Earth and Environmental Sciences 2021 & 2022 Department Newsletter

College of Arts and Sciences

Department of Earth and Environmental Sciences

Earth & Environmental Sciences

2021 & 2022 DEPARTMENT NEWSLETTER

Regular Faculty
Andrea Erhardt, Associate Professor
Frank Ettensohn, Professor
Rebecca Freeman, Associate Professor
Alan Fryar, Professor
Michael McGlue, Associate Professor
David Moecher, Professor
Keely O'Farrell, Assistant Professor
Dhananjay Ravat, Professor
Ryan Thigpen, Associate Professor
Kevin Yeager, Professor
Ed Woolery, Professor

Research Faculty
Bill Haneberg, Professor
Jim Hower, Distinguished Fellow

Senior Lecturer
Kent Ratajeski

Lecturer
Summer Brown

Emeritus Faculty
William Blackburn
Bruce Moore
Kieran O'Hara
Sue Rimmer
Lyle Sendlein
Ron Street
William Thomas

Staff
Meaghan Bushling, Dept. Manager
Kimberly Schindler, SER2L Lab Manager
Aaron Shultis, Stable Isotope Lab Manager

Adjunct Faculty
Drew Andrews, KGS
Rick Bowersox, KGS
Seth Carpenter, KGS
Matthew Crawford, KGS
Jason Dortch, KGS
Cortland Eble, KGS
Steve Greb, KGS
John Hickman, KGS
Georgina Lukoczki, KGS
Marty Parris, KGS
Ben Tobin, KGS
Zhenming Wang, KGS
Amy Wolfe, KGS
Junfeng Zhu, KGS

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Stay Connected and Keep in Touch!

You can keep track of department events, the Rast-Holbrook seminar schedule, our contact information, and alumni events via the department web page: ees.as.uky.edu

If your contact information changes, let us know! Send a note to, email, or call us!

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The Chair 's Reflection

Greetings EES alumni and friends!

Despite the extended pandemic challenges, we have continued to create opportunities to improve and broaden our research, teaching, and service mission during the past year. I have distilled and highlighted some of these opportunities below:

•The faculty worked very hard to produce a revised Bachelor of Science curriculum. New courses, along with implementing six emphasis areas will allow our undergraduate majors to design more individualized and responsive degree options for a wider variety of geoscience paths that best fit their interests and career goals. More details on the BS curriculum revision will soon be available on our webpage as we move toward implementation in the new year. Reassessing the curricula associated with the BA, MS, and PhD degrees is also planned during the next couple of years. Ultimately, we want all our degree curricula to be dynamic, nimble, and experiential in their ability to prepare students for success in the complex challenges associated with 21st century geoscience.

•The Department is leading a 5-year $20M idea to organize geoscience programs across the Commonwealth that will better address climate science and natural hazards, an area our self-reflection survey identified as a current EES strength. The aim for the proposal is to build transdisciplinary leadership capacity, research expertise, facilities, and educational opportunities for all the geosciences and allied disciplines across UK's campus and throughout the state. If successful, this initiative will enhance our state's national competitiveness in this important area, as well as promote societal resilience and promote economic development. More information will be forthcoming as this evolves.

•Our proposal to become an American Geophysical Union Bridge Partner was successful this past year. We joined 31 existing partners, from some of the most prestigious institutions in the country, to increase diversity in the Department's graduate program. This now provides us access to the AGU Bridge Program student applicant database, national recognition as a department committed to geoscience diversity and inclusion, and a national recommendation to all underrepresented groups of the Department's commitment to provide a supportive environment for graduate education.
In addition to our program opportunities, we also want to take some time to celebrate its accomplishments.

•We congratulate Prof. Andrea Erhardt on her successful promotion to Associate Professor with tenure, as well as Prof. Kevin Yeager's promotion to Full Professor; both promotions were fully earned and deserved, representing a significant accomplishment in their academic careers. Well done!

The Chair 's Reflection

•To maintain our commitment to experiential learning, our generous Alumni Board donated over $60,000 in a little over 30 days, after initiating the idea at the spring Board Meeting, to purchase a new 15-passenger van that will safely and reliably transport our students to the field. The residual resources will provide a head start as we begin the campaign for a second van that can fully cover our student transportation needs.

•EES and the Kentucky Geological Survey have a mutual symbiosis that is often taken for granted, but the recent challenges have reminded us of our ability to act as “force multipliers” for one another. I thought it would be a helpful reminder for everyone to focus attention on a few examples of our ongoing collaborations in this newsletter. Some of the active collaborations are several decades old while others have just begun. No matter the timeframe, we anticipate the “special” relationship to continue serving our current scholars, as well as those yet to arrive.

As always, I would like to acknowledge the generosity and incredible support provided by our alumni and friends. That so many of you continue to find the time to support the Department during these challenging times is greatly appreciated. I look forward to all the opportunities ahead of us and seeing as many of you as possible in the coming year.

Many cheers,
Ed Woolery
MS '93, PhD '98

Graduate Student Degrees

(WITH THESIS ADVISOR, AS OF APRIL 2022)

2021-2022

Stephanie Sparks, MS: “Influence of bedrock erodibility on orogen evolution in collisional systems and implications for geodynamic models” (R. Thigpen)

Brandon Spencer, PhD: “Syn-to Post-Organic evolution of collisional mountain systems: Investigating the potential for crustal flow using thermochronology and munerical models” (R. Thigpen)

Catherine Herbert, MS: "The Revised Systematics and Paleoecology of the Devonian Stemless Crinoid Genus *Edriocrinus* Hall, 1858" (F. Ettensohn)

Undergraduate Degrees

Bachelor of Arts

Elisha Miller
Zachary Walton

Bachelor of Science

Gillian Clark
Michael Edelen
Kevin Haller
Laura Oborne
Kyle Skeese

Undergraduate Awards

Pirtle Outstanding Senior Scholarship
Jack Chappuies

Rice-Hagan Memorial Tuition Scholarship
Lucas Ruckdeschel

Sigma Gamma Epsilon Tarr Award
Alexandra Arimes

Advancing Science for Kentuckians (ASK) Scholarship
Riley Grove

Jay G. Henthorne Jr. Scholarship
Miysam Al Azri

Rast Brown Scholarship
Daniel Alexsandrowski
Mackenzie Choffel
John Gribbins III
Connor Hopps

Curt and Jean Hull Scholarship
Morgan Garrity
Zachary Walton

Ed Harris Scholarship
Jack Chappuies

Diane and Bill Spies Scholarship
Austin Benningfield
Sean Givens
Bianca Salinas

Graduate Awards

William and Rachel Thomas Graduate Fellowship
Sarah Arpin

KGS-EES Commonwealth Research Assistantship
Russel Rogers

Pirtle-Boone Summer Graduate Fellowships
Callia Cortese
Ryan Dapkus
Ryan Goldsby
Sierra Heimel
Russel Rogers
Brooks Rosandich
Meredith Swallom

Brown-McFarlan Fund Travel Award
Shishir Sarker
Sierra Heimel
Ryan Goldsby
Bailee Hodelka
Gustavo Martins
Alex Reis
Sarah Johnson

Ferm Graduate Research Award
Meredith Swallom
Callia Cortese
Sam Whitehead
Alex Reis
Shishir Sarker
Antonia Bottoms
John Dilworth

Outstanding TA Award
John Dilworth
Leandro Luz
Shishir Sarker

GSA On to the Future Award
Leandro Luz

SE-NC GSA Travel Award
Edward Lo
Leandro Luz

John W. Hess Research Award in Karst Studies (GSA)
Sierra Heimel

EarthRates Award
John Dilworth
Bailee Hodelka
Edward Lo
Leandro Luz
Gustavo Martins

Omicron Delta Kappa Honor Society
Gustavo Martins

Hahn Fellowship
Meredith Swallom

Lyman T. Johnson Fellowship
Alexandria Thomas

Crawford Hydrology Laboratory Research Grant
Sarah Arpin

Carbonate Critical Zone Research Coordination Network Travel Grants
Shishir Sarker

Rast-Holbrook Seminar Speakers

The Rast-Holbrook Seminar Series is a weekly Department event. It is an opportunity for students and faculty to hear about emerging research and for us to showcase the Department. The Rast-Holbrook endowment was made possible by a generous foundational donation by Mr. Charles Holbrook, and numerous donations by alumni made in memory of Prof. Nicholas Rast.

Thank you to all the speakers who joined us, both in person and online in 2021 and 2022:

Dr. Fabio Crameri, Centre for Earth Evolution and Dynamics (Oslo)

Dr. Camelia Knapp, Oklahoma State University

Dr. Racha El Kadiri, Middle Tennessee State University

Dr. Valdir Novello, University of São Paulo

Dr. Ibukun Bode-Omoleye, Kansas Geological Survey

Dr. Michael Soreghan, University of Oklahoma

Dr. Ann Dulea, Woods Hole Oceanography Institution

Dr. Maegen Rochner, University of Louisville

Dr. Lindsay Prothro, Texas A&M University

Dr. Trish Gregg, University of Illinois

Dr. Alina Shchepetkina, University of Lisbon

Dr. Abe Springer, Northern Arizona University

Dr. Chen Zhu, Indiana University

Dr. Chad Yost, Indiana State University

Mr. Richard Wooten, Former North Carolina Geological Survey

Ms. Sarah Burgess, Indiana Geological Society

Dr. Lisa Park Boush, University of Connecticut

Dr. Susan Zimmerman, Berkeley Geochronology Center & Center for AMS (CAMS), Lawrence Livermore National Lab

Transitions

J.S. Hudnall Endowed Professorship

EES Department Chair Dr. Ed Woolery was awarded the James S. Hudnall Professorship in Geology during the Spring Semester. Then A&S Interim Dean Christian Brady cited Professor Woolery as "an esteemed scholar and valued faculty member…most deserving of this award." The endowed professorship was created in 1973 by Dr. James S. Hudnall, a 1921 alumnus and legendary geologist in the early Texas oil industry, to recognize outstanding faculty. Dr. Woolery, who becomes the third Hudnall Professor of Geology following Drs. Nicholas Rast and William Thomas, is also an alumnus of the Department, having earned both a master's degree ('93) and Ph.D. ('98). He has been a faculty member since 2001 and finds his greatest joy in working with students to design non-traditional geophysical experiments for testing challenging scientific hypotheses. This is reflected in his exceptional record as a graduate advisor where his lab has established a graduation rate of ~1.5 MS/PhD students per year during the past two decades. Ed's research is focused in near-surface geophysics, seismic hazards, engineering seismology and neotectonics; but he earned his national and international recognition in the various applications of horizontally polarized seismic shear waves (SH-mode) to active fault studies in low-velocity near-surface sediment. Prof. Jianghai Xia, Editor-in-Chief for the Journal of Applied Geophysics and Qiushi Endowed Chair of Geophysics at Zhejiang University, described Woolery's application of SH-wave imaging to seismic and environmental hazards as "benchmark contributions to our near-surface geophysics community." Dr. William Stephenson, chief geophysicist for the U.S. Geological Survey's geological hazards program described Professor Woolery as an "internationally recognized expert in the field of shear-wave seismic reflection and refraction imaging." He went on to state that Ed has been "at the forefront of understanding the regional tectonics and seismic hazard of the central United States" and "a pioneer in the analysis of geophysical data for characterizing the Wabash Valley Seismic Zone."

Ed said that he is "honored and deeply humbled" to receive this recognition, and after his more than 10-year-long administrative appointment expires, looks forward to stewarding the professorship and his time toward increasing undergraduate research opportunities in near-surface geophysical techniques and natural hazard applications.

Transitions

EES Research Professor Bill Haneberg

Bill Haneberg, **State Geologist and Director of the Kentucky Geological Survey**, as well as EES faculty member will be stepping down from his KGS duties at the end of FY2023; however, we hope his plans allow him to remain part of the EES research faculty. The Department has benefited from Bill's significant scholarly impact and overall faculty citizenship. He is the first KGS Director in its long illustrious history to have a full faculty appointment in an academic department, and it has certainly proven to be an effective model. In addition to the considerable administrative duties, Bill has maintained an active research portfolio, steadily publishing peer-reviewed journal articles, writing successful grant proposals, mentoring students, and pushing state-of-knowledge boundaries associated with machine-learning and remote sensing in the geosciences generally, but natural hazards particularly. Also, his 13th Survey initiated the KGS-EES Commonwealth Graduate Research Assistantship, overseen the new KGS Paul Edwin Potter Internship Program, and facilitated the Kentucky part of a 5-state Geopipeline initiative with HBUCs. All of which provide more inclusive geological opportunities for a larger number of students.

We wish Bill and his wife Lisa all the best as they begin the next chapter of their lives in New Mexico, where they met and were married nearly 25 years ago.

Transitions

EES Stable Isotope Laboratory Manager

Aaron Shultis onboarded this past June as the new **Stable Isotope Lab Manager**. Dr. Shultis received his PhD from the University of Nebraska-Lincoln with a doctoral dissertation titled, "A Proxy Based Geochemical Study of Carbonate Sediments Deposited During the End of the Late Paleozoic Ice Age." Aaron has more than 15 years of isotope lab experience, including soils, nitrates, phosphates, and noble gases. This has enabled him to quickly understand the EES instrumentation and its architecture, assisting Prof. Erhardt to get the SIL back to normal functionality before she departed for her one-year sabbatical in Germany. We welcome Aaron to the Department and look forward to seeing all the new ideas he has for the SIL come to fruition.

EES Department Manager

Meaghan Bushling onboarded as the EES Department Manager in mid-March. She is a graduate of UK with a degree in Integrated Strategic Communication. Prior to coming to the Department, she worked as an administrative assistant at a local architectural firm where she coordinated all information flowing into and out of the office, as well as managed imagery, video and copy across their multiple social media platforms. She also interned at Walt Disney World Resort as a Jungle Cruise skipper, performing for park guests as well as solving guest issues to improve their park visit. We welcome Meaghan to the Department and appreciate the efficiencies she has already brought to the Department operations.

Alumni Van Initiative

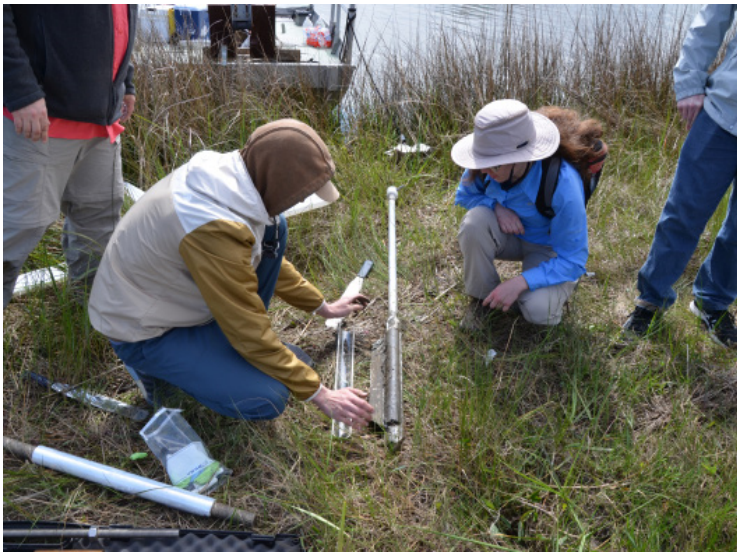
EES teaching and research often involves experiential "in the field" activities. These field trips can be local (e.g., Frankfort, Clays Ferry, Camp Nelson, etc.) or distant (e.g., Smoky Mountains, Gulf Coast, West Coast, Basin and Range, etc.), requiring a reliable vehicle fleet that includes 15 passenger vans. For well-rounded geological scholarship, reliable and safe transportation is as important as classroom technology (e.g., microscopes) and laboratory equipment (e.g., mass spectrometers). The vehicles transport students, faculty, gear, and frequently supporting research equipment to these various locations.

The Department currently has six vehicles for teaching and research. Their initial purchase was made through use of various discretionary department funds, with maintenance funded through the student lab fee account. The entire vehicle fleet is between 18 and 23 years old, and most have mileage more than 150,000 miles, making their reliability suspect. Institutional policies now preclude purchase of new vehicles with department funds and the campus motor pool was liquidated during the pandemic budget crisis, so easy and reliable in-house transportation access is no longer available. Moreover, the commercial vendor contracted to replace the UK motor pool does not have the flexibility or fleet availability to efficiently respond to the often-weekly needs of the Department. After learning of our needs, the College successfully argued for and convinced the University to provide EES a waiver for vehicle ownership. The Alumni Board seized this window of opportunity during the April board meeting to initiate a campaign to purchase a 2023 15-passenger Ford Transit Van XL with stabilizing dual back wheels and extra cargo space (see picture inset). Within a month over $60K was committed for the purchase. The order was placed in early July with a delivery date of early January 2023. A few thousand dollars were left over from the purchase of the first van, and these residual funds are being used as the initial kick-off funds for a second 15-passenger van that will provide comprehensive safe and reliable transportation for the anticipated size of any EES field experience.

It is difficult for words to express how grateful our faculty and students are for the exceptional generosity and support of the EES Alumni. Philanthropic initiatives such as this provide critical assistance for the program to maintain the high standards of geological scholarship. It is what makes our alumni the model for the College.

Restarting EES Course Field Trips

The University Health Corps relaxed some of the travel barriers that had been in place since the beginning of the pandemic, and a few of our courses were able to have extended long-distance field trips during the Spring 2022 Semester. This included a week-long field trip to the Gulf Coast during Spring Break for the undergraduate and graduate students taking Prof. Yeager's dual listed EES 480-730 Coastal Processes course. The students had a chance to experience the Louisiana Coastal Zone (LCZ), one of America's most unique and important regional coastal ecosystems which hosts vital natural resources, appreciable human infrastructure, and a diverse cultural heritage. The goals for student appreciation included: 1) complex geological processes that have influenced and continue to affect the LCZ evolution, 2) the need for regional coastal restoration and management, and 3) the challenges of developing and implementing scientifically-sound solutions to the degradation of a sensitive ecosystems to which humans are intimately linked. The trip successfully accomplished all its goals and was enjoyed by everyone. Dr. Yeager and the students were very appreciative of the Haynes field Trip Fund in Geological Sciences and the Overcash Student Travel Scholarship that made this logistically complex trip possible.



Sabbatical & Fellowship Leaves

Frank Ettensohn – Sabbatical Spring 2022: Prof. Ettensohn's sabbatical has been used to complete a draft textbook for his EES 160 Geology for Teachers class. Of course, he has also been working to finish several of his research manuscripts, as well as taken time to give back to the profession by helping dedicate the Lower Howard's Creek in Clark County as a Distinguished Geology Site in Kentucky.

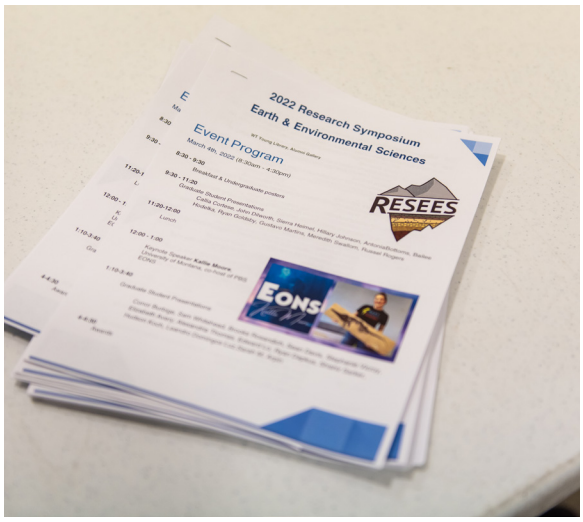
Dave Moecher – Fulbright Fellow, Spring 2022: Prof. Moecher completed his Fulbright in Ireland at Trinity College Dublin and University College Dublin. He and his collaborators were testing a hypothesis of new mineral dating techniques that would reveal a more accurate record of the assembly of the supercontinent Rodinia from the three ancient continents, 1 billion years ago.

Ryan Thigpen – Sabbatical, Spring 2022: Prof. Thigpen's sabbatical has been dedicated to understanding how faults drive the development of mountain belts and how that development relates to seismic hazards. This work had him traveling frequently to the Teton Range of Wyoming and the southern Appalachian Inner Piedmont. The various projects may have sparked an emerging interest in near-surface geophysical imaging as well; time will tell!

Tiku Ravat – Sabbatical, Fall 2021-Spring2022: Prof. Ravat's sabbatical was focused on using magnetic field variations for assessing volcanic hazards, using the Taupo Volcanic Zone in New Zealand as a case study. He and his New Zealand colleagues have been performing optimized field deployments to acquire new data for their improved inverse modeling algorithms that they believe can provide higher resolution and less uncertainty in the hazard assessment.

2022 ReSEES Symposium

The Research Symposium in Earth and Environmental Sciences was established in 2020-21 as a venue for EES graduate students to share their research with their in-house colleagues, faculty, alumni and friends. The Geoscience Graduate Group (G3) committee chaired by Ryan Goldsby and Ryan Dapkus organized the 2021-22 annual ReSEES at the Alumni Gallery, WT Young Library on March 4, 2022. Although this was the second year of the symposium, ReSEES was held in-person for the first time with a hybrid attendance option. Twenty three graduate students gave oral presentations, and three undergraduate students presented posters. Presentation topics ranged from geohazards and geophysics to paleolimnology and stratigraphy. The program was capped with a science communication keynote presentation by Kallie Moore, (University of Montana) who is co-host of PBS Eons. The success of the conference was made possible by generous financial support from the UK Student Government Association and the Student Sustainability Council. Hazard Coffee Company, in solidarity with Appalachian small businesses, provided generous helpings of coffee and pastries, and Campus Kitchens at the University of Kentucky provided a sustainably sourced lunch. Thanks especially to the EES alumni and scientists who volunteered to judge the marathon oral presentations, and G^3 looks forward to organizing the 2022-23 ReSEES!



EES-KGS Collaborations - Dave Moecher

Acquisition of a Scanning Electron Microscope for Earth Science Teaching and Research (Dave Moecher and Dave Harris)

KGS and EES joined forces in 2016 to obtain funding for the purchase of a scanning electron microscope (SEM). A scanning electron microscope reveals micron scale textures of minerals in rocks that aid in interpretation of a rock's origin and history. It can also determine the chemical composition of a spot on a mineral smaller than a human hair! The instrument serves faculty and undergraduate and graduate students in EES; students and faculty in other programs at UK (Anthropology, Material Science and Engineering), faculty and students from neighboring institutions (Univ. of Cincinnati, Miami University), and KGS research staff. The instrument is made available to the public – it has been used by members of the Bluegrass Gem and Mineral Club, and by students and teachers from the Fayette County school systems. The instrument is housed in a modern facility in Mining and Mineral Resources. The most exciting recent project was confirmation of what was suspected to be an iron meteorite by Ethan Davis of the KGS.

HBCU STEM to Geo Pipeline Initiative

Bill Haneberg (KGS Director) and Dave Moecher in EES are representing UK in a consortium of state geological surveys and universities (Kentucky, Illinois, Ohio, Indiana, and Missouri) to create more opportunities for undergraduate students from historically black colleges and universities (HBCUs) to matriculate in geoscience graduate programs. UK EES and the KGS are working specifically with faculty at Kentucky State University to identify and recruit students to enter the EES graduate program. KGS was also among several midwestern state geological surveys to receive generous financial gifts from the late Prof. Paul Potter (University of Cincinnati) to support a paid summer internship program. Some of the Potter summer internships will be used in conjunction with our HBCU STEM to Geo activities.

Precambrian Tectonic Evolution of the Eastern Midcontinent Basement

Mitchell Clay, an EES Ph.D. candidate supervised by Dave Moecher, is working with Rick Bowersox, Dave Harris, and John Hickman of the KGS to investigate the history of the Precambrian basement in Kentucky and surrounding states. This project actually began 30 years ago as part of the Cincinnati Arch Consortium by Dave Harris and Jim Drahovzal (former KGS staff scientist). In spite of its age, we continue to make new discoveries about crystalline rocks underlying the Paleozoic strata of Kentucky. The project is supported by NSF and takes advantage of the outstanding facilities of the KGS, specifically the Earth Analysis Research Library that houses a mountain of basement drill core from across Kentucky. Drill core and cuttings are the sole sources of information on the lithologic composition of the crystalline basement. Combined with geochronology and geophysics we are able to delineate one of the most profound crustal boundaries in North America – the Grenville Front Tectonic Zone – that runs directly under Lexington. This study resulted in two peer-reviewed publications to-date with two more in preparation as part of Clay's dissertation in EES.

EES-KGS Collaborations - Ryan Thigpen

The Structure and Geodynamics Group, led by Prof. Ryan Thigpen, has started working with the Kentucky Geological Survey on a number of surface process and hazards-based initiatives that focus both on local societal challenges facing the state of Kentucky and a number of global projects. Many of these developing projects, which include locales in the greater Southern Appalachians, Puerto Rico, Haiti, and Nepal, lie at the nexus of topographic hazards, rapidly changing climate impacts, and broader economic and societal challenges in these communities. This collaboration has allowed us to leverage SGG skillsets in structural geology, tectonics, geodynamics, climate-tectonic linkages, and forward modeling of landscape evolution with digital mapping, and LiDAR and morphometric analysis expertise at the KGS that is absolutely world class. These emerging collaborations are focused on developing multiple competitive peer-reviewed research proposals that, if successful, will support both staff scientists at the KGS and graduate students and post-doctoral researchers in EES.

EES-KGS Collaborations - Andrea Erhardt

Regular collaboration with KGS has been a hallmark of Dr. Andrea Erhardt's time at UK. The Kentucky Stable Isotope Geochemistry Laboratory has extensive capabilities to measure isotopes in a wide range of samples, allowing for collaboration across a range of geologic disciplines.

Dr. Erhardt and Dr. Ben Tobin have worked together on numerous projects, integrating Dr. Tobin's work with caves and karst with Dr. Erhardt's isotope expertise. While co-advising MS Student Jon Wilson (BS UKY 2018, MS 2020), they utilized isotopic and other water chemistry tracers to understand groundwater hydrology in the Grand Canyon. This work, published in January 2022, identified unique groundwater flow paths, critical information as this region experiences continuing water deficits. Building on that work, Dr. Tobin's MS student Sierra Heimel is preparing samples for sulfur isotope analysis to understand water sources controlling Grand Canyon cave formation. In other cave systems, Drs. Erhardt and Tobin are combining their isotope and cave expertise, along with genetic tracing, to understand cave hydrology and ecosystem development in Fern Cave (Alabama).

Additionally, Dr. Erhardt has worked closely with Dr. Marty Parris and Dr. Junfeng Zhu at the KGS to understand sources of groundwater methane in Eastern Kentucky. Working with Dr. Alan Fryar, the four researchers guided MS Student Cristopher Alvarez-Villa (MS 2020) on his project utilizing geochemistry tracers. They found that the majority of the groundwater methane was from shallow, microbial methane generation, not deeper sources typically linked with fracking. Additionally, they found that locations closer to mining activity had higher sulfate concentrations, suppressing methane generation. This work has been presented at recent conferences (AGU 2021, SE GSA 2022) and will be submitted for publication this year.

A new collaborative project with the KGS involves a closer look at the chemistry of acid mine drainage and microbial mediation. Working with Dr. Amy Wolfe of the KGS, Dr. Erhardt and her MS student Conor Burbidge are investigating the role bacteria play in acerating acid mine drainage, specifically the influence that additional nitrate has on this process. They propose that nitrate contamination, widespread across agricultural regions, can accelerate pyrite oxidation, increasing acid mine drainage generation. They are currently pursuing funding for this project and Dr. Wolfe will serve as a committee member for Mr. Burbidge.

EES-KGS Collaborations - Alan Fryar

Alan Fryar is collaborating with KGS Water Section staff on several karst-related projects. Fryar's PhD advisee Shishir Sarker is examining how the flow of a spring in the mountainous region of Kashmir (India) responds to seasonal variability in precipitation. Junfeng Zhu, one of Sarker's committee members, has been helping him develop machine-learning-based models to predict how climate change could affect the spring's flow. Fryar's MS advisee Ryan Dapkus, who received the 2021-22 Commonwealth Research Assistantship from KGS, is studying the utility of tryptophan-like fluorescence of natural organic matter (NOM) as a predictor of E. coli bacteria concentrations. Ben Tobin, one of Dapkus' committee members, is assisting with laboratory analyses of NOM from Royal Spring in Georgetown and Camden Creek near Versailles and is guiding the development of statistical models. Tobin will also provide guidance on a fluorescent dye tracer test from the Kentucky Horse Park to Royal Spring as part of this study. Fryar is also supervising Sarah Arpin in her PhD research on the hydrogeology of the Silvertip karst region in the Bob Marshall Wilderness Area of Montana.

EES-KGS Collaborations - Frank Ettensohn

Three-Dimensional Mapping of the Upper Lexington Limestone, Inner Bluegrass Region, Central Kentucky

The Upper Ordovician Lexington Limestone underlies most of central Kentucky, forming a gently rolling plain that has been ideal for agriculture and transportation into the area for business and light industry. The Lexington Limestone was thought to be a relatively tabular, "layer-cake" unit, but U.S. Geological Survey mapping that ended in the 1990s showed that upper parts of the Lexington represent a complexly intertonguing facies mosaic with abrupt facies changes, disjunct unit distribution, and frequent unconformities. Work since the 1990s has suggested that many of these anomalies may be related to basement structures that were reactivated by far-field forces during the coeval Taconian orogeny. The organization of this complex facies mosaic is still not understood, and hence, this data-synthesis EDMAP project is proposed in order to develop a three-dimensional geoframework to determine whether three-dimensional mapping be used to characterize complex geologic surfaces like those in the upper Lexington Limestone of central Kentucky, and in so doing, confirm the presence of structural control on the distribution of facies in the upper Lexington Limestone. At the same time, the project is providing an educational opportunity for a graduate student to use maps for data collection and then learn to manipulate that data using GIS tools to make three-dimensional geoframework maps.

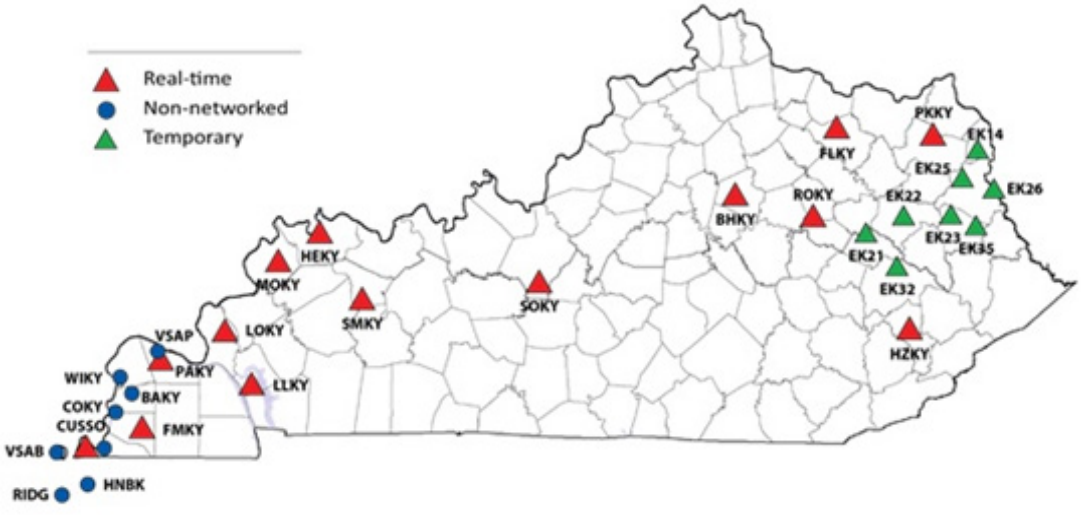
The project will include the collection of location and elevation data for key stratigraphic horizons from local exposures, cores, well logs, geologic quadrangle maps, and student theses, followed by the use of ESRI Arc Pro and Arc Online to manage and interpolate this data to visualize subsurface geologic contacts, faults, and other geologic data on three-dimensional geologic maps. The graduate student will produce a robust GeMS-compliant geodatabase of isopachs and contours of the boundaries and internal subdivisions of the Lexington Limestone, raster data of the relevant surfaces (formatted and transmitted in consultation with NCGMP staff), and a report summarizing methods, correlations, and sources used in the project. A geologic map with appropriate map-polygon content, descriptions, collar information, nomenclature, and symbology will be produced to communicate the key stratigraphic and correlation outcomes of the project.

This EDMAP project will complement ongoing 3D geoframework projects at the Kentucky Geological Survey, and the results will be available for inclusion with regional or national compilations through the KGS geoframework database. The expected three-dimensional maps of the upper Lexington Limestone will not only provide an educational opportunity and contribute to an ongoing KGS statewide geoframework project, but will also have major geotechnical implications for understanding the distribution of karst, groundwater, and agriculturally productive soils in the Bluegrass Region of central Kentucky.

EES-KGS Collaborations – Ed Woolery and Zhenming Wang

The Kentucky Seismic and Strong-Motion Network

Perhaps the longest EES-KGS continuous research collaboration is the Kentucky Seismic and Strong Motion Network (KSSMN). The KSSMN was began more than 40 years ago as a response to the Lg magnitude 5.3 earthquake near Sharpsburg, Kentucky which was the most significant seismic event in Kentucky since the great New Madrid earthquake sequence in the winter of 1811-12. EES (formerly Department of Geology) Prof. Ron Street, an early career seismologist at the time, used start-up funds to install the network's first seismic station at Lock 6 on the Kentucky River during the summer of 1980. After its modest beginning, the KSSMN has evolved into a leading state-of-the-art seismological research and information center for the central and eastern United States, currently consisting of twenty-two permanent seismic and strong-motion stations and eight temporary stations. The most significant point in the KSSMN history since its beginning was the Kentucky General Assembly's 1991 directive for the KGS and Department to expand the network as part of a budget modification for KGS. This allowed the KSSMN to add short-period seismic stations across the state, as well as construct remotely operated strong-motion stations of engineering interest in the New Madrid seismic zone. The next major turning point was in 2001 when all network operations moved from EES (formerly Dept. of Geological Sciences) to the KGS as part of their newly formed Geologic Hazards Section and onboarding of research seismologist, Zhenming Wang, accompanied with the transition of Ed Woolery to an EES tenure-track position. Since that time, the KGS has continued to invest in both seismological personnel and infrastructure, including two additional seismologists (Seth Carpenter and Jon Schmidt), deep vertical strong-motion arrays, and several broad-band seismometers replacing the older short-period instruments. Collaboratively, the EES-KGS curiosity-driven scholarship has demonstrated remarkable output, which has included dozens of peer-reviewed papers, conference abstracts, book chapters, and technical reports. More importantly, there has been tremendous student benefit from the collaboration. The KSSMN has contributed to more than 20 graduate theses and dissertations, as well as multiple undergraduate/high-school STEM internships, and several post-doctoral and visiting scholar appointments. The collaborative arrangement has shown no signs of slowing down, and we look forward to the significant scientific discoveries that will be made in the coming years.



The Kentucky Seismic and Strong-Motion Network station locations.
(https://www.uky.edu/KGS/earthquake/earthquake_research_kssmn.php)

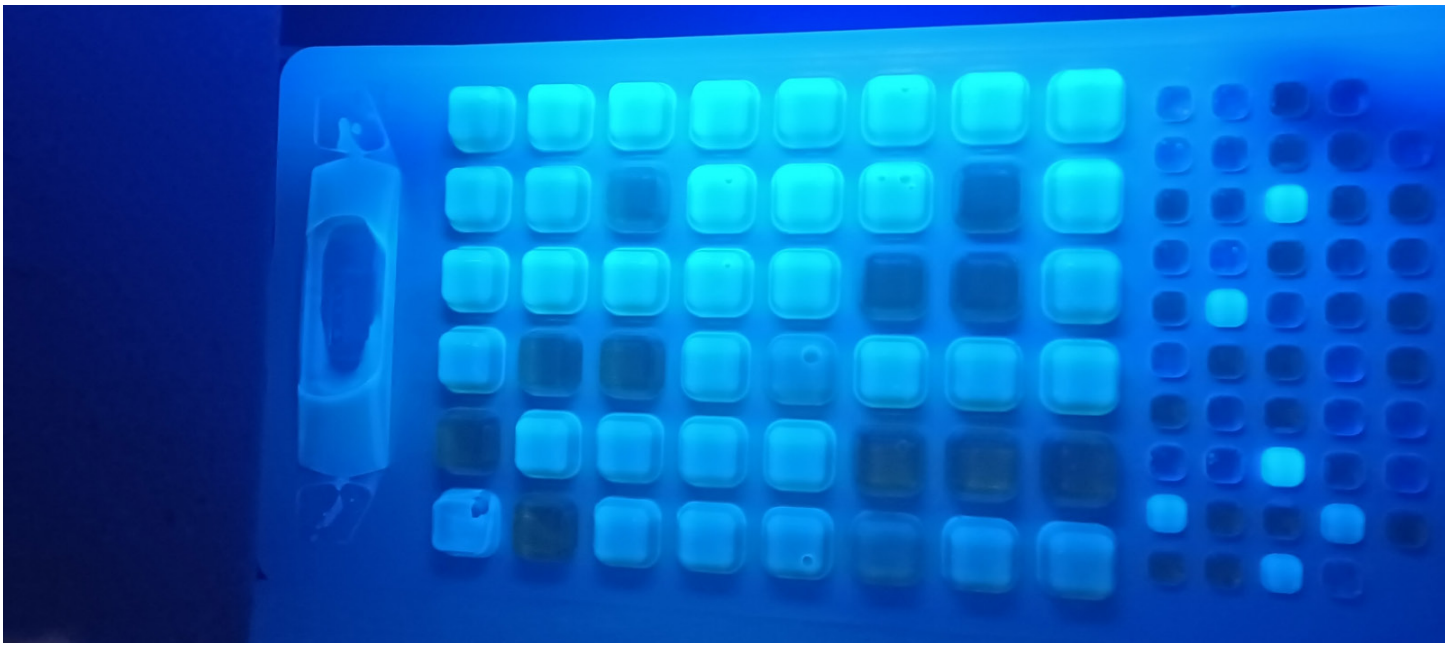
Department News

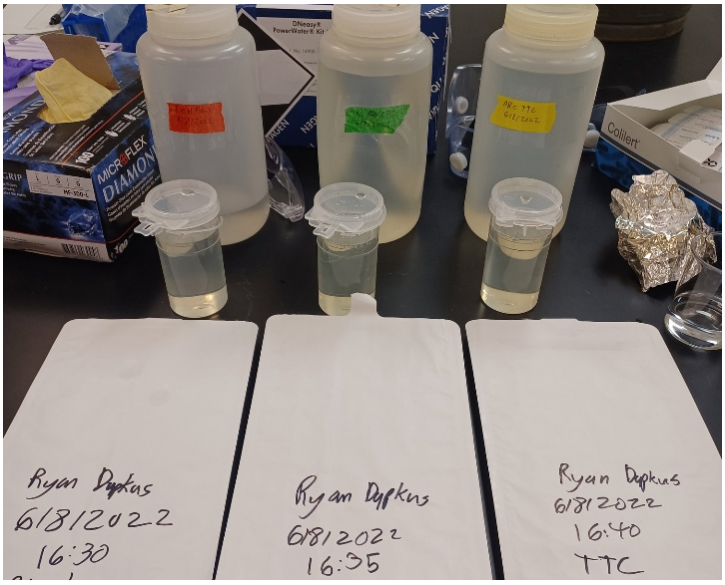
William A. and Rachel L. Thomas Graduate Fellowship in Geology

Last year Bailee Hodelka became the first recipient of the Thomas Graduate Fellowship in Geology. The Thomas family established this endowment in 2019 to honor Bill and Rachel, and to support graduate students engaged in "hands-on" field-based scholarship. Bailee's detailed research plan was selected by an independent panel of UK geoscience faculty as best fitting the purpose and spirit of this award. She is a doctoral student working with Professor McGlue on the late Quaternary paleoecology of Mono Lake and the paleoclimate of the eastern Sierra Nevada region for her dissertation. Funds from the Thomas Graduate Fellowship allowed Bailee to travel to Mono County California for a two-week field season. During that time, she sampled the Pleistocene Wilson Creek Formation (a spectacular exposure of lacustrine silts with numerous interbedded tephras), modern springs, streams, and deltas for ostracods. Bailee explains that "Ostracods are bivalved microcrustaceans that respond rapidly to changes in the environment, and their carbonate shells often form exceptional fossil records in continental settings. By analyzing the ostracod assemblages in the streams and springs surrounding Mono Lake, it provides us with modern analog insights that are useful for comparison with the ancient fossils in the Wilson Creek Formation and from cores collected in Mono Lake." She further noted that "Funds were used to purchase plane tickets, food, sampling supplies, and a campsite rental - this was my first field season following the Covid-19 pandemic, and I am very grateful to the Thomas family, as this field season would not have been possible without the award; it places me one step closer to finishing my dissertation."

KGS-EES Commonwealth Research Assistantship

Ryan Dapkus was this past year's recipient of the KGS-EES Commonwealth Research Assistantship. The RA was established to support excellence in Kentucky-based research. Ryan's research has involved weekly sampling events at Royal Spring and sites around the University of Kentucky's animal research center where he has recorded temperature, specific conductance, dissolved oxygen, and pH on a YSI sensor. While in the field he also maintained and downloaded data from an in-situ fluorometer logging tryptophan-like fluorescence, chromophoric dissolved organic matter, and fluorescein. These samples were brought back to campus for E. coli testing and for PARAFAC analysis. Ryan explains the purpose of his research is to "…find a linkage between tryptophan-like fluorescence and other proxies with E.coli to be able to more quickly predict fecal contamination in surface and groundwater." Behavior during storm events were also of interest. The fluorescein optics on the in-situ fluorometer were used for a 24-hour storm sampling event at Royal Spring where TLF was logged continuously at a 15-minute interval and environmental samples for E. coli and field parameters were collected every hour. During an event a dye trace was conducted which consisted of injecting fluorescein dye into a swallet at the Kentucky Horse Park and detecting its arrival via the fluorometer at Royal Spring.





Alumni Advisory Board Chair's Letter

An unsettled world appears to be shifting, somewhat chaotically, towards a new normal that we hope includes a greener and more equitable economy. Institutions of higher learning are adapting to these rapidly changing circumstances. These shifts are having a tangible impact on the geological community. EES has had to ride out the turbulence and adapt to its effects, such as budget austerity, lower undergraduate enrollments, lagging diversity and an evolving curriculum. I have watched the department as it moves in the right direction with vigor and dedication. The Alumni Advisory Board continues to share its perspectives and provide encouragement and resources, which includes creating new opportunities to engage and mentor students. The following examples demonstrate our commitment.

Recognizing the growing interest of many EES graduates to pursue environmental geoscience careers, Board member Cal Butler (MS '92) compiled a list of the top 40 US environmental firms hiring geologists and environmental scientists in 2021. These companies and the professionals they hire are well positioned to lead the rapidly expanding global green economy for many decades.

Post pandemic, EES has returned to providing long distance field trips, including one to Alabama/Georgia and a second to Louisiana to examine coastal processes. Field trip funds were provided through generous endowments by two department alumni, current Board member, and former Chair, Wendell Overcash (BS '77, JD '80) and Elizabeth Haynes (MS '00), former Board Chair. Your donations specifically to these named travel funds will grow the pot and ensure that every student has frequent, meaningful field experiences that are critical to their professional development.

As we all remember, field trips can be one-day or weeks in length traveling in-state or across the country. In recent years, a fleet of aging vans with high mileage, diminishing reliability and increasing maintenance have required the department to turn to costly rentals. But thanks to momentum from the Board and support from the Interim Dean of LAS, Christian Brady, UK Environmental Health and Safety approved the purchase of two new 15-passenger vans with many safety features. The Board members urgently and enthusiastically stepped up and successfully raised funds for the purchase of the first van, due in early 2023. The fund-raising campaign for the second van continues. Contributions of any size are greatly appreciated.

In order to stimulate greater interest among undergraduates to major in the geological sciences, the Alumni Board and the department plan to convene an alumni panel in the fall 2022 semester. The diverse panel will provide career guidance before a gathering of undergraduate geology majors and interested non-majors. A question and answer period will be followed by a social hour to further engage with students and establish longer term relationships. We are looking for alumni volunteers, particularly those in the KY region, who can visit campus (tentatively Oct. 28) this fall. Interested alumni should contact the UK Geology office to sign up.

This past spring the Alumni Board welcomed Brandon Spencer as a new member. Brandon earned his PhD this year under the guidance of Associate Professor Ryan Thigpen. As a graduate student in EES, Brandon was made Head Teaching Assistant in recognition of his instructional and organizational skills. He is employed by Oklahoma State University as a Teaching Assistant Professor and Director of their summer field camp program.

Michael Bourque, BS '74

Thank You!

The following people, companies, and entities constitute the donors who helped us achieve some of our fundraising goals to various department endowments. Many contributed to more than one fund, and corporate matches were counted as donations.
We greatly appreciate this outpouring of support!

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