EARTH SCIENCE NEWS

FALL 2019

Greetings from Earth Sciences at the University of Memphis! Another year has passed by with much happening in the department. Some major changes during the past year include the hiring of Dr. Elizabeth Rhenberg as a visiting assistant professor. Beth's expertise is in paleontology with research emphasis in crinoids and their lavish lifestyles during the Paleozoic Era. We also hired Dr. Deborah Leslie as an assistant professor. Deb's expertise is in hydrogeology and aqueous geochemistry. Another important hire is our new administrative associate, Jessica Abernathy, who has done an absolutely splendid job wrangling the administrative office back into shape. Having new faculty and staff blood around the department is invigorating and keeps us old curmudgeons on our toes!

Sadly, we also lost a former faculty member. Dr. Robert Connolly, who held a joint appointment in Anthropology and Earth Sciences and was former director of the C.H. Nash Museum at Chucalissa, passed away in August. Connolly mentored several graduate students in Earth Sciences and maintained a strong academic as well as community outreach focus at Chucalissa during his years as director.

Earth Sciences was academically reviewed during the past year, receiving favorable comments in most areas and all of the quality assurance points, which made the bean counters happy! From a faculty standpoint, what really mattered was learning that the students truly appreciated their educational experience in Earth Sciences and felt that faculty were engaged, involved and supportive of their education goals. This level of achievement is evident again at the national level as Earth Sciences was ranked No. 111 among the best graduate programs in Earth Sciences nationally based on the *U.S. News & World Report* assessment.

We have another full year of colloquium speakers scheduled in Earth Sciences; visit **memphis.edu/earthsciences** for names, topics and dates. We hosted the Geological Society of America Birdsall-Dreiss lecturer, Dr. Laura Crossey, on Oct. 24. On Nov. 1, we hosted a colloquium lecture by alumnus Dr. Charles Thibault, followed by an alumni reception honoring Dr. Phili Deboo for his years of service to the department and the profession.

Interested in visiting campus, meeting faculty and students and seeing what is happening in Earth Sciences? I encourage you to explore the many facets of our program through our website. Feel free to contact me or any of the other faculty members – we would love to hear from you! Go Tigers Go!

EARTH SCIENCES ACCOLADES

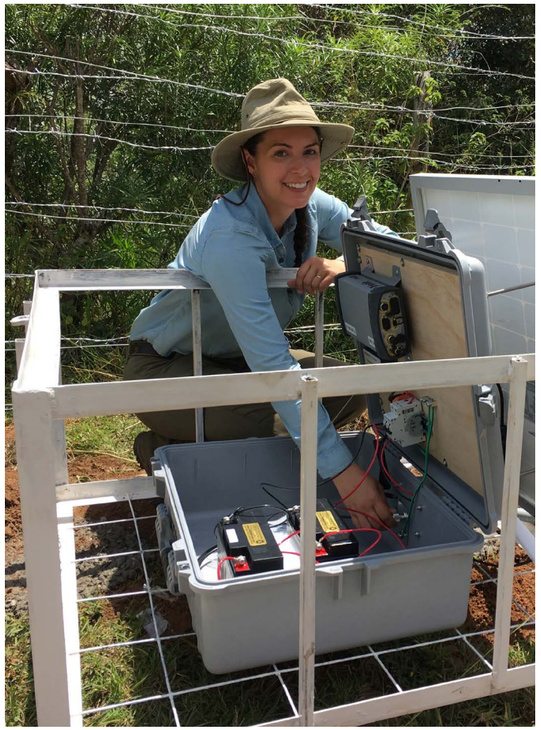
Several faculty and staff in Earth Sciences either received awards or were nominated for awards last year. Drs. David Dye and Arleen Hill each were awarded a Professional Development Assignment (PDA) for a semester during the 2019-20 academic year. Both Dye and Hill will be working with Dr. Dorian Burnette on a textbook addressing the question of global environmental change from the combined perspectives of current climate and recent paleoclimate (Burnette), ancient peoples (Dye) and natural hazards (Hill).

Within the Department of Earth Sciences, several awards are made to students each year. Ashley Bowery received the Paul H. Sisco Outstanding Senior Award in Geography and has now received her commission as an officer in the U.S. Navy. Jodi Messick received the Outstanding Senior in Geology. Saida Burns-Moore received the Chi Beta Phi Science Award in Geology. Melinda Martin received the Davies Award in Archaeology. Our newest award, the Outstanding Earth Scientist Award, was given to Steffen Matthews for all-around service contributions to the department and academic excellence. Messick and Valarie Harrison received the Lounsbury Scholarships in Geology. Graduate student Hunter Saunders received second prize in the Natural Sciences category at the Graduate Student Research Forum last spring.

Fieldwork is a common thread through all disciplines in Earth Sciences and as such, we are interested in developing a fieldwork fund in the name of Dr. David Lumsden. Lumsden is still active and has been an advocate of field research throughout his career, through development and years of directing the University of Memphis Geology Field Camp. Access the Make a Gift tab at

memphis.edu/earthsciences

if you are interested in contributing to the David N. Lumsden Earth Sciences Fieldwork Award or an existing award fund.



EARTH SCIENCES ALUMNA

Our featured alumna this year is **Dr. Sarah Stamps,** who graduated from Earth Sciences in 2007.

My undergraduate studies in the Department of Earth Sciences prepared me for a career of nearly endless adventures that have taken me to places spanning the globe from the Caribbean to Korea, with frequent trips to Africa in between. I earned a bachelors degree in Earth Sciences and a minor in Mathematics in 2007 from the University of Memphis, which provided the background I needed to become a geophysicist. Currently, I am an assistant professor of geophysics at Virginia Tech, where I study plate tectonic theory using a combination of field measurements and computational modeling to elucidate the physics driving surface motions that I measure with GPS.

It was quite early that I learned about geophysics. As a high school student, I was exposed to careers in metallurgical engineering, nuclear engineering, ceramics and geology and geophysics through a summer program for rising seniors. When the geology and geophysics group showed me an image of a fault beneath the surface detected with seismic waves I became hooked on geophysics. I had no idea you could peer into the Earth with instruments. I was always fascinated by the physical world around me. Geophysics, particularly in academia, seemed like the perfect fit for my future career.

My college search led me to the University of Memphis because of the Center for Earthquake Research and Information, where Dr. Robert Smalley was studying plate tectonics using GPS instruments. His research was incredibly interesting to me, so I chose the UofM hoping I could work with him as an undergraduate researcher while earning a degree in Earth Sciences. Indeed, my dream came true. I worked with Professor Smalley for three years while I attended the UofM — an experience that would shape my future career.

After undergraduate studies at the UofM, I obtained a PhD from Purdue University in geophysics and held postdoctoral fellowships at MIT and UCLA. In 2015, my dream of becoming a professor of geophysics came true when I accepted my position at Virginia Tech. Now I manage a group of eight students with research projects around the world that involve using GPS to study plate tectonic processes.

I am truly grateful for the educational and research experiences I had through the Department of Earth Sciences. My dreams came true thanks to the top-notch education I received at UofM.

EARTH SCIENCES FACULTY

Dr. Angela Antipova – I continue to work with a colleague from LSU on a project studying trip generation modification in Louisiana (the project has a no-cost extension until Jan. 1, 2020). Other projects include impacts of air pollution exposure on health and school performance, and visiting U.S. national parks. My MA student Dennis West graduated in May 2019. PhD student Ehsan Momeni is expected to graduate in 2020. Currently, my MS student Lilien Ploderer is working on the impact of vacant lands and greenspaces on youth wellbeing. I contributed a chapter to *The Spatiotemporal Analysis of Air Pollution and Its Application in Public Health*, edited by Lixin Li, Xiaolu Zhou and Weitian Tong. My chapter is "Analysis of Exposure to Ambient Air Pollution: The Link Between Environmental Exposure and Children's School Performance in Memphis, TN." On April 3-5 in Washington, D.C., I both chaired a session on *Accessibility and the Journey-to-Work,* and presented the talk "Using Onthemap for the analysis of commuting distances of low-income workers in Shelby County, TN" at the annual meeting of the American Association of Geographers (AAG).

Dr. Jerry Bartholomew – Because of the sudden, unexpected death on Sept. 14, 2018, of my friend and colleague, Dr. Dewei Li, who was a professor at the China University of Geosciences at Wuhan, I was not able return to China to continue our research on active faults and big earthquakes in China. However, I have served as a mentor for Guifan Chen (our visiting doctoral student in 2013) who was one of Li's PhD students. We recently submitted her manuscript (Chen, G., Bartholomew, M., Li, D., Armstrong, T., Feng, M., "The Ms7.5 14 April 1955 Zheduotang earthquake and Late Quaternary paleoseismicity along the Zheduotang fault of the Xianshuihe fault system, southeastern margin of the Tibetan Plateau") to *Tectonophysics*.

I also worked in the field with Dr. William Jackson (one of our former MS students). Our new paper (Jackson, W., McKay, M., Bartholomew, M., Allison, D., Spurgeon, D., Shaulis, B., VanTongeren, J., Jacob Setera, J., 2019, "Laramide tectonism recorded by Late Cretaceous paleoseismites in the northern Bighorn Basin, USA: Field indicators of an applied end load stress") will appear in *Geology* in a few months.

Graham Ellsworth and I submitted his MS work (Ellsworth, G.G., Bartholomew, M.J., "The Brittle

Deformation Sequence at Dead Indian Hill and the Heart Mountain Detachment, Wyoming, USA") to the Geological Society of America Bulletin. After review, the editor requested some revision and we are waiting to see how the reviewers like the revision.

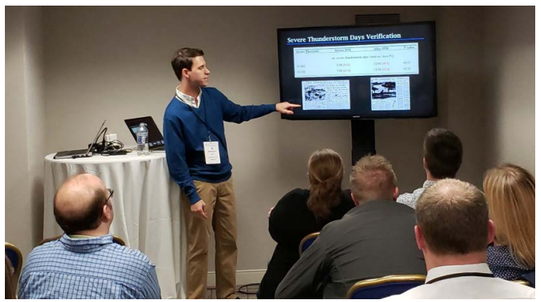
Early in 2019, Taylor Armstrong and I submitted a paper (Armstrong, T.F., Bartholomew, M.J., Mickelson, A.M., Feng, L., Li, D., Liu, D., Rittenour, T., Sun, G.Q., on Late Quaternary earthquake-ages with Bayesian-ordered 14C and OSL ages from our trench work in 2011 and 2012 along the Yushu fault, Qinghai Province, China), but it got declined so we are revising it again.

I also used some of my sabbatical to kindle a new field of interest in landscape evolution. First, I gave a presentation (with a cast of 10) at the spring meeting of the SE section of Geological Society of America in 2019 and then co-chaired (with Kevin Stewart) a topical session on "The New Appalachians: Cenozoic Deformation, Drainage Reorganization, and Landscape Disequilibrium in a Paleozoic Orogen" at the national meeting of the Geological Society of America in Phoenix. All of the speakers at that session are interested in contributing papers for an edited volume in 2020.

Dr. Dorian J. Burnette – I have been collaborating with Dr. Claudio Meier in the Department of Civil Engineering on surface water issues in urban environments. Recently, we were awarded a grant from the Tennessee Department of Transportation, in which we will collaborate with the U.S. Geological Survey (USGS) in Nashville to update the equations for peak flow estimation in urban creeks and streams across the state. We are also seeking additional funding to continue urban flood work we started with colleagues in City and Regional Planning. This next effort will seek to expand the project nationally and internationally, involving colleagues at the University of Massachusetts-Boston and the University of Catania in Italy.

The collaborative project with Dave Stahle (Arkansas), Ed Cook (Lamont-Doherty Earth Observatory) and Ben Cook (NASA Goddard Institute for Space Studies) funded by the National Science Foundation continues to produce publications. One article on multi-decadal modulation of the El Niño Southern Oscillation teleconnection to precipitation tree growth was published this past summer in *Paleoceanography and Paleoclimatology*. Another article details a new tree-ring reconstructed seasonal precipitation atlas for North America; it is currently in review at the *Journal of Climate*.

I have continued to give presentations at conferences on an interdisciplinary project with Drs. David Dye and Arleen Hill looking at drought variability and its associated impacts at various archaeological sites over the southeast. This past year, the work was presented at the American Association of Geographer's annual meeting in Washington, D.C., the Society for American Archaeology annual meeting in Albuquerque and internationally at the 3rd Biennial Warfare, Environment, Social Inequality and Pro-Sociability (WESIPS) Conference in Seville, Spain. We submitted two book chapters on this work over the summer and are working on additional peer-reviewed articles.



Doctoral candidate Bradley Baker giving a presentation on his PhD research at the American Association of Geographers Annual Meeting in Washington, D.C.

Two of my graduate students are producing results. Bradley Baker (PhD candidate) gave his first presentation on his dissertation at the American Association of Geographers annual meeting in Washington, D.C. His research involves reconstructing severe thunderstorm days from reanalysis and validating those using historical methods. He has also come up with a potential way to adjust the day counts due to inhomogeneities embedded within the reanalysis data. Preston Bradley (MS student) has been processing data for his thesis all summer and gave a presentation on some preliminary results at the National Weather Association annual meeting in Huntsville, Ala., in September. He is investigating radar and environmental parameters that previous investigators have done nationally to see if those values can potentially be regionalized to reduce tornado warning false alarm rates over the Memphis National Weather Service's county warning area.

Spring Break Field Excursion, Ozark Dome in the snow.

Dr. Randy Cox – During the 2018-19 academic year, I taught Seminar in Geology (Midcontinent Tectonics) to graduate students, Structural Geology to seniors and graduate students, Spring Break Field Excursion to juniors and seniors, as well as an introductory historical geology class to freshmen. My graduate student Samia Noor successfully defended her MS thesis (supported by the USGS) "Tectonic geomorphology of the Eastern Lowlands, Mississippi Valley, using LiDAR data" in summer 2019. Michael Parton (my second-year MS student) is wrapping up his thesis project concerning quaternary faulting in the eastern Tennessee seismic zone, funded by the USGS. I took on a new graduate student, Tyler Myrman, and he had a productive year. Tyler is conducting investigations of the transition region between Appalachian and Ouachita foreland deformation on the Western Highland Rim of central Tennessee. He's finding lots of folding and faulting where it shouldn't be.

My students in Structural Geology were very anxious to get into the field, so we took a muddy but enjoyable fieldtrip to the Sugar Creek area in Tipton County, Tenn. They got to see exposures of folding and faulting that are rare in west Tennessee. The spring break field excursion to the Ozark Dome was memorable for students and faculty (Ryan Parrish and me) alike. The Ozarks were cold in March and I was counting on global warming to kick in a little more, but no such luck. The committed pupils and faculty camped in 9° temperatures. The less committed rented cabins. For a few pupils, this was their first and possibly last taste of camping. The group got a varied experience, visiting caves, mines, artesian springs, fossil collecting sites, Cahokia Native American city, etc. Such a good time was had by all that the students organized a return trip on their own the following month (when it was warmer).

Dr. David Dye – Over the course of this year I have enjoyed working on several research projects and teaching some interesting courses. During the spring semester, I team-taught Global Environmental Change with Drs. Arleen Hill and Dorian Burnette. We had some outstanding students who clearly have an abiding interest in climate change and its effects on human society. For the spring and fall semesters I taught Biological Anthropology and Prehistory, a whirlwind tour of human biological and cultural evolution, taking the student from the beginning of the Cenozoic Era to the great civilizations of the eastern and western hemispheres. One of my graduate students, Melinda Martin, received her master's degree in May and has been accepted into the doctoral program for fall. Dru Wilhite is completing his thesis and hopes to graduate this year. Both students are doing an excellent job and have a real passion for archaeology and our attempts to decipher the past.

Several book chapters are slated to appear this fall, including "Cahokians and the Circulation of Rituals Goods in the Middle Cumberland Region" (with Robert Sharp and Kevin Smith) to be published in *Cahokia in Context: Hegemony and Diaspora,* edited by Charles McNutt and Ryan Parish for the University Press of Florida. In the same volume I have a chapter on Cahokian exports to Spiro. "Culture Heroes, Inalienable Goods, and Religious Sodalities: Long Distance Exchange in Eastern North America at European Contact" will be published in *Trade Before Civilization* by Cambridge University Press, and "Anthropomorphic Pottery Effigies as Personal Spirits in the Lower Mississippi Valley" will appear in *Cognitive Archaeology: Mind, Ethnography, and the Past in South Africa and Beyond* by Routledge Press. Also, "Head Pots and Religious Sodalities in the Lower Mississippi Valley" should be out in the edited volume, *Shamans, Priests, Practice, Belief: Archaeological Examination of Religion and Ritual in the Eastern Woodlands,* University of Alabama Press. And finally, my chapter on indigenous witchcraft, "Fire Burn and Caldron Bubble: Mississippian Witchcraft Accusations, Agency, and Visualization" will appear in *Implementing and Assessing Iconographic Method and Theory,* University Press of Florida.

Conference presentations included three papers at the Current Research in Tennessee Archaeology meeting (one with Robert Sharp and Kevin Smith, and another in honor of Charles McNutt with Mitch Childress and Drew Buchner), and two papers at the Society for American Archaeology annual conference (one of which was co-authored with Arleen Hill and Dorian Burnette). This November I will be attending the American Anthropological Association meeting in Vancouver to present an invited paper on Native American legerdemain as a form of male violence.

Dwellings in Acoma Pueblo, photographed by Dr. Dye

Over the course of the year, Robert Sharp and I continue to pursue our Mississippian research, documenting and photographing objects at the Jones Archaeological Museum at Moundville, Ala., the Department of Anthropology at Vanderbilt University, the Tennessee State Museum in Nashville and the National Museum of Natural History in Washington, D.C., While in Albuquerque, N.M., last April, I also had the opportunity to visit and photograph Acoma Pueblo, the oldest continuously inhabited community in the United States, as well as photograph Bandelier National Monument during late spring snow showers. Ryan Parish and I completed our final year of funding from the National Science Foundation for a project to test the chert sourcing applications of reflectance spectroscopy. Overall, it has been a rich and rewarding year working with colleagues on a variety of fascinating projects.

Dr. Arleen Hill – Writing this as the impacts of Hurricane Dorian on the Bahamas are becoming clear makes thoughts of disruption unavoidable. Disruption and resilience are the prominent themes of my engagement, research, service and teaching. The vulnerability of people and places to disruption regardless of the threat (earthquake, hurricane or environmental change) is complex and dynamic. I am working with colleagues at Vanderbilt, ECD and TDEC to build an assessment tool for communities to consider their vulnerability (a multi-year, multi-disciplinary National Disaster Resilience Competition project). Most recently, I am exploring chronic, multi-decadal droughts in prehistory with Drs. Burnette and Dye. These droughts exert a pressure of places and populations and we are working to make sense of the magnitude, duration and spatial extent of the droughts while also uncovering lessons of adaptation and coping strategies related to resilience. During the fall 2019 semester I am leading off our book-writing effort focused on environmental change and resilience, Drs. Dye and Burnette will carry the effort forward during subsequent semesters. If you have a thought or anecdote about resilience, please share it with me.

Dr. Hsiang-te Kung – I have continued my research with colleagues in the department and with Chinese geographers and graduate students at Xinjiang University, China. We have published the following three articles in 2019: Xiaoping Wang, Fei Zhang, Hsiang-te Kung and Verner C. Johnson. "New Methods for Improving the Remote Sensing Estimation of Soil Organic Matter Content (SOMC) in the Ebinur Lake Wetland National Nature Reserve (ELWNNR) in Northwest China." *Remote Sensing of Environment.* 218 (2018) 104-118, Elsevier; Xianlong Zhang, Fei Zhang, Hsiang-te Kung, Ping Shi, Ayinur Yushanjiang and Shidan Zhu. "Estimation of the Fe and Cu Contents of the Surface Water in the Ebinur Lake Basin Based on LIBS and a Machine Learning Algorithm". *The International Journal of Environmental Research and Public Health (JERPH),* October 28, 2018 (mdpi.com/journal/ijerph); and Fei Zhang, Yushanjiang Ayinuer, Hsiang-te Kung and Ping Shi. "Relationship Between Landscape Pattern and Environmental Indices in Ebinur Lake Wetland National Natural Reserve". In Proceedings of the International Workshop on Environment and Geoscience (IWEG 2018), pages 132-138, IWEG@a-scie.org, Hanzhou, June 15-17, 2018.

I continue to serve as an associate editor for a peer-reviewed journal – *Frontiers of Earth Sciences (FESCI)* and served as external assessor for faculty promotion at Hong Kong University, Education University of Hong Kong and Universiti Kebangsaan Malaysia. I have been invited by the Research Grants Council of Hong Kong (RGS) as an external assessor for research proposals on urban climatology in Hong Kong and the Pearl River Delta region. I gave an invited presentation on "Tourism Industry and Business in China" to the Hilton Headquarters in Memphis in July.

Besides teaching (Water Resources, Thematic Studies in China and weather and climate classes), research and advising students in the department, I serve as director of the Confucius Institute (CIUM) and Asian Studies and International Trade Program (ASIT). I attended the 13th Global CI Conference in Chengdu and participated in the second CIUM Teachers and Alumni Association meeting. The CIUM and Rhodes College co-sponsored the 58th Southeast Conference of the Association for Asian Studies (SEC-AAS) in January. I was invited to chair a session and served as a panel member.

The CIUM also co-sponsored with Chongqing Normal University an International Conference on "Protection and Utilization of Chinese Historical and Cultural Heritage" at the University of Memphis in August. The CIUM recruited two new Chinese language teachers (Wei Xuemei and Ma Jun), and co-sponsored with the English department, Sociology, Political Science, Public Administration and Earth Sciences (Archaeology) and invited six visiting faculty members to the university from China to collaborate research with faculty in their respective fields. The CIUM hosted a lecture series and film-appreciation series during the year. In celebration of the Chinese Lunar New Year and Spring Festival, CIUM staff and teachers were invited to perform the dragon dance and Tai Qi Fan dance in the Rose Theatre in February.

Traditional Chinese dancers at the 2019 Multi-cultural Festival at Wolfchase Mall.

The CIUM is strongly engaged in the community activities such as K-12 Chinese language and culture teaching, summer bridge camp and China studies for principals, superintendents, educators and university administrators. The CIUM was invited to participate in the Germantown, Cordova, Collierville and Lakeland International Multcultural Festivals and demonstrated calligraphy, Chinese painting, paper cutting, Chinese knot, tai chi, tai chi sword, martial arts, han dynasty drum dance, fashion and traditional Chinese dresses and dragon dance. The CIUM collaborates and partners with different academic units and departments on Chinese arts exhibitions (block wood painting), study abroad, and culture exchange programs, and also facilitates communications between the Chinese and U.S. organizations, such as Hubei Business College and Ezhou Government Delegations with the UofM and City of Memphis.

Dr. Youngsang Kwon – It has been a busy and productive year for me. Michelle Field earned her MS degree and is now working as a GIS specialist at Smith Seckman Reid Inc. She also successfully finished her internship through a USGS Cooperative Field Training Program at Colorado right before her new full-time position at SSR. Witnessing student success is the most rewarding thing working in academia. Starting in September 2018, I volunteered as a Korean culture and language teacher every Sunday for adults and elementary school kids. This community service is in partnership with Vision Tree Center for Education and Development. With a mega-hit by Korean boy band BTS, these Korean classes are getting bigger.

In research, I published seven peer-reviewed papers on topics ranging from a macro-scale species distribution model (SDMs) in biogeography to a local-scale geologic mapping using drones. Some of the work has been sitting in my hard drive for years and some was done within two months (from the idea to the submission). And of course, there are several work-in-progress manuscripts I am working on now. You can check out my publications and projects at **youngclick4.wixsite.com/kwon**. Also, I secured an internal grant as a PI to conduct deep learning applications in examining tree species richness. Lian Feng, a PhD student, is working on this project as an RA and hopefully she can continue this topic as her dissertation. Lastly, I participated in a three-day teaching workshop (Earth Educators Rendezvous) for the National Association of Geoscience Teachers at Nashville to adopt active learning pedagogy. It was truly a great experience working with many energetic geoscience teachers to share their experiences and learn a new pedagogy. I will definitely adopt new teaching tools (e.g., active learning) in my classes.

Dr. Dan Larsen – It has been another busy year with students, research, teaching and chair duties. During the past year, three MS students, James Eason, Mike Smith and Spencer Smith, finished their degrees. Each found employment fairly quickly after receiving their degree or had employment before they finished, so I figure we must be doing something right. In addition to second-year MS students Scarlett Brimingham and Rizwan Hasan, I have added three more MS and one PhD student. One MS student, Devin Hainje, is supported by muncipal groundwater contracts and the Sandy Creek project. Two master's students, Kate Moore and Jessica Towell, are supported on an MLGW contract to investigate water quality in the Memphis aquifer, and the PhD student, Saddam Hossain, is on a Carnegie R1 Fellowship to study the origin and hydrogeologic behavior of the shallow aquifer in Shelby County. I am really happy to be able to mentor and support these fine students as they achieve their academic and professional goals!

After being out of the rotation for teaching freshman classes for several years, I taught a section of ESCI 1020, Landforms, during spring 2019. I found the experience of engaging the broad cross-section of students in a general education course wonderfully exhilarating and was able to try some new techniques to keep them focused on the class rather than their phones. I even did some reverse teaching with students leading the presentations and discussions. I also taught Field Methods in Hydrology in fall 2019, which is a fun course for me, although not always for the students (too many reports).

A chance encounter with T. Rex at the Geological Society of America annual meeting in Phoenix, September 2019.

We had a strong contingent of students from the University of Memphis, UT Knoxville, MTSU and even a Hilltopper from Western Kentucky University at the geology field camp in South Dakota this summer. We had good weather for the most part, and tried some new map areas. For the first time in my history as field camp director, two students had a mountain lion encounter. Everyone was fine and we were able to avoid any problems, but I know those students will have a great story for years to come.

Our work at CAESER (Center for Applied Earth Science and Engineering Research) has continued with support from MLGW, Collierville and Germantown and the West Tennessee River Basin Authority. I am nearly finished with an EDMAP-funded geologic mapping project in and around Fort Pillow State Park, an area that is more structurally and geologically interesting than is evident from the surface exposures. I am currently working on publications summarizing hydrogeologic studies at Pinecrest Camp in Fayette County and saline groundwater in southeastern Arkansas as well as other collaborations.

Although I have enjoyed being chair of Earth Sciences for the past five years, it is time for new blood at the helm of our program and I will be stepping down from the chair position in spring 2020.

Dr. Deborah Leslie – I am thrilled to join the dynamic group of faculty in Earth Sciences this fall. My background is in environmental geochemistry, stable isotopes as tools in hydrology, and groundwater-surface water interactions. My ongoing research projects extend from my previous postdoctoral position with the USDA-ARS Delta Water Management Research Unit in Jonesboro, Ark. This interdisciplinary research focuses on groundwater management and recharge through combining disciplines of hydrology, agriculture and water resource management. The research focus is to address Mississippi River Valley Alluvial Aquifer declines in the Cache Critical Groundwater Area in eastern Arkansas. A major objective is to develop, test and refine tactics for managed aquifer recharge (MAR). We are planning to test an infiltration gallery as a strategy for MAR this upcoming fall/winter.

Earth Sciences Archaeological Field School

Alex Sharp, a new MS graduate student, will be working on this as her thesis project. I look forward to building relationships with the department, alumni, University and local stakeholders, and also beginning collaborations with CAESAR (Center for Applied Earth Science and Engineering Research) during this next year.

Dr. Andrew Mickelson – For three weeks in May, my graduate and undergraduate students participated in the 13th annual archaeological field school at Ames Plantation, an 18,000-acre land base located in western Tennessee, and perennial home to the National Bird Dog Championships. We excavated the remains of three 13th century A.D. structures constructed by prehistoric Native Americans. The goal of this year's research is to better understand prehistoric settlement and land-use patterns during this time. Our field school also hosted an archaeological field school from the Department of Anthropology and Geography at the University of Colorado under the direction of Ed Henry. Additionally, my graduate student Katie Proctor completed a phosphate soil analysis project across the Ames town site and demonstrated the feasibility of detecting archaeological deposits measuring plant-available phosphorus.

Dr. Esra Ozdenerol – My collaboration with UT Health Science Center and West Clinic produced useful results and publication of two papers in prestigious journals. The distribution of radiation therapy (RT) interruption disparities was mapped across the Memphis metro region with cancer outcome disparities and described in the paper "Location as destiny: Identifying geospatial disparities in radiation treatments in the Mid-Southern United States". Radiation treatment interruption was found in a significant number of financially and socially vulnerable patients in our high-risk population. My spatial analysis affords an opportunity to directly correlate RT access disparities on a neighborhood level and to inform effective risk adaptive interventions and public policy-level strategies.

In the second collaborative paper, "Location, Location, Location: Utilizing Needs-Based Assessment of Trauma Systems-2 (NBATS-2) in Trauma System Planning" published in the Journal of Trauma and Acute Care Surgery, the group shows the significant potential of using NBATS-2 and geospatial modeling in trauma system planning. Needs-Based Assessment of Trauma Systems-1 was an important first step in defining and establishing objective criteria for a trauma system that meets its regional needs, but the ability to create predictive models using GIS-based methodology makes NBATS-2 a much more practical tool than the original.

My book *Spatial Gender inequalities: GIS approaches to Gender Analysis* will be published in July 2020, by Taylor and Francis-CRC Press. This book is unique for integrating GIS and spatial analysis in gender inequality research and for presenting this global problem through a spatial perspective. While the first part of the book focuses on introducing key concepts, the consecutive parts contain chapters of selected papers presenting in-depth case studies that discuss gender indicator data and data collection processes, key literature for the appropriate spatial analytical methods applied and illustration of cartographic techniques for visualizing and mapping gender inequalities of a particular place or region/country.

I served on NSF's scientific review panels and am heading an important proposal on advancing women scientists in STEM fields. I continue my research on health inequalities by mapping the opioid epidemic and modelling vaccine deployment for Lyme disease with PhD students Ryan Hanson and Rebecca Bingham.

The GIS certificate program is continually being improved. I am developing new online course offerings and launching a fully online GIS certificate program with social media presence. We expect the first online certificate enrollment in fall 2020. The University of Memphis' Graduate Certificate in GIS will be unique in higher education as we combine research with extensive hands-on experience using the latest data — sourcing techniques, leveraging the best GIS software and working with spatial data in a real-world context. Graduates will be able to go beyond basic analysis of GIS data and become adept at developing solutions for some of the industry's most complex problems.

I added drone image processing and ArcGIS Pro training to my GIS workshop series this summer at the University of Memphis. Attendees included a diverse group of professionals from the Memphis Fire Department and Memphis Airport Authority. Now is an excellent time to consider attending the next GIS workshop to be offered this winter! If workshop participants are interested in earning University credit and a graduate level GIS certificate, they can preview the GIS certificate application process at this link: **memphis.edu/earthsciences/programs/graduate/gis_certificate.php**.

For more information about GIS workshop series offerings and the GIS certificate program, contact the director of both programs, Dr. Esra Ozdenerol, at eozdenrl@memphis.edu

A frosty river in the Ozarks during the spring break trip in 2019.

Dr. Ryan Parish – Archaeology in the Department of Earth Sciences continues to thrive through the dual degree program with Anthropology. Many of our students take advantage of this opportunity to obtain two degrees in four years. Our undergraduate students are also involved in research-focused work. This past year I've had three undergraduate students assist me on research projects domestically and abroad. The students then present their research at conferences on campus and professionally. Several students also braved the cold Ozarks in March on our annual spring break excursion trip. We visited both geologic and archaeologic sites in Missouri and Arkansas.

The Southeastern Archaeology Conference is being held in Jackson, Miss., in November. The proximity to Memphis will allow a large group of us to attend and present our research. I have three graduate students presenting and one undergraduate student presenting. Additionally, I plan to present research in Austin, Texas, at the annual Society of American Archaeology meeting and in Budapest, Hungary, this fall.

A National Science Foundation Grant continues to provide funding to expand a chert-type database containing over 6,000 samples from the Midwest, Southeast, Europe and South America. The use of reflectance spectroscopy in matching chert artifacts back to where prehistoric people obtained the tool stone is being applied on a variety of projects. The chert source projects include identifying the source of over 8,000 Hopewell chert discs deposited in a burial mound in Ohio. Research is also being conducted on artifacts used by Paleoindian groups in northern Alabama and along the Savanah River in South Carolina at the end of the last Ice Age. A graduate student and I are identifying the sources of spear-point knives found at the Poverty Point site, Louisiana, in an area without good nearby tool stone sources. Locally, we are testing stone artifacts excavated this summer at Pinson Mounds, Tenn., to see if the material comes from Ohio. Research continues abroad as my colleagues and I track tool stone use in Poland, Argentina and Chile. Additionally, the newly acquired portable X-ray florescence device (pXRF) allowed a master's student in Egyptology to analyze a goose mummy in order to identify resins used in the embalming process.

Finally, local conservation efforts along Nonconnah Creek are progressing as we continue to connect the greater Memphis community to the creek and the natural and cultural resources within. Please visit **blogs.memphis.edu/rmparish/** for more information regarding ongoing research projects or find us on Facebook to get involved in the Nonconnah Creek Conservancy.

Earth Sciences Club

The Earth Sciences Club is involved in several activities on campus and sponsors lectures, field trips, and other outdoor activities.

Dr. Jose Pujol – As I near retirement (next year), most of my non-teaching activities concentrated on the writing of my book, which is progressing steadily, although not as fast as I expected it would go. Part of the reason for that is a comment I published in the Bulletin of the Seismological Society of America in 2017, referred to in the 2018 newsletter. The author's reply questioned the accuracy of my comment. Unfortunately, I did not have the opportunity to read the reply before publication, and I could not challenge their statements. Then they wrote another paper where they repeated the same statistical methodological and practical mistakes I had criticized. After that, I wrote a new comment and asked the editor to have a professional statistician review the new paper and comment to have the matter settled. The editor did that and the reviewer concluded that the paper should not have been published. Then the editor asked me to submit a new shortened comment, which I did. I am still waiting for the author's reply. I dwell on this matter because I think there is a lesson here for those engaged in interdisciplinary research. As my story shows, not everything that is published is correct.

This year I submitted a paper describing a numerical method for the solution of underdetermined systems of linear equations that has some novel aspects. The results described there will be included in my book, and the purpose of my submission was to get them reviewed by mathematicians. Unfortunately, the reviewers ignored most of my results and concentrated on peripheral issues. Now I am working on a rebuttal, which is time-consuming. I will report on the outcome of this episode in next year's newsletter.

Dr. Beth Rhenberg – I joined the faculty as a visiting assistant professor with specialties in paleontology and sedimentology in January 2019 with a whirlwind of officially getting the position, moving, and starting classes within two weeks. I taught Physical Geology and Sedimentology and Stratigraphy my first semester. It was a lot of fun getting to know the students and department. In March, I presented fossils to fifth graders at Bailey Station Elementary in Collierville as part of their biotechnology fair. I introduced them to several types of animals and helped them decipher what they could tell us about the environment they lived in. I also helped Julie Johnson with the Science Olympiad tournament, with this year's theme being paleontology.

This summer I spent my time teaching Physical Geology and working on crinoids from the Lake Valley Formation in New Mexico. It's great to have office space to work on research again and this current project entails a systematic review of the four groups of crinoids that I did not tackle in my dissertation.

This fall I am teaching Earth Through Time and Paleontology. I spoke to the Memphis Archaeological and Geological Society on semi-local crinoids from Hardin County, Tenn. I also took a group of students to GeoConclave, where I administered the Fossil ID portion and the students competed wonderfully, coming in third place in the Rock Bowl.

Dr. Roy Van Arsdale – The 2019 year has been particularly busy and productive. I published a paper with Dr. Cox and Dr. Lumsden in the *Journal of Geology*, "Quaternary Uplift in the Lower Mississippi River Valley." I also coauthored the paper, a *Geophysical and Geological Evidence for Quaternary Displacement on the Caborn Fault, Wabash Valley Fault System, Southwestern Indiana,"* that was published in *Seismological Research Letters*. My research has involved a number of students this year. Caroline Behrman published her undergraduate research, a Drone Geologic Mapping of an Active Sand and Gravel Quarry, DeSoto County, Mississippi" in the journal *Drones*. This research convinced me of the power of drones in geologic investigations. Taylor Weathers completed his MS degree and his research "Lake County, Tennessee, in the Heart of the New Madrid Seismic Zone," is published in *Frontiers in Earth Science*. Taylor illustrates two impressive subsurface 3D models of Lake County, Tenn., in his paper. Both Caroline and Taylor's articles are available online. Audrey Price completed her MS thesis and the first paper to be published from her work, "Quaternary Displacement on the Joiner Ridge Fault, Eastern Arkansas" in *Seismological Research Letters*. I also have two new graduate students who are working on a HUD-funded project mapping the surface and subsurface geology of Dyer and Lauderdale counties in Tennessee. My work with Dr. Cox and Dr. Lumsden on the Pliocene of the Mississippi River Valley remains controversial – I am told. However, we have yet to read a published argument against our primary idea that the Pliocene Mississippi River was huge and drained southern Canada.

Emeritus faculty in residence:

Dr. David Lumsden – Dr. Lumsden finally retired! Yes, the long-anticipated event (18 years after he turned 65) has finally taken place. He still plans to continue research on the evolution of the Mississippi Valley (with Drs. Van Arsdale and Cox) and the origin of petrified wood. In the summer he basks in the sun on the shore of Lake Erie with a cool breeze and a cold beer.

Instructor/Coordinator:
Dr. Julie Johnson - Last September, I transitioned into the Earth Sciences department's new instructor coordinator position. The responsibilities of this new position include helping to manage the introductory general education labs in the Earth Sciences department, providing mentoring to the graduate students teaching those labs, as well as organization and assistance in the inventory of lab supplies, and the upkeep and distribution of teaching materials for our teaching assistants.

Using lab fees, we have made purchases to replace and supplement some general education lab supplies and activities. In addition, I have spent considerable time beginning to catalogue and organize the department's extensive collection of rocks, minerals and fossils. One of my first priorities as instructor coordinator is to make our Earth Sciences general education labs the best learning experience for the undergraduate students that we can. Hopefully these improvements are a step in that direction.

For the second consecutive year, faculty in the department participated in the regional Science Olympiad tournament in Memphis. The event, hosted at Southwest Tennessee Community College, has grown since last year and included students from local middle schools and high schools who competed in a wide variety of science activities. This year, Dr. Beth Rhenberg put together a variety of fossils and helped proctor the activities for the students.

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STUDENT SPOTLIGHT

Jacob Seboly
Geography and mapping have been lifelong passions of mine. According to my parents, when I was 5 years old I could recite the capitals of all 50 states. Throughout my childhood, I collected the Rand McNally Road Atlas every year and drew countless maps of my own. I still always keep a copy of the Rand McNally atlas open on my desk! I have also been fascinated by the weather throughout my life. When I was a child, I would turn on the local news any time there was a tornado warning, regardless of whether it affected my location, just to see the meteorologists track the storm. I got a personal weather station and started keeping a weather journal when I was 13. My answer to the question "What do you want to be when you grow up?" was usually a meteorologist or cartographer. Because of these passions, the Earth Sciences major with a concentration in Geography was a perfect fit for me.

When I applied to the University of Memphis, I was planning to major in Mathematics and also checked out the Earth Sciences department to see if I wanted to double-major. During my freshman year, I took Landforms from Dr. Youngsang Kwon and Weather and Climate from Dr. Dorian Burnette. I tremendously enjoyed both classes and decided to add Earth Sciences as a major. Earth Sciences quickly became my favorite of the two majors as I continued to take classes within the department. My favorite classes have been Climatology, Severe Weather and Synoptic Meteorology with Dr. Burnette and Introduction to and Advanced GIS with Dr. Esra Ozdenerol. I have kept my math major, but because I have enjoyed earth sciences so much, I am hoping that my career will be in a geography-related field.

Last summer, I was awarded an Honors Summer Research Fellowship to conduct original undergraduate research with the help of a faculty mentor, Dr. Ozdenerol. I researched tornado vulnerability in Tennessee. I assessed the frequency with which tornadoes occur in each Tennessee county, pored over historical tornado reports to obtain fatality and casualty totals for each county and collected data on social vulnerability to tornadoes. I combined tornado frequency and social vulnerability for each county to estimate the overall likelihood of each county to experience negative societal impacts from tornadoes. Unfortunately, I found West Tennessee to be the most vulnerable part of the state. I created an online tool with which the public can view my tornado vulnerability assessment: **(arcg.is/1qbWCP)**. I was grateful for the opportunity to spend my summer in such a fun and productive way and get experience at doing original research. Dr. Ozdenerol and Dr. Burnette were very helpful in the completion of this project as well.

Looking forward, I am planning to graduate in December 2019. I have become very skilled in GIS through the classes I have taken and my undergraduate research, so I am hoping to spend my career doing GIS-related work. I am also considering applying to graduate schools and earning a master's degree in Geography or GIS. No matter which direction I go, I know that the time I have spent taking classes and working with faculty in the Earth Sciences department will provide a helpful foundation for me down the road. I am grateful for the opportunity I have had to study here and the teaching and advice I have received from my professors. To any scientific-minded undergraduate student still deciding on a major, I would definitely recommend Earth Sciences.

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Earth Sciences

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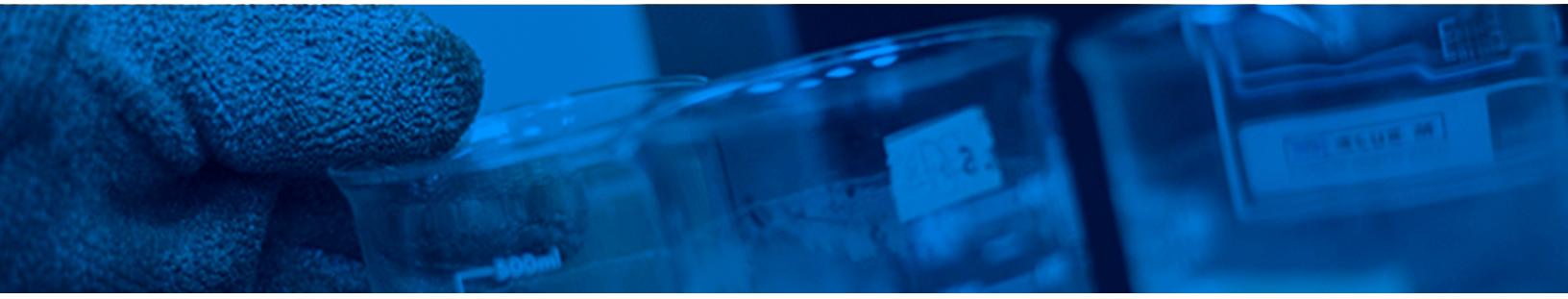

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