry, and other stakeholders. The Team uses a multidisciplinary approach at the intersection of earth sciences and the built environment to improve health and safety in the Commonwealth by reducing risk from geologic hazards (Figure 16).

Figure 16. The KGS Landslides and Engineering Geology Team.

Landslide Mapping

This year, FEMA's Hazard Mitigation Grant Program supported the enhancement and expansion of the Team's inventory and modeling efforts. **Evelyn Bibbins** upgraded the KGS Landslide Inventory, standardized data collection, and leveraged high-resolution lidar data to map landslide polygons—significant contributions that expanded the Team's understanding of landslides and the relationship between landslide occurrence and storm events. Meanwhile, the Team worked with **Jason Dortch** to complete a three-year project using KGS Landslide Inventory data and machine learning to map landslide susceptibility in the Kentucky River Area Development District. This project established a reliable

approach for assessing landslide susceptibility at a regional scale using statistics and geomorphic variables.

The Team also conducted work supported by other federal and state partners. **Hudson Koch** led a landslide mapping project funded by the U.S. Department of Agriculture Forest Service in the Jellico Area of the Daniel Boone National Forest. **Koch** leveraged the mapped landslides to produce a landslide susceptibility model for the area, providing the Forest Service with critical information for logging, forest health, and forest management decisions. Supported by USGS, **Matt Crawford**, **Hudson Koch**, and **Evelyn Bibbins** are mapping landslides triggered by the July 2022 eastern Kentucky flood using lidar change detection (LCD), an elevation differencing technique that produces a detailed inventory for use in hazard management and event response. KGS faculty affiliate **Sarah Johnson** (research assistant professor), **Jason Dortch**, Yichuan Zhu (Temple University), Dylan Ward (University of Cincinnati), and Dan Sturmer (University of Cincinnati) were awarded a USGS Landslide Hazards Program grant to conduct landslide inventory mapping and generate landslide susceptibility maps for the Greater Cincinnati area of northern Kentucky. At the state level, the Team is using UAV-based LCD data collected by **Glynn Beck** and Leighia Eggett (UK Department of Plant and Soil Sciences) to quantify slope movement and evaluate landslide activity at the Maxey Flats Disposal Site operated by the Kentucky Energy and Environment Cabinet.

EPSCoR CLIMBS

As part of EPSCoR CLIMBS Project 5, **Ryan Ramsey** is leading efforts to install a network of slope hydrologic monitoring stations across eastern Kentucky. The stations measure soil moisture, water potential, rainfall, and other parameters to help us understand how hydrologic conditions on steep slopes

change over time. The data will support future projects related to slope stability modeling, hydrological thresholds and their relationship to landslide occurrence, and potentially, landslide forecasting (Figure 17).

Figure 17. The Landslides and Engineering Geology Team inspects a landslide that impacted a home in Powell County.

Critical Minerals and Geochemistry Team

The Critical Minerals and Geochemistry Team, led by **Gina Lukoczki**, investigates how Earth's mineral systems evolve, focusing on both the processes that generate critical mineral resources and the environmental legacies of past resource extraction. The Team's work combines field studies, laboratory analyses, and geochemical modeling to address questions central to sustainable resource management, energy transition, and environmental stewardship. Current research areas include (1) ore-forming processes and critical mineral enrichment and (2) environmental geochemistry and hazard assessment of legacy oil and gas infrastructure.

Ore-Forming Processes and Critical Mineral Enrichment

A major focus of the Team is on understanding the geologic and geochemical factors that control mineralization in Kentucky and surrounding regions. Investigations into Mississippi Valley-Type (MVT) deposits, led by **Gina Lukoczki** and **John Hickman** and carried out by UK EES graduate students **Dairian Boddy** and **Benjamin Schaffler**, highlight the influence of crustal architecture and

fluid migration pathways on ore formation. Funded by the USGS Earth MRI Program, the Team is identifying the relative contributions of basement-derived versus basin-derived fluids by integrating isotopic tracers such as lead, strontium, neodymium, and sulfur. This work investigates how deep crustal features, such as the Cincinnati Arch and the Rough Creek Graben/Rome Trough system, shaped pathways for mineralizing fluids, with implications for the enrichment of critical elements like germanium and gallium in MVT deposits.

The USGS Earth MRI Program also supports parallel efforts by **Gina Lukoczki**, with contributions from **Zachary Walton** and outside collaborators, to target the role of alkaline and ultramafic igneous intrusions in redistributing rare earth elements (REEs).

In addition, the Team recently completed a USGS Earth MRI-funded project with **Paul Puckett**, who combined archival mining records with modern remote sensing techniques to identify and delineate potential non-coal mine waste sites across Kentucky. This effort produced the first geospatial database of mine waste in the state, with a particular emphasis on the Western Kentucky Fluorspar District. Beyond documenting potential secondary sources of critical minerals such as fluorine, germanium, REEs, and zinc, the project also contributes to national mine waste inventories and provides a foundation for future land management, remediation planning, and environmental risk assessment.

The Team is also examining REE enrichment in Devonian black shales, a major metalliferous unit spanning the Illinois and Appalachian basins. Funded by the USGS Earth MRI Program, **Alex Washburn** analyzed the REE concentrations of more than 100 core samples housed at EARL and identified distinct behaviors among light, medium, and heavy REE groups, furthering our understanding of both

critical mineral resources and basin-scale fluid evolution. A similar effort led by **Cortland Eble** evaluates the critical mineral potential of Pennsylvanian black shales in Kentucky.

Together, these studies establish a framework for linking tectonic features, fluid pathways, magmatic processes, and historical mining legacies to Kentucky's critical mineral potential, directly informing both exploration strategies and environmental decision-making.

Environmental Geochemistry and Methane Emission of Legacy Oil and Gas Infrastructure

To address the environmental impacts of Kentucky's legacy oil and gas industry, **Alex Washburn**, **Deron Zierer**, **Zachary Walton**, **Madison High**, and **Andrew Hawksley** have partnered with the Kentucky Division of Oil and Gas on a statewide project funded by the U.S. Department of the Interior through the Bipartisan Infrastructure Law. **Carrie Pulliam**, manager of KGS's petroleum well files and database, provides the digitized records essential to locating and characterizing orphaned and abandoned wells and helps the Team engage stakeholders, including senior petroleum company personnel, landowners, and state representatives. With more than 14,000 such wells documented statewide, the Team is refining the inventory, measuring methane emissions at selected sites, deploying a data-driven plugging-prioritization strategy to maximize emission reductions within available funds, and advancing studies on the controls on emissions and their health and environmental impacts.

Studies on methane emissions carried out by **Deron Zierer** reveal highly variable fluxes, ranging from negligible to more than 1,000 g/hr. Importantly, just ten wells account for over 80% of measured methane emissions, suggesting that targeted plugging of high-emitting wells could provide substantial climate benefits. Isotopic and compositional

analyses indicate that methane often has mixed origins, influenced by both geologic factors (such as producing formations and coal-bearing strata) and anthropogenic ones (such as historical mining activity). Ongoing isotopic fingerprinting of methane aims to better resolve these sources.

Alongside these efforts, the Team is refining its measurement methodologies for orphaned well emissions to improve efficiency without sacrificing accuracy. Currently, emission rates are determined by averaging the results of six ten-minute tarped chamber tests per well, reported as grams per hour to the Kentucky Division of Oil and Gas. To streamline fieldwork and allow more wells to be measured each day, **Andrew Hawksley** is evaluating whether reducing the protocol to three ten-minute tests provides comparable accuracy. His work includes quantifying variance introduced by field conditions—such as tarp placement or use of corrugated pipe—as well as comparing results from two measurement systems, the Hi-Flow sampler and the Smart Chamber, with the goal of minimizing the need for redundant equipment.

The Team also investigates hydrogen sulfide (H2S) emissions, a lesser known but serious hazard. Measurements at abandoned wells carried out by **Zachary Walton** in west-central Kentucky show H2S concentrations ranging from 1.7 to 212 ppm, with average emission rates exceeding 7,000 mg/hr. These emissions are spatially clustered in Mississippian to Silurian carbonate reservoirs. Because petroleum in the region is sulfur-poor, the likely drivers are either bacterial sulfate reduction or wellbore degradation, highlighting the need for isotopic studies to pinpoint origins. These findings carry implications for both public health and infrastructure integrity.

Expanding the scope, the Team examines how emissions from legacy oil and gas wells interact with karst systems. Kentucky's cave-rich landscape provides natural laboratories for **Madison High** to study gas transport. Preliminary surveys at caves in Kentucky absent of nearby oil and gas wells expectedly show that caves generally act as methane sinks, with concentrations dropping from atmospheric levels of ~2 ppm at cave entrances to below 100 ppb in cave interiors. Other surveys are planned to examine caves near legacy oil and gas wells, including one cave that is penetrated by an abandoned oil well, in which higher cave methane concentrations are expected. This research bridges geomicrobiology, climate science, and karst hydrology, emphasizing how abandoned wells may alter subterranean environments and ecological dynamics.

Outlook

By integrating studies of mineral systems with investigations into legacy energy infrastructure, the Critical Minerals and Geochemistry Team advances the understanding of both resource potential and environmental responsibility. Our work on ore-forming processes clarifies the tectonic and geochemical drivers of critical mineral enrichment, while our studies on methane and hydrogen sulfide emissions inform strategies for climate mitigation and public safety. Together, these efforts position the team at the intersection of critical resource science and environmental stewardship, contributing essential knowledge for the sustainable use of Kentucky's geologic resources.

Fossil Energy and Subsurface Geology Team

The Fossil Energy and Subsurface Geology (FESG) Team investigates the subsurface structures and stratigraphy of Kentucky. The Team's work includes oil and gas assessments and carbon and gas storage assessments through state and industry partnerships, as well as research into the Commonwealth's geothermal energy and geologic hydrogen resources.

State Mandates

State statute KRS 353.660 requires oil and gas well drillers to submit well records to the Kentucky Division of Oil and Gas within 90 days of the termination of permitted operations for transmittal to KGS, as well as to provide samples of well cuttings to KGS upon request. In fulfillment of this statute, the FESG Team 1) operates and maintains the KGS Oil and Gas Database, 2) maintains the Kentucky Oil and Gas Well Database and Documents Archive (which contains scanned survey plats, completion reports, geophysical well logs, and plugging affidavits), and 3) requests geologic samples from new wells when appropriate. FESG Team members **Carrie Pulliam** and **Monte Rivers** continue to receive, record, and archive oil and gas well documents submitted to the Commonwealth as part of the legal well permitting process.

The Kentucky Oil and Gas Well Database and Documents Archive contains more than 800,000 document images. These documents contain valuable geologic data not accessible through the KGS Oil and Gas Database. In an effort to remedy this, in FY24–25, **Carrie Pulliam** engaged in multiple discussions with the U.S. Department of Energy's National Energy Technology Laboratory (NETL) staff about using their Object-Oriented Graphics Rendering Engine (OGRE) to extract written data from the scans. We hope to begin testing this technique in late 2025.

Alternative Energy

In addition to their work fulfilling KGS's state-mandated responsibilities, the Team is investigating alternative sources of energy for the Commonwealth, including geothermal and geologic hydrogen. In response to requests from members of the Beshear Administration, FESG Team Leader **John Hickman** produced new fact sheets on shallow geothermal resources and geologic hydrogen potential in Kentucky.

Carbon Management

This year, the Team participated in several carbon management projects. **John Hickman** worked on a project led by Kunlei Liu (director of UK's Institute for Decarbonization and Energy Advancement) that intends to extract CO2 from ambient air (direct air capture) and sequester it underground within Homer Field, a drained gas field in Elliott County. The FESG Team produced a preliminary volumetric assessment of the field and acted as a local liaison to the oil and gas industry. **Hickman** also contributed to the Batelle Memorial Institute's DOE-funded CarbonSAFE CO2 storage assessment project at the TVA Paradise Power Plant in Muhlenberg County. Work in FY24–25 included building a regional stratigraphic model, assisting Battelle with data compilation, and designing the research well layout at the station. Finally, the Midwest Regional Carbon Initiative (MRCI) ended in 2025. **Steve Greb** and **John Hickman** completed the remaining stratigraphic and faulting correlations on the MRCI Regional Cross Sections. These cross sections illustrate the midcontinent rocks that are within sequestration applicable depths. As an added benefit, many "state border faults" (differences in nomenclature that produce abrupt map changes) and cross-correlation errors have been identified and corrected during this process.

Subsurface Geology

The Team continued subsurface geology work in FY24-25. **Steve Greb**, **Glynn Beck**, and colleagues at the Illinois and Missouri Geological Surveys interpreted the shallow Cretaceous geology of the Jackson Purchase region. This ongoing project involves data from over 1,700 shallow borings across the region. Additionally, **John Hickman** has been assisting the Critical Minerals and Geochemistry Team with subsurface mapping using geophysical surveys for KGS's Earth MRI projects (Kentucky-Tennessee Mineral District and the Central Kentucky Mineral District), led by **Gina Lukoczki**. This work includes a new airborne radiometric and magnetic survey that covers ~2/3rds of Kentucky, along with parts of Tennessee and Arkansas (Figure 18). As part of the 2023–2024 USGS STATEMAP Project, **John Hickman** and **Donna Robinson** interpreted Middle-Upper Mississippian age Chester Series units from geophysical logs of oil and gas wells in northwestern Kentucky (Union, Henderson, Webster, and Daviess Counties). **Hickman** created contour maps in Petra, then **Robinson** used these data to produce Esri 3D multipatch files for digital 3D mapping efforts.

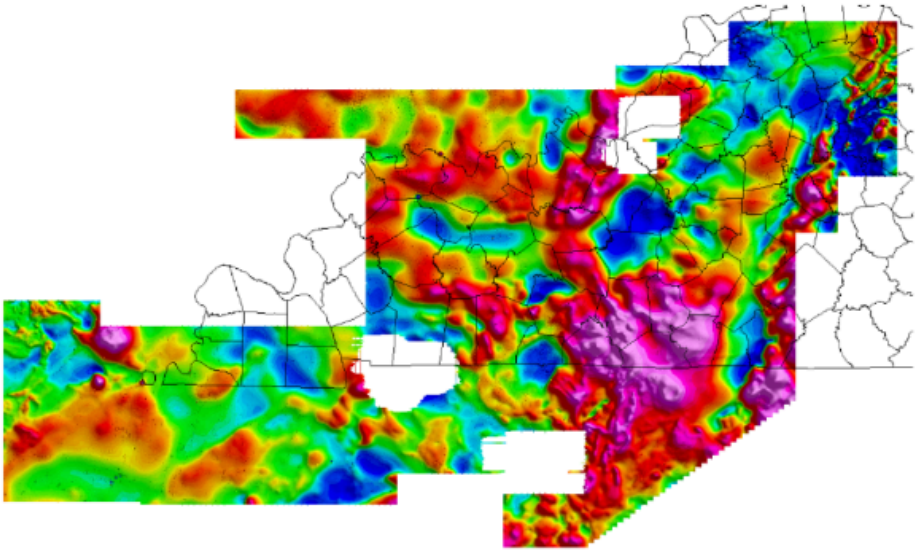


Figure 18. Preliminary image of a new USGS aeromagnetic/radiometric survey across the southern Illinois Basin and the Cincinnati Arch (final data expected at KGS in October 2025). Hotter colors represent higher magnetic intensity, and cooler colors represent magnetic lows. This dataset was acquired as part of the Earth MRI program's critical minerals research.

Outreach

The Team has a strong presence in the local oil and gas industry. Members regularly attend meetings of the East Kentucky Section of the Society of Petroleum Engineers (EKy-SPE) and operate a display booth at the annual Kentucky Oil and Gas Association (KOGA) meetings, and **Carrie Pulliam** also attends the Kentucky Oil and Gas Workgroup meetings. This year, **John Hickman** gave a plenary lecture at Geotechnical Frontiers 2025 in Louisville.

Monte Rivers answers a nearly constant stream of rock, fossil, and potential meteorite identification questions from the public. This spring, **Monte Rivers**, **Carrie Pulliam**, and KGS Director **Michael McGlue** visited a couple in the Campbellsville area who thought they may have a meteor impact site on their property. After thorough analysis, **Rivers** determined that the sample in question was a piece of altered Lost River Chert (Ft. Payne Formation)—unfortunately, not a meteorite. **Rivers** gave the couple a copy

of the Geologic Quadrangle that covers their property and explained how their sample fit into the local stratigraphy.

Geohealth Team

The Geohealth Team explores how Kentucky's geology and microbiology intersect with human health and medicine. Our work focuses on understanding how the Commonwealth's rocks, soils, and waters shape microbial ecosystems, chemical exposures, and opportunities for biomedical discovery. The team's research spans three main areas:
geomicrobiology, radon,
and water quality and hydrobiogeochemistry.

In geomicrobiology, the Team investigates how microbes interact with minerals, karst systems, and geochemical environments. This includes statewide microbial mapping, bioprospecting for new bioactive compounds, and studying emerging pathogens to better understand the biomedical potential of Kentucky's native microorganisms. The radon research area focuses on measuring radon levels in soils and developing detailed maps of radon exposure risk across the state. This work identifies the geologic and soil factors that influence radon release and supports efforts to improve radon awareness, mitigation, and construction policy. The expanding water quality
and hydrobiogeochemistry component will examine surface and groundwater systems to assess microbes, heavy metals, radon, PFAS, algal toxins, and nutrient contamination, with the goal of understanding how contaminants and recharge rates influence microbial populations, ecosystem function, and health-related processes.

The Geohealth Team comprises **Rachel Washburn**,
health geologist and director of the Washburn Center

for geoHealth and Applied Omics Studies (CHAOS Lab), and **Donna Robinson**. The team also collaborates with **Sarah Gilbert**, a UK EES student researcher who contributes to statewide microbial mapping and geomicrobiology projects. Active collaborations extend across the UK College of Nursing, College of Pharmacy, and Kentucky Water Research Institute, as well as with St. Jude Children's Research Hospital and the University of Louisville, integrating expertise across disciplines to advance geomicrobiology, radon geology, and water-quality science in Kentucky.

Figure 19. **Rachel Washburn** collecting microbial sediment samples in a low passage of a Kentucky cave. These samples will be used to analyze the microbial ecology, biochemistry, and geochemistry of the cave environment, helping to reveal how microbial communities and mineral processes are interconnected within Kentucky's karst systems.

CHAOS Lab, led by **Rachel Washburn**, integrates biomedical, microbiological, and geological research to investigate how microbes and minerals interact across Kentucky's natural systems. Trained in biomedical sciences with a specialization in immunology and infectious disease and with postdoctoral work in health geology, **Washburn** brings a uniquely interdisciplinary approach to KGS. CHAOS Lab focuses on geomicrobiology, which investigates how geological processes influence microbial communities, metabolic pathways, and the production of bioactive compounds. Current projects include the discovery of novel antibiotics and therapeutic molecules from cave and karst microbiomes and the development of a statewide map of microbial diversity in soils and subsurface environments (Figure 19). The Lab is expanding into hydrobiogeochemistry to study how water quality, contaminants, and aquifer recharge processes shape microbial ecosystems and potential health outcomes, positioning Kentucky's natural microbial and

geologic resources as a foundation for future biotechnological and biomedical innovation.

Donna Robinson leads the geologic component of the Radon on the RADAR project at KGS, in collaboration with the UK College of Nursing and Old Dominion University (Figure 20). This multimillion-dollar effort, funded by the National Institute of Environmental Health Sciences (NIEHS), aims to close critical gaps in radon risk reduction for rural communities across Kentucky. KGS examines how geologic, soil, and residential factors influence indoor radon levels to guide education initiatives and inform radon-resistant construction policy. **Robinson**'s doctoral research builds on this work by developing updated radon measurement standards for KGS and studying how near-surface radon relates to soil properties such as moisture, porosity, and permeability, as well as how seasonal and atmospheric changes affect radon release. Her goal is to identify the geologic pathways that control radon movement and to create a refined radon hazard potential dashboard for Kentucky that integrates geologic and environmental data to visualize where and why radon risk varies statewide.

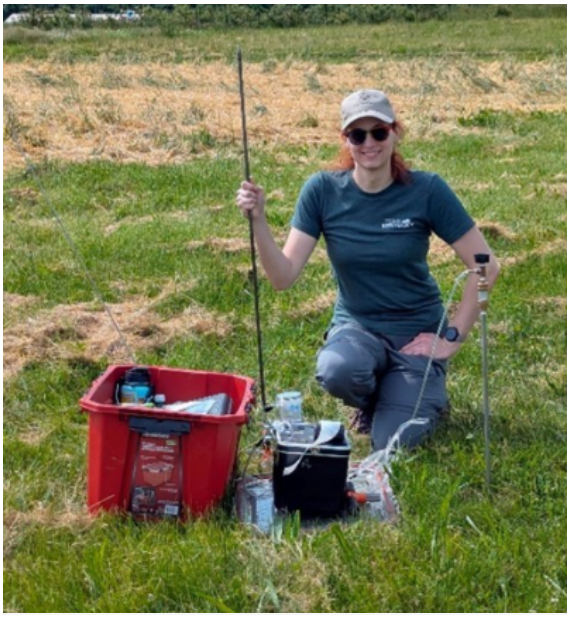


Figure 20. **Donna Robinson** collecting soil samples and radon measurements at a Kentucky Mesonet station (part of a dense network of automated weather and environmental monitoring stations and environmental data. These samples help link soil properties and local atmospheric conditions to radon release, improving understanding of how geology and weather patterns influence radon behavior across the Commonwealth.

As a newly established program, the Geohealth Team has had an exceptionally productive first year, rapidly building research capacity, student engagement, and statewide collaborations. Team members have visited more than 40 sites

across Kentucky to collect microbial, geological, and radon samples, creating integrated datasets that connect geology, microbiology, and health indicators. The team has mentored eight students, produced a KGS publication on geohealth, and released a geomicrobiological dataset detailing Escherichia coli concentrations and microbial diversity across Kentucky. One of the Team's initiatives, the Kentucky Microbiome Map, is actively compiling microbial, geochemical, and watershed data into an interactive statewide visualization that will serve as a foundation for future geomicrobiological and biomedical research. The Team also submitted a review article on geohealth in Kentucky and is analyzing more than 20 years of E. coli data from Kentucky's rivers and streams to identify long-term trends and potential predictors of contamination. Over the past year, Team members have presented their findings at more than a dozen conferences, highlighting Kentucky's growing leadership in geomicrobiology and health geology. The Team continues to expand partnerships with organizations such as the Louisville Grotto, Diamond Caverns, and Crystal Onyx Cave, while the CHAOS Lab's outreach brings geohealth science to broader audiences through accessible and engaging social media communication.

The Geohealth Team is positioning Kentucky at the forefront of research that connects geology, microbiology, and human health. By integrating geologic mapping, geochemistry, microbial discovery, and analytical chemistry, the team generates data that directly support the Commonwealth's efforts to manage natural resources, mitigate geologic health risks, and explore new avenues for biomedical innovation. This work provides decision-makers, educators, and researchers with evidence-based insights into how Kentucky's unique geology influences water quality, radon exposure, and microbial ecosystems—factors that ultimately shape the health and resilience of communities statewide. Through academic, industry, and community partnerships,

the Geohealth Team is advancing scientific understanding while creating new opportunities for workforce development, education, and long-term stewardship of Kentucky's natural and biological resources.

Environmental Geology

The Environmental Geology Team (EGT) is made up of KGS Director **Michael McGlue**, **Sarah Arpin**, **Bailee Hodelka**, and EES graduate students **Luciano Cardone** and **Mary Covell**. The mission of the EGT is to conduct research that examines connections between humans and the environment. We are interested in how geological processes affect communities, as well as how human activities impact the Earth's geological systems. Consequently, our work straddles both pure and applied research, but in all cases seeks to build resilience for the Commonwealth. Our vision is to develop a nationally recognized, externally funded research program whose members actively engage with stakeholders to help support economic prosperity, sustainable development, and public interest in geo-environmental issues in Kentucky. The EGT counts collaboration, transparency, ethics, sustainability, and professionalism among its most cherished values. Our motto is Labor extra domum.

Founded in 2025, the EGT is the newest team in the 14th Survey. While team members take advantage of the many field and analytical tools available at KGS, the EGT is in the process of developing a new soil and sediment core analytical facility at EARL with the help of **Liz Adams** and **Ryan Pinkston**. **Bailee Hodelka** is the acting co-PI of this facility, which supports the analysis and archiving of Quaternary soils and sediments from around the state. The lab is currently outfitted with a GEOTEK Multi-Sensor Core Logger, which develops high-resolution physical properties datasets (e.g.,

magnetic susceptibility, Gamma-ray density) from both rock and sediment cores. A new P-wave velocity sensor was added to the system, using external funds from the KRCEE to expand environmental management research at the PGDP. With this new sensor, **Hodelka** analyzed dozens of loess cores collected from western Kentucky in collaboration with contractors and faculty associate professor **Ed Woolery**, supporting efforts to search for Holocene faults near the PGDP. The lab also added an Edgetech model 3400 subbottom profiler, which is a seismic geophysical tool that will allow the EGT to study the distribution of sediments in Kentucky's rivers, lakes, and reservoirs. We anticipate a tranche of new analytical tools will be added to the lab next year—stay tuned for updates and an official lab opening in 2026!

In addition to research at PGDP, the EGT is deeply involved in the NSF-sponsored CLIMBS project (https://kynsfepscor.uky.edu/climbs), which seeks to build climate resilience through multidisciplinary big data learning, prediction, and b uilding response systems. The Team is developing late Quaternary records of environmental change at floodplain sites in Estill, Fayette, and Boone Counties and pursuing speleothem records of paleo-precipitation in and around Mammoth Cave National Park. Next year, we anticipate expanding our research to include (a) new assessments of reservoirs, with a special emphasis on understanding the effects of extreme weather on sediment transport and redistribution in these engineered waterways, (b) a paleo-ecotoxicology study of Metropolis Lake (McCracken County), and (c) an exploration of tufas across the state, as possible archives of ancient groundwater discharge.

Analytical Chemistry Laboratory

The KGS Analytical Chemistry Laboratory supports many KGS projects, such as the Critical Minerals and Geochemistry Team's abandoned oil and gas well project. **Jason Backus** and **Andrea Conner** analyze gas samples to determine methane, ethane, propane, butane, pentane, nitrogen, oxygen, carbon dioxide, and carbon monoxide concentrations using the Lab's SRC portable gas chromatograph (Figure 21). In FY24–25, the Critical Minerals and Geochemistry Team began submitting water samples from abandoned coal mines, shallow groundwater, and deep-water brine to the Lab, where **Backus** and **Conner** will use an ICP optical emission spectrometer, an ion chromatograph, and other wet chemistry instrumentation to determine anion and cation concentrations.

Figure 21. The KGS Analytical Chemistry Laboratory fact sheet can be found on our website or using the QR code above.

In addition to their work with KGS, the Lab also supports the broader UK research community. **Jason Backus** and **Andrea Conner** analyze water samples for nitrogen and carbon forms as part of long-term water quality monitoring projects conducted by Jimmy Fox (UK Department of Civil Engineering) in South Elkhorn Creek and the ground and surface waters of the Kentucky Horse Park.

KGS Fact Sheets - Kentucky Geological Survey

Informational fact sheets about Kentucky geology, natural resources, and geologic hazards.

https://kygs.uky.edu/pubs/factsheets

GEMS Lab

Gina Lukoczki standing in the GEMS Lab.

The Geochemical Exploration of Mineral Systems (GEMS) Lab, directed by **Gina Lukoczki**, is a cutting-edge facility that supports the advanced analytical work of the Critical Minerals and Geochemistry Team and the wider UK research community. The Lab harnesses an impressive suite of instruments—including microscopes equipped for fluid and melt inclusion microthermometry, cathodoluminescence, and a newly acquired Horiba LabRAM Odyssey Raman spectrometer—to unravel the geochemical processes governing critical mineral formation and carbonate transformations (Figure 22). Many instrument upgrades were made possible through funding support from UK's Energy and Materials Research Priority Areas. A central focus of the Lab is investigating Kentucky's subsurface mineral potential: from REE distribution in ultramafic rocks of the Illinois-Kentucky Fluorspar District and MVT deposits rich in germanium and gallium, to phosphate-bearing carbonate rocks that may simultaneously offer rare earth elements and bear environmental concerns such as radon exposure. These efforts are supported by current externally funded projects (summarized in the Critical Minerals and Geochemistry Team section of the report) and the UKinSPIRE grant, which will fund two workshops in the spring of 2026: a core workshop on ultramafic lamprophyres of western Kentucky and a Raman microspectroscopy short course. By integrating state-of-the-art geochemical microanalysis tools with geological field data, the GEMS Lab seeks to illuminate the formation,

history, and resource potential of mineral systems vital to sustainable resource exploration.

Surface Processes and Modeling

In January 2025, the Landscape Evolution and Mapping Team built and opened the Surface Processes and Modeling (SP&M) Lab at KGS with support from the NSF EPSCoR CLIMBS award (Figure 23). This state-of-the-art computational facility comprises seven high-end workstations and a dedicated modeling server. This infrastructure enables SP&M Lab personnel to combine and streamline complex workflows to develop integrated surface process and flood models, which support current CLIMBS research and will serve as catalysts for future multidisciplinary collaborations. In pursuit of this goal, **Jason Dortch**, **Meredith Swallom**, **Luciano Cardone** (UK EES PhD student), and colleagues from Morehead State completed training on the SP&M Lab's new TUFLOW FV flood simulation software. **Meredith Swallom** trained collaborators from UK EES, including MS student **Mackenzie Choffel**, and West Virginia University on TUFLOW Heavily Parallelized Compute software. Moreover, the SP&M Lab proudly hosted its first Fulbright Scholar, Olena Ivanik, a senior landslide scientist from the University of Kyiv, along with collaborators from the University of Cincinnati. **Jason Dortch** participated in the acquisition of NSF funding for the Center for Land Surface Hazards at the University of Michigan, where **Meredith Swallom** and **Hudson Koch** will learn new skills, including debris flow and Landlab modeling. Finally, the SP&M Lab is collaborating with KGS faculty affiliates Ryan Thigpen (associate professor) and **Sarah Johnson** (research assistant professor) to undertake 3D and surface modeling of handheld and drone lidar datasets.

Figure 23. After a thorough discussion of mass movement hazards, this group of researchers gathered for a photo before heading to lunch. From left to right, **Hudson Koch**, Dan Sturmer (University of Cincinnati), Olena Ivanik (Taras Shevchenko National University of Kyiv), **Ryan Ramsey**, **Evelyn Bibbins**, **Jason Dortch**.

Hydrologic Modeling Laboratory

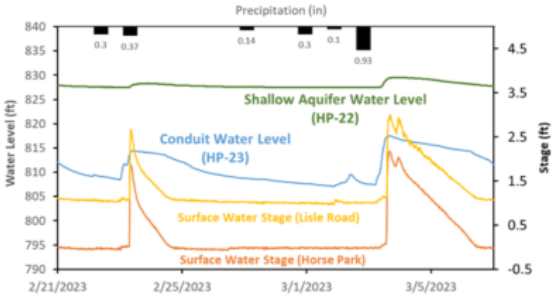


Figure 24. Complex spatial and temporal variations observed for surface water, a karst conduit, and a shallow aquifer in Cane Run, a tributary of the Kentucky River.

Funded by the NSF EPSCoR CLIMBS project, KGS established the Hydrologic Modeling Laboratory (HydroLab) in early 2025. Led by **Junfeng Zhu**, HydroLab's team of researchers and graduate students seeks to advance our understanding of water budget and availability for Kentucky's surface and groundwater resources through data collection, quantitative modeling supported by the Lab's high-performance computing capability, and interdisciplinary collaboration. This research objective is aimed at supporting sustainable management of water resources and helping build resilience on water availability, flooding, and other water-related hazards for communities throughout Kentucky. In

2025, with funding support from the EPSCoR CLIMBS project, the Lab focused on building water budget models for the Kentucky River and the Four Rivers watersheds (Figure 24).

CHAOS Lab

The Washburn Center for geoHealth and Applied Omics Studies (CHAOS Lab; Figure 25) seeks to understand how geology impacts human health, investigate bioactive compounds for medicine and biotechnology, inform medical decision-making, and inspire curiosity about earth systems. Using methodology from microbiology, geochemistry, and biomedicine, the CHAOS Lab studies hydrological contamination, microbial pathogenic shifts from extreme weather events, and the medical potential of microorganisms living in extreme environments. The Lab's fieldwork in Kentucky's most extreme and underexplored environments (Figure 26) is backed by serious lab muscle, including our most important piece of equipment: an ultra-low temperature (−80°C) freezer that safeguards rare and irreplaceable microbial and geologic samples. The Lab is building capacity for metabolite extraction (isolating small molecules made by microbes with potential health or industrial applications) and microbial PCR (amplifying DNA to identify and study microbial species and functions), all underpinned by big data integration, merging bioinformatics, geoinformatics, and the full spectrum of omics (genomics, transcriptomics, metabolomics, and more) to reveal how geologic processes shape microbial chemistry. Our flagship project, the Kentucky Microbiome Map, is an open-access, geospatially informed database that connects microbial diversity to environmental conditions, putting Kentucky at the

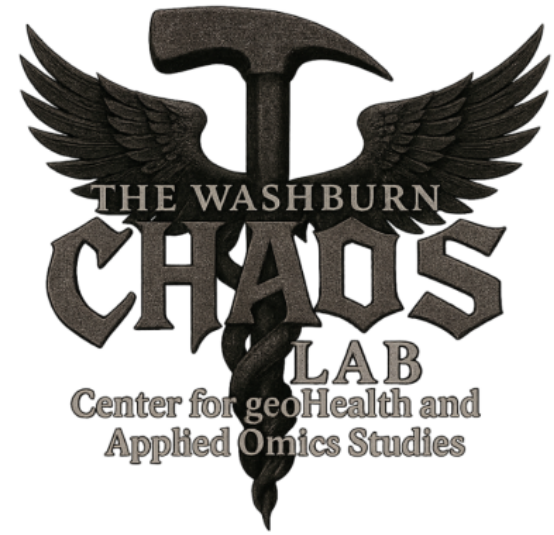


Figure 25.

forefront of natural products and microbiological research and sparking new collaborations worldwide. Beyond the lab, CHAOS Lab is committed to outreach, showing people that anyone can be a scientist and that geology rocks by inviting citizen scientists to join sample collection, presenting to community organizations and groups, and engaging with a global audience through social media.

Figure 26. KGS Potter summer interns helping out the CHAOS Lab with some sampling work. Photograph by Nicholas Belen.

Awards and Memberships

Sarah Arpin

- Kentucky Section of the American Institute of Professional Geologists Stewardship and Outreach Award, in recognition of the Big Blue Rock Pod podcast (with **Matt Crawford** and **Doug Curl**)

Seth Carpenter

- American Geophysical Union, Member
- Eastern Section of the Seismological Society of America, Vice President
- Seismological Society of America, Member

Matt Crawford

- Kentucky Section of the American Institute of Professional Geologists Stewardship and Outreach Award, in recognition of the Big Blue Rock Pod podcast (with **Sarah Arpin** and **Doug Curl**)
- Kentucky Association of Mitigation Managers, Secretary

Doug Curl

- Kentucky Section of the American Institute of Professional Geologists Stewardship and Outreach Award, in recognition of the Big Blue Rock Pod podcast (with **Sarah Arpin** and **Matt Crawford**)
- Association of American State Geologists, Associate Member
- Kentucky Association of Mapping Professionals, Member
- Kentucky River Watershed Watch, Board Member
- KyFromAbove, Technical Advisory Committee
- National Geologic Map Database Working Group, Member

Cortland Eble

- Geological Society of America, Member
- Geological Society of Kentucky, Member
- Kentucky Paleontological Society, Member
- Palynological Society, Member
- Society for Organic Petrology, Member

Cheyenne Hohman

- Kentucky Council on Archives, Member

Carrie Pulliam

- Association for Women Geoscientists, Southeastern Bluegrass Chapter, Member
- Petroleum History Institute, Member

Monte Rivers

- American Association of Petroleum Geologists, Member
- Geological Society of Kentucky, Member
- Morehead State University Geological Society, Member

Donna Robinson

- American Institute of Professional Geologists, Member
- Association for Women Geoscientists, Southeastern Bluegrass Chapter, Treasurer
- Geological Society of America, Member
- Kentucky Academy of Science, Member
- Kentucky Association of Mapping Professionals, Education and Professional Development Committee Member
- Kentucky Association of Mitigation Managers, Member
- Kentucky Climate Consortium, Member

Jon Schmidt

- Seismological Society of America, Member
- Eastern Section of the Seismological Society of America, Member
- American Geophysical Union, Member

Meredith Swallom

- Geological Society of America, Member
- John P. Wyatt, M.D., Environment and Health Symposium, 1st Place Lightning Talk

- John P. Wyatt, M.D., Environment and Health Symposium, 2nd Place People's Choice Lightning Talk

Chuck Taylor

- Kentucky Agriculture Water Quality Authority, Appointed Member
- Kentucky Water Well Drillers Certification Board, Appointed Member
- National Groundwater Association/Association of Groundwater Scientists and Engineers, Member

Alex Washburn

- Society for Sedimentary Geology, Member
- Geological Society of America, Member
- American Geophysical Union, Member

Rachel Washburn

- Ivy Tech Community College 2024 Nancy McClure Award for Excellence in Instruction
- UK Office of the Vice President of Research 2025 Postdoctoral Research Fellowship Award
- Geological Society of America, Member
- American Society for Microbiology, Member
- American Society of Pharmacognosy, Member
- Kentucky Academy of Sciences, Member
- Kentucky Association of Mapping Professionals, Member
- North American Cartographic Information Society, Member
- Society of Postdoctoral Scholars, Member

Junfeng Zhu

- *Groundwater*, Associate Editor

- Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI), Official Representative of the University of Kentucky
- American Geophysical Union, Member

Publications

KGS Abstracts

Adams, E., and Cagle, L., 2025, Sample discovery in the archives—A review of how physical samples are referenced in published research [abs.]: University of Kansas Biodiversity Institute, Society for the Preservation of Natural History Collections Annual Meeting, May 31, 2025, Lawrence, KS.

Adams, E., Raia, N., Choe, S., **Curl, D.**, and **Nobel-Varney, R.**, 2024, The Missing Middle—Engaging a state geological survey in implementing leading data stewardship practices [abs.]: Earth Science Information Partners, 2024 July ESIP Meeting, July 22–26, 2024, Asheville, NC, https://doi.org/10.6084/m9.figshare.26351632.v1.

Adhikari, S., Stone, J., **McGlue, M.M.**, Luz, L.D., and Rasbold, G.G., 2024, A 2,068-year paleo-limnological study of Lake Tanganyika based on the diatoms and sediment chemistry from the central basin of Lake Tanganyika [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Andrews, W., and Cetin, H., 2024, Kentucky as art—Collaborating across universities for science communication [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403246.

Andrews, W., Fielder, W., and Oney, H., 2024, Battles not fought—Mapping geology and terrain as defense in Civil War Kentucky [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403298.

Aossey, C., **Beck, E.G.**, Smith, D.R., Williamson, T.N., Unrine, J.M., Eggett, L., and Lee, B.D., 2024, The spatial and temporal dynamics of phosphorus in palustrine wetlands of the Northern Mississippi Embayment [abs.]: American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, CANVAS 2024, November 10–13, 2024, San Antonio, TX.

Aossey, C., **Beck, G.**, Williamson, T., Unrine, J., Eggett, L., and Lee, B., 2024, Phosphorus dynamics in a palustrine wetland chronosequence in the Jackson Purchase region [abs.]: Kentucky Water Research Institute, 2024 Kentucky Water Resources Annual Symposium, September 27, 2024, Lexington, KY.

Arpin, S., Fryar, A., and **Tobin, B.**, 2024, Alpine karst of Silvertip Mountain, Bob Marshall Wilderness, Montana [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-405204.

Arpin, S.M., Hodelka, B.N., Dortch, J.M., and **Tobin, B.W.**, 2025, Sediment transport dynamics in a complex fluviokarst system, south-central Kentucky [abs.]: 12th Mammoth Cave Research Symposium, May 13–15, 2025, Mammoth Cave National Park, KY.

Arpin, S., Tobin, B., and Fareedi, M., 2024, Updates to Kentucky's karst dye trace database—A resource for managers, researchers, and the public [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-405014.

Beck, E.G., Ruckdeschel, L., and Lee, B., 2024, Kentucky center-pivot irrigation a decade after the 2012 drought [abs.]: Soil and Water Conservation Society, 79th SWCS International Annual Conference, July 21–24, 2024, Myrtle Beach, SC.

Bettel, L., Fox, J., Riddle, B., Beckman, M., **Zhu, J.**, and Al Aamery, N., 2025, Multilayer sediment dynamics in fluviokarst systems—Insights from stable isotopes and sensor measurements [abs.]: European Geosciences Union, EGU General Assembly 2025, April 27–May 2, 2025, Vienna, Austria, https://doi.org/10.5194/egusphere-egu25-13413.

Bledsoe, L.A., **Tobin, B.W.**, and Groves, C., 2024, Protecting Kentucky's geo-heritage—A dye trace investigation to study groundwater resources in the Glenns Creek drainage basin, Franklin and Woodford counties, Kentucky [abs.]: Kentucky Water Research Institute, 2024 Kentucky Water Resources Annual Symposium, September 27, 2024, Lexington, KY.

Carpenter, S., Rodriguez Cardozo, F.R., **Schmidt, J.P.**, Braunmiller, J., **Woolery, E.W.**, and **Wang, Z.**, 2025, Cost-effective groundwater monitoring using nodal geophones—Updates from a case study in the Upper Mississippi Embayment [abs.]: Seismological Research Letters, v. 96, no. 2B, p. 1400, https://doi.org/10.1785/0220250104.

Carpenter, N.S., Rodriguez Cardozo, F., **Woolery, E.W.**, **Schmidt, J.P.**, Braunmiller, J., and **Wang, Z.**, 2024, 4-D passive aquifer characterization in the Upper Mississippi Embayment with nodal geophones—Background and instrument evaluation [abs.]: Eastern Section-SSA, 96th Annual Meeting of the Eastern Section of the Seismological Society of America, October 20–22, 2024, Atlanta, GA.

Carpenter, N.S., Rodriguez Cardozo, F., **Woolery, E.W.**, **Schmidt, J.**, Braunmiller, J., and Wang, Z., 2024, 4-D

passive aquifer characterization in the Upper Mississippi Embayment with nodal geophones—Background and instrument evaluation [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Carpenter, N.S., and **Wang, Z.**, 2024, Identifying site resonance using HVSR—Insights from ambient-noise and earthquake S-wave energy sources [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Carpenter, S., and **Wang, Z.**, 2025, Identifying site resonance in the Central and Eastern U.S. using HVSR—Insights from ambient-noise and earthquake S-wave energy sources and implications for site characterizations [abs.]: Seismological Research Letters, v. 96, no. 2B, p. 1469, https://doi.org/10.1785/0220250104.

Crawford, M., Koch, H., Bibbins, E., Dortch, J., and **Wang, Z.**, 2025, Beyond landslide susceptibility and risk modeling in Kentucky—Tackling stakeholder engagement and perception of long-term risk [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 2, https://doi.org/10.1130/abs/2025SE-408564.

Crawford, M., Koch, H., and **Dortch, J.M.**, 2024, Evaluating refinements in statistics-based landslide susceptibility modeling through model performance and map quality [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403302.

Curl, D., Douthitt, K., and Ryland, G., 2024, Housing suitability maps for flood survivors in eastern KY [abs.]: Esri, 2024 Esri User Conference, July 15–28, 2024, San Diego, CA.

Davis, E., Mako, C., Morse, S., **Thigpen, R.**, Caddick, M., Law, R.D., and Moore, L.R., 2025, Titanite and monazite constraints

on the timing of metamorphism and penetrative deformation in the southern part of the Northern Highlands terrane, Scotland [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 3, https://doi.org/10.1130/abs/2025NE-408459.

DeBari, S., Escobar-Burciaga, R., Aughenbaugh, K., **Cunningham, D.**, Florea, A., Garvey, B., Kaplan, E., Shamloo, H., Tucker, D., Walowski, K., and Yoder, E., 2025, Phenocryst or not? Using a stratovolcano's crystal cargo to explore crustal-scale magmatic systems through time [abs.]: European Geosciences Union, EGU General Assembly 2025, April 27–May 2, 2025, Vienna, Austria, https://doi.org/10.5194/egusphere-egu25-14391.

Domingos Luz, L., **McGlue, M.M.**, and Soreghan, M.J., 2024, High-resolution μ-XRF records of Common Era environmental and limnological change from central Lake Tanganyika, eastern Africa [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Domingos-Luz, L., Rasbold, G.G., and **McGlue, M.M.**, 2024, High-frequency shifts in savanna ecosystem states revealed by sediment core proxy records from Lake Tanganyika (Africa) [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-404293.

Dortch, J., O'Dell, M.L., and **Thigpen, R.**, 2024, Assessing anthropogenic contributions to July 2022 flood severity in eastern Kentucky—Implications for other "flashy" catchments [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Eggett, L., **Beck, E.G.**, Grove, J.H., Haramoto, E., Unrine, J.M., Longacre, S.C., Creech, Z., Goins, S., Dunaway, K., Dorward, E., Shrestha, S., Smith, T., Main, V., and Lee, B.D., 2024, Blue Water Farms—Edge of field water quality monitoring network in

western Kentucky [abs.]: American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, CANVAS 2024, November 10–13, 2024, San Antonio, TX.

Hodelka, B.N., McGlue, M.M., and Zimmerman, S.R.H., 2024, Identification of non-volcanic event layers in Late Quaternary Mono Lake (California, USA) sediment cores [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Koch, H.J., Dortch, J., Harrison, B., and **Crawford, M.**, 2024, Addressing stochastic machine learning derived landslide susceptibility model results [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Lee, B., **Beck, G.**, Grove, J., Haramoto, E., Unrine, J., Eggett, L., Longacre, S., Creech, Z., and Goins, S., 2024, Edge of field nutrient and sediment monitoring network in western Kentucky [abs.]: Kentucky Water Research Institute, 2024 Kentucky Water Resources Annual Symposium, September 27, 2024, Lexington, KY.

Lukoczki, G., and **Hickman, J.B.**, 2024, Critical mineral potential of Mississippi Valley-type mineralization in Kentucky [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403266.

Lukoczki, G., Walton, Z., Dietsch, C., Xu, X., and Steele-MacInnis, M., 2024, Critical mineral potential of ultramafic lamprophyres associated with the Reelfoot Rift, western Kentucky [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403284.

Martin, S., and **Greb, S.**, 2025, Distribution of natural arches in Kentucky [abs.]: Geological Society of America

Abstracts with Programs, v. 57, no. 2, https://doi.org/10.1130/abs/2025SE-407580.

Massey, M.A., and **Andrews, W.**, 2024, Linking landscape to hydrology—Testing the relationship between terrain clusters and stream flow event frequencies [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Massey, M.A., and Stanifer, S., 2024, Spatial heterogeneity of radon levels across Kentucky—Insights from geostatistical analysis [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

McGlue, M.M., Mwangala, N., Yeager, K.M., Luz, L.D., Soreghan, M.J., Miller, E., Cohen, A.S., Zytkow, C., Sinyinza, D., Banda, K., and Nymabe, I., 2024, Limnogeological processes and patterns in Nsumbu National Park—A sediment core transect from southern Lake Tanganyika (Zambia) [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

McGlue, M.M., Thigpen, R., Woolery, E.W., Brown, S.J., Yeager, K., Woller, K., Dilworth, J., Rasbold, G.G., Whitehead, S.J., and Portwood, A., 2025, CHIRP seismic atlas for Jackson Lake, Wyoming—Evidence for late Quaternary tectonic, climatic, and anthropogenic changes [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 5, https://doi.org/10.1130/abs/2025RM-409653.

Miller, E., Soreghan, M., Jepson, G., **McGlue, M.M.**, and Saroni, J., 2024, Constraining the initiation of rifting in a magma poor system—Lake Tanganyika (East African Rift) [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-401778.

Morse, S., **Thigpen, R.**, Law, R.D., Caddick, M., Moore, L.R., and Davis, E., 2025, Constraining the polymetamorphic history of the Northern Highlands and Grampian terranes, Scotland—Preliminary results from monazite and xenotime U-Pb geochronology [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 3, https://doi.org/10.1130/abs/2025NE-408720.

Mwangala, N., **McGlue, M.M.**, and Soreghan, M.J., 2024, Geochemical and sedimentological signals of bottom water oxygen dynamics from Lake Tanganyika (Zambia) [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403296.

Portwood, A., **McGlue, M.M., Thigpen, R., Johnson, S., Woolery, E.W.**, Brown, S.J., Dilworth, J., and Rasbold, G.G., 2025, A novel high-resolution Holocene record of environmental change from Grand Teton National Park, Wyoming [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 5, https://doi.org/10.1130/abs/2025RM-409710.

Preece, M., **Thigpen, R.**, Stockli, D.F., and Johnson, J.P.L., 2024, Investigating climatic effects on the structural and topographic evolution of the Himalayas through landscape analysis and thermokinematic modelling [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-404147.

Prince, P., Bauer, J., Fuemmeler, S., and **Thigpen, R.**, 2024, Field investigation of geologic controls on the September 27, 2024, Craigtown (Garren Creek) debris flow event, Buncombe County, North Carolina [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Ramsey, A., Moecher, D.P., **Thigpen, R.**, Mittwede, S., **Massey, M.**, O'Brien, T., and Samson, S., 2025, Source-to-sink

assessment and provenance of potential placer monazite critical mineral resources in the southeastern Blue Ridge, Piedmont, and Coastal Plain provinces [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 2, https://doi.org/10.1130/abs/2025SE-408357.

Sawyer, A., Decker, L., Field, H., Danner, K., Welch, S., Binley, A., **Zhu, J.**, Hanrahan, B.R., and King, K.W., 2024, Phosphorus transport across the groundwater-surface water interface in intensively managed agricultural streams and relevance to Great Lakes water quality [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403869.

Schaefer, L.N., Bilderback, E., Allstadt, K., Baxstrom, K., Bedinger, E., Belair, G., Burgi, P., Cerovski-Darriau, C., Carlson Dunlap, L.R., Chirico, P., Collins, E., Ellison, S., Einbund, M., Godt, J., …, **Crawford, M.**, et al., 2024, Multi-agency landslide emergency response efforts and insights after Hurricane Helene [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Scheip, C., **Crawford, M., Bibbins, E., Koch, H.**, Graham, A., Winters, S., Hsiao, V., Weidner, L., Zellman, M., and Anderson, S., 2025, Improving landslide-event inventories using high-fidelity lidar change detection in eastern Kentucky [abs.]: European Geosciences Union, EGU General Assembly 2025, April 27–May 2, 2025, Vienna, Austria, https://doi.org/10.5194/egusphere-egu25-10018.

Schmidt, J.P., Carpenter, S., and **Wang, Z.**, 2025, Event detection and hypocenter uncertainty analysis of induced earthquakes within the Rome Trough, West Virginia [abs.]: Seismological Research Letters, v. 96, no. 2B, p. 1379, https://doi.org/10.1785/0220250104.

Schnell, D., Calnan, J., Roghanchi, P., Hernandez Garcia, C., Agioutantis, Z., and **Woolery, E.**, 2025, A review of current blast ground vibration velocity and amplitude impact models and methods [abs.]: American Rock Mechanics Association, 59th U.S. Rock Mechanics/Geomechanics Symposium, June 9–11, 2025, Santa Fe, NM, https://doi.org/10.56952/ARMA-2025-0188.

Soreghan, M., **McGlue, M.M.**, Bright, J., Kaufman, D.S., Ryan-Oordt, E., Zimmerman, S., Kimirei, I.A., and Cohen, A., 2024, Radiocarbon derived time averaging of shell bed accumulations in Lake Tanganyika—Evidence for anthropogenic impact on a unique habitat [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-401650.

Swallom, M., 2025, Drainages, dams and downpours—What makes a flood? [abs.]: University of Kentucky Center for the Environment, John P. Wyatt, M.D., Environment and Health Symposium, April 22, 2025, Lexington, KY.

Thigpen, R., Brown, S.J., Gallen, S.F., Prince, P., **Johnson, S., McGlue, M.M., Dortch, J.,** and **O'Dell, M.L.**, 2024, Where hurricanes go to die—Long-term denudation of southern Appalachian topography punctuated by major erosional pulses during catastrophic weather events [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Thigpen, R., Law, R.D., Mako, C., Powell, N., Spencer, B.M., Moecher, D., Morse, S., Davis, E., and Caddick, M., 2025, Integrating multisystem geo- and thermochronology and thermobarometric data to develop evolutionary tectonic models for the Paleozoic Laurentian margin—Honoring the outstanding career of Rob Strachan [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 3, https://doi.org/10.1130/abs/2025NE-408821.

Thigpen, R., McGlue, M.M., Cortese, C.J., **Woolery, E.W.**, Dilworth, J., Rasbold, G.G., Yeager, K.M., Whitehead, S.J., Brown, S.J., and **Johnson, S.**, 2024, Teton fault paleoseismology—New seismic reflection and long-core evidence for Late Quaternary earthquakes from Jackson Lake, Wyoming, USA [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Thompson, S.C., Carpenter, S., and **Wang, Z.**, 2025, Exploring possible tornado seismic signals from the December 10–11, 2021, tornado outbreak in the central U.S. [abs.]: Seismological Research Letters, v. 96, no. 2B, p. 1403, https://doi.org/10.1785/0220250104.

Wang, Z., and **Carpenter, N.**, 2024, Challenges with probabilistic seismic hazard analysis (PSHA) in the central United States [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Wang, Z., and **Carpenter, N.**, 2024, Science for policy—A case from earthquake science to mitigation policy in the New Madrid Seismic Zone of the central United States [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Wang, Z., and **Carpenter, N.S.**, 2024, The 5 April 2024 Whitehouse Station, New Jersey earthquake (Mw 4.8)—Implications for seismic hazard assessment and communication in the central and eastern U.S. [abs.]: Eastern Section-SSA, 96th Annual Meeting of the Eastern Section of the Seismological Society of America, October 20–22, 2024, Atlanta, GA.

Washburn, A., 2024, Impactful research in calcite geochronology—Understanding mudstone evolution through time [abs.]: AISES, 2024 AISES National Conference, October 3–5, 2024, San Antonio, TX.

Washburn, A., Hickman, J., Lukoczki, G., and Abshire, M., 2024, Investigating spatial and temporal changes in trace element abundance in Devonian shales of Kentucky [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-402123.

Washburn, A., and Sylvester, P., 2024, A proposed methodology for LA-ICP-MS data reduction for U-Pb calcite geochronology [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-404039.

Woods, S., **Zierer, D., Parris, T.M.,** and **Webb, S.E.**, 2024, A hazard-informed prioritization strategy for plugging orphaned oil and gas wells in Kentucky [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Woolery, E.W., Woller, K., Vicroy, S., and Ford, J., 2024, Forensic ground-penetrating-radar imaging—Signal processing, resolution, and partial exhumation of a suspicious burial chamber, south-central Kentucky, USA [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Zach, T., **Thigpen, R.**, Goldsby, R., Grove, R., Hoar, R.M., **Swallom, M., Johnson, S., Woolery, E.W., McGlue, M.M.**, and Brown, S.J., 2025, Reconstructing the Paleozoic-Miocene paleo-topography of the northern Teton Range with implications for the paleo-Teton collapse hypothesis—New insights from detailed geologic mapping of the Survey Peak 7.5’ quadrangle [abs.]: Geological Society of America Abstracts with Programs, v. 57, no. 5, https://doi.org/10.1130/abs/2025RM-410204.

Zhu, J., and **Koch, H.**, 2024, Evaluating karst susceptibility and vulnerability for the Lincoln Trail Area Development District,

Kentucky, from high-resolution data and a ranking-based approach [abs.]: Kentucky Water Research Institute, 2024 Kentucky Water Resources Annual Symposium, September 27, 2024, Lexington, KY.

Zierer, D., Parris, T.M., and **Webb, S.E.**, 2024, Assessing methane abatement from the plugging of Kentucky's orphaned oil and gas wells [abs.]: American Geophysical Union, AGU24, December 9–13, 2024, Washington, DC.

Zierer, D., Woods, S., **Parris, T.M.,** and **Webb, S.**, 2024, Plugging Kentucky's orphaned oil and gas wells—Hazard scores to optimize environmental protection [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-402322.

Zimmerman, S., Wahl, D., Champagne, M., Hassel, C.A., and **McGlue, M.M.**, 2024, More dates, better dates—Progress in chemical concentration, flow-cytometric purification and radiocarbon dating of pollen from terrestrial sedimentary archives [abs.]: Geological Society of America Abstracts with Programs, v. 56, no. 5, https://doi.org/10.1130/abs/2024AM-403532.

KGS Series Publications

Beck, E.G., and **Summers, R.L.**, 2024, Kentucky Groundwater Observation Network Well KGON-3: Kentucky Geological Survey, ser. 14, Interactive Tour 2, https://arcg.is/14mrLq0.

Crawford, M., Koch, H., and **Dortch, J.**, 2024, Multi-jurisdictional hazard mitigation plan for landslides for the Big Sandy Area Development District, Kentucky: Kentucky Geological Survey, ser. 14, Contract Report 1, 56 p., https://doi.org/10.13023/kgs14.ct1.2024.

Eggett, L., **Beck, E.G.**, Longacre, S., Creech, Z., and Lee, B., 2024, University of Kentucky blue water farms—Status of the

edge of field nutrient and sediment monitoring network in western Kentucky (project years 2018–2023): Kentucky Geological Survey, ser. 14, Interactive Tour 1, https://arcg.is/Gaf100.

Koch, H.J., Haneberg, W.C., **Crawford, M.M., Dortch, J.M., and Swallom, M.L.**, 2025, Evaluating the physics-based slope stability program PISA-m at a regional scale: Kentucky Geological Survey, ser. 14, Report of Investigations 1, 22 p., https://doi.org/10.13023/kgs.14.ri.1.2025.

Martin, S., 2025, Natural arches of Kentucky: Kentucky Geological Survey, ser. 14, Special Publication 1, 2 p., https://doi.org/10.13023/kgs.14.sp.1.2025.

Wang, Z., and **Carpenter, N.S.**, 2024, Assessing seismic hazard in western Kentucky and at the Paducah Gaseous Diffusion Plant—An overview of the issues, mitigation strategies, and the research conducted by the Kentucky Geological Survey: Kentucky Geological Survey, ser. 13, Bulletin 1, 100 p., https://doi.org/10.13023/kgs.bn.13.1.

Maps

Hodelka, B., Massey, M.A., Swallom, M., Martin, S., Wells, C., and **Morris, E.**, 2024a, Surficial geologic map of the Bristow 7.5-minute quadrangle, Kentucky: Kentucky Geological Survey, ser. 14, Contract Report 3, scale 1:24,000, https://doi.org/kgs14.ct3.2024.

Massey, M.A., Swallom, M., Hodelka, B., Hayes, H., Wells, C., Martin, S., and **Morris, E.**, 2024, Surficial geologic map of the Bowling Green South 7.5-minute quadrangle, Kentucky: Kentucky Geological Survey, ser. 14, Contract Report 2, scale 1:24,000, https://doi.org/kgs14.ct2.2024.

Swallom, M., Hodelka, B., Massey, M.A., Hayes, H., Wells, C., and **Morris, E.**, 2024, Surficial geologic map of the Smiths

Grove 7.5-minute quadrangle, Kentucky: Kentucky Geological Survey, ser. 14, Contract Report 4, scale 1:24,000, https://doi.org/kgs14.ct4.2024.

Research Data

Burgi, P.M., Toney, L.D., Collins, E.A., Murphy, C.R., Ellison, S.M., Schmitt, R.G., Allstadt, K.E., Bedinger, E.C., Belair, G.M., Bilderback, E.L., Dunlap, L.R.C.C., Cattanach, B., **Crawford, M.**, Einbund, M.M., et al., 2025, Preliminary landslide inventory for landslides triggered by Hurricane Helene (September 2024): U.S. Geological Survey, data release, https://doi.org/10.5066/P14CHGKS.

Crawford, M.M., Bibbins, E.M., and **Koch, H.J.**, 2022, Kentucky Geological Survey landslide inventory [ver. 4, 2024-10]: Kentucky Geological Survey, ser. 14, research data, https://doi.org/10.13023/kgs.data.2022.01.

Massey, M., 2024, Kentucky surficial geologic map compilation database [ver. 1, 2024-9]: Kentucky Geological Survey, ser. 14, research data, https://doi.org/kgs.data.10.02.2024.

Massey, M., and Imran, A.A.Z., 2025, EarthScape AI dataset [ver. 1, 2025-5]: Kentucky Geological Survey, ser. 14, research data, https://doi.org/10.13023/kgs.data.05.01.2025.

Robinson, D., Pearson, A.**, Hickman, J., Lukoczki, G.,** and **Andrews, W., Jr.**, 2024, Earth MRI Western Kentucky Fluorspar District 3D geological modeling: Kentucky Geological Survey, ser. 14, research data, https://doi.org/10.13023/kgs.data.09.17.2024.

External Publications

Adams, E., Raia, N., Choe, S., Wink, I., and **Curl, D.**, 2025, Engaging state geological surveys in implementing data stewardship practices—A pilot workshop at the Kentucky

Geological Survey: Research Ideas and Outcomes, v. 11, article e155393, https://doi.org/10.3897/rio.11.e155393.

Arpin, S.M., 2025, Book review—Karst Hydrogeology, Geomorphology, and Caves: Groundwater, v. 63, no. 1, p. 9, https://doi.org/10.1111/gwat.13409.

Ashjari, J., **Tobin, B.**, Fryar, A.E., and Ashjari, Z., 2024, Numerical modeling of development of Leandras and Double Bopper Caves, Grand Canyon, USA: Hydrogeology Journal, v. 32, p. 1751–1768, https://doi.org/10.1007/s10040-024-02812-z.

Bettel, L., Fox, J., Husic, A., Mahoney, T., Marin-Ramirez, A., **Zhu, J., Tobin, B.**, Al-Aamery, N., Osborne, C., Riddle, B., and Pollock, E., 2025, Hydrologic pathways and baseflow contributions, and not the proximity of sediment sources, determine the shape of sediment hysteresis curves—Theory development and application in a karst basin in Kentucky USA: Journal of Hydrology, v. 649, article 132300, https://doi.org/10.1016/j.jhydrol.2024.132300.

Crawford, M.M., Koch, H.J., and **Dortch, J.M.**, 2025, Evaluating map quality and model performance through iterative statistics-based landslide susceptibility in eastern KY: Natural Hazards, v. 121, p. 11633–11661, https://doi.org/10.1007/s11069-025-07255-7.

Daruna, A., Zadorozhnyy, V., **Lukoczki, G.**, and Chiu, H.-P., 2024, GFM4MPM—Towards geospatial foundation models for mineral prospectivity mapping, in Nascimento, M.A., Xiong, L., Züfle, A., Chiang, Y.-Y., Eldawy, A., and Kröger, P., eds., Proceedings of the 32nd ACM International Conference on Advances in Geographic Information Systems: New York, Association for Computing Machinery, p. 565–568, https://doi.org/10.1145/3678717.3691268.

Daruna, A., Zadorozhnyy, V., **Lukoczki, G.**, and Chiu, H.-P., 2024, Enabling scalable mineral exploration—Self-supervision and explainability, in Ding, W., Lu, C.-T., Wang, F., Di, L., Wu, K., Huan, J., Nambiar, R., Li, J., Ilievski, F., Baeza-Yates, R., and Hu, X., eds., 2024 IEEE International Conference on Big Data: IEEE, p. 2090–2099, https://doi.org/10.1109/BigData62323.2024.10825956.

Dilworth, J.R., **McGlue, M.M., Thigpen, R.J.**, Brown, S.J., Yeager, K.M., **Woolery, E.W., Johnson, S.E.**, Whitehead, S.J., Cortese, C.J., and Matocha, C., 2024, Holocene paleoenvironmental history of Jackson Lake (Grand Teton National Park, USA) deduced from CHIRP seismic reflection and radiocarbon-dated sediment cores: Quaternary Science Reviews, v. 336, article 108748, https://doi.org/10.1016/j.quascirev.2024.108748.

Domingos-Luz, L., Rasbold, G.G., Ivory, S.J., Yost, C.L., Stone, J.R., Adhikari, S., Soreghan, M.J., Kimirei, I.A., and **McGlue, M.M.**, 2025, Phytolith and macrocharcoal records from Lake Tanganyika (Africa) reveal high-frequency shifts in savanna ecosystem states during the Common Era: GSA Bulletin, v. 137, no. 9–10, p. 3998–4014, https://doi.org/10.1130/B37860.1.

Domingos-Luz, L., Soreghan, M.J., Rasbold, G.G., Ellis, G.S., Birdwell, J.E., Kimirei, I.A., Scholz, C.A., and **McGlue, M.M.**, 2024, Middle and Late Holocene paleolimnological changes in central Lake Tanganyika—Integrated evidence from the Kavala Island Ridge (Tanzania): The Holocene, v. 34, no. 9, p. 1167–1180, https://doi.org/10.1177/09596836241254475.

Goldsby, R.C., **Thigpen, J.R.**, Preece, M.B., and Swanger, W.R., 2024, Developing evolutionary models for deformation band formation in high-porosity suprasalt sandstones—An example from Paradox Basin, Utah: Journal of Structural Geology, v. 185, article 105188, https://doi.org/10.1016/j.jsg.2024.105188.

Grove, J., Teutsch, C., Ritchey, E., Lee, B., and **Beck, G.**, 2025, After a big rain—N loss, erosion, and other things: Kentucky Field Crops News, v. 1, no. 4, p. 7–12.

Helfrich, A.L., **Thigpen, J.R.**, Buford-Parks, V.M., McQuarrie, N., Brown, S.J., and Goldsby, R.C., 2024, Constraining displacement magnitude on crustal-scale extensional faults using thermochronology combined with flexural-kinematic and thermal-kinematic modeling—An example from the Teton Fault, Wyoming, USA: Tectonics, v. 43, no. 7, article e2024TC008308, https://doi.org/10.1029/2024TC008308.

Hodelka, B.N., Black, M., Benfield, A.J., Ivory, S.J., **Woolery, E.W.**, Woller, K., Zimmerman, S.R.H., and **McGlue, M.M.**, 2025, Sedimentary records of late Pleistocene-Holocene paleoenvironments from Convict Lake (California, USA): Quaternary International, v. 724, article 109739, https://doi.org/10.1016/j.quaint.2025.109739.

Hodelka, B.N., McGlue, M.M., Palacios-Fest, M.R., Benfield, A.J., Ivory, S.J., Starratt, S.W., and Zimmerman, S.R.H., 2024, Late Quaternary ostracode stratigraphy of Mono Lake (California, USA)—Evidence for benthic ecosystem sensitivity to climate change: Journal of Quaternary Science, v. 39, no. 4, p. 648–664, https://doi.org/10.1002/jqs.3607.

Hower, J.C., **Eble, C.F.**, Hopps, S.D., Morgan, T.D., and Edwards, V.A., 2025, Petrology and geochemistry of the Middle Pennsylvanian (Langsettian) Clintwood coalbed, Pike County, Kentucky: International Journal of Coal Science & Technology, v. 12, article 22, https://doi.org/10.1007/s40789-025-00764-7.

Jáger, V., Héja, G.H., Dabi, G., and **Lukoczki, G.**, 2024, Cretaceous Fe-oxidising microbial mats in injection dykes in the Variscan gold-bearing metamorphic basement of the Tisza Mega-unit (SE Hungary): Palaeogeography,

Palaeoclimatology, Palaeoecology, v. 650, article 112372, https://doi.org/10.1016/j.palaeo.2024.112372.

Johnson, S.E., and Haneberg, W.C., 2025, Machine learning for surficial geologic mapping: Earth Surface Processes and Landforms, v. 50, no. 1, article e6032, https://doi.org/10.1002/esp.6032.

Knecht, R.J., Benner, J.S., Swain, A., Azevedo-Schmidt, L., Cleal, C.J., Labandeira, C.C., Engel, M.S., Dunlop, J.A., Selden, P.A., **Eble, C.F.**, Renczkowski, M.D., Wheeler, D.A., Funderburk, M.M., Emma, S.L., et al., 2024, Early Pennsylvanian Lagerstätte reveals a diverse ecosystem on a subhumid, alluvial fan: Nature Communications, v. 15, article 7876, https://doi.org/10.1038/s41467-024-52181-0.

Laverde-Montaño, F., Clavijo-Torres, J., Guzmán-Ospitia, G., and **Torres-Zamora, A.**, 2024, Los Santos Formation in the Platanalito section—A fluvial and transgressive river-mouth estuary deposit of the Eastern Cordillera of Colombia: Boletín de Geología, v. 46, no. 3, p. 39–68, https://doi.org/10.18273/revbol.v46n3-2024002.

Law, R.D., Strachan, R., Thirlwall, M., and **Thigpen, J.R.**, 2024, The Caledonian Orogeny—Late Ordovician–Early Devonian tectonic and magmatic events associated with closure of the Iapetus Ocean, in Smith, M., and Strachan, R., eds., The geology of Scotland [5th ed.]: London, Geological Society, p. 205–258, https://doi.org/10.1144/GOS5-2022-71.

Law, R.D., **Thigpen, J.R.**, Mako, C.A., Kylander-Clark, A., Caddick, M.J., Moore, L.R., Becker, C., Holdsworth, R.E., Strachan, R.A., and Leslie, A.G., 2025, The timing and significance of mid-crustal shearing and exhumation of amphibolite-facies rocks along the Great Glen Fault Zone, Scotland: Journal of the Geological Society, v. 182, no. 4, article jgs2024-264, https://doi.org/10.1144/jgs2024-264.

Lo, E.L., **McGlue, M.M.**, Matocha, C.J., Silva, A., Rasbold, G.G., Kuerten, S., Louzada, R.O., and Haller, K.C., 2024, Pantanal Basin river muds from source to sink—Compositional changes in a tropical back-bulge depozone: Sedimentologika, v. 2, no. 1, https://doi.org/10.57035/journals/sdk.2024.e21.1342.

Lopera Congote, L., **McGlue, M.M.**, Yeager, K.M., Westover, K.S., and Stone, J.R., 2024, Diatom spatial variations in Gull Lake (California) sediments—Implications for improving paleolimnological interpretations in small glacial lakes: Hydrobiologia, v. 851, p. 5151–5166, https://doi.org/10.1007/s10750-024-05670-8.

Lopera-Congote, L., **McGlue, M.M.**, Westover, K.S., Yeager, K., Streib, L., and Stone, J.R., 2024, Detecting climate-driven ecological changes in high-altitude lakes in the Sierra Nevada, California: The Holocene, v. 34, no. 7, p. 870–880, https://doi.org/10.1177/09596836241236324.

Lyon, E.C., Erhardt, A.M., Streib, L.C., Zimmerman, S.R.H., and **McGlue, M.M.**, 2025, A high-resolution record of Late Holocene drought in the eastern Sierra Nevada (California, USA) from June Lake carbonate geochemistry: Quaternary Research, v. 123, p. 1–15, https://doi.org/10.1017/qua.2024.38.

Ma, C., Jiao, H., Hao, Y., Yeh, T.-C.J., **Zhu, J.**, Hao, H., Lu, J., and Dong, J., 2025, Simulation of spring discharge using deep learning, considering the spatiotemporal variability of precipitation: Water Resources Research, v. 61, no. 4, https://doi.org/10.1029/2024WR037449.

Ma, C., Lu, J., Hao, Y., **Zhu, J.**, Zhao, Z., Hao, H., and Xu, K., 2025, Modeling spatial-temporal behavior of precipitation-driven karst spring discharge using a hybrid deep learning model: Journal of Hydrology, v. 655, article 132948, https://doi.org/10.1016/j.jhydrol.2025.132948.

Mastalerz, M., Ames, P., **Eble, C.**, Hasenmueller, N., Marietta, G., and Liu, B., 2024, Modifications of Pennsylvanian stratigraphy in Indiana: Indiana Journal of Earth Sciences, v. 6, https://doi.org/10.14434/ijes.v6i1.39762.

Mastalerz, M., Ames, P., **Eble, C.**, Hasenmueller, N., and Padgett, P., 2024, The St. Meinrad Coal Member (Pennsylvanian)—Reference sections from Spencer County, Indiana: Indiana Journal of Earth Sciences, v. 6, https://doi.org/10.14434/ijes.v6i1.39143.

Moore, J., Hanna, H., Royce, B., Daft, G., **Andrews, W., Eble, C.**, and Brown, S., 2024, Regional investigation of rare earth element-enriched underclay deposits in the central and eastern United States—An Earth Mapping Resources Initiative (Earth MRI) geochemical reconnaissance study: West Virginia Geological and Economic Survey, Report of Investigations 37, 31 p.

O'Keefe, J.M.K., Pound, M.J., Romero, I.C., Nuñez Otaño, N.B., Gibson, M.E., McCoy, J., Alden, M.E., Fairchild, C.J., Fitzpatrick, J., Hodgson, E., Horsfall, T., Jones, S., Lennex-Stone, J.E., Marsh, C.A., …, **Eble, C.F.**, et al., 2024, Summer-wet hydrologic cycle during the Middle Miocene of the United States—New evidence from fossil fungi: Research, v. 7, article 0481, https://doi.org/10.34133/research.0481.

Rasbold, G.G., Louzada, R., Bergier, I., Domingos-Luz, L., Lo, E.L., Silva, A., Gradella, F., Stevaux, J.C., Leli, I.T., Kuerten, S., and **McGlue, M.M.**, 2025, Hydroclimate change affects tropical lake ecosystems on floodplains in the Pantanal: Inland Waters, v. 15, no. 1, article 2491903, https://doi.org/10.1080/20442041.2025.2491903.

Steelquist, A.T., Seixas, G.B., Gillam, M.L., **Saha, S.**, Moon, S., and Hilley, G.E., 2024, The impact of bedrock meander cutoffs on 50 kyr scale incision rates, San Juan River, Utah: Earth

Surface Dynamics, v. 12, p. 1071–1089, https://doi.org/10.5194/esurf-12-1071-2024.

Swallom, M.L., Koch, H.J., Dortch, J.M., Crawford, M.M., Thigpen, J.R., and **Andrews, W.M.**, 2025, Evaluating root strength index as an indicator of landslide-prone slopes in eastern Kentucky: Landslides, v. 22, p. 567–578, https://doi.org/10.1007/s10346-024-02384-9.

Szekanecz, Z., Besnyi, A., Kónya, P., Füri, J., **Király, E.**, Bertalan, É., Falus, G., Udvardi, B., Kovács-Kis, V., Andrássy, L., Maros, G., Fancsik, T., Pethő, Z., Gomez, I., et al., 2024, Bones or stones—How can we apply geophysical techniques in bone research? International Journal of Molecular Sciences, v. 25, no. 19, article 10733, https://doi.org/10.3390/ijms251910733.

Wang, Z., and **Carpenter, N.S.**, 2025, Assessing seismic hazards for engineering design and other applications in Kentucky, in Beauregard, M.S., and Budge, A.S., eds., Geotechnical Frontiers 2025—Geotechnics of natural hazards: Reston, VA, American Society of Civil Engineers, Geotechnical Special Publication 366, p. 409–418, https://doi.org/10.1061/9780784485996.039.

Washburn, R.L., and Dufour, J.M., 2024, Gene expression profiles of neonatal porcine Sertoli cells at baseline and after incubation in normal human serum as determined by RNA sequencing: Tissue Barriers, v. 12, no. 3, article 2242060, https://doi.org/10.1080/21688370.2023.2242060.

Washburn, R.L., and Dufour, J.M., 2024, Regulation of complement by Sertoli cells may contribute to the immune protective environment within the blood-testis barrier: Tissue Barriers, v. 12, no. 3, article 2233385, https://doi.org/10.1080/21688370.2023.2233385.

Washburn, A.M., Sylvester, P.J., Poros, Z., and Snell, K.E., 2024, Thermal maximum and overpressure of the Wolfcamp formation in the Delaware Basin of Texas and New Mexico through age and temperature of beef calcite veins: AAPG Bulletin, v. 108, no. 11, p. 2073–2092, https://doi.org/10.1306/07232423096.

Whitehead, S.J., Yeager, K.M., Dilworth, J.R., **McGlue, M.M., Thigpen, J.R.**, Schindler, K.J., and **Woolery, E.W.**, 2025, High-resolution lake infill time modeling at Jackson Lake, Wyoming (USA): Inland Waters, v. 15, no. 1, article 2431401, https://doi.org/10.1080/20442041.2024.2431401.

Zhu, Y., **Carpenter, N.S.**, Miller, A.C., Wang, H., and **Wang, Z.**, 2025, Modeling spatial variability of ground-motion site resonances for the Jackson Purchase Region in the New Madrid Seismic Zone, in Geotechnical Frontiers 2025—Soil characterization and improvement: Reston, VA, American Society of Civil Engineers, Geotechnical Special Publication 368, p. 65–74, https://doi.org/10.1061/9780784486016.007.

2024–2025 Staff

Adams, Elizabeth. Engagement Division Director, Archive Manager

Andrews, William. Section Head, retired January 2025

Armstrong, Ambre. Administrative Support Associate I

Arpin, Sarah. Geologist II

Backus, Jason. Geologist IV/Laboratory Manager

Beck, Glynn. Geologist IV/Facility Manager

Bhatt, Shashank. Computational Geology Programmer

Bibbins, Evelyn. Geologist I

Bowersox, Rick. Geologist IV, retired March 2025

Carmichael, Matthew. Geologist II

Carpenter, Seth. Geologist V

Carr-Trebelhorn, Julia. Geologic Archive Technician

Conner, Andrea. Scientist I

Counts, Talon. Student Geologist

Crawford, Matt. Geologist IV

Cunningham, Desireé. Geologist I

Curl, Doug. Information Management Division Director

Daniel, Ray. Principal Research Analyst

DeJesus, Ralph. Administrative Engineering Systems I

Devereaux, Percy. Archive Technician

Dortch, Jason. Geologist V

Eble, Cortland. Geologist V

Ellis, Kati. Administrative Business Officer

Ellis, Mike. IT Support Specialist IV

Fields, Natalie. Geologic Photographer

Frazier, Rebekah. Communications Officer

Fulton, Shelby. Geologic Publication Editor

Greb, Steve. Geologist V, Acting Section Manager, retired March 2025

Hall, Charlie. Archive Technician

Hawksley, Andrew. Geologist I

Hickman, John. Geologist IV

High, Madison. Geologist I

Hodelka, Bailee. Geologist II

Hohman, Cheyenne. Publication Resources Curator Manager

Ison, Sierra. Archive Technician

Koch, Hudson. Geologist II

Lukoczki, Gina. Geologist IV

Martin, Steve. Geologist III

Massey, Matt. Geologist IV

McGlue, Michael. State Geologist and Director

McDonald, Caitlin. Student Archive Technician

Morris, Emily. Cartographic Data Manager

Morris, Zachary. Geologic Archive Technician

Parris, Marty. Geologist V, retired February 2025

Peredo, Mark. Web Designer

Phillips, Gwen. Staff Support Associate II

Pinkston, Ryan. Research Facility Manager

Puckett, Paul. Geology Database Support

Pulliam, Carrie. Database Manager Specialist

Ramsey, Ryan. Geologist I

Rivers, Monte. Geologist II

Robinson, Donna. Geologist II

Sailors, Mallory. Research Warehouse Technician

Schmidt, Jon. Geologist II

Sparks, Tom. Geologist III, retired January 2025

Steiner, Greg. Temporary STEPS Technical Scientific

Summers, Riley. Summer Geo Tech

Swallom, Meredith. Geologist II

Taylor, Chuck. Section Head

Teleky, Olivia. Archive Technician

Torres-Zamora, Angela. Geologist I

Walton, Zachary. Geologist I

Wang, Zhenming. Associate Director

Washburn, Alex. Geologist III

Washburn, Rachel. Health Geoscientist Postdoctoral Scholar

Williams, Kurstin. Geologist I

Woolery, Ed. Geophysics Faculty Associate

Zhu, Junfeng. Geologist V

Zierer, Deron. Geologist II

KGS Paul Edwin Potter Internship, Summer 2025

- Apostolides, Victoria. Potter Intern, Appalachian State University freshman
- Gardner, Finley. Potter Intern, Murray State University junior
- Hughes, Maysn. Potter Intern, Western Kentucky University junior
- Ison, Hala. Potter Intern, Berea College junior
- Lennex-Stone, June. Potter Intern, Morehead State University junior
- Willhoite, Emmerson. Potter Intern, University of Kentucky junior